



CALS TEST NETWORK

CTN Test Report

90-045

AFTB-ID-90-013



**Technical Publication
 Transfer Test Using
 GTE Government Systems
 Provided Data:
 MIL-M-28001 (SGML) and
 MIL-R-28003 (CGM)**

Quick Short Test Report

October 25, 1990

REVISED

DATA QUALITY INSPECTED

Prepared for
 Air Force Logistics Command
 Air Force CALS Test Bed (LMSC/SBC)
 Wright-Patterson AFB, OH 45433-5000

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CTN Test Report
90-045

AFTB-ID-90-13

Technical Publication Transfer
Using GTE Government Systems

Provided Data:

MIL-M-28001 (SGML)

MIL-R-28003 (CGM)

Quick Short Test Report

25 October 1990

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25 October 1990

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1. Introduction

1.1 Background

The DOD Computer-aided Acquisition and Logistic Support (CALs) Test Network (CTN) is conducting tests of the military standard for the Automated Interchange of Technical Information, MIL-STD-1840A, and its companion suite of military specifications. The CTN is a DOD-sponsored confederation of voluntary participants from industry and government managed by the Air Force Logistics Command.

The primary objective of the CTN is to evaluate the effectiveness of the CALs standards (Standards) for technical data interchange and to demonstrate the technical capabilities and operational suitability of those Standards. Two general categories of tests are performed to evaluate the Standards, formal and informal. Formal tests are large, comprehensive tests that follow a written test plan, require specific authorization from DOD, and may take months to prepare, execute, and report.

Informal tests are quick and short, taking only a few hours to set up and execute. They are used by the CTN technical staff to broaden the testing base by including representative samples of the many systems and applications used by CTN participants. They also allow the CTN staff to gain feedback from many industry and government interpretations of the Standards, to increase the base of participation in the CALs initiative, and to respond, in a timely manner, to the many requests for help that come from participants. Participants take part voluntarily and are benefited by receiving an evaluation of their latest implementation (interpretation) of the Standards, interacting with the CTN technical staff, gaining experience in use of the Standards, and developing increased confidence in them. The results of informal tests are reported in Quick Short Test Reports (QSTRs) that briefly summarize the standard(s) tested, the hardware and software used, the nature of the test, and the results.

1.2 Purpose

The purpose of the informal test reported in this QSTR was to analyze GTE Government Systems' interpretation and use of the CALs standards in transferring technical publications data including CGM files. GTE used its CALs Technical Data Interchange System to produce data in accordance with the Standards and delivered it to the CTN technical staff on a 9-track magnetic tape.

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2. Test Parameters

Test Plan: AFTB 90-13

Date of Evaluation: October 25, 1990

Evaluators: Air Force CALS Test Bed
HQ AFLC IMSC/SNX
Wright-Patterson AFB, OH 45433-5000

Data Originator: GTE Government Systems Corporation
80 "A" Street
Needham, MA 02194

Data Description: Operation and Technical Manual
Red Telephone Switching Subsystem
1 text file
91 CGM files

Data Source System:

Text/SGML

DEC MicroVAX II system
Author Editor
IBM PC
FastTag

CGM

Macintosh II
Claris MacDraw II
GSC Associates GraphPorter

Evaluation Tools Used:

1840A SUN 3/280
CIN TAPEITool (v1.0) UNIX
SUN 3/60
Agfa Compugraphics CALS

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SGML Cheetah Gold 486
Exoterica XGML
SUN 3/60
Agfa Compugraphics CALS

CGM
Metacals

**Standards
Tested:**

MIL-STD-1840A Notice 1
MIL-M-28001
MIL-D-28003

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3. 1840A Analysis

3.1 External Packaging

The tape arrived at the Air Force Test Bed enclosed in a box IAW ASTM D 3951. The exterior of the box was marked with the required magnetic tape warning label, MIL-STD-1840A, para. 5.3.1.3.

The tape was not enclosed in a barrier bag or barrier sheet material as required by MIL-STD-1840A, para. 5.3.1.2. Enclosed in the box was a packing list showing all files that were recorded on the tape.

3.2 Transmission Envelope

The nine-track tape received by the Air Force Test Bed contained MIL-STD-1840A files. The files were named per the standard conventions.

3.2.1 Tape Formats

The 1840A Tape was run through the AFTB TAPETOOL utility version 1.1. No errors were encountered while evaluating the contents of the tape labels.

The tape was also run into the AFTB system using Agfa Compu-graphics read1840A utility. No errors were noted.

3.2.2 Declaration and Header Fields

No errors were reported with these files.

4. SGML Analysis

The GTE Government systems text submission consisted of 165 pages of tagged text with seven tagged tables. GTE provided a listing of the type tag and number of occurrences in the document. This list is included in Appendix E.

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The text file from this document was tested using the Software Exoterica XGML parser. With the text file parsed using the 38794B DTD, over 500 errors were reported. Many of these errors relate to the external entity references made at the start of the document.

Parsing the file without the 38784B DTD, over 300 errors were reported. The majority of these errors relate to incorrect ROW references in tables. A shortened part of the error log is shown in Appendix B.

The file was also parsed using the SOBEMAP product in Agfa Compugraphics CAPS/CALS. The initial parsing attempt was not successful. The problem was in the added information on the DOCTYPE line of the SGML document. Once this information was removed the document parsed with errors. They relate to TABLE callouts and were the same errors as reported by XGML.

The document was then made into an Agfa CAPS document and displayed on the screen. Currently, the Agfa product does not support CGM files so these were not inserted into the screen display.

5. CGM Analysis

This tape contained 91 CGM files. Agfa Compugraphics has just announced a CGM addition to their CALS software. This should be available in the near future in the AFTB for CGM analysis.

These files were checked by Bruce Garner of CTNO Technical Operations Lab ,LLNL. Appendix D is the results of the this analysis.

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6. Conclusions and Recommendations

In summary, the MIL-STD-1840A tape from GTE Government Systems was correct. The tape could be read properly using the CTN TAPE-TOOL Software without errors

The SGML file was read correctly and processed using the Agfa CALS/CAPS software. Many errors resulted during the parsing operation which could be traced to TABLE calls in the document when using both the SOBEMAP and XGML parser.

For conclusions and recommendation of CGM files see Appendix D of this report.

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7. Appendix A - Tape Tool Report Logs

7.1 Tape Catalog

CALS Test Network Tape Evaluation - Version 1.1

MIL-STD-1840A Tape Evaluation Catalog

Mon Oct 22 17:01:19 1990
/cals/tapetool2/Set018

Document File Set Directory:

Page: 1

| File Name | File Type | Record Type | Record Length |
|-----------|----------------------|-------------|---------------|
| d001 | Document Declaration | D | 00260 |
| d001t001 | Text | D | 00260 |
| d001c001 | CGM | F | 00080 |
| d001c002 | CGM | F | 00080 |
| d001c003 | CGM | F | 00080 |

<<<<<<<< Remainder of file deleted >>>>>>>>

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7.2 Tape Import Log

CALS Test Network Document File Set Validation - Version 1.1

MIL-STD-1840A Imported Document File Set Validation Log

Found file: d001
Renaming Document Declaration file: d001
Extracting 1840A Document Declaration header records...
Validating Document Declaration header records...

srcsys: GTE GOVERNMENT SYSTEMS CALS VAX B
srcdocid: RTSS_OPER_AND_MAINTENANCE_MANUAL_VOL1
srcrelid: NONE
chglvl: ORIGINAL
dteisu: 19900919
dstsys: CALS_TEST_NETWORK_HQ_AFLC_LMSC/SJT_WRIGHT-PATTERSON AFB
dstdocid: RTSS_OPER_AND_MAINTENANCE_MANUAL_VOL1
dstrelid: NONE
dtetrn: 19900918
dlvacc: NONE
filcnt: T1,C91
ttlcls: UNCLASSIFIED
doccls: UNCLASSIFIED
doctyp: Technical Publication
docttl: NONE

Saving Document Declaration header file: d001_hdr

Found file: d001t001
Renaming Text file: d001t001
Extracting 1840A Text header records...
Validating Text header records...

srcdocid: RTSS_OPER_AND_MAINTENANCE_MANUAL_VOL1
dstdocid: RTSS_OPER_AND_MAINTENANCE_MANUAL_VOL1
txtfilid: W
doccls: UNCLASSIFIED
notes: NONE

Saving Text header file: d001t001_hdr
Saving Text data file: d001t001_txt

Found file: d001c001
Renaming CGM file: d001c001
Extracting 1840A CGM header records...
Validating CGM header records...

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srcdocid: RTSS_OPER_AND_MAINTENANCE_MANUAL_VOL1
dstdocid: RTSS_OPER_AND_MAINTENANCE_MANUAL_VOL1
txtfilid: W
figid: F1
srcgph: C1
doccls: UNCLASSIFIED
notes: NONE

Saving CGM header file: d001c001_hdr
Saving CGM data file: d001c001_cgm

<<<<< PART OF LOG REMOVED HERE >>>>>>

Checking file count...
No errors were found.
File Count verification complete.

No errors were encountered in document d001.

No errors were encountered during validation.

MIL-STD-1840A File Set Validation Complete.

7.3 Tape Error Log

No errors reported.

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8. Appendix B - Parser Logs

8.1 Exoterica Parser Error Log

C:\XGML\XGMLNORM.EXE --
Error on line 549 in file \9013\d001t001:
Undeclared attribute specification.
For start tag 'TABLE': Unknown attribute is 'SCILEVEL'.
Allowed attributes for the element 'TABLE' are: 'ID', 'INSCHLVL',
'DELCHLVL', 'LABEL', 'TEXTTYPE', 'ITEMID', 'CONFIG', 'SKILLTRK', 'HCP'
and 'XREF'.

C:\XGML\XGMLNORM.EXE --
Error on line 560 in file \9013\d001t001:
Attribute does not have a current value.
For start tag 'ENTRY': For CURRENT NMTOKEN attribute 'ROW'..

C:\XGML\XGMLNORM.EXE --
Error on line 562 in file \9013\d001t001:
Attribute does not have a current value.
For start tag 'ENTRY': For CURRENT NMTOKEN attribute 'ROW'..

C:\XGML\XGMLNORM.EXE --
Error on line 569 in file \9013\d001t001:
Attribute does not have a current value.
For start tag 'ENTRY': For CURRENT NMTOKEN attribute 'ROW'..

C:\XGML\XGMLNORM.EXE --
Error on line 571 in file \9013\d001t001:
Attribute does not have a current value.
For start tag 'ENTRY': For CURRENT NMTOKEN attribute 'ROW'..

<<<<<<<< Remainder OF LOG REMOVED HERE >>>>>>>>>
<<<<<<<< MORE ROW ERRORS >>>>>>>>>

8.2 Agfa Compugraphics Parser Log

<!--*** file:nold.T.sgm line:560 pos:23292
Missing first specification of a CURRENT default value type attribute
(ROW)-->

<!--*** file:nold.T.sgm line:562 pos:23332
Missing first specification of a CURRENT default value type attribute
(ROW)-->

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<!--*** file:nold.T.sgm line:569 pos:23400
Missing first specification of a CURRENT default value type attribute
(ROW)-->

<!--*** file:nold.T.sgm line:571 pos:23435
Missing first specification of a CURRENT default value type attribute
(ROW)-->

```
559     <THEAD>
560     <ROW>
561     <ENTRY COL="1">MAJOR COMPONENT
562     </ENTRY>
563     <ENTRY COL="2">DESCRIPTION
564     </ENTRY>
565     </ROW>
566     </THEAD>
567
568     <TBODY>
569     <ROW>
570     <ENTRY COL="1">RED Switch
571     </ENTRY>
572     <ENTRY COL="2">
573     </ENTRY>
574     </ROW>
```

<<<<<<<< PART OF LOG REMOVED HERE >>>>>>>>>
<<<<<< MORE TABLE-ROW ERRORS >>>>>>>>>

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9. Appendix C - SGML Tags Used

| NAME | COUNT | DESCRIPTION |
|----------|-------|-------------------------------|
| BODY | 1 | Body Matter |
| CHAPTER | 1 | Chapter |
| COLBDEF | 7 | Column Body Definition |
| COLHDEF | 19 | Column Heading Definition |
| CONTENTS | 1 | Generated Table of Contents |
| CONTRNO | 1 | Contract Number |
| DEF | 161 | Definition |
| DEFLIST | 19 | Definition List |
| DOC | 1 | Document Level Element |
| DOCNO | 1 | Document Number |
| DOCTYPE | 1 | Document Type |
| ENDEMPH | 258 | End Emphasis |
| ENTRY | 382 | Table Entry |
| FIGURE | 91 | Figure |
| FRONT | 1 | Front Matter |
| GLOSSARY | 1 | Glossary |
| GLOSSHD | 19 | Glossary Head |
| GRAPHIC | 91 | Graphic |
| IDINFO | 1 | Title Page |
| ILUSLIST | 1 | Generated Illustration List |
| LEP | 1 | Gen. List of Effective Pages |
| MFR | 1 | Manufacturer |
| MODELNO | 1 | Equipment Model Number |
| NOMEN | 1 | Equipment Nomenclature |
| NOTICE | 2 | Notice |
| PARA | 11 | Paragraph |
| PARA0 | 22 | Primary Paragraph |
| PARATEXT | 720 | Paragraph Text |
| PRECAUT | 5 | Precaution |
| PRTITLE | 1 | Prime Title |
| PUBDATE | 1 | Publication Date |
| PUBNO | 1 | Publication Number |
| REAR | 1 | Rear Matter |
| ROW | 131 | Table Row |
| SAFESUM | 1 | Safety Summary |
| SECTION | 3 | Section |
| STEMPH | 258 | Start Emphasis |
| STEP1 | 262 | Procedural Step, First Level |
| STEP2 | 19 | Procedural Step, Second Level |
| SUBPARA1 | 79 | Subordinate Paragraph, 1 |
| SUBPARA2 | 78 | Subordinate Paragraph, 2 |
| SUBPARA3 | 67 | Subordinate Paragraph, 3 |
| TABDEF | 9 | Table Definition |
| TABLE | 9 | Table |

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| | | |
|----------|-----|--------------------------|
| TABLIST | 1 | Generated List of Tables |
| TBODY | 9 | Table Body |
| TERM | 161 | Symbol |
| THEAD | 8 | Table Head |
| TITLE | 350 | Title |
| TITLEBLK | 1 | Title Block Matter |
| USER | 1 | User Service |
| WARNING | 6 | Warning |
| WARNSUM | 1 | Warning Summary |
| XREF | 138 | Cross Reference |

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10. Appendix D - CGM Analysis

The 91 metafiles were stripped of their MIL-STD-1840A headers at AFTB. They were provided to CTNO Technical Operations Lab on DOS floppy disk.

Each of the 91 GTE metafiles was analyzed with two beta version programs for analysis of CGMs. These CGM analysis programs, ValidCGM and MetaCALS, check CGMs for agreement with the requirements of MIL-D-28003 and, in the case of MetaCALS, with the requirements of ANSI/ISO 8632 also. The errors reported are discussed in this report.

All of the metafiles were interpreted and plotted with MetaView on an IBM compatible (DOS) personal computer. In addition, some of the files also were plotted with CGMView and/or GPLOT on a SUN/3 computer running under the UNIX operating system.

This is a revised report. The initial report generated considerable discussion of our interpretation of the reported testing. This lead to a better understanding of the requirements of the ANSI/ISO standard for CGM, for the CALS application profile for CGM, and lead to refined and improved operational procedures for interchange tests such as this one. The revised report is a result of this improved understanding.

10.1 Analysis

10.1.1 File Size

The GTE CGMs, stripped of their 1840A headers, ranged from 960 bytes to 146,880 bytes. File sizes are listed in Table 2.

10.1.2 Elements used in GTE CGMs

The general nature of the GTE illustrations, nearly all of which are schematic diagrams of communications systems, leads to a general similarity in the metafiles and to a relative simplicity in their make-up of CGM elements. All of the files use the same set of Delimiter, Metafile Descriptor, Picture Descriptor, Attribute, Escape and External Elements. The detailed values of the parameters for each were not examined. Only one file, d004.cgm, invokes a Control Element. Only three to six types of Graphical Primitive Elements are used in any one metafile. To the extent examined, the POLYLINE element is used only for two-point lines. This differs from previously examined metafiles in which large numbers of POLYLINES with hundreds of points are

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the primary tool for construction of complex images. The construction of the GTE files is a relatively efficient construction.

The number of different elements used and the number of occurrences of each are summarized in Table 1.

10.1.3 Summary of Graphical Primitive Elements used in GTE CGMs

The GTE CGMs use from 27 to 677 Graphical Primitive Elements per file. This relatively small element count is a result of the type of image represented, generally schematic diagrams made up of regular closed shapes with connecting lines and arrows and with labels.

Eight Graphical Primitive Elements are used. They are POLYLINE, RESTRICTED TEXT, POLYGON, CELL ARRAY, RECTANGLE, ELLIPSE, ELLIPTICAL ARC, and ELLIPTICAL ARC CLOSE. The use of CELL ARRAY materially increased the size of the files in which it was used.

The number of occurrences of each Graphical Primitive Element in each GTE metafile is given in Table 2.

10.1.4 Discrepancies in CGM files

Each of the 91 GTE metafiles was analyzed with a pre-release version of MetaCALs and with the "beta" version of ValidCGM. Compliance with MIL-D-28003 requires compliance with the base standard, ANSI/ISO 8632, and with the additional specifications and restrictions of MIL-D-28003. The MetaCALs analysis software checks CGMs for agreement with the requirements of either ANSI/ISO 8632 alone or with those of MIL-D-28003 additionally. ValidCGM looks primarily at agreement with the requirements of MIL-D-28003.

END METAFILE Element Missing (ISO 8632/ANSI X3.122 error)

This usage is not allowed by either ISO 8632 and MIL-D-28003.

The END METAFILE element is missing in seven metafiles, d016, d029, d056, d058, d068, d077 and d089. It must be presumed that this error would not occur in a production transfer, in which both sending and receiving systems have been well tested. In the present instance it is not known where the END METAFILE element was lost. However, as the END PICTURE element is present, it is unlikely that other data was trimmed away. Within the CTN

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project, this error occurred in non-routine procedures which added MIL-STD-1840A headers to the CGMs.

This error had no observable effect on image transfer. Comparison with the original files would be necessary to determine whether or not any data was lost, but data loss is considered unlikely.

This problem seems to be a result of either the preparation or the reading of the MIL-STD 1840A tape under "laboratory" conditions.

CHARACTER SET LIST Element

Two sets of files were tested for CHARACTER SET LIST contents. Following a violation report from MetaCALS on the first set and some dispute among the interested parties over interpretation of the MIL-D-28003 specifications, adjustments were made to the CGM generating software and a new set of files was submitted and tested. The new files are completely correct in the contents of the CHARACTER SET LIST.

The violation report from MetaCALS, on the original set of files, was the only MIL-D-28003 related message in the original testing (it occurred in each file). The author of the generating software interpreted the specification as requiring the 3-character strings "4/2" and "4/1" for the designation tail sequences, whereas it is now agreed that the CGM standard and MIL-D-28003 actually require the single characters in positions 4/2 and 4/1 of the code table to be used (which are respectively "B" and "A" in the ASCII character set).

The disagreement over interpretation arose due to the complex and confusing nature of this particular specification in MIL-D-28003 -- it requires careful reference to the CGM standard itself, and to an altogether different ISO standard as well (ISO 2022) in order to accurately define the notation. Research subsequent to the initial testing has indicated that this misinterpretation is frequent. In discussions among the concerned parties it was agreed that the text of MIL-D-28003 should be clarified to help prevent this misinterpretation. This recommendation will be made during the current review of Revision A of MIL-D-28003.

Regardless of the dispute over the validity of the original violation report from MetaCALS, the "violation" in the original set of files had no practical effect, i.e., it had no effect on the graphical image which would be displayed by any correct interpreter, no effect on the usability of the files in inter-

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change, and would not have been valid cause for rejection of the files as deliverables.

The CGM generating software has been modified subsequent to the first test and ensuing discussion. The CHARACTER SET LIST elements generated by this CGM generator are now error free and are completely in agreement with the agreed interpretation of the MIL-D-28003 specification.

10.2 Comments on plots of GTE metafiles

Comparison of plots of the received metafiles with plots produced by the originating system showed several visual discrepancies, as follows:

Shift to the left of text strings unless interpreter option selected. "Blocking" of some parts of image represented by CELL ARRAY.

The "blocking" is sufficiently serious that pictures would require minor editing of the received images prior to publication.

10.2.1 Shift to left of RESTRICTED TEXT strings

It is well known in the graphics standards community that placement of a text string within the bounding rectangle of the RESTRICTED TEXT element is not well defined. This uncertainty affects both the CGM generator and the CGM interpreter. There is uncertainty both in the creation of the bounding rectangle by the generator and in the placement of text in the bounding rectangle by the interpreter. In this instance the generating software, GraphPorter, is known to define a "box" that just fits the displayed text. However, the current version of the CGM standard does not require a matching fit of the text string into the defined "box". This "fuzzyness" in the standard is not a problem when the interpreter is written to conform to common practice. One interpreter used in this study, MetaView, permits operator selection of either of two modes of placement of text in the bounding rectangle of the RESTRICTED TEXT element. One of these modes gives a satisfactory interpretation of the text strings as intended by the originating system.

All text in the GTE metafiles is represented by the RESTRICTED TEXT element. Figure 1 shows the originating system's plot of the image of file, d004.cgm, and Figures 2 and 3 show the MetaView plots with the two available modes for RESTRICTED TEXT.

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Amendment 3 to ISO 8632 (CGM) provides means for exactly defining the placement of text within the bounding rectangle of the RESTRICTED TEXT element. A draft of MIL-D-28003A, currently being reviewed by CALS, also will incorporate this more exact definition.

10.2.2 "Blocking" of image by CELL ARRAY

There are several instances in interpreting the 91 metafiles from GTE where portions of the image which appear in the original plots do not appear in the plots obtained from the receiving CGM interpreters. This occurs several times in the previously referenced file, d004.cgm, as shown in Figure 3. Again, the clear text conversion of the files permits not only examination of the files for reasons for this behavior, but also modification of the files to illustrate the problem.

In each case the files include the CELL ARRAY element, used generally to insert a small "picture" into the otherwise schematic image. In the originating system, the black on white "pictures" are transparent in the white regions, so that the CELL ARRAYS may be overlapped without blocking the previously plotted image. The CGM standard includes a TRANSPARENCY element that applies to several graphical primitive elements, but does not apply to the CELL ARRAY element. Consequently the CGM standard requires that a CELL ARRAY element block the previously laid down image.

Figure 4 illustrates the blocking of the previously laid down image by subsequently plotted CELL ARRAYS.

A recommendation for application of transparency to CELL ARRAY background color has been prepared. This change would apply both to the ANSI/ISO standard and to MIL-D-28003A. In the meantime, members of the ISO committee responsible for CGM have been asked to consider a "fix" to this problem and an appropriate change to the standard already is under consideration.

For the present, the user of graphics programs which permit CELL ARRAYS with transparent background should keep in mind that appearance may differ when the image file is translated to CGM.

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10.3 Conclusions and recommendations

The transfer of GTE illustrations in the form of Computer Graphics Metafiles was generally successful with the interpreters available at the receiving system.

The GTE metafiles made good use of the more complex graphical primitive elements such as rectangle and ellipse. Polylines were used only for simple lines between two points.

Analysis of the CGMs with the MetaCALs and ValidCGM programs for evaluation against the requirements of ISO 8632 and MIL-D-28003 revealed one deviation in a required character string for the CGM element, CHARACTER SET LIST. There is disagreement among CGM "experts" as to the exact requirement of MIL-D-28003 in this matter. Several files were found to be missing the required END METAFILE element. Neither discrepancy prevented correct interpretation of the transferred CGMs.

The use of the RESTRICTED TEXT element for all text provided an example of the problems that may occur due to the present imprecise definition of this CGM element in the ISO standard for Computer Graphics Metafile. At present, it is necessary to determine whether generating and receiving systems provide compatible treatment of the RESTRICTED TEXT element.

Blocking of some parts of several images was caused by the improper use of the CELL ARRAY element. CGM does not permit that background color in a CELL ARRAY be transparent, so that a CELL ARRAY interpreted after other elements may block out the previously laid down image. It is recommended that the CGM standards, ANSI/ISO 8632 and MIL-D-28003, be modified to permit transparency for CELL ARRAYS as practiced in many drawing programs.

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Table 1. Distribution of CGM elements.

The files included the following distribution of elements:

| Element Class | | Number of different elements | Number of occurrences |
|------------------------------|-----------|------------------------------------|-----------------------------|
| Delimiter Elements | (Class 0) | 5 | 5 |
| Metafile Descriptor Elements | (Class 1) | 14 | 14 |
| Picture Descriptor Elements | (Class 2) | 7 | 7 |
| Control Elements | (Class 3) | 0-1 | 0- 15 |
| Graphical Primitive Elements | (Class 4) | 3-6 | 27-677 |
| Attribute Elements | (Class 5) | 14 | 11-406 |
| Escape Elements | (Class 6) | 0 | 0 |
| External Elements | (Class 7) | 0 | 0 |

Only one file, d004.cgm, had a Control Element. File size, the distribution of Graphical Primitive Elements and total number of elements for each file are given in Table 2.

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Table 2. Occurrence of Graphical Primitive Elements in GTE CGMs with File Size and Total Number of Elements

| | | Number of each element for each file | | | | | | | | | | | | | | | |
|------------------------------------|------------------------|--------------------------------------|-----|-----------------------|---|---------------|----|------------------|----|------------------|----|----------------|--|-----------------------|--|-----------------------------|-------------------------------|
| Element --> & Element Number | | POLYLINE (4-1) | | RESTRICTED TEXT (4-5) | | POLYGON (4-7) | | CELL ARRAY (4-9) | | RECTANGLE (4-11) | | ELLIPSE (4-17) | | ELLIPTICAL ARC (4-18) | | ELLIPTICAL ARC CLOSE (4-19) | Total Elements in Metafile |
| File Number | File Size, Bytes | | | | | | | | | | | | | | | | |
| d001.cgm | 5840 | 110 | 43 | | | | | 149 | 12 | 12 | 12 | 12 | | | | | 338 |
| d002.cgm | 7440 | 170 | 46 | | | | | 181 | 25 | 12 | 12 | | | | | | 446 |
| d003.cgm | 10640 | 256 | 84 | | | | | 284 | 25 | 12 | 12 | | | | | | 673 |
| d004.cgm | 27840 | 398 | 110 | 64 | 9 | 84 | 12 | | | | | | | | | | 677 |
| d005.cgm | 5120 | 93 | 45 | 30 | | 44 | | | | 24 | 24 | | | | | | 260 |
| d006.cgm | 5120 | 92 | 45 | 30 | | 44 | | | | 24 | 24 | | | | | | 259 |
| d007.cgm | 5040 | 91 | 45 | 29 | | 44 | | | | 24 | 24 | | | | | | 257 |
| d008.cgm | 5120 | 96 | 45 | 30 | | 44 | | | | 24 | 24 | | | | | | 263 |
| d009.cgm | 5040 | 95 | 46 | 27 | | 44 | | | | 24 | 24 | | | | | | 260 |
| d010.cgm | 5120 | 96 | 45 | 29 | | 44 | | | | 24 | 24 | | | | | | 262 |
| d011.cgm | 5040 | 94 | 45 | 30 | | 44 | | | | 24 | 24 | | | | | | 261 |
| d012.cgm | 5040 | 93 | 45 | 28 | | 44 | | | | 24 | 24 | | | | | | 258 |
| d013.cgm | 5040 | 96 | 45 | 29 | | 44 | | | | 24 | 24 | | | | | | 262 |
| d014.cgm | 4880 | 89 | 45 | 23 | | 44 | | | | 24 | 24 | | | | | | 249 |
| d015.cgm | 3360 | 101 | 59 | 1 | | 36 | | | | | | | | | | | 197 |
| d016.cgm | 3520 | 76 | 79 | 1 | | 34 | | | | | | | | | | | 190 |
| d017.cgm | 5840 | 223 | 70 | 37 | | 38 | | | | | | | | | | | 368 |
| d018.cgm | 6720 | 266 | 74 | 47 | | 38 | 2 | 4 | | | | | | | | | 431 |
| d019.cgm | 2720 | 121 | 24 | | | 32 | | | | | | | | | | | 177 |
| d020.cgm | 1280 | 13 | 15 | 12 | | 8 | | | | | | | | | | | 48 |
| d021.cgm | 3120 | 42 | 49 | 30 | | 18 | | | | 12 | | | | | | | 151 |
| d022.cgm | 1120 | 12 | 13 | 9 | | 6 | | | | | | | | | | | 40 |
| d023.cgm | 1920 | 93 | 15 | 8 | | 3 | | | | | | | | | | | 119 |
| d024.cgm | 2000 | 93 | 15 | 8 | | 3 | | | | | | | | | | | 119 |
| d025.cgm | 1920 | 93 | 15 | 8 | | 3 | | | | | | | | | | | 119 |
| d026.cgm | 2800 | 29 | 77 | 1 | | 35 | | | | | | | | | | | 142 |
| d027.cgm | 4720 | 114 | 103 | 12 | | 34 | 4 | | | | | | | | | | 267 |
| d028.cgm | 1760 | 30 | 33 | 10 | | 9 | | | | | | | | | | | 82 |
| d029.cgm | 3520 | 160 | 30 | 22 | | 22 | | | | | | | | | | | 234 |
| d030.cgm | 3680 | 141 | 54 | 21 | | 16 | | | | | | | | | | | 232 |
| d031.cgm | 3680 | 141 | 54 | 21 | | 16 | | | | | | | | | | | 232 |
| d032.cgm | 3680 | 141 | 54 | 21 | | 16 | | | | | | | | | | | 232 |

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| | | | | | | | | | |
|----------|--------|-----|-----|-----|----|----|----|----|-----|
| d033.cgm | 3680 | 141 | 54 | 21 | | 16 | | | 232 |
| d034.cgm | 3680 | 141 | 54 | 21 | | 16 | | | 232 |
| d035.cgm | 5360 | 197 | 71 | 29 | | 14 | 16 | | 327 |
| d036.cgm | 4800 | 216 | 69 | 8 | | 22 | 10 | | 325 |
| d037.cgm | 5840 | 105 | 118 | 60 | | 10 | | | 293 |
| d038.cgm | 1120 | 17 | 18 | 1 | | 6 | | | 42 |
| d039.cgm | 25625 | 109 | 44 | 17 | 3 | 9 | 6 | | 188 |
| d040.cgm | 3520 | 153 | 41 | 20 | | 9 | 5 | | 228 |
| d041.cgm | 1760 | 60 | 19 | 7 | | 6 | | | 92 |
| d042.cgm | 2480 | 91 | 28 | 14 | | 10 | | | 143 |
| d043.cgm | 7520 | 131 | 120 | 121 | | 15 | 6 | 8 | 401 |
| d044.cgm | 2800 | 42 | 39 | 37 | | 3 | 8 | | 129 |
| d045.cgm | 3200 | 97 | 55 | 20 | | 8 | 4 | | 184 |
| d046.cgm | 3680 | 106 | 59 | 22 | | 10 | 6 | 8 | 211 |
| d047.cgm | 4880 | 79 | 77 | 72 | | 17 | | | 245 |
| d048.cgm | 2000 | 31 | 31 | 23 | | 5 | | | 90 |
| d049.cgm | 4880 | 79 | 77 | 72 | | 17 | | | 245 |
| d050.cgm | 2560 | 27 | 51 | 21 | | 7 | 4 | | 110 |
| d051.cgm | 1920 | 52 | 25 | 8 | | 3 | 8 | | 96 |
| d052.cgm | 1760 | 26 | 28 | 10 | | 6 | 4 | | 74 |
| d053.cgm | 1680 | 28 | 22 | 8 | | 6 | 8 | | 72 |
| d054.cgm | 1680 | 28 | 23 | 8 | | 6 | 8 | | 73 |
| d055.cgm | 1760 | 28 | 23 | 10 | | 6 | 8 | | 75 |
| d056.cgm | 2000 | 80 | 26 | 8 | | | 4 | | 118 |
| d057.cgm | 6080 | 124 | 107 | 44 | | 28 | 36 | | 339 |
| d058.cgm | 5040 | 148 | 103 | 41 | | 10 | 2 | | 304 |
| d059.cgm | 119120 | 176 | 89 | 16 | 10 | 35 | 20 | | 346 |
| d060.cgm | 5520 | 59 | 119 | 44 | | 32 | 14 | 8 | 276 |
| d061.cgm | 5280 | 183 | 84 | 33 | | 8 | 2 | 12 | 322 |
| d062.cgm | 2560 | 94 | 25 | 12 | | 4 | | 12 | 147 |
| d063.cgm | 1520 | 39 | 22 | | | 16 | | | 77 |
| d064.cgm | 5360 | 156 | 72 | 31 | | 16 | 28 | | 303 |
| d065.cgm | 2480 | 86 | 34 | 15 | | 8 | | | 143 |
| d066.cgm | 2160 | 27 | 27 | 18 | | | 12 | 12 | 96 |
| d067.cgm | 3200 | 69 | 36 | 37 | | 18 | | | 160 |
| d068.cgm | 2000 | 77 | 21 | 7 | | 8 | | | 113 |
| d069.cgm | 2320 | 30 | 30 | 21 | | 23 | | 4 | 108 |
| d070.cgm | 2400 | 22 | 32 | 21 | | 33 | | | 108 |
| d071.cgm | 2240 | 49 | 28 | 23 | | 10 | 2 | | 112 |
| d072.cgm | 2320 | 47 | 32 | 27 | | 4 | | | 110 |
| d073.cgm | 2000 | 58 | 41 | | | 8 | 8 | | 115 |
| d074.cgm | 2720 | 44 | 50 | 26 | | 17 | | | 137 |
| d075.cgm | 1920 | 52 | 32 | | | 20 | | | 104 |
| d076.cgm | 5120 | 87 | 90 | 45 | | 18 | 20 | | 260 |
| d077.cgm | 6080 | 112 | 83 | 69 | | 34 | 16 | | 314 |
| d078.cgm | 4480 | 76 | 78 | 44 | | 26 | 12 | | 236 |
| d079.cgm | 1440 | 23 | 20 | 14 | | 6 | | | 63 |
| d080.cgm | 146880 | 23 | 50 | 1 | 5 | 41 | 14 | | 134 |
| d081.cgm | 2240 | 51 | 25 | 16 | | 10 | 6 | | 108 |

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| | | | | | | | | | | |
|----------|--------|-----|-----|-----|----|-----|----|----|----|-----|
| d082.cgm | 1760 | 30 | 25 | | | 12 | | 5 | 5 | 77 |
| d083.cgm | 1360 | 18 | 21 | | | 12 | 4 | 2 | | 57 |
| d084.cgm | 8800 | 106 | 41 | 1 | 1 | 28 | 18 | 2 | | 197 |
| d085.cgm | 1600 | 12 | 35 | | | 14 | | | | 61 |
| d086.cgm | 2000 | 35 | 27 | 16 | | 6 | | 8 | | 92 |
| d087.cgm | 1760 | 59 | 17 | 6 | | 8 | | | | 90 |
| d088.cgm | 1440 | 33 | 8 | 12 | | 10 | | | | 63 |
| d089.cgm | 960 | 3 | 10 | 6 | | 8 | | | | 27 |
| d090.cgm | 4720 | 127 | 59 | 37 | | 45 | | | | 268 |
| d091.cgm | 2480 | 18 | 60 | 17 | | 14 | | | | 109 |
| Minimum | 960 | 3 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 27 |
| Maximum | 146880 | 398 | 120 | 121 | 10 | 284 | 25 | 36 | 24 | 677 |

MetaCALs (Beta Version 2.0) reported that all files have an error in the required string for CHARACTER SET LIST. This was due to different interpretation of MIL-D-28003 and the CGM standard by the authors of the testing tool and the CGM generating software, and should not be reported as an error. MetaCALs correctly reported that seven files were missing the END METAFILE elements.

Table 3. Reported errors in metafiles

| Message | Number of files in which found |
|--|-----------------------------------|
| CGM errors - | |
| END METAFILE missing | 7 |
| MIL-D-28003 errors - | |
| CHARACTER SET LIST invalid; must contain exactly the two list entries: (0,"4/2") and (1,"4/1"). | 91 |

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10.4 List of Figures

- Figure 1. Originating system's plot of metafile, d004.cgm. This is the reference image for examining the effects of RESTRICTED TEXT and CELL ARRAY elements.
- Figure 2. MetaView plot of metafile, d004.cgm, without "-r" option. Text, represented by the RESTRICTED TEXT element, is shifted to the left.
- Figure 3. MetaView plot of metafile, d004.cgm, with "-r" option. Text, represented by the RESTRICTED TEXT element, is centered and is a satisfactory, though less than exact, match to the original text.
- Figure 4. Demonstration of the image blocking of images by CELL ARRAYS. The partial plots on the left, with image blocking, are from the CGM with CELL ARRAYS; those on the right, without image blocking, are from the edited clear text CGM with CELL ARRAYS removed.

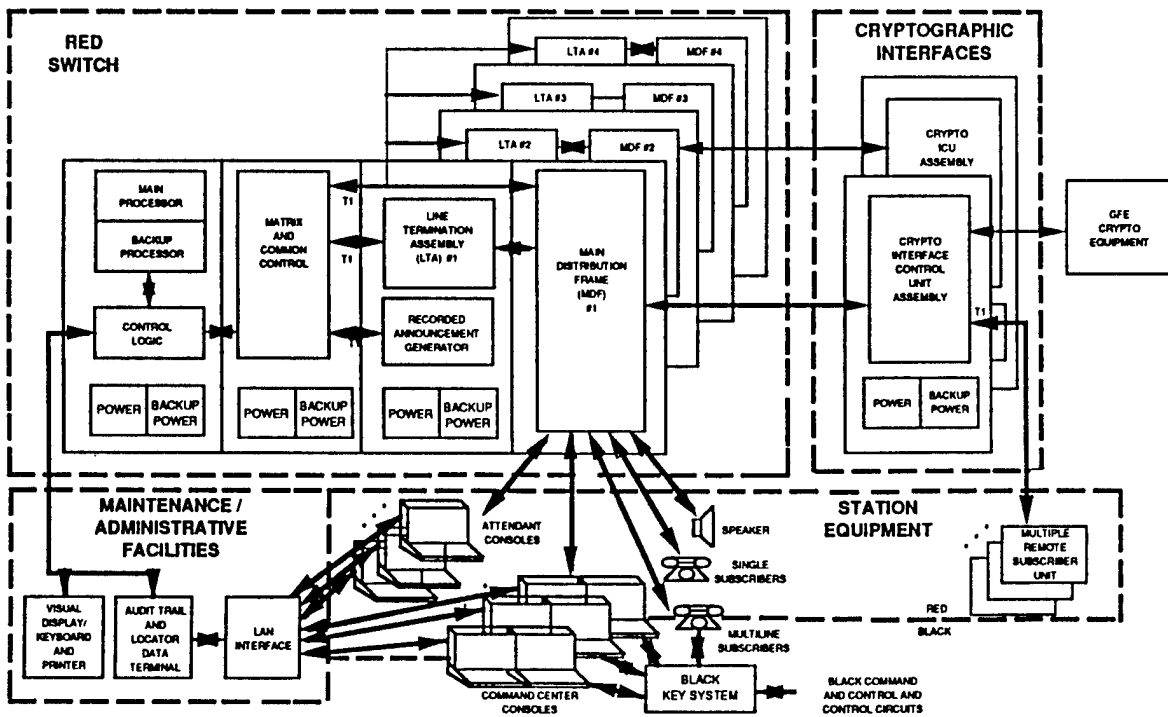


Figure 1. Originating system's plot of metafile, d004.cgm. This is the reference image for examining the effects of RESTRICTED TEXT and CELL ARRAY elements.

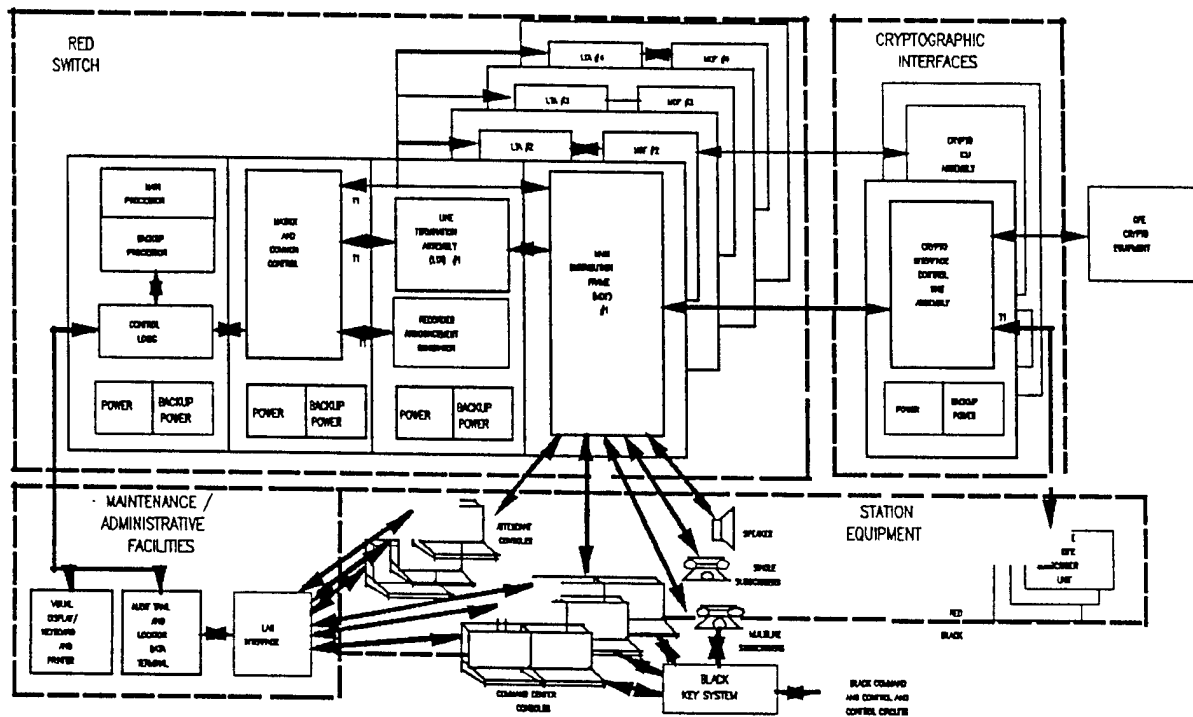


Figure 2. MetaView plot of metafile, d004.cgm, without "-r" option. Text, represented by the RESTRICTED TEXT element, is shifted to the left.

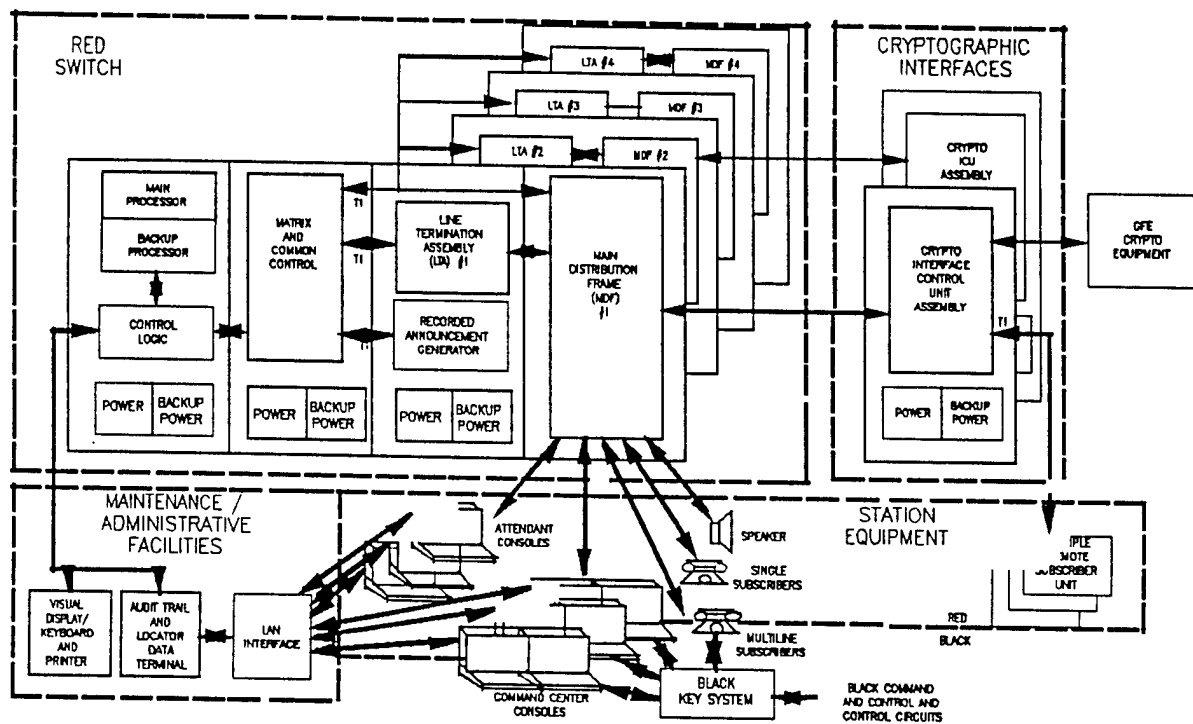
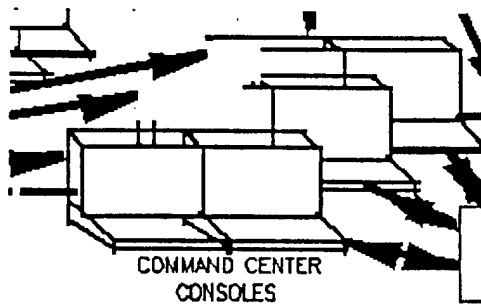
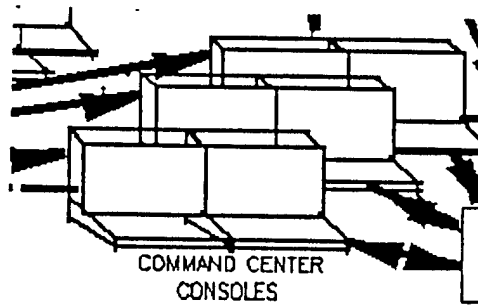


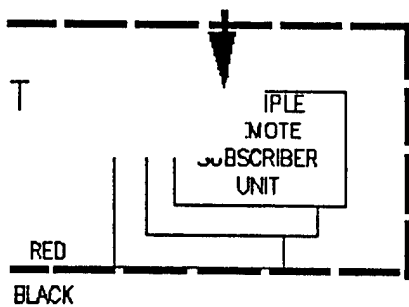
Figure 3. MetaView plot of metafile, d004.cgm, with "-r" option. Text, represented by the RESTRICTED TEXT element, is centered and is a satisfactory, though less than exact, match to the original text.



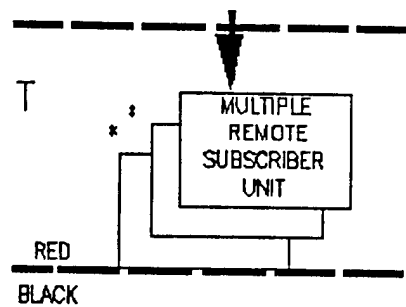
With CELL ARRAYS



Without CELL ARRAYS.



With CELL ARRAYS



Without CELL ARRAYS.

Figure 4. Demonstration of the image blocking of images by CELL ARRAYS. The partial plots on the left, with image blocking, are from the CGM with CELL ARRAYS; those on the right, without image blocking, are from the edited clear text CGM with CELL ARRAYS removed.