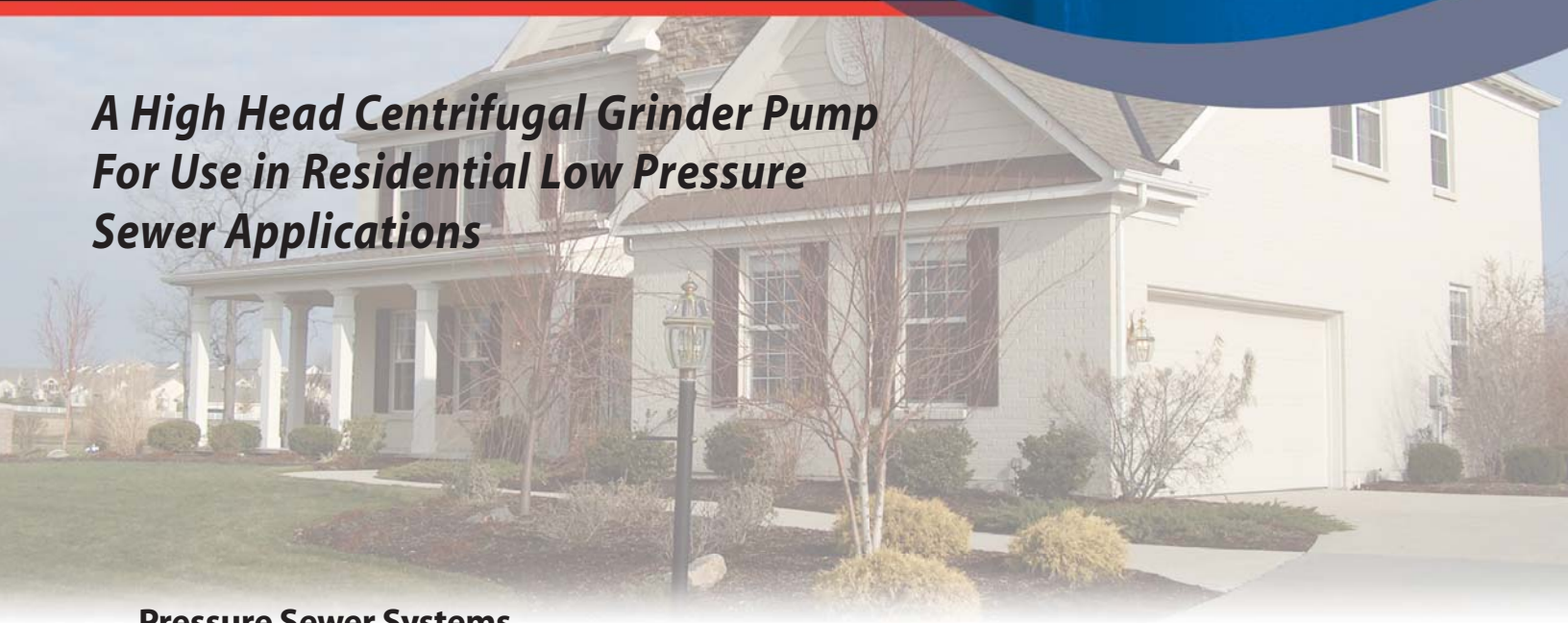
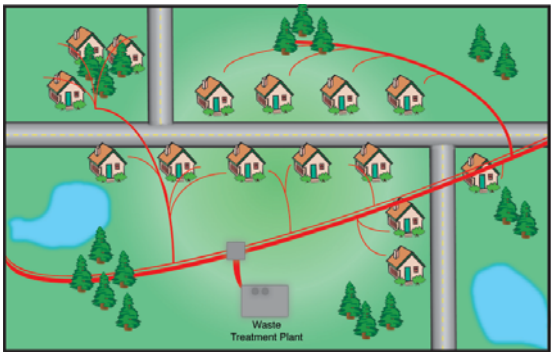
BARNES® PRESSURE SYSTEMS

A High Head Centrifugal Grinder Pump For Use in Residential Low Pressure Sewer Applications

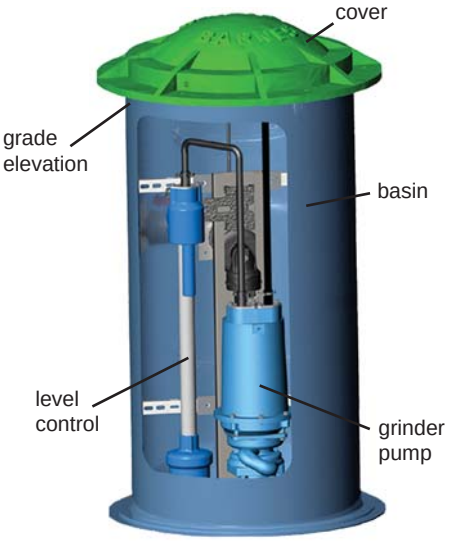


Pressure Sewer Systems

Pressure sewer systems are an effective method to transfer residential wastewater through small diameter pipes to collection or treatment facilities where other methods are less economical or less feasible. The primary differences between conventional gravity sewer systems and pressure sewer systems are in the piping network and the reduction of solids size in the wastewater at each residence. Pressure sewer systems use specialized submersible grinder pumps, which are designed to reduce sewage particulate size to easily move the sewage through small diameter pipes.



Adopted from SWPA White Paper, "A Pressure Sewer Overview"



Typical Pressure Sewer System

The application of grinder pumps and pressure sewer systems is a cost-effective, longer life answer to allow more home sites, both existing and new, access to a public sewer system or regional private wastewater treatment system.

Pressure sewer systems can be used where gravity systems won't work because of uphill topography, surface rock, high water tables, waterfront locations, very flat land and other constraints on excavation. In general, these systems are installed outdoors, below grade, with a locked cover mounted just above grade. The burial depth (i.e., basin length) is set by local codes and usually depends on maximum frost depth and residence elevations. A typical system includes a pump, basin, controls, piping and valves.

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CRANE PUMPS & SYSTEMS

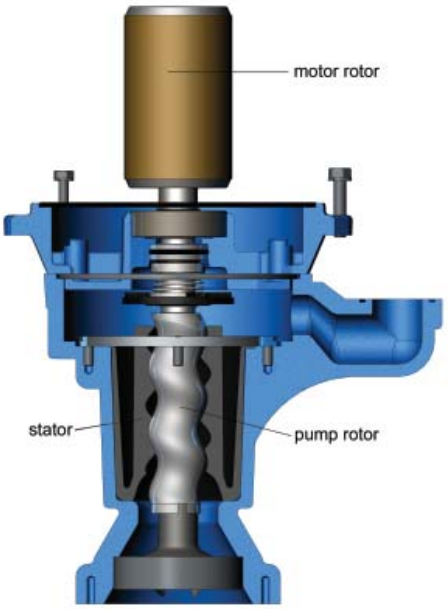
Pressure Sewer Solution

Grinder Pumps

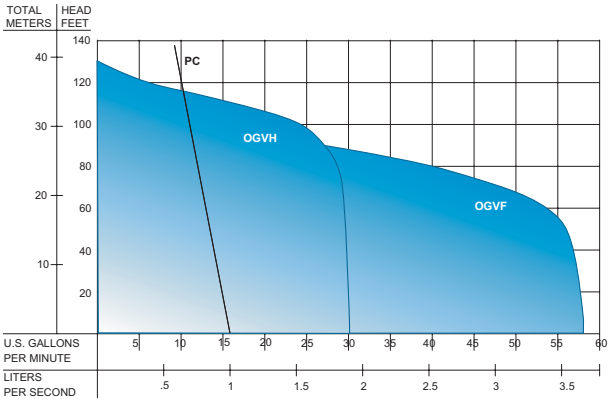
The heart of a pressure sewer system is the grinder pump. This pump grinds the particulates in the sewage into a fine slurry and transfers the sewage into the pressure main, where it ultimately flows to a collection point or directly to the waste treatment plant. The basin, in which the grinder pump is located, receives sewage from the residence under gravity flow and retains it until the level control system causes the pump to operate, shutting off as the sewage is reduced to a pre-set low level.

There are two basic forms of grinder pumps utilized in pressure sewer systems, both of which have been in use for at least 25 years. The first, a centrifugal pump, utilizes a grinder mechanism to reduce any particulates and then a vortex-style centrifugal impeller that pumps the resulting sewage slurry into the piping system. The impeller is so-named because, as it is rotated, the motion of the impeller blades creates a vortex within the pump casing that carries the slurry out with the vast majority of particles, never coming into contact with either the impeller or the casing. A vortex pump, therefore, offers long life as it experiences very little wear.

The other style of grinder pump in use today is a progressing cavity pump. After flowing through the grinder mechanism, pumping is performed by a specially shaped stainless steel rotor that turns within a multi-lobed rubber "boot" or stator to develop the necessary pressure. The perceived advantage of a progressing cavity, or PC pump, is that it pumps a fairly narrow range of flows depending on system pressure. However, there is one major drawback: A PC pump operates with a friction interface between the rotor and stator, so that it is slowly but continually wearing. That wear rate increases with excessive pressures or higher than expected flow rates that increase operating time.



Partial view of Progressing Cavity Grinder Pump



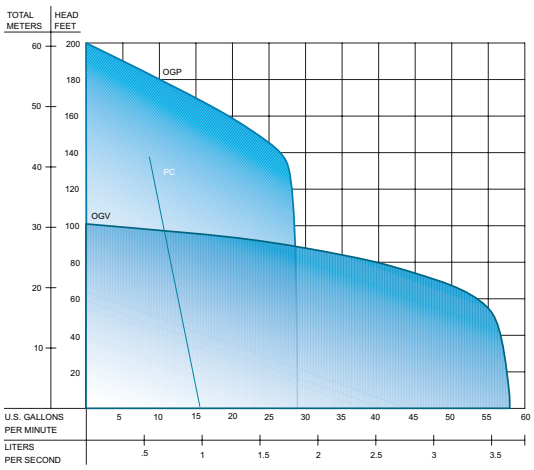
OGV / PC Curve compares typical centrifugal grinder (OGV) to progressing cavity (PC)

As a result, many engineers specify centrifugal grinder pumps when system heads are expected to be low (up to 80-90 feet) but switch to PC grinders when higher heads are expected. When systems have been installed with higher heads or have experienced higher flow rates due to infiltration or unexpected higher inflow, many users have wished for residential-sized grinder pumps with the life of a centrifugal vortex design.

High Head Centrifugal Grinder Pump

Centrifugal grinder pumps capable of heads to 200 feet have been available for a number of years for use in commercial installations with correspondingly higher flow rates. As a result, they require motor sizes that would be highly inappropriate for residential applications. In response to the need for a long-life grinder unit suitable for residential use, Crane Pumps & Systems has developed a Barnes® brand centrifugal vortex grinder pump that combines long life with high head capability that outperforms progressing cavity grinder pumps.

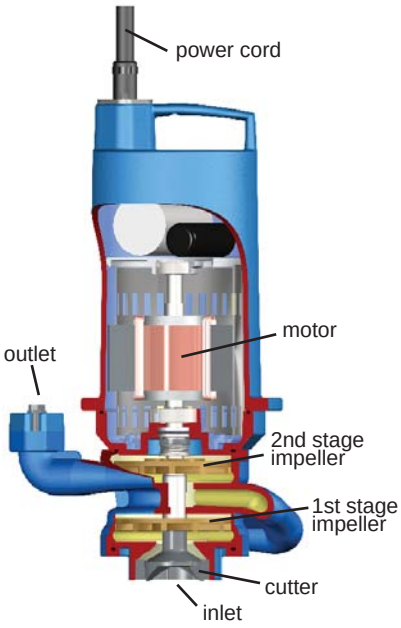
This pump, known as the Omni Grind Plus™ or OGP, is a 2HP two-stage design that meets the needs of residential pressure sewer applications. The pump easily handles higher system heads, with a maximum head of 200 feet and will pump nearly 30 gallons per minute when heads are low. An advantage of the vortex design is that the pump can idle at no flow (maximum head) or anywhere on its curve with no damage or excessive wear. To ensure maximum life, the pump is provided with silicon carbide mechanical seals and 100,000 hour, angular contact, oil lubricated bearings. The start and run capacitors are mounted within the motor housing eliminating the need for a control panel.



OGP / OGV / PC Curve compares high and moderate-head centrifugal grinders with PC

The OGP is fitted with the Barnes exclusive Slicerator™, a hardened stainless steel cutter and ring that utilize a "slicing" rather than "chopping" motion for superior grinding and to eliminate jamming. The stationary ring is reversible in order to double life, and the cutter has two alternating cutting edges to minimize starting torque.

OGP Cross Section



Barnes exclusive Slicerator™ eliminates jams

Testing Program

During the development of the Barnes OGP, the testing program was a primary focus of the engineering team. Performance and hydrostatic testing was performed on all of the pre-production prototypes as well as the individual wet-end components. Motors were tested for torque versus temperature rise to ensure proper loading.

NSF / ANSI 46 Challenging Material 6 Week Test	Times / Day	Days / Week
Toilet tissue	4	5
Facial tissue	2	5
Filter tip cigarettes	1	5
Egg	1	5
Paper towel	1	5
Personal hygiene products	1	5
8 oz, chlorine laundry bleach	1	5
Cotton swab w/ plastic stick	1	5
Large disposable diaper	1	5
Adhesive bandage, wrapper	1	5
Dental floss, 12 inches	1	5
8 oz, alkali drain cleaner		1
Handi-Wipe or equivalent		1
8 oz, acidic liquid drain cleaner		1
4 oz, liquid animal fat		1
One pair large panty hose		1
Wet cloth diaper	Once During Test	
Toothbrush		
Wood pencil		
Plastic table utensil		
Metal bottle cap		
HDPE bottle cap		
Metal toy car		
Crushed 8 oz drinking glass		

An accelerated grind test was performed in which all of the items listed in the 6 Week NSF46 test standard were introduced into the pump over an eight-hour period with no difficulty. A long-term performance test program was then begun. Most grinder pumps in residential use operate only several times per day for a few minutes at a time, so a valid estimation of life can be obtained by two tests.

In the first, two groups of pumps were operated continuously for 10,000 hours, one group near shut-off and the other near run-out. These two conditions represent the highest loads on centrifugal pumps, and the hours of operation roughly equate to ten years of operation in a pressure sewer application. In the second test, we operated a group of pumps in basins on a continuous start-stop basis through 100,000 cycles, or ten years' worth.

BARNES PRESSURE SYSTEMS

NSF/ANSI 46 – 2002

While the accelerated test provided a good indication of the pump's ability to handle solids, a full-fledged 6 week test to the requirements of NSF/ANSI 46 would be a more significant test. The NSF standard calls for a performance test as a baseline, a six-week period of operation at various capacities with the introduction of challenging materials, and a final performance test to confirm that performance has not decreased. During test, the pump is cycled 24 hours per day, seven days per week with a minimum of ten starts per hour to simulate actual use. The test pump is then disassembled and inspected to ensure that wear and accumulation of materials does not occur. Some of the mandated challenging materials introduced during the course of the test include paper and cloth towels, laundry bleach, various sanitary products, disposable diapers, panty hose, ground glass, alkali and acidic drain cleaner, a toothbrush, a plastic utensil, bottle caps, even a metal toy car! The Omni Grind Plus™ or OGP handled all of these except the toy car, which only sat on the bottom of the basin.

As a result of this testing, CSA and NSF have certified that the Barnes OGP & OGV meets the requirements NSF/ANSI 46, "Grinder Pumps and Related Components".

Installations

A large number of Beta site installations were utilized to verify pump operation in real-world conditions. In some cases, the OGP replaced progressing cavity pumps of two different manufacturers that were experiencing stator wear. Pump performance was found to be impressive, as the OGP is nearly impervious to high pressure or high inflow volume effects. Contrary to some notions, OGP units operated in systems containing progressing cavity pumps had no impact on the wear rate or life of the PC pumps.

Barnes OGP grinder pumps are now successfully operating on a wide variety of difficult, as well as more normal, pressure sewer basin applications. The pump has proven to be a dependable answer where high heads or high flow rates may be encountered. The vortex impeller design allows operation anywhere on its curve, so the pump is truly a universal pump for use in residential pressure sewer basins.

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