Report on the Performance Evaluation of BioLet Deluxe Composting/Biological Toilet July 1991 Under the Provisions of NSF Standard 41 Relating to Evaluation of Wastewater Recycle/Reuse and Water Conservation Devices

Contents

CERTIFICATION

NSF *International* (NSF) has determined, by performance evaluation under the provisions of NSF Standard 41: Wastewater Recycle/Reuse and Water Conservation Devices, that the BioLet biological toilet manufactured by Vakuumplast AB, Industrigigatan 4, S 33021 LE, SWEDEN, has fulfilled the

requirements of Standard 41. This BioLet model has therefore been authorized to bear the NSF Mark so long as it continues to meet the requirements of Standard 41.

All tests of the BioLet biological toilet were completed on a system installed at NSF in Ann Arbor, Michigan. Waste loading for the test was provided by NSF staff. A description of respective waste loading characteristics is included in this report.

The observations and analyses included in this report are certified to be correct and true copies of the data secured during the performance tests conducted by NSF on the waste treatment device described herein.

The certified data are the property of the manufacturer of the subject device and can be released or reproduced only with the permission of the manufacturer. The manufacturer has agreed to present the data in this certification in its entirety whenever it is used in advertising, prospectuses, bids or similar uses.

PERFORMANCE EVALUATION

This report is applicable to the BioLet biological toilet manufactured by Vakuumplast AB of REFTELE, Sweden. The BioLet biological toilet is an aerobic composting device. The maximum design rate capacity is for full-time use by four persons. The device provides for continuous treatment of human wastes by means of a composting pile. Specifications and design data are included in Appendix A.

STARTUP EVALUATION

The biological toilet to be used for this evaluation, including necessary appurtenant fixtures and component parts, was delivered to NSF and installed in the test room used for evaluating waterless toilets. The instructions of the manufacturer were followed in installation of the device.

The Standard Performance Evaluation Method for composting (containment/biological) devices under *NSF Standard 41: Wastewater Recycle/Reuse and Water Conservation Devices*was employed in the testing and

evaluation of the BioLet. Points of sampling and associated evaluation parameters are shown in Figure 1 and Table 1, respectively.

Operation was initiated November 14, 1990 and continued through May 24, 1991, when the evaluation period terminated. During this period the BioLet received black water waste generated by staff of NSF in Ann Arbor, Michigan. The device was loaded at the average rated daily capacity specified under the test protocol.

During the preliminary 33-day period of operation extending from November 14 to December 16, 1990, loading of maximum design rated capacity of twelve uses per day was applied to the BioLet. From December 12, 1990 through January 11, 1991, the load applied was varied according to the pattern represented in Figure 2, which describes the stress testing protocol of the performance evaluation. Following the period of stress testing, routine operation at the design rated capacity was reinstated and maintained for the duration of the evaluation. Table II summarizes the loading experience and the performance of the device during the evaluation. Results presented in the following narrative are the results of the performance evaluation, with appropriate tabulations and graphical representations included in the text and Appendix B.

The test protocol for performance evaluation of the BioLet biological toilet for start-up operation does not require analytical testing of performance. Rather, the protocol stipulates weekly observations for liquid containment and odor at the toilet bowl and at ground level from the compost chamber. This is required during periods of normal operation an also during stress testing.

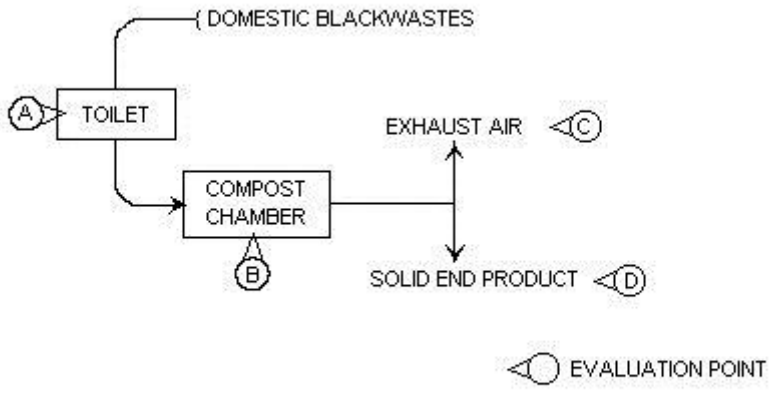


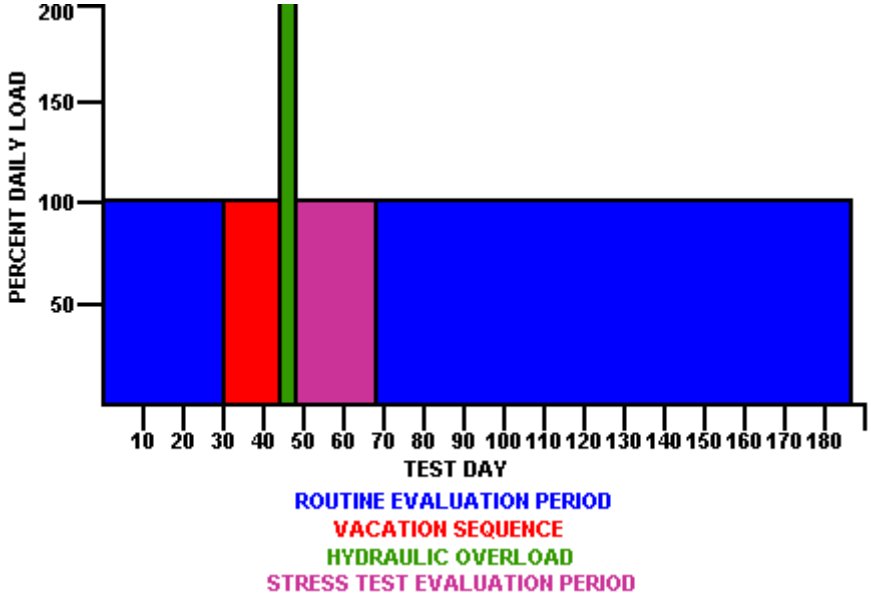
Figure 1. Flow and evaluation diagram.

TABLE 1. EVALUATION PARAMETERS

EVALUATION	EVALUATION PARAMETERS

POINT	NEW DEVICE				
	Liquid Containment	Odor	Liquid Accumulation	Explosive Hazard	
A		R/S			
B	R	R/S	S	S	
C		R/S			
D					
MATURE DEVICE					
	Liquid Containment	Odor	Fecal Coliform	Moisture	Storage Characteristics
A		X			
B	X				
C		X			
D			X	X	X

R - Routine Testing, Evaluate One Time Per Week
S - Stress Testing, Evaluate Immediately Prior to and Following Stress Event, and Every 48 hours Thereafter for Seven Days
X - One Time Evaluation



EVALUATION OF MATURED DEVICES

Section

s 7.1.1 of Standard 41 requires that "The device operated for end product evaluation shall be tested when the manufacturer's operation and maintenance instructions require the user to first contact the solid end product." At the end of the six month performance evaluation, one drawer of

decomposed material was removed for end product characteristics. Therefore, testing of a matured device for end products characteristics of routine operation was conducted on the same device as the performance evaluation of a new device observed for startup characteristics.

Solid end product was collected from the BioLet on May 30, 1991 which represented 6 months of actual use. The samples were evaluated for fecal coliform, moisture content, and seven day storage characteristics. The samples were obtained from five different locations in the compost clean-out tray. Sample collection and analysis was conducted in conformance with the 17th Edition of *Standard Methods for the Examination of Water and Wastewater,* the EPA Manual, *Microbiological Methods for Monitoring the Environment, Water and Wastes, and the Standard Performance Evaluation Method. The requirements and actual results of the analysis for solid end product are presented in Table III.**

The results herein reported and presented in Tables II and III are consistent with the performance criteria contained in NSF Standard No. 41 for Compost (biological/containment) Devices. During the evaluation period, the BioLet being evaluated for start-up characteristics did not require any maintenance or other service intervention incidental to normal operation, except for shear pin replacement caused by allowing the compost to dry out.

*** See Appendix C for Methods used.**

TABLE II. SUMMARY OF PERFORMANCE DATE, START-UP DEVICE

Parameter	Period	Median	Average	Range	Q_1-Q_3
LOAD (Uses/day)?	Preliminary	11	9.4	14	6-12
	Vacation Loading	0	0	0-0	0-0
	Hydraulic Overload	N/A	N/A	22-24	
	Power Outage Loading	0	0	N/A	N/A
	Routine Operation	11	10.1	2-13	6-12
LIQUID	Preliminary	No liquid escape from device			
	Vacation Loading	No liquid escape from device			
	Hydraulic Overload	No liquid escape from device			
	Power Outage Loading	No liquid escape from device			
	Routine Operation	No liquid escape from device			
ODOR	Preliminary	None Observed at bowl or vent			
	Vacation Loading	None Observed at bowl or vent			
	Hydraulic Overload	None Observed at bowl or vent			
	Power Outage Loading	None Observed at bowl or vent			
	Routine Operation	None Observed at bowl or vent			
LIQUID ACCUMULATION	Preliminary	(1)	(1)	(1)	(1)

(Gallons)	Vacation Loading	0	0	0	0
	Hydraulic Overload	0	0	0	0
	Power Outage Loading	N/A	N/A	N/A	N/A
	Routine Operation	(1)	(1)	(1)	(1)

(1) Evaluation not required

Median: 50% of the values are equal to or less then this value.

Interquartile Range Q_1-Q_3: The range of variability about the median which is sufficient to contain 50% of the observations; it lies between the upper and lower 25% of the observations.

***See Performance Evaluation Section**

TABLE III. PERFORMANCE DATA, MATURED DEVICE

PARAMETER	OBSERVATIONS	REQUIREMENTS	ANALYTICAL RESULTS
Liquid Containment		No Leakage	No Liquid Escape Evident
Odor	Bowl	None Objectionable	Non offensive Odor
	Vent	None Objectionable	Non offensive Odor
Fecal Coliform (No/Gm)		<=200 MPN/gm	3 MPN/gm
Moisture Content (% By Weight)		<=75%	7.8%
Solid End Product Storage Characteristics Seven Day	Airtight Container	None Objectionable	Offensive
	Open Container 68% Moisture Content	None Objectionable	Offensive
	Airtight Container 60% Moisture Content	None Objectionable	Offensive

---

PROCESS DESCRIPTION

The BioLet biological toilet employs an aerobic composting process in the treatment of black waste products. Feces, urine and toilet paper are deposited directly into the waste chamber. Two metal bars level, mix and aerate the compost automatically by rotating through the pile. The motor is activated by a switch when the seat is closed.

Aerobic composting is a biological process which relies upon microorganisms naturally present within the blackwater or organic material to decompose (compost) the waste in a non aqueous, aerobic environment. The process is facilitated by maintaining ambient temperatures above 18 C (64 F), a moisture content between 45 and 75 percent within the composting pile, depending upon the texture of the decomposing material, and provision of a sufficient quantity of air to maintain aerobic conditions and remove moisture and other gaseous products of the composting process. At start-up a kit is supplied which contains loose, dry, organic material, bioactivator give organisms) and diatomaceous earth. This loose easily aerated pile enhances decomposition by allowing oxygen to reach the organisms liquid wastes to be readily absorbed and excess liquid to drain to the bottom of the toilet through a grate to be evaporated in the clean-out tray.

A continuous supply of fresh air is provided to the mass by means of a 20 watt fan installed at the rear of the toilet. Air entering the compost chamber is drawn though the system and up the vent where it is exhausted. The positive ventilation assures that negative pressure is maintained in the composting device so that fresh air is continuously pulled through the system and process air is confined within and discharged from the system only through the exhaust vent. For winter use the toilet should still be installed in a heated space, or other means of heating the intake air should be provided to maintain maximum capacity.

Liquid wastes entering the system are controlled by several means. First, excess liquid is absorbed by the compost pile which helps maintain the proper moisture content of the mass. Second, moisture is removed as water vapor from the composting pile. Finally, any excess liquid percolates though the pile and drains into the clean-out tray where it is evaporated by means of a 225 watt heating element and an 80 watt bottom heating pad. The water vapor is drawn out through the vent by the 20 watt fan.

OPERATING INSTRUCTIONS

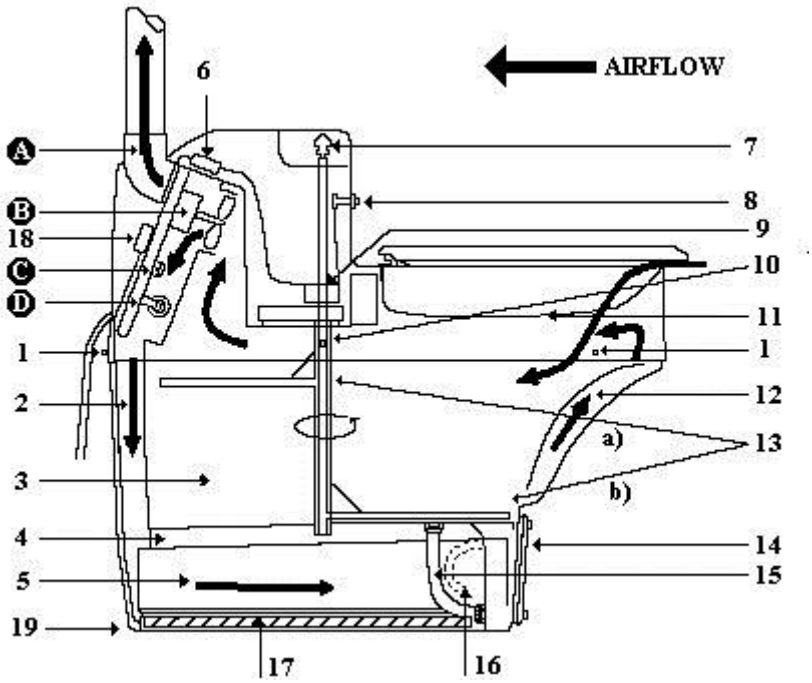
Prior to initiating use, the components of a start-up kit supplied by BioLet U.S.A., Inc. 45 Newbury Street, Boston, MA 02116, must be added to ensure a proper medium for starting the composting process. The kit consists of dry organic material (primarily buckwheat hulls), live soil organisms, and diatomaceous earth. These components are mixed according to the instructions provided and added to the toilet through the seat opening. Plug the power cord into a 120 volt service and the toilet is ready for use.

The thermostat should be set so that the compost is maintained in a uniformly moist state. If the pile becomes too wet, turn up the thermostat to evaporate the moisture. If the compost becomes too dry, turn down the thermostat and sprinkle warm water over the surface to break up the clumps.

When the compost pile reached the upper mixing bar, it is time to empty the clean-out tray. Turn up the thermostat for 2-3 days to dry out the material in the tray. Remove the compost tray and dispose of the compost according to acceptable procedures. Additional material from the starter kit may be added to the main pile at this time to maintain the proper mass.

Appendix A
PLANT SPECIFICATION

Item	Description	Item	Description
A	Ventilation outlet	9	Mixer motor assembly (XL & Deluxe)
B	Fan motor/fan blade	10	Shear pin (XL & Deluxe)
C	Adjustable thermostat	11	Compost cover
D	Heating element	12	Air return channel
1	Phillips screws, top/lower section	13	Mixer arm a) leveling b) raking
2	Warm air channels	14	Front cover for humus tray
3	Compost	15	Fluid level indicator, emptying
4	Grate	16	Fluid level indicator, humus tray
5	Humus Tray	17	Bottom heating element, XL
6	Quick release connector (XL & Deluxe)	18	Quick release connector for bottom heating element
7	Mixer handle with shear pin (Standard)	19	Brackets, holding bottom heating element tray
8	Micro switch automatic model		



Appendix B
Log of Actual Use
Vakuumplast BioLet Deluxe

Date	Urine	Fecal	Comments
11/14/90	8	4	Start-Up
11/15/90	7	5	2 liters of water sprayed over compost
11/16/90	8	4	1 liter sprayed over compost. No leakage or odor
11/17/90	3	2	
11/18/90	3	1	
11/19/90	8	4	Thermostat set on 2
11/20/90	8	5	
11/21/90	9	5	
11/22/90	3	1	Thanksgiving Day
11/23/90	3	1	Holiday
11/24/90	3	1	
11/25/90	3	1	
11/26/90	8	4	
11/27/90	8	4	
11/28/90	8	4	
11/29/90	8	4	
11/30/90	7	5	No leaks or odor detected
12/1/90	3	1	

12/2/90	**4**	**2**	
12/3/90	**8**	**4**	
12/4/90	**8**	**4**	
12/5/90	**8**	**4**	
12/6/90	**8**	**3**	
12/7/90	**8**	**4**	**No leaks or odor detected**
12/8/90	**4**	**2**	
12/9/90	**4**	**2**	
12/10/90	**8**	**4**	
12/11/90	**8**	**4**	**1 liter water sprayed over compost**
12/12/90	**8**	**4**	
12/13/90	**8**	**4**	
12/14/90	**8**	**4**	**No leaks or odor detected**
12/15/90	**3**	**2**	
12/16/90	**3**	**1**	
12/17/90	**0**	**0***	**Start vacation stress. 3 liter water mixed into compost. Power disconnected**
12/18/90	**0**	**0***	**No leaks or odor detected**
12/19/90	**0***	**0***	**(*vacation stress) No odor or leaks detected**
12/21/90	**0***	**0***	**(*vacation stress)**
12/22/90	**0***	**0***	**(*vacation stress) No odor or leaks detected**
12/23/90	**0***	**0***	**(*vacation stress)**
12/24/90	**0***	**0***	**(*vacation stress)**
12/25/90	**0***	**0***	**(*vacation stress)**
12/26/90	**0***	**0***	**(*vacation stress)**
12/27/90	**0***	**0***	**(*vacation stress)**
12/28/90	**0***	**0***	**(*vacation stress) No odor or leaks detected**
12/29/90	**0***	**0***	**(*vacation stress)**
12/30/90	**0***	**0***	**(*vacation stress)**
12/31/90	**0***	**0***	**(*vacation stress)**
1/1/91	**0***	**0***	**(*vacation stress)**
1/2/91	**3**	**2**	**Start hydraulic overload stress. 40% normal loading over 3 hour period. 3 liters water mixed over compost, 2 liters starter added. No leaks or odor detected.**
1/3/91	**16**	**6**	**Hydraulic Overload No odors or leaks detected**
1/4/91	**16**	**8**	**Hydraulic Overload No odors or leaks detected**
1/5/91	**0***	**0***	**Start Power Out Stress No odor or leaks detected**
1/6/91	**0***	**0***	**(*Power Out Stress)**
1/8/91	**0***	**0***	**(*Power Out Stress)**
1/9/91	**0***	**0***	**(*Power Out Stress)**
1/10/91	**0***	**0***	**(*Power Out Stress)**
1/11/91	**0***	**0***	**(*Power Out Stress) No odor or leaks detected**

1/12/91	**2**	**1**	**Resume power and loading**
1/13/91	**3**	**0**	
1/14/91	**8**	**4**	**2 L water added**
1/14/91	**8**	**4**	**2 L water added**
1/16/91	**8**	**4**	
1/17/91	**8**	**4**	
1/18/91	**8**	**3**	**No odor or leaks detected**
1/19/91	**4**	**2**	
1/20/91	**4**	**2**	
1/21/91	**8**	**4**	
1/22/91	**8**	**4**	
1/23/91	**8**	**4**	
1/24/91	**8**	**4**	
1/25/91	**8**	**4**	
1/26/91	**3**	**2**	
1/27/91	**0**	**0**	
1/28/91	**8**	**4**	
1/29/91	**8**	**4**	
1/30/91	**8**	**4**	
1/31/91	**8**	**4**	
2/1/91	**8**	**4**	**No odor or leaks detected**
2/2/91	**5**	**3**	**Thermostat increased to 5 to remove liquid in tube.**
2/3/91	**5**	**4**	
2/4/91	**8**	**5**	
2/5/91	**8**	**4**	
2/6/91	**8**	**4**	
2/7/91	**8**	**4**	
2/8/91	**8**	**4**	**No odor or leaks detected**
2/9/91	**8**	**4**	
2/10/91	**6**	**3**	
2/11/91	**8**	**4**	
2/13/91	**8**	**4**	
2/14/91	**8**	**5**	
2/15/91	**8**	**5**	
2/16/91	**7**	**4**	
2/17/91	**7**	**4**	
2/18/91	**8**	**5**	
2/19/91	**8**	**4**	**Thermostat increased to 10 to remove liquid in site tube.**
2/20/91	**7**	**3**	
2/21/91	**8**	**4**	
2/22/91	**8**	**4**	**No odor or leaks detected**

2/23/91	**3**	**2**	
2/24/91	**2**	**2**	
2/25/91	**8**	**4**	
2/26/91	**8**	**4**	**Grinding noise noted in stirrer motor**
2/27/91	**8**	**4**	
3/1/91	**8**	**4**	**No odor or leaks detected**
3/2/91	**5**	**2**	
3/3/91	**7**	**3**	
3/4/91	**8**	**4**	**Shear pin changed**
3/5/91	**8**	**4**	**Thermostat set to 2**
3/6/91	**8**	**4**	
3/7/91	**7**	**4**	
3/8/91	**8**	**4**	**No odor or leaks detected**
3/9/91	**4**	**3**	
3/10/91	**4**	**2**	
3/11/91	**8**	**4**	
3/12/91	**8**	**4**	
3/13/91	**8**	**4**	
3/14/91	**7**	**3**	
3/15/91	**8**	**5**	**No odor or leaks detected**
3/16/91	**4**	**2**	
3/17/91	**4**	**1**	
3/18/91	**8**	**4**	
3/19/91	**7**	**4**	
3/20/91	**8**	**4**	
3/21/91	**8**	**4**	
3/22/91	**6**	**3**	**No odor or leaks detected**
3/23/91	**4**	**2**	
3/24/91	**6**	**3**	
3/25/91	**8**	**4**	
3/26/91	**8**	**4**	
3/27/91	**8**	**4**	
3/28/91	**5**	**3**	
3/29/91	**7**	**3**	**No odor or leaks detected**
3/30/91	**4**	**3**	
3/31/91	**4**	**1**	
4/1/91	**7**	**3**	
4/2/91	**8**	**4**	
4/3/91	**8**	**4**	
4/4/91	**4**	**2**	
4/5/91	**7**	**3**	**No odor or leaks detected**

4/6/91	**5**	**1**	
4/7/91	**4**	**3**	
4/8/91	**8**	**3**	
4/9/91	**8**	**4**	
4/10/91	**8**	**4**	
4/11/91	**8**	**4**	
4/12/91	**8**	**4**	**No odor or leaks detected**
4/13/91	**4**	**2**	
4/14/91	**6**	**2**	
4/15/91	**8**	**4**	
4/16/91	**8**	**4**	
4/17/91	**8**	**4**	
4/18/91	**8**	**4**	**1 Liter water sprayed over compost**
4/19/91	**8**	**4**	**No odor or leaks detected**
4/20/91	**5**	**2**	
4/21/91	**5**	**2**	
4/22/91	**8**	**4**	
4/23/91	**8**	**4**	
4/24/91	**7**	**3**	
4/25/91	**8**	**4**	
4/26/91	**8**	**4**	**No odor or leaks detected**
4/27/91	**4**	**2**	
4/28/91	**1**	**1**	
4/29/91	**8**	**4**	
4/30/91	**8**	**4**	
5/1/91	**8**	**4**	
5/2/91	**7**	**3**	
5/3/91	**7**	**3**	**No odor or leaks detected**
5/4/91	**2**	**1**	
5/5/91	**4**	**1**	
5/6/91	**8**	**4**	
5/7/91	**8**	**4**	
5/8/91	**7**	**2**	
5/9/91	**8**	**4**	
5/10/91	**8**	**4**	**No odor or leaks detected**
5/11/91	**8**	**3**	
5/12/91	**7**	**3**	
5/13/91	**8**	**4**	
5/14/91	**8**	**4**	
5/15/91	**8**	**5**	
5/16/91	**8**	**4**	

5/17/91	**8**	**4**	**No odor or leaks detected**
5/18/91	**4**	**1**	
5/19/91	**4**	**1**	
5/20/91	**8**	**4**	**Thermostat set to 10**
5/21/91	**8**	**5**	
5/22/91	**5**	**4**	
5/23/91	**7**	**3**	**No odor or leaks detected**
5/24/91	**8**	**4**	**End of test**
5/30/91			**Core samples collected**

Appendix C
PERFORMANCE EVALUATION METHOD

SECTION 5. GENERAL PERFORMANCE EVALUATION METHOD

5.0 PREQUALIFICATION: Before performance evaluation, the manufacturer of a device shall supply sufficient evidence to establish the basic feasibility of the device with respect to its intended use. A description of the device, and design data including drawings and specifications, shall accompany the application.

5.1 GENERAL TEST CONDITIONS: Performance evaluation shall be independent of design and construction. However, structural weaknesses or defects, and failures of process support equipment during the test, shall be reported to the manufacturer. The manufacturer's recommended start-up procedure shall be carefully followed. The evaluation shall require at least six months total time for completion, including stress testing.

5.2 OPERATION AND MAINTENANCE:During the testing period, the device shall be operated and maintained according to the manufacturer's instructions.

5.3 METHODOLOGY: All sample collection and analytical methods shall be those set forth in the 14th Edition of Standard Methods for Examination of Water and Wastewater, published by the American Public Health Association, except as otherwise specified.

5.4 MODEL SERIES: Evaluation of a model series shall be conducted on the model determined by the testing agency as most representative of the series. Results shall be accepted in a series which vary only in size, number of units components, hardware, or rated capacities.

5.5 TEST SITE: A device shall be tested either at facilities operated by the testing agency or, if requested by the manufacturer, at a field installation approved by the testing agency. In either situation, access to the device by the manufacturer or his authorized representative shall be controlled by the testing agency.

5.5.1 If tested in facilities operated by the testing agency, devices intended to treat blackwater and recycle or reuse process fluids, and water conservation devices intended for handling blackwastes, shall be loaded normally; i.e., with actual use, to the fullest extent possible. When the design capacity of the unit or loading pattern requirements exceed use availability, loadings shall be supplemented with solid and/or liquid wastes obtained directly from a municipal wastewater

treatment facility. When the loading pattern is to be supplemented with simulated waste, the waste shall be added at a level of 1.5 liters containing 150 grams of solid (dry weight) per user per day. Devices intended for treating greywater (including the greywater component of loading to integrated black-greywater devices) shall be loaded with simulated waste detailed in Appendix A, or other equivalent formula acceptable to the testing agency consistent with intended application. If simulated waste is used, volume and composition shall be monitored and reported.

5.5.2 If tested at a field installation, the manufacturer shall obtain from owners of the device all such permissions and waivers as may be required. All tests and sampling shall be performed by the testing agency or by a laboratory whose personnel have been determined in advance to be qualified by the testing agency. Unannounced visits to the test site and the qualified laboratory shall be made by testing agency personnel at periodic intervals during the testing period. Except for mature composting toilets, an existing installation selected for testing shall be restored to a condition representative of a new installation at start up.

5.5.3 Installation of any device for testing (regardless of the test site selected) shall be in accordance with manufacturer's instructions.

5.6 USAGE: the number of users during a test shall be tallied on a cumulative counter and recorded weekly. A complete profile of usages vs. time shall be recorded.

5.7 REPORTING: A report of testing experiences associated with each device found to conform with the standard shall be prepared by the testing agency. The report shall follow a prescribed, uniform format, including numbered sections and subsections carrying a title identifying with the standard. The report shall include:

- **Identification of the type and model designation of the device tested;**
- **Rated capacities of the device tested, including average, minimum and maximum loadings (usage) specified by the manufacturer,**
- **Schematic or design drawing to indicate integral components of device tested;**
- **Description of test site;**
- **Log of actual use during testing with documentation of all supplemental loading - quantity and type - supplied during the test;**
- **Chronological list of any scheduled or unscheduled maintenance performed during the test;**
- **Chronological list of pertinent equipment/component failures and actions required for correction;**
- **Incidents relating to testing agency equipment or personnel performance affecting test conditions or data acquired during testing;**
- **Histograms or other appropriate graphical or tabular displays of data from first month of preliminary operation, each stressing sequence, the final months of routine operation under conditions of design loading;**
- **Results of toxicity testing;**
- **Quantity and type of any wastes, discharged or removed from the device or any of its components, during test.**

6.0 TEST PROTOCOL: The device shall be tested for a total period of at least six

months under four operational patterns in the following sequence: start up; preliminary operation; stressing; and routine operation.SECTION 7. WATER CONSERVATION DEVICES

7.0 GENERAL TEST PROTOCOL: The device shall be tested for a total period of not less than six months under four operational patterns in the following sequence: startup; preliminary operation; stressing; routine operation.

7.0.1 LOADING PATTERN: Loading under each operational pattern except startup shall be determined by dividing the total daily loading to be applied by eight hours to determine the number of doese per hour to be applied to the device.

***Example* (If Applicable)**

A. Preliminary and routine operation at design rated capacity (manufacturer's designated average daily use) = 40 flushes/day (fpd).

4018 = 5 flushes/hour

to be dosed over eight hour period in each 24 hour day.

B. For stressing to simulate hydraulic overload, 200 percent of design rated capacity = 80 fpd.

8018=10 flushes/hour

7.0.2 STARTUP: The device shall be loaded and operated in accordance with manufacturer's instructions for a period specified by manufacturer.

7.0.3 PRELIMINARY OPERATION: The device shall be loaded at design rated capacity seven days per week and operated for one month following startup.

7.0.4 STRESSING: The device shall be loaded sequentially to simulate stressing typical of vacation with subsequent shock (i.e., return home), hydraulic underload, hydraulic overload and power outage.

7.0.5 ROUTINE OPERATION: The device shall be loaded at design rated capacity seven days per week and operated for a period of not less than three months and sufficient to provide at least six months of total testing.

7.1 COMPOSTING (CONTAINMENT/GEOLOGICAL) DEVICES: Two composting toilets shall be evaluated: one, a device used for a sufficient time to produce end products characteristic of routine operation; and one a new device observed for startup characteristics.

7.1.1 TEST PROTOCOL; The device being operated for end product evaluation shall be tested at the time the manufacturer's operation and maintenance instructions require the user to first come in contact with solid end product. The new device shall be loaded at design rated capacity and evaluated one time each week during a one-month period prior to stressing, and for the remaining period (see Item 7.0) of operation following stressing (reference Appendix B, Figure 2).

7.1.1.1 STRESS TESTING: Vacation, hydraulic overload and power outage shall be simulated in sequence after one month of design use of the new device. Devices shall be evaluated immediately prior to, and immediately and every 48 hours following stressing for a period of seven days.

- **Vacation shall be simulated by 17 days of nonuse followed by 40 percent of design rated capacity over three hour period.**
- **Hydraulic overload shall be simulated by loading at 200 percent of design rated capacity, applied over one eight-hour period, during each 24-hour day, for two days.**
- **All power to the device shall be cut off for a period of seven days. Loading shall be discontinued during this period.**

7.1.2 PARAMETERS: Liquid containment and odor characteristics shall be observed each time the devices are evaluated during routine testing program (nonstressing). In addition, fecal coliforms, odor and moisture content of the solid end product, shall be determined upon initial removal of the end product as recommended in the manufacturer's operation and maintenance instructions. Liquid accumulation and odor shall be determined for each evaluation during period of stress testing.

7.1.3 SAMPLING: Five core samples of solid product shall be collected from the composting device being operated for end product evaluation. The samples shall be collected from the compost chamber at the cleanout port. Each core sample shall be a minimum of ten grams in weight.

7.1.4 PERFORMANCE SPECIFICATIONS: The following specifications shall apply as indicated:

7.1.4.1 All devices shall provide for containment of liquid.

7.1.4.2 Gas emitted from the vent system shall be nonoffensive at ground level and there shall be no offensive odors at the bowl or at the composting chamber.

7.1.4.3 Solid end products shall not produce an objectionable odor immediately following removal from the devices.

7.1.4.4 Three examples of solid end product shall be evaluated for production of offensive odors after storage for seven days. Storage conditions of each sample shall differ as follows:

- **One sample shall be stored in an airtight container**
- **The second sample shall be adjusted to a moisture content of 60 percent and stored in an open container.**

Appendix D
Laboratory Procedures

---

1. **Moisture Content: (Volatile and Fixed Matter in Solid Samples): Gravimetric Method. Reference, <u>Standard Methods for the examination of Water and Wastewater</u>, 17th Edition, 1975, pp. 96-98.**
2. **Fecal Coliform: Dry solid samples (Modified). Reference, E.P.A. Manual, <u>Microbiological Methods for Monitoring the Environment, Water & Wastes</u>. Part II, sec. C. pp. 62-63.**

3. **Solid End Product Characterization: Seven Day Storage. Reference, NSF Standard No. 41: Wastewater Recycle/Reuse and Water Conservation Systems. Sec. 7.1.4.4. pg. 9.**

Appendix E
REFERENCES

---

1. **APHA, AWWA, WPCF, Standard Methods for the Examination of Water and Wastewater, 14th Edition, American Public Health Association, Washington, DC, 1975.**
2. **NSF, Standard No. 41 for Wastewater Recycle/Reuse and Water Conservation Devices, National Sanitation Foundation, Ann Arbor, MI, December 1980.**
3. **U.S. EPA, Microbiological Methods for Monitoring the Environment Water and Wastes, EPA 600/8-78-077, Office of Research and Development, Environmental Monitoring and Support Laboratory, Cincinnati, OH, December, 1978.**