LAKE HOPATCONG HABS GRANT - ADDENDUM

MORRIS AND SUSSEX COUNTIES, NEW JERSEY

MARCH 2023

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1.0 INTRODUCTION

This report is an addendum to the Lake Hopatcong HABs Grant Final Report that was submitted in July 2022. This addendum summarizes the two remaining projects that were funded through the New Jersey Department of Environmental Protection (NJDEP) HABs Grant that was issued in 2020. These two remaining projects include Floating Wetland Islands (FWIs) in Ashley Cove and two near-shore Nanobubble Aeration Systems. All other projects funded through this grant were completed prior to the 2022 growing season and were summarized in the Lake Hopatcong HABs Grant Final Report.

The FWIs in Ashley Cove were initially scheduled to be installed in the spring of 2022; however, due to time sensitive availability of the required wetland plants, the FWIs were not installed until 9 June 2022. In total, four new islands (7.5 ' X 10') totaling 300 sq. ft were installed and one of the existing FWIs in Ashley Cove was replanted. Originally, two of the existing FWIs were intended to be replanted and one new island was to be installed. However, one of the existing FWIs was in poor shape and beyond the point of repair and had become the home to a pair of swans. Thus, it was decided to leave one of the existing islands alone and instead install an extra new island.

Three different near-shore aeration systems with the goal of minimizing or avoiding the development of HABs in beach areas were installed in the fall of 2020 and the spring of 2021. The Air Curtain was installed without any issues and monitored over the course of the 2021 season; results and analysis are provided in the Lake Hopatcong HABs Grant Final Report. However, both Nanobubble Aeration Systems had logistical and infrastructure issues in 2021 and could not be properly monitored during that season. These issues were resolved prior to the 2022 season and were monitored five times over the course of that season. The results and analysis from this monitoring is provided in this addendum.

2.0 FLOATING WETLAND ISLANDS IN ASHLEY COVE

PROJECT SUMMARY

All FWI activities in Ashley Cove were conducted on 9 June 2022. An existing FWI was re-planted and provided with upgraded anchoring and tethering material and then relocated to an area where it will receive full sunlight. Additionally, four new islands (7.5' X 10') totaling 300 sq. ft were installed and planted in a nearshore area that receives full sunlight. An inspection of the existing FWIs over the 2021 growing season revealed that one of them is being used as a nesting site for a family of swans. Thus, it was decided to refurbish the Island that is not being used by the swans and purchase an extra set of new FWIs in replacement of the existing FWI that was in poor condition. The four new islands that were installed were tethered together in pairs, essentially creating two 150 sq. ft islands.

FWIs are primarily used to control nutrient loading in lakes using biological nutrient uptake, a type of bioremediation. These systems provide a natural method to assist in nutrient removal relative to some other techniques, such as chemical nutrient inactivants. FWIs are polymer mats that are anchored to the lakebed. The mats are planted with a variety of native wetland vegetation with the plants rooted in peat or other soil matrix and eventually growing down into the water column where they take up nutrients to support vegetative growth. In addition to the plants, the matrix of these islands is colonized by a variety of naturally-occurring beneficial microbes including bacteria and periphyton in biofilms that also remove nutrients from the water including both nitrogen and phosphorus. The islands are deployed into open waters and have water quality, aesthetic, fishery and wildlife benefits. Specifically, these benefits include:

- Being a net sink (absorption) of nutrients and other pollutants that would otherwise be available for nuisance algae and aquatic plants. The microbial community underneath the island, coupled with the accumulation of terrestrial / wetland plants on the island itself, removes nutrients and other pollutants from the water column.
- Provides structure and habitat for a variety of aquatic organisms including young fish. In turn, larger gamefish will be attracted to the structures.
- Provides potential shoreline stabilization when placed along near shore areas.
- Being an aesthetic amenity for the lake. Attractive annual and perennial vegetation can be planted on the island to function as a scenic "lake-scape."

PLANT LIST

Table 2.1 below provides a list of all species that were planted on the FWIs in Ashley Cove, including the four new islands and the one old island that was replanted. An approximate quantity of each plant species is also included.

Table 2.1: List of floating wetland island plant species in Ashley Cove

Ashley Cove: Floating Wetland Island Plant List		
Botanical Name	**Species Name**	**Quantity**
Asclepias incarnata	Swamp Milkweed	200
Eupatorium perfoliatum	Boneset	400
Iris versicolor	Blueflag Iris	200
Lobelia Siphilitica	Blue Lobelia	100
Schoenoplectus cyperinus	Woolgrass	200

MAINTENANCE

Maintenance for FWIs that are anchored firmly in place is very simple, especially after the first year. The following is a list of simple maintenance measures that should be followed while the FWIs are deployed:

- During the first few weeks following installation, ensure that the plants receive enough water. If the forecast does not include rain, this could involve splashing the plants with water using a paddle or something similar. The plants will begin to extend their roots through the mat and will eventually be suspended in the water column beneath, allowing for water absorption.
- During the first two years following the installation, periodically check the health of the plants to ensure that they're receiving enough water and continually growing.
- During the first two years following installation while the young plants are still growing, ensure that the protective goose netting remains in place.
- Periodically visually check the FWIs while they remain in the water to ensure that no geese or other animals are eating the plants or nesting on the islands.
- Periodically visually check that the FWIs remain in place where they were installed and that the anchors have not been dislodged.

PICTURES

Photo 2.1: Preparing the new FWIs with a soil and peat moss mixture

Photo 2.2: New FWIs planted and ready for installation

Photo 2.3: Replanting the existing FWI

Photo 2.4: Tethering and anchoring FWIs

Photo 2.5: FWIs deployed in Ashley Cove

3.0 INSTALLATION AND EVALUATION OF NANNOBUBBLE AERATION

PROJECT SUMMARY

Two varying forms of near-shore aeration for HAB prevention, mitigation, and control were installed along two specific beach areas in Lake Hopatcong. The first is the installation of a Nanobubble Oxygen system along the Mount Arlington Municipal Beach (511 Windemere Ave, Borough of Mt. Arlington). The second is the installation of a Nanobubble Ozone system along the Lake Forest Yacht Club (35 Yacht Club Drive, Lake Hopatcong: Township of Jefferson). Nanobubble technology is a fairly new form of aeration that has started to yield very positive results relative to HAB control and prevention. Thus, this new aeration technology was evaluated at Lake Hopatcong. An Air Curtain was also installed as part of this objective, however that system was monitored over the course of the 2021 season and the results and analysis were provided in the Lake Hopatcong HABs Grant Final Report.

SCHEDULE OF EVENTS

The Air Curtain was installed at the Shore Hills Country Club (Roxbury) on 4-6 November 2020 (Picture 5.1). An evaluation of the Air Curtain and how it can prevent, mitigate and/or control HABs was conducted over three (3) monitoring events on 19 May, 29 June, and 27 July 2021.

The Nanobubble Ozone system at the Lake Forest Yacht Club (Jefferson) was also installed in the fall of 2020 while the Nanobubble Oxygen System at the Memorial Municipal Beach (Mt. Arlington) was installed in the spring of 2021. However, there were logistical and infrastructure issues with both Nanobubble systems which prevented proper monitoring of these sites over the course of the 2021 season. Thus, both of these systems were monitored five times over the course of the 2022 season and results are provided below.

SAMPLING METHODOLOGY

During each monitoring event, samples were collected from an area within the zone of aeration influence, or the "treatment zone," and outside of the area affected by Nanobubble systems, or the "control zone." Samples were collected and analyzed for cyanobacteria cell counts, phycocyanin, and water clarity. *In-situ* data was also be collected for temperature, DO, pH, and conductivity. Please note that samples at Lake Forest Yacht Club were not collected directly within the swimming area due to limitations with the size of the boat.

RESULTS

Tables with full *in-situ* data and plankton results are provided in Appendix I.

NANOBUBBLE AERATION SYSTEM

The following analysis will assess the effectiveness of the Nanobubble Oxygen system located at the Mt. Arlington Municipal Beach.

WATER CLARITY

Water clarity was measured with a Secchi disk at a station within the treatment zone and outside of the area affected by the Nanobubble Oxygen system, or the control zone, five times during the 2022 season (Figure 3.1). There was no boat access within the treatment zone due to the shallow depth and the presence of swimmers. However, the control zone was in slightly deeper water. Thus, water clarity was to the bottom of the shallow

treatment zone station during all five sampling events. Water clarity was often reported to be higher in the control zone because the station was over 1.0 m deep. To avoid misrepresentation of water clarity between the two stations, the reported Secchi depths at the control station on Figure 3.1 are the same depth as the measured Secchi depth at the treatment zone unless the control zone had a lower Secchi depth. There is no way to assume the actual water clarity in the shallow treatment zone because the Secchi depth was to the bottom during each event. Thus, water clarity was similar between both stations throughout the 2022 season.

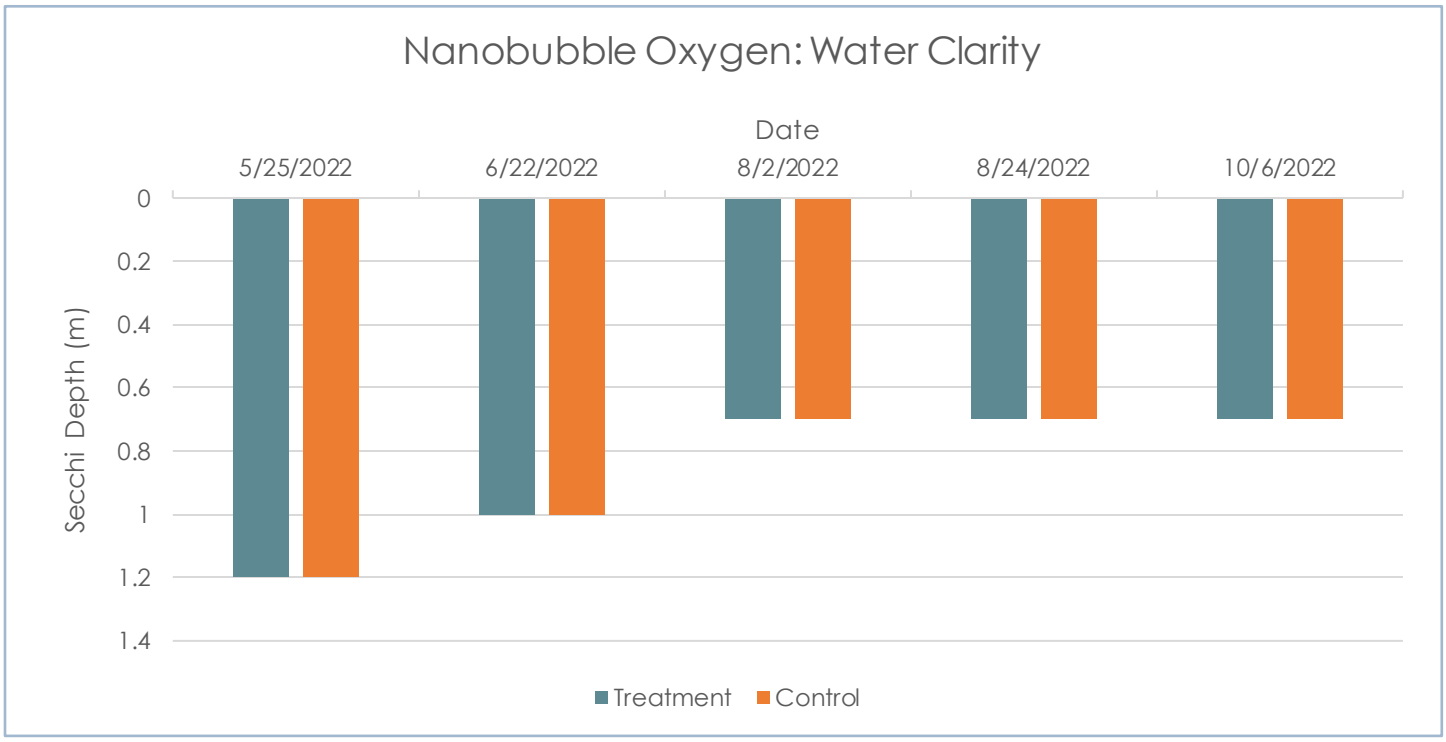

Figure 3.1: Secchi depth in the Nanobubble Oxygen treatment and control zones

CYANOBACTERIA CELL COUNTS

Surface samples for the analysis of cyanobacteria cell counts were collected at a station within the treatment zone and outside of the area affected by the Nanobubble Oxygen system, or the control zone, five times during the 2022 season (Figure 3.2). Cyanobacteria cell counts were lower in the treatment zone during all five sampling events in 2022. The difference in cell counts between the two stations ranged between a low of 9% on 22 June, in which the treatment zone had a cell count of 18,710 cells/mL and the control zone had a cell count of 20,484 cells/mL, up to a high of 69% on 25 May, in which the treatment zone had a cell count of 13,125 cells/mL and the control zone had a cell count of 42,905 cells/mL. Cell counts at both stations were extremely elevated on 24 August, with respective cyanobacteria cell counts of 234,444 cells/mL and 260,641 cells/mL at the treatment and control zones. Please note that due to visual observations that were not indicative of a bloom and the relatively low phycocyanin concentration in the treatment zone on 24 August, that plankton sample was not analyzed until early October. Thus, the beach was not informed of the elevated cyanobacteria count during the swimming season.

Cyanobacteria cell counts were elevated throughout a large area of the lake from early August through early October due to an intense cyanobacteria bloom that originated in the Crescent Cove / River Styx area of the lake. The control zone had cell counts that triggered the NJDEP Watch HAB Alert Tier three times in 2022. During all three of these events, cell counts remained below the 20,000 cells/mL Watch threshold within the treatment

zone. Additionally, the cyanobacteria cell count of 88,495 cells/mL in the control zone on 2 August triggered the NJDEP Advisory HAB Alert Tier. However, cell counts remained within the Watch HAB Alert Tier within the treatment zone during this event. Thus, cyanobacteria cell counts were significantly lower in the treatment zone affected by the Nanobubble Oxygen system relative to the control zone throughout the 2022 season.

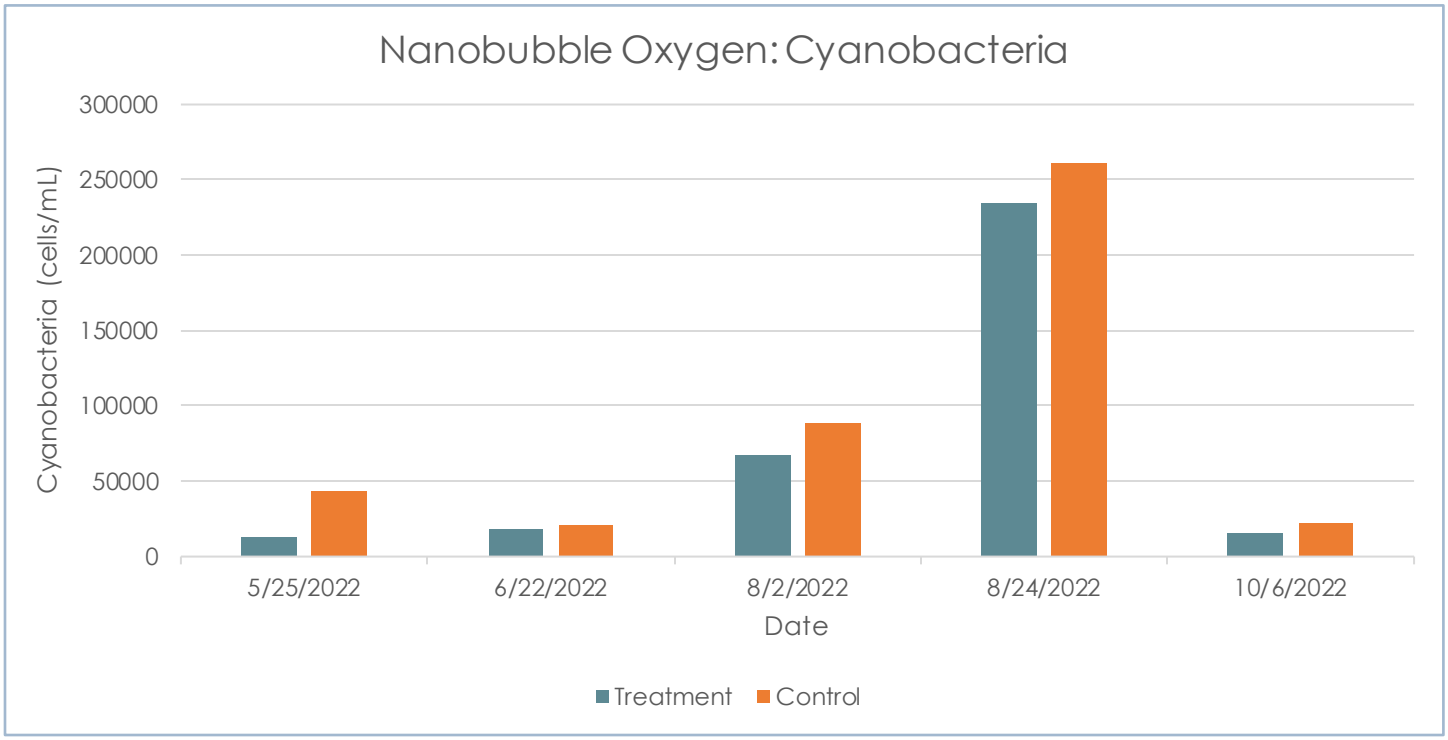

Figure 3.2: Secchi depth in the Nanobubble Oxygen treatment and control zones

PHYCOCYANIN

Phycocyanin was measured at a station within the treatment zone and outside of the area affected by the Nanobubble Oxygen system, or the control zone, five times during the 2022 season (Figure 3.3). Similar to the cyanobacteria results, phycocyanin values were consistently lower within the treatment zone throughout the season. The difference in phycocyanin values between the two stations ranged between a low of 0% on 6 October, in which both stations had phycocyanin values of 6 µg/L, up to a high of 33% on 22 June, in which the treatment zone had a phycocyanin value of 14 µg/L and the control zone had a phycocyanin value of 21 µg/L. Thus, it appears that the Nanobubble Oxygen system had a positive effect on phycocyanin concentrations in the Mt. Arlington Municipal Beach swim area throughout the season.

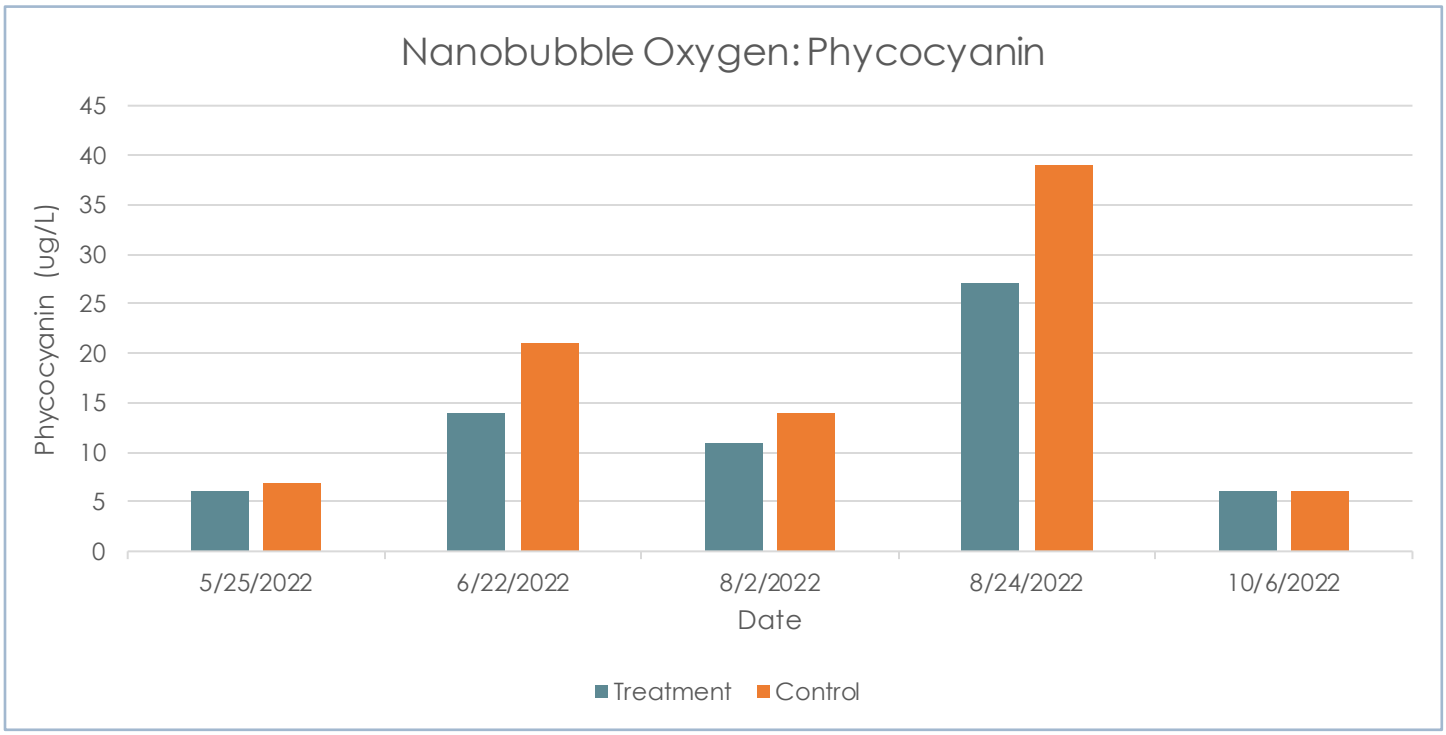

Figure 3.3: Phycocyanin values in the Nanobubble Oxygen treatment and control zones

NANOBUBBLE OZONE SYSTEM

The following analysis will assess the effectiveness of the Nanobubble Ozone system located at the Lake Forest Yacht Club.

WATER CLARITY

Water clarity was measured with a Secchi disk at a station within the treatment zone and outside of the area affected by the Nanobubble Ozone system, or the control zone, five times during the 2022 season (Figure 3.4). There was no boat access within the treatment zone due to the shallow depth and the presence of swimmers. However, the control zone was in slightly deeper water. Thus, water clarity was to the bottom of the shallow treatment zone station during all five sampling events. Water clarity was often reported to be higher in the control zone because the station was over 1.0 m deep and the Secchi depth was only to the bottom of the station in May. To avoid misrepresentation of water clarity between the two stations, the reported Secchi depths at the control station on Figure 3.4 are the same depth as the measured Secchi depth at the treatment zone unless the control zone had a lower Secchi depth. There is no way to assume the actual water clarity in the shallow treatment zone because the Secchi depth was to the bottom during each event. Thus, water clarity was similar between both stations throughout the 2022 season. There was one instance on 22 June when water clarity was slightly higher at the treatment zone; 1.0+ m at the treatment station and 0.9 m at the control station.

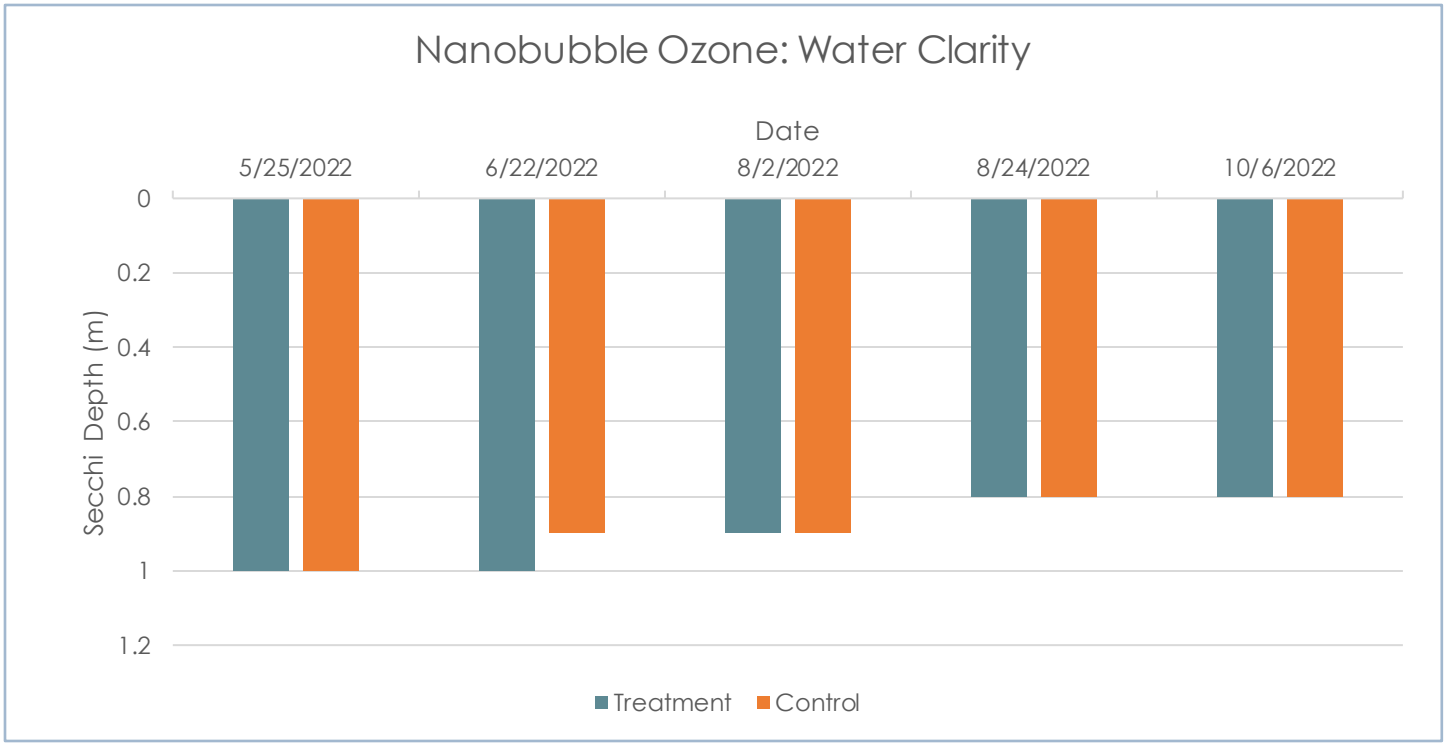

Figure 3.4: Secchi depth in the Nanobubble Ozone treatment and control zones

CYANOBACTERIA CELL COUNTS

Surface samples for the analysis of cyanobacteria cell counts were collected at a station within the treatment zone and outside of the area affected by the Nanobubble Ozone system, or the control zone, five times during the 2022 season (Figure 3.5). It should be noted that cyanobacteria cell counts were elevated throughout a large area of the lake from early August through early October due to an intense cyanobacteria bloom that originated in the Crescent Cove / River Styx area of the lake. Cyanobacteria cell counts were variable between the two stations in May and June but remained low; cell counts never exceeded 21,011 cells/mL. The treatment zone had a cyanobacteria cell count 83% lower than the control zone on 25 May but had a cell count that was 107% higher in June.

Cyanobacteria cell counts were elevated at both stations on 2 August and 24 August as the lake was experiencing a bloom. However, although still elevated, cell counts were lower in the treatment zone during both of these events. Cyanobacteria cell counts were 15% lower in the treatment zone on 2 August and 7% lower on 24 August. The 2 August sample was dominated by the genera *Pseudanabaena* which has very small cells and forms fine filaments and does not account for a lot of biomass. Thus, visual conditions were not indicative of a bloom on 2 August and phycocyanin concentrations were also relatively low. The sample was also not collected from directly within the swimming zone due to limitations with the boat. Please note that due to visual observations that were not indicative of a bloom and the relatively low phycocyanin concentration in the treatment zone on 24 August, that plankton sample was not analyzed until early October. Thus, the club was not informed of the elevated cyanobacteria count during the swimming season.

Cyanobacteria cell counts were still elevated in October and similar at both stations. The treatment zone had a cyanobacteria cell count of 108,774 while the control zone had a cell count of 105,301; this was a 3% difference. Cell counts in both the treatment and control zones exceeded the NJDEP Advisory HAB Alert Tier from August through October.

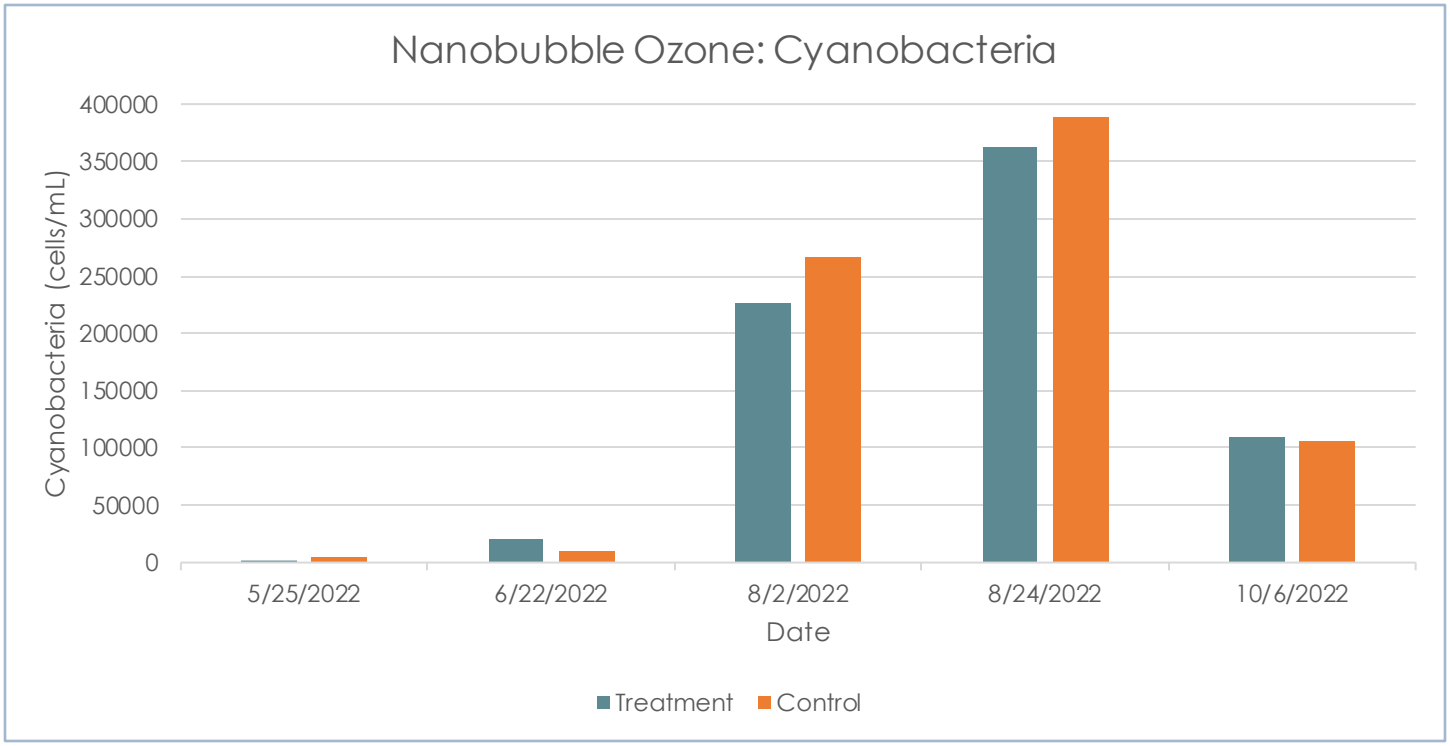

Figure 3.5: Cyanobacteria cell counts in the Nanobubble Ozone treatment and control zones

PHYCOCYANIN

Phycocyanin was measured at a station within the treatment zone and outside of the area affected by the Nanobubble Ozone system, or the control zone, five times during the 2022 season (Figure 3.6). Similar to the cyanobacteria results, phycocyanin values were variable by location throughout the season but were generally similar. Phycocyanin values were 4% lower in the treatment zone on 22 June and 31% lower on 6 October. Phycocyanin values in the treatment zone were 7% higher than the control zone on 24 August. Phycocyanin values were the same across stations on 25 May and 2 August. Thus, phycocyanin was similar in the treatment and control zones throughout the season but were slightly lower in the treatment zone overall.

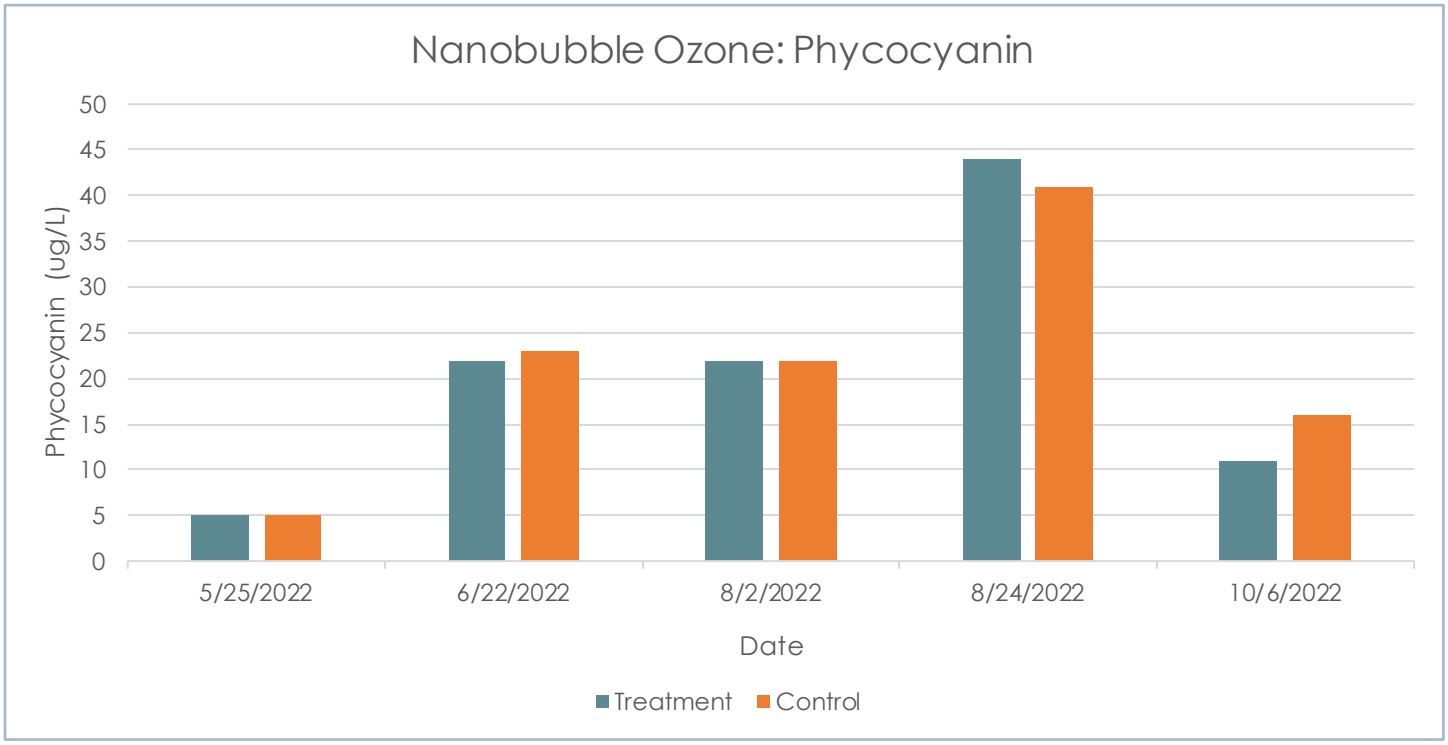

Figure 3.6: Phycocyanin concentrations in the Nanobubble Ozone treatment and control zones

SUMMARY

Water clarity results were inconclusive at both locations due to the shallow depth of the treatment zone stations. These stations were sampled from the shoreline because Princeton Hydro couldn't bring the boats into the swimming areas. Thus, water clarity was to the bottom of the treatment zone station during each event at both locations. This is still a positive sign and indicates that, at the very minimum, water clarity remained above 0.7 m at the Mount Arlington Municipal Beach and above 0.8 m at Lake Forest Yacht Club. For reference, water clarity remained below 0.5 m in Landing Channel during the summer cyanobacteria bloom that also affected both aeration sites.

Cyanobacteria and phycocyanin results indicate that the Nanobubble Oxygen system in Mt. Arlington was successful in limiting cyanobacteria growth within the treatment zone. Cyanobacteria cell counts were lower in the treatment zone relative to the control zone during each sampling event at Mt. Arlington Municipal Beach. The control zone had cell counts that triggered the NJDEP Watch HAB Alert Tier three times in 2022. During all three of these events, cell counts remained below the 20,000 cells/mL Watch threshold within the treatment zone. Additionally, the cyanobacteria cell count of 88,495 cells/mL in the control zone on 24 August triggered the NJDEP Advisory HAB Alert Tier. However, cell counts remained within the Watch HAB Alert Tier within the treatment zone during this event. Those instances represented 80% of all sampling events, and the only sampling event where both stations were within the Advisory HAB Alert Tier was when the majority of the lake was experiencing a cyanobacteria bloom. Phycocyanin results were similar to the cyanobacteria results in Mt. Arlington and indicated a positive influence from the Nanobubble Oxygen system.

Cyanobacteria and phycocyanin results were less conclusive for the Nanobubble Ozone system due to the variability in results throughout the season. It is a positive sign that cyanobacteria cell counts remained slightly lower in the treatment zone during both August sampling events when cell counts were elevated. Cell counts were elevated around the lake at this time and it would be extremely difficult to remain below the Advisory HAB

Alert Tier in a beach area that is located on the main body of the lake rather than in a secluded cove, regardless of what management measures are being implemented.

It's evident from these results that the ozone generator included with the Lake Forest Yacht Club Nanobubble system did not have much of an influence on water quality. Results were more favorable at the regular Nanobubble Oxygen system in Mt. Arlington. Additionally, there were issues with keeping the ozone generator running throughout the entire project. Based on these results and the reported issues with the ozone generator, Princeton Hydro does not think that the ozone generator is a cost-effective addition to the Nanobubble Oxygen system at this time.

It should be noted that an added benefit to the ozone generator may be that is aids in accelerating the decomposition of cyanotoxins. While Princeton Hydro conducted some limited field-based Abraxis monitoring of microcystins as part of this study, concentrations were consistently below the limit of detection. Thus, the potential effectiveness of ozone to breakdown this group of cyanotoxins could not be evaluated.

While the results from both systems are limited to one growing season, they indicate that the Nanobubble Oxygen system had a positive influence on water quality in Mt. Arlington. Specifically, HAB metrics, including cyanobacteria cell counts and phycocyanin, remained lower in the treatment zone throughout the season. It is difficult to assess why this system resulted in better water quality conditions than the Nanobubble Ozone system, but one explanation could be due to location. Mt. Arlington Municipal beach is located within a relatively secluded area, with a large cement dock extending along the southern edge of the swim area. The main body of the lake is also much deeper around the Mt. Arlington Municipal Beach; the deepest point in the lake is located slightly to the northwest. Conversely, the main body of Lake Hopatcong north of Brady Bridge, where Lake Forest Yacht Club is located, has a much shallower maximum and average depth than the main body of the lake near Mt. Arlington Municipal Beach. Thus, the swim area at Lake Forest Yacht Club is likely more susceptible to benthic cyanobacteria growth that may be occurring throughout this section of the lake. A review of the 2022 water quality data from the standard long-term monitoring that's conducted annually indicates that total phosphorus, chlorophyll *a*, and total suspended solids (TSS) concentrations were elevated in this northern section of the lake relative to the main body. Thus, baseline water quality conditions were already less favorable in the section of the lake around the Nanobubble Ozone system throughout the season.

While these Nanobubble systems appear to have a positive influence on conditions, it is also evident that they will not keep the treatment area pristine if water quality conditions in the surrounding lake are significantly impaired, such as during the intense cyanobacteria bloom experienced in August 2022. These systems are intended to improve water quality conditions in the treatment zone relative to areas outside of the beach area. The results from this study indicate that they have the capability to do this and Princeton Hydro recommends the continued use of Nanobubble Oxygen systems in beach areas around the lake.

Operation and Maintenance Manuals for the Nanobubble Oxygen and Nanobubble Ozone systems are provided in Appendices II and III, respectively.

PICTURES

Photo 3.1: Air Curtain at Shore Hills Beach Club

Photo 3.2: Air Curtain at Shore Hills Beach Club

Photo 3.3: Nanobubble Ozone System at Lake Forest Yacht Club

Photo 3.4 Nanobubble Oxygen System at Mt. Arlington Municipal Beach

APENDIX I

Evaluation of Aeration System Sites, 5/25/22										
Station	**DEPTH (meters)**			**Temperature**	**Specific Conductance**	**Dissolved Oxygen**		**pH**	**Phycocyanin**	**Chlorophyll a**
	Total	**Secchi**	**Sample**	**°C**	**mS/cm**	**mg/L**	**% Sat.**	**S.U.**	**µg/L**	**ug/L**
Mt. Arlington Beach: Treatment	1.2	1.2+	0.1	20.34	0.427	9.91	111.7	8.12	6	4
			1.0	19.69	0.435	10.34	115.2	8.24		
Mt. Arlington Beach: Control	2.2	1.6	0.1	19.75	0.415	9.79	109.1	8.10	7	5
			1.0	19.53	0.431	9.83	109.1	8.13		
			2.0	19.27	0.433	9.37	103.1	8.02		
rest: Treatment	1.0	1.0+	0.1	22.35	0.331	8.35	97.9	7.34	5	8
Lake Forest: Control	2.2	1.3+	0.1	21.90	0.381	8.43	98.1	7.45	5	7
			1.0	21.36	0.381	8.57	98.3	7.45		

Evaluation of Aeration System Sites, 6/22/22										
Station	**DEPTH (meters)**			**Temperature**	**Specific Conductance**	**Dissolved Oxygen**		**pH**	**Phycocyanin**	**Chlorophyll a**
	Total	**Secchi**	**Sample**	**°C**	**mS/cm**	**mg/L**	**% Sat.**	**S.U.**	**µg/L**	**ug/L**
Mt. Arlington Beach: Treatment	1.0	1.0+	0.1	20.71	0.430	9.41	108.1	7.99	14	7
			0.8	20.85	0.432	9.35	107.9	8.07		
Mt. Arlington Beach: Control	1.8	1.5	0.1	20.88	0.423	8.59	99.1	7.87	21	9
			1.0	20.95	0.423	8.56	98.9	7.90		
			1.5	20.98	0.425	8.49	98.0	7.88		
rest: Treatment	1.0	1.0+	0.1	20.61	0.376	8.52	97.6	7.85	22	31
Lake Forest: Control	1.8	0.9	0.1	20.95	0.375	8.42	97.2	7.81	23	33
			1.0	21.01	0.374	8.46	97.0	7.85		
			1.5	21.02	0.374	8.28	95.8	7.82		

Evaluation of Aeration System Sites, 8/2/22										
Station	**DEPTH (meters)**			**Temperature**	**Specific Conductance**	**Dissolved Oxygen**		**pH**	**Phycocyanin**	**Chlorophyll a**
	Total	**Secchi**	**Sample**	**°C**	**mS/cm**	**mg/L**	**% Sat.**	**S.U.**	**µg/L**	**ug/L**
Mt. Arlington Beach: Treatment	0.7	0.7+	0.1	26.01	0.470	7.85	100.3	7.72	11	5
			0.5	26.02	0.469	7.81	100.0	7.71		
Mt. Arlington Beach: Control	2.1	1.7	0.1	25.84	0.455	7.35	93.6	7.58	14	6
			1.0	25.84	0.455	7.39	94.1	7.60		
			2.0	25.70	0.455	7.27	92.4	7.60		
rest: Treatment	0.9	0.9+	0.3	27.20	0.411	8.14	107.4	7.79	22	11
Lake Forest: Control	1.2	0.9	0.1	26.60	0.408	8.19	105.9	7.64	22	16
			1.0	26.53	0.408	8.03	102.5	7.57		

Evaluation of Aeration System Sites, 8/24/22										
Station	**DEPTH (meters)**			**Temperature**	**Specific Conductance**	**Dissolved Oxygen**		**pH**	**Phycocyanin**	**Chlorophyll a**
	Total	**Secchi**	**Sample**	**°C**	**mS/cm**	**mg/L**	**% Sat.**	**S.U.**	**µg/L**	**ug/L**
Mt. Arlington Beach: Treatment	0.7	0.7+	0.1	25.63	0.581	8.87	111.8	8.18	27	5
			0.5	25.67	0.581	8.87	112.1	8.20		
Mt. Arlington Beach: Control	1.9	1.5	0.1	25.09	0.458	9.05	113.0	8.31	39	6
			1.0	25.04	0.458	9.08	113.0	8.31		
			1.5	24.92	0.458	9.15	112.8	8.34		
rest: Treatment	0.5	0.5+	0.3	28.64	0.443	8.83	112.5	8.52	44	15
Lake Forest: Control	1.2	0.8	0.1	26.41	0.439	9.94	127.6	8.50	41	16
			1.0	25.43	0.436	8.14	102.2	7.91		

Evaluation of Aeration System Sites, 10/6/22										
Station	**DEPTH (meters)**			**Temperature**	**Specific Conductance**	**Dissolved Oxygen**		**pH**	**Phycocyanin**	**Chlorophyll a**
	Total	**Secchi**	**Sample**	**°C**	**mS/cm**	**mg/L**	**% Sat.**	**S.U.**	**µg/L**	**ug/L**
Mt. Arlington Beach: Treatment	0.7	0.7+	0.1	15.47	0.447	7.77	80.2	7.57	6	3
Mt. Arlington Beach: Control	1.4	1.1	0.1	15.33	0.446	7.48	77.2	7.55	6	4
			1.0	14.91	0.445	7.61	77.6	7.50		
rest: Treatment	0.5	0.5+	0.3	14.80	0.425	10.54	107.3	8.08	11	8
Lake Forest: Control	1.2	1.0	0.1	15.34	0.428	10.67	103.6	7.80	16	6
			1.0	13.00	0.421	10.27	102.0	7.84		

Phytoplankton and Zooplankton Community Composition Analysis

Sampling Location: Lake Hopatcong | **Sampling Date: 5/25/22** | **Examination Date: 6/23/22**

Site 1: Mt. Arlington Aeration | **Site 2: Mt. Arlington Control** | **Site 3: Lake Forest Aeration** | **Site 4: Lake Forect Control**

Phytoplankton

Bacillariphyta (Diatoms)	**1**	**2**	**3**	**4**	**Chlorophya (Green Algae)**	**1**	**2**	**3**	**4**	**Cyanophyta (Blue-Green Algae)**	**1 (#/mL)**	**2 (#/mL)**	**3 (#/mL)**	**4 (#/mL)**
Asterionella	P	P	A	A	*Akinstrodesmus*	P	P	C	C	*Aphanizomenon*	13,125	37,309		
Cymbella	R				*Chlorella*	P	P	P		*Aphanocapsa*				4,175
Fragilaria	A	A	P	R	*Chlorogonium*			R		*Coelosphaerium*		5,330		
Melosira	P	P	P	P	*Coelastrum*				P	*Dolichospermum*		266	65	
Nitzschia	C		P	C	*Cosmarium*	R	P			*Microcystis*			650	
Stephanodiscus		R		R	*Dicellula*			P	P					
Synedra		P			*Elakatothrix*			R						
Tabellaria	R	C		P	*Gleocystis*		R		R					
					Kirchneriella									
					Koliella			P	P	**Euglenophyta (Euglenoids)**				
					Micrasterias	R				*Euglena sp.*			P	
					Oocystis			P	P	*Trachelomonas*	C	C		
					Pediastrum	P		P	C					
					Pleodorina				R					
					Scenedesmus	C	C	C	C					
Chrysophyta (Golden Algae)					*Sphaerocystis*	P		P	R	**Pyrrhophyta (Dinoflagellates)**				
Dinobryon	P	P	R	P	*Staurastrum*		P	C	C	*Ceratium*			R	
					Cryptomonads									
					Cryptomonas	C	C	A	A					

Sites:	**1**	**2**	**3**	**4**	**Comments:**
Total Phytoplankton Genera	17	18	21	19	
Total Cyanobacteria Cell Count (cells/mL)	13,125	42,905	715	4,175	

Princeton Hydro, LLC
35 Clark Street, Trenton, NJ 08611; Phone (908) 237-5660

Phytoplankton and Zooplankton Community Composition Analysis

Sampling Location: Lake Hopatcong					**Sampling Date: 6/22/22**					**Examination Date: 6/23/22**				
Site 1: Mt. Arlington Aeration			**Site 2: Mt. Arlington Control**		**Site 3: Lake Forest Aeration**					**Site 4: Lake Forect Control**				
Phytoplankton														
Bacillariphyta (Diatoms)	**1**	**2**	**3**	**4**	**Chlorophya (Green Algae)**	**1**	**2**	**3**	**4**	**Cyanophyta (Blue-Green Algae)**	**1 (#/mL)**	**2 (#/mL)**	**3 (#/mL)**	**4 (#/mL)**
Asterionella			P	C	*Actinastrum*	R				*Aphanizomenon*	10,988	12,694		4,785
Cyclotella			P	P	*Akinstrodesmus*	P		P	P	*Aphanocapsa*			1,715	
Fragilaria	P	P	P	P	*Brachiomonas*	P	P	P	P	*Coelosphaerium*		173	3,859	
Melosira	P	P	C	C	*Chlorella*	P	P	A	C	*Dolichospermum*	1,211	692	15,437	5,384
Nitzschia		P	P	P	*Chlorogonium*		P		P	*Microcystis*		289		
Synedra			P	C	*Coelastrum*	P		C	P	*Pseudanabaena*	6,511	6,636		
Tabellaria	P	P	P	P	*Crucigenia*				R					
					Dicellula			P						
					Golenkinia			P						
					Koliella			P	P	**Euglenophyta (Euglenoids)**				
					Mougeotia	P				*Euglena sp.*		P		
					Oocystis	P	P	C	P	*Phacus*			P	R
					Pandorina			P	P	*Trachelomonas*	P	C	P	P
					Pediastrum	C	P	C	C					
					Scenedesmus	P	C	A	P					
					Selenastrum	P		P	P					
					Sphaerocystis	P	P							
					Staurastrum		P	C	C					
					Staurodesmus	R								
Chrysophyta (Golden Algae)					*Teilingia*			P		**Pyrrhophyta (Dinoflagellates)**				
					Tetraspora			P		*Ceratium*	P	P		R
					Westella			P						
					Cryptomonads									
					Cryptomonas	C	C	P	P					
Sites:	**1**	**2**	**3**	**4**	**Comments:**									
Total Phytoplankton Genera	21	21	29	26										
Total Cyanobacteria Cell Count (cells/mL)	18,710	20,484	21,011	10,169										

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Phytoplankton and Zooplankton Community Composition Analysis

Sampling Location: Lake Hopatcong | **Sampling Date: 8/2/22** | **Examination Date: 8/6/22**

Site 1: Mt. Arlington Aeration | **Site 2: Mt. Arlington Control** | **Site 3: Lake Forest Aeration** | **Site 4: Lake Forect Control**

Phytoplankton

Bacillariphyta (Diatoms)	**1**	**2**	**3**	**4**	**Chlorophya (Green Algae)**	**1**	**2**	**3**	**4**	**Cyanophyta (Blue-Green Algae)**	**1 (#/mL)**	**2 (#/mL)**	**3 (#/mL)**	**4 (#/mL)**
Cyclotella				R	*Akinstrodesmus*	P	C	P	C	*Aphanizomenon*	1,792	3,169	4,388	14,975
Fragilaria	P			P	*Chlorella*	P	P	P	P	*Aphanocapsa*	1,791	2,377		1,797
Melosira	P	P	C	C	*Coelastrum*			R		*Coelosphaerium*			1,463	
Nitzschia		P		P	*Cosmarium*			P		*Cylindrospermopsis*	26,877	62,588	1,463	19,467
Synedra	P	P			*Eudorina*	P	P			*Dolichospermum*	448	396		2,995
Tabellaria	C	C	C	C	*Golenkinia*				R	*Lyngbya*	179	951		
					Koliella	P	R		P	*Merismopedia*				599
					Micrasterias			P		*Microcystis*	896	792		2,246
					Oocystis	P	P	P	P	*Pseudanabaena*	35,837	18,222	219,394	224,618
					Pediastrum			P	C	**Euglenophyta (Euglenoids)**				
					Scenedesmus	P	P	A	C	*Euglena sp.*	R			P
					Staurastrum	P	P	P	C	*Phacus*			P	P
					Staurodesmus		R			*Trachelomonas*	P	R	P	P
					Teilingia		R							
					Tetraspora			P	P					
					Westella			P	P					
Chrysophyta (Golden Algae)										**Pyrrhophyta (Dinoflagellates)**				
					Cryptomonads									
					Chroomonas			P						
					Cryptomonas	P	P							

Sites:	**1**	**2**	**3**	**4**	**Comments:**
Total Phytoplankton Genera	21	22	20	24	
Total Cyanobacteria Cell Count (cells/mL)	67,820	88,495	226,708	266,697	

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Phytoplankton and Zooplankton Community Composition Analysis

Sampling Location: Lake Hopatcong					**Sampling Date: 8/24/22**					**Examination Date: 10/7/22**				
Site 1: Mt. Arlington Aeration			**Site 2: Mt. Arlington Control**		**Site 3: Lake Forest Aeration**					**Site 4: Lake Forect Control**				
Phytoplankton														
Bacillariphyta (Diatoms)	**1**	**2**	**3**	**4**	**Chlorophya (Green Algae)**	**1**	**2**	**3**	**4**	**Cyanophyta (Blue-Green Algae)**	**1 (#/mL)**	**2 (#/mL)**	**3 (#/mL)**	**4 (#/mL)**
Navicula	R				*Akinstrodesmus*	P	P	P	P	*Aphanizomenon*	17,343	13,519	16,933	10,455
Fragilaria	P	P	P		*Chlorella*	P	P	P	P	*Cylindrospermopsis*	210,597	240,092	338,655	373,780
Melosira	C	C	C	C	*Coelastrum*			P	R	*Dolichospermum*	4,955	7,030	4,939	4,574
Synedra	P	P	C	P	*Gleotila*	P	P			*Lyngbya*	1,549			
Tabellaria	P	P	P	C	*Golenkinia*				R	*Microcystis*			2,116	
					Micrasterias			R						
					Oocystis			P	P					
					Pediastrum		R	P	R					
					Scenedesmus	P	P	C	C					
					Sphaerocystis	R				**Euglenophyta (Euglenoids)**				
					Staurastrum	P	P	P	P	*Euglena sp.*			P	
					Tetraspora				P	*Trachelomonas*	C	C	P	
					Westella				P					
Chrysophyta (Golden Algae)										**Pyrrhophyta (Dinoflagellates)**				
					Cryptomonads									
					Cryptomonas		P	P	P					
Sites:	**1**	**2**	**3**	**4**	**Comments:**									
Total Phytoplankton Genera	16	15	19	17										
Total Cyanobacteria Cell Count (cells/mL)	234,444	260,641	362,643	388,809										

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Phytoplankton and Zooplankton Community Composition Analysis													
Sampling Location: Lake Hopatcong					**Sampling Date: 8/24/22**					**Examination Date: 10/7/22**			
Site 1: Mt. Arlington Aeration			**Site 2: Mt. Arlington Control**		**Site 3: Lake Forest Aeration**					**Site 4: Lake Forect Control**			
Phytoplankton													
Bacillariphyta (Diatoms)	**1**	**2**	**3**	**4**	**Chlorophya (Green Algae)**	**1**	**2**	**3**	**4**	**Cyanophyta (Blue-Green Algae)**	**1 (#/mL)**	**2 (#/mL)**	**3 (#/mL)**	**4 (#/mL)**
Cyclotella	P	P	R		*Akinstrodesmus*	C	C	P	P	*Aphanizomenon*	10,680	14,789	104,205	100,180
Fragilaria	C	C	C	C	*Chlorella*		P		P	*Dolichospermum*	297	1,585		2,246
Melosira	P	C	P	C	*Cosmarium*	P				*Lyngbya*	2,967			
Nitzschia	P	P			*Crucigenia*			P	P	*Merismopedia*			2,565	
Synedra	C	C	C	C	*Eudorina*				P	*Pseudanabaena*	1,780	6,074	2,004	2,875
Tabellaria	P	P	P	P	*Golenkinia*				P					
					Micrasterias	R								
					Pediastrum		P	C	C					
					Scenedesmus	P	P	C	C					
					Sphaerocystis	P			P	**Euglenophyta (Euglenoids)**				
					Staurastrum	P	P	P	P	*Phacus*	R	R	R	
										Trachelomonas	C	C	C	C
Chrysophyta (Golden Algae)										**Pyrrhophyta (Dinoflagellates)**				
Dinobryon		P	P	P						*Ceratium*	R		R	
					Cryptomonads									
					Cryptomonas	P	P	C	C					
Sites:	**1**	**2**	**3**	**4**	**Comments:**									
Total Phytoplankton Genera	20	18	18	19										
Total Cyanobacteria Cell Count (cells/mL)	15,724	22,448	108,774	105,301										
Princeton Hydro, LLC **35 Clark Street, Trenton, NJ 08611; Phone (908) 237-5660**														

APPENDIX II

NANOBUBBLE GENERATOR

OPERATION AND WINTERIZATION MANUAL

DECEMBER 2022

PREPARED FOR:

MT ARLINGTON TOWNSHIP DPW
1 ALTENBRAND AVE
MOUNT ARLINGTON, NJ, 07856

PREPARED BY:

PRINCETON HYDRO
35 CLARK STREET
TRENTON, NJ, 08611

Mount Arlington Department of Public Works

RE: Nanobubble generator system operation and winterization manual

As a participant in the Lake Hopatcong Commission's 2020 NJDEP Harmful Algae Bloom (HABs) Grant, Memorial Beach received a nanobubble generator system, which is help fight HABs. This system was purchased and installed at your facility with NJDEP grant money. At the completion of the two year project, the grant money also paid for Princeton Hydro to winterize the system in December of 2022. After this winterization, the ownership, maintenance and winterization of the system is now the responsibility of Mount Arlington Township.

The following pages detail the relatively simple winterization process, as well as the manufacturers operation and maintenance manual. While Princeton Hydro is more than happy to help with any issues with the system, it will be under a service agreement contract.

Princeton Hydro would like to thank the Mount Arlington Municipal Government for participating in the NJDEP HABs grant.

Sincerely,

J.P. Bell
Project Manager – Aquatics

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SYSTEM OVERVIEW

At the edge of the concrete adjacent to the beach sits a green cabinet – this is the Homeport Nanobubble generator system. There is one green intake hose and out blue output hose. The system generates nanobubbles that are dispersed throughout the water column, where they disrupt the formation of algae and help stop the spread of Harmful Algae Blooms.

MANUFACTURERS OWNER AND MAINTENANCE MANUALS

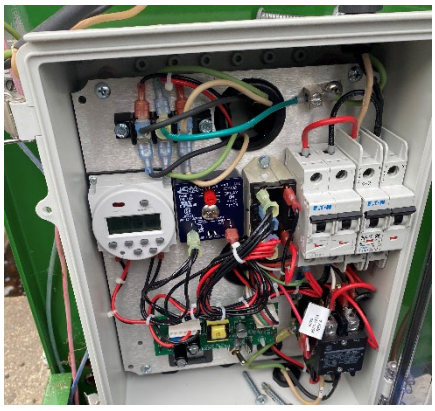
The manufactures manuals were downloaded from their respective websites and are located at the end of this document. The Homeport nanobubble generator manual is in Appendix A and and the Electrical Schematic for the nanobubble system located in Appendix B

SYSTEM WINTERIZATION

There are only a few steps to complete the winterization of the systems. The steps required to complete the winterization doesn't require in depth knowledge of the system, only the use of a few wrenches. The nanobubble system has two large hoses – a green intake and blue output hose. They do NOT need to be pulled out of the water during winter. These two hoses are weighted down in the water so they remain where they were strategically placed.

The nanobubble system does have a few steps that need to be completed for winterization of the unit. While working with these units during the NJDEP grant project, Princeton Hydro has encountered some issues with the pump impeller seizing inside the pump housing and not pumping at all. If the unit has not been run in a while,

Main On / Off switch



Timer on left

the first thing that should be done is see if the pump is seized. This can be done by simply turning on the unit with the main switch. If you see water moving in the clear outlet hose, the pump is operating properly. If not, turn the unit off. This can be done with the large red dial switch on the front of the unit. Now, open the cabinet and check for and remove any debris that may have accumulated. If so desired, the timer switch inside the cabinet can be turned off or the "on" times adjusted. The timer switch looks like a clock and is located in the clear plastic covered gray box inside the cabinet.

If the pump is seized, the impeller needs to be knocked free. This can be accomplished by removing a sensor attached at the base of the pump. Use an appropriately sized wrench or an adjustable wrench to remove the

Remove the senor

Steel rod to free impeller

Spray lubricant into pump housing

sensor. Now lower a steel rod into the hole and use a hammer to gently tap the rod and break the rust that has formed on the impeller. Once the impeller is free, then liberally spray lubricant into the pump housing and turn the impeller with the steel rod so the entire impeller gets coated with lubricant. For now, leave the sensor off to the side and the hole open.

The final step is to fill the primer pot and pump housing with antifreeze. Five gallons of antifreeze is needed. Princeton Hydro has been using RV and Marine antifreeze, which is propylene glycol based, environmentally friendly and inexpensive. Remove the primer pot lid with an adjustable wrench. Pull out the debris basket inside and remove any debris that has accumulated. Now pour the antifreeze into the primer pot. The antifreeze will

Remove primer pot lid

Remove / clean debris basket

Filling with antifreeze

enter the pump housing from the bottom of the primer pot. Keep filling until the pump housing is filled, and antifreeze appears at the sensor hole. Now the sensor can be screwed back into place. Finish filling the primer pot with antifreeze to just below the green intake hose and screw the primer pot lid back on. When the system is turned on again next year, the antifreeze will be flushed out and released into the lake waters. This should not be an issue as the antifreeze is environmentally friendly and the five gallons of antifreeze will be completely diluted with thousands of gallons of lake water.

SUGGESTIONS FOR FUTURE USE

The primer pot was installed on the nanobubble generator after the unit was originally installed. There were issues with getting the system started. The height of the unit above the lake's water level is just a bit too high for the pump to pull water up the intake hose. When the primer pot was installed, it was filled with water via buckets. That primer pot water was then directly released into the pump housing when the system was started, causing enough suction to pull lake water up the intake hose. The intake hose does have backflow preventer valve, so theoretically when the system is run on a routine basis, the primer pot should always be full and the system should start up immediately without issue. Realistically, when the system hasn't run in a few weeks or months, water may have seeped out from the backflow valve and the primer pot lid should be removed and the pot filled if needed before system startup.

APPENDIX A: HOMEPORT NANOBUBBLE SYSTEM OPERATIONS AND MAINTENANCE MANUAL

MaxDO LB 1000/2000 Ultra Fine Bubble Generator
Safety, Installation, Operation and Maintenance Manual

Revision 1.7.

June 5 th, 2019

Table of Contents

1. Introduction and safety

1.1. Introduction

Purpose of this manual

The purpose of this manual is to provide necessary information for:

- Safety
- Installation
- Operation
- Maintenance

NOTICE:
Read this manual carefully before installing and using the product. Improper use of the product can cause personal injury and damage to property, and may void the warranty.

CAUTION:
Always specify the exact product type and part number when requesting technical information or spare parts from the Sales and Service Department

CAUTION:
Save this manual for future reference, and keep it readily available at the location of the unit.

1.1. Users

WARNING:
This product is intended to be operated by qualified personnel only. Be aware of the following precautions:

- Children must be supervised to ensure that they do not play on or around the product

1.2. Safety terminology and symbols

About safety messages

It is extremely important that you read, understand, and follow the safety messages and regulations carefully, before handling the product. They are published to help prevent these hazards:

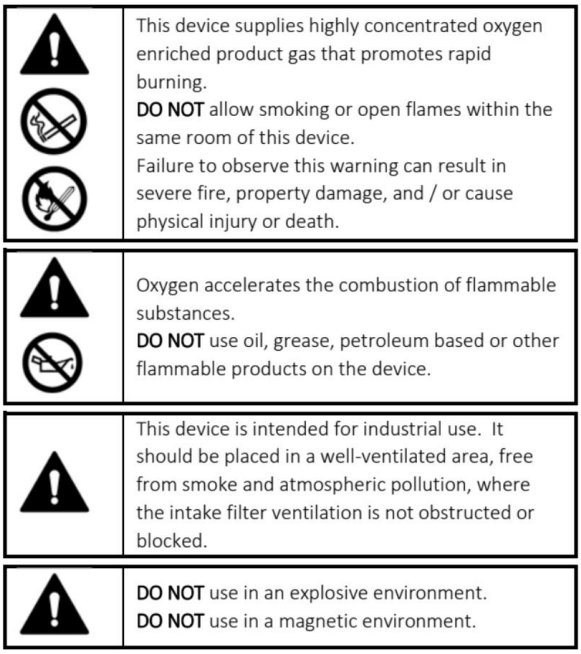
- Personal accidents and health problems
- Damage to the product
- Product malfunction

Hazard Level	Indication
 **DANGER:**	A hazardous situation which, if not avoided, will result in death or serious injury
 **WARNING:**	A hazardous situation which, if not avoided, could result in death or serious injury
 **CAUTION:**	A hazardous situation which, if not avoided, could result in minor or moderate injury
NOTICE:	A potential situation which, if not avoided, could result in undesirable conditions • A practice not related to personal injury

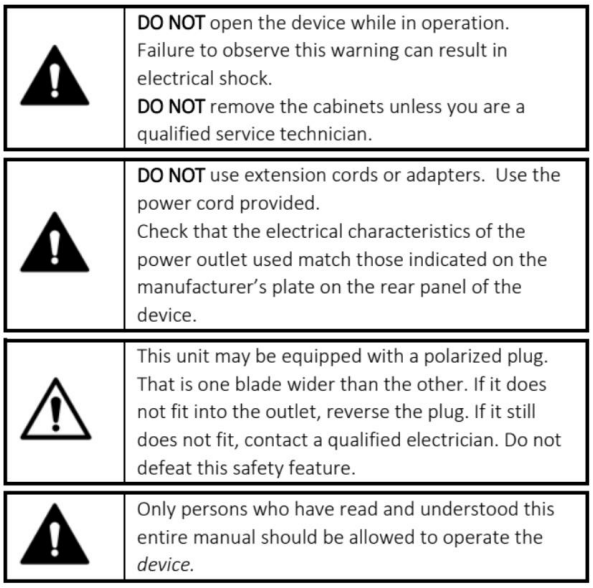
1.3. Safety Instructions

The instructions and warnings that are provided in this manual concern the standard version, as described in the unit specification sheet. Special UFB (Ultra fine bubble) generator versions may be supplied with supplementary instruction leaflets. Refer to sales contract for any modifications or special version characteristics. For instructions, situations, or events that are not considered in this manual or the sales document, contact your Dealer.

1.3.1. Safety Instructions for Oxygen Generator Parts



	This device supplies highly concentrated oxygen enriched product gas that promotes rapid burning. **DO NOT** allow smoking or open flames within the same room of this device. Failure to observe this warning can result in severe fire, property damage, and / or cause physical injury or death.
	Oxygen accelerates the combustion of flammable substances. **DO NOT** use oil, grease, petroleum based or other flammable products on the device.
	This device is intended for industrial use. It should be placed in a well-ventilated area, free from smoke and atmospheric pollution, where the intake filter ventilation is not obstructed or blocked.
	DO NOT use in an explosive environment. **DO NOT** use in a magnetic environment.



	DO NOT open the device while in operation. Failure to observe this warning can result in electrical shock. **DO NOT** remove the cabinets unless you are a qualified service technician.
	DO NOT use extension cords or adapters. Use the power cord provided. Check that the electrical characteristics of the power outlet used match those indicated on the manufacturer's plate on the rear panel of the device.
	This unit may be equipped with a polarized plug. That is one blade wider than the other. If it does not fit into the outlet, reverse the plug. If it still does not fit, contact a qualified electrician. Do not defeat this safety feature.
	Only persons who have read and understood this entire manual should be allowed to operate the *device.*

The WARNINGS below indicate a potentially hazardous situation. If conditions are not avoided a situation could occur that results in serious injury or death.

- Oxygen is not a flammable gas, but it accelerates the combustion of materials. Do not use in explosive atmosphere. To avoid risk of fire and explosion the concentrator should be kept away from flames or heat sources, incandescent sources, smoking materials, matches, oil, grease, solvents, aerosols, etc. Do not allow oxygen to accumulate on upholstery or other fabric such as tarps, bedding or personal clothing

- Use of other accessories not described in this Guide is not recommended and may void the Warranty.
- No modification to the equipment is allowed. To do so may void the Warranty.
- Device must have power to operate. In the event of power loss and for continued operation a backup source is recommended.
- DO NOT disassemble due to danger of electrical shock. Refer servicing to qualified service personnel.
- Use the power cord provided and check that the electrical characteristics of the power socket used match those indicated on the manufacturer's plate on the rear panel of the device.
- We recommend against the use of extension cords and adapters, as they are potential sources of sparks and fire.
- This unit may be equipped with a polarized plug. That is one blade wider than the other. If it does not fit into the outlet, reverse the plug. If it still does not fit, contact a qualified electrician. Do not defeat this safety feature.

1.3.2. Safety Instructions for Water Pump Parts

The WARNINGS below indicate a potentially hazardous situation. If conditions are not avoided a situation could occur that results in serious injury or death.

Do not use pump for any purpose other than recommended application by Homeport and the pump manufacturer (see attachment). Components have not been designed for other applications. Severe pump failure may result. Any unapproved use will void Warranty.

Always follow basic safety precautions with this equipment, including:

- Provide sufficient ventilation to maintain air temperature below the maximum ambient temperature rating shown on the motor nameplate. Pump house must allow adequate ventilation to assure the ambient temperature remains below the motor rating when the pump is operating.
- Locate the machine on a non-combustible surface. The surface should be hard, level, dry, well ventilated, out of direct sunlight. The surrounding area should provide protection from the elements and allow sufficient space for maintenance and service. Ensure the drainage will flow away from the pump.
- Deploy the external inflow hose to allow the pump suction inlet height to be as close to water level as possible. If the pump must be located above the filled water level, keep the vertical distance to a minimum. Use short, direct piping; this will minimize Ultrafine bubble loss due to friction.

Fire and burn hazard

Motors run at high temperatures. Do not allow leaves, debris, or foreign matter to collect around the pump motor. Keep ventilation holes always open. Allow motor to cool before handling. Keep flammable liquids away. If the thermal overload protection in the motor trips or if the GFCI trips determine the reason and correct the problem before re-starting pump.

Use rigid or flexible PVC, with no interior rigs for intake and outflow piping. Ensure pipe ends are clean and free of any flash caused by cutting. Use the proper glue for the type of pipe selected.

NOTE: Use a supplier recommended primer to ensure glued joints are secure. Many local codes require primer with a purple tracer to verify primer use.

Consider climatic conditions when applying adhesives. Atmospheric conditions such as high humidity will make the adhesive action of certain glues less effective. Follow the manufacturer's instructions.

1.4. Disposal of packaging and product

Observe the local regulations and codes in force regarding sorted waste disposal.

1.5. Warranty

Homeport Water Solutions warrants to the original end purchase during the warranty period, every new MaxDo LB 1000/2000 Ultra Fine Bubble Generator to be free from defects in material and workmanship under normal use and service, when properly installed, used, and maintained, (in accordance with Homeport's's operational manual), for a period (starting from the first installation):

- twelve (12) months for the oxygen concentrator part
- twenty four (24) months for the oxygen compressor part
- thirty six (36) months for the water pump parts
- thirty six (36) months for the UFB generator and
- sixty (60) months for the housing parts (exluding locks, hatches, ventilators, switch boards, electrical installations, cables and tubes)

For detailed information about warranty services and limitations, see the sales contract.

1.6. Spare parts

WARNING:
Only use original spare parts to replace any worn or faulty components. The use of unsuitable spare parts may cause malfunctions, damage, and injuries as well as void the Warranty

WARNING:
Always specify the exact product type and part number when requesting technical information or spare parts from the Sales and Service Department

2. Transportation and Storage

2.1. Delivery Inspection

- Prior to signing bill of lading/shipment and rleasing shipper, check the outside of the package for evident signs of damage. If damage is evident, file appropriate claim with shipper and inform your Dealer.
- Notify our Dealer within three days of the delivery date, if the product bears visible signs of damage.

Unpack the unit

Follow applicable step:

- If the unit is packed in a carton, then remove the staples and open the carton.
- If the unit is packed in a wooden crate, then open the cover while paying attention to the nails and straps. Remove the securing screws or the straps from the wooden base
- Do not pull or tug the unit out of the packing material without removing nails or staples as this may damage the unit

Inspect the unit

- Remove packing materials from the product. Dispose of all packing materials in accordance with local regulations.
- Inspect the product to determine if any parts have been damaged or are missing.
- If applicable, unfasten the product by removing any screws, bolts, or straps. For your personal safety, be careful when you handle nails and straps.
- Contact the local sales representative if there is any issue.

2.2. Transportation guidelines

Precautions

WARNING:
Observe accident prevention regulations in force.
- Crush hazard. The unit and the components can be heavy. Use proper lifting methods and wear steel-toed shoes at all times

Check the gross weight that is indicated on the package in order to select proper lifting equipment.

MaxDO units are NOT to be stacked at any time.

Position and fastening

The generator or generator unit can be transported only horizontally. Make sure that the UFB unit is securely fastened during transportation and cannot slide, roll or fall over.

2.3. Storage guidelines

When not deployed the unit must be stored in a covered and **dry** location free from heat, dirt, and vibrations.

NOTICE:
- Protect the product against humidity, heat sources, and mechanical damage
- Do not place heavy weights on the packed product.

2.3.1 Long-term storage

If the unit is stored for more than 6 months, these requirements apply:

- Unit must be flushed with clean sweet water and all water must be drained from system
- Store in a covered and dry location.
- Store the unit free from heat, dirt, and vibrations.

For questions about possible long-term storage treatment services, please contact your local sales and service representative.

MaxDO units are NOT to be stacked at any time.

Ambient temperature

The product must be stored at an ambient temperature from 0°C to +40°C (32°F to 104°F)

3. System Applications

MaxDo LB1000/2000 Series Ultra Fine Bubble ("UFB") Generators are applied to increase oxygen/gas levels for lakes, ponds, sewage or agricultural treatment ponds and aquaculture installations.The size, rising speed, negative polarity, oxygen/gas transfer rates and development of Hydroxyl Radicals during the collapse of Ultrafine bubbles make them a unique and effective aeration choice. Your Dealer can help you understand the cleaning action provided by each of these features of the LB1000/2000 Series.

It should be understood that the treatment and application to achieve a self-purification process closely depends on the cause and level of pollution and if the source of this pollution has been eliminated. The basic function and performance are described as follows.

3.1. Functional Principle

The MaxDo LB1000/2000 Series UFB generators use patented technology for mixing liquid with oxygen or other gases through leveraging hydrodynamics to create Ultra fine bubbles.

Our LB1000/2000 Series UFB generators continuously produce more than 160,000,000 bubbles per ml of water. These bubbles are of a diameter smaller than 100 Nano meters (one billionth of a meter). These Ultra fine bubbles activate the source water, through their size, rising speed, negative polarity, oxygen/gas transfer rates and development of Hydroxyl Radicals. The resulting oxygenated water and subsequent growth of naturally occurring beneficial bacteria and oxidization of chemical and metal contaminants resolves pollutants and microbes which cause pollution, and molecules that produce smell.

As the result, the water returns to a natural balance without impacting the environment. The process does not involve chemicals or heavy metals and is a sustainable solution.

Ultra Fine Bubbles are negatively charged. On the contrary, harmful microbes and bacteria are positively charged. As the minus and plus charge pull toward each other, the Ultrafine bubbles adhere to the microbes and the bad bacteria due to attractive force existing between them, when they meet with each other there is a distructive action.

Hydroxyl ions exsist in abundance in ultra-fine bubble water and they sterilize bad microbes and bacteria effectively. Hydroxyl ions can also oxidize heavy metals like iron or manganese in the water.

Ultra . ine Bubbles can also oxydize chemical such as Ammonia (NH4), P2O5, compounds of Cr+6 and As- compounds.

4. System Performance

Please speak with your Dealer to properly size the application of LB1000/2000 Series UFB platform. Proper sizing based on the size, depth, in flows, outflows and pollution currently impacting the water body is imperative to achieving desired results. Under sizing may result in extended time to achieve results or a minimal result, while over treatment can produce opposite results. For best results, please discuss your specific characteristics of the waterbody with your Homeport dealer.

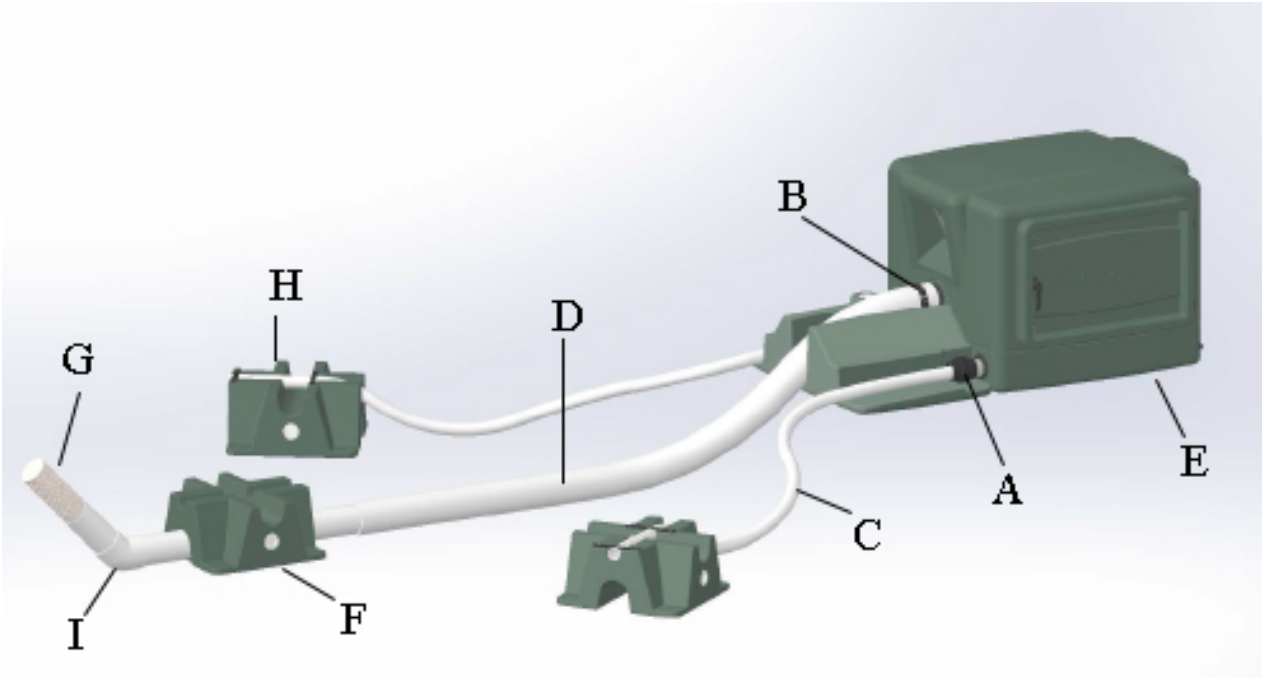
Homeport strongly suggests the use of Probiotics and Enzymes in order to supplement the positive effect of UFB injection into the water body, as well as enhance the natural balance of the ecosystem. Please request our Probiotic Information sheet for further info. Probiotics should be used monthly for the first 3 months followed by quarterly treatment. This depends on the polution level of your waterbody. Please consult Homeport for profesional conclusions and advise. Homeport offers Probiotics , Organic Probiotics and Enzymes specifically produced based on your waterbodies problems and desired outcomes.

5. Installation parts requirements

1 piece swing flap, non return valve : 3 inch for LB1000, 4 inch for LB2000. **(F)**
1 piece suction strainer, non corrosive, min 12 inches/30 cm long **(G)**
2 pieces 30 feet/ 10 m (maximum) 2 inch pvc tube or flexible PVC, with no interior ribs/ridges **(C)**
or alternative:
2 pieces up to 150 feet (maximum) 2,5 inch pvc tube or flexible pvc, as above. Exact same lenght
1 piece ,as short as possible, 3 inch rigid or flexible PVC *for LB1000* ***(D)***
1 piece, as short as possible, 4 inch, rigid or flexible PVC, *for LB2000* ***(D)***
2 pieces PVC connectors for discharge hose or pipe, 2 or 2,5 inch. to connect to unit **(A)**
1 piece connector for suction hose or pipe, 3 inch for LB1000, 4 inch for LB 2000, to connect to unit **(B)**
3 pieces weight (hollow bloc or similar) for 2 inch discharge fixation to ground. Minimum 12 inch/ 30 cm above ground **(H)**
1 piece 45 degrees PVC connector for suction strainer. 3 inch for LB1000, 4 inch for LB2000 **(I)**
1 piece solid , horizontal platform for unit **(E)**

PVC primer, PVC glue, hose clamps, tools

Maximum elevation difference between suction end and machine is 10 feet.
The shorter the suction and discharge tube the more it reduces head pressure.



Suction strainer **(G)**

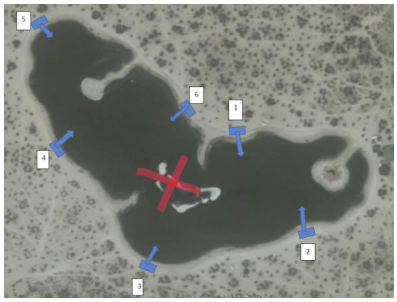
PVC Swing Check Valve **(F)**

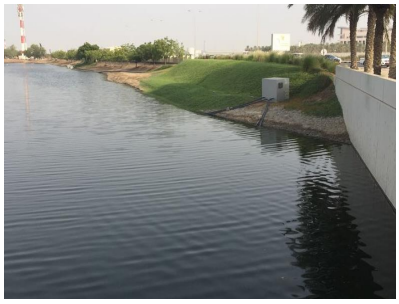
Solid, horizontal platform **(E)**

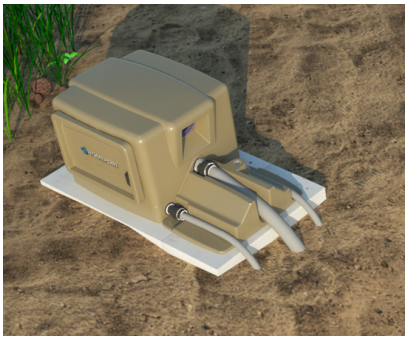
6. Recommendations for Installation Location

Considering the water volume to be cleaned, water flow, and the treatment capacity of LB1000/2000 series UFB generator, the number of units and locations must be determined with the help of your Dealer. Typical indications are as follows.

(1) Make sure that the power source is available at the installation site (220 Volt, 30 amps)
(2) Make sure you have necessary authorizations and permissions to install the system
(3) Make sure your installation complies to all local municipal rules and regulations
(4) Make sure that your installation site is preferably shaded and protected from environmental impact
(5) Set up the LB1000/2000 series close to the shore but not where it might be flooded from changing water levels.
(6) Set up one MaxDO LB1000/2000 near the inflow of the water body
(7) Understanding the hydrodynamics of the water body is fundamental for optimal performance of the installed system
(8) Understanding water pollution through professional testing is fundamental for good performance of the installed system, please work with your Dealer to obtain proffessional testing before and after installation . These reports will also help to determine the amount and type of Probiotics needed.






7. Restrictions of usage

WARNING:
Improper use of the generator may create dangerous conditions and cause personal injury and damage to property.

DANGER:
Do not use this generator to handle flammable and/or explosive liquids.

LB1000/2000 series UFB generators have an integrated pump solution designed to work in on-shore fixed or mobile installations.

The machine is not suitable for water and gases with the features below:

- Water density greater than 1000 kg/m3 (8.34 pounds/gallon);
- Water kinematic viscosity in the range 0,7-1,5 cSt);
- Water pH lower than 4;
- Chemically and mechanically aggressive substances for the materials of the generator;
- Flammable and/or explosive substances;
- Ozone or any other aggressive gases. This unit is built for oxygen or atmospheric air only. If use of ozone is required for specific application, please refer to our special LB model version for ozone.

8. Installation

8.1. Installation Precautions

WARNING:
- Observe accident prevention regulations in force.
- Use suitable equipment and protection.
- Always refer to the local and/or national regulations, legislation, and codes in force regarding the selection of the installation site, and power connections.

Installations should be performed by authorized Dealer.

Following precautions must be considered:

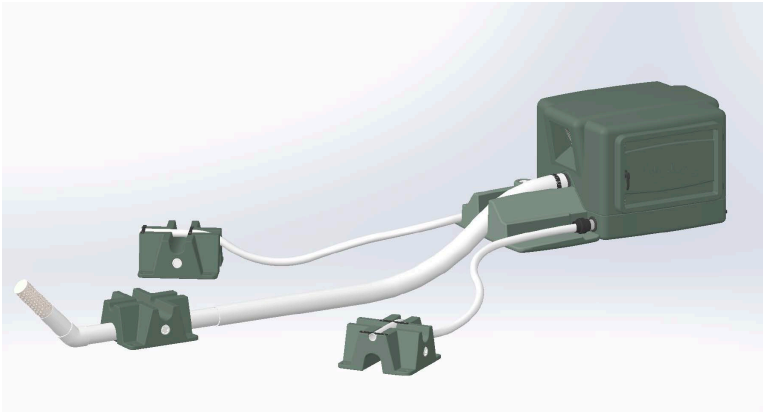
8.2. Installation site:

- The surface should be non-combustible, hard, level, dry, well ventilated, out of direct sunlight (if possible).
- The surrounding area should provide protection from the elements and allow sufficient space for maintenance and service.
- The generator should be installed on solid and horizontal base – best if concrete or other robust material.
- To avoid possible damage to the generator, please check the tides or flood information in order to prevent water entry into the generator box.

8.3. Suction/discharge :

- Suction and discharge hose should have the same length and not be longer than 10 m (30 ft) with 2 inch discharge tube and no longer then 45 m (150 ft) with 2,5 inch tube. In both occasions suction is 3 (LB1000)or 4 inch (LB2000).
- Use rigid or flexible PVC, with *no interior* ribs/ridges for suction and discharge piping.
- Ensure pipe ends are clean and free of any flash caused by cutting.
- Use the proper glue for the type of pipe selected.
- Choose an appropriate intake screener / strainer with a minimum lenght of 33 cm/1 ft
- Suction hose with screener should be deployed at a minimum depth of 30 cm (1 ft) and maximum depth of 2 m (6 ft) below the water surface
- Suction hose with screener should be deployed min 30 cm (1 ft) above the lake bed, ie sludge level . It should not lay on ground in order to avoid clogging of the screener and disturbing of the sediments layer.
- Suction and discharge hose ends should not be positioned close to each other in the water. A distance of min 3 m (10 ft) is recommended.
- The end of the discharge hose should be directed under slightly upward at an angle of (approx. 20 °) for the best Ultra fine bubble dispersion, were depths is more than 1 meter /3 feet. If the water is less then 1 meter/3 feet deep, pipes should be installed horizontally.
- Mark the discharge and the suction position of the hoses in the water with buoys in order to prevent any incidents or interference from lake activity.
- Strainer must be 3 inch diameter for the MaxDO LB 1000 and 4 inch for the MaxDO LB2000 and at least 1 ft long to avoid suction friction.
- Suction pipe must be equiped with a non return valvue right before the strainer

Installation set up example:
Suction above the sludge/ground layer
Discharge approx.1 ft / 30 cm above sludge/ground to avoid stiring up sediments etc.
Note: Due to the outflowing pressure the tube needs to be fixed to avoid " whipping" around



8.4 Electrical specification

ELECTRICAL HAZARD:

- Make sure that all connections are performed by qualified installation technicians and in compliance with the municipal regulations in force.
- Before starting work on the unit, make sure that the unit and the control panel are isolated from the power supply and cannot be energized. This applies to the control circuit as well.

Electrical installation can ONLY be concluded by a certified electrician

A Ground Fault Circuit Interrupter (GFCI) is required in the circuit. For size of GFCI required see Pump manufacturer's instructions.

- Never ground to a gas supply line.
- To avoid dangerous or fatal electrical shock: turn OFF, disconnect the power at its source, lock out power to motor and place a tag on the dedicated GFCI circuit breaker indicating the power is to remain OFF before working on electrical connections.

Ground Fault Circuit Interrupter (GFCI) tripping indicates an electrical problem. If GFCI trips, determine the reason for tripping. If you are uncertain, have a qualified electrician inspect and repair the electrical system. Verify supply voltage matches the nameplate voltage. Incorrect voltage can cause fi re or seriously damage motor and voids warranty.

VOLTAGE

Voltage at motor must be within 10% of the motor nameplate rated voltage or motor may overheat, causing overload tripping and reduced component life. Verify voltage is correct before applying power. If voltage does not fall within the specified range during operation consult the power company.

The units are shipped with motors wired for 208-230 operation. Refer to pump manual for specific pump related instructions.

Breaker /amp and cable

Homeport recommends a #10 gauge wire and a 30 amp breaker. This is only a recomendation and needs to be installed according to local law regulations.

Grounding (earthing)

ELECTRICAL HAZARD:

- Always connect the external protection conductor to ground (earth) terminal before making other electrical connections.
- You must ground (earth) all electrical

Install, ground, bond and wire motor according to local or National Electrical Code requirements. Permanently ground the motor. Use ground terminal provided in the terminal box on the back of the motor. Use size and type wire required by local codes. Connect motor ground terminal to electrical service ground. Bond motor to protective structure. Use a solid copper conductor, size No. 6 AWG or larger. Run wire from external bonding lug to reinforcing rod or mesh. Use solid copper bonding conductor not smaller than 6 AWG (13 mm2) from the accessible wire connector on the motor to all metal parts of the structure.

WIRING

Follow all national and local wiring codes. If unsure of code requirements consult a professional electrician. Pump must be permanently connected to a dedicated circuit. If unsure consult a licensed electrician.

NOTE: All electrical wiring and components must be selected and installed in conformance with the latest NEC requirements and local codes. If you are unsure about the requirements consult a licensed electrician familiar with the requirements.

Before conducting any maintenance and/or repair on the generator, disconnect it from the mains power supply. Connection point should be located far enough from water region and the perfect prevention of electric leakage is required.

9. Operations

CAUTION: Do not block pump suction. To do so with body parts will cause severe or fatal injury.

Fire and burn hazard.
Motor runs at high temperatures, to reduce the risk of fire, do not allow debris, or foreign matter to collect around the pump motor. Allow motor to cool prior to handling or performing maintenance.

Do not run pump dry. Fill pump with water before starting motor

1. Open water pump strainer basket cover and fill carefully with water, without having water leak into the unit, until the system is full of water. The check valve/non return valve will ensure that the water system will afterwards stay filled with water, incase of shutdown.

2. Close water pump strainer basket cover.

3. After safety measures are confirmed, switch on main power switch

4. Only Fan and Oxygen generator will start running.This is to prevent water been pushed into the O2 lines.

5. After 30 to 45 seconds the water pump will automatically switch on

6. After 5 min of operations check the transparent tube at discharge outflow. You should be able to see a helix (looks like a small tonado, see pic 1,2 & 3 below) formed in the middle of the water column. This indicates that Ultra Fine Bubbes are been produced. On the water surface you should see micro bubbles above the discharge location (see picture 4). Unit is working correctly.

7. Close unit and check gauges as per following recomendation

The motor is equiped with an internal thermal protection circuit to guard against overheating. The maximum ambient temperature for motor operation must not exceed the rating as specified on the motor model plate.

1

2

3

4

9.1 Gauge readings

Following readings should be indicated on the gauges

Suction: 5 to 12 max. If higher indication, clean the pump basket strainer and the water strainer.
Oxygen: 10 to 16
Temperature: max 60 C/ 140 F.
Discharge: 8 to 12

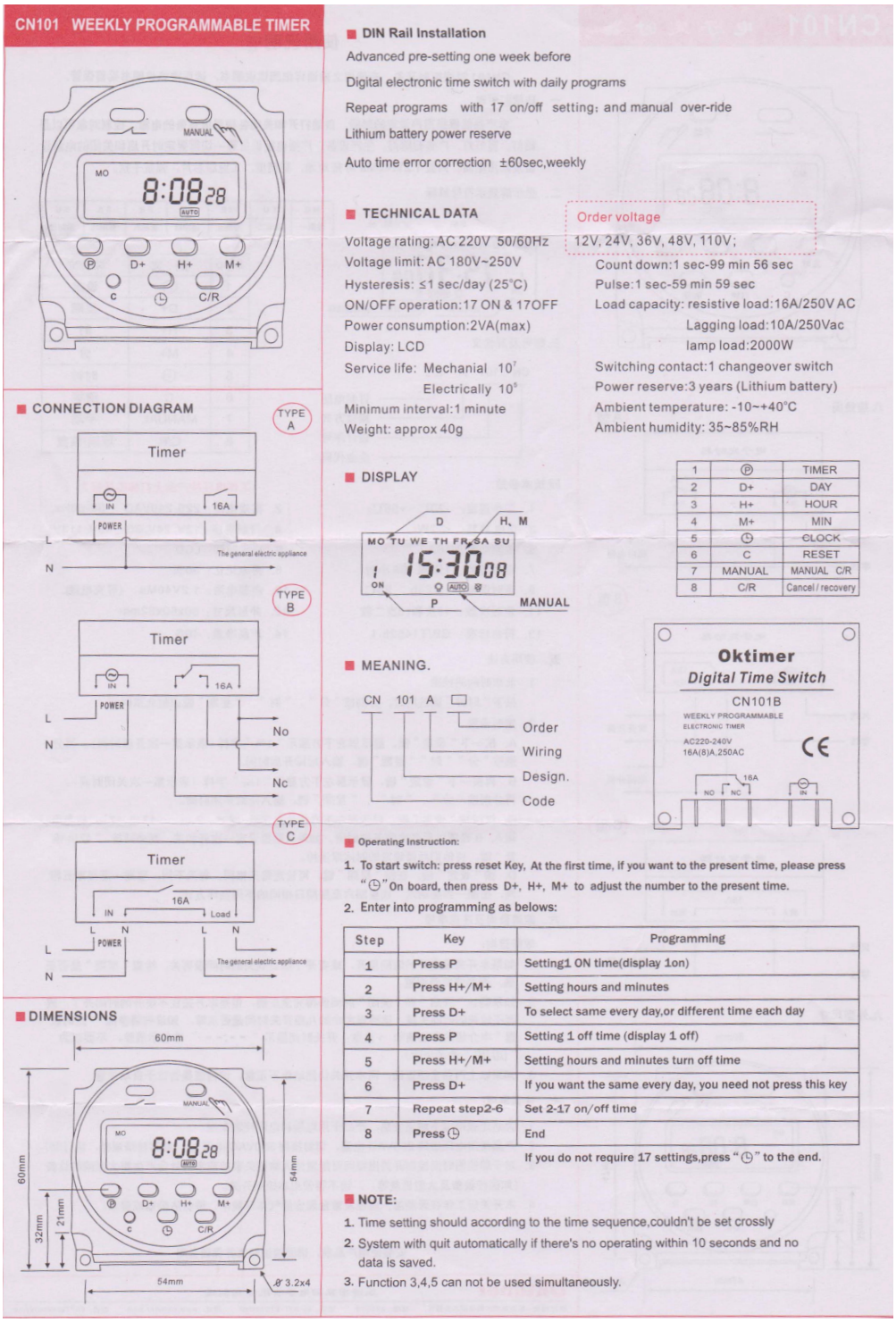
9.2 Operation time

Considering the volume of the water body to be purified, water flow, and the purification capability of LB1000/2000 UFB generator, the recommended generator operation times be determined with the help of our authorized resellers. Homeport recommends 24/7 running time for first 60 days.
Typical indications are as follows, when desired water quality levels are reached for at least 2 months:

- Normal operation mode: 12 hrs on, 12 hrs off.
- Intensive mode (in case of heavy pollution) 24 hrs on

9.3 Timer

The UFB generator is equipped with an electronic timer to regulate working hours of the unit.



CN101 WEEKLY PROGRAMMABLE TIMER

MANUAL

MO 8:08 28 AUTO

Ⓟ D+ H+ M+

C C/R

■ CONNECTION DIAGRAM

TYPE A

Timer

IN 16A

POWER

L

N

The general electric appliance

TYPE B

Timer

IN 16A

POWER

L

N

No

Nc

TYPE C

Timer

16A

IN Load

L N L N

POWER

L

N

The general electric appliance

■ DIMENSIONS

60mm

MANUAL

MO 8:08 28 AUTO

Ⓟ D+ H+ M+

C C/R

60mm

32mm

21mm

54mm

54mm

Ø 3.2x4

■ DIN Rail Installation

Advanced pre-setting one week before

Digital electronic time switch with daily programs

Repeat programs with 17 on/off setting: and manual over-ride

Lithium battery power reserve

Auto time error correction ±60sec,weekly

■ TECHNICAL DATA

Order voltage

12V, 24V, 36V, 48V, 110V;

Voltage rating: AC 220V 50/60Hz

Voltage limit: AC 180V~250V

Hysteresis: ≤1 sec/day (25°C)

ON/OFF operation:17 ON & 17OFF

Power consumption:2VA(max)

Display: LCD

Service life: Mechanial 10^7

Electrically 10^5

Minimum interval:1 minute

Weight: approx 40g

Count down:1 sec-99 min 56 sec

Pulse:1 sec-59 min 59 sec

Load capacity: resistive load:16A/250V AC

Lagging load:10A/250Vac

lamp load:2000W

Switching contact:1 changeover switch

Power reserve:3 years (Lithium battery)

Ambient temperature: -10~+40°C

Ambient humidity: 35~85%RH

■ DISPLAY

D H、M

MO TU WE TH FR SA SU

1 ON 15:30 08 AUTO

P MANUAL

1	Ⓟ	TIMER
2	D+	DAY
3	H+	HOUR
4	M+	MIN
5	◷	CLOCK
6	C	RESET
7	MANUAL	MANUAL C/R
8	C/R	Cancel / recovery

■ MEANING.

CN 101 A □

Order

Wiring

Design.

Code

Oktimer

Digital Time Switch

CN101B

WEEKLY PROGRAMMABLE ELECTRONIC TIMER

AC220-240V 16A(8)A,250AC

CE

16A NO NC IN

■ Operating Instruction:

1. To start switch: press reset Key, At the first time, if you want to the present time, please press "◷" On board, then press D+, H+, M+ to adjust the number to the present time.
2. Enter into programming as belows:

Step	Key	Programming
1	Press P	Setting1 ON time(display 1on)
2	Press H+/M+	Setting hours and minutes
3	Press D+	To select same every day,or different time each day
4	Press P	Setting 1 off time (display 1 off)
5	Press H+/M+	Setting hours and minutes turn off time
6	Press D+	If you want the same every day, you need not press this key
7	Repeat step2-6	Set 2-17 on/off time
8	Press ◷	End

If you do not require 17 settings,press "◷" to the end.

■ NOTE:

1. Time setting should according to the time sequence,couldn't be set crossly
2. System with quit automatically if there's no operating within 10 seconds and no data is saved.
3. Function 3,4,5 can not be used simultaneously.

9.4. Water Quality Inspection

Sampling Report No : GTL/DX/SR/2018-953
Sample Container / Size : PLASTIC BOTTLE / 1.5 L
Appearance : TURBID / GREENISH LIQUID
Sender's Reference : NOT GIVEN

RESULTS OF CHEMICAL ANALYSIS DA

PARAMETER	TEST METHOD (REFERENCE NO.)	UNIT
pH @ 20 °C *	APHA - 4500 H+ B	-
CONDUCTIVITY @ 25 °C	APHA - 2510 B	µS/cm
SULPHATE	APHA - 4500 $SO4^{2-}$ C	mg/L
CHEMICAL OXYGEN DEMAND *	APHA - 5220 D	mg/L
CHLORIDE	APHA - 4500 Cl^- B	mg/L
CARBONATE	APHA - 2320 B	mg/L
BICARBONATE	APHA - 2320 B	mg/L
TOTAL HARDNESS	APHA - 2340 C	mg/L
SALINITY	APHA - 2520 B	PSU
TOTAL PHOSPHOROUS	HACH - 8048	mg/L
DISSOLVED OXYGEN	HACH - 8166	mg/L
AMMONIA	HACH - 8155	mg/L
TOTAL NITROGEN	PHOTOMETRY	mg/L
IRON as (Fe) *	APHA - 3120 B	mg/L
BORON as (B)	APHA - 3120 B	mg/L
SODIUM as (Na)	APHA - 3120 B	mg/L
POTASSIUM as (K)	APHA - 3120 B	mg/L
CALCIUM as (Ca)	APHA - 3120 B	mg/L
MAGNESIUM as (Mg)	APHA - 3120 B	mg/L
BOD (5 DAYS) @ 20 °C*	APHA - 2510 B	mg/L
TOTAL ALKALINITY	APHA - 2320 B	mg/L
COLOUR	HACH - 8025	Units
SATURATION INDEX	WI-5	-
SODIUM ADSORPTION RATIO (SAR)	IHTP - 19	meq/L

It is imperative that you check the Dissolved Oxygen at least once a week. DO meters are inexpensive and are very easy to handle. You need to calibrate according to the manual regularly.
When you reach a saturation of 150 % you need to switch off the system. Make sure you have good flow/water circulation in the waterbody.

Once the DO level goes down to 80 % you can switch the system back on. An over saturation of the water body is harmful for the water quality and aquatic live.

Homeport recommends regular Water tests through a certified Laboratory.

Here is a link to a water saturation calculator:

www.wateronthewеb.org/under/waterquality/DOSatCalc.html

10.Maintenance

ELECTRICAL HAZARD:
Disconnect and lock out electrical power before installing or servicing the unit

WARNING:
Maintenance and service must be performed by skilled and qualified personnel only.
- Observe accident prevention regulations in force.
- Use suitable equipment and protection.
- Make sure that the drained liquid does not cause damage or injuries

Any work on the LB1000/2000 series Ultra fine Bubble generator must be carried out by a qualified Dealer. Contact your dealer for special maintanances packages which Homeport offers to their clients.

Disassembly is not required; any tampering can jeopardize the performance of the machine and void the Warranty. If there is a danger of your lake or pond freezing, you should contact your Dealer to empty the water from the Unit.

With proper attention, inspection and maintenance the Homeport system will operate efficiently and effectively for many years. Maintenance frequency is dependent on the environment into which the system is deployed. Environments with heavy organic material flowing through the system will require more frequent attention to particulate buildup than those with clearer water being drawn into the system.
It is recommended that users inspect their systems as specified below

Weekly

- check all gauges and confirm that they match specified parameters.
- Check the strainer on the suction hose to assure it is free of debrise
  Machines needs to be off for this proceedure.
- clean airfilter / mesh of Fan intake
- check Helix (see picture nr 2 page 16)
- clean unit inside from debris, insects etc only with compressed air, no liquids
- check unit for any water leaks or wet spots
- assure stability of unit

Monthly

- Check that the electric power supply is correct and that the current absorbed is balanced and not greater than the value featured on the plate;
- Check the electrical insulation of the motor;
- clean airfilter of the Oxygen compressor, with compressed air, no liquids.
- clean UFB generator as follows:

  Drain water from the system by opening the 2 inch discharge conection/union **OUTSIDE** the unit. Remove the UFB Generator(s) by loosening the unions at either end of the component(s). Visually inspect the interior for debris or buildup. If any is found, flush with clean water until clear. (Do not use a pressure washer as this could damage the component). If any organic material buildup remains (brown growth/ biofilm or slime), soak the generator(s) in 3 to 6 % bleach for one hour and repeat the flush procedure. (Brushing the interior surface with a soft bristle brush, without any sharp edges, will help the removal process of organic material buildup). Repeat as necessary until the generator is substantially clear.

UFB Generator

- Check O2 purity and liter per minute produced. The oxygen concentrator is a fragile equipment, which suffers at high humidity and can decline in purity production. Therefore a mothly purification test must be conducted. This is done with an Oxygen meter. This instrument shows the purity of oxygen produced as well as the liters per minute been produced.

11. Disposal

There is no need for special disposal procedures, please refer to local requirements in terms of disposal, recovery, reuse and recycling of materials.

12. Oxygen Generator Certifications

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Food and Drug Administration
10903 New Hampshire Avenue
Silver Spring, MD 20993

Certificate No. 10876-6-2017

CERTIFICATE TO FOREIGN GOVERNMENT

In order to allow the importation of United States products into foreign countries , the U.S. Food and Drug Administration (FDA) certifies the following information concerning the product(s) to be exported listed below:

Name of Product(s)

See Attached List

(One Page)

Name of Manufacturer/Distributor, Address

Name of Manufacturer
NIDEK MEDICAL PRODUCTS, INC.
3949 VALLEY EAST INDUSTRIAL DR
Birmingham, AL USA 35217

The product(s) described above (and the manufacturing/distribution site(s) which produces/distributes it) is subject to the jurisdiction of the FDA under the Federal Food, Drug, and Cosmetic Act.

It is certified that the above product(s) may be marketed in, and legally exported from, the United States of America at this time. The manufacturing plant(s) in which the product(s) is produced is subject to periodic inspections. The last such inspection showed that the plant(s), at that time, appeared to be in substantial compliance with current good manufacturing practice requirements for the product(s) listed above.

Robin W. Newman

Robin W. Newman MSN EdD CPNP
Director
Office of Compliance
Center for Devices and Radiological Health
U.S. Food and Drug Administration, DHHS

This certificate is valid from June 27, 2017 to June 26, 2019.

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Food and Drug Administration
10903 New Hampshire Avenue
Silver Spring, MD 20993

Certificate No. 10876-6-2017

Certificate to Foreign Government - Name of Product(s) Attachment Page 1 of 1

Name of Manufacturer

NIDEK MEDICAL PRODUCTS, INC.
3949 VALLEY EAST INDUSTRIAL DR
Birmingham, AL USA 35217

Name of Product(s)

Pulmo-Mist Compressor
Mark 5 Nuvo Oxygen Concentrator
Mark 5 Nuvo Lite Std Oxygen Concentrator
Mark 5 Nuvo Lite OCSI Oxygen Concentrator
Mark 5 Nuvo Lite 3 Oxygen Concentrator
Mark 5 Nuvo 8 Std Oxygen Concentrator
Mark 5 Nuvo 8 OCSI Oxygen Concentrator
Mark 5 Nuvo 10 Oxygen Concentrator
----------END OF PRODUCT LIST----------

Fan Certifications

Certification

Safety

VDE-Reg-Nr.1350

13. Pump Certifications

Live safer.®
NSF International

FOR IMMEDIATE RELEASE

April 1, 2009

NSF Certifies First Pump Manufacturer to Pool/Spa American National Standards

AquaPRO Systems/Wayne Water Systems' Certification to NSF Standard 50 and UL Standard 1081 Demonstrates Commitment to Pool Safety

ANN ARBOR, Mich. – NSF International today announced that **AquaPRO Systems** is the first pump manufacturer to receive certification to both NSF/ANSI Standard 50 - *Equipment for Swimming Pools, Spas, Hot Tubs and Other Recreational Water Facilities* and ANSI/UL 1081 - *Standard for Swimming Pool Pumps, Filters, and Chlorinators* from NSF. Certification to NSF Standard 50 and UL 1081 for pool pumps verifies compliance with the American National Standards for these products, which establish performance and safety requirements.

"AquaPRO Systems' decision to bundle both NSF 50 and UL 1081 certifications to one accredited certification organization, NSF, which is accepted by regulators in the pool and spa industry, was a strategic move for us. It significantly reduced our time to market and total certification cost," said Joe Mauro, President of Wayne Water Systems, d/b/a AquaPRO Systems.

NSF services for pumps include certification to NSF Standard 50 and UL 1081 along with California Energy Commission and sound emissions testing. Ongoing compliance is verified through periodic facility inspections and retesting.

"We are proud to provide proactive manufacturers, such as AquaPRO Systems, the combined testing and certification services they need to demonstrate their commitment to producing safer, quality products," said Dave Purkiss, General Manager, NSF International Water Treatment and Distribution Systems. "Obtaining certification is important because it helps consumers select recreational water products that have been tested and proven to meet national standards."

NSF/ANSI Standard 50 is the American National Standard for swimming pool equipment, spas, hot tubs and other recreational facilities including filters and filter media, pumps, valves, water circulation devices, hose, piping, fittings, pool alarms, pool covers, chemical generation and feeding systems, and advanced water treatment and oxidation technologies, such as ozone and ultraviolet (UV) systems. Most local pool codes require compliance with NSF/ANSI Standard 50. ANSI/UL 1081 is also an American National Standard that includes requirements for motor-operated, non-submersible water pumps, pump-filter combinations, and chlorinators for use with swimming pools, hot tubs, and spas. The California Energy Commission (CEC) includes testing to verify compliance with multiple efficiency requirements.

NSF is accredited as a Nationally Recognized Testing Laboratory (NRTL) by Occupational Safety and Health Administration (OSHA) and as a certification organization by the Standards Council of Canada (SCC) and the American National Standards Institute (ANSI) for numerous product standards. NSF is also registered by the State of California for testing pumps to CEC requirements.

The official NSF Standard 50 Listing for AquaPRO Systems/Wayne Water Systems is available on NSF's Web site. By achieving certification, AquaPRO Systems can place the NSF Mark on its certified pumps.

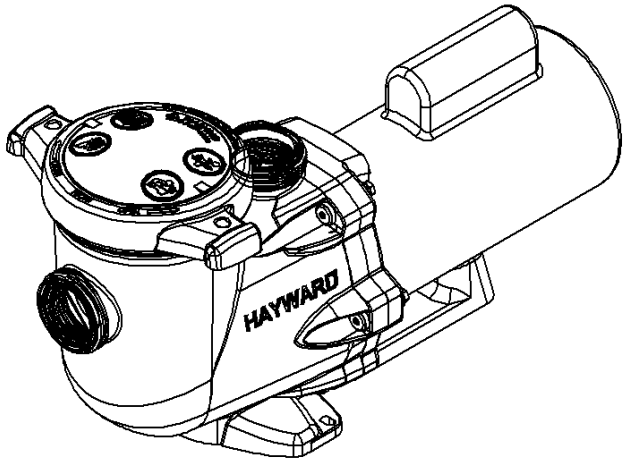
For more information on AquaPRO Systems' certification or NSF's Standard 50, contact Richard Martin at martin@nsf.org or 734-769-5346. More information on AquaPRO Systems is available at http://www.aquaprosystems.com.

About NSF International: NSF International, an independent, not-for-profit organization, helps protect you by certifying products and writing standards for food, water and consumer goods (www.nsf.org). Founded in 1944, NSF is committed to protecting public health and safety worldwide. NSF is a World Health Organization Collaborating Centre for Food and Water Safety and Indoor Environment. Additional services include safety audits for the food and water industries, management systems registrations delivered through NSF International Strategic Registrations, organic certification provided by Quality Assurance International and education through the NSF Center for Public Health Education.

HAYWARD®

OWNER'S MANUAL

INSTALLATION, OPERATION & PARTS



TriStar® Pump Series

The Hayward TriStar Pump is specifically engineered for the demanding requirements of today's in-ground swimming pool/spa that is equipped with large capacity filters, heaters, and pool cleaning equipment. The TriStar is a self-priming pump that includes an improved seal and impeller design that will provide many years of efficient, dependable, corrosion-free service. The advanced design provides superior performance while reducing maintenance requirements. **NOTE -** To prevent potential injury and to avoid unnecessary service calls, read this manual carefully and completely.

IMPORTANT – READ CAREFULLY

NOTE - The TriStar is a high performance, high efficiency pump. When replacing most existing pumps, **you can use a TriStar pump with a lower horsepower rating than the existing pump.**

Required: 2" plumbing minimum
Recommended: 2 ½" plumbing or larger

TriStar Pump Replacement Guide

TriStar Model No. **Full** Rated	**TriStar** Model No. **Max** Rated	**Super II** Model No. **Full** Rated	**Super II** Model No. **Max** Rated
---	SP3207X10	SP3007EEAZ	SP3007X10AZ
SP3207EE	SP3210X15	SP3010EEAZ	SP3010X15AZ
SP3210EE	SP3215X20	SP3015EEAZ	SP3015X20AZ
SP3215EE	SP3220X25	SP3020EEAZ	SP3020X25AZ
SP3220EE	SP3225X30	SP3025EEAZ	SP3025X30AZ
SP3230EE	---	---	---

Hayward Pool Products
620 Division Street, Elizabeth, NJ 07207
Phone: (908) 351.5400
www.haywardpool.com

IMPORTANT SAFETY INSTRUCTIONS

Basic safety precautions should always be followed, including the following: Failure to follow instructions can cause severe injury and/or death.

⚠ This is the safety-alert symbol. When you see this symbol on your equipment or in this manual, look for one of the following signal words and be alert to the potential for personal injury.

⚠ **WARNING** warns about hazards that **could** cause serious personal injury, death or major property damage and if ignored presents a potential hazard.

⚠ **CAUTION** warns about hazards that **will** or **can** cause minor or moderate personal injury and/or property damage and if ignored presents a potential hazard. It can also make consumers aware of actions that are unpredictable and unsafe.

The **NOTICE** label indicates special instructions that are important but not related to hazards.

⚠ **WARNING - Read and follow all instructions in this owner's manual and on the equipment. Failure to follow instructions can cause severe injury and/or death**.

⚠ **WARNING – Suction Entrapment Hazard.**

Suction in suction outlets and/or suction outlet covers which are, damaged, broken, cracked, missing, or unsecured can cause severe injury and/or death due to the following entrapment hazards:

Hair Entrapment- Hair can become entangled in suction outlet cover.

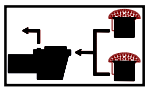
Limb Entrapment- A limb inserted into an opening of a suction outlet sump or suction outlet cover that is damaged, broken, cracked, missing, or not securely attached can result in a mechanical bind or swelling of the limb.

Body Suction Entrapment- A negative pressure applied to a large portion of the body or limbs can result in an entrapment.

Evisceration/ Disembowelment - A negative pressure applied directly to the intestines through an unprotected suction outlet sump or suction outlet cover which is, damaged, broken, cracked, missing, or unsecured can result in evisceration/ disembowelment.

Mechanical Entrapment- There is potential for jewelry, swimsuit, hair decorations, finger, toe or knuckle to be caught in an opening of a suction outlet cover resulting in mechanical entrapment.

⚠ **WARNING - To Reduce the risk of Entrapment Hazards:**



- When outlets are small enough to be blocked by a person, a minimum of two functioning suction outlets per pump must be installed. Suction outlets in the same plane (i.e. floor or wall), must be installed a minimum of three feet (3') [1 meter] apart, as measured from near point to near point.
- Dual suction fittings shall be placed in such locations and distances to avoid "dual blockage" by a user.
- Dual suction fittings shall not be located on seating areas or on the backrest for such seating areas.
- The maximum system flow rate shall not exceed the flow rating of as listed on Table 1.
- Never use Pool or Spa if any suction outlet component is damaged, broken, cracked, missing, or not securely attached.
- Replace damaged, broken, cracked, missing, or not securely attached suction outlet components immediately.
- In addition two or more suction outlets per pump installed in accordance with latest ASME, APSP Standards and CPSC guidelines, follow all National, State, and Local codes applicable.
- Installation of a vacuum release or vent system, which relieves entrapping suction, is recommended.

⚠ **WARNING – Failure to remove pressure test plugs and/or plugs used in winterization of the pool/spa from the suction outlets can result in an increase potential for suction entrapment as described above.**

⚠ **WARNING – Failure to keep suction outlet components clear of debris, such as leaves, dirt, hair, paper and other material can result in an increase potential for suction entrapment as described above.**

⚠ **WARNING – Suction outlet components have a finite life, the cover/grate should be inspected frequently and replaced at least every ten years or if found to be damaged, broken, cracked, missing, or not securely attached.**

⚠ **CAUTION – Components such as the filtration system, pumps and heater must be positioned so as to prevent their being used as means of access to the pool by young children.**

⚠ **WARNING – Never operate or test the circulation system at more than 50 PSI.**

⚠ **WARNING – Never change the filter control valve position while the pump is running.**

⚠ **WARNING** – To reduce risk of injury, do not permit children to use or climb on this product. Closely supervise children at all times. Components such as the filtration system, pumps, and heaters must be positioned to prevent children from using them as a means of access to the pool.

⚠ **WARNING – Hazardous Pressure.** Pool and spa water circulation systems operate under hazardous pressure during start up, normal operation, and after pump shut off. Stand clear of circulation system equipment during pump start up. Failure to follow safety and

operation instructions could result in violent separation of the pump housing and cover, and/or filter housing and clamp due to pressure in the system, which could cause property damage, severe personal injury, or death. Before servicing pool and spa water circulation system, all system and pump controls must be in off position and filter manual air relief valve must be in open position. Before starting system pump, all system valves must be set in a position to allow system water to return back to the pool. Do not change filter control valve position while system pump is running. Before starting system pump, fully open filter manual air relief valve. Do not close filter manual air relief valve until a steady stream of water (not air or air and water) is discharged.

⚠ **WARNING – Separation Hazard.** Failure to follow safety and operation instructions could result in violent separation of pump and/or filter components. Strainer cover must be properly secured to pump housing with strainer cover lock ring. Before servicing pool and spa circulation system, filters manual air relief valve must be in open position. Do not operate pool and spa circulation system if a system component is not assembled properly, damaged, or missing. Do not operate pool and spa circulation system unless filter manual air relief valve body is in locked position in filter upper body.

⚠ **WARNING** – **Risk of Electric Shock.** All electrical wiring MUST be in conformance with applicable local codes, regulations, and the National Electric Code (NEC). Hazardous voltage can shock, burn, and cause death or serious property damage. To reduce the risk of electric shock, do NOT use an extension cord to connect unit to electric supply. Provide a properly located electrical receptacle. Before working on any electrical equipment, turn off power supply to the equipment.

⚠ **WARNING** – To reduce the risk of electric shock replace damaged wiring immediately. Locate conduit to prevent abuse from lawn mowers, hedge trimmers and other equipment.

⚠ **WARNING –** Electrical ground all electrical equipment before connecting to electrical power supply. Failure to ground all electrical equipment can cause serious or fatal electrical shock hazard.

⚠ **WARNING –** Do NOT ground to a gas supply line.

⚠ **WARNING** – To avoid dangerous or fatal electrical shock, turn OFF power to all electrical equipment before working on electrical connections.

⚠ **WARNING** – Failure to bond all electrical equipment to pool structure will increase risk for electrocution and could result in injury or death. To reduce the risk of electric shock, see installation instructions and consult a professional electrician on how to bond all electrical equipment. Also, contact a licensed electrician for information on local electrical codes for bonding requirements.

Notes to electrician: Use a solid copper conductor, size 8 or larger. Run a continuous wire from external bonding lug to reinforcing rod or mesh. Connect a No. 8 AWG (8.4 mm^2) [No. 6 AWG (13.3 mm^2) for Canada] solid copper bonding wire to the pressure wire connector provided on the electrical equipment and to all metal parts of swimming pool, spa, or hot tub, and metal piping (except gas piping), and conduit within 5 ft. (1.5 m) of inside walls of swimming pool, spa, or hot tub.
IMPORTANT - Reference NEC codes for all wiring standards including, but not limited to, grounding, bonding and other general wiring procedures.

⚠ **WARNING** – Risk of Electric Shock. Connect only to a branch circuit protected by a ground-fault circuit-interrupter (GFCI). Contact a qualified electrician if you cannot verify that the circuit is protected by a GFCI.

⚠ **WARNING** – Risk of Electric Shock . The electrical equipment must be connected only to a supply circuit that is protected by a ground-fault circuit-interrupter (GFCI). Such a GFCI should be provided by the installer and should be tested on a routine basis. To test the GFCI, push the test button. The GFCI should interrupt power. Push reset button. Power should be restored. If the GFCI fails to operate in this manner, the GFCI is defective. If the GFCI interrupts power to the electrical equipment without the test button being pushed, a ground current is flowing, indicating the possibility of an electrical shock. Do not use this electrical equipment. Disconnect the electrical equipment and have the problem corrected by a qualified service representative before using.

⚠ **CAUTION –** This pump is intended for use with permanently-installed pools and may be used with hot tubs and spas if so marked. Do not use with storable pools. A permanently-installed pool is constructed in or on the ground or in a building such that it cannot be readily disassembled for storage. A storable pool is constructed so that it is capable of being readily disassembled for storage and reassembled to its original integrity.

SAVE THESE INSTRUCTIONS

General Information

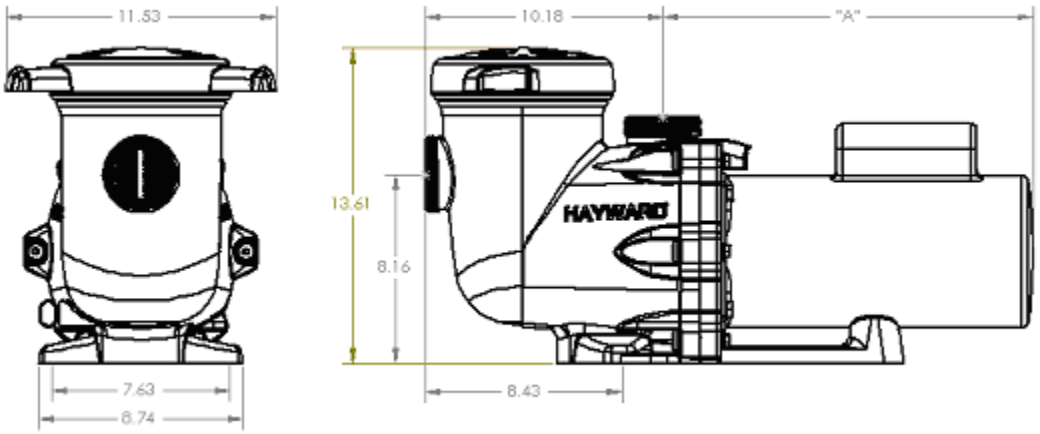
Introduction

This manual contains information for the proper installation and operation of the Hayward TriStar Pump Series. The instructions in this manual **MUST** be followed precisely. **Failure to install according to defined instructions will void warranty.**

Product Benefits

The new TriStar Pump's advanced fluid dynamic design optimizes the three essential pump elements to deliver superior flow, energy efficiency, and quietness. Plus, the heavy-duty pump and motor construction operates cooler for years of dependability. It is the first to feature a Tri-Lock cam and ramp strainer cover design that closes with less than a quarter turn, and the TriStar's super-sized, smooth no-rib basket with extra leaf-holding capacity is easy to clean. TriStar has a variety of bases available to seamlessly retrofit to existing filtration systems.

Product Specifications



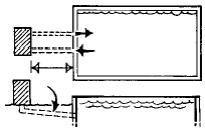
HP	FR "A"	MR "A"
½	13 5/8"	-
¾	13 7/8"	13 3/8"
1	14 3/8"	13 7/8"
1 *	14 3/8"	-
1 ½	14 7/8"	13 7/8"
1 ½ *	14 7/8"	14 3/8"
2	14 7/8"	15 1/8"
2 *	14 7/8"	14 7/8"
2 **	13 1/2"	-
2 ½	-	14 7/8"
2 ½ *	-	14 7/8"
3	17 1/8"	15 5/8"
3 **	14 1/2"	-
5	17 1/8"	-

* Two-Speed Pump
** Three-Phase Pump

Installation Instructions

⚠ **WARNING –** This product should be installed and serviced only by a qualified professional.

Pump Location



Locate pump as close to pool as practical and run suction lines as direct as possible to reduce friction loss. Suction lines should have continuous slope upward from lowest point in line. Joints must be tight (but not over-tightened). Suction line diameter must equal or be larger than the discharge line diameter.

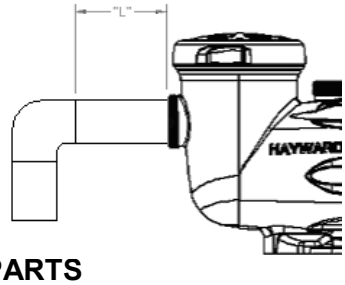
Though the pump is designed for outdoor use, it is strongly advised to place pump and filter in the shade to shield them from continuous direct heat. Select a well-drained area that will not flood when it rains. **Do NOT install pump and filter in a damp or non-ventilated location.** Keep motor clean. Pump motors require free circulation of air for cooling.

Pump Mounting

Install pump on a level concrete slab or other rigid base to meet all local and national codes. Secure pump to base with screws or bolts to further reduce vibration and stress on pipe or hose joints. The base must be level, rigid, and vibration free.

Pump mount must:

- Allow pump inlet height to be as close to water level as possible.
- Allow use of short, direct suction pipe (to reduce friction losses).
- Allow for gate valves in suction and discharge piping.
- Be protected from excess moisture and flooding.
- Allow adequate access for servicing pump and piping.



USE ONLY HAYWARD GENUINE REPLACEMENT PARTS

Pipe Sizing Chart

MAXIMUM RECOMMENDED SYSTEM FLOW RATE BY PIPE SIZE								
Pipe Size [mm]	Flow Rate GPM [LPM]	Suction Pipe Length *	**Pipe Size** [mm]	Flow Rate GPM [LPM]	Suction Pipe Length *	**Pipe Size** [mm]	Flow Rate GPM [LPM]	Suction Pipe Length *
1" [32]	20 [75]	5"	**1 ½"** [50]	45 [170]	7 ½"	**2 ½"** [75]	110 [415]	12 ½"
1 ¼" [40]	30 [110]	6 ¼"	**2"** [63]	80 [300]	10"	**3"** [90]	160 [600]	15"

*** NOTE -** It is recommended that a minimum length of straight piping (shown as "L" in above diagram), equivalent to 5 pipe size diameters, be used between the pump suction inlet and any plumbing fittings (elbows, valves, etc.).

⚠ **WARNING – Hazardous Pressure.** Pumps, filters, and other equipment/ components of a swimming pool filtration system operate under pressure. Incorrectly installed and/or improperly tested filtration equipment and/or components may fail resulting in severe personal injury or death.

Plumbing

Use **Teflon tape** to seal threaded connections on molded plastic components. All plastic fittings must be new or thoroughly cleaned before use. **NOTE - Do NOT use Plumber's Pipe Dope as it may cause cracking of the plastic components.** When applying **Teflon tape** to plastic threads, wrap the entire threaded portion of the male fitting with one to two layers of tape. Wind the tape clockwise as you face the open end of the fitting, beginning at the end of the fitting. The pump suction and outlet ports have molded-in thread stops. **Do NOT attempt to force hose connector fitting past this stop.** It is only necessary to tighten fittings enough to prevent leakage. Tighten fitting by hand and then use a tool to engage fitting an additional 1 ½ turns. Use care when using Teflon tape as friction is reduced considerably; **do NOT over-tighten fitting or you may cause damage**. If leaks occur, remove connector, clean off old Teflon tape, re-wrap with one to two additional layers of Teflon tape, and re-install connector.

Fittings restrict flow. For better efficiency, use the fewest possible fittings (but at least two suction outlets). Avoid fittings that could cause an air trap. Pool and spa fittings MUST conform to the International Association of Plumbing and Mechanical Officials (IAPMO) standards. Use a non-entrapping suction fitting in pool (multiple drains) or double suction (skimmer and main drain).

Electrical

⚠ **WARNING –** All electrical wiring MUST be in conformance with all applicable local codes, regulations, and the National Electric Code (NEC). Ground and bond motor before connecting to electrical power supply. Failure to ground and bond pump motor can cause serious or fatal electrical shock hazard. Do NOT ground to a gas supply line. To avoid dangerous or fatal electrical shock, turn OFF power to motor before working on electrical connections. **Fire Hazard - match supply voltage to motor nameplate voltage.** Insure that the electrical supply available agrees with the motor's voltage, phase, and cycle, and that the wire size is adequate for the HP (kW) rating and distance from the power source. Use copper conductors only.

Voltage

Voltage at motor **MUST NOT** be more than 10% above or below motor name plate rated voltage, or motor may overheat, causing overload tripping and reduced component life. If voltage is less than 90% or more than 110% of rated voltage when motor is running at full load, consult power company.

Grounding and Bonding

Install, ground, bond, and wire motor in accordance with local or national electrical code requirements.

Permanently ground motor. Use green ground terminal provided under motor canopy or access place; use size and type wire required by code. Connect motor ground terminal to electrical service ground.

Bond motor to pool structure. Bonding will connect all metal parts within and around the pool with a continuous wire. Bonding reduces the risk of a current passing between bonded metal objects, which could potentially cause electrical shock if grounded or shorted. **Reference NEC codes for all wiring standards including, but not limited to, grounding, bonding and general wiring procedures.**

Use a solid copper conductor, size 8 or larger. Run wire from external bonding lug to reinforcing rod or mesh. Connect a No. 8 AWG (8.4 mm^2) solid copper bonding wire to the pressure wire connector provided on the motor housing and to all metal parts of swimming pool, spa, or hot tub, and to all electrical equipment, metal piping (except gas piping), and conduit within 5 ft. (1.5 m) of inside walls of swimming pool, spa, or hot tub.

Wiring

⚠ **WARNING –** All electrical wiring MUST be in conformance with all applicable local codes, regulations, and the National Electric Code (NEC).

Pump MUST be permanently connected to circuit. If other lights or appliances are also on the same circuit, be sure to add their amp loads before calculating wire and circuit breaker sizes. Use the load circuit breaker as the Master On-Off switch.

Motor Specifications

	Motor Brake Horsepower	Motor Rated Horsepower	Motor Electric V/A		Wire Size / Breaker	
	HP (kW)	HP (kW)	Voltage	Amps	AWG	Amps
Full Rate Pumps	0.99 (0.74)	0.50 (0.37)	208 - 230 / 115	5.3 - 4.9 / 9.8	14	10 / 15
	1.39 (1.04)	0.75 (0.56)	208 - 230 / 115	7.0 - 6.2 / 12.4	14	10 / 15
	1.85 (1.38)	1.00 (0.75)	208 - 230 / 115	8.5 - 7.4 / 14.8	14 / 12	15 / 20
	2.40 (1.79)	1.50 (1.12)	208 - 230 / 115	11.2 - 10.2 / 20.4	14 / 10	15 / 30
	2.70 (2.01)	2.00 (1.49)	208 - 230	11.8 - 11.0	14	15
	2.70 (2.01) **	2.00 (1.49) **	208 - 230 **	7.0 - 6.6 **	14 **	10 **
	3.60 (2.69)	3.00 (2.24)	208 - 230	16.0 - 14.8	12	20
	3.60 (2.69) *	3.00 (2.24) *	208 - 230 / 460 *	9.6 - 9.4 / 4.7 *	14 *	15 / 10 *
	5.00 (3.73)	5.00 (3.73)	208 - 230	21.0 - 19.4	10	30
	1.85 / 0.22 (1.38 / 0.16)	1.00 / 0.12 (0.75 / 0.09)	208 - 230	8.6 - 8.2 [1]	14	15
	2.40 / 0.28 (1.79 / 0.21)	1.50 / 0.18 (1.12 / 0.13)	208 - 230	11.4 - 10.4 [2]	14	15
	2.70 / 0.33 (2.01 / 0.25)	2.00 / 0.25 (1.49 / 0.19)	208 - 230	12.4 - 11.2 [3]	14	15
Max Rate Pumps	0.94 (0.70)	0.75 (0.56)	230 / 115	5.4 / 10.8	14	10 / 15
	1.25 (0.93)	1.00 (0.75)	230 / 115	7.0 / 14.0	14 / 12	10 / 20
	1.65 (1.23)	1.50 (1.12)	230 / 115	7.7 / 15.4	14 / 12	10 / 20
	2.20 (1.64)	2.00 (1.49)	230 / 115	10.8 / 21.6	14 / 10	15 / 30
	2.60 (1.94)	2.50 (1.86)	230	11.5	14	15
	3.45 (2.57)	3.00 (2.24)	230	13.5	12	20
	1.85 / 0.22 (1.38 / 0.16)	1.50 / 0.18 (1.12 / 0.13)	208 - 230	8.6 - 8.2 [1]	14	15
	2.40 / 0.28 (1.79 / 0.21)	2.00 / 0.25 (1.49 / 0.19)	208 - 230	11.4 - 10.4 [2]	14	15
	2.70 / 0.33 (2.01 / 0.25)	2.50 / 0.30 (1.86 / 0.22)	208 - 230	12.4 - 11.2 [3]	14	15
50 Hz Pumps	0.75 (0.56)	0.75 (0.56)	220 / 110	7.0 / 14.0	14 / 12	10 / 20
	1.00 (0.75)	1.00 (0.75)	220 / 110	8.0 / 16.0	14 / 12	10 / 20
	1.50 (1.12)	1.50 (1.12)	220 / 110	9.8 / 19.6	14 / 10	15 / 30
	2.00 (1.49)	2.00 (1.49)	220	11.0	14	15
	3.00 (2.24)	3.00 (2.24)	220	12.0	14	15
	3.00 (2.24) *	3.00 (2.24) *	380 - 415 / 190 *	4.9 - 4.8 / 9.8 *	14 *	10 / 15 *

[1, 2, 3] Low Speed Amps: ([1] 2.8 - 3.0) ([2] 3.2 - 3.4) ([3] 3.8 - 4.1)

* Three-Phase (3Φ) Pump - motor starter required

** Three-Phase (3Φ) Pump - variable-speed applications only (Not available as a stand-alone pump. May only be used with SP3220VSC.)

Start-Up & Operation

Prior to Start-Up

NOTE - If it is necessary to perform a pressure test, prior to initial use to ensure pump is functioning properly, then the following criteria should be maintained for this test:

1. Have a professional perform this test.
2. Ensure all pump and system components are sealed properly to prevent leaks.
3. Remove any trapped air in the system by fully opening filter manual air relief valve until a steady stream of water (not air or air and water mix) is discharged from the valve.
4. Allow no more than 50 psi (345 kPa) at a water temperature no higher than 100° F (38° C).
5. Run pressure test for no longer than 24 hours. Immediately inspect all parts to verify they are intact and functioning properly.

⚠ **WARNING - If pump is being pressure tested (50 PSI MAXIMUM), be sure pressure has been released, using the filter manual air relief valve, before removing strainer cover.**

⚠ **WARNING –** All suction and discharge valves **MUST** be **OPEN**, as well as filter air relief valve (if available) on filter, when starting the circulating pump system. Failure to do so could result in severe personal injury.

Starting/Priming the Pump:

Pumps with single speed motors are self priming to 10 ft. and pumps with 2 speed motors are self priming to 10 ft. on high speed only. Fill strainer housing with water to suction pipe level. If water leakage occurs from anywhere on the pump or filter, DO NOT start the pump. If no leakage occurs, stand at least 10 feet from pump and/or filter and proceed with starting the pump.

⚠ **WARNING –** Return to filter to close filter manual air relief valve when a steady stream of water (not air or air and water) is discharged from valve. Failure to do so could result in severe personal injury.

⚠ **ATTENTION – NEVER OPERATE THE PUMP WITHOUT WATER**. Water acts as a coolant and lubricant for the mechanical shaft seal. NEVER run pump dry. Running pump dry may damage seals, causing leakage, flooding, and voids warranty. Fill strainer housing with water before starting motor.

⚠ **ATTENTION –** Do NOT add chemicals to pool/spa system directly in front of pump suction. Adding undiluted chemicals may damage pump and voids warranty.

⚠ **ATTENTION –** Before removing strainer cover:

1. **STOP PUMP** before proceeding.
2. **CLOSE VALVES** in suction and outlet pipes.
3. **RELEASE ALL PRESSURE** from pump and piping system using filter manual air relief valve. **See filter owner's manual for more details.**
4. If water source is higher than the pump, pump will prime itself when suction and outlet valves are opened. If water source is lower than the pump, unscrew and remove strainer cover; fill strainer housing with water.
5. Clean and lubricate strainer cover O-ring with "Jack's 327" if necessary.
6. Replace strainer cover on strainer housing; turn clockwise to tighten cover.
   NOTE - Tighten strainer cover lock ring by hand only (no wrenches).

Before re-starting pump, see "**Starting/Priming the Pump"** instructions.

⚠ **ATTENTION –** Wait five (5) seconds before re-starting pump. Failure to do so may cause reverse rotation of motor and consequent serious pump damage.

Turn on power and wait for pump to prime, which may take up to five (5) minutes. Priming time will depend on vertical length of suction lift and horizontal length of suction pipe. If pump does NOT prime within five minutes, stop motor and determine cause. Be sure all suction and discharge valves are open when pump is running. See Troubleshooting Guide.

Maintenance

- Clean strainer basket regularly. Do NOT strike basket to clean. Inspect strainer cover gasket regularly and replace as necessary.
- Hayward pumps have self-lubricating motor bearings and shaft seals. No lubrication is necessary.
- Keep motor clean. Insure motor air vents are free from obstruction to avoid damage. Do NOT use water to hose off motor.
- Occasionally, shaft seals must be replaced, due to wear or damage. Replace with genuine Hayward seal assembly kit. See "Shaft Seal Change Instructions" in this manual.

Storage/Winterization

⚠ **WARNING – Separation Hazard.** Do not purge the system with compressed air. Purging the system with compressed air can cause components to explode, with risk of severe injury or death to anyone nearby. Use only a low pressure (below 5 PSI), high volume blower when air purging the pump, filter, or piping.

⚠ **ATTENTION –** Allowing the pump to freeze will void the warranty.

⚠ **ATTENTION –** Use ONLY propylene glycol as antifreeze in your pool/spa system. Propylene glycol is non-toxic and will not damage plastic system components; other anti-freezes are highly toxic and may damage plastic components in the system.

Drain all water from pump and piping when expecting freezing temperatures or when storing pump for a long time (see instructions below). Gravity drain system as far as possible.

Keep motor dry and covered during storage. To avoid condensation/corrosion problems, do NOT cover or wrap pump with plastic film or bags.

Storing Pump for Winterization

⚠ **WARNING –** To avoid dangerous or fatal electrical shock hazard, turn OFF power to motor before draining pump. Failure to disconnect power may result in serious personal injury or death.

1. Drain water level below all inlets to the pool.
2. Remove drain plugs and strainer cover from strainer housing. (See Parts Diagram on page 11 of this manual for pump component locations.)
3. Disconnect pump from mounting pad, wiring (after power has been turned OFF), and piping.
4. Once the pump is removed of water, re-install the strainer cover and drain plugs. Store pump in a dry area.

Shaft Seal Change Instructions

IMPORTANT SAFETY INSTRUCTIONS
PLEASE READ AND FOLLOW ALL INSTRUCTIONS

When servicing electrical equipment, basic safety precautions should always be observed including the following. Failure to follow instructions may result in injury.

A. ⚠ **WARNING** – To reduce risk of injury, do not permit children to use this product.
B. Disconnect all electrical power service to pump before beginning shaft seal replacement.
C. Only qualified personnel should attempt rotary seal replacement. Contact your local authorized Hayward Dealer or service center if you have any questions.

Exercise extreme care in handling both the rotating and the stationary sections of the two-part replacement seal. Foreign matter or improper handling will easily scratch the graphite and ceramic sealing surfaces.

Removing the Motor Assembly (See Parts Diagram on page 11 of this manual for pump component locations.)

1. Remove the six (6) 5/16" x 2" hex head bolts (item #17), which hold the motor assembly to the pump/strainer housing (item #3), using a 1/2" wrench or socket.
2. Slide the motor assembly out of the pump/strainer housing (item #3), exposing the diffuser (item #9). Remove the two diffuser screws (item #7), and pull the diffuser (item #9) off of the seal plate (item #15) to expose the impeller (item #12).

Removing the Impeller (See Parts Diagram on page 11 of this manual for pump component locations.)

3. Remove the motor canopy by removing the two (2) screws and pulling the canopy away from the motor.
4. To prevent motor shaft from turning, carefully place a 7/16" open-end wrench over the two (2) flats on the end of the shaft.
5. Rotate the impeller screw (item #10) clockwise (note that screw has left-hand thread) and remove. Remove the impeller (item #12) by rotating counterclockwise.

Removing the Ceramic Seat (See Parts Diagram on page 11 of this manual for pump component locations.)

6. Remove the spring seal assembly (item #13) and seal plate (item #15) from the motor by removing the four (4) 3/8" x 1" bolts (item #18) that secure it to the motor, using a 9/16" wrench or socket. Remove the motor support bracket (item #20) from the seal plate (item #15).
7. Press the ceramic seat with rubber cup out of the seal plate (item #15). If tight, use a small screwdriver to tap seal out.
   STOP - Clean all recesses & parts to be reassembled. Inspect gaskets & replace if necessary.

Seal Installation (See Parts Diagram on page 11 of this manual for pump component locations.)

8. Clean and lightly lubricate the motor shaft and seal recesses in the seal plate (item #15) with a dilute solution of non-granulated liquid-type soap. Gently wipe the polished face of the ceramic seal with a soft cotton cloth. Lubricate the rubber cup on the ceramic seat and press it firmly into the recess of the seal plate (item #15), with the polished ceramic surface facing out.
9. Reassemble the motor to the seal plate (item #15) using the four (4) 3/8" x 1" bolts (item #18), and re-attach the motor support (item #20) to the seal plate (item #15).
10. Gently wipe the black, polished surface of the spring seal assembly (item #13) with a soft cotton cloth.
11. Press the spring seal assembly (item #13) onto the motor shaft, with the black polished surface facing the ceramic seat.

Replacing the Impeller and Diffuser (See Parts Diagram on page 11 of this manual for pump component locations.)

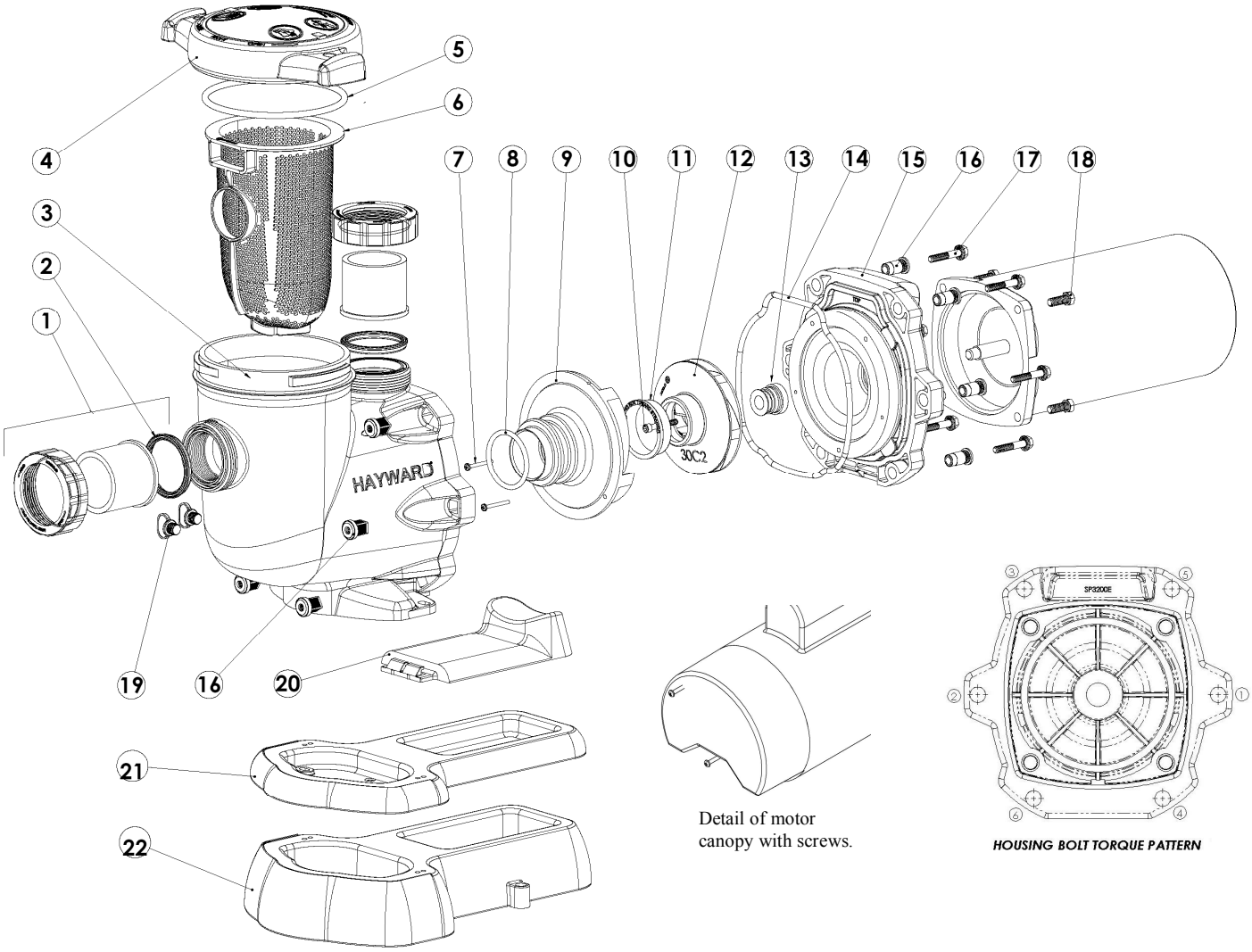
12. Screw the impeller (item #12) onto the motor shaft in a clockwise direction, and screw the impeller screw (item #10) into the motor shaft in a counterclockwise direction. Tighten snugly by holding motor shaft with wrench as noted in step #4. Place the impeller ring (item #11) back onto the impeller (item #12), with flange facing towards the diffuser (item #9).
13. Place the diffuser (item #9) over the impeller (item #12) and onto the seal plate (item #15), aligning the three pins on the diffuser (item #9) with the three holes on the seal plate (item #15). Replace the two diffuser screws (item #7).

Replacing the Motor Assembly (See Parts Diagram on page 11 of this manual for pump component locations.)

14. Re-attach motor canopy using the two (2) hex headed screws. Slide the motor assembly, with the diffuser (item #9) in place, into pump/strainer housing (item #3), being careful not to disturb the diffuser gasket (item #8).
15. Fasten assembly to pump/strainer housing (item #3) using the six (6) 5/16" x 2" bolts (item #17). (Be sure housing gasket (item #14) is in place, and lubricated. Replace if damaged). Tighten bolts alternately and evenly to 185 inch-pounds according to housing bolt torque pattern detail.

Replacement Parts

Parts Diagram



Detail of motor canopy with screws.

HOUSING BOLT TORQUE PATTERN

Parts Listing

Ref. No.	Part No.	Description	Ctn. Qty.
1	SPX3200UNKIT	Union Connector Kit (Includes Union Nut, Union Connector, Union Gasket - 2 ea.)	1
2	SPX3200UG	Union Gasket	1
3	SPX3200A	Pump Strainer Housing, 2" x 2 1/2" with Drain Plugs, threaded style	1
4	SPX3200DLS	Strainer Cover Kit (Includes Strainer Cover, Lock Ring, O-Ring)	10
4	SPX3200DLSB	Strainer Cover Kit (Biguanide Sanitizer Applications Only; **NOT** Pressure Testable)	10
5	SPX3200S	Strainer Cover O-Ring	10
6	SPX3200M	Strainer Basket	15

USE ONLY HAYWARD GENUINE REPLACEMENT PARTS

Ref. No.	Part No.	Description	Ctn. Qty.
7	SPX3200Z8	Diffuser Screw	1
8	SPX4000Z1	Diffuser O-Ring	10
9	SPX3200B3	Diffuser	1
10	SPX3200Z1	Impeller Screw	1
11	SPX3021R	Impeller Ring	1
12	SPX3205C	Impeller for ½ HP with Impeller Screw	10
12	SPX3207C	Impeller for ¾ HP with Impeller Screw	10
12	SPX3207CM	Impeller for 1 HP with Impeller Screw (Max Rate)	10
12	SPX3210C	Impeller for 1 HP with Impeller Screw (Full Rate)	10
12	SPX3215C	Impeller for 1 ½ HP with Impeller Screw	10
12	SPX3220C	Impeller for 2 HP with Impeller Screw (Full Rate)	10
12	SPX3220CM	Impeller for 2 ½ HP with Impeller Screw (Max Rate)	10
12	SPX3230C	Impeller for 3 HP with Impeller Screw	10
12	SPX3230C5	Impeller for 5 HP with Impeller Screw	10
13	SPX3200SA	Shaft Seal Assembly	10
14	SPX3200T	Housing O-Ring	10
15	SPX3200E	Seal Plate	1
16	SPX3200Z211	Housing Insert/Seal Plate Spacer Kit	1
17	SPX3200Z3	Housing Bolt	10
18	SPX3200Z5	Motor Bolt	1
19	SPX4000FG	Drain Plug with O-Ring	10
20	SPX3200GA	Bracket, Motor Support, TriStar	1
21 *	SPX3200WF	Base, Short Riser, TriStar	1
22 *	SPX3200SR	Base, Tall Riser, TriStar	1

Pump SKU Detail

	Model P/N	Motor P/N	Power End P/N (1)	Impeller P/N
Full Rate Pumps	SP3205EE	SPX3205Z1BER	SPX3205Z1PE	SPX3205C
	SP3207EE	SPX3207Z1BER	SPX3207Z1PE	SPX3207C
	SP3210EE	SPX3210Z1BER	SPX3210Z1PE	SPX3210C
	SP3215EE	SPX3215Z1BER	SPX3215Z1PE	SPX3215C
	SP3220EE	SPX3220Z1BER	SPX3220Z1PE	SPX3220C
	SP3230EE	SPX3230Z1BER	SPX3230Z1PE	SPX3230C
	SP3250EE	SPX3240Z1MER	SPX3250Z1PE	SPX3230C5
	SP32102EE	SPX3210Z2BER	SPX3210Z2PE	SPX3210C
	SP32152EE	SPX3215Z2BER	SPX3215Z2PE	SPX3215C
	SP32202EE	SPX3220Z2BER	SPX3220Z2PE	SPX3220C
	SP322063EEV (2)	SPX3220Z1DRV (2)	SPX3220Z1PE3V (2)	SPX3215C
	SP323063EE	SPX3230Z1DR	SPX3230Z1PE3	SPX3230C
Max Rate Pumps	SP3205X7	SPX3205Z1MR	SPX3205X7Z1PE	SPX3205C
	SP3207X10	SPX3207Z1MR	SPX3207X10Z1PE	SPX3207CM
	SP3210X15	SPX3210Z1MR	SPX3210X15Z1PE	SPX3210C
	SP3215X20	SPX3215Z1MR	SPX3215X20Z1PE	SPX3215C
	SP3220X25	SPX3220Z1MR	SPX3220X25Z1PE	SPX3220CM
	SP3225X30	SPX3225Z1MR	SPX3225X30Z1PE	SPX3230C
	SP3210X152	SPX3210Z2MER	SPX3210X15Z2PE	SPX3210C
	SP3215X202	SPX3215Z2MER	SPX3215X20Z2PE	SPX3215C
	SP3220X252	SPX3220Z2MER	SPX3220X25Z2PE	SPX3220C
50 Hz Pumps	SP3205X751	SPX3205Z1MCR	N/A	SPX3207C
	SP3207X1051	SPX3207Z1MCR	N/A	SPX3210C
	SP3210X1551	SPX3210Z1MCR	N/A	SPX3215C
	SP3215X2051	SPX3215Z1MCR	N/A	SPX3220C
	SP3225X3051	SPX3220Z1MCR	N/A	SPX3230C
	SP3225X3053	SPX3230Z1DR	N/A	SPX3230C

NOTE: (1) Power end assembly includes parts #7-18 and motor.
(2) Variable-speed applications only (Not available as a stand-alone pump. May only be used with SP3220VSC.)

USE ONLY HAYWARD GENUINE REPLACEMENT PARTS

Troubleshooting

Motor Will NOT Start – Check For:

Make sure the terminal board connections agree with the wiring diagram on motor data plate label. Be sure motor is wired for available field supply voltage (see pump operating label).

1. Improper or loose wiring connections; open switches or relays; tripped circuit breakers, or blown fuses.

Solution: Check all connections, circuit breakers, and fuses. Reset tripped breakers or replace blown fuses.

2. Manually check rotation of motor shaft for free movement and lack of obstruction.

Solution: Refer to Steps 4 & 5 of "Shaft Seal Change Instructions" in this manual.

3. If you have a timer, be certain it is working properly. Bypass it if necessary.

Motor Shuts OFF – Check For:

1. Low voltage at motor or power drop (frequently caused by undersized wiring or extension cord use).

Solution: Contact qualified professional to check that the wiring gauge is heavy enough.

NOTE: Your Hayward pump motor is equipped with an "automatic thermal overload protector." The motor will automatically shut off if power supply drops before heat damage can build up causing windings to burn out. The "thermal overload protector" will allow the motor to automatically restart once the motor has cooled. It will continue to cut On/Off until the problem is corrected. **Be sure to correct cause of overheating.**

Motor Hums, But Does NOT Start – Check For:

1. Impeller jammed with debris.

Solution: Have a qualified repair professional open the pump and remove the debris.

Pump Won't Prime, Check For:

1. Empty pump/strainer housing.

Solution: Make sure pump/strainer housing is filled with water and cover o-ring is clean. Ensure o-ring is properly seated in the cover o-ring groove. Ensure o-ring sealing surface is lubricated with "Jack's 327" and that strainer cover is locked firmly in position. Lubricant will help to create a tighter seal.

2. Loose connections on suction side.

Solution: Tighten pipe/union connections.

NOTE - Any self-priming pump will not prime if there are suction air leaks. Leaks will result in bubbles emanating from return fittings on pool wall.

3. Leaking O-ring or packing glands on valves.

Solution: Tighten, repair, or replace valves.

4. Strainer basket or skimmer basket loaded with debris.

Solution: Remove strainer housing cover or skimmer cover, clean basket, and refill strainer housing with water. Tighten cover.

5. Suction side clogged.

Solution: Contact a qualified repair professional.

Block off to determine if pump will develop a vacuum. You should have 5" - 6" of vacuum at the strainer cover **(Only your pool dealer can confirm this with a vacuum gauge)**. You may be able to check by removing the skimmer basket and holding your hand over the bottom port with skimmer full and pump running. If no suction is felt, check for line blockage.

a. If pump develops a vacuum, check for blocked suction line or dirty strainer basket. An air leak in the suction piping may be the cause.
b. If pump does not develop a vacuum and pump has sufficient "priming water":
    i. Re-check strainer housing cover and all threaded connections for suction leaks. Check if all system hose clamps are tight.
    ii. Check voltage to ensure that the motor is rotating at full RPM's.
    iii. Open housing cover and check for clogging or obstruction in suction. Check impeller for debris.
    iv. Remove and replace shaft seal only if it is leaking.

Low Flow – Generally, Check For:

1. Clogged or restricted strainer or suction line.

Solution: Contact a qualified repair professional.

2. Undersized pool piping.

Solution: Correct piping size.

3. Plugged or restricted discharge line of filter, valve partially closed (high gauge reading).

Solution: Sand filters – backwash as per manufacturer's instructions; D.E. filters – backwash as per manufacturer's instructions; Cartridge filters – clean or replace cartridge.

4. Air leak in suction (bubbles issuing from return fittings).

Solution: Re-tighten suction and discharge connections using Teflon tape. Inspect other plumbing connections and tighten as required.

5. Plugged, restricted, or damaged impeller.

Solution: Replace including new seal assembly.

Noisy Pump – Check For:

1. Air leak in suction piping, cavitations caused by restricted or undersized suction line or leak at any joint, low water level in pool, and unrestricted discharge return lines.

Solution: Correct suction condition or throttle return lines, if practical. Holding hand over return fitting will sometimes prove this point or putting in a smaller eyeball fitting.

2. Vibration due to improper mounting, etc.

Solution: Mount the pump on a level surface and secure the pump to the equipment pad.

3. Foreign matter in pump housing. Loose stones/debris hitting impeller could be cause.

Solution: Clean the pump housing.

4. Motor bearings noisy from normal wear, rust, overheating, or concentration of chemicals causing seal damage which will allow chlorinated water to seep into bearings wiping out the grease causing bearing to whine.

Solution: All seal leaks should be replaced at once.

PRODUCT REGISTRATION
(Retain For Your Records)

DATE OF INSTALLATION _____

INITIAL PRESSURE GAUGE READING (CLEAN FILTER) _____

PUMP MODEL _____ HORSEPOWER _____

FILTER MODEL _____ SERIAL NUMBER _____

HAYWARD® Pool Products Limited Warranty

To original purchasers of this equipment, Hayward Pool Products, Inc. warrants its products to be free from defects in materials and workmanship for a period of ONE (1) year from the date of purchase, when used in single family residential applications.

The limited warranty excludes damage from freezing, negligence, improper installation, improper use or care or any Acts of God. Parts that fail or become defective during the warranty period shall be repaired or replaced, at our option, within 90 days of the receipt of defective product, barring unforeseen delays, without charge.

Proof of purchase is required for warranty service. In the event proof of purchase is not available, the manufacturing date of the product will be the sole determination of the purchase date.

To obtain warranty service, please contact the place of purchase or the nearest Hayward Authorized Service Center. For assistance on your nearest Hayward Authorized Service Center please visit us at www.haywardpool.com.

Hayward shall not be responsible for cartage, removal, repair or installation labor or any other such costs incurred in obtaining warranty replacements or repair.

The Hayward Pool products warranty does not apply to components manufactured by others. For such products, the warranty established by the respective manufacturer will apply.

The express limited warranty above constitutes the entire warranty of Hayward Pool Products with respect to its' pool products and is in lieu of all other warranties expressed or implied, including warranties of merchantability or fitness for a particular purpose. In no event shall Hayward Pool products be responsible for any consequential, special or incidental damages of any nature.

Some states do not allow a limitation on how long an implied warranty lasts, or the exclusion of incidental or consequential damages, so the above limitation may not apply to you. This warranty gives you specific legal rights, and you may also have other rights, which vary from state to state.

Hayward Pool Products
620 Division Street
Elizabeth, NJ 07207

***Supersedes all previous publications.**

▲Retain this Warranty Certificate (upper portion) in a safe and convenient location for your records.

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HAYWARD®

DETACH HERE: Fill out bottom portion completely and mail within 10 days of purchase/installation or register online.

TriStar® Pump Series

Warranty Card Registration

Please Print Clearly:

First Name_____ **Last Name**_____

Street Address_____

City_____ **State**_____ **Zip**_____

Phone Number_____ **Purchase Date**_____

E-Mail Address_____

Serial Number

Model Number_____

Pool Capacity_____(U.S. Gallons)

☐Please include me on all e-mail communications regarding Hayward® Equipment or promotions.

Mail to: Hayward Pool Products, 620 Division Street, Elizabeth, NJ 07207

Attn: Warranty Dept

Or REGISTER YOUR WARRANTY ON-LINE AT WWW.HAYWARDPOOL.COM

Years Pool has been in service

☐ < 1 year ☐ 1-3 ☐ 4-5 ☐ 6-10 ☐ 11-15 ☐ >15

Purchased from_____

☐Builder ☐Retailer ☐Pool Service ☐Internet/Catalog

Company Name_____

Address_____

City_____ State_____ Zip_____

Phone_____

Type of Pool:

☐ Concrete/Gunite ☐ Vinyl ☐ Fiberglass

☐ Other_____

☐ New Installation ☐ Replacement

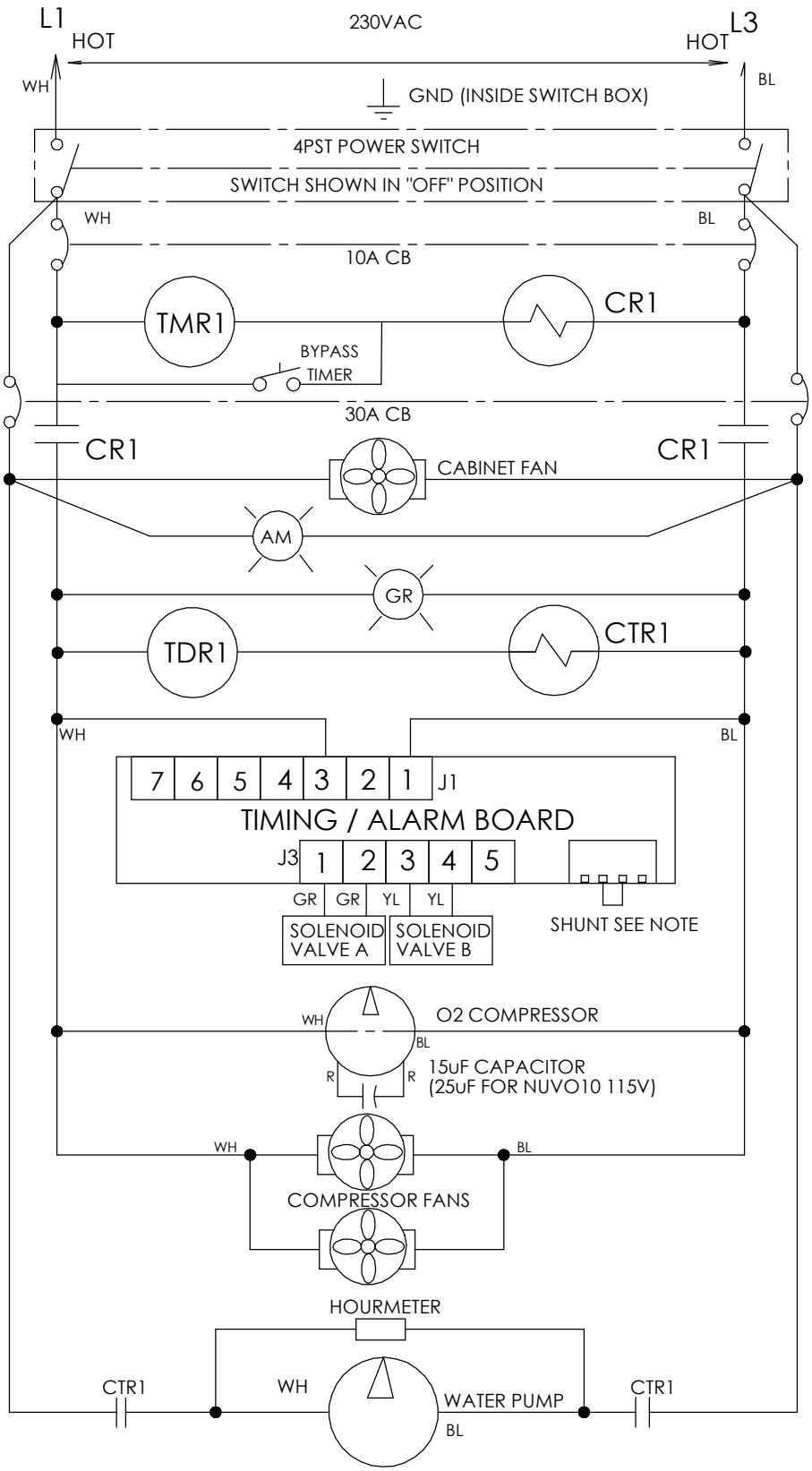
Installation for:

☐ In Ground ☐ Above Ground ☐ Spa

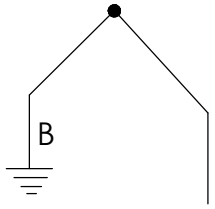
USE ONLY HAYWARD GENUINE REPLACEMENT PARTS

APPENDIX B: ELECTRICAL SCHEMATIC PLAN FOR THE HOMEPORT NANOBUBBLE GENERATOR

REV	DESCRIPTION	BY	REF. TO	APP.	DATE
A	INITIAL ISSUE	GM	ECC18-013		8/10/18
B					
C					
D					



GROUNDING DETAIL



GND ROD

GND TO POOL PUMP

GND LUG LOCATED ON SWITCH PANEL

VOLTAGE SELECTION
ONE SHUNT FOR 230V (SHOWN)
TWO SHUNTS FOR 115V
SHUNT 8400-1513

THERMAL DEVICE INSIDE

WIRE COLORS
B = BARE
BL = BLACK
WH=WHITE
GR = GREEN
YL = YELLOW

TOLERANCES UNLESS OTHERWISE SPECIFIED
UNITS ARE IN INCHES

0.0 = 0.060"
0.00 = 0.020"
0.000 = 0.005"

ANGLES +1 ° ' "
- ° ' "

ELECTRICAL SCHEMATIC HOMEPORT UNIT 230VOLT

NIDEK Medical

DRAWN BY	GM	APPRV BY	--
CHEKD BY	--	SCALE	

DWG NO. ES00033 REV A

STK CODE

REF.DWG. SHEET 1 OF 1

DATE 8/10/18

CAD FILE ES00033 Rev A, Electrical Schematic 240V Control Panel

APPENDIX III

NANOBUBBLE GENERATOR

OPERATION AND WINTERIZATION MANUAL

DECEMBER 2022

PREPARED FOR:

LAKE FOREST YACHT CLUB
35 YACHT CLUB DRIVE
JEFFERSON TOWNSHIP, NJ, 07849

PREPARED BY:

PRINCETON HYDRO
35 CLARK STREET
TRENTON, NJ, 08611

Dan Schultz, President
Lake Forest Yacht Club
35 Lake Forest Drive
Jefferson, NJ, 07849

RE: Nanobubble generator system operation and winterization manual

Dear Mr. Schultz:

As a participant in the Lake Hopatcong Commission's 2020 NJDEP Harmful Algae Bloom (HABs) Grant, the Lake Forest Yacht Club received a nanobubble generator system with an ozone generator. This system was purchased and installed at your facility with NJDEP grant money. At the completion of the two year project, the grant money also paid for Princeton Hydro to winterize the system in December of 2022. After this winterization, the ownership, maintenance and winterization of the system is now the responsibility of the Lake Forest Yacht Club.

The following pages detail the relatively simple winterization process, as well as the manufacturers operation and maintenance manual. While Princeton Hydro is more than happy to help with any issues with the system, it will be under a service agreement contract.

Princeton Hydro would like to thank the Lake Forest Yacht Club for participating in the NJDEP HABs grant.

Sincerely,

J.P. Bell
Project Manager – Aquatics

TABLE OF CONTENTS

SYSTEM OVERVIEW

There are two units that make up the entire system: The Pro O2 ozone generator system that feeds ozone to the Homeport nanobubble generator system. On site, the ozone generator is housed in the blue box, and the nanobubble generator is housed in the green box. When the system is operating, the ozone generator creates ozone that is pushed through tubes that lead to the nanobubble system. The ozone is combined with the nanobubbles in the output chamber, which is then released into the water. A professional electrician was hired to run electric to the site and the system has its own circuit breaker on the main panel located elsewhere on the Lake Forest site.

MANUFACTURERS OWNER AND MAINTENANCE MANUALS

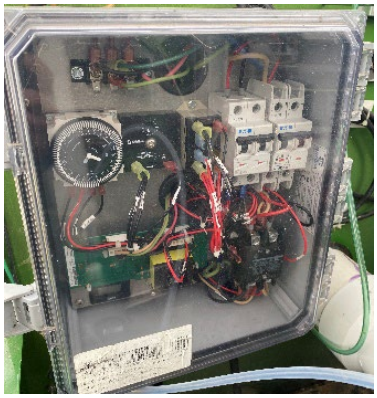
The manufactures manuals were downloaded from their respective websites and are located at the end of this document. The Homeport nanobubble generator manual is in Appendix A and the Electrical Schematic for the nanobubble system located in Appendix B

SYSTEM WINTERIZATION

There are only a few steps to complete the winterization of both systems. The steps required to complete the winterization doesn't require in depth knowledge of the system, only the use of a few wrenches. The ozone generator has two plastic lines that connect it to the nanobubble system. The nanobubble system has two large hoses – an intake and output hose. The ozone lines do not need to be touched and the two hoses do not need to come out of the water. The ozone generator has no official winterization procedures, only to cut the electricity, which can be done at the breaker on the electric panel. It is recommended that any debris around the area around the blue box be removed, as well as removing the side panel and checking for debris inside the cabinet.

The nanobubble system does have a few steps that need to be completed for winterization of the unit. While working with these units during the NJDEP grant project, Princeton Hydro has encountered some issues with the pump impeller seizing inside the pump housing and not pumping at all. If the unit has not been run in a while,

Main On / Off switch



Timer on left

the first thing that should be done is see if the pump is seized. This can be done by simply turning on the unit with the main switch. If you see water moving in the clear outlet hose, the pump is operating properly. If not, turn the unit off. This can be done with the large red dial switch on the front of the unit. Now, open the cabinet and check for and remove any debris that may have accumulated. If so desired, the timer switch inside the cabinet can be turned off or the "on" times adjusted. The timer switch looks like a clock and is located in the clear plastic covered gray box inside the cabinet.

If the pump is seized, the impeller needs to be knocked free. This can be accomplished by removing a sensor attached at the base of the pump. Use an appropriately sized wrench or an adjustable wrench to remove the

Remove the senor

Steel rod to free impeller

Spray lubricant into pump housing

sensor. Now lower a steel rod into the hole and use a hammer to gently tap the rod and break the rust that has formed on the impeller. Once the impeller is free, then liberally spray lubricant into the pump housing and turn the impeller with the steel rod so the entire impeller gets coated with lubricant. For now, leave the sensor off to the side and the hole open.

The final step is to fill the primer pot and pump housing with antifreeze. Five gallons of antifreeze is needed. Princeton Hydro has been using RV and Marine antifreeze, which is propylene glycol based, environmentally friendly and inexpensive. Remove the primer pot lid with an adjustable wrench. Pull out the debris basket inside and remove any debris that has accumulated. Now pour the antifreeze into the primer pot. The antifreeze will

Remove primer pot lid

Remove / clean debris basket

Filling with antifreeze

enter the pump housing from the bottom of the primer pot. Keep filling until the pump housing is filled, and antifreeze appears at the sensor hole. Now the sensor can be screwed back into place. Finish filling the primer pot with antifreeze to just below the green intake hose and screw the primer pot lid back on. When the system is turned on again next year, the antifreeze will be flushed out and released into the lake waters. This should not be an issue as the antifreeze is environmentally friendly and the five gallons of antifreeze will be completely diluted with thousands of gallons of lake water.

SUGGESTIONS FOR FUTURE USE

During discussions with Homeport during troubleshooting, the nanobubble generator manufacturer, it was revealed that the ozone system should only be run for about an hour a day. But the nanobubble generator should be run for more than an hour to be effective. In fact, during the 2022 winterization, it was noted that the timer on the nanobubble system was set to run from 9am till noon, and then again from 6pm to 8pm. At present, there is not a timer on the ozone generator, but it is recommended that a licensed electrician install one. This way, the ozone generator can be set to run for a short amount of time (ie, a half hour) during each of the nanobubble generator cycles.

Also, the primer pot was installed on the nanobubble generator after the unit was originally installed. There were issues with getting the system started. The height of the unit above the lake's water level is just a bit too high for the pump to pull water up the intake hose. When the primer pot was installed, it was filled with water via buckets. That primer pot water was then directly released into the pump housing when the system was started, causing enough suction to pull lake water up the intake hose. The intake hose does have backflow preventer valve, so theoretically when the system is run on a routine basis, the primer pot should always be full, and the system should start up immediately without issue. Realistically, when the system hasn't run in a few weeks or months, water may have seeped out from the backflow valve and the primer pot lid should be removed and the pot filled if needed before system startup.

APPENDIX A: HOMEPORT NANOBUBBLE SYSTEM OPERATIONS AND MAINTENANCE MANUAL

MaxDO LB 1000/2000 Ultra Fine Bubble Generator
Safety, Installation, Operation and Maintenance Manual

Revision 1.7.

June 5 th, 2019

Table of Contents

1. Introduction and safety

1.1. Introduction

Purpose of this manual

The purpose of this manual is to provide necessary information for:

- Safety
- Installation
- Operation
- Maintenance

NOTICE:
Read this manual carefully before installing and using the product. Improper use of the product can cause personal injury and damage to property, and may void the warranty.

CAUTION:
Always specify the exact product type and part number when requesting technical information or spare parts from the Sales and Service Department

CAUTION:
Save this manual for future reference, and keep it readily available at the location of the unit.

1.1. Users

WARNING:
This product is intended to be operated by qualified personnel only. Be aware of the following precautions:

- Children must be supervised to ensure that they do not play on or around the product

1.2. Safety terminology and symbols

About safety messages

It is extremely important that you read, understand, and follow the safety messages and regulations carefully, before handling the product. They are published to help prevent these hazards:

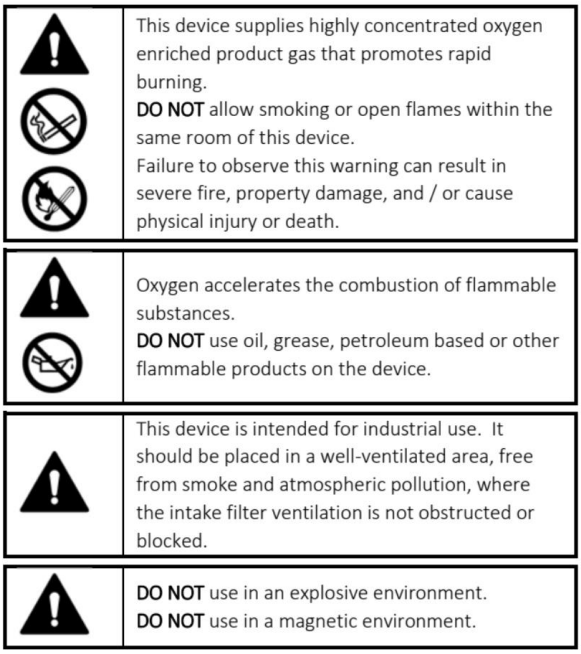
- Personal accidents and health problems
- Damage to the product
- Product malfunction

Hazard Level	Indication
 **DANGER:**	A hazardous situation which, if not avoided, will result in death or serious injury
 **WARNING:**	A hazardous situation which, if not avoided, could result in death or serious injury
 **CAUTION:**	A hazardous situation which, if not avoided, could result in minor or moderate injury
NOTICE:	A potential situation which, if not avoided, could result in undesirable conditions • A practice not related to personal injury

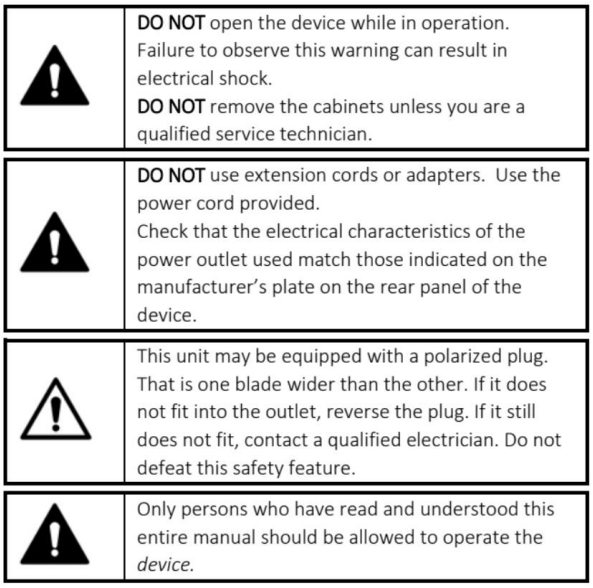
1.3. Safety Instructions

The instructions and warnings that are provided in this manual concern the standard version, as described in the unit specification sheet. Special UFB (Ultra fine bubble) generator versions may be supplied with supplementary instruction leaflets. Refer to sales contract for any modifications or special version characteristics. For instructions, situations, or events that are not considered in this manual or the sales document, contact your Dealer.

1.3.1. Safety Instructions for Oxygen Generator Parts



	This device supplies highly concentrated oxygen enriched product gas that promotes rapid burning. **DO NOT** allow smoking or open flames within the same room of this device. Failure to observe this warning can result in severe fire, property damage, and / or cause physical injury or death.
	Oxygen accelerates the combustion of flammable substances. **DO NOT** use oil, grease, petroleum based or other flammable products on the device.
	This device is intended for industrial use. It should be placed in a well-ventilated area, free from smoke and atmospheric pollution, where the intake filter ventilation is not obstructed or blocked.
	DO NOT use in an explosive environment. **DO NOT** use in a magnetic environment.



	DO NOT open the device while in operation. Failure to observe this warning can result in electrical shock. **DO NOT** remove the cabinets unless you are a qualified service technician.
	DO NOT use extension cords or adapters. Use the power cord provided. Check that the electrical characteristics of the power outlet used match those indicated on the manufacturer's plate on the rear panel of the device.
	This unit may be equipped with a polarized plug. That is one blade wider than the other. If it does not fit into the outlet, reverse the plug. If it still does not fit, contact a qualified electrician. Do not defeat this safety feature.
	Only persons who have read and understood this entire manual should be allowed to operate the *device.*

The WARNINGS below indicate a potentially hazardous situation. If conditions are not avoided a situation could occur that results in serious injury or death.

- Oxygen is not a flammable gas, but it accelerates the combustion of materials. Do not use in explosive atmosphere. To avoid risk of fire and explosion the concentrator should be kept away from flames or heat sources, incandescent sources, smoking materials, matches, oil, grease, solvents, aerosols, etc. Do not allow oxygen to accumulate on upholstery or other fabric such as tarps, bedding or personal clothing

- Use of other accessories not described in this Guide is not recommended and may void the Warranty.
- No modification to the equipment is allowed. To do so may void the Warranty.
- Device must have power to operate. In the event of power loss and for continued operation a backup source is recommended.
- DO NOT disassemble due to danger of electrical shock. Refer servicing to qualified service personnel.
- Use the power cord provided and check that the electrical characteristics of the power socket used match those indicated on the manufacturer's plate on the rear panel of the device.
- We recommend against the use of extension cords and adapters, as they are potential sources of sparks and fire.
- This unit may be equipped with a polarized plug. That is one blade wider than the other. If it does not fit into the outlet, reverse the plug. If it still does not fit, contact a qualified electrician. Do not defeat this safety feature.

1.3.2. Safety Instructions for Water Pump Parts

The WARNINGS below indicate a potentially hazardous situation. If conditions are not avoided a situation could occur that results in serious injury or death.

Do not use pump for any purpose other than recommended application by Homeport and the pump manufacturer (see attachment). Components have not been designed for other applications. Severe pump failure may result. Any unapproved use will void Warranty.

Always follow basic safety precautions with this equipment, including:

- Provide sufficient ventilation to maintain air temperature below the maximum ambient temperature rating shown on the motor nameplate. Pump house must allow adequate ventilation to assure the ambient temperature remains below the motor rating when the pump is operating.
- Locate the machine on a non-combustible surface. The surface should be hard, level, dry, well ventilated, out of direct sunlight. The surrounding area should provide protection from the elements and allow sufficient space for maintenance and service. Ensure the drainage will flow away from the pump.
- Deploy the external inflow hose to allow the pump suction inlet height to be as close to water level as possible. If the pump must be located above the filled water level, keep the vertical distance to a minimum. Use short, direct piping; this will minimize Ultrafine bubble loss due to friction.

Fire and burn hazard

Motors run at high temperatures. Do not allow leaves, debris, or foreign matter to collect around the pump motor. Keep ventilation holes always open. Allow motor to cool before handling. Keep flammable liquids away. If the thermal overload protection in the motor trips or if the GFCI trips determine the reason and correct the problem before re-starting pump.

Use rigid or flexible PVC, with no interior rigs for intake and outflow piping. Ensure pipe ends are clean and free of any flash caused by cutting. Use the proper glue for the type of pipe selected.

NOTE: Use a supplier recommended primer to ensure glued joints are secure. Many local codes require primer with a purple tracer to verify primer use.

Consider climatic conditions when applying adhesives. Atmospheric conditions such as high humidity will make the adhesive action of certain glues less effective. Follow the manufacturer's instructions.

1.4. Disposal of packaging and product

Observe the local regulations and codes in force regarding sorted waste disposal.

1.5. Warranty

Homeport Water Solutions warrants to the original end purchase during the warranty period, every new MaxDo LB 1000/2000 Ultra Fine Bubble Generator to be free from defects in material and workmanship under normal use and service, when properly installed, used, and maintained, (in accordance with Homeport's's operational manual), for a period (starting from the first installation):

- twelve (12) months for the oxygen concentrator part
- twenty four (24) months for the oxygen compressor part
- thirty six (36) months for the water pump parts
- thirty six (36) months for the UFB generator and
- sixty (60) months for the housing parts (exluding locks, hatches, ventilators, switch boards, electrical installations, cables and tubes)

For detailed information about warranty services and limitations, see the sales contract.

1.6. Spare parts

WARNING:
Only use original spare parts to replace any worn or faulty components. The use of unsuitable spare parts may cause malfunctions, damage, and injuries as well as void the Warranty

WARNING:
Always specify the exact product type and part number when requesting technical information or spare parts from the Sales and Service Department

2. Transportation and Storage

2.1. Delivery Inspection

- Prior to signing bill of lading/shipment and rleasing shipper, check the outside of the package for evident signs of damage. If damage is evident, file appropriate claim with shipper and inform your Dealer.
- Notify our Dealer within three days of the delivery date, if the product bears visible signs of damage.

Unpack the unit

Follow applicable step:

- If the unit is packed in a carton, then remove the staples and open the carton.
- If the unit is packed in a wooden crate, then open the cover while paying attention to the nails and straps. Remove the securing screws or the straps from the wooden base
- Do not pull or tug the unit out of the packing material without removing nails or staples as this may damage the unit

Inspect the unit

- Remove packing materials from the product. Dispose of all packing materials in accordance with local regulations.
- Inspect the product to determine if any parts have been damaged or are missing.
- If applicable, unfasten the product by removing any screws, bolts, or straps. For your personal safety, be careful when you handle nails and straps.
- Contact the local sales representative if there is any issue.

2.2. Transportation guidelines

Precautions

WARNING:
Observe accident prevention regulations in force.
- Crush hazard. The unit and the components can be heavy. Use proper lifting methods and wear steel-toed shoes at all times

Check the gross weight that is indicated on the package in order to select proper lifting equipment.

MaxDO units are NOT to be stacked at any time.

Position and fastening

The generator or generator unit can be transported only horizontally. Make sure that the UFB unit is securely fastened during transportation and cannot slide, roll or fall over.

2.3. Storage guidelines

When not deployed the unit must be stored in a covered and **dry** location free from heat, dirt, and vibrations.

NOTICE:
- Protect the product against humidity, heat sources, and mechanical damage
- Do not place heavy weights on the packed product.

2.3.1 Long-term storage

If the unit is stored for more than 6 months, these requirements apply:

- Unit must be flushed with clean sweet water and all water must be drained from system
- Store in a covered and dry location.
- Store the unit free from heat, dirt, and vibrations.

For questions about possible long-term storage treatment services, please contact your local sales and service representative.

MaxDO units are NOT to be stacked at any time.

Ambient temperature

The product must be stored at an ambient temperature from 0°C to +40°C (32°F to 104°F)

3. System Applications

MaxDo LB1000/2000 Series Ultra Fine Bubble ("UFB") Generators are applied to increase oxygen/gas levels for lakes, ponds, sewage or agricultural treatment ponds and aquaculture installations.The size, rising speed, negative polarity, oxygen/gas transfer rates and development of Hydroxyl Radicals during the collapse of Ultrafine bubbles make them a unique and effective aeration choice. Your Dealer can help you understand the cleaning action provided by each of these features of the LB1000/2000 Series.

It should be understood that the treatment and application to achieve a self-purification process closely depends on the cause and level of pollution and if the source of this pollution has been eliminated. The basic function and performance are described as follows.

3.1. Functional Principle

The MaxDo LB1000/2000 Series UFB generators use patented technology for mixing liquid with oxygen or other gases through leveraging hydrodynamics to create Ultra fine bubbles.

Our LB1000/2000 Series UFB generators continuously produce more than 160,000,000 bubbles per ml of water. These bubbles are of a diameter smaller than 100 Nano meters (one billionth of a meter). These Ultra fine bubbles activate the source water, through their size, rising speed, negative polarity, oxygen/gas transfer rates and development of Hydroxyl Radicals. The resulting oxygenated water and subsequent growth of naturally occurring beneficial bacteria and oxidization of chemical and metal contaminants resolves pollutants and microbes which cause pollution, and molecules that produce smell.

As the result, the water returns to a natural balance without impacting the environment. The process does not involve chemicals or heavy metals and is a sustainable solution.

Ultra Fine Bubbles are negatively charged. On the contrary, harmful microbes and bacteria are positively charged. As the minus and plus charge pull toward each other, the Ultrafine bubbles adhere to the microbes and the bad bacteria due to attractive force existing between them, when they meet with each other there is a distructive action.

Hydroxyl ions exsist in abundance in ultra-fine bubble water and they sterilize bad microbes and bacteria effectively. Hydroxyl ions can also oxidize heavy metals like iron or manganese in the water.

Ultra . ine Bubbles can also oxydize chemical such as Ammonia (NH4), P2O5, compounds of Cr+6 and As- compounds.

4. System Performance

Please speak with your Dealer to properly size the application of LB1000/2000 Series UFB platform. Proper sizing based on the size, depth, in flows, outflows and pollution currently impacting the water body is imperative to achieving desired results. Under sizing may result in extended time to achieve results or a minimal result, while over treatment can produce opposite results. For best results, please discuss your specific characteristics of the waterbody with your Homeport dealer.

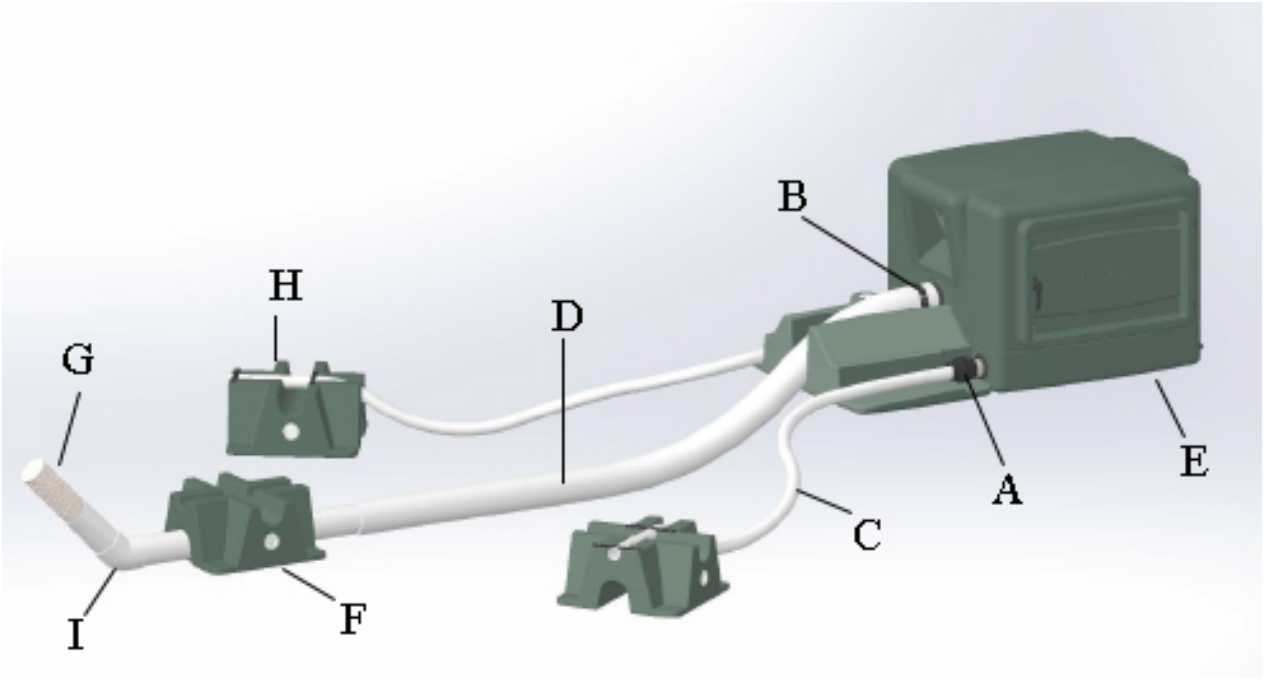
Homeport strongly suggests the use of Probiotics and Enzymes in order to supplement the positive effect of UFB injection into the water body, as well as enhance the natural balance of the ecosystem. Please request our Probiotic Information sheet for further info. Probiotics should be used monthly for the first 3 months followed by quarterly treatment. This depends on the polution level of your waterbody. Please consult Homeport for profesional conclusions and advise. Homeport offers Probiotics , Organic Probiotics and Enzymes specifically produced based on your waterbodies problems and desired outcomes.

5. Installation parts requirements

1 piece swing flap, non return valve : 3 inch for LB1000, 4 inch for LB2000. **(F)**
1 piece suction strainer, non corrosive, min 12 inches/30 cm long **(G)**
2 pieces 30 feet/ 10 m (maximum) 2 inch pvc tube or flexible PVC, with no interior ribs/ridges **(C)**
or alternative:
2 pieces up to 150 feet (maximum) 2,5 inch pvc tube or flexible pvc, as above. Exact same lenght
1 piece ,as short as possible, 3 inch rigid or flexible PVC *for LB1000* ***(D)***
1 piece, as short as possible, 4 inch, rigid or flexible PVC, *for LB2000* ***(D)***
2 pieces PVC connectors for discharge hose or pipe, 2 or 2,5 inch. to connect to unit **(A)**
1 piece connector for suction hose or pipe, 3 inch for LB1000, 4 inch for LB 2000, to connect to unit **(B)**
3 pieces weight (hollow bloc or similar) for 2 inch discharge fixation to ground. Minimum 12 inch/ 30 cm above ground **(H)**
1 piece 45 degrees PVC connector for suction strainer. 3 inch for LB1000, 4 inch for LB2000 **(I)**
1 piece solid , horizontal platform for unit **(E)**

PVC primer, PVC glue, hose clamps, tools

Maximum elevation difference between suction end and machine is 10 feet.
The shorter the suction and discharge tube the more it reduces head pressure.



Suction strainer **(G)**

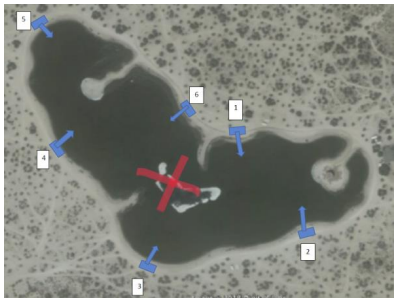
PVC Swing Check Valve **(F)**

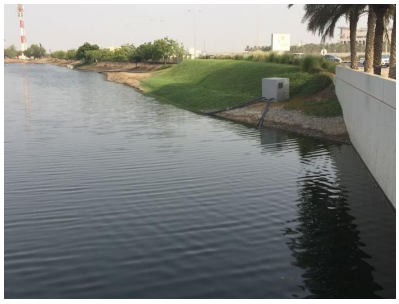
Solid, horizontal platform **(E)**

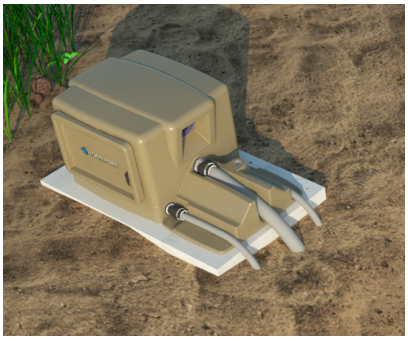
6. Recommendations for Installation Location

Considering the water volume to be cleaned, water flow, and the treatment capacity of LB1000/2000 series UFB generator, the number of units and locations must be determined with the help of your Dealer. Typical indications are as follows.

(1) Make sure that the power source is available at the installation site (220 Volt, 30 amps)
(2) Make sure you have necessary authorizations and permissions to install the system
(3) Make sure your installation complies to all local municipal rules and regulations
(4) Make sure that your installation site is preferably shaded and protected from environmental impact
(5) Set up the LB1000/2000 series close to the shore but not where it might be flooded from changing water levels.
(6) Set up one MaxDO LB1000/2000 near the inflow of the water body
(7) Understanding the hydrodynamics of the water body is fundamental for optimal performance of the installed system
(8) Understanding water pollution through professional testing is fundamental for good performance of the installed system, please work with your Dealer to obtain proffessional testing before and after installation . These reports will also help to determine the amount and type of Probiotics needed.






7. Restrictions of usage

WARNING:
Improper use of the generator may create dangerous conditions and cause personal injury and damage to property.

DANGER:
Do not use this generator to handle flammable and/or explosive liquids.

LB1000/2000 series UFB generators have an integrated pump solution designed to work in on-shore fixed or mobile installations.

The machine is not suitable for water and gases with the features below:

- Water density greater than 1000 kg/m3 (8.34 pounds/gallon);
- Water kinematic viscosity in the range 0,7-1,5 cSt);
- Water pH lower than 4;
- Chemically and mechanically aggressive substances for the materials of the generator;
- Flammable and/or explosive substances;
- Ozone or any other aggressive gases. This unit is built for oxygen or atmospheric air only. If use of ozone is required for specific application, please refer to our special LB model version for ozone.

8. Installation

8.1. Installation Precautions

WARNING:
- Observe accident prevention regulations in force.
- Use suitable equipment and protection.
- Always refer to the local and/or national regulations, legislation, and codes in force regarding the selection of the installation site, and power connections.

Installations should be performed by authorized Dealer.

Following precautions must be considered:

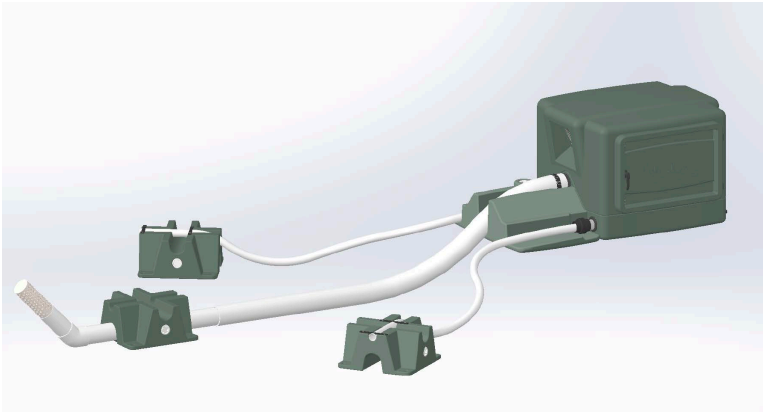
8.2. Installation site:

- The surface should be non-combustible, hard, level, dry, well ventilated, out of direct sunlight (if possible).
- The surrounding area should provide protection from the elements and allow sufficient space for maintenance and service.
- The generator should be installed on solid and horizontal base – best if concrete or other robust material.
- To avoid possible damage to the generator, please check the tides or flood information in order to prevent water entry into the generator box.

8.3. Suction/discharge :

- Suction and discharge hose should have the same length and not be longer than 10 m (30 ft) with 2 inch discharge tube and no longer then 45 m (150 ft) with 2,5 inch tube. In both occasions suction is 3 (LB1000)or 4 inch (LB2000).
- Use rigid or flexible PVC, with *no interior* ribs/ridges for suction and discharge piping.
- Ensure pipe ends are clean and free of any flash caused by cutting.
- Use the proper glue for the type of pipe selected.
- Choose an appropriate intake screener / strainer with a minimum lenght of 33 cm/1 ft
- Suction hose with screener should be deployed at a minimum depth of 30 cm (1 ft) and maximum depth of 2 m (6 ft) below the water surface
- Suction hose with screener should be deployed min 30 cm (1 ft) above the lake bed, ie sludge level . It should not lay on ground in order to avoid clogging of the screener and disturbing of the sediments layer.
- Suction and discharge hose ends should not be positioned close to each other in the water. A distance of min 3 m (10 ft) is recommended.
- The end of the discharge hose should be directed under slightly upward at an angle of (approx. 20 °) for the best Ultra fine bubble dispersion, were depths is more than 1 meter /3 feet. If the water is less then 1 meter/3 feet deep, pipes should be installed horizontally.
- Mark the discharge and the suction position of the hoses in the water with buoys in order to prevent any incidents or interference from lake activity.
- Strainer must be 3 inch diameter for the MaxDO LB 1000 and 4 inch for the MaxDO LB2000 and at least 1 ft long to avoid suction friction.
- Suction pipe must be equiped with a non return valvue right before the strainer

Installation set up example:
Suction above the sludge/ground layer
Discharge approx.1 ft / 30 cm above sludge/ground to avoid stiring up sediments etc.
Note: Due to the outflowing pressure the tube needs to be fixed to avoid " whipping" around



8.4 Electrical specification

ELECTRICAL HAZARD:

- Make sure that all connections are performed by qualified installation technicians and in compliance with the municipal regulations in force.
- Before starting work on the unit, make sure that the unit and the control panel are isolated from the power supply and cannot be energized. This applies to the control circuit as well.

Electrical installation can ONLY be concluded by a certified electrician

A Ground Fault Circuit Interrupter (GFCI) is required in the circuit. For size of GFCI required see Pump manufacturer's instructions.

- Never ground to a gas supply line.
- To avoid dangerous or fatal electrical shock: turn OFF, disconnect the power at its source, lock out power to motor and place a tag on the dedicated GFCI circuit breaker indicating the power is to remain OFF before working on electrical connections.

Ground Fault Circuit Interrupter (GFCI) tripping indicates an electrical problem. If GFCI trips, determine the reason for tripping. If you are uncertain, have a qualified electrician inspect and repair the electrical system. Verify supply voltage matches the nameplate voltage. Incorrect voltage can cause fi re or seriously damage motor and voids warranty.

VOLTAGE

Voltage at motor must be within 10% of the motor nameplate rated voltage or motor may overheat, causing overload tripping and reduced component life. Verify voltage is correct before applying power. If voltage does not fall within the specified range during operation consult the power company.

The units are shipped with motors wired for 208-230 operation. Refer to pump manual for specific pump related instructions.

Breaker /amp and cable

Homeport recommends a #10 gauge wire and a 30 amp breaker. This is only a recomendation and needs to be installed according to local law regulations.

Grounding (earthing)

ELECTRICAL HAZARD:

- Always connect the external protection conductor to ground (earth) terminal before making other electrical connections.
- You must ground (earth) all electrical

Install, ground, bond and wire motor according to local or National Electrical Code requirements. Permanently ground the motor. Use ground terminal provided in the terminal box on the back of the motor. Use size and type wire required by local codes. Connect motor ground terminal to electrical service ground. Bond motor to protective structure. Use a solid copper conductor, size No. 6 AWG or larger. Run wire from external bonding lug to reinforcing rod or mesh. Use solid copper bonding conductor not smaller than 6 AWG (13 mm2) from the accessible wire connector on the motor to all metal parts of the structure.

WIRING

Follow all national and local wiring codes. If unsure of code requirements consult a professional electrician. Pump must be permanently connected to a dedicated circuit. If unsure consult a licensed electrician.

NOTE: All electrical wiring and components must be selected and installed in conformance with the latest NEC requirements and local codes. If you are unsure about the requirements consult a licensed electrician familiar with the requirements.

Before conducting any maintenance and/or repair on the generator, disconnect it from the mains power supply. Connection point should be located far enough from water region and the perfect prevention of electric leakage is required.

9. Operations

CAUTION: Do not block pump suction. To do so with body parts will cause severe or fatal injury.

Fire and burn hazard.
Motor runs at high temperatures, to reduce the risk of fire, do not allow debris, or foreign matter to collect around the pump motor. Allow motor to cool prior to handling or performing maintenance.

Do not run pump dry. Fill pump with water before starting motor

1. Open water pump strainer basket cover and fill carefully with water, without having water leak into the unit, until the system is full of water. The check valve/non return valve will ensure that the water system will afterwards stay filled with water, incase of shutdown.

2. Close water pump strainer basket cover.

3. After safety measures are confirmed, switch on main power switch

4. Only Fan and Oxygen generator will start running.This is to prevent water been pushed into the O2 lines.

5. After 30 to 45 seconds the water pump will automatically switch on

6. After 5 min of operations check the transparent tube at discharge outflow. You should be able to see a helix (looks like a small tonado, see pic 1,2 & 3 below) formed in the middle of the water column. This indicates that Ultra Fine Bubbes are been produced. On the water surface you should see micro bubbles above the discharge location (see picture 4). Unit is working correctly.

7. Close unit and check gauges as per following recomendation

The motor is equiped with an internal thermal protection circuit to guard against overheating. The maximum ambient temperature for motor operation must not exceed the rating as specified on the motor model plate.

1

2

3

4

9.1 Gauge readings

Following readings should be indicated on the gauges

Suction: 5 to 12 max. If higher indication, clean the pump basket strainer and the water strainer.
Oxygen: 10 to 16
Temperature: max 60 C/ 140 F.
Discharge: 8 to 12

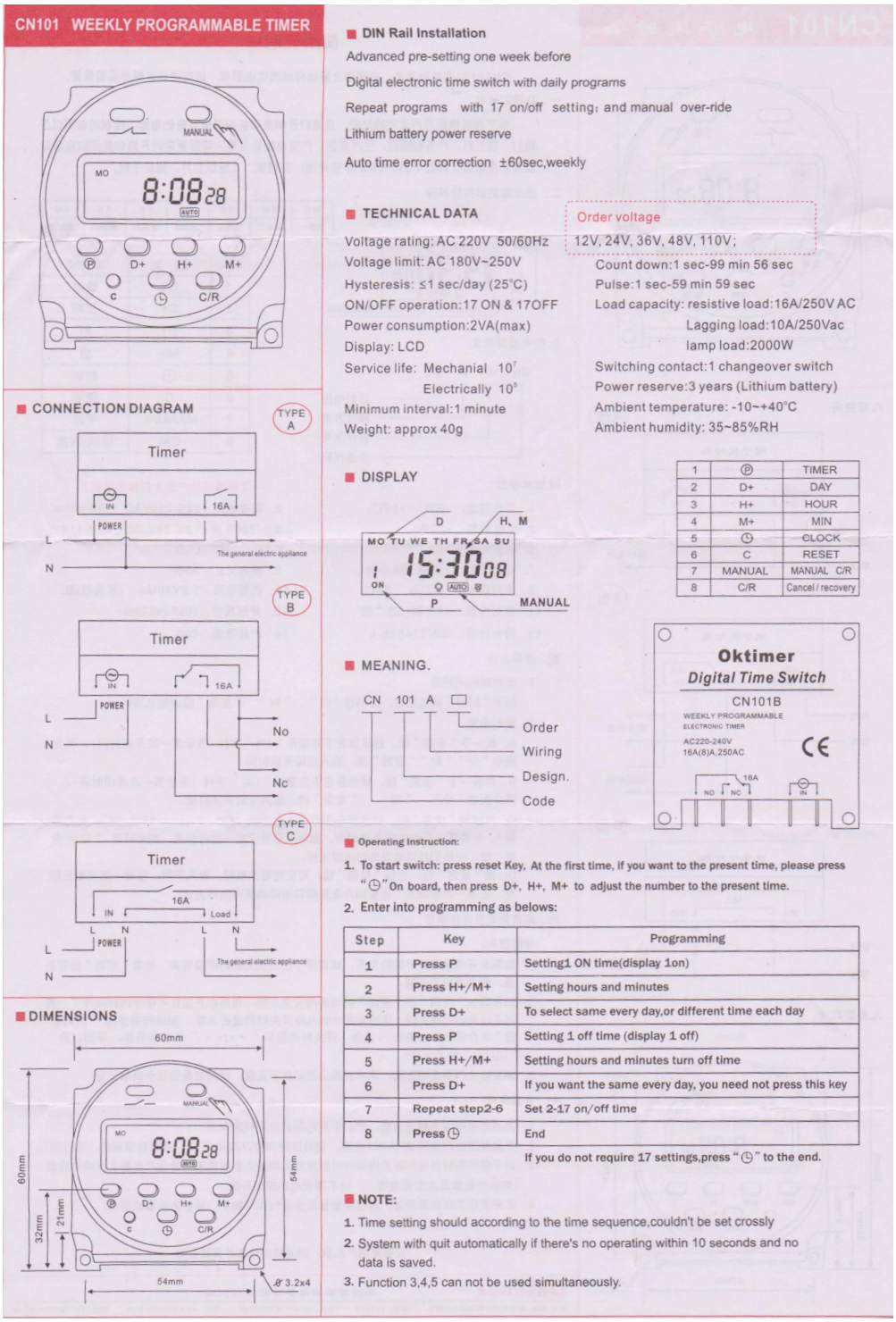
9.2 Operation time

Considering the volume of the water body to be purified, water flow, and the purification capability of LB1000/2000 UFB generator, the recommended generator operation times be determined with the help of our authorized resellers. Homeport recommends 24/7 running time for first 60 days.
Typical indications are as follows, when desired water quality levels are reached for at least 2 months:

- Normal operation mode: 12 hrs on, 12 hrs off.
- Intensive mode (in case of heavy pollution) 24 hrs on

9.3 Timer

The UFB generator is equipped with an electronic timer to regulate working hours of the unit.



CN101 WEEKLY PROGRAMMABLE TIMER

MANUAL

MO 8:08 28 AUTO

Ⓟ D+ H+ M+

C C/R

■ CONNECTION DIAGRAM

TYPE A

Timer

IN 16A

POWER

L

N

The general electric appliance

TYPE B

Timer

IN 16A

POWER

L

N

No

Nc

TYPE C

Timer

16A

IN Load

L N L N

POWER

L

N

The general electric appliance

■ DIMENSIONS

60mm

MANUAL

MO 8:08 28 AUTO

Ⓟ D+ H+ M+

C C/R

60mm

32mm

21mm

54mm

54mm

Ø 3.2x4

■ DIN Rail Installation

Advanced pre-setting one week before

Digital electronic time switch with daily programs

Repeat programs with 17 on/off setting: and manual over-ride

Lithium battery power reserve

Auto time error correction ±60sec,weekly

■ TECHNICAL DATA

Order voltage

12V, 24V, 36V, 48V, 110V;

Voltage rating: AC 220V 50/60Hz

Voltage limit: AC 180V~250V

Hysteresis: ≤1 sec/day (25°C)

ON/OFF operation:17 ON & 17OFF

Power consumption:2VA(max)

Display: LCD

Service life: Mechanial 10^7

Electrically 10^5

Minimum interval:1 minute

Weight: approx 40g

Count down:1 sec-99 min 56 sec

Pulse:1 sec-59 min 59 sec

Load capacity: resistive load:16A/250V AC

Lagging load:10A/250Vac

lamp load:2000W

Switching contact:1 changeover switch

Power reserve:3 years (Lithium battery)

Ambient temperature: -10~+40°C

Ambient humidity: 35~85%RH

■ DISPLAY

D H、M

MO TU WE TH FR SA SU

1 ON 15:30 08 AUTO

P MANUAL

1	Ⓟ	TIMER
2	D+	DAY
3	H+	HOUR
4	M+	MIN
5	◷	CLOCK
6	C	RESET
7	MANUAL	MANUAL C/R
8	C/R	Cancel / recovery

■ MEANING.

CN 101 A □

Order

Wiring

Design.

Code

Oktimer

Digital Time Switch

CN101B

WEEKLY PROGRAMMABLE ELECTRONIC TIMER

AC220-240V 16A(8)A,250AC

CE

16A NO NC IN

■ Operating Instruction:

1. To start switch: press reset Key, At the first time, if you want to the present time, please press "◷" On board, then press D+, H+, M+ to adjust the number to the present time.
2. Enter into programming as belows:

Step	Key	Programming
1	Press P	Setting1 ON time(display 1on)
2	Press H+/M+	Setting hours and minutes
3	Press D+	To select same every day,or different time each day
4	Press P	Setting 1 off time (display 1 off)
5	Press H+/M+	Setting hours and minutes turn off time
6	Press D+	If you want the same every day, you need not press this key
7	Repeat step2-6	Set 2-17 on/off time
8	Press ◷	End

If you do not require 17 settings,press "◷" to the end.

■ NOTE:

1. Time setting should according to the time sequence,couldn't be set crossly
2. System with quit automatically if there's no operating within 10 seconds and no data is saved.
3. Function 3,4,5 can not be used simultaneously.

9.4. Water Quality Inspection

Sampling Report No : GTL/DX/SR/2018-953
Sample Container / Size : PLASTIC BOTTLE / 1.5 L
Appearance : TURBID / GREENISH LIQUID
Sender's Reference : NOT GIVEN

RESULTS OF CHEMICAL ANALYSIS DA

PARAMETER	TEST METHOD (REFERENCE NO.)	UNIT
pH @ 20 °C *	APHA - 4500 H+ B	-
CONDUCTIVITY @ 25 °C	APHA - 2510 B	µS/cm
SULPHATE	APHA - 4500 $SO4^{2-}$ C	mg/L
CHEMICAL OXYGEN DEMAND *	APHA - 5220 D	mg/L
CHLORIDE	APHA - 4500 Cl^- B	mg/L
CARBONATE	APHA - 2320 B	mg/L
BICARBONATE	APHA - 2320 B	mg/L
TOTAL HARDNESS	APHA - 2340 C	mg/L
SALINITY	APHA - 2520 B	PSU
TOTAL PHOSPHOROUS	HACH - 8048	mg/L
DISSOLVED OXYGEN	HACH - 8166	mg/L
AMMONIA	HACH - 8155	mg/L
TOTAL NITROGEN	PHOTOMETRY	mg/L
IRON as (Fe) *	APHA - 3120 B	mg/L
BORON as (B)	APHA - 3120 B	mg/L
SODIUM as (Na)	APHA - 3120 B	mg/L
POTASSIUM as (K)	APHA - 3120 B	mg/L
CALCIUM as (Ca)	APHA - 3120 B	mg/L
MAGNESIUM as (Mg)	APHA - 3120 B	mg/L
BOD (5 DAYS) @ 20 °C*	APHA - 2510 B	mg/L
TOTAL ALKALINITY	APHA - 2320 B	mg/L
COLOUR	HACH - 8025	Units
SATURATION INDEX	WI-5	-
SODIUM ADSORPTION RATIO (SAR)	IHTP - 19	meq/L

It is imperative that you check the Dissolved Oxygen at least once a week. DO meters are inexpensive and are very easy to handle. You need to calibrate according to the manual regularly.
When you reach a saturation of 150 % you need to switch off the system. Make sure you have good flow/water circulation in the waterbody.

Once the DO level goes down to 80 % you can switch the system back on. An over saturation of the water body is harmful for the water quality and aquatic live.

Homeport recommends regular Water tests through a certified Laboratory.

Here is a link to a water saturation calculator:

www.wateronthewеb.org/under/waterquality/DOSatCalc.html

10.Maintenance

ELECTRICAL HAZARD:
Disconnect and lock out electrical power before installing or servicing the unit

WARNING:
Maintenance and service must be performed by skilled and qualified personnel only.
- Observe accident prevention regulations in force.
- Use suitable equipment and protection.
- Make sure that the drained liquid does not cause damage or injuries

Any work on the LB1000/2000 series Ultra fine Bubble generator must be carried out by a qualified Dealer. Contact your dealer for special maintanances packages which Homeport offers to their clients.

Disassembly is not required; any tampering can jeopardize the performance of the machine and void the Warranty. If there is a danger of your lake or pond freezing, you should contact your Dealer to empty the water from the Unit.

With proper attention, inspection and maintenance the Homeport system will operate efficiently and effectively for many years. Maintenance frequency is dependent on the environment into which the system is deployed. Environments with heavy organic material flowing through the system will require more frequent attention to particulate buildup than those with clearer water being drawn into the system.
It is recommended that users inspect their systems as specified below

Weekly

- check all gauges and confirm that they match specified parameters.
- Check the strainer on the suction hose to assure it is free of debrise
  Machines needs to be off for this proceedure.
- clean airfilter / mesh of Fan intake
- check Helix (see picture nr 2 page 16)
- clean unit inside from debris, insects etc only with compressed air, no liquids
- check unit for any water leaks or wet spots
- assure stability of unit

Monthly

- Check that the electric power supply is correct and that the current absorbed is balanced and not greater than the value featured on the plate;
- Check the electrical insulation of the motor;
- clean airfilter of the Oxygen compressor, with compressed air, no liquids.
- clean UFB generator as follows:

  Drain water from the system by opening the 2 inch discharge conection/union **OUTSIDE** the unit. Remove the UFB Generator(s) by loosening the unions at either end of the component(s). Visually inspect the interior for debris or buildup. If any is found, flush with clean water until clear. (Do not use a pressure washer as this could damage the component). If any organic material buildup remains (brown growth/ biofilm or slime), soak the generator(s) in 3 to 6 % bleach for one hour and repeat the flush procedure. (Brushing the interior surface with a soft bristle brush, without any sharp edges, will help the removal process of organic material buildup). Repeat as necessary until the generator is substantially clear.

UFB Generator

- Check O2 purity and liter per minute produced. The oxygen concentrator is a fragile equipment, which suffers at high humidity and can decline in purity production. Therefore a mothly purification test must be conducted. This is done with an Oxygen meter. This instrument shows the purity of oxygen produced as well as the liters per minute been produced.

11. Disposal

There is no need for special disposal procedures, please refer to local requirements in terms of disposal, recovery, reuse and recycling of materials.

12. Oxygen Generator Certifications

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Food and Drug Administration
10903 New Hampshire Avenue
Silver Spring, MD 20993

Certificate No. 10876-6-2017

CERTIFICATE TO FOREIGN GOVERNMENT

In order to allow the importation of United States products into foreign countries , the U.S. Food and Drug Administration (FDA) certifies the following information concerning the product(s) to be exported listed below:

Name of Product(s)

See Attached List

(One Page)

Name of Manufacturer/Distributor, Address

Name of Manufacturer
NIDEK MEDICAL PRODUCTS, INC.
3949 VALLEY EAST INDUSTRIAL DR
Birmingham, AL USA 35217

The product(s) described above (and the manufacturing/distribution site(s) which produces/distributes it) is subject to the jurisdiction of the FDA under the Federal Food, Drug, and Cosmetic Act.

It is certified that the above product(s) may be marketed in, and legally exported from, the United States of America at this time. The manufacturing plant(s) in which the product(s) is produced is subject to periodic inspections. The last such inspection showed that the plant(s), at that time, appeared to be in substantial compliance with current good manufacturing practice requirements for the product(s) listed above.

Robin W. Newman

Robin W. Newman MSN EdD CPNP
Director
Office of Compliance
Center for Devices and Radiological Health
U.S. Food and Drug Administration, DHHS

This certificate is valid from June 27, 2017 to June 26, 2019.

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Food and Drug Administration
10903 New Hampshire Avenue
Silver Spring, MD 20993

Certificate No. 10876-6-2017

Certificate to Foreign Government - Name of Product(s) Attachment Page 1 of 1

Name of Manufacturer

NIDEK MEDICAL PRODUCTS, INC.
3949 VALLEY EAST INDUSTRIAL DR
Birmingham, AL USA 35217

Name of Product(s)

Pulmo-Mist Compressor
Mark 5 Nuvo Oxygen Concentrator
Mark 5 Nuvo Lite Std Oxygen Concentrator
Mark 5 Nuvo Lite OCSI Oxygen Concentrator
Mark 5 Nuvo Lite 3 Oxygen Concentrator
Mark 5 Nuvo 8 Std Oxygen Concentrator
Mark 5 Nuvo 8 OCSI Oxygen Concentrator
Mark 5 Nuvo 10 Oxygen Concentrator
----------END OF PRODUCT LIST----------

Fan Certifications

Certification

Safety

VDE-Reg-Nr.1350

13. Pump Certifications

Live safer.®
NSF International

FOR IMMEDIATE RELEASE

April 1, 2009

NSF Certifies First Pump Manufacturer to Pool/Spa American National Standards

AquaPRO Systems/Wayne Water Systems' Certification to NSF Standard 50 and UL Standard 1081 Demonstrates Commitment to Pool Safety

ANN ARBOR, Mich. – NSF International today announced that **AquaPRO Systems** is the first pump manufacturer to receive certification to both NSF/ANSI Standard 50 - *Equipment for Swimming Pools, Spas, Hot Tubs and Other Recreational Water Facilities* and ANSI/UL 1081 - *Standard for Swimming Pool Pumps, Filters, and Chlorinators* from NSF. Certification to NSF Standard 50 and UL 1081 for pool pumps verifies compliance with the American National Standards for these products, which establish performance and safety requirements.

"AquaPRO Systems' decision to bundle both NSF 50 and UL 1081 certifications to one accredited certification organization, NSF, which is accepted by regulators in the pool and spa industry, was a strategic move for us. It significantly reduced our time to market and total certification cost," said Joe Mauro, President of Wayne Water Systems, d/b/a AquaPRO Systems.

NSF services for pumps include certification to NSF Standard 50 and UL 1081 along with California Energy Commission and sound emissions testing. Ongoing compliance is verified through periodic facility inspections and retesting.

"We are proud to provide proactive manufacturers, such as AquaPRO Systems, the combined testing and certification services they need to demonstrate their commitment to producing safer, quality products," said Dave Purkiss, General Manager, NSF International Water Treatment and Distribution Systems. "Obtaining certification is important because it helps consumers select recreational water products that have been tested and proven to meet national standards."

NSF/ANSI Standard 50 is the American National Standard for swimming pool equipment, spas, hot tubs and other recreational facilities including filters and filter media, pumps, valves, water circulation devices, hose, piping, fittings, pool alarms, pool covers, chemical generation and feeding systems, and advanced water treatment and oxidation technologies, such as ozone and ultraviolet (UV) systems. Most local pool codes require compliance with NSF/ANSI Standard 50. ANSI/UL 1081 is also an American National Standard that includes requirements for motor-operated, non-submersible water pumps, pump-filter combinations, and chlorinators for use with swimming pools, hot tubs, and spas. The California Energy Commission (CEC) includes testing to verify compliance with multiple efficiency requirements.

NSF is accredited as a Nationally Recognized Testing Laboratory (NRTL) by Occupational Safety and Health Administration (OSHA) and as a certification organization by the Standards Council of Canada (SCC) and the American National Standards Institute (ANSI) for numerous product standards. NSF is also registered by the State of California for testing pumps to CEC requirements.

The official NSF Standard 50 Listing for AquaPRO Systems/Wayne Water Systems is available on NSF's Web site. By achieving certification, AquaPRO Systems can place the NSF Mark on its certified pumps.

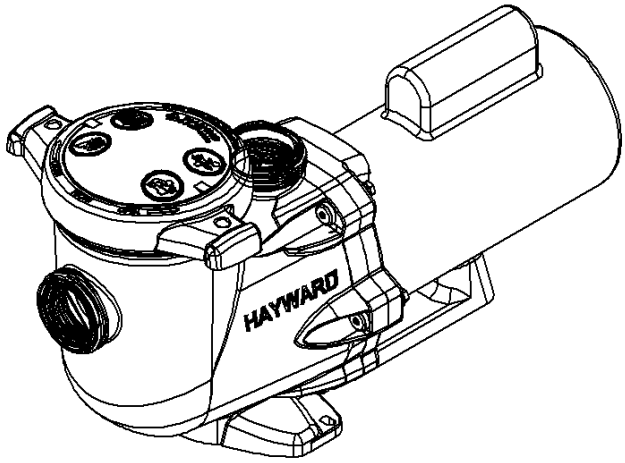
For more information on AquaPRO Systems' certification or NSF's Standard 50, contact Richard Martin at martin@nsf.org or 734-769-5346. More information on AquaPRO Systems is available at http://www.aquaprosystems.com.

About NSF International: NSF International, an independent, not-for-profit organization, helps protect you by certifying products and writing standards for food, water and consumer goods (www.nsf.org). Founded in 1944, NSF is committed to protecting public health and safety worldwide. NSF is a World Health Organization Collaborating Centre for Food and Water Safety and Indoor Environment. Additional services include safety audits for the food and water industries, management systems registrations delivered through NSF International Strategic Registrations, organic certification provided by Quality Assurance International and education through the NSF Center for Public Health Education.

HAYWARD®

OWNER'S MANUAL

INSTALLATION, OPERATION & PARTS



TriStar® Pump Series

The Hayward TriStar Pump is specifically engineered for the demanding requirements of today's in-ground swimming pool/spa that is equipped with large capacity filters, heaters, and pool cleaning equipment. The TriStar is a self-priming pump that includes an improved seal and impeller design that will provide many years of efficient, dependable, corrosion-free service. The advanced design provides superior performance while reducing maintenance requirements. **NOTE -** To prevent potential injury and to avoid unnecessary service calls, read this manual carefully and completely.

IMPORTANT – READ CAREFULLY

NOTE - The TriStar is a high performance, high efficiency pump. When replacing most existing pumps, **you can use a TriStar pump with a lower horsepower rating than the existing pump.**

Required: 2" plumbing minimum
Recommended: 2 ½" plumbing or larger

TriStar Pump Replacement Guide

TriStar Model No. **Full** Rated	**TriStar** Model No. **Max** Rated	**Super II** Model No. **Full** Rated	**Super II** Model No. **Max** Rated
---	SP3207X10	SP3007EEAZ	SP3007X10AZ
SP3207EE	SP3210X15	SP3010EEAZ	SP3010X15AZ
SP3210EE	SP3215X20	SP3015EEAZ	SP3015X20AZ
SP3215EE	SP3220X25	SP3020EEAZ	SP3020X25AZ
SP3220EE	SP3225X30	SP3025EEAZ	SP3025X30AZ
SP3230EE	---	---	---

Hayward Pool Products
620 Division Street, Elizabeth, NJ 07207
Phone: (908) 351.5400
www.haywardpool.com

IMPORTANT SAFETY INSTRUCTIONS

Basic safety precautions should always be followed, including the following: Failure to follow instructions can cause severe injury and/or death.

⚠ This is the safety-alert symbol. When you see this symbol on your equipment or in this manual, look for one of the following signal words and be alert to the potential for personal injury.

⚠ **WARNING** warns about hazards that **could** cause serious personal injury, death or major property damage and if ignored presents a potential hazard.

⚠ **CAUTION** warns about hazards that **will** or **can** cause minor or moderate personal injury and/or property damage and if ignored presents a potential hazard. It can also make consumers aware of actions that are unpredictable and unsafe.

The **NOTICE** label indicates special instructions that are important but not related to hazards.

⚠ **WARNING - Read and follow all instructions in this owner's manual and on the equipment. Failure to follow instructions can cause severe injury and/or death**.

⚠ **WARNING – Suction Entrapment Hazard.**

Suction in suction outlets and/or suction outlet covers which are, damaged, broken, cracked, missing, or unsecured can cause severe injury and/or death due to the following entrapment hazards:

Hair Entrapment- Hair can become entangled in suction outlet cover.

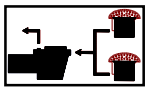
Limb Entrapment- A limb inserted into an opening of a suction outlet sump or suction outlet cover that is damaged, broken, cracked, missing, or not securely attached can result in a mechanical bind or swelling of the limb.

Body Suction Entrapment- A negative pressure applied to a large portion of the body or limbs can result in an entrapment.

Evisceration/ Disembowelment - A negative pressure applied directly to the intestines through an unprotected suction outlet sump or suction outlet cover which is, damaged, broken, cracked, missing, or unsecured can result in evisceration/ disembowelment.

Mechanical Entrapment- There is potential for jewelry, swimsuit, hair decorations, finger, toe or knuckle to be caught in an opening of a suction outlet cover resulting in mechanical entrapment.

⚠ **WARNING - To Reduce the risk of Entrapment Hazards:**



- When outlets are small enough to be blocked by a person, a minimum of two functioning suction outlets per pump must be installed. Suction outlets in the same plane (i.e. floor or wall), must be installed a minimum of three feet (3') [1 meter] apart, as measured from near point to near point.
- Dual suction fittings shall be placed in such locations and distances to avoid "dual blockage" by a user.
- Dual suction fittings shall not be located on seating areas or on the backrest for such seating areas.
- The maximum system flow rate shall not exceed the flow rating of as listed on Table 1.
- Never use Pool or Spa if any suction outlet component is damaged, broken, cracked, missing, or not securely attached.
- Replace damaged, broken, cracked, missing, or not securely attached suction outlet components immediately.
- In addition two or more suction outlets per pump installed in accordance with latest ASME, APSP Standards and CPSC guidelines, follow all National, State, and Local codes applicable.
- Installation of a vacuum release or vent system, which relieves entrapping suction, is recommended.

⚠ **WARNING – Failure to remove pressure test plugs and/or plugs used in winterization of the pool/spa from the suction outlets can result in an increase potential for suction entrapment as described above.**

⚠ **WARNING – Failure to keep suction outlet components clear of debris, such as leaves, dirt, hair, paper and other material can result in an increase potential for suction entrapment as described above.**

⚠ **WARNING – Suction outlet components have a finite life, the cover/grate should be inspected frequently and replaced at least every ten years or if found to be damaged, broken, cracked, missing, or not securely attached.**

⚠ **CAUTION – Components such as the filtration system, pumps and heater must be positioned so as to prevent their being used as means of access to the pool by young children.**

⚠ **WARNING – Never operate or test the circulation system at more than 50 PSI.**

⚠ **WARNING – Never change the filter control valve position while the pump is running.**

⚠ **WARNING** – To reduce risk of injury, do not permit children to use or climb on this product. Closely supervise children at all times. Components such as the filtration system, pumps, and heaters must be positioned to prevent children from using them as a means of access to the pool.

⚠ **WARNING – Hazardous Pressure.** Pool and spa water circulation systems operate under hazardous pressure during start up, normal operation, and after pump shut off. Stand clear of circulation system equipment during pump start up. Failure to follow safety and

operation instructions could result in violent separation of the pump housing and cover, and/or filter housing and clamp due to pressure in the system, which could cause property damage, severe personal injury, or death. Before servicing pool and spa water circulation system, all system and pump controls must be in off position and filter manual air relief valve must be in open position. Before starting system pump, all system valves must be set in a position to allow system water to return back to the pool. Do not change filter control valve position while system pump is running. Before starting system pump, fully open filter manual air relief valve. Do not close filter manual air relief valve until a steady stream of water (not air or air and water) is discharged.

⚠ **WARNING – Separation Hazard.** Failure to follow safety and operation instructions could result in violent separation of pump and/or filter components. Strainer cover must be properly secured to pump housing with strainer cover lock ring. Before servicing pool and spa circulation system, filters manual air relief valve must be in open position. Do not operate pool and spa circulation system if a system component is not assembled properly, damaged, or missing. Do not operate pool and spa circulation system unless filter manual air relief valve body is in locked position in filter upper body.

⚠ **WARNING** – **Risk of Electric Shock.** All electrical wiring MUST be in conformance with applicable local codes, regulations, and the National Electric Code (NEC). Hazardous voltage can shock, burn, and cause death or serious property damage. To reduce the risk of electric shock, do NOT use an extension cord to connect unit to electric supply. Provide a properly located electrical receptacle. Before working on any electrical equipment, turn off power supply to the equipment.

⚠ **WARNING** – To reduce the risk of electric shock replace damaged wiring immediately. Locate conduit to prevent abuse from lawn mowers, hedge trimmers and other equipment.

⚠ **WARNING –** Electrical ground all electrical equipment before connecting to electrical power supply. Failure to ground all electrical equipment can cause serious or fatal electrical shock hazard.

⚠ **WARNING –** Do NOT ground to a gas supply line.

⚠ **WARNING** – To avoid dangerous or fatal electrical shock, turn OFF power to all electrical equipment before working on electrical connections.

⚠ **WARNING** – Failure to bond all electrical equipment to pool structure will increase risk for electrocution and could result in injury or death. To reduce the risk of electric shock, see installation instructions and consult a professional electrician on how to bond all electrical equipment. Also, contact a licensed electrician for information on local electrical codes for bonding requirements.

Notes to electrician: Use a solid copper conductor, size 8 or larger. Run a continuous wire from external bonding lug to reinforcing rod or mesh. Connect a No. 8 AWG (8.4 mm^2) [No. 6 AWG (13.3 mm^2) for Canada] solid copper bonding wire to the pressure wire connector provided on the electrical equipment and to all metal parts of swimming pool, spa, or hot tub, and metal piping (except gas piping), and conduit within 5 ft. (1.5 m) of inside walls of swimming pool, spa, or hot tub.
IMPORTANT - Reference NEC codes for all wiring standards including, but not limited to, grounding, bonding and other general wiring procedures.

⚠ **WARNING** – Risk of Electric Shock. Connect only to a branch circuit protected by a ground-fault circuit-interrupter (GFCI). Contact a qualified electrician if you cannot verify that the circuit is protected by a GFCI.

⚠ **WARNING** – Risk of Electric Shock . The electrical equipment must be connected only to a supply circuit that is protected by a ground-fault circuit-interrupter (GFCI). Such a GFCI should be provided by the installer and should be tested on a routine basis. To test the GFCI, push the test button. The GFCI should interrupt power. Push reset button. Power should be restored. If the GFCI fails to operate in this manner, the GFCI is defective. If the GFCI interrupts power to the electrical equipment without the test button being pushed, a ground current is flowing, indicating the possibility of an electrical shock. Do not use this electrical equipment. Disconnect the electrical equipment and have the problem corrected by a qualified service representative before using.

⚠ **CAUTION –** This pump is intended for use with permanently-installed pools and may be used with hot tubs and spas if so marked. Do not use with storable pools. A permanently-installed pool is constructed in or on the ground or in a building such that it cannot be readily disassembled for storage. A storable pool is constructed so that it is capable of being readily disassembled for storage and reassembled to its original integrity.

SAVE THESE INSTRUCTIONS

General Information

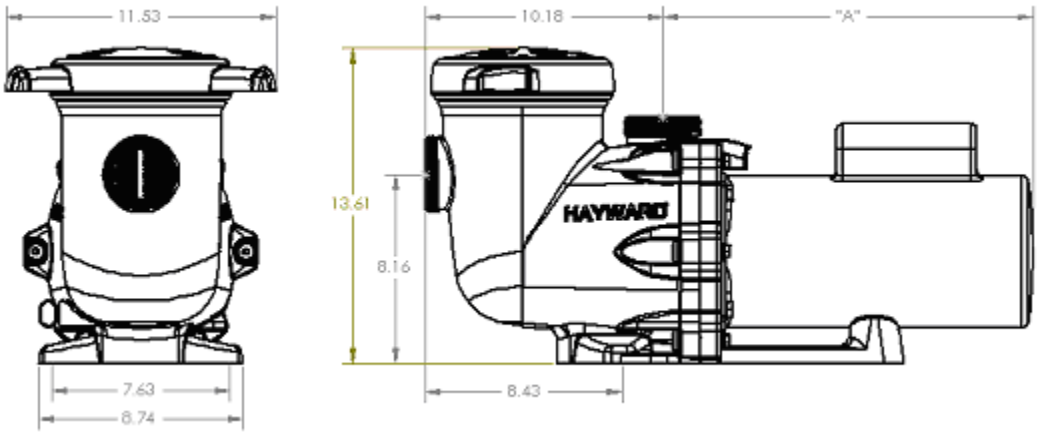
Introduction

This manual contains information for the proper installation and operation of the Hayward TriStar Pump Series. The instructions in this manual **MUST** be followed precisely. **Failure to install according to defined instructions will void warranty.**

Product Benefits

The new TriStar Pump's advanced fluid dynamic design optimizes the three essential pump elements to deliver superior flow, energy efficiency, and quietness. Plus, the heavy-duty pump and motor construction operates cooler for years of dependability. It is the first to feature a Tri-Lock cam and ramp strainer cover design that closes with less than a quarter turn, and the TriStar's super-sized, smooth no-rib basket with extra leaf-holding capacity is easy to clean. TriStar has a variety of bases available to seamlessly retrofit to existing filtration systems.

Product Specifications



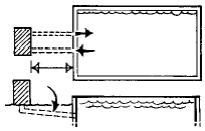
HP	FR "A"	MR "A"
½	13 5/8"	-
¾	13 7/8"	13 3/8"
1	14 3/8"	13 7/8"
1 *	14 3/8"	-
1 ½	14 7/8"	13 7/8"
1 ½ *	14 7/8"	14 3/8"
2	14 7/8"	15 1/8"
2 *	14 7/8"	14 7/8"
2 **	13 1/2"	-
2 ½	-	14 7/8"
2 ½ *	-	14 7/8"
3	17 1/8"	15 5/8"
3 **	14 1/2"	-
5	17 1/8"	-

* Two-Speed Pump
** Three-Phase Pump

Installation Instructions

⚠ **WARNING –** This product should be installed and serviced only by a qualified professional.

Pump Location



Locate pump as close to pool as practical and run suction lines as direct as possible to reduce friction loss. Suction lines should have continuous slope upward from lowest point in line. Joints must be tight (but not over-tightened). Suction line diameter must equal or be larger than the discharge line diameter.

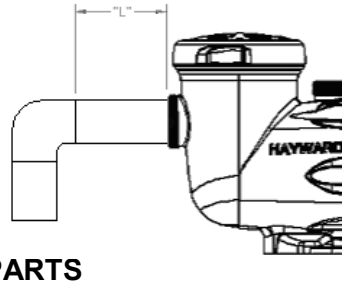
Though the pump is designed for outdoor use, it is strongly advised to place pump and filter in the shade to shield them from continuous direct heat. Select a well-drained area that will not flood when it rains. **Do NOT install pump and filter in a damp or non-ventilated location.** Keep motor clean. Pump motors require free circulation of air for cooling.

Pump Mounting

Install pump on a level concrete slab or other rigid base to meet all local and national codes. Secure pump to base with screws or bolts to further reduce vibration and stress on pipe or hose joints. The base must be level, rigid, and vibration free.

Pump mount must:

- Allow pump inlet height to be as close to water level as possible.
- Allow use of short, direct suction pipe (to reduce friction losses).
- Allow for gate valves in suction and discharge piping.
- Be protected from excess moisture and flooding.
- Allow adequate access for servicing pump and piping.



USE ONLY HAYWARD GENUINE REPLACEMENT PARTS

Pipe Sizing Chart

MAXIMUM RECOMMENDED SYSTEM FLOW RATE BY PIPE SIZE								
Pipe Size [mm]	Flow Rate GPM [LPM]	Suction Pipe Length *	**Pipe Size** [mm]	Flow Rate GPM [LPM]	Suction Pipe Length *	**Pipe Size** [mm]	Flow Rate GPM [LPM]	Suction Pipe Length *
1" [32]	20 [75]	5"	**1 ½"** [50]	45 [170]	7 ½"	**2 ½"** [75]	110 [415]	12 ½"
1 ¼" [40]	30 [110]	6 ¼"	**2"** [63]	80 [300]	10"	**3"** [90]	160 [600]	15"

*** NOTE -** It is recommended that a minimum length of straight piping (shown as "L" in above diagram), equivalent to 5 pipe size diameters, be used between the pump suction inlet and any plumbing fittings (elbows, valves, etc.).

⚠ **WARNING – Hazardous Pressure.** Pumps, filters, and other equipment/ components of a swimming pool filtration system operate under pressure. Incorrectly installed and/or improperly tested filtration equipment and/or components may fail resulting in severe personal injury or death.

Plumbing

Use **Teflon tape** to seal threaded connections on molded plastic components. All plastic fittings must be new or thoroughly cleaned before use. **NOTE - Do NOT use Plumber's Pipe Dope as it may cause cracking of the plastic components.** When applying **Teflon tape** to plastic threads, wrap the entire threaded portion of the male fitting with one to two layers of tape. Wind the tape clockwise as you face the open end of the fitting, beginning at the end of the fitting. The pump suction and outlet ports have molded-in thread stops. **Do NOT attempt to force hose connector fitting past this stop.** It is only necessary to tighten fittings enough to prevent leakage. Tighten fitting by hand and then use a tool to engage fitting an additional 1 ½ turns. Use care when using Teflon tape as friction is reduced considerably; **do NOT over-tighten fitting or you may cause damage**. If leaks occur, remove connector, clean off old Teflon tape, re-wrap with one to two additional layers of Teflon tape, and re-install connector.

Fittings restrict flow. For better efficiency, use the fewest possible fittings (but at least two suction outlets). Avoid fittings that could cause an air trap. Pool and spa fittings MUST conform to the International Association of Plumbing and Mechanical Officials (IAPMO) standards. Use a non-entrapping suction fitting in pool (multiple drains) or double suction (skimmer and main drain).

Electrical

⚠ **WARNING –** All electrical wiring MUST be in conformance with all applicable local codes, regulations, and the National Electric Code (NEC). Ground and bond motor before connecting to electrical power supply. Failure to ground and bond pump motor can cause serious or fatal electrical shock hazard. Do NOT ground to a gas supply line. To avoid dangerous or fatal electrical shock, turn OFF power to motor before working on electrical connections. **Fire Hazard - match supply voltage to motor nameplate voltage.** Insure that the electrical supply available agrees with the motor's voltage, phase, and cycle, and that the wire size is adequate for the HP (kW) rating and distance from the power source. Use copper conductors only.

Voltage

Voltage at motor **MUST NOT** be more than 10% above or below motor name plate rated voltage, or motor may overheat, causing overload tripping and reduced component life. If voltage is less than 90% or more than 110% of rated voltage when motor is running at full load, consult power company.

Grounding and Bonding

Install, ground, bond, and wire motor in accordance with local or national electrical code requirements.

Permanently ground motor. Use green ground terminal provided under motor canopy or access place; use size and type wire required by code. Connect motor ground terminal to electrical service ground.

Bond motor to pool structure. Bonding will connect all metal parts within and around the pool with a continuous wire. Bonding reduces the risk of a current passing between bonded metal objects, which could potentially cause electrical shock if grounded or shorted. **Reference NEC codes for all wiring standards including, but not limited to, grounding, bonding and general wiring procedures.**

Use a solid copper conductor, size 8 or larger. Run wire from external bonding lug to reinforcing rod or mesh. Connect a No. 8 AWG (8.4 mm^2) solid copper bonding wire to the pressure wire connector provided on the motor housing and to all metal parts of swimming pool, spa, or hot tub, and to all electrical equipment, metal piping (except gas piping), and conduit within 5 ft. (1.5 m) of inside walls of swimming pool, spa, or hot tub.

Wiring

⚠ **WARNING –** All electrical wiring MUST be in conformance with all applicable local codes, regulations, and the National Electric Code (NEC).

Pump MUST be permanently connected to circuit. If other lights or appliances are also on the same circuit, be sure to add their amp loads before calculating wire and circuit breaker sizes. Use the load circuit breaker as the Master On-Off switch.

Motor Specifications

	Motor Brake Horsepower	Motor Rated Horsepower	Motor Electric V/A		Wire Size / Breaker	
	HP (kW)	HP (kW)	Voltage	Amps	AWG	Amps
Full Rate Pumps	0.99 (0.74)	0.50 (0.37)	208 - 230 / 115	5.3 - 4.9 / 9.8	14	10 / 15
	1.39 (1.04)	0.75 (0.56)	208 - 230 / 115	7.0 - 6.2 / 12.4	14	10 / 15
	1.85 (1.38)	1.00 (0.75)	208 - 230 / 115	8.5 - 7.4 / 14.8	14 / 12	15 / 20
	2.40 (1.79)	1.50 (1.12)	208 - 230 / 115	11.2 - 10.2 / 20.4	14 / 10	15 / 30
	2.70 (2.01)	2.00 (1.49)	208 - 230	11.8 - 11.0	14	15
	2.70 (2.01) **	2.00 (1.49) **	208 - 230 **	7.0 - 6.6 **	14 **	10 **
	3.60 (2.69)	3.00 (2.24)	208 - 230	16.0 - 14.8	12	20
	3.60 (2.69) *	3.00 (2.24) *	208 - 230 / 460 *	9.6 - 9.4 / 4.7 *	14 *	15 / 10 *
	5.00 (3.73)	5.00 (3.73)	208 - 230	21.0 - 19.4	10	30
	1.85 / 0.22 (1.38 / 0.16)	1.00 / 0.12 (0.75 / 0.09)	208 - 230	8.6 - 8.2 [1]	14	15
	2.40 / 0.28 (1.79 / 0.21)	1.50 / 0.18 (1.12 / 0.13)	208 - 230	11.4 - 10.4 [2]	14	15
	2.70 / 0.33 (2.01 / 0.25)	2.00 / 0.25 (1.49 / 0.19)	208 - 230	12.4 - 11.2 [3]	14	15
Max Rate Pumps	0.94 (0.70)	0.75 (0.56)	230 / 115	5.4 / 10.8	14	10 / 15
	1.25 (0.93)	1.00 (0.75)	230 / 115	7.0 / 14.0	14 / 12	10 / 20
	1.65 (1.23)	1.50 (1.12)	230 / 115	7.7 / 15.4	14 / 12	10 / 20
	2.20 (1.64)	2.00 (1.49)	230 / 115	10.8 / 21.6	14 / 10	15 / 30
	2.60 (1.94)	2.50 (1.86)	230	11.5	14	15
	3.45 (2.57)	3.00 (2.24)	230	13.5	12	20
	1.85 / 0.22 (1.38 / 0.16)	1.50 / 0.18 (1.12 / 0.13)	208 - 230	8.6 - 8.2 [1]	14	15
	2.40 / 0.28 (1.79 / 0.21)	2.00 / 0.25 (1.49 / 0.19)	208 - 230	11.4 - 10.4 [2]	14	15
	2.70 / 0.33 (2.01 / 0.25)	2.50 / 0.30 (1.86 / 0.22)	208 - 230	12.4 - 11.2 [3]	14	15
50 Hz Pumps	0.75 (0.56)	0.75 (0.56)	220 / 110	7.0 / 14.0	14 / 12	10 / 20
	1.00 (0.75)	1.00 (0.75)	220 / 110	8.0 / 16.0	14 / 12	10 / 20
	1.50 (1.12)	1.50 (1.12)	220 / 110	9.8 / 19.6	14 / 10	15 / 30
	2.00 (1.49)	2.00 (1.49)	220	11.0	14	15
	3.00 (2.24)	3.00 (2.24)	220	12.0	14	15
	3.00 (2.24) *	3.00 (2.24) *	380 - 415 / 190 *	4.9 - 4.8 / 9.8 *	14 *	10 / 15 *

[1, 2, 3] Low Speed Amps: ([1] 2.8 - 3.0) ([2] 3.2 - 3.4) ([3] 3.8 - 4.1)

* Three-Phase (3Φ) Pump - motor starter required

** Three-Phase (3Φ) Pump - variable-speed applications only (Not available as a stand-alone pump. May only be used with SP3220VSC.)

Start-Up & Operation

Prior to Start-Up

NOTE - If it is necessary to perform a pressure test, prior to initial use to ensure pump is functioning properly, then the following criteria should be maintained for this test:

1. Have a professional perform this test.
2. Ensure all pump and system components are sealed properly to prevent leaks.
3. Remove any trapped air in the system by fully opening filter manual air relief valve until a steady stream of water (not air or air and water mix) is discharged from the valve.
4. Allow no more than 50 psi (345 kPa) at a water temperature no higher than 100° F (38° C).
5. Run pressure test for no longer than 24 hours. Immediately inspect all parts to verify they are intact and functioning properly.

⚠ **WARNING - If pump is being pressure tested (50 PSI MAXIMUM), be sure pressure has been released, using the filter manual air relief valve, before removing strainer cover.**

⚠ **WARNING –** All suction and discharge valves **MUST** be **OPEN**, as well as filter air relief valve (if available) on filter, when starting the circulating pump system. Failure to do so could result in severe personal injury.

Starting/Priming the Pump:

Pumps with single speed motors are self priming to 10 ft. and pumps with 2 speed motors are self priming to 10 ft. on high speed only. Fill strainer housing with water to suction pipe level. If water leakage occurs from anywhere on the pump or filter, DO NOT start the pump. If no leakage occurs, stand at least 10 feet from pump and/or filter and proceed with starting the pump.

⚠ **WARNING –** Return to filter to close filter manual air relief valve when a steady stream of water (not air or air and water) is discharged from valve. Failure to do so could result in severe personal injury.

⚠ **ATTENTION – NEVER OPERATE THE PUMP WITHOUT WATER**. Water acts as a coolant and lubricant for the mechanical shaft seal. NEVER run pump dry. Running pump dry may damage seals, causing leakage, flooding, and voids warranty. Fill strainer housing with water before starting motor.

⚠ **ATTENTION –** Do NOT add chemicals to pool/spa system directly in front of pump suction. Adding undiluted chemicals may damage pump and voids warranty.

⚠ **ATTENTION –** Before removing strainer cover:

1. **STOP PUMP** before proceeding.
2. **CLOSE VALVES** in suction and outlet pipes.
3. **RELEASE ALL PRESSURE** from pump and piping system using filter manual air relief valve. **See filter owner's manual for more details.**
4. If water source is higher than the pump, pump will prime itself when suction and outlet valves are opened. If water source is lower than the pump, unscrew and remove strainer cover; fill strainer housing with water.
5. Clean and lubricate strainer cover O-ring with "Jack's 327" if necessary.
6. Replace strainer cover on strainer housing; turn clockwise to tighten cover.
   NOTE - Tighten strainer cover lock ring by hand only (no wrenches).

Before re-starting pump, see "**Starting/Priming the Pump"** instructions.

⚠ **ATTENTION –** Wait five (5) seconds before re-starting pump. Failure to do so may cause reverse rotation of motor and consequent serious pump damage.

Turn on power and wait for pump to prime, which may take up to five (5) minutes. Priming time will depend on vertical length of suction lift and horizontal length of suction pipe. If pump does NOT prime within five minutes, stop motor and determine cause. Be sure all suction and discharge valves are open when pump is running. See Troubleshooting Guide.

Maintenance

- Clean strainer basket regularly. Do NOT strike basket to clean. Inspect strainer cover gasket regularly and replace as necessary.
- Hayward pumps have self-lubricating motor bearings and shaft seals. No lubrication is necessary.
- Keep motor clean. Insure motor air vents are free from obstruction to avoid damage. Do NOT use water to hose off motor.
- Occasionally, shaft seals must be replaced, due to wear or damage. Replace with genuine Hayward seal assembly kit. See "Shaft Seal Change Instructions" in this manual.

Storage/Winterization

⚠ **WARNING – Separation Hazard.** Do not purge the system with compressed air. Purging the system with compressed air can cause components to explode, with risk of severe injury or death to anyone nearby. Use only a low pressure (below 5 PSI), high volume blower when air purging the pump, filter, or piping.

⚠ **ATTENTION –** Allowing the pump to freeze will void the warranty.

⚠ **ATTENTION –** Use ONLY propylene glycol as antifreeze in your pool/spa system. Propylene glycol is non-toxic and will not damage plastic system components; other anti-freezes are highly toxic and may damage plastic components in the system.

Drain all water from pump and piping when expecting freezing temperatures or when storing pump for a long time (see instructions below). Gravity drain system as far as possible.

Keep motor dry and covered during storage. To avoid condensation/corrosion problems, do NOT cover or wrap pump with plastic film or bags.

Storing Pump for Winterization

⚠ **WARNING –** To avoid dangerous or fatal electrical shock hazard, turn OFF power to motor before draining pump. Failure to disconnect power may result in serious personal injury or death.

1. Drain water level below all inlets to the pool.
2. Remove drain plugs and strainer cover from strainer housing. (See Parts Diagram on page 11 of this manual for pump component locations.)
3. Disconnect pump from mounting pad, wiring (after power has been turned OFF), and piping.
4. Once the pump is removed of water, re-install the strainer cover and drain plugs. Store pump in a dry area.

Shaft Seal Change Instructions

IMPORTANT SAFETY INSTRUCTIONS
PLEASE READ AND FOLLOW ALL INSTRUCTIONS

When servicing electrical equipment, basic safety precautions should always be observed including the following. Failure to follow instructions may result in injury.

A. ⚠ **WARNING** – To reduce risk of injury, do not permit children to use this product.
B. Disconnect all electrical power service to pump before beginning shaft seal replacement.
C. Only qualified personnel should attempt rotary seal replacement. Contact your local authorized Hayward Dealer or service center if you have any questions.

Exercise extreme care in handling both the rotating and the stationary sections of the two-part replacement seal. Foreign matter or improper handling will easily scratch the graphite and ceramic sealing surfaces.

Removing the Motor Assembly (See Parts Diagram on page 11 of this manual for pump component locations.)

1. Remove the six (6) 5/16" x 2" hex head bolts (item #17), which hold the motor assembly to the pump/strainer housing (item #3), using a 1/2" wrench or socket.
2. Slide the motor assembly out of the pump/strainer housing (item #3), exposing the diffuser (item #9). Remove the two diffuser screws (item #7), and pull the diffuser (item #9) off of the seal plate (item #15) to expose the impeller (item #12).

Removing the Impeller (See Parts Diagram on page 11 of this manual for pump component locations.)

3. Remove the motor canopy by removing the two (2) screws and pulling the canopy away from the motor.
4. To prevent motor shaft from turning, carefully place a 7/16" open-end wrench over the two (2) flats on the end of the shaft.
5. Rotate the impeller screw (item #10) clockwise (note that screw has left-hand thread) and remove. Remove the impeller (item #12) by rotating counterclockwise.

Removing the Ceramic Seat (See Parts Diagram on page 11 of this manual for pump component locations.)

6. Remove the spring seal assembly (item #13) and seal plate (item #15) from the motor by removing the four (4) 3/8" x 1" bolts (item #18) that secure it to the motor, using a 9/16" wrench or socket. Remove the motor support bracket (item #20) from the seal plate (item #15).
7. Press the ceramic seat with rubber cup out of the seal plate (item #15). If tight, use a small screwdriver to tap seal out.
   STOP - Clean all recesses & parts to be reassembled. Inspect gaskets & replace if necessary.

Seal Installation (See Parts Diagram on page 11 of this manual for pump component locations.)

8. Clean and lightly lubricate the motor shaft and seal recesses in the seal plate (item #15) with a dilute solution of non-granulated liquid-type soap. Gently wipe the polished face of the ceramic seal with a soft cotton cloth. Lubricate the rubber cup on the ceramic seat and press it firmly into the recess of the seal plate (item #15), with the polished ceramic surface facing out.
9. Reassemble the motor to the seal plate (item #15) using the four (4) 3/8" x 1" bolts (item #18), and re-attach the motor support (item #20) to the seal plate (item #15).
10. Gently wipe the black, polished surface of the spring seal assembly (item #13) with a soft cotton cloth.
11. Press the spring seal assembly (item #13) onto the motor shaft, with the black polished surface facing the ceramic seat.

Replacing the Impeller and Diffuser (See Parts Diagram on page 11 of this manual for pump component locations.)

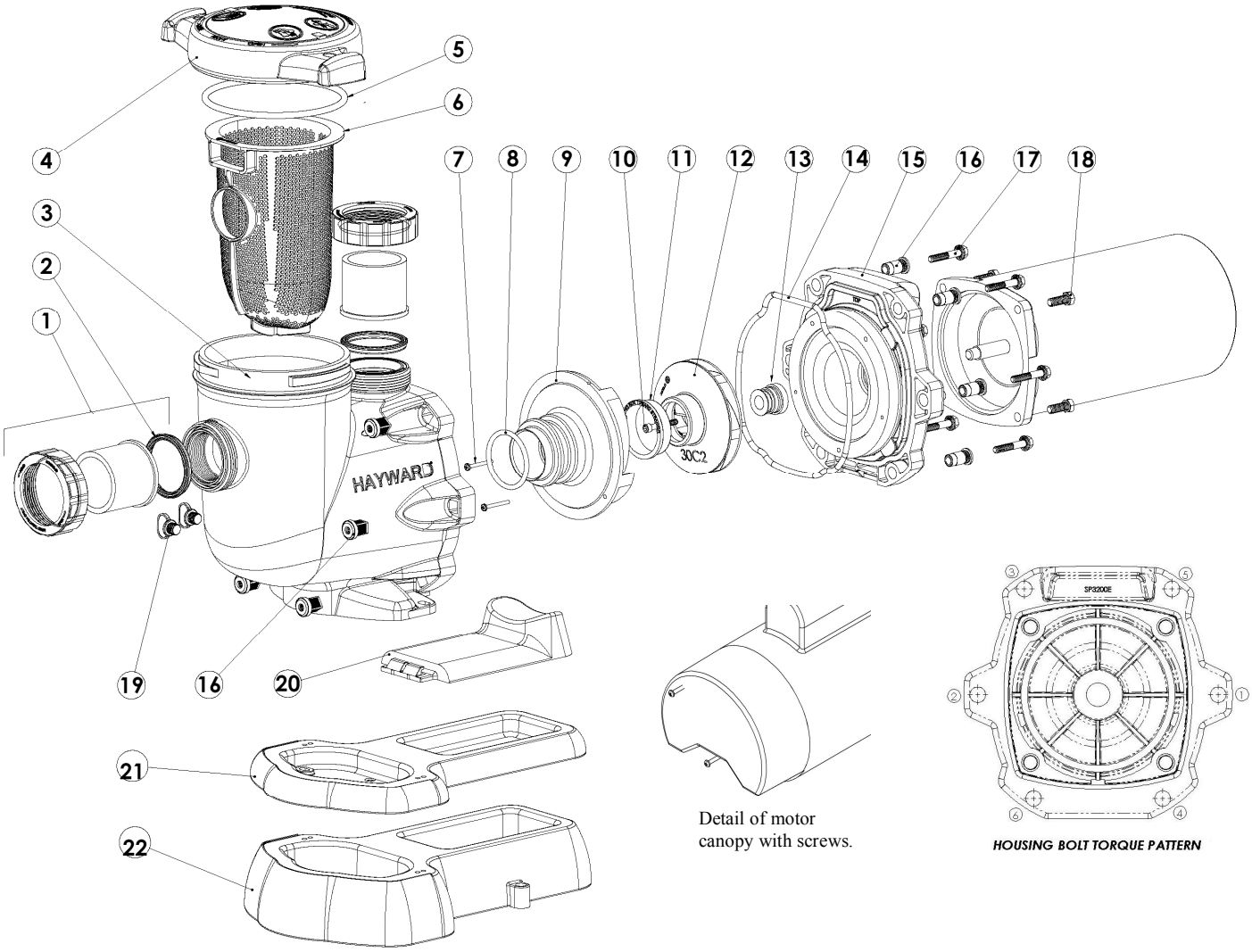
12. Screw the impeller (item #12) onto the motor shaft in a clockwise direction, and screw the impeller screw (item #10) into the motor shaft in a counterclockwise direction. Tighten snugly by holding motor shaft with wrench as noted in step #4. Place the impeller ring (item #11) back onto the impeller (item #12), with flange facing towards the diffuser (item #9).
13. Place the diffuser (item #9) over the impeller (item #12) and onto the seal plate (item #15), aligning the three pins on the diffuser (item #9) with the three holes on the seal plate (item #15). Replace the two diffuser screws (item #7).

Replacing the Motor Assembly (See Parts Diagram on page 11 of this manual for pump component locations.)

14. Re-attach motor canopy using the two (2) hex headed screws. Slide the motor assembly, with the diffuser (item #9) in place, into pump/strainer housing (item #3), being careful not to disturb the diffuser gasket (item #8).
15. Fasten assembly to pump/strainer housing (item #3) using the six (6) 5/16" x 2" bolts (item #17). (Be sure housing gasket (item #14) is in place, and lubricated. Replace if damaged). Tighten bolts alternately and evenly to 185 inch-pounds according to housing bolt torque pattern detail.

Replacement Parts

Parts Diagram



Detail of motor canopy with screws.

HOUSING BOLT TORQUE PATTERN

Parts Listing

Ref. No.	Part No.	Description	Ctn. Qty.
1	SPX3200UNKIT	Union Connector Kit (Includes Union Nut, Union Connector, Union Gasket - 2 ea.)	1
2	SPX3200UG	Union Gasket	1
3	SPX3200A	Pump Strainer Housing, 2" x 2 1/2" with Drain Plugs, threaded style	1
4	SPX3200DLS	Strainer Cover Kit (Includes Strainer Cover, Lock Ring, O-Ring)	10
4	SPX3200DLSB	Strainer Cover Kit (Biguanide Sanitizer Applications Only; **NOT** Pressure Testable)	10
5	SPX3200S	Strainer Cover O-Ring	10
6	SPX3200M	Strainer Basket	15

USE ONLY HAYWARD GENUINE REPLACEMENT PARTS

Ref. No.	Part No.	Description	Ctn. Qty.
7	SPX3200Z8	Diffuser Screw	1
8	SPX4000Z1	Diffuser O-Ring	10
9	SPX3200B3	Diffuser	1
10	SPX3200Z1	Impeller Screw	1
11	SPX3021R	Impeller Ring	1
12	SPX3205C	Impeller for ½ HP with Impeller Screw	10
12	SPX3207C	Impeller for ¾ HP with Impeller Screw	10
12	SPX3207CM	Impeller for 1 HP with Impeller Screw (Max Rate)	10
12	SPX3210C	Impeller for 1 HP with Impeller Screw (Full Rate)	10
12	SPX3215C	Impeller for 1 ½ HP with Impeller Screw	10
12	SPX3220C	Impeller for 2 HP with Impeller Screw (Full Rate)	10
12	SPX3220CM	Impeller for 2 ½ HP with Impeller Screw (Max Rate)	10
12	SPX3230C	Impeller for 3 HP with Impeller Screw	10
12	SPX3230C5	Impeller for 5 HP with Impeller Screw	10
13	SPX3200SA	Shaft Seal Assembly	10
14	SPX3200T	Housing O-Ring	10
15	SPX3200E	Seal Plate	1
16	SPX3200Z211	Housing Insert/Seal Plate Spacer Kit	1
17	SPX3200Z3	Housing Bolt	10
18	SPX3200Z5	Motor Bolt	1
19	SPX4000FG	Drain Plug with O-Ring	10
20	SPX3200GA	Bracket, Motor Support, TriStar	1
21 *	SPX3200WF	Base, Short Riser, TriStar	1
22 *	SPX3200SR	Base, Tall Riser, TriStar	1

Pump SKU Detail

	Model P/N	Motor P/N	Power End P/N (1)	Impeller P/N
Full Rate Pumps	SP3205EE	SPX3205Z1BER	SPX3205Z1PE	SPX3205C
	SP3207EE	SPX3207Z1BER	SPX3207Z1PE	SPX3207C
	SP3210EE	SPX3210Z1BER	SPX3210Z1PE	SPX3210C
	SP3215EE	SPX3215Z1BER	SPX3215Z1PE	SPX3215C
	SP3220EE	SPX3220Z1BER	SPX3220Z1PE	SPX3220C
	SP3230EE	SPX3230Z1BER	SPX3230Z1PE	SPX3230C
	SP3250EE	SPX3240Z1MER	SPX3250Z1PE	SPX3230C5
	SP32102EE	SPX3210Z2BER	SPX3210Z2PE	SPX3210C
	SP32152EE	SPX3215Z2BER	SPX3215Z2PE	SPX3215C
	SP32202EE	SPX3220Z2BER	SPX3220Z2PE	SPX3220C
	SP322063EEV (2)	SPX3220Z1DRV (2)	SPX3220Z1PE3V (2)	SPX3215C
	SP323063EE	SPX3230Z1DR	SPX3230Z1PE3	SPX3230C
Max Rate Pumps	SP3205X7	SPX3205Z1MR	SPX3205X7Z1PE	SPX3205C
	SP3207X10	SPX3207Z1MR	SPX3207X10Z1PE	SPX3207CM
	SP3210X15	SPX3210Z1MR	SPX3210X15Z1PE	SPX3210C
	SP3215X20	SPX3215Z1MR	SPX3215X20Z1PE	SPX3215C
	SP3220X25	SPX3220Z1MR	SPX3220X25Z1PE	SPX3220CM
	SP3225X30	SPX3225Z1MR	SPX3225X30Z1PE	SPX3230C
	SP3210X152	SPX3210Z2MER	SPX3210X15Z2PE	SPX3210C
	SP3215X202	SPX3215Z2MER	SPX3215X20Z2PE	SPX3215C
	SP3220X252	SPX3220Z2MER	SPX3220X25Z2PE	SPX3220C
50 Hz Pumps	SP3205X751	SPX3205Z1MCR	N/A	SPX3207C
	SP3207X1051	SPX3207Z1MCR	N/A	SPX3210C
	SP3210X1551	SPX3210Z1MCR	N/A	SPX3215C
	SP3215X2051	SPX3215Z1MCR	N/A	SPX3220C
	SP3225X3051	SPX3220Z1MCR	N/A	SPX3230C
	SP3225X3053	SPX3230Z1DR	N/A	SPX3230C

NOTE: (1) Power end assembly includes parts #7-18 and motor.
(2) Variable-speed applications only (Not available as a stand-alone pump. May only be used with SP3220VSC.)

USE ONLY HAYWARD GENUINE REPLACEMENT PARTS

Troubleshooting

Motor Will NOT Start – Check For:

Make sure the terminal board connections agree with the wiring diagram on motor data plate label. Be sure motor is wired for available field supply voltage (see pump operating label).

1. Improper or loose wiring connections; open switches or relays; tripped circuit breakers, or blown fuses.

Solution: Check all connections, circuit breakers, and fuses. Reset tripped breakers or replace blown fuses.

2. Manually check rotation of motor shaft for free movement and lack of obstruction.

Solution: Refer to Steps 4 & 5 of "Shaft Seal Change Instructions" in this manual.

3. If you have a timer, be certain it is working properly. Bypass it if necessary.

Motor Shuts OFF – Check For:

1. Low voltage at motor or power drop (frequently caused by undersized wiring or extension cord use).

Solution: Contact qualified professional to check that the wiring gauge is heavy enough.

NOTE: Your Hayward pump motor is equipped with an "automatic thermal overload protector." The motor will automatically shut off if power supply drops before heat damage can build up causing windings to burn out. The "thermal overload protector" will allow the motor to automatically restart once the motor has cooled. It will continue to cut On/Off until the problem is corrected. **Be sure to correct cause of overheating.**

Motor Hums, But Does NOT Start – Check For:

1. Impeller jammed with debris.

Solution: Have a qualified repair professional open the pump and remove the debris.

Pump Won't Prime, Check For:

1. Empty pump/strainer housing.

Solution: Make sure pump/strainer housing is filled with water and cover o-ring is clean. Ensure o-ring is properly seated in the cover o-ring groove. Ensure o-ring sealing surface is lubricated with "Jack's 327" and that strainer cover is locked firmly in position. Lubricant will help to create a tighter seal.

2. Loose connections on suction side.

Solution: Tighten pipe/union connections.

NOTE - Any self-priming pump will not prime if there are suction air leaks. Leaks will result in bubbles emanating from return fittings on pool wall.

3. Leaking O-ring or packing glands on valves.

Solution: Tighten, repair, or replace valves.

4. Strainer basket or skimmer basket loaded with debris.

Solution: Remove strainer housing cover or skimmer cover, clean basket, and refill strainer housing with water. Tighten cover.

5. Suction side clogged.

Solution: Contact a qualified repair professional.

Block off to determine if pump will develop a vacuum. You should have 5" - 6" of vacuum at the strainer cover **(Only your pool dealer can confirm this with a vacuum gauge)**. You may be able to check by removing the skimmer basket and holding your hand over the bottom port with skimmer full and pump running. If no suction is felt, check for line blockage.

a. If pump develops a vacuum, check for blocked suction line or dirty strainer basket. An air leak in the suction piping may be the cause.
b. If pump does not develop a vacuum and pump has sufficient "priming water":
    i. Re-check strainer housing cover and all threaded connections for suction leaks. Check if all system hose clamps are tight.
    ii. Check voltage to ensure that the motor is rotating at full RPM's.
    iii. Open housing cover and check for clogging or obstruction in suction. Check impeller for debris.
    iv. Remove and replace shaft seal only if it is leaking.

Low Flow – Generally, Check For:

1. Clogged or restricted strainer or suction line.

Solution: Contact a qualified repair professional.

2. Undersized pool piping.

Solution: Correct piping size.

3. Plugged or restricted discharge line of filter, valve partially closed (high gauge reading).

Solution: Sand filters – backwash as per manufacturer's instructions; D.E. filters – backwash as per manufacturer's instructions; Cartridge filters – clean or replace cartridge.

4. Air leak in suction (bubbles issuing from return fittings).

Solution: Re-tighten suction and discharge connections using Teflon tape. Inspect other plumbing connections and tighten as required.

5. Plugged, restricted, or damaged impeller.

Solution: Replace including new seal assembly.

Noisy Pump – Check For:

1. Air leak in suction piping, cavitations caused by restricted or undersized suction line or leak at any joint, low water level in pool, and unrestricted discharge return lines.

Solution: Correct suction condition or throttle return lines, if practical. Holding hand over return fitting will sometimes prove this point or putting in a smaller eyeball fitting.

2. Vibration due to improper mounting, etc.

Solution: Mount the pump on a level surface and secure the pump to the equipment pad.

3. Foreign matter in pump housing. Loose stones/debris hitting impeller could be cause.

Solution: Clean the pump housing.

4. Motor bearings noisy from normal wear, rust, overheating, or concentration of chemicals causing seal damage which will allow chlorinated water to seep into bearings wiping out the grease causing bearing to whine.

Solution: All seal leaks should be replaced at once.

PRODUCT REGISTRATION
(Retain For Your Records)

DATE OF INSTALLATION _____

INITIAL PRESSURE GAUGE READING (CLEAN FILTER) _____

PUMP MODEL _____ HORSEPOWER _____

FILTER MODEL _____ SERIAL NUMBER _____

HAYWARD® Pool Products Limited Warranty

To original purchasers of this equipment, Hayward Pool Products, Inc. warrants its products to be free from defects in materials and workmanship for a period of ONE (1) year from the date of purchase, when used in single family residential applications.

The limited warranty excludes damage from freezing, negligence, improper installation, improper use or care or any Acts of God. Parts that fail or become defective during the warranty period shall be repaired or replaced, at our option, within 90 days of the receipt of defective product, barring unforeseen delays, without charge.

Proof of purchase is required for warranty service. In the event proof of purchase is not available, the manufacturing date of the product will be the sole determination of the purchase date.

To obtain warranty service, please contact the place of purchase or the nearest Hayward Authorized Service Center. For assistance on your nearest Hayward Authorized Service Center please visit us at www.haywardpool.com.

Hayward shall not be responsible for cartage, removal, repair or installation labor or any other such costs incurred in obtaining warranty replacements or repair.

The Hayward Pool products warranty does not apply to components manufactured by others. For such products, the warranty established by the respective manufacturer will apply.

The express limited warranty above constitutes the entire warranty of Hayward Pool Products with respect to its' pool products and is in lieu of all other warranties expressed or implied, including warranties of merchantability or fitness for a particular purpose. In no event shall Hayward Pool products be responsible for any consequential, special or incidental damages of any nature.

Some states do not allow a limitation on how long an implied warranty lasts, or the exclusion of incidental or consequential damages, so the above limitation may not apply to you. This warranty gives you specific legal rights, and you may also have other rights, which vary from state to state.

Hayward Pool Products
620 Division Street
Elizabeth, NJ 07207

***Supersedes all previous publications.**

▲Retain this Warranty Certificate (upper portion) in a safe and convenient location for your records.

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HAYWARD®

DETACH HERE: Fill out bottom portion completely and mail within 10 days of purchase/installation or register online.

TriStar® Pump Series

Warranty Card Registration

Please Print Clearly:

First Name_____ **Last Name**_____

Street Address_____

City_____ **State**_____ **Zip**_____

Phone Number_____ **Purchase Date**_____

E-Mail Address_____

Serial Number

Model Number_____

Pool Capacity_____(U.S. Gallons)

☐Please include me on all e-mail communications regarding Hayward® Equipment or promotions.

Mail to: Hayward Pool Products, 620 Division Street, Elizabeth, NJ 07207

Attn: Warranty Dept

Or REGISTER YOUR WARRANTY ON-LINE AT WWW.HAYWARDPOOL.COM

Years Pool has been in service

☐ < 1 year ☐ 1-3 ☐ 4-5 ☐ 6-10 ☐ 11-15 ☐ >15

Purchased from_____

☐Builder ☐Retailer ☐Pool Service ☐Internet/Catalog

Company Name_____

Address_____

City_____ State_____ Zip_____

Phone_____

Type of Pool:

☐ Concrete/Gunite ☐ Vinyl ☐ Fiberglass

☐ Other_____

☐ New Installation ☐ Replacement

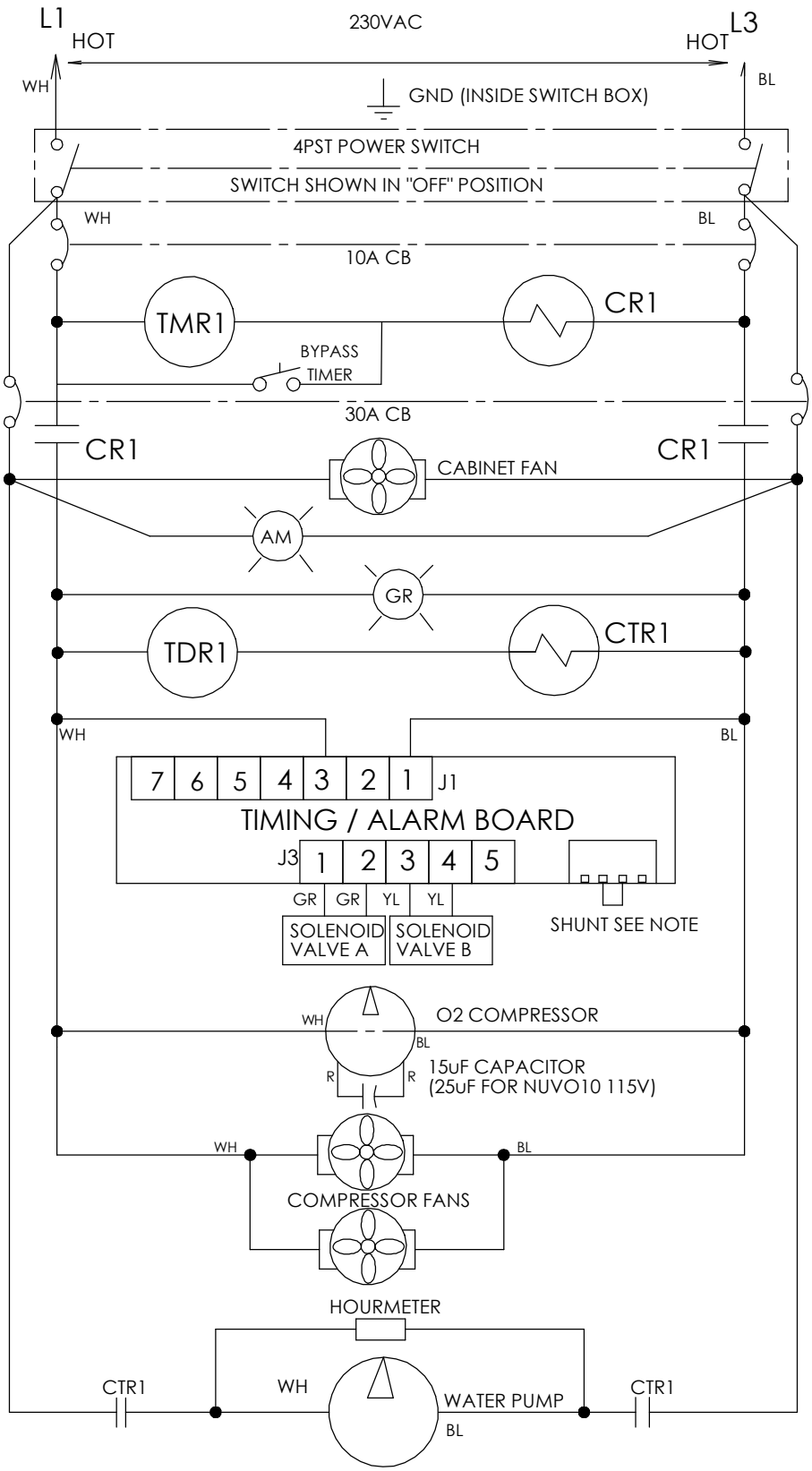
Installation for:

☐ In Ground ☐ Above Ground ☐ Spa

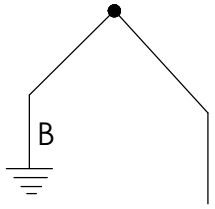
USE ONLY HAYWARD GENUINE REPLACEMENT PARTS

APPENDIX B: ELECTRICAL SCHEMATIC PLAN FOR THE HOMEPORT NANOBUBBLE GENERATOR

REV	DESCRIPTION	BY	REF. TO	APP.	DATE
A	INITIAL ISSUE	GM	ECC18-013		8/10/18
B					
C					
D					



GROUNDING DETAIL



GND ROD

GND TO POOL PUMP

GND LUG LOCATED ON SWITCH PANEL

VOLTAGE SELECTION
ONE SHUNT FOR 230V (SHOWN)
TWO SHUNTS FOR 115V
SHUNT 8400-1513

THERMAL DEVICE INSIDE

WIRE COLORS
B = BARE
BL = BLACK
WH=WHITE
GR = GREEN
YL = YELLOW

TOLERANCES UNLESS OTHERWISE SPECIFIED
UNITS ARE IN INCHES

0.0 = 0.060"
0.00 = 0.020"
0.000 = 0.005"

ANGLES +1 ° ' "
- ° ' "

ELECTRICAL SCHEMATIC HOMEPORT UNIT 230VOLT

NIDEK Medical

DRAWN BY	GM	APPRV BY	--
CHEKD BY	--	SCALE	

DWG NO. ES00033 REV A

STK CODE

REF.DWG. SHEET 1 OF 1

DATE 8/10/18

CAD FILE ES00033 Rev A, Electrical Schematic 240V Control Panel