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/exteriors, 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/exteriors, 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/exteriors, 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?

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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, 4\textsuperscript{th} or 5\textsuperscript{th} Edition
- Water Treatment Plant Operation, Volume II, California State University, Sacramento, CA, 3\textsuperscript{rd} Edition
- Water Distribution System Operation & Maintenance, California State University, Sacramento, CA, 4\textsuperscript{th} or 5\textsuperscript{th} edition
- Small Water System Operation & Maintenance, California State University, Sacramento, CA, 4\textsuperscript{th} Edition
- Standard Methods for the Examination of Water and Wastewater, 20\textsuperscript{th} edition
- Recommended Standards for Water Works Design, 2003 Edition
- Water Quality & Treatment, 5\textsuperscript{th} Edition, AWWA

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, 4\textsuperscript{th} or 5\textsuperscript{th} Edition
- Water Treatment Plant Operation, Volume II, California State University, Sacramento, CA, 3\textsuperscript{rd} Edition
- Water Distribution System Operation & Maintenance, California State University, Sacramento, CA, 4\textsuperscript{th} or 5\textsuperscript{th} edition
- Small Water System Operation & Maintenance, California State University, Sacramento, CA, 4\textsuperscript{th} Edition
- Water Quality & Treatment, 5\textsuperscript{th} Edition, AWWA

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.