SLOVENSKI STANDARD
SIST EN ISO/IEC 9592-4:1998

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Information processing systems - Computer graphics - Programmer's Hierarchical Interactive Graphics System (PHIGS) - Part 4: Plus Lumiere und Surfaces, PHIGS PLUS (ISO/IEC 9592-4:1992, including Technical Corrigendum 1:1994)

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Systemes de traitement de l'information - Infographie - Interface de programmation du systeme graphique hiérarchisé (PHIGS) - Partie 4: Plus Lumiere und Surfaces, PHIGS PLUS (ISO/IEC 9592-4:1992, Rectificatif Technique 1:1994 inclus)

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Information processing systems - Computer graphics - Programmer's Hierarchical Interactive Graphics System (PHIGS) - Part 4: Plus Lumière und Surfaces, PHIGS PLUS (ISO/IEC 9592-4:1992, including Technical Corrigendum 1:1994)

Systèmes de traitement de l'information - Infographie - Interface de programmation du système graphique hiérarchisé (PHIGS) - Partie 4: Plus Lumière und Surfaces, PHIGS PLUS (ISO/IEC 9592-4:1992, Rectificatif Technique 1:1994 inclus)

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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Foreword

The text of the International Standard from ISO/IEC/JTC 1 "Information Technology" of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) has been taken over as a European Standard by the Technical Board of CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 1996, and conflicting national standards shall be withdrawn at the latest by August 1996.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Endorsement notice

The text of the International Standard ISO/IEC 9592-4:1992, including Technical Corrigendum 1:1994 has been approved by CEN as a European Standard without any modification.

INTERNATIONAL STANDARD

ISO/IEC 9592-4

First edition
1992-09-01

Information processing systems — Computer graphics — Programmer's Hierarchical Interactive Graphics System (PHIGS) —

Part 4: Plus Lumière und Surfaces, PHIGS PLUS

Systèmes de traitement de l'information — Infographie — Interface de programmation du système graphique hiérarchisé (PHIGS) — Partie 4: Plus Lumière und Surfaces, PHIGS PLUS

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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 9592-4 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*.

ISO/IEC 9592 consists of the following parts, under the general title *Information processing systems — Computer graphics — Programmer's Hierarchical Interactive Graphics System (PHIGS)*:

— *Part 1: Functional description*

— *Part 2: Archive file format*

— *Part 3: Clear-text encoding of archive file*

— *Part 4: Plus Lumière und Surfaces, PHIGS PLUS*

Annex D forms an integral part of this part of ISO/IEC 9592. Annexes A, B, C, E and F are for information only.

Introduction

ISO/IEC 9592-1 provides a set of functions for the definition, display and modification of 2D or 3D graphical data. It does not provide support for simulating the effects of lighting, shading, and other properties that are important for the display of multi-dimensional data. This part of ISO/IEC 9592 specifies a basic set of such functionality for use in conjunction with the functionality defined in ISO/IEC 9592-1 and its amendment 1.

To provide this support, PHIGS PLUS defines

a) output primitives specified by rational and non-rational B-spline curves and surfaces;

b) output primitives containing both geometric and non-geometric data in their definition;

c) attributes that control the application of lighting and shading to both the new primitives and the primitives specified in ISO/IEC 9592-1;

d) a generalized mechanism for colour specification to allow non-indexed colour specification.

Information processing systems– Computer graphics– Programmer's Hierarchical Interactive Graphics System (PHIGS)– Part 4—Plus Lumière und Surfaces, PHIGS PLUS

1 Scope

This part of ISO/IEC 9592 specifies an additional set of functionality of the Programmer's Hierarchical Interactive Graphics System. This additional functionality is intended to satisfy basic application requirements in the areas of lighting and shading and defines additional primitives and functionality for controlling the rendering of 3D objects. It relies on the coexistence of the functions and functionality specified in ISO/IEC 9592-1, and is meant to extend that functionality in the above areas.

It is the intent of this part of ISO/IEC 9592 to be compatible with ISO/IEC 9592-1 and its Amendment 1. That is, in a standard conforming PHIGS PLUS implementation all functions defined in ISO/IEC 9592-1 and not altered by ISO/IEC 9592-4 shall perform as specified in ISO/IEC 9592-1, and all functions defined in ISO/IEC 9592-1 but altered in ISO/IEC 9592-4 shall perform as specified in ISO/IEC 9592-1 and ISO/IEC 9592-4, and, an application functionally conforming to ISO/IEC 9592-1 produces the same effect running on a standard conforming PHIGS PLUS implementation as it would produce running on a standard conforming PHIGS ISO/IEC 9592-1 implementation, excepting such differences among implementations as are allowed in ISO/IEC 9592-1. If PHIGS PLUS functions are used, they should only cause the extended effects specified in this part of ISO/IEC 9592.

This part of ISO/IEC 9592 defines a language independent extension to a graphics system for integration into a programming language. PHIGS PLUS is embedded in a language layer obeying the particular conventions of the language. Such language bindings are specified for ISO or ISO/IEC languages in ISO/IEC 9593.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 9592. 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 9592 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated 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 exchange.*

ISO/IEC 7942:1985, *Information processing systems – Computer graphics – Graphical Kernel System (GKS) functional description.*

ISO/IEC 8632:1987, *Information processing systems – Computer graphics – Metafile for storage and transfer of picture description information.*

ISO/IEC 8805:1988, *Information processing systems – Computer graphics – Graphical Kernel System for Three Dimensions (GKS-3D) functional description.*

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

ISO/IEC 9592-1:1989/Amd.1:1992, *Information processing systems – Computer graphics – Programmer's Hierarchical Interactive Graphics System (PHIGS) – Part 1: Functional description – Amendment 1.*

ISO/IEC 9592-2:1989, *Information processing systems – Computer graphics – Programmer's Hierarchical Interactive Graphics System (PHIGS) – Part 2: Archive file format.*

ISO/IEC 9592-2:1989/Amd.1:1992, *Information processing systems – Computer graphics – Programmer's Hierarchical Interactive Graphics System (PHIGS) – Part 2: Archive file format – Amendment 1.*

ISO/IEC 9592-3:1989, *Information processing systems – Computer graphics – Programmer's Hierarchical Interactive Graphics System (PHIGS) – Part 3: Clear text encoding of archive file.*

ISO/IEC 9592-3:1989/Amd.1:1992, *Information processing systems – Computer graphics – Programmer's Hierarchical Interactive Graphics System (PHIGS) – Part 3: Clear text encoding of archive file – Amendment 1.*

ISO/IEC 9593:1990, *Information processing systems – Computer graphics – Programmer's Hierarchical Interactive Graphics System (PHIGS) language bindings.*

3 Definitions

For the purpose of this part of ISO/IEC 9592 the following definitions apply. This part of ISO/IEC 9592 also makes use of the definitions in ISO/IEC 9592-1. (Terms used within definitions in this clause that are themselves defined in this clause are italicized.)

3.1 ambient light source: A *light source* that contributes to the *reflectance calculation* independently of the orientation or position of the area being illuminated or the location of the viewer's eye.

3.2 ambient reflection coefficient: The fraction of *ambient light* reflected from an area.

3.3 area primitive: Any of the output primitives: fill area, fill area set, cell array, *fill area set with data*, cell array PLUS, *set of fill area sets with data*, *triangle set* with data, *triangle strip* with data, *quadrilateral mesh* with data, non-uniform B-spline surface and non-uniform B-spline surface with data. In addition, some generalized drawing primitives may have this classification.

3.4 attenuation coefficient: A coefficient that determines the decrease in intensity of light as a function of the distance between a *light source* and an illuminated object.

3.5 back facing: A back-facing facet has a *facet normal* that, when transformed to NPC, has a negative Z component. See also *front facing*.

3.6 colour mapping: The conversion of direct colours in the *rendering pipeline* to other colours before they are displayed on the workstation.

3.7 colour spline: The parametric curve or surface in colour space (or homogeneous colour space) defining the colour distribution over an output primitive.

3.8 concentration exponent: A parameter of a *spot light* source that specifies the relative decrease of light as the angle of the light diverges from the centreline of the light source's *cone of influence*.

3.9 cone of influence: A conceptual cone that represents the influence of light from a *spot light* source. The cone of influence is defined by the light source's position, direction and *spread angle*.

3.10 data mapping: The conversion of application-specific data or colour to *intrinsic colour*.

3.11 depth cueing: An effect in which the colours of points on an output primitive are combined with a specified depth cue colour. The degree of combination is dependent on the depth (Z in normalized projection coordinates) of the points.

3.12 depth cue mode: A field in each entry of the *depth cue table* of the workstation state list that indicates whether or not *depth cueing* should be performed.

3.13 depth cue table: A table in the workstation state list that contains information used to control *depth cueing*.

3.14 diffuse reflection: An approximation of the light reflected equally in all directions from an area.

3.15 diffuse reflection coefficient: The fraction of light from non-*ambient light* sources that is diffusely reflecting from an area.

3.16 direct colour specification: A non-indexed method of specifying colour where the components of the colour, i.e., coordinates in colour space, are specified together with the colour model in which those components are expressed.

3.17 directional light source: A *light source* that contributes to the *reflectance calculation* dependent on the orientation of the area being illuminated but independent of the area's position.

3.18 edge visibility flag: An indicator that is part of the specification of some output primitives, such as *fill area set with data*, that controls whether an individual edge is visible.

3.19 eye point: A point in world coordinates that transforms to infinite positive Z in normalized projection coordinates. This point is used in the *reflectance calculation* for determining viewing-position-dependent effects of lighting.

3.20 facet: An interior segment of an *area primitive*. Each facet of an output primitive is defined by a subset of the primitive's set of vertices. The subset is dependent on the individual primitive type, and in the case of parametric surfaces, on the approximation of the surface. Facets have an orientation in NPC described as *back-facing* or *front-facing*.

3.21 facet culling: The process of removing *front-facing* or *back-facing facets* of area primitives.

3.22 facet data: *Intrinsic colour* data or a *normal vector* specified with an *area primitive*.

3.23 facet normal: A *normal vector* associated with a *facet* of an *area primitive*. Facet normals are used to determine the orientation of a facet and in some cases for determining the *reflectance normal*.

3.24 fill area set with data: An output primitive consisting of a set of coplanar polygons. It is similar to the fill area set output primitive defined in ISO/IEC 9592-1. The corresponding structure element may include other information such as colours or normals that are conditionally used to colour, light and shade the output primitive.

3.25 front facing: A front-facing facet has a *facet normal* that, when transformed to NPC, has a positive or zero Z component. See also *back facing*.

3.26 general colour: A data type that allows both the direct and indirect specification of colour. General colour specifies a colour type together with a type-dependent colour value. The colour type can either indicate a colour model, in which case the colour values are coordinates in the colour space corresponding to that model, or it can indicate that the colour is being specified indirectly, in which case the single colour value is an index into the workstation-dependent colour table.

3.27 geometry spline: The parametric curve or surface defining the geometry of a *parametric output primitive*.

3.28 indirect colour specification: A method of specifying colour via an index into a workstation dependent colour table.

3.29 intrinsic colour: The colour or colours of an output primitive that are independent of *lighting*, *depth cueing* and *colour mapping*.

3.30 intrinsic colour data: Colour or application-specific data associated with output primitives and specified in the output primitive's structure element. Intrinsic colour data, when specified, is conditionally used to determine the *intrinsic colour* of an output primitive.

3.31 isoparametric curve: A curve on a parametric surface produced by evaluating the surface over the range of one of its independent variables while holding its other independent variable constant.

3.32 knot vector: A non-decreasing sequence of real numbers that is part of the definition of non-uniform B-splines. This vector consists of values of the independent variables and is used in computing the B-spline basis polynomials.

3.33 light source: A simulated source of light.

3.34 light source direction: A unit vector that defines the orientation of oriented *light sources*.

3.35 light source state: A field in the traversal state list that selects which *light sources* in a workstation light source table are active.

3.36 lighting: See *reflectance calculation*.

3.37 normal vector: A unit length vector, typically indicating the orientation of a *facet* or object.

3.38 parameter range: The *parameter space* over which a parametric curve or surface is defined.

3.39 parameter range limits: Minimum and maximum parameter values, specified separately from any knot values, that limit the parameter range over which parametric curves are generated.

3.40 parametric output primitive: Output primitives defined as a mapping from a parameter space to modelling coordinates. Parametric output primitives defined in PHIGS PLUS are non-uniform B-spline curve, non-uniform B-spline curve with colour, non-uniform B-spline surface and non-uniform B-spline surface with data.

3.41 parameter space: The coordinate system of the independent variable(s) of parametric curves and surfaces. The parameter space is one-dimensional for curves and two-dimensional for surfaces.

3.42 polyline set with colour: An output primitive consisting of an unconnected set of polylines. The corresponding structure element may include colour information that is conditionally used to shade the primitive.

3.43 portion: A portion of an area primitive refers to one or more *facets* of the primitive that are distinguished as a group from its other facets by some property such as orientation or position relative to a *trimming loop*. The term can be applied to groups of explicitly defined facets as well as the facets conceptually used to approximate a non-uniform B-spline surface.

3.44 positional light source: A *light source* that contributes to the *reflectance calculation* dependent on the orientation and position of an area being illuminated relative to the light source.

3.45 quadrilateral mesh: An output primitive in which an array of quadrilaterals is specified by a two-dimensional array of vertices.

3.46 reflectance calculation: The computation of the effect of *light sources* on the colour of an area primitive's facets.

3.47 reflectance model: An aspect that selects the *reflectance calculation* and thereby specifies which lighting effects are to be displayed.

3.48 reflectance formulae: Formulae that model the light reflected by an *area primitive*.

3.49 reflectance normal: A vector used in the *reflectance calculation* and indicating the orientation of a primitive at a point on the primitive. The vector is conceptually perpendicular to the surface of an object being represented by an *area primitive*. It is derived from the *vertex normals* of the primitive, if specified, or the *facet normal*.

3.50 reflectance properties: An aspect of *area primitives* that indicates how a primitive reflects light.

3.51 rendering colour model: The colour model used for performing colour interpolation during *shading* and *depth cueing*.

3.52 rendering pipeline: A sequence of operations that performs *data mapping*, *lighting*, *shading*, *depth cueing*, and *colour mapping* of output primitives. Each of these operations is considered a stage in the rendering pipeline.

3.53 rigid-body transformation: A modeling transformation composed of at most translation, rotation, and scaling transformations, where translation transformations move every point of an object an equal distance in the same direction, the rotation transformations maintain relative angles, and the scaling transformations apply equal scaling in all coordinate dimensions.

3.54 set of fill area sets with data: An output primitive in which a number of possibly non-coplanar fill area sets are defined by indices into a single list of vertex data. The fill area sets are not required to form a closed or connected surface.

3.55 shading: The interpolation stage of the *rendering pipeline*.

3.56 specular colour: A *reflectance property* indicating the effect of a primitive on the colour of *specular reflections* from that primitive.

3.57 specular exponent: A non-negative number indicating the shininess of an area. The higher the specular exponent, the shinier the area. A specular exponent of 0 indicates a minimum relative degree of shininess.

3.58 specular reflection: An approximation of the unequal reflection of light in different directions from an *area primitive*, dependent on the relationship of the viewer to the primitive and the *light source*.

3.59 specular reflection coefficient: The fraction of non-*ambient light* contributing to *specular reflection*.

3.60 spot light source: A *light source* that contributes to the *reflectance calculation* dependent on the orientation and relative position of the area being illuminated. Light from such a source is restricted to a semi-infinite cone of influence and its intensity may decrease as it deviates from the centreline of this cone. (See *concentration exponent* and *spread angle*.)

3.61 spread angle: An angle that determines the shape of the *cone of influence* of a *spot light* source. Spread angle is the angle between the center of the cone of influence and the limit of the cone of influence measured at the position of the spot light source.

3.62 triangle set: An output primitive in which a number of possibly unrelated triangular facets are defined by indices into a single list of vertex data.