CALS TEST NETWORK

CTN Test Report 91-024

U.S. Army Computer-Aided Acquisition and Logistics Support (CALS) Test Bed

MIL-STD-1840A Data Delivery Using Non-Magnetic-Tape Media

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U.S. Army Computer-Aided Acquisition and Logistic Support (CALS) Test Bed

Final Test Report

MIL-STD-1840A
Data Delivery Using Non-Magnetic-Tape Media

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EXECUTIVE SUMMARY

The Army Computer-Aided Acquisition and Logistic Support (CALS) Test Bed is a CALS Test Network (CTN) designated Lead Service Test Bed. Among other things, it supports the CTN in achieving the objectives stated in the CTN strategic plan. During Phase I of the CALS Program, the focus has been on standards for digital interchange of technical information among dissimilar computer systems. The governing standard for data interchange is MIL-STD-1840A, "Automated Interchange of Technical Information." This standard specifies detailed requirements on file structure and content, transfer media, and packaging for transferring technical publications and product data. But MIL-STD-1840A is neither clear nor thorough on non-magnetic-tape media.

The objective of this test effort was to:

a. Evaluate the effectiveness of MIL-STD-1840A when the data delivery medium is not magnetic tape.

b. Recommend guidelines and automated routines for preparing MIL-STD-1840A compliant data transfer using non-magnetic media.

c. Recommend acceptance criteria and procedures for data received via non-magnetic media.

d. Identify problems and technical limitations encountered during data interchange using non-magnetic media.

e. Recommend additional specifications for the "media option" section of MIL-STD-1840A to include non-magnetic media.

The major findings of the test are summarized below:

a. MIL-STD-1840A needs more examples and detail to avoid misinterpretations (See Section 4.1).

b. Inadequacies were found in the MIL-STD-1840A naming conventions and maximum file counts (See Sections 4.1 and 4.3).

c. Details for preparing CGM files were not addressed in MIL-STD-1840A (See Section 4.1).

d. There is a need for more automated tools. Files can be corrupted during manual preparation due to human error (See Sections 4.1, 4.2 and 4.3).

e. Over the Defense Data Network (DDN), 2 Mbytes of data were transmitted in approximately 9 minutes. With larger data transfers, more time will be needed (See Section 4.2).

f. The declaration file formats and data file formats required by MIL-STD-1840A for magnetic tape can be used for transfers over the DDN and optical disk (See Sections 4.2 and 4.3).

g. Working with large volumes of data requires new approaches to both receiving the data and in preparing it for transfer. For example, the current practice of downloading all the data from the transfer medium to a hard disk before processing is not appropriate for optical disk (See Section 4.3).

Based on analyses of the findings, the following recommendations are made (See Section 5):

a. The MIL-STD-1840A document should provide more examples and additional detail.

b. Work should continue on the development of automated tools for creating, validating and retrieving MIL-STD-1840A files from various media.

c. MIL-STD-1840A should provide a way to transfer more files than is currently permitted under the file naming limitation of 999.

d. The media specific formats specified for magnetic tape can be used for telecommunications and optical disk transfers.

e. The random access capabilities of the optical disk should be retained for MIL-STD-1840A data transfers.

f. When transferring large volumes of data, there are advantages to including a copy of the declaration file on the same optical disk volume(s) as its file set. More research should be conducted into this area.

g. MIL-STD-1840A should provide the option for transferring compressed files as is the case for raster.

1. INTRODUCTION.

This report is divided into five major sections: Section 1 states the objectives of this test and provides a brief description of the MIL-STD-1840A delivery process; Section 2 describes the test data and explains how it was developed; Section 3 summarizes the testing process; Section 4 presents the findings of this test effort and provides an analysis of these findings; and Section 5, based on the findings and analysis, provides a list of recommendations to be considered for incorporation into MIL-STD-1840A. Also provided are two appendices: Appendix A contains a hard copy of the declaration files used in this test and Appendix B contains the data file header records.

1.1 Background.

The Computer-Aided Acquisition and Logistic Support (CALS) Program Phase I effort has focused on standards for digital interchange of technical information among dissimilar computer systems. The governing standard for data interchange is MIL-STD-1840A, "Automated Interchange of Technical Information," which specifies detailed requirements on file structure, media option and packaging for transfer of technical publications and product data. Although many CALS Test Network (CTN) tests concerning MIL-STD-1840A have been conducted, the transfer medium used in those tests was exclusively magnetic tape because it is the only media option that has been specified in detail in the standard.

The omission of detailed requirements on optical disk and telecommunications (hereafter collectively referred to as non-magnetic media) as transfer media is due mainly to the lack of optical disk standard for the former and inadequacy in handling large volume of data for the latter. Nevertheless, these two media are becoming more and more common and popular in the industry; thus they cannot be ignored.

It is the purpose of this test effort to identify any constraints and needed improvements to MIL-STD-1840A so that optical disk and telecommunications link can be clearly and realistically specified as media options for the interchange of technical information between organizations.

1.2 Purpose.

The objectives of this test are as follows:

a. Evaluate the effectiveness of MIL-STD-1840A when the data delivery medium is not magnetic tape.

b. Recommend guidelines and automated routines for preparing MIL-STD-1840A-compliant data transfer using non-magnetic media.

c. Recommend acceptance criteria and procedures for data received via non-magnetic media.

d. Identify problems and technical limitations encountered during data interchange using non-magnetic media.

e. Recommend additional specifications for the "media option" section of MIL-STD-1840A to include non-magnetic media.

1.3 Scope.

The scope is as follows:

a. The Defense Data Network (DDN) was the selected medium for the telecommunications transfer because it was accessible to both the Army CALS Test Bed and the Information Management Directorate of the Information Systems Command at Picatinny Arsenal. It is also widely used among Government and industry.

b. The Kodak 6800 14-inch optical disk was chosen for the optical disk transfer because a Kodak 6800 Optical Disk Drive System was available at both the Army and Air Force CALS Test Beds. It was necessary to use an optical disk from the same manufacturer due to lack of compatibility throughout the industry.

c. The data for this test was derived from the CTN Reference Data developed by the CALS Test Network. Although portions of this data are intended for demonstration use only, it was felt that the CTN data was suitable for this test because it is of precisely known content and generally available to others.

d. The data transfer over non-magnetic tape media was validated using a MIL-STD-1840A magnetic tape containing the baseline reference data. This tape was sent to both the Air Force CALS Test Bed and Picatinny Arsenal. The data received from the non-magnetic-tape media were compared with the baseline reference data from magnetic tape using a software utility that recognizes differences between files. Additional processing of the data, such as viewing or parsing, was optional.

e. Tools were developed as required to perform the test.

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1.4 Description of MIL-STD-1840A Data Delivery.

The process of delivering digital data using MIL-STD-1840A is depicted in Figure 1. Product and technical publication digital data are furnished in the formats defined in the following specifications:

a. MIL-D-28000, Digital Representation for Communication of Product Data (Initial Graphics Exchange Specification - IGES)

b. MIL-M-28001, Markup Requirements and Generic Style Specification for Electronic Printed Output and Exchange of Text (Standard Generalized Markup Language - SGML or Technical Publication)

c. MIL-D-28002, Requirements for Raster Graphics Representation in Binary Format (Raster)

d. MIL-D-28003, Digital Representation for Communication of Illustration Data: CGM Application Profile (Computer Graphics Metafile - CGM)

1.4.1
These CALS-compliant data are then prepared in accordance with MIL-STD-1840A, which entails the following:

a. Creating declaration and header files.[1]

b. Formatting the declaration, data, and header files to the correct record and block sizes.

c. Appending the data files to the appropriate header files.

d. Writing the declaration and appended data files out to the selected transfer medium.

The transfer medium, be it 9-track tape, optical disk or telecommunications, is employed to move the data from the sending site to the receiving site. At the receiving site, the CALS-compliant data files are removed from the MIL-STD-1840A envelope. This is accomplished by stripping off data file header records and converting back to original record and block formats. The declaration and header files will provide information necessary to the successful disposition of the data files.

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1 The declaration file is a fifteen-record file that provides information, including the identifications, source, destination and classification, of a document and gives a count of the files in the set of files that makes up the complete document. A data file header contains information pertinent to the data file which is appended to it.

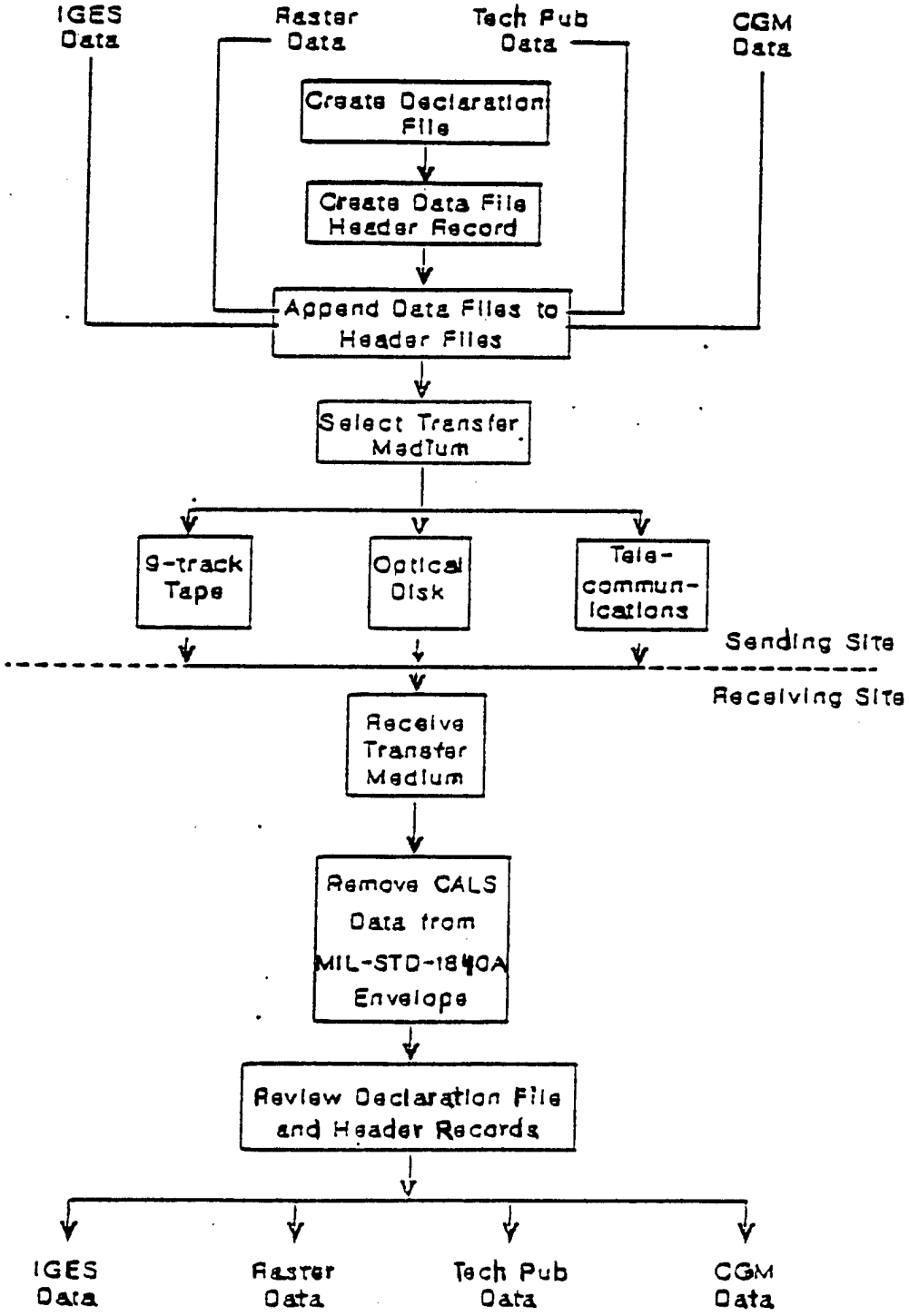


Figure 1. Generic MIL-STD-1840A Data Transfer

1.5 References.

The following documents contain information applicable to this report:

a. "Final Test Plan, MIL-STD-1840A Data Delivery Using Non-Magnetic-Tape Media", dated 25 October 1989

b. MIL-STD-1840A, "Automated Interchange of Technical Information", dated 20 December 1988

c. MIL-D-28000, "Digital Representation for Communication of Product Data: Application Subsets", dated 22 December 1987

d. MIL-M-28001, "Markup Requirements and Generic Style Specification for Electronic Printed Output and Exchange of Text", dated 26 February 1988

e. MIL-R-28002, "Raster Graphics Representation in Binary Format, Requirements For", dated 20 December 1988

f. MIL-D-28003, "Digital Representation for Communication of Illustration Data: CGM Application Profile", dated 20 December 1988

g. FIPS PUB 25, "Recorded Magnetic Tape for Information Interchange (1600 CPI, PE) (ANSI X3.39)", dated 1986

h. FIPS PUB 50, "Recorded Magnetic Tape for Information Interchange (6250 CPI, Group-coded Recording) (ANSI X3.54)", dated 1986

i. FIPS PUB 79, "Magnetic Tape Labels and File Structure for Information Interchange (ANSI X3.27)", dated 1987

j. Kodak Pub. No. XP0712-1, "Fundamental Theory Guide for the Kodak Optical Disk System 6800", dated April 1989

k. "A Guide to Technical Committee X3B11, Optical Digital Data Disks", dated June 1990

2. TEST DATA SET.

2.1 Description.

A comprehensive sampling of MIL-STD-1840A formatted data was assembled for the test. The data included SGML, IGES (Class I and Class II), Raster (Type I) and CGM files. This data was selected from CALS Test Network Reference Test Data. It was reorganized by the Army CALS Test Bed for the test effort. The following CALS Test Network Reference Test Data was used:

a. The CTN MIL-D-28000 Class I Reference Illustrations - Revision A. This file set consists of two IGES files which contain the IENTITY and the LGTABLE illustrations. These illustration files and one declaration file were received from the CTN on a 9-track magnetic tape (Label = CTNN01, Draft Jan 90) that was formatted in accordance with MIL-STD-1840A.

b. The CTN MIL-D-28000 CLASS II Reference Drawings - Revision C. This file set consists of two IGES files which contain the N-entity and the L-bracket reference drawings. These drawings and one declaration file were received from the CTN on a 9-track magnetic tape (Label = CTNN01, Draft Jan 90) that was formatted in accordance with MIL-STD-1840A.

c. The CTN MIL-R-28002 raster drawings. This file set consists of 15 image files. These image files and one declaration file were received from the CTN on a 9-track magnetic tape (Label = CTN1, Draft Jan 90) that was formatted in accordance with MIL-STD-1840A.

d. The CTN CALS EXPO '89 MIL-STD-1840A Technical Publication. This file set consists of an SGML file, a DTD and 5 raster files. This data and one declaration file were received from the CTN on a 9-track magnetic tape (Label = CALS01, Draft Jan 90) that was formatted in accordance with MIL-STD-1840A.

e. The CTN Reference Computer Graphics Metafiles. This file set consists of 4 files, each a different representation of the same "All Graphical Primitives" reference file. These four files represent clear text CGM integer, clear text CGM real, binary CGM integer and binary CGM real versions of the reference file. The clear text CGM files are not legal MIL-D-28003 files because they are not binary format files. They were included in this test so that the recipient can have the complete set of data from the CTN and because they can be visually reviewed. This data was received from the CTN on a floppy disk (Label = CTN Reference CGM's, 07-19-1990).

2.2 Preparation.

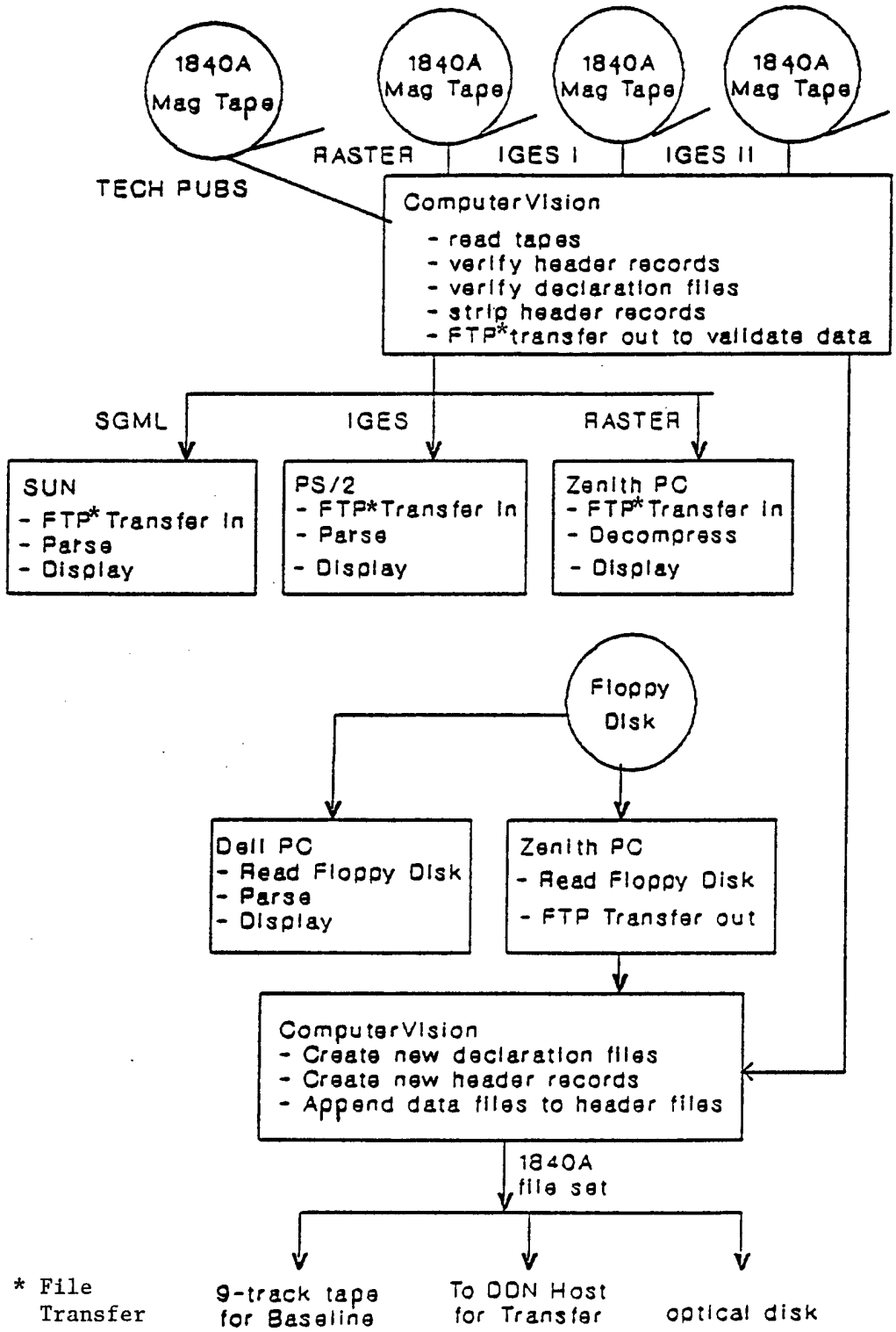
The data used in this test was assembled and validated in the Test Bed using commercial software, CTN created tools and Test Bed created tools as shown below:

- ComputerVision model CDS3000 running UNIX BSD 4.2
- SUN model 3/160 running UNIX 4.0.3
- IBM PS/2 running DOS
- Zenith 248 running DOS
- Dell 386 running DOS
- Ethernet LAN
- Interleaf CALS Preparedness Package
- CADKEY version 3.5
- MetaView version 1.12
- Army CALS Test Bed Raster Tools
- CTN Tapetool version 1.1

The test data was then reorganized into seven MIL-STD-1840A document file sets. These document file sets would serve as the **baseline reference data.** File names were changed to reflect MIL-STD-1840A file naming requirements. Figure 2 depicts the flow of the data through the Test Bed as it was being processed. Several computers were used because they each contained a capability that was required for the test. It was also a good exercise to use that many different computers. The details are as follows:

a. **Receive Data.** The MIL-STD-1840A conforming SGML, DTD, Raster and IGES data files used for this test were loaded into the ComputerVision via 9-track magnetic tapes. The CTN Tapetool version 1.1 software was used to process the tapes. Only minor, known errors in the declaration files and the data file header records were encountered when the tapes were processed (e.g. The declaration file "srcdocid" record did not match its counterpart in the IGES class II reference drawing data file header records. This was done intentionally.). The tool automatically stripped the data file header records from the data files. The CGM data was read in from floppy disk into a Zenith 286 PC.

b. **Validate Data.** Copies of the data files were then sent over the Test Bed LAN to computers which contained the appropriate software for reviewing/validating the particular data file formats. The results were as follows:



* File Transfer Protocol (FTP)

Figure 2. Data Preparation

1) The SGML coded text file and the DTD file were transferred over the LAN to the SUN 3/160 workstation using File Transfer Protocol (FTP) software. The files were then processed by the Interleaf CALS Preparedness Package (CPP) software which parsed the SGML document against the DTD. No major problems were encountered.

2) The Raster files were transferred over the LAN to a Zenith 286 PC using FTP software. The mode was set to binary for the transfer. Using Test Bed tools, these files were decompressed and the images were displayed. A comparison of the images against CTN provided hard copies of the drawings was made to confirm their correctness.

3) The IGES files were transferred over the LAN to an IBM PS/2. Again, FTP was used. They were translated into CADKEY format for review using CADKEY version 3.5. The parse was successful with only a few entities not being translated. The files were displayed using the CADKEY software and compared to hardcopy originals to further confirm their correctness.

4) The CGM files were displayed on a Dell System 325 PC using MetaVIEW version 1.12. All 4 file types were interpreted, displayed and compared against the original drawing. Several errors were observed. These were known to the CTN prior to the release of this draft data set to the Test Bed. The errors were not significant enough to prevent the data being used for the test. The CGM files on floppy disk were then loaded onto a Zenith PC on the Test Bed LAN. The CGM data files were sent over the LAN using FTP to the ComputerVision to join the other data files.

c. **Reorganize Data.** The files were then reorganized into seven documents as shown in Figure 3. The CTN Tapetool version 1.1 was used to create the declaration files, header files and to append the data files to the appropriate header files. A printout of the declaration file records and the data file header records is found in Appendix A and B respectively. The CGM files were not acceptable to Tapetool because they were not in 80-byte fixed length records. Therefore, the UNIX "dd" command was used to format the CGM files into acceptable record lengths. The seven documents were then copied to 9-track magnetic tape using the CTN Tapetool.

TEST DATA FILES		CTN SOURCE FILES
File Name	File Type	
d001	Declaration	
d002	Declaration	
d003	Declaration	
d004	Declaration	
d005	Declaration	
d006	Declaration	
d007	Declaration	
d001q001	IGES	Class II N-entity
d002q001	IGES	Class II I-bracket
d003r001	Raster	15 CTN Raster drawings
d003r002	Raster	(same order)
d003r003	Raster	
d003r004	Raster	
d003r005	Raster	
d003r006	Raster	
d003r007	Raster	
d003r008	Raster	
d003r009	Raster	
d003r0010	Raster	
d003r0011	Raster	
d003r0012	Raster	
d003r0013	Raster	
d003r0014	Raster	
d003r0015	Raster	
d004q001	IGES	Class I IENTITY
d005q001	IGES	Class I LGTABLE
d006t001	Text	CALS Expo '89 Tech Pubs Data
d006r001	Raster	(raster files in same order)
d006r002	Raster	
d006r003	Raster	
d006r004	Raster	
d006r005	Raster	
d006g001	DTD	
d007c001	CGM	CTN - oli.clr
d007c002	CGM	CTN - oli.CGM
d007c003	CGM	CTN - olr.clr
d007c004	CGM	CTN - olr.CGM

Figure 3. Correspondence Between Test Data and CTN Source Files

2.3 CTN Tapetool

The CTN Tapetool was used to prepare the baseline reference data. This tool enables a user to create declaration files, data file header records, append data files to header files and copy the file sets onto 9-track magnetic tape in accordance with MIL-STD-1840A. The tool will also read MIL-STD-1840A tapes, validate declaration and header records, strip the header records from the data files and copy the data onto a hard disk.

This tool also aided in the preparation of the test data to be transferred over the DDN and on optical disk. Specifically, the tool stores declaration files, header files and data files appended to header files on the hard disk. When the tool is used to write to tape, the declaration files and data files with header records are output in accordance with the tape media requirements of MIL-STD-1840A. For the DDN and optical disk transfer, the files as stored by the Tapetool on the hard disk were used. This provided data in essentially the same file formats as used by the tape standards. Differences which did arise will be discussed in the analysis section of this report (see Section 4).

3. TEST EXECUTION.

The tests were performed with the Air Force CALS Test Bed and with Picatinny. The test execution with the Air Force CALS Test Bed consisted of:

a. The Army CALS Test Bed preparing and shipping a magnetic tape containing the baseline reference data to the Air Force CALS Test Bed.

b. The Air Force CALS Test Bed importing the data transferred on magnetic tape into their system.

c. The Army CALS Test Bed preparing and shipping the optical disk to the Air Force CALS Test Bed.

d. The Air Force CALS Test Bed importing the data transferred on optical disk into their system.

e. The Air Force CALS Test Bed comparing the data transferred on the magnetic tape with the data transferred on optical disk.

f. The Army CALS Test Bed obtaining and processing feedback from the Air Force CALS Test Bed.

3.1
The test execution at Picatinny consisted of:

a. The Army CALS Test Bed preparing and shipping a magnetic tape containing the baseline reference data to Picatinny.

b. Picatinny importing the data transferred on magnetic tape into their system.

c. The Army CALS Test Bed transmitting the test data set over the DDN to Picatinny.

d. Picatinny importing the data transferred over the DDN into their system.

e. Picatinny comparing the data transferred on the magnetic tape with the data transferred over the DDN.

f. The Army CALS Test Bed obtaining and processing feedback from Picatinny.

3.2 Test of MIL-STD-1840A Data Delivery Using Telecommunications.

3.2.1 Test Parameters.

The test was conducted between the Army CALS Test Bed at Fort Monmouth, NJ,which served as the sending site and the Information Management Directorate of the Information Systems Command at Picatinny Arsenal who received the data. The transfer over the DDN took place on 17 September 1990. The Army CALS Test Bed used a ComputerVision model CDS3000 running UNIX BSD 4.2 to initiate the transfer to a DDN host. At Picatinny, the data was transferred from the DDN to an Alliant FX/8 running the Concentrix operation system version 5.5.04.

3.2.2 Test Method.

Picatinny was sent a copy of the CTN Tapetool Source Code, version 1.1, and a tape containing the baseline reference data. Upon receipt, Picatinny performed the following steps:

a. Loaded the CTN Tapetool Source Code onto the Alliant FX/8.

b. Compiled Tapetool into executable code using the instructions shipped with the tool.

c. Ran Tapetool to import the baseline reference data by following the menu selections for importing a MIL-STD-1840A tape.

d. After the import process was completed, the directory containing the baseline reference data was examined to confirm that it contained the sub-directories D001 through D007. The log files were then printed and any errors noted.

e. Compared the declaration file records listed in the log file with those on the packing list shipped with the tape. Any anomalies were noted.

f. Set up a directory to store the data to be received off the DDN.

g. Set up a temporary account on the DDN.

3.2.2.1
The Army CALS Test Bed then performed the following steps:

a. Set up a temporary account on the ComputerVision.

b. Moved the test data set to the temporary account.

c. Transferred the data over the Army CALS Test Bed LAN to a DDN host at Fort Monmouth. The FTP command "mget" was used at the host.

d. The test data was then sent over the DDN to a DDN host at Picatinny. The FTP "msend" command was used at the DDN host at Fort Monmouth.

After the DDN transfer was completed, Picatinny transferred the data from their DDN host to their Alliant FX/8. The files received over the DDN were compared with the baseline reference data files by using the UNIX "diff" command. Any differences were recorded.

3.3 Test of MIL-STD-1840A Data Delivery Using Optical Disk.

3.3.1 Test Parameters.

The test was conducted between the Army CALS Test Bed at Fort Monmouth, NJ, which served as the sending site and the Air Force CALS Test Bed at Wright-Patterson AFB, Ohio,who received the data. A 14" Kodak optical disk and a 9-track magnetic tape were sent on 4 September 1990. The Army CALS Test Bed used a ComputerVision model CDS3000 with a 9-track magnetic tape drive. The ComputerVision operating system was UNIX BSD 4.2 and it was running version 1.1 of the CTN Tapetool. The Army CALS Test Bed also used a Kodak Optical Disk System 6800 connected to a Sun 3/160. The Sun operating system was Sun O/S 4.0.3. Kodak drive utilities were also used.

The Air Force CALS Test Bed used a Kodak Optical Disk System 6800 connected to a Sun 3/60. Other hardware used in the test included a Sun 3/280 and a Cheetah Gold 486. Software used for the test included Kodak drive utilities, calsb.350 (a CTN Raster Tool), Agfa Compugraphics CAPS/CALS (SGML, Raster), Software Exoterica XGML normalizer (SGML), Prepare/Preview (IGES), CADKEY (IGES), Autocad (IGES) and CTN Tapetool version 1.1.

3.3.2 Test Method.

The Air Force CALS Test Bed was sent a tape containing the baseline reference data. Upon receipt, they performed the following steps:

a. Ran Tapetool to import the baseline reference data by following the menu selections for importing a MIL-STD-1840A tape.

b. After the import process was completed, the directory containing the baseline reference data was examined to confirm that it contained the sub-directories D001 through D007. The log files were then printed and any errors noted.

c. Compared the declaration file records listed in the log file with those on the packing list shipped with the tape. Any anomalies were noted.

3.3.2.1
The Army CALS Test Bed prepared the optical disk using the following steps:

a. The seven documents prepared using the CTN Tapetool (see Section 2) were transferred to the Sun 3/160 using FTP software.

b. The files were then duplicated on the optical disk to produce 70 documents containing 370 data files. The file names were renumbered from 1 to 70 to conform with the standard prior to writing them to the optical disk. The files were copied onto the optical disk using the KOSI-FS software supplied with the optical disk system. No special parameters were required in using the copy command provided by this optical disk software. Over 21 megabytes were copied to the optical disk. Note that the optical disk also contains a file directory.

c. The optical disk was then packaged in its original shipping carton and sent to the Air Force CALS Test Bed for evaluation. Note that the optical disk is mounted in a carrier. When the disk and its carrier are removed from the system, they are automatically enclosed in a cartridge for protection. The cartridge protects the media from contamination and damage.

3.3.2.2
The Air Force CALS Test Bed read the data from the optical disk and tested for correctness as follows:

a. The Air Force CALS Test Bed listed and reviewed the contents of the declaration files and the header files. The CTN tapetool was not designed to work with optical disk media and therefore was not used to validate the data.

b. Data files were validated using appropriate tools such as IGES translators and CAD software for IGES data and decompression and display software for Raster data. Specific tools utilized were identified in Section 3.3.1.

c. The baseline reference data was read from the 9-track magnetic tape. The UNIX "diff" command was used to compare files from the tape with their counterparts from the optical disk.

4. FINDINGS AND ANALYSIS.

The results of this test are presented in the following three sections which deal with the data preparation, DDN transfer and Optical Disk transfer respectively.

4.1 Data Preparation.

In preparing the data for this test, several problems arose with respect to using MIL-STD-1840A. They indicate the need for more examples and details in the standard to clarify salient points. In particular:

a. The standard is not clear on how to number data files. For example, which method should be used in transferring 3 raster files and 2 IGES files in one document?

- d001, d001q001, d001q002, d001r001, d001r002, d001r003

or

- d001, d001q001, d001q002, d001r003, d001r004, d001r005

b. The standard does not state requirements for preparing CGM data file header records for output to magnetic tape. We used ANSI type F, 80-byte fixed-length records, 2000-byte block length. This is the same as IGES header files which have the same records.

c. The standard should clarify the use of end-of-line symbols (e.g., a "new line") in IGES and SGML data files when transferred in accordance with MIL-STD-1840A. Some computer-aided design (CAD) packages and Authoring systems require them. They have not been included on data files supplied by the CTN on tape since they are not required by MIL-STD-1840A and its referenced tape standards (See References g, h and i).

4.1.1
There was also a need for appropriate tools such as an optical disk version of Tapetool. The following mistakes could have been avoided had the proper tools been available:

a. The CGM data file names for document D007 were incorrectly written on the optical disk. This mistake could have been avoided if an automated tool was available for writing MIL-STD-1840A files to the optical disk.

b. In transmitting data files across the Test Bed LAN, we forgot to change the mode to binary when using FTP. This resulted in the binary files (i.e., raster and some CGM) being corrupted prior to being written to the optical disk. A similar problem occurred when using FTP to transfer files over the DDN.

A comprehensive MIL-STD-1840A tool set could avoid this problem by determining the file type and automatically setting the mode prior to transferring the files.

c. In reading one of the baseline reference data tapes that were prepared for the tests, the Tapetool software indicated that there were additional files on tape. This tape was previously written to several times. It appears that the Tapetool contained a bug that incorrectly identified some carry over from previous writes as valid data.

4.2 MIL-STD-1840A Data Delivery Using Telecommunications.

A total of 2,127,460 bytes of data in 37 files were transferred over the DDN. The transfer took 9 minutes. All files were received at Picatinny and validated against the baseline reference data using the UNIX "diff" command. As previously noted, the binary files transferred were corrupted because the FTP mode was not set to binary. Also, the SGML files did not match exactly. It was determined that the Tapetool had deleted blanks that occurred before a "new line". This did not affect the validity of the SGML files but did cause the files read from tape to be slightly smaller than those transferred over the DDN.

The non-media-specific file structures required by MIL-STD-1840A were implementable on DDN transfers. The file formats used for this test were essentially the same as specified in MIL-STD-1840A for tape. One difference was that files containing variable-length records such as the declaration file and SGML files have their record length specified on tape by the use of a record control word (RCW). These files were sent over the DDN using a "new line" as a terminator in lieu of a RCW. This was done to expedite the file transfers since the "new line" format was provided on the hard disk by the Tapetool. (The translation from the "new line" to the RCW was done directly to tape by the Tapetool.) The receiving systems could also process these files without having to convert from the RCW format.

The DDN seems to be adequate for moderate-sized MIL-STD-1840A file transfers such as performed in the test. However, larger transfers will need longer transmission times. This time could be reduced if all of the files were compressed. For example, previous experiments have shown that IGES files can be compressed 5:1 using PKARC (an ASCII file compression software available for DOS PCs).

4.3 MIL-STD-1840A Data Delivery Using Optical Disk.

Optical disk standards are just now emerging. The reasons are as follows:

a. There are several types of optical disks including Write Once Read Many (WORM), Read Only (RO) and Rewritable which is also know as Erasable.

b. Optical disks also come in different sizes including 5.25, 3.5, 12 and 14 inches in diameter.

c. Work on optical disk standards began only about 6 years ago with 12-inch diameter optical disks.

4.3.1
Today, standards organizations including the Optical Digital Data Disks technical committee X3B11 of ANSI are working on the interchange of stored digital information on this media. The present status of the standards effort (See Reference k.) with respect to the 14-inch WORM optical disk used in this test is as follows:

a. A 356mm (14-inch) WORM draft standard is complete and has been sent to the ANSI X3B11 committee for review. This standard was proposed by Kodak.

b. Kodak has also presented its on-disk format for review by the ANSI X3B11.1 committee. This task group is working on WORM file structures and hopes to have a first draft ready by year end.

4.3.2
To conduct the test, we worked within the boundaries of the Kodak optical disk software and hardware, namely:

a. The optical disk system stores files as byte strings. The system has no knowledge of the contents of any file.

b. Presently, the system cannot retrieve portions of files (e.g. records). The user must access the entire file.

c. Unlike magnetic tape, the optical disk system is a random access device which relies on a file directory to locate files on the disk.

This did not present any major problems in creating the MIL-STD-1840A files for each document (i.e.,declaration file and data files with header records). We were able to write declaration files and data files (with header records) to the optical disk in the file structure, content and order specified in the non-media-specific section of the standard. As was the case for the DDN transfer, the file formats used for this test were essentially the same as specified in MIL-STD-1840A for tape. As was also the case for the DDN transfer Section 4.2), a "new line" was used as a record terminator in lieu of a RCW for files containing variable length records.

4.3.3
Other issues which arose during the preparation of the optical disk are as follows:

a. MIL-STD-1840A permits 999 unique declaration file names (See page 14, para. 5.1.1.1 of Reference b) and data file names (See page 17, para. 5.1.3

of Reference b). This may not be enough when dealing with the large volume of data that can be stored on an optical disk. In our test, the 70 documents required only 21 megabytes of the 6.8 gigabytes of space available on the optical disk. It is conceivable that transfers could occur over optical disk media involving product data which contain over 1000 drawings and technical publications which number over 1000 documents.

b. Working with large volumes of data requires new approaches to preparing the data for transfer. For this test, we did not encounter any storage problems on the hard disk since only seven documents were used. A routine was written to duplicate the data onto the optical disk as 70 documents. Had we worked with 70 unique documents, finding available space on the hard disk on the ComputerVision would have become a problem.

c. When the data transfer necessitates the use of multiple volumes, is it effective that all of the declaration files be located on the first volume as required by MIL-STD-1840A? This is reasonable because optical disk volumes (i.e., each side of a disk platter for a single read/write head) must be mounted separately as is the case for 9-track tape volumes. It would also be desirable to know from reading the first volume how many documents and files were in the transfer. However, when transferring large volumes of data, there are advantages to also include a copy of the declaration file on the same optical disk volume(s) as its file set. More research should be conducted into this area.

d. Packaging requirements for optical disk transfers were not specified in MIL-STD-1840A. The packaging provided by Kodak appeared to be adequate since the optical disk was not damaged during several transfers.

4.3.4
The results of the Air Force CALS Test Bed's testing are as follows:

a. The Air Force CALS Test Bed had no problem accessing files from the Kodak optical disk as one would hope since they were using the same optical disk system.

b. Standard CTN tools for reading and checking declaration and header files could not be used since they were not designed to read from optical disks.

c. As in the case for writing data to the optical disk, reading large volumes of data into the hard disk all at the same time would pose special problems due to storage limitations. The user will probably require that files be accessed from the optical disk selectively, for review and acceptance, taking

advantage of the random access feature of the optical disk.

d. Through the use of the optical disk software, selected files were copied onto the hard disk. They were then validated using available tools for processing IGES, RASTER, SGML and CGM data. This led to the discovery of the corrupted binary files as previously noted in Section 4.1.1. Subsequent transfer of additional raster files in the proper format indicated that these files were transferred correctly on the optical disk.

e. Selected files were also read from the baseline reference data on magnetic tape and compared to their counterparts read from the optical disk. The UNIX "diff" command confirmed that the files were identical.

5. RECOMMENDATIONS.

Based on the findings and analysis the following recommendations are made:

a. The MIL-STD-1840A document should provide more examples and additional detail. This can be provided in the standard itself, in appendices to the standard or through the creation of an accompanying handbook. Included should be more examples on file naming and formats. This would include addressing end-of-line symbols for IGES and SGML files. CGM data file header record format requirements on magnetic tape must also be addressed (See Section 4.1).

b. Work should continue on the development of automated tools for creating, validating and retrieving MIL-STD-1840A files. For practical purposes, tools should first be developed for widely used operating systems and media. The capabilities of tools should be expanded to automatically collect data over networks from distributed data repositories for MIL-STD-1840A preparation (See Sections 4.1, 4.2 and 4.3).

c. MIL-STD-1840A should provide a way to transfer more files than is currently permitted under the file naming limitation of 999. This includes adding the capability to transfer more than 999 documents and more than 999 data files of the same type within a file set (See Section 4.3).

d. The media specific file formats specified for magnetic tape can be used for telecommunications and optical disk transfers. (See Sections 4.2 and 4.3).

e. The random access capability of the optical disk should be utilized. Therefore a file directory or other technique for providing random access to files on the optical disk should be provided (See Section 4.3).

f. When transferring large volumes of data, there are advantages to including a copy of the declaration file on the same optical disk volume(s) as its file set. Since large amounts of data could be involved, data is likely to be retrieved incrementally. This will require volumes to be accessed several times and the data might even bypass storage on the magnetic disk during validation (See Section 4.3). More research should be conducted into this area.

g. MIL-STD-1840A should provide the option for transferring compressed files as is the case for raster. The need was clearly demonstrated during the telecommunications tests. The IGES standard (See Reference c.) does

provide for a compressed format but it has not been widely used. A study should be done to determine if compression techniques should be tailored to the individual data types or if one common compression technique can be adopted (See Section 4.2).

APPENDIX A

DECLARATION FILE RECORDS

1840A Declaration File Records

Records of Declaration File d001

srcsys: Army CALS Testbed, Fort Monmouth, NJ
srcdocid: NENTITY
srcrelid: LBRACKT
chglvl: Revision C 19881229
dteisu: 19881015
dstsys: Test Participants
dstdocid: NENTITY
dstrelid: LBRACKT
dtetrn: 19900829
dlvacc: This reference drawing will be used for structured IGES testing
filcnt: q1
ttlcls: Unclassified
doccls: Unclassified
doctyp: CTN IGES Reference Drawing
docttl: N-entity Reference Drawing

Records of Declaration File d002

srcsys: Army CALS Testbed, Fort Monmouth, NJ
srcdocid: LBRACKT
srcrelid: NENTITY
chglvl: Revision C 19881229
dteisu: 19881015
dstsys: Test Participants
dstdocid: LBRACKT
dstrelid: NENTITY
dtetrn: 19900829
dlvacc: This reference drawing will be used for structured IGES testing
filcnt: q1
ttlcls: Unclassified
doccls: Unclassified
doctyp: CTN IGES Reference Drawing
docttl: L-bracket Reference Drawing

Records of Declaration File d003

srcsys: Army CALS Testbed, Fort Monmouth, NJ
srcdocid: CTN RASTER TEST NODE - REF. DATA TAPE 1
srcrelid: NONE
chglvl: ORIGINAL
dteisu: 19891101
dstsys: Test Participants
dstdocid: NONE
dstrelid: NONE
dtetrn: 19900829
dlvacc: NONE
filcnt: r15
ttlcls: UNCLASS
doccls: UNCLASS
doctyp: CTN REFERENCE DATA - MIL-R-28002
docttl: NONE

Records of Declaration File d004

srcsys: Army CALS Testbed, Fort Monmouth, NJ
srcdocid: IENTITY
srcrelid: LGTABLE
chglvl: Revision A 19900829
dteisu: 19891031
dstsys: Test Participants
dstdocid: IENTITY
dstrelid: LGTABLE
dtetrn: 19900829
dlvacc: This reference illustration will be used for structured IGES testing
filcnt: q1
ttlcls: Unclassified
doccls: Unclassified
doctyp: CTN MIL-D-28000 Class I Reference Illustration
docttl: IENTITY Reference Illustration

Records of Declaration File d005

srcsys: Army CALS Testbed, Fort Monmouth, NJ
srcdocid: LGTABLE
srcrelid: IENTITY
chglvl: Revision A 19900829
dteisu: 19890707
dstsys: Test Participants
dstdocid: LGTABLE
dstrelid: IENTITY
dtetrn: 19900829
dlvacc: This reference illustration will be used for structured IGES testing
filcnt: q1
ttlcls: Unclassified
doccls: Unclassified
doctyp: CTN MIL-D-28000 Class I Reference Illustration
docttl: LGTABLE Reference Illustration

Records of Declaration File d006

srcsys: Army CALS Testbed, Fort Monmouth, NJ
srcdocid: 11W1SHORT
srcrelid: NONE
chglvl: ORIGINAL
dteisu: 19890728
dstsys: Test Participants
dstdocid: 11W1SHORT
dstrelid: NONE
dtetrn: 19900829
dlvacc: NONE
filcnt: t1,g1,r5
ttlcls: UNCLASSIFIED
doccls: UNCLASSIFIED
doctyp: Technical Manual
docttl: NONE

Records of Declaration File d007

srcsys: Army CALS Testbed, Fort Monmouth, NJ
srcdocid: Reference Computer Graphics Metafiles Draft File ver 1990-07-19
srcrelid: NONE
chglvl: ORIGINAL
dteisu: 19900828
dstsys: Test Participants
dstdocid: 1840A Non-magnetic media transfer test data
dstrelid: NONE
dtetrn: 19900829
dlvacc: NONE
filcnt: c4
ttlcls: UNCLASSIFIED
doccls: UNCLASSIFIED
doctyp: Computer Graphics
docttl: NONE

APPENDIX B

DATA FILE HEADER RECORDS

1840A Data File Header Records

Records of Header Record File d001q001_hdr

srcdocid: CS - The rest of this line will be completed IAW MIL-STD-804
dstdocid: NENTITY
txtfilid: NONE
figid: NONE
srcgph: NONE
doccls: Unclassified
notes: The first line of the IGES file begins after this "notes:" line.

Records of Header Record File d002q001_hdr

srcdocid: CS - The rest of this line will be completed IAW MIL-STD-804
dstdocid: LBRACKT
txtfilid: NONE
figid: NONE
srcgph: NONE
doccls: Unclassified
notes: The first line of the IGES file begins after this "notes:" line.

Records of Header Record File d003r001_hdr

srcdocid: PD CTN RAS DWG 01 00010016ULL N
dstdocid: CALS TEST NETWORK (CTN) RASTER TEST NODE TEST DATA
txtfilid: NONE
figid: NONE
srcgph: NONE
doccls: UNCLASS
rtype: 1
rorient: 000,270
rpelcnt: 001728,002200
rdensty: 0200
notes: NONE

Records of Header Record File d003r002_hdr

srcdocid: PD CTN RAS DWG 02 00020016ULL N
dstdocid: CALS TEST NETWORK (CTN) RASTER TEST NODE TEST DATA
txtfilid: NONE
figid: NONE
srcgph: NONE
doccls: UNCLASS
rtype: 1
rorient: 000,270
rpelcnt: 002720,003232
rdensty: 0200
notes: NONE

Records of Header Record File d003r003_hdr

srcdocid: PD CTN RAS DWG 03 00030016ULL N
dstdocid: CALS TEST NETWORK (CTN) RASTER TEST NODE TEST DATA
txtfilid: NONE
figid: NONE
srcgph: NONE
doccls: UNCLASS
rtype: 1
rorient: 000,270
rpelcnt: 002240,003400
rdensty: 0200
notes: NONE

Records of Header Record File d003r004_hdr

srcdocid: PD CTN RAS DWG 04 00040016ULL N
dstdocid: CALS TEST NETWORK (CTN) RASTER TEST NODE TEST DATA
txtfilid: NONE
figid: NONE
srcgph: NONE
doccls: UNCLASS
rtype: 1
rorient: 000,270
rpelcnt: 003488,004600
rdensty: 0200
notes: NONE

Records of Header Record File d003r005_hdr

srcdocid: PD CTN RAS DWG 05 00050016ULL N
dstdocid: CALS TEST NETWORK (CTN) RASTER TEST NODE TEST DATA
txtfilid: NONE
figid: NONE
srcgph: NONE
doccls: UNCLASS
rtype: 1
rorient: 000,270
rpelcnt: 003456,004400
rdensty: 0200
notes: NONE

Records of Header Record File d003r006_hdr

srcdocid: PD CTN RAS DWG 06 00060016ULL N
dstdocid: CALS TEST NETWORK (CTN) RASTER TEST NODE TEST DATA
txtfilid: NONE
figid: NONE
srcgph: NONE
doccls: UNCLASS
rtype: 1
rorient: 000,270
rpelcnt: 003488,004600
rdensty: 0200
notes: NONE

Records of Header Record File d003r007_hdr

srcdocid: PD CTN RAS DWG 07 00070016ULL N
dstdocid: CALS TEST NETWORK (CTN) RASTER TEST NODE TEST DATA
txtfilid: NONE
figid: NONE
srcgph: NONE
doccls: UNCLASS
rtype: 1
rorient: 000,270
rpelcnt: 004416,006800
rdensty: 0200
notes: NONE

Records of Header Record File d003r008_hdr

srcdocid: PD CTN RAS DWG 08 00080016ULL N
dstdocid: CALS TEST NETWORK (CTN) RASTER TEST NODE TEST DATA
txtfilid: NONE
figid: NONE
srcgph: NONE
doccls: UNCLASS
rtype: 1
rorient: 000,270
rpelcnt: 004928,007312
rdensty: 0200
notes: NONE

Records of Header Record File d003r009_hdr

srcdocid: PD CTN RAS DWG 09 00090016ULL N
dstdocid: CALS TEST NETWORK (CTN) RASTER TEST NODE TEST DATA
txtfilid: NONE
figid: NONE
srcgph: NONE
doccls: UNCLASS
rtype: 1
rorient: 000,270
rpelcnt: 006848,008800
rdensty: 0200
notes: NONE

Records of Header Record File d003r010_hdr

srcdocid: PD CTN RAS DWG 10 00100016ULL N
dstdocid: CALS TEST NETWORK (CTN) RASTER TEST NODE TEST DATA
txtfilid: NONE
figid: NONE
srcgph: NONE
doccls: UNCLASS
rtype: 1
rorient: 000,270
rpelcnt: 006912,008800
rdensty: 0200
notes: NONE

Records of Header Record File d003r011_hdr

srcdocid: PD CTN RAS DWG 11 00110016ULL N
dstdocid: CALS TEST NETWORK (CTN) RASTER TEST NODE TEST DATA
txtfilid: NONE
figid: NONE
srcgph: NONE
doccls: UNCLASS
rtype: 1
rorient: 000,270
rpelcnt: 004688,006616
rdensty: 0200
notes: NONE

Records of Header Record File d003r012_hdr

srcdocid: PD CTN RAS DWG 12 00120016ULL N
dstdocid: CALS TEST NETWORK (CTN) RASTER TEST NODE DATA
txtfilid: NONE
figid: NONE
srcgph: NONE
doccls: UNCLASS
rtype: 1
rorient: 000,270
rpelcnt: 003312,004680
rdensty: 0200
notes: NONE

Records of Header Record File d003r013_hdr

srcdocid: PD CTN RAS DWG 13 00130016ULL N
dstdocid: CALS TEST NETWORK (CTN) RASTER TEST NODE DATA
txtfilid: NONE
figid: NONE
srcgph: NONE
doccls: UNCLASS
rtype: 1
rorient: 000,270
rpelcnt: 002352,003312
rdensty: 0200
notes: NONE

Records of Header Record File d003r014_hdr

srcdocid: PD CTN RAS DWG 14 00150016ULL N
dstdocid: CALS TEST NETWORK (CTN) RASTER TEST NODE DATA
txtfilid: NONE
figid: NONE
srcgph: NONE
doccls: UNCLASS
rtype: 1
rorient: 000,270
rpelcnt: 003488,004600
rdensty: 0200
notes: NONE

Records of Header Record File d003r015_hdr

srcdocid: PD CTN RAS DWG 16 00160016ULL N
dstdocid: CALS TEST NETWORK (CTN) RASTER TEST NODE DATA
txtfilid: NONE
figid: NONE
srcgph: NONE
doccls: UNCLASS
rtype: 1
rorient: 000,270
rpelcnt: 003600,003600
rdensty: 0200
notes: CTN RASTER NODE SYNTHETIC IMAGE - NO IMAGE CONTENT

Records of Header Record File d004q001_hdr

srcdocid: IENTITY
dstdocid: IENTITY
txtfilid: None
figid: None
srcgph: None
doccls: Unclassified
notes: The first line of the IGES file begins after this "notes" line.

Records of Header Record File d005q001_hdr

srcdocid: LGTABLE
dstdocid: LGTABLE
txtfilid: None
figid: None
srcgph: None
doccls: Unclassified
notes: The first line of the IGES file begins after this "notes" line.

Records of Header Record File d006r001_hdr

srcdocid: 11W1SHORT
dstdocid: 11W1SHORT
txtfilid: W
figid: NONE
srcgph: RLANDGEA
doccls: UNCLASSIFIED
rtype: 1
rorient: 000,270
rpelcnt: 000656,000600
rdensty: 0300
notes: CALS Test Network LANDGEAR Reference Illustration, part A

Records of Header Record File d006r002_hdr

srcdocid: 11W1SHORT
dstdocid: 11W1SHORT
txtfilid: W
figid: NONE
srcgph: RLGTABLB
doccls: UNCLASSIFIED
rtype: 1
rorient: 000,270
rpelcnt: 000944,000601
rdensty: 0300
notes: CALS Test Network LGTABLE Reference Illustration, part B

Records of Header Record File d006r003_hdr

srcdocid: 11W1SHORT
dstdocid: 11W1SHORT
txtfilid: W
figid: NONE
srcgph: RLGTABLC
doccls: UNCLASSIFIED
rtype: 1
rorient: 000,270
rpelcnt: 002048,000451
rdensty: 0300
notes: CALS Test Network LGTABLC Reference Illustration, part C

Records of Header Record File d006r004_hdr

srcdocid: 11W1SHORT
dstdocid: 11W1SHORT
txtfilid: W
figid: NONE
srcgph: RLANDGED
doccls: UNCLASSIFIED
rtype: 1
rorient: 000,270
rpelcnt: 002096,002551
rdensty: 0300
notes: CALS Test Network LANDGEAR Reference Illustration, part D

Records of Header Record File d006r005_hdr

srcdocid: 11W1SHORT
dstdocid: 11W1SHORT
txtfilid: W
figid: NONE
srcgph: RLGTABLE
doccls: UNCLASSIFIED
rtype: 1
rorient: 000,270
rpelcnt: 002048,002600
rdensty: 0300
notes: CALS Test Network LGTABLE Reference Illustration, part E

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Records of Header Record File d006t001_hdr

srcdocid: 11W1SHORT
dstdocid: 11W1SHORT
txtfilid: W
doccls: UNCLASSIFIED
notes: NONE

Records of Header Record File d006g001_hdr

srcdocid: 11W1SHORT
dstdocid: 11W1SHORT
notes: All external Entity Definitions for Graphic Boardno are declared in the text file.

Records of Header Record File d007c001_hdr

srcdocid: Reference Computer Graphics Metafiles Draft File ver 1990-07-19
dstdocid: 1840A Non-magnetic media transfer test data
txtfilid: NONE
figid: NONE
srcgph: NONE
doccls: UNCLASSIFIED
notes: This is the file CTN-01i.clr

Records of Header Record File d007c002_hdr

srcdocid: Reference Computer Graphics Metafiles Draft File ver 1990-07-19
dstdocid: 1840A Non-magnetic media transfer test data
txtfilid: NONE
figid: NONE
srcgph: NONE
doccls: UNCLASSIFIED
notes: This is the file CTN-01i.cgm.

Records of Header Record File d007c003_hdr

srcdocid: Reference Computer Graphics Metafiles Draft File ver 1990-07-19
dstdocid: 1840A Non-magnetic media transfer test data
txtfilid: NONE
figid: NONE
srcgph: NONE
doccls: UNCLASSIFIED
notes: This the file CTN-01r.clr.

Records of Header Record File d007c004_hdr

srcdocid: Reference Computer Graphics Metafiles Draft File ver 1990-07-19
dstdocid: 1840A Non-magnetic media transfer test data
txtfilid: NONE
figid: NONE
srcgph: NONE
doccls: UNCLASSIFIED
notes: This is the file CTN-01r.cgm.