

## TENNESSEE OPERATOR NEED-TO-KNOW

Need-to-Know can be simply defined as that knowledge that an operator or those desiring to be operators must possess to be prepared for the duties and challenges he will face as an operator. This Need-to-Know document was developed to provide those individuals with a listing of subject matter and understanding areas for each operator classification of water treatment, distribution systems, wastewater treatment and collection systems available in Tennessee. A person having a mastery of the eleven understanding areas in each subject matter area should possess the knowledge and be qualified to operate the plant or system in the particular field of study or endeavor.

The following are eleven UNDERSTANDING AREAS and a brief description. Each understanding areas should be applied to each SUBJECT AREA (on the following pages) and if applicable, the person, should strive to develop his knowledge and skills in the areas needed.

### Understanding areas

- PROCESS** Addresses the biological, chemical and mechanical actions, which may be occurring in any of the subject areas. It certainly includes all the many biological and chemical actions but it may also include how a piece of machinery or equipment works.
- OPERATION** Addresses activities in which an operator has the ability to exercise judgment and take action to affect the processes. Included within this definition is plant design and plant construction.
- MAINTENANCE** Includes both routine and emergency maintenance. Included within this definition is troubleshooting and other problem identification activities.
- GENERAL** Includes any basic knowledge questions which address the subject in a broad nature. (e.g. What is the purpose of pretreatment?)
- PROCEDURE** Is primarily designed for lab questions but can be used whenever an industry-recognized procedure for accomplishing a task is identified. (e.g. testing reduced pressure backflow preventers)
- DATA INTERPRETATION** Is used for questions where data is received, analyzed and acted upon
- PUBLIC HEALTH** Includes any questions relating to the subject's impact on public health. (e.g. Which of the following diseases is transmitted by inadequately treated water?). It includes laws, rules and regulations, quality control and compliance.
- MATH** Includes any applicable math activity associated with the subject area. It includes basic operations, square/cubes, fractions/percents, graphs, tables, formulas, conversion, etc.
- SCIENCE** Includes any basic science, biology, chemistry and microbiology concept or principle which relates to the subject.
- SAFETY** Includes any recommended or required safety practices as well a the "common sense" practices (e.g. What does the beeping sound on the tow motor mean?). It includes identification and description of categories, procedures and violations.
- RULES** Includes any applicable state or federal rule or reporting which addresses the subject.

## **Table of Contents**

Water Treatment I

Water Treatment II

Water Treatment III

Water Treatment IV

# Grade 1 Water Treatment Operator Need-To-Know Criteria (Subject Areas)

The following list of categories suggests topics of information that are important to know in order to be a successful and proficient Grade 4 Water Treatment Operator. The list may not be all-inclusive, and knowledge of additional topics may be of benefit to the operator.

## ***Category of Information: Processes***

- Pre-Treatment
  - Screens (Wells; Intake)
- Aeration
  - Slat tray
- Disinfection
  - Gas Chlorinators
  - Hypochlorinators
  - Chlorine Dioxide
  - Mixed Oxidants
  - Ultra-violet
- Fluoridation
  - Fluorosilicic Acid
  - Sodium fluoride
  - Sodium Fluorosilicate
- Corrosion Control
  - Corrosion Inhibitors
  - Aeration
- Iron/Manganese Removal
  - Chemical Oxidation Precipitation
    - Potassium Permanganate
    - Sodium Permanganate
    - Chlorine Dioxide
  - Aeration
  - Filters
- Storage
  - Ground Storage
  - Elevated Tanks
  - Standpipes
  - Hydropneumatic Tanks
- Cross Connections
  - Air Gap
  - Vacuum Breakers
  - Backflow
  - Backpressure
  - Backsiphonage
  - Cross Connection

## ***Category of Information: Support Systems***

- Motors
  - Single Phase
  - Three Phase
- Pumps
  - Centrifugal
  - Positive Displacement (Diaphragm)
  - Turbine
  - Metering
- Pipes
  - Ductile Iron
  - PVC
  - Asbestos Cement
- Joints
  - Flanged
- Valves
  - Ball
  - Check
  - Globe
  - Gate
  - Pressure Control
  - Vacuum Relief
  - Butterfly
  - Air Release
  - Foot
  - Altitude
- Fittings
  - Coupling
  - Union
  - Plug/Caps
  - Corporation
  - Curb Stop
- Cathodic Protection Devices
  - Anode Rod/Bags
  - Cathode Rod/Bags
  - Rectifiers
  - Dissimilar metals – Galvanic Corrosion
- Chemical Feeders
  - Solids
  - Liquids
  - Evaporators
  - Gas
  - Slurry
- Safety
  - Personal Protection Equipment
  - Self Contained Breathing Apparatus
  - Confined Space
  - MSDS Information
  - Traffic Control (Warning Devices; Barricades)
  - Hazard Detection
  - First Aid/Hygiene

## **Category of Information: Support Systems (continued)**

### Measuring/Control

- Signal Generators
  - Magnetic Flowmeter
  - Parshall Flume
  - Rectangular Weir
  - Venturi
  - Propeller Meter
  - Ultrasonic
  - Pitot tube
- Signal Transmitters
  - Electric
  - Pneumatic
  - Hydraulic
- Meters
  - Electrical - Multi – VOM
  - Electrical - Multi – MA
- Alarms
- Controls
  - Pneumatic
  - Hydraulic
  - Timers

### Security

- Attack
  - Prevention
  - Detection
  - Recovery

## **Category of Information: Lab Tests**

### Lab Tests

- |   |   |
|---|---|
| <ul style="list-style-type: none"><li>▪ Alkalinity</li><li>▪ Calcium</li><li>▪ Disinfectant residual</li><li>▪ Disinfectant demand</li><li>▪ Fluoride</li><li>▪ Orthophosphate</li><li>▪ pH</li></ul> | <ul style="list-style-type: none"><li>▪ Temperature</li><li>▪ Total Coliform</li><li>▪ Total Hardness</li><li>▪ THM</li><li>▪ HAA5</li><li>▪ Turbidity</li><li>▪ Specific Gravity</li></ul> |
|---|---|

## **Category of Information: General Information**

### Units of Expression

- Definition
- Conversion

### Sources and Characteristics

- Characterization
- Quality/quantity
- Physical/chemical/biological characteristics

### Electrical Concepts (Basic)

- 

### Maps/Plans

## Grade 2 Water Treatment Operator Need-To-Know Criteria (Subject Areas)

The following list of categories suggests topics of information that are important to know in order to be a successful and proficient Grade 4 Water Treatment Operator. The list may not be all-inclusive, and knowledge of additional topics may be of benefit to the operator.

### ***Category of Information: Processes***

- Pre-Treatment
  - Screens (Wells; Intake)
- Aeration
  - Slat tray
  - Cascade
  - Draft Aerators
    - Induced draft
    - Positive draft
    -
- Coagulation/Flocculation
  - Mixers-in-line
  - Baffles
  - *Polymers*
  - Coagulants
    - Alum
    - Ferric Chloride and Sulfate
- Clarification
  - Sedimentation Basins
  - Tube settlers
- Filtration
  - Pressure
  - Membrane
  - Oxidation
    - Potassium Permanganate
    - Sodium Permanganate
  - Point of entry cartridge filter
  - Bag
- Disinfection
  - Gas Chlorinators
  - Hypochlorinators
  - Chlorine Dioxide
  - Mixed Oxidants
  - Ultra-violet
- Fluoridation
  - Fluorosilicic Acid
  - Sodium fluoride
  - Sodium Fluorosilicate
- Taste/Odor Control
  - Aeration
  - Powdered Activated Carbon
  - Oxidation
    - Potassium Permanganate
    - Sodium Permanganate
    - Chlorine
    - Peroxide
- Softening
  - Chemical Precipitation
  - Ion Exchange
- Corrosion Control
  - Calcium Carbonate Equilibrium
  - Corrosion Inhibitors
  - Aeration
- Iron/Manganese Removal
  - Chemical Oxidation Precipitation
    - Potassium Permanganate
    - Sodium Permanganate
    - Chlorine Dioxide
  - Aeration
  - Filters
  - Green Sand
- Storage
  - Ground Storage
  - Elevated Tanks
  - Standpipes
  - Hydropneumatic Tanks
- Sludge Disposal
  - Land Application of Solids
- Cross Connections
  - Air Gap
  - Vacuum Breakers
  - Backflow
  - Backpressure
  - Backsiphonage
  - Cross Connection

### ***Category of Information: Support Systems***

- Motors
  - Single Phase
  - Three Phase
  - Variable Speed
- Drives
  - Coupled
  - Direct
- Pumps
  - Centrifugal
  - Positive Displacement (Diaphragm)
  - Turbine
  - Metering

## **Category of Information: Support Systems (continued)**

### Generators

- AC

### Pipes

- Ductile Iron
- PVC
- Asbestos Cement

### Joints

- Flanged
- Compression/Dresser

### Valves

- Ball
- Check
- Globe
- Gate
- Plug
- Pressure Control
- Vacuum Relief
- Butterfly
- Air Release
- Foot
- Altitude

### Fittings

- Coupling
- Union
- Plug/Caps
- Corporation
- Curb Stop

### Cathodic Protection Devices

- Anode Rod/Bags
- Cathode Rod/Bags
- Rectifiers
- Dissimilar metals – Galvanic Corrosion

### Measuring/Control

- Signal Generators
  - Magnetic Flowmeter
  - Parshall Flume
  - Proportional Weir
  - Rectangular Weir
  - Venturi
  - Propeller Meter
  - Ultrasonic
  - Pitot tube
- Signal Transmitters
  - Electric
  - Pneumatic
  - Hydraulic

### Engines

- Gasoline & Diesel

### Measuring/Control (continued)

- Signal Receivers
  - Counters
  - Indicators
  - Log Scale Indicators
  - Totalizers
  - Recorders
- Meters
  - Hydraulic/Rotameters
  - Electrical – Amp
  - Electrical – Watt
  - Electrical - Multi – VOM
  - Electrical - Multi – MA
- Alarms
- Controls
  - Pneumatic
  - Float
  - Hydraulic
  - Electrical
  - Telemetry
  - Timers

### Chemical Feeders

- Solids
- Liquids
- Gas
- Slurry

### Rolling Stock

- Service Vehicles
- Trucks

### Safety

- Personal Protection Equipment
- Self Contained Breathing Apparatus
- Confined Space
- MSDS Information
- Traffic Control (Warning Devices; Barricades)
- Hazard Detection
- First Aid/Hygiene

### Security

- Attack
  - Prevention
  - Detection
  - Recovery

## **Category of Information: Lab Tests**

### Lab Tests

- Alkalinity
- Calcium
- Disinfectant residual
- Disinfectant demand
- Fluoride
- Iron
- Manganese
- Orthophosphate
- pH
- Temperature
- Threshold Odor Number
- Total Coliform
- THM
- HAA5
- Total Hardness
- Turbidity (NTU)
- CO<sub>2</sub>
- Specific Gravity

## ***Category of Information: General Information***

### Units of Expression

- Definition
- Conversion

### Sources and Characteristics

- Characterization
- Quality/quantity
- Physical/chemical/biological characteristics

### Electrical Concepts (Basic)

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### Hydraulic Concepts (Basic)

- 

### Maps/Plans

## Grade 3 Water Treatment Operator Need-To-Know Criteria (Subject Areas)

The following list of categories suggests topics of information that are important to know in order to be a successful and proficient Grade 4 Water Treatment Operator. The list may not be all-inclusive, and knowledge of additional topics may be of benefit to the operator.

### *Category of Information: Processes*

#### Pre-Treatment

- Screens (Wells; Intake)
- Bar screens (Hand-cleaned; mechanically cleaned)

#### Aeration

- Slat tray
- Cascade
- Draft Aerators
  - Induced draft
  - Positive draft

#### Coagulation/Flocculation

- Mixers-in-line
- Mechanical
- Baffles
- Polymers
- Coagulants
  - Alum
  - Ferric Chloride and Sulfate
  - Polyaluminum Chloride

#### Clarification

- Pre-sedimentation
- Sedimentation Basins
- Upflow Solids Clarifiers
- Tube settlers

#### Filtration

- Rapid Sand
- Mixed Media
- Pressure
- Slow Sand
- Membrane
- Oxidation
  - Potassium Permanganate
  - Sodium Permanganate
- Point of entry cartridge filter
- Bag

#### Disinfection

- Gas Chlorinators
- Hypochlorinators
- Ozonators
- Chlorine Dioxide
- Mixed Oxidants
- Ultra-violet

#### Fluoridation

- Fluorosilicic Acid
- Sodium fluoride
- Sodium Fluorosilicate

#### Taste/Odor Control

- Aeration
- Powdered Activated Carbon
- GAC Contactors
- Oxidation
  - Potassium Permanganate
  - Sodium Permanganate
  - Chlorine
  - Peroxide

#### Softening

- Chemical Precipitation
- Ion Exchange

#### Corrosion Control

- Calcium Carbonate Equilibrium
- Corrosion Inhibitors
- Aeration

#### Iron/Manganese Removal

- Chemical Oxidation Precipitation
  - Potassium Permanganate
  - Sodium Permanganate
  - Chlorine Dioxide
- Aeration
- Filters
- Green Sand

#### Storage

- Ground Storage
- Elevated Tanks
- Standpipes
- Hydropneumatic Tanks

#### Recirculation

- Water Systems
- Sludge Systems

#### Sludge Disposal

- Drying Beds
- Filter Press
- Land Disposal
- Belt Press
- Landfill Solids
- Land Application of Solids

#### Cross Connections

- Air Gap
- Vacuum Breakers
- Backflow
- Backpressure
- Backsiphonage
- Cross Connection

## Category of Information: Support Systems

### Motors

- Single Phase
- Three Phase
- Variable Speed

### Drives

- Coupled
- Direct

### Pumps

- Air Lift
- Centrifugal
- Positive Displacement (Piston Plunger; Cavity; Diaphragm)
- Turbine
- Metering

### Blowers and Compressors

- Centrifugal
- Positive Displacement

### Generators

- AC & DC

### Engines

- Gasoline & Diesel

### Pipes

- Ductile Iron
- PVC
- Asbestos Cement

### Joints

- Flanged
- Compression/Dresser
- Threaded

### Valves

- Ball
- Check
- Globe
- Gate
- Plug
- Pressure Control
- Vacuum Relief
- Mud
- Butterfly
- Multiport
- Sluice Gate
- Air Release
- Foot
- Altitude
- RBPB
- Double Check

### Fittings

- Coupling
- Union
- Plug/Caps
- Corporation
- Curb Stop

### Cathodic Protection Devices

- Anode Rod/Bags
- Cathode Rod/Bags
- Rectifiers

- Dissimilar metals – Galvanic Corrosion
- ### Measuring/Control

- Signal Generators
  - Magnetic Flowmeter
  - Parshall Flume
  - Proportional Weir
  - Rectangular Weir
  - Venturi
  - Propeller Meter
  - Ultrasonic
  - Pitot tube
- Signal Transmitters
  - Electric
  - Pneumatic
  - Hydraulic
  - Mechanical
  - Telemetry
- Signal Receivers
  - Counters
  - Indicators
  - Log Scale Indicators
  - Totalizers
  - Recorders
- Meters
  - Hydraulic/Rotameters
  - Electrical – Amp
  - Electrical – Watt
  - Electrical - Multi – VOM
  - Electrical - Multi - MA
- Alarms
- Controls
  - Pneumatic
  - Float
  - Hydraulic
  - Electrical
  - Telemetry
  - Timers

### Chemical Feeders

- Solids
- Liquids
- Evaporators
- Gas
- Slurry

### Rolling Stock

- Service Vehicles
- Trucks
- Portable Pumps
- Generators

### Safety

- Personal Protection Equipment
- Self Contained Breathing Apparatus
- Confined Space
- MSDS Information
- Traffic Control (Warning Devices; Barricades)
- Hazard Detection
- First Aid/Hygiene

### Security

- Attack
  - Prevention
  - Detection
  - Recovery

## ***Category of Information: Lab Tests***

### Lab Tests

- Alkalinity
- Calcium
- Disinfectant residual
- Disinfectant demand
- Fluoride
- Iron
- Jar Test
  - Maximum Gradient
  - Velocity Gradient
  - Viscosity of Water
- Manganese
- Orthophosphate
- pH
- Specific Conductance
- Temperature
- Threshold Odor Number
- Total Coliform
- Total Hardness
- Turbidity (NTU)
- CO<sub>2</sub>
- Specific Gravity
- THM
- HAA5

## ***Category of Information: General Information***

### Units of Expression

- Definition
- Conversion

### Sources and Characteristics

- Characterization
- Quality/quantity
- Physical/chemical/biological characteristics

### Electrical Concepts (Basic)

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### Hydraulic Concepts (Basic)

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### Maps/Plans

## Grade 4 Water Treatment Operator Need-To-Know Criteria (Subject Areas)

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  - Ferric Chloride and Sulfate
  - Polyaluminum Chloride
- Polymers

#### Clarification

- Pre-sedimentation
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#### Filtration

- Rapid Sand
- Mixed Media
- Pressure
- Slow Sand
- Membrane
- Oxidation
  - Potassium Permanganate
  - Sodium Permanganate
- Point of entry cartridge filter
- Bag

#### Disinfection

- Gas Chlorinators
- Hypochlorinators
- Ozonators
- Chlorine Dioxide
- Mixed Oxidants
- Ultra-violet

#### Fluoridation

- Fluorosilicic Acid
- Sodium fluoride
- Sodium Fluorosilicate

#### Taste/Odor Control

- Aeration
- Powdered Activated Carbon
- GAC Contactors
- Oxidation
  - Potassium Permanganate
  - Sodium Permanganate
  - Chlorine
  - Peroxide

#### Softening

- Chemical Precipitation
- Ion Exchange

#### Corrosion Control

- Calcium Carbonate Equilibrium
- Corrosion Inhibitors
- Aeration

#### Iron/Manganese Removal

- Chemical Oxidation Precipitation
  - Potassium Permanganate
  - Sodium Permanganate
  - Chlorine Dioxide
- Aeration
- Filters
- Green Sand

#### Storage

- Ground Storage
- Elevated Tanks
- Standpipes
- Hydropneumatic Tanks

#### Recirculation

- Water Systems
- Sludge Systems

#### Sludge Disposal

- Drying Beds
- Filter Press
- Land Disposal
- Belt Press
- Landfill Solids
- Land Application of Solids

#### Cross Connections

- Air Gap
- Vacuum Breakers
- Backflow
- Backpressure
- Backsiphonage
- Cross Connection

## Category of Information: Support Systems

- Dissimilar metals – Galvanic Corrosion

### Motors

- Single Phase
- Three Phase
- Variable Speed

### Drives

- Coupled
- Direct

### Pumps

- Air Lift
- Centrifugal
- Positive Displacement (Piston Plunger; Cavity; Diaphragm)
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- Metering

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### Pipes

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### Joints

- Flanged
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### Valves

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  - Rectangular Weir
  - Venturi
  - Propeller Meter
  - Ultrasonic
  - Pitot tube
- Signal Transmitters
  - Electric
  - Pneumatic
  - Hydraulic
  - Mechanical
  - Telemetry
- Signal Receivers
  - Counters
  - Indicators
  - Log Scale Indicators
  - Totalizers
  - Recorders
- Meters
  - Hydraulic/Rotameters
  - Electrical – Amp
  - Electrical – Watt
  - Electrical - Multi – VOM
  - Electrical - Multi - MA
- Alarms
- Controls
  - Pneumatic
  - Float
  - Hydraulic
  - Electrical
  - Telemetry
  - Timers

### Chemical Feeders

- Solids
- Liquids
- Evaporators
- Gas
- Slurry

### Rolling Stock

- Service Vehicles & Trucks
- Portable Pumps
- Generators

### Safety

- Personal Protection Equipment
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### Hydraulic Concepts (Basic)

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### Maps/Plans