

Illinois Environmental Protection Agency
Bureau of Water
Collection System Operator Certification
Study Guide

The purpose of this study guide is to explain the testing process and to help you prepare for the collection system operator certification examination.

The eligibility requirements for the collection system examination are as follows:

Education: Completion of High School or GED

Experience: 1 Year (A minimum of 3 months must be collection system operating experience.)

Substitutions: Wastewater treatment facility operating experience may be substituted for up to 9 months of collection system operating experience.

3 months credit for completion of a collection system and/or wastewater treatment course. Credit for collection system and/or wastewater treatment courses may be substituted for up to 9 months of collection system operating experience.

If this is your first exam attempt, a short history of the current exam development should be of interest. The exam questions were developed by experts in the wastewater field. Each question has been validated through a process of panel review. The panel is comprised of experts who have worked for many years in the wastewater field. Every question with each of the four answer selections has been examined for content, readability, accuracy, and relation to the Task Analysis.

The process of validation has taken several years. It is an on-going process with new questions being developed and reviewed each year. You might say the job is never finished since existing validated questions must also prove reliable; that is they must test what they are supposed to test. Reliability can only be established from statistical evidence, which takes a minimum question repetition of 100 times. If statistics show a validated question to be unreliable, it is removed from the active question bank. Validated questions that are unreliable are sent back to the review panel for reevaluation.

Each exam question is related back to one of the collection system subject categories. These subject categories are:

1. Chemical Addition
2. Collection Systems
3. Electrical (including electric motors)
4. Flow Measurement

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5. General Information
6. Maintenance
7. Management
8. Mathematics
9. Preliminary Treatment
10. Pumps and Pumping (including lift stations)
11. Recordkeeping
12. Rules and Regulations
13. Safety and Health (including confined space entry, lockout/tagout, fall protection, traffic control, rescue, etc.)

Each Collection system exam version has 100 multiple choice questions taken from any combination of the above categories.

When you take the Collection system exam, you are given one exam booklet containing questions, formulas and conversion factors, one answer sheet, two sheets of scratch paper and two pencils. The only item you may bring to the exam site is your calculator, which must be non-programmable and incapable of storing alphanumeric data. You are allowed a maximum of three hours to complete the exam. A copy of the conversion factors and formulas used on the examination is provided at the back of this study guide. If you familiarize yourself with the conversion factors and formulas in the study guide, it should cut down your referencing time during the examination.

Usually within two weeks of exam completion, your results are sent to your home. Whether or not you passed the exam, you receive a detailed breakdown of your performance as shown below:

CATEGORY	NUMBER OF QUESTIONS	NUMBER CORRECT	NUMBER INCORRECT	% CORRECT IN CATEGORY
RULES and REGULATIONS	1	0	1	0%
PRELIMINARY TREATMENT	1	0	1	0%
PUMPS and PUMPING	10	5	5	50%
MATH	10	6	4	60%
FLOW MEASUREMENT	3	2	1	67%
SAFETY	15	12	3	80%
COLLECTION SYSTEMS	50	40	10	90%
RECORDKEEPING	1	1	0	100%
GENERAL INFORMATION	9	9	0	100%

TOTAL	100	75	25	75%

Should you fail to achieve a score of 70%, you can use these results to determine the areas to study. In the above example, the examinee scored the lowest percent correct on Rules and Regulations (0%) and Preliminary Treatment (0%); but lost the most points on Collection Systems (10 points), Pumps and Pumping (5 points), and Math (4 points). It would be wise to review all five of these subject categories. Notice how the category list progresses from lowest percent correct (Rules and Regulations 0%) to highest percent correct (General Information 100%). This category list would appear in different orders for various examinees, depending on each examinee's area(s) of weakness.

If you score less than 70%, you may reschedule the collection system exam without submitting another application by returning the exam scheduling form provided with your results. When you do retest, the number of questions per category or the categories themselves may differ on the exam you are given. If you find a need for additional technical information, there is a list of suggested reading on page 8 of this study guide.

The following is a list of the main subject areas that may be covered on the collection system examination. The questions are provided to show you the type of questions that one might expect to see on the examination; however, these exact questions do not appear on the examination.

I. General Information

- A. Characteristics of wastewater
- B. Collection System Terminology

Example Question:

Collection systems transport wastewater via:

- a. hoses
- b. pipes
- c. ditches
- d. conduits

II. Collection Systems

- A. Purposes and types of collection systems
- B. Collection system components
- C. Routine operation and maintenance procedures
- D. Sewer installation inspections
- E. Troubleshooting collection systems

Example Question:

A 48-inch interceptor that transports a wastewater flow which is 10% of the design flow may:

- a. be difficult to inspect
- b. provide sufficient scouring velocities
- c. allow the excessive production of hydrogen sulfide gas
- d. indicate excessive inflow and/or infiltration is occurring

III. Pumps and Pumping

- A. Types of pumps and motors and their application
- B. Operation and maintenance of pumps
- C. Operation and maintenance of pump motors
- D. Operation and maintenance of pump controls

Example Question:

When shutting down a centrifugal pump for an extended period of time, an operator should:

- a. close the discharge line and open the suction line so that seals are not allowed to dry out
- b. close the suction line and open the discharge line so gases that might build up in the pump won't break the casing
- c. close the discharge line and suction line, open the air vent line and drain the pump
- d. open the discharge, suction and air vent lines so that the pump remains full of water and is vented to prevent gas build up

IV. Flow Measurement

- A. Instruments
- B. Process controls

Example Question:

A magnetic flow meter is a:

- a. displacement meter
- b. differential head meter
- c. velocity head meter
- d. pressure head meter

V. Preliminary Treatment

- A. Theory of preliminary treatment
- B. Operation and maintenance
 - 1. Bar screens
 - 2. Comminutors

Example Question:

Bar screens are particularly useful for the removal of _____ from the wastewater.

- a. organic material
- b. grit and sand
- c. suspended solids
- d. larger solids and trash

VI. Safety and Health

- A. Clothing and apparel
- B. Machinery
- C. Chemical handling
- D. Collection systems

Example Question:

Of the following items, what is the first thing the operator should do before he places his hand inside a pump volute to clear an obstruction?

- a. make sure he has the proper tools to do the job
- b. trip and lock out the circuit breaker
- c. flush and drain the pump
- d. put on rubber gloves

VII. Record Keeping

- A. Collection system operations
- B. Financial data
- C. Maintenance data
- D. Accident data

Example Question:

A daily operating log should be maintained and includes information such as:

- a. operational duties performed
- b. unusual conditions
- c. accidents to plant personnel
- d. all of the above

VIII. Rules and Regulations

- A. 35 Ill. Adm. Code, Subtitle C: Water Pollution
- B. Local ordinances

Example Question:

A collection system overflow is required to have an NPDES permit to allow discharge to a:

- a. pump station
- b. river or stream
- c. wastewater treatment facility
- d. collection system owned by another entity

IX. Mathematics

- A. General math
- B. Collection system math

Example Question:

The cross sectional area of a 24 inch pipe is:

- a. 3.14 square feet
- b. 12.56 square feet
- c. 37.68 square feet
- d. 452 square feet

X. Electrical (including Electric Motors)

- A. Motors
- B. Controls

Example Question:

A properly operating electric motor will:

- a. be too hot to touch
- b. vibrate and be noisy
- c. feel cold when touched
- d. feel warm when touched

XI. Management

- A. Supervision
- B. Organization
- C. Scheduling

Example Question:

One responsibility of management is to:

- a. keep employees uninformed
- b. ignore employee suggestions
- c. provide uniforms for employees
- d. provide rules and guidelines for employee conduct

XII. Maintenance

- A. Preventive Maintenance
- B. Corrective Maintenance

Example Question:

Collection system components should be inspected:

- a. when they break
- b. every 5 years
- c. at predetermined intervals
- d. only when problems occur

XIII. Chemical Addition

- A. Chlorine
- B. Root Control
- C. Cleaning Agents

Example Question:

Chlorine may be added in a collection system to:

- a. reduce odors
- b. decrease infiltration
- c. prevent solids deposition
- d. eliminate fecal coliform bacteria

LIST OF SUGGESTED RESOURCE MATERIALS

1. MOP 1 Safety and Health in Wastewater Systems
2. MOP OM-5 Prime Movers: Engines, Motors, Turbines, Pumps, Blowers, & Generators
3. E90004HJ Building Sewer Installation and Inspection
4. MOP 7 Wastewater Collection Systems Management

The preceding four publications are available through:

Water Environment Federation
Publications Order Department
601 Wythe Street
Alexandria, VA 22314-1994
(800) 666-0206
Website: www.wef.org

5. Manual of Wastewater Collection

Available through:

Texas Water Utilities Association
1106 Clayton Lane, Suite 101-E
Austin, TX 78723-1033

6. Operation and Maintenance of Wastewater Collection Systems, a Field Study Training Program
 - a. Volume I
 - b. Volume II

Available through:

Office of Water Programs
California State University, Sacramento
6000 J Street
Sacramento, CA 95819-6025
(916) 278-6142
Website: www.owp.csus.edu

OR

Correspondence Course Coordinator
Environmental Resources Training Center
Campus Box 1075 - Southern Illinois Univ.
Edwardsville, IL 62026-1075
(618) 650-2030

7. Wastewater Collection System Maintenance

Available through:

Technomic Publishing Company, Inc.
851 New Holland Avenue, Box 3535
Lancaster, PA 17604
(800) 233-9936

8. WPCF/ABC Studyguide for Wastewater Treatment and Collection System Personnel (Order No. E0-376PC) by the Water Environment Federation and the Association of Boards of Certification

Available through:

Water Environment Federation
Publications Order Department
601 Wythe Street
Alexandria, VA 22314-1994
(800) 666-0206
Website: www.wef.org

FORMULAS

CONVERSION FACTORS

Pi (π) = 3.14

1 mile = 5280 feet

1 gallon of water = 8.34 pounds

1 gallon of water = 4 quarts = 8 pints = 3.785 liters

1 Population Equivalent (PE) = 0.17 pounds BOD/capita/day

" = 0.20 pounds SS/capita/day

" = 100 gallons water/capita/day

1 day = 24 hours = 1440 minutes

1 square foot (ft^2) = 144 square inches (in^2)

1 square yard (yd^2) = 9 square feet (ft^2)

1 cubic foot (ft^3) = 7.5 gallons = 1728 cubic inches (in^3)

1 cubic yard (yd^3) = 27 cubic feet (ft^3)

1 acre = 43560 square feet (ft^2)

1 horsepower (HP) = 33,000 foot-pounds/minute ($\text{ft}\cdot\text{lb}/\text{min}$) = 746 watts = 0.746 kilowatts (kw)

1 foot of water = 0.433 pounds/square inch (psi)

1 pound/square inch (psi) = 2.31 feet of water

VOLUMES, AREAS, & PERIMETERS

GIVEN: V = Volume, L = Length, H = Height, W = Width, r = radius, d = diameter, π = Pi,
b = base, P = Perimeter, C = Circumference

VOLUMES

Rectangular Solid: $V = L \times W \times H$

Cylinder: $V = \pi r^2 H = \frac{\pi d^2 H}{4} = 0.785 d^2 H$

Sphere: $V = \frac{4}{3} \pi r^3$

Cone: $V = \frac{1}{3} \pi r^2 H$

Pyramid: $V = \frac{1}{3} L \times W \times H$

PERIMETERS

Polygon: $P = L_1 + L_2 + L_3 + \dots + L_n$

Circle: $C = \pi d$

AREAS

Rectangle: $A = L \times W$

Triangle: $A = \frac{1}{2} b \times H$

Circle: $A = \pi r^2 = \frac{\pi d^2}{4} = 0.785 d^2$

Trapezoid: $A = \frac{1}{2} (b_1 + b_2) H$

OTHER FORMULAS

TEMPERATURE

$$^{\circ}\text{F} = 9/5 \text{ }^{\circ}\text{C} + 32$$

$$^{\circ}\text{C} = 5/9 (\text{ }^{\circ}\text{F} - 32)$$

$$^{\circ}\text{K} = \text{ }^{\circ}\text{C} + 273$$

FLOW MEASUREMENT

$$90^{\circ} \text{ V-notch weir: } Q = 2.5H^{2.5}$$

$$\text{Sharp-crested weir: } Q = 3.33LH^{1.5}$$

$$\text{Cippolletti weir: } Q = 3.367LH^{1.5}$$

$$\text{Proportional weir: } Q = 7.57mH$$

$$\text{Parshall flume: } Q = 4WH^{1.52}W^{0.026}$$

ELECTRICITY

$$\text{Power} = \text{Current} \times \text{Voltage}$$

$$\text{Voltage} = \text{Current} \times \text{Resistance}$$

$$\text{Average Current} = \frac{\text{Line 1 Current} + \text{Line 2 Current} + \text{Line 3 Current}}{3}$$

$$\text{Current Imbalance} = \frac{\text{Average Current} - \text{Maximum Deviation}}{\text{Average Current}} \times 100$$

MISCELLANEOUS

$$\text{Velocity} = \frac{\text{Distance}}{\text{Time}}$$

$$\text{Detention Time} = \frac{\text{Volume}}{\text{Flow Rate}}$$