

Guide for Concrete Construction Quality Systems in Conformance with ISO 9001

Reported by ACI Committee 121



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First Printing
July 2008

Guide for Concrete Construction Quality Systems in Conformance with ISO 9001

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ISBN 978-0-87031-282-3

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Guide for Concrete Construction Quality Systems in Conformance with ISO 9001

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Additional recognition to C. Raymond Hays, who led the subcommittee that developed this document, Lawrence G. Mrazek, who actively participated, and Anthony R. Ameruso, posthumously, for his work on the committee.

ACI Committee 121 developed this manual to provide ISO 9001:2000-based quality management system requirements and guidance to the concrete construction industry. Discussion is offered for each clause of the ISO 9001:2000, providing advice and construction-specific information that can be used as a reference to either produce a new quality management system compliant with ISO 9001:2000, or to upgrade an ISO 9001:1994 or other quality management system to meet the ISO 9001:2000 requirements.

Appendix A, "Model Quality Management System Manual for Designers, Construction Managers, and Constructors," is based on the "NYC MTA Bridges and Tunnels, Engineering and Construction Department," and is recommended for use as a template for any company beginning to write a quality manual.

Keywords: quality assurance; quality control; procedures.

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Reference to this document shall not be made in contract documents. If items found in this document are desired by the Architect/Engineer to be a part of the contract documents, they shall be restated in mandatory language for incorporation by the Architect/Engineer.

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ACI 121R-08 supersedes ACI 121R-04 and was adopted and published July 2008.

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This manual has been developed to address quality management for design and construction, with particular emphasis on concrete construction. It is based on the requirements of the ISO 9001:2000, “Quality Management Systems—Requirements,” which is referred to herein as ISO 9001:2000 or the “Standard.”

As an internal advantage, basing the quality management system on the Standard brings the concept of process management to the forefront of an organization. Rather than using the production control methods as an end in themselves, the organization uses them as tools and measures of process effectiveness, aids to continual improvement, elements of employee involvement, and indicators of customer satisfaction.

As an external advantage, the ISO 9001:2000 has international recognition. Compliance with the Standard has become a necessity for conducting business internationally and, more recently, in the United States. Because it places the responsibility for quality management on the vendor, those in compliance are seen as well-managed organizations with methods of quality management that can be assessed against a recognized standard. International and U.S. government agencies and private companies are requiring

International Organization for Standardization (ISO) compliance or sometimes registration to conform to contract requirements or to become a preferred vendor.

Review of this publication and assessment of an organization’s quality management system may indicate that many of the requirements of the Standard are already in place. Therefore, the objective should not be to reinvent the organization’s quality management system in the image of the Standard, but rather to conduct a gap analysis to determine where compliance is already in place and in what areas it is weak or lacking.

ISO history

In the 1920s, statistical theory began to take shape and the first control chart was developed by Walter Shewart at Bell Labs for use in production. It was the first use of a formalized quality control technique. Out of this grew an approach to manufacturing that expanded after World War II. Inspectors had been a specialized function in production facilities since World War I, but the emphasis was on avoidance of the defects without a statistical basis.

In the 1950s, W. Edward Deming and Joseph Juran were invited to Japan by General McArthur to bring new life to a damaged industry by teaching a total management approach to production. By the beginning of the 1960s, the phrase “made in Japan” took on a new meaning, and the West began to follow suit.

Throughout the 1950s, manufacturing developed in the West without a formal quality management standard. In 1959, the United States developed MIL-Q-9858, “Quality Program Requirements,” for military procurement (U.S. Department of Defense 1959). Following this, NASA developed “Quality System Provisions for Space System Contractors” (NPC 200-2) in 1962, and NATO adopted the Allied Quality Assurance Publications for procurement of equipment in 1968 (NATO 1968).

Throughout the 1960s, various systems of quality assurance were required of the manufacturers in the United Kingdom and Canada. In 1971, to standardize the systems, the British Standards Institute (BSI) published the first UK standard for quality assurance. This was followed in 1974 by BS 5179 (British Standards Institute 1974). These publications placed the responsibility of quality management in the hands of the third-party inspection.

In 1979, after meetings and agreements with key industry bodies, the British Standards Institute published BS 5750. Key industry bodies agreed to drop their own standards and use BS 5750 as a common contractual document. Process improvement was not addressed; only production control was addressed. The requirements were enforced by audit. The BS 5750 carried the core 20 elements that would form the backbone of ISO 9000:1987, and were continued into the ISO 9000:1994 series.

ISO was originally created in 1947 to facilitate world trade. Its emphasis up to the late 1970s had been on technical standards, engineering practices, and manufacturing. The development of quality management and increasing international trade led to the need for an international standard, which was pursued by ISO Committee TC176.

The result was that BS 5750 was adopted by ISO in 1987 as ISO 9000:1987. It carried the 20 core elements found in the BS 5750, and was enhanced with information from other documents in use around the world. It addressed quality systems for service industries, though the emphasis was still heavily on the manufacturing sector, which was the focus of BS 5750. In spite of attempts to focus on management processes, the emphasis was mainly on conformance alone.

In 1994, the Standard was again revised as the ISO 9000:1994 series. The emphasis was shifted toward preventive action, but continued to require documented procedures. This inclined organizations to create a system of procedural manuals, but without emphasis on improvement of processes.

The ISO 9001:2000 places the focus on processes and their interaction. The format has been changed, but the objectives have not. Aside from the addition of continual improvement and customer satisfaction, the goals remain the same. The focus on written procedures is reduced, as long as clear evidence (metrics) can be shown that the process is working. Controls to production, which once served as documentation of compliance, are now indicators for performance and tools for improvements. Audits are not intended to measure compliance alone. They are used to see if the process will attain the goals.

ACI Publication 121 history

ACI Committee 121 was founded in 1977 with the intent of developing an overall quality standard for the concrete construction industry. With the rise of the nuclear power industry, members within ACI believed a quality management standard for concrete work was in order to provide a framework for the quality activities necessary to deliver a project. The original ACI 121 document, published as ACI 121R-85 (ACI Committee 121 1985), was based on current ANSI standards for nuclear power plants and the Military Standard MIL-Q-9858A (U.S. Department of Defense 1963). It proposed basic definitions, activities, records, and responsibilities. It was the first ACI document that addressed overall quality management.

The document was revised in 1998, and ACI 121R-98 (ACI Committee 121 1998) was modeled after the ISO 9004:1994. It was expanded to incorporate 18 of the 20 elements found in the ISO 9004:1994 and addressed them using much of the information presented in the original document in addition to some new text and tables. The emphasis again was on the steps to set up a quality management system for a concrete construction project and assign responsibilities.

In 2004, the ACI 121 document was again revised, but was still based on the ISO 9001:1994 standard. With the advent of ISO 9001:2000, the definitions and intent of ACI 121R-04 (ACI Committee 121 2004) had to be modified. Additionally, the increase in project delivery by the design-build method, which often specifies the ISO 9001:2000 system, has outdated ACI 121R-04.

ACI 121R-08 is based on ISO 9001:2000. The language has been generalized to suit the myriad of contractual arrangements found in the present market, and examples from concrete construction are provided. An appendix has

been added to provide a template to creating a quality manual following ISO 9001:2000.

For ACI 121R-08, the transition to the ISO 9001:2000 represents a shift in focus to a process approach for quality management, placing the emphasis on continual improvement rather than on avoidance of nonconformity alone.

9000 series explained

The following documents comprise the ISO 9000:2000 series:

- ISO 9001:2000: American National Standard “Quality Management Systems—Requirements” (Gives basic requirements for compliance.)
- ISO 9000:2000: “Quality Management Systems Fundamentals and Vocabulary” (Explains terms and definitions. Was upgraded to ISO 9000:2005 without significant change to definitions.)
- ISO 9004:2000: “Quality Management Systems—Guidelines for Performance Improvements” (Provides enhancements and examples beyond ISO 9001:2000, with additional recommendations for improvements to systems.)

Layout of text, discussion, and commentary

Following is the text of the publication ISO 9000:2001. The Standard is organized into sections numbered 0 through 8. Each section contains a number of subsections, which are identified as clauses. The section, clause, and clause titles in this document coincide with those in the Standard.

A reference to each clause of the Standard is followed by discussion, interpretation, and examples in terms and situations familiar to those in the concrete construction industry.

INTRODUCTION

0.1—General

Refer to ISO 9001:2000, Section 0.1.

Discussion for Section 0.1

These clauses (0.1, 0.2, and 0.3) do not contain any requirements. Therefore, your quality management system (QMS) is not evaluated against these introductory items for compliance with the Standard.

0.2—Process approach

Refer to ISO 9001:2000, Section 0.2.

Discussion for Section 0.2

The model in Fig. 1 can be viewed as the essence of the Standard distilled into a single model; the activities represented by management responsibility, resource management, product realization, and measurement correspond to the main sections of the Standard, numbered 5 to 8, respectively. Section 4, Quality Management System, can be seen as an overview or executive summary of what is required to implement a QMS.

In Fig. 1, inputs from the customer (in terms of specifications or requirements) and outputs to the customer (in terms of products and satisfaction) reflect a document that is the International Standard. If the customer is not satisfied, then

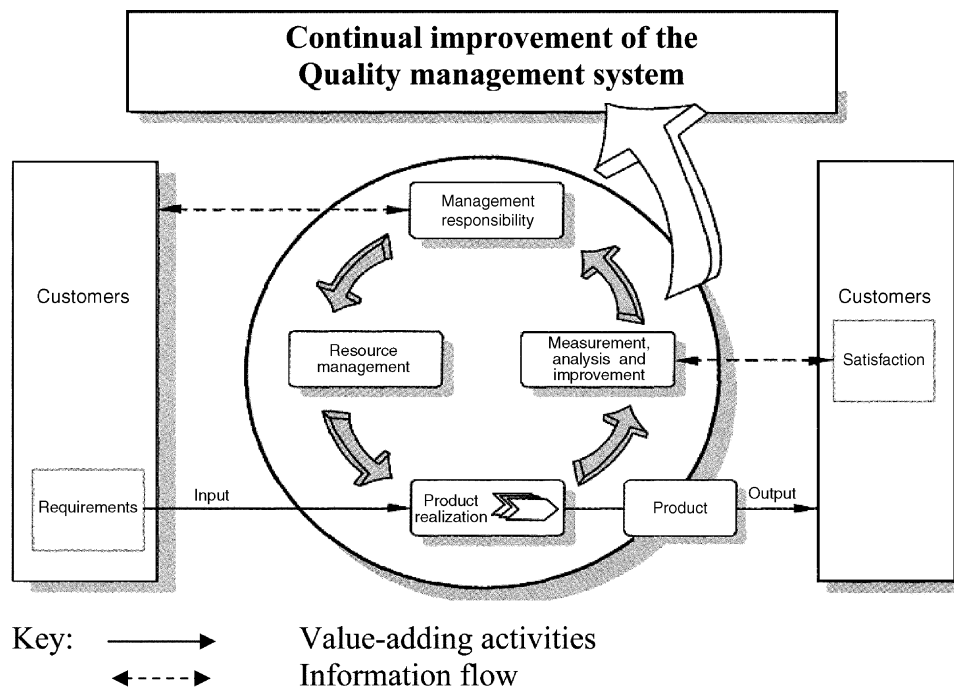


Fig. 1—Model of a process-based quality management system. This figure as taken from ISO 9001:2000 Quality Management Systems—Requirements—Figure 1.

an opportunity has been missed for repeat business and the ability to leverage past successes into future projects.

The process approach is based on the concept that all work gets done by a process, that is, a system of activities that turns inputs and resources into outputs.

It is important to take the time to think through this process approach, as the requirements of the Standard are based on this concept. This provides a tool for breaking down big tasks or projects into a series of inputs, processes, and subprocesses, which can then be monitored and measured before being used as outputs to the next stage. When the work performed by the organization involves a number of processes and subprocesses, the process approach model can be applied by means of:

- Identifying inputs (from the output of the previous stage);
- Planning;
- Monitoring; and
- Improving.

This approach can achieve results when used as a base for planning, analysis, and resource allocation. Construction projects involve a number of stages and processes. Each project stage or element can be considered as a series of inter-related subprocesses. As examples, concrete construction involves subprocesses such as structural design, mixture proportioning, procurement and control of the materials, selection of the subcontractors and suppliers, formwork design and procurement, scheduling, logistics of supply and access, inspection and testing, and curing.

0.3—Relationship with ISO 9004

Refer to ISO 9001:2000, Section 0.3.

Discussion for Section 0.3

The 2000 editions of ISO 9001 and 9004 have a common structure and numbering system, which simplifies using the Standard with the recommendations of ISO 9004. ISO 9004 is not a guide to ISO 9001.

0.4—Compatibility with other management systems

Refer to ISO 9001:2000, Section 0.4.

Discussion for Section 0.4

The environmental standard, ISO 14001, is aligned with ISO 9001:2000. Although environmental and safety topics are not addressed in this guide, it should be noted that many firms seeking ISO 9001 registration address environmental and safety requirements in their processes. It should be noted that Annex A of ISO 9001:2000 (not contained herein) provides a comparison between the ISO 9001:2000 requirements versus the ISO 14001 requirements.

Additional discussion related to the Introduction

Quality construction is achievable within an organization when all levels of management insist on quality and all employees know what is expected of them. It is always less costly to build it right the first time.

How do employees know that quality is important within their organization? They become aware when they are trained in what level of quality is expected, and when they see poor workmanship or materials removed and replaced voluntarily by their organization regardless of the cost.

Consistent quality construction can only occur when each employee within the organization has been properly trained and is empowered to produce quality work. Quality construction then becomes the norm.

QUALITY MANAGEMENT SYSTEMS— REQUIREMENTS

SECTION 1—SCOPE

1.1—General

Refer to ISO 9001:2000, Section 1.1.

Discussion for Section 1.1

This general clause explains the scope of ISO 9001 and the reasons to apply it. In this section of a quality manual, it is good practice to describe the scope or project(s) for which the Quality Management System (QMS) is applicable. The QMS can apply to all or only some projects. The QMS can also state whether the organization is registered to ISO 9001:2000 or simply complies without registration.

1.2—Application

Refer to ISO 9001:2000, Section 1.2.

Discussion for Section 1.2

The title of this section, “Quality Management Systems—Requirements” truly gives meaning to all that follows. These are the requirements of an ISO 9001:2000-compliant QMS, and are not optional. The extent to which each organization details each element in their quality manual, however, is open to interpretation.

What if some of the requirements in Clause 7 don’t apply?

If any requirements in Clause 7.3, Design and Development, are not applicable to particular processes, they can be excluded. The exclusion and the reasons for the exclusion should be stated clearly in the organization’s quality manual.

For many organizations in the construction industry, the requirements in Section 7.3, Design and Development, would not apply. For organizations that design concrete mixtures, formwork, or temporary shores, however, the section on design applies. Most contractors subcontract the supply of concrete to a concrete contractor or have a laboratory prepare the concrete mixture proportions. Formwork is usually designed by the form manufacturer. Shoring design can be outsourced or done in-house. Regardless, it is the organization’s responsibility to verify that the input to the design is consistent with the requirements and uses of the output, be it mixture design specifications, formwork pressures, or construction loadings.

SECTION 2—NORMATIVE (STANDARD) REFERENCE

Refer to ISO 9001:2000, Section 2.

Discussion for Section 2

The word “normative” herein means “standard.” The reference to ISO 9000:2000 directs you to that document as a source for fundamentals, principles, and definitions of the terms used in ISO 9001 and ISO 9004.

SECTION 3—TERMS AND DEFINITIONS

Refer to ISO 9001:2000, Section 3.

Discussion for Section 3

The terms used in ISO 9001:2000 are set out in ISO 9000:2000. With the revision of the 2000 Standard, the terms are now in line with common American English terms. Concrete contractors are encouraged to become familiar with the definitions contained in “ACI Concrete Terminology” (American Concrete Institute 2008). Note that the term “quality assurance” as defined by ISO applies to the activities of the producer or contractor as well as the owner.

It is noted that the ACI Web site presently carries the “ACI Concrete Terminology” publication, which can provide definitions of terms as they are commonly used in the industry.

Terms used under discussion sections

Note that ISO does not impose terms on the user other than those indicated in ISO 9000:2000. Even the name or title of an organization’s quality system is left to choice. The following terms are commonly used in the discussion section of this guide.

quality control—actions taken by an organization to provide control and documentation over what is being done and what is being provided so that the applicable standard of good practice and the contract documents for the work are followed.

quality assurance—actions taken by an organization to provide and document assurance that what is being done and what is being provided are in accordance with the contract documents and standards of good practice for the work.

quality manual—this term identified in Clause 4.2.1(b) can be thought of as the entire body of quality documents or binders that collectively describe the quality management system.

quality plan—the overview document that describes the objectives of a quality management system.

work methods—the processes used to produce and supply a product of service.

SECTION 4—QUALITY MANAGEMENT SYSTEM

4.1—General requirements

Refer to ISO 9001:2000, Section 4.1.

Discussion for Section 4.1

Setting up a quality management system

The requirements of Section 4.1 provide the framework to set up and document a QMS. It requires the following:

- Identify the processes an organization uses to provide its products or services;
- Determine the sequence of and interactions of those processes; and
- Manage and continually improve the effectiveness of the system.

One way to accomplish the above is to draw a flow chart of the processes. This provides a simple way to understand all of the inputs and interfaces and to evaluate a system. A suggestion for Section 4.1 of a quality plan is to reproduce the six items (from 4.1(a) to (f)) and identify where this information is provided in the quality manual. For Example 4.1(c), (d), and (e) may be checked and provided with an organization’s work methods.

4.2—Documentation requirements

4.2.1 General

Refer to ISO 9001:2000, Section 4.2.1.

Discussion for Section 4.2.1

Documenting a quality management system

Each organization should determine the approach that best suits its needs. Field conditions and sequences of installation not within the bounds of common practice need to be detailed. However, the construction industry relies on the competence of operating personnel. When people are highly skilled and experienced, the need to document may be less, and common processes may require only a minimum amount of documentation (for example, working from drawings without detailed work instructions, but only when the methods and means of installation are within the common operating procedures of the industry).

The requirements described in the following six clauses should be included in the documented procedures:

- 4.2.3 Control of documents;
- 4.2.4 Control of records;
- 8.2.2 Internal audit;
- 8.3 Control of nonconforming product;
- 8.5.2 Corrective action; and
- 8.5.3 Preventive action.

These are the only clauses where the existence of a documented procedure is a specific requirement.

While Clause 4.2.1, Item (c) of the International Standard requires “documented procedures” in regard to the six clauses listed above, the titles, format, and grouping of these procedures is for the user to determine. Please note that this manual uses the term “process documents” to cover the documentation referred to in both Items (c) and (d) of this clause.

It is important to remember that employees should have the information needed to do their job. Some common terms are:

- Work practices, work procedures, work methods, or work instructions;
- Operating practices or instructions;
- Production schedules;
- Preferred supplier list (see Section 7.4, Purchasing);
- Specifications; and
- Drawings.

Many engineering firms have standards for drawing lettering size and plan orientation as well as procedures to check their work.

Documentation should indicate—to the extent necessary—which positions within an organization perform a specific task, where the task is performed, and when the task is performed. How the activity shall be performed depends on the qualifications of individuals performing the task.

4.2.2 Quality manual

Refer to ISO 9001:2000, Section 4.2.2.

Discussion for Section 4.2.2

What is a quality manual?

A quality manual is simply a document that describes a QMS. It is presented in a way that suits the organization’s operations.

The format, title, and how much detail is included in the manual is up to each organization. It can contain all management system documentation, or only part of it.

One recommendation is to use ISO 9001:2000 as a checklist for the production of a document called the “quality plan.” Each item in the Standard is identified in the quality plan with a description of how the organization addresses the item. The quality manual is then the entire collection of documents related to quality, including the quality plan, quality procedures, and work methods that constitute many separate documents.

What should be included in the quality manual?

Clause 4.2.2 lists items that should be covered in a manual: the scope of its application; identification of any excluded requirements (such as Clause 7.3, Design); the documented procedures (in detail or by reference); and a description of the sequences and interaction of the processes.

It is convenient to provide the manual in tiers such that the quality plan spells out the objectives of the QMS for the project, the procedures (which are referenced in the plan) provide the methods by which those objectives are realized, and work methods provide the details of execution. Depending on the complexity of the project, work methods and procedures can be combined or separate. Procedures and work methods should describe the particulars of execution such as the application, test methods, acceptance criteria, references, documentation requirements, and responsibilities. By constructing the QMS in tiers, procedures and methods can be added or revised individually without reissuing the plan.

Example quality plan outline

The quality plan should follow the same section and clause numbering used in ISO 9001:2000. The following outline provides recommended section names and content for a quality plan. Furthermore, Appendix A can be used as a template to assist in the development of a quality plan for an organization or project. See also Appendix A, “Model Quality Management System Manual for Designers, Construction Managers, and Constructors.”

Section 1—Scope:

- Describe the organization and its products or services it provides; and
- Explain the scope covered by the QMS.

Section 2—Normative reference:

Identify the source of reference standards for the QMS.

Section 3—Terms and definitions:

- Identify source document or documents providing these definitions; and
- Add other definitions specific to an organization, if appropriate.

Section 4—Quality management system:

- Describe the structure of the QMS documents, such as quality plan, quality manual, quality procedures, and work methods;
- Include a detailed description of how an organization

fulfills the requirements of ISO 9001:2000; and

- Include a flow chart of the processes; it is useful in this section.

Section 5—Management responsibility:

- Use Clause 5.3 to present the organization's quality policy; and
- Include an organizational chart.

Section 6—Resource management:

- Create a matrix of training requirements that compares positions and the "must know" procedures for each position requiring training.

Section 7—Product realization:

- If the QMS will be used by a design firm, then:
 - Include design requirements in this section; and
 - Reference any design or engineering procedure(s) in this section.
- If the QMS will be used by a construction firm, then:
 - Reference work methods in this section; and
 - Identify and describe the typical elements of the organization's work methods in Clauses 7.1 and 7.5.

Section 8—Measurement, analysis, and improvement:

- Address the organization's important monitoring issues, such as inspection, testing, auditing, nonconformance, and improvement.

4.2.3 Control of documents

Refer to ISO 9001:2000, Section 4.2.3.

Discussion for Section 4.2.3

Document control provides a method to ensure that the document in use is the correct document and is approved as required. Document control is the first of the ISO 9001:2000 required procedures.

Typical internal documents include:

- Working drawings;
- Shop drawings;
- Procedures;
- Instructions;
- Reference materials; and
- Check prints of designs, drawings, and specifications.

Typical external documents include:

- Regulations;
- Codes;
- Specifications;
- Contract drawings;
- Change orders;
- Request for information; and
- Field change notices.

What does "controlled" mean?

"Controlled" means having a systematic, planned approach to document preparation, identification, review, approval, distribution, availability, storage, and revision control.

The controls needed and the extent of control possible might be different from document to document. Controls will be different for internal and external documents, and

need to be established appropriately. For internal documents, Clauses (a) through (e) and (g) apply. For external documents, Clauses (c) through (g) apply.

Which documents need to be controlled?

Examples of documents covered by this clause include:

- Design outputs (such as drawings and specifications);
- Contract documentation (including variations with the customer and with suppliers);
- Outputs from planning activities such as design verification, schedules, and checklists;
- Documents describing the operation of your QMS (quality manual, procedures [including those required by ISO 9001], and forms);
- Policies or guidelines;
- Organizational structure and position descriptions;
- Design input including standards, codes, design briefs, and environmental impact statements; and
- Software used for design.

What about electronic documents?

Where electronic documents are used, the version on the network should be identified as the latest version. A statement can be added to indicate that any paper copy is uncontrolled, and it is up to the reader to verify that it is the latest copy by checking the network.

4.2.4 Control of records

Refer to ISO 9001:2000, Section 4.2.4.

Discussion for Section 4.2.4

Records are a statement of the facts existing at the time an activity occurred, and they cannot be revised. Superseded or revised documents can become records.

Control of records is the second required procedure. This clause requires the organization to implement a procedure to provide evidence that the project requirements and specifications have been met.

In the construction industry, appropriate records may also provide protection for an organization (for example, records of delay, photos of completed work before covering, or inspection showing criteria being met).

Typical types of records

The types of records to keep include:

- Design files and calculations;
- Customers orders and contract reviews;
- Meeting notes;
- Internal audit reports;
- Details of nonconformities;
- Corrective and preventive action reports;
- Purchase orders;
- Suppliers' test records;
- Inspection records;
- Calibration reports;
- Training records;
- Details of goods received and delivered; and
- Construction photos and check prints.

For concrete construction, the following records should be kept:

- A recorded diary of a construction project (this is extremely valuable, especially when a problem develops);

- Daily photographs that are properly dated;
- Identification, examination, acceptance, and testing of materials and subassemblies;
- Inspection before casting concrete, including a check of form dimensions, size and position of reinforcing or prestressing steel, joint materials, inserts, form condition, cleanliness of reinforcement, shoring and support for forms, location of pipe, conduits and inserts, and the condition of soil in excavations;
- Preparation of concrete specimens and their proper storage while awaiting testing;
- Stressing records for post-tensioned construction;
- Performance of tests for temperature, slump, cylinder strength, air content, and unit weight;
- Inspection of form removal and finishing of formed and unformed surfaces; and
- General observation of equipment, working conditions, weather, and other items that could affect the long-term durability of the concrete. (Curing and protection from the elements should also be observed. Temperature records are particularly important.)

Because the buildings and engineering facilities may last longer than the construction organization, the project principal needs to give particular consideration to the long-term accessibility of design and construction records.

How much detail is needed in process documentation?

An organization will determine what records are required in addition to what is required by ISO 9001:2000. Each type of record should have a plan for how long it needs to be kept, where it will be stored, and how it will be disposed of.

SECTION 5—MANAGEMENT RESPONSIBILITY

5.1—Management commitment

Refer to ISO 9001:2000, Section 5.1.

Discussion for Section 5.1

Top management is defined in ISO 9000:2000, Clause 3.2.7, as “the person or group of people who directs and controls the organization at the highest level.” This clause specifically identifies the responsibilities of top management, and emphasizes the need for effective leadership.

Evidence of commitment can be achieved through:

- Business-planning processes that identify customers, and the regulatory requirements applicable to the organization;
- Identifying the organization’s policies and objectives;
- Communicating the quality policy and objectives to the people;
- Management review; and
- Providing resources.

5.2—Customer focus

Refer to ISO 9001:2000, Section 5.2.

Discussion for Section 5.2

What does the customer want?

This clause makes it clear that, irrespective of who actually undertakes interaction with the customer, it is the responsibility

of top management to make certain that those requirements are understood and that the necessary resources are available.

5.3—Quality policy

Refer to ISO 9001:2000, Section 5.3.

Discussion for Section 5.3

A quality policy establishes a commitment to:

- Quality;
- Continual improvement of the QMS;
- Framework for quality objectives; and
- Internal communication and review.

In the most general sense, a quality policy should be a clear statement of the organization’s commitment to a standard of quality. This should provide evidence of commitment from the top management that quality will not be compromised when it is in conflict with other interests.

5.4—Planning

5.4.1 Quality objectives

Refer to ISO 9001:2000, Section 5.4.1.

Discussion for Section 5.4.1

Satisfying the requirements in Section 5.3 establishes an organization’s quality policy. To put that policy into effect, top management needs to establish clearly defined objectives for the organization. The established objectives should be realistic and related to achievable and measurable outcomes such as:

- Meeting specified technical, safety, environmental, time, and financial requirements for a product or service;
- Documenting various internal business processes;
- Improving contract documentation;
- Improving training;
- Controlling operations/projects;
- Identifying and controlling nonconformance;
- Gaining repeat business; and
- Identifying new market and service opportunities.

Objectives should focus on areas that will bring a return to the business in both financial terms and in terms of increased customer satisfaction.

What about setting quality objectives on projects?

Project objectives are appropriate and should be consistent with an organization’s objectives. They need to be in agreement with the project intent. Project objectives can be more specific to project deliverables and the client’s objectives.

For example, if an organization is responsible for the management of the project, it may need to:

- Ensure that the project objectives are realistic and are able to be communicated to all levels within the project;
- Identify the suppliers involved with the project that are required to establish quality objectives consistent with the project quality policy;
- Ensure that it has identified its objectives appropriately; and
- Ensure that it includes a review of its performance in meeting these objectives as part of the management review (see 5.6).

5.4.2 Quality management system planning

Refer to ISO 9001:2000, Section 5.4.2.

Discussion for Section 5.4.2

Control is the act of comparing planned results to achieved results, so that corrective action can be taken when there is deviation. If there is no plan, there is no control.

This clause deals with planning at two levels:

1. Planning necessary to meet the requirements of 4.1; and
2. Planning necessary to meet quality objectives.

What about project planning?

For construction, a project is a one-time, multitask job with a definite starting point, a defined scope of work, a budget, and a team of professionals, often brought together for the first time with different formats, methods, and business cultures. The lack of a clearly defined scope can become a major problem with construction projects. It is the customer's (owner's) responsibility to communicate with bidders to ensure the scope is clearly defined.

The recommended model is:

- Definition:
 - Define the problem;
 - Develop the vision; and
 - Write the mission statement.
- Planning:
 - Develop strategy;
 - Develop implementation planning; and
 - Develop risk management.
- Execution:
 - Do the work;
 - Monitor the progress; and
 - Take corrective action.

5.5—Responsibility, authority, and communication**5.5.1 Responsibility and authority**

Refer to ISO 9001:2000, Section 5.5.1.

Discussion for Section 5.5.1

Who does what?

Top management needs to ensure that people in the organization know what is expected (responsibility), and what is allowed (authority). An organizational chart should be included in the organization's QMS to define lines of responsibility. This chart could be included as an appendix to allow for frequent revision.

Attention should be paid to interfaces between project participants to ensure continuity between participants and organizations. Phases of projects should also be considered for interface issues.

Although individuals should be aware of his or her quality responsibilities, there should be a system of quality control, including inspections or checking, to ensure accountability. One of the first tasks of management is to develop a written plan for quality control (QMS) that includes all activities critical to quality, criteria, and frequency of inspections or checking, and the assignment of responsibilities. Qualified personnel can then develop a checklist for inspection.

Inspection does not take responsibility away from the construction worker. It provides management with a quality measure, data for improving the system, and the ability to take corrective action. Every contractor should be responsible for quality and should communicate to all employees that, "We do quality construction and are proud of each of our projects."

5.5.2 Management representative

Refer to ISO 9001:2000, Section 5.5.2.

Discussion for Section 5.5.2

Who looks after the quality management system?

Top management assigns one person to have overall responsibility and authority as the management representative. An organization, however, may have more than one person performing similar roles—such as in different branches or on projects—and in such cases, their roles, delegated authority, and lines of reporting need to be defined.

In smaller organizations, the management representative may do the administrative and training activities in addition to other functions within the organization.

The quality management representative should be independent from the management of the project organization to avoid conflicts of interest. This person should report directly to the upper management at least one level above that of production. This should be clearly shown on the organizational chart and in the job descriptions for the various positions on the organizational chart.

5.5.3 Internal communication

Refer to ISO 9001:2000, Section 5.5.3.

Discussion for Section 5.5.3

Keeping people informed

For a QMS to work effectively, good communication is essential. To be effective, communication processes should provide the organization's employees with the ability to:

- Transmit and receive information quickly and to act on it;
- Build trust with each other;
- Transmit the importance of customer satisfaction and process performance; and
- Identify opportunities for improvement.

All information should be clear, understandable, and adapted to the intended audience. Unfortunately, good communication within an organization is rare; it is often perceived by top management as better than it actually is.

Communicating information about the effectiveness of a QMS could be through a variety of means such as bulletins, newsletters, internal meetings, meeting minutes, nonconformance logs, preventive action suggestions, and circulation of reports.

5.6—Management review**5.6.1 General**

Refer to ISO 9001:2000, Section 5.6.1.

5.6.2 Review input

Refer to ISO 9001:2000, Section 5.6.2.

5.6.3 Review output

Refer to ISO 9001:2000, Section 5.6.3.

Discussion for Section 5.6.3

Is the quality management system working?

Top management should review the QMS on a regular basis. A new system should be reviewed quarterly, with reviews given annually thereafter. To be effective, the review should be preplanned; it is recommended that the requirements of 5.6.2 and 5.6.3 be specifically addressed at each management review.

The management review will usually be recorded in a form that includes identification of:

- Date and location of the review;
- Scope of review (for example, full system or part of the system);
- Identity of participants (name and functions);
- Minutes of proceedings; and
- Actions (if any) and responsibilities, including target dates.

This record will typically be minutes of a meeting, but for a small organization, a less formal record, such as a diary note, may be appropriate.

Actions resulting from the review meeting are typically those that require top management understanding or endorsement, such as trends, amendments to policy, improvements, and preventive actions involving capital expenditure. Other responsibilities, such as follow-up actions, are typically delegated.

The record of a management review becomes an important part of the organization's quality records and becomes the first input into the next management review.

SECTION 6—RESOURCE MANAGEMENT

6.1—Provision of resources

Refer to ISO 9001:2000, Section 6.1.

Discussion for Section 6.1

What is needed?

Organizations need to make sure the resources needed to implement, maintain, and improve the QMS are available. Within the construction industry, resource management occurs in response to a change in workload such as winning a new contract, scope changes to an existing contract, or dealing with unpredictable conditions. Management needs to be flexible and quickly respond to resource issues. Resources include not only the personnel required, but also finance, facilities, and equipment. For example, it might be necessary to:

- Develop new procedures or work methods;
- Obtain additional equipment that can be rented, leased, or purchased; and
- Acquire the resources and skills through a subcontract.

6.2—Human resources

6.2.1 General

Refer to ISO 9001:2000, Section 6.2.1.

Discussion for Section 6.2.1

Are the people able to do what is required?

The most important factor in achieving a desired outcome and customer satisfaction is having competent people doing the right job.

Note that this clause specifically refers to personnel performing work that affects product quality.

6.2.2 Competence, awareness, and training

Refer to ISO 9001:2000, Section 6.2.2.

Discussion for Section 6.2.2

Checking competence and training

Organizations should regularly compare the experience, qualifications, capabilities, and abilities of the people relative to the skills and qualifications needed by the business for current and future contracts.

Evaluating the effectiveness of training programs

The ACI certification programs can be a key element in ensuring that concrete testing technicians and craftsmen are trained for their role in the concrete construction process.

Records of the assessment process, such as ACI certifications and programs, should be kept.

Training programs may be developed to fill needs or to further develop the organization's capabilities. Training on the QMS or on specific work methods can be effectively provided by a review meeting.

Other sections of the Standard that relate to training are:

- Clause 8.5.3, Preventive action;
- Clause 8.2.2, Internal audit; and
- Clause 5.6, Management review.

How is employee awareness raised?

Typical ways to raise employee awareness of their contribution to achieving quality objectives include:

- Orientating employees to the organization's quality policy when safety orientation is conducted;
- Holding team briefings (for example, design and construction start-up);
- Holding toolbox meetings on the work sites when safety toolbox meetings are conducted (to generate quality awareness at the craft level, it is practical to generate job-specific handouts that express topics in short bullets with illustrations and photos);
- Ensuring that quality objectives are highly visible to employees (for example, on meeting agendas and displays);
- Recognizing and rewarding good work performance; and
- Reporting nonconformances and actively giving employees information about why nonconformances occurred and how they were resolved.

6.3—Infrastructure

Refer to ISO 9001:2000, Section 6.3.

Discussion for Section 6.3

The right tools for the job include not only the construction equipment, but also the computers, software, reference materials, cell phones, and other peripherals that are necessary to operate a project.