PERFORMANCE SPECIFICATION

DIGITAL REPRESENTATION FOR COMMUNICATION OF ILLUSTRATION DATA: CGM APPLICATION PROFILE

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

1. **SCOPE**

1.1 Scope. This performance specification is a revision of MIL-PRF-28003A. This revision supersedes MIL-PRF-28003A in its entirety. This revision adopts the Computer Graphics Metafile (CGM) standard ISO/IEC 8632:1999 Parts 1, 3, and 4 and the following profiles:

  a. Model profile as contained in ISO/IEC 8632:1999
  b. Air Transport Association (ATA) Specification iSpec 2200, Information Standards for Aviation Maintenance, Section 5-2-4.7.1
  c. Web CGM profile (REC-WebCGM-19990121)

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be used in improving this document should be addressed to: ATTN CALS Digital Standards Office, DISA Center for Information Technology Standards, Code JIEO/JEBEB, 10701 Parkridge Blvd, Reston VA 20191-4357, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A   AREA IPSC

1.2 Classification. This specification establishes the requirements for the communication or interchange of illustration data in digital format for use in technical illustrations and publications.

1.2.1 Color classification. A metafile or an interpreter is classified as either monochrome, grayscale, or color. Color classifications are defined as follows:

    a.   Monochrome; characterized by the use of only two distinct colors (such as black and white) – one color for the background, the other color for displaying the image/text.

    b.   Grayscale; characterized by the use of varying tones of gray.

    c.   Full color; characterized by use of color, gray tones, and black and white. Tones of individual colors are determined by color model and the indices placed in the color table.

1.3 Other classifications. This specification employs four CGM metafile versions – Version 1, 2, 3, and 4. Every metafile declares itself with the METAFILE VERSION element. All versions are nested and upwardly compatible. That is, a valid version 1 metafile is automatically a valid version 2 metafile, a valid version 2 metafile is automatically a valid version 3 metafile, and so on.

1.3.1 Metafile version 1. Version 1 provides a basic drawing and picture interchange capability. It is relatively simple, and is suited to simple and common graphical tasks.

1.3.2 Metafile version 2. Version 2 metafiles allow all version 1 elements, plus add graphical segment capabilities. Notable additions are: segmentation – the saving and later multiple reuse of common sequences of graphical primitives; and the closed figure primitive – a filled composite primitive defined by a path composed of other CGM line and fill primitives.

1.3.3 Metafile version 3. Version 3 metafiles permit version 1 and 2 elements, plus add the capability to represent compressed tiled images, define external symbol libraries, and provide greater control of drawing aspects for graphic arts, presentation graphics, and electronic publishing. Version 3 provides a significant increase in the metafile's capability.

1.3.4 Metafile version 4. Version 4 metafiles are permitted in this specification. Version 4 metafiles allow all previous version elements, and add application structuring extensions. These capabilities are critical for using CGM in intelligent graphics applications.

1.4 Year 2000 compliance This performance specification now meets DoD Year 2000 (Y2K) compliance requirements. The "Y2K" logo is a registered trademark of the United States Government. Details on U.S. Government Y2K requirements may be referenced at: http://www.y2k.gov/

2. **APPLICABLE DOCUMENTS**

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

DEPARTMENT OF DEFENSE STANDARDS

2.3 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are Department of Defense (DoD) adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of the documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AIR TRANSPORT ASSOCIATION (ATA)

ATA iSpec 2200   –   Information Standards for Aviation Maintenance, Section 5-2-4.7.1

(Application for copies should be addressed to the Air Transportation Association (ATA), 1301 Pennsylvania Ave., NW, Suite 1100, Washington, DC 20004-1707 or http://www.air-transport.org/).

THE WORLD WIDE WEB CONSORTIUM (W3C)

REC-WebCGM-19990121   –   WebCGM Profile

(Copies of the WebCGM profiles may be obtained from http://www.w3.org/tr/1999/rec-webcgm-19990121).

INTERNATIONAL ORGANIZATION FOR STANDARDS (ISO)

ISO/IEC 8632-1:1999   –   Information Technology – Computer graphics – Metafile for the storage and transfer of picture description information – Part 1: Functional specification

[Part 2 no longer exists and is not supported.]

ISO/IEC 8632-3:1999   –   Information Technology – Computer graphics – Metafile for the storage and transfer of picture description information – Part 3: Binary encoding

ISO/IEC 8632-4:1999   –   Information Technology – Computer graphics – Metafile for the storage and transfer of picture description information – Part 4: Clear text encoding

ISO/IEC 10641:1993   –   Information technology – Computer graphics and image processing – Conformance testing of implementations of graphics standards

(Application for copies should be addressed to American National Standards Institute (ANSI), 11 West 42nd Street, 13th Floor, New York, NY 10036 or http://www.ansi.org and ISO Central Secretariat, Case Postale 56, 1 rue de Varembé, CH-1211, Genève 20, Switzerland/Suisse or http://www.iso.ch)

(Non–Government standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 <u>General requirements</u>. The CGM conformance requirements specified pertain to the application of metafiles, generators, and interpreters. Specific requirements for conforming metafiles, for all CGM elements and parameters allowed in a conforming metafile, are specified herein. Illustration data that meets the requirements of this specification shall be in the form of one or more conforming metafiles. Conforming metafiles shall meet the rules and element constraints of ISO/IEC 8632 and associated amendments.

3.1.1 <u>ISO/IEC 8632 Model profile</u>. The model profile provides guidance for CGM implementation by furnishing a baseline set of requirements ("Required Elements") for conforming metafiles, recommended elements ("Permitted Elements"), metafile and multi-element rules, generator implementation requirements, and interpreter implementation requirements. The model profile uses a format called the Profile Proforma (PPF). The PPF format provides a direct side-by-side comparison between the implementer's objective profile and the model profile.

3.1.2 <u>ATA iSpec 2200 profile</u>. Due to the continued advancements in digital data, developers required to provide electronic media graphics and illustrations shall do so in accordance with (IAW) ATA iSpec 2200, section 5-2-4.7.1 or its latest successor.

3.1.3 <u>WebCGM profile</u>. With the growing utilization of the World Wide Web (WWW) it has become necessary to develop web based CGM profiles. The World Wide Web consortium (W3C) in coordination with leading industry experts has generated the appropriate profile for utilizing CGM data on the WWW. When required, developers shall produce CGM graphics and illustrations IAW REC-WebCGM-19990121 or its latest successor.

3.1.4 <u>Acquisition guidance</u>. For contracting purposes acquisition managers shall identify either the use of ATA iSpec 2200 or WebCGM profile for technical or engineering data. Selection of one or both of the above specified profiles shall be solely at the discretion of the contracting authority.

3.2 <u>Year 2000 compliance</u> When representing a date within a CGM metafile, the year must be clearly and unambiguously represented using four digits.

4. **VERIFICATION**

4.1 <u>Classification of inspections</u>. The inspection requirements specified herein are classified as follows:

      a. First article inspection (see 4.2).

      b. Conformance inspection (see 4.3).

      c. Hyperlink compliance inspection (see 4.4)

4.2 <u>First article inspection</u>. Unless otherwise specified by the contract or other form of agreement, first article inspection shall be the inspection of the first article CGM data deliverable as specified herein. First article inspection shall also include the requirements of the conformance inspection for verification of the CGM image quality. All first article inspections shall be performed using the contract specified system, or on a system equal to the destination system that will eventually use the CGM application being delivered under the contract. If the contract does not specify a system, all first article inspections shall be performed on an alternative system known to rigorously exercise all requirements and attributes of this specification. First article inspection shall assure the quality of the CGM metafile, generator, and interpreter in accordance with this specification independent of the system used for generating and interpreting the CGM metafile (see 6.3).

4.2.1 <u>First article inspection elements</u>. CGM applications selected for the first article inspection shall be rigorously tested to exercise all attributes, values, color conformance classifications, and the complexity of the required deliverables as specified in the contract. As much as possible, the inspection and analysis procedures shall be automated with appropriate computer programs/test suites that report analysis and inspection results. The Government may require the inclusion of Government-furnished or contract specified test charts or images with diverse image content.

4.3 <u>Conformance inspection</u>. Conformance inspection shall be performed on the CGM data deliverable to assure conformance of the CGM metafile to the requirements established by this specification, by the contract or other form of agreement. Inspection processes shall include, but not be limited to, visual inspection of the metafile, and/or digital review with a Government-accepted CGM metafile computer program. CGM metafiles shall be inspected to verify their syntactic and semantic conformance to this specification. Metafiles shall also be analyzed for conformance to values for CGM elements and parameters. Visual inspection shall be performed in conjunction with a Government-accepted CGM metafile computer program. The Government may require the inclusion of Government-furnished or contract specified reference pictures. Each metafile is interpreted using the Government-accepted CGM metafile computer program. Such additional images, when included for conformance inspection, shall contain pictures covering the range of complexity equal to the contract deliverable. The resulting CGM picture is then compared to the reference picture and a pass/fail decision is made (see 6.3).

4.4 <u>Hyperlink compliance inspection</u>. Hyperlink compliance inspection shall be performed on all CGM data deliverables to assure compliance of the CGM metafile to the requirements established by this specification, by the contract or other form of agreement. Inspection processes shall include, but not be limited to, viewing and displaying CGM metafiles for purposes of exercising/navigating the individual hyperlinks. Individual CGM metafiles shall be displayed using a Government-accepted CGM metafile computer program and each or a select set of hyperlinks shall be exercised. Broken or non-functional hyperlinks will be grounds for failing to meet this specification.

5. **PACKAGING**

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of material is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. **NOTES**

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 <u>Intended use</u>. This specification is designed to be incorporated into a contract to define the technical performance requirements for the purchase of illustration or picture description data (in contrast to product definition data) in digital form for use in technical illustrations and technical publications. A metafile, as provided in this document, represents illustration data in the form of a conforming metafile. A conforming metafile contains, in device-independent, system-independent, and implementation-independent form, the picture description data represented by the functions invoked through an application program interface. This specification defines the allowable elements and parameters that may be used to compose the picture.

6.1.1 <u>CGM Application Profile (AP)</u>. The AP defines the options, elements, and parameters of ISO/IEC 8632 necessary to accomplish a particular function and maximize the probability of interchange between systems implementing the profile. Profiles are defined by application constituencies who agree to adhere to the same subset of CGM for the purpose of graphical data interchange using ISO/IEC 8632. A profile addresses metafile requirements as well as generator and interpreter implementation requirements. This specification is a CGM AP based on ISO/IEC 8632, and currently accepted and approved industry standards. An AP is required in order for the specification to be conforming to ISO/IEC 8632.

6.1.2 <u>Structure of the CGM standard</u>. Metafiles in the CGM standard are defined as a series of layers of detail. The highest level of structure is the metafile itself. Each metafile may contain one or more pictures, which are completely independent of each other. Each of the items stored in a metafile is stored as an element. Each element may have associated with it a list of data called parameters. Elements may be grouped into segments, which may be referenced and reused multiple times. There are ten classes of elements, and each is defined in turn in the CGM standard: delimiter elements, metafile descriptor elements, control elements, graphical primitive elements, attribute elements, escape elements, external elements, application structure descriptor elements, and segment elements.

6.1.3 <u>ISO/IEC 8632</u>. ISO/IEC 8632 is a graphics data interchange standard which defines a neutral computer-interpretable representation of 2-dimensional graphical (pictorial) information in a manner that is independent from any particular application or system. The purpose of the standard is to facilitate the storage and retrieval of graphical information between applications, software systems, and devices. ISO/IEC 8632, Part 1, provides the functional specification for CGM elements and parameters, and their permissible values, while Parts 3 and 4 specify encodings. In particular, ISO/IEC 8632, Part 3, specifies binary encoding requirements. There is no longer a Part 2, as character encoding has been deprecated. The Rules for Profiles section specifies how profiles should be written. Although it adds no new functionality, it provides rules for: writing profiles; definition of conforming generators, interpreters, and metafiles; and a model profile (a complete and valid profile that also provides a template for writing profiles). The Application Structure Extensions section adds the capability to use application structures and related functions. Application structures provide device-independent "links" to other applications, and are vital in the use of intelligent graphics within CGM. ISO/IEC 8632 is recognized as the governing CGM standard for US industry and the international community.

6.2 <u>Acquisition requirements</u>. Acquisition documents must specify the following:

a.   Title, number, and date of this specification.

b.   Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2).

c.   Packaging requirements (see 5.1).

d.   Whether the metafile is monochrome, grayscale, or color.

e.   First article inspection (see 4.2)

f.   Conformance inspection (see 4.3)

g.   Hyperlink compliance inspection (see 4.4)

6.2.1 <u>Upward compatibility issues</u>. Acquisition managers should be aware of incompatibilities that existed between MIL-PRF-28003 and MIL-PRF-28003A metafiles. Changes to several elements in MIL-PRF-28003A prevented MIL-PRF-28003A conforming interpreters from effectively reading many legacy (MIL-PRF-28003) metafiles. In particular, conforming interpreters should accept Metafile Descriptor element character strings from legacy metafiles (MIL-PRF-28003A). Interpreter requirements now state that metafiles procured in accordance with previous revisions of MIL-PRF-28003 will be accepted, provided that no negative indices for LINE TYPE or HATCH STYLE DEFINITION are included and no escape elements are included in the metafiles.

6.2.2 <u>Downward compatibility issues</u>. Acquisition managers should note the downward compatibility impact caused by profile changes to this specification. Legacy interpreters may not be able to read new metafiles generated in accordance with the requirements of this specification.

6.2.3 <u>MIL-PRF-28002 raster graphics issues</u>. MIL-PRF-28002 raster graphics may be used as MIL-PRF-28003 metafile tile arrays when appropriate. In order to provide a MIL-PRF-28002 raster file as a MIL-PRF-28003 metafile it is necessary to have a CGM metafile header record. MIL-PRF-28002 specifies the requirements for the representation of bitonal raster graphics in binary format. The following issues should be carefully considered before using MIL-PRF-28002 raster graphics in CGM metafiles.

a.   MIL-PRF-28002 raster formats are used to image information suitable for CGM illustrations, such as formatted document pages, graphs, charts, pictures, tables, and figures. However, MIL-PRF-28002 raster formats are also used to image large format engineering drawings that have been scanned from paper or microfiche media. These images may not be suitable for MIL-PRF-28003 CGM illustrations, because of their large "footprint" and large size (number of bits/bytes). For example, the footprint of an E-size engineering drawing is 34 x 44 inches too large for standard or legal size paper without reduction. Image reduction may unacceptably distort or delete information.

b.   The MIL-PRF-28002 raster file format adds file identification and image processing information to the raster graphic to facilitate file interchange and image presentation. MIL-PRF-28003 CGM generators are not required to process this information to produce an acceptable CGM tile array.

6.2.4 Conversion of data to CGM version 4. When purchasing conversion of data to CGM version 4, the buyer has the right to require CGM version 4 application structure elements to be introduced to the data. Simply changing the metafile descriptor number is not sufficient to take advantage of the new functionality capable in a non-proprietary neutral CGM version 4 file.

6.3 Additional validation testing information. Consult ISO/IEC 10641 for additional information on CGM validation procedures.

6.3 Definitions.

6.3.1 Acronyms. Commonly used acronyms in this specification are defined as follows:

a.	ANSI	–	American National Standards Institute
b.	AP	–	Application Profile
c.	ATA	–	Air Transport Association
d.	CALS	–	Continuous Acquisition and Life-Cycle Support
e.	CD-ROM	–	Compact Disk-Read Only Memory
f.	CFITS	–	Center for Information Technology Standards
g.	CGM	–	Computer Graphics Metafile
h.	DISA	–	Defense Information Systems Agency
i.	DoD	–	Department of Defense
j.	DoDISS	–	Department of Defense Index of Specifications and Standards
k.	IEC	–	International Electrotechnical Commission
l.	ISO	–	International Organization for Standards
m.	NIST		National Institute of Standards and Technology
n.	OSD	–	Office of the Secretary of Defense
o.	PPF	–	Profile Proforma
p.	WWW	–	World Wide Web
q.	Y2K	–	Year 2000

6.3.2 Glossary.

6.3.2.1 Application Profile (AP). A set of specifications (beyond that in the published ISO/IEC 8632 standard) appropriate to a particular environment. The goal of an AP is to eliminate implementation dependencies and provide for the effective and unambiguous use of a standard.

6.3.2.2 Application structure. A sequence of metafile elements delimited by the BEGIN APPLICATION STRUCTURE and END APPLICATION STRUCTURE elements, containing one BEGIN APPLICATION STRUCTURE BODY element, and optionally containing one or more APPLICATION STRUCTURE ATTRIBUTE elements.

6.3.2.3 Computer Graphics Metafile (CGM). The functional specification for a mechanism for storing and transferring illustration data.

6.3.2.4 Conforming generator. A metafile generator that produces only conforming metafiles (or that can be reliably commanded to function in that mode), and additionally conforms to any additional generator requirements as specified herein.

6.3.2.5 Conforming interpreter. A metafile interpreter that correctly interprets and renders any conforming metafile of the same color conformance classifications as specified herein, and additionally conforms to any additional requirements as specified herein.

6.3.2.6 Conforming metafile. A metafile that complies with this specification.

6.3.2.7 <u>Conforming metafiles, test</u>. Metafiles that can be used to test the conformance of CGM products and software can be downloaded from NIST's CGM Web site at http://www.nist.gov/cgm.html

6.3.2.8 <u>Metafile</u>. A mechanism for the storage and transfer of graphical data and control information. This representation contains a device-independent description of one or more pictures.

6.3.2.9 <u>Metafile element</u>. A functional item that can be used to construct a picture or convey information.

6.3.2.10 <u>Metafile generator</u>. The software or hardware that creates a picture or conveys information in the CGM representation.

6.3.2.11 <u>Metafile interpreter</u>. The process or equipment that reads the CGM and interprets the contents. An interpreter may be needed in order to drive a computer graphics interface or other device interface to obtain a picture that resembles the intended picture as closely as possible.

6.3.2.12 <u>Raster graphics</u>. A graphical format in which an image is defined by an array of individual grid squares (pixels, cells, or pels).

6.3.2.13 <u>Vector graphics</u>. The presentation or storage of images as sequences of line segments.

Note: Refer to ISO/IEC 8632, Definitions and abbreviations, for further definitions of computer graphics terms.

6.4 <u>Year 2000 compliance</u>. To ensure proper data interchange into the 21st century, all new software and data required by DoD should be Y2K compliant. That is, both software and data should be capable of explicitly expressing and representing date fields with full four-digit years. Years should be properly represented and computed beyond the year 1999. The year 2000 should be recognized properly by calendar functions as a leap year. Software and data intended for use in 2000 and beyond should represent a year as four (4) digits.

6.5 <u>Note on document fonts</u>. As part of the CALS initiative to introduce the use of digital technology into the process of reviewing and coordinating standards, this revision of the standard has been reformatted for improved readability as both a paper and an electronic document. The body text of this document uses the same font as the previous revision, but slightly enlarged to give an improved on-screen appearance when displayed by a computer.

6.6 <u>Subject term (keyword) listing</u>.

      CALS
      Computer Graphics Metafile
      ISO 8632
      Technical illustrations
      Technical publications
      Vector graphics
      Y2K
      Year 2000 compliance

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CONCLUDING MATERIAL

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I RECOMMEND A CHANGE:	**1. DOCUMENT NUMBER** MIL-PRF-28003B	**2. DOCUMENT DATE (YYYYMMDD)** 20000430

3. DOCUMENT TITLE   Digital Representation for Communication of Illustration Data: CGM Application Profile

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

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a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
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8. PREPARING ACTIVITY

a. NAME CALS Digital Standards Office DISA Center for Information Technology Standards Code JIEO/JEBEB	b. TELEPHONE *(Include Area Code)* (1) Commercial (2) AUTOVON (703) 735-3553 653-3553
c. ADDRESS *(Include Zip Code)* 10701 Parkridge Blvd Reston, VA 20191-4357	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman Road, Suite 2533 Ft. Belvoir, VA 22060-2533 Telephone (703) 767-6888 AUTOVON 427-6888

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