NISTIR 6034

PROPOSED FORMAT FOR DATA ON CEMENTS IN A MATERIAL PROPERTIES DATABASE

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Abstract

The format for data on cement materials that is described in this report is intended to aid in the creation of a coherent system of concrete material property databases. This preliminary document is a guide that presents a recommended format for use in computerization of concrete material property data. It addresses the problem of distinguishing one cement from another by providing a logical scheme for organizing and subdividing material characteristics and parameters to create a unique cement material identifier. The organization and structure presented in this proposed format provide a framework for cross-referencing cement properties, data, and other information and is consistent with the principles laid down in the standard guides that have been prepared by ASTM Committee E-49 and which are due to be adopted by American Concrete Institute (ACI) Committee 126. This preliminary document is intended to assist the work of ACI Committee 126 by providing a draft for use by committee members and others who may offer suggestions for its development. The document has been published on the Internet World Wide Web and will provide additional enhancements to reviews and feedback.

Keywords: Building technology, cement, cement material properties, database, standard formats.

CONTENTS

1. PURPOSE OF THIS REPORT

Use of the Internet has created a new dimension for the use of computerized databases. This is one factor that is driving the need to develop consistent methods and standards that permit interoperability among computerized databases existing on different computing hardware platforms and database management systems. Currently, there is no accepted standard or guide for using and identifying the material properties of cements in computerized databases. This report contains a proposed cement material properties format that will be submitted to the American Concrete Institute (ACI), Committee 126 on "Database Formats for Materials Properties " for consideration and incorporation into the Committee's proposed Guide to the Constituents of Concrete.

In the interest of obtaining the best possible feedback to ensure the guide is practical for use by the concrete industry, this report is being published in written form and has been electronically published on the Internet. The printed report will be distributed to private and standards-setting organizations to review and provide comments on the proposed format. The Internet version of the guide can be viewed by pointing a World Wide Web client program (browser) to the address:

`http://www.ciks.nist.gov/cementfmt.html`

Feedback can be provided to the developers at NIST using an automated feedback form available at the WEB site. Review comments will be considered for incorporation into the document that will be submitted to ACI. It is expected that other technical committees, such as American Standards for Testing and Materials (ASTM) Committee C.1 and ACI Committee 225 on "Hydraulic Cements," will provide feedback to this document. Providing the document in electronic form will enhance the feedback mechanism through an easy to use and compatible format. The WEB site will be available for 90 days after the publication date of this report. Comments after that time should be addressed to the authors.

Example use of the proposed format is expected to include the representation and exchange of cement materials property data for the following areas:

- the communication of cement material product data among cement material manufactures and cement and concrete industry users;
- the integration of cement and concrete material property data with computer-based models, and expert systems where the properties data are a required data format (e.g. production of high-performance concrete for extended durability and service life and lower cost alternatives);
- the creation, exchange, and interpretation of cement material property databases that allow the user to obtain an understanding of the changes in material properties from different manufactures and at different time periods.

Figure 1 shows an example of a cement material property database system that has been implemented at NIST.

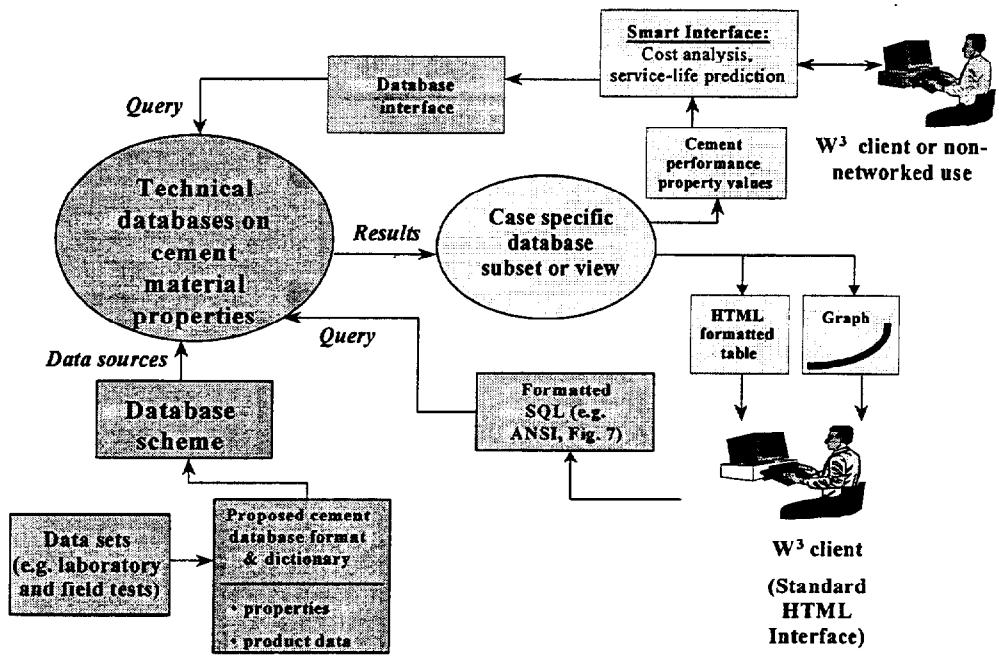

Figure 1: NIST interactive database system model.

2. SCOPE

2.1 Introduction

Databases are essential in organizing data such as test results, whether from the laboratory or field. The first step in forming a database for cement materials is to identify the parameters that are essential for characterizing cement materials and their properties. ACI Committee 126 is creating guides for formatting data on concretes and related materials for use in preparing concrete material property databases. The work of Committee 126 focuses on the first step shown in Figure 2 as the "Data Dictionary Step." This step also includes the identification of parameters that are essential in characterizing materials and their properties. The "Database schema" and "Database implementation" steps shown in Figure 2 are the responsibility of the database developer, for example those who develop content and computerize databases.

This guide for cement materials is the third in a series of related documents being prepared by Committee 126. Other guides in the series are for formatting data for identification

of concrete and its constituents, and of data for aggregates, chemical and mineral admixtures, concrete processing, and concrete properties and performance. Figure 3 shows the components of a concrete material property database and their relationships. The formats are intended for use in the computerization of data in concrete material property databases. The formats are consistent with the principles laid down by ASTM Committee E 49 on "Computerization of Material and Chemical Property Data." The organization of this guide for the identification of cement material was strongly influenced by ASTM E 1309 and ASTM E 1338.

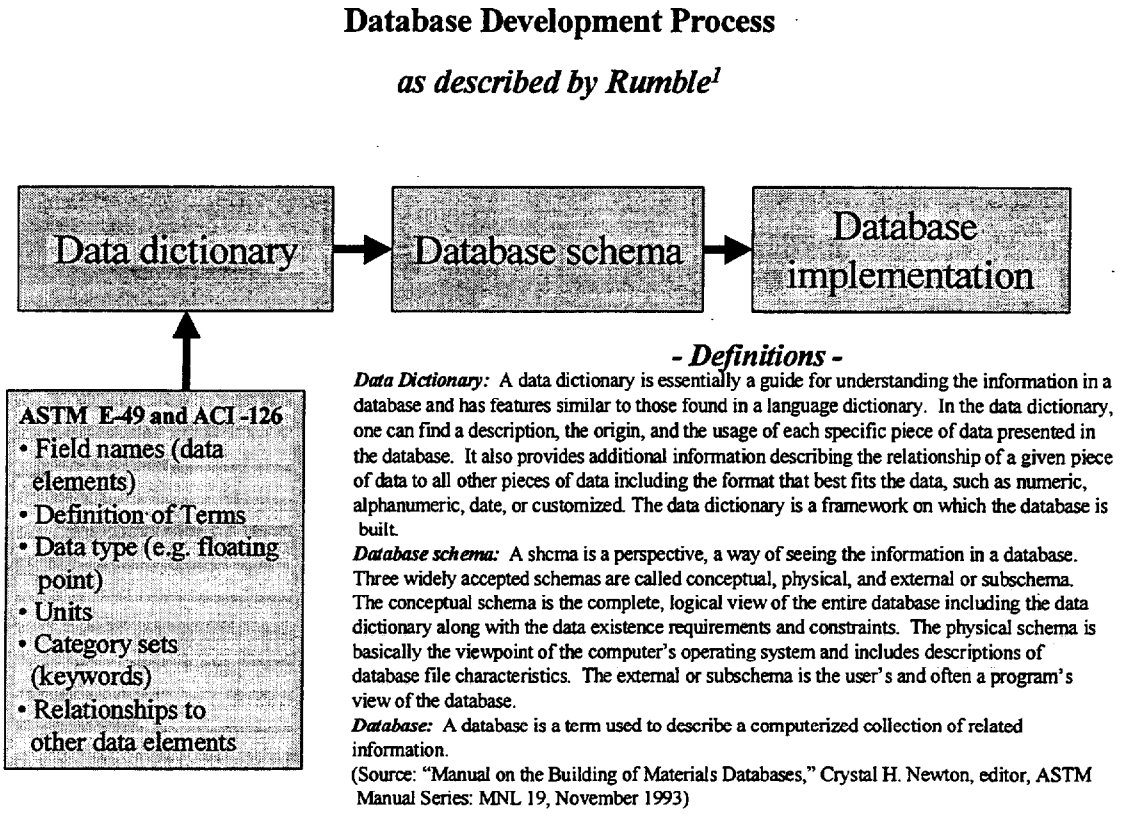

Figure 2: Database development process.

1 "Database Systems in Science and Engineering", J.R. Rumble and F.J. Smith Adam Hilger, New York, NY (1990).

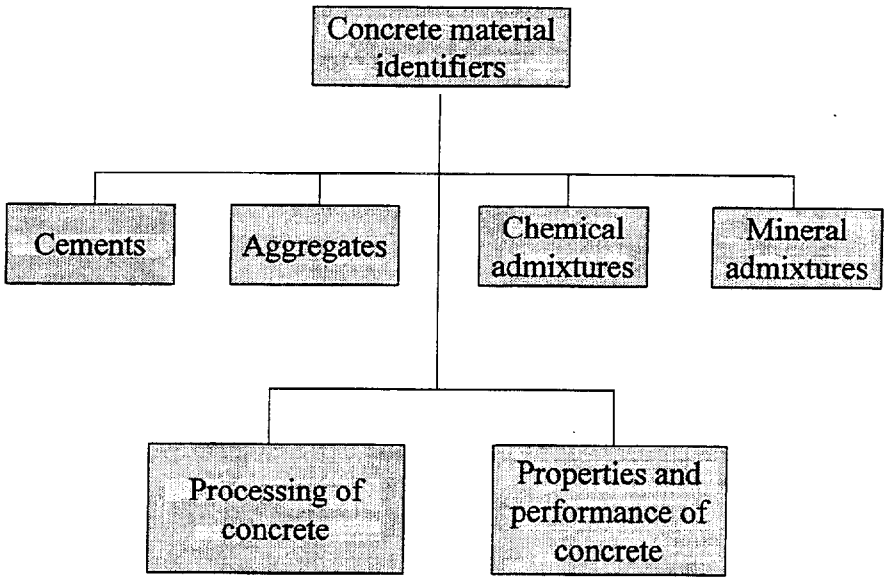

Figure 3: Components of a concrete materials database and their relationships.

2.2 Objective and Use of This Guide

As stated earlier, the objective this guide is to provide a general structure for cement material databases which is consistent with the formats recommended for other concrete materials in the companion documents prepared by ACI 126. This guide is intended to simplify exchange of similarly complete sets of data between different databases. It suggests the subject matter to be included in a cement database. It is not intended to be an all-inclusive list of data to be stored and it is not a database. A database does not have to include all the data elements listed here, and there are no constraints on how data should be displayed in specific databases. The guide includes data elements (fields) needed to uniquely identify cement, to describe its properties, and to report its usage in concrete.

3. TERMINOLOGY

3.1 Terms specific to concrete

Concrete is defined in ACI 116R as a composite material that consists essentially of a binding medium within which are embedded particles or fragments of aggregate. Other concrete related terms used in this guide are defined in documents listed in Chapter 6.

Portland Cement is produced by pulverizing clinker consisting essentially of hydraulic calcium silicates, usually containing one or more of the forms of calcium sulfate as an interground addition.

Hydraulic Cement is defined in ACI 116R as a cement that sets and hardens by chemical interaction with water and is capable of doing so under water.

Blended Cement is defined in ACI 116R as a hydraulic cement consisting essentially of an intimate and uniform blend of granulated blast-furnace slag and hydrated lime; or an intimate and uniform blend of portland cement and granulated blast-furnace slag, portland cement and pozzolan, or portland blast-furnace slag cement and pozzolan, produced by intergrinding portland cement clinker with the other materials or by blending portland cement with the other materials, or a combination of intergrinding and blending.

3.2 Terms used in this guide

Terms used to describe the components of a concrete materials property database are presented in this section. The relationships among the components are shown in Figure 4. A database consists of data files that are, internally, composed of data segments and data elements.

3.2.1 *Concrete materials property database:* a collection of data files in which information about concrete materials properties of concrete materials are organized and stored.

3.2.2 *Data file:* a complete concrete material property database entry or record that contains properties, data, and information for one particular concrete.

3.2.3 *Data segment:* a category of information that is used to subdivide and designate sets of related data elements.

Note: Certain data segments may be used repeatedly to report constituent information and properties of particular concrete.

3.2.4 *Data element*: an individual piece of information used in describing a material or recording test results; for example, a variable name or test parameter.

Note: Each data element in this guide is represented by a data element number, data element name, data element type, and data element format. Certain data elements, which are included in this guide because they are essential for unique material identification of cement, are also functional parts of other ACI Committee 126 guides. Entries for these particular data elements may be scattered throughout the data file.

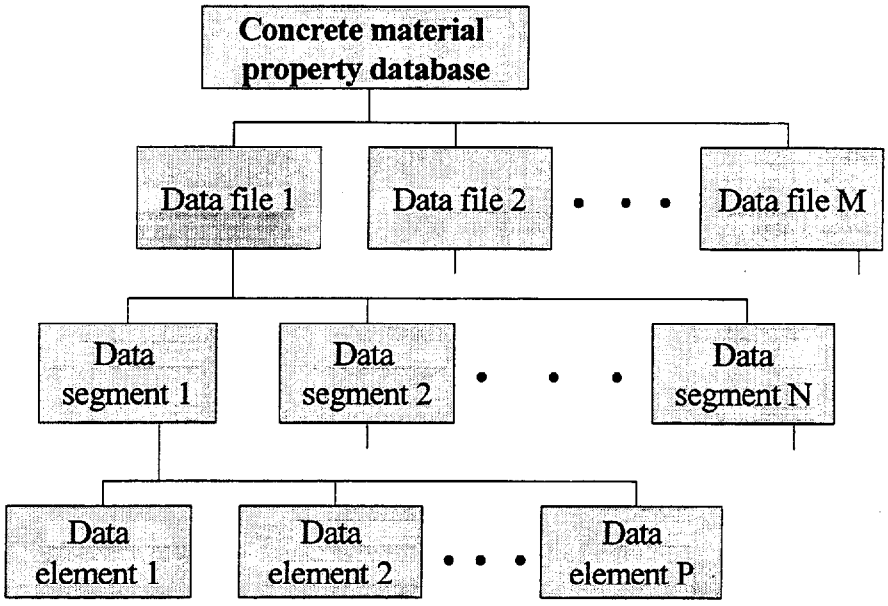

Figure 4: Relationships among components of a concrete materials property database.

3.2.5 *Data element number:* a four or six-digit number used to denote an individual data element.

Note: The number represents the entire set of information in a particular data element. Data element numbers are considered a functional part of the guide and may be used for data element reference. The first digit in the data number provides cross reference to other ACI Committee 126 guides. Data elements with numbers that include an "X" designate data elements from other databases developed in accord with other ACI 126 guides. For example, 5XXX.XX denotes a data element from the Properties and Performance Guide, while 6XXX.XX denotes a data element from the Processing Guide, and X001.XX denotes a data element from one of the cement, aggregate, chemical admixture, mineral admixture, or other constituent guides. The two digits following the decimal point in the last two examples can be used to distinguish between entries in a set having the same four-digit data element number. The ranges of data element numbers assigned are represented in Table 1.

Data element number range	ACI Committee 126 Task Group	Guide Subject
1000-1999	1	Cements
2000-2999	2	Aggregates
3000-3999	3	Chemical admixtures
4000-4999	4	Mineral admixtures
5000-5999	5	Properties and performance
6000-6999	6	Processing
7000-7999	7	Material identifiers
8000-8999	8	Other solid constituents
9000-9999	9	Other liquid constituents

Table 1: Data element number range designations.

3.2.6 *Data element name:* a descriptive term or title that designates the type of information or data to be reported in the data element

3.2.7 *Data element type:* a designation of "essential" or "desirable" that reflects the significance of the data element entry.

Note: Fields are designated "essential" if they are necessary to make a meaningful comparison of property data from different sources. (A comparison of data from different sources may still be possible if essential information is omitted, but the value of the comparison may be greatly reduced).

3.2.8 *Data element format*: the presentation style used to report information or data.

Note: Alphanumeric, floating point, and special entry formats may be specified in this guide for use in reporting information, unit designations, numerical values, and text. Details of the YYYYMMDD (year:month:date) format are presented in Subsection 5.5.2

4. DATA SEGMENTS

4.1 Introduction

Five data segments represent categories of information that are necessary for identification of a cement material and for recording its properties and performance in concrete. They are:

- Cement constituent identification
- Chemical characteristics
- Physical characteristics
- Properties of the cement paste or mortar
- Raw materials

Each data segment is identified and defined in Section 4.2. Table 2 lists all data segments and identifies the data elements associated with each data segment.

TABLE 2 - DATA SEGMENT AND DATA ELEMENTS FOR THE DEFINITION OF CEMENT MATERIALS FOR CONCRETE

CEMENT IDENTIFICATION			
Data element number[a]	Field Name	Field Type[b]	Data Format
1001	Constituent Class	Essential	Alphanumeric String
1002	Constituent Common Name	Essential	Alphanumeric String
1003	Constituent Specification Organization	Desirable	Alphanumeric String
1004	Constituent Specification Number	Desirable	Alphanumeric String
1005	Constituent Specification Version	Desirable	Alphanumeric String
1006	Constituent Specification Designation	Desirable	Alphanumeric String
1007	Constituent Supplier Name	Essential	Alphanumeric String
1008	Constituent Material Plant Location	Essential	Alphanumeric String
1009	Date of Manufacture	Essential	Date
1010	Date of Delivery	Essential	Date
1011	Constituent Notes	Desirable	Alphanumeric String
Chemical Characteristics of Cement a) Elemental Composition			
1100.xx	Oxide No. 1 Content[c] (%)	Desirable	Floating Point
1101.xx	Test Method[c]	Desirable	Alphanumeric String
1102.xx	Calibration Standards[c]	Desirable	Alphanumeric String
b) Phase Composition of Clinker			
1200.xx	Phase Content[c] (%)	Desirable	Floating Point
1201.xx	Test Method[c]	Desirable	Alphanumeric String
1202.xx	Comments[c]	Desirable	Alphanumeric String

Data element number[a]	Field Name	Field Type[b]	Data Format
	c) Other Components		
1251	Loss on Ignition (% by mass)	Desirable	Floating Point
1252	CO^2 Content (% by mass)	Desirable	Floating Point
1253	H_2O Content (% by mass)	Desirable	Floating Point
1254	Insoluble Residue (% by mass)	Desirable	Floating Point
1255	Test Method	Desirable	Alphanumeric String
	Physical Characteristics of Cement a) Surface Area		
1300	Specific Surface Area (m^2/kg)	Desirable	Floating Point
1301	Test Method	Desirable	Alphanumeric String
	b) Particle Size Distribution		
1304.xx	Particle Size[c]	Desirable	Alphanumeric String
1305.xx	Percent in Size Fraction[c]	Desirable	Floating Point
1306	Test Method	Desirable	Alphanumeric String
	c) Color		
1361	Color	Desirable	Alphanumeric String
1362	Test Method	Desirable	Alphanumeric String
	Properties of Cement in Paste or Mortar a) Compressive Strength		
1400	Water/cementitious material	Desirable	Floating Point
1401	Flow	Desirable	Floating Point
1402.xx	Age[c] (days)	Desirable	Floating Point
1403.xx	Compressive Strength[c]	Desirable	Floating Point
1404	Test Method	Desirable	Alphanumeric String
	b) Properties of the Fresh Cement Paste or Mortar		
1440	Normal Consistency (% by mass)	Desirable	Floating Point
1441	Initial Setting Time (minutes)	Desirable	Alphanumeric String
1442	Final Setting Time (minutes)	Desirable	Alphanumeric String
1443	Test Method for Time of Set	Desirable	Alphanumeric String
1444	False Set Percent Final Penetration (%)	Desirable	Floating Point
1445	Test Method	Desirable	Alphanumeric String
1446	Test Temperature (°C)	Desirable	Floating Point
1447	Air Content (% by volume)	Desirable	Floating Point
1448	Test Method for Air Content		Alphanumeric String

Data element number[a]	Field Name	Field Type[b]	Data Format
c) Heat of Hydration			
1450.xx	Time[c] (days)	Desirable	Numeric
1451.xx	Heat[c] (joules/gram)	Desirable	Floating Point
1452	Test Method	Desirable	Alphanumeric
d) Volume Stability			
1500	Soundness (percent change)	Desirable	Alphanumeric String
1501	Soundness Test Method	Desirable	Alphanumeric String
1502	Sulfate Expansion (% at 14 days)	Desirable	Alphanumeric String
1503	Sulfate Expansion Test Method	Desirable	Alphanumeric String
1504	Sulfate Resistance Salt	Desirable	Alphanumeric String
1505	Sulfate Resistance Test Method	Desirable	Alphanumeric String
1506.xx	Sulfate Resistance Expansion[c] (percent)	Desirable	Floating Point
1507.xx	Sulfate Resistance Age[c] (percent days)	Desirable	Floating Point
Manufacturing Process			
1600	Grinding mill	Desirable	Alphanumeric String
1601	Kiln system	Desirable	Alphanumeric String
1602	Comments	Desirable	Alphanumeric String
Raw Materials			
1651.xx	Material[c]	Desirable	Alphanumeric String
1652.xx	Material Source[c]	Desirable	Alphanumeric String
1653.xx	Material Type[c]	Desirable	Alphanumeric String
1654.xx	Addition[c]	Desirable	Alphanumeric String
1655.xx	Addition[c] Source	Desirable	Alphanumeric String
1656.xx	Addition[c] Type	Desirable	Alphanumeric String

[a] Field numbers are for reference only and are not considered a functional part of the standard format.
[b] All data fields are considered desirable. Some data fields are considered essential.
[c] The data fields for this data segment shall be repeated for each oxide or element in the hydraulic cement.

4.2 Data Segment Definitions

4.2.1 *Cement constituent identification*: 11 data elements used to identify a specific cement constituent in the database.

4.2.2 *Chemical characteristics:* 11 data elements used to identify each chemical in the cement.

4.2.2.1 *Elemental composition:* 3 data elements used to identify oxide content in the cement.

4.2.2.2 *Phase composition:* 3 data elements used to identify the mineral content in the cement.

4.2.2.3 *Other components:* 5 data elements used to identify additional chemical components in the cement.

4.3.3 *Physical characteristics:* 7 data elements used to identify the physical properties of the cement.

4.3.3.1 *Surface area:* 2 data elements used to identify the specific surface area.

4.3.3.2 *Particle size distribution:* 3 data elements use to identify the particle size distribution.

4.3.3.3 *Color:* 2 data elements to identify the color of the cement.

4.3.4 *Properties of the cement paste or mortar:* 24 data elements used to identify cement properties in paste or mortar.

4.3.4.1 *Strength:* 5 data elements used to identify the strength measurement test results.

4.3.4.2 P*roperties of the fresh cement paste or mortar:* 9 data elements used to identify the fresh properties of a constituent material.

4.3.4.3 *Heat of hydration:* 3 data elements used of identify the heat of hydration test results.

4.3.4.4 *Volume stability:* 8 data elements used to identify volume stability test results.

4.3.5 *Manufacturing process:* 3 data elements used to identify the manufacturing process information.

4.3.6 *Raw materials:* 6 data elements used to identify cement-making raw material, processing and functional addition(s).

Note: Types of results that could be reported include, but are not limited to, rheological properties, setting time, air content, compressive strength, flexural strength, length change and frost resistance. These results may be obtained from tests performed using concrete, cement paste, or mortar.

5. DATA ELEMENTS

5.1 Introduction

Each data segment is subdivided into sets of data elements that are used to report either essential or desirable information. Each data element is defined in the following section. The use of

SI units is preferred and the reporting of all properties in SI units is always required. Table A consists of an example use of the guide.

5.2 Cement Constituent Identification

5.2.1 *Constituent class (essential):* distinguishes one broad class of concrete constituents from another.
5.2.2 *Constituent common name (essential):* the common name for the class of constituents reported in the previous data element: portland cement is an example of a common name of a cement .
5.2.3 *Constituent specification organization (desirable):* the company, industry, national or international organization that produced the specification, if any, with which the constituent complies; ASTM and ISO are examples of organizations that issue standard specifications for materials.
5.2.4 *Constituent specification number (desirable):* the specification number for the standards organization reported above; numbers such as C150, A820, C260 and C618 are examples of ASTM standard specification numbers for concrete constituents.
5.2.5 *Constituent specification version (desirable):* the version of the standard specification reported in the preceding data element.
5.2.6 *Constituent specification designation (desirable):* the designation, if any, of the product within the standard specification reported above. Type I and Type III are examples of ASTM standard specification designations for portland cements.
5.2.7 *Constituent supplier name (essential):* the name of the company that produced the constituent.
5.2.8 *Constituent material plant location (essential):* the plant location where the constituent was produced.
5.2.9 *Date of manufacture (essential):* the date the constituent material was produced.
5.2.10 *Date of delivery (essential):* the date of constituent material delivery.
5.2.11 *Constituent notes (desirable):* notes and comments about the constituent.

5.3 Chemical Characteristics

5.3.1 Elemental Composition

5.3.1.1 *Oxide content (desirable):* the name of an oxide(s) present in the cement, reported in percent by mass.
5.3.1.2 *Test method (desirable):* the test method used to determine the oxide(s) content.
5.3.1.3 *Calibration standard (desirable):* the calibration standard used in determining oxide content.

5.3.2 Phase Composition of Clinker

5.3.2.1 *Phase content (desirable):* the oxide contents of the portland cement clinker phases, reported in percent.
5.3.2.2 *Test method (desirable):* the test method used to determine the phase content.
5.3.2.3 *Comments (desirable):* notes and comments about the phase composition.

5.3.3 Other Components

5.3.3.1 *Loss on ignition (desirable):* the total loss of mass on ignition representing the moisture and CO_2 in the cement, reported in percent by mass.
5.3.3.2 *CO_2 content (desirable):* the loss of CO_2 on ignition, reported in percent by mass.
5.3.3.3 *H_20 content (desirable):* the loss of moisture (H_20) on ignition, reported in percent by mass.
5.3.3.4 *Insoluble residue (desirable):* the amount of insoluble residue in the cement, reported in percent by mass.
5.3.3.5 *Test method:* the test method used to determine the "other components" in the cement.

5.4 Physical Characteristics

5.4.1 Surface Area

5.4.1.1 *Specific surface area (desirable):* specific surface area of the test sample, reported in m^2/kg
5.4.1.2 *Test method (desirable):* the test method used to measure the specific surface area.

5.4.2 Particle size distribution

5.4.2.1 *Particle size (desirable):* the particle size used to determine the fineness of the cement, reported by the sieve used.
5.4.2.3 *Percent in size fraction (desirable):* the cut-off point of cement passing through the sieve, reported in percent by mass.
5.4.2.2 *Test method (desirable):* the test method used to calculate the particle size distribution.

5.4.3 Color

5.4.3.1 *Color (desirable):* the CIE category as determined using a spectrophotometer.
5.4.3.2 *Test method (desirable):* the test method used to determine color.

5.5 Properties in Cement Paste or Mortar

5.5.1 Strength

5.5.1.1 *Water/cementitious material(desirable):* the mass ratio of water to cement used to determine compressive strength.
5.5.1.2 *Test method (desirable):* the test method used to determine strength.
5.5.1.3 *Flow (desirable):* the resulting increase in average base diameter of the mortar mass resulting from flow measurements.
5.5.1.4 *Age (desirable):* the age of the cement paste or mortar used in determining compressive strength, reported in days
5.5.1.5 *Strength (desirable):* the compressive strength calculated from the recorded maximum load indicated by the testing machine, reported in pounds per square inch or mega-pascals.

5.5.2 Properties of the Fresh Cement Paste or Mortar

5.5.2.1 *Normal consistency (desirable):* the water content used to prepare the cement paste, reported in percent by mass.

5.5.2.2 *Initial setting time (desirable):* the initial setting time as determined by a needle penetration of 25mm, reported in minutes.

5.5.2.3 *Final setting time (desirable):* the final setting determined by non-penetration of the needle, reported in minutes.

5.5.2.4 *Setting time test method (desirable):* the test method used to determine the set time.

5.5.2.5 *False set percent of final penetration (desirable):* the penetration depth occurring before final setting time, reported in percent.

5.5.2.6 *False set test method (desirable):* the test method used in determining the false set percent.

5.5.2.7 *Test temperature (desirable):* the temperature of the specimen measured at the time of the false set final penetration result.

5.5.2.8 *Air content percent (desirable):* the air content calculated from the measured density of the cement mortar, reported in percent by volume.

5.5.2.9 Air content t*est method (desirable):* test method used to determine the air content.

5.5.3 Heat of Hydration

5.5.3.1 *Time (desirable):* the age of the partially hydrated cement, reported in days.

5.5.3.2 *Heat (desirable):* the heat of hydration calculated by measuring the heat of solution of dry cement and a separate portion of partially hydrated cement, reported in joules/gram.

5.5.3.3 *Test method (desirable):* the test method used to calculate heat of hydration.

5.5.4 Volume Stability

5.5.4.1 *Soundness (desirable):* the determination of soundness as measured by the change in length resulting from autoclave expansion test, reported in percent change in length.

5.5.4.2 *Soundness test method (desirable):* the test method used to determine soundness.

5.5.4.3 *Sulfate expansion (desirable):* the measured difference in length of a cement and gypsum mortar bar as determined after 14 days, reported in percent change.

5.5.4.4 *Sulfate expansion test method (desirable):* the test method used to determine the sulfate expansion.

5.5.4.5 *Sulfate resistance (desirable):* identifies the quantity of gypsum used to produce the mortar bar.

5.5.4.6 *Sulfate resistance test method (desirable):* the test method used to determine the sulfate resistance.

5.5.4.7 *Sulfate resistance expansion (desirable):* the measured difference in length of cement mortar bar, reported in percent change.

5.5.4.8 *Sulfate resistance age (desirable):* the age of the mortar bar at the time of the sulfate expansion test.

5.5.5 Manufacturing Process

5.5.5.1 *Grinding mill (desirable):* the type and manufacturer of the grinding mill used to produce the cement.
5.5.5.2 *Kiln system (desirable):* the type of kiln system used to produce the cement clinker.
5.5.5.3 *Comments (desirable):* notes and comments about the cement manufacturing process.

5.6 Raw Materials

5.6.1 *Material (desirable):* the identification of a raw material used in the production of the cement.
5.6.2 *Material source (desirable):* the source of the raw material.
5.6.3 *Material type (desirable):* the type of a raw material used in the production of the cement. Sulfate is an example of a raw material.
5.6.4 *Addition (desirable):* a material used to facilitate the production or to provide functional performance for the cement.
5.6.5 *Addition source (desirable):* the source of the addition added during the manufacture of the cement.
5.6.6 *Addition type (desirable):* the type of addition added during the manufacture of the cement.

6. DOCUMENTS CITED IN THIS GUIDE

6.1 American Concrete Institute documents

116	Cement and Concrete Terminology
126	Guide to a Recommended Format for the Identification of Concrete in a Materials Property Database (to be published)

6.2 American Society for Testing and Materials documents

C 109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
C 114	Standard Test Method for Chemical Analysis of Hydraulic Cement
C 125	Standard Terminology Relating to Concrete and Concrete Aggregates
C 150	Standard Specification for Portland Cement
C 185	Standard Test Method for Air Content of Hydraulic Cement Mortar
C 186	Standard Test Method for Heat of Hydration of Hydraulic Cement
C 191	Standard Test Method for Time of Setting of Hydraulic Cement by Vicat Needle
C 430	Standard Test for Fineness of Hydraulic Cement using 45-μm Sieve
C 452	Standard Test Method for Potential Expansion of Portland Cement Mortars Exposed to Sulfate
C 494	Specification for Chemical Admixtures for Concrete
C 1012	Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution
E 1309	Standard Guide for the Identification of Composite Materials in Computerized Material Property Databases

E 1338	Standard Guide for the Identification of Metals and Alloys in Computerized Material Property Databases
E 1443	Standard Terminology Relating to Building and Accessing Material and Chemical Databases

7. APPENDIX A: EXAMPLE USE OF THE FORMAT

IDENTIFICATION OF A HYDRAULIC CEMENT USING THE PROPOSED FORMAT		
Cement Identification		
Number	**Name**	**Example Entry**
1001	Constituent class	Cement
1002	Constituent common name	Portland cement
1003	Constituent specification organization	ASTM
1004	Constituent specification number	C150
1005	Constituent specification version	95a
1006	Constituent specification designation	Type I/III
Chemical Characteristics of Cement a) Elemental Composition		
1100.01	Silicon dioxide	21.46
1101.01	Test method	ASTM C114-94
1102.01	Calibration standard	NIST cement SRM
1100.02	Aluminum oxide	4.38
1101.02	Test method	ASTM C114-94
1102.02	Calibration standard	NIST cement SRM
1100.03	Ferric oxide	2.87
1101.03	Test method	ASTM C114-94
1102.03	Calibration standard	NIST cement SRM
1100.04	Calcium oxide	63.33
1101.04	Test method	ASTM C114-94
1102.04	Calibration standard	NIST cement SRM
1100.05	Free lime	0.42
1101.05	Test method	ASTM C114-94
1102.05	Calibration standard	NIST cement SRM
1100.06	Magnesium oxide	2.60
1101.06	Test method	ASTM C114-94
1102.06	Calibration standard	NIST cement SRM
1100.07	Sulfur trioxide	2.76
1101.07	Test method	ASTM C114-94
1102.07	Calibration standard	NIST cement SRM
1100.08	Sodium oxide	0.18
1101.08	Test method	ASTM C114-94
1102.08	Calibration standard	NIST cement SRM
1100.09	Potassium oxide	0.70
1101.09	Test method	ASTM C114-94
1102.09	Calibration standard	NIST cement SRM
c) Other Components		
1251	Loss on ignition	1.42
1252	CO_2 content	0.0
1253	H_2O content	0.0
1254	Insoluble residue	0.36
1255	Test method	ASTM C114-94

TABLE A (cont.): IDENTIFICATION OF A HYDRAULIC CEMENT USING THE GUIDE (EXAMPLE)		
Physical Characteristics		
a) Surface Area		
Number	Name	Example Entry
1300.01	Specific surface area	3759 cm^2/g
1301.01	Test method	ASTM C204-96
1300.02	Specific surface area	2035 $cm^2.g$
1301.02	Test method	ASTM C115-96
b) Particle Size Distribution		
1304	Size fraction	Passing 45 μm sieve
1305	Percent in size fraction	91.43
1306	Test method	ASTM C430-95
Properties of the Fresh Cement in Paste or Mortar		
a) Compressive Strength		
1400	Water/cementitious material	0.485
1401	Flow	117
1402.01	Age	3
1403.01	Strength	3509
1402.02	Age	7
1403.02	Strength	4333
1402.03	Age	28
1403.03	Strength	5634
1404	Test method	ASTM C109-95
b) Fresh Properties		
1440	Normal consistency water	25.0
1441	Initial setting time	165
1442	Final setting time	274
1443	Test method for time of set	ASTM C191-92
1444	False set percent of final penetration	68
1447	Air Content	9.4
1448	Test method for air content	ASTM C185-95
c) Heat of Hydration		
1450.01	Time	7
1451.01	Heat	80.0
1450.02	Time	28
1451.02	Heat	87.8
1452	Test method	ASTM C186-95
d) Volume Stability		
1500	Soundness	-0.05
1501	Soundness test method	ASTM C151-93a