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

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1. Scope

1.1 This practice facilitates the interoperability of NDE imaging and data acquisition equipment by specifying the image data file format 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:*

E 1316 Terminology for Nondestructive Examinations

2.2 *Other Documentation:*

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 E 1316.

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.

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.

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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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*—used to specify whether an *attribute* of an IOD is mandatory, mandatory only under certain conditions, or optional.

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

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

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

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

3.2.18 *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 *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.

4.2 The DICONDE practice will consist of descriptions of the 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.

4.1.1 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.

4.3 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 definitions that represent a conversion between the medical community language present in DICOM, to the terminology appropriate for NDE. For the DICONDE practices, only the attributes and object definitions that differ from the medical implementation will be discussed. In the case where no replacement attribute or object exists, the DICOM standard should be followed.

4.4 The key to interoperability using the DICOM standard is the conformance statement. This formal statement is associated with a specific implementation of the DICOM standard. It specifies the service classes, information objects, communication protocols, and media storage application profiles supported by the implementation. Complete information on DICOM conformance statements, including several examples, can be found in Part 2 of the DICOM standard.

4.4.1 Specific implementations of the DICONDE standard should also provide conformance statements. The majority of the conformance statement for DICONDE will be similar to DICOM. The exception being that the information objects listed in the