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Recode Draft Plumbing Code for Composting and Urine Diversion Toilets

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Justification

Introduction

Water scarcity and pollution concerns are driving the adoption of composting and urine diversion toilet systems in the US and abroad. In the US, these systems have been treated unevenly by a patchwork of regulations in Health, Onsite Sanitation, and Building Code departments because they do not fit neatly into categories designed to guarantee safe sanitary drainage systems. It is the opinion of this code group that composting and urine diversion toilets are at a turning point, mature enough to build sound regulation around while also being a site of active research and development. Our intent is therefore to create code language that provides for strict protections on public health while also encouraging the growth of domestic industry and innovation in composting and urine diversion systems.

Performance Coding

As far as is possible, this code is a performance code, meaning that it does not judge systems on what they look like, but rather on the operational conditions within. For this code, that means integrating field testing into the evaluations of new systems and providing prescriptive best practice guidance in conjunction with performance requirements.

Protections for Public & Homeowner Health

This code is a combination of performance testing and prescriptive guidelines for ventilation, screening, and retention time of compost and diverted urine to create easy-to-follow and inspect requirements that protect public health even in the event of system failure and poor owner maintenance. Our code mandates that unsaturated aerobic decomposition conditions be maintained, that temperature stay within the range of beneficial decomposing organisms, and that decomposition occur for at least one year, outside the survival time of pathogens. In the event of maintenance failure, watertightness, screening, and ventilation requirements prevent both public health threats from arising and major inconvenience in the home.

Environmental Protection:

Urine diversion can reduce nitrogen in domestic wastewater by 80%, and Composting Toilet Systems can reduce household nitrogen by close to 90%, both at installed costs of $3-6,000. This is a higher performance than Alternative Treatment Technologies (ATTs) and sand filters currently required in many jurisdictions with surface and groundwater concerns, and at a fraction of the cost. This code brings new, lower cost options for environmental protection to homeowners.

Innovation:

This code enables the installation of innovative technologies by creating a code with clear inspection points to safeguard public health even in the event of the failure of new or experimental designs. The output of the installations of a composting toilet system are subjected to biological field testing and verification to assure performance. Our hope is that this code will help launch a vigorous domestic industry in composting toilets and urine diversion systems.

Composting Toilet System Definitions

Commode. The composting toilet fixture for collecting, containing, or transporting excreta to the compost processor.

Compost Additives. Any material such as sawdust, wood shavings, and other compostable material added to the commode or compost processor to maintain operational conditions within the composting toilet system.

Composting Toilet System. A system designed to safely collect and process excreta and compost additives into humus through aerobic decomposition.

Compost Processor. The site of aerobic decomposition transforming excreta and compost additives into humus.

Desiccation. The process of dehydrating excreta or leachate.

Diverted Urine. Urine that is collected and has not made contact with feces.

Excreta. Includes but is not limited to urine, feces, menses, toilet paper, and other human body emissions and biodegradable cleaning products.

Humus. The biologically decomposed, soil-like output of the compost processor.

Leachate. Liquid draining from the compost processor.

Owner's Manual. A manual provided to the owner of a composting toilet system containing instructions for all management aspects of that system.

Secondary Composting. Additional retention and continued decomposition of humus removed from compost processors in order to meet a safe retention time.

Site-Built. Constructed at the site of use.

Transfer. The controlled transfer of excreta or partially processed humus between commode and composting processor or between multi-stage composting processors.

Urine Diversion. Separation of urine from other excreta that occurs at the commode.

Vectors. An organism that has the potential to transmit disease.

Composting Toilet Systems

General. The provisions of this section shall apply to the design, construction, performance, alteration, and repair of composting toilet and urine diversion systems.

Design and Construction Requirements. Composting toilets, composting toilet systems, and urine diversion systems shall meet the design, construction, and performance requirements of either Listed Composting Toilets and Composting Toilets Systems or Alternative Design Systems.

Listed Composting Toilets and Composting Toilet Systems. Composting toilets and composting toilet systems shall be listed to NSF/ANSI Standard 41.

Alternative Design Systems. Composting toilet and urine diversion systems for residential and commercial applications complying with the provisions of this section shall be permitted where approved by the Authority Having Jurisdiction.

System Materials and Components. Pipe, pipe fittings, traps, fixtures, material, and devices used in composting toilet and urine diversion systems that are expected to contact leachate or diverted urine shall be listed or labeled (third-party certified) by a listing agency (accredited conformity assessment body), unless otherwise approved by the Authority Having Jurisdiction. Materials and components shall comply to approved applicable recognized standards referenced in this supplement and the plumbing code, and shall be free from defects. Unless otherwise provided for in this supplement, materials, fixtures, or devices used or entering into the construction of plumbing systems, or parts thereof, shall be submitted to the Authority Having Jurisdiction for approval.

System Design. Composting toilet and urine diversion systems complying with this code shall be designed by a person registered or licensed to perform plumbing design work or who demonstrates competency to design composting toilet and urine diversion systems.

Permit. It shall be unlawful for any person to construct, install, alter, or cause to be constructed, installed, or altered any composting toilet and urine diversion system in a building or on a premise without first obtaining a permit to do such work from the Authority Having Jurisdiction.

Maintenance and Inspection. Composting toilet and urine diversion systems and components shall be maintained and inspected in accordance with the following Sections Maintenance and Responsibility, Operation, and Inspection.

Maintenance Responsibility. The required maintenance and inspection of composting toilet and urine diversion systems shall be the responsibility of the property owner, unless otherwise required by the Authority Having Jurisdiction. The property owner is responsible for retaining test result records in accordance with the Section titled 'Humus' and making them available to the Authority Having Jurisdiction upon request. Upon transfer of property or tenancy, all test records shall be transferred and humus shall be re-tested after its first treatment period and a record retained.

Operation. Composting toilet and urine diversion systems shall be operated in a safe and sanitary condition in accordance with the owner's manual in accordance with the Section Operation and Maintenance Manual.

Inspection. In the event of a nuisance complaint or documented system failure, the composting toilet and urine diversion system shall be made available for inspection and the owner or owner's agent shall conduct sufficient repairs or alterations to the composting toilet system. At the owner's expense, the Authority Having Jurisdiction shall be permitted to request results of all laboratory testing and require new tests in accordance with Section Testing, following repairs to alleviate dangerous or unsanitary conditions.

Operation and Maintenance Manual. An owner's manual shall present clear instructions for maintenance and be transferred to the new owner upon transfer of property or tenancy. The owner's manual shall include:

1. Schedule for addition of necessary compost additives.
2. Source or provider of necessary compost additives. Source may be on-site.
3. Schedule and instructions for all regular maintenance tasks.
4. Expected input of and capacity for excreta and compost additives to compost toilet system specifying loading of commode(s) and compost processor(s).
5. Plan for container transfer and cleaning where transfer is used.
6. Expected schedule for removing humus from composting processors and where used secondary composting bins.

7. Plan for on-site disposal of humus or professional removal.
8. Plan for managing leachate.
9. Plan for microbial testing in accordance with Section on Humus.

Composting Toilet System Design Requirements. The design and installation of composting toilet systems shall be in accordance with Section Durability through Section Humus Removal.

Durability. All components expected to contact excreta or leachate shall be constructed of corrosion-resistant material such as stainless steel or durable polymers (ABS, PVC Schedule 40, Polypropylene, High-density polyethylene, Fiber-reinforced polyester, or material of equivalent durability). Concrete in contact with excreta or leachate shall meet requirements of Section Concrete Construction.

Concrete Construction. Concrete construction shall be reinforced, watertight and able to withstand loading weight. Where drainage is required, the processor floor shall be sloped not less than ¼-inch per foot. The flange of each sub-drain shall be set level.

Commodes.

Structure. Commodes shall be designed to support users.

Odor. Commode design or use shall mitigate the infiltration of odors into the building during normal operation and in the event of temporary power failure.

Contact. Commodes shall transport excreta into the compost processor or contain excreta for transfer as designed according to the owner's manual.

Vectors. Commodes shall limit vectors and prevent human contact except for regular maintenance as designed according to the owner's manual.

Compost Processors. Compost processors shall be designed in accordance with Section Leachate through Sizing and shall maintain unsaturated aerobic composting conditions within the compost mass, through the drainage, absorption, or desiccation of leachate, and aeration of the processor.

Leachate. Leachate shall be collected for removal or recirculation within the processor, evaporated, or drained to an approved plumbing drainage system or other location approved by the Authority Having Jurisdiction. Leachate storage tanks shall be constructed and installed in accordance Section Venting through Openings.

Venting. Leachate storage tanks shall be vented as required for pressure equalization. When required, vents shall be installed on leachate storage tanks and shall extend from the top of the tank. Storage tank vents shall be permitted to connect to the plumbing venting system 6 inches above the flood level rim of the highest fixture. Vents extending to the outdoor shall terminate no less than 12-inches above grade. The vent terminal shall be directed downward and covered with a 3/32 inch mesh screen to prevent the entry of vermin and insects.

Vent Size. Pressure equalization vents that prevent nitrogen loss by the use of restrictions, or of piping or tubing that is less than the minimum pipe diameter required in the plumbing code shall be approved by the Authority Having Jurisdiction.

Overflow. Where storage tank overflows are installed they shall be connected to the plumbing drainage system.

Backwater Valve. Storage tank overflows shall be provided with a backwater valve or check valve at the point of connection to the plumbing drainage system when connected to a public sewer system. The backwater valve shall be accessible for inspections and maintenance.

Construction. Leachate storage tanks shall be constructed of polyethylene terephthalate (PET), polyethylene napthalate (PEN), polyamide (Nylon) or a blend of PET, PEN, ethyl vinyl alcohol (EVOH), Nylon, HDPE, or other tanks listed or certified to US 49 CFR Section 178.274 "Specifications for UN portable tanks."

Above Grade. Above grade storage tanks shall not be permitted where subject to freezing conditions, or shall be provided with an adequate means of freeze protection. The above grade leachate storage tank shall be provided with a high-water alarm. The alarm shall report when 80 percent volume is reached.

Below Grade. Leachate storage tanks installed below grade shall be structurally designed to withstand all anticipated earth or other loads. Tank covers shall be capable of supporting an earth load of not less than 300 pounds per square foot (lb/ft^2) (1465 kg/m^2) when the tank is designed for underground installation. Below grade

leachate tanks installed underground shall be provided with manholes. The manhole opening shall be a minimum diameter of 20 inches (508 mm) and located a minimum of 4 inches (102 mm) above the surrounding grade. The surrounding grade shall be sloped away from the manhole. Underground tanks shall be ballasted, anchored, or otherwise secured, to prevent the tank from floating out of the ground when empty. The combined weight of the tank and hold down system should meet or exceed the buoyancy force of the tank. The below grade leachate storage tank level shall be provided with a high-water alarm.

Marking. Where openings are provided to allow a person to enter the tank, the opening shall be marked with the following words: "DANGER—CONFINED SPACE."

Openings. All openings shall be covered and secured to prevent tampering. Openings shall be screened or covered to prevent rodent infiltration and be protected against unauthorized human entry.

Vectors. The compost processor shall be designed and installed to limit vector access through management as required in the owner's manual.

Transfer. Where unfinished excreta or diverted urine is transferred between processors or from commode to processor, transfer and cleaning of containers and provisions for limiting user exposure shall be according to the owner's manual.

Watertightness. Processors shall be constructed of watertight material in accordance with Section Durability.

Rodent proofing. The compost processor shall be protected to prevent the entrance of insects, birds, or rodents. No unsecured opening other than vents, drainage, or commode may exceed ½-inch in the least dimension.

Active Conditions. The compost processor or processors shall be sized to compost excreta for a minimum of one year of biologically active conditions. Biologically active conditions are at or above a daily average of 42°F (6°C).
Exception: Systems with shorter retention shall be permitted where either,
(a) humus from the compost processor has been tested according to Section Humus and there is a secondary composting stage where humus is retained in a well maintained compost bin or other facility designated for the exclusive purpose of containing humus removed from the compost processor, or (b) humus is removed off site for processing or disposal at an approved facility.

Secondary Composting. Humus transferred to secondary composting shall first be tested according to the Humus section. Secondary composting shall be labeled and protected from human contact. Contact with precipitation and surface waters is prohibited.

Ventilation. Negative ventilation between the commode and compost processor shall be provided when the compost processor is connected directly to the commode without a trap. Commodes that are not connected to the compost processor do not require a vent.

Vent Terminals. Vent stacks shall terminate exterior the building as required by the plumbing or mechanical code.

Sizing. The compost processor shall be sized to accommodate the maximum daily adult usage as specified by the manufactures published ratings. Site built compost processors shall be sized to hold a minimum of 10 gallons of material per person per year while allowing for the removal of the humus, or as specified by the system designer.

Testing. Composting toilet systems shall be tested in accordance with the following sections on Compost Processors and Humus.

Compost Processors. Compost processors shall be tested for water tightness by filling the system to the maximum designed liquid storage capacity of the unit for a duration of 24 hours.

Humus. The owner or owner's agent of the composting toilet system shall verify user's compliance with the manufacturer's maintenance and operation manual in accordance with the Humus Section by submitting a sample of the humus from the first treatment period after a minimum of one year of biologically active conditions to a certified laboratory before removal of humus from the composting processor. Where multiple compost processors are used, the humus sample shall be removed from the last compost processor. The sample collection shall be tested in accordance with EPA/625/R-92/013, Appendix F, Section 1.2. Humus shall not have a moisture content exceeding 75% by weight, and shall not exceed 200 fecal coliforms/gram.

Humus Removal. Humus shall be removed according to the owner's manual. Humus from the compost processor shall be permitted to be used around ornamental shrubs, flowers, trees, or fruit trees and shall be mixed with soil

or mulch and covered with 3 inches of cover material. Depositing humus from any composting toilet system around any edible vegetable or vegetation shall be prohibited.

Urine Diversion Systems

Urine Diversion System Design Requirements. The design and installation of urine diversion systems shall be in accordance with Section Purpose through Section Treatment, Reuse, and Disposal.

Purpose. The purpose of this section is to enable the installation of urine diversion and collection systems to improve the function of composting toilet systems and prevent nutrient pollution of ground and surface waters.

Material Requirements. Material used for urine diversion shall be stainless steel or non-metallic pipe. Concrete piping is prohibited.

Identification. All urine diversion piping shall be identified.

Change of Direction. Changes in direction of urine diversion piping shall be made by a long-sweep 90 degree fitting or other approved fittings of equivalent sweep.

Sizing. Pipe sizes shall be in accordance with the plumbing code. Each urine diversion fixture shall be rated as one drainage fixture unit. Piping or tubing for urine diversion that is less than the minimum pipe diameter required in the plumbing code shall be approved by the Authority Having Jurisdiction.

Traps. Fixtures discharging into urine diversion piping connected to the plumbing drainage system shall be trapped and vented according to the plumbing code.

Grade of Horizontal Piping. Urine diversion piping shall be installed at a minimum grade of ½-inch per foot, or 4 percent toward the point of disposal.

Cleanouts. A cleanout shall be provided at the upper terminal of each drain line, every 50 feet and at an aggregate horizontal change of direction exceeding 135 degrees.

Venting. Commode fixtures without traps that require ventilation shall be connected to either a dry toilet ventilation stack or a urine diversion ventilation stack. Nonwater urinals used as urine diversion systems shall be connected to a dry toilet ventilation stack or a urine diversion ventilation stack.

Discharge. A urine-diversion system shall be diverted to a storage tank or discharge to an approved plumbing drainage system.

Urine Storage Tanks. Urine storage tanks shall be constructed and installed in accordance with the following: Section Venting through Openings.

Venting. Urine storage tanks shall be vented as required for pressure equalization. When required, vents shall be installed on urine storage tanks and shall extend from the top of the tank. Storage tank vents shall be permitted to connect to the plumbing venting system 6 inches above the flood level rim of the highest fixture. Vents extending to the outdoor shall terminate no less than 12-inches above grade. The vent terminal shall be directed downward and covered with a 3/32 inch mesh screen to prevent the entry of vermin and insects.

Vent Size. Pressure equalization vents that prevent nitrogen loss by the use of restrictions, or of piping or tubing that is less than the minimum pipe diameter required in the plumbing code shall be approved by the Authority Having Jurisdiction.

Traps. Urine storage tanks shall prevent odors and nitrogen loss from the tank inlet by means of a P-trap, mechanical trap, submerged inlet piping, or other means approved by the Authority Having Jurisdiction. Submerged inlet piping shall remain submerged during use and after pumpout. Exception: Tanks of five gallons or less connected to fixtures with active ventilation or having an integrated seal.

Overflow. Where storage tank overflows are installed they shall be connected to the plumbing drainage system.

Backwater Valve. Storage tank overflows shall be provided with a backwater valve or check valve at the point of connection to the plumbing drainage system when connected to a public sewer system. The backwater valve shall be accessible for inspections and maintenance.

Construction. Urine storage tanks shall be constructed of polyethylene terephthalate (PET), polyethylene napthalate (PEN), polyamide (Nylon) or a blend of PET, PEN, ethyl vinyl alcohol (EVOH), Nylon, HDPE, or other tanks listed or certified to US 49 CFR Section 178.274 "Specifications for UN portable tanks."

Above Grade. Above grade storage tanks shall not be permitted where subject to freezing conditions, or shall be provided with an adequate means of freeze protection. The above grade urine storage tank shall be provided with a high-water alarm. The alarm shall report when 80 percent volume is reached.

Below Grade. Urine storage tanks installed below grade shall be structurally designed to withstand all anticipated earth or other loads. Tank covers shall be capable of supporting an earth load of not less than 300 pounds per square foot (lb/ft^2) (1465 kg/m^2) when the tank is designed for underground installation. Below grade urine tanks installed underground shall be provided with manholes. The manhole opening shall be a minimum diameter of 20 inches (508 mm) and located a minimum of 4 inches (102 mm) above the surrounding grade. The surrounding grade shall be sloped away from the manhole. Underground tanks shall be ballasted, anchored, or otherwise secured, to prevent the tank from floating out of the ground when empty. The combined weight of the tank and hold down system should meet or exceed the buoyancy force of the tank. The below grade urine storage tank level shall be provided with a high-water alarm.

Marking. Where openings are provided to allow a person to enter the tank, the opening shall be marked with the following words: "DANGER—CONFINED SPACE."

Openings. All openings shall be covered and secured to prevent tampering. Openings shall be screened or covered to prevent rodent infiltration and be protected against unauthorized human entry.

Maintenance Plan. Every urine diversion system shall have a maintenance plan that includes both a pumpout schedule and contract, or an onsite discharge plan. The maintenance plan shall also include a pipe cleaning schedule.

Treatment, Reuse, and Disposal. Where urine is to be reused onsite, a treatment method for sanitization shall be included in the owner's manual. Approved methods of treatment shall include:

1. Retention without addition for six months before usage. Two or more holding tanks shall be required for retention,
2. Application to the compost processor,
3. Pasteurization to 158° F. (70°C) for thirty minutes, or
4. Other method approved by the Authority Having Jurisdiction.

Appendix

Note: All images are conceptual and are not construction diagrams.

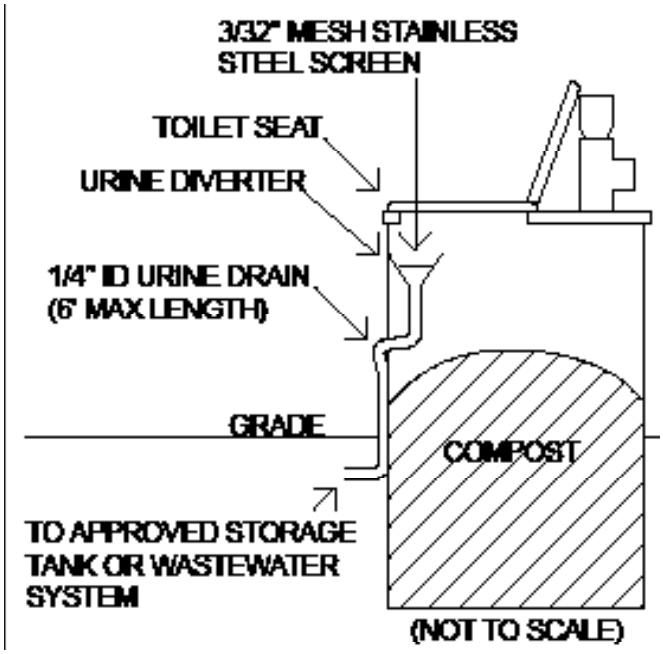
Barrel Composting Toilet & Urine Diverter with 1/4" hose

Design by David Omick.

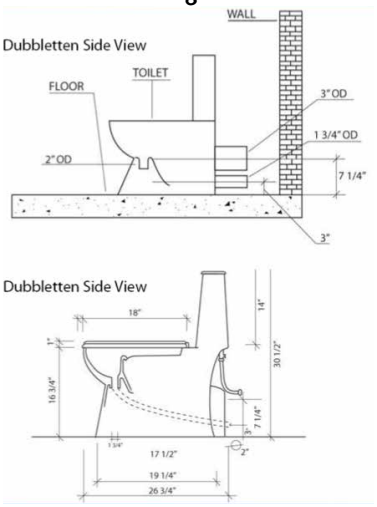
Urine also contains high concentrations of dissolved minerals that form deposits on the inside of ordinary drain pipes, eventually clogging them. The small diameter pipe requires only a 1/2 cup of water following each use to thoroughly rinse the entire inside surface of the pipe thus preventing mineral buildup. Complete rinsing reduces the chance of struvite forming.

A small diameter drain also helps to prevent cockroaches and other disease vectors from entering or leaving the toilet through the drain.

Automotive fuel hose makes a good urine drain hose as it's durable, non-corrosive and resistant to kinking.



Dubbletten Urine Diverting Toilet with 2" hose



EcoFlush Urine Diverting Flush Toilet with 1" hose

Advantages: lowers water consumption by approximately 70-90% of a conventional flush toilet which lowers volume for collection system. Large flush is 2.5 L, small flush is 0.3-0.5 L.

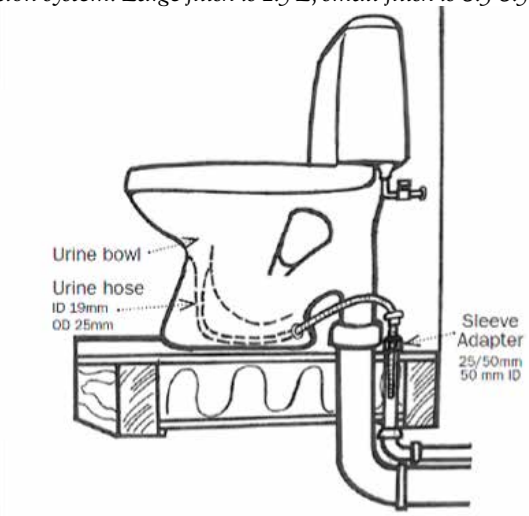


TABLE 1 TYPICAL PATHOGEN SURVIVAL TIMES AT 20 TO 30°C IN VARIOUS ENVIRONMENTS

	Survival Time, Days		
Pathogen	**Fresh Water and Wastewater**	**Crops**	**Soil**
Bacteria			
Fecal coliforms[a]	< 60 but usually < 30	< 30 but usually < 15	< 120 but usually < 50
Salmonella (spp.)[a]	< 60 but usually < 30	< 30 but usually < 15	< 120 but usually < 50
Shigella[a]	< 30 but usually < 10	< 10 but usually < 5	< 120 but usually < 50
Vibrio cholerae[b]	< 30 but usually < 10	< 5 but usually < 2	< 120 but usually < 50
Protozoa			
E. histolytica cysts	< 30 but usually < 15	< 10 but usually < 2	< 20 but usually < 10
Helminths			
A. lumbricoides eggs	Many months	< 60 but usually < 30	< Many months
Viruses[a]			
Enteroviruses[c]	< 120 but usually < 50	< 60 but usually < 15	< 100 but usually < 20

a In seawater, viral survival is less and bacterial survival is very much less than in fresh water.
b *V. cholerae* survival in aqueous environments is a subject of current uncertainty.
c Includes polio, echo, and coxsackie viruses.

Source: Adapted from: Crites and Tchobanoglous, 1998.