INTERNATIONAL STANDARD

ISO/IEC 8632-2

Second edition
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Information technology — Computer graphics — Metafile for the storage and transfer of picture description information —

Part 2:
Character encoding

Technologies de l'information — Infographie — Métafichier de stockage et de transfert des informations de description d'images —

Partie 2: Codage des caractères

Reference number
ISO/IEC 8632-2:1992(E)

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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 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/IEC 8632-2 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*.

This second edition cancels and replaces the first edition (ISO 8632-2:1987), which has been technically revised.

ISO/IEC 8632 consists of the following parts, under the general title *Information technology – Computer graphics – Metafile for the storage and transfer of picture description information* :

Part 1: Functional specification

Part 2: Character encoding

Part 3: Binary encoding

Part 4: Clear text encoding

Annex A forms an integral part of this part of ISO/IEC 8632.

Introduction

0.1 Purpose of the character encoding

The Character Encoding of the Computer Graphics Metafile (CGM) provides a representation of the Metafile syntax intended for situations in which it is important to minimize the size of the metafile or transmit the metafile through character-oriented communications services. The encoding uses compact representation of data that is optimized for storage or transfer between computer systems.

If minimizing the processing overhead is more important than data compaction, an encoding such as the Binary Encoding contained in ISO/IEC 8632-3 may be more appropriate. If human readability is the most important criterion, an encoding such as the Clear Text Encoding in ISO/IEC 8632-4 may be more appropriate.

0.2 Objectives

This encoding was designed with the following objectives:

a) regular syntax: All elements of the metafile should be encoded in a uniform way so that parsing the metafile is simple;

b) compactness: The encoding should provide a highly compact metafile, suitable for systems with restricted storage capacity or transfer bandwidth;

c) extensibility: the encoding should allow for future extensions;

d) transportability: the encoding should be suitable for use with transport mechanisms designed for character-oriented data based on a standard national character set derived from ISO/IEC 646.

0.3 Metafile characteristics

Each CGM command follows a simple regular syntax. Thus, new commands can be added in a future revision of ISO/IEC 8632 such that existing CGM interpreters can recognize (and ignore) the new commands. Also, new operands can be added to existing commands in the future revision of the standard such that existing CGM interpreters can recognize (and ignore) the additional operands.

Each CGM operand follows a simple regular syntax. Operands are variable in length. This permits small values to be represented by the smallest number of bytes.

A certain range of operand values of standard commands have been reserved for private use; the remaining range is either standardized or reserved for future standardization.

0.4 Relationship to other International Standards

The Character Encoding has been developed in collaboration with the ISO subcommittee responsible for character sets and coding, ECMA, and CEPT. The encoding conforms to the rules for code extension specified in ISO 2022 in the category of complete coding system.

The representation of character data in this part of ISO/IEC 8632 follows the rules of ISO/IEC 646 and ISO 2022.

For certain elements, the CGM defines value ranges as being reserved for registration. The values and their meanings will be defined using the established procedures (see ISO/IEC 8632-1, sub-clause 4.12.)

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Information technology – Computer graphics – Metafile for the storage and transfer of picture description information –

Part 2 :
Character encoding

1 Scope

This part of ISO/IEC 8632 specifies a character encoding of the Computer Graphics Metafile. For each of the elements specified in ISO/IEC 8632-1 an encoding is specified.

This encoding of the Computer Graphics Metafile provides a highly compact representation of the metafile, suitable for applications that require the metafile to be of minimum size and suitable for transmission with character-oriented transmission services.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 8632. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO/IEC 8632 are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO/IEC 646:1991, *Information technology – ISO 7-bit coded character set for information interchange.*

ISO 2022:1986, *Information processing – ISO 7-bit and 8-bit coded character sets – Code extension techniques.*

ISO 2375:1985, *Data processing – Procedure for registration of escape sequences.*

ISO 6429:1988, *Information processing – Control functions for 7-bit and 8-bit coded character sets.*

ECMA 96, *Graphics Data Syntax for a multiple Workstation Interface.*

CEPT, *Revision of T/CD 6.1 Videotex Presentation Layer Data Syntax.*

3 Notational conventions

3.1 7-Bit and 8-Bit code tables

The bits of the bit combinations of the 7-bit code are identified by b7, b6, b5, b4, b3, b2, and b1, where b7 is the highest-order, or most-significant, bit and b1 is the lowest-order, or least-significant, bit.

The bit combinations may be interpreted to represent integers in the range 0 to 127 in binary notation by attributing the following weights to the individual bits:

Bit:	b7	b6	b5	b4	b3	b2	b1
Weight:	64	32	16	8	4	2	1

In this part of ISO/IEC 8632, the bit combinations are identified by notation of the form *x/y*, where *x* is a number in the range 0 to 7 and *y* is a number in the range 0 to 15. The correspondence between the notations of the form *x/y* and the bit combinations consisting of the bits b7 to b1 is as follows:

— *x* is the number represented by b7, b6, and b5 where these bits are given the weights 4, 2, and 1 respectively;

— *y* is the number represented by b4, b3, b2, and b1 where these bits are given the weights 8, 4, 2, and 1 respectively.

The notations of the form *x/y* are the same as those used to identify code table positions, where *x* is the column number and *y* is the row number.

A 7-bit code table consists of 128 positions arranged in eight columns and sixteen rows. The columns are numbered 0 to 7 and the rows are numbered 0 to 15. Figure 1 shows a 7-bit code table.

An example illustrates the 7-bit code: "1/11" refers to the bit combination in column 1, row 11 of the code table, binary 0011011.

The bits of the bit combinations of the 8-bit code are identified by b8, b7, b6, b5, b4, b3, b2, and b1, where b8 is the highest-order, or most-significant, bit and b1 is the lowest-order, or least-significant, bit.

The bit combinations may be interpreted to represent integers in the range 0 to 255 in binary notation by attributing the following weights to the individual bits:

Bit:	b8	b7	b6	b5	b4	b3	b2	b1
Weight:	128	64	32	16	8	4	2	1

Using these weights, the bit combinations of the 8-bit code are interpreted to represent numbers in the range 0 to 255.

In this part of ISO/IEC 8632, the bit combinations are identified by notation of the form *xx/yy*, where *xx* and *yy* are numbers in the range 00 to 15. The correspondence between the notations of the form *xx/yy* and the bit combinations consisting of the bits b8 to b1 is as follows:

— *xx* is the number represented by b8, b7, b6, and b5 where these bits are given the weights 8, 4, 2, and 1 respectively;

— *yy* is the number represented by b4, b3, b2, and b1 where these bits are given the weights 8, 4, 2, and 1 respectively.

The notations of the form *xx/yy* are the same as those used to identify code table positions, where *xx* is the column number and *yy* is the row number. An 8-bit code table consists of 256 positions arranged in sixteen columns and sixteen rows. The columns and rows are numbered 00 to 15. Figure 2 shows an 8-bit code

table.

An example illustrates the 8-bit code: 04/01 represents the 8-bit byte 01000001, whereas 4/1 represents the 7-bit byte 1000001.

3.2 Code extension techniques vocabulary

In describing the characters that may occur within string parameters, certain terms imported from other standards (e.g., ISO 2022) are useful. In the context of the CGM, these terms, and the concepts to which they refer, apply only within the string parameters of the TEXT, APPEND TEXT, and RESTRICTED TEXT metafile elements.

3.2.1 C0 sets

A C0 set is a set of 30 control characters represented in a 7-bit code by 0/0 to 1/15, except 0/14 and 0/15 which shall be unused, and in an 8-bit code by 00/00 to 01/15, except 00/14 and 00/15 which shall be unused. C0 sets occupy columns 0 and 1 of a 7-bit code table or columns 00 and 01 of an 8-bit code table. The meanings of C0 controls within string parameters are described in 6.9.3.

3.2.2 C1 sets

A C1 set is a set of up to 32 control characters represented by bit combinations 08/00 to 09/15 in an 8-bit code. C1 sets occupy columns 08 and 09 of the 8-bit code table. In a 7-bit code the C1 control functions are represented by 2-byte escape sequences. This CGM encoding reserves the bit combinations 9/8 and 9/12 (ESC 5/8 and ESC 5/12 in a 7-bit environment, ESC = 1/11); these shall not be part of the content of string parameters. Other C1 control characters from other standards, such as ISO 6429, may be used within string parameters by agreement between the interchanging parties.

3.2.3 G-sets

The G-sets (G0, G1, G2, G3) are coded character sets of 94 or 96 characters. CHARACTER SET INDEX designates which character set is to be the G0 set. ALTERNATE CHARACTER SET INDEX designates a character set to be used as both the G1 and G2 sets. The G-sets may be "invoked into" (caused to occupy) columns 2 through 7 of a 7-bit code table, or columns 02 through 07 and 10 through 15 of an 8-bit code table. This encoding of the CGM uses the G0 and G1/G2 sets within string parameters. The G3 set may be used within the string parameters of conforming metafiles; this requires selection of the extended 7-bit or extended 8-bit mode in the CHARACTER CODING ANNOUNCER. The CGM does not provide an element to explicitly designate the G3 sets; this may be done within a text string in accordance with ISO 2022, or by other means agreed upon by the interchanging parties.

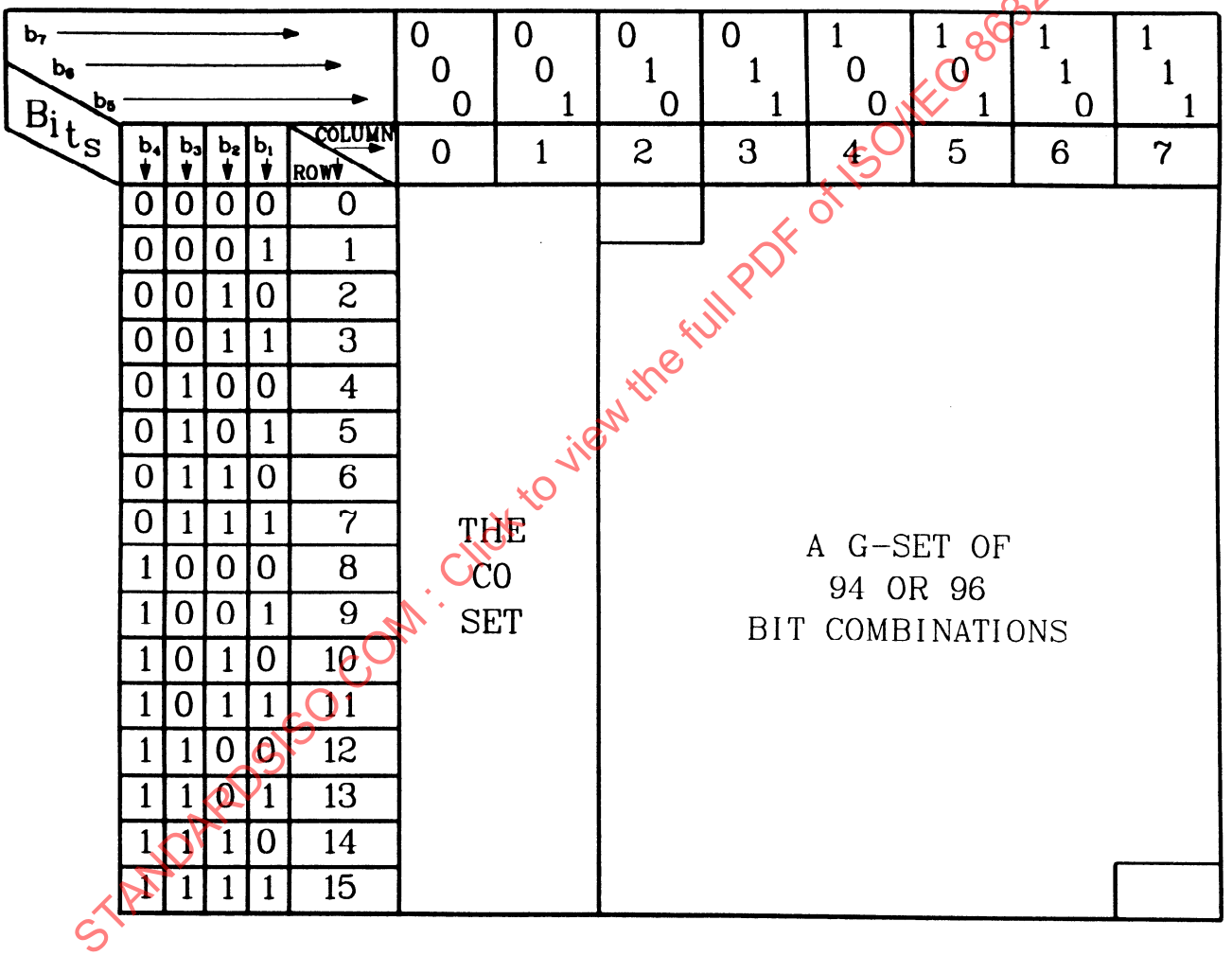


Figure 1 — The 7-bit code table

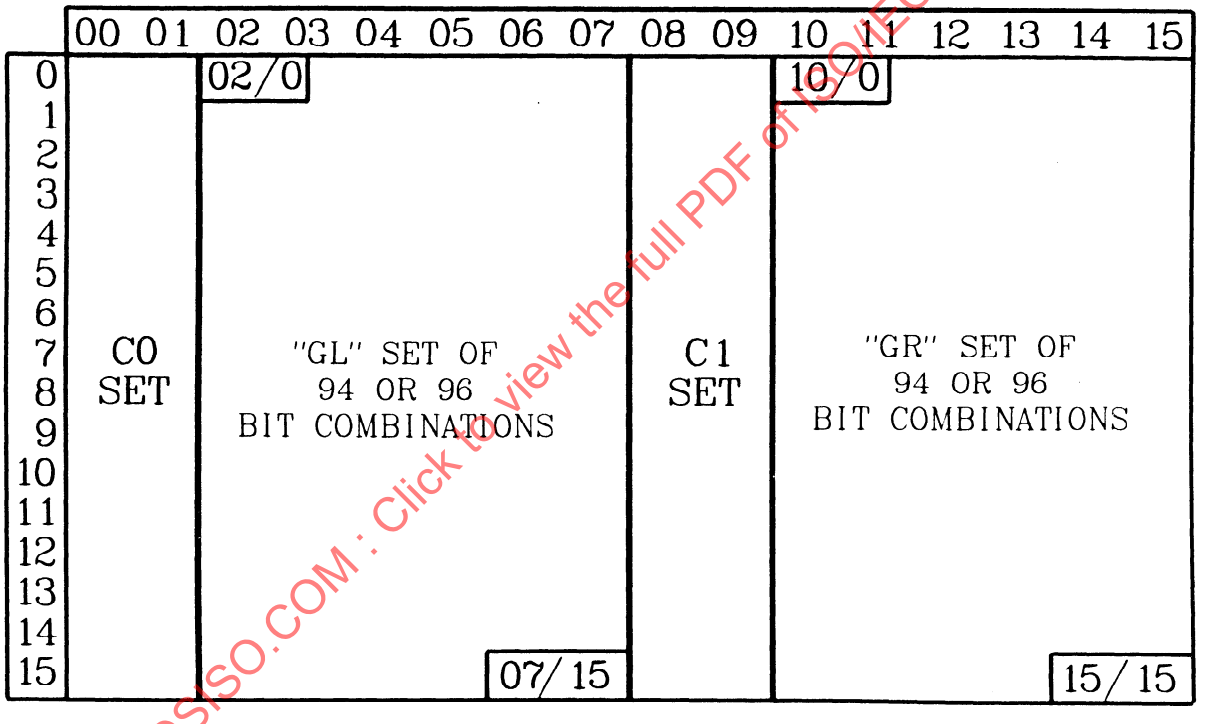


Figure 2 — The 8-bit code table

4 Entering and leaving the metafile environment

4.1 Implicitly entering the metafile environment

The CGM coding environment may be entered implicitly, by agreement between the interchanging parties. This is suitable only if there is not to be any interchange with services using other coding techniques.

4.2 Designating and invoking the CGM coding environment from ISO 2022

For interchange with services using the code extension techniques of ISO 2022, the CGM coding environment shall be designated and invoked from ISO 2022 environment by the following escape sequence:

ESC 2/5 F

where ESC is the bit combination 1/11, and F refers to a bit combination that will be assigned by the ISO Registration Authority for ISO 2375.

The first bit combination occuring after this escape sequence will then represent the opcode of a CGM metafile element.

After the end of one or more metafiles (i.e., after the END METAFILE element) or between pictures (i.e., after the END PICTURE element), the following escape sequence may be used to return to the ISO 2022 coding environment:

ESC 2/5 4/0

This not only returns to the ISO 2022 coding environment, but also restores the designation and invocation of coded character sets to the state that existed prior to entering the CGM coding environment with the ESC 2/5 F sequence. (The terms "designation" and "invocation" are defined in ISO 2022.)

5 Method of encoding opcodes

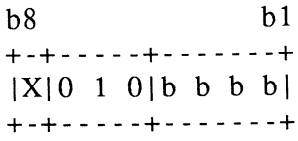
Each metafile element is composed of one opcode and parameters as required. The opcodes are coded as a sequence of bit combinations from columns 2 and 3 of the code chart. The encoding technique supplies:

— the basic opcode set;

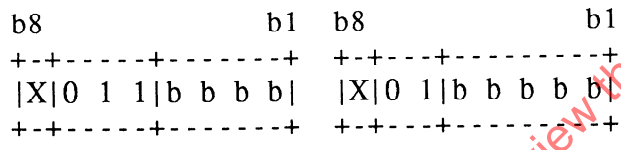
— extension opcode sets.

5.1 Encoding technique of the basic opcode set

The basic opcode set consists of single-byte and double-byte opcodes. Single-byte opcodes are from column 2 of the code chart. Bits b4 to b1 are used to encode the opcode. The format is as follows:



The "X" bit (bit b8) is the parity bit (or omitted bit) in a 7-bit environment. In an 8-bit environment it is 0. For double-byte opcodes the first byte is from column 3 and the second byte is from column 2 or 3 of the code chart. Bits b4 to b1 of the first byte and bits b5 to b1 of the second byte are used to encode the opcode:



The bit combination 3/15, the EXTEND OPCODE SPACE (EOS) allows extension of the basic opcode space (see 5.2).

The basic opcode set, supplied by this encoding technique consists of 496 opcodes, being:

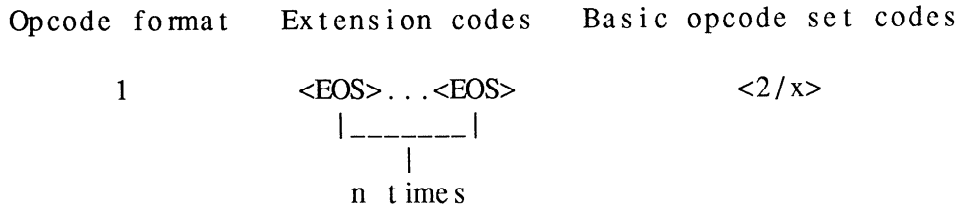
— 16 single-byte opcodes (from column 2);

— 15 x 32 = 480 double-byte opcodes (first byte from column 3 except bit combination 3/15, second byte from column 2 or 3).

5.2 Extension mechanism

The basic opcode set can be extended with an unlimited number of extension opcode sets by means of the EXTEND OPCODE SPACE code (EOS, 3/15).

The N-th extension opcode set consists of opcodes of the basic opcode set, prefixed with n times the code EOS. The three possible formats of an opcode from the N-th extension opcode set are



Method of encoding opcodes		Extension mechanism
2	<EOS>. . .<EOS> |_____| | n t ime s	<3/y> <2/z>
3	<EOS>. . .<EOS> |_____| | n t ime s	<3/y> <3/z>

<EOS> = 3/15
x = 0,1,..,15
y = 0,1,..,14
z = 0,1,..,15
n = 0,1,.....

n = 0 selects the basic opcode set.
n = 1 selects the first extension opcode set.
n = N selects the N-th extension opcode set.

The number of opcodes supplied by this encoding technique (basic opcode set plus extension opcode sets) is 496*(n+1), where n is the number of extension sets. (Each extension set has 496 opcodes — 16 single-byte opcodes plus 480 double-byte codes.)

5.3 Opcode assignments

Table 1 lists the opcode assignments for the CGM elements. All opcodes are from the basic opcode set. They are organized as follows: single-byte opcodes are assigned to Graphical Primitive elements except for some of the Circular and Elliptical output elements, where double-byte opcodes with combination 3/4 for the first byte are assigned. All other metafile elements have double-byte opcodes with the following bit combinations for the first byte:

3/0	for Delimiter Elements
3/1	for Metafile Descriptor Elements
3/2	for Picture Descriptor Elements
3/3	for Control Elements
3/5 and 3/6	for Attribute Elements
3/7	for Escape and External Elements
3/8	for Segment Control Elements and Segment Attribute Elements

Table 1 — Opcodes for metafile elements

Opcode	7-Bit coding		8-Bit coding	
BEGIN METAFILE opcode	3/0	2/0	03/0	02/0
END METAFILE opcode	3/0	2/1	03/0	02/1
BEGIN PICTURE opcode	3/0	2/2	03/0	02/2
BEGIN PICTURE BODY opcode	3/0	2/3	03/0	02/3
END PICTURE opcode	3/0	2/4	03/0	02/4
BEGIN SEGMENT opcode	3/0	2/5	03/0	02/5
END SEGMENT opcode	3/0	2/6	03/0	02/6
BEGIN FIGURE opcode	3/0	2/7	03/0	02/7
END FIGURE opcode	3/0	2/8	03/0	02/8
BEGIN PROTECTION REGION opcode	3/0	2/12	03/0	02/12
END PROTECTION REGION opcode	3/0	2/13	03/0	02/13
BEGIN COMPOUND LINE opcode	3/0	2/14	03/0	02/14
END COMPOUND LINE opcode	3/0	2/15	03/0	02/15
BEGIN COMPOUND TEXT PATH opcode	3/0	3/0	03/0	03/0
END COMPOUND TEXT PATH opcode	3/0	3/1	03/0	03/1
BEGIN TILE ARRAY opcode	3/0	3/2	03/0	03/2
END TILE ARRAY opcode	3/0	3/3	03/0	03/3
METAFILE VERSION opcode	3/1	2/0	03/1	02/0
METAFILE DESCRIPTION opcode	3/1	2/1	03/1	02/1
VDC TYPE opcode	3/1	2/2	03/1	02/2
INTEGER PRECISION opcode	3/1	2/3	03/1	02/3
REAL PRECISION opcode	3/1	2/4	03/1	02/4
INDEX PRECISION opcode	3/1	2/5	03/1	02/5
COLOUR PRECISION opcode	3/1	2/6	03/1	02/6
COLOUR INDEX PRECISION opcode	3/1	2/7	03/1	02/7
MAXIMUM COLOUR INDEX opcode	3/1	2/8	03/1	02/8
COLOUR VALUE EXTENT opcode	3/1	2/9	03/1	02/9
METAFILE ELEMENT LIST opcode	3/1	2/10	03/1	02/10
BEGIN METAFILE DEFAULTS REPLACEMENT opcode	3/1	2/11	03/1	02/11
END METAFILE DEFAULTS REPLACEMENT opcode	3/1	2/12	03/1	02/12
FONT LIST opcode	3/1	2/13	03/1	02/13
CHARACTER SET LIST opcode	3/1	2/14	03/1	02/14
CHARACTER CODING ANNOUNCER opcode	3/1	2/15	03/1	02/15
NAME PRECISION opcode	3/1	3/0	03/1	03/0
MAXIMUM VDC EXTENT opcode	3/1	3/1	03/1	03/1
SEGMENT PRIORITY EXTENT opcode	3/1	3/2	03/1	03/2
COLOUR MODEL opcode	3/1	3/3	03/1	03/3
COLOUR CALIBRATION opcode	3/1	3/4	03/1	03/4
FONT PROPERTIES opcode	3/1	3/5	03/1	03/5
GLYPH MAPPING opcode	3/1	3/6	03/1	03/6
SYMBOL LIBRARY LIST opcode	3/1	3/7	03/1	03/7

Table 1 — Opcodes for metafile elements (continued)

Opcode	7-Bit coding		8-Bit coding	
SCALING MODE opcode	3/2	2/0	03/2	02/0
COLOUR SELECTION MODE opcode	3/2	2/1	03/2	02/1
LINE WIDTH SPECIFICATION MODE opcode	3/2	2/2	03/2	02/2
MARKER SIZE SPECIFICATION MODE opcode	3/2	2/3	03/2	02/3
EDGE WIDTH SPECIFICATION MODE opcode	3/2	2/4	03/2	02/4
VDC EXTENT opcode	3/2	2/5	03/2	02/5
BACKGROUND COLOUR opcode	3/2	2/6	03/2	02/6
DEVICE VIEWPORT opcode	3/2	2/7	03/2	02/7
DEVICE VIEWPORT SPECIFICATION MODE opcode	3/2	2/8	03/2	02/8
DEVICE VIEWPORT MAPPING opcode	3/2	2/9	03/2	02/9
LINE REPRESENTATION opcode	3/2	2/10	03/2	02/10
MARKER REPRESENTATION opcode	3/2	2/11	03/2	02/11
TEXT REPRESENTATION opcode	3/2	2/12	03/2	02/12
FILL REPRESENTATION opcode	3/2	2/13	03/2	02/13
EDGE REPRESENTATION opcode	3/2	2/14	03/2	02/14
INTERIOR STYLE SPECIFICATION MODE opcode	3/2	2/15	03/2	02/15
LINE AND EDGE TYPE DEFINITION opcode	3/2	3/0	03/2	03/0
HATCH STYLE DEFINITION opcode	3/2	3/1	03/2	03/1
GEOMETRIC PATTERN DEFINITION opcode	3/2	3/2	03/2	03/2
VDC INTEGER PRECISION opcode	3/3	2/0	03/3	02/0
VDC REAL PRECISION opcode	3/3	2/1	03/3	02/1
AUXILIARY COLOUR opcode	3/3	2/2	03/3	02/2
TRANSPARENCY opcode	3/3	2/3	03/3	02/3
CLIP RECTANGLE opcode	3/3	2/4	03/3	02/4
CLIP INDICATOR opcode	3/3	2/5	03/3	02/5
LINE CLIPPING MODE opcode	3/3	2/6	03/3	02/6
MARKER CLIPPING MODE opcode	3/3	2/7	03/3	02/7
EDGE CLIPPING MODE opcode	3/3	2/8	03/3	02/8
NEW REGION opcode	3/3	2/9	03/3	02/9
SAVE PRIMITIVE CONTEXT opcode	3/3	2/10	03/3	02/10
RESTORE PRIMITIVE CONTEXT opcode	3/3	2/11	03/3	02/11
PROTECTION REGION INDICATOR opcode	3/3	3/0	03/3	03/0
GENERALIZED TEXT PATH MODE opcode	3/3	3/1	03/3	03/1
MITRE LIMIT opcode	3/3	3/2	03/3	03/2
TRANSPARENT CELL COLOUR opcode	3/3	3/3	03/3	03/3
POLYLINE opcode	2/0		02/0	
DISJOINT POLYLINE opcode	2/1		02/1	
POLYMARKER opcode	2/2		02/2	
TEXT opcode	2/3		02/3	
RESTRICTED TEXT opcode	2/4		02/4	
APPEND TEXT opcode	2/5		02/5	
POLYGON opcode	2/6		02/6	
POLYGON SET opcode	2/7		02/7	
CELL ARRAY opcode	2/8		02/8	
GENERALIZED DRAWING PRIMITIVE opcode	2/9		02/9	
RECTANGLE opcode	2/10		02/10	

Table 1 — Opcodes for metafile elements (continued)

Opcode	7-Bit coding		8-Bit coding	
CIRCLE opcode	3/4	2/0	03/4	02/0
CIRCULAR ARC 3 POINT opcode	3/4	2/1	03/4	02/1
CIRCULAR ARC 3 POINT CLOSE opcode	3/4	2/2	03/4	02/2
CIRCULAR ARC CENTRE opcode	3/4	2/3	03/4	02/3
CIRCULAR ARC CENTRE CLOSE opcode	3/4	2/4	03/4	02/4
ELLIPSE opcode	3/4	2/5	03/4	02/5
ELLIPTICAL ARC opcode	3/4	2/6	03/4	02/6
ELLIPTICAL ARC CLOSE opcode	3/4	2/7	03/4	02/7
CIRCULAR ARC CENTRE REVERSED opcode	3/4	2/8	03/4	02/8
CONNECTING EDGE opcode	3/4	2/9	03/4	02/9
HYPERBOLIC ARC opcode	3/4	2/10	03/4	02/10
PARABOLIC ARC opcode	3/4	2/11	03/4	02/11
NON-UNIFORM B-SPLINE opcode	3/4	2/12	03/4	02/12
NON-UNIFORM RATIONAL B-SPLINE opcode	3/4	2/13	03/4	02/13
POLYBEZIER opcode	3/4	2/14	03/4	02/14
POLYSYMBOL opcode	3/4	2/15	03/4	02/15
BITONAL TILE opcode	3/4	3/0	03/4	03/0
TILE opcode	3/4	3/1	03/4	03/1
LINE BUNDLE INDEX opcode	3/5	2/0	03/5	02/0
LINE TYPE opcode	3/5	2/1	03/5	02/1
LINE WIDTH	3/5	2/2	03/5	02/2
LINE COLOUR opcode	3/5	2/3	03/5	02/3
MARKER BUNDLE INDEX opcode	3/5	2/4	03/5	02/4
MARKER TYPE opcode	3/5	2/5	03/5	02/5
MARKER SIZE opcode	3/5	2/6	03/5	02/6
MARKER COLOUR opcode	3/5	2/7	03/5	02/7
TEXT BUNDLE INDEX opcode	3/5	3/0	03/5	03/0
TEXT FONT INDEX opcode	3/5	3/1	03/5	03/1
TEXT PRECISION opcode	3/5	3/2	03/5	03/2
CHARACTER EXPANSION FACTOR opcode	3/5	3/3	03/5	03/3
CHARACTER SPACING opcode	3/5	3/4	03/5	03/4
TEXT COLOUR opcode	3/5	3/5	03/5	03/5
CHARACTER HEIGHT opcode	3/5	3/6	03/5	03/6
CHARACTER ORIENTATION opcode	3/5	3/7	03/5	03/7
TEXT PATH opcode	3/5	3/8	03/5	03/8
TEXT ALIGNMENT opcode	3/5	3/9	03/5	03/9
CHARACTER SET INDEX opcode	3/5	3/10	03/5	03/10
ALTERNATE CHARACTER SET INDEX opcode	3/5	3/11	03/5	03/11
FILL BUNDLE INDEX opcode	3/6	2/0	03/6	02/0
INTERIOR STYLE opcode	3/6	2/1	03/6	02/1
FILL COLOUR opcode	3/6	2/2	03/6	02/2
HATCH INDEX opcode	3/6	2/3	03/6	02/3
PATTERN INDEX opcode	3/6	2/4	03/6	02/4
EDGE BUNDLE INDEX opcode	3/6	2/5	03/6	02/5
EDGE TYPE opcode	3/6	2/6	03/6	02/6
EDGE WIDTH opcode	3/6	2/7	03/6	02/7
EDGE COLOUR opcode	3/6	2/8	03/6	02/8
EDGE VISIBILITY opcode	3/6	2/9	03/6	02/9
FILL REFERENCE POINT opcode	3/6	2/10	03/6	02/10

Table 1 — Opcodes for metafile elements (concluded)

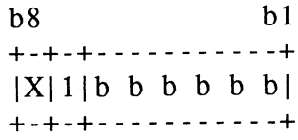
Opcode	7-Bit coding		8-Bit coding	
PATTERN TABLE opcode	3/6	2/11	03/6	02/11
PATTERN SIZE opcode	3/6	2/12	03/6	02/12
COLOUR TABLE opcode	3/6	3/0	03/6	03/0
ASPECT SOURCE FLAGS opcode	3/6	3/1	03/6	03/1
PICK IDENTIFIER opcode	3/6	3/2	03/6	03/2
LINE CAP opcode	3/5	2/8	03/5	02/8
LINE JOIN opcode	3/5	2/9	03/5	02/9
LINE TYPE CONTINUATION opcode	3/5	2/10	03/5	02/10
LINE TYPE INITIAL OFFSET opcode	3/5	2/11	03/5	02/11
TEXT SCORE TYPE opcode	3/5	2/12	03/5	02/12
RESTRICTED TEXT TYPE opcode	3/5	2/13	03/5	02/13
INTERPOLATED INTERIOR opcode	3/5	2/14	03/5	02/14
EDGE CAP opcode	3/5	2/15	03/5	02/15
EDGE JOIN opcode	3/6	2/13	03/6	02/13
EDGE TYPE CONTINUATION opcode	3/6	2/14	03/6	02/14
EDGE TYPE INITIAL OFFSET opcode	3/6	2/15	03/6	02/15
SYMBOL LIBRARY INDEX opcode	3/6	3/3	03/6	03/3
SYMBOL COLOUR opcode	3/6	3/4	03/6	03/4
SYMBOL SIZE opcode	3/6	3/5	03/6	03/5
SYMBOL ORIENTATION opcode	3/6	3/6	03/6	03/6
ESCAPE opcode	3/7	2/0	03/7	02/0
DOMAIN RING opcode	3/7	3/0	03/7	03/0
MESSAGE opcode	3/7	2/1	03/7	02/1
APPLICATION DATA opcode	3/7	2/2	03/7	02/2
COPY SEGMENT opcode	3/8	2/0	03/8	02/0
INHERITANCE FILTER opcode	3/8	2/1	03/8	02/1
CLIP INHERITANCE opcode	3/8	2/2	03/8	02/2
SEGMENT TRANSFORMATION opcode	3/8	2/3	03/8	02/3
SEGMENT HIGHLIGHTING opcode	3/8	2/4	03/8	02/4
SEGMENT DISPLAY PRIORITY opcode	3/8	2/5	03/8	02/5
SEGMENT PICK PRIORITY opcode	3/8	2/6	03/8	02/6

NOTE — There is no no-op element in the character encoding. However, the character substitution mechanism allows generators to achieve this effect.

6 Method of encoding parameters

The parameter part of a CGM element may contain one or more parameters, each parameter consisting of one or more bytes.

All parameters are coded in columns 4 through 7. (However, the coded representation of a 'string' parameter may include bit combinations from other columns of the code table — see the description of string parameters in 6.9). The general format of a parameter byte is

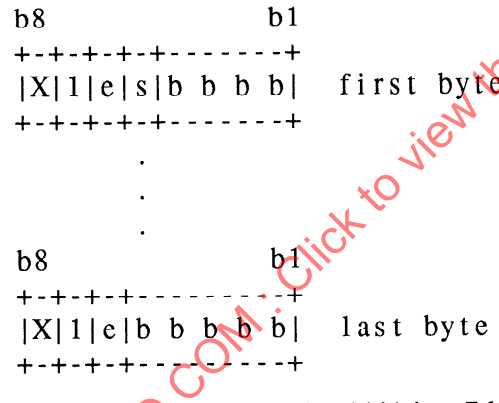


The "X" (bit b8) is the parity bit (or omitted bit) in a 7-bit environment. In an 8-bit environment it is 0. Bit b7 is the parameter flag.

Except for 'string', 'string fixed', and 'data record' parameters all parameters are encoded using one or both of two formats, Basic format or Bitstream format.

6.1 Basic format

Each Basic format parameter is coded as a sequence of one or more bytes, structured as follows:



The "X" (bit b8) is the parity bit (or omitted bit) in a 7-bit environment. In an 8-bit environment it is 0. Bit b7 is the parameter flag.

"e" (b6 of each byte) is the extension flag. For single byte parameters, the extension flag is 0. In multi-byte parameters, the extension flag is 1 in all bytes except the last byte, where it is 0.

Bits b5 through b1 are the data bits of the parameter.

"s" is the sign bit; if equal to 0 then the integer is non-negative and if equal to 1 then the integer is negative. The number zero shall always be coded as "plus zero" 4/0. The "minus zero" coding is reserved for special usage (see 6.6.3).

The Basic format is used to encode

a) enumerated types (E);

b) colour indices (CI);

c) colour components (CCO);

d) indices other than colour indices (IX);

e) integers (I);

f) real numbers (R);

g) non-incremental coordinates.

h) fixed-precision 8-bit unsigned integers — octets (UI8);

i) fixed-precision 32-bit unsigned integers (UI32).

The most significant part of the parameter is coded in the first byte. The least significant part of the parameter is coded in the last byte.

6.2 Bitstream format

Each Bitstream format parameter is encoded as a sequence of one or more bytes, structured as follows:

```
b8              b1
+-+-+-----------+
|X|1|b b b b b b|   first byte
+-+-+-----------+
        .
        .
        .
b8              b1
+-+-+-----------+
|X|1|b b b b b b|   last byte
+-+-+-----------+
```

The "X" is the parity bit (or omitted bit) in a 7-bit environment. In an 8-bit environment it is 0. Bit b7 is the parameter flag.

Bits b6 through b1 are the data bits of the parameter.

The Bitstream format is used to encode:

a) incremental mode coordinates (see 6.6.2);

b) colour direct (see 6.8);

c) colour index lists (see 6.8).

d) the compressed bitstream (BS) data type (see 6.15).

Bitstream data are packed in consecutive databits starting from high-numbered bits to lower-numbered bits of the first byte for the most significant part of the bitstream data.

The end of a Bitstream format parameter cannot be derived from the Bitstream format itself (the format is not self-delimiting). Instead,

— for incremental mode coordinates, the end of the data (which identifies the end of the Bitstream format parameter) is identified by the <End of Block> code;

— for colour index lists, the number of bits needed to encode the colour index list (which identifies the end of the Bitstream format parameter) is set by the COLOUR INDEX PRECISION element, or by the *local colour precision* parameter (for those elements which contain such a parameter);

— for colour direct data, the number of bits needed to encode the data (which identifies the end of the Bitstream format operand) is set by the COLOUR PRECISION element, or by the *local colour precision* parameter (for those elements which contain such a parameter).

— for compressed binary colour specifiers of Tile Array elements, the SOS/ST delimiters that are also used for String operands are used to delimit the Bitstream operand.

6.3 Coding integers

Integers are coded as sequences of bytes in the range from 4/0 to 7/15 in the Basic format. If a byte is from columns 4 or 5 of the code table, it is either the last byte in the integer's coded representation or it is a single-byte integer. A multi-byte integer begins with a byte from columns 6 or 7 of the code table.

The structure of integer parameters is as illustrated for Basic format (see 6.1). "bbb..." are bits representing the magnitude of the integer. The most significant part of the parameter is coded in the first byte. The least significant part of the parameter is coded in the last byte.

Any integer can be coded with leading most significant bits which are all zero. For example, 4/3 and 6/0 6/0 4/3 are both valid codings for the integer "+3"; however, efficient metafile generators should avoid such redundant codings.

The size of integer parameters is limited by the current INTEGER PRECISION value.

Integers in the range of -15 to +15 can be coded as single bytes.

(integer: +1) = 4/1 (integer: -1) = 5/1
(integer: +15) = 4/15 (integer: -15) = 5/15

Larger integers require more bytes.

(integer: +16) = 6/0 5/0 (integer: -16) = 7/0 5/0
(integer: +1034) = 6/1 6/0 4/10 (integer: -1034) = 7/1 6/0 4/10

6.4 Coding real numbers

Each real number is coded as an integer mantissa followed by an optional exponent, both coded in the Basic format. The exponent is the power of two by which the integer mantissa is to be multiplied.

The exponent may be implicitly defined as a default exponent, which is then omitted in the Real format, or the exponent may be coded explicitly as the second part of the Real format:

<real format> = <mantissa part> [<exponent part>]

Depending on the "exponent allowed" parameter of the REAL PRECISION element, one of the bits in the first byte of the mantissa tells whether the exponent follows. If the "exponent follows" bit in the mantissa is zero, or if REAL PRECISION has specified that there is to be no "exponent follows" bit, then the exponent is omitted and a default value is assumed which is set by another parameter of the REAL PRECISION element.

Note that the coding of real VDC coordinates is controlled by VDC REAL PRECISION, not by REAL PRECISION, and that the rules for default exponents in real VDC coordinates are slightly different (see 6.5 and 6.6).

The mantissa is an integer which is coded in the Basic format. The first byte takes one of two forms, depending on whether or not REAL PRECISION has specified that an "exponent follows" bit is to be included. The format is as follows (first byte):

```
b8              b1
+-+-+-+-+-+-+-+-+  {if explicit exponent allowed = 'allowed',
|X|1|e|s|p|b b b|   i.e. the exponent-follows bit is present}
+-+-+-+-+-+-+-+-+

or

b8              b1
+-+-+-+-+-+-+-+-+   {if explicit exponent allowed = 'forbidden',
|X|1|e|s|b b b b|    i.e. there is no exponent-follows bit}
+-+-+-+-+-+-+-+-+
     .
     .
b8              b1
+-+-+-+-+-+-+-+-+
|X|1|e|b b b b b|   {last byte}
+-+-+-+-+-+-+-+-+
```

"e" is the extension flag, see 6.1 for a description.

"s" is the sign bit (bit b5 of the first byte): 0 for a positive mantissa, 1 for a negative mantissa.

Here "p" is the exponent-follows bit. If the current "explicit exponent allowed" value of the REAL PRECISION element is 'allowed', bit b4 of the first byte of a mantissa is used as the "exponent follows" bit: 1 if an explicit exponent follows, 0 if no exponent follows the mantissa (then the default exponent set by REAL PRECISION is assumed). If the current "explicit exponent allowed" value of the REAL PRECISION element is 'forbidden', bit b4 of the first byte is used as a databit and the default exponent set by REAL PRECISION is assumed.

The exponent is coded as an integer in Basic format, see 6.3.

Mantissas or exponents of "minus zero" are not allowed and reserved for future use.

For example, suppose that REAL PRECISION has specified that each real parameter is to be coded with an "exponent follows" bit in its mantissa. In that case, the binary numeral +1.110010110011 is coded as follows:

```
(real: binary +1.11 00101 10011)

=  (mantissa: +111 00101 10011, "exponent-follows")
   (exponent: -12)

   +-+---+-+-+-----+ +-+-+-+---------+ +-+-+-+---------+
=  |X|1|1|0|1|1 1 1| |X|1|1|0 0 1 0 1| |X|1|0|1 0 0 1 1| {mantissa}
   +-+---+-+-+-----+ +-+-+-+---------+ +-+-+-+---------+
   +-+-+-+-+-+-+-+-+
   |X|1|0|1|1 1 0 0| {exponent}
   +-+-+-+-+-+-+-+-+

=  6/15  6/5  5/3  5/12
```

Again, suppose that REAL PRECISION has specified that real parameters are to be coded without exponents and without exponent-follows bits in their mantissas, and that the default exponent is to be -13. In that case, binary +1.110010110011 is coded as follows:

```
(real: binary +1.110010110011)

=  (mantissa: +1110 01011 00110)

   +-+-+-+-+-------+ +-+-+-+---------+ +-+-+-+---------+
=  |X|1|1|0|1 1 1 0| |X|1|1|0 1 0 1 1| |X|1|0|0 0 1 1 0| {mantissa}
   +-+-+-+-+-------+ +-+-+-+---------+ +-+-+-+---------+

=  6/14  6/11  4/6
```

6.5 Coding VDCs and points

A point is a pair of VDC scalars. A VDC scalar is either an integer or real number according to whether VDC TYPE is integer or real.

When VDC TYPE is integer, the encodings of the VDC and point data types are as described in 6.3, Coding Integers. The size of the VDC and point parameters is limited by the current VDC INTEGER PRECISION value.

When VDC TYPE is real, the encodings of the VDC and point data types are as described in 6.4, Coding Real Numbers. The size of the VDC and point parameters is limited by the current VDC REAL PRECISION value. Whether or not "exponent follows" bits are included in the mantissas of VDCs and points is determined by a parameter of VDC REAL PRECISION. The default value for an omitted exponent in a VDC is determined by the "default exponent" parameter in VDC REAL PRECISION. If the exponent is omitted from a point data type, a default exponent is assumed as follows:

— If the point is not in a point list, or is the first point of a point list, the omitted exponent assumes the default value exponents of VDC parameters, as specified by VDC REAL PRECISION.

— If the point is in a point list, but is not the first point of that point list, an omitted exponent may assume a different value as follows: if the exponent is omitted from the x-component of a real point, it defaults to the value of the exponent in the preceding x-component; similarly, an exponent omitted from a y-component assumes the value of the exponent in the preceding y-coordinate.

6.6 Coding point list parameters

Point lists may be coded with one or both of the following coding structures. These structures are called 'Displacement Mode' and 'Incremental Mode'. Both formats may be used within a single point list.

Individual points and the first point of each point list are always be coded in Displacement Mode. The displacement values delta-x and delta-y are displacements measured from the origin, i.e. absolute positions. For points after the first point in a point list, each displacement is measured from the preceding point of the point list (this is true regardless of whether the preceding point was coded in Displacement Mode or in Incremental Mode).

6.6.1 Displacement mode

In Displacement Mode, each point is coded as a sequence of two VDCs. The first VDC value gives the x-component of the point's displacement from the preceding point, while the second VDC value specifies the y-component of that displacement.

<P> = <VDC: delta x> <VDC: delta y>

6.6.2 Incremental mode

The Incremental Mode is defined as a Differential Chain Code (DCC).

NOTE — Because of the difficulty of applying the DCC method effectively, the use of DCC coding is discouraged. The DCC method may be removed in a future revision of this part of ISO/IEC 8632.

The data in this mode does not reflect actual coordinates, but defines steps (increments) from one coordinate position to another. These increments are identified by points on a Ring. A Ring is a set of points on a square whose centre is the previously identified point. The first centre point is encoded in Displacement Mode.

A Ring is characterized by its Radius (R) in Basic Grid Units (BGU), its Angular resolution (by a factor p) and its Direction (D). The maximum number of points on a Ring is 8R. The actual number of points on a Ring with a given Angular resolution factor p follows from

$$N=\frac{8R}{2^p}, \quad p=0,1,2,3$$

N is required to be even.

The points on the Ring are numbered, starting at the Direction point D, counter clockwise from 0 to M-1 and clockwise from -1 to -M, with M=N/2.

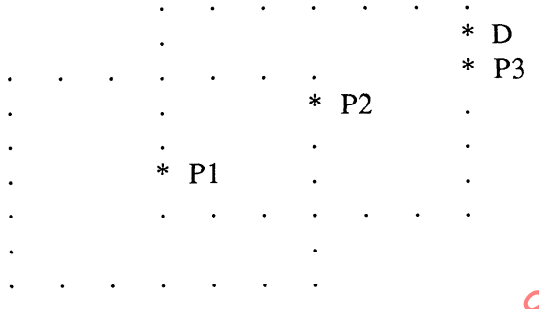
Following are examples of two Rings, both having Radius R=3. The Ring on the left has Angular resolution factor p=0 and the one on the right has Angular resolution factor p=1.

The Direction of the Ring is given by the position of the point with number ZERO. The initial position of this point is on the positive x-axis of VDC space, while the Cartesian axes are drawn through the centre point of the Ring. The Direction of the Rings following the initial one is dependent on the direction of the increments. This Direction is determined in the following way:

Let P2 be the current centre point and P1 the previous one, i.e., P2 is a point on the Ring with centre in P1. The Direction of the Ring is obtained by drawing a line from P1 through P2; where this direction ray intersects P2's Ring is the ZERO point of that Ring. So the Direction of the Ring is dependent on the direction of the line to be displayed.

Coding point list parameters **Method of encoding parameters**

In the DCC only the differences between points on the consecutive Rings are coded. The position of point P3, i.e., the increment on the new Ring (centre P2) is described by the difference between the position of point P2 on the previous Ring and the position of the new point P3 on the current Ring, the positions numbered with respect to the previous Ring. As shown in example below, the position of point P3 is defined by the difference: P3 - P2 = -1. P3 and P2 being point numbers on the two Rings, numbered as given in the previous figure. The Direction (position of the point with number ZERO) is identified by D.



Change of direction with R=3

The basic Radius of the Ring, as used in Incremental mode, is dependent on the BGU. The BGU is the smallest nonzero value that can be expressed within the precision set by the VDC INTEGER or REAL PRECISION element. For VDC TYPE integer, basic Radius (=BGU) = 1. For VDC TYPE real the size of the BGU is set by a parameter of VDC REAL PRECISION, called smallest-real code: letting "src" stand for smallest-real code, $BGU=2^{src}$. The basic Radius is a multiple of the BGU, i.e. it is a positive integer. For VDC TYPE real the default value for the basic Radius follows from

smallest-real code	basic Radius
> g	1
= g	1
< g	$\frac{2^g}{BGU}$

where g is a nominal smallest-real code. A value of g = -8 is used in this part of ISO/IEC 8632.

The basic Radius and the Angular resolution factor may be changed with the DOMAIN RING element. If the basic Radius is set to a value less than ONE, the value ONE is assumed for the basic Radius.

The encoding used in Incremental Mode makes use of the DCC property by using variable length codewords (Huffman Code). The encoding also allows changing of the Radius and the Angular resolution factor. The Radius can have a value of R, 2R, 4R or 8R, where R is the defined Radius. The Angular resolution factor p can be 0, 1, 2, or 3, the default value is 0.

The Huffman Code table (see table 2) used in the Incremental mode is a fixed length table. To allow the encoding of more points on a Ring two Escape codes are defined. With these Escape codes the points outside the Huffman Code table can be addressed. The end of the Incremental mode data is indicated by an End of Block value in the Huffman Code table.

Table 2 — Huffman code table for incremental mode

Length	Code-word	Point number
2	00	0
2	10	1
2	01	-1
4	1100	2
4	1101	-2
6	111000	3
6	111001	-3
6	111010	4
6	111011	-4
8	11110000	5
8	11110001	-5
8	11110010	6
8	11110011	-6
8	11110100	7
8	11110101	-7
8	11110110	8
8	11110111	-8
10	1111100000	9
10	1111100001	-9
10	1111100010	10
10	1111100011	-10
10	1111100100	11
10	1111100101	-11
10	1111100110	12
10	1111100111	-12
10	1111101000	13
10	1111101001	-13
10	1111101010	14
10	1111101011	-14
10	1111101100	15
10	1111101101	-15
10	1111101110	16
10	1111101111	-16
10	1111110000	17
10	1111110001	-17
10	1111110010	18
10	1111110011	-18
10	1111110100	19
10	1111110101	-19
10	1111110110	C1
10	1111110111	-20
10	1111111000	C2
10	1111111001	C3
10	1111111010	C4
10	1111111011	C5
10	1111111100	C6
10	1111111101	IM-ESC 1
10	1111111110	IM-ESC 2
10	1111111111	End of Block

The <End of Block> code from the Huffman Code table identifies the end of the Incremental mode data. Remaining bits in the last Incremental mode data byte have no meaning; they are required to be zero.

The Incremental Mode escape codes <IM-ESC 1> and <IM-ESC 2> are used to extend the addressable number of points, e.g. points outside the range -20 to 19. The code <IM-ESC 1> adds +20 or -20 to the following code, depending on the sign of that following point. The code <IM-ESC 2> adds +40 or -40 to the following code, depending on the sign. The escape codes can follow each other in any desired order. The following examples demonstrate some possible combinations, *n* is a point number.

	<IM-ESC 1>	[1]	= point number 21
	<IM-ESC 1>	[-1]	= point number -21
	<IM-ESC 2>	[14]	= point number 54
	<IM-ESC 2>	[-12]	= point number -52
<IM-ESC 1>	<IM-ESC 2>	[6]	= point number (20+40+6) = 66
<IM-ESC 2>	<IM-ESC 1>	[-18]	= point number (-40-20-18) = -78

The codes C1 up to C6 are used to change the parameters that define the Ring to be used. The values of R are taken from the range R0, 2R0, 4R0 and 8R0, where R0 is the value of the Ring Radius before entering the Incremental Mode. The values of p are taken from the range 0, 1, 2 and 3. The function of these codes is as follows:

C1 Change the Ring parameters, R and p, to the next higher value, e.g. if the Radius is R0 it is set to 2R0, if the Angular resolution is p=0 it is set to p=1. R cannot become greater than 8R0 and p cannot become greater than 3. For example if the current Ring Radius is 8R0 and the current Angular resolution factor 3, the code <C1> has no effect.

C2 Change the Ring parameters, R and p, to the next lower value. The effect of the code <C2> is the inverse of code <C1>. R cannot become smaller than R0 and p cannot become smaller than 0. For example if the current Radius is R0 and the current Angular resolution factor 0, the code <C2> has no effect.

C3 Change the Ring Radius R to the next higher value. The code <C3> has no effect if the current Radius is 8R0.

C4 Change the Angular resolution factor p to the next higher value. The code <C4> has no effect if the current factor is 3.

C5 Change the Ring Radius R to the next lower value. The code <C5> has no effect if the current Radius is R0.

C6 Change the Angular resolution factor p to the next lower value. The code <C6> has no effect if the current factor is 0.

In addition, those codes (C1 to C6) set the position of the point with number ZERO on the positive x-axis, while the cartesian axes are drawn through the centre point of the Ring.

6.6.3 Incremental mode encoding

The structure of the incremental mode format is given below:

```
b8              b1
+-+-+-+-+-+-+-+-+
|X|1|0|1|0|0|0|0| first byte
+-+-+-+-+-+-+-+-+

+-+-+-+-+-+-+-+-+
|X|1|0|0|0|0|0|1| second byte
+-+-+-+-+-+-+-+-+

+-+-+-----------+
|X|1|b|b|b|b|b|b| other bytes
+-+-+-----------+
```

The first byte is coded according to the Basic format structure indicating an integer value "minus zero".

The second byte is structured according to the basic format structure. Bit b1 of the second byte is set to 1 to identify the use of Direct Chain Coding (DCC). The bits b5 to b2 are reserved for future use and shall be set to zero. The following bytes are coded according to the Bitstream format (see 6.2).

Because the Incremental mode uses variable length code words, these may not fit in the Incremental mode data bits (bits b6 to b1 of the other bytes). The code words are packed in consecutive bits of the Incremental mode bytes, starting from high numbered bits to lower numbered bits.

The end of Incremental mode data is identified by the <End of Block> code. Remaining bits in the last Incremental mode data byte have no meaning; they are required to be zero.

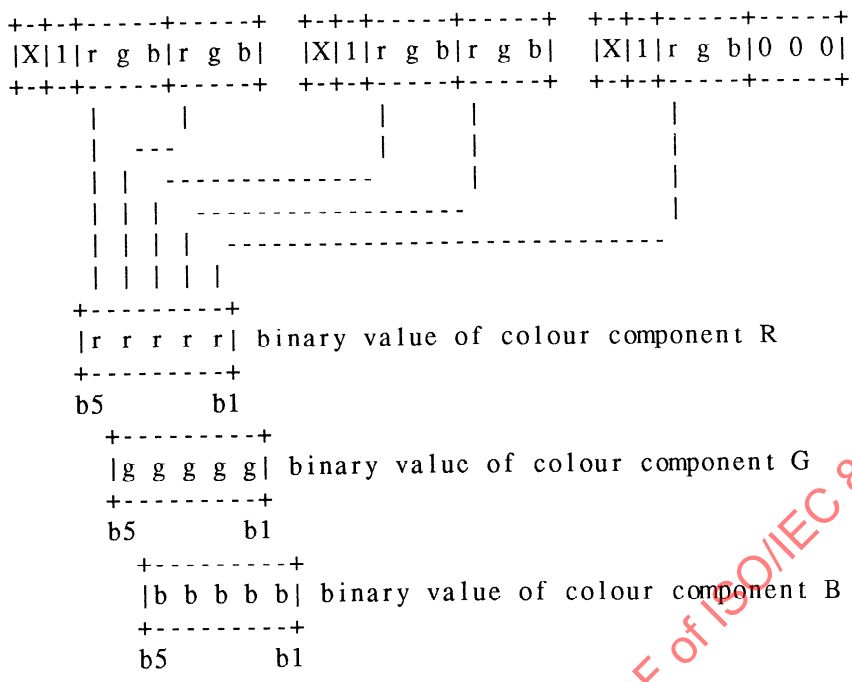
6.7 Colour specifiers

Colour specifiers are coded either as colour indexes (if COLOUR SELECTION MODE is 'indexed') or as direct colour parameters (if COLOUR SELECTION MODE is 'direct').

A colour index parameter is coded as an integer in the Basic format.

The direct colour parameters used if COLOUR SELECTION MODE is 'direct' are coded as a series of bytes in the range of 4/0 to 7/15 (Bitstream format). The six least significant bits in each byte hold binary bits representing the direct colour values, starting from high numbered bits to lower numbered bits from the first byte to the last byte. The number of bits needed to encode this data is set by COLOUR PRECISION. If this value is set to N bits, there are $3N$ or $4N$ colour value bits (as determined by the COLOUR MODEL element); i.e. there are only as many bytes in a direct colour parameter as are necessary to hold those $3N$ or $4N$ bits.

EXAMPLE — Consider RGB colour space with COLOUR PRECISION set to 5 bits. The RGB parameters then have the following form:



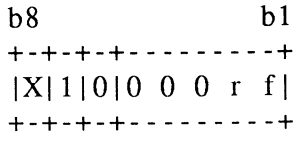
Each byte contains two bits for each component (R,G,B). The first byte contains the most significant bits. If bits b3 to b1 in the last byte are unused they are required to be zero. Direct colour parameters in other 3-tuple and 4-tuple spaces are encoded correspondingly.

6.8 Colour lists

A colour list is a structured data type consisting of a coding type indicator followed by a sequence of colour list elements, each element specifying a colour value (indexed or direct).

Seven different formats are possible for colour lists, based on the current value of the COLOUR SELECTION MODE and the coding type indicator which precedes the colour values.

This coding type indicator is coded in Basic format and may have values of 0 through 3; these can be viewed as setting two one-bit flags. Bits b5-b3 are reserved for future use, and shall be set to 0. The coding type indicator:



coding type	runlength(r)	format(f)	"name"
0	0	0	normal
1	0	1	bitstream
2	1	0	runlength
3	1	1	runlength bitstream

Runlength encoding is efficient if many adjacent colour list elements have the same colour value. For each run, the colour of the cells is specified, followed by a count telling how many cells are in the run. This

count is always in Basic format; the format of the colour values is described below.

If adjacent colour cells are not the same colour, runlength encoding is less efficient than the normal or bitstream formats.

In the normal formats, colour values are coded as for individual colour parameters (see 6.7).

In the bitstream formats, colour values are packed together as tightly as possible, six bits at a time, in consecutive data bits starting from high-numbered bits to lower-numbered bits, into characters from columns 4 to 7 of the code chart. The parameters are permitted to straddle character boundaries.

Bitstream format parameters are not self-delimiting (see 6.2). Any unused bits in the last character of a Bitstream format parameter have no meaning; they are required to be zero.

6.8.1 Normal format (coding type=0)

When COLOUR SELECTION MODE is 'indexed', the colour list is a sequence of numbers in Basic format, each an individual CI.

When COLOUR SELECTION MODE is 'direct', the colour list is a sequence of bitstreams, each bitstream representing one direct colour value.

The normal format is the easiest to produce, and matches the formats used for individual colour values (e.g., LINE COLOUR).

6.8.2 Bitstream format (coding type=1)

When COLOUR SELECTION MODE is 'indexed', the colour list is a single bitstream which is the concatenation of numbers representing CI in the Local Colour Precision. This form is similar to that used for "raster screen dumps" in many applications.

When COLOUR SELECTION MODE is 'direct', the colour list is a single bitstream which is the concatenation of the direct colour bitstream in the Local Colour Precision. This is the most compact form of direct colour list where colours vary greatly within a row.

6.8.3 Runlength format (coding type=2)

When COLOUR SELECTION MODE is 'indexed', the colour list is a sequence of pairs, each pair consisting of [CI in Basic format at Local Colour Precision; number of repetitions in Basic format]. This is the simplest form of runlength indexed list.

When COLOUR SELECTION MODE is 'direct', the colour list is a sequence of pairs, each pair consisting of [direct colour bitstream at Local Colour Precision; number of repetitions in Basic format].

6.8.4 Runlength bitstream format (coding type=3)

When COLOUR SELECTION MODE is 'indexed', the colour list is a sequence of pairs, each pair consisting of [CI in Bitstream format at Local Colour Precision; number of repetitions in Basic format]. The advantage over Runlength format is that the "extend bit" and "sign bit" of the Basic format are available as data bits for the index itself, which means that CI in the range 16..63 may be coded in one character instead of two.

When COLOUR SELECTION MODE is 'direct', this format is identical to the Runlength format.

6.8.5 Examples

The following example shows a colour index list in Runlength coding:

Coding:	Runlength
Datatype:	Colour Index List
Parameter Values:	2,3,3,3,3,4

4/2	first byte: r=1,f=0
4/2,4/1	Run Colour 1 (value 2), Run Count 1 (value 1)
4/3,4/4	Run Colour 2 (value 3), Run Count 2 (value 4)
4/4,4/1	Run Colour 3 (value 4), Run count 3 (value 1)

As an example for a colour indexed list, suppose that COLOUR INDEX PRECISION is 5 so that each colour index has 5 bits. Then, the colour indexes are packed into the Bitstream as follows:

```
+-+-----------+
|1|A A A A A B|
+-+-----------+
+-+-----------+
|1|B B B B C C|
+-+-----------+
+-+-----------+
|1|C C C D D D|
+-+-----------+
+-+-----------+
|1|D D 0 0 0 0|
+-+-----------+
        .
        .
        .
```

Note that AAAAA is the binary numeral for the first colour index, BBBBB is the binary numeral for the second colour index, and so on.

The leftover bits in the last byte have no meaning; they are required to be zero.

The following example shows the Bitstream coding with the same colour index list as used in the Runlength coding:

Coding:	Bitstream
Datatype:	Colour Index List
Parameter Values:	2,3,3,3,3,4 (COLOUR INDEX PRECISION = 4)

4/1	first byte : r=0,f=1
4/8	Colour Index 1 and (half of) 2
7/3	Colour Index (half of) 2 and 3
4/12	Colour Index 4 and (half of) 5
7/4	Colour Index (half of) 5 and 6

In the Basic format the same colour index list would occupy more bytes, as shown in the following example:

Coding:	Basic Fomat
Datatype:	Colour Index List
Parameter Values:	2,3,3,3,3,4

4/0 first byte : r=0,f=0
4/2 Colour Index 1 (value 2)
4/3 Colour Index 2 (value 3)
4/3 Colour Index 3 (value 3)
4/3 Colour Index 4 (value 3)
4/3 Colour Index 5 (value 3)
4/4 Colour Index 6 (value 4)

6.9 String parameters

6.9.1 Overall string parameter format

Strings, both String (S) and String Fixed (SF) types, are coded as sequences of bytes, starting with START OF STRING (SOS) and terminated by STRING TERMINATOR (ST).

SOS is represented by the C1 control 9/8. In a 7-bit environment SOS is coded ESC 5/8 (where ESC is the bit combination 1/11). ST is coded as ESC 5/12 in a 7-bit environment, and 9/12 in an 8-bit environment.

	7-bit environment	8-bit environment
SOS	1/11 5/8	09/08
ST	1/11 5/12	09/12

NOTE — The environment refers to the environment of the metafile and is not affected by the Character Coding Announcer.

6.9.2 Bit combinations permitted within string parameters of text elements

If the character set is a complete code then all bit combinations are allowed. If ST is used it terminates the string and so ST cannot be used within a string.

For all other character set types the following bit combinations are allowed as bytes in string parameters in a conforming metafile:

a) Bit combinations from columns 2 through 7 of a 7-bit or 8-bit code chart. If the CHARACTER CODING ANNOUNCER has selected an 8-bit coding technique, then bit combinations from columns 10 through 15 of an 8-bit code chart are also permitted within string parameters.

b) The following C0 control characters: NUL (0/0), BS (0/8), HT (0/9), LF (0/10), VT (0/11), FF (0/12), CR (0/13), SO (0/14), SI (0/15) and ESC (1/11). The NUL control is permitted, but has no effect on the meaning of the string. The bit combinations 0/8 to 0/13 are permitted, but have no standardized effect. The SO, SI, and ESC controls are permitted within conforming metafiles, dependent on the CHARACTER CODING ANNOUNCER. If the bit combinations 0/14 or 0/15 are present, they shall have the meanings (SO or LS1, and SI or LS0) specified for them in ISO 2022, unless a private coding technique has been selected by CHARACTER CODING ANNOUNCER. Other C0 controls are reserved for future standardization.

c) The ESCAPE control (bit combination 1/11 with the exception of the bit combinations 1/11 5/8 and 1/11 5/12 for SOS and ST), and escape sequences formed according to the rules specifed in ISO 2022. Those escape sequences for which meanings are specified in ISO 2022 shall have those specified meanings. ESCAPE sequences are only permitted if the CHARACTER CODING ANNOUNCER has selected a 2022-compatible technique. (If a private value of CHARACTER CODING ANNOUNCER is selected, ESCAPE may be used for escape sequences in a manner agreed upon by the interchanging parties. However this is not recommended as it will decrease the portability of the metafile.)

d) When the 7-bit or extended 8-bit mode has been selected using CHARACTER CODING ANNOUNCER the bit combinations 08/14 and 08/15 (or ESC 4/14 and ESC 4/15) are permitted and, if present, shall have the meanings SS2 (SINGLE SHIFT TWO) and SS3 (SINGLE SHIFT THREE) as defined in ISO 2022.

The bit combinations 0/1 through 0/7, 1/0 through 1/10, and 1/12 through 1/15 are reserved for future standardization.

6.9.3 C0 control within string parameters

Table 3 — C0 control set

Column 0			Column 1		
0/0	NUL	(NULL-ignored)	1/0	DLE	(reserved)
0/1	SOH	(reserved)	1/1	DC1	(reserved)
0/2	STX	(reserved)	1/2	DC2	(reserved)
0/3	ETX	(reserved)	1/3	DC3	(reserved)
0/4	EOT	(reserved)	1/4	DC4	(reserved)
0/5	ENQ	(reserved)	1/5	NAK	(reserved)
0/6	ACK	(reserved)	1/6	SYN	(reserved)
0/7	BEL	(reserved)	1/7	ETB	(reserved)
0/8	BS	(no standardized effect)	1/8	CAN	(reserved)
0/9	HT	(no standardized effect)	1/9	EM	(reserved)
0/10	LF	(no standardized effect)	1/10	SUB	(reserved)
0/11	VT	(no standardized effect)	1/11	ESC	(ESCAPE)
0/12	FF	(no standardized effect)	1/12	IS4	(reserved)
0/13	CR	(no standardized effect)	1/13	IS3	(reserved)
0/14	SO	(SHIFT OUT)	1/14	IS2	(reserved)
0/15	SI	(SHIFT IN)	1/15	IS1	(reserved)

6.9.4 Using G-sets in string parameters

The G-sets (G0, G1, G2, and G3) are coded character sets of 94 or 96 bit combinations. They may be invoked into columns 2 through 7 of a 7-bit code chart, or columns 02 through 07 and 10 through 15 of an 8-bit code chart. This encoding of the CGM uses G-sets within string parameters, as follows:

6.9.4.1 String parameters of TEXT, APPEND TEXT, and RESTRICTED TEXT

For the string parameters of TEXT, APPEND TEXT, and RESTRICTED TEXT, the CHARACTER SET INDEX element designates a particular character set (from the list established by CHARACTER SET LIST) as the G0 set. Likewise, ALTERNATE CHARACTER SET INDEX designates a particular character set as both the G1 and G2 sets. These attributes may also apply to string parameters within data records of GDP elements.

At the start of each picture, BEGIN PICTURE invokes the G0 set into columns 2 through 7 of a 7-bit or 8-bit code chart. In an 8-bit environment, BEGIN PICTURE invokes the G1 set into columns 10 through 15 of the 8-bit code chart.

The ISO 2022 C0 or C1 controls or escape sequences to designate character sets as G0, G1, G2, or G3, or to invoke G-sets into the 7-bit or 8-bit code chart ("in-use table") may be included within the string parameters of the graphical primitive elements identified in 6.9.4.1 (with the exception of the string delimiter, listed in 6.9.1), if the CHARACTER CODING ANNOUNCER has selected an extended 2022 technique, whereupon they assume the meanings specified in ISO 2022.

6.9.4.2 String fixed

The String Fixed type (SF) is not subject to CHARACTER CODING ANNOUNCER, CHARACTER SET INDEX, and ALTERNATE CHARACTER SET INDEX. See part 1, 4.3.4.5.

6.10 Enumerated parameters

Enumerated parameters represent choices within a fixed set of standardized options.

6.11 Index parameters

Indexes are coded as integers (Basic format), at INDEX PRECISION. Private (non-standard) values of index parameters are all coded using negative integers.

6.12 Data record parameters

Data record parameters are delimited identically to string parameters in this encoding. A data record is a string of bytes delimited by SOS/ST.

The constraints on character code values and the character set switching mechanisms (both those related to CHARACTER SET INDEX, and the purely ISO 2022 switching methods) do not necessarily apply to data records, as they do to the structurally similar S and SF parameters.

How the data are encoded, the meaning of the data bytes in the record, and the effect (if any) of character set switching mechanisms are part of the definitions of the individual Escape, GDP, and External elements to which the data record belongs.

NOTE 1 The coding technique of the SDR data type (see 6.16) is one valid form for a Data Record parameter. This form is recommended for GDP, Escape, and External element proposals submitted for Graphical Registration.

6.13 Coding VCs and viewport point parameters

A viewport point (VP) is a pair of VC (Viewport Coordinate) scalars representing the x and y coordinates of a point in viewport specification space. A VC scalar is either an integer or real number according to whether VIEWPORT SPECIFICATION MODE is 'fraction of display surface', 'millimetres with scale factor' or 'physical device coordinates'.

When VIEWPORT SPECIFICATION MODE is 'fraction of display surface', the encoding of the VC and viewport point data type is as described in 6.4, Coding Real Numbers. The size of the viewport point parameters is limited by the current REAL PRECISION value.

When VIEWPORT SPECIFICATION MODE is 'millimetres with scale factor' or 'physical device coordinates', the encoding of the viewport point data type is as described in 6.3, Coding Integers. The size of the viewport point parameters is limited by the current INTEGER PRECISION value.

6.14 Name parameters

Name parameters are coded as integers (basic format) at NAME PRECISION.

6.15 Compressed bitstream operands

The bitstream (BS) data type of ISO/IEC 8632-1 is assigned to the compressed colour specifier lists of tile array elements. These operands are compressed binary data objects. The Bitstream encoding method of this part is used to represent the BS data type of part 1. In general it is not possible to deduce the length of the compressed bitsteam from such information as the colour precisions or the number of cells in a tile. For this reason these operands are delimited in the same way that String operands are delimited (see 6.9.1), using SOS before the Bitstream operand and ST after.

6.16 Structured data record operands

The structured data record (SDR) data type defined in ISO/IEC 8632-1 is composed entirely of other standardized data types (including SDR itself) in a structure which is self-defining. SDR is encoded by encoding each of the component operands according to the normal encoding rules for its corresponding data type. The string of bytes comprising the encoded operands is then delimited by SOS/ST, similar to the way operands of data type string are delimited.

6.17 Glyph mapping

ISO/IEC 8632-1 specifies a code/glyphname association which consists of a list of codes and a list of glyphnames, as one of the parameters of this element. These data are encoded with a run length format. A single code or a successive number of codes in the code list are encoded by: an octet (for the run count), and m octets (for the code), where m is the number of octets per code. A single glyphname or a successive number of glyphnames in the list of glyphnames are encoded by: an integer (for the glyph name). All of these are encoded as integers in Basic format.

If the run count is 1, then a single code and glyphname is defined by the encoded items in the respective lists. If the run count is *N*, greater than 1, then a sequence of *N* codes and glyphnames is defined. The base code and base glyphname of the sequence is the encoded code and glyphname from the respective lists. Successive members of the "runs" of codes and glyphnames each have values 1 greater than the previous items. The run count defines the number of pairs in the sequence, and is limited to 255 per sequence (for uniformity of results across encodings). The run count only occurs in the code list.

7 Character substitution

To accommodate systems in which it is inconvenient or impossible to include C0 control characters, the SPACE character (2/0), or the DELETE character (7/15) in the metafile, this CGM encoding includes a "character substitution" option. Characters in the range of 0/0 to 1/15, the characters 2/0, 7/14, and 7/15 may be replaced by 2-byte sequences provided each such 2-byte sequence is declared in the first parameter of the BEGIN METAFILE element.

Although the first parameter, 'substitution strings', of the BEGIN METAFILE element is of data type "string" the START OF STRING (SOS) introducer is omitted in this special case. This is because the SOS contains characters for which character substitution may be required. The STRING TERMINATOR (ST), however, is included in this parameter (character substitution, if selected, will already be in effect by the end of the string parameter, because the declared substitutions take effect immediately upon encountering the 2-byte replacement sequence, as described below).

Table 4 shows the characters that may be replaced by such 2-byte sequences, and the 2-byte sequences with which they are replaced. Note that all the 2-byte sequences begin with 7/14. Therefore, if the character substitution option is used at all, that character (7/14) shall be declared as one of the characters that is being replaced with a 2-byte sequence. This is done by including its replacement sequence (7/14 3/14) in the first parameter of BEGIN METAFILE.

Once a character (or rather, its 2-byte replacement) has been declared in the BEGIN METAFILE element, "character substitution" is in effect for that character immediately and will remain in effect until the end of the metafile (that is, until the END METAFILE element). The metafile interpreter would ignore any characters for which character substitution is in effect.

Note that once TILDE itself has been declared within the substitution string, it is only the occurrence of the character TILDE as part of the data of the metafile (e.g., a TILDE as a character in the parameter of a TEXT element) which is subject to substitution. Its occurrence as part of the syntax of the substitution mechanism itself is not affected. The single character TILDE is always the first of two characters of a replacement pair.

Supposing, for example, that it is desirable to avoid using the characters SPACE, TILDE, and DELETE in the metafile, and for the metafile interpreter to ignore those characters if they are inadvertently inserted (for example, by a host operating system or some process other than the metafile generator).

In that case, the metafile generator declares "character substitution" for the above two characters and for the TILDE character, 7/14. It does this in the first parameter of BEGIN METAFILE as follows:

```
BEGIN METAFILE
  = 3/0  2/0                  {BEGIN METAFILE opcode}

    7/14 6/0  7/14 3/14 7/14 3/15     { string: ~ ~>~?}
    1/11 5/12                 { STRING TERMINATOR (ST)}

    1/11 5/8                  { START OF STRING (SOS)}
    metafile name
    1/11 5/12                 { ST}
```

Throughout the metafile, wherever the metafile generator would otherwise put a SPACE, TILDE (7/14), or DELETE character, it substitutes the 2-byte sequences 7/14 6/0, 7/14 3/14, or 7/14 3/15, respectively.

In this example, wherever the metafile interpreter encounters the character 7/14, it interprets it as the first character of a 2-byte sequence representing one of these characters. The metafile interpreter would then ignore the characters 2/0 (SPACE), and 7/15 (DELETE).

Table 4 — Character substitution

The character		May be replaced with 7-bit		8-bit		ISO 646 char.
0/0	(NUL)	7/14	4/0	07/14	04/0	(~@)
0/1	(SOH)	7/14	4/1	07/14	04/1	(~A)
0/2	(STX)	7/14	4/2	07/14	04/2	(~B)
0/3	(ETX)	7/14	4/3	07/14	04/3	(~C)
0/4	(EOT)	7/14	4/4	07/14	04/4	(~D)
0/5	(ENQ)	7/14	4/5	07/14	04/5	(~E)
0/6	(ACK)	7/14	4/6	07/14	04/6	(~F)
0/7	(BEL)	7/14	4/7	07/14	04/7	(~G)
0/8	(BS)	7/14	4/8	07/14	04/8	(~H)
0/9	(HT)	7/14	4/9	07/14	04/9	(~I)
0/10	(LF)	7/14	4/10	07/14	04/10	(~J)
0/11	(VT)	7/14	4/11	07/14	04/11	(~K)
0/12	(FF)	7/14	4/12	07/14	04/12	(~L)
0/13	(CR)	7/14	4/13	07/14	04/13	(~M)
0/14	(SO)	7/14	4/14	07/14	04/14	(~N)
0/15	(SI)	7/14	4/15	07/14	04/15	(~O)
1/0	(DLE)	7/14	5/0	07/14	05/0	(~P)
1/1	(DC1)	7/14	5/1	07/14	05/1	(~Q)
1/2	(DC2)	7/14	5/2	07/14	05/2	(~R)
1/3	(DC3)	7/14	5/3	07/14	05/3	(~S)
1/4	(DC4)	7/14	5/4	07/14	05/4	(~T)
1/5	(NAK)	7/14	5/5	07/14	05/5	(~U)
1/6	(SYN)	7/14	5/6	07/14	05/6	(~V)
1/7	(ETB)	7/14	5/7	07/14	05/7	(~W)
1/8	(CAN)	7/14	5/8	07/14	05/8	(~X)
1/9	(EM)	7/14	5/9	07/14	05/9	(~Y)
1/10	(SUB)	7/14	5/10	07/14	05/10	(~Z)
1/11	(ESC)	7/14	5/11	07/14	05/11	(~[)
1/12	(FS or IS4)	7/14	5/12	07/14	05/12	(~\)
1/13	(GS or IS3)	7/14	5/13	07/14	05/13	(~])
1/14	(RS or IS2)	7/14	5/14	07/14	05/14	(~^)
1/15	(US or IS1)	7/14	5/15	07/14	05/15	(~_)
2/0	(SPACE)	7/14	6/0	07/14	06/0	(~`)
7/14	(TILDE,~)	7/14	3/14	07/14	03/14	(~>)
7/15	(DELETE)	7/14	3/15	07/14	03/15	(~?)

In a 7-bit or an 8-bit CGM coding environment the "GL" part of the code table (columns 02 through 07), table 4 may be summarized as follows: each character from decimal 0 (0/0) to decimal 32 (2/0) may be replaced by a 2-byte sequence in which the first byte is decimal 126 (7/14) and the decimal equivalent of the second byte is obtained by adding 64, modulo 128, to the decimal equivalent of the original character.

8 Representation of each element

For convenience, the 7-bit opcode is given for each element described in the remainder of this clause. To determine the 8-bit opcode, a zero is added in front of the column specification (for example, 02/1 instead of 2/1). A list of opcodes is given in table 1.

The defaults for the elements are as given in clause 6 of part 1 of this International Standard.

This clause specifies some of the constraints on parameter values. The specifications are not exhaustive, for example such constraints as the non-colinearity of text vectors are not stated. All parameter value and other element state constraints of ISO/IEC 8632-1, including those in the formal grammars, shall apply to metafiles encoded according to this part.

Notation Used:

<symbol>* = 0 or more occurrences

<symbol>+ = 1 or more occurences

<symbol>o = optional, 0 or more occurences

<symbol>(n) - exactly n occurrences, n=1,2,...

{comment} = explanation of a production

<x:y> = construct x with meaning y

<size-specifier> =
<VDC>
{if associated specification mode is 'absolute'}
| <real>
{if associated specification mode is 'scaled', 'fractional', or 'mm'}

NOTE — The "associated specification mode" for each element encoded with the <size-specifier> production is given in 5.1 of part 1 of this International Standard.

<colour-specifier> =
<index: colour-index>
{if COLOUR SELECTION MODE is indexed}
| <direct-colour-specifier>
{if COLOUR SELECTION MODE is direct}

<index: colour-index> =<non-negative-integer>

<direct-colour-specifier> =
<red green blue>
{if COLOUR MODEL is RGB}
| <L A B>
{if COLOUR MODEL is CIELAB}
| <L U V>
{if COLOUR MODEL is CIELUV}

| <cyan magenta yellow black>
{if COLOUR MODEL is CMYK}
| <A B C>
{if COLOUR MODEL is RGB-related}

8.1 Delimiter elements

8.1.1 BEGIN METAFILE

<BEGIN-METAFILE-opcode: 3/0 2/0>
<string-fixed: substitution-codes>
<string-fixed: metafile-identifier>

The BEGIN METAFILE and END METAFILE elements respectively mark the beginning and the end of a metafile. (More than one metafile can be recorded in a single computer file provided each metafile is delimited by the elements BEGIN METAFILE and END METAFILE.)

The first parameter, <string: substitution-codes>, lists those 2-character substitution codes that will be used in the metafile to represent C0 control characters (bit combinations in the range of 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.

NOTE — Substitution codes are not opened by an SOS introducer, see clause 7.

8.1.2 END METAFILE

<END-METAFILE-opcode: 3/0 2/1>

8.1.3 BEGIN PICTURE

<BEGIN-PICTURE-opcode: 3/0 2/2>
<string-fixed: picture-identifier>

8.1.4 BEGIN PICTURE BODY

<BEGIN-PICTURE-BODY-opcode: 3/0 2/3>

8.1.5 END PICTURE

<END-PICTURE-opcode: 3/0 2/4>

8.1.6 BEGIN SEGMENT

<BEGIN-SEGMENT-opcode: 3/0 2/5>
<name: segment-identifier>

<name: segment-identifier> = <integer>

8.1.7 END SEGMENT

<END-SEGMENT-opcode: 3/0 2/6>

8.1.8 BEGIN FIGURE

<BEGIN-FIGURE-opcode: 3/0 2/7>

8.1.9 END FIGURE

<END-FIGURE-opcode: 3/0 2/8>

8.1.10 BEGIN PROTECTION REGION

<BEGIN-PROTECTION-REGION-opcode: 3/0 2/12>
<index: region-index>

<index: region-index> = <positive integer>

8.1.11 END PROTECTION REGION

<END-PROTECTION-REGION-opcode: 3/0 2/13>

8.1.12 BEGIN COMPOUND LINE

<BEGIN-COMPOUND-LINE-opcode: 3/0 2/14>

8.1.13 END COMPOUND LINE

<END-COMPOUND-LINE-opcode: 3/0 2/15>

8.1.14 BEGIN COMPOUND TEXT PATH

<BEGIN-COMPOUND-TEXT-PATH-opcode: 3/0 3/0>

8.1.15 END COMPOUND TEXT PATH

<END-COMPOUND-TEXT-PATH-opcode: 3/0 3/1>

8.1.16 BEGIN TILE ARRAY

<BEGIN-TILE-ARRAY-opcode: 3/0 3/2>
<point: position>

<enumerated: cell-path-direction>
<enumerated: line-progression-direction>
<integer: number-of-tiles-in-path-direction>
<integer: number-of-tiles-in-line-direction>
<integer: number-of-cells/tile-in-path-direction>
<integer: number-of-cells/tile-in-line-direction>
<real: cell-size-in-path-direction>
<real: cell-size-in-line-direction>
<integer: image-offset-in-path-direction>
<integer: image-offset-in-line-direction>
<integer: image-number-of-cells-in-path-direction>
<integer: image-number-of-cells-in-line-direction>

<enumerated: cell-path-direction> = <integer: 0> {0 degrees}
| <integer: 1> {90 degrees}
| <integer: 2> {180 degrees}
| <integer: 3> {270 degrees}

<enumerated: line-progression-direction> = <integer: 0> {90 degrees}
| <integer: 1> {270 degrees}

<integer: number-of-tiles-in-path-direction> =<positive integer>

<integer: number-of-tiles-in-line-direction> =<positive integer>

<integer: number-of-cells/tile-in-path-direction>
= <positive integer>

<integer: number-of-cells/tile-in-line-direction>
= <positive integer>

<real: cell-size-in-path-direction> = <positive real>

<real: cell-size-in-line-direction> = <positive real>

<integer: image-offset-in-path-direction>
= <non-negative integer>

<integer: image-offset-in-line-direction>
= <non-negative integer>

<integer: image-number-of-cells-in-path-direction>=<positive integer>

<integer: image-number-of-cells-in-line-direction>=<positive integer>

8.1.17 END TILE ARRAY

<END-TILE-ARRAY-opcode: 3/0 3/3>

8.2 Metafile descriptor elements

8.2.1 METAFILE VERSION

<METAFILE-VERSION-opcode: 3/1 2/0>
<integer: version>

<integer: version> = <integer: 1> {Version 1}
| <integer: 2> {Version 2}
| <integer: 3> {Version 3}

8.2.2 METAFILE DESCRIPTION

<METAFILE-DESCRIPTION-opcode: 3/1 2/1>
<string-fixed: description-of-the-metafile>

8.2.3 VDC TYPE

<VDC-TYPE-opcode: 3/1 2/2>
<enumerated: VDC-type>

<enumerated:VDC-type> = <integer: 0> {integer}
| <integer: 1> {real}

8.2.4 INTEGER PRECISION

<INTEGER-PRECISION-opcode: 3/1 2/3>
<integer: largest-integer-code + 1 >

The largest-integer-code tells how many bits occur in the largest possible magnitude for an integer. For example, if integers in the metafile can range from -32767 to +32767, the largest-integer-code is 15. One additional bit is required for the sign, and so is added to obtain the proper precision. Thus in this example the parameter would be 16.

8.2.5 REAL PRECISION

<REAL-PRECISION-opcode: 3/1 2/4>
<integer: largest-real-code+1>
<integer: smallest-real-code>
<integer: default-exponent-for-reals>
<enumerated: exponents-allowed>

<enumerated: exponents-allowed> = <integer: 0> {allowed}
| <integer: 1> {forbidden}

The largest-real-code and smallest-real-code together specify the maximum number of bits of precision that can occur in the coded representations of real numbers. The largest-real-code specifies the largest

possible magnitude of positive or negative real numbers, while the smallest-real-code specifies the granularity of the real number space.

The largest-real-code tells how many bits can occur to the left of the (binary) radix point in the largest possible real number. For example, if the largest possible real number is binary +11111111111111111111.111, the largest-real-code would be 20.

The smallest-real-code shows the granularity of the real number space by indicating how small a non-zero real number can be. It does this by specifying the smallest exponent that is permitted in the coded representation of a real number. For example, if all real numbers are integer multiples of 1/64 (2 raised to the power -6), the smallest-real-code would be -6. This indicates that there are six bits of precision to the right of the binary radix point and that the smallest allowable exponent is -6.

It is possible for the smallest-real-code to be positive. For example, if the only real numbers to be coded are multiples of 8, smallest-real-code would be +3, since 8, or binary 1000, is 2 raised to the power +3.

The largest-real-code shall be greater than the smallest-real-code. The difference, largest-real-code minus smallest-real-code, gives the number of bits of precision which are required in order to store real numbers with full precision.

The default-exponent-for-reals is the exponent that is to be assumed if an exponent is omitted from the coded representation of a real number. This parameter shall be greater than or equal to the smallest-real-code.

The exponents-allowed parameter specifies whether or not an "exponent follows" bit is included in the mantissa of the coded representation of each number. If this parameter is 0, exponents are allowed in real parameters, and the exponent-follows bit is included in their mantissas. If this parameter is 1, exponents are not allowed in real parameters and the mantissas of real parameters do not include the exponent-follows bit. In that case, the omitted exponents of all real parameters are deemed to have the value determined by the default-exponent-for-reals parameter.

8.2.6 INDEX PRECISION

<INDEX-PRECISION-opcode: 3/1 2/5>
<integer: largest-index-code + 1>

The largest-index-code tells how many bits occur in the largest possible magnitude for an index. For example, if indexes in the metafile can range from -511 to +511, the largest-index-code is 9. One additional bit is required for the sign, and so is added to obtain the proper precision. Thus in this example the parameter would be 10.

8.2.7 COLOUR PRECISION

<COLOUR-PRECISION-opcode: 3/1 2/6>
<integer: largest-component code>

The largest-component-code tells how many bits occur in the largest possible magnitude for a direct colour component. For example, if the largest-component-code is 10, then direct colour components in the range 0-1023 can be handled.

8.2.8 COLOUR INDEX PRECISION

<COLOUR-INDEX-PRECISION-opcode: 3/1 2/7>
<integer: largest-colour-index-code+1>

The parameter specifies the number of bits used in the binary numerals that represent colour indexes. For example, if the parameter is 4, then the largest-colour-index-code is 3, and there are 8 possible colour indexes: binary 0000 (decimal 0) to binary 0111 (decimal 7).

8.2.9 MAXIMUM COLOUR INDEX

<MAXIMUM-COLOUR-INDEX-opcode: 3/1 2/8>
<integer: maximum-colour-index>

8.2.10 COLOUR VALUE EXTENT

<COLOUR-VALUE-EXTENT-opcode: 3/1 2/9>
<colour mapping specifier>

<colour mapping specifier> = <red green blue: minimum-colour-value>
<red green blue: maximum-colour-value>
{if COLOUR MODEL is 'RGB'}

| <cyan magenta yellow black: minimum-colour-value>
<cyan magenta yellow black: maximum-colour-value>
{if COLOUR MODEL is 'CMYK'}

| <real: colour-scale-first-component>
<real: colour-offset-first-component>
<real: colour-scale-second-component>
<real: colour-offset-second-component>
<real: colour-scale-third-component>
<real: colour-offset-third-component>
{if COLOUR MODEL is 'CIELAB', 'CIELUV', or 'RGB-related'}

8.2.11 METAFILE ELEMENT LIST

<METAFILE-ELEMENT-LIST-opcode: 3/1 2/10>
<string: element-list>

<string: element-list> = SOS <element names>* ST

<element names> = <element opcode>
| <enumerated: element set>

<enumerated: element set> = <integer: 0> {DRAWING SET}
| <integer: 1> {DRAWING PLUS CONTROL SET}
| <integer:2> {VERSION 2 SET}
| <integer:3> {EXTENDED PRIMITIVES SET}

| <integer:4> {VERSION 2 GKSM SET}
| <integer:5> {VERSION 3 SET}

8.2.12 METAFILE DEFAULTS REPLACEMENT

<BEGIN-METAFILE-DEFAULTS-opcode: 3/1 2/11>
<element-that-sets-a-default>+
<END-METAFILE-DEFAULTS-opcode: 3/1 2/12>

The <element-that-sets-a-default> list is given in part 1, clause 6. The coding format for each of the elements that appear in METAFILE DEFAULTS REPLACEMENT is exactly as described in this clause, Representation of Each Element. The parameter values express the default values to be used. For example, in a 7-bit encoding, the default values for CLIP INDICATOR and HATCH INDEX would be as follows:

```
3/1 2/11    {BEGIN-METAFILE-DEFAULTS-opcode}
3/3 2/5     {CLIP-INDICATOR-opcode}
integer: 1  {clip-indicator-on}
3/6 3/3     {HATCH-INDEX-opcode}
integer: 2  {default index equal to 2}
3/1 2/12    {END-METAFILE-DEFAULTS-opcode}
```

8.2.13 FONT LIST

<FONT-LIST-opcode: 3/1 2/13>
<font-name>+

<font-name> = <string-fixed: name-of-font>

The FONT LIST element declares the character fonts that may be named in subsequent TEXT FONT INDEX elements and establishes the font index value that is associated with each such character font.

The first <font-name> in the list names the character font whose font index value is to be 1. Likewise, the second, third, fourth, etc., <font-name> occurrences name the fonts whose index values are to be 2, 3, 4, etc. The <font-name>s are separated from each other by the string delimiter characters.

8.2.14 CHARACTER SET LIST

<CHARACTER-SET-LIST-opcode: 3/1 2/14>
<character-set-declaration>+

<character-set-declaration> = <enumerated: character-set-type>
<string-fixed: end-of-escape-sequence-to-designate-set>

<enumerated: character-set-type> = <integer: 0> {94-character G-set}
| <integer: 1> {96-character G-set}
| <integer: 2> {multibyte 94-character G-set}
| <integer: 3> {multibyte 96-character G-set}
| <integer: 4> {"complete code" character set}

8.2.15 CHARACTER CODING ANNOUNCER

<CHARACTER-CODING-ANNOUNCER-opcode: 3/1 2/15>
<enumerated: coding-technique>

<enumerated: coding-technique>	=	<integer: 0>	{basic 7-bit}
	|	<integer: 1>	{basic 8-bit}
	|	<integer: 2>	{extended 7-bit}
	|	<integer: 3>	{extended 8-bit}

8.2.16 NAME PRECISION

<NAME-PRECISION-opcode: 3/1 3/0>
<integer: largest-name-code + 1>

The largest-name-code indicates how many bits occur in the largest possible magnitude for a name.

8.2.17 MAXIMUM VDC EXTENT

<MAXIMUM-VDC-EXTENT-opcode: 3/1 3/1>
<point: first-corner>
<point: second-corner>

8.2.18 SEGMENT PRIORITY EXTENT

<SEGMENT-PRIORITY-EXTENT-opcode: 3/1 3/2>
<integer: minimum-segment-priority-value> =<non-negative integer>
<integer: maximum-segment-priority-value> =<non-negative integer>

8.2.19 COLOUR MODEL

<COLOUR-MODEL-opcode: 3/1 3/3>
<index: colour-model>

<index: colour-model>	=	<integer: 1>	{RGB}
	|	<integer: 2>	{CIELAB}
	|	<integer: 3>	{CIELUV}
	|	<integer: 4>	{CMYK}
	|	<integer: 5>	{RGB-related}
	|	<integer: >5>	{reserved for registered values}

8.2.20 COLOUR CALIBRATION

<COLOUR-CALIBRATION-opcode: 3/1 3/4>
<index: calibration-selection>
<calibration-data>

<index: calibration-selection>	=	<integer: 1> {unspecified} <integer: 2> {reference white only} <integer: 3> {reference white, matrix1} <integer: 4> {reference white, matrix1, lookup tables} <integer: 5> {reference white, matrix1, lookup tables, matrix2} <integer: 6> {reference white, matrix1, matrix2} <integer: 7> {lookup tables, matrix2} <integer: 8> {matrix2} <integer: 9> {reference white, grid locations + grid values} <integer: >9> {reserved for registered values}
<calibration-data>	=	<real: reference-white-Xn> <real: reference-white-Yn> <real: reference-white-Zn> <RGB-and-RGB-related-calibration-data> <CMYK-calibration-data>
<RGB-and-RGB-related-calibration-data>	=	<RGB-calibration-matrix> <ABC-transformation-matrix> <integer: n> {number-of-lookup-table-entries} <lookup-table-entry-R>(n) <lookup-table-entry-G>(n) <lookup-table-entry-B>(n)
<RGB-calibration-matrix>	=	<real: Xr> <real: Xg> <real: Xb> <real: Yr> <real: Yg> <real: Yb> <real: Zr> <real: Zg> <real: Zb>
<ABC-transformation-matrix>	=	<real: Ra> <real: Rb> <real: Rc> <real: Ga> <real: Gb> <real: Gc> <real: Ba> <real: Bb> <real: Bc>
<integer: n>	=	<non-negative integer>
<lookup-table-entry-R>	=	<colour-component: R> <colour-component: R'>
<lookup-table-entry-G>	=	<colour-component: G> <colour-component: G'>
<lookup-table-entry-B>	=	<colour-component: B> <colour-component: B'>
<CMYK-calibration-data>	=	<integer: m> {number of grid locations} <CMYK-grid-location>(m) <XYZ-grid-location>(m)
<integer: m>	=	<non-negative integer>
<CMYK-grid-location>(n)	=	<direct colour list>
<XYZ-grid-location>	=	<real: CIEXYZ-X>

<real: CIEXYZ-Y>
<real: CIEXYZ-Z>

8.2.21 FONT PROPERTIES

<FONT-PROPERTIES-opcode: 3/1 3/5>
<font-property-3-tuple>+

<font-property-3-tuple>	=	<index: property-indicator> <integer: priority> <structured data record: property-value-record>
<index: property-indicator>	=	<integer: 1> {font index} | <integer: 2> {standard version} | <integer: 3> {design source} | <integer: 4> {font family} | <integer: 5> {posture} | <integer: 6> {weight} | <integer: 7> {proportionate width} | <integer: 8> {included glyph collections} | <integer: 9> {included glyphs} | <integer: 10> {design size} | <integer: 11> {minimum size} | <integer: 12> {maximum size} | <integer: 13> {design group} | <integer: 14> {structure} | <integer: >14> {reserved for registered values}
<property-value-record>	=	<SOS> <property-value-record-contents> <ST>
<property-value-record-contents>	=	<<integer: i_IX><integer: 1><index: font-index>> | <<integer: i_I><integer: 1><integer: standard-version>> | <<integer: i_SF><integer: 1><string-fixed: design-source>> | <<integer: i_SF><integer: 1><string-fixed: font-family>> | <<integer: i_IX><integer: 1><index: posture>> | <<integer: i_IX><integer: 1><index: weight>> | <<integer: i_IX><integer: 1><index: proportionate-width>> | <<integer: i_IX><integer: n><included-glyph-collections>(n)> | <<integer: i_UI32><integer: m><included-glyphs>(m)> | <<integer: i_R><integer: 1><real: design-size>> | <<integer: i_R><integer: 1><real: minimum-size>> | <<integer: i_R><integer: 1><real: maximum-size>> | <<integer: i_UI8><integer: 3><design-group>> | <<integer: i_IX><integer: 1><index: structure>>

NOTE — i_XX in the above denotes the integer value of the 'data type designator' for data type "XX" as assigned in annex C of ISO/IEC 8632-1. For example i_IX represents the designator for data type IX, which is assigned the value 11.

<index: font-index>	=	<positive integer>

Representation of each element **Metafile descriptor elements**

<integer: standard-version>	=	<positive integer>
<index: posture>	=	<integer: 0> {not applicable}
	|	<integer: 1> {upright}
	|	<integer: 2> {oblique}
	|	<integer: 3> {back slanted oblique}
	|	<integer: 4> {italic}
	|	<integer: 5> {back slanted italic}
	|	<integer: 6> {other}
	|	<integer: >6> {reserved for registered values}
<index: weight>	=	<integer: 0> {not applicable}
	|	<integer: 1> {ultra light}
	|	<integer: 2> {extra light}
	|	<integer: 3> {light}
	|	<integer: 4> {semi light}
	|	<integer: 5> {medium}
	|	<integer: 6> {semi bold}
	|	<integer: 7> {bold}
	|	<integer: 8> {extra bold}
	|	<integer: 9> {ultra bold}
	|	<integer: >9> {reserved for registered values}
<index: proportionate-width>	=	<integer: 0> {not applicable}
	|	<integer: 1> {ultra condensed}
	|	<integer: 2> {extra condensed}
	|	<integer: 3> {condensed}
	|	<integer: 4> {semi condensed}
	|	<integer: 5> {medium}
	|	<integer: 6> {semi expanded}
	|	<integer: 7> {expanded}
	|	<integer: 8> {extra expanded}
	|	<integer: 9> {ultra expanded}
	|	<integer: >9> {reserved for registered values}
<included-glyph-collections>	=	<index: character-set-index>+
<included-glyphs>	=	<UI32: AFII-glyph-identifier>+
<UI32: AFII-glyph-identifier>	=	<integer: 1..(2^{32}-1)>
<index: character-set-index>	=	<positive integer>
<real: design-size>	=	<positive real>
<real: minimum-size>	=	<positive real>
<real: maximum-size>	=	<positive real>
<design-group>	=	<UI8: design-group-class>
		<UI8: design-group-subclass>
		<UI8: design-group-specific-group>

Metafile descriptor elements		Representation of each element
<UI8: design-group-class>	=	<integer: 0..255>
<UI8: design-group-subclass>	=	<integer: 0..255>
<UI8: design-group-specific-group>	=	<integer: 0..255>
<index: structure>	=	<integer: 0> {undefined or not applicable}
	|	<integer: 1> {solid}
	|	<integer: 2> {outline}
	|	<integer: >2> {reserved for registered values}

8.2.22 GLYPH MAPPING

<GLYPH-MAPPING-opcode: 3/1 3/6>
<index: character-set-index>
<basis-set>
<integer: octets-per-code>
<index: glyph-source>
<structured data record: code-glyph-association>

<index: character-set-index>	=	<positive-integer>
<basis-set>	=	<enumerated: character-set-type> {see 8.2.14, CHARACTER SET LIST} <string-fixed: designation-sequence-tail> {see 8.2.14, CHARACTER SET LIST}
<integer: octets-per-code>	=	<positive integer> {=m}
<index: glyph-source>	=	<integer: 1> {AFII} <integer: >1> {reserved for registered values}
<structured data record: code-glyph-association>	=	<SOS> <association-record-contents> <ST>
<association-record-contents>	=	<i_UI8, n(m+1), <explicit-code-run>(n)> <i_UI32, n, <implicit-glyph-name-run>(n)>
<explicit-code-run>	=	<UI8: run-count> <character-code>
<character-code>	=	<UI8: octet>(m)
<implicit-glyph-name-run>	=	<UI32: afii-glyph-identifier>

NOTE — The lists containing the codes and glyph names are parallel lists. Hence the run-length encoding only need be explicit in the first list, which is the code list.

<UI8: run-count>	=	<integer: 1..255>
<character-code>	=	<UI8: octet>(m)
<UI8: octet>	=	<integer: 1..255>

<UI32: afii-glyph-identifier> = <integer: 1..(2^{32}-1)>

8.2.23 SYMBOL LIBRARY LIST

<SYMBOL-LIBRARY-LIST-opcode: 3/1 3/7>
<symbol-library-name>+

<symbol-library-name> = <string-fixed: name-of-symbol-library>

8.3 Picture descriptor elements

8.3.1 SCALING MODE

<SCALING-MODE-opcode: 3/2 2/0>
<enumerated: scaling-mode>
<real: metric-scale-factor>

<enumerated: scaling-mode> = <integer: 0> {abstract}
| <integer: 1> {metric}

8.3.2 COLOUR SELECTION MODE

<COLOUR-SELECTION-MODE-opcode: 3/2 2/1>
<enumerated: colour-selection-mode>

<enumerated: colour-selection-mode> = <integer: 0> {indexed}
| <integer: 1> {direct}

8.3.3 LINE WIDTH SPECIFICATION MODE

<LINE-WIDTH-SPECIFICATION-MODE-opcode: 3/2 2/2>
<enumerated: specification-mode>

<enumerated: specification-mode> = <integer: 0> {absolute}
| <integer: 1> {scaled}
| <integer: 2> {fractional}
| <integer: 3> {mm}

8.3.4 MARKER SIZE SPECIFICATION MODE

<MARKER-SIZE-SPECIFICATION-MODE-opcode: 3/2 2/3>
<enumerated: specification-mode>

<enumerated: specification-mode> = <integer: 0> {absolute}
| <integer: 1> {scaled}
| <integer: 2> {fractional}
| <integer: 3> {mm}

8.3.5 EDGE WIDTH SPECIFICATION MODE

<EDGE-WIDTH-SPECIFICATION-MODE-opcode: 3/2 2/4>
<enumerated: specification-mode>

<enumerated: specification-mode> = <integer: 0> {absolute}
| <integer: 1> {scaled}

| <integer: 2> {fractional}
| <integer: 3> {mm}

8.3.6 VDC EXTENT

<VDC-EXTENT-opcode: 3/2 2/5>
<point: first-corner>
<point: second-corner>

8.3.7 BACKGROUND COLOUR

<BACKGROUND-COLOUR-opcode: 3/2 2/6>
<direct-colour-specifier: background-colour> {see clause 8.}

8.3.8 DEVICE VIEWPORT

<DEVICE-VIEWPORT-opcode: 3/2 2/7>
<viewport point: first-corner>
<viewport point: second-corner>

8.3.9 DEVICE VIEWPORT SPECIFICATION MODE

<DEVICE-VIEWPORT-SPECIFICATION-MODE-opcode: 3/2 2/8>
<enumerated:VC-specifier>
<real: metric-scale-factor>

<enumerated: VC-specifier> = <integer:0> {fraction of display surface}
| <integer:1> {millimetres with scale factor}
| <integer:2> {physical device coordinates}

8.3.10 DEVICE VIEWPORT MAPPING

<DEVICE-VIEWPORT-MAPPING-opcode: 3/2 2/9>
<enumerated: isotropy-flag>
<enumerated: horizontal-alignment-flag>
<enumerated: vertical-alignment-flag>

<enumerated: isotropy-flag> = <integer:0> {not forced}
| <integer:1> {forced}

<enumerated: horizontal-alignment-flag> = <integer:0> {left}
| <integer:1> {centre}
| <integer:2> {right}

<enumerated: vertical-alignment-flag> = <integer:0> {bottom}
| <integer:1> {centre}
| <integer:2> {top}

8.3.11 LINE REPRESENTATION

<LINE-REPRESENTATION-opcode: 3/2 2/10>
<index: line-bundle-index>
<index: line-type>
<size-specifier: line-width-specifier> {see clause 8.}
<colour-specifier> {see clause 8.}

<index: line-bundle-index> = <positive integer>

<index: line-type> = <integer: 1> {solid}
| <integer: 2> {dash}
| <integer: 3> {dot}
| <integer: 4> {dash-dot}
| <integer: 5> {dash-dot-dot}
| <integer: >5> {reserved for registered values}
| <integer: negative> {private line type}

8.3.12 MARKER REPRESENTATION

<MARKER-REPRESENTATION-opcode: 3/2 2/11>
<index: marker-bundle-index>
<index: marker-type>
<size-specifier: marker-size-specifier> {see clause 8.}
<colour-specifier> {see clause 8.}

<index: marker-bundle-index> = <positive integer>

<index: marker-type> = <integer: 1> {dot}
| <integer: 2> {plus}
| <integer: 3> {asterisk}
| <integer: 4> {circle}
| <integer: 5> {cross}
| <integer: >5> {reserved for registered values}
| <integer: negative> {private marker type}

8.3.13 TEXT REPRESENTATION

<TEXT-REPRESENTATION-opcode: 3/2 2/12>
<index: text-bundle-index>
<index: text-font-index>
<enumerated: text-precision>
<real: character-spacing>
<real: expansion-factor>
<colour-specifier> {see clause 8.}

<index: text-bundle-index> = <positive integer>

<index: text-font-index> = <positive integer>

<enumerated: text-precision> = <integer:0> {string}
| <integer:1> {character}
| <integer:2> {stroke}

<real: character spacing> = <real>

<real: expansion-factor> = <non-negative real>

8.3.14 FILL REPRESENTATION

<FILL-REPRESENTATION-opcode: 3/2 2/13>
<index: fill-bundle-index>
<enumerated: interior-style>
<colour-specifier> {see clause 8.}
<index: hatch-index>
<index: pattern-index>

<index:fill-bundle-index> = <positive integer>

<enumerated: interior-style> = <integer:0> {hollow}
| <integer: 1> {solid}
| <integer: 2> {pattern}
| <integer: 3> {hatch}
| <integer: 4> {empty}
| <integer: 5> {geometric pattern}
| <integer: 6> {interpolated interior}

<index: hatch-index> = <integer: 1> {horizontal}
| <integer: 2> {vertical}
| <integer: 3> {positive slope}
| <integer: 4> {negative slope}
| <integer: 5> {horizontal/vertical cross}
| <integer: 6> {positive/negative cross}
| <integer: >6> {reserved for registered values}
| <integer: negative> {private styles}

<index: pattern-index> = <positive integer>

8.3.15 EDGE REPRESENTATION

<EDGE-REPRESENTATION-opcode: 3/2 2/14>
<index: edge-bundle-index>
<index: edge-type>
<size-specifier: edge-width-specifier> {see clause 8.}
<colour-specifier> {see clause 8.}

<index: edge-bundle-index> = <positive integer>

<index: edge-type> = <integer: 1> {solid}
| <integer: 2> {dash}

| <integer: 3> {dot}
| <integer: 4> {dash-dot}
| <integer: 5> {dash-dot-dot}
| <integer: >5> {reserved for registered values}
| <integer: negative> {private edge type}

8.3.16 INTERIOR STYLE SPECIFICATION MODE

<INTERIOR-STYLE-SPECIFICATION-MODE-opcode: 3/2 2/15>
<enumerated: specification-mode>

<enumerated: specification-mode> = <integer: 0> {absolute}
| <integer: 1> {scaled}
| <integer: 2> {fractional}
| <integer: 3> {mm}

8.3.17 LINE AND EDGE TYPE DEFINITION

<LINE-AND-EDGE-TYPE-DEFINITION-opcode: 3/2 3/0>
<index: line-type>
<size-specifier: dash-cycle-repeat-length> {see clause 8.}
<list-of-dash-elements>

<index: line-type> = <negative-integer>

<list-of-dash-elements> = <non-negative-integer>+

8.3.18 HATCH STYLE DEFINITION

<HATCH-STYLE-DEFINITION-opcode: 3/2 3/1>
<index: hatch-index>
<enumerated: style-indicator>
<size-specifier: DX-first-vector> {see clause 8.}
<size-specifier: DY-first-vector>
<size-specifier: DX-second-vector>
<size-specifier: DY-second-vector>
<size-specifier: duty-cycle-length> {see clause 8.}
<integer: number-of-hatch-lines>
<list-of-gap-widths>
<list-of-line-types>

<integer: hatch-index> = <negative-integer>

<enumerated: style-indicator> = <integer: 0> {parallel}
| <integer: 1> {cross-hatch}

<integer: number-of-hatch-lines> = <positive-integer> {n}

<list-of-gap-widths> = <positive integer>(n)

<list-of-line-types> = <integer>(n)

8.3.19 GEOMETRIC PATTERN DEFINITION

<GEOMETRIC-PATTERN-DEFINITION-opcode: 3/2 3/2>
<index: geometric-pattern-index>
<name: segment-identifier>
<pattern-extent>

<index: geometric-pattern-index> = <positive index>

<name: segment-identifier> = <integer>

<pattern-extent> = <point>(2)

8.4 Control elements

8.4.1 VDC INTEGER PRECISION

<VDC-INTEGER-PRECISION-opcode: 3/3 2/0>
<integer: largest-integer-code+1>

The largest-integer-code tells how many bits occur in the largest possible magnitude for an integer point. For example, if integer points in the metafile can range from -32767 to +32767, the largest-integer-code is 15. One additional bit is required for the sign, thus an additional bit is added to obtain the appropiate field width. Thus in this example the parameter would be 16.

8.4.2 VDC REAL PRECISION

<VDC-REAL-PRECISION-opcode: 3/3 2/1>
<integer: largest-real-code+1>
<integer: smallest-real-code>
<integer: default-exponent-for-vdc-reals>
<enumerated: exponents-allowed>

<enumerated: exponents-allowed> = <integer: 0> {allowed}
| <integer: 1> {forbidden}

The largest-real-code and smallest-real-code (or granularity code) together specify the maximum number of bits of precision that can occur in the coded representations of real VDC space coordinates and VDC scalars. The largest-real-code specifies the largest possible magnitude of positive or negative real VDC coordinates and VDC scalars, while the smallest-real-code specifies the granularity of VDC space.

The largest-real-code tells how many bits can occur to the left of the (binary) radix point in the largest possible VDC scalar. For example, if the largest possible real number is binary +11111111111111111111.111, the largest-real-code would be 20.

The smallest-real-code shows the granularity of VDC space by indicating how small a non-zero VDC scalar can be. It does this by specifying the smallest exponent that is permitted in the coded representation of a VDC scalar, thus determining the Basic Grid Unit: letting "src" stand for smallest-real-code, $BGU=2^{src}$. For example, if all VDC scalars are integer multiples of 1/64 (2 raised to the power -6), the smallest-real-code would be -6. This indicates that there are six bits of precision to the right of the binary radix point and that the smallest allowable exponent is -6.

It is possible for the smallest-real-code to be positive. For example, if all VDC scalars to be coded are multiples of 8, smallest-real-code would be +3, since 8, or binary 1000, is 2 raised to the power +3.

The largest-real-code shall be greater than the smallest-real-code. The difference, largest-real-code minus smallest-real-code, gives the number of bits of precision which are required in order to store VDC coordinates with full precision. It is especially important to use all these bits of precision when coding the point list parameters of the POLYLINE, DISJOINT POLYLINE, POLYMARKER, POLYGON, POLYGON SET, GDP, and POLYSYMBOL.

The default-exponent-for-vdc-reals is the exponent that is to be assumed if an exponent is omitted from the coded representation of a real VDC coordinate or VDC scalar. This parameter shall be greater than or equal to the smallest-real-code.

The exponents-allowed parameter specifies whether or not an "exponent follows" bit is included in the mantissa of the coded representation of a real VDC coordinate or VDC scalar. If this parameter is 0, exponents are allowed in real VDC coordinates and VDC scalars, and the exponent-follows bit is included in their mantissas (see 6.5.) If this parameter is 1, exponents are not allowed in real VDC coordinates and VDC scalars; in that case the mantissas of real VDC coordinates and VDC scalar do not include the exponent-follows bit. In that case, the omitted exponents of all real parameters are deemed to have the value determined by the default-exponent-for-reals parameter.

8.4.3 AUXILIARY COLOUR

<AUXILIARY-COLOUR-opcode: 3/3 2/2>
<colour-specifier: auxiliary-colour> {see clause 8.}

8.4.4 TRANSPARENCY

<TRANSPARENCY-opcode: 3/3 2/3>
<enumerated: transparency indicator>

<enumerated: transparency indicator> = <integer: 0> {off}
| <integer: 1> {on}

8.4.5 CLIP RECTANGLE

<CLIP-RECTANGLE-opcode: 3/3 2/4>
<point: first-corner>
<point: second-corner>

8.4.6 CLIP INDICATOR

<CLIP-INDICATOR-opcode: 3/3 2/5>
<enumerated: clip-indicator>

<enumerated: clip-indicator> = <integer: 0> {off}
| <integer: 1> {on}

8.4.7 LINE CLIPPING MODE

<LINE-CLIPPING-MODE-opcode: 3/3 2/6>
<enumerated: clipping-mode>

<enumerated: clipping-mode> = <integer:0> {locus}
| <integer:1> {shape}
| <integer:2> {locus then shape}

8.4.8 MARKER CLIPPING MODE

<MARKER-CLIPPING-MODE-opcode: 3/3 2/7>
<enumerated: clipping-mode>

<enumerated: clipping-mode> = <integer:0> {locus}
| <integer:1> {shape}
| <integer:2> {locus then shape}

8.4.9 EDGE CLIPPING MODE

<EDGE-CLIPPING-MODE-opcode: 3/3 2/8>
<enumerated: clipping mode>

<enumerated: clipping mode> = <integer:0> {locus}
| <integer:1> {shape}
| <integer:2> {locus then shape}

8.4.10 NEW REGION

<NEW-REGION-opcode: 3/3 2/9>

8.4.11 SAVE PRIMITIVE CONTEXT

<SAVE-PRIMITIVE-CONTEXT-opcode: 3/3 2/10>
<name: context>

<name: context> = <integer>

8.4.12 RESTORE PRIMITIVE CONTEXT

<RESTORE-PRIMITIVE-CONTEXT-opcode: 3/3 2/11>
<name: context>

<name: context> = <integer>

8.4.13 PROTECTION REGION INDICATOR

<PROTECTION-REGION-INDICATOR-opcode: 3/3 3/0>
<index: region-index>
<index: region-indicator>

<index: region-index> = <positive integer>

<index: region-indicator> = <integer: 1> {off}
| <integer: 2> {clip}
| <integer: 3> {shield}

8.4.14 GENERALIZED TEXT PATH MODE

<GENERALIZED-TEXT-PATH-MODE-opcode: 3/3 3/1>
<enumerated: text-path-mode>

<enumerated: text-path-mode> = <integer: 0> {off}
| <integer: 1> {non-tangential}
| <integer: 2> {axis-tangential}

8.4.15 MITRE LIMIT

<MITRE-LIMIT-OPCODE-opcode: 3/3 3/2>
<real: mitre-limit>

<real: mitre-limit> = <non-negative-real>

8.4.16 TRANSPARENT CELL COLOUR

<TRANSPARENT-CELL-COLOUR-opcode: 3/3 03/3>
<enumerated: transparency-indicator>
<colour-specifier> {see clause 8.}

<enumerated: transparency-indicator> = <integer: 0> {off}
| <integer: 1> {on}

8.5 Graphical primitive elements

8.5.1 POLYLINE

<POLYLINE-opcode: 2/0>
<point-pair>
<point-list>

<point-pair> = <point>(2)

<point-list> = <point>*

8.5.2 DISJOINT POLYLINE

<DISJOINT-POLYLINE-opcode: 2/1>
<point-pair>+

<point-pair> = <point>(2)

8.5.3 POLYMARKER

<POLYMARKER-opcode: 2/2>
<point>
<point-list>

<point-list> = <point>*

8.5.4 TEXT

<TEXT-opcode: 2/3>
<point: starting-point>
<enumerated: final-or-not-final>
<string: text-to-be-displayed>

<enumerated: final-or-not-final> = <integer: 0> {not final}
| <integer: 1> {final}

8.5.5 RESTRICTED TEXT

<RESTRICTED-TEXT-opcode: 2/4>
<VDC: delta-width>
<VDC: delta-height>
<point: starting-point>
<enumerated: final-or-not-final>
<string: text-to-be-displayed>

<VDC: delta-width> = <non-negative VDC>
<VDC: delta-height> = <non-negative VDC>

<enumerated: final-or-not-final> = <integer: 0> {not final}
| <integer: 1> {final}

8.5.6 APPEND TEXT

<APPEND-TEXT-opcode: 2/5>
<enumerated: final-or-not-final>
<string: text-to-be-displayed>

<enumerated: final-or-not-final> = <integer: 0> {not final}
| <integer: 1> {final}

8.5.7 POLYGON

<POLYGON-opcode: 2/6>
<point-triple>
<point-list>

<point-triple> = <point>(3)
<point-list> = <point>*

8.5.8 POLYGON SET

<POLYGON-opcode: <2/7>
<flagged point-triple>
<flagged point-list>

<flagged point-triple> = <flagged-point>(3)

<flagged point-list> = <flagged-point>*

where the first coordinate is coded as an absolute coordinate and subsequent coordinates as displacement coordinates, as in the point list parameter type.

<flagged-point> = <point> <enumerated: edge-out>

<enumerated: edge-out> = <integer: 0> {invisible}
| <integer: 1> {visible}
| <integer: 2> {close invisible}
| <integer: 3> {close visible}

8.5.9 CELL ARRAY

<CELL-ARRAY-opcode: 2/8>
<P: point>

Graphical primitive elements **Representation of each element**

<Q: point>
<R: point>
<integer: nx>
<integer: ny>
<local-colour-precision>
<colour-list>

<integer: nx> = <positive integer>
<integer: ny> = <positive integer>

<local-colour-precision> = <default-colour-precision-indicator>
| <number-of-bits>

<default-colour-precision-indicator> = <integer: 0>
<number-of-bits> = <positive integer>

The value 0 for the local-colour-precision is the 'default colour precision indicator'. It indicates that the colour specifications of the CELL ARRAY element are in the precision of the COLOUR INDEX PRECISION or the COLOUR PRECISION (depending upon the value of the COLOUR SELECTION MODE). If positive, then it is the 'number of bits' of the colour specifications of the CELL ARRAY element (as in COLOUR PRECISION and COLOUR INDEX PRECISION).

<colour-list> = <indexed colour list>
| <direct colour list>

<indexed colour list> = <indexed normal colour list>
| <indexed bitstream colour list>
| <indexed runlength colour list>
| <indexed runlength bitstream colour list>

<direct colour list> = <direct normal colour list>
| <direct bitstream colour list>
| <direct runlength colour list>
| <direct runlength bitstream colour list>

<indexed normal colour list> = <integer: 0>
<basic format>+

<indexed bitstream colour list> = <integer: 1>
<bitstream: concatenation of colour indexes>

<indexed runlength colour list> = <integer:2>
<indexed run>+

<indexed run> = <integer: colour index>
<integer: number of repetitions>

<indexed runlength bitstream colour list> = <integer:3>
<indexed bitstream run>+

<indexed bitstream run> = <bitstream: colour index>
<integer: number of repetitions>

<direct normal colour list>	=	<integer: 0> <direct-colour-specifier: colour value>+
<direct bitstream colour list>	=	<integer: 1> <bitstream: concatenation of colour values>
<direct runlength colour list>	=	<integer: 2> <direct run>+
<direct run>	=	<direct-colour-specifier: colour value> <integer: number of repetitions>
<direct runlength bitstream colour list>	=	<integer: 3> <direct run>+

8.5.10 GENERALIZED DRAWING PRIMITIVE

<GDP-opcode: 2/9>
<integer: GDP-identifier>
<point-list>
<data-record: data-record>

<point-list>	=	<point>*

8.5.11 RECTANGLE

<RECTANGLE-opcode: 2/10>
<point: first-corner>
<point: second-corner>

8.5.12 CIRCLE

<CIRCLE-opcode: 3/4 2/0>
<point: centre-of-circle>
<VDC: radius-of-circle>

8.5.13 CIRCULAR ARC 3 POINT

<CIRCULAR-ARC-3-POINT-opcode: 3/4 2/1>
<point: starting-point>
<point: intermediate-point>
<point: ending-point>

8.5.14 CIRCULAR ARC 3 POINT CLOSE

<CIRCULAR-ARC-3-POINT-CLOSE-opcode: 3/4 2/2>
<point: starting-point>

<point: intermediate-point>
<point: ending-point>
<enumerated: close-type>

<enumerated: close-type> = <integer: 0> {pic}
| <integer: 1> {chord}

8.5.15 CIRCULAR ARC CENTRE

<CIRCULAR-ARC-CENTRE-opcode: 3/4 2/3>
<point: centrepoint>
<VDC: DX_start>
<VDC: DY_start>
<VDC: DX_end>
<VDC: DY_end>
<VDC: radius>

8.5.16 CIRCULAR ARC CENTRE CLOSE

<CIRCULAR-ARC-CENTRE-CLOSE-opcode: 3/4 2/4>
<point: centrepoint>
<VDC: DX_start>
<VDC: DY_start>
<VDC: DX_end>
<VDC: DY_end>
<VDC: radius>
<enumerated: close-type>

<enumerated: close-type> = <integer: 0> {pie}
| <integer: 1> {chord}

8.5.17 ELLIPSE

<ELLIPSE-opcode: 3/4 2/5>
<point: centrepoint>
<point: endpoint of first conjugate diameter>
<point: endpoint of second conjugate diameter>

8.5.18 ELLIPTICAL ARC

<ELLIPTICAL-ARC-opcode: 3/4 2/6>
<point: centrepoint>
<point: endpoint of first conjugate diameter>
<point: endpoint of second conjugate diameter>
<VDC: DX_start>
<VDC: DY_start>
<VDC: DX_end>
<VDC: DY_end>

8.5.19 ELLIPTICAL ARC CLOSE

<ELLIPTICAL-ARC-CLOSE-opcode: 3/4 2/7>
<point: centrepoint>
<point: endpoint of first conjugate diameter>
<point: endpoint of second conjugate diameter>
<VDC: DX_start>
<VDC: DY_start>
<VDC: DX_end>
<VDC: DY_end>
<enumerated: close-type>

<enumerated: close-type> = <integer: 0> {pie}
| <integer: 1> {chord}

8.5.20 CIRCULAR ARC CENTRE REVERSED

<CIRCULAR-ARC-CENTRE-REVERSED-opcode: 3/4 2/8>
<point: centrepoint>
<VDC: DX_start>
<VDC: DY_start>
<VDC: DX_end>
<VDC: DY_end>
<VDC: radius>

8.5.21 CONNECTING EDGE

<CONNECTING-EDGE-opcode: 3/4 2/9>

8.5.22 HYPERBOLIC ARC

<HYPERBOLIC-ARC-opcode: 3/4 2/10>
<point: centre-point>
<point: transverse-radius-endpoint>
<point: conjugate-radius-endpoint>
<VDC: DX_start>
<VDC: DY_start>
<VDC: DX_end>
<VDC: DY_end>

8.5.23 PARABOLIC ARC

<PARABOLIC-ARC-opcode: 3/4 2/11>
<point: tangent-intersection-point>
<point: start-point>
<point: end-point>

8.5.24 NON-UNIFORM B-SPLINE

<NON-UNIFORM-B-SPLINE-opcode: 3/4 2/12>
<integer: spline-order>
<integer: number-of-control-points>
<control-points>
<list-of-knots>
<real: parameter-start-value>
<real: parameter-end-value>

<integer: spline-order>	=	<positive integer> {m>0}
<integer: number-of-control-points>	=	<positive integer> {n≥m}
<control-points>	=	<point: control-point>(n)
<list-of-knots>	=	<real: knot>(m+n)

8.5.25 NON-UNIFORM RATIONAL B-SPLINE

<NON-UNIFORM-B-SPLINE-opcode: 3/4 2/13>
<integer: spline-order>
<integer: number-of-control-points>
<control-points>
<list-of-knots>
<real: parameter-start-value>
<real: parameter-end-value>
<weights>

<integer: spline-order>	=	<positive integer> {m>0}
<integer: number-of-control-points>	=	<positive integer> {n≥*m*}
<control-points>	=	<point: control-point>(n)
<list-of-knots>	=	<real: knot>(m+n)
<weights>	=	<real: weight>(n)

8.5.26 POLYBEZIER

<POLYBEZIER-opcode: 3/4 2/14>
<index: continuity indicator>
<control-points>

<index: continuity indicator>	=	<integer: 1> {discontinuous}
	|	<integer: 2> {continuous}
<control-points>	=	<point>(n) {n≥4}

8.5.27 POLYSYMBOL

<POLYSYMBOL-opcode: 3/4 2/15>
<index: symbol-index>
<point>
<point-list>

<index: symbol-index> = <positive integer>

<point-list> = <point>*

8.5.28 BITONAL TILE

<BITONAL-TILE-opcode: 3/4 3/0>
<index: compression-type>
<integer: row-padding-indicator>
<cell-background-colour>
<cell-foreground-colour>
<structured-data-record: method-specific-parameters>
<bitstream: compressed-colour-specifiers>

<index: compression-type> = <integer: 0> {null background}
| <integer: 1> {null foreground}
| <integer: 2> {T6}
| <integer: 3> {T4 1-dimensional}
| <integer: 4> {T4 2-dimensional}
| <integer: 5> {bitmap}
| <integer: 6> {run length}
| <integer: >6> {reserved for registered values}

<integer: row-padding-indicator> = <non-negative integer>

<cell-background-colour> = <colour specifier> {see 8.}

<cell-foreground-colour> = <colour specifier> {see 8.}

<structured-data-record: method-specific-parameters>=
<SOS>
<method-specific-record-contents>
<ST>

<method-specific-record-contents> = <>{null, for compression types 1-5}
= <<integer: i_I><integer: 1><run-count precision>> {types 6}
= {register-defined, for types >6}

NOTE — i_I in the above denotes the integer value of the 'data type designator' for data type Integer as assigned in annex C of ISO/IEC 8632-1.

8.5.29 TILE

<TILE-opcode: 3/4 3/1>
<index: compression-type>
<integer: row-padding-indicator>
<integer: cell-colour-precision>
<structured-data-record: method-specific-parameters>
<bitstream: compressed-colour-specifiers>

<index: compression-type>	=	<integer: 0> {null background}
	|	<integer: 1> {null foreground}
	|	<integer: 2> {T6}
	|	<integer: 3> {T4 1-dimensional}
	|	<integer: 4> {T4 2-dimensional}
	|	<integer: 5> {bitmap}
	|	<integer: 6> {run length}
		{>6, reserved for registered values}
<integer: row-padding-indicator>	=	<non-negative integer>
<integer: cell-colour-precision>	=	<non-negative integer>
<cell-colour-precision>	=	<default-colour-precision-indicator>
	|	<number-of-bits>
<default-colour-precision-indicator>	=	<integer: 0>
<number-of-bits>	=	<positive integer>

The value 0 for the local-colour-precision is the 'default colour precision indicator'. It indicates that the colour specifiers of the TILE element, prior to compression, are in the precision of the COLOUR INDEX PRECISION or the COLOUR PRECISION (depending upon the value of the COLOUR SELECTION MODE).

<structured-data-record: method-specific-parameters>=
<SOS>
<method-specific-record-contents>
<ST>

<method-specific-record-contents>	=	<>{null, for compression types 1-5}
	=	<<integer: i_I><integer: 1><run-count precision>> {types 6}
	=	{register-defined, for types >6}

NOTE — i_I in the above denotes the integer value of the 'data type designator' for data type Integer as assigned in Annex C of ISO/IEC 8632-1.

8.6 Attribute elements

8.6.1 LINE BUNDLE INDEX

<LINE-BUNDLE-INDEX-opcode: 3/5 2/0>
<index: line-bundle-index>

<index: line-bundle-index> = <positive integer>

8.6.2 LINE TYPE

<LINE-TYPE-opcode: 3/5 2/1>
<index: line-type>

<index: line-type> =
| <integer: 1> {solid}
| <integer: 2> {dash}
| <integer: 3> {dot}
| <integer: 4> {dash-dot}
| <integer: 5> {dash-dot-dot}
| <integer: >5> {reserved for registered values}
| <integer: negative> {private line type}

8.6.3 LINE WIDTH

<LINE-WIDTH-opcode: 3/5 2/2>
<size-specifier: line-width-specifier> {see clause 8.}

8.6.4 LINE COLOUR

<LINE-COLOUR-opcode: 3/5 2/3>
<colour-specifier> {see clause 8.}

8.6.5 MARKER BUNDLE INDEX

<MARKER-BUNDLE-INDEX-opcode: 3/5 2/4>
<index: marker-bundle-index>

<index: marker-bundle-index> = <positive integer>

8.6.6 MARKER TYPE

<MARKER-TYPE-opcode: 3/5 2/5>
<index: marker-type>

Attribute elements		Representation of each element
<index: marker-type>	=	<integer: 1> {dot}
	|	<integer: 2> {plus}
	|	<integer: 3> {asterisk}
	|	<integer: 4> {circle}
	|	<integer: 5> {cross (x)}
	|	<integer: >5> {reserved for registered values}
	|	<integer: negative> {private marker type}

8.6.7 MARKER SIZE

<MARKER-SIZE-opcode: 3/5 2/6>
<size-specifier: marker-size-specifier> {see clause 8.}

8.6.8 MARKER COLOUR

<MARKER-COLOUR-opcode: 3/5 2/7>
<colour-specifier: marker-colour> {see clause 8.}

8.6.9 TEXT BUNDLE INDEX

<TEXT-BUNDLE-INDEX-opcode: 3/5 3/0>
<index: text-bundle-index>

<index: text-bundle-index> = <positive integer>

8.6.10 TEXT FONT INDEX

<TEXT-FONT-INDEX-opcode: 3/5 3/1>
<index: text-font-index>

<index: text-font-index> = <positive integer>

8.6.11 TEXT PRECISION

<TEXT-PRECISION-opcode: 3/5 3/2>
<enumerated: text-precision>

<enumerated: text-precision>	=	<integer: 0> {string}
	|	<integer: 1> {character}
	|	<integer: 2> {stroke}

8.6.12 CHARACTER EXPANSION FACTOR

<CHARACTER-EXPANSION-FACTOR-opcode: 3/5 3/3>
<real: expansion-factor>

<real: expansion-factor> = <non-negative real>

8.6.13 CHARACTER SPACING

<CHARACTER-SPACING-opcode: 3/5 3/4>
<real: character-spacing>

8.6.14 TEXT COLOUR

<TEXT-COLOUR-opcode: 3/5 3/5>
<colour-specifier> {see clause 8.}

8.6.15 CHARACTER HEIGHT

<CHARACTER-HEIGHT-opcode: 3/5 3/6>
<VDC: character-height>

<VDC: character-height> = <non-negative VDC>

8.6.16 CHARACTER ORIENTATION

<CHARACTER-ORIENTATION-opcode: 3/5 3/7>
<VDC: x-component of up vector>
<VDC: y-component of up vector>
<VDC: x-component of base vector>
<VDC: y-component of base vector>

8.6.17 TEXT PATH

<TEXT-PATH-opcode: 3/5 3/8>
<enumerated: text-path>

<enumerated: text-path> = <integer: 0> {right}
| <integer: 1> {left}
| <integer: 2> {up}
| <integer: 3> {down}

8.6.18 TEXT ALIGNMENT

<TEXT-ALIGNMENT-opcode: 3/5 3/9>
<enumerated: horizontal-alignment>
<enumerated: vertical-alignment>
<real: continuous-horizontal-alignment>
<real: continuous-vertical-alignment>

<enumerated: horizontal-alignment> = <integer: 0> {normal horizontal}

Attribute elements **Representation of each element**

	|	<integer: 1> {left}
	|	<integer: 2> {centre}
	|	<integer: 3> {right}
	|	<integer: 4> {continuous horizontal}
<enumerated: vertical-alignment>	=	<integer: 0> {normal vertical}
	|	<integer: 1> {top}
	|	<integer: 2> {cap}
	|	<integer: 3> {half}
	|	<integer: 4> {base}
	|	<integer: 5> {bottom}
	|	<integer: 6> {continuous vertical}

8.6.19 CHARACTER SET INDEX

<CHARACTER-SET-INDEX-opcode: 3/5 3/10>
<index: character-set-index>

<index: character-set-index> = <positive integer>

8.6.20 ALTERNATE CHARACTER SET INDEX

<ALTERNATE-CHARACTER-SET-INDEX-opcode: 3/5 3/11>
<index: alternate-character-set-index>

<index: alternate-character-set-index> = <positive integer>

8.6.21 FILL BUNDLE INDEX

<FILL-BUNDLE-INDEX-opcode: 3/6 2/0>
<index: fill-bundle-index>

<index: fill-bundle-index> = <positive integer>

8.6.22 INTERIOR STYLE

<INTERIOR-STYLE-opcode: 3/6 2/1>
<enumerated: interior-style>

<enumerated: interior-style>	=	<integer: 0>	{hollow}
	|	<integer: 1>	{solid}
	|	<integer: 2>	{pattern}
	|	<integer: 3>	{hatch}
	|	<integer: 4>	{empty}
	|	<integer: 5>	{geometric pattern}
	|	<integer: 6>	{interpolated}