

Cal Poly Solar Decathlon

Water Systems

by

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Executive Summary

The final design of the water systems for the Cal Poly Solar Decathlon House includes the fresh, grey, and black water subsystems. This includes the West end of the deck including the “tank farm,” which will contain most of our system’s components. We believe that these systems have been designed to ensure low cost and energy usage, safe transportation of all water, and aesthetics that fit in well with the architect’s design.

Supply Water

For the Solar Decathlon competition, the house will need a source of pressurized fresh water, since the house will not be connected to a municipal water supply network. This means we will need to pressurize our own supply water from the fresh water supply tank. For this system, the Department of Energy will provide water and energy for pressurization, but we needed to specify components and design the means of transporting the water to the rest of the house. The Water Systems Team is in charge of the supply tank and pressurization of fresh water going to the house while the Piping and Plumbing sub team is in charge of the piping within the interior of the house. Referencing our water budget, we decided to purchase a 1275 gallon Norwesco Low-Profile Storage Tank for our supply water. The tank will be placed within the tank farm, which will be shaded from direct sunlight and away from human eyesight. We plan to purchase a Walrus TQ800 1 HP booster pump for water pressurization. It is a pressure controlled pump with an internal pressure tank, allowing for small amounts of energy storage. We also plan to purchase a 20 gallon Water Worker pressure tank for intermediate storage. Both the pump and intermediate tank will be stored in the tank farm. Using fluid dynamics calculations, we have confirmed that this system will provide the interior of the house with 50 psig of water pressure.

Grey Water Recycling

We plan to recycle grey water output from the washing machine, shower, and bathroom sink using a constructed wetlands filtration system. With the wetlands operating at steady state, the system will be able to mechanically, biologically, and chemically treat the grey water so it can be safely used as irrigation to plants around the house. The wetlands are composed of three cascading wetland cells filled with layers of gravel and soil, with water dwelling plants rooted into the soil. A pump will be used to transport the grey water coming from the house to the first wetland tank, located at the southwest corner of the deck. We plan to purchase a Drainosaur Little Giant Sump Pump, which will be located underneath the deck outside of the exterior bathroom wall. Grey water from the house will be gravity fed to the pump, which is contained within a 3.5 gallon tank. As the container fills with water, a controller will switch the pump on, transporting the water to the first planter tank. The three tanks are connected in series, so the grey water will flow through each wetland cell and exit from the outlet of the third tank. After the plants and gravel filter the water, it will be safe to be used for irrigation or discharged into the ground. We plan to transport the recycled water to another planter bed designed by the landscape architecture team.

Black Water Removal

Our final subsystem involves removing black water from the house and storing it in a shaded outdoor tank. This includes water from the dishwasher, kitchen sink, and toilet. Although the

toilet will be sealed during the competition, we will produce black water from the sink and dishwasher. The Piping and Plumbing sub team specified a black water pump and designed the piping, so we chose a storage tank to hold the water. Using our water budget, we chose a 50 gallon Den Hartog Low-Profile Utility Tank for black water storage.

Chapter 1: Introduction

Our group is devoted to designing and building a functional water system for the Cal Poly Solar Decathlon house, dealing with the movement and storage of fresh, grey, and black water. We plan to transport fresh water to all appliances and water outlets, recycle as much grey water as possible, and safely dispose of all black water. Since California is currently experiencing one of the largest droughts in recorded history, we are focusing on creating an efficient and cost-effective grey water system in order to safely reuse water. To do this, we plan to design and build a pressurized fresh water supply system, a constructed wetland grey water filtration system, and a black water storage tank.

Pressurized Supply Water: The fresh water will need to be pressurized to around 50 psi for adequate pressure to each house appliance. We plan to pressurize a smaller tank before the water enters the house which will be controlled by a pump that first pressurizes the water, then shuts off and prevents backflow. This keeps the water pressurized while not requiring the pump to be on continuously.

Subsurface Flow (SSF) Constructed Wetlands: In order to safely reuse the grey water for irrigation, we first need to provide filtration of suspended particulate in the water as well as chemical and biological filtration. Along with pre-filter integrated in the intermediate pump, the constructed wetlands will provide sufficient chemical and biological filtration by running the water under the substrate with the plants growing on top. The microorganisms grow and thrive off the waste in the grey water and thus clean the water before it is sent to irrigation. There will be three cascading wetlands in order to maximize the wetland area and allow plenty of room for adequate filtration.

Black Water Storage Tank: The black water coming from the kitchen sink and dishwasher will need to be safely stored before getting picked up after the competition. To do this, a simple storage tank will be used to store any black water and excess grey water coming from the house during competition.

Project Management

In order to execute the goals of the Water Systems Team in a timely manner, a management plan was utilized throughout the project to help keep the team organized. The Gantt chart used to organize the project schedule can be seen in Appendix M. Throughout the project the team kept on track and reached all deadlines on the Gantt Chart in a timely manner. Although the project is a collective effort overall, each team member was in charge of different aspects of the water system. The responsibilities are divided up as follows:

Constructed Wetlands Tank Dimensions/Layout and Tank Farm Housing/Layout - Lauren Jones

Supply Water Pressurization and Grey Water Pump - Jake Morris

Constructed Wetlands Filtration Materials and Water Treatment - Zach Yasuda

Chapter 2: Background

CA Building Code and Competition Rules

The Solar Decathlon is a competition held by the U.S. Department of Energy which challenges teams to build solar-powered houses that are cost-effective, energy-efficient, and attractive [1]. The Cal Poly Solar Team is currently in the process of designing a house for the 2015 competition held in Irvine, CA. Recently, in January 2014, Governor Brown officially declared a drought State of Emergency in the state of California [2]. Given the drought condition, it is imperative to build a house that is not only energy-efficient and cost effective, but water-efficient as well. In order to reduce the amount of water the house will require, a water system must be developed to capture and reuse grey water. The California Plumbing Code defines grey water as, "Pursuant to Health and Safety Code Section 17922.12, "grey water" means untreated wastewater that has not been contaminated by any toilet discharge, has not been affected by infectious, contaminated, or unhealthy bodily wastes, and does not present a threat from contamination by unhealthful processing, manufacturing, or operating wastes. "Grey water" includes but is not limited to wastewater from bathtubs, showers, bathroom washbasins, clothes washing machines, and laundry tubs, but does not include wastewater from kitchen sinks or dishwashers." [3]

Grey Water

Currently, private home grey water systems are primarily used to collect water for irrigation, indoor water reuse, and heat recovery. Although grey water may be reused indoors, the focus of our project is preparing the water for irrigation purposes as dictated by Solar Decathlon rules, which prohibit the use of grey water for any other use. In order to use the reclaimed water for irrigation, the water needs to be filtered to remove the large particles and harmful chemicals/bacteria that can wash down drains and come from washing machines. To clean the water, special grey water pumps and filters or constructed wetlands may be used.

Filters & Pumps

Many grey water systems employ the use of pumps and filters to actively clean the water before sending it out to irrigation. Although all grey water systems that collect water from the clothes washing machine benefit from the flow caused by the washing machine pump, some systems use additional pumps to keep the water flowing. The benefits of pump driven systems include: uphill water travel and the ability to move the water far distances for irrigation far from the home. The main disadvantage of using additional pumps is the energy input required to run the system. An effective filter and pump system on the Australian market is the Aqua2Use GreyWater Diversion Device [4]. This device uses 3 progressive filtration chambers to remove hair, lint, soap residue, and other particles from the grey water. Clean filtered water is then pumped out of the device to be used in a garden application such as a drip line. This pump system has advantages including small size, simple installation, and it plugs into a 110 Volt outlet. However, the numerous advantages come at a high price tag with an initial cost of \$700 plus another \$150 every 6 months to replace the filters.



Figure 1. Aqua2Use Grey Water Diversion Device used to actively filter grey water [4].

Constructed Wetlands

Constructed wetlands are used in water systems to contain and filter grey water while providing vital nutrients to plant life. The benefits of using a constructed wetland for water filtration include: minimal required maintenance, can tolerate fluctuations in water flow, may require only gravity for flow, provide habitat for wetland organisms, and they fit harmoniously into the landscape. The disadvantages of a constructed wetland system include: minimum water amount required to sustain plant life, water surges may hinder filtration quality, and wetlands require more square footage than a simple pump and filter [5].

Two types of constructed wetlands include surface flow (SF) and subsurface flow (SSF) wetlands, each having their own advantages and disadvantages. Surface flow wetlands require the surface of the water to flow above the substrate surface by a few inches. This provides more air to the water and thus more aerobic processes to occur. Surface flow wetlands are generally simpler and have less costs associated with setup and maintenance. On the other hand, subsurface flow wetlands have the flow of water completely underneath the substrate and through a porous material. This provides better temperature tolerances and pest control as well as more anaerobic processes. Although subsurface flow wetlands are more complicated and require a more uniform water flow free of larger particulate, they are generally better for smaller volumes of water and require less space. The increased surface area of the porous material provide more water treatment than surface flow wetlands per square foot and therefore do not require as large of a footprint [5]. This is important to us as aesthetics are an important aspect to the house and our wetland must fit in with the rest of the house.

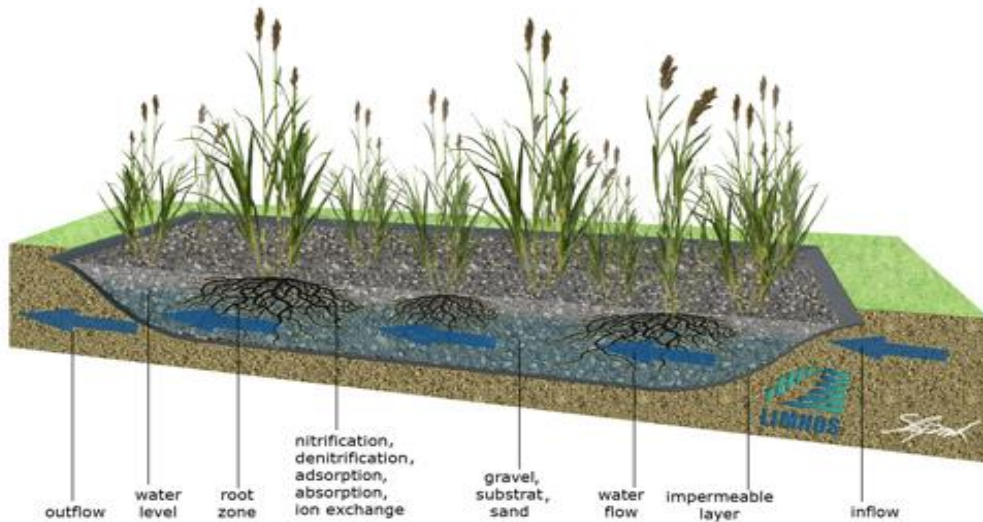


Figure 2. Subsurface Flow (SSF) Constructed Wetlands [6].

Design of the wetland is based on many factors to ensure sufficient water treatment for the given water volume, influent water quality, and required effluent water quality. Most water treatment processes focus on treating BOD (biochemical oxygen demand), suspended solids (TSS), and nitrogen, as well as other levels of metals, organics, and pathogens.

Biochemical oxygen demand is the oxygen required by any organics in the water. This is removed by running the water through the beneficial bacteria growing on the porous rock and roots of the wetland. These include both aerobic and anaerobic processes (requiring/not requiring oxygen), which means ideally, the water should have sufficient oxygen in it to support these processes. Influent BOD levels can be anywhere from 150 - 500 mg/L which depends largely on where the grey or black water is coming from. Much of the BOD is a result from the food particulate coming from the kitchen sink or dishwasher. Since we will not be collecting water from either of these sources (which are considered black water and cannot be used for anything), our influent BOD levels will be much lower than normal. Depending on the size of the wetland, effluent BOD levels can be as low as 20 mg/L, a common permit requirement, or lower. BOD removal is a factor of flow rate, substrate surface area (porosity), temperature, the wetland volume, and the influent and effluent BOD levels [7].

Total suspended solids are also a design criteria for many wetlands. This is the removal of inorganic particulate in the water. Most wetlands are able to remove most of the TSS in the first 12-20% of the wetland area, going from around 160 mg/L to under 20 mg/L exiting the wetland [7]. A common problem with TSS removal is short circuiting the water flow. This occurs with either improper design of inlet and exit locations, an uneven bed or substrate distribution, or clogging leading to water flowing over the surface. Careful design and construction is required to ensure an even distribution of water flow as well as a pre filter or settling tank to prevent clogging of the wetland.

Wetlands are also very effective in the removal of nitrogen in the grey water. This includes organic nitrogen, ammonia nitrogen, and nitrate nitrogen. These nitrogen removal processes

differ but generally require sufficient surface area and biological growth and oxygen in the water. Removal of nitrogen is also temperature dependent which is especially important in places where the temperature gets below freezing. Since the processes are highly dependent on the biological growth in the wetland, it may take several years to develop the necessary biological diversity and reach equilibrium.

Settling Tank

In order to ensure a uniform flow through the wetland, a pre-filter must be in place to initially remove some of the larger particulates such as hair or large dirt particles. The large particulates must be removed to prevent help prevent clogging of the wetlands. Clogging is an issue because it causes disruptions in the water flow which can lead to short-circuiting. There are a few different pre-filter options to consider, but the two most commonly used are screen filters and settling tanks. A filter was considered but decided against it because not only would it require additional maintenance and operating costs, would also possibly clog and restrict all flow into the wetland. Instead we chose to implement a settling tank, which is simply a tank that the water passes through before heading to the wetland. This tank would slow the flow of water enough to let any large particles to sink to the bottom where they won't get sucked through the exit, located closer to the top of the tank.

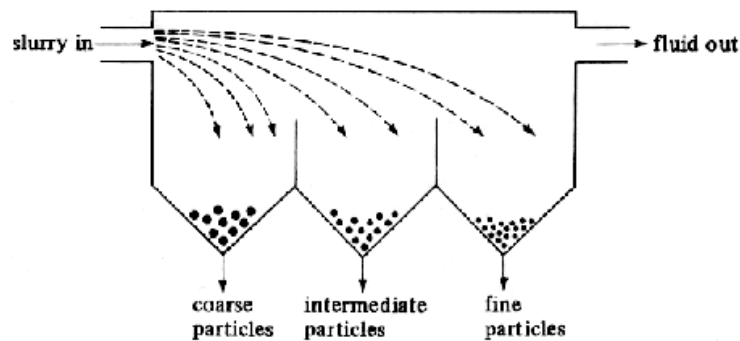


Figure 3. Simple settling tank designed to remove particles from the water [8].

Previous Solar Decathlon Example

Although grey water recycling is not common in the average home, many past Solar Decathlon houses have successfully collected and recycled grey water. The winner of the 2011 competition was the WaterShed, built by University of Maryland, which was designed with its water system as the focus of the house [9]. This house utilized a green, butterfly roof for collecting rainwater and constructed wetlands for grey water filtration. The constructed wetlands successfully filtered the grey water for irrigation while adding to the aesthetic appeal of the landscape. Although the WaterShed house built a very successful filtration system, the house lacked the ability to extract heat from the grey water before it entered the holding tanks.



Figure 4. University of Maryland WaterShed House with Constructed Wetlands

Heat Recovery

In addition to using the grey water for irrigation, it is also possible to extract heat from some of the grey water in order to reduce the energy needs of the house. Grey water heat recovery systems have been implemented worldwide ranging from city-wide sewer heat recovery to simple residential shower heat recovery. There are currently products on the market for waste heat recovery, such as the EcoDrain, which claim to recover up to 45% of waste heat from shower drains [10]. The EcoDrain is a small horizontal heat exchanger that can be installed in any existing plumbing system. The design aspect that makes the EcoDrain successful is the turbulator in the freshwater stream which maximizes the heat transfer. In a study done at the Norwegian University of Science and Technology it was concluded that a shower waste water heat exchanger can reduce the energy use per shower by 42.6% [11].



Figure 5. EcoDrain heat exchanger for use with the shower water [10].

Supply Water

Most houses use water from the city where it is initially pressurized to about 40-60 psi, which is sufficient to allow a steady flow through all faucets and appliances used in the house. For the Solar Decathlon, we are required to store our water in tank on site. This means that we will not have the luxury of connecting to the municipal water supply and must pressurize the water ourselves. Fortunately, all of the power used for this purpose does not need to be included in the energy budget and will be covered by the Department of Energy during the competition. Nevertheless, we would still like to build an energy efficient and cost effective system.

Tank

We have several options when selecting a tank to store our supply water. Supply water tanks are generally made out of polyethylene, a cheap material that will retain its shape without deflecting or breaking when holding large weights of water. Additionally, the plastic works as good insulator to combat environmental effects. Water tanks can also be made out of steel. These tanks have the option of being pressurized, and are more likely to hold their form when filled. Within these two materials, there are several subsets of tanks. This leaves us with a large number of options for a supply water tank.

Pump

We will need to use a pump in order to pressurize the supply water in the household pipes. There are several types of pumps and tanks that could solve this issue for us. Our initial possibility would be to continuously run a pump to keep a constant pressure in the pipes. This would require a special geared pump which can vary its operating speed and flow rate in order to keep a constant pressure while multiple appliances are running. A normal pump with a constant speed will result in a drop in pressure and flow rate as different appliances are turned on, requiring more and more water from the source. Using a complex gear pump could be more expensive and we could have issues with raising the pressure too much in the pipes. This also requires the pump to be on 24 hours a day, which requires a lot of unnecessary energy use.

Another existing option is to pressurize our supply water tank. In this case, the pump would run on a control system that would turn it on only after the tank reaches a certain low pressure level. This system would require a steel supply water tank, as it would be experiencing high gage pressures, but the pump would not have to run 24/7.

We have also found different types of booster pumps, which allow the user to add pressure when they don't receive enough power from the municipal system. Although many of these pumps require a minimum inlet pressure, we have found instances in which these pumps are used for shallow wells. Well systems are analogous to our water system, in which the water is initially under atmospheric pressure. When pumping water from a well, the systems generally run on a centrifugal jet pump [12]. This pump creates a vacuum in the piping, which sucks water up from the well toward an intermediate pressure tank. The tank and pump are connected to a control system, in which the pump will turn on and off when the tank is at certain pressures. Like the previous option, this allows us to use less power on the pump.

Black Water

The Solar Decathlon rules do not allow black water to be reused during the competition. All water that has the ability to become septic must be sent directly to a storage tank where it will be picked up at the end of the competition. Since most septic tanks allow for anaerobic decomposition before sending the water out and back into the ground, our “septic tank” won’t actually be a septic tank, but a simple above-ground storage tank.

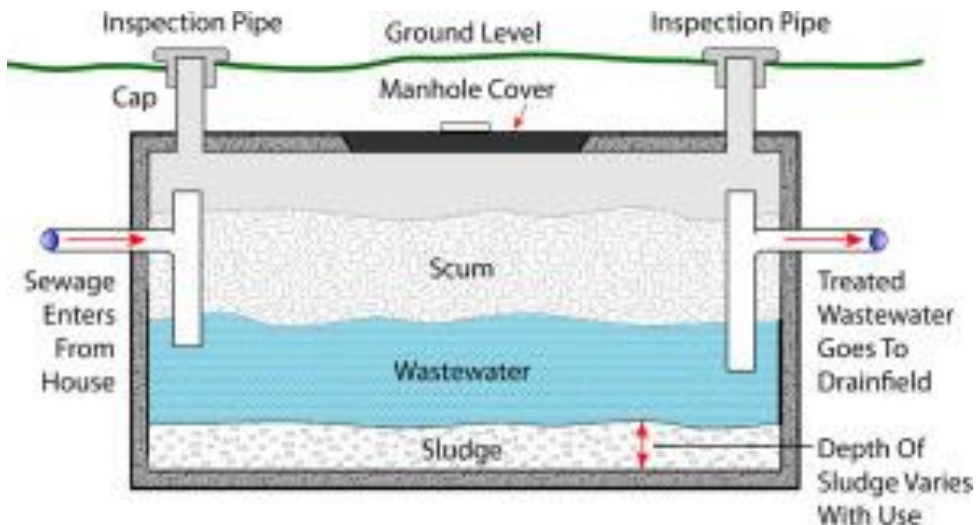


Figure 6. Schematic of a typical septic tank [13].

Customer Requirements

The Water Systems team is dedicated to making the most energy and water efficient water system as possible. Our water system needs to provide pressurized fresh water to the house, a safe storage tank for black water, and an adequate filtration system for the grey water. Since the house will be located in California and will compete in the D.O.E. Solar Decathlon, the water system must abide by all CA code and 2015 Solar Decathlon rules. Table 1 below shows each customer requirement which must be met to ensure a water system that satisfies the customer and wins the competition.

Table 1. Customer requirements for each system with verification type and weights

Water System	Requirement	Target	Verification	Weight
Black Water	Stored in a sealed storage tank	100% of black water	Testing	High
	Aesthetics – Tank must be concealed	90% of surface area	Analysis/Visual	Medium
Constructed Wetlands	Effluent BOD levels	Less than 20 mg/L	Testing	High
	Effluent TSS levels	Less than 20 mg/L	Testing	High
	Surge Protection - Water level	Less than 2 inches below the surface	Testing	High
	Energy Usage	Less than 0.03 kWh per day	Analysis	Medium
	Aesthetics – Footprint	Less than 75 square feet	Analysis/Testing	Low
	Aesthetics – Architectural Design	Integrated with the rest of the house’s architecture	Visual	Low
Fresh Water Supply	Constant supply of pressurized water	At least 40 psi (gauge)	Testing	High
	Aesthetics – Tank must be partially concealed	80% of surface area	Analysis/Visual	Medium

Constructed Wetlands

- Effluent BOD levels - The biochemical oxygen demand exiting the constructed wetland must be less than 20 mg/L. This is an average target value set by many cities to ensure the water discharged into the ground is clean enough and won’t contaminate the groundwater.
- Effluent TSS levels - The total suspended solids exiting the constructed wetland must be less than 20 mg/L. Similar to above, the exiting water must be clean enough so that it doesn’t contaminate the groundwater in any harmful ways.

- Protection - The subsurface flow constructed wetlands must remain subsurface flow. According to the CA Plumbing Code, all grey water must be contained or at least 2 inches below the surface. Our wetland must be able to handle at least 6 gpm of water for 10 minutes. This is the maximum flow rate of grey water coming from the house when all appliances are being used.
- Energy Usage - The constructed wetland system must not use more than 0.03 kWh per day. This equates to around 30 Watts for 1 hour each day. We want to make sure the constructed wetland stays mostly a passive system so to put less of an energy demand on the house.
- Aesthetics - Footprint - The wetland must have a footprint less than 50 square feet. In addition to leaving sufficient patio space and room for other projects, our wetland must not be unnecessarily large to take away from the aesthetics of the house.
- Aesthetics - Architecture - The wetland must be visually appealing and fit in with the rest of the house's architectural design and story. Since it is not the only project being presented outside, our wetland cannot be the overwhelming visual centerpiece. It must be integrated with the house with similar aesthetic designs so that the wetland is presented as part of the house and not simply a side project.

Fresh Water Supply

- Supply Pressurized Water - The supply water must be pressurized to at least 40 psi (gauge) before entering the house. This is to maintain pressure to all household appliances for use at any time. The pressure must be held constant at all times so that the water supply does not decrease as demand increases when additional appliances throughout the house are used.
- Aesthetics - Similar to the septic tank, 80% of the total surface area of the fresh water supply tank must be covered. Since these tanks are significantly larger than the septic tank, it is not feasible to conceal as much of it especially when the inlet must be open and easily accessible. We do not want any large tanks to be visible and take away from the aesthetics from the back patio area.

Black Water

- Disposal and Storage - All (100% of) black water must be safely disposed and stored in a designated, sealed storage tank. The Solar Decathlon Rules prohibit black water from being used for anything and must be sent directly to a storage tank to be picked up after the competition.
- Aesthetics - 90% of the total septic tank surface area must be covered and out of sight when standing anywhere on the patio. This requirement is to ensure a clean and visually appealing patio area that doesn't disrupt the architecture of the house.

In addition to each of the requirements detailed above, the entire water system must also adhere to any and all Solar Decathlon Rules and California Water Code. There are strict guidelines regarding grey and black water in the Solar Decathlon Competition Rules set by the Department of Energy. Since the house may still be used after the competition, the water systems we are proposing must abide by California Plumbing Code Chapter 16A regarding grey water systems as well. According to section 1602 A.0 of the California Plumbing Code, a simple grey water system is defined as a system serving a one or two family dwelling with a discharge of 250 gallons or less per day [3]. In order to determine how many gallons of grey water the spine house will produce per day, an analysis was done for the competition and for average household grey

water production. According to the Solar Decathlon guidelines [14], the maximum grey water production for a single day of contests will be approximately 72 gallons. The detailed water budget for the competition can be found in Appendix B. After the competition, the grey water production can be predicted using the Procedure for Estimating Grey water Discharge outlined in Section 1606A.0 in the California Plumbing Code. The code states that a one-bedroom house will produce 45 GPD/occupant from the showers, bathtubs, wash basins, and laundry. If we assume that the house will have two occupants, we can estimate that the average grey water production per day will be 80 gallons.

Chapter 3: Design Development

Since we are focusing on multiple aspects within the final house design, we followed the standard design process for part of the project. We have several customer requirements listed above and will focus on each requirement independently in order to create an effective design.

Rainwater Collection

In the initial designs for the proposed water systems, rainwater capture was going to be an integral part of the grey water irrigation system. We considered several methods to collect rainwater including a green roof, rain barrels, and a gutter run-off system. We worked closely with Erik Hoffnagle, our environmental engineering student contact, to try and implement the green roof. While the competition has strict limitations for rainwater use, we hoped a green roof would allow the future owner of the house to utilize naturally filtered rainwater in other parts of their home. However, due to the fact that no rainfall is expected during competition and the final resting place of the house is still unknown, the rainwater collection will not be considered in any future water system designs. Instead, the architects have designed a gutter system to allow rainwater to cascade off the roof and into the planter boxes providing water for plants.

Wastewater Heat Recovery

We discussed routing the waste shower water through a heat exchanger in order to recover heat and transfer it to fresh water before sending the grey water to the wetlands. The idea was to preheat the supply water before entering the solar water heater, thus reducing the energy load on the house. However, the solar heating unit designed by Jared Tower is efficient enough that the heat recovery we would achieve is negligible. Thus, the research of shower water heat recovery was halted and we narrowed our focus onto the constructed wetland filtration system.

Grey Water Collection and Filtration

In order to design an effective grey water treatment system, it was important to first know how much grey water production is expected throughout the Decathlon. Overall, we are expecting to be able to capture 350 gallons of grey water from the shower, bathroom sink, and washing machine. This comes out to an average of 40 gallons of water per day. The largest volume of grey water that the wetlands must handle in one day is 72.52 gallons, which occurs on a day

with 3 hot water draws from the shower and 2 cycles of laundry. The water budget for the competition can be seen in Appendix B.

Location

In determining wetland location, we collaborated with the architects and landscape architects to find the best place to showcase the wetlands. Multiple potential locations were considered, including next to the house, along the side of the deck, and around the SW corner of the deck. Originally, we focused on placing the wetlands right outside of the bathroom, next to the house, to minimize pumping energy required. However, we ultimately decided against this location due to constraints on the available size and the possibility of the wetland leaking or overflowing and damaging the structure of the house. Our finalized location is around southwest corner of the patio, south of the tank farm containing the black water and supply tanks. This allows the grey water to pass next to the septic tank which a three way valve could divert the water to if necessary. The only drawback of the SW corner is the increased distance from the house, however a pump was inevitable since the wetlands will be above ground and cannot be completely gravity fed from the house.

Wetland Layout, Size, and Configuration

Our constructed wetland design is configured in three connected cells around the SW corner of the backyard patio. In order to prevent clogging of the wetland, a settling tank will be placed between the sources of the grey water and the first wetland tank to filter out large debris. The grey water coming from the house will be pumped from the settling tank to the first wetland tank. The water will slowly pass through the constructed wetland providing sufficient filtration over the course of a few days before reaching the outlet to be used for irrigation. We will continue to collaborate with the landscape architects who are working on a planter box next to the wetland. The water from our wetland will supply plenty of water to the plants next to it. The constructed wetland acts as the primary filtration of grey water coming from the house. This includes filtering out organics and inorganics to acceptable BOD and TSS levels described in the requirements above. In order to achieve this, the wetland needs to be sized large enough with sufficient surface area in the selected substrate. The wetland sizing was a major design decision which is dependent on a variety of factors including the influent water quality, desired effluent water quality, substrate used, and volume of water flowing through the wetland. We started with some initial calculations provided in *Natural Systems for Waste Management and Treatment* [7] along with calculations involving the our desired volume for the 350 gallons of grey water sent through the wetland during the competition, shown in Appendix B. We wanted to make sure the wetland can handle a large surge of water without overflowing but not too large which would require a high minimum water flow in order to keep the plants alive.

With many different configurations considered for the flow path of the water through the wetland, we ultimately decided to go with a three celled, cascading wetland design. For basic analysis of the wetland, we used a single cell design. This is the most basic wetland design that is simply a single wetland tank large enough to properly treat the water. While simple to build and easy to analyze, it allows for the possibility of short-circuiting to occur where the water is channeled through a particular area and doesn't distribute evenly across the entire wetland. A vertical flow wetland was also considered. With this design, the grey water is distributed near the surface of the wetland and allows gravity to pull the water through the plant roots and

substrate before exiting out the bottom. Since no additional benefits to this system were evident, and it is a less proven design, we decided to stay with a horizontal flow wetland which more information has been published on.

In order to limit the possibility of short circuiting in the wetland, we considered a zig-zag design. Short circuiting of a wetland is when the water flows directly from inlet to outlet without fully being filtered by the substrate. This design utilizes a narrower path for the water that zig-zags back and forth through the wetland. This method forces the water to travel through more of the wetland before exiting, ensuring proper filtration. This also allows for more flexibility in the overall shape as the path can travel in any direction as long as it is sloped downwards. We ultimately decided against this idea because it would further complicate the already sensitive hydraulic load analysis on the wetland and could easily lead to clogging in a narrower flow path. All designs considered can be seen in Appendix C.

After considering all the possible wetland configurations, we ultimately decided on a multi-celled, cascading wetland design. In this configuration, we still had some flexibility in the designed flow path and number of cells used. The benefits of this design include more control of even water distribution at each cell while limiting the potential for clogging. We can also analyze the hydraulic loading for each cell individually, since each cell is simply a single celled wetland. With multiple cells, each decreasing slightly in height, the wetland remains simple while still being visually appealing. The cascading effect should add to the aesthetics of the house and, with proper material selection, should integrate nicely with the architect of the house.

Intermediate Settling Tank

In order to create a steady flow through the wetlands, we needed to find a way to control surges within the grey water line. This would help protect the wetland from short-circuiting, which can result in inadequate filtration. We also needed some form of pre-filtration, in order to remove larger particles such as hair and lint. These particles can clog the wetlands, which could drastically slow the flow rate and cause an overflow. We determined that including an intermediate settling tank within the grey water line would provide pre-filtration and surge protection. We explored different types and placements of settling tanks to be used in our system.

Our initial idea was to include a settling region within the first wetland tank. In this case, water would be pumped directly from the washing machine, shower, and bathroom sink to the wetland. This would simplify our system by containing all filtration within the wetlands. Additionally, we would be able to place a controlled pump at the beginning of the line and avoid storing water underneath the house. Unfortunately, this option had a few flaws that could not be overlooked. If the pump failed for any reason, the grey water line would get backed up and overflow into the house. Along with overflow, cost became an issue because an expensive macerating pump would be required since the filtration would occur after pumping.

The other option that we ultimately decided on is to include an intermediate tank within the grey line. We will use gravity to direct grey water underneath the house to a low profile tank with a filter screen. We will then place the inlet of a pressure-controlled pump at the bottom of the tank, which will transport the water to the wetlands. This should avoid clogging within the pipes and

remove the need for a macerating pump. Using a normal pump will also be more cost-effective in our design. Additionally, this design complies with California Code by keeping all grey water covered and away from human contact.

Grey Water Pump

Traditionally, constructed wetlands are built into the ground, which allows the water to be moved from the house to the wetland using gravity alone. The Solar Decathlon house will be built above a parking lot, which does not allow for digging into the ground. Our final location of the wetland will be around the perimeter of the deck and raised about 5 1/2 feet. Because the grey water will exit below the house and will to enter the wetland 3 feet above the deck, we will need to use a pump to get the water to our wetland entrance height. Using the Extended Bernoulli's equation, we determined the system curve necessary to transport the grey water to the wetlands. Assuming no pressure changes from state 1 to state 2 and accounting for losses within the pipe, we calculated a system curve of $h_{a,sys} = (4.5 + 0.00853Q^2)$ ft, where Q is in gpm. This calculation can be found in Appendix E.

One of the largest issues for our grey water system was creating a partially self-sustaining system. Although energy is required for the pump, we would like the user to view the constructed wetlands as a living system. In order to achieve this, we decided that the pump must have a controller, turning it on and off when necessary. After researching pressure controlled pumps used for grey water applications, we decided to choose between two pumps: the Saniflo Saniswift Grey Water Pump and the Little Giant Sump Pump. Both are pressure-controlled submerged pumps that are mounted within their own containers. This is perfect for our system, as the containers could act as intermediate settling tanks, filtering out large particles and slowing water surges. Additionally, both pumps require 1/3 HP. The Saniswift has a macerator, which would chop up larger particles before transporting water to the wetlands. It costs about \$330. The Little Giant pump container includes a filter screen, which catches large particles before pumping water to the wetlands. It costs about \$200. After comparing our system curve to each pump curve, we found that the Saniswift didn't provide enough head to transport water to the wetlands. The Little Giant worked perfectly for our application. The system curve and Little Giant pump curve are plotted together in Appendix E. Additionally, it was over \$100 cheaper than the Saniswift. For these reasons, we chose the Little Giant Sump Pump to transport water to the constructed wetlands.

Aesthetics

Along with grey water filtration, one of the main goals of the constructed wetlands is to contribute to the overall aesthetics of the house. To achieve maximum visual appeal, we had to consider the plants used in the wetlands, the building materials for the wetlands, and the heights of each wetland in relation to the deck height. Plant selection for the wetlands was driven mainly by the climate in Irvine, CA and recommendations by the landscape architects working on the project. For building materials of the wetlands, only wood was considered to allow the wetlands to blend with the architecture and other planters around the deck. Initially, we considered using reclaimed pallet wood for the wetlands due to the sustainable, earth-friendly and low cost appeal of reclaimed wood. However, it was decided by the architects that we would use the wood that was being used for the house screen for the wetlands and tank covers in order to make the house and deck area more cohesive. Additionally, we will cover the grey

water and settling tank so it cannot be seen as well as hide as much piping and pumps as possible in the infrastructure of the house or beneath the patio.

CA Code and Decathlon Rules

Since the Solar Decathlon rules are stricter than California Code, we had to ensure our water system did not only abide by state code, but did not break any rules of competition. The main rule from the competition is that grey water can only be used for irrigation, while all blackwater must be disposed. If we set up our system as planned, we will be able to successfully follow this rule. Additionally, by California Code, we are required to cover the grey water by at least 2 inches of soil in order to avoid human contact. The constructed wetlands will allow us to filter grey water while keeping it underground and away from any contact. After flowing through the wetlands, the grey water will be clean enough to be exposed and used to water a planter bed. Another rule set by California Code requires the system to have the option of rerouting the water toward the septic tank by the home dweller. We plan to include a three-way valve that allows the user to manually control the flow of water. This three-way valve will be located in an area of the home that is easily accessible at any time for the homeowner.

Supply Water

In our background research, several options were considered for the supply tank and pump. In order to determine size, location, and components of our design many factors had to be taken into account. Throughout the process, we had several constraints set by the Plumbing Team, Architecture Team, Water Heating Team, and the overall Solar Decathlon Rules.

Tank

Our first issue involved with creating our supply water system involved specifying the type and size of the water tank for the home, accounting for the water budget and certain size constraints. According to our water budget (Appendix B), we will require a tank that can store more than 1100 gallons of water. Additionally, the aquaponics team requires 200-300 gallons of water for their system. By competition rules, both the supply and return water tanks must be fully shaded but also have a foot of clearance for water addition or removal on all coverings [14].

When we first created the design of the constructed wetlands, we wanted to place the planter boxes at the west end of the house, directing water toward the southwest corner of the backyard. With this design, we could place the 3-way valve outside the mechanical room, where water could be redirected north. We planned to place both the supply water and black water tanks on the northwest corner of the home, where they would have shading from the house and be mostly out of eyesight. At this point, our only constraint was minimum sizing. We simply specified a large polyethylene water tank, in which we could pump water south toward the mechanical room, at the start of the supply line. This soon became an issue, as we were informed that the architecture team planned to park the electric car at the northwest corner of the house. Additionally, the Aquaponics System was set to be placed at the same location as the constructed wetlands. After moving the design of the constructed wetlands to the southwest corner of the house, we decided to use a purchase a low-profile tank that could be placed underneath a wood

covering. This would allow us to keep the tank out of direct sunlight while remaining within the square footage of the plot.

Supply Water Pump

After specifying our supply water tank and its location, we focused on how we would transport water from the supply tank to the inside of the house. As stated in the background section, we would like to achieve a static pressure of about 50 psi throughout the piping in the household. We calculated the supply water system curve by using the Extended Bernoulli's equation. We designated two states: state 1, which refers to unpressurized water in the supply tank, and state 2, which denotes the water in the house piping, at 50 psig. Accounting for losses in the pipe and neglecting gravitational potential energy changes, we calculated a system curve of $h_{a,sys} = (115.38 + 0.00411Q^2)$ ft, where Q is in gpm. We considered several options that could complete this task. The supporting analysis can be seen in Appendix F.

Our initial plan was to have a single pump constantly running and adding pressure to the house. This had several issues. Firstly, it would consume a large amount of energy. Even though we will not need to include this power in our energy budget, we would like to create an energy efficient system. Additionally, the pump will not allow us to maintain constant pressure in the house. If we turn on multiple appliances, the pipes would experience large pressure drops. This could cause problems for us throughout the competition. We also had concerns with over-pressurizing the pipes. For these reasons, we decided that a single constantly running pipe would not be sufficient for the Solar House.

Our second option involved using a pump on a control system. In this case, we would store our supply water in a pressurized steel tank. We would set the system to turn the pump on when the pressure in the pipe fell below a certain level. The largest issue with this plan was the tank. We would no longer be able to use a low-profile polyethylene tank, and our new steel tank would be too large to store under the Aquaponics tanks.

Our final option involved combining our first two ideas. We researched domestic pumping from shallow wells, in which users are unable to pressurize their supply water source. These types of systems generally use pumps with controllers and an intermediate tank to store pressure. This allows on-demand water pressure without needing to constantly run the pump. We looked into using this type of pump for our application. Many manufacturers create booster pumps with no minimum required inlet pressure, which will allow us to pull water from the tank when needed. We plotted our system curve against several pump curves and selected a pump that provided a head of 50 psig and a reasonable operating flow rate. For our final design, we planned to purchase the Walrus TQ800 Booster Pump.

Black Water

Since the plumbing team is designing the pump and piping for the return black water in the home, we simply needed to provide a tank that will suit all of our needs. We plan to install a small tank to store our black water before collection at the end of the competition, as we will not need to consider anaerobic digestion within a septic tank. Shown in our water budget, we will only produce about 33 gallons of water throughout the entire competition. Our main internal constraint in choosing a tank for black water storage is that it must be placed underneath the tank farm cover, next to the supply water tank. Like the supply water tank, it must have a foot of clearance for water removal and it must be shaded from direct sunlight. Since the tank can be fairly small, we will be able to purchase a tank that easily satisfies these requirements.

Chapter 4: Final Design Description

The final water system design allows us to showcase the treatment of grey water through the constructed wetlands while concealing the supply and black water components in a visually appealing, yet functional manner. The entire design wraps around the southwest corner of the patio from the mechanical room to the bifacial room. The supply and black water tanks will be located directly outside the mechanical room in an area that has been termed the “tank farm.” Directly south of the tank farm are the constructed wetlands. The three wetland cells will extend down to and around the southwest corner and end before reaching the bifacial room. The tank farm and the constructed wetlands are all tall enough so that they can act as a safety railing on the deck, which is required per the competition rules. The full arrangement of the tank farm and wetlands with respect to the level of the deck is shown in Appendix G.

Supply Water

Our final design for our fresh water system involves a large storage tank, a booster pump, and a small intermediate pressurized tank. We believe that this design will be compact and energy efficient, while refraining from harming the aesthetics of the house. All components of the supply water system (pump, pressure tank, and storage tank) will be housed in the tank farm underneath a wood housing. A detailed model of the tank farm layout and wood housing can be seen in Appendix H.

Fresh Water Storage Tank

For fresh water storage, we decided to purchase a 1500 gallon polyethylene low-profile tank, manufactured by Norwesco. We believe that it will be perfect for our application within the household. The tank will cost \$1768.00 for us to purchase. While cheaper tanks exist, we chose a low-profile tank in order to store it under the counter in the tank farm while keeping it out of direct sunlight. During the competition, we plan to store about 1100 gallons of water. Additionally, the aquaponics team requires 200-300 gallons of prefill for their system, so we sized a larger tank. We chose to size the tank slightly larger than our requirement, to account for any changes to the water budget. The 1500 gallon tank is 44” tall, covering an area of 74 ft². Full specifications can be found in Appendix I. The competition dictates that water tanks must be shaded from direct sunlight, so the tank will be located in the tank farm on the west side of the

house under the wood cover. The competition also requires 1 ft of clearance above the tank opening for filling so the tank farm covering was designed in order to satisfy that requirement. A detailed drawing of the storage tank is shown in Appendix Q.



Figure 7. 1500 Gallon Norwesco Low-Profile Storage Tank

Supply Water Pump

As we stated in our customer requirements, we will need to pressurize the water to 50 psig in order to produce a flow rate similar to a standard municipal system. We selected the Walrus TQ800 Booster pump, with a rated motor output of 1 HP. The pump will cost \$410.00 for us to purchase for our system. We plan to connect piping from the bottom of the fresh water tank to the pump, which will then lead to the intermediate pressure tank. Although we will have pressure head due from the height of the water in the supply tank, we designed for worst case conditions, in which the inlet of the pump is at atmospheric pressure. We plotted our system curve against the pump curve for this model in Appendix F. We have determined that the system will have a head of 115 ft and an operating flow rate of about 12 gpm. The TQ800 uses a pressure controller that turns on when the pressure within the piping falls below 36 psig or it detects a flow rate of 0.75 gpm or greater. Additionally, the pump contains a small internal pressure tank that will store a small amount of pressure for minor faucet uses. Since the power used to pressurize supply water does not need to be included in the energy budget, we do not need to worry about the supply pump energy usage. A detailed list of specifications for the TQ800 is included in Appendix I. We have also included a detailed drawing of the pump in Appendix Q.



Figure 8. Walrus TQ800 Booster Pump

Intermediate Pressure Tank

Although we do not have a limit on our energy usage for the supply water pump, we wanted to avoid turning it on and off at every water demand. We decided to place a 20 gallon Water Worker pressurized tank in series with the TQ800 to handle minor water usage. It will cost about \$125 to purchase. When the controlled pump is switched on to provide pressure to the piping, the intermediate tank will fill with water, storing energy for future use. This will allow the pump to stay off when a faucet is used for a short amount of time. This will reduce unnecessary sound within the house. The pressure tank is initially pressurized with air, containing an internal rubber bladder for water storage. When the tank is filled, the bladder expands until the water reaches the desired pressure. The complete list of specifications for the pressure tank can be found in Appendix I.



Figure 9. 20 Gallon Water Worker Horizontal Pressure Tank

The installation guides for the pressure tank and pump can be found in Appendix R.

Black Water

The black water must be diverted from the house to the black water storage tank under the tank farm. There is an expected 33 gallons of black water coming from the house during the competition due to the different tests that will be run. We wanted to make sure the tank chosen was oversized to account for any additional water use during initial tests and any grey water diverted to the black water line. The black water tank must also have a low enough profile to fit under the tank farm cover with at least a foot of clearance for access to the outlet. To fulfill these requirements, we chose the 50 gallon low-profile tank from Den Hartog. A detailed drawing is shown in Appendix Q. This will cost about \$160 and is large enough to hold the expected 33 gallons plus room for additional water. Full specifications can be found in Appendix I. The exact location of the tank underneath the tank farm cover can be seen in Appendix G. The black water will be gravity fed from the house to a pump underneath the deck where it will be pumped to the black water storage tank. The associated pump and all piping will be detailed by the plumbing team.

Grey Water

The grey water coming from underneath the house will first be diverted to the intermediate settling tank and pump, then sent over the tank farm area before entering the first wetland cell. The water will continue through the other two wetland cells along the south edge of the deck before being sent to water the plants in the planter box next to the bifacial room. The cascading design of the wetlands allow people to visualize the water flowing through and down each wetland tank, as the gravel and microorganisms treat the water for safe use as irrigation for the plants nearby.

Constructed Wetlands Layout

The final design layout of the constructed wetlands can be seen in Figure 10. The wetlands consist of 3 cascading tanks located around the SW corner of the deck and extending toward the bifacial room. The deck configuration can be found in Appendix G. Each tank has a depth of 2 ft with an inlet 6" and outlet 12" from the top of the tank. This 6" drop from each inlet to outlet will allow the water to flow through the wetlands at a sufficient flow rate for filtration. The tank heights were decided with respect to the deck height which is 21" above the ground. The first tank will be raised up so the top of the tank will be 42" (3.5 ft) above the deck. Each subsequent tank will be 6" lower than the preceding one with the last tank height being 30" (2.5ft) above deck height. The 6" drop between tanks ensures that the inlet of the lower tank lines up with the outlet of the tank before it. The architects are going to construct all supports necessary to elevate the tanks to the desired heights

Each wetland tank will contain two sizes of gravel, water, and plants. A cross section of the tanks can be seen in Figure 10. Each tank will be filled with 18" of gravel (6" above the water height to protect from overflow during surges). The plants will be planted in the gravel with their roots extending down into the grey water, allowing filtration. We will use a mixture of 1 1/2" crushed granite at the entrance of the wetlands and 3/8" bradley pea gravel everywhere else, both by Kritz Trucking. The plants that will be living in each wetland will ultimately be decided by

the landscape architects based on what is available in Irvine, but will most likely be Juncaceae or Rushes family.

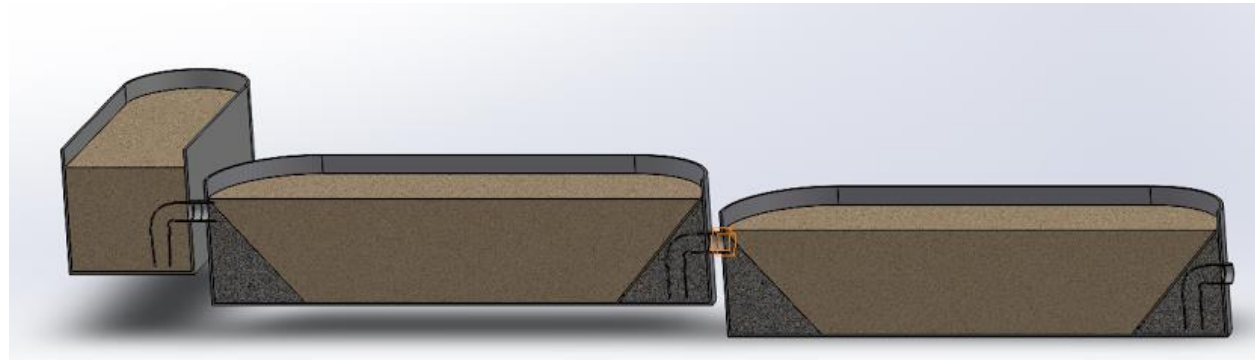


Figure 10. Section view of the south side of the wetlands. The gravel layers are shown.

The wetland tanks themselves are galvanized steel stock tanks. The steel troughs will be able to withstand the weight and pressure of the water and gravel when full. The connecting inlet and outlets will be constructed using inexpensive ABS pipe. In order to meet our goal of fully integrating the wetland with the architect's design of the rest of the house, there will be a wood housing covering all of the tanks. The wood used will be the same type as the tank farm housing. This wood will be selected by the architects and will maximize the aesthetic appeal of the entire deck space.

At steady state, the wetlands are expected to hold approximately 133 gallons of water. The steady state water depth in each tank is 1ft as dictated by the outlet height. The 1ft water depth was chosen because it was deep enough to hold a substantial amount of water while still leaving enough space in the tank to allow for water surges and avoid overflow. The gravel height is 18" deep giving a 6" buffer for water surges before the dirt. The first wetland tank has enough space for a surge of 39 gallons of water before an overflow will occur. In competition, the worst case scenario is that the dishwasher, shower, and clothes washer all run at the same time which would produce 31.3 gallons of water. Our surge protection of 39 gallons is more than enough to handle the worst case scenario.

Once the water has flowed through all 3 wetland tanks, it will be ready for irrigation. The water will leave the 3rd tank and will provide water for plants in a planter box on the south side of the sun room.

Wetland Flow

The flow of water through the constructed wetlands will determine its effectiveness in cleaning the grey water. The wetlands are designed specifically for the expected grey water produced during the competition. This means that the overall volume of the wetlands and design flow rate were determined based on the expected flow during the competition.

The wetlands were initially sized so that they will completely fill up during the first couple of days of competition. We will also prefill the third wetland cell so only the first and second cells need to be filled. Appendix K shows the volume of water the wetlands will hold when completely filled, which is simply a calculation based on the overall size of the wetlands and the

porosity of gravel. We determined that it will take 75 gallons of water over the first 3 days of competition to fill the first and second wetland cells. For the rest of the competition, there will be a steady flow of water through the wetland with the use of water in the house.

Using Darcy’s Law, which models the flow of water through porous media, we were able to analyze the flow rate through each wetland cell. This analysis, shown in Appendix K, determines the flow rate based on the dimensions of the wetland, hydraulic loading, and hydraulic conductivity. Since our entire system will be at atmospheric pressure, the hydraulic loading will be solely based on the height difference between the inlet and outlet. The hydraulic conductivity of the soil will have the most significant impact on the flow through the wetland. This can be determined experimentally or based on the average gravel diameter using the Kozeny-Carman Equation, shown in Appendix K.

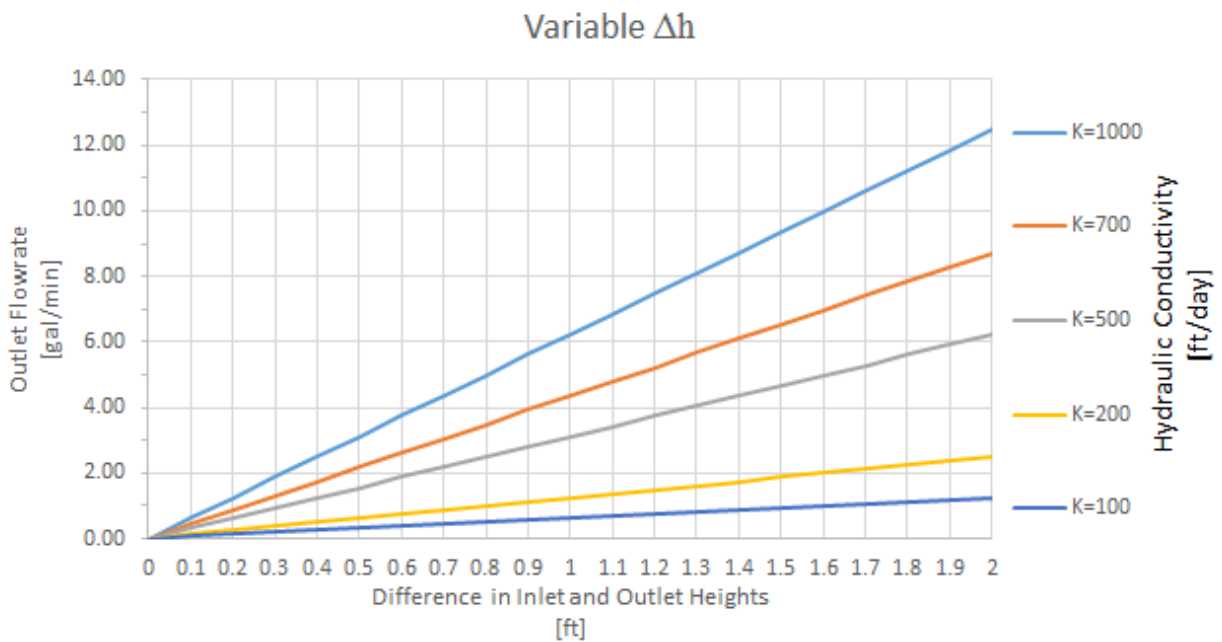


Figure 11. Flowrate through the wetland with differing hydraulic loading and gravel hydraulic conductivity using 1-D Darcy’s Law.

Figure 11 shows the results of our 1-D analysis of our wetlands using Darcy’s Law. Different hydraulic conductivities were plotted with varying inlet and outlet heights determining the hydraulic loading. This shows that as both the height difference increases as well as a higher hydraulic conductivity, the flow rate also increases. With a height difference set to 6” between each cascading wetland cell (0.5 ft), we determined that a hydraulic conductivity of about 1000 ft/day will result in a flow rate of slightly over 3 gal/min.

Little Giant Sump Pump

We selected the Little Giant WRSC-6 to transport the grey water from the house to the constructed wetlands. The Little Giant is a pump contained in its own settling tank with an internal filter, which is less than 11” tall. This is perfect for our system and location, as it will allow us to place the pump and tank underneath the deck outside the bathroom. We plan to include an access door on the deck for maintenance and cleaning, shown in Appendix E. The pump will cost \$206.15 to purchase, which is cheaper than similar grey water pumps in the market. We plotted our system curve against the pump curve and determined that it will provide a head of 10.5 ft and an operating flow rate of 27 gpm. This figure is shown in Appendix E. Unlike the supply water pump, the required by the grey water pump must be included in our energy budget. It is rated at $\frac{1}{3}$ HP, but it requires 720 W of electrical power. We ensured that this will work for our energy budget by calculating its energy usage per week. We determined that the pump will consume an average of 0.0173 kWh per day, which is below our maximum energy allowance. This calculation is shown in Appendix L. The pump uses a controller switch that turns itself on and off when the water level in the tank reaches a certain level. A detailed list of the pump specifications can be found in Appendix I. Additionally, a detailed drawing is included in Appendix Q, while an installation guide is shown in Appendix R.



Figure 12. Drainosaur Little Giant Sump Pump

Cost Breakdown

The total cost of raw materials for the project is \$4,607.26. The cost of the components for the black, gray, and supply water systems can be seen in Table 2.

Table 2. The cost breakdown of ordered parts for the water system.

Components	Cost
Black Water	
Tank	\$432.55
Supply Water	
Storage Tank	\$1,767.99
Pressure Tank	\$124.58
Pump	\$459.99
Accessories	\$269.00
Grey Water	
Wetland Boxes	\$905.00
Pump	\$206.15
Gravel	\$335.00
Accessories	\$107.00
Total	\$4,607.26

The supply water components were the most expensive, costing \$2,621.56. The grey water system came to a final price of \$1,553.15. The cost of installation was not included in any cost estimations for the project. A breakdown of the vendor, manufacturer, and unit cost of all purchased parts can be found in Appendix P.

Chapter 5: Product Realization

Because of the many delays in officially starting construction of the house, none of our systems are ready to be implemented yet. We have done our best to prepare the wetlands to be put into the house but are unable to continue with any further construction.

Constructed Wetlands

Our main challenges associated with building our constructed wetlands involved cutting holes in the steel troughs, cutting the ABS piping to length, and waterproofing the holes and ABS connections. In order to connect the three steel tanks, we cut 4" holes that were large enough to

hold couplings in place. The couplings will allow the on-site engineers to connect each tank together using 3” piping. Our first efforts include using a 4” hole saw. We found this method to be much more difficult and dangerous than we initially anticipated. Because of this, we decided to use the plasma cutter, which allows for a much faster cutting time and safer operation. The plasma cutter produced holes that were too rough for the piping, so we smoothed the holes down using a rotary grinder. After rounding out the holes, we were able to fit and seal the couplings, using caulk. We then glued the piping, coupling, and elbows using ABS cement. A drawing of the wetlands can be found in Appendix J.

Future Manufacturing Recommendations

Due to the timeline of the project, the Water Systems Team will be unable to completely finish the wetlands construction and testing. With the house only in its initial stages of construction, the wetlands cannot be placed in the right location before being filled with gravel where they will become too heavy to move around. In order to ensure that the wetlands and other water components are implemented correctly, we have passed on the responsibility to the landscape architects and engineers that will be present at competition.

The last steps in order to finish the wetland construction include placing the tanks in their final location relative to the house so that the connecting pipes can be measured and cut. With everything in place, all that is left is to fill the wetlands with the two types of gravel, plant the plants, and fill them with grey water.

1. Wetland placement

The smaller, 6’ tank goes first, followed by the two larger, 8’ tanks. The layout of the wetlands can be seen below. Wood pallets will need to be added underneath the wetlands to raise them to the desired heights. Since the flow of water relies on gravity, the wetlands must be cascading with each tank 6” lower than the previous. The inlet couplings are placed 6” higher than the exit couplings, which should help orientate the wetlands. This 6” difference should allow the couplings to line up horizontally. The outlets also have an additional elbow bend on the inside of the wetland.

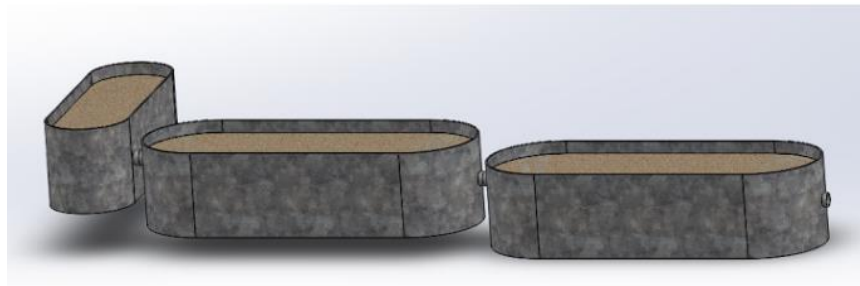


Figure 13. Wetland layout on the Southwest deck facing North.

2. Add connecting pipe

With the wetlands in place, 3" connecting pipe will need to be measured, cut, and fitted to connect the wetlands together. The connecting pipe and ABS glue (for connections) are currently being stored in one of the tanks at the building site. The couplings are already installed and waterproofed in the wetlands. When cutting the pipes to the desired length, make sure to add an additional 1 1/2" on each side to account for the pipes fitting into the connectors.

For the final installation in Irvine, add the ABS glue to the inside of the connector and the outside of the pipe before fitting the pipes together to ensure a waterproof seal.

3. Add gravel

The one ton of 1 1/2" crushed granite and 4 tons of 3/8" bradley pea gravel can be ordered from Kritz Trucking with a lead time of about a day. The coarse, 1 1/2" gravel will just be placed at the ends while the finer, 3/8" gravel will fill up the rest of the tank. The plants will be planted before the competition in Irvine by the landscape architecture team.

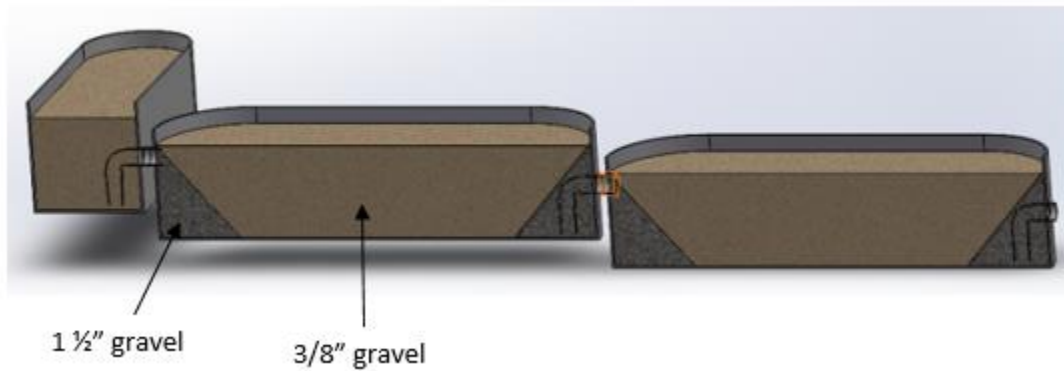


Figure 14. Section view showing where the gravel should be placed.

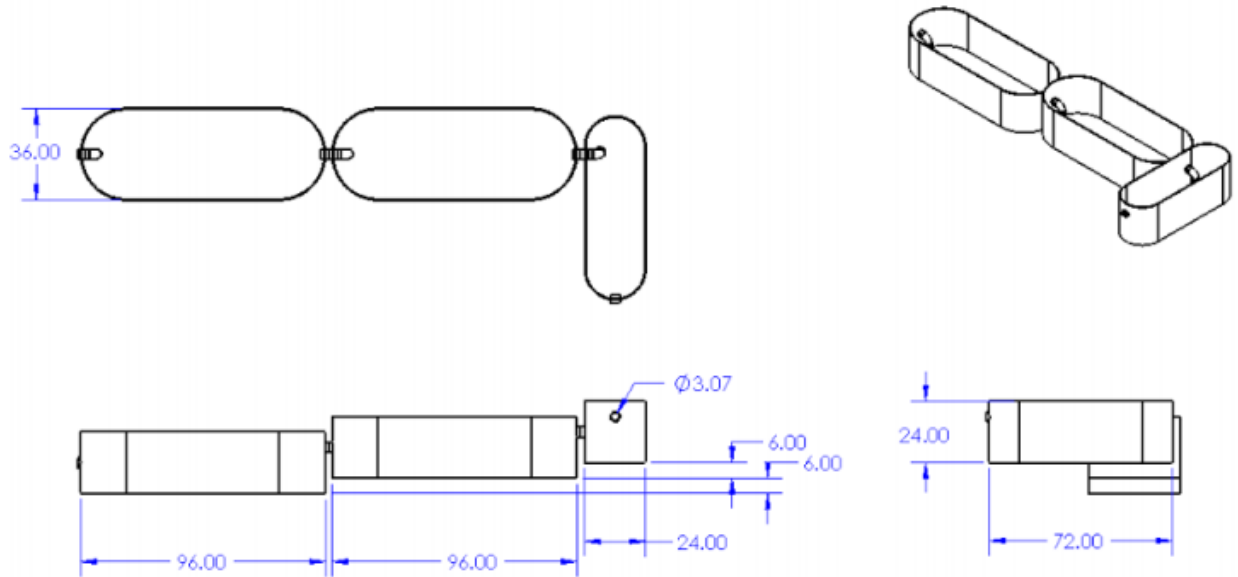


Figure 15. Wetland drawing with all dimensions and showing the 6'' drop from wetland to wetland

Pump and Tank Installation

All installation of the pumps and tanks will be done by licensed plumbers and contractors. The installation guides provided by the manufacturers for the supply water pump, grey water pump, and intermediate storage tank are in Appendix R. The manufacturer provided data sheets can be found in Appendix S.

Chapter 6: Design Verification Plan (Testing)

In addition to the analysis of the pumps' energy usage and ensuring our design covers the supply and black water tanks to the requirements, additional tests will be performed to ensure our systems work as designed and meet our customer requirements. Unfortunately, since the build of the house is behind schedule, none of our systems have been implemented yet and thus cannot be tested at this point. Testing will be performed in September, after all necessary components of the water system has been put in. Below is a list of the tests that will be performed before the house is sent to competition.

Black Water

- 100% of black water must be stored in the designated, sealed storage tank.

We will test this after the plumbing system has been installed and running water through the toilet, dishwasher, and kitchen sink. We will then check the tank to ensure that all the water made it to the storage tank. We will also check to make sure there is enough clearance to access the outlet during the competition.

- 90% of the black water tank's surface area must be covered.

To ensure we meet this requirement, we will analyze our wood covering of the tank area and make sure it covers at least 90% of the tank's surface area. We will also do a visual inspection

after it has been built to make sure the tank isn't visible or aesthetically detracting from the house.

Constructed Wetlands

Due to the critical organic component of the wetlands required to make the system work properly, the water quality tests cannot be performed until the system has had time to develop and reach a steady state. The wetlands need to have plants in place and plenty of microorganisms growing in the gravel before the system is able to properly treat the influent water. It is important to note that the wetlands are meant to be a long term treatment process that takes time to develop into steady state and provide sufficient filtration. Because of this, we will have to delay testing until the plants have been planted and water has been flowing through the wetlands, allowing the system to reach a steady state. Since the plants will be planted during the competition, the earliest we will be able to test the wetlands will be at least a few days into the competition where we will be able to test the TSS (total suspended solids) in the water. Organics in the gravel will take even longer to develop which means we won't be able to test the BOD (biochemical oxygen demand) levels until the system has been operating at a steady state for a few months.

- Effluent BOD must be less than 20 mg/L.

Since BOD is a measure of oxygen used by the microorganisms, we will need to wait until plenty of microorganisms have developed in the wetland before we can perform this test. The BOD5 test measures the dissolved oxygen in the sample before and after 5 days. During these 5 days, the microorganisms "eat" the organics in the water and in the process, also use up dissolved oxygen. Therefore, the amount of oxygen used up over 5 days relates to the amount of organics in the water. More oxygen used up correlates to more organics being consumed by the microorganisms. Although there are limitations to this method with a large error associated with it, it is the best method used to measure organics. In order to have the effluent water tested, we will need to send the sample to a professional lab to be tested using a standard procedure.

- Effluent TSS must be less than 20 mg/L.

The TSS coming out of the wetlands must be less than the 20 mg/L limit to ensure the water has been mechanically filtered properly. In order to test this, we will perform a simple TSS test while the wetland is in operation. A TSS test involves weighing a piece of filter paper as accurately as possible before and after water has been passed through it. To do this, the filter paper should be cleaned with DI (deionized) water before weighing it. An arbitrary, but measured, amount of water should then be passed through the filter (usually either 100 mL or 1 L). Next, the filter paper must be dried in a clean area under a hot lamp before weighing. The difference in weight divided by the volume of water used is the TSS. This test should be performed multiple times before averaging the results in order to obtain a more accurate value. To obtain even more accurate results, the samples should be sent to a professional lab to be testing to ensure the water is testing according to a standard procedure so that the results can hold up in a legal court.

- All grey water must remain at least 2 inches below the surface of the wetlands.

To make sure we meet this requirement, we will test the wetlands by pumping water into the wetlands at 6 gpm for 10 minutes. The test will have to be performed after the wetland has been built and all gravel and soil is added. In order to verify this test, we will need to dig two inches into the soil on top and make sure the water has not reached that level during the test. In addition,

we made sure the wetland cells all have watertight seals and no grey water leaks. By filling up the tanks with water, we were able to visually inspect that no water was leaking around the pipe seals.

- Energy usage of the entire constructed wetlands must be less than 0.03 kWh per day in order to comply with the house's overall energy budget. We were able to analyze the pump Drainosaur Little Giant pump based on the electrical power, the flowrate, and our total grey water. We concluded that for 9 days of competition, the pump will use on average 0.0175 kWh per day. This is much less than what we originally allocated for energy consumption and even allows a little breathing room for other systems on a tight electrical budget.
- The constructed wetlands must be visually integrated with the rest of the house and have a footprint of less than 75 ft². We ultimately decided on using three galvanized stock tanks with rounded ends for our wetland cells, two at 8' x 3' and one at 6' x 3'. The area of these wetlands add up to about 82 ft². Even though this is more than our 75 ft² maximum requirement, we decided that we were close enough that it wouldn't have a significant impact on the overall aesthetics. The tanks will also be integrated further into the architect's design with a wood base to be built around them. Since the aesthetics part of this requirement is purely subjective, we will have to review the final wetlands after construction to make sure the design and aesthetics match what they envisioned and fit in with the architecture of the rest of the house.

Supply Water

- A constant supply of fresh water at a minimum of 50 psi must be provided to the house. In order to ensure all faucets and water using appliances have a constant supply of water at 50 psi, we will need to test the fresh water tank and pump system in two steps. For the first step, we will cap off the main supply line into the house and run our system. Using a pressure gauge, we will verify the system provides the necessary 50 psi. This initial step is required so that we can test the system independent of the rest of the house. It will also allow us to test before all the appliances are put in, which will be towards the end of the construction process. The second test will be done after all appliances are put in and the entire water system has been implemented. In addition to testing the water pressure, we will also test each appliance and faucet to ensure sufficient flow rates and that our fresh water supply has been properly integrated with the plumbing.

- 80% of the fresh water tank's surface area must be covered.

To ensure we meet this requirement, we will analyze our wood covering of the tank area and make sure it covers at least 80% of the tank's surface area. We will also do a visual inspection after it has been built to make sure the tank isn't visible or aesthetically detracting from the house.

Chapter 7: Conclusions and Recommendations

The water system, including the fresh, grey, and black water, is an integral part of any house. The Water Systems Team has been working hard on designing a water system for the Cal Poly Solar Decathlon House that provides pressurized fresh water, safely stores the black water, and filters the grey water for reuse in irrigation. By working with the Piping and Plumbing Team, we have designed a system that efficiently provides pressurized water from the fresh water tank to each appliance before being discarded and sent to either the black water tank or the constructed wetlands for water treatment.

Many of our initial ideas for a more efficient house were not followed through because of the location of the house for the competition in Irvine and final location possibly in San Luis Obispo. With the competition in October in Irvine, we expect very little rainwater, if at all. Because of this, our team decided against designing a rainwater collection system. If the house's final location was somewhere with much more rainfall, rainwater collection would be a much more viable option that would save fresh water. We also decided against using a heat recovery system between the shower and fresh water. This system would preheat the incoming cold, fresh water by passing it through the hot water from the shower drain. Using a heat exchanger, this would save on energy used by the hot water heater. However, due to the effectiveness of the solar hot water heater used for the house, we decided a heat exchanger was unnecessary and decided against using this system. For future Solar Decathlon houses or just any energy efficient house, the rainwater collection systems or the heat recovery heat exchanger would both be viable options to pursue.

For any non-Solar Decathlon house that is connected to the municipal supply water, these water systems would be drastically different. The municipal supply water is already pressurized, which gets rid of the need for a fresh water supply tank and intermediate pressure tank. The house would also most likely be connected to the city's sewage. Additionally, we would not need a black water storage tank. In the case that the house is not connected to the city's sewage, a specific septic tank would be required to break down biological particles in the black water, rather than simply storing it. Lastly, a constructed wetland would still be effective in treating both grey and black water. Since you would most likely build the constructed wetland in the ground, this gets rid of the intermediate storage tank and pump. Pressurized fresh water would be supplied by the city as well as black water disposal, leaving the grey water to be gravity fed into the constructed wetlands. Overall, with access to the municipal supply water, sewage, and construction in the ground, like most houses, many of the systems designed specifically for this house would be unnecessary.

References

- Appendix A. QFD
- Appendix B. Water Budget
- Appendix C. Preliminary Wetland Designs
- Appendix D. Final Wetland Design (3 Cascading Cells)
- Appendix E. Grey Water Pump Calculations and Pump Curve
- Appendix F. Supply Water Pump Calculations and Pump Curve
- Appendix G. SolidWorks Model of Deck Layout with Wetlands and Tank Farm
- Appendix H. Tank Farm Layout
- Appendix I. Short Form Spec Sheets for Pumps and Tanks
- Appendix J. Wetland Box Drawing
- Appendix K. Wetland Supporting Analysis
- Appendix L. Grey Water Pump Energy Usage
- Appendix M. Gantt Chart
- Appendix N. Hazard Checklist
- Appendix O. DFMEA and DVPR
- Appendix P. List of Ordered Parts (Vendors, Manufacturers, & Unit cost)
- Appendix Q. Detailed Drawings of Pumps and Tanks
- Appendix R. Manufacturer Provided Installation Manuals for Pumps and Tanks
- Appendix S. Manufacturer Provided Data Sheets for Pumps and Tanks

Appendix A. QFD

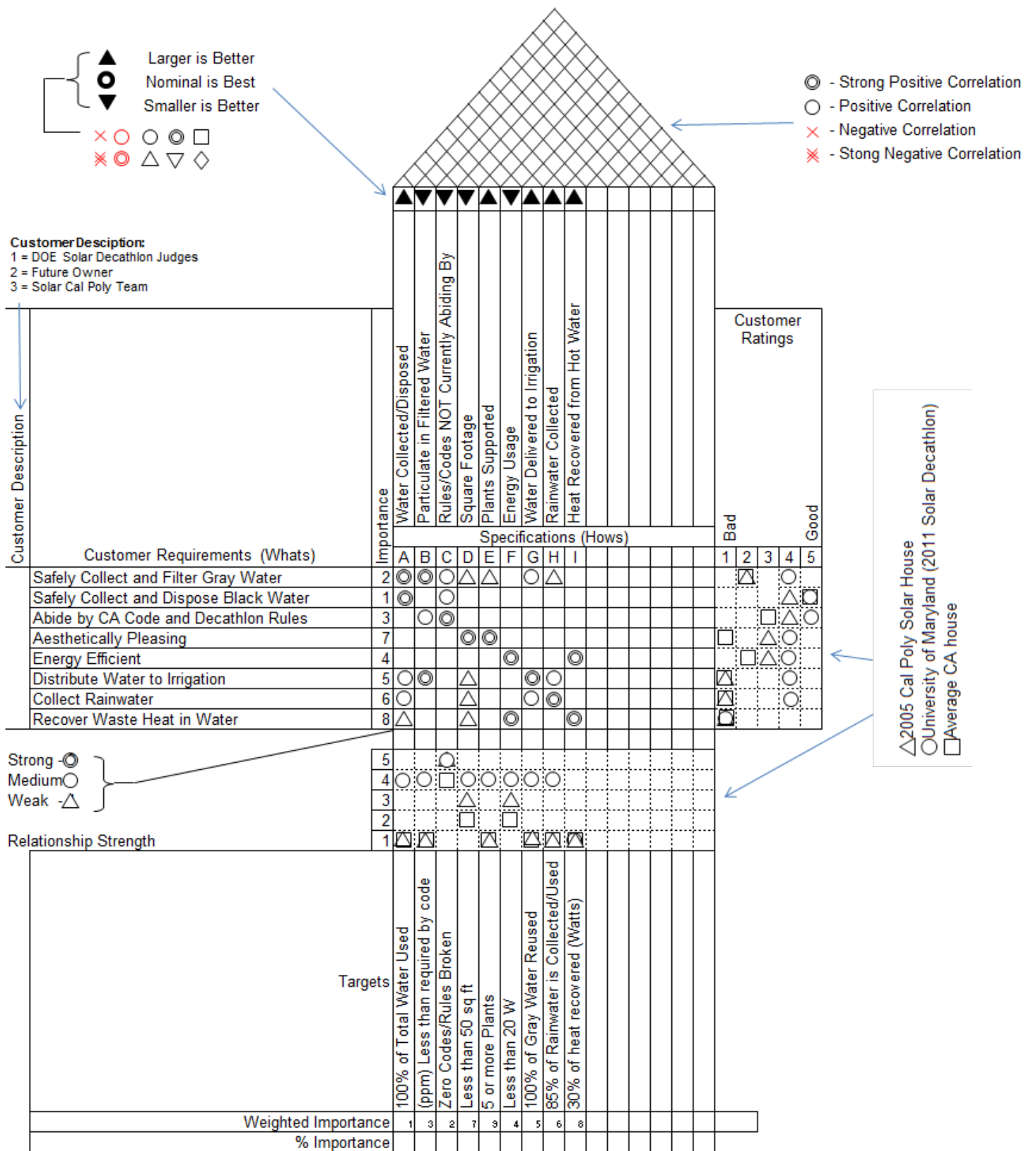


Figure A1. QFD for the project.

Appendix B. Water Budget

Table B1. The water budget for competition.

Functions	Water Use (Gallons)	Calculations		Notes
		Gallons	Events	
Hot Water Draws	240	15	16	
Water Vaporization	3	0.6	5	Each event requires 5lb or 2kg of water
Dishwasher	17.78	2.54	7	5 Competition Events and 2 Dinner Parties
Clothes Washer	109.36	13.67	8	
Vegetation	50			Constructed Wetland Support
Fire Protection	280			
Thermal Storage Tanks	150			
Testing	50			
Solar Thermal Collectors	80			2 - 40 Gallon tanks
Safety Factor	100			
TOTAL:	1080.14			

Table B2. A table showing the breakdown of black and gray water production per day of competition.

Day	Dish Washer		Hot Water Draws		Clothes Washing		Gray Per Day	Black Per Day	Total GPD
	Events	GPD	Events	GPD	Events	GPD			
11	1	2.54	0	0	0	0	0	2.54	2.54
12	1	2.54	1	15	1	13.76	28.76	2.54	31.3
13	1	2.54	2	30	1	13.76	43.76	2.54	46.3
14	1	2.54	1	15	1	13.76	28.76	2.54	31.3
15	0	0	3	45	2	27.52	72.52	0	72.52
16	1	2.54	3	45	0	0	45	2.54	47.54
17	0	0	3	45	2	27.52	72.52	0	72.52
18	1	2.54	2	30	0	0	30	2.54	32.54
19	1	2.54	1	15	1	13.76	28.76	2.54	31.3
Total	7	17.78	16	240	8	110.08	350.08	17.78	367.86

<p>Dish Washer = 2.54 Gallons Per Event Clothes = 13.76 Gallons Per Event Hot Water = 15 Gallons Per Event</p>
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Constructed Wetlands

Septic Tank

Appendix C. Preliminary Wetland Designs

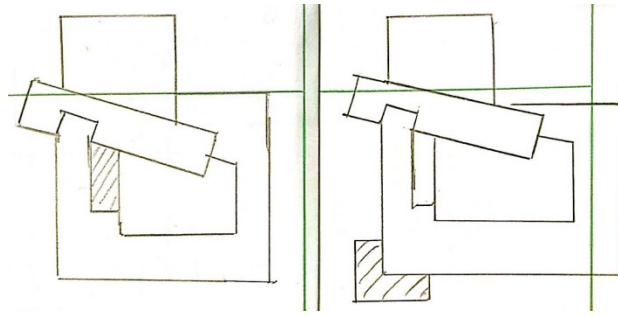


Figure C1. Possible wetland locations (a) next to the house and (b) around the patio corner

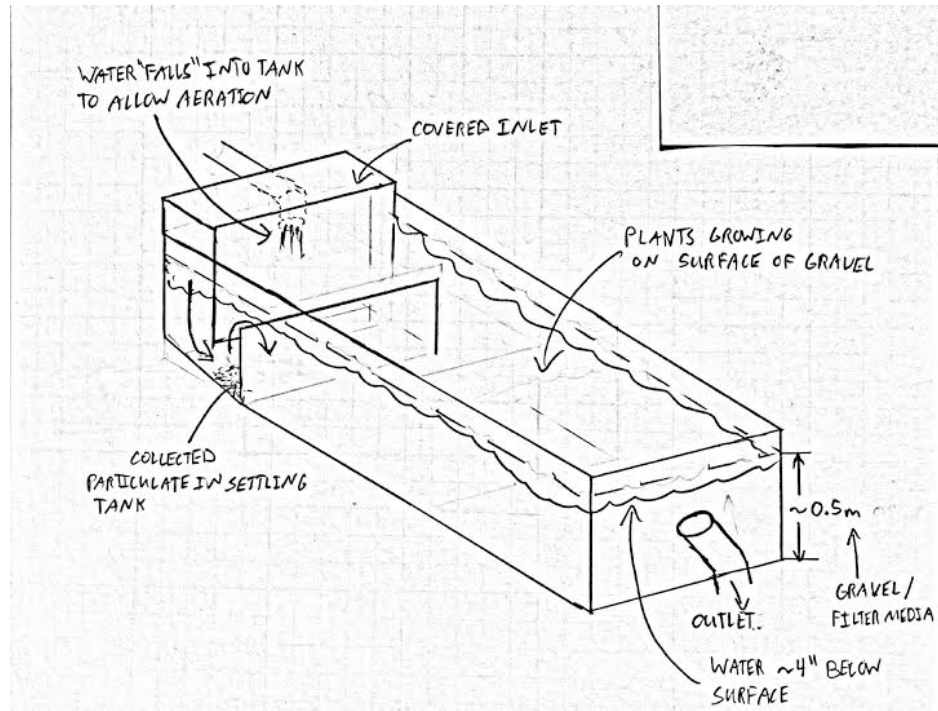


Figure C2. Single cell wetland with integrated settling tank

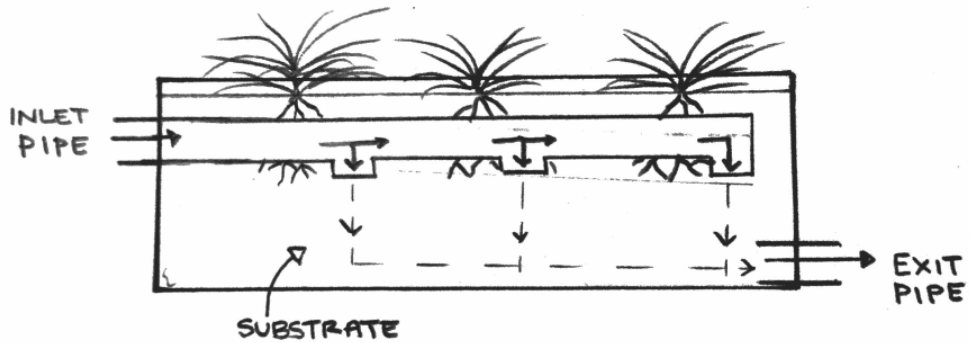


Figure C3. Vertical flow wetland design

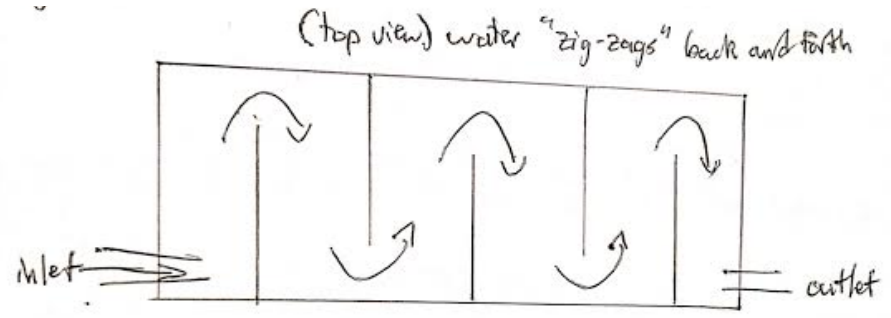
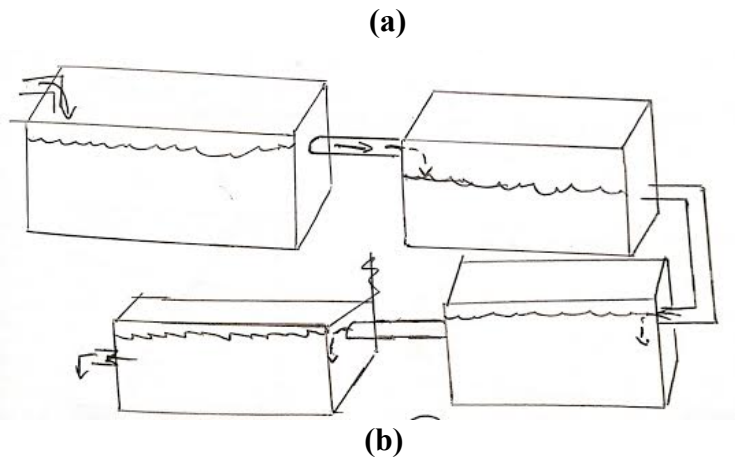


Figure C4. (a) Multi-celled cascading wetland and (b) zig-zag designs considered

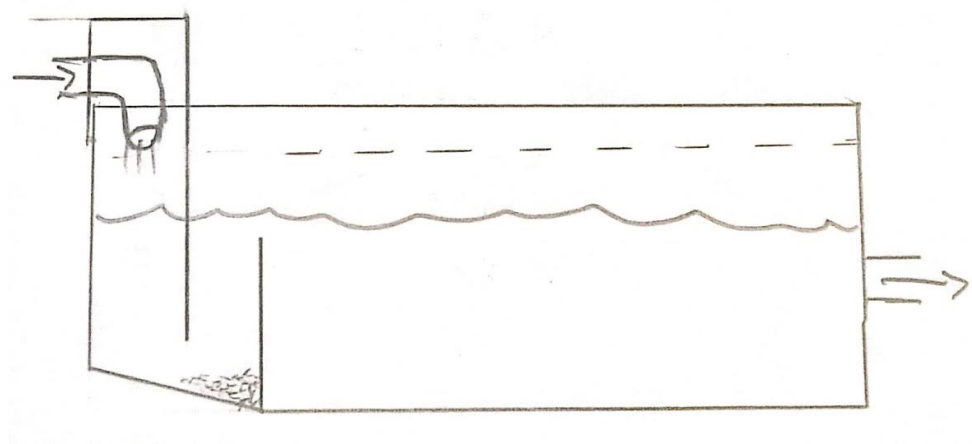


Figure C5. Side view of settling tank connected to the first wetland cell

Appendix D. Final Wetland Design (3 Cascading Cells)

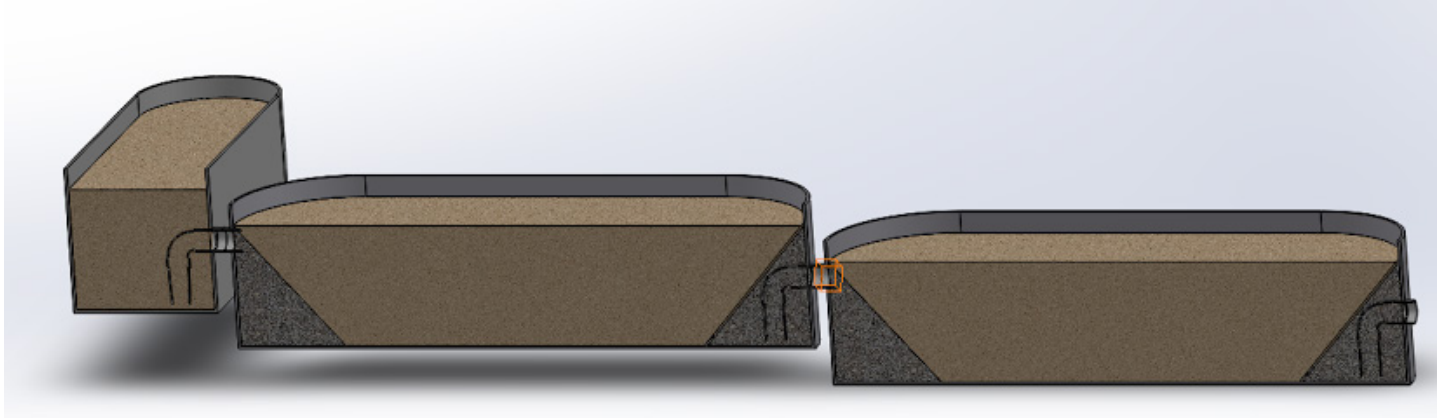


Figure D1. Section view of the south side of the wetlands. The different sized gravel layers can be seen.

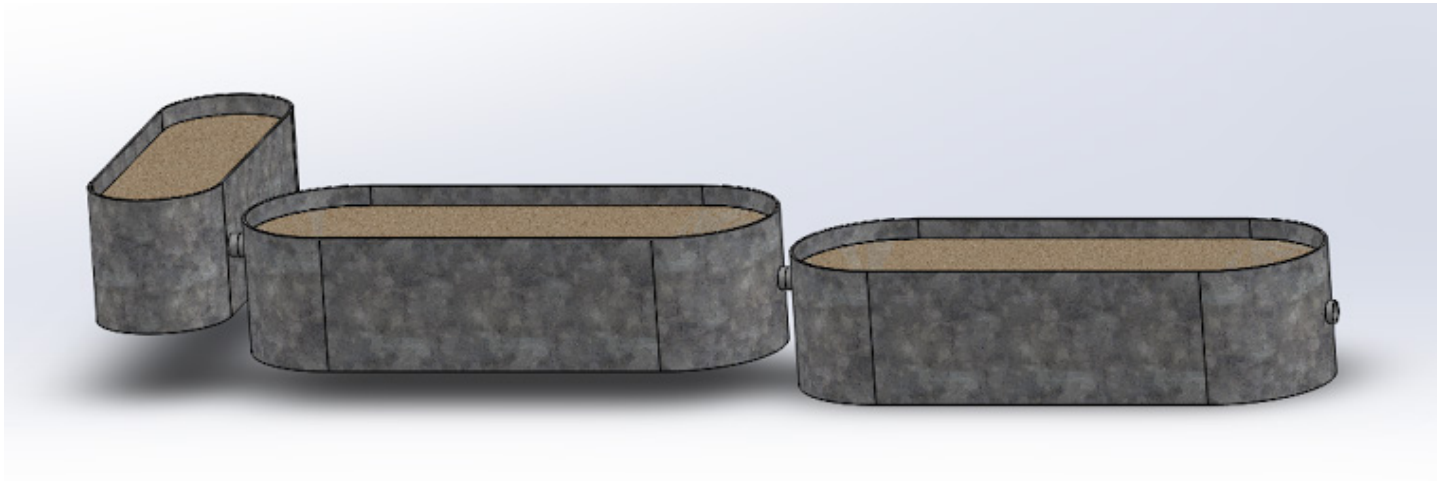


Figure D2. Constructed wetlands final design (Viewed from south of patio).

Appendix E. Grey Water Pump Calculations and Pump Curve

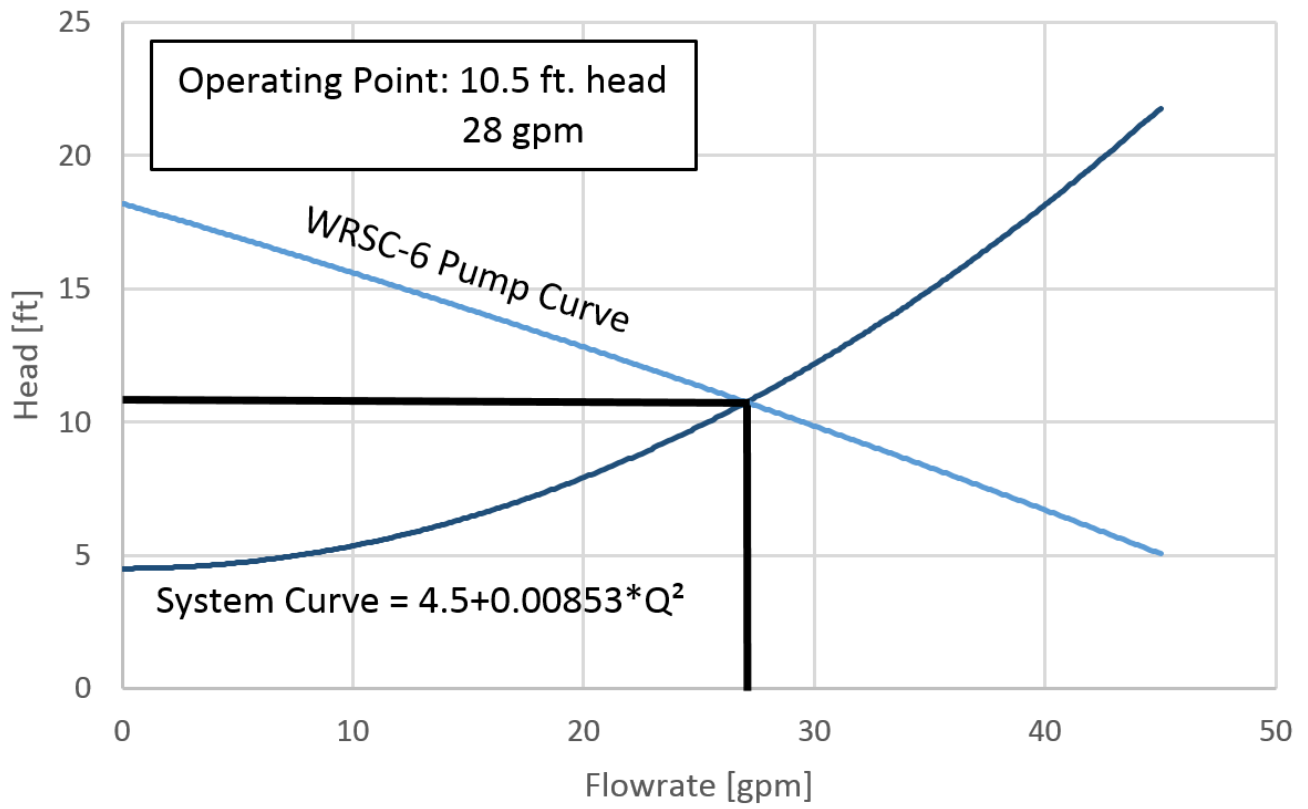
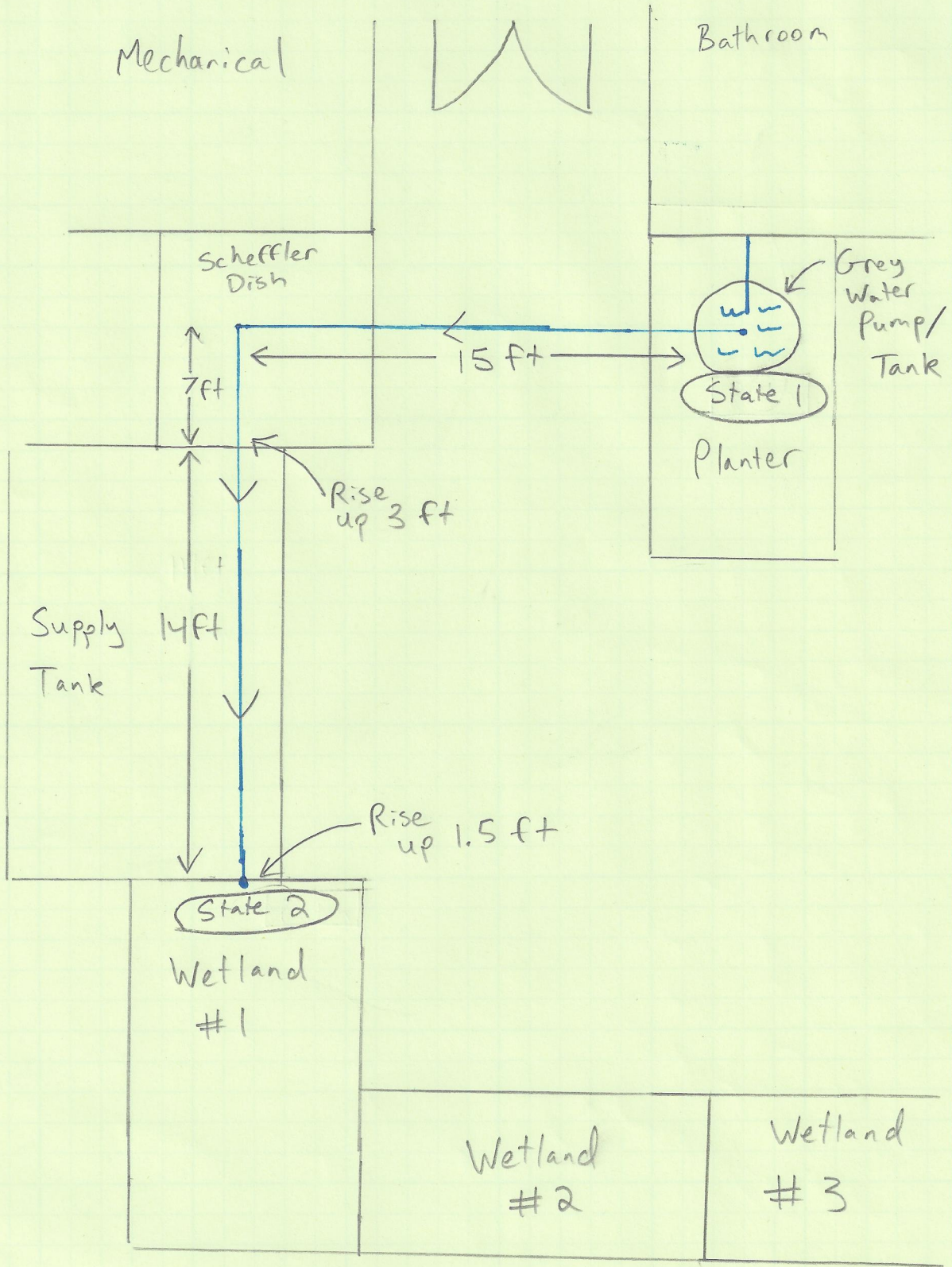


Figure E1. The pump and system curve for the grey water pump. The operating point is shown.

42381 50 SHEETS EYE-GLASS® - 5 SQUARES
42382 100 SHEETS EYE-GLASS® - 5 SQUARES
42386 200 SHEETS EYE-GLASS® - 5 SQUARES
National Brand



Piping: ABS

$$\Rightarrow \epsilon = 0.003 \text{ mm} \\ = 1.181 \times 10^{-4} \text{ in}$$

$$D = 1.5 \text{ in}$$

$$L = 15 \text{ ft} + 7 \text{ ft} + 3 \text{ ft} + 14 \text{ ft} + 1.5 \text{ ft} \\ = 40.5 \text{ ft}$$

$$z_1 = 0$$

$$z_2 = 4.5 \text{ ft}$$

$$P_1 = P_2 = 14.7 \text{ psia}$$

Minor Losses:

- sharp entrance $\Rightarrow K_{L_1} = 0.5$
 - sharp exit $\Rightarrow K_{L_2} = 1.0$
 - 6 elbows, 90°, threaded $\Rightarrow K_{L_3} = 6(1.5) = 9$
- $$\Rightarrow \Sigma K_L = 10.5$$

Major Losses:

$$\frac{\epsilon}{D} = \frac{1.181 \times 10^{-4} \text{ in}}{1.5 \text{ in}}$$

$$\approx 7.87 \times 10^{-5}$$

Assume $Re = 10^5$ (turbulent flow)

Using Moody chart:

$$\Rightarrow f = 0.0195$$

Additional Assumptions:

- steady flow
- incompressible
- STP
- 1-D flow

$$h_{a, \text{sys}} = \frac{p_2 - p_1}{\gamma} + \frac{L}{2g} (\alpha_2 \bar{V}_2^2 - \alpha_1 \bar{V}_1^2) + (z_2 - z_1) + h_L$$

$$= z_0 + K Q^2, \quad \text{where } z_0 = z_2 - z_1$$

$K = \text{total losses}$

$$= z_0 + \left[f \frac{L}{D} + K_L \right] \frac{1}{2g} \left[\frac{Q}{\frac{\pi D^2}{4}} \right]^2$$

$$= 4.5 \text{ ft} + \left[0.019 \frac{(40.5 \text{ ft})}{(1.5 \text{ in}) \left(\frac{\text{ft}}{12 \text{ in}} \right)} + 10.5 \right] \frac{1}{2(32.2 \frac{\text{ft}}{\text{s}^2})} \frac{Q^2}{\frac{\pi^2}{16} \left((1.5 \text{ in}) \left(\frac{\text{ft}}{12 \text{ in}} \right) \right)^4}$$

$$= 4.5 \text{ ft} + 1717.37 \frac{\text{s}^2}{\text{ft}^2} Q^2$$

$$= 4.5 \text{ ft} + \left(1717.37 \frac{\text{s}^2}{\text{ft}^2} \right) \left(\frac{\text{ft}^3}{7.48 \text{ gal}} \right)^2 \left(\frac{\text{min}}{60 \text{ s}} \right)^2 Q^2$$

$$h_{a, \text{sys}} = (4.5 + 0.00853 Q^2) \text{ ft}, \quad \text{where } Q \text{ is in gpm}$$

Appendix F. Supply Water Pump Calculations and Pump Curve

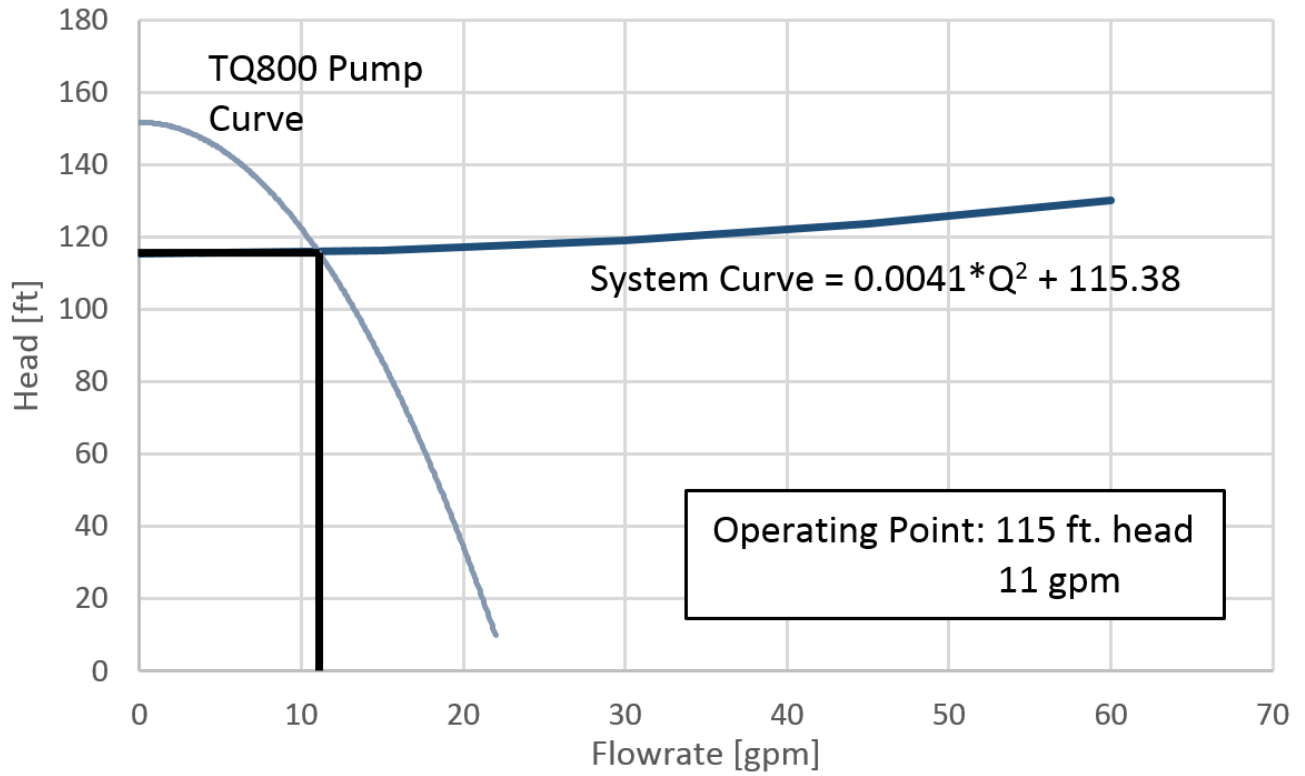
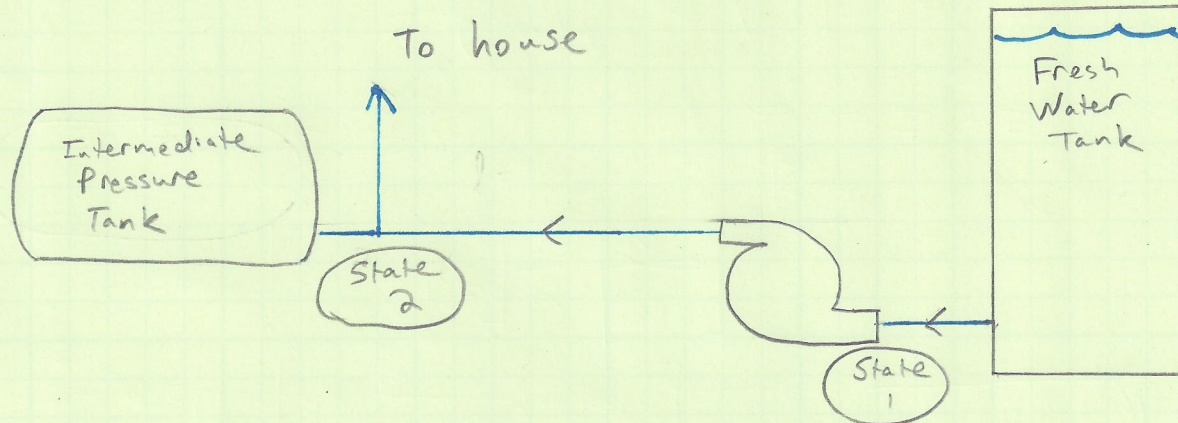


Figure F1. The pump and system curve for the Walrus TQ800 Pump



Piping: PEX

$$\Rightarrow \epsilon = 0.007 \text{ mm}$$

$$= 0.0002756 \text{ in}$$

$$D = 1.5 \text{ in}$$

$$l = 10 \text{ ft}$$

$$z_1 - z_2 \approx \text{negligible}$$

$$p_1 = 14.7 \text{ psia} \quad (\text{assuming worst case conditions: no added pressure from height of water in tank})$$

$$p_2 = 50 \text{ psig}$$

Minor Losses:

$$\text{- sharp entrance} \Rightarrow K_L = 0.5$$

$$\text{- sharp exit} \Rightarrow K_L = 1.0$$

$$\text{- 2 elbows, } 90^\circ, \text{ threaded} \Rightarrow K_L = 2(1.5) = 3$$

$$\text{- Threaded Branch flow tee} \Rightarrow K_L = 2.0$$

$$\Rightarrow \sum K_L = 6.5$$

Major Losses:

$$\frac{\epsilon}{D} = \frac{0.0002756 \text{ in}}{1.5 \text{ ft}}$$

$$= 1.837 \times 10^{-4}$$

Assume $Re = 10^5$ (turbulent flow)

Using Moody chart

$$\Rightarrow f = 0.019$$

$$h_{a,sys} = \frac{p_2 - p_1}{\gamma} + \frac{1}{2g} (\alpha_2 \bar{V}_2^2 - \alpha_1 \bar{V}_1^2) + \cancel{(z_2 - z_1)} + h_L$$

$$= z_0 + K Q^2, \quad \text{where } z_0 = \frac{p_2 - p_1}{\gamma}$$

$K = \text{total losses}$

$$= z_0 + \left[f \frac{l}{D} + K_L \right] \frac{1}{2g} \left[\frac{Q}{\frac{\pi}{4} D^2} \right]^2$$

$$= \frac{(50 \text{ psi}) \left(\frac{14.1 \text{ in}^2}{\text{ft}^2} \right)}{62.4 \frac{\text{lb}}{\text{ft}^3}} + \left[0.019 \frac{(10 \text{ ft})}{(1.5 \text{ in}) \left(\frac{\pi}{12 \text{ in}} \right)} + 6.5 \right] \frac{1}{2 \left(32.2 \frac{\text{ft}}{\text{s}^2} \right)} \frac{Q^2}{\frac{\pi^2}{16} \left((1.5 \text{ in}) \left(\frac{\text{ft}}{12 \text{ in}} \right) \right)^4}$$

$$= 115.38 \text{ ft} + 826.93 \frac{\text{s}^2}{\text{ft}^2} Q^2$$

$$= 115.38 \text{ ft} + \left(826.93 \frac{\text{s}^2}{\text{ft}^2} \right) \left(\frac{\text{ft}^3}{7.48 \text{ gal}} \right)^2 \left(\frac{\text{min}}{60 \text{ s}} \right)^2 Q^2$$

$$h_{a,sys} = (115.38 + 0.00411 Q^2) \text{ ft}, \quad \text{where } Q \text{ is in gpm}$$

Additional Assumptions

- Steady, incompressible flow
- 1-D flow
- STP

Appendix G. SolidWorks Model of Deck Layout with Wetlands and Tank Farm

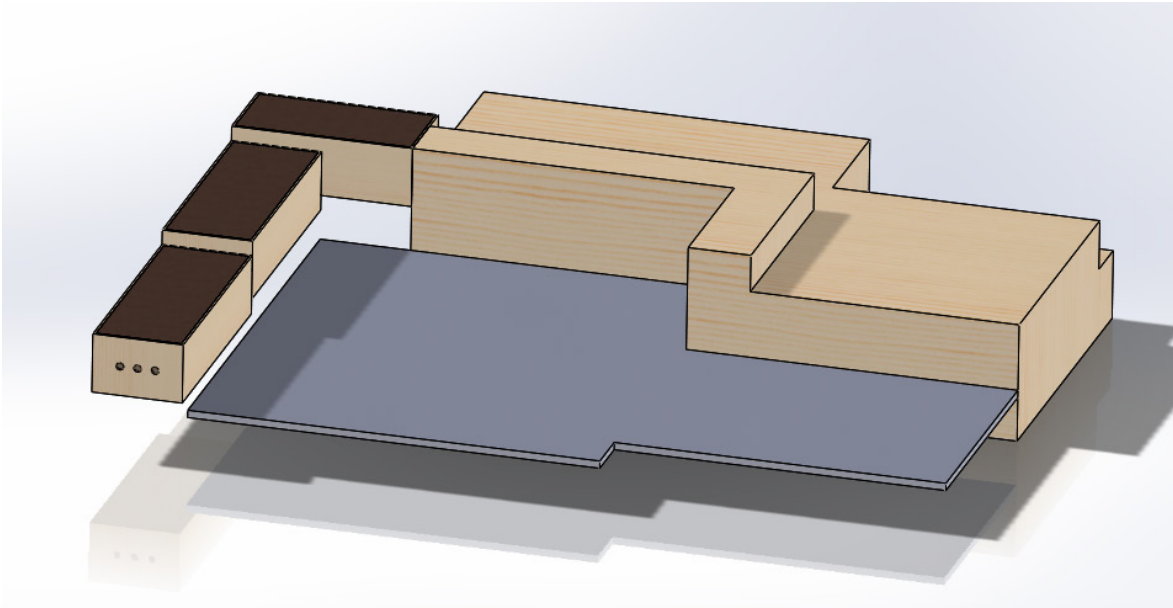


Figure G1. The layout of the tank farm cover and wetlands. The deck is shown for a height reference on all the components. Pallets will be used to raise the wetlands up to the desired heights.



Figure G2. Top view of the tank farm cover and wetlands.

Appendix H. Tank Farm Layout

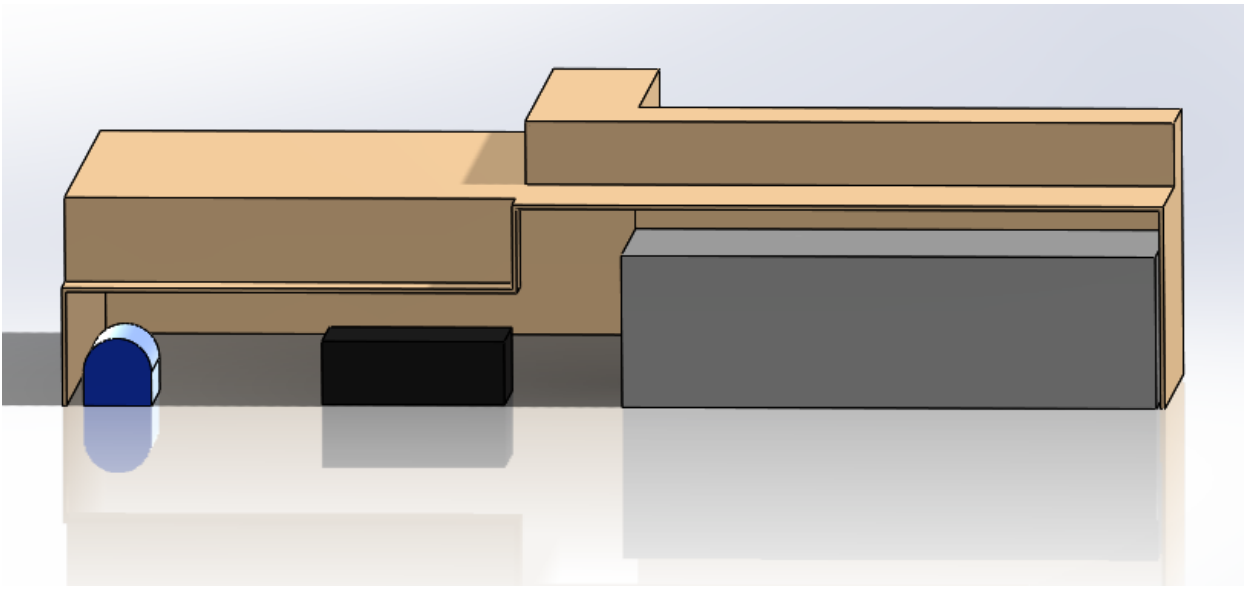


Figure H1: Section view of the tank farm viewed from the west. The blue tank is the supply pressure tank. The black tank is the black water tank. The gray tank is the supply water tank. Not pictured is the supply water pump which will be located between the black water tank and the pressure tank.

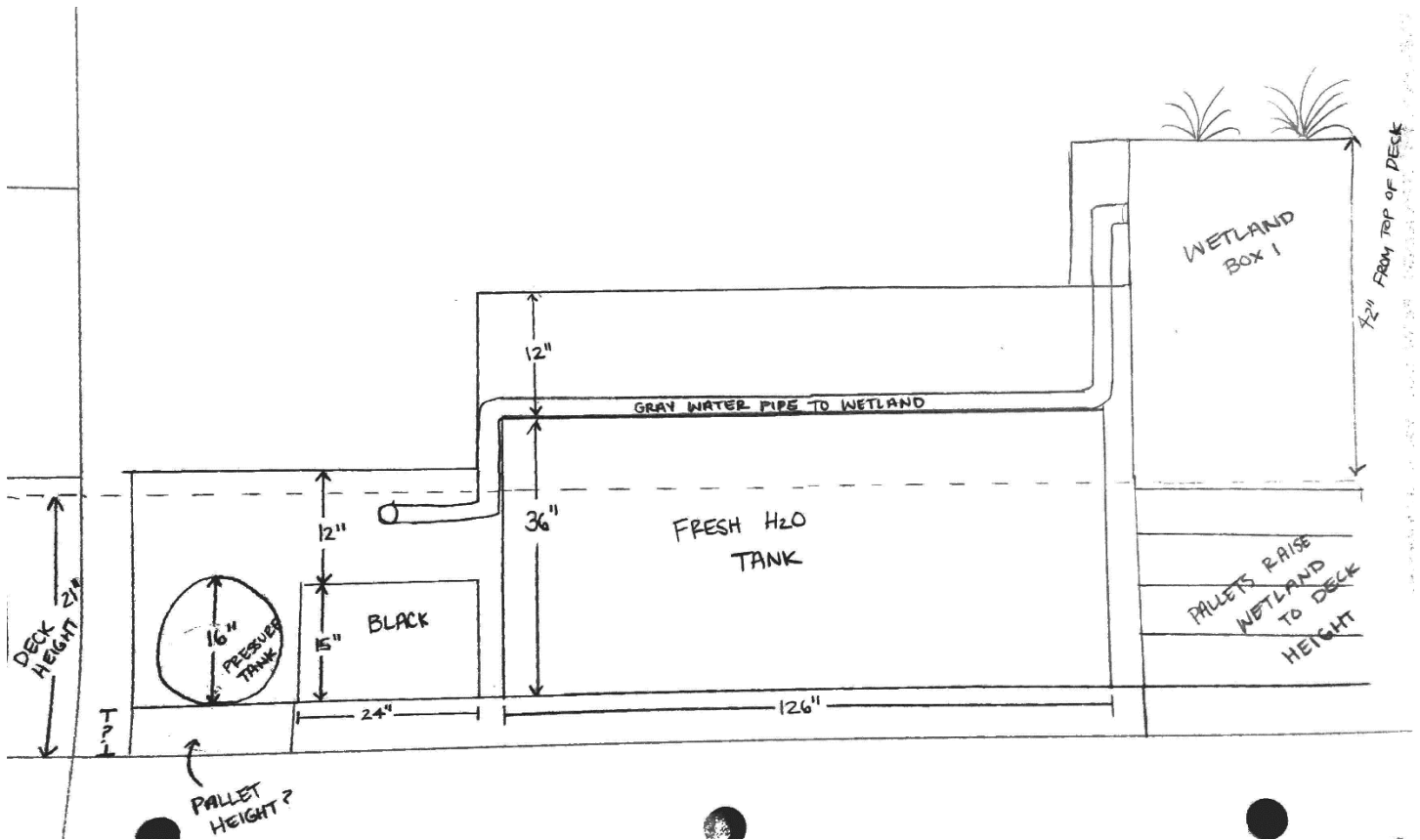


Figure H2. Hand drawing of the tentative tank farm layout discussed with architects (All dimensions in inches)

Appendix I. Short Form Spec Sheets for Pumps and Tanks

SECTION 22 12 00 STORAGE TANKS

PART 1 GENERAL

1.1 SUMMARY

- A. Provide storage tanks for fresh, grey, and black water.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Data Sheet: Submit data sheet indicating capacity, material characteristics, details of construction, and connections

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Storage Tanks:
 - 1. Fresh Water Storage Tank
 - a. Manufacturers: Norwesco
 - b. Model: Low Profile Tank (N-41392)
 - c. Capacity: 1500 gallons
 - d. Type: Ground.
 - e. Storage: Potable water.
 - f. Materials: Polyethylene
 - g. Type: Factory-fabricated.
 - 2. Black/Grey Water Tank
 - a. Manufacturers: Den Hartog Industries
 - b. Model: Low Profile Tank Ace Roto-Mold (LP0300-RT)
 - c. Capacity: 300 gallons
 - d. Type: Ground.
 - e. Storage: Non-potable water.
 - f. Materials: High Density Polyethylene
 - g. Type: Factory-fabricated.
 - 3. Fresh Water Pressure Tank
 - a. Manufacturers: Water worker
 - b. Model: Pressurized Well Tank (Model # HT20HB)
 - c. Capacity: 20 gallon
 - d. Type: Ground.
 - e. Storage: Potable water.
 - f. Materials: Steel.
 - g. Type: Factory-fabricated.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install

materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

- B. Install assemblies complete with all anchors, inserts, supports and accessories. Test for proper operation. Clean and protect work from damage.

END OF SECTION

SECTION 22 14 29
DOMESTIC WATER PUMPS

PART 4 GENERAL

4.1 SUMMARY

- A. Provide domestic water pumps for supply and grey water.

4.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

4.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 5 PRODUCTS

5.1 MATERIALS

- A. Domestic Water Pumps:
 - 1. Grey Water Sump Pump
 - a. Manufacturer: Little Giant
 - b. Model: Drainosaur WRSC-6 (Compact size)
 - c. Mfr Part#: 506065
 - d. Application: Locations indicated.
 - 2. Plumbing Pump
 - a. Manufacturer: Walrus
 - b. Model: TQ 800-115 Booster Pump
 - c. Application: Locations indicated.

PART 6 EXECUTION

6.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Clearly label and tag all components.
- D. Test and balance all systems for proper operation.
- E. Restore damaged finishes. Clean and protect work from damage.
- F. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

Appendix J.

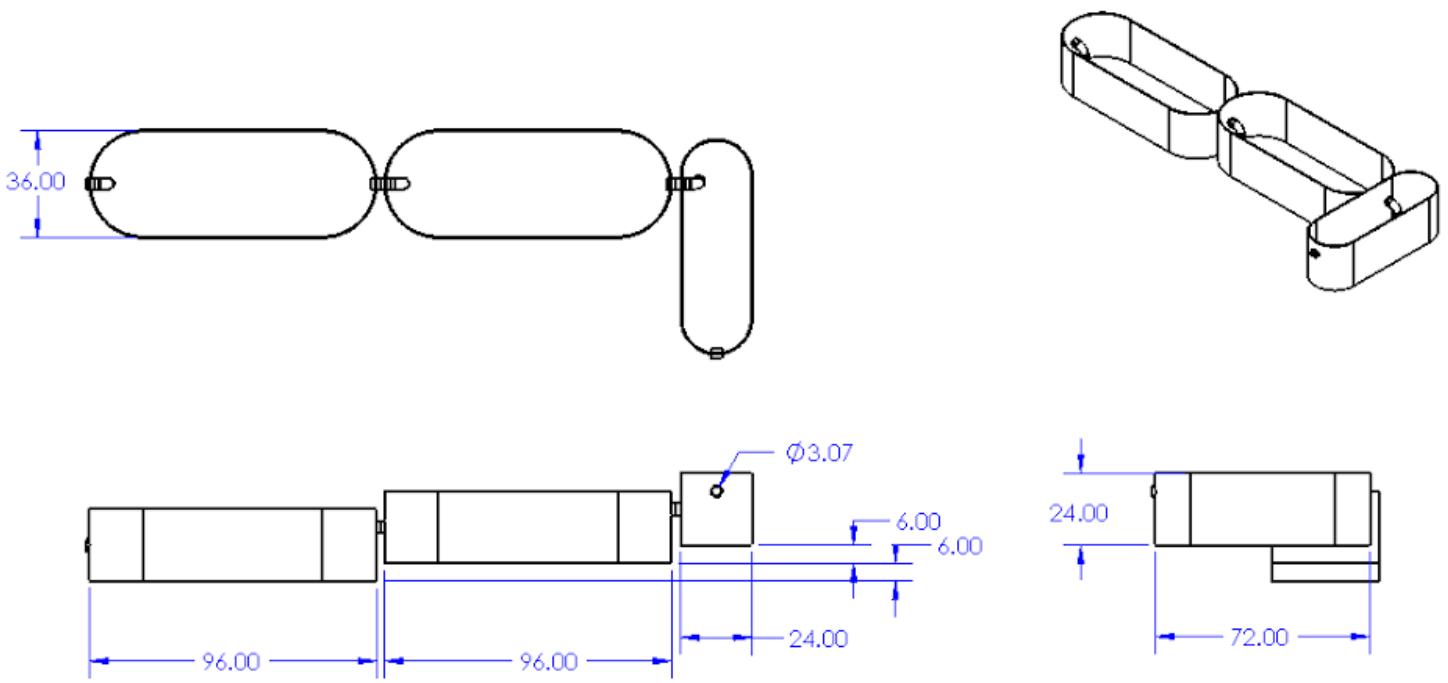


Figure J1: Drawing of Cascading Wetlands with dimensions (in inches)/ All pipe fitting are made of 3" ABS.

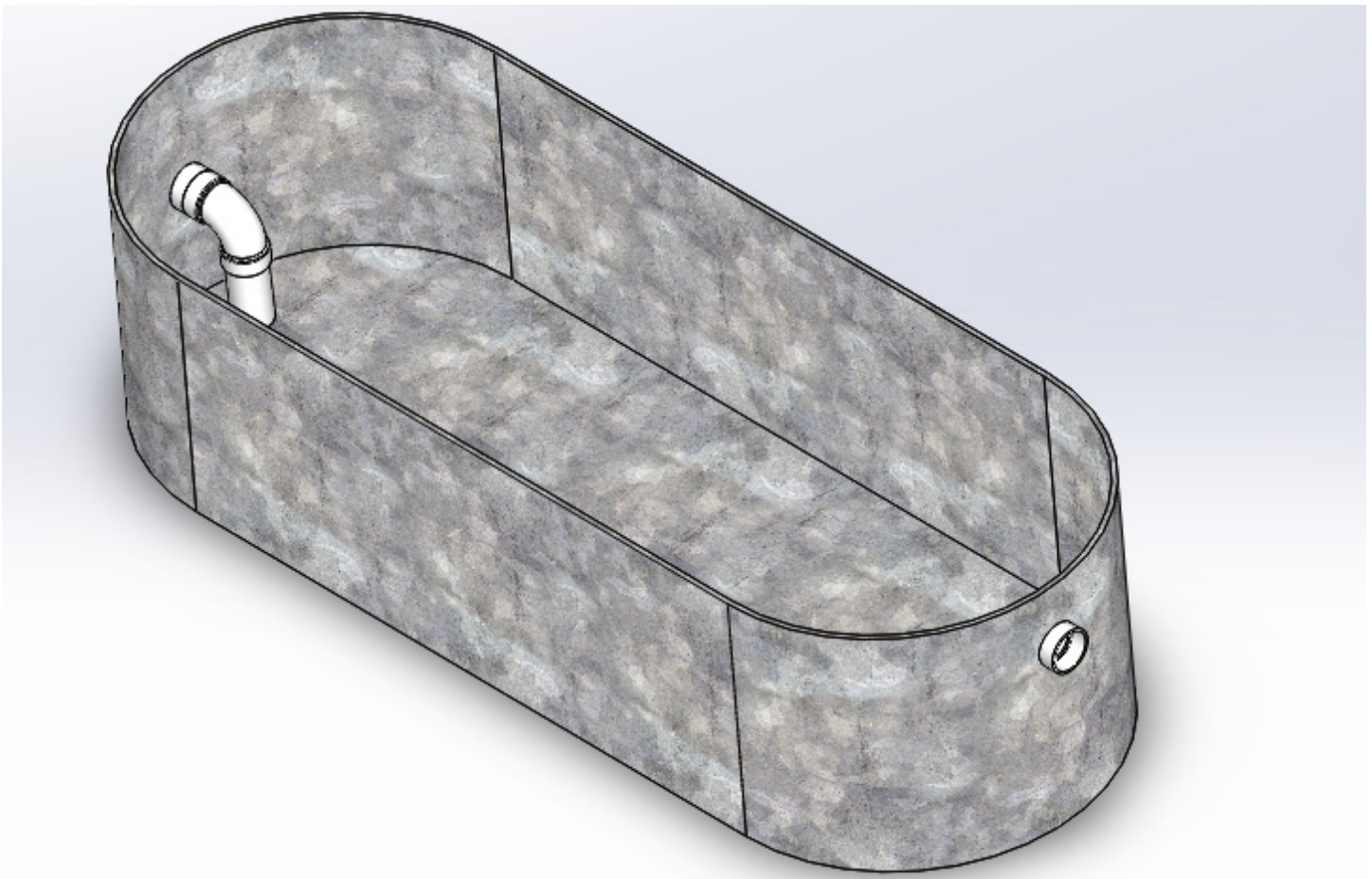


Figure J2. Single wetland cell with no filling

Appendix K. Wetland Supporting Analysis

Table K1. The volume of water each box will hold for different water heights. All numbers were calculated using a gravel porosity of 0.25.

Max Water Depth (ft)	Volume of Water (Gallons)			
	Box 1	Box 2	Box 3	Total
2	64.79	87.00	87.00	238.79
1.9	61.55	82.65	82.65	226.85
1.8	58.31	78.30	78.30	214.91
1.7	55.07	73.95	73.95	202.97
1.6	51.83	69.60	69.60	191.03
1.5	48.59	65.25	65.25	179.10
1.4	45.35	60.90	60.90	167.16
1.3	42.11	56.55	56.55	155.22
1.2	38.87	52.20	52.20	143.28
1.1	35.63	47.85	47.85	131.34
1	32.39	43.50	43.50	119.40
0.9	29.16	39.15	39.15	107.46
0.8	25.92	34.80	34.80	95.52
0.7	22.68	30.45	30.45	83.58
0.6	19.44	26.10	26.10	71.64
0.5	16.20	21.75	21.75	59.70
0.4	12.96	17.40	17.40	47.76
0.3	9.72	13.05	13.05	35.82

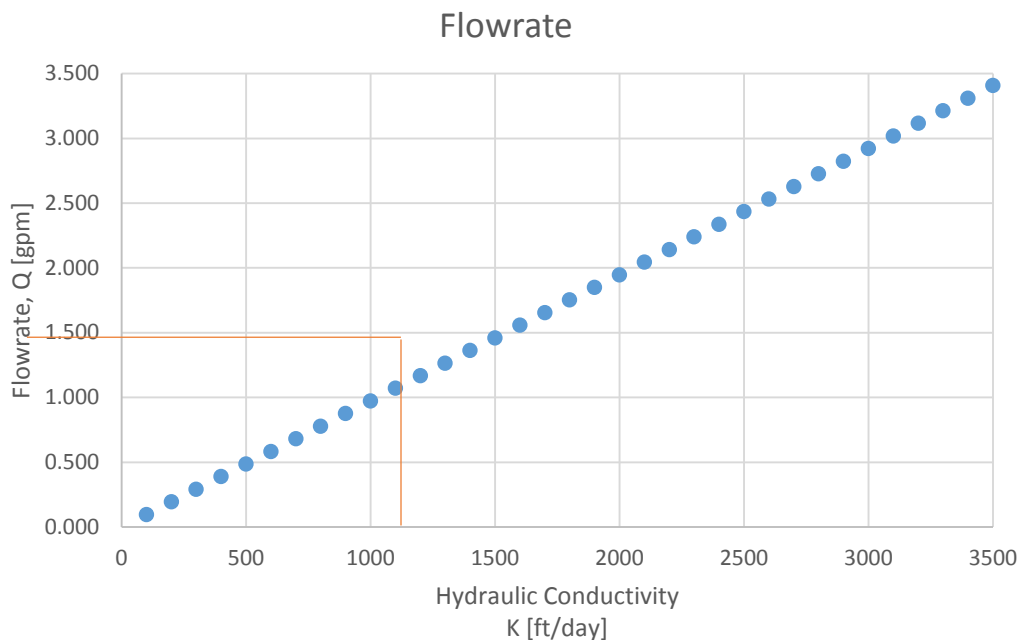


Figure K1. Flow rate through a single wetland cell for varying hydraulic conductivities.

HYDRAULIC CONDUCTIVITY - KOZENY-CARMAN EQUATION

$$K_{sm} = \left(\frac{\rho g}{\mu} \right) \left[\frac{d_p^2 \phi_m^3}{140 (1 - \phi)^2} \right]$$

K_{sm} : SATURATED HYDRAULIC CONDUCTIVITY

d_p : PARTICLE DIAMETER

ρ : FLUID DENSITY

g : GRAVITY

μ : DYNAMIC VISCOSITY

ϕ_m : POROSITY OF A BINARY MIXTURE

SAMPLE CALL

(.05" PARTICLE DIAMETER, .30 POROSITY)

$$K_{sm} = \frac{1.936 \frac{\text{slug}}{\text{ft}^3} \cdot 32.2 \frac{\text{ft}}{\text{s}^2}}{2.034 \cdot 10^{-3} \frac{\text{lb} \cdot \text{s}}{\text{ft}^2}} \left[\frac{\left(\frac{.05}{12} \right)^2 \text{ft}^2 \cdot .30^3}{140 (1 - .30)^2} \right] \left(\frac{60 \text{ s}}{1 \text{ min}} \cdot \frac{60 \text{ min}}{1 \text{ hr}} \cdot \frac{24 \text{ hr}}{1 \text{ day}} \right)$$

$$= \underline{\underline{1407 \text{ ft/day}}}$$

HYDRAULIC DESIGN - DARCY'S LAW

ASSUMPTIONS: 1-D FLOW

LAMINAR FLOW

UNIFORM & CONSTANT FLOW (Q)

NEGLECT WALL SHEAR STRESSES

INLET AND OUTLET AT ATMOSPHERIC PRESSURE

$$Q = AK \frac{\Delta h}{L}$$

A: AREA PERPENDICULAR TO L

K: HYDRAULIC CONDUCTIVITY

L: LENGTH

Δh : CHANGE IN HYDRAULIC HEADING

(CHANGE IN INLET & OUTLET HEIGHT FOR $p_1 = p_2$ AT ATMOSPHERIC)

Q: FLOWRATE (AVERAGE: $\frac{Q_{in} + Q_{out}}{2}$)

$$Q = (1 \text{ ft}) (3 \text{ ft}) (1500 \text{ ft/day}) \left(\frac{1/2 \text{ ft}}{4 \text{ ft}} \right)$$

$$= 281.25 \text{ ft}^3/\text{day} \left(7.48 \frac{\text{gal}}{\text{ft}^3} \right) \left(\frac{1 \text{ day}}{24 \text{ hr}} \cdot \frac{1 \text{ hr}}{60 \text{ min}} \right) = \underline{\underline{1.46 \text{ gpm}}}$$

Given: $P_{in} = 720 \text{ W}$ (electrical power)

$Q_{op} = 27 \text{ gpm}$ (operating grey pump flowrate)

$V_{tot} = 351 \text{ gallons}$ (total grey water pumped)

Find: Energy used to pump grey water throughout the competition

Analysis: $V_{tot} = Q_{op} t$, where t is time spent pumping

$$t = \frac{V_{tot}}{Q_{op}}$$

$E_{tot} = P_{in} t$, where E_{tot} is total energy consumed

$$= \frac{P_{in} V_{tot}}{Q_{op}}$$

$$= \frac{(720 \text{ W})(351 \text{ gal})}{(27 \text{ gpm})\left(\frac{60 \text{ min}}{\text{hr}}\right)} \left(\frac{\text{kWh}}{1000 \text{ Wh}}\right)$$

$$E_{tot} = 0.156 \text{ kWh}$$

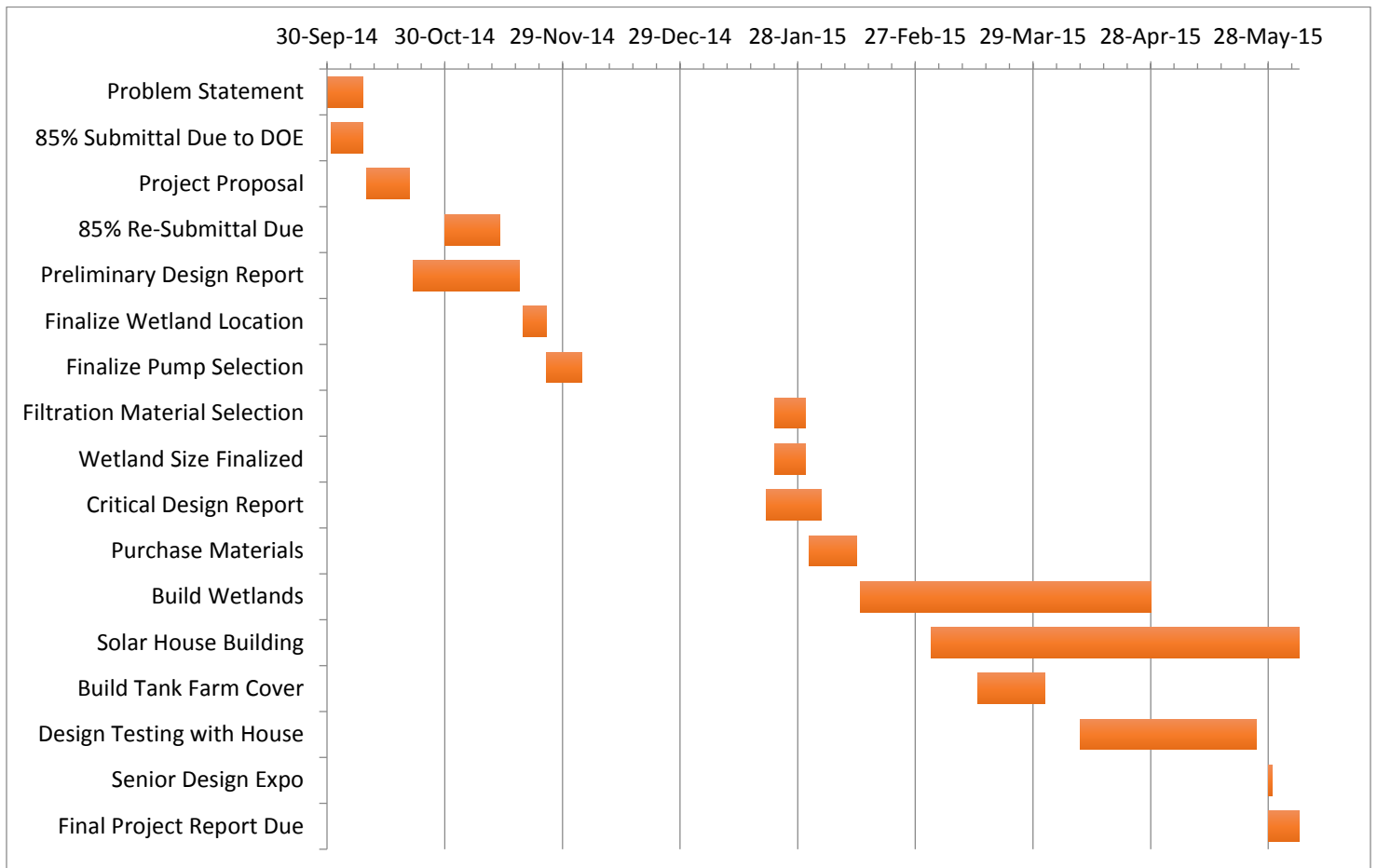
For 9 days of competition, we will require an average of $E_{tot}/9$ per day for pumping.

$$E_{day} = \frac{0.156 \text{ kWh}}{9}$$

$$E_{day} = 0.0173 \text{ kWh}$$

Appendix M. Gantt Chart

Task	Start Date	End Date	Duration
Problem Statement	30-Sep-14	9-Oct-14	9
85% Submittal Due to DOE	1-Oct-14	9-Oct-14	8
Project Proposal	10-Oct-14	21-Oct-14	11
85% Re-Submittal Due	30-Oct-14	13-Nov-14	14
Preliminary Design Report	22-Oct-14	18-Nov-14	27
Finalize Wetland Location	19-Nov-14	25-Nov-14	6
Finalize Pump Selection	25-Nov-14	4-Dec-14	9
Filtration Material Selection	22-Jan-15	30-Jan-15	8
Wetland Size Finalized	22-Jan-15	30-Jan-15	8
Critical Design Report	20-Jan-15	3-Feb-15	14
Purchase Materials	31-Jan-15	12-Feb-15	12
Build Wetlands	13-Feb-15	28-Apr-15	74
Solar House Building	3-Mar-15	5-Jun-15	94
Build Tank Farm Cover	15-Mar-15	1-Apr-15	17
Design Testing with House	10-Apr-15	25-May-15	45
Senior Design Expo	28-May-15	29-May-15	1
Final Project Report Due	28-May-15	5-Jun-15	8



ME428/429/430 Senior Design Project

2014-2015

SENIOR PROJECT CONCEPT DESIGN HAZARD IDENTIFICATION CHECKLISTTeam: Cal Poly Solar Decathlon Water Systems Advisor: Kim Shollenberger

- | Y | N | |
|-------------------------------------|-------------------------------------|--|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | Will any part of the design create hazardous revolving, reciprocating, running, shearing, punching, pressing, squeezing, drawing, cutting, rolling, mixing or similar action, including pinch points and shear points? |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | Can any part of the design undergo high accelerations/decelerations? |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | Will the system have any large moving masses or large forces? |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | Will the system produce a projectile? |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | Would it be possible for the system to fall under gravity creating injury? |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | Will a user be exposed to overhanging weights as part of the design? |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | Will the system have any sharp edges? |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | Will any part of the electrical systems not be grounded? |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Will there be any large batteries or electrical voltage in the system above 40 V either AC or DC? |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Will there be any stored energy in the system such as batteries, flywheels, hanging weights or pressurized fluids? |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | Will there be any explosive or flammable liquids, gases, or dust fuel as part of the system? |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | Will the user of the design be required to exert any abnormal effort or physical posture during the use of the design? |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | Will there be any materials known to be hazardous to humans involved in either the design or the manufacturing of the design? |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | Can the system generate high levels of noise? |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Will the device/system be exposed to extreme environmental conditions such as fog, humidity, cold, high temperatures, etc? |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Is it possible for the system to be used in an unsafe manner? |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | Will there be any other potential hazards not listed above? If yes, please explain on reverse. |

For any "Y" responses, add a complete description, list of corrective actions to be taken, and dates to be completed on the reverse side.

Description of Hazard	Corrective actions to be Taken	Planned Completion Date	Actual Completion Date
We will include two pumps in our final design: a 115 V pump for the constructed wetland and another 115 V pump for the supply water.	We have included both of these devices in the overall spec sheet for the home. We also plan to communicate with the electrical engineering team in order to connect the pumps to the grid. Both pumps will be pre-manufactured, so we will assume that they can be used safely under their operating pressures and flowrates.	3/15/15	6/5/15
We will be storing energy in pressurized fluids. We will have all of the supply water pressurized in the intermediate tank and supply pipes.	We are working closely with the plumbing team in order to safely store water in the household piping. They plan to follow all California code to ensure that the pipes will not fail from pressures below 70 psi. Additionally, we are purchasing a pre-manufactured pressure tank. As with the pumps, we will assume that the tank can safely be used under the operating pressure.	5/15/15	6/5/15
The constructed wetlands and water tanks will be outside, so they are susceptible to environmental effects.	The supply water and black water tanks are made out of polyethylene, so there will not be any rusting issues. Additionally, they will be placed under the solar cooker, keeping them out of direct sunlight. The constructed wetlands will be made out of wood, so there will not be any substantial environmental effects.	3/15/15	6/5/15
The wetlands could possibly be used in an unsafe manner. At its highest point, they will be 5.5 ft tall. If someone climbs up on the edge, they could fall and hurt themselves.	We plan to have small railings around the wetlands to keep people from climbing up the sides. Additionally, because of the smooth outer sides, the boxes will be very difficult to climb.	3/15/15	6/5/15

Appendix O. DFMEA and DVPR

Potential
**Failure Mode and Effect Analysis
(Design FMEA)**

___ System
 ___ Subsystem
 ___ Component

FMEA Number: _____

Design Responsibility: _____

Page 1 of 1

Model Year(s)/Vehicle(s): _____ Key Date: _____

Prepared By: _____

Core Team: Lauren Jones, Jake Morris, Zach Yasuda

FMEA Date (Orig.) _____ (Rev.) _____

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S v r t e e i g	Potential Cause(s) / Mechanism(s) of	O c c u r	C i r t	Recommended Action(s)	Responsibility & Target Completion	Action Results			
									Actions Taken	S u	D e	C i r t
Supply Water Pump	Does not pressurize water to 50 psi	The appliances in the house do not work.	7	Insufficient pump sizing; broken pump	2	14	Size a bigger pump	Jake March 1st, 2015				
	Pressurizes the water too much (tank cant handle it)	The pressure tank bursts	10	The controller doesn't stop the pump from running all day	1	10	Ensure the controller is properly functioning	Jake March 1st, 2015				
	Not keep the tank pressurized	The house loses prssure throughout the day	4	The controller doesn't turn the pump on when the pressure drops; tank leaking	3	12	Check the tank for leaks; Ensure the controller is functioning properly	Jake March 1st, 2015				
Grey Water Pump	Does not lift water up the 5.5 ft to the wetlands	Waterless Wetland; Backflow into the house	7	Undersized Pump; Loss of power to pump; Clog	2	14	Bigger pump; check power supply; check for clogs	Lauren March 1st, 2015				
	Doesn't turn on from the water pressure	Waterless Wetland; Backflow into the house	7	Broken pressure sensor/ controller;	1	7	Replace prssure controller	Lauren March 1st, 2015				
3 Way Valve	Not open	Backflow into the house; Breaks building code	8	Clog; Rust; Fatigue;	2	16	Clean it. Fix it. Purchase a new valve	Lauren March 1st, 2015				
	Direct the water in both ways instead fo 1	Overflow Septic Tank; Not enough water in wetlands	8	Broken Valve Mechanism	1	8	Fix the broken valve	Lauren March 1st, 2015				
Wetlands	Overflow	Unsafe water flowing all over deck/property	8	clogging; too much water; insufficient sizing	1	8	Limit water flow to the wetland (see 3 way valve); Check for clogs; Build a bioer wetland	Zach March 1st, 2015				
	Not enough water	Plants die; water doesn't flow all the way through the wetlands (staonant water)	4	Insufficient Sizing; Homeowners go on a extended vacation; Hot Temperatures	1	4	Add filler water; Build smaller wetland;	Zach March 1st, 2015				
	Not filter	Unsafe water discharged out of the wetland	7	Too much water; Improper Sizing and Material selection; short-circuiting of	1	7	Rearrange the substrate; add plants	Zach March 1st, 2015				

ME428 DVP&R Format

Report Date	12/1/2014	Sponsor				Component/Assembly		REPORTING ENGINEER:					
TEST PLAN							TEST REPORT						
Item No	Specification or Clause	Test Description	Acceptance Criteria	Test Respons	Test Stage	SAMPLES		TIMING		TEST RESULTS			NOTES
						Quantity	Type	Start date	Finish date	Test Result	Quantity Pass	Quantity Fail	
1	Fresh Water Pressure	Must provide at least the minimum required	50 psi	Jake	Complete d House	1		19-Mar	11-May				
2	TSS out	Filtered water from wetland must have less	20 mg/L	Zach	Wetland	1		13-Feb	18-Mar				
3	BOD out	Filtered water from wetland must have less	20 mg/L	Zach	Wetland	1		13-Feb	18-Mar				
4	Wetland Flow	test incoming and	30 gal/day	Lauren	Wetland	1		19-Mar	11-May				
5	Flow rate in each	each appliance must have sufficient water flow	shower: 2 gpm	Jake	Complete d House	1		19-Mar	11-May				
6	Power input to greywater and well pumps	Pumps must use no more than the power budget allows	1.5 hp	Zach	Complete d House	1		19-Mar	11-May				
7	Gravel Porosity	Fill a bucket with gravel and water and measure	0.3	Zach	Wetland	1		5-Jan	22-Jan				
8	Black Water Storage	Check for air tight seals	zero leaks	Lauren	Complete d House	1		19-Mar	11-May				
9	Storage Tank Aesthetics	Tanks are not visible from deck	zero visibility	Lauren	Complete d House	1		19-Mar	11-May				

Appendix P. List of Ordered Parts (Vendors, Manufacturers, & Unit cost)

Item	Manufacturer	Model #	Quantity	Source	Unit Price	Specs
Low Profile Fresh Water Tank	Norwesco	N-41392	1	Tank Depot	\$1,767.99	1500 Gallon
Black Water Storage Tank	Ace-Roto Mold	LP0300-RT	1	Sievers	\$432.55	300 Gallon
Pressurized Well Tank	Water Worker	HT20HB	1	Home Depot	\$124.58	20 gallons
Walrus DIY Installation Package	Walrus	diy-walrus-install-kit-1	1	Aqua Science	\$269.00	
Galvanized Stock Tank	Tractor Supply Co.	SKU 2177285	3	Tractor Supply Co.	\$250.00	8' x 3' x 2'
Galvanized Stock Tank	Tractor Supply Co.	SKU 2177227	1	Tractor Supply Co.	\$155.00	6' x 2' x 2'
Supply Water Pump	Walrus	TQ800	1	Aqua Science	\$459.99	1 HP
Grey Water Pump	Drainosaur	WRSC-6 (Compact Size)	1	Little Giant Pump	\$206.15	1/3 HP
3M Super Silicone Sealant	3M	74955A54	1	McMaster-Carr	\$16.35	10.3-oz Cartridge
Wetland Gravel - Fine	Kritz Trucking	3/8" Bradley Pea	4 tons	Kritz Trucking	\$335.00	Cost stated is total for all gravel
Wetland Gravel - Coarse	Kritz Trucking	1 1/2" crushed granite	1 ton	Kritz Trucking		
3 in. ABS 90 Degree Elbow, Female	McMaster-Carr	1608T126	7	McMaster-Carr	\$7.83	3 in.
3 in. X 5 ft. Plastic ABS pipe	McMaster-Carr	1608T505	2	McMaster-Carr	\$25.88	3 in. X 5 ft.
3 Way Valve	Orbit	38314	1	Home Depot	\$36.97	1-1/2"
3 in. ABS Coupling, Female	McMaster-Carr	1608T104	7	McMaster-Carr	\$3.62	
Plastice ABS Pipe Cement	McMaster-Carr	74605A19	1	McMaster-Carr	\$16.35	16-oz Can

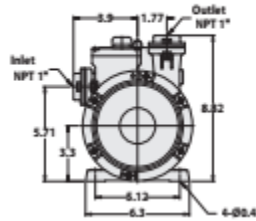
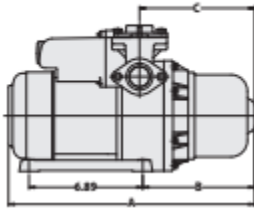
Appendix Q. Detailed Drawings of Pumps and Tanks



WALRUS®

TQ Series 60Hz
Electronic Control Pump

Dimensions: (in.)
TQ200/400/800



Model	A (in.)	B (in.)	C (in.)
TQ 200	14.37	6.26	6.46
TQ 400	14.92	6.77	6.97
TQ 800	17.76	7.80	7.99
TQ1500~3700	19.72	7.76	8.35

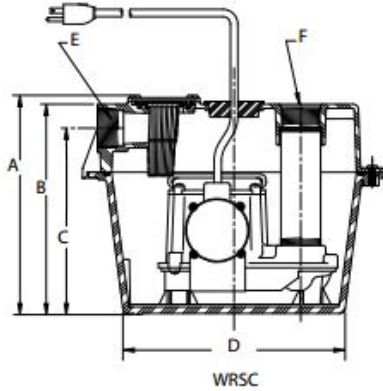
Specification:

Model	Power (HP)	Cycle (Hz)	Phase (Ø)	Voltage (V)	Amp's (A)	Inlet (NPT)	Outlet (NPT)	Preset activation pressure (psi)	Max discharge pressure (psi)	Q max. (GPM)	N.W. (lbs)
TQ200	¼	60	1	115 or 230	4.0 or 2.0	1"	1"	17	31	16.9	16.3
TQ400	½	60	1	115 or 230	6.0 or 3.0	1"	1"	26	40	18.5	19.6
TQ800	1	60	1	115 or 230	11.0 or 5.5	1"	1"	36	67	23.8	25.6
TQ1500	2	60	1 or 3	230	9.5 or 6.5	1½"	1½"	43	58	66.0	62.8
TQ2200	3	60	3	230	9.5	2"	2"	43	60	71.3	68.3
TQ3700	5	60	3	230	12	2"	2"	43	72	71.3	74.4



Drainosaur

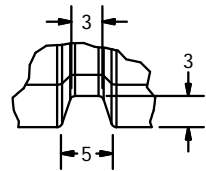
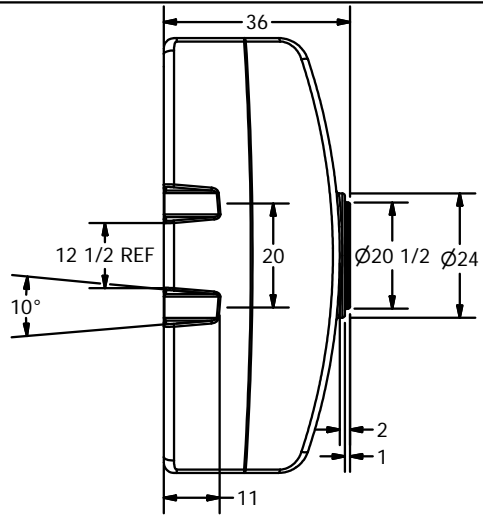
Water Removal Systems



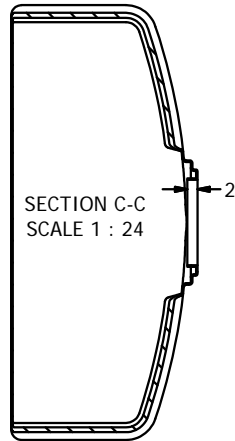
Model	A	B	C	D	E	F
WRSC-6	10.55" 26.8 cm	10.06" 25.55 cm	8.9" 22.61 cm	10.63" 27 cm	1-1/2" FNPT 3.81 cm	1-1/2" FNPT 3.81 cm

HP	Volts	Hz	Amps		Watts	Performance (GPM @ Height in Feet)				Shut-Off (ft)	PSI
			FLA	Start		5'	10'	15'	20'		
1/6	115	60	5	6.4	380	15	12	8	-	21.00	9.1
1/3	115	60	9	14.3	720	46	29	13	-	18.00	7.8
1/3	230	50/60	4.5	6.3	720	46	29	13	-	18.00	7.8
4/10	115	60	9	17	920	80	63	54	40	29.00	9.1

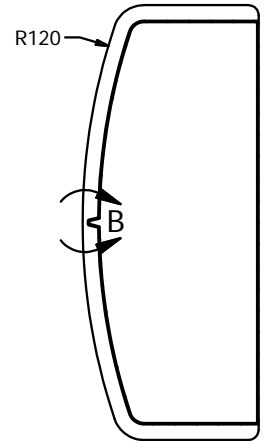
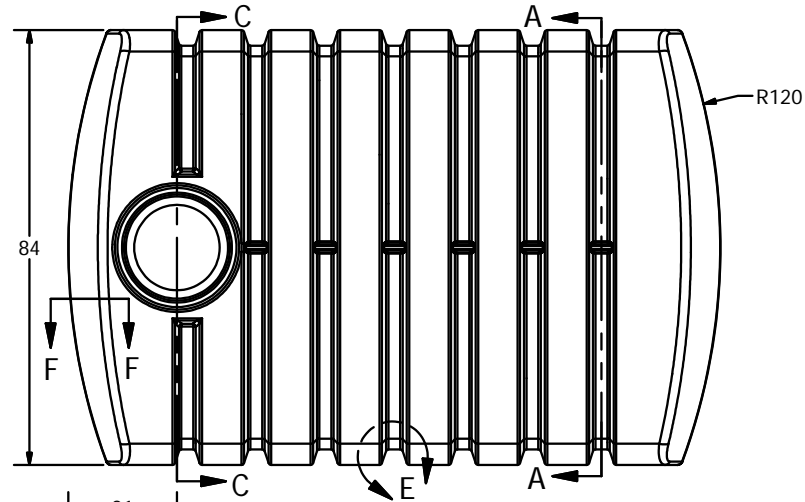
Item No.	Model	HP	Volts	Tank Size	Switch Type/ Operation	On Level	Off Level	Cord	Weight
505055	WRS-5	1/6	115	5 Gallon	Piggyback Diaphragm	6" - 9" 15.2 cm - 23 cm	1" - 4" 2.5 cm - 10 cm	10' 3 m	19 lbs 8.62 Kg
506065	WRSC-6	1/3	115	3.5 Gallon	Integral Diaphragm	4" - 7" 10.2 cm - 17.8 cm	1" - 3" 2.5 cm - 7.6 cm	10' 3 m	24 lbs 10.89 Kg
506066	WRSC-6	1/3	230	3.5 Gallon	Piggyback Mechanical Float	4" - 7" 10.2 cm - 17.8 cm	1" - 3" 2.5 cm - 7.6 cm	10' 3 m	17.75 lbs 8.05 Kg
506055	WRS-6	1/3	115	5 Gallon	Integral Diaphragm	7" - 10" 17.8 cm - 25.4 cm	1" - 4" 2.5 cm - 10.2 cm	10' 3 m	26 lbs 11.79 Kg
506056	WRS-6	1/3	230	5 Gallon	Integral Diaphragm	7" - 10" 17.8 cm - 25.4 cm	1" - 4" 2.5 cm - 10.2 cm	10' 3 m	27 lbs 12.25 Kg
509268	WRS-9EN	4/10	115	5 Gallon	Piggyback Vertical Mechanical	7" - 10" 17.8 cm - 25.4 cm	2" - 5" 5 cm - 12.7 cm	10' 3 m	35 lbs 15.88 Kg



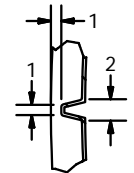
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SCALE 1 / 12



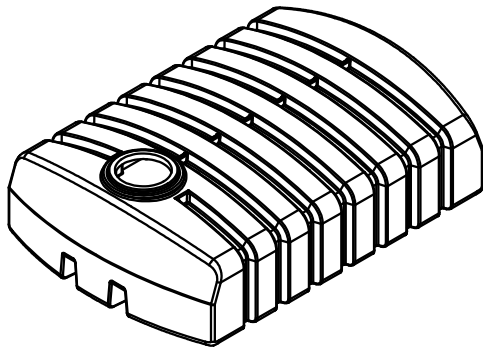
SECTION F-F
SCALE 1 : 24



SECTION A-A
SCALE 1 : 24



DETAIL B
SCALE 1 / 12



FOB ST BONIFACIUS MN AND LANCASTER OH

DRAWN Jerry Paulson	3/23/2009
CHECKED	
QA	
MFG	
APPROVED	



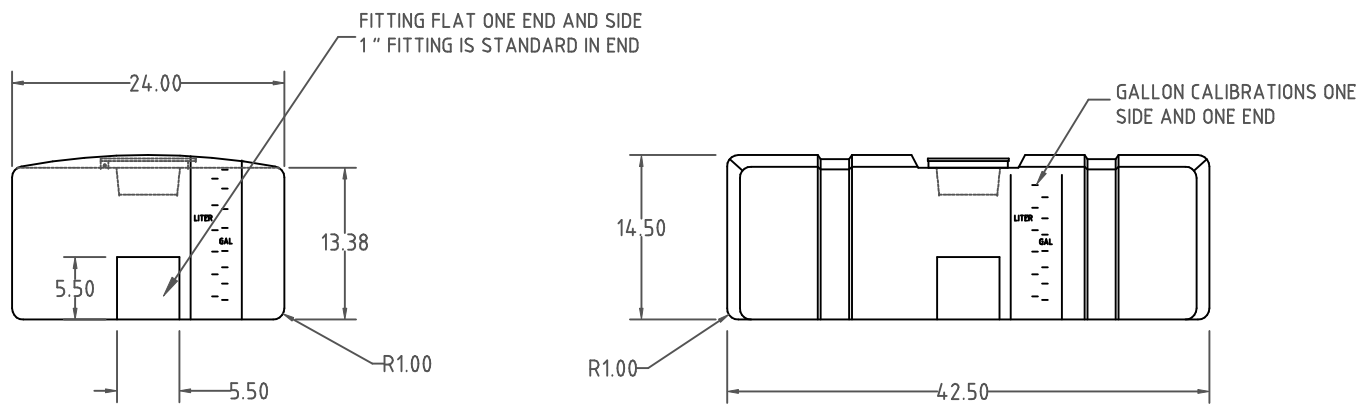
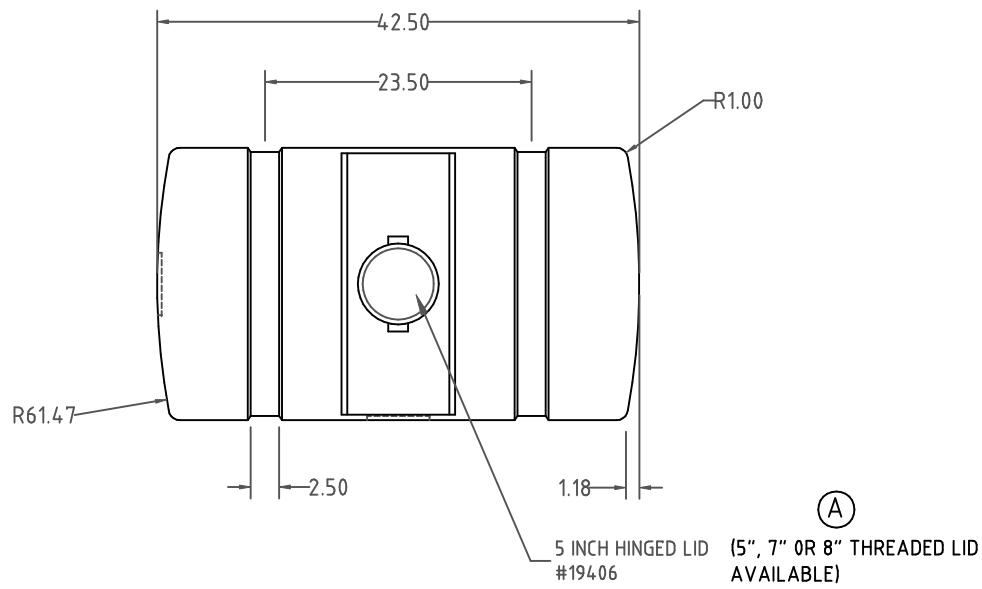
NORWESCO, INC., ST. BONIFACIUS, MN


TITLE
1275 GALLON LOW PROFILE WATER TANK

SIZE B	DWG NO	REV
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SCALE: 1/24

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		DRAWN / DATE DHJ 6/14/06		MATERIAL 10420 3 MELT		 Den Hartog INDUSTRIES, INC. Ace Roto-Mold Injection Molding Blow Molding Sowjoy 4010 HOSPERS DRIVE S. BOX 425, HOSPERS, IOWA 51238-0425	
		APPRD. / DATE REH 6/16/08					
A	5", 7" AND 8" LID ADDED	REH 10/14/10	2100				
REV	DESCRIPTION	BY / DATE	CCN				
ALL DIMENSIONS ARE IN DECIMAL INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED		THIRD ANGLE PROJECTION ANSI 14.5M		SHOT WEIGHT: 35LB.		NOTES: 1. .260 NOM. WALL	
POLYETHYLENE		METAL		SHIPPING WEIGHT: 37 LB.			
±1% @ 68° F		DECIMAL ± .125" FRACTION ± 1/4" ANGLE ± 1°		FINISH:			
						DESCRIPTION	50 GALLON RECTANGULAR TANK
						SCALE	N.S.
						PART NO.	LP0050-RT

Appendix R. Manufacturer Provided Installation Manuals

Although Tank Depot's tanks are extremely durable, improper handling and installation can result in damage to tank, fittings, and accessories. Failure to comply with handling and installation instructions voids all warranties.



At delivery, inspect your tank immediately for defects or shipping damage. Any discrepancies, or product problems, should be noted on both the driver's bill of lading and your packing list.



When unloading your tank from the delivery truck, avoid its contact with sharp objects. Forklift blades can cause significant damage if proper precautions are not taken. Do not allow tanks to be rolled over on the fittings. Large bulk storage tanks, whenever possible, should be removed from truck bed by use of a crane or other suitable lifting device. OSHA regulation 29CFR 1910.178 through 1910.189 addresses specific standards for hoisting and lifting. Keep unloading area free of rocks, sharp objects, and other materials that could damage the tank. If tank is unloaded on it's side, carefully brace to prevent rolling.



Support bottom of tank firmly and completely. Concrete pads provide the best foundation. However, when seismic and wind factors are not being considered, tanks with a base load bearing of less than 800 pounds per square foot require a firm, even, compacted bed of sand, pea gravel, or fine soil that won't wash away. Tanks with a base load bearing of 800 pounds per square foot, or greater, require a reinforced concrete base. Steel support stands concentrate the loaded tank weight onto the stand leg pads. It is recommended that stands are mounted on a concrete base. Bolting of stands is necessary to prevent movement due to agitation, wind, seismic loads and accidental contact.



Install tanks in an area that is accessible. Ease of maintenance and removal should be considered.



Test by filling tank with water prior to use, to prevent material loss through unsecured fittings, shipping damage, or manufacturing defects. Tanks should be tested for a minimum 5 hours.



Plastic screw on bulkhead fittings are designed to be hand tightened. Overtightening can cause fittings to leak.



Support sides of rectangular tanks. In general, tanks with heights greater than 18" must be supported. However, specific applications must be considered: smaller tanks with contents that have high specific gravity and/or elevated temperatures must be supported.



Do not mount heavy equipment on tank sides.



Do not allow weight on tank fittings. Fully support pipes and valves.



Use expansion joints to prevent damage at fittings from the differential expansion and contraction of the piping and tanks.



Tanks are designed for use only in the atmospheric storage of chemicals, never for vacuum or pressure applications.



Immersion heaters should never touch the walls of the tank. Minimum spacing should be 3" - 4" from wall.



Refer to the chemical capability chart on this site as a guide. Be certain tank, fittings, and fitting gasket material are compatible with chemicals at the anticipated operating temperatures. Contact our technical staff for information on chemicals not listed, or when uncertain conditions exist.



Protect tanks from impact, especially at temperatures below 40 degrees F.



Confined spaces must be considered hazardous. Do not enter tank without first taking proper precautions.



Tank sizes as listed are nominal and calibrations on molded tanks are only approximates, but provide an indication of volume. Polyethylene tanks expand and contract which will effect volume. The degree in which this occurs depends on the size of the tanks, wall thickness, specific gravity of contents, temperature of contents and ambient temperatures.

EN ENGLISH

This instruction sheet will provide you with information required to safely own and operate your Little Giant WRSC-6 kit. This unit is designed to pump wastewater from laundry trays, washing machines, sinks, or dehumidifiers. It is not designed to pump raw sewage, fluids other than water, or fluids with solids. The inlet screen will remove many solids over 1/8" diameter, but large amounts of solids can clog screen and result in pump failure. Maximum fluid temperature is 125° F. Unit is designed to fit under most sinks so in many cases it is not necessary to recess the unit into the floor.

This instruction sheet covers the standard models in this pump series. This form is applicable to other models in this series not listed by catalog number in the replacement parts list section of this pamphlet. If the catalog number of your pump is not listed in the replacement parts section, then exercise caution when ordering replacement parts. Always give the catalog number of your pump when ordering replacement parts.

The Little Giant unit you have purchased is of the highest quality workmanship and material. It has been engineered to give you long and reliable service.

Little Giant pumps are carefully packaged, inspected, and tested to ensure safe operation and delivery. When you receive your pump, examine it carefully to determine that there are no broken or damaged parts that may have occurred during shipment. If damage has occurred, make notation and notify the firm where you purchased the pump. They will assist you in replacement or repair, if required.

READ INSTRUCTIONS CAREFULLY BEFORE ATTEMPTING TO INSTALL, OPERATE OR SERVICE THE LITTLE GIANT PUMP. KNOW THE PUMP APPLICATION, LIMITATIONS, AND POTENTIAL HAZARDS. PROTECT YOURSELF AND OTHERS BY OBSERVING ALL SAFETY INFORMATION. FAILURE TO COMPLY WITH INSTRUCTIONS COULD RESULT IN PERSONAL INJURY AND/OR PROPERTY DAMAGE! RETAIN INSTRUCTIONS FOR FUTURE REFERENCE.

SAFETY GUIDELINES



1. Make certain that the unit is disconnected from the power source before attempting to service or remove any component!
2. Do not use to pump flammable or explosive fluids such as gasoline, fuel oil, kerosene, etc. Do not use in explosive atmospheres or hazardous locations as classified by NEC, ANSI/NFPA70. Pump should be used with liquids compatible with pump component materials.
3. Do not handle the pump with wet hands or when standing on a wet or damp surface or in water.
4. Do not pull the pump out of the water by the power cord when the pump is operating or connected to power source.
5. This pump is supplied with a grounding conductor and/or grounding-type attachment plug. To reduce the risk of electrical shock, be certain that it is connected to a properly grounded grounding type receptacle.
6. The National Electric Code requires a ground fault circuit interrupter (GFCI) be installed in the branch circuit supplying fountain equipment, pools, etc.
7. In any installations where property damage and/or personal injury might result from an inoperative or leaking pump due to power outages, discharge line blockage, or any other reason, a backup system(s) and/or alarm should be used.
8. Support pump and piping during assembly and when installed. Failure to do so may cause piping to break, pump to fail, motor bearing failures, etc.

9. The pump motor is equipped with an automatic resetting thermal protector and may restart unexpectedly. Protector tripping is an indication of motor overloading as a result of excessively high or low voltage, inadequate wiring, incorrect motor connections, or a defective motor or pump.
10. If pump is an oil-filled pump, the motor housing is filled with a dielectric lubricant at the factory for optimum motor heat transfer and lifetime lubrication of the bearings. Use of any other lubricant could cause damage and void the warranty. This lubricant is non-toxic; however, if it escapes the motor housing, it should be removed from the surface quickly by placing newspapers or other absorbent material on the water surface to soak it up, so aquatic life is undisturbed.

ELECTRICAL CONNECTIONS



1. Check the pump label for proper voltage required. Do not connect to voltage other than that shown.
2. If pump is supplied with a 3-prong electrical plug, the third prong is to ground the pump to prevent possible electrical shock hazard. **DO NOT REMOVE** the third prong from the plug. A separate branch circuit is recommended. Do not use an extension cord. Do not cut plug from the cord. If the plug is cut or the cord is shortened, then this action will void the warranty.
3. If the cord is equipped with stripped lead wires, such as on 230 V models, be sure that the lead wires are connected to a power source correctly. The (green/yellow) wire is the ground. The (blue or white) and the (brown or black) are live. **CONSULT INSTRUCTION SHEET ILLUSTRATIONS FOR PROPER ASSEMBLY AND DISASSEMBLY OF YOUR LITTLE GIANT PUMP.**
4. Check local electrical and building codes before installation. The installation must be in accordance with their regulations as well as the most recent National Electrical Code (NEC).
5. Plug into a grounded receptacle with vent tube pointed down. Vent tube must remain unobstructed for proper pump operation.
6. If installed in basement, plug connection should be four feet or more above floor, especially if basement floods. Be sure electrical connections cannot be reached by rising water. Under no circumstances should outlet box or receptacle be located where it may become flooded or submerged by water.

OPERATION

1. Determine proper location for unit. Unit should be located so that inlet is gravity-fed. Unit will not draw water up from a lower level. Position and level basin. Keep basin away from any item that could puncture basin. Position selected should be convenient to inlet, discharge and vent piping and electrical supply.
 2. Plumb inlet. Using proper adapter, plumb discharge to basin cover fitting. Use a P-trap and a union next to the basin. Use pipe joint compound and hand tighten only on plastic fittings. A 1-1/2" MNPT x 2" slip pipe adapter is provided if a 2" inlet is required. See "Typical Installation."
 3. Plumb discharge. Using proper adapter, plumb discharge to basin cover fitting. Use a swing check valve as close as possible to top of basin cover and union. Be sure check valve is installed in proper flow direction. If check valve is installed backwards, no water will flow out of unit. Be sure discharge piping is sealed with pipe joint compound and that lift height of pump is not exceeded. Hand tighten only on plastic fitting. A 1-1/2" MNPT x 2" slip pipe adapter is provided if a 2" discharge is required.
 4. Plumb vent. Plumb vent using 2" threaded pipe to fitting in basin cover. Use pipe joint compound on threads and hand tighten only on plastic fittings. The basin must be vented in accordance with state and local codes. A 2" MNPT x 1-1/2" Slip pipe adapter is provided if a 1-1/2" vent is required.
- THIS UNIT WILL NOT OPERATE WITHOUT PROPER VENTING. **CAUTION:** Do not use a mechanical vent with this product. A mechanical vent will cause improper operation of the automatic switch.
5. Test Unit. Connect power cord to electrical supply as stated in ELECTRICAL CONNECTIONS. Secure power cord to piping with ties or tape. Fill unit with water through inlet. Pump should turn on with 4" to 7" (10.2 - 17.8 cm) of water in tank, and turn off when 1 1/2" to 3 1/2" (3 - 8 cm) of water is left in tank. See Pump Troubleshooting Guide if problems occur.

SPECIFICATIONS • CARACTÉRISTIQUES TECHNIQUES • ESPECIFICACIONES

Model No. Modèle No. N° de Modelo	Catalog No. Référence Catalogue Número	Volts Volts Voltios	Hertz Hertz Hertz	Amps Ampères Amperios		Watts Watts Watts	Gallons per hour (GPH) at ht. Litres par huere Litros por hora			Shutoff (FT.) Hauteur à débit nul A Válvula Cerrda	PSI Kg/cm2
				S	R		5'	10'	15'		
				WRSC-6	506065		115	60	13		
WRSC-6	506066	230	50	7	5	720	2580	1050	—	12	5.2

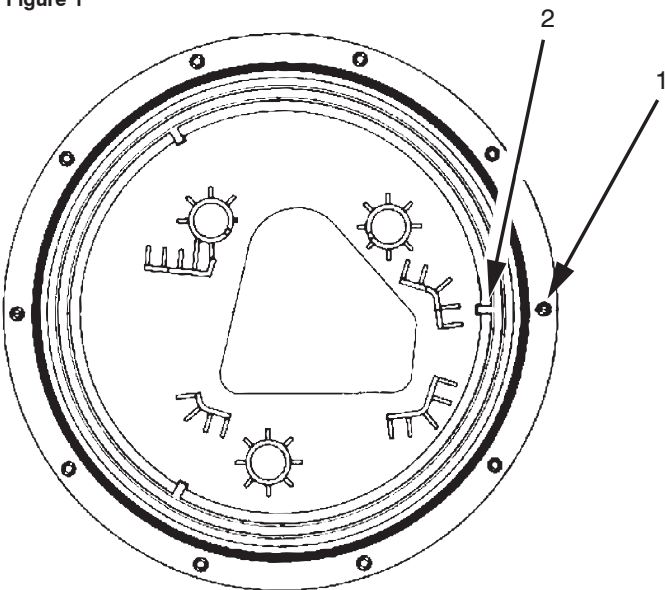
SERVICE INSTRUCTIONS



MAKE CERTAIN THE UNIT IS DISCONNECTED FROM THE POWER SOURCE BEFORE ATTEMPTING TO SERVICE OR REMOVE ANY COMPONENT!

1. To clean inlet filter remove the 4 cover plate screws (21), cover plate (19), seal ring (item 28), and screen (item 27). Clean inlet screen using a mild detergent and water. Examine o-ring and if deformed, replace with new o-ring. See replacement parts list.
2. Sediment may build up in basin causing pump to operate improperly. Remove 10 1/4-20 screws (item 21) from cover. Remove cord grommet and loosen cords to allow slack and then remove cover.
Remove pump and clean basin using a mild detergent and water. Reassemble in reverse order. Torque screws (item 21) 18-20 in.-lbs.
3. If pump alignment plate is removed, it must be reinstalled per plate alignment diagram (Figure 1).
4. Sediment or lint can clog pump and cause improper operation. If necessary, remove pump and pull off the pressed-in screen, clean using a mild detergent and water, and reinstall. Plastic pump base may also be removed to clean around impeller and inside base. Remove the six base screws and clean base using a mild detergent and water. Do not remove impeller. When reinstalling base, be sure seal ring is seated properly in groove and torque screws to 12-17 in.-lbs. See pump manual for other information. For any other pump repair, return the pump to a Little Giant authorized service center.
5. This unit is permanently lubricated. Oiling is not required. Do not, in any case, open the sealed portion of the unit or remove housing screws.
6. Remove screws (item 4) that hold base to volute and clean impeller and volute passage. Do not use strong solvents on impeller.
7. Be sure impeller turns freely after cleaning. **WARNING: DO NOT REMOVE IMPELLER. REMOVAL OF IMPELLER REQUIRES SPECIAL TOOLS AND IS TO BE DONE ONLY BY AN AUTHORIZED SERVICE CENTER.**
8. When reinstalling base, be sure seal ring is seated properly in groove and torque screws (item 4) to 10-15 in.-lbs.
9. **DO NOT REMOVE MOTOR HOUSING COVER. WARRANTY IS VOID IF MOTOR HOUSING COVER, IMPELLER OR SEALS HAVE BEEN REMOVED. ANY REPAIR ON MOTOR MUST BE DONE BY AN AUTHORIZED LITTLE GIANT SERVICE CENTER.**
10. Be certain power cord is in good condition with no nicks or cuts.

Figure 1



**PLATE ALIGNMENT DIAGRAM
DIAGRAMME DE L'ALIGNEMENT DE LA PLAQUE
DIAGRAMA DE ALINEACION DE LA PLACA**

FR FRANÇAIS

Cette liste de directives vous fournit les renseignements nécessaires pour utiliser une WRSC-6 Little Giant en toute sécurité. Cette pompe est conçue pour pomper les eaux usées des bacs à linge sale, des machines à laver, des éviers ou des déshumidificateurs.

Elle n'est pas conçue pour pomper des eaux d'égout, des liquides autres que de l'eau ou des liquides comportant des solides. L'écran d'entrée retiendra beaucoup de particules dépassant 1/8 po de diamètre; toutefois, une grande quantité de matières solides peut bloquer l'écran et causer une panne de la pompe. La température du liquide ne doit pas dépasser 125°F. La pompe est conçue pour aller sous la majorité des éviers; il est donc dans la plupart des cas inutile de l'encastrer dans le plancher.

La présente feuille d'instructions décrit les modèles standard de cette série de pompe. Ce document s'applique également à d'autres modèles de cette série qui ne sont pas indiqués par leur numéro de catalogue dans la section des pièces de remplacement du présent document. Si tel était le cas avec votre pompe, il faudra être particulièrement attentif au moment de commander des pièces. Toujours donner le numéro de catalogue de votre pompe lors de la commande de pièces.

Votre nouvelle pompe Little Giant a été fabriquée avec les meilleurs matériaux et avec le plus grand soin. Elle a été conçue pour fonctionner bien et longtemps.

Les pompes Little Giant sont soigneusement emballées, et testées pour assurer une livraison et un fonctionnement sans problèmes. Lorsque vous recevez votre pompe, examinez-la attentivement pour vous assurer qu'il n'y a pas eu de pièce cassée ou endommagée pendant l'acheminement. S'il y a eu des dégâts, prenez-en note et signalez-le au magasin où vous avez acheté la pompe. Ils vous aideront pour le remplacement ou la réparation, si nécessaire. Cette pompe est conçue pour pomper de l'eau. **NE POMPEZ PAS** de produit chimique, de solvant, d'eau salée, ou de liquides épais tels que des huiles ou de la graisse.

BIEN LIRE LES INSTRUCTIONS AVANT D'INSTALLER, DE FAIRE FONCTIONNER OU D'ENTREtenir LA POMPE LITTLE GIANT. IL FAUT CONNAÎTRE L'APPLICATION, LES LIMITESET LES DANGERS POTENTIELS DE LA POMPE. PROTÉGEZ-VOUS ET LES AUTRES EN RESPECTANT TOUTES LES NORMES DE SÉCURITÉ. LE NON-RESPECT DES INSTRUCTIONS PEUT CAUSER DES ATTEINTES AUX PERSONNES OU À LA PROPRIÉTÉ! GARDER LE PRÉSENT DOCUMENT POUR RÉFÉRENCE ULTÉRIEURE.

Position the alignment plate inside the basin as shown. This will position the mounting holes properly when installing the basin cover. Any other position will prevent assembly of cover.

Placer la plaque de l'alignement à l'intérieur du réservoir, tel qu'illustré. Ainsi, les trous de montage seront correctement alignés au moment de la pose du couvercle du réservoir. Tout autre positionnement de la plaque ne permettra pas la pose du couvercle.

Coloque la placa de alineacion dentro del depósito como se ilustra. Esto permitirá la alineación apropiada de los agujeros de montaje cuando instale la cubierta del depósito. Cualquier otra posición no permitirá armar la cubierta.

Ensure mounting hole (1) lines up with locating rib (2) on inside of basin.

Le trou de montage (1) s'aligne avec une nervure (2) de positionnement située à l'intérieur du réservoir.

Los agujeros de montaje (1) se alinean con un saliente de ubicación (2) dentro del depósito.

DIRECTIVES DE SÉCURITÉ



1. Votre pompe demandera très peu d'entretien. Si, pour une raison quelconque, elle ne peut pas fonctionner, suivez les instructions ci-dessous!
2. Ne pas utiliser pour pomper des liquides explosifs ou inflammables (essence, huile, kérosène, etc.) No se use en ambientes explosivos o lugares epligrosos, segun la clasificacion delCodigo Electrico Nacional (NEC) y la norma NFPA70 Del Instituto Nacional Norteamericano De Normas. Utiliser avec des liquides compatibles avec les matériaux de la pompe.
3. Ne pas manipuler la pompe les mains humides, les pieds posé sur une surface mouillée ou humide, ou les pieds dans l'eau.
4. N'utilisez pas le cordon d'alimentation pour sortir la pompe de l'eau alors que la pompe fonctionne ou qu'elle est reliée à une source d'alimentation.
5. Votre pompe vient avec un fil de mise a la terre et/ou une prise a trois branches. Afin de réduire le rusque de choc électrique, s'assurer que la pompe est branchée a une prise correctement mise a la terre.
6. Le Code national de l'Électricité exige qu'un interrupteur de mise à la terre (GFI) soit installé sur le circuit d'installation d'une fontaine, d'une piscine, etc.
7. L'utilisation d'un ou de plusieurs systèmes auxiliaires et/ou d'un système d'alarme est recommandée pour toute installation potentiellement dangereuse (fuite ou défectuosité causées par une coupure de courant, un blocage du circuit de refoulement ou pour toute autre raison) pour les personnes ou la propriété.
8. Immobiliser la pompe et les tuyaux lors de l'installation et de l'utilisation afin d'éviter tout risque de dommages aux tuyaux. À la pompe aux roulements à bille du moteur, etc.
9. Le moteur de la pompe est pourvu d'un dispositif de protection thermique à démarrage automatique ; elle peut redémarrer à tout moment. Le déclenchement du dispositif de protection indique une surchauffe du moteur provoquée par un voltage excessif ou insuffisant, un câblage non approprié, des erreurs de raccordement du moteur, une défaillance du moteur ou une défaillance de la pompe.

10. Si la pompe est remplie d'huile. le carter est rempli d'huile diélectrique servant de caloporteur pour la chaleur engendrée par le moteur et de lubrifiant pour les paliers. L'emploi d'un autre lubrifiant quel qu'il soit pourrait endommager l'appareil et annuler la garantie. Bien que cette huile ne soit pas toxique, en cas de fuite, l'enlever rapidement à l'aide de journaux posés rapidement à la surface de l'eau pour que la vie aquatique ne soit pas perturbée.

CONNEXIONS ÉLECTRIQUES



1. Consulter l'étiquette de la pompe pour connaître la tension appropriée. Ne pas raccorder à une source autre que la tension spécifiée.
2. Si la pompe est équipée d'une fiche d'alimentation électrique à trois broches, la troisième est destinée à raccorder la pompe à la terre pour éliminer les risques d'électrocution. NE PAS ENLEVER cette troisième broche du cordon d'alimentation. Un circuit de branche séparé est recommandé. Ne pas utiliser un prolongateur. Ne pas couper la fiche du cordon. Couper la fiche ou raccourcir le cordon entraînera l'annulation de la garantie.
3. Si le cordon est muni de conducteurs codés à l'aide de rayures, comme pour les modèles en 230 volts, s'assurer que ces fils sont correctement raccordés à la source d'alimentation électrique. Ainsi le fil vert/jaune est prévu pour le retour à la terre alors que les deux autres (bleu ou blanc) sont sous tension.

LIRE ATTENTIVEMENT LE MODE D'EMPLOI AVANT LE MONTAGE OU LE DEMONTAGE DE LA POMPE LITTLE GIANT.

4. Vérifiez la réglementation locale en matière d'électricité et de bâtiment avant de procéder à l'installation. L'installation doit respecter cette réglementation ainsi que le Code national de l'électricité le plus récent.
5. S'assurer que le tuyau de ventilation est dirigé vers le bas, et raccorder à une prise mise à la terre. Pour que la pompe fonctionne bien, le tuyau ne doit pas être obstrué.
6. Si la pompe est installée dans un sous-sol, la connexion électrique doit se faire à au moins quatre pieds du niveau du sol, particulièrement si le sous-sol risque d'être inondé. S'assurer que l'eau ne peut atteindre le niveau des connexions. Le boîtier ou la prise de courant ne devrait jamais se trouver à endroit où il pourrait être submergé.

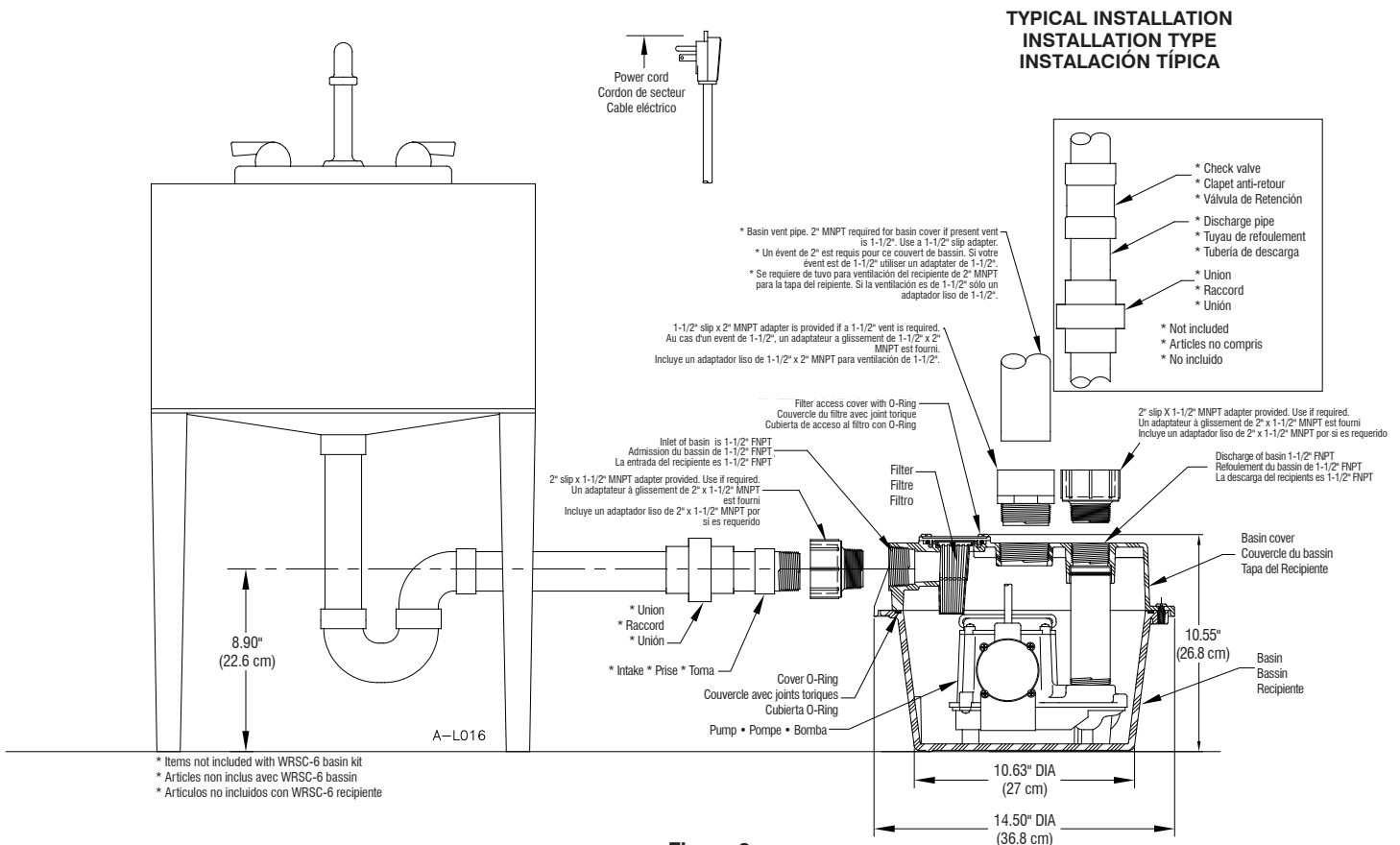


Figure 2

* Items not included with WRSC-6 basin kit
 * Articles non inclus avec WRSC-6 bassin
 * Artículos no incluidos con WRSC-6 recipiente

FUNCIONNEMENT

1. Installer la pompe à un endroit adéquat. Elle devrait être placée de manière à ce que l'entrée soit alimentée par gravité, car elle ne peut aspirer l'eau se trouvant à un niveau inférieur. Installer le réservoir et le mettre de niveau. Éloigner du réservoir tout objet qui pourrait le perforer. L'emplacement choisi pour la pompe doit convenir à l'entrée et à la sortie, aux tuyaux d'aération et aux fils électriques.
2. Faire le raccordement de l'entrée. À l'aide de la carte appropriée, plumb décharge raccord de couverture du bassin. Utiliser un siphon en P et un raccord-union à proximité du réservoir. Utiliser de la pâte à joints et ne serrer les raccords de plastique qu'à la main. Ne pas utiliser des tuyaux dont le diamètre est inférieur à 1 1/2 po. A 1-1/2" MNPT x 2" Un adaptateur de tube par glissement est fourni si une entrée de 2" est requise. Voir Installation typique.
3. Faire le raccordement de la sortie. À l'aide de la carte appropriée, plumb décharge raccord de couverture du bassin. Utiliser un clapet de non-retour à battant à une distance ne dépassant pas 8 cm (3 po) du couvercle du réservoir et d'un raccord-union. S'assurer que le clapet est installé dans le bon sens : s'il est installé à l'envers, l'eau ne pourra pas être refoulée par la pompe. S'assurer aussi que la conduite de sortie est scellée avec de la pâte à joints et que la hauteur statique de refoulement de la pompe n'a pas été dépassée. Ne serrer les raccords de plastique qu'à la main. A 1-1/2" MNPT x 2" Un adaptateur de tube par glissement est fourni si un refoulement de 2" est requis.
4. Faire le raccordement du tuyau d'aération. À l'aide de la carte appropriée, plumb décharge raccord de couverture du bassin. Utiliser de la pâte à joints sur les filets et ne serrer les raccords de plastique qu'à la main. Le réservoir doit être aéré conformément aux normes nationales et provinciales. A 2" MNPT x 1-1/2" Un adaptateur de tube par glissement est fourni si un évent de 1-1/2" est requis. **CET APPAREIL NE FONCTIONNERA PAS SANS UNE AÉRATION ADÉQUATE. MISE EN GARDE :** Ne pas utiliser d'aération mécanique avec ce produit : un tel dispositif causerait un mauvais fonctionnement de l'interrupteur automatique.
5. Tester la pompe. Brancher le cordon d'alimentation à une fiche électrique, comme cela est indiqué à la section «Branchements électriques». Fixer le cordon d'alimentation au tuyau avec des attaches ou du ruban adhésif. Remplir le réservoir d'eau par l'entrée. La pompe doit se mettre en marche lorsque le niveau d'eau dans le réservoir est de 10 - 18 cm (4 - 7 po) et s'arrêter lorsqu'il est à 3-8 cm (1 1/2 - 3 1/2 po). Voir le Guide de dépannage de la pompe si des problèmes surviennent.

DIRECTIVES D'ENTRETIEN



VOTRE POMPE DEMANDERA TRÈS PEU D'ENTRETIEN. SI, POUR UNE RAISON QUELCONQUE, ELLE NE PEUT PAS FONCTIONNER, SUIVEZ LES INSTRUCTIONS CI-DESSOUS!

1. Pour nettoyer le filtre d'arrivée, retirer les 4 vis du couvercle de la grille d'entrée (article 21), le couvercle (article 19), anneau du joint (article 28) et la grille d'entrée (article 27). Utiliser un détergent doux et de l'eau pour nettoyer la grille d'entrée. Vérifier le joint torique; s'il est déformé, le remplacer. Consulter la liste des pièces de remplacement.
2. Réservoir: Des sédiments peuvent s'accumuler dans le réservoir et causer un mauvais fonctionnement de la pompe. Enlever les 10 vis 1/4-20 du couvercle, retirer le passe-fil, donner du jeu aux fils et retirer le couvercle. Retirer la pompe et nettoyer le réservoir à l'aide d'eau et d'un détergent doux. Réassembler. Serrer les vis avec un couple de 21-23 cm·kg.
3. Si la plaque d'alignement de la pompe a été enlevée, elle doit être réinstallée selon le diagramme d'alignement de la pompe.
4. Pompe : Des sédiments ou d'autres débris peuvent bloquer la pompe et causer son mauvais fonctionnement. Si nécessaire, retirer la pompe de l'installation, retirer l'écran, nettoyer à l'aide d'un détergent doux et réinstaller. La base de plastique de la pompe peut aussi être enlevée afin de nettoyer le contour de la turbine et l'intérieur de la base. Enlever les six vis de la base et nettoyer cette dernière avec un détergent doux. Ne pas retirer la turbine. Au moment de la réinstallation de la base, s'assurer que l'anneau d'étanchéité se trouve dans la rainure. Resserrer les vis avec un couple de 12-17 cm·kg. Consulter le manuel de la pompe pour d'autres renseignements. Pour toute autre réparation, expédier la pompe à un Centre de service autorisé Little Giant.
5. Cette unité est lubrifiée en permanence. Il n'est pas nécessaire de la graisser. N'ouvrez jamais la partie scellée de l'unité et n'enlevez jamais les vis du boîtier.
6. Retirez les vis (pièce 4) qui relient la base à la volute, puis nettoyez la turbine et le passage de la volute. N'utilisez aucun solvant puissant sur la turbine.

7. Veillez à ce que la turbine tourne librement une fois le nettoyage terminé. **AVERTISSEMENT : LAISSEZ LA TURBINE EN PLACE. LE RETRAIT DE LA TURBINE NÉCESSITE DES OUTILS SPÉCIAUX ET NE PEUT ÊTRE EFFECTUÉ QU'À UN CENTRE DE SERVICE AUTORISÉ.**
8. Au moment de la réinstallation de la base, s'assurer que l'anneau d'étanchéité se trouve dans la rainure. Resserrer les vis avec un couple de 12-17 cm·kg.
9. **LAISSEZ LE COUVERCLE DU BOÎTIER DU MOTEUR EN PLACE. LE RETRAIT DU COUVERCLE DU BOÎTIER DU MOTEUR, DE LA TURBINE OU DES JOINTS ANNULE LA GARANTIE. TOUTE RÉPARATION DU MOTEUR DOIT ÊTRE EFFECTUÉE À UN CENTRE DE SERVICE AUTORISÉ LITTLE GIANT.**
10. Assurez-vous que le cordon d'alimentation est en bon état et ne présente ni entaille ni coupure.

ES ESPAÑOL

Esta hoja de instrucciones le proporcionará la información requerida para que pueda ser propietario de y poner en funcionamiento con seguridad las WRSC-6 Little Giant. Esta unidad está diseñada para bombear aguas residuales de bandejas de lavandería, lavadoras, lavaplatos o deshumidificadores. La unidad no está diseñada para bombear aguas residuales no tratadas, fluidos que no sean agua, o fluidos con sólidos. La rejilla de la toma eliminará muchos sólidos con un diámetro de más de 1/8", pero grandes cantidades de sólidos pueden obstruir la rejilla y causar la falla de la bomba. La temperatura máxima del fluido es 125° F. La unidad está diseñada para instalarse bajo la mayoría de los lavaplatos, de manera que, en muchos casos, no es necesario empotrar la unidad en el piso.

Esta hoja de instrucciones cubre los modelos estándar en esa serie de bombas. Este formulario es aplicable a otros modelos en esta serie que no aparecen listados por número de catálogo en la sección de piezas de repuesto de este folleto. Si el número de catálogo de su bomba no está listado en esa sección de piezas de repuesto, se debe entonces tomar precauciones cuando se hace el pedido de piezas de repuesto. Cuando pida piezas de repuesto, dé siempre el número de catálogo de su bomba.

La unidad Little Giant que usted ha adquirido posee la más alta calidad de fabricación y materiales. Ha sido diseñada para brindarle una larga vida de servicio sin problemas.

Las bombas Little Giant se envasan cuidadosamente, registradas y probadas para asegurar la entrega y operación segura. Cuando usted recibe su bomba, examina lo cuidadosamente para determinar que no hay roto o dañado partes que pueden haber ocurrido durante el embarque. Si el daño ha ocurrido, hecho anotación y notificado la firma que usted compró la bomba desde. Ellos ayudarán usted en el reemplazo o la reparación, si requirió.

LEA DETENIDAMENTE LAS INSTRUCCIONES ANTES DE INTENTAR INSTALAR OPERAR O DAR MANTENIMIENTO A LA BOMBA LITTLE GIANT. CONOZCA LAS LIMITACIONES, APLICACIONES Y LOS PELIGROS POTENCIALES DE LA BOMBA. PROTEJASE A SI MISMO Y A LOS DEMAS CUMPLIENDO TODAS LAS RECOMENDACIONES DE SEGURIDAD. ¡EL INCUMPLIMIENTO DE LAS INSTRUCCIONES PODRÍA RESULTAR EN LESIONES PERSONALES Y/O DAÑOS MATERIALES! CONSERVE LAS INSTRUCCIONES PARA REFERENCIAS FUTURAS.

REGLAMENTO DE SEGURIDAD



1. Asegurese de que la unidad este desconectada de la fuente de alimentacion electrica antes de intentar prestar servicio a la unidad o quitar cualquier componente de ella!
2. No use la unidad para bombear liquidos inflamables ni explosivos tales como gasolina, fueloil, queroseno, etc. **NO SE USE EN AMBIENTES EXPLOSIVOS O LUGARES EPLIGROSOS, SEGUN LA CLASIFICACION DEL CODIGO ELECTRICO NACIONAL (NEC) Y LA NORMA NFPA70 DEL INSTITUTO NACIONAL NORTEAMERICANO DE NORMAS.** La bomba se debe usar con liquidos compatibles con los materiales de los componente de la bomba.
3. No manipule la bomba con las manos mojadas, ni mientras se encuentre en una superficie mojada o húmeda o entre el agua.
4. No saque la bomba del agua tirando del cable de potencia cuando la bomba está en funcionamiento o cuando está conectada a la fuente de potencia.
5. Esta bomba se suministra con un conductor a tierra y/o un enchufe de conexion de tipo de conexion a tierra. Para reducir el riesgo de descarga electrica asegurese de conectar la unidad a un receptaculo del tipo polarizado y adecuadamente conectado a tierra.

- El Código Eléctrico Nacional (National Electric Code) requiere la instalación de un interruptor de circuito por falla a tierra (GFCI) en el ramal del circuito que suministra la corriente a fuentes, piscinas, etc.
- En cualquier instalación donde puedan ocurrir daños materiales y/o lesiones personales que resulten del funcionamiento inadecuado o de fugas en la bomba a causa de fallos en la alimentación eléctrica, bloqueo de la línea de la descarga, o cualquier otra razón, se deberá usar uno o varios sistemas de respaldo y/o alarmas.
- Apoye la bomba y la tubería durante el ensamblado de la unidad y al completar la instalación. El no hacerlo así puede causar la ruptura de la tubería, el fallo de la bomba, el fallo de los cojinetes del motor, etc.
- El motor de la bomba está equipado con un protector térmico de reposición automática y puede reposicionarse inesperadamente. El accionamiento del protector es una indicación de sobrecarga del motor debida a un voltaje demasiado alto o bajo, un cableado inadecuado, conexiones de motor incorrectas o un motor o bomba defectuosos.
- Si la bomba es una bomba llena de aceite, la caja del motor viene de fábrica llena de un lubricante dieléctrico, para proporcionar una transferencia óptima del motor y una lubricación permanente de los cojinetes. El uso de cualquier otro lubricante podría causar averías y anular la garantía. Este lubricante no es tóxico; no obstante, si escapa de la caja del motor, puede quitarse rápidamente de la superficie del agua, colocando sobre ella toallas de papel u otro material absorbente para embeberlo, con el fin de no perturbar la vida acuática.

CONEXIONES ELECTRICAS



- Consulte el rótulo de la bomba, para conocer el voltaje adecuado que se requiere. No la conecte a un voltaje distinto del indicado.
- Si la bomba está dotada de un enchufe eléctrico de tres dientes, el tercer diente es para ponerla a tierra, con el fin de prevenir el peligro de posibles choques eléctricos. NO QUITE el tercer diente del enchufe. Se recomienda un circuito de ramal independiente. No utilice cables de extensión. No corte el enchufe del cable. Si se corta el enchufe o se acorta el cable, la garantía será nula.
- Si el cable viene dotado de hilos conductores forrados, como ocurre en los modelos de 230 voltios, cerciórese de que los hilos conductores se encuentren conectados correctamente a una fuente de electricidad. El hilo verde o amarillo, es el de puesta a tierra; el hilo azul o blanco y el marrón o negro, son hilos con corriente.

CONSULTE LAS ILUSTRACIONES DE LA HOJA DE INSTRUCCIONES, PARA MONTAR Y DESMONTAR CORRECTAMENTE SU BOMBA LITTLE GIANT.

- Verifique los códigos locales de construcción y eléctricos antes de la instalación. La instalación debe estar de acuerdo con los reglamentos así como con el Código Eléctrico Nacional (National Electrical Code; NEC) más reciente.
- Enchufe a un receptáculo conectado a tierra con el tubo del respiradero indicando hacia abajo. Éste debe mantenerse sin obstrucciones para el funcionamiento apropiado de la bomba.
- Si la bomba se instala en un sótano, la conexión de enchufe debe estar a cuatro pies o más por encima del nivel del piso, especialmente si el sótano se inunda. Asegúrese de que las conexiones eléctricas no puedan ser alcanzadas por la subida de las aguas. En ninguna circunstancia debe estar ubicado el tomacorriente donde el agua lo pueda inundar o sumergir.

FUNCIONAMIENTO

- Determine la ubicación apropiada para la unidad. Ubíquela de forma tal que la toma de entrada esté alimentada por gravedad. La unidad no extraerá agua desde un nivel más bajo. Coloque y nivele el depósito. Manténgalo alejado de cualquier artículo que pueda perforarlo. La posición seleccionada debe ser conveniente para las tuberías de entrada, descarga, del respiradero y alimentación eléctrica.
- Instale la tubería de entrada. Usar el adaptador de descarga apropiado al mecanismo de sujeción de la tapa del depósito. Utilice un sifón tipo P y una unión a continuación del depósito. Use un compuesto de unir tuberías y apriete a mano solamente los accesorios plásticos. No disminuya el tamaño de la tubería por debajo de 1-1/2". Se provee un adaptador liso de 1-1/2" MNPT x 2" si se requiere entrada de 2". Consulte "Instalación típica".
- Instale la tubería de descarga. Usar el adaptador de descarga apropiado al mecanismo de sujeción de la tapa del depósito. Use una válvula de retención móvil a no más de 3" de la tapa del depósito y la unión. Asegúrese que la válvula de retención está instalada en la dirección

correcta del fluido. Si ésta se instala contrariamente, no correrá agua hacia afuera de la unidad. Asegúrese que la tubería de la descarga está sellada con un compuesto de unir tuberías y que la altura de elevación de la bomba no se excede. Apriete a mano solamente los accesorios plásticos. Se provee un adaptador liso de 1-1/2" MNPT x 2" si se requiere descarga de 2".

- Usar el adaptador de descarga apropiado al mecanismo de sujeción de la tapa del depósito. Use un compuesto de unir tuberías en las roscas y apriete a mano solamente los accesorios plásticos. El depósito debe estar ventilado en conformidad con los códigos estatales y locales. Se provee un adaptador liso de 2" MNPT x 1-1/2" si se requiere ventilación de 1-1/2". **ESTA UNIDAD NO OPERARÁ SIN UN RESPIRADERO ADECUADO. CUIDADO:** No use un respiradero mecánico con este producto, ya que producirá un funcionamiento incorrecto del interruptor automático.
- Pruebe la unidad. Conecte el cordón eléctrico a la alimentación como se indica en Conexiones eléctricas ["ELECTRICAL CONNECTIONS"]. Asegure el cordón eléctrico a la tubería con ataduras o cinta adhesiva. Llene la unidad con agua a través de la toma de entrada. La bomba debe encenderse cuando hay de 4" a 7" de agua en el depósito y apagarse cuando en éste queden de 1-1/2" a 3-1/2" de agua. Ver a bomba Troubleshooting Guide si se producen problemas.

INSTRUCCIONES DE SERVICIO



¡ASEGURESE DE QUE LA UNIDAD ESTE DESCONECTADA DE LA FUENTE DE ALIMENTACION ELECTRICA ANTES DE INTENTAR PRESTAR SERVICIO A LA UNIDAD O QUITAR CUALQUIER COMPONENTE DE ELLA!

- Para limpiar el filtro de la toma de entrada quite los cuatro (4) tornillos de la cubierta de la cobertura (ítem 21), la cubierta de la cobertura (ítem 19), anillo de cierre (ítem 28) y la rejilla (ítem 27). Limpie la rejilla de la toma utilizando un detergente ligero y agua. Examine el anillo anular tipo O y si está deformado, reemplácelo con uno nuevo. Vea Listado de piezas de repuesto.
- Depósito: Se puede acumular sedimento en el depósito y ello causa que la bomba funcione mal. Quite (10) tornillos de 1/4-20 de la cubierta. Saque la arandela aislante y afloje los cables para que tengan holgura y luego saque la cubierta. Saque la bomba y limpie el depósito con un detergente suave y agua. Vuelva a armar en orden inverso. Apriete los tornillos con una torsión de 21 a 23 cm-Kg.
- Si se saca la placa de alineación de la bomba, debe volver a instalarse según el diagrama de alineación de la bomba.
- Bomba: El sedimento o las hilachas pueden tapar la bomba y causar que funcione mal. Si es necesario, saque la bomba y quite la rejilla instalada a presión, límpiela con un detergente suave y agua y instale de nuevo. La base plástica de la bomba también puede sacarse para limpiar alrededor del impulsor y dentro de la base. Saque los seis tornillos de la base y limpie la base con un detergente suave y agua. No saque el impulsor.
Cuando instale de nuevo la base, asegúrese que el anillo de sellado esté apropiadamente asentado en la ranura y apriete los tornillos con una torsión de 12 a 17 cm-Kg. Vea el manual de la bomba para obtener información adicional. Para cualquier otro tipo de reparación de la bomba, envíe la bomba a un centro de servicio autorizado por Little Giant.
- Esta unidad se encuentra lubricada permanentemente. No se requiere lubricación. Jamás, en ningún caso, abra la parte de la unidad que está sellada o retire los tornillos de la caja.
- Quite los tornillos (artículo 4) que sostienen la base de la voluta y limpie el impulsor y el pasaje de la voluta. No use solventes fuertes en el impulsor.
- Asegúrese de que el impulsor gire libremente antes de limpiarlo. **ADVERTENCIA: NO QUITE EL IMPULSOR. PARA QUITAR EL IMPULSOR SE REQUIEREN HERRAMIENTAS ESPECIALES Y ESTO DEBE HACERSE SOLO EN UN CENTRO DE SERVICIO AUTORIZADO.**
- Cuando instale de nuevo la base, asegúrese que el anillo de sellado esté apropiadamente asentado en la ranura y apriete los tornillos con una torsión de 12 a 17 cm-Kg.
- NO QUITE LA CUBIERTA DE LA CAJA DEL MOTOR. LA GARANTIA ES NULA SI SE QUITA LA CUBIERTA DE LA CAJA DEL MOTOR, EL IMPULSOR O LOS OBTURADORES. CUALQUIER REPARACION DEL MOTOR DEBE HACERSE EN UN CENTRO DE SERVICIO AUTORIZADO DE LITTLE GIANT.**
- Asegúrese de que el cable de potencia esté en buenas condiciones y que no tenga cortes o rasgaduras.

**TROUBLESHOOTING INFORMATION • INFORMATION SUR LA RELÈVE DES DÉRANGEMENTS
• INFORMACION DE INVESTIGACION DE AVERIAS**

PROBLEM • FONCTIONNEMENT DÉFECTUEUX • PROBLEMA	PROBABLE CAUSES • CAUSES PROBABLES • CAUSAS PROBABLES	CORRECTIVE ACTIONS • SOLUTIONS • SOLUCION
<p>Pump will not shut off. Note: Before troubleshooting automatic control check to see that pump operates on manual control. To do this, create slight vacuum on breather tube (near plug), then close off tube with thumb, plug into wall outlet. If pump works, proceed to check switch; if not, fault is in pump or power supply. • Le moteur de la pompe ne s'arrête pas. Remarque: avant de contrôler le fonctionnement automatique, vérifier que la pompe fonctionne en manuel. Pour cela, faire un vide dans le tube de purge (près de la prise), fermer ensuite le tuyau avec le pouce et brancher dans la prise murale. Si la pompe fonctionne, vérifier le commutateur; si elle ne fonctionne pas, c'est la faute de la pompe ou du bloc d'alimentation. • La bomba no se apaga. Nota: antes de buscar averías en el control automático, verifique si la bomba funciona con control manual. Para hacer esto, desconéctela de la línea del enchufe del interruptor accionado por el flotador. Conecte el cable eléctrico de la bomba a una toma en la pared. Si la bomba funciona, proceda a inspeccionar el interruptor; si no, la falla está en la bomba o el suministro de electricidad.</p>	<p>Diaphragm switch. • C'est le commutateur de diaphragme. • Interruptor del diafragma.</p>	<p>Replace switch. • Remplacer le commutateur. • Cambie el interruptor.</p>
	<p>Weak or hardened rubber diaphragm. • Le caoutchouc du diaphragme est faible ou durci. • Diafragma de caucho debilitado o endurecido.</p>	<p>Replace rubber diaphragm. • Remplacer le caoutchouc du diaphragme. • Cambie el diafragma de caucho.</p>
	<p>Plugged vent tube. • Le tuyau de purge est branché. • Tubos de aspiración ocluidos.</p>	<p>Clear vent tube of any obstructions. • Nettoyer le tuyau de purge. • Despeje el tubo de aspiración de cualquier obstrucción.</p>
	<p>Dirt or sediment lodged between retainer ring and rubber diaphragm causing contacts to remain closed. • Boue ou résidus logés entre le jonc et le caoutchouc du diaphragme empêchent les contacts de s'ouvrir. • El sucio o sedimento atrapado entre el anillo de retención y el diafragma de caucho causa que los contactos permanezcan cerrados.</p>	<p>Clean area around rubber diaphragm. • Nettoyer le contour de caoutchouc du diaphragme. • Limpie el área que rodea el diafragma de caucho.</p>
	<p>Pump is air locked. • Poche d'air dans la pompe. • Burbujas de aire en la bomba.</p>	<p>Shut power off for approximately 1 minute, then restart. Repeat several times to clear air from pump. If system includes a check valve, a 3/16" hole should be drilled in discharge pipe approximately 2" above discharge connections. • Couper le courant pendant 1 minute environ puis recommencer. Répéter cette opération plusieurs fois pour évacuer l'air de la pompe. S'il y a une soupape d'arrêt, percer un trou de 3/16 po dans le tuyau d'écoulement, à environ 2 po au-dessus des connexions d'écoulement. • Desconecte la electricidad durante un minuto, aproximadamente. Luego, vuélvala a conectar. Repita varias veces, para purgar el aire de la bomba. Si el sistema tiene una válvula de retención, debe perforarse un orificio de ventilación en el tubo de descarga, aproximadamente 2 pulgadas por encima de las conexiones de descarga.</p>
	<p>Liquid inflow matches pump capacity. • Afflux de liquide correspondant au volume de la pompe. • El caudal que entra es igual a la capacidad de la bomba.</p>	<p>Larger pump required. • Une pompe plus puissante est nécessaire. • Se requiere una bomba mayor.</p>
	<p>Defective switch. • Commutateur défectueux. • Interruptor defectuoso.</p>	<p>Disconnect switch, check w/ohmmeter, Open-infinite resistance, closed-zero. • Débrancher le commutateur, vérifier avec un ohmmètre. Ouvert-résistance infinie, fermé-zéro. • Desconecte el interruptor e inspecciónelo con el ohmmetro; abierto, resistencia infinita; cerrado, cero.</p>
<p>Loose connection in level control wiring. • Connexion des fils électriques du niveau de contrôle distendue. • Conexiones flojas en los cables del regulador de nivel.</p>	<p>Check control wiring. • Vérifier le circuit électrique. • Inspeccione los cables del regulador.</p>	
<p>Pump runs but does not discharge liquid. • La pompe fonctionne mais il n'y a pas d'écoulement de liquide. • La bomba funciona, pero no descarga líquido.</p>	<p>Check valve installed backwards. • Montage à l'envers de la soupape d'arrêt. • Válvula de retención montada al revés</p>	<p>Check flow indicating arrow on check valve body to insure it is installed properly. • Vérifier la flèche indiquant l'écoulement pour s'assurer que la soupape d'arrêt est bien montée. • Inspeccione la flecha indicadora del flujo en el cuerpo de la válvula de retención, para cerciorarse de que se encuentre instalada correctamente.</p>
	<p>Check valve stuck or plugged. • Soupape d'arrêt bloquée ou obstruée. • Válvula de retención atorada u ocluida.</p>	<p>Remove check valve and inspect for proper operation. • Démontez et vérifiez la soupape d'arrêt pour un bon fonctionnement. • Quite la válvula de retención, y verifique que funcione debidamente.</p>
	<p>Lift too high for pump. • Aspiration trop puissante pour la pompe. • Altura de impulsión excesiva para la bomba.</p>	<p>Check rating table. • Vérifier le tableau d'évaluation. • Estudie la tabla de capacidad.</p>
	<p>Inlet to impeller plugged. • Arrivée de la roue à aubes obstruée. • Toma de la rueda móvil conectada.</p>	<p>Pull pump and clean. • Tirer la pompe pour la nettoyer. • Saque la bomba y límpiela.</p>
	<p>Pump is air locked. • Présence d'une poche d'air dans la pompe. • La bomba está llena de burbujas de aire.</p>	<p>(See corrective action above.) • (Voir ci-dessus la solution.) • (Remítase a la solución anterior.)</p>
<p>Pump does not deliver rated capacity. • La pompe ne pompe pas le volume normal. • La bomba no impele a su capacidad normal.</p>	<p>Lift too high for pump. • Aspiration trop puissante pour la pompe. • Altura de impulsión excesiva para la bomba.</p>	<p>Check rated pump performance. • Vérifier les caractéristiques techniques de la pompe. • Verifique el rendimiento normal de la bomba.</p>
	<p>Low voltage, speed too slow. • Voltage et vitesse pas assez puissants. • Voltaje demasiado bajo, velocidad demasiado baja.</p>	<p>Check for proper supply voltage to make certain it corresponds to nameplate voltage. • S'assurer que le voltage correspond bien à celui mentionné sur la plaque. • Verifique que el suministro de electricidad sea adecuado, para cerciorarse de que corresponde al voltaje indicado en la placa del fabricante.</p>
	<p>Impeller or discharge pipe is clogged. • Obstruction de la roue à aubes ou du tuyau d'écoulement. • La rueda móvil en el tubo de descarga está ocluida.</p>	<p>Pull pump and clean. Check pipe for scale or corrosion. • Tirer la pompe pour la nettoyer. Vérifier la présence de dépôts ou de corrosion dans les tuyaux. • Saque la bomba y límpiela. Inspeccione el tubo, en busca de capas de óxido o corrosión.</p>
	<p>Impeller wear due to abrasives. • Usure de la roue à aubes due aux abrasifs. • Desgaste de la rueda móvil, debido a abrasivos.</p>	<p>Replace worn impeller. • Remplacer la roue à aubes usée. • Cambie la rueda móvil gastada.</p>

Figure 3

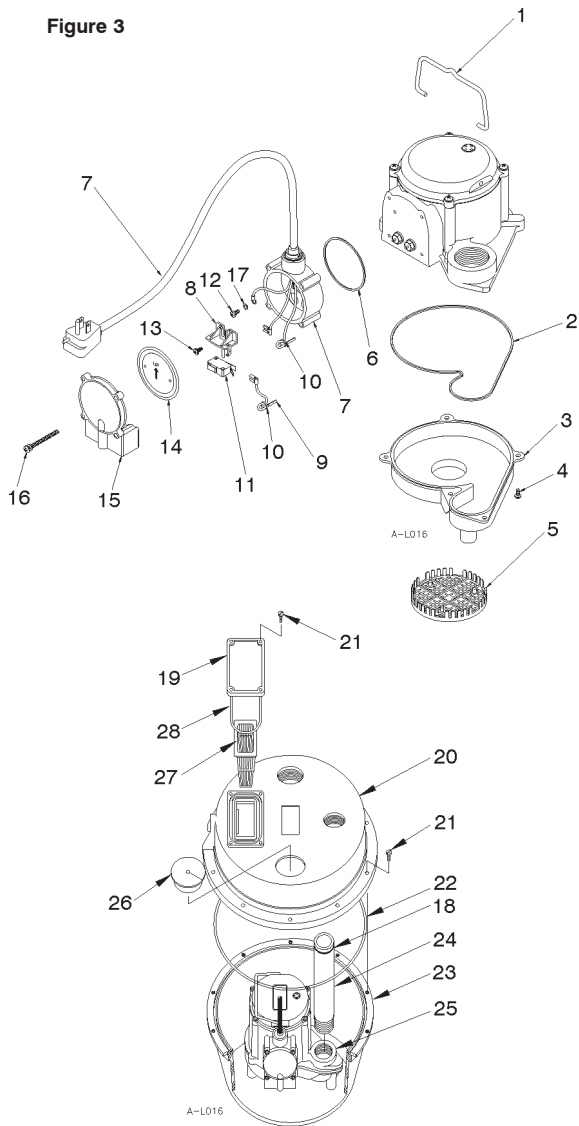
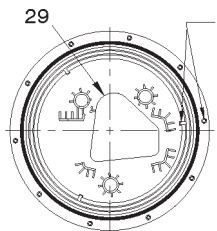


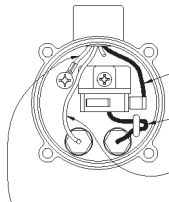
PLATE ALIGNMENT DIAGRAM



Mounting hole lines up with a locating rib on the inside of the basin. • Le trou de montage s'aligne avec une nervure de positionnement située à l'intérieur du réservoir. • Los agujeros de montaje se alinean con un saliente de ubicación dentro del depósito.

Position the pump locating plate inside the basin as shown. This will allow proper alignment of mounting holes when installing the basin cover. Any other position will not allow assembly of cover. • Placer la plaque à l'intérieur du réservoir, tel qu'illustré. Ainsi, les trous de montage seront correctement alignés au moment de la pose du couvercle du réservoir. Tout autre positionnement de la plaque ne permettra pas la pose du couvercle. • Coloque la bomba poniendo la placa dentro del depósito como se ilustra. Esto permitirá la alineación apropiada de los agujeros de montaje cuando instale la cubierta del depósito. Cualquier otra posición no permitirá armar la cubierta.

AUTOMATIC PUMP MODELS
MODÈLES DE POMPES AUTOMATIQUES
MODELOS DE BOMBA AUTOMÁTICA



BLACK OR BROWN
NOIR OU MARRON
NEGRO O CAFE

BLACK
NOIR
NEGRO

WHITE OR BLUE
BLANC OU BLEU
BLANCO O AZUL

GREEN OR GREEN/YELLOW
VERT OU VERT ET JAUNE
VERDE O VERDE AMARILLENTO

REPLACEMENT PARTS LIST			
ITEM NO.	PART NO.	DESCRIPTION	QTY.
1	108101	Handle, pump • Poignée, pompe • Manivela, bomba	1
2	928004	Seal ring • Anneau d'étanchéité • Anillo de estancamiento	1
3	108034	Pump base, manual, blue • Pompe manuel de base bleue • Bomba manual de base azul	1
4	909021	Screw/washer #10-24 x 1/2" • Vis/rondelle N° #10-24 x 1/2" • Tornillo y arandela de #10-24 x 1/2" de pulgada	5
5	108082	Screen, intake • Filtre d'admission • Rejilla, toma	1
6	928028	Seal ring • Anneau d'étanchéité • Anillo de estancamiento	1
7	108051	Housing assembly, automatic, 8' (115v) • Carter ensemble turbine, Automatique 2.4 m (115 V) • Cubierta ensamble de impulsor, automático 2.4 m (115 V)	1
7	108052	Housing assembly, automatic, 8' (230v) • Carter ensemble turbine, Automatique 2.4 m (230 V) • Cubierta ensamble de impulsor, automático 2.4 m (230 V)	1
8	108202	Bracket, switch • Patte D'attache, Commutateur • Soporte, Interruptor	1
9	951961	Lead wire assembly • Assemblage fils plombés • Conjunto de hilos conductores	1
10	924001	O-ring, Buna-N, 2-007 • Joint torique, Buna-N, 2-007 • Junta tórica, Buna-N, 2-007	2
11	950322	Switch, miniature • Commutateur, miniature • Interruptor, miniature	1
12	901529	Screw, machine #10-24 x 1/4" • Vis mécanique #10-24 x 1/4" • Tornillo para metales de #10-24 x 1/4" de pulgada	1
13	902404	Screw, tap #8-18 x 3/8" • Vis taraudée N° #8-18 x 3/8" • Tornillo, rosca macho #8-18 x 3/8" de pulgada	1
14	108125	Diaphragm • Diaphragme • Diafragma	1
15	108055	Cover, automatic switch housing • Couvercle, boîtier du contacteur automatique • Cubierta de la caja del interruptor automático	1
16	909027	Screw/washer #10-24 x 1-3/4" • Vis/rondelle N° #10-24 x 1-3/4" • Tornillo y arandela de #10-24 x 1-3/4" de pulgada	4
17	921023	Washer, #10 lock • Rondelle, verrouillage #10 • Arandela de seguridad #10	1
18	924047	O-ring, Buna-N, 2-131 • Joint torique, Buna-N, 2-131 • Junta tórica, Buna-N, 2-131	1
19	113132	Cover plate, screen • Couvercle plaque, grille • Cubierta de placa, rejilla	1
20	113130	Basin cover • Réservoir couvercle • Dépósito cubierta	1
21	901709	Screw, 1/4"-20 x 1/2" • Vis, 1/4"-20 x 1/2" • Tornillo, 1/4"-20 x 1/2"	14
22	924065	Seal ring • Anneau d'étanchéité • Anillo de estancamiento	1
23	113229	Basin • Réservoir • Dépósito	1
24	113024	Discharge pipe • Refoulement tuyau • Descarga tubo	1
25	506160	Pump, 6-CIA-ML (115 v) • Pompe, 6-CIA-ML (115 v) • Bomba, 6-CIA-ML (115 v)	1
25	506161	Pump, 6-CIA-ML (230 v) • Pompe, 6-CIA-ML (230 v) • Bomba, 6-CIA-ML (230 v)	1
26	925016	Cord grommet • Passe-fil • Arandela aislante de cordón	1
27	113131	Intake screen • D'admission filtre • Toma rejilla	1
28	924066	O-ring, Buna-N, 2-339 • Joint torique, Buna-N, 2-339 • Junta tórica, Buna-N, 2-339	1
29	113135	Alignment plate (See page 1) • Plaque d'alignement (Montré sur la page 1) • Plato de alineación (Mostrado en la página 1)	1

LIMITED WARRANTY

THIS WARRANTY SETS FORTH THE COMPANY'S SOLE OBLIGATION AND PURCHASER'S EXCLUSIVE REMEDY FOR DEFECTIVE PRODUCT.

Franklin Electric Company, Inc. and its subsidiaries (hereafter "the Company") warrants that the products accompanied by this warranty are free from defects in materials or workmanship of the Company that exist at the time of sale by the Company and which occur or exist within the applicable warranty period. Any distributor, sub-distributor, recipient, end-user and/or consumer agrees that by accepting the receipt of the products, the distributor, sub-distributor, recipient, end user and/or consumer expressly agrees to be bound by the terms of the warranty set forth herein.

I. APPLICABLE WARRANTY PERIOD

The products accompanied by this warranty shall be covered by this Limited Warranty for a period of 24 months from the date of original purchase by the consumer. In the absence of suitable proof of purchase date, the warranty period of this product will begin to run on the product's date of manufacture.

II. INSTRUCTIONS APPLICABLE TO THIS LIMITED WARRANTY

- Consumers wishing to submit a warranty claim must return the products accompanied by this warranty to the point of purchase for warranty consideration.
- Upon discovery of a defect, any personal injury, property damage or any other type of resulting damage, if applicable, shall be reasonably mitigated to the extent possible.
- At its discretion, the Company may inspect products either at its facilities, or in the field, and after determination of a warranty claim, will, at its option, repair or replace defective parts. Repaired or replaced parts will be returned freight prepaid by the Company.
- This warranty policy does not cover any labor or shipping charges. The Company shall not be liable for any costs or charges attributable to any product testing, maintenance, installation, repair or removal, or for any tools, supplies, or equipment needed to install, repair, or remove any product.

III. LIMITATIONS APPLICABLE TO THIS LIMITED WARRANTY
THIS WARRANTY DOES NOT APPLY TO ANY OF THE FOLLOWING:

- Brushes, impeller or cam on models with brush-type motors and/or flex-vane impellers.
- Any product that is not installed, applied, maintained and used in accordance with the Company's published instructions, applicable codes, applicable ordinances and/or with generally accepted industry standards.
- Any product that has been subject to misuse, misapplication, neglect, alteration, accident, abuse, tampering, acts of God (including lightning), acts of terrorism, acts of war, fire, improper storage or installation, improper use, improper maintenance or repair, damage or casualty, or to an excess of the recommended maximums as set forth in the product instructions.
- Any product that is operated with any accessory, equipment, component, or part not specifically approved by the Company.
- Use of replacement parts not sold by the Company, the unauthorized addition of non-Company products to other Company products, and the unauthorized alteration of Company products.
- Products damaged by normal wear and tear, normal maintenance services and the parts used in connection with such service, or any other conditions beyond the control of the Company.
- Any product that has been used for purposes other than those for which it was designed and manufactured.
- Any use of the product where installation instructions and/or instructions for use were not followed.
- Products connected to voltage other than indicated on nameplate.
- Products where the pump was exposed to any of the following: sand, gravel, cement, grease, plaster, mud, tar, hydrocarbons, hydrocarbon derivatives (oil, gasoline, solvents, etc.) or other abrasive or corrosive substances.
- Products in which the pump has been used to pump or circulate anything other than fresh water at room temperature.
- Products in which the pump was allowed to operate dry (fluid supply cut off).
- Products in which the sealed motor housing has been opened or the product has been otherwise dismantled by customer.
- Products in which the cord has been cut to a length of less than three feet.

The Company reserves the right at any time, and from time to time, to make changes in the design and/or improvements upon its product without thereby imposing any obligation upon itself to make corresponding changes or improvements in or upon its products already manufactured and/or previously sold. The Company further reserves the right to substitute parts or components of substantially equal quality in any warranty service required by operation of this Limited Warranty.

This written Limited Warranty is the entire warranty authorized and offered by the Company. There are no warranties or representations beyond those expressed in this document.

THIS WARRANTY AND REMEDY IS IN LIEU OF ALL OTHER WARRANTIES AND REMEDIES INCLUDING WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY SPECIFICALLY DISCLAIMED AND EXPRESSLY EXCLUDED. CORRECTION OF NON-CONFORMITIES, IN THE MANNER AND FOR THE PERIOD OF TIME AS SET FORTH ABOVE, SHALL CONSTITUTE FULFILLMENT OF ALL LIABILITY OF THE COMPANY TO THE PURCHASER WHETHER BASED ON CONTRACT, NEGLIGENCE, OR OTHERWISE.

THE COMPANY SHALL NOT BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES SUCH AS, BUT NOT LIMITED TO:

DAMAGE TO OR LOSS OF OTHER PROPERTY OR EQUIPMENT, LOSS OF USE OF EQUIPMENT, FACILITIES OR SERVICE, LOSS OF PROFIT OR SALES, COST OF PURCHASES OR REPLACEMENT GOODS, CLAIMS OF CUSTOMERS OF THE PURCHASER, FAILURE TO WARN AND/OR INSTRUCT, LOSS OF OTHER PRODUCTS, OR COSTS OF ENVIRONMENTAL REMEDIATION, OR DIMINUTION IN PROPERTY VALUE. THE REMEDIES OF THE PURCHASER SET FORTH HEREIN ARE EXCLUSIVE, AND THE LIABILITY OF THE COMPANY SHALL NOT, EXCEPT AS EXPRESSLY PROVIDED HEREIN, EXCEED THE PRICE OF THE PRODUCTS UPON WHICH SUCH LIABILITY IS BASED. DAMAGES AS SET FORTH IN THIS PARAGRAPH SHALL BE REASONABLY MITIGATED TO THE EXTENT POSSIBLE. THIS PARAGRAPH SHALL ALSO APPLY TO ALL DAMAGES RESULTING FROM CONDITIONS SET FORTH IN SECTION III ABOVE AND (1) DEFECTS IN PRODUCT PROTOTYPES OR REPLACEMENT PART PROTOTYPES THAT HAVE NOT BEEN PUT INTO PRODUCTION, CIRCULATED AND SOLD BY THE COMPANY, AND/OR (2) DEFECTS THAT WERE NOT FOUND AT THE TIME OF SALE DUE TO SCIENTIFIC AND TECHNOLOGICAL REASONS.

This Limited Warranty gives you specific legal rights. You may have other rights, which vary according to the applicable laws and regulations. Where any term of this warranty is prohibited by such laws, it shall be null and void, but the remainder of this warranty shall remain in full force and effect.

DISCLAIMER: Any oral statements about the product made by the seller, the Company, the representatives or any other parties, do not constitute warranties, shall not be relied upon by the user, and are not part of the contract for sale. Seller's and the Company's only obligation, and buyer's only remedy, shall be the replacement and/or repair by the Company of the product as described above. Before using, the user shall determine the suitability of the product for his intended use, and user assumes all risk and liability whatsoever in connection therewith.

GARANTIE LIMITÉE

LA PRÉSENTE GARANTIE ÉNONCE LA SEULE OBLIGATION DE LA SOCIÉTÉ ET LE RECOURS EXCLUSIF DE L'ACHETEUR POUR UN PRODUIT DÉFECTUEUX.

Franklin Electric Company, Inc et ses filiales (ci-après - la Société -) garantit que les produits accompagnés de cette garantie sont exempts de défauts de matériaux ou de fabrication de la Société existant au moment de la vente par la Société et qui se produisent ou existent pendant la période de garantie applicable. Tout distributeur, sous-distributeur, destinataire, utilisateur final et/ou consommateur, en acceptant la réception des produits, convient que le distributeur, sous-distributeur, destinataire, utilisateur final et/ou consommateur accepte expressément d'être lié par les termes de la garantie qui y sont énoncés.

I. PÉRIODE DE GARANTIE APPLICABLE

Les produits accompagnés par cette garantie doivent être couverts par cette Garantie Limitée pour une période de 24 mois à compter de la date d'achat originale par le consommateur. En l'absence de preuves concrètes de la date d'achat, la période de garantie de ce produit commencera à partir de la date de fabrication du produit.

II. INSTRUCTIONS APPLICABLES À CETTE GARANTIE LIMITÉE

- Les consommateurs qui souhaitent soumettre une réclamation de garantie doivent retourner les produits avec cette garantie au point de vente pour considération de garantie.
- En cas de découverte d'un défaut, une lésion corporelle, un dommage matériel ou tout autre type de dommages en résultant, le cas échéant, doivent être raisonnablement atténués dans la mesure du possible.
- À sa discrétion, la Société peut inspecter les produits, soit à ses installations, soit au site, et après détermination d'une réclamation de garantie, à sa discrétion, fera réparer ou remplacer les pièces défectueuses. Les pièces réparées ou remplacées seront retournées avec frais de transport prépayés par la Société.
- Cette politique de garantie ne couvre pas les frais de main d'œuvre ou d'expédition. La Société ne sera pas responsable des coûts ou des frais imputables à tout essai, entretien, installation, réparation ou enlèvement de produit, ou pour tout outil, fourniture, ou équipement nécessaire pour installer, réparer ou enlever tout produit.

**III. LIMITATIONS APPLICABLES À CETTE GARANTIE LIMITÉE
CETTE GARANTIE NE S'APPLIQUE PAS AUX SUIVANTS :**

- Balais, impulseur ou came sur des modèles avec des moteurs de type balais et/ou des impulseurs flex-vane (à palette flex).
- Tout produit qui n'est pas installé, appliqué, entretenu et utilisé conformément aux instructions publiées par la Société, aux codes et règlements applicables en vigueur et/ou aux normes généralement acceptées de l'industrie.
- Tout produit qui a fait l'objet d'une utilisation anormale, d'une mauvaise application, de négligence, d'altération, d'accident, d'abus, de modification, d'actes de Dieu (y compris la foudre), d'actes de terrorisme, d'actes de guerre, d'incendie, d'un mauvais entreposage ou installation, d'une mauvaise utilisation, d'un mauvais entretien ou d'une mauvaise réparation, de dommages ou pertes, ou d'une utilisation au-delà des maximums recommandés, comme énoncés dans les instructions du produit.
- Tout produit qui est utilisé avec un accessoire, matériel, composant, ou pièce non expressément agréés par la Société.
- L'utilisation de pièces de rechange non vendues par la Société, l'addition non autorisée de produits ne provenant pas de la Société à d'autres produits de la Société, et la modification non autorisée des produits de la Société.
- Les produits endommagés par l'usure normale, les services habituels d'entretien et les pièces utilisées dans le cadre de ces services, ou toute autre condition hors du contrôle de la Société.
- N'importe quel produit qui a été utilisé à des fins autres que celles pour lesquelles il a été conçu et fabriqué.
- Toute utilisation du produit pour laquelle les instructions d'installation et/ou les instructions d'utilisation n'ont pas été suivies.
- Les produits branchés à une tension autre que celle indiquée sur la plaque signalétique.
- Les produits dont la pompe a été exposée à l'un des suivants : sable, gravier, ciment, graisse, plâtre, boue, goudron, hydrocarbures, dérivés d'hydrocarbures (huile, essence, solvants, etc) ou d'autres substances abrasives ou corrosives.
- Les produits dans lesquels la pompe a été utilisée pour pomper ou faire circuler des liquides autres que de l'eau douce à température ambiante.
- Des produits dans lesquels la pompe a été autorisée à fonctionner à sec (alimentation en liquide coupée).
- Les produits dans lesquels la carcasse de moteur scellée a été ouverte ou le produit a été autrement démonté par le client.
- Les produits dans lesquels le cordon a été coupé à une longueur de moins de trois pieds.

La Société se réserve le droit, à tout moment, et de temps à autre, d'apporter des changements à la conception et/ou des améliorations à ses produits sans pour autant imposer une quelconque obligation sur elle-même d'apporter des modifications ou des améliorations correspondantes dans ou sur ses produits déjà fabriqués et/ou déjà vendus. La Société se réserve également le droit de remplacer des pièces ou des composants d'une qualité sensiblement égale dans tout service de garantie exigé par l'exécution de cette Garantie Limitée.

Cette Garantie Limitée écrite est l'entière garantie autorisée et offerte par la Société. Il n'existe aucune garantie ou représentations autres que celles exprimées dans ce document.

CETTE GARANTIE ET CE RECOURS SONT EN LIEU ET PLACE DE TOUTES LES AUTRES GARANTIES ET RECOURS Y COMPRIS, SANS S'Y LIMITER, AUX GARANTIES DE VALEUR MARCHANDE ET/OU D'ADAPTATION À UN USAGE PARTICULIER, QUI SONT ICI SPÉCIFIQUEMENT REJETTES ET EXPRESSÉMENT EXCLUES. LA CORRECTION DES NON-CONFORMITÉS, DE LA FAÇON ET POUR LA PÉRIODE DE TEMPS, COMME ÉNONCÉES CI-DESSUS, CONSTITUE LA RÉALISATION DE TOUTE LA RESPONSABILITÉ DE LA SOCIÉTÉ ENVERS L'ACHETEUR QUI CELA SOIT SUR LA BASE D'UN CONTRAT, D'UNE NÉGLIGENCE OU AUTRE.

LA SOCIÉTÉ NE SERA PAS RESPONSABLE DES DOMMAGES DIRECTS, INDIRECTS OU SPÉCIAUX COMME, MAIS SANS S'Y LIMITER :

DOMMAGES À OU PERTES D'AUTRES BIENS OU ÉQUIPEMENTS, PERTE D'UTILISATION D'ÉQUIPEMENT, INSTALLATIONS OU SERVICES, PERTE DE BÉNÉFICES OU DE VENTES, COUT D'ACHATS OU DE PRODUITS DE RECHANGE, RECLAMATIONS DES CLIENTS DE L'ACHETEUR, OMISSION D'AVERTIR ET/OU DE NOTIFIER, PERTE D'AUTRES PRODUITS, OU COUTS D'ASSAINISSEMENT DE L'ENVIRONNEMENT, OU DIMINUTION DE LA VALEUR DE LA PROPRIÉTÉ. LE RECOURS DE L'ACHETEUR ÉNONCÉ DANS LE PRÉSENT DOCUMENT EST EXCLUSIF ET LA RESPONSABILITÉ DE LA SOCIÉTÉ NE PEUT EXCÉDER, SAUF STIPULATION CONTRAIRE EXPRESSE, LE PRIX DES PRODUITS SUR LESQUELS CETTE RESPONSABILITÉ REPOSE. LES DOMMAGES COMME ÉNONCÉS DANS CE PARAGRAPHE DOIVENT ÊTRE RAISONNABLEMENT ATTENUÉS DANS LA MESURE DU POSSIBLE. CE PARAGRAPHE S'APPLIQUERA ÉGALEMENT À TOUTS LES DOMMAGES RESULTANT DES CONDITIONS ÉNONCÉES DANS LA SECTION III CI-DESSUS ET (1) AUX DÉFAUTS DANS LES PROTOTYPES DE PRODUIT OU LES PROTOTYPES DE PIÈCE DE RECHANGE QUI N'ONT PAS ÉTÉ MIS EN PRODUCTION, DISTRIBUÉS ET VENDUS PAR LA SOCIÉTÉ, ET / OU (2) AUX DÉFAUTS QUI N'ONT PAS ÉTÉ TROUVÉS AU MOMENT DE LA VENTE POUR DES RAISONS SCIENTIFIQUES ET TECHNOLOGIQUES.

Cette Garantie Limitée vous donne des droits légaux spécifiques. Vous pouvez avoir d'autres droits, qui varient selon les lois et règlements applicables. Si toute stipulation de cette garantie est interdite par ces lois, elle sera nulle et sans effet, mais le reste de la présente garantie demeurera en vigueur.

AVIS DE NON-RESPONSABILITÉ : Les déclarations orales concernant le produit effectuée par le vendeur, la Société, les représentants ou toutes autres parties, ne constituent pas une garantie. L'utilisateur ne doit pas s'y fier, et elles ne font pas partie du contrat de vente. La seule obligation du vendeur et de la Société, et l'unique recours de l'acheteur, est le remplacement et/ou la réparation du produit par la Société selon les modalités décrites précédemment. Avant utilisation, l'utilisateur doit déterminer l'aptitude du produit pour son utilisation prévue, et l'utilisateur assume tous les risques et la responsabilité dans n'importe quel cadre avec lequel le produit sera associé.

GARANTÍA LIMITADA

ESTA GARANTÍA ESTIPULA LA ÚNICA OBLIGACIÓN DE LA COMPAÑÍA Y EL ÚNICO RECURSO QUE TENDRÁ EL COMPRADOR ANTE UN PRODUCTO DEFECTUOSO.

Franklin Electric Company, Inc y sus subsidiarias (en adelante "la Compañía") garantizan que los productos que están acompañados por esta garantía se encuentran libres de defectos de material o mano de obra de la Compañía que existan al momento de la venta por parte de la Compañía y que ocurran o aparezcan dentro del periodo de validez de la garantía. Cualquier distribuidor, subdistribuidor, receptor, usuario final o consumidor acuerdan que al aceptar el recibo del producto, el distribuidor, subdistribuidor, receptor, usuario final y/o consumidor implícitamente aceptan que están obligados a los términos de la garantía que aquí se establecen.

I. PERÍODO DE GARANTÍA APPLICABLE

Los productos que están acompañados por esta garantía serán cubiertos por esta Garantía Limitada por un período de 24 meses desde la fecha original de compra por parte del consumidor. Ante la falta de pruebas adecuadas respecto de la fecha de compra, el período de garantía de este producto entrará en vigencia a partir de su fecha de fabricación.

II. INSTRUCCIONES APPLICABLES A ESTA GARANTÍA LIMITADA

- Los consumidores que deseen presentar un reclamo de garantía deberán devolver los productos acompañados por esta garantía al punto de compra para consideración de la garantía.
- Ante el descubrimiento de un defecto, cualquier lesión personal, daño a la propiedad o cualquier otro tipo de daño que resulte, si aplica, será razonablemente mitigado hasta donde sea posible.
- A su criterio, la Compañía puede inspeccionar los productos ya sea en sus instalaciones o en el área, y luego de la determinación del reclamo de garantía, reparará o cambiará las piezas defectuosas a su criterio. Las piezas que fueron reparadas o cambiadas serán devueltas por medio de un flete prepago por parte de la Compañía.
- Esta garantía no cubre ningún cargo por mano de obra o transporte.

La Compañía no se responsabilizará por ningún costo o cargo que esté relacionado a cualquier prueba del producto, su mantenimiento, instalación, reparación o remoción, o de cualquier herramienta, suministro o equipo que sea necesario para, instalar, reparar o remover algún producto.

**III. LIMITACIONES APPLICABLES A ESTA GARANTÍA LIMITADA
ESTA GARANTÍA NO APLICA A NINGUNO DE LOS SIGUIENTES CASOS:**

- Cepillos, turbina o leva en modelos con motor de cepillo y/o turbinas con aleta flexible.
- Cualquier producto que no se instale, aplique, mantenga y utilice según las instrucciones publicadas de la Compañía, códigos aplicables, ordenanzas aplicables y/o estándares industriales generalmente aceptados.
- Cualquier producto que haya sufrido uso indebido, mala aplicación, descuido, alteración, accidente, abuso, modificación, actos de Dios (rayos incluidos), actos de terrorismo, actos de guerra, incendios, almacenamiento e instalación inadecuados, uso inadecuado, mantenimiento o reparación inadecuados, daño o siniestro, en exceso de las máximas recomendadas que se establecen en las instrucciones del producto.
- Cualquier producto que sea operado con cualquier accesorio, equipo, componente, o pieza que no esté específicamente aprobada por la Compañía.
- El uso de piezas de repuesto que no sean vendidas por la Compañía, la adición no autorizada de productos que no sean de la Compañía a productos de la Compañía, y la alteración no autorizada de productos de la Compañía.
- Los productos dañados por el desgaste normal, mantenimiento normal y las piezas utilizadas en conexión con dicho servicio o cualquier otras condiciones más allá del control de la Compañía.
- Cualquier producto que haya sido utilizado para otros propósitos más allá de aquellos para los cuales fue diseñado y fabricado.
- Cualquier uso del producto en el cual las instrucciones de instalación y/o las instrucciones para el uso no hayan sido seguidas.
- Productos conectados a otro voltaje que el indicado en la placa de identificación.
- Productos en los cuales la bomba fue puesta a cualquiera de los siguientes: arena, grava, cemento, grava, yeso, barro, brea, hidrocarburos, derivados de los hidrocarburos (aceite, gasolina, solventes, etc.) u otras sustancias abrasivas o corrosivas.
- Productos en los cuales la bomba fue utilizada para bombear o circular otra cosa aparte de agua potable a temperatura ambiente.
- Productos en los cuales la bomba fue habilitada para operar en seco (sin suministros de fluidos).
- Productos en los cuales la carcasa sellada del motor fue abierta o el producto fue de otro modo desmantelado por el cliente.
- Productos en los cuales la longitud del cable fue cortada a una medida menor a 3 pies.

La Compañía se reserva el derecho de en cualquier momento, y ocasionalmente, introducir cambios en el diseño y/o mejoras en sus productos sin que esto imponga ninguna obligación de introducir los cambios o mejoras correspondientes en los productos ya fabricados y/o previamente vendidos. La Compañía se reserva además el derecho de sustituir piezas o componentes de calidad equivalente en cualquier servicio de garantía requerido por operación de esta Garantía Limitada.

Esta Garantía Limitada escrita es la totalidad de la garantía autorizada y ofrecida por la Compañía. No existen garantías y representaciones más allá de aquellas expresadas en este documento.

ESTA GARANTÍA Y RECURSO ESTÁN POR ENCIMA DE TODAS LAS OTRAS GARANTÍAS Y RECURSOS QUE SE INCLUYEN SIN LIMITACIÓN, GARANTÍAS DE MERCANTILIDAD Y/O ADECUACIÓN PARA UNA FINALIDAD ESPECÍFICA, QUE SON AQUÍ EXPLÍCITAMENTE NEGADAS Y EXPRESAMENTE EXCLUIDAS.

LA CORRECCIÓN DE DISCONFORMIDAD, DE LA MANERA Y EN EL PERÍODO DE TIEMPO ESTABLECIDOS ANTERIORMENTE, CONSTITUIRÁ EL CUMPLIMIENTO DE TODA LA RESPONSABILIDAD DE LA COMPAÑÍA CON EL COMPRADOR YA SEA BASADO EN EL CONTRATO, NEGLIGENCIA O DE OTRO MODO.

LA COMPAÑÍA NO SERÁ RESPONSABLE POR LOS DAÑOS ACCIDENTALES, CONSECUENTES O ESPECIALES TALES COMO, PERO NO LIMITADOS A:

DAÑOS A O PÉRDIDA DE OTRA PROPIEDAD O EQUIPO, PÉRDIDAS DE USO DEL EQUIPO, PRESTACIÓN O SERVICIO, PÉRDIDA DE GANANCIA O VENTAS, COSTO DE COMPRAS O REPLAZO DE BIENES, RECLAMOS DE CLIENTES DEL COMPRADOR, FALLA PARA ADVERTIR Y/O INSTRUIR, PÉRDIDA DE OTROS PRODUCTOS, COSTOS DE REMEDIACIÓN AMBIENTAL O DISMINUCIÓN EN EL VALOR DE LA PROPIEDAD. LOS RECURSOS DEL COMPRADOR AQUÍ ESTABLECIDOS SON EXCLUSIVOS, Y LA RESPONSABILIDAD DE LA COMPAÑÍA NO DEBE, COMO EXPRESAMENTE CONSTAN AQUÍ, EXCEDER EL PRECIO DEL PRODUCTO EN EL QUE DICHA RESPONSABILIDAD SE BASA. LOS DAÑOS QUE SE ESTABLECEN EN ESTE PÁRRAFO SERÁN RAZONABLEMENTE MITIGADOS HASTA DONDE SEA POSIBLE. ESTE PÁRRAFO DEBE TAMBIÉN APLICARSE A TODOS LOS DAÑOS QUE RESULTEN DE LAS CONDICIONES ESTABLECIDAS ANTERIORMENTE EN LA SECCIÓN III Y (1) DEFECTOS EN PROTOTIPOS DE PRODUCTOS O PROTOTIPOS DE PIEZAS DE RESPUESTO QUE NO HAYAN SIDO PRODUCIDAS, PUESTAS EN CIRCULACIÓN O VENDIDAS POR LA COMPAÑÍA, Y/O (2) DEFECTOS QUE NO FUERON ENCONTRADOS AL MOMENTO DE LA VENTA DEBIDO A RAZONES CIENTÍFICAS O TECNOLÓGICAS.

Esta Garantía Limitada le otorga derechos legales específicos. También pueden existir otros derechos que pueden variar según las leyes y regulaciones aplicables. Cuando cualquiera de los términos de esta garantía esté prohibido por dichas leyes, deben considerarse nulos e inválidos, pero el resto de esta garantía continuará con plena vigencia y efecto.

DESCARGO DE RESPONSABILIDAD: Cualquier declaración oral sobre el producto hecha por el vendedor, la Compañía, los representantes o cualquier otra parte, no constituye garantías, no deberá ser considerada válida por el usuario y no son parte del contrato de venta. La única obligación del vendedor y la Compañía, y el único recurso del comprador, serán el reemplazo o la reparación del producto por parte de la Compañía como fue descrito anteriormente. Antes de su uso, el usuario deberá determinar si el producto es adecuado para el uso que se le intenta dar, y el usuario asume todo el riesgo y la responsabilidad cualesquiera que fueren en conexión con el mismo.

For parts or repair, please contact 1.888.572.9933
For technical assistance, please contact 1.888.956.0000

Pour des parties ou la réparation,
entrez s'il vous plaît en contact 1.888.572.9933
Pour l'aide technique, entrez s'il vous plaît en contact 1.888.956.0000

Para partes o la reparación,
por favor póngase en contacto 1.888.572.9933
Para la ayuda técnica, por favor póngase en contacto 1.888.956.0000

www.LittleGiantPump.com
CustomerService-WTS@fele.com



INSTALLATION MANUAL FOR VERTICAL WELL SYSTEM TANKS

Models HT14B, HT20B, HT30B, HT32B, HT44B, HT62B, HT86B and HT119B

Keep this manual with the tank for future reference.

What You'll Need

Recommended Tools

- Adjustable Wrench
- Adjustable Pliers
- Pipe Wrench
- Hacksaw
- Screwdriver
- Tape Measure
- Tire Pressure Gauge

Additional Parts Required (Not Included)

- Tank Water Connection Size 1" NPTF
- Pressure Gauge
- Relief Valve
- Check Valve
- Drain Valve
- Pressure Switch
- Tank Cross (10" Lx1" NPTM)
- Teflon® Tape

Before You Start

Always be sure to equip your well system with a proper Pressure Relief Valve. This should be capable of discharging the full output of the pump at or below the maximum working pressure of the lowest rated component in the system. See the owner's manual for your pump for output information. This is vital for safe operation of the well system. **THIS PRODUCT COMES WITH A 5 YEAR WARRANTY. SEE WATER WORKER LIMITED WARRANTY FOR DETAILS.**

⚠ WARNING READ CAREFULLY THE PRODUCT INSTALLATION, OPERATING AND MAINTENANCE MANUAL. FAILURE TO FOLLOW THE INSTRUCTIONS AND WARNINGS IN THE MANUAL MAY RESULT IN SERIOUS OR FATAL INJURY AND/OR PROPERTY DAMAGE, AND WILL VOID THE PRODUCT WARRANTY. THIS PRODUCT MUST BE INSTALLED BY A QUALIFIED PROFESSIONAL. FOLLOW ALL APPLICABLE LOCAL AND STATE CODES AND REGULATIONS, IN THE ABSENCE OF SUCH CODES, FOLLOW THE CURRENT EDITIONS OF THE NATIONAL PLUMBING CODE AND NATIONAL ELECTRIC CODE, AS APPLICABLE.

⚠ THIS IS THE SAFETY ALERT SYMBOL. IT IS USED TO ALERT YOU TO POTENTIAL PERSONAL INJURY AND OTHER HAZARDS. OBEY ALL SAFETY MESSAGES THAT FOLLOW THIS SYMBOL TO REDUCE THE RISK OF PERSONAL INJURY AS WELL AS PROPERTY DAMAGE.

IMPORTANT GENERAL SAFETY INFORMATION - ADDITIONAL SPECIFIC SAFETY ALERTS APPEAR IN THE FOLLOWING INSTRUCTIONS.

⚠ WARNING Failure to utilize a properly sized well tank will result in excessive strain on the pump and may ultimately lead to product failure, leaking or flooding or property damage.

⚠ WARNING For your safety, the information in this manual must be followed to minimize the rise of electric shock, property damage or personal injury. Properly ground to conform with all governing codes and ordinances.

1. If you are installing an entirely new well system, follow Steps II, III, IV and V. Skip Step I, since you are not removing an existing tank. However, make sure that the power is turned off before you hook up the pressure switch to the household wiring. If you are in any doubt about working with electricity, call a licensed electrician.
2. If you are replacing a plain steel tank with this Water Worker diaphragm tank:
 - a. A diaphragm tank is pressurized with air at the factory (at a pressure close to that of a car tire). For this reason, it will be smaller than the plain steel tank, even though both tanks deliver the same amounts of pressurized water. Because of this, you may have to adjust the piping to reach the new connections.
 - b. Install a pressure relief valve at the tank connection to ensure the safety of the system.
 - c. If you have a deep well submersible pump, remove all the air charging devices from the well system (snifter valves, bleeder

orifices, vacuum lines and connection). Then plug the holes where these devices were located (see your owner's manual for location of these devices). These devices are not needed for pre-charged tanks, and if they are not removed and the holes plugged, air can get into the well system, cause surges, damage the system, and impair performance.

- d. If you have a jet pump, remove the fittings and plug the openings where the vacuum or air lines and air volume controls connect to the pump or piping. If not removed and plugged, they can allow air into the pipes which can damage the well system and impair performance.
- e. In addition to the above, follow Steps I through V.
3. If you are replacing a diaphragm or bladder style tank with this Water Worker diaphragm tank:
 - a. If the two tanks are the same size, follow Steps I through V.
 - b. If they are different sizes, follow Steps I through V and also adjust the piping as necessary to accommodate the new size.
4. It is good practice to replace the pressure gauge and the pressure switch whenever you replace an old tank. Of course, you can re-use the tank cross assembly if you are replacing a diaphragm tank with another diaphragm tank (including the tank cross, pressure gauge, pressure switch, pressure relief valve, pipe nipple and drain).
 - a. If you do re-use a tank cross assembly, skip Step II. In this case, make sure that the tank is installed as closely as possible to the pressure switch. This will make the system operate as efficiently as possible.
 - b. If you replace the tank cross assembly with new parts when you install the new tank, complete all of the steps in these instructions, Steps I through V.

⚠ WARNING RELIEF VALVE REQUIRED. A relief valve should be installed which is set to open at excessive pressures (75 psig or more). This will protect the well tank and other system components should the pressure switch malfunction and fail to shut the pump off. The relief valve should be installed at the connection of the well tank to the system piping and have a discharge equal to the pump's capacity at 75 psig. At least once every 3 years or if discharge is present, a licensed contractor should inspect the temperature and pressure relief valve and replace if corrosion is evident or the valve does not function. FAILURE TO INSPECT THIS VALVE AS DIRECTED COULD RESULT IN UNSAFE TEMPERATURE OR PRESSURE BUILD-UP WHICH CAN RESULT IN PRODUCT FAILURE, SERIOUS INJURY OR DEATH AND/OR SEVERE PROPERTY DAMAGE AND VOID THE PRODUCT WARRANTY.

5. Always make sure that you equip your well system with an appropriate pressure relief valve. Whether you are re-using a tank cross assembly or assembling a new one, check to make sure that the assembly includes a pressure relief valve that is capable of discharging the full output of the pump at or below the maximum working pressure of the lowest rated component in the system. See the owner's manual for your pump for output information. This is vital for safe operation of the system.

How to Install the Tank

Step I: Disconnect and remove the existing tank after turning the power off and draining the system.

1. Find the fuse box or circuit breaker panel for your house. Turn off the power to the well pump.

⚠ WARNING For your safety, the information in this manual must be followed to minimize the risk of electric shock, property damage, or personal injury. Properly ground to confirm with all governing codes and ordinances.



2. Open a faucet inside the house. Drain the system as much as possible by letting the water run until it runs out.



3. Close the ball or gate valve (this is the valve that controls the flow of water from the tank into the plumbing system inside the house) (Fig. 1)



4. Drain the remaining water from the tank with a garden hose into a bucket or floor drain. Attach a garden hose to the faucet on the front of the tank cross. Place the other end of the hose in a bucket so that it is at a level lower than the faucet. Open the drain valve and drain the water out of the tank. It may be necessary to vent the tank through the air valve to allow the tank to drain completely. (Fig. 2)



5. Disconnect the wiring to the pressure switch. **(Check first to be sure that the power to the pump is turned off.)**

- a. Loosen the hex nut on the top of the cap using pliers or an adjustable wrench. Unscrew by hand. (Fig. 3)

- b. Remove the cap to the pressure switch.

- c. Unscrew the connections for the wires.

- d. Mark which wire goes to which screw on the pressure switch (i.e. note that the green wire connects to the front screw; mark using masking tape if necessary). (Fig. 4)

- e. Unscrew the clamp connector holding the wiring to the pressure switch. (Fig. 5)

- f. Pull the wires out of the pressure switch. (Fig. 6)

6. Loosen and unscrew the union connections that hold the tank and the tank cross/pressure gauge/pressure switch assembly in place. (Fig. 7-8)

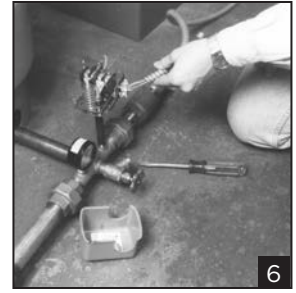


7. Lay the tank on its side with tank cross pointing up. Remove tank cross assembly by unscrewing it using the pipe wrench. (Fig. 9)

Step II: Assemble the new tank cross unit.

NOTE: If you are re-using the tank cross assembly from the old tank skip to Step III.

1. If you are using new parts for the tank cross assembly, remove the new tank cross, pressure gauge, pressure switch, pressure relief valve, and pipe nipple from their packages.



Assemble the tank cross unit. Apply Teflon® tape to the male threads on the tank cross pressure gauge and both ends of the pipe nipple. (Fig. 10) Apply clockwise (i.e. bottom up and coming towards you). Apply 3 full turns.

2. Insert the pipe nipple into one of the holes on the top of the "crossbar" of the tank cross. (It doesn't matter which one.) Tighten using the pipe wrench. (Fig. 11)



3. Insert the pressure gauge in the other hole on top of the crossbar. Tighten using the adjustable wrench on the square brass nut. Tighten hand tight, then wrench tight. Do not over tighten. The Teflon® seal will ensure a sufficient seal. Once tightened, do not loosen. If you do, the joint is more likely to leak. (Fig. 12)



4. Install the pressure switch on the top of the pipe nipple. Again, tighten using the adjustable wrench on the hexagonal brass nut. Tighten hand tight. Then wrench tight.

5. Install drain on the arm of the cross bar of the tank cross. Tighten using pipe wrench. (Fig. 13)

⚠ WARNING A drip pan connected to an adequate drain must be installed if leaking or flooding could cause property damage to the area adjacent to the appliance or to lower floors of the structure.



6. Install the pressure relief valve in the other female threaded opening on the front of the cross bar of the tank. (Fig. 14)

⚠ IMPORTANT Always be sure to equip your well system with a proper pressure relief valve.

Step III: Install the new tank cross assembly on the new tank.

1. Remove the plastic plug from the elbow at the bottom of the tank. Discard the plug.



2. Install the tank cross assembly on the tank. Either use the new tank cross assembly, put together according to Step II above, or reuse the tank cross assembly from the old tank.

3. Apply Teflon® tape to the threads at the bottom of the "stem" of the tank cross. Insert the stem in the female threaded fitting on the bottom of the tank. Tighten hand tight then wrench tight. (Fig. 14-15)

Step IV: Install the new tank.

1. Install the new tank. Place it where the old tank was or stand it in a position so that you can make the pipes meet the tank cross. If necessary, place the tank on garden bricks or cinder blocks to make sure that it stands at the right height. Connect the tank to the pump supply lines using piping to fit. Follow all applicable local and state codes and ordinances. **Note:** Do not place the tank where it or the controls on it will freeze. This can damage the system.



2. Screw the pipe unions hand tight first, then tighten wrench tight using the pipe wrench.
3. Re-install the wires in the pressure switch. Attach the leads to the connections as you marked them. (Fig. 16)

4. Replace the cover to the pressure switch. Check to make sure that the standard drain/boiler drain valve is closed. (Fig. 17)



5. Remove the plastic cap on the air valve on top of the tank. Check the air charge in the tank using the tire pressure gauge.

Adjust the precharge pressure in the tank to be 1 to 2 psi below the pressure switch pump cut-in setting. First, look inside the cap to the pressure switch to determine the pump cut-in setting. It should say "20/40" or "30/50" or the like. The pressure in the tank should be adjusted to be 2 psi below the lower of these two numbers. That is, the tank pressure should be set at about 18 psi if the cap indicates a cut-in setting of 20/40, or set at about 28 if the cap indicates a setting of 30/50.



The table, "Exhibit A", indicates the air charge in the tank when the tank is shipped from the factory. Release or add air to adjust the pressure properly. If the charge is too high, release some air by pressing down on the pin inside the air valve. If the charge is too low, pump it up using a bicycle tire pump or air compressor.

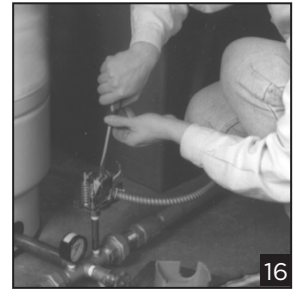


Alternatively, you can adjust the pressure switch to match the pressure in the tank. See instructions on the inside of the cap to the pressure switch for how to do this.



Step V: Turn the power back on. The pump will fill the tank. The system is now ready to use.

1. Open the gate valve to let water flow back into the tank. This is the valve that you closed in Step I.3 {See Step I.3 for a photo of the gate valve} (Fig. 18)



2. Turn on the faucet that is the highest in the house and farthest from the tank. This will allow air to exit the system as water enters.

3. Turn the power back on. The pump will start and fill the tank. Watch for any leaks in the system. If you do see a leak, turn the power off immediately and repair the leak at the joint. It should take 30 seconds to a minute for the pump to prime if it is a jet pump. If the pump does not fill the tank and shut off in one minute or so, check the pressure gauge. If the gauge is moving, let the pump continue to run. If the gauge is not moving, turn the power off. This means that the pressure switch is either installed improperly or is defective. Check the manufacturer's instructions. Replace it if necessary and test the system again to see that it is installed properly.



4. Turn a faucet on nearby to check that the system is working correctly.



EXHIBIT A

VERTICAL TANKS	
MODEL NO.	PRECHARGE PRESSURE
HT14B	38 psi
HT20B	38 psi
HT30B	38 psi
HT32B	38 psi
HT44B	38 psi
HT62B	38 psi
HT86B	38 psi
HT119B	38 psi

IMPORTANT

Safety Instructions • Be sure to read.

▲IMPORTANT This tank is designed for use with potable water, limited to a maximum pressure of 100 psi and a maximum working temperature of 130°F. Please note: a hot water heater or a boiler in a hydronic heating system will heat water hotter than 130°F routinely. Use a thermal expansion tank for hot water overflow from a hot water heater, or use an expansion tank for hot water overflow in a hydronic heating system. See the owner's manual for your pump for output information.

▲WARNING **EXPLOSION OR RUPTURE HAZARD** A relief valve must be installed to prevent pressure in excess of local code requirement or maximum working pressure designated in the Product Manual, whichever is less. Do not expose Product to freezing temperatures or temperatures in excess of 200° F. Do not adjust the pre-charge or re-pressure this Product except for any adjustments required at the time of initial installation, especially if Product corroded, damaged or with diminished integrity. Adjustments to pre-charge must be done at ambient temperature only. Failure to properly size the Product or follow these instructions may result in excessive strain on the system lead to Product failure, serious or fatal personal injury, leakage and/or property damage.

▲WARNING This Product, like most Products under pressure, may over time corrode. Weaken and burst or explode, causing serious or fatal injury, leaking or flooding and/or property damage. To minimize risk, a licensed professional must install and periodically inspect and service the Product. A drip pan connected to an adequate drain must be installed if leaking or flooding could cause property damage. Do not locate in an area where leakage of the tank or connections could cause property damage to the area adjacent to the appliance or to lower floors of the structure.

▲WARNING **Chlorine & Aggressive Water:** The water quality can significantly influence the life of this Product. You should test for corrosive elements, acidity, total solids and other relevant contaminants, including chlorine and treat your water appropriately to insure satisfactory performance and prevent premature failure.

Note: Inspect for shipping damage and notify freight carrier or store where purchased immediately if damage is present. To avoid risk of personal injury and property damage, if the product appears to be malfunctioning or shows signs of corrosion, call a qualified professional immediately. Current copies of the Product manual can be viewed at www.waterworkerdiy.com. Use proper safety equipment when installing.

▲CAUTION As in all plumbing products and water storage vessels, bacteria can grow in this Product, especially during times of non-use. Consult your local plumbing professional regarding any steps you may wish to take to safely disinfect your home's plumbing system.

▲WARNING **DANGER! EXPLOSION HAZARD, WHEN THE WELL TANK HAS BEEN IN SERVICE AND A CHANGE TO A HIGHER PRE-CHARGE PRESSURE IS NECESSARY**

DUE TO A REQUIRED CHANGE IN THE PRESSURE SWITCH SETTING, FAILURE TO FOLLOW INSTRUCTION MANUAL CAN CAUSE A RUPTURE OR EXPLOSION, POSSIBLY CAUSING SERIOUS OR FATAL INJURY, AND/OR PROPERTY DAMAGE.

DO NOT ADJUST THE PRE-CHARGE PRESSURE IF THERE HAS BEEN A REDUCTION OF THE PUMP CYCLE TIME OR THE PRE-CHARGE PRESSURE COMPARED TO ITS INITIAL SETTING. THIS IS BECAUSE REDUCTION IN PUMP CYCLE TIME CAN RESULT FROM LOSS OF TANK AIR PRESSURE WHICH IN TURN CAN MEAN THERE MAY BE INTERNAL CORROSION AND ANY RE-PRESSURIZATION OR ADDITIONAL PRESSURE COULD RESULT IN RUPTURE OR EXPLOSION, AND/OR PROPERTY DAMAGE.

▲WARNING **MAXIMUM WORKING PRESSURES.** Every well tank is air tested to 125 psig, the maximum working pressure for the well tank line. Should pressures exceed 125 psig, proper selection and sizing of an ASME constructed well tank should be made.

▲WARNING **RELIEF VALVE REQUIRED.** A relief valve should be installed which is set to open at excessive pressures (75 psig or more). This will protect the well tank and other system components should the pressure switch malfunction and fail to shut the pump off. The relief valve should be installed at the connection of the well tank to the system piping and have a discharge equal to the pump's capacity at 75 psig. At least once every 3 years or if discharge is present, a licensed contractor should inspect the temperature and pressure relief valve and replace if corrosion is evident or the valve does not function. **FAILURE TO INSPECT THIS VALVE AS DIRECTED COULD RESULT IN UNSAFE TEMPERATURE OR PRESSURE BUILD-UP WHICH CAN RESULT IN PRODUCT FAILURE, SERIOUS INJURY OR DEATH AND/OR SEVERE PROPERTY DAMAGE AND VOID THE PRODUCT WARRANTY.**

▲WARNING For your safety, the information in this manual must be followed to minimize the rise of electric shock, property damage or personal injury. Properly ground to conform with all governing codes and ordinances

Do not use this tank for chemicals, solvents, petroleum products, acids, or any fluids other than potable water. This can cause premature failure due to corrosion.

Make sure that the pressure switch in your well system is set low enough to shut off the pump. If all of the faucets and valves are closed in your plumbing system and the pressure switch setting is too high, the pump can run continuously without moving water through the system. This could damage or burn out the pump.

▲WARNING **CALIFORNIA PROPOSITION 65 WARNING!** This product contains a chemical known by the State of California to cause cancer and to cause birth defects or other reproductive harm. (California Installer/Contractor - California law requires that this notice be given to consumer/end user of this product.) For more information: www.waterworkerdiy.com/propp65.htm

WATER WORKER® LIMITED PRODUCT WARRANTY

Products covered: all Products manufactured by WATER WORKER. (“WATER WORKER”).

This warranty cannot be transferred – it is extended only to the original Purchaser or First User of the Product. By accepting and keeping this Product you agree to all of the warranty terms and limitations of liability described below.

IMPORTANT WARNING – READ CAREFULLY THE INSTALLATION, OPERATING AND MAINTENANCE INSTRUCTIONS MANUAL (“MANUAL”) to avoid serious personal injury and/or property damage and to ensure safe use and proper care of this product

Mail Your Product Registration Card Within 30 Days of Purchase to Ensure Your Warranty Coverage or Proof of Purchase Will Be Required for All Warranty Claims.

Who Receives WATER WORKER’s Product Warranty

All purchasers or first users of the new Product. The Warranty is non-transferable.

What is covered by this Warranty

WATER WORKER warrants to the purchaser or first user of the new Product that at the time of manufacture, the Product is free from defects in material and workmanship. **Any warranty claim must be made within one (1) year unless another time period is set forth in the Manual, measured from the time the Product was purchased.**

What WATER WORKER Will Do If You Have a Covered Warranty Claim

In the event of a breach of the foregoing warranty, WATER WORKER will at its option either make repairs to correct any defect in material or workmanship or supply and ship either new or used replacement parts or products. WATER WORKER will not accept any claims for labor or other costs.

What This Warranty Does Not Cover - Exclusions and Limitations

This Warranty does not cover any failure or problem unless it was caused by a defect in material or workmanship. In addition, this Warranty shall not apply:

- if the Product is not correctly installed, operated, repaired or maintained as described in the Manual provided with the Product;
- to any failure or malfunction resulting from abuse (including freezing); improper or negligent: handling, shipping (by anyone other than WATER WORKER), storage, use, operation, accident; or alteration, lightning, flood or any other environmental condition;
- to any failure or problem resulting from the use of the Product for any purpose other than those specified in the accompanying Manual or alteration of any part of the product;
- this Warranty does not cover labor costs, shipping charges, service charges, delivery expenses, administrative fees or any costs incurred in removing or reinstalling the Product;
- this Warranty does not cover any claims submitted to WATER WORKER or a WATER WORKER-authorized distributor or retailer more than 30 days after expiration of the applicable warranty time period described in this Warranty;
- this Warranty also does not cover repair or replacement costs not authorized in advance by WATER WORKER.

Additional Warranty Limitations

ALL IMPLIED WARRANTIES, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE SPECIFICALLY DISCLAIMED.

Limitations of Remedies

THE REMEDIES CONTAINED IN THIS WARRANTY ARE THE PURCHASER’S OR FIRST USER’S EXCLUSIVE REMEDIES. IN NO CIRCUMSTANCES WILL WATER WORKER BE LIABLE FOR MORE THAN, AND PURCHASER-FIRST USER’S REMEDIES SHALL NOT EXCEED, THE PRICE PAID FOR THE PRODUCT. IN NO CASE SHALL WATER WORKER BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, WHETHER RESULTING FROM NON-DELIVERY OR FROM THE USE, MISUSE, OR INABILITY TO USE THE PRODUCT OR FROM DEFECTS IN THE PRODUCT OR FROM WATER WORKER’S OWN NEGLIGENCE OR OTHER TORT. This exclusion applies regardless of whether such damages are sought for breach of warranty, breach of contract, negligence, strict liability, in tort or under any other legal theory. Such damages include, but are not limited to, inconvenience, loss or damage to property, mold, loss of profits, loss of savings or revenue, loss of use of the Products or any associated equipment, facilities, buildings or services, downtime, and the claims of third parties including customers.

What To Do If You Have a Problem Covered By This Warranty

Any covered Warranty service must be authorized by WATER WORKER. Contact the person from whom you purchased the Product, who must receive authorization from a WATER WORKER distributor or WATER WORKER. If you do not receive a prompt response, call WATER WORKER directly at 877-324-8863. Notice of a Warranty claim should be submitted by the authorized distributor for WATER WORKER at the following address:

WATER WORKER, Warranty Claim Dept.
1400 Division Road, West Warwick, RI 02893

Before WATER WORKER determines to provide any replacement part or Product, it may as a pre-condition to making such a determination require that the warranty claimant ship the Product, postage prepaid to an authorized WATER WORKER distributor, or to WATER WORKER and provide proof of purchase evidenced by the original sales receipt or Product registration.

Replacement Product Warranty

In case of replacement of a Product or any component part, WATER WORKER reserves the right to make changes in the design, construction, or material of the substitute components or products, which shall be subject to all of the terms and limitations of this Warranty, except that the applicable warranty periods shall be reduced by the amount of time the warranty claimant owned the product prior to submitting notification of the warranty claim.



1400 Division Road, West Warwick, RI 02893 • T: 401.884.6300 • F: 401.885.2567 • www.waterworkerdiy.com

MANUEL D'INSTALLATION POUR SYSTÈME DE RÉSERVOIRS VERTICAUX POUR PUIITS

Modèles HT14B, HT20B, HT30B, HT32B, HT44B, HT62B, HT86B et HT119B

Veillez conserver ce manuel avec le réservoir pour vous y référer ultérieurement.

Ce dont vous aurez besoin

Outils recommandés

Clé ajustable	Tournevis
Pince ajustable	Ruban à mesurer
Clé à tuyau	Manomètre à pneus
Scie à métaux	

Pièces additionnelles requises (non incluses)

Raccord de 25,4 mm (1 po) NPTF pour réservoir d'eau	Robinet de vidange
Manomètre	Manostat
Soupape de surpression	Croix du réservoir (25,4 cm L x 2,54 cm (10" Lx1" NPTM))
Clapet de non-retour	Ruban Teflon®

Avant de commencer

Assurez-vous de toujours équiper adéquatement votre système pour puits avec une bonne soupape de surpression. Elle devrait être en mesure d'évacuer le débit complet de la pompe à ou en dessous de la pression maximale de fonctionnement du composant présentant la plus faible pression dans le système. Consultez le manuel du propriétaire de votre pompe pour l'information de sortie. Cela est primordial pour le fonctionnement sécuritaire du système pour puits. **Ce produit est fourni avec une garantie de 5 ans. Voir la garantie limitée de WATER WORKER pour les détails.**

⚠ WARNING VEUILLEZ LIRE ATTENTIVEMENT LE MANUEL D'INSTALLATION, DE FONCTIONNEMENT ET D'ENTRETIEN DU PRODUIT. OMETTRE DE SUIVRE LES INSTRUCTIONS ET LES AVERTISSEMENTS QUI SE TROUVENT DANS LE MANUEL POURRAIT CAUSER DES BLESSURES GRAVES OU LA MORT ET/OU DES DOMMAGES MATÉRIELS, ET ANNULERA LA GARANTIE DU PRODUIT. CE PRODUIT DOIT ÊTRE INSTALLÉ PAR UN PROFESSIONNEL QUALIFIÉ. SUIVEZ TOUS LES CODES ET RÉGLEMENTS LOCAUX ET PROVINCIAUX APPLICABLES ; EN L'ABSENCE DE TELS CODES, SUIVEZ L'ÉDITION COURANTE DU CODE NATIONAL ÉLECTRIQUE ET DE LA PLOMBERIE, SI APPLICABLE.

⚠ CELA EST LE SYMBOLE D'ALERTE DE SÉCURITÉ. IL EST UTILISÉ POUR VOUS AVISER DES DANGERS POTENTIELS DE BLESSURES ET AUTRES. RESPECTEZ TOUS LES MESSAGES DE SÉCURITÉ INDIQUÉS APRÈS CE SYMBOLE POUR RÉDUIRE LE RISQUE DE BLESSURES ET DE DOMMAGES MATÉRIELS.

INFORMATIONS IMPORTANTES DE SÉCURITÉ GÉNÉRALE - DES AVERTISSEMENTS SUPPLÉMENTAIRES PRÉCIS APPARAÎSSENT DANS LES INSTRUCTIONS SUIVANTES.

⚠ WARNING Omettre d'utiliser un réservoir pour puits de bonne dimension provoquera une contrainte excessive sur la pompe et pourrait éventuellement provoquer une défaillance, une fuite ou une inondation, ou des dommages matériels.

⚠ WARNING Pour votre sécurité, les informations qui se trouvent dans ce manuel doivent être suivies pour réduire le risque de chocs électriques, de dommages matériels ou de blessures. Assurez-vous d'avoir une mise à la terre adéquate et conforme aux codes et aux ordonnances.

1. Si vous installez un tout nouveau système, suivez les étapes II, III, IV et V. Sautez l'étape I puisque vous n'enlevez pas un réservoir existant. Cependant, assurez-vous que l'alimentation électrique est coupée avant de brancher le manostat au câblage électrique de votre maison. Si vous avez des doutes à travailler avec l'électricité, appelez un électricien qualifié.
2. Si vous remplacez un réservoir en acier noir avec ce vase d'expansion à membrane Water Worker :
 - a. Un vase d'expansion à membrane est pressurisé avec de l'air en usine (à une pression similaire à celle utilisée dans un pneu d'automobile). C'est la raison pour laquelle il sera plus petit qu'un réservoir en acier noir ; et ce, même si les deux réservoirs distribuent la même quantité d'eau sous pression. Pour cette raison, vous aurez peut-être à modifier la tuyauterie de façon à rejoindre les nouvelles connexions.
 - b. Installez une soupape de surpression au niveau de la connexion du réservoir afin d'assurer la sécurité du système.
 - c. Si vous avez une pompe submersible pour puits profond, retirez tous les dispositifs d'alimentation en air du système pour puits (reniflards, valves à prise de gaz, tuyauterie à vide et connexions). Puis bouchez les trous où ces dispositifs se trouvaient (consultez votre manuel du propriétaire pour leur emplacement). Ces dispositifs ne sont pas nécessaires pour les

réservoirs préchargés, et s'ils ne sont pas enlevés et les trous bouchés, l'air pourrait s'infiltrer dans le système et causer des surpressions, des dommages au système et nuire à sa performance.

- d. Si vous avez une pompe à jet, enlevez les raccords et bouchez les ouvertures là où la tuyauterie à vide ou à air comprimé et là où les commandes de volume d'air se raccordent à la pompe ou à la tuyauterie. S'ils ne sont pas enlevés et les trous bouchés, cela pourrait permettre à l'air d'entrer dans les tuyaux, ce qui pourrait endommager le système pour puits et nuire à la performance.
- e. En plus de ce qui précède, suivez les étapes I à V.
3. Si vous remplacez un vase d'expansion à membrane ou un réservoir à vessie avec ce vase d'expansion à membrane Water Worker :
 - a. Si les deux réservoirs sont de la même dimension, suivez les étapes I à V.
 - b. S'ils ne sont pas de la même dimension, suivez les étapes I à V et ajustez également la tuyauterie, au besoin, afin qu'elle s'adapte à la nouvelle dimension.
4. C'est une bonne pratique de remplacer le manomètre et le manostat lorsque vous remplacez un vieux réservoir. Vous pouvez évidemment réutiliser le bloc croisillon du réservoir si vous remplacez un vase d'expansion à membrane avec un autre (y compris la croix de réservoir, le manomètre, le manostat, la soupape de retour, le mamelon pour tuyau et le tuyau d'évacuation).
 - a. Si vous réutilisez le bloc croisillon du réservoir, passez à l'étape II. Dans ce cas, assurez-vous que le réservoir est installé aussi près que possible du manostat. Cela permettra au système de fonctionner aussi efficace que possible.
 - b. Si vous remplacez le bloc croisillon du réservoir avec de nouvelles pièces lors de l'installation du nouveau réservoir, effectuez toutes les étapes dans ces instructions, étapes I à V.

⚠ WARNING **SOUPEPE DE SURPRESSION REQUISE.** Une soupape de surpression doit être installée, laquelle est configurée pour s'ouvrir lors de pressions excessives (75 psi manométriques ou plus). Cela protégera le réservoir pour puits et les autres composants du système dans l'éventualité d'une défaillance du manostat, laquelle préviendrait l'arrêt de la pompe. La soupape de surpression doit être installée au raccord du réservoir pour puits et à la tuyauterie, et avoir un écoulement équivalant à la capacité de la pompe à 75 psi manométriques. Au moins une fois tous les 3 ans, ou s'il y a présence d'écoulement, un entrepreneur licencié devrait vérifier la température et inspecter la soupape de surpression, et la remplacer s'il y a une présence évidente de corrosion ou si elle ne fonctionne pas. OMETTRE L'INSPECTION DE CETTE SOUPEPE COMME INDIQUÉ POURRAIT RÉSULTER EN UNE TEMPÉRATURE D'EAU NON SÉCURITAIRE OU UNE ACCUMULATION DE PRESSION, CE QUI POURRAIT PROVOQUER LA DÉFAILLANCE DU PRODUIT, DES BLESSURES GRAVES OU LA MORT ET/OU DES DOMMAGES MATÉRIELS IMPORTANTS ET ANNULERA LA GARANTIE DU PRODUIT.

5. Assurez-vous de toujours équiper adéquatement votre système pour puits avec une bonne soupape de surpression. Que vous réutilisez le bloc croisillon du réservoir ou que vous en assembliez un nouveau, assurez-vous que le bloc comprenne une soupape de surpression en mesure d'évacuer le débit complet de la pompe à ou en dessous de la pression maximale de fonctionnement du composant présentant la plus faible pression dans le système. Consultez le manuel du propriétaire de votre pompe pour l'information de sortie. Cela est primordial pour le fonctionnement sécuritaire du système pour puits.

Comment installer le réservoir

Étape I : lorsque vous aurez fermé l'alimentation électrique et vidé le système, débranchez et enlevez le réservoir existant.

1. Trouvez la boîte à fusibles ou le panneau des disjoncteurs de votre maison. Coupez le courant à la pompe pour puits.

⚠ WARNING Pour votre sécurité, les informations qui se trouvent dans ce manuel doivent être suivies pour réduire le risque de chocs électriques, de dommages matériels ou de blessures. Assurez-vous d'avoir une mise à la terre adéquate et conforme aux codes et aux ordonnances.

2. Ouvrez un robinet à l'intérieur de la maison. Videz l'eau du système jusqu'à ce qu'elle cesse de couler.

3. Fermez le robinet à tournant sphérique ou le robinet-vanne (il s'agit du robinet qui contrôle le débit d'eau entre le réservoir et la plomberie qui se trouve à l'intérieur de la maison) (Fig. 1)

4. Videz ce qui reste d'eau dans le réservoir avec un tuyau d'arrosage dans un seau ou dans le siphon de sol. Fixez un tuyau d'arrosage au robinet à l'avant de la croix du réservoir. Placez l'autre extrémité du tuyau dans le seau de façon à ce qu'il soit plus bas que le robinet. Ouvrez le robinet de vidange et videz l'eau du réservoir. Il sera peut-être nécessaire d'évacuer l'air par le robinet d'admission d'air afin de permettre au réservoir de se vider complètement. (Fig. 2)

5. Déconnectez le câblage au manostat. (Avant de déconnecter le câblage, assurez-vous que l'alimentation électrique à la pompe soit bien fermée.)

- a. Desserrez l'écrou hexagonal sur le dessus du capuchon avec des pinces ou une clé ajustable. Dévissez manuellement. (Fig. 3)

- b. Enlevez le capuchon au manostat.

- c. Dévissez les connexions pour les câbles.

- d. Sur le manostat, indiquez quel câble va sur quelle vis (prendre note que le câble vert se branche à l'avant de la vis ; indiquez en utilisant du ruban-cache, au besoin). (Fig. 4)

- e. Dévissez le raccordement à collets qui maintient le câblage au manostat. (Fig. 5)

- f. Tirez les câbles hors du manostat. (Fig. 6)

6. Desserrez et dévissez le raccord union qui maintient le réservoir et le bloc comprenant la croix du réservoir, le manomètre et le manostat. (Fig. 7-8)

7. Déposez le réservoir sur le côté, la croix du réservoir pointant vers le haut. Enlevez le bloc croisillon du réservoir en le dévissant avec la clé à tuyau. (Fig. 9)



Étape II : assemblez le nouveau bloc croisillon du réservoir.

REMARQUE : si vous réutilisez le bloc croisillon de l'ancien réservoir, passez à l'étape III.

1. Si vous utilisez de nouvelles pièces pour le bloc croisillon du nouveau réservoir, déballez la croix du réservoir, le manomètre, le manostat, la soupape de surpression et le mamelon pour tuyau de leur emballage.

Assemblez le bloc croisillon du réservoir. Appliquez DU RUBAN Teflon® au filetage mâle sur le manomètre de la croix du réservoir et aux deux extrémités du mamelon pour tuyau. (Fig. 10) Appliquez dans le sens des aiguilles d'une montre (c'est à dire le bas vers le haut et vers vous). Appliquez 3 tours complets.

2. Insérez le mamelon pour tuyau dans l'un des trous sur le dessus du « croisillon » de la croix du réservoir. Serrez en utilisant la clé à tuyau. (Fig. 11)

3. Insérez le manomètre dans l'autre trou sur le dessus du croisillon. Serrez avec la clé ajustable sur les écrous en laiton carrés. Serrez manuellement, puis avec la clé. Ne serrez pas trop. Le ruban Teflon® assurera une étanchéité suffisante. Une fois serré, ne desserrez pas. Si vous le faites, le joint est plus susceptible de fuir. (Fig. 12)

4. Installez le manostat sur le dessus du mamelon pour tuyau. Serrez avec la clé ajustable sur l'écrou en laiton hexagonal. Serrez manuellement. Puis avec la clé.

5. Installez le tuyau d'évacuation sur le bras du croisillon de la croix du réservoir. Serrez en utilisant la clé à tuyau. (Fig. 13)

⚠ WARNING Un bac récepteur connecté à un drain adéquat doit être installé s'il y a un risque qu'une fuite et qu'une inondation cause des dommages matériels à la zone adjacente à l'appareil ou aux étages inférieurs de l'immeuble.

6. Installez la soupape de surpression dans l'ouverture du filetage femelle sur l'avant de la croix du réservoir. (Fig. 14)

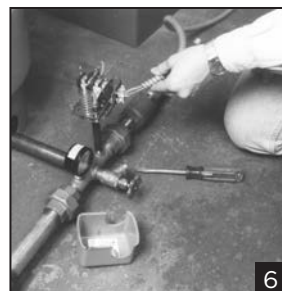
⚠ IMPORTANT Assurez-vous de toujours équiper adéquatement votre système pour puits avec une bonne soupape de surpression.

Étape III : installez le bloc croisillon sur le nouveau réservoir.

1. Enlevez le bouchon en plastique du coude au bas du réservoir. Jetez le bouchon.

2. Installez le bloc croisillon au réservoir. Utilisez soit le nouveau bloc croisillon du réservoir, assemblé selon l'étape II ci-dessus, ou réutilisez le bloc de l'ancien réservoir.

3. Appliquez du ruban Teflon® au filetage au bas de la « tige » de la croix du réservoir. Insérez la tige dans le raccord du filetage femelle au bas du réservoir. Serrez manuellement, puis avec la clé. (Fig. 14-15)



Étape IV : installez le nouveau réservoir.

1. Installez le nouveau réservoir. Placez-le à l'endroit où se trouvait l'ancien réservoir, ou positionnez-le verticalement afin de pouvoir joindre les tuyaux à la croix du réservoir. Si nécessaire, placez le réservoir sur des briques ou des blocs de béton de mâchefer pour vous assurer qu'il soit à la bonne hauteur. Branchez le réservoir à la conduite d'alimentation de la pompe en utilisant une tuyauterie adéquate. Suivez tous les codes et ordonnances locales et provinciales.

Remarque : ne placez pas le réservoir dans un endroit où il y a risque de gel du réservoir ou des commandes. Cela peut endommager le système.

2. Vissez, en premier, les raccords de tuyauterie manuellement, puis serrez-les avec la clé à tuyau.



3. Réinstallez le câblage au manostat. Fixez les conducteurs aux connexions en suivant vos indications. (Fig. 16)

4. Remettez le couvercle au manostat. Assurez-vous que le robinet de vidange standard/de vidange de la chaudière soit fermé. (Fig. 17)



5. Enlevez le capuchon de plastique du robinet d'admission d'air sur le dessus du réservoir. Avec le manomètre à pneus, vérifiez la charge d'air du réservoir.



Ajustez la pression de précharge dans le réservoir de 1 à 2 psi en dessous du réglage de l'amorçage du manostat de la pompe. Regardez tout d'abord à l'intérieur du capuchon au manostat pour déterminer le réglage de l'amorçage du manostat de la pompe. Il devrait indiquer « 20/40 » ou « 30/50 » ou un réglage similaire. La pression dans le réservoir devrait être ajustée pour être 2 psi en dessous de la pression la moins élevée de ces deux chiffres. C'est-à-dire, la pression du réservoir devrait être réglée à environ 18 psi si le capuchon indique un réglage de 20/40, ou à environ 28 psi s'il indique un réglage de 30/50.

Le tableau, « Annexe A », indique la charge d'air dans le réservoir lorsqu'il est expédié de l'usine. Relâchez ou ajoutez de l'air pour bien ajuster la pression. Si cette charge est trop élevée, laissez échapper un peu d'air en appuyant sur la broche à l'intérieur du robinet d'admission d'air. Si la charge n'est pas suffisamment élevée, pompez-la avec une pompe pour pneus de bicyclette ou avec un compresseur d'air.



Sinon, vous pouvez ajuster le manostat de manière à ce qu'il corresponde à la pression dans le réservoir. Consultez les instructions à l'intérieur du capuchon du manostat pour prendre connaissance de la démarche à suivre.



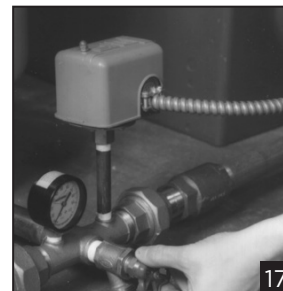
Étape V : rétablissez l'alimentation électrique. La pompe remplira le réservoir. Le système est maintenant prêt à être utilisé.

1. Ouvrez le robinet-vanne afin de permettre à l'eau de refluer dans le réservoir. Cela est le robinet que vous avez fermé à l'étape 1.3 {consultez l'étape 1.3 pour voir la photo du robinet-vanne} (Fig. 18)



2. Ouvrez le robinet dans la maison qui se trouve le plus élevé et le plus éloigné du réservoir. Cela laissera échapper l'air du système à mesure qu'il se remplit d'eau.

3. Rétablissez l'alimentation électrique. La pompe se mettra en marche et remplira le réservoir. Vérifiez le système pour des fuites. Si vous constatez une fuite, fermez immédiatement l'alimentation électrique et réparez la fuite au joint. L'amorçage de la pompe, si cela est une pompe à jet, devrait prendre de 30 secondes à 1 minute. Si la pompe ne remplit pas le réservoir et s'éteint au bout d'environ une minute, vérifiez le manomètre. Si la jauge se meut, laissez la pompe fonctionner. Si la jauge ne meut pas, fermez l'alimentation électrique. Cela signifie que le manostat est soit défectueux ou n'a pas été installé correctement. Vérifiez les instructions du fabricant. Remplacez-le si nécessaire et testez le système une autre fois pour vous assurer qu'il est bien installé.



4. Ouvrez un robinet à proximité pour vous assurer que le système fonctionne correctement.



ANNEXE A

RÉSÉROIRS VERTICAUX	
NUMÉRO DE MODÈLE	PRESSION DE PRÉCHARGE
HT14B	38 psi
HT20B	38 psi
HT30B	38 psi
HT32B	38 psi
HT44B	38 psi
HT62B	38 psi
HT86B	38 psi
HT119B	38 psi

IMPORTANT

Consignes de sécurité • Assurez-vous de les lire.

▲ IMPORTANT Ce réservoir est conçu pour utilisation avec de l'eau potable et est limité à une pression maximale de 100 psi et à une température de service de 54,44 °C (130 °F). Veuillez prendre note qu'un chauffe-eau ou qu'une chaudière dans un système de chauffage à eau chaude chauffera couramment l'eau à une température plus élevée que 54,44 °C (130 °F). Utilisez un réservoir d'expansion thermique pour un débordement d'eau chaude provenant d'un chauffe-eau, ou utilisez un réservoir d'expansion pour un débordement d'eau chaude dans un système de chauffage à eau chaude. Consultez le manuel du propriétaire de votre pompe pour l'information de sortie.

▲ WARNING **RISQUE D'EXPLOSION OU DE RUPTURE** Une soupape de surpression doit être installée pour prévenir un excès de pression conformément au code local ou selon la pression de service maximale désignée dans le manuel du produit, celui qui est le moins élevé. N'exposez pas le produit à des températures de gel ou supérieures à 93,33 °C (200 °F). N'ajustez pas la précharge ou ne repressurisez pas ce produit à moins d'avoir besoin d'effectuer des ajustements lors de l'installation initiale, et surtout si le produit est corrodé, endommagé ou présente une intégrité réduite. Les ajustements à la précharge doivent être faits uniquement à la température ambiante. Omettre d'avoir la bonne dimension de produit ou de suivre ces instructions pourrait provoquer une contrainte excessive sur le système et pourrait provoquer une défaillance du produit, des blessures graves ou la mort, une fuite et/ou des dommages matériels.

▲ WARNING Ce produit, comme la plupart des produits sous pression, peut se corroder avec le temps. Il peut s'affaiblir et éclater ou exploser, causant des blessures graves ou la mort, une fuite et/ou des dommages matériels. Pour réduire ce risque, un professionnel qualifié doit installer, inspecter et effectuer l'entretien périodique du produit. Un bac récepteur connecté à un drain adéquat doit être installé s'il y a un risque qu'une fuite ou qu'une inondation cause des dommages matériels. N'effectuez pas cette installation dans un endroit où une fuite du système ou des raccords pourraient causer des dommages matériels à la zone adjacente à l'appareil ou aux étages inférieurs de l'immeuble.

▲ WARNING **Chlore et eau agressive** : la qualité de l'eau peut influencer de manière importante la durée de vie de ce produit. Vous devriez le tester afin d'y détecter la présence possible d'éléments corrosifs, d'acidité, de matières solides totales et d'autres contaminants pertinents, y compris le chlore, et traitez votre eau adéquatement pour vous assurer d'un rendement satisfaisant et pour prévenir une défaillance prématurée.

Remarque : inspectez l'appareil pour des dommages encourus lors de l'expédition. Si vous constatez des dommages, avisez immédiatement le transporteur ou le magasin où l'achat a été effectué. Si le produit présente des signes de défectuosité ou de corrosion, veuillez appeler immédiatement un professionnel qualifié afin d'éviter tout risque de blessures et de dommages matériels. Des exemplaires courants du manuel du produit peuvent être visualisés au www.waterworkerdiy.com. Utilisez un équipement de sécurité approprié lors de l'installation.

▲ CAUTION Comme avec tous les produits de plomberie et de réservoirs de stockage d'eau, les bactéries peuvent y proliférer et ce, particulièrement pendant les périodes de non-utilisation. Consultez votre professionnel local en plomberie concernant la démarche à suivre pour désinfecter sécuritairement votre plomberie résidentielle.

▲ WARNING **DANGER ! RISQUE D'EXPLOSION LORSQUE LE RÉSERVOIR POUR PUIITS A ÉTÉ EN SERVICE ET QU'UN CHANGEMENT À UNE PRESSION DE PRÉCHARGE SUPÉRIEURE**

EST NÉCESSAIRE EN RAISON D'UNE MODIFICATION REQUISE AU RÉGLAGE DU MANOSTAT ; OMETTRE DE SUIVRE LES INSTRUCTIONS DU MANUEL POURRAIT CAUSER UNE RUPTURE OU UNE EXPLOSION, POSSIBLEMENT CAUSER DES BLESSURES GRAVES OU LA MORT, ET/OU DES DOMMAGES MATÉRIELS.

N'AJUSTEZ PAS LA PRESSION DE PRÉCHARGE S'IL Y A EU UNE RÉDUCTION DU TEMPS DE LA FRÉQUENCE DE POMPAGE OU LA PRESSION DE PRÉCHARGE COMPARÉE À SON RÉGLAGE INITIAL. LA RAISON EST QUE LA RÉDUCTION EN TEMPS DE LA FRÉQUENCE DE POMPAGE PEUT SURVENIR D'UNE PERTE DE PRESSION D'AIR DANS LE RÉSERVOIR QUI, À SON TOUR, PEUT INDICHER QU'IL Y A PEUT ÊTRE DE LA CORROSION INTERNE ET TOUTE REPRESSURISATION OU PRESSION ADDITIONNELLE POURRAIT PROVOQUER UNE RUPTURE OU UNE EXPLOSION, ET/OU DES DOMMAGES MATÉRIELS.

▲ WARNING **PRESSION DE SERVICE MAXIMALE.** Chaque réservoir pour puits est testé pour être étanchéité à l'air à 125 psi manométriques, la pression de service maximale pour la conduite du réservoir pour puits. S'il s'avérait que la pression dépasse 125 psi manométriques, une bonne sélection et un bon format de réservoir pour puits de fabrication ASME devrait être effectué.

▲ WARNING **SOUPAPE DE SURPRESSION REQUISE.** Une soupape de surpression doit être installée, laquelle est configurée pour s'ouvrir lors de pressions excessives (75 psi manométriques ou plus). Cela protégera le réservoir pour puits et les autres composants du système dans l'éventualité d'une défectuosité du manostat, laquelle préviendrait l'arrêt de la pompe. La soupape de surpression doit être installée au raccord du réservoir pour puits et à la tuyauterie, et avoir un écoulement équivalent à la capacité de la pompe à 75 psi manométriques. Au moins une fois tous les 3 ans, ou s'il y a présence d'écoulement, un entrepreneur licencié devrait vérifier la température et inspecter la soupape de surpression, et la remplacer s'il y a une présence évidente de corrosion ou si elle ne fonctionne pas. OMETTRE L'INSPECTION DE CETTE SOUPAPE COMME INDIQUÉ POURRAIT RÉSULTER EN UNE TEMPÉRATURE D'EAU NON SÉCURITAIRE OU UNE ACCUMULATION DE PRESSION, CE QUI POURRAIT PROVOQUER LA DÉFAILLANCE DU PRODUIT, DES BLESSURES GRAVES OU LA MORT ET/OU DES DOMMAGES MATÉRIELS IMPORTANTS ET ANNULERA LA GARANTIE DU PRODUIT.

▲ WARNING Pour votre sécurité, les informations qui se trouvent dans ce manuel doivent être suivies pour réduire le risque de chocs électriques, de dommages matériels ou de blessures. Assurez-vous d'avoir une mise à la terre adéquate et conforme aux codes et aux ordonnances.

N'utilisez pas ce réservoir pour des produits chimiques, des solvants, des produits pétroliers, des acides, ou tout liquide autre que l'eau potable. Cela pourrait entraîner une défaillance prématurée due à la corrosion.

Assurez-vous que le manostat à l'intérieur de votre système pour puits soit réglé assez bas pour arrêter la pompe. Si tous les robinets et les soupapes de votre plomberie sont fermés et que le réglage du manostat est trop élevé, la pompe peut fonctionner continuellement sans faire passer l'eau dans le système. Cela pourrait endommager ou griller la pompe.

▲ WARNING **AVERTISSEMENT AFFÉRENTE À LA PROPOSITION 65 DE LA CALIFORNIE !** D'après l'état de la Californie, ce produit contient des substances chimiques susceptibles d'être cancérigènes, de causer des anomalies congénitales ou d'autres problèmes reproductifs. (Installateur/entrepreneur de la Californie - la loi de la Californie exige que cet avis soit donné aux consommateurs/utilisateurs de ce produit.) Pour de plus amples renseignements : www.waterworkerdiy.com/propp65.htm

GARANTIE LIMITÉE DU PRODUIT WATER WORKER®

Produits couverts : tous les produits fabriqués par WATER WORKER. (« WATER WORKER »).

Cette garantie ne peut pas être transférée - elle s'applique uniquement au premier acheteur ou le premier utilisateur du produit. En acceptant et en gardant ce produit, vous acceptez toutes les conditions de la garantie et les restrictions de responsabilités indiquées ci-dessous.

AVERTISSEMENT IMPORTANT - VEUILLEZ LIRE ATTENTIVEMENT LES INSTRUCTIONS DU MANUEL D'INSTALLATION, DE FONCTIONNEMENT ET D'ENTRETIEN (« MANUEL ») pour éviter des blessures graves et/ou des dommages matériels, et pour vous assurer d'une utilisation sécuritaire et du bon entretien de ce produit.

Postez votre carte d'enregistrement du produit dans les 30 jours suivant l'achat pour assurer votre couverture de garantie. Dans le cas contraire, une preuve d'achat sera requise pour chaque réclamation sous garantie.

Qui reçoit la garantie du produit WATER WORKER

Tous les acheteurs ou les premiers utilisateurs du nouveau produit. Cette garantie n'est pas transférable.

Qu'est-ce qui est couvert par cette garantie

WATER WORKER garantit à l'acheteur ou au premier utilisateur du nouveau produit qu'au moment de la fabrication, le produit est sans défaut matériel ou de main-d'oeuvre. **Toute réclamation sous garantie doit être soumise dans un délai d'un (1) an à moins qu'une autre période de temps soit énoncée dans le manuel, à partir de la date à laquelle le produit a été acheté.**

Ce que WATER WORKER fera si vous avez une réclamation couverte sous garantie

Dans l'éventualité du non-respect de la présente garantie, WATER WORKER va, à sa discrétion soit effectuer des réparations pour corriger toute défektivité matérielle ou de main-d'oeuvre, soit fournir et livrer des pièces ou des produits de remplacement neufs ou usagés. WATER WORKER n'acceptera pas toutes réclamations pour des coûts de main-d'oeuvre ou pour tout autre coût.

Ce que cette garantie ne couvre pas - Exclusions et restrictions

Cette garantie ne couvre pas toute défaillance ou tout problème à moins qu'il n'ait été causé par une défektivité matérielle ou de main-d'oeuvre. De plus, cette garantie ne s'appliquera pas :

- Si le produit n'est pas correctement installé, utilisé, réparé ou entretenu tel qu'indiqué dans le manuel fourni avec le produit ;
- Pour toute défaillance ou défektivité encourue lors d'abus (y compris le gel) ; négligence et inadéquat : manutention, expédition (par quiconque autre que WATER WORKER), entreposage, utilisation, fonctionnement, accident ; ou modification, foudre, inondation ou toute autre condition environnementale ;
- Pour toute défaillance ou tout problème résultant de l'utilisation du produit à des fins autres que celles spécifiées dans le manuel du produit ou la modification de toute pièce du produit ;
- La présente garantie ne couvre pas les coûts de main-d'oeuvre, les frais d'expédition, les frais de services, les dépenses afférentes à la livraison, les frais administratifs ou tout coût engendré lors de la désinstallation ou de l'installation du produit ;
- La présente garantie ne couvre pas les réclamations soumises à WATER WORKER, à un distributeur ou à un détaillant autorisé WATER WORKER plus de 30 jours après l'expiration de la période de garantie décrite dans la présente garantie ;
- La présente garantie ne couvre pas les coûts de réparation ou de remplacement non autorisés à l'avance par WATER WORKER.

Restrictions supplémentaires de garantie

TOUTES LES GARANTIES EXPLICITES, Y COMPRIS LES GARANTIES EXPLICITES DE QUALITÉ MARCHANDE ET D'APTITUDE POUR UN USAGE PARTICULIER SONT EXPRESSÉMENT EXCLUES.

Restrictions des recours

LES RECOURS CONTENUS DANS CETTE GARANTIE SONT LES RECOURS EXCLUSIFS DE L'ACHETEUR OU DU PREMIER UTILISATEUR. WATER WORKER NE SERA EN AUCUN CAS TENU RESPONSABLE POUR UNE SOMME SUPÉRIEURE AU PRIX PAYÉ POUR LE PRODUIT, ET LES MONTANTS AFFÉRENTS AUX RECOURS DE L'ACHETEUR OU DU PREMIER UTILISATEUR NE POURRONT ÊTRE SUPÉRIEURS AU PRIX PAYÉ POUR LE PRODUIT. WATER WORKER, NE SERA EN AUCUN CAS TENU RESPONSABLE POUR TOUT DOMMAGE PARTICULIER, INDIRECT, ACCESSOIRE OU CONSÉCUTIF, RÉSULTANT SOIT DE LA NON-LIVRAISON, DE L'UTILISATION, DE LA MAUVAISE UTILISATION DU PRODUIT ; DE L'INCAPACITÉ À UTILISER LE PRODUIT ; DE DÉFAUTS DANS LE PRODUIT ; DE LA NÉGLIGENCE DE WATER WORKER OU DE TOUT AUTRE DÉLIT. Cette exclusion s'applique indépendamment du fait que de tels dommages soient recherchés pour violation de la garantie, rupture de contrat, négligence, responsabilité sans faute, délit ou en vertu de toute autre théorie juridique. De tels dommages comprennent, sans y être limités, les inconvénients, la perte ou les dommages à la propriété, la moisissure, la perte de profits, la perte d'épargne ou de revenu ; la perte de l'utilisation des produits ou tout autre équipement associé, d'installations, de bâtiments ou services ; les temps d'arrêt ; et les réclamations des tierces parties, y compris les clients.

Que faire si vous avez un problème couvert par cette garantie

Tout service couvert par la garantie doit être autorisé par WATER WORKER. Contactez la personne à qui vous avez acheté le produit, lequel doit recevoir l'autorisation d'un distributeur WATER WORKER ou de WATER WORKER. Si vous n'obtenez pas une réponse rapide, veuillez contacter directement WATER WORKER au 877-324-8863. Un avis de réclamation sous garantie devrait être soumis par le distributeur autorisé à WATER WORKER à l'adresse suivante :

WATER WORKER, département de réclamation sous garantie.
1400 Division Road, West Warwick, RI 02893

Avant que WATER WORKER prenne une décision quant à fournir tout pièce ou produit de remplacement, il peut en tant que condition préalable à la prise d'une telle décision, exiger que le demandeur de la réclamation sous garantie expédie le produit par port prépayé à un distributeur autorisé WATER WORKER ou à WATER WORKER et de fournir la preuve d'achat attestée par la facture de vente d'origine ou par l'enregistrement du produit.

Garantie de remplacement du produit

En cas de remplacement d'un produit ou de tout composant, WATER WORKER se réserve le droit d'apporter des changements à la conception, à la fabrication ou au matériel du produit ou du composant de remplacement, lesquels seront assujettis à toutes les conditions et restrictions de cette garantie, hormis que la période de garantie applicable sera réduite proportionnellement à la durée pendant laquelle le demandeur possédait le produit avant de soumettre une notification de la réclamation sous garantie.



MANUAL DE INSTALACIÓN PARA LOS TANQUES VERTICALES DEL SISTEMA DE POZO

Modelos HT14B, HT20B, HT30B, HT32B, HT44B, HT62B, HT86B y HT119B

Guarde este manual con el tanque para referencia en el futuro.

Lo que necesitará

Herramientas recomendadas

Llave inglesa	Destornillador
Pinzas regulables	Cinta métrica
Llave para tuberías	Medidor de presión de neumáticos
Sierra para metales	

Piezas adicionales requeridas (no incluidas)

Tamaño de conexión del tanque de agua de 1" NPTF (rosca para tubos)	Válvula de drenaje
Manómetro	Interruptor de presión
Válvula disipadora	Cruce del tanque (10" Lx1" NPTM)
Válvula de retención	Cinta Teflon®

Antes de comenzar

Siempre asegúrese de equipar el sistema de pozo con una válvula disipadora de presión adecuada. Con esto debería ser posible descargar todo el caudal de la bomba a, o por debajo de, la presión de trabajo máxima del componente nominal más bajo del sistema. Consulte el manual del usuario para obtener información sobre el caudal de la bomba. Esto es fundamental para el funcionamiento seguro del sistema de pozo. **Este producto cuenta con una garantía de 5 años. Consultar la Garantía Limitada de WATER WORKER para más detalles.**

⚠ WARNING LEA DETENIDAMENTE EL MANUAL DE INSTALACIÓN, FUNCIONAMIENTO Y MANTENIMIENTO DEL PRODUCTO. SI NO SIGUE LAS INSTRUCCIONES Y LAS ADVERTENCIAS EN EL MANUAL PODRÍAN PRODUCIRSE LESIONES GRAVES O MORTALES O DAÑOS MATERIALES E INVALIDAR LA GARANTÍA DEL PRODUCTO. ESTE PRODUCTO DEBE SER INSTALADO POR UN PROFESIONAL CALIFICADO. SIGA TODAS LAS NORMATIVAS Y LOS CÓDIGOS ESTATALES Y LOCALES VIGENTES. EN CASO DE NO TENER DICHS CÓDIGOS, SIGA LAS EDICIONES ACTUALES DEL CÓDIGO DE PLOMERÍA NACIONAL Y DEL CÓDIGO DE ELECTRICIDAD NACIONAL, SEGÚN CORRESPONDA.

⚠ ESTE ES EL SÍMBOLO DE LAS ALERTAS DE SEGURIDAD. SE USA PARA ALERTAR SOBRE POSIBLES LESIONES PERSONALES Y OTROS PELIGROS. OBEDEZCA TODOS LOS MENSAJES DE SEGURIDAD QUE SIGAN ESTE SÍMBOLO PARA DISMINUIR EL RIESGO DE LESIONES PERSONALES Y DAÑOS MATERIALES.

INFORMACIÓN DE SEGURIDAD GENERAL IMPORTANTE: EN LAS SIGUIENTES INSTRUCCIONES APARECEN ALERTAS DE SEGURIDAD ESPECÍFICAS ADICIONALES.

⚠ WARNING Si no se usa un tamaño de tanque de pozo adecuado, esto implicará una tensión excesiva y podría producir fallas en el producto, filtraciones, desbordamientos o daños materiales.

⚠ WARNING Para su seguridad, debe seguir la información en este manual para minimizar el riesgo de descargas eléctricas, lesiones personales o daños materiales. Realice la conexión a tierra adecuada para cumplir con todos los códigos y las normas gubernamentales.

- Si va a instalar un sistema de pozo completamente nuevo, siga los pasos II, III, IV y V. Omita el paso I, ya que no va retirar un tanque existente. Sin embargo, asegúrese de que el suministro eléctrico esté apagado antes de conectar el interruptor de presión a las conexiones eléctricas de la casa. Si tiene alguna duda sobre el trabajo con la electricidad, llame a un profesional autorizado.
- Si va a reemplazar un tanque de acero plano por un tanque de diafragma Water Worker:
 - Un tanque de diafragma está presurizado con aire desde fábrica (a una presión similar a la de la de un neumático de auto). Es por esto que será menor al tanque de acero plano, aunque ambos tanques proporcionen la misma cantidad de agua presurizada. Por eso, es posible que tenga que ajustar la tubería para alcanzar las conexiones nuevas.
 - Instale una válvula disipadora en la conexión del tanque para garantizar la seguridad del sistema.
 - Si tiene una bomba sumergible de pozo profundo, quite todos los dispositivos de carga de aire desde el sistema de pozo (válvulas de

descarga, orificios divisores de tensión, líneas de vacío y conexiones). Luego tape los orificios donde estaban colocados estos dispositivos (consulte el manual del usuario para verificar la ubicación de los dispositivos). Estos dispositivos no son necesarios para los tanques precargados y si no los quita y tapa los orificios, puede entrar aire en el sistema de pozo, crear sobretensión, dañar el sistema y afectar el rendimiento.

- Si tiene una bomba de chorro, quite los accesorios y tape las aperturas donde las líneas de vacío o aire y los controles del volumen de aire se conectan con la bomba o la tubería. Si no los quita y tapa los orificios, puede entrar aire a las tuberías y dañar el sistema de pozo y afectar el rendimiento.
- Además de lo anteriormente mencionado, siga los pasos I al V.
- Si va a reemplazar un tanque de diafragma o flexible por este tanque de diafragma Water Worker:
 - Si los dos tanques tienen el mismo tamaño, siga los pasos I a V.
 - Si tienen distintos tamaños, siga los pasos I a V y también ajuste la tubería según corresponda para adaptarla al nuevo tamaño.
- Es una buena práctica reemplazar el manómetro y el interruptor de presión siempre que reemplace un tanque viejo. Por supuesto que puede volver a usar el ensamblaje cruzado del tanque si reemplaza un tanque de diafragma por otro tanque de diafragma (incluido el cruce del tanque, el manómetro, el interruptor de presión, la válvula disipadora, la boquilla de la tubería y el drenaje).
 - Si vuelve a usar el ensamblaje cruzado del tanque, omita el paso II. En este caso, asegúrese de que el tanque se instale lo más cerca posible del interruptor de presión. Esto hará que el sistema funcione con la mayor eficacia posible.
 - Si reemplaza el ensamblaje cruzado del tanque con piezas nuevas cuando instala el tanque nuevo, complete todos los pasos de las instrucciones, pasos I al V.

⚠ WARNING **VÁLVULA DISIPADORA REQUERIDA.** Se debe instalar una válvula disipadora y debe estar configurada para abrirse cuando haya presiones excesivas (75 psig o más). Esto protegerá el tanque del pozo y otros componentes del sistema en caso de que el interruptor de presión funcione mal y no se pueda apagar la bomba. La válvula disipadora se debe instalar en la conexión del tanque del pozo a la tubería del sistema y debe tener una descarga igual a la capacidad de la bomba de 75 psig. Al menos una vez cada 3 años o cuando se descargue, un contratista autorizado debe inspeccionar la válvula disipadora de presión y temperatura y reemplazarla si hubiera corrosión o no funcionara. **SI NO SE INSPECCIONA ESTA VÁLVULA COMO SE INDICA, PODRÍA PRODUCIRSE UN INCREMENTO DE PRESIÓN O DE TEMPERATURA PELIGROSO QUE PODRÍA OCASIONAR LA FALLA DEL PRODUCTO, LESIONES GRAVES O INCLUSO LA MUERTE O DAÑOS MATERIALES GRAVES E INVALIDAR LA GARANTÍA DEL PRODUCTO.**

- Siempre asegúrese de equipar el sistema de pozo con una válvula disipadora de presión adecuada. Ya sea que vuelva a usar el ensamblaje cruzado del tanque o haya montando uno nuevo, asegúrese de que el ensamblaje incluya una válvula disipadora que pueda descargar todo el caudal de la bomba a, o por debajo de, la presión de trabajo máxima del componente nominal más bajo en el sistema. Consulte el manual del usuario para obtener información sobre el caudal de la bomba. Esto es fundamental para el funcionamiento seguro del sistema.

Cómo instalar el tanque

Paso I: Desconecte y retire el tanque existente después de apagar el suministro eléctrico y de drenar el sistema.

1. Encuentre el panel del disyuntor o de la caja de fusibles de su casa. Apague el suministro eléctrico de la bomba del pozo.

⚠️ WARNING Para su seguridad, debe seguir la información en este manual para minimizar el riesgo de descargas eléctricas, lesiones personales o daños materiales. Realice la conexión a tierra adecuada para cumplir con todos los códigos y las normas gubernamentales.



2. Abra una canilla dentro la casa. Drene el sistema todo lo que sea posible dejando correr el agua hasta que se termine.



3. Cierre la válvula de bola o esclusa (esta es la válvula que controla el flujo de agua del tanque hacia el sistema de tuberías de la casa). (Fig. 1)

4. Drene el agua restante del tanque con una manguera de jardín en un balde o en el drenaje del suelo. Coloque una manguera de jardín en la canilla al frente del cruce del tanque. Coloque el otro extremo de la manguera en un balde para que esté a un nivel inferior que la canilla. Abra la válvula de drenaje y drene el agua hacia afuera del tanque. Puede ser necesario ventilar el tanque con la válvula de aire para dejar que se drene por completo. (Fig. 2)



5. Desconecte la conexión eléctrica del interruptor de presión. **(Primero asegúrese de que el suministro eléctrico a la bomba este apagado.)**

- a. Afloje la tuerca hexagonal en la parte superior de la tapa con pinzas o con la llave inglesa. Desenrosque a mano. (Fig. 3)

- b. Quite la tapa del interruptor de presión.
- c. Desenrosque las conexiones de los cables.



- d. Marque qué cable va con qué tornillo en el interruptor de presión (es decir, tenga en cuenta que el cable verde se conecta al tornillo frontal; de ser necesario, márkelo con cinta de enmascarar). (Fig. 4)

- e. Desenrosque el conector de la abrazadera que sostiene la conexión eléctrica al interruptor de presión. (Fig. 5)

- f. Saque los cables del interruptor de presión. (Fig. 6)

6. Afloje y desenrosque las conexiones de unión que sostienen el tanque y el conjunto del cruce del tanque/manómetro/interruptor de presión en su lugar. (Fig. 7-8)

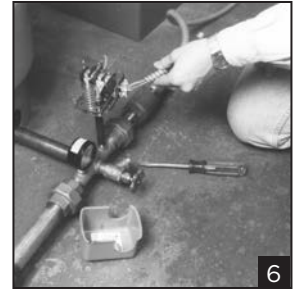


7. Coloque el tanque de costado con el cruce del tanque apuntando hacia arriba. Quite el ensamblaje cruzado del tanque desenroscándolo con la llave para tuberías. (Fig. 9)

Paso II: Monte la unidad cruzada del tanque nuevo.

NOTA: Si vuelve a usar el ensamblaje cruzado del tanque viejo, vaya al paso III.

1. Si usa piezas nuevas para el ensamblaje cruzado del tanque, saque el cruce del tanque, el manómetro, el interruptor de presión, la válvula disipadora y la boquilla de la tubería nueva de sus embalajes.



Monte la unidad cruzada del tanque nuevo. Aplique cinta Teflon® a las roscas macho en el manómetro del cruce del tanque y en ambos extremos de la boquilla de la tubería. (Fig. 10) Aplíquela en el sentido de las agujas del reloj (es decir, parte inferior hacia arriba y hacia usted). Aplique 3 vueltas completas.

2. Inserte la boquilla de la tubería en uno de los orificios en la parte superior de la "barra" del cruce del tanque. (No importa cuál). Ajuste con la llave inglesa. (Fig. 11)



3. Inserte el manómetro en el otro orificio en la parte superior de la barra. Ajuste la tuerca de latón cuadrada con la llave inglesa. Ajuste a mano, luego con una llave. No ajuste demasiado. La cinta Teflon® garantizará un sellado suficiente. Una vez ajustado, no lo afloje. Si lo hace, es más probable que haya filtraciones en las juntas. (Fig. 12)

4. Instale el interruptor de presión en la parte superior de la boquilla de la tubería. Una vez más, ajuste la tuerca de latón hexagonal con la llave inglesa. Ajústela a mano. Luego ajuste con la llave.



5. Instale un drenaje en el brazo de la barra del cruce del tanque. Ajústelo con la llave inglesa. (Fig. 13)

⚠️ WARNING Se debe instalar una bandeja colectora a un drenaje adecuado en caso de que la filtración o el desbordamiento puedan causar daños materiales al área adyacente al artefacto o a pisos inferiores de la estructura.

6. Instale la válvula disipadora en la otra apertura roscada hembra en el frente de la barra del tanque. (Fig. 14)

⚠️ IMPORTANT Siempre asegúrese de equipar el sistema de pozo con una válvula disipadora de presión adecuada.



Paso III: Instale el nuevo ensamblaje cruzado del tanque en el tanque nuevo.

1. Quite el tapón plástico del codo en la parte inferior del tanque. Deseche el tapón.

2. Instale el ensamblaje cruzado del tanque en el tanque. Ya sea que use el ensamblaje cruzado del tanque nuevo o que vuelva a usar el ensamblaje cruzado del tanque viejo, colóquelo según el paso II antes mencionado.



3. Aplique cinta Teflon® en las roscas en la parte inferior del "vástago" del cruce del tanque. Inserte el vástago en el adaptador roscado hembra en la parte inferior del tanque. Ajuste a mano, luego con una llave. (Fig. 14-15)

Paso IV: Instale el tanque nuevo.

1. Instale el tanque nuevo. Colóquelo donde estaba el tanque viejo o sosténgalo en una posición para lograr que las tuberías encajen con el cruce del tanque. De ser necesario, coloque el tanque sobre ladrillos de jardín o bloques de hormigón para asegurarse de que esté a la altura adecuada. Conecte el tanque a las líneas de suministro de la bomba usando tuberías para que encajen. Siga todos los códigos y las regulaciones estatales y locales vigentes. **Nota:** No coloque el tanque donde este o los controles se puedan congelar. Esto puede dañar el sistema.



2. Primero enrosque las uniones de las tuberías a mano, luego ajuste con la llave inglesa.

3. Vuelva a instalar los cables en el interruptor de presión. Coloque los cables en las conexiones según lo que haya marcado. (Fig. 16)



4. Vuelva a colocar la tapa del interruptor de presión. Asegúrese de que la válvula de drenaje de la caldera/del drenaje estándar esté cerrada. (Fig. 17)

5. Quite la tapa de plástico de la válvula de aire en la parte superior del tanque. Controle la carga de aire en el tanque con el medidor de presión de neumáticos.

Ajuste la presión de precarga en el tanque para que esté entre 1 y 2 psi por debajo del parámetro de reducción de la bomba del interruptor de presión. Primero mire dentro de la tapa hacia el interruptor de presión para determinar el parámetro de reducción de la bomba. Debería decir "20/40" o "30/50" o similar. La presión del tanque se debe ajustar a 2 psi por debajo de la presión inferior de estos dos números. Es decir, la presión del tanque debe configurarse aproximadamente a 18 psi si la tapa indica un parámetro de reducción de 20/40 o a 28 si la tapa indica un parámetro de 30/50.



La tabla, "Muestra A", indica la carga de aire en el tanque cuando el tanque se envía de fábrica. Libere o agregue aire para ajustar la presión de forma adecuada. Si la carga es demasiado alta, libere una parte del aire presionando hacia abajo el perno dentro de la válvula de aire. Si la carga es demasiado baja, cargue el tanque con una bomba para neumáticos de bicicleta o un compresor de aire.

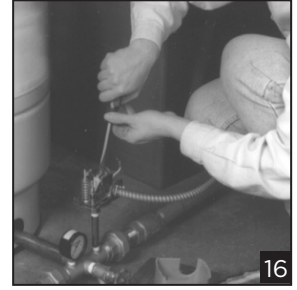


También puede ajustar el interruptor de presión para que coincida con la presión en el tanque. Lea las instrucciones dentro de la tapa del interruptor de presión para saber cómo hacer esto.



Paso V: Vuelva a encender el suministro eléctrico. La bomba llenará el tanque. Ahora, el sistema está listo para su uso.

1. Abra la válvula de esclusa para dejar correr el agua de nuevo hacia el tanque. Esta es la válvula que cerró en el paso 1.3 (consulte el paso 1.3 para ver la foto de la válvula de esclusa). (Fig. 18)



2. Abra la canilla de la casa que esté más alta y más lejos del tanque. Esto permitirá que el aire salga del sistema a medida que entra el agua.

3. Vuelva a encender el suministro eléctrico. La bomba arrancará y llenará el tanque. Controle que no haya filtraciones en el sistema. Si ve una filtración, apague el suministro eléctrico de inmediato y repare la filtración en la junta. Le tomará de 30 segundos a 1 minuto a la bomba cebar si es una bomba a chorro. Si la bomba no llena el tanque y se apaga en un minuto más o menos, controle el manómetro. Si el medidor se mueve, deje que la bomba siga funcionando. Si el medidor no se mueve, apague el suministro eléctrico. Esto significa que el interruptor de presión está mal instalado o es defectuoso. Verifique las instrucciones del fabricante. De ser necesario, reemplácelo y vuelva a probar el sistema para ver que se haya instalado correctamente.



4. Abra una canilla cercana para ver si el sistema funciona correctamente.



MUESTRA A

TANQUES VERTICALES	
N.º DE MODELO	PRESIÓN DE PRECARGA
HT14B	38 psi
HT20B	38 psi
HT30B	38 psi
HT32B	38 psi
HT44B	38 psi
HT62B	38 psi
HT86B	38 psi
HT119B	38 psi

IMPORTANTE

Instrucciones de seguridad • Asegúrese de leerlas.

▲ IMPORTANT Este tanque está diseñado para ser usado con agua potable, está limitado a una presión máxima de 100 psi y a una temperatura máxima de trabajo de 54 °C (130 °F). Tenga en cuenta que: un calentador de agua o una caldera en un sistema hidrónico de calefacción habitualmente calentará el agua a más de 54 °C (130 °F). Use un tanque de expansión termal para el desbordamiento de agua caliente de un calentador de agua o use un tanque de expansión para el desbordamiento de agua caliente de un sistema hidrónico de calefacción. Consulte el manual del usuario para obtener información sobre el caudal de la bomba.

▲ WARNING PELIGRO DE EXPLOSIÓN O ROTURA Se debe instalar una válvula de alivio para evitar que la presión exceda los requisitos del código local o la presión de trabajo máxima designada en el Manual del producto, la que sea menor. No exponga el producto a temperaturas de congelación o que excedan los 93 °C (200 °F). No ajuste la precarga ni vuelva a aplicar presión a este producto excepto en los ajustes requeridos al momento de la instalación inicial, en especial si el producto se corroe, se daña o disminuye su integridad. Los ajustes de precarga se deben realizar solo a temperatura ambiente. Si no se calibra el producto de manera adecuada o no sigue estas instrucciones causará una tensión excesiva en el sistema que llevará a la falla del producto, a lesiones personales graves o mortales, a filtraciones o a daños materiales.

▲ WARNING Este producto, como la mayoría de los productos a presión, se puede corroer con el paso del tiempo. Se puede debilitar y estallar o explotar causando lesiones graves o mortales, filtración o desbordamiento o daños materiales. Para minimizar el riesgo, un profesional autorizado debe instalar el producto e inspeccionarlo y realizar el servicio técnico periódicamente. Se debe instalar una bandeja colectora a un drenaje adecuado en caso de que la filtración o el desbordamiento puedan causar daños materiales. No lo coloque en un área donde la filtración del tanque o las conexiones puedan causar daños materiales al área adyacente al artefacto o a pisos inferiores de la estructura.

▲ WARNING Cloro y agua agresiva: la calidad del agua puede influenciar de forma significativa la vida útil de este producto. Debe hacer una prueba para elementos corrosivos, acidez, sólidos totales y otros contaminantes relevantes, incluido el cloro, y tratar el agua de manera adecuada para garantizar un rendimiento satisfactorio y prevenir las fallas prematuras.

Nota: Inspeccione si hay daños debidos al transporte, de ser así, notifique al transportista o al comercio donde lo compró de inmediato. Para evitar el riesgo de lesiones personales y daños materiales, si el producto parece funcionar mal o muestra signos de corrosión, llame a un profesional calificado de inmediato. Las copias actualizadas del Manual del producto se pueden encontrar en www.waterworkerdiy.com. Use el equipo de seguridad adecuado cuando realice la instalación.

▲ CAUTION Como en todos los productos de plomería y en los contenedores para el almacenamiento de agua, pueden crecer bacterias en este producto, en especial mientras no está en uso. Consulte a su plomero profesional local acerca de los pasos que puede tomar para desinfectar de forma segura el sistema de tuberías de su hogar.

▲ WARNING PELIGRO PELIGRO DE EXPLOSIÓN, SI SE HA REALIZADO EL SERVICIO TÉCNICO AL TANQUE DE

POZO Y ES NECESARIO CAMBIAR A UNA PRESIÓN DE PRECARGA MÁS ALTA DEBIDO A UN CAMBIO REQUERIDO EN EL PARÁMETRO DEL INTERRUPTOR DE PRESIÓN, SI NO SIGUE EL MANUAL DE INSTRUCCIONES PUEDE OCASIONAR UNA ROTURA O UNA EXPLOSIÓN QUE POSIBLEMENTE CAUSEN LESIONES GRAVES O MORTALES O DAÑOS MATERIALES.

NO AJUSTE LA PRESIÓN DE PRECARGA SI HUBO UNA REDUCCIÓN EN EL TIEMPO DE CICLO DE LA BOMBA O EN LA PRESIÓN DE PRECARGA COMPARADA CON EL PARÁMETRO INICIAL. ESTO SE DEBE A QUE LA REDUCCIÓN EN EL TIEMPO DE CICLO DE LA BOMBA SE PUEDE DEBER A LA PÉRDIDA DE PRESIÓN DE AIRE DEL TANQUE QUE A SU VEZ PUEDE SIGNIFICAR QUE EXISTE UNA CORROSIÓN INTERNA Y TODA REPRESURIZACIÓN O PRESIÓN ADICIONAL PUEDE OCASIONAR UNA ROTURA O UNA EXPLOSIÓN O DAÑOS MATERIALES.

▲ WARNING PRESIONES MÁXIMAS DE TRABAJO. Cada tanque de pozo se prueba con aire a 125 psig, la presión máxima de trabajo para la línea del tanque de pozo. Si las presiones exceden los 125 psig, se debe realizar la selección adecuada y la calibración de un tanque de pozo construido bajo las normas ASME.

▲ WARNING VÁLVULA DISIPADORA REQUERIDA. Se debe instalar una válvula disipadora y debe estar configurada para abrirse cuando haya presiones excesivas (75 psig o más). Esto protegerá el tanque del pozo y otros componentes del sistema en caso de que el interruptor de presión funcione mal y no se pueda apagar la bomba. La válvula disipadora se debe instalar en la conexión del tanque del pozo a la tubería del sistema y debe tener una descarga igual a la capacidad de la bomba de 75 psig. Al menos una vez cada 3 años o cuando se descargue, un contratista autorizado debe inspeccionar la válvula disipadora de presión y temperatura y reemplazarla si hubiera corrosión o no funcionara. SI NO SE INSPECCIONA ESTA VÁLVULA COMO SE INDICA, PODRÍA PRODUCIRSE UN INCREMENTO DE PRESIÓN O DE TEMPERATURA PELIGROSO QUE PODRÍA OCASIONAR LA FALLA DEL PRODUCTO, LESIONES GRAVES O INCLUSO LA MUERTE O DAÑOS MATERIALES GRAVES E INVALIDAR LA GARANTÍA DEL PRODUCTO.

▲ WARNING Para su seguridad, debe seguir la información en este manual para minimizar el riesgo de descargas eléctricas, lesiones personales o daños materiales. Realice la conexión a tierra adecuada para cumplir con todos los códigos y las normas gubernamentales.

No use este tanque para químicos, solventes, derivados del petróleo, ácidos ni ningún otro fluido que no sea agua potable. Esto puede causar fallas prematuras debido a la corrosión.

Asegúrese de que el interruptor de presión en el sistema de pozo se configure lo suficientemente bajo como para apagar la bomba. Si todas las canillas y las válvulas están cerradas en el sistema de tuberías y el parámetro del interruptor de presión es muy alto, la bomba puede funcionar sin interrupción sin agua en el sistema. Esto puede dañar o quemar la bomba.

▲ WARNING ADVERTENCIA, PROPOSICIÓN 65 DE CALIFORNIA Este producto contiene un químico que el Estado de California reconoce que es cancerígeno y que causa defectos de nacimiento u otros daños reproductivos. (Instalador/contratista de California: la ley de California exige que se notifique al consumidor/usuario final de este producto). Para obtener más información: www.waterworkerdiy.com/prop65.htm

GARANTÍA LIMITADA DEL PRODUCTO WATER WORKER®

Productos cubiertos: todos los productos fabricados por WATER WORKER. (“WATER WORKER”).

Esta garantía no puede ser transferida: se extiende solo al primer usuario o al comprador original del producto. Al aceptar y quedarse con este producto usted está de acuerdo con todos los términos de la garantía y las limitaciones de responsabilidad descritas a continuación.

ADVERTENCIA IMPORTANTE: LEA DETENIDAMENTE EL MANUAL DE INSTALACIÓN, FUNCIONAMIENTO Y MANTENIMIENTO (“MANUAL”) para evitar lesiones personales graves o daños materiales y garantizar el uso seguro y el cuidado adecuado del producto.

Envíe por correo su tarjeta de registro del producto dentro de los 30 días de compra para asegurarse la cobertura de la garantía o se le solicitará un comprobante de compra para todos los reclamos en garantía.

Quién recibe la garantía de producto de WATER WORKER

Todos los compradores o primeros usuarios del producto nuevo. La garantía no es transferible.

Qué cubre esta garantía

WATER WORKER garantiza al comprador o primer usuario del producto nuevo que al momento de la fabricación el producto no presenta defectos en el material ni de mano de obra. **Todo reclamo en garantía se debe realizar dentro de un (1) año, a menos que el manual indique otro período de tiempo, contado desde el momento en que se compró el producto.**

Qué hará WATER WORKER si usted tiene un reclamo que cubre la garantía

En caso de incumplimiento de la presente garantía, WATER WORKER, si lo desea, puede hacer reparaciones para corregir cualquier defecto en el material o de la mano de obra o suministrar y enviar, ya sean, piezas de repuesto o productos nuevos o usados. WATER WORKER no aceptará ningún reclamo por mano de obra u otros costos.

Qué no cubre esta garantía: exclusiones y limitaciones

Esta garantía no cubre ninguna falla o problema, a menos que haya sido causado por un defecto en el material o en la mano de obra. Además, esta garantía no tendrá validez:

- Si el producto no está bien instalado, operado, reparado o mantenido según las indicaciones del Manual provisto con el producto.
- Para ninguna falla o disfunción causada por el uso incorrecto (incluido el congelamiento); inadecuado o negligente: manipulación, transporte (que no sea por WATER WORKER), almacenamiento, uso, funcionamiento, accidente o alteración, rayo, inundación o cualquier otra condición ambiental.
- Para ninguna falla o problema causado por el uso del producto para un fin que no sea el especificado en el Manual correspondiente o por la alteración de cualquiera de las partes del producto.
- Esta garantía no cubre costos de mano de obra, cargos por transporte, cargos por servicio técnico, gastos de entrega, pagos administrativos ni ningún costo correspondiente a la remoción o reinstalación del producto.
- Esta garantía no cubre ningún reclamo enviado a WATER WORKER, un minorista o un distribuidor autorizado de WATER WORKER después de los 30 días del período de tiempo de vigencia de la garantía descrita aquí.
- Esta garantía tampoco cubre los costos de reparación ni reemplazo no autorizados con anterioridad por WATER WORKER.

Limitaciones adicionales de la garantía

TODAS LAS GARANTÍAS IMPLÍCITAS, INCLUIDAS TODAS LAS GARANTÍAS IMPLÍCITAS DE COMERCIABILIDAD E IDONEIDAD PARA UN FIN PARTICULAR QUEDAN ESPECÍFICAMENTE EXCLUIDAS.

Limitaciones de soluciones

LAS SOLUCIONES CONTENIDAS EN ESTA GARANTÍA SON LOS RECURSOS EXCLUSIVOS DEL COMPRADOR O PRIMER USUARIO. EN NINGÚN CASO WATER WORKER SERÁ RESPONSABLE DE NINGÚN MONTO MAYOR AL PRECIO PAGADO POR EL PRODUCTO Y LOS RECURSOS DEL COMPRADOR/ PRIMER USUARIO NO LO DEBERÁN EXCEDER. EN NINGÚN CASO WATER WORKER SERÁ RESPONSABLE DE NINGÚN DAÑO ESPECIAL, INDIRECTO, CASUAL O RESULTANTE, YA SEA QUE DERIVE DE LA FALTA DE ENTREGA O DEL USO, MAL USO O INCAPACIDAD DE USAR EL PRODUCTO O DE DEFECTOS EN EL PRODUCTO O DE LA PROPIA NEGLIGENCIA DE WATER WORKER U OTRO AGRAVIO. Esta exclusión se aplica independientemente de si dichos daños son buscados para incumplir la garantía, incumplir el contrato, por negligencia, responsabilidad absoluta, agravio o de acuerdo a cualquier otra teoría legal. Dichos daños incluyen, aunque no de forma excluyente, inconvenientes, pérdidas o daños materiales, moho, pérdida de beneficios, pérdida de ahorros o de ingresos, pérdida del uso de los productos o cualquier equipo asociado, instalaciones, edificaciones o servicios, tiempo de inactividad y los reclamos de terceros, incluidos los clientes.

Qué hacer si tiene un problema que cubre esta garantía

Todo servicio cubierto por la garantía debe ser autorizado por WATER WORKER. Comuníquese con el vendedor del producto, quien debe recibir autorización de un distribuidor de WATER WORKER o de WATER WORKER. Si no recibe una pronta respuesta, llame directamente a WATER WORKER al 877-324-8863. El distribuidor autorizado de WATER WORKER debe enviar el aviso de reclamo en garantía a WATER WORKER al siguiente domicilio:

WATER WORKER, Warranty Claim Dept.
1400 Division Road, West Warwick, RI 02893

Antes de que WATER WORKER determine si proporciona la pieza de repuesto o el producto, puede, como precondition para tomar dicha determinación, solicitar que el demandante de la garantía envíe el producto, con franqueo postal pagado, a un distribuidor de WATER WORKER autorizado o a WATER WORKER y proporcione un comprobante de compra, ya sea el recibo de venta original o el registro del producto.

Garantía de reemplazo del producto

En caso de que se reemplace el producto o cualquier componente, WATER WORKER se reserva el derecho de realizar cambios en el diseño, construcción o material de los componentes o productos sustitutos, que estarán sujetos a todos los términos y las limitaciones de esta garantía, excepto que los períodos de la garantía vigente fueran reducidos a la cantidad de tiempo que el demandante de la garantía tuvo el producto antes de enviar la notificación del reclamo de la garantía.



1400 Division Road, West Warwick, RI 02893 • Tel.: 401.884.6300 • Fax: 401.885.2567 • www.waterworkerdiy.com



WALRUS

TQ Series

Electronic Control Pump Instruction Manual



ISO 9001 Certified

Walrus America Inc

EC Declaration of Conformity

Manufacturer:

Walrus Pump Co., Ltd.

Address:

No. 83 -14, Dapiantou, Sanjhieh Township, Taipei County 252, Taiwan

Declare that the machinery described:

Name : Water Pump

Model : TQ Series

Conform to the following directive:

2006/42/EC—Machinery directive

2006/95/EC—Low voltage directive

2004/108/EC—EMC (Electromagnetic compatibility) directive

Refer to the following standards:

EN ISO 12100:2010

EN ISO 13857:2008

EN 809:1998+A1:2009

EN 60335-1:2002

EN 60335-2-41:2003

EN 61000-6-2:2005

EN 61000-6-3:2007

R&D department manager: Kao Tien-chuan

Manager:

Kao Tien chuan

TQ Series Instruction Manual

Please read all instructions carefully before installing your new systems, as failures caused by incorrect installation or operation are not covered by the warranty.

I. Product

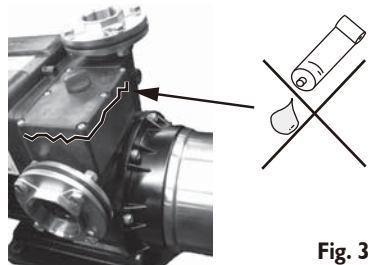
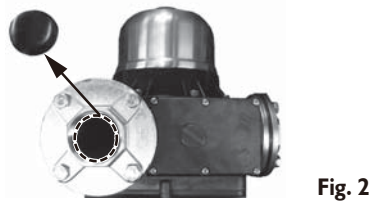
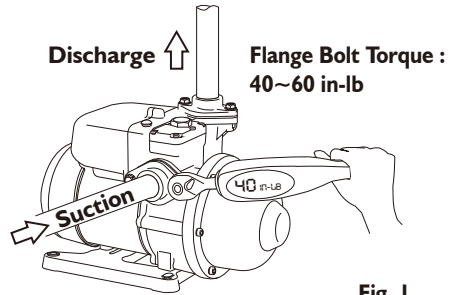
The TQ series are designed for the pumping of non-aggressive water, or water not containing solid particles.

II. Operating conditions:

1. Ambient temp. : Max. +104°F (40°C)
2. Liquid temp. : +39°F(4°C) ~ +104°F(40°C)Max.
3. System pressure: Max. 120 PSI
4. Relative humidity: Max. 85%(RH)

III. Installation

1. The pump foundation should be rigid enough to absorb any vibration from the motor, and the pump should be securely bolted to the foundation.
2. It is recommended that the plumber/installer provides an adequate draining system to avoid damage in case of leakage, particularly when installed indoors. When it is installed outside, it should be covered by a weather-proof housing, well ventilated to allow motor heat to escape.
3. Connect the suction pipe to the side and discharge pipe on the top. (See Fig 1)
4. When it is installed with water heater, a check valve should be installed between pump (discharge) pipeline and water heater (suction) to avoid high-pressure steam backflow.
5. It is required to shut off the pump when the liquid source is unavailable; although it has the dry run cut off function.
6. For TQ1500/2200/3700, please cut out the center of the rubber gasket inside the inlet and outlet flanges as it will block the water flow. (See Fig 2)
7. Regular maintenance requires to open the prime cover in order to access the check valve. DO NOT apply any bonded material (such as silicon, glue etc) to seal the chamber cover (See Fig 3).



IV. Piping

1. The suction line should be installed as short and straight as possible, with a minimum of bends. The internal diameter of the suction pipe must be equal to, or greater than the ports of the pump.
2. The connection between the suction line and pump must be airtight, and the suction pipe must be positioned so it has an upward slope to the pump (thus avoiding the formation of air pockets).
3. If it is likely the water supply may contain solid particles, such as leaves and sand, a filter should be installed on the suction line.
4. If hose is used as the suction pipe, it must be non-collapsible.
5. To minimize pressure drop, the discharge pipe should be at least the same size as the discharge port of the pump.
6. For long suction pipes or high suction lifts over 13 ft, the suction pipe should be of greater diameter than the suction port.
7. Ensure all connections are completely sealed using thread tape only.

V. Connections to Water Source

I. Flooded Suction- from Well System

With gravity feed to the pump, there are no special adjustments to be made. See Fig. 4 below for recommended layout. Simply make necessary plumbing connections and apply power. The pump is ready to use.

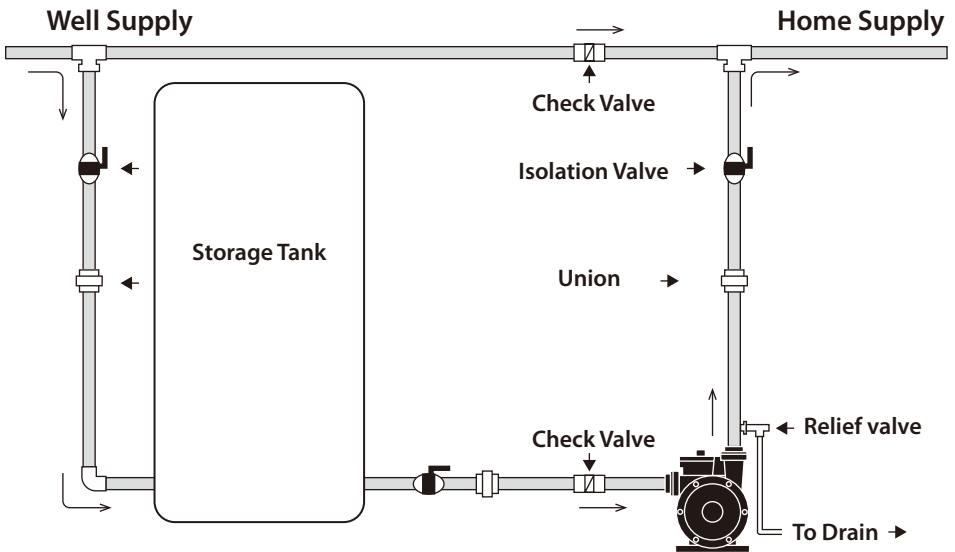


Fig. 4

2. Flooded Suction -from city water supply

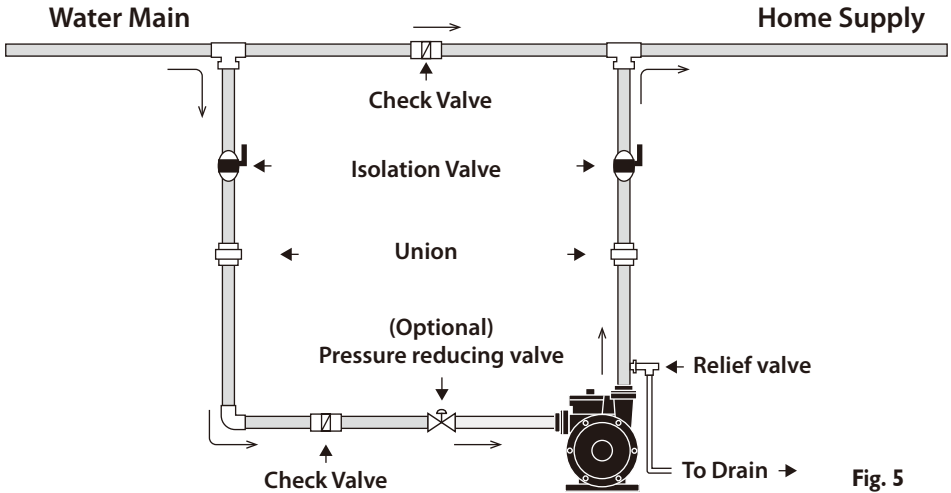


Fig. 5

Directly applied city pressure can exceed pump operating pressure and damage the pump. The max inlet pressure should not exceed 50 psi, except TQ3700 which is limited to 45 PSI. Any greater incoming pressure is required to install a pressure reducing valve on the suction side of the pump. In some areas where local codes restrict maximum home pressure, a pressure reducing valve is also required on suction to lower the inlet pressure. The chart below shows the applicable settings for the pressure reducing valve :

Local code limits for home pressure	Pressure reducing valve setting (psi)					
	TQ200	TQ400	TQ800	TQ1500	TQ2200	TQ3700
No limit	50	50	50	50	50	45
90 psi	50	50	25	30	30	20
80 psi	45	40	15	20	20	10

3. Suction Lift- below ground water sources

This connection does not require any adjustment. Whenever the installation position of the pump is higher than 3ft above the lowest water level, a foot valve must be installed on the end of suction pipe.

Warning

The pump is not designed for continuous operation under low discharge flows such as slow closing float valves, slow running taps. Under this application, please install an extra tank (typically 2-3 gallon) to avoid “cycling”. (Fig 6) Please set the extra pressure tank prussure the same as activation pressure. Leaking discharge line and leaking taps will damage the unit through causing the pump to repeatedly start and stop.

Note: Optional external water pressure tank can be used to decrease the on/off cycle rate of the pump system, which can extend the life of the pump.

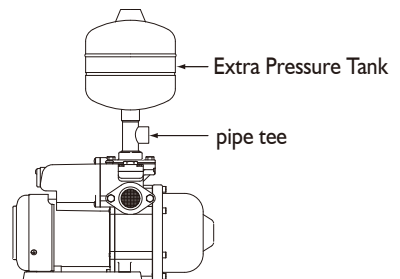


Fig. 6

VI. Electrical connection



This mark located outside the connection box is a warning for an electrical hazard.

1. Ensure the mains voltage is the same as the value shown on the motor plate and that the pump is safely connected to ground/earth.
2. The single phase models are supplied with plug and lead and can be connected directly to the mains supply. The 3 phase models should hook up with a circuit breaker.

VII. Wiring diagram

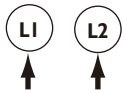
WARNING:

Risk of electric shock - This pump has not been investigated for use in swimming pool or marine areas.

To reduce the risk of electric shock, connect only to a properly grounded, grounding-type receptacle.

Before operation, please ensure the voltage is correct and the circuit breaker and grounding connectors are all connected in accordance with local regulations.

Single-phase power supply

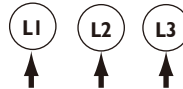


Input power



Grounding

3-phase power supply (check if rotation is correct)



Input power



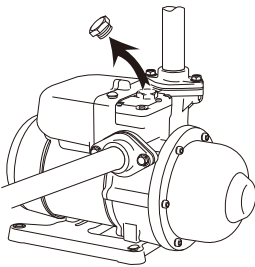
Grounding

Fig. 7

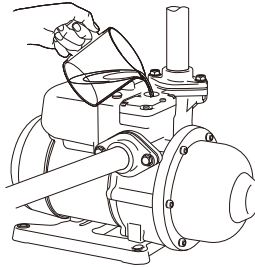
VIII. Starting

1. Before starting, the pump must be primed. For installation with no inlet pressure, please follow the procedure as shown in Fig 8.

a. Remove the filling plug



b. Fill water in chamber



c. Replace the filling plug

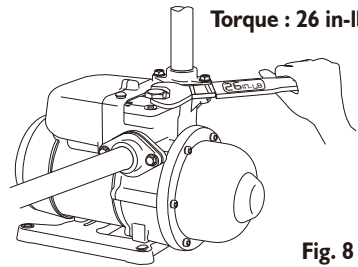


Fig. 8

2. For installation with inlet pressure, remove the priming plug and allow the water to flow into the priming chamber until all air is expelled.
3. The priming procedure should be repeated until all air is expelled and the pump delivers a full stream of water without air bubbles.
4. The pump must always be checked for prime if not used for a prolonged period. It is imperative to fill the pump with liquid before operation as dry running causes irreparable damage to the mechanical seal.
5. When 3-phase motor is supplied, please ensure if the rotation is correct. You can switch any of the 2 wires to change the rotation.

IX. Precautions

1. The pump should be shut down and the trouble corrected if the pump is running at speed and found to have any of the following problems:
 - No liquid discharged - Not enough liquid discharged
 - Excessive vibration - Motor runs hot
2. Do not allow the pump to continually start and stop (cycling) as this will reduce the motor life.
3. Cycling can occur on pressure units when the pressure tank pre-charge drops, or where there is a leak in the discharge plumbing.

X. Operation and maintenance

Under normal operating conditions, the pump does not require any maintenance as long as the following points are observed:

1. Periodically check the condition of the check valve and strainer (if used).
2. If the pump is to be inactive for long periods, it should be rinsed thoroughly with clean water, then, drained and stored in a dry place.
It has to be re-primed before start-up.
3. If the pump shaft is seized up after periods of inactivity, please place a screw driver from the motor end to rotate the shaft. It should free the pump shaft. (See Fig 9) If this does not remedy the problem, the unit will need dismantling.

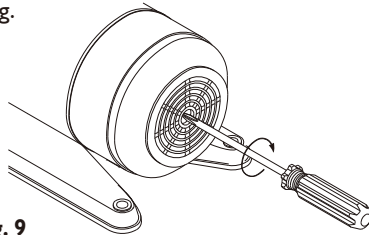


Fig. 9

4. Pressure tank air charge should be checked at regular intervals of every 6 months and after the pump has not been used for a prolonged period. To check the Pressure Tank air pressure, turn off power, open a tap on the discharge line to release pressure from the pump, unscrew the black plastic cover and apply an accurate pressure gauge to the valve as shown in Fig 10.

Pressure should be adjusted to the original pre-charge as follows:

TQ200: 20 psi (1.4 Kg/cm²)

TQ400: 28 psi (2.0 Kg/cm²)

TQ800: 36 psi (2.5 Kg/cm²)

TQ1500 up to TQ3700: 43 psi (3.0 Kg/cm²)

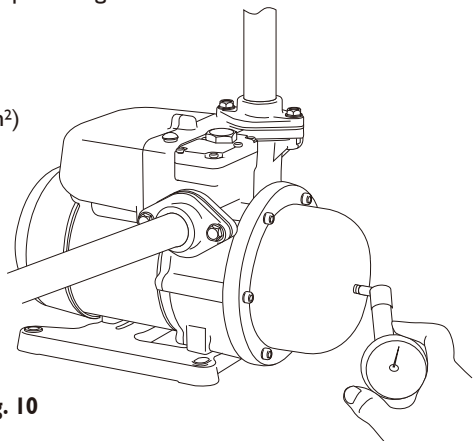


Fig. 10

XI. Flooded Suction Performance Table

TQ200

Inlet pressure (psi)	Flow rate				
	3 gpm	6 gpm	9 gpm	12 gpm	15 gpm
10	37	32	27	22	15
20	47	42	37	32	25
30	57	52	47	42	35

TQ400

Inlet pressure (psi)	Flow rate					
	3 gpm	6 gpm	9 gpm	12 gpm	15 gpm	18 gpm
10	48	42	37	30	23	15
20	58	52	47	40	33	25
30	68	62	57	50	43	35

TQ800

Inlet pressure (psi)	Flow rate						
	3 gpm	6 gpm	9 gpm	12 gpm	15 gpm	18 gpm	21 gpm
10	71	65	60	50	43	35	23
20	81	75	70	60	53	45	35
30	91	85	80	70	63	55	45
40	101	95	90	80	73	65	55

TQ1500

Inlet pressure (psi)	Flow rate					
	10 gpm	20 gpm	30 gpm	40 gpm	50 gpm	60 gpm
10	63	59	55	48	39	27
20	73	69	65	58	49	37
30	83	79	75	68	59	47
40	93	89	85	78	69	57

TQ2200

Inlet pressure (psi)	Flow rate					
	10 gpm	20 gpm	30 gpm	40 gpm	50 gpm	60 gpm
10	66	62	58	53	46	36
20	76	72	68	63	56	46
30	86	82	78	73	66	56
40	96	92	88	83	76	66

TQ3700

Inlet pressure (psi)	Flow rate					
	10 gpm	20 gpm	30 gpm	40 gpm	50 gpm	60 gpm
10	80	75	70	65	59	49
20	90	85	80	75	69	59
30	100	95	90	85	79	69
40	110	105	100	95	89	79

XII. Frequently asked questions:

1. What causes the TQ to start?

The TQ has the built-in pressure switch and internal flow switch. Each of these can turn the pump on depending on water consumption. The pump will start when:

- The pressure is BELOW the pressure switch activation point. OR
- The flow rate is greater than 0.7 GPM.

The preset activation point for each model is provided in the pump specifications.

2. What causes the TQ to stop?

The flow switch is designed to automatically stop the TQ pump when flow drops to below 0.7 GPM. The pump will shut off in a few seconds after flow stops (TQ200-800 is programmed to stop after 8 seconds and TQ1500-3700 is programmed to stop after 15 seconds). In addition, the TQ will be turned off in the event of dry-run or over temperature alarm.

3. What is the purpose of the built-in pressure tank?

The pressure tank comes from the factory pressurized at approximately 20-43 psi (with the pump pressure at zero). It is designed to minimize motor startup due to small flow demand or minor leak of the pipeline.

TQ200 - 20 psi (1.4 Kg/cm²)

TQ400 - 28 psi (2.0 Kg/cm²)

TQ800 - 36 psi (2.5 Kg/cm²)

TQ1500 up to 3700 - 43 psi (3.0 Kg/cm²)

4. How is the dry-run condition determined and the protection provided?

The dry-run is defined when the motor is running AND the flow rate is less than 0.3 GPM AND when pressure is less than the pressure switch setting. The protection is provided:

When the pump is run dry 2 minutes, it will automatically shut off for 10 minutes and then attempts to restart. When all 3 attempts are failed, the pump will rest for 1 hour and then attempts to restart. This protection mode will be repeated until the water supply is back to normal.

In case the pump is cycling (on-and-off repeatedly) due to small flow (less than 0.3GPM), air pocket in the system, air loss in the pressure tank or leak in the pipeline, the protection is provided:

The pump will run for 8 seconds and stop for about 3 seconds. When the cycling mode repeat for 15 times consecutively, the pump will be rest for 1 hour. Then it will start over the protection mode until the problem is corrected.

Note: The pump can be reset anytime by removing the power plug.

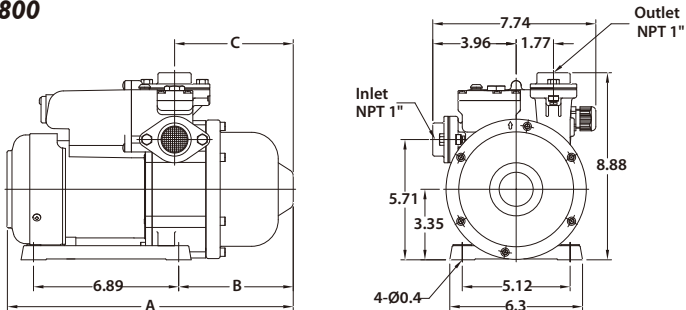
5. What is the maximum inlet pressure allowed in the TQ?

The maximum internal system pressure allowed for TQ is 120 psi. The maximum inlet pressure when added to the TQ pressure must not exceed 120 psi. For example with a 40 psi inlet pressure supplied to the TQ800, internal system pressures can reach approximately 107 psi (67 + 40 psi).

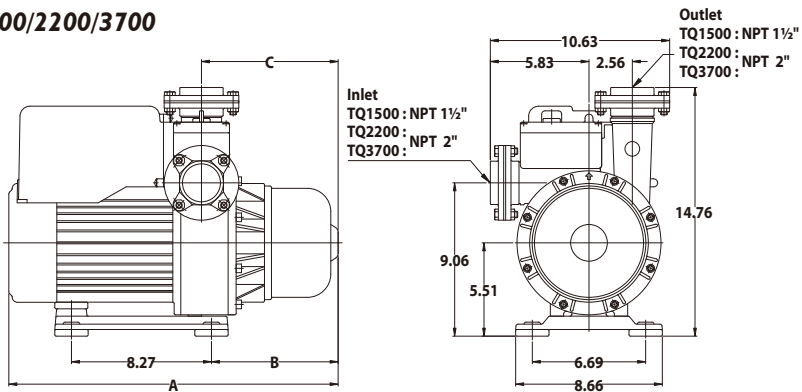
Additionally, if inlet pressures exceed the built-in pressure switch activation point (20-43 psi factory default), the pressure switch will be unable to function, and the ability to turn the TQ on at low flow rates will be lost. In this situation, only the flow switch will be able to turn the TQ on at flow rates above 0.7 gpm.

XIII. Dimensions: (in.)

TQ200/400/800



TQ1500/2200/3700



Model	A (in.)	B (in.)	C (in.)
TQ 200	13.23	5.08	5.28
TQ 400	13.56	5.43	5.63
TQ 800	16.42	6.46	6.65
TQ1500~3700	19.72	7.76	8.35

XIV. Specification: 60Hz

Model	Power (HP)	Phase (Ø)	Voltage (V)	Amp's (A)	Preset activation pressure (psi)	Max discharge pressure (psi)	Q max. (GPM)	N.W. (lbs)
TQ200	¼	I	115 or 230	4.0 or 2.0	20	31	16.9	16.3
TQ400	½	I	115 or 230	6.0 or 3.0	28	40	18.5	19.6
TQ800	I	I	115 or 230	11.0 or 5.5	36	67	23.8	25.6
TQ1500	2	I or 3	230	9.5 or 6.5	43	58	66.0	62.8
TQ2200	3	3	230	9.5	43	60	71.3	68.3
TQ3700	5	3	230	12	43	72	71.3	74.4

XV. Troubleshooting



Before starting work on the pump, make sure that the electricity supply has been switched off and that it cannot be accidentally switched on.

Problem	Cause	Remedy
1. pump does not start	a. No power supply	Connect the electricity supply
	b. Too low/high voltage	Check if supply voltage is within $\pm 10\%$
	c. No water consumption	Open a tap
	d. Seized-up pump	Place a screwdriver against the shaft end of the motor to check if the rotor will spin freely, and contact your pump supplier.
2. Pump cuts out during operation	a. Seized-up pump	Same as above
	b. Overloaded motor	Turn off the power supply and restart or contact your pump supplier.
	c. Poor water supply	Check if pump suction inlet is blocked.
	d. The protection for pump dry run or cycling is activated.	Check the detailed information per XII (Frequently asked questions).
3. Pump starts when no water is consumed	a. Existing pipe is leaking	Fix the leakage.
	b. Defective check valve	Clean or replace a new one.
	c. Pipe suck in air.	Check the suction pipe and water supply.
4. Pump starts and stops too frequently	a. Leakage in suction pipe or air in the water.	Check the suction pipe and water supply.
	b. Discharge flow is too low.	Set your tap on a higher water flow.
5. Electric shock	a. Defective ground connection	Correct the ground connection.
6. Pump does not stop when water is not consumed	a. Poor water supply or air suck in.	1. Turn off the power supply and open the refilling plug to release the air. Then restart. 2. In case of long suction pipes, turn off the power and make sure if water supply is adequate.
	b. Defective check valve.	Clean or replace with a new valve.
7. Pump runs normal but with very low discharge flow	a. 3-phase motor runs in wrong rotating direction	Switch any of the 2 wires from motor terminal to correct rotation.
	b. Poor water supply	check if water supply is adequate and if the suction pipe is blocked.

Limited Warranty

Products manufactured by Walrus Pumps Co (Walrus) are warranted to the first user only to be free of defects in material and workmanship for a period of 12 months from date of installation, but no more than 24 months from date of shipment. Walrus' liability under this warranty shall be limited to repairing or replacing at our election, without charge, FOB Walrus' distribution center or authorized service agent. Walrus will not be liable for any cost of removal, installation, transportation or any other charges that may arise in connection with warranty claim.

The warranty period commences on the date of original purchase of the equipment. Proof of purchase and installation date, failure date, and supporting installation data must be provided when claiming repairs under warranty.

This warranty is subject to due compliance by the original purchaser with all directions and conditions set out in the installation and operating instructions. Failure to comply with these instructions, damage or breakdown caused by fair wear and tear, negligence, misuse, incorrect installation, inappropriate chemicals or additives in the water, inadequate protection against freezing, rain or other adverse weather conditions, corrosive or abrasive water, lightning or high voltage spikes or through unauthorized persons attempting repairs are not covered under warranty.

Walrus will not be liable for any incidental or consequential damages, losses, or expenses, arising from installation, use, or any other causes. There are no express or implied warranties, including merchantability or fitness for a particular purpose, which extend beyond those warranties described or referred to above.

Certain states do not permit the exclusion or limitation of incidental or consequential damages or the placing of limitations on the duration of an implied warranty, therefore, the limitations or exclusions herein may not apply. This warranty sets forth specific legal rights and obligations, however, additional rights may exist, which may vary from state to state.

Supersedes all previous publications



Walrus America Inc

20220 Hempstead Road, Suite #30, Houston, TX 77065

Web: www.walrusamerica.com

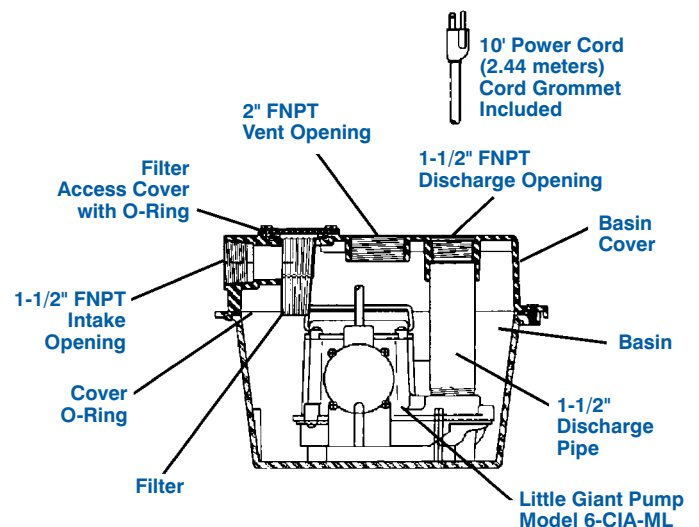
Little GIANT®

WRSC-6



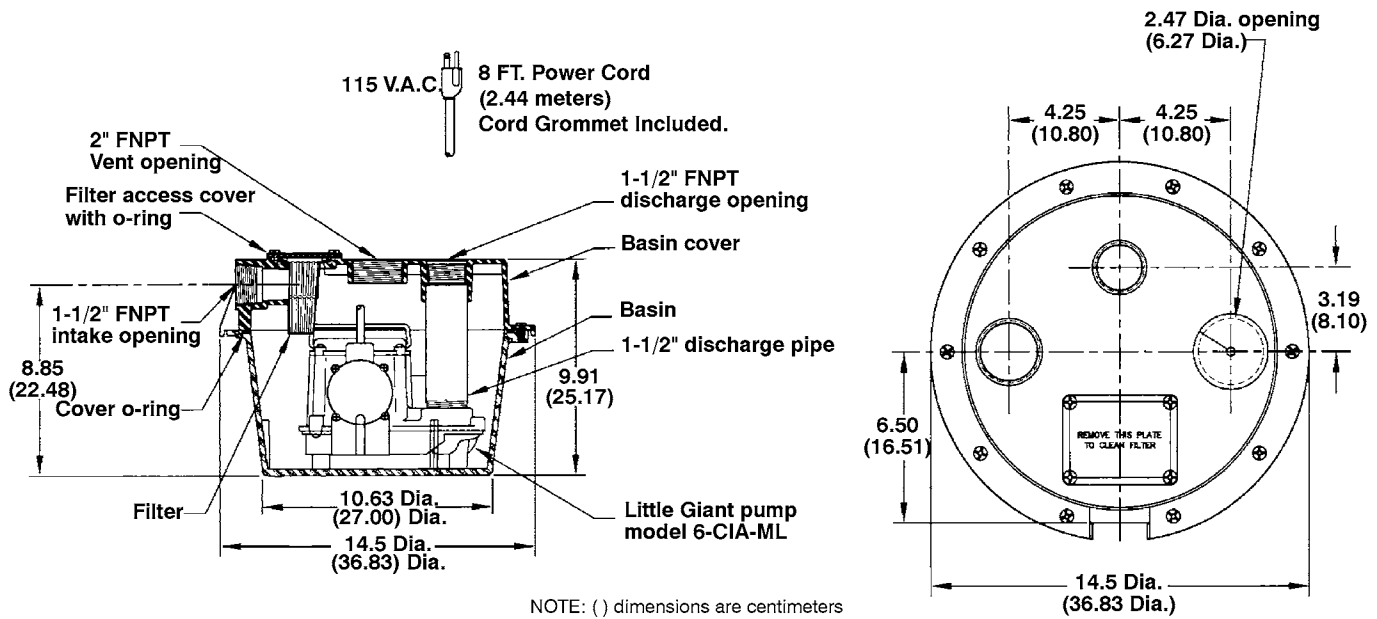
Features

- Pump made of cast iron housing with protective epoxy coating for corrosion resistance
- Screened intake
- 1/3 HP motor with thermal overload protection
- Automatic diaphragm pressure switch enclosed in nylon housing with “on” level at 4”–7” and “off” level at 1”–3”
- Compact design for limited space applications
- Basin made of polypropylene, light weight, and corrosion resistant
- Basin designed with O-rings to provided a water-tight seal
- Basin cover comes with a removable filter screen for easy cleaning
- Cover comes with 1-1/2" FNPT discharge, a 1-1/2" FNPT intake opening, 2" FNPT vent opening and a rubber cord grommet to fit cord exit hole
- IAPMO listed basin
- Pre-assembled ready to be installed



The compact “DRAINOSAUR” removes water from laundry trays, lavatory sinks, wet bar sinks, dehumidifiers, air conditioners (condensate), water softeners, etc. Installs above floor, no need to dig a sump. Unit is pre-assembled and ready-to-install.

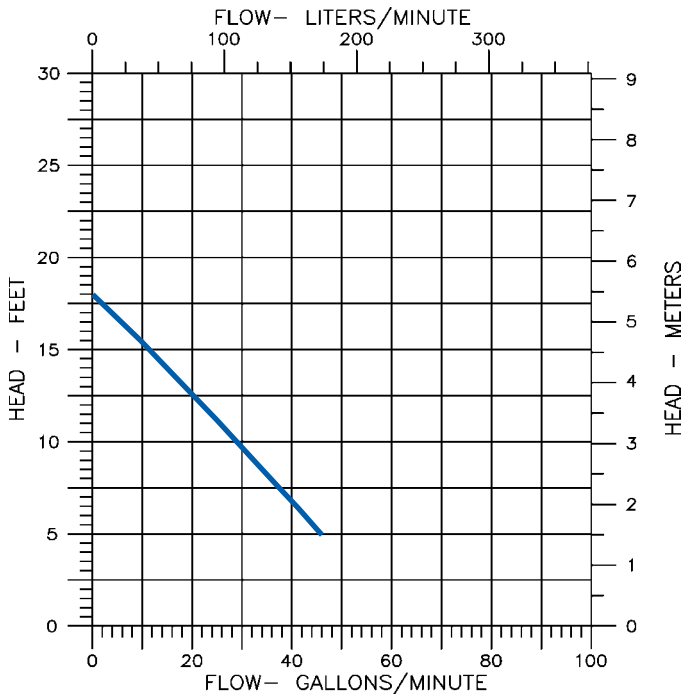
WRSC-6



Specifications

Model No.	Item No.	Discharge	Listing	HP	Volts	Hz.	Running Amps/Watts	Flow (GPM @ Head)			Shutoff Head (ft.)	Weight (lbs.)	Dimensions (H x L x W) (in.)
								5'	10'	15'			
WRSC-6	506065	1-1/2"	UL/CSA/IAPMO	1/3	115	60	9/720	45	29	12	18'	25	14.50 x 9.91
WRSC-6	506066	1-1/2"	UL/CSA/IAPMO	1/3	230	50/60	5/720	45	29	12	18'	25	14.50 x 9.91

UL/CSA listing for pump only



Pump Construction

Motor Housing	Epoxy-coated Cast Iron
Impeller Material	Nylon
Impeller Type	Non-Clog
Volute	Polypropylene
Power Cord	SJTW-A
Mechanical Shaft Seal	Carbon & Ceramic Faces with Nitrile Bellows
Fasteners	Stainless Steel
Shaft	CRS
Bearings	Upper and Lower Sintered Sleeve Bearings

Basin Construction

Basin/Cover	Polypropylene
Basin Fluid Capacity (approx.)	3.5 Gallons
Discharge Size	1-1/2" FNPT
Intake Size	1-1/2" FNPT
Vent Size	2" FNPT



WALRUS®

TQ Series 60Hz Electronic Control Pump

ISO 9001



Applications

The TQ series pumps are designed for water supply and pressure boosting in residential, commercial and light industrial applications where low or inadequate water pressure exists. It is suitable for boosting pressure from underground or surface water supplies.

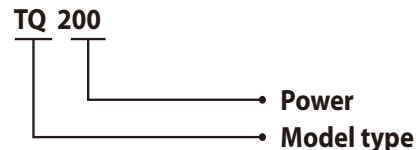
Suitable liquids

Potable water or other clean or non-corrosive liquids.

Operation Conditions:

1. Ambient temperature: Max. +104°F (40°C)
2. Liquid temperature: + 39°F(4°C) ~ +104°F (40°C)
3. System Pressure : Max. 85 PSI
4. Relative humidity: Max. 85% (RH)
5. Under normal operation, it is not necessary to adjust the pressure unless the cut in pressure is higher than preset activation point (refer to specification).

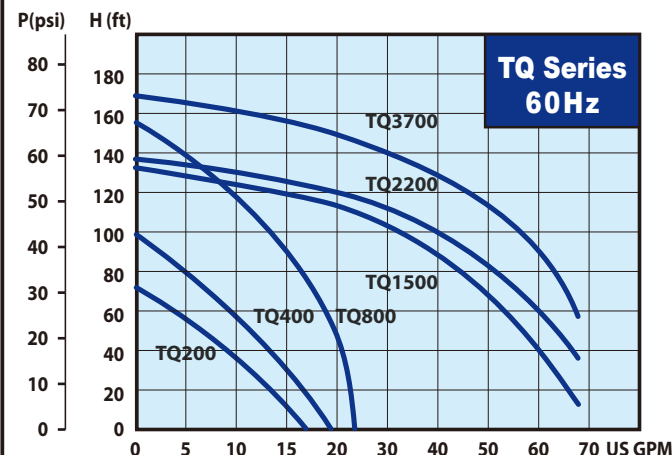
Product code



Product Features

1. The TQ is a complete, all-in-one unit, consisting of pump, motor, pressure tank, and electronic controller. The built-in electronic controller provides constant pressure which ensures that the pump starts automatically when water is consumed and operates continuously until water is not required.
2. Compact design and quiet operation make the TQ series suitable for many applications.
3. The TQ is constructed from the top quality corrosion resistant materials.
4. Pump has built in dry-run shut off with automatic reset function.
5. The motor has built-in thermal overload to protect against high operating temperatures and over current. (Single phase motor only)
6. The TQ has an anti-cycling feature which prevents the pump from continuous starting and stopping when you have a dripping tap or minor leak in the system.
7. The pumps will lift water up to 25 ft. with foot valve and pump suction piping filled with water.

Hydraulic Performance curve:



Walrus America Inc





WALRUS®

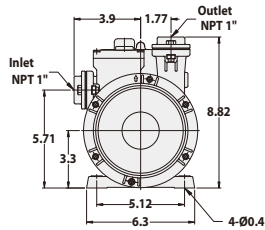
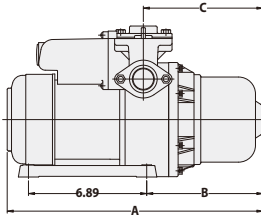
TQ Series Electronic Control Pump

Materials

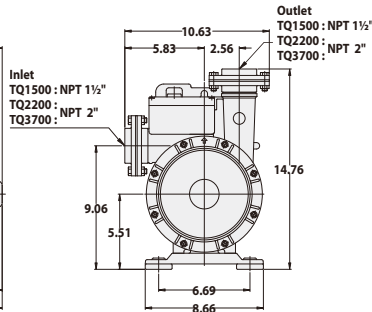
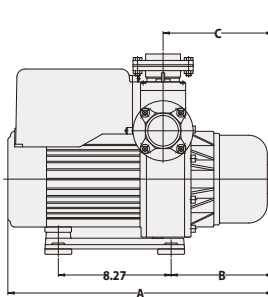
Part name	TQ200/400	TQ800	TQ1500/2200/3700
Pump casing	Glass filled noryl		
Filling plug	NyLon		
Outlet & Inlet	SUS 304		
Intermediate Chamber	Glass filled polycarbonate	SUS 304	
Impeller	Glass filled noryl	SUS 304	
Mechanical Seal	Ceramic+Carbon+NBR	Carbon+SiC+Viton	
Shaft	SUS 410	SUS 304	
Motor Shell	Coating Steel	Aluminum alloy	

Dimensions: (in.)

TQ200/400/800



TQ1500/2200/3700



Model	A (in.)	B (in.)	C (in.)
TQ 200	14.37	6.26	6.46
TQ 400	14.92	6.77	6.97
TQ 800	17.76	7.80	7.99
TQ1500~3700	19.72	7.76	8.35

Suction Lift Performance Table

Model	Discharge pressure in psi	Capacity in US gallons per Minute					
		Suction Lift in Feet					
		0	5	10	15	20	25
TQ200	10	12.6	11.4	10.2	9.2	8.2	7.1
	20	7.7	6.4	5.2	3.8	2.4	0.5
TQ400	10	16.6	15.6	14.6	13.6	12.7	11.7
	20	12.0	11.0	10.0	9.0	7.8	6.6
	30	7.1	5.8	4.5	3.2	2.0	0.6
TQ800	10	22.4	22.1	21.7	21.3	20.8	20.5
	20	20.7	20.2	19.8	19.2	18.8	18.2
	30	18.3	17.8	17.1	16.2	15.3	14.2
	40	14.7	13.8	12.9	12.1	11.1	10.2
	50	10.5	9.3	8.1	6.9	5.6	4.3
TQ1500	10	66.2	65.0	63.7	62.0	60.2	58.1
	20	58.2	57.0	55.3	53.7	51.7	49.0
	30	50.0	47.3	44.3	41.8	39.7	37.2
	40	38.2	35.7	32.5	29.0	24.8	20.0
TQ2200	10	69.0	69.0	68.7	67.8	66.7	65.3
	20	65.8	64.4	62.8	61.2	59.3	57.2
	30	58.0	55.9	53.3	50.5	47.2	43.5
	40	45.0	41.2	37.6	34.1	30.0	24.6
TQ3700	10	70.9	70.4	70.0	69.5	69.2	68.7
	20	68.9	68.5	68.2	67.9	67.3	66.2
	30	66.7	65.5	64.2	62.8	61.3	59.8
	40	60.4	58.5	56.5	54.3	51.9	48.8
	50	50.0	46.6	42.8	39.0	35.8	32.6
60	34.0	30.4	25.8	20.0	12.7	5.7	

Note - The total system pressure will be :
"the inlet supply pressure + max pump boost pressure."

Specification:

Model	Power (HP)	Cycle (Hz)	Phase (Ø)	Voltage (V)	Amp's (A)	Inlet (NPT)	Outlet (NPT)	Preset activation pressure (psi)	Max discharge pressure (psi)	Q max. (GPM)	N.W. (lbs)
TQ200	¼	60	1	115 or 230	4.0 or 2.0	1"	1"	17	31	16.9	16.3
TQ400	½	60	1	115 or 230	6.0 or 3.0	1"	1"	26	40	18.5	19.6
TQ800	1	60	1	115 or 230	11.0 or 5.5	1"	1"	36	67	23.8	25.6
TQ1500	2	60	1 or 3	230	9.5 or 6.5	1½"	1½"	43	58	66.0	62.8
TQ2200	3	60	3	230	9.5	2"	2"	43	60	71.3	68.3
TQ3700	5	60	3	230	12	2"	2"	43	72	71.3	74.4

Walrus America Inc

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 Phone: 281-955-8035 Fax: 281-955-8037
 Web: www.walrusamerica.com

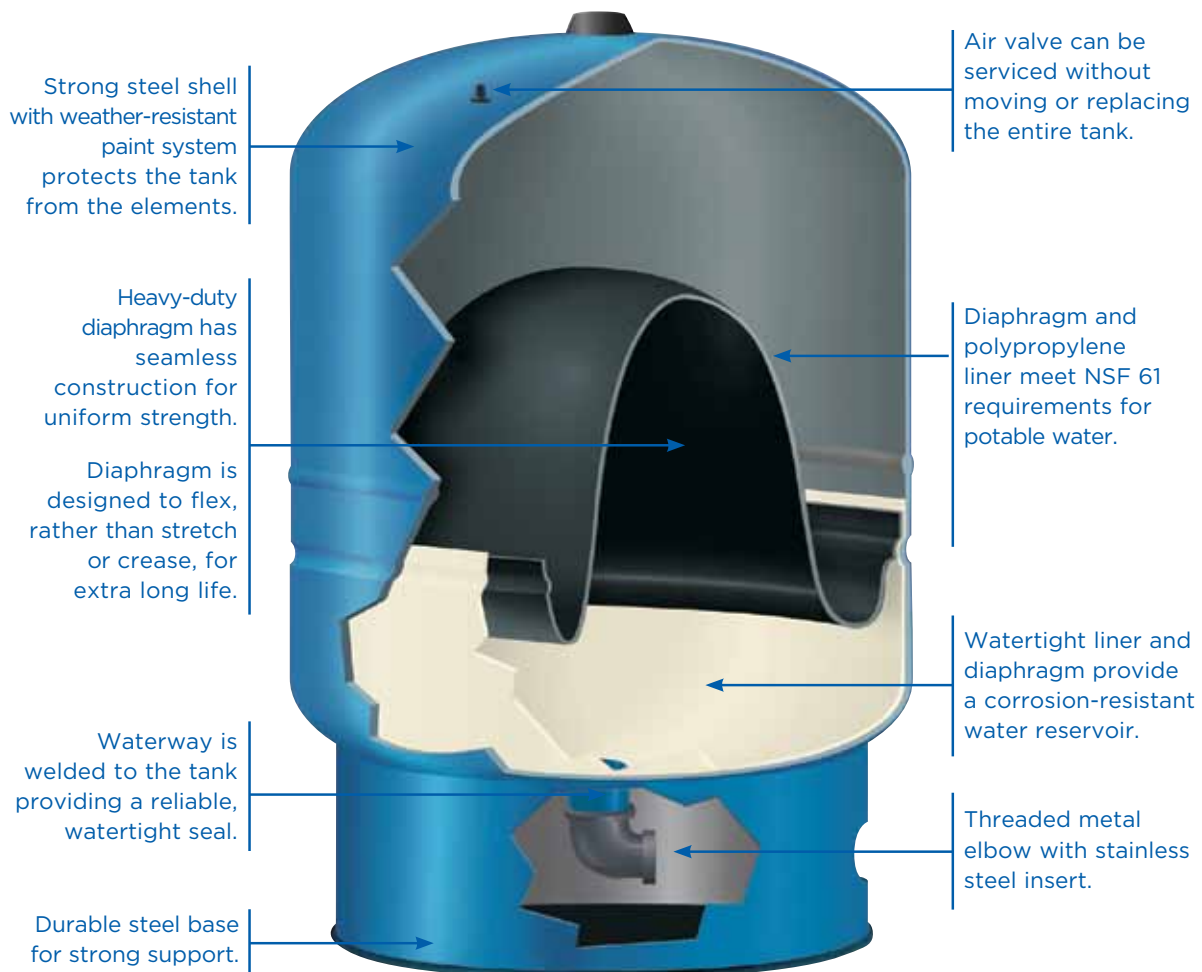
All specifications are subject to change without notice. 006

Well Tanks and Expansion Tanks



Water Worker well tanks are specifically engineered to provide a buffer of clean, fresh, pressurized water that reduces pump cycling, saves energy and improves system performance. Made in the USA, Water Worker well tanks feature colorful, informative packaging, are easy to install and are designed to provide years of trouble free service.

- ◆ Complete line-up offers direct-fit replacement for most installed systems.
- ◆ Meets NSF® Standard 61 requirements for clean, safe drinking water.
- ◆ Maximum working pressure: 100 psi.
- ◆ Maximum operating temperature: 200°F.
- ◆ Factory pre-charge: 38 psi.
- ◆ Made in the USA.
- ◆ 5-year warranty.



Well Tanks



In-Line Precharged Well Tank								
Model	Tank Volume (Gallons)	Plain Steel Equivalent (Gallons)	UPC (642031)	Ship Weight (lbs.)	Package Dimensions (Inches)			Sys. Conn. NPTF* (Inches)
					Length	Width	Height	
HT-2B	2.0	N/A	613073	5	8	8	13	3/4
HT-4B	4.4	N/A	613080	9	11	11	16	3/4
HT-8B	7.6	30	613103	15	11	11	23	3/4

*Threaded Metal Connection with Stainless Steel Insert.



Vertical Precharged Well Tank								
Model	Tank Volume (Gallons)	Plain Steel Equivalent (Gallons)	UPC (642031)	Ship Weight (lbs.)	Package Dimensions (Inches)			Sys. Conn. NPTF* (Inches)
					Length	Width	Height	
HT-14B	14	30	613110	25	16	16	26	1
HT-20B	20	42	613134	33	16	16	33	1
HT-30B	26	42	613141	36	16	16	40	1
HT-32B	32	82	613158	43	16	16	47	1
HT-44B	44	120	613165	69	23	23	37	1-1/4
HT-62B	62	120	613172	92	23	23	48	1-1/4
HT-86B	86	220	613189	123	27	27	49	1-1/4
HT-119B	119	315	613196	166	27	27	63	1-1/4

*Threaded Metal Elbow with Stainless Steel Insert.

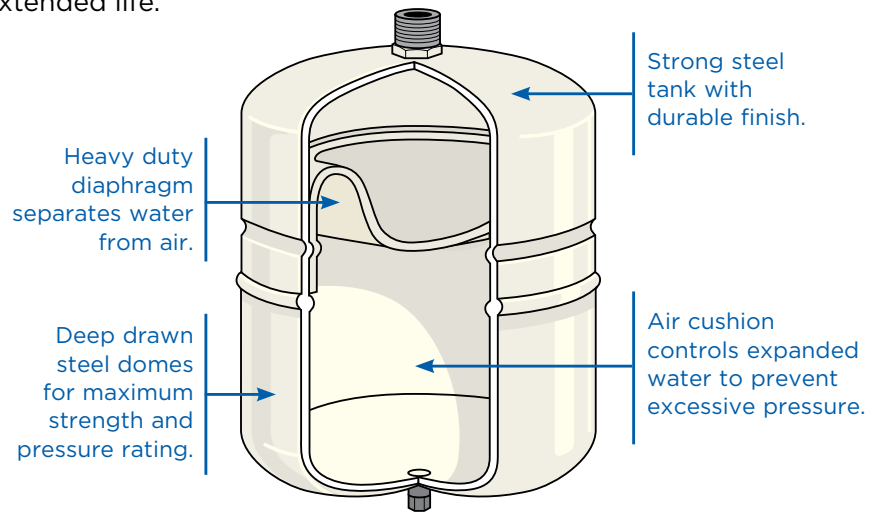


Horizontal Precharged Well Tank								
Model	Tank Volume (Gallons)	Plain Steel Equivalent (Gallons)	UPC (642031)	Ship Weight (lbs.)	Package Dimensions (Inches)			Sys. Conn. NPTF* (Inches)
					Length	Width	Height	
HT-6HB	5	12	613097	15	19	11	12	3/4
HT-14HB	14	30	613127	29	23	16	17	1
HT-20HB	20	42	650443	35	31	15	17	1

*Threaded Metal Connection with Stainless Steel Insert.

Water Worker expansion tanks are specifically designed for each application. All feature deep drawn steel dome construction and a heavy duty diaphragm for extra-long life. Colorful and informative packaging helps differentiate each model to ensure proper product selection.

- ◆ Deep drawn steel domes for maximum strength.
- ◆ Heavy duty diaphragm for extended life.
- ◆ Made in the USA.
- ◆ 5-year warranty.

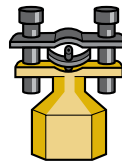


Water Heater Expansion Tanks

Water Worker Water Heater Expansion Tanks safely control pressure buildup and fluctuations during water heater operation. Absorbing this expanded water eliminates the hazards of relief valve discharge, water hammer and fixture damage while saving water and energy. Plumbing codes and all major water heater brands now require installation of an expansion tank in any closed piping system.

- ◆ Polypropylene liner provides a corrosion resistant reservoir.
- ◆ Maximum working pressure: 150 psi.
- ◆ Maximum operating temperature: 200° F.
- ◆ Factory pre-charge: 40 psi.

Saddle Valve for Easy Installation



- ◆ Solid bronze for copper tubing.
- ◆ Fits 3/4" NPT connection.
- ◆ Available on G-5 and G-12 models.



Water Heater Expansion Tank							
Model	Tank Volume (Gallons)	UPC (000815)	Ship Weight (lbs.)	Package Dimensions (Inches)			Sys. Conn. NPTF* (Inches)
				Length	Width	Height	
G-5 with saddle valve	2.0	900083	8	8	8	13	3/4
G-5L	2.0	900137	5	8	8	13	3/4
G-12 with saddle valve	4.4	900090	12	11	11	16	3/4
G-12L	4.4	900144	9	11	11	16	3/4

*Stainless Steel System Connection.

Expansion Tanks

Boiler System Expansion Tanks

Water Worker® Boiler Expansion Tanks are compatible with closed-loop hydronic heating systems using baseboards or radiators. A heavy duty diaphragm flexes against an air cushion to maintain a safe operating pressure. This eliminates relief valve discharge and creates a quiet, longer lasting system.

- ◆ Maximum working pressure: 100 psi.
- ◆ Maximum operating temperature: 240° F.
- ◆ Factory pre-charge: 12 psi.



Boiler System Expansion Tank							
Model	Tank Volume (Gallons)	UPC (642031)	Ship Weight (lbs.)	Package Dimensions (Inches)			Sys. Conn. NPTF* (Inches)
				Length	Width	Height	
HTEX-15	2.0	654595	8	8	8	13	1/2
HTEX-30	4.4	654601	9	11	11	16	1/2

*Carbon Steel System Connection.

Radiant Expansion Tanks

Water Worker Radiant Expansion Tanks are designed for modern, high efficiency in-floor heating systems. The corrosion resistant stainless steel connection and plastic oxygen barrier are compatible with antifreeze fluids and all tubing types to promote dependable, efficient system operation.

- ◆ Plastic liner is compatible with barrier and non-barrier tubing.
- ◆ Maximum working pressure: 100 psi.
- ◆ Maximum operating temperature: 200° F.
- ◆ Factory pre-charge: 12 psi.



Radiant Expansion Tank							
Model	Tank Volume (Gallons)	UPC (642031)	Ship Weight (lbs.)	Package Dimensions (Inches)			Sys. Conn. NPTF* (Inches)
				Length	Width	Height	
RE2R	2.0	631404	5	8	8	13	1/2
RE5R	4.4	631428	9	11	11	16	1/2

*Stainless Steel System Connection

Expansion Tank Sizing

Water Heater			Boiler System			Radiant		
Water Heater Size	Minimum Tank Volume	Model	Boiler BTU Rating	Minimum Tank Volume	Model	Boiler BTU Rating	Minimum Tank Volume	Model
Up to 50 gallon	2.0	G-5	25,000 to 75,000	2.0	RE2R	25,000 to 75,000	2.0	HTEX-15
Up to 80 gallon	4.4	G-12	Up to 150,000	4.4	RE5R	Up to 150,000	4.4	HTEX-30

Digital Pump Control

The Water Worker Digital Pump Control replaces any traditional pressure switch for an instant well system upgrade by combining a digital pressure switch, pump protector and pressure gauge. Simple push button adjustments allow increased pressure and steady, city-like water delivery. Active system monitoring protects against rapid cycling, dry running and improper voltage.

- ◆ Fits new or existing systems.
- ◆ Spins onto most tank tees; no unions or special fittings required.
- ◆ Compatible with 115 and 230VAC pumps up to 2 hp.
- ◆ Familiar 4-wire configuration won't damage control by incorrect wiring.
- ◆ UL listed NEMA 3R enclosure helps prevent moisture and bug infiltration.
- ◆ Adjustable from 10 to 80 psi with a 10 to 55 psi differential.
- ◆ Made in the USA.
- ◆ 2-year warranty.



Digital Pump Control					
Model	UPC (642031)	Ship Weight (lbs.)	Package Dimensions (Inches)		
			Length	Width	Height
WWDPK	656322	2	8	4	4

Universal Deck Kit

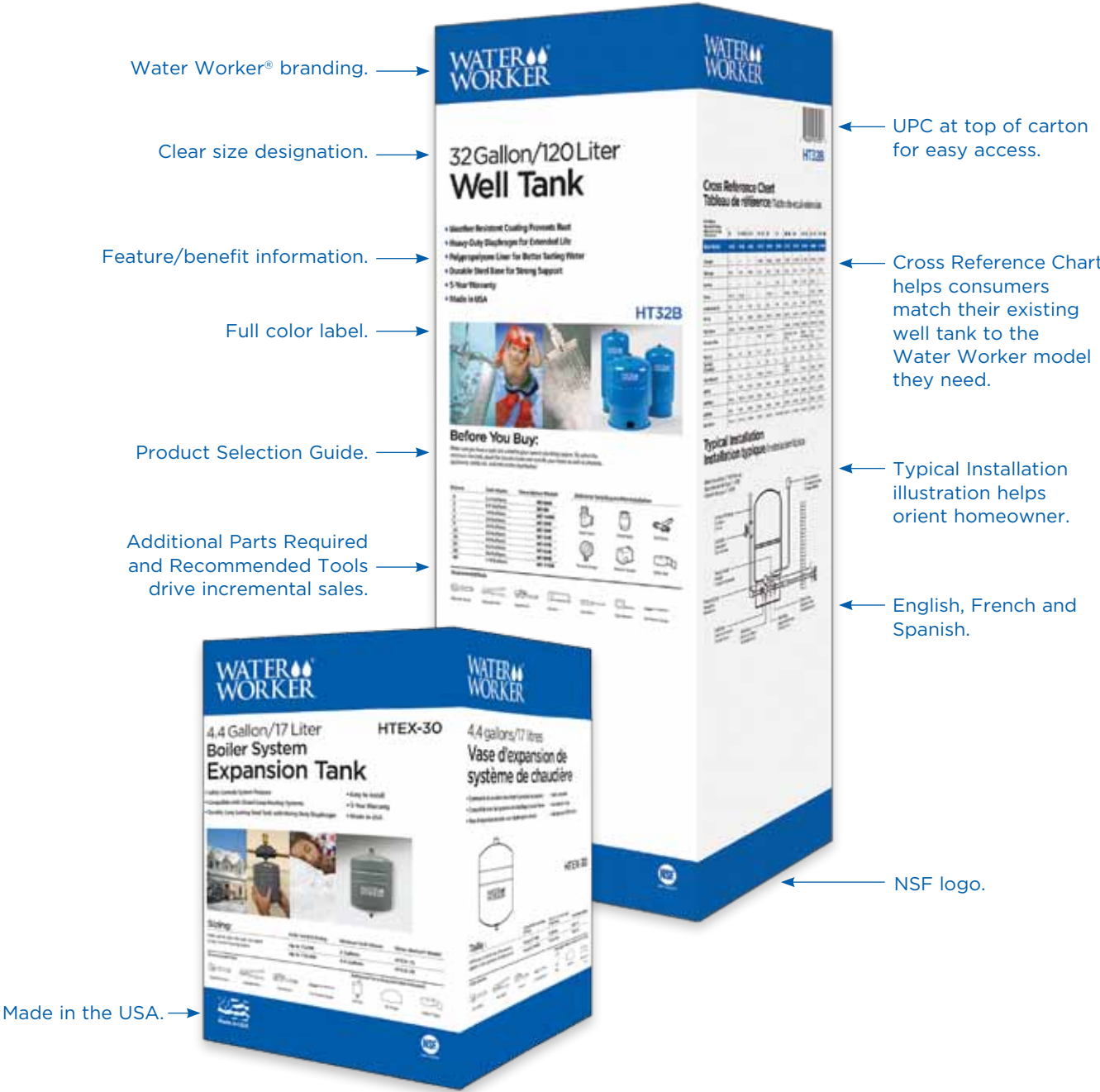
- ◆ Tough, powder coated stand fits Water Worker vertical well tanks.
- ◆ Laser-cut mounting slots accommodate most jet pumps.
- ◆ Mounting hardware included.



Universal Deck Kit					
Model	UPC (049708)	Ship Weight (lbs.)	Package Dimensions (Inches)		
			Length	Width	Height
UNVDKT	018405	6	10	8	3

Self-Selling Package Design

Consumer oriented package design provides information in a clear, attractive and easy to understand format for a powerful in-store presentation. Store Associates are able to self-educate and be more effective when helping guests find what they need.



Informative Take Home Brochures

- ◆ Provide well tank and water heater expansion tank information including why they are needed.
- ◆ Cutaway illustrations highlight product features and consumer benefits.
- ◆ Well Tank Brochure (MC# 7230) has typical tank installation diagrams, drawdown chart, tank sizing information and product cross reference.
- ◆ Water Heater Expansion Tank Brochure (MC# 7220) illustrates how an expansion tank improves system performance.



Powerful Website

- ◆ Provides complete product information including installation manuals, warranty details and FAQ's.
- ◆ How-to videos help homeowners troubleshoot common problems.
- ◆ Find-a-store provides links to customer websites to drive traffic.

