Previous Section

4.0 -- Digital Representation for Communication of Product Data: IGES Application Subsets and IGES Application Protocols (MIL-PRF-28000)

4.1 -- Purpose

MIL-PRF-28000 is the military specification for the digital representation of product definition data using the Initial Graphics Exchange Specification (IGES) as specified by American National Standard (ANS) US PRO/IPO-100-1996. The pending revision of MIL-PRF-28000, Revision B, will allow the use of any IGES version from IGES 4.0 (American Society of Mechanical Engineers (ASME) standard Y14.26M-1989, Digital Representation for Communication of Product Definition Data) through the newly-released IGES 5.3.

In essence, MIL-PRF-28000 defines the DoD application protocols for IGES. MIL-PRF-28000 is organized into five classes by application area to meet the delivery needs of each application.

Class	Content
1	Technical Illustrations Subset
2	Engineering Drawings Subset
3	Electrical/Electronic Applications Subset (**Withdrawn**)*
4	Geometry for NC Manufacturing Subset
5	Three-Dimensional (3D) Piping Application Protocol
6	Layered Electrical Products (LEP) Application Protocol
7	3D Geometry

Note *: ***Class 3 IGES will be withdrawn from MIL-PRF-28000 in Revision B, and replaced with the class 6 LEP Application Protocol.***

The basic unit of information within a MIL-PRF-28000 class is an entity, such as a line, point, circle, or conic arc. The subsets are composed of entities from ASME Y14.26M -- 1989, the equivalent of IGES Version 4.0, and later. The class 5 Application Protocol is composed of entities from IGES Version 5.1. The class 6 Application Protocol is defined in ANS US PRO/IPO-111-1996. A MIL-PRF-28000 file must use one of the six approved classes shown above, indicating the specific conformance class used in the start section at the beginning of the MIL-PRF-28000 file.

4.2 -- Scope

MIL-PRF-28000 specifies six classes of the IGES standard (technical illustrations, engineering drawings, numerical control manufacturing, 3D piping, Layered Electrical Products, and 3D geometry) as opposed to the entire IGES standard. MIL-PRF-28000 subdivides the IGES specification, because IGES is large and complex, with different options that may be used to represent the same Computer Aided Design (CAD) model entity. As a result, CAD software vendors seldom support every IGES entity in the specification, but support a subset of IGES that best matches the features of their CAD system. Invariably, there is a

mismatch between the set of entities by one CAD system's pre-processor and another CAD system's post-processor. There is no guarantee that the intersection of the two different CAD systems' supported IGES entities is adequate for the required data transfer (see paragraph 4.4).

4.2.1 -- Application Subsets

The first four classes and class 7 of MIL-PRF-28000 specify the entities needed for specific application subsets. In this way the recipient of a MIL-PRF-28000 data file may specify the class of data needed without becoming an expert on the IGES. The only other entities allowed in the file are "volunteer" entities. As stated by MIL-PRF-28000, "volunteer" entities must be:

- Valid ASME Y14.26M entities,
- Not necessary for the product data representation, and
- Meant only for restoring the environment on the CAD system that originally developed the file for transmittal.

These requirements are placed on volunteer entities so that the CAD system that receives the file will not lose product information if it does not transfer the "volunteer" entities.

The MIL-PRF-28000 application subsets specify the entities allowed in that class through a list of ASME Y14.26M entities given in table form. Limits on the entities are given through notes on that table. Rules are also given for the entity construction. Guidance is provided for MIL-PRF-28000 file construction requirements for each section (start section, global section, directory entry section, parameter data section, and terminate section) of an IGES file for each class.

The subset concept addresses many of the user's problems, but is not an entire solution. One difficulty is that the subsets address the needs of applications by directly specifying the particular IGES entities to be included in the subsets, but do not include enough information on how to use those entities to transfer all the product data typically needed by that application. Most IGES entities are general purpose in nature. They can be combined to create constructs needed for product data transfer, such as a circuit in an electrical application, but they do not rigorously define how this is done. This can be a problem in transfer, because unless the receiving system knows how the IGES entities were combined to create the construct, and has a rigorous definition of the meaning of the construct, that receiving system will not be able to interpret the construct. The basic data is translated, but not all the information needed to translate product data for the application is transferred. In general, this is because IGES is designed to exchange product data rather than product "models." See paragraph 8.0 on STEP for further information on standards which support the exchange of product models.

The five application subsets defined within MIL-PRF-28000 are described in the following paragraphs.

Class 1: Technical Illustrations Application Subset. The class 1 application subset is for the exchange of illustrations, normally used for technical publications. The emphasis in a class 1 IGES exchange is on the visual appearance of the illustrations, not on the functionality of the entities within the class. Class 1 is a two dimensional subset with limited non-geometric information (such as subfigures).

Class 2: Engineering Drawings Application Subset. The class 2 application subset is for the exchange of

product data to be delivered as part of a technical data package (TDP). Note that MIL-T-31000, Technical Data Packages, General Specification for, which originally governed the contents of a TDP, has been cancelled and is being transitioned to a detail specification, MIL-DTL-31000. The emphasis in a class 2 IGES exchange is on completeness, functionality of the drawing model, and visual equivalency for human interpretation. The class contains many geometric entities, annotation entities and attributes such as color and line fonts, along with organizational information such as levels and subfigures. The geometric entities in this class are three dimensional, though two dimensional data can be transferred by placing all the information on the same plane within the sending CAD system.

Class 3: Electrical/Electronic Applications Subset. With Revision B of MIL-PRF-28000, the class 3 application subset will be withdrawn, and replaced by the class 6 Layered Electrical Products (LEP) Application Protocol.

Class 4: Geometry for NC Manufacturing Application Subset. The Class 4 application subset is for the exchange of product data for manufacturing by numerical control. It is designed to directly support the geometry data needs of process planning and numerical control (NC) cutter path generation. The emphasis in a class 4 IGES exchange is on the completeness and functionality of the part model. Geometry data for NC manufacturing is either two-dimensional (2D) wireframe, for profiles or sheet metal, or a 3D wireframe model, for multi-axis machining. Precision and accuracy on the wireframe and surface geometry must be maintained, as well as first order continuity. Geometry and Text form the majority of the data for this class.

Class 7: 3D Geometry Subset. The Class 7 application subset is for the exchange of geometry data for manufacturing by numerical control. The emphasis in a class 7 IGES exchange is on the completeness and functionality of the part model. Geometry data for NC manufacturing is used to describe the nominal shape of the part, either as a 3D wireframe, or as a 3D wireframe model with surfaces, such as for multi-axis machining. Geometry data alone forms all of the data items in this class.

4.2.2 -- Application Protocols

An Application Protocol (AP) is a way to transfer defined product data through IGES. An AP documents the user requirements for an application in a graphical model called an Application Reference Model (ARM). The requirements in the ARM are then represented by specific IGES entities in a given AP (the Application Interpreted Model, or AIM). APs enable IGES to be used to transfer product data reliably until PDES/STEP is mature and widely available from the commercial CAD vendors. APs provide a defined and more reliable method for transferring product data through IGES.

- An AP is composed of the following elements:
- A scope and requirements section;
- An Application Reference Model (ARM) of the supported information that explains what is covered in the application and how the different elements relate to one another;
- An Application Interpreted Model (AIM) that shows how the information is mapped into IGES entities; and
- Conformance Requirements and Abstract Test Purposes.

APs are very specific in nature. For example the 3D Piping AP (class 5) exclusively supports the exchange of product data for 3D piping system models. It does not support piping engineering drawings. A user wishing to transfer an engineering drawing of a piping system would have to use an Engineering Drawing AP. Also, only CAD/CAM systems supporting piping will be able to support the piping AP. A CAD/CAM system that does not support piping just does not have the appropriate constructs within its database to either output data in the Piping AP, or input the data reliably. APs will provide increased information transfer, but with a much narrowed scope in the information that is transferred.

Class 5: 3D Piping Application Protocol.: The class 5 application protocol is for the exchange of product data for 3D piping system models, but not piping drawings or internal details of equipment. The class 5 AP conveys shape and location, connectivity, material characteristics, information about elements in the piping system, and the piping system as a whole. The emphasis in a class 5 AP exchange is on the requirements for the fabrication and assembly of piping systems. The class 5 application protocol provides information for the core requirements of: interference analysis, connectivity checks, basic parts lists, graphics presentation, basic piping isometrics, pipe bending instructions, and limited piping redesign. This class 5 AP is not intended for general purpose CAD systems, but for 3D piping system applications only. Both the sending and receiving systems must support the 3D piping system application and the class 5 3D Piping Application Protocol for meaningful exchange.

Class 6: Layered Electrical Product (LEP) Application Protocol. The class 6 application protocol models electrical components and assemblies to support the exchange of electrical product models. The class 6 AP replaces the class 3 Electrical/Electronics Application Subset. The emphasis in a class 6 AP exchange is on the requirements for the fabrication and assembly of electrical systems. The class 6 application protocol uses some entities from IGES 5.1 or later which are not included in earlier versions of IGES. Class 6 files are created in accordance with the ANS US PRO/IPO-111-1996 Layered Electrical Products IGES application protocol.

4.3 -- Status and Planned Extensions

The current revision of MIL-PRF-28000, Revision A, Amendment 1, is based upon an underlying American National Standard (ASME Y14.26M-1989) and the Initial Graphics Exchange Specification (IGES) Version 5.1, both of which were developed by the IGES/PDES Organization (IPO). The OASD CALS Evaluation and Integration Office (EIO) cooperates with the voluntary IPO through the IPO's CALS-PDE Standing Committee. The CALS-PDE reviews proposed changes and suggests new changes at the IPO meetings. The CALS-PDE is a source of IGES technical expertise and is instrumental in ensuring the quality of revisions or amendments to MIL-PRF-28000A. The new performance specification MIL-PRF-28000B is scheduled to be published in the Autumn of 1997. This pending revision of MIL-PRF-28000B, will allow the use of any IGES version from IGES 4.0 (American Society of Mechanical Engineers (ASME) standard Y14.26M-1989, Digital Representation for Communication of Product Definition Data) through the newly-released IGES 5.3.

The following is a list of technical changes that will be included in MIL-PRF-28000B:

- Add class 6 -- IGES Layered Electrical Product (LEP) AP
- Delete class 3 -- Electrical/Electronic Applications Subset

- Update class 2 -- Engineering Drawing Subset to IGES v5.3
- Add Visual Conformance Requirements

4.4 -- Implementation Issues

The method by which the senders of a MIL-PRF-28000-compliant IGES file will produce application subsets is a possible concern for the implementation of MIL-PRF-28000. The preferred method is for the originator's CAD system's IGES translator to produce the MIL-PRF-28000 file. But, an alternative method is for the CAD system to produce the IGES file which is subsequently run through commercial flavoring software to produce the MIL-PRF-28000 compliant file. This method must be performed very carefully to prevent any loss of the file's underlying structure, and is not suited for the transfer of application protocols.

Even perfect transfer of the application subset does not ensure that all of the information in the original CAD model will be translated. For example, a CAD system may recognize objects such as resisters and capacitors in its internal data base, but since IGES has no standard way to represent such objects, these objects may be transferred as a grouping of points, lines and curves which represent the object. The concept that a group of entities represent an object is not necessarily conveyed by the subset to the receiving CAD system. MIL-PRF-28000A displays an awareness of this problem by specifying that "It is the intent of this specification to evolve in the direction of application protocols to ensure quality data exchanges". The application protocol work is being developed within the IGES/PDES Organization to transfer objects within an application area instead of merely a geometric representation with little standardized intelligence attached. The 3D Piping AP is the first AP developed by the IPO.

Most IGES entities are general purpose in nature. They can be combined to create constructs needed for product data transfer, such as a circuit in an electrical application, but they do not rigorously define how this is done. This can be a problem in transfer, because unless the receiving system knows how the IGES entities were combined to create the construct, the receiving system may not be able to interpret it. The basic data will be translated, but all the information needed to translate product data for the application will not be available.

MIL-PRF-28000 does not contain any rationale for why a specific set of entities was chosen for an application subset over another set of entities. This can make extensions to the subsets laborious, and raises many questions from the user and vendor community.

Note that due to the complexity of IGES and CAD systems in general, no CAD software vendor supports every possible IGES entity. This means that IGES translation from one CAD system's pre-processor to another CAD system's post-processor usually results in a mismatch of at least some entities between the two systems. Users are advised to research and test the IGES translation between different CAD systems before relying on them for regular interchange of product data. Test suites of validated IGES entities to assist in this testing are available from several sources, including the CALS Standards Web site at:

<http://www-cals.itsi.disa.mil>.

4.5 -- Extent and Nature of User and Vendor Support

The IGES specification has much support from CAD system vendors. Most CAD systems have some type of IGES translator, and even some non-CAD systems, such as Interleaf (an electronic publications system), support the IGES specification. The support for MIL-PRF-28000 (i.e., the subsets) is not as widespread as the support for the full IGES standard. The greatest stated support of the subsets comes from the commercial flavoring software and syntax checking software. MIL-PRF-28000 class 2, engineering drawings, is the most commonly supported class, followed by MIL-PRF-28000 class 1, technical illustrations. Intergraph has a MIL-PRF-28000 class 5 translator under development.

4.6 -- Additional Documentation

- ASME Y14.26M -- 1989, Digital Representation for Communication of Product Definition Data.

  (ASME Y14.26M was adopted by DoD on 22 December 1989. DoD activities may order ASME Y14.26M from: Department of Defense Single Stock Point, Commanding Officer, Naval Publications and Forms Center (NPFC), 5801 Tabor Avenue, Philadelphia, PA 19120.)

- IGES V5.1 Initial Graphics Exchange Specification (IGES), Version 5.1, September 1991, NISTIR 4412

- US PRO/IPO-100 Digital Representation for Communication of Product Definition Data, IGES 5.2, November 1993

- US PRO/IPO-100-1996 Digital Representation for Communication of Product Definition Data, IGES 5.3, December 1996

- 3-D Piping IGES Application Protocol, Version 1.2 USPRO/IPO-110, September 1993

- US PRO/IPO-111-1996, Layered Electrical Products Application Protocol.

(Application for copies of the above document shall be addressed to: U.S. Product Data Association (US PRO), 2722 Merrilee Drive, Suite 200, Fairfax VA 22031, **Attn:** IPO Administrator.)

Military Standards

MIL-STD-1840	Automated Interchange of Technical Information

(Copies of the referenced military specifications and standards are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

Federal Information Processing Standards (FIPS)

FIPS PUB 79	Magnetic Tape Labels and File Structure for Information Interchange

(Copies of the Federal Information and Processing Standards (FIPS) are available to Department of Defense activities from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue,

Philadelphia, PA 19111-5094. Others must request copies of FIPS from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161-2171.)

National Institute of Standards and Technology (NIST)

IGES V4.0 Initial Graphics Exchange Specification (IGES), Version 4.0, September 1988, NBS88

IGES Technical Illustrations Application Guide, issue date July 19, 1990, NISTIR 4379

IGES 5.0 Recommended Practices (RP) Guide -- May 1991, NISTIR 4600

3-D Piping IGES Application Protocol, Version 1.1, March 1992 NISTIR 4797

(Application for copies of the above documents shall be addressed to the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.)

(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.)

5.0 -- Standardized Generalized Markup Language (SGML) MIL-PRF-28001

5.1 -- Purpose

MIL-PRF-28001 establishes the DoD requirements for the digital interchange of technical publication text using the Standard Generalized Markup Language (SGML) standard. Data prepared in conformance to MIL-PRF-28001 will facilitate the automated storage, retrieval, interchange, and processing of technical documents from heterogeneous data sources.

MIL-PRF-28001 was prepared by Office of the Assistant Secretary of Defense (OASD) Production and Logistics (P&L) CALS and first published on 26 June 1993. The CALS specification MIL-PRF-28001 is the DoD implementation of the international standard ISO 8879 "Standard Generalized Markup Language (SGML)". Some familiarity with SGML is needed to understand MIL-PRF-28001. MIL-PRF-28001 Revision C is currently under development and its anticipated release date is the Spring of 1997.

The CALS SGML specification defines both a methodology and a high level computer language for document representation. It provides a coherent and unambiguous grammar and syntax for describing whatever a user chooses to identify within a document regardless of the type of document or the nature of the document's text. SGML provides a formal markup procedure, also independent of system and output environments, for this purpose. The definition of the document's structure or content in terms of "elements", their "attributes", "entities", and other components is called a "Document Type Definition (DTD)". A DTD defines the structure or framework of a specific class of documents.

"SGML markup" (or an "SGML document instance" or "SGML tagged instance") consists of unformatted ASCII text with inserted SGML "tags" corresponding to the elements and attributes of the DTD. These tags identify elements of the text (e.g., titles, paragraphs, tables, footnotes) defined in the document's DTD.

The "marked up" document (or SGML document instance) can then be "parsed" using special software to determine if the document's tagging conforms to the DTD. The SGML tagged instance is the actual "information content" of a document encoded in SGML.

The third and final required element to complete an SGML document is some form of output specification. MIL-PRF-28001 defines a Formatting Output Specification Instance, or FOSI. The international SGML community has been developing the Document Style Semantics and Specification Language (DSSSL) for a number of years, and the DSSSL approach is beginning to be implemented. The FOSI was designed as an interim approach to meet DoD needs, and may be supplanted by DSSSL as DSSSL implementations mature.

MIL-PRF-28001 does not contain any DTDs to be used for delivering data to the Government. MIL-HDBK-28001, Application of MIL-PRF-28001 Using Standard Generalized Markup Language (SGML), provides the so-called "template" DTD in appendix A. Its chief function is to serve as a "toolkit" for the construction of DTDs by providing SGML coding that can be incorporated or modified in DTDs being developed. The template DTD also provides a set of elements and attributes for use in new DTDs. DTDs developed by each of the services can be found on the World Wide Web.

A "declaration subset" is used to define a new DTD in terms of changes to an existing DTD. The implementation of the changes in a declaration subset results in a complete and different DTD for the corresponding military specification. The use of such "declaration subsets" in creating new DTDs this way actually allows tighter control over the number of distinct DTDs. While DoD wishes MIL-PRF-28001 to be implemented in a wide variety of applications, DoD is also quite concerned with the uncontrolled proliferation of DTDs, which would require skilled maintainers and extensive configuration control efforts to manage effectively.

New DTDs must be developed for all applications of automated technical publications for which existing CALS DTDs are inadequate. New DTDs should be constructed using those elements and attributes of the "template" DTD as defined in Appendix A of MIL-HDBK-28001 whenever possible. This Appendix provides general guidance for development of DTDs. The DTD for a given class of documents such as technical manuals will either be provided in the governing specifications for such documents or else be completely specified within the governing specifications.

5.2 -- Applications

Several DoD activities have centered around the re-use of already-developed SGML DTDs and SGML tags or elements. See the CALS SGML Library and CALS SGML Registry at the CALS Standards WWW site:

<**http://www-cals.itsi.disa.mil**>

Numerous DTDs have been developed, including those DTDs developed by the Air Force under the Technical Manual Specifications Standardization (TMSS) program, as well as a Work Package DTD developed for Naval Air Systems Command (NAVAIR). These DTDs will be included or specified in the appropriate functional specifications. DTDs can be obtained through the World Wide Web at:

Air Force:	http://wpcdso1.wpafb.af.mil
Army:	http://www.asrl.com/construct.htm
Naval Forces:	http://navycals.dt.navy.mil

MIL-PRF-28001 is primarily concerned with the digital interchange of paper-based manuals, although MIL-PRF-28001 Revision C will include at least limited screen display capabilities. However, efforts are underway to fully define the digital interchange of "paperless", i.e., screen medium technical publications. The MIL-PRF-87269 specification uses SGML to specify a revisable data base for the support of interactive electronic technical manuals (IETMs).

5.3 -- Status and Planned Extensions

It is in the interest of both DoD and industry to agree on the widest applicable set of conventions for the preparation and interchange of publications for defense and non-defense use. The following is a list of technical changes that will be included in MIL-PRF-28001C, scheduled to be published in the Spring of 1997:

- Better identify the contents of an SGML application.
- Provide guidance on registering SGML objects in the CALS SGML Library (CSL).
- Provide common rules for developing a Formal Public Identifier (FPI) within the DoD.
- Provide restrictions on developing program-specific SGML objects.
- Refer to data format performance specifications to specify notation declarations.
- Modify the CALS SGML Declaration to allow SUBDOC and to change the declaration quantities and capacities.
- Remove a significant amount of explanatory information which is duplicated in MIL-HDBK-28001.
- The new CALS SGML constructs, Presentation Specification (PS) and Formatting Presentation Specification Instance (FPSI), are introduced in section 3.6.
- A "conforming" SGML document shall include a Formatting Output Specification Instance (FOSI), FPSI, DSSSL, or "style sheet" as specified per contract.
- Acquisition and tailoring requirements are defined in section 6.2.
- Appendix A is completely new. Appendix A now contains expanded information on how to implement the options listed in paragraph 6.2 of the specification. Generalized SGML information and the Example DTD were moved to MIL-HDBK-28001. The SGML Declaration has been moved to section 3 of the specification.
- Appendix B, the Output Specification has been modified extensively.

- Appendix C is completely new. Appendix C is an enhancement of the OS DTD to allow for the electronic formatting and display of SGML tagged data. Data format notation declarations are now specified in their governing specifications (e.g., MIL-PRF-28002). Character sets and replacement text entities have been removed. Math and electronic review subsets have been moved to MIL-HDBK-28001.

MIL-PRF-28001 also includes features which provide a more comprehensive specification for the interchange of SGML data. Such applications include the specifications for an Output Specification, Electronic Review, and Partial Document delivery. These specifications are briefly discussed below.

5.3.1 -- Output Specification

In order to format an SGML source file, associated formatting information must be provided. This associated formatting information must define formatting characteristics such as a page model, font and family characteristics, point size, indenting, etc. A standard language was developed for providing the associated formatting information of SGML instances. This language is in SGML and is in the form of an "Output Specification" (OS) DTD. Appendix Bof MIL-PRF-28001 contains the CALS paper medium OS DTD.

The OS DTD defines a finite set of formatting characteristics used to rigorously describe the composition processing functions to be performed with respect to the tags of a SGML source file. A Formatting Output Specification Instance (FOSI) is an instance of the OS DTD. The FOSI defines values for the formatting characteristics defined in the OS DTD for every SGML element used in the document DTD, taking into account every context in which the SGML element has a unique formatting requirement. For example, a title of a TM/TO chapter is formatted differently than a title of a TM/TO subparagraph. The objective of the FOSI is to rigorously define the format style of the document to be produced from the SGML tagged source file, as required by the appropriate functional specification (MIL-M-38784C, etc.).

A FOSI should be developed for each DTD to describe all default formatting characteristics necessary to compose and publish a document authored according to that DTD. The FOSI should be delivered with the SGML source tagged file. Since all FOSIs will be written with respect to the standard OS (paper medium), vendors will be able to develop software that can accept and process FOSIs and interface with the publishing software. However, such automatic processing of a FOSI is not a requirement of MIL-PRF-28001.

5.3.2 -- Electronic Review

MIL-PRF-28001 provides a mechanism which enables an electronic review and comment capability for SGML tagged source files. This capability allows reviewers located in diverse environments to make and exchange comments electronically on multiple copies of a document file over a network. The comments may then be sorted, processed, and incorporated into the document by the file "owner".

The mechanism for electronic review of SGML tagged source files consists of certain SGML constructs which are incorporated into a DTD for a given document type. These SGML constructs have been defined as generally as possible to take into account the many kinds of reviews: internal contractor reviews, Government reviews, contractor/Government reviews, specification reviews, etc.

Plans for future extensions of electronic review include both a CALS graphics comment capability using SGML tagging for the comments, and a capability to link SGML text and CALS graphics files for related changes. Efforts will also be made to develop a more precise addressing mechanism for indicating the location within document elements of a proposed change.

5.3.3 -- Partial Documents

Partial document delivery is used to transmit SGML tagged source data either as an interim deliverable or as an update package containing data for a document that has been previously delivered (e.g., "change pages"). Its purpose is to minimize the retransmission of unchanged data or to indicate incomplete data. Partial document delivery is not intended to address the issues of page integrity or fidelity, nor is it intended to include specific change pages. The intent of this methodology is to allow the delivery of certain portions of a source document such that the receiving system can identify the location of the information in the original document and perform the appropriate addition, deletion, or replacement operations. Both the manner in which this is accomplished and the effect of the change on composition depends on the receiving system.

5.4 -- Implementation Issues

MIL-PRF-28001 has undergone extensive revisions since its initial publication on 26 February 1988. SGML is a complex and voluminous language, and MIL-PRF-28001 contains a large subset of its specifications and/or recommendations for the interchange of data. Some of these have not been thoroughly tested, including:

- the method for tagging mathematical equations (moved to MIL-HDBK-28001, as guidance information at this time)
- the sufficiency of OS/FOSI to describe format requirements
- the linkage of SGML source files with graphics
- the receipt of partial "change package" documents from contractors

Currently, there are no tests for vendor products claiming conformance to MIL-PRF-28001. Such MIL-PRF-28001 product conformance testing will depend upon the product's function. For instance, conformance testing of SGML parsers entails the correct interpretation of ISO 8879. Conformance testing of "auto-taggers" or "authoring stations" would be limited to determining the parsability of the instances generated, and again would involve correct ISO 8879 interpretation. With few exceptions, there is no disagreement regarding the correct interpretation of ISO 8879.

However, conformance testing of CALS SGML publishing systems involves MIL-PRF-28001 compliance but MIL-PRF-28001 does not rigorously define system requirements. For example, while MIL-PRF-28001 specifies the requirements of a FOSI, it does not require a system to automatically process such a FOSI. Therefore, MIL-PRF-28001 conformance testing of a publishing system would likely be limited to tests for CALS data acceptance and valid document formatting. At this time, MIL-PRF-28001 testing usually amounts to a "sufficiency check" of the tool in use; e.g., "can I get it to

give me the output I want to see?"

5.5 -- Extent and Nature of User and Vendor Support

The vendor community is aware of the evolving nature of MIL-PRF-28001. Some vendors are waiting until the standard is finalized, while other vendors are undertaking full implementations at the present time. A large vendor community is represented on the CALS Industry Steering Group (ISG) Electronic Publishing Committee. For the CALS environment, vendors supporting MIL-PRF-28001 should not "hard-code" their systems to process only a single DTD or FOSI. Certainly, most users will be processing a variety of technical publications which must conform to multiple DTDs and will require a system that can be configured to adapt to new and changing requirements as they arise.

Currently there are various types of SGML software products available on the Internet or in the commercial market, including:

- SGML parsers. Such parsers check DTDs for conformance to the SGML grammar and syntax. They also check document instances for conformance to a given DTD. They return error reports on errors found in the parsing process. Many other SGML software packages (e.g., SGML editors) come with a "built-in" parser.

- SGML authoring and editing software which "understands" the DTD as it is given. Such software guides an author through the creation of a document, not requiring the author to type in the SGML tags. The keyed-in text is automatically formatted and displayed (non-WYSIWYG) on the screen.

- SGML Publishing systems which accept an SGML-tagged document and associated graphics and compose the entire document in accordance with the document's format specifications, whether in the form of a FOSI or system-internal "style-sheet".

- Software which automatically tags an ASCII file based on format-driven triggers. Most of the "structure" type tags (for paragraphs, lists, etc.) can be automatically generated without any trouble. However, unless the software is very sophisticated, the "content" type tags (for cross references, equipment numbers, etc.) cannot be automatically generated. Content type tags are very important in data base applications. This "auto-tagging" software can be used in conjunction with media converters to translate formatted "system-dependent" files (i.e., "WordPerfect") into SGML files.

Because of the international nature of the SGML standard, more and more software vendors are beginning to make their publication products at least "SGML-aware," so users can read a tagged instance and get at least some output. However, SGML tools remain a relatively immature field at this writing, especially for office automation software.

5.6 -- Additional Documentation

The primary SGML reference document is the International Organization for Standardization publication, ISO 8879 "Information Processing -- Text and Office Systems -- Standard Generalized Markup Language

(SGML)". This is the authoritative source for SGML, and it provides the most general description of SGML. All non-proprietary SGML implementations are based on the meta-language defined therein.

Additional documents providing general and technical background information on SGML are:

- MIL-HDBK-28001, Application of MIL-PRF-28001 Using Standard Generalized Markup Language (SGML).
- "SGML: The User's Guide to ISO 8879" by Joan M. Smith and Robert Stutely (John Wiley, 1988) -- chiefly an index and cross-reference to ISO 8879.
- "The SGML Handbook" by Charles M. Goldfarb (Oxford University Press, 1990) -- essentially an annotated version of ISO 8879.
- "SGML An Author's Guide to the Standard Generalized Markup Language" by Martin Bryan (Addison-Wesley, 1988) -- a general introduction to SGML.
- "Practical SGML" by Eric Van Herwijnen (Kluwer Academic, 1990) -- another general introduction to SGML.

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