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Standard Practice for
Digital Imaging and Communication in Nondestructive Evaluation (DICONDE)[1]

This standard is issued under the fixed designation E2339; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice facilitates the interoperability of NDE imaging and data acquisition equipment by specifying the image data in commonly accepted terms. This practice represents a harmonization of NDE imaging systems, or modalities, with the NEMA Standards Publication titled Digital Imaging and Communications in Medicine (DICOM, see http://medical.nema.org), an international standard for image data acquisition, review, storage and archival. In addition, this practice will provide a standard set of industrial NDE specific information object definitions, which travel beyond the scope of standard DICOM modalities. The goal of this practice is to provide a standard by which NDE image/signal data may be displayed on by any system conforming to the ASTM DICONDE format, regardless of which NDE modality was used to acquire the data.

1.2 This practice has been developed to overcome the issues that arise when archiving or analyzing the data from a variety of NDE techniques, each using proprietary data acquisition systems. As data acquisition modalities evolve, data acquired in the past must remain decipherable. This practice proposes an image data file format in such a way that all the technique parameters, along with the image file, are preserved, regardless of changes in NDE technology. This practice will also permit the viewing of a variety of image types (CT, CR, Ultrasonic, Infrared and Eddy Current) on a single workstation, maintaining all of the pertinent technique parameters along with the image file. This practice addresses the exchange of digital information between NDE imaging equipment.

1.3 This practice does not specify:

1.3.1 A testing or validation procedure to assess an implementation's conformance to the standard.

1.3.2 The implementation details of any features of the standard on a device claiming conformance.

1.3.3 The overall set of features and functions to be expected from a system implemented by integrating a group of devices each claiming DICONDE or DICOM conformance.

1.4 Although this practice contains no values that require units, it does describe methods to store and communicate data that do require units to be properly interpreted. The SI units required by this practice are to be regarded as standard. No other units of measurement are included in this standard.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E1316 Terminology for Nondestructive Examinations

2.2 *Other Documentation:*[3]

NEMA Standards Publication PS3.1, Version 3: Digital Imaging and Communications in Medicine (DICOM)

ACR-NEMA 300–1998 Digital Imaging and Communication in Medicine

3. Terminology

3.1 *Definitions:*

3.1.1 Nondestructive evaluation terms used in this practice can be found in Terminology E1316.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *AE*—application entity

3.2.2 *attribute*—a property of an information object. An attribute has a name and a value, which are independent of any encoding scheme.
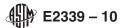
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[1] This practice is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.11 on Digital Imaging and Communication in Nondestructive Evaluation (DICONDE).

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from National Electrical Manufacturers Association (NEMA), 1300 N. 17th St., Suite 1752, Rosslyn, VA 22209, http://www.nema.org.

3.2.3 *attribute tag* —a unique identifier for an *attribute* of an *information object* composed of an ordered pair (gggg, eeee) where gggg represents the group number and eeee represents the data element.

3.2.4 *conformance statement*—a formal statement associated with a specific implementation of the standard, specifying the service class, information objects, and communications protocols supported by the implementations.

3.2.5 *data dictionary*—a registry of data elements, which assigns a unique tag, a name, value characteristics, and semantics to each data element.

3.2.6 *data element*—a unit of information as defined by a single entry in the *data dictionary*. An encoded IOD attribute that is composed of, at a minimum, three fields: a *data element tag*, a *value length*, and a *value field*.

3.2.7 *data element tag*—a unique identifier for a *data element* composed of an ordered pair of numbers (a *group number* followed by an *element number*).

3.2.8 *data element type (type)*—used to specify whether an *attribute* ~~of an IOD is mandatory, mandatory only under certain conditions, or optional.~~ of an IOD is required and must have a non-zero value (Type 1), required but may have a zero value (Type 2), required only under certain conditions (Type 1C and 2C), or optional (Type 3). See Part 5, Section 7.4 of the DICOM standard for additional details.

3.2.9 *element number*—the second number in the ordered pair of numbers that make up a *data element tag*.

3.2.10 *group number*—the first number in the ordered pair of numbers that makes up a *data element tag*.

3.2.11 *information object definition (IOD)*—a data abstraction of a class of similar *real-world objects* which defines the nature and *attributes* relevant to the class of *real-world object* represented.

3.2.12 *module*—a set of *attributes* with an *Information Object Definition*.

3.2.13 *private data element*—additional *data element*, defined by an implementer, to communicate information that is not contained in standard *data elements*. Private *data elements* have odd *group numbers*.

3.2.14 *usage*—used to specify whether an information module is Mandatory (M), Conditional (C), or User Option (U). See Part 3, Section A.1.3 of the DICOM standard for additional details.

3.2.15 *value*—a component of a *value field*. A *value field* may consist of one or more of these components.
~~3.2.15~~

3.2.16 *value field*—the field within a *data element* that contains the *value* (s) of that *data element*.
~~3.2.16~~

3.2.17 *value length*—the field within a *data element* that contains the length of the *value field* of the *data element*.
~~3.2.17~~

3.2.18 *value multiplicity (VM)*—specifies the number of *values* contained in the *value field* of a *data element*.
~~3.2.18~~

3.2.19 *value representation (VR)*—specifies the data type and format of the *value* (s) contained in the *value field* of a *data element*. A complete list of all the VR's can be found in 6.2 of Part 5 of the DICOM standard.
~~3.2.19~~

3.2.20 *DICONDE version identifier*—unique string placed in the DICONDE object to identify the version of DICONDE used to create the object.

4. Summary of Practice

4.1 The basic concept of using DICONDE (or DICOM) is the usage of standardized data tag identifiers. This means all participants are using database entries representing the same information and have a common understanding of communication protocols for mutual use. For standardization of data transfer, the conformance statement, a mutually agreed upon document provides the specific database tag identifiers for every part of the NDE data stream as well as the communications protocols.

4.1.1 DICOM was developed in liaison with ACR (the American College of Radiology) and NEMA (the National Electrical Manufacturers Association) and other Standard Organizations including CEN TC251 in Europe and JIRA in Japan, with review also by other organizations including IEEE, HL7 and ANSI in the USA. The DICOM Standard is structured as a multi-part document.

4.2 ~~This practice will contain terms and definitions that apply to all NDE modalities. DICONDE terms and definitions that apply to a specific NDE modality will be contained in a separate standard practice for that modality. This standard practice is meant to be used in conjunction with the modality specific standard practices.~~

4.2 This practice will contain terms and definitions that apply to all NDT methods. DICONDE terms and definitions that apply to a specific NDT method will be contained in a separate standard practice for that method as illustrated in Fig. 1. This practice is intended to be used in conjunction with the method-specific standard practices. If no method-specific practice exists, the user should default back to the DICOM terms and definitions for the modality associated with that test method.

4.3 The DICONDE practices will consist of descriptions of the attribute and object definitions that are specific to NDE (that is, no equivalent counterpart in medicine) and provide standard database tag identifiers for use with the DICOM database already in existence. The use of this practice is based upon and to be used in conjunction with the medical DICOM standard. This practice, in conjunction with the DICOM standard, will set forth the requirements for the transfer and display of NDE image data from any NDE image modalities equipment.

4.3.1 DICONDE, utilizing the existing DICOM database of object definitions, provides both replacement and additional module