Study Guide
of
Typical Exam Content
for
Waterworks Operator
Certification Examinations

LIMITED TREATMENT

D CLASSIFICATIONS

D-4 Entry Level of Certification
D-3 Intermediate Level of Certification
D-2 Advanced Level of Certification
D-1 Highest Level of Certification

Written Examinations: The written examinations for all classifications are developed from need-to-know type exam questions. The design of the questions has been selected so that they are clear, not misleading or tricky.

Style of Questions: All exam questions are multiple choice. The style of questions and number of questions may change without notice.

Exam Content: The subjects typically covered on the various certification examinations are grouped by exam on the following pages. These subjects may change without notice.
D-4 & D-3 Study Guide

Corrosion
Definition, causes/effects/prevention of corrosion on interiors/exteriors, Langelier Index.

Cross Connections
Definition, types, causes, prevention and/or correction (devices and when each is used), which agency is responsible for inspections, testing of devices.

Disinfection
Chemicals used, all aspects of disinfection with chlorine (PPM calculations, residual, available concentration, demand, and dose etc.), methods of measuring chlorine residual, storage, testing, handling, safety, etc. of chlorine.

Emergencies and Security
Contingency plan (requirements, key topics, examples, etc).

Fluoridation
Chemicals used, dosage calculations, reasons for addition, safety and handling, regulations (sampling frequency).

Hardness/Softening
Causes/effects, dosage calculations.

Hydraulics
Definitions, volume, density, specific gravity, area, circumference, pressure/hydraulic head calculations, detention time, abbreviations/conversions.

Instrumentation
What processes should be instrumented and why? Type of instrumentation (flow meters, valves, etc.) Measuring & control of water equipment such as float levels and weirs, flow measurements, pressure controls, electrical controls.

Iron Removal
Processes to remove or stabilize the iron (aeration, potassium permanganate, phosphate addition, etc.) filter backwash rate calculations.

Laboratory
Procedures, techniques, equipment, medias, preservatives, calculations, thorough understanding of results, routine testing, etc.

Management
How to handle given management situations (town meetings, employee discipline or motivation, hostile customers, etc.)

Membrane Technology
Types of membranes (reverse osmosis, microfiltration, etc.), selectivity of membranes, cleaning of membranes.
**Microbiology**  
Definitions, testing procedures, standard methods for analysis, medias used etc. Classification of waterborne diseases (viruses, bacteria, protozoa, etc), indicator organisms (name, purpose, etc.), reporting of results.

**O & M**  
Procedures for general & preventative maintenance of equipment, trouble shooting, operational procedures and common installations.

**Phosphate**  
Optimum dose, dosage calculations, advantages/disadvantages of application, solubility in water.

**Public Relations**  
Principles to maintain a good public image, contact with the public and handling customer complaints.

**Pumps & Motors**  
Understanding of pumps and motors, their operation, types, trouble shooting, calculations, etc.

**Recordkeeping**  
Water quality & samples results (bacteriological and chemical), MDEQ operation reports, data management.

**Safety**  
Personal & site safety associated with chemicals, equipment, maintenance operations, etc., confined spaces (define, give examples, entry procedures, etc.)

**Sampling**  
Procedures (pre-sampling, sampling - bacteriological/chemical, Pb/Cu), results (understand and interpret), routine sampling (regulation, benefits, etc), sample preservation techniques and handling procedures.

**SDWA**  
Michigan Safe Drinking Water Act as amended, (rules and regulations), National Primary & Secondary Drinking Water Standards, operator certification, MCL's, notification, regulated compounds, etc., public health.

**Taste & Odor**  
Causes and solutions to taste and odor complaints, Standard Methods tests.

**Wells**  
Definitions; groundwater hydrology, monitoring schedules, pumpage logs, maintenance, etc., isolation area (define, size, etc.), good housekeeping in a pump/well house (explain, give examples, etc.), firm capacity (define, examples, etc.), well casing appurtenances (vents, valves, etc.)
D-2 Study Guide

**Corrosion**
Causes/effects of corrosion on interiors/exteriors, Langelier index.

**Cross Connections**
Definition: prevention and/or correction (devices and when each is used). What agency is responsible for inspections?

**Disinfection**
All aspects of disinfection with chlorine (PPM calculations, residual, available concentrations, demand, etc.) methods (DPD, storage, testing, handling, safety, etc), UV and ozone.

**Emergency/Security**
Contingency Plan (requirements, key topics, examples, etc.)

**Fluoridation**
Dosage calculations, reasons for addition, fluoride compounds used, analysis technology, etc.

**Hardness/Softening**
Causes/effects, ion exchange units, etc.

**Hydraulics**
Volume, density, area, circumference, and pressure/hydraulic head calculations, abbreviations/conversions.

**Instrumentation**
What processes should be instrumented and why? Type of instrumentation (flow meters, valves, etc.)

**Iron Removal**
Processes to remove or stabilize the iron (aeration, potassium permanganate, phosphate addition, etc.), filter backwash rate calculations.

**Laboratory Procedures**
Procedures, techniques, equipment, medias, preservatives, etc., through understanding of results, routine testing, etc.

**Management**
How to handle given management situations (town meetings, employee discipline or motivation, hostile customers, etc.)

**Membrane Technology**
Types of membranes (reverse osmosis, microfiltration, etc.), selectivity of membranes, cleaning of membranes.

**Microbiology**
Testing procedures, standard methods for analysis, medias used, etc., classification of waterborne diseases (viruses, bacteria, protozoa, etc.), indicator organisms (name, purpose, etc.)
O & M
Operational procedures and common installations.

Phosphate
Optimum dose, dosage calculations, advantages/disadvantages of application, solubility in water.

Public Relations
Describe situations where you may come in contact with the public, how to handle these situations and maintain a good public image.

Pumps & Motors
Understanding of pumps, motors, their operation, types, trouble shooting, pump curves, etc. Be able to calculate the dynamic head and horsepower for given pump specifications.

Recordkeeping
Water quality & sample results (bacteriological/chemical, MDEQ operation reports, advantages of recordkeeping with respect to treatment efficiency.

Safety
Personal & site safety associated with chemicals, equipment, maintenance operations, etc. confined spaces (define, give examples, entry procedures, etc.)

Sampling
Procedures (pre-sampling, sampling bacteriological/chemical, Pb/Cu, nitrates, etc.) Results (understand & interpret), routine sampling (regulations, benefits, etc.)

SDWA
Michigan Safe Drinking Water Act as amended. National Primary & Secondary Drinking Water Standards, rules & regulations, operator certification, MCL's, notification, regulated compounds, etc.)

Taste & Odor
Standard Methods Test, causes, solutions, etc.

Wells
Groundwater hydrology, monitoring schedules, pumpage logs, maintenance & rehabilitation, etc. Isolation area (define, size, etc.), good housekeeping in a pump/well house (explain, give examples, etc.), firm capacity (define, examples, etc.), well casing appurtenances (vents, valves, etc.)
D-1 Study Guide

Corrosion
Causes/effects of corrosion on interiors/exteriors, Langelier Index.

Cross Connections
Definition, prevention and/or correction (devices and when each is used). What agency is responsible for inspections? Be able to give examples of cross connections.

Disinfection
All aspects of disinfection with chlorine (PPM calculations, residual, available concentration, demand, etc.) methods (DPD, storage, testing, handling, safety, etc), UV and ozone.

Emergency/Security
Contingency plan (requirements, key topics, examples, etc.)

Fluoridation
Dosage calculations, reasons for addition, fluoride compounds used, analysis technology, etc.

Hardness/Softening
Causes/effects, softening calculations, temperature effects, etc.
Describe the ion exchange process (regeneration, typical resins, removal calculations, etc.)

Hydraulics
Volume, density, area, circumference, and pressure/hydraulic head calculations abbreviations/conversions.

Instrumentation
What processes should be instrumented and why? Types of signals used. Type of instrumentation (flow meters, valves, solenoids, thermocouples, floats, etc.)

Iron Removal
Processes to remove or stabilize the iron (aeration, potassium permanganate, phosphate addition, etc.), filter backwash rate calculations.

Laboratory Procedures
Procedures, techniques, equipment, medias, preservatives, etc., through understanding of results, routine testing, etc.

Management
How to handle given management situations (town meetings, employee discipline or motivation, task delegation, hostile customers, etc.)

Membrane Technology
Types of membranes (reverse osmosis, microfiltration, etc.), selectivity of membranes, cleaning of membranes.

Microbiology
Testing procedures, standard methods for analysis, medias used, etc., classification of waterborne diseases (viruses, bacteria, protozoa, etc.), indicator organisms (name, purpose, etc.)
O & M
Operational procedures and common installations.

Phosphate
Optimum dose, dosage calculations advantages/disadvantages of application, solubility in water.

Public Relations
Describe situations where you may come in contact with the public, how to handle these situations and maintain a good public image.

Pumps & Motors
Understanding of pumps, motors, their operation, types, trouble shooting, pump curves, etc. Be able to calculate the dynamic head and horsepower for given pump specifications.

Recordkeeping
Water quality & sample results (bacteriological/chemical), MDEQ operation reports, advantages of recordkeeping with respect to treatment efficiency.

Safety
Personal & site safety associated with chemicals, equipment, maintenance operations, etc. Confined spaces (define, give examples, entry procedures, etc.)

Sampling
Procedures (pre-sampling, sampling bacteriological/chemical, Pb/Cu, nitrates, etc.). Results (understand & interpret), routine sampling (regulations, benefits, etc.)

SDWA
Michigan Safe Drinking Water Act as amended, National Primary & Secondary Drinking Water Standards, rules & regulations, operator certification, MCL's, notification, regulated compounds, etc.

Taste & Odor
Standard Methods Test, causes, solutions, etc.

Wells
Groundwater hydrology, monitoring schedules, pumpage logs, maintenance, rehabilitation, disinfection techniques, etc., good housekeeping in a pump/well house (explain, give examples, etc.), firm capacity (define, examples, etc.), well casing appurtenances (vents, valves, etc.) Understand all aspects of wells (construction, isolation area, surface contaminant protection, etc.)
The following is a list of selected references for the all **D examinations only**.

- Michigan Safe Drinking Water Act, Act 399, P.A. 1976 as amended
- Water Treatment Plant Operation, Volume I, California State University, Sacramento, CA, 6th or 7th Edition
- Water Treatment Plant Operation, Volume II, California State University, Sacramento, CA, 6th Edition
- Water Distribution System Operation & Maintenance, California State University, Sacramento, CA, 5th or 6th Edition
- Small Water System Operation & Maintenance, California State University, Sacramento, CA, 4th Edition
- Water Treatment Membrane Processes, AWWARF, McGraw Hill, 1996
- Standard Methods for the Examination of Water and Wastewater, 23rd Edition
- Recommended Standards for Water Works Design, 2018 Edition

The Michigan Safe Drinking Water Act can be found on the Internet at [www.michigan.gov/deq](http://www.michigan.gov/deq). After you get to this site, click on Water and then Drinking Water and then Community Water. If you scroll down with your cursor, you can locate the laws that will include the Michigan Safe Drinking Water Act.