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MILITARY SPECIFICATION
RASTER GRAPHICS REPRESENTATION IN BINARY
FORMAT, REQUIREMENTS FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification identifies the requirements to be met when raster graphics data represented in digital, binary format are delivered to the Government.

1.2. Classification. The digital representation of raster graphics data shall be one of the following types as specified by the contract or other form of agreement:

Type I - Untiled Raster Graphics Data (Default Mode)

Type II - Tiled Raster Graphics Data (Optional Mode)

Note 6.1 describes the difference between the raster graphics types.

Beneficial comments (recommendations, additions, deletions and any pertinent data which may be used in improving this document shall be addressed to: Director, CALS Policy Office, DASD(S)CALS Pentagon, Room 2B322, Washington, DC 20301, by using the self addressed Standardization Document Approval Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

AREA ILSS

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

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2. APPLICABLE DOCUMENTS

2.1. Government documents.

2.1.1. Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

MILITARY

- | | |
|------------|--|
| DOD-D-1000 | - Drawings, Engineering and Associated Lists |
| MIL-M-9868 | - Requirements for Microfilming of Engineering Documents, 35mm |

STANDARDS

FEDERAL

- | | |
|--------------|---|
| FIPS PUB 150 | - Telecommunications: Facsimile Coding Schemes and Coding Control Functions for Group 4 Facsimile Apparatus |
|--------------|---|

MILITARY

- | | |
|--------------|--|
| DOD-STD-100 | - Engineering Drawing Practices |
| MIL-STD-1840 | - Automated Interchange of Technical Information |

(Copies of the referenced federal and military specifications and standards are available from the Department of Defense Single Stock Point, Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA, 19120. For specific acquisition functions, these documents should be obtained from the contracting activity.)

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2.1.2. Other Government documents. The following other Government documents form a part of this specification to the extent specified herein. Unless otherwise specified the issues of these documents shall be those in effect on the date of the solicitation.

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

NISTIR 88-4017 - Report on Standards for the Interchange
of Large Format Tiled Raster Documents

(Application for copies shall be addressed to Tiling
Task Group, Room A266, Technology Building, National
Institute of Standards and Technology, Gaithersburg,
Maryland, 20899)

2.2. Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS shall be the issue of the nongovernment documents which is current on the date of the solicitation.

AMERICAN NATIONAL STANDARDS INSTITUTE

ANSI Y14.1 - American National Standard, Drawing
Sheet Size and Format

(Application for document should be addressed to ASME,
United Engineering Center, 345 E. 47th Street, New York,
NY, 10017)

INTERNATIONAL STANDARDS ORGANIZATION

ISO 8613/1 - Information processing - Text and office
systems - Office Document Architecture
(ODA) and interchange format - Part 1:
Introduction and General Principles

ISO 8613/2 - Information processing - Text and office
systems - Office Document Architecture
(ODA) and interchange format - Part 2:
Document structures

ISO 8613/4 - Information processing - Text and office
systems - Office Document Architecture
(ODA) and interchange format - Part 4:
Document profile

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- ISO 8613/5 - Information processing - Text and office systems - Office Document Architecture (ODA) and interchange format - Part 5: Office Document Interchange Format (ODIF)
- ISO 8613/7 - Information processing - Text and office systems - Office Document Architecture (ODA) and interchange format - Part 7: Raster Graphics Content Architectures
- ISO 8613/7 Addendum - Information processing - Text and office systems - Office Document Architecture (ODA) and interchange format - Part 7: Raster Graphics Content Architectures Tiled Raster Graphics Addendum (ISO SC18 WG5 First Working Draft)
- ISO 8824 - Information processing-Open Systems Interconnection - Specification of Abstract Syntax Notation One (ASN.1)
- ISO 8825 - Information processing-Open Systems Interconnection - Specification of basic encoding rules for Abstract Syntax Notation One (ASN.1)

(Application for documents should be addressed to the American National Standards Institute, Communications Department, 1430 Broadway, New York, NY, 10018)

2.3. Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

Accession For	
NTIS GRA&I	☒
DTIC TAB	☐
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3. REQUIREMENTS

3.1. General requirements. All digital raster graphic files complying with this specification shall conform to one of the two binary formats defined in this specification. Type I raster graphics binary format consists of Group 4 encoding as defined in CCITT Recommendation T.6 (FIPS PUB 150). Type II raster graphics binary format consists of ASN.1 and Group 4 encoding as specified by the large format document application profile presented in NISTIR 88-4017.

As specified in MIL-STD-1840 type I or type II binary raster data are preceded by a block of records that describe the binary raster data.

Unless otherwise specified type I raster binary data shall be delivered when this specification is cited by the contract. Contractors shall not deliver type II data unless specifically authorized by the contract.

3.1.1. Raster data file header records. As specified in MIL-STD-1840 files of type I or type II raster binary data are initiated by a data block containing header records that characterize the image encoded by the raster data. Header records 7, 8, 9 and 10 have the following permissible and default values. Default values are used in the absence of a permissible definition of the header record value.

3.1.1.1. Raster data type. This value has permissible values of '1' and '2'. The default value is '1'.

3.1.1.2. Raster image orientation. Raster image orientation is dependent on the orientation of the scanned medium relative to the scanning mechanism. For typical scanning of technical documentation the pel path direction is 0 degrees and the line progression direction is 270 degrees. For typical scanning of large format documents the pel path direction is 90 degrees and the line progression direction is 270 degrees. The relationship of pel path to line progression directions for these two cases is depicted in Figure 1 of section 6.

The permissible values for the pel path direction are '0', '90', '180' and '270'. The permissible values for the line progression are '90' and '270'. The default values are '0' for the pel path direction and '270' for the line progression direction.

3.1.1.3. Raster image pel count. Pel count shall be utilized to identify the dimensions of the original image in a coordinate system defined by the pel path and line progression directions. The dimensions are a set of any two positive integers. As a guide the dimensions for standard size technical documents and large format drawings are presented in section 6.3.2.

3.1.1.4. Raster image density. Permissible values are 200, 240, 300, 400, 600 and 1200 pels per inch. For typical technical documentation scanning the raster image density is 300 pels per inch. For typical large format document scanning the raster image density is 200 pels per inch. The default resolution is 200 pels per inch.

3.1.2. Raster binary data. As specified in MIL-STD-1840 type I and type II raster binary data shall be contained in data blocks that follow the header record data block.

3.1.3. File format and physical file structure. The record, blocking and physical file structure of files containing raster binary data is specified in MIL-STD-1840.

3.1.4. Validation. Contractors delivering digital raster data in conformance with this specification shall undergo validation of their ability to deliver such data. Validation is described in section 4.3.

3.2. Specific requirements for type I raster binary data.

For type I raster graphics the binary data blocks following the header record block shall contain CCITT Recommendation T.6 (FIPS PUB 150) Group 4 encoding of raster image data. The uncompressed escape option defined in T.6 is not used.

3.3. Specific requirements for type II raster binary data.

Type II raster binary data consist of Open Document Architecture and Interchange Format (ODA/ODIF) data structures encoded using Abstract Syntax Notation One (ASN.1). ODA/ODIF is described in ISO 8613 parts 1, 2 and 5. The raster graphics content architecture is described in ISO 8613 part 7. The extensions necessary to support tiled raster graphics are described in an addendum to ISO 8613 part 7. Encoding of ODA/ODIF data structures in ASN.1 notation is defined in ISO 8824 and 8825.

The application of these various standards to type II raster graphics is presented in NISTIR 88-4017 which includes the document application profile for implementation of ODA for large format, tiled raster graphics data. See section 6.1 for a discussion of relevant information and intended use of tiled raster graphics.

3.3.1. Type II raster data document structure. As specified in NISTIR 88-4017 type II raster data are characterized by the following:

- document profile
- logical characteristics
- layout characteristics
- content characteristics
- raster graphics content

Type II document architecture corresponds to the formatted processable type described in ISO 8613 and NISTIR 88-4017. The raster graphics binary data stream is in accordance with the Office Document Interchange Format Class A as specified in NISTIR 88-4017.

3.3.1.1. Document profile. NISTIR 88-4017 and ISO 8613 specify the document profile for type II raster graphics files.

3.3.1.2. Logical characteristics. NISTIR 88-4017 specifies the logical components and structure of type II raster graphics files.

3.3.1.3. Layout characteristics. NISTIR 88-4017 specifies the layout components and structure of type II raster graphics files. Layout components consist of a document root object and a page object.

3.3.1.4. Content characteristics. NISTIR 88-4017 and ISO 8613 specify the default, basic and non-basic content attributes of type II raster graphics files. These attributes include:

- Application specific attributes for tile indexing
- Presentation attributes for pel-path, line-progression, pel transmission density and clipping.
- Raster graphics attributes for type of coding, compression, number of pels per line, number of lines, number of pels per tile line, number of lines per tile, tiling offset and tile types.

3.3.1.5. Raster graphics content. NISTIR 88-4017, ISO 8613/7 and the ISO 8613/7 tiled raster graphics addendum specify the content encoding rules of type II raster graphics. For type II tiled raster graphics encoding consists of a series of octet strings which represent CCITT Recommendation T.6 Group 4 (FIPS PUB 150) encoding or bitmap encoding. The uncompressed escape option defined in T.6 is not used.

4. QUALITY ASSURANCE PROVISIONS

4.1. Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2. Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known, defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.3. Inspection procedures. The quality of raster graphics data files is dependent on a number of quality factors including original document quality, scanning quality and adherence to raster graphic file specifications.

4.3.1. Original document quality. Original documents, whether paper drawings or filmed aperture cards, form the basis of quality of raster graphics files. The contractor must adhere to appropriate standards and specifications in creating such documents to maximize raster image quality. The contract or purchase order shall specify inspection procedures to guarantee high quality of the original document utilizing existing standards for large format document drafting and filming including DOD-STD-100, DOD-D-1000, and MIL-M-9868.

4.3.2. Scanning quality. Documents are converted to electronic format through the scanning process which renders an image of a document as a set of data elements. Typically scanning quality is enhanced by a control step that enables a workstation operator to improve the quality of the image before final raster graphic file creation. Scanning devices and the processes associated with scanning require regular inspection procedures to ensure high-quality operation of the scanner hardware and appropriate performance of scanner and image quality control personnel. Such inspections are critical in an operating environment where actual raster graphics file usage may occur many years after scanning. The contract or purchase order shall specify inspection procedures to guarantee high quality of scanning operations.

4.3.3. Raster specification adherence. The translation of scanned data into a format adhering to accepted standards and specifications is a necessary element of raster graphic quality. Validation shall ensure that all attributes, nonbasic values, basic values, permissible and default values conform to the type I or type II formats to ensure appropriate adherence to raster graphics digital data standards. In addition content encoding shall be analyzed for conformance to FIPS PUB 150 for Group 4 encoding. Insofar as possible inspection and analysis procedures shall be automated with appropriate computer programs that report analysis and inspection results.

4.4. Source system for validation. Validation of vendor application of this specification is required. For type I raster graphics this validation shall determine the validity of vendor application of FIPS PUB 150 encoding. For type II raster graphics validation shall determine the validity of vendor application of FIPS PUB 150 encoding, ISO 8613, ISO 8613/7 addendum and NISTIR 88-4017. Validation shall be accomplished using five different standard raster graphics production files with diverse image content supplied by the Government. The contract shall provide specific instructions regarding arrangements for examinations, approval of validation test results and disposition of raster graphics files. The Government reserves the right to waive the requirement for validation to those bidders which have previously been validated. Bidders who wish to rely on previous validation must furnish evidence with the bid that prior Government approval is appropriate for the pending contract.

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5. PACKAGING

Packaging of raster graphic data files shall be in accordance with the requirements of MIL-STD-1840.

6. NOTES

6.1. Intended use. This specification is intended to be used by contracting agencies of the Department of Defense in the procurement of raster graphics data and raster graphics applications. The specification presents raster graphics requirements which are applicable to electronic storage and transmission of raster encoding of office document pages and large format engineering drawings.

Raster graphics representation specified herein consists of two types. Type I or untiled raster graphics data has no document architecture and is represented by a single compressed data entity. Type II or tiled raster graphics has a document architecture conforming to ISO 8613 wherein the raster content consists of extensions to the ISO 8613-part 7 raster content architecture. The extensions are presented in the form of part 7 addenda and permit the encoding of layout content which is subdivided into tiles.

Untiled raster graphics requirements are intended to be used in procuring data for systems that utilize untiled raster graphic representations. Examples of such systems include typical technical documentation systems and DSREDS/EDCARS used by the Army and Air Force.

Tiled raster graphics requirements are intended to be used in procuring data for systems that utilize tiled raster graphics representations. Such representations are best applied in systems handling large format drawings typically associated with engineering design. The subdivision of a drawing into compressed tiles permits selection of only those portions of an image required by the application. This can result in reduced requirements for workstation memory and workstation display area. In addition tiling permits compression and decompression activities to be performed in parallel upon the drawing tiles.

The following sections provide additional information concerning tiled and untiled raster graphics standardization.

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6.1.1. Use of ISO office document architecture for tiled raster graphics. It is the intent of MIL-R-28002 to use existing and emerging standards as the basis for implementation. Tiled formats presented for type II data utilize such standards. This assures that raster graphics specification efforts are within the mainstream of raster imaging standards and promotes interoperability with other raster graphics formats utilized in the office document architecture standard. It is the intent of MIL-R-28002 to use new mechanisms or objects only where existing work cannot reasonably accommodate specification needs.

6.1.2. Tiled raster graphics presentation and content attributes. ISO 8613 provides accommodation of a variety of document sizes, contents, and styles. However, 8613 does not supply specific limits and defaults for each of the architecture attributes. Such values are presented in NISTIR 88-4017.

6.1.3. Restriction to Group 4 compression. This specification exclusively requires Group 4 compression for type I and type II raster graphics encoding with a bitmap option for type II encoding. Group 3 compression is specifically not supported. The uncompressed escape option defined in FIPS PUB 150 is not supported.

For tiled raster graphics the ability to intersperse compressed and uncompressed tiles as described by the "Tile types" attribute in ISO 8613/7 addendum and in NISTIR 88-4017 meets several user requirements for tiled raster graphic content. A system or peripheral which must meet a given throughput requirement can selectively choose to leave uncompressed those tiles which do not compress in a specified amount of time. Similarly, when a given storage requirement must be met, this ability permits an upper bound to storage needs by using bitmap encoding for those tiles which would have reverse compression. Both these requirements arise from the need to predict the behavior of an essentially statistical encoding technique.

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6.2. Ordering data. The contract or other form of agreement should specify the following:

- a) Title, number, and date of this specification.
- b) The type of raster graphics data being procured as type I or type II.
- c) The delivery medium to be used.
- d) The raster image orientation.
- e) The raster image pel density.

6.3. Data Requirements.

6.3.1. File size and efficiency considerations. Files containing large format drawings in raster graphics form are relatively large. After Group 4 compression E-sized drawings require approximately .5 Megabyte of storage for a moderately detailed drawing. For tiled raster graphics files, the use of a tile index is recommended. Such an index permits direct access of image tiles contained in the content stream. The format of this index is described in NISTIR 88-4017. The tile index is placed in the application comment attribute associated with the layout object of the tiled raster graphics content and is only supported by tiled raster graphic applications.

6.3.2. Scanlines for engineering drawings. The drawing sizes, A through K, specified by ANSI Y14.1 and metric drawing sizes, A4 through A0 are summarized in the following tables together with the nominal number of pels per line and the nominal number of scanlines. These recommended values are shown for the default pel transmission density for raster graphics of 200 pels per inch. There are allowances in the number of pels per line and number of scanlines for extra white space on the margins and for byte alignment of the pels. However these allowances are minimal and particular requirements associated with overscanning should be identified and specified in contract documents.

North American Drawing Sizes

Drawing Size	WxL(max) (inches)	Pels Per Line	Lines Per Layout Object
A	8.5x11	1728	2200
B	11x17	2240	3400
C	17x22	3456	4400
D	22x34	4416	6800
E	34x44	6848	8800
F	28x40	5632	8000
G	11x90	2240	18000
H	28x143	5632	26000
J	34x176	6848	35200
K	40x143	8064	28600

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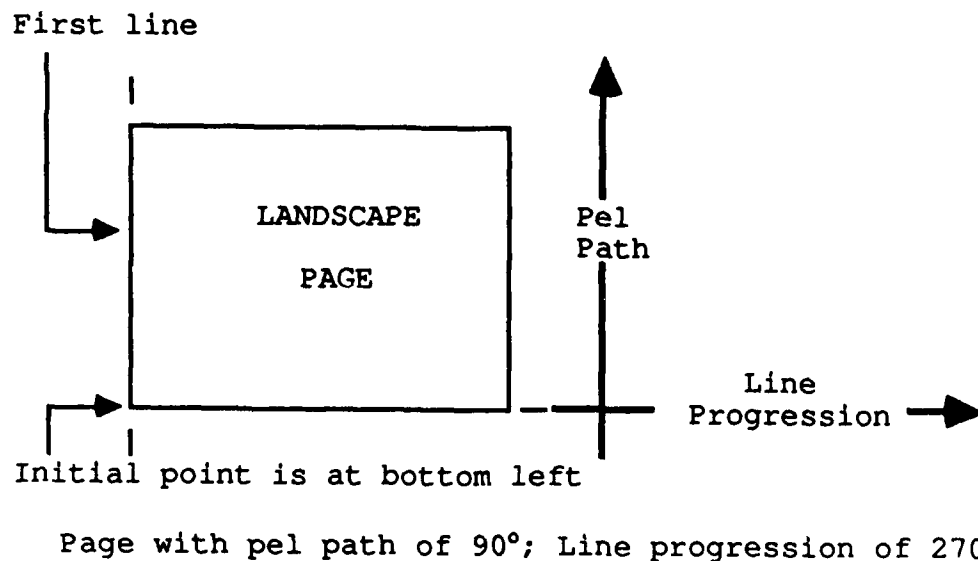
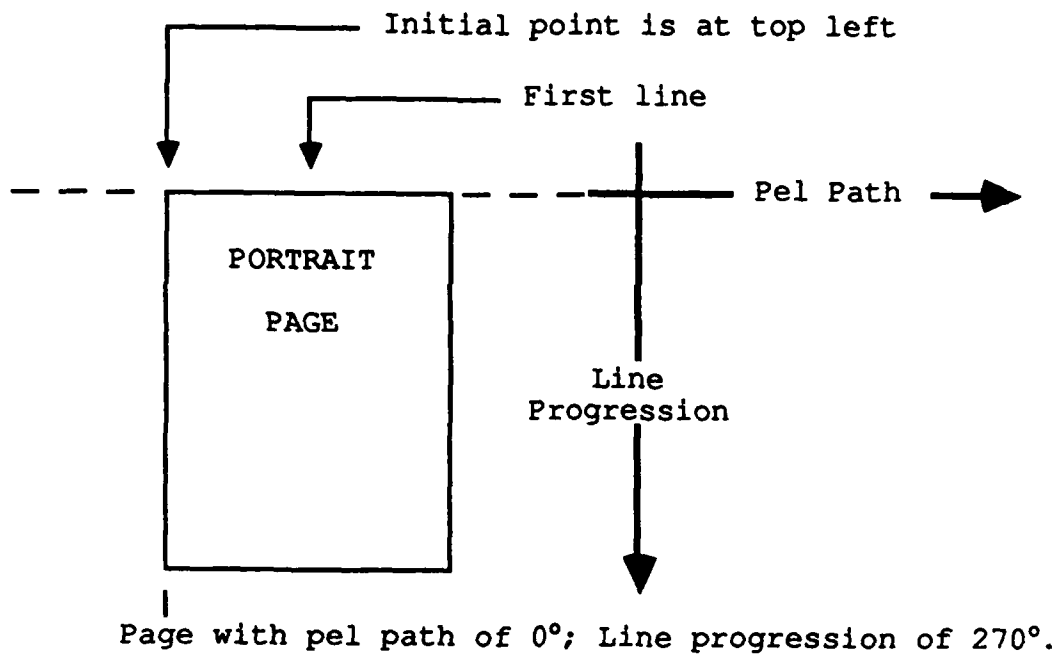
Metric Drawing Sizes

Drawing Size	WxL(max) (mm)	Pels Per Line	Lines Per Layout Object
A4	210x297	1656	2344
A3	297x420	2344	3312
A2	420x594	3312	4680
A1	594x840	4680	6616
A0	840x1188	6616	9360

6.3.3. Generation of raster data by scanning. Raster data for either technical publication or product definition materials may be generated by scanning source document sheets or pages in accordance with this specification. Scanning is performed in a line-by-line sequence from left to right, beginning at the leading edge of a page as it is fed into the scanner, and at a standard density selected to faithfully preserve the smallest detail (minimum line pair spacing) represented in the source material. Note that the image orientation may be such that the top of the page does not correspond to the leading edge of the scanned page. This scan-produced raster data is initially stored in intermediate, digital form as a binary bitmap such that respective ones and zeros reflect the black and white physical picture elements of the scanned image. In this intermediate or expanded form, raster scan data may be processed for enhancement or editing, or directly reproduced by an appropriate display or printing device.

The relationship between the orientation of scanning and the orientation of image display must be accurately specified in the raster graphics presentation attributes. Figure 1 shows the relationship between the pel path and line progression attributes for typical images scanned with a page scanner (portrait page) and an aperture card scanner (landscape page).

6.3.4. Additional data processing conditions. This specification defines the data formats required to describe a single page or sheet of type I or type II raster graphic content. Issues related to database management such as document information, aperture card Hollerith code, document and page relationships, sheets, revisions, and multiple aperture card frames are not considered in this specification. If such data is required as a deliverable, the procurement contract should specify the content and format of such data; other requirements standards, notably MIL-STD-1840, consider these issues and should be appropriately referenced by the contract document.



Note 1: The pel path direction is measured in degrees counterclockwise from the positive, horizontal axis.

Note 2: The line progression direction is measured in degrees counterclockwise from the pel path direction.

FIGURE 1. Position of pels.

6.4. Definitions.

6.4.1. Acronyms. Acronyms used in this specification are defined as follows:

- a) ANSI. The American National Standards Institute
- b) ISO. International Standards Organization
- c) NIST. National Institute of Standards and Technology

6.4.2. Application profile. The result of selecting a particular document architecture level, content architectures, a document profile level, an interchange format level, objects and attributes with classification of attributes into mandatory, non-mandatory and defaultable and definitions of basic, non-basic and default attribute values and control function parameter values.

6.4.3. Attribute. An element of a constituent of a document that has a name and a value and that expresses a characteristic of this constituent or a relationship with one or more constituents.

6.4.4. Basic value. Attribute value that is unconditionally allowed in document interchange in the context of a given application profile.

6.4.5. Bitmap. A two- or three-dimensional data field representing a pel array.

6.4.6. Clipping. The actual pel array to be imaged as determined by applying all clipping parameters.

6.4.7. Decoding. The process of deriving a bitmap from an octet string by translating any compression algorithm used to create the octet string.

6.4.8. Default value. Attribute value that is the standard value in document interchange in the context of a given application profile.

6.4.9. Encoding. The process of deriving an octet string from a bitmap by applying a compression algorithm to the bitmap.

6.4.10. Line progression. The direction of progression of successive lines of pels in an image.

- 6.4.11. Nonbasic value. Attribute value that is only allowed in document interchange in the context of a given application profile if its use is declared in the document profile.
- 6.4.12. Null tile. A tile specified in the tiled raster graphics content attributes with no corresponding encoded content.
- 6.4.13. Octet. A subdivision of bits numbered from 8 to 1 where bit 8 is the most significant bit and bit 1 is the least significant bit.
- 6.4.14. Page. A type of layout object or layout object class that corresponds to a rectangular area used as a reference area for presenting the content of the document.
- 6.4.15. Pel (Picture Element). The smallest graphic element that can be individually addressed within a picture.
- 6.4.16. Pel array. A two-dimensional array of pels used to represent a pictorial image.
- 6.4.17. Pel path. The direction of progression of successive pels along a line in an image.
- 6.4.18. Pel spacing. The distance between any two successive pels along a line in an image.
- 6.4.19. Raster graphics. The electronic data processing medium used to depict any arbitrary assemblage of text characters, graphical figures, or pictorial images with a pel array.
- 6.4.20. Spacing ratio. The ratio of line spacing to pel spacing.
- 6.4.21. Tile. A rectangular region in a layout object in which all such regions have the same dimensions, no part of any region overlaps any other region, and regions are positioned in a fixed grid, determined by partitioning the layout object into region-sized areas.

6.5. Subject term listing.

Raster
Raster graphic file
Image
Tiled
Untiled
Digital
Binary
MIL-STD-1840
ISO 8613/7
Scanning

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Custodians:

Army - CR
Navy - SH
Air Force - 24
DLA - DH

Preparing activity:

OSD-CL
(Project ILSS-0033)

Review activities:

Army - AM
Air Force - 01, 02
NSA - NS
DCA - DC
NASA - NA
Others - NBS, DOE, GPO, NCS

User activities:

OSD-IR

Army - AL, AT, AV, EA, ER, GL, ME, MI, MR, SM, TE, TM
Navy - AS, EC, OS, SA, YD
Air Force - 11, 13, 14, 17, 18, 19, 68, 79, 99

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER

MIL-R-28002

2. DOCUMENT TITLE

RASTER GRAPHICS REPRESENTATION IN BINARY FORMAT, REQUIREMENTS FOR

3a. NAME OF SUBMITTING ORGANIZATION

4. TYPE OF ORGANIZATION (Mark one)

☐ VENDOR

☐ USER

☐ MANUFACTURER

☐ OTHER (Specify): _____

b. ADDRESS (Street, City, State, ZIP Code)

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER (Last, First, MI) - Optional

b. WORK TELEPHONE NUMBER (Include Area Code) - Optional

c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional

8. DATE OF SUBMISSION (YYMMDD)

(TO DETACH THIS FORM, FOLLOW THIS LINE.)

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