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# **ABC Need-to-Know Criteria for Water Treatment Operators**

## **Association of Boards of Certification**

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## **Acknowledgment**

The Association would like to thank the members of the Water Treatment Validation and Examination Committee for their effort in developing the *ABC Need-to-Know Criteria for Water Treatment Operators*. Committee members included:

- Martin Nutt (Chair), Arkansas Department of Health
- Alan S. Dillon, New Jersey Department of Environmental Protection
- Damon Harper, City of Tifton, Georgia
- James Holeva, Massachusetts Department of Environmental Protection
- Dennis Quintana, New Mexico Environment Department
- Michael Wentink, Nebraska Health and Human Services System

## **Introduction**

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As part of the development of its certification exams, the Association of Boards of Certification (ABC) conducted a job analysis of water treatment operators in 1997. As part of this process, ABC conducted a national survey of water treatment operators. In 2002 and 2003, ABC's Water Treatment Validation and Examination (V&E) Committee re-evaluated the results of the job analysis. The Need-to-Know Criteria was developed from the results of the re-evaluation of ABC's 1997 water treatment operator job analysis.

## **How the Need-to-Know Criteria Was Developed**

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### *Review of Task Survey*

The results of the 1997 task survey were provided to the ABC Water Treatment V&E Committee. In the task survey, operators rated job tasks and capabilities for frequency of performance and seriousness of inadequate or incorrect performance. These two rating scales were used because they provide useful information (i.e., how critical each task is and how frequently each task is performed) pertaining to certification. Of the 244 operators who completed the survey, 15% were class I operators, 21% were class II operators, 24% were class III operators, and 40% were class IV operators.

### *Committee Ratings*

The Water Treatment V&E Committee met in September 2002 to begin development of the new Need-to-Know Criteria. During their meeting, the committee rated the job tasks and capabilities found in the job analysis as essential, useful or not need-to-know. The committee then provided a criticality rating for each task on a scale of 0 (not need-to-know) to 6 (essential).

### *Analysis of Ratings*

The committee ratings were combined with the operator ratings from the task survey to form a composite criticality rating. The composite criticality ratings and percentage of operators reporting that they performed the tasks were used to determine what is covered on each level of certification exam.

## **Core Competencies**

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The essential tasks and capabilities that were identified through this process are called the core competencies. The following pages list the core competencies for water treatment operators. The core competencies are clustered into the following job duties:

- Monitor, Evaluate and Adjust Treatment Processes
- Collect Samples and Interpret Analysis
- Perform Plant Process Control Laboratory Analysis
- Evaluate Characteristics of Source Water
- Comply with Drinking Water Regulations
- Operate Equipment
- Evaluate and Maintain Equipment
- Perform Security, Safety and Administrative Procedures

## Core Competencies for Water Treatment Operators

Monitor, Evaluate and Adjust Treatment Processes	Class Level			
	I	II	III	IV
<b>Source Water Treatment</b>				
Algae control			X	X
Chemical treatment (copper sulfate)			X	X
Intake structure			X	X
<b>Chemical Treatment/Addition</b>				
Fluoridation	X	X	X	X
Chlorine disinfection	X	X	X	X
Chlorine dioxide disinfection			X	X
Ozone disinfection			X	X
Ultraviolet disinfection	X	X	X	X
pH adjustment	X	X	X	X
Corrosion control	X	X	X	X
<b>Coagulation and Flocculation</b>				
Chemical coagulants		X	X	X
Rapid mix units		X	X	X
Flocculation tanks			X	X
<b>Clarification/Sedimentation</b>				
Sedimentation basins		X	X	X
Up-flow solids-contact clarification		X	X	X
Inclined-plate sedimentation		X	X	X
Tube sedimentation		X	X	X
Dissolved air flotation		X	X	X
<b>Filtration</b>				
Gravity/rapid sand filtration		X	X	X
Membrane filtration (RO, MF, UF, NF, ED)		X	X	X
Diatomaceous earth filters			X	X
Cartridge filters		X	X	X
Slow sand filters	X	X	X	X
Direct filtration		X	X	X
Pressure or greensand filtration		X	X	X

(continued)

## Core Competencies (continued)

Monitor, Evaluate and Adjust Treatment Processes (continued)	Class Level			
	I	II	III	IV
<b>Other Treatment Processes</b>				
Aeration		X	X	X
Packed tower aeration		X	X	X
Ion exchange softening		X	X	X
Iron and manganese sequestration/removal		X	X	X
Lime-soda ash softening		X	X	X
Copper sulfate treatment			X	X
Granular activated carbon		X	X	X
Powdered activated carbon			X	X
Coagulation aids			X	X
Filter aids			X	X
Backwash aids			X	X
<b>Residuals Disposal</b>				
Discharge to lagoons		X	X	X
Discharge to lagoons and then surface water		X	X	X
Mechanical dewatering			X	X
Land application			X	X
On-site disposal		X	X	X
Solids composting		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 measurement
- Knowledge of treatment concepts and processes
- Knowledge of water treatment design parameters

## Core Competencies (continued)

Collect Samples and Interpret Analysis	Class Level			
	I	II	III	IV
Alkalinity	X	X	X	X
Aluminum			X	X
Carbon dioxide			X	X
Chlorine demand	X	X	X	X
Chlorine residual	X	X	X	X
Conductivity				X
Cryptosporidium			X	X
Disinfectant by-products (THM)			X	X
Dissolved oxygen			X	X
Fluoride concentration	X	X	X	X
Giardia lamblia			X	X
Hardness	X	X	X	X
Inorganic (heavy metal) chemical	X	X	X	X
Iron/manganese	X	X	X	X
Jar test		X	X	X
Lead/copper	X	X	X	X
Microbiological	X	X	X	X
Nitrate	X	X	X	X
Ortho-polyphosphate	X	X	X	X
pH	X	X	X	X
Radiological parameters		X	X	X
Settleable solids			X	X
Synthetic organic chemicals	X	X	X	X
Temperature	X	X	X	X
Turbidity		X	X	X
Volatile organic chemicals	X	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 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
- Knowledge of *Standard Methods for the Examination of Water and Wastewater*

## Core Competencies (continued)

Perform Plant Process Control Laboratory Analysis	Class Level			
	I	II	III	IV
Alkalinity		X	X	X
Chlorine demand	X	X	X	X
Chlorine residual	X	X	X	X
Fluoride concentration	X	X	X	X
Hardness	X	X	X	X
Iron/manganese	X	X	X	X
Jar test		X	X	X
Microbiological	X	X	X	X
pH	X	X	X	X
Settleable solids		X	X	X
Temperature	X	X	X	X
Turbidity		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 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
- Knowledge of *Standard Methods for the Examination of Water and Wastewater*

Evaluate Characteristics of Source Water	Class Level			
	I	II	III	IV
Bacteriological	X	X	X	X
Biological	X	X	X	X
Chemical	X	X	X	X
Physical	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)**

Comply with Drinking Water Regulations	Class Level			
	I	II	III	IV
<b>United States Exams – Code of Federal Regulations, Title 40, Part 141 - National Primary Drinking Water Regulations:</b>				
Subpart A - General definitions	X	X	X	X
Subpart B - Maximum contaminant levels	X	X	X	X
Subpart C - Monitoring and analytical requirements	X	X	X	X
Subpart D - Reporting and recordkeeping	X	X	X	X
Subpart E - Special regulations	X	X	X	X
Subpart G - National revised primary drinking water regulations: maximum contaminant level and maximum residual disinfectant levels	X	X	X	X
Subpart H - Filtration and disinfection			X	X
Subpart I - Control of lead and copper	X	X	X	X
Subpart J - Use of non-centralized treatment devices	X	X	X	X
Subpart K - Treatment techniques			X	X
Subpart L - Disinfection residuals, disinfection byproducts, and disinfection byproduct precursors			X	X
Subpart O - Consumer confidence reports	X	X	X	X
Subpart P - Enhanced filtration and disinfection			X	X
Subpart Q - Public notification of drinking water violations	X	X	X	X
<b>Canadian Exams</b>				
Provincial and territorial regulations	X	X	X	X

Operate Equipment	Class Level			
	I	II	III	IV
Blowers, compressors and pneumatics			X	X
Chemical feeders	X	X	X	X
Computers		X	X	X
Electronic testing equipment		X	X	X
Generators	X	X	X	X
Hydraulic equipment	X	X	X	X
Instrumentation	X	X	X	X
Intake structure		X	X	X
Prime movers/drives (engines and motors)	X	X	X	X
Valves	X	X	X	X
Water pumps	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 Level			
	I	II	III	IV
<b>Evaluate operation of equipment:</b>				
Inspect equipment for abnormal conditions	X	X	X	X
Read charts	X	X	X	X
Read meters	X	X	X	X
Read pressure gauges	X	X	X	X
<b>Perform maintenance:</b>				
Blowers, compressors and pneumatics			X	X
Chemical feeders	X	X	X	X
Fittings	X	X	X	X
Instrumentation	X	X	X	X
Intake structure		X	X	X
Pipes	X	X	X	X
Prime movers/drives (engines and motors)	X	X	X	X
Valves	X	X	X	X
Water pumps	X	X	X	X
Water treatment filters	X	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 order necessary spare parts
- 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 Level			
	I	II	III	IV
<b>Perform security and safety procedures related to:</b>				
Chemical handling	X	X	X	X
Confined space entry	X	X	X	X
Electrical hazards	X	X	X	X
Facility upset			X	X
Fire safety	X	X	X	X
Lock-out/tag-out	X	X	X	X
Pathogens			X	X
Personal protective equipment	X	X	X	X
Spill response			X	X
<b>Perform administrative procedures, such as:</b>				
Administer compliance, emergency preparedness and safety program	X	X	X	X
Develop budget	X	X	X	X
Develop operation and maintenance plan	X	X	X	X
Plan and organize work activities	X	X	X	X
Record and evaluate data	X	X	X	X
Respond to complaints	X	X	X	X
Write regulatory authority reports	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 and ordinances
- 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 public administration practices
- Knowledge of recordkeeping function and policies
- Knowledge of regulations
- Knowledge of risk management

## **ABC Water Treatment Certification Exams**

The ABC water treatment certification exams evaluate an operator's knowledge of tasks related to the operation of water treatment plants. The Water Treatment V&E Committee determined the content of each exam based on the results of the national job analysis. To successfully take an ABC exam, an operator must demonstrate knowledge of the core competencies in this document. Because certificates may be used to work in various treatment plants, the exams may include technologies that are not used in each treatment plant but are commonly used in many treatment plants.

Four levels of certification exams are offered by ABC, with class I being the lowest level and class IV the highest level. The specifications for the exams are based on a weighting of the job analysis results so that they reflect the criticality of tasks performed on the job. The specifications list the percentage of questions on the exam that fall under each job duty. For example, 21% of the questions on the ABC class I exam relate to the job duty "Monitor, Evaluate and Adjust Treatment Processes." For a list of tasks and capabilities associated with each job duty, please refer to the list of core competencies on the previous pages.

### **ABC Water Treatment Exam Specifications**

	Exam Level			
	Class I	Class II	Class III	Class IV
Monitor, Evaluate and Adjust Treatment Processes	21%	38%	43%	43%
Collect Samples and Interpret Analysis	14%	11%	11%	11%
Perform Plant Process Control Laboratory Analysis	7%	8%	5%	5%
Evaluate Characteristics of Source Water	5%	5%	5%	5%
Comply with Drinking Water Regulations	20%	15%	15%	15%
Operate Equipment	8%	6%	5%	5%
Evaluate and Maintain Equipment	14%	10%	10%	10%
Perform Security, Safety and Administrative Procedures	11%	7%	6%	6%

### **Suggested Water Treatment Exam References**

The following are approved as reference sources for the ABC water treatment examinations. Operators should use the latest edition of these reference sources to prepare for the exam.

#### **American Water Works Association (AWWA)**

Principles and Practices of Water  
Supply Operations Series:

- *Water Sources*
- *Water Treatment*
- *Water Transmission and Distribution*
- *Water Quality*
- *Basic Science Concepts and Applications*

Other AWWA References:

- *Water Quality and Treatment*
- *Water System Security, A Field Guide*

To order, contact: American Water Works Association  
6666 W Quincy Ave  
Denver CO 80235

Web site: [www.awwa.org](http://www.awwa.org)  
Phone: (800) 926-7337  
Fax: (303) 347-0804  
E-mail: [custsvc@awwa.org](mailto:custsvc@awwa.org)

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## **Suggested Water Treatment Exam References** *(continued)*

### **Association of State Drinking Water Administrators (ASDWA) and National Rural Water Association (NRWA)**

- *Security Vulnerability Self Assessment Guide for Small Drinking Water Systems*

To order, contact: ASDWA  
1025 Connecticut Ave NW Ste 903  
Washington DC 20036

Available online in PDF format (select “Security”):

Web site: [www.asdwa.org](http://www.asdwa.org)  
Phone: (202) 293-7655  
Fax: (202) 293-7656  
E-mail: [info@asdwa.org](mailto:info@asdwa.org)

### **California State University, Sacramento (CSUS) Foundation, Office of Water Programs**

- *Water Treatment Plant Operation*, Volumes I and II
- *Utility Management*
- *Manage for Success*

To order, contact: Office of Water Programs  
California State University, Sacramento  
6000 J St  
Sacramento CA 95819-6025

Web site: [www.owp.csus.edu](http://www.owp.csus.edu)  
Phone: (916) 278-6142  
Fax: (916) 278-5959  
E-mail: [wateroffice@owp.csus.edu](mailto:wateroffice@owp.csus.edu)

## **Regulations**

For United States exams:

- *Code of Federal Regulations*, Title 40, Part 141 ([www.gpo.gov](http://www.gpo.gov))
- State regulations (contact information for state certification programs is available on the Certification Contacts page of ABC’s web site, [www.abccert.org](http://www.abccert.org))

For Canadian exams:

- *Guidelines for Canadian Drinking Water Quality*. Federal-Provincial-Territorial Subcommittee on Drinking Water. Ottawa, ON: Health Canada ([www.hc-sc.gc.ca/waterquality](http://www.hc-sc.gc.ca/waterquality))
- Provincial and territorial regulations (contact information for provincial/territorial certification programs is available on the Certification Contacts page of ABC’s web site, [www.abccert.org](http://www.abccert.org))

## **Study Guides**

American Water Works Association, *Operator Certification Study Guide: A Guide to Preparing for Water Treatment and Distribution Operator Certification Exams* ([www.awwa.org](http://www.awwa.org); complete contact information is on preceding page)