GUIDANCE ON ACQUISITION AND CONVERSION OF LOGISTICS PRODUCT / TECHNICAL DATA TO DIGITAL FORM

(Revision 1)

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Table of Contents

PREFACE

This document is a revision to the document first published in November 1999. The revisions reflect both the evolution of the Department of Navy planned uses and architectures for Logistics technical data, as well as, the evolution and maturation of the digital data format specifications and standards and related software implementation tools. The principal revisions are:

- Increased emphasis on Extensible Markup Language (XML) as the markup language of choice for technical publications
- Increased emphasis on WebCGM as format for 2D vector data
- Inclusion of Scalable Vector Graphics (SVG) as a choice for 2D vector data
- Stronger endorsement of the Adobe Systems' Portable Data Format (PDF) as an economical conversion format
- Updates to references and web-sites

This guidance was developed by the Technical Information Systems Department, Code 205, at the Naval Surface Warfare Center, Carderock Division, in Bethesda, MD, working in support of the Logistics Planning and Innovation Division (N40) of the Office of Deputy Chief of Naval Operations for Fleet Readiness and Logistics (N4/N4B). Implementation assistance may be obtained from NSWC Carderock Division through contacts listed on **http://navycals.dt.navy.mil**.

1. INTRODUCTION

This document provides Department of the Navy (DON) programs and activities specific guidance on how to specify digital data formats for both the acquisition of new technical data and also the conversion of legacy data to digital forms that support the migration toward an integrated digital data environment (IDDE). The digital data formats set forth below apply to any data developed by programs or activities that must be distributed or used outside of the program or activity or used within the DON infrastructure programs and systems. The guidance considers both existing technologies and existing data standards and specifications for identifying the desired digital formats. These acquisition and conversion efforts and these digital formats support the goal of the DON's digital data policy to achieve an integrated digital data environment for logistics technical data and support the DON strategy to exploit World Wide Web (WWW) and Internet technology to access, distribute, and use logistics data. The data standards referenced are the best available for the data types identified and comply and agree with the DON Information Technology Standards Guidance. The latest versions of all standards are to be assumed unless otherwise specifically identified within the guidance. As the standards and related digital technologies mature, and as DON requirements and strategies evolve, this guidance will change, clarify, and expand.

This guidance document focuses on logistics technical data that takes the form of engineering data, schematics, drawings, and technical manuals because digital formats for these forms are supported by published commercial and Government performance standards and common DON conventions and practices. These standards-based digital forms for logistics technical data provide the foundation for interoperability that will be required to achieve the sharing and integration of technical and training data discussed in Section 6. Many other components of acquisition and life cycle support logistics data, such as provisioning, configuration management, software/firmware and supply support, are not addressed because neither suitable standards nor DON consensus exist on the treatment of these forms of digital data. When the DON agrees on these standards and conventions, they will be incorporated within this document.

The DoD has published military performance specifications and standards, and endorsed commercial standards, for the data types discussed in this guidance, specifically: 1) character data and document text, 2) raster data (bitmaps), 3) vector data (lines), and 4) Computer Aided Design (CAD) data (models). These four data types constitute major components upon which a technical data IDDE is built, e.g., publications, drawings, and engineering models. Guidance to help program managers make informed decisions in the acquisition of this digital data is provided by the Naval Surface Warfare Center Carderock Division in conjunction with the Navy Logistics Planning and Innovation Office (N40), (**http://navycals.dt.navy.mil/calsdata/**). New programs are encouraged to develop a Government Concept of Operations (GCO) as part of the acquisition process. The GCO should address the configuration status accounting of the data, the types of digital data to be acquired, and how it is to be stored, managed, distributed, used, viewed within the DON community and its associated information technology infrastructure. The Logistics Planning and Innovation Division (OPNAV N40) will be following up this Guidance with a Navy *Contracting for Technical Data Handbook* to assist acquisition managers in buying logistics product and technical data.

The data formats and conventions to be used for the digital logistics technical data covered by this guidance are summarized in the sections below. For quick reference, the formats and data standards recommended within this document are summarized in tables contained in Appendix A. Appendix B is a guide to World Wide Web (WWW) resources providing additional information for implementation of digital technical data.

2. ACCESS CONTROL FOR DIGITAL DOCUMENTS

All documents, whether created digitally or subsequently digitized from paper or aperture cards, must be properly marked for access control, including as applicable: the document's security classification, export control status, no-foreign-access status, distribution statement, and data rights limitations. Security and access control requirements and procedures apply to digital data just as they do to paper or other hard copy documents. Digital technologies and formats for encryption and secure transfer of data will be addressed in future versions of this guidance document when DON agrees upon suitable standards and conventions. The formats and conventions identified in this Guidance have been selected to guarantee that the digital data is created, received, maintained, and distributed in common, neutral formats that will allow DON to minimize and simplify DON corporate investments in managing, viewing, and application software.

3. SPECIFICATIONS FOR DRAWINGS AND ENGINEERING DATA

This section deals with formats for two and three-dimensional engineering product data including models, drawings, schematics, and illustrations and also geospatial data deliverables for installations and facilities. Included are Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), and Computer Aided Engineering (CAE) product data for weapon systems and platforms as well as architecture, engineering, and construction data for facilities.

3.1 Product Data and CAD Data

Product data, engineering design and manufacturing data (CAD/CAM/CAE), 3-D vector data, and product model data should be delivered in a data definition format for neutral file exchange in accordance with the **Standard for the Exchange of Product Model Data STEP (ISO 10303)**. STEP should be used for product and CAD data in those areas for which a STEP application protocol (AP) is defined.

Current approved APs that are recommended for use are:

> **AP202: Associative draughting (ISO 10303-202:1996):** Supports exchange of computer-interpretable drawing information and associated 2 and 3-D product geometry and definition data.

AP203: Configuration controlled 3D designs of mechanical parts and assemblies (ISO 10303-203:1994): Defines exchange of configuration controlled-design information and 3D geometrically bounded wireframe and/or surface models exchange.

AP207: Sheet metal die planning and design (ISO 10303-207:1999): Supports exchange of information to enable the manufacturing/stamping of sheet metal parts using dies.

AP209: Composite and metallic structural analysis and related design (ISO 10303-209:2001): Enables exchange of composite and metallic structural product definition including their shape, their associated finite element analysis (FEA) model and analysis results, and material properties.

AP210: Electronic assembly, interconnect and packaging design (ISO 10303-210:2001): Specifies the information requirements for exchange of the design of electrical printed circuit assemblies.

AP212: Electrotechnical design and installation (ISO 10303-212:2001): Specifies information requirements for the exchange of design information of electrotechnical plant, industrial, and ship systems.

AP214: Core data for automotive mechanical design processes (ISO 10303-214:2001): Provides exchange of information between various applications which support the development process of a vehicle.

AP215: Ship arrangement (ISO 10303-215:2004): Describes exchange of three-dimensional product definition data and its configuration status information for Naval and commercial ship arrangements.

AP216: Ship moulded forms (ISO 10303-216:2003): Provides for exchange of ship moulded form definitions, geometric representations, and related hydrostatic properties.

AP218: Ship structures (ISO 10303-218:2004): Specifies the use of the integrated resources necessary for the scope and information requirements for the exchange of product definition data and its configuration and approval status information for ship structural systems such as plates, stiffeners, and welding.

AP224: Mechanical product definition for process planning using machining features (ISO 10303-224:2001): Specifies the information needed to exchange product data necessary for manufacturing single mechanical parts and assemblies.

AP225: Building elements using explicit shape representation (ISO 10303-225:1999): Supports exchange of building element shape, property, and spatial arrangement information requirements for buildings.

AP227: Plant spatial configuration (ISO 10303-227:2001): Specifies the use of the integrated resources necessary for the exchange of spatial configuration and manufacturing information of process plant and ship piping. The next edition will support HVAC, mechanical systems, and cable trays.

AP232: Technical data packaging core information and exchange (ISO 10303-232:2002): Enables exchange of product information so that configuration controlled exchanges can be achieved among Product Data Management (PDM) systems.

AP232 supports bundling of multiple STEP files and formats and any other documents and formats agreed to by the exchange partners.

Information about the STEP standard, what application protocols exist, and their status may be obtained from the "STEP on a Page" web site maintained by the National Institutes of Standards and Technology (NIST) at **http://www.mel.nist.gov/sc5/soap/**. The Shipbuilding Team (T 23) within the STEP standard work group (TC 184/SC 4/WG 3) of ISO is maintaining and developing STEP APs for shipbuilding. Information on ship APs may be obtained from the T 23 web site (**http://www.usashipbuilding.com/niddesc/t23.html**).

3.2 Computer Aided Drafting and Design (CADD) Data for Naval Facilities and Installations

CADD drawings used for the planning, design, construction, operations, maintenance, and demolition of Department of the Navy facilities and installations should be delivered in conformance with the US National CAD Standard. The American Institute of Architects, the Construction Specification Institute (CSI), and the CADD/GIS Technology Center developed this standard under the auspices of the National Institute of Building Sciences (NIBS) for Facilities, Infrastructure and Environment (hereinafter referred to as CADD/GIS Technology Center) with support from the United States Coast Guard. The standard can be ordered on-line from **http://www.nationalcadstandard.org**. Drawings should be prepared for bid solicitation in accordance with the NAVFAC Electronic Design Deliverable Manual of Policies and Procedures, **http://www.efdlant.navfac.navy.mil/downl/lantops_04/ebs/LantDiv_EBS_Manual.pdf**.

3.3 Digital Geospatial Data Deliverables for Naval Installations

Digital geospatial data used for the planning and management of DON facilities, land and associated environmental planning and management purposes shall be acquired and managed in conformance with the latest version of the following standards and policies:

- ***Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE)*** (previously named ***Tri-Service Spatial Data Standards***), ANSI/NCIT Standard 353, developed by the CADD/GIS Technology Center, **http://tsc.wes.army.mil/products/TSSDS-TSFMS/tssds/html/**. The standards are harmonized with and extend the Federal Geographic Data Committee (FGDC) standards at **http://www.fgdc.gov** required by Executive Order

12906 of 11 April 1994, "Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure".

- ***FGDC Content Standard for Digital Geospatial Metadata*** (CSDGM). This FGDC metadata standard shall be used to document Navy facilities, land and associated environmental planning and management geospatial data. The metadata shall be made electronically accessible to the National Spatial Data Clearinghouse (**http://www fgdc.gov/clearinghouse/clearinghouse.html**) by submission to the CADD/GIS Technology Center node (**http://tsc.wes.army.mil/products/metadata/**) of the Clearinghouse.

- ***NAVFAC Guidelines for Installation Mapping and Geospatial Data*** (**http://www.foundationknowledge.com**)**.** This guideline, which is a companion document to the CADD/GIS Technology Center's ***Guidelines for Installation Mapping and Geospatial Data*** (**http://tsc.wes.army.mil/downloadtracking/DownloadData.asp?PID=107**), shall be used for acquiring facilities, installation, and environmental mapping and geospatial data.

3.4 2-D Drawings, Illustrations, and Schematics

Two dimensional drawings, illustrations, and schematics, not intended for Computer Aided Design (CAD) applications, may be delivered in several different formats. The choice of recommended format should be governed by the nature of the image, the intended use of the image, the software tools used to create the image, and the hardware and software available to users for viewing the image. Two-dimensional drawings, illustrations and schematics intended for static (vice animated) image presentations are usually delivered in either a raster (bit-map) or vector format. The raster formats are recommended for the simple capture of existing drawings not already in an acceptable vector format and also half-tone images, and photographs. Vector formats are preferred for all new 2-D drawings, schematics, and illustrations to be delivered to the Government. Acceptable raster and vector formats and their relative advantages are discussed in the following sections. Images required for use in CAD environments should be delivered in engineering CAD formats.

3.4.1 2-D Raster Image Formats

Acceptable raster image formats include commonly used commercial standards (TIFF, BMP, JPEG, and PNG) and two military formats (Types 1 and 4 in MIL-PRF-28002). Each is best suited for different types of images and image presentation effects. Raster formats, in general, are best suited for static images with no requirement for navigation (hot-spotting, hyper-linking) within the image, and no need to attach metadata or added information to text or graphic elements within the image.

3.4.1.1 Commercial Raster Formats

There are four commonly used and acceptable raster formats:

- **TIFF** (Tiled Image File Format) is a commonly supported industry standard format for the representation and compression of bit-map renditions of images. TIFF is best suited for black and white images. (**http://partners.adobe.com/asn/developer/pdfs/tn/TIFF6.pdf**)

- **BMP** (Bit Map Picture) (**http://www.dcs.ed.ac.uk/home/mxr/gfx/2d/BMP.txt**) is a commonly supported raster format, often used in place of TIFF, and most suitable for monochrome images. Both TIFF and BMP provide high image fidelity (i.e., very accurate rendition of the original image consistent with the precision allowed by the selected scan density, or "dots per inch", of the conversion process).

- **JPEG** (Joint Photographic Experts Group) (**http://www.jpeg.org/**) is an international standard for color image (and halftone photograph) sampling and compression. JPEG allows selectable compression ratios that achieve smaller files sizes at the expense of image fidelity (a so-called "lossy" compression of the image). JPEG is a good choice for photographic images and is suitable for applications requiring conveyance of only a visual image.

- **PNG** (Portable Network Graphics) (**http://www.w3.org/Graphics/PNG/**) is a royalty-free replacement to the royalty-required Graphic Interchange File (GIF) format. It was also designed to replace TIFF. Unlike BMP, it can handle both grayscale and color images. Unlike JPEG, it has a lossless compression. However, PNG should not be used for photographic images where JPEG is superior for that application. Web Browsers natively support PNG (**http://www.libpng.org/pub/png/pngstatus.html#browsers**).

3.4.1.2 Military Raster Formats

MIL-PRF-28002C, Raster Graphics Representation in Binary Format, 30 September 1997, specifies two acceptable raster formats. The preferred raster formats in MIL-PRF-28002 are either the Joint Engineering Data Management Information and Control System **(JEDMICS) C4 (CALS Type 4)** compressed image format, or the **CCITT Group 4 (CALS Type 1)** compressed format specified therein. DON acquisition and conversion efforts should not use the ODA/ODIF format (CALS Type 2) included within MIL-PRF-28002. The C4 format is recommended for engineering drawings to be easily accommodated within JEDMICS.

3.4.2 2-D Vector Images Not Intended for CAD

Vector formats are preferred for all new 2-D drawings, schematics, and illustrations delivered to the Government. The preferred vector formats for products that are not intended for computer-aided design (CAD) applications are the Computer Graphic

Metafile (**CGM**) and Scalable Vector Graphics (**SVG**). Each of these formats is based on international and World Wide Web standards. Each has advantages depending on the type of image desired and the current and future functionality intended, or anticipated, for, and within, the images. CGM is ideal for static vector images and provides options for including hot spotting, linking and other WWW navigation functionality within the image itself. SVG is better suited for animation than is CGM. SVG also supports image-filtering (e.g., flashing, blurring, lighting, etc.) effects for the World Wide Web and has an XML-encoded format. The merits of these two formats are further discussed in the following two sections. Programs and activities should pay careful attention to the degrees of functionality available in each and to the impact on user viewing environments.

3.4.2.1 CGM for Vector Graphics

Vector graphic images for 2-D drawings, schematics, and illustrations should be delivered to the Government in CGM in accordance with the international specification, ISO/IEC 8632, and either the implementation profile specified by **WebCGM** recommendation, REC-WebCGM-19990121, or the profile specified in MIL-PRF-28003.

3.4.2.1.1 WebCGM

WebCGM, published by the WWW Consortium (W3C), (**http://www.w3.org/Graphics/WebCGM**) is a CGM implementation profile designed to support interoperability of CGM, Version 4 applications in web presentation and viewing environments. WebCGM will support WWW navigation, hot spotting, and hyper-linking among graphic components and text elements. WebCGM has been developed by CGM Open (**www.cgmopen.org**) and through the collaboration of the major CGM software tool developers. These tool developers support WebCGM in their newer product releases. WebCGM also supports Versions 1, 2, 3 of CGM and, at that level, is compatible with the profiles specified for these in MIL-PRF-28003 CGM.

3.4.2.1.2 MIL-PRF-28003 (CGM)

The military specification, MIL-PRF-28003, defines an implementation profile for Versions 1, 2, and 3 of CGM and also cites the WebCGM profile. Versions 1, 2, and 3 of CGM define progressively larger sets of graphic primitives with which to build progressively more complex vector graphic images. The CGM Versions 1, 2, and 3 do not support navigation and hyper-linking within the CGM image; however, MIL-PRF-28003 images can be presented and viewed on the WWW with appropriate CGM viewer tools.

3.4.2.2 SVG for Vector Graphics

Vector graphics requiring animation, gradients, or XML as the foundation should use SVG in accordance with Recommendation 1.0 of the World Wide Web Consortium (W3C) (**http://www.w3.org/TR/2001/REC-SVG-20010904/**). SVG is presently supported by

a number of implementations (http://www.w3.org/Graphics/SVG/SVG-Implementations.htm8). A test suite is available (http://www.w3.org/Graphics/SVG/Test/). SVG has both native and Document Object Model (DOM) controlled animation features as described in Chapter 19 of the recommendation (http://www.w3.org/TR/SVG/animate.html). In addition, an "event model" has been defined for SVG providing functionality based on user interaction (http://www.w3.org/TR/SVG/interact.html#SVGEvents).

3.4.2.3 Factors Governing the Selection of CGM/WebCGM and Scalable Vector Graphics (SVG)

SVG and CGM (WebCGM in particular) are similar formats. CGM is a well established; stable standard supported by a mature set of software implementation tools. The set of tools supporting SVG is not as well established at this time. SVG is fully encoded in XML and some SVG advocates see this as a potential advantage as it will allow XML concepts or tools, such as XSLT (Extensible Stylesheet Language Transformations), to be applied to SVG images to achieve special transformation and visual effects. However, CGM images can be embedded within XML files or documents and displayed in XML applications. Each format requires special plug-in software to be viewed with web browsers. There is no compelling reason for programs with existing investment in CGM/WebCGM data to change to SVG. Both SVG and CGM/WebCGM data can reside in the same data base management system (DBMS). The size of the existing CGM/WebCGM repository investments in authoring and publishing tools may justify continued acquisition of CGM/WebCGM graphics. Furthermore, CGM/WebCGM can be transformed into SVG with relative ease and newer CGM/WebCGM tools can create SVG from CGM/WebCGM on the fly for delivery to the web.

3.4.3 2-D Images Intended for CAD

Two dimensional drawings, illustrations, and schematics, intended for CAD applications, should be delivered in accordance with **STandard for the Exchange of Product model data (STEP), ISO 10303, AP 201:1994 (Explicit Draughting) or AP 202:1996 (Associative Draughting)** format. If the visual accuracy of the image is critical then the vector form should be accompanied by a raster representation of the image in a format discussed in 3.4.1.

3.4.4 Indexing 2-D Drawings, Illustrations, and Schematics

Users must deliver all 2-D and 3-D drawings and illustrations with complete and accurate indexing data. Indexing data are identifiers and attributes that allow the receiver of the images to associate each with complete documents, and to associate documents with one another and with the correct material items. The 2-D images should be delivered as required by the JEDMICS Compact Disk Engineering Data Exchange (preferred) or as designated by MIL-STD-1840C.

3.4.5 3-D Vector Images Not Intended for CAD

Three dimensional drawings, illustrations, and schematics, not intended for CAD applications, should be delivered in digital 3-D vector format in accordance with the Virtual Reality Modeling Language (VRML97), ISO/IEC 14772-1:1997 (**www.web3d.org**). X3D is a developing specification within the international standards community that is generally expected to replace VMRL. X3D has reached Final Committee Draft status within ISO. Government programs should wait for X3D to achieve final publication status before citing it on contracts.

3.5 Electronic Motion Pictures

The recommended international standards for digital audio and video images are those developed by the Motion Picture Experts Group (MPEG) of the International Standards Organization (ISO/IEC/JTC1/SC29/WG11) (**http://mpeg.telecomitalialab.com**). These standards are:

- MPEG-1 (ISO/IEC-11172) for coding of motion pictures and associated audio for digital storage media at up to about 1.5 Mbits/sec.; for such products as video CDs
- MPEG-2 (ISO/IEC-13818) for generic coding of moving pictures and associated audio information; for such products as digital TV and DVD
- MPEG-4 (ISO/IEC-14496) for multimedia for user interaction and web applications.

3.6 Conversion of Legacy Drawings to Digital Format

Conversion of legacy data to digital involves careful business decisions regarding what to convert and what format the conversion should deliver:

- Conversion of drawings or graphics to vector formats is more expensive than conversion to bitmap or raster data but the vector data can be more versatile and easier to update.

- The legacy graphics themselves should be carefully assessed as to their importance, continuing usefulness with respect to product life cycle and maintenance, and anticipated frequency of use and modification before deciding on a target format for the conversion.

- Drawings that will require frequent modifications are best candidates for vector conversion because the vector formats are easier to modify.

- The conversion to raster is generally cheaper but provides a bitmap image of the original that is not easy to modify.

- The conversion to vector, however, can result in digital image files that are larger than those produced by raster conversion and just as difficult to manipulate, unless human intervention is included in the conversion process to improve the vector images. The human intervention desirable in vector conversion can achieve efficiency in file sizes and

subsequent ability to manipulate the images, but does so at the expense of higher conversion costs.

3.6.1 Conversion Formats for Legacy Drawings

Existing (legacy) hard copy paper and aperture card drawings, illustrations, and schematics should be converted to 1) a raster format in accordance with MIL-PRF-28002, TIFF, BMP, JPEG or PNG or 2) a vector format CGM per MIL-PRF-28003 (which includes WebCGM) or SVG. The preferred raster formats in MIL-PRF-28002 are either the Joint Engineering Data Management Information and Control System (JEDMICS) C4 (CALS Type 4) compressed image format, or the Navy Image File Format (NIFF) (CALS Type 3) compressed image format, or the CCITT Group 4 (CALS Type 1) compressed format specified therein. DON acquisition and conversion efforts should not use the ODA/ODIF format (CALS Type 2) included within MIL-PRF-28002. The C4 format is recommended for engineering drawings to be easily accommodated within JEDMICS.

4. SPECIFICATIONS FOR TECHNICAL MANUALS/DOCUMENTS

Technical manuals are to be acquired, authored and developed in either the Standard Generalized Markup Language (SGML) or the Extensible Markup Language (XML) as described in Section 4.1. Legacy hard copy technical manuals may be converted to SGML or XML, or Portable Document Format (PDF) or raster formats, where document use and content do not warrant the added expense of conversion to SGML/XML. The DON CIO has published the "DON Policy on the Use of Extensible Markup Language (XML) of December 2002" dated 13 December 2002 and the "Department of the Navy XML Developers Guide, Version 1.1" dated 1 May 2002 to promote interoperability in the exchange of data. Specific guidance for the XML Technical Manual developer is being written to accompany the DON XML Developer's Guide. The DON CIO guidance for XML in TMs is not expected to conflict with this Logistics technical data guidance. TM developers are encouraged to follow the guidance presented below and also to monitor the progress of the DON CIO XML guidance for technical publications. This logistics guidance will be updated if necessary when the DON CIO guidance is completed.

4.1 New Technical Manuals

All new technical manuals should be acquired and authored in digital form in XML in accordance with the W3C Recommendation, "Extensible Markup Language (XML) 1.0 (Second Edition)." For the special exceptions identified below, new technical manuals may be acquired in the Standard Generalized Markup Language (SGML) in accordance with MIL-PRF-28001. The selection of XML or SGML is discussed in the following section. U. S. Marine Corps acquisitions should follow specific USMC guidance contained in Section 4.1.7.

4.1.1 Factors Governing Selection of XML or SGML

XML was conceived within the World Wide Web community as both a simplification and enhancement of SGML that would more easily provide the markup language functionality of SGML on the World Wide Web. In the past two years, XML has matured rapidly since its publication as a W3C Recommendation. The XML specification has been formally published, a wide range of software tools is commercially available, and XML has become the industry-preferred format for WWW applications. The strength of the XML technology and current DON plans and strategies for web-enabling applications and data (Department of Navy, *Web-Enabling Navy Logistics, Implementation Plan,* June 2001) make XML the preferred format for new technical manual (TM) acquisitions.

Programs and activities with no existing digital data in the SGML format should acquire and author new technical manuals in XML in accordance with the W3C Recommendation, "Extensible Markup Language (XML) 1.0 (Second Edition)" as described below in Section 4.1.1.1.

Programs with existing investment in SGML data need not migrate to XML immediately as it may not be cost-effective for them. The amount of the existing SGML data, the need

to use an SGML DTD (Document Type Definition), and the investments in DTDs, style sheets, and publishing tools are valid reasons for continuing acquisition of SGML TMs. Since SGML and XML are quite similar it is relatively easy to transform SGML into XML for rendition on the web. This reduces the risk of SGML-based programs from being excluded from the preferred DON web-based data environment. It should also be noted that XML and SGML data can reside in the same SGML/XML data base management system (DBMS), and most SGML/XML DBMSs can create XML from SGML on the fly for delivery to the web. Programs who need to continue acquisition of TMs in SGML should follow guidance set forth in Section 4.1.1.2.

4.1.1.1 XML for New Manuals

Programs and activities, that have no business case to remain in an SGML environment, should author and acquire new technical manuals (TMs), Electronic Technical Manuals (ETMs), and Interactive Electronic Technical Manuals (IETMs) in XML format in accordance with the W3C Recommendation, "Extensible Markup Language (XML) 1.0 (Second Edition)". XML is a subset of SGML designed to facilitate the use of SGML on the WWW. XML accommodates a wide variety of Web applications and can greatly enhance user interaction.

4.1.1.1.1 XML DTDs for New Manuals

At present, most XML technical manual applications use a DTD, an XML/SGML data construct defining the structure and content of the type of document to be created. Some DTDs are complex and costly to develop, but may be created to satisfy a broad range of documents. Program and acquisition managers should require the deliverables described in Sec 4.1.2 for XML TMs.

4.1.1.1.2 XML Schemas for New Manuals

XML literature often refers to XML Schemas. A Schema is an XML construct to describe data content. XML Schemas have a very strong data typing capability that makes XML Schemas ideally suited for describing data transactions and interchanges between information processing systems. Most XML Schema applications, to date, have been for electronic business transactions. Software tools and application software support for TM Schemas have yet to mature to a satisfactory level. Therefore, new XML TMs should be authored and acquired in accordance with an XML DTD with deliverables described in Section 4.1.2. When XML Schemas are fully implemented and adequately supported with application software for technical manuals, this guidance will be reviewed and modified as required. XML Schemas are defined in the following three W3C Recommendations: "XML Schema Part 0: Primer" dated 2 May 2001 (**http://www.w3.org/TR/xmlschema-0/**); "XML Schema Part 1: Structures" dated 2 May 2001(**http://www.w3.org/TR/xmlschema-1/**); and "XML Schema Part 2: Datatypes" dated 2 May 2001 (**http://www.w3.org/TR/xmlschema-2/**).

4.1.1.1.3 Conclusion

XML Documents and DTDs must conform to the W3C Recommendation, "Extensible Markup Language (XML) 1.0 (Second Edition)". Authors and

contractors should be encouraged to use existing DTDs and style sheets for all TMs/ETMs/IETMs. DON DTDs and style sheets are currently stored in the Navy XML/SGML Repository (**http://navycals.dt.navy.mil/dtdfosi/repository.html**).

4.1.1.2 SGML for New Manuals

Programs and activities with pre-existing SGML repositories, databases, and management and distribution infrastructures, for which XML is not yet feasible, should author and acquire new TMs, ETMs, and IETMS in SGML format in accordance with MIL-PRF-28001. MIL-PRF-28001 is the DoD performance specification defining the DoD requirements (military interpretation or profile) for the application of the International Standard for SGML, ISO 8879, *Information Processing - Text and Office Systems - Standard Generalized Markup Language (SGML)*. Proper creation of a document in SGML requires a DTD, an XML/SGML data construct defining the structure and content of the type of document to be created. DTDs may be complex and costly to develop but may be created to satisfy a broad range of documents. Authors and contractors should be encouraged to use existing DTDs and style sheets for all TMs/ETMs/IETMs. DON DTDs and style sheets are currently stored in the Navy XML/SGML Repository (**http://navycals.dt.navy.mil/dtdfosi/repository.html**).

4.1.2 Deliverables for New Technical Manuals

TM/ETM/IETM delivery to the Government should consist of the following:

- XML/SGML source file(s)
- Graphic source files
- Associated DTD (whether new or existing)
- Entity files
- DTD Data Dictionary
- Tagging Conventions Document
- Any associated style sheets and filters,

All of the above are necessary to manage, maintain, edit, and re-author the documents. Delivery must also include the style sheets and filters necessary to produce the desired presentation to users. The XML/SGML source file consists of the TM text with the embedded XML/SGML tags. This file is what will be stored and maintained in a repository or database at the document management activity. Entity files are files associated with the source file that may be created and referenced by the DTD. Some entity files are created when there is standard text in the document that will be used or shared among instances of a class of documents. Other entity files, such as those provided in the ISO character entity sets, are used to provide special characters (e.g. the degree symbol and mathematical symbols) in the documents. The contents of the entity files are available to any document using the associated DTD. The DTD Data Dictionary defines the meaning of XML/SGML tags used within the DTD. The Tagging Conventions document describes the rules for applying each XML/SGML tag to actual

data or document content. It is meant to be a practical guide to authors in applying the markup to real document content and to describe the preferred way to markup (tag) the document in accordance with the DTD. The Tagging Conventions document is especially useful to authors and editors when new or custom DTDs are being used. The information contained within the Dictionary and Conventions documents will be helpful in the maintenance and revision of the TMs and should also be provided to the Navy XML/SGML Repository (**http://navycals.dt.navy.mil/dtdfosi/repository.html**).

4.1.3 HTML and XHTML for New Manuals

Neither the Hypertext Markup Language (HTML) nor the Extensible Hypertext Markup Language (XHTML) is a suitable format for the storage and management of new technical manual data. DON activities should receive and manage documents in XML or SGML in accordance with a DTD that describes some degree of multi-level structure and content for the manual. HTML is a specific SGML application. It uses a set of three standardized SGML DTDs used for data formatting and delivery on the WWW using Web software browsers. XHTML is a reformulation of HTML 4 as an XML 1.0 application. It consists of three XML DTDs corresponding to the three SGML DTDs defined by HTML 4. Both HTML and XHTML consist of a fixed set of tags. Web browsers present the data by interpreting each tag to provide an agreed upon format.

If an HTML or XHTML version of the manual is desired for delivery and presentation, program and document managers should also require delivery of the manual in XML in accordance with a W3C Recommendation "Extensible Markup Language (XML) 1.0 (Second Edition)" compliant DTD, or in SGML in accordance with a MIL-PRF-28001 compliant DTD in addition to the HTML or XHTML deliverable. If a contractor develops conversion software or filters to convert the SGML or XML document to an HTML or XHTML document, the DON procurement activity should request delivery of the conversion software or filters also.

Programs choosing to acquire or create manuals directly in HTML or XHTML will have very limited content management capability and limited ability to utilize the data re-use and content searching functionality provided by XML/SGML document management tools. If a program chooses to author manuals in HTML or XHTML, it should require delivery of the HTML or XHTML DTD used for authoring. Since there are many versions and browser extensions of the HTML and XHTML DTDs, copies of the authoring DTDs should be retained with the manuals for updates and revisions.

4.1.4 Formatting XML/SGML Content

Since an XML/SGML file is intended to contain no formatting information, presentation applications use descriptions of formats called style sheets to determine what style/format to apply to a TM written to a DTD. Style sheets can apply to all instances conforming to a DTD, not just a single XML or SGML file. A DTD can have multiple style sheets associated with it to provide alternate formats for instances conforming to that DTD. The

filter conversion (Section 4.1.5) of SGML or XML text into an HTML or XHTML file with predetermined format is -an alternative to a style sheet.

4.1.5 Filter Conversion

Filters are translation programs or software that convert one encoded data stream, such as XML or SGML text, into another data stream with codes that can be readily interpreted and processed by the user's equipment and software. Filters may be developed to translate, or "filter", an SGML file into an HTML or XHTML file. This may be done when the TM management activity wants to store and manage data in SGML but have HTML or XHTML as one method of delivery/presentation. Filters may also be used to translate data, tagged as an instance of one DTD, into data, tagged according to another DTD.

4.1.6 IETM and ETM Functionality

Interactive electronic technical manuals (IETMs), the interactive version of electronic technical manuals (ETMs), have evolved to include a broad spectrum of visual and functional characteristics. This diversity is due to wide variances in electronic presentation form and format, as well as embedded functionality. Consequently, the guidance and associated specifications governing these documents and implementations must remain flexible and accommodate the desired appearance and functionality of the product. In general, a primary factor in specifying an IETM is the desired level of functionality in the presentation of the IETM information. IETMs may, on the one hand, be as simple as selectable Table of Contents access to electronic representations of paper pages or non-interactive implementations of technical data encoded as elemental PDF, HTML, or XML. At the other extreme, IETMs may be very complex, such as highly interactive electronic documents dynamically created out of a database that are designed and authored specifically for electronic screen presentation with navigation control built into the IETM database itself. The Aerospace Industries Association (AIA) IETM functionality matrix (included in Chapter 6.4 of the 2003 release of AECMA Specification S1000D, discussed in 4.1.6.4 below) may be used to characterize the various levels of IETM functionality for acquisition purposes.

4.1.6.1 Justify Requirement for Advanced Functionality

Requiring high-end functionality within an IETM can add significantly to its development cost. Programs should acquire high functionality IETMs only in situations where they can return suitable value. High functionality IETMs (i.e., dynamically created and database supported) are usually required for a tightly, and interactively, controlled presentation of procedural information such as a troubleshooting or diagnostic procedure. Such an advanced IETM may also be desirable when a program is acquiring a large number of high-end weapon systems that are likely to be differently configured. In this case, highly dynamic IETMs created from a single database will be more cost effective than the distribution of unique IETMs for each platform.

4.1.6.2 Basic Level of Functionality Adequate for Most IETMs

For most IETM applications, basic interactive functionality can be achieved by a presentation format employing scrolling text or small linked information frames specifically designed to eliminate the need for scrolling. In most cases the only needed interactive functionality is user selectable links contained in a Table of Contents or embedded in the presented text. This core functionality should be adequate for general-purpose use. At this time no single format exists for the run-time form of such IETMs. However, the editable source data should be developed and maintained in an authoring system independent form. This editable source should be delivered to the procuring activity along with the actual run-time version of the IETM. In accordance with guidance provided Section 4.1.1 of this document, this format should be that of SGML or XML tagged data developed in accordance with a documented DTD that is part of the procurement package. The most common formats currently utilized for the runtime versions of these IETMs are Adobe PDF, HTML, or XML. All of these can work satisfactorily using commonly available browsers and provide the basic interactive functionality needed for most of the Navy IETMs. Only approved plug-ins should be utilized when required for the graphics and illustrations selected for the IETM project (see Section 3.4.2.3 on graphic selection in this document.).

4.1.6.3 IETM Specifications

The military performance specifications, MIL-PRF-87268 and MIL-PRF-87269, define procedures to procure IETMs and contractually specify them. MIL-PRF-87268 prescribes the user interface and presentation format for these IETMs. MIL-PRF-87269 presents both an approach and a DTD protocol to guide the development of the DTDs for such high-end IETMs. That specification requires that a content-specific DTD be negotiated and documented for each procurement, The content-specific DTD in MIL-PRF-87269 is only an example intended for guidance and is not the required procurement DTD. Both of these specifications require significant input and participation from the Acquisition Program in determining a suitable, mutually agreed upon IETM design.

4.1.6.4 Future Options for Specifying IETMs

The NAVSEA MIL-DTL-24784B specification, maintained by NSDSA, is being modified to contain requirements for IETMs. Very soon it will be available for preparing Technical Manual Contract Requirements (TMCRs) as an option for specifying NAVSEA IETMs. The NAVAIR specification, MILK-STD-3001-1(AS) may be used for NAVAIR IETMs. Another option for IETM specification is the **AIA/AECMA *International Specification for Technical Publications Utilising a Common Source Database*, Spec 1000D, Issue 2.0, 31 May 2003** (**http://www.s1000d.org**). The technical team working on the S1000D specification intends to have a suitable replacement specification for the DoD IETM specifications

by the next iteration of the specification planned for late 2004 along with a formal "adoption" by the DoD for that purpose.

4.1.6.5 Common User Interface Look and Feel

Achieving a common user interface and uniform look and feel for DON IETMs has been a long-sought objective of IETM specification developers. The latest consensus among the DoD Services concerning IETMs is contained in MIL-HDBK-511, *Department of Defense Handbook for Interoperability of Interactive Electronic Technical Manuals,* published in May 2000. This handbook provides useful guidance regarding a move towards a Web-oriented weapon system support infrastructure. It also provides general guidance for achieving a common user interface look-and-feel to IETMs based on WWW browsers. Efforts are currently underway to include common look and feel specifications in the next version of MIL-DTL-24784, as well as, future versions of AIA/AECMA S1000D.

4.1.7 Acquisition of New Technical Manuals for the Marine Corps

In accordance with Marine Corps Order 5215.7, "The Marine Corps Technical Publications System", digital data publications are required for all new Marine Corps programs with an initial operating capability (IOC) during FY 2000 and beyond, unless the Commander, Marine Corps Systems Command, approves a waiver.

Program Managers (PMs) shall identify unique or usual user environments not serviced by Marine Corps Common Computer Hardware Suites and items that may not be conducive to digital data to the Director, Program Support. When developing ETMs, contractors will normally be required to use the Interactive Authoring and Display System (IADS) Government furnished software identified in Marine Corps Order 5215.7. PMs should ensure that any proprietary or contractor-proposed authoring software, other than IADS, is compatible with the IADS reader application. PMs shall budget and fund for electronic publications for all systems with an IOC during FY 2000 and beyond.

4.2 Conversion of Legacy Technical Manuals and Documents to Digital Format

The DON, subject to availability of funding and justification by cost benefit analysis, will convert legacy (including hard copy and raster) TMs to a digital format. Conversion to an XML or SGML format can provide great flexibility for the edit, revision, management and presentation of the manual as discussed in Section 4.1.1, but the cost of this type of conversion can be expensive and require significant involvement of subject matter experts. Conversion to a raster format or to PDF may be less expensive, easier on the requesting activity, and still provide acceptable versatile digital copy. Guidance and considerations for choosing the appropriate format for conversion are presented below. Specific guidance for U. S. Marine Corps conversion efforts is contained in Section 4.2.4.

4.2.1 Conversion to XML or SGML

Legacy TMs, which experience high usage, extensive life cycle, and frequent revision, should be converted to either XML or SGML. XML is the preferred format for digital TMs as it will become the prominent format for the DON's web-enabled digital environment. Many more TMs are now in SGML form than in XML. Consequently, programs with existing SGML TM databases and repositories may convert hard copy legacy to SGML. The selection of XML or SGML for the conversion format is subject to the same considerations discussed in Section 4.1.1 concerning acquisition formats. When converting technical manuals, program and document managers should require delivery of XML in accordance with a W3C conforming DTD or SGML in accordance with a MIL-PRF-28001 compliant DTD that is suitable for the document being converted. Where possible, existing DTDs and style sheets should be used. Programs should require conversion of data format and should not demand or expect full or detailed replication of the composition and pagination of the original legacy documents as this may greatly increase the complexity and cost of the conversion effort and related style sheet development. The DTD defines the extent, complexity, and ultimate functionality of the XML or SGML encoding of a document. Conversion to simple DTDs is easier and cheaper than conversion to more complex DTDs. Options for management, access, and presentation of the TM data based on a simple DTD will be more limited than if the TM is based on a complex DTD. Conversion to complex DTDs requires more manual effort and is more expensive but can provide (if the DTD is properly designed) many more options for data/information management and presentation. If a new DTD is used for the conversion, the program should request delivery of the DTD as well as other files identified in Section 4.1.2 with the XML or SGML data to enable the DON to properly maintain the converted documents. XML Schemas may replace DTDs as models for document classes that require significant data typing. XML DTDs will most likely continue to be used for the traditional technical manual. For reasons discussed in Section 4.1.1.1 "XML for New Manuals", programs should use DTDs for conversion. The maturity of software tools for XML Schema development and processing in the technical manual area will be monitored, and this guidance will be modified as necessary.

4.2.2 Conversion to HTML or XHTML

HTML (RFC 1866) is a specific SGML application or DTD that provides a uniform means for creating documents for presentation and viewing on the WWW using standard software browsers. XHTML is a specific XML application consisting of a set of XML DTDs that provide a uniform means for creating documents for presentation and viewing on the WWW using standard software browsers. In this context, HTML and XHTML are acceptable digital formats for distribution and presentation of TMs. However, neither HTML DTDs nor XHTML DTDs are suitable for storage and management of data since they contain no content tags and only minimal structure tags. The DTDs are generic in nature and do not add intelligent markup for TM data. HTML merely identifies areas in a document to affect formatting and is not meant to identify data for storage and management.

If conversion to HTML or XHTML is desired, program and document managers should also require delivery of documents converted to XML in accordance with a W3C conforming DTD or SGML in accordance with a MIL-PRF-28001 compliant DTD in addition to the HTML or XHTML deliverable. By requiring delivery of XML or SGML and the DTD used, the DON will be better able to manage updates and revisions to the document. If the contractor develops conversion software or filters to convert the XML or SGML document to an HTML or XHTML document, the program should request delivery of the conversion software or filters also. The DON's intention is to receive and manage documents in XML or SGML and if desired convert to HTML or XHTML only for distribution and presentation purposes. If a program chooses to convert directly to HTML or XHTML and not another XML or SGML DTD, it should require delivery of the HTML or XHTML DTD used for conversion. This DTD will be necessary for management and revision of the HTML or XHTML documents since there are many versions as well as browser extensions of the HTML and XHTML DTDs.

4.2.3 Conversion to Raster and PDF

Legacy manuals may be converted to the PDF or the Navy Implementation for Raster Scanning (NIRS)/NIFF (MIL-PRF-28002, Type 3) for distribution and use. Both of these formats are suitable for obtaining a digital image representation of the original document and for electronic display and presentation to users. Neither format is well suited for document edits and revisions. Consequently, a common approach taken by programs is to initially convert documents to raster or PDF and, as some manuals begin to require significant amount of revisions, consider converting them or re-authoring them in XML or SGML.

PDF is a popular commercial format that has achieved widespread use through availability of free viewer software. Conversion to PDF is quite commonplace and activities can easily contract for conversion to PDF or can convert documents themselves by purchasing the Adobe Capture software. Conversion to basic PDF may not be much more expensive than conversion to raster. The PDF format and Adobe tools, however, can be used to add various navigation functionality (such as indexing, linking, hot-spotting) to the documents, and the extent and degree of this added functionality could drive the conversion cost much higher. Many commands and activities consider PDF as their minimum electronic format.

The conversion of paper (or raster) to PDF generates an ASCII rendition as an interim product. If this ASCII is available, it should be saved as a possible basis for performing revisions to the document. Managers, who are converting documents to PDF should request delivery of the ASCII or other revisable files, if they exist, to satisfy future revision and edit needs. If revisable files are not available, they should be created only when needed.

Hard copy paper (legacy) TMs may be raster scanned in accordance with NIRS/NIFF specified in MIL-PRF-28002. NIFF is a version of TIFF. NIRS/NIFF can be specified on contract by citing Type 3 raster conversion in the raster performance specification,

MIL-PRF-28002. TIFF is widely interchangeable with common computer systems. NIRS/NIFF documents are stored aboard ship in the ATIS (Advanced Technical Information Support) repository and the ATIS system provides the necessary viewers to display the documents. NIRS/NIFF provides some document navigation capabilities and is generally a smaller file than an image-based PDF version and thus may be preferable to an image-based PDF format. Text-based PDF, however, is recommended over NIRS/NIFF.

Programs should be aware that viewing raster scanned foldout illustrations and schematics is a problem for users without oversized monitors unless the foldout images are re-authored or reprocessed to satisfy the viewing software, or special viewing software is provided.

4.2.4 Conversion of Marine Corps Legacy Manuals to Digital Format

All Marine Corps legacy TMs will be converted to SGML. They will be managed and maintained in SGML and published and made available to users as either an IETM or indexed PDF (IPDF) form based on operational needs and requirements. Commercial manuals will be made available in IPDF format only. Additional information can be found in MCO P5215.17C.

4.3 Technical Manual Graphics

The DON, subject to availability of funding and justification by cost benefit analysis, will convert technical manual graphics to a digital format. Conversion to a vector format can provide great flexibility for the edit, revision, management and presentation of the technical manual graphic but the cost of this type of conversion can be expensive and require significant involvement of subject matter experts. Conversion to a raster format or to PDF may be less expensive, easier on the requesting activity, and still provide acceptable versatile digital copy. Guidance and considerations for choosing the appropriate format for conversion are presented below. Specific guidance for U. S. Marine Corps conversion efforts is contained in Section 4.2.4.

4.3.1 Vector

The following vector formats are preferred for all new 2-D drawings, schematics, and illustrations:

- CGM delivered in accordance with the ISO/IEC 8632 international specification and the implementation profile of the WebCGM recommendation (**http://www.w3.org/Graphics/WebCGM REC-WebCGM-19990121**)

- SVG delivered in accordance with the W3C “Scalable Vector Graphics (SVG) 1.0” specification (**http://www.w3.org/TR/2001/REC-SVG-20010904/**)

SVG is preferred for vector graphics requiring animation or gradients.

4.3.2 Raster

Raster imaging is generally discouraged for the acquisition of legacy 2-D drawings, schematics, or illustrations. However, raster formats such as TIFF, BMP, PNG or JPEG may be used to capture existing drawings not already in an acceptable vector format.

Raster graphics should not be used where there is a requirement:

- for navigation (hot-spotting or hyper-linking) within the image or
- to attach metadata or added information to text or graphic elements within the image.

Legacy applications may continue to use MIL-PRF-28002C format types 1, 3, and 4 for raster graphics representation in binary format. However, the MIL-PRF-28002C type 2 format, the ODA/ODIF format (CALS Type 2), should not be used. While the NIFF format is allowed for drawings and schematics, its use is discouraged.

4.4 Publication, Distribution, and Management

TMs should be published in ETM or IETM formats suitable for distribution and use based upon availability of the requisite hardware and software in the user community.

The DON will cease the practice of creating, managing, stocking, and distributing change-pages. TM/document editing and management should be performed at a document component level through processes suitable for an XML/SGML document environment. Under this approach, when a document is modified, only the component(s) added/deleted/changed are modified in the document repository or database. A new version of the whole document does not have to be stored. When data is managed at a component level, components that are common to multiple document instances (e.g., cautions, warnings) can be edited and managed in one spot and shared among documents. This eliminates redundancy as well as increases accuracy of data. Updates of user digital documents will be distributed at a full document level.

At present, there is no DON-wide consensus that can be cited concerning highlighting or identification of document changes or procedures for notification of users of those changes. Activities should define and employ change identification and user notification procedures that best fit their TM management and usage practices.

5. DELIVERY OF LOGISTICS TECHNICAL DATA

Because all users may not have the latest computer technology, it may be necessary to reproduce the digital data in traditional hard copy formats.

5.1 Delivery of Schematics and Fold-out Drawings

Particular consideration should be given to digital foldout drawings and long line schematics, which can be difficult to work with in electronic form. Paper copies of these drawings are often considered necessary for their effective use by technicians. For this reason, programs and data management activities should be prepared to provide drawings in easily readable paper copies to users. These special considerations for foldouts and schematics should remain in effect until the user community has the capability to satisfactorily view and print them when needed.

6. INTEGRATION OF PRODUCT / TECHNICAL DATA AND TRAINING DATA

The training and human performance community is one of the largest users of technical and product data in the Navy. Typically, the engineering community creates the technical data needed to maintain, repair, and support the platforms, systems, and equipment in the Fleet. The training and human performance community produces the necessary training curricula and materials based on the technical data products. Both of these communities have recognized the value of sharing data and are actively engaged in defining an environment for the integration of logistics content, training content, and management and delivery systems. The guidance contained within this document supports the creation of digital, standards-based authoritative sources for technical and product data that can be accessed and used by training developers. Training product development is guided by the performance specification, MIL-PRF-29612B, “Training Data Products”, which establishes the data requirements to support life cycle maintenance of training data products, and by the Sharable Content Object Reference Model (SCORM) produced by the Advanced Distributed Learning Initiative. An OPNAV N40 and NOOT sponsored Training / Technical Data Workshop, 13 – 15 November 2002 endorsed a “Concept of Operations for Technical and Training Data Integration”. In the summer of 2003, the Naval Personnel Development Center is leading an effort to plan for the inclusion of the Naval System Commands in the Integrated Learning Environment and to integrate training content with product and technical data. Programs and Commands are encouraged to track these efforts and employ a digital content management and reuse strategy that enables integration of technical data and publications with learning and job performance support applications.

7. COMMERCIAL OFF-THE-SHELF (COTS) PRODUCT DOCUMENTATION

When acquisition and product life cycle support requirements involve the procurement of commercial off-the-shelf (COTS) items and associated product/technical data, Acquisition Managers should contract for the delivery of the data and documentation in digital form and/or access to the data and documentation as provided digitally from the contractor. Where COTS

providers only have the data in hardcopy, acquisition managers should negotiate agreements for digital conversion to formats outlined above. In the case of copyrighted data, acquisition managers must be prepared to accept limited rights or access to the data and, in some cases, accept paper copies. These limited rights to the content should be obtained to allow the government to maintain, modify, extract, and re-use the content in digital form.

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Initial Graphics Exchange Specification (IGES), IGES (ANS US PRO/IPO-100 Series), **https://www.uspro.org/** or **http://www.nist.gov/iges/index.html**

Standard for the Exchange of Product Model Data (STEP), ISO 10303

Product Data Exchange using STEP (PDES), (ANS US PRO/IPO-200 Series)

National Shipbuilding Research Program (NSRP) Navy/Industry Digital Data Exchange Standards Committee (NIDDESC) STEP Application Protocols (APs):

NIDDESC Piping AP, NSRP 0424, (ISO 10303 AP 227:2001)
NIDDESC Electrical & Raceways AP, NSRP 0425, (ISO 10303 AP 212:2001)
NIDDESC Heating Ventilation, and Air Condition (HVAC) AP, NSRP 0426, (ISO 10303 Draft AP 227 Edition 2)
NIDDESC Outfit and Furnishings AP, NSRP 0428
NIDDESC Ship Structural Systems AP, NSRP 0429, (ISO 10303 Draft AP's 215, 216, 218)

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Content Standard for Digital Geospatial Metadata, CSDGM, Version 2, Federal Geographic Data Committee, **http://www.fgdc.gov/metadata/contstan.html**

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International Standard ISO 8879, *Information Processing - Text and Office Systems - Standard Generalized Markup Language (SGML),* International Organization for Standardization, 1986.

Amendment 1 to ISO 8879, International Organization for Standardization, 1987.

ISO/IEC JTC1/SC34 N0029, *Document Description and Processing Languages, Annex K (Normative): Web SGML Adaptations* - December 6, 1998, **http://www.ornl.gov/sgml/sc34/document/0029.htm**

HTML 4.01 Specification - 24 December, 1999, **http://www.w3.org/TR/html4/**

Extensible Markup Language (XML) 1.0 (Second Edition), W3C Recommendation, 6 October 2000, **http://www.w3.org/TR/REC-xml**

MIL-PRF-87268A, October 1995, *Manual, Interactive Electronic Technical; General Content, Style, Format, and User Interaction Requirements*, **http://navycals.dt.navy.mil/cals/documents/S87268a.pdf**

MIL-PRF-87269, October 1995, *Data Base Revisable, Interactive Electronic Technical Manuals for Support of*, **http://navycals.dt.navy.mil/cals/documents/sp87269A.pdf**

MIL-HDBK-28001, 30 June 1995, *Application of MIL-PRF-28001 Using Standard Generalized Markup Language (SGML),* **http://navycals.dt.navy.mil/cals/documents/28001.pdf**

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Appendix A

DIGITAL DATA STANDARDS and SPECIFICATIONS TABLES

These tables present a quick guide to data formats and standards. The information is compliant with the DON Information Technology Standards Guidance published by the DON Chief Information Officer (CIO).

TABLE 1 - Legacy Data Conversion

LEGACY FORM	DESIRED CONVERSION	STANDARDS & SPECS
TECHNICAL MANUALS (section 4.2)	Conversion to XML (section 4.2.1)	XML per W3C Recommendation And Use existing XML DTD or Use new XML DTD & Request delivery of DTD
	Conversion to SGML (section 4.2.1)	SGML per MIL-PRF-28001 And Use existing SGML DTD or Use new SGML DTD & Request delivery of DTD
	Conversion to XHTML or HTML (section 4.2.2) (XHTML and HTML used for presentation only. XML or SGML is used for storage and management. This is the preferred method of XHTML or HTML conversion: supports life cycle management of the converted TM)	Convert first to XML per W3C Recommendation or SGML per MIL-PRF-28001 And Use existing XML/SGML DTD or Use new XML/SGML DTD & Request delivery of XML/SGML DTD Then Convert XML or SGML to XHTML or HTML And Deliver HTML or XHTML
	Conversion to XHTML or HTML (section 4.2.2) (XHTML and HTML used for presentation, storage and management. This is an alternate method of XHTML or HTML conversion: life cycle management of TM may be difficult due to instability of XHTML/HTML DTD)	Convert direct to XHTML or HTML per existing version of XHTML or HTML DTD And Deliver XHTML or HTML with the W3C DTD used
	Conversion to Raster (section 4.2.3)	PDF per Adobe Systems, Inc Or NIRS/NIFF per MIL-PRF-28002 Type 3 Or TIFF, BMP, JPEG, PNG

LEGACY FORM	DESIRED CONVERSION	STANDARDS & SPECS
GRAPHICS (section 3.6)	Conversion of hard copy graphics/aperture cards to raster	C4 (JEDMICS) per MIL-PRF-28002 Type 4 Or NIRS/NIFF per MIL-PRF-28002 Type 3 Or CCITT Group 4 per MIL-PRF-28002 Type 1 Or TIFF, BMP, JPEG, PNG
	Conversion of hard copy or raster graphics to vector	CGM per MIL-PRF-28003 Or SVG
	Conversion of hard copy or raster graphics to vector with hyperlink Capability	CGM, Version 4, per WebCGM Or SVG

TABLE 2 - Technical Manual Creation

DESIRED FORM	**Text STANDARDS & SPECS**	**Graphics**	**Graphics Standards and Specifications**
Electronic Technical Manuals (ETMs)	XML per W3C Recommendation Or SGML per MIL-PRF-28001 Use existing DTD Or Use new DTD & Request delivery of DTD (section 4.1.1)	2-D vector graphics for illustrations & TMs ---------- 2-D graphics for hyperlinked illustrations ---------- Raster (bitmapped) images	MIL-PRF-28003 -CGM ---------- CGM Version 4 per WebCGM Or SVG ---------- MIL-PRF-28002 Type 1 – CCITT.G4
Interactive Electronic Technical Manuals (IETMs)	XML per W3C Recommendation Or SGML per MIL-PRF-28001 And Use MIL-PRF-87269 as guide to DTD And User interface per MIL-PRF-87268 And MIL-HDBK-511 (section 4.1.6)	2-D vector graphics for illustrations & TMs ---------- 2-D graphics for hyperlinked illustrations ---------- Raster (bitmapped) images	MIL-PRF-28003 - CGM Or SVG ---------- CGM Version 4 per WebCGM Or SVG ---------- MIL-PRF-28002 Type 1 – CCITT.G4

TABLE 3 - Product Data Creation

APPLICATION	**STANDARDS & SPECS**
2-D graphics for use in CAD	STEP per ISO 10303 AP201 or AP 202
Product data CAD/CAM/CAE 3-D vector Product Model	STEP per ISO 10303
Ship Design	STEP Shipbuilding Team (T23) Recommendations Within ISO Technical Committee 184/ SC 4/ WG 3 of ISO 10303 STEP

Appendix B

WWW RESOURCE GUIDE
FOR DIGITAL TECHNICAL DATA IMPLEMENTATION

Www.w3schools.com	XML and programming language tutorials
Http://nsdsa.phdnswc.navy.mil	TD acquisition and lifecycle support
Http://armyec.army.mil/knowbase/docs/doc64/opening.htm	CALS Toolkit
Http://nsdsa.phdnswc.navy.mil/sgml/ietm-production.asp?lvl=1	Description of NAVSEA Publishing System
Http://navycals/ietm/CLASSES.PDF	IETM classes
Http://nsdsa.phdnswc.navy.mil/sgml/ietm-spawar.asp?lvl=1	Access to SPAWAR XML DTD, XSLT, tagging guidance and parser files
Http://navycals.dt.navy.mil	Navy CALS Web site
Https://www.uspro.org/	US Product Data Association
Http://www.usashipbuilding.com/niddesc/t23.html.	Shipbuilding product model data
Http://mpeg.telecomitalialab.com	MPEG information
Http://ric.crane.navy.mil/	Navy Resource and Implementation Cooperative (RIC)
Http://www.doncio.navy.mil/doncio/index.html	DON Chief Information Officer
Http://www.doncio.navy.mil/training/ools/itsg/	Information Technology Standards Guidance
Http://usn.hq.navy.mil/	Deputy Chief of Naval Operations for Logistics OPNAV N4 Logistics
Http://www.peoarbs.navy.mil	Program Executive Officer for Acquisition Related Business Systems (PEO(ARBS))
Http://diicoe.disa.mil/coe/	Defense Information Infrastructure (DII) Common Operating Environment (COE)
Http://www.adobe.com:80/support/techdocs/20ac6.htm	How to create Adobe PDF files for print and press
Http://www.oasis-open.org/cover/sgml-xml.html	SGML & XML information
Http://navycals.dt.navy.mil/dtdfosi/repository.html	Navy XML/SGML Repository
Http://www-jta.itsi.disa.mil/	DoD Joint Technical Architecture (JTA)
Http://www.adlnet.org/index.cfm?fuseaction=scormabt	Sharable Content Object Reference Model (SCORM) information through the Advanced Distributed Learning (ADL) Initiative website

Appendix C

LIST OF ACRONYMS

Acronym	Definition
2-D	Two Dimensional
3-D	Three Dimensional
AIA	Aerospace Industries Association
AP	Application Protocol
ASCII	American Standard Code for Information Interchange
ATIS	Advanced Technical Information Support
BMP	Bit Map Picture
CAD	Computer Aided Design
CADD	Computer Aided Drafting and Design
CAE	Computer Aided Engineering
CALS	Continuous Acquisition and Life-Cycle Support
CAM	Computer Aided Manufacturing
CGM	Computer Graphics Metafile
CIO	Chief Information Officer
COE	Common Operating Environment
CSDGM	Content Standard for Geospatial Metadata
DII	Defense Information Infrastructure
DON	Department of the Navy
DTD	Document Type Definition
ETM	Electronic Technical Manual
FGDC	Federal Geographic Data Committee
GCO	Government Concept of Operations
HTML	Hyper Text Mark-Up Language
IADS	Interactive Authoring and Display System
IDE	Integrated Data Environment
IETM	Interactive Electronic Technical Manual
IGES	Initial Graphics Exchange Specification
ISO	International Organization for Standardization

JEDMICS	Joint Engineering Data Management Information and Control System
JPEG	Joint Photographic Experts Group
NIBS	National Institute of Building Sciences
NIDDESC	Navy/Industry Digital Data Exchange Standards Committee
NIFF	Navy Image File Format
NIRS	Navy Implementation for Raster Scanning
NSDSA	Naval Systems Data Support Activity
NSRP	National Shipbuilding Research Program
NSWC	Naval Surface Warfare Center
ODA	Open Document Architecture
ODIF	Open Document Interchange Format
PDF	Portable Document Format
PEO	Program Executive Officer
PM	Program Manager
PNG	Portable Network Graphics
SCORM	Sharable Content Object Reference Model
SGML	Standard Generalized Markup Language
STEP	STandard for Exchange of Product Model Data
SVG	Scalable Vector Graphics
SYSCOM	System Commander
TIFF	Tagged Image File Format
TM	Technical Manual
TMINS	Technical Manual Identification Numbering System
VMRL	Virtual Reality Modeling Language
W3C	World Wide Web Consortium
WWW	World Wide Web
X3D	Extensible 3D, Draft International Standards
XHTML	Extensible Hypertext Markup Language
XML	Extensible Markup Language
XSLT	Extensible Stylesheet Language Transformations