



**NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES®**  
sponsored by the National Society of Professional Engineers

**Building Construction**  
**WATER/WASTEWATER PLANTS**

**PROGRAM DETAIL MANUAL**

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## CAUTION

The Institute occasionally makes changes in its certification programs which will significantly affect the currency of individual program detail manuals. These changes could include any or all of the following:

- o deletion, modification, or addition of work elements
- o modification to the Examination Requirements Chart
- o modification to crossover work element credit
- o changes to the work experience requirement
- o changes to the verification requirement

**KEEP YOUR  
MANUALS  
CURRENT**

Since these changes could affect the requirements for certification, it is highly recommended that you contact the Institute before applying for an examination if this manual is more than a year old.

This interim edition is the first edition of this program detail manual. If this manual is more than one year old, it is highly recommended that you contact the Institute before you use it to apply for an examination. The date of publication of this manual is March 1993.

It is the applicant's responsibility to make sure he/she is using a current manual.

**PAYMENT OF  
ANNUAL RENEWAL  
BILL**

Once certified, each certificant will be mailed an annual renewal bill. If the yearly payment is not made for three consecutive calendar years, the certification "EXPIRES" (all certification records as well as all testing records will be deleted) and certification can be regained only by reapplying as a new applicant and meeting the current criteria.

Payment of an exam fee does not substitute for payment of the annual renewal fee.

All certificants need to be aware of Policy #30, "Continuing Professional Development." This Policy can be found on the NICET website ([www.nicet.org](http://www.nicet.org)). The first Recertification period begins in 1996.

**RECERTIFICATION  
POLICY**

**DELETION OF TEST RECORDS**

All test records for an individual certification area will be purged from the database after 5 years if no further testing is done in that certification area and you are not certified in that certification area. See Policy #26 on the NICET website ([www.nicet.org](http://www.nicet.org)).

**FIELD OF BUILDING CONSTRUCTION ENGINEERING TECHNOLOGY**

**SUBFIELD OF WATER/WASTEWATER TREATMENT PLANTS**

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**GENERAL INFORMATION**

This Program Detail Manual contains the information needed to apply for a NICET certification examination in the Water/Wastewater Plants subfield of Building Construction.

This manual does not contain all of the rules and procedures for obtaining certification. For this, you must refer to the website (www.nicet.org).

National Institute for Certification in Engineering Technologies (NICET)  
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This certification program is for engineering technicians performing the inspection during construction of water/wastewater treatment plants, pumping stations and related buildings and structures. Areas covered include reading and interpreting of plans, specifications and shop drawings; on-site inspection; testing procedures; construction techniques and equipment; and recordkeeping and reporting.

This program became operational in 1993. Development of this program was initiated in 1988 with technical guidance from the Washington Suburban Sanitary Commission (Laurel, Maryland).

**WORK ELEMENT DESCRIPTIONS**

The typical job duties and associated responsibilities of engineering technicians who inspect construction of water/wastewater plants have been broken down into discrete work elements which form the basis for an evaluation of the candidate's knowledge. Each work element is written in sufficient detail to permit candidates to make reasonable assumptions about the types of questions likely to be asked.

In addition, the supervisor verifying the experience of the candidate should be able to interpret the scope of the activities associated with each work element.

**WORK ELEMENT IDENTIFICATION NUMBERS**

The identification number assigned to each work element is 5 digits long. The first digit identifies the technical subfield within the field of Building Construction:

- (1) Code and Specification Compliance\*
- (2) Water/Wastewater Plants

The second digit identifies the level (Levels I through IV) and the work element type (General or Special):

**GENERAL WORK ELEMENTS**

- (1) Level I General
- (3) Level II General
- (5) Level III General
- (7) Level IV General

**SPECIAL WORK ELEMENTS**

- (2) Level I Special
- (4) Level II Special
- (6) Level III Special
- (8) Level IV Special

The third, fourth and fifth digits identify the individual work element within each category. A sample of this numbering system is illustrated below for work element number 02423008:

Technical Field Code:	024	Building Construction Engineering Technology
Subfield:	2	Water/Wastewater Plants
Level/Type:	3	Level II General
Work Element Number:	008	

\*This program is not operational.

This eight-digit identification number is needed when using the application form to request an examination or provide work element verification.

### **REQUIREMENTS FOR CERTIFICATION AT LEVELS I THROUGH IV**

Level I is designed for entry-level technicians with very limited relevant work experience in this technical subfield. The Institute recommends that persons with eighteen or more months of relevant work experience set their initial certification goal at Level II. Certification at a particular level does **NOT** require prior certification at a lower level. The Examination Requirements Chart lists the actual examination requirements for certification at Levels I, II, III, and IV in the subfield of Water/Wastewater Plants.

### **WORK ELEMENT SELECTION FOR AN INITIAL EXAM**

1. Refer to the Examination Requirements Chart on the following page.
2. Select the appropriate box for the level of certification desired.
3. Note the number of work elements required for certification, by category, as shown in the selected box.
4. Turn to the Work Element Listing section and carefully select work elements from the required categories, paying attention at each level to whether they are classified as General, Special or Core work elements. Select first those work elements most likely to be passed. (We suggest that all examinees sign up for the Level I General Core work element on their first exam.)
5. When possible, select a few extra in each category so that failing one or more work elements leaves enough passed work elements to satisfy the examination requirement. (Alternatives are not available in the case of Core work elements.)
6. If the requirement for the desired level is more than 34, it is advisable to examine first all lower level work elements needed to achieve certification. Save the upper level work elements for a subsequent examination.
7. It is strongly recommended that the maximum number of work elements (34) be selected for each examination taken. Selection of 34 work elements provides the greatest opportunity for successful completion of the examination requirement with the smallest number of subsequent examinations. Recognize, however, that all elements selected on an exam application **WILL BE SCORED**, even if no attempt is made to answer the questions. That is, a score of "0" will be assigned to the work element even if the questions are not answered and the work element will have one failure marked against it.
8. It is imperative that all applicants keep a copy of their applications as submitted. This will assist in resolving questions over the telephone and will allow a quick resubmission if the original application does not get delivered to NICET.

# EXAMINATION REQUIREMENTS CHART

## (Subfield: Water/Wastewater Plants)

You must pass the number of work elements shown in each category to achieve certification at that level.

You must pass this many work elements to achieve certification at **Level I**

Level I - General - 6 Level I - Special - 4  TOTAL 10
--

You must pass this many work elements to achieve certification at **Level II**  
(Note a)

Level I - General - 10a Level I - Special - 4 Level II - General - 8 Level II - Special - 3  TOTAL 25
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You must pass this many work elements to achieve certification at **Level III**  
Notes (a) and (b)

Level I - General - 10a Level I - Special - 8 Level II - General - 11 Level II - Special - 11 Level III - General - 6 Level III - Special - 4  TOTAL 50
--

You must pass this many work elements to achieve certification at **Level IV**  
Notes (a), (b) and (c)

Level I - General - 10a Level I - Special - 10 Level II - General - 11 Level II - Special - 13 Level III - General - 6 Level III - Special - 8 Level IV - General - 8 Level IV - Special - 5  TOTAL 71
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**NOTES:**

**(a) Work element #21011 must be passed to satisfy certification requirements at Levels II, III, and IV.**

**(b) Time restrictions dictate that no more than 34 work elements can be scheduled for any single examination sitting. Therefore, at least two examination sittings will be needed in order to complete this requirement.**

**(c) Read very carefully the two sections applicable to Level IV certification in this manual before seeking Level IV certification.**

**GENERAL NOTES:**

**(1) Work elements passed which are in excess of the requirement at a particular level and which can be used to meet**

**the requirement at the next higher level are automatically applied to that higher level requirement.**  
**(2) Use the Personal Tally Worksheet in this manual to keep track of the number of work elements you have successfully passed.**

### **WORK ELEMENT SELECTION FOR ALL SUBSEQUENT EXAMS**

All the items listed above for the initial examination apply to subsequent exams. In addition, the following should be understood:

1. It is not necessary to retest work elements which were failed on an earlier exam if there are other work elements in the appropriate categories which can be selected instead. If you do wish to retest a failed work element, you must skip one test cycle before testing it again. In addition, you will be blocked from signing up for a work element a fourth time if it has been previously failed three times. For further information, read the section on repeating failed work elements in Section IV of the general information booklet.
2. If an adequate number of work elements has been selected to meet the certification requirement (with a few extra selected to provide a cushion), and there is room on the exam application to add more elements, it is appropriate to include work elements that will satisfy the examination requirement of the next level of certification or to include work elements from another subfield or another field.

### **CROSSOVER WORK ELEMENTS**

NICET makes every effort to identify work elements in a subfield that are identical or virtually identical in coverage and intent to work elements in one or more other fields/subfields. Once such a work element is passed on an examination it does not normally have to be taken again on any other examinations. Such work elements are classified as crossover work elements.

Crossover work elements within a given technical field which are passed on an examination are automatically credited to all subfields within that field. Until the Code and Specification Compliance subfield is developed, intrafield crossover work elements will not be listed for this subfield.

In addition, some NICET certification programs permit crossover work element credit among different technical fields. When such is the case, we will make available an Interfield Crossover Credit Worksheet. For the Water/Wastewater Plants subfield, crossover credit has been established to work elements in the Transportation field (subfields of Highway Construction and Bridge Safety Inspection), the Underground Utilities Construction field (subfield of Water and Sewer Lines), and the Construction Materials Testing field (subfields of Asphalt, Concrete, and Soils). This Crossover Credit Worksheet must be requested separately.

NICET has also developed "generic" work elements which are treated as crossover work elements among almost all of our certification programs. These generic work elements cover communication skills, math, physical science and other basic areas of knowledge which should be known by all engineering technicians. Call NICET to request a copy of the "Generic Work Element Crossover Credit Listing" if you have taken any previous exams and have passed any of these generic work elements. The generic crossover work elements are identified in the Work Element Listing by the symbol (^) after the work element title.

### **VERIFICATION OF WORK ELEMENTS**

Verification should be provided by the applicant's immediate supervisor. The verifier, by signing his or her initials, is signifying that the applicant has actually performed at least the operations indicated in the work element description and that the verifier is confident that the applicant has performed the specific job tasks repeatedly and satisfactorily. Exposure to a job task through demonstrations by others or through partial involvement by the applicant should not be a basis for a supervisor to verify that the task can be performed correctly by the candidate under a variety of conditions.

## WARNING

**NICET takes very seriously the role of the verifier. All certification candidates and their verifiers must understand that verification is an important component of the certification process.**

NICET's Policy #2, "Handling of Certification Process Irregularities" says, in part, that if NICET determines that any verification was obtained from a non-qualified verifier or was given for tasks not actually performed, the NICET action against the candidate can be to permanently deny the certification sought or revoke the certification(s) held. The NICET action against the verifier can be to terminate the privilege of serving as a verifier. If the verifier is NICET-certified, the certification(s) could be revoked.

Lack of verification on any (or all) work elements does not prevent an applicant from testing those work elements. Certification, however, will not be awarded until all work elements counted toward certification are verified.

### **WORK EXPERIENCE REQUIREMENT**

A preponderance of the work experience must be acquired while residing in the United States and its territories, employing U.S. standards and practices.

### **LEVEL IV WORK EXPERIENCE REQUIREMENT**

In addition to the normal work experience information requested on the technician application form, all candidates for certification at Level IV, Senior Engineering Technician, in Building Construction, technical subfield of Water/Wastewater Plants, must establish, in writing, that they have occupied a senior position of responsibility throughout the duration of one or more major water/wastewater plant construction projects. It must be remembered that ten years or more of employment in the technical area, by itself, is not sufficient for the granting of a Level IV certification.

The writeup sent to NICET must provide detailed, concise descriptions of projects which show the candidate's involvement in a majority of the various aspects of the construction process. The pertinent work experience must be described in depth by the candidate personally -- official job descriptions or testimonials from others will not be evaluated.

**The writeup on each project should include such information as:**

- 1. type of project (water or wastewater, pumping station capacity);**
- 2. scope of project (project time period, time spent on the job);**
- 3. your supervisory responsibilities and/or on-site authority on each project; and**
- 4. the range of your experiences on the project as related to such various components as recordkeeping, testing, inspection, observation, quality control, etc. If all of these components cannot be documented for a single project, they may be accumulated via several narrowly-focused projects.**

**IF YOU HAVE BEEN ASSIGNED TO PROJECTS WHICH RESULT IN NARROWLY FOCUSED EXPERIENCES, YOU SHOULD DESCRIBE SEVERAL ASSIGNMENTS WHICH COLLECTIVELY CAN BE USED TO MEET THE EXPERIENCE REQUIREMENT.**

Your write-up must address the Level IV requirement that your level of responsibility demonstrates independent engineering technician work, including delegated responsibilities and duties for which engineering precedent exists.

In order to avoid lengthy delays in processing your Level IV certification, this write-up should be sent with the Level IV examination application.

## **EARLY TESTING OF LEVEL IV WORK ELEMENTS**

Although NICET does permit testing of Level IV work elements prior to satisfying the work experience requirement, the Institute reserves the right to question the validity of Level IV work elements passed by, and verified for, persons with little work experience. If, for example, a technician with a total of 3 years of experience passes Level IV work elements, NICET may require documentation of how this higher level knowledge was obtained without accumulating the requisite work experience. NICET may require specific work elements to be tested and passed again, at the candidate's expense, prior to the Level IV certification decision.

In addition, NICET reserves the right to require reverification of work elements designated for meeting the Level IV examination requirement if the verifications were signed more than three years prior to the time of the Level IV certification decision.

## **PREPARATION FOR TESTING**

Since the NICET written exams are designed for individuals who have already performed the work elements associated with the program on a routine basis, it is anticipated that preparation for these exams should be minimal.

## **SUPPORT MATERIALS FOR TESTING**

The NICET exams are "open-book"; therefore bringing standards, references, or textbooks to the exam session is permitted (and encouraged). When appropriate, the work element descriptions are rather specific in mentioning applicable standards or procedures.

When work elements are keyed directly to specific industry-wide standards, they will be identified by a normally-used notation at the end of the work element description. NICET will use the most recent edition of the standards in the exams, provided that the edition was published at least one year prior to the date of testing.

Additionally, when a specific publication is used as an authoritative source in writing the work element questions, the title will be listed at the end of the work element. Refer to the "Selected General References" in this manual for publisher information.

## **TRAINING COURSES**

NICET does not endorse, certify, or accredit training programs; any claims to that effect should be viewed with caution. NICET does, however, provide information on its certification procedures and objectives so that training courses can be developed specifically to help persons planning to take a NICET certification exam.

## Work Element Listing

### WATER/WASTEWATER PLANTS

#### LEVEL I - GENERAL WORK ELEMENTS

(Work at Level I Is performed under direct supervision)

##### CORE WORK ELEMENTS (See Note 1)

<b>ID#</b>	<b><u>Work Element Title and Description</u></b>
21011	BASIC METRIC UNITS AND CONVERSIONS (^) Perform conversions to and from metric units. (E 380)

##### NON-CORE WORK ELEMENTS

21001	SIMPLE PLANS AND SPECIFICATIONS Use simple plans and specifications to determine basic dimensions, types and specifications of component materials (steel, concrete, masonry, mortar, grout, etc.), and component locations, etc.
21002	BASIC MATHEMATICS (^) Solve mathematical problems requiring simple addition, subtraction, multiplication, division, and raising numbers to exponential powers. Round to the correct number of significant figures, calculate percentages, read graphs, and use simple geometric definitions and formulas. (See general mathematic textbooks.)
21003	CODE-REFERENCED SPECIFICATIONS Know basic code requirements (tolerances, clearances, maximum/minimum limitations) as specified for various construction areas and features, both interior and exterior, such as stairs, slabs, foundation details, structural details.
21004	TOPOGRAPHIC MAPS AND SITE PLANS Use topographic maps and site plans to determine ground distances, areas, elevations, and differences in elevations and slopes. Determine direction of drainage, recognize drainage features.
21005	BASIC COMMUNICATION SKILLS (^) Use proper punctuation, vocabulary, spelling, and sentence structure. Follow written instructions. (See basic grammar references.)
21006	TERMS AND DEFINITIONS Know the standard terms and definitions applicable to the various aspects of building construction and inspection. (General building construction textbooks)
21007	BASIC PHYSICAL SCIENCE (^) Apply terms, definitions, and concepts from mechanics, electricity, heat and chemistry. (Solutions may involve simple formulas found in basic physic textbooks, but will not involve algebraic manipulation or trigonometry.)
21008	INDIVIDUAL SAFETY REQUIREMENTS (^) Know safety practices as they apply to tasks performed. Recognize improper safety practices on work site. ( <u>Construction Industry Standards</u> - OSHA 2202)

Note 1: Work element number #21011, "Basic Metric Units and Conversions", is mandatory for certification at Levels II, III and IV.

- 21009 CLEARING AND GRUBBING  
Observe clearing and grubbing work to be sure that "save" items are not disturbed, that removals are complete, and that work is accomplished within specific limits. Record findings.
- 21010 SHOP DRAWINGS  
Understand and be familiar with approved shop drawings to assure compliance with contractual requirements.
- 21012 BASIC BUILDING COMPONENTS  
Recognize and identify basic building components, structural members, and structural materials.

### **LEVEL I - SPECIAL WORK ELEMENTS**

- 22001 SOILS CLASSIFICATION  
Classify soils in accordance with the Unified Soil Classification System. (D 2487, D 2488, M 145)
- 22002 BASIC EROSION CONTROLS  
Understand the basis of accepted practices and procedures for controlling erosion, and protecting slopes and landscaping during construction.
- 22003 FENCING  
Perform inspection to assure placement as staked out. Check type of fencing used, compliance with specs for setting of posts, corners, gates, and bracing. Check alignment and work to assure quality.
- 22004 SAMPLING SOIL  
Be familiar with soil sampling practices and techniques including adequate sample size, classification, and moisture conditioning. (D 421, D 1586, D 2217, D 2487)
- 22005 FIRST AID PROCEDURES (^)  
Understand the basic rules and procedures of first aid. (See general handbooks on first aid.)
- 22006 SAMPLING FRESH CONCRETE  
Obtain representative samples of fresh concrete as delivered to a project site for testing. (C 172)
- 22007 SAMPLING BITUMINOUS MATERIALS  
Be familiar with the sampling liquid, semi-solid, and solid bituminous materials for testing at the point of manufacture, supply terminal, or at the point of shipment delivery. (D 140, D 979)
- 22008 BASE AND SUBBASE MATERIALS  
Determine quantities of base and subbase materials delivered to site. Assure placement as required by specifications, and compact in manner specified.
- 22009 SAMPLING/AGGREGATES  
Have a knowledge of field sampling procedures and preparation of samples for testing. (D 75, C 702)
- 22010 BACKFILLING  
Observe backfilling to assure use of proper materials, moisture content, lift depths and compaction methods. Assure compliance with final grade requirements. Report on quantities of materials and equipment used; assure protection of buried pipes, tanks, etc.
- 22011 BORING LOGS AND LOCATION PLANS  
Read and interpret boring log symbols, descriptions, and location plans.
- 22012 SAMPLING GROUT AND MORTAR  
Obtain representative sample of fresh grout and mortar for testing. (C 943, C 780, C 1019)

- 22013 EXCAVATION AND TRENCHING  
Observe excavation to required cut and fill requirements. Observe trenching for proper width, depth, underlayment preparation, and shoring (if required). Report any unusual or unsafe conditions to project engineer.

## **LEVEL II - GENERAL WORK ELEMENTS**

(Work at Level II Is Performed Under General Supervision)

- 23001 STANDARD PLANS AND SPECS  
Use standard plans and specs (contract and as-built) to determine dimensions, types of materials, elevations, slopes, component (structural members, piping systems, electrical systems, mechanical systems) sizes, shapes, and locations, etc.
- 23002 WRITTEN DOCUMENTATION  
Write an accurate, comprehensive written report on conditions observed when participating in the inspection of a project. Maintain supporting record drawings and records of quantities for payments.
- 23003 OSHA AND OTHER SAFETY REGULATIONS  
Identify and apply OSHA, EPA, and other applicable safety regulations and procedures. Recognize proper and improper safety practices on the job.
- 23004 MATERIAL PROPERTIES  
Know the physical properties of concrete, steel, timber, masonry, and other building construction materials.
- 23005 BASIC DRAFTING (^)  
Know elementary drafting techniques. Familiar with architectural and engineering drawings including structural, mechanical and electrical drawings.
- 23006 BASIC SURVEYING  
Use engineer's transit and level to conduct simple surveying operations such as measuring horizontal angles and distances; determining the elevation of object or points; making field notes in the field book.
- 23007 INTERMEDIATE MATHEMATICS (^)  
Perform mathematical calculations utilizing basic algebra (fundamental laws, algebraic expressions), geometry, and the trigonometric functions of right triangles. (See basic textbooks on algebra and trigonometry.)
- 23008 PRECONSTRUCTION INSPECTION  
Inspect job-site for variances against plans and specs, including location of existing utilities, structures, and all other features and site conditions.
- 23009 PROCESS INSPECTION INFORMATION  
Compute, record, handle and file inspection information in accordance with good standard procedures.
- 23010 CONCRETE STRUCTURE INSPECTION  
Know the performance characteristics of plain, reinforced, and prestressed concrete. Be aware of forming, placement, curing and finishing procedures for concrete members. Recognize the significance of damaged or deteriorated concrete, rebars, and prestressed tendons on the overall structure. Be familiar with ACI standards.
- 23011 STEEL STRUCTURE INSPECTION  
Know the performance characteristics of structural steel and steel wire and cable. Be aware of handling and erection procedures for steel members. Recognize the significance of damaged or deteriorated members on the overall structure, and the effects of load repetitions, fire and heat. Be familiar with AISC Manual of Steel Construction.

- 23012 **TIMBER STRUCTURE INSPECTION**  
 Know the performance characteristics of timber and laminated wood. Know the types, grades and preservatives. Recognize the significance of damaged or deteriorated members on the overall structure, including the effects of decay and insect damage. Be familiar with the major building code used in your region to regulate construction or installation practice. (UBC, SBC, or BBC)
- 23013 **MASONRY STRUCTURE INSPECTION**  
 Know the performance characteristics of masonry in structures. Know masonry types, sizes, mortar constituents, erection techniques. Recognize the significance of damaged or deteriorated masonry on the overall structure. Be familiar with the major building code used in your region to regulate construction or installation practice. (UBC, SBC or BBC)
- 23014 **EARTH-MOVING OPERATIONS**  
 Be familiar with equipment used for trenching, backfilling, removal, placement, and compaction. Be familiar with stockpiling of select materials and balancing of cuts and fills.
- 23015 **WATER RETENTION STRUCTURES**  
 Be familiar with the basic principles for the construction of water retention structures. Apply these principles to common applications such as dams, levees, water retention ponds, diversions, cofferdams, etc.
- 23016 **TUNNELING METHODS**  
 Know the common methods of construction for small diameter and large diameter tunnels and their adaptability to different soil, rock and underwater conditions.
- 23017 **FOUNDATION CONSTRUCTION**  
 Be familiar with various facets of foundation construction including spread footings, pressure-injected footings, grade beams, mud mats, pilings, caissons, etc.

## **LEVEL II - SPECIAL WORK ELEMENTS**

- 24001 **REINFORCING STEEL**  
 Know the requirements for handling and placement of reinforcing steel for reinforced concrete. (ACI 301 & 318)
- 24002 **PLACEMENT AND CURING OF CONCRETE**  
 Know the requirements for placement, consolidation, and curing of concrete. (ACI 301)
- 24003 **DEWATERING SYSTEMS**  
 Know the various types and applications of dewatering systems and be familiar with the equipment and theories used in their installation.
- 24004 **FORMWORK AND SHORING**  
 Know the basic requirements for the placement of formwork and shoring for concrete. (ACI 301 & 318)
- 24005 **BLASTING**  
 Understand the practices and principles of blasting operations, including safety measures, as they apply to underground structures.
- 24006 **COMPUTERS**  
 Know the functions and uses of computers and their potential use in the field of engineering construction.
- 24007 **QUANTITY TAKEOFFS**  
 Perform simple quantity takeoffs and calculations; prepare materials lists.
- 24008 **PILE DRIVING**  
 Be familiar with types of piling and pile driving procedures and precautions.

- 24009    **STRUCTURAL MATERIALS AND MEMBERS**  
Perform inspection to assure compliance with plans, specs, and ASTM standards for materials and structural members. Determine adequacy and completeness of shop inspection reports and certificates. Cross reference standards as required and utilize certificates in project files.
- 24010    **RECORD PLANS**  
Verify completion and adequacy of "as-built" inspection and posting. Confirm dimensions, workmanship, material and conformance to standards or acceptability of modifications to original plans.
- 24011    **STRUCTURAL STEEL ERECTION**  
Understand structural steel erection processes, including handling, placement, use of structural steel drawings in compliance with AISC Specification and Codes.
- 24012    **FIELD TESTING CONCRETE**  
Perform slump and air content tests on fresh concrete. Cast and begin curing cylinders and beams for subsequent testing. (C 31, C 143, C 173, C 231 and T 119)
- 24013    **FIELD MOISTURE AND DENSITY DETERMINATION**  
Know the various methods for determining the in-place moisture content of soils.
- 24014    **READY-MIXED CONCRETE**  
Be familiar with specifications for manufacture and delivery of ready-mixed concrete. (C 94)
- 24015    **SEDIMENT CONTROL PLANS**  
Know the general requirements of the sediment control plan. Know its effect on subsequent landscaping, drainage, final grades, etc.
- 24016    **SLUDGE COMPOSTING**  
Know the fundamental processes involved in sludge composting operations, fermentation, aeration, and separation of components.
- 24017    **WATER/WASTEWATER TREATMENT**  
Know the types of water and wastewater filtration and treatment processes and their purposes, including primary, secondary, and tertiary processes.
- 24018    **WATER/WASTEWATER PUMPING STATIONS**  
Know the major components of water and wastewater pumping stations including generators, pumps, motors, shafting, flushing water systems, etc. Be familiar with the installation and operation of equipment.
- 24019    **PIPE INSULATION AND COATING REQUIREMENTS**  
Be familiar with various pipe insulation and coating specifications and design characteristics. Understand line lists and specifications where applicable. Make provision for insulation clearances on all piping drawings. Make proper notes and details on drawings.
- 24020    **PIPING SYMBOLOGY**  
Have a thorough knowledge of all piping, valves, fittings and other related components. Determine from piping specification sheets which of the components are to be used for a particular service. Be familiar with procedures and techniques applied in the use of each piping component. Be thoroughly familiar with pressure ratings, materials, component variations, and applications of each item in a piping system.
- 24021    **SIMPLE PIPING DRAWINGS**  
Read, interpret and understand simple piping drawings. Use simple piping arrangement drawings to inspect the assembly of piping systems.
- 24022    **UNDERGROUND PIPING**  
Be familiar with special requirements for types, arrangements, connections, and anchorage of underground

pipings.

- 24023    **STRUCTURAL PAINTING**  
Assure compliance with plans and specifications of materials used; condition of surfaces painted; temperature of air and surfaces when surfaces are primed and painted; adequacy of drying time, and adequacy of paint coverage. Record findings.
- 24024    **CHEMICALS AND FILTRATION MEDIA**  
Know the purposes and uses of common types of chemicals and filter media used in graduated filters and in secondary and tertiary treatment processes.
- 24025    **TESTING OF PIPING SYSTEMS**  
Understand basic treatment process and flow diagrams. Know the piping specifications as applied to hydrostatic and non-hydrostatic testing of specific piping systems. Show knowledge of construction capabilities and equipment required for specified tests. Know the test procedures and code and safety standards applicable when conducting tests.

### **LEVEL III - GENERAL WORK ELEMENTS**

- 25001    **COMPLEX PLANS AND SPECIFICATIONS**  
Read and interpret plans and drawings depicting various systems required for water/wastewater processing including pumping stations.
- 25002    **BUSINESS COMMUNICATIONS (^)**  
Use the rules of syntax and style to write clear sentences and paragraphs in preparing routine correspondence and reports. Follow standard business communications procedures. (See basic grammar and writing handbooks.)
- 25003    **INTERMEDIATE PHYSICAL SCIENCE (^)**  
Solve problems in mechanics, electricity, heat, and inorganic chemistry. (Solution may involve algebra and trigonometry.)
- 25004    **COMPLIANCE WITH GOVERNMENTAL REGULATIONS**  
Be familiar with the requirements of government regulations at all levels (EEOC, OJT, Davis-Bacon, environmental, etc.) and assure compliance on the job by scheduled and nonscheduled inspections. Work with contractors, municipalities, and other agencies to set up a workable system of inspection and verification.
- 25005    **EXTERNAL WORKING RELATIONS**  
Establish effective working relations with contractors, subcontractors, suppliers, consultants, utility companies, government agencies, municipalities, property owners, design personnel and the public.
- 25006    **LOADS AND FORCES ON BUILDINGS**  
Be familiar with the internal and external primary and secondary forces acting upon and within buildings. Understand deadloads, live loads, wind pressure, thermal stresses, seismic effects, etc.
- 25007    **ROOFING SYSTEMS**  
Interpret detailed drawings of roofing systems, including metal, shingle, membrane, and built-up-roofs; and gutters and flashing.
- 25008    **COMPACTION DATA ANALYSES**  
Assimilate and interpret the results of soil compaction and density tests conducted by the various methods such as sand cone, nuclear, etc.
- 25009    **SOIL BORING REPORTS**  
Read and interpret boring logs. Recognize how to locate additional borings.

- 25010    **STATICS**  
Solve simple problems involving equilibrium and Newton's laws, torque, friction, addition of forces/torques, and/or systems of forces and loads in two dimensions.
- 25011    **MECHANICS OF MATERIALS**  
Solve simple problems involving normal and shear stress and strain, Hooke's law, Poisson's ratio, shear and moment diagrams, the flexure formula, and torsional stress and strain involving circular members. Locate simple centroids.
- 25012    **FOUNDATION INSPECTION**  
Perform field inspections of deep and shallow excavations for foundation construction, caissons, and bored friction piles. Monitor installation and stressing procedures for tied-back shoring systems.
- 25013    **LARGE VALVES**  
Perform inspections of complex installations of large valves commonly associated with pipe systems and insure compliance with specifications and manufacturer's recommendations. Report findings.
- 25014    **PLANT OPERATION**  
Understand the basic function and operation of water/wastewater treatment plant systems.

### **LEVEL III - SPECIAL WORK ELEMENTS**

- 26001    **PRECAST AND PRESTRESSED CONCRETE STRUCTURES**  
Be familiar with approved repair and installation practices for precast and prestressed concrete structures, including handling, substructure preparation, and coatings.
- 26002    **EXCAVATION PROBLEMS**  
Recognize the various potential construction problems that may occur during excavation operations, including the effect of unusual soil and/or groundwater conditions, existing underground structures, utility lines, etc.
- 26003    **MECHANICAL SYSTEMS PLANS**  
Understand drawings of mechanical systems. Inspect mechanical systems (heating and air conditioning, plumbing, hydraulic, compressed air, etc.).
- 26004    **WATER FILTRATION**  
Observe the proper installation and operation of all elements commonly used in water filtration plants and systems including tube setters, troughs, scrubbers, piping, pumps, etc.
- 26005    **ELECTRICAL SYSTEMS**  
Understand drawings of electrical systems. Inspect electrical systems, including lighting, power supply and distribution, alarms, etc.
- 26006    **WELDS, BOLTS, AND FASTENERS**  
Recognize and document deficiencies found in riveted and bolted connections.
- 26007    **POST-TENSIONED CONCRETE INSPECTION**  
Inspect post-tensioned concrete. Have knowledge of materials, forms, tensioning procedures, etc. (Prestressed Concrete Institute, MNL 116)
- 26008    **ENGINEERING OFFICE WORKS**  
Perform all duties associated with Clerk-of-the-Works and engineering aide positions.

- 26009    ELEMENTARY STRUCTURAL ANALYSIS  
Solve elementary problems involving stress in the analysis of simple beams, tension and compression members. Recognize overloading and deformation of structures. Record findings.
- 26010    PROTECTIVE COATINGS  
Be familiar with protective coatings on building structures and elements, including paints, sealants, and preservatives, etc.
- 26011    STRESS AND TORQUE TESTS  
Perform stress and torque tests on nuts, fittings, and welds in conjunction with proper installation techniques of structural steel systems.
- 26012    STORAGE TANK CONSTRUCTION  
Inspect the foundation preparation and construction of water, fuel, and chemical storage tanks, including steel and fiberglass types.
- 26013    SEDIMENT CONTROL DEVICES  
Know the materials, methods of operation and installation practices for sediment control devices.
- 26014    STRUCTURAL STEEL SHOP INSPECTION  
Assure compliance with plans and specifications by reviewing certificates from manufacturers, fabricators, and private laboratories. Verify size, type of steel, weld quality, fastening data, etc.
- 26015    FLOCCULATION SYSTEMS  
Inspect flocculation systems and flocculent material delivery systems for conformance with specification requirements. Document observations and make recommendations.
- 26016    SLUDGE MANAGEMENT SYSTEMS  
Know basic sludge management system components and processes, including conveyor systems, shakers and screens, bottom hoppers, settlement ponds, weigh scales, and blower systems. Inspect for contract compliance.
- 26017    ODOR CONTROL SYSTEMS  
Know the materials, component parts, and methods of operation for odor control systems. Inspect for conformance with contract documents.
- 26018    ARCHITECTURAL (FINISH) FEATURES  
Know specification requirements for quality, grade, and application of architectural features such as paint, carpets, wall coverings, etc.
- 26019    HVAC SYSTEMS  
Know the basic components of HVAC systems. Be familiar with HVAC equipment, specifications, symbols, operation, etc.

#### **LEVEL IV - GENERAL WORK ELEMENTS**

**NOTE: Certification at Level IV requires that the candidate must have occupied a senior position of responsibility throughout the duration of one major water/wastewater plant construction inspection project. There are no exceptions to this requirement and documentation must be present in the work history listed on the application form.**

- 27001    DISPUTE AND CONFLICT MANAGEMENT  
Be involved in the management of disputes, including arbitration, litigation, mediations, and claims. Handle grievances and complaints and refer matters beyond delegated authority to proper supervisor.

- 27002 MAJOR CONSTRUCTION PROJECT  
Act as Chief Inspector or assistant to Project Engineer on all aspects of a major construction project. Supervise inspectors, material samplers and testers, other technicians and workers on the job. Assure full compliance with plans, specifications and contract provisions. Supervise and coordinate safety provisions. Supervise submittal of required reports, certificates, payrolls, etc., and maintain project files in good order. Keep current records of work to permit ready preparation of record plans. Have all data in compliance for acceptance of job by a designated authority.
- 27003 BUILDING CODES  
Understand building codes and their enforcement. Know the relationship between building codes and installation standards.
- 27004 ALTERATIONS TO DESIGN  
Review plans and specifications to determine applicability to specific jobs. Recognize design deficiencies and/or mistakes or changed conditions in plans and specifications; analyze needs of job to determine appropriate corrective action and prepare detailed recommendations for delivery to appropriate authority.
- 27005 CHANGE ORDERS  
Gather information from subordinates or from personal inspection and review. Prepare complete contract change order in final format with clear justifications and cost estimates for approval of contracting officer.
- 27006 TECHNICAL LIBRARIES  
Perform research to keep abreast of state-of-the-art accomplishments of authoritative organizations regarding physical properties of materials, testing methods and acceptable standards. Extract and utilize applicable information, recommend rechecks to substantiate usage.
- 27007 TRAINING NEEDS  
Use experience and knowledge of performance factors to determine performance of subordinates. Evaluate need for training programs to increase the skills of workers performing special duties. If program is needed, get approval, select subject matter, recruit and supervise instructors and work with instructors on course program. Evaluate OJT and other training programs.
- 27008 APPLIED STATISTICS  
Apply basic statistical concepts to the sampling and evaluation of materials or component batches. Utilize established standards or develop limits of acceptance which consider the practical variability of sampling procedures. (ASTM E 105, E 22, E 141, D 3665. See textbooks on statistics)
- 27009 TECHNICAL PRESENTATIONS AND REPORTS (^)  
Organize and deliver oral presentations and prepare technical reports and correspondence.
- 27010 PUBLIC RELATIONS  
Assure dissemination of pertinent information to appropriate groups (utilities, local government agencies, and citizen interest groups). Establish effective working relations with contractors, subcontractors, suppliers, consultants, utility companies, government agencies, municipalities, property owners, design personnel, and the public.
- 27011 SCHEDULING AND COORDINATION  
Understand and interpret the Critical Path Method (CPM) diagrams for construction event scheduling. Establish communication channels with other operations in accordance with coordination responsibility.

#### **LEVEL IV - SPECIAL WORK ELEMENTS**

- 28001 STRUCTURAL STEEL SYSTEMS  
Understand the structural steel systems and related erection procedures including complex steel connections.

- 28002 REINFORCED CONCRETE STRUCTURAL SYSTEMS  
Understand the basics of reinforced concrete structural systems and related erection and installation procedures.
- 28003 TIMBER STRUCTURAL SYSTEMS  
Understand the basics of timber structural systems, including related erection procedures and timber connections.
- 28004 COMPOSITE STRUCTURAL SYSTEMS  
Understand the basics of composite structural systems and related erection and installation procedures.
- 28005 CONSTRUCTION DEFICIENCIES  
Recognize construction deficiencies, take proper corrective action to alleviate problems immediately. Recognize safety implications and overall structural effects. Document and report to proper authority.
- 28006 TUNNELING PRACTICES  
Know the routine tunneling practices associated with utility systems. Be familiar with rock tunneling and other non-routine applications.
- 28007 WATER/WASTEWATER TREATMENT CONTROL SYSTEMS  
Be familiar with electro-mechanical control systems for water and wastewater treatment. Inspect construction and installation.

**PERSONAL TALLY SHEET**

Passed Work Elements in Water/Wastewater Plants

Put a checkmark next to the appropriate work element number when you receive a passing score on your Examination Score Report. Put a "C" next to the appropriate work element number if you have crossover credit from another field/subfield.

<b>Level I General</b>	<b>Level II General</b>	<b>Level II Special</b>	<b>Level III General</b>	<b>Level III Special</b>	<b>Level IV General</b>
_21001	_23001	_24001	_25001	_26001	_27001
_21002	_23002	_24002	_25002	_26002	_27002
_21003	_23003	_24003	_25003	_26003	_27003
_21004	_23004	_24004	_25004	_26004	_27004
_21005	_23005	_24005	_25005	_26005	_27005
_21006	_23006	_24006	_25006	_26006	_27006
_21007	_23007	_24007	_25007	_26007	_27007
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_21010	_23010	_24010	_25010	_26010	_27010
_21011	_23011	_24011	_25011	_26011	_27011
_21012	_23012	_24012	_25012	_26012	
	_23013	_24013	_25013	_26013	<b>Level IV</b>
	_23014	_24014	_25014	_26014	<b>Special</b>
<b>Level I</b>	_23015	_24015		_26015	_28001
<b>Special</b>	_23016	_24016		_26016	_28002
_22001	_23017	_24017		_26017	_28003
_22002		_24018		_26018	_28004
_22003		_24019		_26019	_28005
_22004		_24020			_28006
_22005		_24021			_28007
_22006		_24022			
_22007		_24023			
_22008		_24024			
_22009		_24025			
_22010					
_22011					
_22012					
_22013					

## SELECTED GENERAL REFERENCES\*

ACI Manual of Concrete Inspection (SP-2), 8th edition. American Concrete Institute. Detroit, MI.

Ambrose, James and Harry Parker. Simplified Mechanics and Strength of Materials, 4th edition. John Wiley & Sons. New York, NY.

Annual Book of ASTM Standards. American Society for Testing and Materials. Philadelphia, PA.

Basic Building Code. Building Officials and Code Administrators International Inc. (BOCA). Country Club Hills, IL.

Construction Industry - OSHA Safety and Health Standards Digest (OSHA 2202). U.S. Department of Labor. Washington, D.C. (Available from U.S. Government Printing Office)

O'Brien, James J. Construction Inspection Handbook, 2nd edition. Van Nostrand Reinhold Company, Inc. New York, NY.

Putnam, Robert E. The Builder's Comprehensive Dictionary. Craftsman Book Company. Carlsbad, CA.

Standard Building Code. Southern Building Code Congress International, Inc. (SBCCI). Birmingham, AL.

Standard First Aid and Personal Safety. American Red Cross. Washington D.C.

Uniform Building Code. International Conference of Building Officials (ICBO). Whittier, CA.

\*This listing is not intended to be complete or representative.

## SAMPLE SCORE REPORT

EXAM NO. 000100

APPL. NO. 123/45/6789

1420 King Street, Alexandria, Virginia 22314-2715 / 703-684-2837

Report Date: 11/01/92

Date of Examination: 10/01/92

Examination Field: BUILDING CONSTRUCTION

	<u>SCORE</u>	<u>PASS/FAIL</u>
WORK ELEMENT 02/1/001** Simple Plans and Specifications	55.00	FAIL
WORK ELEMENT 02/1/002 Basic Mathematics	100.00	PASS
WORK ELEMENT 02/1/003 Code-Referenced Specifications	80.25	PASS
WORK ELEMENT 02/1/004* Topographic Maps and Site Plans	40.00	FAIL
WORK ELEMENT 02/1/005 Basic Communications Skills	100.00	PASS
WORK ELEMENT 02/1/006 Terms and Definitions*	59.75	FAIL
WORK ELEMENT 02/1/007 Basic Physical Science	75.00	PASS
WORK ELEMENT 02/1/008 Individual Safety Requirements	87.50	PASS
WORK ELEMENT 02/1/009 Clearing and Grubbing	93.00	PASS

JOHN DOE  
1420 King Street  
Alexandria, Virginia 22314-2715

