A Look at Modern Flexible Impeller Pumps

With only one moving part, these innovative pumps are finding homes in an ever-increasing number of industries and applications.

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Flexible impeller pumps combine the self-priming feature of positive displacement units with a material-handling flexibility not found in other pump types to deliver one of the most versatile fluid handling solutions. These workhorses will pump thin or viscous liquids, can handle a wide range of solids in suspension, can operate at high and low speeds and can be mounted in any orientation. Flexible impeller pumps have only one moving part—the flexible impeller itself—with no metal-to-metal contact or gears to jam or clog and become noisy. In general, they require less space in most applications because they deliver greater flow for weight, size and price than any other pumps.

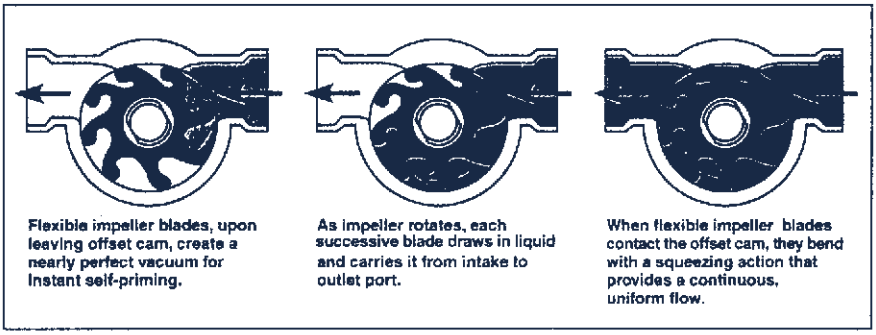

Figure 1. Cross-section of a typical flexible impeller pump

Flexible Impeller Basics

The basic flexible impeller pump consists of a circular housing with one section of the sidewall offset as a cylindrical cam (Figure 1). As the impeller rotates, the cam compresses its flexible blades, reducing the space between them. When the blades leave the cam at the inlet port, the space between them expands to create a vacuum for instant self-priming. The impeller continues to rotate, and each successive blade draws in liquid and carries it from the intake to the outlet port. Here the flexible blades again contact the cam and bend with a squeezing action that provides continuous uniform flow.

The flexible impeller pump has an edge over other pump types for use with in-line and general liquid applications (Table 1). Because it is self-priming, it does not require a check valve to retain liquid in the suction and discharge lines. Impeller blade deflection also provides a built-in pressure relief mechanism, although common practice calls for installation of a separate pressure relief device to keep excessive line pressures from damaging the impeller.

Flexible impeller pumps with standard thickness impeller blades usually operate at low discharge pressures of 20–30 psi. Thicker high-pressure impeller blades can boost operating pressures to 60 psi or more. But these thicker impellers tend to wear faster, increasing maintenance and replacement costs.

Until a few years ago, all flexible impeller pumps were designed as individual units. Parts were not interchangeable and computer-aided design practices were not employed. Modern streamlined models constructed of stainless steel and glass-filled epoxy are widely available. New choices in impeller and seal materials, and new developments in impeller shape, are leading to a great increase in the application of the flexible impeller design.

Pump Performance	Flexible Impeller	Positive Displacement	Centrifugal
Pressure	Low	Low to High	Low to High
Temperature	Moderate	Low to High	Low to High
Capacity	Low to Moderate	Low to High	Low to Very High
Viscosity	Low to High	Moderate to Very High	Low
Speeds	Wide Range	Wide Range	Limited
Self Priming	Excellent	Limited	No
Air-entrained Liquids	Yes	Yes	Limited
Delicate Solids in Suspension	Yes	Yes	No
Abrasive Laden Liquids	Yes	Limited	Limited
Corrosive Liquids	Yes	Yes	Yes
Starting Torque/hp	High	Low	Low
Relief Pressure Required	Not Normally	Yes	No
Continuous Duty	With Periodic Maintenance	Yes	Yes
Ease of Cleaning	Yes	Yes	Yes

Table 1. How do modern flexible impeller pumps measure up against other common pump types in industrial applications?

Interchangeable Parts

Modern flexible impeller pumps are totally modular and offer complete interchangeability of parts—including pump bodies, impellers, seals and wear components—within a particular pump size. For example, either a stainless steel or an epoxy pump body can be mounted on a single standard bearing pedestal for variable speed applications, or either could be attached to a NEMA C-face bracket for close coupling to a motor drive.

With this pump technology, interchangeability also extends to the impeller-drive configuration between the pump shaft and the impeller. A double-flat drive has been incorporated into many of these units, making alignment much easier than traditional splined or key-drive designs.

Such a high level of interchangeability reduces the number of components that users or distributors must inventory for replacement purposes. It also increases the likelihood that users will be able to find and replace pump parts quickly and easily.

Neoprene	(45° to 180° F) standard material used in most flexible impeller pumps, offering a wide range of chemical resistance.
Nitrile	(50° to 180° F) compatible with oil-based products, including oil and water emulsions, lower fraction hydrocarbons, and lubricating and machine cutting oils. Lower temperatures affect priming ability and performance characteristics. Overall performance rated about 10% less than neoprene.
Viton	(60° to 180° F) recommended for pumping hydrocarbons, solvents and severely corrosive chemicals. It is unsuitable for low temperature and high-pressure applications.
Sanitary Neoprene	(45° to 165° F) used in hygienic applications pumping food, beverage and pharmaceutical products.
Sanitary EPDM	(60° to 185° F) used for hygienic applications at elevated temperatures, and for use with some ketone solvents.
Natural rubber	(28° to 120° F) used for cold water applications only.

Table 2. Flexible impeller compounds

Selecting the Right Pump

Flexible impeller pumps are ideal for use in applications with flow rates of less than 25 gpm and operating pressures of 60 psi or less. Matching them to a specific use involves choosing the right body material and then selecting the appropriate impellers and seals.

The two most common choices for body materials in industrial applications are stainless steel and epoxy plastic. Typical applications for stainless steel bodies include:

- General Industrial - circulating and transferring, velocity mixing, pumping machine tool coolants, spill return, sump drainage, chemicals, pharmaceuticals, soap, liquors, ink, dyes, alcohol, dilute acids, tanning liquors, glycerin and brine
- Pharmaceutical - processing medicines, lotions and preparations; filtering solutions; filling line supply pumping
- Paper Processing - transferring and applying starches, sizes and other suspensions; circulating and processing wood pulp slurries
- Food, Beverage and Dairy - transfer brines, vinegar and syrups during processing; liquids containing solids in suspension

Typical applications for impeller pumps with epoxy plastic bodies include:

- Industrial - circulating and transferring corrosive liquids, transferring foaming solutions with entrained air, handling pure solutions, acids, alkalis, photo chemicals, dyes, waxes, gels, solutions with suspended solids or emulsions, and sampling or pilot plant operations
- Metal Plating - filtration of plating solutions, filling and emptying vats, adding chemicals for pH balancing
- Pharmaceutical - processing lab solutions, medicines and preparations; filtering solutions

In general, either body type can be used in agricultural applications for transferring liquid fertilizers, herbicides and pesticides. Matching the right body material to the liquid to be handled opens unlimited applications to flexible impeller pumps.

Impeller and Seal Options

Modern flexible impeller pumps are offered with a complete complement of impeller and seal options (Table 2). The most common impellers include those made of neoprene or silica-reinforced nitrile rubber.

As the standard for most modern flexible impeller pumps, neoprene impellers offer superior head-flow and self-priming characteristics, as well as longer life. The inert nature of the neoprene compound makes it ideal over a wide range of fluid transfer and chemical-handling applications.

The new silica-reinforced materials offer all the characteristics and mechanical properties of older carbon reinforced materials with greater blade flexibility and inherent self-lubrication. Silicon reinforced impellers also offer improved resistance to swelling in diesel fuel, while providing greater resistance to run-dry damage, tearing, abrasion and heat aging.

Nitrile impellers will resist swelling better than neoprene impellers, especially when pumping emulsions of oil and water, low-fraction hydrocarbons, lubricating oils and machine tool cutting oils.

Carbon-on-ceramic designs are considered the standard mechanical seals for use in most applications. Where abrasive or crystallizing fluids are present, extremely hard silicon-carbide vs. silicon-carbide seals are an option to resist wear.

Operation and Maintenance

In general, flexible impeller pumps can by mounted in any position. The rotation of the pump shaft determines the location of the pump's intake and discharge ports. Jabsco pumps are normally assembled at the factory for clockwise rotation when looking at the end cover.

Belt or direct drives can be used with impeller pumps. In general, capacitor start motors are required to provide the starting torque needed by the impeller. Caution should be taken with belt drives for belt tension, since an over-tight belt load will reduce pump bearing life. In direct-drive applications, clearance should be left between the drive and pump shafts when installing the coupling. Always mount and align the pump and drive shafts before tightening the coupling set screws. If a pulley or coupling must be pressed on the shaft, remove the end cover of the pump and impeller to support the shaft from the impeller end during the press fit operation. Never hammer a pulley or coupling on the shaft, as this will almost certainly damage a bearing or seal.

If the suction lines are airtight, Jabsco pumps are self-priming. For a vertical dry suction lift of 10 feet, minimum speeds of 100 to 1,000 rpm are required, depending on pump size. Pumps will generally maintain suction lift of greater than 20 feet when wet. Nevertheless, units depend on the liquid being transported for lubrication and should not be run dry for more than 30 seconds or impeller damage may result.

Maintenance of flexible impeller pumps is very minimal, and usually involves wear on the impeller induced by the liquid being transported. In general, a flexible impeller pump can be disassembled in short order by removing four end-cover and four adapter flange screws. This will provide clear access to the impeller for inspection and replacement. To avoid inconvenient shutdowns, it would be wise to keep an impeller, and a seal and O-ring set on hand for easy replacement. ■

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