Professional Operator

Wastewater Treatment
Need-to-Know Criteria

A Need-to-Know Guide when preparing for the PO Wastewater Treatment Certification Examination
Acknowledgement

ABC and C2EP would like to thank the members of the 2010-2011 wastewater treatment examination committee for their effort in conducting the job analysis and developing the Professional Operator Wastewater Treatment Need-to-Know Criteria. Committee members included:

- John “Jack” W. Vanderland, Virginia (Chair)
- Michael Bolt, North Carolina
- Frank DeOrio, New York
- Chris Hoffman, New Jersey
- Paul Krauth, Utah
- Barbara Monroe, Louisiana
- John Reynolds, British Columbia
- LeAnna Risso, Nevada
- Donovan Sheppard, Washington

Introduction

As part of the development of the Professional Operator certification exams, ABC conducted a job analysis of wastewater treatment operators in 2010. As part of this process, the examination committee conducted a national survey of wastewater treatment operators. This Need-to-Know Criteria was developed from the results of the 2010 wastewater treatment operator job analysis.

How the Need-to-Know Criteria Was Developed

Review of Task Survey

The results of the 2010 task analysis survey were provided to the wastewater treatment examination committee. In the task analysis 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 1018 individuals in the wastewater treatment industry who completed the survey, 119 were class I operators, 162 were class II operators, 237 were class III operators, and 366 were class IV operators.

Analysis of Ratings

The composite criticality ratings and percentage of operators reporting that they performed the tasks were presented to the wastewater treatment examination committee in January 2011 to begin development of this Need-to-Know Criteria. Examination committee members were given the opportunity to retain tasks which did not meet decision criteria (a criticality value of at least 10.5, and a percent performing
value of at least 50%) if a significant rationale could be provided for their importance on the examination. The examination committee members were also given the opportunity to remove any tasks which met criteria on the survey but were deemed untestable or inappropriate for the wastewater treatment certification examination. Final examination blueprint weights were calculated by summing the criticality values of all remaining tasks, and dividing the criticality value of each task by the grand total criticality value. Weights of individual tasks were summed for each core competency area to determine the proportion of the wastewater treatment certification examination devoted to each core competency.

Core Competencies

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

- Evaluate Physical Characteristics of Wastestream
- Perform Security, Safety, and Administrative Procedures
- Evaluate and Maintain Equipment
- Operate Equipment
- Monitor, Evaluate, and Adjust Treatment Processes
- Laboratory Analysis

The level of knowledge (i.e., comprehension, application, analysis) required for each task is also identified in the following pages.

- **Comprehension** is the most basic level of understanding and remembering. Items written at the comprehension level require examinees to recognize, remember, or identify important ideas.
- Items written at the **application** level require examinees to interpret, calculate, predict, use or apply information and solve problems.
- Items written at the **analysis** level require examinees to compare, contrast, diagnose, examine, analyze, and relate important concepts.

The level of knowledge is a hierarchy from basic comprehension to analysis. The level of knowledge tested is cumulative. Therefore, tasks identified as application may include questions written at both the application and comprehension levels. Tasks identified as analysis may include questions written at the comprehension, application, and analysis levels.
About the Certification Commission for Environmental Professionals

The Certification Commission for Environmental Professionals (C2EP) of the Association of Boards of Certification (ABC) implements certification programs for water environment industry professionals. C2EP awards its certificants the Professional Operator (PO) designation, the industry’s first professional designation for operators.

C2EP functions as an independent entity to develop and administer certification in water treatment, water distribution, wastewater collection, and wastewater treatment operations. Commission members include water environment industry and certification subject matter experts charged with developing programs meeting the highest standards for testing and personnel certification.

The standardized exams developed by C2EP for the Professional Operator (PO) program reflect water environment industry best practices and meet international certification standards. They are based on national job task analyses completed by more than 2,500 certified operators and guidance from exam experts to ensure fairness, reliability, and validity.

C2EP promotes recognition of the Professional Operator program to certifying authorities with the aim of establishing the Professional Operator as a uniformly recognized symbol of professional competence and integrity.

C2EP Mission Statement

C2EP is committed to protecting public health and the environment through certification and professional designation of water industry operators.

About the Association of Boards of Certification

In 1972, water and wastewater industry leaders began conversations that developed the groundwork for an association to foster operator certification throughout North America and reduce the diversity among certification programs. From those early discussions, ABC was born.

Today, the Association includes almost 100 certifying authorities, representing more than 40 states, 10 Canadian provinces and territories, as well as several international and tribal programs. These programs have certified more than 240,000 water and wastewater operators, laboratory analysts, plant maintenance technologists, biosolids landappers, and backflow prevention assembly testers.

Why Was C2EP Established?

Professional certification can protect humanity and the environment by verifying that water environment operations personnel possess specific critical knowledge and skills.
ABC created C2EP to enhance the integrity of operator certification and address the need for standardized exams and certification standards. Although most jurisdictions administer operator certification programs to ensure that skilled professionals keep water sources safe, every state program is different. The diversity of programs limits career opportunities for operators, restricts employer recruitment efforts, and underlines the value of certification. Widespread recognition of the PO program can transform the industry by advancing the development of a highly skilled and mobile workforce. More importantly, standardized exams offer public assurance that geography does not influence professional competence.

ABC Mission

ABC is dedicated to advancing the quality and integrity of environmental certification programs.

PO Wastewater Treatment Certification Exams

The PO wastewater treatment certification exams evaluate an operator's knowledge of tasks related to the operation of wastewater treatment systems. The wastewater treatment exam committee determined the content of each exam based on the results of the national task analysis survey. To successfully take a PO exam, an operator must demonstrate knowledge of the core competencies in this document.

Four levels of certification exams are offered by C2EP, 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, 16% of the questions on the PO wastewater treatment exam class I relate to the job duty “Operate Equipment.” For a list of tasks and capabilities associated with each job duty, please refer to the list of core competencies on the following pages.

<table>
<thead>
<tr>
<th>Blueprint Area</th>
<th>Class I</th>
<th>Class II</th>
<th>Class III</th>
<th>Class IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor, Evaluate, and Adjust Treatment Processes</td>
<td>30%</td>
<td>28%</td>
<td>31%</td>
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<tr>
<td>Laboratory Analyses</td>
<td>12%</td>
<td>13%</td>
<td>11%</td>
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<tr>
<td>Comply with Drinking Water Regulations</td>
<td>12%</td>
<td>12%</td>
<td>11%</td>
<td>10%</td>
</tr>
<tr>
<td>Operate and Maintain Equipment</td>
<td>27%</td>
<td>26%</td>
<td>24%</td>
<td>25%</td>
</tr>
<tr>
<td>Perform Security, Safety, and Administrative</td>
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<td>16%</td>
<td>18%</td>
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</tr>
<tr>
<td>Procedures</td>
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<td></td>
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</tr>
<tr>
<td>Evaluate Characteristics of Source Water</td>
<td>6%</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
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</tbody>
</table>
### Evaluate Physical Characteristics of Wastestream

<table>
<thead>
<tr>
<th></th>
<th>Class I</th>
<th>Class II</th>
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<th>Class IV</th>
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</thead>
<tbody>
<tr>
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<td>Flow</td>
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<td>Foam</td>
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<tr>
<td>Mixing</td>
<td>Analysis</td>
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<tr>
<td>Odor</td>
<td>Analysis</td>
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<tr>
<td>Solids concentration</td>
<td>Analysis</td>
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<tr>
<td>Temperature</td>
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<td>Analysis</td>
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<tr>
<td>Volume/loading</td>
<td>Analysis</td>
<td>Analysis</td>
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<td>Analysis</td>
</tr>
</tbody>
</table>

### Required Capabilities

**Knowledge of:**
- Normal characteristics of wastewater
- Personal protective equipment
- Proper safety procedures
- Regulations
- Reporting requirements

**Ability to:**
- Communicate in writing
- Communicate verbally
- Demonstrate safe work habits
- Discriminate between normal and abnormal conditions
- Operate safety equipment
- Perform physical measurements
- Recognize unsafe work conditions
- Record information
- Report findings

### Perform Security, Safety, and Administrative Procedures

<table>
<thead>
<tr>
<th></th>
<th>Class I</th>
<th>Class II</th>
<th>Class III</th>
<th>Class IV</th>
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</thead>
<tbody>
<tr>
<td><strong>Apply Safety Procedures</strong></td>
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<tr>
<td>Bloodborne pathogens</td>
<td>Analysis</td>
<td>Analysis</td>
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<tr>
<td>Waterborne pathogens</td>
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<tr>
<td><strong>Chemical Hazards</strong></td>
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<tr>
<td>Chemical hazard communication</td>
<td>Analysis</td>
<td>Analysis</td>
<td>Analysis</td>
<td>Analysis</td>
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<tr>
<td>Chemical spill response</td>
<td>Analysis</td>
<td>Analysis</td>
<td>Analysis</td>
<td>Analysis</td>
</tr>
<tr>
<td><strong>Personal Protective Equipment</strong></td>
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<tr>
<td>Respiratory protection</td>
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<td>Analysis</td>
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<tr>
<td>Self-contained breathing apparatus</td>
<td>Analysis</td>
<td>Analysis</td>
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<tr>
<td>Other Personal protective equipment</td>
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</table>
Perform Security, Safety, and Administrative Procedures Continued

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<tr>
<th>General Safety and Health</th>
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<td>Emergency eyewash/shower</td>
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<tr>
<td>Fire suppression</td>
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<td>Analysis</td>
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<tr>
<td>First aid</td>
<td>Analysis</td>
<td>Analysis</td>
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<tr>
<td>Lifting</td>
<td>Analysis</td>
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<td>Analysis</td>
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<tr>
<td>Personal hygiene</td>
<td>Analysis</td>
<td>Analysis</td>
<td>Analysis</td>
<td>Analysis</td>
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<tr>
<td>Slips, trips, and falls</td>
<td>Analysis</td>
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</table>

<table>
<thead>
<tr>
<th>Establish and Follow Emergency Preparedness Plan</th>
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<tbody>
<tr>
<td>Facility upset</td>
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<tr>
<td>Major spill response</td>
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<tr>
<td>Natural disasters</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Record Information</th>
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</thead>
<tbody>
<tr>
<td>Corrective actions</td>
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<tr>
<td>Facility Operation</td>
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<tr>
<td>Financial</td>
</tr>
<tr>
<td>Laboratory</td>
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<tr>
<td>Maintenance</td>
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<tr>
<td>Respond to complaints</td>
</tr>
<tr>
<td>Write/Complete reports (federal, state, internal)</td>
</tr>
</tbody>
</table>

Required Capabilities

**Knowledge of:**
- Arbitration procedures
- Building codes
- Clean Water Act
- Code of Federal Regulations
- Disciplinary procedures
- Emergency plans
- Facility operation and maintenance
- Function of recordkeeping system
- Human resource practices
- Legislative process
- Local codes and ordinances
- Material Safety Data Sheet

**Ability to:**
- Assess likelihood of disaster occurring
- Assign work to proper trade
- Communicate in writing
- Communicate verbally
- Conduct meetings
- Conduct training programs
- Coordinate emergency response with other organizations
- Demonstrate safe work habits
- Determine what information needs to be recorded
- Develop a budget
Required Capabilities Continued

Knowledge of:
- Monitoring requirements
- Operation and maintenance practices
- Personal protective equipment
- Potential causes of disasters in facility
- Potential impact of disasters on facility
- Principles of behavioral psychology
- Principles of finance
- Principles of general communication
- Principles of management
- Principles of measurement
- Principles of public relations
- Principles of supervision
- Proper chemical handling and storage
- Proper lifting procedures
- Proper safety procedures
- Public administration practices
- Public participation process
- Recordkeeping policies
- Regulations
- Reporting requirements
- Risk management
- Safety regulations
- Wastewater treatment design parameters
- Watershed protection
- State/provincial and federal wastewater regulations and effluent guidelines
  - Clean Water Act Section 301: Effluent Standards
  - Clean Water Act Section 302: Water Quality-Related Effluent Limitations
  - Clean Water Act Section 307: Toxic and Pretreatment Effluent Standards
  - Clean Water Act Section 402: National Pollutant Discharge Elimination System
  - Clean Water Act Section 405: Disposal of Sewage Sludge
  - 40 CFR 136: Guidelines establishing test procedures for the analysis of pollutants
  - 40 CFR 401.11: General definitions (concerning Clean Water Act legislation)
  - 40 CFR 401.15: Toxic pollutants

Ability to:
- Develop a public relations campaign
- Develop a staffing plan
- Develop a work unit
- Evaluate employee performance
- Evaluate promotional materials
- Evaluate proposals
- Generate a written safety program
- Generate capital plans
- Generate long term plans
- Generate short term plans
- Identify potential safety hazards
- Interpret data
- Interpret Material Safety Data Sheet
- Negotiate contracts
- Order necessary spare parts
- Organize information
- Perform impact assessments
- Prepare proposals
- Recognize unsafe work conditions
- Record information
- Report findings
- Review reports
- Select safety equipment
- Transcribe data
- Translate technical language into common terminology
- Write policies and procedures
<table>
<thead>
<tr>
<th>Evaluate and Maintain Equipment</th>
<th>Class I</th>
<th>Class II</th>
<th>Class III</th>
<th>Class IV</th>
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<tbody>
<tr>
<td><strong>Evaluate Equipment</strong></td>
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<tr>
<td>Calibrate chemical feeders</td>
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<tr>
<td>Check and evaluate capacity of equipment</td>
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<tr>
<td>Check speed of equipment</td>
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<tr>
<td><strong>Electrical grounding</strong></td>
<td>Comprehension</td>
<td>Comprehension</td>
<td>Application</td>
<td>Application</td>
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<tr>
<td>Inspect equipment for abnormal conditions</td>
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<td>Measure and evaluate head loss</td>
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<td>Measure temperature of equipment</td>
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<td>Read and evaluate charts</td>
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<td>Read and evaluate gauges</td>
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<td>Read and evaluate meter results</td>
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<tr>
<td><strong>Perform Preventative and Corrective Maintenance</strong></td>
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<tr>
<td>Aerators</td>
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<tr>
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<td>Bar screens</td>
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<td>Bioreactors</td>
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<tr>
<td>Blowers and compressors</td>
<td>Analysis</td>
<td>Analysis</td>
<td>Analysis</td>
<td>Analysis</td>
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<tr>
<td>Boilers</td>
<td>Comprehension</td>
<td>Comprehension</td>
<td>Comprehension</td>
<td>Comprehension</td>
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<tr>
<td>Cathodic protection systems</td>
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<tr>
<td>Chemical feeders</td>
<td>Analysis</td>
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<tr>
<td>Chlorinators</td>
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<td>Clarifiers</td>
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<td>Comminuters</td>
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<td>Dewatering equipment</td>
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<tr>
<td>Digesters (Aerobic)</td>
<td>Comprehension</td>
<td>Application</td>
<td>Analysis</td>
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</table>
### Evaluate and Maintain Equipment Continued

<table>
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<th>Perform Preventative and Corrective Maintenance Continued</th>
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<tbody>
<tr>
<td><strong>Class I</strong></td>
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<tr>
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</tr>
<tr>
<td>Digesters (Anaerobic)</td>
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<tr>
<td>Drives</td>
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<tr>
<td>Engines (gas, diesel)</td>
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<tr>
<td>Fittings/piping</td>
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<tr>
<td>Flow measuring devices</td>
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<tr>
<td>Gates</td>
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<tr>
<td>Generators</td>
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<tr>
<td>Grit collectors</td>
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<tr>
<td>Heat exchangers</td>
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<tr>
<td>Hydraulic equipment</td>
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<tr>
<td>Hypochlorinators</td>
</tr>
<tr>
<td>Instrumentation</td>
</tr>
<tr>
<td>Lock-out/tag-out</td>
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<tr>
<td>Motors</td>
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<tr>
<td>Off-gas equipment</td>
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<td>Ozonators</td>
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<tr>
<td>Pneumatic equipment</td>
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<tr>
<td>Pumps</td>
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<tr>
<td>Safety equipment</td>
</tr>
<tr>
<td>Screw conveyors</td>
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<tr>
<td>Valves</td>
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</tbody>
</table>

### Required Capabilities

**Knowledge of:**
- Dewatering equipment
- Flow measuring devices
- Function of tools
- General electrical principles
- Grit collectors
- HVAC
- Hypochlorinators
- Internal combustion engines
- Lubricant and fluid characteristics
- Mechanical equipment
- Operation and maintenance practices

**Ability to:**
- Calibrate equipment
- Calibrate instruments
- Demonstrate safe work habits
- Differentiate between preventative and corrective maintenance
- Evaluate operation of equipment
- Identify potential safety hazards
- Monitor electrical equipment
- Monitor mechanical equipment
- Operate safety equipment
- Perform physical measurements
### Required Capabilities Continued

#### Knowledge of:
- Personal protective equipment
- Pneumatics
- Principles of measurement
- Process control instrumentation
- Proper lifting procedures
- Proper safety procedures
- Start-up and shut-down procedures

#### Ability to:
- Recognize unsafe work conditions
- Record information
- Report findings
- Select safety equipment
- Translate technical language into common terminology
- Use hand tools

<table>
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<tr>
<th>Operate Equipment</th>
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<th>Class IV</th>
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<tbody>
<tr>
<td>Backflow prevention devices</td>
<td>Comprehension</td>
<td>Comprehension</td>
<td>Comprehension</td>
<td>Comprehension</td>
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<tr>
<td>Blowers and compressors</td>
<td>Application</td>
<td>Application</td>
<td>Analysis</td>
<td>Analysis</td>
</tr>
<tr>
<td>Boilers</td>
<td>Comprehension</td>
<td>Comprehension</td>
<td>Application</td>
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<td>Cathodic protection systems</td>
<td>Comprehension</td>
<td>Comprehension</td>
<td>Comprehension</td>
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<tr>
<td>Chemical feeders</td>
<td>Application</td>
<td>Analysis</td>
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<td>Computers</td>
<td>Analysis</td>
<td>Analysis</td>
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<tr>
<td>Digesters and gas collection</td>
<td>Application</td>
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<td>Drives</td>
<td>Application</td>
<td>Analysis</td>
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<td>Electronic testing equipment</td>
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<td>Engines (gas, diesel)</td>
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<td>Flow measuring devices</td>
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<td>Gates</td>
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### Required Capabilities

**Knowledge of:**
- Facility operation and maintenance
- Flow measuring devices
- General electrical principles
- HVAC
- Hydraulic principles
- Hypochlorinators
- Internal combustion engines
- Lubricant and fluid characteristics
- Mechanical equipment
- Operation and maintenance practices
- Pneumatics
- Proper lifting procedures
- Proper safety procedures
- Safety regulations
- Start-up and shut-down procedures

**Ability to:**
- Adjust equipment
- Calibrate equipment
- Calibrate instruments
- Demonstrate safe work habits
- Discriminate between normal and abnormal conditions
- Evaluate operation of equipment
- Identify potential safety hazards
- Interpret Material Safety Data Sheet
- Monitor electrical equipment
- Monitor mechanical equipment
- Operate safety equipment
- Perform physical measurements
- Recognize unsafe work conditions
- Record information
- Report findings

### Monitor, Evaluate, and Adjust Treatment Processes

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Required Capabilities

Knowledge of:
- Aerators
- Bar screens
- Biological science
- Bioreactors
- Chemical properties
- Chlorinators
- Clarifiers
- Comminuters
- Dewatering equipment
- Facility operation and maintenance
- Flow measuring devices
- General chemistry
- Grit collectors
- Hydraulic principles
- Hypochlorinators
- Normal characteristics of wastewater
- Normal chemical range
- Operation and maintenance practices
- Ozonators
- Personal protective equipment
- Physical science
- Pneumatics
- Pollutants
- Primary treatment processes
- Principles of measurement
- Process control instrumentation
- Proper application of chemicals
- Proper chemical handling and storage
- Proper lifting procedures
- Proper safety procedures
- Safety regulations
- Screw conveyors
- Secondary treatment processes
- Start-up and shut-down procedures
- Tertiary treatment processes
- Wastewater treatment concepts
- Wastewater treatment design parameters
- State/provincial and federal wastewater regulations and effluent guidelines
  - Clean Water Act Section 301: Effluent Standards
  - Clean Water Act Section 302: Water Quality-Related Effluent Limitations
  - Clean Water Act Section 307: Toxic and Pretreatment Effluent Standards
  - Clean Water Act Section 402: National Pollutant Discharge Elimination System
  - Clean Water Act Section 405: Disposal of Sewage Sludge

Ability to:
- Adjust chemical feed rates
- Adjust equipment
- Adjust flow patterns
- Adjust process units
- Calculate dosage rates
- Calibrate equipment
- Calibrate instruments
- Communicate in writing
- Communicate verbally
- Confirm chemical strength
- Demonstrate safe work habits
- Diagnose/troubleshoot process units
- Discriminate between normal and abnormal conditions
- Evaluate facility performance
- Evaluate process units
- Identify potential safety hazards
- Interpret data
- Maintain processes in normal operating condition
- Measure chemicals
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Required Capabilities

Knowledge of:
- Basic laboratory techniques
- Biological science
- Chemical properties
- Code of Federal Regulations
- Flow measuring devices
- General chemistry
- Laboratory equipment
- Monitoring requirements
- Normal chemical range
- Physical science
- Principles of measurement
- Proper chemical handling and storage
- Proper safety procedures
- Proper sampling procedures
- Quality control/quality assurance practices
- Regulations
- Reporting requirements
- Safety regulations
- Standard Methods
- State/provincial and federal wastewater regulations and effluent guidelines
  - Clean Water Act Section 405: Disposal of Sewage Sludge
  - 40 CFR 136: Guidelines establishing test procedures for the analysis of pollutants
  - 40 CFR 401.17: pH effluent limitations under continuous monitoring

Ability to:
- Calibrate instruments
- Communicate in writing
- Communicate verbally
- Confirm chemical strength
- Demonstrate safe work habits
- Identify potential safety hazards
- Interpret data
- Interpret Material Safety Data Sheet
- Measure chemicals
- Perform basic math
- Perform laboratory calculations
- Perform physical measurements
- Prepare chemicals
- Recognize abnormal analytical results
- Recognize unsafe work conditions
- Record information
- Report findings
- Select safety equipment
- Transcribe data
References
The following are approved as reference sources for the PO wastewater treatment examinations. Operators should use the latest edition of these reference sources to prepare for the exam.

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

- Operation of Wastewater Treatment Plants, Volume I and II
- Advanced Waste Treatment
- Manage for Success

To order, contact:
Office of Water Programs
California State University, Sacramento
6000 J Street
Sacramento, CA 95819-6025
Web site: www.owp.csus.edu
Phone: (916) 278-6142
Fax: (916) 278-5959
E-mail: wateroffice@owp.csus.edu

National Environmental Training Center for Small Communities (NETCSC)

- Protecting Your Community's Assets: A Guide for Small Wastewater Systems

More Information:
A PDF version of this guide is available from:
www.nesc.wvu.edu/training.cfm
You may also request a printed and bound hard copy of the guide by calling NETCSC at (800) 624-8301, and asking for product TRBKMG03 (shipping and handling charges may apply).

Water Environment Federation

- Operation of Municipal Wastewater Treatment Plants - Manual of Practice No. 11
- Activated Sludge - Manual of Practice OM-9

To order, contact:
Water Environment Federation
601 Wythe Street
Alexandria, VA 22314-1994
Web site: www.wef.org
Phone: (800) 666-0206
Fax: (703) 684-2492
E-mail: pubs@wef.org