OPERATOR NEED-TO-KNOW
WATER PRODUCTION
CLASS 1

SKILL LEVEL REQUIREMENTS

A. Know the responsibilities of a small water system operator.
B. Know the hydrologic cycle, the sources of water and their physical, chemical and biological characteristics.
C. Know the potable water requirements as to quality, chemical and bacteriological.
D. Know the general water quality characteristics of surface water and groundwater supplies.
E. Know the types of pumps used and the relationship of capacity to head.
F. Know how to collect water samples both surface and from production facilities.
G. Understand basic mechanical and electrical principles as they apply to facilities of this type and class.
H. Know the sanitary and construction rules and regulations of water wells.
I. Know the sanitary considerations of watersheds.
J. Know the reasons for disinfection, methods of disinfection, test requirements and procedures.
K. Know the purpose of a well and intake structure, their similarities and differences.
L. Know the safe use, handling and storage of chlorine and other chemicals used in water production.
M. Know the AWWA and or NSF Standards for water treatment chemicals.
N. Know and understand the hazards of cross-connections and how to prevent them.
O. Know and understand drinking water quality standards as formulated by EPA, Health Department or other governmental agencies.
P. Know the various types of storage facilities and purpose.

MATH NEED TO KNOW

Converting of Standards
Area Calculations

OPERATOR NEED-TO-KNOW
WATER PRODUCTION
CLASS 2

SKILL LEVEL REQUIREMENTS

A. Know all skills required in lower class.
B. Know the problems and consequences of undesirable chemical, materials in drinking water.
C. Know how to select sampling points for chemical and bacteriological samples.
D. Know how to sample, preserve and transport samples.
E. Know what common nuisance organisms are, what problems they cause, and how to correct them.
F. Know how to operate a residual disinfection system, including the computation of material requirements.
G. Know the merits of various type of pumps and the basic parts of each.
H. Know and understand basic for screen size, materials used, and the use of gravel wall or gravel packed wells.
I. Know how to calculate well, lines and tank volumes and convert flow rates and pressure.
J. Know the basis for screen size, materials used, and the use of gravel wall or gravel packed wells.
K. Know the effect of land use on a watershed and water quality.
L. Know how to make emergency repairs or temporary replacement of equipment to provide continuous supply.
M. Know the safety features of properly designed chlorine equipment.
N. Know how to respond to a chemical release and how to remediate.
O. Know safety aspects of water production.
P. Develop customer relations program.

MATH NEED TO KNOW

Converting of Standards
Area Calculations
Volume Calculations – Circle & Square
Converting of Flow Rates
Velocity
Percent Calculations
Chemical Dosage (Simple)
Detention, Retention

OPERATOR NEED-TO-KNOW
WATER PRODUCTION
CLASS 3

SKILL LEVEL REQUIREMENTS

A. Know all skills required in lower classes.
B. Know how to determine adequacy of supply with partial failure to meet demands.
C. Know how to set up and carry out a preventative maintenance program.
D. Know how to measure water flows, calculate pump rates from flows on fill or withdrawal volumes.
E. Understand the principles and applications of instrumentation, controls and SCADA equipment which are common with such systems of this class.
F. Know how to select a pump from head/capacity curves and be able to interpret a pump performance curve.
G. Know the causes of decreased well production and how to determine the loss and how the loss may be corrected.
H. Know the sources of data on wells and water quality in various aquifers.
I. Know the problems caused by algae in and impoundment and methods of control.
J. Know the causes and effects of water hammer as they relate to production facilities.
K. Know how to calculate chemical dosage.
L. Know how to calculate pump work and horsepower requirements.
M. Know the requirements of OSHA and other safety regulatory agencies.
N. Know how to identify taste and odor problems and correct.

MATH NEED TO KNOW

Converting of Standards
Area Calculations
Volume Calculations – Circle & Square
Converting of Flow Rates
Velocity
Percent Calculations
Chemical Dosage (Simple)
Detention, Retention
Percent Strength of Solutions
Pump Capacity (Curves)
Horsepower and Cost
Pump and Motor Efficiency
Pumping Equipment Capacity Calculations

OPERATOR NEED-TO-KNOW
WATER PRODUCTION
CLASS 4

SKILL LEVEL REQUIREMENTS

A. Know all skills required in lower classes.
B. Know how to prepare and interpret pump performance curves from given test data.
C. Know the essential features and purpose of sanitary surveys of drinking water supply source.
D. Know the potential sources of groundwater pollution.
E. Know the potential sources of surface water pollution.
F. Know how to determine production cost and make cost reports.
G. Understand the basic principles and application of flow formula for orifices, venturi or weirs.
H. Know how to plan and carry out a watershed sanitation program.
I. Know how to measure evaporation and calculate the water loss from an impoundment.
J. Know the cause and effects of drawdowns, the influence on adjacent wells, and what should be done to minimize.
K. Know how to determine manpower requirements to provide continuous plant operations.
L. Know the consequence of contamination and spread of various diseases.
M. Know how to set up a safety program production facilities.
N. Know math skills needed for this level.
O. Know how to compute chemical requirements in production and cost.
P. Know how to calculate pumping heads and pumping cost.

MATH NEED TO KNOW

Converting of Standards
Area Calculations
Volume Calculations – Circle & Square
Converting of Flow Rates
Velocity
Percent Calculations
Chemical Dosage (Simple)
Detention, Retention
Percent Strength of Solutions
Pump Capacity (Curves)
Horsepower and Cost
Pump and Motor Efficiency
Pumping Equipment Capacity Calculations

OPERATOR NEED-TO-KNOW
WATER DISTRIBUTION
CLASS 1

SKILL LEVEL REQUIREMENTS

A. Know the hydrologic cycle, the sources of water, and their physical, chemical, and biological characteristics.
B. Know the potable water requirements as to quantity and chemical and bacteriological quality.
C. Know the names, uses, and operation of appurtenances used in systems of this size class.
D. Know the materials, construction methods, and installation procedures for distribution systems in this class.
E. Know the materials, procedures, and testing methods for disinfection.
F. Know the purposes, methods, and testing procedure for residual chlorination and know safe handling of chlorine and other chemicals used in water distribution.
G. Know the types of pumps used and the relationship of capacity to head.
H. Know the purpose of metering, reading, and simple field checking.
I. Know the safety aspects of water distribution and rules and regulations.
J. Know how to collect water samples.
K. Know the purposes and procedures for flushing.
L. Understand basic principles of mechanical and electrical principles as they apply to this class facility.
M. Know the definition of cross-connection and the hazards of them.
N. Know and understand drinking water quality standards as formulated by EPA, Health Department or other governmental agencies.

MATH NEED TO KNOW

Converting of Standards
Area Calculations

OPERATOR NEED-TO-KNOW
WATER DISTRIBUTION
CLASS 2

SKILL LEVEL REQUIREMENTS

A. Know and understand basic capacity and flow calculations as applies to water distribution.
B. Know all skills required in lower class plus.
C. Know the advantages and disadvantages of various construction materials used in water distribution systems.
D. Be able to identify common cross-connections and how to correct them.
E. Know how to select sampling points in a distribution system, what bacteriological tests are commonly run, and the meaning of the results.
F. Know the common nuisance organisms are, what problems they cause, how they might affect consumers and basic control methods.
G. Know how to operate a residual chlorination system including computation of material requirements.
H. Know how to compute disinfection dosages.
I. Know the effect of metering errors.
J. Know how to compute volume calculations, velocity %, and flow rates.
K. Know how to compute tank capacities and convert flow rates and pressures.
L. Understand basic principles of distribution system hydraulics as related to pipe type, roughness, size, fittings length.
M. Know the advantages and disadvantages of various type of pumps and the basic parts of each.
N. Know the sanitary features, operation and maintenance procedures for storage tanks and appurtenances in this class.
O. Know how to perform simple friction loss computations in pipe lines.

MATH NEED TO KNOW

Converting of Standards
Area Calculations
Volume Calculations – Circle & Square
Converting of Flow Rates
Velocity
Percent Calculations
Chemical Dosage (Simple)
Detention, Retention

OPERATOR NEED-TO-KNOW
WATER DISTRIBUTION
CLASS 3

SKILL LEVEL REQUIREMENTS

A. Know how to compute horsepower and work in computing pumping requirements.
B. Know all skills required in lower classes.
C. Know how to determine adequacy of production and storage to meet needs with partial system failure.
D. Know how to plan a bacteriological sampling program and be familiar with test procedure.
E. Know how to plan a cross-connection program.
F. Know how to make emergency repairs or temporary replacement of equipment to provide continuous service.
G. Know how to set up and carry out a preventative maintenance program.
H. Know the causes of unaccounted for water, how to minimize it, and loss control techniques.
I. Know how to measure water flows, calculate pump rates from flows or fill or withdrawal volumes.
J. Understand basic principles of instrumentation and controls which would be common at systems of this class.
K. Know how to select a pump from a capacity head curve and interpret the pump performance curve.
L. Know the legal responsibilities of a water utility.
M. Know the causes of loss of main carrying capacity and know how it may be corrected.
N. Know distribution safety, i.e., traffic, trenching, first aid, and know the safety features of a chlorine storage building.

MATH NEED TO KNOW

Converting of Standards
Area Calculations
Volume Calculations – Circle & Square
Converting of Flow Rates
Velocity
Percent Calculations
Chemical Dosage (Simple)
Detention, Retention
Percent Strength of Solutions
Pump Capacity (Curves)
Horsepower and Cost
Pump and Motor Efficiency
Water Loss
Pumping Equipment Capacity Calculations

OPERATOR NEED-TO-KNOW
WATER DISTRIBUTION
CLASS 4

SKILL LEVEL REQUIREMENTS

A. Know all skills required in lower classes.
B. Know how to prepare and interpret pump performance curves from given test data.
C. Know how to determine economical pump replacement schedules.
D. Know how to determine costs and make cost reports.
E. Know how a meter shop is set up, its functions and operations.
F. Know how to plan, carry out, and report a plant safety program.
G. Understand the principles of the application of flow formulas for orifices, weirs, etc.
H. Know how to plan and carry out a public relations program.
I. Know how to perform complex friction loss calculations in pipe lines.

MATH NEED TO KNOW

Converting of Standards
Area Calculations
Volume Calculations – Circle & Square
Converting of Flow Rates
Velocity
Percent Calculations
Chemical Dosage (Simple)
Detention, Retention
Percent Strength of Solutions
Pump Capacity (Curves)
Horsepower and Cost
Pump and Motor Efficiency
Water Loss
Pumping Equipment Capacity Calculations

OPERATOR NEED-TO-KNOW
WATER TREATMENT
CLASS 1

SKILL LEVEL REQUIREMENTS

A. Know the reason for adding fluoride to water, the amount desired, and the method of testing necessary.
B. Know the fluoridation chemicals most commonly used, their characteristics, and handling procedures.
C. Know the reason for adjusting pH, and what pH is a measure of.
D. Know what chemicals are used to adjust pH, their characteristics, and handling procedures.
E. Know what is meant by a comparator, how it is used, and how to minimize reading errors.
F. Know the various types of feeders used in this type and class facility and how the chemicals are fed.
G. Know how to run a calibration check on a solution feeder.
H. Know the maintenance procedure for feeders.
I. Know the reason for chlorinating, the materials used, the methods of application, and the test procedures.
J. Know the quantitative per capita water requirements.
K. Know the safe handling of chlorine and other chemicals used in water treatment in this type and class facility.
L. Know and understand use of chlorine and other chemicals for sterilization.
M. Know and understand water quality standards as formulated by E.P.A., Health Department, or other governmental agencies.
N. Have basic knowledge of the principals of aeration, coagulation/flocculation, sedimentation, iron and manganese removal, softening, filtration, corrosion control, taste and odor control, maintenance, pumps, electric motors, electricity and cross connection control.
O. Know the reasons for measuring turbidity and the basic test procedures.
P. Have basic understanding of applicable state/federal regulations.

MATH NEED TO KNOW

Converting of Standards
Area Calculations

OPERATOR NEED-TO-KNOW
WATER TREATMENT
CLASS 2

SKILL LEVEL REQUIREMENTS

A. Know all the skills required in the lower class.
B. Know what impurities are found in water and what undesirable effects they cause.
C. Know what materials may be removed by degasification (aeration) equipment as well as the problems created by such equipment.
D. Know what impurities can be neutralized and/or oxidized by chemical feed and what chemicals are so used.
E. Know what ion exchange is and what is used to remove, what media are capable of.
F. Know the operation and maintenance procedures for ion exchange units (both softening and Fe-Mn removal).
G. Understand the basic principles of and the operation of iron removal plants using oxidation followed by settling and/or filtration.
H. Know what tests are run on plants in this type and class and be able to run them.
I. Know how to collect chemical and bacteriological samples from a plant.
J. Know how chlorine demand is determined and the various forms of residual chlorine.
K. Know and understand the principles of aeration, coagulation/flocculation, sedimentation, iron and manganese removal, lime softening, ion exchange softening, filtration, disinfection, corrosion control, taste and odor control, maintenance, pumps, electric motors, electricity, and cross connection control.
L. Know and understand basic capacity calculations and velocity calculations as applied to water treatment.
M. Know and understand applicable state/federal regulations.
N. Know water plant arithmetic according to the table.

MATH NEED TO KNOW

Converting of Standards
Area Calculations
Volume Calculations – Circle & Square
Converting of Flow Rates
Velocity

OPERATOR NEED-TO-KNOW
WATER TREATMENT
CLASS 3

SKILL LEVEL REQUIREMENTS

A. Know all skills required in lower classes.
B. Know the physical and bacteriological characteristics of surface water and well waters.
C. Know what chemicals are used in water treatment, what they do, and how they are handled.
D. Know how chemicals are fed and the operation and maintenance of feeders, including calibration.
E. Know how to run jar test.
F. Know how to run all chemical test for chemical coagulation and softening plants. (chlorine, turbidity, pH, temperature, hardness, phenolphthalein and total alkalinity).
G. Know the purpose of, operations, control, and maintenance of mixing equipment (Chlorine, pH, turbidity).
H. Know the operation, control and maintenance of flocculation equipment.
I. Know the purpose, operation, control, and maintenance of settling tanks, including comparison of upflow and straight line units.
J. Know the purpose, operation, control, and maintenance of filters, including appurtenances such as loss of head gages and rate of flow controllers.
K. Know the operation and control of chlorination systems including gas and hypochlorination equipment.
L. Know the safety aspects of water treatment and know the safety features of a properly designed chlorine equipment/storage building.
M. Know the various types of valves, pumps, and similar equipment and the operation and maintenance of each.
N. Know how to compute chemical requirements and costs of water treatment.
O. Know how to compute pump rates, filter rates, horsepower requirements.
P. Know how bacteriological tests are run and be able to interpret results.
Q. Know how to compute retention times.
R. Know how to find the break-point for chlorination and understand the process of breakpoint chlorination.
S. Know how to calculate chemical dosage.
T. Know how to read and interpret a pump performance curve.
U. Know, understand, and have a good working knowledge of applicable state/federal regulations.
V. Understand what causes trihalomethanes, their health effects, and methods of THM control.

W. Understand VOC removal (air stripping and GAC filtration).
X. Know water plant arithmetic according to the table.

MATH NEED TO KNOW

Converting of Standards
Area Calculations
Volume Calculations – Circle & Square
Converting of Flow Rates
Velocity
Chemical Dosage (Simple)
Chemical Requirements
Pump Rates
Filter Rates
Horse Power
Retention Time
Treatment Cost

OPERATOR NEED-TO-KNOW
WATER TREATMENT
CLASS 4

SKILL LEVEL REQUIREMENTS

A. Know all skills required in lower classes.
B. Know how to select treatment methods for various raw water characteristics.
C. Know how to estimate chemical dosage from raw water analysis and finished water requirements and compute chemical requirements to treat a given amount of water.
D. Know how to prepare and interpret pump performance curves from given test data.
E. Know the various methods of sludge disposal and regulations.
F. Know how to determine treatment costs and make cost reports.
G. Know how to determine manpower requirements to provide continuous plant operation.
H. Know how to set up a bacteriological lab testing program, including knowing the laboratory procedures.
I. Know how to plan and carry out a public relations program.
J. Know how to measure evaporation and calculate water loss from an impoundment by evaporation.
K. Know how to plan and carry out a public relations program.
L. Know what instrumentation and control equipment is common to water treatment plants of this class including SCADA.
M. Know, understand, and have an expert working knowledge of applicable state/federal regulations.
N. Know how to analyze for and interpret results of the following laboratory tests (by priority): chlorine, turbidity, pH, temperature hardness, phenolphthalein and total alkalinity, color, total dissolved solids, chlorides and fluoride.
O. Understand reverse osmosis.
P. Understand electrodialysis.
Q. Know water plant arithmetic.

MATH NEED TO KNOW

Converting of Standards
Area Calculations
Volume Calculations – Circle & Square
Converting of Flow Rates
Velocity
Chemical Dosage (Simple)
Chemical Requirements
Pump Rates
Filter Rates
Horse Power
Retention Time
Treatment Cost