

XO₂-in-a Box Design Manual
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Manufactured by:

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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 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 into a pump basin or pump chamber where it is timed or demand dosed to an approved dispersal component.

The *XO₂-B coils* are 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 meets treatment level “A” (3 mg/l CBOD₅, 2 mg/l TSS, and <40 FC/100 ml MPN), without UV disinfection.

The single family residence packages are designated as: *XO₂B-240*, *XO₂B-300*, *XO₂B-360*, *XO₂B-450*, *XO₂B-480*, and *XO₂B-600* and have the corresponding design flows of 240, 300, 360, 450, 480, and 600 gallons per day. Design flows greater than 600 gallons per day are considered custom and will require design assistance from *Lowridge Onsite Technologies, Inc.*

The *XO₂-B* units can be designed in increments of 62.5 (OS-50) or 125 (OS-100) gpd gallons per coil per day. An *XO₂-B* system can have a design flow up to 3500 gpd.

Design:

Each coil in a *XO₂-B* system can be designed to treat 2.5 gpd/sq. ft. Minimum vertical separation depth for the disposal component is 12 inches, except in soil type 1 where a minimum of 18 inches of vertical separation is required.

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

XO₂:

The treatment and discharge tanks for the XO₂-B shall be listed on the *Washington State Department of Health's Registered Sewage Tanks* list with a minimum volume 1,000 gallons. XO₂-B tanks must be sized according to Table 1-2.

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.

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 XO₂-B packages with design flows between 240 to 600 gpd include a headworks (model HWN-.7-RF) for dosing the coils. Table 1 & 2 depicts the number of coils and laterals required for a given design flow using an *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

Table 1-2

Design Flow	Septic	Aeration	Clarifier	Pump	Aerator Size
500 gpd	660-670	330-340	660-670	330-340	80 l/m
750 gpd	1,000	500	1,000	500	120 l/m or more
1125 gpd	1,500	750	1500	750	180 l/m or more
2250 gpd	3,000	1,500	3,000	1,500	360 l/m or more
3,000 gpd	4,000	3,000	4,000	2,000	480 l/m or more
3,500 gpd	4,500	3,000	4,500	3,000	560 l/m or more

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
Hydraulic Layout
***XO2-B* Coils, OS-50 coils**

Design Flow	Total Coils	# of Lats.	Coils per lat.	Dose GPM	Flush GPM	Excess TDH
240	4	4	1	1.4	7.8	50'
300	5	5	1	1.75	9.75	50'
360	6	3	2	2.1	6.2	50'
450	8	4	2	2.8	9.2	50'
480	8	4	2	2.8	9.2	50'
600	10	5	2	3.5	11.5	50'

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

Design Flow	Total Coils	# of Lats.	Coils per lat.	Dose GPM	Flush GPM	Excess TDH
240	2	2	1	1.4	4.6	50'
360	3	3	1	2.1	6.9	50'
480	4	4	1	2.8	9.2	50'
600	5	5	1	3.5	11.5	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" such 40 PVC.

Controller:

The *LF2P-RF-OS-AUXR* control panel shall be used to operate the timed dosing sequencing of the *XO2-B* and 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
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.

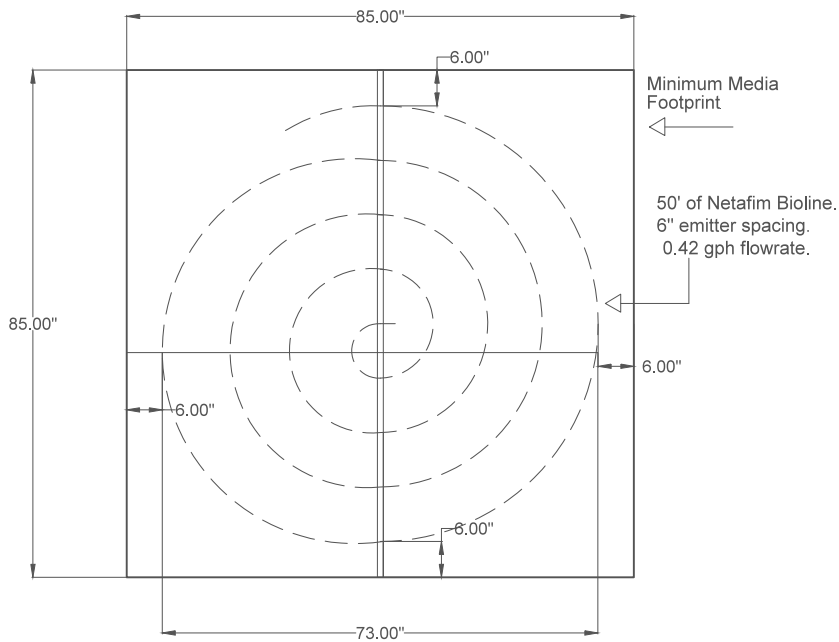
Set-backs:

All set backs are according to local code or WAC 246-272A for a waste water containment tank.

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. footprint. Emitter concentration is 2 emitters per sq. ft. Design flow for each OS-100 is 50 gpd.

XO₂-B Parts list.

Each XO₂-B kit will include:

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

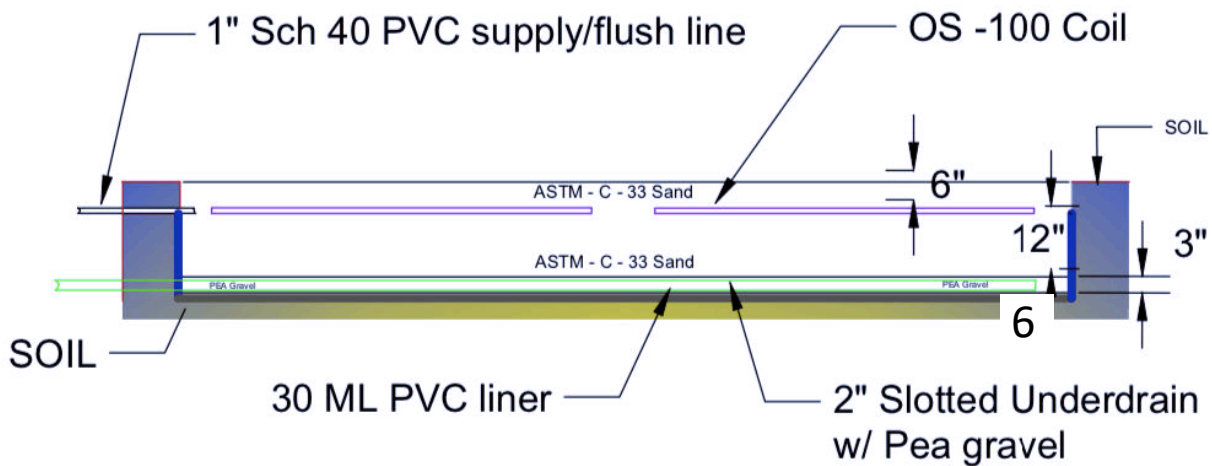
Headworks: HWN-.7-RF

- 3/4" Arkal disc filter, mesh, 130 micron
- 3/4" Arad flow meter
- Three oil filled pressure gauges
- 5 Netafim normally closed throttling solenoid valves

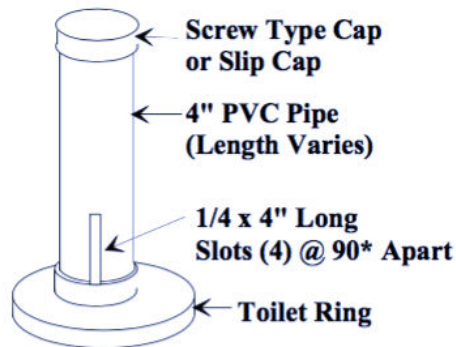
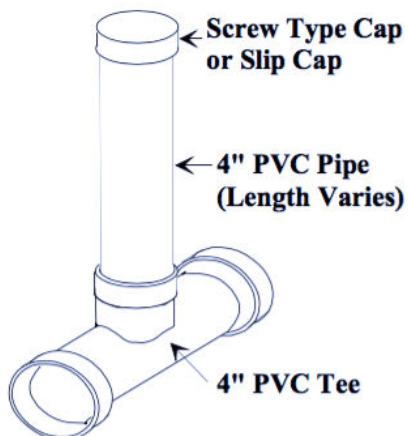
Containment Vessel:

Use a 30 ml PVC liner as per Washington Department of Health's Recommended Standards and Guidance for Intermittent Sand Filters. 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)

Do Not Cover C-33 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.

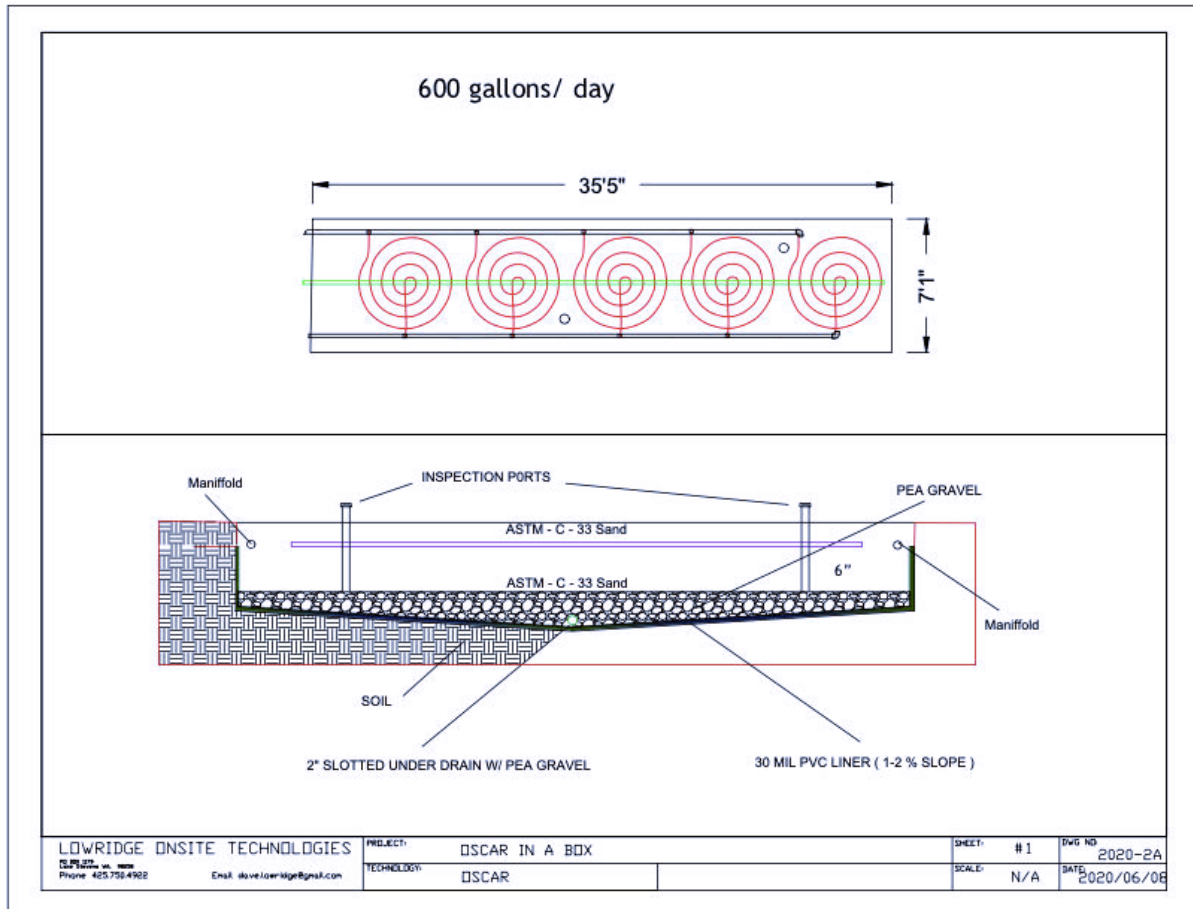
Cold Weather Options.

In colder climates (eastern Washington) 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 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

Number of Bedrooms	Dimension of Vessel for OS-50 coils	Dimension of Vessel for OS-100 coils
2	11.5 x 11.5 or 6 x 22.5	7.1 x 14.2
3	11.5 x 17	7.1 x 21.3
4	11.5 x 22.5	7.1 x 28.4
5	11.5 x 28	7.1 x 35.5

Sand Media Criteria.

ASTM C-33 sand media: as per Washington Department of Health's Recommended Standards and Guidance for Intermittent Sand Filters.