

Michigan Department of Environmental Quality
Water Bureau

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

FILTRATION

F CLASSIFICATIONS

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

F-4 & F-3 Study Guide

Alkalinity

Definitions, types, procedures, reagents used, etc.

Chemistry

Treatment chemistry (compounds, elements, atomic weights, etc), chemical symbols and properties of important water treatment chemicals.

Coagulation & Flocculation

Bench testing (influential factors, procedure, apparatus and chemicals used, etc.). Mechanics of coagulation & flocculation and its importance.

Contingencies and Emergencies

Contingency Plan (Requirements, key topics, examples).

Corrosion

Causes/Effects of corrosion on interiors/exterior, testing.

Cross Connections

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

Customer Relations

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

DBP's

Definitions, MCL, reactions, causes, turbidity effects, etc.

Disinfection

Chemicals used, all aspects of disinfection with chlorine (CT, PPM Calculations, etc.), methods for – DPD residual testing, storage, testing, handling, safety, etc), chemical feeding.

Filtration

Definitions, backwashing (procedures, cause/effect of mud balls, etc), turbidity measurements, hydraulic calculations (loading, operation, design, etc.)

Fluoridation

Chemicals used, dosage calculations, reasons for addition, safety and handling, regulations, chemical feeding.

Hydraulics

Definitions, volume, density, area, circumference, pressure/hydraulic head calculations, abbreviations/conversions.

Instrumentation

What processes should be instrumented and why? Measuring & control of water equipment such as float levels and weirs, flow measurements, pressure controls, electrical controls.

Laboratory

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

Management

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

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.)

O & M

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

Other Disinfectants

Advantages and disadvantages, types, properties.

Pretreatment

Definitions, techniques, clarification, chemical feeding.

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 laboratory, chemicals, equipment, plant operations, 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, (rules & regulations), National Primary & Secondary Drinking Water Standards, operator certification, MCL's, notification, regulated compounds, etc., public health.

Sludge

Sources, disposal methods, etc.

Softening

Lime-Soda process, dosage calculations, etc.

Source

Definitions, well appurtenances, hydrologic cycle, types (sampling requirements), properties of water, lake cycles.

Storage

Design calculations, maintenance, contact time, piping, pumpage rates.

Taste & Odor

Causes and solutions to taste and odor complaints, Standard Methods tests.

F-2 Study Guide

Alkalinity & Hardness

Definition, types, procedures, calculations, reagents used, end points, etc.

Chemistry

Treatment chemistry (compounds, elements, atomic weights, uses in water treatment, etc.) chemical formulas, analytical methods, molarity/normality.

Chlorination

All aspects of disinfection with chlorine (CT, ppm calculations, feed rates, tanks, properties, bi-products, etc.), methods (DPD, storage, testing, handling, safety, chemical formulas, etc.)

Coagulation & Flocculation

Bench testing (influential factors, procedure, apparatus used, etc.), seasonal problems, calculations (ex. alum), mechanics of coagulation & flocculation and its importance.

Contingencies & Emergencies & Security

Contingency plan (requirements, key topics, examples, etc.), notification procedures, security devices & protocol

Corrosion

Causes/effects of corrosion on interiors/exterior, how to control, Langelier index.

Cross Connections

Definition, prevention and/or correction (devices and when each is used), frequency of testing, 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.

Filtration

Backwashing (procedures, cause/effect of mud balls, temp, etc.), filter operation problems (causes/solutions), turbidity measurements, hydraulic calculations (loading, operation, design, backwashing, etc.), gradation (uniformity coef, effective size, etc.)

Fluoridation

Dosage calculations, reasons for addition, types and chemical formulas (purity)

Hydraulics

Volume, density, area, circumference, and pressure/hydraulic head calculations, abbreviations/conversions, design calculations for all treatment processes, meters (types, advantages/disadvantages, design or layout, etc.), pumping rates/efficiency.

Instrumentation

Types of actuators, reliability, accuracy, problems, compatibility, etc. What processes should be instrumented and why?

Laboratory

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

Management

How to handle given management scenarios (town meetings, employee discipline, hostile customers, etc.), manager functions (supervising, staffing, etc.)

Membrane Technology

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

Microbiology

Testing procedures (incubation times, etc.), standard methods for analysis, medias used & media preparation, classification of waterborne diseases (viruses, bacteria, protozoa, etc.), plankton (properties, etc.)

O & M

Operational procedures and common Installations.

Other Disinfectants

Advantages/disadvantages, types, their properties, etc.

Pretreatment

Definition, techniques, why it is used, etc.

Pumps & Motors

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

Recordkeeping

Water quality & sample results (bacteriological/chemical), MDEQ operation reports.

Safety

Personal & site safety associated with laboratory, chemicals, equipment, 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.

Sludge

Calculation of amount, sources, disposal methods, etc.

Softening

Lime-soda process, dosage calculations, etc.

Source

Types (sampling requirements)., properties of water, lake cycles, etc.

Storage

Design calculation, pumpage rates, maintenance, etc.

Taste & Odor

Standard Methods test, causes, solutions, etc.

THMs

Definition, MCLs, reactions, causes, turbidity effects, etc.

F-1 Study Guide

Alkalinity & Hardness

Definition, types, procedures, calculations, reagents used, end points, etc.

Chemistry

Treatment chemistry (compounds, elements, atomic weights, uses in water treatment, etc) chemical formulas, analytical methods, molarity/normality

Chlorination

All aspects of disinfection with chlorine (CT, ppm calculations, feed rates, tanks, properties, bi-products, etc.), methods (DPD, storage, testing, handling, safety, chemical formulas, etc.)

Coagulation & Flocculation

Bench testing (influential factors, procedure, apparatus used, etc.), seasonal problems, calculations (ex. alum), mechanics of coagulation & flocculation and its importance.

Contingencies & Emergencies & Security

Contingency plan (requirements, key topics, examples, etc.), notification procedures, security devices & protocol.

Corrosion

Causes/effects of corrosion on interiors/exterior, how to control, Langelier index.

Cross Connections

Definition, prevention and/or correction (devices and when each is used), frequency of testing, which 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.

Filtration

Backwashing (procedures, cause/effect of mud balls, temp, etc.), filter operation problems (causes/solutions), turbidity measurements, hydraulic calculations (loading, operation, design, backwashing, etc.), gradation (uniformity coef., effective size, etc.)

Fluoridation

Dosage calculations, reasons for addition, types and chemical formulas (purity).

Hydraulics

Volume, density, area, circumference, and pressure/hydraulic head calculations, abbreviations and conversions, design calculations for all treatment processes, meters (types, advantages and disadvantages, design or layout, etc.), pumping rates/efficiency.

Instrumentation

Types of actuators, reliability, accuracy, problems, compatibility, etc., what processes should be instrumented and why?

Laboratory

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

Management

How to handle given management scenarios (town meetings, employee discipline, hostile customers, etc.), manager functions (supervising, staffing, etc.)

Membrane Technology

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

Microbiology

Testing procedures (incubation times, etc.), standard methods for analysis, medias used & media preparation, classification of waterborne diseases (viruses, bacteria, protozoa, etc.), plankton (properties, etc.)

O & M

Operational procedures and common installations.

Other Disinfectants

Advantages/disadvantages, types, their properties, etc.

Pretreatment

Definition, techniques, why pretreatment is used, etc.

Pumps & Motors

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

Recordkeeping

Water quality & sample results (bacteriological/chemical), MDEQ operation reports.

Safety

Personal & site safety associated with laboratory, chemicals, equipment, 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.

Sludge

Calculation of amount, sources, disposal methods, etc.

Softening

Lime-soda process, dosage calculations, etc.

Source

Types (sampling requirements), properties of water, lake cycles, etc.

Storage

Design calculation, pumpage rates, maintenance, etc.

Taste & Odor

Standard methods test, causes, solutions, etc.

THMs

Definition, MCLs, reactions, causes, turbidity effects, etc.

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

- Michigan Safe Drinking Water Act, 1976 P.A. 399 as amended
- 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
- Water Distribution System Operation & Maintenance, California State University, Sacramento, CA, 4th or 5th edition
- Small Water System Operation & Maintenance, California State University, Sacramento, CA, 4th Edition
- MDEQ Cross Connection Rules Manual, Third Edition
- Standard Methods for the Examination of Water and Wastewater, 20th edition
- Hydraulics for Operators, Revised Edition, Wm. Elgar Brown, 1985, Michigan Section AWWA
- Recommended Standards for Water Works Design, 2003 Edition
- Water Quality & Treatment, 5th Edition, AWWA
- Handbook of Public Water Systems, 2nd Edition, HDR Engineering, Inc.

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

- Michigan Safe Drinking Water Act, 1976 P.A. 399 as amended
- 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
- Water Distribution System Operation & Maintenance, California State University, Sacramento, CA, 4th or 5th edition
- Small Water System Operation & Maintenance, California State University, Sacramento, CA, 4th Edition
- Water Quality & Treatment, 5th Edition, AWWA
- Handbook of Public Water Systems, 2nd Edition, HDR Engineering, Inc.

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.