

Product Testing and Evaluation Certification Report

Norweco, Inc.
Bio-Kinetic System
Chlorine Disinfection Device
NWE010415F
February 1, 2016



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High Standards • Integrity • Technical Expertise



ANSI Accredited Program
PRODUCT CERTIFICATION
NSF/ANSI Standards 40/46/245
#0833

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Product Certification Summary

**Norweco, Inc.
Bio-Kinetic System
Chlorine Disinfection Device**

**200 GPD Minimum Flow Capacity
600 GPD Maximum Flow Capacity**

**Under the provisions of
NSF/ANSI Standard 46 : 2014 -
Evaluation of Components and Devices
Used in Wastewater Treatment Systems**

February 1, 2016

Preface

Performance evaluation of chlorination devices is achieved within the provisions of NSF/ANSI Standard 46: "Evaluation of Components and Devices Used in Wastewater Treatment Systems". NSF/ANSI Standard 46, Section 11 applies specifically to the requirements for chlorination devices. NSF/ANSI Standard 46 was developed by the NSF Joint Committee on Wastewater Technology.

Chlorination devices conforming to NSF/ANSI Standard 46 are classified as Chlorine Dispensers or Chlorine Disinfection Devices according to the test criteria to which the device is tested. Chlorine Dispensers are tested with potable water and must provide an average chlorine concentration of > 15 mg/L. Chlorine Disinfection Devices are tested with secondary residential treated wastewater and must achieve a fecal coliform geometric mean under the minimum and maximum hydraulic loading conditions of ≤ 200 organisms / 100 mL.

NSF/ANSI Standard 46 requires the testing facility to provide the manufacturer of the chlorination device with a report including all data collected and observations made in accordance with the performance evaluation of the device. NAT policy specifies the provision of performance evaluation reports to appropriate state regulatory agencies at publication. Subsequent direct distribution of the report by NAT is made only at the specific request of, or by permission of, the manufacturer.

Conformance with the Standard is recognized by issuance of the NAT Mark. The NAT Mark and the Evaluation Certification Report are a certification of the data provided by the test and an indication of compliance with the requirements expressed in the Standard. Permission to use the NAT Mark is granted only after the equipment has been tested, found to perform satisfactorily and all other requirements of the Standard have been satisfied. Continued use of the Mark is dependent upon evidence of compliance with the Standard and NAT policies. This compliance is determined by periodic re-inspection of the equipment at the factory and reports from the field.

The following report contains results of the entire testing program, a description of the device, its operation, and a narrative summary of the test program, including test location, procedures, and significant occurrences. The chlorine device represented herein reflects the equipment authorized to bear the NAT Mark.

Executive Summary

Testing of the Norweco, Inc. Bio-Kinetic System was conducted under the provisions of NSF/ANSI Standard 46: "Evaluation of Components and Devices Used in Wastewater Treatment Systems", 2014 revision. NSF/ANSI Standard 46, Section 11 applies specifically to the requirements for chlorination devices.

The performance evaluation was conducted at the North American Testing, LLC (NAT) Water and Wastewater Test Facility located in Norwalk, Ohio, USA using secondary treated residential wastewater. The Bio-Kinetic System was evaluated as a Chlorine Disinfection Device at a daily flow capacity of 200 to 600 GPD which provided a minimum contact time of 14 minutes. The evaluation consisted of a 100 day Chlorine Resistance Test, a 30 day operational Life Test, and a 1 day disinfection Chlorination Test. The Chlorine Resistance Test began on September 15, 2015 and was completed on December 24, 2015. The Life Test began on October 1, 2015 and was completed on November 1, 2015. The Chlorination Test was conducted on November 3, 2015.

Chlorine Resistance Test

Over the course of the 100 day Chlorine Resistance Test, the temperature ranged between 15° and 24° C. At the end of the test, the Bio-Kinetic System did not show any visible signs of chemical attack or structural deformation after exposure to Calcium Hypochlorite tablets and water for 100 days. The Bio-Kinetic System successfully passed the Chlorine Resistance Test.

Life Test

Over the course of the 30 day Life Test, the influent water CBOD₅ averaged 15 mg/L, ranging between 6 and 23 mg/L, and the influent water total suspended solids (TSS) averaged 29 mg/L, ranging between 20.0 and 40.0 mg/L. The average influent water fecal coliforms was 38,827 cfu/100 mL ranging between 6,000 and 106,000 cfu/100 mL. The average influent water pH was 7.7 S.U. ranging between 7.4 and 7.9 S.U., and the average influent water temperature was 19.6° C ranging between 18.5° and 21.1° C. The average influent water ammonia (NH₃) was 6.9 mg/L, ranging between 0.1 and 9.8 mg/L.

The Bio-Kinetic System successfully operated and delivered chlorine for the required 30 days without maintenance at the minimum daily flow of 200 GPD. No visible signs of damage were observed following the 30 day Life Test.

Chlorination Test

During the Chlorination Test, the influent CBOD₅ was 15 mg/L, the influent total suspended solids (TSS) was 19.0 mg/L, the influent pH was 7.5 S.U., the influent temperature was 19.0° C, and the influent ammonia (NH₃) was 2.7 mg/L. The average of all influent water fecal coliform samples collected during the Chlorination Test was 24,500 cfu/100 mL.

The Bio-Kinetic System achieved a fecal coliform geometric mean of 2 cfu/100 mL during the Chlorination Test at a minimum flow capacity of 200 GPD and at the maximum flow capacity of 600 GPD. The Bio-Kinetic System successfully met all of the design and performance requirements established by NSF/ANSI Standard 46 for Chlorine Disinfection Devices when tested at a daily flow capacity of 200 to 600 GPD.

Certification

North American Testing, LLC has determined by performance evaluation under the provisions of NSF/ANSI Standards 46 – 2014 that the Bio-Kinetic System manufactured by Norweco, Inc. has fulfilled the requirements of NSF/ANSI Standard 46 for Chlorine Disinfection Devices. This includes:

1. Compliance with the materials, design, and construction requirements of NSF/ANSI 46, Sections 5 and Section 6.
2. Compliance to the product literature requirements of NSF/ANSI 46, Section 6.
3. Compliance to the performance requirements of NSF/ANSI 46, Section 11.

The Bio-Kinetic System has therefore been authorized to bear the NAT Mark so long as Norweco, Inc. continues to meet the requirements of NSF/ANSI Standard 46 and NAT policies. The Bio-Kinetic System is certified by North American Testing as an NSF/ANSI 46 Chlorine Disinfection Device for flow capacities of 200 to 1500 GPD when used with either Bio-Sanitizer or Blue Crystal chlorine tablets.

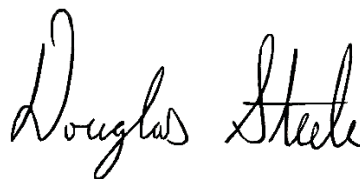
The Bio-Kinetic System is a component of several different Norweco wastewater treatment systems, including the Singulair 960, Singulair Green, Singulair TNT, and the Bio-Kinetic 2000. The NSF/ANSI Standard 46 certification applies only to the Bio-Kinetic System, specifically as a Chlorine Disinfection Device. The device shall be installed and operated as tested when used for the purpose of disinfecting secondary treated wastewater.

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 NAT on the wastewater treatment system described herein. 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. This report shall not be reproduced, except in its entirety, without the permission of NAT.

North American Testing, LLC. is accredited by the American National Standards Institute to certify wastewater treatment products under the scope of Sewage Water (13.060.30) and applicable NSF/ANSI Standards.



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The Bio-Kinetic System is a flow equalized and flow proportional chemical dosing unit designed to dispense chemical tablets in the Norweco Singulair and Bio-Kinetic 2000 wastewater treatment systems. The Bio-Kinetic System uses filtration, flow equalization, chemical addition, settling, and and flow detention to achieve treatment.

Flow to be treated enters the Bio-Kinetic System by passing through the design flow mesh that extends around the baffled perimeter. The design flow filter mesh provides for initial filtration and entrapment of solids. Larger peak flow filter mesh is located above the design flow mesh.

Liquid is channeled through three pairs of flow equalization ports which become submerged orifices as the water level in the chamber rises, equalizing the flow rate through the system and the device. Two design flow ports are located at the normal liquid level in the system and manage standard flow variations through the system. The two sustained flow ports manage longer hydraulic surges which have caused significant head rise in the system. The two peak flow ports accommodate prolonged hydraulic surges, and are located safely in reserve, well above the design and sustained flow ports. The flow equalization feature ensures a steady flow rate which evenly erodes the chemical tablets and allows consistent chemical application to low, sustained, variable, intermittent, and surge flows.

All flow passing through the flow equalization ports drops to the flow distribution deck where the chlorine tablets are contained in a chemical feed tube. The flow deck directs the water through the chemical feed tube where active chemicals are released into the flow stream as the liquid erodes the tablets. The flow deck incorporates a retaining ring with locating ribs for the feed tube. The locating ribs engage positioning slots in the feed tube to secure the tube in the proper orientation. The flow deck is elevated one-quarter inch higher than the device outlet for drainage of effluent from the flow channel which allows the tablets to dry during periods of no flow.

The feed tube is positioned vertically into the flow deck through the vapor shield. The liquid flows through six equally spaced flow windows in the feed tube for contact with the tablets. As the chemical tablets are eroded by the flow of water, additional tablets stacked in the feed tube drop into place and are exposed to the liquid. The chemical feed rate is dependent upon the flow rate and is not manually adjustable.

After contact with the chemical tablets, the treated liquid travels vertically downward through the unbaffled perimeter settling zone and into the contact chamber basin. The Bio-Kinetic System has an integrated contact chamber which contains a volume of 11.5 gallons and provides the required contact time for the chlorine solution to mix with the flow and disinfect the liquid. Generally, 15 minutes of contact time with the bacteria is required to destroy the organism cells. The inner baffle of the device contains 42 deck plates which act to intermix the chlorinated liquid and evenly disperse the chemical. Finally, the disinfected effluent exits the device through the internal chamber of the flow deck and out the gasketed discharge flange.

The chlorine tablets used for disinfection are manufactured from calcium hypochlorite and contain at least 70% available chlorine. The tablets incorporate beveled edges to enhance the chemical dissolution pattern.

The effectiveness of chlorination is dependant upon the pH and temperature of the water, the chlorine concentration in the water, contact time with the chlorine solution, and the concentration of contaminants such as ammonia and dissolved organics in the water. The pH of the liquid influences which type of chlorine solution is created when mixed with the flow. Chlorination is more effective at higher temperatures. Chlorine solutions react with ammonia to form chloramines, effectively reducing the disinfection ability of the chlorine solution. Organic compounds such as CBOD₅ also interferes with the effectiveness of the chlorine solution and creates a chlorine demand above what should be required to disinfect the water.

2.0 PERFORMANCE TESTING AND EVALUATION

2.1 Description of the Evaluated Units

The Norweco Bio-Kinetic System tested in this evaluation has a minimum daily flow capacity rating of 200 GPD and a maximum daily flow capacity rating of 600 GPD. The Bio-Kinetic System body is manufactured from HDPE (High Density Polyethylene), with components made of Polypropylene (PP), ABS (Acrylonitrile Butadiene Styrene), Nylon, and rubber. The Bio-Kinetic System is a component of several different Norweco wastewater treatment systems including the Singular series and the Bio-Kinetic 2000 and is designed specifically for use in these systems. For the purpose of this product evaluation, the Bio-Kinetic was installed and tested in the clarification chamber of a concrete Singular system, which is its most common installation location. The gasketed discharge flange of the device is connected to the receiving flange outlet hub of the wastewater treatment system. Specifications and drawings of the device are included in Appendix A.

The Bio-Kinetic System is equipped with a molded, chemical feed tube with twist lock caps. The feed tube and cap are constructed of NSF/ANSI Standard 61 listed PVC (Polyvinyl chloride). The feed tube is manufactured with the translucent ClearCheck design which allows the operator to determine whether tablet refill is required by visual inspection. The feed tube utilizes chemical tablets with the nominal weight and dimensions of 5 ounces, 2 5/8" diameter and 13/16" to 1" height.

Two Bio-Kinetic Systems were randomly selected from a stock of finished and ready to ship products from the warehouse. The first tablet feeder was used to complete the Chlorine Resistance Test portion of NSF/ANSI Standard 46, section 11. The second tablet feeder was used to complete the Life Test and Chlorination Test portions of NSF/ANSI Standard 46, Section 11, consecutively.

The Bio-Kinetic System was evaluated using Bio-Sanitizer brand tablets provided by the manufacturer. The tablets are manufactured from pure calcium hypochlorite and contain at least 70% available chlorine. Bio-Sanitizer disinfecting tablets are registered with the USEPA for water and wastewater treatment. Each tablet is 2-5/8" diameter, compressed to a 13/16" thickness, has an approximate weight of 5 ounces, and is white in color for easy identification.

2.2 Test Protocol

Testing for certification was conducted per Section 11.6 of NSF/ANSI Standard 46 protocol, "Performance Testing and Evaluation of Chlorination Devices." This section describes the methods used to evaluate the performance of the Norweco Bio-Kinetic System. The device was designed, installed, and tested as a Chlorine Disinfection Device. The device was subjected to the following test procedures:

Chlorine Resistance Test -	100 Days
Life Test -	30 Days
Chlorination Test -	1 Day

These tests were conducted on two separate chlorination devices. The Life Test and the Chlorination Test were performed consecutively in the order listed above using the same chlorination device.

2.3 Test Chronology

The Chlorine Resistance Test was conducted using the first tablet feeder and began on September 15, 2015. After 100 days of chemical exposure, the Chlorine Resistance Test concluded on December 24, 2015.

The Life Test was conducted using the second tablet feeder and began on October 1, 2015. Sample collection began on October 6, 2015. After 31 days of operation, the Life Test concluded on November 1, 2015.

The Chlorination Test followed the Life Test using the same tablet feeder tested for the Life Test and was conducted on November 3, 2015. Samples for disinfection testing were collected at 10 minute intervals during the minimum and maximum flow capacities.

The NSF/ANSI Standard 46 performance evaluation was completed on December 24, 2015.

2.4 Preparation for Testing and Evaluation

The device was assembled and installed in accordance with the manufacturer's instructions.

The manufacturer inspected the system for proper installation. No defects were detected and the system was judged to be structurally sound.

The devices were filled with the chemical specified by the manufacturer, Bio-Sanitizer Disinfecting Tablets, prior to the start of the performance evaluation.

There were no mechanical repairs made to the device or its components during the performance testing and evaluation.

The device was operated in accordance with the manufacturer's instructions. Routine service and maintenance of the system was not permitted during the performance testing and evaluation period.

The device has no electrical requirements for proper operation. The device has no moving mechanical components that are required for proper operation.

The device contains several one way valves which are utilized to facilitate the filling and draining process during installation and removal of the device. The drain valve opens only during removal of the device, and allows for the exit of liquid. The fill valve opens only during installation of the device and is engineered to open when the pressure outside the device reaches 16" of head, which allows for the filling of the device. Both valves remain closed and do not operate during normal operation of the Bio-Kinetic System.

2.5 Dosing Methods and Volumes

Dosing was accomplished by opening an electrically actuated valve to feed raw sewage wastewater to an aerated wastewater treatment system. Ten gallon doses (exactly 10.40 gallon doses) were spread uniformly over each dosing period to comprise the total dosing volume for the period. The aerated wastewater treatment system treated the raw sewage and provided the secondary treated residential wastewater referred to as "influent water" to the chlorination device.

The average daily volume of the wastewater delivered to the system was within 100% $\pm$ 4% of the devices' daily rated hydraulic capacities.

2.6 Sample Collection

All sample collection methods were in accordance with APHA's Standard Methods for the Examination of Water and Wastewater unless otherwise specified. Sample containers for Fecal Coliform analysis contained Sodium Thiosulfate tablets to halt the disinfection action of the chlorine.

NSF/ANSI Standard 46 does not specify sampling frequency for the Life Test. Flow proportioned 24-hour composite influent water samples were collected three days per week during the Life Test. The influent composite samples were analyzed for five-day carbonaceous biochemical oxygen demand (CBOD₅), total suspended solids (TSS), pH, and ammonia. Influent water grab samples were collected three days per week and analyzed for pH and fecal coliform. On-site determinations of the influent water temperature were made three days per week. Although not required by the Standard, effluent grab samples were also collected three days per week and analyzed for fecal coliform and total chlorine.

Flow proportioned 24-hour composite influent water samples were collected during the Chlorination Test. The influent composite samples were analyzed for five-day carbonaceous biochemical oxygen demand (CBOD₅), total suspended solids (TSS), pH, and ammonia. Influent water grab samples were collected and analyzed for pH and fecal coliform. On-site determinations of the influent water temperature were made three days per week. Although not required by the Standard, effluent grab samples were collected and analyzed for total chlorine. The effluent flow rates during each effluent fecal coliform grab sample moment were also recorded.

2.7 Chlorine Resistance Test

The Chlorine Resistance Test is designed to evaluate the durability of the chlorinator device materials and their resistance to chemical attack. During the Chlorine Resistance Test, the parts of the chlorination device normally in contact with chlorine are exposed for a period of 100 days to the maximum in-use concentration of the chemical specified to be used by the manufacturer.

The Bio-Kinetic System feed tube was filled to the maximum level with the chemical specified by the manufacturer, Bio-Sanitizer Disinfecting Tablets. The six inlet flow ports were sealed with polyethylene welds. The discharge flange was sealed with a pipe cap and the device was filled with potable water. The device was exposed to the chemical mixture for 100 days at a temperature of 20 ±5 °C. During the Chlorine Resistance Test, the device was periodically visually examined for leakage, damage, or noticeable changes.

2.7.1 Criteria

At the conclusion of the Chlorine Resistance Test, no component of the chlorination device shall show any visible sign of chemical attack or structural deformation.

At the end of the 100 day test period, the device was drained, disassembled, and inspected by a licensed Professional Engineer. The components of the device did not show any visible sign of chemical attack, structural deformation, or leakage. The Bio-Kinetic System passed the criteria of the Chlorine Resistance Test.

2.8 Life Test

The Life Test is designed to evaluate the capability of the chlorination device to operate for at least 30 days without maintenance or replenishing of chemicals. During the Life Test, the device is assembled, installed, and operated in accordance with the manufacturer's specifications. The device is filled to the maximum level with the chemical specified by the manufacturer. The device shall be capable of operating and delivering the chemical throughout the evaluation to the completion of the Chlorination Test.

Results of the analyses and measurements made during the Life Test are summarized in Section 3.0.

2.8.1 Manufacturer Specifications

The manufacturer shall specify all key elements for effective chlorination and the device shall be tested under these specifications. The manufacturer's specifications include:

The device is designed to treat flows at a minimum daily flow capacity of 200 gallons per day (GPD) and a maximum daily flow capacity of 600 gallons per day (GPD).

The manufacturer specifies the use of Bio-Sanitizer Disinfecting Tablets or Blue Crystal Residential Disinfecting Tablets both manufactured by Norweco, Inc. The Bio-Sanitizer tablets and the Blue Crystal tablets both contain 73% Calcium Hypochlorite with 70% available chlorine.

The device does not require the use of any external contact chamber tank. Mixing of the chemical with the water is achieved by the natural mixing of the water in the contact chamber with the incoming flow.

2.8.2 Hydraulic Loading

The device shall be operated under the minimum daily flow capacity specified by the manufacturer during the Life Test. The device was dosed with secondary treated wastewater meeting the specifications for Influent Water at the minimum design loading rate specified by NSF/ANSI Standard 46 as follows:

Minimum Daily Flow Capacity - 200 Gallons Per Day (GPD)

6 a.m. to 9 a.m. – 35% of daily rated capacity or 70 gallons

11 a.m. to 2 p.m. – 25% of daily rated capacity or 50 gallons

5 p.m. to 8 p.m. – 40% of daily rated capacity or 80 gallons

The system was dosed 7 days a week for a period of 31 days with a wastewater volume equivalent to the daily minimum flow capacity of the device. On 10/29/2015, the device was mistakenly dosed with 416 gallons of flow. The increased flow for this one day did not affect the outcome of the evaluation.

2.8.3 Influent Water Characteristics

The Influent Water to the chlorination device shall be secondary treated residential wastewater meeting the specifications defined in NSF/ANSI Standard 46:

(1) CBOD₅: The CBOD₅ concentration shall be ≤ 25 mg/L.

(2) TSS: The total suspended solids (TSS) concentration shall be ≤ 30 mg/L.

(3) Fecal Coliform: The fecal coliform population shall be between 10,000 and 1,000,000 (10⁴ to 10⁶) organisms / 100 mL.

(4) pH: The pH of the influent water shall be between 6.0 to 9.0 S.U.

(5) Temperature: The temperature of the influent water shall be between 6° and 30° C.

(6) Ammonia: The ammonia (NH₃) concentration shall be between ≥ 2.0 and ≤ 4.0 mg/L.

The Standard recognizes that achieving the influent characteristics above will not always be possible.

2.8.4 Effluent Requirements

The Standard does not require effluent sampling and has no requirements for the device effluent during the Life Test. At the request of the manufacturer, the device effluent was sampled every day that the influent water was sampled. The chlorination device effluent was analyzed for Total Chlorine and Fecal Coliform.

2.8.5 Criteria

At the conclusion of the test, there shall be no visible signs of damage or structural change that may adversely affect proper operation of any component of the chlorination device.

At the conclusion of the performance testing and evaluation, the device was disassembled, and inspected by a licensed Professional Engineer. The components of the device did not show any visible sign of damage or structural change. The Bio-Kinetic System passed the criteria of the Life Test.

2.9 Chlorination Test

The Chlorination Test is conducted immediately following the Life Test using the same device that was tested during the Life Test. The Chlorination Test is designed to evaluate the disinfection capabilities of the chlorination device while operating at the minimum and maximum chemical feed rates at both the minimum and maximum daily flow capacities.

No maintenance was performed following completion of the Life Test or prior to the Chlorination Test. The chemicals placed into the device were not replenished or supplemented following the Life Test or prior to the Chlorination Test.

2.9.1 Hydraulic Loading

For each feed setting (maximum and minimum), flow shall be delivered to the chlorination device continuously over a 3-hour period at approximately 40% of the rated minimum and maximum daily hydraulic capacity for each feed setting.

The Bio-Kinetic System does not have manually adjustable chemical feed rates, therefore, the tablet feeder was tested at the minimum and maximum daily flow capacities using the single feed rate setting. The device was dosed with secondary treated wastewater meeting the specifications for Influent Water at the minimum and maximum hydraulic loading rates specified by the device manufacturer and the pattern specified by NSF/ANSI Standard 46 as follows:

Minimum Daily Flow Capacity - 200 Gallons Per Day (GPD)
40% of 200 GPD = 80 gallons delivered over a 3-hour dosing period

Maximum Daily Flow Capacity - 600 Gallons Per Day (GPD)
40% of 600 GPD = 240 gallons delivered over a 3-hour dosing period

During the Chlorination Test, actual effluent flow rates were physically measured at each individual effluent sampling event for both the minimum daily flow capacity and the maximum daily flow capacity test sequences. During the minimum daily flow capacity test sequence, the lowest effluent flow rate measured was 0.33 GPM and the highest effluent flow rate measured was 0.47 GPM with an average flow rate of 0.41 GPM. During the maximum daily flow capacity test sequence, the lowest effluent flow rate measured was 0.72 GPM and the highest effluent flow rate measured was 0.83 GPM with an average flow rate of 0.77 GPM.

2.9.2 Influent Water Characteristics

The Influent Water to the chlorination device shall be secondary treated residential wastewater meeting the specifications defined in NSF/ANSI Standard 46:

- (1) CBOD₅: The CBOD₅ concentration shall be ≤ 25 mg/L.
- (2) TSS: The total suspended solids (TSS) concentration shall be ≤ 30 mg/L.
- (3) Fecal Coliform: The fecal coliform population shall be between 10,000 and 1,000,000 (10^4 to 10^6) organisms / 100 mL.
- (4) pH: The pH of the influent water shall be between 6.0 to 9.0 S.U.
- (5) Temperature: The temperature of the influent water shall be between 6° and 30° C.
- (6) Ammonia: The ammonia (NH₃) concentration shall be between ≥ 2.0 and ≤ 4.0 mg/L.

The Standard recognizes that achieving the influent characteristics above will not always be possible. Daily sampling shall continue following the Life Test until the influent characteristics have been met during the Chlorination Test. The pass/fail criteria shall be applied to the effluent sample average from the first sample day meeting the influent water requirements.

Any test day during the Chlorination Test in which the influent water pH or temperature are outside the parameters shall be excluded from the evaluation. Any test day during the Chlorination Test in which the influent ammonia or fecal coliform is below the required range shall be excluded from the evaluation. Test days in which the CBOD₅, TSS, fecal coliform, or ammonia are above the required range may be included at the manufacturers' discretion if the chlorination device is able to successfully disinfect the influent water under the more difficult test conditions. CBOD₅, TSS, fecal coliform, or ammonia concentrations higher than the range specified in the Standard create a more challenging test condition.

On the day the Chlorination Test was conducted, all influent water characteristics were within the required specifications and the test data qualified for completion of the Chlorination Test.

2.9.3 Effluent Sampling and Analysis

During each hydraulic loading period, 5 effluent grab samples shall be collected, beginning after a minimum of 2 chamber volumes of the influent wastewater has passed through the device and continuing at 10 minute intervals.

During the Chlorination Test sequence, effluent grab samples were collected at ten minute intervals after two chamber volumes of wastewater had passed through the device during both the minimum and maximum daily flow capacities. Each feed and flow rate combination was separated by one hour of no wastewater dosing before beginning the next sequence. The chlorination device effluent was analyzed for Total Chlorine and Fecal Coliform.

2.9.4 Criteria

Chlorine Disinfection Devices shall achieve a geometric mean fecal coliform concentration of all hydraulic loading conditions of ≤ 200 organisms / 100 mL on the first day that the influent requirements are met.

The device achieved a geometric mean fecal coliform concentration of both hydraulic loading conditions of 2 cfu/100 mL which was consistent and acceptable disinfection of secondary treated residential wastewater with daily effluent discharge capacities between 200 and 600 gallons per day (GPD) and effluent flow rates between 0.33 and 0.83 gallons per minute (GPM). The Bio-Kinetic System passed the disinfection criteria of the Chlorination Test.

3.0 ANALYTICAL RESULTS

3.1 Summary

Analysis of samples collected during the evaluation were completed using the appropriate methods and procedures in APHA's *Standard Methods for the Examination of Water and Wastewater*. Copies of data generated during the evaluation are included in Appendix B. Results of the analyses, on-site observations, and measurements made during the Life Test are summarized in Table I. Results of the analyses, on-site observations, and measurements made during the Chlorination Test are summarized in Table II.

Criteria for evaluating the analytical results from the testing are described in Section 11.6 of NSF/ANSI Standard 46. In completing the Life Test and Chlorination Test qualifications for the data, an allowance is made for elevated CBOD₅, TSS, Ammonia, and Fecal Coliform concentrations in the Influent Water which may be above the parameters specified.

The North American Testing Laboratory conforms to ISO/IEC 17025 for all management and technical requirements.

3.2 Biochemical Oxygen Demand

The five-day carbonaceous biochemical oxygen demand (CBOD₅) analysis was completed using Method 5210B of Standard Methods. Data from this analysis is summarized in Table I. The CBOD₅ data for the evaluation is shown in Appendix B.

Influent Water CBOD₅ :

The influent water CBOD₅ ranged from 6 to 23 mg/L during the Life Test, with an average concentration of 15 mg/L. The average influent water CBOD₅ value was within the ≤ 25 mg/L range specified by the Standard.

The influent water CBOD₅ was 15 mg/L on the day the Chlorination Test was conducted, which was within the ≤ 25 mg/L range specified by the Standard.

**TABLE I. SUMMARY OF ANALYTICAL RESULTS
LIFE TEST**

TABLE I

	Average	Minimum	Maximum
Carbonaceous Biochemical Oxygen Demand (mg/L)			
<i>Influent Water (CBOD₅)</i>	15	6	23
Total Suspended Solids (mg/L)			
<i>Influent Water (TSS)</i>	29.1	20.0	40.0
Fecal Coliform (cfu/100 mL)			
<i>Influent Water</i>	38,830	6,000	106,000
<i>Effluent</i>	1	1	4
pH (SU)			
<i>Influent Water</i>	7.7	7.4	7.9
Temperature (°C)			
<i>Influent Water</i>	19.6	18.5	21.1
Ammonia (mg/L)			
<i>Influent Water (NH₃)</i>	6.9	0.1	9.8
Total Chlorine (mg/L)			
<i>Effluent</i>	11	3	18

**TABLE II. SUMMARY OF ANALYTICAL RESULTS
CHLORINATION TEST**

TABLE II

	Average	Minimum	Maximum	Geometric Mean
Carbonaceous Biochemical Oxygen Demand (mg/L)				
<i>Influent Water (CBOD₅)</i>	15	na	na	na
Total Suspended Solids (mg/L)				
<i>Influent Water (TSS)</i>	19.0	na	na	na
Fecal Coliform (cfu/100 mL)				
<i>Influent Water</i>	24,500	12,500	34,000	22,747
<i>Effluent</i>	3	1	8	2
pH (SU)				
<i>Influent Water</i>	7.5	na	na	na
Temperature (°C)				
<i>Influent Water</i>	19.0	na	na	na
Ammonia (mg/L)				
<i>Influent Water (NH₃)</i>	2.7	na	na	na
Total Chlorine (mg/L)				
<i>Effluent</i>	8	2	14	na

3.3 Total Suspended Solids

TSS analysis was completed using Method 2540D of Standard Methods. Data from this analysis is summarized in Table I. The TSS data for the evaluation is shown in Appendix B.

Influent Water TSS:

The influent water TSS ranged from 20.0 to 40.0 mg/L during the Life Test, with an average concentration of 29.1 mg/L. The average influent water TSS value was within the ≤ 30 mg/L range specified by the Standard.

The influent water TSS was 19.0 mg/L on the day the Chlorination Test was conducted, which was within the ≤ 30 mg/L range specified by the Standard.

3.4 Fecal Coliform

Fecal coliform analysis was completed using Method 9222D of Standard Methods. Data from this analysis is summarized in Table I. The fecal coliform data for the evaluation is shown in Appendix B.

Influent Water Fecal Coliform:

The influent water fecal coliform ranged from 6,000 to 106,000 cfu/100 mL during the Life Test, with an average concentration of 38,827 mg/L. The average influent water fecal coliform was within the 10^4 to 10^6 (10,000 - 1,000,000) organisms / 100 mL range specified by the Standard.

The influent water fecal coliform ranged from 12,500 to 34,000 cfu/100 mL on the day the Chlorination Test was conducted, with an average concentration of 24,500 mg/L. The average influent water fecal coliform was within the 10^4 to 10^6 (10,000 - 1,000,000) organisms /100 mL range specified by the Standard.

Effluent Fecal Coliform:

The effluent fecal coliform ranged from <1 to 4 cfu/100 mL during the Life Test, with an average concentration of 1.2 cfu/100 mL and a geometric mean of 1.1 cfu/100 mL. The Standard does not have a requirement for effluent fecal coliform during the Life Test.

The effluent fecal coliform ranged from <1 to 8 cfu/100 mL on the day the Chlorination Test was conducted, with an average concentration of 3.0 cfu/100 mL and a geometric mean of 2.0 cfu/100 mL. The fecal coliform geometric mean was within the ≤ 200 organisms /100 mL limit required by the Standard.

3.5 pH

pH analysis was completed using Method 4500-H B of Standard Methods. Data from this analysis is summarized in Table I. The pH data for the evaluation is shown in Appendix B.

Influent Water pH:

The influent pH ranged from 7.4 to 7.9 S.U. during the Life Test with an average value of 7.7 S.U. The average influent water pH was within the 6.0 to 9.0 range specified by the Standard.

The influent pH was 7.5 S.U. on the day the Chlorination Test was conducted, which was within the 6.0 to 9.0 range specified by the Standard.

3.6 Temperature

Temperature analysis was completed using a digital thermometer. Data from this analysis is summarized in Table I. The temperature data for the evaluation is shown in Appendix B.

Influent Water Temperature:

Influent water temperature ranged from 18.5° to 21.1° C during the Life Test with an average value of 19.6° C. The average influent water temperature was within the 6° to 30° C range specified by the Standard.

Influent water temperature was 19.0° C on the day the Chlorination Test was conducted, which was within the 6° to 30° C range specified by the Standard.

3.7 Ammonia

Ammonia analysis was completed using Method 4500-NH₃ D of Standard Methods . Data from this analysis is summarized in Table I. The ammonia data for the evaluation is shown in Appendix B.

Influent Water Ammonia:

The influent water ammonia concentration ranged from 0.1 to 9.8 mg/L during the Life Test, with an average ammonia concentration of 6.9 mg/L. The average influent water ammonia value was above the ≥ 2 to ≤ 4 mg/L range specified by the Standard. The Standard recognizes that achieving the required influent characteristics will not always be possible.

The influent water ammonia concentration was 2.7 mg/L on the day the Chlorination Test was conducted, which was within the ≥ 2 to ≤ 4 mg/L range specified by the Standard.

3.8 Total Chlorine

Total chlorine analysis was completed using Method 4500-Cl B of Standard Methods. Data from this analysis is summarized in Table I. The total chlorine data for the evaluation is shown in Appendix B.

Effluent Total Chlorine:

The effluent total chlorine ranged from 3 to 18 mg/L during the Life Test, with an average concentration of 10.8 mg/L. The Standard does not have a requirement for effluent total chlorine during the Life Test.

The effluent total chlorine ranged from 2.2 to 14 mg/L during the Chlorination Test, with an average concentration of 8.1 mg/L. The Standard does not have a requirement for effluent total chlorine when evaluating Chlorine Disinfection Devices during the Chlorination Test.

4.0 References

- Standard Methods for the Examination of Water and Wastewater, 21st Edition
- NSF/ANSI Standard 46 : 2014 "Evaluation of Components and Devices Used in Wastewater Treatment Systems"

APPENDIX A

DEVICE SPECIFICATIONS AND DRAWINGS



High Standards • Integrity • Technical Expertise

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DEVICE SPECIFICATIONS

Norweco, Inc. Bio-Kinetic® System

Chlorine Contact Chamber Volume	11.5 Gallons
Minimum Design Flow	200 GPD
Minimum Flow Rate	0.33 gpm*
Hydraulic Retention Time	35 minutes
Maximum Design Flow	600 GPD
Maximum Flow Rate	0.83 gpm*
Hydraulic Retention Time	14 minutes

*Due to the flow equalization feature of the Bio-Kinetic System, actual flow rates through the device are significantly reduced from the flow rate entering the wastewater treatment system.

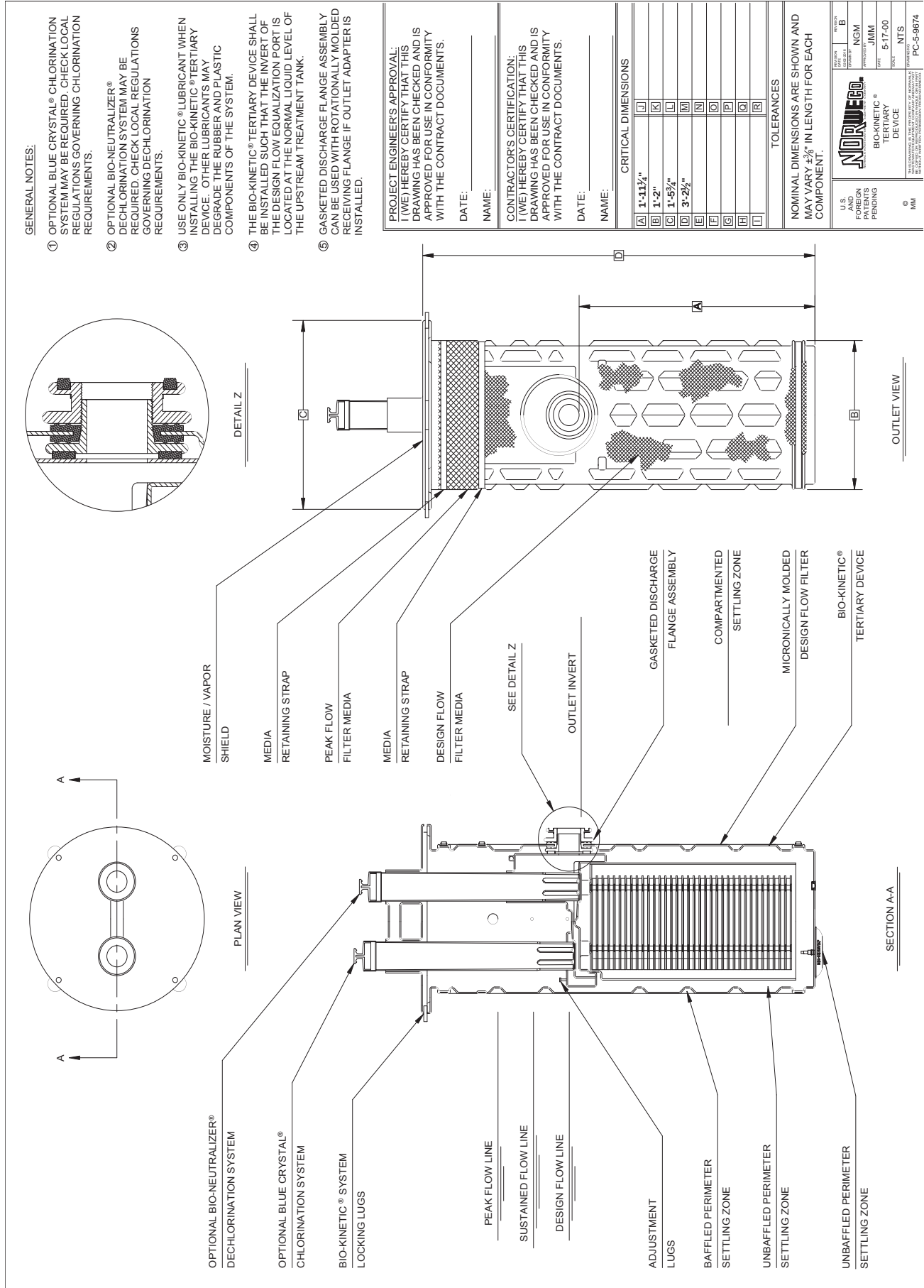
CHEMICAL SPECIFICATIONS

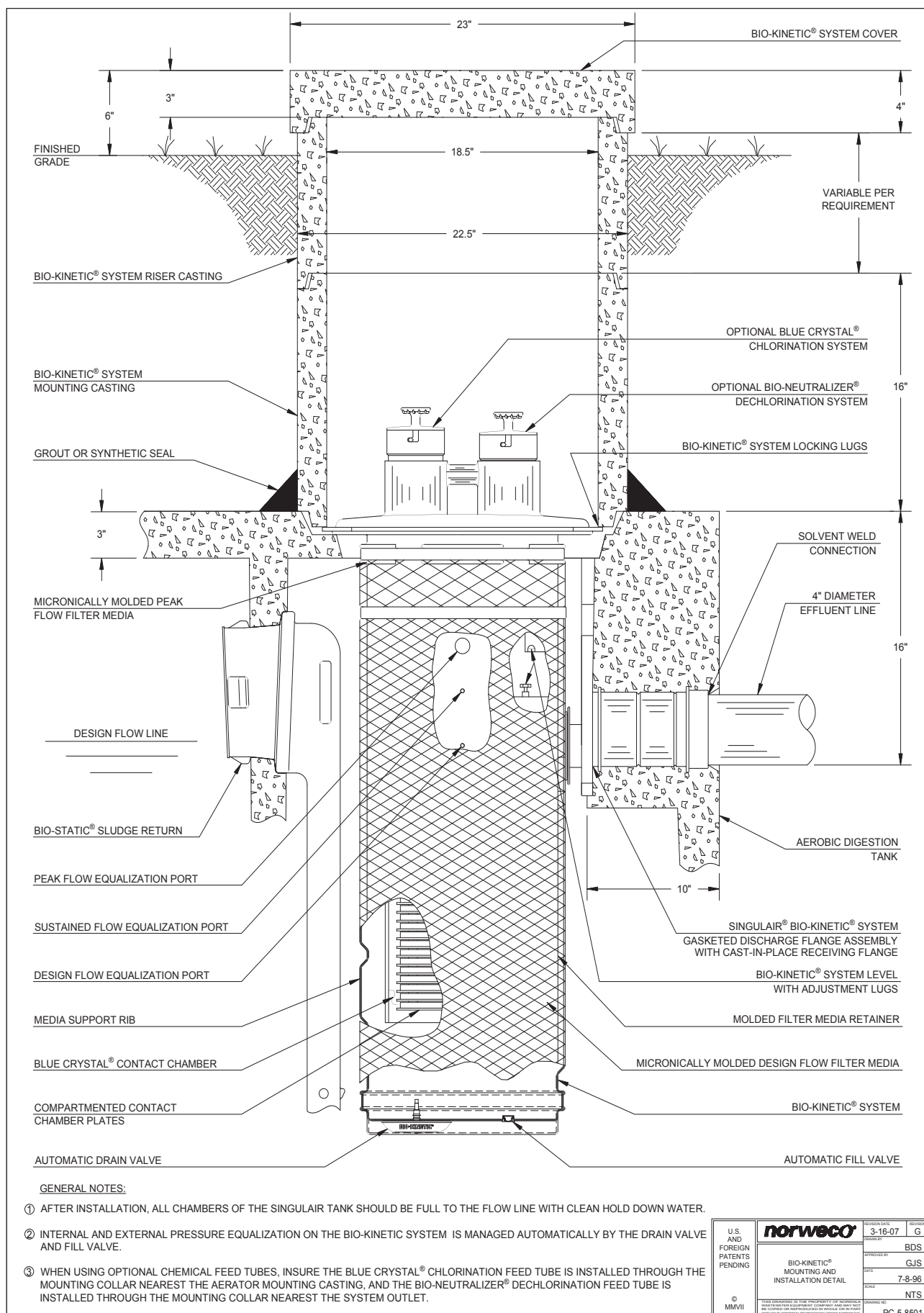
Norweco, Inc. Bio-Sanitizer® Disinfecting Tablets

Tablet	
Diameter	2-5/8"
Thickness	13/16"
Weight	5 oz. (140 grams)
Special Design Features	Beveled Edges
Active Ingredient	
Calcium Hypochlorite (Ca(OCl) ₂ * (H ₂ O)	73%
Minimum Available Chlorine	70%

Norweco, Inc. Blue Crystal® Residential Disinfecting Tablets

Tablet	
Diameter	2-5/8"
Thickness	1"
Weight	5 oz. (140 grams)
Special Design Features	Beveled Edges
Active Ingredient	
Calcium Hypochlorite (Ca(OCl) ₂ * (H ₂ O)	73%
Minimum Available Chlorine	70%





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APPENDIX B

ANALYTICAL RESULTS



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NSF/ANSI Standard 46 - Chlorine Disinfection Device

Week Beginning 9/27/2015

Site Code: NWE010415

Weeks Into Test: Installation

Day and Date		Sunday 9/27	Monday 9/28	Tuesday 9/29	Wednesday 9/30	Thursday 10/1	Friday 10/2	Saturday 10/3	Week's Average
Dosed Volume (Gallons)						198	198	198	198
CBOD ₅ (mg/L)	Influent								na
Total Suspended Solids (mg/L)	Influent								na
Fecal Coliform (cfu/100 mL)	Influent								na
	Effluent								na
pH	Influent								na
Temperature (°C)	Influent								na
Ammonia	Influent								na
Total Chlorine	Effluent								na

(a) Site Problem

Notes : 10/1/2015- Begin Life Test.

(b) Malfunction of system under test

(c) Sample/reading not taken

(d) Lab Error

(e) Other

NSF/ANSI Standard 46 - Chlorine Disinfection Device

Week Beginning 10/4/2015

Site Code: NWE010415

Weeks Into Test: 1

Day and Date		Sunday 10/4	Monday 10/5	Tuesday 10/6	Wednesday 10/7	Thursday 10/8	Friday 10/9	Saturday 10/10	Week's Average
Dosed Volume (Gallons)		198	198	198	198	198	198	198	198
CBOD ₅ (mg/L)	Influent			22	10	14			15
Total Suspended Solids (mg/L)	Influent			36.0	29.0	37.0			34.0
Fecal Coliform (cfu/100 mL)	Influent			89,000	30,000	6,000			41,667
	Effluent			1	1	1			1
pH	Influent			7.8	7.6	7.9			7.7
Temperature (°C)	Influent			20.6	20.4	(c)			20.5
Ammonia	Influent			0.1	0.9	5.1			2.0
Total Chlorine	Effluent			3	4	4			4

(a) Site Problem

Notes :

(b) Malfunction of system under test

(c) Sample/reading not taken

(d) Lab Error

(e) Other

NSF/ANSI Standard 46 - Chlorine Disinfection Device

Week Beginning 10/11/2015

Site Code: NWE010415

Weeks Into Test: 2

Day and Date		Sunday 10/11	Monday 10/12	Tuesday 10/13	Wednesday 10/14	Thursday 10/15	Friday 10/16	Saturday 10/17	Week's Average
Dosed Volume (Gallons)		198	198	208	198	198	198	198	199
CBOD ₅ (mg/L)	Influent			17	6	16			13
Total Suspended Solids (mg/L)	Influent			23.0	23.0	23.0			23.0
Fecal Coliform (cfu/100 mL)	Influent			10,500	14,000	8,000			10,833
	Effluent			1	1	4			2
pH	Influent			7.8	7.5	7.7			7.6
Temperature (°C)	Influent			21.1	20.8	20.5			20.8
Ammonia	Influent			8.6	9.5	9.8			9.3
Total Chlorine	Effluent			5	9	11			8

(a) Site Problem

Notes :

(b) Malfunction of system under test

(c) Sample/reading not taken

(d) Lab Error

(e) Other

NSF/ANSI Standard 46 - Chlorine Disinfection Device

Week Beginning 10/18/2015

Site Code: NWE010415

Weeks Into Test: 3

Day and Date		Sunday 10/18	Monday 10/19	Tuesday 10/20	Wednesday 10/21	Thursday 10/22	Friday 10/23	Saturday 10/24	Week's Average
Dosed Volume (Gallons)		198	198	208	208	208	208	198	204
CBOD ₅ (mg/L)	Influent		13	23	18				18
Total Suspended Solids (mg/L)	Influent		39.0	40.0	33.0				37.3
Fecal Coliform (cfu/100 mL)	Influent		30,500	71,000	74,000				58,500
	Effluent		1	1	1				1
pH	Influent		7.7	7.7	7.8				7.7
Temperature (°C)	Influent		18.7	18.7	18.9				18.8
Ammonia	Influent		9.3	8.7	8.1				8.7
Total Chlorine	Effluent		12	18	15				15

(a) Site Problem

Notes :

(b) Malfunction of system under test

(c) Sample/reading not taken

(d) Lab Error

(e) Other

NSF/ANSI Standard 46 - Chlorine Disinfection Device

Week Beginning 10/25/2015

Site Code: NWE010415

Weeks Into Test: 4

Day and Date		Sunday 10/25	Monday 10/26	Tuesday 10/27	Wednesday 10/28	Thursday 10/29	Friday 10/30	Saturday 10/31	Week's Average
Dosed Volume (Gallons)		198	208	198	198	416	198	198	231
CBOD ₅ (mg/L)	Influent		23	16	11	9			15
Total Suspended Solids (mg/L)	Influent		26.0	24.7	25.0	20.0			23.9
Fecal Coliform (cfu/100 mL)	Influent		19,000	106,000	24,750	22,000			42,938
	Effluent		1	1	1	1			1
pH	Influent		7.6	7.6	7.4	7.9			7.6
Temperature (°C)	Influent		19.2	18.9	18.7	18.5			18.8
Ammonia	Influent		8.6	7.2	6.4	7.2			7.4
Total Chlorine	Effluent		16	11	15	18			15

(a) Site Problem

Notes :

(b) Malfunction of system under test

(c) Sample/reading not taken

(d) Lab Error

(e) Other

NSF/ANSI Standard 46 - Chlorine Disinfection Device

Week Beginning 11/1/2015

Site Code: NWE010415

Weeks Into Test: 5

Day and Date		Sunday 11/1	Monday 11/2	Tuesday 11/3	Wednesday 11/4	Thursday 11/5	Friday 11/6	Saturday 11/7	Week's Average
Dosed Volume (Gallons)		198	198	380	380	380	380	380	328
CBOD ₅ (mg/L)	Influent			15					15
Total Suspended Solids (mg/L)	Influent			19.0					19.0
Fecal Coliform (cfu/100 mL)	Influent			24,500					24,500
	Effluent			2					2
pH	Influent			7.5					7.5
Temperature (°C)	Influent			19.0					19.0
Ammonia	Influent			2.7					2.7
Total Chlorine	Effluent			8					8

(a) Site Problem

Notes : 11/3/2015 - Begin Chlorination Test

(b) Malfunction of system under test

(c) Sample/reading not taken

(d) Lab Error

(e) Other

NSF/ANSI Standard 46 - Chlorine Disinfection Device
Chlorination Test (11.6.3)

Date 11/3/2016

Site Code NWE010415

Influent Water

Requirement		Analysis Result			
CBOD ₅	≤ 25 mg/L	CBOD ₅	15 mg/L	Within Range	
TSS	≤ 30 mg/L	TSS	19 mg/L	Within Range	
pH	6.0 - 9.0	pH	7.5 S.U.	Within Range	
Temperature	6° - 30° C	Temperature	19 ° C	Within Range	
Ammonia	≥ 2.0 - ≤ 4.0 mg/L	Ammonia	2.7 mg/L	Within Range	
Fecal Coliform	10,000 - 1,000,000 cfu/100 mL	Fecal Coliform	12,500 cfu/100 mL	Flow	Time
			20,000 cfu/100 mL	200 GPD	8:39
			31,500 cfu/100 mL	200 GPD	9:21
			34,000 cfu/100 mL	600 GPD	11:47
				600 GPD	12:29
		Average	24,500 cfu/100 mL	Within Range	
		Geometric Mean	22,750 cfu/100 mL	Within Range	

Effluent

Requirement		Analysis Result			
Fecal Coliform	≤ 200 cfu/100 mL	Fecal Coliform	4 cfu/100 mL	Flow	Time
			1 cfu/100 mL	200 GPD	8:40
			1 cfu/100 mL	200 GPD	8:50
			1 cfu/100 mL	200 GPD	9:00
			8 cfu/100 mL	200 GPD	9:10
			8 cfu/100 mL	200 GPD	9:20
			1 cfu/100 mL	600 GPD	0.42 gpm
			1 cfu/100 mL	600 GPD	0.33 gpm
			1 cfu/100 mL	600 GPD	0.47 gpm
			1 cfu/100 mL	600 GPD	0.42 gpm
			1 cfu/100 mL	600 GPD	0.40 gpm
			4 cfu/100 mL	600 GPD	0.72 gpm
Fecal Coliform	≤ 200 cfu/100 mL	Geometric Mean	2.0 cfu/100 mL	11:48	0.72 gpm
				11:58	0.72 gpm
Total Chlorine	No Requirement	Total Chlorine	2 mg/L	12:08	0.76 gpm
			14 mg/L	12:18	0.81 gpm
				12:28	0.83 gpm

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APPENDIX C

OWNER'S MANUAL



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norweco®

SINGULAIR® BIO-KINETIC®

WASTEWATER TREATMENT SYSTEM WITH SERVICE PRO® CONTROL CENTER

MODELS 960 AND TNT® OWNER'S MANUAL

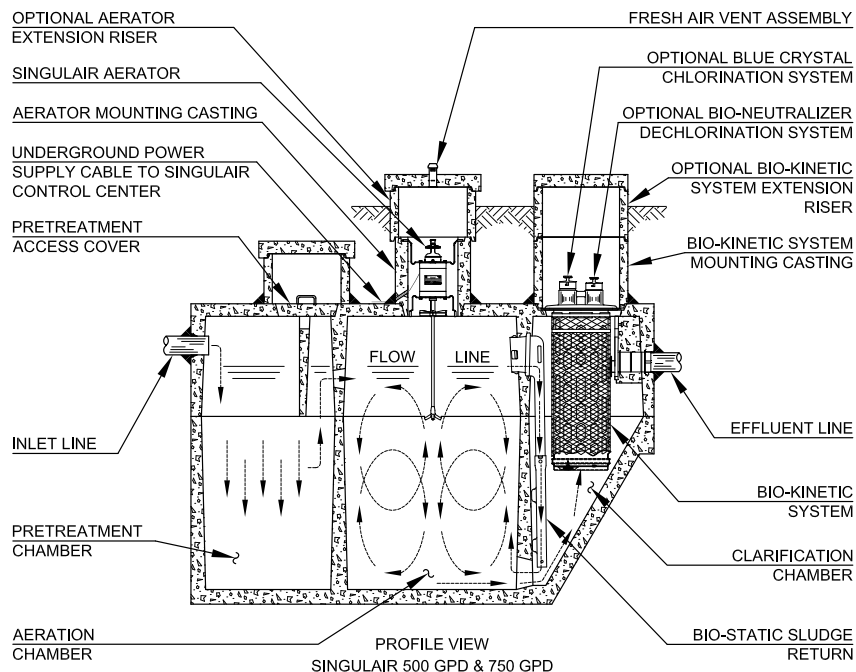
INTRODUCTION

The Singulair system is the finest equipment available and utilizes the most up-to-date wastewater treatment technology. It is a sound investment that protects you and the environment. Please take the time to familiarize yourself with the contents of this manual.

HOW THE SINGULAIR® SYSTEM WORKS

Developed to serve homes and small businesses beyond the reach of city sewers, the Singulair system employs the extended aeration process. Similar to the treatment method used by most municipal wastewater treatment facilities, this process involves a natural, biological breakdown of the organic matter in wastewater.

Wastewater enters the pretreatment chamber where anaerobic bacterial action combines with the effects of gravity to precondition the waste before it flows into the aeration chamber. Once in the aeration chamber, aerobic bacteria utilize the organic matter in the wastewater to biologically convert the waste into stable substances. Following aeration, flow is transferred to the clarification chamber where the effects of gravity settle out biologically active material. The Bio-Static sludge return, located in the clarification chamber, creates hydraulic currents that gently transfer settled particles back to the aeration chamber. As clarified liquids pass through the Bio-Kinetic system, they are filtered, settled and flow equalized. As a result, complete pretreatment, aeration, clarification and final filtration are assured. The Singulair system reliably protects you, your property and the environment.



FEATURES AND ADVANTAGES

Singulair tanks are reinforced precast concrete, manufactured by the licensed Norweco distributor. Internal walls and baffles are cast-in-place to insure uniformity and maximum strength. Risers and access covers are either heavy duty plastic or concrete construction. All components within the system that will contact the wastewater are constructed entirely of molded plastic, stainless steel or rubber.

The Singulair aerator is powered by a 1725 RPM, 115 volt, 60 hertz, single-phase, fractional horsepower motor. It is the only electrically powered component in the Singulair system. The aerator has been designed specifically for use in the Singulair system. It costs less to operate and consumes fewer kilowatt hours of electricity than most major appliances.

Singulair aerators are supplied with a Service Pro control center with MCD technology. The NEMA rated control center contains a power switch and time clock that control aerator operation. The local distributor's name, address and telephone number are displayed on the control center cover.

All system controls and necessary owner information are conveniently located at your fingertips.

Non-mechanical flow equalization and final filtration is accomplished within the Singulair tank by the Bio-Kinetic system. This revolutionary device is installed in the clarification chamber and connected to the system outlet. Optional chlorination and dechlorination may be included in the Bio-Kinetic system if required. All Singulair components work together to assure complete pretreatment, aeration, clarification and final filtration.

SINGULAIR® SYSTEM PERFORMANCE

Rivalling the performance of the most advanced wastewater treatment plants in the world, the Singulair system complies with USEPA wastewater treatment guidelines for secondary treatment systems and meets all requirements of NSF/ANSI Standard 40. In ecologically sensitive areas, the most stringent effluent standards are 10 mg/L CBOD and 10 mg/L TSS. Rated Class I after successfully completing the 7 month Standard 40 test protocol, the Model 960 system averaged effluent of 6 mg/L CBOD and 10 mg/L TSS. The Model TNT system averaged effluent of 4 mg/L CBOD, 9 mg/L TSS and 12 mg/L Total Nitrogen and met all requirements of NSF/ANSI Standard 245.

OPERATIONAL REQUIREMENTS

The Singulair system is designed to treat only domestic wastewater. Domestic wastewater is defined as the waste generated from a typical residence. This includes flows originating from: bathtubs, clothes washers, dishwashers, drinking fountains, water coolers, food grinders, kitchen sinks, lavatories, mop basins, service sinks, shower stalls, sinks, wash sinks, water closets and whirlpool baths. While the use of bio-degradable detergents is recommended, the Singulair system has been designed to handle any reasonable amount of bathroom, kitchen or laundry waste. However, some care should be exercised to insure that non-biodegradable and/or toxic materials are not disposed of via the domestic wastewater plumbing. Do not use the plumbing system for disposal of lint, cooking grease, scouring pads, diapers, sanitary napkins, cotton balls, cotton swabs, cleaning rags, dental floss, strings, cigarette filters, rubber or plastic products, paints and thinning agents, gasoline, motor oil, drain cleaners or other harsh chemicals. These items could plug portions of the plumbing and/or adversely affect system performance. Never connect roofing down spouts, footer drains, sump pump piping, garage and basement floor drains or water softener backwash to the domestic wastewater plumbing or the treatment system. Water softener backwash will interfere with biological treatment and must be disposed of separately.

ELECTRICAL REQUIREMENTS

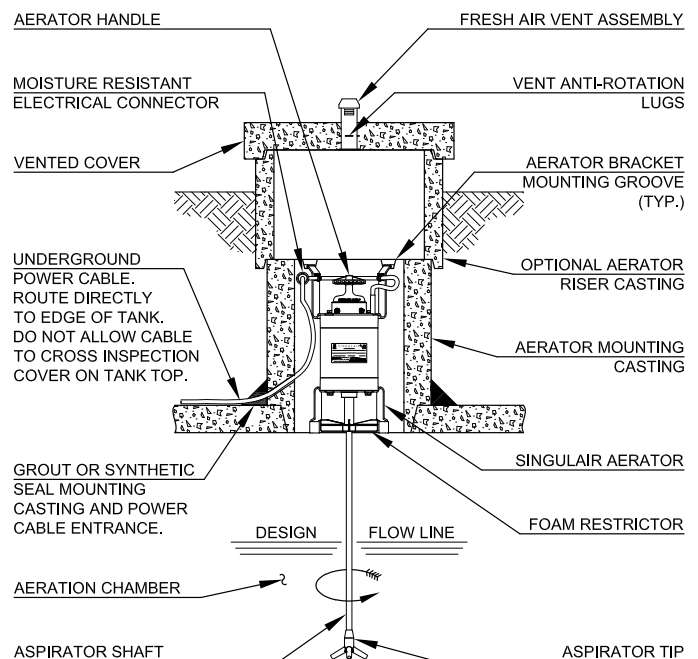
Each Singulair control center must be wired to a dedicated 115 VAC, single-phase circuit at the main electrical service panel. A 15 amp circuit is recommended (10 amp minimum). A pictorial wiring diagram is provided inside the control center enclosure. All electrical work must be performed in accordance with the requirements of the National Electrical Code and all applicable local codes. Electrical connections should be made only by a qualified electrician following proper procedures and using safe tools.

CAUTION: Any time service is required, first shut off the dedicated circuit breaker in the main electrical service panel. Next, shut off the power switch in the Singulair control center. Failure to do so could result in personal injury or equipment damage.

SINGULAIR® AERATOR

The aerator has been specifically designed for use in the Singulair system and includes special alloy and molded plastic parts to prolong aerator life. Aerator bearings are pre-lubricated and sealed. Singulair aerators are installed in a concrete mounting casting above the aeration chamber. Fresh air enters the aerator through four intake ports located under the aerator handle. The air is drawn down the hollow aspirator shaft where it is introduced below the liquid surface. Only the molded plastic aspirator and the lower portion of the stainless steel aspirator shaft are submerged.

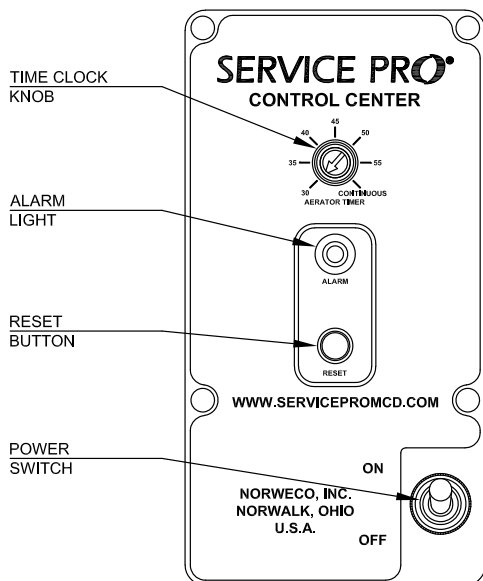
The aerator is not designed to run under water and will automatically shut off if a high water condition occurs. If the liquid rises to the level of the foam restrictor, the control center will shut off power to the aerator. Next, an automatic diagnostic sequence begins, as outlined in the section titled "Service Pro Control Center".



Each Singulair aerator is a precision engineered electro-mechanical device. Do not remove it from its installed position. Do not attempt any type of repair. Contact your Singulair service provider if service is needed. Unauthorized tampering or repair will void important provisions of the limited warranty and exchange program.

FRESH AIR VENTING SYSTEM

An aerator vent assembly is cast into the concrete access cover above each aerator. The vent assembly supplies fresh air to the aerator, which is drawn through the aspirator and into the wastewater. Finished landscaping should be maintained six inches below the top of the vented access cover and graded to drain runoff away from the cover. Do not allow plants, shrubbery, mulch or landscaping of any type to restrict the flow of air to the vent assembly or obstruct the access cover.



NOTE
TIME CLOCK
IS FACTORY
PRESET TO
RUN 30 MIN
PER HOUR

SERVICE PRO® CONTROL CENTER

Prewired controls are supplied in a sealed NEMA rated enclosure for your safety and the protection of components and wiring. The controls should be located so the alarm light can be seen and the audible alarm heard, while minimizing exposure to harsh weather or conditions that might prevent routine access. If an issue with the aerator is detected, the red alarm light will flash and the control center will attempt to restart the aerator every five minutes for two hours. For an open motor or under current condition, the alarm light will display two short flashes followed by a pause. For an over current condition, the alarm light will flash evenly. If the aerator does not restart after two hours, the audible alarm will sound. To silence the audible alarm and attempt to restart the aerator, push the reset button. If the alarm condition is not resolved, the audible alarm will be silenced for 48 hours, but the alarm light will continue to flash. In this case, contact your service provider. Model 960 systems are supplied with a time clock adjustable in five minute increments up to continuous run. This clock is factory preset to run 30 minutes per hour and should only be adjusted by an authorized Singulair service provider. Model TNT systems are supplied with a non-adjustable time clock.

SERVICE PRO® MONITORING CENTER

An optional Service Pro MCD control center is available for use with the Singulair system. Designed to connect to a standard telephone line or internet connection, this control center provides MONITORING, COMPLIANCE and DIAGNOSTIC functions complete with telemetry for communication with the Service Pro monitoring center. Once your Service Pro MCD control center is connected to a telephone line or internet connection, commissioned, and covered by a remote monitoring agreement, your service provider will be immediately notified of any alarm condition. The Service Pro monitoring center will automatically log the time and date of alarm conditions, as well as service performed, and store them in your system history record for viewing at www.servicepromcd.com.

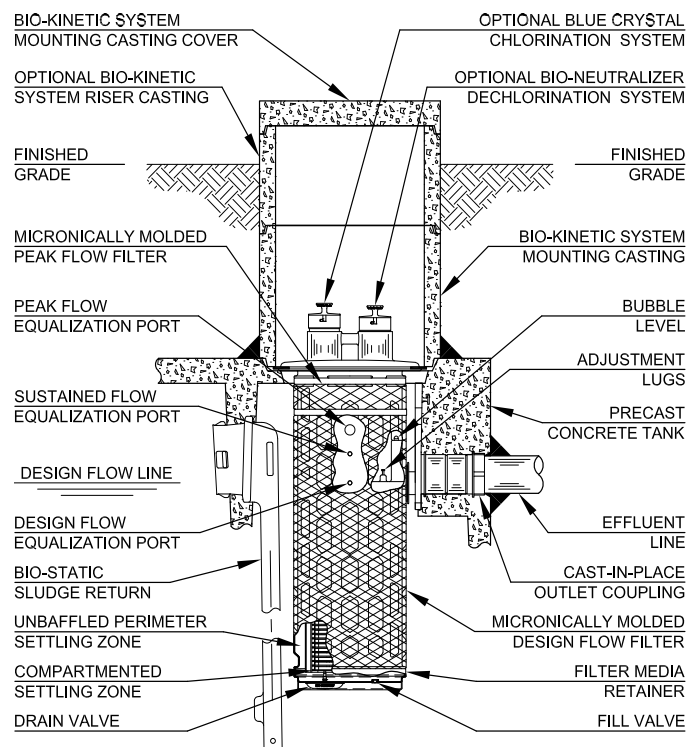
NOTE: The control center regularly communicates with the Service Pro monitoring center using your telephone line or an internet connection. If the control center is using the telephone line when you attempt to place a call, a high pitched digital communication signal will be heard. Hang up all telephones sharing the line and wait a few seconds. This will automatically disconnect the control center and make the line available for use.

BIO-STATIC® SLUDGE RETURN

Each Bio-Static sludge return is installed in the aeration/clarification chamber wall. Aeration chamber hydraulic currents enter the sludge return(s) and transfer solids from the clarification chamber back to the aeration chamber for additional treatment. The Bio-Static sludge return accomplishes resuspension and return of settled solids without disturbing the contents of the clarification chamber.

BIO-KINETIC® SYSTEM

Bio-Kinetic systems provide non-mechanical flow equalization through all plant processes. The Bio-Kinetic system contains 3 separate filtration zones, 8 independent settling zones, optional chlorination and dechlorination tablet feed systems and serves as its own chlorine contact chamber. When used with Blue Crystal disinfecting tablets, the performance of the Bio-Kinetic system as a chlorination device is certified to NSF/ANSI Standard 46, Section 11. All components are manufactured from plastic or rubber. Your service provider has the necessary training, tools and equipment for removal and cleaning. If your Bio-Kinetic system is in need of service, contact your service provider. During each semi-annual service inspection, your service provider will remove and clean the Bio-Kinetic system or replace it with a unit from their service stock.



NON-MECHANICAL FLOW EQUALIZATION

The patented design of the Bio-Kinetic system provides non-mechanical flow equalization for the Singulair wastewater treatment plant. Equalization reduces incoming hydraulic surges (e.g. typical shower of 10 minutes duration, bathtub discharge of 5 minutes duration, clothes washer discharge of 2 minutes duration and dishwasher discharge of 2 minutes duration) throughout the system. The flow equalization provided by the Bio-Kinetic system causes wastewater to be held upstream of the final outlet during hydraulic surges, which preserves treatment integrity and enhances system operation. The actual rate of equalization varies and depends upon specific loading patterns and the duration of each flow surge. At the design loading pattern used during the NSF/ANSI Standard 40 performance evaluation, the Singulair system equalizes all flow an average of 48%. As a result, hydraulic surges and periods of high wastewater flow are automatically reduced to protect the environment and all treatment plant processes on a demand use, as needed, basis.

BLUE CRYSTAL® RESIDENTIAL DISINFECTING TABLETS

If local regulations require, an initial supply of Blue Crystal disinfecting tablets will be placed in the Bio-Kinetic system chlorine feed tube(s) at system start-up. Specifically formulated for use in the Singulair system, Blue Crystal disinfecting tablets provide efficient and reliable disinfection when effluent chlorination is desirable. Manufactured from calcium hypochlorite, Blue Crystal disinfecting tablets provide effective, economical bacteria killing power. Liquid entering the Bio-Kinetic system contacts the installed Blue Crystal disinfecting tablets, just downstream of the equalization ports. A fully charged feed tube will last an average of six months. During each semi-annual inspection, your Singulair service provider will check system operation, the rate of tablet consumption and install tablets during routine service inspections.

NOTE: USEPA guidelines state “On the average, satisfactory disinfection of secondary wastewater effluent can be obtained when the chlorine residual is 0.5 ppm after 15 minutes contact.” Retention time must comply with the controlling regulatory jurisdiction.

CAUTION: *The improper handling of Blue Crystal tablets may cause personal injury or property damage. Keep out of the reach of children and do not allow the tablets or feed tube to contact skin, eyes, or clothing. Tablets may be fatal if swallowed and tablet dust is irritating to the eyes, nose and throat. Do not handle the tablets or feed tubes without first carefully reading the product container label, MSDS information and the handling and storage instructions. Mixing of chemicals may cause a violent reaction leading to fire or explosion. For additional information about Blue Crystal tablets contact your Singulair service provider.*

BIO-NEUTRALIZER® DECHLORINATION TABLETS

In environmentally sensitive areas, environmental regulations may require the use of Bio-Neutralizer dechlorination tablets. Manufactured as an efficient and dependable means to chemically neutralize both free and combined chlorine, Bio-Neutralizer dechlorination tablets provide consistent reduction or elimination of chlorine residual without unnecessarily reducing the level of dissolved oxygen in the treatment system effluent. Bio-Neutralizer dechlorination tablets utilize a unique chemical mixture for chlorine reduction and environmental protection. As liquid passes through the final discharge zone of the Bio-Kinetic system, the flow contacts the installed Bio-Neutralizer tablets and residual chlorine is removed from the system effluent. A fully charged Bio-Neutralizer feed tube will last an average of six months. During each semi-annual inspection, your Singulair service provider will check system operation, the rate of tablet consumption and install tablets during routine service inspections.

CAUTION: *Bio-Neutralizer tablets or feed tubes should not be mixed with Blue Crystal tablets. Do not handle the tablets or feed tubes without first carefully reading the product container label, MSDS information and the handling and storage instructions. For additional information about Bio-Neutralizer tablets contact your Singulair service provider.*

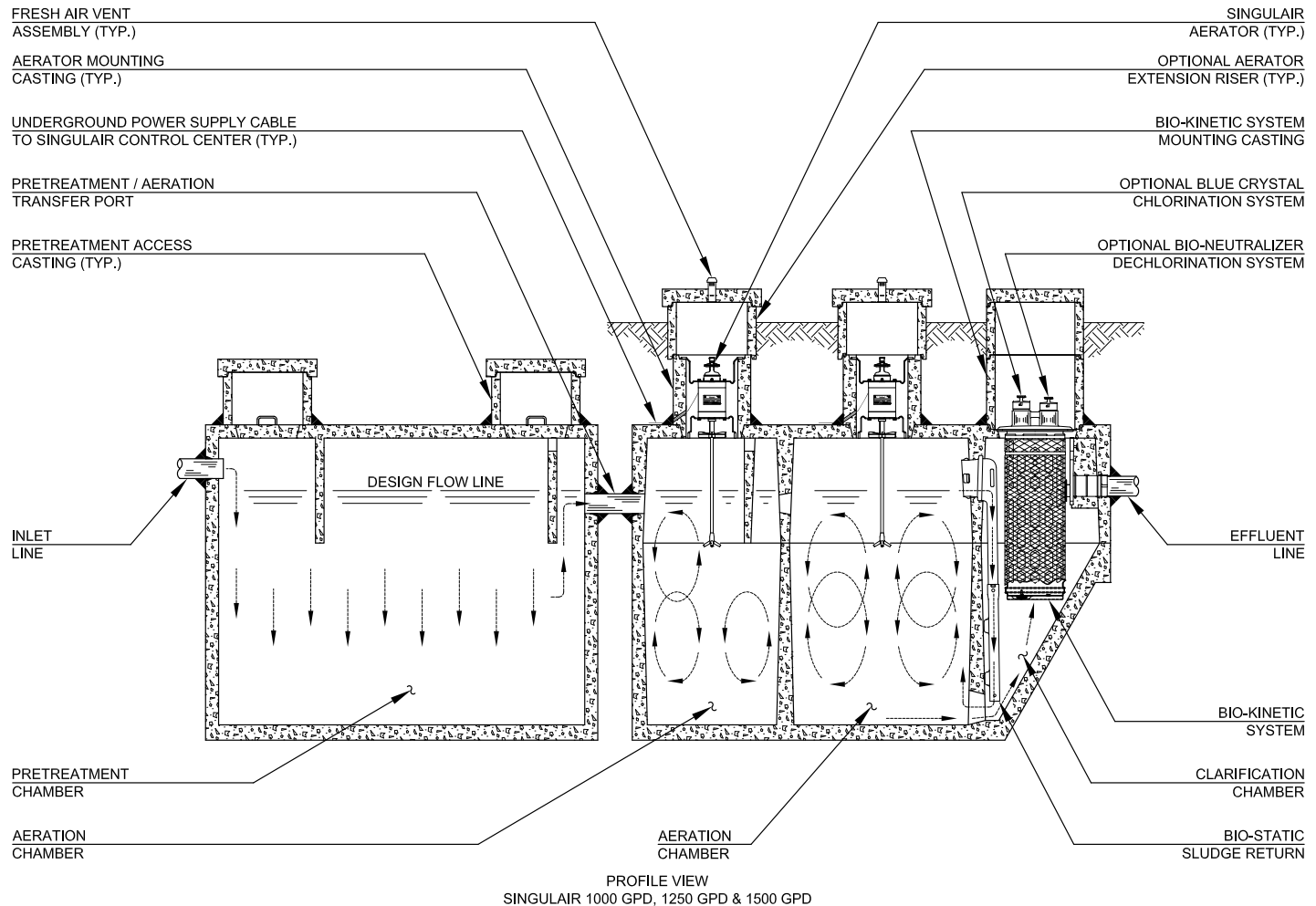
NO OWNER MAINTENANCE

The Singulair system is inspected and serviced by a local, factory-trained service provider, therefore, no owner maintenance is required during the warranty period. The Singulair system does not require pumping as often as a septic tank. Under normal use only the pretreatment chamber should be pumped. How often pumping is necessary depends on system use. The local Singulair service provider will inspect the aeration chamber contents and plant effluent at six month intervals to determine if the pretreatment chamber is discharging excessive solids. Every three years, the pretreatment chamber should be inspected. The pretreatment chamber will normally require pumping at three to five year intervals. Contact your local service provider prior to tank pumping for complete information on removal of equipment, access to individual chambers, coordination of services and proper disposal of tank contents. A tank pumping service licensed by the local regulatory agency must be used for removal and disposal of tank contents. The tank pumper should consult with local authorities to determine the proper disposal method.

If a period of intermittent use, or an extended period of non-use of the Singulair system is anticipated, contact your Singulair service provider for instructions. Your service provider has comprehensive Singulair service instructions and has been factory-trained in troubleshooting procedures. Contact your service provider if you require service or information regarding tank pumping.

SINGULAIR® SERVICE PROGRAM

Semi-annual service inspections, at six month intervals for the first two years of system operation, are provided by your local Norweco distributor and are included in the original purchase price of the Singulair system. Costs for travel and labor are not charged to the owner. During an inspection, each mechanical aerator, Bio-Kinetic system and other plant components are serviced as outlined in the Singulair Product Manual. After the initial two year service program is completed, the local service provider will provide continued service at the owner's option. The service program should be renewed by the owner to insure maximum system performance.



Ask your Singulair service provider about a renewable service contract. If you allow service coverage to expire, you can still obtain the professional assistance of a factory-trained technician. However, these special service calls will be performed on a time and materials basis. Professional service is important to proper system operation and should not be allowed to lapse. Be sure to consider the advantages of a renewable service contract.

The Singulair service provider will perform the following services during each service inspection:

- | | |
|--|--|
| ✓ Check aerator operation | ✓ Inspect outlet coupling |
| ✓ Check aerator power consumption | ✓ Install a clean Bio-Kinetic system |
| ✓ Check aerator air delivery | ✓ Fill Blue Crystal feed tube |
| ✓ Clean stainless steel aspirator shaft | ✓ Fill Bio-Neutralizer feed tube |
| ✓ Clean aspirator tip | ✓ Inspect effluent quality |
| ✓ Clean fresh air vent in concrete cover | ✓ Inspect outlet line |
| ✓ Inspect aeration chamber contents | ✓ Inspect ground water relief point |
| ✓ Check operation of control center | ✓ Inspect effluent disposal system |
| ✓ Adjust time clock when required | ✓ Complete 3-part service record |
| ✓ Remove the Bio-Kinetic system | ✓ Hang owner's record on front door |
| ✓ Scrape the clarification chamber | ✓ Enter record into www.servicepromcd.com |
| ✓ Inspect the Bio-Static sludge return | ✓ Mail health department notification |

WARRANTY REGISTRATION

A Warranty Registration Card was included with the Model 206C aerator before it was shipped from the factory. If this card has not been returned to Norweco, complete and mail it immediately. If it is not returned within thirty days of the installation date, the three year limited warranty and lifetime aerator exchange program will begin on the date of component shipment from the factory.

Remove the aerator model number and serial number record card and store it in a safe location with this Owner's Manual for future reference. If it is necessary to call your service provider for service, make note of the information on the control center data plate and the aerator serial number before calling. Warranty and service records are cross-indexed by owner name, aerator serial number or control center serial number. Supplying the aerator serial number and control center serial number with the service request will give the service provider a ready reference so that changes in system ownership will not delay service.

SINGULAIR® LIMITED WARRANTY

The Singulair aerator enjoys the distinction of being the only aerator on the market today backed by a lifetime warranty and exchange program. Each Singulair aerator, Service Pro control center, Bio-Kinetic system and any other components manufactured by Norweco, are warranted to be free from defects in material and workmanship, under normal use and service, for a period of three years from the date of purchase. The three year limited warranty is included in the original purchase price of every Singulair system. The comprehensive aerator exchange program offers Singulair owners a lifetime of protection. Owners with a Singulair system may exchange any aerator of any age for a replacement unit at a prorated cost. If the Singulair aerator or Service Pro control center fails, do not use or dismantle the unit. The local, licensed distributor has detailed warranty and exchange information and should be contacted for service or replacement instructions.

SERVICE PRO® SECURITY LOG IN

For your convenience, record your www.servicepromcd.com access information here:

User name:	Password:
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SUPPLEMENTAL SERVICE RECORD

For your reference, please document service performed on the following chart:

DATE	DESCRIPTION



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