Preparing Activity: USACE Superseding
UFGS-44 41 13.19 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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SECTION 46 07 53.19

COMPOSTING TOILET
02/11

NOTE: This guide specification covers the requirements for packaged composting toilets that can be used for human waste treatment at remote sites where a power source (AC or DC) is provided but water is not.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

PART 1 GENERAL

1.1 REFERENCES

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically

place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA P5	(2015) Standard for Waterborne Preservatives

ASM INTERNATIONAL (ASM)

ASM 06118G	(1993) ASM Metals Reference Book (3rd Ed)

ASTM INTERNATIONAL (ASTM)

ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D746	(2014) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D790	(2017) Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D883	(2020a) Standard Terminology Relating to Plastics
ASTM D1248	(2016) Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D1505	(2018) Standard Test Method for Density of Plastics by the Density-Gradient Technique
ASTM D1525	(2017) Standard Test Method for Vicat Softening Temperature of Plastics
ASTM D1593	(2009) Standard Specification for Nonrigid Vinyl Chloride Plastic Film and Sheeting
ASTM D2765	(2016) Standard Test Methods for Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.1 (2021) Butts and Hinges

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-272 (Rev B; Notice 1) Caulking Compounds

1.2 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

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Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G[, [_____]]

Installation; G[, [_____]]

SD-03 Product Data

Composting Toilet; G[, [_____]]

Spare Parts

Battery Capacity

Photovoltaic Thin-Film Modules

Framed Instructions

SD-06 Test Reports

Acceptance Tests

Factory Testing

SD-10 Operation and Maintenance Data

Manuals; G[, [_____]]

1.3 DELIVERY, STORAGE, AND HANDLING

Protect from the weather, humidity and temperature variations, dirt, dust, and other contaminants equipment delivered and placed in storage.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide the large, continuous composting type composting toilet. Add wastes at the top of the pile so that the composting material will eventually flow by gravity to the finished compost area as the underlying finished compost is removed. The composting toilet includes the composting chamber, ventilation fan and vent stack, stool with chute, and urinal with piping. Supply these elements and necessary related appurtenances and pieces by a single composting toilet manufacturer.

Submit detail drawings of equipment and material to be provided. Detail drawings containing complete wiring and schematic diagrams and other details required to demonstrate that the system is coordinated and will function properly as a unit.

2.1.1 Design

Provide composting chamber that holds a minimum of [_____] cubic meter feet of composting material. The composting chamber must receive wastes from [_____] stools, and from [_____] urinals. Design the vents, air ducts, and air inlets to the composting chamber so that air can flow from the user compartment into the composting chamber but not in the reverse direction, and so that no air can reach the vent without first passing through the composting material. Design the toilet so that all liquid entering the composting chamber will drain over and through the composting pile, and not along the chamber walls. Collect all excess liquid to an easily accessible liquid holding area. The toilet must [contain a pump for removing excess liquid] [be equipped with a drainage port in the bottom of the liquid holding area that can be connected to a liquid

disposal system]. Depending on liquid volume, expected usage, and if a pump is used, permanently install [automatic] [manual] variety pump with automatic control. Design and construct the toilet so that liquids can enter the composting chamber only through the waste ports. Provide materials and joints in the toilet that are impermeable to liquids and not subject to biological, chemical, or physical corrosion. Preserve wood in accordance with AWPA P5.

2.1.2 Performance

The composting toilet must produce an inert, odor-free compost with a moisture content less than 60 percent. The finished compost must not produce enough gas to inflate a plastic bag which is 80 percent full of compost after being sealed in the bag for 24 hours at an ambient temperature. The toilet must prevent the entry of insects in the user compartment and surrounding area through the use of noncorrosive screens over all air and ventilation inlets. Assure that the composting toilet is installed properly and demonstrate that it will operate properly.

2.2 JOINT SEALANTS

Provide joint sealants that are resistant to water and biological decomposition in conformance with CID A-A-272.

2.3 LUMBER

Use pressure-treated or preserved sanded, two sided (S2S) construction-grade pine or fir without excess crown lumber for the tank support. Treat lumber for preservation in accordance with AWPA P5.

2.4 DRAIN PIPE

Provide drain pipe from the urinal to the composting tank at least 32 mm 1-1/4 inches inside diameter (ID) and sloped continuously toward the tank. Provide pipe made of a corrosion-resistant material. Locate the pipe outlet to the composting tank such that the urine flows onto or close to the center of the compost pile, to ensure that the urine flows through the pile and does not short-circuit down the tank walls.

2.5 STOOL, CHUTE, SEAT, AND LID

Construct the toilet stool in two pieces, consisting of an exterior piece that is permanently connected to the floor of the user compartment and an interior piece that is mounted inside the exterior piece and conveys wastes into the toilet chute. Construct the interior piece of high-density polyethylene, fiberglass, or stainless steel (Type 304). Construct the exterior piece of [high-density polyethylene] [fiberglass] [oak] [stainless steel]. The top of the installed toilet stool must be a minimum of 360 to a maximum of 460 mm 14 to a maximum of 18 inches above the user compartment floor. The minimum diameter of the interior piece opening into the chute must be 300 mm 12 inches. Fabricate the toilet chute from stainless steel (0.4775 to 0.6350 mm 24 to 26 gauge), high-density polyethylene, or fiberglass, and may be fabricated in one piece or in several pieces that are assembled in the field. Attach the chute to the composting toilet with a chute/tank connector fabricated from the same material as the chute. Fabricate the seat and lid from high-density polyethylene, ABS plastic, hardwood, or stainless steel. Provide toilet, chute, chute/tank connector, seat, and lid by the composting toilet manufacturer and certified by the manufacturer to be

compatible with the manufacturer's composting toilet.

2.6 COMPOSTING VENTILATION SYSTEM

Install a ventilation system to draw air through the composting tank to provide a continuous supply of oxygen to the compost pile, ensuring that aerobic decomposition and dehydration occur. The ventilation system must also draw off odors or gases generated by the pile. Provide a system with the following components:

2.6.1 Electrically Powered Exhaust Fan

An electrically powered exhaust fan, installed and sized to provide a minimum flow of 0.042 to 0.057 cubic meters/second 90 to 120 cfm of air. Place the fan as high as possible in the building, but easily accessible for maintenance or replacement. The fan must not be closer than 760 mm 30 inches to the roof and a maximum of 1.8 m 6 feet from a power disconnect.[If ac power is not available, a 12 volt direct current (dc) fan may be substituted and powered by a solar power generating system. Provide roof mounted solar power generating array consisting of amorphous photovoltaic thin-film modules with a minimum power output required to operate the fan and recharge the battery at one sun. Array nominal voltage rating must be 12 volts dc. Provide storage battery consisting of sealed, liquid, lead-acid, deep-cycle batteries with absolute style plate technology. This configuration permits the fan to operate at night, and during overcast conditions. Secure and ventilate the battery storage area to prevent the buildup of explosive gases. Provide battery capacity that is a minimum of 18 hours continuous operation without recharging. Submit calculations which prove that the photovoltaic thin-film modules and batteries will provide power for the required period.]

2.6.2 Interior Vent Pipe

At least 150 mm 6 inches in diameter, extending from the composting tank to support box just under the exterior roof. If elbows are used, they must have minimal bend and frequency of occurrence. Vent pipe must be made of a corrosion-resistant material. Install pipes with the bell down to prevent the entry of water. Tape joints using duct tape.

2.6.3 Exterior Pipe

An exterior pipe extending from the support box to the rain cap. Surround the pipe with insulation (fiberglass or equivalent R-1.23 (7) R-7). Extend the exterior pipe at least 600 mm 2 feet above the peak or highest point of the roof. Install pipes with the bell down to prevent the entry of water. Do not use elbows greater than 45 degrees. Provide elbows made of, or coated with, a corrosion-resistant material.

2.6.4 Vent Pipe Roof Sleeves

Made of, or coated with, a corrosion-resistant material.

2.6.5 Slip Joint

A slip joint installed above the fan for the easy removal of the fan. The sleeve of the slip joint must be long enough to slide down and close the gap left by the fan when the fan is removed.

2.6.6 Support Box

A support box installed under the roof to connect the interior and exterior vent pipes. Provide support box made of, or coated with, a corrosion-resistant material.

2.6.7 Roof Jack and Rain Collar

These components must be made of, or coated with, a corrosion-resistant material.

2.6.8 Rain Cap

Mounted on the top of the exterior vent pipe. The rain cap must be made of, or coated with, a corrosion-resistant material.

2.6.9 Braces

Braces installed on the exterior vent pipe if winds greater than 80 km/hour 50 mph or snow load greater than 900 mm 3 feet can be expected, or if the exterior pipe extends more than 1.2 m 4 feet above the peak of the roof.

2.7 URINALS

Install one trough urinal for each composting unit. This trough must be made of stainless steel or corrosion-resistant material. The trough must be at least 660 mm 26 inches long and 200 mm 8 inches deep; extend the back at least 890 mm 35 inches above the bottom of the trough to protect the wall in back of the urinal. Mount the urinal at a height of approximately 400 mm 16 inches.

2.8 COMPOST BAFFLES

Provide two baffles, front and back, to form a compartment to contain the compost pile. Attach the front baffle securely; however, sealing is not required.

2.9 LIQUID BAFFLE, DRAIN PORTS, AND SCREENS

Install a liquid baffle with a screen at the front of the compost tank to retain the compost, and permit the passage of water seeping from the compost pile. Provide screen openings at least 6 mm 1/4 inch to minimize plugging. The screen must be easily accessible so that it can be checked for plugging and can be cleaned. Provide a drain port in front of the liquid baffle to drain any seepage to a wastewater collection or treatment system. Place the drain port as low as possible in front of the liquid baffle so that no water stands in the bottom of the tank. Provide an overflow drain to permit the drainage of water should the drain plug become clogged. Place the overflow port just below the level of the top of the liquid baffle. Provide drain line at least 32 mm 1-1/4 inches ID.

2.10 LIQUID DRAIN FITTINGS

Provide fittings made of corrosion-resistant or impervious material such as polyvinyl chloride, polyethylene, or stainless steel.

2.11 AIR DUCTS

Provide at least 2 air ducts to carry air beneath the compost pile. Construct the air ducts of a material impervious to corrosion and to biological decomposition.

2.12 AIR INTAKES

Provide air intakes at the front of the compost tank that are at least 5800 square mm 9 square inches in cross section.

2.13 SIGNS

Affix signs to the major components of the composting toilet that identify those components. Provide names on the signs consistent with the identifying names in the operating instructions. Place other signs securely in the user compartment telling users that trash, cigarettes and matches thrown into the toilet can interfere with the composting process or set the compost pile on fire.

2.14 FIRE EXTINGUISHER

If fire extinguishers are used, furnish the type that will not interfere with the composting process (ammonium phosphate type is acceptable).

2.15 COMPOST RAKE

Supply a conventionally sized (approximately 1.5 m 5 foot long handle, 300 mm 12 inch side-toothed end), commercially available garden rake or cultivator (approximately 1.5 m 5 foot long handle, 150 mm 6 inch tined head) for raking the compost pile.

2.16 COMPOST HOLDING TANK

2.16.1 Design

Design the tank that receives and holds the human wastes during composting (the compost holding tank) so that wastes enter from the top of the tank, and the composting material and excess liquid are removed from the bottom of the composting pile. The tank may be supplied in one, two, or three pieces; bolt tanks supplied in more than one piece together in place. Construct the tank of [plastic] [layered polyester fiberglass] [stainless steel] or an equivalent material that is impermeable to water and is corrosion-resistant. Construct the inner surfaces of the tank of material that is not susceptible to chemical or biological decomposition and is impervious to the absorption of waste and chemical derivatives. Slope the tank bottom towards the compost removal and liquid removal areas of the tank. Design the tank walls and floor to resist forces equal to or greater than the hydrostatic forces that would occur if the tank were filled with water with a maximum deflection in the walls or floor of 13 mm 1/2 inch. The tank roof must resist a 445 N 100 pound load, with a maximum deflection of 13 mm 1/2 inch. Equip the tank with a door that provides access to the bottom of the composting pile and an inspection door opening into the area above the composting pile as specified. The composting tank selected for installation is subject to the approval of the Contracting Officer, and is based on the detail drawings.

2.16.2 Polyethylene Tank

****
NOTE: When a polyethylene tank is specified, delete paragraphs "Fiberglass Tank" and "Stainless Steel Tank".
****

2.16.2.1 Alternative Standards I

ASTM D1248, Type 1, Class M, Grade 2, Category 3, with the following additional requirements:

a. Provide resin containing [stabilizers] [pigmentation] to resist ultraviolet degradation (for occasional exposure).

b. Provide [uncolored] [unfilled] resin density range of 0.938 to 0.942 grams per mL 0.938 to 0.942 grams per mL.

c. Provide resin with a maximum melt index of 5.

2.16.2.2 Alternative Standards II

Alternatively, the following standards apply.

a. Unless otherwise indicated, use the plastics technology in accordance with the definitions given in ASTM D883.

b. The molding resin must not contain any fillers. Provide plastics that contain a minimum of 0.25 percent ultraviolet stabilizer and a maximum of 0.50 percent. Pigments may be added but do not exceed 1.0 percent of the weight of the molded compost shell.

c. The minimum mechanical properties of the materials are as follows based on molded parts:

Property	ASTM	Value
Density	ASTM D1505	0.935 - 0.940 gm/cc59 lb/cu ft
ESCR spec. thickness 125 mils F50	ASTM D1593	900-1000 hr
Tensile strength ultimate 2 in./min.	ASTM D638 Type IV Spec.	17,925 kPa2600 psi
Elongation at break 2 in./min.	ASTM D638 Type IV Spec.	400 percent
Vicat softening temp.	ASTM D1525	116 degrees C240 degrees F
Brittleness temp.	ASTM D746	minus 118 degrees Cminus 180 degrees F
Flexural modulus	ASTM D790	690.5-758.4 MN/square meter 100,000-110,000 psi

d. The finished surface of the molded part must be as free as possible through commercial processing from visual defects such as foreign inclusions, air bubbles, pinholes, and craters. Trim and smooth cut edges.

e. Mold composting tank shells to a nominal 10 mm 3/8 inch thickness. Take physical dimensions externally and must fall within plus or minus 1 percent of the required dimensions.

2.16.3 Fiberglass Tank

****
NOTE: When a fiberglass tank is specified, delete paragraphs "Polyethylene Tank" and paragraph "Stainless Steel Tank."
****

Fiberglass construction must follow appropriate industrial standards. The gel coating must be a minimum of 2 mm 1/16 inch thick, impervious to corrosion and microbial degradation. The next layers are 12 to 25 mm 0.5 to 1.0 inch of high-density polyurethane insulation. Saturate the mats with isothalic resin.

2.16.4 Stainless Steel Tank

****
NOTE: When a stainless steel tank is specified, delete paragraphs "Polyethylene Tank" and paragraph "Fiberglass Tank." In general, stainless steel is not recommended due to its corrosivity.
****

Construct stainless steel in accordance with ASM 06118G.

2.17 COMPOST ACCESS DOOR

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NOTE: Metal hinges are permissible, but it is recommended that an appropriate plastic hinge be substituted because plastic is corrosion-resistant.
****

2.17.1 Design and Construction

Equip the compost holding tank with a door mounted above the finished compost holding area to remove compost and to detect and remove excess liquid. Provide minimum door opening of 0.339 square meters 525 square inches. Construct the door of material that is impermeable to water, corrosion-resistant, and not susceptible to attack by composting organisms. Provide door that supports a minimum of 1.33 kN 300 pounds with a maximum deflection of 13 mm 1/2 inch. Position the door opening such that personnel can see all of the finished compost and liquid storage excess liquid without requiring their heads or torsos to enter the composting tank. Attach the door to the compost holding tank with stainless steel hinges meeting the standards of ANSI/BHMA A156.1, or a full-length stainless steel piano hinge, or with plastic hinges. Maintain the door in any open position, when required, without braces or other external support or restraint. Normally, keep the door closed, and equip with a stainless steel latch that is easily operated by personnel but that prevents animals from entering the composting chamber.

2.17.2 Surrounding Area

Design the area around the compost access door so that maintenance personnel can remove compost while in a standing position. Provide a dry, stable work platform with adequate area for personnel movement and placement of the buckets or bags receiving the removed compost or liquids. Design stairs or ramps to the compost removal area to allow easy access to the area and safe transportation of compost and liquid containers from the area.

2.18 INSPECTION DOOR

****
NOTE: Metal hinges are permissible, but it is recommended that an appropriate plastic hinge be substituted because plastic is corrosion-resistant.
****

2.18.1 Design and Construction

Equip the compost holding tank with a door near the top of the tank that is used to remove debris, to rake the top of the compost pile, to observe the pile surface, to add water, and to perform other necessary operation and maintenance activities on the pile surface. Provide minimum door opening of 0.186 square meters 288 square inches. Construct the door opening of material that is impermeable to water, corrosion-resistant, and not susceptible to attack by composting organisms. Position the door opening so that personnel can see all of the pile surface from outside the tank and can reach all of the pile surface without requiring their head or torsos to enter the composting tank. Attach the door to the compost holding tank with aluminum or stainless steel piano hinge, or with plastic hinges. Design the door to stay in an open position when required, without braces or other external support or restraint. Normally, keep the door closed, and equip with a stainless steel latch that is easily operated by personnel but that prevents animals from entering the composting chamber.

2.18.2 Maintenance Provisions

Design the area in front of the inspection door so that maintenance personnel will have a stable, level platform to stand upon while inspecting the top of the compost pile. Construct the platform surface at an elevation that puts the center of the inspection door at eye level of maintenance personnel using the platform. Keep an area in front of the inspection door clear of obstructions that would interfere with inserting a 1.8 m 6 foot long rake through the inspection door.

2.19 SOURCE QUALITY CONTROL

2.19.1 Molded Unit Inspection

Visually inspect each molded unit to ensure that it is as free as possible from defects. In addition, take test samples from a "cut-away" section of the compost tank shell and the following tests performed:

2.19.1.1 Impact Test

Use ASTM D746 for this test. Sample must not shatter at 162.7 J (120 foot pounds) 120 foot pounds at minus 29 degrees C minus 20 degrees F (minimum).

2.19.1.2 Degree of Cross-Linking Test

Using ASTM D2765, a minimum gel of 70 percent must be reported on the inside half of the sample.

2.19.2 Factory Testing

Submit factory test results attesting to manufacturing quality control of the proposed system, at least [_____] days before the Contracting Officer approves or disapproves the composting toilet proposed for installation. Document [_____] installations of composting toilets, essentially identical to the composting toilet installed under this specification, and that those installations have at least [_____] consecutive years of operating experience. Include available operating data for each of the [_____] installations, along with the names, addresses, and telephone numbers of personnel at the [_____] installations that will furnish information upon request regarding questions of interest to the Contracting Officer.

PART 3 EXECUTION

3.1 INSTALLATION

Submit drawings showing proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work, including clearances for maintenance and operation.Install toilet in accordance with the manufacturer's installation instructions and in accordance with the approved submittals. Install the toilet using craftsmen and laborers with demonstrable experience and, where appropriate, certification or license in the required skills. Ensure that composting toilet is in working order.

3.2 CLEANING

Thoroughly clean the installed composting toilet, enclosure, and appurtenances.

3.3 FRAMED INSTRUCTIONS

Post framed operating instructions, under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, where directed. Prepare condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal, safe operation, and procedures for starting and maintaining the system safely in typed form, frame as specified for the wiring and control instructions and post beside the diagrams. Submit proposed diagrams, instructions and other sheets for framed instructions.

3.4 CLOSEOUT ACTIVITIES

3.4.1 Spare Parts

Submit spare parts data, including a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after [1][and][3] years of service, after approval of the detail drawing and not later than [_____] months prior to the date of beneficial occupancy.

3.4.2 Operation and Maintenance Manuals

Submit operation manual outlining step-by-step procedures required for system operation. Include with the instructions the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Maintenance manual listing routine maintenance procedures, possible breakdowns and repairs. Include with the manual diagrams for the system as installed.

3.4.3 Training Course

Conduct a training course for the operating staff as designated by the Contracting Officer. The training period must consist of a total of [_____] hours of normal working time, and must start after the system is functionally completed but prior to final acceptance tests. Cover all of the items contained in the operating and maintenance instructions, as well as demonstrations of routine maintenance operations. Notify the Contracting Officer at least 14 days in advance of proposed beginning of the training course.

-- End of Section --