John Elias Baldacci
Governor

Maine Department of Health and Human Services

Maine Center for Disease Control and Prevention
286 Water Street, 3rd Floor
11 State House Station
Augusta, ME 04333-0011

Brenda M. Harvey,
Commissioner

Dora Anne Mills, MD, MPH
Public Health Director
Maine CDC Director

July 21, 2006

Orenco Systems, Inc.
Attn.: Sam Carter, GRM
814 Airway Avenue
Sutherlin, OR 97479

Subject: Product Registration, Orenco Systems, Inc. **Fiberglass Septic Tanks**

Dear Mr. Carter:

The Division of Environmental Health has completed a review of a registration application for your company's product. This information was submitted pursuant to Section 1802 of the Maine State Plumbing Code, Subsurface Wastewater Disposal Rules, for code registration, for use in Maine.

Product Description

The Orenco Systems, Inc. **Fiberglass Septic Tanks** consist of injection molded fiber-reinforced plastic (FRP) tanks in 1,000 and 1,500 gallon capacities. Inlet and outlet baffles are conventional plastic "tee" fittings. The tanks feature a ribbed design which allows optional installation of baffles, to create multiple compartment tanks with varying capacities in each compartment.

Claim

According to the information you provided, the Orenco Systems, Inc. **Fiberglass Septic Tanks** received approval in numerous jurisdiction in the United States of America, and listed by IAPMO/UPC.

Determination

On the basis of the information submitted, in the Division has determined that the Orenco Systems, Inc. **Fiberglass Septic Tanks** meet or exceed the requirements of Sections 900.0 through 906.0 of the Maine Subsurface Wastewater Disposal Rules, CMR 241.

In the event that the product fails to perform as claimed by the applicant, use of the product in Maine, including all installations approved pursuant to Chapter 18 of the Rules, shall cease. Use of the product shall not resume until the applicant and the Division have reached a mutually acceptable agreement for resolving the failure to perform as claimed.

Because installation and owner maintenance has a significant effect on the working order of onsite sewage disposal systems, including their components, the Division makes no representation or guarantee as to the efficiency and/or operation of Orenco Systems, Inc. **Fiberglass Septic Tanks**. Further, registration of this product for use in the State of Maine does not represent Division preference or recommendation for this product over similar products.

If you have any questions please feel free to contact me at (207) 287-5695.

Sincerely,

James A. Jacobsen

James A. Jacobsen, Environmental Specialist IV
Wastewater and Plumbing Control Program
Division of Health Engineering
e-mail: james.jacobsen@state.me.us

/jaj

Enc.: Chapter 9, CMR 241

xc: Product File

June 28, 2006

Orenco Systems' Incorporated

814 AIRWAY AVENUE
SUTHERLIN, OREGON
97479

TOLL FREE:
(800) 348-9843

TELEPHONE:
(541) 459-4449

FACSIMILE:
(541) 459-2884

WEB SITE:
www.orenco.com

Russell G. Martin, P.E.
Maine Division of Environmental Health
Department of Health & Human Resources
Maine Center for Disease Control and Prevention
Division of Environmental Health
11 State House Station
Augusta, ME 04333

RE: Orenco Systems, Inc. Products Approval Request

Dear Mr. Martin:

Please accept this letter as a formal request to approve the following products as manufactured by Orenco Systems, Inc. for General use in the State of Maine. I have enclosed ~~information on~~ each product line to support this request for approval.

AdvanTex® Treatment System
Orenco ~~Systems Inc. has been co~~nducting research and development on packed bed filters for over 25 years. Our efforts have produced the AdvanTex® Treatment System. AdvanTex incorporates a non-woven textile as the substrate for an attached growth (fixed film) treatment process. The textile media incorporates the best process treatment features of the Intermittent and Recirculating Sand Filters into one compact unit. The AdvanTex - AX filter system will significantly reduce BOD_5, TSS and Total Nitrogen in residential strength wastewater to levels that meet advanced wastewater treatment standards.

Enclosed you will find an Approvals Binder that includes an Approvals Summary, Frequently Asked Questions, Treatment System Overviews, Drawings, Design Criteria, AdvanTex Treatment System Performance Summary, Warranties, Installation Instructions, and Operation and Maintenance Procedures. Included in the appendix is information on the history of packed bed filters, as well as technical papers on textile packed bed filters.

Fiberglass Tank
Orenco's injection-molded, watertight tanks have been optimized for use in onsite wastewater collection and treatment systems (residential and commercial) and in communitywide effluent sewer systems. Tanks are made of fiberglass-reinforced polyester for durability, and injection-molded for unmatched part quality and consistency. Two sizes are available 1000-gallon and 1500-gallon.

Enclosed you will find an Orenco Fiberglass Tank Approvals Binder that includes drawings and detail sheets, installation instructions, and structural analysis.

Biotube® Effluent Filters
Orenco's FT-Series Biotube effluent filters are used in new or existing tanks, for both residential and commercial applications. Each filter comes with a Biotube filter cartridge (in 4-, 8-, and 15-in. diameters), PVC housing, and extendible PVC handle. A shortened version of our standard 8- and 12-in. diameter filters, called a "base inlet filter", is available for low-profile tanks.

Enclosed you will find an Orenco Effluent Filter Folder that includes product sheets, drawings, and sizing information.

I have also enclosed a general Product Catalog that covers all the products Orenco Systems, Inc. manufactures which may require approval of some sort. Understandably you may need additional or more specific information on any of these products, that I would be happy to send you.

Please feel free to contact me to discuss what additional information you may need or if you have any questions.

Best Regards,

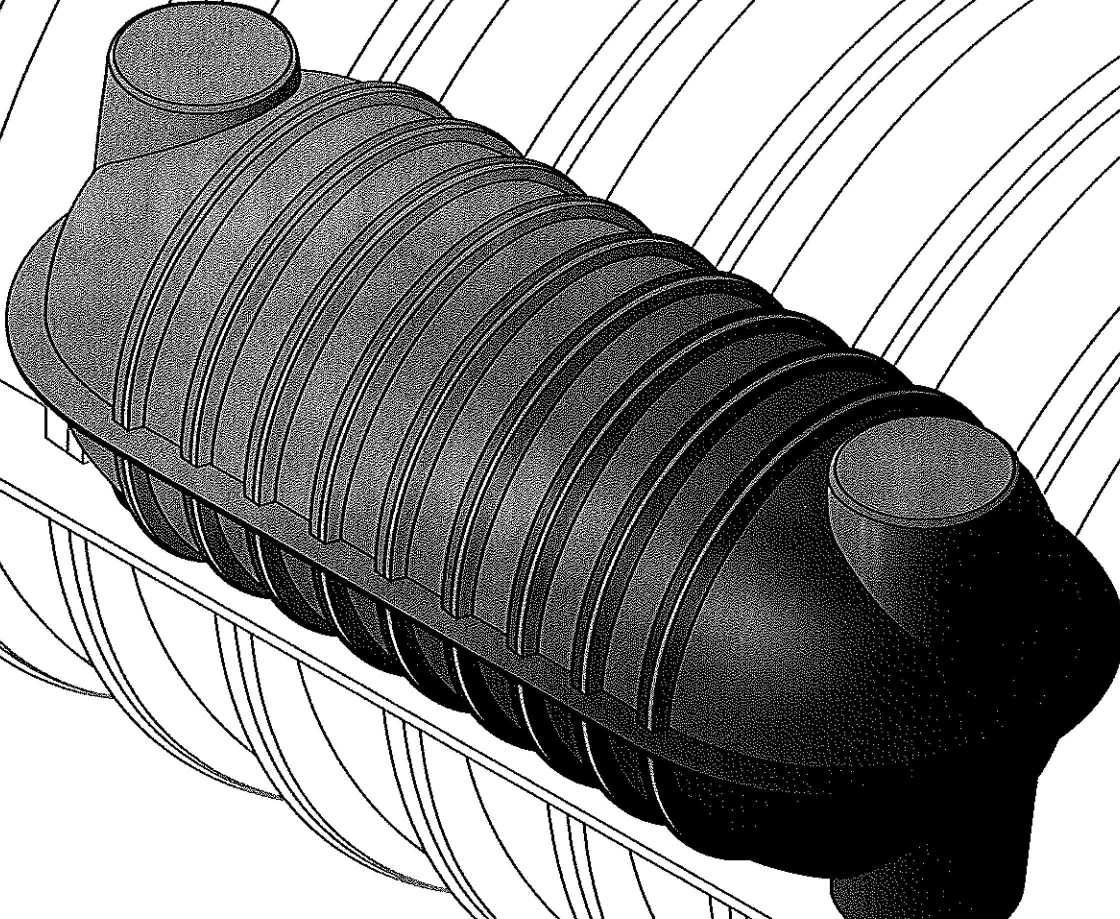
Sam Carter
Government Relations Manager
Orenco Systems, Inc.
1-800-536-4192
scarter@orenco.com

Orenco Systems®, Incorporated

Fiberglass Tanks

APPROVALS

APPROVALS PACKAGE



Orenco Systems® Incorporated

Changing the Way the World Does Wastewater®

1-800-348-9843
orenco.com

Introduction to Orenco Fiberglass Tanks

Orenco Systems®
Incorporated
1-800-348-9843

After 2 decades of research, design, and lecture in regards to septic tanks, Orenco Systems, Inc. has released the structurally sound Orenco Fiberglass Tank!

Our patented Orenco Fiberglass Tank is watertight, lightweight, durable and highly versatile. The tank is injection molded, providing excellent consistency in quality.

The Orenco Fiberglass Tank can be used in a variety of applications, from the standard STEP system to a packed bed filter system.

Hundreds of Orenco Fiberglass Tanks have been installed all over the U.S.

The enclosed binder includes numerous documents to support a request for regulatory approval in your area. However, your jurisdiction may require additional information relevant to your regulations, and we would be happy to supply whatever additional documentation you need. Please call Sam Carter, Regulatory Relations Coordinator, 1-800-536-4192 or Angela Bounds, Business Development Assistant, 1-800-536-4197 with any additional questions.

Orenco Systems®, Incorporated

Orenco Fiberglass Tanks

Approvals Package

VERSION 1.0

Orenco Systems® Incorporated
Changing the Way the World Does Wastewater®
1.800.348.9843
www.orenco.com

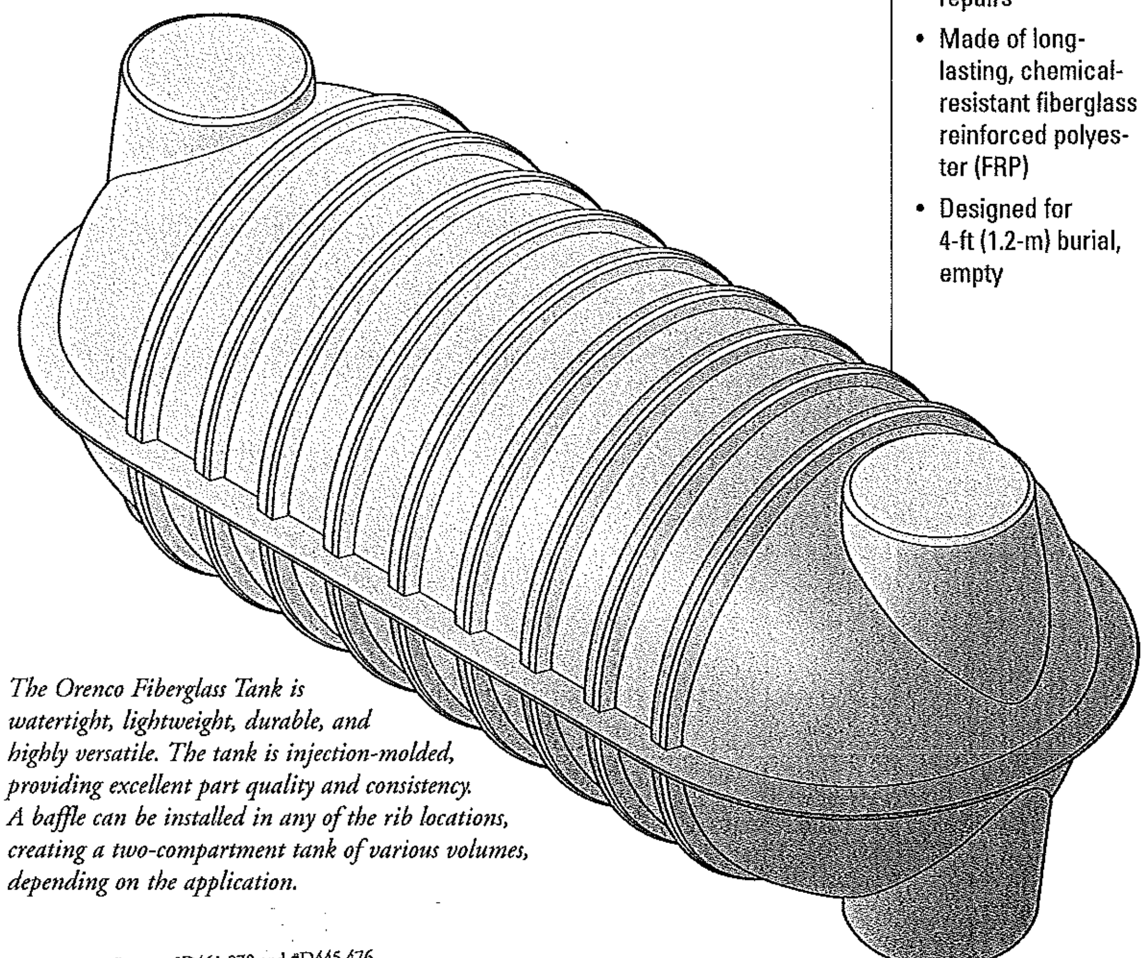
Orenco Fiberglass Tank

1000 gallon (3785 liter); 1500 gallon (5678 liter)

Applications

The watertight Orenco injection-molded Fiberglass Tank* comes in two sizes and has been optimized for use in onsite wastewater collection and treatment systems (residential and commercial) and in community-wide effluent sewer systems. As the tank collects and digests organic matter, it provides primary wastewater treatment, reducing wastewater contaminants by 65–70%.

Note: These tanks have not been tested for use with potable water.



The Orenco Fiberglass Tank is watertight, lightweight, durable, and highly versatile. The tank is injection-molded, providing excellent part quality and consistency. A baffle can be installed in any of the rib locations, creating a two-compartment tank of various volumes, depending on the application.

*Covered by U.S. Patents #D461,870 and #D445,476

Listed by IAPMO/UPC.

Placement in a traffic area requires an engineered traffic-bearing pad. Contact Orenco for details.

Features & Benefits

- 100% watertight, for optimal wastewater treatment; every tank is water tested before shipping
- Injection molded for unmatched part quality and consistency; eliminates costly call-backs for repairs
- Made of long-lasting, chemical-resistant fiberglass reinforced polyester (FRP)
- Designed for 4-ft (1.2-m) burial, empty
- Light enough to transport in a pickup or small trailer and install with a backhoe (lifting brackets attached); no waiting for delivery truck
- No-hassle installation, even on the smallest lots
- Accommodates a baffle wall in any of the rib locations, creating a two-compartment tank of various volumes
- Directly accepts standard Orenco 24-in. (600-mm) diameter PVC risers; adapter available for 30-in. (760-mm) diameter
- Installation and orientation of inlet and outlet easily accomplished with watertight EPDM grommets

(Dimensions and ordering information on back.)

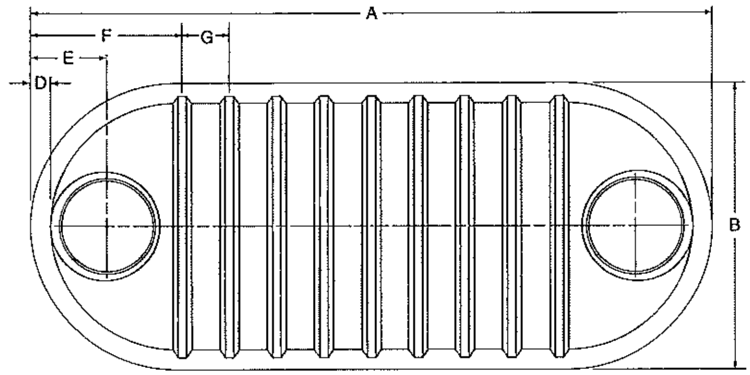
Orenco Systems® Incorporated

Changing the Way the World Does Wastewater®

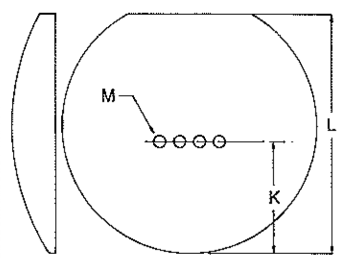
www.orenco.com

APS-TNK-1
Rev. 2.2, © 5/05
Orenco Systems®, Inc.

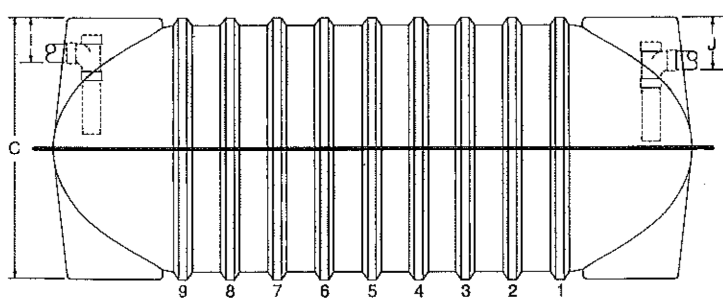
Orenco Fiberglass Tank Nominal Dimensions*



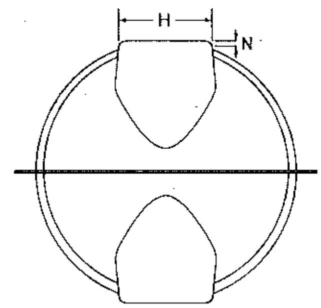
Top View



Baffle Side and Front View (If Applicable)



Side View



End View

Specifications

	1000 gal. (3785 L)	1500 gal. (5678 L)
Dimensions in inches (and millimeters)		
A Length	121.0 (3073)	168.0 (4270)
B Width	72.0 (1830)	72.0 (1830)
C Height	64.5 (1640)	64.5 (1640)
D Flange width	5.5 (140)	5.5 (140)
E End to center of tank access	21.5 (550)	21.5 (550)
F End to first rib	37.0 (940)	37.0 (940)
G Rib spacing	11.6 (295)	11.6 (295)
H Outside diameter of tank access	23.5 (600)	23.5 (600)
I Inlet invert (typical)	11.0 (280)	11.0 (280)
J Outlet invert (typical – if used)	13.0 (330)	13.0 (330)
K Height to pass-through holes (typ.)**	30.0 (760)	30.0 (760)
L Height to top of baffle	60.0 (1520)	60.0 (1520)
M Pass-through hole diameter	3.0 (76)	3.0 (76)
N Riser adapter depth	1.5 (38)	1.5 (38)
Weight in pounds (and kilograms)		
1-compartment (assembled)	320 (145)	470 (213)
2-compartment (assembled)	350 (159)	500 (227)
Volume in gallons (and liters)		
Volume to typical invert of inlet	1086 (4111)	1615 (6112)
Volume to typical invert of outlet	1050 (3974)	1561 (5908)
Total tank volume (approximate)	1210 (4580)	1800 (6813)

* *Detailed drawings and additional technical documentation are available, including volume charts and installation instructions.*

** *Other baffle configurations are available.*

Model Code

T□-□-□/□-□/□-□/□

Riser connections (inlet/outlet):
Blank = accepts 24" riser (no adapter needed)
12 = accepts 12" riser (no adapter needed)
30 = 30" diameter adapter installed

Depth to inverts (inlet/outlet):
Blank = no openings
11"
13"
C = custom; specify

Diameter of access riser openings (inlet side/outlet side):
Blank = no openings
12"
20"
23"
C = custom; specify

Number of compartments and baffle location (ribs 1 through 9):
01 = one compartment
22 = two compartments, rib #2
23 = two compartments, rib #3, etc.

Tank size (gallons):
1000
1500

Tank

To Order

Call Orenco Systems®, Inc., 800-348-9843, for your nearest Distributor.

Orenco's Tank Production Process

Orenco Systems® Incorporated
1-800-348-9843

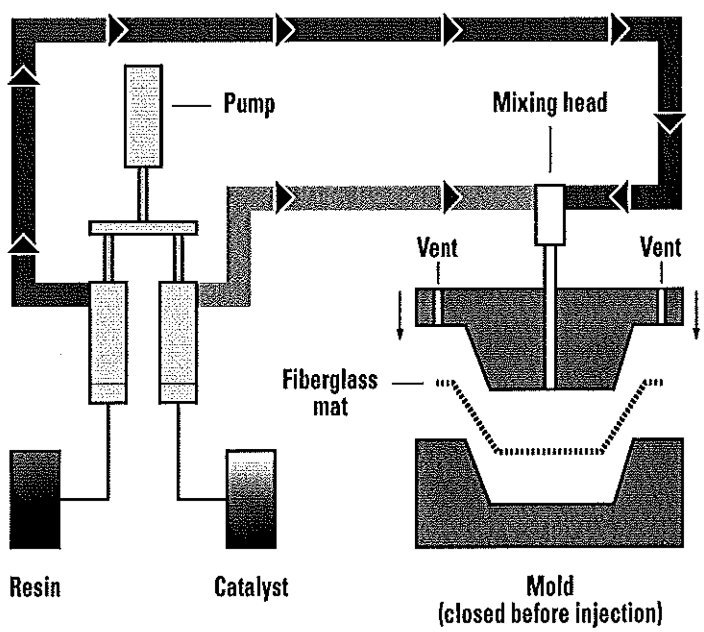
Resin Transfer Molding (RTM)

Orenco Systems, Inc. manufactures fiber-reinforced plastic ("fiberglass") composite tanks using a closed-mold process called *resin transfer molding* (RTM). The diagram below describes how the RTM process works.

Components built with the RTM process are typically superior to conventional spray-up in terms of structural properties, watertightness, and aesthetics. Additionally, since parts are made within a closed mold, part consistency and quality are also superior. Orenco injection-molded RTM tanks only vary in weight by a few pounds.

The closed-mold RTM process is very environment-friendly compared to the conventional spray-up fiberglass process. In fact, RTM is considered by the EPA to be such an environmentally friendly process that its MACT (Maximum Achievable Control Technology) standard for Reinforced Plastics Composite Production does not require additional emissions controls or material limitations for RTM, as it does for virtually every other composite process.

The RTM Process



RTM Process Description:

- Dry reinforcement (fiberglass mat) is laid into the mold.
- The mold is closed and liquid polyester resin is injected into the mold.
- The part is cured in the mold.
- The mold is opened and the part is removed.

Fiberglass Tank Volume Charts

Orenco Systems® Incorporated
1-800-348-9843

Baffle Placement Volume Chart

This document shows various volume measurements for 1000- and 1500-gallon Orenco injection-molded fiberglass septic tanks.

The table below shows the volume split — in gallonage and percentage — between the two compartments of a tank, depending on which rib a baffle is installed in. For example, if a baffle is inserted in Rib 3 in a 1500-gallon tank (as shown in the diagram), the first compartment will have 1126-gallons (63%) and the second compartment will have the remaining volume: 674 gallons (37%).

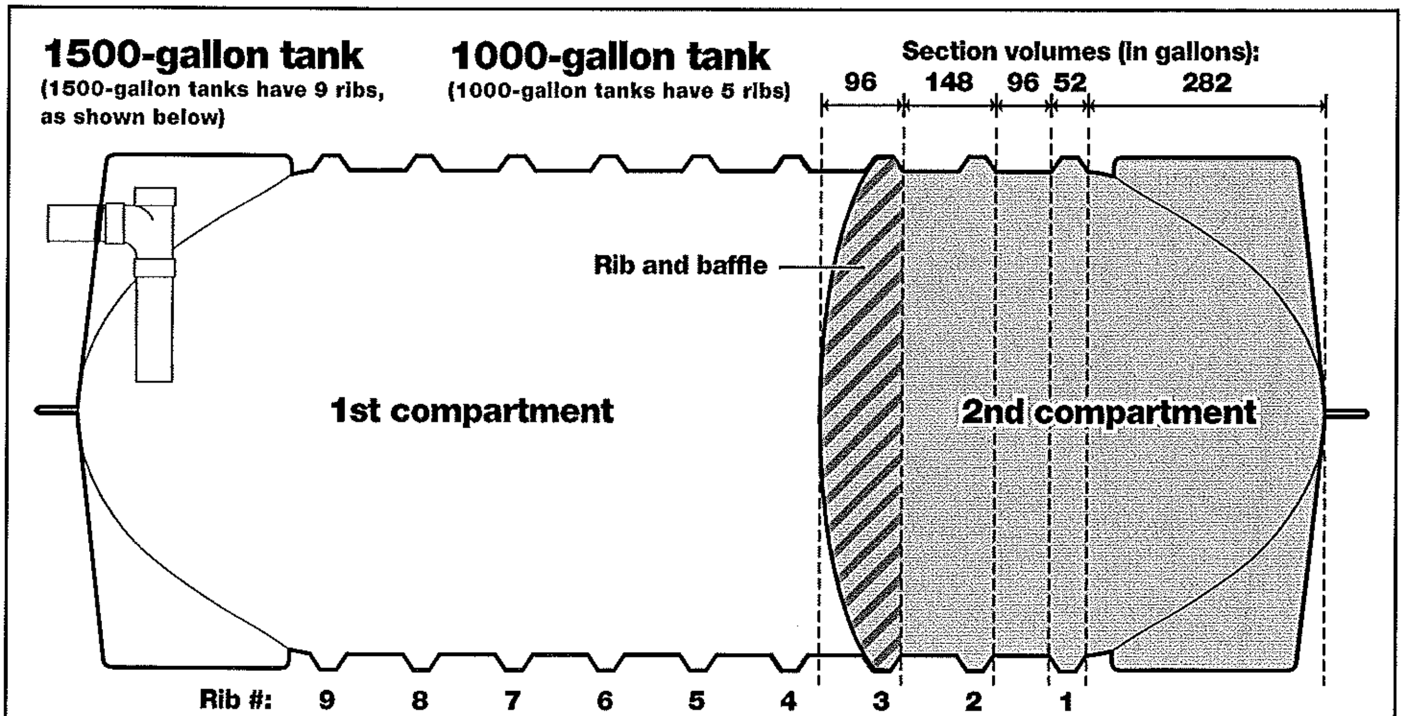
Rib	1000-gallon tank				1500-gallon tank			
	1st compart.		2nd compart.		1st compart.		2nd compart.	
1	832 gal	69%	378 gal	31%	1422 gal	79%	378 gal	21%
2	684 gal	57%	526 gal	43%	1274 gal	71%	526 gal	29%
3	536 gal	44%	674 gal	56%	1126 gal	63%	674 gal	37%
4	388 gal	32%	822 gal	68%	978 gal	54%	822 gal	46%
5	240 gal	20%	970 gal	80%	830 gal	46%	970 gal	54%
6	n/a	n/a	n/a	n/a	682 gal	38%	1118 gal	62%
7	n/a	n/a	n/a	n/a	534 gal	30%	1266 gal	70%
8	n/a	n/a	n/a	n/a	386 gal	21%	1414 gal	79%
9	n/a	n/a	n/a	n/a	238 gal	13%	1562 gal	87%

If you would prefer to calculate the volumes cumulatively, especially if you intend to use multiple baffles, here are some important sectional volumes:

Tank end to rib:	282 gallons
Rib:	52 gallons
Midsection (between ribs):	96 gallons
Rib and midsection:	148 gallons
Rib and baffle:	96 gallons

These volumes appear in gallons on the upper right corner of the figure below.

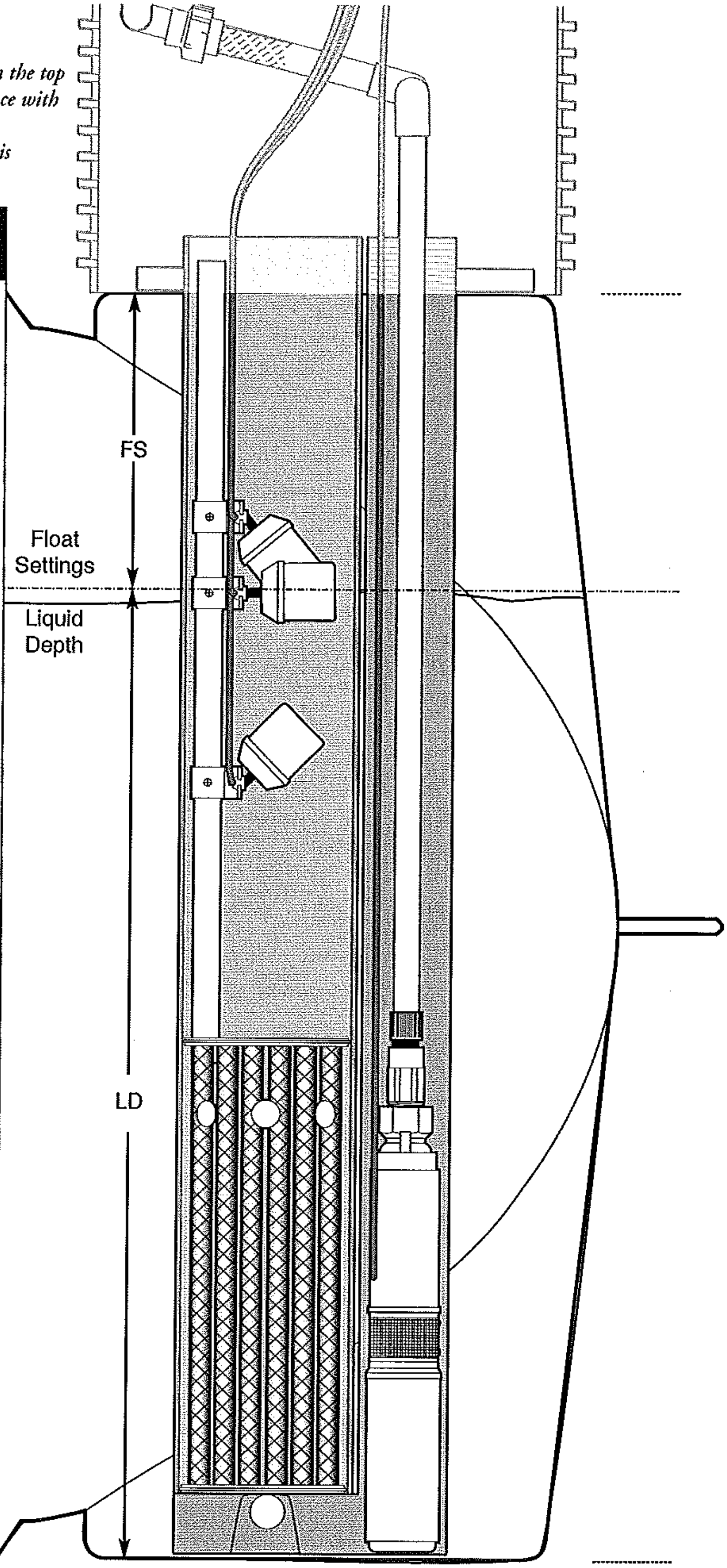
Note: Because the gallonage numbers above are rounded figures, some of the totals reached by adding them together may not match the total volume of the tank.



* *The invert of inlet is typically set 11 inches down from the top of the tank (see Float Setting columns), or in accordance with prevailing state or local regulations.*

** *For gravity discharge applications, the invert of outlet is typically located 13 inches from the top.*

Liquid depth LD (in.)	1500-gallon tank Float setting FS (in.)	Gallons per inch of depth	Gallons in tank
64	Top	19	1800
63	—	—	—
62	—	—	—
61	—	16	—
60	4	17	1765
59	5	18	1748
58	6	21	1730
57	7	22	1709
56	8	23	1687
55	9	24	1664
54	10	25	1640
53	11*	26	1615
52	12	28	1589
51	13**	29	1561
50	14	30	1532
49	15	31	1502
48	16	32	1471
47	17	32	1439
46	18	33	1407
45	19	34	1374
44	20	35	1340
43	21	35	1305
42	22	36	1270
41	23	36	1234
40	24	36	1198
39	25	36	1162
38	26	37	1126
37	27	37	1089
36	28	37	1052
35	29	38	1015
34	30	38	977
33	31	39	939
32	32	39	900
31	33	38	861
30	34	38	823
29	35	37	785
28	36	37	748
27	37	37	711
26	38	36	674
25	39	36	638
24	40	36	602
23	41	36	566
22	42	35	530
21	43	35	495
20	44	34	460
19	45	33	426
18	46	32	393
17	47	32	361
16	48	31	329
15	49	30	298
14	50	29	268
13	51	28	239
12	52	26	211
11	53	25	185
10	54	24	160
9	55	23	136
8	56	22	113
7	57	21	91
6	58	18	70
5	59	17	52
4	60	16	35
3	—	19	—
—	—	—	—
Floor	64	—	0



Tank Approvals Summary

Orenco Systems® Incorporated
1-800-348-9843

Basis for Approvals

Orenco Fiberglass Tank.

Orenco Systems has been researching septic tanks for over 20 years. This research has afforded us the knowledge to design a consistent, watertight, and structurally sound septic tank. The importance of a watertight and structurally sound tank is critical to the success and long-term operation of any onsite treatment system.

Following is a summary of Orenco Fiberglass Tank approvals. Additional supporting information is available. If you have any questions, please call Sam Carter, 1-800-536-4192 or Angela Bounds, 1-800-536-4197.

Documented Approvals and Installations

Orenco Fiberglass tanks have undergone rigorous testing by not only Orenco Systems, Inc, but also by a third-party engineering firm.

Following is a summary of approvals, arranged alphabetically by state, with contact names and phone numbers.

Arizona: Orenco Fiberglass Tanks meet all tank requirements in Arizona, and can installed. Contact: Ed Swanson, Arizona DEQ, (602) 771-4440.

Arkansas: Orenco Fiberglass Tanks were granted approval February 26, 2004. Contact: Fay Boozman, Arkansas DEQ, (501) 661-2000.

Hawaii: Orenco's Fiberglass Tank was granted approval September 4, 2003. Contact: Harold Yee, Hawaii Department of Health, (800) 274-3141.

El Dorado County, CA: Orenco Fiberglass Tanks meet all tank requirements in El Dorado County, and can be installed. Contact: Fred Sanford, (530) 621-7614.

Humboldt County, CA: Orenco Fiberglass Tanks meet all tank requirements in Humboldt County, and can be installed. Contact: David Spinosa, (707) 268-2209.

Marin County, CA: Orenco Fiberglass Tanks meet all tank requirements in Marin County, and can be installed. Contact: Armando Alegria, (415) 499-6907.

Nevada County, CA: Orenco Fiberglass Tanks meet all tank requirements in Nevada County, and can be installed. Contact: Kurtis Zumwalt, (530) 265-1467.

Plumus County, CA: Orenco Fiberglass Tanks were granted approval June 25, 2004. Contact: Gerald Sipe, (530) 283-6355.

Santa Cruz, CA: Orenco Fiberglass Tanks meet all tank requirements in Santa Cruz County, and can be installed. Contact: Richard Wilson, (831) 454-2761.

Port Charles, FL: Orenco Fiberglass Tanks were granted approval for use with the Port Charles STEP System.

Georgia: Orenco Fiberglass Tanks were granted approval January 8, 2004. Contact: Greg Harless, (404) 657-6534.

Idaho: Orenco Fiberglass Tanks were granted approval June 25, 2004. Contact: Barry Burnell, (208) 373-0502.

Massachusetts: Orenco Fiberglass Tanks meet all requirements in Massachusetts and can be installed. Contact: Steve Corr, (617) 292-5920.

Ohio: Orenco's Fiberglass Tank design was granted approval July 2, 2002. Contact: Tom Grigsby, Ohio Department of Health, (614) 644-8663.

Oregon: Orenco's Fiberglass Tank was granted approval December 9, 2002. Contact: Uri Papish, Oregon DEQ, (503) 229-5858.

Rhode Island: Orenco Fiberglass Tanks meet all tank requirements in Texas, and can be installed. Contact: Peter O'Rourke, Rhode Island Department of Environmental Health, (401) 222-4700.

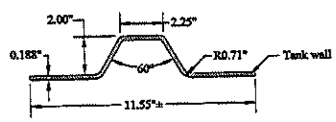
Texas: Orenco Fiberglass Tanks meet all tank requirements in Texas, and can be installed. Contact: Ken Graber, TNRCC, (512) 239-4775.

Vermont: Orenco Fiberglass Tanks were granted approval May 27, 2004. Contact: Frank O'Brien, (802) 241-3822.

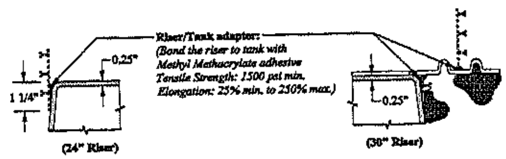
Virginia: Orenco's Fiberglass Tank design was granted approval June 17, 2003. Contact: Don Alexander, Virginia Department of Health, (804) 864-7452.

Washington: The Orenco Fiberglass Tank was granted approval on February 13, 2002. Contact: Virginia Darrell, P.E., (509) 456-2754.

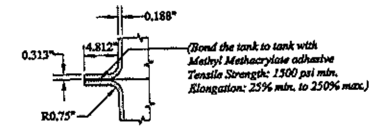
Note:
The details shown are typical. Where applicable: reference Data Submittal sheets for more specific information, and optional uses.



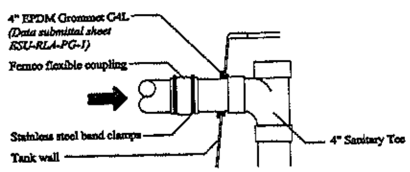
(A/GDS) Fiberglass Tank Rib Detail



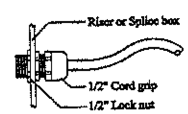
(B/GDS) Tank Riser Attachment Detail



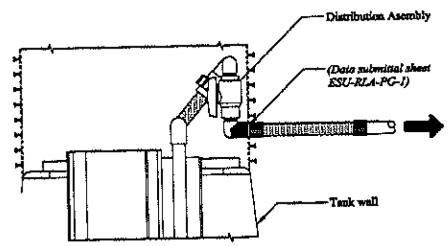
(C/GDS) Fiberglass Tank Mid-Flange Detail



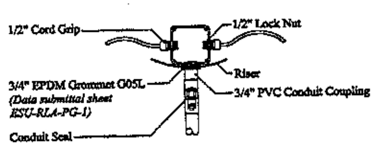
(D/GDS) Typical Inlet/Outlet & Baffle Tee Detail for Fiberglass Tanks



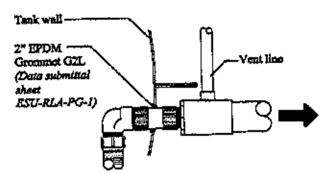
(E/GDS) Strain Relief Detail



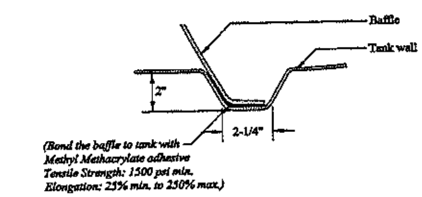
(F/GDS) Typical Pump Outlet Detail for Fiberglass Tanks



(G/GDS) Splice Box Detail



(H/GDS) Typical Siphon Outlet Detail for Fiberglass Tanks



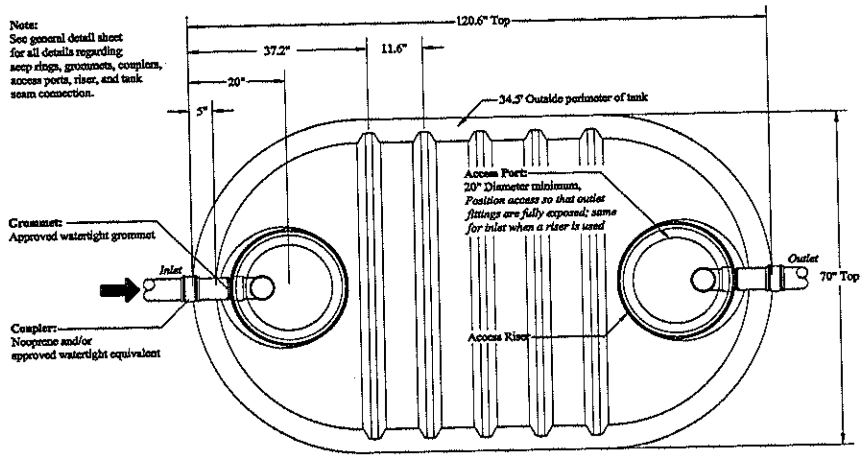
(I/GDS) Fiberglass Tank Baffle Connection

ORENCO SYSTEMS, INC.
814 AIRWAY AVENUE
SUTHERLIN, OR 97479
PHONE: 541-459-4449

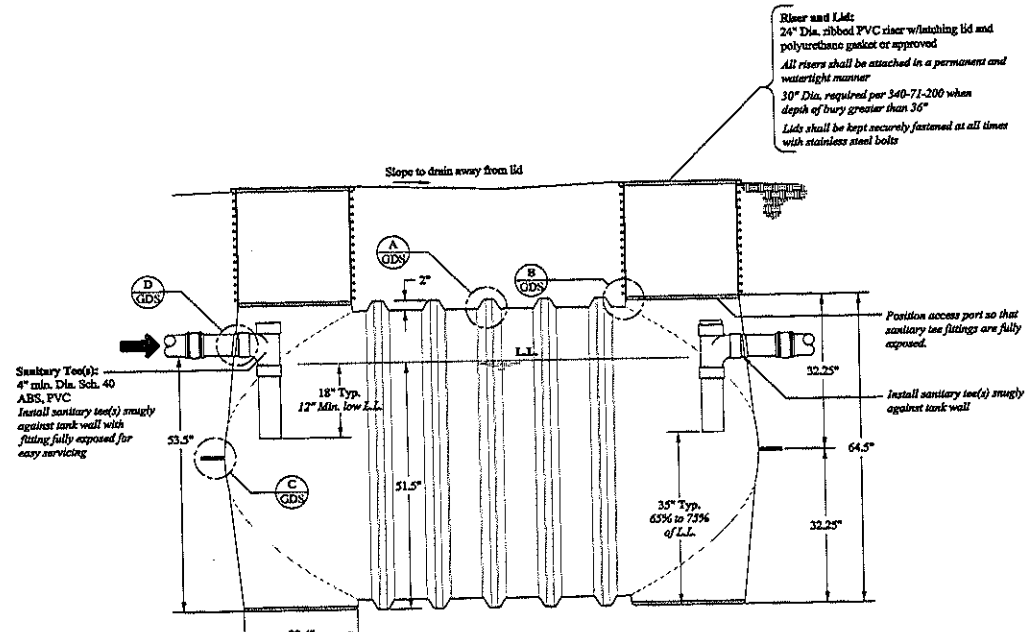
REGISTERED PROFESSIONAL ENGINEER 9634 OREGON JULY 13, 1979 TERRY R. BOUNDS

General Detail Sheet
FRP Tanks

Approved By: TRB P.E.	Designed By: TRB P.E.
Drawing By: CSJ	Drawing #: GDS
Date:	Project #:
Scale: none	Revision #:



Top View



Side View 1000 Gallon Tank

General Notes:

Tank Volumes: Total Volume: 1192 gal±
Operating Volume: 1050 gal± @ 51-1/2"
Unit volume at typical operating depth : 18 gal./in.±

Loads: Top = 500 psf minimum
Lateral Load = 62.4 pcf, EFP
Concentrated Wheel Load = 2500 lb.
The septic tank shall be capable of withstanding long-term hydrostatic loading, in addition to the soil loading, due to a water table maintained at ground surface.
Soil Bearing = 1000 psf (*re-evaluate support base if soil bearing is less or unequal*)

Fiberglass: Method of calcuations:
1. Fiberglass tanks shall be analyzed using finite element analysis for buried structures.
2. Calculations shall address the following:
   - strength
   - buckling
   - deflection of 5% of the tank diameter, based on service load (including long-term deflection lag)
   - buoyancy
3. Performance testing

Resin: polyester (ortho, iso, dcpd)
Reinforcement: Fiberglass (25-35%). The thickness for different regions of the tanks shall be described and shown in drawings for each individual tank.

The laminate properties listed here along with the minimum thickness as shown in the details are considered design minimums that must be maintained during the manufacturing of the tanks. The primary strength properties are listed below:

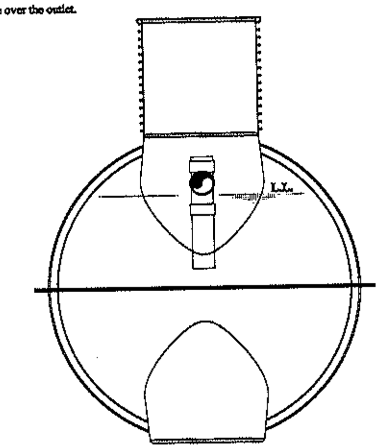
Property	Type I Laminate
Tensile modulus E_t	1,000,000 psi
Flexural modulus E_f	800,000 psi
Shear modulus G	400,000 psi
Ult, Tensile strength F_t	11,000 psi
Ult, Flexural strength F_b	18,000 psi
Ult, compressive strength F_c	21,000 psi
Ult, Shear In-Plane F_s	7,800 psi
Interlaminar Shear F_{is}	1,500 psi

The tank shall be constructed with a glass fiber and resin content specified by the manufacturer and with no exposed glass fibers. Any permanent metal part shall be 300 series stainless steel.

Installation: Installation, bedding, compaction, etc., shall be in strict compliance with the manufacturers standards and state or local rules and or guidlines. All tanks shall be set level on a minimum 4 inch thick compacted sand or approved granular bedding overlying a firm uniform base. The base shall be stable and uniform in order to ensure equal bearing across the tank bottom. Installations with 18 inches or less of ground cover may require additional buoyancy considerations as described in the manufacturers instructions. A minimum cover of 12 inches is required over the tank in areas subject to occasional light wheel loads.

Test: Tanks shall be tested and certified watertight per manufacturers recommendations and or any prevailing rules or guidelines, whichever is more restrictive.

Tank Markings: Place marking on the upper most surface over the outlet.
Liquid capacity: 1000 gal. ±
Max burial depth: 4ft.
Max traffic (wheel): 2500 lbs.
Date manufactured: ________
Permit no.: ________
: ________

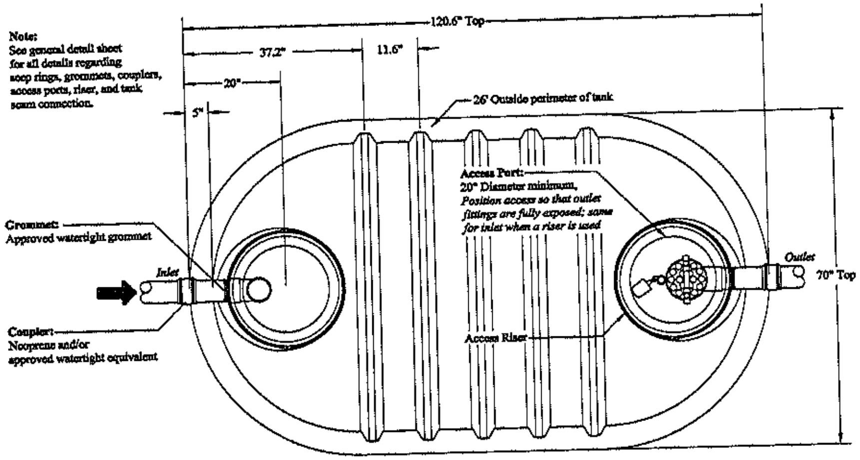


End View

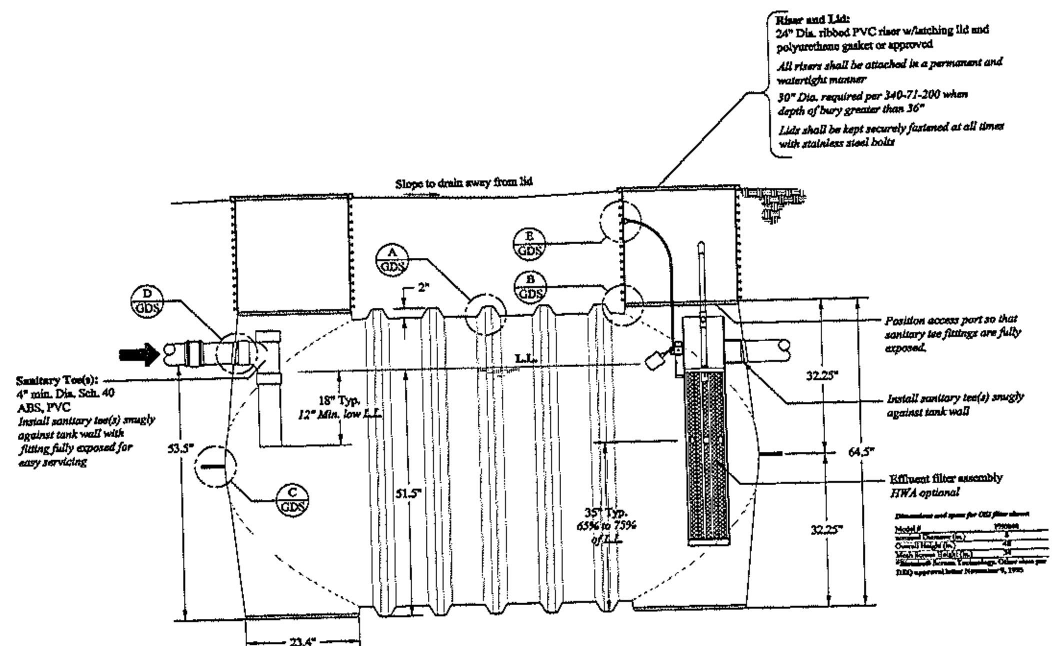
ORENCO SYSTEMS, INC.
814 AIRWAY AVENUE
SUTHERLIN, OR 97479
PHONE: 541-459-4449

Orenco Systems Inc.
Sutherlin, OR
1000 Gallon Septic Tank

Approved By: TRB P.E.	Designed By: TRB P.E.
Drawing By: CSJ	Drawing #: 1 of 4
Date:	Project #:
Scale: 1" = 2'	Revision #:



Top View



Side View 1000 Gallon Tank

General Notes:

Tank Volumes: Total Volume: 1192 gal±
Operating Volume: 1050 gal± @ 51-1/2"
Unit volume at typical operating depth : 18 gal./in.±

Loads: Top = 500 psf minimum
Lateral Load = 62.4 pcf, EFP
Concentrated Wheel Load = 2500 lb.
The septic tank shall be capable of withstanding long-term hydrostatic loading, in addition to the soil loading, due to a water table maintained at ground surface.
Soil Bearing = 1000 psf (*re-evaluate support base if soil bearing is less or unequal*)

Fiberglass: Method of calcuations:
1. Fiberglass tanks shall be analyzed using finite element analysis for buried structures.
2. Calculations shall address the following:
- strength
- buckling
- deflection of 5% of the tank diameter, based on service load (including long-term deflection lag)
- buoyancy

3. Performance testing

Resin: polyester (ortho, iso, dcpd)
Reinforcement: fiberglass (25-35%). The thickness for different regions of the tanks shall be described and shown in drawings for each individual tank.

The laminate properties listed here along with the minimum thickness as shown in the details are considered design minimums that must be maintained during the manufacturing of the tanks. The primary strength properties are listed below:

Property	Type I Laminate
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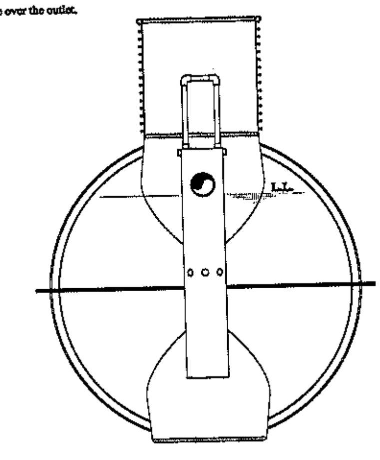
Flexural modulus E_f	800,000 psi
Shear modulus G	400,000 psi
Ult. Tensile strength F_t	11,000 psi
Ult. Flexural strength F_b	18,000 psi
Ult. compressive strength F_c	21,000 psi
Ult. Shear In-Plane F_s	7,800 psi
Interlaminar Shear F_{is}	1,500 psi

The tank shall be constructed with a glass fiber and resin content specified by the manufacturer and with no exposed glass fibers. Any permanent metal part shall be 300 series stainless steel.

Installation: Installation, bedding, compaction, etc., shall be in strict compliance with the manufacturers standards and state or local rules and or guidlines. All tanks shall be set level on a minimum 4 inch thick compacted sand or approved granular bedding overlying a firm uniform base. The base shall be stable and uniform in order to ensure equal bearing across the tank bottom. Installations with 18 inches or less of ground cover may require additional buoyancy considerations as described in the manufacturers instructions. A minimum cover of 12 inches is required over the tank in areas subject to occasional light wheel loads.

Test: Tanks shall be tested and certified watertight per manufacturers recommendations and or any prevailing rules or guidelines, whichever is more restrictive.

Tank Markings: Place marking on the upper most surface over the outlet.
Liquid capacity: 1000 gal. ±
Max burial depth: 4ft.
Max traffic (wheel): 2500 lbs.
Date manufactured: ________
Permit no.: ________
: ________

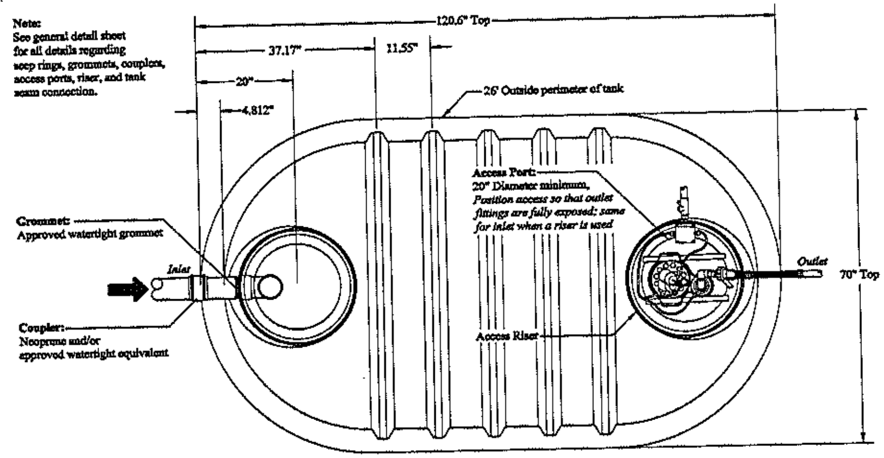


End View

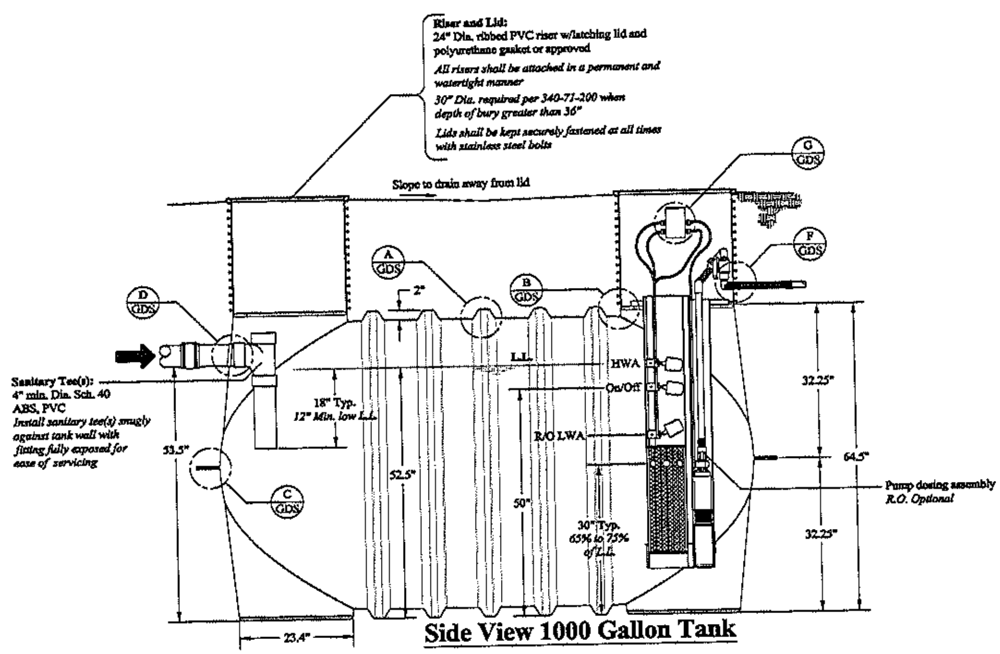
ORENCO SYSTEMS, INC.
814 AIRWAY AVENUE
SUTHERLIN, OR 97479
PHONE: 541-459-4449

Orenco Systems Inc.
Sutherlin, OR
1000 Gallon Septic Tank

Approved By: TRB P.E.	Designed By: TRB P.E.
Drawing By: CSJ	Drawing #: 2 of 4
Date:	Project #:
Scale: 1" = 2'	Revision #:



Top View



Side View 1000 Gallon Tank

General Notes:

Tank Volumes: Total Volume: 1192 gals.±
Operating Volume: 1024 gals± @ 50"
Unit volume at typical operating depth : 19 gal./in.±

Loads: Top = 500 psf minimum
Lateral Load = 62.4 pcf
Concentrated Wheel Load = 2500 lb.
The septic tank shall be capable of withstanding long-term hydrostatic loading, in addition to the soil loading, due to a water table maintained at ground surface.
Soil Bearing = 1000 psf (*re-evaluate support base if soil bearing is less or unequal*)

Fiberglass: Method of calculations:
1. Fiberglass tanks shall be analyzed using finite element analysis for buried structures.
2. Calculations shall address the following:
- strength
- buckling
- deflection of 5% of the tank diameter, based on service load (including long-term deflection lag)
- buoyancy

3. Performance testing

Resin: polyester (ortho, iso, dcpd)
Reinforcement: Fiberglass (25-35%). The thickness for different regions of the tanks shall be described and shown in drawings for each individual tank.

The laminate properties listed here along with the minimum thickness as shown in the details are considered design minimums that must be maintained during the manufacturing of the tanks. The primary strength properties are listed below:

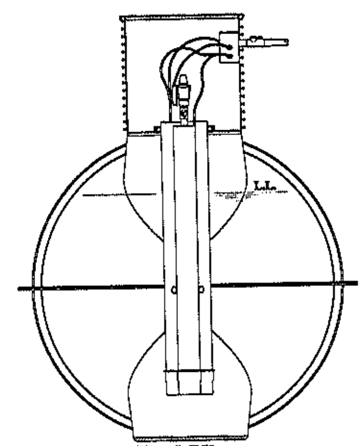
Property	Type I Laminate
Tensile modulus E_t	1,000,000 psi
Flexural modulus E_f	800,000 psi
Shear modulus G	400,000 psi
Ult. Tensile strength F_t	11,000 psi
Ult. Flexural strength F_b	18,000 psi
Ult. compressive strength F_c	21,000 psi
Ult. Shear In-Plane F_s	7,800 psi
Interlaminar Shear F_{is}	1,500 psi

The tank shall be constructed with a glass fiber and resin content specified by the manufacturer and with no exposed glass fibers. Any permanent metal part shall be 300 series stainless steel.

Installation: Installation, bedding, compaction, etc., shall be in strict compliance with the manufacturers standards and state or local rules and or guidelines. All tanks shall be set level on a minimum 4 inch thick compacted sand or approved granular bedding overlying a firm uniform base. The base shall be stable and uniform in order to ensure equal bearing across the tank bottom. Installations with 18 inches or less of ground cover may require additional buoyancy considerations as described in the manufacturers instructions. A minimum cover of 12 inches is required over the tank in areas subject to occasional light wheel loads.

Test: Tanks shall be tested and certified watertight per manufacturers recommendations and or any prevailing rules or guidelines, whichever is more restrictive.

Tank Markings: Place marking on the upper most surface over the outlet.
Liquid capacity: 1000 gal. ±
Max burial depth: 4ft.
Max traffic (wheel): 2500 lbs.
Date manufactured: ______
Permit no.: ______

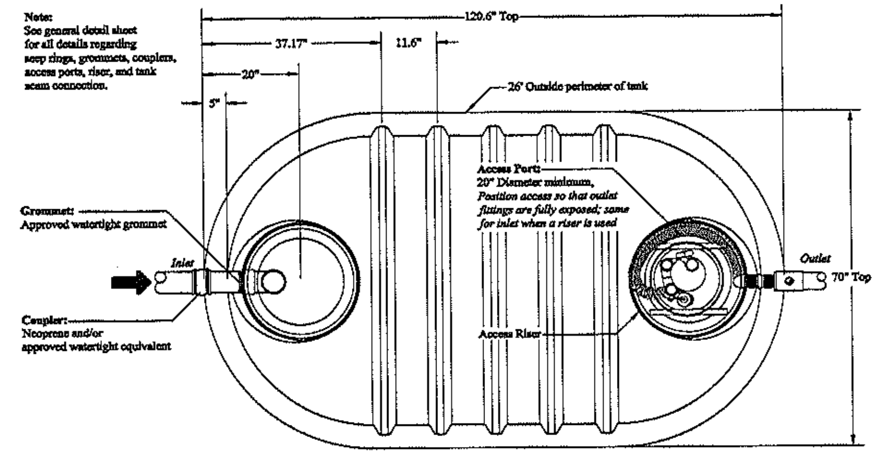


End View

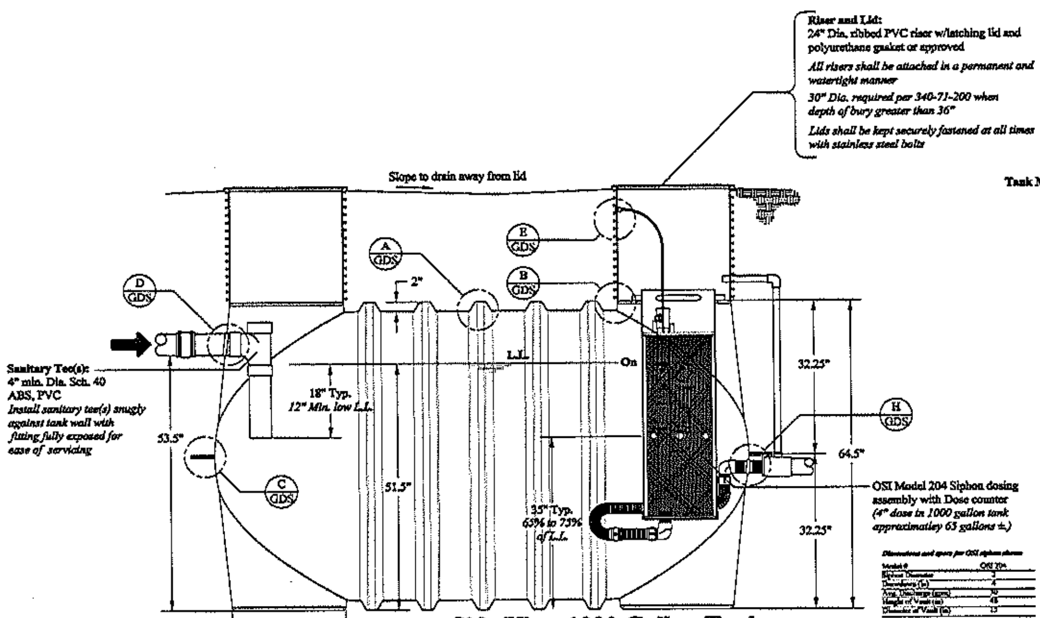
ORENCO SYSTEMS, INC.
814 AIRWAY AVENUE
SUTHERLIN, OR 97479
PHONE: 541-459-4449

Orenco Systems Inc.
Sutherlin, OR
1000 Gallon Dosing Septic Tank

Approved By: TRB P.E.	Designed By: TRB P.E.
Drawing By: CSJ	Drawing #: 3 of 4
Date:	Project #:
Scale: 1" = 2'	Revision #:



Top View



Side View 1000 Gallon Tank

General Notes:

Tank Volumes: Total Volume: 1192 gal±
Operating Volume: 1050 gal± @ 51-1/2"
Unit volume at typical operating depth : 18 gal./in.±

Loads: Top = 500 psf minimum
Lateral Load = 62.4 pcf
Concentrated Wheel Load = 2500 lb.
The septic tank shall be capable of withstanding long-term hydrostatic loading, in addition to the soil loading, due to a water table maintained at ground surface.
Soil Bearing = 1000 psf (*re-evaluate support base if soil bearing is less or unequal*)

Fiberglass: Method of calculations:
1. Fiberglass tanks shall be analyzed using finite element analysis for buried structures.
2. Calculations shall address the following:
- strength
- buckling
- deflection of 5% of the tank diameter, based on service load (including long-term deflection lag)
- buoyancy

3. Performance testing

Resin: polyester (ortho, iso, dcpd)
Reinforcement: Fiberglass (25-35%). The thickness for different regions of the tanks shall be described and shown in drawings for each individual tank.

The laminate properties listed here along with the minimum thickness as shown in the details are considered design minimums that must be maintained during the manufacturing of the tanks. The primary strength properties are listed below:

Property	Type I Laminate
Tensile modulus E_t	1,000,000 psi
Flexural modulus E_f	800,000 psi
Shear modulus G	400,000 psi
Ult. Tensile strength F_t	11,000 psi
Ult. Flexural strength F_b	18,000 psi
Ult. compressive strength F_c	21,000 psi
Ult. Shear In-Plane F_s	7,800 psi
Interlaminar Shear F_{is}	1,500 psi

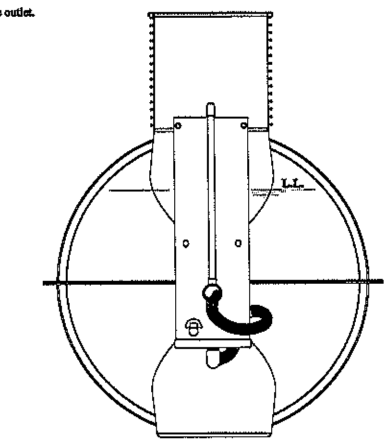
Installation: The tank shall be constructed with a glass fiber and resin content specified by the manufacturer and with no exposed glass fibers. Any permanent metal part shall be 300 series stainless steel.

Installation, bedding, compaction, etc., shall be in strict compliance with the manufacturers standards and state or local rules and or guidelines. All tanks shall be set level on a minimum 4 inch thick compacted sand or approved granular bedding overlying a firm uniform base. The base shall be stable and uniform in order to ensure equal bearing across the tank bottom. Installations with 18 inches or less of ground cover may require additional buoyancy considerations as described in the manufacturers instructions. A minimum cover of 12 inches is required over the tank in areas subject to occasional light wheel loads.

Test: Tanks shall be tested and certified watertight per manufacturers recommendations and or any prevailing rules or guidelines, whichever is more restrictive.

Dosing: Dosing volumes not to exceed maximum limits set by Oregon on-site rules 340-71 and 73. Maximum percent of projected daily flow: 10% to sandfilters or 20% in other applications. Maximum discharge rate from single compartment dosing septic tank 30 gpm. *(Dosing siphons may be used on systems where 20% dose is allowed.) Float and dosing levels may vary within the limits of the onsite rules.*

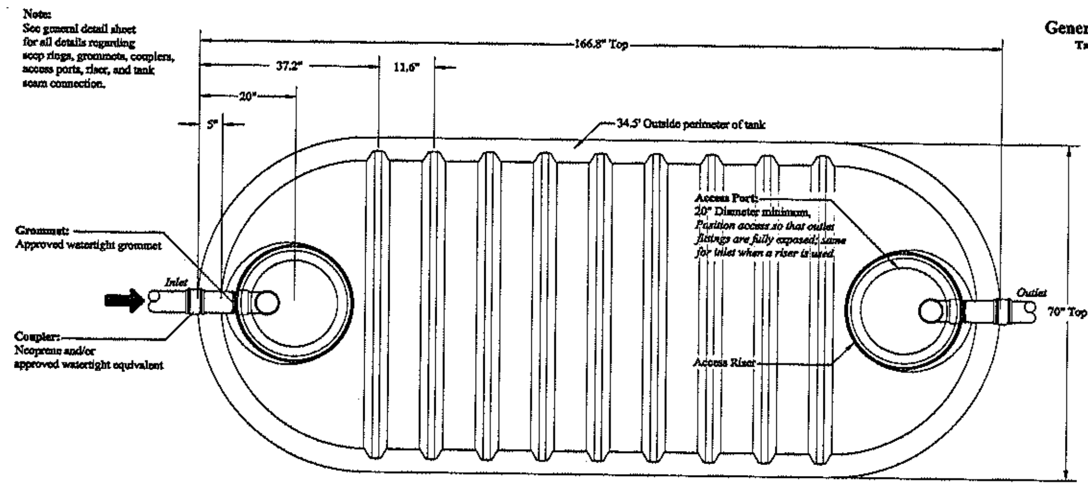
Tank Markings: Place marking on the upper most surface over the outlet.
Liquid capacity: 1000 gal. ±
Max burial depth: 4ft.
Max traffic (wheel): 2500 lbs.
Date manufactured: ______
Permit no.: ______



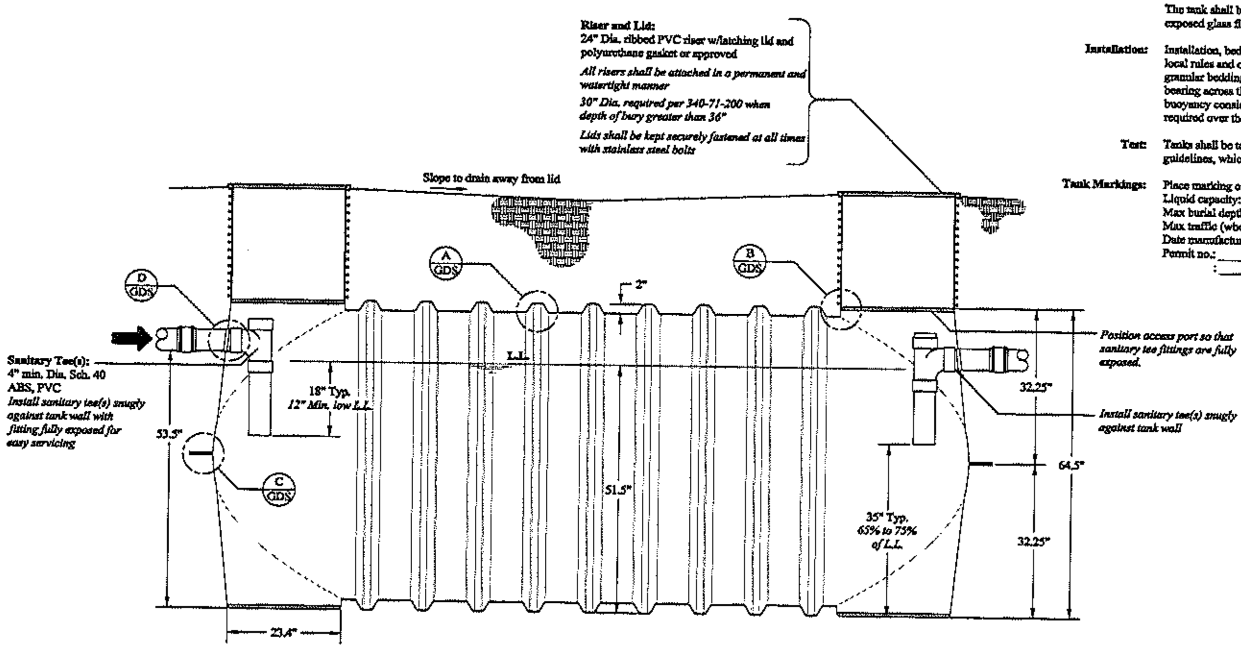
End View

ORENCO SYSTEMS, INC.
814 AIRWAY AVENUE
SUTHERLIN, OR 97479
PHONE: 541-459-4449

Orenco Systems Inc. *Sutherlin, OR* *1000 Gallon Dosing Septic Tank*	
Approved By: TRB P.E.	Designed By: TRB P.E.
Drawing By: CSJ	Drawing #: 4 of 4
Date:	Project #:
Scale: 1" = 2'	Revision #:



Top View



Side View 1500 Gallon Tank

General Notes:

Tank Volumes: Total Volume: 1785 gal±
Operating Volume: 1570 gal± @ 51-1/2"
Unit volume at typical operating depth : 27.5 gal/in.±

Loads: Top = 500 psf minimum
Lateral Load = 62.4 pcf, EFP
Concentrated Wheel Load = 2500 lb.
The septic tank shall be capable of withstanding long-term hydrostatic loading, in addition to the soil loading, due to a water table maintained at ground surface.
Soil Bearing = 1000 psf (*re-evaluate support base if soil bearing is less or unequal*)

Fiberglass: Method of calculations:
1. Fiberglass tanks shall be analyzed using finite element analysis for buried structures.
2. Calculations shall address the following:
- strength
- buckling
- deflection of 5% of the tank diameter, based on service load (including long-term deflection lag)
- buoyancy

3. Performance testing

Resin: polyester (ortho, iso, dcpd)
Reinforcement: Fiberglass (25-35%). The thickness for different regions of the tanks shall be described and shown in drawings for each individual tank.

The laminate properties listed here along with the minimum thickness as shown in the details are considered design minimums that must be maintained during the manufacturing of the tanks. The primary strength properties are listed below:

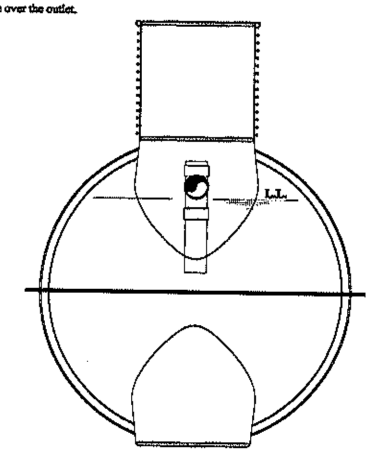
Property	Type I Laminate
Tensile modulus E_T	1,000,000 psi
Flexural modulus E_F	800,000 psi
Shear modulus G	400,000 psi
Ult. Tensile strength F_t	11,000 psi
Ult. Flexural strength F_b	18,000 psi
Ult. compressive strength F_c	21,000 psi
Ult. Shear In-Plane F_s	7,800 psi
Interlaminar Shear F_{is}	1,500 psi

The tank shall be constructed with a glass fiber and resin content specified by the manufacturer and with no exposed glass fibers. Any permanent metal part shall be 300 series stainless steel.

Installation: Installation, bedding, compaction, etc., shall be in strict compliance with the manufacturers standards and state or local rules and or guidlines. All tanks shall be set level on a minimum 4 inch thick compacted sand or approved granular bedding overlying a firm uniform base. The base shall be stable and uniform in order to ensure equal bearing across the tank bottom. Installations with 18 inches or less of ground cover may require additional buoyancy considerations as described in the manufacturers instructions. A minimum cover of 12 inches is required over the tank in areas subject to occasional light wheel loads.

Test: Tanks shall be tested and certified watertight per manufacturers recommendations and or any prevailing rules or guidelines, whichever is more restrictive.

Tank Markings: Place marking on the upper most surface over the outlet.
Liquid capacity: 1500 gal. ±
Max burial depth: 4ft.
Max traffic (wheel): 2500 lbs.
Date manufactured: ______
Permit no.: ______
: ______

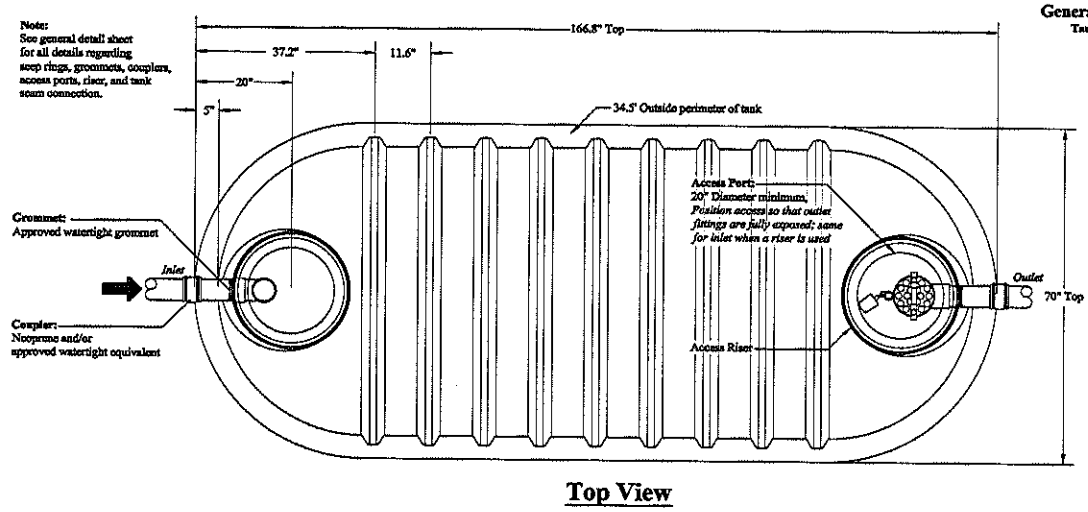


End View

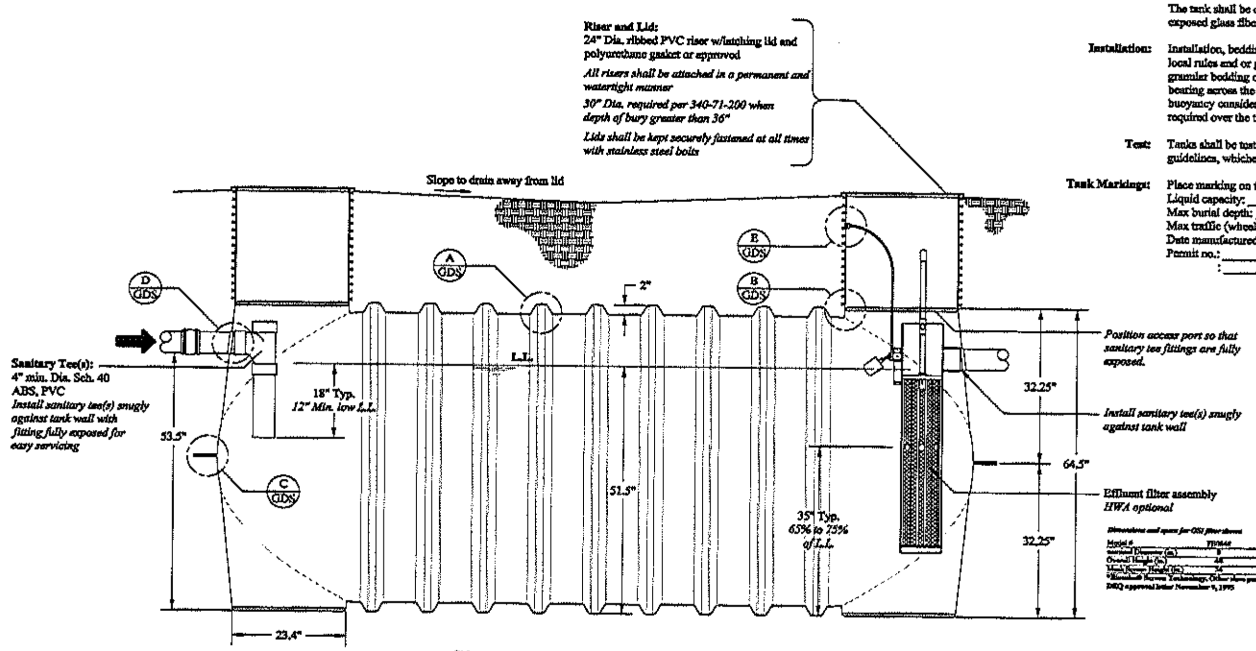
ORENCO SYSTEMS, INC.
814 AIRWAY AVENUE
SUTHERLIN, OR 97479
PHONE: 541-459-4449

Orenco Systems Inc.
Sutherlin, OR
1500 Gallon Septic Tank

Approved By: TRB P.E.	Designed By: TRB P.E.
Drawing By: CSJ	Drawing #: 1 of 7
Date:	Project #:
Scale: 1" = 2'	Revision #:



Top View



Side View 1500 Gallon Tank

General Notes:

Tank Volumes: Total Volume: 1785 gal±
Operating Volume: 1570 gal± @ 51-1/2"
Unit volume at typical operating depth : 27.5 gal./in.±

Loads: Top = 500 psf minimum
Lateral Load = 62.4 pcf, EFP
Concentrated Wheel Load = 2500 lb.
The septic tank shall be capable of withstanding long-term hydrostatic loading, in addition to the soil loading, due to a water table maintained at ground surface.
Soil Bearing = 1000 psf (*re-evaluate support base if soil bearing is less or unequal*)

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- deflection of 5% of the tank diameter, based on service load (including long-term deflection lag)
- buoyancy
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Ult, Shear In-Plane F_s	7,800 psi
Interlaminar Shear F_{is}	1,500 psi

The tank shall be constructed with a glass fiber and resin content specified by the manufacturer and with no exposed glass fibers. Any permanent metal part shall be 300 series stainless steel.

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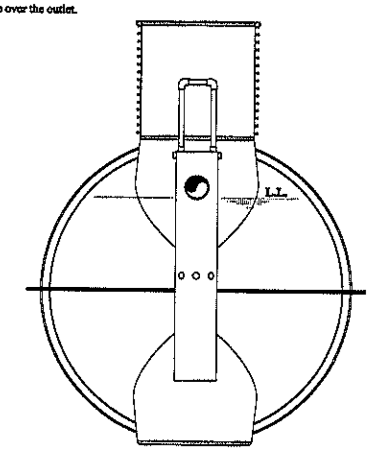
Test: Tanks shall be tested and certified watertight per manufacturers recommendations and or any prevailing rules or guidelines, whichever is more restrictive.

Tank Markings: Place marking on the upper most surface over the outlet.
Liquid capacity: 1500 gal. ±
Max burial depth: 4ft.
Max traffic (wheel): 2500 lbs.
Date manufactured: ________
Permit no.: ________
: ________

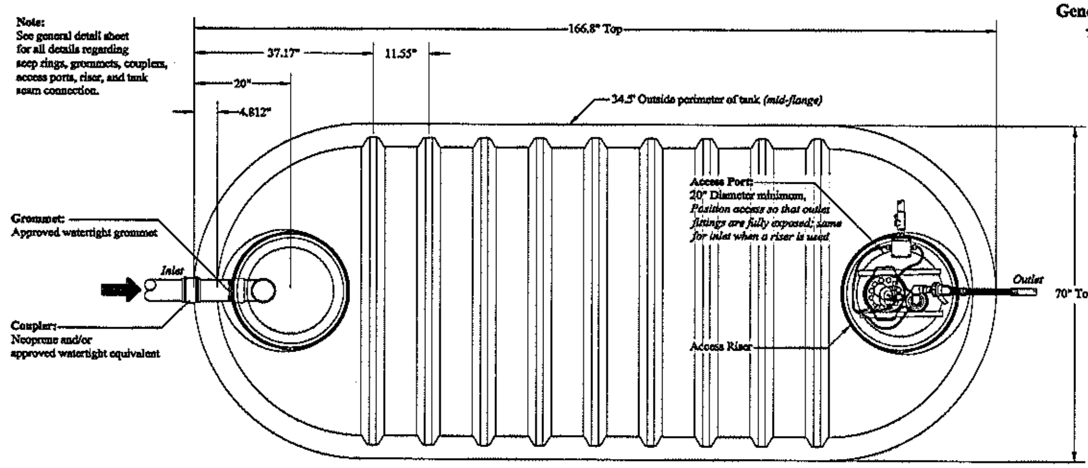


End View

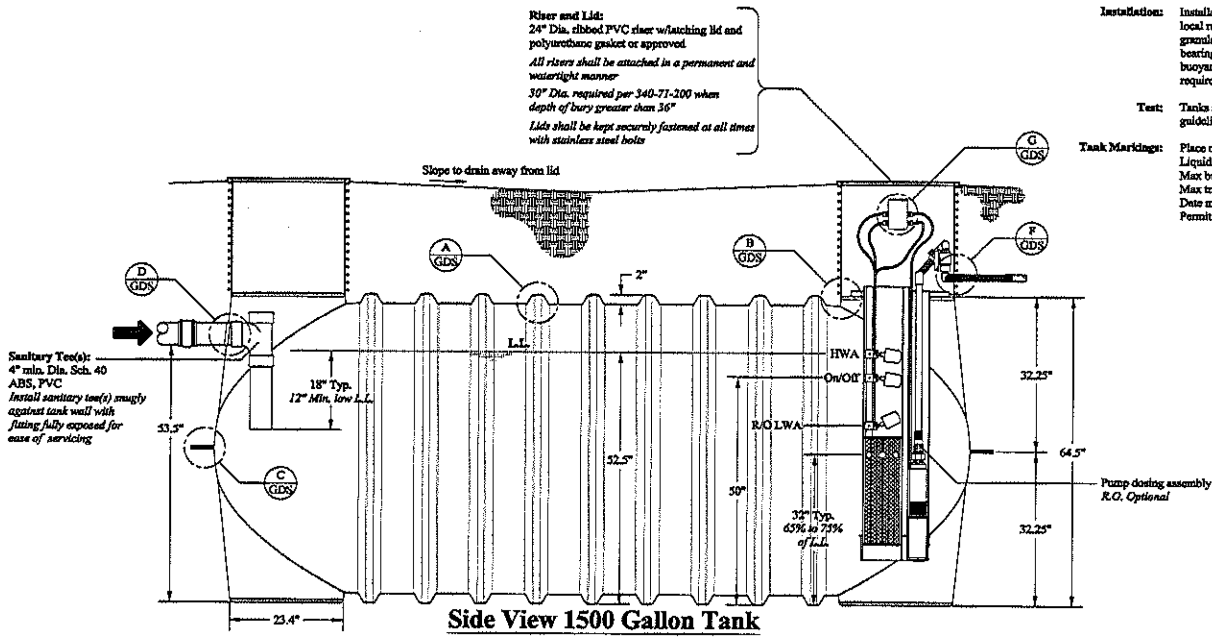
ORENCO SYSTEMS, INC.
814 AIRWAY AVENUE
SUTHERLIN, OR 97479
PHONE: 541-459-4449

Orenco Systems Inc.
Sutherlin, OR
1500 Gallon Septic Tank

Approved By: TRB P.E.	Designed By: TRB P.E.
Drawing By: CSJ	Drawing #: 2 of 7
Date:	Project #:
Scale: 1" = 2'	Revision #:



Top View



Side View 1500 Gallon Tank

General Notes:

Tank Volumes: Total Volume: 1785 gal±
Operating Volume: 1537 gal± @ 50"
Unit volume at typical operating depth : 27.5 gal./in.±

Loads: Top = 500 psf minimum
Lateral Load = 62.4 pcf
Concentrated Wheel Load = 2500 lb.
The septic tank shall be capable of withstanding long-term hydrostatic loading, in addition to the soil loading, due to a water table maintained at ground surface.
Soil Bearing = 1000 psf (*re-evaluate support base if soil bearing is less or unequal*)

Fiberglass: Method of calculations:
1. Fiberglass tanks shall be analyzed using finite element analysis for buried structures.
2. Calculations shall address the following:
- strength
- buckling
- deflection of 5% of the tank diameter, based on service load (including long-term deflection lag)
- buoyancy

3. Performance testing

Resin: polyester (ortho, iso, dcpd)
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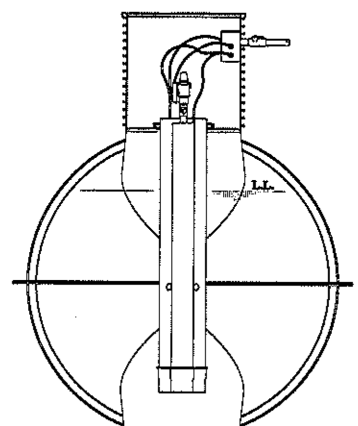
Flexural modulus E_f	800,000 psi
Shear modulus G	400,000 psi
Ult. Tensile strength F_t	11,000 psi
Ult. Flexural strength F_b	18,000 psi
Ult. compressive strength F_c	21,000 psi
Ult. Shear In-Plane F_s	7,800 psi
Interlaminar Shear F_{is}	1,500 psi

The tank shall be constructed with a glass fiber and resin content specified by the manufacturer and with no exposed glass fibers. Any permanent metal part shall be 300 series stainless steel.

Installation: Installation, bedding, compaction, etc., shall be in strict compliance with the manufacturers standards and state or local rules and or guidelines. All tanks shall be set level on a minimum 4 inch thick compacted sand or approved granular bedding overlying a firm uniform base. The base shall be stable and uniform in order to ensure equal bearing across the tank bottom. Installations with 18 inches or less of ground cover may require additional buoyancy considerations as described in the manufacturers instructions. A minimum cover of 12 inches is required over the tank in areas subject to occasional light wheel loads.

Test: Tanks shall be tested and certified watertight per manufacturers recommendations and or any prevailing rules or guidelines, whichever is more restrictive.

Tank Markings: Place marking on the upper most surface over the outlet.
Liquid capacity: 1500 gal. ±
Max burial depth: 4ft.
Max traffic (wheel): 2500 lbs.
Date manufactured: ______
Permit no.: ______
: ______

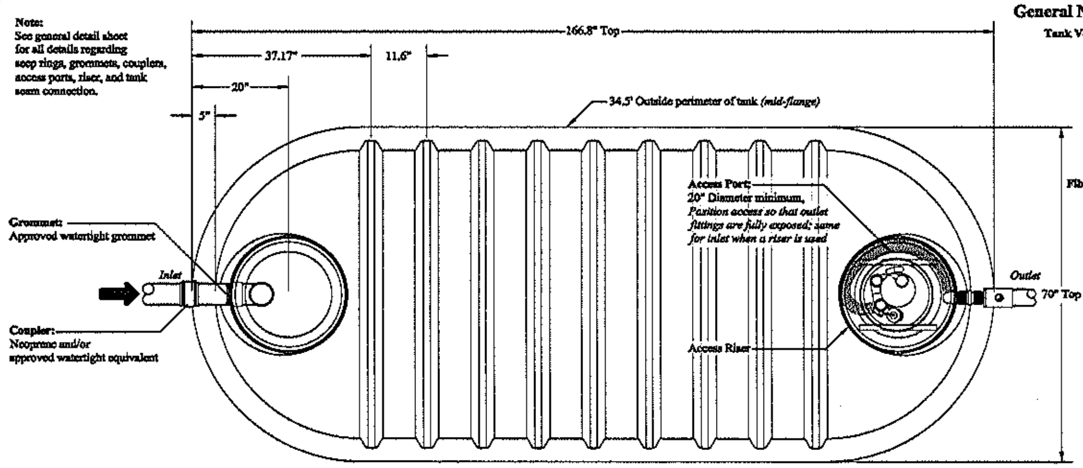


End View

ORENCO SYSTEMS, INC.
814 AIRWAY AVENUE
SUTHERLIN, OR 97479
PHONE: 541-459-4449

Orenco Systems Inc.
Sutherlin, OR
1500 Gallon Dosing Septic Tank

Approved By: TRB P.E.	Designed By: TRB P.E.
Drawing By: CSJ	Drawing #: 3 of 7
Date:	Project #:
Scale: 1" = 2'	Revision #:



Top View

General Notes:

Tank Volumes: Total Volume: 1785 gal± \
Operating Volume: 1570 gal± @ 51-1/2" \
Unit volume at typical operating depth : 27.5 gal./in.±

Loads: Top = 500 psf minimum \
Lateral Load = 62.4 pcf \
Concentrated Wheel Load = 2500 lb. \
The septic tank shall be capable of withstanding long-term hydrostatic loading, in addition to the soil loading, due to a water table maintained at ground surface. \
Soil Bearing = 1000 psf (*re-evaluate support base if soil bearing is less or unequal*)

Fiberglass: Method of calculations:
1. Fiberglass tanks shall be analyzed using finite element analysis for buried structures.
2. Calculations shall address the following:
   - strength
   - buckling
   - deflection of 5% of the tank diameter, based on service load (including long-term deflection lag)
   - buoyancy
3. Performance testing

Resin: polyester (ortho, iso, dcpd) \
Reinforcement: Fiberglass (25-35%). The thickness for different regions of the tanks shall be described and shown in drawings for each individual tank.

The laminate properties listed here along with the minimum thickness as shown in the details are considered design minimums that must be maintained during the manufacturing of the tanks. The primary strength properties are listed below:

Property	Type I Laminate
Tensile modulus E_t	1,000,000 psi
Flexural modulus E_f	800,000 psi
Shear modulus G	400,000 psi
Ult. Tensile strength F_t	11,000 psi
Ult. Flexural strength F_b	18,000 psi
Ult. compressive strength F_c	21,000 psi
Ult. Shear In-Plane F_s	7,800 psi
Interlaminar Shear F_{is}	1,500 psi

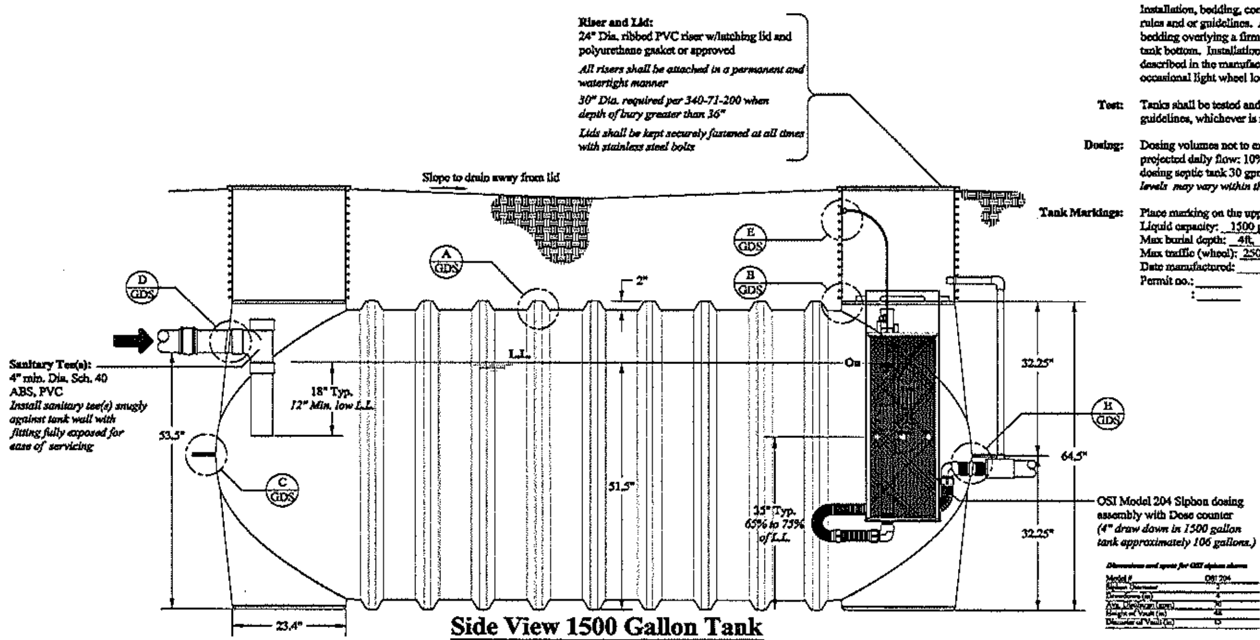
Installation: The tank shall be constructed with a glass fiber and resin content specified by the manufacturer and with no exposed glass fibers. Any permanent metal part shall be 300 series stainless steel.

Installation, bedding, compaction, etc., shall be in strict compliance with the manufacturers standards and state or local rules and or guidelines. All tanks shall be set level on a minimum 4 inch thick compacted sand or approved granular bedding overlying a firm uniform base. The base shall be stable and uniform in order to ensure equal bearing across the tank bottom. Installations with 18 inches or less of ground cover may require additional buoyancy considerations as described in the manufacturers instructions. A minimum cover of 12 inches is required over the tank in areas subject to occasional light wheel loads.

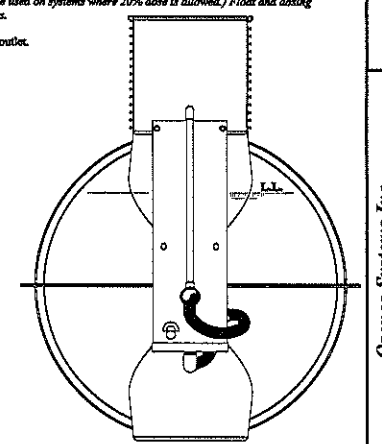
Test: Tanks shall be tested and certified watertight per manufacturers recommendations and or any prevailing rules or guidelines, whichever is more restrictive.

Dosing: Dosing volumes not to exceed maximum limits set by Oregon on-site rules 340-71 and 73. Maximum percent of projected daily flow: 10% to sandfilters or 20% in other applications. Maximum discharge rate from single compartment dosing septic tank 30 gpm. *(Dosing siphons may be used on systems where 20% dose is allowed.) Float and dosing levels may vary within the limits of the onsite rules.*

Tank Markings: Place marking on the upper most surface over the outlet. \
Liquid capacity: 1500 gal. ± \
Max burial depth: 4ft. \
Max traffic (wheel): 2500 lbs. \
Date manufactured: _______ \
Permit no.: _______ \
: _______



Side View 1500 Gallon Tank



End View

ORENCO SYSTEMS, INC.
814 AIRWAY AVENUE
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Orenco Systems Inc.
Sutherlin, OR
1500 Gallon Dosing Septic Tank

Approved By: TRB P.E.	Designed By: TRB P.E.
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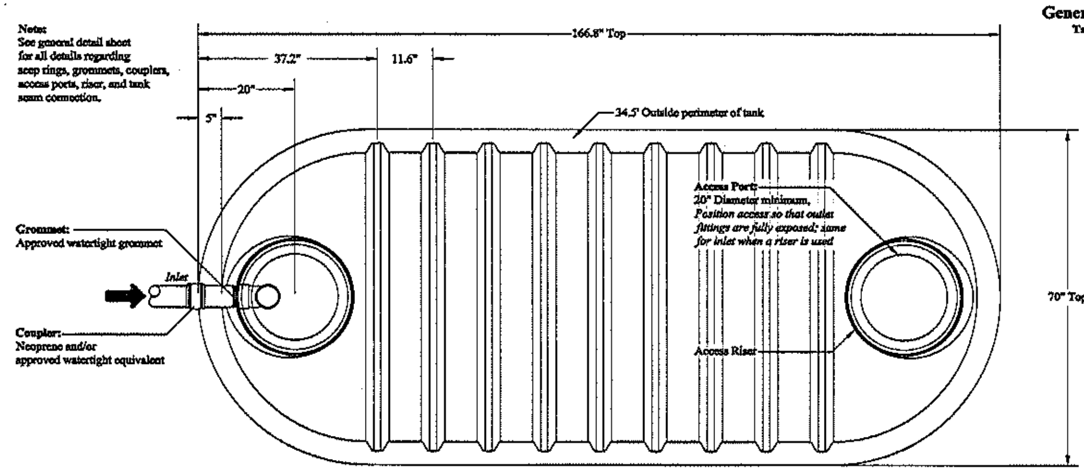
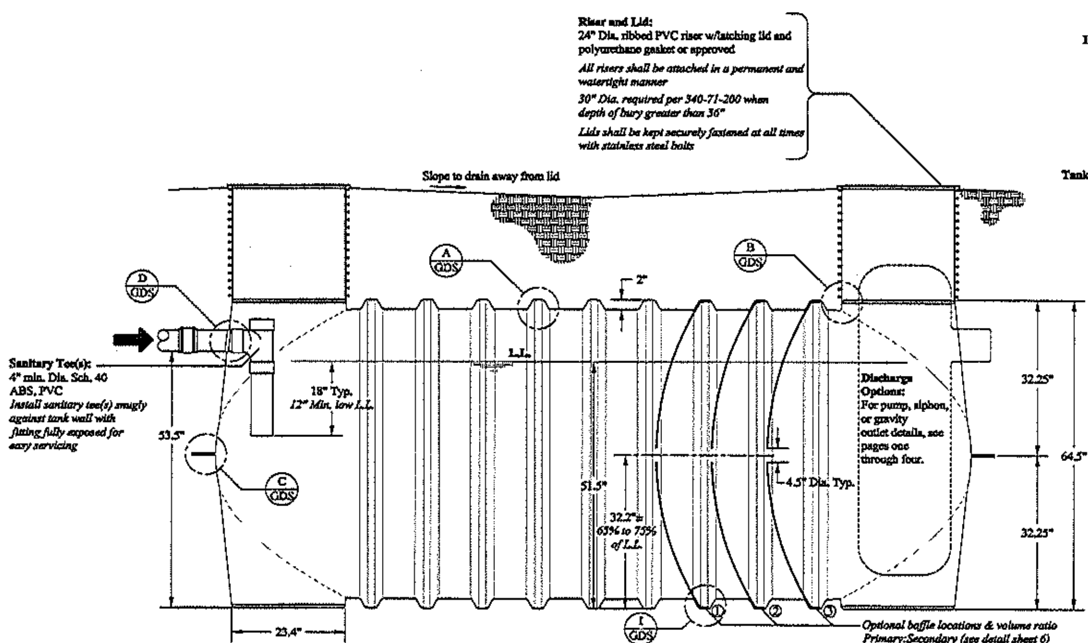


Top View



Side View 1500 Gallon Tank

General Notes:

Tank Volumes: Total Volume: 1785 gal±
Operating Volume: 1570 gal± @ 51-1/2"
Unit volume at typical operating depth : 27.5 gal./in.±

Loads: Top = 500 psf minimum
Lateral Load = 62.4 pcf, EFP
Concentrated Wheel Load = 2500 lb.
The septic tank shall be capable of withstanding long-term hydrostatic loading, in addition to the soil loading, due to a water table maintained at ground surface.
Soil Bearing = 1000 psf (*re-evaluate support base if soil bearing is less or unequal*)

Fiberglass: Method of calcuations:
1. Fiberglass tanks shall be analyzed using finite element analysis for buried structures.
2. Calculations shall address the following:
- strength
- buckling
- deflection of 5% of the tank diameter, based on service load (including long-term deflection lag)
- buoyancy

3. Performance testing

Resin: polyester (ortho, iso, dcpd)
Reinforcement: Fiberglass (25-35%). The thickness for different regions of the tanks shall be described and shown in drawings for each individual tank.

The laminate properties listed here along with the minimum thickness as shown in the details are considered design minimums that must be maintained during the manufacturing of the tanks. The primary strength properties are listed below:

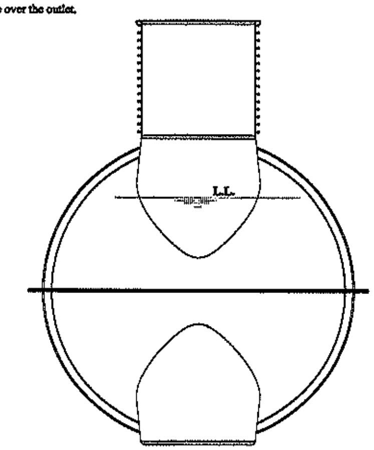
Property	Type I Laminate
Tensile modulus E_t	1,000,000 psi
Flexural modulus E_f	800,000 psi
Shear modulus G	400,000 psi
Ult. Tensile strength F_t	11,000 psi
Ult. Flexural strength F_b	18,000 psi
Ult. compressive strength F_c	21,000 psi
Ult. Shear In-Plane F_s	7,800 psi
Interlaminar Shear F_{is}	1,500 psi

The tank shall be constructed with a glass fiber and resin content specified by the manufacturer and with no exposed glass fibers. Any permanent metal part shall be 300 series stainless steel.

Installation: Installation, bedding, compaction, etc., shall be in strict compliance with the manufacturers standards and state or local rules and or guidlines. All tanks shall be set level on a minimum 4 inch thick compacted sand or approved granular bedding overlying a firm uniform base. The base shall be stable and uniform in order to ensure equal bearing across the tank bottom. Installations with 18 inches or less of ground cover may require additional buoyancy considerations as described in the manufacturers instructions. A minimum cover of 12 inches is required over the tank in areas subject to occasional light wheel loads.

Test: Tanks shall be tested and certified watertight per manufacturers recommendations and or any prevailing rules or guidelines, whichever is more restrictive.

Tank Markings: Place marking on the upper most surface over the outlet.
Liquid capacity: 1500 gal. ±
Max burial depth: 4ft.
Max traffic (wheel): 2500 lbs.
Date manufactured: ________
Permit no.: ________
: ________



End View

ORENCO SYSTEMS, INC.
814 AIRWAY AVENUE
SUTHERLIN, OR 97479
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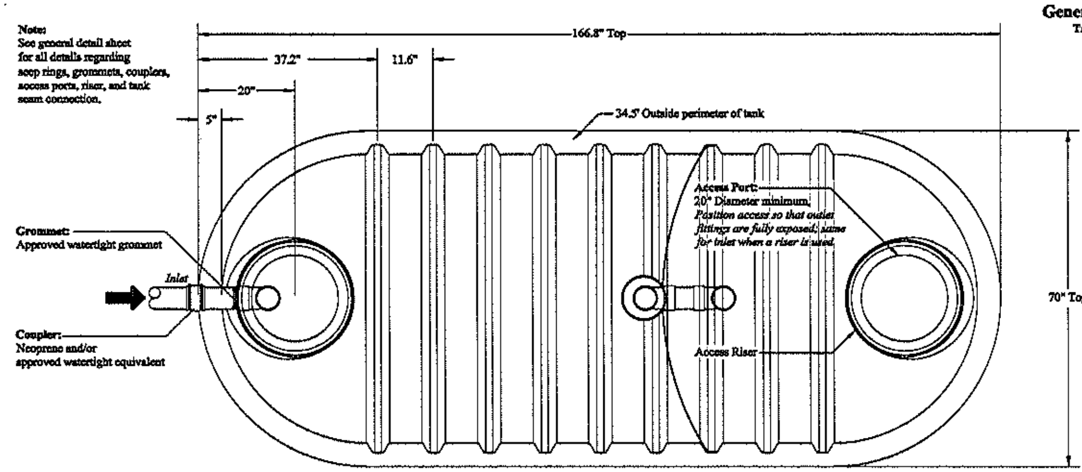
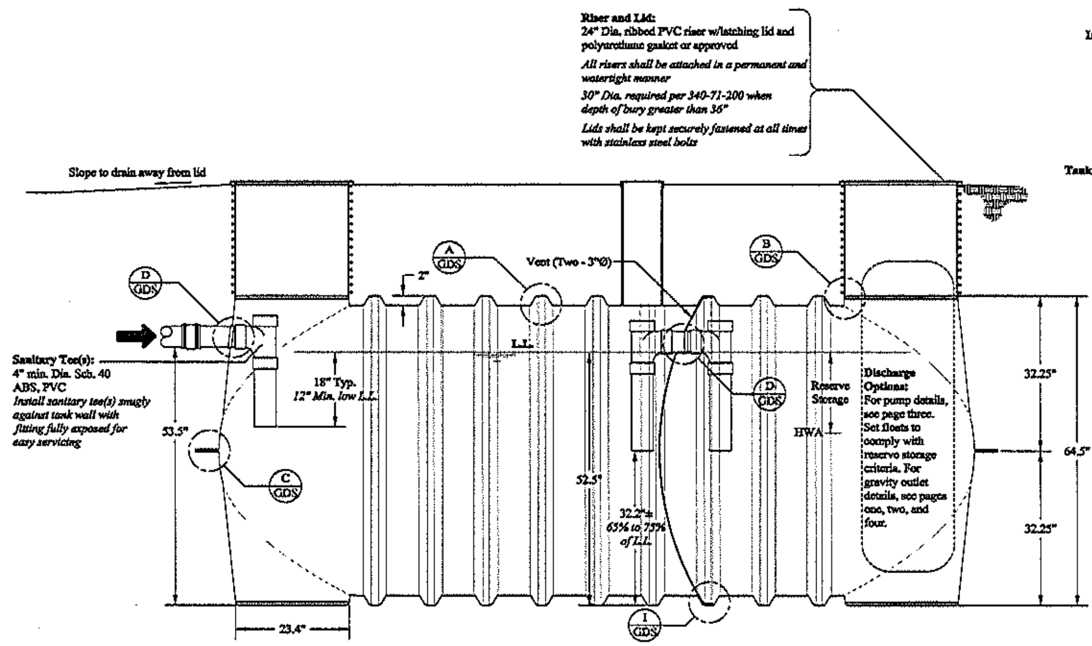
Orenco Systems Inc.
Sutherlin, OR
1500 Gallon Dosing Septic Tank with Flow Through baffle

Approved By: TRB P.E.	Designed By: TRB P.E.
Drawing By: CSJ	Drawing #: 5 of 7
Date:	Project #:
Scale: 1" = 2'	Revision #:



Top View



Side View 1500 Gallon Tank

General Notes:

Tank Volumes:
Total Volume: 1785 gal±
Operating Volume: 1570 gal± @ 51-1/2"
Unit volume at typical operating depth : 27.5 gal/in± (~1/3 for second chamber & 2/3 for primary.)

Loads:
Top = 500 psf minimum
Lateral Load = 62.4 pcf, EFP
Concentrated Wheel Load = 2500 lb.
The septic tank shall be capable of withstanding long-term hydrostatic loading, in addition to the soil loading, due to a water table maintained at ground surface.
Soil Bearing = 1000 psf (*re-evaluate support base if soil bearing is less or unequal*)

Fiberglass:
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1. Fiberglass tanks shall be analyzed using finite element analysis for buried structures.
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Ult. Shear In-Plane F_s	7,800 psi
Interlaminar Shear F_{is}	1,500 psi

The tank shall be constructed with a glass fiber and resin content specified by the manufacturer and with no exposed glass fibers. Any permanent metal part shall be 300 series stainless steel.

Installation:
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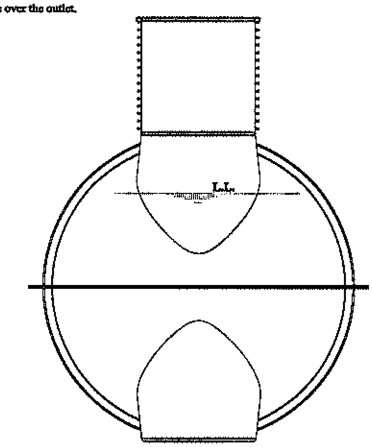
Test:
Tanks shall be tested and certified watertight per manufacturers recommendations and or any prevailing rules or guidelines, whichever is more restrictive.

Tank Markings:
Place marking on the upper most surface over the outlet.
Liquid capacity: 1500 gal. ±
Max burial depth: 4ft.
Max traffic (wheel): 2500 lbs.
Date manufactured: ________
Permit no.: ________
: ________

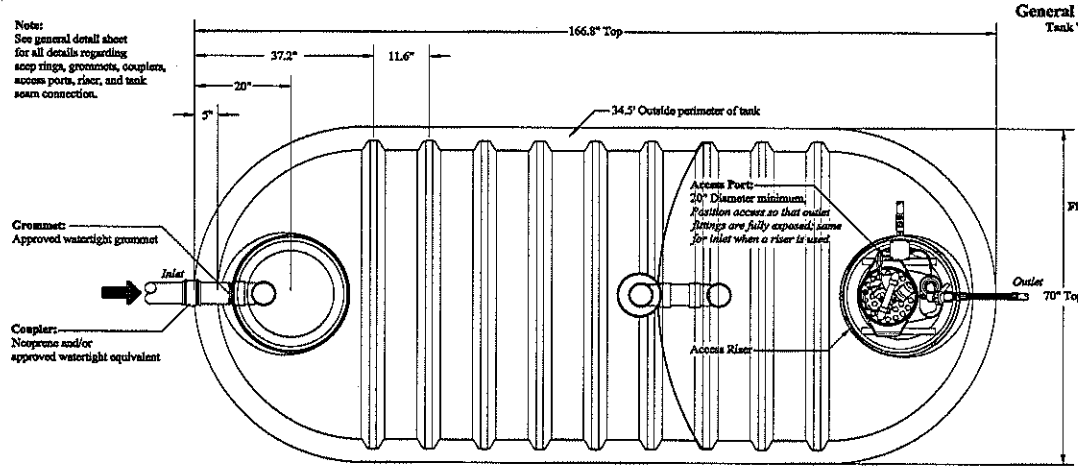


End View

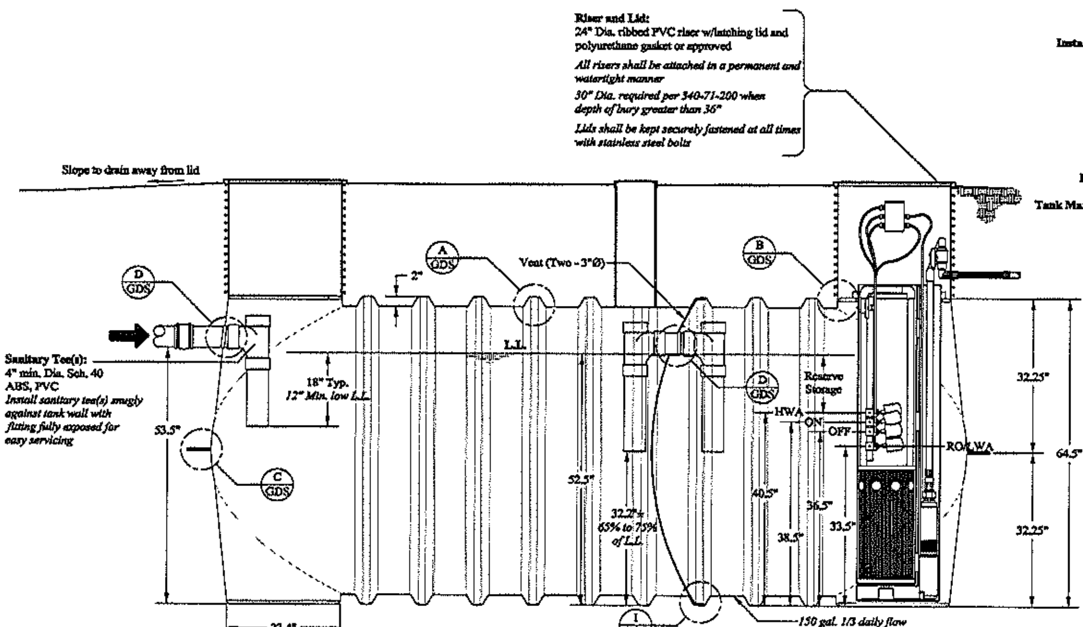
ORENCO SYSTEMS, INC.
814 AIRWAY AVENUE
SUTHERLIN, OR 97479
PHONE: 541-459-4449

Orenco Systems Inc.
Sutherlin, OR
Two-Compartment 1500 Gallon Septic Dosing Tank

Approved By: TRB P.E.	Designed By: TRB P.E.
Drawing By: CSJ	Drawing #: 6 of 7
Date:	Project #:
Scale: 1" = 2'	Revision #:



Top View



Side View 1500 Gallon Tank

General Notes:

Tank Volumes: Total Volume: 1785 gal±
Primary Volume: 1190 gal±
Secondary Volume: 595 gal±
Operating Volume: 1570 gal± @ 51-1/2"
Unit volume at typical operating depth : 27.5 gal./in.± (⅓ -for second chamber & ⅔ for primary.)

Loads: Top = 500 psf minimum
Lateral Load = 62.4 pcf, EFP
Concentrated Wheel Load = 2500 lb.
The septic tank shall be capable of withstanding long-term hydrostatic loading, in addition to the soil loading, due to a water table maintained at ground surface.
Soil Bearing = 1000 psf (*re-evaluate support base if soil bearing is less or unequal*)

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1.-Fiberglass tanks shall be analyzed using finite element analysis for buried structures.
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  deflection of 5% of the tank diameter, based on service load (including long-term deflection lag)
  buoyancy

3. Performance testing

Resin: polyester (ortho, iso, dcpd)
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Interlaminar Shear F_{is}	1,500 psi

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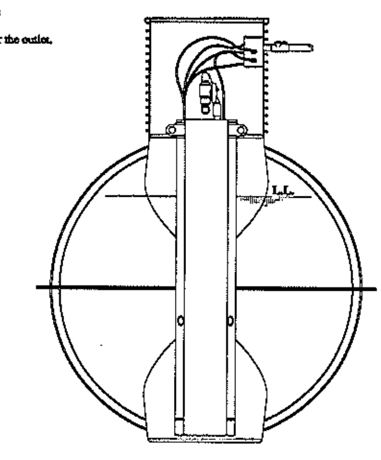
Test: Tanks shall be tested and certified watertight per manufacturers recommendations and or any prevailing rules or guidelines, whichever is more restrictive.

Dosing: Max. 10% to sand filters; Max. 70% to others

Tank Markings: Place marking on the upper most surface over the outlet.
Liquid capacity: 1500 gal. ±
Max burial depth: 4ft.
Max traffic (wheel): 2500 lbs.
Date manufactured: ______
Permit no.: ______
: ______



End View

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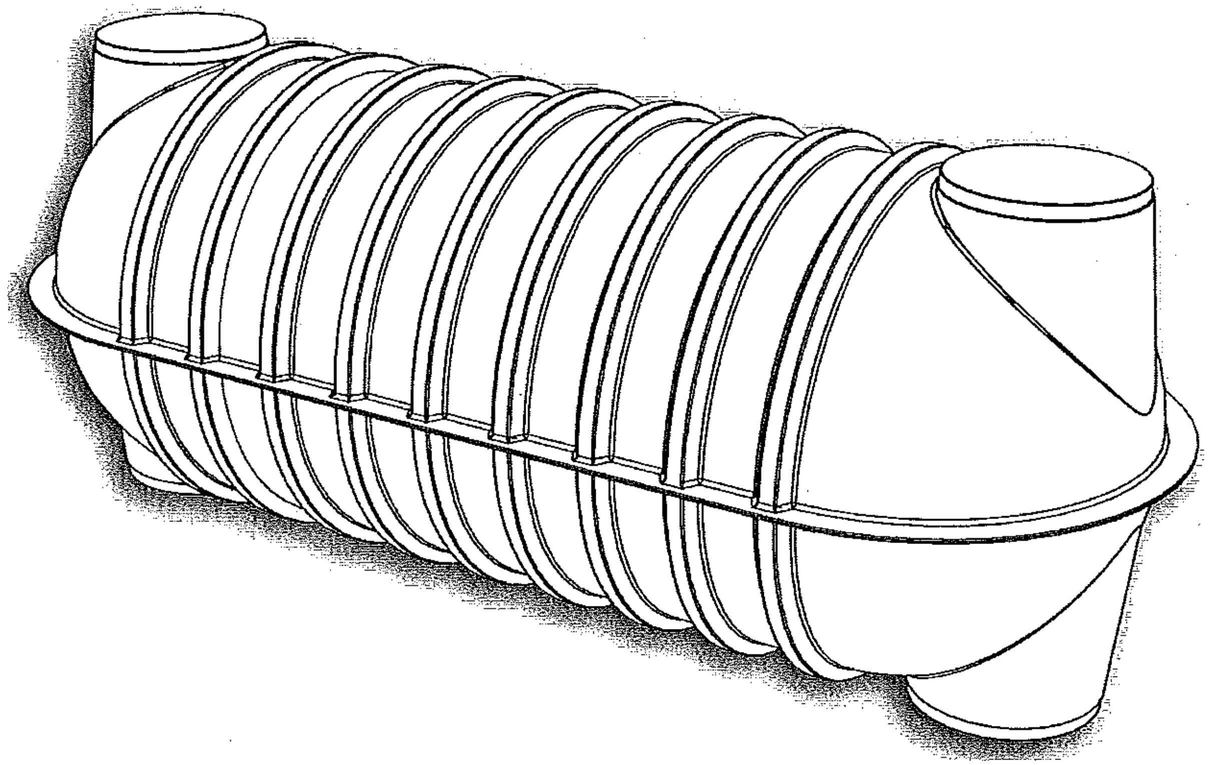
Orenco Systems Inc.
Sutherlin, OR
Two-Compartment 1500 Gallon Septic Dosing Tank

Approved By: TRB P.E.	Designed By: TRB P.E.
Drawing By: CSJ	Drawing #: 7 of 7
Date:	Project #:
Scale: 1" = 2'	Revision #:

Orenco®
Fiberglass Tank

Design Loading Conditions & Structural Analysis



REGISTERED PROFESSIONAL
ENGINEER
9634
OREGON
JULY 13, 1979
TERRY R. BOUNDS

Orenco Systems® Incorporated

814 AIRWAY AVENUE

SUTHERLIN, OREGON

97479

TOLL FREE:

(800) 348-9846

TELEPHONE:

(541) 459-4449

FACSMILE:

(541) 459-2884

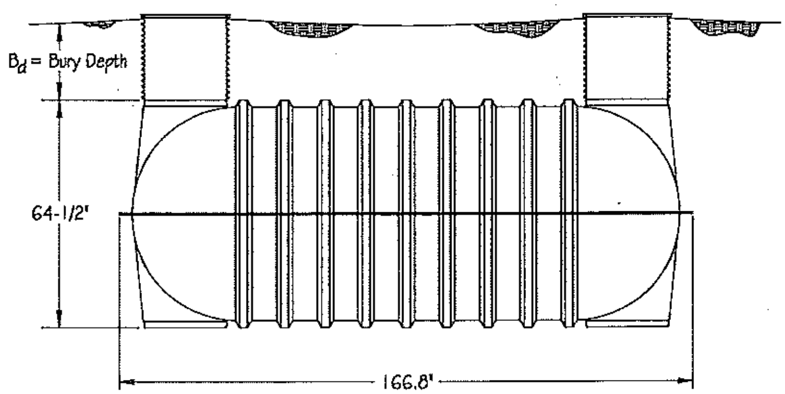
WEB SITE:

www.orenco.com

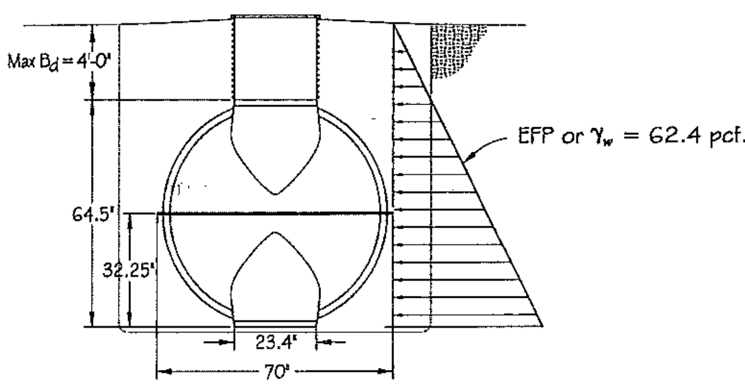
Oct. 5, 2001

Fiberglass Tank Details, Loading Conditions, & Evaluation
TS 1500 & TS 1000

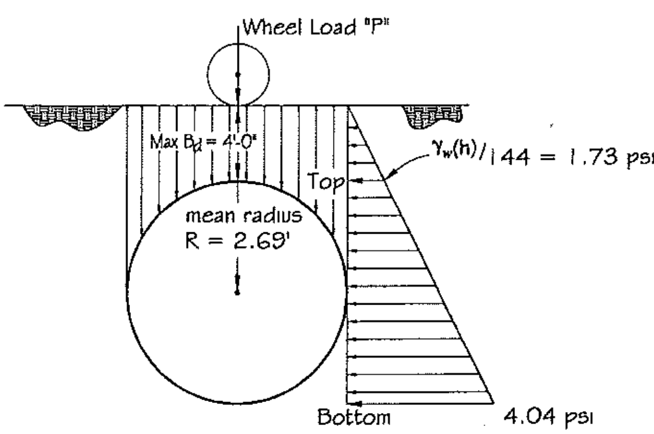
TB p.1



Side View



End View



Typical Loads

Loading Conditions:

Case 1: 4' Bury
γ_w = 62.4 pcf Hydrostatic to grade
D_F = 0.9

Case 2: 4' Bury
γ_w = 62.4 pcf Hydrostatic to grade
P = 2,500 pound wheel load
Wheel load impact factor, IF = 0
D_F = 1.33

Case 3: 1' Bury
EFP = 30 pcf
P = 2,500 wheel load
Wheel load Impact Factor IF = 0.3
D_F = 1.33

Case 4: Free standing : Internal Hydrostatic Test:

Snow Load = 25 psf (Not simultaneous w/wheel load)

Soil Density Dry, γ_d = 127 pcf dry
Soil Density Saturated, γ_s = 140 pcf
= For load bearing analysis.

Soil Bearing, q_u = 1,000 psf (minimum required)

Minimum Combined Vertical Load = 500 psf

E - Type fiberglass

Fiberglass: (25% minimum glass fiber)

Typical Properties:

F_t = 11,000 psi (ultimate tensile strength)

F_{flex} = 18,000 psi (ultimate flexural strength)

F_c = 21,000 psi (ultimate compression strength)

E_t = 1,000,000 psi (tensile modulous)

E_{flex} = 800,000 psi (flexural modulous)

G = 400,000 psi (shear modulous)

F_s = 7,800 psi (ultimate shear strength)

$F_{lam.\ shear}$ = 1,500 psi (Interlaminar shear)

Poisson's ratio $\left(\mu = \frac{\epsilon \text{ lateral}}{\epsilon \text{ axial}}\right)$: 0.3

$\delta = \epsilon L$ (dimensional change)

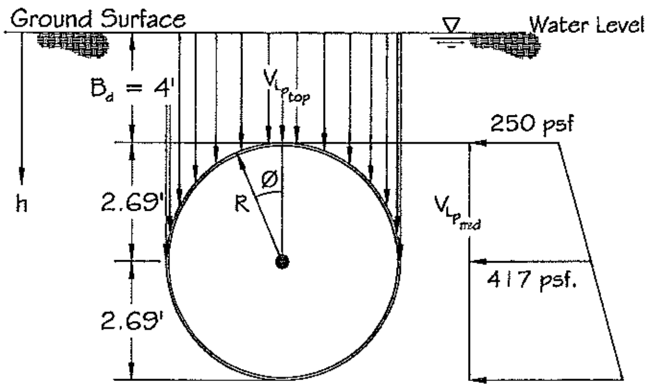
FS (factory of safety) $= \frac{\text{Ult Strength}}{\text{Allowable Strength}}$

Flextural Stress:

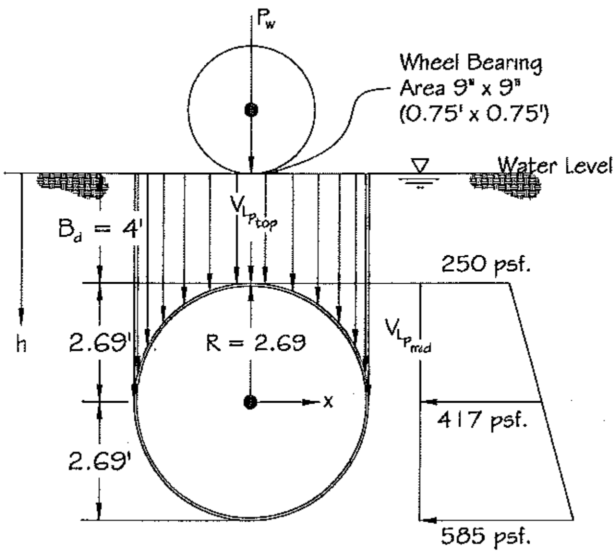
$S_{flex} = \frac{Mc}{I}$

$S = \epsilon E$

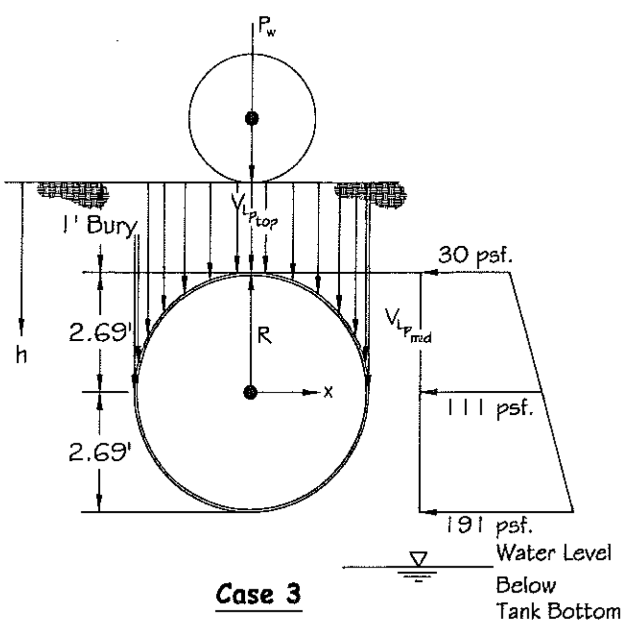
Loading Conditions:



Case 1



Case 2



Case 3

TB p.2

Case 1:

$B_d = 4'$

$\gamma_{sat} = 140pcf$

Vertical Load Pressure (L_P)

$V_{LP} = h\gamma_w + h(\gamma_{sat} - \gamma_w) = h\gamma_{sat}$

$V_{LP\,top} = 560$ psf > 500 psf min.

$V_{LP\,mid} = 936.6$ psf.

Horizontal Load Pressure

EFP = 62.4 pcf.

$HL_P = \gamma_{wh}(h)$

$HL_{P_t} = 250$ psf.

$HL_{Pb} = 585$ psf.

Case 2:

$B_d = 4'$

$P_w = 2500\#$ (IF = 0)

Vertical Load Pressure

$V_{LP_h} = P_w/(0.75' + h)^2 + h\gamma_{sat}$

$V_{LP_t} = 671$ psf

$V_{LP_{mid}} = 982$psf

Horizontal Load Pressure

EFP = 62.4 pcf.

$HL_P = \gamma_w(h)$

$HL_{P_t} = 250$psf

$HL_{P_b} = 585$psf

Case 3:

$B_d = 1'$

$P_w = 2500\#$ (IF = 0.30)

$\gamma_{dry} = 127pcf$

Vertical Load Pressure

$V_{LP_h} = (1.3)P_w/(0.75' + h)^2 + h(\gamma_{dry})$

$V_{LP_t} = 1188$psf

$V_{LP_{mid}} = 707$psf

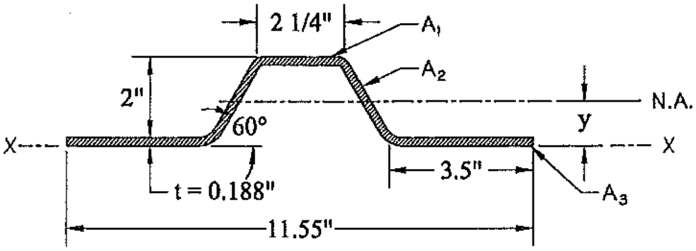
Horizontal Load Pressure

EFP = 30 pcf.

$HL_{P_t} = 30$psf

$HL_{P_b} = 191.4$psf

FRP Tank Rib Section: TS 1500 & TS 1000



Rib Section:

$$A_1 = 2.25'' (0.188'') = 0.423 \text{ in}^2$$

$$A_2 = \frac{2''}{\sin 60''} (0.188'') = 0.434 \text{ in}^2$$

$$A_3 = \left[\frac{11.55'' - 2\left(\frac{2''}{\tan 60}\right) - 2.25''}{2} \right] (0.188'') = 0.657 \text{ in}^2$$

$$A_{total} = A_1 + 2A_2 + 2A_3 = 2.605 \text{ in}^2$$

Section Neutral Axis (NA):

Center of Mass $\Sigma M_{xx} = 0$

$$A_T Y = A_1 Y_1 + 2A_2 Y_2 + 2A_3 Y_3$$

$$A_T Y = 0.423''(2.094'') + 2(0.434'')(1.188'')$$
$$+ 2(0.657'')\frac{(0.188'')}{2} = 2.04$$

$$Y = \frac{2.04 \text{ in}^3}{2.605 \text{ in}^2} = 0.783''$$

Section Moment of Inertia (I_{na}):

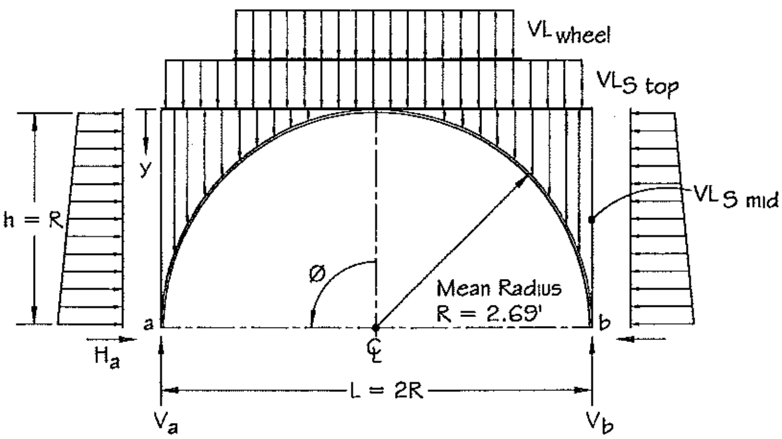
$$I_{na} = 2.25'' \frac{(0.188'')^3}{12} + 2\frac{(3.5'')(0.188'')^3}{12}$$
$$+ 2\frac{(0.188'')(2)^3}{12}$$
$$+ 2(0.657'')\left(0.783'' - \frac{0.188''}{2}\right)^2$$
$$+ 2(0.434'')(1.188'' - 0.783'')^2$$
$$+ (0.423'')(2.094'' - 0.783'')^2$$

$$I_{na} = \underline{1.75 \text{in}^4}$$

$$S_{top} = \frac{1.75}{1.405''} = \underline{1.25 \text{in}^3}$$

$$S_{bottom} = \frac{1}{0.783''} = \underline{2.24 \text{in}^3}$$

Arch Section Analysis



TB p.4

Arch Reactions

Horizontal loads left and right side are equal. $M_a = 0$ & pinned both ends. $\Delta_H = 0$

$$H_a = \frac{LP_H}{A_{HH}}$$ (Roark & Young fifth edition p.g. 240)

$$V_b = \frac{1}{2} VL \text{ Total}$$

$$A_{HH} = \phi + 2\phi c^2 - 3sc + \alpha(\phi + sc) + \beta(\phi - Sc)$$

Where:

$$\phi = 90° = \frac{\Pi}{2}$$

$$c = \cos\phi = 0$$

$$s = \sin\phi = 1$$

Axial stress deformation factor: $\alpha = \frac{I}{AR^2}$

$$\alpha = \frac{1.75}{(2.605)(32.25)^2} = 0.0007$$

Transverse shear deformation factor: $\beta = \frac{FEI}{GAR^2}$

$$\beta = \frac{1.1(800{,}000)(1.75)}{400{,}000(2.605)(32.25)^2} = 0.0015$$

Note: small values of α & β indicate that bending governs deformation.

$E = 800{,}000$ psi

$G = 400{,}000$ psi

$I = 1.75$ in^4

$A = 2.605$ in^2

D_1 & D_2 = Y distance from N.A. of wall rib section

R = Arch radius = 32.25"

F = Shape factor...(I - beam or box section with consistent web & flange thickness D_2 & D_1 $\therefore \frac{t_1}{t_2} = 1$)

$$F = \left[1 + \frac{3}{2}\frac{(D_2^3 - D_1^3)D_1}{D_2^3}\left(\frac{t_1}{t_2} - 1\right)\right]\left(\frac{4D^2}{10r^2}\right)$$

$$r = \text{radius of gyration} = \sqrt{\frac{I}{A}} = \sqrt{\frac{1.75}{2.605}} = 0.82"$$

$$F = \frac{4(1.405)^2}{10(0.82)^2} = 1.17$$

$$A_{HH} = \phi + 2\phi\cancel{c^2}^{\,0} - 3s\cancel{c}^{\,0} + \alpha(\phi + s\cancel{c}^{\,0}) + \beta(\phi - S\cancel{c}^{\,0})$$

$$A_{HH} = \frac{\Pi}{2}(1 + \alpha + \beta)$$

$$A_{HH} = \frac{\Pi}{2}\left(1 + \frac{I}{AR^2} + \frac{FEI}{GAR^2}\right) = 1.574$$

$$LP_H = wR\left[\frac{Sc^2}{2} - \frac{2s^3}{3} + \frac{\phi c}{2} - \phi c^3 + (\alpha - \beta)\frac{2s^3}{3}\right]$$

$$LP_H = wR\left[0 - \frac{2(1)^3}{3} + 0 - 0 + (0.0007 - 0.0015)\frac{2(1)^3}{3}\right]$$

$$LP_H = -0.6672\ wR$$

Horizontal reaction

$$H_a = \frac{LP_H}{A_{HH}} = \frac{0.667\ wR}{1.57} = 0.42\ wR$$

Arch Section Analysis

Vertical Loads.

$$VL_{wheel} = \frac{P}{\left(B_d + 0.75'\right)^2}$$

$$VL_{S1} = \gamma B_d$$

$$VL_{S2} = \gamma y$$

Where:

y = depth from top tank to midseam, ft

$\gamma = \gamma_{dry}$ or γ_{wet} depending on groundwater condition.

ASSHO Two-hinged full span uniform vertical load:

$$H = \frac{wl^2 v}{8h}$$

$$v = \frac{1}{1 + \frac{15}{8}\frac{I_c}{A_c h^2}} = \frac{1}{1 + \frac{15}{8}\frac{1.75\ in^4}{2.605\ in^2 (32.25\ in)^2}}$$

$$v = 0.999 \sim 1$$

$$H = \frac{wl^2}{8h}$$

$$V = \frac{wl}{2}$$

$$H_{max} = \frac{wh^2}{8}$$

ASSHO w/Fixed - Ends:

$$H = \frac{wl^2}{8h}$$

$$V = \frac{wl}{2}$$

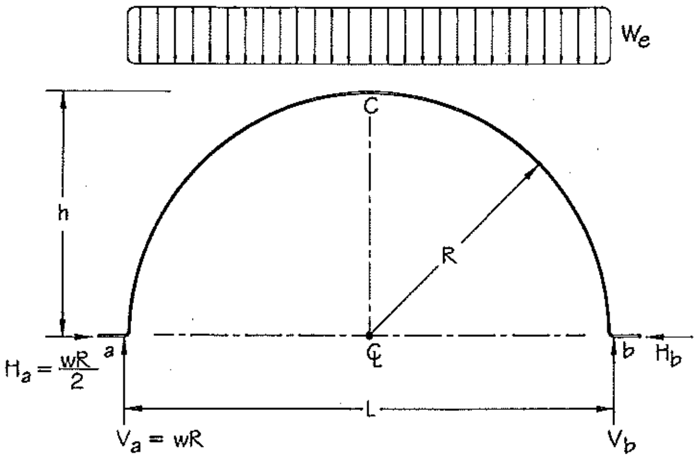
$$M_{ends} = \frac{1}{12} wl^2(1-v)$$

$$M_c = \frac{1}{24} wl^2(1-v)$$

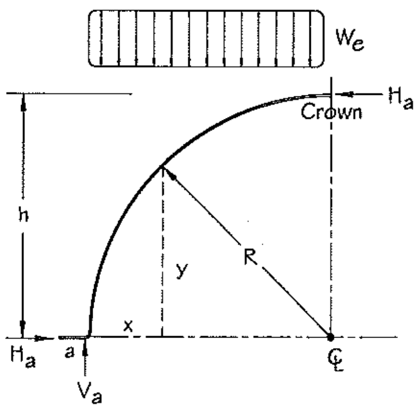
$$v = \frac{1}{1 + \frac{45}{4}\frac{I_c}{A_c h^2}} = 0.992$$

$\therefore$ Moments at crown & midseam negligible

Arch Section Analysis



$$R = \frac{4h^2 + L^2}{8h} = 2.69'$$



$$y^2 = R^2 - (R - x)^2$$

$$y = \sqrt{R^2 - (R^2 - 2Rx + x^2)}$$

$$y = \sqrt{2Rx - x^2}$$

$$\Sigma M_{end} = 0: \; V_a = V_b = \frac{wl}{2}$$

$$\Sigma M_{center} = 0: \; H_a = H_b = \frac{wl^2}{8h}$$

Note: arch section is semicircle, therefore,

$h = R$

$L = 2R = 2h$

$H_a = H_b = \frac{wR}{2}$

$V_a = V_b = wR$

AITC Maximum moment with uniform horizontal projected load

$$M_{max} = \frac{wh^2}{8}$$

Equivalent Uniform Load Projections (W_e)

Case 1

$$W_e = 560 + \left[\frac{(936.6 - 560)(5.38) - \left(\frac{140}{2}\right)\left(\frac{\Pi(5.38)^2}{4}\right)}{5.38}\right]$$

$W_e = 560 + 81 = \underline{640 \text{ psf}}$

$V_a = 640(2.69) = 1722 \; \frac{\text{lb.}}{\text{ft. seam}}$

$H_a = \frac{640(2.69)}{2} = 860 \; \frac{\text{lb.}}{\text{ft. seam}}$

Case 2

$$W_e = 671 + \left[\frac{(982 - 671)(5.38) - \left(\frac{140}{2}\right)\left(\frac{\Pi(5.38)^2}{4}\right)}{5.38}\right]$$

$W_e = 671 + 82 = \underline{\underline{753 \text{ psf}}}$

$V_a = 753(2.69) = 2030 \; \frac{\text{lb.}}{\text{ft. seam}}$

$H_a = \frac{753(2.69)}{2} = 1013 \; \frac{\text{lb.}}{\text{ft. seam}}$

Case 3

$VL_{wheel} = \frac{2500 \text{ lb}}{(1 + 0.75)^2}(1.3) = 1061$ psf (10-1/2" left & right of ℄)

$VL_{S1} = 127$ psf (at crown)

$VL_{S2} = 127 \text{ psf } (2.69) = 341.6$

VL_S (vertical soil load) varies from zero at around surface to 469 psf at the mid-seam depth.

Horiz loads (HL_R & HL_L) are equal & opposite:

$\therefore \Sigma M_a = 0$

$$M = 2.69' \left[1061 \text{ psf}\left(\frac{21"}{12"}\right) + 127 \text{ psf } (5.38')\right]$$

$$+ 2.69' \left[341.6 \text{ psf } (5.38') - \left(\frac{127 \text{ psf}}{2}\right)\left(\frac{\Pi(5.38)^2}{4}\right)\right]$$

$$+ \frac{2.69}{2}\left[HL_R - HL_L\right]^{0}$$

$$- 5.38\,(V_b)$$

$$V_b = \frac{2.69'}{5.38'}\left[1{,}857 + 683.3 + 394.3\right]$$

$V_b = 1467 \; \frac{\text{lb.}}{\text{ft. seam}}$

$$W_e = \frac{V_b}{R} = \frac{1467 \frac{\text{lb.}}{\text{ft. seam}}}{2.69'} = \underline{545 \text{ psf}}$$

$$H_a = \frac{W_e R}{2} = \frac{545\,(2.69)}{2} = 743 \; \frac{\text{lb.}}{\text{ft. seam}}$$

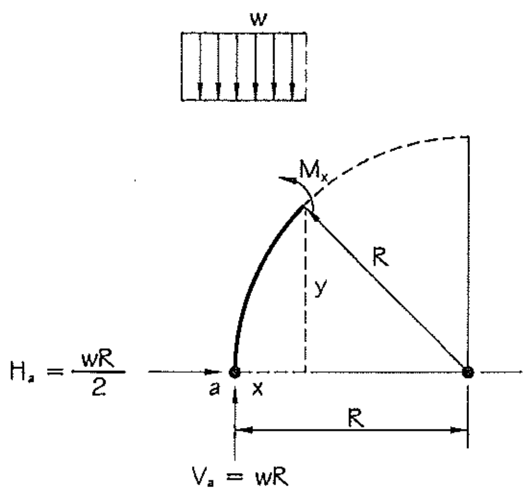
Midseam support from soil
Lateral Bearing q_H:

$q_H = 200 \; \frac{\text{psf}}{\text{ft. depth}}$

@ $B_d = 1'$: $q_H = 200(3.69') = 740 \text{ psf} \approx H_a = 743$

@ $B_d = 4'$: $q_H = 200(6.69') = 1340 \text{ psf} > H_a = 1013$

Flexural Stress Moment Analysis. Two hinged Arch



Where: $L = 2R$ & $h = R$ (h = Arch height)

$$H_a = \frac{wL^2}{8h} = \frac{wR}{2}$$

$$V_a = \frac{wL}{2} = wR$$

$$M_x = \frac{wL}{2}X - \frac{wX^2}{2} - \frac{wL^2}{8h}Y$$

$$M_x = wRX - \frac{wX^2}{2} - \frac{wR}{2}Y$$

And:

$$Y = \sqrt{2RX - X^2}$$

Therefore:

$$M_x = w\left(RX - \frac{X^2}{2} - R\frac{\sqrt{2RX - X^2}}{2}\right)$$

@ X = R(Moment at crown is):

$$M_c = w\left(R^2 - \frac{R^2}{2} - R\frac{(2R^2 - R^2)^{1/2}}{2}\right)$$

$$M_c = w\left(\frac{R^2}{2} - \frac{R}{2}\sqrt{R^2}\right) = w\left(\frac{R^2}{2} - \frac{R^2}{2}\right) = 0$$

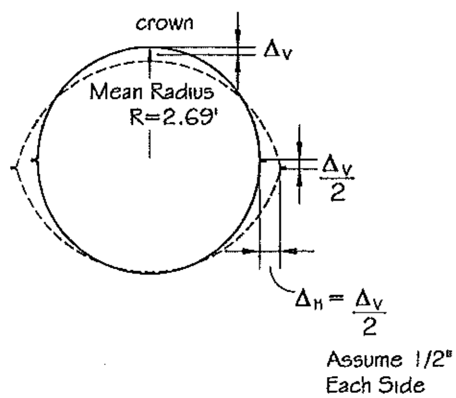
Case 2

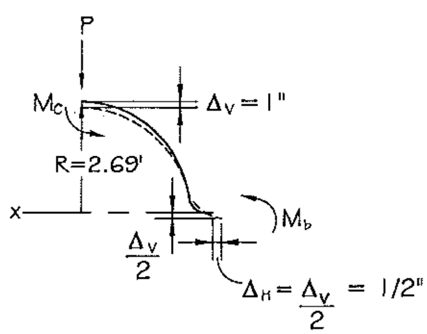
x ft	w psf	R ft	M_x ft-#/ft
0.25	753	2.69	-664
0.4	753	2.69	**-679**
0.5	753	2.69	-663
0.75	753	2.69	-580
1	753	2.69	-471
1.25	753	2.69	-357
1.5	753	2.69	-252
1.75	753	2.69	-161
2	753	2.69	-88
2.25	753	2.69	-36
2.5	753	2.69	-7
2.69	753	2.69	0

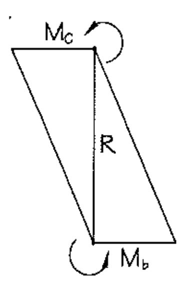
Maximum Moment at "x" distance approximately 15% from point "a," which is consitant for uniform vertical loaded archs.

$$M \sim \frac{wh^2}{8}$$

Stress Analysis







$M_C = M_B$

$$\Delta = \int \frac{Mmdx}{EI} = \underbrace{\left[\frac{M}{EI}\right]}_{\text{area}} \begin{bmatrix}\text{Moment}\\ \text{Arm}\end{bmatrix}$$

$\Sigma M_B = 0 \quad M_c + M_b - PR = 0$

$$2M_c = PR$$

$$M_c = \frac{PR}{2}$$

$$\Delta = \frac{M}{EI}\left(\frac{R}{2}\right)\left(\frac{2}{3}R\right) - \frac{M}{EI}\left(\frac{R}{2}\right)\left(\frac{1}{3}R\right)$$

$$\Delta = \frac{MR^2}{3EI} - \frac{MR^2}{6EI} = \frac{MR^2}{6EI}$$

$$\Delta = \frac{MR^2}{6EI}$$

$M = \Delta \frac{6EI}{R^2}$ (Actual stress relative deflection 1/2")

$$M = \frac{1/2"\,(6EI)}{(2.69')^2}$$

$$M = \frac{(1/2")(6)\,(800{,}000)(1.75"in^4)}{(32.25")^2}$$

$M = \underline{\underline{4038"^{\#}}}$ per 11.55" rib section

$$f_s = \frac{M}{S} = \frac{4038"^{\#}}{1.25in^3}$$

$f_s = \underline{\underline{3{,}230 \text{ psi}}}$

Arch Section Analysis

Stress Analysis:

$W_{e\,max} = 753$ psf

$P_{max} = 2{,}030^{\#}$

$M_{max} = \dfrac{753 \text{ psf } (2.69)^2}{8} = 681'\#$ (@15% M = 679'#)

$V_{max} = 1{,}013^{\#}$

1) Combined compression & Flexural Stress:

$$\frac{f_c}{F_c} + \frac{f_{flex}}{F_{flex}} \leq 1 \text{ (DF)}$$

$$\frac{\dfrac{2{,}030\#}{2.605 \text{ in}^2}}{21{,}000 \text{ psi}} + \frac{\dfrac{681'\#(12)}{1.25 \text{ in}^3}}{18{,}000 \text{ psi}} \leq 1.33$$

$0.037 + 0.363 = 0.40 << 1.33$ SF = 3.3

Flexural Stress Due to 1/2 Horizontal Deflection @ Midseam: $f_{flex} = 3{,}246$ psi

(With adequate backfill, the probability of this scenario is low.)

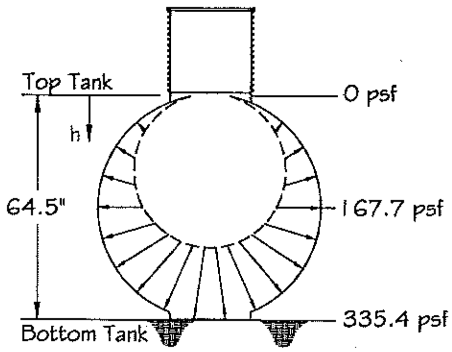
2) Combined compression, flexural, and deflection stress:

$$\frac{f_c}{F_c} + \frac{f_{flex}}{F_{flex}} + \frac{f_{\Delta}}{F_{flex}} = 0.037 + 0.363 + \frac{3{,}230}{18{,}000} = 0.58 < 1.33$$ SF = 2.3

Shear Stress:

$$v = \frac{3}{2}\frac{V}{A} = \frac{3}{2}\left(\frac{1{,}013}{2.605}\right) = 583 \text{ psi} < 7{,}800$$ SF = 13.3

Loading Conditions Four



Case 4

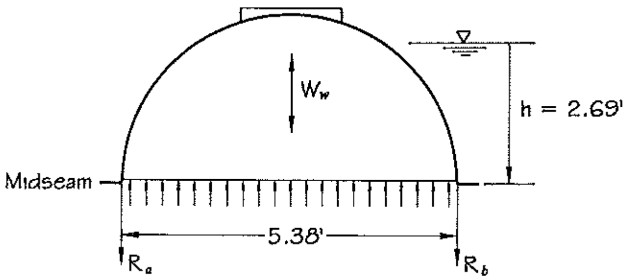
Case 4: Hydrostatic Test Condition

Hydrostatic Load:

$$HL = \gamma_w (h)$$

$$W_{w_{\text{top section}}} = \gamma_w (A_{section}) = \frac{62.4\left(\frac{\Pi(5.375')^2}{4}\right)}{2}$$

$$\underline{\underline{W_{w_{\text{top section}}} = 707.9\ \#/_{ft}}}$$



Top Section

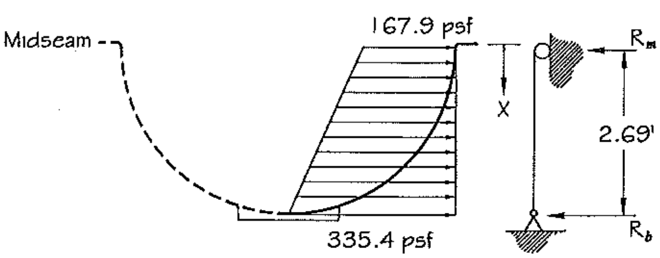
Top Section:

Average Lifting Pressure:

$$R_a \,\&\, R_b = \gamma_w(h)\left(\frac{5.38'}{2}\right) - \frac{W_w}{2} = \gamma_w(2.69)\left(\frac{5.38'}{2}\right) - \frac{707.9}{2}$$

$$= 451.5\ \#/_{ft} - 354.6\ \#/_{ft}$$

$$= 96.9\ \#/_{ft} \text{ seam} = 8.08\ \#/\text{inch of seam}$$



Bottom Section

Bottom Section:

Flexural Stress (Lateral Load Evaluation)

Tank shell is free to flex at midseam & angular rotation is unresisted at the bottom bearing point. Threefore, the simple support condition show is used as a conservative approach to evaluate case 4 flexural stress.

$$\therefore R_m = \frac{167.9\,(2.69)}{2} + \frac{(335.4 - 167.9)(2.69)}{6} = 301\ \#/_{ft}$$

$$M_m = R_m(X) - 167.9\,\frac{X^2}{2} - 62.4\,\frac{X^3}{6}$$

$$\frac{dM_m}{dx} = R_m - 167.9x - 62.4\,\frac{X^2}{2} = 0$$

$\therefore$

$$31.2X^2 + 167.9x - 301 = 0$$

$$X = \frac{-167.9 \pm \sqrt{(167.9)^2 - 4(31.2)(-301)}}{2(31.2)} = 1.42' \text{ down from midseam}$$

so

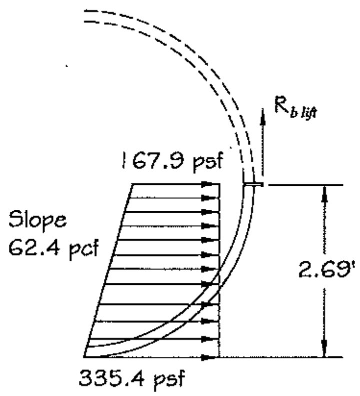
$$M_t = 228'\ \#/_{ft} = 2741''\ \#/_{ft}$$

$$f_{flex} = \frac{2741''\ \#/_{ft}\left(\frac{11.55}{12}\right)}{(1.25\ in^3)} = 2110 \text{ psi}$$

1 hr: DF = 1.5

24 hr: DF = 1.35

Case 4



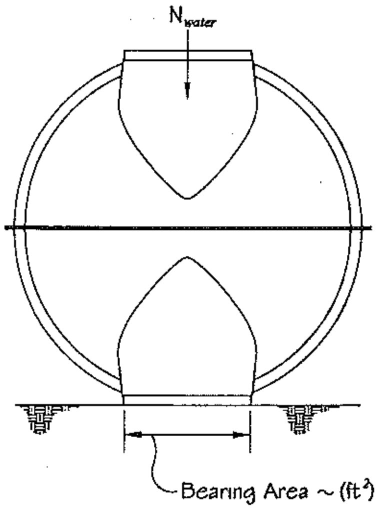
Alternate Model Condition:

ΣM_{bottom} = Assume Cantileve w/Top Section Resisting Rotation:

$$M_b = \frac{167.9(2.69)^2}{2} + \frac{62.4\,(2.69)^3}{6} - 97\,{}^{\#}/_{ft}\,(2.69)$$

$$M_b = 549'\,{}^{\#}/_{ft} = 6{,}588''\,{}^{\#}/_{ft}$$

$$f_{flex} = \frac{6{,}588''\,{}^{\#}/_{ft}\left(\frac{11.55''}{12}\right)}{(1.25\ in^3)} = 5{,}073\ psi$$



9 ribs

2 Accesses

Bottom Bearing Area:

Total $N_w = 1{,}585$ gal $(8.34\ ^{\#}/_{gal}) = \underline{\underline{13{,}220^{\#}}}$

Bearing Area: $9\ (2\frac{1}{4}") \ (x_{unloaded}) = 61\ in^2$

During Hydrostatic Test: $x_{fully\ loaded}$

where:

$x_{unloaded} = 3"$

$x_{fully\ loaded} = 4"$

End Access Flats (two)

$$\frac{2\ \Pi\ (23.4")^2}{4} = 860\ in^2$$

$$f_{c_\perp} = \frac{13{,}219^{\#}}{920\ in^2}$$

$$f_{c_{ribs}} = \frac{13{,}219^{\#}}{A_{total}}$$

Compressive stress in riser access walls and rib walls:

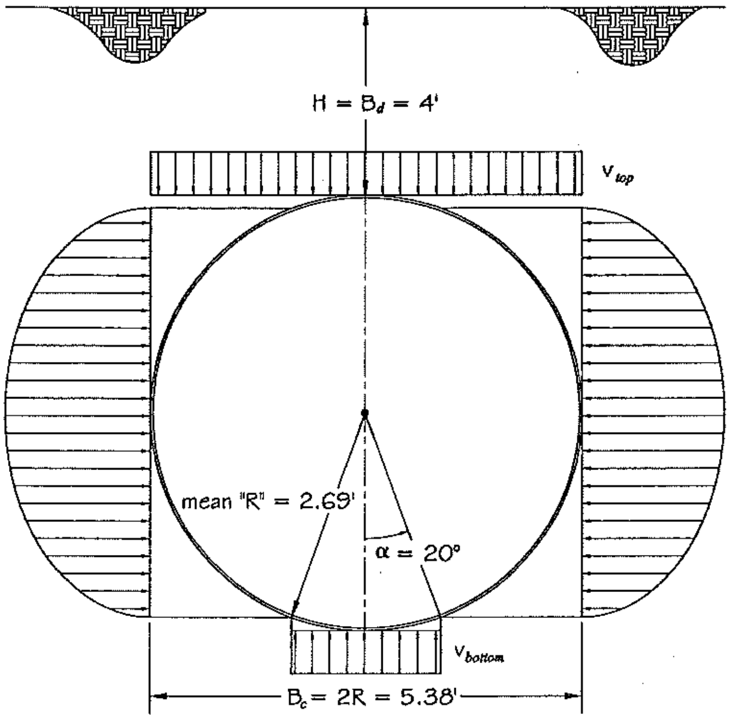
$A_{Access\ perimeter} = \Pi (23.4")\ (2)\ (0.19") = 27.9\ in^2$

$A_{rib} = 9\ (2)\ (3")\ (0.19") = 10.26\ in^2$

$A_t = 27.9\ in^2 + 10.26\ in^2 = 38.2\ in^2$

$$f_{c_{ribs\ walls}} = \frac{13{,}219^{\#}}{38.2\ in^2} = 346\ psi$$

Design for Flexible Cylinder Sections



End View

Gaylord & Gaylord Structural Engineering Handbook

Relative loading system for flexible pipe under earth fill

$\gamma_{dry} = 127$ pcf

Vertical Load:

Bury Depth $H = B_d = 4'$

Compact backfill to 90% relative density

B_c = width tank = 5.38'

Longitudinal Load:

$$W_c = C_c \gamma_{dry} B_c^2$$

$$C_c = \frac{H}{B_c} = \frac{4'}{5.38'} = 0.74$$

$$W_c = (0.74)\,127\,(5.38)^2$$

$$W_c = 2{,}730\ ^{\#}/_{ft}$$

Top & Bottom Load:

Top $v = \dfrac{W_c}{2R} = 508$ psf

Bottom $v' = \dfrac{W_c}{2R(\sin\alpha)} = 1485$ psf

Bedding Distribution assume $\alpha = 20°$

Bedding coef. K = 0.106

Approximate Vertical Deflection:

$$\Delta_{vert} = D_l \frac{KW_cR^3}{EI + 0.061E'R^3}$$

D_l = Deflection lag factor = 1.25 to 1.5

E' = modulus of soil reaction, psi (700 psi per AASHO)

I = moment of inertia of wall section per inch

W_c in units of pound per inch

$$\Delta_{vert} = \frac{1.25\,(0.106)\left(\frac{2730\ ^{\#}/_{ft}}{12\ ^{"}/_{ft}}\right)(32.25")^3}{1\,(10^6)\left(\frac{1.75\text{ in}^3}{11.55}\right) + 0.061\,(700\text{ psi})(32.25")^3} = \underline{0.64"}$$

$\therefore$ Horiz. $\Delta_H \simeq \dfrac{\Delta_v}{2} = 0.32"$

Horizontal Load:

$$h = \frac{e\Delta_{vert}}{2}$$

e = Soil modulus of passive resistance

$$e = \frac{E'}{R}$$

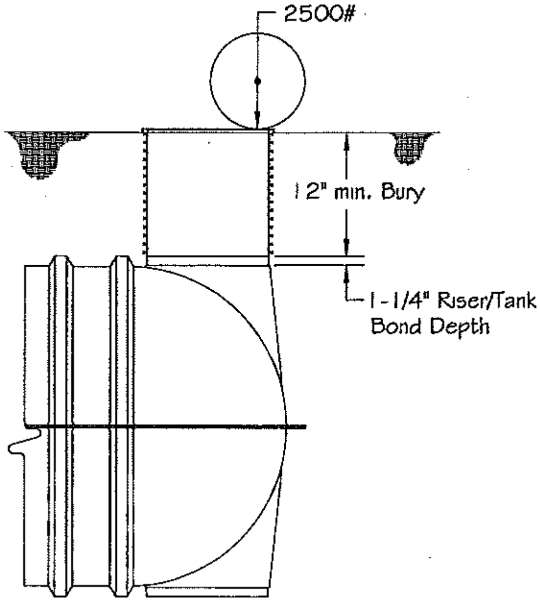
$$h = \frac{700\text{ psi}}{32.2"}\left(\frac{0.64"}{2}\right)$$

h = 6.4 psi

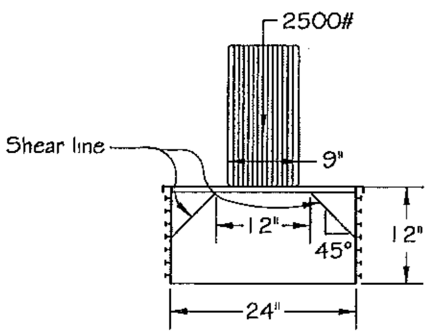
h = 998 psf

$$\frac{\Delta_h}{B_c} = \frac{0.32"}{64.5"} = 0.005 = 1/2\% < 3\%\ \ \underline{\underline{\therefore\ OK}}$$

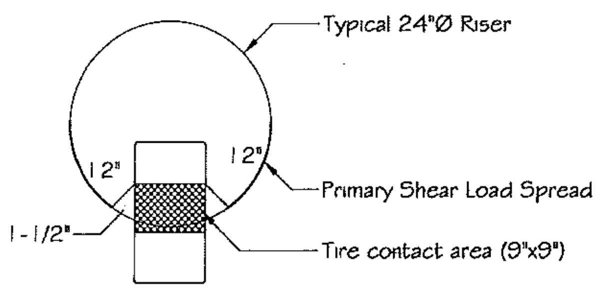
Riser/Tank Connection & Shear



Side View



End View



Top View

Wheel Load: 2500#

Wheel Bearing Area: 9"x9"

Shear angle down PVC riser: 45°

Minimum Bury: 12"

Shear Strength:

ADH100: f_v = 112 psi

MA320: f_v = 2000 psi

ABS/PVC: f_v = 1300 psi

Riser/Tank shear load perimeter contact length (L)

L = 36"

depth of bond = 1-1/4"

$\therefore$ Bond shear area = 45 in^2

$$P = \frac{45 \text{ in}^2 (112 \text{ psi})}{1000} = 5.04^k$$

Full 24" Dia. riser bearing capacity

$$A_{perim} = \Pi(23.5")(1.25") = 92.28 \text{ in}^2$$

$$P_t = \frac{92.28 \text{ in}^2 (112 \text{ psi})}{1000} = 10.3^k$$

Riser Shear:

$$\frac{P}{2} = 1300 \text{ psi } \frac{(1.414)(12")(t)}{1000}$$

Average thickness = 0.65"

$$\therefore \frac{P}{2} = 14.3^k \text{ each shear line}$$

$$\therefore P_{total} = 2(14.3) = 28.6^k \gg 2.5^k \text{ wheel load}$$

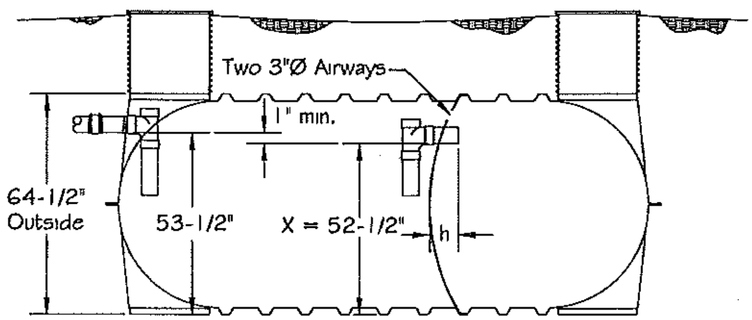
Fiberglass Laminate Shear:

$F_{lam\ shear}$ = 1500 psi >> Min. epoxy shear strength

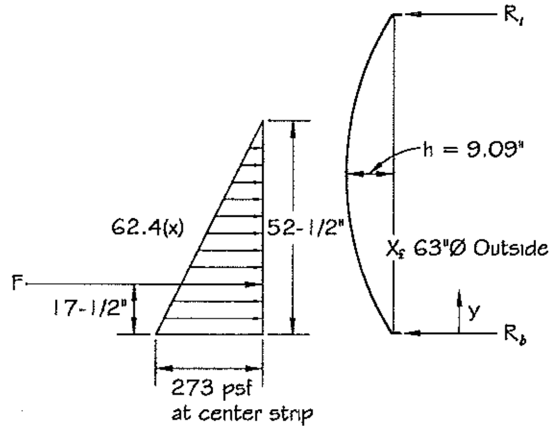
BAFFLE DESIGN CALCULATIONS

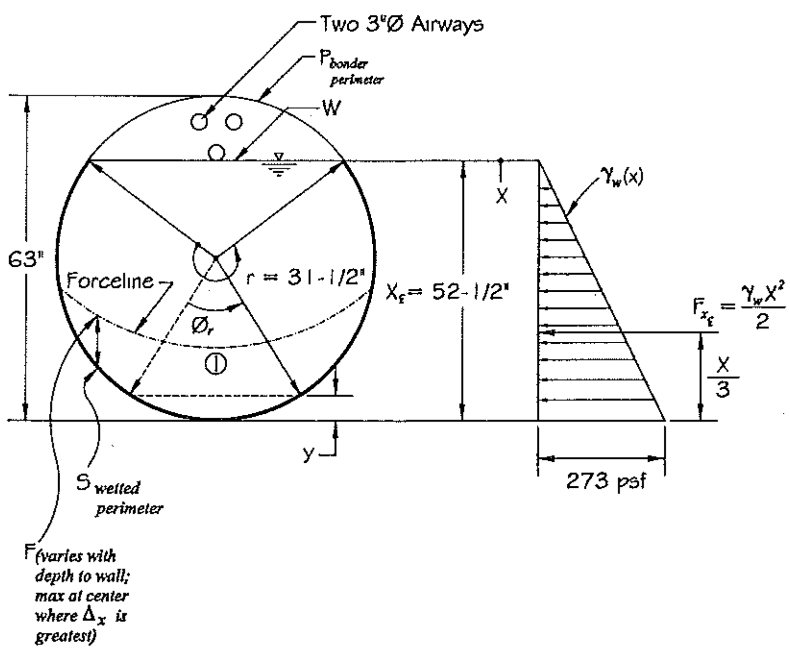
1000 - 1500 Baffle Design

TB
Baffle pg. 1
Dec. 6, 2001



Side View





Max liquid level differential (ΔX) = 52.5"
Hydrostatic Force:

$$F_{x_\ell} = \frac{\gamma_w X^2}{2}$$

$$F_{x_\ell} = \frac{62.4\left(\frac{52.5}{12}\right)^2}{2} = 597\,\tfrac{\#}{ft}$$

Σ Moments R_t:

$$R_{b_\ell} = F_{x_\ell}\left(\frac{63" - \frac{x_\ell}{3}}{63"}\right) =$$

$$R_{b_\ell} = 597\tfrac{\#}{ft}\left(\frac{63" - \frac{52.5"}{3}}{63"}\right) = 431.2\,\tfrac{\#}{ft}$$

$$R_{t_\ell} = 597 - 431.2 = 165.8\,\tfrac{\#}{ft}$$

Bending Moment:

$$M = R_b(y) - \frac{273y^2}{2} + \frac{62.4y^3}{6}$$

$$\frac{dm}{dy} = R_b - 273y + \frac{62.4y^2}{2} = 0$$

$$\frac{dm}{dy} = 431.2 - 273y + 31.2y^2 = 0$$

$y = 2.07'$ from R_b

$$M_{max} = 431.2\,(2.07) - 136.5\,(2.07)^2 + 10.4\,(2.07)^3$$

$$M_{max} = 400'\tfrac{\#}{ft}$$

Epoxy:

$$W_{(surface\ width)} = 2r \sin\frac{\O_o}{2}$$

$$\O_o = 2\cos^{-1}\left(\frac{r-y}{r}\right) = 263.6°$$

$$W = 47"$$

$$A_{52\text{-}1/2} = \frac{D^2(\O_r - \sin \O_o)}{8} = 2{,}780 \text{ in}^2 = 19.3 \text{ ft}^2$$

$$P_{bonder\ perimeter} = \Pi D = 198" = 16.5'$$

$$A_{bonder} = 12"\left[2.25" + \frac{2"}{\sin 60°}\right] = \frac{54.7 \text{ in}^2}{ft}$$

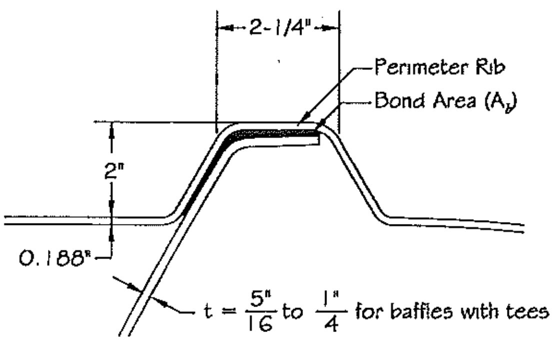
Epoxy Strength: 1500 psi

$$E_{shear} / \text{Tensil Strength/ft} = \frac{54.7 \text{in}^2 (1500 \text{ psi})}{ft}$$

$E_s = 82\,\tfrac{k}{ft}$ = more than adequate

1000 - 1500 Baffle Design

TB
Baffle pg. 2
Dec. 6, 2001



Shear Stress:

$$f_{shear} = \frac{3}{2}\frac{R_b}{A} = \frac{3}{2}\frac{(431.2)}{(\frac{1}{4}"(12"))}$$

$$= 216 \text{ psi} < F_v = 7{,}800 \text{ psi}$$

Bending Stress:

$$f_{bending} = \frac{M}{SC_d} = \frac{M}{\frac{bt^2}{6}C_d} = \frac{400\text{'\#} \cdot (12\text{"/ft})}{\frac{12"\,(t)^2}{6}C_d}$$

$C_d = 1.33$ (24 hr. duration)

$$f_b = \frac{400}{t^2}\left(\frac{6}{1.33}\right) = \frac{1805\#}{t^2}$$

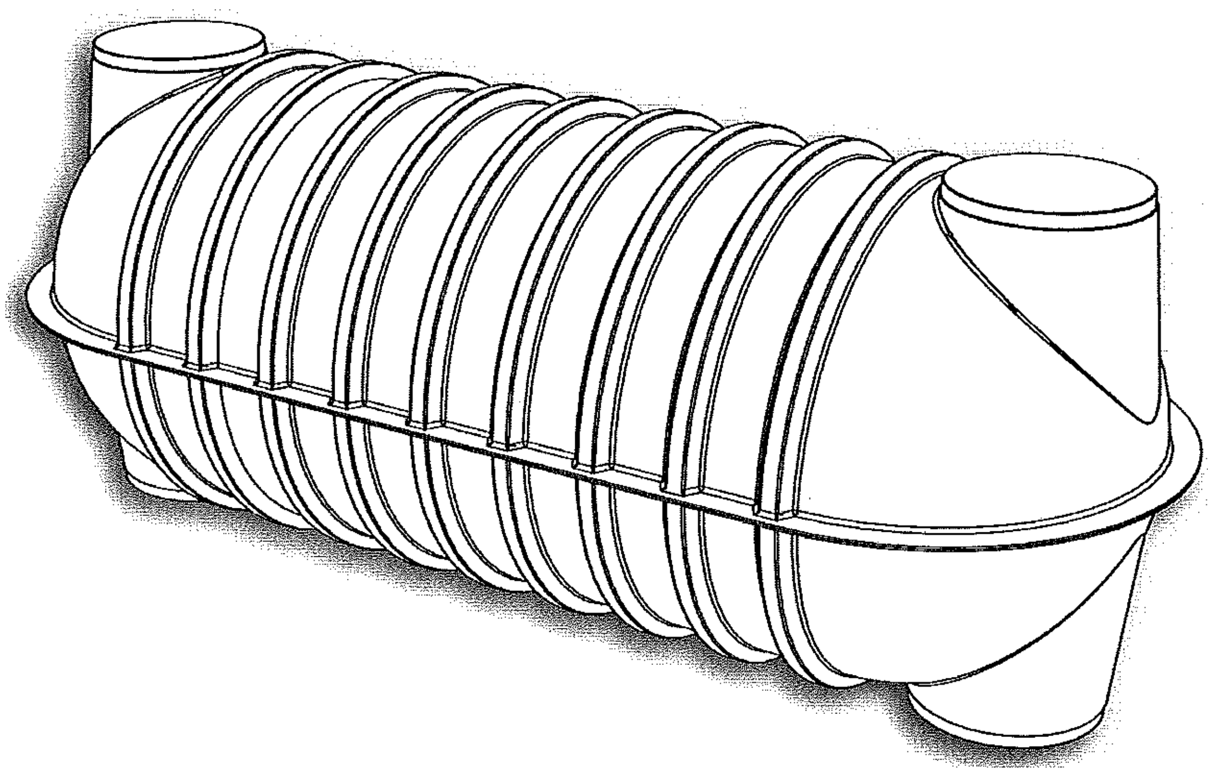
$$t_{max} = \left[\frac{1805\#}{18{,}000 \text{ psi}}\right]^{1/2} = 0.317"$$

For Two-Compartment Tanks with Tee'd baffle, vary baffle thickness from $\frac{5}{16}"$ to $\frac{1}{4}" \pm$

ANTI-BUOYANCY CALCULATIONS

Orenco® Fiberglass Tank

Design Loading Conditions & Structural Analysis



Orenco Systems® Incorporated

814 AIRWAY AVENUE

SUTHERLIN, OREGON

97479

TOLL FREE:

(800) 348-9846

TELEPHONE:

(541) 459-4449

FACSMILE:

(541) 459-2884

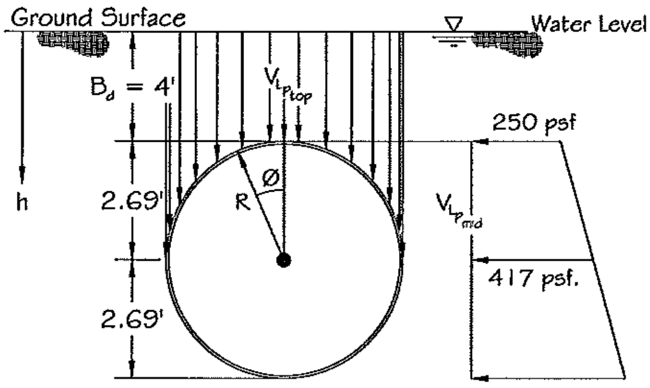
WEB SITE:

www.orenco.com

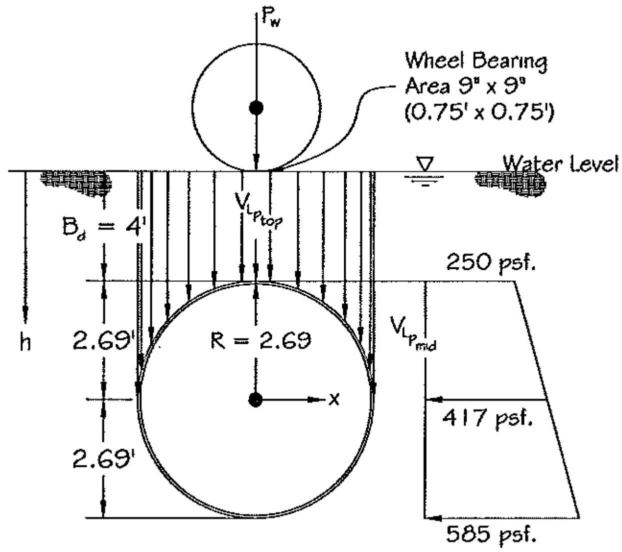
REGISTERED PROFESSIONAL ENGINEER 9634 OREGON JULY 13, 1979 TERRY R. BOUNDS

Oct. 5, 2001

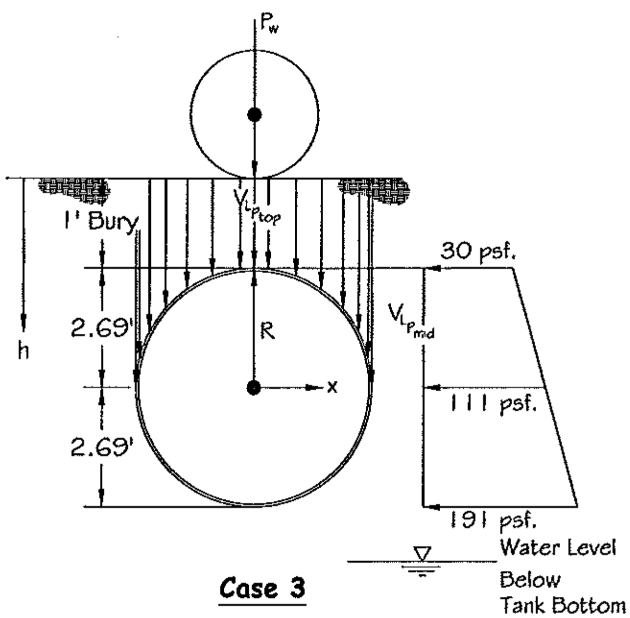
Loading Conditions:



Case 1



Case 2



Case 3

Case 1:

$B_d = 4'$

$\gamma_{sat} = 140 pcf$

Vertical Load Pressure (L_P)

$V_{LP} = h\gamma_w + h(\gamma_{sat} - \gamma_w) = h\gamma_{sat}$

$V_{LP\,top} = 560$ psf > 500 psf min.

$V_{LP\,mid} = 936.6$ psf.

Horizontal Load Pressure

EFP = 62.4 pcf.

$HL_P = \gamma_{wh}(h)$

$HL_{P_t} = 250$ psf.

$HL_{Pb} = 585$ psf.

Case 2:

$B_d = 4'$

$P_w = 2500\#$ (IF = 0)

Vertical Load Pressure

$V_{LP_h} = P_w/(0.75' + h)^2 + h\gamma_{sat}$

$V_{LP_t} = 671$ psf

$V_{LP_{mid}} = 982$psf

Horizontal Load Pressure

EFP = 62.4 pcf.

$HL_P = \gamma_w(h)$

$HL_{P_t} = 250$psf

$HL_{P_b} = 585$psf

Case 3:

$B_d = 1'$

$P_w = 2500\#$ (IF = 0.30)

$\gamma_{dry} = 127$pcf

Vertical Load Pressure

$V_{LP_h} = (1.3)\,P_w/(0.75' + h)^2 + h(\gamma_{dry})$

$V_{LP_t} = 1188$psf

$V_{LP_{mid}} = 707$psf

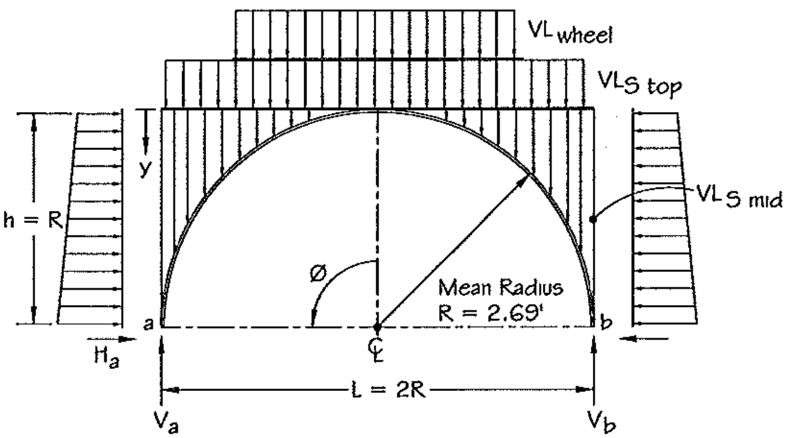
Horizontal Load Pressure

EFP = 30 pcf.

$HL_{P_t} = 30$psf

$HL_{P_b} = 191.4$psf

Arch Section Analysis



Arch Reactions

Horizontal loads left and right side are equal. $M_a = 0$ & pinned both ends. $\Delta_H = 0$

$$H_a = \frac{LP_H}{A_{HH}}$$ (Roark & Young fifth edition p.g. 240)

$$V_b = \frac{1}{2} VL \text{ Total}$$

$$A_{HH} = Ø + 2Øc^2 - 3sc + \alpha\,(Ø + sc) + \beta\,(Ø - Sc)$$

Where:

$$Ø = 90° = \frac{\Pi}{2}$$

$$c = \cos Ø = 0$$

$$s = \sin Ø = 1$$

Axial stress deformation factor: $\alpha = \frac{I}{AR^2}$

$$\alpha = \frac{1.75}{(2.605)(32.25)^2} = 0.0007$$

Transverse shear deformation factor: $\beta = \frac{FEI}{GAR^2}$

$$\beta = \frac{1.1(800{,}000)(1.75)}{400{,}000(2.605)(32.25)^2} = 0.0015$$

Note: small values of α & β indicate that bending governs deformation.

$E = 800{,}000$ psi

$G = 400{,}000$ psi

$I = 1.75\ \text{in}^4$

$A = 2.605\ \text{in}^2$

D_1 & D_2 = Y distance from N.A. of wall rib section

R = Arch radius = 32.25"

F = Shape factor...(I - beam or box section with consistent web & flange thickness D_2 & D_1 $\therefore \frac{t_1}{t_2} = 1$)

$$F = \left[1 + \frac{3}{2}\frac{(D_2^2 - D_1^2)\,D_1}{D_2^3}\left(\frac{t_1}{t_2} - 1\right)\right]\left(\frac{4D^2}{10r^2}\right)$$

$$r = \text{radius of gyration} = \sqrt{\frac{I}{A}} = \sqrt{\frac{1.75}{2.605}} = 0.82"$$

$$F = \frac{4(1.405)^2}{10(0.82)^2} = 1.17$$

$$A_{HH} = Ø + 2Ø\cancel{c^2}^{0} - 3s\cancel{c}^{0} + \alpha(Ø + s\cancel{c})^{0} + \beta(Ø - S\cancel{c})^{0}$$

$$A_{HH} = \frac{\Pi}{2}(1 + \alpha + \beta)$$

$$A_{HH} = \frac{\Pi}{2}\left(1 + \frac{I}{AR^2} + \frac{FEI}{GAR^2}\right) = 1.574$$

$$LP_H = wR\left[\frac{Sc^2}{2} - \frac{2s^3}{3} + \frac{Øc}{2} - Øc^3 + (\alpha - \beta)\,\frac{2s^3}{3}\right]$$

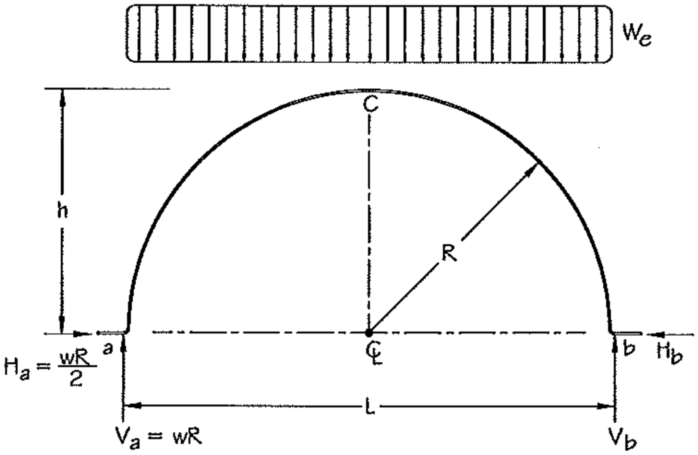
$$LP_H = wR\left[0 - \frac{2(1)^3}{3} + 0 - 0 + (0.0007 - 0.0015)\,\frac{2(1)^3}{3}\right]$$

$$LP_H = -\,0.6672\ wR$$

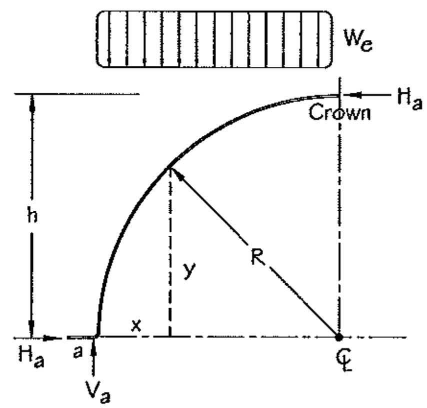
Horizontal reaction

$$H_a = \frac{LP_H}{A_{HH}} = \frac{0.667\ wR}{1.57} = 0.42\ wR$$

Arch Section Analysis



$$R = \frac{4h^2 + L^2}{8h} = 2.69'$$



$$y^2 = R^2 - (R - x)^2$$

$$y = \sqrt{R^2 - (R^2 - 2Rx + x^2)}$$

$$y = \sqrt{2Rx - x^2}$$

$$\Sigma M_{end} = 0: \; V_a = V_b = \frac{wl}{2}$$

$$\Sigma M_{center} = 0: \; H_a = H_b = \frac{wl^2}{8h}$$

Note: arch section is semicircle, therefore,

$$h = R$$

$$L = 2R = 2h$$

$$H_a = H_b = \frac{wR}{2}$$

$$V_a = V_b = wR$$

AITC Maximum moment with uniform horizontal projected load

$$M_{max} = \frac{wh^2}{8}$$

Equivalent Uniform Load Projections (W_e)

Case 1

$$W_e = 560 + \left[\frac{(936.6 - 560)(5.38) - \left(\frac{140}{2}\right)\left(\frac{\Pi(5.38)^2}{4}\right)}{5.38}\right]$$

$$W_e = 560 + 81 = \underline{\underline{640 \text{ psf}}}$$

$$V_a = 640(2.69) = 1722 \; \frac{\text{lb.}}{\text{ft. seam}}$$

$$H_a = \frac{640(2.69)}{2} = 860 \; \frac{\text{lb.}}{\text{ft. seam}}$$

Case 2

$$W_e = 671 + \left[\frac{(982 - 671)(5.38) - \left(\frac{140}{2}\right)\left(\frac{\Pi(5.38)^2}{4}\right)}{5.38}\right]$$

$$W_e = 671 + 82 = \underline{\underline{753 \text{ psf}}}$$

$$V_a = 753(2.69) = 2030 \; \frac{\text{lb.}}{\text{ft. seam}}$$

$$H_a = \frac{753(2.69)}{2} = 1013 \; \frac{\text{lb.}}{\text{ft. seam}}$$

Case 3

$VL_{wheel} = \frac{2500 \text{ lb}}{(1 + 0.75)^2}(1.3) = 1061$ psf (10-1/2" left & right of ℄)

$VL_{S1} = 127$ psf (at crown)

$VL_{S2} = 127$ psf $(2.69) = 341.6$

VL_S (vertical soil load) varies from zero at around surface to 469 psf at the mid-seam depth.

Horiz loads (HL_R & HL_L) are equal & opposite:

$$\therefore \Sigma M_a = 0$$

$$M = 2.69' \left[1061 \text{ psf}\left(\frac{21"}{12"}\right) + 127 \text{ psf } (5.38')\right]$$

$$+ 2.69' \left[341.6 \text{ psf } (5.38') - \left(\frac{127 \text{ psf}}{2}\right)\left(\frac{\Pi(5.38)^2}{4}\right)\right]$$

$$+ \frac{2.69}{2}\left[\cancel{HL_R - HL_L}\right]$$

$$- 5.38 (V_b)$$

$$V_b = \frac{2.69'}{5.38'}\left[1{,}857 + 683.3 + 394.3\right]$$

$$V_b = 1467 \; \frac{\text{lb.}}{\text{ft. seam}}$$

$$W_e = \frac{V_b}{R} = \frac{1467 \frac{\text{lb.}}{\text{ft. seam}}}{2.69'} = \underline{\underline{545 \text{ psf}}}$$

$$H_a = \frac{W_e R}{2} = \frac{545\,(2.69)}{2} = 743 \; \frac{\text{lb.}}{\text{ft. seam}}$$

Midseam support from soil
Lateral Bearing q_H:

$$q_H = 200 \; \frac{\text{psf}}{\text{ft. depth}}$$

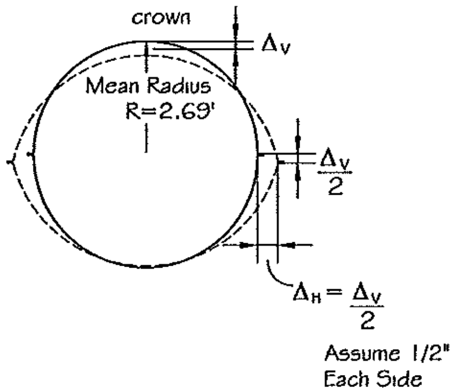
@ $B_d = 1'$: $q_H = 200(3.69') = 740$ psf $\approx H_a = 743$

@ $B_d = 4'$: $q_H = 200(6.69') = 1340$ psf $> H_a = 1013$

Stress Analysis

$M_C = M_B$

$$\Delta = \int \frac{M m dx}{EI} = \underbrace{\left[\frac{M}{EI}\right]}_{\text{area}} \left[\begin{matrix}\text{Moment}\\ \text{Arm}\end{matrix}\right]$$



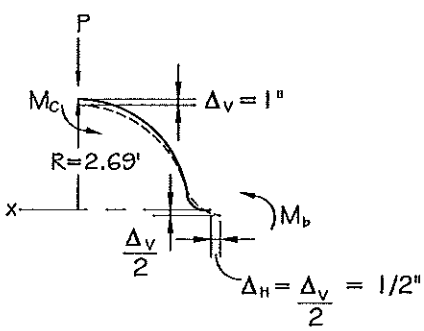
$\Sigma M_B = 0 \quad M_C + M_b - PR = 0$

$$2M_C = PR$$

$$M_C = \frac{PR}{2}$$

$$\Delta = \frac{M}{EI}\left(\frac{R}{2}\right)\left(\frac{2}{3}R\right) - \frac{M}{EI}\left(\frac{R}{2}\right)\left(\frac{1}{3}R\right)$$

$$\Delta = \frac{MR^2}{3EI} - \frac{MR^2}{6EI} = \frac{MR^2}{6EI}$$

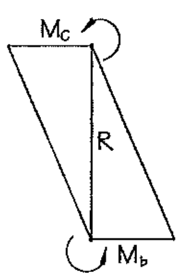


$$\Delta = \frac{MR^2}{6EI}$$

$$M = \Delta \frac{6EI}{R^2}$$ (Actual stress relative deflection 1/2")

$$M = \frac{1/2''\,(6EI)}{(2.69')^2}$$

$$M = \frac{(1/2'')(6)\,(800{,}000)(1.75''\text{in}^4)}{(32.25'')^2}$$

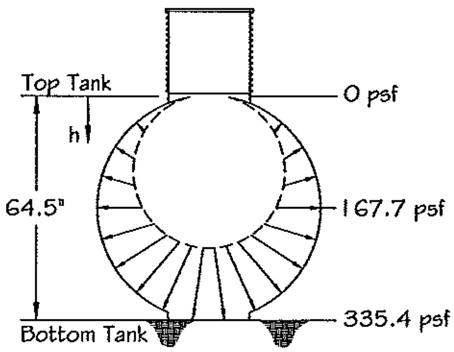


$M = \underline{\underline{4038''^{\#}}}$ per 11.55" rib section

$$f_s = \frac{M}{S} = \frac{4038''^{\#}}{1.25\text{in}^3}$$

$f_s = \underline{\underline{3{,}230 \text{ psi}}}$

Loading Conditions Four



Case 4

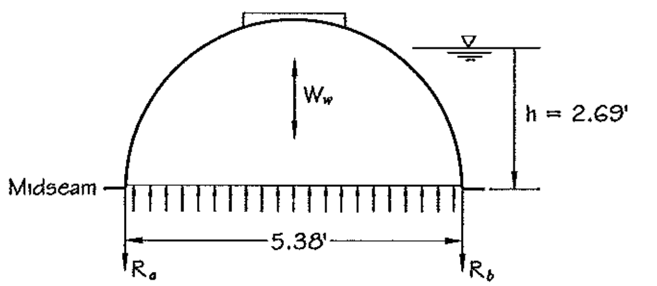
Case 4: Hydrostatic Test Condition

Hydrostatic Load:

$$HL = \gamma_w (h)$$

$$W_{w_{\text{top section}}} = \gamma_w (A_{section}) = \frac{62.4\left(\frac{\Pi(5.375')^2}{4}\right)}{2}$$

$$\underline{\underline{W_{w_{\text{top section}}} = 707.9\ ^{\#}/_{ft}}}$$



Top Section

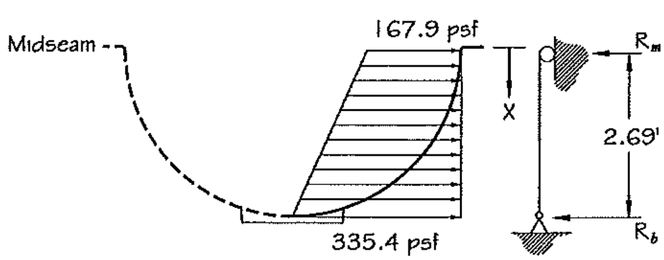
Top Section:

Average Lifting Pressure:

$$R_a \,\&\, R_b = \gamma_w(h)\left(\frac{5.38'}{2}\right) - \frac{W_w}{2} = \gamma_w(2.69)\left(\frac{5.38'}{2}\right) - \frac{707.9}{2}$$

$$= 451.5\ ^{\#}/_{ft} - 354.6\ ^{\#}/_{ft}$$

$$= 96.9\ ^{\#}/_{ft} \text{ seam} = 8.08\ ^{\#}/\text{inch of seam}$$



Bottom Section

Bottom Section:

Flexural Stress (Lateral Load Evaluation)

Tank shell is free to flex at midseam & angular rotation is unresisted at the bottom bearing point. Threefore, the simple support condition show is used as a conservative approach to evaluate case 4 flexural stress.

$$\therefore R_m = \frac{167.9\ (2.69)}{2} + \frac{(335.4 - 167.9)(2.69)}{6} = 301\ ^{\#}/_{ft}$$

$$M_m = R_m(X) - 167.9\ \frac{X^2}{2} - 62.4\ \frac{X^3}{6}$$

$$\frac{dM_m}{dx} = R_m - 167.9x - 62.4\ \frac{X^2}{2} = 0$$

$\therefore$

$$31.2\,X^2 + 167.9x - 301 = 0$$

$$X = \frac{-167.9 \pm \sqrt{(167.9)^2 - 4(31.2)(-301)}}{2(31.2)} = 1.42' \text{ down from midseam}$$

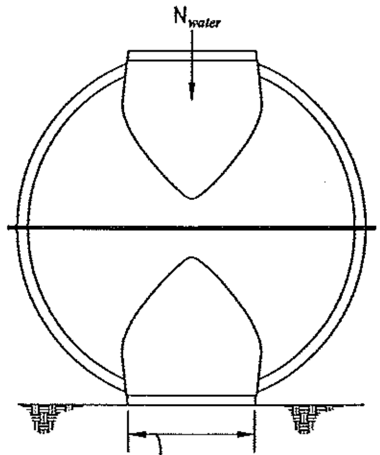
so

$$M_1 = 228'\ ^{\#}/_{ft} = 2741''\ ^{\#}/_{ft}$$

$$f_{flex} = \frac{2741''\ ^{\#}/_{ft}\left(\frac{11.55}{12}\right)}{(1.25\ in^3)} = 2110 \text{ psi}$$

1 hr: DF = 1.5

24 hr: DF = 1.35



Bottom Bearing Area:

Total N_w = 1,585 gal (8.34 #/gal) = 13,220#

Bearing Area: $9\,(2\frac{1}{4}")\,(x_{unloaded}) = 61\ in^2$

During Hydrostatic Test: $x_{fully\ loaded}$

where:

$x_{unloaded} = 3"$

$x_{fully\ loaded} = 4"$

End Access Flats (two)

$$\frac{2\,\Pi\,(23.4")^2}{4} = 860\ in^2$$

$$f_{c_1} = \frac{13{,}219^{\#}}{920\ in^2}$$

$$f_{c_{ribs}} = \frac{13{,}219^{\#}}{A_{total}}$$

Compressive stress in riser access walls and rib walls:

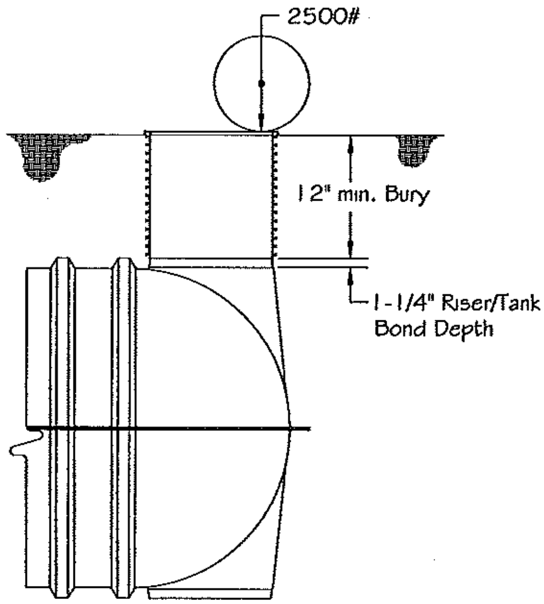
$A_{\substack{Access\\perimeter}} = \Pi(23.4")\,(2)\,(0.19") = 27.9\ in^2$

$A_{rib} = 9\,(2)\,(3")\,(0.19") = 10.26\ in^2$

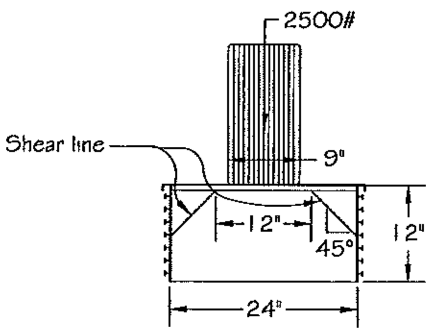
$A_t = 27.9\ in^2 + 10.26\ in^2 = 38.2\ in^2$

$$f_{c_{\substack{ribs\\walls}}} = \frac{13{,}219^{\#}}{38.2\ in^2} = 346\ psi$$

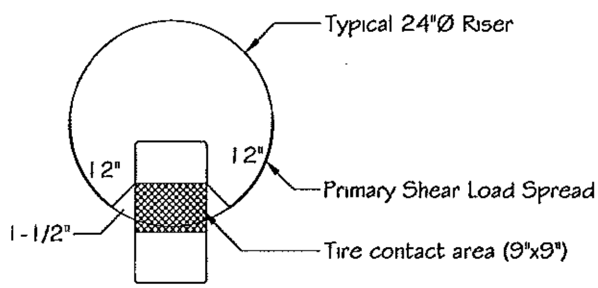
Riser/Tank Connection & Shear



Side View



End View



Top View

Wheel Load: 2500#

Wheel Bearing Area: 9"x9"

Shear angle down PVC riser: 45°

Minimum Bury: 12"

Shear Strength:

ADH100: $f_v = 112$ psi

MA320: $f_v = 2000$ psi

ABS/PVC: $f_v = 1300$ psi

Riser/Tank shear load perimeter contact length (L)

L = 36"

depth of bond = 1-1/4"

∴ Bond shear area = 45 in²

$$P = \frac{45\ in^2\,(112\ psi)}{1000} = 5.04^k$$

Full 24" Dia. riser bearing capacity

$$A_{perim} = \Pi(23.5")(1.25") = 92.28\ in^2$$

$$P_t = \frac{92.28\ in^2\,(112\ psi)}{1000} = 10.3^k$$

Riser Shear:

$$\frac{P}{2} = 1300\ psi\ \frac{(1.414)(12")(t)}{1000}$$

Average thickness = 0.65"

$$\therefore \frac{P}{2} = 14.3^k \text{ each shear line}$$

$$\therefore P_{total} = 2(14.3) = 28.6^k \quad >> 2.5^k \text{ wheel load}$$

Fiberglass Laminate Shear:

$F_{lam\ shear} = 1500$ psi >> Min. epoxy shear strength

Access Risers & Tank Adapters

Orenco Systems® Incorporated
1-800-348-9843

Installation Instructions

Access risers provide access to septic tank openings, simplifying inspection and maintenance procedures. It is important that the riser be sized correctly and installed properly (i.e., appropriate tank adapter, attachment method, etc.) to ensure a watertight seal. Without a watertight seal, groundwater or surface water can leak into the tank, reducing the tank's performance. When setting a riser, orient the grommets in the appropriate directions before bonding to the tank.

Riser Sizing

The installed riser should extend about 3 inches above the finished ground level (approximately 2 inches for tank settlement and 1 inch to ensure drainage away from the riser). If the riser is too long, it may be cut to the appropriate height using a circular saw or table saw. Always cut excess length from the bottom of the riser. To ensure a good fit and watertight joint, a square cut is essential. If the riser is too short, a grade ring may be used as an extension.

Selecting a Riser and Tank Adapter Installation Method

To select an appropriate riser and tank adapter installation method, first determine the type of tank being used: concrete or fiberglass. Then refer to the chart, below, as you follow these steps:

Concrete Tanks

1. Determine desired riser diameter.
2. Determine if the riser tank adapter will be cast-in or bolted down.
3. Referring to the chart below, pick the appropriate tank adapter for your riser diameter and method of attachment. If the bolt-down method is being used, make sure the adapter you selected will cover the tank's opening.

Orenco Fiberglass Tanks (contact your distributor or Orenco for other fiberglass tanks)

1. For 30" riser, choose the FRTA30-FRP tank adapter.
2. For 24" riser, no adapter is needed; 24" riser fits tank directly.

Tank Adapter	Method of Attachment	Riser Diameter	Max. Tank Opening
PRTA24	Bolted down or cast into concrete tank	24"	24" round/17" square
PRTA30	Bolted down or cast into concrete tank	30"	30" round/21" square
RRFTA	Bolted down to concrete tank or epoxied to top of non-Orenco FRP tank	21" or 24"	24" round/24" square
RRFTA30	Bolted down to concrete tank	30"	30" round/30" square
FRTA30-FRP	Glued onto Orenco FRP tank or PRTA24, allowing it to accept 30" riser.	30"	NA

Choosing Your Instruction Set

Following are six different installation instruction sets, depending on your application, adapter, and method of attachment. Refer to the chart below to determine which instruction set to use:

Instruction Set	Adapter Type Used	Page #
1. Orenco FRP Tank Adapter	FRTA30-FRP	2
2. Cast-In Adapters	PRTA24, PRTA30	3
3. Round Bolt-Down Adapters	PRTA24, PRTA30	4
4. Square Bolt-Down Adapters	RRFTA, RRFTA30	5
5. No Adapters: Ultra-Rib Bolt-Down Kit	None, Ultra-Rib pipe	6
6. No Adapters: Grooves in Tank	None, grooves formed in tank	7

Installation Instructions (continued)

Important Adhesive Notes!

ADH100 adhesive requires a clean, dry mating surface to bond correctly. Single-component adhesive has the consistency of toothpaste and will sag slightly in warmer temperatures. Handling strength is achieved within 12 hours, full cure in 2 to 3 days. Comes in a 10.2 oz. cartridge tube.

ADH10 (IPS810) adhesive requires a roughened, clean, and dry mating surface to bond correctly. Two-component ADH10 (IPS810) has the consistency of honey and will run down vertical surfaces. Cure time is achieved in 30 minutes to 3 hours, depending on temperature. Comes in pints, quarts, and gallons.

MA320 adhesive requires a clean, dry mating surface to bond correctly, but surface roughening is not necessary. Two-component MA320 has the consistency of peanut butter and will not run. Cure time is achieved in 30 minutes to 3 hours, depending on temperature. MA320 is preferable for bonding PVC or fiberglass **but does not bond to concrete.** Comes in a two-part 200-gram pouch.

SS620 adhesive has the same properties as MA320. It is good for cool temperatures (winter usage). It is available in a 29.4 oz. cartridge for large-volume users. **Requires a pneumatic gun to dispense.**

SS630 adhesive has the same properties as SS620 except it has a longer set time. It is good for warm temperatures (summer usage). It is available in a 29.4 oz. cartridge for large-volume users. **Requires a pneumatic gun to dispense.**

Clockwise from top: ADH100, SS620 (and SS630), ADH10 (2-part), and MA320 (sack).

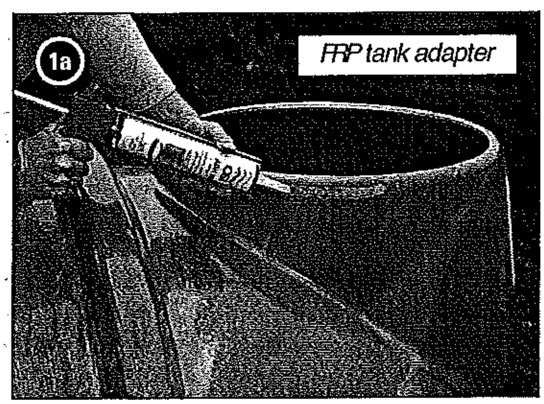
Instruction Set 1: Orenco 30" FRP Tank Adapter

Adapter type used :	FRTA30-FRP
Adhesive used:	ADH100, MA320, SS620, or SS630
Bolt-down kit used:	None

Step 1a: Apply adhesive

Apply adhesive to the ouside surface of the riser tank adapter.

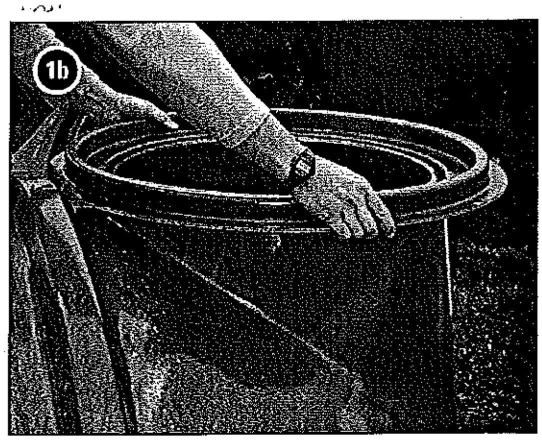
Hint: If you plan to backfill the same day, the use of MA320, SS620 or SS630 adhesive is recommended because of their quicker cure times. If you have multiple riser installations and do not have bulk adhesive (SS620/SS630), you may want to consider the use of both MA320 and ADH100. Apply just enough MA 320 on the outside of the tank adapter for a quick structural joint (cure time is typically less than an hour). A single package of MA320 can be used to provide a structural joint on two or three risers. Then apply ADH100 to the inside of the adapter and the riser joint, for a watertight seal.



Step 1b: Install riser

The riser may be installed and sealed to the adapter in the same way as with the cast-in adapter. (Refer to Instruction Set 2, steps 2b - 2d.)

Note: Adapter is only required with 30" risers. Orenco tanks accept 24" risers directly, with appropriate adhesive.



Installation Instructions (continued)

Instruction Set 2: Cast-In Adapters

Adapter type used: PRTA24 or PRTA30
Adhesive used: ADH100, MA320, SS620, or SS630
Bolt-down kit used: None

Step 2a: Apply adhesive

Apply adhesive to the ouside surface of the riser tank adapter.

Hint: If you plan to backfill the same day, the use of MA320, SS620 or SS630 adhesive is recommended because of their quicker cure times. If you have multiple riser installations and do not have bulk adhesive (SS620/SS630), you may want to consider the use of both MA320 and ADH100. Apply just enough MA 320 on the outside of the tank adapter for a quick structural joint (cure time is typically less than an hour). A single package of MA320 can be used to provide a structural joint on two or three risers. Then apply ADH100 to the inside of the adapter and the riser joint, for a watertight seal.

Step 2b: Place riser

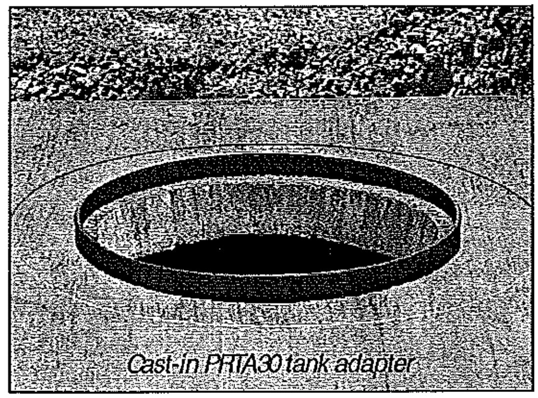
Orient the riser correctly and carefully slide it onto the adapter before the adhesive cures.

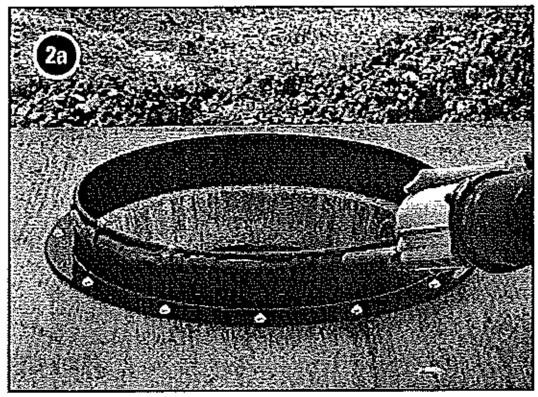
Step 2c: Seal adapter-to-riser joint

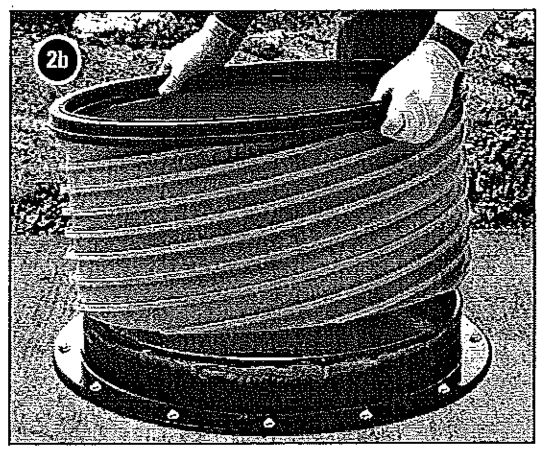
Apply adhesive to the inside of the adapter and riser joint. Use a putty knife or similar tool to form a continuous fillet between the tank adapter and the inside of the riser.

Step 2d: Cure adhesive

Allow adhesive to harden before backfilling. For ADH100, handling strength is typically achieved within 12 hours. For MA320, cure time is achieved within 30 minutes to 3 hours, depending on temperature.


Cast-in PRTA30 tank adapter





Installation Instructions (continued)

Instruction Set 3: Round Bolt-Down Adapters

Adapter type used: PRTA24, PRTA30
Adhesive used: ADH100, MA320, SS620, or SS630
Bolt-down kit used: PRTA24BDKIT, PRTA30BDKIT

Step 3a: Drill holes into tank

Place the adapter over the tank opening. Using a 1/4" masonry drill bit, drill through the holes in the adapter a minimum 1 3/8" deep into the concrete to accept the concrete anchors. Clear holes of debris.

Step 3b: Apply butyl tape to adapter

Apply butyl tape just inboard of the bolt pattern to the underside of the tank adapter. Be sure to thoroughly clean the tape mating surface before applying. While lining up the drilled holes, place tank adapter on tank surface, butyl tape side down.

Step 3c: Assemble anchor

Install the washer and begin threading the nut on the end of the concrete anchor. Leave nut flush with end of anchor to protect the threads.

Step 3d: Locate anchor

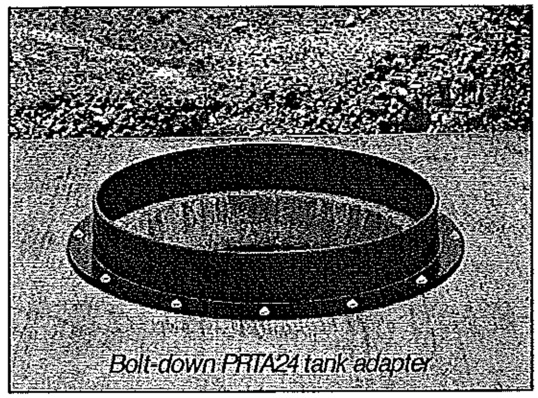
Using a hammer, drive the concrete anchor through the tank adapter mounting holes into the drilled hole in the concrete, until the anchor is bottomed out in the hole.

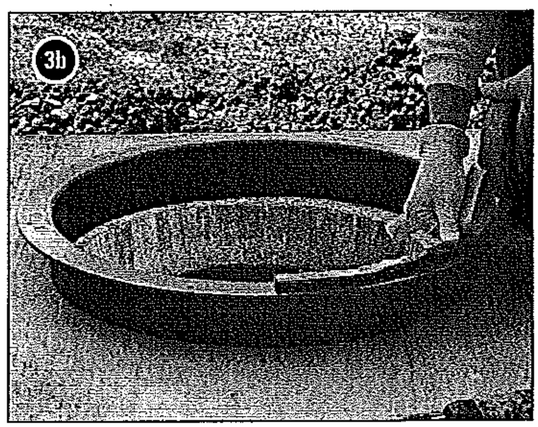
Step 3e: Secure adapter

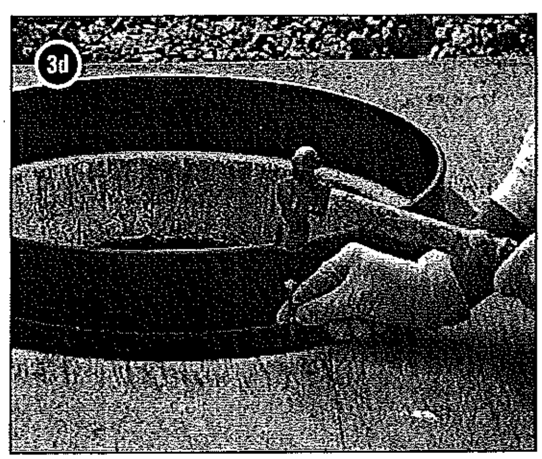
Bolt the tank adapter to the tank by tightening the anchor nut 3 to 5 turns past the hand tight position. Repeat the process until all concrete anchors are firmly attached. The butyl tape should form a watertight seal between the adapter and tank.

Step 3f: Install riser

After the riser tank adapter has been securely attached, the riser may be installed in the same way as with a cast-in tank adapter. (Refer to Instruction Set 2, steps 2a - 2d.)

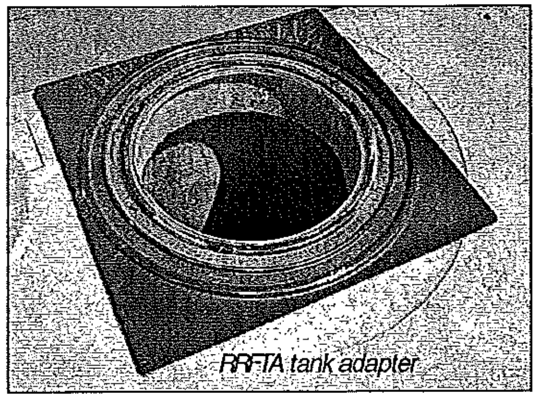

Bolt-down PRTA24 tank adapter

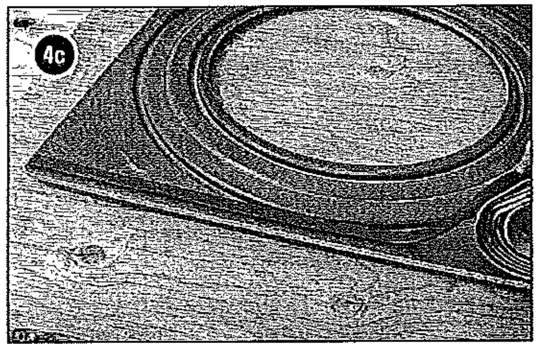


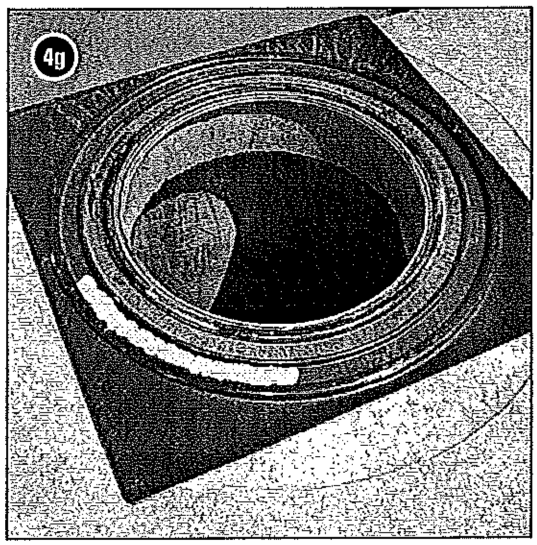


Installation Instructions (continued)

Instruction Set 4: Square Bolt-Down Adapters







Adapter type used :	RRFTA, RRFTA30
Adhesive used:	ADH10 (IPS810)
Bolt-down kit used:	RRFTABDKIT, RRFTA30BDKIT

Step 4a: Mark bolt hole locations

Place the adapter over the tank opening and mark bolt hole locations on the adapter. Use a 1/4" drill bit to drill the holes through the adapter.

Step 4b: Drill holes into tank

Using a 1/4" masonry drill bit, drill through the holes in the adapter a minimum 1 3/8" deep into the concrete to accept the concrete anchors. Clear holes of debris.

Step 4c: Apply butyl tape to adapter

Apply butyl tape just inboard of the bolt pattern to the underside of the tank adapter. Be sure to thoroughly clean the tape mating surface before applying. While lining up the drilled holes, place tank adapter on tank surface, butyl tape side down.

Step 4d: Assemble anchor

Install the washer and begin threading the nut on the end of the concrete anchor. Leave nut flush with end of anchor to protect the threads.

Step 4e: Locate anchor

Using a hammer, drive the concrete anchor through the tank adapter mounting holes into the drilled recess in the concrete, until the anchor is bottomed out in the hole.

Step 4f: Secure anchor

Bolt the tank adapter to the tank by tightening the anchor nut 3 to 5 turns past the hand tight position. Repeat the process until all concrete anchors are firmly attached. The butyl tape should form a watertight seal between the adapter and tank.

Step 4g: Apply adhesive to adapter

Determine which groove in the adapter you will be using by test-fitting your riser. RRFTA adapter accommodates both 21" and 24" diameter risers and requires one pint of adhesive to fill the locating groove. RRFTA30 has only one groove for 30" diameter risers and requires one quart of adhesive to fill the locating groove.

Step 4h: Place riser

Be sure to orient the riser correctly before adhesive cures. Set the riser in place by twisting gently while working it into the groove. If necessary, use a putty knife on the inside of the riser to shape the bead of displaced adhesive into a continuous, watertight fillet.

Step 4i: Cure adhesive

Allow adhesive to harden before backfilling.

Installation Instructions (continued)

Instruction Set 5: Ultra-Rib Bolt-Down Kit

Adapter type used :	None, Ultra-Rib Pipe
Adhesive used:	None
Bolt-down kit used:	RUBDKIT
	(1 for 18" dia. riser; 2 for 24" dia. riser)

Step 5a: Mark bolt hole locations

With the Ultra-Rib Riser in place over the outlet opening, measure 1/2" to 3/4" outward from the outside of the riser's rib, and locate three holes positioned equally around the outside of the riser for 18" pipe, 6 holes for 24" pipe.

Step 5b: Drill holes

Using a 1/4" masonry drill bit, drill each hole a minimum 1 3/8" deep to accept the concrete anchors. Clear hole of debris.

Step 5c: Apply butyl tape to adapter

Apply butyl tape to the underside of the Ultra-Rib Pipe. Be sure to thoroughly clean the tape mating surface before applying. Place Ultra-Rib pipe on the tank surface, butyl tape side down.

Step 5d: Assemble anchor

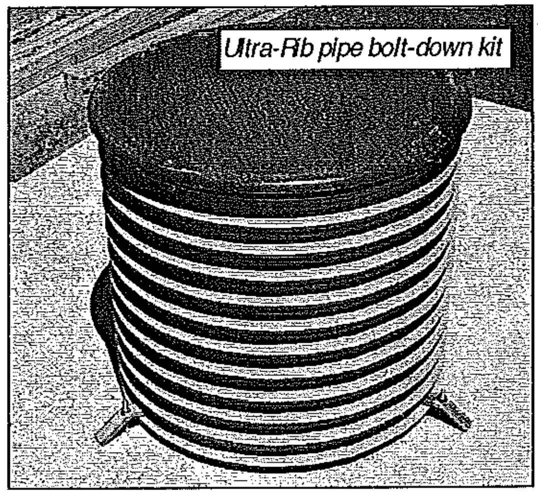
Install the washer and begin threading the nut on the end of the concrete anchor. Leave nut flush with end of anchor to protect the threads.

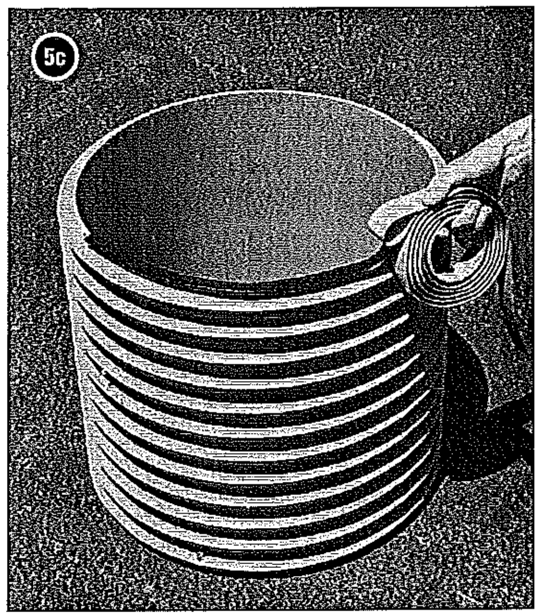
Step 5e: Locate anchor and mount strap

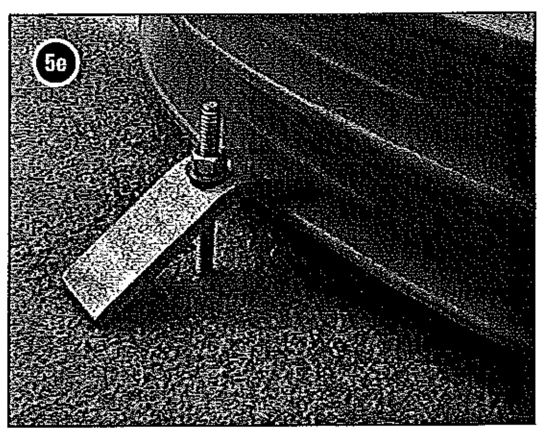
Slide anchor through the slotted hole in the stainless steel mount strap. Using a hammer, drive the concrete anchor into the drilled recess in the concrete, until the anchor is bottomed out in the hole.

Step 5f: Secure riser

Bolt the Ultra-Rib pipe to the tank by tightening the anchor nut 3 to 5 turns past the hand tight position. Repeat the process until all concrete anchors are firmly attached. The butyl tape should form a watertight seal between the adapter and tank.







Installation Instructions (continued)

Instruction Set 6: Grooves in Tank

(Least effective method)

Adapter type used:	None
Adhesive used:	ADH10 (IPS810)
Bolt-down kit used:	None.

Step 6a: Prepare mounting surface

Roughen, clean, and dry the surfaces of the riser and tank where they are to be joined. If the groove is wet, sponge up as much water as possible, then dry thoroughly.

Step 6b: Apply adhesive to groove

Fill the groove with approximately one pint of adhesive for 21" or 24" diameter grooves or one quart of adhesive for 30" diameter grooves.

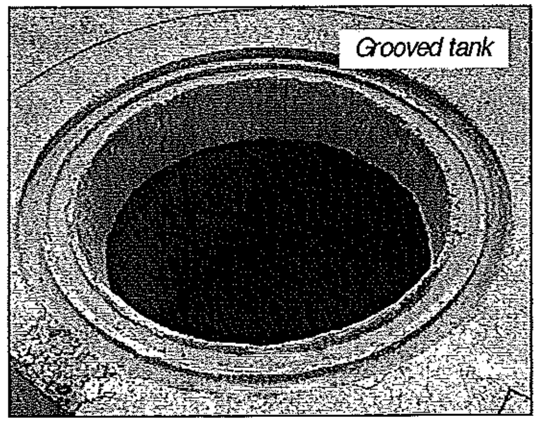
Step 6c: Place riser

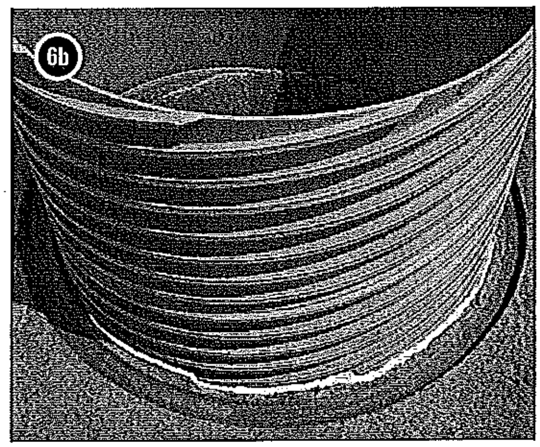
Be sure to orient the riser correctly before adhesive cures. Set the riser in place by twisting gently while working it into the groove. Use a putty knife on the inside of the riser to shape the bead of displaced adhesive into a continuous, watertight fillet.

Step 6d: Cure adhesive

Allow adhesive to harden before backfilling.

Caution: This method is susceptible to failure due to tank settlement and frost heave.

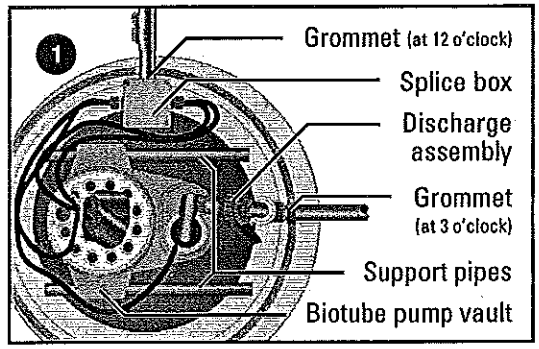




Grommet Installation Instructions

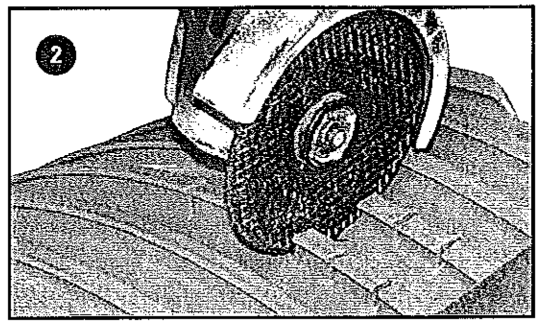
Orenco Systems® Incorporated
1-800-348-9843

Installing Grommets



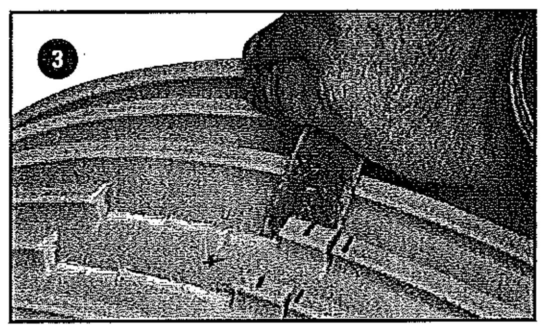
Step 1:

To install grommets in the field, first mark the riser for location of the grommets — in the 12 o'clock and 3 o'clock positions, as shown in the diagram. (For Perma-Loc risers, you should try to avoid cutting through the pipe seam — the extra thick rib — unless it is unavoidable.)



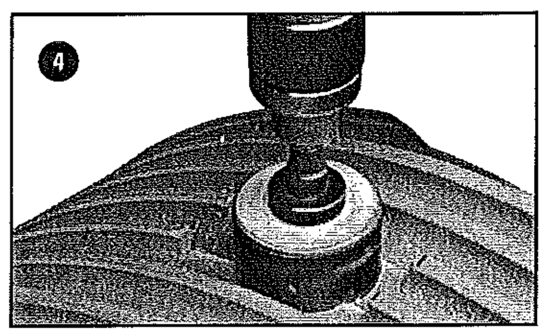
Step 2:

Using a 4" grinder or other cutting tool, notch through the PVC ribs to the wall of the PVC riser. Remove an area of ribbing equal to approximately 1" larger than the grommet diameter.



Step 3:

Using a hammer and chisel, break the notched ribs from the riser. Use a grinder to remove any remaining rib material so that you are left with a smooth area, ensuring a watertight fit.

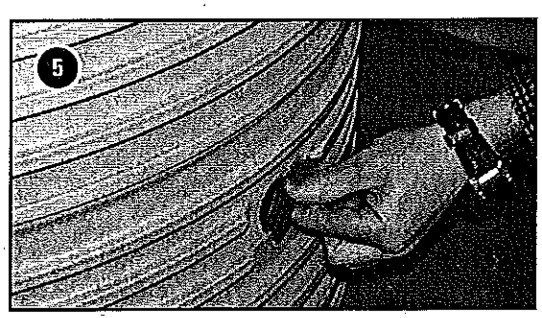


Step 4:

Using the Grommet Hole Saw Sizing Chart below, select a hole saw for the grommet installation and drill out the opening. Use a deburring tool or knife to deburr the edges of the opening, being careful not to enlarge the opening.

Grommet Hole Saw Sizing Chart

Grommet / Pipe Diameter Size (in.)	Hole Size (in.)
1/2	1
3/4	1-1/4
1	1-9/16
1-1/4	1-3/4
1-1/2	2-1/8
2	2-3/4
3	3-7/8
4	5



Step 5:

Install the grommet in the riser. We highly recommend applying a bead of ADH100 adhesive to the groove of the grommet prior to insertion into the riser hole. This will make the grommet more secure and will overcome any imperfections in the drilled hole.

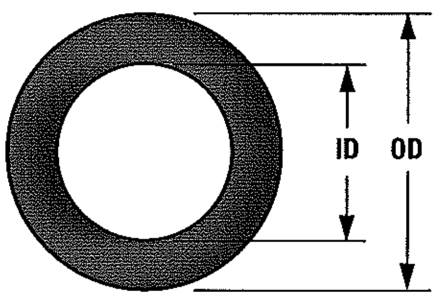
Pipe Grommets

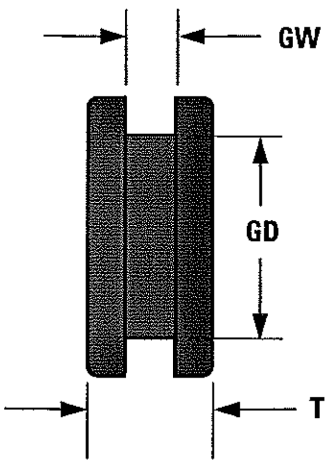
Submittal
Data Sheet

Orenco Systems®
Incorporated
1-800-348-9843

Applications

Orenco Pipe Grommets are used to provide a seal to prevent the passage of liquids through pipe ports.





General

Orenco Pipe Grommets are constructed of corrosion-resistant rubber to provide long-lasting seals. Grommets conform to standard IPS sizes. Not all models conform exactly to the depiction shown.

Standard Models

G05L, G075L, G1L, G125L, G150L, G2L, G3L, G4L, G6L

Nomenclature

G □□□ L

Indicates not installed

Indicates grommet diameter:
05 = 1/2"
075 = 3/4"
1 = 1"
125 = 1-1/4"
150 = 1-1/2"
2 = 2"
3 = 3"
4 = 4"
6 = 6"

Grommet

Specifications

Dimensions

Model	G05L	G075L	G1L	G125L	G150L	G2L	G3L	G4L	G6L
OD (inches)	1 1/4	1 1/2	1 7/8	2 1/8	2 1/2	3 7/8	5	6	8 1/8
ID (inches)	3/4	1	1 1/4	1 1/2	1 3/4	2 1/8	3 1/4	4 3/16	6 11/16
GD (inches)	1	1 1/4	1 5/8	1 3/4	2 1/8	2 11/16	3 13/16	4 15/16	7 5/8
GW (inches)	3/16	3/16	1/4	1/4	1/4	5/16	5/16	1/4	1/4
T (inches)	1/2	7/16	9/16	5/8	5/8	15/16	15/16	7/8	13/16
Holesaw Size (inches)	1	1 1/4	1 9/16	1 3/4	2 1/8	2 3/4	3 7/8	5	7

Material of Construction:

EPDM synthetic rubber in accordance with MIL-STD-417, 60 durometer.

Submittal Data Sheet

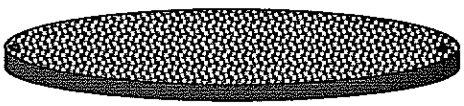
Fiberglass Access Lids

Orenco Systems® Incorporated
1-800-348-9843

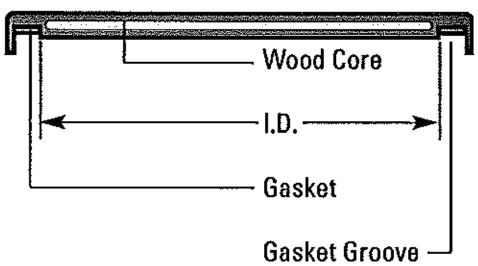
Applications

Orenco Fiberglass Access Lids are used as riser covers, pump basin covers, and access port covers. Lids fit Perma-Loc, Ultra-Rib, KOR FLO, and Ultra-Corr pipe.

Actual View



Cutaway View



General

Orenco Fiberglass Access Lids are molded using fiberglass reinforced polyester resin encapsulating a wood core. The finish is green and the top surface is textured to provide a non-skid surface. (Gasketed lids include a polyurethane or neoprene gasket.) Lid comes with either two or four 1/4" stainless steel flathead socket cap screws and a hex key wrench. Orenco Fiberglass Access Lids are capable of supporting a 2500 lb. wheel load; however, they are not designed or recommended for vehicular traffic.

Standard Models

FL18G-4BU, FL21G, FL24G, FL24-4B, FL24G-4BK, FL30G, FL48G

Nomenclature

FL □□ □ - □ - □ - □

Riser pipe:
Blank = Ultra-Rib, Perma-Loc
K = KOR FLO, Ultra-Corr

Color:
Blank = green
B = brown

Attachment method:
Blank = 2-bolt-hole lid (30" diameter only)
4B = 4-bolt-hole lid (24" diameter only)
4BU = 4-bolt-hole lid Ultra-Rib (18" and 24" diameter only)

Options:
G = gasket
V = vent
CF = carbon filter
I2 = 2" insulation
I4 = 4" insulation

Lid diameter: 18", 24", 30", 48"

Fiberglass lid

Specifications

Dimensions	Model FL18	Model FL21	Model FL24	Model FL30	Model FL48
O.D. (in.)	20.25	22.5	26.25	32.0	53.875
Groove I.D. (in.)	17.5	20.25	23.25	29.5	47.5
Avg. Thickness (in.)	0.75	0.75	0.75	1.0	1.5

Options Available

Feature	Model Code Adder	Optional/Standard
Air Vent	V	Optional
Carbon Filter[1]	CF	Optional
Lid Insulation[2]	I2 or I4	Optional

[1] *For more information on this option, refer to the Carbon Filters Submittal Data Sheet, NSU-RLA-CF-1.*

[2] *Blue styrofoam; R-value per 2" increment is 10.*

Materials of Construction

Fiberglass Reinforced Polyester
Wood Core
Neoprene or Polyurethane Gasket

Access Risers – Perma-Loc

Submittal Data Sheet

Orenco Systems® Incorporated
1-800-348-9843

Applications

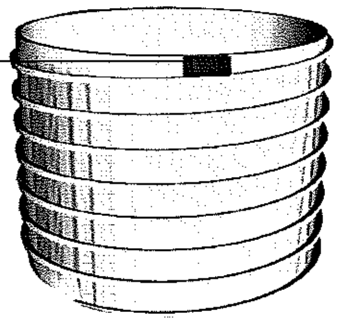
Orenco Access Risers are used to provide easy entry to septic tank access ports for maintenance purposes.

General

Orenco Perma-Loc Access Risers are constructed of ribbed PVC pipe and are available in 21", 24", and 30" diameters. 21" and 30" risers come with bolt catches for fastening lids. 24" risers come with a gasketed ABS lid adapter for fastening lids. Risers are available in any height in one-inch increments.

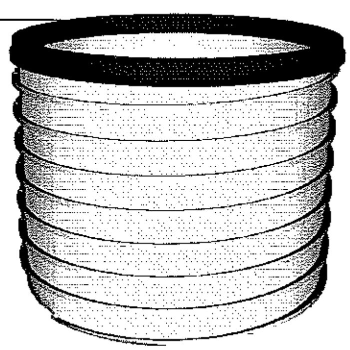
Bolt Catch

For use with 21" and 30" fiberglass access lids



Lid Adapter

For use with 24" fiberglass access lids



Standard Models

RR21XX, RR24XX, RR30XX

Nomenclature

RR ☐☐ ☐☐ + ☐ + ☐

- Indicates discharge grommet option:
  - 10 = 1"
  - 12 = 1-1/4"
  - 15 = 1-1/2"
  - 20 = 2"
- Indicates splice box option:
  - S = 1" grommet installed
  - L = 1.25" grommet installed
  - S1 = SB1 attached
  - S2 = SB2 attached
  - S3 = SB3 attached
  - S4 = SB4 attached
  - L5 = SB5 attached
  - L6 = SB6 attached
- Indicates riser height (inches)
- Indicates riser diameter: 21", 24", 30"
- Ribbed riser

Specifications

Dimensions

	Model RR21XX	Model RR24XX	Model RR30XX
I.D. (in.)	20.75	23.5	29.5
Wall Thickness - excluding ribs (in.)	0.12	0.14	0.20
O.D. - including ribs (in.)	21.91	24.82	31.00

Materials of Construction

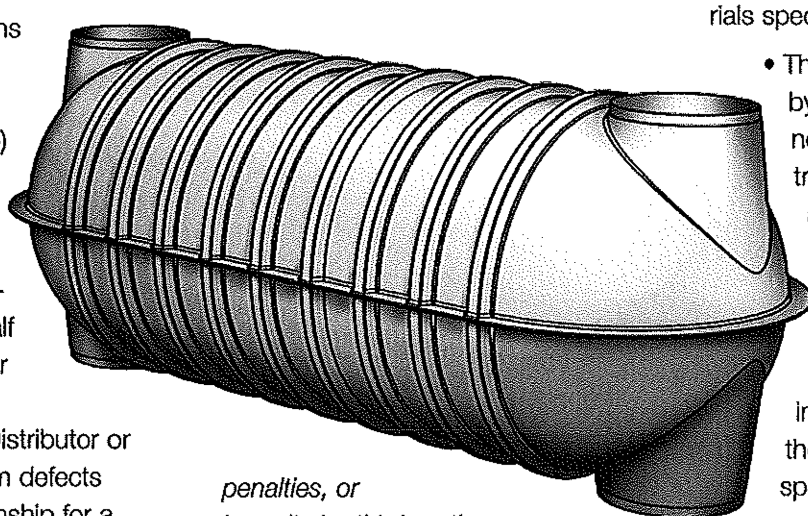
Ribbed PVC pipe: PVC
Bolt catch: PVC
Lid adapter: ABS

Orenco Systems®, Incorporated

FRP Septic Tank Half-Shell

Limited Warranty

Warranty Coverage



Subject to the conditions and limitations contained herein, Orenco Systems®, Inc. (Orenco) warrants to Orenco Distributor or Dealer that Orenco fiberglass reinforced polyester (FRP) septic tank half shells sold to Distributor or Dealer for assembly into finished tanks by Distributor or Dealer shall be free from defects in materials or workmanship for a period of five years from the date of shipment from Orenco.

Exclusive Remedy

The exclusive remedy for breach of this limited warranty shall be for Orenco or a representative designated by Orenco to repair or replace the defective septic tank half shells which shall be determined to the satisfaction of Orenco, upon Orenco examination, to have been defective. Orenco shall not be liable for any loss, injury, or damages to persons or property resulting from failure or any defect in the septic tank components or any failure in any other component of the wastewater treatment system that uses the septic tank assembled by Distributor or Dealer. Nor shall Orenco be liable for any incidental, consequential, special, economic, or indirect damages of any kind, including, but not limited to, loss of profits, plant downtime, fines or penalties, or lawsuits by third parties against the owner of the septic tank assembled by Distributor or Dealer. In no event shall the liability of Orenco exceed the total invoiced price of the defective septic tank half shells.

Disclaimer

Orenco makes no warranty as to the suitability or fitness for any particular purpose, nor any warranty of merchantability of the septic tank assembled by Distributor or Dealer from the septic tank half shells. There are no warranties, express, implied, or statutory, except the warranty set forth herein.

Exclusions, Limitations And Conditions

This warranty shall be void if any of the following occur:

- The septic tank assembled from the half shells sold to Distributor or Dealer by Orenco is not assembled in accordance with assembly instructions, procedures, and materials specified by Orenco.
- The septic tank is assembled by anyone who has not completed Orenco training in FRP septic tank assembly.
- The septic tank assembled from the half shells sold to Distributor or Dealer by Orenco is not installed in accordance with the installation instructions specified by Orenco.
- The septic tank assembled from the half shells sold to Distributor or Dealer by Orenco is used for any application other than the storage or processing of residential strength wastewater, unless written approval is obtained from Orenco in advance.
- Maintenance, including pumping to remove sludge accumulation, is not performed in accordance with Orenco's recommended maintenance procedures and schedules.
- Documentation of all septic tank maintenance does not accompany the warranty claim.

Procedures

Any claim for breach of this limited warranty must be made in writing within the 5-year warranty period. Any claim must be mailed or delivered to Orenco Systems®, Inc., 814 Airway Avenue, Sutherlin, OR 97479. Telephone: 541-459-4449.