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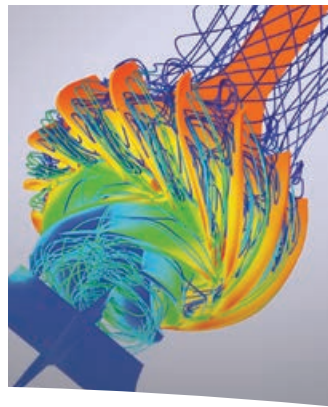
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Lawrence Pumps® VPL1700 **Multistage Vertical Toxic Liquid Pump**

Mechanical and Hydraulic Upgrades



Experience In Motion



Pump Supplier to the World

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.

Life Cycle Cost Solutions

Flowserve provides pumping solutions that permit customers to reduce total life cycle costs and 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 initial inquiry.

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.

Pump designs include:

- Single-stage process
- Between bearings single-stage
- Between bearings multistage
- Vertical
- Submersible motor
- Positive displacement
- Nuclear
- Specialty

Product Brands of Distinction

ACEC™ Centrifugal Pumps

Aldrich™ Pumps

Byron Jackson® Pumps

Calder™ Energy Recovery Devices

Cameron™ Pumps

Durco® Process Pumps

Flowserve® Pumps

IDP® Pumps

INNOMAG® Sealless Pumps

Lawrence Pumps®

Niigata Worthington™ Pumps

Pacific® Pumps

Pleuger® Pumps

Scienco™ Pumps

Sier-Bath® Rotary Pumps

TKL™ Pumps

United Centrifugal® Pumps

Western Land Roller™ Irrigation Pumps

Wilson-Snyder® Pumps

Worthington® Pumps

Worthington Simpson™ Pumps

Lawrence Pumps VPL1700

**Multistage Vertical Toxic
Liquid Pump**

VPL1700

The Flowserve VPL1700 pump is a vertical, top tank entry, bottom suction, toxic liquid pump.

Applications

- Chlorine
- Anhydrous hydrogen cyanide
- Phosgene
- Bromine
- Sulfur trioxide
- Other toxic liquids

Typical Operating Parameters

- Flows to 182 m³/h (800 gpm)
- Heads to 244 m (800 ft)
- Temperatures from -51°C (-60°F) to 52°C (125°F)

Complementary Pump Designs

Flowserve also can provide the following complementary pumps:

VTP – vertical turbine, wet-pit pump

VPL3200 – cantilever dry-run capable

VPL3300 – cantilever volatile organic compounds

VPL3400 – molten salt transfer

VPL3500 – single-stage vertical lineshaft ISO 13709/API 610 (VS4) compliant

VPL3600 – vertical lineshaft, slurry impeller custom shaft, ISO 13709/API 610 (VS4) compliant



VPL1700 Mechanical and Hydraulic Upgrades

With safety and reliability being of equal importance in the handling of toxic liquids, Flowserve offers upgrades that increase environmental and personnel safety during the production and distribution of toxic liquefied gases.

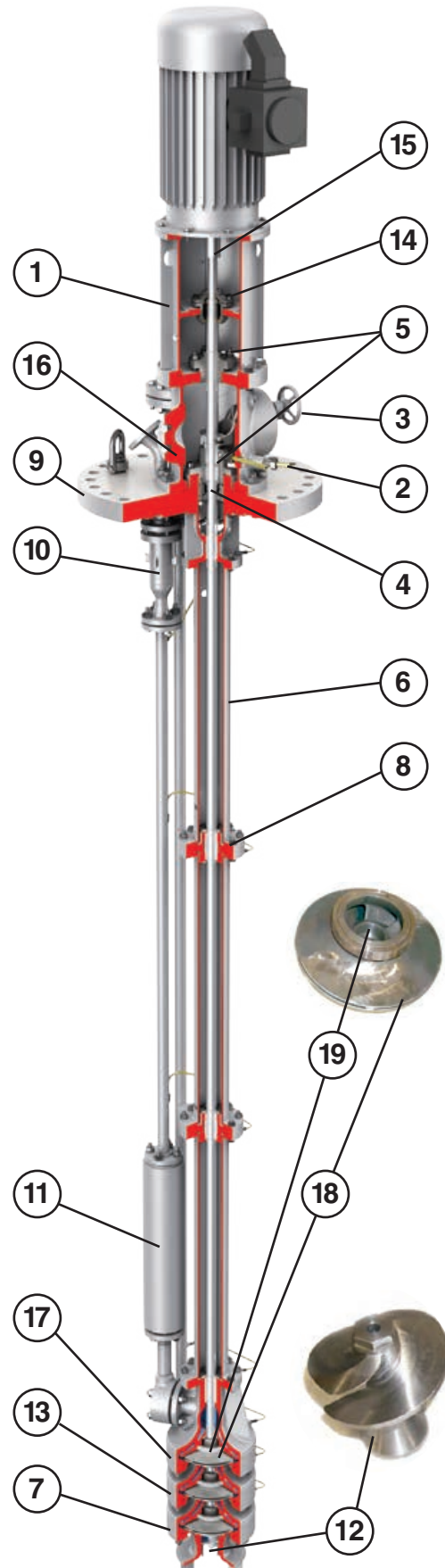
High-performance, cost-effective upgrades are available for Lawrence Pumps' complete line of VPL1700 vertical, top tank entry, bottom suction pumps. These upgrades increase operating reliability, reduce maintenance costs, and improve safety and performance.

Shaft and Sealing System Upgrades

1. **Vibration Monitoring** — transducers and proximity probes sense any changes in the mechanical operation.
2. **Temperature Monitoring** — thermocouples or RTD's for the bearings, mechanical seal, sleeve bearings, lower seal chamber or packing box send a signal notifying the operator of an excessive temperature in these areas.
3. **Adjustable Gland Mechanism** — permits remote packing adjustment external to the process environment.
4. **Emergency Seal** — located below the lower sealing element, isolating the storage vessel from the atmosphere should a packing or mechanical seal failure occur. An additional isolation seal can be added as part of the bearing frame maintenance kit; see page 6.
5. **Gas Mechanical Seals** — to replace packing or older seals for energy savings, lowest level of buffer gas consumption and fewer emissions. The seals employ state of the art, non-contacting seal face geometry, for a new level of sealing reliability over a wide range of operating pressures. Gas mechanical seals provide the lowest fugitive emissions without complex piping, instrumentation or regulation.

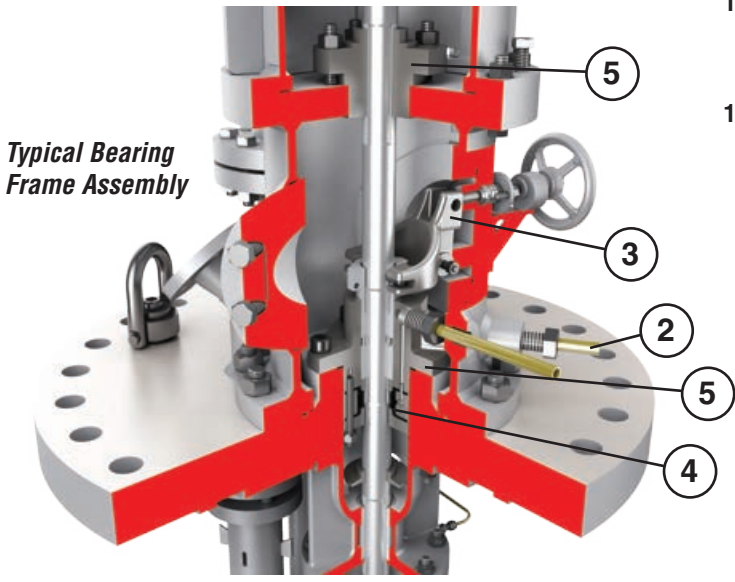
Material and Arrangement Upgrades

6. **Overall Pump Length Changes and Additional Stages** — for increased head output to accommodate system changes and/or for alternate tank use.
7. **High Alloy Wet Ends** — for corrosion and/or erosion prevention, low temperature and resistance to sparking.
8. **Ceramic/Intermetallic Wear Components** — for applications requiring high heat dissipation or wear resistance due to lack of lubrication or solids being present.
9. **ASME Code Stamped Mounting Plate** — available for pressure and toxic services.

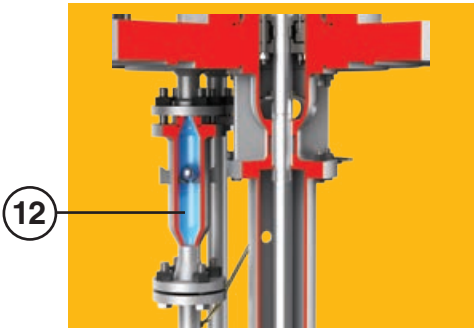


Hydraulic Upgrades

- 10. Excess Flow Check Valve** — stops the flow of toxic fluids should a line rupture occur outside the tank. A double-acting check valve can also be added for both excess and minimum flows. Check valves are also sold separately for systems handling dangerous toxic fluids.
- 11. Surge Chamber** — absorbs the high-pressure shock wave (water-hammer) that occurs with the sudden closure of the check valve or system control valves. Surge chamber is designed for easy clean out.
- 12. Inducer** — reduces the pump's required submergence (NPSHA) by 35% to 50%, thus minimizing tank inventory levels.
- 13. Higher Flow and Head Wet Ends** — that fit through the same tank nozzle are available for capacities of up to 136 m³/h (600 gpm) and heads up to 274 m (900 ft) on chlorine, 427 m (1400 ft) on water. New hydraulics can be developed to meet special operating conditions.



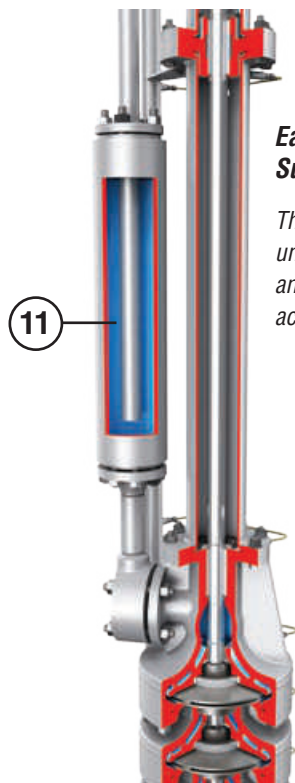
Typical Bearing Frame Assembly



Excess Flow Check Valve

Reliability and Maintenance Upgrades

- 14. Cartridge Thrust Bearing** — mounted on a sleeve to facilitate removal of seals and thrust bearings during rebuilds. Heavy-duty, anti-friction bearings operating in a well-protected bearing housing, providing an L10 life in excess of 25 000 hours.
- 15. Dry Disc Spacer Coupling** — goes with the cartridge thrust bearing to facilitate bearing and seal removal. Spacer couplings are maintenance free, have low axial and bending stiffness, reducing the load on the pump and motor bearings.
- 16. Compact Style Bearing Frame** — for use with new mechanical gas seals.
- 17. Diffuser Style Casings** — balance the radial thrust around the circumference of the impeller. The radial load carried by the sleeve bearings is minimized. Confined, controlled compression gasketing for more positive sealing of stages.
- 18. Wear Rings** — replaceable casing and impeller wear rings optimize efficiency and extend the life of critical components.
- 19. Enclosed Impellers** — with sealing rings, allow variations in impeller clearances without affecting the overall hydraulic performance. Optional non-metallic and ceramic coated alloys are available for wear surfaces.



Easy Clean-Out Design Surge Chamber

This surge chamber design unbolts at both the top and bottom, allowing easy access for cleaning.

*Multiple
Maintenance
Upgrade
Options
Available*

Lifting mechanism engaged in upper position



Lifting mechanism in lowered position



VPL1700 Bearing Frame Maintenance Kit

The VPL1700 upgrade kit allows access to the upper gas mechanical seal or upper packing and thrust bearing cartridge without decommissioning the tank to remove the pump for maintenance. A Flowserve representative will individually assess existing in-service pumps for this upgrade. This feature is also available on new pumps.

The kit consists of:

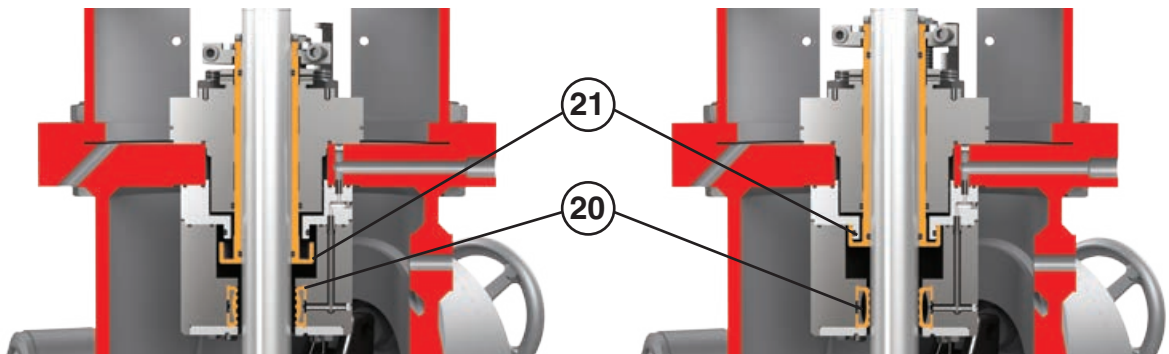
- 20. Isolation Seal** — this seal can be activated in series with the lower emergency seal to provide true redundancy.
- 21. Specialized Sleeve With Lifting Mechanism** — with the isolation seal engaged, the specialized sleeve is lifted into place, engaging an O-ring. This O-ring, in combination with a series of additional O-rings, creates a static seal that isolates the area above it from the process; maintenance can now be performed safely. A sleeve-lifting mechanism is utilized to operate this device.

Pressure Monitored

The area under the sealing sleeve assembly can be safely purged to evacuate any trapped toxic gas and then re-pressurized with nitrogen. Monitoring this pressure to ensure it is maintained verifies the isolation seal is operating properly.

Ease of Operation

With the pump stopped, the lower and upper emergency seals are activated. A lifting mechanism is then installed and the specialized sleeve is lifted into place easily by turning a pair of nuts. These nuts force the lifting mechanism to raise and lock in place at the upper stop, shown in the images above. This sleeve is then lowered and the lifting mechanism removed from the shaft when returning the pump to operation.



**Isolation Seal and Sealing Sleeve in
Deflated Position**

**Isolation Seal and Sealing Sleeve in
Inflated Position**

Global Service and Technical Support



Life Cycle Cost Solutions

Typically, 90% of the total life cycle cost (LCC) of a pumping system is accumulated after the equipment is purchased and installed. Flowserve has developed a comprehensive suite of solutions aimed at providing customers with unprecedented value and cost savings throughout the life span of the pumping system. These solutions account for every facet of life cycle cost, including:

Capital Expenses

- Initial purchase
- Installation

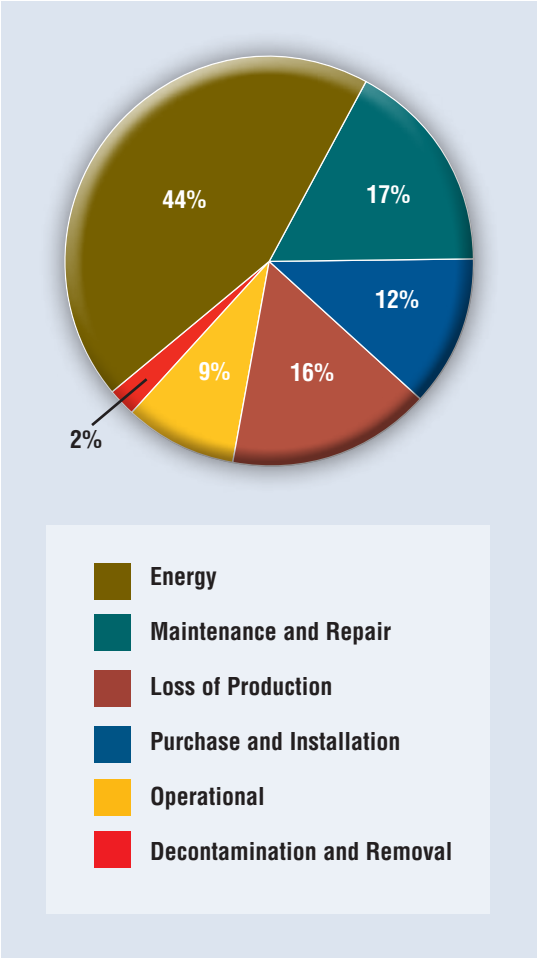
Operating Expenses

- Energy consumption
- Maintenance
- Production losses
- Environmental
- Inventory
- Operating
- Removal

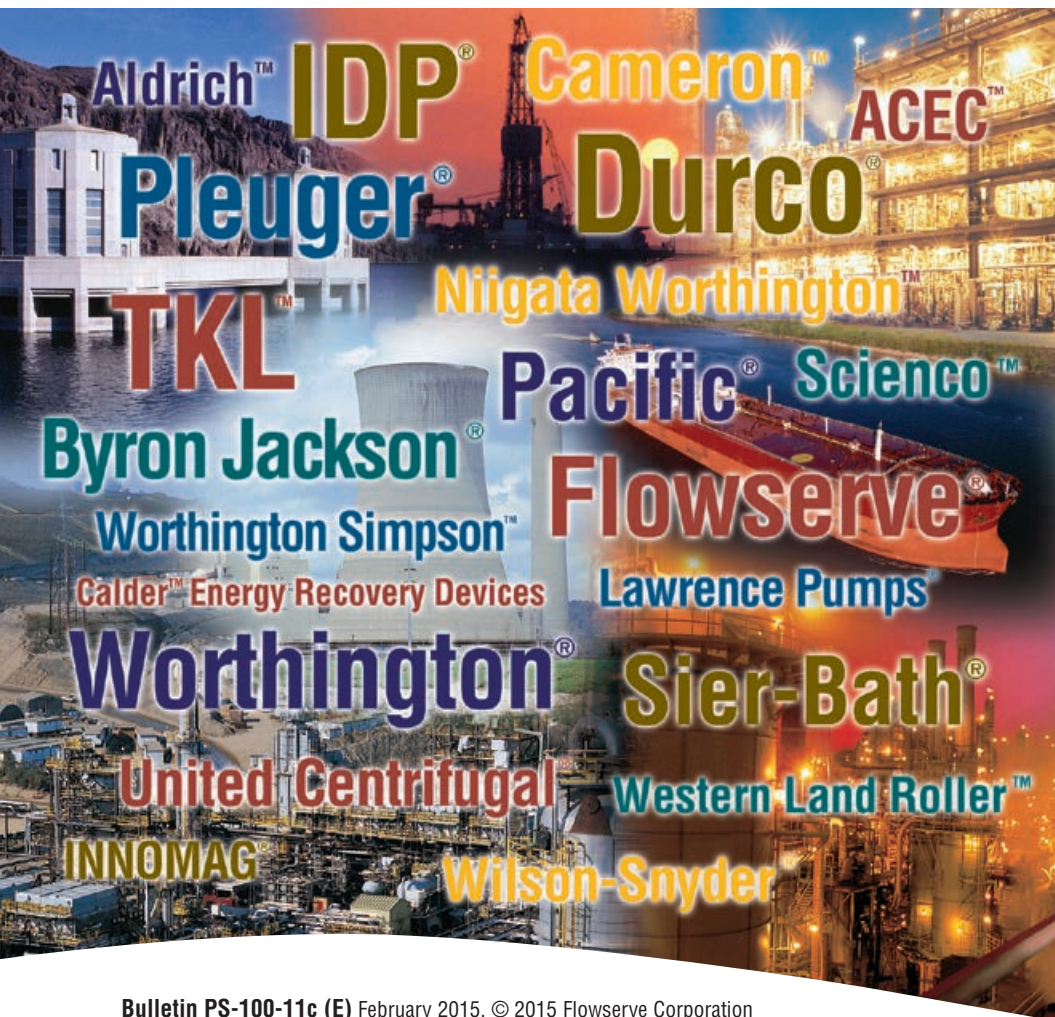
Innovative Life Cycle Cost Solutions

- New Pump Selection
- Turnkey Engineering and Field Service
- Energy Management
- Pump Availability
- Proactive Maintenance
- Inventory Management

Typical Pump Life Cycle Costs¹



¹ While exact values may differ, these percentages are consistent with those published by leading pump manufacturers and end users, as well as industry associations and government agencies worldwide.



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