



# Mechanical Technologist Candidate Handbook

MT CERTIFICATION

**CWEA**

TECHNICAL  
CERTIFICATION  
PROGRAM

v2026.01

[cert.cwea.org](https://cert.cwea.org)

# Mechanical Technologist Candidate Handbook

Version 2026.01

Congratulations on pursuing certification. Certification is a great way to demonstrate competency, show commitment to the profession, and help with job advancement.

This handbook contains information about California Water Environment Association's Technical Certification Program for certification candidates. Please read this entire handbook to become familiar with CWEA's certification policies and procedures. Certification candidates are responsible for knowing the contents of this handbook. Please contact the CWEA office at (510) 382-7800 with any questions.

All policies are subject to change. The most recent edition of this handbook can be downloaded for free on [Cert.CWEA.org](https://www.cert.cwea.org). Candidates should ensure that they have the most current version as indicated by the date in the title above.

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## INTRODUCTION TO THE TECHNICAL CERTIFICATION PROGRAM

**CWEA's** Technical Certification Program (TCP) develops and administers competency-based certification exams for wastewater professionals in a number of different vocations. The certification program was founded in 1937. The first certification offered was the Wastewater Treatment Plant Operator certification, which was later adopted by the State Water Board. The exams are developed and revised by CWEA Subject Matter Experts under the guidance of exam development professionals. The certifications continue to grow and be refined in accordance with water sector and certification professional practices. Exams are offered throughout the year and are experience based, ranging from entry level to upper management.

CWEA currently certifies over 7,000 individuals. Certification is a great way to demonstrate competency, show commitment to the water profession, and help with job advancement.

### TECHNICAL CERTIFICATION PROGRAM Executive Committee

The Technical Certification Program Executive Committee is the governing body of CWEA's certification program. It was created to develop and implement a multilevel technical certification program for individuals employed in the wastewater field. They are responsible for the development and administration of the Technical Certification Program, including the application, examination development, examination administration, and certification renewal process. They develop the guidelines, criteria, and testing procedures that are responsive to the needs of the water quality industry and allow participants to demonstrate technical competence. They are also responsible for maintaining the quality of the examinations through continuous upgrading and review.

For current Committee members, contact the CWEA office.

## Overview of the Certification Process

To become certified all applicants must complete the following requirements:

1. Submit an application
2. Pay the application fee
3. Meet the minimum qualifications regarding professional experience
4. Pass the exam

Once an applicant successfully completes the requirements, they will be mailed their certificate. In order to maintain the certification once earned, certified individuals must continue to meet the following recertification requirements:

1. Submit 12 contact hours of continuing education every two years
2. Pay the annual renewal fee

## Certifications Offered by CWEA

- Collection Systems Maintenance, Grades 1-4
- Electrical & Instrumentation, Grades 1-4
- Environmental Compliance Inspector, Grades 1-4
- Laboratory Analyst, Grades 1-4
- Mechanical Technologist, Grades 1-4
- Advanced Water Treatment Operator, Grades 3-5
  - Offered in partnership with California-Nevada Section of the American Water Works Association. For more information visit [www.AWTOperator.org](http://www.AWTOperator.org).

Please note that the **Wastewater Treatment Plant Operator Certification** and **Drinking Water Treatment Plant Operator Certification** are administered by the State of California. To work on a drinking water treatment system, distribution system or in a wastewater treatment plant, an individual must have a valid operator certificate or an operator-in-training certificate from the State Water Board. For information about these programs, please contact the [State Water Board Office of Operator Certification](#).

## APPLICATION PROCESS

### Submitting an Application

Candidates must submit an application and be approved before they can schedule an exam. Applications can be faxed, emailed or mailed to the CWEA office at any time throughout the year. Applications are reviewed by CWEA TCP Staff and/or Subject Matter Experts. Once the application is processed, candidates are notified of their approval status via email. Please follow all instructions on the application carefully. Incomplete applications may delay approval. The application is available on the [Cert.CWEA.org](http://Cert.CWEA.org) website.

### Application Deadlines and Exam Windows

The year is divided into four exam windows, each with an application deadline. Applications are valid for one year from the first date of the applicant's original exam window. Applicants may transfer exam windows throughout the year, for details see *Transferring Exam Windows* (p. 15).

Exam Windows	Exam Dates	Application Deadlines
FALL	October 1 <sup>st</sup> - December 31 <sup>st</sup>	August 31 <sup>st</sup>
WINTER	January 1 <sup>st</sup> - March 31 <sup>st</sup>	November 30 <sup>th</sup>
SPRING	April 1 <sup>st</sup> - June 30 <sup>th</sup>	February 28 <sup>th</sup>
SUMMER	July 1 <sup>st</sup> - September 30 <sup>th</sup>	May 31 <sup>st</sup>

### CWEA Application Fees

Current fees are listed on the application. Valid CWEA members qualify for a discounted member rate. The non-member rate includes a one-year CWEA membership. If an applicant does not wish to take advantage of the membership, they must note it on the application.

## Minimum Qualifications: Qualifying Education and Experience

Applicants must meet the minimum qualifications for the exam at the time the application is submitted. The table below gives the combinations of education and/or experience that will satisfy the requirements. There is no education or experience requirement to take any Grade 1 exam, however, the Grade 1 exams test at the level of one year of experience in the field. Education and experience should be relevant to the vocation and reflect the job knowledge for that grade level. Relevancy is at the sole discretion of CWEA. Applicant’s experience must be indicated on the application under “Job Duties”. Applicants should provide sufficient detail to demonstrate they possess the relevant experience. The best way to provide this information is to include the official job description for the position. Applicants consent to a thorough investigation of employment records and other qualifications in related activities for the purpose of verification of qualifications. CWEA may verify job history by contacting employers.

### MT Certification Minimum Qualifications Chart

<b>GRADE 1</b>	<ul style="list-style-type: none"> <li>▪ No experience required</li> <li>▪ (1 year of experience in the vocation is recommended)</li> </ul>
<b>GRADE 2</b>	<ul style="list-style-type: none"> <li>▪ 2 years of experience in the vocation</li> </ul>
<b>GRADE 3</b>	<ul style="list-style-type: none"> <li>▪ MT Grade 2 certification in good standing</li> <li>▪ 4 years of experience in the vocation OR 3 years with a bachelor’s degree or a water/wastewater associate degree</li> </ul>
<b>GRADE 4</b>	<ul style="list-style-type: none"> <li>▪ MT Grade 3 certification in good standing</li> <li>▪ 6 years of experience in the vocation OR 5 years with a bachelor’s degree or a water/wastewater associate degree</li> <li>▪ 1 year experience supervising others in the vocation, crew lead experience qualifies</li> </ul>

**\*Related experience from outside industries will be evaluated and may count for up to 50% of experience for Grade 2 (1 year), and no more than 25% for Grades 3 and 4.**

**\*Mechanical experience at a wastewater or water treatment plant are both considered acceptable forms of experience.**

## Application Approval

Once an application has been approved, the applicant will receive a Certification Application Approval Notification via email. It is very important that applicants use a current email address when filling out the application. CWEA will only contact applicants in regard to their application status via email. The Certification Application Approval Notification will contain the certification exam the applicant has been approved for, the exam window and CWEA ID number. This ID number is needed when contacting Pearson VUE to schedule an exam appointment.

## Rejected Application

Applications will be rejected if applicants do not meet all requirements at the time they apply. CWEA will refund the application fee minus a \$50 admin fee. Refunds are automatically issued within two weeks of rejection to the original form of payment. Candidates may request that their rejected application be reviewed by the Technical Certification Program Executive Committee by submitting a request in writing to [tcpcommittee@cwea.org](mailto:tcpcommittee@cwea.org).

## Code of Ethics

All CWEA certification holders and applicants are expected to meet the following standards of professional conduct and ethics:

1. To protect public health, themselves, their co-workers, property, and the environment by performing the essential duties of the CWEA certified vocation safely and effectively, and complying with all applicable federal, state and local regulations.
2. To represent themselves truthfully and honestly throughout the entire certification process.
3. To adhere to all test site rules and make no attempt to complete the test dishonestly or to assist any other person in doing so.
4. To refrain from activities that may jeopardize the integrity of the Technical Certification Program.

The CWEA Code of Ethics establishes basic values and standards of conduct for certification applicants and certification holders. Any action of a certification holder or applicant that compromises the reliability of the certification process may be subject to the process described by the Ethics Procedures.

The Ethics Procedures provide a fair process for dealing with ethics complaints. The procedures define the participants in an ethics case and how each case will be handled. Individuals going through the process will be given opportunities to defend themselves and appeal any decisions made. The Ethics Officer handles all official ethics complaints and determines if there is enough merit in each case to follow through with the procedures. If appropriate, the Ethics Officer may suggest mediation to resolve ethics disputes without the formality of going through the entire procedural process. This information is paraphrased for clarity from the 05-01 CWEA Code of Ethics and Ethics Procedures.

A full copy of the policy can be requested by contacting the TCP department.

Some examples of violations would be:

- Providing false work history on an application
- Using prohibited reference materials during a test
- Taking test materials from a test site
- Falsifying documentation of continuing education contact hours

Any action that might undermine CWEA's process of certifying basic minimal competency will be investigated.

## Non-Discrimination Policy

CWEA does not discriminate among applicants on the basis of age, gender, race, religion, national origin, disability, sexual orientation or marital status.

## Accommodations

In compliance with the Americans with Disabilities Act, reasonable accommodations will be provided for those individuals who provide CWEA with a physician's certificate, or its equivalent, documenting a physical or psychological disability that may affect the individual's ability to successfully complete the certification examination. Written requests for reasonable accommodations must be submitted with the application.

Language barriers and lack of familiarity with computers are not covered under ADA laws.

## Privacy

CWEA is committed to protecting privacy. Exam results and any other information regarding an application are confidential and will only be released to the applicant. Basic certification information is available on our [Certification Registry](#). Employers can use the registry to verify an individual's certification status.

## Out-of-State Programs

Anyone anywhere in the United States can apply for CWEA certification. Our certifications are specific to the state of California.

CWEA partners with the following water environment associations to administer certification exams for their members:

- Hawaii Water Environment Association
- Michigan Water Environment Association

Candidates wishing to earn certification through one of those associations should be sure to use the correct application that is specific to that association.

## Reciprocity

CWEA does not grant certification by reciprocity. For other certification programs that do offer reciprocity, CWEA will provide any information necessary for verification upon request.

# SCHEDULING AN EXAM

## Scheduling an Exam Appointment

Once an applicant receives the approval notification email, they will be eligible to schedule an exam appointment. Applicants can schedule an exam appointment through [Pearson VUE's website](#) by creating an account or by logging into an existing account. The applicant's CWEA ID number is needed when creating an account. The CWEA ID number can be found in the approval notification email. To schedule an appointment over the phone, call Pearson VUE at

888-749-3881. Test centers are conveniently located throughout the U.S. Locations can be found on [Pearson VUE's Test Center Search](#).

## Online Proctored Exams

Online proctoring is available for CWEA exams. Candidates will be notified in their approval email of the option to schedule their exam online versus at an in-person test center. Candidates should examine both options before making the choice that is best for them. Candidates will make their selection at the time when they schedule their exam.

Online proctored exams are a convenient way to take an exam at home or at work. Candidates will complete a check in process and are monitored online by a live proctor. **An onscreen calculator and white board are provided, no physical calculators or scratch paper are allowed.**

For more information about the online proctored experience, please see: <https://home.pearsonvue.com/cwea/onvue>. Please review the system requirements and Pearson Vue policies and procedures for online proctored exams before you schedule your appointment. You will be required to accept and comply with these policies.

To take an online proctored exam, candidates must meet the system requirements. If a candidate is testing at work, they should check with their Network Administrator or IT Professional that their system meets the requirements.

**It is the candidate's responsibility to ensure they meet the system requirements prior to their appointment time.** If a candidate does not meet the system requirements, they will not be able to complete their exam and will need to reschedule.

## Canceling an Existing Appointment

To cancel an appointment, applicants must notify Pearson VUE 24 hours before their scheduled appointment time. Failure to notify Pearson VUE at least 24 hours before the existing appointment will result in an \$85 No Show fee. Pearson VUE will send applicants a Cancellation Confirmation to the email on file in their Pearson VUE account.

The following are considered No Shows and will result in an \$85 No Show fee:

- Failing to appear at a scheduled test appointment
- Failing to check-in for an online appointment
- Arriving at the test center without a current, government-issued photo ID
- Arriving at the test center 15 minutes or later to a scheduled test appointment

Applicants must pay the No Show fee to schedule a new test appointment. Applicants should contact the CWEA office to reschedule.

## Rescheduling an Exam Appointment

To reschedule an existing appointment within the same exam window, applicants must call Pearson VUE directly at least 24 hours before their existing exam appointment, for details see *Canceling an Existing Appointment* (p. 14).

Applicants must contact the CWEA office to reschedule (transfer) an existing exam appointment to a different exam window. Before contacting CWEA, the applicant must cancel their existing appointment.

## Transferring Exam Windows

Applications are valid for one year from the first date of the applicant's original test window. Applicants may transfer exam windows throughout the year. The first transfer is complimentary, subsequent transfers are \$50.

Applicants can request a transfer at any time. If an applicant does not test by the last date of their original exam window, CWEA will automatically initiate a transfer and the applicant will be notified via email.

## PREPARING FOR THE EXAM

### Mechanical Technologist Certification Scope

Specifications	Grade 1	Grade 2	Grade 3	Grade 4
Brief description of the Grade Level in relation to the job family.	Entry and basic working level.	Skilled or journey level.	Lead/advanced technical/supervisory level.	Manager/superintendent/supervisory level.
Level of knowledge, skill and ability within the job family, in relation to job tasks, including the taxonomic level of knowledge applied on the job.	Basic knowledge and ability, as needed to safely and effectively perform basic tasks.  This includes: recall and recognition, comprehension, application, and basic math skills.	Knowledge and ability to safely and effectively accomplish most technical tasks in the job family.  This includes: comprehension, application, and math calculations.	Knowledge, skill and ability to safely and effectively accomplish and coordinate complex tasks.  This includes: application, analysis, synthesis, and math calculations.	Knowledge, skill and ability to create, coordinate and manage complex programs across vocations.  This includes: analysis, synthesis, and evaluation.
Level of supervision received.	Receives direct supervision.	Receives limited supervision.	Receives general direction.	May receive broad direction.
Level of supervision exercised.	None.	May provide technical direction over other staff.	May lead/supervise entry or journey level staff, and oversee and direct complex tasks performed by others.	Will provide direct supervision and coordinate program activities within or across vocations.
Level of training provided to other personnel.	None.	May train lower level personnel.	May assist in the design and/or administration of a training program.	Designs and administers training programs within the job family.

Specifications	Grade 1	Grade 2	Grade 3	Grade 4
Use of tools.	Will recognize and understand how to use the basic tools and equipment of the job family.	Will be able to apply most of the tools used by those in the job family, including knowledge and use of specialty tools.	Will select tools for individuals and teams in relation to specific problems.	Manages and evaluates systems and facilities.
Problem solving and troubleshooting responsibilities.	Follows directions.	May independently troubleshoot and solve common problems.	May independently troubleshoot, solve complex problems, and assist subordinates with complex problems.	Evaluates program effectiveness, takes corrective actions as needed, and assists subordinates with complex problems.
Actions in relation to safety problems.	Recognizes and reports unsafe conditions.	Recognizes, reports, and corrects unsafe conditions.	Anticipates and prevents unsafe conditions.	Designs and administers safety programs.
Actions in relation to standard operating procedures (S.O.P.s), laws and regulations.	Has the ability to follow S.O.P.s.	Has the ability to understand and apply S.O.P.s, laws and regulations, and provides input for improving S.O.P.s.	Formulates new S.O.P.s, in compliance with laws and regulations.	Assures program compliance with laws and regulations.
Actions in relation to documentation of work activities.	Comprehends and completes minimal work process documentation.	Completes routine work process documentation.	Responsible for detailed technical report writing and review. Updates CMMS and asset management.	Responsible for quality assurance of program documentation.

## Exam Content

CWEA’s Technical Certification Program Mechanical Technologist exams are based on exam blueprints that outline the exam content and are periodically reviewed by CWEA Subject Matter Experts. An exam blueprint is based on a job task analysis that includes research of the essential duties of a Mechanical Technologist worker at a representative cross-section of systems and facilities in California. The Mechanical Technologist Certifications were last reviewed by Subject Matter Experts in 2021.

The exam content outline that follows presents content covered on the Mechanical Technologist exams and shows the amount of the exam devoted to each Domain in the column labeled weighting.

## MT GRADE 1 EXAM CONTENT OUTLINE

Content Domain	Weighting
Domain 1 - Inspection, Maintenance, Installation, and Repair	27%
Domain 2 - Tools and Equipment	19%
Domain 3 - Records, Reports, and SCADA	12%
Domain 4 - Safety	20%
Domain 5 - Communication	12%
Domain 6 - Math for Mechanical Technologists	10%
Total	100%

## Domain 1: Inspection, Maintenance, Installation, and Repair

### Sub-Domain 1.1:

#### Inspection of Systems and Equipment

1. Assist in the general inspection of water/wastewater plant and/or lift/pump station mechanical components (pumps, valves, gates, drive systems, motors, engines, compressors, actuators, pneumatics, hydraulics, odor control systems, etc.)
2. Assist in identifying and troubleshooting mechanical problems
3. Inspect small motorized equipment and vehicles
4. Assist in the inspection of buildings and grounds equipment and structures, including building structures, doors, windows, HVAC systems, roofing systems, containment systems, plumbing systems, irrigation systems, etc.
5. Observe and assist in the inspection of equipment used for confined space entries (atmospheric monitors, air testers, blowers, etc.)

### Sub-Domain 1.2:

#### Maintenance and Repair of Tools, Equipment, Systems, and Facilities

1. Assist in the disassembly and reassembly of equipment
2. Perform general clean-up of tools, equipment, and work areas
3. Clean and lubricate motors, generators, compressors, pumps, turbines, and other moving equipment
4. Assist with regularly scheduled preventative maintenance and repair work on water/wastewater plant and lift/pump station equipment, pipelines, and valves
5. Assist in the maintenance of mechanical equipment necessary to the operation of water/wastewater facilities, including pumps, portable gas and diesel driven pumps, motors, hydraulic controls and regulators, pumping systems, chemical feed and processing equipment, compressors, heating and ventilating equipment, generators, disinfection equipment, and all other related equipment
6. Basic knowledge of building and grounds maintenance, including plumbing, painting, basic carpentry, masonry, and pipefitting repair

### Sub-Domain 1.3:

#### Installation of Components and Equipment

1. Assist in the installation of plant, field, and shop equipment, components, and machinery
2. Assist with and have a basic understanding of process equipment, including installation, mounting, alignment, guarding, pipe strain etc.

## Domain 2: Tools and Equipment

### Sub-Domain 2.1:

#### Design and Fabrication of Equipment

1. Assist in the fabrication and assembly of a variety of systems/equipment, parts, and fittings
2. Have a general understanding of how to read and interpret simple blueprints, sketches, written and verbal instructions, etc.

### Sub-Domain 2.2:

#### Operation of Tools, Equipment, and Vehicles

1. Basic understanding of working with cranes and rigging equipment for moving/placing pumps, machinery, or other heavy equipment during installation, maintenance, and repair activities
2. Operate vehicles used for installation, maintenance, and repair activities (trucks, forklifts, heavy equipment, etc.)
3. Operate equipment used for installation, maintenance, and repair activities (generators, steam cleaners, compressors, valves, pumps, gauges, engines, and electro-mechanical devices)
4. Operate hand and power tools used for installation, maintenance, and repair activities (sandblaster; grinder; pneumatic, hydraulic, and electric tools; oxy-acetylene torch, etc.)
5. Operate precision measuring instruments in the performance of various work assignments (calipers, micrometers, dial indicators, laser equipment)
6. Basic understanding of meters (such as flow meters)
7. Basic knowledge of practices, procedures, tools, and equipment of machinery and welding shops (plasmacutting, metal inert gas (MIG), tungsten inert gas (TIG), shielded metal arc welding (SMAW), oxy-acetylene torches, lathes, and mills)

## Domain 3: Records, Reports, and SCADA

### Sub-Domain 3.1:

#### Documentation

1. Basic understanding of the importance of accurate documentation
2. Assist in the preparation of work orders and field reports
3. Record various data for pumps, motors, generators, and related equipment

4. Basic understanding of workflow process and documentation in a computerized maintenance management system (CMMS)
5. Follow Operations and Maintenance (O&M) Manual and standard operating procedures (SOPs)

#### Sub-Domain 3.2:

##### Supervisory Control and Data Acquisition (SCADA)

1. Basic understanding of Supervisory Control and Data Acquisition (SCADA) system
2. Assist in identifying the status of a station or plant based on SCADA information

## Domain 4: Safety

#### Sub-Domain 4.1:

##### Safety

1. Knowledge of safety rules and safe work practices
2. Basic knowledge of Cal / OSHA standards and safety procedures for working with chemicals (such as Safety Data Sheets)
3. Basic knowledge of and ability to assist with confined space entries per Cal / OSHA and local regulations
4. Perform vehicle, tool, and equipment safety checks
5. Follow Lockout Tagout (LOTO) safety procedures
6. Identify and implement proper Personal Protective Equipment (PPE) for the work environment (safety glasses, hard hat, gloves, ear protection, respirator, face shield, hazmat suit, etc.)
7. Interpret and assist with the use of safety forms, such as Job Safety Analysis (JSA), confined space entry permits, hot work permits, etc.

## Domain 5: Communication

#### Sub-Domain 5.1:

##### Communication

1. Understand and follow oral and written instructions

2. Establish and maintain cooperative working relationships with those contacted in the course of work, including peers, operators, superiors, vendors, contractors, customers, and the general public

## Domain 6: Math for Mechanical Technologists

### Sub-Domain 6.1:

#### Math Calculations and Basic Computations

1. Calculate flow rates
2. Calculate volume and area
3. Calculate pressure
4. Convert metric and American standard measurements

## Suggested References

CWEA's exam is based on a job task analysis that includes research of the essential duties of a Mechanical Technologist at a representative cross-section of systems and facilities in California. CWEA's exams do not correspond directly to any specific textbook, educational course, or program; instead, the exams are based on an analysis of the duties commonly performed in actual practice. In developing the exam, CWEA Subject Matter Experts used their years of experience in the field along with textbooks and reference materials. Candidates should understand that the references listed do not necessarily cover all exam content. Candidates who meet the minimum qualifications for this exam may find these suggested references useful when preparing for this exam; however, these suggested references are not required reading and should not be interpreted as constituting the sole source of all exam questions.

This list does not include all the available textbooks and materials for studying for this exam. Candidates are strongly encouraged to seek additional material, training, and experience, especially in content areas for which the candidate is not adequately prepared. Candidates are encouraged to prepare for CWEA certification exams using as many different study materials as possible plus education events and on-the-job training. Recommended reading from the Office of Water Programs (which is a third-party) was provided by their team based on their expertise and review of CWEA's content outlines. Candidates are encouraged to develop their own personal study plan based on individual needs and knowledge.

## Domain 1 – Inspection, Maintenance, Installation, and Repair

Sub-Domain 1.1	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 – Eighth Edition. Pages 138 – 236, 278 – 280, 346, 365 – 369</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 24 – 25, 65 – 68, 72 – 77, 83 – 103, 124 – 128, 138 – 140, 166 – 419</p> <p>Operation of Wastewater Treatment Plants: Volume 1 – Eighth Edition. Pages 42 – 43, 47, 150 – 152, 157, 161, 171, 210 – 212, 218 – 220, 349 – 350, 365 – 381, 436 – 447, 518 – 527, 545 – 547, 602 – 605, 611 – 622, 628 – 632, 635 – 640, 653 – 685, 747, 767 – 768</p> <p>Operation of Wastewater Treatment Plants: Volume 2 – Eighth Edition. Pages 73 – 75, 79 – 80, 82 – 83, 92 – 94, 103 – 104, 122 – 124, 200 – 203, 207 – 209, 217 – 222, 225 – 230, 248 – 251, 262 – 267, 335 – 343, 353 – 355, 367 – 371, 375 – 377, 380, 387 – 395, 396 – 399, 403 – 404, 407 – 408, 432 – 433, 446 – 448, 456 – 457, 476 – 480, 482, 490 – 491, 525 – 527, 580 – 596, 605 – 713</p> <p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 110 – 112, 114</p> <p>Small Water System Operation and Maintenance – Sixth Edition. Pages 23 – 24, 86 – 89, 99 – 116, 227, 245 – 246, 271, 307 – 313, 316 – 344, 347 – 353, 360 – 371, 375</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 – Third Edition. Pages 41 – 46, 118 – 119, 207 – 218, 266, 326 – 328, 373 – 387, 422, 425 – 428, 464, 509 – 534, 561 – 633</p> <p>Water Treatment Plant Operation: Volume 1 – Seventh Edition. Pages 38 – 43, 108 – 109, 119 – 120, 177 – 178, 194 – 195, 197 – 198, 304, 374 – 380, 384, 397 – 399</p> <p>Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 83 – 84, 180 – 183, 319 – 321, 346 – 353, 371 – 374, 383 – 384, 515 – 523, 528 – 539, 552 – 596, 598 – 603, 616 – 618</p>
Sub-Domain 1.2	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 – Eighth Edition. Pages 138 – 182, 184 – 236, 278 – 280, 346, 365 – 369</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. 24 – 25, 65 – 68, 72 – 77, 83 – 103, 124 – 128, 138 – 140, 166 – 167, 169 – 194, 195 – 201, 203 – 205, 207 – 228, 229 – 237, 237 – 419</p> <p>Operation of Wastewater Treatment Plants: Volume 1 – Eighth Edition. Pages 42 – 43, 47, 150 – 152, 157, 161, 171, 210 – 212, 218 – 220, 349 – 350, 365 – 381, 436 – 447, 518 – 527, 545 – 547, 602 – 605, 611 – 618, 621 – 622, 628 – 632, 635 – 640, 653 – 662, 665 – 685, 747, 767 – 768</p>

	<p>Operation of Wastewater Treatment Plants: Volume 2 - Eighth Edition. Pages 73 - 75, 79 - 80, 82 - 83, 92 - 94, 103 - 104, 122 - 124, 200 - 203, 207 - 209, 217 - 222, 225 - 230, 248 - 251, 262 - 267, 335 - 343, 353 - 355, 367 - 371, 375 - 377, 380, 387 - 399, 403 - 404, 407 - 408, 432 - 433, 446 - 448, 456 - 457, 476 - 480, 482, 490 - 491, 525 - 527, 580 - 596, 605 - 713</p> <p>Operation of Wastewater Treatment Plants: Volume 3 - First Edition. Pages 110 - 112, 114</p> <p>Small Water System Operation and Maintenance - Sixth Edition. Pages 23 - 24, 86 - 89, 99 - 116, 227, 245 - 246, 271, 307 - 313, 316 - 344, 347 - 353, 360 - 371, 375</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 - Third Edition. Pages 41 - 46, 118 - 119, 207 - 218, 266, 326 - 328, 373 - 382, 384 - 387, 422, 425 - 428, 464, 509 - 534, 561 - 633</p> <p>Water Treatment Plant Operation: Volume 1 - Seventh Edition. Pages 38 - 43, 119 - 120, 171 - 172, 177 - 178, 196 - 199, 234, 253, 304, 373 - 380, 396 - 399, 415 - 417, 421, 468, 497 - 498, 500 - 501, 551 - 552</p> <p>Water Treatment Plant Operation: Volume 2 - Seventh Edition. Pages 70 - 71, 83, 93, 121, 126, 180 - 181, 234, 294, 319, 352 - 353, 371 - 376, 428 - 429, 497 - 498, 522, 534 - 539, 544 - 545, 548 - 608, 618</p>
Sub-Domain 1.3	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 - Eighth Edition. Pages 428 - 438, 441 - 456, 460 - 462, 464 - 465</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 - Eighth Edition. Pages 105 - 116, 179 - 182, 207 - 228, 279 - 322</p> <p>Operation of Wastewater Treatment Plants: Volume 1 - Eighth Edition. Pages 93 - 97, 156, 165 - 171, 180 - 186, 205 - 206, 224 - 225, 248 - 251, 347 - 350, 437 - 439, 449 - 456, 513 - 514, 542 - 543, 565 - 566, 598 - 601, 661, 684, 747 - 752</p> <p>Operation of Wastewater Treatment Plants: Volume 2 - Eighth Edition. Pages 92 - 98, 115, 126, 139 - 147, 217 - 222, 231, 252, 268, 409 - 410, 492 - 505, 594, 596 - 598, 651 - 653, 672 - 682, 689 - 692</p> <p>Operation of Wastewater Treatment Plants: Volume 3 - First Edition. Pages 72, 79, 96 - 98, 113, 192, 222 - 228</p> <p>Small Water System Operation and Maintenance - Sixth Edition. Pages 343 - 345, 414, 416 - 418</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 - Third Edition. Pages 162 - 167, 313</p> <p>Water Distribution System Operation and Maintenance - Seventh Edition. Pages 91, 93 - 129, 132 - 146, 152 - 154, 324 - 332, 362 - 363</p> <p>Water Treatment Plant Operation: Volume 1 - Seventh Edition. Pages 389 - 391</p>

	Water Treatment Plant Operation: Volume 2 - Seventh Edition. Pages 246, 281 - 289, 293, 346 - 347, 616 - 617
<b>Domain 2 - Tools and Equipment</b>	
Sub-Domain 2.1	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 - Eighth Edition. Pages 33 - 51, 72 - 74, 89 - 203, 315 - 319, 422 - 426, 428 - 435, 442 - 445, 446 - 456, 460 - 462, 464</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 - Eighth Edition. Pages 52 - 54, 106, 166 - 234, 283 - 309, 311 - 322</p> <p>Operation of Wastewater Treatment Plants: Volume 1 - Eighth Edition. Pages 184 - 186, 224 - 225, 450 - 456, 513 - 514, 542 - 543, 565 - 566, 599 - 601, 661, 684, 747 - 752</p> <p>Operation of Wastewater Treatment Plants: Volume 2 - Eighth Edition. Pages 92 - 93, 105 - 106, 115, 126, 139 - 147, 231, 252, 268, 636 - 638, 644 - 647, 651 - 653, 659 - 673</p> <p>Operation of Wastewater Treatment Plants: Volume 3 - First Edition. Pages 113 - 114, 192</p> <p>Water Treatment Plant Operation: Volume 1 - Seventh Edition. Pages 212 - 219, 227 - 231</p> <p>Water Distribution System Operation and Maintenance - Seventh Edition. Pages 120 - 122, 208</p> <p>Water Treatment Plant Operation: Volume 2 - Seventh Edition. Pages 246, 293 - 294, 371 - 376</p>
Sub-Domain 2.2	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 - Eighth Edition. Pages 427 - 428, 440 - 441, 458 - 460</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 - Eighth Edition. Pages 143 - 153</p> <p>Operation of Wastewater Treatment Plants: Volume 1 - Eighth Edition. Pages 77, 82 - 89, 142 - 150, 184, 285 - 290, 409 - 414, 606 - 608</p> <p>Operation of Wastewater Treatment Plants: Volume 2 - Eighth Edition. Pages 257 - 259, 595 - 596, 605 - 622, 698 - 701, 709 - 710</p> <p>Operation of Wastewater Treatment Plants: Volume 3 - First Edition. Pages 373 - 375</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 - Third Edition. Pages 120 - 123, 137 - 139, 527, 631 - 634</p> <p>Water Distribution System Operation and Maintenance - Seventh Edition. Pages 146 - 470</p> <p>Water Treatment Plant Operation: Volume 2 - Seventh Edition. Pages 72, 77 - 83, 465 - 470, 515 - 523, 597 - 605</p>

## Domain 3 – Records, Reports, and SCADA

Sub-Domain 3.1	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 – Eighth Edition. Pages 308 – 309, 415, 488</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 107 – 108, 124 – 131, 241 – 245, 406 – 408</p> <p>Operation of Wastewater Treatment Plants: Volume 1 – Eighth Edition. Pages 298 – 301, 810 – 812</p> <p>Operation of Wastewater Treatment Plants: Volume 2 – Eighth Edition. Pages 69 – 73, 85, 98 – 103, 111 – 114, 118 – 120, 124 – 129, 132 – 133, 138 – 139, 144 – 147, 212, 223 – 230, 248, 259 – 262, 291 – 293, 300 – 301, 328 – 335, 347 – 353, 358 – 367, 373 – 375, 378 – 380, 418 – 431, 450 – 456, 463 – 476, 481 – 482, 486 – 513, 518, 524 – 525, 532 – 533, 577 – 579, 635</p> <p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 454 – 458, 461 – 463</p> <p>Small Water System Operation and Maintenance – Sixth Edition. Pages 152 – 160, 253 – 255, 498 – 499, 615 – 619</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 – Third Edition. Pages 334 – 335, 396 – 399, 507 – 509, 561</p> <p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 74, 259 – 260, 568 – 571</p> <p>Water Treatment Plant Operation: Volume 1 – Seventh Edition. Pages 36 – 38, 43, 101, 111 – 112, 120, 162 – 163, 166, 168, 170, 246 – 247, 294, 548 – 549</p> <p>Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 194, 249 – 250, 351 – 352, 545 – 548, 668 – 669, 716 – 720</p>
Sub-Domain 3.2	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 82 – 83, 127 – 129</p> <p>Operation of Wastewater Treatment Plants: Volume 2 – Eighth Edition. Pages 115, 222 – 223, 231, 246 – 247, 280 – 282, 295 – 296, 450, 457, 577 – 579, 605, 632 – 634</p> <p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 203 – 206</p> <p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 264 – 265, 521 – 525</p> <p>Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 343 – 344, 671 – 673</p>

## Domain 4 – Safety and Facility Maintenance

Sub-Domain 4.1	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 – Eighth Edition. Pages 88 – 216</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 7 – 19, 57, 137 – 138, 381 – 408</p> <p>Operation of Wastewater Treatment Plants: Volume 1 – Eighth Edition. Pages 43 – 46, 55 – 98, 101 – 130, 137 – 140, 164 – 165, 181 – 182, 205 – 207, 225, 245 – 252, 580 – 583, 634, 642 – 645, 665, 696, 762 – 774</p> <p>Operation of Wastewater Treatment Plants: Volume 2 – Eighth Edition. Pages 40 – 42, 97 – 98, 202 – 204, 230 – 231, 251 – 252, 267 – 268, 448 – 450, 596 – 600</p> <p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 39 – 41, 54 – 55, 155, 215 – 218, 488 – 498</p> <p>Small Water System Operation and Maintenance – Sixth Edition. Pages 271, 273, 393, 395, 403 – 406, 411, 414, 416 – 418, 420, 464 – 466, 467 – 475</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 – Third Edition. Pages 52 – 136, 210, 272 – 275, 326, 345, 434 – 435, 505 – 506</p> <p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 30 – 32, 74 – 75, 130, 334 – 335, 365 – 369, 386 – 411, 456 – 467, 543 – 558</p> <p>Water Treatment Plant Operation: Volume 1 – Seventh Edition. Pages 19 – 24, 49 – 51, 101 – 102, 112, 120, 163, 168, 170, 178 – 179, 254, 305, 362, 393, 401 – 406, 408, 421, 550 – 556</p> <p>Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 52 – 66, 68 – 70, 73 – 77, 80, 83 – 88, 90 – 92, 93 – 132, 162 – 163, 277 – 279, 357, 390 – 391, 459 – 464, 508 – 510, 690 – 716</p>
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## Domain 5 – Communication

Sub-Domain 5.1	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 – Eighth Edition. Page 74</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 21 – 22, 365 – 375</p> <p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 478 – 488</p> <p>Small Water System Operation and Maintenance – Sixth Edition. Page 25</p> <p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 31 – 32, 268 – 270, 501 – 510</p>
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	<p>Water Treatment Plant Operation: Volume 1 – Seventh Edition. Pages 49, 164, 166</p> <p>Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 652 – 660</p>
<b>Domain 6 – Math</b>	
Sub-Domain 6.1	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 – Eighth Edition. Pages 513 – 521, 524 – 531, 534 – 537, 538 – 539</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 499 – 507, 510 – 517, 520 – 525</p> <p>Operation of Wastewater Treatment Plants: Volume 1 – Eighth Edition. Pages 957 – 965, 968 – 975, 978 – 983</p> <p>Operation of Wastewater Treatment Plants: Volume 2 – Eighth Edition. Pages 735 – 748, 757 – 771, 778 – 781, 782 – 785, 790</p> <p>Operation and Maintenance of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 537 – 550, 559 – 573, 580 – 587</p> <p>Small Water System Operation and Maintenance – Sixth Edition. Pages 651 – 659, 664 – 669, 672 – 677</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 – Third Edition. Pages 655 – 668, 677 – 691, 698 – 705</p> <p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 599 – 607, 612 – 617, 620 – 625</p> <p>Water Treatment Plant Operation: Volume 1 – Seventh Edition. Pages 647 – 655, 658 – 665, 668 – 673</p> <p>Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 747 – 755, 758 – 765, 768 – 773</p>

## Suggested References List

- [Operation and Maintenance of Wastewater Collection Systems, Volume 1, Eighth Edition, Office of Water Programs](#)
- [Operation and Maintenance of Wastewater Collection Systems, Volume 2, Eighth Edition, Office of Water Programs](#)
- [Operation of Wastewater Treatment Plants, Volume 1, Eighth Edition, Office of Water Programs](#)
- [Operation of Wastewater Treatment Plants, Volume 2, Eighth Edition, Office of Water Programs](#)
- [Operation of Wastewater Treatment Plants, Volume 3, First Edition, Office of Water Programs](#)
- [Small Water System Operation and Maintenance, Sixth Edition, Office of Water Programs](#)
- [Small Wastewater System Operation and Maintenance, Volume 1, Third Edition, Office of Water Programs](#)
- [Water Treatment Plant Operations, Volume 1, 7th Edition, Office of Water Programs](#)
- [Water Treatment Plant Operations, Volume 2, 7th Edition, Office of Water Programs](#)
- [Water Distribution System Operation and Maintenance, Seventh Edition, Office of Water Programs](#)

## Sample Questions

This section provides sample questions to help applicants become familiar with the exam format and subject matter.

1. What is the proper definition of an engine?
  - a. It is a machine designed to move a piece of equipment
  - b. It is a machine designed to convert energy into useful mechanical motion
  - c. It is a machine designed to generate heat to create energy
  - d. It is a machine designed to convert gasoline to kinetic energy
2. You are working on a pump that has no internal moving parts. What type of pump are you working on?
  - a. Centrifugal Pump
  - b. Double Diaphragm Pump
  - c. Open Screw Pump
  - d. Submersible Pump
3. What is the purpose of a breakaway switch?
  - a. To shut down an engine in the event of a runaway engine
  - b. To prevent broken belts from injuring bystanders
  - c. To apply the brakes on a trailer in the event of a trailer release from a vehicle
  - d. To stop a vehicle in the event of brake failure
4. Which type of saw is used to cut metallic materials?
  - a. Coping saw
  - b. Crosscut saw
  - c. Rip saw
  - d. Hacksaw
5. A scale on a blueprint indicates 1"=2". What does the scale mean?
  - a. Each one inch and two inch increment on the print will be marked
  - b. Each line on the print is accurate within one to two inches of the actual line
  - c. Each line on the print is shown twice its actual size
  - d. Each line on the print is shown half its actual size
6. A computerized maintenance management system (CMMS) is a/an:
  - a. concept.
  - b. idea.
  - c. wastewater process.
  - d. tool.

7. Which problem will not occur when a person works in a very hot area for a prolonged period of time?
  - a. Heat stroke
  - b. Cramps
  - c. Exhaustion
  - d. Hypothermia
8. What is the purpose of a confined space safety permit?
  - a. It avoids legal responsibility when a fatal accident occurs during the entry
  - b. It supports limiting the employer's liability for injuries that may occur
  - c. It informs regulating agencies that dangerous work is being performed
  - d. It ensures the use of safety precautions and safe procedures
9. You and a coworker are doing a preventative maintenance task and you notice that they are not taking notes for record keeping. Which of the following reasons should you give your coworker to ensure he takes notes on the maintenance?
  - a. Records are needed to show who worked on the maintenance task. Staff needs to be able to record their tasks completed at any time during working hours
  - b. Records are needed to show the maintenance was done and how quickly it was completed. It proves the effectiveness of the maintenance programs
  - c. Records are needed to show the type and frequency of maintenance of operating units and to evaluate the effectiveness of the maintenance programs
  - d. Records are needed to show that the maintenance was completed in a safe manner. All parties involved in the maintenance need to document that no accident occurred
10. Which is the **least** important when accepting a work order?
  - a. The tools and parts necessary for the task. That way you will not start a job only to find you are missing items and keep equipment off-line for extended periods of time
  - b. The need for speedy completion. After all, they are assigned and you want to look good
  - c. The task and its goal, the procedure and safety requirements of the job
  - d. Ask questions to clarify what is needed so it is done properly. That way time and effort aren't wasted and equipment potentially damaged
11. During the shimming process of a pump, there is a 3/16-inch gap at one corner, causing a soft foot condition. Which of the following shims or combination of shims would eliminate the soft foot condition?
  - a. One 0.3125-inch shim
  - b. One 0.48-inch shim
  - c. One 0.125-inch shim and one 0.0625-inch shim
  - d. One 0.3-inch shim and one 0.16-inch shim

12. A water storage tank has a total capacity of 8,000 gallons. If the tank is 75% full, how much water is in the tank?
- a. 5,000 gallons
  - b. 6,000 gallons
  - c. 6,500 gallons
  - d. 7,500 gallons

## Answer Key and Solutions

1. B - Domain 1
2. C - Domain 1
3. C - Domain 2
4. D - Domain 2
5. D - Domain 3
6. D - Domain 3
7. D - Domain 4
8. D - Domain 4
9. C - Domain 5
10. B - Domain 5
11. C - Domain 6
12. B - Domain 6

## MT GRADE 2 EXAM CONTENT OUTLINE

Content Domain	Weighting
Domain 1 - Inspection, Maintenance, Installation, and Repair	29%
Domain 2 - Tools and Equipment	21%
Domain 3 - Records, Reports, and SCADA	12%
Domain 4 - Safety	18%
Domain 5 - Administration and Communication	10%
Domain 6 - Math for Mechanical Technologists	10%
Total	100%

### Domain 1: Inspection, Maintenance, Installation, and Repair

#### Sub-Domain 1.1:

##### Inspection of Systems and Equipment

1. Inspect water/wastewater machinery and process equipment (pumps, valves, gates, drive systems, motors, engines, compressors, actuators, pneumatic, hydraulic, and odor control systems, etc.)
2. Independently troubleshoot and diagnose mechanical malfunctions. Make recommendations and determine effective course of action for correcting them
3. Basic electrical knowledge of pumps, motors, and other equipment
4. Basic knowledge of standard practices and procedures for precision alignment and coupling of rotating equipment, including gear-reduction drives, shafts, and belts/sheaves.
5. Adjust and set valve clearance, adjust engine timing, troubleshoot fuel systems and other engine control/components
6. Inspect and maintain motorized equipment and vehicles
7. Use vibration analysis tools, thermal imaging cameras, and other appropriate efficiency data to assess equipment using a predictive maintenance program

### Sub-Domain 1.2:

#### Maintenance and Repair of Tools, Equipment, Systems, and Facilities

1. Perform regularly scheduled preventative maintenance and repair work on water/wastewater plants, lift/pump station equipment, pipelines, and valves
2. Maintain and troubleshoot mechanical equipment necessary to the operation of water/wastewater facilities, including pumps, portable gas/diesel driven pumps, motors, hydraulic controls, regulators, pumping systems, chemical feed, processing equipment, compressors, heating and ventilating equipment, generators, disinfection equipment, and all other related equipment
3. Clean and lubricate motors, generators, compressors, pumps, turbines, and other moving equipment
4. Collaborate with industry peers (such as other departments or agencies) to perform major and minor repair work on water/wastewater facility equipment
5. Inspect, calibrate, and maintain equipment used for confined space entries (atmospheric monitors, air testers, etc.)
6. Investigate the root cause of failures, identify defects, and resolve complex mechanical repair problems
7. Advanced knowledge of building and grounds maintenance including plumbing, painting, basic carpentry, masonry, and pipefitting repair

### Sub-Domain 1.3:

#### Installation of Components and Equipment

1. Install and adjust a variety of mechanical equipment necessary to the operation of water/wastewater facilities, including pumps, motors, hydraulic controls and regulators, valves, pumping systems, chemical feed, processing equipment, compressors, heating and ventilating equipment, generators, and other related equipment
2. Recommend improvements to the design and installation of water/storm/sewer stations and water/wastewater facilities

## Domain 2: Tools and Equipment

### Sub-Domain 2.1:

#### Design and Fabrication of Equipment

1. Design, fabricate, and assemble a variety of systems/equipment, parts, and fittings

2. Fabricate parts and fittings, make assemblies, and repair equipment based on drawings, specifications, sketches, work orders, verbal instructions, or personal visual inspection

### Sub-Domain 2.2:

#### Operation of Tools, Equipment, and Vehicles

1. Operate a crane or rigging equipment for moving/placing pumps, machinery, or other heavy equipment during installation, maintenance, and repair activities
2. Operate vehicles used for installation, maintenance, and repair activities (trucks, forklifts, heavy equipment, etc.)
3. Operate equipment used for installation, maintenance, and repair activities (portable and stationary generators, jackhammers, steam cleaners, portable pumps, compressors, valves, pumps, gauges, engines, and electro-mechanical devices)
4. Operate hand and power tools used for installation, maintenance, and repair activities (sandblaster, grinder, drill, drill press, pneumatic, hydraulic, and electric tools, oxy-acetylene torch)
5. Operate precision measuring instruments in the performance of various work assignments (calipers, micrometers, dial indicators, laser equipment)
6. Knowledge of practices, procedures, tools, and equipment of machinery and welding shops (plasma-cutting, metal inert gas (MIG), tungsten inert gas (TIG), shielded metal arc welding (SMAW), oxy-acetylene torches, lathes, and mills)

## Domain 3: Records, Reports, and SCADA

### Sub-Domain 3.1:

#### Maps and Blueprints

1. Read street and utility maps (GIS)
2. Read and interpret blueprints, basic electrical schematics, drawings, and as-builts
3. Document changes or discrepancies (redline) in existing blueprints, drawings, and as-builts, and communicate changes appropriately

### Sub-Domain 3.2:

#### Documentation

1. Maintain comprehensive and detailed records of maintenance and repairs
2. Record repair actions and parts requests
3. Record work orders and field reports
4. Record various data for pumps, motors, generators, and related equipment

5. Prepare reports on operations and activities (posting of work orders, daily logs, ledgers, parts lists, invoices, and inventories)
6. Knowledge of documentation and regulatory requirements (such as regional Air Pollution governing body, Department of Toxic Substances Control (DTSC), Certified Unified Program Agencies (CUPA), California Code of Regulations Title 22)
7. Work with and understand how to use a computerized maintenance management system (CMMS) and use the system for preventative, predictive, and corrective repair of assets

### Sub-Domain 3.3:

#### Supervisory Control and Data Acquisition (SCADA)

1. General understanding of Supervisory Control and Data Acquisition (SCADA) system
2. General knowledge of SCADA trending tools to monitor equipment status and predict/anticipate equipment failure

## Domain 4: Safety

### Sub-Domain 4.1:

#### Safety

1. Knowledge of safety rules and safe work practices with understanding of local, state, and federal laws, ordinances, and rules
2. Handle all work-related chemicals in accordance with Cal / OSHA standards and safety procedures (such as Safety Data Sheets)
3. Perform confined space entries per Cal / OSHA and local regulations
4. Perform vehicle, tool, and equipment safety checks, and chemical tests
5. Understand and follow Lockout Tagout (LOTO) safety procedures
6. Identify and implement proper Personal Protective Equipment (PPE) for work environment (safety glasses, hard hat, gloves, ear protection, respirator, face shield, hazmat suit)
7. Interpret and use safety forms, such as Job Safety Analysis (JSA), confined space entry permits, and hot work permits

## Domain 5: Administration and Communication

### Sub-Domain 5.1:

#### Administration

1. Assist in the development of a preventative maintenance schedule
2. Work with other individuals and departments to accomplish the planned maintenance routines
3. Evaluate operations and activities of assigned responsibilities and recommend improvements/modifications
4. General knowledge of process to request quotes and purchase of small equipment, parts, tools, and contractor work
5. Knowledge of how to prepare rough estimates of labor and materials necessary to accomplish the maintenance and repair activities
6. Follow Operations and Maintenance (O&M) Manual and standard operating procedures (SOPs) and provide input for improvement
7. Lead and train new team members

### Sub-Domain 5.2:

#### Communication

1. Understand and follow oral and written instructions
2. Establish and maintain cooperative working relationships with those contacted in the course of work, including peers, operators, direct reports, superiors, vendors, contractors, customers, and the general public

## Domain 6: Math for Mechanical Technologists

### Sub-Domain 6.1:

#### Math Calculations and Basic Computations

1. Calculate flow rates
2. Calculate volume and area
3. Calculate horsepower (brake and motor)
4. Calculate precision measurements (using calipers, micrometers, etc.)
5. Calculate drive ratios
6. Calculate pressure
7. Convert metric and American standard measurements
8. Interpret a pump curve

## Suggested References

CWEA’s exam is based on a job task analysis that includes research of the essential duties of a Mechanical Technologist at a representative cross-section of systems and facilities in California. CWEA’s exams do not correspond directly to any specific textbook, educational course, or program; instead, the exams are based on an analysis of the duties commonly performed in actual practice. In developing the exam, CWEA Subject Matter Experts used their years of experience in the field along with the key textbooks and reference materials listed below. Candidates should understand that the references listed do not necessarily cover all exam content. Candidates who meet the minimum qualifications for this exam may find these suggested references useful when preparing for this exam; however, these suggested references are not required reading and should not be interpreted as constituting the sole source of all exam questions.

This list does not include all the available textbooks and materials for studying for this exam. Candidates are strongly encouraged to seek additional material, training, and experience, especially in content areas for which the candidate is not adequately prepared. Candidates are encouraged to prepare for CWEA certification exams using as many different study materials as possible plus education events and on-the-job training. Recommended reading from the Office of Water Programs (which is a third-party) was provided by their team based on their expertise and review of CWEA’s content outlines. Candidates are encouraged to develop their own personal study plan based on individual needs and knowledge.

### Domain 1 – Inspection, Maintenance, Installation, and Repair

#### Sub-Domain 1.1

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Operation of Wastewater Treatment Plants: Volume 1 – Eighth Edition. Pages 153, 212–221, 340–343, 347–355, 365–381, 408–409, 436–448, 452–453, 456, 518–528, 544–545, 546–547, 567–568, 610–622, 635–640, 653–661, 665–685, 735

Operation of Wastewater Treatment Plants: Volume 2 – Eighth Edition. Pages 79–83, 200–202, 207–208, 248–251, 262–267, 335–343, 353–355, 367–371, 375–377, 387–413, 432–433, 456–457, 476–480, 482, 490–491, 498–511, 518–530, 536, 580–594, 600–604, 616, 622–632, 640, 644–658, 659–706

Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 117–129, 135–137, 140–145, 220–228, 246–247

	<p>Small Wastewater System Operation and Maintenance: Volume 1 – Third Edition. Pages 40-41, 195-196, 204-205, 212-218, 328-329, 539-559, 571-586</p> <p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 70-73, 132-142, 195-201, 232-238</p> <p>Water Treatment Plant Operation: Volume 1 – Seventh Edition. Pages 38-43, 119-120, 177-178, 194-195, 197-198, 304, 374-380, 384, 397-399</p> <p>Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 83-84, 88-89, 180-183, 319-321, 346-353, 357, 383-384, 456-459, 512-539, 556-596</p>
Sub-Domain 1.2	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 24-28, 118-121, 122-124, 164-165, 168, 174-176, 182-183, 185-200, 203-205, 207-241, 250-258, 270-276, 331-345, 428-448</p> <p>Operation of Wastewater Treatment Plants: Volume 1 – Eighth Edition. Pages 62-64, 183-184, 292-297, 347-355, 365-381, 437-447, 466-485, 518-527, 529-536, 551-554, 594-598, 602-605, 611-618, 621-622, 628-632, 635-640, 653-662, 665-668, 672-673, 677-678, 679-682, 718</p> <p>Operation of Wastewater Treatment Plants: Volume 2 – Eighth Edition. Pages 73-75, 79-80, 82-83, 103-104, 122-124, 200-203, 207-209, 225-230, 248-251, 262-267, 335-343, 353-355, 367-371, 375-377, 380, 387-404, 407-408, 432-433, 456-457, 476-480, 482, 490-491, 525-527, 580-596, 605-635, 636-713</p> <p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 96 – 99, 110 – 112, 114</p> <p>Small Water System Operation and Maintenance – Sixth Edition. Pages 99, 140-144, 245-247, 318-334, 338-339, 350-353, 563-564</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 – Third Edition. Pages 40-41, 162-166, 212-218, 219-255, 300-313, 317-324, 513-528, 563-564, 582-586, 592-595</p> <p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 58 – 61, 68</p> <p>Water Treatment Plant Operation: Volume 1 – Seventh Edition. Pages 108-109, 196-198, 234, 253, 304, 396-397, 416-417, 421, 468</p> <p>Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 70-77, 352-353, 463-464, 497-498, 548-552, 566-581, 587-600</p>
Sub-Domain 1.3	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 34-35, 108-116, 166-167, 169-182, 184-203, 258-267, 270-274</p> <p>Operation of Wastewater Treatment Plants: Volume 1 – Eighth Edition. Pages 184-186, 451, 513-514, 565-566, 599-600, 661, 684, 747-752</p>

	<p>Operation of Wastewater Treatment Plants: Volume 2 - Eighth Edition. Pages 139-140, 231, 252, 268, 643, 652-653, 662-664, 689-693, 698-703</p> <p>Operation of Wastewater Treatment Plants: Volume 3 - First Edition. Pages 113, 192, 222-228</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 - Third Edition. Pages 178 - 189, 199 - 202, 373 - 382, 484 - 489, 587 - 600</p> <p>Water Treatment Plant Operation: Volume 1 - Seventh Edition. Pages 389 - 391</p>
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## Domain 2 - Tools and Equipment

Sub-Domain 2.1	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 - Eighth Edition. Pages 23-51, 72-74, 315-319</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 - Eighth Edition. Pages 52-54, 166-234</p> <p>Operation of Wastewater Treatment Plants: Volume 1 - Eighth Edition. 450 - 456</p> <p>Operation of Wastewater Treatment Plants: Volume 2 - Eighth Edition. Pages 66-69, 636-638, 644-647, 651-653, 659-654, 665-673</p> <p>Water Treatment Plant Operation: Volume 1 - Seventh Edition. Pages 212-227, 424-431</p> <p>Water Treatment Plant Operation: Volume 2 - Seventh Edition. Pages 293 - 294, 371 - 376</p>
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Sub-Domain 2.2	<p>Operation of Wastewater Treatment Plants: Volume 1 - Eighth Edition. Pages 77, 82-89, 142-150, 184, 285-290, 409-414, 606-608</p> <p>Operation of Wastewater Treatment Plants: Volume 2 - Eighth Edition. Pages 257-259, 351-353, 364-367, 375, 595-596, 605-622, 698-701, 709-710</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 - Third Edition. Pages 120-123, 137-139</p> <p>Water Distribution System Operation and Maintenance - Seventh Edition. Pages 389-391</p> <p>Water Treatment Plant Operation: Volume 2 - Seventh Edition. Pages 72, 77-83, 597-605</p>
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## Domain 3 - Records, Reports, and SCADA

Sub-Domain 3.1	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 - Eighth Edition. Pages 72-74, 488-489</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 - Eighth Edition. Pages 23-24, 106, 129-130, 250-258, 461-471</p>
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	<p>Operation of Wastewater Treatment Plants: Volume 1 - Eighth Edition. Pages 184, 225-226, 450-453, 513-514, 565-566, 747-753</p> <p>Operation of Wastewater Treatment Plants: Volume 2 - Eighth Edition. Pages 92-93, 105-106, 115, 126, 139-147, 231, 252, 268, 574-577</p> <p>Operation of Wastewater Treatment Plants: Volume 3 - First Edition. Pages 72, 95, 113, 455-456</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 - Third Edition. Pages 509 - 512</p> <p>Water Distribution System Operation and Maintenance - Seventh Edition. Pages 260 - 264, 518 - 519</p> <p>Water Treatment Plant Operation: Volume 2 - Seventh Edition. Pages 668 - 669</p>
Sub-Domain 3.2	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 - Eighth Edition. Pages 308-309, 462-463, 488-489</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 - Eighth Edition. Pages 28, 118-121, 124-128, 129-130, 241-244, 250-258, 449-452, 476-478</p> <p>Operation of Wastewater Treatment Plants: Volume 1 - Eighth Edition. Pages 43, 298-300, 678-679, 810-812</p> <p>Operation of Wastewater Treatment Plants: Volume 2 - Eighth Edition. Pages 300-301, 577-579, 635</p> <p>Operation of Wastewater Treatment Plants: Volume 3 - First Edition. Pages 454-457, 461-463, 476-477</p> <p>Small Water System Operation and Maintenance - Sixth Edition. Pages 153-160, 498-499, 616-618</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 - Third Edition. Pages 334-335, 396-399, 507-509</p> <p>Water Distribution System Operation and Maintenance - Seventh Edition. Pages 74, 233, 237, 259-260, 568-571</p> <p>Water Treatment Plant Operation: Volume 1 - Seventh Edition. Pages 36-38, 43, 101, 111-112, 120, 162-163, 166, 168, 170, 246-247, 294, 481</p> <p>Water Treatment Plant Operation: Volume 2 - Seventh Edition. Pages 194, 249-250, 351-352, 491-495, 507-510, 545-547, 718-720</p>
Sub-Domain 3.3	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 - Eighth Edition. Pages 82-83, 127-129</p> <p>Operation of Wastewater Treatment Plants: Volume 2 - Eighth Edition. Pages 115, 222-223, 231, 246-247, 280-282, 295-296, 450, 457, 577-579, 605, 632-634</p>

	<p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 203 – 206</p> <p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 264-265, 521-525</p> <p>Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 343-344, 671-673</p>
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### Domain 4 – Safety and Facility Maintenance

Sub-Domain 4.1	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 – Eighth Edition. Pages 88-134, 135-216</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 7-19, 57, 137-138, 381-408</p> <p>Operation of Wastewater Treatment Plants: Volume 1 – Eighth Edition. Pages 43-46, 55-82, 90-92, 95-98, 101-130, 137-140, 164-165, 181-182, 205-207, 225, 245-252, 580-583, 634, 642-645, 665, 696, 762-774</p> <p>Operation of Wastewater Treatment Plants: Volume 2 – Eighth Edition. Pages 40-42, 97-98, 202-204, 230-231, 251-252, 267-268, 448-450, 596-600</p> <p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 39-41, 54-55, 155, 215-218, 488-498</p> <p>Small Water System Operation and Maintenance – Sixth Edition. Pages 271, 273, 393, 395, 403-406, 411, 414, 416-418, 420, 464-466, 467-475</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 – Third Edition. Pages 52-136, 210, 272-275, 326, 345, 434-435, 505-506</p> <p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 30-32, 74-75, 130, 334-335, 365-369, 386-387, 389, 391, 392-411, 456-467, 543-558</p> <p>Water Treatment Plant Operation: Volume 1 – Seventh Edition. Pages 19-24, 49-51, 101-102, 112, 120, 163, 168, 170, 178-179, 254, 305, 362, 393, 401-406, 408, 421, 550-556</p> <p>Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 52-66, 68-70, 73-77, 80, 83-88, 90-97, 97-132, 162-163, 277-279, 357, 390-391, 459-464, 508-510, 690-716</p>
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### Domain 5 – Administration and Communication

Sub-Domain 5.1	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 2-5, 25-28, 118-121, 243-244, 275-278, 331-342, 350-364, 392, 401, 428-448</p> <p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 428-441, 450-451, 461-463</p>
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	<p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 487–499, 519–520</p> <p>Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 637–650, 662–665, 718</p>
Sub-Domain 5.2	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 – Eighth Edition. Page 74</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 21–22, 365–375</p> <p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 478 – 488</p> <p>Small Water System Operation and Maintenance – Sixth Edition. Page 25</p> <p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 31–32, 268–270, 501–510</p> <p>Water Treatment Plant Operation: Volume 1 – Seventh Edition. Pages 49, 164, 166</p> <p>Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 652 – 660</p>

## Domain 6 – Math

Sub-Domain 6.1	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 – Eighth Edition. Pages 77–82, 513–521, 524–534, 534–537, 538–539, 540–544, 546–548</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 499–507, 510–520, 520–524, 524–525, 526–530, 532–534</p> <p>Operation of Wastewater Treatment Plants: Volume 1 – Eighth Edition. Pages 140–142, 148–149, 157–161, 179–180, 258–278, 283–284, 495–497, 635–639, 707–717, 775–777, 788–790, 795–797, 957–965, 968–975, 978–988, 990–992</p> <p>Operation of Wastewater Treatment Plants: Volume 2 – Eighth Edition. Pages 166–171, 192–194, 297–299, 321–322, 325–326, 450–455, 463–469, 701–702, 735–748, 757–771, 778–782, 782–785, 786–790, 795–797</p> <p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 239–246, 256–261, 270–272, 291–294, 303–305, 384–385, 537–550, 559–573, 580–583, 584–587, 588–592, 597–599</p> <p>Small Water System Operation and Maintenance – Sixth Edition. Pages 118–126, 200–203, 230–233, 264–267, 320–321, 384–385, 486, 495–496, 507–509, 514, 651–659, 662–669, 672–682, 684–686</p>
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	<p>Small Wastewater System Operation and Maintenance: Volume 1 - Third Edition. Pages 277-287, 446-455, 537-538, 624-625, 655-668, 677-681, 682-691, 698-705, 706-710, 715-717</p> <p>Water Distribution System Operation and Maintenance - Seventh Edition. Pages 48-51, 81-86, 125-129, 212-216, 242-245, 252-259, 274-279, 312-314, 316-317, 321-324, 337-341, 371-374, 377-380, 599-607, 610-612, 620-630, 632-634</p> <p>Water Treatment Plant Operation: Volume 1 - Seventh Edition. Pages 94-101, 158-162, 186-189, 219, 291-294, 364-368, 428-431, 534-536, 545-546, 558-559, 561-564, 647-655, 658-665, 668-678, 680-682, 737</p> <p>Water Treatment Plant Operation: Volume 2 - Seventh Edition. Pages 185-204, 295-314, 321-330, 364-366, 424-428, 513-514, 566-570, 608-612, 747-755, 758-765, 768-773, 774-778, 780-782</p>
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## Suggested References List

- [Operation and Maintenance of Wastewater Collection Systems, Volume 1, Eighth Edition, Office of Water Programs](#)
- [Operation and Maintenance of Wastewater Collection Systems, Volume 2, Eighth Edition, Office of Water Programs](#)
- [Operation of Wastewater Treatment Plants, Volume 1, Eighth Edition, Office of Water Programs](#)
- [Operation of Wastewater Treatment Plants, Volume 2, Eighth Edition, Office of Water Programs](#)
- [Operation of Wastewater Treatment Plants, Volume 3, First Edition, Office of Water Programs](#)
- [Small Water System Operation and Maintenance, Sixth Edition, Office of Water Programs](#)
- [Small Wastewater System Operation and Maintenance, Volume 1, Third Edition, Office of Water Programs](#)
- [Water Treatment Plant Operations, Volume 1, 7th Edition, Office of Water Programs](#)
- [Water Treatment Plant Operations, Volume 2, 7th Edition, Office of Water Programs](#)
- [Water Distribution System Operation and Maintenance, Seventh Edition, Office of Water Programs](#)

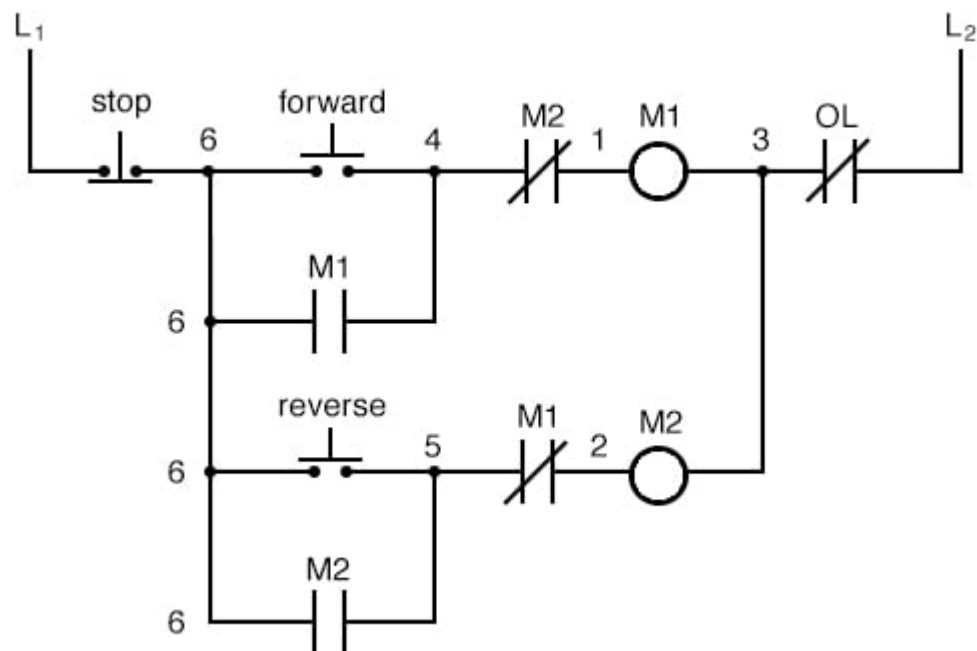
## Sample Questions

This section provides sample questions to help applicants become familiar with the exam format and subject matter.

1. You work at a plant that discharges to a local stream with hypochlorite disinfection. During the wet season, locals report that higher flows are negatively impacting the stream wildlife. What should you recommend to alleviate this issue?
  - a. Design and build a storage basin to skim some of the winter flow.
  - b. Increase chlorine residual and chlorination.
  - c. Design and build more secondary treatment volume as a “wide spot”.
  - d. Decrease reclaimed water usage at the plant site.
2. Which of the following is the most likely cause for a pump to quickly become noisy and vibrate?
  - a. Over lubrication
  - b. Worn parts
  - c. Loss of foundation bolts
  - d. Cavitation
3. What is the advantage of a split mechanical seal compared to a cartridge mechanical seal?
  - a. The seal can be installed without removing the pump
  - b. Seal water is not required
  - c. Packing glands are easier to adjust
  - d. Split in seal allows additional cooling
4. What is a thread chaser likely to be used for?
  - a. Adjust die stocks
  - b. Repair damaged threads
  - c. Remove broken belts
  - d. Flare tubing
5. Which of the following is most true about predictive maintenance?
  - a. Results in more downtime than preventative maintenance
  - b. Costs less than preventative maintenance
  - c. Ensure less downtime than breakdown maintenance
  - d. Requires more spare parts on hand than breakdown maintenance
6. A mechanic is troubleshooting why a conveyor motor will not start in forward or reverse to clear the Jam. The basic control schematic shows:
  - A STOP push button (normally closed)

- A start FORWARD / REVERSE push button (normally open)
- A motor starter coil (M1&M2)
- A normally-open auxiliary seal-in contact (M-Aux)
- A normally-closed overload contact (OL) in the control circuit
- When the mechanic presses the FORWARD & REVERSE start button, the motor still will not energize. Voltage is present on the line side of the control circuit.

Using all of the information above, why will the conveyor motor not start?



- The overload contact (OL) is open, preventing power from reaching the contactor coil.
  - The STOP pushbutton is stuck normally closed.
  - The FORWARD / REVERSE button spring is weak, but it still clicks when pressed.
  - The M-Aux contact is not closing because the coil is not energized yet.
7. Which task does not require Lock Out/Tag Out in order to complete?
- Clear a blocked pump impeller
  - Replace a mechanical seal
  - Collect vibrations data from a shaft bearing
  - Adjust the tension on a v-belt

8. Why should an electric hand tool, such as a drill, never be lifted or carried by its service cord?
  - a. The tool might swing and be damaged by striking some hard object
  - b. The cord might be pulled off its terminals and become short-circuited
  - c. The rubber covering the cord might overstretch
  - d. The tool might slip out of your hand because the cord is slick
9. A gravity belt thickener (GBT) has been identified to have three possible points of failure: bearing seizure, belt slippage, and motor burnout. Your plant has a second GBT that can be put online if a failure occurs. Your maintenance shop carries backup bearings and belts in case of GBT failure. What kind of maintenance method is BEST described in this scenario?
  - a. Preventative maintenance
  - b. Reliability-centered maintenance
  - c. Reactive maintenance
  - d. Predictive maintenance
10. Which of the following is the best description of a total head?
  - a. It is equal to static head minus dynamic head
  - b. It is the amount of energy in water due to water pressure
  - c. It is the amount of energy in water due to velocity
  - d. It is equal to the static head plus dynamic head minus friction losses
11. Your supervisor tasked you with assisting in calculations for plan pump cycles to prevent overflow for a lift station that has a cylindrical wet well with a diameter of 12 feet and a depth of 15 feet. Approximately how many gallons will the wet well hold?
  - a. 12,140 gallons
  - b. 12,690 gallons
  - c. 13,080 gallons
  - d. 14,822 gallons
12. The exterior walls of an open-top tank are to be painted. If the tank is 25 feet in diameter and 12 feet high, what is the total surface work area of the tank in square feet?
  - a. 79 ft<sup>2</sup>
  - b. 113 ft<sup>2</sup>
  - c. 942 ft<sup>2</sup>
  - d. 1,356 ft<sup>2</sup>

## Answer Key and Solutions

1. A - Domain 1
2. D - Domain 1
3. A - Domain 2
4. B - Domain 2
5. C - Domain 3
6. A - Domain 3
7. C - Domain 4
8. B - Domain 4
9. B - Domain 5
10. D - Domain 5
11. B - Domain 6
12. C - Domain 6

Solution:

$$A[ft^2] = \pi \times D[ft] \times H[ft] = 3.14 \times 25[ft] \times 12[ft] = 942 ft^2$$

## MT GRADE 3 EXAM CONTENT OUTLINE

Content Domain	Weighting
Domain 1 - Inspection, Maintenance, Installation, and Repair	28%
Domain 2 - Tools and Equipment	18%
Domain 3 - Records, Reports, and SCADA	13%
Domain 4 - Safety	18%
Domain 5 - Administration and Communication	12%
Domain 6 - Math for Mechanical Technologists	11%
Total	100%

### Domain 1: Inspection, Maintenance, Installation, and Repair

#### Sub-Domain 1.1:

##### Inspection of Systems and Equipment

1. Supervise and participate in the inspection of water/wastewater machinery and equipment (pumps, valves, motors, engines, compressors, actuators, pneumatics and odor control systems, boilers, centrifuges, etc.)
2. Independently troubleshoot and diagnose complex mechanical malfunctions and determine effective course of action for correcting them
3. Advanced knowledge of standard practices and procedures for precision alignment of rotating equipment, vari-speed drives, gear-reduction drives, shafts, and belts
4. Advanced knowledge of standard practices and procedures for engine-driven equipment, such as natural gas, methane, diesel, and propane systems
5. Oversee acceptance testing for any new equipment or stations, and after any major overhaul of equipment, systems, and facilities, and assist in the inspection of newly constructed water/wastewater facilities

6. Advanced Knowledge and methods of condition monitoring equipment (vibration, oil sampling, thermal imaging, ultrasound equipment, etc.)

#### Sub-Domain 1.2:

##### Installation, Maintenance, and Repair of Tools, Equipment, Systems, and Facilities

1. Supervise and participate in the installation of mechanical equipment necessary to the operation of water/wastewater facilities, including pumps, motors, engines, hydraulic controls and regulators, valves and pumping systems, chemical feed and processing equipment, compressors, ventilating equipment, generators, drive systems, and all other related equipment
2. Supervise and participate in the troubleshooting and repair of mechanical equipment necessary to the operation of water/wastewater facilities (including pumps, motors, engines, hydraulic controls and regulators, valves and pumping systems, chemical feed and processing equipment, compressors, ventilating equipment, generators, drive systems, and all other related equipment)
3. Supervise maintenance and repair of equipment used for disinfection of water/wastewater treatment facilities using various disinfection processes
4. Supervise and participate in the replacing of packing and mechanical seals in pumps, rebuilding or replacement of valves, bearings in motors, pumps, and other equipment
5. Investigate process equipment failures, identify defects, and resolve complex mechanical repair problems
6. Recommend improvements to the design and maintenance of water/storm/sewer stations and equipment used to operate water/wastewater facilities

## Domain 2: Tools and Equipment

#### Sub-Domain 2.1:

##### Design and Fabrication of Equipment

1. Design, fabricate, and assemble a variety of equipment
2. Fabricate parts and fittings, make assemblies, and repair units based on drawings, specifications, sketches, work orders, verbal instructions, or personal visual inspection
3. Advanced knowledge of rigging and installing a variety of equipment
4. Advanced knowledge of pipe-fitting and application

#### Sub-Domain 2.2:

#### Operation of Tools, Equipment, and Vehicles

1. Supervise the use and operation of various cranes/hoists/lifting/rigging equipment for moving/replacing pumps, machinery, or other heavy equipment during installation, maintenance, and repair activities (overhead, gantry, etc.)
2. Supervise the use and operation of vehicles used for installation, maintenance, and repair activities (trucks, forklifts, heavy equipment, etc.)
3. Supervise the use and operation of equipment used for installation, maintenance, and repair activities (generators, jackhammers, steam cleaners, pumps, compressors, valves, gauges, engines, and electromechanical devices)
4. Supervise the use and operation of hand and power tools used for installation, maintenance, and repair activities (lathe, milling machine, sandblaster, grinder, drill, drill press, pneumatic, hydraulic, and electric tools, oxy-acetylene torch)
5. Supervise the use and operation of precision measuring instruments in the performance of various work assignments (shaft alignment, calipers, micrometers, atmospheric testers, vibration analyzers, dial indicators, laser equipment)
6. Advanced knowledge of practices, procedures, tools, and equipment of machinery and welding shops (plasma-cutting, metal inert gas (MIG), tungsten inert gas (TIG), and shielded metal arc welding (SMAW), oxyacetylene torch)

## Domain 3: Records, Reports, and SCADA

### Sub-Domain 3.1:

#### Maps and Blueprints

1. Read and interpret maps (such as GIS), sketches, blueprints, manufacturer diagrams, basic electrical schematics, drawings, as-builts and operation manuals (O&M)
2. Provide input on design blueprints and recommend changes before finalization
3. Review and document changes or discrepancies (redline) in existing blueprints, drawings, and as-builts, and make recommendations to appropriate parties

### Sub-Domain 3.2:

#### Documentation

1. Prepare and maintain comprehensive and detailed records of maintenance activities (work orders, field reports, daily logs, ledgers, parts lists, invoices, inventories, etc.)
2. Update asset information in a computerized maintenance management system (CMMS)

3. Establish a preventative maintenance (PM) schedule based on manufacturers' recommendations or operational condition
4. Record various data for pumps, motors, generators, and related equipment
5. Interpret and implement applicable permit requirements (engines, boilers, pressure vessels, odor control systems, etc.)
6. Knowledge of Sewer System Management Plan (SSMP) permit requirements

### Sub-Domain 3.3:

#### Supervisory Control and Data Acquisition (SCADA)

1. Knowledge of Supervisory Control and Data Acquisition (SCADA) system
2. Knowledge of SCADA trending tools to monitor equipment status and predict/anticipate equipment failure

## Domain 4: Safety

### Sub-Domain 4.1:

#### Safety

1. Knowledge of safety rules and safe work practices (local, state, and federal laws, ordinances, and rules)
2. Knowledge of occupational hazards and safety precautions necessary in the work
3. Ensure that assigned personnel adhere to all safety regulations (Cal / OSHA, National Fire Protection Association (NFPA) 70E arc flash safety, Fall Protection, Heat Protection, Traffic Control)
4. Handle all work-related chemicals in accordance with Cal / OSHA standards and safety procedures (such as Safety Data Sheets), including cleanup procedures
5. Ensure confined space entry is performed per Cal / OSHA and local regulations
6. Perform vehicle, tool, and equipment safety checks including chemical tests, atmospheric air quality tests, and atmospheric testing
7. Ensure that proper Personal Protective Equipment (PPE) for work environment is implemented (safety glasses, hard hats, gloves, ear protection, respirator, face shields, hazmat suit, etc.)
8. Ensure proper implementation of safety forms, such as Job Safety Analysis (JSA), confined space entry permits, hot work permits

## Domain 5: Administration and Communication

### Sub-Domain 5.1:

#### Administration

1. Supervise, train, and evaluate subordinates
2. Develop and oversee the implementation of standard operating procedures (SOPs)
3. Inform budget development by preparing estimates of labor and materials necessary to accomplish maintenance and repair activities
4. Order and maintain inventory of mechanical equipment, materials, and parts
5. Perform detailed job preparation including job scope, step-by-step procedures, man-hour estimates, skills and materials required, and safety concerns/procedures
6. Inspect the work of personnel and crews engaged in field and plant maintenance and repair
7. Utilize a computerized maintenance management system (CMMS) to monitor and improve the reliability of equipment and productivity of assigned personnel
8. Review and screen work requests for completeness, accuracy, and necessity
9. Layout, assign, and review work of subordinates
10. Coordinate work activities with other departments, divisions, and outside contractors
11. Solicit bids to purchase equipment, parts and tools, and contractor work
12. Monitor and control expenditures
13. Provide training on the use of operation and maintenance (O&M) manuals and computerized maintenance management system CMMS

### Sub-Domain 5.2:

#### Communication

1. Understand direction and effectively instruct subordinates
2. Establish and maintain cooperative working relationships with those contacted in the course of work, including peers, operators, direct reports, superiors, vendors, contractors, customers, and the general public

## Domain 6: Math

### Sub-Domain 6.1:

#### Math calculations and basic computations

1. Calculate flow rates
2. Calculate volume and area
3. Calculate horsepower (brake and motor)
4. Calculate precision measurements (using calipers, micrometers, etc.)
5. Calculate drive ratios
6. Calculate pressure
7. Calculate energy cost of equipment (including lift/pump stations)
8. Calculate thermal expansion rates
9. Calculate density and weight
10. Interpret a pump curve

## Suggested References

CWEA’s exam is based on a job task analysis that includes research of the essential duties of a Mechanical Technologist at a representative cross-section of systems and facilities in California. CWEA’s exams do not correspond directly to any specific textbook, educational course, or program; instead, the exams are based on an analysis of the duties commonly performed in actual practice. In developing the exam, CWEA Subject Matter Experts used their years of experience in the field along with the key textbooks and reference materials listed below. Candidates should understand that the references listed do not necessarily cover all exam content. Candidates who meet the minimum qualifications for this exam may find these suggested references useful when preparing for this exam; however, these suggested references are not required reading and should not be interpreted as constituting the sole source of all exam questions.

This list does not include all the available textbooks and materials for studying for this exam. Candidates are strongly encouraged to seek additional material, training, and experience, especially in content areas for which the candidate is not adequately prepared. Candidates are encouraged to prepare for CWEA certification exams using as many different study materials as possible plus education events and on-the-job training. Recommended reading from the Office of Water Programs (which is a third-party) was provided by their team based on their expertise and review of CWEA’s content outlines. Candidates are encouraged to develop their own personal study plan based on individual needs and knowledge.

<b>Domain 1 – Inspection, Maintenance, Installation, and Repair</b>	
Sub-Domain 1.1	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 – Eighth Edition. Pages 89 – 93, 366 – 369, 474 – 487</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 74 – 77, 107 – 116, 118 – 121, 174 – 176, 179 – 182, 185 – 234</p> <p>Operation of Wastewater Treatment Plants: Volume 1 – Eighth Edition. Pages 153, 183 – 184, 212 – 221, 292 – 297, 340 – 344, 347 – 355, 365 – 381, 419 – 422, 436 – 448, 466 – 485, 518 – 528, 529 – 536, 544 – 547, 551 – 554, 567 – 568, 594 – 598, 610 – 622, 635 – 640, 653 – 661, 665 – 685, 718, 735</p> <p>Operation of Wastewater Treatment Plants: Volume 2 – Eighth Edition. Pages 79 – 83, 200 – 202, 207 – 208, 248 – 251, 262 – 267, 335 – 343, 353 – 355, 367 – 371, 375 – 377, 387 – 413, 432 – 433, 456 – 457, 476 – 480, 482, 490 – 491, 498 – 511, 518 – 530, 536, 580 – 596, 647 – 658, 659 – 706</p>

	<p>Operation of Wastewater Treatment Plants: Volume 3 - First Edition. Pages 96 - 99, 220 - 228</p> <p>Small Water System Operation and Maintenance - Sixth Edition. Pages 56 - 92, 117 - 126, 140 - 144, 246, 351, 371, 397, 414, 416 - 418</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 - Third Edition. Pages 40 - 41, 138 - 139, 162 - 166, 212 - 218, 219 - 255, 300 - 313, 317 - 324, 328 - 329, 335 - 337, 356 - 382, 513 - 528, 539 - 549, 573 - 633</p> <p>Water Distribution System Operation and Maintenance - Seventh Edition. Pages 52 - 55, 70 - 73, 195 - 201, 232 - 238, 391</p> <p>Water Treatment Plant Operation: Volume 1 - Seventh Edition. Pages 38 - 43, 108 - 109, 119 - 120, 177 - 178, 194 - 195, 197 - 198, 253, 304, 374 - 380, 384, 397 - 399</p> <p>Water Treatment Plant Operation: Volume 2 - Seventh Edition. Pages 80 - 84, 180 - 183, 319 - 321, 346 - 353, 371 - 374, 383 - 384, 515 - 523, 528 - 539, 552 - 596, 598 - 603, 616 - 618</p>
Sub-Domain 1.2	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 - Eighth Edition. Pages 346, 365 - 369</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 - Eighth Edition. Pages 34 - 35, 108 - 116, 122 - 123, 138 - 236, 258 - 267, 270 - 274</p> <p>Operation of Wastewater Treatment Plants: Volume 1 - Eighth Edition. Pages 142 - 146, 150 - 153, 211 - 212, 229, 334, 349 - 350, 365 - 381, 415 - 426, 436 - 442, 446, 513 - 514, 521 - 527, 546 - 547, 611 - 618, 620 - 622, 626, 631, 635 - 640, 653 - 661, 665 - 685</p> <p>Operation of Wastewater Treatment Plants: Volume 2 - Eighth Edition. Pages 73 - 75, 79 - 80, 82 - 83, 103 - 104, 200 - 203, 207 - 209, 225 - 230, 248 - 250, 262 - 267, 335 - 343, 353 - 355, 367 - 371, 375 - 377, 380, 387 - 395, 396 - 399, 403 - 404, 407 - 408, 432 - 433, 456 - 457, 476 - 480, 482, 490 - 491, 525 - 527, 580 - 596, 605 - 712</p> <p>Operation of Wastewater Treatment Plants: Volume 3 - First Edition. Pages 110 - 112, 114</p> <p>Small Water System Operation and Maintenance - Sixth Edition. Pages 23 - 25, 141 - 144, 339 - 344, 350 - 353, 369 - 371</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 - Third Edition. Pages 208 - 209, 217 - 218, 373 - 382, 525, 565 - 633</p> <p>Water Distribution System Operation and Maintenance - Seventh Edition. Pages 52 - 53, 195 - 201, 346 - 358</p> <p>Water Treatment Plant Operation: Volume 1 - Seventh Edition. Pages 170 - 178, 194 - 198, 319, 353 - 356, 384 - 390, 397 - 399, 415 - 417, 472</p>

	Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 180 – 183, 234, 290 – 291, 319, 352, 552 – 560, 566 – 604
<b>Domain 2 – Tools and Equipment</b>	
Sub-Domain 2.1	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 – Eighth Edition. Pages 33 – 51, 60 – 71, 72 – 74, 315 – 319, 338, 349 – 352, 359 – 360, 422 – 426, 428 – 435, 442 – 445, 446 – 456, 460 – 462, 464</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 57, 106, 166 – 234, 288 – 322</p> <p>Operation of Wastewater Treatment Plants: Volume 1 – Eighth Edition. Pages 450 – 456, 747 – 753</p> <p>Operation of Wastewater Treatment Plants: Volume 2 – Eighth Edition. Pages 92 – 93, 105 – 106, 115, 126, 139 – 147, 231, 252, 268, 636 – 638, 644 – 647, 651 – 653, 659 – 673</p> <p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Page 113</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 – Third Edition. Pages 212, 290 – 299, 484 – 489</p> <p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 97 – 107, 120 – 123, 153 – 162, 208 – 212</p> <p>Water Treatment Plant Operation: Volume 1 – Seventh Edition. Pages 212 – 219, 227 – 231</p> <p>Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 246, 293 – 294, 371 – 376</p>
Sub-Domain 2.2	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 – Eighth Edition. Pages 427 – 428, 440 – 441, 458 – 460</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 143 – 153</p> <p>Operation of Wastewater Treatment Plants: Volume 1 – Eighth Edition. Pages 77, 82 – 89, 409 – 414, 606 – 608, 623 – 624</p> <p>Operation of Wastewater Treatment Plants: Volume 2 – Eighth Edition. Pages 595 – 596, 605 – 622, 698 – 701, 709 – 710</p> <p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 373 – 375</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 – Third Edition. Pages 120 – 123, 137 – 139, 527, 529 – 530, 631 – 634</p> <p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 146 – 170, 389 – 391</p>

	Water Treatment Plant Operation: Volume 2 - Seventh Edition. Pages 72, 77 - 83, 465 - 470, 515 - 523, 597 - 605
<b>Domain 3 - Records, Reports, and SCADA</b>	
Sub-Domain 3.1	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 - Eighth Edition. Pages 72 - 74, 422, 488 - 489</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 - Eighth Edition. Pages 23 - 24, 106, 129 - 130, 250 - 258, 461 - 471</p> <p>Operation of Wastewater Treatment Plants: Volume 1 - Eighth Edition. Pages 184, 225 - 226, 450 - 453, 513 - 514, 542 - 543, 565 - 566, 747 - 753</p> <p>Operation of Wastewater Treatment Plants: Volume 2 - Eighth Edition. Pages 92 - 93, 105 - 106, 115, 126, 139 - 147, 231, 252, 268, 574 - 577</p> <p>Operation of Wastewater Treatment Plants: Volume 3 - First Edition. Pages 72, 95, 113, 455 - 456</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 - Third Edition. Pages 509 - 512</p> <p>Water Distribution System Operation and Maintenance - Seventh Edition. Pages 260 - 264, 518 - 519</p> <p>Water Treatment Plant Operation: Volume 2 - Seventh Edition. Pages 668 - 669</p>
Sub-Domain 3.2	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 - Eighth Edition. Pages 268 - 269, 288, 308 - 309, 488</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 - Eighth Edition. Pages 21, 24 - 25, 28, 118 - 121, 124 - 130, 241 - 244, 250 - 258, 389 - 395, 449 - 452, 473 - 474, 476 - 478</p> <p>Operation of Wastewater Treatment Plants: Volume 1 - Eighth Edition. Pages 43, 298 - 300, 810 - 812</p> <p>Operation of Wastewater Treatment Plants: Volume 2 - Eighth Edition. Pages 43, 72 - 73, 635</p> <p>Operation of Wastewater Treatment Plants: Volume 3 - First Edition. Pages 38, 454 - 463</p> <p>Small Water System Operation and Maintenance - Sixth Edition. Pages 149, 153 - 160, 498 - 499, 615 - 618</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 - Third Edition. Pages 113 - 118, 334 - 335, 384 - 387, 396 - 399, 497 - 504, 507 - 509, 561</p> <p>Water Distribution System Operation and Maintenance - Seventh Edition. Pages 74, 233, 237, 259 - 260, 521 - 525, 568 - 571</p>

	<p>Water Treatment Plant Operation: Volume 1 - Seventh Edition. Pages 12 - 13, 36 - 37, 43, 120, 177 - 178, 253, 304</p> <p>Water Treatment Plant Operation: Volume 2 - Seventh Edition. Pages 314 - 319, 351 - 353, 497 - 498, 545 - 548, 668 - 669, 718 - 720</p>
Sub-Domain 3.3	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 - Eighth Edition. Pages 65, 82 - 83, 116 - 117, 127 - 129</p> <p>Operation of Wastewater Treatment Plants: Volume 1 - Eighth Edition. Pages 290 - 291, 409 - 414</p> <p>Operation of Wastewater Treatment Plants: Volume 2 - Eighth Edition. Pages 115, 222 - 223, 231, 246 - 247, 280 - 282, 295 - 296, 450, 457, 577 - 579, 605, 632 - 634</p> <p>Operation of Wastewater Treatment Plants: Volume 3 - First Edition. Pages 203 - 206</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 - Third Edition. Pages 559 - 561</p> <p>Water Distribution System Operation and Maintenance - Seventh Edition. Pages 264 - 265, 521 - 525</p> <p>Water Treatment Plant Operation: Volume 2 - Seventh Edition. Pages 343 - 344, 492 - 495, 671 - 673</p>

**Domain 4 - Safety and Facility Maintenance**

Sub-Domain 4.1	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 - Eighth Edition. Pages 88 - 216</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 - Eighth Edition. Pages 7 - 22, 57, 381 - 406</p> <p>Operation of Wastewater Treatment Plants: Volume 1 - Eighth Edition. Pages 43 - 46, 55 - 98, 101 - 130, 137 - 140, 164 - 165, 181 - 182, 205 - 207, 225, 245 - 252, 580 - 583, 634, 642 - 645, 665, 696, 762 - 774</p> <p>Operation of Wastewater Treatment Plants: Volume 2 - Eighth Edition. Pages 40 - 42, 97 - 98, 202 - 204, 230 - 231, 251 - 252, 267 - 268, 448 - 450, 598 - 600</p> <p>Operation of Wastewater Treatment Plants: Volume 3 - First Edition. Pages 39 - 41, 54 - 55, 155, 217 - 219, 488 - 498</p> <p>Small Water System Operation and Maintenance - Sixth Edition. Pages 271 - 273, 393, 395, 403 - 406, 411, 414, 420, 464 - 475</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 - Third Edition. Pages 52 - 56, 58 - 63, 68 - 139, 150, 169, 210, 270 - 275, 326, 345, 434 - 435, 505 - 506</p>
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	<p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 32, 74 – 75, 130, 334 – 335, 365 – 369, 386 – 408, 412, 456 – 467, 543 – 558</p> <p>Water Treatment Plant Operation: Volume 1 – Seventh Edition. Pages 19 – 24, 49 – 51, 101 – 102, 112, 120, 163, 168, 170, 178 – 179, 254, 305, 401 – 406, 408, 421, 550 – 555</p> <p>Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 52 – 66, 68 – 70, 73 – 77, 80, 83 – 88, 93 – 132, 162 – 163, 236, 277 – 279, 357, 390 – 391, 459 – 464, 690 – 716</p>
<b>Domain 5 – Administration and Communication</b>	
<p>Sub-Domain 5.1</p>	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 – Eighth Edition. Pages 14 - 16</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 28, 124 – 128, 243 – 244, 275 – 279, 328 – 345, 350 – 364, 376 – 380, 392, 401 – 402, 423 – 424, 428 – 452, 454 – 456, 474, 476 – 478</p> <p>Operation of Wastewater Treatment Plants: Volume 1 – Eighth Edition. Pages 70 – 72 OWTp2, Pages 39, 577 – 580</p> <p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 38, 400 – 403, 406 – 409, 424 – 441, 441 – 477</p> <p>Small Water System Operation and Maintenance – Sixth Edition. Pages 24 – 25, 587 – 602, 612 – 616</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 – Third Edition. Pages 41 – 46, 57 – 58, 333 – 334, 384, 388 – 389, 502 – 504, 508 – 512</p> <p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 30 – 31, 476 – 479, 487 – 499, 541 – 543, 561 – 563, 571</p> <p>Water Treatment Plant Operation: Volume 1 – Seventh Edition. Pages 38 – 45, 47 – 49</p> <p>Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 66 – 68, 279, 624 – 626, 637 – 650, 661 – 667, 668 – 669, 710 – 715, 718 – 720</p>
<p>Sub-Domain 5.2</p>	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 – Eighth Edition. Pages 74, 166 – 167, 284 – 286</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 21 – 22, 363 – 364, 366 – 375, 448 -449, 452 – 453</p> <p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 188 – 190, 479 – 488</p>

	<p>Small Water System Operation and Maintenance – Sixth Edition. Pages 25, 611 – 612</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 – Third Edition. Pages 41 – 46</p> <p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 31 – 32, 268 – 270, 501 – 510</p> <p>Water Treatment Plant Operation: Volume 1 – Seventh Edition. Pages 49, 164, 166</p> <p>Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 6, 652 – 660, 725</p>
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## Domain 6 – Math

Sub-Domain 6.1	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 – Eighth Edition, Pages 27 – 31, 56 – 58, 77 – 82, 475 – 486, 513 – 534, 538 – 544, 546 – 548</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 49, 108 – 116, 230, 499 – 520, 524 – 530, 532 – 534</p> <p>Operation of Wastewater Treatment Plants: Volume 1 – Eighth Edition. Pages 140 – 142, 148 – 149, 157 – 161, 179 – 180, 258 – 278, 283 – 284, 495 – 497, 635 – 639, 707 – 717, 775 – 777, 788 – 790, 795 – 797, 957 – 978, 982 – 988, 990 – 992</p> <p>Operation of Wastewater Treatment Plants: Volume 2 – Eighth Edition. Pages 166 – 171, 192 – 194, 297 – 299, 321 – 322, 325 – 326, 450 – 455, 463 – 469, 701 – 702, 735 – 750, 757 – 771, 782 – 790, 795 – 797</p> <p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 239 – 246, 256 – 261, 270 – 272, 291 – 294, 303 – 305, 384 – 385, 537 – 552, 559 – 573, 584 – 592, 597 – 599</p> <p>Small Water System Operation and Maintenance – Sixth Edition. Pages 118 – 126, 200 – 203, 230 – 233, 264 – 267, 320 – 321, 384 – 385, 486, 495 – 496, 507 – 509, 514, 651 – 659, 662 – 669, 676 – 682, 684 – 686, 733 – 734, 736 – 739, 741 – 742</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 – Third Edition. Pages 277 – 289, 446 – 455, 537 – 538, 624 – 625, 655 – 670, 677 – 691, 702 – 710, 715 – 717</p> <p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 48 – 51, 81 – 86, 125 – 129, 212 – 216, 242 – 245, 252 – 259, 274 – 279, 312 – 314, 316 – 317, 321 – 324, 337 – 341, 371 – 374, 377 – 380, 599 – 608, 610 – 617, 624 – 630, 632 – 634</p> <p>Water Treatment Plant Operation: Volume 1 – Seventh Edition. Pages 45 – 47, 94 – 101, 158 – 162, 186 – 189, 219, 291 – 294, 364 – 368, 428 – 431,</p>
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Water Treatment Plant Operation: Volume 2 - Seventh Edition. Pages 185 - 204, 295 - 314, 321 - 330, 364 - 366, 424 - 428, 513 - 514, 566 - 570, 608 - 612, 747 - 756, 758 - 765, 772 - 778, 780 - 782

## Suggested References List

- [Operation and Maintenance of Wastewater Collection Systems, Volume 1, Eighth Edition, Office of Water Programs](#)
- [Operation and Maintenance of Wastewater Collection Systems, Volume 2, Eighth Edition, Office of Water Programs](#)
- [Operation of Wastewater Treatment Plants, Volume 1, Eighth Edition, Office of Water Programs](#)
- [Operation of Wastewater Treatment Plants, Volume 2, Eighth Edition, Office of Water Programs](#)
- [Operation of Wastewater Treatment Plants, Volume 3, First Edition, Office of Water Programs](#)
- [Small Water System Operation and Maintenance, Sixth Edition, Office of Water Programs](#)
- [Small Wastewater System Operation and Maintenance, Volume 1, Third Edition, Office of Water Programs](#)
- [Water Treatment Plant Operations, Volume 1, 7th Edition, Office of Water Programs](#)
- [Water Treatment Plant Operations, Volume 2, 7th Edition, Office of Water Programs](#)
- [Water Distribution System Operation and Maintenance, Seventh Edition, Office of Water Programs](#)

## Sample Questions

This section provides sample questions to help applicants become familiar with the exam format and subject matter.

1. A machine installation requires a tolerance for shaft alignment angularity of 0.008 inches for a 10-inch coupling. What would the alignment angularity be for a machine that requires a 5-inch coupling?
  - a. A shaft angularity of 0.004
  - b. A shaft angularity of 0.005
  - c. A shaft angularity of 0.007
  - d. A shaft angularity of 0.009
2. Periodic inspection and testing of mechanical equipment by plant staff is done for what purpose?
  - a. Estimate the time before breakdown
  - b. Discover minor equipment faults before they develop into major breakdowns
  - c. Encourage the crew to better understand how the equipment works
  - d. Help the crew better understand individual responsibilities
3. Which welded joint provides the greatest strength when full penetration is achieved?
  - a. Corner joint
  - b. Edge joint
  - c. Lap joint
  - d. Butt joint
4. What is a Parshall flume used to measure?
  - a. Liquid flows in an open channel
  - b. Air flows in a heating system
  - c. Water flow in a piping system
  - d. Exhaust emissions
5. SCADA tools can be used to check which performance factors on a pump at a lift station?
  - a. Flow and speed
  - b. Emergency power alarms
  - c. PSI and level trend
  - d. High-level and low-level alarms
6. Maintenance systems, both computer generated and manual records, include which of the following?
  - a. Equipment, scheduled maintenance and safety records
  - b. Equipment, scheduled maintenance, work orders and cost records
  - c. Tools, SOPs, and safety records

- d. Location of equipment, supplier and parts records
7. Which OSHA regulation directs Hot Work regulations?
    - a. 29 CFR 1926.21
    - b. 29 CFR 1926.106
    - c. 29 CFR 1910.147
    - d. 29 CFR 1910.252
  8. Accidents are less likely to occur if:
    - a. employee morale is kept high.
    - b. safety policies are frequently changed.
    - c. safety policies are informal.
    - d. employee input is solicited for safety programs.
  9. When inspecting maintenance work, what is the supervisor's main goal?
    - a. To find out who is responsible for any mistakes
    - b. To keep track of who does certain jobs correctly
    - c. To ensure the job meets safety, quality, and operational standards
    - d. To know who is the most efficient at job specific tasks
  10. What is true about disagreements in the workplace?
    - a. It is always detrimental to the work unit
    - b. It is potentially useful
    - c. It is never educational
    - d. It is never appropriate
  11. A pump is being driven by a motor pulley system. The motor RPM is 1200 with a 4-inch pulley, and the pump pulley is 10 inches. What is the pump's RPM?
    - a. 300 RPM
    - b. 480 RPM
    - c. 800 RPM
    - d. 1000 RPM
  12. The training room at your plant needs new carpet. If the room is rectangular in shape and measures 30 feet by 54 feet, how much carpet is needed, in square yards?
    - a. 84 yd<sup>2</sup>
    - b. 180 yd<sup>2</sup>
    - c. 540 yd<sup>2</sup>
    - d. 1,620 yd<sup>2</sup>

## Answer Key and Solutions

1. A - Domain 1
2. B - Domain 1
3. D - Domain 2
4. A - Domain 2
5. A - Domain 3
6. B - Domain 3
7. D - Domain 4
8. D - Domain 4
9. C - Domain 5
10. B - Domain 5
11. B - Domain 6
12. B - Domain 6

Solution:

$$A[yd^2] = L[ft] \times \frac{yd}{3ft} \times W[ft] \times \frac{yd}{3ft} = 30[ft] \times \frac{yd}{3ft} \times 54[ft] \times \frac{yd}{3ft} = 180 yd^2$$

## MT GRADE 4 EXAM CONTENT OUTLINE

Content Domain	Weighting
Domain 1 – Inspection, Maintenance, Installation, Repair, and Tools	19%
Domain 2 – Administration	28%
Domain 3 – Records, Reports, and SCADA	18%
Domain 4 – Safety and Emergency Response	21%
Domain 5 – Communication	14%
Total	100%

### Domain 1: Inspection, Maintenance, Installation, Repair, and Tools

#### Sub-Domain 1.1:

##### Inspection of Systems and Equipment

1. Oversee, facilitate, and report root cause analysis
2. Oversee failure and reliability analysis
3. Perform and oversee field inspections of work in progress and at completion
4. Oversee, inspect, and monitor water/wastewater systems for needed maintenance and repairs
5. Inspect work sites before, during, and after completion of work to assure the work is completed in a satisfactory and thorough manner
6. Inspect and approve work completed by outside contractors

#### Sub-Domain 1.2:

##### Installation, Maintenance, and Repair of Tools, Equipment, Systems, and Facilities

1. Manage, direct, and organize advanced preventative and predictive maintenance on a variety of equipment for water/wastewater treatment facilities

2. Oversee major testing, troubleshooting, and repair projects and upgrades to plants, lift/pump stations, and recharge basin facilities, systems, and related equipment
3. Advanced knowledge of types and levels of maintenance and repair activities generally performed in water/wastewater systems
4. Advanced knowledge of principles and practices, methods, techniques, tools, and equipment used in the design, installation, testing, calibration, maintenance, and repair of facilities, equipment, machinery, and vehicles common to a complex water/wastewater system
5. Knowledge of principles, practices, documents, and terminology used in condition-based maintenance and repair activities
6. Ensure proper operation and maintenance of tools and equipment
7. Collaborate and troubleshoot issues arising from the inspection of tools and equipment for compliance with safety standards
8. Oversee the operation of condition monitoring tools and software
9. Prioritize and coordinate emergency work

## Domain 2: Administration

### Sub-Domain 2.1:

#### Budgeting

1. Collaborate in the preparation and administration of operating and capital improvement budgets
2. Knowledge of budgeting procedures and techniques
3. Participate in the forecasting of funds needed for labor, equipment, materials, and supplies
4. Prepare Requests for Proposals (RFP) and Requests for Quotes (RFQ) for the solicitation of bids to purchase equipment, parts, tools, and contractor work

### Sub-Domain 2.2:

#### Supervision and Training

1. Knowledge of principles and practices of supervision, training, and personnel management
2. Provide leadership, guidance, and direction for subordinate staff
3. Evaluate employee work performance, behavior, and technical ability
4. Participate in scheduling, assigning, and monitoring work of employees for completeness, accuracy, and conformance with standards

5. Provide information, instruction, and training on work processes, proper use of equipment, and safe work practices
6. Educate and train staff on new and revised approaches, and the operation/inspection of new equipment and tools
7. Participate in the selection and recommendation of the appointment of personnel
8. Establish and implement performance standards for personnel, implement discipline procedures, and work with staff to correct deficiencies
9. Oversee, identify, and participate in employee development and advancement initiatives and succession planning
10. Oversee training on the use of operation and maintenance (O&M) manuals and computerized maintenance management systems (CMMS)
11. Develop and oversee the training plan for all maintenance personnel
12. Ensure labor relations standards are implemented

### Sub-Domain 2.3:

#### Management and Planning

1. Review job plans
2. Estimate personnel, equipment, and material requirements for assigned jobs
3. Order work materials, tools, equipment, and supplies
4. Provide input on asset replacement schedules
5. Provide recommendations for the development/enhancement of maintenance programs and strategies
6. Work with contractors and engineers to resolve potential problems with new installation and construction, and the purchase of new equipment
7. Monitor the performance of contractors and employees to ensure timely completion of maintenance/repair projects and work orders
8. Schedule and coordinate activities with other sections and departments
9. Research new technologies, equipment, work methods, and processes
10. Analyze and recommend new or modified equipment, tools, methods, processes, forms, and materials to improve productivity, efficiency, and employee safety
11. Assist in the development and implementation of policies and procedures
12. Assist in the setting of goals and objectives for staff and the organization
13. Review capital improvement plans (CIPs) and provide input regarding future maintenance activities
14. Identify and initiate needed capital improvement projects

## Domain 3: Records, Reports, and SCADA

### Sub-Domain 3.1:

#### Documentation

1. Maintain and audit detailed documentation and work records, including data on facilities, detail of failures, descriptions of work performed, as-built sketches, and drawings
2. Maintain and audit maintenance records and requests including, work order tracking
3. Understand Sewer System Management Plan (SSMP) permit requirements
4. Ensure accurate asset information in a computerized maintenance management system (CMMS)
5. Oversee preventative maintenance (PM) schedules based on manufacturers' recommendations or operational condition
6. Interpret and implement applicable permit requirements (engines, boilers, pressure vessels, odor control systems, etc.)

### Sub-Domain 3.2:

#### Supervisory Control and Data Acquisition (SCADA)

1. Knowledge of Supervisory Control and Data Acquisition (SCADA) system
2. Knowledge of SCADA trending tools to monitor equipment status and predict/anticipate equipment failure
3. Assist in the development of key performance indicator reports for the monitoring of equipment condition and reliability

## Domain 4: Safety and Emergency Response

### Sub-Domain 4.1:

#### Safety

1. Understand and comply with local, state, and federal laws and regulations regarding the transmission of water, including the Safe Drinking Water Act and relevant Environmental Protection Agency (EPA) regulations
2. Review internal policies and make recommendations to ensure alignment with applicable regulations, such as Cal / OSHA regulations, confined space entry, lockout/tagout (LOTO) procedures, National Fire Protection Association (NFPA) 70E arc flash safety, Fall Protection, Heat Protection, and Spill Protection Control Countermeasure (SPCC)

3. Advanced Knowledge of occupational hazards and standard safety precautions
4. Ensure the adherence to safe work practices in accordance with all applicable safety and traffic regulations by subordinate personnel (Lockout/Tagout, implementation of proper PPE, confined space entry, safety datasheets, traffic control, etc.)

#### Sub-Domain 4.2:

##### Emergency Response

1. Collaborate in the development of response plans for contingencies and emergency conditions such as natural disasters, catastrophic equipment failures, pandemics, etc.
2. Oversee and participate in the implementation and execution of emergency response plans and personnel
3. Develop and implement procedures that maintain equipment and facilities for use during an emergency response
4. Collaborate to determine conditions that will warrant activation of emergency response plans

## Domain 5: Communication

#### Sub-Domain 5.1:

##### Communication

1. Establish and maintain cooperative working relationships with those contacted in the course of work, including peers, operators, direct reports, superiors, vendors, contractors, customers, and the general public
2. Prepare and present various reports and other necessary correspondence
3. Respond and resolve difficult or sensitive public inquiries and complaints in a professional and courteous manner

## Suggested References

CWEA’s exam is based on a job task analysis that includes research of the essential duties of a Mechanical Technologist worker at a representative cross-section of systems and facilities in California. CWEA’s exams do not correspond directly to any specific textbook, educational course, or program; instead, the exams are based on an analysis of the duties commonly performed in actual practice. In developing the exam, CWEA Subject Matter Experts used their years of experience in the field along with the key textbooks and reference materials listed below. Candidates should understand that the references listed do not necessarily cover all exam content. Candidates who meet the minimum qualifications for this exam may find these suggested references useful when preparing for this exam; however, these suggested references are not required reading and should not be interpreted as constituting the sole source of all exam questions.

This list does not include all the available textbooks and materials for studying for this exam. Candidates are strongly encouraged to seek additional material, training, and experience, especially in content areas for which the candidate is not adequately prepared. Candidates are encouraged to prepare for CWEA certification exams using as many different study materials as possible plus education events and on-the-job training. Recommended reading from the Office of Water Programs (which is a third-party) was provided by their team based on their expertise and review of CWEA’s content outlines. Candidates are encouraged to develop their own personal study plan based on individual needs and knowledge.

<b>Domain 1 – Inspection, Maintenance, Installation, Repair, and Tools</b>	
Sub-Domain 1.1	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 – Eighth Edition. Pages 224 – 238, 259 – 270, 280 – 295, 303 – 304, 412 – 421, 426 – 427, 439 – 440, 462 – 463, 468 – 474, 488 – 491</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 2 – 7, 20, 25 – 30, 105 – 121, 250 – 279, 328 – 330, 335 – 342, 412 – 422, 425 – 427</p> <p>Operation of Wastewater Treatment Plants: Volume 1 – Eighth Edition. Pages 184 – 186, 225 – 226, 285 – 297, 327 – 329, 415 – 426, 436 – 456, 502 – 506, 518 – 521, 546 – 547, 610 – 618, 659 – 661</p> <p>Operation of Wastewater Treatment Plants: Volume 2 – Eighth Edition. Pages 115, 122 – 124, 252 – 253, 268, 574 – 577, 580 – 596</p> <p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 94 – 95</p>

	<p>Small Water System Operation and Maintenance - Sixth Edition. Pages 23 - 25, 245 - 246, 327 - 338, 350 - 351</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 - Third Edition. Pages 141 - 143, 384 - 387</p> <p>Water Distribution System Operation and Maintenance - Seventh Edition. Pages 30 - 31, 56 - 58, 169 - 171, 194 - 207, 358 - 363, 474 - 476</p> <p>Water Treatment Plant Operation: Volume 1 - Seventh Edition. Pages 12 - 15, 25 - 26, 38 - 43, 155, 252 - 253, 278 - 283, 304, 385 - 389, 396 - 397, 503 - 504</p> <p>Water Treatment Plant Operation: Volume 2 - Seventh Edition. Pages 180 - 182, 348 - 349, 352 - 353, 450 - 451, 495 - 496, 566 - 597, 624 - 626, 680 - 682</p>
Sub-Domain 1.2	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 - Eighth Edition. Pages 24 - 25, 34 - 51, 105 - 130, 136 - 166, 166 - 245, 250 - 258, 275 - 279, 411 - 412, 422 - 427, 473 - 476</p> <p>Operation of Wastewater Treatment Plants: Volume 1 - Eighth Edition. Pages 42 - 43, 140 - 153, 184 - 186, 224 - 226, 285 - 298, 365 - 368, 449 - 457, 513 - 515, 518 - 529, 542 - 544, 546 - 547, 565 - 568</p> <p>Operation of Wastewater Treatment Plants: Volume 2 - Eighth Edition. Pages 38 - 39, 73, 200 - 202, 207, 252 - 253, 268 - 269, 335 - 344, 353 - 356, 367 - 371, 375 - 377, 456 - 457, 476 - 480, 482, 490 - 491, 536, 568 - 600, 605 - 622, 636 - 712</p> <p>Operation of Wastewater Treatment Plants: Volume 3 - First Edition. Pages 230 - 341</p> <p>Small Water System Operation and Maintenance - Sixth Edition. Pages 95 - 105, 116 - 129, 140 - 149</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 - Third Edition. Pages 496 - 534</p> <p>Water Distribution System Operation and Maintenance - Seventh Edition. Pages 56 - 70, 201 - 249, 266 - 268, 358 - 364, 518 - 521, 528 - 539, 692 - 697</p> <p>Water Treatment Plant Operation: Volume 1 - Seventh Edition. Pages 10 - 15, 32 - 36, 38 - 44, 170 - 178, 194 - 195</p> <p>Water Treatment Plant Operation: Volume 2 - Seventh Edition. Pages 234, 246, 293 - 294, 350 - 353, 450 - 459, 495 - 499, 506 - 508, 533 - 536, 566 - 597, 603, 618, 626 - 627, 669 - 671, 679 - 690</p>
<b>Domain 2 - Administration</b>	
Sub-Domain 2.1	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 - Eighth Edition. Pages 275 - 279, 375 - 380, 454 - 456, 474</p>

	<p>Manage for Success — Second Edition. Pages 117 - 129, 142 - 169, 203</p> <p>Operation of Wastewater Treatment Plants: Volume 3 - First Edition. Pages 441 - 454, 470 - 475</p> <p>Small Water System Operation and Maintenance - Sixth Edition. Pages 584 - 615</p> <p>Water Distribution System Operation and Maintenance - Seventh Edition. Pages 511 - 517</p> <p>Water Treatment Plant Operation: Volume 1 - Seventh Edition. Page 44</p> <p>Water Treatment Plant Operation: Volume 2 - Seventh Edition. Pages 661 - 667</p>
Sub-Domain 2.2	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 - Eighth Edition. Pages 335 - 365, 365 - 371, 385 - 386, 448</p> <p>Manage for Success — Second Edition. Pages 59 - 62, 222 - 250</p> <p>Operation of Wastewater Treatment Plants: Volume 1 - Eighth Edition. Pages 70 - 72</p> <p>Operation of Wastewater Treatment Plants: Volume 2 - Eighth Edition. Pages 39, 577 - 580</p> <p>Operation of Wastewater Treatment Plants: Volume 3 - First Edition. Pages 38, 403 - 406, 416 - 440</p> <p>Small Water System Operation and Maintenance - Sixth Edition. Pages 24 - 25, 393 - 394, 616</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 - Third Edition. Pages 57 - 58, 333 - 334, 384, 388 - 389, 502 - 504, 508 - 512</p> <p>Water Distribution System Operation and Maintenance - Seventh Edition. Pages 30 - 31, 487 - 500, 541 - 543, 561 - 563, 571</p> <p>Water Treatment Plant Operation: Volume 1 - Seventh Edition. Pages 44 - 45, 47 - 49</p> <p>Water Treatment Plant Operation: Volume 2 - Seventh Edition. Pages 66 - 68, 279, 631 - 652</p>
Sub-Domain 2.3	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 - Eighth Edition. Pages 72 - 74, 228 - 231, 256 - 258, 282 - 283, 292, 310 - 315, 327 - 328, 335, 349, 358, 418 - 419, 440 - 441, 458 - 460, 471 - 491</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 - Eighth Edition. Pages 29 - 30, 105 - 108, 250 - 258, 275 - 279, 328 - 345, 388 - 408, 425 - 427, 428 - 448, 476 - 478</p> <p>Manage for Success — Second Edition. Pages 222 - 225</p>

	<p>Operation of Wastewater Treatment Plants: Volume 1 – Eighth Edition. Pages 184 – 186, 224 – 226, 449 – 457, 513 – 515, 542 – 544, 565 – 567, 599 – 602, 661</p> <p>Operation of Wastewater Treatment Plants: Volume 2 – Eighth Edition. Pages 105 – 107, 115, 126, 139 – 148, 231, 252 – 253, 268</p> <p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 72 – 73, 95, 113 – 114, 192, 407 – 412, 419 – 421, 438 – 441, 451 – 454, 470 – 475</p> <p>Small Water System Operation and Maintenance – Sixth Edition. Pages 587 – 591, 619 – 631</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 – Third Edition. Pages 11 – 18, 63 – 78, 124 – 128, 140 – 150, 207 – 211, 255 – 256, 334, 345 – 347, 349 – 350</p> <p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 474 – 475, 480 – 481, 506, 515 – 517, 528 – 567</p> <p>Water Treatment Plant Operation: Volume 1 – Seventh Edition. Pages 5 – 8, 12 – 14, 44 – 45, 167 – 168, 250 – 251, 253 – 254, 300 – 303, 305 – 309</p> <p>Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 52 – 69, 246, 293 – 294, 631 – 632, 638 – 650, 657, 665 – 667, 679 – 716, 718</p>
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**Domain 3 – Records, Reports, and SCADA**

Sub-Domain 3.1	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 – Eighth Edition. Pages 236, 263 – 270, 308 – 309, 415 – 416, 488 – 489, 507 – 509</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 124 – 130, 241 – 244</p> <p>Manage for Success – Second Edition. Pages 88 – 117</p> <p>Operation of Wastewater Treatment Plants: Volume 1 – Eighth Edition. Pages 43, 298 – 300, 810 – 812</p> <p>Operation of Wastewater Treatment Plants: Volume 2 – Eighth Edition. Pages 43, 72 – 73, 635</p> <p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 38, 454 – 458, 461 – 463</p> <p>Small Water System Operation and Maintenance – Sixth Edition. Pages 149 – 150, 153 – 160, 498 – 499, 615 – 619</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 – Third Edition. Pages 113 – 118, 334 – 335, 384 – 387, 396 – 399, 497 – 504, 561</p> <p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 74, 233, 237, 259 – 260, 521 – 525, 568 – 572</p>
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	<p>Water Treatment Plant Operation: Volume 1 – Seventh Edition. Pages 12 – 14, 36 – 38, 43, 120, 177 – 178, 253, 304</p> <p>Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 249 – 250, 314 – 319, 351 – 353, 497 – 498, 545 – 548, 668 – 669, 718 – 721</p>
Sub-Domain 3.2	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 65, 82 – 83, 116 – 117, 127 – 129</p> <p>Operation of Wastewater Treatment Plants: Volume 1 – Eighth Edition. Pages 290 – 291, 409 – 414</p> <p>Operation of Wastewater Treatment Plants: Volume 2 – Eighth Edition. Pages 115, 222 – 223, 231, 246 – 247, 280 – 282, 295 – 296, 450, 457, 577 – 579, 605, 632 – 634</p> <p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 203 – 206</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 – Third Edition. Pages 559 – 561</p> <p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 264 – 265, 521 – 525</p> <p>Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 343 – 344, 492 – 495, 671 – 673</p>

## Domain 4 – Safety and Emergency Response

Sub-Domain 4.1	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 – Eighth Edition. Pages 88 – 176, 193 – 216</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 5 – 7, 9 – 19, 137 – 140, 381 – 385, 387 – 408, 458 – 459</p> <p>Operation of Wastewater Treatment Plants: Volume 1 – Eighth Edition. Pages 43 – 46, 55 – 130, 137 – 139, 164 – 165, 181 – 182, 205 – 207, 225, 245 – 251, 696, 762 – 774</p> <p>Operation of Wastewater Treatment Plants: Volume 2 – Eighth Edition. Pages 40 – 42, 97 – 98, 202 – 203, 230 – 231, 251 – 252, 267 – 268, 448 – 449, 598 – 600</p> <p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 39 – 41, 54 – 55, 155, 215 – 220, 488 – 498</p> <p>Small Water System Operation and Maintenance – Sixth Edition. Pages 18 – 22, 25, 271 – 273, 280 – 283, 375, 392 – 475, 500 – 506</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 – Third Edition. Pages 11 – 13, 52 – 139, 169, 210, 266 – 275, 326, 345, 434 – 435, 505 – 507</p>
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	<p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 12 – 15, 32, 74, 130, 286 – 288, 334 – 335, 365 – 370, 386 – 289, 389 – 466, 539 – 568</p> <p>Water Treatment Plant Operation: Volume 1 – Seventh Edition. Pages 5 – 8, 19 – 25, 49 – 51, 101 – 102, 112, 120, 163, 168, 170, 178 – 179, 254, 305, 401 – 406, 408, 421, 550 – 556</p> <p>Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 2 – 132, 162 – 163, 236, 277 – 279, 357, 390 – 391, 459 – 464, 691 – 716</p>
Sub-Domain 4.2	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 – Eighth Edition. Pages 103, 306 - 308</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 411 – 412, 459 – 461, 472 – 473</p> <p>Manage for Success – Second Edition. Pages 186 – 201</p> <p>Operation of Wastewater Treatment Plants: Volume 1 – Eighth Edition. Pages 72 – 73</p> <p>Operation of Wastewater Treatment Plants: Volume 2 – Eighth Edition. Pages 103, 120 – 122, 598 – 600</p> <p>Operation of Wastewater Treatment Plants: Volume 3 – First Edition. Pages 70, 109, 511 – 513</p> <p>Small Water System Operation and Maintenance – Sixth Edition. Pages 619 – 631</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 – Third Edition. Pages 60 – 62, 387 – 388</p> <p>Water Distribution System Operation and Maintenance – Seventh Edition. Pages 266 – 268, 528 – 539</p> <p>Water Treatment Plant Operation: Volume 1 – Seventh Edition. Pages 32 – 36, 44</p> <p>Water Treatment Plant Operation: Volume 2 – Seventh Edition. Pages 679 – 690</p>
<b>Domain 5 – Communication</b>	
Sub-Domain 5.1	<p>Operation and Maintenance of Wastewater Collection Systems: Volume 1 – Eighth Edition. Page 74</p> <p>Operation and Maintenance of Wastewater Collection Systems: Volume 2 – Eighth Edition. Pages 20 – 22, 365 – 375</p> <p>Manage for Success – Second Edition. Pages 29 – 37, 59 – 61, 88, 163 – 165, 171 – 172, 201 – 202, 251 – 252, 254</p>

	<p>Operation of Wastewater Treatment Plants: Volume 3 - First Edition. Pages 188 - 192, 479 - 488</p> <p>Small Water System Operation and Maintenance - Sixth Edition. Pages 25, 207 - 208, 611 - 612</p> <p>Small Wastewater System Operation and Maintenance: Volume 1 - Third Edition. Pages 41 - 46</p> <p>Water Distribution System Operation and Maintenance - Seventh Edition. Pages 31 - 32, 268 - 270, 501 - 510</p> <p>Water Treatment Plant Operation: Volume 1 - Seventh Edition. Pages 26, 36, 49, 164, 166</p> <p>Water Treatment Plant Operation: Volume 2 - Seventh Edition. Pages 6, 652 - 660</p>
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## Suggested References List

- [Manage for Success, Effective Utility Leadership Practices, 1st Edition, Office of Water Programs](#)
- [Operation and Maintenance of Wastewater Collection Systems, Volume 1, Eighth Edition, Office of Water Programs](#)
- [Operation and Maintenance of Wastewater Collection Systems, Volume 2, Eighth Edition, Office of Water Programs](#)
- [Operation of Wastewater Treatment Plants, Volume 1, Eighth Edition, Office of Water Programs](#)
- [Operation of Wastewater Treatment Plants, Volume 2, Eighth Edition, Office of Water Programs](#)
- [Operation of Wastewater Treatment Plants, Volume 3, First Edition, Office of Water Programs](#)
- [Small Water System Operation and Maintenance, Sixth Edition, Office of Water Programs](#)
- [Small Wastewater System Operation and Maintenance, Volume 1, Third Edition, Office of Water Programs](#)
- [Water Treatment Plant Operations, Volume 1, 7th Edition, Office of Water Programs](#)
- [Water Treatment Plant Operations, Volume 2, 7th Edition, Office of Water Programs](#)
- [Water Distribution System Operation and Maintenance, Seventh Edition, Office of Water Programs](#)

## Sample Questions

This section provides sample questions to help applicants become familiar with the exam format and subject matter.

1. Which of the following is the MOST critical factor when prioritizing and coordinating emergency work?
  - a. The ease of completing the work
  - b. The duration needed to complete all work
  - c. The immediate risk to life, health, and safety
  - d. The total cost of the project
2. Which if the following methods is the best way to increase pump efficiency, therefore potentially reducing a utilities electrical energy costs?
  - a. Use one large pump to pump more volume
  - b. Redesign all facilities for gravity flow conditions only
  - c. Perform no maintenance to eliminate labor cost
  - d. Use two or more small pumps instead of one large pump so excess capacity may be turned off
3. During the design phase, you are reviewing the Request for Proposals (RFP) received for the replacement of your plant blowers. What essential information must be included to ensure you receive accurate, comparable and complete proposals?
  - a. Testimonials and locations and organizations where the equipment has been successfully installed
  - b. Verification from the engineering department that Submission and Evaluation Guidelines for the RFP are met
  - c. Detailed pricing of the equipment, operational specifications, and power consumption estimates
  - d. Technical specifications of the equipment as requested, operational parameters, and plant needs
4. What is the key to success for a computerized maintenance management system (CMMS)?
  - a. System to generate work orders (not parallel with stem)
  - b. System to confirm work order completion (not parallel with stem)
  - c. Proper use of performance measures
  - d. Adequate spare parts inventory (not parallel with stem)

5. For utility records and/or rate analyses purposes, customers with similar patterns of water use are usually grouped together into classes. Which one of the following classes is **not** generally used?
  - a. Retail
  - b. Commercial
  - c. Domestic
  - d. Industrial
6. A Sewer System Management Plan (SSMP) requires an internal audit to be conducted how often?
  - a. Once every three years
  - b. Once every four years
  - c. Once every five years
  - d. On an as needed basis
7. What role should a maintenance manager play in ensuring that the work performed by their team complies with internal safety policies?
  - a. Defer responsibility for safety policies entirely to regulatory agencies and outside safety consultants rather than internal management.
  - b. Focus primarily on meeting production and scheduling goals, addressing safety policies as issues are identified or incidents occur.
  - c. Rely on individual employees to interpret safety policies independently and apply them as they see fit during daily work activities.
  - d. Ensure that internal safety policies are clearly developed, communicated, enforced, and routinely reviewed to protect employees and maintain regulatory compliance.
8. What is true of nonverbal communication?
  - a. It masks inappropriate feelings
  - b. It is limited to emotional contexts
  - c. It can convey more information than verbal communication
  - d. It requires good eye contact
9. What is the most appropriate first step when responding to a sensitive public complaint about odor near a wastewater facility?
  - a. File a complaint in public records and cooperate with media coverage of the issue.
  - b. Provide a list of wastewater projects that are in process so the public is aware of what to expect next.
  - c. Acknowledge the concern and gather relevant details, document the issue and follow up.
  - d. Reassure the public that the issue does not pose a safety hazard.

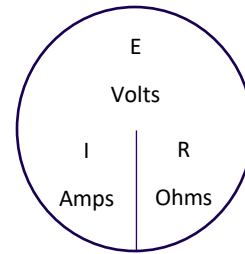
## Answer Key and Solutions

1. C - Domain 1
2. D - Domain 1
3. D - Domain 2
4. C - Domain 2
5. A - Domain 2
6. A - Domain 3
7. D - Domain 4
8. C - Domain 3
9. C - Domain 5

## MT FORMULA SHEET

*This formula sheet is available onscreen during the exam.*

1 cubic foot	1,728 cubic inches
1 cubic foot	7.48 gallons
1 cubic foot of water	62.43 pounds
1 gallon of water	8.34 pounds
1 cubic foot/second	448.8 gallons/minute
1 MGD	694 gallons/minute
1 horsepower	33,000 foot-pounds/minute
1 psi	2.31 feet of water
1 kilowatt	1000 watts
1 horsepower	746 watts
1 horsepower	42.45 Btu/minute
1 MGD	1.55 cubic feet/second
1 Btu	778 foot-pounds
1 watt	3.412 Btu/hour
1 thermal unit	100,000 Btu
π	3.14
Coefficients of thermal expansion	Steel: 0.00000633/°F Brass: 0.00001/°F



$Circumference_{circle} = \pi \times diameter$	$Volume_{rectangular\ solid} = length \times width \times height$
$Area_{triangle} = \frac{base \times height}{2}$	$Volume_{triangular\ solid} = \frac{base \times height \times length}{2}$
$Area_{circle} = \frac{\pi}{4} \times diameter^2$	$Volume_{cylinder} = \frac{\pi}{4} \times diameter^2 \times height$
$Area_{circle} = 0.785 \times diameter^2$	$Volume_{cylinder} = \pi \times radius^2 \times height$
$Area_{circle} = \pi r^2$	$3\ phase\ VA = V \times A \times 1.732$
$Area_{circle} = \pi \times radius^2$	$Flowing\ quantity = Area \times Velocity$
$Area_{rectangle} = base \times height$	$Efficiency = \frac{work\ output}{work\ input}$
$Perimeter_{rectangle} = 2 \times (length + width)$	$Energy = power \times time$
$Thermal\ expansion = coeff.\ of\ thermal\ expansion \times length \times \Delta T$	
$Hydrostatic\ force = column\ area \times column\ height \times fluid\ density$	
$Motor\ horsepower = \frac{flow \times head \times specific\ gravity}{3960 \times efficiency\ pump \times efficiency\ motor}$	
$Brake\ horsepower = \frac{flow \times head \times specific\ gravity}{3960 \times efficiency}$	
$3\ phase\ A = \frac{746 \times horsepower}{1.732 \times V \times efficiency \times power\ factor}$	
$Brake\ horsepower = \frac{water\ horsepower}{efficiency}$	
$Water\ horsepower = \frac{flow \times total\ head \times specific\ gravity}{3960}$	
$V = d/t$	

## CREATING A STUDY PLAN

### Completing a Gap Analysis

CWEA certification exams are experience based. The Gap Analysis Tool is designed to help candidates identify which grade level is best suited to their current level of experience, and where they may be lacking sufficient experience.

This free self-evaluation is available on the [CWEA website](#) for all vocations.

Candidates are encouraged to develop their own personal study plan based on individual needs, experience and knowledge. Candidates should seek as many different study materials as possible as well as attend educational events and on-the-job training. This is especially important for areas in which the candidate is not adequately prepared.

CWEA's exams do not correspond directly to any specific textbook, educational course, or program. Instead, the exams are based on an analysis of the duties commonly performed in actual practice.

### CWEA Education and Training

It is the goal of CWEA's Technical Certification Program to operate in line with established best practices for certification programs. As such, CWEA is careful to separate its education and training activities from its certification program to ensure that no conflict of interest exists. Any educational materials or trainings that are designed to prepare candidates for an exam are developed and conducted by individuals that do not have access to the exams.

### CWEA's Online Wastewater Education Network (OWEN)

OWEN provides essential training to wastewater professionals throughout their careers. It supplies access to timely, relevant training and certification preparation training that helps professionals excel throughout their careers. These courses cover important topics and in a variety of practice areas, with more content, training and certification preparation being added all the time. Search the [OWEN](#) catalogue for on-demand courses or upcoming live webinars.

## CWEA Local Section Training

CWEA Local Sections host education and training events throughout the year that focus on the job duties tested by our certifications. These trainings are limited based on demand and volunteer availability.

Local Section trainings can be found on the [CWEA Events Website](#). For questions about a Local Section training, please contact the Local Section directly. Contact information for individual Local Sections can be found in our [Directory](#).

## EXAM DAY INFORMATION

### Test Site Admission and Exam Information

Applicants are required to show at least one current, valid, government-issued photo identification, such as a state driver's license or ID, or passport. A temporary license is acceptable if there is an expiration date, or if it is accompanied by paperwork explaining an expiration date.

Candidates have three (3) hours to complete the exam.

The formula sheet from this Handbook will be available on the exam screen.

For more information about the number of questions on each exam, see *Exam Scoring* (p. 97).

## Calculators Allowed

An onscreen calculator with basic and scientific capability is available on all CWEA exams. Applicants may bring a handheld calculator to a test center as long as it is from the CWEA approved calculator list:

<b>Casio</b>	All FX-115 models (any Casio calculator with FX-115 in its name)
<b>Texas Instruments</b>	All TI-30x and TI-36x models
<b>Sharp</b>	EL models <i>except</i> EL-W516B and EL-W535B

## Pearson VUE’s Candidate Rules Agreement

Pearson VUE maintains its own rules regarding professional examinations. All applicants are required to sign the [Candidate Rules Agreement](#) at the test center prior to sitting the exam. Applicants are responsible for knowing and complying with these rules. CWEA recommends all applicants familiarize themselves with this agreement prior to testing.

## AFTER THE EXAM

### Exam Result Notification

Applicants will see their result on the screen immediately after the exam is submitted. An Official Score Report will be printed out and given to the applicant before they leave the test center. Additional copies can be obtained by logging into the [Pearson VUE user account](#). All results are confidential and will only be released to the applicant. No results will be given over the phone, by fax or email.

## Exam Appeal Policy

All appeals must be submitted within two weeks of the exam date. Appeals will be reviewed by CWEA staff and/or Subject Matter Experts. Candidates' personal information will remain confidential and will not be accessible to Subject Matter Experts. Candidates will be updated on the status of their appeal within 4-6 weeks, and they will be notified in writing when a decision has been made. Once an appeal has been processed, candidates cannot submit a new appeal for the same exam.

Candidates cannot submit an appeal simply because they did not pass the exam.

Candidates can appeal under the following justifications:

### Exam Delivery Appeal

Candidates may appeal testing conditions severe enough to have caused a major disruption of the examination process. CWEA staff will review the appeal and consult our exam administrator, Pearson VUE, to investigate the appeal if necessary. Please note, under Pearson VUE's candidate agreement, candidates must notify the proctor immediately during the exam of any issues to open a claim documenting the incident. If candidates did not notify the proctor during the exam, an appeal may still be submitted but may be dismissed if CWEA cannot verify the validity of the complaint.

### Exam Question Appeal

If the candidate wishes to comment on specific exam questions, they may flag the question during the exam using the Flag to Enter a Comment function. Candidates are allowed to add comments about any question as long as there is time remaining. All comments will be reviewed and considered by the Technical Certification Program as part of the ongoing exam review and development process. Candidates that wish to submit an appeal of their exam results, must complete the form below within two weeks of their exam date. Candidates that wish to have specific comments considered in support of their appeal should indicate so on the appeal form.

Non-substantive appeals or appeals without just cause will be automatically rejected. If candidates are not satisfied with the outcome of their appeal, they may submit a request for review by the Technical Certification Program Executive Committee at [tcpcommittee@cwea.org](mailto:tcpcommittee@cwea.org). The committee's decision will be final.

All communication related to certification decisions and appeal results with the Technical Certification Program Executive Committee must be sent in writing to [tcpcommittee@cwea.org](mailto:tcpcommittee@cwea.org). We ask that candidates do not contact committee members directly.

The appeal form can be accessed here: [CWEA Exam Appeal Form](#).

## Retest Application

If the candidate does not pass the exam the first time, they can submit a retest application along with the appropriate fees. The candidate will be required to skip at least one exam window before they are eligible to retest. If the candidate tested within the first 15 days of a window, they are not required to skip an exam window. Under no circumstances are candidates allowed to sit for the same exam twice in the same window. There are no exceptions to this policy.

To be eligible to use the retest application form, candidates must submit the application within one year of their original exam date. Candidates must meet the minimum qualifications of the exam for which they are applying. CWEA may require candidates to fill out a full application with job history to verify candidates meet the minimum requirements. Use of a retest application does not guarantee approval for any exam.

## Receiving the Certificate and Blue Card

Certificates and Blue Cards will be issued to all candidates who pass their exam. The certificate contains the certification number and expiration date. The Blue Card contains the expiration date, contact hour due date and contact hour period. These documents are mailed along with the Score Report within 4 weeks to the address on file with CWEA. Candidates are responsible for making sure this address is current.

# MAINTAINING CERTIFICATION

## How to Renew

All certifications must be renewed annually. Certifications expire one year from the last day of the month in which the certification was earned. Renewal notices are mailed to certification holders three months before the expiration date. Certification holders can pay their renewal

online by logging into their [mycwea.org](https://mycwea.org) account or by mailing their renewal notice with a check or credit card information to the CWEA office. Renewal certificates and blue cards will be mailed within 4 weeks to the address on file with CWEA.

Certification holders are required to meet Continuing Education (CE) requirements. This requirement is met by completing 12 contact hours (1.2 CEUs) of vocation-related education or training every two years. For more information about earning contact hours, for details see *Earning Contact Hours* (p. 92).

Not meeting these requirements by the expiration date will cause the certification to expire. Certifications that have been expired for more than three months are subject to a \$35 late fee. If a certification holder does not meet the renewal requirements within two years of their expiration date their certification will permanently expire. To become certified once again, the individual must re-apply for certification and pass the exam. It is the certification holder's responsibility to ensure that his or her certification remains valid. There are no exceptions to these policies.

## Renewal Fees

Current fees are listed on the [CWEA website](#). Valid CWEA members qualify for a discounted member rate. The non-member rate includes a one-year CWEA membership. If an applicant does not wish to take advantage of the membership, please inform CWEA.

## Continuing Education (CE) Requirement

Certification holders are required to meet Continuing Education (CE) requirements. This requirement is met by completing 12 contact hours (1.2 CEUs) of vocation-related education or training every two years. Certification holders may submit up to 50% (6 contact hours) of the required contact hours in safety related training. One contact hour is defined as 50 minutes of participation in an organized continuing education experience under responsible sponsorship, capable direction, and qualified instruction.

Contact hours must be earned within the contact hour period. Hours are earned on the date of completion of the educational or training program. The program may begin before, but must be completed during the contact hour period. If a certification holder will not earn the required hours within their contact hour period, they must notify CWEA before the period ends if they wish to remain certified, for details see *Temporary Deactivation* (p. 93).

Individuals holding more than one CWEA certification can apply the same contact hours to each certification as long as the training is relevant to each vocation. Training is acceptable as long as it is related to the vocations in which certification is held. CWEA may send contact hour certificates to Subject Matter Experts to determine relevancy.

In-house training can be used to meet this requirement as long as standard Safety Tailgate meetings do not exceed 50% (6 contact hours). In-house training includes any training that is conducted by an employer, or a trainer contracted by an employer.

## Earning Contact Hours

Contact hours may be earned by any of the following activities:

- Attendance at educational/training programs, including in-house training
- Teaching, instructing or presenting educational/training material (1 hour per 25 min)
- Developing and reviewing CWEA certification exam content as a Subject Matter Expert (1 hour per 25 minutes)
- Authorship of published books or articles (2 hours per book or article)
- Retesting and passing the relevant CWEA certification exam (12 hours)
- Membership in professional membership organizations (.5 hours per year, per membership, with a maximum of 6 hours per contact hour period)

CWEA may require and request additional documentation to assess the authenticity and/or relevance of these activities.

This information is paraphrased for clarity from the 02-03 TCP Re-Certification Policy; a full copy of the policy can be requested by contacting the TCP department.

## Contact Hour Documentation

Proof of contact hour completion for an educational/training program must meet these following guidelines:

- The name of the training organization
- The training title
- The name of the attendee who completed the program
- The number of contact hours earned
- The date of completion

- An official signature or stamp from the training organization, instructor's signature is acceptable

For other continuing education activities, CWEA may request additional information. Any documentation that does not meet these guidelines will not be accepted. It is the certification holder's responsibility to retain verification of records documenting earned contact hours and submit proof to CWEA.

## Contact Hour Audit

Audits are conducted on a regular basis by CWEA to ensure that certification holders are complying with the continuing education requirement and that the documentation meets the guidelines. Certification holders are randomly selected for an audit of contact hours. The audit reviews the relevancy of the trainings to the vocation, and the dates in which the contact hours were earned to ensure that they fall within the appropriate contact hour period.

Selected participants will be notified via email that they have either successfully passed the audit, or that CWEA requires further information.

## Temporary Deactivation

The Temporary Deactivation program is for certification holders that will not meet the continuing education requirement for recertification by their expiration date. Under this program, certification holders can request that CWEA temporarily deactivate their certification for up to two years from their expiration date. This grants the individual extra time to earn the required contact hours. During the time of temporary deactivation, the CWEA certification is invalid and may not be used. Certification holders can apply for reactivation once they fulfill all requirements. Certification must be in good standing to qualify for this program. For more information including current fees, or to request an application for temporary deactivation, contact the CWEA office.

The application must be submitted before the certification expiration date. There is no exception to this policy.

## Reinstating Certification

If a certification expires, it is invalid until all recertification requirements are met. There is a three-month grace period before a certification is considered lapsed. Once a certification becomes lapsed, the certification holder will need to pay a \$35 late fee in addition to meeting the renewal requirements. Certification will remain lapsed for up to two years from the expiration date. If a lapsed certification is not renewed within the two-year period, the certification becomes permanently expired.

## Expired Certification

Certificates expired for two years, or longer, cannot be reinstated under any circumstances. To become certified once again, the individual must re-apply for certification and pass the exam. It is the certification holder's responsibility to ensure that his or her certification remains valid. There are no exceptions to these policies.

## Retiring Certification

Certification holders can request that CWEA retire their certification at the time it expires if they no longer wish to hold it. Once a certification has been retired, the certification will no longer be valid and CWEA will cease all communications regarding the certification. A retired certification can be reactivated only if the certification holder has met all renewal requirements within the appropriate timeframe and the certification has not permanently expired.

# EXAM DESIGN AND FORMAT

## Exam Design

All certification exams are designed to test knowledge required to perform the essential duties of a job at a given grade level with minimum acceptable competence. Exams are created by Subject Matter Experts under the guidance of exam development professionals.

Exam content is developed from a job task analysis that includes research of the essential duties at a representative cross-section of systems and facilities throughout California. All

exam items are written by subject matter experts based on the content outline established by the job task analysis. These items are used to create the exam forms. The pass point for each exam is based on difficulty, using the Modified Angoff Method, for details see *Pass Point* and *How Pass Points are Set* (p. 96).

## Exam Delivery Mechanism

All exams are computer-based format and are available in the English language only. Exams are delivered at Pearson VUE testing centers or via Pearson VUE's online testing platform On Vue.

## Exam Format

All certification exams are in multiple-choice format. Multiple-choice is considered the most effective format for use in standardized tests as it allows for greater content coverage for a given amount of testing time and improves competency measurement reliability. Multiple choice questions range in complexity from simple recall of knowledge to the synthesis and evaluation of the subject matter.

## Weighting

The percentage of the exam that covers a particular content area is referred to as its weighting. Weightings are established through a Job Task Analysis and are based on the frequency and criticality of the task. A weighting is approximate and shows the relative importance of a particular area compared to the other portions of the exam. Weightings are indicated on the content outline for each exam and can be found in the preparation materials. Each weighting on the actual certification exam may vary slightly.

## Pass Points

An exam pass point is the minimum score required to pass a certification exam. The pass point is also known as a cut score or passing score. Candidates should try to score as high as possible on their exam. Pass points for CWEA certification exam vary with each exam form. The pass point for each vocation, grade level and exam form is set independently.

## How Pass Points are Set

A modified Angoff Method is used to determine the pass point for each version of each exam. The modified Angoff Method uses expert judgments to determine the difficulty level of the exam. The easier the exam, the higher the pass point. Likewise, the more difficult the exam, the lower the pass point.

The following is a basic outline of the modified Angoff Method (some details have been omitted):

1. A group of Subject Matter Experts (SMEs) independently rate each exam question within a given exam. The ratings are defined as the probability, or likelihood, that a minimally competent person with the requisite education and experience will answer the question correctly. A minimally competent person is defined as someone who adequately performs all job functions safely and requires no further training to do so.
2. The SMEs review each exam question as a group. A consensus is reached for the rating of each exam question. During this time the SMEs review comments submitted in writing by exam-takers. Any exam question that is judged to be ambiguous, has more than one correct answer, or has no correct answers is eliminated from the scoring process for that exam. These exam questions are then revised for future use, re-classified, or deleted from the exam item bank.
3. After the data are refined, the final step is to calculate the mean, or average, of all the exam question ratings. This becomes the overall pass point estimation.

## Why Use Modified Angoff?

Each version of a given certification exam pulls questions from an exam item bank. Each of these questions varies in difficulty. Because a different mix of questions is used in each exam form, the overall difficulty level is not fixed. Thus, it is important to make sure that the varying difficulty level is reflected in the pass point of each exam to ensure that results are reliable. Exam reliability is concerned with the reproducibility of results for each version of a given exam. In other words, for an exam to be reliable it must yield the same result (pass or fail) for the same individual under very similar circumstances. For example, imagine a candidate takes an exam at a certain grade level and passes it. Immediately after completing the exam, the candidate takes the same grade level exam, but a different version. If the exam is reliable they will achieve the same result: pass. If they do not, it is likely that the exam is not a reliable measure of minimal competency.

By taking into consideration the difficulty level of an exam, the modified Angoff Method significantly increases the reliability of the exams. Also, since each exam is adjusted for difficulty level, each exam version has the same standard for passing. Thus, exam-takers are treated equitably and fairly, even if they take different versions of the exam.

There are other methods for setting pass points. However, for the type of exams administered by CWEA, the modified Angoff Method is the best.

## Exam Scoring

All exams are electronically scored by Pearson VUE. Most exam items are valued at one point unless otherwise stated on the exam. After exams are scored, total points are compiled, and an overall score is calculated as the sum of all points earned on the exam. If the overall score is equal to, or greater than the established pass point, the candidate has passed the exam. Each question is worth 1 point. Total points possible for each exam are as follows:

- Grade 1 – 100 points
- Grade 2 – 100 points
- Grade 3 – 100 points
- Grade 4 – 85 points

## Summary of Certification Activities

A summary of certification activities for each vocation is available upon request. The summary includes pass/fail statistics, and the number of individuals currently certified. To request this information, please visit the [CWEA website](http://www.CWEA.org).