

XO₂-in-a Box Install & Design Manual
June 2025, OR

Manufactured by:

Lowridge Onsite Technologies

PO Box 1179

Lake Stevens, WA 98258

877 476-8823

info@lowridgetech.com

www.oscaronsite.com



Introduction:

XO₂-in-a-Box (XO₂-B) is an onsite sewage treatment system for use with wastewater meeting concentrations typical of residential sewage. Wastewater first passes through four chambers: a septic chamber, an aeration chamber, a clarifier, and then into a dosing chamber. Liquid is then dosed to the *XO₂-B* coils (specially produced Netafim drip tubing). Effluent is micro dosed through the coils into a layer of ASTM C-33 (C-33) sand, encased in a PVC liner, where physical, biological, and chemical treatment processes remove organic compounds and pathogens from the waste stream. Treated liquid migrates downward through the sand and is collected in an underdrain. Treated effluent from underdrain flows by gravity or by pump to the drainfield.

The *XO₂-B* is comprised of a 6 inch layer of C-33 sand media under the coils. An *XO₂-B* is built inside a 30 ml PVC lined containment vessel with a booted underdrain. Coils are then placed on the C-33 media and then covered with another 6 inches of C-33 sand media. No other cover material is required. To control inadvertent disturbance from children or animals the C-33 sand can be covered with jute mat or with a shallow layer of mineral soil. Another option is to spread straw over final cover until vegetative cover takes hold: plant grass seed or other ground cover as soon as possible. See appendix for more details.

The *XO₂-B* system treats the wastewater with averages of 3 mg/l CBOD₅, 2 mg/l TSS, and <40 FC/100 ml MPN), without UV disinfection.

The single family residence package is designated as: *XO₂B-500*. It has the corresponding design flow of 500 gallons per day. Design flows 500 gallons per day and under are compliant with the standard *XO₂B-500* package.

Design:

An *XO₂-B* has four (4) sizing criteria: treatment *tank*, discharge *tank*, *hydraulic layout*, and *containment box*.

XO₂:

All tanks must be approved by *Oregon Department of Environmental Quality* as wastewater containment vessels. Tanks can be concrete, polyethylene, or fiberglass with a minimum volume 1,500 gallons. *XO₂-B* tanks must be sized according to Table 1-2.

Table 1-2

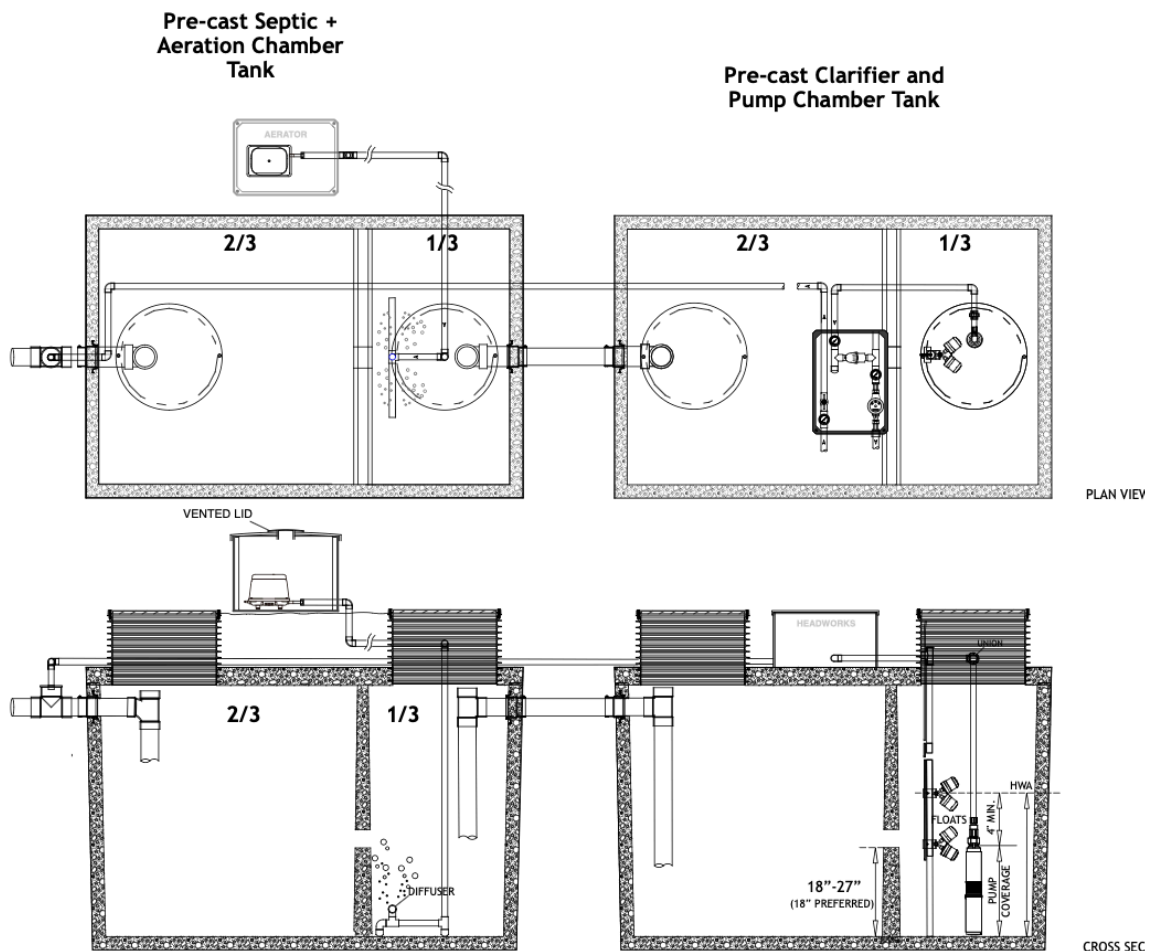
Design Flow	Septic	Aeration	Clarifier	Pump	Aerator Size
500 gpd	1,000	500	660-670	330-340	80 l/m

Treatment Tank: The partition wall between the first and second compartment of the treatment tank must have a 4 inch by-pass hole or the bottom of the tee baffle located between 40% to 60% of the liquid depth.

Discharge Tank: The partition between the first and second compartment of the discharge tank must have a 4 inch by-pass hole located at least 18 inches above the floor of the tank and no more than 27 inches between the bottom of the by-pass hole and floor of the tank. Recommended height is 18 inches, if possible.

Below is a drawing of the tank arrangement. Tanks for the X02-B system have two requirements: 1. The tank meets the minimum size/volume requirement and 2. The tank are approved by the Oregon DEQ.

X02 Tanks



Hydraulic Layout:

Coils are arranged in laterals. Each lateral is a single coil or a group of coils linked in series between the supply and flush manifolds.

The standard single family residence *XO2B-500* package include a headworks (model HWN-.7-MAN) for dosing the coils. Table I-2 depicts the number of coils and laterals required for the *XO2B-500* package, using a *Lowridge Onsite Technologies*, 1/2 hp, 110 volt turbine pump, model LOT-30. There is a maximum total dynamic head (TDH) of 50 feet available for the supply line feeding the *XO2-B* system. It is critical to verify that the TDH of the supply line is within tolerance. Refer to Table 3.

Measure the distance between the discharge tank and the *XO2-B*. Then, estimate the elevation gain from the discharge tank to the *XO2-B*. Cross reference those two values on Table 3. If the intersection of the two values falls within the blue shaded area, the TDH is within tolerance of the pump curve. If the intersection of the values fall outside of the blue shaded area, call *Lowridge* for assistance. The criteria in these tables **must be** followed. If a deviation is required, contact *Lowridge* for assistance.

Containment Vessel:

The *XO2-B* coils must be built inside a containment vessel. The containment vessel must be water tight except for the top and an outlet for the underdrain. The containment vessel must be designed and installed to preclude surface or ground water from infiltrating the unit and be of sufficient size to accommodate a layer of clean, washed pea gravel that covers the 2 inch diameter underdrain, 6 inch layer of ASTM C-33 sand under the coil.

TABLE 1-2
Hydraulic Layout
***XO2-B* Coils, OS-100 coils**

Design Flow	Total Coils	# of Lats.	Coils per lat.	Dose GPM	Flush GPM	Excess TDH
480	4	4	1	2.8	9.2	50'

Table 3: Total Dynamic Head Chart

Elevation lift in feet	Supply Line Length in Feet 1" Sch 40							
	20'	40'	60'	80'	100'	150'	200'	300'
2	4'	6'	7'	9'	10'	14'	18'	26'
5	7'	9'	10'	12'	13'	17'	21'	29'
10	12'	14'	15'	17'	18'	22'	26'	34'
15	17'	19'	20'	22'	23'	27'	31'	39'
20	22'	24'	25'	27'	28'	32'	36'	44'
25	27'	29'	30'	32'	33'	37'	41'	49'
30	32'	34'	35'	37'	38'	42'	46'	54'
35	37'	39'	40'	42'	43'	47'	51'	59'

Supply and flush lines are assumed to be 1" sch 40 PVC.

Controller:

The *LF2P-RF-ARA* control panel shall be used to operate the timed dosing sequencing of the *XO2-B* and possible discharge pump for the drainfield. Timer settings for the *XO2-B* are short and very frequent (3 minutes off and 30 seconds on). Timer settings for drainfield will be determined by others. This controller will override off pump #1 when there is an aerator failure condition.

The timer settings for the *XO2-B* may need to be changed for two reasons:

1. In colder climates where the supply line needs to drain between doses, the "on time" will need to be increased to compensate for filling the supply line prior to each dose. See Table 4 below for details.

TABLE 4
Timer Settings
for
Drain Down

Length of Supply Line*	Dose Time	Fill Time	Total "ON" Time	Total "OFF" Time
100'	22 Sec.	10 Sec.	32 Sec.	7 min, 28 seconds

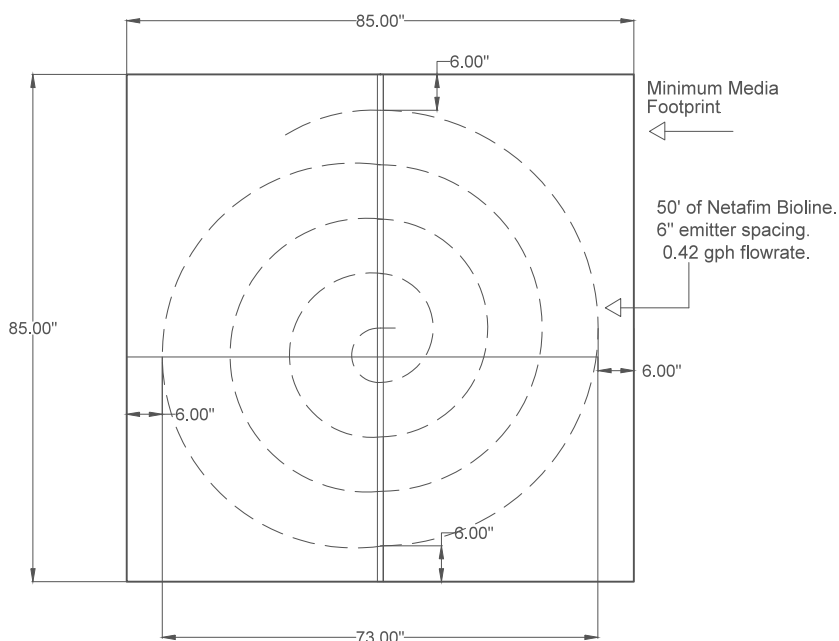
Length of Supply Line*	Dose Time	Fill Time	Total "ON" Time	Total "OFF" Time
200'	22 Sec.	20 Sec.	42 Sec.	7 min., 18 seconds
300'	22 Sec.	30 Sec.	52 Sec.	7 min., 8 seconds
400'	22 Sec.	40 Sec.	62 Sec.	6 min., 58 seconds
500'	22 Sec.	50 Sec.	72 Sec.	6 min., 48 seconds

*Assumes supply line is same length as the flush line and compensated for in the table. Only the amount of pipe that drains is used to determine the supply line length.

Appendix

XO₂-B Coils or **OS-100**: The OS-100 OSCAR coil is made with 50 feet of custom Netafim Bioline with 0.42 gph emitters @ 6 inch spacing (100 emitters), an average of 2 emitters per sq. ft. Each coil has a minimum area of 50 sq. ft. (85" x 85"). The actual coil diameter is 73". There must be a 12" minimum spacing between the tubing of differing OS-100 coils and a 6" spacing between any tubing and the liner.

OS-100 Coil Detail:



The OS-100 OSCAR coil contains 100

0.42 gph Netafim emitters in a 50 sq. ft. foot print. Emitter concentration is 2 emitters per sq. ft. Design flow for each OS-100 is 125 gpd.

***XO₂-B* Parts list.**

Each *XO₂-B* kit will include:

- LF2P-RF-ARA control panel
- 1/2 hp, 30 gpm LOT-30 pump (Drainfield pump not included)
- OS-100 Coils (4)
- PVC fittings and drip tubing adapters
- HWN-.7-MAN manual headworks
- Solid 1/2" poly tubing for connections
- 4 float switches

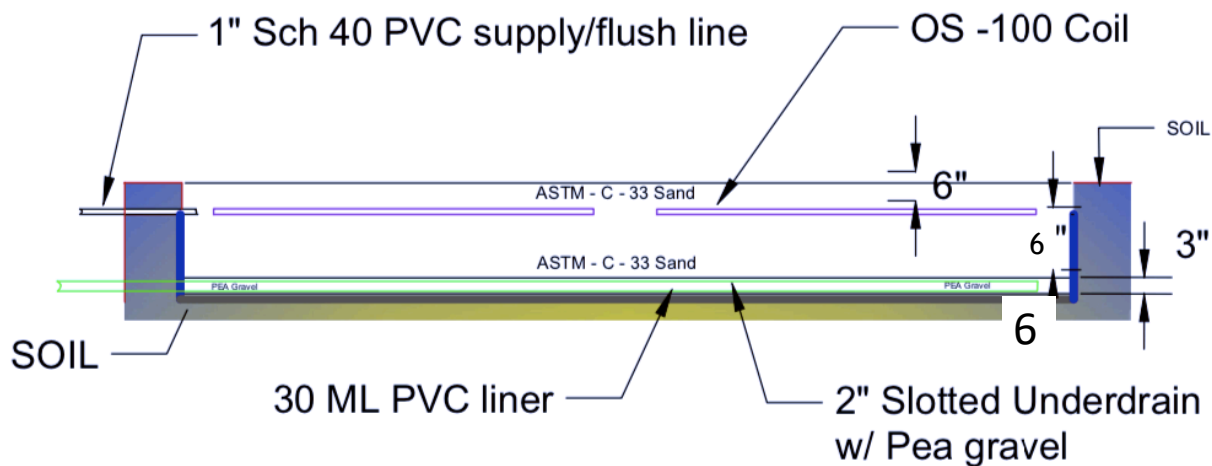
Headworks: HWN-.7-MAN

- 3/4" Arkal disc filter, mesh, 130 micron
- 3/4" Arad flow meter
- Three oil filled pressure gauges
- 1" Spears gate valve

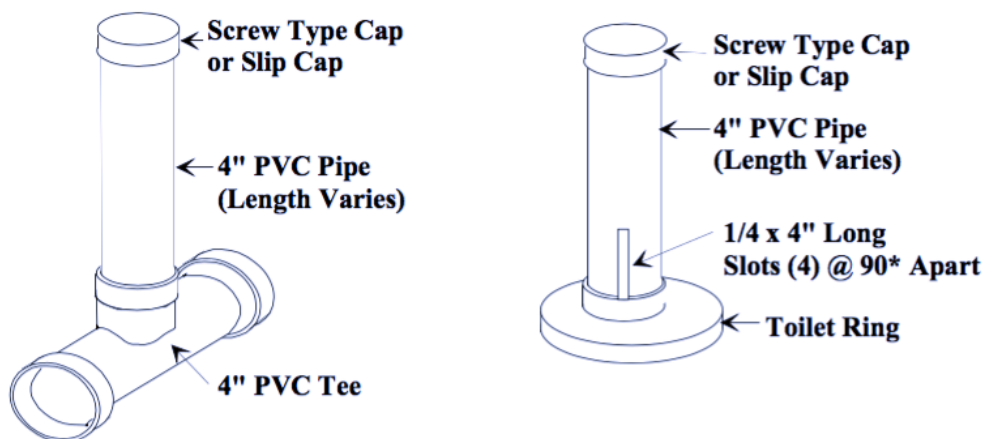
Containment Vessel:

Use a 30 ml PVC liner. Top of liner must be above ground water level and be installed to prevent surface water from infiltrating. Use pea gravel around slotted pipe for the underdrain.

***XO₂-B* Containment Vessel Cross Section**



Inspection ports.



XO₂-B Coil Cover Options.

There may be a desire to cover the *XO₂-B* coils with something additional to the specified ASTM C-33 sand. Options include:

- landscaping jute mat with grass seed or ground cover plantings
- a thin layer of mineral soil low in organic content (<10% organics)
- large aggregate to 5 inch diameter
- beauty bark

Do Not Cover Coarse Sand media & ASTM C-33 concrete sand with:

- organic mix (manufactured top soil from compost)
- filter fabric

The intent is not to have too much additional cover over the final C-33 sand layer. Placing too much cover will inhibit plant root growth. Because the C-33 sand is sub-surface irrigated, grass and other ground cover will grow rapidly, forming a firm protective cover over the XO₂-B. At the end of the first growing season the C-33 sand layer will be as firm as native soil to walk on.

Cold Weather Options.

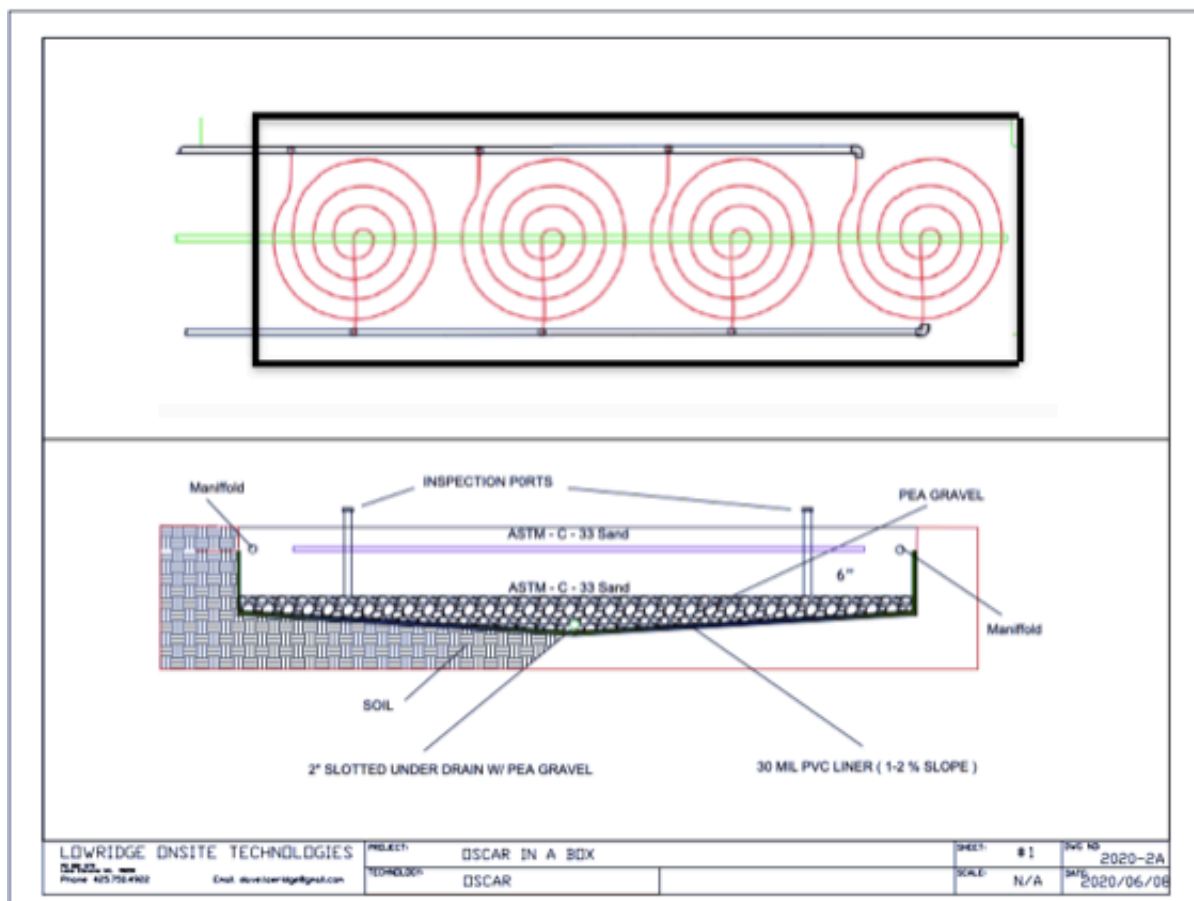
In colder climates it may be necessary to prevent freezing. This is especially true with vacation homes where the houses are vacant in the winter and all power is turned off. In these situations Lowridge recommends the following steps:

- Allow the internal portion of the headworks to drain between doses.
- Install supply and flush lines below frost line.
- Place headworks box on tanks as show.
- Do not install check valves.
- Use no more than one extension riser on headworks to increase bury depth.

Hydraulic Layout

The hydraulic layout exemplified illustrates how the coils are to be plumbed. The actual size of the containment vessel will be slightly larger than the length and width dimensions given to provide room for plumbing and installation.

Containment Vessel Dimensions



Dimension of Vessel for OS-100 coils

8.0' x 30'

Sand Media Criteria.

Coarse Sand media & ASTM C-33 concrete sand (see page 21 for detail)

Prior to Installing an *XO2-in-a-Box System*:

Before installing a *XO2-B*, the installer must complete in-class and in- field training by representatives designated by *Lowridge Onsite Technologies, Inc.* The Installer must ensure that no water softener discharge is plumbed into any of the drains that feed the system. The residential *XO2-B* system is intended to treat only wastewater generated by normal activities from laundry machines, toilets, showers, and kitchen and bathroom sinks. No special chemical additives are needed for the normal function.

Unloading and un-packaging instructions:

Lowridge Onsite Technologies, Inc. takes great care to manufacture and package the *XO2-B* system to prevent damage during shipping and handling. It is expected that everyone from the manufacturing personnel to the installation crew take reasonable steps not to drop, throw, or damage the product.

If there are defects in any of the components, call *Lowridge*.

Installation steps:

For reference, please see instructional videos on our website at: www.oscaronsite.com, click on "Training Video" page, select Oregon State and then *XO2-in-a-Box*.

Step 1: Determine the orientation and position of the tanks.

Some designs will have specific locations for the system components based on required set-backs, elevation, logistical issues, or aesthetic concerns. Before excavating begins, verify that the proposed locations of the tanks are laid out in a manner that will allow for efficient pipe connections.

Step 2: Excavate the holes for tanks.

Excavate the tank holes as per the tank manufacturer's recommendations. Take appropriate steps to ensure the tanks will not settle after backfill.

Step 3: Setting tanks.

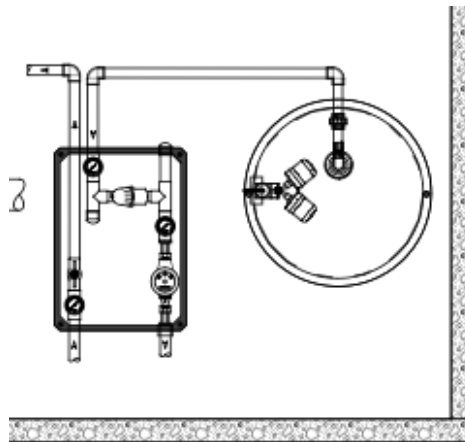
Tanks: Set tanks according to tank manufacturer's recommendations.

Step 4: Install dosing pump.

Place the pump into the discharge tank, second compartment. Attach a 1" union on the horizontal supply line and exit the tank through the riser wall. Make sure to use an appropriate grommet or other method to ensure the protrusion is water tight.

Step 5: Install headworks and flow meter.

Install the headworks on top of the discharge tank. If the risers are taller than 12 inch, cut an additional riser for an extension. Plumb the pump and headworks at right angles as shown below.



Step 6: Aerator and Diffusor placement

The aeration box must be installed so that the bottom of the box is at a higher elevation than the top of the tank risers. The aeration box must **NOT** be placed near windows, door ways, or areas where people will congregate, like BBQs and patios.

Diffusor Installation

Remove Diffusor brackets from Aerator box. Attach diffusors and short PVC pipe to bracket.



Estimate the length of pipe by touching bracket against partition wall.



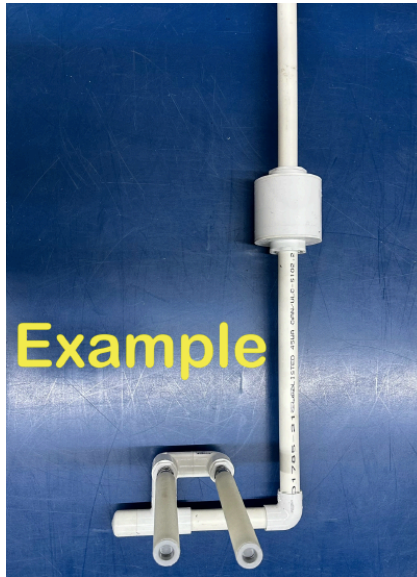
Cut pipe and glue second bracket piece.



Glue vertical pipe to bracket and place in aeration chamber. Attached union and exit riser wall through grommet.



Splice “muffler” piece into the air line to help with noise from the aerator.



Place aeration box so that the bottom of box is at or above the top of the tank risers. Attached air line though bottom of box.



Step 7: Plumbing connections

The headworks has four plumbing connections: pump line from dosing pump, *XO2-B* supply line, *XO2-B* flush line, flush vent line to tank inlet. Plumb the connections to the headworks so that the pipes are supported by the top of the tank or hand bed the pipes before backfilling the system.



Step 8: Wire control panel, floats, pump, and aerator.

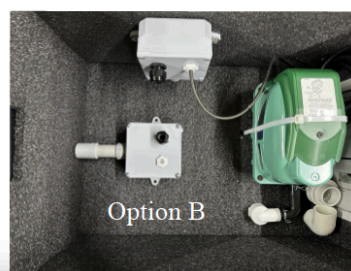
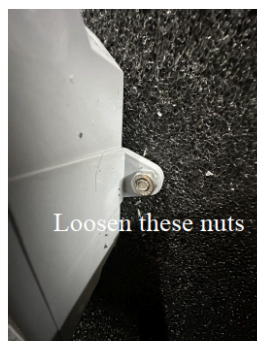
Mount the control panel chest to eye level.

Always use PVC electrical conduit between the splice boxes and the control panel and follow all applicable electrical codes. Do not use direct burial wire on *XO2-B* systems. Follow the wiring directions provided inside the control panel. The electrician shall attach conduit through the bottom of the aerator box as shown. Up to three aerators can be wired in parallel to one 10 amp circuit. Up to three pressure switches can be wired in parallel to one circuit.

Power requirements for the *XO2-B* system components are as follows:

- Discharge pump, 110 volt, up to 18 amps start and 11 amps running
- Disposal pump, 110 volt, up to 18 amps start and 11 amps running
- Aerator is 110 volt, 1.6 amps

***Splice Box Alternative Installation:** The splice box default mount is on the side of the headworks box. You can undo the nuts and mount them alternate positions if you need different access points:



Step 9: Aerator placement.

Place the bottom of the aerator box at least as high as the top of the top of the tank riser openings. This will prevent the aerator from becoming submerged if the tank should flood. Aerator should be placed out of sight of windows and away from areas of people congregating.

Step 10: Floats and Pump settings.

Set float using the floats and float clips provided. The bottom float (Timer enable float) should be set at a minimum of 24 inches above the bottom of the tank to ensure the entire pump motor and wet end are completely submerged. The top float (high level alarm) should be set at least 4 inches above the bottom float. A greater distance can be used if a large working volume is required.

Step 11: Back fill and water test.

Prior to backfilling, all tanks should be water tested and all start-up procedures must be completed. Fill tanks to 2 inches above riser connections and mark water level. There should be no measurable water loss for 2 hours. Backfill tanks with appropriate material. At all times follow tank manufacturer's instructions. Hand-bed all pipes.

Step 12: *XO₂-B* installation.

Installation:

Excavate a hole to accommodate the dimensions of the containment vessel. Bottom of excavation should be level. Line the bottom of the excavation with sand. The sides may be supported by plywood or comparable materials. Place 30 ml PVC liner in excavation. Install slotted underdrain pipes as shown on design. Cover underdrain with clean, washed pea gravel. Pea gravel layer must be level. Place 6 inches of ASTM C-33 sand. Place and extra 1.5 inches to compensate for shrinkage. Install coils and connect to manifolds as shown on design. Cover coils with 6 inches of C-3 sand.

It is recommended to immediately broadcast grass seed or plant a ground cover, preferably periwinkle (*vinca-minor*). A layer of natural mineral soil can be added to cover the sand. Do not use a manufactured top soil mix. Also, avoid soil that is high in organic matter. A couple of inches of beauty bark could be used to top dress the sand.

When acquiring the sand for the *XO₂-B* unit, confirm with the sand supplier that the sand is within the specification requirements listed on page 19-20 of this manual.

Step 13: Panel Operation and Start-up procedures.

Panel Operation:

The ***LF2P-RF-ARA*** control panel is a 110 volt universal panel for most single family *XO₂-B* systems. It has the capacity to operate three major outputs: Dose pump, discharge pump, and the “*Reverse Flush*” headworks. All logic is controlled by a Siemens Logo. The pump operation options are as follows:

- Dose Pump (Pump #1): is operated in a time-dose mode. Pump #1 pressurizes the *Coil*, back-flushes the disc filter and forward flushes the

Coil(s) in three different cycles. The control panel allows the operator to determine the number of dose cycles before the disc filter flush and *Coil* flush cycles (default setting is 90 doses).

- **Discharge Pump (Pump #3):** The discharge pump is time-dosed. The bottom float switch operates as the “Timer On” float switch. The high level alarm float will override Pump #1 off as well as cause an audible and visual alarm signal.

The timers have the following factory default settings:

- Dose-pump: 3 minutes, 30 seconds off, 30 seconds on. (V1_OFF, V1_ON)

Start Up Procedures:

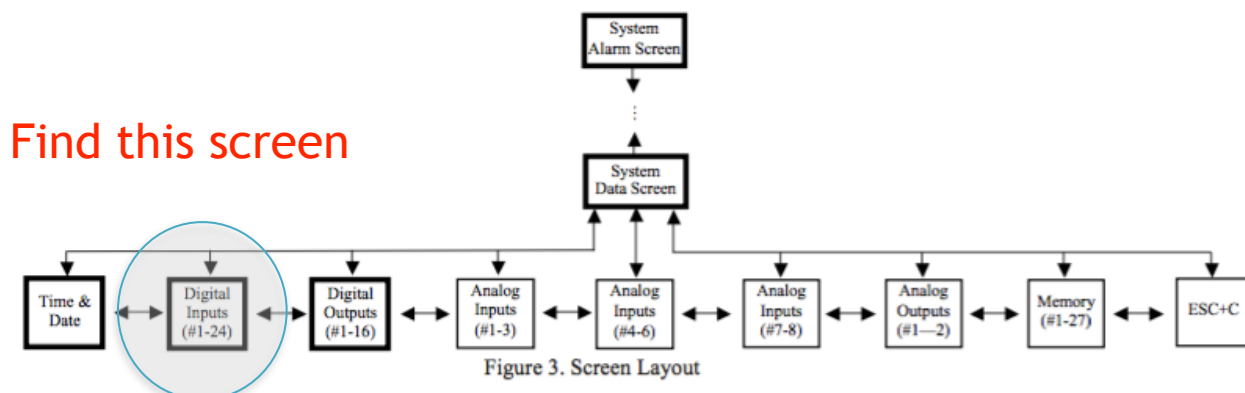
Prior to conducting any of the following procedures, inspect the wiring to ensure the system is correctly wired. Pull all the float trees from the tanks and place across the tank openings so all the floats hang down. Now power up the system and turn all the breakers to the “ON” position and all of the toggle switches in the off position. Ensure there is enough water in tanks to conduct pump tests.

a. Test floats:

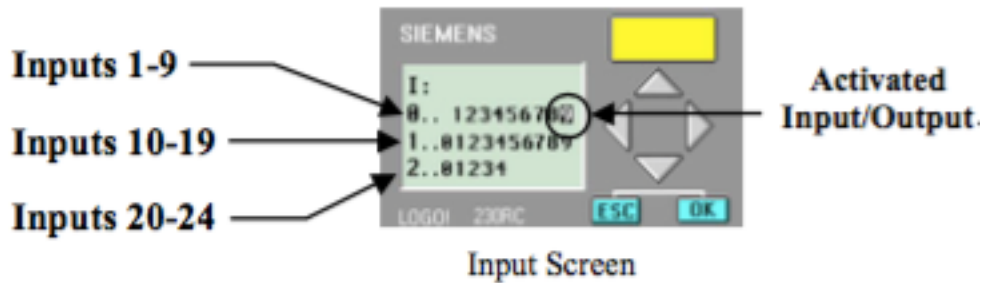
On the Seimens Logo scroll to the input screen as shown here:

Screen Navigation:

The screens are arranged in the order shown in Figure 3 below. To move between screens, use the four arrow keys. The screens of interest are shown in bold. Additional built-in screens will be present, but do not contain useful information.



The actual screen will look like this:



When lifting the floats check this screen to determine if the floats are wired into the correct position. When the floats are lifted a corresponding digit will be back lit. The input values are as follows:

1 = bottom discharge tank float
2 = top discharge tank float.

Test floats:

Lift top float. Input indicator "2" will back light and the alarm should sound and the beacon should illuminate.

Lift bottom float. Input indicator "1" will back light.

Place floats back into tanks.

b. Test pump:

Dose/Flush pump and valves:

Place pump 1 toggle switch to MAN position. Pump should dose and all three pressure gauges should stabilize about 50 psi. No water should be flowing into septic tank.

Replacement Instructions:

There are several components that are critical to process performance: drip tubing in the *Coil*, and the discharge pump.

Coil, Netafim Bioline, 08WRAM.4-06V500:

To replace the *Coil* remove sand media from top of *Coil*, cut the 1/2" poly feed lines adjacent to the manifolds, fold the feed lines up, and remove *Coil*. Place the new *Coil* in the sand, fold down the feed lines and couple to the feed lines, and cover *Coil* with sand. *Coils* can be obtained from any *XO2-B system* dealer or *Lowridge Onsite Technologies, Inc., ll*

Aerator:

Cut power to aerator. Access splice box in aerator box. Disconnect wire nuts, remove and replace aerator. Connect wire nuts and turn power on.

Discharge pump, Lowridge Onsite Technologies, 1/2 hp, 30 gpm model LOT-30:

Cut power to pump, disconnect wire connections in splice box, remove pump from tank, and disconnect pump from piping. Connect new pump piping, connect wiring in splice box, place pump into tank, and re-energize power to pump circuit.

Material Specifications:

Media:

Coarse Sand media & ASTM C-33 concrete sand:

Coarse Sand Media Specification - The filter media must meet items below: (Source: State of Oregon On-Site Sewage Disposal Rules and the State of Wisconsin Single Pass Sand Filter Component Manual)

1. Particle size distribution:

Sieve Particle Size Percent Passing

3/8 in 9.50 mm 100

No. 4 4.75 mm 95 to 100

No. 8 2.36 mm 80 to 100

No. 16 1.18 mm 45 to 85

No. 30 0.6 mm 15 to 60

No. 50 0.3 mm 3 to 15

No. 100 0.15 mm 0 to 4

2. Effective Particle Size (D10) > 0.3 mm.

3. Uniformity Coefficient (D60/ D10) < 4.0

ASTM C-33 Specification -

1. Particle size distribution:

Sieve Particle Size Percent Passing

3/8 in 9.50 mm 100

No. 4 4.75 mm 95 to 100

No. 8 2.36 mm 80 to 100

No. 16 1.18 mm 50 to 85

No. 30 0.6 mm 25 to 60

No. 50 0.3 mm 5 to 30

No. 100 0.15 mm 0 to 10

(prefer <4)

2. The sand must have not more than 45% pass any one sieve and be retained on the next consecutive sieve of those shown above.

3. The fineness modulus must be neither less than 2.3 nor more than 3.1. The fineness modulus is calculated by adding the cumulative percentages of material in the sample retained in the sieves shown above and dividing the sum by 100.

4. The limit for material that can pass the No. 200 sieve must not be more than 3%.

Treatment Vessels, Pump tanks and Pump Basins: All treatment vessels, pump tank, and pump basins must on the Oregon DEQ approved List of Registered Sewage Tanks. Man-hole openings must be 24" or greater nominal size to surface grade with a locking lid to preclude un-authorized access. All tanks must be water tight to the riser lid opening. All protrusion through the riser wall for electrical conduits and other piping must be sealed to preclude any water infiltration. Containment vessels can be concrete, polyethylene, fiberglass, or PVC.

Concrete: Where ever possible, concrete tank bodies should be single piece construction. Man-hole risers should be cast in-place.

Plumbing: All piping must be PVC. The 1 inch supply and flush lines must be sch40.

Assembled components: *Lowridge* assembles the following components: headworks, *Coil (partially assembled)*, and *Coil* manifold connections.

Headworks: the headworks for the *XO2-B* is made of all 1" sch PVC pipe and fittings, 1" NC *Dorot* solenoid valves, 3/4" *Arkal* disc filter (120 mesh, 130 micron), Three oil filled pressure gauges, and a polyethylene valve box with lid.

Coil: The *Coil* is constructed of Netafim Bioline™ (0.42 gph emitter at 6 inch spacing) attached to a 1/2 inch or 1 inch PVC bracket.

Discharge pump: *Lowridge Onsite Technologies*, LOT-30, 1/2 hp, 30 gpm

Disposal Pump: Determined by others. Must not exceed 20 amp circuit, 120 volts, 1/2 hp motor.

Aerator: Hiblow XP-80 aerator: 1.6 amp, 120 volt.