



Specialist for Pumping Technology

**Session 18 –
Overhung Process Pumps
Part 1 - OH1 & OH2**

Simon Smith November 2022





Presenter Profile – Simon Smith

Simon graduated with an honours degree in Chemical Engineering from the University of Surrey in 1978 and began a long career in the engineered pump industry spanning 40 years (so far!) with Peerless Pump, BW/IP International / Flowserve, SPP Pumps, Ruhrpumpen and Ebara Cryodynamics.

Over his long career he has filled various roles as Applications Engineer / Manager, Project Manager, Key Account Specialist, Vertical Pump Product Specialist, International Sales Engineer / Manager / Director and he has considerable experience in Training & Mentoring young engineers.





RuhRPumpen Short Courses

Here is a listing of all the previous courses.

- No 1 – API610 12th v 11th editions
- No 2 - Curve Shape
- No 3 – The Importance of System Curves
- No 4 - Selecting the Right Pump for the Application
- No 5 - NPSH & Nss
- No 6 - Mechanical Seals & Systems
- No 7 - Firepumps
- No 8 - BB5 Barrel Pumps
- No 9 - Pump Instrumentation
- No 10 – Non-Destructive Examination
- No 11 - Vertical Pumps (Part 1) Type VS1, VS2, VS3
- No 12 – Vertical Pumps (Part 2) Type VS4, VS5, VS6 & VS7
- No 13 – Performance Testing of Centrifugal Pumps; the What, the Why & the How
- No 14 – Testing & Inspection of API 610 Pumps
- No 15 – Start-Up, Commissioning & Troubleshooting Centrifugal Pumps
- No 16 – Introduction to Positive Displacement (Plunger) Pumps

Any you have missed you can get from our website using this link <https://short-courses.ruhrpumpen.com/>

Or from www.ruhrpumpen.com and follow the link to [RP Short Courses](#)



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Pumps for
Oil and Gas

The most reliable and efficient pumps with cutting-edge technology according to API standards

[+ Learn More](#)

The most efficient and reliable pump systems worldwide

Ruhrpumpen is an innovative and efficient pump technology company that offers highly-engineered and standard pumping solutions for the oil & gas, power generation, industrial, chemical and water markets. We offer a broad range of centrifugal and reciprocating pumps that meet and exceed the requirements of the most demanding quality specifications and industry standards such as API, ANSI, ISO and Hydraulic Institute.

[+ About Ruhrpumpen](#) [+ Our Pumps](#)



RuhRPumpen Short Courses

<https://short-courses.ruhrpumpen.com/>



Join us in Youtube

All Courses

Ruhrpumpen short courses are a platform that boosts knowledge to all those interested in understanding the theoretical principles of centrifugal pumps, pump operations, hydraulics, pump performance curves, and/or receiving practical insights into the safe operation of your equipment.

You'll find below all the past courses and the coming ones. Join us and learn with us!

SHORT COURSE 1

Comparison of API-610 12th vs 11th edition.

Simon Smith
Speaker

GO TO COURSE

Comparison of API-610 12th vs 11th edition.

With 12th edition now issued, many End Users, Consultants and Licensors will be incorporating it into their Standards...

[→ Go to Course](#)

SHORT COURSE 2

Curve Shape, Head-Rise to Shutoff and Zero Tolerances on Equipment Selection, Reliability, & Pricing

Simon Smith
Speaker

GO TO COURSE

Curve Shape, Head-Rise to Shutoff and Zero Tolerances on Equipment Selection, Reliability, & Pricing.

Aimed at Process and Mechanical Engineers and Consultant Engineers specifying pumping equipment...

[→ Go to Course](#)

SHORT COURSE 3

The Importance of Using System Curves in Pump Selection and Successful Pump Operation.

Simon Smith
Speaker

GO TO COURSE

The Importance of Using System Curves in Pump Selection and Successful Pump Operation.

Aimed at Process and Mechanical Engineers and Consultant Engineers specifying pumping equipment as well as Applications Engineers selecting and quoting them...curves



Session 18 – “Overhung Process Pumps – Part 1 - API Types OH1 & OH2”

Comparing and contrasting OH1 and OH2 pumps.

Aimed at Process and Mechanical Engineers, and Consultant Engineers who specify pumping equipment as well as Applications & Sales Engineers selecting and quoting them.

Part 2 (Session 19) will look at vertical overhung pumps (OH3,4,5 & 6)



OH1 vs OH2 Pumps

What's the Difference? - API 610 definition

4.2.2.1 Pump type OH1

Foot-mounted, single-stage overhung pumps shall be designated pump type OH1. (This type does not meet all the requirements of this International Standard; see Table 3.)

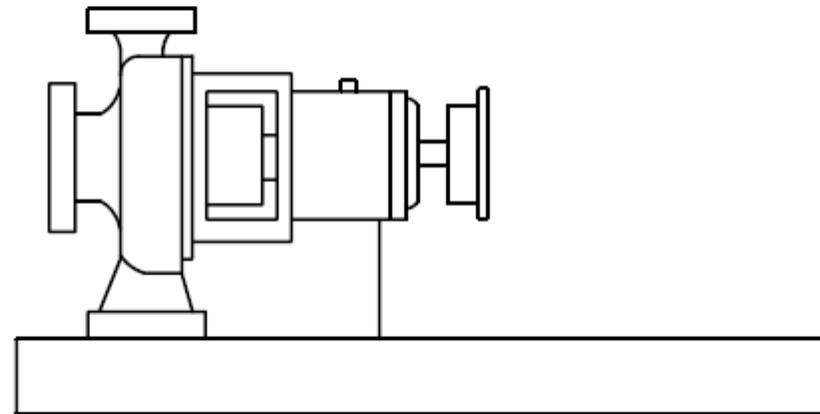


Figure 1 — Pump type OH1



OH1 vs OH2 Pumps

What's the Difference? - API 610 definition

6.2 Pump types

The pump types listed in Table 3 have special design features and shall be furnished only if specified by the purchaser and if the manufacturer has proven experience for the specific application. Table 3 lists the features requiring special consideration for these pump types, and gives in parentheses the relevant subclause(s) of this International Standard.

Table 3 — Special design features of particular pump types

Pump type	Features requiring special consideration
Horizontal foot-mounted overhung, OH1	a) Pressure rating (6.3.5) b) Casing support (6.3.11)

6.3.5 "...the MAWP Shall not be less than....a gauge pressure rating equal to at least 4 Mpa (40 bar; 600psi) at 38 C"

6.3.11 "Centreline-supported pumps shall be used for all horizontal pumps"



OH1 vs OH2 Pumps

What's the Difference? - API 610 definition

4.2.2.2 Pump type OH2

Centreline-mounted, single-stage overhung pumps shall be designated pump type OH2. They have a single bearing housing to absorb all forces imposed upon the pump shaft and maintain rotor position during operation. The pumps are mounted on a baseplate and are flexibly coupled to their drivers.

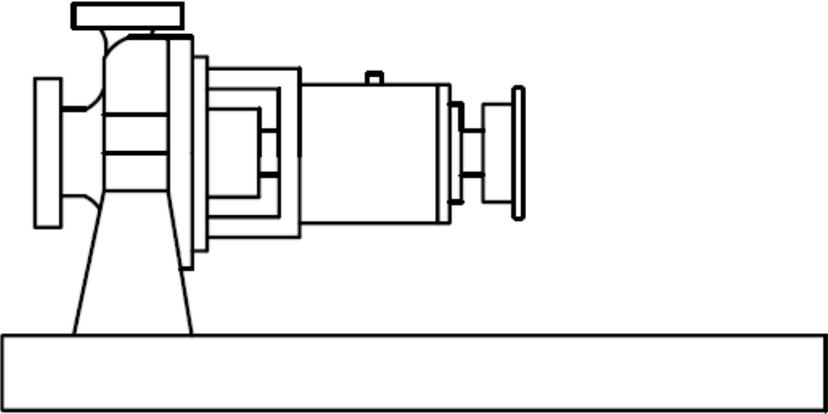


Figure 2 — Pump type OH2



OH1 vs OH2 Pumps

What's the Difference? - API 610 vs ASME B73.1 – Overview Explanation

API610 Pumps are Heavy-Duty, Centreline Mounted, Mechanically Sealed Pumps. Which are designed to fulfil the requirements of Petroleum, Petrochemical and Liquefied Natural Gas Industries and all Refinery applications.

API610 gives rules covering aspects such as case design, maximum material stress allowed, flange ratings (usually a minimum of 300# ASME), piping design, material specifications, non-destructive testing, baseplate design, shaft stiffness criteria and dynamics, bearing designs & application, bearing housing design & lubrication, wear ring design and standardized minimum clearances, stuffing box sizes, mechanical seal design criteria including reference to the mechanical seal API 682 specification, balancing criteria, vibration limits, coupling designs, coupling guard design, instrumentation and pump testing requirements, noise level testing.



OH1 vs OH2 Pumps

What's the Difference? - API 610 vs ASME B73.1 – Overview Explanation

By comparison, **ASME B73.1** is designed for horizontal end suction centrifugal pumps and provides rules to cover the general chemical pump applications, where the emphasis is on low pressures, usually ASME 150# pressure ratings (18 Bar at ambient temps), and also on meeting standardized dimensional limits, to ensure that pumps within the same size group are dimensionally interchangeable. This is a less arduous design specification.

As we show later, there is a great deal of difference in the design requirements and limitations between these two Pump standards. **API is a much stronger and heavier duty design, capable of higher pressures and higher liquid temperatures.**



OH1 vs OH2 Pumps

What's the Difference? - API 610 vs ASME B73.1

DESIGN DIFFERENCES

Pump Design Life.

Interchangeable Pump Dimensional Standards.

Hydraulic Head and Flow standards.

API610 PUMP DESIGNS

Minimum Service Life of 20 Years, with 3 Years continual operation, between Servicing.

There are No Interchangeable Pump Dimensional standards for API610.

There are No Hydraulic Head & Flow standards for API610.

ASME B73.1 PUMP DESIGNS

Although these are long lasting Pumps, there is no reference stating the minimum Pump life.

All ASME B73 Pumps of the same size are Interchangeable, as the Specification lists all ANSI Pump dimensions.

All ASME B73 Pumps of the same size are hydraulically Interchangeable, as the Specification lists the Head and Flow at BEP at Maximum Impeller Diameter & also lists the Minimum Continuous Flow, for all ANSI Pump sizes.



OH1 vs OH2 Pumps

What's the Difference? - API 610 vs ASME B73.1

DESIGN DIFFERENCES

Pump Casing mount design.

Pump Designs

Pump Construction Materials

API610 PUMP DESIGNS

All OH2 Pump Casings are Centerline mounted on their Baseplates, for low & high temps. To allow very high temperature operations without vertical expansion causing alignment issues.

API610 specifies & shows the complete range of (18) pump types, vertical & horizontal, single and multi-stage, that are regularly used in oil and gas production and refining facilities.

API610 shows 10* combinations of pump construction metallurgy and details the precise material for every pump component
*(14 in 11th Edition)

ASME B73.1 PUMP DESIGNS

OH1 ASME Pump Casings are Foot Mounted designs. But there are High Temperature designs that are centerline mounted on the pump Baseplate.

ASME B73.1 specifies a single stage, end-suction, top-discharge & radially split casing design.

ASME B73 covers both 7 combinations of pumps with construction metals, and also alternative thermoplastic & thermoset polymer pumps.



OH1 vs OH2 Pumps

What's the Difference? - API 610 vs ASME B73.1 - Materials

API 12th Edition

Table H.1—Material Classes for Pump Parts

Part	Material Classes and Abbreviations										
	Material Class	S-4 ^k	S-5 ^k	S-6 ^{f k}	S-8 ^k	S-9 ^k	C-6	A-7	A-8	D-1 ⁱ	D-2 ⁱ
	Full Compliance Material ^{a b}	STL	STL	STL	STL	STL	STL	12 % CR	AUS	316 AUS	Duplex
Trim Material ^{a b}	STL	STL 12 % CR	12 % CR	316 AUS	Ni-Cu Alloy	12 % CR	AUS ^{c d}	316 AUS ^d	Duplex	Super Duplex	

API 11th Edition

Table H.1 — Material classes for pump parts

Part	Material classes and abbreviations														
	Material class	I-1	I-2	S-1	S-3	S-4	S-5	S-6	S-8 ^l	S-9 ^l	C-6	A-7	A-8	D-1 ^j	D-2 ^j
	Full compliance material ^a	CI ^b	CI	STL	STL	STL	STL	STL	STL	STL	STL	12 % CR	AUS	316 AUS	Duplex
Trim material	CI	BRZ	CI	Ni-resist	STL	STL 12 % CR	12 % CR	316 AUS	Ni-Cu alloy	12 % CR	AUS ^{cd}	316 AUS ^d	Duplex	Super Duplex	



OH1 vs OH2 Pumps

What's the Difference? - API 610 vs ASME B73.1 - Materials

ASME B73.1

Table 5.8.1.2-1 Pump Material Classification Codes

Part Name	Base Code – Pressure Casing and Impeller						
	73DI-	73DI/SS-	73SS-	73A20-	73CD4-	73C276-	73X-
Casing	Ductile iron	Ductile iron	316 SS	Alloy 20	CD4 MCu	Alloy C276	As specified
Impeller	Ductile iron	316 SS	316 SS	Alloy 20	CD4 MCu	Alloy C276	As specified
Cover	Ductile iron	Ductile iron	316 SS	Alloy 20	CD4 MCu	Alloy C276	As specified
Seal gland	316 SS	316 SS	316 SS	Alloy 20	Alloy 20	Alloy C276	As specified



OH1 vs OH2 Pumps

What's the Difference? - API 610 vs ASME B73.1

NOZZLE LOADS & MOMENT LIMITS:-

API610 PUMPS are designed to withstand much higher Suction & Discharge Nozzle LOADS and MOMENTS than ASME B73.1 PUMPS.

The Nozzle LOADS & MOMENTS shown within API610-11th Edition in TABLE-5, show the very high values.

Also, API610 (6.3.3) states that the Pump Casing must be designed to withstand the following 3 Factors at the same time.

Without causing internal contact between Rotating & Stationary Wear Rings & other Components:-

1. Take both TWICE the Combined X-Y-Z Nozzle LOADS and MOMENTS on both FLANGES.
2. Withstand the Maximum Allowable Working Pressure & Temperature.
3. Operating without Leakage.

The lower Nozzle LOADS and MOMENTS for ANSI B73.1 PUMPS are established by using the Calculations within ANSI/HI-9.6.2 Specification.



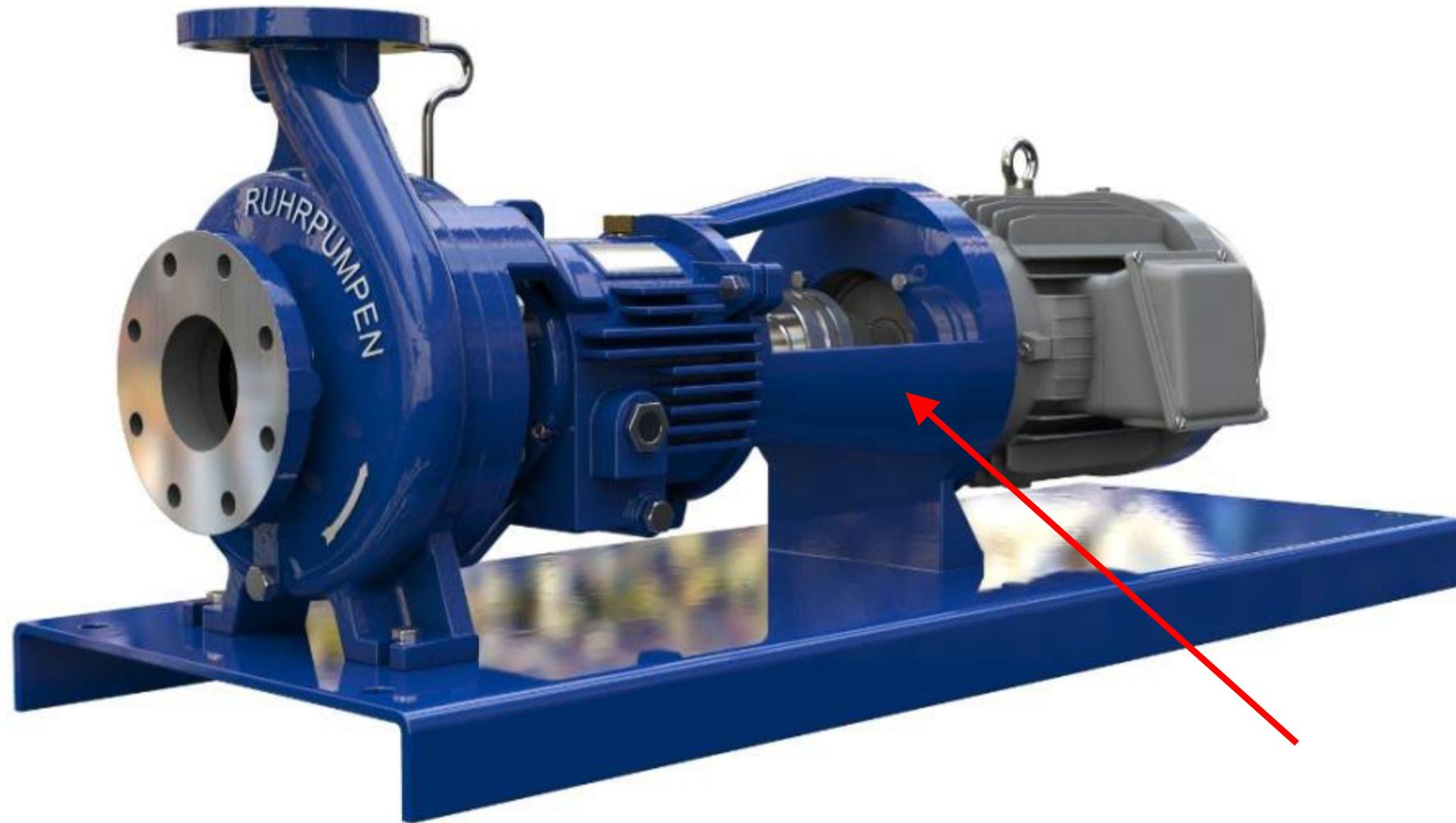
ANSI Chemical Process Pump OH1

CPO / CPP



C-Frame Configuration

CPO / CPP



Don't Forget The Workhorse of Pumps!

CPO/ CPP

BROAD APPLICATION RANGE

The Ruhrpumpen CPO is designed for a wide range of industrial, chemical process and municipal applications such as but not limited to:

- Petrochemical
- Oil & Gas
- Steel Industry
- Automotive
- Agriculture
- Tank Farm
- Pulp and Paper
- Chemical
- Semiconductor
- Food Processing
- Power Generation
- Pharmaceuticals
- Water treatment
- Pipeline
- General Industries
- Textile
- Mining

ANSI Chemical Process Pump OH1

CPO / CPP

- Horizontal End-Suction pump with open impeller (CPO) or enclosed Impeller (CPP) (OH1)
- ASME (ANSI) B73.1 – 2012 full compliant.

Sizes	31
Flow	7000 GPM (1590 m3/h)
Head	650 ft (198 m)
Pressures	375 psi (26 bar)
Discharge Flange	1" to 8"
Flange ratings	Cl. 150, Cl. 300, FF and RF
Min. Bearings life	50 000 hrs at BEP, max. speed, max. diameter and no Suction Pressure
Materials in stock	DI / SST DI / Duplex SST / SST Duplex / Duplex
Special materials	Alloy 20 Hastelloy B and C Zirconium Titanium Others

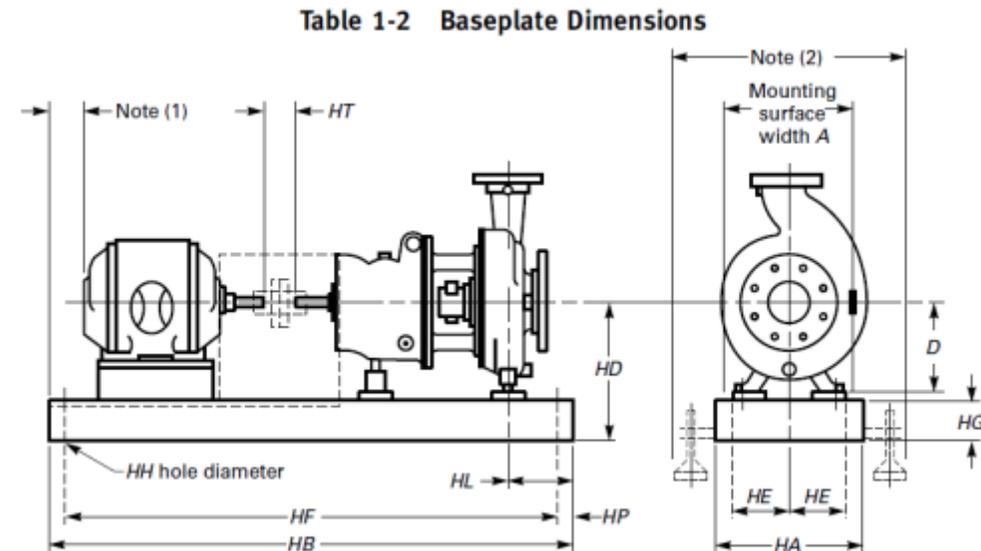
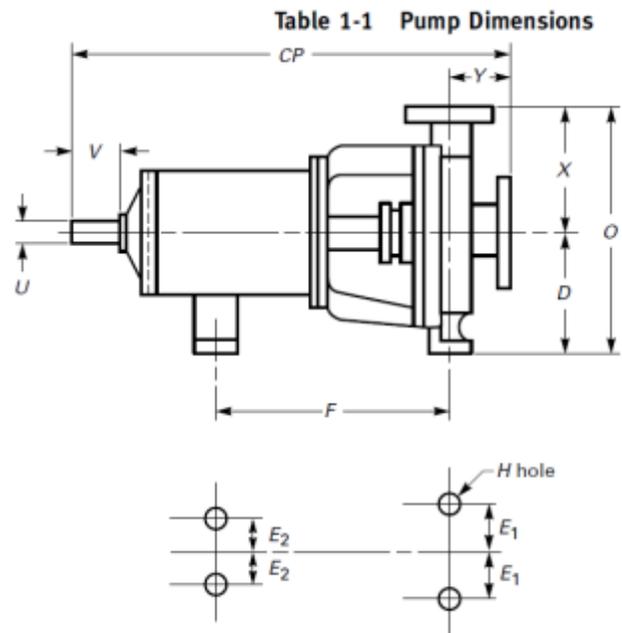


ANSI Chemical Process Pump OH1

CPO /CPP

What is ANSI B73.1 ?

- Regulates dimensions, general design and performance
- Guarantee the interchangeability
- Performance envelope for ease of competitive replacement



ANSI Chemical Process Pump OH1

Lubrication

- Oil sump (standard)
- Re-greasable bearings
- Greased for life
- Oil mist



Luneta Sight Glass: Easy to see and high strength



ANSI Chemical Process Pump OH1

CPO Impeller



All impellers made of Stainless or Duplex using Investment Casting process. This gives the best casting quality and hydraulic reliability

Materials:

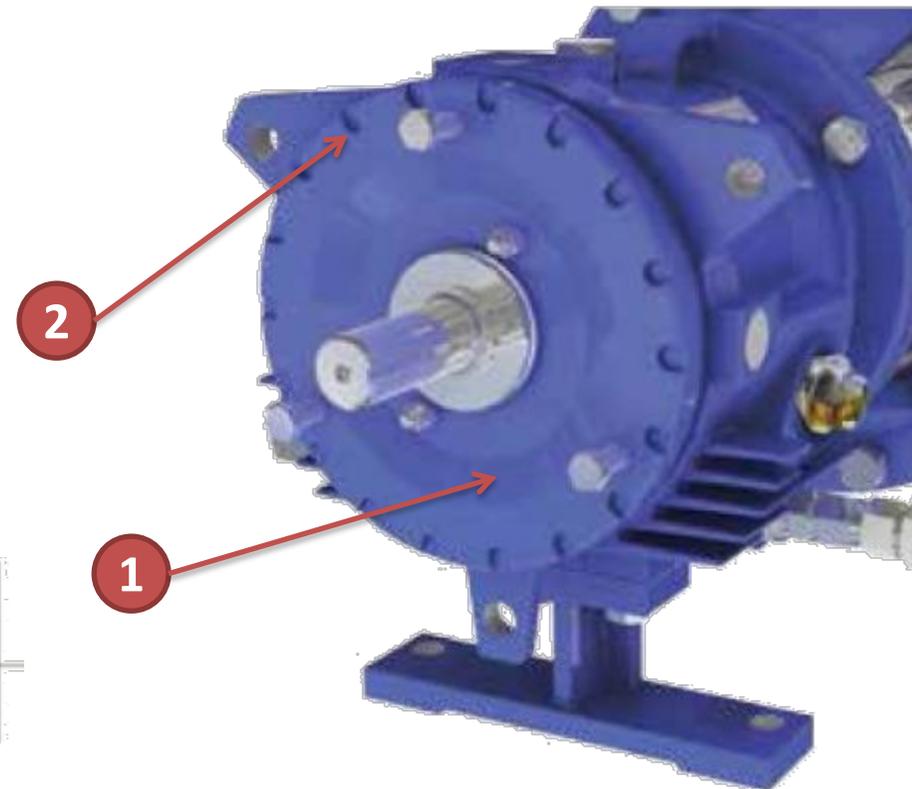
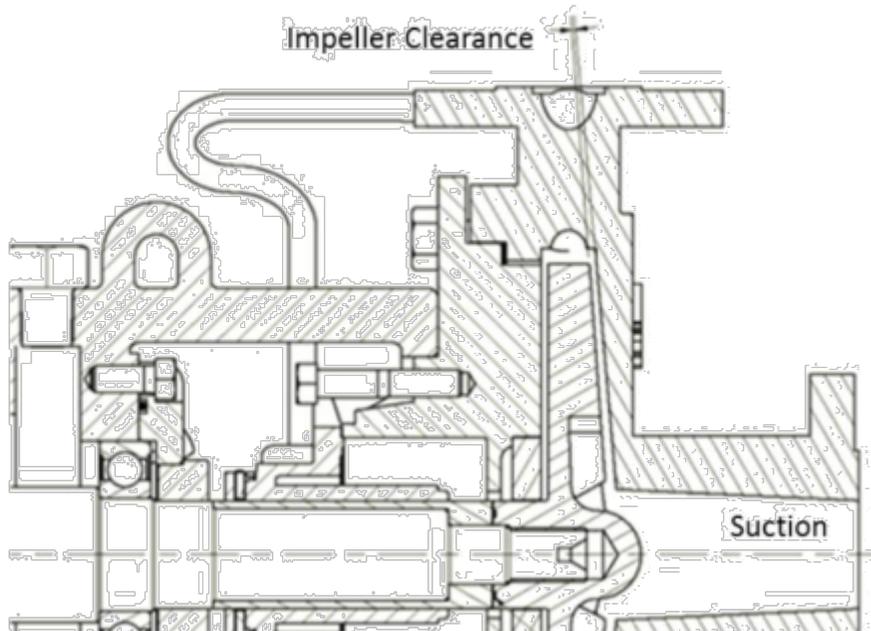
- SST 316 (CF8M)
- Duplex (CD4MCu)
- Alloy 20, Hastelloy B or C, Titanium, Zirconium.



ANSI Chemical Process Pump OH1

Bearing Carrier

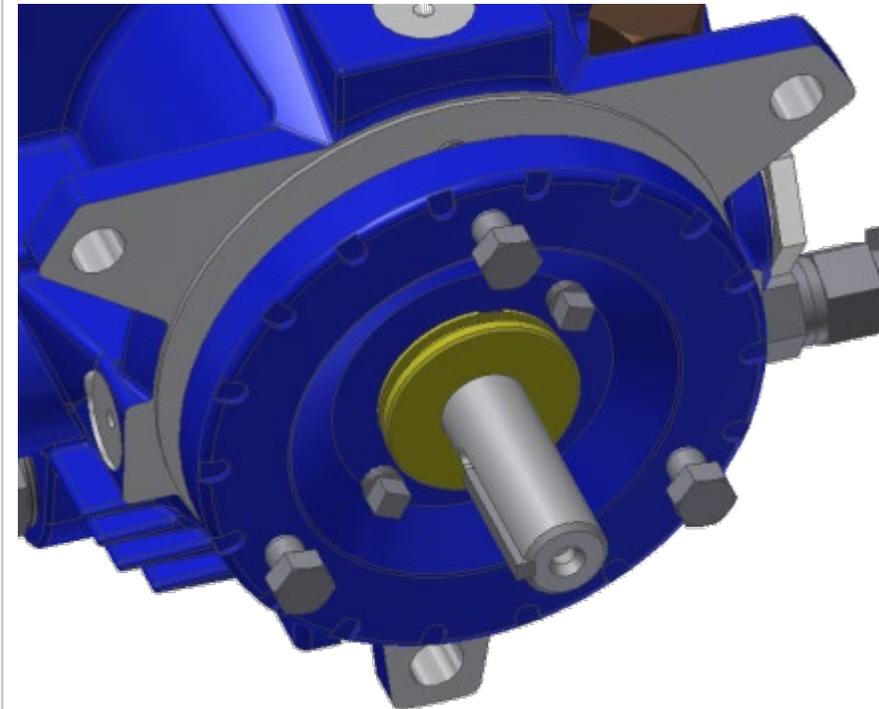
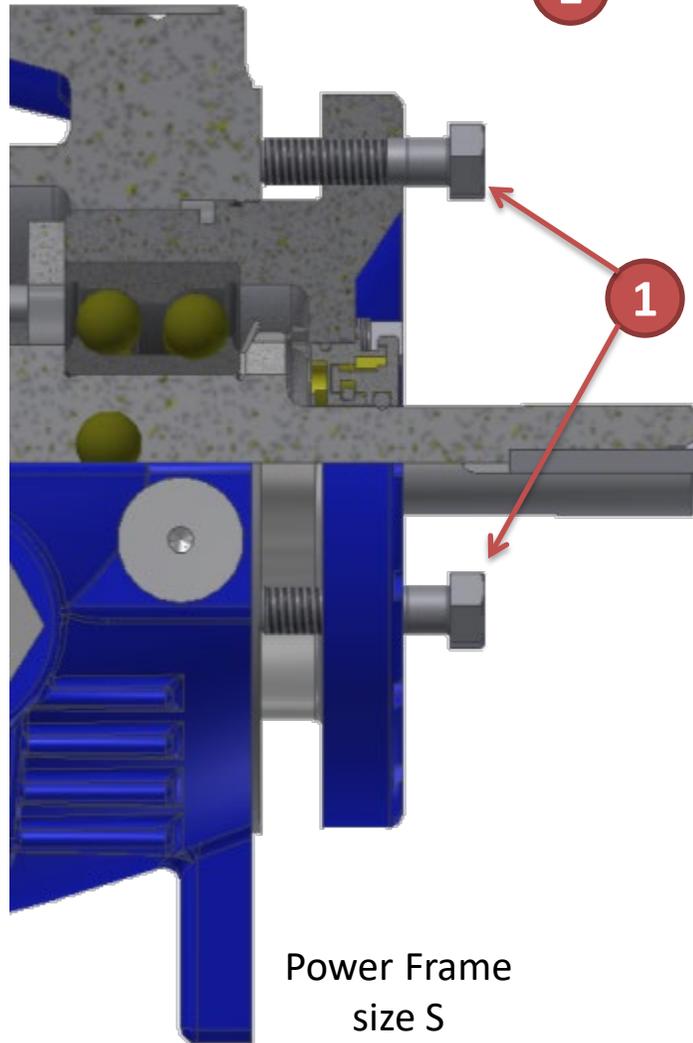
- 1 The Bearing Carrier is threaded to the frame and rotates to displace axially the entire rotor
- 2 Each mark rotation represents an axial movement of 0.003" (0,08 mm)



ANSI Chemical Process Pump OH1

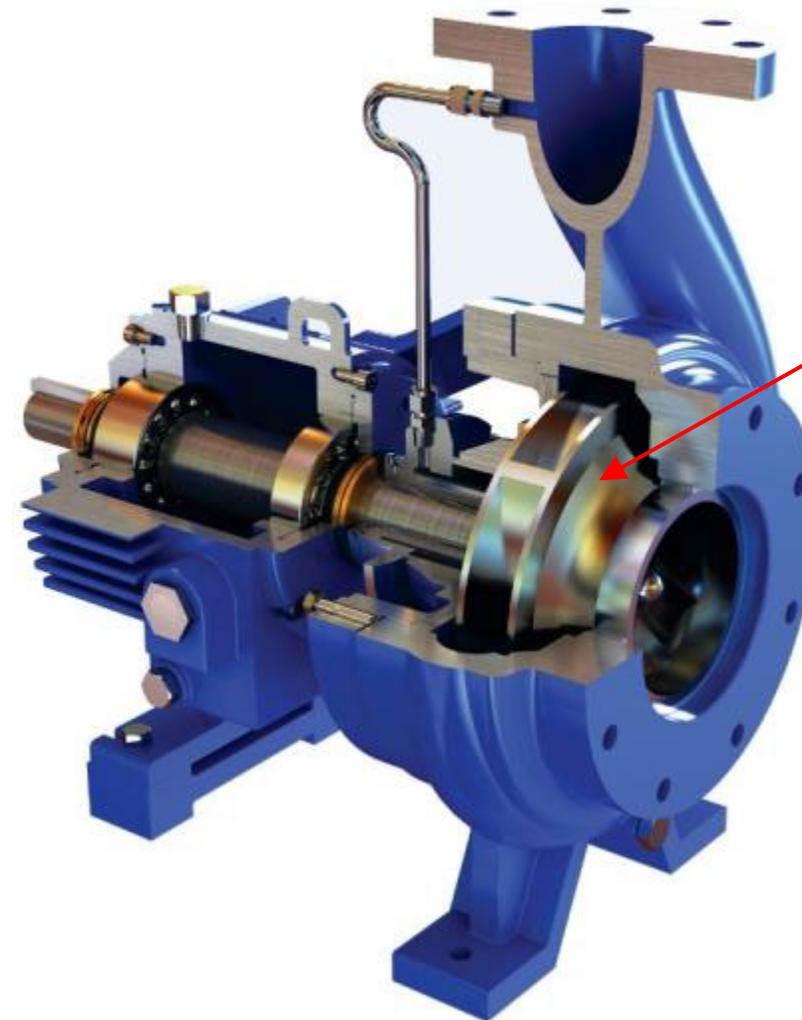
Bearing Carrier

- 1 Three hexagonal bolts to lock the bearing carrier rotation once we have the axial clearance required



ANSI Chemical Process Pump OH1

CPP Impeller

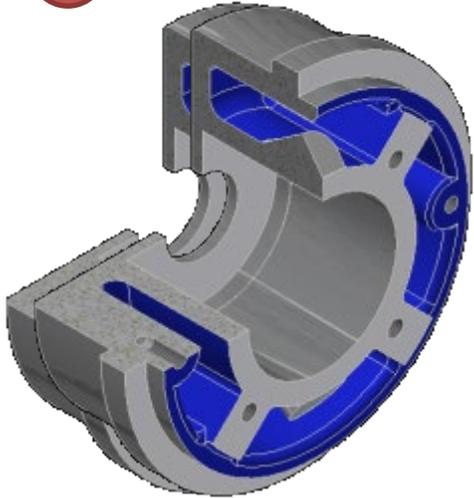


CPP has
Enclosed
Impeller

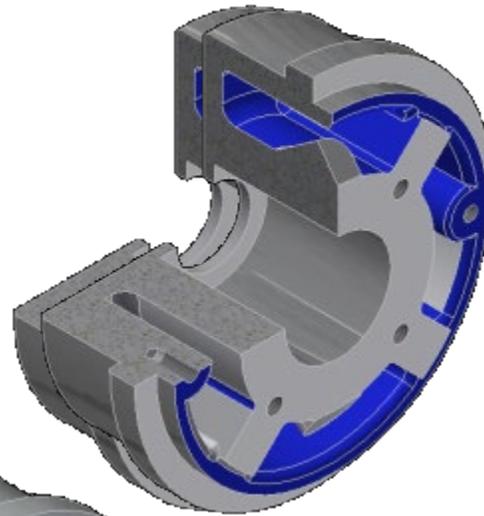
ANSI Chemical Process Pump OH1

Case Cover

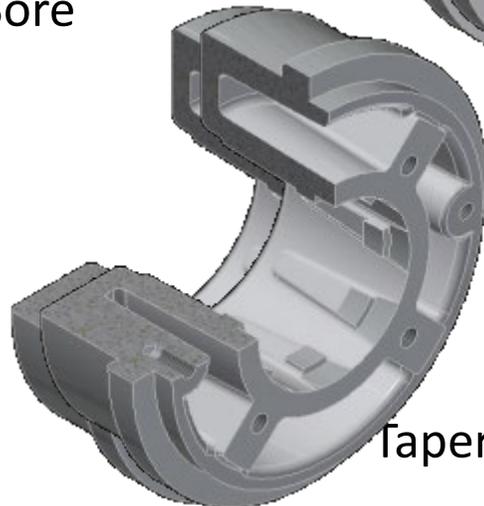
1 Packing, Single & Double mechanical seal



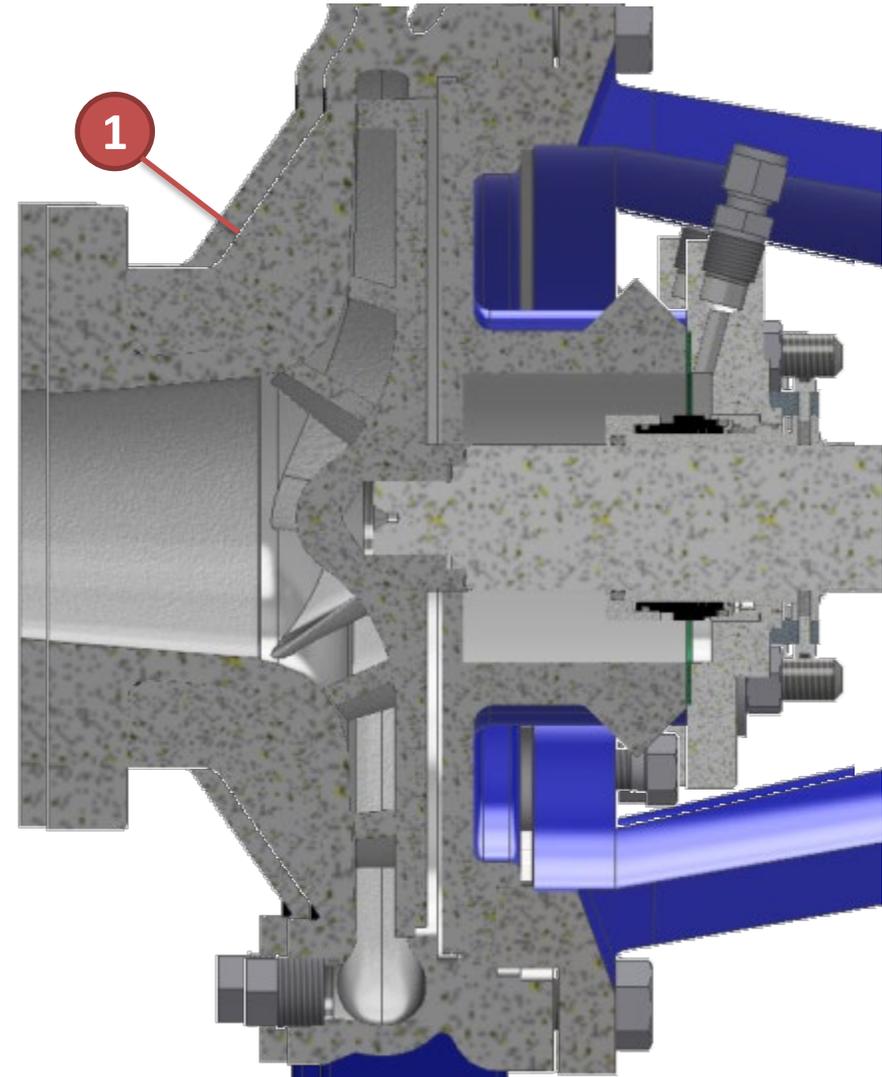
Big Bore



Small Bore



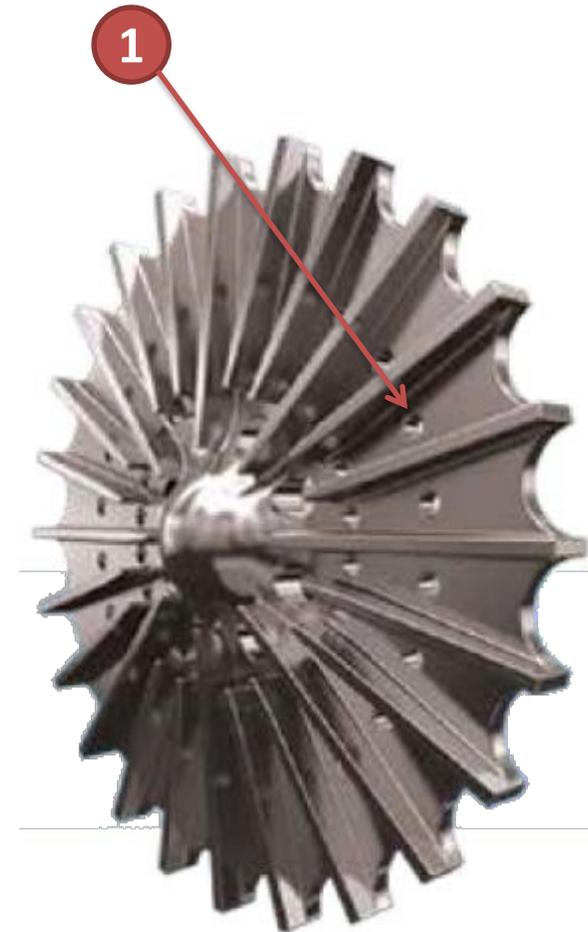
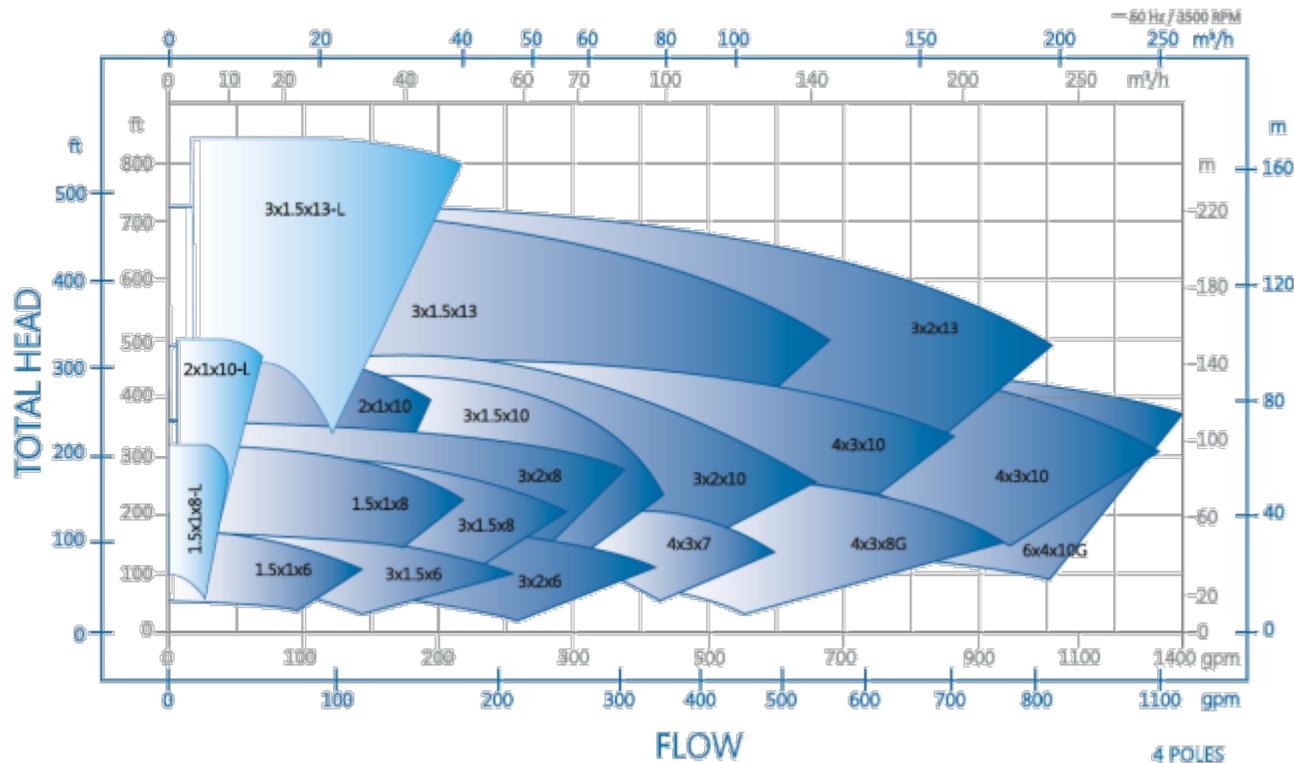
Tapered Bore



ANSI Chemical Process Pump OH1

Range

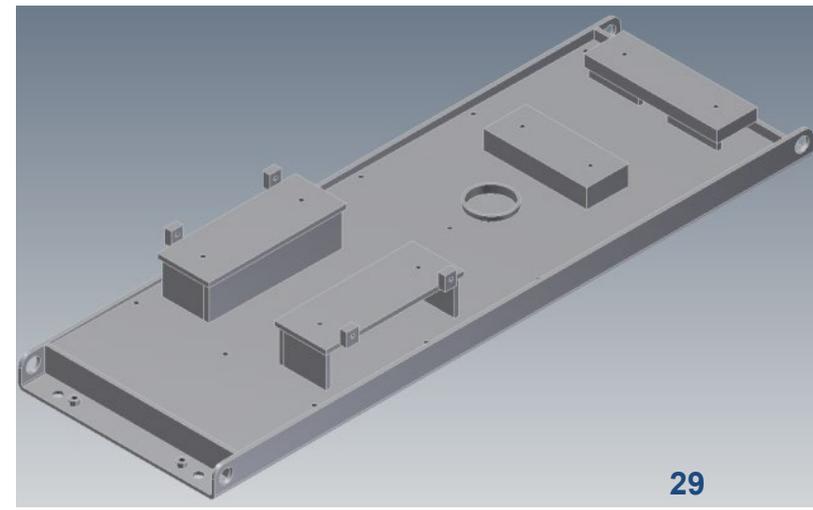
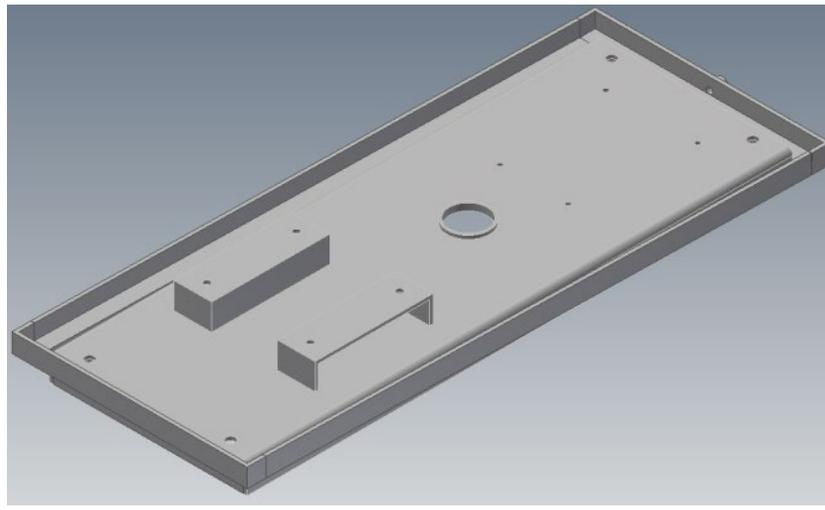
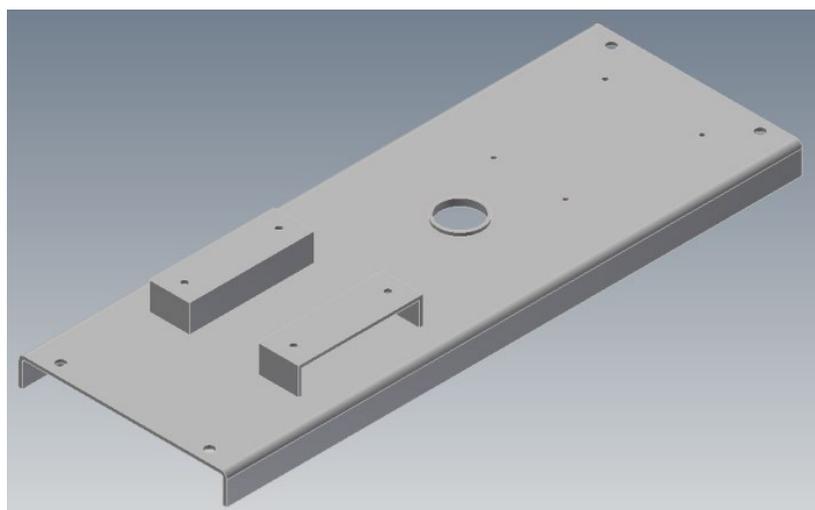
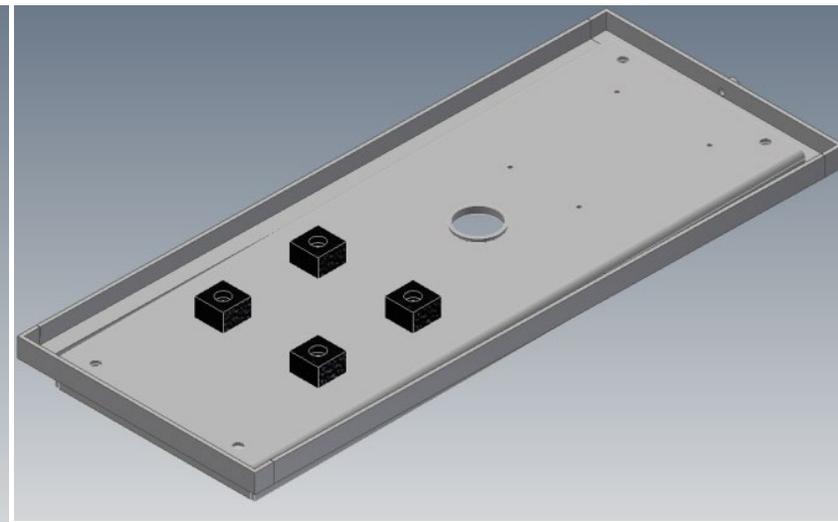
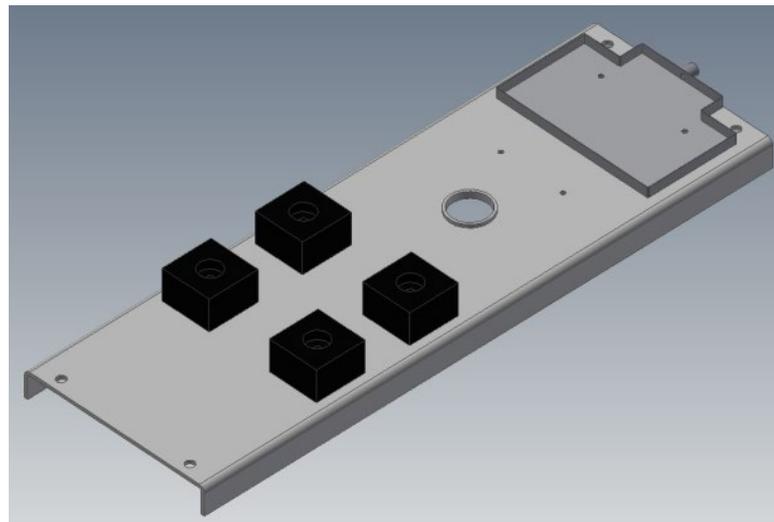
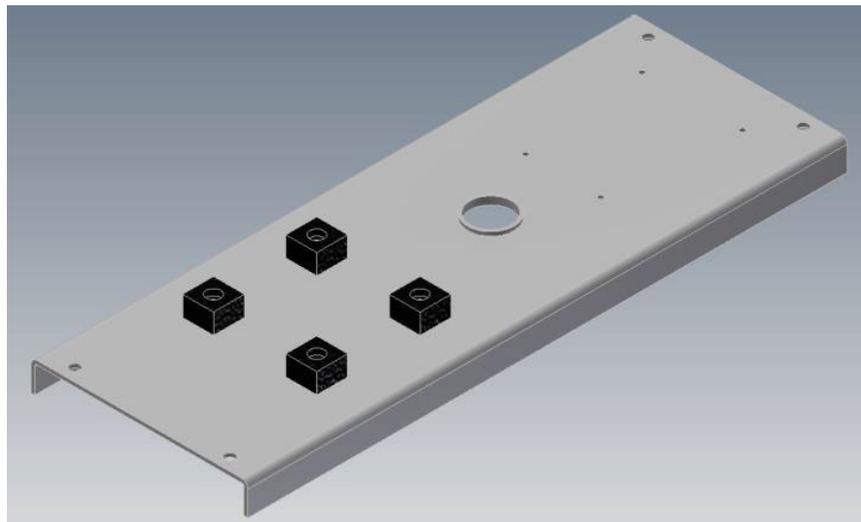
- ✓ CPO-L has a semi-open radial vanes impeller (Barske type), for low flow high head applications.
Three sizes: 1 1/2x1x8-L, 2x1x10-L and 3x1 1/2x13-L.
- 1 Balancing holes to reduce axial thrust





Baseplates

CPO/ CPP



Quick Ship Program

CPO / CPP

- Same day or “Quick Ship” program for our standard products.
 - Quick ship inventory from several North American locations.

- Fast and effective technical support.



“OH2 Pumps: Centreline-mounted, single-stage overhung pumps. Radially split”

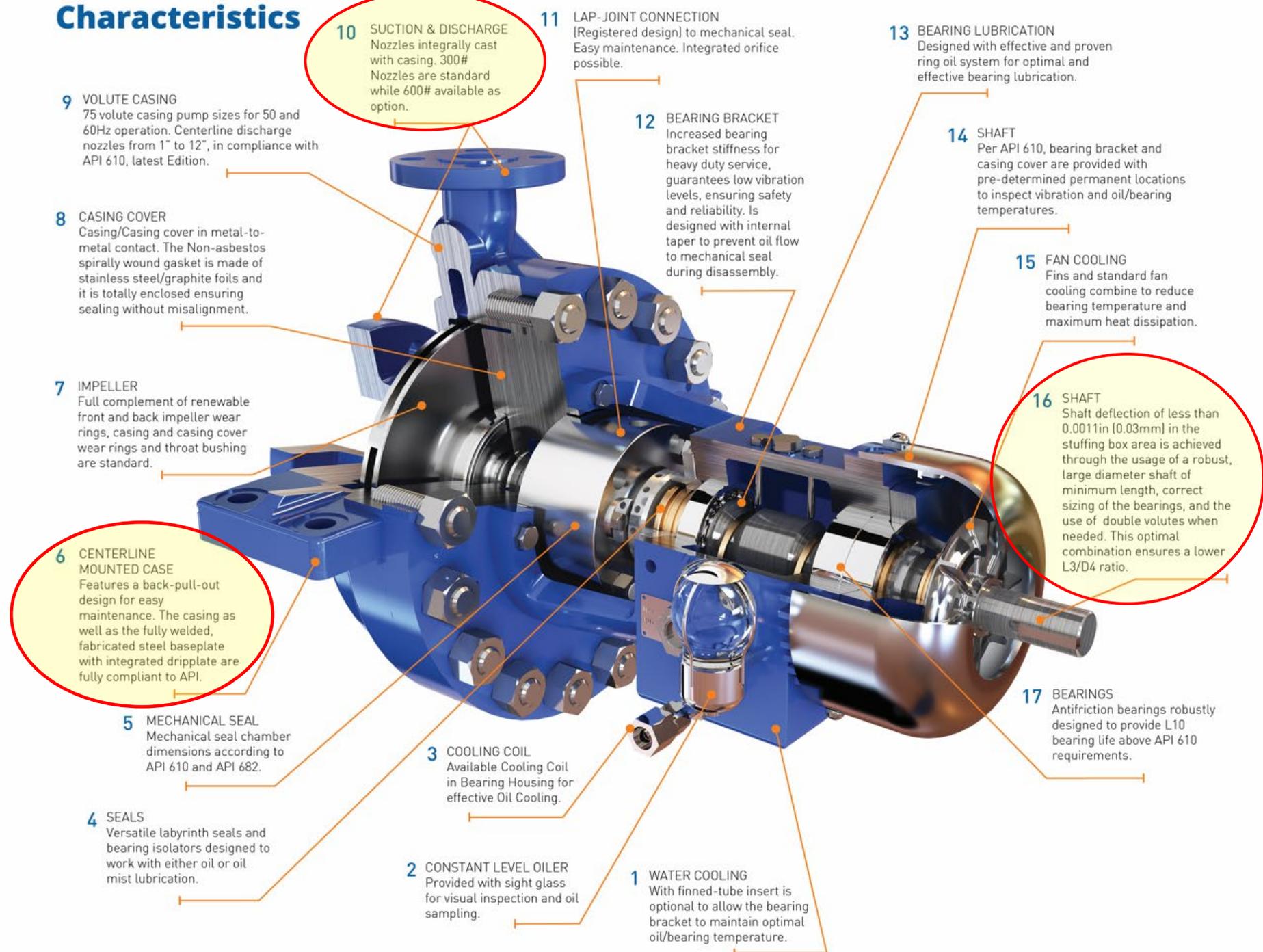
- APPLICATIONS:

- Petroleum Refining, Production and Distribution (Pipeline)
 - Industrial Wastes
 - Petrochemical and Chemical Industry
 - Gas Industry Services
 - Hydrocarbon Processing
 - Hot Oil Service
 - Utilities
 - Boiler Feed Recirculation
 - HRSG Recirculation
 - Water
 - General Industry
-
- Retrofitting Refinery Downturns – replacing BB pumps with OH2’s.





Characteristics



9 VOLUTE CASING
75 volute casing pump sizes for 50 and 60Hz operation. Centerline discharge nozzles from 1" to 12", in compliance with API 610, latest Edition.

8 CASING COVER
Casing/Casing cover in metal-to-metal contact. The Non-asbestos spirally wound gasket is made of stainless steel/graphite foils and it is totally enclosed ensuring sealing without misalignment.

7 IMPELLER
Full complement of renewable front and back impeller wear rings, casing and casing cover wear rings and throat bushing are standard.

6 CENTERLINE MOUNTED CASE
Features a back-pull-out design for easy maintenance. The casing as well as the fully welded, fabricated steel baseplate with integrated dripplate are fully compliant to API.

5 MECHANICAL SEAL
Mechanical seal chamber dimensions according to API 610 and API 682.

4 SEALS
Versatile labyrinth seals and bearing isolators designed to work with either oil or oil mist lubrication.

2 CONSTANT LEVEL OILER
Provided with sight glass for visual inspection and oil sampling.

1 WATER COOLING
With finned-tube insert is optional to allow the bearing bracket to maintain optimal oil/bearing temperature.

3 COOLING COIL
Available Cooling Coil in Bearing Housing for effective Oil Cooling.

10 SUCTION & DISCHARGE
Nozzles integrally cast with casing. 300# Nozzles are standard while 600# available as option.

11 LAP-JOINT CONNECTION
[Registered design] to mechanical seal. Easy maintenance. Integrated orifice possible.

12 BEARING BRACKET
Increased bearing bracket stiffness for heavy duty service, guarantees low vibration levels, ensuring safety and reliability. Is designed with internal taper to prevent oil flow to mechanical seal during disassembly.

13 BEARING LUBRICATION
Designed with effective and proven ring oil system for optimal and effective bearing lubrication.

14 SHAFT
Per API 610, bearing bracket and casing cover are provided with pre-determined permanent locations to inspect vibration and oil/bearing temperatures.

15 FAN COOLING
Fins and standard fan cooling combine to reduce bearing temperature and maximum heat dissipation.

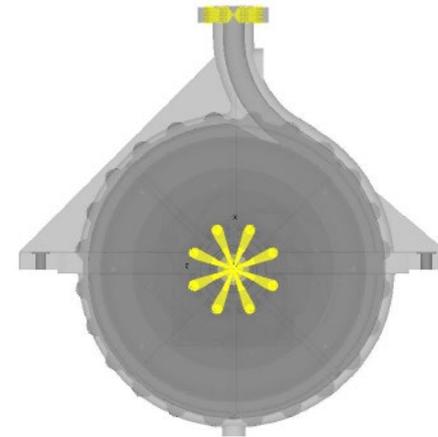
16 SHAFT
Shaft deflection of less than 0.0011in (0.03mm) in the stuffing box area is achieved through the usage of a robust, large diameter shaft of minimum length, correct sizing of the bearings, and the use of double volutes when needed. This optimal combination ensures a lower L3/D4 ratio.

17 BEARINGS
Antifriction bearings robustly designed to provide L10 bearing life above API 610 requirements.



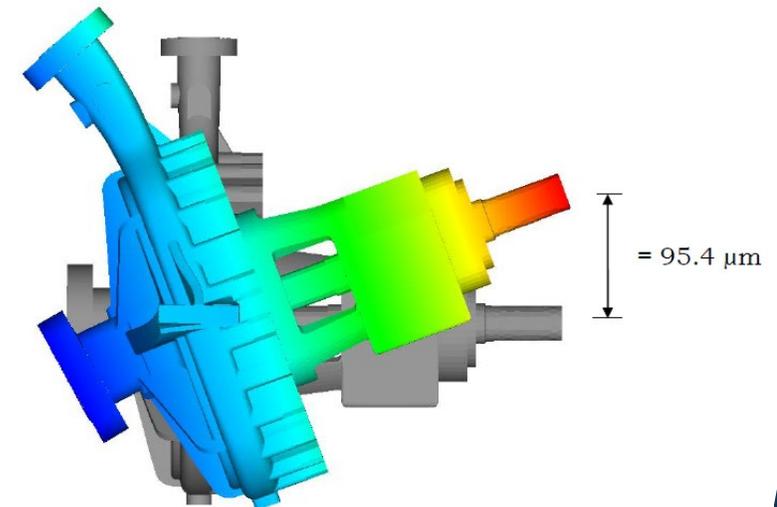
Casing – Forces and moments

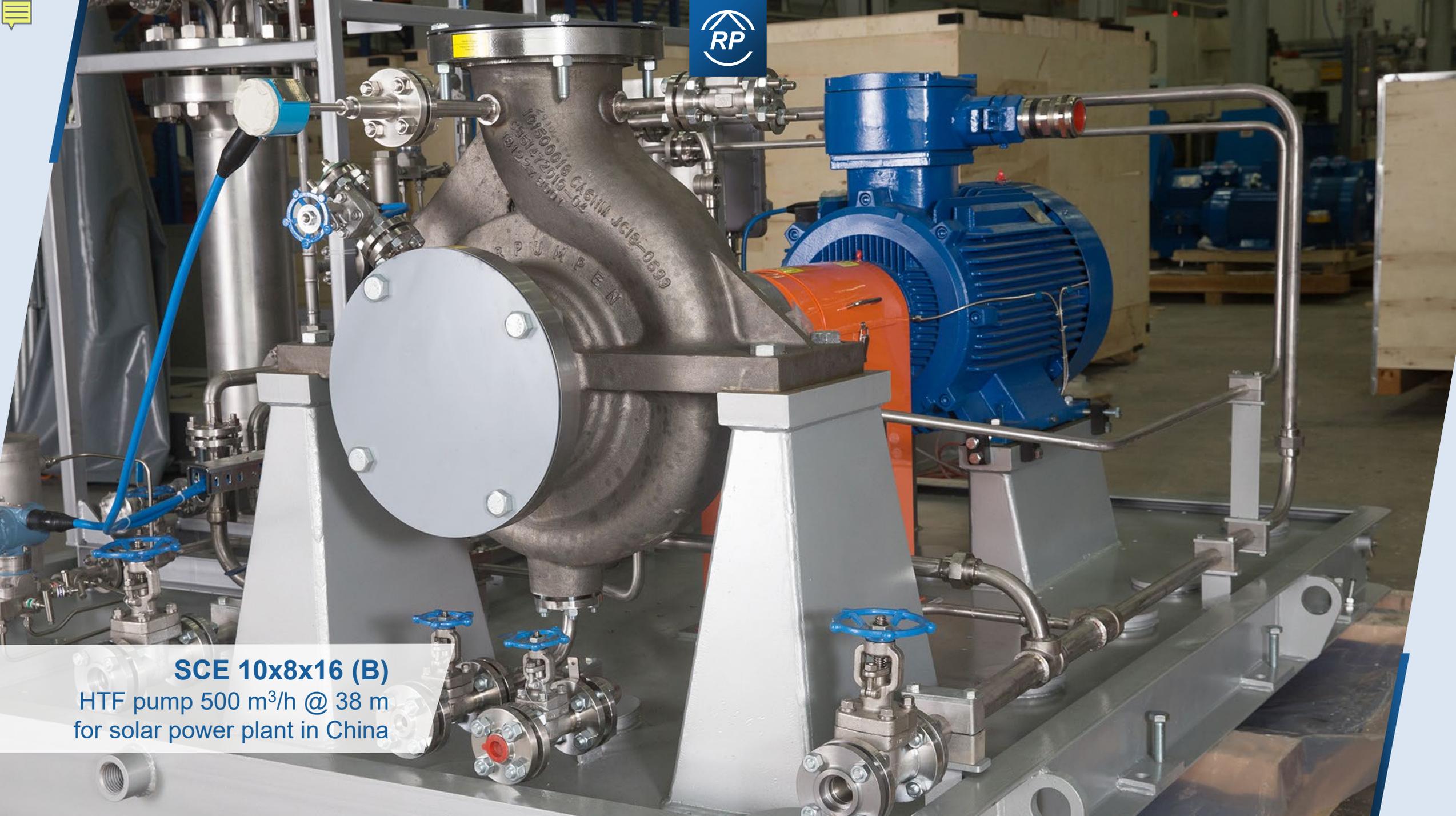
- The forces and moments that can be withstood by the nozzles in SCE pumps, and their baseplates, expressed as a factor of the API nozzle forces and moments, is 2x API forces and moments.
- For 3x and more, additional time and cost for the analysis should be done on a case by case basis, considering variables such as suction pressure, pump materials, etc. Please consider that for 3x and more FEA analysis is needed, also, an extra cost might be incurred for changes in casing pattern or baseplate modifications.



Forces and Moments

Maximum Shaft Displacement due to 2X API Moments



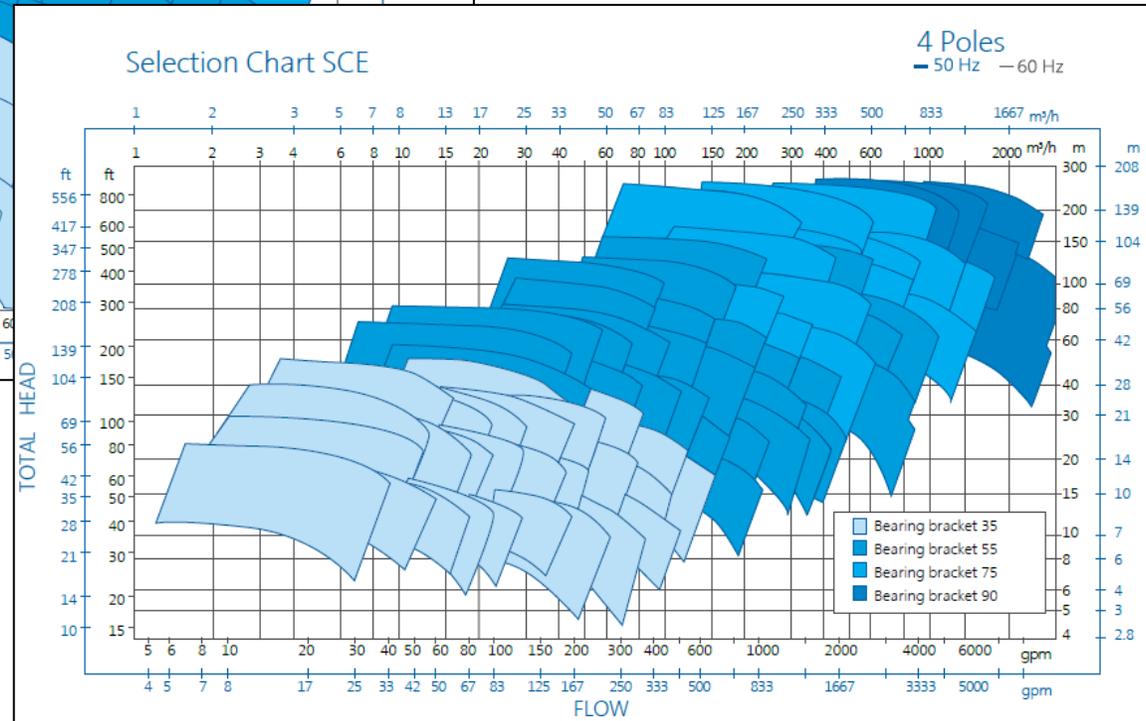
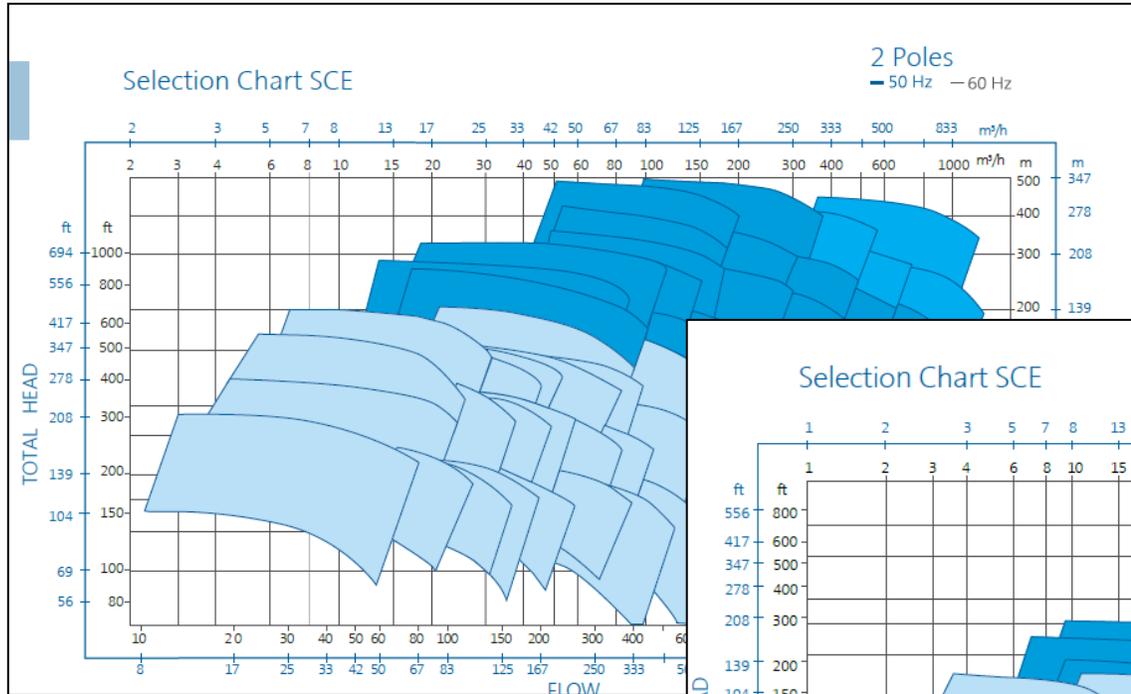


SCE 10x8x16 (B)

HTF pump 500 m³/h @ 38 m
for solar power plant in China



HYDRAULIC RANGE

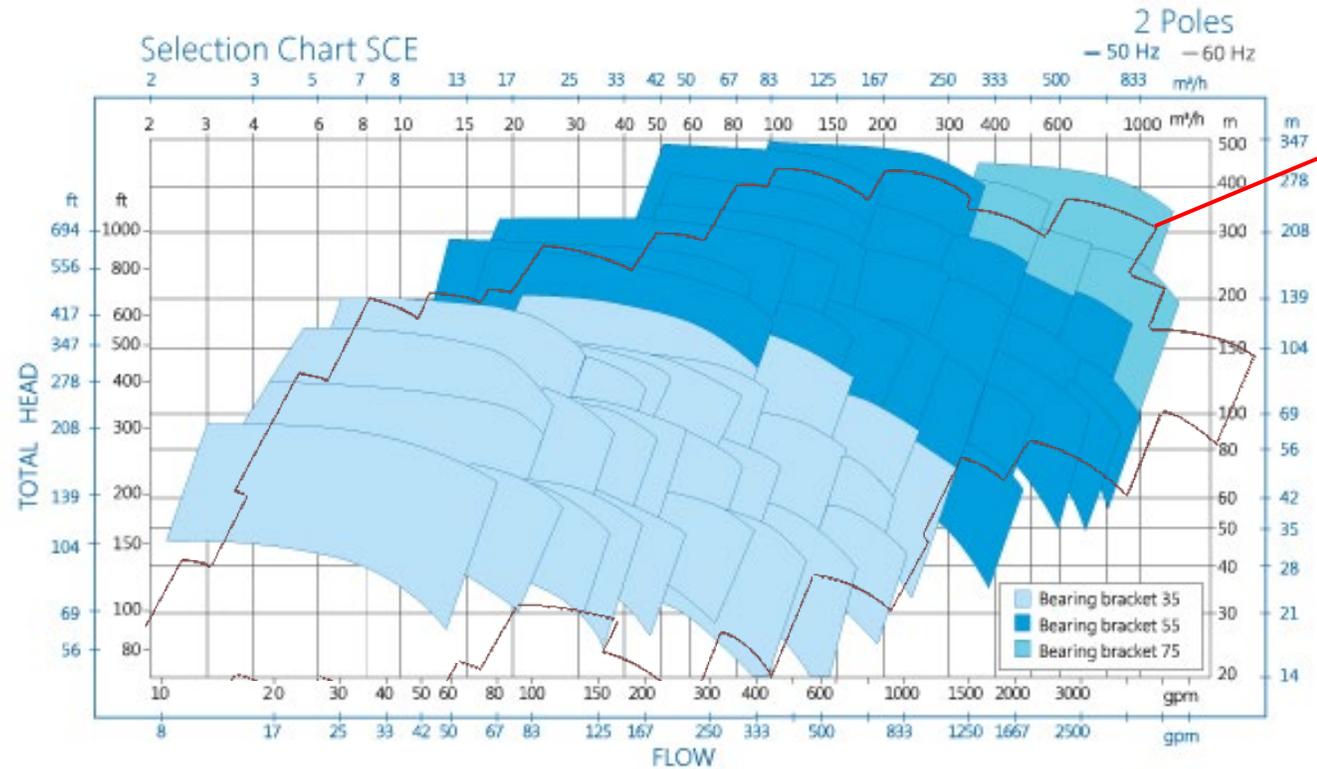
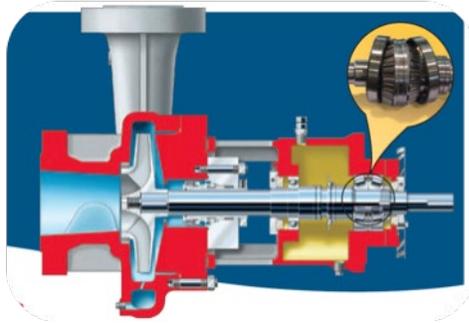




Benchmark

Ruhrpumpen vs Flowserve

Benchmark



Flowserve



Benchmark

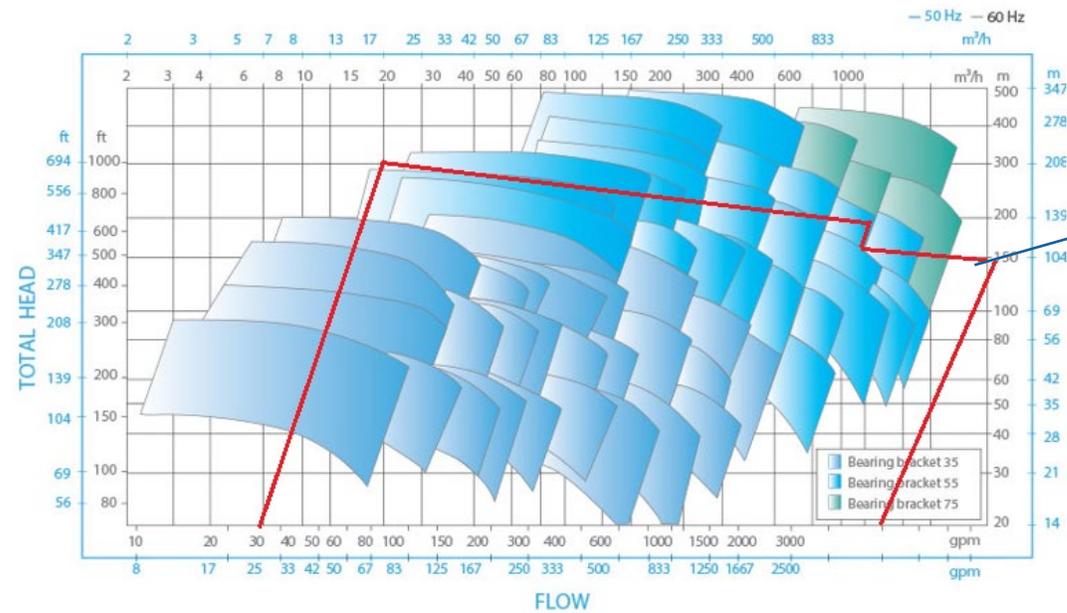
Ruhrpumpen vs Sulzer

Benchmark



Selection Chart SCE

2 POLES



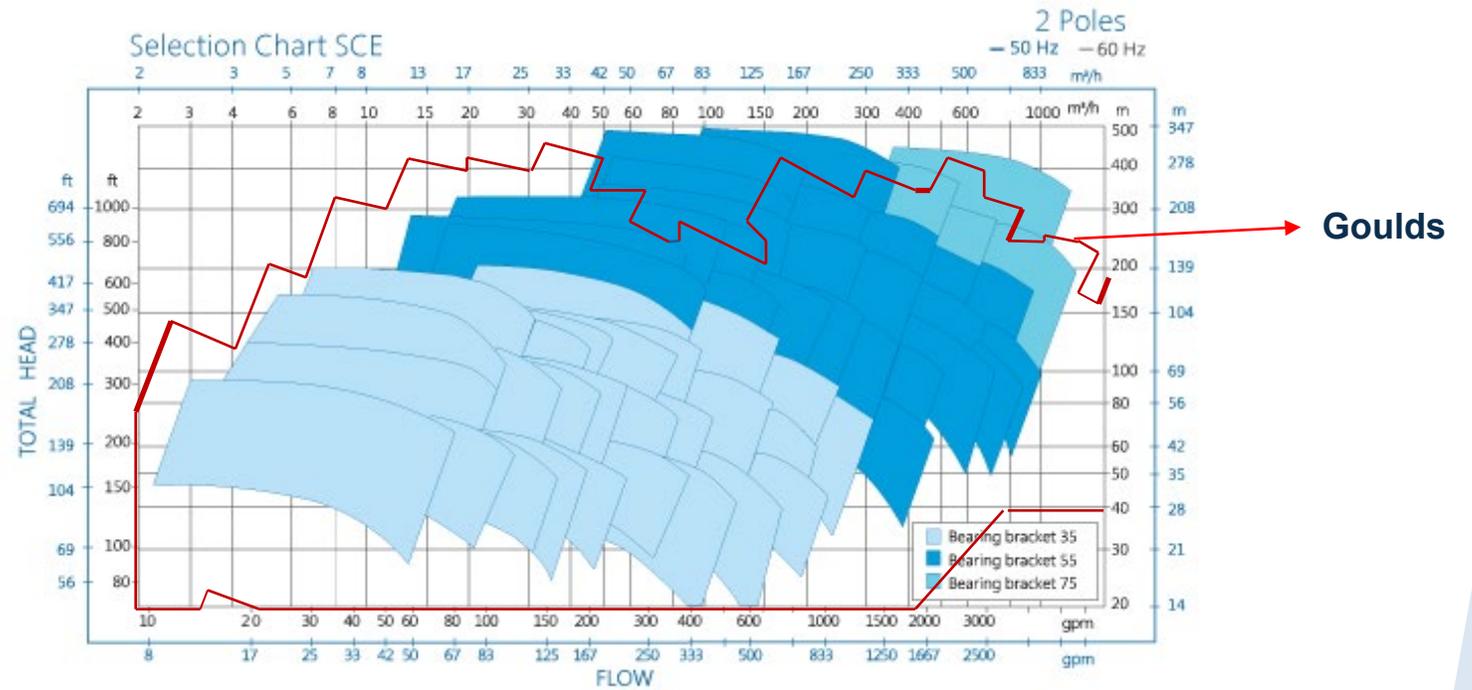
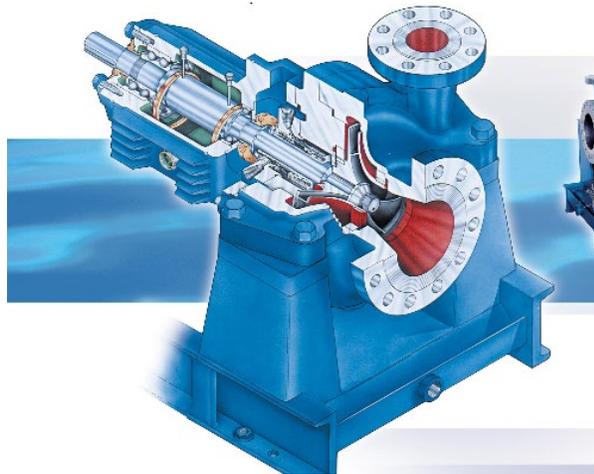
Sulzer



Benchmark

Ruhrpumpen vs Goulds

Benchmark



http://www.gouldspumps.com/ittgp/medialibrary/goulds/website/Products/3700/3700_reader_spreads.pdf?ext=.pdf



Coming Attractions 😊

“Overhung Process Pumps – Part 2 – Vertical Overhung Process Pumps
API Types OH3,4,5 & 6”

Thurs 24th November – 08.00 (UK GMT) (Eastern Hemisphere) &
17.00 (UK GMT) (Western Hemisphere)

Comparing and contrasting vertical overhung pumps (OH3,4,5 & 6)

Aimed at Process and Mechanical Engineers, and Consultant Engineers who specify pumping equipment as well as Applications & Sales Engineers selecting and quoting them.

The logo for RUHRPUMPEN features a stylized white circle with a white triangle inside, pointing upwards. The word "RUHRPUMPEN" is written in a bold, white, sans-serif font across the middle of the circle.

RUHRPUMPEN

Specialist for Pumping Technology

Q & A

www.ruhrpumpen.com

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RUHRPUMPEN AT A GLANCE

**VERTICAL
INTEGRATION**

**SALES
OFFICES IN
+35 COUNTRIES**

**MANUFACTURING
FACILITIES
IN 10 COUNTRIES**

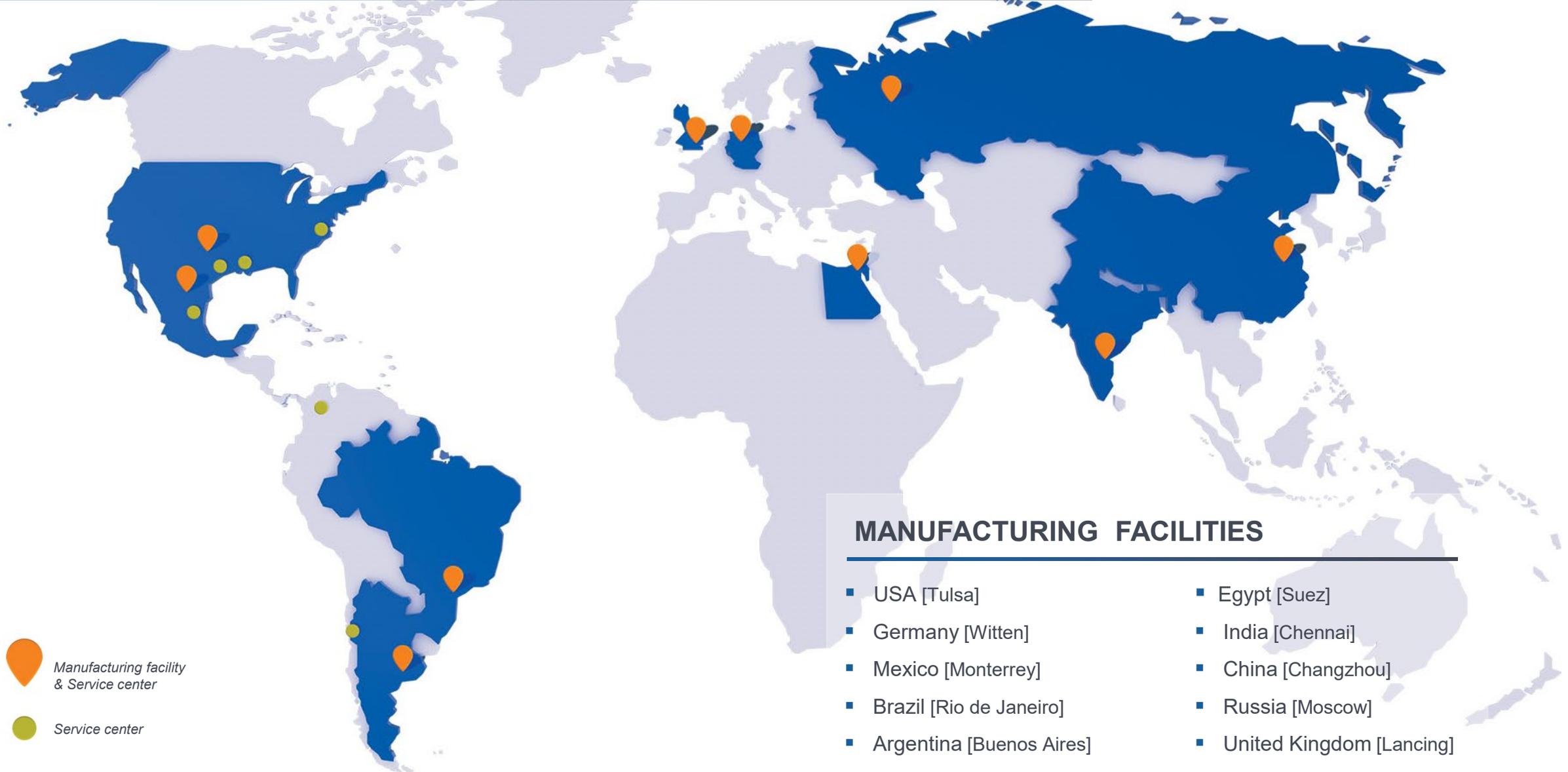
**+70 YEARS
OF EXPERIENCE**

**+2,000
EMPLOYEES**

**15 SERVICE
CENTERS**

+70,000 PUMPING SOLUTIONS INSTALLED WORLDWIDE

A GLOBAL COMPANY



MARKETS WE SERVE

Our commitment to create innovations that offer reliable solutions to our customers allow us to provide a complete range of pump systems to support **core markets** as:



OIL & GAS



CHEMICAL



INDUSTRIAL



POWER



WATER



OUR PUMP LINES

Ruhrpumpen offers a broad range of highly engineered and standard pumping products that meet and exceed the requirements of the most demanding quality specifications and industry standards.

Our pumps can handle head requirements as high as 13,000 ft (4,000 m) and capacities up to 300,000 gpm (68,000 m³/hr). Moreover, our pump designs cover temperatures from cryogenic temperatures of -310 °F (-196 °C) up to 752 °F (400 °C).

Products include:

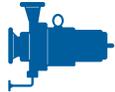
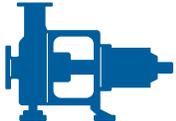
- Single Stage Overhung Pumps
- Between Bearings Pumps
- Horizontal Multi-Stage Pumps
- Vertical Multi-Stage Pumps
- Vertical Mixed Flow & Axial Flow Pumps
- Positive Displacement Pumps
- Full Range of Industrial Pumps
- Submersible Pumps
- Magnetic Drive Pumps
- Decoking Systems
- Packaged Systems
- Fire Systems





OUR PUMPS

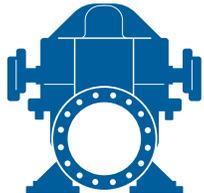
OVERHUNG PUMPS

CATEGORY	RP MODEL	DESIGN STANDARD	
Sealless Magnetic Drive Pumps	CRP-M / CRP-M-CC	ISO 2858 & 15783 HI design (OH11)	
	SCE-M	API 685	
Foot Mounted OH1 and General End Suction Pumps	IPP	HI design (OH1)	
	CPP / CPP-L	HI design (OH1) ANSI B73.1	
	CPO / CPO-L	HI design (OH1) ANSI B73.1	
	CRP	HI design (OH1) ISO 2858 & 5199	
	GSD	HI design (OH0)	
	SHD / ESK / SK / SKO SKV / ST / STV	HI design (OH1)	
	SWP	HI design (OH3A)	
Centerline Mounted	SCE	API 610 (OH2)	
Vertical In-Line Pumps	SPI	API 610 (OH3)	
	IVP / IVP-CC	HI design (OH4 / OH5)	
	IIL	HI design (OH5) Dimensionally compliant with ANSI B73.2	
	SPN	API 610 (OH5)	





BETWEEN BEARING PUMPS

CATEGORY		RP MODEL	DESIGN STANDARD	
1 and 2 stage	Axially split	HSC / HSD / HSL HSR / ZW	HI design (BB1)	
		HSM	HI design (BB3)	
		ZM / ZMS ZLM / ZME	API design (BB1)	
	Radially split	HVN / J	API design (BB2)	
		RON / RON-D	API design (BB2)	
Multi-stage	Axially split	SM / SM-I	API design (BB3)	
		JTN	API design (BB3)	
	Radially split <i>single casing</i>	GP	API design (BB4)	
	Radially split <i>double casing</i>	A LINE	API design (BB5)	





VERTICAL PUMPS

CATEGORY		RP MODEL	DESIGN STANDARD	
Single casing	Diffuser	VTP	HI & API 610 (VS1)	
		VCT	HI & API 610 (VS1)	
		HQ	HI & API 610 (VS1)	
		VLT	HI & API 610 (VS1)	
	Volute	DSV / DX	HI & API 610 (VS2)	
	Discharge through column – Axial flow	VAF	HI & API 610 (VS3)	
Separate discharge line	VSP / VSP-Chem	HI & API 610 (VS4)		
Double casing	Diffuser	VLT / VMT	HI & API 610 (VS6)	
	Volute	DSV / DX	HI & API 610 (VS7)	
Submersible pumps		SMF	HI design (OH8A)	
		VLT-Sub / VTP-Sub	HI design (VS0)	





SPECIAL SERVICE PUMPS

CATEGORY	RP MODEL	DESIGN STANDARD	
Pitot tube pumps	COMBITUBE	HI design	
Reciprocating pumps	RDP	API 674 ISO 13710	
Vertical turbine generator	VTG	HI design (VS6)	
Barge	LS BARGE	HI design	
Floating dock pumps	ZVZ	HI design	
	LVZ	HI design	
Cryogenic pumps	SVNV	-	
	VTG Cryogenic	-	
	VLT Cryogenic VLTV	-	
Pre-packaged fire pump systems	Fire systems incorporate pumps, drivers, control systems and pipework in a single container. They can be skid mounted, with or without enclosure and supplied with electric motor or diesel engine.	NFPA-20-850 UL and FM approved components	

