



Underground Utilities Construction Engineering Technology
WATER AND SEWER LINES

PROGRAM DETAIL MANUAL

Please check NICET's website (www.nicet.org) to make sure you have the most recent edition of this document.

Effective upon issuing a new edition of any program detail manual, all previous editions of that program detail manual become obsolete.

This manual may be freely copied in its entirety.

IMPORTANT INFORMATION

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 previous testing records will be deleted) and active 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.

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:

KEEP YOUR MANUALS CURRENT

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

Such changes could affect the requirements for certification. Therefore, if this manual is more than a year old, NICET highly recommends that you check www.nicet.org (or, if you don't have access to the Internet, call NICET at 888-476-4238) to make sure that you have the current edition of the Program Detail Manual before applying for an examination. The date of publication of this manual is November 1993.

It is the responsibility of all applicants to make sure they are using a current manual.

CHANGES TO THIS MANUAL

This fourth edition of the Water and Sewer Lines program detail manual contains the following substantive change from the third edition:

- o Work element #11011, “Basic Metric Units and Conversions”, is no longer mandatory for certification at Levels II, III, and IV..

Whenever an exam requirement changes, those persons who are already certified should understand that they do not need to comply with any changes for the level(s) of certification they have already been awarded — they only have to satisfy the incremental exam requirements for the higher level(s).

In other words, if you are already certified, NICET recognizes you as having met all the exam requirements for that level even if the requirement changes from what it was when you were awarded certification.

FIELD OF UNDERGROUND UTILITIES CONSTRUCTION ENGINEERING TECHNOLOGY

SUBFIELD OF WATER AND SEWER LINES

TABLE OF CONTENTS

GENERAL INFORMATION AND PROGRAM DESCRIPTION	1
CERTIFICATION REQUIREMENTS.....	1
WORK ELEMENT DESCRIPTION.....	2
FIELD CODE AND WORK ELEMENT IDENTIFICATION NUMBERS	2
WORK ELEMENT SELECTION FOR AN INITIAL EXAM	3
CROSSOVER WORK ELEMENTS	4
EXAMINATION REQUIREMENTS CHART	5
WORK ELEMENT SELECTION FOR ALL SUBSEQUENT EXAMS	6
VERIFICATION OF WORK ELEMENTS.....	6
WORK EXPERIENCE REQUIREMENT	6
LEVEL IV WORK EXPERIENCE REQUIREMENT.....	7
EARLY TESTING OF LEVEL IV WORK ELEMENTS.....	7
PREPARATION FOR TESTING.....	8
TRAINING COURSES	8
WORK ELEMENT LISTING	
Level I General Work Elements	9
Level I Special Work Elements	10
Level II General Work Elements	10
Level II Special Work Elements.....	11
Level III General Work Elements.....	13
Level III Special Work Elements.....	14
Level IV General Work Elements	16
Level IV Special Work Elements	17
PERSONAL TALLY WORKSHEET	18
SELECTED GENERAL REFERENCES	19
SAMPLE SCORE REPORT.....	20

GENERAL INFORMATION

This Program Detail Manual contains the information needed to apply for the NICET certification examination in the Water and Sewer Lines subfield of Underground Utilities Construction.

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

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in Engineering Technologies (NICET)
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PROGRAM DESCRIPTION

This certification program is for technicians engaged in the construction and inspection of underground water and sewer lines and is applicable to both private and public sector technicians. Areas covered are specifications and contract plan interpretation; field construction and installation techniques; field inspection and testing procedures; recordkeeping and reporting; and supervisory duties.

This program became operational in 1988. Development of the program was initiated in 1985 with technical guidance provided by the Engineering Department of the Washington Suburban Sanitary Commission (Laurel, Maryland).

CERTIFICATION REQUIREMENTS

There are four criteria that must be met to be certified at any level:

- complete the written examination requirement
- work element verification by the immediate supervisor
- technician recommendation by an acceptable recommender
- appropriate employment history

The last three components **MUST** be accepted and approved in order to achieve certification. Simply passing the examination does not guarantee certification.

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 any level does **NOT** require prior certification at a lower level. The Examination Requirements Chart on page 5 lists the examination requirements for certification at Levels I, II, III, and IV in Water and Sewer Lines.

WORK ELEMENT DESCRIPTION

The typical job duties and associated responsibilities of water and sewer line construction technicians 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.

FIELD CODE AND WORK ELEMENT IDENTIFICATION NUMBERS

In order for NICET to prepare individualized examinations for each candidate, identification numbers have been assigned to each work element. This identification number is normally five digits long. The technical field code number for Underground Utilities Construction is **021**.

The first digit identifies the technical subfield within the field of Underground Utilities Construction:

(1) Water and Sewer Lines

Additional subfields under consideration for the field of Underground Utilities Construction might include certification programs covering gas lines, steam lines, electrical and telephone cables (in and out of conduit).

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 021/15005:

Technical Field Code:	021	(Underground Utilities Construction)
Subfield:	1	(Water and Sewer Lines)
Level/Type:	5	(Level III General)
Work Element Number:	021/15005	(Field Code Number/ 5-Digit Work Element ID Number)

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

WORK ELEMENT SELECTION FOR AN INITIAL EXAM

1. Refer to the Examination Requirements Chart on page 5.
2. Select the appropriate box for the level of certification desired. Note that at least two years of relevant work experience is required for certification at Level II, at least five years of relevant experience is required for Level III, and at least ten years of relevant experience is required for Level IV.
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 or Special work elements. The General work elements are further divided into Core Work Elements and Non-Core Work Elements. Core Work Elements are those whose successful completion is MANDATORY for certification at a particular level. When selecting work elements for testing, it is recommended that Core Work Elements be given preference; then selection should be based on those remaining work elements most likely to be passed.
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 requirements.
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. Unless your initial goal is Level I certification only, it is 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 requirements with the smallest number of subsequent examinations. Recognize, however, that all elements requested 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 suggested that all examination candidates keep a copy of their filled out applications. This will assist in resolving questions over the telephone.

CROSSOVER WORK ELEMENTS

Individuals who have tested in other NICET subfields may be eligible to receive crossover credit towards the examination requirement. NICET's Personal Records Order Form, available on the NICET website (www.nicet.org) may be used to order a crossover listing free of charge.

NICET "Crossover" work elements are identified as identical or nearly identical in topic coverage and test questions to work elements in other selected fields/subfields. Almost all NICET certification programs have "generic" crossover work elements covering communication skills, mathematics, physical science and other basic areas of knowledge. Once a crossover work element is passed on an examination, it does not normally have to be taken again on any other examinations. Crossover credit for the passed elements will be assigned to an examinee's record as follows:

- **First Time Testing in New Subfield:** When you test work elements in a new subfield (at least one element), any crossover credit from previously tested subfields will automatically be assigned to the new subfield. At the same time, any crossover credit from the new subfield will automatically be assigned to previously tested subfields. This assignment of crossover credit will occur every time a new subfield is tested.
- **Additional Testing in Previously Tested Subfield:** When you test new work elements or retest failed work elements from a previously-tested subfield, any crossover credit from the newly-passed work elements will automatically be assigned to all previously-tested subfields.
- No crossover credit will be assigned to a subfield until you **test at least one work element** from that subfield.
- Crossover credit will not be assigned to or from work elements if the certification is in Delinquent or Expired Status.
- The three-month waiting period policy, which applies to failed work elements, also applies to all work elements that have crossover credit to that work element (see Policy #20).
- The following documents are available. Use the Decal and Personal Records Order Form on our website.
 - **Personal Crossover Evaluation** lists your "potential" crossover credit to a designated **untested** subfield.
 - **Crossover Listing** lists all current crossovers between three specified subfields.
 - **Official Personal Transcript** lists all work elements presently credited to the examinee's testing record (including those passed on an exam and those achieved through crossover) for a designated subfield.

WARNING

Revisions to certification programs can occasionally eliminate previous crossovers relationships or create new ones. Thus, crossover credit shown on the "Personal Crossover Evaluation" and on any "Crossover Listing" cannot be assumed to be permanent.

The Personal Crossover Evaluation is a "potential" list. Only when a new subfield is tested and the crossover credit is posted to the test record does it become permanent. The Official Personal Transcript shows the crossover credit actually awarded.

EXAMINATION REQUIREMENTS CHART

Subfield: Water and Sewer Lines

You must pass the number of work elements shown in each box to complete the exam requirement for certification at that level.

Level I

Level I - General	-	5
Level I - Special	-	<u>3</u>
TOTAL		8

You must pass this many work elements to complete the **Level I** exam requirement.

Level II

Level I - General	-	9
Level I - Special	-	4
Level II - General	-	8
Level II - Special	-	<u>6</u>
TOTAL		27

You must pass this many work elements to complete the **Level II** exam requirement.

Level III

Level I - General	-	9a
Level I - Special	-	6
Level II - General	-	8
Level II - Special	-	16
Level III - General	-	6
Level III - Special	-	<u>6</u>
TOTAL		51

You must pass this many work elements to complete the **Level III** exam requirement.
Read Note (a) below

Level IV

Level I - General	-	9b
Level I - Special	-	6
Level II - General	-	8
Level II - Special	-	21
Level III - General	-	6
Level III - Special	-	10
Level IV - General	-	8
Level IV - Special	-	<u>4</u>
TOTAL		72

You must pass this many work elements to complete the **Level IV** exam requirement.
Read Note (b) below

NOTES:

- (a) 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.
- (b) 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 type and level, but 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 passed.

WORK ELEMENT SELECTION FOR ALL SUBSEQUENT EXAMS

All the items listed on page 3 for the initial examination apply to subsequent exams. In addition, the following should be understood:

1. It is not necessary to retest failed work elements if there are other work elements, in the appropriate categories, which can be selected. If you need to retest a failed work element, you must wait three months from the last time you failed it before you will be permitted to test that element again. In addition, you will be blocked from signing up for a work element a fourth time **if it has been previously failed four times within a two-year span**. For further information, read Policy #20, "Retesting of Failed Work Elements," available on our website (www.nicet.org).
2. If an adequate number of work elements has been selected to meet the desired 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 permissible to select work elements from another subfield or another field.

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.

NICET certification is only conferred upon persons performing engineering technician level work. NICET will not certify persons performing higher level work (such as engineering) or lower level work (such as craft).

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 Water and Sewer Lines must establish, in writing, that they have occupied a senior position of responsibility throughout the duration of one or more major water and/or sewer line 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 documentation sent to NICET must provide detailed, concise descriptions of water and sewer line 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 write-up on each of the projects should include such information as:

- 1. type of pipeline (water supply, sanitary sewer, storm sewer);**
- 2. type of piping materials used (vitreous clay, concrete, corrugated metal, etc.);**
- 3. scope of the project (length of pipeline, construction time period, pipe diameters);**
- 4. your supervisory responsibilities on each project; and**
- 5. the range of your experiences on each project as related to recordkeeping, new construction, rehabilitation, roadway restoration, right-of-way/easement restoration, traffic control, blasting, shoring, tunneling, and acceptance testing.**

Your documentation 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 documentation 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 work experience was obtained prematurely.

If documentation is inadequate, NICET may require specific work elements to be tested and passed again, at the candidate's expense, at the time of 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 are over three years old at the time of the Level IV certification decision.

PREPARATION FOR TESTING

The NICET written examinations are designed by the individual who has performed the work elements associated with the program. Preparation for this examination should be minimal.

When appropriate, the work element description specifies the applicable standards or procedures. The standards and other references cited in the work element descriptions are permitted (and encouraged) at the test site.

TRAINING COURSES

NICET does not endorse, certify, or accredit training programs and any claims to that effect should be viewed with caution. NICET does, however, provide information on the 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 and Sewer Lines

LEVEL I - GENERAL WORK ELEMENTS

(Work at Level I Is Performed Under Direct Supervision)

- 11001 **BASIC PLANS, SPECIFICATIONS AND CONTRACT DOCUMENTS**
Use basic plans, specifications and contract documents to determine conditions, procedures, types of materials, dimensions, elevations and slopes.
- 11002 **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 completed within specified limits. Record findings.
- 11003 **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 used and compliance with specifications on all operations. Assure protection of buried pipes and structures from collapse. Record findings.
- 11004 **BASIC MATHEMATICS (^)**
Solve mathematical problems requiring simple addition, subtraction, multiplication, and division. Round to the correct number of significant figures, calculate percentage, read graphs, and use simple geometric definitions and formulas. (See general math textbooks.)
- 11005 **BASIC COMMUNICATION SKILLS (^)**
Use proper punctuation, vocabulary, spelling, and sentence structure. Follow written instructions. (See basic grammar references.)
- 11006 **TERMS AND DEFINITIONS**
Know pipe nomenclature and abbreviations and standard definitions of soil and rock terms as related to utility construction. Be familiar with related surveying, excavation, backfill, and equipment terminology. (ASTM D-653)
- 11007 **BASIC INDIVIDUAL SAFETY REQUIREMENTS (^)**
Know safety practices as they apply to tasks performed, particularly in deep and/or unstable excavations, confined spaces, and when explosive gas mixtures or oxygen-deficient conditions exist. Recognize improper safety practices at work site. (OSHA 2202)
- 11008 **TRAFFIC CONTROLS**
Know basic requirements of traffic safety during construction. Set up required controls for traffic and work force during a simple construction project. Assure adequate supply of signs, signals, markings, and protective equipment on job. Keep traffic moving safely in effective manner with no danger to work force or to motorists, pedestrians or bystanders. Record activities. (MUTCD-Part VI)
- 11009 **CONSTRUCTION SURVEYING AIDS**
Know the various types of temporary survey monuments and temporary survey aids set up during a construction project. Prepare and utilize cut sheets.
- 11010 **MANUFACTURED COMPONENTS**
Perform inspection of pipe, conduit, fittings and precast concrete structures, including all manhole elements, fittings, and connections. Understand proper fabrication methods. Record findings.

General Note: See “Selected General References” page in this manual for information on listed standards and publications.

(^) Indicates that generic crossover credit exists in other fields for this work element. Contact the Institute to request a copy of the “Generic Work Element Listing.”

- 11011 BASIC METRIC UNITS AND CONVERSIONS (^)
Perform conversions to and from basic metric (SI) units. (ASTM E-380).
- 11012 BASIC PHYSICAL SCIENCE (^)
Apply terms, definitions, and concepts from mechanics, electricity, heat, and chemistry. (Solutions may involve simple formulas found in basic physics textbooks, but will not involve algebraic manipulations or trigonometry.)

LEVEL I - SPECIAL WORK ELEMENTS

- 12001 MOISTURE CONTENT DETERMINATION
Perform moisture content tests on soils. Record results. (ASTM D-2216)
- 12002 BASIC EROSION CONTROLS
Understand the basics of accepted practices and procedures for controlling erosion and sedimentation during construction.
- 12003 QUANTITY VERIFICATION
Perform computations to verify quantities of work items. Check estimates to see if quantities reflect completed work to date.
- 12004 CONCRETE TESTING
Perform slump and air content tests on fresh concrete. Cast and store concrete cylinders and beams for subsequent testing. Record results. (ASTM C-31)
- 12005 CULVERTS
Perform inspection to assure compliance with plans and specifications on sizing and materials used for culverts, bedding, backfilling (to include lift depths, methods and protection of culverts from damage), cover, approach and outfall slopes, headwalls and wingwalls, finishing and cleanup. Check and report on final work.
- 12006 PIPING
Know basic principles associated with the handling of pipe and pipe materials, including unloading and storage on the job site.
- 12007 PIPE REPAIR
Recognize the need for, and the approved repair methods for small diameter pipe, including the installation of sleeves and similar repair methods.
- 12008 SMALL VALVES
Perform inspections and insure compliance with engineering specifications in the routine installation of small valves and valve housings. Record findings.
- 12009 PIPE INSTALLATION PRACTICES
Recognize proper basic pipe installation requirements and practices.

LEVEL II - GENERAL WORK ELEMENTS

(Work at Level II Is Performed Under General Supervision)

- 13001 STANDARD PLANS AND SPECIFICATIONS
Read, interpret under supervision, and utilize standard plans and specifications such as site, grading and utility plans.
- 13002 BASIC SURVEYING
Check field notes of simple surveys to detect possible errors. Perform pipe alignment checks and grade checks from offset hub layouts.

- 13003 SAFETY REQUIREMENTS
Assure compliance with OSHA, organizational, state and local safety requirements. Recognize violations and report violations to project engineer or supervisor. (OSHA 2207)
- 13004 GEOTECHNICAL TERMS AND DEFINITIONS
Know standard geotechnical terms, terms related to materials testing, and terms related to all operations associated with utility construction.
- 13005 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.)
- 13006 COMPUTE QUANTITIES
Perform quantity computations for work items. Determine volumes, in-place volumes, areas and weights. Compute costs from unit prices.
- 13007 INSPECT CONSTRUCTION MATERIALS
Perform inspections of pipe, conduit, fittings, and precast concrete structures leading to a recommendation to approve, reject or repair such material. Record findings.
- 13008 PIPE TAPPING
Understand pipe-tapping methods for iron, steel, concrete, and vitrified clay. Document variances to sound tapping practices.
- 13009 DISPUTES AND CONFLICTS
Assist in the identification and documentation of potential disputes.
- 13010 PRECONSTRUCTION INSPECTION
Inspect job-site for variances against plans and specifications, including location of existing utilities, borings and sampling sites, and other features and site conditions. Report findings.
- 13011 INTERMEDIATE PHYSICAL SCIENCE (^)
Solve problems in mechanics, electricity, heat, and inorganic chemistry. (Solutions may involve algebra and trigonometry.)
- 13012 FIRST AID PROCEDURES (^)
Understand the basic rules and procedures of first aid. (See general handbooks on first aid.)

LEVEL II - SPECIAL WORK ELEMENTS

- 14001 MONITOR GROUNDWATER LEVELS
Monitor and document groundwater levels in excavations and observation wells and relate to testing requirements.
- 14002 SOIL WEIGHT-VOLUME RELATIONSHIPS
Know the various methods for density determination, calculate basic soil weight-volume relationships derived from laboratory and field tests.
- 14003 REINFORCING STEEL
Know the requirements for handling and placement of reinforcing steel for reinforced concrete. (ACI-301 and 318)
- 14004 READY MIX CONCRETE
Know the requirements for placement, consolidation, and curing of concrete. Be familiar with specifications for manufacture and delivery of ready mixed concrete. (ACI-301 and 318, ASTM C-94)

- 14005 SUBGRADE AND BASE PREPARATION
Know the general requirements and specifications for subgrade and base preparation for pavement replacement.
- 14006 CONCRETE FORMWORK AND SHORING
Know the basic requirements for the placement of formwork and shoring for concrete (ACI-301 and 318).
- 14007 CONCRETE TESTING
Know the procedures for obtaining representative samples of fresh concrete as delivered to project site. Know method and materials used for capping concrete cylinders. (ASTM C-172 and C-617)
- 14008 CONCRETE PAVEMENT REPLACEMENT
Be familiar with the reinforcement, placement, finishing, and curing of concrete pavement. Assure proper preparation prior to placement and conformance to concrete replacement detail on the plans.
- 14009 ASPHALT PAVEMENT REPLACEMENT
Know basic types of asphaltic pavements, prime and tack coats, and the compaction (rolling) of asphalt paving mixtures. Know requirements for acceptance during construction. Record findings.
- 14010 LANDSCAPING AND CLEANUP
Perform inspection to assure proper preparation of soils for seeding, sodding or planting, proper slopes and drainage provisions, use of specified fertilizer, seeds or plants, installation of required supports or protection. Record areas covered, plants placed, etc. Assure cleanup and provisions for watering to establish growth as specified. Assure that final appearance of job complies with plans and specifications.
- 14011 NUCLEAR METHODS
Determine the density and moisture content of soil and soil-aggregate in-place using nuclear equipment. Be familiar with safety precautions and all applicable government regulations (ASTM D-2922 and D-3017).
- 14012 CHLORINATION PROCEDURES
Understand the principles and procedures used to chlorinate and disinfect water systems.
- 14013 MASONRY STRUCTURES
Know the masonry construction methods and materials used for the proper installation of underground masonry vaults and structures. Record findings.
- 14014 PIPE INSTALLATION PRACTICES
Know special methods and requirements in the handling and installation of large diameter pipe including valves, fittings, gaskets, and seals.
- 14015 PIPELINE PRESSURE TEST
Perform and interpret the results of two-hour high pressure and twenty-four-hour hydrostatic water pressure test of water lines and force mains. Record findings.
- 14016 AIR PRESSURE TEST OF SANITARY SEWERS
Perform and interpret the results of air pressure tests on sanitary sewer lines. Record findings.
- 14017 LINE AND GRADE INSPECTIONS
Using accepted surveying practices, perform postconstruction quality control inspection of utility lines to ensure proper alignment and grade.
- 14018 INSPECT CATHODIC PROTECTION
Understand bonding, test stations, installation of joints, and other procedures. Understand the reasons for providing cathodic protection of piping. Report findings.
- 14019 LINER PLATE TUNNELS
Be familiar with liner plate tunnel construction. Inspect and record findings, including the grade and alignment, plate coatings and fittings, and mucking operations.

- 14020 HORIZONTAL EARTH BORING
Inspect horizontal earth boring operations and record the activities associated with these operations, including the field checking of line and grade. Be familiar with types of equipment used.
- 14021 BLASTING
Have a basic understanding of the practices and principles of blasting operations as they apply to trenching and underground structures.
- 14022 PIPING
Know the engineering characteristics of commonly used types of pipe and pipe materials, including bedding and handling requirements. Assure proper size and type of pipe (RCP, VCP, PVC, DI, CI, PCCP, steel, copper and other pipe). Assure proper handling, storage, jointing, and bedding of pipe. Check on quality of workmanship and final installation. Keep proper records.
- 14023 PIPE REPAIR
Know pipe repair methods for large diameter pipe. Understand the need for repair, both prior to and after installation, based on the damage present.
- 14024 LARGE VALVES
Perform inspections and insure compliance with engineering specifications and manufacturer's recommendations for the complex installation of large valves commonly associated with pipe systems. Report findings.
- 14025 FENCING
Perform inspection to assure alignment and quality of fencing, including posts, corners, gates and bracing.
- 14026 PILE DRIVING
Have a basic knowledge of pile driving procedures, including determination of blow count using ENR or other formulas.
- 14027 SEWER REHABILITATION
Know the common methods of sewer line rehabilitation such as testing and sealing joints, slip-lining, and Insituform lining.
- 14028 BASIC DRAFTING (^)
Recognize and describe standard manual drafting techniques. Describe the characteristics and proper usage of standard drafting equipment. (See basic technical drawing textbooks.)

LEVEL III - GENERAL WORK ELEMENTS

- 15001 DISPUTE AND CONFLICT MANAGEMENT
Review, gather information, and assist in the preparation of presentations of disputes related to claims, arbitrations, litigation and mediations.
- 15002 COMPLIANCE WITH GOVERNMENTAL PROGRAMS
Know requirements of federal, state, and local programs (EEO, 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.
- 15003 PUBLIC RELATIONS
Assure dissemination of pertinent information to appropriate groups (utilities, local governments, 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.

- 15004 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.)
- 15005 TEST RESULTS
Review test results to see if they contain all required information and an unbiased estimate of the information desired. Compare results with conclusions determined under similar circumstances in the same area, working with the same or similar materials. Review procedures used to determine if the results properly utilize data collected. Reconcile apparent divergences from expected results.
- 15006 ON-THE-JOB TRAINING
Use experience and knowledge of performance factors to implement on-the-job training programs to increase the skills of workers performing routine duties and special duties, as required. Be able to evaluate the progress and capabilities of trainees and others in on-the-job training situations.
- 15007 CONTRACT DOCUMENTS
Know the purposes and requirements of contract documents, including performance, maintenance, payment, retainage, labor and material bonds; contractor insurance; information for bidders; awards; contract form; and shop and working drawings. Know if the documents are in proper form, display full coverage and protection, are properly executed and filed, and are otherwise in conformance with expected practices and requirements.
- 15008 AS-BUILT PLANS
Verify completion and adequacy of as-built inspection and posting. Confirm certification by authorized inspector or engineer of dimensions, workmanship, and materials. Understand as-built ties and their conformance to standards or to original plans.
- 15009 BASIC STATISTICS
Apply basic statistical concepts related to probability, frequency distributions such as histograms, central tendency measures such as mean and mode, and dispersion measures such as standard deviation. (See elementary statistics textbooks.)

LEVEL III - SPECIAL WORK ELEMENTS

- 16001 SOILS CLASSIFICATION
Classify soils in accordance with the Unified Soil Classification System and the AASHTO Soil Classification System. (ASTM D-2487 and D-2488, AASHTO M-145)
- 16002 CONSTRUCTION SURVEYS
Supervise and coordinate construction surveys to assure compliance with plans and specifications. Assure layout and staking in accordance with plans and specifications, including drainage, grade, line, earthwork, curbs and gutters. Oversee recording and check accuracy of notes. Verify dimensions and volumes by trigonometric and quantity survey methods. (Example: Determine quantities removed from borrow pits.)
- 16003 COMPLEX PLANS AND SPECIFICATIONS
Utilize complex plans and specifications to assure compliance during and after construction with intent and quality of project. Use plans and specifications to plan inspection program and check stakeouts and preliminary work.
- 16004 TRAFFIC CONTROLS AND DETOURS
Insure adequate measures to protect workers and the public during all phases of a project. Coordinate activities with other offices and agencies as required. Arrange in advance for detours and traffic maintenance procedures. (MUTCD - Part VI)
- 16005 SOIL SAMPLING
Know proper techniques for taking soil samples for testing, including Solid Stem, Hollow Stem, hand auger, bucket type rig, large diameter auger or other practice or procedure used to obtain soil samples during trenching and backfilling operations or pursuant to soil exploration.

- 16006 REPAIR OF CONCRETE STRUCTURES
Be familiar with approved repair and installation practices for precast and cast-in-place concrete structures, including handling, substructure preparation, and coatings.
- 16007 PUMPS
Have a knowledge of installation and performance requirements for various types of pumps for water/wastewater systems.
- 16008 INFILTRATION AND INFLOW
Know the principles behind and the practices involved in reducing or eliminating infiltration or inflow in the construction of sanitary sewer systems, including pipelining, remote grouting practices and other infiltration and inflow reduction methods.
- 16009 TRENCHING PROBLEMS
Have a knowledge of various potential construction problems that may occur during a trenching operation, including the effect of unusual soil and/or ground water conditions, adjacent structures and conditions, existing underground structures, etc. (OSHA CFR 1926)
- 16010 VALVES
Perform inspections and have knowledge of the installation practices, materials and methods associated with large and small valves commonly encountered in pipe systems, and the special valves and valve housings that may be encountered.
- 16011 OPEN CHANNEL FLOW
Determine the flow capacities, flow characteristics, and discharge rates of the various types of pipes used utilizing Manning's equation or other open channel flow equation or method.
- 16012 FOUNDATION CONSTRUCTION
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.
- 16013 VIBRATION MONITORING
Know the applications of vibratory monitoring relative to blasting in trenching and excavation operations, and other vibration applications.
- 16014 WATER AND WASTEWATER SYSTEMS
Understand the basic operation of water/wastewater systems.
- 16015 METERS
Know the function of meters and other flow control devices. Perform inspections, report findings.

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 at least one major construction project. There are no exceptions to this requirement and documentation must be present in the work history listed on the application form.

17001 MAJOR CONSTRUCTION PROJECT

Act as chief inspector or assistant to project engineer on all aspects and for the duration of a complex construction project. Supervise inspectors, survey parties, soils and material samplers and testers, and other technicians and workers on the job. Assure full compliance with plans, specifications and contract provisions. Supervise and coordinate safety and traffic movement. 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 as-built plans and records. Have all data in compliance for acceptance of job by a designated authority.

17002 TECHNICAL PRESENTATIONS AND REPORTS (^)

Organize and deliver oral presentations and prepare technical reports and correspondence.

17003 APPLIED STATISTICS

Apply basic statistical concepts to the sampling and evaluation of materials or component batches. Utilize established standards or develop limits or acceptance which consider the practical variability of sampling procedures.

17004 COST AND PERFORMANCE MANAGEMENT

Maintain effective internal management over cost and performance on any project assigned.

17005 QUALITY ASSURANCE

Perform quality assurance for all direct work or supervised work.

17006 ALTERATIONS TO DESIGN

Review plans and specifications to determine applicability to specific jobs. Recognize design deficiencies and/or changed conditions in plans and specifications, analyze needs of job to determine appropriate corrective action, and to prepare detailed recommendations for delivery to appropriate authority.

17007 CHANGE ORDERS

Gather information from subordinates or from personal inspections and review. Prepare, in final format, complete contract change order with clear justifications and cost estimates for approval of a contracting officer.

17008 SPECIAL TRAINING NEEDS

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 instructor on course program. Be able to evaluate OJT and other training programs.

17009 REPORTS AND PROPOSALS

Know the requirements and purpose of geotechnical reports, and the desired results of an engineering/geotechnical proposal. Apply the information in geotechnical literature for pertinent facts used in analysis, reports, or field operations.

17010 PERFORMANCE EVALUATION

Use experience and knowledge of performance factors to evaluate performance of subordinates. Chart performance values, prepare evaluation reports.

LEVEL IV - SPECIAL WORK ELEMENTS

- 18001 **COMPUTERS**
Have a general knowledge of the function and use (and potential uses) of computers in the field of engineering and project management.
- 18002 **ENVIRONMENTAL IMPACT**
Aid the engineering staff in evaluating various environmental conditions at isolated geographical areas, etc., and know the relevant considerations. Know how to deal with archeological problems; recognize and report on potential and real contamination problems.
- 18003 **DISPUTE AND CONFLICT MANAGEMENT**
Assist in managing disputes, including arbitrations, litigation, mediations and claims management. Handle grievances and complaints and refer matters beyond delegated authority to proper supervisor.
- 18004 **UNDERWATER CONSTRUCTION**
Be familiar with underwater trenching and pipe laying operations, including knowledge of the materials and methods used. Inspect construction and recommend the adoption of change orders and other contractual alterations, if required.
- 18005 **LINE INSPECTION BY TV**
Be familiar with the equipment and procedures used for television inspection of water/wastewater lines.
- 18006 **TECHNICAL RESEARCH**
Perform research to keep abreast of state-of-the art accomplishments of other organizations regarding physical properties of materials, testing methods, acceptable standards, etc. Extract applicable information, utilize in conjunction with assigned projects, recommend necessary rechecks to substantiate usage.
- 18007 **TESTING PROGRAM COORDINATION**
Coordinate a program of testing and/or research in the field or lab to assure effective performance and compliance of sampling and testing procedures with standards. Maintain records of man-hours, equipment, and material costs for each phase. Receive, review, and collate results; summarize and compare results to determine accuracy. Prepare a report of entire program of findings with recommendations to proper authority.
- 18008 **PHYSICAL GEOLOGY**
Understand basic physical geologic phenomena such as glacial and volcanic action, weathering, rock cycle; the three families of rock and examples of each; stratigraphic features such as anticlines and synclines, strike and dip, etc.

PERSONAL TALLY WORKSHEET

Passed Work Elements in Water and Sewer Lines

- 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. Read page 4 in this manual concerning crossover credit.
- Refer to the Examination Requirements Chart on page 5 to determine whether you have passed an exam requirement.

Level I	Level I	Level II	Level II	
<u>General</u>	<u>Special</u>	<u>General</u>	<u>Special</u>	
__11001	__12001	__13001	__14001	__14015
__11002	__12002	__13002	__14002	__14016
__11003	__12003	__13003	__14003	__14017
__11004	__12004	__13004	__14004	__14018
__11005	__12005	__13005	__14005	__14019
__11006	__12006	__13006	__14006	__14020
__11007	__12007	__13007	__14007	__14021
__11008	__12008	__13008	__14008	__14022
__11009	__12009	__13009	__14009	__14023
__11010		__13010	__14010	__14024
__11011		__13011	__14011	__14025
__11012		__13012	__14012	__14026
			__14013	__14027
			__14014	__14028

Level III	Level III	Level IV	Level IV
<u>General</u>	<u>Special</u>	<u>General</u>	<u>Special</u>
__15001	__16001	__17001	__18001
__15002	__16002	__17002	__18002
__15003	__16003	__17003	__18003
__15004	__16004	__17004	__18004
__15005	__16005	__17005	__18005
__15006	__16006	__17006	__18006
__15007	__16007	__17007	__18007
__15008	__16008	__17008	__18008
__15009	__16009	__17009	
	__16010	__17010	
	__16011		
	__16012		
	__16013		
	__16014		
	__16015		

SELECTED GENERAL REFERENCES

ACI Manual of Concrete Practice. American Concrete Institute. Detroit, MI.

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

Concrete Pipe Handbook. American Concrete Pipe Association. Vienna, VA.

Concrete Pipe Installation Manual. American Concrete Pipe Association. Vienna, VA.

Construction Industry. (OSHA 2207). Government Printing Office (Order #029-016-001-221). Washington, D.C.

Construction Industry Digest. (OSHA 2202). Government Printing Office (Order #029-016-001-280). Washington, DC.

Guide for the Installation of Ductile Iron Pipe. Ductile Iron Pipe Research Association. Birmingham, AL.

Handbook: Ductile Iron Pipe, Cast Iron Pipe. Cast Iron Pipe Research Association. Oak Brook, IL.

Handbook of Steel Drainage and Highway Construction Products. American Iron and Steel Institute. New York, NY.

Manual on Uniform Traffic Control Devices for Streets and Highways. Federal Highway Administration. U.S. Department of Transportation. Washington, D.C.

“Standard for Installation of Ductile-Iron Water Mains and Appurtenances.” AWWA Standards. American Water Works Association. Denver, CO.

WARNING

On its website, NICET maintains a complete listing of references that are allowed in the paper-and-pencil testing centers. Please view the document “Reference Material Allowed in NICET Paper and Pencil Test Centers” at www.nicet.org/candidates/allowable_reference_material.pdf.

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