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Information technology — Computer graphics — Interfacing techniques for dialogues with graphical devices (CGI) — Functional specification —

Part 3: Output

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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 9636-3 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology.*

ISO/IEC 9636 consists of the following parts, under the general title *Information technology — Computer graphics — Interfacing techniques for dialogues with graphical devices (CGI) — Functional specification*:

— *Part 1: Overview, profiles, and conformance*
— *Part 2: Control*
— *Part 3: Output*
— *Part 4: Segments*
— *Part 5: Input and echoing*
— *Part 6: Raster*

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Annexes A and B form an integral part of this part of ISO/IEC 9636. Annexes C, D, E, F, G, and H are for information only.

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Introduction

This part of ISO/IEC 9636 describes the functions needed for generating and displaying graphical output.

The functional capability incorporated in this part of ISO/IEC 9636 is concerned with graphic primitives and their associated attributes, control over the graphic object output pipeline, and the rendering of graphic objects. It should at least be read in conjunction with the overview in ISO/IEC 9636-1, and the general control functions detailed in ISO/IEC 9636-2.

The functional capability described in this part of ISO/IEC 9636 applies to CGI Virtual Devices of class OUTPUT and OUTIN.

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Information technology – Computer graphics – Interfacing techniques for dialogues with graphical devices (CGI) – Functional specification –

Part 3:
Output

1 Scope

This part of ISO/IEC 9636 establishes those functions of the Computer Graphics Interface concerned with output primitives and associated attributes and controls for creating graphical pictures.

This part of ISO/IEC 9636 is part 3 of ISO/IEC 9636, and should be read in conjunction with ISO/IEC 9636-1 and ISO/IEC 9636-2. The relationship of this part of ISO/IEC 9636 to the other parts of ISO/IEC 9636 is described in ISO/IEC 9636-1 and in clause 4.

The functionality described in this part of ISO/IEC 9636 pertains to OUTPUT and OUTIN classes of CGI Virtual Device.

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2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 9636. 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 9636 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 646 : 1983 *Information processing – 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 8632-1 : 1987 *Information processing systems – Computer graphics – Metafile for the storage and transfer of picture description information (CGM) – Part 1: Functional specification.*

ISO/IEC 9541-1 : -[1)] *Information technology – Font information interchange – Part 1: Architecture.*

ISO/IEC 9541-2 : -[1)] *Information technology – Font information interchange – Part 2: Interchange format.*

ISO/IEC 9541-3 : -[1)] *Information technology – Font information interchange – Part 3: Glyph shape representation.*

ISO/IEC 9592-1 : 1989 *Information processing systems – Computer graphics – Programmer's Hierarchical Interactive Graphics System (PHIGS) – Part 1: Functional description.*

ISO/IEC 9636-1 : 1991 *Information technology — Computer graphics — Interfacing techniques for dialogues with graphical devices (CGI) — Functional specification — Part 1: Overview, profiles, and conformance.*

ISO/IEC 9636-2 : 1991 *Information technology — Computer graphics — Interfacing techniques for dialogues with graphical devices (CGI) — Functional specification — Part 2: Control.*

ISO/IEC 9636-4 : 1991 *Information technology — Computer graphics — Interfacing techniques for dialogues with graphical devices (CGI) — Functional specification — Part 4: Segments.*

ISO/IEC 9636-5 : 1991 *Information technology — Computer graphics — Interfacing techniques for dialogues with graphical devices (CGI) — Functional specification — Part 5: Input and echoing.*

ISO/IEC 9636-6 : 1991 *Information technology — Computer graphics — Interfacing techniques for dialogues with graphical devices (CGI) — Functional specification — Part 6: Raster.*

ISO/IEC 9637-1 : -[1)] *Information technology — Computer graphics — Interfacing techniques for dialogues with graphical devices (CGI) — Data stream binding — Part 1: Character encoding.*

ISO/IEC 9637-2 : -[1)] *Information technology — Computer graphics — Interfacing techniques for dialogues with graphical devices (CGI) — Data stream binding — Part 2: Binary encoding.*

ISO/IEC TR 9973 : 1988 *Information processing — Procedures for registration of graphical items.*

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1) To be published.

3 Concepts

3.1 Introduction

This part of ISO/IEC 9636 covers the device-independent graphic object output functionality of the CGI. It covers primitive functions, attributes, object formation and subsequent processing, and related control and inquiry functionality. This functionality is divided into the following areas:

- *Graphic primitive functions*, which describe the geometry of the components of a picture in the CGI.
- *Attribute functions*, which set modal values in state lists that are used to determine certain properties (including visual aspects) of these geometric picture components.
- *General attribute and output control functions*, which specify the modes of operation of certain other functions, control some aspects of the device's operation with respect to graphic objects and attribute functions, and which provide facilities for the construction of compound objects.
- *Retrieval function*, which returns information useful for the positioning of text objects.
- *Output inquiry functions*, which provide access to the description tables and state lists concerned with output and attributes.

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3.2 General output concepts

3.2.1 Types of graphic primitive functions

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The CGI defines graphic primitive functions for the specification of the geometry of the components of a picture.

These graphic primitive functions, grouped according to primitive type: line, marker, text, fill, and image, are as follows:

Line functions:	*Fill functions:*
POLYLINE	POLYGON
DISJOINT POLYLINE	POLYGON SET
CIRCULAR ARC 3 POINT	RECTANGLE
CIRCULAR ARC CENTRE	CIRCLE
CIRCULAR ARC CENTRE REVERSED	CIRCULAR ARC 3 POINT CLOSE
ELLIPTICAL ARC	CIRCULAR ARC CENTRE CLOSE
CONNECTING EDGE	ELLIPSE
	ELLIPTICAL ARC CLOSE
Marker function:	*Text functions:*
POLYMARKER	TEXT
	APPEND TEXT
	RESTRICTED TEXT
Image function:	*Generalized drawing primitive function:*
CELL ARRAY	GENERALIZED DRAWING PRIMITIVE (GDP)

NOTE – GDP does not have an explicit primitive type, but rather an instance of GDP may generate a primitive of one of the above primitive types depending on the specific GDP identifier.

See ISO/IEC 9636-1, 5.2.1 for an overall description of graphic primitives in relationship to the CGI Graphic Object Pipeline.

3.2.2 Attributes and controls

Primitives have attribute values associated with them as they pass through the Graphic Object Pipeline. Once a set of attribute values has been associated with a primitive the complete entity is referred to as a graphic object. Some of these attribute values determine the appearance of primitives when they are rendered as graphic objects. See ISO/IEC 9636-1, 5.2.1 for an overview of where attribute values are associated and used within the Graphic Object Pipeline.

Control functions are also defined in this part of ISO/IEC 9636 and provide control over other operations of the Graphic Object Pipeline, e.g. colour table. Some of these control functions also set corresponding entries in CGI state lists, but these control values are not associated with graphic primitives.

3.2.3 Output states

The Output State entry in the General Attributes and Output Control State List applies to the functions defined in this part of ISO/IEC 9636. The Output State may have only one of the values ACTIVE, TEXT OPEN, or FIGURE OPEN, the normal state being ACTIVE. It is set to state TEXT OPEN during the construction of a compound text object and to state FIGURE OPEN during the construction of a closed figure object. Figure 1 illustrates the output states of this part of ISO/IEC 9636 and indicates which functions result in a state transition.

State restrictions are defined in Output State TEXT OPEN for all primitive functions which do not contribute to compound text (see table 2). In particular, in Output State TEXT OPEN, all graphic primitive functions except APPEND TEXT are prohibited. Similarly, in Output State FIGURE OPEN, primitive functions which do not contribute to the construction of closed figures (i.e. all but line and fill type primitives) are prohibited (see table 3). In Output State ACTIVE, primitive functions which are relevant only in the state TEXT OPEN and FIGURE OPEN are prohibited (see table 1). There are no state restrictions applicable to attribute setting functions in any of these states.

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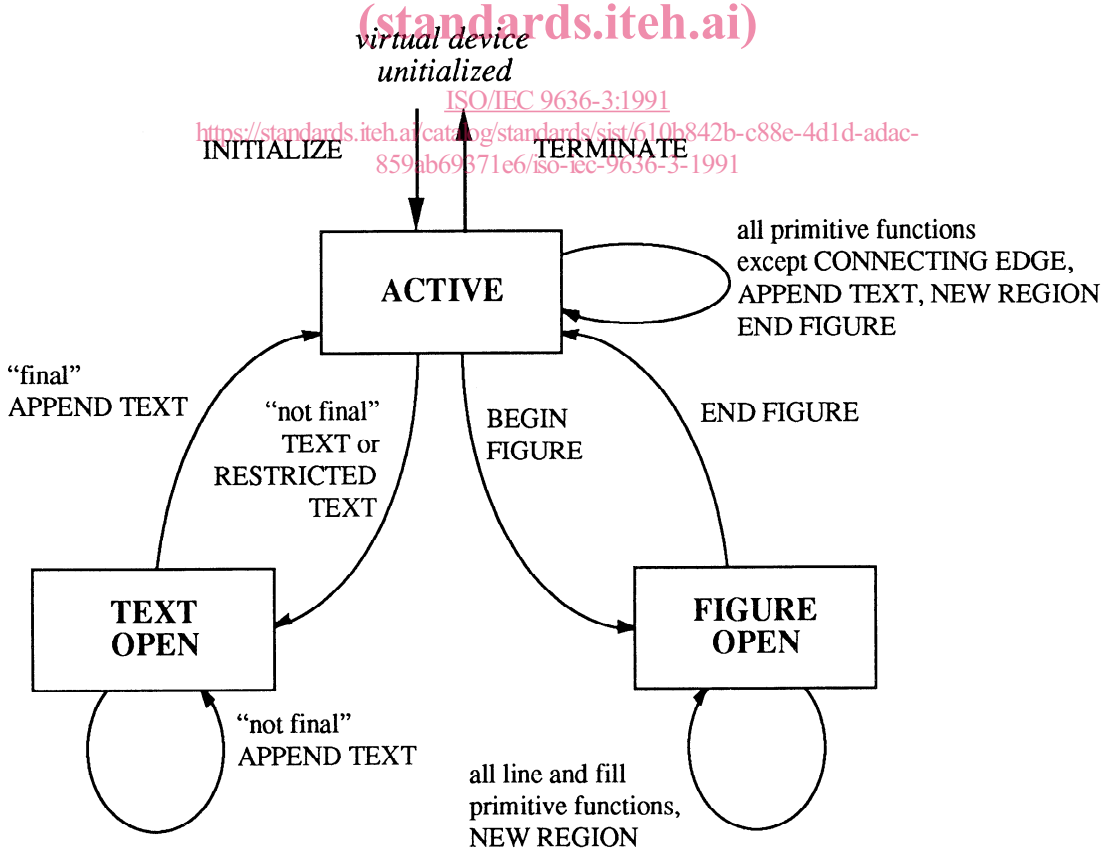

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NOTE – Whether or not a particular GDP is allowed in any of the output states is dependent on the specification of the GDP and its defined effect on the Output State entry in the General Attributes and Output Control State List.

Figure 1 – Output state diagram (for primitive functions)

Table 1 – Functions Not Allowed in Output State ACTIVE

APPEND TEXT	CONNECTING EDGE
END FIGURE	NEW REGION

Table 2 – Functions Not Allowed in Output State TEXT OPEN

POLYLINE	CIRCULAR ARC CENTRE
DISJOINT POLYLINE	CIRCULAR ARC CENTRE REVERSED
CIRCULAR ARC 3 POINT	ELLIPTICAL ARC
CONNECTING EDGE	
POLYGON	CIRCULAR ARC 3 POINT CLOSE
POLYGON SET	CIRCULAR ARC CENTRE CLOSE
RECTANGLE	ELLIPSE
CIRCLE	ELLIPTICAL ARC CLOSE
BEGIN FIGURE	END FIGURE
NEW REGION	
TEXT	RESTRICTED TEXT
POLYMARKER	CELL ARRAY

Table 3 – Functions Not Allowed in Output State FIGURE OPEN

TEXT	POLYMARKER
RESTRICTED TEXT	CELL ARRAY
APPEND TEXT	BEGIN FIGURE

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3.3 Individual and bundled attribute values

3.3.1 Introduction

The appearance of a graphic object is determined by a number of attribute values associated with the object. These attribute values control both the geometric and non-geometric aspects of the object. In addition, there is an attribute value which is used to identify an object or group of objects in a segment (see ISO/IEC 9636-4 for the definition of pick identifier).

These attribute values are set modally and have entries in primitive type specific state lists. Individual specification of these attributes is provided by separately defined CGI functions. A subsequent change of the state list entry for an attribute will not affect the value associated with any existing graphic objects. Attribute values associated from such state list entries are referred to as individual attribute values.

Some attribute values may, in addition to this modal specification, be grouped into bundle entries in various bundle tables. Bundle tables are defined for line, marker, text, fill, and edge. A particular bundle entry can be selected for use with an object via a bundle index attribute. There is a bundle index attribute value for each primitive type (with the exception of the image type).

Whether the value for a particular attribute is a directly associated modal value or whether it is indirectly referenced by means of a bundle index attribute value and subsequently obtained from the referenced bundle is determined by a further set of attributes, called aspect source flags (ASFs). Each ASF may take either the value INDIVIDUAL or BUNDLED and allows the distinction to be made for each of the attribute values which may be bundled.

A number of bundles are predefined when the CGI Virtual Device is initialized. Each such predefined bundle shall be visually distinguishable from that of the other predefined bundles for a given primitive type when all aspect source flags are BUNDLED. These and other bundles may subsequently be redefined by the client. Bundles may be deleted by the client. However, the predefined bundle with index 1 cannot be deleted.

If the values of a bundle are changed and that bundle is already in use, a modification of the rendered picture may result. Whether such modification of the rendered picture occurs immediately on execution of the changing function or at some later time is determined by the Implicit Segment Regeneration Mode (see ISO/IEC 9636-4) and is dependent on whether the Virtual Device has segment capabilities. The Dynamic Modification Accepted For entries in the output description tables of an implementation indicate which changes may be performed immediately or may lead to subsequent regeneration.

3.3.2 Modes of attribute specification and selection

In CGI state lists, the values for attributes controlled by specification or selection modes are stored in the mode in which they were last specified (or the mode corresponding to the default value) along with the value of the corresponding mode. The corresponding attributes in the bundle tables are also stored in the mode in which they were specified, along with the specification mode. When the attribute value is associated with a primitive, during object formation, the mode in which it was set is also associated. The stored mode acts as a data type identification, and is used for that purpose in the inquiry functions based on the state list. These stored values are thereafter independent of the current specification or selection mode on the General Attributes and Output Control State List.

3.4 Colour

3.4.1 Direct and indexed modes

The CGI provides two mechanisms for colour selection:

- Direct, in which the colour is defined by providing values for the normalized weights of the RGB components, and
- Indexed, in which the colour is defined by an index into a table of colour values.

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Selection of one of these mechanisms may be achieved using the function COLOUR SELECTION MODE. It is possible to have both direct and indexed colour in use simultaneously in the same picture on devices which implement direct colour selection for object colour attributes.

ISO/IEC 9636-3:1991
https://standards.iteh.ai/catalog/standards/sist/610b842b-c88e-4d1d-adac-859ab69371e6/iso-iec-9636-3-1991

3.4.1.1 Direct colour and COLOUR VALUE EXTENT

For direct colour specification, the CGI uses the RGB additive colour model. Each colour specifier is a three-tuple of values providing the normalized weight of the red, green, and blue components of the desired colour.

The integer components of a client specified CD value are normalized to a three-tuple of abstract RGB colour values, each of which is a real number in the range [0.0, 1.0]. The normalization also has the property that any 3-tuple with 3 identical components, (x,x,x), represents equal weights of the red, green, and blue components. For any given component, one end of the range (0.0) indicates that none of that component is included, and the other end (1.0) indicates that the maximum intensity of that component is included in the colour, with an infinite number of component values in between. (0,0,0) thus represents black, (1,1,1) represents white, and (x,x,x) with x between 0 and 1 represents a grey.

The abstract minimum colour value of (0,0,0) is represented by (min_red, min_green, min_blue) and the abstract maximum colour value of (1,1,1) is represented by (max_red, max_green, max_blue). These minimum and maximum values are specified with the COLOUR VALUE EXTENT function which defines a linear mapping of these values onto the device's abstract colour range.

Although CGI supports only the RGB colour model, it provides entries in the Output Control Description Table for constants which are necessary for conversion of colour values between the CIE colour model and RGB colour model. A client may inquire these values and use them in performing the colour model conversion. (See ISO/IEC 9592-1, annex I.)

3.4.1.2 Indexed colour and COLOUR TABLE

The colour table used with indexed colour selection is a contiguous set of colour values indexed from the range [0, colour table size - 1]. It is initialized in the following manner: index 0 contains an implementation-dependent background colour; index 1 and greater contain implementation-dependent foreground colours. The COLOUR TABLE function is provided for changing the contents of the colour table by specifying the colour by RGB values as described above. The COLOUR TABLE function may be used at various times throughout the specification of a picture. However, whether changes in the colour table

affect the appearance of any rendered graphic objects that use the affected indices is indicated by the Dynamic Modification Accepted For Colour Table entry in the Output Control Description Table.

3.4.1.3 Gamma correction

There is no gamma correction nor specification of the source colours implied for the tri-stimulus values for direct colour specification. This degree of control over colour may be available on an implementation-dependent basis through the use of ESCAPE functions.

3.4.1.4 Colour and monochromatic devices

All devices capable of displaying output are considered to have at least two colours – the background and the foreground. The drawing medium will always count as one colour for the Number of Simultaneously Available Direct Colours, Number of Simultaneously Available Indexed Colours, and Number of Available Colours entries in the Output Description Table. Therefore, none of the colour counts may be less than two.

Interpretation of the Number of Simultaneously Available Direct Colours or the Number of Simultaneously Available Indexed Colours, when either is greater than two, depends on whether the device is monochromatic. If the Monochromatic Device entry in the Output Control Description Table is NO, then the device is capable of rendering at least two different foreground colours (varying in either hue or saturation) but not differing exclusively in intensity (such as light green, dark green). If the Monochromatic Device entry is YES, then the interpretation of the Number of Simultaneously Available Direct Colours when colour selection mode is DIRECT and the Number of Simultaneously Available Indexed Colours when colour selection mode is INDEXED is taken to mean the number of steps in a single colour intensity scale whose low value is closest to the default background colour (or drawing medium for those devices without background colour capability) and whose high value has maximum contrast relative to the default background colour.

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3.4.1.5 Transparency and auxiliary colour

Various graphic primitives have "holes" which may or may not be rendered. Examples of such "holes" include gaps in dashed lines or edges, the background of a character cell, and the spaces between lines in a hatched fill primitive.

ISO/IEC 9636-3:1991
https://standards.iteh.ai/catalog/standards/sist/610b842b-c88e-4d1d-adac-859ab69371c6/iso-iec-9636-3-1991

Two of the general attributes which are associated with graphic primitives as they enter the graphic object pipeline are TRANSPARENCY and AUXILIARY COLOUR. The associated TRANSPARENCY attribute value determines whether the drawing of the "holes" occurs. If this attribute value is TRANSPARENT, those portions of the object which are considered to be "holes" will not be drawn; hence, potentially affected portions of the graphic picture remain unchanged. If this attribute value is OPAQUE, those portions of the object which are considered to be "holes" will be drawn; hence, affected portions of the graphic picture will be modified. The associated AUXILIARY COLOUR attribute value is used in determining the colour of the "holes". The DRAWING MODE attribute associated with the object is not applied (see 3.4.1.6) until after the application of TRANSPARENCY and AUXILIARY COLOUR.

When TRANSPARENCY is OPAQUE, non-solid (e.g. dot-dash) lines or edges, text, and hatched interiors for fill objects are rendered as two separate point sets in abstract DC space: one with the normal associated colour attribute values and the other with the associated auxiliary colour attribute value.

3.4.1.6 Overwrite capability, colour realization, and DRAWING MODE

Due to inherent technology differences, the physical devices used as the display for CGI Virtual Devices differ in their behaviour when something is rendered in the same physical location on the drawing surface as previously rendered output or displayed on the display surface at the same location as previously displayed output.

Raster technology devices can overwrite the contents of the drawing surface, so that each object rendered "in front of" previously rendered ones (see the lower right-hand picture shown in figure 2). Vector devices cannot usually do this: the Colour Overwrite entry in the Output Control Description Table indicates whether the Virtual Device has this capability.

Output rendered on the drawing surface will ultimately be displayed on the display surface; it may be mixed additively or subtractively on the display surface with which previously displayed output (see the lower left-hand picture shown in figure 2). The Colour Realization entry in the Output Control Description Table indicates which colour mixing is used.