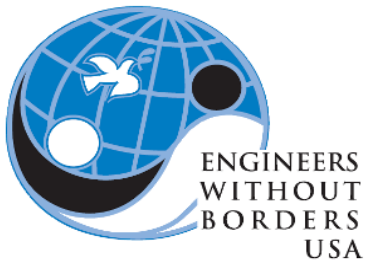

Document 525
PRE-IMPLEMENTATION REPORT

CHAPTER: EWB-JSC South Houston Professionals
COUNTRY: MEXICO
COMMUNITY: LA JOYA
PROJECT: BYOW
TRAVEL DATES: 12/2009

PREPARED BY
Dan Garguilo
Dorothy Ruiz
Lauren Mitchon

09/21/2009

Document 525 - Pre-Implementation Report
EWB-JSC
La Joya, Mexico
BYOW

ENGINEERS WITHOUT BORDERS-USA
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Pre-Implementation Report Part 1 – Administrative Information

1.0 Contact Information

	Name	Email	Phone	Chapter
Project Leads	Dorothy Ruiz	dorotinaruiz@gmail.com	832-524-8639	EWB-JSC
President	Dan Garguilo	daniel.p.garguilo@nasa.gov	832-628-5148	EWB-JSC
Mentor #1	N/A			
Mentor #2	N/A			
Faculty Advisor (if applicable)	N/A			
Health and Safety Officer	Dean Muirhead	dean.muirhead-1@nasa.gov	281-217-2820	EWB-JSC
Assistant Health and Safety Officer	N/A			
NGO/Community Contact	Juan Reyes	N/A	01152-200-1243450	N/A
Education Lead	Dorothy Ruiz	dorotinaruiz@gmail.com	832-524-8639	EWB-JSC

2.0 Travel History

Dates of Travel	Assessment or Implementation	Description of Trip
March 21-25, 2007	Identification Trip – Pre-Assessment	During this phase, members of the EWB-JSC trip identified 5 rural communities in need of clean water and other basic services in the South of Nuevo Leon. At the end of the trip and

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		while discussing several pros and cons, EWB-JSC identified the community as one of the ones with the most need for clean water.
April 23-26, 2009	Assessment	During this phase, EWB-JSC team members traveled to La Joya and conducted water quantity and quality testing, and health assessment surveys. After the assessment it was concluded La Joya qualified for a BYOW System developed by EWB-JSC.

3.0 Travel Team

Name	E-mail	Phone	Chapter	Student or Professional
Dorothy Ruiz	dorothy.ruiz-1@nasa.gov	832-524-8639	JSC-South Houston	Professional
Dan Garguilo	daniel.p.garguilo@nasa.gov	832-628-5148	JSC-South Houston	Professional
Tien Nguyen	tien.q.nguyen@nasa.gov	713-876-3633	JSC-South Houston	Professional
Michael Martinez	michael.martinez@albemarle.com	832-524-8639	JSC-South Houston	Professional
Jody Muniz	joseph.muniz-1@nasa.gov	832-455-2734	JSC-South Houston	Professional
Angela Cason	angela.m.cason@nasa.gov	832-385-4996	JSC-South Houston	Professional
Dean Muirhead	dean.muirhead-1@nasa.gov	281-217-2820	JSC-South Houston	Professional
Jose Ruiz	jose.ruiz-2@nasa.gov	281-483-1435	JSC-South Houston	Professional

4.0 Safety

4.1 State Department Warning

Although there is no State Department Warning for Mexico at this moment, there are some travel alerts relating to crime, kidnapping and extortions. Even though the portion of the country where the team will travel is not affected, however, some precautions need to be taken:

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Personal Safety: Visitors should be aware of their surroundings at all times. Victims, who have almost always been unaccompanied, have been raped, robbed of personal property, or abducted and then held while their credit cards were used at various businesses or Automatic Teller Machines (ATMs). Travelers should avoid any overt displays of wealth such as showing money, wearing flashy jewelry, driving expensive automobiles, etc. U.S. citizens should be very cautious in general when using ATMs in Mexico. If an ATM must be used, it should be accessed only during the business day at large protected facilities (preferably inside commercial establishments, rather than at glass-enclosed, highly visible ATMs on streets). U.S. and Mexican citizens are sometimes accosted on the street and forced to use their ATM cards to withdraw money from their accounts.

Kidnapping, including the kidnapping of non-Mexicans, continues to occur at alarming rates. So-called express kidnappings, i.e., attempts to get quick cash in exchange for the release of an individual, have occurred in almost all of Mexico's large cities and appear to target not only the wealthy but also the middle class. Criminal assaults have occurred on highways throughout Mexico; travelers should exercise extreme caution at all times, avoid traveling at night, and may wish to use toll (ìcuotaî) roads rather than the less secure ìfreeî (ìlibreî) roads whenever possible. Always keep car doors locked and windows up while driving, whether on the highway or in town. While in heavy traffic or stopped in traffic, leave enough room between vehicles to maneuver and escape, if necessary. In addition, U.S. citizens should not hitchhike or accept rides from or offer rides to strangers anywhere in Mexico. Tourists should not hike alone in backcountry areas, or walk alone on infrequently visited beaches, ruins or trails.

Harassment/Extortion: In some instances, Americans have become victims of harassment, mistreatment and extortion by Mexican law enforcement and other officials. Mexican authorities have cooperated in investigating such cases, but one must have the officer's name, badge number, and patrol car number to pursue a complaint effectively. Please note this information if you ever have a problem with police or other officials. In addition, tourists should be wary of persons representing themselves as police officers or other officials. When in doubt, ask for identification. Be aware that offering a bribe to a public official to avoid a ticket or other penalty is a crime in Mexico.

4.2 Point to point travel detail

– Day 1: Leave Houston with equipment in truck and trailer
– Day 2 : Arrive to La Joya de San Diego
– Days 3-6: Stay at La Joya to work on implementation
– Day 7: Return to Houston

• Where will the team be staying?
– The team will be staying at La Joya de San Diego
– Community Contact: Juan Reyes (01152-200-1243450, 51, 52)
– Team Contacts: Dorothy Ruiz (832-860-2683); Dan Garguilo (832-628-5148)

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• What will be the sources of food and water for the team?
– Water and food supplies will be bought in the nearest city of Dr. Arroyo. The team will try to cook the food at a household if allowed and the team will only drink bottled water purchased from reliable sources in Dr. Arroyo.

• The EWB-JSC team will visit the surrounding community of Aguilar during one of the days (time permitting) to conduct follow-up assessment of the previously installed BYOW System.

4.3 Safety Plan

While traveling on the road, the group may not separate. If separation occurs, everybody should carry contact information and basic Spanish phrases to catch a taxi, make a phone call, and get to the nearest bus station. Every person should have a map of the area and should know how to get back to the U.S. While in the village, persons should walk in groups of 2 and always need to ask for permission before entering a private premise, house or lot. No interventions from the EWB team members should occur if a dispute arises between village inhabitants. EWB-JSC members should not drink water from the village and should always follow the rules of the village.

4.4 Emergency Plan and Exit Strategy

In case of an emergency in the village, go to the store phone (the only one available) and call an ambulance if the person cannot move. In case of an emergency where treatment is not available, act according the health insurance policies purchased for the trip. If none of the above applies, drive to the nearest hospital in Dr. Arroyo. The local hospital information is provided to all team members. If there is political unrest, evacuate the village as soon as possible. The team has an established relationship with the US Consulate and Mexican Consulate.
Both organizations will be assisting in the logistics of the trip, and will also provide assistance in case of an emergency.

4.5 Contacts

Family in town of Dr. Arroyo: Josefina Contreras (01152-148888-80588)
Call Consul of Mexico in Houston, Julian Escutia - (713) 778 - 6117
To call long distance from Mexico, dial 01 before the number.

4.5.1 On-the-ground phone number and email for travel team

The team members can be reached at the Village Phone Number: 01152-200-124-3450, cell phone signals don't reach the village.

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Outside the village where signal is available, team members can be reached via cell phone numbers provided in the list of the traveling team.

4.5.2 Nearest US Consulate Contact Information

U.S. Consulate General Monterrey
Avenida ConstituciÛn 411 Pte.
Monterrey, N.L. 64000
(81) 8345-2120
http://monterrey.usconsulate.gov/acs.html

4.5.3 Nearest Hospital Contact Information

The nearest hospital/clinic to Puerto de Aguilar would be Dr Arroyo, a town located approx 1hr, 45 min by automobile. There is a relatively modern hospital in the town of Dr Arroyo. Doctor health providers service the hospital 24 hours a day. There are also hospital facilities in Matehuala, about 2.5 hours away from the site.
Name: Hospital General Doctor Arroyo
Address: Padre Severeano M. Km. 1; Carretera Matehuala; Dr. Arroyo, Nuevo Leon.
Telephone: 01 (826-86) 366-99

5.0 Budget

5.1 Cost

Expense	Total Cost
Airfare	$1,000
On Ground	$1,000
Materials	$4,000
Other	---
Total	$6,000

5.2 Hours

Names	# of Weeks	Hours/Week	Trip Hours	Total Hours
Project Lead (list names)	16	6	94	190
Mentor (list name)	N/A			
Other Team Members	16	30	94	574

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5.3 Donors and Funding

Donor Name	**Type (**company, foundation, private, in-kind**)**	**Account Kept at EWB-USA?**	**Amount**
ERM Group Foundation	Foundation	Yes	$3,500
Willowbrook Rotary	Rotary	Yes	$2,000
St. Bernadette Church	Private	Yes	$7,200
Total Amount Raised:			**$12,700**

6.0 Project Location

Longitude: 99.8985833 W
Latitude: 23.8806 N

7.0 Project Impact

A reliable source of potable water will provide security and better health for the town residents. The incidence of gastrointestinal diseases like diarrhea can be reduced or eliminated. The differences between villages in the fight for clean water can be resolved and people who cannot afford water will be able to obtain it. People will no longer have to pay for a higher charge on bottled water due to transportation costs. A reliable source of water will avoid people to walk long distances. Such type of project will encourage village participation and may open the door for other sustainability projects to reduce hardships and generate better micro-economies.

Number of persons directly affected: 170
Number of persons indirectly affected: 0

8.0 Mentor Resume

NA

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Pre-Implementation Report Part 2 – Technical Information

1.0 INTRODUCTION

In March of 2007, EWB-JSC team members traveled to South Nuevo Leon, Mexico as part of an identification effort to locate villages in need of clean water and other public health needs. Based on water quality testing and brief health surveys, the team identified 5 communities that met the criteria, including the village of La Joya. However, per the assessments, the team decided to start with the community of Aguilar based on different parameters measuring need, and health conditions based on water quality, quantity, consumption proportional to population and degree of contamination. EWB-JSC decided to install a BYOW system in the village of Aguilar with a modification from a previously installed BYOW system in Rwanda. A pump was added to the system (versus a gravity fed system) to adapt it to the needs of the community (the team took into account the existence and use of electricity in the village). Once the system was installed in the summer of 2008, EWB-JSC decided to install another system in another one of the villages previously identified in 2007. It was determined the next best candidate is La Joya de San Diego, located about 3.5 hrs away from the nearest city of Dr. Arroyo.

2.0 PROGRAM BACKGROUND

The first phase of work in La Joya will be to install a water treatment system to treat the village's existing water supply. To this end, EWB-JSC will be building on previous development effort done for the Bring Your Own Water (BYOW) treatment system in Aguilar and Rwanda. The BYOW system has been a joint development effort between EWB-JSC and EWB-CU. The main advantage of the BYOW treatment system is that it can be located centrally in a community and treat water from a variety of sources. The BYOW system in La Joya differs from the previously installed systems in Aguilar and Rwanda. The system in Rwanda is basically a gravity fed system consisting of a roughing filter and a sand filter to filtrate the water, and a UV light to kill the bacteria. The BYOW in Aguilar has the same concept, except it is not gravity fed and an electric pump is used instead. For La Joya, since electricity is not reliable and the cost is extremely high, a manual pump will be used in the BYOW system to extract water from their main source. The major source of water in La Joya comes from an underground spring where the water is collected (an 8m deep hole). Around this hole, a small man made pond has been dug to collect more quantity of water during the rain season. Villagers seem to think the spring is the source of water, however EWB-JSC concluded rainwater replenishes this hole because the hole empties out during the dry season, and therefore the spring is really just underground rainwater that runs downhill from the mountains every time it rains. This water is collected by and distributed amongst the community on a daily basis depending on the needs of each family. The BYOW system lends itself to be easily inserted into this process to treat the water before final consumption.

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3.0 FACILITY DESIGN

3.1 Description of the Proposed Facilities

La Joya is a rural mountain community located in South Nuevo Leon, where poor health practices and water contamination cause various gastro-intestinal diseases. Infants get sick about 2-4 times per month, and the most common diseases are diarrhea, conjunctivitis, and respiratory infections. Adults get sick about 5-8 times per year with gastro-intestinal diseases, and home remedies are commonly used for treatment. Though doctors recommend boiling the water, it is not commonly practiced because most villagers feel that boiling water requires too much fuel, which is expensive and difficult to obtain. The villagers reported that they do not receive government assistance, and most people are reluctant to help because of the remote location. Most families send women and children to get water for drinking and cooking, and they try to ration water two tanks per week, which is below the minimum UN standard of 20L per day. Bottled water is not consumed because it is expensive and difficult to obtain. The proposed BYOW water purification system will allow villagers to safely consume water from their current reservoir, thus alleviating many of the gastro-intestinal diseases.

Due to the high cost of electricity in the remote mountain communities, manual pumps were investigated for delivering water to the BYOW system. Driving factors for pump selection include durability and performance. Because the reservoir is located approximately 10 feet below the location chosen for BYOW installation, the pump must deliver water across a height difference of 10 feet at approximately 5gpm for regular use. Additional pressure and flow out of the pump is desired for backwash capability because the terrain near the BYOW does not have natural elevation changes to support a backwash tank, as was implemented by EWB-JSC in Rwanda. A treadle style pump infrastructure was chosen for implementation due to design simplicity and prior success in many similar applications in the developing world.

The pump system will deliver water from the reservoir to a rapid sand filter. Water quality testing at the reservoir indicated low turbidity (<5 NTU), which eliminates the need for a roughing filer and simplifies the overall design. The rapid sand filer will reduce water turbidity to less than 1 NTU to ensure water clarity sufficient for sterilization. Backwashing will be used to remove debris from the filter system on a routine basis, so the system is designed to withstand the higher pressures associated with this operation and the piping allows for suitable forward and reverse flow paths.

Ultraviolet (UV) light will be used to kill microorganisms remaining in the water after filtration. The light is powered by a renewable energy source due to the high electricity costs, and solar power was identified as the best method for La Joya. After passing through the UV sterilization system, clean water will be dispensed to personal collection containers.

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3.2 Description of Design and Design Calculations

3.2.1 Pump System

The primary modification of the BYOW system design for the implementation in La Joya is the use of a manual pump for both pushing water through the system and to fluidize the sand bed when required for filter maintenance. EWB-JSC conducted a trade study on various manual pump designs to accomplish these goals.

3.2.1.1 Pump Trade Study

Two bilge style diaphragm pumps and a rotary pump were chosen for an initial capability test (see Appendix A for pump specifications). The team set up all three pumps in a stairwell to assess the feasibility of pumping water across a height difference of 15ft. The large bilge pump could not be self primed for water delivery at this height, and attempts to prime the pump were unsuccessful. The rotary pump produced steady output with a drill powering the rotating motion, but it also required assistance for priming. Implementation of the rotary pump would have utilized human power transferred from a bicycle through a gear train. The smaller bilge pump was able to pull water up 15ft, and it was successful in an additional test to simultaneously pull water up 15ft and push it another 10 ft to the next landing. Also this pump was capable of self priming.

Stairwell Testing

Research was conducted on the two pumps with successful stairwell test results. According to the rotary pump specification sheet (Appendix A), the lowest operating temperature for the Neoprene impeller is 45°F, and running the pump dry for more than 30 seconds can cause

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damage to the impeller. Therefore, the rotary pump was eliminated due to the restrictive operating temperatures and low durability.

Rotary Pump

The diaphragm material on the small bilge pump, Buna-N (NBR), can withstand temperatures as low as -30°C (MatWeb-Material Property Data), so we expect it to remain operational in the freezing weather La Joya experiences. We also placed the pump in a freezer overnight and began pumping it dry immediately upon removal. No damage on the pump was observed after this test or a repeated freezing test. Additionally it was determined that by integrating multiple small bilge pumps, the pump system can support backwashing. The manufacturer states a maximum flow rate of 15gpm for each pump at 90 cycles per minute. Prior BYOW designs accomplished backwashing by emptying a 55 gallon drum from a height of 10 feet into the sand filter. A test was conducted to determine the minimum flow rate required to fluidize the sand bed using the existing 55 gallon drum at a height of 10 feet and restricting flow incrementally. An average flow rate of 18gpm produced minimally acceptable backwashing results; therefore, two bilge pumps should be able to fluidize the sand bed.

3.2.1.2 Pump Design

For the final design, four small bilge pumps were chosen for the pump system to incorporate redundancy and reduce the speed required for backwashing. A quick test was conducted to ensure four pumps could sufficiently fluidize the sand bed. PVC inlet and outlet manifolds were used, and the test was performed without a height differential. Two men pumping two pumps each were able to achieve an acceptable level of fluidization.

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Initial Pump Backwashing Test

Information regarding pump life was obtained from a conversation with Bosworth, the small bilge pump manufacturer. A technical representative said the pumps lasted 400,000 cycles in their testing, which required the pump to lift water 2 feet and discharge in line with the pump, and the diaphragms were always the source of failure. Because our application demands a greater pump performance, the Bosworth representative estimated pump life would be cut in half. According to EWB-JSC's South Nuevo Leon Report, 20L of water lasts about three days for a family of four, and La Joya has approximately 50 families for a total population of 200. Using this information, we can estimate the life of our pump system.

(1) $20L/3\ days/4\ people \times (.264\ gal/1L) = 0.44\ gal/day/person$

The La Joya BYOW will need to process an average of 88 gallons per day for village consumption.

(2) $200{,}000\ cycles \times (.63L/cycle) \times (.264\ gal/1L) = 33{,}000\ gal$

Each pump will provide approximately 33,000 gallons over its life.

(3) $\frac{33{,}000gal \times 4\ pumps}{(88gal/day) \times (365\ days/year)} = 4$

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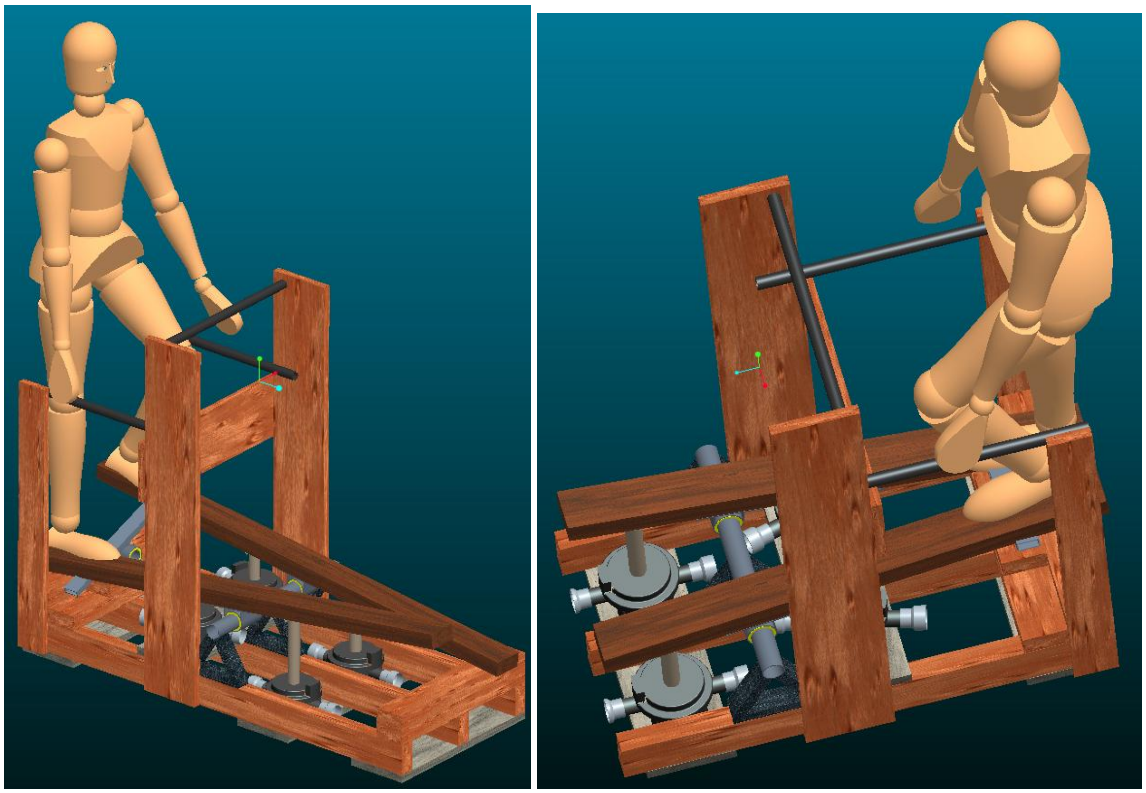
Therefore 4 pumps can provide water for La Joya for approximately 4 years, assuming cycles due to backwash are negligible (which is acceptable due to the low frequency).

Four water lines will run from the water source to the inlet of each pump. To improve ergonomics associated with pump use, provide for one person operation, and integrate the 4 pumps into a single system, our team designed a treadle infrastructure that would allow loads to be applied to the pumps from the legs instead of the arms. Each leg powers two pumps, attached to points below the steps. Handles will be installed for stability during use. Water will exit the pumps into a manifold, which will condense the output into one pipe going into the filer.



Pump System with Treadle-Style Infrastructure

3.2.2 Filtration System

The filtration system for La Joya utilizes a previously developed EWB-JSC and EWB-CU rapid sand filter design that has been successfully implemented in both Rwanda and Mexico. Test results have shown that it is capable of decreasing water turbidity to 1 NTU or lower. In this design, incoming water enters the rapid sand filter through a distribution arm at the top of the filter drum and flows down through the sand where small particles and bacteria are removed through a physical straining process. In backwashing mode the system is run in reverse to fluidize the sand bed and allow collected sediment to be washed out of the system.

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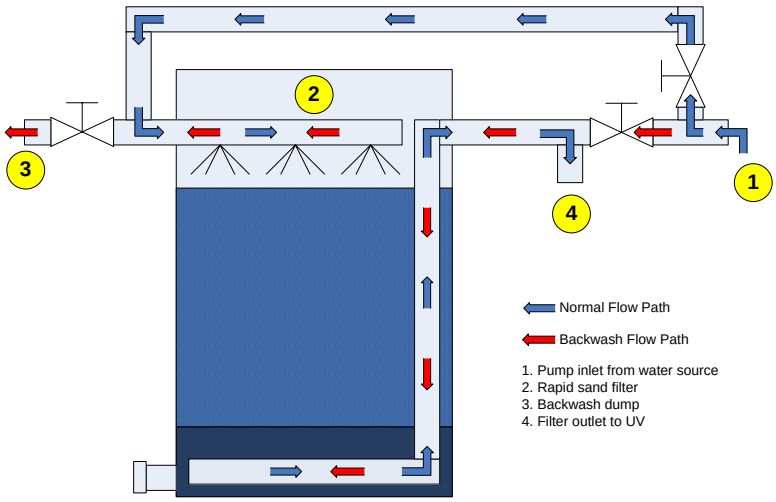

Filtration System Design

The filtration system was built inside a UN standard 55 gallon drum due to the large size and worldwide availability. Piping was constructed from PVC, and improvements for this iteration of the BYOW include optimized spacing of water outlet holes in the distribution arms and larger diameter piping to decrease pressure needed for the backwash operation.

3.2.3 Sterilization System

UV light is used for the final sterilization stage because it can achieve a 99.99% reduction of bacteria, viruses, and protozoa. The disinfection system design, also successfully implemented in communities in Rwanda and Mexico, utilizes a commercial-off-the-shelf disinfection unit and ballast capable of disinfecting water at 6 gpm. All the electronic components will be contained in a weatherproof electrical enclosure along with the necessary electrical and plumbing connections. The system is operated by actuating an electrical timer switch on the side of the box which allows the UV lamp to warm up. This switch turns on the UV system ballast, providing power to the light, and also actuates an electrical solenoid valve to allow the water to flow from the system after 60 seconds have passed. The UV system is powered by a 100 watt photovoltaic panel. The total draw of the disinfection system is approximately 25-40 watts. The PV installation was sized to provide power to the system for about 7 hours per day. Sealed, long life batteries were selected that require no maintenance and will ensure sufficient power is available for up to three days of continuous cloud cover.

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Sterilization System Diagram

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4.0 PROJECT OWNERSHIP

The community will own the EWB-JSC project. There is a plan to establish a committee with the women of the village. Once the committee is established, EWB members will help them establish a method to cover maintenance costs of the system, such as collecting a bi-monthly quota from each household or selling the filtrated water to each household at a minimum cost through water collectors and transporters. During the meetings, management of the project will be discussed to determine who gets to manage the project on the community level and what kind of external help they will be getting either from EWB-JSC or from a partner in Mexico. Finally, the committee will be educated on the operation and maintenance of the system, as well as on health education and usage of collected filtrated water to avoid recontamination.

5.0 CONSTRUCTION

5.1 Construction Plan

The pump consists of trimmed wood and metal stock, general fasteners, and manufactured parts. Prior to delivery, all parts will be pre-fabricated or purchased. The pump hardware will then be locally constructed and assembled for acceptance testing. Any refinements to the design will be implemented and retested for final acceptance. The hardware will then be disassembled and packaged for delivery to La Joya. The sand filter and UV electronics will also be constructed in Houston and transported via truck to Mexico.

EWB-JSC team members will assemble the hardware on site. Construction in La Joya will include pouring a cement pad to act as a foundation for the sand filter and pump. Once the system has been reassembled on the pad, a masonry housing will be built around the filter to provide additional protection and keep out light (the drum lids are not 100% opaque and allow light transmission, which can lead to algae growth if not covered). A small pole will be anchored in the pad for mounting the solar panel and UV electronics. Local representatives will be included in the assembly process to educate them about the system design. In La Joya, only general labor skills and basic tools will be needed.

5.2 Construction Safety Plan

Knowledgeable EWB-JSC members will be present during all phases of construction in La Joya to ensure proper safety protocol is being followed. These EWB representatives will be familiar with the product, as well as its testing and construction, from their involvement in the development efforts in Houston. Villagers will be properly educated before assisting in the construction of the BYOW or performing any operation/maintenance activities.

6.0 OPERATION AND MAINTENANCE PLAN

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Operation and maintenance of the BYOW is very simple, and a group of villagers will be trained by EWB-JSC members to perform these tasks. Additionally, a page of instructions, utilizing graphics to the extent practical, will be given to each family and placed at the site of the BYOW for reference. All written instructions will be provided in Spanish.

During normal operation, a user will place a personal water collection container under the outlet faucet and push a nearby button to turn on the sterilization system. After a one minute warm-up period for the UV light, the user will stand on the levers of the pump system and move in a stair-stepping fashion. This will force water from the reservoir through the sand and UV filters to the outlet. There will be a flow meter marked with the flow rate the pump operator needs to achieve for normal water filtration. This flow rate is limited by the capability of the UV light to ensure maximum sterilization. To prevent flow rates above the maximum, an overflow valve will be installed in the piping before the sand filter.

Periodic maintenance must be performed to clean the sand filer. Prior BYOW installations have utilized backwashing to remove debris from the filter. This will require someone to turn a valve, which will reverse the flow of water through the sand filter and clear out any built up debris. The pump system will be operated normally, but the flow meter will indicate another flow rate required to achieve fluidization of the sand bed. This flow rate is a minimum performance specification and will be higher than the flow rate for water collection. After pumping at the specified flow rate for two minutes, the valve should be switched back and normal operation can continue. To be conservative, backwashing has been traditionally recommended on a monthly cycle; however assessment trip results indicate that the La Joya water source has low initial turbidity. Because backwashing intervals are a factor of system use and source water contamination, it is recommended that La Joya perform backwashing maintenance once every 3 months or any time there is difficulty achieving an acceptable flow rate for water collection.

The UV light bulbs are rated for 365 days of continuous use. They are estimated to last at least 2-3 years with the anticipated usage schedule. Procedures for changing the bulbs and spare bulbs will be provided to the community.

7.0 SUSTAINABILITY

The BYOW system was designed to be compatible with La Joya's climate and culture. The only regular maintenance item for the BYOW system is backwashing. If villagers forget or do not perform the backwash, they can still receive clean water, but the flow rate may be reduced. The filtration system and the sterilization box have been successfully implemented in Rwanda by EWB-JSC, and are therefore proven designs for remote, rural communities.

Material availability and durability were strongly considered during selection of pump system components so that any unexpected repairs can be completed locally. The infrastructure is composed of standard materials, such as wooden boards and stock metal. Parts that cannot be assembled with standard fasteners will be welded together to strengthen the construction. The

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system runs off of human power, and the ergonomics will be configured so that women and children can operate the system. Because the pump diaphragm may wear out after a few years of use, replacement diaphragms will be provided to the villagers. Training on diaphragm replacement will be conducted during the implementation trip, and the replacement can be completed with a single Phillips head screwdriver.

While the UV/PV system is higher in design, there are many water treatment systems in the region that are on par with this level of engineering sophistication. Therefore, replacement parts are available if needed. The only anticipated maintenance will be changing the UV light bulb, and spare bulbs will be provided to the community. However, even with a total failure of the UV system the community will still have filtered water of a greater quality than they are currently consuming.

8.0 COST ESTIMATE

Cost estimate is included in section 5.1 (materials) for the water filtration system. The $4,000 for total materials includes the cost of the final pump infrastructures (about $1,000). The Bosworth pumps are about $80 each.

9.0 MENTOR ASSESSMENT

N/A

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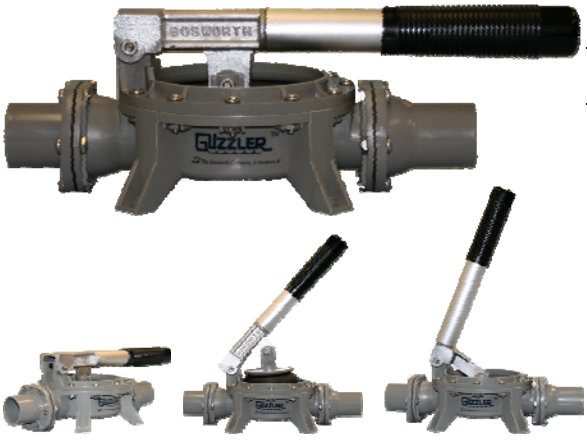
The BOSWORTH Company

Appendix A

GUZZLER® 500 HAND PUMP



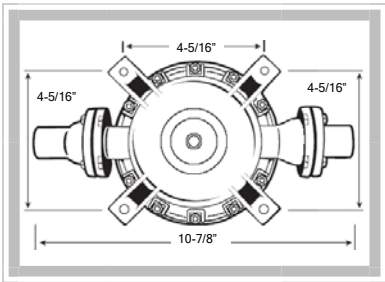
End View | Horizontal Handle–Upstroke | Vertical Handle–Downstroke

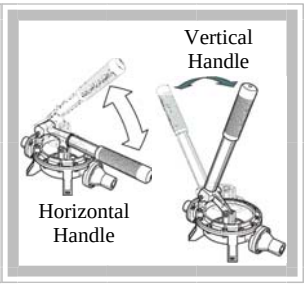
Model GH-500

Description Hand pump for use with 1 1/4" to 2" hose. Available with either horizontal or vertical handle.

Features

- Lightweight, economical
- Durable – Tough Delrin® plastic
- Clamp ring adjusts to 12 different handle orientations
- Available with a wide range of connection styles and sizes





Performance

	per Stroke	per Minute (@ 90 cycles/min)
Flow Rate	0.67 Qt 0.63 L	15 Gals 56.8 L
Max Pressure	20 psi	1.4 kg/cm^2
Max Head	12 ft	3.7 m
Max Lift	12 ft	3.7 m

Available Materials

Pump Body	Delrin (Gray)
Clamp Ring	Delrin, Epoxy-coated Aluminum
Diaphragm	Buna Nitrile (Buna N), Buna N Double Sided, Buna-N 3-Ply, Neoprene, Viton, EPDM, Urethane, Silicone
Valves	Buna N

Dimensions

	Length			Width	Height	
	Body	incl. H. Handle	incl. V. Handle		incl. H. Handle Up	incl. V. Handle Up
in	10 7/8	13 3/8	13	5 1/2	12	12 1/4
cm	27.62	33.97	33.02	13.97	30.48	31.12

Mounting Holes	4		
Mounting Hole Diameter	1/4 in	0.64 cm	**Weight**
Bolt Circle Diameter	6 1/8 in	15.56 cm	1.80 lb 0.82 kg
Hole-to-Hole Distance	4 5/16 in	10.95 cm	

Inlet & Outlet Ends & Sizes

in	mm	Hose (Smooth)	N.P.T. Female (Tapped Inside)	N.P.T. Male (Threaded Outside)
1 1/4	31.8		●	
1 1/2	38.1	**S**		●
2	50.8	●		

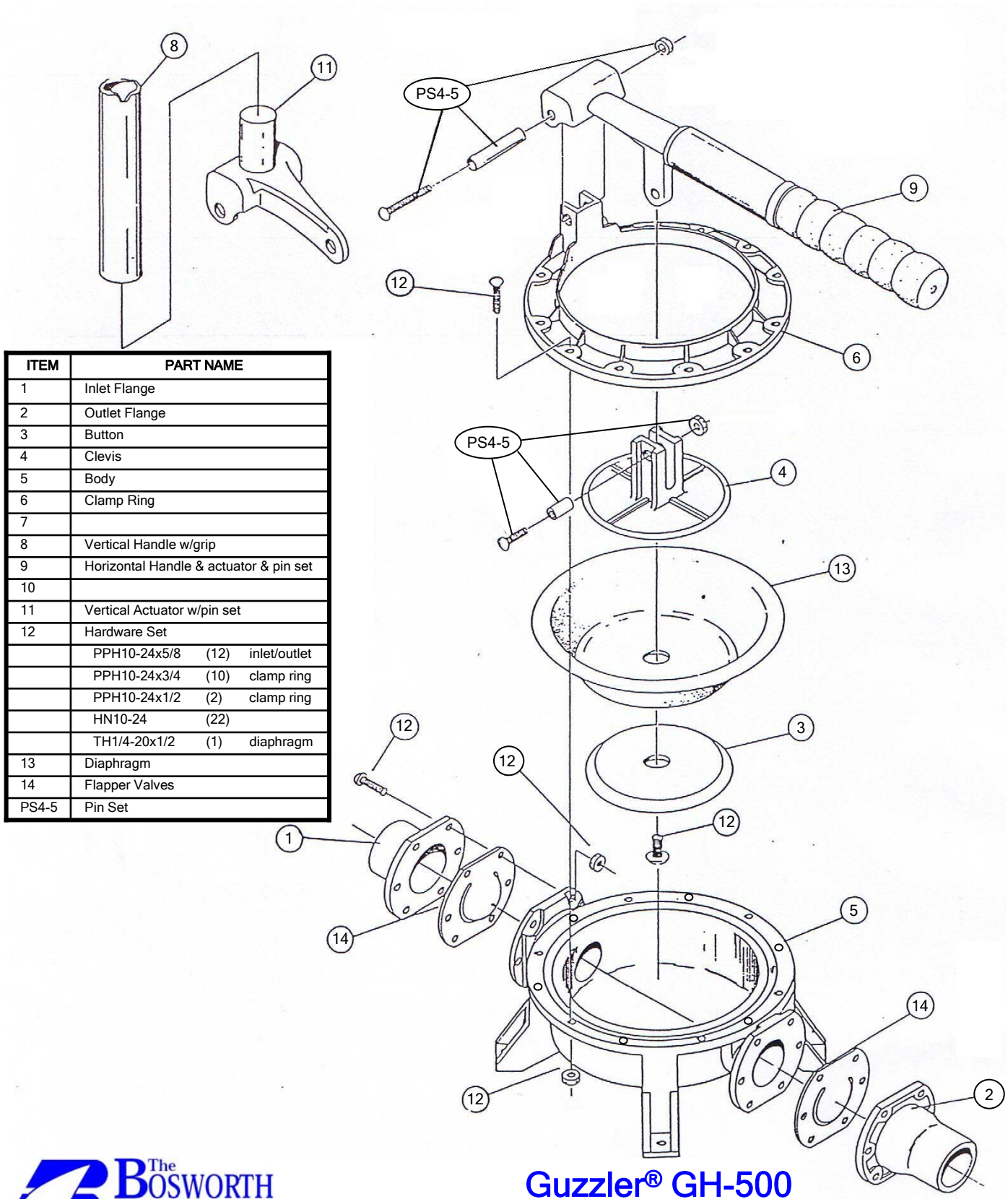
(**S**: standard ●: optional)

Other Options

Item	Standard	Optional
Valves	Flapper	Duckbill
Handle Style	Horizontal	Vertical (removable)
Other		Thru Deck Mounting Kit *(only for vertical handle)*
		Internal Spring

Consult factory for other options.

930 Waterman Avenue East Providence, Rhode Island 02914
Ph: 888-438-1110 Fax: 401-438-2713 Web: www.thebosworthco.com



ITEM	PART NAME		
1	Inlet Flange		
2	Outlet Flange		
3	Button		
4	Clevis		
5	Body		
6	Clamp Ring		
7			
8	Vertical Handle w/grip		
9	Horizontal Handle & actuator & pin set		
10			
11	Vertical Actuator w/pin set		
12	Hardware Set		
	PPH10-24x5/8	(12)	inlet/outlet
	PPH10-24x3/4	(10)	clamp ring
	PPH10-24x1/2	(2)	clamp ring
	HN10-24	(22)	
	TH1/4-20x1/2	(1)	diaphragm
13	Diaphragm		
14	Flapper Valves		
PS4-5	Pin Set		

Guzzler® GH-500

The Bosworth Company
930 Waterman Avenue East Providence, RI 02914
Ph: 401-438-1110 888-438-1110 Fax: 401-438-2713
www.thebosworthco.com

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JABSCO®

Model 1673-Series

SELF-PRIMING PUMPS

FEATURES

Body: Bronze
Impeller: Neoprene or Nitrile (Oil Resistant)
Shaft: Stainless Steel
Shaft Seal: Lip Seal, Buna N
Bearings: Sealed Ball Bearings
Ports: 1/2" NPT
Weight: 4-1/4 lb (2 kg) approx.

VARIATIONS AVAILABLE

MODEL	VARIATIONS
1673-1001	Neoprene Impeller
1673-1003	Nitrile Impeller (Oil Resistant)
1673-1051	Half Thickness Cam, (Where reduced capacity is required with a fixed speed)

Model 1673-Series

APPLICATIONS & OPERATING INSTRUCTIONS

MARINE: Engine cooling, Pumping bilges, Washdowns, Circulating water in bait tanks, Utility dock side pump.

INDUSTRIAL: Circulating and transferring, Velocity-mixing, Pumping machine tool coolants, Return spill, Sump drainage, Chemicals, Pharmaceuticals, Soap, Liquors, Ink, Dyes, Alcohol, Various acids, Tanning liquors, Glycerine, Brine, etc.

FARMING: Pumping water for stock, Pumping water from shallow wells and cisterns, Pumping liquid ballast into tractor tires.

PLUMBING AND HOME EMERGENCY USE: Pumping out flooded basements, Cesspools, Sumps, Water heaters and water closets, Drains and sinks, Draining fishponds and pools.

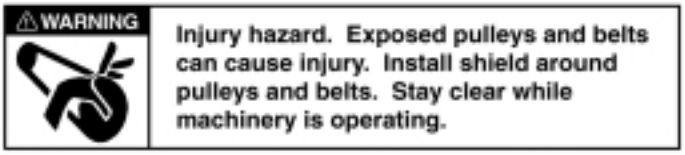
1. **INSTALLATION** – Pump may be mounted in any position. Intake and discharge ports are determined by the direction of shaft rotation (refer to Dimensional Drawing). Before installing, turn the pump shaft in the direction of the operating rotation.

2. **DRIVE** – Belt or Direct with flexible coupling.

   NOTICE: Do not press pulley or coupling on the shaft without supporting the shaft at the opposite end to prevent its movement into the impeller bore.

   Belt Drive – Overtight belt load will reduce pump bearing life.

   Direct Drive – Clearance should be left between drive shaft and pump shaft when installing coupling. Always mount and align pump and drive shaft before tightening the coupling set screw.



3. **SPEEDS** – 100 RPM to the maximum shown in the performance table. Consult the factory for operation at speeds above those shown. For longer pump life, operate at lowest possible speeds.

4. **SELF-PRIMING** – Primes at low or high speeds. For vertical lift of 10 feet (3.0mm), a minimum of 800 RPM is required. Pump will produce suction lift of up to 22 feet (6.7m) when wetted. BE SURE SUCTION LINES ARE AIRTIGHT OR PUMP WILL NOT SELF-PRIME.

5. **RUNNING DRY** – Unit depends on liquid pumped for lubrication. DO NOT RUN DRY for more than 30 seconds. Lack of liquid will damage the impeller.

6. **NOTICE** – Do not pump light fraction petroleum derivatives, solvents, thinners, highly concentrated or organic acids. Damage to pump may result. Consult Jabsco Chemical Resistance Table, available upon request from Jabsco, for proper body materials and impeller compounds. If corrosive fluids are handled, pump life will be prolonged if pump is flushed with water after each use or after each work day.

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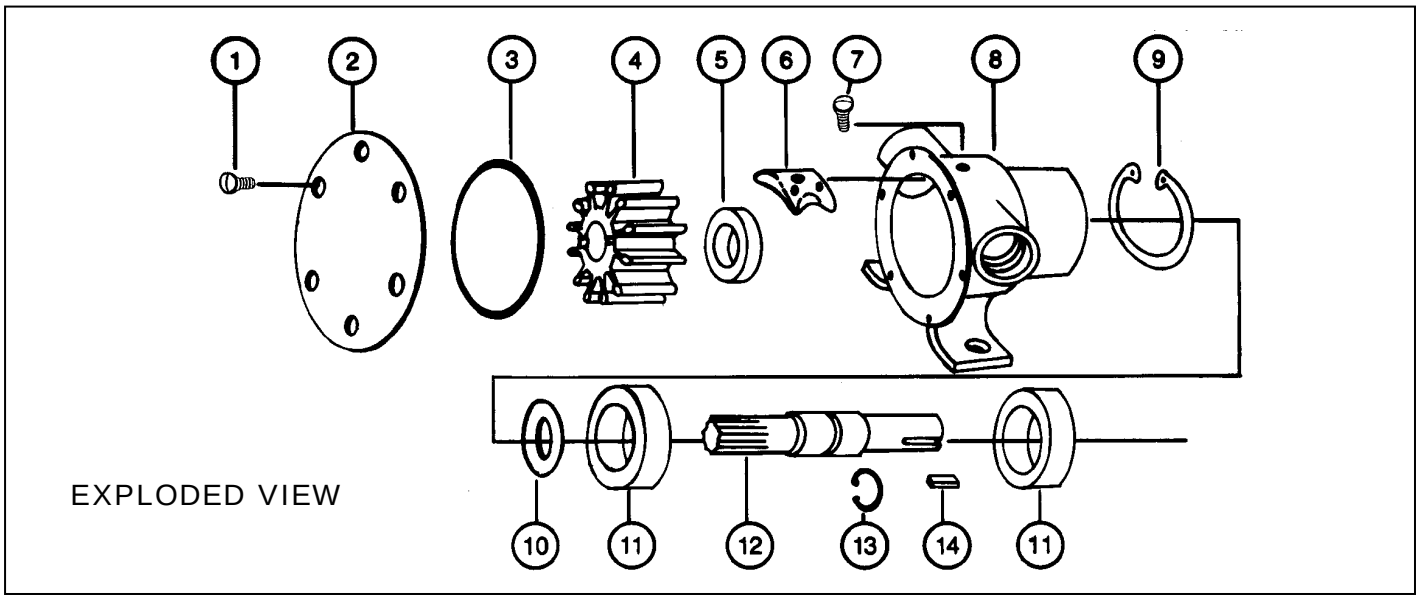
OPERATING INSTRUCTIONS (Cont.)

7. **PRESSURES -** Consult Head Capacity Table for recommended maximum for continuous operation. If pressures exceed those shown, consult the factory.

8. **TEMPERATURES -** Neoprene 45°-180° F (7°-82° C), Nitrile 50°-180° F (10°-82° C).

9. **FREEZING WEATHER -** Drain unit by loosening end cover. The following anti-freeze compounds can be used without any adverse effects to the neoprene impeller: Atlas “Permaguard”, DuPont “Zerex” and “Telar”, Dow Chemical “Dowguard” and Olin Mathison “Pyro Permanent”. Most methyl alcohol (methanol) based antifreeze can be used with neoprene. **(DO NOT USE PETROLEUM BASED ANTI-FREEZE COMPOUNDS OR RUST INHIBITORS.)**

10. **SPARE PARTS -** To avoid costly shut downs, keep a JABSCO Service Kit on hand.



EXPLODED VIEW

PARTS LIST

KEY	DESCRIPTION	PART NO.	QTY
1	SCREW KIT (CAM & END COVER SCREWS)†	18753-0134	1
2	ENDCOVER	11836-0000	1
3	*O-RING	18753-0133	1
4	*IMPELLER		1
	NEOPRENE	1210-0001	
	NITRILE	1210-0003	
5	*SEAL	92700-0060	1
6	CAM		1
	FULL THICKNESS	490-0001	
	HALF THICKNESS	2434-0000	
7	SCREW, CAM	SEE KEY1	
8	BODY	18753-0128	1
9	RETAINING RING	18753-0131	1
10	SLINGER	3286-0000	1
11	BEARING	92600-0120	2
12	SHAFT	18753-0129	1
13	RETAINING RING	18753-0132	1
14	KEY	9215-0010	1
	SERVICE KIT		
	NEOPRENE	90015-0001	
	NITRILE	90015-0003	

* Parts supplied in Service Kit. Also included is an end cover gasket for older model pumps. Do not use gasket with O-ring end cover seal.

† Screw Kit contains 7 each #10-32 x 3/8” pan. hd. mach. screws and 1 each #10-32 x 5/16”pan. hd. mach. screw. The 5/16” screw is used only with a half thickness cam.

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DISASSEMBLY

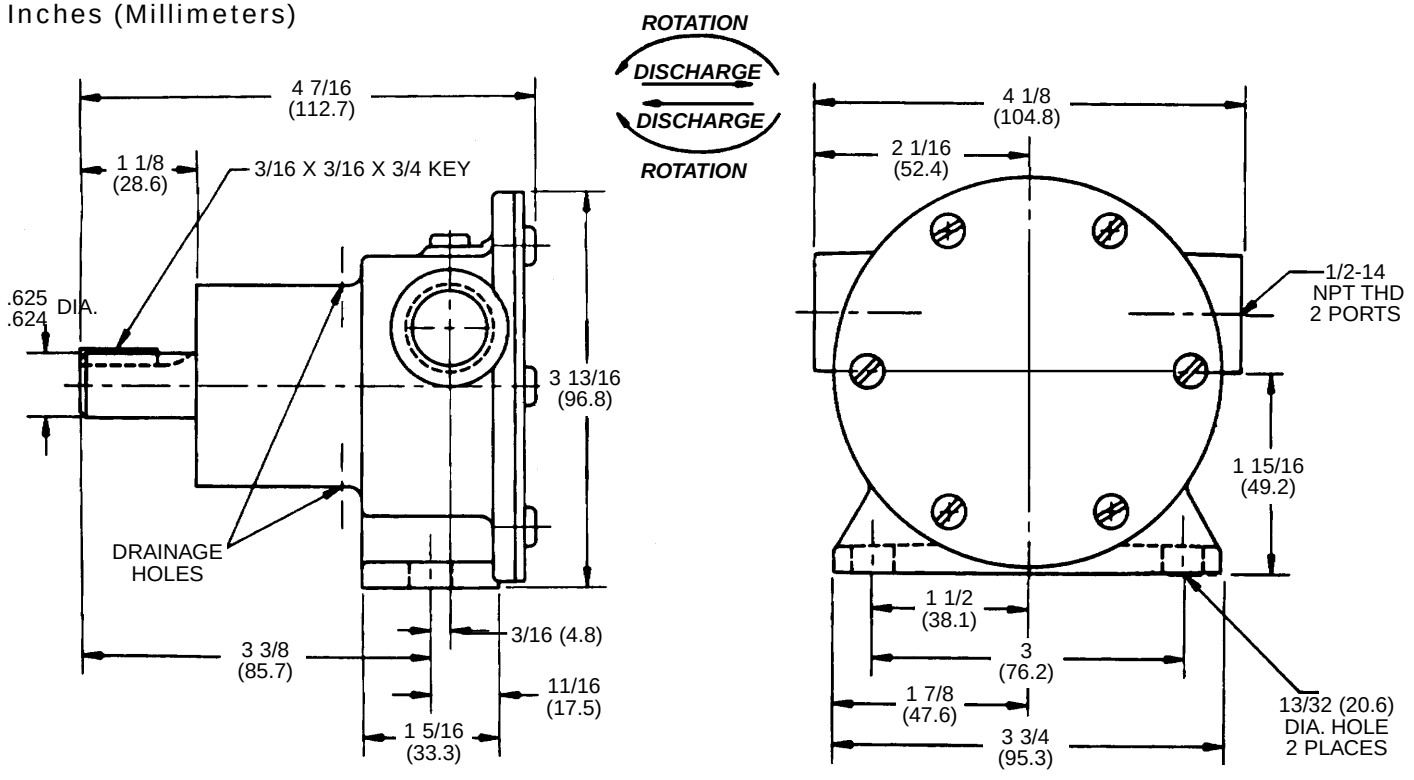
1. Remove end cover screws, end cover and O-ring.
2. Remove impeller by grasping hub with water pump pliers.
3. Loosen cam screw and remove cam (clean off sealant).
4. Remove pulley or coupling and key from shaft.
5. Remove retaining ring which secures bearing shaft assembly to pump body.
6. From impeller end of pump, press bearing and shaft assembly out of bearing bore. Remove slinger from shaft.
7. From drive end of pump, press the seal out of the seal bore.
8. It bearings or shaft need to be replaced, carefully insert two equal size slot screwdrivers between bearings 180 apart. Simultaneously twist screwdrivers in opposite directions to separate bearings. Continue to push bearings off of shaft taking care not to damage bearings or scratch shaft.
9. Remove snap ring that positions the bearings on the shaft.

NOTE: Inspect all parts for wear or damage and replace where necessary.

ASSEMBLY

1. Install bearing positioning snap ring on shaft.
2. Press bearings (one from each end of shaft) onto shaft and against positioning snap ring. Slide slinger onto impeller end of the shaft and position against raised shoulder near bearings.
3. Press seal (with lip pointing toward impeller bore) into seal bore in pump body. Ensure it is seated in bottom of seal bore. Lubricate seal lip with a small amount of grease.
4. Align impeller end of shaft with the seal and press shaft/bearing assembly into the bearing bore (push on bearing outer race). Install bearing retaining ring in retaining ring groove With concave side facing out toward drive end of shaft.
5. Apply a thin layer of sealant to screw threads and top of cam and install in body. Secure with cam screw.
6. Lubricate impeller bore with light coat of water pump grease and start impeller into bore with a rotary motion, until impeller screw engages slot in shaft, then push into bore.
7. Install O-ring and end cover. Secure with end cover screws.

DIMENSIONAL DRAWING
Inches (Millimeters)



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HEAD CAPACITY TABLES

1673-1001 NEOPRENE

TOTAL HEAD		500 RPM		1160 RPM		1750 RPM		2100 RPM		2450 RPM		2750 RPM		3000 RPM		3600 RPM	
P.S.I. (kPa)	Ft. of Water (metre)	GPM (L/min)	HP	GPM (L/min)	HP	GPM (L/min)	HP	GPM (L/min)	HP	GPM (L/min)	HP	GPM (L/min)	HP	GPM (L/min)	HP	GPM (L/min)	HP
4.3	10	3.0	1/6	7.6	1/4	11.0	1/4	13.0	1/3	15.2	1/2	16.7	1/2	18.0	1/2	19.6	3/4
(29.7)	(3)	(11.3)		(28.7)		(41.6)		(49.2)		(57.5)		(63.2)		(68.1)		(74.2)	
8.7	20	1/8	1/6	6.4	1/4	10.0	1/4	11.5	1/3	13.7	1/2	15.4	1/2	17.0	1/2	18.8	3/4
(60.0)	(6)	(6.8)		(24.2)		(37.8)		(43.5)		(51.8)		(58.3)		(64.3)		(71.1)	
13.0	30	–	–	4.8	1/4	8.5	1/3	10.0	1/2	12.0	1/2	13.6	3/4	15.3	3/4	17.5	3/4
(89.7)	(9)			(18.2)		(32.2)		(37.8)		(45.4)		(51.5)		(57.9)		(66.2)	
17.3	40	–	–	3.3	1/4	6.7	1/3	8.5	1/2	10.4	1/2	12.0	3/4	13.5	3/4	16.0	1
(119.4)	(12)			(12.5)		(25.3)		(32.2)		(39.3)		(45.4)		(51.1)		(60.5)	
21.6	50	–	–	–	–	5.0	1/2	6.7	1/2	8.5	3/4	10.0	3/4	11.8	3/4	14.5	1
(149.0)	(15)					(18.9)		(25.3)		(32.2)		(37.8)		(44.6)		(54.9)	
26.0	60	–	–	–	–	–	–	5.0	1/2	7.0	3/4	8.3	3/4	10.0	3/4	13.0	1
(179.4)	(18)							(18.9)		(26.5)		(31,4)		(37.8)		(49.2)	
30.3	70	–	–	–	–	–	–	–	–	–	–	6.5	3/4	8.0	1	11.0	1
(209.1)	(21)											(24.6)		(30.3)		41.6	

1673-1003 NITRILE

TOTAL HEAD		500 RPM		1160 RPM		1750 RPM		2100 RPM		2450 RPM		2750 RPM		3000 RPM		3600 RPM	
P.S.I. (kPa)	Ft. of Water (metre)	GPM (L/min)	HP	GPM (L/min)	HP	GPM (L/min)	HP	GPM (L/min)	HP	GPM (L/min)	HP	GPM (L/min)	HP	GPM (L/min)	HP	GPM (L/min)	HP
4.3	10	2.2	1/6	5.8	1/4	9.5	1/4	11.5	1/3	13.3	1/2	15.0	1/2	16.0	1/2	18.2	3/4
(29.7)	(3)	(8.3)		(21.9)		(35.9)		(43.5)		(50.3)		(56.8)		(60.5)		(68.9)	
8.7	20	–	–	4.3	1/4	7.6	1/3	9.4	1/3	11.4	1/2	13.0	1/2	14.4	1/2	17.0	3/4
(60.0)	(6)			(16.3)		(28.7)		(35.6)		(43.1)		(49.2)		(54.5)		(64.3)	
13.0	30	–	–	2.5	1/4	6.0	1/3	7.4	1/2	9.3	1/2	11.0	1/2	12.6	3/4	15.3	3/4
(89.7)	(9)			(9.4)		(22.7)		(28.0)		(35.2)		(41.6)		(47.7)		(57.9)	
17.3	40	–	–	–	–	4.2	1/2	5.6	1/2	7.5	1/2	9.2	3/4	10.8	3/4	13.6	1
(119.4)	(12)					(15.9)		(21.2)		(28.4)		(34.8)		(40.9)		(51.5)	
21.6	50	–	–	–	–	–	–	3.9	1/2	5.7	3/4	7.2	3/4	9.0	3/4	11.7	1
(149.0)	(15)							(14.7)		(21.6)		(27.2)		(34.0)		(42.3)	
26.0	60	–	–	–	–	–	–	–	–	–	–	5.5	3/4	7.1	3/4	9.7	1
(179.4)	(18)											(20.8)		(26.9)		(36.7)	

1673-1051 HALFCAM NEOPRENE

TOTAL HEAD		500 RPM		1160 RPM		1750 RPM		2100 RPM		2450 RPM		2750 RPM		3000 RPM		3600 RPM	
P.S.I. (kPa)	Ft. of Water (metre)	GPM (L/min)	HP	GPM (L/min)	HP	GPM (L/min)	HP	GPM (L/min)	HP	GPM (L/min)	HP	GPM (L/min)	HP	GPM (L/min)	HP	GPM (L/min)	HP
4.3	10	1.6	1/6	4.1	1/6	6.3	1/4	7.7	1/3	9.0	1/3	10.1	1/2	11.0	1/2	13.1	3/4
(29.7)	(3)	(6.1)		(15.5)		(23.8)		(29.1)		(34.0)		(38.2)		(41.6)		(49.6)	
8.7	20	1.2	1/6	3.6	1/6	5.8	1/4	7.0	1/3	8.4	1/2	9.5	1/2	10.2	1/2	12.3	3/4
(60.0)	(6)	(4.5)		(13.6)		(22.0)		(26.5)		(31.8)		(35.9)		(38.6)		(46.5)	
13.0	30	–	–	3.1	1/6	5.0	1/3	6.2	1/3	7.6	1/2	8.6	1/2	9.4	3/4	11.3	3/4
(89.7)	(9)			(11.7)		(18.9)		(23.4)		(28.7)		(32.5)		(35.6)		(42.8)	
17.3	40	–	–	2.4	1/6	4.1	1/3	5.3	1/2	6.7	1/2	7.7	3/4	8.9	3/4	10.3	3/4
(119.4)	(12)			(9.1)		(15.5)		(20.0)		(25.3)		(29.1)		(31.8)		(39.0)	
21.6	50	–	–	–	–	3.1	1/3	4.2	1/2	5.7	1/2	6.7	3/4	7.4	3/4	9.2	3/4
(149.0)	(15)					(11.7)		(15.9)		(21.5)		(25.3)		(28.0)		(34.8)	
26.0	60	–	–	–	–	–	–	–	–	4.5	1/2	5.6	3/4	6.3	3/4	8.1	3/4
(179.4)	(18)									(17.0)		(21.2)		(23.8)		(30.6)	

Note: Progressively longer life may be expected as operating pressures and speeds are reduced. Factory Application Engineering assistance suggested for operation in light area and recommended for heavy shaded area Capacitor type motor recommended. Table shows approximate Head-Flow for new pump in US gallons (and liters) per minute.

Jabsco

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