Orenco Liquid-Only Sewer
Equipment Specifications

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LIQUID-ONLY SEWER EQUIPMENT SPECIFICATIONS

PART 1. GENERAL

1.01 DEFINITIONS

Wherever used in these specifications and printed with bold, first-capital letters, the terms listed below will have the meanings indicated, which are applicable to both the singular and plural thereof.

- **Bid** – The offer or proposal of a **Bidder**, submitted on the prescribed form, setting forth the prices for the work to be performed.
- **Bidder** – An individual or entity who submits a **Bid** directly to the **Owner**.
- **Contractor** – The individual or entity with whom the **Owner** has entered into an agreement to install a **Liquid-Only Sewer**.
- **Liquid-Only Sewer** – A wastewater pretreatment and collection system designed to provide on-site solids retention and reduction and to convey pretreated liquid effluent to a centralized facility for treatment.
- **Engineer** – The named individual or entity responsible for preparation and certification of the construction plans and/or construction management.
- **Gravity Effluent Discharge (GED)** – A type of **Liquid-Only Sewer** equipment used at sites where the elevation allows effluent discharge into a pressurized collection main without the use of a pump.
- **Inspector** – The specific individual designated by the **Owner**, **Engineer**, **Contractor**, and **Manufacturer** to ensure quality control by inspecting and certifying that each **Liquid-Only Sewer** package is in compliance with the **Manufacturer**'s recommendations and requirements.
- **Manufacturer** – A supplier, fabricator, distributor, or vendor having a direct contract with the **Contractor** or **Owner** to furnish materials or equipment to be incorporated in the work by the **Contractor**.
- **Manufacturer's Representative** – A firm under contract with the **Manufacturer** to sell or solicit sales and/or represent the **Manufacturer** as a limited agent for the **Manufacturer**'s products.
- **Owner** – The individual or entity that has entered into the agreement and for whom the work is to be performed.
- **Pressurized Effluent Discharge (PED)** – A type of **Liquid-Only Sewer** equipment used on sites where a pump is used to discharge effluent into a pressurized collection main.

1.02 GENERAL DESCRIPTION

The **Liquid-Only Sewer** package shall be an Orenco Prelos® Processor unless specified otherwise on the plans and specifications. The **Manufacturer** or **Manufacturer's Representative** shall furnish a complete, factory-built and tested **Liquid-Only Sewer** package(s), each consisting of a tank, access riser, access lid, pump vault with effluent filter, float switches, pump, discharge assembly, wiring connection system, and control panel. All approved **Liquid-Only Sewer** packages must be sourced from a single manufacturer and sold as a complete assembly. In addition, the on-site tank must be deemed by the **Manufacturer** or **Manufacturer's Representative** in writing as being compatible with the approved **Liquid-Only Sewer** package.

1.03 SUBMITTALS

The **Manufacturer** or **Manufacturer's Representative** shall submit an electronic set of shop drawings and technical data sheets. The submittals shall clearly specify the materials of construction and equipment compatibility, along with drawings for each unique package being supplied.

1.04 OR APPROVED EQUAL EVALUATIONS

For this project, "approved equal" shall mean equal in the judgment of the **Engineer**, and the term "**Engineer**-approved equal" will therefore be used throughout this specification as defined in this section.

A. Should the **Bidder** seek approval of a product other than the brand or brands named in the specifications, the **Bidder** shall furnish written evidence that such product conforms in all respects to the specified requirements, and that it has been used successfully elsewhere under similar conditions. It will not be the responsibility of the **Engineer** to research, review, or determine equality, nor the responsibility of the **Manufacturer**, specified within these specifications, to provide research, documentation, or data supporting the difference between the "or equal" and the specified product. This will be the sole responsibility of any **Bidder** seeking the approval.

B. Where the specified requirements involve conformance to recognized codes or standards, the **Bidder** shall furnish evidence of such conformance in the form of test or inspection reports, prepared by a recognized agency, and bearing an authorized signature. A manufacturer's standard data and catalog cut sheets will not be considered sufficient in themselves, and the **Engineer** will not be responsible for seeking further data from the manufacturer, or for otherwise researching the product. Failure to provide complete data will be cause for rejection of the product. The submission shall include any impacts that could be expected from the alternative product and shall also indicate any product that would require a license or royalty, the actual fees, and a note that these fees would be handled by the **Bidder**. The **Bidder** shall provide submissions meeting the above parameters no less than TWO WEEKS prior to the **Bid** opening for review by the **Engineer**. **Bidders** seeking approval of "or equal" products or systems shall provide, at minimum, the following information:

1. Product and system submittals, including, but not limited to, the number of years the **Manufacturer** has been in business of manufacturing relevant products/systems.
2. Company size, including:
    a. Number of employees related to relevant products/systems
    b. Number of engineers on staff related to relevant products/systems
3. Product specifications and a detailed description of how each product, system, and component is equal to the specified tank, access riser, access lid, pump vault with effluent filter (including flow and surface area), float switches, pump motor, pump liquid end, discharge assembly, wiring connection system, or control panel.

    A side-by-side comparison of each product, system, and component is required, including, but not limited to, the description, manufacturer, origin, expected operating life, and expected life-cycle cost (repair and replacement cost).
4. Warranties for each product, system, and component, along with any and all limitations and exclusions.
5. Performance validation data for each product, system, and component demonstrating how each product, system, and component has proven to be equal to the specified tank, access riser, access lid, pump vault with effluent filter (including flow and surface area), float switches, pump motor, pump liquid end, discharge assembly, wiring connection system, and control panel.

    A side-by-side comparison of each product, system, and component is required, including, but not limited to, the operating life, number of units in operation, maintenance frequency, and life-cycle cost (including repair and replacement frequency and cost).
6. Evidence of successfully obtaining approval for a system with similar permit requirements with the regulating authority.
7. Summary of product/system track record and history, including, but not limited to:
    a. Number of similarly sized systems
    b. Detailed summary of, at minimum, ten (10) similarly sized systems, at least five (5) years old, including, but not limited to:
        - Project name, location, and application
        - Years in operation

- Current average daily flows and design flows
- Operator name and contact information

C. The **Bidder** shall specify and furnish documentation related to manufacturer (or representative) support services, including, but not limited to:

1. Installation training program and support material
2. Installation oversight program and support material
3. Operator training program and support material
4. Start-up services program and support material

D. The **Engineer** is eligible for reimbursement for the evaluation of any substitute to determine if it is "approved equal."

1. The **Engineer** will record **Engineer**'s costs in evaluating "or approved equal" substitutes proposed or submitted by the **Bidder**.
2. Whether or not the **Engineer** determines a substitute to be an "approved equal" so proposed or submitted by the **Bidder**, the **Bidder** shall reimburse the **Owner** for the reasonable charges of the **Engineer** for evaluating each proposed substitute.
3. The **Bidder** shall reimburse the **Owner** for the reasonable charges of the **Engineer** for making changes in the contract documents (or in the provisions of any other direct contract with the **Owner**) resulting from the acceptance of each "approved equal" substitute.

E. The **Bidder** and/or **Contractor** may not knowingly contract with a supplier or manufacturer if the individual or entity who prepared the plans and specifications has a corporate or financial affiliation with the supplier or manufacturer. The **Owner**'s officers, employees, or agents shall not engage in the award or administration of this contract if a conflict of interest, real or apparent, would be involved. Such a conflict would arise when: a) the employee, officer, or agent; b) any member of their immediate family; c) their partner; or d) an organization that employs, or is about to employ, any of the above, has a financial interest in the **Contractor**. The **Owner**'s officers, employees, or agents shall neither solicit nor accept gratuities, favors, or anything of monetary value from the **Contractor** or subcontractors.

F. During the bidding process, any approved "or approved equal" or substitute shall be accepted by the **Engineer** and released as an addendum to the contract documents.

1.05 EXPERIENCE CLAUSE

The equipment furnished shall be manufactured and supplied by a company experienced in the design and manufacture of **Liquid-Only Sewer** systems. The **Manufacturer** shall have a minimum ten (10) years' experience in the design and manufacture of **Liquid-Only Sewer** systems of similar size and equipment specified. The **Manufacturer** shall have a minimum of twenty-five (25) successful installations of **Liquid-Only Sewer** systems, five of which shall have more than 100 connections or be at least the size of the system being bid, whichever is smaller.

1.06 MANUFACTURER

The **Manufacturer** shall be Orenco or **Engineer**-approved equal. The **Manufacturer** shall furnish a complete, factory-built **Liquid-Only Sewer** package(s), consisting of a tank, access riser, access lid, pump vault with effluent filter, float switches, pump, discharge assembly, wiring connection system, and control panel. The **Manufacturer** shall supply detailed installation instructions and operation and maintenance (O&M) instructions. The **Manufacturer** or **Manufacturer's Representative** shall also provide the following support personnel:

A. Professional engineer, or personnel under the supervision of a professional engineer, dedicated to supporting the project through design, construction, and O&M.

B. Asset Management Department dedicated to assisting operators with operational and maintenance activities.

1.07 WARRANTY

The **Manufacturer** of the **Liquid-Only Sewer** package shall provide a warranty of five (5) years from the date of installation to include, without being limited to, the pump vault, effluent filter, float switches, discharge assembly, wiring connection system, and control panel, with a separate warranty of ten (10) years from the date of manufacture on the liquid end of the effluent pump. The **Manufacturer** shall submit detailed limitations and exclusions from the warranty. The warranty shall be documented in product literature.

All tanks shall be warrantied in writing by the **Manufacturer** for a period of five (5) years from the date of final acceptance.

1.08 INTEGRATED SYSTEM

The entire **Liquid-Only Sewer** package, including the tank, pump vault with effluent filter, float switches, pump, discharge assembly, wiring connection system, and control panel, shall be an integrated package provided by a single manufacturer and designed to work together.

1.09 SERVICEABILITY

The **Liquid-Only Sewer** package(s) shall be completely serviceable, with easy access to the pump(s), filter, and float switches. The pump(s) shall be designed for removal without removing the filter and float switches. The pump(s) must consist of a motor, a liquid end, and an electrical cable and must be repairable (by replacing impellers and/or diffusers), serviceable, and cleanable. The pump(s) shall be lightweight for easy removal and maintenance without removing the filter or float switches.

1.10 BUILDING SEWER

Building/side sewers shall be watertight and installed by a contractor licensed for such work as per all applicable local and state licensing requirements. Building-sewer materials, installation, and testing shall be per the current local plumbing code.

PART 2. ON-SITE TANK

2.01 GENERAL REQUIREMENTS

A. The **Manufacturer** shall provide the structural design and certification to the **Engineer** for review. The design shall be in accordance with accepted engineering practice. All tanks shall be Prelos Processor tanks, unless alternatives are explicitly specified in the plans and specification. Precast concrete, dicyclopentadiene, or polyethylene tanks shall have been designed by a registered engineer and approved by the state or province and local regulatory agencies or authorities in which the tank is being used and must meet or exceed the specification contained herein. Additionally, the tank must be approved in writing by the manufacturer of the integrated pump system for use with its product. Due to the configuration of the Prelos Processor, it is suitable for residential applications with as many as four (4) bedrooms. To achieve effective performance and minimize pump-out occurrences, all other residential tanks shall have a minimum usable volume of 1000gal (3785L) for up to three (3) bedrooms and 1500gal (5678L) for up to four (4) bedrooms. Tank sizing for homes with more than four (4) bedrooms shall be at the discretion of the **Engineer** and shall follow all applicable regulations.

B. Loading criteria:

1. The tank shall be rated for a minimum 500lbs/ft^2 (2441kg/m^2) loading criteria and shall be evaluated both with saturated and unsaturated backfill.
2. The minimum lateral loading shall be 62.4lbs/ft^3 (1000kg/m^3). Lateral loading shall be determined from ground surface.
3. The tank shall support a concentrated wheel load of 2500lbs (1134kg).

C. There are four (4) typical loading conditions that should be analyzed:

1. 5ft (1.5m) bury + full exterior hydrostatic load
2. 5ft (1.5m) bury + full exterior hydrostatic load + 2500lb (1134kg) wheel load
3. 1ft (0.3m) bury + 2500lb (1134kg) wheel load

4. Tank full, interior hydrostatic load, and unsupported by soil.

Load Case 4 represents the tank full of liquid at 62.4lbs/ft^3 (1000kg/m^3). This condition addresses seam and haunch stress-strain relationships that occur during watertightness testing, as well as poor soil bedding conditions that provide inadequate support.

D. Tanks requiring deep burial (> 60in or 1524mm) or subject to truck or heavy traffic loading require special consideration. A minimum soil cover of 12in or approximately 300mm shall be used, unless specified otherwise by the **Manufacturer**.

E. All tanks shall be designed to be structurally sound and watertight and shall be warrantied in writing by the **Manufacturer** as described in Section 1.07 WARRANTY. The **Manufacturer**'s signed warranty, including any and all limitations and exclusions, shall accompany the **Bid**. The tank warranty shall be furnished at the time of submittal. The tank shall be capable of withstanding long-term hydrostatic loading, in addition to soil loading, with a water table maintained at ground surface.

F. Prelos Processor tanks shall be manufactured and furnished with one access opening capable of accepting a 30in (750mm) nominal diameter access riser and of the configuration shown on the **Manufacturer**'s drawings. Modification of completed tanks will not be permitted.

G. Inlet plumbing shall include an inlet tee that penetrates 18in (457mm) into the liquid from the inlet flow line. (The depth may vary depending on the tank's height; in all cases, though, the inlet should extend to a level below the bottom of the maximum scum depth.) The inlet plumbing shall allow for natural ventilation back through the building sewer and vent stack.

H. Tanks shall be capable of successfully withstanding an above-ground static hydraulic test and shall be individually tested to the **Manufacturer**'s specifications.

I. All tanks shall be installed in strict accordance with the **Manufacturer**'s recommended installation instructions.

2.02 PRELOS PROCESSOR TANK, DICYCLOPENTADIENE (DCPD)

A. The **Manufacturer** shall be Orenco Systems or **Engineer**-approved equal. The **Manufacturer** shall supply detailed installation instructions, O&M instructions, and warranty terms to the **Engineer**.

B. Method of calculations:

1. DCPD tanks shall be analyzed using finite element analysis for buried structures, and calculations shall address the following:
    a. Strength
    b. Buckling
    c. Deflection of 5% of the tank diameter, based on service load (including long-term deflection lag)
    d. Buoyancy
2. Performance testing

C. The material properties and laminates considered in this analysis shall be DCPD. The resin must be considered acceptable for use with tank construction. The thicknesses for different regions of the tanks shall be described and shown in shop drawings for each individual tank. Typical design strength properties are listed below:

1.	Design tensile strength psi (bar)	2300 (159)
2.	Design flexural strength psi (bar)	3500 (241)
3.	Design compressive strength psi (bar)	3100 (214)
4.	Design shear in-plane psi (bar)	2400 (165)
5.	Flexural modulus psi (bar)	274,000 (18,892)

D. The tank shall be constructed by reaction injection molding, with a dicyclopentadiene resin content specified by the **Manufacturer**. Any permanent metal part shall be 300 series stainless steel.

E. The minimum tank weight shall be specified by the **Manufacturer**'s engineer, e.g., 450lbs± (204kg±) for 1000gal (3785L) tanks.

F. All penetrations specified for the tank shall be provided by the **Manufacturer**.

G. **Manufacturer**-supplied EPDM grommets or methacrylate bonding (for ABS piping only), or **Engineer**-approved equal, shall be used at the inlet to join the tank wall and the inlet piping. ABS or Schedule 40 PVC pipe and fittings shall be used at the inlets.

H. Inlet plumbing shall include an inlet tee that penetrates 18in (457mm) into the liquid from the inlet flow line. (The depth may vary depending on the tank's height; in all cases, though, the inlet should extend to a level below the bottom of the maximum scum depth). The inlet plumbing shall allow for natural ventilation back through the building sewer and vent stack.

I. In order to demonstrate watertightness, tanks shall be tested at the factory prior to shipping and again on-site prior to acceptance. During installation, each tank shall be backfilled to just below the midseam flange, then the tank shall be completely filled with water to a level 2in (51mm) into the riser. The tank shall be inspected for leaks after a minimum two-hour wait (or as required by local rules). There should be no drop in liquid level and no visual leakage from seams, pinholes, or other imperfections. No tank will be accepted if there is any leakage over the two (2) hour period. Once the tank has passed this field test, the water level in the tank shall be dropped to a level below the tank invert, but not below the mid-seam.

J. Tanks shall be manufactured and furnished with one access opening capable of accepting a 30in (750mm) nominal diameter access riser and of the configuration shown on the **Manufacturer**'s drawings. Modification of completed tanks will not be permitted. This access port will provide access to both the inlet and the outlet/discharge pumping equipment.

K. Installation shall be in accordance with the **Manufacturer**'s recommendations, or as shown on the contract plans, whichever is more stringent – with no variations.

2.03 CONCRETE TANKS

A. The **Manufacturer** shall supply detailed installation instructions, O&M instructions, and warranty terms to the **Engineer**. All concrete tanks will be preapproved by the **Engineer**. Walls, bottom, and top of reinforced concrete tanks shall be designed across the shortest dimension using one-way slab analysis. Stresses in each face of monolithically constructed tanks may be determined by analyzing the tank cross-section as a continuous fixed frame.

B. The walls and bottom slab shall be poured monolithically; alternatively, water stops may be provided. Mid-seam or clamshell tanks are not acceptable.

C. Reinforcing steel shall be ASTM A615 Grade 60, fy = 60,000psi (4137bar). Details and placement shall be in accordance with ACI 315 and ACI 318.

D. Concrete shall be ready-mix with cement conforming to ASTM C150, Type II. It shall have a cement content of not less than six (6) sacks per cubic yard (7.8 sacks per cubic meter) and maximum aggregate size of 3/4in (19mm). Water/cement ratio shall be kept low (0.35±), and concrete shall achieve a minimum compressive strength of 4000psi (27.58MPa) in 28 days. The **Contractor** shall submit a concrete mix design to the **Engineer** for review and approval. Three (3) concrete sample cylinders shall be taken and tested for each tank manufactured until the **Manufacturer** and **Engineer** are satisfied that the minimum compression strength is being obtained. To ensure compliance, the **Manufacturer** shall then make and set three (3) sample cylinders for a minimum of 20% of the remaining tanks at the discretion of the **Engineer**. If the minimum compressive strength is not being obtained, the **Manufacturer** shall be required to make and test sample cylinders for each tank manufactured. Calcium chloride will not be allowed in the mix design. The cost of testing cylinders shall be the tank **Manufacturer**'s responsibility. The tank **Manufacturer** may supply a Swiss hammer for compressive testing in the field in lieu of sample cylinders.

E. Tanks may be protected by applying a heavy, cement-based waterproof coating, on both inside and outside surfaces, in compliance with Council of American Building Officials (CABO) report #NRB-168; 6181; however, the tank should be watertight without the addition of seal coatings.

F. The form release used on tank molds shall be Nox-Crete® by Nox-Crete Products Group or **Engineer**-approved equal. Diesel or other petroleum products are not acceptable.

G. Tanks shall not be moved from the manufacturing site to the job site until the tank has cured for seven (7) days or has reached two-thirds of the design strength.

H. Tanks shall be manufactured and furnished with access openings a minimum diameter of 19in (483mm) and designed to accommodate individual packaged pump systems. For 24in (600mm) nominal diameter access risers, the tank **Manufacturer** shall cast in place a flanged tank adapter to facilitate the bonding of a 24in (600mm) nominal diameter access riser. The flanged tank adapter shall be Orenco Model PRTA24 or **Engineer**-approved equal. The flanged tank adapter shall be made of 1/4in (6.35mm) thick ABS and have an overall height of no less than 3in (76mm) to allow 1.5in (38mm) exposed for sufficient bonding area once the adapter is installed in the tank. For 30in (750mm) nominal diameter access risers, either a grooved tank adapter plate (Orenco Model RRFTA30) or a flanged tank adapter (Model PRTA30) may be installed in the tank. The adapter shall be manufactured of fiberglass or ABS and shall accommodate a 30in (750mm) diameter access riser. Inlet access shall be a minimum of 12in (305mm) in diameter.

I. The tank and the top slab shall be sealed with a preformed flexible plastic gasket. The flexible plastic gasket shall be equal to the flexible butyl resin sealant CS-102 or CS-202 as manufactured by ConSeal Concrete Sealants, Inc., and shall conform to federal specification SS-S-00210 (2iOA) and AASHTO M-198. A mechanical fastening method shall be used if the seasonal groundwater level may reach the top slab seam of the tank.

J. In order to demonstrate watertightness, tanks shall be tested at the factory prior to shipping and again on-site prior to acceptance. The tank inlet and outlet connections shall incorporate Press-Seal Cast-A-Seal™ 402 rubber boot fittings or **Engineer**-approved equal. During factory testing, each tank shall be filled with water to the soffit and left to stand to allow for concrete moisture absorbtion. After 24 hours, the tank shall be refilled to the soffit and the exfiltration rate shall be determined by measuring the water loss during the next two (2) hours. Any leakage shall be cause for rejection. After installation is completed and before backfilling, each tank shall be filled with water to the soffit and the water loss measured after a 24hr period. If it has been determined that there is no leakage, backfill to a minimum depth of 2in (51mm) above the riser seam to prevent damage from hydrostatic uplift. Then fill the tank with water to a point 2in (51mm) above the riser seam and let sit for a period of not less than two (2) hours. If there is no leakage over the two (2) hour period, the tank will be accepted as watertight.

2.04 HIGH-DENSITY POLYETHYLENE (HDPE) TANKS

A. All HDPE tanks shall be manufactured by Roth Industries or **Engineer**-approved equal. All HDPE tanks plus fittings and fixtures, as necessary, will be preapproved by the **Engineer**. All HDPE tanks provided must be certified to and/or listed with both CSA and IAPMO. CSA and UPC (IAPMO) marks must be clearly molded into the tank. In addition, all state and local regulations and codes shall be followed. The **Manufacturer** shall supply detailed installation instructions, O&M instructions, and warranty terms to the **Engineer**.

B. The following generally recognized testing methods for plastic materials shall apply:

1. ASTM D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
2. ASTM D1693 – Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
3. ASTM D638 – Standard Test Method for Tensile Properties of Plastics
4. CSA International – CAN/CSA-B66-00 Prefabricated Septic Tanks and Sewage Holding Tanks
5. ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

C. The polyethylene used shall comply with ASTM Standard D1248, Specification for Polyethylene Plastics Molding and Extrusion Materials. Raw materials shall meet or exceed the following:

1. D638 – tensile strength of 2400psi (16.55MPa) or greater and either D1248 Class B – requiring ultraviolet stabilizer, or D1248 Class C - requiring a minimum 1% carbon black
2. D1693 – Environmental stress crack resistance of 150 hours or more
3. D790 – Flexural modulus of elasticity of 85,000psi (586.05MPa) or greater

D. All tanks shall be of monolithic construction and shall be blow molded using high molecular weight HDPE resin. There shall be no metal parts molded into polyethylene tanks. Field assembly or modification of tanks is strictly prohibited with the exception of basic piping systems and risers.

E. Wall thickness of all HDPE tanks shall be determined by **Manufacturer**'s design to meet performance standards as set forth in Section 2.01 GENERAL REQUIREMENTS and shall be a minimum of 0.25in (6.35mm). Internal baffles and partitions shall be determined by **Manufacturer**'s design and shall be a minimum of 0.1875in (4.76mm). The tanks shall have a minimum weight to volume ratio of 0.35lbs/gal (0.04kg/L). This ratio shall be calculated by dividing the net weight of the tank only (without lids, risers, compartment walls, t-baffles etc.) by the total capacity of the tank. Total capacity shall be defined as the volume of the tank when completely filled and without air space.

F. All tanks shall have sufficient structural integrity to withstand being pumped dry without incurring structural deformation (for example, rib collapse).

G. All risers shall be watertight.

H. The tank should be buried no greater than 36in (914mm) below grade. Tanks may be buried at greater depths upon consultation with the **Manufacturer**. Establish tank subgrade elevation and over-excavate to a minimum of 6in (152mm) below bottom of tank. Excavate to provide 2ft (0.6m) of horizontal clearance between outer surface of structure and trench wall to allow for proper backfilling. Place a minimum of 6in (152mm) of well-graded clean stone, 1/8in (3.2mm) to 3/4in (19mm) diameter, or coarse sand over subgrade and rake smooth. Where rock is encountered such that the structure would bear on rock, remove the rock to a minimum of 8in (203mm) below the structure, and place an 8in (203mm) cushion of clean stone over the exposed rock. All pipe connections shall be watertight. Backfill in an alternating method around tank in 6-8in (152-203mm) lifts. Backfill material may be native soils provided soil is free of debris, organic matter, sharp stones, and stones greater than 2in (51mm) in diameter. However, soil must be able to freely flow into corrugations between tank ribs, including midpoint to bell of tank. Tank installer may place water in tank to stabilize tank during backfilling. Do not backfill with muddy or frozen soil.

I. In order to demonstrate watertightness, tanks shall be tested at the factory prior to shipping and again on-site prior to acceptance. During installation, each tank shall be backfilled to just below the midseam flange, then the tank shall be completely filled with water to a level 2in (51mm) into the riser. The tank shall be inspected for leaks after a minimum two-hour wait (or as required by local rules). There should be no drop in liquid level and no visual leakage from seams, pinholes, or other imperfections. No tank will be accepted if there is any leakage over the two (2) hour period. Once the tank has passed this field test, the water level in the tank shall be dropped to a level below the tank invert, but not below the mid-seam.

PART 3. TANK ACCESS EQUIPMENT

3.01 RISERS

Risers shall be required for access to internal vaults and access into the tanks for septage pumping. A single manufacturer shall supply risers, lids, and attachment components to ensure product compatibility. Riser **Manufacturer** shall be Orenco. All risers shall be fiberglass unless specified otherwise. All risers shall be constructed to be watertight and be attached to the tanks such that a watertight seal is provided. Risers shall extend 3in (76mm) above original grade to allow for settlement and to ensure positive drainage away from the access. Adhesive required to adhere the PVC or fiberglass risers to either fiberglass or ABS tank adapters shall be a two-component methacrylate structural adhesive or **Engineer**-approved equal.

3.02 STANDARD: FIBERGLASS RISERS

Risers shall be Orenco Model RF24XX or RF30XX filament-wound fiberglass-reinforced polymer or **Engineer**-approved equal. Bolt catches used to attach the lid shall be molded from glass-filled nylon and be replaceable. Bolt catches shall include stainless steel nut to prevent corrosion and galling with the stainless steel lid fastener.

3.03 ALTERNATE: PVC RISERS

All other risers shall be Orenco Model Ultra-Rib® PVC or **Engineer**-approved equal. The material shall be PVC as per ASTM D1784, tested in accordance with AASHTO M304M-89, constructed of noncorrodible material, and designed to be buried in soil. Risers shall have a minimum stiffness of 10psi (0.69bar) when tested according to ASTM D2412. Risers shall be capable of withstanding a truck wheel load (54in^2 or 0.035m^2) of 2500lbs (1134kg) for 60 minutes with a maximum vertical deflection of 1/2in (13mm). (Note: This does not imply that PVC risers are intended for traffic areas.) Inlet risers shall have a minimum nominal diameter of 18in (450mm). Outlet risers shall have a minimum nominal diameter of 24in (600mm) for simplex pumping applications or 30in (750mm) for duplex pumping applications or when the depth of bury is 36in (914mm) or greater. Risers shall extend 3in (76mm) above the ground surface to allow for settlement.

3.04 SECONDARY SAFETY BARRIER

All risers shall be equipped with an Orenco Model RTS24 or RTS30 Tank Shield™ secondary safety barrier or **Engineer**-approved equal. Secondary safety barriers shall be constructed of copolymer polypropylene and shall be capable of demonstrating support for a 250lb (113kg) weight load.

3.05 RISER-TO-TANK ATTACHMENT

Risers shall be attached to tanks with one of the following attachment systems or **Engineer**-approved equal:

A. Orenco Model FRTA18 tank adapter cast into tank lid and a two-component methacrylate structural adhesive.

B. Orenco Model PRTA24 tank adapter cast into tank lid or bolted to lid using Orenco Model PRTA24BDKIT bolt-down kit and a two-component methacrylate structural adhesive.

C. Orenco Model PRTA24-2 tank adapter cast into tank lid and a two-component methacrylate structural adhesive when tank burial depth is greater than 36in (914mm).

D. For Roth HDPE tank: Orenco Model FRTA24-RVF tank adapter bolted to tank using an Orenco Model FRTA24-RBDKIT bolt-down kit or an Orenco Model PRTA30 tank adapter bolted to the tank using an Orenco Model PRTA30-RBDKIT and a two-component methacrylate structural adhesive.

All attachment components shall be constructed of waterproof, noncorrodible materials, such as PVC, ABS, fiberglass, or stainless steel. All adhesives and sealants shall be waterproof, corrosion resistant, and approved for the intended application. The riser-to-tank connection shall be watertight and structurally sound, capable of withstanding a vertical uplift of 5000lbs (2268kg) to prevent riser separation due to tank settlement, frost heave, or accidental vehicle traffic over the tank.

3.06 LIDS

Lids shall be Orenco DuraFiber® Model FLD24G or FLD30G, Orenco FiberLast™ Model FLL24G, or **Engineer**-approved equal. One lid and stainless steel bolts, or stainless steel fasteners with a recessed hex drive and removal tool, shall be furnished with each access riser. Lids shall be made of fiberglass and be watertight, corrosion resistant, UV resistant, and flat, with an allowable crown or dome of no more than 1/4in (6.4mm). Lids shall not allow water to pond on them. Lids shall be capable of making a watertight seal with the top of the riser. Lids shall have a nonskid finish. Self-lubricating plastics, such as polyethylene, shall only be considered nonskid with the addition of a nonskid coating. Lids shall be rated for non-traffic loads up to 2500lbs (1134kg). The **Manufacturer** shall be able to provide evidence that lid will withstand a 2500lb (1134kg) load applied over a 9in × 9in (229mm × 229mm) area for 30 minutes with no more than 3/4in (19mm) deflection, as well as demonstrate a one-minute load of 5000lbs (2268kg) without permanent deformation. Optional components may include the following:

A. Traffic-bearing lid: The traffic-bearing lid shall be a cast iron frame and cover (part number 6024, 3060, 4036) as manufactured by Sather Manufacturing Co., Inc., or **Engineer**-approved equal, which will fit over a standard lid. The cover shall have the word "SEWER" cast into it.

B. Foam insulation: Rigid closed-cell foam insulation of 2in (51mm) or 4in (102mm) thickness shall be attached to the underside of the lid. Any fasteners shall be made of corrosion-resistant stainless steel. The insulation shall have an R-value of no less than 10 (RSI 1.8) per 2in (51mm) increment.

3.07 RISER INSTALLATION

Riser installation shall be accomplished according to the **Manufacturer**'s instructions. For cold weather areas, risers shall be backfilled with 3/8in (approximately 10mm) pea gravel or other similar granular material to prevent frost heave.

PART 4. GRAVITY EFFLUENT DISCHARGE (GED) ASSEMBLIES

All filter systems shall be supplied by a reputable manufacturer with at least ten (10) years of experience in supplying equipment for **Liquid-Only Sewer**s. Effluent filters shall prevent particles larger than 1/8in (3.2mm) in diameter from leaving the tank. Effluent filters shall have a solid bottom or deflecting device that prevents vertically rising solids from reaching the filtering surface area during ebullition (sludge bulking).

4.01 RISERS AND LIDS

See PART 3. TANK ACCESS EQUIPMENT.

4.02 SINGLE-FAMILY RESIDENCE EFFLUENT FILTERS

A. Standard: 6in (150mm) Biotube Effluent Filter

An Orenco Model PSC06 Biotube Effluent Filter or **Engineer**-approved equal shall be installed in **Gravity Effluent Discharge (GED)** tanks for single-family dwellings of fewer than four bedrooms. The filter shall consist of a 6in diameter (150mm) PVC vault. The Biotube cartridge shall be made with 1/8in (3.2mm) mesh polypropylene and have a deflector plate installed at the base. The Biotube filter cartridge shall be housed inside the PVC vault. The filter shall have an effective filter area of no less than 6.3ft^2 (0.59m^2). The filter shall be installed in conformance with the **Engineer**'s plans. The lateral from the tank to the collection line shall be laid to a uniform grade with no high points.

B. Alternate: 4in (100mm) Biotube Effluent Filter

An Orenco Model FT04 Biotube Effluent Filter or **Engineer**-approved equal shall be installed in **Gravity Effluent Discharge (GED)** tanks for single-family dwellings of fewer than four bedrooms. The filter shall consist of a 4in (100mm) diameter PVC vault with eight (8) 1.125in (29mm) diameter holes evenly spaced around the perimeter, located appropriately to allow for maximum sludge and scum accumulation before requiring pumping (approximately 70% of minimum liquid level). An optional flow-modulating plate containing two (2) 1/2in (15mm) diameter discharge orifices and one (1) 1/2in (15mm) diameter vent hole is available. The Biotube cartridge shall be made with 1/8in (3.2mm) mesh polypropylene and have a solid base to prevent solids from entering through the bottom during ebullition. The Biotube cartridge shall be housed inside the PVC vault. The filter shall have an effective filter area of no less than 5.1ft^2 (0.47m^2). The filter shall be installed in conformance with the **Engineer**'s plans. The lateral from the tank to the collection line shall be laid to a uniform grade with no high points.

C. Alternate: 8in (200mm) Biotube Effluent Filter and 1500gal (5678L) Tank

An Orenco Model FT08 Biotube Effluent Filter or **Engineer**-approved equal shall be installed in **Gravity Effluent Discharge (GED)** tanks of minimum 1500gal (5678L) size for single-family dwellings of four bedrooms or more. The filter shall consist of an 8in (200mm) diameter PVC vault with eight (8) 1.375in (35mm) diameter holes evenly spaced around the perimeter, located appropriately to allow for maximum sludge and scum accumulation before requiring pumping (approximately 70% of minimum liquid level). The direct-coupled outlet for the 8in (200mm) filter shall contain two (2) 1.125in (29mm) diameter flow-modulating orifices and one (1) 3/4in (19mm) diameter vent hole. The Biotube cartridge shall be made with 1/8in (3.2mm) mesh polypropylene and have a solid base to prevent solids from entering through the bottom during ebullition. The Biotube cartridge shall be housed inside the PVC vault. The filter shall have

an effective filter area of no less than 14.6ft^2 (1.36m^2). The filter shall be installed in conformance with the **Engineer**'s plans. The lateral from the tank to the collection line shall be laid to a uniform grade with no high points.

4.03 COMMERCIAL AND MULTIPLE-USER TANKS

Commercial and multiple-user tanks require larger effluent filters, the sizes of which must be individually determined and spelled out in the specifications. Commercial applications should be sized according to the Orenco document *Biotube Effluent Filter Sizing*, NDA-FT-FT-1.

A. Alternate: 8in (200mm) Effluent Filter

An Orenco Model FT08 series Biotube effluent filter or **Engineer**-approved equal shall be installed in commercial and multiple-user tanks. The filter shall consist of an 8in (200mm) nominal diameter PVC vault with eight (8) 1.375in (35mm) diameter holes evenly spaced around the perimeter, located appropriately to allow for maximum sludge and scum accumulation before requiring pumping (approximately 70% of minimum liquid level). The Biotube cartridge shall be made with 1/8in (3.2mm) mesh polypropylene and have a solid base to prevent solids from entering through the bottom during ebullition. The Biotube cartridge shall be housed inside the PVC vault. The filter shall have an effective filter area of no less then 14.6ft^2 (1.36m^2). The filter shall be installed in conformance with the **Engineer**'s plans.

B. Alternate: 12in (300mm) Effluent Filter

An Orenco Model FT12 series Biotube effluent filter or Engineer-approved equal shall be installed in commercial and multiple-user tanks. The filter shall consist of a 12in (300mm) nominal diameter PVC vault with eight (8) 1.375in (35mm) diameter holes evenly spaced around the perimeter, located appropriately to allow for maximum sludge and scum accumulation before requiring pumping (approximately 70% of minimum liquid level). The Biotube cartridge shall be made with 1/8in (3.2mm) mesh polypropylene and have a solid base to prevent solids from entering through the bottom during ebullition. The Biotube cartridge shall be housed inside the PVC vault. The filter shall have an effective filter area of no less than 30.0ft^2 (2.8m^2). Optional 4in (102mm) PVC slide rail for easy removal of vault housing is available. The filter shall be installed in conformance with the **Engineer**'s plans.

4.04 ELECTRICAL SPLICE BOX (OPTIONAL)

Standard: External Splice Box

The external splice box shall be Orenco Model SBEX or **Engineer**-approved equal. The splice box shall be UL approved for wet locations, equipped with up to four (4) electrical cord grips and two (2) 3/4in (19mm) outlet fittings. UL-listed, waterproof butt-splice connectors shall also be included. The use of a UL-approved conduit seal kit, accessible above ground, shall be required to prevent the passage of gases, vapors, or flames through the conduit to the control panel. An additional UL-classified sealant shall be added to the splice box coupling to prevent condensation accumulation in the splice box. The following UL-approved sealants shall be used:

A. UL-classified moisture-cure polyurethane quick-drying foam or **Engineer**-approved equal with an R-value of 5 (RSI 0.88) rating per inch (25mm) of foam.

B. UL-classified silicone sealant or **Engineer**-approved equal consisting of a neutral-cure, non-acetic, noncorrosive silicone capable of withstanding temperatures to 450°F (232°C).

4.05 ALARM PANEL (OPTIONAL)

Alarm panels shall be Orenco Model AMAHW or **Engineer**-approved equal. Alarm panels shall be listed per UL 508, be rated for indoor/outdoor use, and meet the following specifications:

A. Enclosure: 6in (152mm) high × 6in (152mm) wide × 4in (102mm) deep, UL Type 4X (IP 66)

B. Audio Alarm: 95dB at 24in (610mm), warble-tone sound, gasketed, UL Type 4X (IP 66)

C. Visual Alarm: 7/8in (22mm) diameter red lens, "push-to-silence," UL Type 4X, 1W LED bulb, 120VAC

D. Audible Alarm Silence Relay: 120VAC, automatic reset

4.06 ALARM FLOAT SWITCH (OPTIONAL)

Float switches shall be Orenco Model MFP mercury-free switches. The switch shall be mounted on a PVC stem and attached to the filter housing. The float switch must be adjustable and removable without removing the filter cartridge. The float switch lead shall be secured with a nylon strain relief bushing at the splice box. The high-level alarm shall be preset as shown in the **Engineer**'s plans.

PART 5. PRESSURIZED EFFLUENT DISCHARGE (PED) SYSTEM FOR SINGLE-FAMILY RESIDENCES

The collection system on-lot package shall be certified to have been manufactured by Orenco or **Engineer**-approved equal. The **Manufacturer** shall provide a unique Certificate of Origin with each collection system on-lot package that lists all products in the collection system on-lot package. This Certificate of Origin shall warrant that any products that comprise a collection system on-lot package be free from defects in materials and workmanship that cause the product to lose structural integrity or to electrically or mechanically operate improperly within a period of five (5) years from the date of installation of the equipment. The **Manufacturer** shall submit detailed limitations and exclusions from the warranty.

5.01 PRELOS PROCESSOR PUMPING SYSTEM

The Prelos Processor Pumping System is an integrated package designed specifically for use in the Prelos Processor Tank. The **Manufacturer** of the complete integrated system shall be Orenco and shall provide the following integrated components as part of the system:

A. The pump vault shall be an Orenco Prelos Pump Vault, manufactured of sturdy, corrosion-proof polyethylene with an effective screen area of 14ft^2 (1.3m^2). The vault shall have a sloped port, not only to provide an inlet of effluent from the tank clear zone, but also to allow for solids to be flushed out during servicing and to settle out during resting periods. The filter must be serviceable and cleanable without removing pumps or the entire vault.

B. Effluent pumps shall be Orenco Model PF100511CV, 1/2hp (0.37kW), 115VAC, submersible, high head, single-phase, 60Hz, with two-wire motors and 10ft (3m) long, extra-heavy-duty SOOW electrical cords with ground. Pumps shall be UL and CSA listed for use with effluent. Pumps shall include an internal check valve and shall be capable of delivering 18gpm (1.1L/sec) at a pressure of 14ft (4.3m) and 10gpm (0.63L/sec) at 171ft (52m) and have a shut off head of 250ft (76m). When used in conjunction with a flow controller, the pump shall be capable of providing 5gpm (0.32L/sec) against a head of 190ft (57.9m). The pump intake screen must be 1/8in (3.2mm) mesh polypropylene. The pump shall have a 1/8in (3.2mm) bypass orifice to ensure flow circulation for motor cooling and to prevent air bind. The pump must have a minimum 24hr run-dry capability without water lubrication while submerged in water. The pump shall have a floating impeller design to protect against up thrust and to increase pump life. The pump's liquid ends must be repairable (by replacing impellers and/or diffusers) for better long-term cost of ownership. The motor must be rated for continuous use and frequent cycling (at least 300 cycles per day). The pump shall have internal thermal overload protection and internal lightning protection. The pump shall be lightweight for easy removal and maintenance. All pumps shall undergo 3-point (dead head, design flow, and design flow + 50%) wet testing at the factory to confirm performance. The pump motor cable must be suitable for Class I, Division 1 and 2 applications. The pump lead quick-connector shall be a glass-filled thermoplastic with a silicone gasket, triple-pole, and a max load of 13A at 240V.

C. The discharge piping assembly shall be an Orenco Model HDAS30125FCASLC hanging style, allowing for quick removal without unions, or **Engineer**-approved equal. Discharge assembly shall be 1.25in (32mm) diameter and include an anti-siphon mechanism, flow control disk, and high-pressure reinforced EPDM flex hose with working pressure rating of 250psi (17.24bar), 1.25in (32mm) EZ pull quick-disconnect, line check valve, and Schedule 80 PVC pipe.

D. Float switches shall be Orenco Model MF2P mercury-free mechanical switches. Two (2) mechanical float switches shall be mounted on a PVC stem and attached to the filter cartridge. The float switches must be adjustable and must be removable without removing the pump vault. The on/off float switch shall be rated for a minimum of 5A @ 120VAC. The float switch lead quick-connector shall be a glass-filled thermoplastic with a silicone gasket, double-pole, and a max load of 1A at 120V. Each float switch lead shall be secured with a nylon strain relief bushing at the splice box. The high-level alarm and on/off functions shall be preset as shown in the **Engineer**'s plans.

E. The wiring connection system shall be Orenco Model CLK2-60 or **Engineer**-approved equal. The wiring connection system shall be pre-wired with 62ft (19m) of direct burial PVC/nylon cable with 14AWG wire for the pump and 18AWG wire for the float switches. The housing shall be ABS, UL listed for wet locations, and capable of accepting active connections to two (2) float switches with another input connector capable of accepting an active connection to one (1) pump.

F. Control panels for most single-family home applications shall be Orenco Model S1-HR series with high water redundant ON/OFF feature or **Engineer**-approved equal. Panels shall be listed per UL 508 and shall be repairable in the field without the use of soldering irons or substantial disassembly. Standard and optional control panel features include the following:

Standard Components

1. Motor-Start Contactor: 120VAC, 1hp (0.75kW), 17 full load amperage (FLA) at line voltage, 60Hz, 2.5 million cycles at FLA (10 million at 50% of FLA)
2. Toggle Switch: Single-pole, double-throw HOA switch, 20A, 1hp (0.75kW)
3. Controls Circuit Breaker: 10A, OFF/ON switch, single-pole 120VAC, DIN rail mounting with thermal magnetic tripping characteristics
4. Pump Circuit Breaker: 20A, OFF/ON switch, single-pole 120VAC, DIN rail mounting with thermal magnetic tripping characteristics
5. Audio Alarm: 95dB at 24in (610mm), warble-tone sound
6. Visual Alarm: 7/8in (22mm) diameter red lens, "push-to-silence," UL Type 4X, 1W LED bulb, 120VAC
7. Enclosure: Measures 11.5in high x 9.3in wide x 5.4in deep, UL Type 4X rated or Type 3R when using a generator receptacle, constructed of UV-resistant fiberglass, stainless steel hinges and latch
8. S1 Panel Ratings: 120VAC, 1hp (0.75kW), 14A, single-phase, 60Hz

Optional Components

1. Redundant Off Relay: 120VAC, secondary off, sounds alarm on low-level condition, DIN rail mount
2. Pump Run Light: 7/8in green lens, UL Type 4X, 1W LED bulb, 120VAC
3. Heater: Anti-condensation, self-adjusting (radiates additional wattage as temperature drops)
4. 3-Way (main, auto, off) Manual Transfer/Disconnect Switch
5. Generator Receptacle
6. Event Counter: 120VAC, 6 digit, non-resettable
7. Elapsed Time Meter: 120VAC, 7 digit, non-resettable, limit of 99,999 hours, accurate to 0.01 hours

5.02 BIOTUBE® PUMPING SYSTEM

The Biotube Pumping System is an integrated package designed for use in concrete, fiberglass, or HDPE tanks. The **Manufacturer** of the complete integrated system shall be Orenco and shall provide the following integrated components as part of the system:

A. The pump vault shall be an Orenco Model PVU-Series or PVP-Series Universal Biotube Pump Vault. The filter shall have a minimum effective screen area of no less than 14ft^2 (1.3m^2). The Biotube filter, consisting of 1/8in (3.2mm) mesh polypropylene tubes, shall be housed inside the polyethylene vault. Attached to the vault is a flow inducer to accept one or two high-head effluent pumps. The pump vault shall be installed in conformance with the **Engineer**'s plans.

B. Effluent pumps shall be Orenco Model PF100511CV high-head pumps: 1/2hp (0.37kW), 115VAC, submersible, single-phase, 60Hz with two-wire motors and 10ft (3m) long, extra-heavy-duty SOOW electrical cords with ground. Pumps shall be UL and CSA listed for use with effluent. Pumps shall include an internal check valve and shall be capable of delivering 13gpm (0.82L/sec) at a pressure of 75ft (23m) and 5gpm (0.32L/sec) at 206ft (63m) and have a shut off head of 250ft (76m). When used in conjunction

with a flow controller, the pump shall be capable of providing 5gpm (0.32L/sec) against a head of 190ft (57.9m). The pump intake screen must be 1/8in (3.2mm) mesh polypropylene. The pump shall have a 1/8in (3.2mm) bypass orifice to ensure flow circulation for motor cooling and to prevent air bind. The pump must have a minimum 24hr run-dry capability without water lubrication while submerged in water. The pump shall have a floating impeller design to protect against up thrust and to increase pump life. The pump's liquid ends must be repairable (by replacing impellers and/or diffusers) for better long-term cost of ownership. The motor must be rated for continuous use and frequent cycling (at least 100 cycles per day). The pump shall have internal thermal overload protection and internal lightning protection. The pump shall be lightweight for easy removal and maintenance. All pumps shall undergo 3-point (dead head, design flow, and design flow + 50%) wet testing at the factory to confirm performance. The pump motor cable must be suitable for Class I, Division 1 and 2 applications. The pump lead quick-connector shall be a glass-filled thermoplastic with a silicone gasket, triple-pole, and a max load of 13A at 240V.

C. The discharge piping assembly shall be an Orenco Model HDAS24125FCASLC hanging style, allowing for quick removal without unions, or **Engineer**-approved equal. Discharge assembly shall be 1.25in (32mm) diameter and include an anti-siphon mechanism, flow control disk, and high-pressure reinforced EPDM flex hose with working pressure rating of 250psi (17.24bar), 1.25in (32mm) EZ pull quick-disconnect, line check valve, and Schedule 80 PVC pipe.

D. The float switch shall be mercury-free, Orenco Model MF2P with two mechanical float switches mounted on a PVC stem and attached to the filter cartridge. The float switches must be adjustable and must be removable without removing the pump vault. The float switch lead quick-connector shall be a glass-filled thermoplastic with a silicone gasket, double-pole, and a max load of 1A at 120V. The high-level alarms and on/off function shall be preset as shown in the **Engineer**'s plans. Each float switch lead shall be secured with a nylon strain relief bushing at the splice box. The on/off float switch shall be rated for a minimum of 5.0A @ 120VAC.

E. The wiring connection system shall be Orenco Model CLK2-60 or **Engineer**-approved equal, pre-wired with 62ft (19m) of direct-burial PVC/nylon cable with 14AWG wire for the pump and 18AWG wire for the float switches. The housing shall be ABS, UL listed for wet locations, and capable of accepting active connections to two (2) float switches with another input connector capable of accepting an active connection to one (1) pump.

F. Controls and alarms shall be listed per UL 508. Panels shall be repairable in the field without the use of soldering irons or substantial disassembly. For most single-family home applications, control panel shall be an Orenco Model S1 series or **Engineer**-approved equal control panel that includes the following:

Standard Components

1. Motor-Start Contactor: 120VAC, 1hp (0.75kW), 17FLA, 60Hz, 2.5 million cycles at FLA (10 million at 50% of FLA)
2. Toggle Switch: Single-pole, double-throw HOA switch, 20A, 1hp (0.75kW)
3. Controls Circuit Breaker: 10A, OFF/ON switch, single-pole 120VAC, DIN rail mounting with thermal magnetic tripping characteristics
4. Pump Circuit Breaker: 20A, OFF/ON switch, single-pole 120VAC, DIN rail mounting with thermal magnetic tripping characteristics
5. Audio Alarm: 95dB at 24in (610mm), warble-tone sound
6. Visual Alarm: 7/8in (22mm) diameter red lens, "push-to-silence," UL Type 4X, 1W LED bulb, 120VAC
7. Enclosure: Measures 11.5in high x 9.3in wide x 5.4in deep, UL Type 4X rated or Type 3R when using a generator receptacle, constructed of UV-resistant fiberglass, stainless steel hinges and latch
8. S1 Panel Ratings: 120VAC, 1hp (0.75kW), 14A, single-phase, 60Hz

Optional Components

1. Redundant Off Relay: 120VAC, secondary off, sounds alarm on low-level condition, DIN rail mount

2. Pump Run Light: 7/8in (22mm) green lens, UL Type 4X, 1W LED bulb, 120VAC
3. Heater: Anti-condensation, self-adjusting (radiates additional wattage as temperature drops)
4. 3-Way (main, auto, off) Manual Transfer/Disconnect Switch
5. Generator Receptacle
6. Event Counter: 120VAC, 6 digit, non-resettable
7. Elapsed Time Meter: 120VAC, 7 digit, non-resettable, limit of 99,999 hours, accurate to 0.01 hours

G. Access Risers: See PART 3. TANK ACCESS EQUIPMENT.

5.03 INSTALLATION

All pumping system components shall be installed in accordance with the **Manufacturer**'s recommendations, **Engineer**'s plans, and all state and local regulations.

5.04 LOCATION

The pump control panel shall be mounted on a post or exterior wall nearest the tank and pump. If the panel is mounted to an exterior wall, it should be to a garage or outbuilding where the sound of the motor contactor engaging won't be noticed. If a garage or outbuilding wall isn't available, the installation should include use of sound-deadening insulation. (Post and panel mounting assemblies are acceptable.) The control panel shall be located within 50ft (15.24m) of, and within sight of, the pump motor or shall be provided with a lockable disconnect switch. When possible, the panel should be mounted in the shade and protected from the weather. The panel should be located at a convenient height (usually about 5ft or 1.5m above the ground) and where it will be accessible for maintenance.

PART 6. PRESSURIZED EFFLUENT DISCHARGE (PED) SYSTEM FOR COMMERCIAL CONNECTIONS

The collection system on-lot package shall be certified to have been manufactured by Orenco or **Engineer**-approved equal. The **Manufacturer** of the complete, integrated system shall be Orenco. The **Manufacturer** shall provide a unique Certificate of Origin with each on-lot package that lists all products in the on-lot package. This Certificate of Origin shall warrant that any products that comprise an on-lot package be free from defects in materials and workmanship that cause the product to lose structural integrity or to electrically or mechanically operate improperly within a period of five (5) years from the date of installation of the equipment. The **Manufacturer** shall submit detailed limitations and exclusions from the warranty. The **Manufacturer** shall provide the following integrated components as part of the system:

6.01 BIOTUBE PUMPING SYSTEM

The Biotube Pumping System is an integrated package designed for use in concrete, fiberglass, or HDPE tanks. The **Manufacturer** of the complete, integrated system shall be Orenco and shall provide the following integrated components as part of the system:

A. The pump vault shall be an Orenco Model PVU-Series or PVP-Series Universal Biotube Pump Vault. The filter shall have a minimum effective screen area of no less than 14ft^2 (1.3m^2). The Biotube filter, consisting of 1/8in (3.2mm) mesh polypropylene tubes, shall be housed inside a polyethylene vault. A flow inducer attached to the vault shall accept one or two high-head effluent pumps. The pump vault shall be installed in conformance with the **Engineer**'s plans.

B. Effluent pumps shall be Orenco Model PF-Series high-head pumps: X hp, X VAC, single-phase, 60Hz, with two-wire motors and 10ft (3m) long, extra-heavy-duty SOOW electrical cords with ground. All commercial applications shall use duplex (2-pump) pumping systems for redundancy. All pumps shall comply with general requirements set forth in Section 1.10 BUILDING SEWER (above). Pumps shall be UL and CSA listed for use with effluent. Pumps shall be capable of delivering X gpm at a pressure of X ft, X gpm at X ft, and X gpm at X ft. The pump intake screen shall be 1/8in (3.2mm) mesh polypropylene. The pump shall have a 1/8in (3.2mm) bypass orifice to ensure flow circulation for motor cooling and to prevent air bind. The pump shall have internal thermal overload protection and internal lightning protection. The pump shall be lightweight for easy removal and maintenance. The pump must have a minimum 24hr run-dry capability without water lubrication while submerged in water. The pump shall have a floating impeller design to protect against upthrust and to increase pump life. The pump's liquid end must be repairable (by

replacing impellers and/or diffusers) for better long-term cost of ownership. The motor must be rated for continuous use and frequent cycling (at least 100 cycles per day). All pumps shall undergo 3-point (dead head, design flow, and design flow + 50%) wet testing at the factory to confirm performance. The pump motor cable must be suitable for Class I, Division 1 and 2 applications.

C. The discharge piping assembly shall be an Orenco Model HDAD30125CASLC hanging style, allowing for quick removal without unions, or **Engineer**-approved equal. Discharge assembly shall be 1.25in (32mm) diameter and include a bronze check valve, anti-siphon mechanism, and high-pressure reinforced EPDM flex hose with working pressure rating of 250psi (17.24bar), 1.25in (32mm) EZ pull quick-disconnect, line check valve, and Schedule 80 PVC pipe.

D. Float switches shall be Orenco Model MF4P mercury-free mechanical switches. Four (4) float switches shall be mounted on a PVC stem and attached to the filter cartridge. Each float switch lead shall be secured with a nylon strain relief bushing at the splice box. The float switches shall be UL or CSA listed. The float switches must be adjustable and must be removable without removing the pump vault. The high/lag, pump on, pump off, and low-level alarms shall be preset as shown in the **Engineer**'s plans.

E. External Splice Box

Standard: SBEX
The external splice box shall be Orenco Model SBEX or **Engineer**-approved equal. Splice box shall be UL approved for wet locations, equipped with up to four (4) electrical cord grips and two (2) 3/4in (19mm) outlet fittings. Also included shall be UL-listed, waterproof butt-splice connectors. The use of a UL-approved conduit seal kit, accessible above ground, shall be required to prevent the passage of gases, vapors, or flames through the conduit to the control panel. An additional UL-classified sealant shall be added to the splice box coupling to prevent condensation accumulation in the splice box. The following UL-approved sealants shall be used:

1. UL-classified moisture-cure polyurethane quick-drying foam or **Engineer**-approved equal with an R-value of 5 (RSI 0.88) rating per inch (25mm) of foam.
2. UL-classified silicone sealant or **Engineer**-approved equal consisting of a neutral-cure, non-acetic, noncorrosive silicone capable of withstanding temperatures to 450°F (232°C).

Alternate: Class I, Division 1 Splice Box
Class I, Division 1 splice box shall be Orenco Model SBX or **Engineer**-approved equal. Splice box must be UL approved for Class I, Division 1 Group D gas applications and be equipped with one (1) quick-disconnect, aluminum receptacle and a malleable iron mounting box. An explosion-proof fitting for the pump wire connection shall also be included.

F. CONTROLS AND ALARMS

The duplex control panel shall be Orenco MVP-Duplex. Controls and alarms shall be listed per UL 508. The panel shall be repairable in the field without the use of soldering irons or substantial disassembly. The panel shall meet the following requirements:

Standard Components:

1. Programmable Logic Unit: 120/240VAC programmable logic unit with built-in LCD screen and programming keys, providing control functions and timing for panel operation
2. Motor-Start Contactor: 120VAC 17FLA, 1hp (0.75kW), 60Hz, 2.5 million cycles at FLA (10 million at 50% FLA); 240VAC 17FLA, 3hp, 60Hz, 2.5 million cycles at FLA (10 million at 50% FLA)
3. Toggle Switch: Single-pole, double-throw HOA switch, 20A, 1hp (0.75kW)
4. Controls Circuit Breaker: 10A, OFF/ON switch, single-pole 120VAC, DIN rail mounting with thermal magnetic tripping characteristics
5. Pump Circuit Breaker: 20A, OFF/ON switch, single-pole 120VAC, double-pole 240VAC, DIN rail mounting with thermal magnetic tripping characteristics; power supplied by a 30A breaker

6. Audio Alarm: 95dB at 24in (610mm), warble-tone sound
7. Visual Alarm: 7/8in (22mm) diameter red lens, “push-to-silence,” UL Type 4X, 1W LED bulb, 120VAC
8. Enclosure: UL Type 4X rated or Type 3R when using generator receptacles with stainless steel hinges, latch, and conduit couplings provided
9. MVP Panel: Ratings of 120VAC, 1hp (0.75kW), 16A, single-phase, 60Hz and 240VAC, 3hp (2.24kW), 16A, single-phase, 60Hz

Optional Components:

1. Pump Run Light: 7/8in (22mm) green lens, UL Type 4X, 1W LED bulb, 120VAC
2. Effluent Alarm: 95dB at 24in (610mm), warble-tone sound
3. Flashing Light: Red, SABIC Lexan™ lens, flanged based, UL recognized
4. 3-Way (main, auto, off) Manual Power Transfer/Disconnect Switch
5. Generator Receptacle
6. 120VAC Ground Fault Interrupter (GFI)
7. Surge Arrestor: AG2401 120/230V, three 18in (457mm) leads, rated for a maximum of 32,000A, UL/CSA listed
8. Heater: Anti-condensation, self-adjusting (radiates additional wattage as temperature drops)
9. Intrinsically Safe Controls Relays: Larger enclosure required; 120VAC; listed per UL 913; for Class I, Division 1, Groups A, B, C, and D hazardous locations
10. Current Sensor: 120VAC, go/no-go operation, pump fail indicator light on panel, manual reset switch

G. Access Risers: See PART 3. TANK ACCESS EQUIPMENT.

6.02 INSTALLATION

All pumping system components shall be installed in accordance with the **Manufacturer**’s recommendations, **Engineer**’s plans, and all state and local regulations.

6.03 LOCATION

The **Contractor** shall install the pump control panel onto a post or exterior wall nearest the tank and pump. If the panel is mounted to an exterior wall, it should be to a garage or outbuilding where the sound of the motor contactor engaging won’t be noticed. If a garage or outbuilding wall isn’t available, the installation should include use of sound-deadening insulation. (Post and panel mounting assemblies are acceptable.) The control panel shall be located within 50ft (15.24m) and within sight of the pump motor or shall be provided with a lockable disconnect switch. When possible, the panel should be mounted in the shade and protected from the weather. The panel should be located at a convenient height (usually about 5ft or 1.5m above the ground) and where it will be accessible for maintenance.

6.04 SERVICE CONNECTION

The service connection shall be an Orenco Model SC100 nominal 1in (25mm), SC125 1.25in (32mm), SC150 1.5in (40mm), or SC200 2in (51mm) or **Engineer**-approved equal. The service connection will include a swing-check valve, factory-connected to a ball valve. All components will be PVC Schedule 40 and rated for 150psi (10.34bar).

A. The service connection shall be enclosed in PVC access riser as manufactured by Orenco or **Engineer**-approved equal. Risers shall extend to 3in (76mm) above the ground surface to allow for settlement and shall have a minimum nominal diameter of 8in (200mm).

B. Lids shall be Orenco Model FL8G or **Engineer**-approved equal, fiberglass with green nonskid finish. One lid shall be furnished with each access riser.

6.05 SERVICE LINE TESTING

An air compressor may be used to bring the line to its test pressure; the test is a success if the pressure holds for 60 seconds or more. Any leakage will require the line to be repaired and retested. When the service line can be filled with water from the tank test (particularly if the service line is short and doesn't require a large volume to fill it) a small hand pump with pressure gauge can be employed for the pressure test.

PART 7. FORCE MAIN COMPONENTS AND TESTING

7.01 COMBINATION AUTOMATIC AIR/VACUUM RELEASE VALVE

The valve shall be an A.R.I. Model D-021 or **Engineer**-approved equal. The valve base shall be made of reinforced nylon and include a base O-ring seal constructed of Buna-N rubber. The body shall be constructed of reinforced nylon, housing a foamed polypropylene float and stainless steel stem. The valve will also include a polypropylene elbow to expel air horizontally. The valve shall be corrosion resistant and operable with a minimum line pressure of 3psi (0.21bar).

A. The piping shall be Orenco Model ARA or **Engineer**-approved equal. The piping shall be constructed of Schedule 40 PVC and include a 2in (51mm) nominal diameter PVC isolation valve, a 3/4in (20mm) diameter PVC ball valve for bypass, and a pressure gauge connection. All components shall be rated for 150psi (10.34bar) working pressure.

B. Air-release assemblies shall be enclosed in ribbed PVC access risers as manufactured by Orenco or **Engineer**-approved equal. The material shall be PVC as per ASTM D1784 and tested in accordance with AASHTO M304M-89. Risers shall extend to 2in (51mm) above the ground surface to allow for settlement and shall have a minimum nominal diameter of 30in (750mm).

C. Lids shall be Orenco DuraFiber Model FLD30G or **Engineer**-approved equal, made of fiber-reinforced polymer (FRP), come with stainless steel bolts, and meet the requirements as stated in Section 3.06 LIDS.

7.02 MANUAL VALVES

The valve shall be an Orenco Model ARA or **Engineer**-approved equal as listed above. Valves will include the following piping:

A. The piping shall be constructed of Schedule 40 PVC and include a 2in (51mm) diameter PVC isolation valve, a 3/4in (19mm) diameter PVC ball valve for bypass, and a pressure gauge connection. All components shall be rated for 150psi (10.34bar) working pressure and allow the installation of a combination air/vacuum release valve.

B. Air-release assemblies shall be enclosed in ribbed PVC access risers as manufactured by Orenco or **Engineer**-approved equal. The material shall be PVC as per ASTM D1784 and tested in accordance with AASHTO M304M-89. Risers shall extend to 2in (51mm) above the ground surface to allow for settlement and shall have a minimum nominal diameter of 30in (750mm).

C. Lids shall be Orenco DuraFiber Model FLD30G or **Engineer**-approved equal, made of fiber-reinforced polymer (FRP), come with stainless steel bolts, and meet the requirements as stated in Section 3.06 LIDS.

7.03 FORCE MAIN TESTING

A. The **Contractor** shall rigorously adhere to all hydrostatic testing procedures and requirements. Leakages should not exceed what is allowable by American Water Works Association (AWWA) standards. Zero leakage is the goal. The hydrostatic test procedure is as follows:

1. Fill the line with water to expel air.
2. Pressurize to the desired pressure at the lowest point.
3. Hold for two hours to ± 5psi (± 34 kPa) of test pressure.
4. Accurately record time, pressure readings, and amount of leakage.
5. Determine whether these leakages are in the allowable range. Refer to the *AWWA Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances* C600-93, Section 4: Hydrostatic Testing.

B. Portions of the line that are critical or suspect should be left exposed throughout the hydrostatic test to allow visual inspection. Leaks detected visually should be repaired regardless of test results. The use of dye during initial filling and testing of a mainline section makes isolating leaks much easier, especially in areas having high ground water.

C. Check valve failure in service lines is difficult to diagnose and may misrepresent mainline integrity. Therefore, service line connections should remain closed until mainline testing has been completed. Accurate records must be kept to assure all service line connections have been opened after the mainline system has been approved.

D. Testing long segments of line should be avoided whenever possible. A lengthy segment of line may pass the leakage test, yet still have an isolated leak that is excessive and which could prove to be a problem later. Testing shorter segments of line reduces this possibility and more readily isolates any leaks. The most common recommendation is to limit the test length to 12,000/D, where D is the pipe diameter in inches and the length of the test segment is in feet.

E. Because air escapes from pipelines more rapidly than does liquid, it is important that all air is purged from a section of line prior to hydrostatic testing. Failure to do so may give misleading test results, possibly causing the section of line to appear to fail the test.

PART 8. SUPPORT, TRAINING, TESTING, AND OVERSIGHT

8.01 PRECONSTRUCTION CONFERENCE

Before any work at the site is started, a conference attended by the **Owner**, **Contractor**, **Engineer**, and **Manufacturer** or **Manufacturer's Representative**(s) (or their agents) and others, as appropriate, will be held to establish a working understanding among the parties as to the work involved for installing each **Liquid-Only Sewer** unit. At this conference, the **Owner**, **Contractor**, **Engineer**, and **Manufacturer** or **Manufacturer's Representative** shall designate, in writing, a specific individual to act as the **Inspector** for the installation of each **Liquid-Only Sewer** unit. Any cost or fees associated with the services of the **Inspector** or the **Engineer** during construction will be the responsibility of the **Owner**.

8.02 INSTALLATION AND FIELD-TESTING TRAINING

A. The **Manufacturer** or **Manufacturer's Representative** shall provide the services of a trained representative to instruct the installing **Contractor**'s crew and **Inspector** regarding the proper installation and field testing of each **Liquid-Only Sewer** unit per the **Manufacturer**'s recommendations and requirements. The **Manufacturer** or **Manufacturer's Representative** shall have a trained representative provide installation and training services for a minimum of one (1) visit consisting of a minimum of one (1) eight-hour day at the beginning of construction.

B. As part of the **Manufacturer**'s or **Manufacturer's Representative**'s installation training and to help ensure that subsequent installations are installed in accordance with the **Manufacturer**'s installation instructions, the **Manufacturer** or **Manufacturer's Representative** shall inspect and submit an inspection checklist report for the first complete installation. Subsequent installations shall not commence until the first installation is inspected by the **Manufacturer** or **Manufacturer's Representative** and the **Inspector** and accepted by the **Engineer**.

8.03 QUALITY CONTROL

A. To ensure quality control, the **Inspector** shall inspect and certify that an initial installation of each **Liquid-Only Sewer** unit is in compliance with the **Manufacturer**'s recommendations and requirements, using the form provided in APPENDIX A, "LIQUID-ONLY SEWER INSTALLATION CHECKLIST."

B. The **Manufacturer** or **Manufacturer's Representative** shall provide the services of a trained representative for a minimum of one (1) visit consisting of a minimum of one (1) eight-hour day for the purpose of quality control during construction.

C. Upon completion of the inspection, the **Inspector**, in coordination with the **Engineer**, shall perform or direct the **Contractor** to perform any required adjustments to the equipment and place it into operation under the supervision of the **Engineer**. All equipment and materials required to perform the testing shall be

the responsibility of the **Contractor**. The completed inspection checklist shall be signed by the **Inspector** and copies faxed, emailed, or mailed to the **Engineer** and the **Manufacturer** within one (1) week of each corresponding **Liquid-Only Sewer** unit being installed and prior to system commissioning.

8.04 SYSTEM COMMISSIONING

A. The **Manufacturer** or **Manufacturer's Representative** shall provide the services of a trained representative for training the **Owner**'s service provider, and, when directed, randomly inspecting **Liquid-Only Sewer** installations throughout the project. The inspection will include items covered in APPENDIX A, "LIQUID-ONLY SEWER INSTALLATION CHECKLIST" as well as the effluent package, wiring, and control panel placement.

B. The **Manufacturer** or **Manufacturer's Representative** shall provide the services of a trained representative for a minimum of one (1) visit consisting of a minimum of one (1) eight-hour day for the purpose of system commissioning.

C. Upon system commissioning, the **Manufacturer** or **Manufacturer's Representative** shall provide the **Engineer** a written report of findings. The **Engineer** should then perform, or direct the **Contractor** to perform, any required adjustments to the equipment and place it into operation. All equipment and materials required to perform additional testing shall be the responsibility of the **Contractor**.

PART 9. OPERATION AND MAINTENANCE

9.01 OPERATION AND MAINTENANCE MANUAL

The **Manufacturer** shall provide five (5) operation and maintenance manuals: four (4) to be sent to the **Owner** and one (1) to be sent to the **Engineer**. The operation and maintenance manuals shall include a copy of APPENDIX A, "LIQUID-ONLY SEWER INSTALLATION CHECKLIST" signed by the **Inspector** for each **Liquid-Only Sewer** installation.

9.02 SPARE PARTS

The **Manufacturer** shall provide a spare pump, anti-siphon valve, float switches, line checks, circuit breakers, motor contactors, and other necessary components for every 50 pump systems.

9.03 OPERATION AND MAINTENANCE TOOLS

A. Scum Measuring Device: Upon request, the **Manufacturer** shall provide a minimum of one (1) scum measuring utility gauge. The gauge shall consist of a minimum 3/8in (9.5mm) diameter stainless steel rod with an incremental scale for measuring scum levels. The rod shall be bent at a 90-degree angle at the base to aid in identifying the scum "by feeling." The gauge shall be Orenco Model SMUG or **Engineer**-approved equal.

B. Sludge Measuring Device: Upon request, the **Manufacturer** shall provide a minimum of one (1) Nasco Sludge Judge® Ultra or **Engineer**-approved equal. The unit shall be constructed of polycarbonate treated with an ultraviolet stabilizer, durable in cold temperatures, and able to withstand heat up to 280°F (138°C). The measuring device shall be 3/4in (19mm) diameter and marked with tape to designate 1ft increments.

C. Biotube Cartridge Cleaning Cradle: Upon request, the **Manufacturer** shall include a minimum of one (1) Biotube cleaning cradle. The cradle shall be Orenco Model OM-BIOTUBE CRADLE or **Engineer**-approved equal for housing the Biotube pump vault filter cartridges for cleaning and maintenance.

D. Biotube Cartridge Cleaning Brush: Upon request, the **Manufacturer** shall include a minimum of one (1) Biotube cartridge cleaning brush. The brush shall be Orenco Model OM-BIOTUBE BRUSH or **Engineer**-approved equal for cleaning Biotube pump vault filter cartridges.

APPENDIX A

LIQUID-ONLY SEWER INSTALLATION CHECKLIST

SYSTEM OWNER:_____ **DATE:**_____

SITE ADDRESS:_____

SYSTEM PROVIDER:_____ **CONTRACTOR:**_____

INSPECTOR:_____

AS-BUILT SITE DIAGRAM:

Please draw an as-built sketch of the site, including approximate location of buildings, property boundaries, trees, fences, septic systems, existing wells, tanks, pump basins, sewer piping, etc. Include dimensions.

Yes	No	Pre-Installation	Date/Initial
		Tank location approved per **Engineer**	
		Panel location approved per **Engineer**	
		Electrical supply (# circuits/disconnect) checked	
		Liquid-Only Sewer equipment package reviewed and approved	
		Certificate of Origin received	
		Service connection located	
		Riser-to-tank connection and piping-to-tank method reviewed	
		Tank warranty received	
		Date of manufacture specified	
		Factory leak test documentation received	
		Inlet connection approved	
		Inlet tee installed	
		Riser-to-tank connections approved	
		Tank leveled and properly bedded	
		Leak test/watertight test (tank filled 2in or 51mm above tank/riser connection) passed	

Yes	No	Pumping System	Date/Initial
		ClickTight location acceptable	
		Pump vault/screen easily accessible for maintenance	
		Discharge assembly installed correctly	
		Service lateral properly bedded with sufficient depth	
		Toning wire present	
		Check valve installed correctly	
		Control panel location and height acceptable	
		Conduit wiring acceptable (waterproof wire nuts used, panel and splice box seals present)	
		Service connection valve box accessible	

Yes	No	Start-Up	Date/Initial
		Risers backfilled to grade, within 2in (51mm) of lid	
		Pump circuit breaker appropriately sized	
		All circuit breakers accurately labeled	
		Separate alarm circuit included (preferred, not required)	
		Pump operation checked (voltage and amperage)	
		Float switches work as intended (simulate a rising and lowering of the liquid level)	
		Float switch settings accurate (record dimensions from top of tank)	
		Alarm, on/off, low level tested	
		Controls, audible alarm, and visual alarm tested	
		Emergency call sticker in place	
		All lids in place and secured	
		"Homeowner's Manual" delivered to homeowner	
		Site pictures attached	

Inspector Signature:_____ **Date:**_____