

INTERNATIONAL STANDARD

ISO/IEC
9592-1

Second edition
1997-11-15

Information technology — Computer graphics and image processing — Programmer's Hierarchical Interactive Graphics System (PHIGS) —

Part 1:
iTeh STANDARD PREVIEW
Functional description
(standards.iteh.ai)

Technologies de l'information — Infographie et traitement de l'image —
ISO/IEC 9592-1:1997
Interface de programmation du système graphique hiérarchisé (PHIGS) —
<https://standards.iteh.ai/catalog/standards/sist/019b1cc6-e87c-4e52-a220>
8ea58fb8a709/iso-iec-9592-1-1997
Partie 1: Description fonctionnelle



Reference number
ISO/IEC 9592-1:1997(E)

Contents

1 Scope.....	1
2 Normative references.....	2
3 Definitions.....	3
4 PHIGS functional overview.....	19
4.1 About this part of ISO/IEC 9592.....	19
4.1.1 Specification and conformance.....	19
4.1.2 Registration.....	19
4.1.3 Notational conventions.....	19
4.2 Overview and concepts.....	19
4.2.1 Overview	19
4.2.2 Concepts	20
4.2.3 PHIGS profiles.....	24
4.3 Structures and traversal	25
4.3.1 Structure elements and structures.....	25
4.3.2 Structure networks.....	27
4.3.3 Structure traversal and display	29
4.3.3.1 Posting	29
4.3.3.2 Traversal	29
4.3.3.3 Posting groups	30
4.3.3.4 Priority	33
4.3.3.5 Direct interpretation structure.....	35
4.3.3.6 Traversing structure networks.....	38
4.3.4 Conditional traversal of structures.....	38
4.3.5 Structure editing	41
4.3.6 Structure element moving and copying	42
4.3.7 Manipulation of structures in CSS.....	42
4.3.8 CSS search and inquiry.....	43
4.3.9 Structure archival and retrieval	44
4.3.10 Generalized Structure Elements (GSE)	45
4.3.11 Application data.....	46
4.3.12 Direct interpretation structure picture definition	46
4.3.13 Stability of the non-retained picture	47
4.4 Output primitives	48
4.4.1 Structure elements and output primitives	48
4.4.2 Marker class.....	49
4.4.2.1 Polymarker.....	49
4.4.3 Curve class.....	49
4.4.3.1 Polyline	49
4.4.3.2 Polyline set.....	49
4.4.3.3 Non-uniform B-spline curve.....	49
4.4.3.4 Non-uniform B-spline curve with colour	50

4.4.3.5 Circle	50
4.4.3.6 Circular arc	50
4.4.3.7 Ellipse	51
4.4.3.8 Elliptical arc.....	51
4.4.4 Text class	51
4.4.4.1 Text.....	51
4.4.4.2 Annotation text	51
4.4.5 Surface class	51
4.4.5.1 Facets	51
4.4.5.2 With-data primitives	52
4.4.5.3 Clipping surfaces	53
4.4.5.4 Modelling clip.....	53
4.4.5.5 Fill area.....	53
4.4.5.6 Fill area set.....	53
4.4.5.7 Fill area set with data	54
4.4.5.8 Set of fill area sets with data.....	54
4.4.5.9 Triangle set with data	54
4.4.5.10 Triangle strip with data.....	55
4.4.5.11 Quadrilateral mesh with data.....	55
4.4.5.12 Fill circle.....	56
4.4.5.13 Circular arc close	56
4.4.5.14 Fill ellipse	56
4.4.5.15 Elliptical arc close	56
4.4.5.16 Non-uniform B-spline surface	56
4.4.5.17 Surface trimming	57
4.4.5.18 Non-uniform B-spline surface with data	58
4.4.5.19 Cell array	60
4.4.5.20 Generalized drawing primitive	61
4.5 Output primitive attributes.....	61
4.5.1 Types of attributes	61
4.5.1.1 Main classification.....	61
4.5.1.2 Geometric attributes	62
4.5.1.3 Non-geometric attributes	62
4.5.1.4 Viewing attributes.....	64
4.5.1.5 Identification attributes	64
4.5.1.6 Rendering attributes.....	64
4.5.1.7 Colour	65
4.5.2 General colour specification	65
4.5.3 Polymarker attributes.....	67
4.5.4 Curve attributes.....	69
4.5.4.1 Polyline attributes	69
4.5.4.2 Polyline set attributes.....	70
4.5.4.3 Non-uniform B-spline curve attributes.....	71
4.5.4.4 Non-uniform B-spline curve with colour attributes	72
4.5.5 Text attributes	72
4.5.5.1 Text primitive attributes	72
4.5.5.2 Annotation text attributes	79
4.5.5.3 Text extent and concatenation	80
4.5.6 Surface attributes	82
4.5.6.1 Interior attributes	82
4.5.6.2 Edge attributes	84
4.5.6.3 Individual edge control for surface primitives	85

4.5.6.4 Data mapping attributes.....	85
4.5.6.5 Fill area set with data attributes.....	86
4.5.6.6 Set of fill area set with data attributes.....	86
4.5.6.7 Triangle set with data attributes.....	86
4.5.6.8 Triangle strip with data attributes	86
4.5.6.9 Quadrilateral mesh with data attributes	86
4.5.6.10 Non-uniform B-spline surface attributes	86
4.5.6.11 Non-uniform B-spline surface with data attributes	89
4.5.6.12 Reflectance properties	89
4.5.6.13 Alpha	90
4.5.7 Generalized drawing primitive attributes	91
4.5.8 Implicitly specified attributes	91
4.5.8.1 General.....	91
4.5.8.2 Facet normal	91
4.5.8.3 Facet orientation	93
4.5.8.4 Reflectance normal	93
4.5.8.5 Intrinsic colour.....	93
4.5.8.6 Intrinsic alpha	94
4.5.9 Name set attribute	95
4.5.10 Highlighting	96
4.5.11 Minimal simulations	96
4.5.12 Degenerate primitives	96
4.5.13 Stability	96
4.6 The rendering pipeline.....	97
4.6.1 General.....	97
4.6.1.1 Primitives affected by the rendering pipeline.....	97
4.6.1.2 The effect of the interior style on lighting and shading.....	97
4.6.1.3 Aspects and attributes used in the rendering pipeline	98
4.6.2 Alpha mapping	98
4.6.3 Data mapping.....	98
4.6.4 Texture mapping.....	103
4.6.4.1 General.....	103
4.6.4.2 Specification	104
4.6.4.3 Representation	104
4.6.4.4 Parameterization	105
4.6.4.5 Composition.....	108
4.6.4.6 Sampling.....	112
4.6.4.7 Binding	113
4.6.4.8 Mapping	114
4.6.4.9 Mapping controls	114
4.6.5 Lighting.....	115
4.6.5.1 Reflectance calculation	115
4.6.5.2 Light sources	116
4.6.5.3 Workstation light sources	116
4.6.6 Shading	117
4.6.6.1 General.....	117
4.6.6.2 Interpolation.....	117
4.6.6.3 Colour interpolation.....	117
4.6.6.4 Data interpolation	118
4.6.6.5 Normal-vector interpretation	118
4.6.6.6 Polyline set shading	118
4.6.6.7 Interior shading.....	119

4.6.7	The rendering colour model	123
4.6.8	Depth cueing.....	124
4.6.9	Alpha application.....	125
4.6.10	Colour mapping	125
4.7	Workstations	127
4.7.1	Workstation characteristics	127
4.7.2	Workstation configuration	128
4.7.3	Workstation selection	129
4.7.4	Controlling picture changes	129
4.7.4.1	Introduction	129
4.7.4.2	Retained picture changes	130
4.7.4.3	Non-retained picture updating	136
4.7.4.4	Selective retained picture updating	136
4.7.5	Device coordinate clip regions	137
4.7.6	Clearing the display surface	138
4.7.7	Sending messages to a workstation	138
4.7.8	Hidden line / hidden surface removal.....	138
4.7.9	Image resources	139
4.7.10	Target manipulation.....	140
4.7.11	Traversal resources	142
4.8	Coordinate systems and transformations	143
iTeh STANDARD REVIEW	(standards.itech.ai)	
4.8.1	Coordinate system handedness	143
4.8.2	Modelling transformations and clipping.....	143
4.8.3	Modelling utility functions	145
4.8.4	Viewing	145
4.8.5	Viewing construction functions.....	148
4.8.6	Workstation transformation	154
4.8.7	Transformation of locator input.....	155
4.8.8	Transformation of stroke input	156
4.8.9	Input utility functions	157
4.9	Graphical input	159
4.9.1	Introduction to logical input devices	159
4.9.2	Logical input device model	160
4.9.3	Operating modes of logical input devices	161
4.9.4	Measures of each input class	162
4.9.5	Input queue and current event report.....	165
4.9.6	Initialization of input devices	165
4.9.7	Locator and stroke input using 2D input	167
4.9.8	Pick input using directly structured elements.....	168
4.9.9	Definition of logical input devices.....	169
4.9.10	Local input processing	169
4.9.10.1	General.....	169
4.9.10.2	Local viewing operations.....	170
4.9.10.3	Local lighting operations	174
4.10	PHIGS metafile interface.....	177
4.11	PHIGS states	178
4.12	Inquiry functions.....	179
4.13	Error handling	180
4.14	Special interfaces between PHIGS and application program.....	182
4.15	Limitations	182
4.15.1	General.....	182
4.15.2	Non-planar geometry and data	182

4.15.3 Relationship of shading method to geometry	182
4.15.4 Normal-vector interpolation	183
4.15.5 Effects of transformations	183
4.15.6 Approximation criteria and data splines	183
4.16 Minimum support criteria	184
4.16.1 Concepts of minimum support.....	184
4.16.2 Explicitly defined and required.....	184
4.16.3 Explicitly defined and non-required	184
4.16.4 Conceptually defined and non-required.....	185
5 PHIGS Functional Specification.....	186
5.1 Notational conventions	186
5.1.1 Function heading and parameter list.....	186
5.1.2 Functions generating structure elements	186
5.2 Control functions	188
5.3 Output primitive functions.....	202
5.3.1 General.....	202
5.3.2 Function definitions	203
5.4 Attribute specification functions.....	216
5.4.1 Bundled attribute selection	216
5.4.1.1 General.....	216
5.4.1.2 Function definitions	216
5.4.2 Individually selected bundled attributes	218
5.4.2.1 General.....	218
5.4.2.2 Function definitions	218
5.4.3 Individual attributes	229
5.4.3.1 General.....	229
5.4.3.2 Function definitions	230
5.4.4 Workstation attribute table definition	236
5.4.4.1 General.....	236
5.4.4.2 Function definitions	236
5.4.5 Workstation filter definition.....	244
5.4.6 Colour model control	245
5.4.7 HLHSR attributes	245
5.4.8 Attribute utility functions	246
5.5 Transformation and clipping functions	247
5.5.1 Modelling transformations and clipping.....	247
5.5.1.1 General.....	247
5.5.1.2 Function definitions	247
5.5.2 View operations.....	249
5.5.3 Workstation transformation	250
5.5.4 Utility functions to support modelling	251
5.5.4.1 General.....	251
5.5.4.2 Function definitions	252
5.5.5 Utility functions to support viewing	255
5.5.6 View construction functions.....	256
5.5.7 Workstation utility functions	261
5.6 Structure content functions	261
5.7 Structure manipulation functions.....	272
5.8 Structure display functions	274
5.9 Structure archiving functions.....	278
5.10 Input functions	282
5.10.1 Pick support functions	282

5.10.2 Local input device definition functions	285
5.10.2.1 General.....	285
5.10.2.2 Function definitions	286
5.10.3 Initialization of input devices	291
5.10.3.1 General.....	291
5.10.3.2 Function definitions	292
5.10.4 Setting the mode of input devices.....	295
5.10.5 Request input functions	298
5.10.5.1 General.....	298
5.10.5.2 Function definitions	298
5.10.6 Sample input functions	301
5.10.6.1 General.....	301
5.10.6.2 Function definitions	301
5.10.7 Event input functions.....	303
5.10.7.1 General.....	303
5.10.7.2 Function definitions	304
5.10.8 Local input operation functions	307
5.10.9 Direct interpretation picking functions.....	309
5.10.9.1 General.....	309
5.10.9.2 Function definitions	309
5.11 Metafile functions	310
iTech STANDARD PREVIEW	
5.12 Inquiry functions.....	312
5.12.1 Introduction	312
5.12.2 Inquiry functions for operating state values	313
5.12.3 Inquiry functions for PHIGS description table.....	313
5.12.4 Inquiry functions for PHIGS state list	314
5.12.5 Inquiry functions for workstation state list.....	314
5.12.6 Inquiry functions for workstation description table	315
5.12.6.1 General.....	315
5.12.6.2 Function definitions	316
5.12.7 Inquiry function for structure state list	317
5.12.8 Inquiry functions for structure content	317
5.12.9 Inquiry functions for error state list	321
5.13 Error control functions.....	322
5.14 Special interface function	323
6 PHIGS data structures	324
6.1 Notation and data types	324
6.1.1 Notation	324
6.1.2 Simple datatypes	324
6.1.3 Compound datatypes	325
6.1.4 Integer selection types	332
6.1.5 Enumeration types	342
6.1.6 Data records	348
6.1.7 Combination of datatypes	357
6.1.8 Variant datatypes	357
6.1.9 Language bindings	357
6.1.10 Coordinate systems	357
6.1.11 Permitted values	358
6.1.12 Alphabetic list of datatypes	359
6.2 Operating state table	363
6.3 PHIGS description table	363
6.4 PHIGS traversal state list.....	367

6.5 PHIGS state list.....	368
6.6 Workstation state list	369
6.7 Workstation description table	384
6.8 Structure state list	402
6.9 PHIGS error state list.....	402
6.10 Alphabetic list of entries.....	402
A Function Lists.....	424
A.1 Introduction	424
A.1 Alphabetic list of functions.....	424
B Error list.....	434
B.1 Error list ordered by error number.....	434
B.1.1 Implementation dependent.....	434
B.1.2 States	434
B.1.3 Workstations	434
B.1.4 Output attributes.....	435
B.1.5 Transformations and viewing	436
B.1.6 Structures	437
B.1.7 Input	437
B.1.8 Metafiles.....	437
B.1.9 Escape	438
B.1.10 Archive / retrieve	438
B.1.11 Miscellaneous	438
B.1.12 Output primitives	438
B.1.13 Texture output primitives.....	438
B.1.14 System.....	439
B.1.15 Reserved errors	439
C Interfaces.....	440
C.1 Introduction	440
C.2 Language binding	440
C.3 Implementation	440
D Allowable differences in PHIGS implementations	442
D.1 Introduction	442
D.2 Global differences.....	442
D.3 Workstation dependent differences	443
E HLHSR considerations	448
F Relationship of CGM and PHIGS.....	449
F.1 Introduction	449
F.2 Scope	449
F.3 Overview of the differences between PHIGS and CGM	449
F.4 Mapping concepts	449
F.4.1 Principles.....	449
F.4.2 Workstations	450
F.4.3 Picture generation.....	450
F.4.4 Picture input	450
F.4.5 Coordinates and clipping.....	451
F.4.6 Workstation transformation	451
G Colour models....	452
G.1 Introduction	452
G.2 RGB colour model.....	452
G.3 CIELUV colour model	453
G.3.1 CIE XYZ colour space	453
G.3.2 CIE 1931 (Y,x,y) space	453

G.3.3 The CIE 1976 ($L^*u^*v^*$) CIELUV uniform colour space.....	456
G.3.4 Colour differences	457
G.4 HSV colour model	457
G.5 HLS colour model	458
G.6 Conversion between colour models.....	459
G.6.1 CIE XYZ reference model	459
G.6.2 Conversion between CIELUV and CIE XYZ models.....	459
G.6.3 Conversion between RGB and CIE XYZ models	460
G.6.3.1 Derivation of conversion factors	460
G.6.3.2 Conversion from RGB to CIE XYZ	460
G.6.3.3 Conversion from CIE XYZ to RGB	461
G.6.3.4 Representation of black	461
G.6.3.4 Example conversion	461
H Suggested reflectance formulae.....	462
H.1 Variable definitions and their sources	462
H.1 Reflection formulae	462
I Attributes applying to each primitive.....	464
J Inquiry error indicators and allowable states.....	477
K Suggested depth cueing formulae	484
K.1 Linear colour interpretation.....	484
K.1 Definitions.....	484
K.1 Formulae.....	484
L Bibliography	485
M Index of usage of datatypes	486
N International standardized profiles.....	508
O Configurability _{ISO/IEC 9592-1:1997}	509

<https://standards.iteh.ai/catalog/standards/sist/09bfec6-e87c-4e52-a82b-8ea5f8a709/iso-iec-9592-1-1997>

Figure 1 - Layer model of PHIGS	20
Figure 2 - Direct interpretation structure interpretation	21
Figure 3 - CSS structure interpretation.....	21
Figure 4 - A hierarchical structure network	28
Figure 5 - A structure network with two posted structure networks	30
Figure 6 - PHIGS structure element processing architecture	31
Figure 7 - PHIGS traversal process types.....	32
Figure 8 - Posting group background styles	34
Figure 9 - Posting group with TRANSPARENT background style	35
Figure 10 - Effects of direct interpretation mode	37
Figure 13 - Data that may be associated with a facet.....	52
Figure 12 - Examples of area clipping	53
Figure 11 - Area inside a polygon	54
Figure 14 - A triangle set with data primitive	55
Figure 15 - A triangle strip with data primitive.....	55
Figure 16 - A quadrilateral mesh primitive	56
Figure 17 - Parameter space mapping rules for trimming curves	58
Figure 18 - Examples of valid trimming loops.....	58
Figure 19 - Examples of invalid trimming loops.....	59
Figure 20 - Mapping of CELL ARRAY 3.....	60
Figure 21 - Interpretation of a general colour	65
Figure 22 - Selection of the XXX COLOUR attribute.....	67
Figure 23 - Font description coordinate system	73
Figure 24 - Effects of changes in the geometric text attribute CHARACTER HEIGHT	73
Figure 25 - Effects of changes in CHARACTER EXPANSION FACTOR.....	73
Figure 26 - Effects of changes in CHARACTER SPACING.....	74
Figure 27 - Effects of changes in the geometric text attribute TEXT PATH.....	74
Figure 28 - Effects of changes in CHARACTER UP VECTOR	75
Figure 29 - Effects of changes in horizontal TEXT ALIGNMENT	75
Figure 30 - Effects of changes in vertical TEXT ALIGNMENT.....	76
Figure 31 - Effects of combined changes in text attributes	77
Figure 32 - Effects of different transformations on text in STROKE precision	79
Figure 33 - Replies to INQUIRE TEXT EXTENT with different text attributes and LEFT, RIGHT alignment.....	80
Figure 34 - Replies to INQUIRE TEXT EXTENT with different text attributes and UP, DOWN alignment.....	81
Figure 35 - Replication of the pattern box with fill areas	83
Figure 36 - Projection of the PATTERN REFERENCE POINT AND VECTORS onto the plane of the area.....	84
Figure 37 - The conceptual rendering pipeline.....	97
Figure 38 - UNIFORM data mapping of data values to colours	100
Figure 39 - NON-UNIFORM mapping of data values to colour	101
Figure 40 - UNIFORM mapping of data values to colour lists	102
Figure 41 - BI-VALUE NON-UNIFORM data mapping	103
Figure 42 - Texture parameterization operations	108
Figure 43 - A conceptual rendering pipeline for shading method 1 (NONE)	119
Figure 44 - A conceptual rendering pipeline for shading method 2 (COLOUR).....	120
Figure 45 - A conceptual rendering pipeline for shading method 3 (DATA)	121
Figure 46 - A conceptual rendering pipeline for shading method 4 (DATA AND DOT)	122
Figure 47 - A conceptual rendering pipeline for shading method 5	

(DATA AND NORMAL)	123
Figure 48 - Depth cue scaling.....	124
Figure 49 - Display update part 1: is correct retained picture required.....	133
Figure 50 - Display update part 2: check modification mode	134
Figure 51 - The transformation pipeline.....	145
Figure 52 - Interpretation of the view index on workstations	146
Figure 53 - Viewing model for view representation	147
Figure 54 - Formation of V axis in VRC system.....	149
Figure 55 - Parallel projection view volume	151
Figure 56 - Perspective projection view volume	152
Figure 57 - Data flow chart for locator input.....	157
Figure 58 - Relationship of device coordinates to window system coordinates ...	158
Figure 59 - The relationship between the measure and trigger for different operating modes	162
Figure 60 - Possible usage of metafile.....	178
Figure 61 - The RGB colour model.....	452
Figure 62 - The CIE 1931 x y chromaticity diagram	454
Figure 63 - Range of colours displayable by typical devices.....	455
Figure 64 - CIE 1976 u' v' uniform chromaticity diagram	456
Figure 65 - The HSV colour model.....	458
Figure 66 - The HLS colour model	459

iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO/IEC 9592-1:1997](#)

<https://standards.iteh.ai/catalog/standards/sist/0f9bfec6-e87c-4e52-a82b-8ea5f8f8a709/iso-iec-9592-1-1997>

Table 1 - Output primitive structure elements.....	25	
Table 2 - Bundled attribute selection structure elements	26	
Table 3 - Individually selected bundled attribute structure elements.....	26	
Table 4 - Geometric attribute structure elements	26	
Table 5 - Identification attribute structure elements.....	26	
Table 6 - Viewing attribute structure elements	26	
Table 7 - Rendering attribute structure elements	27	
Table 8 - Transformation and clipping structure elements.....	27	
Table 9 - Control structure elements	27	
Table 10 - Editing structure element	27	
Table 11 - Generalized structure element.....	27	
Table 12 - Application data element	27	
Table 13 - Test methods and the associated test conditions.....	39	
Table 14 - Test conditions of each type.....	39	
Table 15 - Output primitive classes	48	
Table 16 - Colour types	66	
Table 17 - Normal alignments	76	
Table 18 - Initial values of geometric text attributes.....	76	
Table 19 - Initial values of implicitly specified geometric text aspects	76	
Table 20 - Sources of intrinsic colour	93	
Table 21 - Sources of intrinsic alpha.....	94	
Table 22 - Intrinsic colour source selectors.....	99	
Table 23 - COMPOSITE REPLACE	110	
Table 24 - COMPOSITE MODULATE.....	110	
Table 25 - COMPOSITE BLEND ENVIRONMENT COLOUR.....	111	
Table 26 - COMPOSITE DECAL.....	111	
Table 27 - COMPOSITE DECALS BACKGROUND	catalog/standards/sist/09fec6112c-4e52-a82b- ISO/IEC 9592-1:1997	112
Table 28 - Interpolation dependent sample frequencies	115	
Table 29 - Defined reflectance models	116	
Table 30 - Rendering colour models	124	
Table 31 - Workstation categories.....	128	
Table 32 - Light source parameterizations	175	
Table 33 - Minimum required support for the PHIGS profiles	185	
Table 34 - Entries in state lists and description tables.....	403	

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 9592-1 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 24, *Computer graphics and image processing*.

iTeh STANDARD PREVIEW
This second edition cancels and replaces the first edition (ISO/IEC 9592-1:1989) and ISO/IEC 9592-4:1992, which have been technically revised. It also incorporates ISO/IEC 9592-1:1989/Amd.1:1992, ISO/IEC 9592-1:1989/Cor.1:1993, ISO/IEC 9592-1:1989/Cor.2:1994 and ISO/IEC 9592-4:1992/Cor.1:1994.

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

- *Part 1: Functional description*
 - *Part 2: Archive file format*
 - *Part 3: Specification for clear-text encoding of archive file*

Annexes A, B, D, I, J, M and N form an integral part of this part of ISO/IEC 9592. Annexes C, E, F, G, H, K, L and O are for information only.

Introduction

The Programmer's Hierarchical Interactive Graphics System (PHIGS) provides a set of functions for the definition, manipulation and display of geometrically related objects. It provides support for simulating the effects of lighting, shading and other properties that are important for the display of multi-dimensional data. This support is provided by output primitives specified as curves and surfaces; output primitives containing both geometric and non-geometric data in their definition; attributes that control the application of lighting and shading; and a generalized mechanism for colour specification. Support is provided for controlling the application of textures to objects and for interactively applying changes to light source definitions.

This International Standard enables graphical (and application) data to be stored in a hierarchical data store or to be interpreted directly. Information in the hierarchical data store can be inserted, modified and deleted with the provided functions. Information for direct interpretation can only be inserted.

The main motivations for standardization are to improve portability of programs and to define a basic methodology. Portability is achieved by providing all the capabilities necessary in a device independent way. If required, it provides applications with more direct control over the capabilities of the available hardware. The following principles are used in specifying PHIGS:

- a) Design: the three goals are consistency of approach, compatibility with related standards and orthogonal functionality where possible.
- b) Functionality: the goals are completeness with the minimal set of functions. Organization of functions should be such as to achieve compact programs. All the functions necessary for application programs to use a dynamic hierarchical graphics system should be included. Redundant functions are only supported where their availability enables application programs to improve performance or where some collection of capabilities is frequently used. Richness should be provided by utilities and toolkits on top of PHIGS.
- c) Error Handling: error conditions should be minimized, and their impact well defined.
- d) Device independence: the workstation concept in PHIGS deals with all device dependent functions. It allows an application program to address facilities of different graphics input and output devices with minimal changes to the application program. Where necessary, PHIGS allows an application program to address specific capabilities of graphics input and output devices.
- e) Implementation: it should be possible to support PHIGS functions using most languages on most operating systems. A PHIGS implementation should be capable of executing without consuming undue amounts of computer resources.

This international standard has a strong relationship to the principles and functionality of ISO/IEC 9592-1:1989 (known informally as PHIGS-89) and incorporates the functionality of ISO/IEC 9592-4:1992 (known informally as PHIGS PLUS). However, it has been updated to provide additional functionality of relevance to modern hardware and applications.

Information technology – Computer graphics and image processing – Programmer’s Hierarchical Interactive Graphics System (PHIGS) – Part 1: Functional description

1 Scope

iTeh STANDARD PREVIEW (standards.iteh.ai)

This part of ISO/IEC 9592 specifies a set of functions for computer graphics programming, the Programmer’s Hierarchical Interactive Graphics System (PHIGS). PHIGS is a graphics system for application programs that produce computer generated pictures on output devices. It supports operator input and interactions by supplying basic functions for graphical input and hierarchical picture definition. Picture definitions can be retained centrally where they may be edited by an application. Alternatively, graphical data may be processed without first storing it. To assist in this processing, explicit control over resources used to encapsulate the results of these processing operations is provided.

Basic application requirements in the areas of lighting and shading are provided through primitives and functions for controlling the rendering of 3D objects. Utilization of raster images in the generation of PHIGS pictures is provided.

Pictures are displayed on output devices which may have associated input devices. Several input devices can be used simultaneously. The application program is allowed to adapt its behaviour to make best use of their capabilities.

Graphical output can be constrained to particular views. Views can be specified parametrically and automatic processing of input operations can be used to control viewing. New input devices can be defined from the capabilities available.

Functions are specified for archiving picture definitions to file. In addition an interface to the Computer Graphics Metafile (ISO/IEC 8632) is described.

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