

Mechanical Technologist Candidate Handbook

# MT CERTIFICATION

v04.30.21.01

# Mechanical Technologist **Candidate** Handbook

Version 04.30.21.01

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 <u>Cert.CWEA.org</u>. 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 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 <u>www.AWTOperator.org</u>.

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 <u>State Water</u> <u>Board Office of Operator Certification</u>.





# **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 <u>Cert.CWEA.org</u> 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.

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#### 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.

GRADE 1	<ul> <li>No experience required</li> <li>(1 year of experience in the vocation is recommended)</li> </ul>
GRADE 2	<ul> <li>2 years of experience in the vocation</li> </ul>
GRADE 3	<ul> <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>
GRADE 4	<ul> <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>

## MT Certification Minimum Qualifications Chart

\*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.

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#### **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 <u>tcpcommittee@cwea.org</u>.

## 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.

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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.

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#### 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 <u>Certification Registry</u>. 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 <u>Pearson VUE's</u> <u>website</u> 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

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888-749-3881. Test centers are conveniently located throughout the U.S. Locations can be found on <u>Pearson VUE's Test Center Search</u>.

## 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: <u>https://home.pearsonvue.com/cwea/onvue</u>. 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

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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/supervis ory level.	Manager/superint endent/supervisor y 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.

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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.

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#### 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	28%
Domain 2 – Tools and Equipment	20%
Domain 3 - Records, Reports, and SCADA	10%
Domain 4 - Safety and Facility Maintenance	22%
Domain 5 - Communication	9%
Domain 6 – Math	11%
Total	100%

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#### 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, motors, engines, compressors, actuators, computerized pneumatic and odor control systems, etc.)
- 2. Assist in identifying and troubleshooting mechanical problems
- 3. Assist in the tuning of engines, adjusting and setting valve clearance, cleaning and adjusting regulators, cleaning and inspecting magnetic points, cleaning and adjusting engine timing, and checking fueling and other controls and devices
- 4. Inspect small motorized equipment and vehicles

#### Sub-Domain 1.2:

Maintenance and repair of tools, equipment, systems, and facilities

- 1. Assist in the disassembly and reassembly of equipment in order to clean parts and cases
- 2. Perform general clean-up of tools, equipment, and work areas
- Assist in the maintenance and repair of equipment used for disinfection of water/wastewater treatment facilities, including the connection and disconnection of cylinders
- 4. Clean, oil, and lubricate motors, generators, compressors, pumps, turbines, and other moving equipment
- 5. Assist in the inspection, calibration, and maintenance of equipment used for confined space entries (atmospheric monitors, air testers, etc.)
- 6. Assist with regularly scheduled preventative maintenance and repair work on water/wastewater plant and lift/pump station equipment, pipelines, and valves
- 7. Assist in the maintenance of mechanical equipment necessary to the operation of water/wastewater facilities, including large pumps, portable gas and diesel driven pumps, motors, hydraulic controls and regulators, valves and allied pumping systems, chemical feed and processing equipment, compressors, heating and ventilating equipment, emergency generators, and all other related equipment

#### Sub-Domain 1.3:

Installation of components and equipment

1. Assist in the installation of plant, field, and shop equipment, components, and machinery

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## 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 equipment and specialty tools
- 2. Assist in the fabrication of parts and fittings, making of assemblies, and repair of units based on drawings, specifications, sketches, work orders, verbal instructions, or personal visual inspection

#### Sub-Domain 2.2:

Meters

- 1. Read and interpret meters accurately
- 2. Chart and record results
- 3. Notify senior staff members of issues

#### Sub-Domain 2.3:

Operation of tools, equipment, and vehicles

- 1. Assist in the operation of 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, vactors)
- 3. Operate equipment used for installation, maintenance, and repair activities (portable and stationary generators, steam cleaners, portable pumps, compressors, valves, pumps, gauges, engines, and electromechanical devices)
- 4. Operate hand and power tools used for installation, maintenance, and repair activities (sandblaster, grinder, pneumatic, hydraulic, and electric tools, oxygenacetylene torch)
- 5. Operate precision measuring instruments in the performance of various work assignments (calipers, micrometers, dial indicators)

## 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

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- 3. Record data and run times for pump motors, standby generators, and related equipment
- 4. Basic understanding of workflow process and documentation in computerized maintenance management system (CMMS)
- 5. Follow Operations and Maintenance Manual (OMM) 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 and Facility Maintenance

Sub-Domain 4.1:

Safety

- 1. Knowledge of basic safety rules and safe work practices
- 2. Basic knowledge of CalOSHA standards and safety procedures for working with chemicals (e.g., Safety Data Sheets)
- 3. Basic knowledge of safety practices for confined space entry
- 4. Assist with confined space entries per CalOSHA and local regulations
- 5. Perform vehicle, tool, and equipment safety checks and air quality tests
- 6. Follow Lockout Tagout (LOTO) safety procedures
- 7. Identify and implement proper Personal Protective Equipment (PPE) for work environment (safety glasses, hard hat, gloves, ear protection, respirator, face shield, hazmat suit)

#### Sub-Domain 4.2:

Building and grounds maintenance

- 1. Assist with building and grounds maintenance including plumbing, painting, moving furniture, basic carpentry, masonry, and irrigation
- 2. Perform housekeeping duties in facilities including cleaning and removing waste products, cleaning screens and vents, and performing janitorial tasks
- 3. Basic knowledge of general methods of related electrical, carpentry, plumbing, HVAC, and pipefitting repair to identify building and grounds maintenance and repair issues

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#### Domain 5: Communication

Sub-Domain 5.1:

Communication

- 1. Communicate clearly and concisely, both orally and in writing
- 2. Understand and follow oral and written instructions
- 3. 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

#### Sub-Domain 6.1:

Math calculations and basic computations

- 1. Calculate flow rates
- 2. Calculate volume and area
- 3. Calculate pressure
- 4. Basic understanding of converting 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,

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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 – In	spection, Maintenance, Installation, and Repair
Sub-Domain 1.1	Water Treatment Plant Operations, Volume 1, 7th Edition. Pages 38-43, 108
	Water Distribution System O&M, 7th Edition. Pages 40-45, 56-70, 168-173, 466
	Water Treatment Plant Operations, Volume 2, 7th Edition. Pages 180-182, 319-320, 342-349, 352-354, 371-376, 393-394, 451-456, 510-545
	Operation of Wastewater Treatment Plants, Volume 1, 8th Edition. Pages 183-184, 292-298, 344-346, 365-368, 518-521, 542-544, 546-547, 551-554, 565-567, 665- 672, 706-730, 743-746
	Operation of Wastewater Treatment Plants, Volume 2, 7th Edition. Pages 254, 333-458
	Audel Millwrights and Mechanics Guide. 5th Edition
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#### Domain 3 – Records, Reports, and SCADA

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#### 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. What is required for a sealed ball bearing?
  - a. It must regularly be lubricated
  - b. It will need to be annually inspected
  - c. It does not need to be lubricated under normal use
  - d. Only oil lubrication is necessary
- 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.

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- 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 **<u>least</u>** 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. There is a 18 inch-wide red stripe painted on the ground around a tank. The tank is 25 feet high and 150 feet in diameter. What is the perimeter on the outer edge of the stripe?
  - a. 76.5 ft
  - b. 156.2 ft
  - c. 480 ft
  - d. 706 ft

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- 12. A 12-inch diameter pipe, 48 feet long, weighs 35 pounds per lineal foot. What is the weight of the total load?
  - a. 420 lb
  - b. 576 lb
  - c. 1,680 lb
  - d. 3,360 lb





#### 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
  - Solution:

Perimeter = Diameter x pi = (150ft + (2\*18-inch x 1 ft / 12 inch)) x 3.14 = 153ft x 3.14 = 480ft

12. C - Domain 6 Solution:

$$TL[lb] = L[ft] \times w\left[\frac{lb}{ft}\right] = 48[ft] \times 35\left[\frac{lb}{ft}\right] = 1,680\,lb$$





# **MT GRADE 2 EXAM CONTENT OUTLINE**

Content Domain	Weighting
Domain 1 - Inspection, Maintenance, Installation, and Repair	33%
Domain 2 – Tools and Equipment	19%
Domain 3 - Records, Reports, and SCADA	10%
Domain 4 - Safety and Facility Maintenance	18%
Domain 5 - Administration and Communication	9%
Domain 6 - Math	11%
Total	100%

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

#### Sub-Domain 1.1:

Inspection of systems and equipment

- 1. Inspect water/wastewater machinery and equipment (pumps, valves, motors, engines, compressors, actuators, computerized pneumatic and odor control systems, etc.)
- 2. Independently troubleshoot and diagnose mechanical and electrical malfunctions 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 of rotating equipment varispeed drives, gear-reduction drives, shafts, and belts
- 5. Adjust and set valve clearance, clean and adjust regulators, clean and inspect magnetic points, clean and adjust engine timing, and check fuel and other controls and devices
- 6. Inspect small motorized equipment and vehicles

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#### 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 plan and lift/pump station equipment, pipelines, and valves
- 2. Maintain and troubleshoot mechanical equipment necessary to the operation of water/wastewater facilities (including large pumps, portable gas and diesel driven pumps, motors, hydraulic controls and regulators, valves and allied pumping systems, chemical feed and processing equipment, compressors, heating and ventilating equipment, emergency generators, and all other related equipment)
- 3. Maintain and repair of equipment used for disinfection of water/wastewater treatment facilities using various disinfection processes
- 4. Clean, oil, and lubricate motors, generators, compressors, pumps, turbines, and other moving equipment
- 5. Participate in the work of a crew that performs major and minor repair work on water/wastewater facility equipment such as engines, sewer and storm pumping stations, pumps, lift stations, pneumatic control systems, and ventilation blower units
- 6. Inspect, calibrate, and maintain equipment used for confined space entries (atmospheric monitors, air testers, etc.)
- 7. Investigate interruptions of service, identify defects, and resolve complex mechanical repair problems

#### Sub-Domain 1.3:

Installation of components and equipment

- Install and adjust a variety of mechanical equipment necessary to the operation of water/wastewater facilities, including large pumps, portable gas and diesel driven pumps, motors, hydraulic controls and regulators, valves and allied pumping systems, chemical feed and processing equipment, compressors, heating and ventilating equipment, emergency generators, and other related equipment
- 2. Recommend improvements to the design and installation 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 and specialty tools
- 2. Fabricate parts and fittings, make assemblies, and repair units based on drawings, specifications, sketches, work orders, verbal instructions, or personal visual inspection

#### Sub-Domain 2.2:

Meters

- 1. Read and interpret meters accurately
- 2. Chart and record results
- 3. Troubleshoot minor issues and notify senior staff members of complex issues

#### Sub-Domain 2.3:

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, vactors)
- 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, oxygen-acetylene torch)
- 5. Operate precision measuring instruments in the performance of various work assignments (calipers, micrometers, dial indicators)
- 6. Basic knowledge of practices, procedures, tools, and equipment of machinery and welding shops (plasmacutting, MIG, TIG, and ARC welding)





## 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 asbuilts

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 data and run times for pump motors, standby generators, and related equipment
- 5. Prepare reports on operations and activities (posting of work orders, daily logs, ledgers, parts lists, invoices, and inventories)
- Basic knowledge of documentation and regulatory requirements (such as Air Pollution Control District (APCD), Department of Toxic Substances Control (DTSC), Certified Unified Program Agencies (CUPA), California Code of Regulations Title 22)
- 7. Assist in the development and updating of the 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. Basic 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 and Facility Maintenance

#### Sub-Domain 4.1:

Safety

- 1. Knowledge of safety rules and safe work practices with basic understanding of local, state, and federal laws, ordinances, and rules
- 2. Handle all work-related chemicals in accordance with CalOSHA standards and safety procedures (e.g., Safety Data Sheets)
- 3. Knowledge of safety practices for confined space entry
- 4. Perform confined space entries per CalOSHA and local regulations
- 5. Maintain and use self-contained breathing apparatus
- 6. Perform vehicle, tool, and equipment safety checks, chemical tests, and air quality tests
- 7. Understand and follow Lockout Tagout (LOTO) safety procedures
- 8. Identify and implement proper Personal Protective Equipment (PPE) for work environment (safety glasses, hard hat, gloves, ear protection, respirator, face shield, hazmat suit)

#### Sub-Domain 4.2:

Building and grounds maintenance

- 1. Perform building and grounds maintenance including plumbing, painting, moving furniture, basic carpentry, masonry, and irrigation
- 2. Perform housekeeping duties in facilities including cleaning and removing waste products, cleaning screens and vents, and performing janitorial tasks
- 3. Basic knowledge of general methods of related electrical, carpentry, plumbing, HVAC, and pipefitting repair to identify and resolve building and grounds maintenance and repair issues

## Domain 5: Administration and Communication

#### Sub-Domain 5.1:

Administration

- 1. Assist in the development of a preventative maintenance schedule
- 2. Work with others to accomplish the planned maintenance routines
- 3. Evaluate operations and activities of assigned responsibilities and recommend improvements/modifications
- 4. Participate in work activities with other departments and divisions

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- 5. General knowledge of process to solicit bids and purchase equipment, parts, tools, and contractor work
- 6. Knowledge of how to prepare rough estimates of labor and materials necessary to accomplish the maintenance and repair activities
- 7. Follow Operations and Maintenance Manual (OMM) and standard operating procedures (SOPs) and provide input for improvement

### Sub-Domain 5.2:

Communication

- 1. Communicate clearly and concisely, both orally and in writing
- 2. Understand and follow oral and written instructions
- 3. 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. Basic understanding of converting 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 the key textbooks and reference materials listed below. Candidates should understand that the references listed do not necessarily cover all

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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		
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Domain 6 – Math		
Sub-Domain 6.1	Water Treatment Plant Operations, Volume 2, 7th Edition. Pages 295, 733-819	
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### Sample Questions

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

- 1. What is the source of most bearing failure?
  - a. Excessive shaft speed
  - b. Improper installation
  - c. Under lubrication
  - d. Some form of contamination entering the bearing
- 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. Which of the following best describes the efficiency of preventative maintenance for plant equipment?
  - a. The accumulation and analysis of equipment performance data designed to schedule equipment repairs
  - b. Timely response to equipment failure, returning equipment to service with a minimum of downtime

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- c. Periodic inspection of facilities to discover developing defects that could lead to equipment failures
- d. Dependent upon just-in-time parts delivery
- 7. Which task does not require Lock Out/Tag Out in order to complete?
  - a. Clear a blocked pump impeller
  - b. Replace a mechanical seal
  - c. Collect vibrations data from a shaft bearing
  - d. 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. Two major components of a maintenance program are performing tasks and:
  - a. scheduling tasks.
  - b. ordering renewal parts.
  - c. equipment failure analysis.
  - d. completing the paperwork.
- 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 loses
- 11. What is the area of a triangle with a base of 15 feet and 4 inches and height of 8 feet and 9 inches?
  - a. 67 ft<sup>2</sup>
  - b. 68.5 ft<sup>2</sup>
  - c. 134.1 ft<sup>2</sup>
  - d. 137 ft<sup>2</sup>
- 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>





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## Answer Key and Solutions

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

Solution:

$$A[ft^{2}] = \frac{1}{2} \times B[ft] \times H[ft] = \frac{1}{2} \times \left(15[ft] + 4[in] \times \frac{ft}{12in}\right) \times \left(8[ft] + 9[in] \times \frac{ft}{12in}\right) = \frac{1}{2} \times 15.333[ft] \times 8.75[ft] = 67 ft^{2}$$

12. C - Domain 6

Solution:

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





# MT GRADE 3 EXAM CONTENT OUTLINE

Content Domain	Weighting
Domain 1 – Inspection, Maintenance, Installation, and Repair	33%
Domain 2 - Tools and Equipment	17%
Domain 3 - Records, Reports, and SCADA	13%
Domain 4 - Safety and Facility Maintenance	14%
Domain 5 - Administration and Communication	13%
Domain 6 - Math	10%
Total	100%

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

#### Sub-Domain 1.1:

Inspection of systems and equipment

- Supervise and participate in the inspection of water/wastewater machinery and equipment (pumps, valves, motors, engines, compressors, actuators, computerized pneumatic and odor control systems, etc.)
- 2. Independently troubleshoot and diagnose complex mechanical and electrical 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 emergency diesel generator operation, maintenance, and repair
- 5. Advanced knowledge of standard practices and procedures for natural gas engines

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- 6. Advanced knowledge of standard practices and procedures for co-generation systems
- 7. 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
- 8. Knowledge of condition monitoring and predictive maintenance

### Sub-Domain 1.2:

Installation, maintenance, and repair of tools, equipment, systems, and facilities

- Supervise and participate in troubleshooting and repairing defects within mechanical equipment necessary to the operation of water/wastewater facilities (including large pumps, portable gas and diesel driven pumps, motors, hydraulic controls and regulators, valves and allied pumping systems, chemical feed and processing equipment, compressors, heating and ventilating equipment, emergency generators, and all other related equipment)
- 2. Knowledge of standard practices, procedures, tools, and materials used in the installation, maintenance, and repair of heavy plant equipment, pump motors, controllers, variable speed and chain drives, and lift/pump stations
- 3. Supervise and participate in the installation of pumps, variable speed drives and motors, controllers, and timing devices
- 4. Supervise maintenance and repair of equipment used for disinfection of water/wastewater treatment facilities using various disinfection processes
- 5. Supervise and participate in the replacing of packing/mechanical seals in pumps and valves and bearings in motors, pumps, and other equipment
- 6. Investigate interruptions of service, identify defects, and resolve complex mechanical repair problems
- 7. 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 and specialty tools

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

### Sub-Domain 2.2:

Operation of tools, equipment, and vehicles

- 1. Supervise and operate various cranes/hoists/lifting/rigging equipment for moving/replacing pumps, machinery, or other heavy equipment during installation, maintenance, and repair activities (overhead, gantry, mobile cranes, etc.)
- 2. Supervise and operate vehicles used for installation, maintenance, and repair activities (trucks, forklifts, vactors)
- 3. Supervise and operate equipment used for installation, maintenance, and repair activities (portable and stationary generators, jackhammers, steam cleaners, portable pumps, compressors, valves, gauges, engines, and electro-mechanical devices)
- 4. Supervise and operate hand and power tools used for installation, maintenance, and repair activities (lathe, milling machine, sandblaster, grinder, drill, drill press, pneumatic, hydraulic, and electric tools, oxygenacetylene torch)
- 5. Supervise and operate precision measuring instruments in the performance of various work assignments (shaft alignment, calipers, micrometers, atmospheric testers, vibration analyzers, dial indicators)
- 6. Knowledge of practices, procedures, tools, and equipment of machinery and welding shops (plasma-cutting, MIG, TIG, and ARC welding)

# Domain 3: Records, Reports, and SCADA

### Sub-Domain 3.1:

Maps and blueprints

- 1. Knowledge of practices, procedures, tools, and equipment of machinery and welding shops (plasma-cutting, MIG, TIG, and ARC welding)
- 2. Read and interpret sketches, blueprints, manufacturer diagrams, basic electrical schematics, drawings, and as-builts
- 3. Provide input on design blueprints and recommend changes before finalization

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4. Record updates for maps when discrepancies are found, or upgrades are made (repair jobs, small pipe repair jobs, etc.)

### Sub-Domain 3.2:

Documentation

- 1. Maintain comprehensive and detailed records of maintenance, repair, and inspection activities
- 2. Update asset information in computerized maintenance management system (CMMS)
- 3. Establish a preventative maintenance (PM) schedule
- 4. Record repair actions and parts requests
- 5. Record work orders and field reports
- 6. Record data and run times for pump motors, standby generators, and related equipment
- 7. Prepare reports on operations and activities (posting of work orders, daily logs, ledgers, parts lists, invoices, and inventories)
- 8. Knowledge of underground storage tank (UST) regulations and documentation requirements (Title 23, Chapter 16; CA Health and Safety Code, Chapter 6.7)
- Knowledge of diesel engine documentation and regulatory requirements for emergency equipment (Rule 1147; BAAQMD Regulation 2, Permits Rules 1 and 2; Airborne Toxic Control Measure for Diesel Particulate Matter from Portable Engines Rated at 50 HP and Greater; CCR Title 17, Sections 933116.1-933116.5)
- 10. Knowledge of natural gas engine documentation and regulatory requirements (Rule 1110.2)
- 11. Knowledge of boiler documentation and regulatory requirements (Rule 1179.1)
- 12. Knowledge of pressure vessel regulatory requirements (air receivers)(CA Labor Code 7620 7771)
- Knowledge of Spill Prevention Control and Countermeasure (SPCC) documentation and regulatory requirements (40CFR112 (Federal); CA Health and Safety Code, Chapter 25270.1-25270.13; CA Unified Program Agencies, under Chapter 6.67)

### 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 and Facility Maintenance

### 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 (CalOSHA, National Fire Protection Association (NFPA) 70E arc flash safety, Fall Protection, Heat Protection, Traffic Control)
- 4. Maintain and use self-contained breathing apparatus
- 5. Handle all work-related chemicals in accordance with CalOSHA standards and safety procedures (e.g., Safety Data Sheets)
- 6. Ensure confined space entry and rescue are performed per CalOSHA and local regulations
- 7. Perform vehicle, tool, and equipment safety checks including chemical tests, air quality tests, and routine meter readings
- 8. Ensure that proper Personal Protective Equipment (PPE) for work environment is implemented (safety glasses, hard hats, gloves, ear protection, respirator, face shields, hazmat suit)

### Sub-Domain 4.2:

Building and grounds maintenance

- 1. Supervise and participate in general building and grounds maintenance and repair including plumbing, painting, moving furniture, basic carpentry, masonry, and irrigation
- 2. Knowledge of general methods of related electrical, carpentry, plumbing, HVAC, and pipefitting repair to identify and supervise building and grounds maintenance and repair issues

# Domain 5: Administration and Communication

#### Sub-Domain 5.1:

Administration

1. Supervise, train, and evaluate subordinates

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- 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 and use of operation and maintenance manuals (OMM) and CMMS

### Sub-Domain 5.2:

Communication

- 1. Communicate clearly and concisely, both orally and in writing
- 2. Understand direction and effectively instruct subordinates
- 3. 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

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- 6. Calculate pressure
- 7. Calculate energy cost of equipment (including lift/pump stations)
- 8. Calculate thermal expansion rates
- 9. Calculate density and weight

# 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.





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Sub-Domain 1.1	Water Treatment Plant Operations, Volume 2, 7th Edition. Pages 180-182, 319-320, 346-348, 352-354, 371-376, 393-394, 342-349, 451, 456, 510-545	
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Sub-Domain 2.2	Water Treatment Plant Operations, Volume 2, 7th Edition. Pages 597-606	
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  - Chapter 6.7
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- Operation of Wastewater Treatment Plants, Volume 1, 8th Edition, Office of Water
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- Water Distribution System O&M, 7th 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





### Sample Questions

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

- 1. Why should plans and specifications for wastewater installations be carefully reviewed?
  - a. To identify potential safety hazards
  - b. To ensure consistency of symbols in the P&ID
  - c. To check for proper color-coding of power conductors
  - d. To check for proper color-coding of power conductors
- 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. What is a Venturi meter used to measure?
  - a. Flow of sewage
  - b. Pressure of sewage
  - c. Temperature of sewage
  - d. Depth of sewage
- 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. In which of the following locations should the Safety Data Sheets be located?
  - a. At the facility library
  - b. In the break room
  - c. At the work area
  - d. In the manager's office
- 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

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- 7. What is the greatest hazard associated with a liquid polymer spill?
  - a. Fire
  - b. Toxicity
  - c. An explosion
  - d. Slipping
- 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. Which of the following describes using staff members to accomplish common
  - objectives?
    - a. Controlling
    - b. Delegating
    - c. Planning
    - d. Managing
- 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 fence on the perimeter of a sewer lift station measures 235 feet, 366 feet, 266 feet and 298 feet. If a 20-foot gate is to be installed in the 266-foot section, how many linear feet of fence are there?
  - a. 1,464 ft.
  - b. 1,145 ft.
  - c. 1,165 ft.
  - d. 1,185 ft.
- 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. A Domain 2
- 4. A Domain 2
- 5. C Domain 3
- 6. B Domain 3
- 7. D Domain 4
- 8. D Domain 4
- 9. D Domain 5
- 10. B Domain 5
- 11. B Domain 6

Solution:

$$p[ft] = A[ft] + B[ft] + C[ft] + D[ft] = 235[ft] + 366[ft] + 266[ft] + 298[ft] = 1,165 ft$$

Calculate fence length needed by subtracting the gate width

L[ft] = p[ft] - G[ft] = 1,165[ft] - 20[ft] = 1,145 ft

12. B - Domain 6

Solution:

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

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# **MT GRADE 4 EXAM CONTENT OUTLINE**

Content Domain	Weighting
Domain 1 - Inspection, Maintenance, Installation, and Repair	31%
Domain 2 - Administration	20%
Domain 3 - Records, Reports, and SCADA	19%
Domain 4 - Safety and Emergency Response	22%
Domain 5 - Communication	8%
Total	100%

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

Sub-Domain 1.1:

Inspection of systems and equipment

- 1. Perform, facilitate, and report root cause analysis
- 2. Perform failure and reliability analysis
- 3. Perform field inspections of work in progress and at completion
- 4. 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 (including central power generation systems), for water/wastewater treatment facilities

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- 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. Troubleshoot issues arising from inspection of tools and equipment for compliance with safety standards
- 8. Operate condition monitoring tools and software

# Domain 2: Administration

Sub-Domain 2.1:

Budgeting

- 1. Assist 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. Oversee or assist in 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

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- 6. Educate and train staff on new and revised approaches, and operation/inspection of new equipment and tools
- 7. Participate in the selection and recommendation of the appointment of personnel
- 8. Establish performance standards for personnel, implement discipline procedures, and work with staff to correct deficiencies
- 9. Oversee and participate in employee development and advancement initiatives and succession planning
- 10. Provide training and use of operation and maintenance manuals (OMM) and computerized maintenance management system (CMMS)

### Sub-Domain 2.3:

Management and planning

- 1. Review job plans
- 2. Estimate personnel, equipment, and material requirements for assigned jobs
- 3. Requisition work materials, tools, equipment, and supplies
- 4. Provide input on asset replacement schedules
- 5. Provide recommendations for 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 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 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

- Maintain detailed documentation and work records, including data on facilities, detail of failures, descriptions of work performed, as-built sketches and drawings
- 2. Maintain maintenance records and requests including work order tracking
- 3. Knowledge of recordkeeping and reporting procedures
- 4. Knowledge of underground storage tank (UST) regulations and documentation requirements (Title 23, Chapter 16; CA Health and Safety Code, Chapter 6.7)
- Knowledge of diesel and natural gas engine documentation and regulatory requirements for emergency equipment (Rule 1147; BAAQMD Regulation 2, Permits Rules 1 and 2; Airborne Toxic Control Measure for Diesel Particulate Matter from Portable Engines Rated at 50 HP and Greater; CCR Title 17, Sections 933116.1-933116.5; Rule 1110.2 Natural Gas)
- 6. Knowledge of boiler documentation and regulatory requirements (Rule 1179.1)
- 7. Knowledge of pressure vessel regulatory requirements (air receivers)(CA Labor Code 7620 7771)
- 8. Knowledge of Spill Prevention Control and Countermeasure (SPCC) documentation and regulatory requirements (40CFR112 (Federal); CA Health and Safety Code, Chapter 25270.1-25270.13; CA Unified Program Agencies, under Chapter 6.67)
- 9. Basic understanding of Sanitary Sewer Overflow (SSO) regulations

### 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. Knowledge of 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. Ensure compliance with applicable local, state, and federal laws, rules, and regulations
- Knowledge of safety policies, procedures, and safe work practices applicable to assignment including CalOSHA regulations, confined space entry, lockout/tagout (LOTO) procedures, National Fire Protection Association (NFPA) 70E arc flash safety, Fall Protection, Heat Protection, Spill Protection Control Countermeasure (SPCC)
- 4. Knowledge of occupational hazards and standard safety precautions
- 5. 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 data sheets, traffic control, etc.)
- 6. Interpret and apply policies, procedures, rules, and regulations

### Sub-Domain 4.2:

Emergency Response

- 1. Oversee 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 and maintain equipment and facilities for use during an emergency response
- 4. Determine conditions that will warrant activation of emergency response plans





## Domain 5: Communication

Sub-Domain 5.1: Communication

- 1. Communicate clearly and concisely, both orally and in writing
- 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
- 3. Prepare and present various reports and other necessary correspondence
- 4. 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.

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Sub-Domain 1.1	Water Treatment Plant Operations, Volume 2, 7th Edition. Pages 180-182, 319-320, 346-348, 352-354, 371-376, 393-394, 342-349, 451, 456, 510-545	
	Operation of Wastewater Treatment Plants, Volume 1, 8th Edition. Pages 183-184, 292-298, 344-346, 365-368, 518-521, 542-544, 546-547, 551-554, 565-567, 665-672, 706-730, 743-746	
	Operation of Wastewater Treatment Plants, Volume 2, 7th Edition. Pages 254, 333-458	
	Water Treatment Plant Operations, Volume 1, 7th Edition. Pages 38-43, 108	
	Water Distribution System O&M, 7th Edition. Pages 40-45, 56-70, 168- 173, 466	
	California Code of Regulations, Title 8, Section 1618	
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Sub-Domain 1.2	Water Treatment Plant Operations, Volume 2, 7th Edition. Pages 281-290, 616-618	
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	Manage for Success, Effective Utility Leadership Practices, 1st Edition	
Domain 2 – Administration		
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Sub-Domain 2.2	Water Treatment Plant Operations, Volume 2, 7th Edition. Pages 626-661	
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	Water Distribution System O&M, 7th Edition. Pages 476-500	
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	Operation of Wastewater Treatment Plants, Volume 2, 7th Edition. Pages 687-689	
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	State Water Resources Control Board Order No. 2006-0003-DWQ	
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	Title 29 CFR 1910.335
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	• NEC 110.16
	NFPA 70E, Section 130.5
Sub-Domain 4.2	Water Treatment Plant Operations, Volume 2, 7th Edition. Pages 679- 690
	Operation of Wastewater Treatment Plants, Volume 2, 7th Edition. Pages 722-725
	Water Distribution System O&M, 7th Edition. Pages 528-539
Domain 5 – Communication	
Sub-Domain 5.1	Water Treatment Plant Operations, Volume 2, 7th Edition. Pages 652-661
	Operation of Wastewater Treatment Plants, Volume 2, 7th Edition. Pages 708-713
	Water Distribution System O&M, 7th Edition. Pages 265-270, 501-511, 518- 521





# Suggested References List

- Audel Millwrights and Mechanics Guide. 5th Edition. Davis and Nelson.
- Audel Mechanical Trades Pocket Manual. 4th Edition. Davis and Nelson.
- California Code of Regulations Title 8
  - Section 1618
  - <u>Section 1626</u>
  - Section 3314
  - Section 5157
- <u>California Code of Regulations Title 23, Division 3, Chapter 16, Appendix VI</u>
- <u>Manage for Success, Effective Utility Leadership Practices, 1st Edition. Office of Water</u>
  <u>Programs</u>
- NEC 110.16
- NFPA 70E, Section 130.5
- Operation of Wastewater Treatment Plants, Volume 1, 8th Edition, Office of Water
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- Operation of Wastewater Treatment Plants, Volume 2, 7th Edition, Office of Water Programs
- <u>State Water Resources Control Board Order No. 2006-0003-DWQ</u>
- Title 29 CFR
  - <u>1910.335</u>
  - <u>1910.146</u>
- <u>Title 40 CFR Part 112, Spill Prevention Control and Countermeasures Regulation</u>
- <u>Utility Management, A Field Study Training Program, 2nd Edition. Office of Water</u> <u>Programs</u>
- <u>Water Distribution System O&M, 7th Edition, Office of Water Programs</u>
- Water Treatment Plant Operations, Volume 1, 7th Edition, Office of Water Programs
- Water Treatment Plant Operations, Volume 2, 7th Edition, Office of Water Programs

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### Sample Questions

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

- 1. What are the impellers of a rotary lobe positive displacement compressor designed to do?
  - a. Touch each other as they rotate
  - b. Turn in opposite directions
  - c. Turn in the same direction
  - d. Handle high pressure and high volume
- 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. What are some ways of breaking down artificial barriers to efficient operation of an organization?
  - a. Memorandums detailing specific organization goals to be changed and the steps to be taken to fulfill new goals
  - b. Multifunction teams that determine how to accomplish change within the organization
  - c. A newsletter that informs staff of changes coming within an organization
  - d. Managed change, directed and lead from management within an organization
- 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

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- c. Domestic
- d. Industrial
- 6. What is the first thing that should be done if a supervisor suspects that an employee is under the influence of an intoxicant?
  - a. Ignore the employee and discuss this at a time when he/she is not under the influence
  - b. Tell the employee to drive home and charge the rest of the day to sick leave
  - c. Call the employee aside and discuss the behaviors that have led you to suspect the problem
  - d. Fire the employee on the spot for being under the influence at work
- 7. In addition to being large enough for an employee to enter and perform work, what other criteria define a confined space?
  - a. Has limiting or restricted means of entry or exit, and contains or has the potential to contain a hazardous atmosphere
  - b. Has limited or restricted means of entry or exit, and is not designed for continuous human occupancy
  - c. Has limited or restricted means of entry or exit, and contains a hazardous atmosphere
  - d. Is not designed for continuous human occupancy, and contains or has the potential to contain a hazardous atmosphere
- 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 key to effectively handling grievances?
  - a. Asking questions to get the facts
  - b. Establishing the appropriate setting
  - c. Listening effectively
  - d. Ensuring that the grievance is in writing




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#### Answer Key and Solutions

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





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# **MT FORMULA SHEET**

This formula sheet is available onscreen during the exam.

1 cubic foot1,728 cubic inches1 cubic foot7.48 gallons1 cubic foot of water62.43 pounds1 gallon of water8.34 pounds1 cubic foot/second448.8 gallons/minute1 MGD694 gallons/minute1 horsepower33,000 foot-pounds/minute1 kilowatt1000 watts1 horsepower746 watts1 horsepower42.45 Btu/minute1 MGD1.55 cubic feet/second1 Btu778 foot-pounds		
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1 MGD     1.55 cubic feet/second       1 Btu     778 foot-pounds       1 wett     7.412 Ptv / bours		
1 Btu 778 foot-pounds		
1 Watt 5.412 Blu/hour		
1 thermal unit 100,000 Btu		
π 3.14		
Coefficients of thermal Steel: 0.00000633/°F		
expansion Brass: 0.00001/°F		
$Circumference_{circle} = \pi \times diameter$ $Volume_{rectangular solid} = length \times width \times he$	ight	
$Area_{triangle} = \frac{base \times height}{2}$ $Volume_{triangular \ solid} = \frac{base \times height \times len}{2}$	<u>gth</u>	
$Area_{circle} = \frac{\pi}{4} \times diameter^{2} \qquad Volume_{cylinder} = \frac{\pi}{4} \times diameter^{2} \times heigh$	t	
$Area_{circle} = 0.785 \times diameter^{2} \qquad Volume_{cylinder} = \pi \times radius^{2} \times height$		
$Area_{circle} = \pi r^2 \qquad \qquad 3 \ phase \ V \ A = V \ \times A \ \times 1732$	$3 phase V A = V \times A \times 1732$	
$Area_{circle} = \pi \times radius^2 \qquad Flowing quantity = Area \times Velocity$	$Flowing \ quantity = Area \ \times Velocity$	
$Area_{rectangle} = base \times height \qquad Efficiency = \frac{work \ output}{work \ input}$	$Efficiency = \frac{work \ output}{work \ input}$	
$Primeter_{rectangle} = 2 \times (length + width) \qquad Energy = power \times time$		
Thermal expansion = coeff. of thermal expansion $\times$ length $\times \Delta T$		
Hydrostatic force= column area × column height × fluid density		
flow × head × specific gravity		
$Motor horsepower = \frac{3960 \times efficiency pump \times efficiency motor}{3960 \times efficiency pump \times efficiency motor}$		
$Brake \ horsepower = \frac{flow \ \times head \ \times specific \ gravity}{3960 \ \times efficiency}$		
$3 \text{ phase } A = \frac{746 \times \text{horsepower}}{1722 \times 10^{-5} \text{ fm}}$		
1.752 × v × ej j utency × power j uten		
water horsenower		
$Brake horsepower = \frac{water horsepower}{efficiency}$		
$Brake horsepower = \frac{water horsepower}{efficiency}$ $Water horsepower = \frac{flow \times total head \times specific gravity}{22000}$		

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# 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 <u>CWEA website</u> 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 <u>OWEN</u> 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 <u>CWEA Events Website</u>. For questions about a Local Section training, please contact the Local Section directly. Contact information for individual Local Sections can be found in our <u>Directory</u>.

# **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. 86).





#### **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:

Casio	All FX-115 models (any Casio calculator with FX-115 in its name)
Texas Instruments	All TI-30x and TI-36x models
Sharp	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 <u>Candidate Rules Agreement</u> 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 <u>Pearson VUE user account</u>. 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 <u>tcpcommittee@cwea.org</u>. The committee's decision will be final.

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All communication related to certification decisions and appeal results with the Technical Certification Program Executive Committee must be sent in writing to <u>tcpcommittee@cwea.org</u>. We ask that candidates do not contact committee members directly.

The appeal form can be accessed here: <u>CWEA Exam Appeal Form</u>.

# **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

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online by logging into their <u>mycwea.org</u> 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. 81).

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 <u>CWEA website</u>. 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. 82).

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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 O2-O3 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. 84).

## 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 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, reclassified, 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

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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 <u>CWEA website</u>.

