



*NSF International Standard /
American National Standard*

NSF/ANSI 46 - 2014

Evaluation of components and
devices used in wastewater
treatment systems



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for Wastewater Technology —

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Contents

1	General	1
1.1	Purpose	1
1.2	Scope	1
1.3	Alternate materials, design, and construction	1
2	Normative references	1
3	Definitions	2
4	Materials	3
4.1	Dissimilar metals	3
4.2	Welding	3
5	Design and construction	3
5.1	Serviceability	4
5.2	Electrical equipment	4
5.3	Mechanical components and systems	4
5.4	Data plate	4
6	Product literature	4
6.1	Installation manual	4
6.2	Operation and maintenance manual	5
6.3	Troubleshooting and repair manual	5
6.4	Energy requirements	5
6.5	Chemical requirements	5
7	Performance testing and evaluation	5
8	Final report	6
9	Grinder pumps and related components	6
9.1	Scope	6
9.2	Model series classification	6
9.3	Definitions	6
9.4	Performance testing and evaluation	7
9.5	Performance criteria for grinder pumps not utilizing wobble pump stators	10
9.6	Design and construction	11
10	Filtration devices for residential gravity flow septic tank systems	12
10.1	Scope	12
10.2	Model series classification	12
10.3	Definitions	12
10.4	Performance testing and evaluation of septic tank filters	12
10.5	Performance requirements for septic tank filters	16
10.6	Data plate	16
10.7	Installation manual	17
10.8	Operation and maintenance manual	17
10.9	Final report	17
11	Chlorination devices	18
11.1	Scope	18
11.2	Model series classification	18
11.3	Definitions	18

11.4	Design and construction	19
11.5	Product literature	20
11.6	Performance testing and evaluation	21
11.7	Performance testing and evaluation for positive displacement pumps	24
11.8	Performance testing and evaluation for chlorination devices hydraulic pressure	25
11.9	Final report.....	26
12	Ultraviolet (UV) disinfection devices	26
12.1	Scope	26
12.2	Model series classification	26
12.3	Flow delivery	26
12.4	Definitions	26
12.5	Design and construction	27
12.6	Product literature	29
12.7	Performance testing and evaluation	30
12.8	Performance testing and evaluation for UV disinfection devices.....	33
12.9	Final report.....	33
13	Ozone generation devices	34
13.1	Scope	34
13.2	Model series classification	34
13.3	Design and construction	34
13.4	Valve and component identification	35
13.5	Product literature	36
13.6	Performance testing and evaluation	37
Annex A		A1
Annex B		B2
Annex C		C1
Annex D		D1

Foreword²

The purpose of this Standard is to establish minimum materials, design and construction, and performance testing and evaluation requirements for components and devices used in wastewater treatment systems. Minimum literature requirements to be supplied by manufacturers to authorized representatives and owners are also specified.

This edition of the Standard (NSF/ANSI 46 – 2013) includes the following revisions:

Issue 24

This issue was to update normative references and to eliminate the section on Field verification for longevity.

Issue 25

This is to clarify the calculation method (and is consistent with other wastewater standards). In the near future, the chlorine devices will be removed from NSF/ANSI 46 as they will be covered in a new standard, NSF 385 Disinfection.

Issue 26

This issue was to update the status of a NOTE to a requirement.

This Standard was developed by the NSF Joint Committee on Wastewater Technology using the consensus process described in the American National Standards Institute.

Suggestions for improvements of this Standard are welcome. This Standard is maintained on a Continuous Maintenance schedule and can be opened for comment at any time. Comments should be sent to Chair, Joint Committee on Wastewater Technology at standards@nsf.org, or c/o NSF International, Standards Department, P.O. Box 130140, Ann Arbor, Michigan 48113-0140, USA.

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NSF/ANSI Standard for Wastewater Technology –

Evaluation of components and devices used in wastewater treatment systems

1 General

1.1 Purpose

The purpose of this Standard is to establish minimum materials, design and construction, and performance requirements for components and devices used in the handling, treating, recycling, reusing, or disposal of wastewater. This Standard is intended to protect public health and the environment as well as to minimize nuisance factors.

1.2 Scope

This Standard is intended for use with components and devices not covered by other NSF wastewater standards. Components and devices covered by this Standard are intended for use with graywater or blackwater or both. Management methods for the end-products of these components and devices are not addressed in this Standard. This Standard shall in no way restrict new system designs, provided that such designs meet the minimum specifications described herein.

All devices and components meeting the scope of this Standard shall comply with all of the requirements described in 1 through 8. In addition, devices and components shall comply with the applicable subsequent section(s) contained in this Standard. Where subsequent sections of the Standard include requirements that overlap with those found in 1 through 8, the requirements of both sections shall be met unless otherwise specified in the requirements of the subsequent section.

1.3 Alternate materials, design, and construction

While specific materials, designs, and construction may be stipulated in this Standard, devices that incorporate alternate materials, designs, or construction may be acceptable when it is verified that such systems meet the applicable requirements.

2 Normative references

The following documents contain provisions that, through reference in this text, constitute provisions of this Standard. At the time of publication, the indicated editions were valid. All standards are subject to revision, and parties are encouraged to investigate the possibility of applying the recent editions of the standards indicated herein. The most recent published edition of the document shall be used for undated references.

American Public Health Association (APHA), American Water Works Association (AWWA) & Water Environment Federation (WEF): *Standard Methods for the Examination of Water and Wastewater* (hereinafter referred to as *Standard Methods*)³

³ Standard Methods for the Examination of Water and Wastewater <www.standardmethods.org>.

ANSI/HI *Pump Standards*⁴

ASME B40.100 – 2005. *Pressure Gauges and Gauge Attachments*⁵

ASTM C1227-12. *Standard Specification for Precast Concrete Septic Tanks*

NFPA 70®. *National Electrical Code*® (NEC®), 2011⁶

NSF/ANSI 40. *Residential Wastewater Treatment Systems*

NSF/ANSI 55. *Ultraviolet Microbiological Water Treatment Systems*

3 Definitions

3.1 appurtenances: Machinery, appliances, or auxiliary structures attached to a main structure to enable it to function but not considered an integral part of it.⁷

3.2 authorized representative: An organization, group, individual, or other entity that is authorized by the manufacturer to distribute, sell, install, or service a component or device.

3.3 blackwaste: Human body waste, toilet paper, and any other material intended to be deposited in a receptacle designed to receive urine, feces, or both.

3.4 blackwater: Blackwaste and water or other medium used to flush and transport it.

3.5 components: All of the physical, mechanical, and electrical parts that comprise a system.

3.6 contact chamber: The tank in which ozone gas is diffused into treated wastewater.

3.7 contaminant: An undesirable organic or inorganic, soluble or insoluble substance in water. This definition includes microbiological organisms.

3.8 graywaste: Waste material, exclusive of urine, feces, or industrial waste, deposited in plumbing fixtures found in residences, commercial buildings, industrial plants, and institutions.

3.9 graywater: Graywaste and the water or other medium used to flush and transport it.

3.10 manufacturer: The entity that develops, designs, and produces a component or device.

3.11 mechanical component: A part of an ozonation system with an individual and distinct function intended to perform some type of work in diffusing ozone gas into wastewater in a contact chamber.

3.12 ozonation system: A device that produces ozone and introduces it into water for the purpose of disinfection.

⁴ Hydraulic Institute, 6 Campus Drive, First Floor North, Parsippany, NJ 07054-4406 <www.pumps.org>.

⁵ American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016-5990 <www.asme.org>.

⁶ National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269-7471 <www.nfpa.org>.

⁷ Definition adopted from *Glossary, Water and Wastewater Control Engineering, third Edition*. American Public Health Association, American Society of Civil Engineers, American Water Works Association, Water Pollution Control Federation, 1981.

3.13 ozone diffusion system: The device or devices that introduce ozone gas into water to be disinfected.

3.14 ozone disinfection: The act of eliminating disease-causing microorganisms from contaminated water either by physical removal or by killing/inactivation. In this standard, inactivation shall be of fecal coliform by exposure to sufficient intensity and sufficient contact with Ozone.

3.15 ozone generator: A device that generates ozone gas.

3.16 product: The solid, liquid, and gaseous outputs from a component or device.

3.17 residential wastewater: Human body waste and liquid waste generated by the occupants of an individual residence.

3.18 total process: A process receiving raw wastewater and discharging a treated effluent. Types of total processes may be classified as biological, chemical, physical/mechanical, or any combination of these processes.

3.19 unit process: A single step in the total treatment process (comminution, screening, aeration, sedimentation, chemical precipitation, vacuum filtration, centrifugation, incineration, chlorination, etc.).

3.20 wastewater: The spent or used water of a community or industry that contains dissolved and suspended matter.⁷

4 Materials

Materials shall be durable and capable of withstanding stresses and wear during shipping, assembly, installation, and operation. Materials shall not be adversely affected when subjected to the use environment.

NOTE – Because there are numerous design criteria suitable for the manufacture of components and devices used in wastewater treatment systems, manufacturers should acquire appropriate engineering expertise for evaluating the design of such components and devices.

4.1 Dissimilar metals

Dissimilar metal materials, not considered compatible at the electromotive level, shall not be in direct contact. An electrically non-conductive insulating fitting shall be provided at the junction between such dissimilar metal parts or components.

NOTE – ANSI/HI⁴ 9.1-9.5 provides guidance for protecting against galvanic corrosion. Manufacturers are encouraged to use these guidelines and similar guidelines for the design and construction of wastewater treatment devices and their components.

4.2 Welding

Welded seams and deposited weld materials shall show no visible signs of structural change following performance testing and evaluation, including, but not limited to, flaking, pitting, or the formation of structurally significant cracks.

5 Design and construction

Components and devices shall be fabricated to perform their intended functions when installed and operated according to the manufacturer's instructions. They shall not be adversely affected by the use environment.

5.1 Serviceability

Component parts subject to malfunction or wear shall be accessible for repair or replacement.

5.2 Electrical equipment

Electrical components shall be protected by safety devices, such as circuit breakers and fuses. The NFPA 70® NEC® shall be followed for all electrical components, electrical connections, system installation, and system operation.

5.3 Mechanical components and systems

Mechanical components and systems shall be protected against damage or impairment of efficiency for all normally anticipated operating conditions.

5.4 Data plate

A permanent data plate shall be provided. The plate shall be inscribed and installed so as to be easily seen and understood, and shall be securely attached at a location normally visible following recommended installation. It shall include the following:

- name and address (city and state) of manufacturer;
- model and serial number designation;
- design capacity or rated daily capacity if applicable; and
- particle size rating, as applicable.

6 Product literature

All product literature shall contain the manufacturer's name, address and phone number, and the product's model designation.

6.1 Installation manual

Manufacturers shall provide a manual with comprehensive and detailed installation instructions to authorized representatives. The manual shall be written so as to be easily understood by the intended reader and shall include, at a minimum:

- a numbered list of system components and an accompanying illustration, photograph, or print in which the components are respectively identified;
- design, construction, and material specifications for the system's components;
- wiring schematics for the system's electrical components;
- off-loading and unpacking instructions, including safety considerations, identification of fragile components, and measures to be taken to avoid damage to the system;
- a process overview of the function of each component and the expected function of the entire system when all components are properly assembled and connected;
- a clear definition of system installation requirements including plumbing and electrical power requirements, ventilation, air intake protection, bedding, hydrostatic displacement protection, water tightness, slope, and miscellaneous fittings and appurtenances;
- a sequential installation procedure;

- repair or replacement instructions in the event that a system possesses flaws that would inhibit proper functioning, and a list of sources where replacement components can be obtained; and
- a detailed start-up procedure.

6.2 Operation and maintenance manual

Manufacturers shall provide a manual with comprehensive and detailed operation and maintenance instructions to authorized representatives. The manual shall be written so as to be easily understood by the intended reader and shall include, at a minimum:

- a maintenance schedule for all components; and
- a detailed procedure for visual evaluation of system component functions.

6.3 Troubleshooting and repair manual

Manufacturers shall provide a manual with comprehensive and detailed troubleshooting and repair instructions to authorized representatives. The manual shall be written so as to be easily understood by the intended reader and shall include, at a minimum:

- a guide for visually evaluating the system and narrowing the scope of the problem based on effluent characteristics, system operation, and history;
- a sequential method for isolating specific component failure; and
- a step-by-step guide for repairing or replacing all system components.

6.4 Energy requirements

The manufacturer's engineering data and literature shall specify the energy sources and requirements for proper operation of components, devices, and any auxiliary system.

6.5 Chemical requirements

The manufacturer shall make available to owners and authorized representatives Materials Safety Data Sheets (MSDS) or equivalent documentation explaining the toxicity and proper use, handling, and safety of all chemicals required for the operation of all components and devices.

7 Performance testing and evaluation

Performance testing and evaluation shall be independent of design and construction. However, structural weaknesses, undesirable noise, and other environmental defects and failures during the test shall be described in the final report (see 8).

7.1 The device shall be operated and maintained according to the manufacturer's instructions. If these instructions conflict with the performance testing and evaluation protocols of this Standard, the protocols contained in this Standard shall apply.

7.2 All sample collection and analytical methods shall be those established in *Standard Methods*, except as otherwise specified.

7.3 The duration of the evaluation period shall be sufficient to ensure that results are reliable and applicable to anticipated operating conditions. The length of the evaluation period shall be specified in the test report.

8 Final report

A final report shall be prepared that presents all data collected in accordance with the testing and evaluation specified in this Standard.

9 Grinder pumps and related components

9.1 Scope

This section establishes requirements for grinder pumps and associated pump basins, including check and air or vacuum release valves included in the grinder pump package. It is intended for grinder pumps and related components used for pumping wastewater from residential sources.

9.2 Model series classification

Grinder pumps and associated pump basins within a manufacturer's model series may be classified according to the performance testing and evaluation of the most representative model within the series.

9.3 Definitions

9.3.1 capacity: the total volume throughput per unit of time at suction conditions. Assumes no entrained gases at the stated operating conditions.⁸

9.3.2 discharge pressure: the pressure a pump overcomes to transfer liquid, as measured by a gauge in a pipe at the discharge point after the check valve for the pump.

9.3.3 grinder pump: a mechanical device designed to add pressure to a liquid to produce flow and to provide for reduction in the size of solids contained in the wastewater.

9.3.4 head: the expression of the energy content of the liquid referred to a datum, expressed in units of energy per unit weight of liquid. The measuring unit for head is meter (foot) of liquid.⁹

9.3.5 pump basin: a structure containing pumps and appurtenant piping, valves, and other mechanical and electrical equipment for pumping water, wastewater, or other liquids. Also called a lift station⁸.

9.3.6 pump curve: a graph that shows the interrelation of dynamic head and flow capacity of a pump. Also called a hydraulic performance curve.

9.3.7 shut off: the condition of zero flow where no liquid is flowing through the pump, but the pump is primed and operating⁸.

9.3.8 total head: the measure of the work increase per unit mass of the liquid, imparted to the liquid by the pump, which is therefore the algebraic difference between the total head at discharge and the total head at suction.

⁸ Definition adopted from the definition of pump station contained in *Glossary, Water and Wastewater Control Engineering, Third Edition*, American Public Health Association, American Society of Civil Engineers, American Water Works Association, Water Pollution Control Federation, 1981.

⁹ Definition adopted from ANSI/HI 1.6-1994, American National Standard for Centrifugal Pump Tests, Hydraulic Institute, 9 Sylvan Way, Parsippany, NJ 07054-3802.

9.4 Performance testing and evaluation

This section describes the performance testing and evaluation requirements for both grinder pumps and pump basins. The manufacturer shall decide whether the grinder pump alone or pump and basin shall be tested and evaluated.

9.4.1 Performance testing and evaluation for grinder pumps

Prior to and after completing the performance testing and evaluation described in this section, the grinder pump shall be disassembled, and the dimensions of critical cutting elements shall be measured.

Performance testing and evaluation of grinder pumps shall consist of the following five procedures:

- 1) the development of a baseline hydraulic performance curve (see 9.4.1.1);
- 2) a household items loading test (see 9.4.1.2 through 9.4.1.4);
- 3) a shut off test (see 9.4.1.5);
- 4) a negative head test (see 9.4.1.6); and
- 5) the development of a final hydraulic performance curve (see 9.4.1.7).

All of these procedures shall be conducted on a single grinder pump in the chronological order shown. All testing shall be performed using potable water. The grinder pump and pump basin shall be assembled, operated, and maintained during each test period in accordance with the manufacturer's instructions. The pump basin shall be of sufficient diameter to ensure that all challenge materials are introduced to the grinder pump.

9.4.1.1 Development of a baseline hydraulic performance curve

A baseline hydraulic performance curve (baseline curve) shall be developed in accordance with the testing conditions specified in the current, applicable Hydraulic Institute testing standard (for example, centrifugal pumps shall be tested according to ANSI/HI4 1.6; rotary pumps shall be tested according to ANSI/HI4 3.6; and reciprocating pumps shall be tested according to ANSI/HI4 6.6). The baseline curve shall be developed by plotting two measured parameters, capacity and total head, using a minimum of five condition points, one of which shall be the shut off.

9.4.1.2 Household item loading test

During the test period described in 9.4.1.3 and 9.4.1.4, household items shall be added to the pump basin in accordance with table 1. Items shall be loaded in the sequence indicated in table 1. At the end of each day, any household items remaining in the pump basin shall be manually fed to the pump. Discharged solids shall be removed from the water if the water is recycled during the test.

NOTE – This test shall be performed after the gap between the stationary and rotating cutting elements has been measured.

Table 1 – Household items added to the pump basin

Item	Frequency
toilet tissue, 24 perforated sheets (wetted in test water)	4 times per d, 5 d per week
facial tissue	2 per d, 5 d per week
filter tip cigarette	1 per d, 5 d per week
egg	1 per d, 5 d per week
paper towel ¹	1 per d, 5 d per week
condom ¹	1 per d, 5 d per week
sanitary napkin ¹ (wetted in test water)	1 per d, 5 d per week
chlorine laundry bleach ¹ (8 oz)	1 per d, 5 d per week
cotton swab ¹ (plastic stick)	1 per d, 5 d per week
disposable diaper ¹ (children's size large)	1 per d, 5 d per week
tampon ¹ (plastic applicator added separately)	1 per d, 5 d per week
adhesive bandage ¹ (paper wrapper added separately)	1 per d, 5 d per week
dental floss (12-in piece)	1 per d, 5 d per week
alkali drain cleaner (8 oz)	1 per week, at random
Handi-wipe® ² (or equivalent)	1 per week, at random
acidic drain cleaner (8 oz)	1 per week, at random
liquid animal fat (4 oz)	1 per week, at random
one pair of nylon panty hose (size large)	1 per week, at random
cloth diaper (wetted in test water)	1 time during test, at random
toothbrush	1 time during test, at random
wood pencil	1 time during test, at random
plastic table utensil	1 time during test, at random
metal bottle cap	1 time during test, at random
HDPE bottle cap	1 time during test, at random
metal, toy car (Matchbox® ³ or Hotwheels® ³ or equivalent)	1 time during test, at random
8-oz drinking glass (crushed)	1 time during test, at random
¹ Items added separately each day in succession.	
² The Clorox Company, 1221 Broadway, Oakland, CA 94612	
³ Mattel, 333 Continental Blvd., El Segundo, CA 90245	

9.4.1.3 Operating sequence during the household items loading test

The grinder pump shall be subjected to the following operating sequence. Capacities are based on the baseline curve developed in 9.4.1.1:

- 1) two weeks of operation at the low capacity condition point (progressive cavity design) or at 20% of the maximum flow point (centrifugal design);
- 2) two weeks of operation at the mid-capacity point;
- 3) two weeks of operation at the maximum capacity point; and
- 4) 2 h of operation at the maximum capacity point with no challenge materials added to the system.

9.4.1.4 Hydraulic loading during the household items loading test

Hydraulic loading during the operating sequences described in 9.4.1.3 shall be based on the capacity of the pump basin, such that 10 pumping cycles occur every hour. The pump shall be operated 24 h/d, 7 d/week. The household items loading test shall be conducted 8 h/d, 5 d/week.

9.4.1.5 Shut off test

A shut off test shall be conducted by creating a discharge head pressure just below the maximum pressure claimed by the manufacturer, then operating the pump while increasing the pressure to the condition of shut off. This test shall be conducted for a period of 24 h, using the minimum basin size specified by the manufacturer. The water level in the basin shall be maintained at 5.1 to 7.6 cm (2 to 3 in) above the “on” level in order to ensure a continuous operational condition. Any water added to the basin during this test shall be at ambient laboratory temperature.

For pumps with automatic protection devices that turn the pump off during prolonged periods of shut off, the pump shall be allowed to stop and restart automatically during the 24 h of testing. A counter device shall be installed on the pump to record the number of on/off cycles that occurred during the 24-h testing period. The number of on/off cycles shall be recorded in the final report.

9.4.1.6 Negative head test

Testing against negative head shall be conducted by operating the pump for three on/off cycles, under each condition, with the discharge point 0.9, 1.8, 2.7, 3.7, and 4.6 m (3, 6, 9, 12, and 15 ft respectively) lower than the pump. During each test sequence, the power to the pump shall be monitored for ampere draw, voltage, and watts. Any erratic behavior of the pump shall be noted in the final report, along with the elevation difference at which it was first observed.

The negative head test conditions specified in this section are the conditions that shall exist at the pump. Negative head can be simulated using a vacuum source.

9.4.1.7 Development of a final hydraulic performance curve

A final hydraulic performance curve (final curve) shall be developed in accordance with the testing conditions specified in the current, applicable Hydraulic Institute testing standard (for example, centrifugal pumps shall be tested according to ANSI/HI4 1.6; rotary pumps shall be tested according to ANSI/HI4 3.6; and reciprocating pumps shall be tested according to ANSI/HI4 6.6). The final curve shall be developed by plotting two measured parameters, capacity and total head, using a minimum of five condition points, one of which shall be at shut off head (unless not applicable, such as for a positive displacement pump).

9.4.2 Performance testing and evaluation of pump basins

The pump basin shall be installed, during the performance testing and evaluation of the grinder pump, in accordance with the manufacturer's instructions. The pump basin shall be evaluated for both structural integrity (see 9.4.2.1) and basin leakage (see 9.4.2.2).

9.4.2.1 Structural integrity test

Connections to the pump basin shall be sealed, and a vacuum shall be applied to the basin for a period of 60 min. The applied vacuum pressure shall be equivalent to 150% of the pressure that the basin experiences if submerged vertically (normal upright position) in water to the basin's designed burial depth.

9.4.2.2 Basin leakage test

Immediately following the structural integrity test (see 9.4.2.1), the pump basin shall be assembled with discharge piping, electrical connections, and cover in accordance with the manufacturer's instructions. The connections to the pump basin shall be sealed, and the pump basin shall be filled with water to a point that is 30.5 cm (1 ft) above the pump basin's designed burial depth. The water shall be held in the basin for 24 h.

Pumps designed for installation within a building shall be subjected to a 61-cm (2-ft) head of water above the top of the basin.

9.5 Performance criteria for grinder pumps not utilizing wobble pump stators

9.5.1 Grinder pumps shall:

- not clog, jam, or show evidence of mechanical failure during the performance testing and evaluation;
- show no more than a 20% increase in the gap between the stationary and rotating cutting elements at the conclusion of the performance testing and evaluation; and
- exhibit no operational problems with the control systems arising from the water used for testing or from the household items added to the pump basin as described in table 1.

The baseline curve in 9.4.1.1 shall be compared to the manufacturer's published hydraulic testing and performance curve (manufacturer's curve). All of the data collected for the baseline curve shall plot within + 5% to - 3% of the manufacturer's curve in terms of both capacity and total head.

After all of the testing contained in 9.4.1, the final curve (see 9.4.1.7) shall be compared to the baseline curve (see 9.4.1.1). All of the data collected for the final curve shall plot within + 5% to - 5% of the baseline curve in terms of both capacity and total head.

The check valve as well as the air and vacuum release valves included in the pump package shall not be impaired or fouled during, or at the completion of, the performance testing and evaluation of the grinder pump.

9.5.2 Performance criteria for grinder pumps utilizing wobble pump stators

Grinder pumps with wobble pump stators shall:

- not clog, jam, or show evidence of mechanical failure during the performance testing and evaluation;
- show no more than a 20% increase in the gap between the stationary and rotating cutting elements at the conclusion of the performance testing and evaluation;
- remove solids and household items added to the pump basin as described in table 1 and show no significant accumulation of these materials; and
- exhibit no operational problems with the control systems arising from the water used for testing or the household items added to the pump basin as described in table 1.

The baseline curve in 9.4.1.1 shall be compared to the manufacturer's published hydraulic testing and performance curve (manufacturer's curve). All of the data collected for the baseline curve shall meet or exceed the manufacturer's curve in terms of both capacity and total head.

After all of the testing contained in 9.4.1, the final curve (see 9.4.1.7) shall be compared to the manufacturer's curve. All of the data collected for the final curve shall plot within 15% of the manufacturer's curve in terms of both capacity and total head.

The check valve as well as the air and vacuum release valves included in the pump package shall not be impaired or fouled during or at the completion of the performance testing and evaluation of the grinder pump.

9.5.3 Performance criteria for pump basins

Pump basins shall: