

Michigan Department of Environmental Quality
Water Bureau

**Study Guide
of
Typical Exam Content
for
Waterworks Operator
Certification Examinations**

DISTRIBUTION

S CLASSIFICATIONS

- S-4 Entry Level of Certification**
- S-3 Intermediate Level of Certification**
- S-2 Advanced Level of Certification**
- S-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.

S-4 & S-3 Study Guide

Chlorination

Chemicals used, advantages/disadvantages of different methods (ppm calculations, etc.), procedures (including disposal & handling), DPD, storage, testing, handling, safety, etc.

Contingencies and Emergencies/Security

Contingency Plan (requirements, key topics, examples).

Corrosion Control

Causes/effects of corrosion on interiors/exterior, testing, cathodic protection.

Cross Connection Control

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

Customer Relations

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

Hydrants

Definitions, specifications (types, size, barrel, etc), installation and inspection procedures, purpose (primary/secondary) winter maintenance, operation.

Hydraulics

Definitions, volumes, density, area, circumference calculations, pressure/hydraulic head calculations, abbreviations/conversions, basic hydraulic equations (continuity, head loss, etc.)

Instrumentation

Measuring & control of water equipment such as float levels and weirs, electrical controls, pressure controls.

Management

Handling given management situations (town meetings, employee relations & motivation), budgets.

Meters

Definitions, types of meters, flow measurement, interior/exterior installations (advantages and disadvantages, procedures), common types (magnetic, propeller, venture, turbine, etc), causes of malfunctions (failure, inaccurate readings, etc.)

Microbiology

Definitions, procedures, techniques, equipment, medias, preservatives, calculations, thorough understanding of results, routine testing, etc.

O & M

Procedures for general & preventative maintenance of equipment, trouble shooting.

Pipes & Joints

Definitions (coupon, saddle, corporation stop), pipe (names, materials, where used, advantages and disadvantages), types of joints (names, where used, advantages/disadvantages), C factors (define, high vs low).

Pumps and Motors

Understanding of pumps and motors, their operation, types, trouble shooting, calculations, etc.

Recordkeeping

Water quality and sample results (bacteriological and chemical), MDEQ reports, data management, regulations, etc.

Safety

Personal & site safety, confined space entry, fires/extinguishers, trench and excavation safety.

Sampling

Procedures (presampling, sampling – bacteriological/chemical, Pb/Cu), results – understanding and interpreting, routine sampling regulations and health benefits.

SDWA

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

Storage

Calculations, maintenance, contact time, pressure, piping, pumpage rates, ground and elevated tanks (coatings, air vents, overflows, booster pumps, etc.), procedures for putting back online after O & M.

Valves

Types of valves, operation & maintenance, specifications (size, type, direction of operation), procedures & precautions (opening/closing, servicing).

Water Quality

MCL – health effects, common problems in systems (cause/effect).

Water Main Installation

Water main installation requirements (thrust restraints, disinfection, permits, separation, size, flushing, etc), procedure for tapping a new line off the main, trenching.

S-2 Study Guide

Chlorination

Advantages/disadvantages of different methods, procedures (including disposal & handling) ppm & drop dilution method calculations.

Contingencies & Emergencies

Contingency plan (requirements, key topics, examples, etc.), dewatering a large portion of system.

Corrosion

Causes/effects of corrosion on interiors/exterior, prevention (stabilization, coating, etc.), common terms in dealing with corrosion and characteristics of aggressive water.

Cross Connections

Definition (also be able to give examples.), prevention and/or correction (devices and when each is used), what agency is responsible for inspections?

Customer Relations

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

Hydrants

Specifications (types, size, barrel, etc.), installation and inspection procedure, purpose (primary/secondary), additives (keep from freezing).

Hydraulics

Volume, density, area, circumference, and pressure/hydraulic head calculations, know common hydraulic terms, abbreviations, conversions, etc., system design (pressure, layout, overburden loads, capacity, etc), know how to measure (pressure head, velocity head, etc.), understand general hydraulic equations (head loss, continuity, Bernoulli's equation, etc.)

Instrumentation

Electrical equipment (transformers, relays, controls, etc.), general instrumentation (different types and their uses), control system alarms.

Main Installation

Installation requirements (disinfection, permits, separation, size, flushing, thrust blocking, etc.), leakage calculation, procedure for tapping a new line off the main.

Management

Supervisory skills (motivation of employee, employee relations, etc.)

Meters

Interior/exterior installations (advantages/disadvantages), specifications (accuracy, standards, etc.), common types (magnetic, propeller, venturi, turbine, etc.), causes of malfunctions.

O & M

Operational procedures and common installations, be able to describe a systematic maintenance schedule on a grossly neglected system.

Pipes & Joints

Types of joints (names, where used, advantage/disadvantage, etc.), pipe materials (names, where used, advantage/disadvantage, type of joints, allowable, etc.), c factors (define, have a general understanding between a high & low value).

Pumps & Motors

Characteristics, fittings, maintenance associated with pumps (submersible, turbine, centrifugal, etc.)

Recordkeeping

Water quality & sample results (bacteriological/chemical), installation and inspection information, general plan (included, requirements, etc.)

Safety

Confined space (entry procedures, definition), personal & site safety equipment, trench excavation & usage, electrical equipment repair safety and precautions.

Sampling

Procedures (pre-sampling, sampling bacteriological/chemical), results (understand & interpret), lab forms (correctly fill out), routine sampling (regulations, benefits, examples of a good program, etc.)

SDWA

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

Storage Reservoirs

Ground & elevated tanks (coating, air vents, overflows, booster pumps, etc.), procedure for putting back on-line after o & m (incl. disinfection methods, inspections, etc.), purpose of reservoirs (primary/secondary).

Valves

Specifications (size, type, direction of operation, etc.), procedures & precautions (opening/closing, servicing, etc.), types, operation, inspection criteria & recommended maintenance.

Water Quality

MCL's (health effects associated with levels of contaminant), common problems in systems (causes/effects), federal lead/copper corrosion rule, bacteriological indicator used, why? Community flushing program

S-1 Study Guide

Chlorination

Advantages/disadvantages of different methods, procedures (incl. disposal & handling) ppm & drop dilution method calculations, method cost comparison (prices given).

Contingencies & Emergencies

Contingency plan (requirements, key topics, examples, etc.), dewatering a large portion of system/loss of pressure (how would you handle situation).

Corrosion

Causes/effects of corrosion on interiors/exterior, prevention (stabilization, coating, etc.), common terms in dealing with corrosion and characteristics of aggressive water.

Cross Connections

Definition (also be able to give examples.), prevention and/or correction (devices and when each is used), what agency is responsible for inspections?

Customer Relations

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

Hydrants

Specifications (types, size, barrel, etc.), installation and inspection procedure, purpose (primary/secondary), additives (keep from freezing).

Hydraulics

Volume, density, area, circumference, and pressure/hydraulic head calculations, know common hydraulic terms, abbreviations, conversions, how to use pump curves, etc., system design (pressure, layout, overburden loads, capacity, etc), know how to measure (pressure head, velocity head, etc.), understand general hydraulic equations (head loss, continuity, horsepower, efficiency, Bernoulli's equation, etc.)

Instrumentation

Electrical equipment (transformers, relays, controls, etc.), general instrumentation (different types and their uses), control system alarms.

Main Installation

Installation requirements (disinfection, permits, separation, size, flushing, thrust blocking, etc.), leakage calculation, procedure for tapping a new line off the main.

Management

Supervisory skills (motivation of employee, employee relations, etc.)

Meters

Interior/exterior installations (advantages/disadvantages), specifications (accuracy, standards, etc.) common types (magnetic, propeller, venturi, turbine, etc.), causes of malfunctions.

O & M

Operational procedures and common installations, be able to describe a systematic maintenance schedule on a grossly neglected system.

Pipes & Joints

Types of joints (names, where used, advantage/disadvantage, etc.), pipe materials (names, where used, advantage/disadvantage, type of joints, allowable, etc.), C factors (define, have a general understanding between a high & low value).

Pumps & Motors

Characteristics, fittings, maintenance associated with pumps (submersible, turbine, centrifugal, etc.)

Recordkeeping

Water quality & sample results (bacteriological/chemical), installation and inspection information, general plan (included, requirements, etc.)

Safety

Confined space (entry procedures, regulations, definition), personal & site safety equipment trench excavation & usage, electrical equipment repair safety and precautions.

Sampling

Procedures (pre-sampling, sampling bacteriological/chemical/organic/inorganic/etc.) results (understand & interpret), lab forms (correctly fill out), routine sampling (regulations, benefits, examples of a good program, etc.)

SDWA

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

Storage Reservoirs

Ground & elevated tanks (coating, air vents, overflows, booster pumps, etc.), procedure for putting back on-line after o & m (incl. disinfection methods, inspections, etc.), purpose of reservoirs (primary and secondary).

Valves

Specifications (size, type, direction of operation direction of operation, etc.), procedures & precautions (opening/closing, servicing, etc.), types, operation, inspection criteria & recommended maintenance.

Water Quality

MCL's (health effects of levels of contaminant), fed. lead/copper corrosion rule, common problems in systems (causes/effects), community flushing program, bacteriological indicator used, why?, waterborne diseases (names, causes, organisms, etc.)

The following is a list of selected references for the **S-1 and S-2 examinations only**.

- Michigan Safe Drinking Water Act, 1976 PA 399, as amended
- Water Distribution System Operation & Maintenance, California State University, Sacramento, CA, 4th or 5th edition
- Water Treatment Plant Operation, Volume I, California State University, Sacramento, CA, 4th or 5th Edition
- Water Treatment Plant Operation, Volume II, California State University, Sacramento, CA, 3rd Edition
- Small Water System Operation & Maintenance, California State University, Sacramento, CA, 4th Edition
- Hydraulics for Operators, Revised Edition, Wm. Elgar Brown, 1985, Michigan Section AWWA
- Water Treatment Membrane Processes, AWWARF, McGraw Hill, 1996
- MDEQ Cross Connection Rules Manual, 3rd Edition
- Recommended Standards for Water Works Design, 2003 Edition

The following is a list of selected references for the **S-3 and S-4 examinations only**.

- Michigan Safe Drinking Water Act, 1976 PA 399, as amended
- Water Distribution System Operation & Maintenance, California State University, Sacramento, CA, 4th or 5th edition
- Water Treatment Plant Operation, Volume I, California State University, Sacramento, CA, 4th or 5th Edition
- Water Treatment Plant Operation, Volume II, California State University, Sacramento, CA, 3rd Edition
- Small Water System Operation & Maintenance, California State University, Sacramento, CA, 4th Edition

The Michigan Safe Drinking Water Act can be found on the Internet at 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.