



■ User's Guide to ASTM Specification C 94 on

Ready-Mixed Concrete

D. Gene Daniel and Colin L. Lobo



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User's Guide to ASTM Specification C 94 on Ready-Mixed Concrete

D. Gene Daniel and Colin L. Lobo

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ASTM International
100 Barr Harbor Drive
PO Box C700
West Conshohocken, PA 19428-2959
USA



NRMCA
National Ready Mixed Concrete
Association
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ASTM International

100 Barr Harbor Drive

PO Box C700

West Conshohocken, PA 19428-2959, USA

Phone: (610) 832-9585 Fax: (610) 832-9555

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NRMCA

National Ready Mixed Concrete Association

900 Spring Street

Silver Spring, MD 20910, USA

Phone: (301) 587-1400 Fax: (310) 585-4219

E-mail: publications@nrmca.org Website: www.nrmca.org

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Foreword

THIS PUBLICATION, *User's Guide to ASTM Specification C 94 on Ready-Mixed Concrete*, was co-published by ASTM International and The National Ready Mixed Concrete Association (NRMCA). It was both authored and edited by D. Gene Daniel, Concrete Consultant, Rogers, Arkansas; and Colin L. Lobo, The National Ready Mixed Concrete Association, Silver Spring, Maryland. This publication is Manual 49 of ASTM's manual series.

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Preface

What is ASTM?

TO FULLY UNDERSTAND ASTM C 94/C 94M, *Specification on Ready-Mixed Concrete*, it is necessary to understand ASTM and the consensus process for developing standards such as ASTM C 94/C 94M. Getting a view of ASTM from its conception takes us back more than a century. The time period involved is between the American Civil War, which ended in 1865, and World War I, which began in 1914. The true beginning of ASTM coincided with the Spanish-American War fought in 1898.

The world and, more specifically, the United States was in the midst of the second phase of the Industrial Revolution. Major advances in communication and transportation were taking place in a country that in the late 1890s consisted of 45 states. The diesel engine, electrical power, and the steel industry were all coming into prominence. The U.S. was a growing, developing, and prosperous nation with some industrial corporations growing into giants that remain today. William McKinley was elected President in 1896, re-elected in 1900, and assassinated in 1901.

This growth period and the industrial revolution were the backdrop that fostered ASTM. The North American railroad network was expanding in all directions less than 30 years after the completion of the first transcontinental railroad. Charles Dudley, holder of a Ph.D. from Yale University, was a chemist for the Pennsylvania Railroad. Mr. Dudley's degree preceded by two years Custer's last stand at the battle of the Little Big Horn in the hills of Montana. A portion of his duties included research to develop more durable steel for use as rails and then to write a specification conveying those specifics to the rail manufacturers. Mr. Dudley's ideas did not always coincide with those of the steel manufacturers or other railroads who were also buying steel rails. These problems and differing view points led to the first meetings of manufacturers, chemists, engineers, and others in the steel and railroad or bridge business to develop some standards everyone could tolerate. The idea that emerged was that good material standards require the input of manufacturers, designers, builders, and users. This was the idea in June of 1898 when ASTM was first formed under another name, American Section of the International Association for Testing Materials. From the first meeting, the goal was to develop consensus standards.

The first committee dealing with cement, C-1, was formed in 1902, and the concrete and concrete aggregates committee, C9, formed in 1914.

The scope of ASTM has continued to expand, and its name has continued to change. The name today is ASTM International, reflecting both its wide use and its broad international membership. From the original 70 members, ASTM International (ASTM) has grown to more than 30,000 members. For the 100 plus years of its existence, the committee work has remained in the hands of volunteers.

What is Subcommittee C 09.40?

At the bottom of the first page of the document ASTM Standard Specification for Ready-Mixed Concrete (C 94/C 94M) is a notation: "This specification is under the jurisdiction of ASTM Committee C 09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C 09.40 on Ready-Mixed Concrete." Very simply, subcommittee C 09.40 is the group of people who do the actual writing of ASTM C 94/C 94M. This subcommittee is typically composed of approximately 50 people with a wide variety of interests related to the production, delivery, and use of ready-mixed concrete. Some of the groups represented on the subcommittee include pro-

ducers of ready-mixed concrete, private engineers from both design firms and material testing firms, state highway department engineers, representatives of federal agencies, representatives of trade organizations, professors from universities, both foreign and domestic, contractors, representatives from concrete material producers, such as cement and chemical admixtures, as well as others who have a relationship to the industry. Most of these people are engineers or scientists whose daily activities involve them with the concrete industry. Most, but not all, live in the United States.

Members of subcommittee C 09.40 currently meet twice a year to propose and draft potential updates or changes and to commence the balloting process needed to alter the ASTM C 94/C 94M standard. The C 09.40 subcommittee is responsible for only two ASTM documents. The most widely used is ASTM C 94/C 94M, and the other is ASTM Specification for Concrete Made by Volumetric Batching and Continuous Mixing (C 685/C 685M). The latter is the specification for concrete made from materials continuously batched by volume, mixed in a continuous mixer, and delivered in a freshly mixed condition. Historically, the method of batching and mixing takes place in a truck-mounted unit specifically designed for this purpose.

The C 09.40 subcommittee is only one of many subcommittees which function as a part of the Committee C 09 on Concrete and Concrete Aggregates. The main C 09 committee divides into approximately 25 to 30 subcommittees to develop consensus standards for the concrete and concrete aggregates industry.

ASTM Standards Development Process

The development of standards using a consensus process can be a painstaking adventure. The rewards are meaningful standards that benefit users with due consideration of the concerns of all involved parties.

New standards or alterations to existing standards often begin their formation at the task group level of a subcommittee. The task group prepares a letter ballot for the subcommittee membership to review for up to 30 days prior to voting. For a subcommittee letter ballot to proceed to the next level, several things must occur. At least 60 % of the subcommittee must return a ballot, and of those voting affirmative and negative, at least 2/3 must be affirmative. Negative voters must provide a reason for their negative vote. Each negative will be considered at the next biannual subcommittee meeting. The negative vote will be discussed, and the negative voter is provided the opportunity to speak in defense of the negative and to expound on the reason for it. During this discussion, the Committee may accept the negative voter's point of view and consider it for a revised ballot. If a resolution cannot be reached, a vote is then taken of members present, with affirmative votes required from at least 2/3 of those voting affirmative and negative to find the negative voter not persuasive and allow the item to advance to a committee letter ballot.

If the subcommittee had a majority of manufacturers (producers), it would be possible that the proposed changes or new standards would favor the producers. Control by any single group is prevented by limiting votes to one per company or organization and by balance. Each subcommittee and each committee must have a balance between producers and non-producers. A balanced committee or subcommittee must meet the criterion that voting producer members cannot outnumber the combined votes of the other voting membership groups (users, consumers, and general interest). This is a strictly enforced requirement by ASTM.

Items passing successfully through the subcommittee process are placed on a committee letter ballot and again go through the same process, where a larger group of peers has the opportunity to evaluate the proposal. Committee C 09 consists of many subcommittees, with each of these members now eligible to vote. The primary difference in the committee procedure from the subcommittee procedure is that a 90 % affirmative vote of those voting affirmative and negative is now required for passage, rather than 2/3. If a negative vote is found persuasive, the item fails and is sent back to the subcommittee and task group for a decision on whether to simply drop the proposed change or make alterations in line with the thoughts of the negative voter, thereby beginning the process again.

Simultaneously with the committee level vote, the proposed change is also subject to a vote by the entire ASTM Society, which includes all the ASTM members in various

committees. No voting percentages are required at this level, but negative votes must again be considered.

The consensus system also provides for appeals by a negative voter. The appeals system varies depending upon the grounds stated for the appeal.

The primary point in the entire process is that each negative voter's voice and arguments are heard, and the subcommittee or committee is then afforded the opportunity to vote on an issue based on the thoughts and reasoning of one member of the group. A single objection often influences others and alters the content of a proposal or kills the proposal completely. ASTM firmly believes in the old adage that two heads are better than one and has set up a system to ensure that each member's voice is heard.

Original ASTM Specification for Ready-Mixed Concrete

The original C-9 (now C 09) committee required six years (1914–1920) to issue its first standard. The report consisted of the proper means of molding and storing concrete cylinders in the field, describing methods still in use today. The report also included tentative test methods for the unit weight of concrete aggregates and a method for determining voids in concrete fine aggregate. Some additional test methods were also included in the C-9 report, but nothing on ready-mixed concrete was included at that time.

The first such specification was issued in 1933 as a tentative specification for ready-mixed concrete. A copy of the original document that was approved in 1935 is included in the Appendix. The identification number, or designation, was C 94-35. The topics covered did not vary much from today's standard, over 70 years later. One example is that central mixing, partial mixing (shrink mixing), and truck mixing are each included within the specification. The time of hauling was limited to 1 ½ hours, as it is today. Testing was specified but did not include any mention of air content tests, because the advantages of entrained air did not become known until later in the same decade.

The specification has been revised many times since 1935 and continues to undergo revisions to remain in step with technological advances, such as load-cell weighing, and environmental issues, such as limiting plant runoff water by the use of non-potable water in the batching process.

The roots of a successful specification go back to the abilities of the committee prior to 1933 that published a very comprehensive document for the materials, proportioning, mixing, delivery, quality, inspection, testing, and acceptance of ready-mixed concrete delivered to the job site ready for use.

End Result Specification

Specifications are basically one of three types: Proprietary, Prescriptive, or Performance (End Result). Concrete specifications are definitely not Proprietary, because brand names are seldom mentioned, and even when they are, it is usually in the context of Brand Z or approved equal.

Prescriptive specifications provide detailed descriptions of required materials and their properties but do not provide brand names. This type of specification also provides details of how to perform specific parts of the process. The "how to" segment is what ASTM C 94/C 94M does not do. Within the materials segment, ASTM C 94/C 94M does specify specific material requirements such as Specification C 150, Type I portland cement and Specification C 33 aggregates meeting a specific coarse aggregate grading. Minimum cement quantities and maximum water quantities may be specified (prescriptive). Ordering Option B provides the purchaser the opportunity to specify the exact quantities for specific materials and by doing so forfeits any restrictions for final consistency of the delivered product or strength of the hardened product.

The bulk of the ASTM C 94/C 94M standard is a performance or end-result specification. The end result is actually divided into two phases. The first phase is the fresh concrete as delivered in terms of uniformity for placeability and finishability and features such as slump, air-content, and temperature. ASTM C 94/C 94M does provide a slump range (prescriptive) within which the concrete must be, as a consistency re-

quirement, but ASTM C 94/C 94M makes no attempt to describe how to achieve the slump, the air content, or the temperature. The control of placeability and finishability is assisted by the batching accuracy requirements, but there is no hint of describing a method to fulfill these requirements. Thus, phase one of meeting specified numerical requirements is primarily an end-result specification.

Phase two is the hardened concrete requirement for strength. ASTM C 94/C 94M does not prescribe a method of achieving these minimum strengths, thus it is an end-result specification when hardened concrete is considered.

As a whole, ASTM C 94/C 94M is a combined specification with a heavy emphasis on performance (end result) as compared to the prescriptive segments.

Documents Similar to ASTM C 94/C 94M

There are numerous specifications available that address the manufacturing and delivery of ready-mixed concrete. Most of these have been developed by governmental agencies that are typically Federal or State. The general purpose of these specifications is the same as that of ASTM C 94/C 94M with the difference that they are tailored to the specific purpose of the sponsoring agency. This is the reason that such specifications should be viewed with caution by other potential users.

The Forest Service under the umbrella of the U.S. Department of Agriculture has a mini specification within its document, "Specifications for Construction of Roads & Minor Drainage Structures." The title gives a clue regarding the concrete specification when it says "Minor Drainage Structures." The specification primarily deals with material requirements, proportions to attain the proper strength, and the testing of the mixture as delivered. The portion of the specification dealing with manufacture and delivery reads as follows:

"When a commercial supplier is used, the contractor shall furnish a certification with each truckload of concrete certifying that the material and mix proportions used are in conformance with the approved mixture."

This single sentence specification is adequate for a minor drainage structure when the owner and specifier are one and the same.

Some of the U.S. Army Corps of Engineers guide specifications for concrete and concrete batch plants can be quite the opposite of a single-line performance specification. The USACE specifications, if proposed for use on a civilian project, should be studied closely by both purchaser and manufacturer. The specification may be extremely detailed and severe in requirements, causing unnecessary expenses for civilian projects. Such items as monthly scale checks, repeated uniformity tests and measurement of mixing blade wear, varying levels of requirements for automation and recording, and acceptance testing for cementitious materials rather than accepting mill tests are a few of the items to watch. Few civilian projects have the life expectancy of a USACE project and do not require the same degree of caution. A purchaser can unwittingly reference such a specification if not careful, and a manufacturer can agree to conform if not diligent in checking specifications beforehand.

A major specification that is very similar to ASTM C 94/C 94M is the American Association of State Highway and Transportation Officials (AASHTO) M 157 "Standard Specification for Ready-Mixed Concrete." As the association name implies, this organization includes representatives from each state plus some other entities. Like ASTM, the AASHTO specification is a consensus process specification. The ASTM voting membership includes designers, academia, manufacturers, general interest, and users, while AASHTO limits voting interests to designers and users (State DOTs). Each of the 52 state highway agencies are represented and allowed one vote per agency on revisions and requirements of this document. A 2/3 majority is required by AASHTO for passage of any proposal, and every negative vote must be considered and evaluated for merit. The technical differences in C 94/C 94M and M 157 are slight. The first difference noted is that all references to material specifications and test methods are AASHTO documents rather than ASTM designations. The second difference noted also becomes apparent in the Referenced Documents section. ASTM C 94/C 94M references American Concrete Institute Standard CP-1 Technician Workbook for ACI Certification

of Concrete Field Testing Technician—Grade I. This reference is due to the ASTM C 94/C 94M requirement that all testing technicians be certified ACI Concrete Field Testing Technicians, Grade I or equivalent. AASHTO M 157 does not contain such a requirement because each state Department of Transportation (DOT) will have individual requirements. Many states will do all the testing in-house and will address this in other parts of their specification document. This is addressed in AASHTO M 157 by a statement that “Testing shall be conducted by the specifying agency or, with specifying agency approval, by a testing laboratory meeting the requirements of ASTM Recommended Practice E 329.”

There are minor technical differences in such items as chemical limitations for wash water and the minimum concrete temperature in cold weather. A major departure of AASHTO M 157 from ASTM C 94/C 94M is that criteria for acceptance of the concrete based upon strength tests are omitted, as is any mention of steps to be taken to resolve any low-strength tests.

The greatest difference in the two specifications is in the ordering information. ASTM C 94/C 94M has three options providing a wide latitude to the purchaser. AASHTO M 157 does not provide a section on ordering, only a quality of concrete section, which concerns submittals to the engineer by the Contractor or the proportioning prescribed by the engineer and directed to the Contractor. A note at the end of AASHTO M 157 recognizes this difference and suggests: “users other than specifying agencies should consider ASTM C 94.”

State Department of Transportation specifications for the construction of highways and bridges typically take one of two approaches. They will reference AASHTO M 157 as the specification for ready-mixed concrete, or the state DOT will prepare a concrete specification unique to local needs, climatic conditions, and local materials. The provisions of these DOT specifications will vary with each state. The differences can include such items as mandatory computer batching, weighing hoppers fed by overhead bins, scale weight tolerances extremely close, or some very loose regulations based on the knowledge that state DOT inspectors will be at the plant during the batching of concrete for DOT usage.

ASTM C 94/C 94M is the only ready-mixed concrete specification available to private owners, many state and federal agencies, and the design professional community when the technical specifications for a project are prepared. The American Concrete Institute relies on ASTM C 94/C 94M in its document ACI 301 “Specifications for Structural Concrete.” The great majority of substitute specifications available to choose from are written for highway construction, and very few non-DOT projects include highways.

Discussion of New Water Standards for Ready-Mixed Concrete

Environmental aspects facing the concrete industry served as the motivation for a change in ASTM Specification C 94/C 94M during the later portion of 2004. The specific items involved are associated with the use of alternative sources of water, including recycling mixer-truck washout water and on-site storm runoff water as both settled water and as a water slurry including larger quantities of suspended solids. To avoid making significant changes to the Specification for Ready Mixed Concrete, a new specification was created for water to be used in concrete and is referenced by ASTM Specification C 94/C 94M. The new water requirement document is identified as ASTM C 1602/C 1602M (approved 9/2004) *Specification for Mixing Water Used in the Production of Hydraulic-Cement Concrete*.

One of the aspects of the new water specification is a series of definitions categorizing several types of water that could be used in concrete. The four categories of water defined are as follows:

- **potable water**—water suitable for human consumption.
- **non-potable**—water that is not fit for human consumption or that contains quantities of substances that discolor it or make it smell or have objectionable taste but does not contain water from concrete production operations.
- **water from concrete production operations**—water recovered from processes of hydraulic cement concrete production that includes wash water from mixers or that

was a part of a concrete mixture; water collected in a basin as a result of storm water runoff at a concrete production facility; or water that contains quantities of concrete ingredients.

- **combined water**—a mixture of two or more sources of water blended together, before or during introduction into the mixture, for use as mixing water in the production of concrete.

These definitions provide clarity as to what types of water are acceptable for use in concrete production, and the specification provides requirements for proper monitoring and use to protect the producer and purchaser. Non-potable water is intended to cover many sources of water such as recycled water from municipal sources, wells, streams, and other sources that are not potable. Water from concrete production operations includes mixer washout water, process water from washing off drum exteriors, drum loading hoppers, spilled cementitious products, and plant yard storm water runoff. Several items remain unchanged from Chapter 5 of this book, including the properties specified for water being related to total combined water from all sources. Qualification testing is done on concrete mixtures rather than on pastes and mortars. Total combined water was previously called “total mixing water”.

The addition of a second standard, ASTM C 1603/C 1603M (approved 8/2004) *Test Method for Measurement of Solids in Water* has greatly simplified the determination of properties for combination waters. This test method describes an acceptable method of water density (specific gravity) measurement, the measurement of solids content, relationships between density and solids content, and equations for the determination of blending percentages for combined water sources. Each of these relationships is important to the determination of combined water properties.

Testing requirements and frequencies for sources other than potable water are established based on the source and for water from concrete production operations on the density of the combined water. Since it is understood that using water from concrete production operations with significant quantity of solids impacts concrete properties, the testing frequency increases as the density of the combined water proposed for use increases. There are actually five (5) categories of water:

- (1) Potable water
- (2) Non-potable water
- (3) Water from concrete production with a density less than 1.01 g/mL
- (4) Water from concrete production with a density between 1.01 and 1.03 g/mL
- (5) Water from concrete production with a density of 1.03 to 1.05 or greater

Tables 2 and 3 of Chapter 5 are retained in C 1602/C 1602M with respect to requirements with only the test methods and type of water being changed. Table 3 (Table 2 in C 1602/C 1602M) formerly applied only to wash water but now applies to all non-potable mixing water, but the requirements are considered optional in that they have to be invoked by the purchaser. Test methods of Table 2 (Table 1 in C 1602/C 1603M) formerly checked the effects of water, and now the test requirements apply to concrete produced with the water. The consensus of the C09.40 subcommittee was that concrete is the final product and therefore should be what is tested, rather than testing and approving water. These mixtures may be laboratory or full size production batches. The current requirement is for the density of all water from concrete production operations that will be used as mixing water in concrete to be checked at least daily.

Table 2 in C 1602/C 1602M involves only water requirements that are optional for the specifier or owner. It is nevertheless required that if the concrete producer uses non-potable water, the water must be tested for Table 2 compliance at maximum intervals of six months.

With the addition of these new standards, the following revisions were made to ASTM C 94/C 94M-04a (approved 8/2004):

- (1) A statement was added to Section 4—Ordering Information—that the purchaser should include any optional requirements of Table 2 in C 1602/C 1602M.
- (2) Section 5.1.3 on Water was revised to refer to C 1602/C 1602M, and Tables 2 and 3 of C 94/C 94M were removed.
- (3) In Section 13, which covers requirements for the Delivery Tickets, an item was added that the producer should report the source and amount of recycled water used in the specific concrete batch when requested by the purchaser.

Be sure to check the latest version of C 1602 and C 1603 since, as with many new specifications, changes will occur as research provides more information concerning the role of high solids content slurry waters on such items as shrinkage, lower compressive strengths, and increased water demand.

ASTM Terminology System for Standards

Within Section 2, Referenced Documents of ASTM C 94/C 94M, three different types of ASTM documents are listed. These are Specifications, Test Methods, and Practices. There are other types within the ASTM collection of documents prepared to assist the overall needs of an industry. ASTM briefly defines each type of document in its September 2003 manual “Form and Style for ASTM Standards”:

- **standard**, n—as used in ASTM, a document that has been developed and established within the consensus principles of the Society and that meets the approval requirements of ASTM procedures and regulations.

DISCUSSION—The term “standard” serves in ASTM as a nominative adjective in the title of documents, such as test methods, practices, or specifications, to connote specified consensus and approval. The various types of standard documents are based on the needs and usages as prescribed by the technical committees of the Society.

- **specification**, n—an explicit set of requirements to be satisfied by a material, product, system, or service.

DISCUSSION—Examples of specification include, but are not limited to, requirements for: physical, mechanical, or chemical properties and safety, quality, or performance criteria. A specification identifies the test methods for determining whether each of the requirements is satisfied.

- **guide**, n—a compendium of information or series of options that does not recommend a specific course of action.

DISCUSSION—A guide increases the awareness of information and approaches in a given subject area. A guide may have several recommendations on accomplishing the same thing and may require judgment on the part of the user to determine the best course to follow.

- **practice**, n—a definite set of instructions for performing one or more specific operations that does not produce a test result.

DISCUSSION—Examples of practices include, but are not limited to: application, assessment, cleaning, collection, decontamination, inspection, installation, preparation, sampling, screening, and training. For example, making a concrete cylinder, ASTM C 31/C 31M, is considered a practice as it contains specific procedural requirements, but there is no test result from this. The test result comes when the cylinder is broken to determine its strength, and the applicable test method is ASTM C 39/C 39M.

- **test method**, n—a definitive procedure that produces a test result.

DISCUSSION—Test methods most often produce a numerical result. In some cases, a qualitative result, such as a visual rating, will be the test result.

- **terminology standard**, n—a document comprising definitions of terms: explanations of symbols, abbreviations, or acronyms.

Three parts of some ASTM documents need an explanation of how they are used by the Society.

- **Annexes** include mandatory information that is too detailed and lengthy for inclusion in the main body of the document.
- **Appendixes** include non-mandatory supplementary information that is informative but not a part of the main text of the standard.
- **Notes** in the text are advisory and do not include mandatory requirements. Notes are used to include explanatory information, perhaps a caution concerning the potential consequences of an improper procedure, a reason for a specific requirement, or several other purposes that are helpful to the user but non-mandatory.

- **Notes to Tables and Figures** are mandatory and form a part of the table or figure and are not supplementary.

Typical User of ASTM C 94/C 94M

The potential users of ASTM C 94/C 94M, *Specification for Ready-Mixed Concrete*, are virtually endless. It is used as “the reference standard” because of its good coverage of necessary topics for batching, mixing, and delivery of ready-mixed concrete. A broad list of users includes the following:

- ACI specifications such as 301, *Specification for Structural Concrete*; 330, *Specification for Unreinforced Concrete Parking Lots* and a proposed document 305, *Specification for Hot Weather Concreting*
- Architects performing designs for private or institutional owners
- Engineers performing designs for private or institutional owners
- Educational facilities with in-house design professionals
- Municipal governments in-house or outsourced designs
- County governments in-house or outsourced designs
- State government agencies such as Parks & Tourism Departments or the Game & Fish Agency
- Federal government groups such as the Department of Defense or the Federal Aviation Administration
- Contractors doing work not requiring the design services of an architect or engineer
- Private industrial corporations with in-house or outsourced designs
- Ready-mixed concrete producers and testing laboratories, who can be considered users of the specification as they need to ensure that they comply with the requirements for batching and delivery of concrete and testing concrete, respectively

How to Use ASTM C 94/C 94M

The most common usage of ASTM C 94/C 94M is as a reference document within a design professional's specification for cast-in-place concrete. A statement such as “**Unless otherwise specified, use materials, measure, batch, and mix concrete materials and concrete and deliver concrete in approved equipment, all in conformance with ASTM C 94/C 94M**” within the concrete specifications for a project the strength, slump, air content, aggregate size, and other variable factors named in Ordering Information will be provided.

Other methods are suitable if the questions in Ordering Information are answered. A purchase order with a ready-mix manufacturer may simply state “**Produce and deliver concrete as per C 94.**”

An important violation that can cause trouble is using excerpts from ASTM C 94/C 94M or any other specification without a careful reading of the entire document for related segments. Unfortunately there are design professionals following this cut and paste style. It is best to use the complete document by reference.

Definitions to be Used in Discussions

Discussions on what a word or phrase means are inevitable when technical specifications are involved. Unfortunately, different sources may provide differing definitions. A list follows of sources from which to obtain acceptable definitions in decreasing order of preference.

- ASTM C 125 Terminology Relating to Concrete and Concrete Aggregate
- ASTM C 219 Terminology Relating to Hydraulic Cement
- ACI 116R Cement and Concrete Terminology
- ASTM Dictionary of Engineering and Technology, 9th Edition
- Merriam-Webster's Tenth Edition Collegiate Dictionary
- Webster's Third New International Dictionary

Within various technical documents, a small group of words must be very carefully selected due to their precise meanings and connotations. Four such words and their

proper usages follow as extracted from the Form and Style for ASTM Standards manual:

- “Shall” is used to indicate that a provision is mandatory.
- “Should” is used to indicate that a provision is not mandatory but is recommended as good practice.
- “May” is used to indicate that a provision is optional.
- “Will” is used to express futurity, but never to indicate any degree of requirement.

To the extent possible, specifications are written in terse mandatory language that indicates specific items which need to be accomplished. This ensures that the directions to and associated responsibilities of the involved parties are clearly defined. The need for a specification to always be in a mandatory language format will at times produce cumbersome language.

How to Use this Guide

The chapters in this book reflect the sections of C 94/C 94M. Text from C 94/C 94M is reproduced in italic text followed by a discussion of the section. Sentences in the specification are cross-referenced and discussed in the text with identifications S1, S2, etc. Tables, figures, and numerical examples are numbered sequentially by chapter number, except for tables excerpted from C 94, in which cases the actual table number is retained.

Disclaimer

This book represents the interpretation of the authors concerning ASTM C 94/C 94M and does not represent the views of ASTM International or Subcommittee C 09.40.

Introduction

ASTM DESIGNATION: C 94/C 94M-04 STANDARD SPECIFICATION FOR READY-MIXED CONCRETE

THIS IS THE OFFICIAL number and title for the ASTM specification for ready-mixed concrete. Portions of the designation remain constant, and other parts are always subject to change. An analysis of the parts of the alphanumeric identification for the "Specification for Ready-Mixed Concrete" entails four segments:

C 94 includes the group designation C (that comes from the 19 ASTM committees currently grouped under the "C" designation, of which committee C 09 is one of them).

ASTM committee C 09 is responsible for this ready-mixed concrete specification. The permanent number 94 was assigned in numerical sequence from all of the "C" committee standards when first developed.

C 94M means this specification is a combined standard that includes metric (SI) values as well as inch-pound values.

04 indicates the last year (2004) that alterations were made to this specification. ^{e1} superscript (e) following the year designation would indicate that an editorial change has been made later than the substantive changes of 2004.

Footnotes on the title page are self-explanatory.¹

¹ This specification is under the jurisdiction of ASTM Committee C 09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C 09.40 on Ready-Mixed Concrete.

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D. Gene Daniel

D. Gene Daniel holds the degrees of Bachelor of Architectural Engineering from Oklahoma State University and an MSCE from the University of Arkansas. Following a period as an instructor at the University of Arkansas, he entered private practice as a civil engineer in Fort Smith, Arkansas. He also owned and acted as principle engineer for a geotechnical and construction materials testing laboratory. He later became Technical Director and President of a ready-mixed concrete company before becoming Consulting Director of Technical Services for a group of ready-mixed concrete operations.

He is a past president of the American Consulting Engineer's Council of Arkansas and a member of the Arkansas Academy of Civil Engineers. Mr. Daniel has held the title of Fellow in the National Academy of Forensic Engineers and served on the NRMCA Research, Engineering, and Standards Committee. As a longtime member of the American Concrete Institute, he has served on several technical committees and currently is a member of the Technical Specifications Committee. He was elected an ACI Fellow in 1998.

Mr. Daniel, a 42-year member of ASTM International, remains an active member of ASTM Committee C09 on Concrete and Concrete Aggregates and is the current Chair of C09.60, Testing Fresh Concrete, and C09.20.01, C 33 Specification for Concrete Aggregates. He is also a member of C09.40, Ready-Mixed Concrete; C09.61, Testing for Strength; and C09.98, Evaluation of Laboratories.



Colin L. Lobo

Dr. Colin L. Lobo is Vice President of the Engineering Division at the National Ready Mixed Concrete Association in Silver Spring, Maryland. He has been with the NRMCA for 14 years and is an active member of ASTM Committees C09 on Concrete and Concrete Aggregates and C01 on Cement. He is an active member on committees of the American Concrete Institute responsible for the Building Code for Structural Concrete, Specifications for Structural Concrete, and Proportioning and Testing of Concrete. He has published several papers on concrete technology, specifications, and practical use of concrete as a construction material. He has developed and administered educational programs and materials on concrete for the ready-mixed concrete industry and its customers. Dr. Lobo has responsibilities for the education, research, and technical programs at the NRMCA.

Dr. Lobo is a Fellow of the American Concrete Institute. He holds a Ph.D. from Purdue University, an MS from Northeastern University, and a B.E. in Civil Engineering from Mysore University in India. He is a registered Professional Engineer in the state of Maryland.



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