A Special Insert to **AQUATICS INTERNATIONAL** 2011 Fall Edition

NSF®

AQUATICS EQUIPMENT PRIMER

Passing the Test

Understanding NSF testing and certification procedures is a sure way to make the grade when it comes to smart equipment choices and facility managment

CONTENTS

AQUATICS INTERNATIONAL CUSTOM PUBLISHING
hanley wood

EDITORIAL
GARY THILL | Editor
503.288.4402 *gthill@hanleywood.com*
LINDA G. GREEN | Copy Editor
323.801.4973 *lgreen@hanleywood.com*
KENDRA KOZEN | Senior Editor
323.801.4978 *kkozen@hanleywood.com*
JESSY GOODMAN | Products Editor
323.801.4933 *jegoodman@hanleywood.com*
MARGI MILLUNZI | Web Editor
323.801.4975 *mmillunzi@hanleywood.com*
Editorial fax 323.801.4986

SALES
GARY CARR | Sales Manager
323.801.4922 *gcarr@hanleywood.com*
STEVE SCHLANGE | Senior Account Executive
323.801.4921 *sschlange@hanleywood.com*
STEVE HONUM | Senior Account Executive
323.801.4926 *shonum@hanleywood.com*
MELISSA SKLENAR | Senior Account Executive
323.801.4927 *msklenar@hanleywood.com*
SCOTT CHRISTIE | Account Executive
512.828.4240 *schristie@hanleywood.com*
SHELLY SCHNEIDER Account Executive
323.801.4925 *sschneider@hanleywood.com*
STUART SMITH | Regional Sales Manager/U.K.-Europe
THERESA WONG | Sales & Marketing Coordinator
323.801.4929 *twong@hanleywood.com*
PAMELA SINGLETARY | Account Manager
323.801.4928 *psingletary@hanleywood.com*
Sales fax 323.801.4931

ART
DENISE BAKER, TIM BOBKO, NICK ORABOVIC | Graphic Artists

PRODUCTION
PAM FRANKHAUSER | Production Group Director
323.801.4941 *pfrankhauser@hanleywood.com*
NICOLE REYES | Assistant Production Manager
323.801.4950 *nreyes@hanleywood.com*
MEREDITH AKINS | Ad Traffic Manager
323.801.4947 *makins@hanleywood.com*
MARISSA VALENCIA, EFRAIN BARRERA | Production Artists
Production fax 323.801.4951

CIRCULATION
MARY BETH Mc COY | Directory Compilation Coordinator

PUBLISHER
DICK COLEMAN | Publisher
323.801.4903 *dcoleman@hanleywood.com*
LENA ALBITRE | Operations Manager

BUSINESS MEDIA DIVISION
ANDY REID | President, Market Intelligence/e-Media
RICK McCONNELL | President, Exhibitions
RICK STRACHAN | Group President/Residential Remodeling
RON KRAFT | Vice President, Financial Planning & Analysis
NICK CAVNAR | Vice President/Circulation & Database Development
NICK ELSENER | Vice President/Production
SHEILA HARRIS | Vice President/Marketing
ANDREAS SCHMIDT | Executive Director/eMedia
JEFF RULE | Product Director/e-Media

CORPORATE
FRANK ANTON | Chief Executive Officer
MATTHEW FLYNN | Chief Financial Officer
PAUL TOURBAF | Senior Vice President/Corporate Sales
SHAWN EDWARDS | Vice President/Finance
MIKE BENDER | Vice President/General Counsel
JOE CARROLL | Vice President, Corporate Development & Business Management
KEITH ROSENBLOOM | Controller

EDITORIAL AND ADVERTISING OFFICES:
6222 Wilshire Blvd., Suite 600, Los Angeles, CA 90048-5100

SUBSCRIPTION INQUIRIES & BACK-ISSUE ORDERS
888.269.8410 | FAX 847.291.4816 | *aqi@omeda.com*

REPRINTS: BRAD HAIRHOGER
717.505.9701, ext. 128 | *brad.hairhoger@theygsgroup.com*
ADVERTISER BILLING QUESTIONS 202.729.3522

PRIVACY OF MAILING LIST: We rent our subscriber list to reputable companies. If you do not wish to receive promotional materials from other companies, please call us, toll free, at 888.999.5631

POSTMASTER: Please send address changes to Aquatics International, P.O. Box 3413, Northbrook, IL 60065

MONITORING THE MONITORS

A look at the function of automatic controllers and water quality testing devices and how they are evaluated and tested under NSF/ANSI Standard 50

Water quality is key to an enjoyable waterpark, pool, or spa experience. NSF International has addressed the need for increased safety of swimmers and recreational water users since 1959 through research, standards development, product testing, manufacturing facility inspections, and product certification. NSF's most recent research and development of testing and evaluation criteria yielded requirements for evaluation and testing of two product types:

- Automatic Controllers (AC)
- Water Quality Test Devices (WQTD)

The requirements were developed through NSF's Joint Committee on Recreational Water Facilities. This committee is the oversight body that reviews and revises NSF/ANSI Standard 50 requirements. It is comprised of equal voting membership of three stakeholder groups:

1. Public health officials (CDC-Center for Disease Control and Prevention, state, and county public health officials),
2. Product manufacturers (makers of automatic controllers, chemical feeders, chemical generators, pumps, water quality test devices, etc), and
3. Product users (engineering and design firms, aquatic facility managers, service company staff, trade association members, etc)

ACs and WQTDs are critical to water quality maintenance and health safety. NSF Certification of AC and WQTD products to NSF/ANSI Standard 50 assures that the products meet the most stringent criteria in the industry and will perform well for the intended application, (ie pool or spa conditions).

An AC is a device that senses one or more pool/spa related water parameters. If tdetects a level outside a given range, the controller sends a signal to engage other equipment to respond to and correct the situation to return the water to the desired set-point range. Most automatic controllers are systems comprised of the following components:

1. A flow cell is the "test site", which is typically a transparent vessel with ports for installation of one or more chemical probes and inlet/outlet ports to enable a consistent flow of water through the vessel for on going sampling and monitoring.
2. A chemical probe or sensor is "the detective" used to monitor a given control parameter, such as pH, oxidation reduction potential (ORP), temperature, free chlorine, etc.
3. A controller is the "the brain" that receives the signals and data from the chemical probes or sensors, then compares the latest readings to set points, and sends output signals to activate one or more types of equipment.

Other AC components include, chemical storage tanks, chemical generators, and mechanical chemical feeding pumps. The AC system enables an action or response to help maintain water within specific ranges. The AC is commonly used to monitor and maintain temperature, pH, disinfectant level, ORP or other values.

For example, if a pH or ORP value is sensed too low compared to the preset limit, the controller can then activate equipment to add specific chemicals to the water to raise the water chemistry parameter to help the sanitizer in the water be most effective and protective of public health.

NSF's evaluation and testing of ACs includes the following:

1 Chemical resistance testing, which includes a 100-day exposure of the product to chemical challenge solutions, after the product is tested for performance.
2 Monitor display, which shows operation status and other details via a digital or analogue display, if so equipped. Display tests are performed after the chemical resistance tests.
3 Life testing, which involves operating 3 separate controller systems being tested for 110,000 actuation cycles at the manufacturers maximum rated load (ie 2 amp, etc.).
4 Performance operating conditions are assessed to determine if the controller can respond with output signals that accurately correspond with the varying input signal when tested at four increments between 0% and 100% of the operating ranges.
a ORP 650 mV to 850 mV with +/-20 mV accuracy.
b pH 6.8 to 8.2 with +/-0.2 accuracy.
c Free Chlorine (Cl)/Bromine (Br) 0-10 parts per million (ppm) as Cl2 or 0-20 ppm as Br2 with +/-10% accuracy.
d Total Cl/Br 0-10 ppm as Cl2 or 0-20 ppm as Br2 with +/-10% accuracy.
5 The controller shall meet the requirements above before and after the chemical resistance test.
6 Failure sensing and signaling devices:
a The controller shall possess a default mechanism or process capable of detecting and delivering a distinct visible signal to notify the user when the controller is not maintaining a parameter within the acceptable range for the swimming pool or spa/hot tub water as set by the user.
7 Operational protection:
a The AC shall have an automatic mechanism for preventing operation of any chemical feeder by the controller whenever water circulation at the chemical injection points is interrupted, or the manufacturer shall provide printed materials warning the user of the potential for elevated chemical concentrations and/or hazardous gas introduction into the pool or spa resulting from conditions of no flow in the recirculation system.
8 Operation and installation instructions:
a Proper installation, operation, and maintenance instructions
b Diagrams and parts list to help with identification and part orders
c Replacement probe model number or senor output signal requirements
d Maximum external load rated in volts and amps
e Caution statement warning user about public access to system
f Applicable operating ranges (such as pH, ORP min/max)
9 Data plates will be affixed to the controller and contain information such as NSF/ANSI 50 marking, equipment name, manufacturers name and address, model number, electrical requirements (volts, amps, hertz), maximum external load, serial number and date of manufacture, caution statements, replacement sensor model numbers or sensor output signal requirements

The following section provides insight into the different types of water quality testing devices (WQTD) and how they are tested and certified by NSF to NSF/ANSI Standard 50.

- Products are either electronic (probes and meters) or non-electronic (reagent strips and titration kits)
- Visual color comparators or digital display devices
- Liquid reagent kits (may be visual or electronic)
- Test strips (typically visual)
- Probes and meters (almost exclusively electronic)

NSF's evaluation and testing of WQTDs includes the following:

1 Testing of WQTD performance for pH, free chlorine, total chlorine, hardness, total alkalinity, or cyanuric acid concentration.
a Using gravimetric methods and standard methods to create challenge waters.
b Evaluation for accuracy within operating range in standard and as claimed by manufacturer

b Testing in triplicate and averaging results.
c Evaluation for repeatability by testing two products from a production lot
c Evaluation for reproducibility by testing product from two production lots
2 Testing for shelf life:
a Compare performance of a WQTD after storage against a WQTD that was not stored.

Follow duration, temperature recommendations of the manufacturer, the product is tested to verify conformity with the performance of product that has not been stored.

3 Operation and use instructions supplied by the manufacturer to product user:
a NSF testing of products is in accordance with the manufacturer's instructions. This is a critical aspect of product testing. Failure to follow instructions and good laboratory practices will invalidate testing results.
b Manufacturers must specify the WQTD components and conditioning.
c Manufacturers must specify the sample size, reagents required and volume/mass of reagents, mixing procedures, wait times, as well as method of determining test result, including any calculations and conversion factors.
d Manufacturers must specify maintenance of WQTD product/components.
e Manufacturers must specify proper storage conditions.
4 Product Marking:
a The WQTD shall have identification or marking that is permanent, easy to read, and securely attached to the product.

The identification shall contain:

- Manufacturer's name and address
- Model number or part number of the unit
- Parts list to facilitate the identification and ordering of replacement parts
- WQTD classification level (L1, L2, L3) for each parameter in accordance with NSF Testing to show lowest number or best achieved performance
- Production date of the WQTD and its components for use date, as well as shelf life once the product is opened, energized or used.

As evidenced by the detailed assessment criteria above, NSF evaluation, testing, inspection, and certification ensures the products are reble to help you manage your residential or commercial recreational water facilities. ■

SEARCH AND DEPLOY

How to use search engines to find tested and certified products that are up to code

Every aquatic facility requires proven products, they know they can rely upon. It's a wise economic decision to use quality equipment that has been tested and proven to meet the highest industry standards. Taking risks with unproven equipment leads to system failures, shutdowns, image problems, revenue loss, public health risk, or worse. That's why finding tested and certified products is so important.

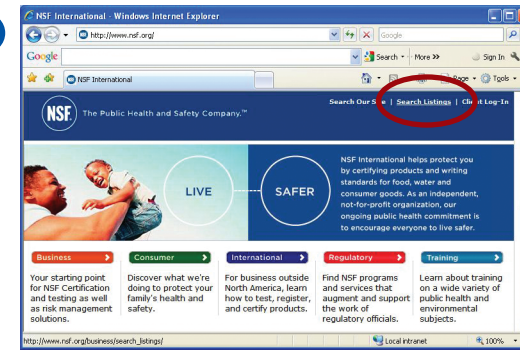
The recreational water and aquatics facility managers have various qualification requirements within their purchasing of new and replacement products and equipment. Typically these requirements derive from the need for proven/reliable products, bid specifications, building codes, public health code requirements, or engineering and design based criteria. The last two criteria may specify details such as specific performance capabilities, output, flow rates, pressures, or a particular standard (such as NSF/ANSI Standard 50, etc). Therefore, knowing where and how to search is important to prevent spending on the wrong product or wasting valuable time looking in the wrong place.

NSF International was the first company to write standards, test, and certify residential and commercial pool, spa, and waterpark equipment.

Since 1960 NSF has provided independent 3rd Party testing and certification for all pool, spa, and waterpark equipment. The NSF Mark is now synonomous with product safety and quality in the aquatics and recreational water industry. In order to help service companies, builders, designers, engineers, facility managers, and public health officials find proven products for use at recreational water facilities we will give you the keys to unlock the product search door and find what you seek. You will learn how to search for all the major product types to help you setup your facility and keep it operating at peak performance.

1 This is the NSF International homepage and a great place to find detailed easy to search "Listings" for different product types equipment, and materials that NSF International has tested, audited, and Certified to some criteria.

- Let's get started at www.nsf.org
- Look at the upper right hand portion of the screen,
- Find and select Search Listings



2 You will be taken to a page where you can select from various Product Type/ Groups, next to each are example standards tohelp you make the right selection. Scroll down the page and you will see the 2 most important choices. Depending upon your needs between pool/spa/waterpark products or common plumbing pipe and fittings, choose one:

- Recreational Water Facility Products to find pumps, filters, chemical feeders, UV, valves, skimmers, etc.
- Plumbing System Components to find common plumbing parts like PVC, CPVC, etc. pipe and fittings.

The two NSF search options above have different choices within the search engines, we will show you how to use both.

3 First we will address the pool and spa products. Select Recreational Water Facility Products and you will next see a page that enables searching by these logical criteria:

- Manufacturer
- Trade Name
- Production Location
- Product Type

The most commonly used search is PRODUCT TYPE because you can choose virtually anything from Automatic Controllers to Water Quality Test Devices.

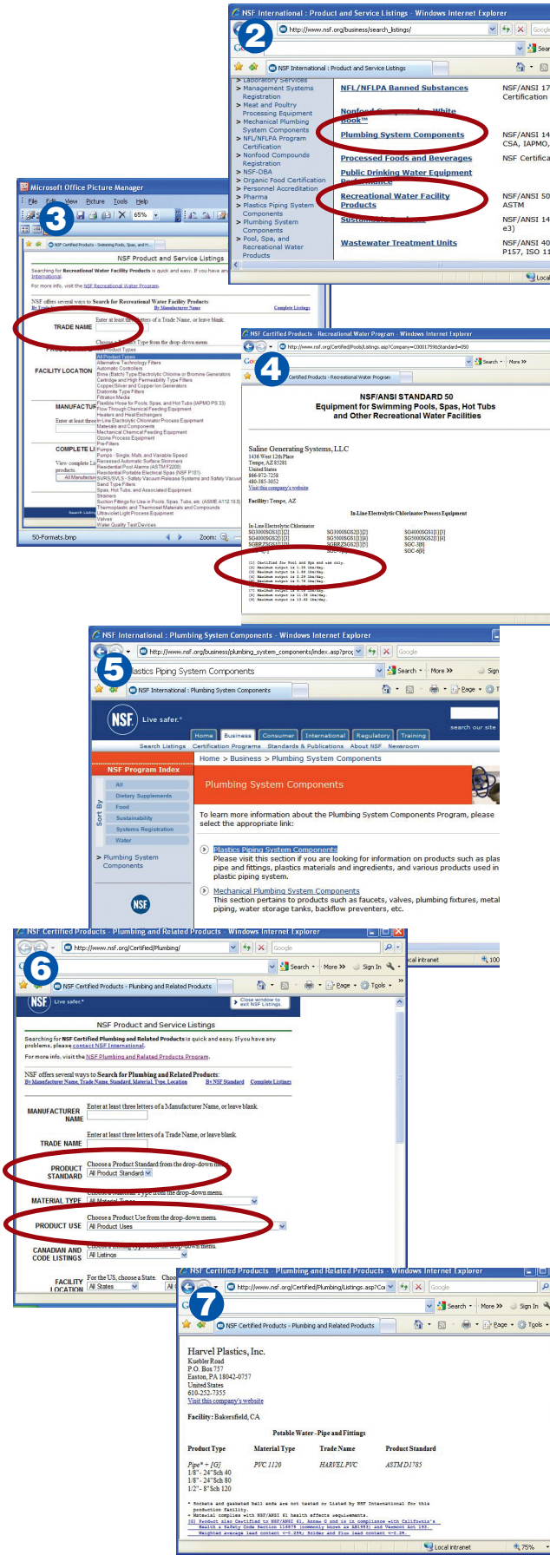
4 Here is an example NSF Standard 50 Listing for an electrolytic chlorinator. Notice the amount of chemicalproduced per day is shown in the NSF Listings. This type of information is critical to ensure you size your system properly. NSF provides this important information for service technicians, facility operators, etc. can quickly find what they need. If you have questions about the listings, products, or need more information, you can get it directly from NSF Staff. Just follow the link at the top of the web listing search page NSF recreational Water Program and follow the link to the main page, From there you can get further information or contact NSF via e-mail or phone, *pool@nsf.org* and 800-NSF-MARK.

5 Now lets address the common plumbing pipe and fittings.If you sought pipe/fittings you would have selected the Plumbing System Components search engine.This engine allows you to find specific circulation pipes or fittings like 2" SCH 40 PVC pipe with the NSF-pw Marking. The NSF-pw Marking means that NSF has tested and certified the product to NSF/ANSI Standard 14 and performed unannounced annual audits at the production location and tested the product for performance and health effects. That gives you the highest level of confidence in the product because the testing includes material physical properties of performance, testing the final pipe and fittings for dimensions crush and burst safety related performance and of course conducting chemical extraction health effects testing for use in a highly pressurized drinking water system. Building, plumbing, and health codes require the NSF-pw if not the NSF-50 marking on products for leak prevention and water conservation, short and long term performance and health safety.

6 Here is how you get to the search engine page:

- Select Plastic Piping System Components
- Then select your search categories to zero in on what you really need, for instance:
  - Product Standard - select ASTM F1785 for PVC Pipe Sch 40, 80, etc.
  - Product Use - select Potable Water - Pipe and Fittings
- Then select SEARCH at the page bottom to execute the search

7 You will be rewarded with thousands of fully tested and certified products to meet your needs. The NSF website makes it easy to find the exact products you want, from the manufacturers you know and trust. NSF tries to make your job easy, and can help you contact manufacturers for further information. Armed with this information you will always be able to locate the products you seek to equip your facility or make needed upgrades. ■



THE RIGHT PART

Using non-OEM parts in pumps and fittings can create unintended changes in how the products operate, and potentially dangerous situations. Here's how to avoid that scenario

Certain product types need service and part replacement due to poorly maintained water chemistry, excessive load, or other factors. During service it's important to use original equipment manufacturer (OEM) replacement parts and components. Use of non-OEM parts or parts not specifically intended and certified for a product can create unintended changes to a product and its performance. Since 2008 there have been many changes to suction fitting installation piping, sumps, mounting and adapter fittings, or cover-grates. These changes can significantly impact performance of a suction fitting. This issue has received much greater attention and awareness of the potential negative impact that not following manufacturer instruction or use of non-OEM parts could create.

In the last few years there has been greater interest in making pools and spas more energy efficient. There are many ways to improve efficiency, (pool covers, better wall insulation, reduced flow rates, larger diameter piping, longer sweep elbow fittings, different chemical delivery and monitoring systems, etc.). Most efficiency improvements require changes in design or equipment, which adds initial cost. Some changes can be made as part of service and repair, but some cannot be easily made after a pool is built.

Let's consider one example of non-OEM part replacement, such as changing a pump to run at a lower rpm or use a different impeller, etc. Before considering the issue, it's helpful to know how pumps are tested and certified by NSF:

- Material health, safety, & corrosion resistance evaluation
- Physical evaluation of design, markings, user manual & instructions
- Hydrostatic pressure testing and 1.5x maximum working pressure
- Strainer, design evaluation and testing
- Motor evaluation for 10% full load voltage variation, thermal protection, marking, etc.
- Performance curve (pump curve) determination
- Self-priming test
- Pump energy efficiencey testing (per California Energy Efficiency requirements)
- Pump sound emmission testing

Use of replacement pump motors, changes to a pump impeller, or changes to connection fittings on an NSF Certified pump could yield a different pump curve, different conditions of flow, pressure and vacuum in the circulation system as well as other impacts upon pump compliance with NSF 50 requirements. Such changes may seem unimportant, but they can be very important when you consider the entire water circulation system and the impact of pump modification upon filters

DO YOU REALLY KNOW PVC?

Many pool builders and installers don't know how to differentiate between pressure piping materials and products. One of their biggestconcerns is having tough piping and making strong field joints that won't leak when assembled, backfilled, and put under a long life ofhigh chemical exposure and varying pressure conditions. Builders/installers have great faith in the performance of their PVC pipingproducts, but few people understand why these products are so reliable, and how this system is maintained. To begin, you need to understandthe marking on PVC piping products such as the rigid PVC piping. In addition it helps to know the history and infrastructure that hashelped to create such a well know, trusted and reliable product. This information will help you wisely choose your products and materials to fit the installation conditions.

What does the print strip on PVC pipe mean?

Let's decipher the marking on some rigid NSF Certified PVC Pipe, Specifically, 2" PVC rigid pipe tested and certified to NSF/ANSI

Standard 14 and ASTM D1785 for potable water end use. PVC is an acronym for the primary ingredient in the plastic compound, called poly vinyl chloride. As noted in its name, PVC contains chlorine and chlorine is a primary water disinfection and treatment chemical. PVC has a long track record of strong performance in pool and spa applications where acids, bases, sanitizers, and salts can be very aggressive and damage other material types. PVC was discovered in the mid-1800s by French and German chemists, but it wasn't used commercially until the early 20th century. Further development with additives in the 1920s yielded greater ease of processing. This set the stage for many uses of PVC in consumer and industrial product applications.

What is NSF/ANSI Standard 14 or the NSF-pw Mark?

NSF/ANSI Standard 14 was created by NSF working with plastic piping manufacturers, public health officials, and product users to create a criteria or standard that would broadly encompass the many types of plastics, pipes, and fittings used for drinking and sewer piping. The work on this project began at NSF in 1950's during the infancy of the plastics and polymer industries in the US. The work culminated in the 1964 issue of NSF Standard 14. This standard has grown and expanded to address virtually every end use of plastic piping such as reclaimed water, gas piping, fire supression piping, radiant floor heating, etc.

Today, such products are tested at NSFs world headquarters, in Ann Arbor, MI. where 600 staff perform product testing at our 125,000 square foot laboratory. The largest portion of piping products tested are for pressurized potable water use ie NSF -pw. NSF-pw pipe is the most commonly used piping for pool, spa, waterpark water treatment and circulation system plumbing. Most common plumbing products can be found under NSF/ANSI Standard 14-Plastic Piping and Components, while more specialized pool industry fittings and products are found under NSF/ANSI Standard 50-Recreational Water Products.

The marking or printing on the product contains the following details at intervals of 5 feet on the outside of the pipe:

1. Nominal size or diameter of the pipe or tubing
2. Type of plastic material ie PVC 1120, this 7 digit code means the pipe is made from Type 1, Grade 1 PVC material with a 'cell class' of 12454-B as determined in accordance with ASTM D1784, the "20" part of the PVC 1120 is a 2 digit abbreviation of the material HDS or hydrostatic design stress of 2000psi, expressed in units of 100psi. PVC 1120 is generally considered the highest or strongest grade of PVC with others such as PVC 2116, PVC 2112, PVC 2110 having lower HDS ratings.
3. Schedule (such as Sch 40-thinnest wall, Sch 80, or Sch 120-thickest wall, the thicker the wall, the greater pressure the pipe can sustain)
4. Pressure rating such as 200psi at 73F.
5. Production code which the manufacturer can use to trace the year, month, day, shift, production location, and extruder that made the pipe.
6. Product standard(s) to which it was certified such as ASTM D1785
7. Trademark of Name of product manufacturer
8. Certification Mark of the lab/certifier such as NSF-pw.

The NSF-pw marking on pressure pipe means:

- The piping materials were evaluated and tested by NSF for long term pressure strength,
- The final product (the pipe) was tested at NSF for
- Health safety testing in accordance with NSF/ANSI Standard 61 (Health Effects-Drinking Water), and
- Performance based upon dimensional, short term burst, regression, flattening, and 1000 hour pressure tests.
- NSF performs 3 or more unannounced annual factory audits at pipe production locations to ensure products continue to comply
- NSF conducts annual performance and health effects testing on piping products

The NSF Mark NSF-pw on PVC pipe is your proof that the product and its materials have been thoroughly evaluated, tested, and audited to the most stringent requirements. As you can see from the above history and details, NSF has worked with the industry to make PVC a strong and reliable choice for pool, spa, and waterpark piping.

that require a certain flow rate and pressure to operate efficiently, ozone and UV systems as well as electrolytic, mechanical, and flow through chemical feeders that also require particular flow rates to achieve rated performance. If pumps are modified, system flows could be increased or decreased in flow or pressure.

There could be damage to filtration efficacy or filter elements if the pressure were too high. If the flow/pressure were too low, there could be insufficient flow to achieve required water turnover, sufficient chemical generation, and proper filtration. Most system components have maximum flow rates and maximum working pressures so elevating flow and or pressure can negatively impact products and overall water treatment system performance in many ways. Due to many variables in pool design and bather loading quantitative assessment of each pool is best. Operating the system at too low a speed could hurt filtration, oxidation, and disinfection performance and may require more frequent water chemistry testing.

Changes to pumps and pumping systems to slow or lower flow rates may reduce levels of pressure and vacuum within the circulation system. At lower levels of pressure and vacuum certain devices may not work as effectively. Supplemental safety devices such as safety vacuum release and limiting systems: air inlets, valves, pump shut off devices, VS-SVRS pumps, or other devices may not have been designed or tested for such conditions. Therefore careful consideration should be made when servicing products. Use of non-OEM parts invalidates NSF Certification product let alone cause other serious impacts upon system performance. ■

GOOD CHEMISTRY

How chemical feeders, generation systems, flow-through feeders and chemical pumps get tested and certified in accordance with NSF/ANSI Standard 50

For the safest swimming experience your chemical generation and delivery systems need to be NSF Certified to NSF/ANSI Standard 50. For more than 50 years NSF has been evaluating, testing, and certifying chemical generation and feeding systems for pools, spas, and waterparks.

Early recreational waters were not treated as today, therefore they needed to be replaced or drained and refilled. You've heard the saying, "still waters run deep," well, still waters are stagnant and can become dangerous without proper treatment, replenishment or dilution. As contaminants accumulate, microorganisms find conditions to their liking, and propagate creating risk.

Clearly, untreated "still waters" presented risk and something needed to be done to improve health and safety. One approach was the process of draining and refilling a pool (aka make-up water). This would be risky (not as much as still waters), but let's assume it could be viable provided there were large quantities of clean water available and financial and environmental costs were not too great. It would be better than "still waters" from a health perspective. But this approach still left far too much to chance.

Ultimately, filtering contaminants and sanitizing the water was found to be the most effective way to prevent microorganism growth and protect swimmer health. In 1960, to help ensure pool and spa operators used appropriate equipment and practices, NSPI, the trade association for the pool industry requested that NSF create standards to evaluate pool and spa products such as chemical feeders and chemicals. Concurrently, NSF was approached by the American Public Health Association (APHA) and other health official and engineering groups about needs for public health protection and safety for public pools. The goal of all groups was robust and appropriate testing and certification of products based upon product end-use, inherent risks of each product, and meeting user and facility operator needs.

The industry knew such work would be contentious and it needed to be performed by a competent, fair and trustworthy third party arbiter to help resolve disagreements. NSPI didn't want manufacturers or other industry insiders such as trade association members to manage the standards writing nor conduct the testing and certification due to concerns about motives, confidentiality, and conflict of interest. They sought someone they could trust to get the job done right. NSF also had an excellent reputation with public officials.

A history of public health protection,

NSF was formed by the University of Michigan, School of Public Health in 1944 by public health officials to help manufacturers, facility managers, and public officials agree to mutually acceptable requirements for product functionality and safety in various industry segments. NSF had established a track record in the food, beverage, and restaurant industry for developing consensus, creating rigorous criteria, effectively managing a research and product testing laboratory as well as operating a product certification program. This reputation for ethical stewardship and getting results made NSF the logical choice.

Therefore the industry chose NSF as the truly independent, fully accredited, third party to write standards and make sure products were safe and would perform as needed during use. From this request NSF created NSF/ANSI Standard 50 with industry and public health official support as part of NSFs equal and balanced voting membership between three groups: Public Officials, Manufacturers, and Product Users. Due to this history, the work outlined here, and the trust in NSF, many states require the use of NSF Certified products and equipment at public use facilities to ensure the highest levels of protection for swimmers.

NSF evaluation, selection and testing

To ensure the highest levels of performance and safety NSF reviews the technical details of manufacturers' products and claims, then obtains detailed supplier information including material formulations. With this information, NSF staff evaluate all system designs to select products that would represent the most aggressive conditions or "worst case units" for testing. If the worst-case units pass all NSF evaluation and testing requirements, then other units or products may be justified for NSF Certification as well. This approach is important because it focuses upon highest risk, yielding the most cost effective way to assess a range of products for performance and protection of public health and safety.

Water safety requires maintenance of water chemistry

Water safety for swimmers is dependent upon maintenance of water chemistry. Use of NSF certified chemical generation and feeding systems enables product users to rely upon NSFs work to investigate and validate manufacturer claims so that the buyer of the product gets what is being advertised. NSF certification makes products better by forcing them to be independently evaluated and tested. Think of it like this, NSF is the acid test or litmus test for the recreational water industry. Products are put through their paces at NSF to help prevent people from having problems with products at pools and spas. As NSF Standard 50 has changed,

NSF Chemical Generator/Feeder Evaluation Criteria

NSF Recreational Water Chemical Generator and Feeder Evaluation Criteria	Flow Through Chemical Feeder Granular, Stick, Tablet	Mechanical Feed Pump Liquid/Dry Slurry Single or Adjustable Rate	In-Line Electrolytic Chlorine & Bromine System	Brine or Batch type Electrolytic Chlorine & Bromine System	Copper and or Silver Ion Generating System
Material formulation - health and safety	•	•	•	•	•
Design and construction durability	•	•	•	•	•
Corrosion resistance - dissimilar metals	•	•	•	•	•
Installation of piping diagram, valves, parts list	•	•	•	•	•
Assembly of piping systems to enable repair	•	•	•	•	•
Cleanability-access, maintenance	•	•	•	•	•
Flow meter, flow indicating device capability	•	•	•	•	•
Performance indication			•	•	•
Operational protection, automatic shut-off			•	•	•
Warning devices, alarms, alarm conditions			•	•	•
Pressure/head loss claim validation, curve			•	•	•
Chemical-resistant materials	•	•	•	•	•
Design pressure 1.5 x max operating pressure	•	•	•	•	•
Verification of chemical output mass/volume	•	•	•	•	•
Output rate adjustable 4 increments over range	•	•*	•		
Delivery/Uniformity of output, 10-20% of setting	•	•	•	•	•
Life test, 3 units for 3,000 hour, high output	•*	•	•	•	•
Tubing life test 500hr or 120% of mfr. claim		•			
Disinfection efficacy for copper/silver systems					•
Salt level ppm/output testing verification			•	•	
Testing kit accuracy for copper and silver					•
Erosion resistance slurry/dry chemical feeding		•*			
Shielding moving parts or motor requirements	•	•			
Suction lift testing		•			
Protection against overdosing instruction/drain		•			
Installation and operating instructions	•	•	•	•	•
Data plate marking requirements	•	•	•	•	•

* If applicable to product

expanded, and improved so too have the products that are Certified by NSF. Users of the products benefit from having greater choice in product types that have been proven as effective and durable. Product users can then help protect swimmers with safer water conditions.

Products and NSF Evaluation Criteria

Here is a brief overview of evaluation and test criteria, by product type, to help you understand how product testing yields better products and safer conditions for swimmers.

Flow-Through Chemical Feeders are tested with specific chemical types, brands, and sizes to achieve the NSF Certified chemical output as noted within the NSF Official Listing. During the intensive testing, the chemical type, configuration and brand must be specified. Using the wrong brand, type or size of chemicals in a feeder can result in serious risk to facility operators and swimmers. If different chemicals are mixed in a chemical feeder an explosion could occur as certain chemicals should never be combined (example if Trichlor + Cal Hypo are combined a dangerous exothermic reactions occurs generating toxic gases, heat, and a potential explosion).

NSF Listings note important restrictions to prevent harm and minimize danger,

- Follow manufacturer's instructions for the installation and operation of this equipment.
- Any modifications, including the use of chemicals other than those recommended by the manufacturer, will void the NSF Certification.

Mechanical Chemical Feed Pumps are also tested with specific chemicals to ensure performance and verify chemical resistance, pressure safety, chemical output, tubing durability, system durability, and many other factors as noted in the table. NSF tests and certifies fixed rate mechanical chemical feeding pumps for use with automatic controllers and other users. NSF also tests and certifies adjustable chemical feeding pumps.

Batch Chlorination and Bromination Systems

Electrolytic chemical generators function by using pre-cursors such as dissolved compounds or minerals in the water to create an electrical-catalyzed reaction to develop specific chemicals. A common approach is to dose sodium chloride or salt (NaCl) in pool or spa water, then apply an electrical current to a catalytic plate to 'break' the chemical bonds within the salt molecule and create hypo-chlorous acid (the highly oxidative and disinfecting form of chlorine in water).

NSF conducts extensive evaluation and testing to thoroughly assess these products (as noted in the table). The testing addresses chemical output and performance, these factors depend upon the concentration of sale in the water. You will find the chemical generation level noted in the NSF Official Listings.

Please note that as with any electrical or chemical generating device, there are inherent risks to modifying products, wiring, and not following manufacturer instructions. NSF tests products with specific components and chemicals. Use of other parts invalidates NSF Certification. Some of the risks of product manipulation or modification include:

- Electrical burn or shock from direct current, don't modify-stay out of the power supply cabinet
- Use of non-OEM cells can fail under pressure, burst and cause harm
- Use of non-OEM cell can have different pressure loss characteristics and impact flow of system
- Use of non-OEM cell or wiring configuration can damage power supply
- Use of non-OEM cell can lead to lower or higher chemical output
- Use of non-OEM cell plates materials, distances, coating thickness, etc. can result in corrosion and rapid or early failure of the cell ■

QUALITY HELP

Understanding UV and ozone and how these supplemental products are tested for efficacy and performance can help you maintain better water quality

Ozone and UV can work independently or synergistically to provide intense localized water treatment to help reduce the load on the chemical treatment systems. To better understand these complementing technologies, it helps to know their function and how they are tested and certified by NSF. With this information you will be better prepared to make decisions about facility design, treatment, and service.

Ozone and UV technologies are extremely effective at oxidation and disinfection and have been in use for more than 100 years in the water treatment industry. After some large spray-park and waterpark cryptosporidiosis outbreaks, regulations for cryptosporidium inactivation were drafted in some states. To address the need for consistency, NSF initiated development of harmonized cryptosporidium inactivation/killing requirements for drinking water and recreational water treatment systems.

What is Ozone and how does it work

Ozone is an unstable molecule of 3 oxygen atoms that quickly breaks down to O2 (oxygen). By it's very nature, ozone is a rapid and intense oxidizer of organic matter. It has powerful capacity, but a very short 'half-life'. Therefore ozone is not used as a traditional residual disinfectant, but has fast acting short half-life disinfection properties.

The ozone system consists of two basic components: an ozone generation system and an ozone management system. Ozone is a gas, which is traditionally dissolved and drawn into a side-stream of pool/spa water. The ozone system is designed to allow the ozonated water sufficient 'contact time' with the organic material, organisms, etc. in a mixing tank or engineered piping system.

The ozone generating system creates ozone gas. The ozone system dissolves the gas into the water, so no un-dissolved ozone is available to off-gas in the pool equipment room or at the pool water surface.

Typically an ozone management system utilizes an oxidation reduction potential (ORP) controller to monitor the proper ozone level in the water. The ozone is introduced after the filtration (and heater), and before the chlorine feeder. An ozone system's oxidation capacity enables properly sized systems to:

1. control the combined chlorine in water
2. increase the oxidation performance more that the residual disinfectants alone,

3. reduce the chlorine consumption while maintaining minimum residuals
4. produce a minimum 3 log (99.9 percent) kill of Cryptosporidium parvum, etc.
5. enable micro-flocculation to aid filtration and water clarity

NSF tests ozone generation system for aspects of safety and functionality including performance, effective mixing, disinfection efficacy, ozone output levels, ozone off-gassing potential, system life testing via testing 3 units for a minimum of 3,000 hours, etc.

How does UV work?

UV systems are designed to generate electromagnetic radiation or the ultra-violet light within the 200-400 nanometer wavelength range. Water is pumped through a reactor vessel where the UV light emitting lamps are separated from the pool/spa water by a protective quartz shield or sleeve. The quartz sleeve allows certain wavelengths of light to pass into the water where photo chemistry and photo oxidation may occur depending upon the wavelength of light, the energy level, the water chemistry and ultra violet light transmissivity level (UVT) and organism or material contacted.

The 200-400nm UV light range has 3 primary sub ranges of interest in water treatment, UVC-200-280nm (can be absorbed by organisms and damage genetic sequence encodings of RNA and DNA), UVB-280-315nm (infamous for links to skin burning and cancer), and UVA-315-400nm (famous for suntans). Within these ranges certain UV systems may focus a high level of output in a narrow range, or a broader distribution of energy with different energy peaks at different wavelengths.

There are different nanometer ranges of importance depending upon the contaminant or organism of concern in your treatment system. And different UV systems may consume more electrical energy or emit more photons of light energy within certain narrow or broad wavelength ranges. For most aquatic and recreational water users of UV, they are primarily interested in the ability of UV to perform 3 roles,

1. Inactivate of kill microorganisms (such as cryptosporidium)
2. Disassociate combined chlorine compounds (such as tri-chloramine or other DBPs)
3. Provide supplemental oxidation of organic matter to reduce load on the treatment system.

Essentially powerful electromagnetic radiation in the 'ultra-violet' wavelength range is used to damage inorganic and organic compounds as well as genetic material of certain organisms preventing them from replicating.

NSF evaluates, tests, and certifies that UV systems are effective at organism killing and inactivation via testing to NSF/ANSI Standard 50 requirements. NSF issued the final harmonized specific testing methods and evaluation criteria for third party testing and certification of UV systems. These requirements were added to the existing UV evaluation and testing requirements already within NSF/ANSI Standard 50. Thus the NSF Standard 50-2010 incorporated new requirements that include a more specific and repeatable derivative of the Long Term 2 Enhanced Surface Water Treatment Rules (LT2ESWTR) and United States Environmental Protection Agency Ultra Violet Disinfection Guidance Manual (USEPAUVDGM), as well as requirements from DVGW W-294 and ONORM 5873 for UV drinking water UV system evaluation criteria. The NSF 50 criteria for UV are summarized below:

- NSF 50 Section 3 Materials
- 3.2 Material formulation (health safety chemical and color extractants)
- 3.3 Corrosion resistance and other sections
- 3.4 Dissimilar metal

Modification Risks to Ozone and UV systems

UV systems

- Don't modify-stay out of the power supply cabinet-Direct Current
- Flow, know your flow to ensure the product is rated-tested for conditions under which it's used
- Replacement sensors, or UVT monitors, changes to these components could compromise detected energy, and power delivery levels and treatment.
- Replacement lamps may not generate same wavelengths nor disinfection efficacy
- Beware low-med or amalgam lamp swapping. Each lamp type and system has different power supply needs and different radiation ranges.
- Replacement sleeves/shields may block more UV, ie less effective
- Replacement sleeves may foul more easily
- Note early burn-in first hours can result in erratic power output,

Ozone systems

- Don't modify-stay out of the power supply cabinet-Direct Current
- Ozone generation systems corona discharge/UV components are critical to system performance
- Ozone destruction or off-gasing systems (vent/carbon, etc)
- Ozone mixing tank/loop is used to ensure sufficient contact time to enable oxidation and disinfection prior to breakdown of O3 or off-gassing

- 3.5 Insulating fittings:
- 3.6 Piping materials
- NSF 50 Section 4 Design and construction
- 4.1 Mechanical parts
- 4.2 Electrical components – installation and components comply with NEC/NRTL
- NSF 50 Section 11 General requirements for process equipment
- 11.3 Design pressure (pressure vessels)
- 11.4 Flow meter
- 11.5 Performance indication
- 11.6 Operation and installation instructions
- 11.7 Disinfection efficacy (minimum of 3 log kill, single pass, 5 cycles, of 2 bacteria [Pseudomonas aeruginosa & Enterococcus faecium] as tested via Annex H)
- 11.8 Valve and components identification, marking, piping diagram
- NSF 50 Section 13 Ultraviolet light process equipment
- 13.2 Operating temperature
- 13.3 Operational Protection (shielding and power cut to lamps)
- 13.4 Life Test of 3 units for at least 3,000 hours each
- 13.5 Cleaning and cleanability of the reactor/sleeves/sensor etc.:
- 13.6 Ultraviolet lamps
- 13.7 Chemically resistant materials
- 13.8 Data plate(s) marking requirements
- 13.9 Head loss or pressure loss testing
- 13.10 Hydrostatic pressure tesing requirements
- 13.11 UV Cryptosporidium parvum inactivation & dose determination

NSFs UV Crypto testing for UV systems

Crypto testing for recreational water use involves testing at NSF of a minimum 2 worst case systems within a product range (ie configuration L, U, etc, lowest power to highest flow, lamps, ballasts, etc. worst hydraulics via CFD, etc.) While NSFs testing for drinking water requires testing of each unit in a range.

- Validation of each model for a minimum 3-log of crypto inactivation performance
- Crypto inactivation testing to drinking water requirements in the USEPAUVDGM-2006 via testing to the 2010 NSF EPA ETV UV Protocol which is the harmonized testing criteria for Drinking and Recreational water uses.

Reporting of technical details about testing and system

- Model no.
- Max. Flow rate (or rates if set line approach testing is chosen)
- Achieved log reduction, (3+, 4, etc. log reduction)
- Effective dose delivered (mJ/cm2)
- Surrogate organism used for testing (MS2, T7, etc.)
- Specify required system minimum operating power level
  - Test reports contain details and data, UVT of water, etc.
- Testing may be set point, set line, or dose based
- Set line is best for dual use of Rec. and Drinking water facilities

You can find NSF Certified ozone and UV systems that comply with NSF/ANSI Standard 50 on NSF's listing Web page: *www.nsf.org/certified/pools*. For further information contact NSF International at *pools@nsf.org* or +1.734.769.8010. ■

POSTAGE-FREE CARD

For more information on advertisers and new products in this issue, circle the corresponding reader service number on the postage-free card opposite.

Advertiser	Page	Circle	Phone # / Website
Aquatherm Industries	NSF-20	1501	800.535.6307
			www.warmwater.com
ASA Manufacturing	NSF-18	1502	352.465.0236
			www.asamfg.com
BECS Technology Inc.	NSF-13	1503	314.567.0088
			www.becs.com
Delta Ultraviolet Corp.	NSF-5	1504	866.889.8765
			www.deltauv.com
Emperor Aquatics Inc.	NSF-19	1505	610.970.0440
			www.emperoraquatics-pool.com
Engineered Treatment Systems	NSF-17	1506	920.885.4628
			www.engineeredtreatmentsystems.com
Hayward Commercial Pool Products	NSF-24	1507	800.657.2287
			www.hayward-commercial-pool.com
Lawson Aquatics	NSF-3	1508	239.435.3700
			www.gratetech.com
Nemato Corp.	NSF-13	1509	800.361.5025
			www.nemato.com
Pentair Water Commercial Pool & Aquatics	NSF-2	1511	800.374.4300
			www.pentairpool.com
Saline Generating Systems	NSF-15	1512	866.972.7258 2
			www.sgschlorinators.com/www.sgsinstruments.com
Waterway Plastics	NSF-23	1513	805-981-0262
			www.waterwayplastics.com

FILTERING EFFECTS

A look at filtration technologies, filter products and filter media — along with how they are tested and certified in accordance with NSF/ANSI Standard 50.

Swimming is a critical life skill that can save your life as well as provide a lifetime of enjoyment. Filtration is an important precursor to swimming because it removes contaminants from the water, increasing the safety of the water and protecting the health swimmers. That's why its important to have filters that you know you can trust to perform well and protect health.

Since 1960, NSF has evaluated and tested filters for burst and safety performance, health effects, and contaminant removal and reduction claims. NSF tests traditional filters as well as innovative and novel product and system designs (pre-filters, drum filters, etc.) to help advance technology and improve best practices in the recreational water industry.

In the late 1950s, the pool industry trade association National Swimming Pool Institute (NSPI) requested that standards writer, testing lab, and product certifier National Sanitation Foundation (NSF) create uniform nationally acceptable standards for pool and spa equipment, chemicals, and supplies. Due to this request, NSF worked with NSPI members, manufacturers, public health officials to create true consensus standards for evaluation, testing, and certification of filters, filter media, and virtually all other pool, spa, and water-park product types. NSF took the lead and networked with the industry to create requirements for virtually all product types.

The first such standard dictated that product types to be NSF Certified were pre-coat (aka DE) filters in 1960. Since then sand/granular and cartridge filters, pre-filters, alternative filters and media have been addressed using NSF/ANSI Standard 50-Equipment for Pool, Spas, Hot-Tubs and Other Recreational Water Facilities.

Each product type must meet certain shared criteria as well as product specific criteria. Some of the common filter evaluation and testing criteria are:

- Material safety and health, (toxicology formulation review)
- Corrosion resistance (dissimilar metals, polymers, etc)
- Design and construction, (such as drains, air release, etc)
- Accessibility of the filter and cleanability of the filter media
- Burst or vacuum pressure tests (such as working pressure/burst/cyclic)
- Product performance tests (such as filtration efficacy, turbidity reduction),
- Capacity and sizing (such as flow rates and filtration area)
- Product marking and user instructions for installation and opertion

NSF's testing and certification of filters and filter media verifies that the products meet stringent performance criteria. The evaluation includes materials health, strength and design criteria as well as a series of pressure and vacuum service tests to assess the durability

and strength of the vessel. NSF is able to achieve pressures as high as 3,000 psi, and flow rates in excess of 6,000 gpm or 8.6 million gallons per day (mgd). So you can see, NSF has the infrastructure and capacity to test any filter. NSF also assesses filter hydraulics by evaluation and testing pressure loss, turbidity reduction, filter media clean ability, media longevity, media size and uniformity, filter area, particulate reduction, and total suspended solids removal as well as other criteria.

Here is a table to help public officials, facility operators, and service technicians understand how filters and filter media are evaluated, tested, and certified by NSF International as well as the different requirements as they apply to different products.

After a filter becomes Certified, NSF subsequently performs annual unannounced monitoring inspections at the product facility. NSF also conducts periodic re-testing of filters and filter media to ensure they continue to comply with NSF criteria.

Today users can easily find thousands of filters and filter media that NSF has tested and certified in accordance with NSF-50. The use of certified products assures buyers that the product will perform well for the certified application and conditions.

You can find all types of filters and filter media such as cellulose, perlite, glass, sand, and zeolite media that comply with NSF/ANSI Standard 50 on NSF's listing Web page: *www.nsf.org/certified/pools*. For further information contact NSF International at *pools@nsf.org* or +1.734.769.8010. ■

NSF Filter & Filter Media Evaluation Criteria

NSF Recreational Water Filter & Filter Media Evaluation Criteria	Pressure Sand & Granular Filter	Vacuum Sand & Granular Filter	Pressure Pre-Coat Filter	Vacuum Pre-Coat Filter	Cartridge Filter	Pre-Filter	Alternative Filter	Sand & Granular Media	Pre-Coat Media	Cartridge Media
Material formulation	•	•	•	•	•	•	•	•	•	•
Corrosion resistance	•	•	•	•	•	•	•			
Design and construction	•	•	•	•	•	•	•			
Filter tank-pressure 4:1 design	•	•	•	•	•	•*	•*			
1.5xWorking pressure	•		•		•	•*	•*			
20,000 low-high pressure	•		•		•	•*	•*			
2.0xWorking pressure	•		•		•	•*	•*			
Filter tanks (vacuum)	•	•		•		•*	•*			
1.5x water weight vacuum	•	•		•		•*	•*			
25in Hg vacuum	•	•		•		•*	•*			
Internal component deformation	•	•	•	•	•	•*	•*			
Initial head loss curve/pressure loss	•	•	•	•	•	•*	•*	•	•	•
Accessibility, drains, air release	•		•		•	•*	•*			
Filter media cleanability & head loss	•	•	•	•	•	•	•	•	•	•
Filtration area calculation	•	•	•	•	•	•	•			•
Filtration rate value	•	•	•	•	•					
Clearance, spacing, baffles, waste/screen			•	•	•					
Turbidity limits precoat operation			•	•						
Cartridge removal, alignment, & waste					•					
Upper distribution system	•	•								
Lower distribution system	•	•								
Filter media behavior/migration	•	•								
Sieve size and uniformity co-efficient	•	•						•		
Cellulose media longevity test									•*	
Turbidity reduction 70% ratio/5 turn	•	•	•	•	•	•	•	•	•	•
Particulate removal size range	•**	•**	•**	•**	•**	•	•	•**	•**	•**
Total suspended solids analysis	•**	•**	•**	•**	•**	•	•	•**	•**	•**
Installation and operating instructions	•	•	•	•	•	•	•	•	•	•
Data plate marking requirements	•	•	•	•	•	•	•	•	•	•

* If applicable to product **Optional quantitative testing