



## **Welcome to Montana's Operator Certification Program**

The study material in this packet is designed to offer you a basic knowledge of the subject areas you need to be familiar with in order to take the operator certification exams successfully. Montana uses ABC (Association of Boards of Certification) standardized exams for testing. This ensures up-to-date exams based on national standards and EPA requirements.

Because Montana's water treatment and water distribution classification system is not labeled the same as ABC's, you will need to determine which levels you are studying for by using the following chart:

<b>Montana Water Treatment Exam</b>	<b>ABC Water Treatment Equivalent</b>
Class 1B	Class III

Remember that this material is supplemental and it is recommended that you consider the suggested reference materials listed on the last page of the Need-to-Know Criteria booklet. Also **highly** recommended:

- Water Operator Certification Study Guide
  - AWWA publication (see contact and order information on last page or go to [www.awwa.org](http://www.awwa.org))

If you have any questions concerning these study materials or anything about Operator Certification, please feel free to contact the operator certification program at 406-444-4584.



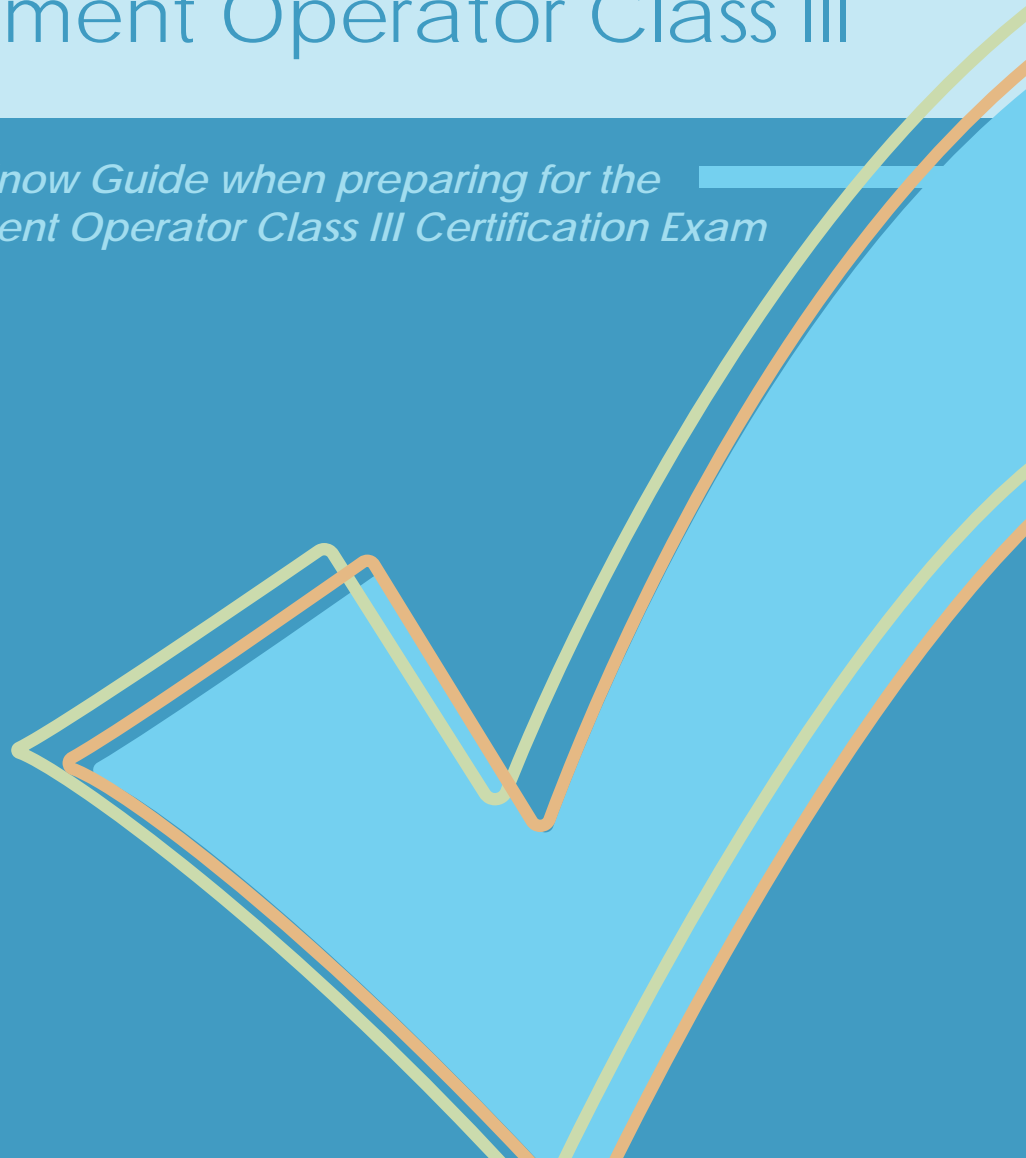
# ABC

Association of  
Boards of Certification

2017

## Need-to-Know Criteria Water Treatment Operator Class III

*A Need-to-Know Guide when preparing for the  
ABC Water Treatment Operator Class III Certification Exam*



## Before You Dive In...

### What is ABC's Need-to-Know Criteria?

This *ABC Water Treatment Operator Class III Need-to-Know Criteria* was developed to assist operators in understanding the content that will be covered in ABC's 2017 Standardized Water Treatment Operator Class III exam. During 2014-2016, a methodical and comprehensive international investigation was conducted to determine the most significant job tasks performed by water treatment operators. The content covered on the exam represents the job tasks identified through this research as essential operator competencies, and is not limited to the practices of your system/facility. The following pages organize these job tasks into Content Areas and identify the amount of the test devoted to each area.

### Is this Need-to-Know Criteria relevant to MY exam?

ABC offers a variety of standardized and customized exam services. This document is reflective only of the 2017 edition of the ABC Standardized Water Treatment Operator Class III exam; older editions of the standardized exam and various customized exams are also administered by various certification programs. Please contact your certifying authority to determine whether they have implemented this exam for your program.

### Pre-Test Questions

Your exam may include up to 10 extra questions that have not been used on previous versions of the exam. These are known as "pre-test" questions and allow ABC to gather valuable data about the new questions before they are included in future tests. Pre-test questions are unidentified and scattered throughout the exam so you will answer them with the same care in which you address scored questions. The pre-test questions are not included in your final score.

### Exam Preparation Resources

Visit [www.abccert.org](http://www.abccert.org) to access the formula/conversion table administered with this exam, a list of approved references, information on purchasing study guides available from partner organizations, and more.

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# Water Treatment Operator Class III Need-to-Know Criteria









## Exam Content

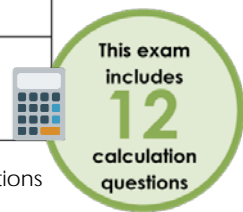
The Water Treatment Operator Class III exam will test you on essential job tasks. These job tasks have been categorized into the Content Areas detailed in the following pages. The table below summarizes the areas that are included on the exam, the number of test questions in each of these areas, and the complexity of the test questions in each area.

Just as water treatment operator job duties vary in their complexity, so will the questions you are asked on the exam. Some will be more simple and routine, whereas others will be more complex, or cognitively demanding. The following three levels are used to describe the complexity of the questions you will encounter on this exam:

-  **Recall** – tasks at this level typically require the simple recall or recognition of specific facts, concepts, processes, or procedures, with little to no problem-solving involved. You may be asked to identify, illustrate, recall, and/or recognize specific information.
-  **Application** – tasks at this level will involve some basic problem solving, calculations, or the interpretation and application of data. You may be asked to calculate, categorize, classify, compare, differentiate, explain, specify, translate, and/or apply knowledge.
-  **Analysis** – tasks at this level may involve higher level problem solving, evaluation, or the fitting together of a variety of elements into a meaningful whole; they will usually require many steps in the thought process. You may be asked to analyze, evaluate, formulate, generalize, judge, predict, and/or use inductive or deductive reasoning to arrive at a solution.

### Exam Content Outline

Number of Questions	Content Area	Job Task Complexity Levels
30	Treatment Process	 5  18  7
13	Laboratory Analysis	 3  7  3
23	Equipment Operation & Maintenance	 5  13  5
10	Source Water Characteristics	 2  6  2
24	Security, Safety, Compliance, & Administrative Procedures	 7  12  5
100*	Total	 22  56  22



This exam includes 12 calculation questions

\*Your exam may contain up to 10 extra unscored pre-test questions (see *Before You Dive In* for more details).



5 Recall



18 Application



7 Analysis

## Treatment Process

### Job Tasks Included in this Content Area:

1. Calculate and/or record:
  - a. Plant residuals
  - b. Backwash water
  - c. Daily flow rates
  - d. Chemical levels and previous days usage
  - e. Filter performance data
  - f. Online analyzers data
2. Calculate chemical dosages
3. Interact with HMI and SCADA
4. Determine correct disinfectant dosage and contact time to maintain desired level of residual in system
5. Control treatment plant processes, chemical dosages, and equipment used to treat water.
6. Determine and adjust plant flows to meet system demands
7. Troubleshoot malfunctions and problems in plant process and equipment
8. Identify trends and abnormal operation in plant processes by interpreting data from gauges, meters, charts, and graphs
9. Interpret facility and process control water meters
10. Maintain records of operation of treatment facilities:
  - a. Daily testing logs
  - b. Daily equipment logs
  - c. Daily intake and production
  - d. Daily maintenance management reports and notes
  - e. Microbiological sampling and testing
11. Make appropriate changes in plant processes to optimize performance and efficiency
12. Mix batches of chemical solutions
13. Add chemicals to hoppers and feed equipment
14. Monitor filter performance and backwash filters
15. Monitor the transmission and distribution system
16. Monitor, evaluate, and adjust:
  - a. Pretreatment
  - b. Coagulation and flocculation (e.g., flocculation tanks, rapid mix units)
  - c. Clarification and sedimentation (e.g., inclined-plate, tube, up-flow solids-contact)
  - d. Filtration (e.g., biofiltration, diatomaceous earth filters, direct and conventional filtration, membranes, microscreens, slow sand, Greensand, pressure, upflow, rapid sand, cartridge).
  - e. Residuals disposal (e.g., lagoons, sludge drying beds, land application, on-site disposal, solids composting)
  - f. Backwash aids
  - g. Source water treatment (e.g., copper sulfate, aeration, mixing).
  - h. Iron/manganese treatment
  - i. Lime-soda ash softening
  - j. Granular activated carbon
  - k. Powdered activated carbon
  - l. Ion exchange
  - m. Chemical feed pumps
  - n. Online instrumentation
17. Operate and control electric motors, pumps, and valves to regulate flow of water at the treatment facility
18. Perform calculations related to process monitoring
19. Ensure the proper handling, storage and use of chemicals:
  - a. Acids
  - b. Bases
  - c. Oxidants
  - d. Coagulants

- e. Polymers
- f. Chemical disinfectants
- g. Fluoride
- h. Corrosion control chemicals



3 Recall



7 Application



3 Analysis

## Laboratory Analysis

Job Tasks Included in this Content Area:

1. Calibrate and repair laboratory instrumentation to ensure proper operation
2. Collect water samples
3. Perform sample preservation and documentation for laboratory samples
4. Perform lab tests, record results, and interpret data
5. Use equipment to evaluate water quality
6. Perform analyses:
  - a. Color
  - b. Taste and odor
  - c. Turbidity
  - d. Free Cl<sub>2</sub> residual
  - e. Total Cl<sub>2</sub> residual
  - f. Fluoride
  - g. pH
  - h. Hardness
  - i. Aluminum
  - j. Alkalinity
  - k. Iron
  - l. Manganese
  - m. Temperature
  - n. Bacteria
  - o. Jar test
  - p. Zeta potential



5 Recall



13 Application



5 Analysis

## Equipment Operation & Maintenance

### Job Tasks Included in this Content Area:

1. Adjust pumps to meet demand
2. Measure and analyze filter media to determine compliance with design specifications
3. Perform facility startup and shutdown per SOP
4. Calibrate inline instrumentation (e.g., pH, turbidimeters, Cl analyzer)
5. Complete equipment maintenance and repair records, including work orders
6. Update asset management log (e.g., CMS)
7. Ensure the operation and maintenance of equipment at the water treatment facility:
  - a. Chlorine disinfection system
  - b. Filter systems (e.g., biofiltration, diatomaceous earth filters, direct and conventional filtration, membranes, microscreens, slow sand, Greensand, pressure, upflow, rapid sand, cartridge)
  - c. Clarifier
  - d. Treated water storage tanks
  - e. Clearwell
  - f. Programmable Logic Control (PLC) System
  - g. SCADA
  - h. Polymer feed system
  - i. Raw and treated water pumping systems
  - j. Raw water screening
  - k. Water intake equipment
  - l. Pumps
  - m. Chemical feed equipment
  - n. Chemical mixing equipment (e.g., rapid mix, flocculators, static mixers)
  - o. Water quality analyzers
  - p. Valves
  - q. Injectors
8. Evaluate filter operation by performing filter surveillance tests
9. Inspect, exercise, and maintain valves
10. Maintain facility and process control water meters
11. Install and maintain facility piping (e.g., air, water, chemical)
12. Lubricate pumps, motors, chains, conveyors, and other machinery and equipment
13. Operate and maintain pumps, drivers, and auxiliary equipment
14. Operate and maintain onsite backup power generator
15. Perform calibration of chemical feeders
16. Perform efficiency tests on pumps and related equipment (e.g., pump curves)
17. Perform preventive and corrective maintenance to the auxiliary water treatment plant equipment:
  - a. Electric motors
  - b. Engines
  - c. Gas and electric powered pumps
  - d. Air compressors
  - e. Emergency systems
  - f. Power generation systems
  - g. Pressure and flow regulators
  - h. Online analyzers
  - i. Filters (e.g., air, oil)
  - j. Chemical feed systems
18. Perform routine maintenance of grounds machinery, structures, equipment, and piping systems (e.g., cleaning, painting)
19. Perform inspections on clear well covers, hatches, access covers, vents, and overflows
20. Backwash filters





2 Recall



6 Application



2 Analysis

## Source Water Characteristics

### Job Tasks Included in this Content Area:

1. Evaluate the following source water characteristics:
  - a. Biological (bacterial, protozoa, viruses)
  - b. Chemical
  - c. Potential sources of source water contamination
  - d. Physical
2. Measure static water level and pumping levels of wells
3. Measure and monitor raw water source
4. Perform inspections of surface water sources and report any issues that may affect water quality (e.g., non-native plant species, mussels, algae, erosion)
5. Perform inspections of ground water well sites and report any issues that may affect water quality (e.g., contamination, flooding, well head protection)
6. Perform raw water reservoir inspection, maintenance, and cleaning
7. Determine if wells are under the direct influence of surface water (GWI)
8. Monitor lake stratification
9. Educate community on source water protection and conservation



7 Recall



12 Application



5 Analysis




## Security, Safety, Compliance, & Administrative Procedures

### Job Tasks Included in this Content Area:

1. Accept chemical shipments
2. Advise on need to order chemicals, repair parts, and tools
3. Advise system staff and/or contractors of potential problems and alarms
4. Prepare budget for chemicals, laboratory reagents, and equipment
5. Inspect plant safety equipment (e.g., fire extinguishers, AED, smoke and gas detectors)
6. Comply with safety requirements of the facility and actively promote safe work practices
7. Conduct tours of facilities
8. Develop and maintain standard operating procedures
9. Determine materials, labor, and cost needed for operation, maintenance, and repairs
10. Procure materials, labor, and cost needed for operation, maintenance, and repairs
11. Investigate consumer complaints regarding water quality and take remedial action
12. Take delivery of chemicals by unloading by hand or with equipment such as fork lifts and cranes (e.g., chlorine cylinders, bulk liquids, and dry bagged chemicals)
13. Inspect chemical containers and security tags before taking delivery (e.g., review SDS's)
14. Comply with lockout tagout procedures
15. Determine if water quality violations have occurred
16. Ensure compliance with regulatory agency standards
17. Manage safety and environmental issues in compliance with appropriate regulatory agencies (e.g., Hazardous Waste Disposal and Air Quality Standards)
18. Monitor and control residual effluents to comply with regulatory permit limits
19. Monitor the use of energy and chemicals
20. Complete monthly reports
21. Track and maintain inventory (e.g., equipment, chemical, and general supplies)
22. Evaluate operating records and trends
23. Maintain facility operation records
24. Conduct confined space entries according to appropriate regulatory guidelines
25. Notify the public when reportable maximum contaminant levels are exceeded
26. Perform facility and perimeter security checks
27. Use, handle, and dispose of chemicals according to safety standards
28. Perform safety procedures (e.g., calibration of atmospheric testing devices, chemical hazards and chemical spill response, pathogens, personal protective equipment)
29. Perform supervisory duties:
  - a. Determining and assigning work schedules and tasks
  - b. Enforcing policies and safety procedures
  - c. Conducting performance evaluations
  - d. Resolving grievances
  - e. Making appropriate hiring decisions
  - f. Initiating, investigating, and implementing disciplinary actions
  - g. Coordinating schedule to ensure that plant resources are being utilized to achieve project specific objectives
30. Plan water treatment operations:
  - a. Production
  - b. Treatment and storage
  - c. Budgeting
  - d. Project management
  - e. Contract management
  - f. Capital improvement planning
  - g. Asset management
31. Review and update facility emergency response plans
32. Respond to emergencies (e.g., facility upset, major spill response, natural disasters, system contamination)

## Supporting Knowledge

The chart below outlines several types of knowledge that support the performance of the job tasks on which you may be tested. These types of knowledge are rated at one of three levels to represent the extent of knowledge needed to perform the job tasks assigned to each Content Area:

- 
**Basic** – A fundamental or lower level of knowledge is required. Operators performing tasks requiring this level of knowledge will be able to do so with some training; this level of knowledge may also be acquired and developed through job experience. Such tasks may be routine, utilizing established procedures, and have a low level of complexity. Not having this level of knowledge will have minimal impact or significance on the performance of the tasks listed in the Content Area, or on public safety and welfare.
  
- 
**Intermediate** – A level of knowledge beyond the basic level is required. Operators performing tasks requiring this level of knowledge will be able to do so with training beyond that of the basic level. The operator will not only be able to apply required fundamental concepts, but will be able to understand and discuss the application and implications of changes to processes, policies, and procedures within the Content Area. Not having this level of knowledge will have a significant impact on the performance of the job and on public safety and welfare.
  
- 
**Advanced** – A very high level of knowledge/job expertise is required and the operator will be functioning at an expert level. The operator can apply all fundamental, as well as highly developed or complex concepts, and will be able to design, review, and evaluate processes, policies, and procedures within the Content Area. Not having this level of knowledge will have a serious impact on the performance of the job and will be very harmful to public safety and welfare.

Supporting Knowledge Type	Treatment Process (30%)*	Laboratory Analysis (13%)*	Equipment Operation & Maintenance (23%)*	Source Water Characteristics (10%)*	Security, Safety, Compliance, & Administrative Procedures (24%)*
Arithmetic (e.g., measurements and calculations)	Advanced	Advanced	Intermediate	Intermediate	Intermediate
Biology (e.g., pathogenic organisms)	Intermediate	Advanced		Advanced	
Chemistry (e.g., water chemistry)	Advanced	Advanced		Advanced	
Chemical dosing (coagulants, oxidants, disinfectants, acids and bases)	Advanced				
Chemical feed equipment (e.g., liquid, solid, gases)			Advanced		
Chemical properties (e.g., reactivity, compatibility, pH)	Advanced	Intermediate	Intermediate		
Contaminants (e.g., organic, inorganic)	Advanced	Advanced		Advanced	
Disciplinary procedures					Basic
General electrical principles (e.g. troubleshooting breakers, relays, circuits)			Intermediate		
Internal combustion engines			Intermediate		
Laboratory equipment (e.g., glassware)		Advanced			
Laboratory instrumentation (e.g., operation and calibration)		Advanced			

Supporting Knowledge Type	Treatment Process (30%)*	Laboratory Analysis (13%)*	Equipment Operation & Maintenance (23%)*	Source Water Characteristics (10%)*	Security, Safety, Compliance, & Administrative Procedures (24%)*
Laboratory procedures and protocols (e.g., Standard Methods)		Advanced			
Laboratory techniques	Advanced	Advanced			
Legislative process					Intermediate
Mechanical principles (e.g., mixing, solids compression)	Intermediate		Intermediate		
Pneumatics (e.g., actuators, compressors, valves)			Intermediate		
Prime mover of water (e.g., pumps)			Advanced		
Principles of finance					Basic
Principles of hydraulics (e.g. mass flow balance, detention time, loading, velocity)	Intermediate			Intermediate	
Principles of hydrology (e.g., hydraulic cycle, aquifers)				Advanced	
Principles of public relations (e.g., water quality concerns, rate increases)				Basic	Intermediate
Process control instrumentation (e.g., pH, turbidity, temperature, etc.)	Intermediate		Advanced	Advanced	
Proper chemical handling and storage		Advanced	Advanced		Advanced
Proper lifting procedures					Basic
Proper sampling procedures (e.g., chain of custody, storage and preservation)		Advanced			Intermediate
Public administration procedures				Intermediate	Intermediate
Quality control/quality assurance practices		Intermediate			Basic
Recordkeeping policies		Intermediate			Advanced
Reporting requirements (e.g., violations, annual reports)					Advanced
Risk management				Intermediate	Basic
Safety Data Sheets	Advanced	Advanced	Advanced		Advanced
Safety equipment (e.g., personal protective equipment, safety showers and eye washes)	Advanced	Advanced	Intermediate		Advanced
Safety procedures and regulations (e.g., lockout tagout, confined space)					Intermediate
Storage (e.g., clearwells, reservoirs)	Intermediate		Intermediate		
Valve operation and maintenance			Intermediate		
Watershed protection				Advanced	

\*Percent of exam associated with the Content Area



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## Water Treatment Operator Exam References

The following are approved as reference sources for the 2017 ABC standardized water treatment operator exams. Reference lists for prior generations of ABC standardized exams are included in the respective *Need-to-Know Criteria*.

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

**<https://www.awwa.org/store/books.aspx>**

1-800-926-7337

- \*WSO: *Water Treatment Series (Grade 1, Grade 2, Grades 3 & 4)*
- \*WSO: *Water Distribution Series (Grades 1 & 2, Grades 3 & 4)*
  - *Basic Science Concepts and Applications*
    - *Water Quality*
    - *Water Sources*
  - *Water System Security, A Field Guide*

\*These WSO texts replace previous AWWA titles *Water Treatment* and *Water Transmission and Distribution*. Visit [www.awwa.org/wso](http://www.awwa.org/wso) to learn more about transitioning between the guides.

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

**<https://www.asdwa.org/security/security-vulnerability-assessment-guides/>**

1-703-812-9505

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

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

**<http://www.owp.csus.edu/courses/drinking-water.php>**

**(916) 278-6142**

- *Manage for Success*
- *Water Treatment Plant Operation, Volume I and II*