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Standard Guide for Data Fields for Computerized Transfer of Digital Radiological Examination Data[1]

This standard is issued under the fixed designation E1475; 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 guide provides a listing and description of the fields that are recommended for inclusion in a digital radiological examination data base to facilitate the transfer of such data. This guide sets guidelines for the format of data fields for computerized transfer of digital image files obtained from radiographic, radioscopic, computed radiographic, or other radiological examination systems. The field listing includes those fields regarded as necessary for inclusion in the data base: (*1*) regardless of the radiological examination method (as indicated by Footnote C in Table 1), (*2*) for radioscopic examination (as indicated by Footnote F in Table 1), and (*3*) for radiographic examination (as indicated by Footnote D in Table 1). In addition, other optional fields are listed as a reminder of the types of information that may be useful for additional understanding of the data or applicable to a limited number of applications.

1.2 It is recognized that organizations may have in place an internal format for the storage and retrieval of radiological examination data. This guide should not impede the use of such formats since it is probable that the necessary fields are already included in such internal data bases, or that the few additions can easily be made. The numerical listing and its order indicated in this guide is only for convenience; the specific numbers and their order carry no inherent significance and are not part of the data file.

1.3 Current users of Guide E1475 do not have to change their software. First time users should use the XML structure of Table A1.1 for their data.

1.4 The types of radiological examination systems that appear useful in relation to this guide include radioscopic systems as described in Guide E1000, Practices E1255, E1411, E2597, E2698 and E2737, and radiographic systems as described in Guide E94 and Practices E748, E1742, E2033, E2445, and E2446. Many of the terms used are defined in Terminology E1316.

1.5 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E94 Guide for Radiographic Examination Using Industrial Radiographic Film
E748 Guide for Thermal Neutron Radiography of Materials
E1000 Guide for Radioscopy
E1255 Practice for Radioscopy
E1316 Terminology for Nondestructive Examinations
E1411 Practice for Qualification of Radioscopic Systems
E1742 Practice for Radiographic Examination
E2033 Practice for Radiographic Examination Using Computed Radiography (Photostimulable Luminescence Method)
E2445 Practice for Performance Evaluation and Long-Term Stability of Computed Radiography Systems
E2446 Practice for Manufacturing Characterization of Computed Radiography Systems
E2597 Practice for Manufacturing Characterization of Digital Detector Arrays

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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.

TABLE 1 Field Listing

Field Number[A]	Field Name and Description	Category Sets, Values and Units[B]
Header Information:		
1[C,D]	Intermediate file name	Alphanumeric string
2[C,D]	Format revision code	Alphanumeric string
3[C,D]	Format revision date	yyyy/mm/dd
4[C,D]	Source file name	Alphanumeric string
5	Examination file description notes	Alphanumeric string
6[C,D]	Examining company/location	Alphanumeric string
7[C,D]	Examination date	yyyy/mm/dd
8	Examination time	hh/mm/ss
9[C,D]	Type of examination	Alphanumeric string
10	Other examinations performed	Alphanumeric string
11[C,D]	Operator name	Alphanumeric string
12[C,D]	Operator identification code	Alphanumeric string
13[C,D]	ASTM, ISO or other applicable standard specification	Alphanumeric string
14	Date of applicable standard	yyyy/mm/dd
15[C,D]	Acceptance criteria	Alphanumeric string
16	Notes	Alphanumeric string
Examination System Description:		
17	Examination system manufacturer(s)	Alphanumeric string
18	Examination system model	Alphanumeric string
19	Examination system serial number	Alphanumeric string
Source Section:		
20[C,D]	Radiologic source manufacturer	Alphanumeric string
21[C,D]	Radiological source model	Alphanumeric string
22	General source description	Alphanumeric string
23	Last calibration date	Alphanumeric string
24	Notes on source section	Alphanumeric string
Image Receptor Section:		
25[C,D]	Receptor type	Alphanumeric string
26[C,D]	Convertor type	Alphanumeric string
27	Receptor manufacturer	Alphanumeric string
28	Receptor model number	Alphanumeric string
29[C,D]	Notes on receptor section	Alphanumeric string
Exposure Section:		
30[C,D]	Peak radiation energy used, or	kV
31[C,D]	Isotope source (use either 30 or 31)	Alphanumeric string
32	Tube current	mA
33	Radiation dosage rate	mR/min
34	Radiation exposure time	min
35[C]	Source-detector distance (SDD)	m
36[C]	Source-object distance (SOD)	m
37[C]	Image magnification of source side of examination object	%
38[D]	Notes on exposure section	Alphanumeric string
Processing Section (Film/Paper):		
39[D]	Process description	Automated or manual
40[D]	Process method	Wet or dry
41	Processor type	Alphanumeric string
42	Processor model number	Alphanumeric string
43	Notes on processor section	Alphanumeric string
Image Processing Description:		
44[C,D]	Image processing used for image data	Alphanumeric string
45	Image processor hardware manufacturer	Alphanumeric string
46	Image processor hardware model	Alphanumeric string
47	Image processor software source	Alphanumeric string
48	Image processor software version	Alphanumeric string
49[D]	Pixel resolution	Pixels per cm
50	Notes on image processor	Alphanumeric string
Examination Sample or Part Description:		
51[C]	Sample or part name	Alphanumeric string
52	Sample or part name description	Alphanumeric string
53[C]	Sample or part identification code	Alphanumeric string
54[C]	Sample or part material	Alphanumeric string
55	Notes on sample or part	Alphanumeric string
56[C]	Number of image segments for sample	Integer number
57[C]	Reference standard identification	Alphanumeric string
58	Reference standard description	Alphanumeric string
59[C]	Reference standard file name	Alphanumeric string
60	Reference standard file location	Alphanumeric string
Coordinate System and Scan Description:		
61[F]	Machine coordinate system scan axis	Alphanumeric string
62[F]	Machine coordinate system index axis	Alphanumeric string
63[F]	Machine coordinate system *z*-axis	Alphanumeric string
64[F]	Part coordinate system *x*-axis	Alphanumeric string
65[F]	Part coordinate system *y*-axis	Alphanumeric string
66[F]	Part coordinate system *z*-axis	Alphanumeric string

TABLE 1 *Continued*

Field Number[A]	Field Name and Description	Category Sets, Values and Units[B]
67	Number of object target points	Integer number
68	Object target point number	Integer number
69	Object target point description	Alphanumeric string
70	Object target point *x*-axis	Alphanumeric string
71	Object target point *y*-axis	Alphanumeric string
72	Object target point *z*-axis	Alphanumeric string
73	Description of data plane projection	Alphanumeric string
74	Notes on coordinate system	Alphanumeric string
Measurement Parameters:		
75[C]	Minimum value of data	Integer
76[C]	Maximum value of data	Integer
77[C]	Dynamic range resolution	Number of bits
78[C,D]	Data scale	Linear, logarithmic, define scale
79[D]	Relationship between film optical density and digital value	Alphanumeric string
80[C,D]	Dynamic range implemented	Real number
81[C]	Physical spacing of the digitization interval at the image receptor	Real number in [µm]
82[C]	Data recording format	Alphanumeric string
Examination Results:		
83	Discontinuity location	Alphanumeric string
84	Discontinuity description	Alphanumeric string
85	Disposition	Accept, reject or repair
86	Notes on examination results	Alphanumeric string
87	Image segment number	Integer number
88	Image segment description	Alphanumeric string
89	Image segment location	Alphanumeric string
90	Image segment orientation	Alphanumeric string
91	Annotation	Alphanumeric string
92	Notes on the data (including notes on compression)	Alphanumeric string
93	Total number of data points	Integer number
94	Actual stream of radiologic data	Real number
Display Settings:		
95[C]	Type of Display	Alphanumeric string
96[E]	Number of display gray values	Integer number
97[C]	Manufacturer of Display	Alphanumeric string
98[C]	Display model number	Alphanumeric string
99[E]	Display mode	Negative (Film like) or Positive (real)
100[E]	Gray value of original image for BLACK on display	Integer number
101[E]	Gray value of original image for WHITE on display	Integer number
102[E]	Factor of gamma for scaling on display	Real number
103	Notes on display section	Alphanumeric string

[A] Field numbers are for reference only. They do not imply a necessity to include all these fields in any specific data base nor imply a requirement that fields used be in this particular order.
[B] Units listed first are SI; those in parentheses are inch-pound (English).
[C] Denotes essential field for computerization of examination results, regardless of examination method.
[D] Denotes essential field for radiographic examination.
[E] Denotes essential field for images with more than 8-bit gray scale.
[F] Denotes essential field for radioscopic examination.

E2698 Practice for Radiographic Examination Using Digital Detector Arrays
E2737 Practice for Digital Detector Array Performance Evaluation and Long-Term Stability

2.2 *Other Standards:*

ISO 12639:2004 Graphic Technology – Prepress digital data exchange – Tag Image File Format for Image Technology (TIFF/IT)
ISO 8879:1986 Information Processing – Text and Office Systems – Standard Generalized Markup Language (SGML)

2.3 *Other Documents:*

Webpage for XML (Extensible Markup Language): World Wide Web Consortium (W3C) http://www.w3.org/XML/

3. Significance and Use

3.1 The primary use of this guide is to provide a standardized approach for the data file to be used for the transfer of digital radiological data from one user to another where the two users are working with dissimilar systems. This guide describes the contents, both required and optional for an intermediate data file that can be created from the native format of the radiological system on which the data was collected and that can be converted into the native format of the receiving radiological data analysis system. This guide will also be useful in the archival storage and retrieval of radiological data as either a data format specifier or as a guide to the data elements which should be included in the archival file.

3.2 Although the recommended field listing includes more than 100 field numbers, only about half of those are regarded as essential and are marked Footnote C in Table 1. Fields so marked must be included in the data base. The other fields recommended provide additional information that a user will find helpful in understanding the radiological image and examination result. These header field items will, in most cases, make up only a very small part of a radiological examination file. The actual stream of radiological data that

make up the image will take up the largest part of the data base. Since a radiological image file will normally be large, the concept of data compression will be considered in many cases. Compressed data should be noted, along with a description of the compression method, as indicated in Field No. 92 (see Table 1).

3.3 This guide provides a data file for a single image. It is recognized that a complete examination record may contain several files for the same examination method in different areas, with or without image processing, for different examination methods, and for variations within a single method (for example, different X-ray energies). This file will permit the examination of a single image and will include information about the existence of other images and records for the examined object. This single image may be one created by overlaying or processing results from multiple examination approaches, for example, data fusion. For such images, the notes sections must clearly state how the image for this file was created.

3.4 The Guide E1475 data fields are assigned at the TIFF group with Tag 50983, called *Data fields of Guide E1475* using XML as format for the data fields. The tag may be used by any user without restrictions. The Extensible Markup Language (XML) is a simple, very flexible text format derived from SGML (ISO 8879). It is used to store all required information of Guide E1475 within one TIFF Tag. Annex A1 provides more information and an example.

4. Description of the Field Listings

4.1 Table 1 is a recommended field format for the computerized storage, retrieval and transfer of radiological image examination data. There are three columns of information, as indicated in 4.1.1 – 4.1.3:

4.1.1 *Field Number*—A reference number for ease of dealing with the individual fields within this guide. It has no permanent value and does not become part of the data base itself.

4.1.2 *Field Name and Description*—The complete name of the field, descriptive of the element of information that would be included in this field of the data base.

4.1.3 *Category Sets, Values or Units*—A listing of the types of information which would be included in the field or the units in which the numbers are expressed. Category sets are closed (that is, complete) sets containing all possible (or acceptable) inputs to the field. Values are representative sets, listing sample (but not necessarily all acceptable) inputs to the field.

4.2 The information for reporting radiological examination results is divided into twelve segments, as follows:

4.2.1 Header information,
4.2.2 Examination system description,
4.2.3 Source description,
4.2.4 Image receptor,
4.2.5 Exposure,
4.2.6 Processing,
4.2.7 Image processing description,
4.2.8 Examination sample or part description,
4.2.9 Coordinate system and scan description,
4.2.10 Measurement parameters,
4.2.11 Examination results, and
4.2.12 Display Settings.

4.3 Additional explanations for selected fields are given in Section 5.

5. Explanation of Fields

5.1 *Field Number, Name, and Description:*

5.1.1 *Field No. 1: Intermediate File Name*—Name of the data base file containing all of the information to follow. This is the archive or transfer file itself.

5.1.2 *Field No. 6: Examining Company/Location*—The legal name/location of the company which performed the radiologic examination.

5.1.3 *Field No. 9: Type of Examination*—Radiographic, radioscopic, CR, DDA, other; x-ray, gamma ray, neutron, other.

5.1.4 *Field No. 10: Other Examinations Performed*—Other NDT examinations, ultrasonic, liquid penetrant, etc.

5.1.5 *Field No. 17: System Manufacturer.*

5.1.6 *Field No. 18: System Model*—Repeat for each system.

5.1.7 *Field No. 19: Serial Number*—Repeat for each system.

5.1.8 *Field No. 25: Receptor Type*—Film/screens, image intensifier, etc.

5.1.9 *Field No. 26: Convertor Type*—Lead screen, gadolinium oxysulfide screen cesium iodide scintillator, etc.

5.1.10 *Field No. 29: Notes on Receptor Section*—Specific film type or other receptor.

5.1.11 *Field No. 38: Notes on Exposure*—Additional useful information (for example, filtration, double-wall technique, 128 frame integration, etc.).

5.1.12 *Field No. 43: Notes on Processor*—Additional useful information (for example, cycle, time/temperature data, etc.).

5.1.13 *Field No. 44: Imaging Processing Used*—Frame integration (No.), edge enhancement, histogram equalization, subtraction, etc.

5.1.14 *Field No. 50: Notes on Image Processor*—Additional useful information (for example, algorithms/transforms, luminance range, etc.).

5.1.15 *Field No. 55: Notes on Sample and Part*—Any service data available for the article including flight hours, aircraft assignments, and special incidents, such as impacts, collisions, hail storms, fires, etc.

5.1.16 *Field No. 56: Number of Image Segments*—If the image of the part is accomplished in multiple physical segments.

5.1.17 *Field Nos. 61 through 63: Machine Coordinate System*—Describe the coordinate system used by the original examination equipment referenced to the radiation source. For example, scan axis = *X* axis, positive down; *Z* axis, positive away.

5.1.18 *Field Nos. 64 through 66: Part Coordinate System*—Describe the coordinate system of the part in the scan frame. Give the origin and unit vectors as referenced to the machine coordinate system.

5.1.19 *Field No. 74: Coordinate System Notes*—Additional information which clarifies the coordinate system or part