



Specialist for Pumping Technology

Session 23 – Pumps for the Desalination Market

Simon Smith April 2023



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.



Ruhr*RP*umpen 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
- No 17 – Refresher Session
- No 18 – Overhung Process Pumps OH1 & OH2
- No 19 – Vertical Overhung Process Pumps OH3-OH6
- No 20 – New Developments in the VS6 Market
- No 21 – BB4 Multistage Pumps for the Power Industry
- No 22 – Coking Process and Hydraulic Decoking Equipment

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

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Oil and Gas

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The most efficient and reliable pump systems worldwide

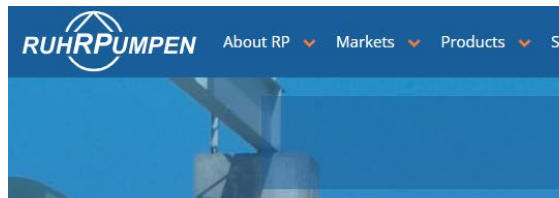
Ruhrpumpen is an innovative and efficient pump technology company that offers highly-engineered and standard pumping solutions for the oil & gas, power generation, industrial, chemical and water markets. We offer a broad range of centrifugal and reciprocating pumps that meet and exceed the requirements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

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- Newsletter Ruhrpumpen Fire Systems - December 2022
- CPP Process Pump Line New Sizes
- All Courses
- Ruhrpumpen Resources
- Hayward Tyler Signs Agreement with Ruhrpumpen to Service Vertical & Industrial Pumps.
- RP achieves ISO 9001:2015 for its industrial pump unit
- Ruhrpumpen CPO pump range for industrial processes
- Packing strips and packing gland tightening procedure
- New life to old vertical pump

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SHORT COURSE 3

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

Full session.

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SHORT COURSE 4

Selecting the Right Pump

Full session.

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Understanding pump instrumentation.

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SHORT COURSE 10

Non-Destructive Examination (NDE).

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Ruh**RP**umpen Short Courses

Session 23 – Pumps for the Desalination Market

This short course will look at the various pumps used in the Desalination Market worldwide.

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



Agenda

Process Overview

Pump Portfolio – Complete Product Offering

- OH1 - CRP
- BB1 - ZW
- HPRO - GPA
- HPRO - GP
- HPRO - SM / JTN
- HPRO - ZM / HS
- HPRO - RDP
- Verticals
- Self-Priming
- Submersibles

Quality

- ITP
- Testing requirements





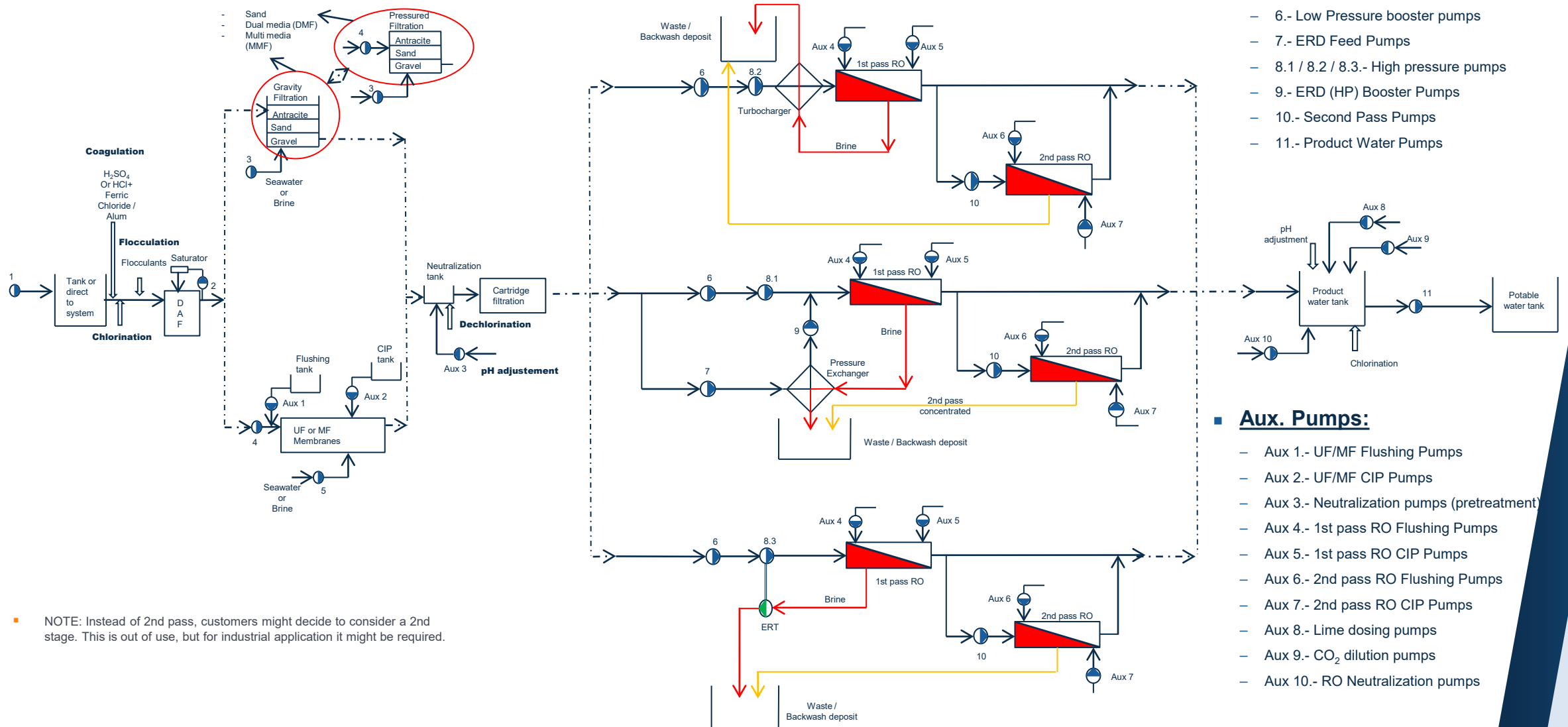
DESALINATION





Desalination: Full Line Supplier

Complete Process Diagram RO



■ Main Pumps:

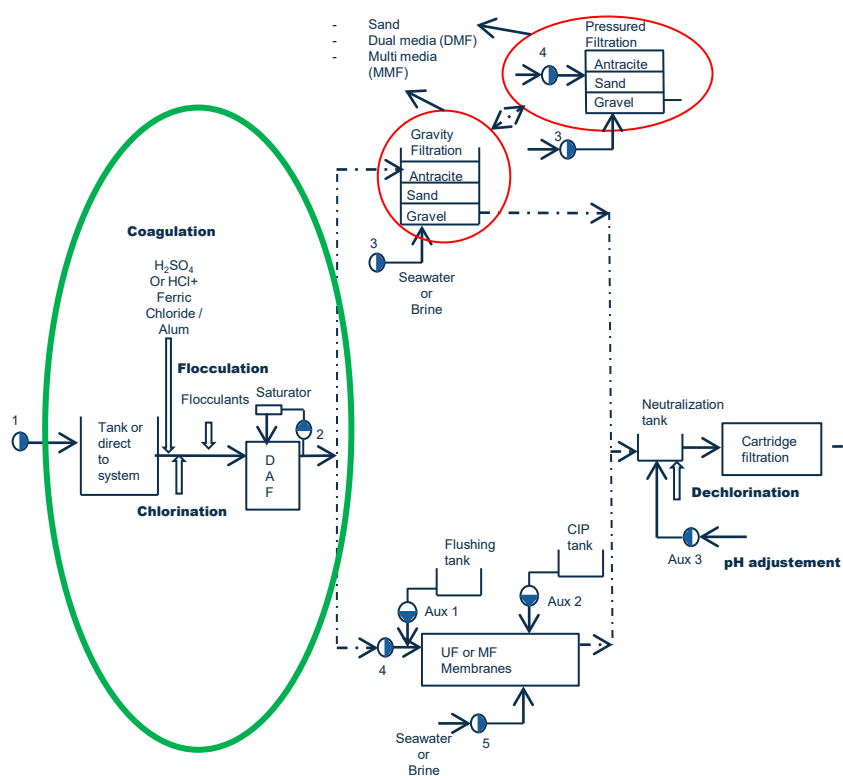
- 1.- Intake pumps
- 2.- DAF pumps
- 3.- Backwash Filter pumps
- 4.- Filter Feed Pumps
- 5.- UF/MF Backwash pumps
- 6.- Low Pressure booster pumps
- 7.- ERD Feed Pumps
- 8.1 / 8.2 / 8.3.- High pressure pumps
- 9.- ERD (HP) Booster Pumps
- 10.- Second Pass Pumps
- 11.- Product Water Pumps

■ Aux. Pumps:

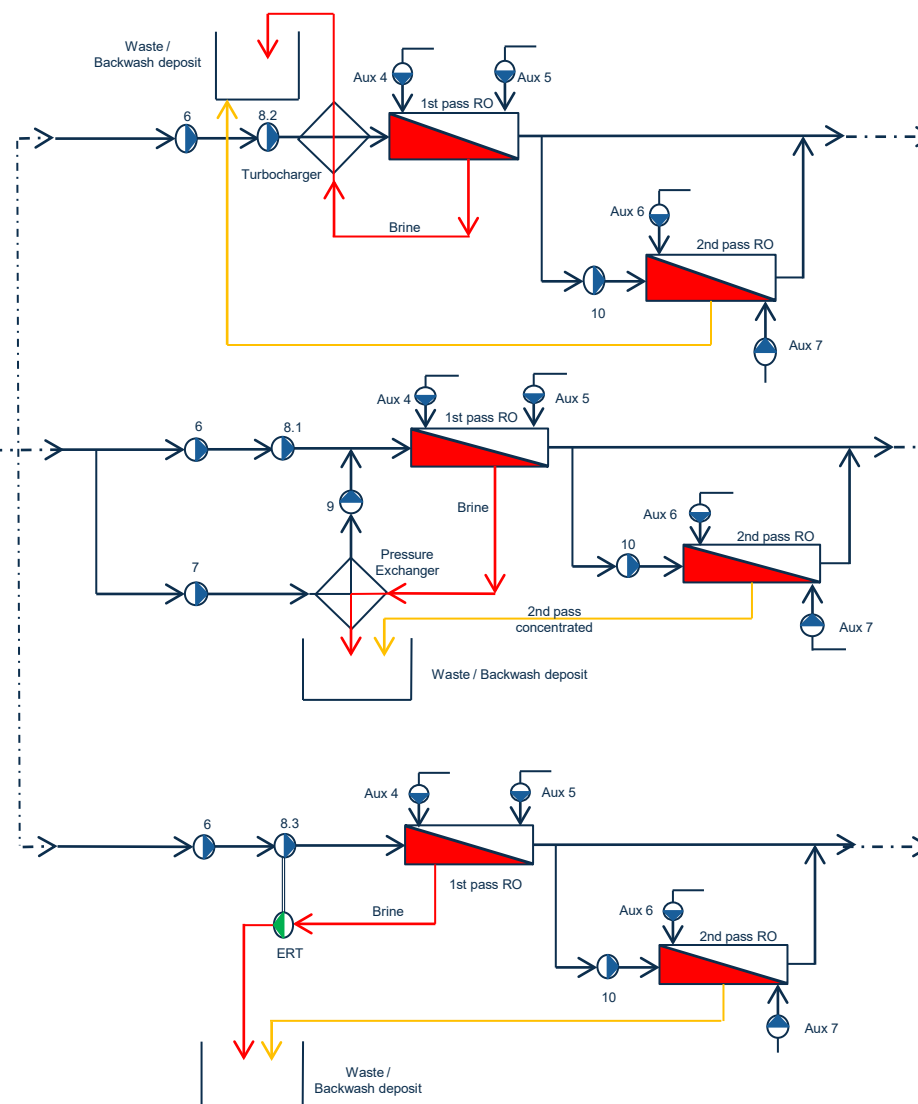
- Aux 1.- UF/MF Flushing Pumps
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- Aux 3.- Neutralization pumps (pretreatment)
- Aux 4.- 1st pass RO Flushing Pumps
- Aux 5.- 1st pass RO CIP Pumps
- Aux 6.- 2nd pass RO Flushing Pumps
- Aux 7.- 2nd pass RO CIP Pumps
- Aux 8.- Lime dosing pumps
- Aux 9.- CO₂ dilution pumps
- Aux 10.- RO Neutralization pumps

Desalination: Full Line Supplier

Pre-Treatment 1 - Coagulation



NOTE: Instead of 2nd pass, customers might decide to consider a 2nd stage. This is out of use, but for industrial application it might be required.



Main Pumps:

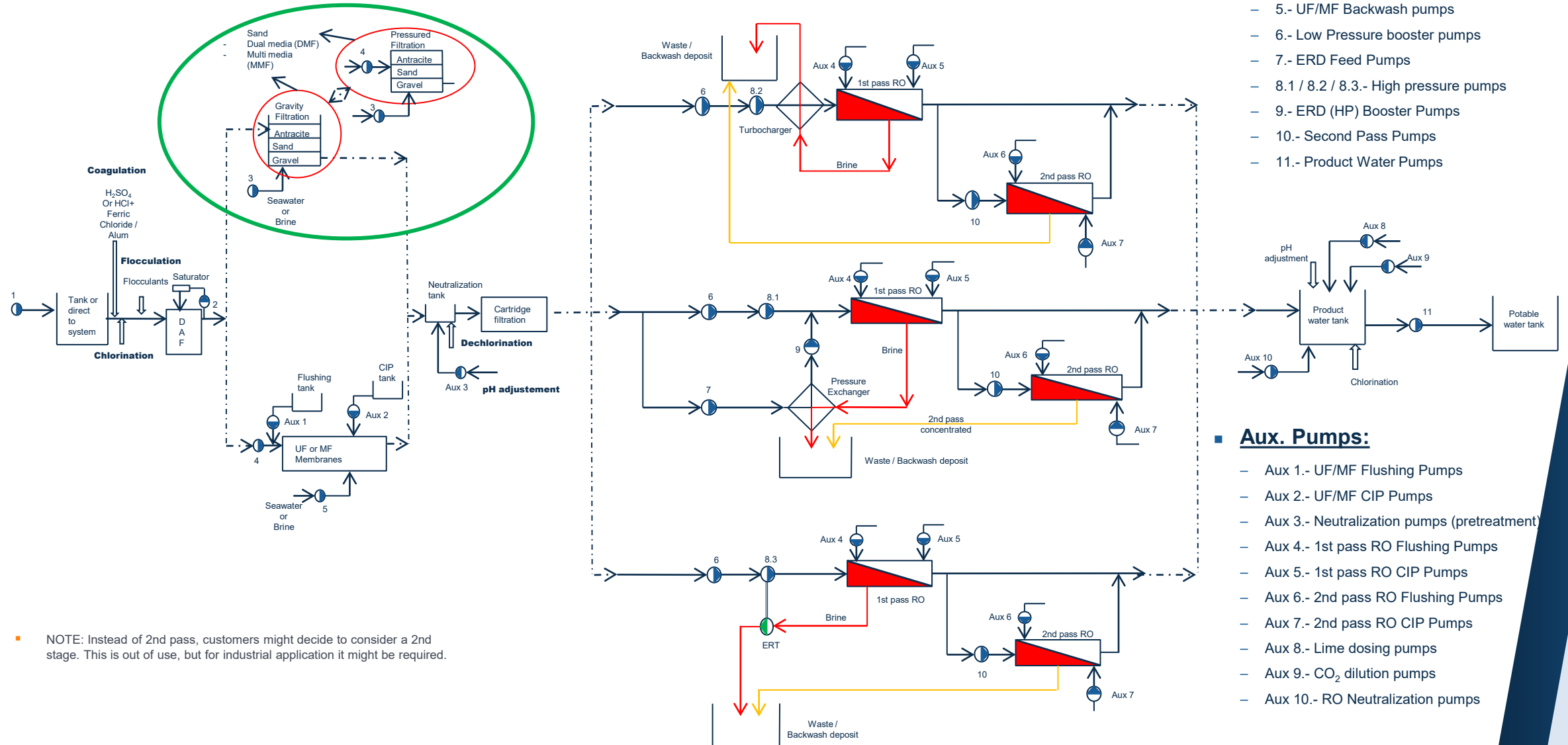
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Aux. Pumps:

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- Aux 7.- 2nd pass RO CIP Pumps
- Aux 8.- Lime dosing pumps
- Aux 9.- CO_2 dilution pumps
- Aux 10.- RO Neutralization pumps

Desalination: Full Line Supplier

Pre-Treatment 2 - Filtration



■ Main Pumps:

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- 2.- DAF pumps
- 3.- Backwash Filter pumps
- 4.- Filter Feed Pumps
- 5.- UF/MF Backwash pumps
- 6.- Low Pressure booster pumps
- 7.- ERD Feed Pumps
- 8.1 / 8.2 / 8.3.- High pressure pumps
- 9.- ERD (HP) Booster Pumps
- 10.- Second Pass Pumps
- 11.- Product Water Pumps

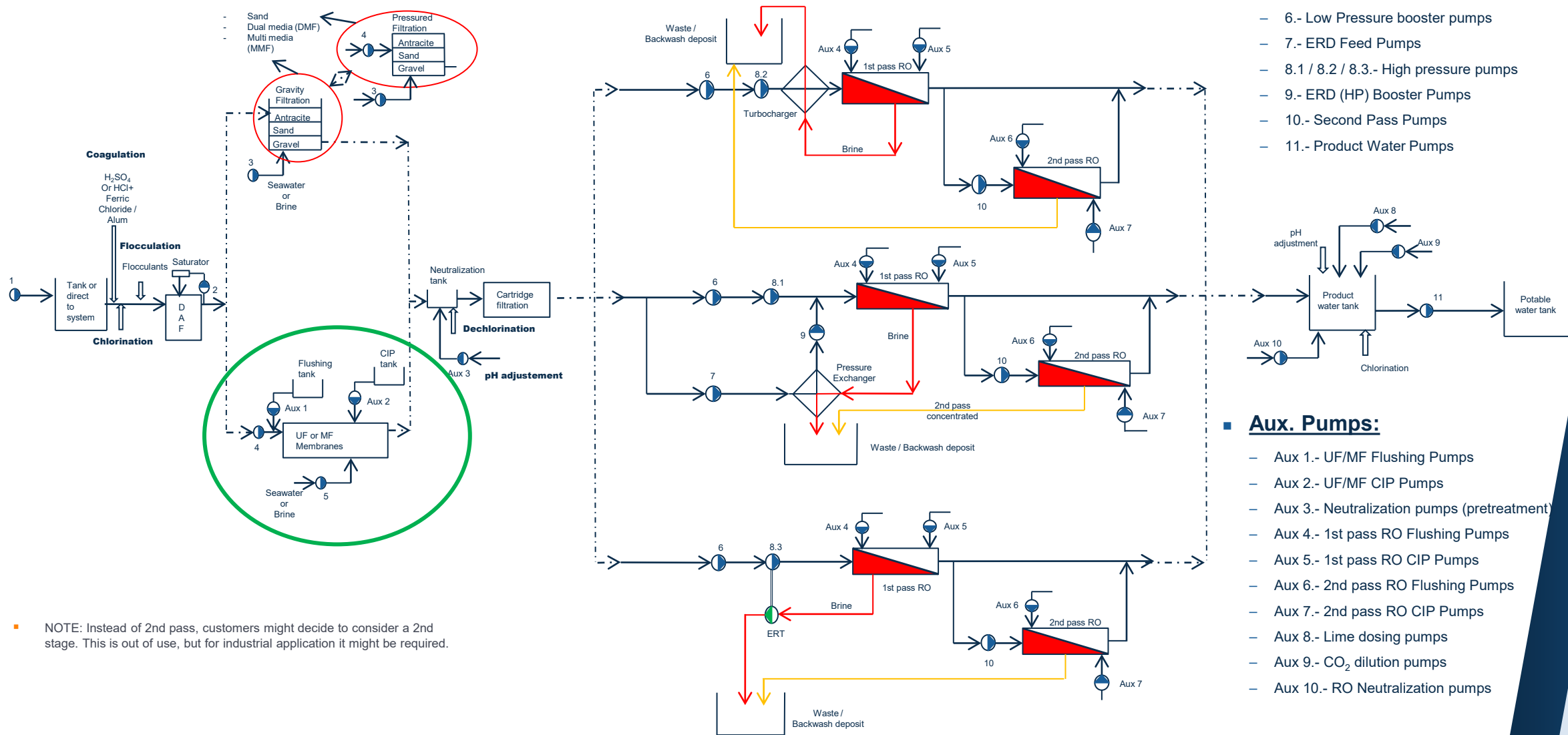
■ Aux. Pumps:

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- Aux 5.- 1st pass RO CIP Pumps
- Aux 6.- 2nd pass RO Flushing Pumps
- Aux 7.- 2nd pass RO CIP Pumps
- Aux 8.- Lime dosing pumps
- Aux 9.- CO_2 dilution pumps
- Aux 10.- RO Neutralization pumps



Desalination: Full Line Supplier

Pre-Treatment 3 – Ultra / Micro Filtration



■ Main Pumps:

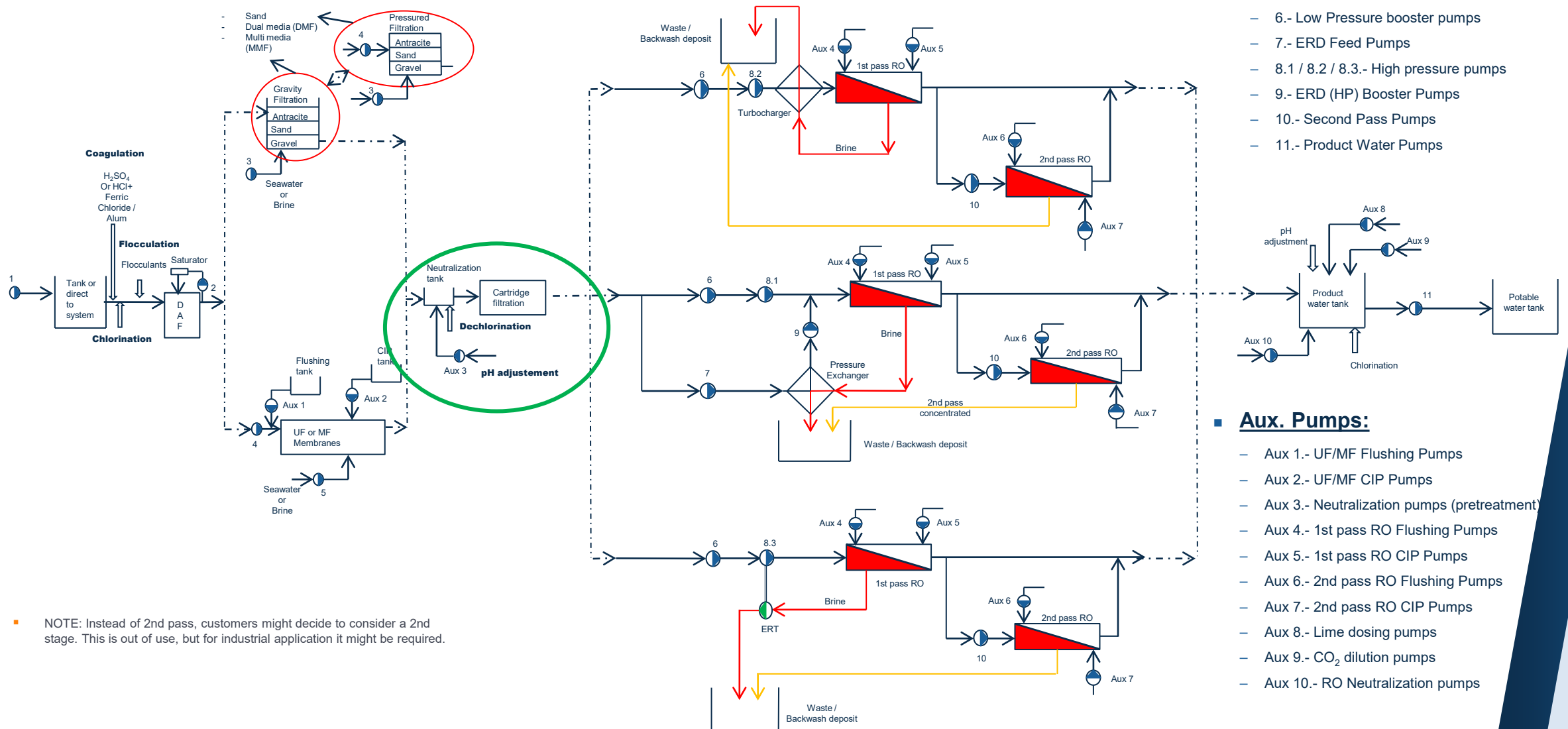
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■ Aux. Pumps:

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- Aux 8.- Lime dosing pumps
- Aux 9.- CO_2 dilution pumps
- Aux 10.- RO Neutralization pumps

Desalination: Full Line Supplier

Pre-Treatment 4 - Neutralisation



Main Pumps:

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- 2.- DAF pumps
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- 4.- Filter Feed Pumps
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- 6.- Low Pressure booster pumps
- 7.- ERD Feed Pumps
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- 10.- Second Pass Pumps
- 11.- Product Water Pumps

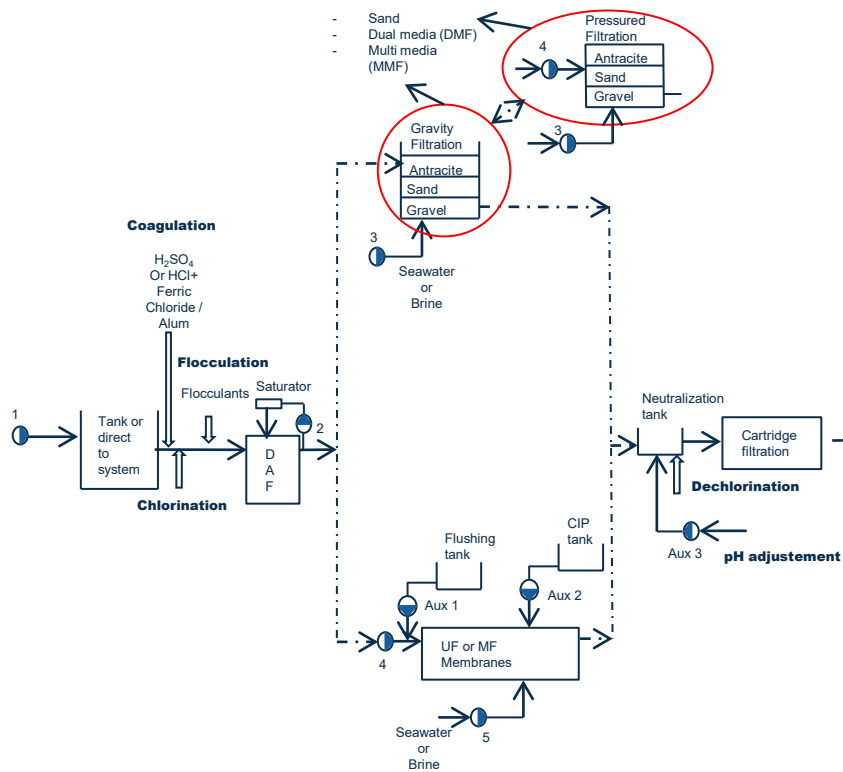
Aux. Pumps:

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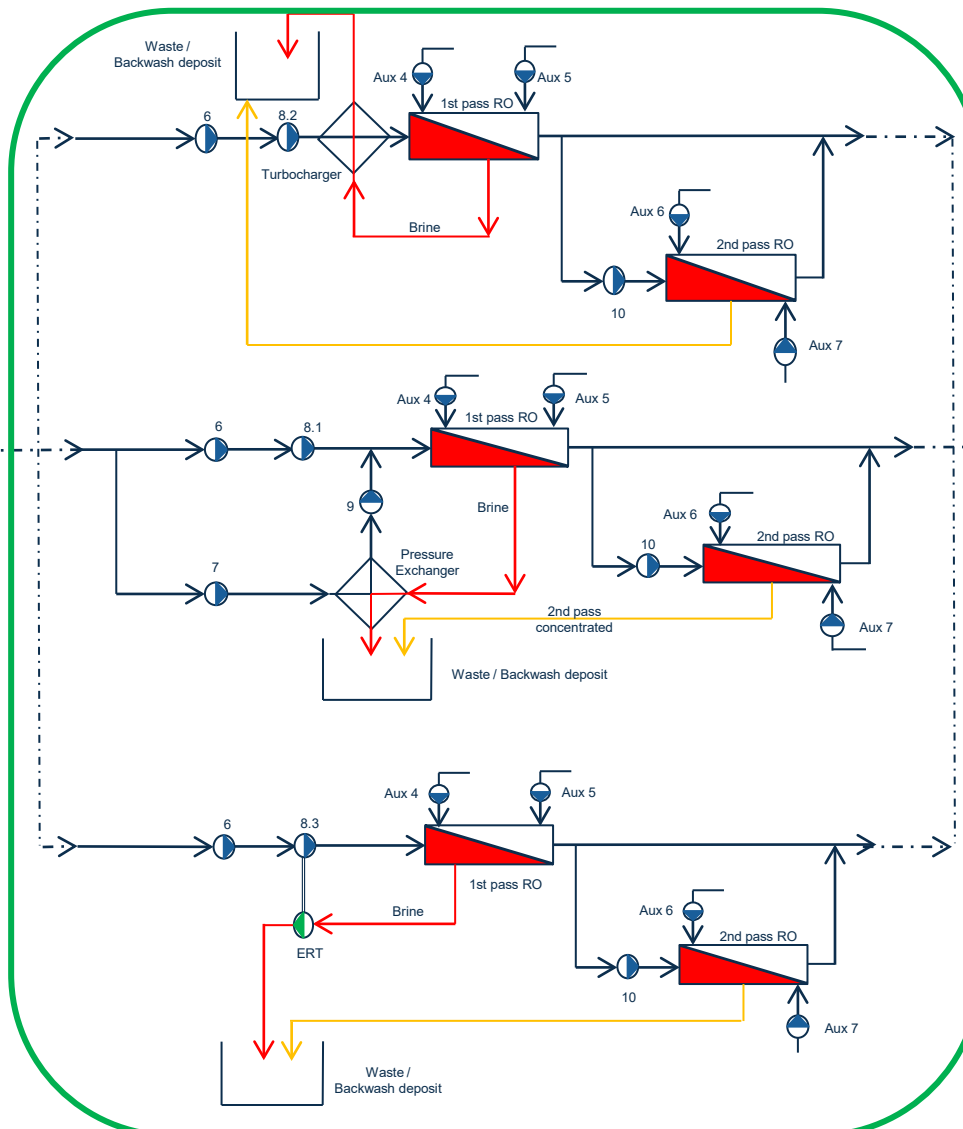


Desalination: Full Line Supplier

Main Treatment – 3 Variants



NOTE: Instead of 2nd pass, customers might decide to consider a 2nd stage. This is out of use, but for industrial application it might be required.



Main Pumps:

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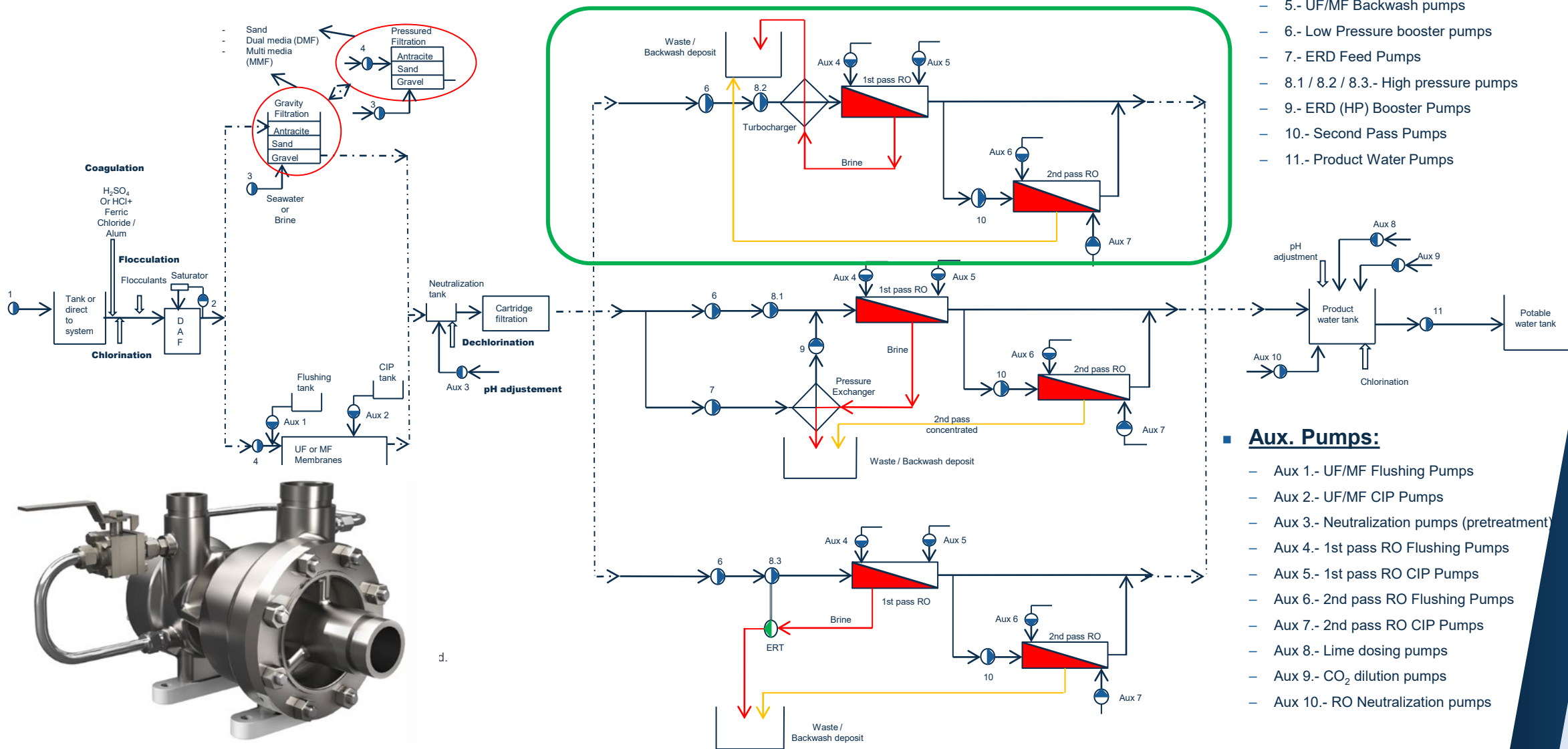
Aux. Pumps:

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- Aux 9.- CO₂ dilution pumps
- Aux 10.- RO Neutralization pumps



Desalination: Full Line Supplier

Main Treatment A – With Turbocharger Energy Recovery



■ Main Pumps:

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- 4.- Filter Feed Pumps
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- 6.- Low Pressure booster pumps
- 7.- ERD Feed Pumps
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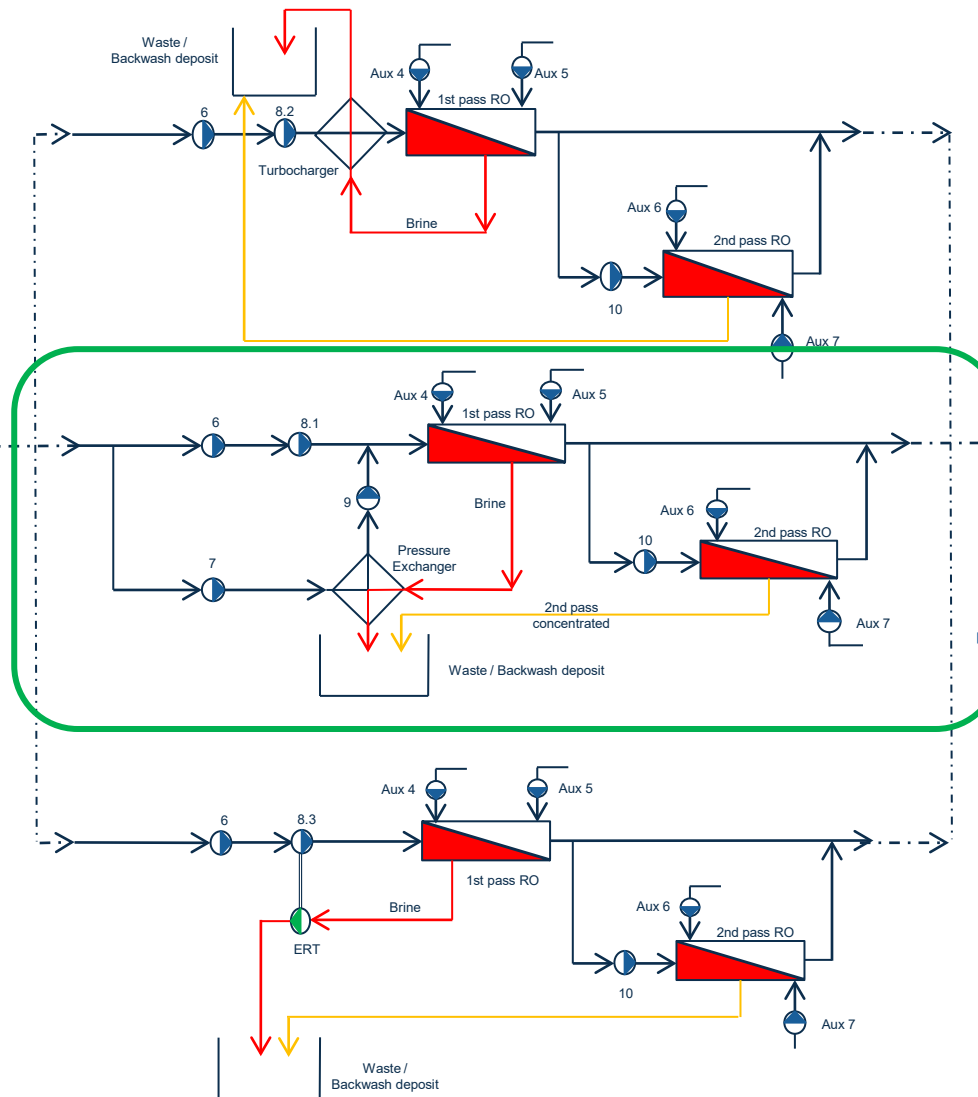
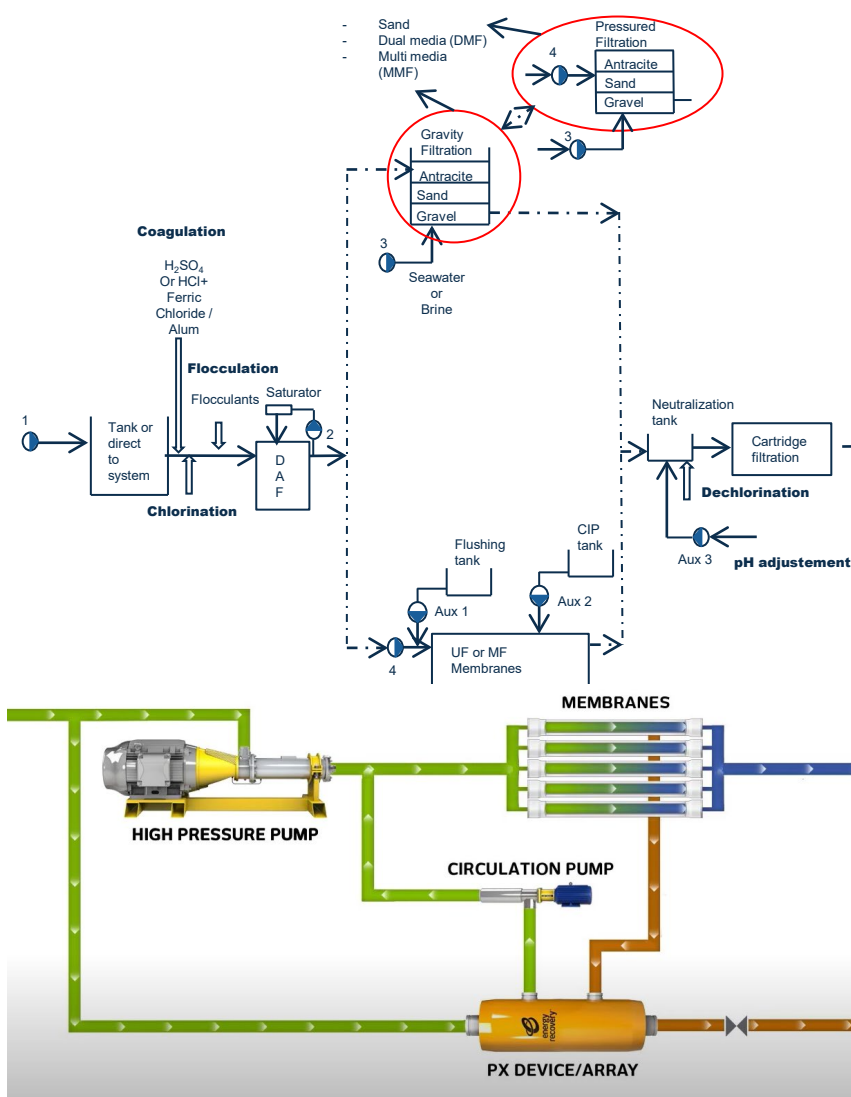
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- Aux 8.- Lime dosing pumps
- Aux 9.- CO₂ dilution pumps
- Aux 10.- RO Neutralization pumps

Desalination: Full Line Supplier

Main Treatment B – With Pressure Exchanger Energy Recovery



■ Main Pumps:

- 1.- Intake pumps
- 2.- DAF pumps
- 3.- Backwash Filter pumps
- 4.- Filter Feed Pumps
- 5.- UF/MF Backwash pumps
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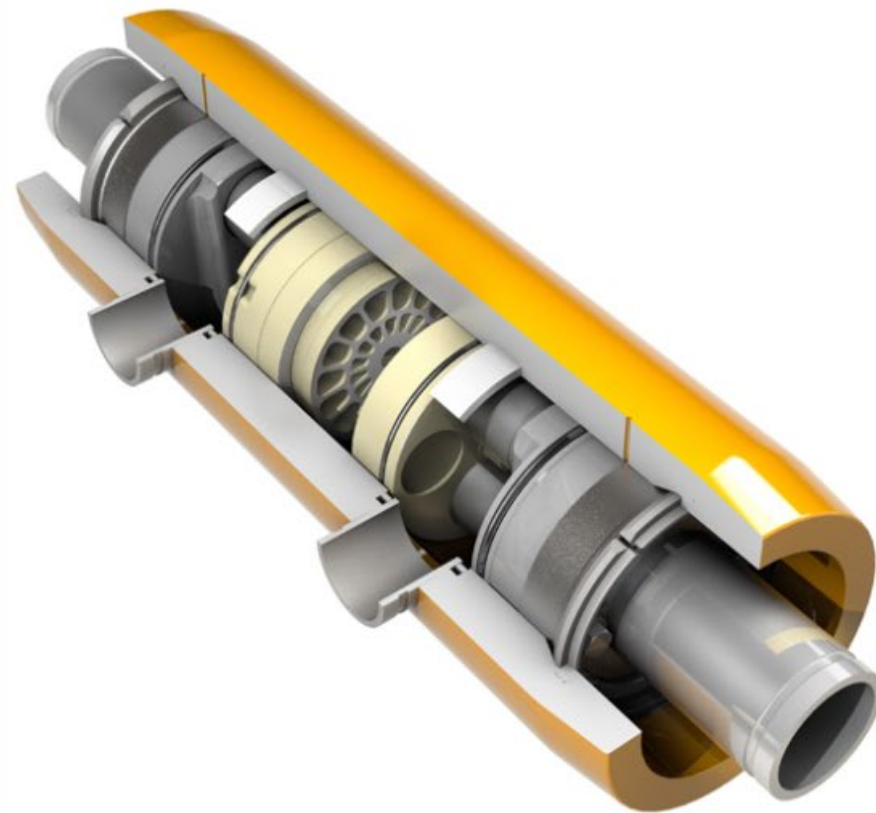
Pressure Exchanger – Energy Recovery Inc

<https://energyrecovery.com/desalination/px-pressure-exchanger/>

PX[®] Pressure Exchanger[®]

Best-in-class Energy Recovery and
Desalination

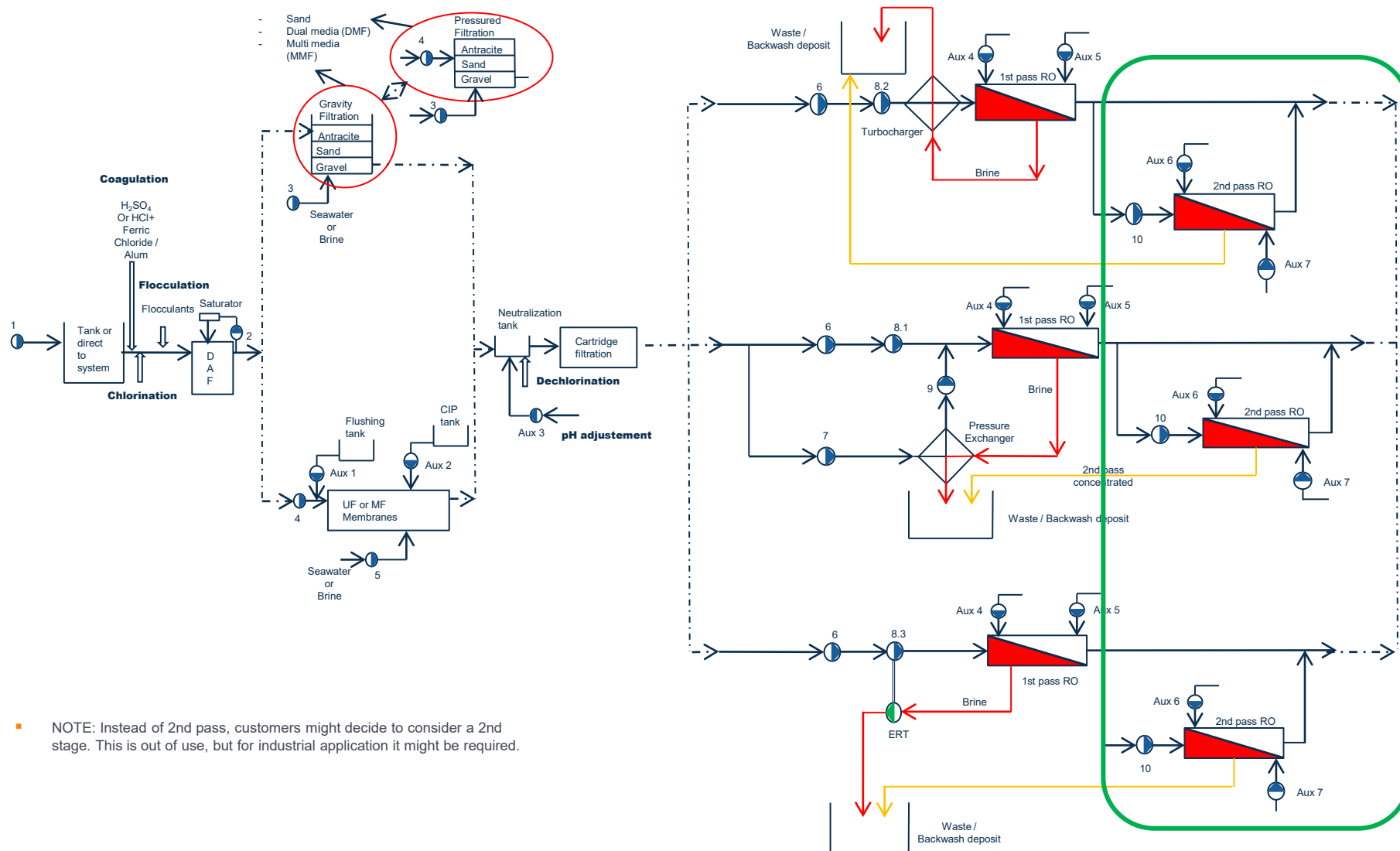
<https://youtu.be/IBwkgrwZYNU>





Desalination: Full Line Supplier

Post Treatment



■ Main Pumps:

- 1.- Intake pumps
- 2.- DAF pumps
- 3.- Backwash Filter pumps
- 4.- Filter Feed Pumps
- 5.- UF/MF Backwash pumps
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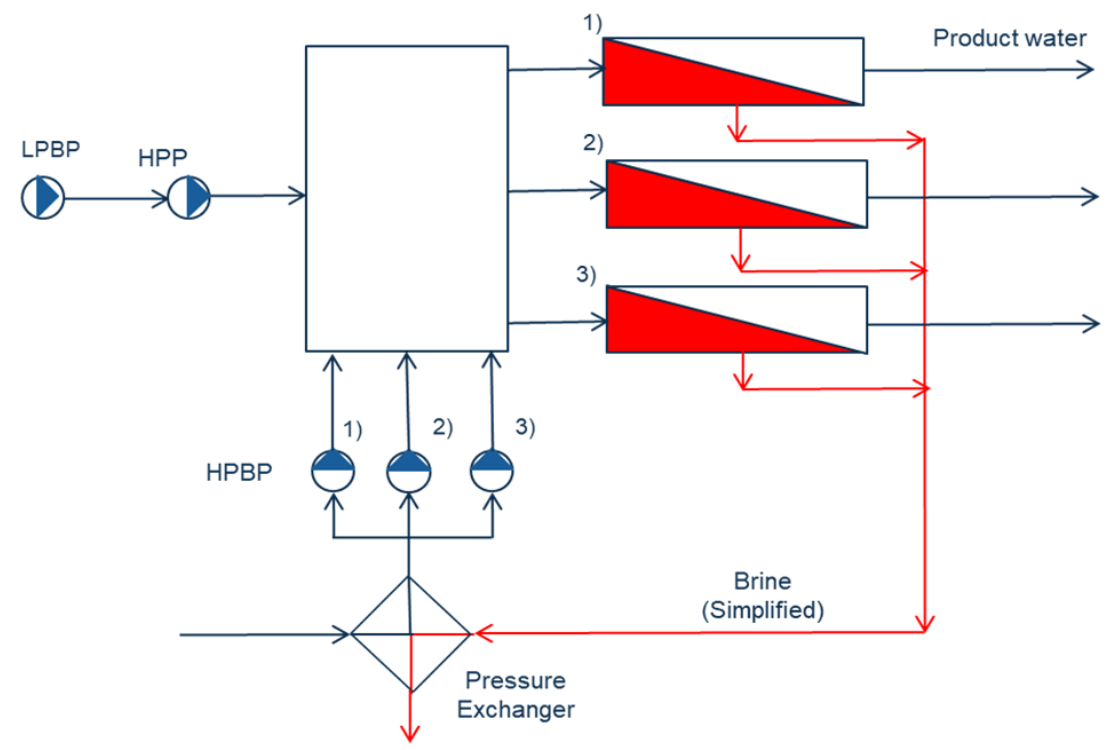
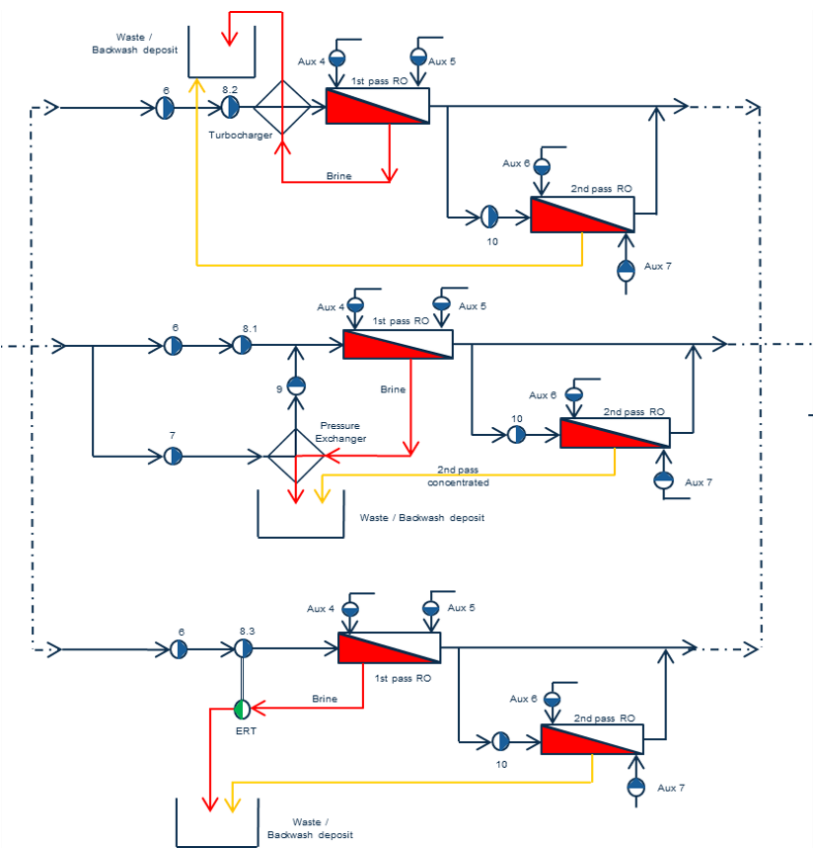
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Desalination: Full Line Supplier.

HP RO Pump : Dedicated Train / Common Manifold

- Traditional configuration, is dedicated train.
- Each membrane bundle uses one HP RO Pump
- For MEGA plants the trend is to use common manifold
- A group of membrane bundle uses one HP RO Pump





OH1 Pumps





OH1 Pumps – CRP

- Designed to exceeds ISO 5199 reliability – CPP for ASME design
- According to ISO 2858 and larger sizes with easy installation, maintenance and service
- Modular interchangeability to reduce inventory
- Industry leading performance and high efficiencies
- High suction pressure design available up to 90 bar

OPERATING LIMITS

Capacity	up to 8,200 m ³ /h
Head	up to 180 m





ANSI Chemical Process Pump OH1

CPO / CPP / CRP



C-Frame Configuration

CPO / CPP / CRP



ANSI Chemical Process Pump OH1

CPO /CPP/CRP

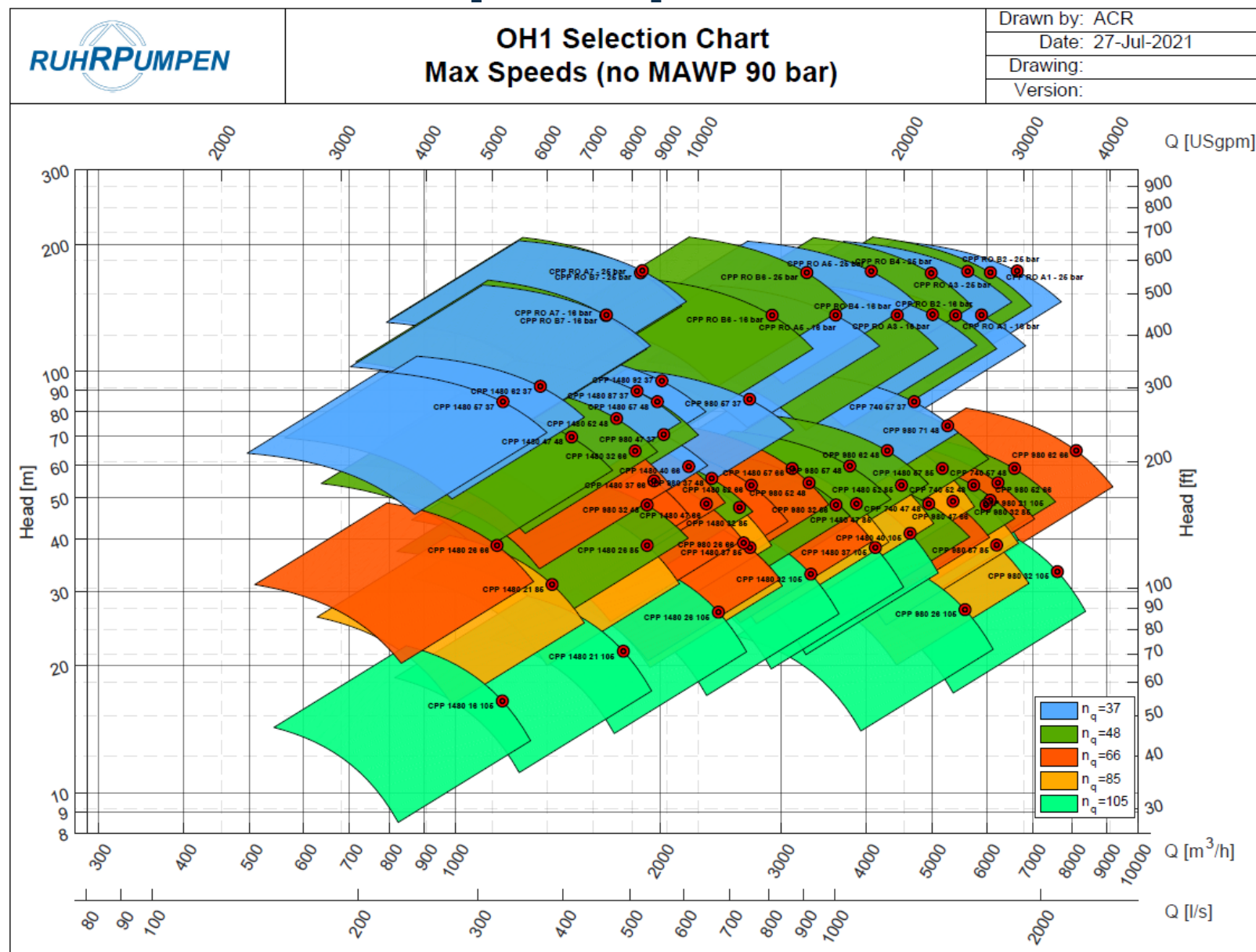
- Horizontal End-Suction pump with open impeller (CPO) or enclosed Impeller (CPP) (OH1)
- ASME (ANSI) B73.1 – 2012 full compliant.

Sizes	70
Flow	36,000 GPM (8200 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





Overall OH1 Pumps Graph



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



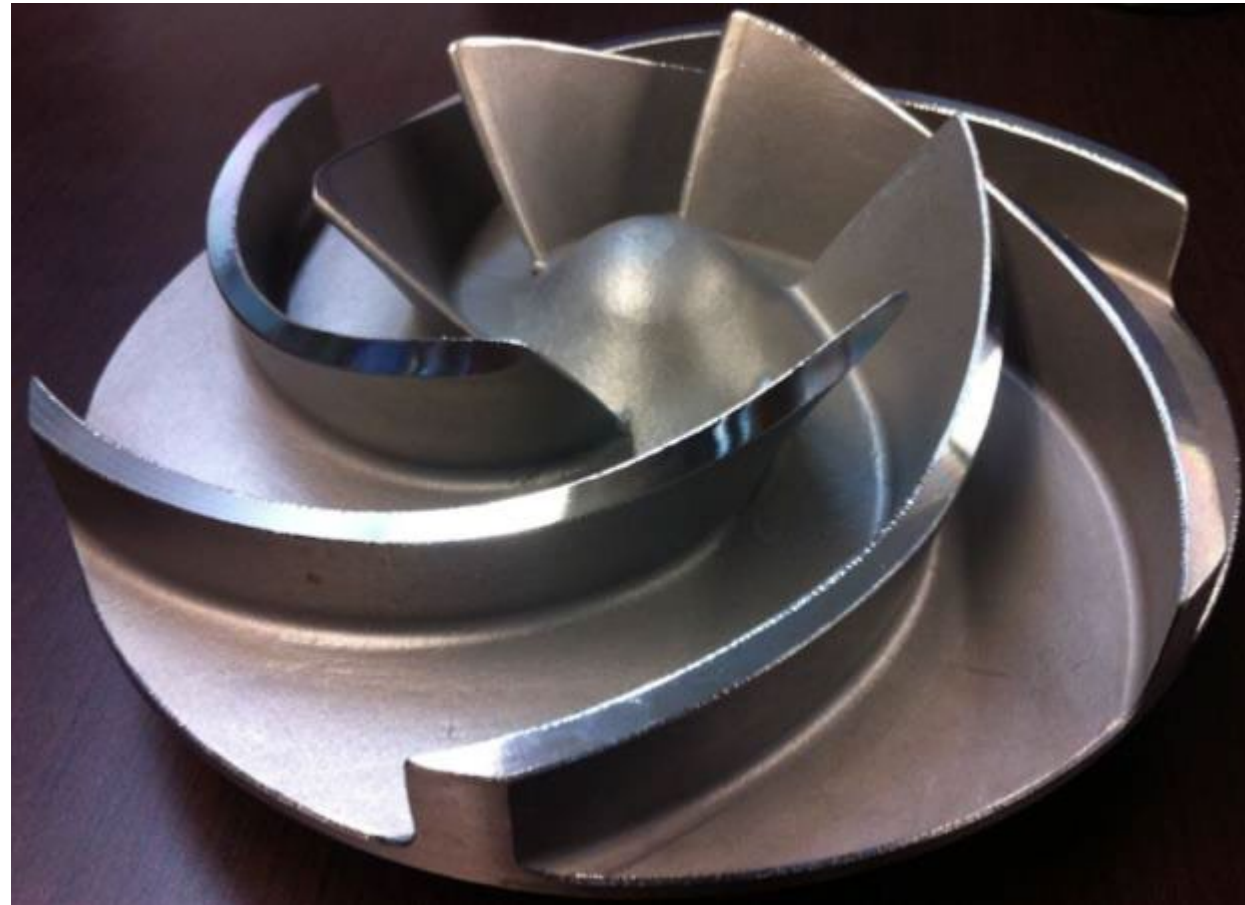
ANSI Chemical Process Pump OH1

CPO Impeller

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

Materials:

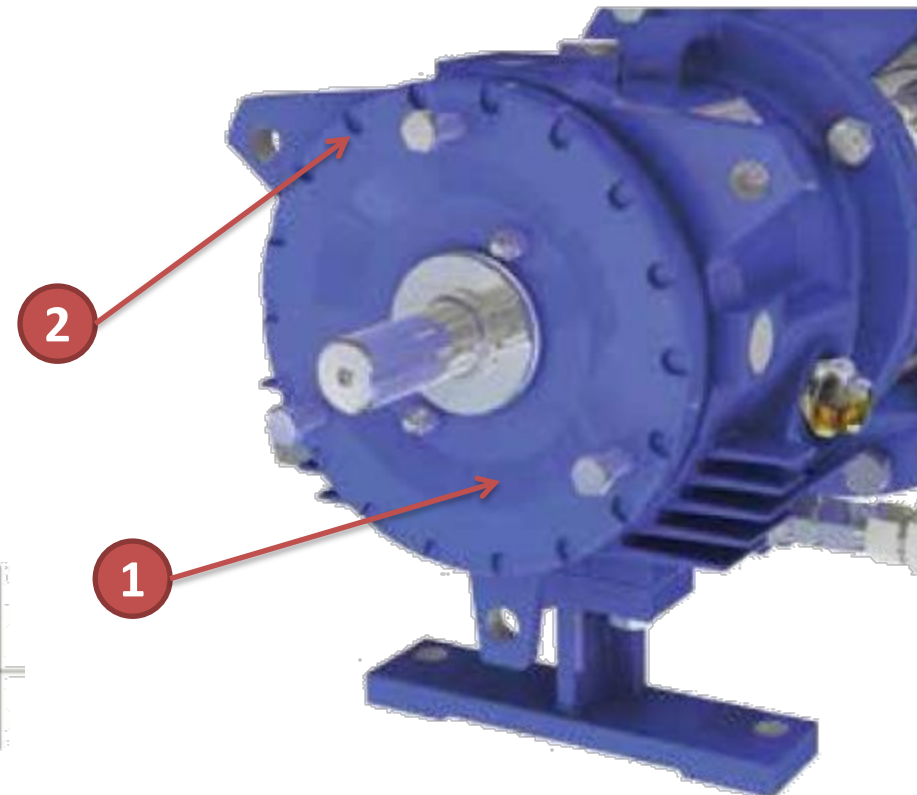
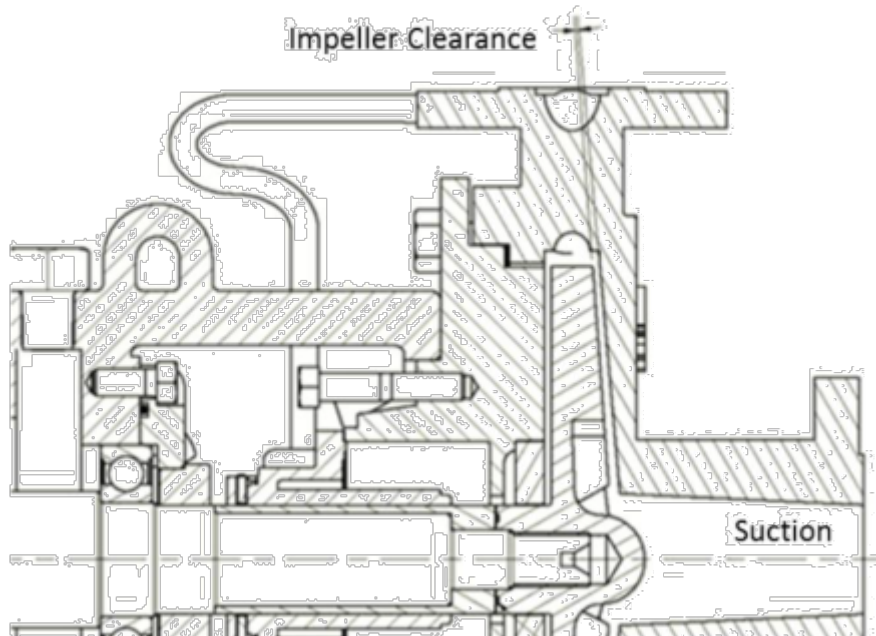
- SST 316 (CF8M)
- Duplex (CD4MCu)
- Alloy 20, Hastelloy B or C, Titanium, Zirconium.



ANSI Chemical Process Pump OH1

Bearing Carrier

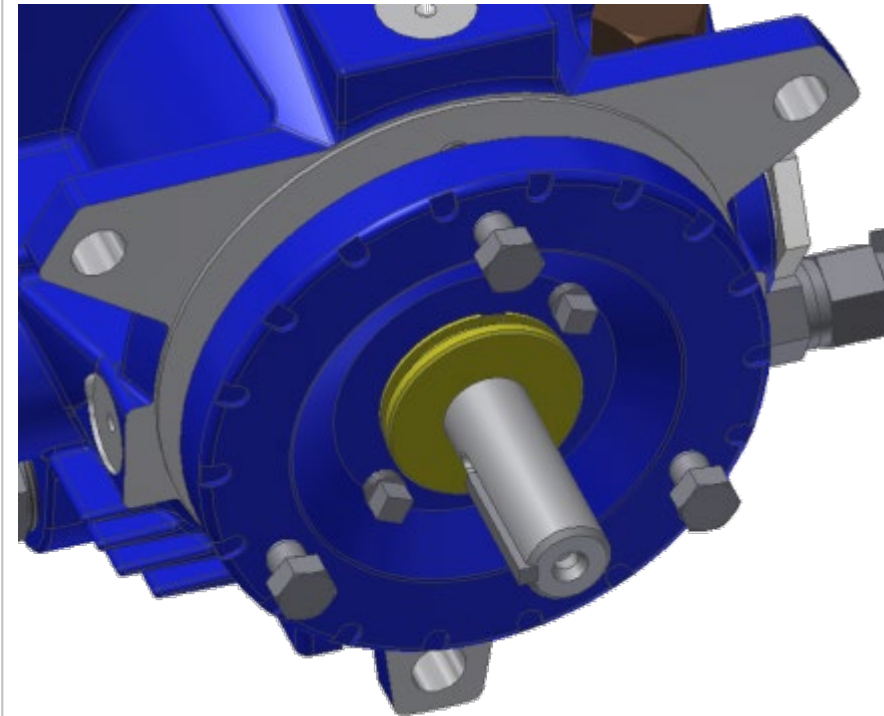
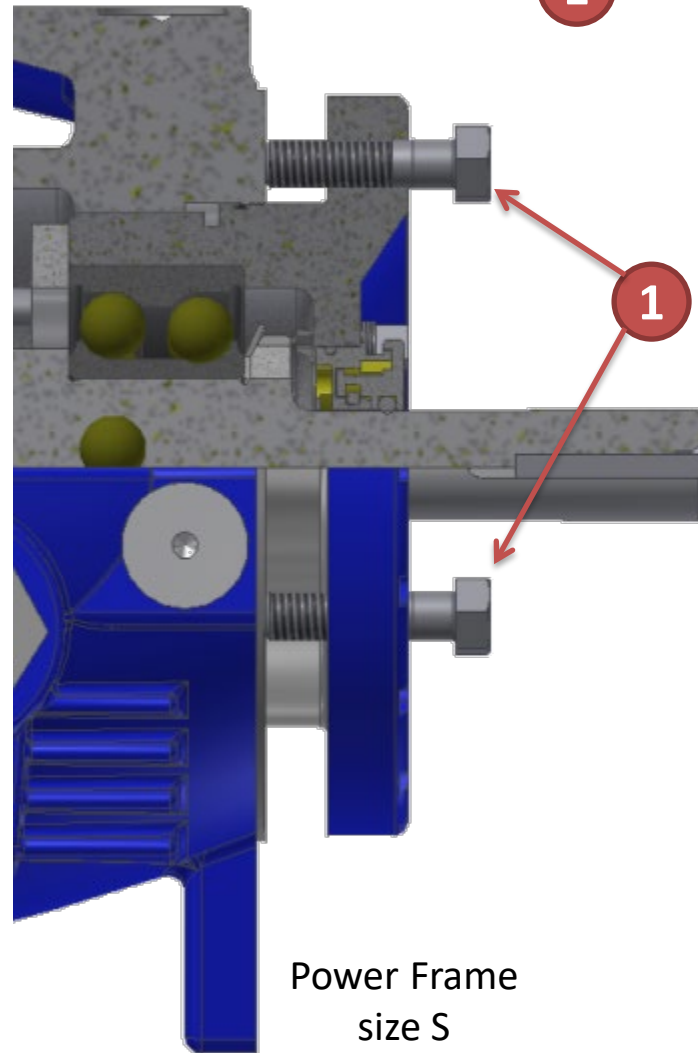
- 1 The Bearing Carrier is threaded to the frame and rotates to displace axially the entire rotor
- 2 Each mark rotation represents an axial movement of 0.003" (0,08 mm)



ANSI Chemical Process Pump OH1

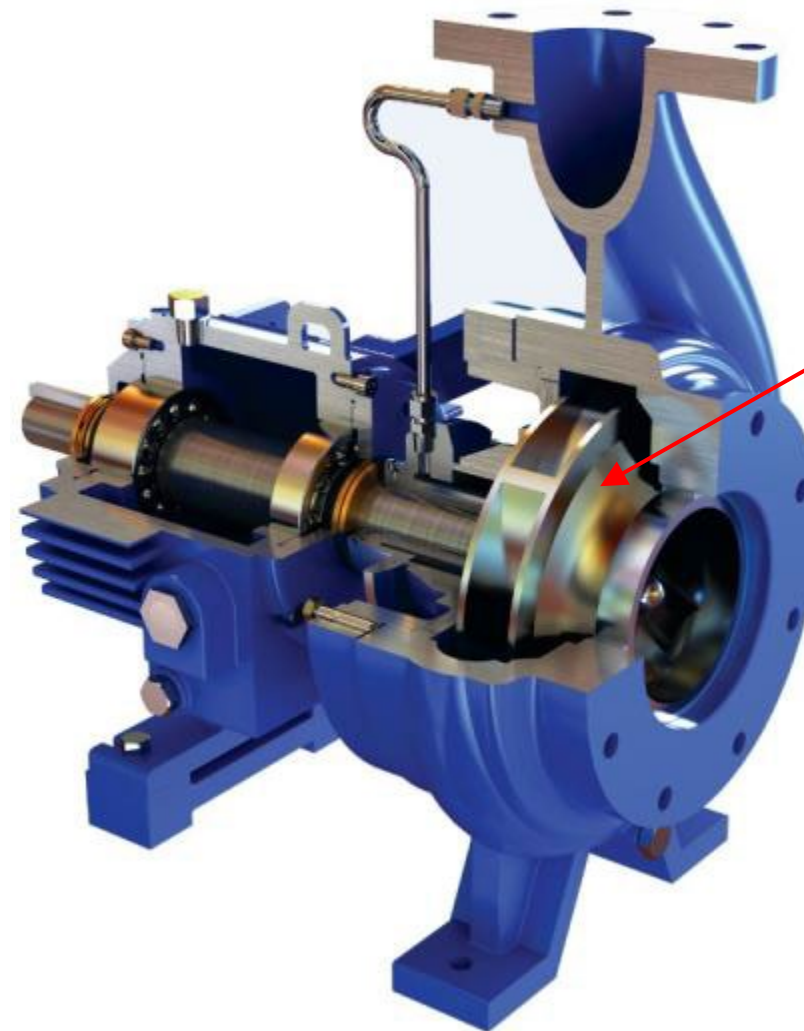
Bearing Carrier

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



ANSI Chemical Process Pump OH1

CPP Impeller

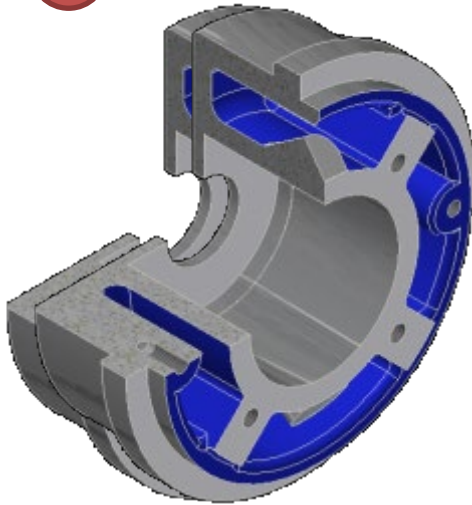


CPP has
Enclosed
Impeller

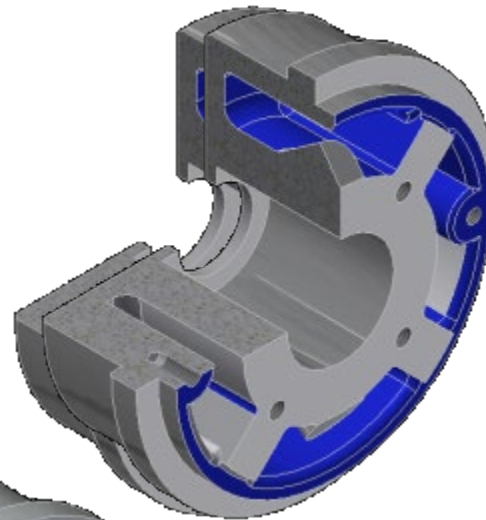
ANSI Chemical Process Pump OH1

Case Cover

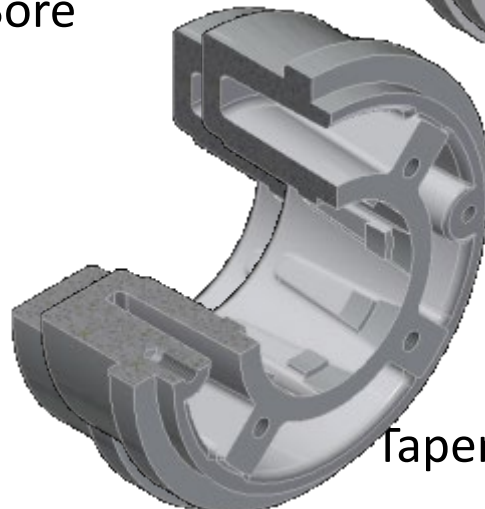
- 1 Packing, Single & Double mechanical seal



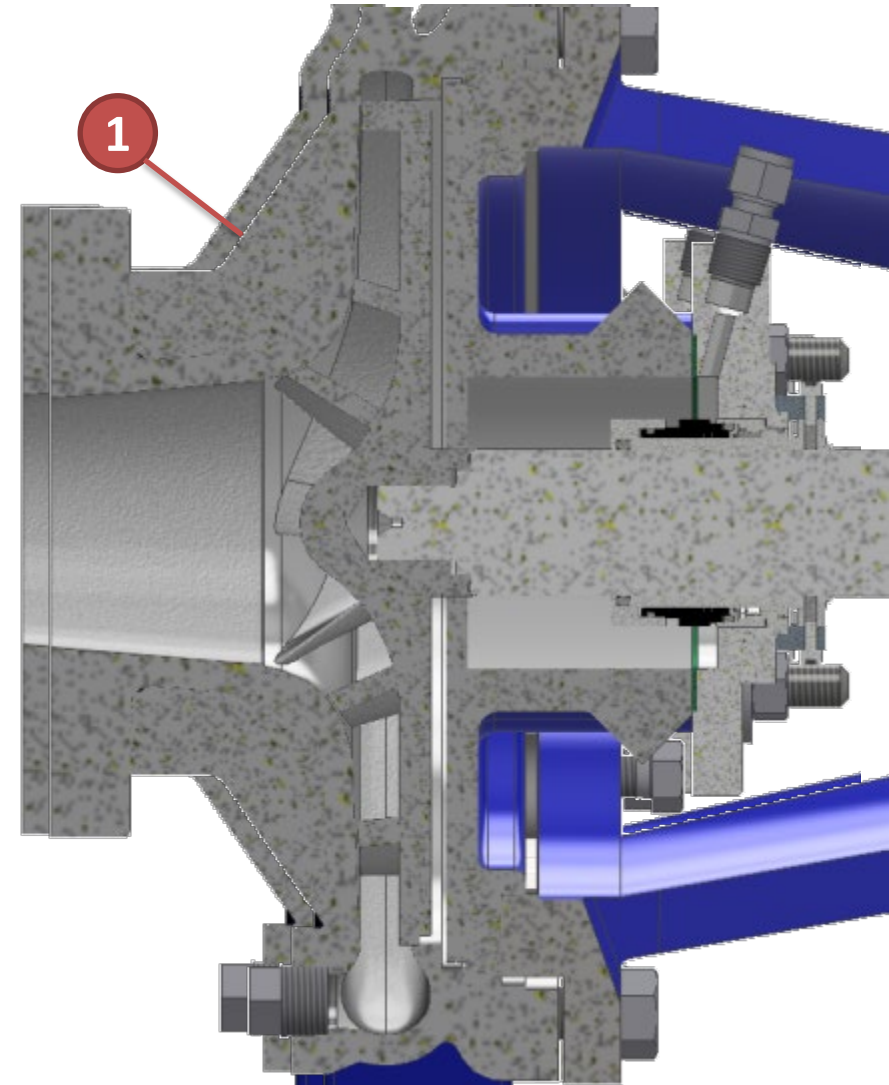
Big Bore



Small Bore



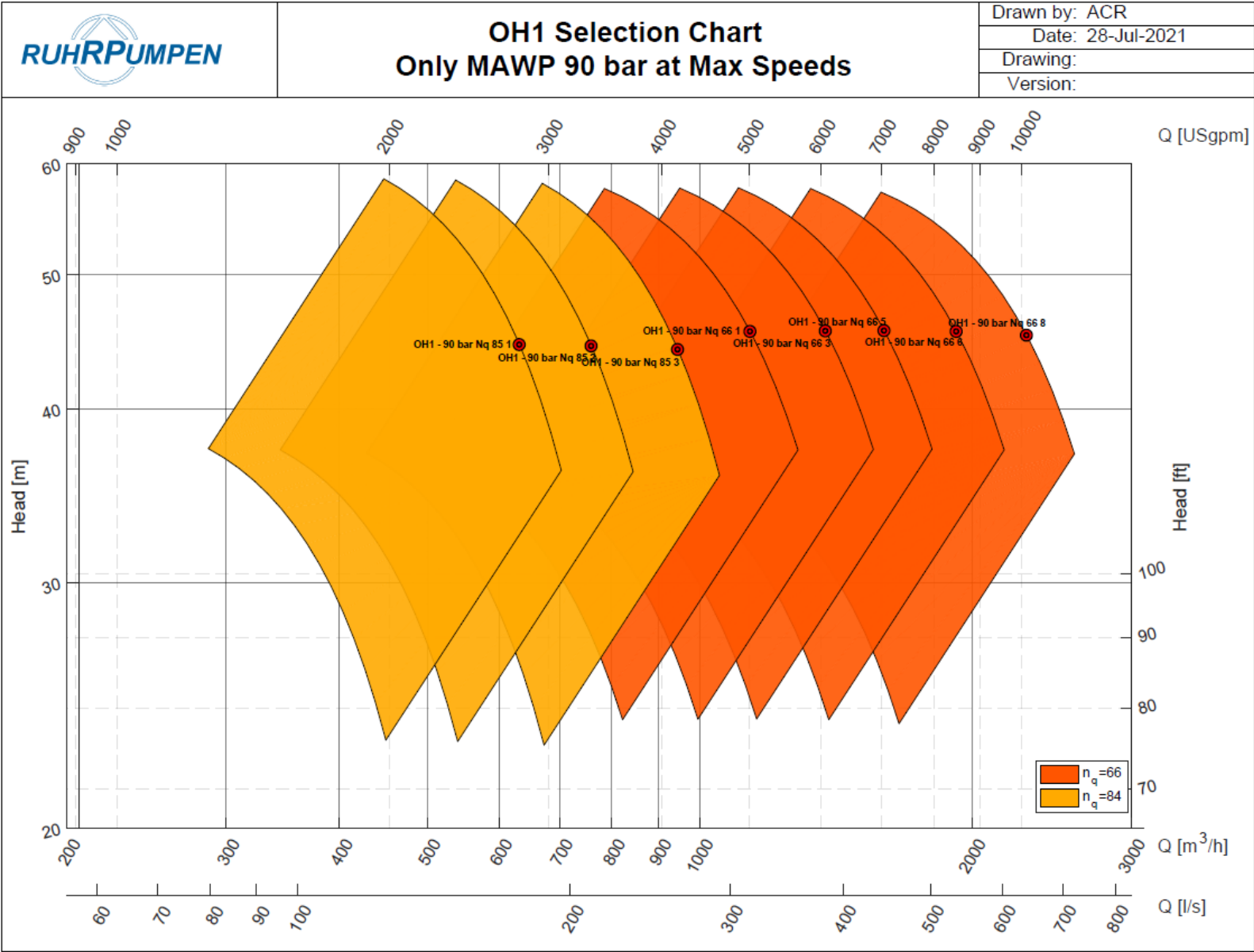
Tapered Bore





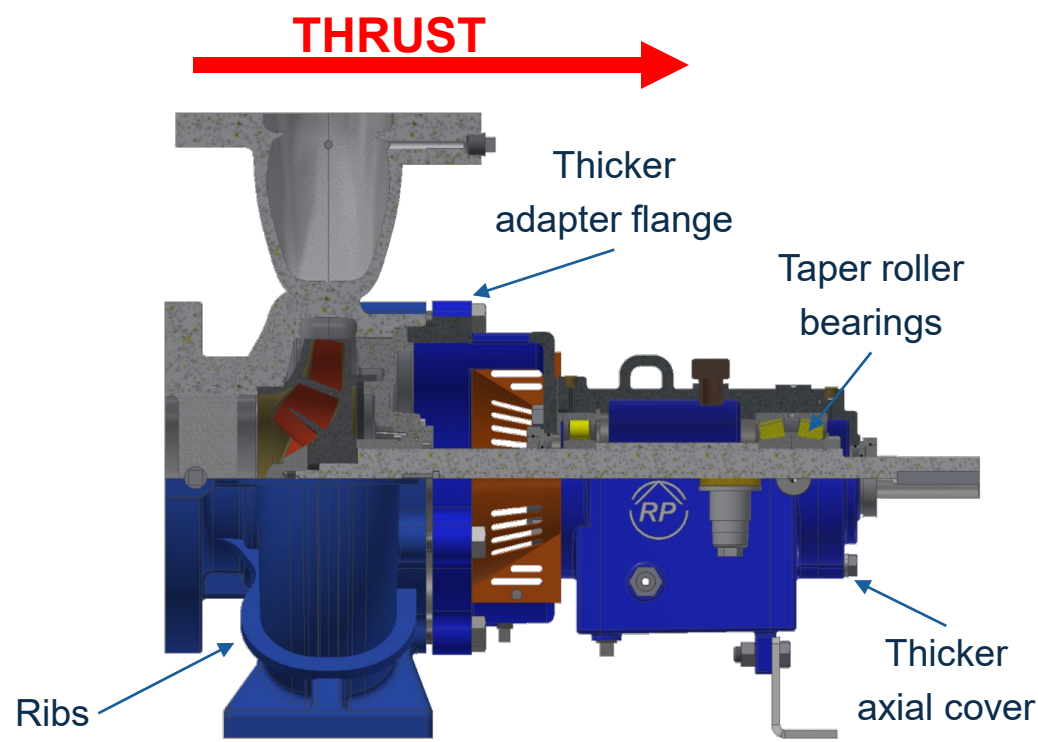
OH1 Pumps: CRP

Overall OH1 Pumps Graph

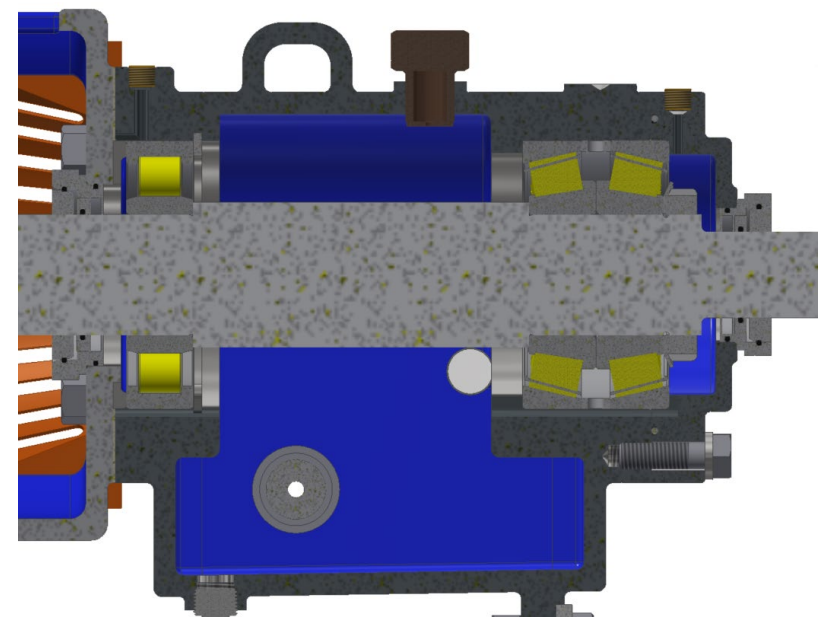


OH1 Pumps

- 90 Bar MAWP Pumps: (82 bar max inlet suction pressure)



Taper Roller Bearings only for the 4 Smallest Units – Rest of units Angular Contact ball bearings



BB1 Pumps – ZW / HS

- Designed according to HI guidelines with easy installation, maintenance and service.
- Double suction, enclosed impellers provide hydraulic balance eliminating axial thrust
- High reliability, easy maintenance machine
- Verticalized construction available.
- Axially split case, single- and double- volute design minimizes thrust loads and allows operation in a wide range of capacities.
- The ZW is NSF ANSI 61/372

OPERATING LIMITS

Capacity	up to 30,000 m ³ /h
Head	up to 340 m



FEATURES AND BENEFITS IMPELLER AND BEARING BRACKET

IMPELLER

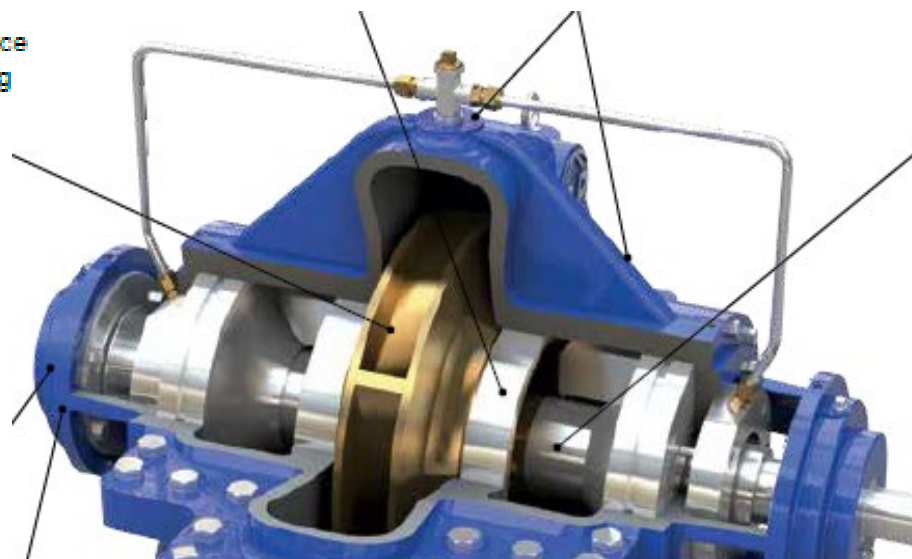
All impellers are double suction, dynamically balanced and held in place by separate nuts. (investment casting and sand casting manufacturing).

BEARING HOUSING

360° bearing housing arrangement to ensure mechanical stability and low vibration levels. Design allows to use the housing for packing (Standard seal) or mechanical seal (Optional seal).

BEARINGS

Interchangeable line and thrust bearings (conservatively rated at 100,000 hours "plus" bearing life) guarantee maximum life at minimum maintenance cost. Either oil or grease lubrication available.



SHAFT SLEEVE

Separate shaft nuts feature provides the greatest simplification of sleeve replacement. Sleeves are sealed to shaft by an "O" ring to prevent leakage and subsequent erosion. 11-13% chrome sleeves are available for extended sleeve life on packing.

SHAFT

A rigid shaft combined with double - volute casing - results in low shaft deflection at all operating points. Low deflection reduces packing wear, ring wear and bearing loading, which ultimately results in sustained efficiency and economic operation.

VERTICAL MOUNTING



All HS/ZW pumps can also be mounted vertically if required by the customer

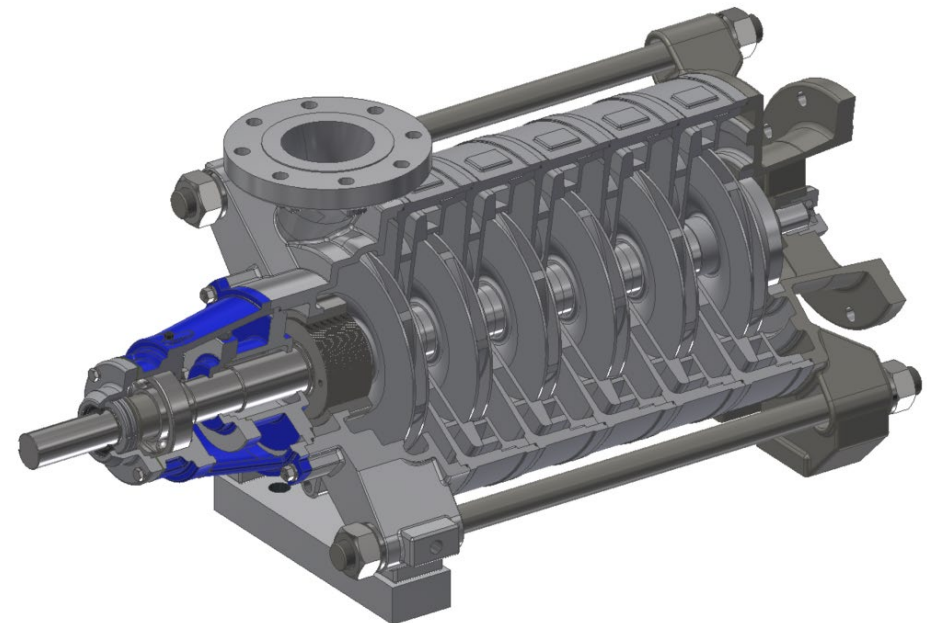


HPRO Pumps – GPA

- Designed according to HI guidelines.
- Easy access for maintenance
- Different flanges configuration available (end-right/top/left)
- Balance drum design for optimal axial thrust compensation.
- One single mechanical seal to minimize components

OPERATING LIMITS

Capacity	up to 300 m ³ /h
Head	up to 720 m



HPRO Pumps – GP

- Designed according to HI guidelines with easy installation, maintenance and service
- Optimized diffuser construction & Hydraulics for enhanced pump efficiency
- Different axial thrust compensation methods available.
- A and B series stage hydraulics available to match different head/flow requirements with maximum efficiency
- Low NPSH (type IS) first stage impeller designs



OPERATING LIMITS

Capacity	up to 1,000 m ³ /h
Head	up to 2000m



Pump Type BB4

Single Case, Multistage, Radially Split Case Pumps

(also called “Ring-Section”, “Segmental
Ring”, and “Tie-rod” pumps)

- 20 GP pumps 6x4x11 supplied by RP India



Ruhrpumpen BB4 Pump – “GP”

The GP pump is a diffuser type, horizontal, multi-stage, between bearings, ring section pump-type BB4. It is engineered to be the most reliable and exceptional pumping solution for the most demanding high-pressure and high temperature applications across many industries.

Its compact design, together with high efficiency hydraulics, provides superior performance and exceptional reliability combined with easy maintenance and minimal operating costs.



HYDRAULIC DESIGN



Designed for speeds up to 2 poles - 50 Hz/60 HZ design



Wide range of hydraulics (A and B impellers for same casing are available to cater to different flow/head requirements with optimum efficiency)

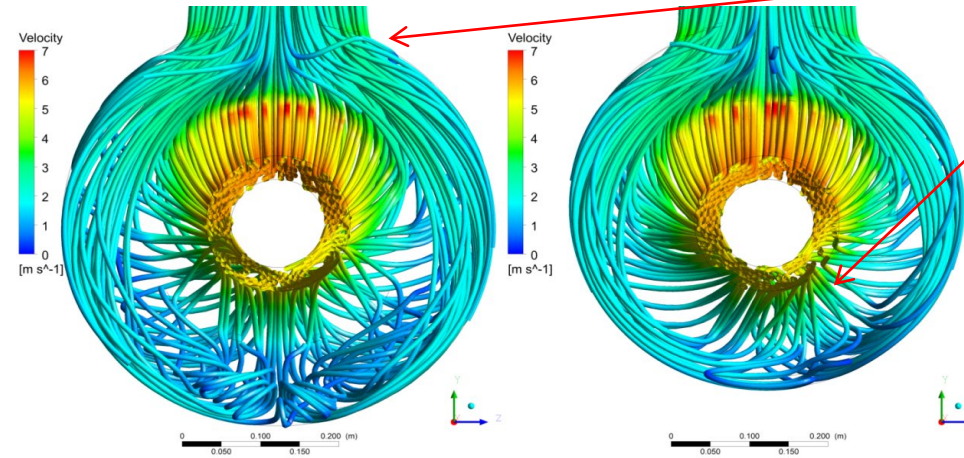


Optimum NPSH performance with special, low NPSH first stage available



Specially designed stages to accommodate interstage take-off flow

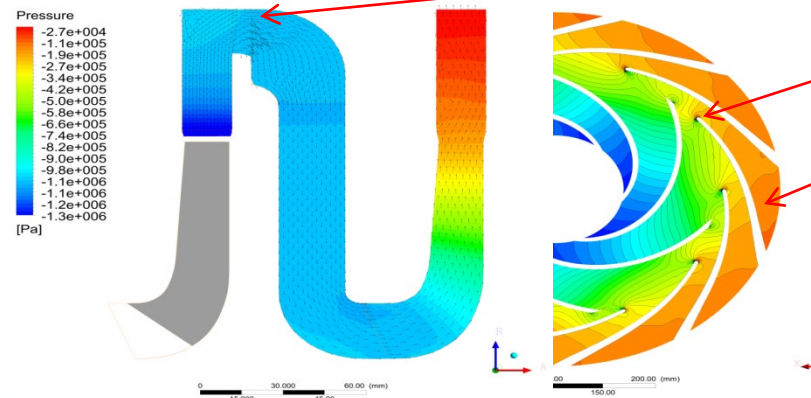
Flow simulation and optimization of the suction chamber with CFX *



flow optimization in the transition
to the suction chamber (vortex
reduction)

flow alignment in the suction
chamber
(reduction of turbulence losses)

Verification of impeller and return stage design with CFX *



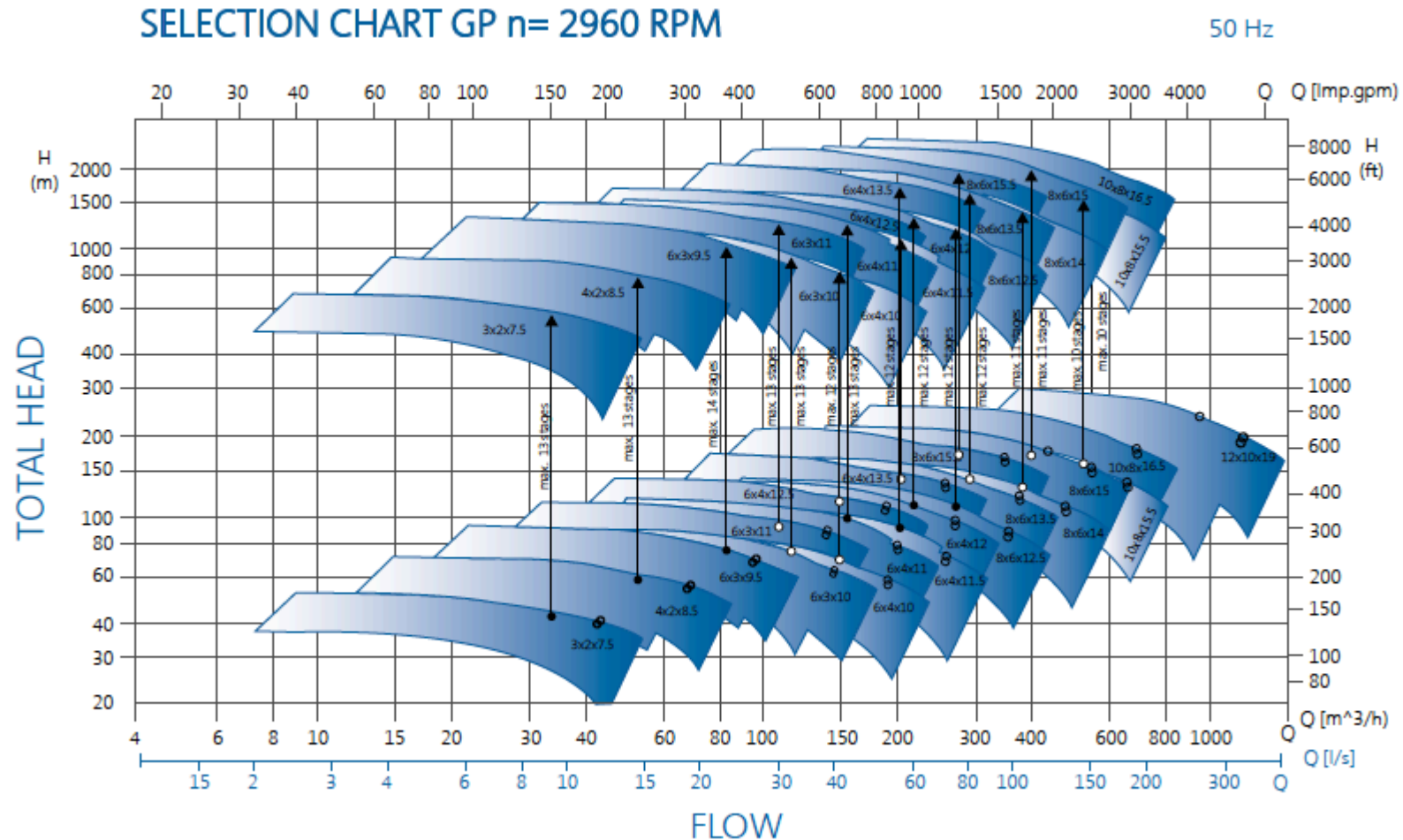
Minimizing flow separations

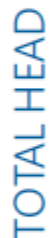
adaptation of inlet angle

continuously rising pressure



GP RANGE CHART







Design with typical features for Industrial Services



Design with typical features for Desalination Market Applications

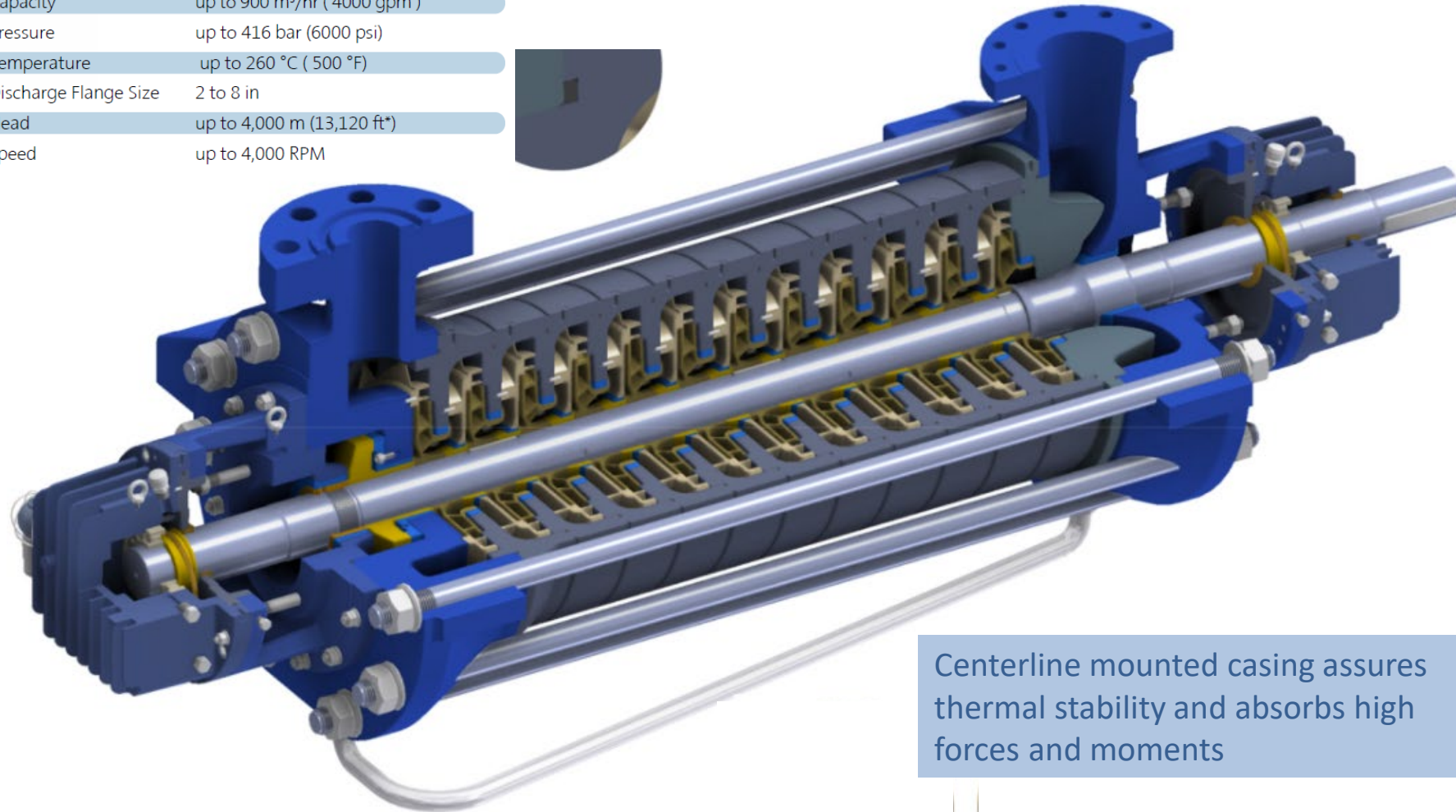


Design with typical features for API 610 Applications

GP PUMP

PERFORMANCE DATA

Capacity	up to 900 m ³ /hr (4000 gpm)
Pressure	up to 416 bar (6000 psi)
Temperature	up to 260 °C (500 °F)
Discharge Flange Size	2 to 8 in
Head	up to 4,000 m (13,120 ft*)
Speed	up to 4,000 RPM

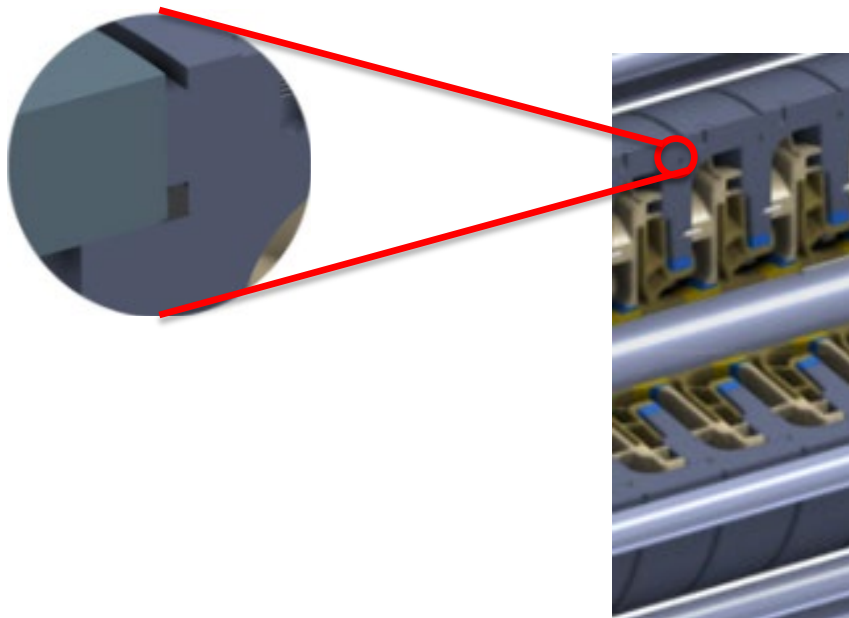


Centerline mounted casing assures thermal stability and absorbs high forces and moments

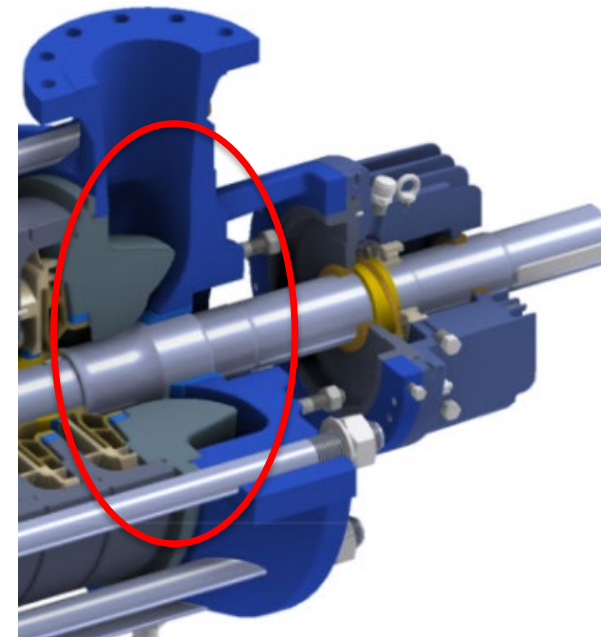


FEATURES AND BENEFITS

Casings are sealed with elastomeric o-rings suitable for rapid temperature variations. Elastomers are confined in grooves and therefore not subject to shear forces and so are less likely to be damaged during assembly and disassembly

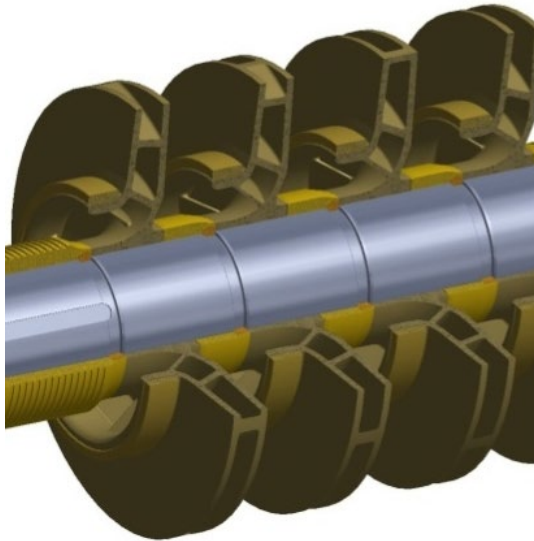


CASING



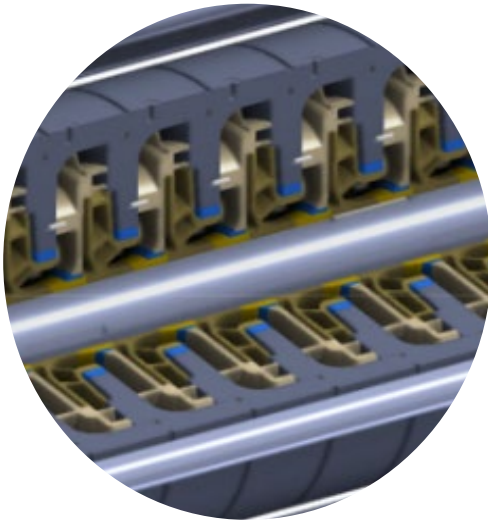
Suction chamber with inlet channel ensures optimum flow distribution

IMPELLERS AND ROTOR



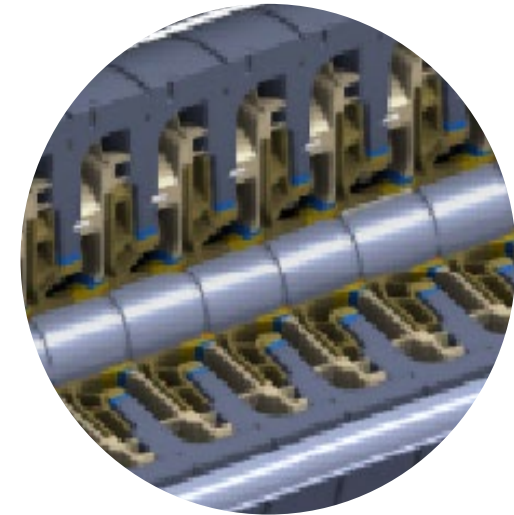
- Closed, single suction impeller design
- Investment casting offers best efficiency and repeatability of hydraulic data
- Keyed to shaft
- Impellers and complete rotor balance to G 2.5 of ISO 1940 (~8w/n) (G 1.0 ~4w/n is optional)
- First stage impeller design for low NPSH is available
- Inline rotor arrangement

IMPELLER MOUNTING AND SHAFT



TYPICAL FEATURE FOR POWER MARKET DESIGN

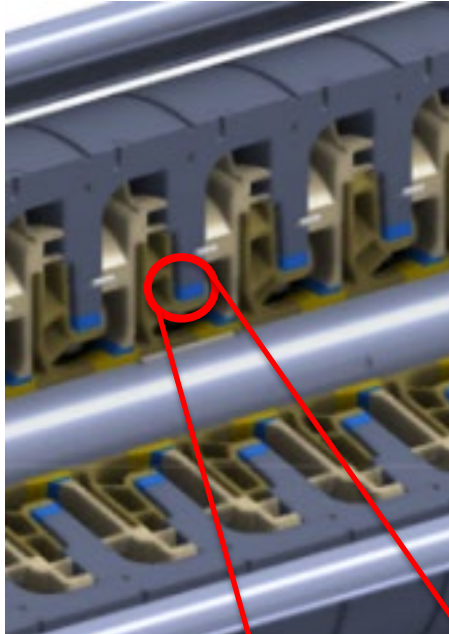
Stacked rotor design with
staggered keyways



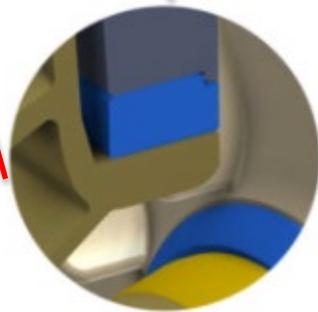
TYPICAL FEATURE FOR API 610 PUMP DESIGN

Stepped rotor design with light
Interference/transition fit allows easy
assembly and disassembly.
Individually secured impellers by split ring

WEARING PARTS

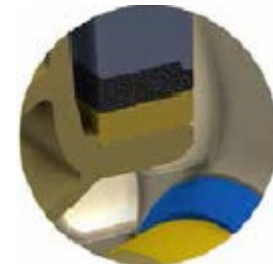
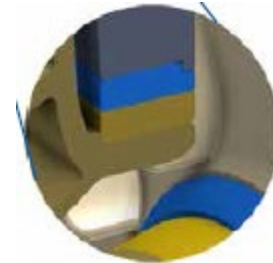
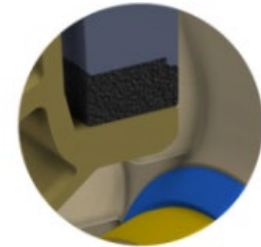


Stationary casing wear rings and interstage bushings are standard



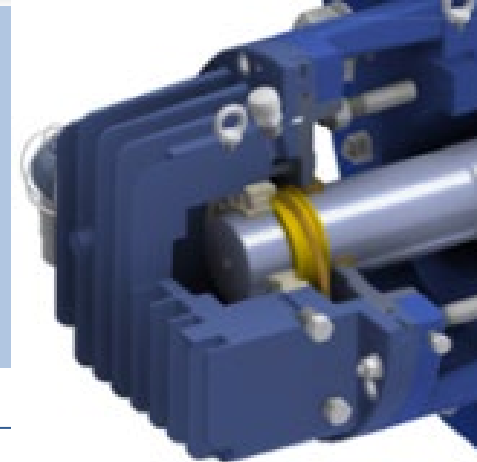
OPTIONAL FEATURES

- Non-metallic casing wear rings with reduced clearances for enhanced efficiency
- Replaceable impeller wear rings
- Optional non-metallic casing wear rings + replaceable wear rings with reduced clearances for enhanced efficiency



BEARING HOUSING

- Rigid, 360° bearing support ensures low vibration
- Clamped bearing cover without screws provides better access to the seals
- Bearing housing with vertical fins provides optimal cooling
- Radial bearing - single row cylinder roller anti-friction with splash oil lubrication and constant level oiler is standard
- “Inpro” bearing isolator



OPTIONAL FEATURES



Shaft driven main oil pump for forced feed lubrication (API 610 is standard with API 614 optional available)

- Oil Mist lubrication
- Water cooled bearing housing
- Radial sleeve bearings for higher loads
- Thrust bearing where required
- Double acting tilting pad thrust bearing with radial sleeve, axial split hydrodynamic bearing with forced feed lubrication in high power applications.



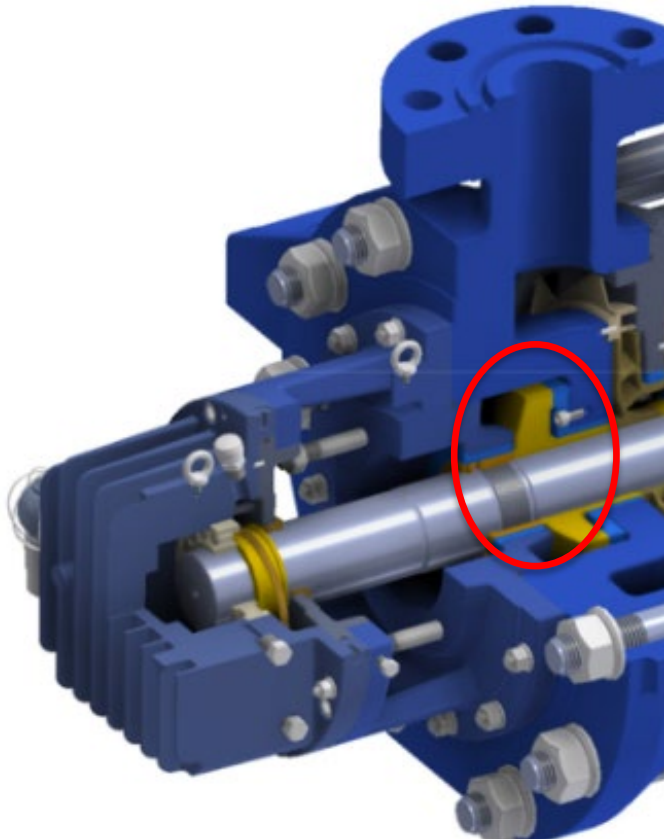
HYDRAULIC BALANCING



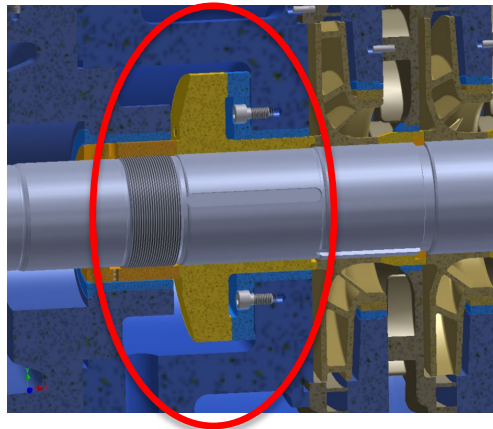
PURPOSE OF BALANCING DEVICES

- In any centrifugal pump, the rotor tends to produce some amount of thrust because of different pressures and different geometries on the two sides of the impeller. This thrust is handled by the pump thrust bearing.
- In a high pressure multi-stage pump (such as BFW) the number of impellers is high, thus the net thrust would be large (putting high load on thrust bearings) unless something is done to reduce it.
- Main ways to reduce the net thrust are to oppose the impellers (for example AB pump) or to use a balance disk/drum (for example in GP pump)
- The balance device (disk or drum) is located after the last stage so it has full discharge pressure on one side. On the other side the balance line is routed back to the suction.
- The main difference between a balance disk and a balance drum is whether the pressure drop is across a radial clearance (drum) or an axial face (disk).

BALANCE DISK



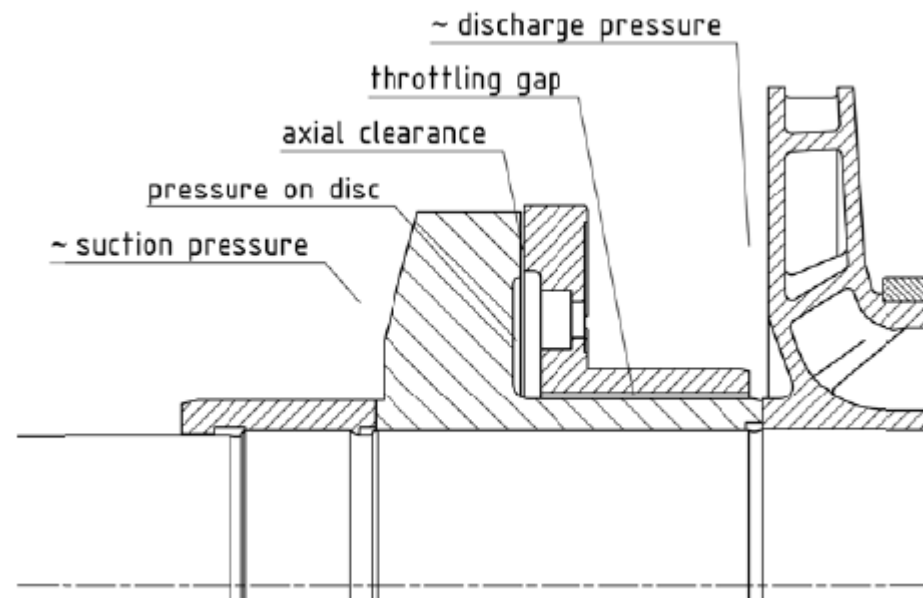
- Uses a close axial clearance to compensate 100% of the axial thrust across the complete pump operating range therefore removing the need for a thrust bearing
- Self adjusting because the clearance increases and decreases with the axial position of the impellers and shaft based on the actual thrust produced
- Suitable for applications with non-abrasive pumping fluid and constant pressure



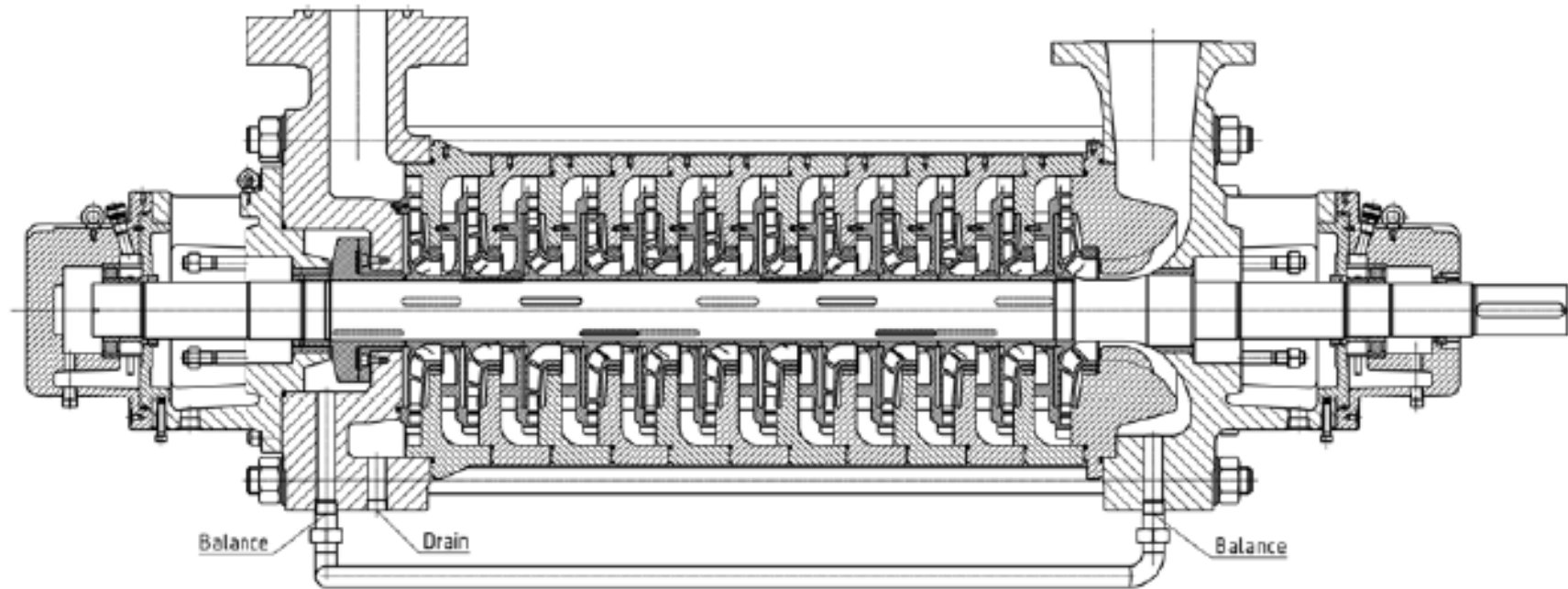
- Highest efficiency balancing method because this has the lowest leakage rate
- Accurate axial rotor setting during assembly is important because there is a risk of contacting of pump and disk

BALANCE DISK

- Available for GP pump
- Clearance is in range 50-100 μm
- Suitable for use in:
 - Non-API applications
 - Non-abrasive process fluids
 - Applications without frequent pressure changes
 - Applications without frequent transient conditions such as pressure drops
 - Applications with head > 160m



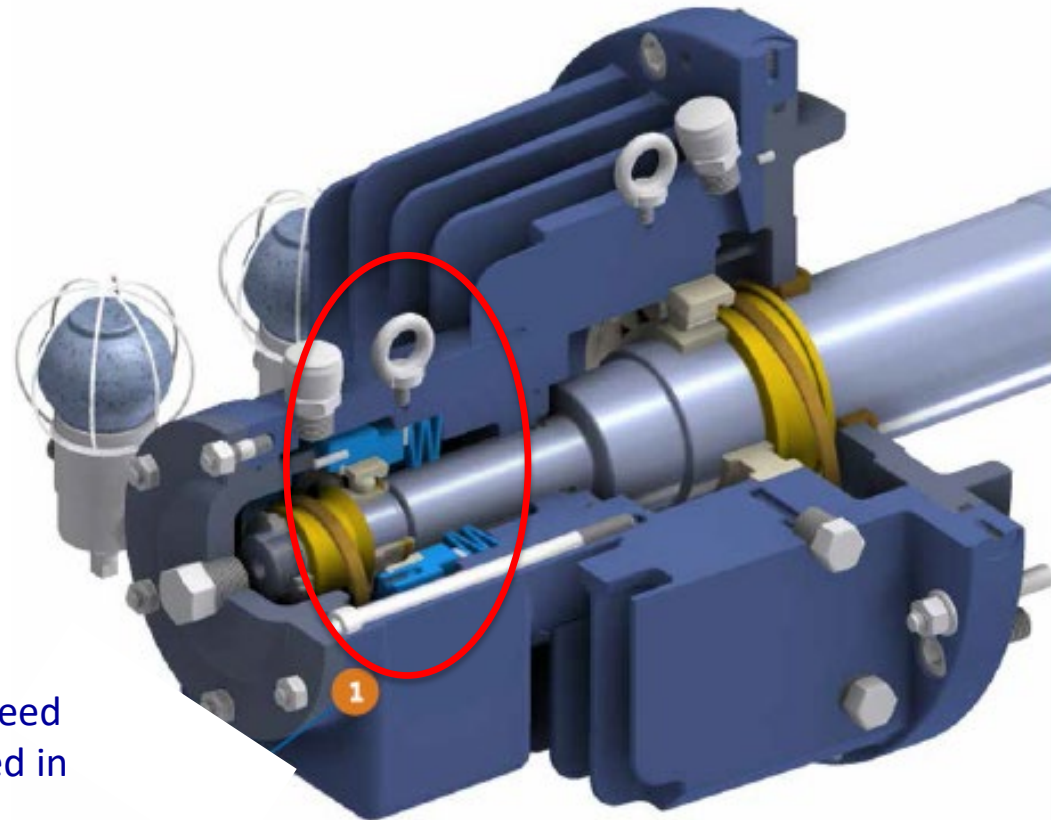
SECTIONAL DRAWING OF GP PUMP SHOWING BALANCE LINE AND BALANCE DISK



LIFT OFF DEVICE

FEATURE FOR POWER APPLICATIONS WITH FREQUENT START/STOP OR LOW SPEED

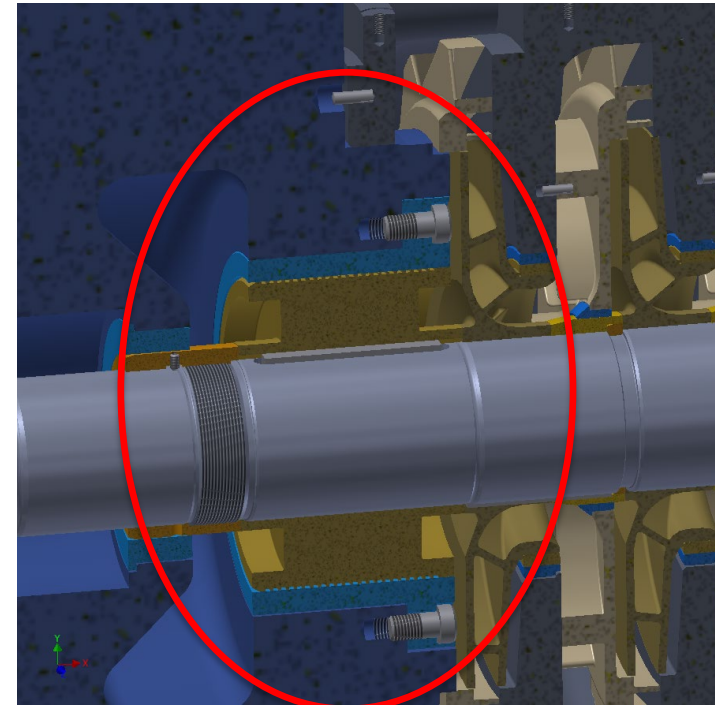
- Optional feature to work alongside balance disk
- The lift-off device ensures that the balancing disk is open during the rest, start-up and run-down of the pump by means of preloaded springs and an angular contact ball bearing.
- It is required in applications with frequently start and stop and/or operating speed below 1000 rpm
- Frequent start-stop is often seen in Boiler Feed Applications, so this feature is often required in pumps for such Power Plants



BALANCING DRUM

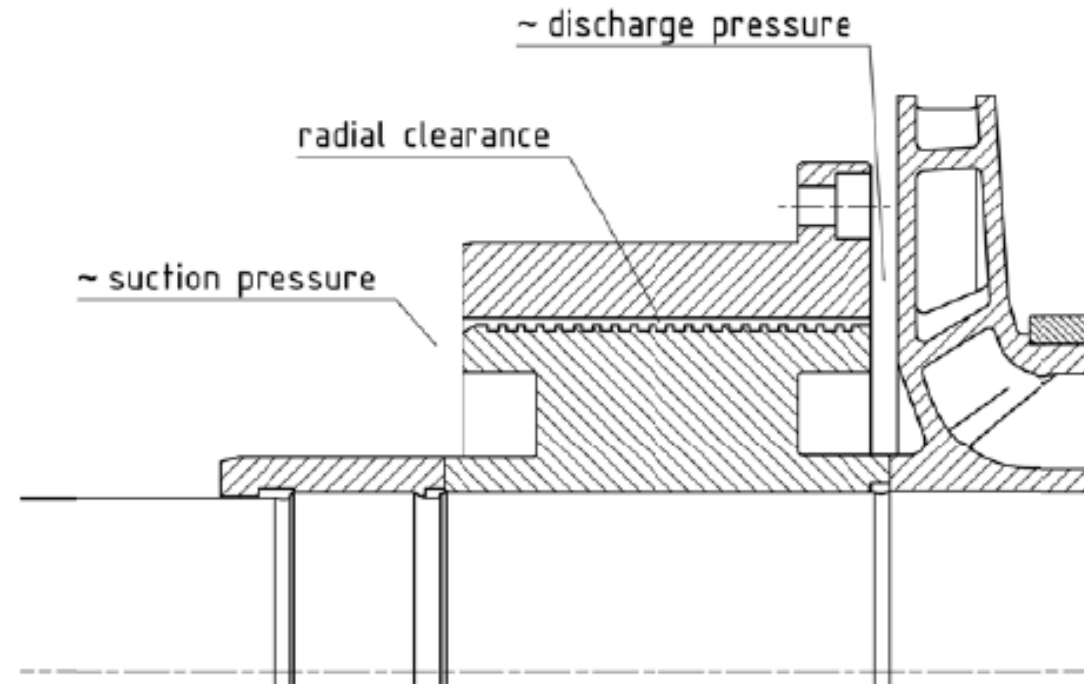
REQUIRED FEATURE FOR API 610 COMPLIANT PUMPS

- Unlike the balancing disk the balancing drum has a constant radial clearance set by the pump design
- Balances large proportion (85-90%) of generated axial forces at the rated operating point
- Residual forces are handled by a thrust bearing which retains the rotor axial position
- Constant clearance allows the use of a balancing drum in all applications and it provides high reliability in applications with transients such as start up and run down, temperature changes, frequent starts and stops
- Used for API 610 pumps because the standard precludes thrust balancing by use of axial clearances (API 610 11th edition 6.7.1) so balance disk cannot be used



BALANCING DRUM

- Available for GP pump
- Slightly reduced efficiency compared with balance disk due to marginally higher leakage rates
- Easy and safe axial rotor setting due to radial clearance (compared with more critical rotor setting for balance disk method with axial clearance)



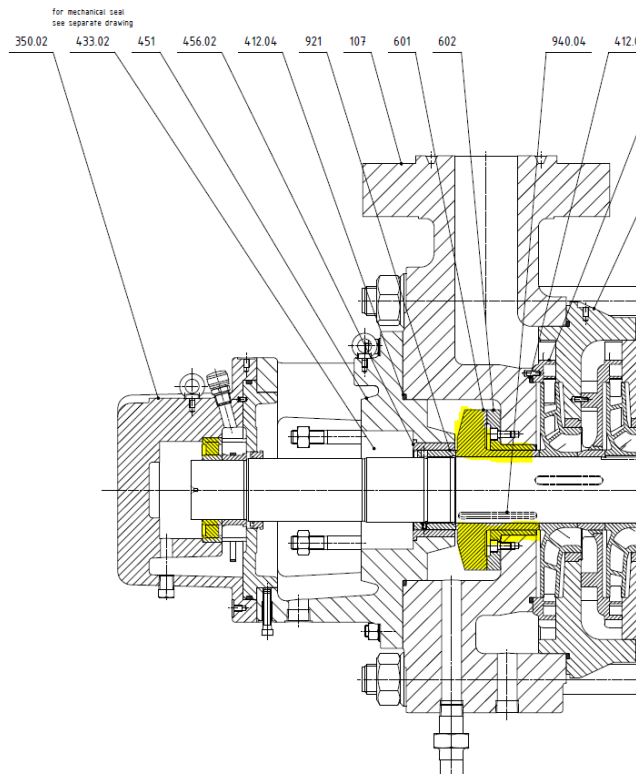


BEARING SELECTION

AVAILABLE BEARING SELECTIONS WITH BALANCE DISK

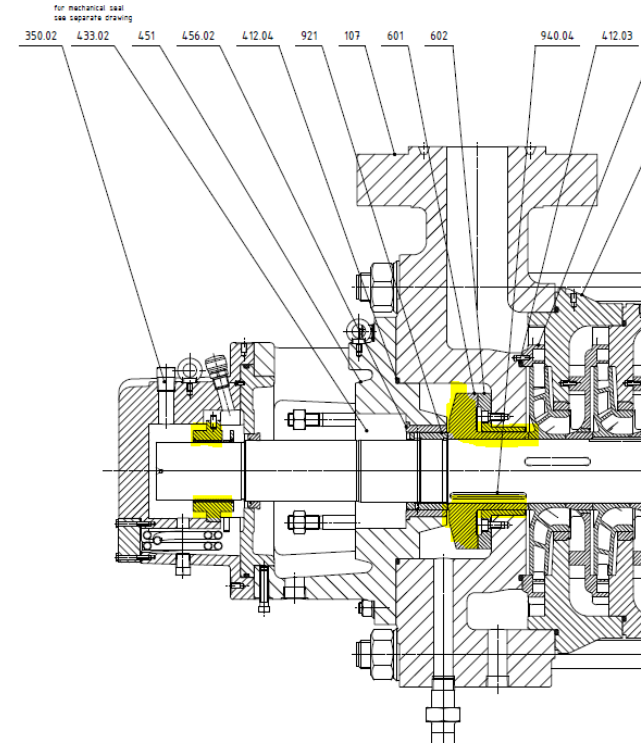
Antifriction

- DE/NDE: Single row, cylindrical roller bearing (no thrust bearing required)
- Lubrication: Ring oil lubrication with Constant Level Oiler and Sight Glass [Option for Oil Mist]



Hydrodynamic

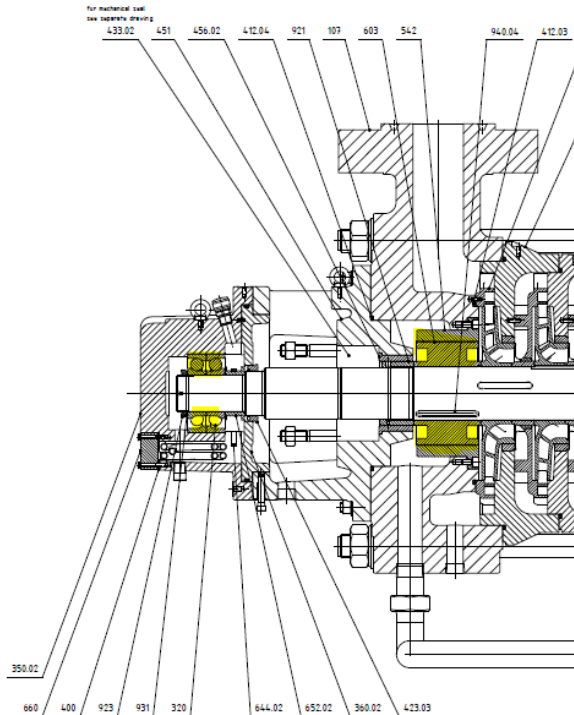
- DE/NDE: Radial Sleeve bearing (no thrust bearing required)
- Lubrication: Ring oil lubrication with Constant Level Oiler and Sight Glass
- Cooling: Water cooling coil



AVAILABLE BEARING SELECTIONS WITH BALANCE DRUM

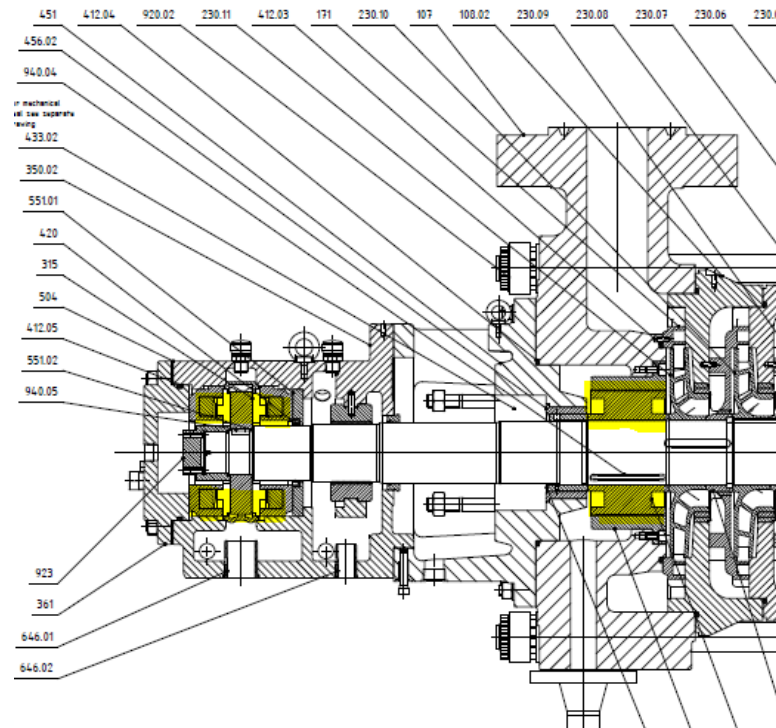
Antifriction

- DE: Single row, deep groove ball bearing
- NDE: Paired back to back, single row, angular contact ball bearings
- Lubrication: Ring oil lubrication with Constant Level Oiler and Sight Glass [Option for Oil Mist]



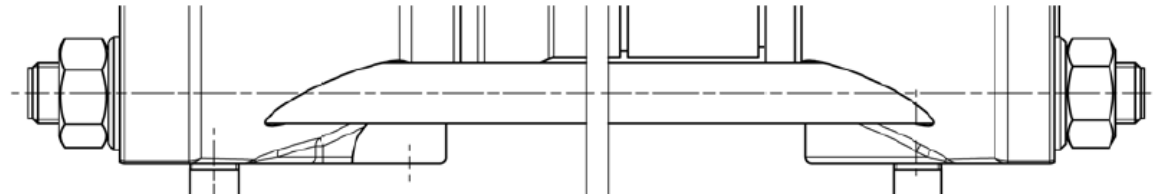
Hydrodynamic

- DE: Radial Sleeve Bearing
- NDE: Radial Sleeve and double acting tilting pad thrust bearing
- Lubrication: Forced Feed Lubrication



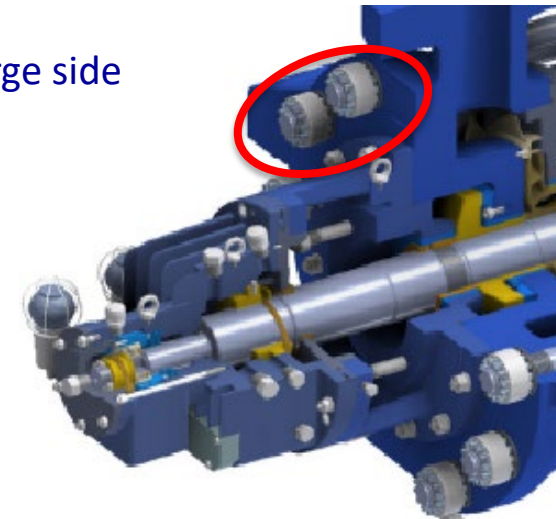
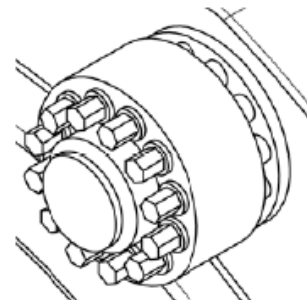
TIE RODS AND BOLTING

Pump casings held together by tie rods and hexagonal bolts with washers



FEATURE FOR HIGH PRESSURE PUMPS, APPLICATIONS REQUIRING COLD START AND LARGER PUMP SIZE

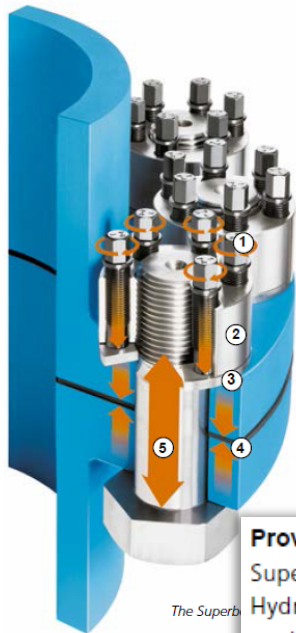
- Ruhrpumpen uses multiple screw mechanical tensioners on the discharge side of the pump (for example „Superbolts“)



MULTIPLE SCREW MECHANICAL TENSIONERS –SUPERBOLTS*

What is Superbolt?

Superbolt tensioners are designed as direct replacements for conventional nuts and bolts. These devices can be threaded onto a new or existing bolt, stud, threaded rod or shaft. The main thread serves to position the tensioner on the bolt or stud against the hardened washer and the load bearing surface. Once it is positioned, actual tensioning of the bolt or stud is accomplished with simple hand tools by torquing the jackbolts which encircle the main thread. The jackbolts transfer the preload evenly into the main thread and, consequently, onto the joint. The main thread is tightened in pure tension.



How Superbolt tensioners work:

- 1) By tightening the jackbolts, a strong thrust (axial) force is generated. This thrust force is directed against a hardened washer. Jackbolts have a small friction diameter and can therefore create a high thrust force with relatively little torque input.
- 2) The loads are transferred through the nut body which is positioned on the main thread by hand.
- 3) A hardened washer is used to transfer the force while protecting the flange face.
- 4) The thrust (axial) force of many jackbolts and the opposite reaction force of the main bolt head create a strong clamping force on the flange.
- 5) The thrust (axial) force from the jackbolt creates an equally strong reaction force in the main bolt.

Proven in the field

Superbolt tensioners are used in many industries: Hydropower, wind turbines, gas and steam turbines, nuclear, steel, mining, shipbuilding, offshore, chemical, transportation, to name a few.

Benefits

- Pure tensile load on tie rods – absence of axial stresses allows higher capability of the rods
- Ensures uniform tightening on all tie rods
- Tie rod elongation can be measured as the gap between the nut body and the washer, giving additional verification of the tightening torque used
- Allows bolt tightening by use of simple hand tools (no need for heavy hydraulic tool) meaning that re-assembly is faster and more simple in the field and no special tools needed

* Trade Mark - Nordlock Group

MULTIPLE SCREW MECHANICAL TENSIONERS – SUPERBOLTS *



<https://www.nordlock.com/superbolt/products/superbolt-tool/>

* Trade Mark - Nordlock Group

HPRO Pumps – SM / JTN

- Back to back impellers configuration for an optimum thrust balance
- Various hydraulics to match different head/flow requirements with maximum efficiency.
- Available double suction first stage Impeller or single suction low NPSH for critical suction needs.
- Based on API 610, gives a robust, easy maintenance product



OPERATING LIMITS

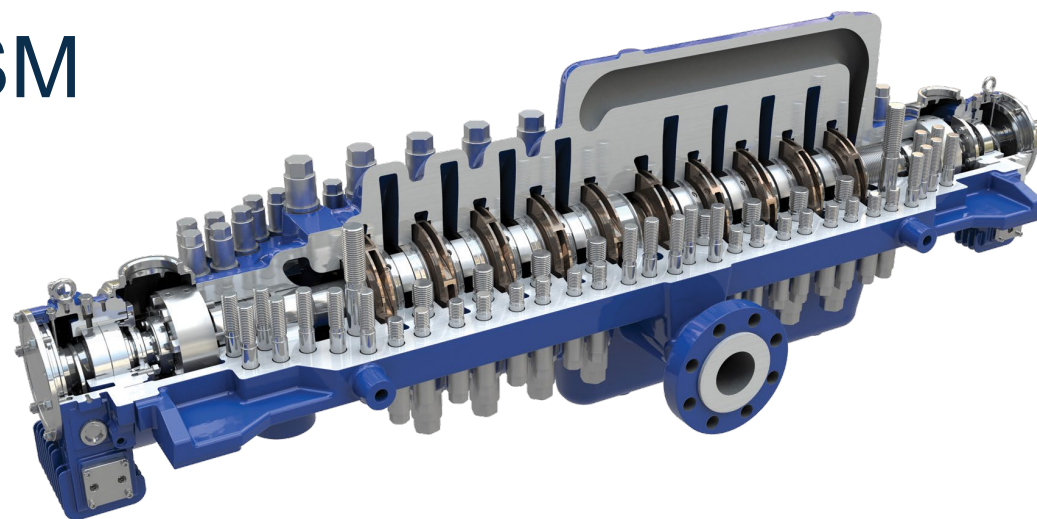
Capacity	up to 1,400 m ³ /h
Head	up to 650 m

OVERVIEW

JTN

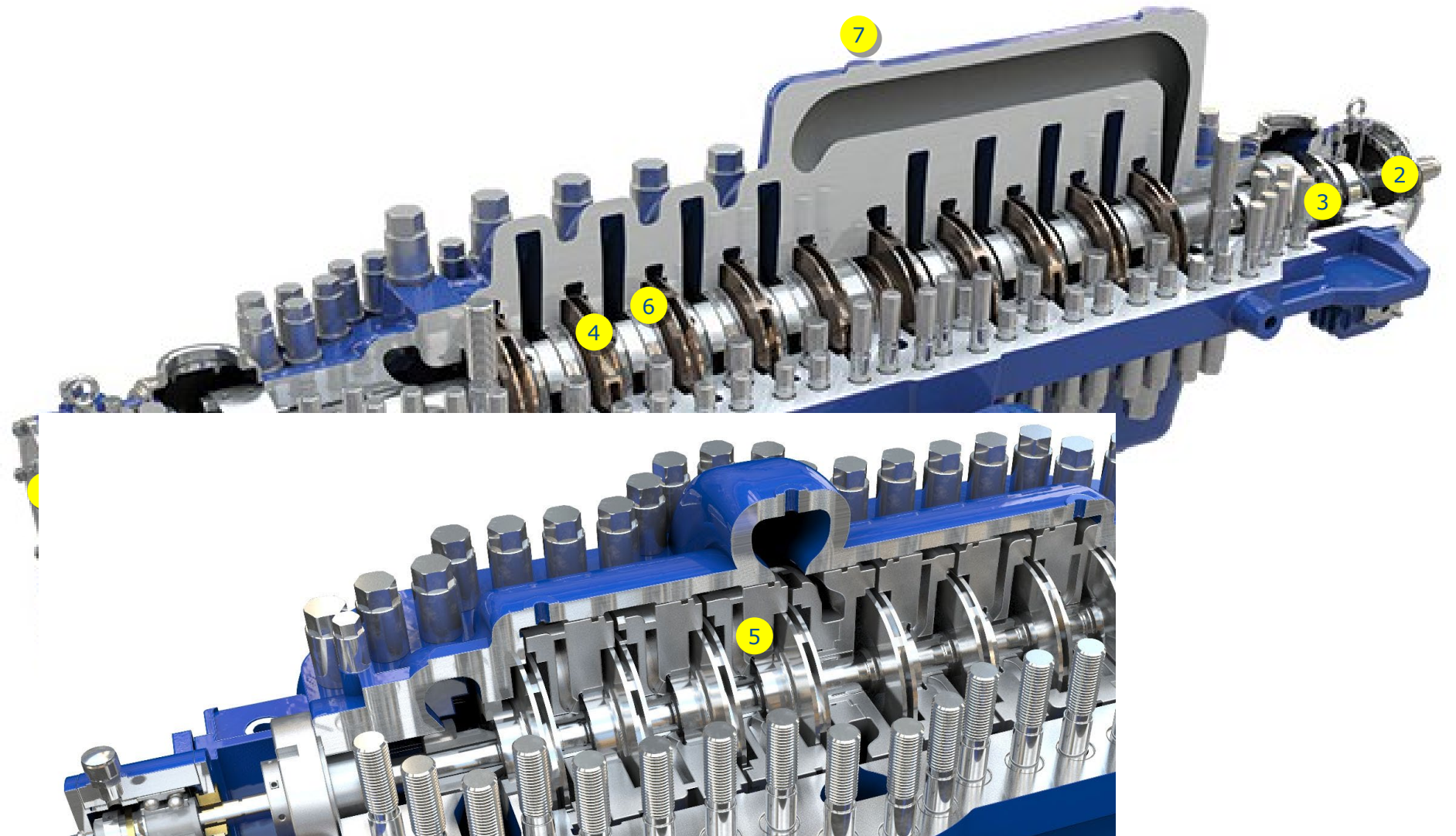


SM



PUMP DESIGN

- 1 Pump casing
- 2 Bearing housings
- 3 Seal chamber
- 4 Impellers
- 5 Diffusers (JTN only)
- 6 Wear rings
- 7 Vent / Drain





HPRO Pumps – ZM

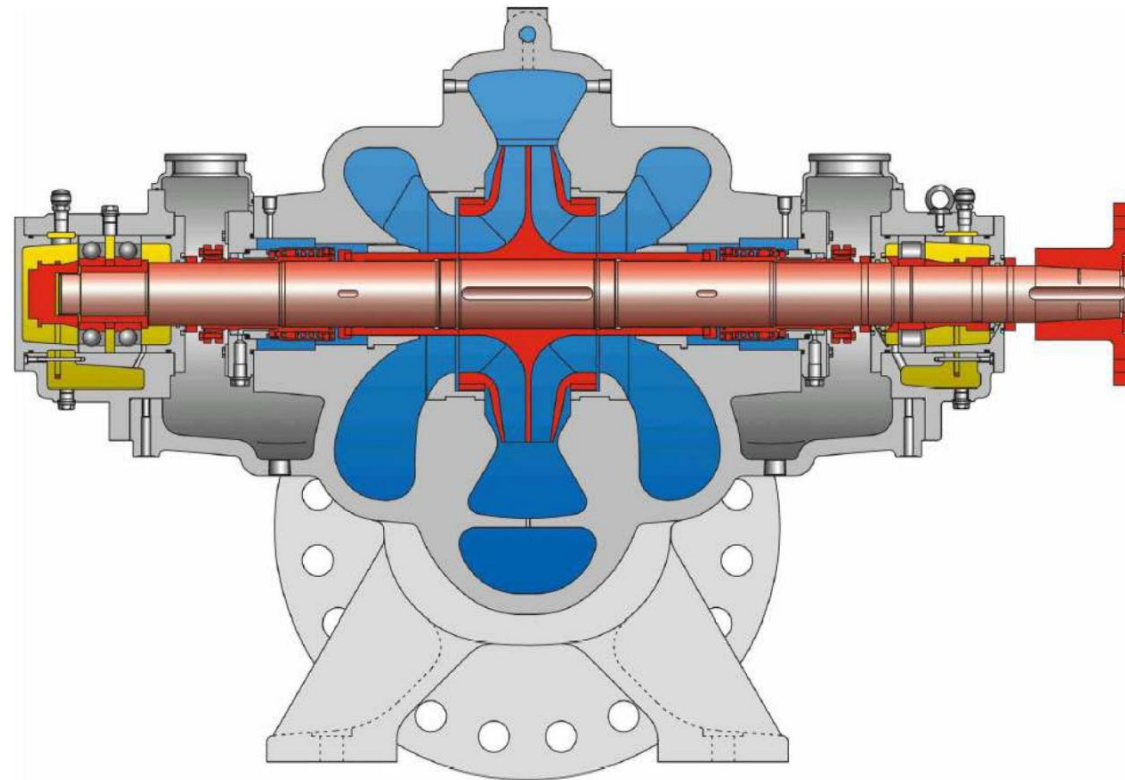
- Tailor made design for a perfect fit solution
- Single and two stages design available.
- Double volute design
- Industry leading performance and high efficiencies.
- Foot or Near-centerline mounted

OPERATING LIMITS

Capacity	up to 9,000 m ³ /h
Head	up to 650 m



ZM PUMP

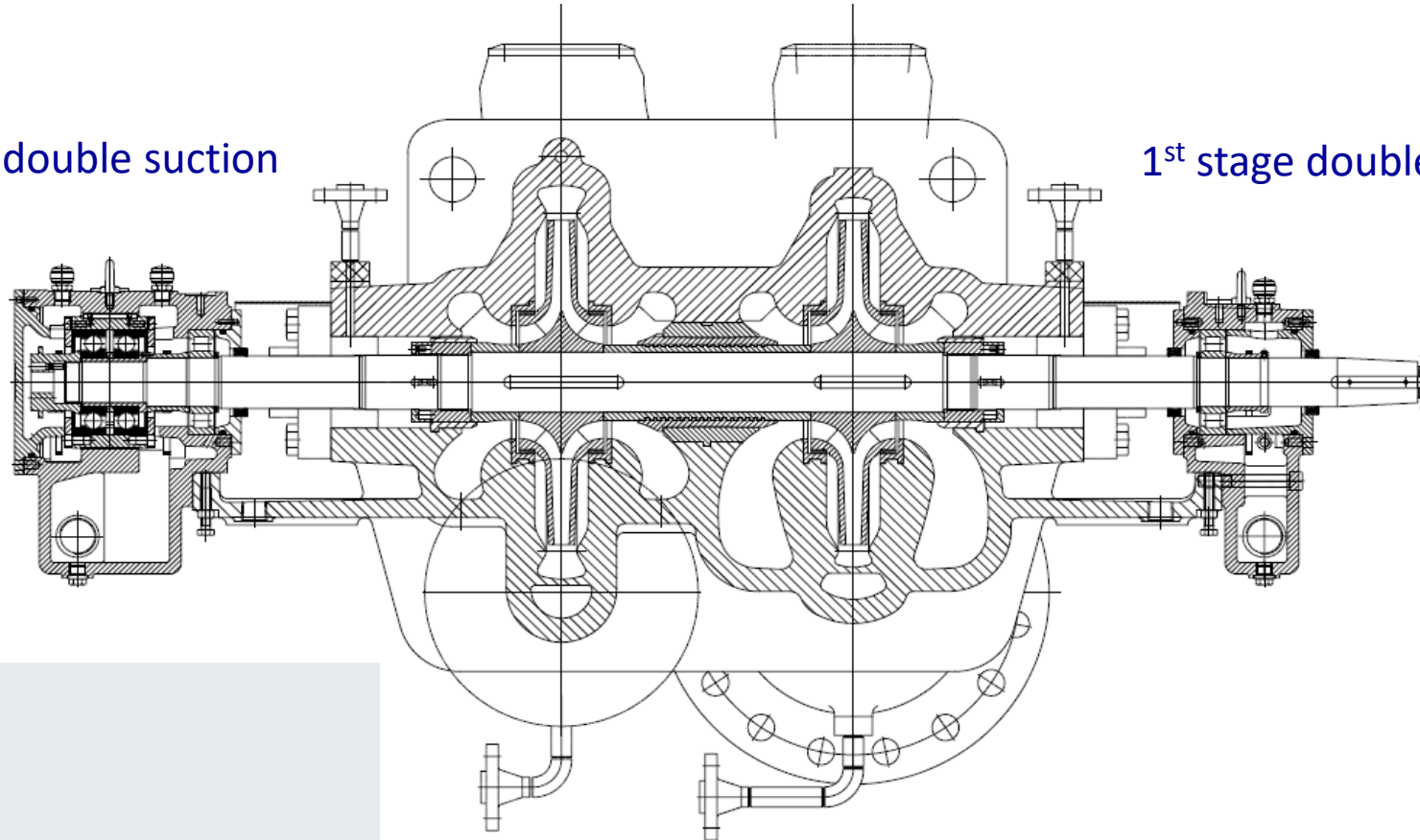




ZM x2

2nd stage double suction

1st stage double suction



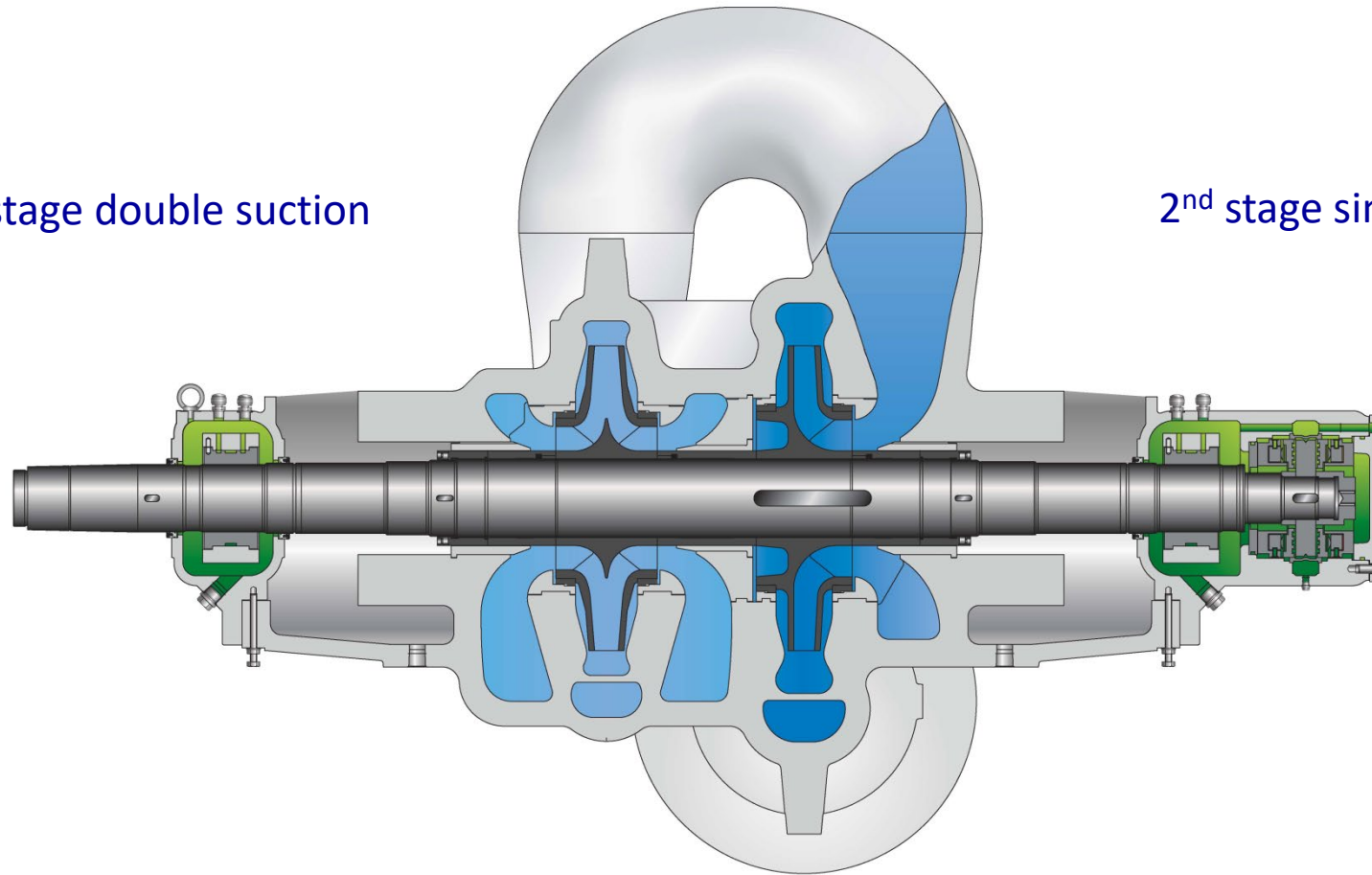
Double Volute



ZMS x2

1st stage double suction

2nd stage single suction



Double Volute



HPRO Pumps – RDP

- Triplex & Quintuplex Plunger Pumps
- Design according to API 674
- Easily accessible service points reducing maintenance time.
- Excellent noise and vibration characteristics < 85dB(A)
- 95% volumetric and 90% mechanical efficiency, exceeding API standards

OPERATING LIMITS

Capacity	up to 366 m ³ /h
Head	up to 1100 m





Vertical Pumps – VTP / VCT

- This broad product line complies with the most demanding quality specifications
- Wide range of impellers & Hydraulics for perfect fit
- Pull out design available for some sizes
- Barrel / can applications available for some sizes
- Submersible deep well available for some sizes

OPERATING LIMITS

Capacity	90,000 m ³ /h
Head	up to 70 m

*Higher heads upon request





Self-Priming

- Self Priming Pump
- Easy maintenance without the need of disconnecting piping
- Easy access to impeller and seal.
- Availability of mounting above the liquid being pumped.
- Designed to allow up to 3 inch diameter solids.
- Lift up to 8,2 m

OPERATING LIMITS

Capacity	1,440 m ³ /h
Head	up to 50 m



Submersible pumps

- Designed according to HI guidelines with easy installation, maintenance and service
- Modular interchangeability to reduce inventory
- Semi-open impeller with Large solid handling
- Double Row Thrust Bearings. Grease lubricated and free of maintenance

OPERATING LIMITS

Capacity	up to 9,000 m ³ /h
Head	up to 73 m





Quality





ITP to be Considered

STANDARD QUALITY CONTROL PLAN - DESALINATION

Item	DESCRIPTION	Standard	Optional	COMMENTS
1	Performance test	Not witnessed Values of tolerance factors based on EN ISO 9906:2012 and HI 14.6-2011. (OSE to check with customer) Testing procedure ISO 9906 Gr 2 With certificate	Option 1) Witness qty. Option 2) Testing Procedure ISO 9906 Gr 1	Normally only 1 witnessed per service. The performance test shall be carried out at pump discharge flows of 0, 25, 50, 75, 100 (rated) and max.
2	Vibrations test	na	Option 1) ISO 10816-7 Cat II Option 2) ISO 10816-7 Cat I Option 3) API	Always during Performance test Standard to be considered to be approved by engineering.
3	Bearing temperature test	na	Option 1) Bearing temperature stability analysis. Option 2) Witnessing. Included when performance test is witnessed.	Always during Performance test
4	Noise level measurement	na	Option 1) Noise level check Option 2) Witnessing. Included when performance test is witnessed	Always during Performance test Always no Warranty
5	NPSH	na	Option 1) Qty Option 2) Witnessed	If mandatory, only 1 per service.



ITP to be Considered

6	Strip test	na	Option 1) Light Strip test (only bearings) Option 2) Complete Strip test	
7	Hydrostatic test	Not Witnessed Standard Hydro Test, 10 minutes. With certificate	Option 1) 30 minutes test. Option 2) Witness Qty.	Witness if mandafotyr only 1 per service
8	Balancing	Impeller to ISO 1940 Gr 6.3, with certificate.	Option 1) Impeller to ISO 1940 Gr 2.5. Option 2) ISO 1940 Gr. 6.3 Rotor Assembling dynamic balanced	
9	Balancing (Coupling)	na	Couplings dynamic balancing certificate to 6.3 ISO 1940	
10	Material certificate	Material test according to EN 10204-2.1 for all parts Material test according to EN 10204-2.2 for all wetted casting components	Material test according to EN 10204-3.1 for all wetted casting components and shaft	1x Certificate for each pump
11	PMI	na	Option 1) Non-witnessed PMI. Qty. Option 2) Witnessed PMI. Qty	All wetted casting components and shaft

ITP to be Considered

12	Liquid Pentrant Test (LPT)	na	Liquid penetrant examination to EN 1371-1 Level 3 - QTY	If required normally is one LPT for each pump. For pressure holding components (Volute case, Case cover, Stuffing box housing, Case)
13	Liquid Penetrant Test on Welds	na	Liquid penetrant examination to EN 1371-1 Level 3 - QTY	
14	Magnetic Particle Examination (MPE)	na	Magnetic particle examination to EN 1369 Level 3 - QTY	If required normally is one MPE for each pump. For pressure holding components (Volute case, Case cover, Stuffing box housing, Case)
15	Ultrasonic Test (Shaft)	na	UT for Shaft examination - QTY	If required normally is one UT for each pump shaft
16	Radiographic Examination	na	Radiographic examination on wet casting parts according to ASTM E1320 Level 7. Only on accessible areas.	Number of shots to be defined by RP engineering and only on accessible & critical areas
17	Radiographic Examination (welds)	na	Radiographic examination on welds	



ITP to be Considered

18	Painting thickness check	na	Painting thickness check	
19	Pickling/Pasivation stainless welds	na	Pickling/Pasivation stainless welds	
20	Metallic Blasting	na	Metallic blasting	
21	Galvanizing	na	Galvanized	
22	Welding and Welder Qualification	na	Docuements to be provided	ASME
23	Visual Examination of Cast Parts	Visual 100%		
24	Frame Assembly, Alignment and Overall Dimensions. Suction and Discharge Flanges	Check 100%	Option 1) With Report Option 2) Witnessed - QTY	If Witnessed normally only one.
25	Nameplate Data Control.	Check 100%	Option 1) With Report	



Coming Attractions ☺

“Cryogenic Pumps”

Thur 25th May – 08.00 (UK GMT+1) (Eastern Hemisphere) & 17.00 (UK GMT+1) (Western Hemisphere)

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

This short course will look at Cryogenic Pumps used in Liquid Oxygen, Liquid Nitrogen and LNG / LPG Services.

Future sessions :

- Magnetic Drive Pumps for the Chemical Process and API Industries (Thursday 22nd June (to be confirmed))*



Specialist for Pumping Technology

Q & A

www.ruhrpumpen.com

info@short-courses.ruhrpumpen.com

RUHRPUMPEN AT A GLANCE

**VERTICAL
INTEGRATION**

**SALES
OFFICES IN
+35 COUNTRIES**

**MANUFACTURING
FACILITIES
IN 10 COUNTRIES**

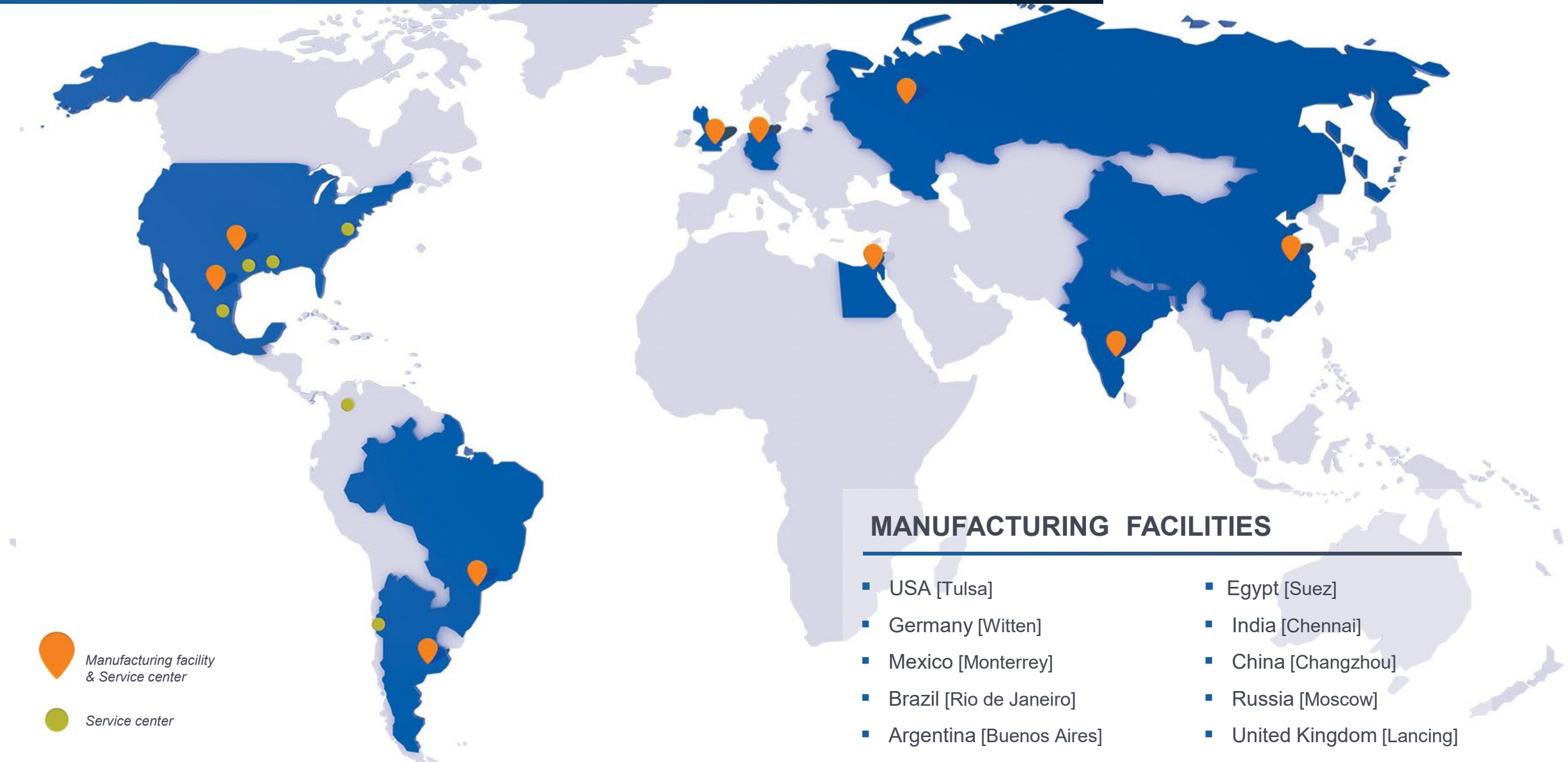
**+70 YEARS
OF EXPERIENCE**

**+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:





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).

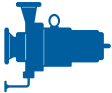









Products include:

- 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



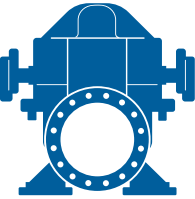




OVERHUNG PUMPS

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

