Durco®
Mark 3™
ANSI Chemical Process Pumps

Mark 3 Standard
Sealmatic
Lo-Flo
Recessed Impeller
Unitized Self-Primer

Bulletin PS-10-13 (E)
Flowserve is the driving force in the global industrial pump marketplace. No other pump company in the world has the depth or breadth of expertise in the successful application of pre-engineered, engineered and special purpose pumps and systems.

**Pumping Solutions**
Flowserve is providing pumping solutions which permit customers to continuously improve productivity, profitability and pumping system reliability.

**Market Focused Customer Support**
Product and industry specialists develop effective proposals and solutions directed toward market and customer preferences. They offer technical advice and assistance throughout each stage of the product life cycle, beginning with the inquiry.

**Dynamic Technologies**
Flowserve is without peer in the development and application of pump technology, including:
- Hydraulic engineering
- Mechanical design
- Materials science
- Intelligent pumping
- Manufacturing technology

**Broad Product Lines**
Flowserve offers a wide range of complementary pump types, from pre-engineered process pumps, to highly engineered and special purpose pumps and systems. Pumps are built to recognized global standards and customer specifications.

- Single stage process
- Between bearing single stage
- Between bearing multistage
- Vertical
- Submersible motor
- Rotary
- Reciprocating
- Nuclear
- Specialty
The Premier Name in ANSI Chemical Process Pumps

The Mark 3 family of ANSI chemical process pumps offers a wide range of configurations including mechanically sealed, dynamically sealed, low-flow, self-priming and recessed impeller pumps. The Mark 3 family, therefore, provides flexibility and breadth of pumping solutions in countless applications throughout the worldwide process industries.

Applications
- Acid transfer
- Brine
- Chemical processing
- Petrochemical processing
- Corrosive services
- Food and beverage processing
- Hydrocarbon processing
- Pharmaceuticals
- Polymers
- Pulp and paper
- Sea water
- Slurries
- Solvents
- Steel and primary metals
- Water and wastewater treatment

Complementary Pumps
- CPX ISO chemical process pump
- Mark 3 ANSI in-line chemical process pump
- Guardian magnetic drive chemical process pump
- PolyChem M-Series ANSI and ISO fluoropolymer lined magnetic drive pumps
- PolyChem S-Series ANSI and ISO fluoropolymer lined chemical process pumps
- GRP ANSI engineered polymer composite chemical process pump
- FRBH heavy-duty paper stock and process pump

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World Renowned for Reliability and Performance

The Flowserve Durco Mark 3 pump is recognized worldwide as the premier name in ANSI chemical process pumps. Conforming to ANSI B73.1 and incorporating advanced design features, the rugged Mark 3 standard pump provides unmatched performance and reliability.

Operating Parameters
- Flows to 1680 m³/h (7400 gpm)
- Heads to 215 m (700 ft)
- Pressures to 27 bar (400 psi)
- Temperatures from -73°C (-100°F) to 370°C (700°F)

Unique Reverse Vane Impeller is the only impeller design that offers repeatable pump performance throughout the life of the pump. Open impellers available

SealSentry™ Seal Chambers feature unique flow modifiers to extend seal life and provide advanced self-flushing capability

External Micrometer Impeller Adjustment accurately sets impeller clearance in 20 seconds, in the shop or the field

Largest Shaft and Bearing Components in standard ANSI pumps extends bearing life and reduces shaft deflection and vibration
Truist Running ANSI Pump
The Mark 3 standard pump is engineered with four precision machined metal-to-metal fit locations – more than any other manufacturer.
- Precision machined metal-to-metal bearing carrier reduces tolerance stack-ups to improve shaft concentricity
- Superior to jackscrew designs which can cause cocking
- Extends bearing and mechanical seal life

Reliability and Performance Enhancing Features
- Precision investment cast reverse vane impeller offers low, predictable seal chamber pressure and repeatable pump performance
- External micrometer impeller adjustment reduces maintenance time and restores pump efficiency

SealSentry family of seal chambers features unique flow modifiers (FM) designed to extend mechanical seal life and increase pump reliability.
- Improves mechanical seal performance and reliability
- Permits use of less expensive seal and flush plan technology
- Improves pump reliability
- Vaalar Award winning design

Choice of Power Ends
- Standard Mark 3A power end with double lip oil seals and top vent/breather
- ANSI 3A™ power end (shown on page 8) featuring Inpro VBXX bearing isolators and a lifetime warranty
The 30 pumps in the Mark 3 family are built with only three different power frames.

SealSentry provides a choice of five different seal chamber options to best meet your specific needs.

Pumps delivered worldwide are manufactured in ISO 9001 certified Flowserve facilities.

Mark 3 Interchangeability

Mark 3 Standard Group 1

Mark 3 Standard Group 2

Mark 3 Standard Group 3

PROS+ proposal and order system is the most comprehensive and user friendly pump selection program in the industry. This software ensures correct sizing and selection of Flowserve pumps to best suit your process application needs.

Pros+ is available from your local sales representative or on-line at www.flowserve.com.
Flowserve offers a choice of power ends: the standard Mark 3A or the optional ANSI 3A™ (shown below).

**Standard Mark 3A Power End**
- Double row angular contact outboard/single row, deep groove inboard bearings for excellent axial and radial load support
- External micrometer impeller adjustment
- Double lip oil seals
- Top mounted vent and oil filler
- Constant level oiler
- Large 25 mm (1 in) diameter reflective sight glass
- Optional magnetic drain plug
- Optional oil slinger

**ANSI 3A Power End**
The ANSI 3A power end is so advanced it carries a lifetime warranty*.
- Certified clean room assembly
- Inpro/Seal’s VBXX non-contact Vapor Block Bearing Isolators keep lubricants in and contaminants out
- Top vent replaced with plug

* Note: Adherence to proper installation, operation and maintenance procedures is necessary for lifetime warranty. Contact your Flowserve representative for detailed terms and conditions.

**Unique, External Micrometer Impeller Adjustment** enables accurate impeller clearance setting in 20 seconds
- Superior to jackscrews
- Protected with O-rings

**Metal-to-Metal Construction** assures a true running and concentric shaft, extending bearing and mechanical seal life

**Critical Shaft Surfaces**
- Round to 0.4 micron (16 µin) finish to ensure secondary sealing ability of the mechanical seals

**Lubrication options**
- Oil mist systems
- Shielded and grease lubricated bearings (three-year bearing guarantee)
- Rigid foot design

**Ductile Iron Frame Adapter** meets ANSI B73.1

**Pump Division**

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The Heart of the Pump: Shaft and Bearing Design

Flowserve offers the largest shaft and bearing components available in standard ANSI pumps. The following comparison of a Mark 3 Group 2 power end with that of a major competitor demonstrates the benefits of heavy-duty design.

### Table 1 Bearing Comparison

<table>
<thead>
<tr>
<th>Group II</th>
<th>I.B. Bearing</th>
<th>Dynamic Load Rating (kg)</th>
<th>O.B. Bearing</th>
<th>Dynamic Load Rating (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flowserve</td>
<td>6310</td>
<td>6078 (13 400 lb)</td>
<td>5310</td>
<td>8709 (19 200 lb)</td>
</tr>
<tr>
<td>Major Competitor</td>
<td>6309</td>
<td>5398 (11 900 lb)</td>
<td>5309</td>
<td>7439 (16 400 lb)</td>
</tr>
</tbody>
</table>

### Bearsings (see Table 1)
Greater load handling rating means extended bearing life.

Extended bearing life comparison is the ratio of the load ratings to the third power or:

\[
I.B. = \frac{6078^3}{5398} = 1.43 \quad (+43\%)
\]

\[
O.B. = \frac{8709^3}{7439} = 1.61 \quad (+61\%)
\]

### Table 2 Deflection Comparison

<table>
<thead>
<tr>
<th>Group II</th>
<th>Overhang Length (mm)</th>
<th>Solid Shaft Diameter (mm)</th>
<th>Deflection Index</th>
<th>Shaft Dia. w/sleeve (mm)</th>
<th>Deflection Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flowserve</td>
<td>189 (7.867 in)</td>
<td>48 (1.875 in)</td>
<td>37</td>
<td>38 (1.5 in)</td>
<td>90</td>
</tr>
<tr>
<td>Major Competitor</td>
<td>213 (8.375 in)</td>
<td>45 (1.75 in)</td>
<td>63</td>
<td>38 (1.5 in)</td>
<td>116</td>
</tr>
</tbody>
</table>

### Shafts (see Table 2)
Solid shafts are recommended over shaft sleeves because they reduce the harmful effects of deflection and vibration. While shaft sleeves may simplify maintenance, solid shafts reduce it.

Proper selection of wet-end materials of construction and mechanical seal design offset positive features of the shaft sleeve option.

The formula \( I = L^2/D \) offers an index of deflection to compare pump designs where:

- \( I \) = index of deflection
- \( L \) = length of shaft overhang from bearing
- \( D \) = rigid shaft diameter

Note: The Deflection Index provides an approximate comparison of shaft stiffness. A detailed analysis should be made to determine actual shaft deflection.

Unique External Micrometer Impeller Adjustment reduces maintenance time and, most importantly, is precisely accurate.
Advanced Mark 3 SealSentry Design Technology

SealSentry chambers maximize seal life, reduce pump operating costs and improve pump reliability.

- Extend seal life
  - Self-flushing
  - Self-venting
  - Self-draining
- Reduce maintenance and repair costs
- Permit use of less expensive seals and flush plans
  - Flush plans 11, 32, 52, 53, etc. can be eliminated
- Increase mechanical seal life
- Provide a safer environment for personnel

Flow Modifiers (FM) Extend Mechanical Seal MTBPM

- Flow modifiers redirect flow from circumferential to axial
- Balanced flow with low pressure drop in the chamber helps keep solids in suspension, minimizing erosion
- The mechanical seal creates a centrifuging action away from its parts
- Solids and slurry merge into the returning flow path and are flushed out of the seal chamber

Available Jacketed Seal Chambers are designed for effective heat transfer in the seal chamber area or across the entire surface area of the process fluid.

- Use the jacketed cylindrical bore when seal chamber cooling is the objective
- Use the jacketed FM seal chamber when protection of the process temperature is important

Mark 3 SealSentry Chambers

Flowserve

Jacketed Seal Chambers

CB

FM

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The SealSentry family of seal chambers offers three FM (flow modifier) and two cylindrical bore (CB) options.

**FML**
- Designed with a large gland bolt and gasket circles, the FML is preferred for most applications.
  - Single internal cartridge seals
  - Dual internal/external cartridge seals
  - Single internal component seals with flexibly mounted seats
  - Dual internal “true” tandem design cartridge seals

**FMS**
- Similar to the FML, the FMS accommodates seals with small gland bolt and gasket circles.
  - Single seals with all seat mounting configurations can be installed

**FMI**
- The FMI incorporates a cast-in integral gland.
  - Single internal, flexibly mounted seals
  - Sanitary-type applications
  - Utilizes sleeve for seal setting and fast installation

**CBL**
- Designed with an oversized cylindrical step bore, the CBL is ideal for seals with large gland bolt and gasket circles.
  - Dual internal component seals isolate the seal chamber from the process with external source flush
  - Single seal with throttle bushing and flush to boost pressure over flash point

**CBS**
- The CBS cylindrical bore seal chamber is designed for packing arrangements and conventional seals with small gland bolt and gasket circles.
Flowserve Durco reverse vane impellers deliver unequalled efficiency and performance. This exclusive impeller design extends bearing and seal life.

- **Low, Predictable Seal Chamber Pressure and Thrust Loads** resulting from back vane pumping action and balance holes
- **Lowest Required NPSH** of any standard pump
- **Rear Cover Plate Wear Surface** as the flow path exits the rear of the impeller. Abrasive wear is on the rear cover rather than the more expensive casing

**In-shop Impeller Adjustment** with the only impeller design that takes full advantage of the back pull-out feature. Since the critical running clearance is set between the rear of the impeller and the rear cover plate, both impeller and mechanical seal settings can be done in the shop, “on the bench,” instead of under adverse field conditions.

**Repeatable Performance Assurance** with the only impeller design that offers repeatable seal chamber pressures and bearing thrust loads.

**Exclusive Reverse Vane Impeller** with balance holes offers important performance enhancing, maintenance-reducing advantages.

**Front Vane Open Style Impeller** is fully inter-changeable with the reverse vane impeller. Excellent choice for fibrous, stringy materials and certain applications requiring high shear against the casing.

**Recessed Impeller** pumps offer excellent solids-handling capabilities. See page 28.

**Low Predictable Seal Chamber Pressure** means longer seal life

**Clearance** is set to the rear cover in the shop – not to the casing which is left in the piping

**Lowest Overall required NPSH of any standard pump**

**In-shop Impeller Adjustment** is practical as well as productive.

**Rear Cover** wear surface versus casing means lower replacement parts costs

**Radial Vane Impeller** is available for low-flow, high-head applications. See pages 22 and 23.
Reverse Vane Impeller

has only one set of pumping vanes and one critical tolerance location—between the impeller and rear cover—to establish:
- Performance
- Efficiencies
- Seal chamber pressures
- Thrust/axial loads

Since an impeller can only be set in one direction, the reverse vane impeller has inherent advantages.

Only Flowserve Durco reverse vane impellers offer repeatable performance after wear and impeller adjustment.

Front Vane Open Style Impeller

has two sets of pumping vanes and two critical tolerance locations:
- The front vane of the impeller clearance to the casing establishes:
  - performance
  - efficiencies
- The impeller pump out vanes clearance to the rear cover establishes:
  - seal chamber pressures and seal life
  - thrust loads and bearing life

An impeller cannot be adjusted to two locations. Seal and bearing life are reduced due to increased loads after wear and maintenance adjustment.
Shaft Material Choices
Investment cast or high alloy bar stock available in a wide range of materials.

Flowserve recommends the use of solid shafts rather than shaft sleeves to reduce the harmful effects of deflection and vibration. Shaft sleeves may simplify maintenance but solid shafts reduce it.

Shaft Choices

- **Friction-Welded**: a steel power end friction-welded to a solid alloy wet end
- **Composite**: a steel shaft end-to-end with an integral (i.e., not replaceable) sleeve of DC8, SD77 high silicon iron, ceramic (alumina or zirconia)
- **Solid**: steel end-to-end or stainless alloy end-to-end
- **Hook Sleeve**: a steel shaft end-to-end or a steel power end friction-welded to a stainless wet end accommodating a hook sleeve

Mark 3 shafts and sleeves are designed to improve pump reliability.

- **1.** Radiused “sled-runner” keyways improve strength at this stress point.
- **2.** Offset keyways aid shaft balance.
- **3.** Critical surfaces ground to a surface finish of 0.4 micron (16 µ) ensure the secondary sealing ability of mechanical seals.
- **4.** Steel power ends handle higher horsepower loads than stainless.
- **5.** Accurate machining under bearings ensures perfect bearing fits without vibration or hot running.
- **6.** Run-out of <0.001 in (0.03 mm) at mechanical seal allows seal faces to run true.
- **7.** Alloy identification on every shaft and sleeve ensures that the right parts go in every time.
- **8.** Large radii fillets add strength.
- **9.** Minimally radiused edges ensure full contact with impeller for reduced run-out.
Specify genuine Mark 3 parts for your pump maintenance needs.

In addition to sure-bet maintenance savings only Flowserve offers:
- Parts that are guaranteed to fit...to last... and to perform
- Lifetime casting guarantee
- Quality assured safety for operating and maintenance personnel
- Off-the-shelf availability from a computer-linked network
- Machining and modification service for special orders
- 24-hour emergency service
- Application and materials expertise
- Complete analysis of your maintenance needs with recommended parts inventory

Flowserve foundries are widely regarded as among the best in the world pouring alloys from ductile iron to stainless steels to light reactive alloys such as titanium. All wet-end Mark 3 castings carry a limited lifetime guarantee.

Attesting to the world-class quality of its castings, Flowserve was the first high alloy foundry in the United States of America to have earned approval by Germany’s Technischer Überwachungs Verein (TUV).

### Flowserve Durco Alloy Materials

<table>
<thead>
<tr>
<th>Designation</th>
<th>Symbol</th>
<th>ACI Designation</th>
<th>Equivalent Wrought Designation</th>
<th>ASTM Specifications*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ductile Iron</td>
<td>DC1</td>
<td>None</td>
<td>None</td>
<td>A395</td>
</tr>
<tr>
<td>Carbon Steel</td>
<td>DS</td>
<td>None</td>
<td>Carbon Steel</td>
<td>A216 Gr. WCB</td>
</tr>
<tr>
<td>CF-8M</td>
<td>D4</td>
<td>CF8M</td>
<td>316</td>
<td>A744, Gr. CF-8M</td>
</tr>
<tr>
<td>Durcomet 100</td>
<td>CD4M</td>
<td>CD4MgN</td>
<td>Ferralium® 255</td>
<td>A995, Gr. 1B</td>
</tr>
<tr>
<td>Durimet 20</td>
<td>D20</td>
<td>CN7M</td>
<td>Alloy 20</td>
<td>A744, Gr. CN-7M</td>
</tr>
<tr>
<td>Durcomet 5</td>
<td>DV</td>
<td>None</td>
<td>None</td>
<td>A494, Gr. CY-40</td>
</tr>
<tr>
<td>CY-40</td>
<td>DYN</td>
<td>CY40</td>
<td>Inconel® 600</td>
<td>A494, Gr. M-35-1</td>
</tr>
<tr>
<td>M-35</td>
<td>DM</td>
<td>M351</td>
<td>Monel® 400</td>
<td>A494, Gr. C-276</td>
</tr>
<tr>
<td>Nickel</td>
<td>DNI</td>
<td>CS100</td>
<td>Nickel 200</td>
<td>A494, Gr. C-100</td>
</tr>
<tr>
<td>Chlorimet 2</td>
<td>DC2</td>
<td>N7M</td>
<td>Hastelloy® B-2</td>
<td>A494, Gr. N-7M</td>
</tr>
<tr>
<td>Chlorimet 3</td>
<td>DC3</td>
<td>CW6M</td>
<td>Hastelloy® C-276</td>
<td>A494, Gr. CW-6M</td>
</tr>
<tr>
<td>Duriron™</td>
<td>D</td>
<td>None</td>
<td>None</td>
<td>A518, Gr. 1</td>
</tr>
<tr>
<td>Durichlor 51™</td>
<td>D51</td>
<td>None</td>
<td>None</td>
<td>A518, Gr. 2</td>
</tr>
<tr>
<td>Superchlor®</td>
<td>SD77</td>
<td>None</td>
<td>None</td>
<td>A518, Gr. 3</td>
</tr>
<tr>
<td>DC-8</td>
<td>DC8</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Titanium</td>
<td>Ti</td>
<td>None</td>
<td>Titanium</td>
<td>B367, Gr. C-3</td>
</tr>
<tr>
<td>Titanium-Pd</td>
<td>Ti-Pd</td>
<td>None</td>
<td>Titanium-Pd</td>
<td>B367, Gr. C-8A</td>
</tr>
<tr>
<td>Zirconium</td>
<td>Zr</td>
<td>None</td>
<td>Zirconium</td>
<td>B752, Gr. 702C</td>
</tr>
</tbody>
</table>

*Alloys conform to the chemical and mechanical requirements of the latest edition of the ASTM specification.

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Extend Pump and Seal Life at Reduced Cost

Flowserve offers five pre-engineered baseplate designs to improve pump performance and reduce costs (see page 17). Flowserve pre-engineered baseplates extend pump and seal life by reducing internal pump stress and vibrations. That is why Flowserve recommends reinforced rigid baseplates.

Plus, customers who know the value of pre-engineered and reinforced baseplates help avoid potential confusion in specification interpretation, delays in shipments and added costs.

Flowserve offers a broad range of metal and non-metallic, grout and stilt mounted designs and standard options. This provides broad flexibility in choosing the baseplate that best meets application needs and operating budget.

---

### Mark 3 Pre-Engineered Baseplate Designs

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Standard Options</th>
<th>Type A Gp 1 &amp; 2</th>
<th>Type B Gp 3</th>
<th>Type C</th>
<th>Type D Type D with Rim</th>
<th>Type E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Machined coplanar mounting surfaces to 0.17 mm/m (0.002 in/ft) with 3.2 micron (125 µ in) finish</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>2</td>
<td>Added structural (cross member) support</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>3</td>
<td>Added torsional support with end caps</td>
<td>NR</td>
<td>Y</td>
<td>Y</td>
<td>D</td>
<td>O</td>
</tr>
<tr>
<td>4</td>
<td>Tapped holes for four (4) motor adjuster bolts</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>Y</td>
<td>O</td>
</tr>
<tr>
<td>5</td>
<td>Four (4) - SS transverse jack bolts - motor adjusters</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>Y</td>
<td>O</td>
</tr>
<tr>
<td>6</td>
<td>Sloped surface to an integral drain</td>
<td>N</td>
<td>N</td>
<td>C</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>7</td>
<td>Integral sloped drip rim around base</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>8</td>
<td>102 mm (4 in) diameter grout holes - max. 762 mm (30 in) run to vent</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>9</td>
<td>15 mm (1/2 in) vent holes at corner of each chamber</td>
<td>NR</td>
<td>O</td>
<td>NR</td>
<td>NA</td>
<td>Y</td>
</tr>
<tr>
<td>10</td>
<td>Lower surface shaped to anchor in grout</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>NA</td>
<td>Y</td>
</tr>
<tr>
<td>11</td>
<td>Integral lifting eyes at four (4) corners</td>
<td>O</td>
<td>Y</td>
<td>O</td>
<td>O</td>
<td>Y</td>
</tr>
<tr>
<td>12</td>
<td>Tapped leveling holes four (4) corners</td>
<td>O</td>
<td>O</td>
<td>N</td>
<td>S</td>
<td>Y</td>
</tr>
<tr>
<td>13</td>
<td>Continuous seam weld construction</td>
<td>NA</td>
<td>Y</td>
<td>NA</td>
<td>O</td>
<td>Y</td>
</tr>
<tr>
<td>14</td>
<td>Welded raised lip around grout hole(s)</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NA</td>
<td>NR</td>
</tr>
<tr>
<td>15</td>
<td>Stilt mounting options with floor cups</td>
<td>NR</td>
<td>NR</td>
<td>O</td>
<td>Y</td>
<td>D</td>
</tr>
<tr>
<td>16</td>
<td>Spring mounted load designs</td>
<td>NA</td>
<td>NA</td>
<td>O</td>
<td>O</td>
<td>D</td>
</tr>
<tr>
<td>17</td>
<td>Catch basin (304SS or other materials)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>NR</td>
</tr>
<tr>
<td>18</td>
<td>Option for eight (8) total motor adjusters</td>
<td>D</td>
<td>D</td>
<td>O</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>19</td>
<td>Dimensions to ANSI B73.1</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

Y = Standard  N = Not available  NR = Not recommended  O = Optional  NA = Not applicable  C = Sloped catch basin with 25 mm (1 in) drain (option)  D = Needs design time  S = Stilts for leveling

See page 17 for model descriptions
Flowserve offers a family of five types of pre-engineered baseplate designs to extend pump life and reduce costs.

**Reducing Internal Stress and Vibration Extends the Life of Pump and Motor Packages**
Pump users specify rigid baseplate designs to:
- Provide torsional lateral and longitudinal rigidity
- Improve vibration dampening
- Protect against transit damage
- Resist twisting during installation
- Maintain shaft alignment
- Reduce installation and shaft alignment time
- Reduce diaphragming or separation from grout
- Improve pump, motor and seal reliability
- Reduce total life cycle pump, motor and seal costs

**Rigid Design Begins With Thick Plate Construction**
Metal baseplate sizes:
- 139 to 258 feature 13 mm (1/2 in) steel plate construction
- 264 to 280 feature 16 mm (5/8 in) steel plate construction
- 368 to 398 feature 19 mm (3/4 in) steel plate construction

Polybase baseplates are constructed of 76 mm (3 in) to 102 mm (4 in) solid polymer concrete. Baseplate types B, C, D and E are reinforced with added structural support for improved rigidity.
Polybase™ Solid Polymer Concrete Baseplate

Polybase™ and Polybloc™ Solid Polymer Concrete Adjustment System

Polybase
- Low installed cost
- Superior vibration dampening
- Corrosion resistant
- Superior resistance to twisting or diaphragming
- Optional catch basin and grout holes
- Inserts available for alternate equipment configuration requirements

Polybloc – Motor Mounting Block
- Flatter and more repeatable height tolerances than steel
- Corrosion resistant
- Superior vibration dampening
- Full foot support (no overhang)
- Shown with optional bloc-lock and fastener support
- Available for other pump and motor or alternate equipment applications

Baseplates are Fundamental to Extending Pump Life
The test stand provided three corner support of the ungrouted baseplates. The addition of weights on the unsupported fourth corner caused baseplate distortion. This distortion resulted in measurable shaft movement that can cause problems with field installations and negatively affect pump reliability and life.

The twist test is a means of comparing rigid baseplate designs. Correctly installed rigid baseplates should not experience these twist effects. For more information about the results of baseplate testing contact your local Flowserve sales representative.

Baseplate Rigidity Test – Twist Mode

<table>
<thead>
<tr>
<th>Load - lb (kg)</th>
<th>Deflection – inch (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.000 (0.00)</td>
</tr>
<tr>
<td>100</td>
<td>0.010 (0.25)</td>
</tr>
<tr>
<td>200</td>
<td>0.020 (0.51)</td>
</tr>
</tbody>
</table>

Maximum Parallel Shaft Deflection at Applied Force

<table>
<thead>
<tr>
<th>Type</th>
<th>Deflection</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.022 in (0.56 mm)</td>
</tr>
<tr>
<td>B</td>
<td>0.004 in (0.01 mm)</td>
</tr>
<tr>
<td>C</td>
<td>0.003 in (0.08 mm)</td>
</tr>
<tr>
<td>D</td>
<td>0.016 in (0.41 mm)</td>
</tr>
<tr>
<td>E</td>
<td>0.005 in (0.13 mm)</td>
</tr>
</tbody>
</table>

Vibration Damping of Polymer Concrete Versus Cast Iron

8-Point Adjuster
- Allows precise motor adjustment to reduce alignment time
- Used with recessed bloc-lock device

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The Polyshield Baseplate and Foundation System is the superior solution for cost-effective, high-performance pump installation. In one complete unit, it combines a traditional baseplate with a formed concrete foundation for pump-drive sets.

Benefits of Selecting the Polyshield Baseplate and Foundation System
• Time savings
  – Quick installation time
  – Reduces time span from receipt at jobsite to commissioning
• Cost savings
  – Reduces total installed cost
  – Dramatically minimizes field rework necessary to meet specifications
• Better performance and reliability
  – Extended pump life
  – Reduced vibration
  – Improved corrosion resistance
• Single structure convenience
  – One-piece construction
  – Flat mounting surfaces
  – One-piece motor mounting block

The Polyshield baseplate and foundation system can be combined with numerous pump designs, including:
• ISO and ANSI metallic and non-metallic
• Foot- and frame-mounted general industrial
• Foot-mounted between bearings
• API 610

Please see Bulletin PS-90-2 for more complete product information.

The Mark 3 offers unique design technologies and component options with superior pump application, installation, process and selection knowledge. These extend pump performance and increase reliability. Certain applications need technical advancement in pump design and performance-enhancing options for continued reliability.

**Centerline Mounted Casings** may be used to reduce loads caused by thermal expansion. Jacketed feet with inlet and outlet ports further ensure effective temperature control.

**Jacketed Casings** provide temperature control. Integral (shown) and bolt-on jackets available.

**Ultralign™ Heavy-Duty, Rigid Design C-Flange Adapter**
- Cantilevered motor shaft stays aligned with pump shaft even with undesirable movement caused by piping and temperature induced stress
- Eliminates foot mounting of motor and pump power end to the base, reducing soft foot, twisting and diaphragming problems
- 0.18 mm (0.007 in) nominal parallel shaft alignment 0.05 mm (0.002 in) with C-Plus precision alignment option
- <0.001 mm/mm (0.001 in/in) angular alignment

**Adjustable Rigid Foot Mount** is designed to support all normal loads and ensures accurate alignment to the baseplate and piping.

**Unique C-Plus Precision Alignment System (Four Point)** routinely delivers shaft alignments below 0.05 mm (0.002 in) in less than 30 minutes.

**Available Stilt Mounted Baseplate** provides relief of external pipe loads by allowing the assembly to move to the point of least resistance.
- Stilts can allow for improved pump alignment to process pipe
- Spring load option absorbs vibration and reduces need for pipe loops or expansion joints
ClearGuard and DurcoShield Non-metallic Safety Guards

ClearGuard and DurcoShield pump guards permit visual inspection of coupling and seal areas, respectively, while protecting personnel from potential safety hazards of rotating parts. Constructed of tough, durable, and transparent polycarbonate with UV light inhibitors, they are designed to withstand tough chemical processing environments.

ClearGuard Non-metallic Coupling Guard meets machinery guard safety guideline. Nothing larger than 6 mm (0.24 in) in diameter can enter the shell. Furthermore, the ability to inspect the coupling through ClearGuard can provide early warning of deteriorating or malfunctioning components.

DurcoShield* Splash and Shaft Guard is a one-piece shield that envelopes the open areas between the bearing housing and casing. Suitable for applications to 150°C (300°F), DurcoShield protects users from:
- Process fluid spray
- Rotating shaft and seal components

Note: DurcoShield is not a containment system or a seal backup system. It is a limited protection device. It will reduce, but not eliminate, the probability of injury.

*Protected by US patent number 5,807,086
The Flowserve Mark 3 Lo-Flo pump is designed to improve pump reliability and performance in low-flow, high-head applications. The first pump manufacturer to introduce an ANSI standard low-flow, high-head pump, Flowserve developed its innovative radial vane impeller and circular, concentric casing to reduce radial loads and shaft vibration while extending bearing and mechanical seal life.

The Flowserve Mark 3 Lo-Flo pump conforms to ANSI B73.1 and is completely interchangeable with the industry-leading Mark 3A power end.

Operating Parameters
- Flows to 50 m³/h (220 gpm)
- Heads to 300 m (985 ft)
- Pressures to 31 bar (450 psi)
- Temperatures from -75°C (-100°F) to 370°C (700°F)

Mark 3 Lo-Flo™ Pump

Radial Vane Impeller provides improved performance over a broader application range

Circular Concentric Casing reduces radial loads and vibration and extends bearing and seal life

SealSentry™ Seal Chambers extend seal life and provide advanced self-flushing ability

External Micrometer Impeller Adjustment accurately sets impeller clearance in 20 seconds, in the shop or the field
Innovative Radial Vane Impeller has a unique twist to provide superior performance in low-flow, high-head conditions.

Circular Concentric Casing is more hydraulically efficient at lower flow rates. An internal bypass drilled in the discharge without breaching the casing wall or creating a potential leak path. This helps to balance pressures.

Improved Performance and Reliability
The innovative radial vane impeller and circular, concentric casing of the Flowserve Durco Lo-Flo pump improve pump performance and reliability when compared to standard pumps. Furthermore, maintenance is reduced.
- Reduced radial loads up to 90% at low-flow conditions
- Minimized thrust loads
- Reduced NPSH requirements
- Reduced shaft vibration
- Extended bearing life
- Extended mechanical seal life
- Broadened application range

Four Sizes
- 1K1.5x1LF-4
- 1K1.5x1LF-8
- 2K2x1LF-10
- 2K3x1.5LF-13
Offered in a wide range of metallurgy to meet application needs.

Choice of Power Ends
- Standard Mark 3A power end with double lip oil seals and top vent/breather
- ANSI 3A™ power end (see page 8) featuring Inpro VBXX bearing isolators and up to a lifetime warranty

Reduced Vibration
Shaft vibration is a critical factor in both bearing and mechanical seal life. Reducing shaft vibration results in significantly improved pump performance and reliability.
Dynamic Sealing
With the Flowserve Mark 3 Sealmatic pump, no mechanical seal is needed during operation. A dynamically sealing repeller (expeller) expels fluid from the seal chamber, making it ideal for hard to seal applications. Furthermore, the need for external flushing and process contamination control are eliminated.

The Sealmatic pump conforms to ANSI B73.1.

Applications
• Tough services where sealing is difficult
• Services where a flush is undesirable (e.g., evaporator feed)
• Continuous, around-the-clock applications
• Batch operations where a “run dry” condition might exist

Operating Parameters
• Flows to 1680 m³/h (7400 gpm)
• Heads to 230 m (750 ft)
• Pressures to 31 bar (450 psi)
• Temperatures from -75°C (-100°F) to 370°C (700°F)

Mark 3 Sealmatic Pump

External Micrometer Impeller Adjustment accurately sets impeller clearance in 20 seconds, in the shop or the field

SealSentry™ Seal Chambers extend seal life and provide advanced self-flushing ability

Standard Reverse Vane Impeller offers repeatable pump performance throughout the life of the pump

Spinning Expeller creates centrifugal force to expel fluid from the seal chamber

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Choice of Static Sealing Options

Flowserve provides a choice of static sealing options to keep the pump from leaking while the pump is stopped. They include:

- Flexible graphite packing
- Dry-running end-face seal
- Stationary fluoropolymer disk seal

Benefits of Sealmatic Dynamic Sealing Technology

- Eliminates the need for conventional mechanical seals
- Eliminates need for external flush and associated product dilution
- Eliminates need for contamination control

Seventeen Sizes

- Eleven Group 2
  - 2K2x1M-10A
  - 2K3x1.5M-10A
  - 2K3x2M-10A
  - 2K4x3M-10
  - 2K4x3M-10H
  - 2K6x4M-10
  - 2K6x4M-10H
  - 2K3x1.5M-13
  - 2K3x2M-13
  - 2K4x3M-13
  - 2K6x4M-13A

- Six Group 3
  - 3K8x6M-14A
  - 3K10x8M-14
  - 3K6x4M-16
  - 3K8x6M-16A
  - 3K10x8M-16
  - 3K10x8M-16H

Offered in a wide range of metallurgy to meet application needs.

Additional Configurations

The Sealmatic design also is available with a recessed impeller configuration.
High and Dry
The Flowserve Mark 3 Unitized Self-Priming pump is engineered to draw from liquid sources below ground level or from sources which have no positive pressure to naturally prime the pump. Conveniently located high and dry at ground level where installation is simple and maintenance is easily and more economically performed, the Mark 3 Self-Priming pump costs less to buy, install and maintain than submersible pumps.

The Mark 3 Self-Priming pump's compact design enables it to fit in tight clearance locations. It also can be mounted on a trailer for movement to various pumping locations, such as wastewater lagoon service.

Applications
- Sump service
- Tank car unloading
- Duplex pumping lift station
- Fly ash pond transfer
- Waste acid transfer
- Waste treatment lagoon service

Operating Parameters
- Flows to 320 m³/h (1400 gpm)
- Heads to 120 m (400 ft)
- Pressures to 20 bar (285 psi)
- Temperatures to 370°C (700°F)
- Static suction lift to 6 m (20 ft)

Mark 3 Unitized Self-Priming Pump

External Micrometer Impeller Adjustment accurately sets impeller clearance in 20 seconds, in the shop or the field

Standard Reverse Vane Impeller offers repeatable pump performance throughout the life of the pump

SealSentry™ Seal Chambers extend seal life and provide advanced self-flushing ability

Unitized Casing has large priming chamber, air separator and volute in one integral component. Eliminates the need for a separate priming tank.
The Priming Cycle
The Mark 3 Unitized Self-Priming pump uses liquid recirculation to prime the pump. The pressure differential between the aerated liquid at the impeller and the non-aerated liquid in the priming chamber creates a vacuum that pulls liquid up the pipe. As a result, the Mark 3 Unitized Self-Priming pump is ideal for suction lift applications or pumping liquids with entrained air or gases.

Benefits of the Mark 3 Unitized Self-Priming Pump
- Eliminates internal valves
- Eliminates external priming devices or foot-valves
- Portable
- Compact
- Ease of installation
- Ease of maintenance

Choice of Power Ends
- Standard Mark 3A power end with double lip oil seals and top vent/breather
- ANSI 3A™ power end (see page 8) featuring Inpro VBXX bearing isolators and a lifetime warranty

Eight Sizes
- Two Group 1
  1J1.5x1US-6
  1K1.5x1.5US-82
- Six Group 2
  2K2x1.5US-10A
  2K3x2US-10
  2K4x3US-10H
  2K3x2US-13
  2K4x3US-13
  2K6x4US-13A

Offered in a wide range of metallurgy to meet application needs.
Vortex Action
The Flowserve Mark 3 Recessed Impeller pump combines the best design features of the Mark 3 ANSI Standard pump with the vortex action of a recessed impeller. These specific purpose features along with thick wall wet-end components offer extended service life when handling solid, stringy or fibrous slurries.

Applications
- Light slurries
- Corrosive or erosive services
- Large diameter solids
- Waste streams
- Fluids with which shearing must be avoided
- Protection of solids integrity

Operating Parameters
- Flows to 455 m³/h (2000 gpm)
- Heads to 120 m (400 ft)
- Pressures to 20 bar (285 psi)
- Temperatures from -75°C (-100°F) to 370°C (700°F)
Benefits of the Mark 3 Recessed Impeller Pump
- Improved solids handling
- Improved air and gas handling
- Improved ability to pass fibrous or stringy substances
- Reduced wear
- Low NPSHR

Cylindrical Volute Casing
minimizes radial loads on the impeller. The result is longer seal life as well as maximized radial bearing life.

Vortex Pumping Action
The vortex created by the spinning impeller does the pumping with less than 20% of media contacting the impeller. Abrasive wear is minimized and solids integrity maintained.

Precision Cast Open Impeller
The Mark 3 Recessed Impeller pump comes standard with an open impeller that ensures peak energy efficiency and low NPSHR. The impeller incorporates pump-out vanes that ensure low, positive seal chamber pressure and expel solids from critical seal areas. Mechanical seal or packing life is maximized.

Choice of Power Ends
- Standard Mark 3A power end with double lip oil seals and top vent/breather
- ANSI 3A™ power end (see page 8) featuring Inpro VBXX bearing isolators and up to a lifetime warranty

Five Sizes
- One Group 1
  1J2x2R-6
  1K1.5x1.5US-82
- Four Group 2
  2K2x2R-10
  2K3x3R-10
  2K4x3R-13
  2K6x4R-13

Offered in a wide range of metallurgy to meet application needs.

Additional Configurations
The Mark 3 Recessed Impeller pump can be specified with the Sealmatic dynamically sealing expeller and as self-priming with priming tank option.
Without Equal

Designed to exceed ANSI B73.2 criteria, the Mark 3 In-Line process pump offers improved pump reliability and extended pump life. The space-saving Mark 3 In-Line has broad application in chemical and hydrocarbon processing as well as in general industry for services, including:

- Chemical transfer
- Heat transfer
- Liquid gases
- Storage
- Water
- Washdown and cleaning
- Condensate return
- Light slurries

Operating Parameters

- Flows to 370 m³/h (1630 gpm)
- Heads to 230 m (760 ft)
- Pressures to 24 bar (350 psi)
- Temperatures to 370°C (700°F)
- Motor sizes to 110 kW (150 hp)

Please see Bulletin PS-10-15 for more complete product information.
PolyChem S-Series Fluoropolymer Lined Chemical Process Pump

The non-metallic PolyChem S-Series chemical process pump conforms to ANSI B73.1, ISO 2858 and JIS drilling standards to meet global demands. Its PFA-lined wet end offers outstanding corrosion and temperature resistance.

Operating Parameters
- Flows to 420 m³/h (1860 gpm)
- Heads to 145 m (480 ft)
- Pressures to 17 bar (250 psi)
- Temperatures from -30°C (-20°F) to 150°C (300°F)

Please see Bulletin PS-10-17 for more complete product information.

GRP Engineered Polymer Composite Chemical Process Pump

The GRP glass reinforced vinyl ester chemical process pump conforms to ANSI B73.5. With corrosion resistance superior to more expensive, high alloy metals and costs closer to that of ductile iron, the GRP pump has proven to be the low-cost, long-term solution in corrosive applications.

Operating Parameters
- Flows to 2500 m³/h (11 000 gpm)
- Heads to 150 m (500 ft)
- Pressures to 17 bar (250 psi)
- Temperatures to 120°C (250°F)

Please see Bulletin PS-10-17 for more complete product information.
CPXS ISO Magnetic Drive Pump
The CPXS magnetic drive process pump conforms to ISO 2858 dimensional and ISO 5199 design criteria. It is CE marked and compliant with applicable European directives, such as ATEX.

Operating Parameters
• Flows to 420 m³/h (1850 gpm)
• Heads to 160 m (525 ft)
• Pressures to 25 bar (365 psi)
• Temperatures from -40°C (-40°F) to 370°C (700°F)

Guardian G & H Series Magnetic Drive Pumps
The Guardian magnetic drive pumps meet ANSI B73.1 dimensional standards and are available in 18 sizes. Offered in a wide range of corrosion-resistant materials, the Guardian magnetic drive pump is ideal for high temperature, leak-free applications.

Operating Parameters
• Flows to 375 m³/h (1650 gpm)
• Heads to 215 m (700 ft)
• Pressures to 24 bar (350 psi)
• Temperatures to 288°C (550°F)

PolyChem M-Series PFA-Lined Magnetic Drive Pump
The PolyChem M-Series fluoropolymer lined, magnetic drive pump meets ANSI B73.1, ISO 2858 and JIS drilling standards.

Operating Parameters
• Flows to 135 m³/h (600 gpm)
• Heads to 145 m (480 ft)
• Pressures to 17 bar (250 psi)
• Temperatures to 150°C (300°F)

Please see Bulletin PS-10-30 for more complete product information.
The KW941 Pump Power Monitor monitors and displays actual power to the pump, offering simultaneous protection from underload and overload operating conditions.

The KW941 helps to eliminate costly downtime and expensive pump repairs caused by:
- Dry running
- Pump overloads
- Cavitation
- Blocked lines
- Closed suction or discharge valves
- Excessive wear or rubbing

**Broad Application Range**
- Works on all pumps having steady (non-pulsating) loads: centrifugal; gear; turbine; ANSI; API; ISO; paper stock; sealed; mag drive; canned motor; self-priming
- One model for up to 600 hp (450 kW). Premium features for reliable protection
- Push buttons display horsepower or kilowatts; automatic conversion when switching displays
- Adjustable low power and high power set points protect pump from underload and overload operation. Alarms can be tripped or pumps shut down before damage occurs
- Adjustable trip delay timers filter out nuisance trips caused by temporary power fluctuations
- Adjustable start-up delay timer is particularly useful in self-priming applications
- 4 to 20 milliamp analog output facilitates remote displays, operator interface and output to PLC or DCS
- Two form C relay outputs for low and high power trips. Outputs can be used to shut down pump or trip alarms
- Automatic, manual and remote reset options for versatile operation

**Easy Setup and Calibration**
- Settings controlled from front panel push buttons; no internal adjustments, dip switches or potentiometers
- Large digital display for easy viewing and accurate settings
- One step calibration can be performed without operating pump. No need to run pump at off-operating conditions to calibrate power monitor
- Settings can be viewed or adjusted during normal pump operation

**The KW941 helps to eliminate costly downtime and expensive pump repairs caused by:**

- Dry running
- Pump overloads
- Cavitation
- Blocked lines
- Closed suction or discharge valves
- Excessive wear or rubbing

**By Sensing Power** and not just amperes, linear measurements are provided with the sensitivity to detect improper operation while eliminating unwanted nuisance trips

**Typical Low Flow/No Flow Pump Protection Zone**

**Power/Current**

- 0% Motor Load
- 100% Motor Load

- **Power**
- **Current**
- **Amperes**

**Easy Setup and Calibration**
- Settings controlled from front panel push buttons; no internal adjustments, dip switches or potentiometers
- Large digital display for easy viewing and accurate settings
- One step calibration can be performed without operating pump. No need to run pump at off-operating conditions to calibrate power monitor
- Settings can be viewed or adjusted during normal pump operation
Flowserve CPX and FRBH Process Pumps

CPX Family of ISO Chemical Process Pumps
The CPX family of ISO chemical process pumps offers a wide range of configurations including mechanically sealed, magnetic drive, self-priming, close-coupled and vertical pumps. Parts interchangeability among the configurations is a key benefit of the CPX family, translating into inventory and maintenance costs savings.

Operating Parameters
• Flows to 370 m³/h (1630 gpm)
• Heads to 230 m (760 ft)
• Pressures to 24 bar (350 psi)
• Temperatures to 370°C (700°F)
• Motor sizes to 110 kW (150 hp)

Please see Bulletin PS-10-30 for more complete product information.

FRBH Heavy-Duty Paper Stock and Process Pump
The FRBH is one of the world’s most efficient and reliable pumps – one that will perform effectively not only at the best efficiency point but across a broad operating range. The high efficiency and rugged construction of the FRBH translate into reduced operating costs.

Operating Parameters
• Flows to 6800 m³/h (30 000 gpm)
• Heads to 100 m (325 ft)
• Pressures to 14 bar (200 psi)
• Temperatures to 150°C (300°F)

Please see Bulletin PS-10-16 for more complete product information.
Global Engineered Services and Support

- Total Cost Reduction
- Asset Management
- Product Life Cycle
- Performance Re-rates
- Site Diagnostics
- Repair Services
- Energy Management
- Spare Parts
- Maintenance Contracts
- Materials Upgrades
- Turnkey Services
- Field Repairs
- Installation
- Project Supervision
- Commissioning
- Equipment Upgrades
- Condition Monitoring
- Systems Analysis
- Field Machining

Service Dedication
Flowserve Engineered Services is focused on providing customers with uncompromising service and support, where and when needed. Dedicated to delivering the highest quality support, Engineered Services integrates its extensive pump and materials engineering knowledge with creative service solutions. Engineered Services fully understands the business challenges facing customers and is prepared to manage solutions to succeed as a team.

A worldwide network of service and repair centers staffed by highly skilled engineers and technicians is available around the clock, seven days a week to respond to customer queries, to evaluate and troubleshoot problems and to provide reliable solutions.

Strength of Experience, Commitment to Excellence
Flowserve has long served industries requiring superior equipment performance and service life.
- Oil and gas production
- Hydrocarbon processing
- Chemical processing
- Water resources
- Power generation
- Nuclear
- Mining and mineral processing
- Pulp and paper
- General industry

Engineered Services is dedicated to maximizing equipment performance and providing reliability-centered maintenance programs for pumps and related equipment, regardless of manufacturer. Using the FlowStar™ asset management software, Engineered Services tracks performance and supports improvement programs using a service life cycle cost business approach. The results are improved reliability and increased profitability.

Business Partner
Flowserve partners with customers to respond to the dynamic business conditions that affect them. Flowserve will work with customers to drive efficiency, maximize throughput and control process quality. Whether user needs involve on-site technical assistance or broader project planning with full turnkey responsibility, Flowserve Engineered Services will deliver professional, reliable results.