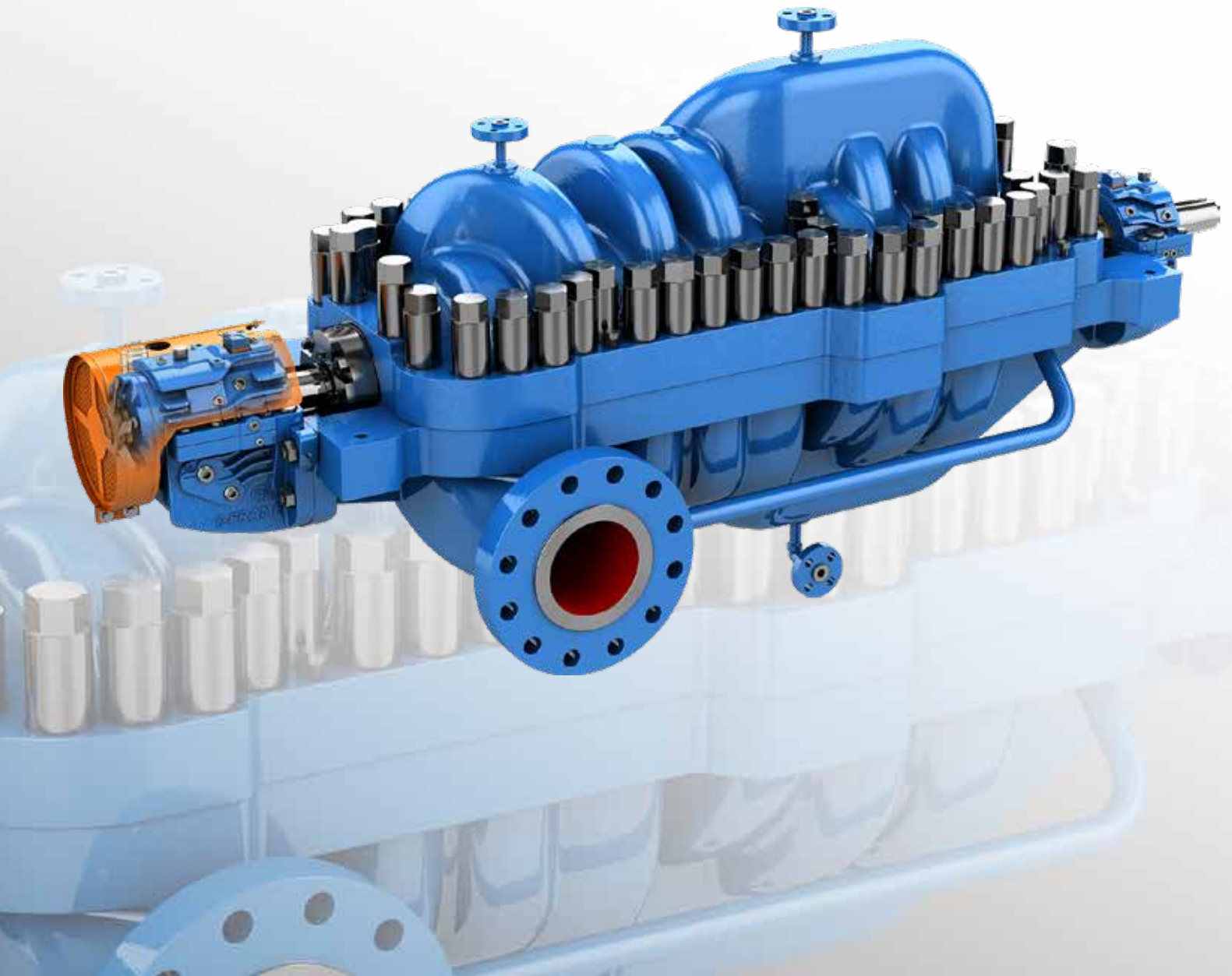




— An ITT Brand

# Goulds API 3600 i-FRAME<sup>®</sup>

API BB3 Between-Bearing, Axially Split,  
Multistage Pump



# 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
- 50+ 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



# 3600 i-FRAME<sup>®</sup>

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

- Capacities to 8,500 GPM (1930 m<sup>3</sup>/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

## Design Features

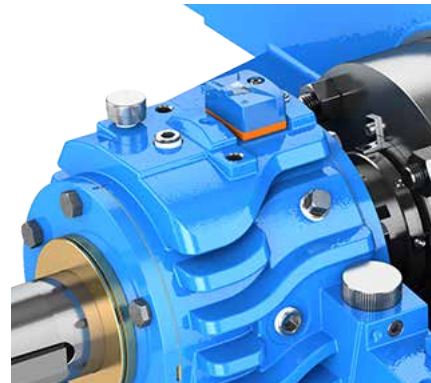
- **Engineered Hydraulics:** dense hydraulic coverage to better match your process for efficiency and reliability. Custom hydraulics are available.
- **Engineered Packaging** with a wide range of drivers, seals, piping, nozzle configurations, flanges, baseplates and QC testing.
- **Axially Split Casing** 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.
- **Bearing Housing:** Filter

## 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.

## i-FRAME<sup>™</sup> Bearing Housing Features

- This modern i-FRAME<sup>™</sup> Ball/Ball design bearing housing comes standard on all Goulds between-bearings pumps. A revolutionary oil capture and delivery system provides consistent lubrication to lower bearing temperatures and optimize bearing life.
- See the difference
  - Patent Pending Oil Filter Assembly removes debris and moisture
  - Optimized Housing Design Lowers bearing temperatures up to 6.7+ °C (20+ °F)
  - i-ALERT2 Machine Health Monitor identifies potential problems before they become costly failures
  - Instrumentation provisions as standard



# 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

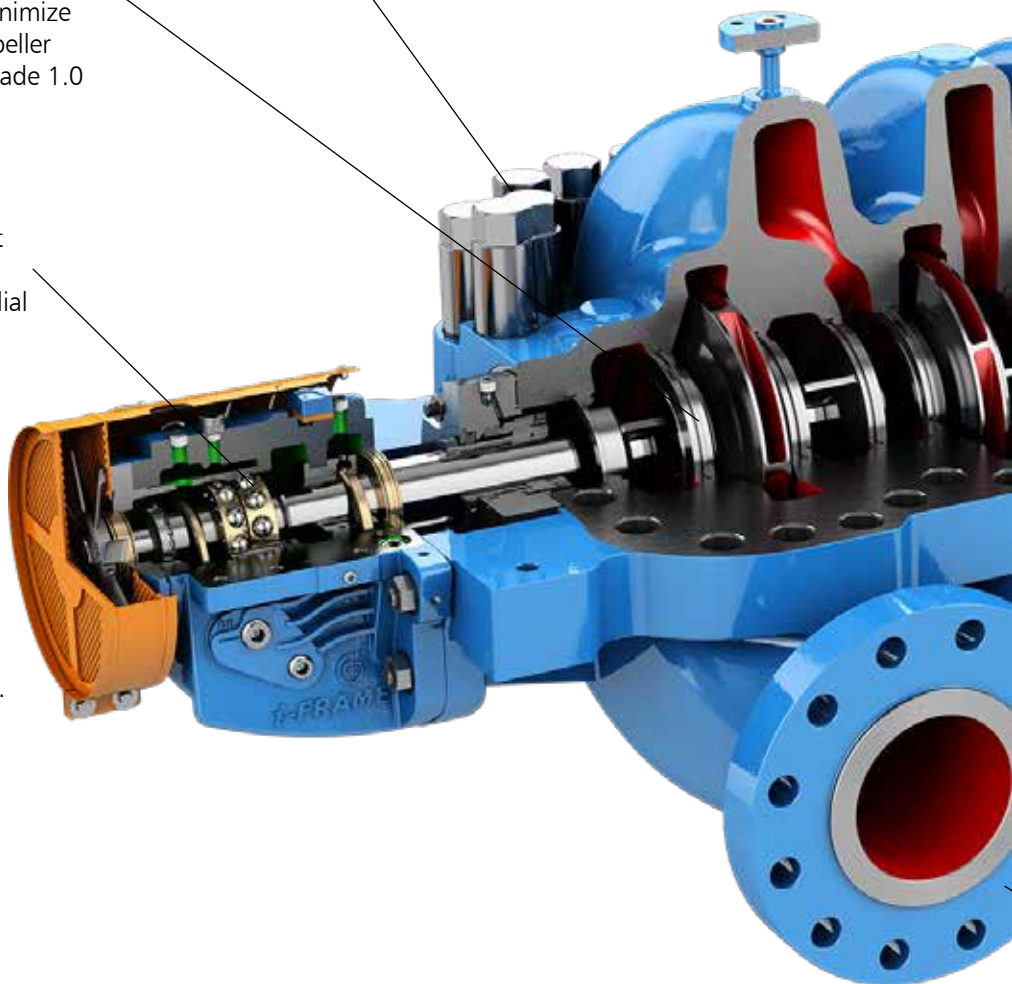
For smooth vibration-free operation. Impellers staggered on shaft to minimize vane-pass vibration. Rotor and impeller balanced to stringent ISO 1940 Grade 1.0 (exceeds API minimum).

### 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.

### SPLIT STAGE PIECES AND CENTER BUSHING

Allow dynamic balancing of assembled rotating element.

### OPPOSED IMPELLER ARRANGEMENT

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

### HEAVY DUTY ANSI B16.5 FLANGES

Class 900 RF standard on suction and discharge; other classes available as options.

# 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.

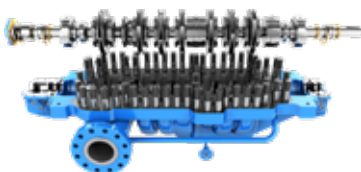


Staggered impeller vane tips reduce pressure pulsations at vane passing frequency.

### 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.



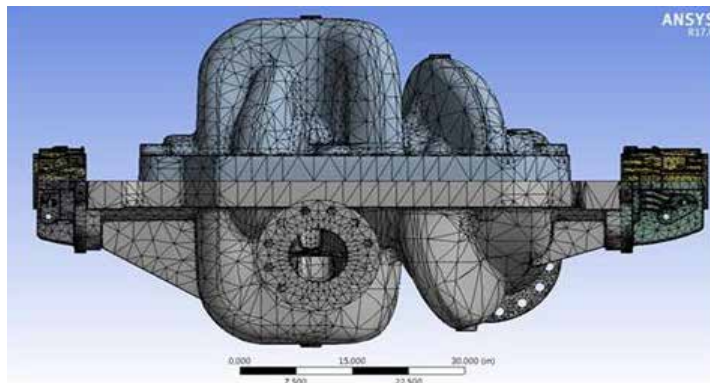
### Designed for API 610 11<sup>th</sup> Edition / ISO 13709 Services

- Casing, nozzles and baseplate meet API 610 / ISO 13709 nozzle load requirements.
- 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

Goulds utilizes FEA and CFD analysis to check the pressure capability, structure integrity of the casings and flow pattern in the pump. Goulds Engineering staff is fully equipped to perform the Rotor Lateral response analysis, Torsional analysis and Rotor residual unbalance checks to ensure stable operation, low vibration level and trouble free operation of the pumps.



## Optional Features for Application Flexibility

### Bearing Arrangements

Oil lubricated Ball/Ball bearings are standard on the Model 3600. Ring oil lubricated Sleeve/Ball or pressure lubricated Sleeve/Tilt bearings can be furnished to meet customer or operating requirements.

Hydrodynamic bearings are offered with pressurized oil lube system.

### Double Suction First Stage Impeller

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

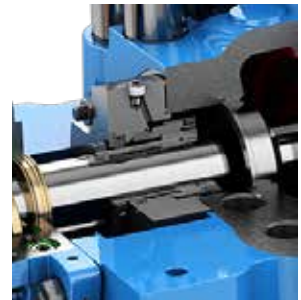


### Destaging

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.

### 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 and seal systems.

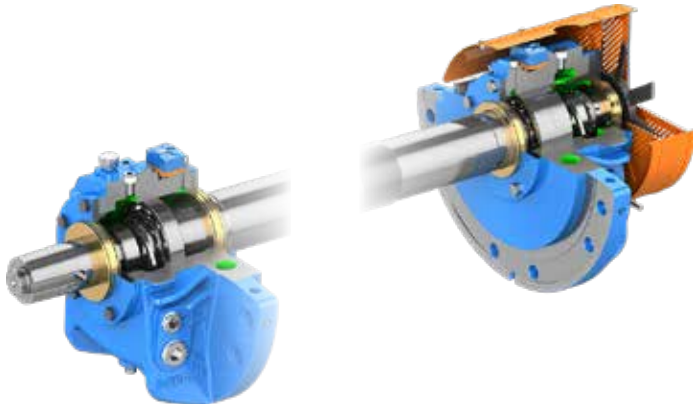


### Instrumentation

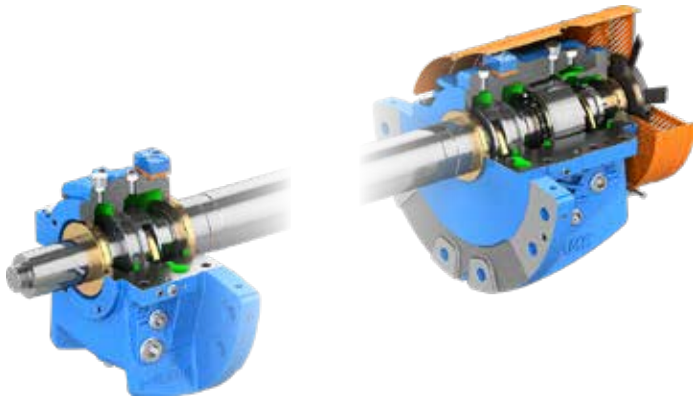
The 3600 can be furnished with instrumentation options to measure vibration and temperature. RTDs or thermocouples can be furnished to measure bearing temperatures and to monitor temperature rise in the casing. Bearing housing vibration can be monitored on pumps furnished with ball bearings. Pumps supplied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

### Interstage Bleedoff

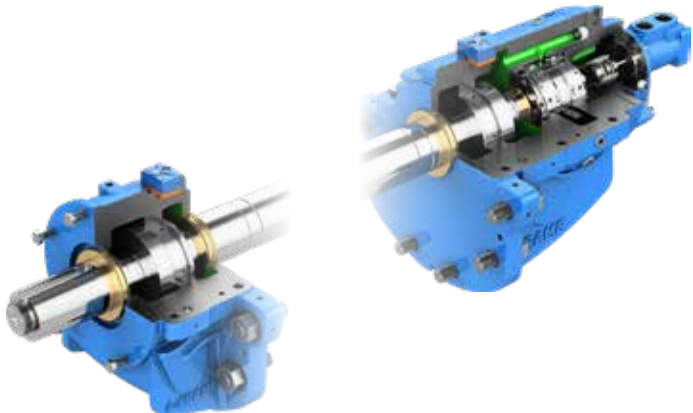
Interstage bleedoff available for multiple discharge conditions



Ball / Ball



Sleeve / Ball



Sleeve / Tilt



# 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.

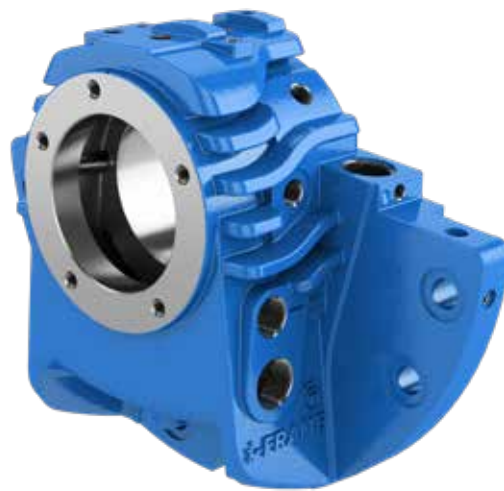
Bearing housings constructed in ASTM A216 Grade WCB carbon steel. Three bearing arrangements available:

- Ball/Ball bearings
  - 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
  - Deep Groove Ball Bearing on the Drive End (DE) to handle radial loads
- Sleeve/Ball bearings
  - Duplex 40° Angular contact Bearing Set on the Non-Drive End (NDE) handle axial loads. Bearing set is supplied with a light clearance.
  - Babbitt lined Sleeve Bearings handle radial loads on NDE and DE (Non Drive End and Drive End)
- Sleeve/Tilt pad bearings
  - Babbitt lined Sleeve Bearings handle radial loads and are installed on NDE and DE (Non Drive End and Drive End).
  - Tilting pad Bearings are installed on NDE to handle axial load.
  - This bearing configuration utilizes an external pressurized LOS to lubricate and cool the bearings. Both API, standard and custom designed systems can be offered.

All bearing housings feature a 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 housings, resulting in reduced vibration.

The bearing housing exterior includes distinctive cooling fins optimized by CFD/FEA analysis to aid in heat dissipation.

The Ball/Ball and Sleeve/Ball 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. The NDE side comes 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 and installation.



Bearing housing put through rigorous testing.

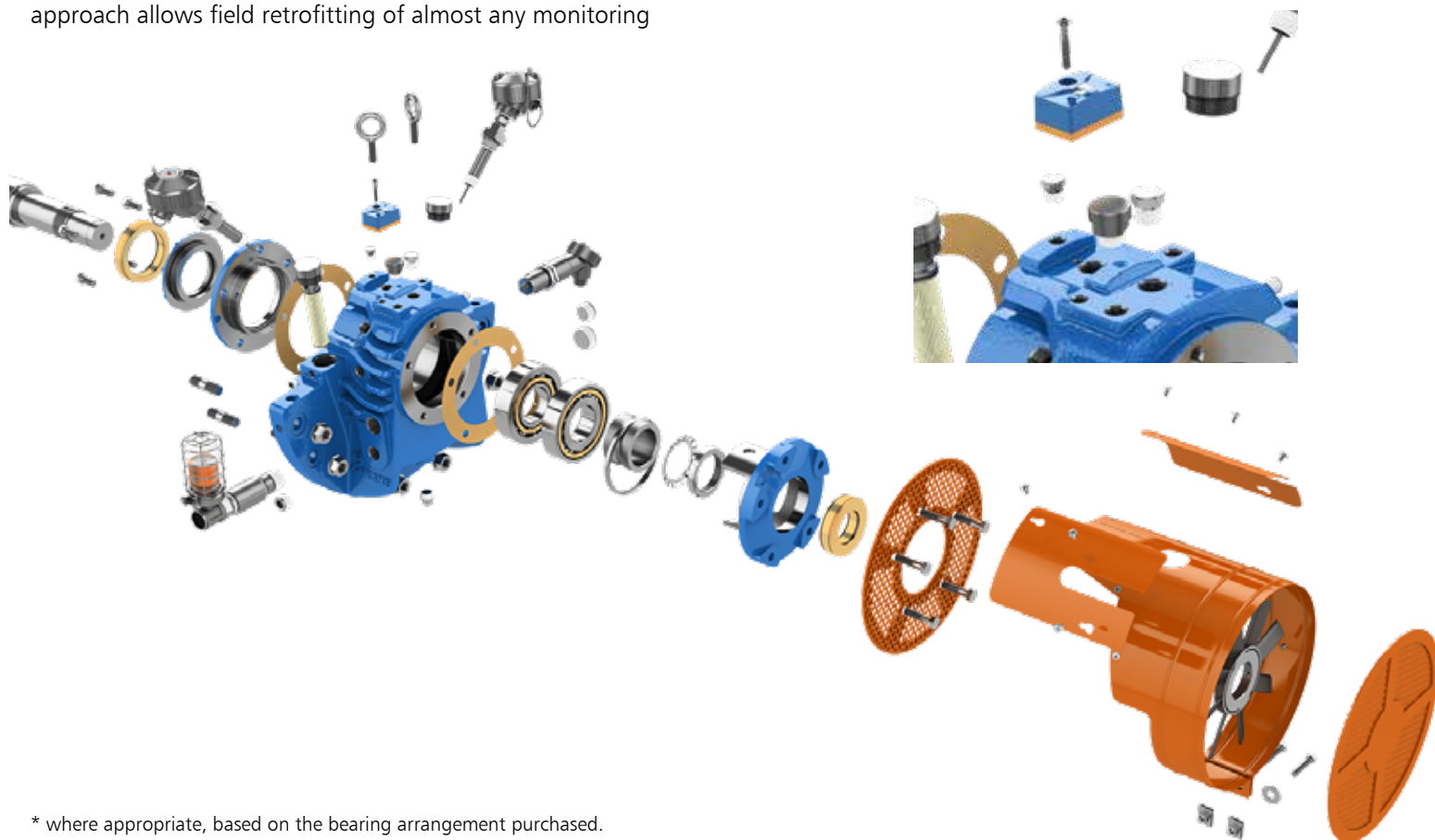


Bearing oil contamination by wind-blown sand and dust together with atmospheric moisture are major contributors to bearings failing well before their design life. In an industry first, all self-contained bearing housings include a cartridge filter assembly that will help safeguard the bearing oil from 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.



\* where appropriate, based on the bearing arrangement purchased.

# i-ALERT<sup>®</sup> Monitoring Solution

## Sensor | App | Ai Platform

www.i-alert.com



### What it Does:

#### Monitor

Tracks vibration, temperature & run-time hours 24/7/365.

#### Alarm

Takes high resolution data when an alarm condition occurs and stores it for later analysis.

#### Trend

Captures data every 1-60 minutes and has up to 170 days of hourly on-board storage.

#### Analyze

Diagnose machine faults with vibration tools  
Fast Fourier Transform (FFT) & Time Wave Form Analysis.

#### Environment

Rated for any industrial environment. water & dust resistant.  
Intrinsically Safe with a 3-year battery life (use dependent).

- ATEX Zone 0 AEx ia IIB Ga (Groups C & D)

#### Wireless

Sync data via Bluetooth Smart enabled smartphones and tablets.

#### Online Monitoring

Monitor and manage all of your i-ALERT enabled machines in one place - i-ALERT Ai Online Platform. This subscription service requires no software to download or dedicated hardware to run.



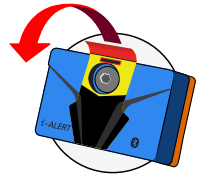
Spend less time collecting data and more time fixing problems. The i-ALERT mobile app has the ability to scan multiple i-ALERT2 sensors within range to quickly and safely inspect multiple machines.



### How it Works:

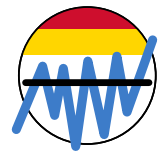
#### 1. ACTIVATE

The i-ALERT2 devices are light activated by removing the sticker. The sensor begins wirelessly broadcasting once activated.



#### 2. AUTO CONFIGURATION

The i-ALERT device averages the vibration over 25 hours of run-time and sets the alarm levels to 2 x average (0.1-1.5ips minimum). Temperature alarm default to 80°C (176°F)



OR

#### 2. MANUAL CONFIGURATION

User manually sets the alarm thresholds via the i-ALERT mobile application.



#### 3. Monitor

The i-ALERT2 sensor is configurable to check every 1-5 minutes. If two consecutive readings are above alarm threshold the i-ALERT device will go into alarm.



#### Dashboard

Simple, intuitive dashboard to track vibration, temperature, run-time & battery life.



#### Trending

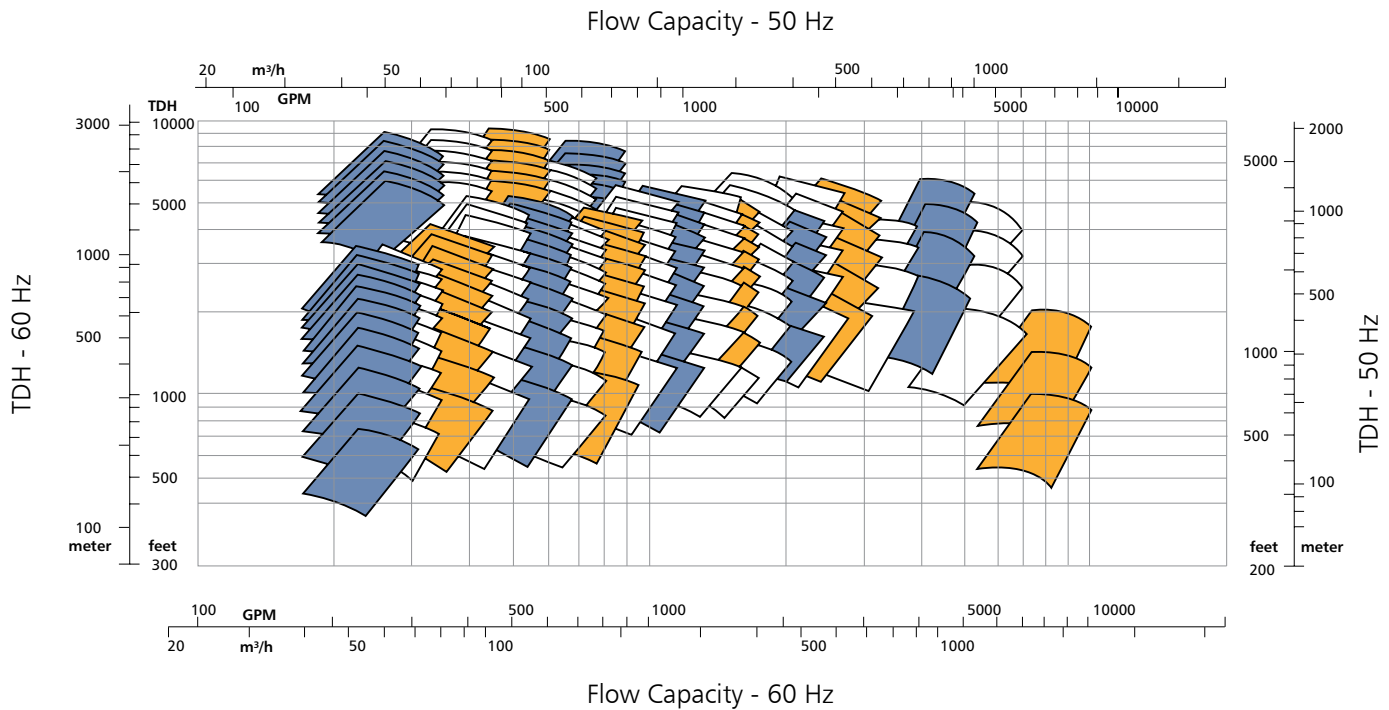
Trend vibration, temperature, & kurtosis to monitor any changes in the equipment operation.



#### BOM

Load the as built of materials based on the pump serial number.

## 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.





# 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



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



Model 3600  
BB-3



Model 7200CB  
BB-5



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B.3600.en-US.2019-08