
Chapter 1

Introduction

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Chapter 1

Introduction

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645.0100 General

This handbook has been prepared by the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). The intended primary users are NRCS employees responsible for providing construction quality assurance where Federal funds are expended for the construction of conservation engineering measures. Other users may include sponsors of local organizations or individual owners who perform construction quality assurance duties. This handbook is only available through the NRCS Electronic Directives System (eDirectives) at: <http://directives.sc.egov.usda.gov/>.

For the purpose of this handbook, the term “conservation engineering measures” means any practice requiring engineering design and construction expertise installed under programs administered by the NRCS. In this handbook, NRCS employees and others responsible for performing construction quality assurance duties are referred to as “quality assurance personnel,” “construction inspectors,” “quality assurance inspectors,” or “inspectors.” These terms will be used interchangeably throughout the handbook to refer to the individual or individuals whose responsibilities include:

- understanding safety issues and taking appropriate action to prevent unsafe conditions during the performance of the work
- understanding the specifications, drawings, and contract terms and conditions
- observing and documenting work performed
- examining the quality control and testing to determine if the work is in compliance with contract or program requirements
- effectively communicating with the owner, construction contractor, and others on construction issues

It is important that the reader understand that government quality assurance inspections and tests are for the sole benefit of the Government and do not:

- relieve the contractor of responsibility for providing adequate quality control measures
- relieve the contractor of responsibility for damage to or loss of material or work before acceptance
- constitute or imply acceptance

645.0101 Purpose

The purpose of this handbook is to provide guidance, procedures, checklists, worksheets, and references to aid in construction quality assurance. NRCS policy governing quality assurance for engineering practices is set forth in the NRCS National Engineering Manual Part 512, Construction. If the instructions provided in this handbook conflict with contract provisions or NRCS policy, the contract provisions and NRCS policy take precedence.

This handbook is not intended to be a guide for construction supervision or quality control. Construction supervision and quality control are the responsibility of the individual or firm responsible for the construction. The individual responsible for the construction will be:

- the owner, if the owner does the work without the aid of a contractor
- a contractor hired or contracted by the owner, sponsors, or NRCS

This individual or firm will henceforth be referred to as the “construction contractor” or “contractor” even when he/she is the owner doing the work without the aid of a contractor. The contractor is responsible for:

- ensuring worker safety
- understanding the specifications, drawings, and contract or agreement terms and conditions
- supervising, managing, and providing quality control for all work
- completing all work required by and in conformance with the specifications, drawings, and other contract requirements

645.0102 Scope

This handbook contains the following information:

- description of the roles and responsibilities of NRCS quality assurance personnel
- general descriptions of work commonly undertaken on NRCS projects
- detailed quality assurance requirements of specific construction items
- standard procedures or reference to standard procedures for conducting field tests
- guidance on documentation of construction activities
- worksheets for recording observations and test data including guidance on completing each worksheet
- quality assurance checklists for guidance in examining and documenting construction activities

This handbook supports quality assurance necessary to ensure compliance with NRCS construction and material specifications prepared in accordance with NRCS National Engineering Handbook (NEH), Part 642, Specifications for Construction Contracts. Those responsible for quality assurance of construction and materials specified by other specifications will also benefit from the guidance in this handbook.

Not all of the chapters in this handbook are focused on compliance with a particular specification(s) and not all of the specifications in NEH 642 can be associated with any one chapter in this handbook. Table 1–1 lists each chapter in this handbook focused on ensuring compliance with specific specification(s) with reference to the applicable specification(s).

Some conservation measures are constructed by the landowner without a construction contract, but most construction is performed under some form of contract. The contract may be a simple verbal agreement between a landowner and a contractor, a contract between a local sponsor and a contractor, or a Federal contract between the NRCS and a contractor. The

Table 1-1 Cross reference between NEH 645 chapters and NEH 642, Specifications for Construction Contracts (Note: Only NEH 645 chapters and NEH 642 construction specifications with direct associations are listed.)

NEH 645, Construction Inspection		NEH 642, Specifications for Construction Contracts	
Chapter no.	Title	Specification no.	Title
3	Contractor Quality Control and NRCS Quality Assurance	94	Contractor Quality Control
5	Surveying and Computations	7	Construction Surveys
6	Erosion and Pollution Control	5	Pollution Control
7	Excavation, Dewatering, and Foundation Preparation	1	Clearing
		2	Clearing and Grubbing
		3	Structure Removal
		11	Removal of Water
		12	Relief Wells
		14	Pressure Grouting
		21	Excavation
8	Earthfill and Rockfill	63	Treatment of Rock Surfaces
		10	Water for Construction
		23	Earthfill
9	Soil Modification	25	Rockfill
		28	Lime Treated Earthfill
10	Geosynthetics	29	Soil-Cement
		95	Geotextile
		97	Flexible Membrane Liner
11	Drains and Filters	98	Geosynthetic Clay Liner
		24	Drainfill
12	Concrete	46	Tile Drains
		31	Concrete for Major Structures
		32	Structure Concrete
13	Roller Compacted Concrete	34	Steel Reinforcement
		35	Concrete Repair
14	Shotcrete	36	Roller Compacted Concrete
15	Pipe	33	Shotcrete
		41	Reinforced Concrete Pressure Pipe Conduits
		42	Concrete Pipe Conduits and Drains
		43	Clay Pipe
		44	Corrugated Polyethylene Pipe
		45	Plastic Pipe
		51	Corrugated Metal Pipe
		52	Steel Pipe
16	Soil Armoring and Reinforcement	53	Ductile-Iron Pipe
		61	Rock Riprap
		62	Grouted Rock Riprap
		64	Gabions and Gabion Mattresses

Table 1-1 Cross reference between NEH 645 chapters and NEH 642, Specifications for Construction Contracts—continued

NEH 645, Construction Inspection		NEH 642, Specifications for Construction Contracts	
Chapter no.	Title	Specification no.	Title
18	Piling	13	Piling
19	Water Control Appurtenances and Metal Fabrications	71	Water Control Gates
		81	Metal Fabrication and Installation
		82	Painting Metalwork
20	Timber	83	Timber Fabrication and Installation
		84	Painting Wood
21	Site Stabilization, Vegetation, Fencing, and Cleanup	6	Seeding, Sprigging, and Mulching
		26	Topsoiling
		91	Chain Link Fence
		92	Field Fence

quality assurance methods explained in this handbook are not dependent on who performs the work or the contract size or type.

Various programs are available that authorize government funds for constructing conservation measures. The information in this handbook is applicable to any and all conservation engineering measures for which the NRCS provides technical or financial assistance.

Documenting construction activities is an essential part of the inspector's role and is required where Federal funds are used or when the NRCS provides engineering services. Daily construction activities are to be documented whenever a quality assurance inspector is onsite. Otherwise, the inspector should provide documentation of construction activities whenever site visits are made. Documentation guidance in this handbook is focused on providing comprehensive, accurate, and concise records of daily construction activities necessary to:

- record equipment, labor, and other resources expended by the contractor
- provide estimated quantities in support of progress payments
- record results of tests and other quality assurance activities to document specification compliance

- document changes or changed conditions especially those that could impact the operation and maintenance of the measure being installed
- document discussions or correspondence with the contractor and others

Accurate and complete documentation is important for several reasons. The documentation may be reviewed in determining issues with operation and maintenance or during investigations of potential deficiencies. Lastly, complete and accurate documentation will be needed if a claim is filed. A general description of records and reports is provided in chapter 3 with specific guidance on records and reports given in each chapter where applicable.

Checklists are included in appendix A to assist inspectors in performing quality assurance inspections of NRCS construction projects. It is important to remember that the checklists do not address all of the conditions that may exist on construction sites. Site conditions and scopes of work vary from project to project, and a checklist cannot address all possible conditions. The checklists should be used by the inspector for guidance only and not relied upon as a comprehensive list of items to be checked. Inspectors should use their experience and knowledge of the work for guidance as to what to examine and look for during quality assurance inspections.

This handbook provides the basics for construction quality assurance. Quality assurance personnel should have field experience and continued training to ensure competency in their duties.

645.0103 Handbook layout

This section addresses the layout, as well as the logic used in the layout of this handbook. Chapters 1 through 4 provide basic information that should be understood by quality assurance personnel before inspecting construction. Chapters 5 through 21 are devoted to the specific types of work that are common in the construction of NRCS conservation measures.

Chapters 1 through 4

- Chapter 1, Introduction, introduces this handbook by stating the intent and explaining its organization.
- Chapter 2, Project Implementation, explains the process of project implementation from planning through the completion of construction including brief explanations of the roles of the various team members. It is intended to help the inspector understand his or her role and relationship to others who make up the project implementation team.
- Chapter 3, Contractor Quality Control and NRCS Quality Assurance, focuses on the role of the inspector and includes detailed descriptions of the various tasks required. It contrasts the quality assurance inspector's role to that of quality control personnel to clarify the difference between quality control and quality assurance.
- Chapter 4, Safety, is the most important topic that must be discussed prior to entering the construction site or beginning quality assurance activities. Safety in construction must be clearly emphasized to all parties concerned before any construction effort takes place, that is, before any mobilization or construction staking. The NRCS puts safety first in every stage of the project implementation process. Safety is emphasized at the first opportunity, and it is stressed and practiced throughout the process. Compliance with Occupational Safety and Health Administration (OSHA) regulations is required on all projects receiving NRCS funding.

Chapters 5 through 21

Chapters 5 through 21 provide detailed information concerning the various items of work required to construct conservation measures. These chapters are ordered so that the first few chapters (5, 6, and 7) contain information that would normally be needed at the beginning of the work. For example, one of the first items to be done at the beginning of a construction project is to layout the work and capture topographic information needed to compute quantities.

- Chapter 5, Surveying and Computations, provides the information necessary to allow the inspector to inspect or complete the surveying that is required at the beginning and throughout the job. It also provides instructions on how to compute quantities used to calculate the value of the work for payment to the contractor.
- Chapter 6, Erosion and Pollution Control, provides the information necessary to allow the inspector to inspect the installation and maintenance of any erosion and pollution control measures that are required at the beginning and throughout the job. Only after the erosion and pollution control measures are operational, can excavation and other construction begin.
- Chapter 7, Excavation, Dewatering, and Foundation Preparation, provides the information necessary for the inspector to inspect and verify that this work is performed in accordance with specification requirements. Most conservation measures require excavation and foundation preparation. Where ground water is present, dewatering is usually required.

The sequence of construction activities can differ based on the type and size of a project. Thus, chapters 8 through 20 may not coincide with the order of any particular project because the information covered in these chapters may be needed at various times. Chapter 21, Site Stabilization, Vegetation, Fencing, and Cleanup, is the last chapter in the handbook because the information provided in this chapter covers work that is generally needed near the end of a construction project.

- Chapter 8, Earthfill and Rockfill, explains selecting earth and rock materials and the processing and handling of these materials. The chapter describes transportation and place-

ment of earth and rock; for earthfill, it also covers moisture conditioning and compaction.

- Chapter 9, Soil Modification, provides information on various soil additives such as lime, bentonite, dispersants, and Portland cement. It addresses the processing, handling, transporting, placing, and the incorporation of these materials into the soil. It also covers moisture conditioning and compaction of the modified soil.
- Chapter 10, Geosynthetics, describes the technology, installation, and workmanship of geosynthetics including geotextiles, flexible membrane liners, and geosynthetic clay liners.
- Chapter 11, Drains and Filters, describes selecting drain and filter materials and the processing and handling of these materials. The chapter explains installation including the transportation and placement of sands and gravels used for filters and drains and moisture conditioning and compaction of filter sand.
- Chapter 12, Concrete, provides information needed to inspect concrete work including information on mixing, transportation, placement, and curing. It also describes forming and the installation of reinforcing steel. Because many excellent publications relating to concrete design, manufacture, and placement are available, most of the explanation in this handbook is confined to various inspection phases that pertain to the actual construction. Inspectors are encouraged to consult other publications for more information.
- Chapter 13, Roller Compacted Concrete, describes mix design, batching, mixing, conveying, placing, compacting, and curing of RCC. Unlike most conventional concrete, the ingredients used to make RCC are typically batched and mixed on the jobsite. Thus, chapter 13 includes information on the mix production process in addition to the other inspection phases that pertain to the actual construction.
- Chapter 14, Shotcrete, provides information needed to inspect shotcrete installation including information on the equipment, two types of shotcrete mixtures, placement, and curing. As with conventional concrete, there are many excellent publications relating to shotcrete that

inspectors may consult. Information in this handbook is limited to the various inspection phases that pertain to shotcrete installation.

- Chapter 15, Pipe, presents the common methods of installing pipe, common materials used, and procedures to follow in handling and storage of these materials. Information in this chapter is applicable to many conservation engineering measures where pipe is used such as dams, irrigation and drainage, and agricultural waste systems.
- Chapter 16, Soil Armoring and Reinforcement, describes measures designed to protect soil surfaces from erosion and failure. Typical protection systems consist of one or more of the following: rock riprap, grouted rock riprap, concrete riprap, gabions, geocells, articulating and cellular concrete blocks, and mechanical soil reinforcement. Chapter 16 presents the common methods of installing these systems, common materials used, and procedures to follow in handling and storage of these materials.
- Chapter 17, Bioengineering, focuses on the use of live and dead plant materials and flexible engineering techniques to alleviate environmental problems such as destabilized and eroding slopes, streambanks, and trail systems.
- Chapter 18, Piling, describes materials and installation techniques used to install bearing piles and sheet piling.
- Chapter 19, Water Control Appurtenances and Metal Fabrications, describes water control appurtenances such as valves, slide and flap gates, trash and debris racks, guard rails, and other structural elements. These may be items that can be obtained from a supplier (valves and gates) or items that are custom fabricated for a specific application (trash and debris racks). Thus, the chapter includes information on steel shapes, fasteners, and coatings that are specified for items that must be custom fabricated.
- Chapter 20, Timber, provides information on various timber products, and fasteners, and the properties that affect their performance. It covers terms used to identify various members commonly used when constructing a timber structure and lists specific items to inspect to

verify that materials and installation conform to specification requirements.

- Chapter 21, Site Stabilization, Vegetation, Fencing, and Cleanup, describes salvaging and placing of topsoil, vegetating, and mulching to protect against wind or water erosion. It also explains gravel plating for stabilizing sites in arid environments. Included are information on fencing and a description of cleanup of the site.

Chapters 6 through 21 each contain four sections:

- **Introduction**—Introduces the work item or items covered in the chapter.
- **Installation**—Explains the equipment, materials, and processes that are commonly required to install the item of work described within the chapter. The section is divided into subsections, each describing the various materials, equipment, and steps required to do the work in the general order that they will be conducted. For example, the installation section of Chapter 13, Roller Compacted Concrete, begins with a subsection entitled “Materials” because approval of materials is generally the first step in the RCC installation process. The second step is to design the mix, so “RCC mix design” is the second subsection in the installation section of chapter 13. The entire installation process is broken down into subsections that are ordered in the general sequence in which they will be performed. Each subsection provides a detailed description of a specific part of the installation process and includes a bulleted list of the inspector’s responsibilities related to that part of the process.
- **Sampling and testing**—Provides guidance on the sampling and testing of materials for quality assurance purposes including materials harvested at the construction site and those that are imported. Quality assurance sampling and testing are used to verify and confirm results from quality control sampling and testing. Sampling and testing are required on mixtures of materials such as concrete mixtures and soil containing additives. Sampling and testing are also required on installed materials such as compacted earthfill and in-place drain and filter materials. Some sampling and testing are per-

formed prior to delivery of materials to the site. For example, testing of geotextile materials is performed during the manufacturing of the materials as part of the manufacturer's quality control. This section describes responsibilities for material sampling and testing commonly performed at the jobsite so that the reader understands when quality control and quality assurance personnel will be required to sample and test.

Sampling and testing methods are not normally detailed in NRCS specifications, but are specified by reference to a standardized test method or procedure described in a written standard. These written standards are obtained from a standards organization such as the American Society of Testing Materials International (ASTM). NRCS construction and material specifications typically reference ASTM standards, but also reference standards from other standards organizations such as the American Water Works Association (AWWA) and American Association of State Highway and Transportation Officials (AASHTO). Reference is made to applicable test or practice standards with additional information provided, but the entire sampling and testing process is not spelled out in the sampling and testing section when there is a relevant standard available.

- **Records and reports**—Lists records and reports related to the item(s) of work described in the chapter. If the records and reports of a particular activity are extensively covered in another chapter, a cross-reference to that chapter is provided.

Appendices

- Appendix A contains checklists for the items of work described in this handbook. The first checklist, entitled "Quality Assurance Inspection Checklist," lists general items for which the inspector is responsible that must be completed when inspecting work performed under Federal contract. Some of the items listed may not apply to all types of contracts. The remaining checklists include items related to the subject matter covered in the chapter to which the checklist is related.

- Appendix B contains blank worksheets that can be used to record test results, record specific aspects of a particular item of work, and record calculations needed to verify compliance or document noncompliance. These worksheets conform to industry standard methodology. Sample worksheets with instructions on completing worksheets are also provided. Working tools are available to aid the NRCS inspector in completing worksheets. These tools include such items as training materials and electronic spreadsheets related to testing and documenting test results. At the beginning of appendix B, a link is provided for NRCS personnel to access these tools.
- Appendix C contains sample job diary entries documenting construction activities for a typical workday. The sample job diary entries relate to construction activities described in this handbook.
- Appendix D contains sample engineering notes typical of notes recorded when laying out and staking NRCS engineering measures.
- Appendix E provides guidance on construction tolerances. This is a general guide to be followed whenever specific tolerances are not provided in the drawings or specifications.
- Appendix F contains the NRCS Supplement to OSHA Parts 1910 and 1926.
- Appendix G contains a glossary of terms and acronyms.