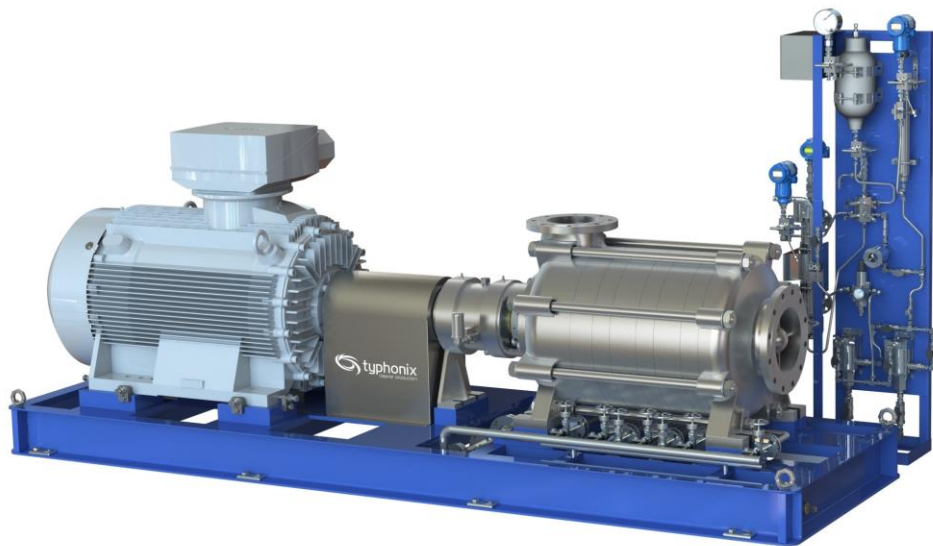


LOW SHEAR PUMP



LOW SHEAR TRIM

Typhonix Pump is a Low Shear centrifugal pump developed primarily for produced water applications.

Due to the robust design in accordance with API 610 and NORSOK, the pump has large OPEX benefits compared to positive displacement pump types.

The patented Low Shear Trim internals minimize oil droplet breakup. With sufficient oil concentration, the trim also promotes droplet-droplet coalescence (see Case B, page 8). This enlarges the oil droplets and improves produced water treatment efficiency.

The Low Shear Trim internals are specially engineered for each individual application, considering factors such as the head requirements, crude viscosity and produced water treatment system requirements.

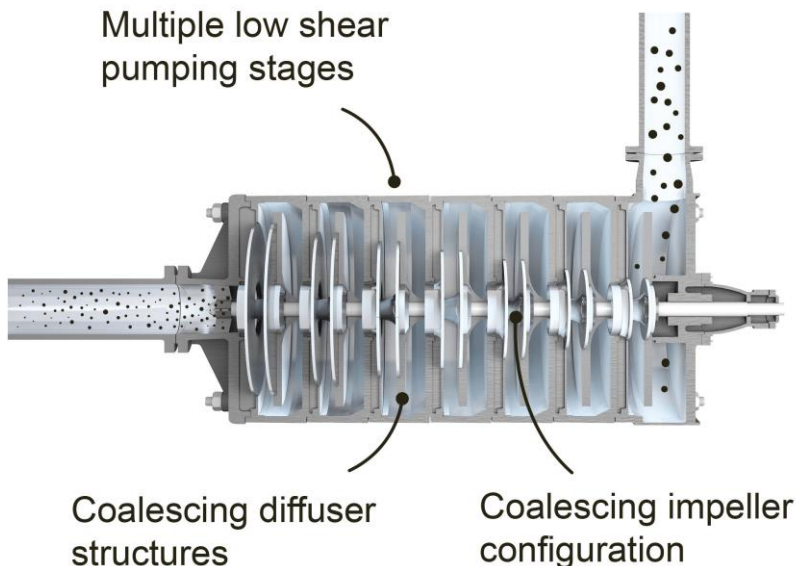
Typhonix Pump is available in BB3, BB4, and BB5 configurations.

Typhonix Pump is built by well-established pump manufacturers, with years of experience and thousands of references.

Typhonix Pump utilizes their standard design (BB3/ BB4 / BB5) and our patented Low Shear Trim to enable both low shear and coalescence.

This combines the highest standards, years of operational experience and mechanical integrity, with an innovative production friendly design.

The layout and configuration of the individual stages are custom designed to control the shear forces, minimize oil droplet breaking and optimize droplet-droplet coalescence.



USER BENEFITS

- Typhonix Pump improves the efficiency of produced water treatment equipment.
- Typhonix Pump has a robust design in accordance with API 610, and therefore has a lower OPEX and longer MTBF compared to most positive displacement pumps.
- Typhonix Pump normally does not require blocked outlet protection (e.g., a PSV), contrary to that of positive displacement pumps.
- Typhonix Pump improves the separation efficiency without resorting to chemicals or additional treatment equipment, reducing oil and chemical discharges.
- Typhonix Pump contributes to a cost-effective and environmentally friendly separation process.
- Typhonix Pump increases produced water treatment system robustness through droplet-droplet coalescence.
- Typhonix Pump contributes to reduced size and footprint of greenfield process plants by increasing the separation efficiency.

How does the technology work?

- Typhonix Pump is a low shear multistage centrifugal pump with high hydraulic efficiency.
- The number of stages and the configuration of the individual stages are designed to control shear forces (Typhonix Low Shear Trim), optimized in accordance with overall process and the pumped media.

Are All Typhonix pump types low shear?

- Yes. All Typhonix Pumps contain our Low Shear Trim, engineered for the specific application.
- Typhonix used to distinguish between Low Shear and Coalescing pump types. Now, all Typhonix Pumps are designed to be both Low Shear and Coalescing.

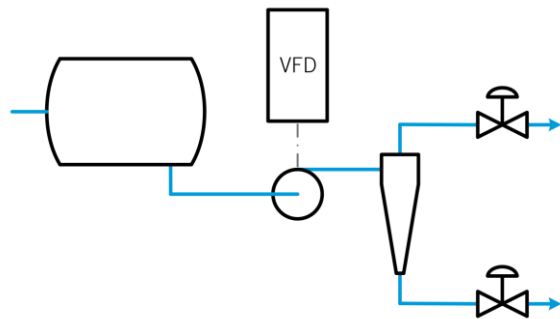
What are the unique benefits of Typhonix Pump?

- Typhonix Pump increases the efficiency of downstream produced water treatment equipment, like that of hydrocyclones.
- This reduces the oil concentration in the discharged or reinjected water. It also enables fewer treatment stages.
- Typhonix Pump increases the process' ability to handle upsets, and fluid and flow instabilities.
- Typhonix Pump is a robust low shear pump type. Long Mean Time Between Failure (MTBF) and low maintenance load in accordance with API 610.

PROCESS LAYOUTS

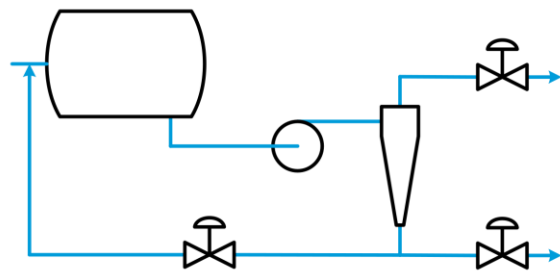
Is there a need for variable speed / frequency drive?

No, but it is highly recommended. For low shear pumping, VFD is the optimal way to handle turndowns. This is to avoid recycling oil and chemicals. Often produced water rates vary. Because of this, fixed speed pumps require minimum flow recirculation lines. These lines have valves that normally cause droplet breakup and thus reduce the overall beneficial effect of the pump. When using a variable speed drive, recirculation valves are avoided.



My process layout requires a fixed speed solution. How can I make this as low shear as possible?

Consider operating the pump intermittently. If this is not possible, a recycle line is often used in produced water applications to handle varying water production rates. It is highly recommended to install the recycle line downstream of the separation equipment, rather than directly downstream of the pump. This reduces the amount of oil that is recycled back upstream. It also reduces the pressure drop across the recycle valve, which is a means to reduce droplet breakup. To further reduce droplet breakup, it is recommended to use a Low Shear valve type, such as the Typhoon® Valve System.



PUMP TYPES

Typhonix Pump is available in BB3, BB4 and BB5 configurations. For most produced water applications, the BB4 configuration is the most cost-effective solution. Typhonix Pump can be supplied as part of a larger pump package. For this, we collaborate with partners that can offer our pumps in packages with other pump types that do not require low shear trim.

CAPACITIES

BB4	20 to 450 m ³ /h	20 to 250 m head
BB3/BB5	200 to 1000 m ³ /h	50 to 1500 m head

BB4

The BB4 pump configuration has end suction. This design has been developed for operating conditions with low NPSHa-values.

Since there is no need for a second mechanical seal, this reduces both capital expenditure and maintenance costs, and improves the overall reliability.

The pump shaft is on the suction side carried by a sleeve bearing unit. The stationary sleeve bearing, and the rotating shaft sleeve are made of wear resistant and corrosion proof SiC material.

The impellers are centered inside of the diffusers. The diffusers have a multifold channel design, effectively converting part of the generated speed in the impeller into pressure.

The guide vanes on the back side of the diffusers lead the pumped liquid to the impeller eye of the following stage.

The pump is supplied with an oil lubricated bearing bracket. The bearings are rated for 25000 operating hours. The oil bath is protected against the atmosphere by a labyrinth seal. Oil level is controlled by a constant level oiler and an additional sight glass. With additional dry safe coating, the sleeve bearing also tolerates dry running conditions.

The shaft sleeve is fitted to the pump shaft by metallic tolerance rings to avoid thermal stresses.

The bearing unit is located in the pumped liquid. To guarantee a stable fluid film in the gap between rotating shaft sleeve and stationary sleeve bearing, the bearing unit is pressurized from discharge side (Plan 13).

Our BB4 pumps are supplied in collaboration with Dickow Pumpen.



PUMP TYPES

BB5

The BB5 configuration has a centerline mounting of the barrel to increase the tolerance to thermal expansion.

The inlet channel is shaped to optimize flow uniformity and to reduce NPSHr.

The impellers are shrunk on to the shaft by heating and double key to minimize residual unbalance.

The cover is held in place by shear rings to minimize assembly / disassembly time.

The bearings have forced lubrication. All frames are fitted with proximity probes and RTDs.

The mechanical seal chamber is compliant with API682/ISO21049 to accommodate the most complex configurations.

The rotor is designed to operate below its first critical speed to increase reliability and life of the seals. The shaft is stepped to facilitate impeller mounting.

The impellers are precision-casted to maximize performance predictability and hydraulic radial load balance. Optional first stage impeller with large eye diameter for reduced NPSH.

Hard coating on all mating surfaces of the stage seals and the balancing drum to increase life.

The balancing drum is shrunk on to the shaft by heating to minimize residual unbalance. Swirl brakes for enhanced rotor stability even when operating in late-lifecycle worn condition.

Our BB3 and BB5 pumps are supplied in collaboration with Nuovo Pignone.

BB3

The BB3 configuration has bearings with forced or ring oil lubrication. All frames can be fitted with proximity probes and RTDs.

The integral centerline mounting feet increases tolerance to thermal expansion.

Optional intermediate pressure take-off.

Double volutes minimize the radial load on the rotor over the whole operating range.

The mechanical seal chamber is compliant with API682/ISO21049 to accommodate the most complex configurations.

The inlet and outlet flanges are integral to the lower half of the case, allowing maintenance without disconnecting the process piping.

Precision-casted impellers to maximize performance predictability and hydraulic radial load balance. They are shrink fitted to avoid fretting and residual unbalance. The first stage impeller is available with single or double suction.

Hard coating on all mating surfaces of the stage seals and the balancing drum to increase life.

The rotor, balanced as an assembly, has a back-to-back impeller arrangement to achieve compensation of the axial thrust even with worn clearances. The shaft is stepped to facilitate mounting of impellers.

The BB3 configuration has integral balancing flow line.



Baker Hughes

REFERENCE CASES

THE DEVELOPMENT

The basis for the Typhonix Pump was developed through a series of JIPs together with leading operators and the Research Council of Norway.

The target was to develop a pump type that combines low shear with a robust and reliable design. In addition to this, our low shear design also has low NPSHr, noise and vibrations. The following three cases showcase applications utilizing the technology.



CASE A

The Typhonix Pump was installed on this brownfield to feed hydrocyclones, either from the 1st stage separator or the 2nd stage separator.

In addition to the optimized low shear performance, the Typhonix Pump was chosen because of its higher reliability and lower maintenance load. The Typhonix Pump was supplied in BB4 configuration with separate skid seal support system.

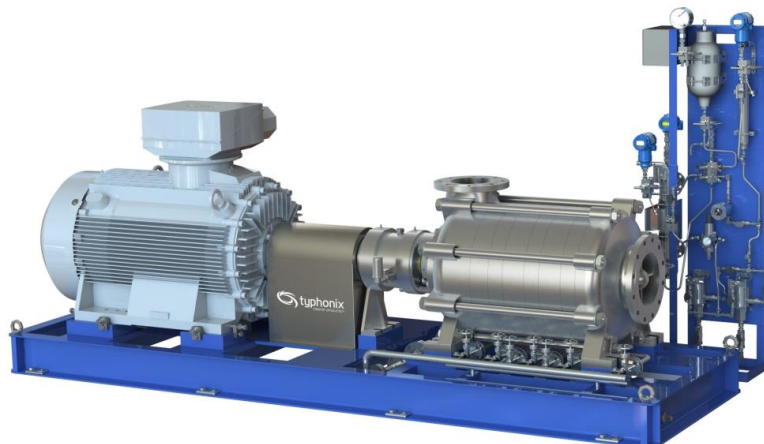
Operating range:
410 m³/h 40 to 125 m head

High efficiency:
> 75 %

Low noise:
< 65 dBA, complete unit 78 dBA

Low vibration:
< 1.2 mm/s RMS

Low NPSHr (3%):
< 4 m



REFERENCE CASES

CASE B

This brownfield required a low shear pump to feed the new filter package. Typhonix Pump was chosen because of the client’s high focus on reliability and long maintenance intervals.

Excellent low shear pumping is critical to maintain high performance of the filters. Third party field measurements showed that the coalescing capabilities of the pump increase the droplet size by more than 50 % (from $d_{v50} = 5.7 \mu\text{m}$ at the pump inlet to $d_{v50} = 8.9 \mu\text{m}$ at the outlet). The Typhonix Pump was supplied in BB4 configuration with a single mechanical seal.



Operating range:
37 m³/h 37 m head

Low vibration:
< 0.4 mm/s RMS

Low NPSHr (3%):
< 1.4 m

Oil concentration:
600 ppm (200 – 1000 ppm)

CASE C

For this greenfield, Typhonix Pump is part of a larger pump package delivered together with Nordic Flow. The low shear pump is used to feed hydrocyclones, with water coming from a coalescer.

The Typhonix Pump is supplied in BB4 configuration with the plan 53B seal support system on the skid.

Operating range:
40 m³/h 58 m head

High efficiency:
70 %

Low noise:
< 65 dBA

Low vibration:
< 0.3 mm/s RMS

Low NPSHr (3%):
< 2.3 m



TYPHONIX TEST CENTER

Typhonix Test Center is available for external projects such as complete unit testing and multiphase testing.

The test center is designed for testing process equipment under realistic conditions.

Typhonix Test Center is equipped with several flow loops, covering a broad spectrum of flow rates, pressures, temperatures and water cuts.

This includes valves and pumps from model size to 8" full-scale.

Other types of flow restricting devices, pumps and processing / separation equipment are easily fitted into the rigs.

The rigs can be operated with either circulating or once through flow.

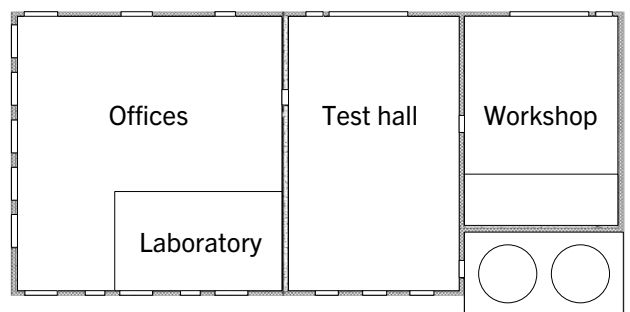
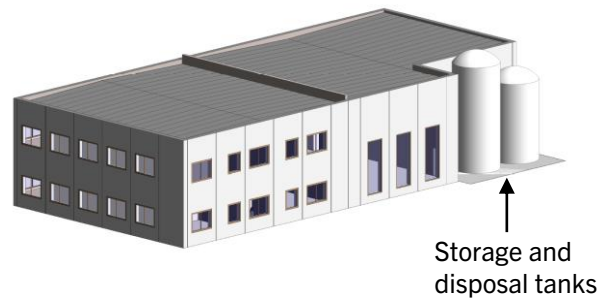
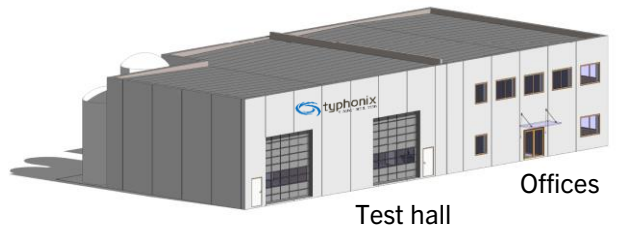
Roof height: 8 m
 Test hall / workshop area: 300 m²

Capacities with shop pumps:
 150 m³/h 40 bar

Higher flow rates possible with additional pumps.

Piping: from model size to 8"

Storage tanks: 10 m³, 15 m³, 60 m³
 Disposal tank: 80 m³



Address Test Center:

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 4340 Bryne
 Norway



typhonix

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