



PSI
3210 E Tropicana
Las Vegas, NV 89121
www.psiexams.com

Before paying for
your examination registration,
be sure you understand
the contents of this bulletin.
Please retain and use it as a reference
when contacting PSI.

COMMONWEALTH OF VIRGINIA DEPARTMENT OF PROFESSIONAL AND OCCUPATIONAL REGULATION

WATERWORKS OPERATOR CLASSES 1-6 EXAMINATION CANDIDATE INFORMATION BULLETIN

EFFECTIVE 12/20/14 PSI WILL NO LONGER BE ADMINISTERING THESE EXAMINATIONS. PLEASE REFER TO DPOR'S WEBSITE AT WWW.DPOR.VIRGINIA.GOV FOR UPDATED INFORMATION.

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Please refer to www.psiexams.com for the latest updates to this bulletin.

EXAMINATIONS BY PSI

This Candidate Information Bulletin provides you with information about the examination and application process for becoming licensed as a Waterworks Operator in the Commonwealth of Virginia. To be licensed, you must pass an examination to confirm that you have attained at least a minimum level of knowledge regarding the principles, practices, statutes and regulations. The Department of Professional and Occupational Regulation (DPOR) has contracted with PSI to conduct its examination program. PSI provides examinations through a network of computer examination centers in Virginia. PSI works closely with DPOR and its Examination Review Committee to be certain that examinations meet local, national and international requirements in basic principles and examination development standards.

This Candidate Information Bulletin provides you with information on how to acquire licenses for the following.

Waterworks Operator Classes 1, 2, 3, 4, 5, 6

Questions regarding applications for licensure should be directed to the:

Commonwealth of Virginia
Department of Professional and
Occupational Regulation
Board for Waterworks and Wastewater Works Operators and
Onsite Sewage System Professionals
9960 Mayland Drive, Suite 400
Richmond, VA 23233
(804) 367-8595
www.dpor.virginia.gov
email: waterwasteoper@dpor.virginia.gov

All questions regarding the scheduling of your examination should be directed to:

PSI
3210 E Tropicana
Las Vegas, NV 89121
(800) 733-9267 • Fax (702) 932-2666 • www.psiexams.com

EXAMINATION ELIGIBILITY AND APPROVAL PROCESS

In order for a candidate to become eligible to take an examination, you must submit a Virginia Waterworks Operator application to DPOR.

APPLICATION FORM. *This application can be found online at <http://www.dpor.virginia.gov>, or you may send an email request to waterwasteoper@dpor.virginia.gov or by calling (804) 367-8595.*

Upon approval of eligibility, you will be mailed a confirmation notice containing instructions for scheduling an appointment to take the examination. If you are determined to be ineligible, DPOR will notify you.

New candidates have one year from the Application approval date to pass the examination or they must reapply and meet all current requirements.

EXAMINATION STUDY MATERIALS

The following is a list of possible study materials for the Waterworks Operator examinations. The list is given to identify resources and does not constitute an endorsement by PSI or by DPOR.

NOTE: All examinations are open-book. You must bring your own references as they are not provided at the test site. **You may use any reference materials related to the content outlines.** You may use later editions of references as they become available, however, all code examination questions will be based on the edition of the code book that is listed.

Candidates may bring any references into the examination room, textbooks and training manuals, which are related to the profession and formulas included as part of a textbook or training manual. Formulas are also provided with the examination booklets. Candidates may highlight and tab textbooks and training manuals prior to entering the exam room.

Study guides that primarily provide test questions are not permitted. Sample examinations are not permitted.

The URL listed for each reference is generated from the most current searches. However placement of material on websites may be modified resulting in some discrepancies. If you are unable to find the reference under the URL listed, it is recommended that you search online via a search engine (i.e., Google).

- Standard Methods for the Examination of Water and Wastewater, 22nd Edition, American Water Works Association, 6666 W Quincy Avenue, Denver, CO 80235, (800) 926-7335
<http://www.awwa.org/store/productdetail.aspx?productid=28493774>
- Small Water System Operation and Maintenance: A Field Study Training Program, 5th Edition, Office of Water Programs, California State University, Sacramento Foundation, 6000 J Street, Sacramento, CA 95819-6025, (916) 278-6142,
<http://www.owp.csus.edu/courses/drinking-water/small-water-system-operation-and-maintenance.php>
- Virginia Administrative Code, Chapter 590 - Waterworks Regulations, 2005, Virginia Department of Professional and Occupational Regulation, Virginia Department of Health, Main Street Station, 1500 East Main Street, Richmond, VA 23219, <http://leg1.state.va.us/000/reg/TOC12005.HTM>
- Virginia Board for Waterworks and Wastewater Works Operators Regulations and Statutes, Title 54.1, Chapter 23, 2013, Virginia Department of Professional and Occupational Regulation, 9960 Maryland Drive, Ste 400, Richmond, VA 23233, (804) 367-8500,
<http://www.dpor.virginia.gov/uploadedFiles/MainSite/Content/Boards/WWWOSSP/A436-19REGS.pdf>
- Principles and Practices of Water Supply Operations: Water Treatment, 4th Edition, American Water Works Association, 6666 W Quincy Avenue, Denver, CO 80235, (800) 926-7335,
<http://www.awwa.org/store/productdetail.aspx?productid=6315>

EXAMINATION CONTENT OUTLINE

- Principles and Practices of Water Supply Operations: Water Transmission and Distribution, 4th Edition, American Water Works Association, 6666 W Quincy Avenue, Denver, CO 80235, (800) 926-7335, <http://www.awwa.org/store/productdetail.aspx?productid=6316>
- Principles and Practices of Water Supply Operations: Water Quality, 4th Edition, American Water Works Association, 6666 W Quincy Avenue, Denver, CO 80235, (800) 926-7335, <http://www.awwa.org/store/productdetail.aspx?productid=6317>
- Water Distribution System Operation and Maintenance: A Field Study Training Program, 6th Edition, Office of Water Programs, California State University, Sacramento Foundation, 6000 J Street, Sacramento, CA 95819-6025, (916) 278-6142, <http://www.owp.csus.edu/courses/drinking-water/water-distribution-system-operation-and-maintenance.php>
- Water Treatment Plant Operation: A Field Study Training Program, Volume I, 6th Edition, Office of Water Programs, California State University, Sacramento Foundation, 6000 J Street, Sacramento, CA 95819-6025, (916) 278-6142, <http://www.owp.csus.edu/courses/drinking-water/water-treatment-plant-operation-vol-i.php>
- Water Treatment Plant Operation: A Field Study Training Program, Volume II, 5th Edition, Office of Water Programs, California State University, Sacramento Foundation, 6000 J Street, Sacramento, CA 95819-6025, (916) 278-6142, <http://www.owp.csus.edu/courses/drinking-water/water-treatment-plant-operation-vol-ii.php>

Candidates may not bring handwritten notes, legal pads or notepads of any kind, and loose papers into the examination room. Handwritten notes inserted into training manuals must be removed prior to entering the examination room or they will be confiscated by the proctor. Handouts provided by the trainers and made part of the training manual are allowed.

If candidates have written notes covering the inside covers and/or any blank pages in the reference books or manuals, they must be erased, scratched through or covered prior to entering the examination room or those references will be confiscated by the proctor. If there are notes written in the margins of reference books and training manuals, they will be allowed in the examination room. It is difficult for proctors to tell whether candidates are copying questions and answers or bringing in previously written questions and answers into the exam. To have proctors examine every page of a reference or note would delay the exam administration and create a burden on both candidates and proctors. For this reason, we expect candidates to refrain from bringing in any handwritten notes on separate papers and limiting the notes in reference materials, as described above.

The following list of tabs may be used. These items may be purchased at local office supply stores.

Acceptable Tabs
Avery Swift Tabs Self-Adhesive Permanent Plastic Tabs
Redi-Tag Self-Stick Permanent Adhesive Index Tabs
Unacceptable Tabs
Post-It Index Flags
Post-It Flags

If a test question answer could differ because of conflicting information in test reference sources, a legal requirement such as a code, law or regulation overrides any other reference. If two legal requirements appear to conflict, the state-specific code, law, or regulation overrides the national one. Information from sources on the test reference list overrides information from other sources or persons.

The Examination Content Outline has been approved by the Virginia Board for Waterworks and Wastewater Works Operators and Onsite Sewage System Professionals (Board). This outline reflects the minimum knowledge required by a Waterworks Operator to perform their duties to the public in a competent and responsible manner. Changes in the examination content will be preceded by changes in the published examination content outline.

Use the outline as the basis of your study. The outline lists the topics that are on the examination and the number of items for each topic. Do not schedule your examination until you are familiar with all topics in the outline. The examination is 4 hours in length.

Exam Class						
Topic Information	1	2	3	4	5	6
Monitor, Evaluate and Adjust Treatment Processes & System	22	24	25	18	13	13
Collect Samples and Interpret Analyses	8	8	6	7	7	7
Perform Plant Process Control Laboratory Analyses	10	7	6	6	6	6
Evaluate Characteristics of Source Water	4	3	2	3	3	3
Operate Equipment	8	8	5	5	7	7
Evaluate and Maintain Equipment	8	6	7	8	10	10
Perform Security, Safety and Administrative Procedures	15	14	9	13	14	14
Total Number of Items	75	70	60	60	60	60

In order to pass the examination, you must achieve the minimum score listed below.

Exam Class	# of Items	Minimum Score Required to Pass
Class 1	75	56
Class 2	70	52
Class 3	60	45
Class 4	60	42
Class 5	60	42
Class 6	60	42

SCHEDULING PROCEDURES

EXAMINATION FEE

Examination Fee	\$80
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NOTE: EXAMINATION FEES ARE NOT REFUNDABLE OR TRANSFERABLE. THE EXAMINATION FEE IS VALID FOR ONE YEAR FROM THE DATE OF PAYMENT

INTERNET REGISTRATION

For the fastest and most convenient test scheduling process, PSI recommends that candidates register for their exams using the Internet. Candidates register online by accessing PSI's registration website at www.psiexams.com. Internet registration is available 24 hours a day.

- Log onto PSI's website and create an account. Please enter your email address and first and last name. This information must match exactly with the information PSI has on file. Be sure to **check the box next to "Check here to attempt to locate existing records for you in the system"**
- You will be asked to select the examination and enter your ID# (the same ID# that you used in filling out the application with DPOR). Your record will be found and you will now be ready to pay and schedule for the exam. Enter your zip code and a list of the testing sites closest to the zip code you entered will appear. Once you select the desired test site, available dates will appear. If you have problems contact PSI at (855) 229-9302 for help.

TELEPHONE

The second fastest method of scheduling is via the telephone with PSI's Interactive Voice Response system (IVR) during non-business hours or through live registrars during business hours. For telephone registration, you will need a valid credit card (Visa, MasterCard, American Express or Discover). Call (855) 229-9302, 24 hours a day and register using the Automated Registration System. Otherwise, PSI registrars are available Monday through Friday, between 7:30 am and 8:00 pm and Saturday, between 11:00 am and 5:00 pm, Eastern Time.

CANCELING AN EXAMINATION APPOINTMENT

You may cancel and reschedule an examination appointment without forfeiting your fee if your *cancellation notice is received 2 calendar days before the scheduled examination date*. For example, for a Monday appointment, the cancellation notice would need to be received on the previous Saturday. You may call PSI at (855) 229-9302. Please note that you may also use the automated system, using a touch-tone phone, 24 hours a day in order to cancel and reschedule your appointment.

Note: A voice mail message is not an acceptable form of cancellation. Please use the PSI Website, automated telephone system (IVR), or call PSI and speak to a Customer Service Representative.

SCHEDULING A RE-EXAMINATION

It is not possible to make a new examination appointment on the same day you have taken an examination; this is due to processing and reporting scores. A candidate who tests unsuccessfully on a Wednesday can call the next day, Thursday, and retest as soon as Friday, depending upon space availability. In order to retest, you must follow the steps for scheduling as outlined earlier.

MISSED APPOINTMENT OR LATE CANCELLATION

Your registration will be invalid, you will not be able to take the examination as scheduled, and you will forfeit your examination fee, if you:

- Do not cancel your appointment 2 calendar days before the schedule examination date;
- Do not appear for your examination appointment;
- Arrive after examination start time;
- Do not present two forms of valid ID, with one bearing your photograph.

SPECIAL EXAMINATION ARRANGEMENTS

All examination centers are equipped to provide access in accordance with the Americans with Disabilities Act (ADA) of 1990, and every reasonable accommodation will be made in meeting a candidate's needs. Applicants with disabilities must fill out the form at the end of this Candidate Information Bulletin and fax it to PSI (702) 932-2666.

EXAMINATION SITE CLOSING FOR AN EMERGENCY

In the event that severe weather or another emergency forces the closure of an examination site on a scheduled examination date, your examination will be rescheduled. PSI personnel will attempt to contact you in this situation. However, you may check the status of your examination schedule by calling (800) 733-9267. Every effort will be made to reschedule your examination at a convenient time as soon as possible. You will not be penalized. You will be rescheduled at no additional charge.

WALK-IN EXAMINATIONS

YOU MUST PRESENT A CONFIRMATION NOTICE OR A FAILING SCORE REPORT TO BE ELIGIBLE FOR A WALK-IN EXAMINATION.

You are strongly encouraged to schedule an examination. However, you may take the examination as a walk-in candidate. Walk-in examinations are available on a space-available, "first-come", "first-served" basis. Walk-in candidates will only be admitted after all scheduled candidates have been admitted. Because of seating limitations at examination centers, admission cannot be guaranteed to walk-in candidates. There is an additional fee of \$15 for walk-in candidates. This fee must be paid by money order, cashier's check, or company check at the examination center.

COMPUTER EXAMINATION CENTER LOCATIONS

FALLS CHURCH LEESBURG PIKE MCILVAINE BUILDING

6201 Leesburg Pike, Suite 404
Falls Church, VA 22044

From I-495, take new exit 47 (old exit 10) (Leesburg Pike) and proceed east past Little Falls. Leesburg becomes Broad St. Proceed on Broad St thru Falls Church. Broad St turns back into Leesburg Pike (Rte 7 East). Follow Rte 7-East signs through the Seven Corners Intersection. Building is on the corner of Leesburg Pike and Patrick Henry Drive. Turn right onto Patrick Henry Dr and right into the building parking lot, then left on the up ramp to the main parking lot. Parking and entrance to the back of the building.

TYSONS CORNER AREA

1651 Old Meadow Rd, Suite B01
McLean, VA 22102

From the Beltway take the McLean Exit (Route 123 North). Turn right on Old Meadow Road (the first traffic light). The site is the first building on the left. Use the back entrance. . Visitor parking for Tysons Corner is in the front of the building (closest to Old Meadow Road).

RICHMOND

Moorefield VI Building
620 Moorefield Park Drive
Suite 205

Richmond, VA 23236

From I-64E, take the Parham Rd exit and turn right. N Parham Rd/VA-73 S becomes VA-150 S/Chippendale Pkwy. Merge onto VA-76 S/Powhite Pkwy. Merge onto Midlothian Turnpike West. Turn left on Moorefield Park Dr.

PSI VIRGINIA BEACH

Pembroke IV Building
291 Independence Blvd, Suite 140
Virginia Beach, VA 23462

From I-264 merge onto Independence Blvd/VA-225 via Exit 17B. Proceed across Va Beach Blvd and make a left turn onto Broad Street (across from Sears). The site is located within the Pembroke Four office building.

PSI CHARLOTTESVILLE

2114 Angus Road, Suite #105-B
Charlottesville, VA 22901

*If going West on US-250, turn right onto US-29N/N Emmet St. Continue on Emmet Street and turn left on Angus Rd.
If going East on US-250, turn left onto US-29N/N Emmet St. Continue on Emmet Street and turn left on Angus Rd.*

ROANOKE AREA

Fralin and Waldron Office Park
2847 Penn Forest Blvd
Building D, Suite 200
Roanoke, VA 24018

From 81 - take 220 Exit (Downtown Roanoke). From 220 take the Franklin Road Exit (not the Franklin Bus Exit). At the stoplight make a right. Franklin Road will turn into Electric Road. Keep going straight until you come to Chaparral Dr and go left. You will see the Fralin & Waldron Bldg to your left. At the next stoplight go left.

If you are traveling from 220 take the first exit, Franklin Road. Follow directions above.

EASTERN SHORE AREA

Beaglin Park Plaza
1323 Mt. Hermon Rd., Suite 2A
Salisbury, MD 21801

The complex is south of Route 50 and west of the 13 By-pass. From Route 50, turn south on Beaglin Park Drive. Turn left at the first light, Mt Hermon Rd. Turn left into Beaglin Park Plaza.

SOUTHWESTERN AREA

Johnson City
904 Sunset Drive, Ste 7A
Johnson City, TN 37604

Take I-26 to Exit 19 (Old number 36). Go South on Highway 381 (North State of Franklin Road) approximately 2.2 miles. At the 4th light turn left (this is Sunset Drive), go approximately .7 tenths of a mile. There is a large building on the left hand side of the road. This is 904 Sunset Drive. Suite 7A is in the row of office spaces behind this building.

REPORTING TO THE EXAMINATION CENTER

On the day of the examination, you should arrive at least 30 minutes before your appointment. This extra time is for sign-in and identification and familiarizing you with the examination process. **If you arrive late, you may not be admitted to the examination center and you will forfeit your registration fee.**

REQUIRED IDENTIFICATION

You must provide 2 forms of VALID (not expired) identification. One must be a VALID form of government-issued identification (Driver's License, State ID, Passport, Military ID) which bears your signature and has your photograph. The second ID must have your signature and preprinted legal name. **All identification provided must match the legal name that you registered under to take the examination.** If the name in the PSI system does not match the name on your government-issued ID and 2nd form of ID, you will not be permitted to take the examination and the examination fee will be forfeited.

If you cannot provide the required identification, you must call (800) 733-9267 at least 3 weeks prior to your scheduled appointment to arrange a way to meet this security requirement. **Failure to provide ALL of the required identification at the time of the examination without notifying PSI is considered a missed appointment and you will not be able to take the examination at that time.**

SECURITY PROCEDURES

The following items are **not** permitted in the examination room:

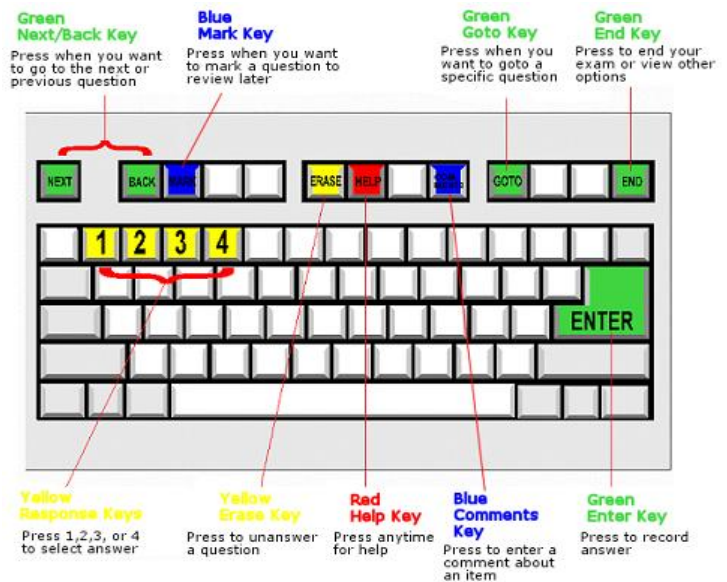
- All personal electronic devices, except those that are a medical necessity.
- Children, guests, cellular telephones, personal digital assistants (PDAs), recording devices, cameras, pagers, purses, notebooks, notebook computers, reference or reading material, music players, radios, electronic games, or briefcases.
- Personal items including watches, backpacks, pens, pencils, or other writing devices, food, drinks (unless prior approval is obtained by your regulatory entity) and good-luck items.
- Hats, baseball caps, or visors (with the exception of religious apparel), coats, shawls, hooded clothing, heavy jackets or overcoats.

The following security procedures will apply during the examination:

- Candidates may bring reference books and training manuals. Reference books may be highlighted, underlined, and/or indexed prior to the exam. Notes previously written in the margins are acceptable. Sample examinations are not allowed.
- Candidates may not bring in handwritten notes, legal pads or notepads of any kind. No loose papers are allowed. Handwritten notes inserted into training manuals must be removed.
- NO conversing or any other form of communication among candidates is permitted once you enter the examination area.
- Only non-programmable calculators that are silent, battery-operated, do not have paper tape printing capabilities, and do not have a keyboard containing the alphabet will be allowed in the examination site.
- No smoking, eating, or drinking will be allowed at the examination site.
- You may not exit the building during the examination.
- Copying or communicating examination content is a violation of PSI security policy and the State Law. Either one may result in the disqualification of examination results and may lead to legal action.

TAKING THE EXAMINATION BY COMPUTER

Taking the PSI examination by computer is simple. You do not need any computer experience or typing skill. You will use fewer keys than you use on a touch-tone telephone. All response keys are colored and have prominent characters. An illustration of the special keyboard is shown here. You may also use the mouse.



IDENTIFICATION SCREEN

You will be directed to a semiprivate testing station to take the examination. When you are seated at the testing station, you will be prompted to confirm your name, identification number, and the examination for which you are registered.

TUTORIAL

Before you start your examination, an introductory tutorial to the computer and keyboard is provided on screen. The time you spend on this tutorial (up to 15 minutes) does NOT count as part of your examination time. Sample questions are included as part of the tutorial so that you may practice using the keys, answering questions, and reviewing your answers.

One question appears on the screen at a time. During the examination, minutes remaining will be displayed at the top of the screen and updated as you record your answers.

EXAMINATION

A sample question display follows. During the examination, you would press 1, 2, 3, or 4 to select your answer or press "MARK" to mark it for later review. You would then press ENTER to record your answer and move on to the next question.

The screenshot shows the examination interface with the following elements:

- Top bar: Mark, Comments, Goto, Help, End
- Question: 3 of 40
- Answered: 2
- Unanswered: 1
- Marked: 0
- View: All
- Time Left(Min): 359
- Question: 3. What do the stars on the United States of America's flag represent?
- Options: (Choose from the following options)
- 1. Presidents
- 2. Colonies
- 3. States
- 4. Wars
- Navigation: << Back, Next >>

IMPORTANT: After you have entered your responses, you will later be able to return to any question(s) and change your response, provided the examination time has not run out.

EXPERIMENTAL QUESTIONS

In addition to the number of examination questions specified in the "Examination Content Outlines", a small number (5 to 10) of "experimental" questions may be administered to candidates during the examinations. These questions will not be scored and the time taken to answer them will not count against examination time. The administration of such unscored, experimental questions is an essential step in developing future licensing examinations.

EXAMINATION REVIEW

PSI, in cooperation with DPOR, will be consistently evaluating the examinations being administered to ensure that the examinations accurately measure competency in the required knowledge areas. Comments may be entered on the computer keyboard during the examination. Your comments regarding the questions and the examinations are welcomed. Comments will be analyzed by PSI examination development staff. While PSI does not respond to individuals regarding these comments, all substantive comments are reviewed. If an error affecting examination scores is discovered as a result, which occurs very rarely, the examination scores of all affected candidates will be automatically adjusted. **This is the only review of the examination available to candidates.**

SCORE REPORTING

Your score will be given to you immediately following completion of the examination. The following summary describes the score reporting process:

- **On screen** - your score will appear immediately on the computer screen. This will happen automatically at the end of the time allowed for the examination; if you are using review features, you will be able to obtain your score immediately when you indicate that you have finished and would like to see your results.
 - If you **pass**, you will immediately receive a successful notification.
 - If you **do not pass**, you will immediately receive an unsuccessful notification on the screen along with a diagnostic report indicating your strengths and weaknesses by examination type. Registration forms for submittal to PSI to retake the examination will be available at the examination site.
- **On paper** - an official score report will be printed at the examination site.

DUPLICATE SCORE REPORTS

You may request a duplicate score report after your examination by emailing scorereport@psionline.com or by calling 800-733-9267.

LICENSURE INSTRUCTIONS

After completing the examination, PSI shall transmit scores automatically to the Board at DPOR. Applicants who successfully pass the examination will receive their license in the mail from DPOR, with no additional action typically required on the part of the applicant. Applicants who fail to pass the exam may choose to re-take the exam by re-scheduling with PSI and submitting a new exam fee to PSI.

Questions regarding applications for licensure or how to obtain a Waterworks Operator license should be directed to the:

Commonwealth of Virginia
Department of Professional and
Occupational Regulation
Board for Waterworks and Wastewater Works Operators and
Onsite Sewage System Professionals
PO Box 26792
Richmond, VA 23261
(804) 367-8595
www.dpor.virginia.gov

Virginia Need-to-Know Criteria for Waterworks Operator

Core Competencies for Virginia Waterworks Operator

Monitor, Evaluate and Adjust Treatment Processes & System	Class					
	6	5	4	3	2	1
Source Water Treatment						
Algae control						X
Pretreatment					X	X
Chemical Treatment/Addition						
Chloramines				X	X	X
Chlorine dioxide disinfection				X	X	X
Chlorine disinfection	X	X	X	X	X	X
Corrosion control			X	X	X	X
Fluoridation				X	X	X
Ozone disinfection						X
pH adjustment				X	X	X
Coagulation and Flocculation						
Chemical coagulants				X	X	X
Flocculation tanks				X	X	X
Rapid mix units				X	X	X
Clarification/Sedimentation						
Dissolved air flotation				X	X	X
Inclined-plate sedimentation				X	X	X
Sedimentation basins				X	X	X
Tube sedimentation				X	X	X
Up-flow solids-contact clarification				X	X	X
Filtration						
Calcite filters	X	X	X	X	X	X
Cartridge filters					X	X
Diatomaceous earth filters				X	X	X
Direct filtration				X	X	X
Gravity/rapid sand filtration				X	X	X
Membrane filtration (RO, MF, UF, NF, ED)			X	X	X	X
Slow sand filters			X	X	X	X
Other Treatment Processes						
Activated carbon adsorption			X	X	X	X
Aeration			X	X	X	X
Backwash aids						X
Coagulation aids				X	X	X
Ion exchange softening			X	X	X	X
Iron and manganese sequestration/removal			X	X	X	X
Lime-soda ash softening				X	X	X

Core Competencies (continued)

Monitor, Evaluate and Adjust Treatment Processes (continued)	Class					
	6	5	4	3	2	1
Residuals Disposal						
Discharge to lagoons				X	X	X
Discharge to lagoons and then surface water				X	X	X
System Inspection						
Flow measurement	X	X	X	X	X	X
Leak detection	X	X	X	X	X	X
System flushing	X	X	X	X	X	X
Well inspection	X	X	X	X	X	X

Required capabilities:

- Ability to adjust chemical feed rates
- Ability to adjust flow patterns
- Ability to calculate dosage rates
- Ability to confirm chemical strength
- Ability to diagnose/troubleshoot process units
- Ability to interpret Material Safety Data Sheets
- Ability to maintain processes in normal operating condition
- Ability to measure chemical weight/volume
- Ability to monitor, evaluate and adjust process units
- Ability to perform basic math
- Ability to perform physical measurements
- Ability to perform process control calculations
- Ability to prepare chemicals
- Knowledge of application of chemicals
- Knowledge of chemical handling and storage
- Knowledge of chemical properties
- Knowledge of drinking water regulations
- Knowledge of general biology and chemistry
- Knowledge of general electrical principles
- Knowledge of hydraulic principles
- Knowledge of normal chemical range
- Knowledge of personal protective equipment
- Knowledge of physical science
- Knowledge of principles of distribution repair
- Knowledge of principles of measurement
- Knowledge of water treatment concepts and processes
- Knowledge of water treatment design parameters

Evaluate Characteristics of Source Water	Class					
	6	5	4	3	2	1
Bacteriological	X	X	X	X	X	X
Biological	X	X	X	X	X	X
Chemical	X	X	X	X	X	X
Physical	X	X	X	X	X	X

Required capabilities:

- Ability to communicate observations verbally and in writing
- Ability to discriminate between normal and abnormal conditions
- Knowledge of hydrology
- Knowledge of normal characteristics of water
- Knowledge of sanitary survey process
- Knowledge of watershed protection

Core Competencies (continued)

Collect Samples and Interpret Analyses	Class					
	6	5	4	3	2	1
Alkalinity				X	X	X
Carbon dioxide			X	X	X	X
Chlorine demand		X	X	X	X	X
Chlorine residual	X	X	X	X	X	X
Conductivity					X	X
Disinfectant by-products (THM)	X	X	X	X	X	X
Fluoride concentration				X	X	X
Hardness			X	X	X	X
Iron/manganese			X	X	X	X
Jar test				X	X	X
Lead/copper	X	X	X	X	X	X
Microbiological	X	X	X	X	X	X
Nitrate	X	X	X	X	X	X
pH	X	X	X	X	X	X
Phosphate				X	X	X
Temperature	X	X	X	X	X	X
Total organic carbon				X	X	X
Total suspended solids					X	X
Turbidity				X	X	X

Required capabilities:

- Ability to recognize abnormal analytical results
- Knowledge of basic laboratory techniques
- Knowledge of chemical handling and storage procedures
- Knowledge of drinking water regulations
- Knowledge of EPA approved analytical methods
- Knowledge of general biology, chemistry and physical science
- Knowledge of Material Safety Data Sheets
- Knowledge of normal characteristics of water
- Knowledge of principles of measurement
- Knowledge of quality control/quality assurance practices
- Knowledge of safety procedures
- Knowledge of sampling procedures

Core Competencies (continued)

Perform Process Control Laboratory Analyses	Class					
	6	5	4	3	2	1
Alkalinity				X	X	X
Chlorine demand		X	X	X	X	X
Chlorine residual	X	X	X	X	X	X
Conductivity					X	X
Disinfectant by-products					X	X
Fluoride concentration					X	X
Hardness			X	X	X	X
Iron/manganese			X	X	X	X
Jar test				X	X	X
Lead/copper				X	X	X
Nitrate					X	X
pH	X	X	X	X	X	X
Temperature			X	X	X	X
Total organic carbon				X	X	X
Turbidity			X	X	X	X

Required capabilities:

- Ability to calibrate instruments
- Ability to follow written procedures for analyses
- Ability to perform laboratory calculations
- Ability to recognize abnormal analytical results
- Knowledge of basic laboratory techniques
- Knowledge of drinking water regulations
- Knowledge of general biology, chemistry, and physical science
- Knowledge of EPA approved analytical methods
- Knowledge of laboratory equipment
- Knowledge of Material Safety Data Sheets
- Knowledge of normal characteristics of water
- Knowledge of principles of measurement
- Knowledge of proper chemical handling and storage
- Knowledge of quality control/quality assurance practices
- Knowledge of safety procedures

Core Competencies (continued)

Operate Equipment	Class					
	6	5	4	3	2	1
Blowers, compressors and pneumatics				X	X	X
Chemical feeders	X	X	X	X	X	X
Computers		X	X	X	X	X
Electronic testing equipment	X	X	X	X	X	X
Generators		X	X	X	X	X
Hydrants		X	X	X	X	X
Instrumentation	X	X	X	X	X	X
Prime movers/drives (engines and motors)	X	X	X	X	X	X
Traps and drains	X	X	X	X	X	X
Valves	X	X	X	X	X	X
Water pumps	X	X	X	X	X	X

Required capabilities:

- Ability to monitor, evaluate and adjust equipment
- Knowledge of drinking water treatment concepts
- Knowledge of function of tools
- Knowledge of general electrical and mechanical principles
- Knowledge of hydraulic and pneumatic principles
- Knowledge of regulations
- Knowledge of safety procedures
- Knowledge of start-up and shut-down procedures

Core Competencies (continued)

Evaluate and Maintain Equipment	Class					
	6	5	4	3	2	1
Evaluate operation of equipment:						
Inspect equipment for abnormal conditions	X	X	X	X	X	X
Read charts	X	X	X	X	X	X
Read meters	X	X	X	X	X	X
Read pressure gauges	X	X	X	X	X	X
Perform maintenance:						
Backflow prevention devices	X	X	X	X	X	X
Blowers, compressors and pneumatics					X	X
Chemical feeders	X	X	X	X	X	X
Electrical equipment	X	X	X	X	X	X
Fittings	X	X	X	X	X	X
Instrumentation	X	X	X	X	X	X
Mechanical equipment		X	X	X	X	X
Pipes	X	X	X	X	X	X
Prime movers/drives (engines and motors)	X	X	X	X	X	X
Treatment units	X	X	X	X	X	X
Valves	X	X	X	X	X	X
Water pumps	X	X	X	X	X	X
Water treatment filters				X	X	X

Required capabilities:

- Ability to assign work to proper trade
- Ability to calibrate equipment
- Ability to diagnose/troubleshoot equipment
- Ability to differentiate between preventive and corrective maintenance
- Ability to discriminate between normal and abnormal operating conditions
- Ability to evaluate and adjust equipment
- Ability to perform general maintenance
- Ability to record information
- Knowledge of facility operation and maintenance
- Knowledge of general electrical and mechanical principles
- Knowledge of hydraulic and pneumatic principles
- Knowledge of lubricant and fluid characteristics
- Knowledge of process control instrumentation
- Knowledge of safety regulations
- Knowledge of start-up and shut-down procedures

Core Competencies (continued)

Perform Security, Safety and Administrative Procedures	Class					
	6	5	4	3	2	1
Perform security and safety procedures related to:						
Chemical handling	X	X	X	X	X	X
Confined space entry	X	X	X	X	X	X
Electrical hazards	X	X	X	X	X	X
Facility upset	X	X	X	X	X	X
Fire safety	X	X	X	X	X	X
Lock-out/tag-out	X	X	X	X	X	X
Pathogens	X	X	X	X	X	X
Personal protective equipment	X	X	X	X	X	X
Source contamination	X	X	X	X	X	X
Spill response	X	X	X	X	X	X
Terrorism		X	X	X	X	X
Traffic control		X	X	X	X	X
Trenching and shoring		X	X	X	X	X
Perform administrative procedures, such as:						
Administer compliance, emergency preparedness and safety program	X	X	X	X	X	X
Administer facility security program	X	X	X	X	X	X
Administer quality control program	X	X	X	X	X	X
Develop operation and maintenance plan	X	X	X	X	X	X
Plan and organize work activities	X	X	X	X	X	X
Record and evaluate data	X	X	X	X	X	X
Respond to complaints	X	X	X	X	X	X
Write regulatory authority reports	X	X	X	X	X	X

Required capabilities:

- Ability to assess likelihood of disaster occurring
- Ability to communicate verbally and in writing
- Ability to conduct meetings and training programs
- Ability to coordinate emergency response with other organizations
- Ability to generate written policies and procedures
- Ability to interpret and transcribe data
- Ability to organize information and review reports
- Ability to perform basic math
- Ability to recognize unsafe work conditions/safety hazards
- Ability to select and operate safety equipment
- Ability to translate technical language into common terminology
- Knowledge of emergency plans
- Knowledge of facility operation and maintenance practices
- Knowledge of local codes, ordinances, and permits
- Knowledge of monitoring and reporting requirements
- Knowledge of potential causes and impact of facility disasters
- Knowledge of principles of finance
- Knowledge of principles of management
- Knowledge of principles of public relations
- Knowledge of procedures to protect plant security
- Knowledge of recordkeeping function and policies
- Knowledge of regulations

Virginia Waterworks Operator Examination Formula Sheet

$$\text{Alkalinity, as mg CaCO}_3\text{L} = \frac{(\text{Titrant Volume, mL}) (\text{Acid Normality}) (50,000)}{\text{Sample Volume, mL}}$$

$$\text{Amps} = \frac{\text{Volts}}{\text{Ohms}}$$

$$\text{Area of Circle} = (\pi/4) (\text{Diameter}^2) \text{ or } (\pi) (\text{Radius}^2)$$

$$\text{Area of Cone (lateral area)} = (\pi) (\text{Radius}) \sqrt{\text{Radius}^2 + \text{Height}^2}$$

$$\text{Area of Cone (total surface area)} = (\pi) (\text{Radius}) (\text{Radius} + \sqrt{\text{Radius}^2 + \text{Height}^2})$$

$$\text{Area of Cylinder (total outside surface area)} = [\text{Surface Area of End \#1}] + [\text{Surface Area of End \#2}] + [(\pi) (\text{Diameter}) (\text{Height or Depth})]$$

$$\text{Area of Rectangle} = (\text{Length}) (\text{Width})$$

$$\text{Area of a Right Triangle} = \frac{(\text{Base}) (\text{Height})}{2}$$

$$\text{Average (arithmetic mean)} = \frac{\text{Sum of All Terms}}{\text{Number of Terms}}$$

$$\text{Average (geometric mean)} = [(X_1)(X_2)(X_3)(X_4)(X_n)]^{1/n} \text{ The } n\text{th root of the product of } n \text{ numbers}$$

$$\text{Chemical Feed Pump Setting, \% Stroke} = \frac{(\text{Desired Flow}) (100\%)}{\text{Maximum Flow}}$$

$$\text{Chemical Feed Pump Setting, mL/min} = \frac{(\text{Flow, MGD}) (\text{Dose, mg/L}) (3.785 \text{ L/gal}) (1,000,000 \text{ gal/MG})}{(\text{Liquid, mg/mL}) (24 \text{ hr/day}) (60 \text{ min/hr})}$$

$$\text{Circumference of Circle} = (\pi) (\text{Diameter})$$

$$\text{Composite Sample Single Portion} = \frac{(\text{Instantaneous Flow}) (\text{Total Sample Volume})}{(\text{Number of Portions}) (\text{Average Flow})}$$

$$\text{Degrees Celsius} = (\text{Degrees Fahrenheit} - 32) (5/9) \text{ or } \frac{(^{\circ}\text{F} - 32)}{1.8}$$

$$\text{Degrees Fahrenheit} = (\text{Degrees Celsius}) (9/5) + 32 \text{ or } (\text{Degrees Celsius}) (1.8) + 32$$

$$\text{Detention Time} = \frac{\text{Volume}}{\text{Flow}}$$

$$\text{Electromotive Force (EMF), volts} = (\text{Current, amps}) (\text{Resistance, ohms}) \text{ or } E = IR$$

$$\text{Feed Rate, lbs/day} = \frac{(\text{Dosage, mg/L}) (\text{Capacity, MGD}) (8.34 \text{ lbs/gal})}{(\text{Purity, decimal percentage})}$$

$$\text{Feed Rate, gal/min (Fluoride Saturator)} = \frac{(\text{Plant capacity, gal/min}) (\text{Dosage mg/L})}{(18,000 \text{ mg/L})}$$

$$\text{Filter Backwash Rise Rate, in/min} = \frac{(\text{BackwashRate, GPM/sqft}) (12 \text{ in/ft})}{(7.48 \text{ gal/cu ft})}$$

$$\text{Filter Drop Test Velocity, ft/min} = \frac{\text{Water Drop, ft}}{\text{Time of Drop, min}}$$

$$\text{Filter Flow Rate or Backwash Rate, GPM/sq ft} = \frac{\text{Flow, GPM}}{\text{Filter Area, sq ft}}$$

$$\text{Filter Yield, lbs/hr/sq ft} = \frac{(\text{Solids Loading, lbs/day}) (\text{Recovery, \% /100\%})}{(\text{Filter operation, hr/day}) (\text{Area, sq ft})}$$

$$\text{Flow Rate, cfs} = (\text{Area, sq ft}) (\text{Velocity, ft/sec}) \text{ or } Q = AV \quad \text{where: } Q = \text{flow rate, } A = \text{area, } V = \text{velocity}$$

$$\text{Force, pounds} = (\text{pressure, psi}) (\text{Area, sq in})$$

$$\text{Gallons/Capita/Day} = \frac{\text{Volume of Water Produced, GPD}}{\text{Population}}$$

$$\text{Hardness, as mg CaCO}_3\text{/L} = \frac{(\text{Titrant Volume mL}) (1,000)}{\text{Sample Volume, mL}} \quad \text{Only when the titration factor is 1.00 of EDTA}$$

$$\text{Horsepower, Brake (bhp)} = \frac{(\text{Flow, GPM})(\text{Head, ft})}{(3,960) (\text{Decimal Pump Efficiency})}$$

$$\text{Horsepower, Motor (mhp)} = \frac{(\text{Flow, GPM})(\text{Head, ft})}{(3,960) (\text{Decimal Pump Efficiency}) (\text{Decimal Motor Efficiency})}$$

$$\text{Horsepower, Water (whp)} = \frac{(\text{Flow, GPM}) (\text{Head, ft})}{3,960}$$

$$\text{Hydraulic Loading Rate} = \frac{\text{Total Flow Applied}}{\text{Area}}$$

$$\text{Hypochlorite Strength, \%} = \frac{(\text{Chlorine Required, lbs}) (100)}{(\text{Hypochlorite Solution Needed, gal}) (8.34 \text{ lbs/gal})}$$

$$\text{Leakage, GPD} = \frac{\text{Volume, gallons}}{\text{Time, days}}$$

$$\text{Mass, lbs/day} = (\text{Flow, MGD}) (\text{Concentration, mg/L}) (8.34 \text{ lbs/gal})$$

$$\text{Mass, lbs} = (\text{Volume, MG}) (\text{Concentration, mg/L}) (8.34 \text{ lbs/gal})$$

$$\text{Milliequivalent} = (\text{mL}) (\text{Normality})$$

$$\text{Molarity} = \frac{\text{Moles of Solute}}{\text{Liters of Solution}}$$

$$\text{Normality} = \frac{\text{Number of Equivalent Weights of Solute}}{\text{Liters of Solution}}$$

$$\text{Number of Equivalent Weights} = \frac{\text{Total Weight}}{\text{Equivalent Weight}}$$

$$\text{Number of Moles} = \frac{\text{Total Weight}}{\text{Molecular Weight}}$$

$$\text{Reduction in Flow, \%} = \frac{(\text{Original Flow} - \text{Reduced Flow}) (100\%)}{\text{Original Flow}}$$

$$\text{Removal, \%} = \frac{(\text{In-Out}) (100)}{\text{In}}$$

$$\text{Slope, \%} = \frac{\text{Drop or Rise}}{\text{Distance}} \times 100$$

$$\text{Solids, mg/L} = \frac{(\text{Dry Solids, grams}) (1,000,000)}{\text{Sample Volume, mL}}$$

$$\text{Solids Concentration, mg/L} = \frac{\text{Weight, mg}}{\text{Volume, L}}$$

$$\text{Specific Gravity} = \frac{\text{Specific Weight of Substance, lbs/gal}}{\text{Specific Weight of Water, lbs/gal}}$$

$$\text{Surface Loading Rate, GPD/sq ft} = \frac{\text{Flow, GPD}}{\text{Area, GPD}}$$

$$\text{Velocity, ft/sec} = \frac{\text{Flow Rate, cfs}}{\text{Time, sec}} \text{ or } \frac{\text{Distance, ft}}{\text{Time, sec}}$$

$$\text{Volume of Cone} = (1/3) (\pi/4) (\text{Diameter}^2) (\text{Height})$$

$$\text{Volume of Cylinder} = (\pi/4) (\text{Diameter}^2) (\text{Height})$$

$$\text{Volume of Rectangular Tank} = (\text{Length}) (\text{Width}) (\text{Height})$$

$$\text{Watts (AC circuit)} = (\text{Volts}) (\text{Amps}) (\text{Power Factor})$$

$$\text{Watts (DC circuit)} = (\text{Volts}) (\text{Amps})$$

$$\text{Weir Overflow Rate, GPD/ft} = \frac{\text{Flow, GPD}}{\text{Weir Length, ft}}$$

$$\text{Wells, Drawdown, ft} = \text{Pumping Level, ft} - \text{Static Level, ft}$$

$$\text{Wells, Specific Capacity, GPM/ft} = \frac{\text{Well Yield, GPM}}{\text{Drawdown, ft}}$$

$$\text{Wire-to-Water Efficiency, \%} = \frac{\text{Water Horsepower, HP}}{\text{Power Input, HP or Motor HP}} \times 100$$

$$\text{Wire-to-Water Efficiency, \%} = \frac{(\text{Flow, GPM})(\text{Total Dynamic Head, ft}) (0.746 \text{ kW/hp}) (100)}{(3,960) (\text{Electrical Demand, kilowatts})}$$

Alkalinity Relationships

Alkalinity mg/L as CaCO₃

Results of Titration	Hydroxide Alkalinity as CaCO ₃	Carbonate Alkalinity as CaCO ₃	Bicarbonate Concentration as CaCO ₃
P = 0	0	0	T
P < 1/2T	0	2P	T - 2P
P = 1/2T	0	2P	0
P > 1/2T	2P - T	2(T-P)	0
P = T	T	0	0

*Key: P - phenolphthalein alkalinity; T - total alkalinity

<u>Conversion Factors</u>	<u>Abbreviations</u>
1 acre = 43,560 square feet	cfs cubic feet per second
1 acre foot = 326,000 gallons	DO dissolved oxygen
1 cubic foot = 7.48 gallons	ft feet
1 cubic foot = 62.4 pounds	g grams
1 cubic foot per second = 0.646 MGD	GPD gallons per day
1 foot = 0.305 meters	gpg grains per gallon
1 foot of water = 0.433 psi	GPM gallons per minute
1 gallon = 3.79 liters	in inches
1 gallon = 8.34 pounds	kW kilowatt
1 grain per gallon = 17.1 mg/L	lbs pounds
1 horsepower = 0.746 kW or 746 watts or 33,000 ft lbs/min	MG million gallons
1 mile = 5,280 feet	MGD million gallons per day
1 million gallons per day = 694 gallons per minute	mg/L milligrams per liter
1 million gallons per day = 1.55 cubic feet per second (cfs)	mL milliliter
1 pound = 0.454 kilograms	ppb parts per billion
1 pound per square inch (psi) = 2.31 feet of water (psi)	ppm parts per million
1% = 10,000 mg/L	psi pounds per square inch
π or pi = 3.14	Q flow
	SS suspended solids
	TOC total organic carbon
	TSS total suspended solids
	TTHM Total trihalomethanes
	VS volatile solids



SPECIAL ARRANGEMENT REQUEST FORM

All examination centers are equipped to provide access in accordance with the Americans with Disabilities Act (ADA) of 1990. Applicants with disabilities or those who would otherwise have difficulty taking the examination may request special examination arrangements.

Candidates who wish to request special arrangements because of a disability should fax this form and supporting documentation to PSI at (702) 932-2666.

Requirements for special arrangement requests

You are required to submit documentation from the medical authority or learning institution that rendered a diagnosis. Verification must be submitted to PSI on the letterhead stationery of the authority or specialist and include the following:

- Description of the disability and limitations related to testing
- Recommended accommodation/modification
- Name, title and telephone number of the medical authority or specialist
- Original signature of the medical authority or specialist

Date: _____ ID#: _____

Legal Name: _____
Last Name First Name

Address: _____
Street City, State, Zip Code

Telephone: (_____) _____ - _____ (_____) _____ - _____
Home Work

Email Address: _____

Check any special arrangements you require (requests must concur with documentation submitted):

- | | |
|--|---|
| ☐ Reader (as accommodation for visual impairment or learning disability) | ☐ Extended time
(Additional time requested:_____) |
| ☐ Large-print written examination | ☐ Service Animals (other than those required for guidance or mobility assistance due to physical disability):_____ |
| ☐ Out-of-State Testing Request (this request does not require additional documentation) | ☐ Other_____ |

Site requested:_____

- Complete and fax this form, along with supporting documentation, to (702) 932-2666.
- After 4 business days, please call (702) 939-6750 and leave a voice message.
- PSI Special Accommodations will call you back to schedule the examination within 48 hours.

DO NOT SCHEDULE YOUR EXAMINATION UNTIL THIS DOCUMENTATION HAS BEEN RECEIVED AND PROCESSED BY PSI SPECIAL ACCOMMODATIONS.

PSI
3210 E Tropicana
Las Vegas, NV 89121