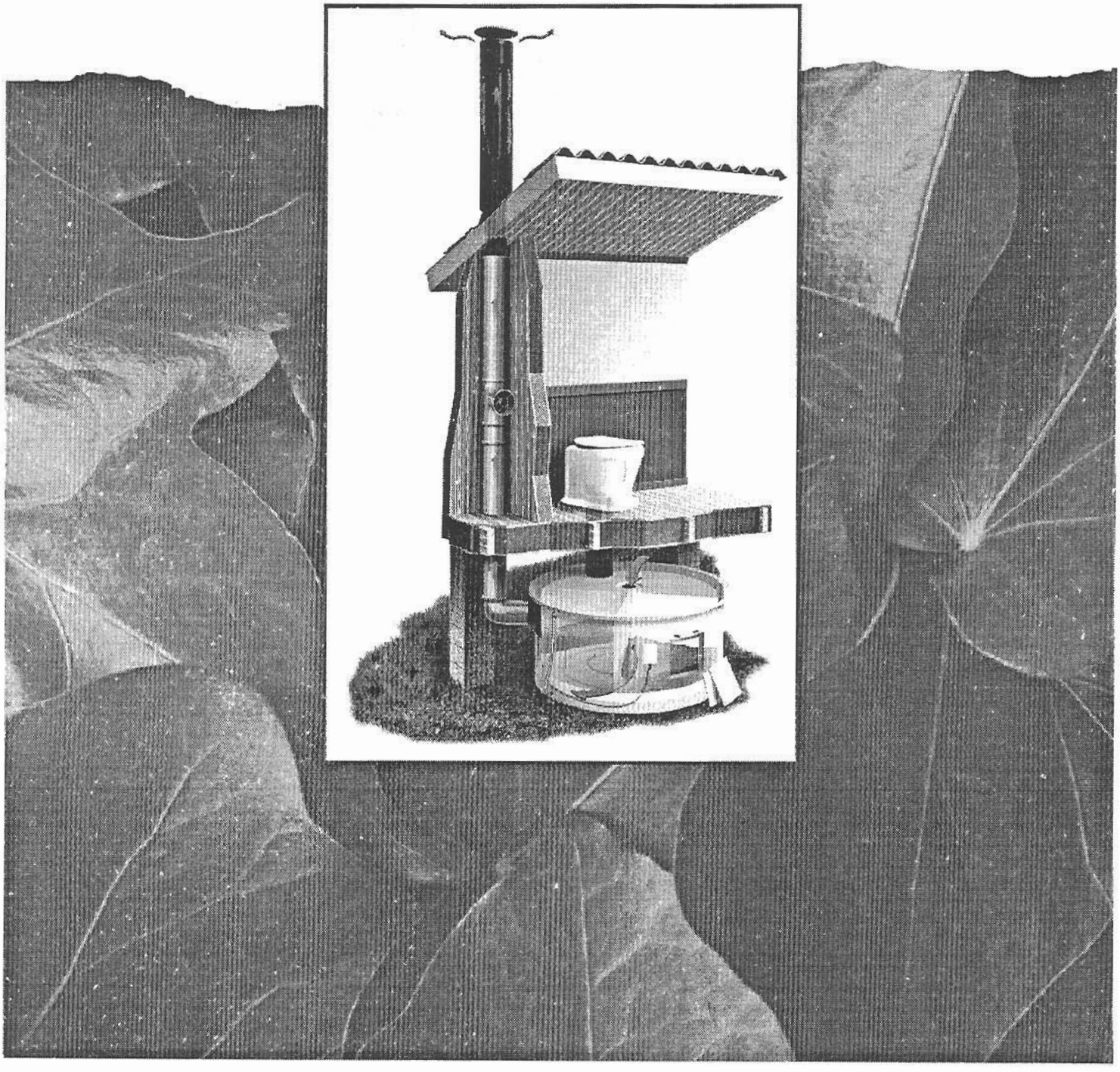
ecotech

# Carousel Composting Toilet System

## INSTALLATION AND OPERATION MANUAL

Version 3.11.5.97



# Welcome to Comfortable Low-Water Living!

EcoTech specializes in high-quality composting toilets, an environmentally safe alternative to septic tanks and other conventional wastewater treatment technologies. EcoTech offers the world's widest variety of models and the most extensive experience in this field. In Norway alone, the Carousel Composting Toilet has been installed in more than 30,000 homes.

Also available from EcoTech are rainwater and gray water systems. EcoTech's rainwater systems collect, treat, and distribute rainwater in a house; our selection of rainwater showers, water heaters, and do-it yourself couplings and pipes make it easy to use rainwater for home water use. EcoTech's gray-water systems use sealed garden beds and plants to manage gray water inexpensively and ecologically.

## Meets North American and Scandinavian Standards

The Carousel Composting Toilet is produced according to the standards and regulations of the Norwegian Foundation for Environmental Labeling's 1996 regulations. In the United States, the Carousel passed the rigorous testing protocol of National Sanitation Foundation's Standard 41 in 1982. It was one of the first composting toilet systems to pass this test.

## Using the Carousel with Toilets

The NSF-certified Carousel Composting Toilet System uses no water to convey excreta to the composter below. A simple no-flush toilet stool (with no trap and mechanisms) is used with an eight-inch (200 mm) vertical drop connection pipe from the toilet stool, through the floor and down to the composting container. Another dry toilet option, the Vera Waterless Toilet, features a mechanical trap that allows this toilet to provide the benefits of a flush toilet. You can also construct your own toilet stool. Ultra-low flush toilets (must be less than one U.S. pint per flush) may be connected to the Carousel to provide attractive, water-flush convenience. Micro-flush toilets ( a non-NSF certified option), that can be used include the Sealand one-pint toilet, the Nepon foam-flush toilet, and Evac vacuum toilet systems.

## Four-Composters-in-One Batch Composting

The key to the Carousel's superior performance is its four-composters-in-one, sequenced batch-processing design, which assures that new excreta does not disrupt composting material. Normally, the finished dry composted material—called "humus"— should be collected from one of the four inner compost chambers (the one containing the most advanced compost) once every six months. That means that the first of the four compartments will not need to be emptied for two years after start-up of the system.

*A bathroom with a waterkess toilet stool and Carousel Composting Toilet.*

# How It Works In Brief

The Carousel Composting Toilet System consists of an outer fixed container and an inner revolvable Carousel (similar to a revolving "lazy susan"). The inner Carousel is divided into four separate composting chambers, each with drain holes in the bottom. All the excrement, toilet paper, and if you choose to add them, vegetable scraps, popped popcorn, or EcoTech special additives are placed in one chamber at a time. When one chamber is full, the next chamber is simply turned into position. The accumulated matter in the first (filled) chamber will remain to further compost and is not emptied until the fourth chamber is filled. In this warm, moist environment, aerobic microbes will, over time, transform the solids into safe, inoffensive soil-like humus, a stable nutrient for plants. The humus can then either be removed and buried on your property to benefit trees and shrubs or you can hire a local septic pumping contractor to remove it. Utilization of the humus must be managed in accordance with the state and local environmental health regulations in your community. Please check with your local health agent.

The excess liquid from the urine and, if used, micro-flush toilets (a non-NSF-certified option), leaches through the compost, and drains through the perforated holes into the bottom of the outer container, where it evaporates or can be removed to an approved wastewater treatment system (check your local regulations). This liquid is called "leachate." If you plan to use the leachate as a nitrogen-rich fertilizer, dilute it with eight parts of fresh water or wash water before using it (applying it under 12 inches of soil—sub-surface irrigation—is usually considered the best way by health officials). Seek approvals from your local health agent for this, if required.

The composting process improves with the addition of small amounts of organic matter (EcoTech additive, popped popcorn, grass clippings, chopped vegetable scraps) at regular intervals. The Carousel utilizes a natural aerobic process: the decomposition of excrement and plant wastes by means of microorganisms, air and heat.

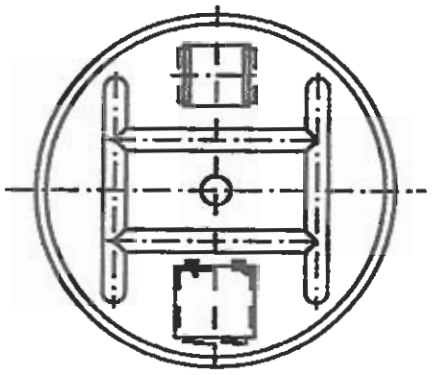
## Processing Time

Use each of the numbered inner compost chambers until it is filled or six months have passed, then rotate it. Aerobic decomposition reduces the mass as new matter is added. If a compartment fills up before six months have passed, the volume of use may be too high and the system may be in danger of eventually being overloaded. After all four chambers are full or have been rotated, empty the first-filled compost chamber to restart the cycle. Open the removal doors in the outer and inner containers to remove the odor-free humus.

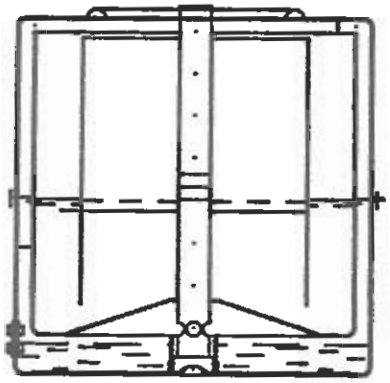
*This Carousel user keeps her reactor in her kitchen pantry. The toilet stool is located in the bathroom above.*

# Carousel Composting Toilet System

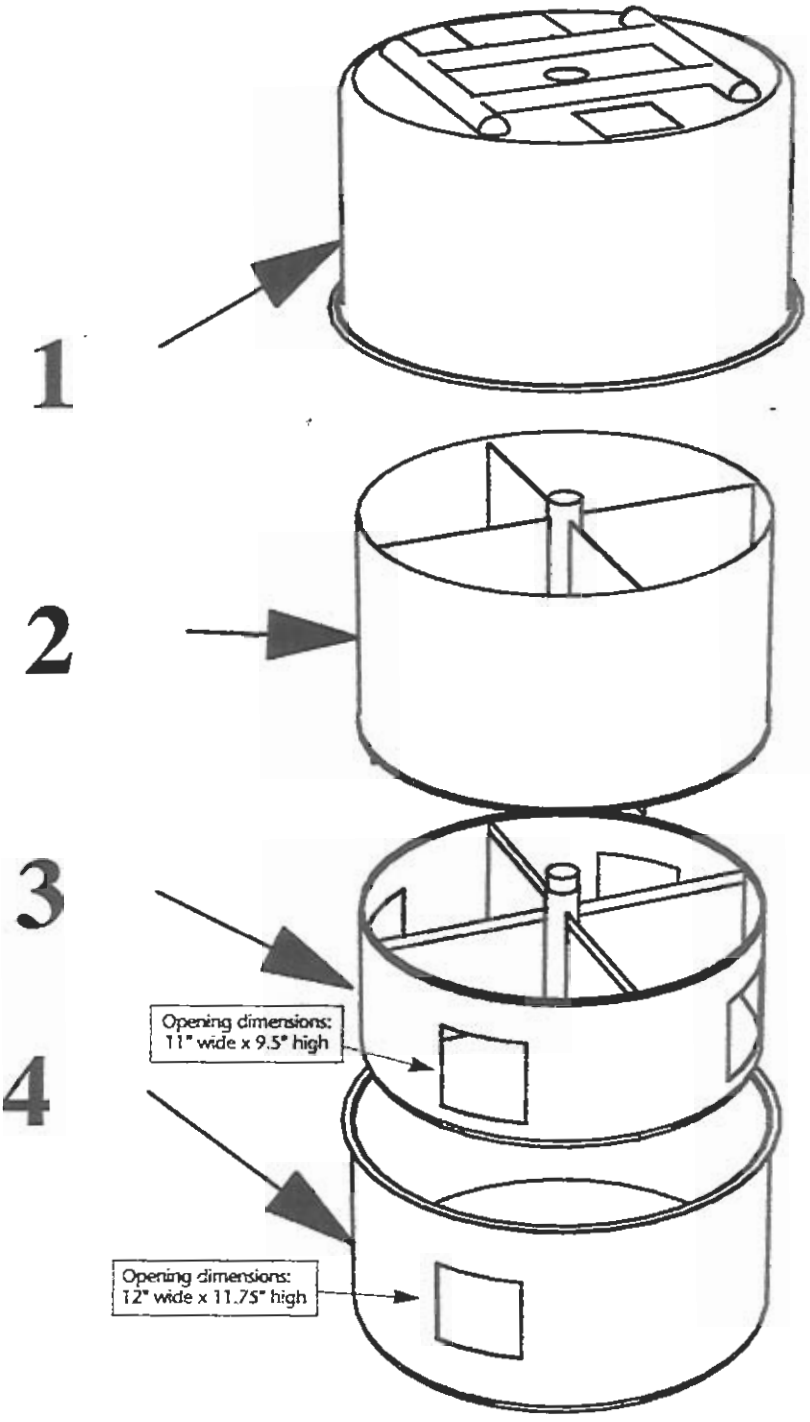
1. Outer container, top unit
2. Inner container, top unit
3. Inner container, bottom unit
4. Outer container, bottom unit



TOP VIEW

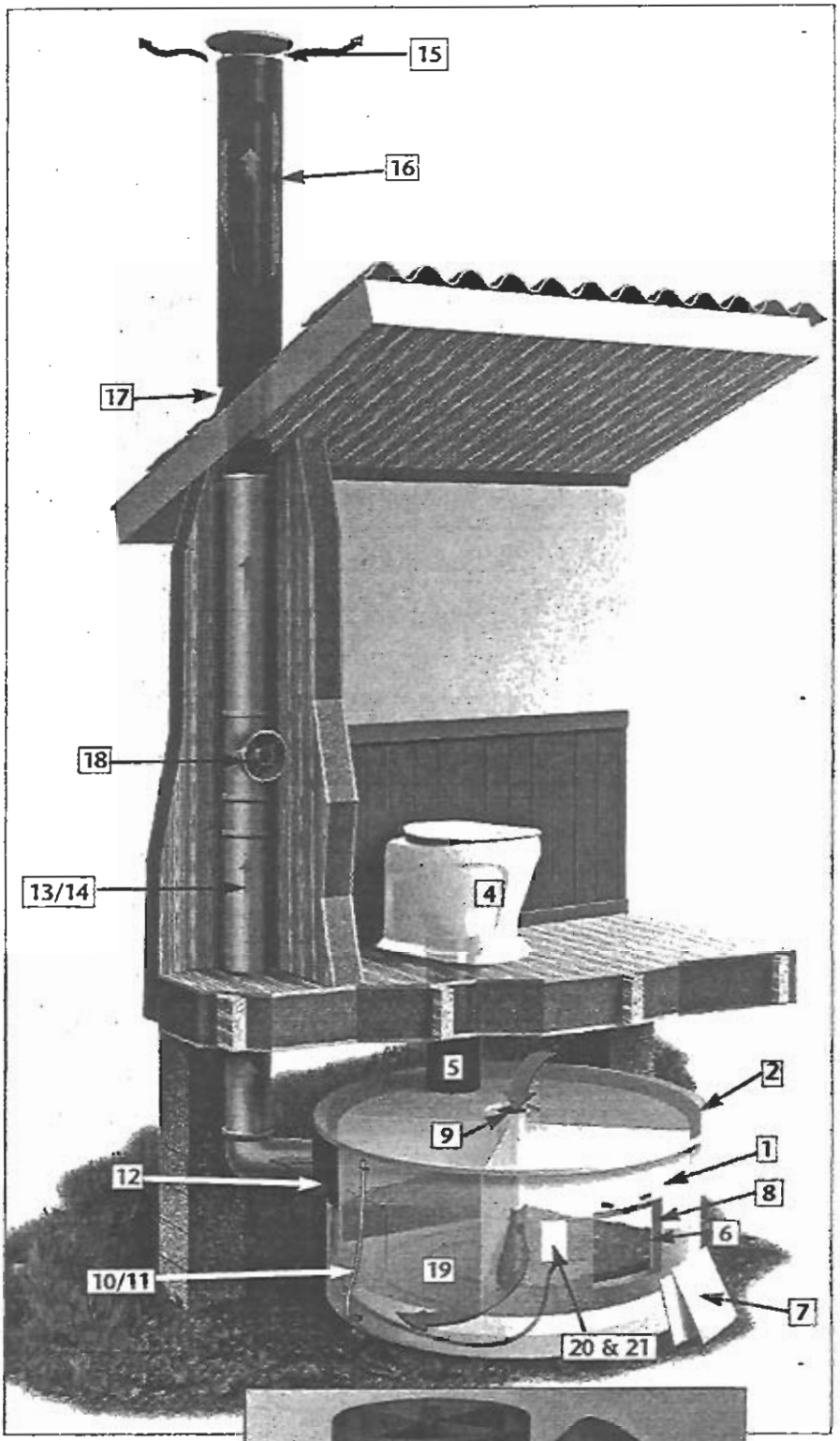


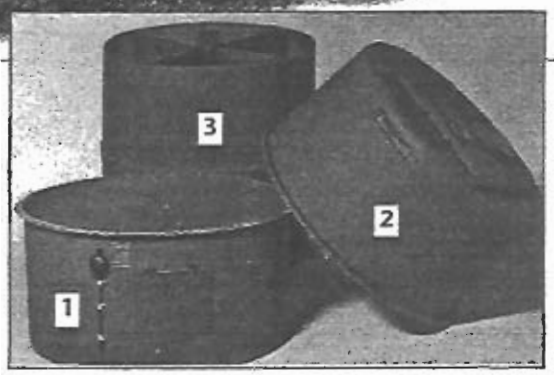
SECTION VIEW



# Parts List

1. Outer container
2. Outer container lid
3. Revolving inner Carousel (divided into four numbered composting chambers)
4. EcoTech simple open-drop dry toilet stool or other waterless toilet (required for NSF certification)
5. Connecting pipe (8" OD or 200mm) to open-drop dry toilet stool (optional)
6. Outer container inspection opening
7. Emptying door on the outer container (for access to 8)
8. Inner Carousel numbered composting chamber access doors (four total, one for each chamber)
9. Center pipe support shaft for revolving the inner container and for air intake
10. Connection and hose for draining excess liquid, if desired (connect to approved wastewater system)
11. Outer container connection and hose for indicating the liquid level
12. Flange for 4" or 6" exhaust vent pipe (optional, must be installed on site)
13. Flexible 4" or 6" exhaust vent pipe
14. 4" or 6" exhaust ventilation pipe (optional)
15. Rain hat or pipe tee for exhaust ventilation pipe (optional)
16. Insulated exhaust ventilation pipe (optional)
17. Neoprene roof flashing boot for exhaust ventilation pipe (optional)
18. Fan 115-volt AC (required for NSF certification)
19. Self-regulating electric resistance heating cable (required for NSF certification)
20. Electrical connection box (required for NSF certification)
21. Thermostat (optional—not required for NSF certification




**For price and availability of parts, contact EcoTech at (978) 369-3951 or email us at watercon@igc.org.**

# Installing It

## What Tools and Equipment You'll Need

To install the Carousel, you will need common household tools, such as a utility knife, screwdrivers, a liquid level and a hack-saw or jig saw. Installing of the Carousel Composting Toilet System requires more common sense than expertise. You may wish to recruit the services of a licensed plumber to assist with the placement of the toilet stool and the required piping. In some locales, building codes require that a licensed plumber and electrician install your composting toilet system.

## Locating the Carousel

For easy maintenance and repair, be sure to have convenient access to the emptying door, the liquid drainage system, the exhaust pipe system and the electrical connector for the heating cable and fan. Check that the support or the floor where the container will be placed is dry and even. The container should be placed on an insulated, level, flat and stable surface, such as concrete, a layer of rock, compacted earth, pressure-treated lumber or similar material. Insulate the bottom to prevent heat-loss with a minimum of two-inch closed-cell foam insulation board (Foamglas® by Pittsburgh Corning is best because it is an all-glass rigid cellular glass foam, will not burn or corrode, and has constant insulating efficiency and zero moisture permeability). **Special note:** All the weight from the container is concentrated in the center of the container. The weight may reach 1,100 pounds (500 kg) and crush the insulation. For that reason, it is important to have good support. Place a small square concrete or hardwood pad under the bottom center axis by cutting a six-inch-by-six-inch-square hole in the insulation and pour in concrete or mortar mix under the center of the bottom of the container.

★ Important!

## Electrical Considerations

Provide a 120 VAC ground fault protected service (switched or unswitched) with a minimum of four amperes available in a conventient spot near the Carousel tank for the heater and hardwire (do not use a wall plug or the heater warranty will be voided) the heater's power connection box in accordance with state electrical codes.

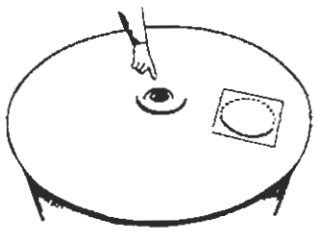
For the fan, provide a grounded 120 VAC with a minimum of 0.5 ampere available service (switched or unswitched) in a conventient spot and connect the fan in accordance with state electrical codes.

## Pipe Connections Considerations

To provide more flexibility in the alignment of the toilet-connecting pipe and/or the compost removal door, one can simply unscrew and rotate the lid or top section of the composting container. It might be necessary to make new holes for the screws.

It is necessary to cut a hole in the top (or side) of the container to make the connection for the ventilation pipe. (A standard four-inch closet flange may be used to connect the four-inch-inside-diameter vent pipe to the top of the outer container.) This hole is not pre-cut, because it should be done by the installing contractor at the installation site to conform to the site's requirements. **Always read the installation instructions and plan the installation before making any cuts in the tank or pipe.**

**Special Note:** In some models, the air-intake opening in the center of the container may be covered with a plastic protection cap, which should be removed. This air-intake opening may be connected to a heating supply duct (a non-NSF-Certified option), such as a clothes dryer exhaust duct (filtered to remove lint) to provide warmed air to the Carousel. This will reduce the electric requirement for the heater. Alternatively, it may simply be covered with a fly-screen tube to prevent access by insects.



The opening for the toilet connecting pipe may also be covered with a plastic protection cap. This should be cut away.

## Using a Flush Toilet (Not NSF-Certified)

To connect the composter to a micro-flush toilet, such as the SeaLand 510, ask EcoTech to provide the Sustainable Strategies Plumbing Code Specification for some installation details. To connect a flush toilet, the 7.7-inch (170 mm) opening for the connecting pipe on the top of the Carousel must be closed with a fiberglass patch , which can be purchased as a kit from a marine or auto parts supply. A licensed plumber can make a new connection with a three-inch closet flange on top of the tank to accommodate the toilet drain line.

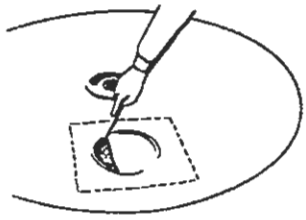
*The Vera Waterless Toilet*

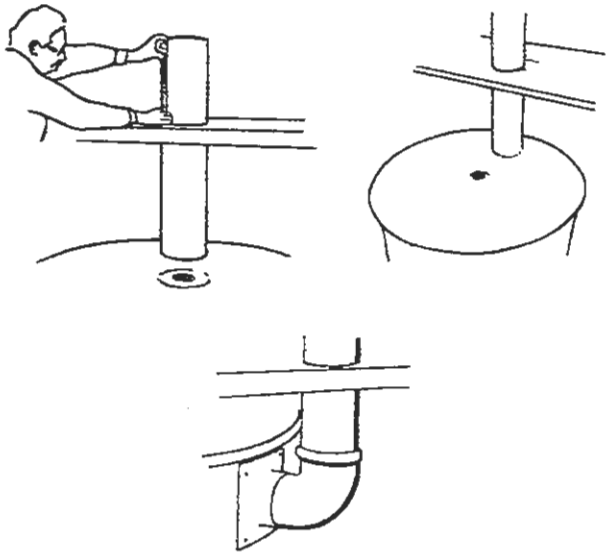
*The Sealand One-Pint Toilet*

## Installation Steps and Sequence

### If you have selected the EcoTech no-trap dry toilet stool, proceed as follows:

1. After carefully measuring, cut a 7.8-inch (200 mm) hole in the floor and place the connecting pipe through the hole and into place in the compost container top. Remember that the container lid can be rotated to the easiest possible access to the emptying door. If the top is loose, check that the center air-intake pipe is in the correct position in the center of the top.





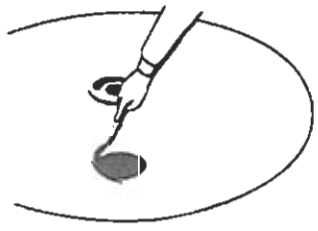
2. Using the silicone caulk, seal any gap between the connecting pipe and the top.

3. Place the toilet stool atop the connecting pipe. The connecting pipe must be carefully cut to desired height above the floor surface to connect to the toilet bowl outlet.

4. Position the toilet stool around the pipe (according to the specifications of the toilet stool you've selected) and secur to the floor.

5. Fasten the top mounting coupling for the vent pipe with screws to the top (or the side) of the outer container and caulk it to seal it. Find the best possible place to make the hole on the top of the container, taking into consideration that the pipe should be as straight as possible. (Note: The fewer the elbows, the better the ventilation.). Now carefully cut the hole.

6. If you are unable to provide a mounting flange, the following is an alternative: Cut a 2 3/4-inch length of the vent pipe and cement it into a coupling. This will leave a 3/4-inch stub beyond the edge of the coupling. Using the outside diameter of the vent pipe as a guide, draw a circle on the top of the lid where you want the vent pipe to be located. Carefully cut out a hole in the fiberglass lid. Place the stub of the vent pipe in the hole cut into the lid and caulk it thoroughly with silicone to prevent odors from escaping when the system is in use.



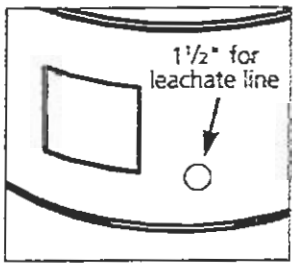
# Using Your UniSeal Pipe Bushing/Grommet

The UniSeal allows you to perfect pipe seals fast and easily.

Available in sizes 3/8" to 6", the UniSeal is made of Alcryn, a synthetic rubber. It resists most foreign substances, and has an extremely long life. A UniSeal can be fitted to flat on concave PVC to PVC, and PVC to copper or steel.

It will fit pipes with ID 3/8" to 6" through any wall to 1/2"

UniSeals are used for leachate drainlines and exhaust vent connections, as well as toilets for the Carousel, such as the SeaLand or the Waterless Toilet from Norway. For pipe diameters other than 6 inches, an alternative coupling mechanism such as a bulkhead fitting must be installed.



Carousel Side

Installing a UniSeal is simple:

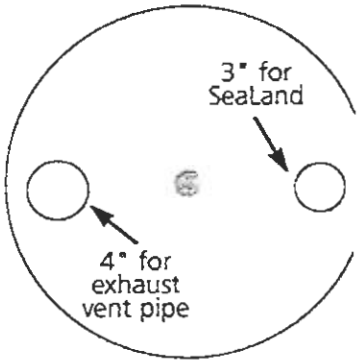
1. With the chart below, determine the specifications and the ID of the pipe you are going to install.

2. Using a hole saw or carefully using a jig saw, cut the appropriate size hole that matches the part number and pipe diameter that you have chosen.

3. Lubricate the UniSeal with a little soapy water.

4. Push in the UniSeal so that the large outer lip is on the outside (the UniSeal inscription will face out). Lubricate the pipe that you are inserting with soapy water and twist it into the UniSeal to a depth of about 3/4"—any longer and the pipe end could obstruct the turning of the internal Carousel.

You have now made a removable but air- and watertight connection to the Carousel. If you must remove the pipe, simply twist it out.

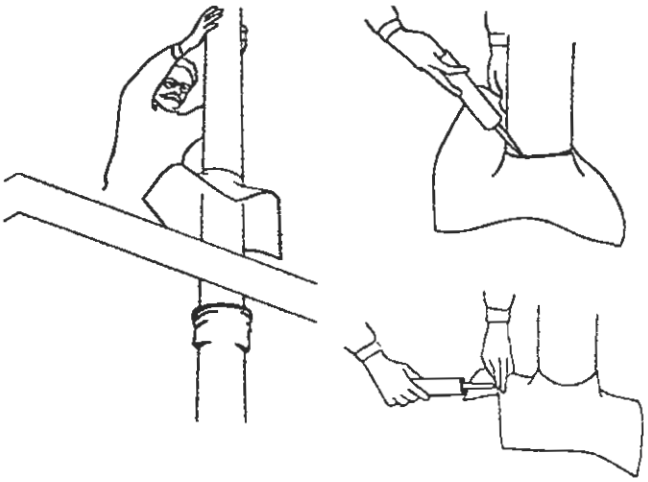


Carousel Top

| Part No. | Pipe I.D. | Pipe O.D. | Holesaw Size |
|---|---|---|---|
| U038 | 3/8" | 0.675" | 1" |
| U050 | 1/2" | 0.840" | 1.25" |
| U075 | 3/4" | 1.050" | 1.25" |
| U100 | 1" | 1.315" | 1.75" |
| U125 | 1 1/4" | 1.660" | 2" |
| U150 | 1 1/2" | 1.900" | 2.5" |
| U200 | 2" | 2.375" | 3" |
| U300 | 3" | 3.5" | 4" |
| U400 | 4" | 4.5" | 5" |
| U400-35 | 4" | 4.35" | 5" |
| U600 | 6" | 6.625" | 7" |

7. Install the fan (required for NSF certification), using the instructions on page 15. The fan is to be mounted in two flexible elastomeric polyvinyl chloride (PVC) couplings to facilitate installation to 4" PVC drain, waste and vent (DWV) pipe and provide a quick-disconnect for service. No special tools are necessary. Installs easily with screwdriver or 5/16" nut driver or socket (to 60' lbs. Torque). Make sure the air-flow arrow on the fan is turned up.

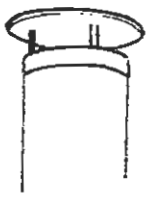
8. Cut a hole in the roof straight above the exhaust vent pipe. Push the ventilation pipe through the hole in the roof and down into rubber roof flashing (optional) on the roof. Fasten the optional rubber flashing gasket both to the ventilation pipe and to the roof with the silicone. This prevents rainwater from seeping into the building.



9. Make sure the exhaust vent pipe is as straight as possible and that all joints are sealed with silicone caulk. In colder climates, insulate the vent pipe to prevent condensation and to improve the draft.

10. Wind may cause strain on the pipe where it meets the roof. If you suspect this might cause a problem, install an extra brace on the roof to prevent damage.

11. Mount the optional pipe rain hat (a 90-degree tee coupling will also serve this purpose) and fasten it with the silicone. To prevent insects from entering the vent pipe, cover the rain hat or pipe tee with a loose bag made from fly screen. Rain will wash off accumulated dust and particles, thus preventing blocked exhaust air flow.



12. Fasten the 1" transparent hose to the two fittings at the lower part of the composting container with stainless steel clamps. This configuration will function as a leachate-level indicator that will show you if the leachate is not evaporating rapidly enough. Leachate must not reach levels as high as the outer container removal hatch or it will spill out when the hatch is removed! If the level in the hose approaches that of the removal hatch door, it must be drained or pumped from the outer container. If you are connecting your Carousel drain to an approved wastewater treatment system, you may cap off the upper 1" fitting and run a hose from the lower fitting to the treatment system.

Periodically check to see if there is excess leachate that should be emptied.

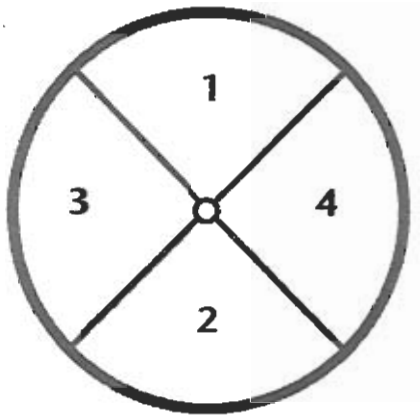
13. Make sure that all connections are airtight and/or watertight. If necessary, use silicone or broad plastic duct tape to seal them. The Carousel is vented by design so that a minor vacuum is created in the compost container that will draw air into the unit. Odors may result if this vacuum disappears, due to loose connections or the emptying door being opened.

For connection to a micro-flush toilet, such as the Sealand 510 (a non-NSF-certified option), a licensed plumber can make the connection in accordance with the local plumbing codes.

# Operating and Maintaining the Carousel

## Start-Up and Daily Use

Before the Carousel is put into use, rotate the inner composting chambers so that chamber number 1 is directly under the pipe connecting the toilet stool to the Carousel. Remember that chamber number 1 is opposite chamber number 2 and chamber number 3 is opposite chamber number 4. This arrangement provides balance for the inner chamber when filling, making it easier to turn..When the chamber labeled number 2 appears in the outer cleanout hatch opening, number 1 is directly opposite.




To initially start the compost chamber, you will be using, add about 2.5 gallons (10 liters) of one-inch bark or wood chips through the toilet stool into chamber number 1. Then add one gallon of EcoTech Special Blend Starter or composted vegetable matter.

*Checking the compost chambers from the Inspection hatch*

The wood chips act as a filter preventing solids from blocking the drain holes at the base of each compost chamber. A handful of the Starter or other additive should be added about every 10th visit. This will help create air pockets in the material, which aid the composting process. The result will be better processing. Kitchen scraps, such as vegetable peels, may also be added (see "Compost Additives" for a complete explanation and list).

If the toilet won't be used for a long period, or if insects or odor become a problem (see "Problems & Solutions" for ways to remedy this), you may tape a sheet of plastic film under the toilet seat and lid (of the dry toilet stool).

## Changing the Compost Chambers

To best utilize the total capacity of each of the four chambers, it is best to slightly move the inner container to offset the "pyramid" of accumulating paper and excreta. When upon inspection you see that the chamber in use is full, you should put a six-inch layer of wet EcoTech Special Blend Starter or composted vegetable matter on top of the waste before rotating to a new chamber.

## Emptying a Compost Chamber

1. Unlatch and open the removal hatch (7) of the emptying door on the outer container

2. With the rope that is attached to the inner Carousel, turn the Carousel to the composting chamber that has been out of use the longest. Usually it is the next in the numbering sequence. Check by opening the inspection hatch (6) on the lid of the outer container.

3. Align the inner access door (8) with the outer emptying door.

4. Unfasten the latches and lift out the hatch.

5. Drape a plastic sheet between the inner and outer hatches to create a bridge to prevent solids from falling into the outer container where they might block the drain.

6. With a small spade, shovel the finished humus into a pail. Or ask a licensed septage hauler to remove it.

**Repeat the "Start-Up and Daily Use" procedure for each chamber placed in service.**

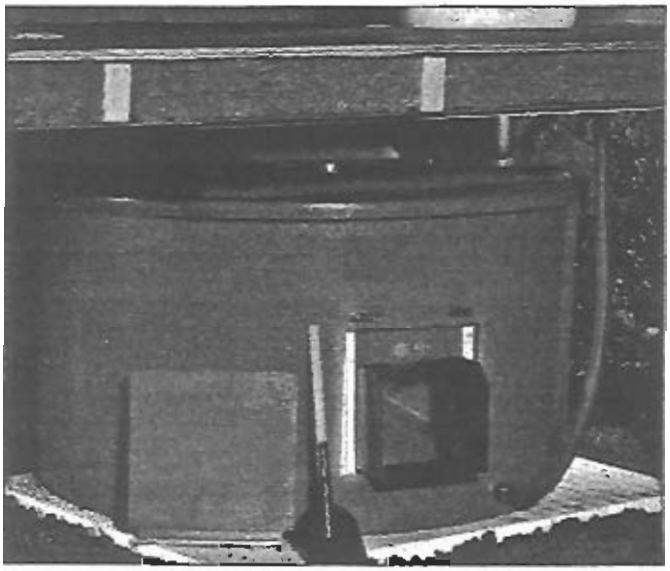
## Using Finished Compost

Each digestion chamber will take about six months or more to fill with normal use and will sit unused for another one to two years while the others are being filled. At this point, when it is time to remove the finished compost, it will not look or smell at all like the original waste material which went in. Instead, it will be

fairly dry with the look and smell of very rich garden soil. This humus is an excellent soil conditioner which can be safely buried next to the roots of any tree.

## Emptying Uncomposted Excreta

The Carousel Composting Toilet System has been designed to fully contain excreta and prevent contact with it until it has been transformed into harmless humus. It is hard to imagine why excreta would be removed prior to complete digestion. However, if it should ever be necessary to remove excreta from one of the digestion chambers before it is completely composted, take great care to avoid direct contact. The excreta can continue composting outside of the digestion chamber, but it should be mixed with leaves and placed in a covered 55-gallon drum and stored in an area where people and animals will not come in contact with it until composting is complete. Wear gloves while handling excreta and be sure to wash yourself and clothes afterward.



*When emptying your Carousel, line the openings of the inner and outer containers with plastic to help avoid dropping compost into the outer container.*

### Caution: Use Gloves!

While the long-term composting process should eliminate the presence of any harmful pathogens under proper operating conditions, there is still the chance that some may have survived if all operating conditions were not properly maintained. Therefore, proper safety precautions should be taken whenever finished compost from the Carousel Compost System is handled. Wear gloves when handling finished compost and wash thoroughly with soap and water afterwards.

## Insect Control

The air intake and the exhaust stack must be screened to prevent the entry of flying insects, which can spread disease-causing organisms if they come into contact with fresh waste. In addition, the high temperatures inside the composting chamber of a properly operating Carousel Compost System will be too warm for most flying insects. However, it is important to take precautions to keep pests out of the Carousel Compost System:

1. Inspect and maintain insect screening.
2. Keep the toilet door closed to prevent insects from entering.
3. Keep the toilet seat closed when not in use to help ensure that any insects which do get into the toilet will not fly down into the composting chamber.

If flying insects do become a problem, a small amount of non-toxic insecticidal soap or a short-lived organic pesticide containing pyrithrins can be used without harming the composting organisms. A five-second burst of spray in the toilet room and in the air intake can be repeated each day until the problem goes away.

However, larvae and other non-flying organisms in the active (in current use) compost chamber are not a concern, and in fact help speed up the composting process by increasing the flow of air through the waste. They will disappear before the finished humus is finally removed.

## Periodic Maintenance

**• Inspecting the compost chamber**
Inspect the compost chamber at least once a month by looking down through the inspection hatch or through the toilet stool with a flashlight. If the composting material appears to be very dry, sprinkle a quart (liter) of fresh water down through toilet seat periodically so that the pile looks moist but not wet.

**• Inspecting insect screens**
Periodically check the insect screens on the air intake and on top of the ventilation pipe and make repairs as necessary to keep flying insects out of the digestion chamber. Also check to make sure that they have not become clogged with dirt or other materials that could block air flow. Use a dry brush to clean the screens at least once a year to keep them from getting clogged.

**• Inspecting the exhaust pipe and air intake**
Periodically check the top of the air intake and exhaust vent pipe to make sure that there are no obstructions blocking the air flow. If either of these pipes is made up of several connected pieces, check the connections to make sure that there are no leaks. Repair with silicone or other caulking compound.

***Tips for improving the composting process:***

- Fill up one chamber at a time in the proper sequence
- If you add vegetable scraps, be sure to cut them into small pieces.
- Try to control the moisture—be sure the compost is not too wet, not too dry.
- Get air into the compost with bulky additives (see "Compost Additives" for a complete explanation and list). These help make the compost less dense.
- Add fresh garden compost from time to time—it adds beneficial micro-organisms to the compost.
- When a chamber is filled up, place a six-inch layer of moist additive on the top of it before rotating it.
- Cover the toilet seat opening when the toilet is not in use. Air flow in the composter will increase, boosting the evaporation of extra moisture. Covering the opening will also help prevent insects from entering the toilet.

**• Inspect the heater**
Periodically (and when liquid is accumulating too fast), check to see that the heater is working. Move away the insulation and touch the aluminum tape around the perimeter of the tank. This secures the heater to the container and will be hot to the touch (can be as high as 220 degrees F!). Check that the fuse or circuit breaker associated with the power outlet is not blown and that the plug has not been pulled from the outlet. Contact your dealer or EcoTech if the heater has failed, as this is not an owner-servicable part.

**• Fan maintenance**
When the fan is installed in the ventilation pipe, it should not be turned off and on, as this will increase the danger of corrosion of the fan's components. Also, if the fan is not running, the natural draft will be prevented, possibly creating odors. However, if you leave for a week or so, consider taking the fan unit out of the ventilation pipe and replacing it with the coupling fittings without the fan in it. The fan should be brushed from time to time to remove dust and particles and stored in a dry place. In this way, you will increase the lifetime of the fan.

**• Cleaning salt accumulation**
Over time, salt and solids will build up in the bottom of the outer container where the leachate is collected. Remove this every other year by pouring some buckets of hot water into the bottom of the container. After soaking a few hours, let the water drain out through the hose for excess liquid. Dispose in accordance with state and local regulations.

**• Inspect gaskets**
Occasionally check the gaskets to be sure they are air- and water-tight. Replace them with closed-cell elastomeric foam gasket tape.

*A Carousel user collects a sample of the finished product, humus. However, she uses a drywall pail when emptying the entire compost chamber.*

# Problems & Solutions

## There is an odor of fresh waste in or around the toilet.

Some odor may be present in or around the top of the roof vent for the first week or two after a composting chamber has been started up before the composting process begins. After this, there may be a slight musty-sweet odor occasionally, if the wind blows air from the exhaust pipe down toward the ground. There should not generally be any objectionable odors.

A foul odor in the bathroom may mean that air from the composting chamber is venting into the room through the toilet seat or perhaps a leak in the ventilation system. Changes in wind and weather may sometimes bring odors down from the top of exhaust pipe above the roof, but it may be difficult to tell where the odor is coming from.

One source of the problem could be that the toilet seat has begun to act as a chimney, drawing air from the chamber up into the room. Normally, air should flow down through the toilet seat into the chamber. You can check this by holding a lit cigarette over the toilet and seeing which way the smoke blows. If air is coming up from the composting chamber into the room from the toilet seat, do the following:

- *First check to see that the fan is running!*
- Make sure the toilet seat is closed when not in use.
- Make sure that the bathroom door remains shut and that there are no windows or large openings in the walls or ceiling. The only openings along the wall should be small and near the bottom. Make repairs as necessary.
- Make sure the top of the exhaust pipe has not become obstructed. It may be that the rain cover has slipped down to cover the opening or that the insect screen has become clogged. The insect screen should be around the outside of the rain cover as shown in the illustration, so it will not restrict air flow and be washed by rain.
- Make sure the air intake pipe is not obstructed and has no leaks.
- Make sure that trees and vegetation are not blocking the vent pipe.
- If the cigarette smoke test shows that the air is flowing properly down into the toilet, the odor may be coming from a improperly sealed pipe or fitting.

Check for leaks and cracks, and repair as necessary.

## There is a strong odor of sewage, rotten eggs or ammonia.

These strong odors indicate that the composting chamber may have become anaerobic or that the microorganisms do not have the right balance of food.

- Try increasing the amount of additive material (see "Addidive for Carousel"). Drop it into the composting chamber through the toilet seat.
- If these measures fail to stop the odor, look down into the chamber with a flashlight to make sure that A) no animal or fish products were put in the toilet and B) the Carousel has not been damaged, allowing wastes to fall down to the bottom of the outer container. Stop using that chamber if this has occurred. If the other chamber has not been used for at least a year, you may remove the finished compost and begin to use it. The contents of the damaged chamber can be removed and the Carousel repaired after the other one has been filled, just as would occur in the normal rotation.
- If the material in the other chamber has completely composted, try to continue using the chamber with the problem by adding larger amounts of bulking material to soak up the excess liquid.

- Are all connections tight?
- Does the toilet room have sufficient ventilation?
- Is the ventilation pipe open and unblocked and as straight as possible?
- Is the top of the ventilation pipe higher than the peak of the roof? If the roof peak is within nine feet horizontal from the top of the ventillation pipe, the pipe should be at least two feet higher than the peak. Tall, dense foliage near the top outlet of the vent pipe may interfere with the draft, as well as create odors.
- Is the ventilation pipe airtight?
- Are the emptying hatches and the inspection door closed and tight?
- Is the ventilation pipe open and unblocked?
- Is there sufficient ventilation where the composting containers are situated? Vents in the toilet room close to the floor are often sufficient to prevent odors.
- Is the fan working? The fan will create a negative pressure or vacuum, so no odors should occur in the toilet room.

Note:

Heavy, tall vegetation (trees) by the outlet of the ventilation pipe may cause problems with the draft, resulting in odors. If you have checked all of the above points and still experience odors, try covering the center air in take pipe. This will allow the system to draw more air from the room via the toilet stool.

### The compost chamber does not seem to be filling up with excreta, even after a year of use.

This is not a problem at all. It means that the excreta is decomposing faster than they are being added. Although this means that no compost can be harvested, it means that the process is working very well. As long as there are no other problems and the composting chamber does not get full, you should keep using it.

### The compost is too dry.

This means that the evaporation rate is too high. Turn off the heater and/or add a few liters of water to the system. Remember to add a layer of moist EcoTech compost starter or other additive to the top of a full compost chamber before turning it.

### The compost is too wet.

The reason for this is that the evaporation rate is too low. Check the heater and fan to make sure they are operating properly. Determine if the vent pipe is blocked or the fan has stopped or the leachate drain line is blocked. Also, try adding more additive.

### The material isn't completely composted.

Improper managment of the composting process, such as not providing enough heat, air or moisture and/or removing the humus too soon, will result in inadequately processed excreta. The problem can be solved by better management, including taking care to not overload the system (too many users in too short a time period).

### Cleaning

Soap and water will not harm the composting process. However, detergents, disinfectants, bleach and other poisons should never be dumped into the composting chamber. This will kill the organisms that carry out the composting process. When usings household disinfectants, apply them with a sponge and wipe the surfaces of the commode.

## Heater, Fan or Neither? Follow the Q10 Principle to Compost More in Smaller Spaces

When deciding which you will need, consider this principle: By increasing the temperature, greater processing rates will occur.

Increasing temperatures can double or triple the release of energy from the respiration of aerobic microbes, increasing the rate of composting.

As the resident aerobes are poikilothermal, their metabolic rate varies with the temperature of their surroundings. **Therefore, the warmer they are, the faster they consume oxygen and digest the molecules of organic matter.**

This is known as the $Q^{10}$ temperature coefficient, which holds that for every 10-degree C. (18 degees F.) rise in temperature, within certain limits, the biochemical rate of reaction is doubled.

Maintaining the system at higher temperatures will significantly increase performance. Insulating the bottom and side walls of the composter is desirable in either extreme of cold or heat (premature drying). About 9,000 Btu will evaporate one gallon of wastewater.

So, heaters and fans significantly increase the rate of processing, allowing more composting to occur in a smaller space. If you are living in a warm-to-hot climate, you may not need this extra boost. There are alternative ways of heating that are non-electrical, such as waste heat from other processes (chimney flues, water pipes, gray water, and solar). However, these systems were not part of the NSF certification.

# Additives for Composting Toilets

The most important factors of good composting is keeping the compost light and aerated, not compact. That means no matter what organic matter you add to the system, ensuring proper aeration is critical to successful processing. Check with the operation manual of your model for the recommended method of aerating the compost.

Biological decomposition requires moisture, oxygen and balanced nutrition, just as humans do. The enzymes that the aerobic bacteria produce to break down larger organic molecules into simple oxidized molecules that can be utilized by plants for growth prefer simple sugars, starches and complex carbohydrates to woody cellulose and lignin found in tree products. We emphasize "prefer" because toilet paper, peat moss and wood shavings will break down; it will take longer and could fill the toilet faster with uncomposted additives.

Add spoiled vegetable foods or leftovers from the house rather than purchasing special materials. The size is important so shred or chop additives into 1/4-inch pieces. Leaves could mat down causing loss of air space, so be cautious.

**Do not add animal, poultry, fish products or oils of any kind. Plant-originated materials only! These materials are not helpful.**

A small handful of additive per person per day is a good rule of thumb. A little more or less will not be a problem.

However, adding a lot of additional matter to the toilet can reduce its capacity to process excrement and will shorten the retention time in the composting process. This means emptying it more often.

Control fruit flies with a fine mist of soap and water (two tablespoons per gallon of water) sprayed directly on insects as much as possible. Diatomaceous earth (a natural mineral) works very well—dust it onto the surface of the compost.

The following is a list of materials in order of ease of digestion by the resident microbes:

1. Sugars
Fructose is a fruit sugar, so add spoiled or dried apples, melons, bananas, coconut meat, pears, raisins, figs, etc. Rinds generally break down more slowly than the pulp so shred them well. Avoid citrus peels (orange, grapefruit lemons) as they

impede the breakdown process.

2. Starches
Potatoes (peels, too), yams, taro, pumpkin and squash.

Corn is both a sugar and a starch, so add dried or spoiled corn kernels and stale popped corn, as they aerate and provide nutrients for the microbes. Corn cobs must be well shredded. All vegetables and stalks work well too, as do pelletized or loose horse and cattle animal feeds.

3. Complex carbohydrates
Cereals (including all breakfast cereals), grains (wheats, oats, rice, alfalfa), pastas, bread and biscuits (crumbs and slices) crackers, burned and stale popcorn, etc.

4. Cellulose
Wood shavings, fine shredded bark and leaves or small chips (not red cedar, eucalyptus wood or birch or pine bark or other woods that inhibit biological decomposition) and no sawdust, as it is too fine and will compact like flat, unshredded leaves.

Toilet paper (preferably white with no perfume) finely chopped newsprint (no colors or glossy paper), plain brown corrugated, dry wood pulp from a paper mill, wood pellets for stoves, etc. Finely chopped straw, hay, alfalfa, pea straw, kenaf, etc.

5. Minerals
Minerals will not break down, but they can help aerate the compost. However, minerals, such as horticultural grade perlite and vermiculite, work well as bulking or aerating agents.

# Composting Ecology and Process: The Science of Composting

For the purpose of educating those who are not familiar with unsaturated aerobic microbial decomposition (composting) toilets, the following will detail the specific requirements and potential problems:

The operation of the composting toilet is dependent on a number of factors which must be maintained within certain broad ranges.

**1. Microbial population:** The ecological benefit of using natural soil organisms as living machines to decompose excrement into safe and valuable by-products is dependent on the presence of a large population of bacteria, actinomycetes, fungi, yeast, algae, protozoa, and other organisms. One gram of healthy soil may support 500,000,000 bacteria, 20,000,000 actinomycetes, 900,000 fungi, 100,000 yeast, 500,000 algae and 500,000 protozoa. The number and activity in the toilet depend on environmental factors enumerated below, plus proper pH and food supply. The food supply in the toilet is provided by human excrement and other organic material deposited in the toilet. The pH is self-regulating if all the other conditions are satisfactory. Adding two handfuls of compost from a warm garden compost pile will provide all the microbes for start-up, or you can purchase Bioactivator from EcoTech to innoculate the composter with soil microbes.

By maintaining the proper environment and food supply for these microbes, they are able to do the work of transforming excreta and all other organic matter into humus, a safe and valuable material.

**2. Aeration:** The aerobes require free atmospheric oxygen. If there is an oxygen deficit, the aerobes will die and be replaced with anaerobes, which will slow the process, generate odors (hydrogen sulfide, ammonia, and amines) and potentially flammable methane gas. Adding wood chips, stale popped popcorn, etc., increases pore spaces, permits air to reach deep into the biomass, and allows heat and CO2 to be exhausted. Maintaining adequate air flow through the biomass, by proper ventilation design (natural convection or forced by a fan) and/or frequent mixing is required for satisfactory operation. However, excessive air flow will remove too much heat and moisture.

**3. Moisture Content:** The optimum range is 45% to 70%. If the moisture level drops below 45%, composting may be hindered. Also, excrement, toilet paper, and organic additive will dry out but not decompose, prematurely filling the toilet (a good indicator that the biomass is too dry).

If moisture exceeds 70%, leachate is formed and will settle to the bottom of the tank by gravity, necessitating energy for evaporation or removal. Further, too much moisture risks the drowning of the microbes, blocking air flow through the biomass, which could become anaerobic as a result. Urine and/or water from less-than-one-pint-per-flush toilets is the primary source of moisture in excreta. Placement of urine in the toilet may not be distributed evenly. Inadequate distribution of moisture within the biomass is a limiting factor.

If energy (heat) is added to vaporize excess liquid accumulation at the bottom of the tank, the upper parts of the biomass may become too dry.

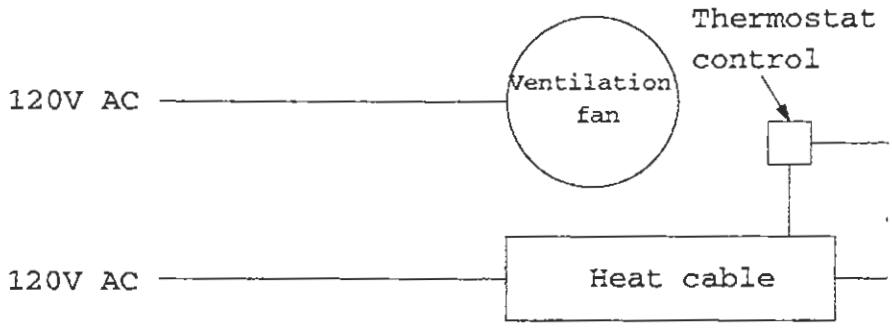
**4. Carbon-to-Nitrogen Ratio:** An important relationship for aerobic bacteria nutrition is that of the Carbon (C) to Nitrogen (N), or C/N, ratio, of the food source. Microorganisms require digestible carbon for growth as an energy source. They also need nitrogen and other nutrients, such as phosphorous and potassium, for creating protein, which is necessary for building cell walls and other structures. When measured on a dry weight basis, an optimum C/N ratio for aerobic bacteria is 30. Primarily due to the high nitrogen content of urine, human excreta has a low C/N ratio. This necessitates the addition of digestible carbonaceous materials, such as popped popcorn (it's the best!), vegetable or fruit scraps, chopped black-and-white newsprint, and wood chips, on a regular basis. A small handful of dried matter per person per day is a good rule of thumb to maintain a proper C/N ratio, absorb excess moisture, and maintain biomass porosity.

Another alternative is to install a urine-separating toilet. A small urinal is cast into the front of the toilet bowl, which collects urine from seated adults and transports it to a container for use as fertilizer or disposal. The nitrogen in the urine from one adult can grow enough plant protein and carbohydrates to feed another adult. So don't dispose it, use it!

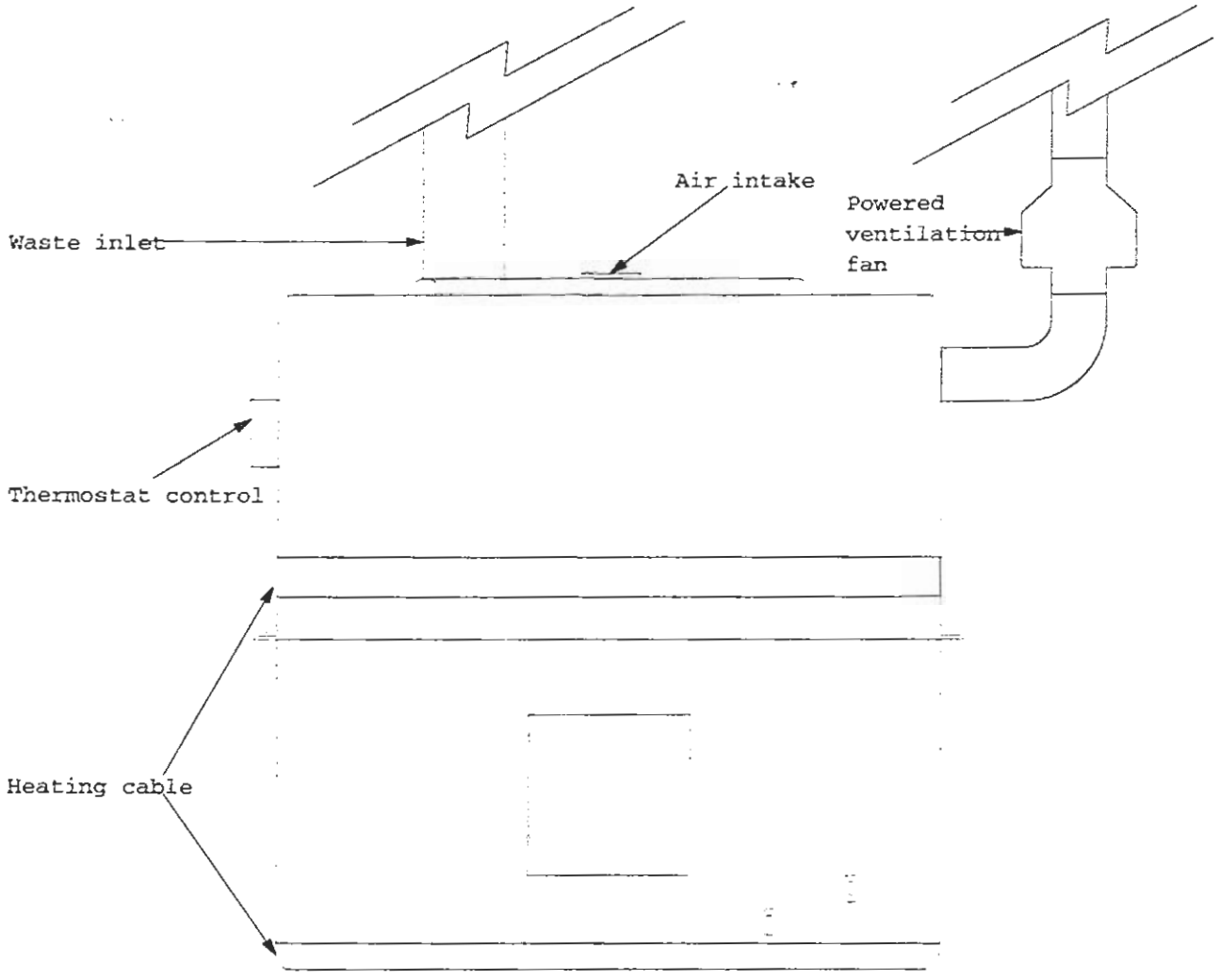
**5. Temperature:** The ideal ambient temperature for rapid biological decomposition is 75° to 100° Fahrenheit. Biological zero is 41° (the temperature at which no cellular respiration occurs), the worst temperature for composting. Microbes don't die unless ice crystals form inside their cell walls. Most stay in suspended animation until their environment warms up. Much higher temperatures (100° to 160°) can be achieved from this base if thermophyllic (95° to 160°) bacteria develop in the process. However, this is not usually the case in biological toilets, because the heat from the respiration of mesophyllic (50° to 100°) aerobic microbes is lost in the ventilation process, and so the thermophyllic bacteria are uncommon. Most proprietary compost toilets have heaters and thermostats to maintain an ambient temperature of 90° to 110° in order to maintain the upper mesophylic range, while evaporating excess liquid. Evaporation of liquid tends to drop the temperature, as the liquid is vaporized and exhausted, requiring additional energy (this can be solar, electrical, and so forth).

Supplemental energy may be required because the average indoor ambient temperature in, for example, northern countries, is less than ideal for aerobic biological toilets (see the Q10 factor explanation at right). Unless supplemental heat is provided, low temperatures will slow down the process and may cause the accumulation of a small amount of residual liquid not consumed in the decomposition process. This liquid is rich in nutrients and table salt, and could either be directed to the evapotranspiration gardens, or be evaporated requiring additional energy. You can buy electrical heating elements to maintain optimum temperatures and evaporate this excess liquid, should it accumulate. However, the least expensive source of this energy is from the sun.

# Specifications




ELECTRICAL SCHEMATIC DIAGRAM




## Carousel Composting Toilet System

**Model:** 80-A • Large
**Part number:** 978273
**Capacity:** 4 adults in residential use (approx. 16 uses per day) at a minimum ambient temperature of 65 degrees Fahrenheit or higher
**Warranty:** 25 years on fiberglass components and 2 years on all other components from date of purchase
**Container:** Fiberglass-reinforced polyester resin with polyester gel coat with series 300 stainless steel fasteners
**Height:** 52" **Diameter:** 52" **Weight:** 175 lbs. empty

# Specifications

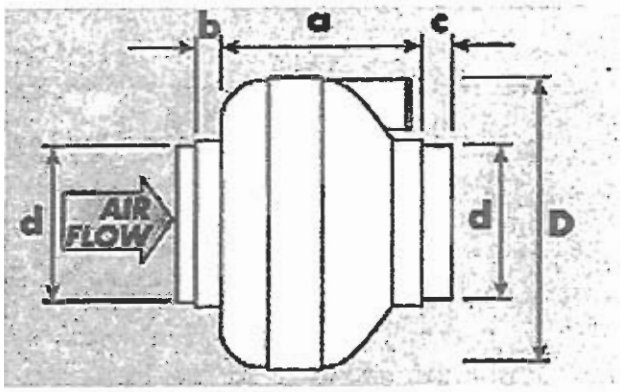
| | |
|---|---|
| Heater: | Raychem 20QTVR1 Self-regulating heating cable |
| Length: | 18' |
| Power output: | 13.3 W/ft |
| Watts: | 0 (min.) to 239 (max.) depending on container temperature |
| Volts: | 120 AC |
| Amps: | 2 |
| Max. cable Temperature: | 220 degrees Fahrenheit |

## How does the heater work so efficiently?

Carousel's self-regulating heating cables consist of two parallel conductors embedded in a heating core made of conductive polymer. The core is radiation-crosslinked to ensure long-term reliability. The heating systems are self-regulating: They automatically adjust their power output to compensate for temperature changes. Heat is generated as electric current passes through the core between the conductors. As the temperature drops, the number of electrical paths through the core increases and more heat is produced. Conversely, as the temperature rises, the core has fewer electrical paths and less heat is produced.

As an example of how this technology works, let's look at what self-regulating heating cables can do to keep the Carousel at a constant temperature. When electricity is applied to cable wires, a current is conducted across microscopic carbon networks. These networks form miniature heater circuits and the cable warms the surrounding area. As the cable itself gets warmer, the plastic expands until most of the carbon circuits are disconnected. Then, if the outside temperature drops, the plastic contracts and the circuits are reconnected. The result is a self-regulating system that delivers just enough heat to keep the Carousel at a constant temperature without using more power than is necessary to accomplish the task.

The optional thermostat is self-regulating and is non-adjustable.




## Fan Dimensions

| a | b | c | D | d |
|---|---|---|---|---|
| 5.25" | 0.875" | 0.875" | 9.5" | 3.875" |

| | |
|---|---|
| Fan: | Fantech FR 100 |
| Max speed: | 2865 (100% speed controllable with a solid-state controller) |
| Max Watts: | 43 |
| Volts: | 115 AC |
| Amps: | 0.374 |
| CFM: | 108@zero static pressure |

### The Fan

The Fantech FR 100 is a remote mounted inline centrifugal fan that features a plastic housing manufactured of GE Noryl plastic, allowing the fan to be mounted in wet and outdoor locations The fan utilizes an external rotor motor with an totally enclosed design that allows the fan to operate in high moisture, lint and dust laden air. The motors are a permanent split capacitor type, with automatic reset thermal overload protection and sealed ball bearings. The fans are caulked at the motor screws, the wiring cables and along the seams of the fan to prevent moisture from entering the housing. The fan is prewired and supplied with a mounting bracket for easy installation (at the point as close to the termination of the 4" exhaust pipe as possible, e.g. under the roof of the building to minimize fan operating noise from being transmitted back through the duct work). This fan is UL recognized and ultraviolet light protected.

The clamps, band screw and housing are made from series 300 stainless steel. They are corrosion resistant and rustproof and specially designed for greater sealing efficiency. The couplings flex with pipe and fan movement, maintaining integrity of seal.

# Installing the Fan

STEP 1.
When selecting fan mounting location, consider the following:

• Fan location should allow sufficient access for service. You will want to insert a piece of exhaust pipe in place of the fan when you are servicing it or the power has been turned off.

• The best location for the fan to be mounted is as close as possible and practical to the termination of the vent pipe. This minimizes the transmission of vibration sound back to the bathroom.

• In order to prevent bathroom odors insure that no competing demands for air, such as open windows(only on the side of the building opposite the direction from which the wind blows), fireplaces, bathroom exhaust fans, are present. If necessary, cut 1 or 2 inches off the bottom of the bathroom door to supply air to the commode.

STEP 2.
Using the wood screws provided, attach the mounting bracket to a support beam at the selected location. We recommend vertical mounting to reduce condensation buildup, however if horizontal installation is necessary, either wrap insulation around the fan or drill a 1/4" hole in the bottom of the housing (along with an threaded insert and drain tubing) allowing condensation to drain.

STEP 3.
Attach fan to the mounting bracket with the sheet metal screws provided. Be careful to ensure that direction of air flow is to the outdoors. Bracket is provided with rubber vibration isolation grommets to prevent the transmission of sound through the structure. Do not to over tighten. Also, care should be taken not to strip the plastic housing. Although screws are self-tapping, we recommend that pilot holes (no larger than 3/32") be drilled.

STEP 4.
Connect 4" ID vent pipe (PVC schedule 40 pipe recommended) to the inlet and outlet of the fan using the quick-disconnect rubber couplings provided. While the worm clamps should be snug, care should be taken not to over tighten ( 60 lbs. of torque max.).

NOTE: Steps 2 & 3 may be reversed.

## The Electrical Connection

Installation work and electrical wiring must be done by qualified persons in accordance with all applicable codes and standards.

DO NOT CONNECT POWER SUPPLY until fan is completely installed. Make sure electrical service to the fan is locked in "OFF" position.

While we recommend that the fan be left running at all times, this unit is suitable for switched use. A number of users have found that it is advantageous to have a wall-mounted switch near the commode so that the fan can be shut off temporarily while the fan is being serviced. It is important to note, however, that the fan be turned on immediately following service. NEVER place a switch where it can be reached from a tub or shower.

STEP 1.
Remove the screws securing the terminal box cover plate located on the side of the fan. All fan motor connections are prewired to an electrical terminal strip. A 3/8" clamp connector is provided to secure the wiring through the knockout provided on the side of the terminal box.

STEP 2.
Bring incoming electrical service through the connector and the knockout. There are two open ports on the terminal strip. Using a small regular screwdriver, tighten the neutral (white) wire of the incoming supply under the open port labeled "N". Tighten the line (black) wire of the incoming supply under the open port labeled "L". Since the fan motor is isolated within a plastic housing, grounding is not necessary.

STEP 3.
Secure connections, clamp connector and terminal box screws.

## Troubleshooting

If fan fails to operate, please check the following:

• Consult wiring diagram provided with the fan, to assure proper connection.

• Check motor lead wiring and incoming supply leads to assure definite contact.

MAINTENANCE
Since fan bearings are sealed and provided with an internal lubricating material, no additional lubrication is necessary. If fan is to be turned off and left inoperative for more than ten (10) days, we recommend that fan be removed from vent pipe and stored in a dry environment (and short section of vent pipe be installed in fan position in vent pipe).

TWO (2) YEAR WARRANTY
During the first two years, EcoTech will repair or replace a fan which has a factory defect in workman-ship or material. Product must be shipped prepaid to the EcoTech factory and be accompanied with a copy of the Bill of Sale. Product will be repaired/replaced and shipped back to the buyer. No credits will be issued.

The following are not covered by this warranty:

Damages from shipping, either concealed or visible. Claim must be filed with the carrier.

Damages resulting from improper wiring or installation.

Damages caused by acts of nature.

# Warranty

EcoTech warrants the parts in each Carousel system to be free from defects in material and workmanship for a period of two years from the date of installation and an extended 25-year warranty on the fiberglass reinforced polyester material.

Some states do not allow limitations on how long the implied warranty lasts, so the above limitation may not apply. Sole obligation under this warranty is as follows: EcoTech as the warrantor shall fulfill this warranty by repairing or exchanging any component part, F.O.B. factory, that in EcoTech's judgment shows evidence of defects, provided said component part has been paid for and is returned through an authorized dealer, transportation prepaid. The purchaser as the warrantee must also specify the nature of the defect to the manufacturer.

The warranty does not cover Carousel systems that have been flooded, by external means, or that have been dismantled by unauthorized persons, improperly installed, or external damage or damage due to altered or improper wiring or overload protection or exposure to chemicals or ultraviolet light that will degrade the polyester resin in the fiberglass components.

The warranty applies to only to the Carousel system as manufactured by EcoTech and does not include any of the building system to include, but not be limited to structure, electrical wiring, ventilation, plumbing, drainage or wastewater disposal device system. EcoTech is not responsible for any delay or damages caused by defective components or material, or for loss incurred because of interruption of service, or for any other special or consequential damages or incidental expenses arising from the manufacture, sale, or use of the Carousel system.

EcoTech reserves the right to revise, change or modify the construction and design of the treatment system or any component part or parts thereof without incurring any obligation to make such changes modifications in previously sold equipment. EcoTech also reserves the right, in making replacements of component parts under this warranty, to furnish a component part which, in its judgment, is equivalent to the original equipment part replaced.

Under no circumstances will EcoTech be responsible to the warrantee for any other direct, indirect or consequential damages, including but not limited to lost profits, lost income, labor charges, delays in production, and/or idle production, which result from defects in material and/or workmanship of the system. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty is expressly in lieu of any other expressed or implied warranty, excluding any warranty of merchantability or fitness, and any other obligation on the part of Ecotech.

This warranty gives you specific rights. You may have other rights which vary from state to state.

**A data plate like this comes with your Carousel and is featured prominently:**

## Carousel Composting Toilet

*The 4 -in-1 Batch-Composting System*

**Model:** 80-A LARGE
**Part number:** 978273
**Serial number:** 1997-
**Capacity:** 4 adults in residential use (approx. 16 uses per day) at a minimum ambient temperature of 65 degrees Fahrenheit or higher
**Warranty:** 25 years on fiberglass components and two years on all other components from date of purchase
**Materials:** Fiberglass-reinforced polyester resin with polyester gel coat

- Must be installed according to local health, building and plumbing codes
- Service may be performed by a licensed septage hauler or equally qualified composting toilet system service person
- Must be installed and operated in accordance with the Carousel Composting System Installation and Operation Manual
- Service at six-month intervals. Remove finished humus after two years of composting (minimum of 6 months per compost chamber)
- Utilize or dispose of humus and leachate in accordance with state and local regulations
- Add, per person per day, *not more than* 1/2 pint (0.28 liter) chopped vegetable scraps or 1/4 pint (0.14 liter ) other additive (see *Additives for Composting Toilets* in the Manual)

ecotech

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