
SECTION 13150
DEFENDER FILTER SYSTEM

PART 1. GENERAL

1.1 INTENT

- A Purpose of the bid is to purchase and have installed a complete filtration and recirculation system for the swimming pool. It is intended to limit the bidding to a style of product and/or company that has a proven history and record of performance.
- B Due to the specialized nature of certain components required for this project, these specifications, in some instances, refer to various components by trade or manufacturers name.
- C Whenever a proprietary (trade) name is used within this Specification Section, it is used for informational purposes to describe a standard of required function, dimension, appearance and quality. References to materials by trade name, make or model number shall not be construed as limiting competition. All bidders are required to bid on the named manufacturer in the BASE BID. The Contractor may at his option, elect to bid using the products and/or services of alternate manufacturers listed as ALTERNATES ON THE BID FORM.

1.2 ALTERNATES

- A Other treatment systems will be considered only if a complete set of drawings and specifications detailing such equipment as it pertains to this project are submitted for evaluation ten (10) days prior to the bid date. The submission should include a list of five (5) operating installations within a reasonable distance of the jobsite. List should include the names and telephone numbers of the operating personnel. The technical contents of the submittal shall include hydraulic calculations, equipment fabrication details, filter room layout in plan and elevation views, warranties, installation and operating instructions.

NOTE: This information must be submitted by a bidding contractor. Submittals will not be considered if provided directly by the alternate equipment manufacturer.

- B Alternates meeting the terms and conditions of the bidding documents will be acknowledged prior to bidding by addendum. No alternates will be considered after the bid.
- C For any and all alternates approved in accordance with the above conditions, state the amount to be DEDUCTED from the BASE BID if an alternate filtration system is being offered. No provision has been or will be made for ADDITIVE bids.

1.3 SUBSTITUTIONS

- A No substitutions will be considered unless the specified product becomes unavailable due to no fault of the Contractor

1.4 QUALITY ASSURANCE

- A Due to the specialized nature of the specified work and products, all bidders shall be required to have a minimum of five (5) years of operating history. The equipment described herein shall be products of a manufacturer regularly engaged in the fabrication of filtration and recirculating systems for at least fifteen (15) years and shall be a professional engineering corporation.
- B The owner requires that filters bear the National Sanitation Foundation (NSF) seal for Standard #50. This NSF listing is required by the owner regardless of local health department regulations.
- C The specified filter system shall have had an NSF listing for at least three (3) years prior to the project bid date.
- D As assurance that each item of apparatus is properly sized to perform in conjunction with each other, the owner requires bidders to use the filter manufacturer as a single source of supply for the items of equipment as listed and described herewith.
- E The "EQUIPMENT SUPPLIER" shall be:

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1.5 GUARANTEE

- A The "EQUIPMENT SUPPLIER" shall guarantee that the equipment to be furnished is of the correct capacity, that the various parts are designed to operate correctly and in conjunction with each other, that if the installation is made in accordance with the project drawings and operated in accordance with the suppliers instructions, the system will perform the prescribed functions correctly, the water entering the pool will be clear, bright, free from suspended matter visible to the unaided eye, and will be sanitary to the satisfaction of all authorities having jurisdiction.

1.6 SUBMITTALS

- A Provide detailed shop drawings of the items of equipment being provided, indicating the dimensions, material of the filter tanks, valves, actuators, RMF system controller & accessory components.
- B Provide a complete set of operating instructions, embracing the operational functions and recurring maintenance processes involved in connection with the complete filtration system.

PART 2. FILTER SYSTEM

2.1 FILTER SYSTEM

- A The filter system under this section shall be a Defender Model _____ as detailed on the drawings.
- B It is the intent of these specifications to describe a filter system complete with all accessory items supplied and warranted by one manufacturer.

- C The primary components of the system consist of the main filter tank, flex tube filter elements, element assembly, bump mechanism, vacuum transfer system, sight glass, pressure gauge panel, inspection (viewing) window, valves, pressure transducers & RMF system controller.
- D All components and related subassemblies shall be factory assembled and tested prior to shipment.

2.2 FILTER SYSTEM CAPACITY

- A The filter system shall have a filtering capacity of _____ gallons in _____ hours at a rate of _____ gallons per minute.
- B The filter system shall consist of _____ Defender filter tank(s) with a total effective filter surface area of _____ square feet each, and operate at a rate of _____ gallons per minute per square foot of filter area.
- C Filtration area shall be provided as specified and as certified to NSF Standard-50 to provide the specific filter rate. No modification, manipulation or interpretation of these values shall be permitted.
- D Filter system shall be designed to maximize sq. ft. of filter area while minimizing operating weight. Systems that operate in excess of 11 lbs. per sq. ft. of filter area shall not be considered.

2.3 FILTER TANKS

- A The filter tank shall not be less than _____" in diameter with a 60" side shell, suitable for 50 psi working pressure and hydrostatically tested to 75 psi. Tank shell shall be not less than $\frac{1}{4}$ " thick. Bottom dished head shall be not less than $\frac{1}{4}$ " thick. Top flat head shall be not less than $1\frac{1}{2}$ " thick. All material shall be Type A-36 carbon steel.

NOTE: Tanks constructed of alternate material shall not be considered

- B All welding shall be performed by qualified operators. Joints shall be butt or fillet welded inside and out by manual or automatic process. Welded joints shall have complete penetration and fusion with little or no reduction of the thickness of the base metal. Welds shall be free of coarse ripples, grooves, overlaps, abrupt ridges or valleys. All welded surfaces shall be chipped and brushed clean, when necessary, leaving no slag or splatter.
- C Tank legs shall be constructed of 6" x $2\frac{1}{2}$ " channel legs $\frac{1}{4}$ " thick. 24", 27" and 33" filters shall have (3) legs. 41", 49" and 55" filters shall have (4) legs. The material shall be Type A-36 carbon steel. Bearing plates shall be 10" x 5" x $\frac{1}{2}$ " type 304L stainless steel. Each bearing plate shall have (2) 5/8" drilled holes to secure to the floor with $\frac{1}{2}$ " x $4\frac{1}{2}$ " stainless steel concrete anchors provided. The legs shall be designed with bolted connections to minimize overall tank height for shipping and access into the mechanical room.

OPTIONAL: REDUCED HEIGHT DEFENDER

- D The tank head shall be bolted to the shell with 7/8" diameter T304 stainless steel bolts, nuts and washers, 9" on center around the tank perimeter.
- E Tank shall be equipped with a UL listed grounding lug.
- F Tank shall incorporate connections for ____" filter influent, ____" effluent, ____" drain; 1½" vacuum transfer piping. Tank shall include a 12" diameter access port with cover, 6" viewing window, hardware to facilitate cleaning of tube elements and interior inspection of filter and lift shaft gland.
- G Tank shall include brackets for mounting of RMF System controller, gauge panel, filter/regulator, vacuum transfer blower, and vacuum hose rack.
- H Tank shall include a integrally mounted hydraulic lifting device (davit). The davit assembly shall be designed to lift the filter head and include a pivot mechanism allowing the head to rotate 180°, for access to the tube sheet.

NOTE: Systems requiring additional devices for filter head removal will not be considered.

2.4 FLEXSOL 3000 INTERIOR LINING

- A All interior surfaces shall be grit blasted to white metal condition with a 3-4 mil profile. Blasted surfaces shall be cleaned of all dust or blast residue. Lining shall be applied as soon as is practical on the same day blasting is done.
- B Flexsol 3000® shall be a urethane, 100% solid plural component lining. Hardness shall be 75 durometer on the Shore D scale. Break tensile strength shall be 4,000 psi with elongation of less than 10%. Adhesion shall be greater than 2,500 psi.
- C Application of Flexsol 3000® lining shall be done by experienced applicators using a high pressure, high temperature plural component system. All wetted surfaces including flange faces, manway rings and manway covers shall be lined to 100 mils +/- 10 mils WFT.
- D Hardness shall be verified after curing to ASTM D 2240 standard.
- E Manufacturer shall submit for approval a sample piece of coated steel to determine flexibility, abrasion tolerance and adhesion integrity.
- F Flexsol 3000® lining shall meet the NSF toxicity standard unconditionally and shall be approved for use with the NSF approved filter.
- G Flexsol 3000® lined vessels shall carry a ten (10) year limited non-prorated warranty.
- H The filter manufacturer shall bear the responsibility for suitability of lining and shall be the sole source for the specified warranty.

2.5 EXTERIOR COATINGS

- A All exterior surfaces shall be grit blasted to white metal condition with a 2-3 mil profile. Blasted surfaces shall be cleaned of all dust or blast residue.
- B Two coats of high solids enamel shall be applied for a total developed film thickness of 5-8 mils.
- C Manufacturer is to supply min. 16 oz of high solids enamel touch-up paint.

2.6 INTERNAL COMPONENTS

- A The filter shall consist of flex tube elements, filter tube sheet, stainless steel lift shaft and internal flow diversion assembly.

- B The filter elements shall be flexible tubes that provide the support structure for the media. The outer wall of each element shall be fabricated of multi-filament high strength polyester braid. Each element shall have an internal T316 stainless steel spring, which acts a support structure for the braided filament.
- C The filter element tube sheet shall be fabricated of T304 (optional T316) stainless steel and provide both support for the top of the element assembly as well as water tight seal to prevent media from escaping the filter tank.
- D The lift shaft shall be fabricated from T304 (optional T316) stainless steel and provide the internal connection between the filter element tube sheet and the external bump mechanism.
- E The filter influent connection shall be fitted with a T304 (optional T316) stainless steel flow diversion assembly to eliminate disturbance to the filter elements during operation.
- F All stainless steel wetted fasteners shall be Type 304. (optional T316)

NOTE: Systems utilizing rigid elements with replaceable filter septum shall not be considered.

2.7 BUMP MECHANISM

- A The bump mechanism shall include a pneumatically operated tire mounted externally on the filter tank head. The tire is alternately pressurized then depressurized causing the connected filter element assembly to move in a downward then upward fashion. This movement shall provide the means of dislodging the media and accumulated solids, which then recoat the filter element.

NOTE: Systems that do not incorporate a pneumatic bump mechanism shall not be considered.

2.8 VACUUM TRANSFER SYSTEM

- A The vacuum transfer system shall be provided to allow the recharging of media into the filter for either bag or bulk media.
- B The vacuum shall include a 5 peak HP 115V or 230V single phase motor 60 Hz or 50 Hz, cULus listed.
- C Vacuum shall be supplied with mating electrical connections pre-wired into RMF System controller for field final connection in a pre-assembled junction box.
- D Provide three (3) 1½" SCH 80 PVC ball valves: for the vacuum drain line, the blower inlet and the vacuum hose.
- E The Manufacturer shall provide all necessary pipe, fittings and hardware for field plumbing of the vacuum transfer system.
- F Provide 1½" vacuum hose with required fittings.

NOTE: Systems requiring external precoat mixing tanks, slurry feed, or other wet media transfer devices shall not be considered.

2.9 RMF SYSTEM CONTROLLER

- A The automatic controller shall provide total control of the system's filtration and regeneration cycles, and provide all necessary equipment interlocks and timing mechanisms to execute the filter program.
- B The controller shall contain at least two microprocessors that will monitor all functions of the system.
- C The controller shall control operation of the following functions:

Standard Features

- 1. Bump cycle/manual or automatic; with or without security interlock for data logging
 - 2. Precoating of filter elements
 - 3. Stopping and starting of main recirculation pump
 - 4. Opening and closing of pneumatically operated valving
 - 5. Vacuum transfer system
 - 6. Heater cool down delay
 - 7. Auxiliary contacts to interlock UV lamps, chemical control, or other equipment
 - 8. 7 inch high-resolution LCD Screen with touch-screen interface
 - 9. Remote operation via web browser or phone
 - 10. Off-site real-time status
 - 11. Email on change of condition
 - 12. Data logging of process
 - 13. Differential pressure monitoring and bump control
 - 14. Exporting of process data logs to .csv Excel™ files
 - 15. Modbus Communications for PLC connectivity
- D The controller panel shall display the following functions:
- 1. Filter status
 - 2. Precoat status
 - 3. Last bump
 - 4. Recirculating pump status
 - 5. Vacuum transfer pump status
 - 6. System power
 - 7. Low pressure alarm
 - 8. Recirculating pump off alarm
 - 9. Pressure differential
 - 10. Flow rate (operational feature when interlocked with VFD)
 - 11. Step-by-step animated graphics
- E The controller enclosure shall be NEMA 4x/IP66 approved system.
- F The RMF controller will provide signal power to the main recirculating pump motor starter. The unit is required to be a variable frequency drive (VFD) and is to be installed with control wiring by the electrical contractor.
- G The RMF shall be 120V/230V, 1 phase, 20 amp rated and shall be UL/CE labeled.

NOTE: Systems without programmable, automatic bump/regeneration/filter modes shall not be considered.

H Options

1. Automated main drain and purge line control package
2. 24/7/365 data monitoring and activity package
3. Automated EZ Strainer control for UV systems.

2.10 VFD

- A A Variable Frequency Drive (VFD) shall be provided with each Defender (one per filter pump) for control of the filter pump motor.
- B The Variable Frequency Drives (VFDs) shall be solid state, with a Pulse Width Modulated (PWM) output. The VFD package as specified herein shall be enclosed in a NEMA 12 enclosure, completely assembled, programmed and tested by the manufacturer. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC induction motors. The VFD shall be a six-pulse input design. The VFD shall be of a PWM output design utilizing current IGBT inverter technology and voltage vector control of the output PWM waveform and shall output a waveform that closely approximates a sine wave.
- C Option for Single Phase input: The VFD shall convert incoming fixed frequency single-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC induction motors. The VFD shall be UL-listed for Single Phase operation. De-rating the VFD for operation on other than UL-labeled voltages shall not be acceptable. The VFD shall be a six-pulse input design. The VFD shall be of a PWM output design utilizing current IGBT inverter technology and voltage vector control of the output PWM waveform and shall output a waveform that closely approximates a sine wave.
- D The VFD shall utilize VVCPLUS, an output voltage-vector switching algorithm, or equivalent, in both variable and constant torque modes. VVCPLUS provides rated RMS fundamental voltage from the VFD. This allows the motor to operate at a lower temperature rise, extending its thermal life. VFD's that cannot produce rated RMS fundamental output voltage or require the input voltage to be increased above motor nameplate value to achieve rated RMS fundamental output voltage are not acceptable. VFD's that utilize Sine-Coded PWM or Look-up tables shall not be acceptable.
- E An Automatic Energy Optimization (AEO) selection feature shall be provided in the VFD to minimize energy consumption in variable torque applications. This feature shall optimize motor magnetization voltage and shall dynamically adjust output voltage in response to load, independent of speed. Output voltage adjustment based on frequency alone is not acceptable for single motor VT configurations.
- F An Automatic Motor Adaptation (AMA) function shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to spin the motor shaft or de-couple the motor from the load to accomplish this optimization. Additionally, the parameters for motor resistance and motor reactance shall be user-programmable.

- G Run permissive circuit shall be provided to accept a “system ready” signal to ensure that the VFD does not start until isolation valves, seal water pumps or other types of auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of sending an output signal as a start command to actuate external equipment before allowing the VFD to start.
- H All greenDrive VFDs shall be factory programmed per the unique requirements of each job per Neptune Benson specifications. Programming shall include but shall not be limited to filter pump, remote start/stop requirements, run confirm requirements and PID loop requirements.
- I VFDs and options shall be UL, CUL, and CE labeled as a component.
- J Harmonic Distortion Control
 - a) The VFD shall provide internal DC link reactors to minimize power line harmonics and to provide near unity power factor. DC Link reactor shall be installed so that power fluctuations to the DC Capacitors shall be reduced to increase Capacitor life. VFDs without a DC link reactor shall provide a 5% impedance line side reactor and provide spare capacitors.
- K Specifications
 - a) Input voltage 200-240, 380-480, 575-600 VAC +/- 10%, 3 phase, 48-63 Hz.
 - b) Voltage tolerance + 10% or - 15% of specified line voltage.
 - c) Output Frequency 0 to 300 Hz. Operation above 60 Hz shall require programming changes to prevent inadvertent high-speed operation.
 - d) Environmental operating conditions: -10 to 50°C, 0 to 1,000 meters above sea level, less than 90% humidity, non-condensing.
 - e) Enclosure shall be rated NEMA 12 or as specifically mentioned elsewhere.
- L The VFD shall be wired into the RMF system controller to provide remote for on/off and run confirm functions. Wiring shall be by electrical contractor.
- M The VFD shall be a greenDrive series.
- N The VFD shall be equipped with a bypass. Bypass option shall send the motor to bypass mode based on an easily accessible door-mounted selector or based on the drive’s programmable relay. A bypass pilot light shall provide indication of the bypass mode. The bypass mode shall provide overload protection. Contactors shall be electrically and mechanically interlocked. An essential services mode shall send the motor to bypass regardless of the selected mode.
- O The bypass enclosure shall be equipped with a circuit breaker/disconnect switch.

2.11 FLOWMETER

- A A digital flowmeter shall be included with a 4-20mA 0-10 VDC analog output.
- B The flowmeter shall be wired into the VFD to provide automatic speed control of the filter pump motor.
- C The VFD shall compensate for varying filter head losses by maintaining the specified flowrate with the 4-20mA output signal of the flowmeter.

2.12 FILTER/REGULATOR

- A Each filter shall include a combination filter/regulator. The regulator shall be adjustable from 0-120 psi. $\frac{1}{2}$ " FPT connections shall be provided for field installation of air lines.

2.13 WATER SEPARATOR

- A One water separator with automatic drain shall be included for each air compressor supplied. $\frac{1}{2}$ " FPT connections shall be provided for field installation of air lines.

2.14 AIR COMPRESSOR

- A The system will require (1) air compressor per mechanical room. The following is the minimum requirement:
- B 20 gallon tank, 2 HP 115v, 1 phase, 15 amp, 5.2 CFM @ 90 psi, air pressure gauge, pressure relief valve, belt guard, pressure switch, air filter, tank drain.

2.15 PNEUMATIC ACTUATORS

- A Each filter shall include pneumatic actuators for (1) effluent valve and (1) precoat valve.
- B The actuators shall be double acting with valve mounted drilling to ISO 5211.
- C The actuators shall include (2) $\frac{1}{8}$ " or $\frac{1}{4}$ " FPT ports for open/close connections. Flow control valves with quick connect fittings shall be provided at each port to allow speed control adjustment for the open/close function of the actuators.
- D Materials of Construction
 1. Body: aluminum alloy, extruded acc. to ASTM 6063, anodized acc. to UNI 4522
 2. Ends: Die-cast in aluminum alloy acc. To ASTM B179, epoxy-polyester coated
 3. Pistons: Die-cast in aluminum alloy acc. To ASTM B179
 4. Pinion: Nickel-plated steel
 5. Slideways: Acetal resin (LAT LUB 731320T)
 6. Fasteners: AISI 304 Stainless steel
 7. Springs: Zinc phosphate coated steel, pre-compressed
 8. Seals: NBR Nitrile rubber
 9. Lubricant: MoS2
- E The actuators shall be factory lubricated to allow for 1,000,000 maneuvers.
- F The actuators shall have adjustable travel stops for both directions.
- G Working temperature limits: 4-186°F.

NOTE: Systems utilizing manually operated valves shall not be considered.

- H A tool kit for adjustment of pneumatic actuators shall be provided by the filter manufacturer.

2.16 SOLENOID VALVES

- A Each filter shall include three (3) single solenoid, 4-way valves mounted on a multi-station manifold for operation of the pneumatic actuators and bump mechanism.
- B The solenoids valves shall include lighted DIN connectors.
- C The solenoid valves shall be factory lubricated and shall not require any field lubrication.

- D The solenoid valves with multi-station manifold shall be located on the bottom of the automatic controller, factory wired and include quick connect fittings for attachment to the pneumatic actuators and bump mechanism.
- E The solenoid valves shall be SMC Series SY 7000.

2.17 VALVES

- A All valves 3-12" shall be constructed with cast aluminum ASTM B179S12C housing and fully coated with Rilsan on all interior and exterior surfaces. Internal components include EPDM resilient lining, Rilsan coated ductile iron disc and T304 stainless steel shaft. Valves 14" and larger shall be constructed with cast iron housing epoxy coated and with nylon coated ductile iron disc.
- B Valves shall be butterfly valves and shall be provided for the influent, effluent and precoat lines.

2.18 SYSTEM VALVES

- A Each defender filter shall include five (5) system valves to facilitate system fill after media recharge, precoat/regeneration, influent & effluent for filtering and media dump/drain valve.
- B The precoat/regeneration and effluent valves shall be butterfly type with pneumatic actuators per 2.15.
- C The system fill valve shall be butterfly type with lever operator and shall be the same size as the precoat/regeneration valve.
- D The influent valve shall be a wafer type check valve, ductile iron body w/double disc, SS type 304, epoxy coated.
- E The dump/rinse valve shall be butterfly type, lever operated with SS extension to facilitate operation.

2.18A MAIN DRAIN & TDS (optional)

Each defender shall include a pneumatically operated drain valve and precoat vent valve to assist with removing debris from the tank bottom and to provide controlled water to waste for makeup & TDS control.

2.18B EZ STRAINER FOR UV (optional)

A wafer type EZ Strainer shall be provided with a pneumatically operated 180° actuator with solenoid valve for UV for automatic cleaning of collected debris.

2.19 DRAIN REQUIREMENTS (BY OTHERS)

- A A sump pit or stand pipe is required for dumping spent media and rinsing tube elements.
- B To prevent overflow the sump or stand pipe drain piping should be sized for 300 gpm capacity.
- C If drain piping cannot be sized for 300 gpm, or if the sewer is at an elevation higher than the filter tank drain, use the following minimum sump sizes:
 - Model SP-24 130 gals

- Model SP-27 160 gals
- Model SP-33 250 gals
- Model SP-41 450 gals
- Model SP-49 620 gals
- Model SP-55 850 gals

NOTE: Systems that can not dump spent media by gravity drain only shall not be considered.

2.20 PACKAGING

- A For loading and unloading, filter tank diameters 24-41" shall be bolted to individual wooden pallets. Filter tank diameters 49" and 55" shall be equipped with temporary lifting legs. All tanks shall be shrink wrapped to prevent damage during transport.
- B The components shall be carefully packaged in a totally enclosed wooden crate to prevent damage during transport.

2.21 MEDIA

- A Media shall be expanded perlite with a median particle size of 37 microns. Percentage retained on a +150 Tyler Mesh shall not be less than 8% or more than 25%. Darcy permeability shall be between 1.2-1.85.
- B The media shall contain no more than 1 tenth of one percent (.001) of crystalline silicate.
- C The media shall be certified by the manufacturer for use in the Defender Filter. The media shall be NSF Std. 50 listed.
- D The media shall be Aquaperl/Harborlite.
- E Each Defender filter shall be furnished with six (6) charges of perlite media.

2.22 FILTER CLEANER

- A Each Defender filter shall be furnished with one (1) charge of chemicals for cleaning and degreasing of filter tube elements.

2.23 WARRANTIES

Refer to Neptune Benson Defender Limited Warranty Statement for specific warranty terms and additional details.

- A Defender filter tanks with Flexsol 3000 shall carry a 10 year limited fully rated warranty as regularly offered by the tank manufacturer.
- B Internal components, including tube elements, shall carry a fully rated 10 year warranty.
- C Valve bodies shall carry a 5 year fully rated warranty.
- D Valve operators and system accessories including the RMF controller, quick exhaust valve, solenoid valve and bump mechanisms shall carry one year warranty as provided by the product manufacturer.
- E Unless otherwise specified, workmanship is to be guaranteed first class and carry a one (1) year warranty.

2.24 AIR SCOUR (OPTIONAL)

- A Each Defender filter shall be equipped with an Air Scour System to aide in the removal of media and debris from the flexible tube elements prior to draining media for recharging.
- B Air Scour System shall consist of a header/lateral arrangement to cover the cross-sectional area of the tank.
- C Laterals shall have 0.12" holes drilled on 1" centers. Header and laterals shall be SS Type 316.
- D A compressor capable of generating 2 standard cubic feet per minute (scfm) per cubic foot of tank volume shall be provided by others.
- E A Rotameter with a 200 scfm scale shall be supplied to meter air flow during Air Scour function.