

# INTERNATIONAL STANDARD

**ISO  
7942**

First edition  
1985-08-15

**AMENDMENT 1**  
1991-03-01

---

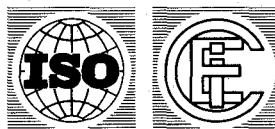
---

## Information processing systems — Computer graphics — Graphical Kernel System (GKS) functional description

### AMENDMENT 1

*Systèmes de traitement de l'information — Infographie — Système graphique de  
base (GKS) — Description fonctionnelle*

*AMENDEMENT 1*



Reference number  
ISO 7942 : 1985/Amd.1 : 1991 (E)

## Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to the national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO 7942/Amd.1 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*.

© ISO/IEC 1991

All rights reserved. No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

ISO/IEC Copyright Office • Case postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

# Information processing systems — Computer graphics — Graphical Kernel System (GKS) functional description

## AMENDMENT 1

*Annex H is a new Annex and should be added following Annex G.*

### Annex H

(informative)

## The GKS session metafile

### H.1 Introduction

The Annex defines a metafile suitable for use with the Metafile Output and Metafile Input workstations of GKS.

### H.2 Relation to other standards

The metafile definition draws extensively on the functionality and encoding defined in the Computer Graphics Metafile (CGM ISO 8632 Parts 1 to 4) for version 2 metafiles.

### H.3 Scope

This Annex defines a metafile suitable for use with the Metafile Output and Metafile Input workstations of GKS. It defines a metafile which captures the dynamics of a GKS session. It is particularly suitable for transporting graphical information from one GKS application to another and for applications where the individual graphics actions need to be replayed, with optional editing. The functionality and encodings of the elements defined in this Annex have been taken from the CGM standard where such elements are available. This Annex identifies those functions within GKS which need to be added to those taken from the CGM standard to support the MO and MI workstations and defines the encodings for these elements. The position of the elements in the metafile is defined in the formal grammar which is a part of this Annex.

### H.4 Concepts

#### H.4.1 Introduction

The CGM standard (ISO 8632) defines a metafile for the capture of static structured picture definitions. It can be used for static picture capture in the GKS environment. Since use of the CGM was not intended to be restricted to GKS environments, there is not a one-to-one mapping between the functions of the two standards - CGM lacks some GKS facilities while offering others not available in GKS.

In particular, some of the GKS control and segment manipulation functions have no counterparts in CGM because of their potential dynamic effects. Exactly these elements are added to the CGM elements such that this Annex defines a metafile for GKS - based on CGM elements where possible - suitable for GKS session capture. As such it comprises a dynamic type of metafile, which is beyond the scope of ISO 8632.

#### H.4.2 GKS session metafile structure

The GKS session metafile consists of a single "session". It does not contain the concept of static pictures, as does ISO 8632. The two metafiles are conceptually different entities. To avoid potential confusion for generators and interpreters, the two metafiles are given distinct delimiters which are uniquely encoded. The GKS session metafile uses the delimiters:

```
BEGIN GKS SESSION METAFILE  
BEGIN GKS SESSION  
END GKS SESSION METAFILE
```

The Metafile Description occurs between the first two of these, and the body of the session between the last two. Unlike ISO 8632, there is no implication of clearing the display surface upon the occurrence of any of these delimiters.

The BEGIN GKS SESSION METAFILE element is similar to the CGM BEGIN METAFILE element. It has a single parameter, of type "string", which is an identifier for implementation-dependent use. This is the first element of a GKS Session Metafile and shall appear exactly once.

BEGIN GKS SESSION has a single parameter of type "string" which is available for implementation-dependent use. It delimits the end of the Metafile Description.

END GKS SESSION METAFILE has no parameters. It is the last element of the metafile and shall appear exactly once.

The GKS Session Metafile also differs from CGM in the concept of defaults. The CGM standard defines default values for Metafile Descriptor, Picture Descriptor, Control, Attribute and Segment Attribute elements. All except the Metafile Descriptor elements may appear in METAFILE DEFAULTS REPLACEMENT to redefine the default. Except for the Metafile Descriptor, elements in a metafile conforming to ISO 8632 are defined to assume their default values upon BEGIN PICTURE. This is contrary to the metafile model of GKS. There are no default values, either implicit or explicit, in the GKS Session Metafile. The MO workstation shall write out all clipping and primitive attribute elements upon ACTIVATE WORKSTATION. There are no defaults assumed by MO for workstation attribute or segment attribute or control elements. This GKS Session Metafile follows GKS - there are no implicit defaults for any elements other than the Metafile Descriptor elements. There are no explicit defaults, and the METAFILE DEFAULTS REPLACEMENT element from the CGM is not used. The only two elements which may have defaults, VDC INTEGER PRECISION and VDC REAL PRECISION, shall be explicitly written by the MO workstation upon ACTIVATE WORKSTATION.

#### H.4.3 Mapping concepts

H.5 and H.6 present mappings between GKS functions and GKS Session Metafile elements. The concepts used to derive the mappings are described below.

##### H.4.3.1 Principles

The following principles are the basis of the GKS Session Metafile model and of the function mappings themselves:

- a) conceptual compatibility with GKS;
- b) compatibility with the design concepts of CGM and use of elements taken from CGM where possible;
- c) extensibility of the element set taken from CGM to a GKS session capture metafile.

##### H.4.3.2 Workstations

The GKS Session Metafile is generated by a workstation of category MO. The GKS Session Metafile is read by a workstation of category MI. Certain elements, such as the metafile descriptor and precision-setting elements, are viewed as directives to the MI workstation, so that it may correctly read the metafile contents.

##### H.4.3.3 Coordinates and clipping

The coordinate space of the metafile, VDC, is conceptually identical to the NDC space of GKS. The MAXIMUM VDC EXTENT allows the mapping of VDC of either type (real or integer) to the unit interval of NDC.

Clipping is always 'on' in the metafile, which is the default value of the CLIP INDICATOR element (hence CLIP INDICATOR elements need never be written to the metafile). The CGM CLIP RECTANGLE element has either the value of the 'clipping rectangle' entry of the GKS state list, or the MAXIMUM VDC EXTENT in VDC, depending upon whether the 'clipping indicator' entry in the GKS state list is 'clip' or 'noclip' respectively. Because the VDC EXTENT element always has the value of the GKS workstation window in VDC, the interpreter of the metafile has complete information to achieve GKS clipping.

#### **H.4.3.4 Workstation transformation**

The workstation transformation is defined in GKS by setting a workstation window in device-independent NDC and a workstation viewport in device-dependent DC. The workstation window is written to the metafile with the VDC EXTENT element. The workstation viewport is written to the metafile with the WORKSTATION VIEWPORT element.

#### **H.4.3.5 Metafile element list**

The metafile element list shorthand defined for use with GKS applications is the 'gks session all set'.

#### **H.4.3.6 Relationship of fonts between CGM and GKS**

The GKS standard includes the concepts of text output primitive attributes. However, the mechanism for specifying the text font differs from that specified in the CGM standard. This subclause defines the approach to handling these attributes within the GKS environment, using the font mechanisms taken from CGM.

##### ***H.4.3.6.1 Overview of the differences between GKS and CGM fonts***

While CGM supports the TEXT output primitive attribute functionality of GKS, a one-to-one mapping between CGM and GKS is not possible in all cases. Specifically

- a) GKS and CGM differ in the way fonts are defined. In the CGM text fonts are defined with the FONT LIST element that associates font names or identifications with entries in a Font Table. In GKS, no mechanism is available for defining text fonts. GKS associates a unique text font number with each font. The Registration Authority is responsible for defining this mapping of font numbers to specific font identifications.
- b) GKS and CGM differ in the way fonts are selected. In the CGM, text fonts are selected with the TEXT FONT INDEX element. The index selects an individual font from different fonts in the font list. In GKS, text fonts are selected with a font number. The font number selects a specific GKS registered font if the value is positive. If the font number is negative an implementation-dependent font is selected.
- c) GKS and CGM differ on the independence of font and text precision. In the CGM, the font and text precision are specified by independent elements. In GKS, the font and text precision are directly associated with specification by a single function.
- d) The character set related elements CHARACTER SET LIST, CHARACTER CODING ANNOUNCER, CHARACTER SET INDEX, ALTERNATE CHARACTER SET INDEX have no counterpart in GKS. GKS does not recognize the concept of character set as a separate concept from the font concept.

##### ***H.4.3.6.2 Suggestion for interpretation of CGM font information by GKS***

GKS environments interpreting a GKS metafile specify fonts with a font number. It is assumed that GKS maintains a list associating positive font numbers with a GKS registered font name or identifier. Private font numbers (i.e. negative values) must be maintained in an implementation-dependent list of associations. As the FONT LIST element is interpreted, an additional list must be maintained that associates individual font names specified in the GKS metafile with a font index. When the TEXT FONT INDEX element is interpreted, the font name associated with the font index is determined from the list of currently used fonts. The font name is used to determine the GKS font number associated with this font from a list of GKS registered fonts. This font number is used as the font parameter of the TEXT FONT AND PRECISION function. The value of the precision parameter is taken from the TEXT PRECISION element.

H.4.3.6.3 Generating CGM font information from GKS

When generating font information from GKS via TEXT FONT AND PRECISION it is recommended that the generator also writes the elements CHARACTER SET INDEX and ALTERNATE CHARACTER SET INDEX as well as TEXT FONT INDEX and TEXT PRECISION. The generator is assumed to have a table associating the positive font numbers of GKS with the registered names. The generator shall put a FONT LIST element in the Metafile Descriptor with the names of those fonts referenced by positive GKS font numbers. Negative GKS font numbers are private and must be mapped to CGM font indices which are positive and beyond the range of the table.

NOTE - To generate a minimal font list the metafile must be completely generated before the FONT LIST element can be written.

H.4.4 Elements in the gks session all element set

Table 5 lists the elements included in this element set and indicates their derivation.

Table 5 - The derivation of elements in the gks-session-all set

| Element class                | Element name               | Derivation        | Notes |
|------------------------------|----------------------------|-------------------|-------|
| Delimiter Elements           | BEGIN GKS SESSION METAFILE | GKS ISO 7942/Am.1 |       |
|                              | BEGIN GKS SESSION          | GKS ISO 7942/Am.1 |       |
|                              | BEGIN SEGMENT              | CGM ISO 8632/Am.1 |       |
|                              | END SEGMENT                | CGM ISO 8632/Am.1 |       |
|                              | END GKS SESSION METAFILE   | GKS ISO 7942/Am.1 |       |
| Metafile Descriptor Elements | METAFILE VERSION           | CGM ISO 8632/Am.1 |       |
|                              | METAFILE DESCRIPTION       | CGM ISO 8632/Am.1 |       |
|                              | VDC TYPE                   | CGM ISO 8632/Am.1 |       |
|                              | INTEGER PRECISION          | CGM ISO 8632/Am.1 |       |
|                              | REAL PRECISION             | CGM ISO 8632/Am.1 |       |
|                              | INDEX PRECISION            | CGM ISO 8632/Am.1 |       |
|                              | COLOUR PRECISION           | CGM ISO 8632/Am.1 |       |
|                              | COLOUR INDEX PRECISION     | CGM ISO 8632/Am.1 |       |
|                              | MAXIMUM COLOUR INDEX       | CGM ISO 8632/Am.1 |       |
|                              | COLOUR VALUE EXTENT        | CGM ISO 8632/Am.1 |       |
|                              | METAFILE ELEMENT LIST      | CGM ISO 8632/Am.1 |       |
|                              | FONT LIST                  | CGM ISO 8632/Am.1 |       |
|                              | CHARACTER SET LIST         | CGM ISO 8632/Am.1 |       |
|                              | CHARACTER CODING ANNOUNCER | CGM ISO 8632/Am.1 |       |
| Picture Descriptor Elements  | NAME PRECISION             | CGM ISO 8632/Am.1 |       |
|                              | MAXIMUM VDC EXTENT         | CGM ISO 8632/Am.1 |       |
|                              | SEGMENT PRIORITY EXTENT    | CGM ISO 8632/Am.1 |       |
| Picture Descriptor Elements  | None required              |                   |       |
| Control Elements             | VDC INTEGER PRECISION      | CGM ISO 8632/Am.1 |       |
|                              | VDC REAL PRECISION         | CGM ISO 8632/Am.1 |       |
|                              | CLIP RECTANGLE             | CGM ISO 8632/Am.1 |       |
|                              | VDC EXTENT                 | CGM ISO 8632/Am.1 |       |
|                              | WORKSTATION VIEWPORT       | GKS ISO 7942      |       |
|                              | CLEAR                      | GKS ISO 7942      |       |
|                              | UPDATE                     | GKS ISO 7942      |       |
|                              | DEFERRAL STATE             | GKS ISO 7942      |       |
| Primitive Elements           | POLYLINE                   | CGM ISO 8632/Am.1 |       |
|                              | POLYMARKER                 | CGM ISO 8632/Am.1 |       |
|                              | TEXT                       | CGM ISO 8632/Am.1 |       |
|                              | POLYGON                    | CGM ISO 8632/Am.1 |       |
|                              | CELL ARRAY                 | CGM ISO 8632/Am.1 |       |
|                              | GDP                        | CGM ISO 8632/Am.1 |       |

Table 5 (concluded)

| Element class              | Element name                  | Derivation        | Notes    |
|----------------------------|-------------------------------|-------------------|----------|
| Attribute Elements         | LINE BUNDLE INDEX             | CGM ISO 8632/Am.1 |          |
|                            | LINE TYPE                     | CGM ISO 8632/Am.1 |          |
|                            | LINE WIDTH                    | CGM ISO 8632/Am.1 |          |
|                            | LINE COLOUR                   | CGM ISO 8632/Am.1 |          |
|                            | MARKER BUNDLE INDEX           | CGM ISO 8632/Am.1 |          |
|                            | MARKER TYPE                   | CGM ISO 8632/Am.1 |          |
|                            | MARKER SIZE                   | CGM ISO 8632/Am.1 |          |
|                            | MARKER COLOUR                 | CGM ISO 8632/Am.1 |          |
|                            | TEXT BUNDLE INDEX             | CGM ISO 8632/Am.1 |          |
|                            | TEXT FONT INDEX               | CGM ISO 8632/Am.1 |          |
|                            | TEXT PRECISION                | CGM ISO 8632/Am.1 |          |
|                            | CHARACTER EXPANSION FACTOR    | CGM ISO 8632/Am.1 |          |
|                            | CHARACTER SPACING             | CGM ISO 8632/Am.1 |          |
|                            | TEXT COLOUR                   | CGM ISO 8632/Am.1 |          |
|                            | CHARACTER HEIGHT              | CGM ISO 8632/Am.1 |          |
|                            | CHARACTER ORIENTATION         | CGM ISO 8632/Am.1 |          |
|                            | TEXT PATH                     | CGM ISO 8632/Am.1 |          |
|                            | TEXT ALIGNMENT                | CGM ISO 8632/Am.1 |          |
|                            | CHARACTER SET INDEX           | CGM ISO 8632/Am.1 |          |
|                            | ALTERNATE CHARACTER SET INDEX | CGM ISO 8632/Am.1 |          |
|                            | FILL BUNDLE INDEX             | CGM ISO 8632/Am.1 |          |
|                            | INTERIOR STYLE                | CGM ISO 8632/Am.1 |          |
|                            | FILL COLOUR                   | CGM ISO 8632/Am.1 |          |
|                            | HATCH INDEX                   | CGM ISO 8632/Am.1 |          |
|                            | PATTERN INDEX                 | CGM ISO 8632/Am.1 |          |
|                            | FILL REFERENCE POINT          | CGM ISO 8632/Am.1 |          |
|                            | PATTERN TABLE                 | CGM ISO 8632/Am.1 |          |
|                            | PATTERN SIZE                  | CGM ISO 8632/Am.1 |          |
|                            | COLOUR TABLE                  | CGM ISO 8632/Am.1 |          |
|                            | ASPECT SOURCE FLAGS           | CGM ISO 8632/Am.1 |          |
|                            | LINE REPRESENTATION           | CGM ISO 8632/Am.1 |          |
|                            | MARKER REPRESENTATION         | CGM ISO 8632/Am.1 |          |
|                            | TEXT REPRESENTATION           | CGM ISO 8632/Am.1 |          |
|                            | FILL REPRESENTATION           | CGM ISO 8632/Am.1 |          |
|                            | PICK IDENTIFIER               | CGM ISO 8632/Am.1 |          |
| Escape Element             | ESCAPE                        | CGM ISO 8632/Am.1 |          |
| External Elements          | MESSAGE                       | CGM ISO 8632/Am.1 |          |
|                            | APPLICATION DATA              | CGM ISO 8632/Am.1 |          |
| Segment Control Elements   | DELETE SEGMENT                | GKS ISO 7942      |          |
|                            | RENAME SEGMENT                | GKS ISO 7942      |          |
|                            | REDRAW ALL SEGMENTS           | GKS ISO 7942      |          |
| Segment Attribute Elements | SEGMENT TRANSFORMATION        | CGM ISO 8632/Am.1 |          |
|                            | SEGMENT VISIBILITY            | GKS ISO 7942      |          |
|                            | SEGMENT HIGHLIGHTING          | CGM ISO 8632/Am.1 | (Note 1) |
|                            | SEGMENT DISPLAY PRIORITY      | CGM ISO 8632/Am.1 | (Note 1) |
|                            | SEGMENT PICK PRIORITY         | CGM ISO 8632/Am.1 | (Note 1) |
|                            | SEGMENT DETECTABILITY         | GKS ISO 7942      |          |

## NOTES

1 The values of these elements are identical in GKS Session Metafiles.

## H.5 Metafile generation

## H.5.1 Introduction

The tables in the subsequent sections show the mapping between the GKS functions and the GKS metafile elements listed in table 5.

## H.5.2 Control functions

Table 6 - The mapping of the control functions

| GKS function                       | GKS Session Metafile element                                                                                        | Notes             |
|------------------------------------|---------------------------------------------------------------------------------------------------------------------|-------------------|
| OPEN WORKSTATION                   | BEGIN GKS SESSION METAFILE<br>{Metafile Descriptor}<br>BEGIN GKS SESSION                                            | (1)<br>(2)<br>(3) |
| CLOSE WORKSTATION                  | END GKS SESSION METAFILE                                                                                            |                   |
| ACTIVATE WORKSTATION               | Enable Output to metafile<br>Attribute settings<br>CLIP RECTANGLE<br>VDC INTEGER PRECISION or<br>VDC REAL PRECISION | (4)<br>(5)        |
| DEACTIVATE WORKSTATION             | Disable output to metafile                                                                                          |                   |
| CLEAR WORKSTATION                  | CLEAR                                                                                                               |                   |
| REDRAW ALL SEGMENTS ON WORKSTATION | REDRAW ALL SEGMENTS                                                                                                 |                   |
| UPDATE WORKSTATION                 | UPDATE                                                                                                              |                   |
| SET DEFERRAL STATE                 | DEFERRAL STATE                                                                                                      |                   |
| MESSAGE                            | MESSAGE                                                                                                             | (6)               |
| ESCAPE                             | ESCAPE                                                                                                              |                   |

## NOTES

- 1 The use of the 'identifier' parameter of BEGIN GKS SESSION METAFILE is implementation dependent.
- 2 See H.5.9.
- 3 The use of the 'identifier' parameter of BEGIN GKS SESSION is implementation dependent.
- 4 The attribute settings ensure that the metafile attributes in effect when the first graphical primitive element is encountered match the current GKS attributes.
- 5 On activate workstation a CLIP RECTANGLE element is written to the metafile with the value MAXIMUM VDC EXTENT if the 'clipping indicator' entry in the GKS state list is 'noclip', or with values corresponding to the 'clipping rectangle' in the GKS state list if the 'clipping indicator' entry in the GKS state list is 'clip'.
- 6 Action required flag is set to 'no action'.

## H.5.3 Output Functions

Table 7 - The mapping of the output functions

| GKS function | GKS Session Metafile element | Notes |
|--------------|------------------------------|-------|
| POLYLINE     | POLYLINE                     | (1)   |
| POLYMARKER   | POLYMARKER                   |       |
| TEXT         | TEXT                         |       |
| FILL AREA    | POLYGON                      | (2)   |
| CELL ARRAY   | CELL ARRAY                   |       |
| GDP          | GDP                          |       |

## NOTES

- 1 The text flag is set to 'final'.
- 2 Colours are selected by indexes pointing into the colour table.

## H.5.4 Output attributes

Table 8 - The mapping of the output attributes

| GKS function                   | GKS Session Metafile element  | Notes |
|--------------------------------|-------------------------------|-------|
| SET POLYLINE INDEX             | LINE BUNDLE INDEX             |       |
| SET LINETYPE                   | LINE TYPE                     |       |
| SET LINEWIDTH SCALE FACTOR     | LINE WIDTH                    | (1)   |
| SET POLYLINE COLOUR INDEX      | LINE COLOUR                   | (2)   |
| SET POLYMARKER INDEX           | MARKER BUNDLE INDEX           |       |
| SET MARKERTYPE                 | MARKER TYPE                   |       |
| SET MARKERSIZE SCALE FACTOR    | MARKER SIZE                   | (1)   |
| SET POLYMARKER COLOUR INDEX    | MARKER COLOUR                 | (2)   |
| SET TEXT INDEX                 | TEXT BUNDLE INDEX             |       |
| SET TEXT FONT AND PRECISION    | TEXT FONT INDEX               | (3)   |
|                                | TEXT PRECISION                |       |
|                                | CHARACTER SET INDEX           |       |
| SET CHARACTER EXPANSION FACTOR | ALTERNATE CHARACTER SET INDEX |       |
| SET CHARACTER SPACING          | CHARACTER EXPANSION FACTOR    |       |
| SET TEXT COLOUR INDEX          | CHARACTER SPACING             |       |
| SET CHARACTER HEIGHT           | TEXT COLOUR                   | (2)   |
| SET CHARACTER UP VECTOR        | CHARACTER HEIGHT              |       |
| SET TEXT PATH                  | CHARACTER ORIENTATION         |       |
| SET TEXT ALIGNMENT             | TEXT PATH                     |       |
| SET FILL AREA INDEX            | TEXT ALIGNMENT                |       |
| SET FILL AREA INTERIOR STYLE   | FILL BUNDLE INDEX             |       |
| SET FILL AREA STYLE INDEX      | INTERIOR STYLE                |       |
|                                | HATCH INDEX                   | (4)   |
|                                | PATTERN INDEX                 | (4)   |
| SET FILL AREA COLOUR INDEX     | FILL COLOUR                   | (2)   |
| SET PATTERN SIZE               | PATTERN SIZE                  |       |
| SET PATTERN REFERENCE POINT    | FILL REFERENCE POINT          |       |
| SET ASPECT SOURCE FLAGS        | ASPECT SOURCE FLAGS           |       |
| SET PICK IDENTIFIER            | PICK IDENTIFIER               |       |
| SET POLYLINE REPRESENTATION    | LINE REPRESENTATION           |       |
| SET POLYMARKER REPRESENTATION  | MARKER REPRESENTATION         |       |
| SET TEXT REPRESENTATION        | TEXT REPRESENTATION           |       |
| SET FILL AREA REPRESENTATION   | FILL REPRESENTATION           |       |
| SET PATTERN REPRESENTATION     | PATTERN TABLE                 | (2)   |
| SET COLOUR REPRESENTATION      | COLOUR TABLE                  |       |

## NOTES

- 1 Widths and sizes are selected by scale factors.
- 2 Colours are selected by indexes pointing into the colour table.
- 3 GKS includes the notion of character set within 'font', whereas CGM separates the two concepts. When the value of 'font' in the GKS state list changes, then the GKS metafile elements TEXT FONT INDEX, TEXT PRECISION, CHARACTER SET INDEX and ALTERNATE CHARACTER SET INDEX are written to the metafile, each with the value of the 'font' and 'precision' entry in the GKS state list. The CGM font index is determined as described sub-clause H.4.3.6.3. The elements shall appear consecutively in the metafile but may appear in any order.
- 4 Legal values of the GKS 'fill area style index' differ depending upon whether the current interior style is 'hatch' or 'pattern'. Therefore, a negative GKS style index results only on the generation of the HATCH INDEX element, and a positive value results in the generation of both the HATCH INDEX and PATTERN INDEX elements.

H.5.5 Transformation functions

Table 9 - The mapping of the transformation functions

| GKS function                                                               | GKS Session Metafile element                                                                        | Notes |
|----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-------|
| SET WINDOW<br>(of currently selected<br>normalization<br>transformation)   | CHARACTER HEIGHT<br>CHARACTER ORIENTATION<br>PATTERN SIZE<br>FILL REFERENCE POINT                   |       |
| SET VIEWPORT<br>(of currently selected<br>normalization<br>transformation) | CHARACTER HEIGHT<br>CHARACTER ORIENTATION<br>PATTERN SIZE<br>FILL REFERENCE POINT<br>CLIP RECTANGLE | (1)   |
| SELECT NORMALIZATION<br>TRANSFORMATION                                     | CHARACTER HEIGHT<br>CHARACTER ORIENTATION<br>PATTERN SIZE<br>FILL REFERENCE POINT<br>CLIP RECTANGLE | (1)   |
| SET CLIPPING INDICATOR                                                     | CLIP RECTANGLE                                                                                      | (2)   |
| SET WORKSTATION WINDOW                                                     | VDC EXTENT                                                                                          | (3)   |
| SET WORKSTATION VIEWPORT                                                   | WORKSTATION VIEWPORT                                                                                |       |

NOTES

- 1 If the 'clipping rectangle' entry in the GKS state list is changed, then a CLIP RECTANGLE element is written to the metafile. The element is written with the values of MAXIMUM VDC EXTENT if the 'clipping indicator' entry in the GKS state list is 'noclip', or with values corresponding to the 'clipping rectangle' in the GKS state list if the 'clipping indicator' entry in the GKS list is 'clip'.
- 2 If the 'clipping indicator' entry in the GKS state list is changed, then a CLIP RECTANGLE element is written to the metafile. The element is written with the values of MAXIMUM VDC EXTENT if the 'clipping indicator' entry in the GKS state list is changed to 'noclip', or with values corresponding to the 'clipping rectangle' in the GKS state list if the 'clipping indicator' entry in the GKS state list is changed to 'clip'.
- 3 The position of the workstation window within the NDC unit square corresponds to the position of the VDC extent within the maximum VDC extent.

H.5.6 Segment manipulation functions

Table 10 - The mapping of the segment manipulation functions

| GKS function                                                           | GKS Session Metafile element                                                                          | Notes        |
|------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|--------------|
| CREATE SEGMENT<br>CLOSE SEGMENT                                        | BEGIN SEGMENT<br>END SEGMENT                                                                          |              |
| RENAME SEGMENT<br>DELETE SEGMENT<br>DELETE SEGMENT FROM<br>WORKSTATION | RENAME SEGMENT<br>DELETE SEGMENT<br><br>DELETE SEGMENT                                                |              |
| ASSOCIATE SEGMENT WITH<br>WORKSTATION                                  | BEGIN SEGMENT<br>(segment attributes,<br>primitives, attributes<br>and clip rectangle)<br>END SEGMENT | (1)<br>(2)   |
| COPY SEGMENT TO WORKSTATION                                            | (transformed primitives,<br>attributes and clip rectangle)                                            | (1)<br>(2,3) |
| INSERT SEGMENT                                                         | (transformed primitives,<br>attributes and clip rectangle)                                            | (1,4)<br>(5) |

## NOTES

- 1 The elements may occur in any order.
- 2 The associated clipping rectangle.
- 3 Primitives transformed by the segment transformation.
- 4 Primitives transformed by the segment transformation followed by the insert transformation.
- 5 A clip rectangle corresponding to the clipping rectangle in the GKS state list if the 'clipping indicator' entry in the GKS state list is 'clip', or the corresponding  $[0,1] \times [0,1]$  clip rectangle - which is the maximum VDC extent - if the 'clipping indicator' entry in the GKS state list is 'noclip'.

## H.5.7 Segment attributes

Table 11 - The mapping of the segment attributes

| GKS function          | GKS Session Metafile element | Notes |
|-----------------------|------------------------------|-------|
| SET SEGMENT TRANSFORM | SEGMENT TRANSFORMATION       |       |
| SET VISIBILITY        | SEGMENT VISIBILITY           |       |
| SET HIGHLIGHTING      | SEGMENT HIGHLIGHTING         |       |
| SET SEGMENT PRIORITY  | SEGMENT DISPLAY PRIORITY     | (1)   |
|                       | SEGMENT PICK PRIORITY        | (1)   |
| SET DETECTABILITY     | SEGMENT DETECTABILITY        |       |

## NOTES

- 1 The elements shall appear consecutively in the metafile but may appear in any order.

## H.5.8 Metafile function

Table 12 - The mapping of the metafile function

| GKS function       | GKS Session Metafile element | Notes |
|--------------------|------------------------------|-------|
| WRITE ITEM TO GKSM | APPLICATION DATA             | (1)   |

## NOTES

- 1 The GKS item type is mapped to the application data identifier.

## H.5.9 Metafile Description

At the head of a metafile is a set of Metafile Descriptor (MD) elements. It is useful to view these elements as forming a Metafile Description Table (similar to the GKS and Workstation Description Tables in GKS).

In the GKS context, the description table shown in table 13 would be written at the beginning of a metafile. For the elements which are listed as "i.d.", it is implementation dependent both whether the elements are included in the table - except for the mandatory elements - and what values are assigned to the elements if they are written to the metafile. For elements not written to the metafile the CGM default values apply.

Table 13 - The metafile descriptor elements

| Description Element        | Element Value                                 | Mandatory |
|----------------------------|-----------------------------------------------|-----------|
| METAFILE VERSION           | 2                                             | X         |
| METAFILE ELEMENT LIST      | Elements listed in H.4.4 or some known subset | X         |
| METAFILE DESCRIPTION       | i.d.                                          |           |
| VDC TYPE                   | i.d.                                          |           |
| INTEGER PRECISION          | i.d.                                          |           |
| REAL PRECISION             | i.d.                                          |           |
| INDEX PRECISION            | i.d.                                          |           |
| COLOUR PRECISION           | i.d.                                          |           |
| COLOUR INDEX PRECISION     | i.d.                                          |           |
| MAXIMUM COLOUR INDEX       | i.d.                                          |           |
| COLOUR VALUE EXTENT        | i.d.                                          |           |
| FONT LIST                  | i.d.                                          |           |
| CHARACTER SET LIST         | i.d.                                          |           |
| CHARACTER CODING ANNOUNCER | i.d.                                          |           |
| NAME PRECISION             | i.d.                                          |           |
| MAXIMUM VDC EXTENT         | i.d.                                          |           |
| SEGMENT PRIORITY EXTENT    | i.d.                                          |           |

## H.6 Metafile interpretation

### H.6.1 Introduction

This sub-clause describes how metafile elements from a metafile of the set gks-session-all, generated by a GKS program according to the mapping described in sub-clause H.5, are subsequently interpreted by the GKS INTERPRET ITEM function and/or the MI workstation.

Those CGM elements which do not map to a GKS item are viewed as directives to the MI workstation itself, so that it may correctly read the metafile contents.

A number of the elements below are specified as causing GKS state list entries to be set, and have parameters specified in VDC (which corresponds to GKS NDC). The GKS state list entries are in world coordinates (WC). The VDC (NDC) are mapped by the inverse of the current normalization transformation before the GKS state list values are set.

### H.6.2 Delimiter elements

Table 14 - The mapping of delimiter elements

| GKS Session Metafile element | GKS Metafile Interface | Item | Notes |
|------------------------------|------------------------|------|-------|
| BEGIN GKS SESSION METAFILE   | -                      | -    | (1)   |
| END METAFILE                 | END ITEM               | 0    | (2)   |
| BEGIN GKS SESSION            | -                      | -    |       |
| BEGIN SEGMENT                | CREATE SEGMENT         | 81   |       |
| END SEGMENT                  | CLOSE SEGMENT          | 82   |       |

#### NOTES

- 1 The first CGM element interpreted by the MI workstation. The metafile description immediately follows. Its elements inform the MI workstation how to read the metafile.
- 2 No further items may be read.

### H.6.3 Metafile descriptor elements

All elements in this class contain only directives to the MI workstation, their interpretation does not correspond to the invocation of any GKS function.

Table 15 - The mapping of metafile descriptor elements

| GKS Session Metafile element | GKS Metafile Interface | Item | Notes |
|------------------------------|------------------------|------|-------|
| METAFILE VERSION             | -                      | -    | (1)   |
| METAFILE DESCRIPTION         | -                      | -    |       |
| VDC TYPE                     | -                      | -    |       |
| INTEGER PRECISION            | -                      | -    |       |
| REAL PRECISION               | -                      | -    |       |
| COLOUR PRECISION             | -                      | -    |       |
| COLOUR INDEX PRECISION       | -                      | -    |       |
| INDEX PRECISION              | -                      | -    |       |
| MAXIMUM COLOUR INDEX         | -                      | -    |       |
| COLOUR VALUE EXTENT          | -                      | -    | (2)   |
| METAFILE ELEMENT LIST        | -                      | -    |       |
| FONT LIST                    | -                      | -    |       |
| CHARACTER SET LIST           | -                      | -    |       |
| CHARACTER CODING ANNOUNCER   | -                      | -    |       |
| NAME PRECISION               | -                      | -    |       |
| MAXIMUM VDC EXTENT           | -                      | -    | (3)   |
| SEGMENT PRIORITY EXTENT      | -                      | -    | (4)   |

#### NOTES

- 1 The value of the parameter must be 2.
- 2 Used to normalize colour direct values to the continuous range of real numbers [0,1].
- 3 Used to normalize VDC range (i.e. NDC) and to allow the proper position of the VDC EXTENT (workstation window) within the normalized VDC range (the unit square). Applies to VDC type 'integer' or 'real'.
- 4 Used to normalize segment priority to the continuous range of real numbers [0,1].

### H.6.4 Control elements

Table 16 - The mapping of control elements

| GKS Session Metafile element | GKS Metafile Interface | Item |
|------------------------------|------------------------|------|
| VDC INTEGER PRECISION        | -                      | -    |
| VDC REAL PRECISION           | -                      | -    |
| CLIP RECTANGLE               | CLIPPING RECTANGLE     | 61   |
| VDC EXTENT                   | WORKSTATION WINDOW     | 71   |
| WORKSTATION VIEWPORT         | WORKSTATION VIEWPORT   | 72   |
| CLEAR                        | CLEAR WORKSTATION      | 1    |
| UPDATE                       | UPDATE WORKSTATION     | 3    |
| DEFERRAL STATE               | DEFERRAL STATE         | 4    |

### H.6.5 Graphical primitive elements

Table 17 - The mapping of graphical primitive elements

| GKS Session Metafile element | GKS Metafile Interface<br>Notes | Item |     |
|------------------------------|---------------------------------|------|-----|
| POLYLINE                     | POLYLINE                        | 11   |     |
| POLYMARKER                   | POLYMARKER                      | 12   |     |
| TEXT                         | TEXT                            | 13   | (1) |
| POLYGON                      | FILL AREA                       | 14   |     |
| CELL ARRAY                   | CELL ARRAY                      | 15   | (2) |
| GDP                          | GDP                             | 16   |     |

## NOTES

- 1 The text flag should be 'final'.
- 2 Colours are selected by indices pointing into the colour table.

## H.6.6 Attribute elements

Table 18 - The mapping of attribute elements

| GKS Session Metafile element  | GKS Metafile Interface     | Item | Notes |
|-------------------------------|----------------------------|------|-------|
| LINE BUNDLE INDEX             | POLYLINE INDEX             | 21   |       |
| LINE TYPE                     | LINE TYPE                  | 22   |       |
| LINE WIDTH                    | LINE WIDTH SCALE FACTOR    | 23   | (1)   |
| LINE COLOUR                   | POLYLINE COLOUR INDEX      | 24   | (2)   |
| MARKER BUNDLE INDEX           | POLYMARKER INDEX           | 25   |       |
| MARKER TYPE                   | MARKER TYPE                | 26   |       |
| MARKER SIZE                   | MARKER SIZE SCALE FACTOR   | 27   | (1)   |
| MARKER COLOUR                 | POLYMARKER COLOUR INDEX    | 28   | (2)   |
| TEXT BUNDLE INDEX             | TEXT INDEX                 | 29   |       |
| TEXT FONT INDEX               | TEXT FONT AND PRECISION    | 30   | (3)   |
| TEXT PRECISION                | TEXT FONT AND PRECISION    | 30   | (3)   |
| CHARACTER EXPANSION FACTOR    | CHARACTER EXPANSION FACTOR | 31   |       |
| CHARACTER SPACING             | CHARACTER SPACING          | 32   |       |
| TEXT COLOUR                   | TEXT COLOUR INDEX          | 33   | (2)   |
| CHARACTER HEIGHT              | CHARACTER VECTORS          | 34   | (4)   |
| CHARACTER ORIENTATION         | CHARACTER VECTORS          | 34   | (4)   |
| TEXT PATH                     | TEXT PATH                  | 35   |       |
| TEXT ALIGNMENT                | TEXT ALIGNMENT             | 36   |       |
| CHARACTER SET INDEX           | TEXT FONT AND PRECISION    | 30   | (3)   |
| ALTERNATE CHARACTER SET INDEX | TEXT FONT AND PRECISION    | 30   | (3)   |
| FILL BUNDLE INDEX             | FILL AREA INDEX            | 37   |       |
| INTERIOR STYLE                | FILL AREA INTERIOR STYLE   | 38   |       |
| FILL COLOUR                   | FILL AREA COLOUR INDEX     | 40   | (2)   |
| HATCH INDEX                   | FILL AREA STYLE INDEX      | 39   |       |
| PATTERN INDEX                 | FILL AREA STYLE INDEX      | 39   |       |
| FILL REFERENCE POINT          | PATTERN REFERENCE POINT    | 42   |       |
| PATTERN TABLE                 | PATTERN REPRESENTATION     | 55   | (2)   |
| PATTERN SIZE                  | PATTERN VECTORS            | 41   |       |
| COLOUR TABLE                  | COLOUR REPRESENTATION      | 56   |       |
| ASPECT SOURCE FLAGS           | ASPECT SOURCE FLAGS        | 43   | (5)   |
| LINE REPRESENTATION           | POLYLINE REPRESENTATION    | 51   |       |
| MARKER REPRESENTATION         | POLYMARKER REPRESENTATION  | 52   |       |
| TEXT REPRESENTATION           | TEXT REPRESENTATION        | 53   |       |
| FILL REPRESENTATION           | FILL AREA REPRESENTATION   | 54   |       |
| PICK IDENTIFIER               | PICK IDENTIFIER            | 44   |       |

## NOTES

- 1 Widths and sizes are selected by scale factors.
- 2 Colours are selected by indices pointing into the colour table.
- 3 Four elements taken from CGM supply the relevant parameter values of the GKS TEXT FONT AND PRECISION item (either explicitly or implicitly by default): TEXT FONT INDEX, TEXT PRECISION, CHARACTER SET INDEX and ALTERNATE CHARACTER SET INDEX. The corresponding GKS font number may be determined as described in H.4.3.6.2. The occurrence of only one of the four elements taken from CGM uniquely indicates the mapping to GKS TEXT FONT AND PRECISION. The occurrence of more than one of the elements taken from CGM within one sequence in any order causes the corresponding GKS item to be returned once.
- 4 Two elements taken from CGM supply the relevant parameter values of the GKS CHARACTER VECTORS item (either explicitly or implicitly by default): CHARACTER HEIGHT and CHARACTER ORIENTATION. The occurrence of only one of the two elements taken from CGM uniquely indicates the mapping to GKS CHARACTER VECTORS. The occurrence of the two elements taken from CGM within one sequence in any order causes the corresponding GKS item to be returned once.
- 5 TEXT FONT ASF and TEXT PRECISION ASF must be equal; they correspond to GKS TEXT FONT AND PRECISION ASF. HATCH and PATTERN INDEX ASF must be equal; they correspond to GKS FILL AREA STYLE INDEX ASF. No edge ASFs are included.

**H.6.7 Escape and external elements****Table 19 - The mapping of escape and external elements**

| GKS Session Metafile element | GKS Metafile Interface | Item | Notes |
|------------------------------|------------------------|------|-------|
| ESCAPE                       | ESCAPE                 | 6    | (1)   |
| MESSAGE                      | MESSAGE                | 5    |       |
| APPLICATION DATA             | USER ITEM              | >100 |       |

**NOTES**

- 1 The 'action required' flag should be 'no action'.

**H.6.8 Segment control elements****Table 20 - The mapping of segment control elements**

| GKS Session Metafile element | GKS Metafile Interface                | Item |
|------------------------------|---------------------------------------|------|
| DELETE SEGMENT               | DELETE SEGMENT                        | 84   |
| RENAME SEGMENT               | RENAME SEGMENT                        | 83   |
| REDRAW ALL SEGMENTS          | REDRAW ALL SEGMENTS ON<br>WORKSTATION | 2    |

**H.6.9 Segment attribute elements****Table 21 - The mapping of segment attribute elements**

| GKS Session Metafile element | GKS Metafile Interface     | Item | Notes |
|------------------------------|----------------------------|------|-------|
| SEGMENT TRANSFORMATION       | SET SEGMENT TRANSFORMATION | 91   | (1)   |
| SEGMENT VISIBILITY           | SET VISIBILITY             | 92   |       |
| SEGMENT HIGHLIGHTING         | SET HIGHLIGHTING           | 93   |       |
| SEGMENT DISPLAY PRIORITY     | SET SEGMENT PRIORITY       | 94   |       |
| SEGMENT DETECTABILITY        | SET DETECTABILITY          | 95   | (1)   |
| SEGMENT PICK PRIORITY        | SET SEGMENT PRIORITY       | 94   |       |

**NOTES**

- 1 Both SEGMENT DISPLAY PRIORITY and SEGMENT PICK PRIORITY supply the parameter value of the GKS SET SEGMENT PRIORITY item.

## H.7 Formal grammar for the GKS Session Metafile

### H.7.1 Introduction

This grammar is a formal definition of a standard GKS session metafile. The encoding-independent and the encoding-dependent productions are separated, and there are subsections showing the syntax of each of the standardized schemes. Details on the encoding of terminal symbols can be found in parts of this Standard that deal with the particular encoding schemes.

### H.7.2 Notation used

|                         |                                           |
|-------------------------|-------------------------------------------|
| <symbol>                | - nonterminal                             |
| <SYMBOL>                | - terminal                                |
| <symbol>*               | - 0 or more occurrences                   |
| <symbol>+               | - 1 or more occurrences                   |
| <symbol>o               | - optional (0 or 1 occurrences)           |
| <symbol>(n)             | - exactly n occurrences, n=2,3,...        |
| <symbol-1>::=<symbol-2> | - symbol-1 has the syntax of symbol-2     |
| <symbol-1> <symbol-2>   | - symbol-1 or alternatively symbol-2      |
| <symbol:meaning>        | - symbol with the stated meaning          |
| {comment}               | - explanation of a symbol or a production |

### H.7.3 Detailed grammar

#### H.7.3.1 Metafile structure

|                      |                                                                                                                                                                                       |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <metafile>           | ::= <BEGIN GKS SESSION METAFILE><br><string : metafile identifier><br><metafile descriptor><br><metafile contents>o<br><END GKS SESSION METAFILE>                                     |
| <metafile contents>  | ::= <extra element>*<br><gks session ><br><extra element>*                                                                                                                            |
| <extra element>      | ::= <external element><br>  <escape element>                                                                                                                                          |
| <gks session>        | ::= <BEGIN GKS SESSION><br><string:session identifier><br><session content>*                                                                                                          |
| <session content>    | ::= <control element><br>  <graphical element><br>  <primitive attribute element><br>  <extra element><br>  <segment attribute element><br>  <segment control element><br>  <segment> |
| <segment>            | ::= <BEGIN SEGMENT><br><segment identifier><br><segment content><br><END SEGMENT>                                                                                                     |
| <segment identifier> | ::= <name>                                                                                                                                                                            |

<segment content> ::= <eligible control element within segments>  
 | <graphical element>  
 | <primitive attribute element>  
 | <extra element>  
 | <segment attribute element>  
 | <segment control element>

<eligible control element within segments> ::= <vdc precision>  
 | <clip rectangle>  
 | <workstation window>  
 | <workstation viewport>  
 | <deferral state>  
 | <update workstation>

### H.7.3.2 Metafile descriptor elements

<metafile descriptor> ::= <<optional descriptor element>\*>  
 <version>  
 <optional descriptor element>\*>  
 <element list>  
 <optional descriptor element>\*>  
 | <<optional descriptor element>\*>  
 <element list>  
 <optional descriptor element>\*>  
 <version>  
 <optional descriptor element>\*>

<version> ::= <METAFILE VERSION>  
 <integer>

<element list> ::= <METAFILE ELEMENT LIST>  
 <element name>\*>  
 | <element name shorthand enumerated>\*

<element name shorthand enumerated> ::= <GKS SESSION ALL>

<optional descriptor element> ::= <VDC TYPE>  
 <vdc type enumerated>  
 | <MAXIMUM COLOUR INDEX>  
 <colour index>  
 | <COLOUR VALUE EXTENT>  
 <red green blue>(2)  
 | <FONT LIST>  
 <string: font name>+  
 | <CHARACTER SET LIST>  
 <character set definition>+  
 | <CHARACTER CODING ANNOUNCER>  
 <coding technique enumerated>  
 | <scalar precision>  
 | <extra element>  
 | <MAXIMUM VDC EXTENT>  
 <point>(2)  
 | <SEGMENT PRIORITY EXTENT>  
 <integer: minimum extent>  
 <integer: maximum extent>

|                                 |                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <vdc type enumerated>           | ::= <INTEGER><br>  <REAL>                                                                                                                                                                                                                                                                                                                                                                |
| <character set definition>      | ::= <char set enumerated><br><designation sequence>                                                                                                                                                                                                                                                                                                                                      |
| <character set enumerated>      | ::= <94 CHAR><br>  <96 CHAR><br>  <MULTI-BYTE 94 CHAR><br>  <MULTI-BYTE 96 CHAR><br>  <COMPLETE CODE>                                                                                                                                                                                                                                                                                    |
| <coding technique enumerated>   | ::= <BASIC 7-BIT><br>  <BASIC 8-BIT><br>  <EXTENDED 7-BIT><br>  <EXTENDED 8-BIT>                                                                                                                                                                                                                                                                                                         |
| <designation sequence>          | ::= <string>                                                                                                                                                                                                                                                                                                                                                                             |
| <scalar precision>              | ::= <INTEGER PRECISION><br><integer precision value><br>  <REAL PRECISION><br><real precision value><br>  <INDEX PRECISION><br><integer precision value><br>  <COLOUR PRECISION><br><colour precision value><br>  <COLOUR INDEX PRECISION><br><colour index precision value><br>  <NAME PRECISION><br><name precision value><br>{these elements have encoding}<br>{dependent parameters} |
| <point>                         | ::= <vdc value>(2)                                                                                                                                                                                                                                                                                                                                                                       |
| <minimum extent>                | ::= <integer>                                                                                                                                                                                                                                                                                                                                                                            |
| <maximum extent>                | ::= <integer>                                                                                                                                                                                                                                                                                                                                                                            |
| <b>H.7.3.3 Control elements</b> |                                                                                                                                                                                                                                                                                                                                                                                          |
| <control element>               | ::= <eligible control element within segments><br>  <clear workstation>                                                                                                                                                                                                                                                                                                                  |
| <vdc precision>                 | ::= <VDC INTEGER PRECISION><br><vdc integer precision value><br>  <VDC REAL PRECISION><br><vdc real precision value><br>{these elements have encoding}<br>{dependent parameters}                                                                                                                                                                                                         |
| <clip rectangle>                | ::= <CLIP RECTANGLE><br><point>(2)                                                                                                                                                                                                                                                                                                                                                       |
| <workstation window>            | ::= <VDC EXTENT><br><point>(2)                                                                                                                                                                                                                                                                                                                                                           |

|                                            |                                                                                               |
|--------------------------------------------|-----------------------------------------------------------------------------------------------|
| <workstation viewport>                     | ::= <WORKSTATION VIEWPORT><br><real>(4)                                                       |
| <clear workstation>                        | ::= <CLEAR><br><control flag enumerated>                                                      |
| <update workstation>                       | ::= <UPDATE><br><update regeneration flag enumerated>                                         |
| <deferral state>                           | ::= <DEFERRAL STATE><br><deferral mode enumerated><br><implicit regeneration flag enumerated> |
| <update regeneration flag<br>enumerated>   | ::= <PERFORM><br>  <POSTPONE>                                                                 |
| <deferral mode enumerated>                 | ::= <ASAP><br>  <BNIG><br>  <BNIL><br>  <ASTI>                                                |
| <implicit regeneration flag<br>enumerated> | ::= <SUPPRESSED><br>  <ALLOWED>                                                               |
| <control flag enumerated>                  | ::= <CONDITIONALLY><br>  <ALWAYS>                                                             |

#### H.7.3.4 Graphical elements

|                        |                                                                                                                                                                        |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <graphical element>    | ::= <polypoint element><br>  <text element><br>  <cell element><br>  <gdp element>                                                                                     |
| <polypoint element>    | ::= <POLYLINE><br><point>(2)<br><point>*<br>  <POLYMARKER><br><point><br><point>*<br>  <POLYGON><br><point>(3)<br><point>*                                             |
| <text element>         | ::= <TEXT><br><point><br><final character list>                                                                                                                        |
| <final character list> | ::= <FINAL><br><string>                                                                                                                                                |
| <cell element>         | ::= <CELL ARRAY><br><point>(3)<br><integer>(2)<br><local colour precision><br><colour>(integer1 x integer2)<br>{this element has an encoding}<br>{dependent parameter} |

<local colour precision> ::= <colour index precision value>  
                                   | <default colour precision indicator>

<colour> ::= <colour index>

<gdp element> ::= <GDP>  
                                   <integer : gdp identifier>  
                                   <point>\*  
                                   <data record>

### H.7.3.5 Attribute elements

<primitive attribute element> ::= <line attribute element>  
                                   | <marker attribute element>  
                                   | <text attribute element>  
                                   | <filled-area attribute element>  
                                   | <aspect source flags>  
                                   | <representation element>  
                                   | <PICK IDENTIFIER>  
                                   <name : pick identifier>

<line attribute element> ::= <LINE BUNDLE INDEX>  
                                   <positive index>  
                                   | <LINE TYPE>  
                                   <index>  
                                   | <LINE WIDTH>  
                                   <size value>  
                                   | <LINE COLOUR>  
                                   <colour>

<index> ::= <standard index value>  
                                   | <private index value>

<standard index value> ::= <positive integer>

<non-negative integer> ::= <integer> {greater or equal to 0}

<positive integer> ::= <integer> {greater than 0}

<private index value> ::= <negative integer>

<negative integer> ::= <integer> {less than 0}

<positive index> ::= <positive integer>

<size value> ::= <non-negative real>

<non-negative real> ::= <real> {greater or equal to 0}

<marker attribute element> ::= <MARKER BUNDLE INDEX>  
                                   <positive index>  
                                   | <MARKER TYPE>  
                                   <index>  
                                   | <MARKER SIZE>  
                                   <size value>  
                                   | <MARKER COLOUR>  
                                   <colour>

|                                      |                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <text attribute element>             | ::= <char attribute element><br>  <string attribute element>                                                                                                                                                                                                                                                                                                                                                    |
| <character attribute element>        | ::= <TEXT BUNDLE INDEX><br><positive index><br>  <TEXT FONT INDEX><br><positive index><br>  <CHARACTER EXPANSION FACTOR><br><real><br>  <CHARACTER SPACING><br><real><br>  <TEXT COLOUR><br><colour><br>  <CHARACTER HEIGHT><br><non-negative vdc value><br>  <CHARACTER ORIENTATION><br><vdc value>(4)<br>  <CHARACTER SET INDEX><br><positive index><br>  <ALTERNATE CHARACTER SET INDEX><br><positive index> |
| <string attribute element>           | ::= <TEXT PATH><br><path enumerated><br>  <TEXT PRECISION><br><text precision enumerated><br>  <TEXT ALIGNMENT><br><horizontal alignment enumerated><br><vertical alignment enumerated><br><continuous align value>(2)                                                                                                                                                                                          |
| <non-negative vdc value>             | ::= <vdc value> {greater or equal to 0}                                                                                                                                                                                                                                                                                                                                                                         |
| <path enumerated>                    | ::= <RIGHT><br>  <LEFT><br>  <UP><br>  <DOWN>                                                                                                                                                                                                                                                                                                                                                                   |
| <text precision enumerated>          | ::= <STRING><br>  <CHARACTER><br>  <STROKE>                                                                                                                                                                                                                                                                                                                                                                     |
| <horizontal alignment<br>enumerated> | ::= <NORMAL HORIZONTAL><br>  <LEFT><br>  <CENTRE><br>  <RIGHT>                                                                                                                                                                                                                                                                                                                                                  |
| <vertical alignment<br>enumerated>   | ::= <NORMAL VERTICAL><br>  <TOP><br>  <CAP><br>  <HALF><br>  <BASE><br>  <BOTTOM>                                                                                                                                                                                                                                                                                                                               |
| <continuous alignment value>         | ::= <real>                                                                                                                                                                                                                                                                                                                                                                                                      |

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <filled-area attribute element> | <p>::= &lt;FILL BUNDLE INDEX&gt;<br/>             &lt;positive index&gt;<br/>               &lt;INTERIOR STYLE&gt;<br/>                 &lt;interior style enumerated&gt;<br/>               &lt;FILL COLOUR&gt;<br/>                 &lt;colour&gt;<br/>               &lt;HATCH INDEX&gt;<br/>                 &lt;index&gt;<br/>               &lt;PATTERN INDEX&gt;<br/>                 &lt;positive index&gt;<br/>               &lt;FILL REFERENCE POINT&gt;<br/>                 &lt;point&gt;<br/>               &lt;PATTERN SIZE&gt;<br/>                 &lt;vdc value&gt;(4)</p>                                                                                                                                                         |
| <interior style enumerated>     | <p>::= &lt;HOLLOW&gt;<br/>               &lt;SOLID&gt;<br/>               &lt;PATTERN&gt;<br/>               &lt;HATCH&gt;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <aspect source flags>           | <p>::= &lt;ASPECT SOURCE FLAGS&gt;<br/>             &lt;asf pair&gt;+</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <asf pair>                      | <p>::= &lt;asf type enumerated&gt;<br/>             &lt;asf enumerated&gt;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <asf type enumerated>           | <p>::= &lt;LINE TYPE ASF&gt;<br/>               &lt;LINE WIDTH ASF&gt;<br/>               &lt;LINE COLOUR ASF&gt;<br/>               &lt;MARKER TYPE ASF&gt;<br/>               &lt;MARKER SIZE ASF&gt;<br/>               &lt;MARKER COLOUR ASF&gt;<br/>               &lt;TEXT FONT ASF&gt;<br/>               &lt;TEXT PRECISION ASF&gt;<br/>               &lt;CHARACTER EXPANSION FACTOR ASF&gt;<br/>               &lt;CHARACTER SPACING ASF&gt;<br/>               &lt;TEXT COLOUR ASF&gt;<br/>               &lt;INTERIOR STYLE ASF&gt;<br/>               &lt;FILL COLOUR ASF&gt;<br/>               &lt;HATCH INDEX ASF&gt;<br/>               &lt;PATTERN INDEX ASF&gt;</p>                                                               |
| <asf enumerated>                | <p>::= &lt;INDIVIDUAL&gt;<br/>               &lt;BUNDLED&gt;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <representation element>        | <p>::= &lt;LINE REPRESENTATION&gt;<br/>             &lt;positive index&gt;<br/>             &lt;index&gt; {line type}<br/>             &lt;size value&gt; {line width}<br/>             &lt;colour&gt;<br/>               &lt;MARKER REPRESENTATION&gt;<br/>                 &lt;positive index&gt;<br/>                 &lt;index&gt; {marker type}<br/>                 &lt;size value&gt;<br/>                 &lt;colour&gt;<br/>               &lt;TEXT REPRESENTATION&gt;<br/>                 &lt;positive index&gt;<br/>                 &lt;positive index&gt; {font}<br/>                 &lt;text precision enumerated&gt;<br/>                 &lt;real&gt; {character spacing}<br/>                 &lt;real&gt; {expansion factor}</p> |

```

    <colour>
  | <FILL REPRESENTATION>
    <positive index>
    <interior style enumerated>
    <colour>
    <index> {hatch index}
    <positive index> {pattern index}
  | <PATTERN TABLE>
    <positive index>
    <integer>(2)
    <local colour precision>
    <colour>(integer1 x integer2)
      {this element has an encoding}
      {dependent parameter}
  | <COLOUR TABLE>
    <starting index>
    <red green blue>+

```

<starting index> ::= <colour index>

<pick identifier> ::= <name>

#### H.7.3.6 Escape elements

```

<escape element> ::= <ESCAPE>
                   <integer : identifier>
                   <data record>

```

#### H.7.3.7 External elements

```

<external element> ::= <MESSAGE>
                      <action flag>
                      <string>
                      | <APPLICATION DATA>
                        <integer> {greater than 100}
                        <data record>

```

<action flag> ::= <NO>

#### H.7.3.8 Segment control elements

```

<eligible segment control element> ::= <DELETE SEGMENT>
                                       <segment identifier>
                                       | <RENAME SEGMENT>
                                         <segment identifier: old segment>
                                         <segment identifier: new segment>
                                       | <REDRAW ALL SEGMENTS>

```

<segment identifier> ::= <name>

## H.7.3.9 Segment attribute elements

|                             |                                                                                                                                                                                                                                                                                                                                                          |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <segment attribute element> | ::= <SEGMENT TRANSFORMATION><br><segment identifier><br><transformation matrix><br>  <SEGMENT VISIBILITY><br><segment identifier><br><visibility enumerated><br>  <SEGMENT HIGHLIGHTING><br><segment identifier><br><highlighting enumerated><br>  <segment priority><br>  <SEGMENT DETECTABILITY><br><segment identifier><br><detectability enumerated> |
| <segment priority>          | ::= <SEGMENT DISPLAY PRIORITY><br><segment identifier><br><integer:segment display priority><br><SEGMENT PICK PRIORITY><br><segment identifier><br><integer:segment pick priority>                                                                                                                                                                       |
| <transformation matrix>     | ::= <2x2 matrix of reals><br><2x1 matrix of vdc>                                                                                                                                                                                                                                                                                                         |
| <visibility enumerated>     | ::= <INVISIBLE><br>  <VISIBLE>                                                                                                                                                                                                                                                                                                                           |
| <highlighting enumerated>   | ::= <NORMAL><br>  <HIGHLIGHTED>                                                                                                                                                                                                                                                                                                                          |
| <detectability enumerated>  | ::= <UNDETECTABLE><br>  <DETECTABLE>                                                                                                                                                                                                                                                                                                                     |

## H.7.4 Terminal symbols

The following are the terminals in this grammar. Their representation is dependent on the encoding scheme used. In annex A of the subsequent parts of this Standard, these encoding-dependent symbols are further described.

<element name>  
 <integer>  
 <real>  
 <vdc value>  
 <string>  
 <colour index>  
 <red green blue>  
 <integer precision value>  
 <real precision value>  
 <index precision value>  
 <colour precision value>  
 <colour index precision value>  
 <name precision value>  
 <default colour precision indicator>  
 <name>  
 <vdc integer precision value>  
 <vdc real precision value>  
 <data record>  
 <2x2 matrix of reals>  
 <2x1 matrix of vdc>

The CGM extended opcodes are encoding dependent. A complete list of them can be found in the productions for <element name enumerated> below.

The enumerated types:

<GKS SESSION ALL SET>  
 <INTEGER>  
 <REAL>  
 <94 CHAR>  
 <96 CHAR>  
 <MULTI-BYTE 94 CHAR>  
 <MULTI-BYTE 96 CHAR>  
 <COMPLETE CODE>  
 <BASIC 7-BIT>  
 <BASIC 8-BIT>  
 <EXTENDED 7-BIT>  
 <EXTENDED 8-BIT>  
 <LEFT>  
 <CENTRE>  
 <RIGHT>  
 <BOTTOM>  
 <TOP>  
 <ASAP>  
 <BNIG>  
 <BNIL>  
 <ASTI>  
 <CONDITIONAL>  
 <ALWAYS>  
 <FINAL>  
 <PERFORM>  
 <POSTPONE>  
 <UP>  
 <DOWN>  
 <STRING>  
 <CHARACTER>  
 <STROKE>  
 <NORMAL HORIZONTAL>  
 <NORMAL VERTICAL>  
 <CAP>  
 <HALF>  
 <BASE>  
 <HOLLOW>  
 <SOLID>  
 <PATTERN>  
 <HATCH>  
 <LINE TYPE ASF>  
 <LINE WIDTH ASF>  
 <LINE COLOUR ASF>  
 <MARKER TYPE ASF>  
 <MARKER SIZE ASF>  
 <MARKER COLOUR ASF>  
 <TEXT FONT ASF>  
 <TEXT PRECISION ASF>  
 <CHARACTER EXPANSION FACTOR ASF>  
 <CHARACTER SPACING ASF>  
 <TEXT COLOUR ASF>  
 <INTERIOR STYLE ASF>  
 <FILL COLOUR ASF>  
 <HATCH INDEX ASF>

<PATTERN INDEX ASF>  
<INDIVIDUAL>  
<BUNDLED>  
<NO>  
<SUPPRESSED>  
<ALLOWED>  
<VISIBLE>  
<INVISIBLE>  
<NORMAL>  
<HIGHLIGHTED>  
<DETECTABLE>  
<UNDETECTABLE>

<element name enumerated> ::= <BEGIN GKS SESSION METAFILE>  
| <END GKS SESSION METAFILE>  
| <BEGIN GKS SESSION>  
| <BEGIN SEGMENT>  
| <END SEGMENT>  
| <METAFILE VERSION>  
| <METAFILE ELEMENT LIST>  
| <METAFILE DESCRIPTION>  
| <VDC TYPE>  
| <INTEGER PRECISION>  
| <REAL PRECISION>  
| <INDEX PRECISION>  
| <COLOUR PRECISION>  
| <COLOUR INDEX PRECISION>  
| <MAXIMUM COLOUR INDEX>  
| <COLOUR VALUE EXTENT>  
| <FONT LIST>  
| <CHARACTER SET LIST>  
| <CHARACTER CODING ANNOUNCER>  
| <MAXIMUM VDC EXTENT>  
| <SEGMENT PRIORITY EXTENT>  
| <NAME PRECISION>  
| <VDC INTEGER PRECISION>  
| <VDC REAL PRECISION>  
| <CLIP RECTANGLE>  
| <VDC EXTENT>  
| <WORKSTATION VIEWPORT>  
| <DEFERRAL STATE>  
| <CLEAR>  
| <UPDATE>  
| <REDRAW ALL SEGMENTS>  
| <POLYLINE>  
| <POLYMARKER>  
| <POLYGON>  
| <TEXT>  
| <CELL ARRAY>  
| <GDP>  
| <LINE BUNDLE INDEX>  
| <LINE TYPE>  
| <LINE WIDTH>  
| <LINE COLOUR>  
| <MARKER BUNDLE INDEX>  
| <MARKER TYPE>  
| <MARKER SIZE>  
| <MARKER COLOUR>  
| <TEXT BUNDLE INDEX>  
| <TEXT FONT INDEX>  
| <TEXT PRECISION>

| <CHARACTER EXPANSION FACTOR>  
 | <CHARACTER SPACING>  
 | <TEXT COLOUR>  
 | <CHARACTER HEIGHT>  
 | <CHARACTER ORIENTATION>  
 | <TEXT ALIGNMENT>  
 | <CHARACTER SET INDEX>  
 | <ALTERNATE CHARACTER SET INDEX>  
 | <TEXT PATH>  
 | <FILL BUNDLE INDEX>  
 | <INTERIOR STYLE>  
 | <FILL COLOUR>  
 | <HATCH INDEX>  
 | <PATTERN INDEX>  
 | <FILL REFERENCE POINT>  
 | <PATTERN SIZE>  
 | <ASPECT SOURCE FLAGS>  
 | <LINE REPRESENTATION>  
 | <MARKER REPRESENTATION>  
 | <TEXT REPRESENTATION>  
 | <FILL REPRESENTATION>  
 | <PATTERN TABLE>  
 | <COLOUR TABLE>  
 | <PICK IDENTIFIER>  
 | <ESCAPE>  
 | <MESSAGE>  
 | <APPLICATION DATA>  
 | <DELETE SEGEMENT>  
 | <RENAME SEGMENT>  
 | <SEGMENT TRANSFORMATION>  
 | <SEGMENT HIGHLIGHTING>  
 | <SEGEMENT VISIBILITY>  
 | <SEGMENT DETECTABILITY>  
 | <SEGMENT DISPLAY PRIORITY>  
 | <SEGMENT PICK PRIORITY>

STANDARDSISO.COM :: Click to buy the PDF of ISO 7942:1985/Amd 1:1991

**H.8 Encodings for the additional elements required for the element set gks-session-all**

This clause specifies the encodings of those elements in table 5 which are derived from ISO 7942/Am.1 or from ISO 7942.

**H.8.1 Character encoding****Table 22 - Opcodes for the GKS session metafile elements**

| Opcode                            | 7-Bit coding |      | 8-Bit coding |       |
|-----------------------------------|--------------|------|--------------|-------|
| BEGIN GKS SESSION METAFILE opcode | 3/0          | 2/9  | 03/0         | 02/9  |
| BEGIN GKS SESSION opcode          | 3/0          | 2/10 | 03/0         | 02/10 |
| END GKS SESSION METAFILE opcode   | 3/0          | 2/11 | 03/0         | 02/11 |
| WORKSTATION VIEWPORT              | 3/3          | 2/12 | 03/3         | 02/12 |
| CLEAR opcode                      | 3/3          | 2/13 | 03/3         | 02/13 |
| UPDATE opcode                     | 3/3          | 2/14 | 03/3         | 02/14 |
| DEFERRAL STATE opcode             | 3/3          | 2/15 | 03/3         | 02/15 |
| DELETE SEGMENT opcode             | 3/8          | 2/7  | 03/8         | 02/7  |
| RENAME SEGMENT opcode             | 3/8          | 2/8  | 03/8         | 02/8  |
| REDRAW ALL SEGMENTS opcode        | 3/8          | 2/9  | 03/8         | 02/9  |
| SEGMENT VISIBILITY opcode         | 3/8          | 2/10 | 03/8         | 02/10 |
| SEGMENT DETECTABILITY opcode      | 3/8          | 2/11 | 03/8         | 02/11 |

**H.8.1.1 BEGIN GKS SESSION METAFILE**

<BEGIN-GKS-SESSION-METAFILE-opcode: 3/0 2/9>

<string: substitution-codes>

<string: metafile-identifier>

The first parameter, <string: substitution-codes>, lists those 2-character substitution codes that will be used in the metafile to represent CO control characters (bit combinations in the range 0/0 to 1/15) or the SPACE, TILDE, and DELETE characters (bit combinations 2/0, 7/14, and 7/15, respectively). Character substitution will be in effect only for those bit combinations whose substitution codes are listed in the first <string> parameter. If the first <string> parameter is empty (represented by a single ST), character substitution is not to be used in this metafile. The character substitution mechanism is described in ISO 8632-2.

NOTE - Substitution codes are not opened by an SOS introducer.

**H.8.1.2 BEGIN GKS SESSION**

<BEGIN-GKS-SESSION-opcode: 3/0 2/10>

<string: session identifier>

**H.8.1.3 END GKS SESSION METAFILE**

<END-GKS-SESSION-METAFILE-opcode: 3/0 2/11>

**H.8.1.4 WORKSTATION VIEWPORT**

<WOKSTATION-VIEWPORT-opcode: 3/3 2/12>

<real:xmin>

<real:xmax>

<real:ymin>

<real:ymax>

NOTE - According to GKS the units associated with the workstation viewport are 'metres or other', but it is unknown and unspecified which the units are on the metafile.