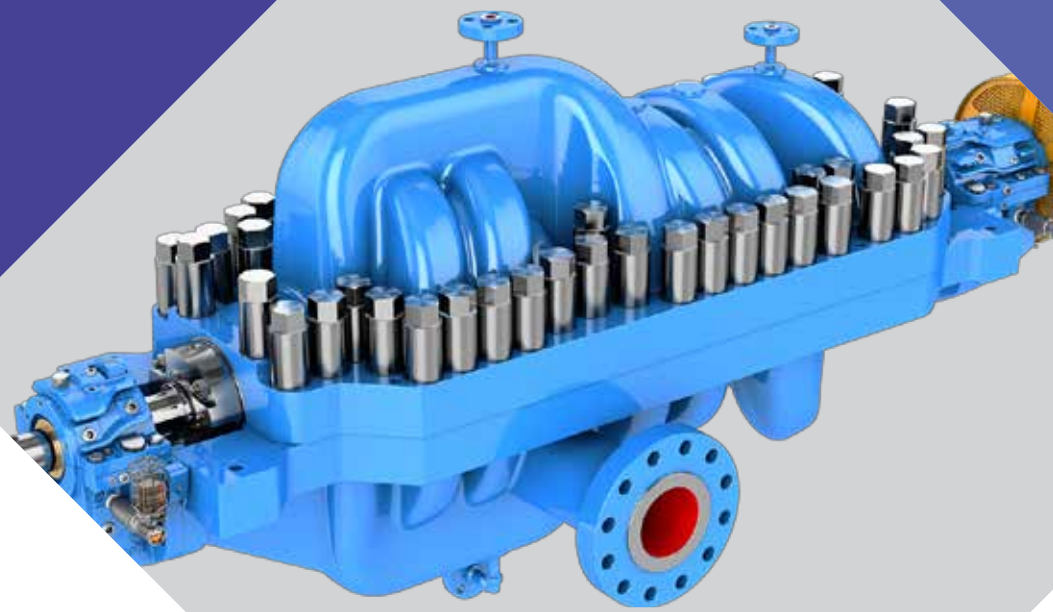
GOULDS PUMPS

Goulds 3600 *i-FRAME®*

Between-Bearing, Axially Split,
Multistage Pump



ITT

ENGINEERED FOR LIFE

3600 *i-FRAME®*

A Leader in API Engineered Pump Package Solutions…

Proven API Leadership

ITT Goulds Pumps is a proven leader in API Pumps

- Over 20,000 units installed
  - Over 17,000 OH2 / OH3s
  - Over 3,000 BB1 / BB2 / BB3 pumps
- 40+ years of API expertise
- Participating member on API 610 and API 682 committees

Family of API Pumps

ITT Goulds Pumps has a family of proven API pumps:

- Overhung pumps
- Single and two-stage between-bearing
- Multistage between-bearing pumps – axially split
- Barrel multistage - radially split
- Vertical, double casing pumps
- Specialty pumps

Industry Leading Hydraulic Coverage

- We offer extensive coverage to meet your process needs.
- Better hydraulic fits can mean improved efficiency and long-term reliability and parts life.

8000 HP / 6000 kW Testing Capability

- Our expanded test facility can test your pump in the most demanding conditions.
- Testing at rated speeds is critical to assess the impact of dynamic conditions including vibration.

API Engineering Expertise

- We are experts in packaging engineered pumps that meet your demanding applications – with true conformance to the latest API specifications.
- We have extensive experience in nearly every type of driver, bearing, seal, piping configuration, nozzle configuration, flange and baseplate design to meet your application needs.
- ITT is a world leader in technology and engineering including hydraulics, materials science, mechanical design and fluid dynamics.

Broad Applications

- Petroleum refining, production and distribution
- Petrochemical and demanding chemical processing
- High temperature applications including boiler circulation
- General industrial requiring high temperature or high pressures

Proven Leadership

ITT Goulds Pumps is a proven leader in Multistage and API Pumps with several thousand engineered multistage pumps sold and 40+ years of multistage pump expertise.

Heavy-Duty Multistage Pumps Designed for High-Head / High Capacity Services

- Capacities to 8,500 GPM (1930 m^3/h)
- Heads to 9,000 feet (2740 m)
- Temperatures to 400° F (205° C)
- Pressures to 4,000 PSIG (275 bar)
- API 610 API / ISO 13709 Latest Edition (API BB3 Compliance is Available)

Design Features

- **Engineered Hydraulics**: dense hydraulic coverage to better match your process for efficiency and reliability. Custom hydraulics are available.
- **Engineered Packaging** with a wide range of drivers, seals, piping, nozzle configurations, flanges, baseplates and QC testing.
- **Axially Split Casing** for ease of maintenance.
- **Dual Volute Design** balances hydraulic radial thrust at each stage for extended seal/bearing life.
- **Heavy Duty Single Row Bolting** prevents distortion and chance of interstage leakage.
- **Precision Cast Impellers**: smooth, dimensionally consistent hydraulic passages for maximum efficiency.
- **Compact Crossover** for streamlined fluid flow, minimum friction loss and maximum efficiency.
- **Dynamically Balanced Impellers and Rotors** ensure smooth operation and increased reliability.

Applications

The model 3600 is a robust solution for a variety of applications. This is an API pump for refineries, injection offshore platforms, remote pipeline, boiler feed in mid-range cogeneration, descaling, mine dewatering, process transfer, desalination and CO2 injection.

Bearings & Bearing Housings

To get superior MTBF you need two things: Optimum pump hydraulics and a robust pump structure. The new i-FRAME housings delivers on the second point by providing a premium robust housing with unique new and improved features that raises the bar on what you can expect from your pump's long term performance. These i-FRAME bearing housings include the new patented one piece design bearing housing for the ball-ball bearing arrangement, as well as the patent pending split bearing housing for the sleeve-ball and sleeve-tilt pad bearing arrangement.

The housings are cast and machined out of ASTM A216 Grade WCB carbon steel. Three unique bearing arrangements are available:

- Ball/Ball (New Orders Only)
  - Deep Groove Ball Bearing on the Drive End (DE) to handle radial loads
  - Duplex 40° Angular Contact Bearing Set on the Non- Drive End (NDE) to handle radial and axial loads. Bearing set is supplied with a light clearance

All ball/ball bearing housings feature a full 180° bearing saddle bolted to the casing positioned with precision dowels for accurate, repeatable alignment. The 180° bearing saddle is optimized for stiffness and rigidity of connection between the pump casing and housing along with increased bolt diameters. This provides significantly increased stiffness compared to the previous design generation, resulting in reduced vibration.

The bearing housing exterior includes distinctive cooling fins placed in a CFD/FEA optimized pattern to aid in heat dissipation.

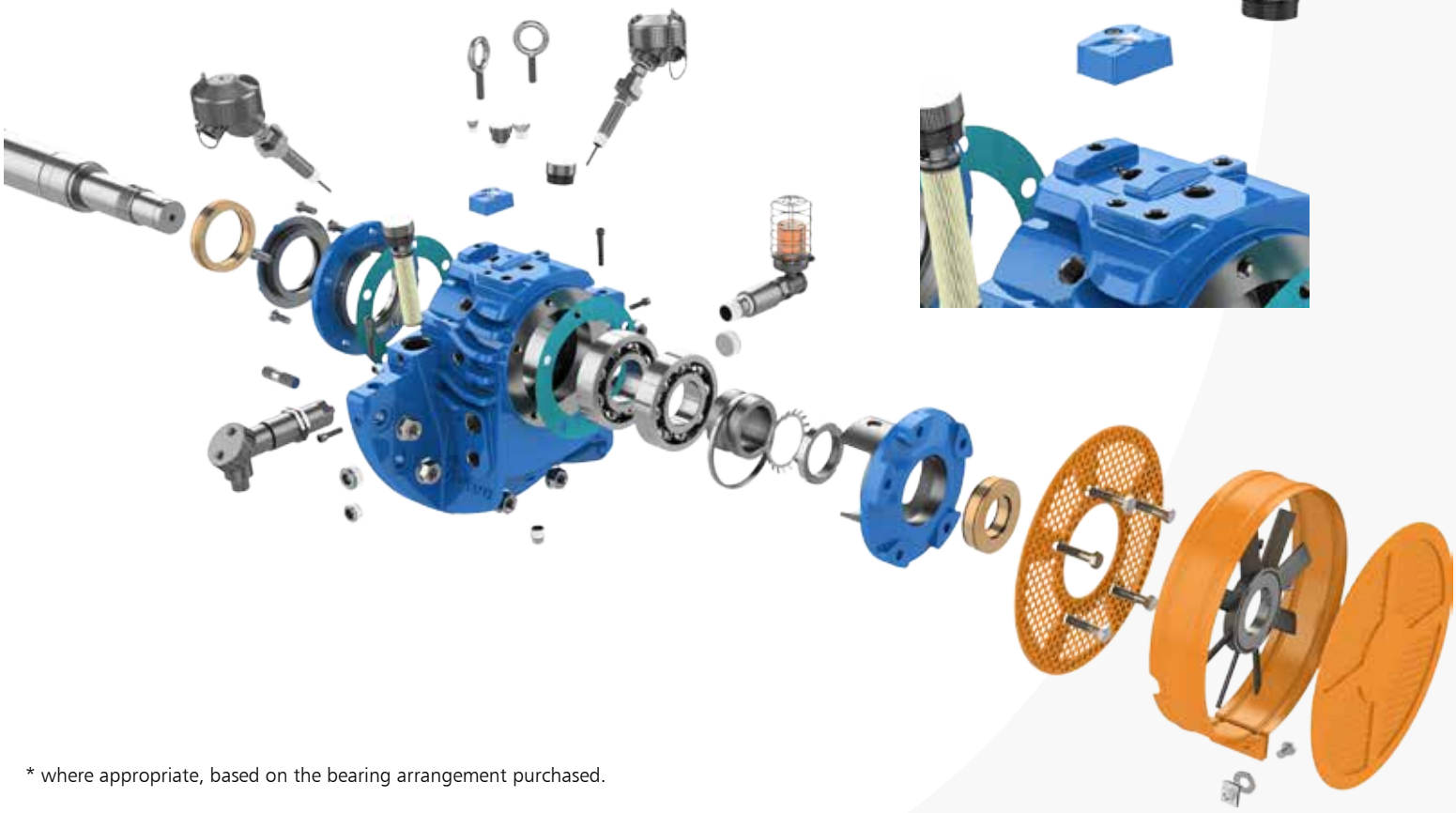
The i-FRAME bearing housings have enhanced air cooling with axial fans and achieves metal and oil temperature reductions of up to 30° F from previous design without the need for cooling water. All shaft ends on the NDE side come standard with a guarded extension to accept a fan for ease of field retrofit, so if your process needs change the fan can be fitted without the need for expensive pump disassembly.

Bearing housing put through rigorous testing.

Bearing oil contamination by wind-blown sand and dust together with atmospheric moisture are major contributors to bearings failing well before their design life. In an industry first, all self-contained bearing housings include a cartridge filter assembly that will help safeguard the bearing oil from debris contamination. The patent pending filter cartridge will also continuously work to scrub dissolved water from the bearing oil utilizing specifically engineered moisture absorbing materials built into the filter. The design allows for easy changeover of filter cartridges even while the pump is operating – no need to stop your process. All this additional reliability is achieved ***without*** the need for additional oil pumps or piping – no additional system complexity, monitoring or control overhead.

Another smart feature included as standard is the award winning, i-ALERT. This provides class leading continuous machine monitoring with comprehensive wireless reporting including diagnostic quality vibration FFTs and operating history to the mobile phone or tablet of your choice. The bearing housings come equipped ***as standard*** with constant level oilers*, sight window* and provisions for instrumentation including: RTD's, proximity probes*, and accelerometers. If your monitoring needs change in the future, this comprehensive approach allows field retrofitting of almost any monitoring scheme without replacing your bearing housings or relying on ad-hoc instrument mounting.

It is important to note these new i-FRAME bearing housings are not interchangeable with the previous design. For other features, see the Standard Product Configuration under the Application and Selection Guide section.



* where appropriate, based on the bearing arrangement purchased.

3600 *i-FRAME®*

Design Features for Optimum Reliability

Low Vibration / Smooth Performance

- Individual impellers and complete rotor assembly dynamically balanced.
- Shrink fit of impellers to shaft ensures precise balancing of rotating assembly.
- Precision cast impellers have equal volumes between vanes for reduced pressure pulsations.
- Impellers are mounted on shaft with vane tips staggered for reduced pressure pulsations.

Staggered impeller vane tips reduce pressure pulsations at vane passing frequency.

Serviceability

- Cartridge type mechanical seals for ease of assembly, proper installation.
- Single row bolting with stud nuts located on upper half for easy accessibility.

Entire rotating assembly can be removed for maintenance without disturbing suction/discharge piping.

Single row bolting simplifies disassembly / reassembly.

Split stage pieces and center case bushing can be removed for inspection of wear surfaces without disassembling rotor assembly.

Designed for API 610 11th Edition / ISO 13709 Services

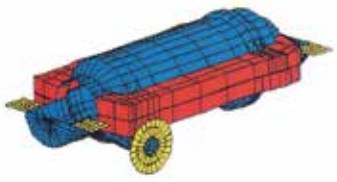
- Casing, nozzles and baseplate meet API 610 / ISO 13709 nozzle load requirements.
- Impellers are shrink fit to shaft and independently secured against axial movement.
- Seal chambers meet dimensional requirements of API 610 / ISO 13709 and can be fitted with single, double or tandem cartridge mechanical seals.
- Non metallic rings available for applications with low specific gravity, or for increased efficiency or ability to withstand short periods of dry running
- Impellers and rotating equipment element dynamically balanced to API 610 / ISO 13709 requirements.

Design / Analysis Capabilities

Casing pressure capability and structural design developed and refined using advanced finite element analysis. Goulds engineering staff is fully equipped to perform the rotor lateral response analysis and residual unbalance checks necessary to ensure stable operation and low vibration levels.

Thermal transient analysis using finite element models used to determine allowable casing temperature rise and ensure mechanical reliability.

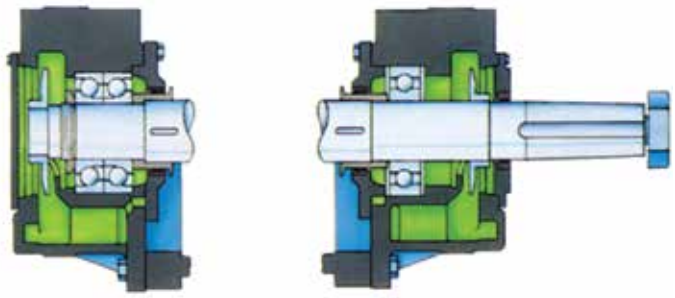
Hydraulic designs developed using dynamic flow models ensure stable performance with consistent, high efficiency levels.



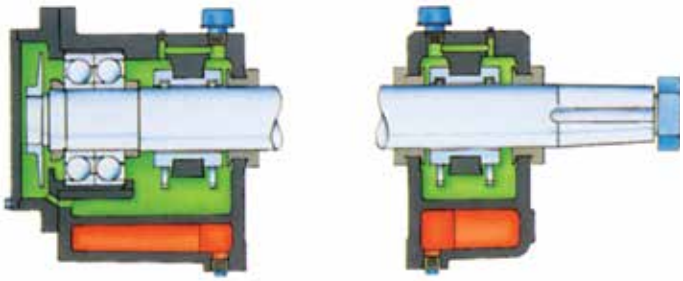
Optional Features for Application Flexibility

Bearing Arrangements

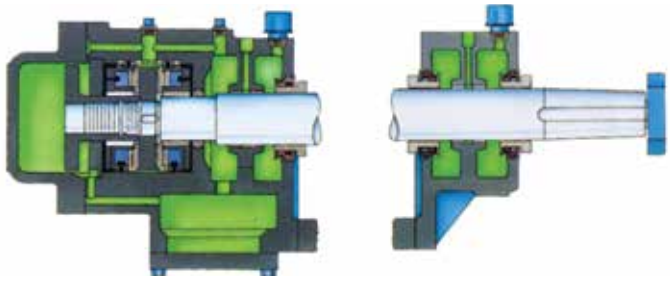
Oil lubricated ball radial and duplex thrust bearings are standard on the Model 3600. Ring oil lubricated sleeve radial and ball thrust or pressure lubricated sleeve radial and tilting pad thrust bearings can be furnished to meet customer or operating requirements. Hydrodynamic bearings offered with pressurized oil lube systems.



Duplex Ball Thrust / Ball Radial Bearings



Duplex Ball Thrust / Sleeve Radial Bearings



Tilting Pad Thrust / Sleeve Radial Bearings

Double Suction First Stage Impeller

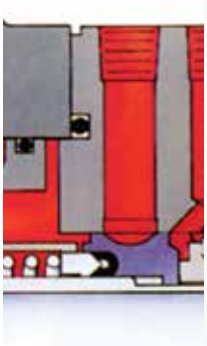
Available on 4-inch and larger discharge size pumps for services where $NPSH_A$ is limited.

Shaft Sealing and Seal Chambers

Seal chambers meet API 610 / ISO 13709 dimensional requirements. We offer any available seal and seal systems that are appropriate for your specific application including API 682 seals.

Destaging

Goulds Model 3600 can be supplied with one or more blank stages to meet existing head conditions and allow for future increases. The shaft is protected by a sleeve to maintain the impeller fit. A bypass cylinder ensures smooth, even flow to the next impeller.



Instrumentation

The 3600 can be furnished with instrumentation options to measure vibration and temperature. RTDs or thermocouples can be furnished to measure bearing temperatures and to monitor temperature rise in the casing. Bearing housing vibration can be monitored on pumps furnished with ball bearings. Pumps supplied with sleeve bearings can be furnished with non-contacting vibration probes to measure actual rotor vibration.

Interstage Bleedoff

Interstage bleedoff available for multiple discharge conditions

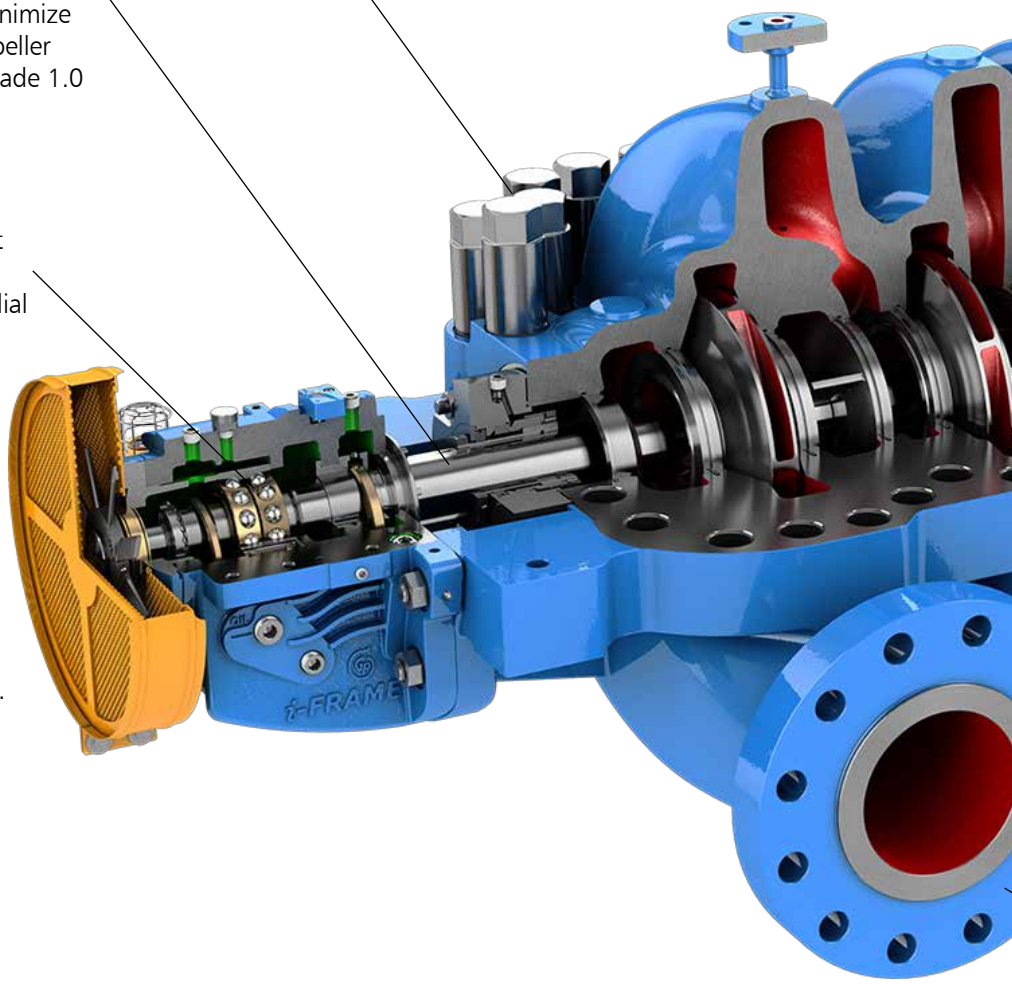
3600 *i-FRAME®*
Between-Bearing, Axially Split, Multistage Pump

DUAL VOLUTE CASING
Assures radial balance, minimum shaft deflection.

SINGLE ROW BOLTING
All nuts located on top for ease of maintenance.

DYNAMICALLY BALANCED IMPELLERS AND ASSEMBLED ROTATING ELEMENT
For smooth vibration-free operation. Impellers staggered on shaft to minimize vane-pass vibration. Rotor and impeller balanced to stringent ISO 1940 Grade 1.0 (exceeds API minimum).

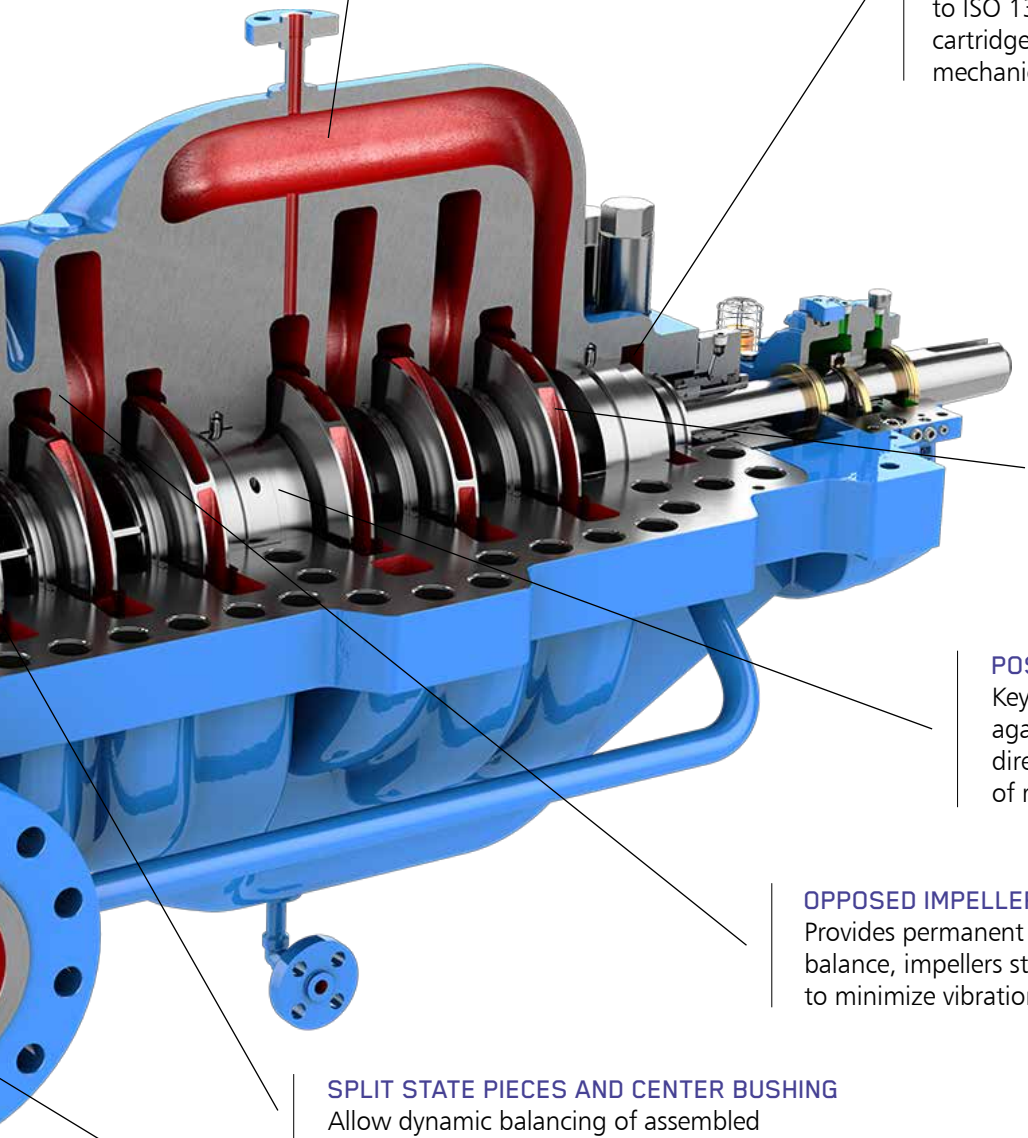
HEAVY DUTY BEARINGS
Oil lubricated ball radial and duplex thrust standard; sleeve radial / ball thrust also available, or pressure lubricated sleeve radial and tilt pad thrust.



DOUBLE SUCTION FIRST STAGE IMPELLER
Available for low NPSH service requirements.

COMPACT CROSSOVERS
For streamlined fluid flow – minimum friction loss, maximum efficiency.

ISO 13709 / API-610 SEAL CHAMBERS
Accept wide range of sealing options including seals conforming to ISO 13709 / API 610, packing, cartridge and conventional mechanical seals.



PRECISION CAST IMPELLERS
Investment cast impellers yield smooth, dimensionally consistent hydraulic passages which maximize efficiency; double suction first stage available for low NPSH applications.

POSITIVELY DRIVEN IMPELLERS
Key driven with shrink fit and secured against axial movement in both directions. Allows precise balancing of rotating element.

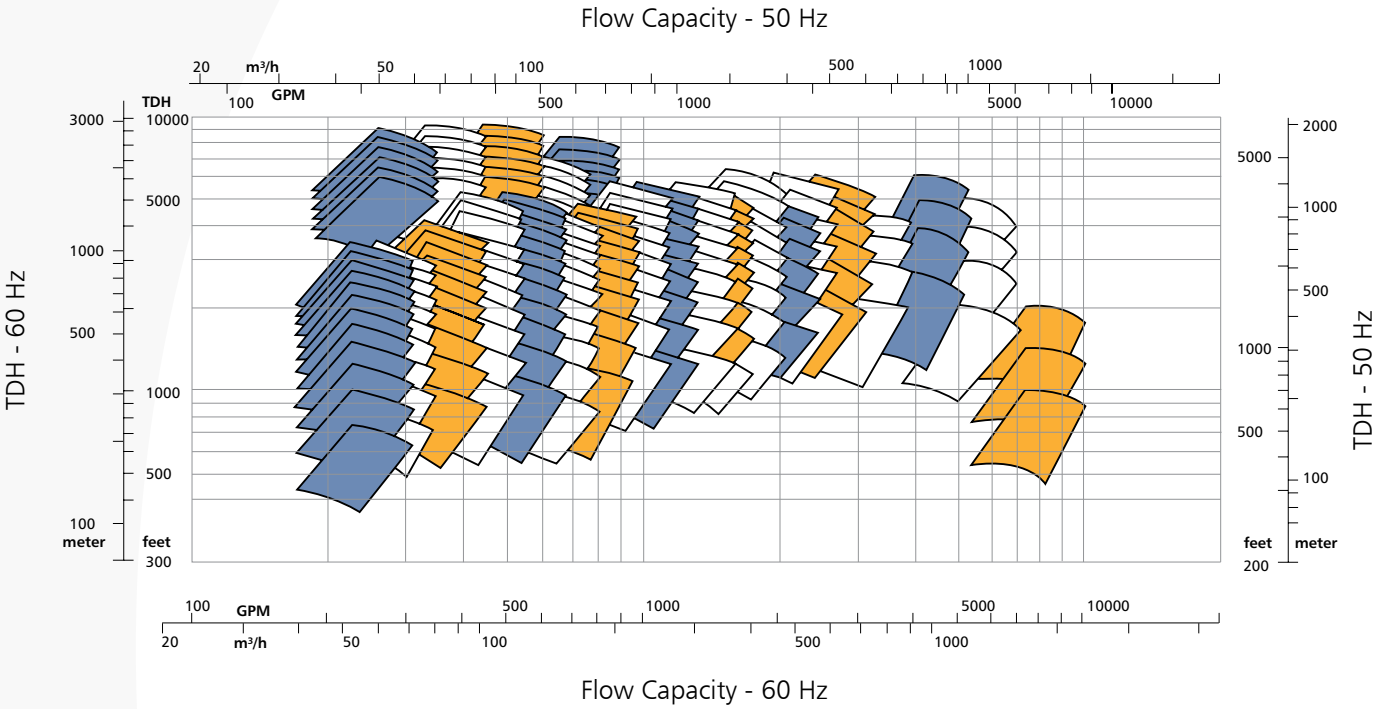
OPPOSED IMPELLER ARRANGEMENT
Provides permanent hydraulic axial balance, impellers staggered on shaft to minimize vibration due to vane pass.

SPLIT STATE PIECES AND CENTER BUSHING
Allow dynamic balancing of assembled rotating element.

HEAVY DUTY ANSI B16.5 FLANGES
Class 900 RF standard on suction and discharge; other classes available as options.

3600 i-FRAME®

Hydraulic Coverage 60 Hz and 50 Hz

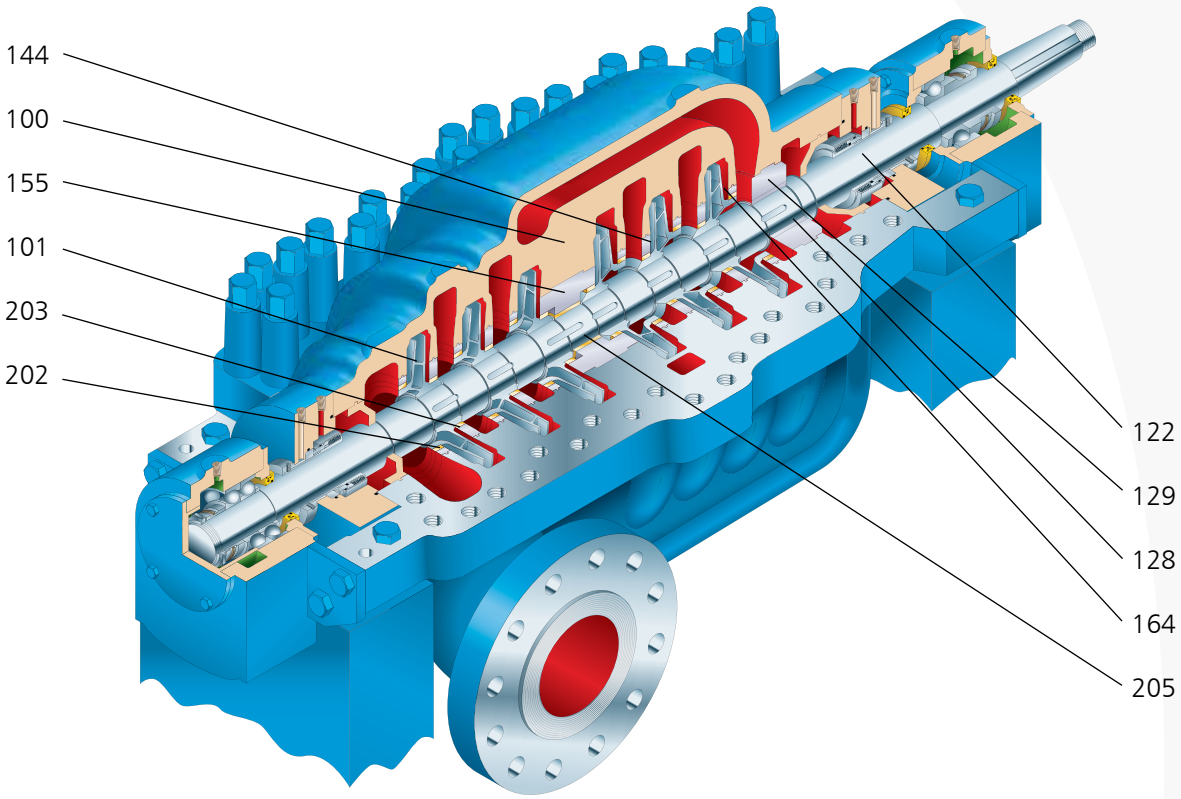


Note: Hydraulics above represent 80% to 110% of best efficiency point (BEP).

Pump Installations

The Goulds Model 3600 is built to handle the toughest services in harsh environments. These pictures show demanding installations in the deserts of the Middle East and Australia.

Sectional View



Parts List and Materials of Construction

Item	Part Name	S-6	S-8	C-6	A-8	D-1	D-2
100	Casing	Carbon Steel		12% Chrome	316L SS	Duplex SS	S. Duplex SS
101	Impeller	12% Chrome	316L SS	12% Chrome	316L SS	Duplex SS	S. Duplex SS
122	Shaft	17-4 ph	Nitronic 50	17-4 ph	Nitronic 50	Duplex SS	S. Duplex SS
202, 203	Wear Ring - Impeller **	17-4 ph	Nitronic 60	12% Chrome	Nitronic 60	Duplex SS/ Stellite 6	S. Duplex SS/ Stellite 6
128	Throttle Sleeve	Nitronic 60				Duplex SS/ Stellite 6	S. Duplex SS/ Stellite 6
205	Center Sleeve	Nitronic 60				Duplex SS/ Stellite 6	S. Duplex SS/ Stellite 6
164	Wear Ring - Casing **	420 SS	316L SS	420 SS	316L SS	Duplex SS/ Stellite 12	S. Duplex SS/ Stellite 12
129	Throttle Bushing	420 SS	316L SS	420 SS	316L SS	Duplex SS/ Stellite 12	S. Duplex SS/ Stellite 12
144	Stage Rings	420 SS	316L SS	420 SS	316L SS	Duplex SS/ Stellite 12	S. Duplex SS/ Stellite 12
155	Center Bushing	420 SS	316L SS	420 SS	316L SS	Duplex SS/ Stellite 12	S. Duplex SS/ Stellite 12

* 410 SS on S-6 when temperature exceeds 350°F (175°C)
* Not utilized on 3700LF low flow pumps.

3600 *i-FRAME®*

A Leader in API Engineered Pump Package Solutions

API Family of Pumps

Model 3700
OH-2

Model 3910
OH-3

Model 3620
3640
BB-2

Model 3610
BB-1

Model 3600
BB-3

API Type	Goulds Model	Capacity M³/Hr (GPM	TDH Meters (Feet)	Temperature °C (°F)	Pressure kg/cm² (PSIG)
OH-2	3700	1930 (8500)	360 (1200)	425 (800)	60 (870)
OH-3	3910	1360 (6000)	230 (750)	340 (650)	42 (600)
BB-1	3610	11355 (50000)	215 (700)	150 (300)	21 (300)
BB-2	3640	1700 (7500)	760 (2500)	455 (850)	75 (1130)
BB-2	3620	4540 (20000)	455 (1500)	455 (850)	70 (1000)
BB-4	3600	1930 (8500)	2740 (9000)	205 (400)	275 (4000)
BB-5	7200CB	910 (4000)	2740 (9000)	425 (800)	275 (4000)
VS4	API 3171	720 (3180)	160 (525)	232 (450)	50 (750)
VS1	VIT	14760 (70000)	1060 (3500)	260 (500)	175 (2500)
VS6	VIC	14760 (70000)	1060 (3500)	260 (500)	175 (2500)

Model 7200CB
BB-5

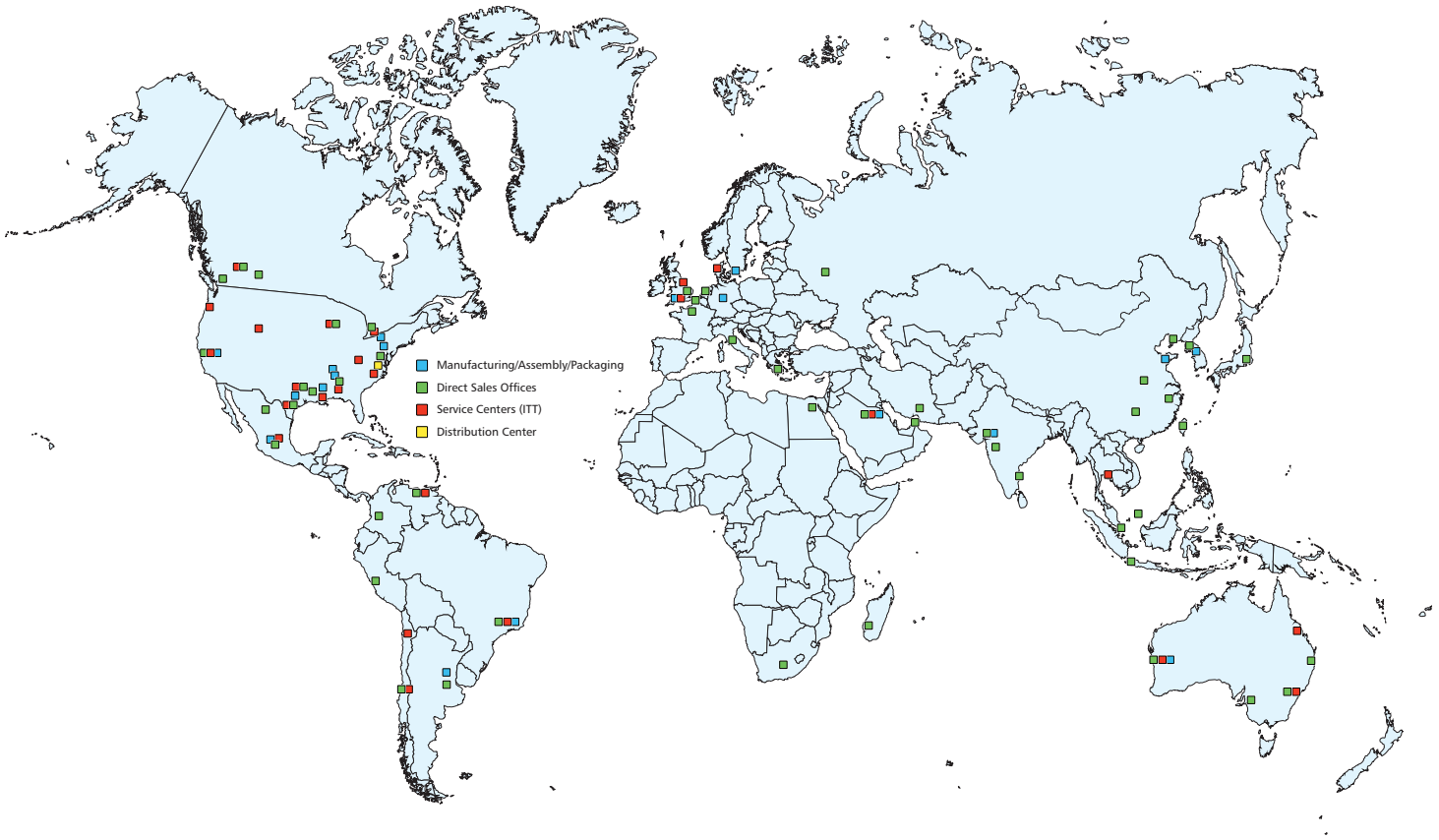
Notes

Notes

Notes

Visit our website at
www.gouldspumps.com

Wherever you are, we're there too.

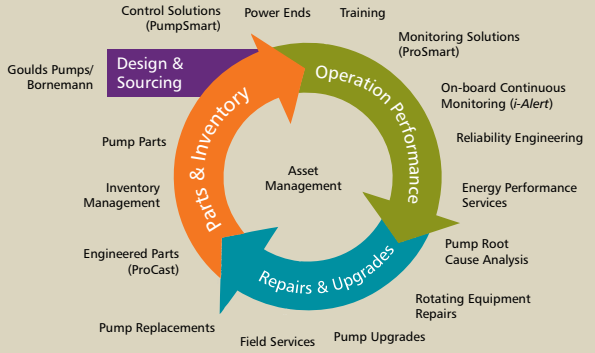


PRO services

Reliability has no quitting time.

Building on over 160 years of Goulds Pumps experience, PRO Services provides an array of services focused on reducing equipment total cost of ownership (TCO) and increasing plant output, including predictive monitoring, maintenance contracts, field service, engineered upgrades, inventory management, and overhauls for pumps and other rotating equipment.

Your Total Solution For Equipment Life Cycle Optimization



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