PRESSURE BOOSTING WHITE PAPER

MAXIMIZING THE ROI ON YOUR PRESSURE-BOOSTING INVESTMENT

A Grundfos Expert Insight

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Introduction

With the bulk of a pressure-boosting pump's total lifecycle cost being dedicated to energy and maintenance, it is easy to see why making the right investments in pump hardware and operation can have such a profound impact on ROI. Here are several key points to consider when evaluating ways to get better results from an investment in pressure-boosting performance.

Key Considerations and Life-Cycle Cost Framework

Purchase costs for different types of pumps used in water distribution and industrial pressure-boosting applications can vary significantly. Whether they are end-suction pumps, split-case pumps, or vertical lineshaft turbines, though, their price tag is only a small fraction of their total life-cycle cost.

Most industry estimates peg energy as the largest single factor in pump life-cycle cost — ranging from 40 percent to as high as 90 percent depending on the pump style and application. That is why it makes sense to reevaluate traditional pressure-boosting pump selection in favor of total life-cycle performance costs, not simply initial purchase costs.

As with so many energy-intensive industry and municipal applications, there are two major ways to reduce total life-cycle costs:

1. Start by identifying the most cost-effective pump designs for energy efficiency and maintenance simplicity.
2. Operate them in a way that optimizes energy consumption — e.g., through task-specific sizing and/or variable frequency drives (VFDs) that optimize loadmatching control.

Consider All Aspects of Lifecycle Costs

Whether the challenge at hand is to find a more economical replacement for an existing pressure-boosting operation or to evaluate the best options for an entirely new one, it pays to evaluate both the capital expense (CAPEX) and operational expense (OPEX) implications of those options. For many applications — such as small municipal utilities, isolated large developments, pressure zones in hilly terrain, industrial power washing, etc. — vertical multistage centrifugal inline pumps offer the best alternatives across a broad range of evaluation categories. Here are their key ROI attributes in terms of power consumption, maintenance, installation, performance, and responsiveness to variable flow and variable water pressure demands:

Reduced Energy Consumption

A single energy-efficient vertical multistage centrifugal inline pump (Figure 1) can output up to 1,000 gpm in high-head applications ranging from 100 up to 1,000 feet. Multiple-pump configurations can achieve flow rates up to 6,000 gpm. The job-matched efficiency of their pump curves makes these pumps excellent choices for optimizing energy efficiency across the entire range of rated output. Each pump design has its own unique pump curve characteristics — some flatter than others, some more abrupt in the change of their slope. In pressure-boosting applications, a relevant pump curve consideration would be how it adapts to changing flow patterns. Because of the flatness of a split-case pump's curve, it would not be as efficient as a multistage pump in reducing speed when flow demand decreases.

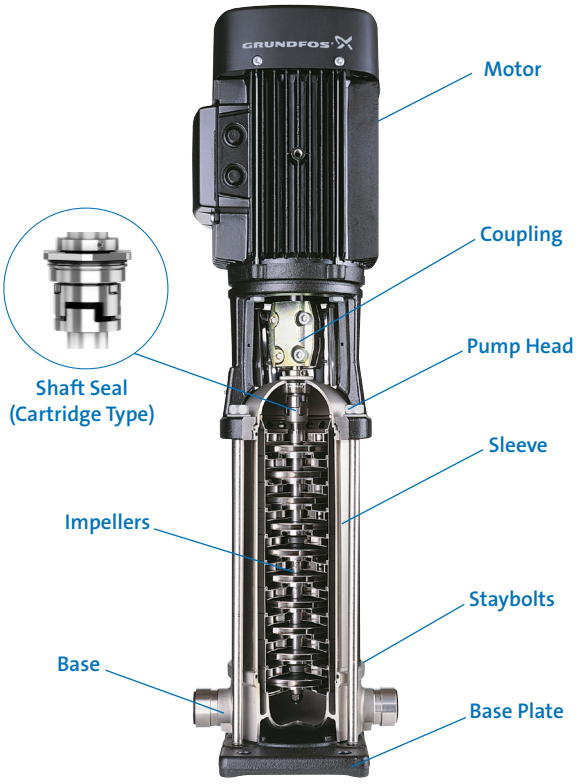
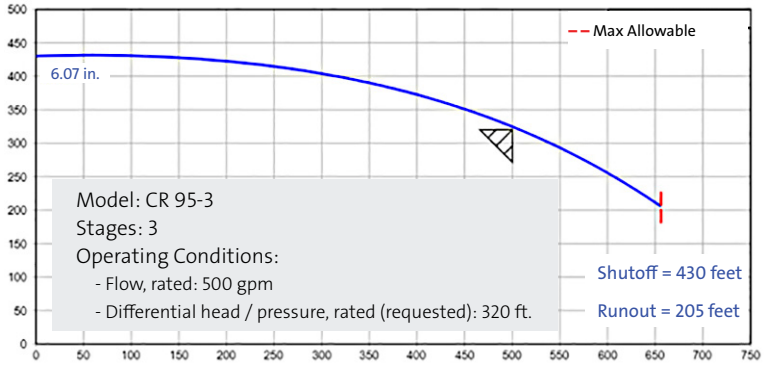


Figure 1: *This cross-section of a vertical multistage centrifugal pump shows multiple impellers stacked in a compact housing with a small footprint. Note how the inline positioning of the inlet and outlet ports allows for installation in existing piping with minimal effort. Flanged, union, and clamp-coupling options provide for quick and easy connection and disconnection for service.*

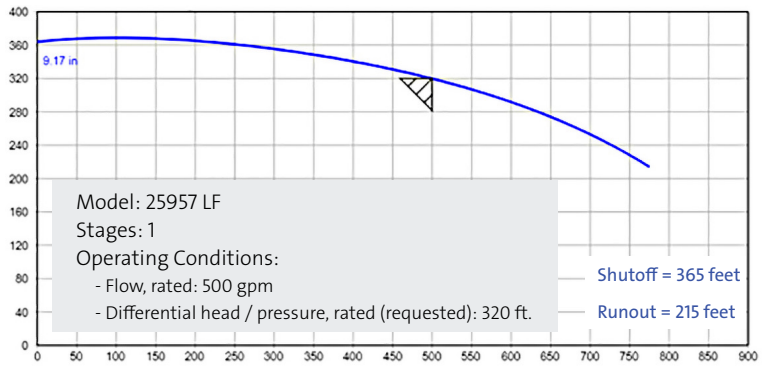
Vertical Inline Multistage Pump



110% head rise from runout to shutoff

34% head rise from duty point to shutoff

End Suction Pump



70% head rise from runout to shutoff

14% head rise from duty point to shutoff

Streamlined Maintenance

Not all pump styles require the same amount or type of maintenance. By their very design, vertical multistage centrifugal inline pumps offer labor and OPEX advantages as compared to end-suction and split-case pumps.

- **Maintenance Frequency**
  Unlike horizontal long-coupled centrifugal pumps or split-case pumps that use greased, metal ball bearings in the pump housing, vertically oriented multistage centrifugal inline pumps exert very little radial load on their bearings. Their pump shafts can use graphite or PTFE bearing materials that are lubricated by the water flowing through the pump. These bearings last for a long time without having to be greased or having the pump dismantled for maintenance.

- **Maintenance Convenience**
  Being able to replace the mechanical seals on a vertical multistage pump without having to remove the motor saves time, saves money, and eliminates alignment issues related to motor removal. The entire process can be achieved in about 20 minutes with one-piece shaft-seal cartridges and can easily be handled by newer technicians with minimal training (Figure 2). That stands in contrast to older pump styles with more labor-intensive component seals or alignment issues that might require a highly experienced in-house technician or third-party maintenance service.

- **Alignment**
  Long-coupled pumps come with a recommended nine-step realignment process to be performed every time the motor is removed — ideally including a laser alignment to assure that it is properly positioned and free from vibration. Short-coupled vertical multistage centrifugal inline pumps that do not require motor removal eliminate that excessive realignment labor, saving many hours of effort and downtime over the life of the pump (Figure 2).

Figure 2: *An easily accessible cartridge simplifies mechanical seal replacement for this vertical multistage centrifugal pump in minutes, without having to remove the motor. This avoids the time and effort typically associated with realigning motors and shafts after seal replacement on long-coupled end-suction pumps and split-case pumps.*

Pump Configuration and Installation Economies

The small footprint requirements and simplified mounting configurations of vertical multistage centrifugal inline pumps offer two additional levels of cost-saving convenience.

- **Easy Retrofit**
  Being able to install multiple vertical pump units in a fraction of the space occupied by existing horizontally mounted pumps makes it easy to upgrade existing applications or configure new installations with limited floorspace. Equally important, the inline mounting format — with flange-to-flange spacing of 18 inches or less — minimizes the amount of piping effort required to fit them into existing infrastructure.

- **Low-Cost Installation**
  Small, simple, floor-mounted pedestals and inline piping designs require minimal added investment for installation. They do not require sweeping vertical piping runs like end-suction pumps do nor the construction of deep pits needed to accommodate inline piping for vertical turbine pumps. High-volume application installations are also streamlined by the adoption of prepackaged multipump systems (Figure 3).

Figure 3: *Packaged multipump systems that integrate speed control to ramp throughput up or down quickly can satisfy a broader range of demand with greater energy efficiency than that typically offered by end-suction or split-case pumps.*

Reduced Vibration

Vibration generated by misalignment issues is one of the biggest pump-killers in pressure boosting applications, causing shortened seal life and potentially even shortened bearing life. Close-coupled vertical multistage centrifugal inline pumps that never require motor removal for maintenance minimize the opportunity for misalignment of shafts connecting the motors and pumps, greatly reducing opportunities for wear-inducing vibration.

Task-Specific Control

While physical design features — hydraulic efficiency, energy-efficient motors, profiled impeller vanes to reduce resistance, etc. — contribute toward OPEX saving potential, the ultimate performance of any pressure-boosting application depends on its ability to respond to changing application demands. Working closely with engineering experts can provide information and insight on the best ways to implement specific projects, whether that involves identifying a proper pump curve or utilizing variable frequency drives.

Depending on the maximum pressure and flow requirement, when working with Grundfos solutions, the VFD can either be an MGE motor or a panel-mounted CUE VFD. The MGE motor is available up to 30 hp, a VFD larger than 30 hp will be a panel mounted CUE VFD. Regardless of whether the VFD is an MGE motor or CUE, the Grundfos factory-loaded firmware includes the pump curve for the pumping end. What this means is that the VFD knows where the pump will run at best efficiency. Grundfos VFDs understand Grundfos pumps, so plant maintenance engineers will not need to trim the system for optimized operational efficiency. The VFD allows the pump to provide low-flow demands at system pressures over a wide operating range.

A Real-World Example

Creating certain chemicals requires precise temperatures to ensure the chemical reaction yields the highest concentration of product. The addition of larger heat exchangers at a Midwest U.S. chemical processing and distribution company resulted in increased capacity for its chemical production. It also caused significant strain to its aging water system. An inability to keep up with the increased load resulted in inefficient product temperatures, as well as frequent and costly service to the pumps. Each time the pumps went down, production was halted for maintenance.

The company chose four CR 95 vertical inline multistage pumps in a Hydro MPC BoosterpaQ system with panel mounted VFDs and a controller. This allowed for a quick, plug-and-pump installation of a complete solution.

The new installation reduced downtime on site. The BoosterpaQ system adjusts based on the plant's demand and the temperature of the quarry water, so the producer is confident their booster system is optimized at all times.

In addition to saving energy by reducing the need for a bypass valve, the automated system also delivered an immediate, real savings in maintenance time and cost, estimated at $30,000 annually.

Learn more at grundfos.us/newcr.

Saving Through Reduced Downtime and Predictive Maintenance

In addition to the intelligence integrated through the panel-mounted VFD and controller, the chemical processing plant installed Grundfos Machine Health (GMH) on their CR pumps. GMH brings artificial-intelligence (AI) to the maintenance world with a next-generation solution that empowers customers to convert their data into meaningful actions aimed at improving efficiency and preventing downtime.

Advanced sensors watch over critical assets 24/7 and alert the end-user with a detailed analysis at the first sign of a developing issue, so maintenance can move from reactive to predictive.

WE ARE IN THE WATER BUSINESS WITH YOU

As a pioneer and global leader in water pump technology, Grundfos creates intelligent, sustainable solutions to help solve the world's water and climate challenges. Through our heritage, we have the experience and innovative capabilities to help our partners, customers and communities move water in an increasingly energy and water efficient manner. We see this as not only a great business opportunity, but as an obligation to ensure the world heads toward a more sustainable tomorrow. Our complete portfolio of pumps and solutions are designed for commercial, residential, groundwater, municipal and industrial applications with emphasis in trendsetting, energy efficient technologies such as permanent magnet motors and advanced pump controls and monitoring. Because water matters, and so does your business.

To learn more, visit **grundfos.in** or follow us on Facebook and LinkedIn.

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Visit grundfos.in/pei to learn more about Department of Energy (DOE) pump energy index (PEI) requirements and PEI ratings on specific Grundfos models.

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