

~~LOAN COPY~~
~~INFORMATION CENTRE~~
~~STANDARDS AUSTRALIA~~

Dup
WITHDRAWN:
14980701

AS 3732.1—1990
ISO/IEC 9592-1:1989

Australian Standard®

**Computer graphics—Programmer's
hierarchical interactive graphics
system (PHIGS)**

Part 1: Functional description

[ISO/IEC title: Information Processing Systems—Computer
Graphics—Programmer's Hierarchical Interactive Graphics System
(PHIGS)—Part 1: Functional Description]

STANDARDS AUSTRALIA



N

This Australian Standard was prepared by Committee IT/3, Computer Related Graphics. It was approved on behalf of the Council of Standards Australia on 25 July 1989 and published on 16 February 1990.

The following interests are represented on Committee IT/3:

ACADS

Association of Consulting Engineers, Australia

Australian Vice Chancellors Committee

Department of Defence

Royal Australian Institute of Architects

Telecom Australia

Review of Australian Standards. To keep abreast of progress in industry, Australian Standards are subject to periodic review and are kept up-to-date by the issue of amendments or new editions as necessary. It is important therefore that Standards users ensure that they are in possession of the latest edition, and any amendments thereto.

Full details of all Australian Standards and related publications will be found in the Standards Australia Catalogue of Publications; this information is supplemented each month by the magazine 'The Australian Standard', which subscribing members receive, and which gives details of new publications, new editions and amendments, and of withdrawn Standards.

Suggestions for improvements to Australian Standards, addressed to the head office of Standards Australia, are welcomed. Notification of any inaccuracy or ambiguity found in an Australian Standard should be made without delay in order that the matter may be investigated and appropriate action taken.

Australian Standard®

**Computer graphics—Programmer's
hierarchical interactive graphics
system (PHIGS)**

Part 1: Functional description

First published as AS 3732.1—1990.

PREFACE

This Standard was prepared by the Standards Australia Committee on Computer Related Graphics. It is identical with, and has been reproduced from International Standard ISO/IEC 9592-1: 1989, *Information processing systems—Computer graphics—Programmer's Hierarchical Interactive Graphics System (PHIGS)—Part 1: Functional description*.

For the purpose of this Australian Standard, the text of the ISO/IEC Standard should be modified as follows:

- (a) *Terminology*—The words 'Australian Standard' should replace the words 'International Standard' wherever they apply.
- (b) *References*—The references to International Standards should be replaced by references to Australian Standards as follows:

<i>Reference to International Standard</i>	<i>Australian Standard</i>
ISO	AS
646 Information processing—ISO 7-bit coded character set for information interchange	1776 Information processing—7-bit coded character set for information interchange
2022 Information processing—ISO 7-bit and 8-bit coded sets—Code extension techniques	1953 Information processing—ISO 7-bit and 8-bit coded character sets—Code extension techniques
7942 Information processing—Computer graphics—Graphical Kernel System (GKS) functional description	2880 Information processing—Computer graphics—Graphical Kernel System (GKS) functional description
8632 Information processing systems—Computer graphics—Metafiles for transfer and storage of picture description information Part 1: Functional specifications Part 2: Character encoding Part 3: Binary encoding Part 4: Clear-text encoding	3603 Computer graphics—Metafiles for transfer and storage of picture description information Part 1: Functional specifications Part 2: Character encoding Part 3: Binary encoding Part 4: Clear-text encoding
8805 Information processing—Computer Graphics—Graphics Kernel System for Three Dimensions (GKS-3D) Functional Description	3656 Computer graphics—Graphics Kernel System for three dimensions (GKS-3D) functional description

© Copyright — STANDARDS AUSTRALIA

Users of Standards are reminded that copyright subsists in all Standards Australia publications and software. Except where the Copyright Act allows and except where provided for below no publications or software produced by Standards Australia may be reproduced, stored in a retrieval system in any form or transmitted by any means without prior permission in writing from Standards Australia. Permission may be conditional on an appropriate royalty payment. Requests for permission and information on commercial software royalties should be directed to the Head Office of Standards Australia.

Standards Australia will permit up to 10 percent of the technical content pages of a Standard to be copied for use exclusively in-house by purchasers of the Standard without payment of a royalty or advice to Standards Australia.

Standards Australia will also permit the inclusion of its copyright material in computer software programs for no royalty payment provided such programs are used exclusively in-house by the creators of the programs.

Care should be taken to ensure that material used is from the current edition of the Standard and that it is updated whenever the Standard is amended or revised. The number and date of the Standard should therefore be clearly identified.

The use of material in print form or in computer software programs to be used commercially, with or without payment, or in commercial contracts is subject to the payment of a royalty. This policy may be varied by Standards Australia at any time.

CONTENTS

	<i>Page</i>
0 Introduction	7
1 Scope and field of application	9
2 References	10
3 Definitions	11
4 The Programmer's Hierarchical Interactive Graphics System	21
4.1 About this part of ISO/IEC 9592	21
4.1.1 Specification and conformance	21
4.1.2 Registration	21
4.2 Overview	22
4.3 Concepts	24
4.3.1 PHIGS concepts	24
4.3.2 Relationship to ISO 7942 (GKS) and ISO 8805 (GKS-3D)	26
4.3.3 Notational conventions	26
4.4 The centralized structure store	28
4.4.1 Structure elements and structures	28
4.4.2 Structure networks	30
4.4.3 Structure traversal and display	31
4.4.4 Structure editing	34
4.4.5 Manipulation of structures in CSS	35
4.4.6 CSS search and inquiry	36
4.4.7 Structure archival and retrieval	38
4.4.8 Generalized Structure Elements (GSE)	39
4.4.9 Application data	39
4.5 Graphical output	40
4.5.1 Structure elements and output primitives	40
4.5.2 Output primitive attributes	44
4.5.3 Polyline attributes	49
4.5.4 Polymarker attributes	49
4.5.5 Text attributes	50
4.5.6 Annotation text attributes	61
4.5.7 Text extent and concatenation	61
4.5.8 Fill area attributes	64
4.5.9 Fill area set attributes	68
4.5.10 Cell array attributes	69
4.5.11 Generalized drawing primitive attributes	69
4.5.12 Colour	69
4.5.13 View index	70
4.5.14 Hidden line / hidden surface removal (HLHSR) identifier	70

4.5.15	Name set attribute	70
4.5.16	Minimal simulations	71
4.5.17	Degenerate primitives	71
4.6	Workstations	73
4.6.1	Workstation characteristics	73
4.6.2	Workstation selection	74
4.6.3	Controlling picture changes	74
4.6.4	Clearing the display surface	81
4.6.5	Sending messages to a workstation	81
4.6.6	Hidden line / hidden surface removal	82
4.7	Coordinate systems and transformations	83
4.7.1	Coordinate system handedness	83
4.7.2	Modelling transformations and clipping	83
4.7.3	Modelling utility functions	85
4.7.4	Viewing	86
4.7.5	Viewing utility functions	90
4.7.6	Workstation transformation	96
4.7.7	Transformation of locator input	98
4.7.8	Transformation of stroke input	99
4.8	Graphical input	101
4.8.1	Introduction to logical input devices	101
4.8.2	Logical input device model	102
4.8.3	Operating modes of logical input devices	103
4.8.4	Measures of each input class	106
4.8.5	Input queue and current event report	107
4.8.6	Initialization of input devices	108
4.8.7	Locator and stroke input using 2D input	110
4.9	PHIGS metafile interface	111
4.10	PHIGS states	113
4.11	Inquiry functions	114
4.12	Error handling	115
4.13	Special interfaces between PHIGS and application program	118
4.14	Minimum support criteria	119
5	PHIGS Functional Specification	122
5.1	Notational conventions	122
5.2	Control functions	123
5.3	Output primitive functions	128
5.4	Attribute specification functions	138
5.4.1	Bundled attribute selection	138
5.4.2	Individual attribute selection	139
5.4.3	Aspect source flag setting	156
5.4.4	Workstation attribute table definition	156
5.4.5	Workstation filter definition	164
5.4.6	Colour model control	165
5.4.7	HLHSR attributes	166
5.5	Transformation and clipping functions	167
5.5.1	Modelling transformations and clipping	167
5.5.2	View operations	171
5.5.3	Workstation transformation	173
5.5.4	Utility functions to support modelling	175
5.5.5	Utility functions to support viewing	182
5.6	Structure content functions	185
5.7	Structure manipulation functions	191
5.8	Structure display functions	194
5.9	Structure archiving functions	196
5.10	Input functions	203
5.10.1	Pick identifier and filter	203
5.10.2	Initialization of input devices	203

5.10.3	Setting the mode of input devices	221
5.10.4	Request input functions	224
5.10.5	Sample input functions	227
5.10.6	Event input functions	231
5.11	Metafile functions	236
5.12	Inquiry functions	238
5.12.1	Introduction	238
5.12.2	Inquiry functions for operating state values	238
5.12.3	Inquiry functions for PHIGS description table	239
5.12.4	Inquiry functions for PHIGS state list	241
5.12.5	Inquiry functions for workstation state list	244
5.12.6	Inquiry functions for workstation description table	265
5.12.7	Inquiry function for structure state list	294
5.12.8	Inquiry functions for structure content	295
5.12.9	Inquiry functions for error state list	306
5.13	Error control functions	308
5.14	Special interface function	310
6	PHIGS data structures	311
6.1	Notation and data types	311
6.2	Operating states	314
6.3	PHIGS description table	315
6.4	PHIGS traversal state list	318
6.5	PHIGS state list	320
6.6	Workstation state list	322
6.7	Workstation description table	326
6.8	Structure state list	332
6.9	PHIGS error state list	333

Annexes

A	Function Lists	334
A.1	Alphabetic	334
A.2	Order of appearance	340
B	Error list	347
B.1	Implementation dependent	347
B.2	States	347
B.3	Workstations	347
B.4	Output attributes	347
B.5	Transformations and viewing	348
B.6	Structures	348
B.7	Input	349
B.8	Metafiles	349
B.9	Escape	349
B.10	Archive / retrieve	349
B.11	Miscellaneous	350
B.12	System	350
B.13	Reserved errors	350
C	Interfaces	351
C.1	Introduction	351
C.2	Language Binding	351
C.3	Implementation	352
D	Allowable differences in PHIGS implementations	354
D.1	Introduction	354
D.2	Global differences	354
D.3	Workstation dependent differences	355
E	The PHIGS viewing model	358
F	PHIGS/GKS differences	359

G	HLHSR considerations	361
H	Relationship of CGM and PHIGS	362
H.1	Introduction	362
H.2	Scope	362
H.3	Overview of the differences between PHIGS and CGM	362
H.4	Mapping concepts	363
H.4.1	Principles	363
H.4.2	Workstations	363
H.4.3	Picture generation	364
H.4.4	Picture input	364
H.4.5	Coordinates and clipping	365
H.4.6	Workstation transformation	365
H.4.7	Colour table	366
H.4.8	Set representation	366
H.5	Metafile generation	366
H.5.1	Control functions	366
H.5.2	Structure traversal	368
H.5.3	Metafile description	369
H.5.4	User items	370
H.6	Interpretation of CGM by PHIGS	370
H.7	Mapping between item types and elements	372
I	Colour models	373
I.1	Introduction	373
I.2	RGB colour model	374
I.3	CIELUV colour model	374
I.3.1	CIE XYZ colour space	374
I.3.2	CIE 1931 (Y,x,y) space	375
I.3.3	The CIE 1976 (L*u*v*) CIELUV uniform colour space	378
I.3.4	Colour differences	379
I.4	HSV colour model	380
I.5	HLS colour model	381
I.6	Conversion between colour models	381
I.6.1	CIE XYZ reference model	381
I.6.2	Conversion between CIELUV and CIE XYZ models	382
I.6.3	Conversion between RGB and CIE XYZ models	382
I.6.3.1	Derivation of conversion factors	382
I.6.3.2	Conversion from RGB to CIE XYZ	383
I.6.3.3	Conversion from CIE XYZ to RGB	383
I.6.3.4	Representation of black	383
I.6.3.5	Example conversion	383

Computer graphics—Programmer's hierarchical interactive graphics system (PHIGS)—Part 1: Functional description

0 Introduction

The Programmer's Hierarchical Interactive Graphics System (PHIGS) provides a set of functions for

- definition, display and modification of 2D or 3D graphical data,
- definition, display and manipulation of geometrically related objects,
- modification of graphics data and the relationships between the graphical data.

This International Standard draws extensively on GKS (Graphical Kernel System ISO 7942) and GKS-3D (Graphical Kernel System for Three Dimensions ISO 8805) for its model and functionality. In addition this International Standard enables graphical (and application) data to be stored in a hierarchical data store. Information in the data store can be inserted, modified and deleted with the provided functions. The relationship of this part of ISO/IEC 9592 to GKS and GKS-3D is further described in 4.3.2.

The choice of which graphics standard to use will depend on a number of factors: application profile, overall system architecture, equipment available, existing application database interaction, system performance considerations, user interface requirements, management policy and other external factors. The aim of producing a compatible set of graphics standards in GKS, GKS-3D and PHIGS is to allow that choice to be made in the most flexible way.

The main reasons for introducing a standard in this area of computer graphics are

- a) to allow application programs using dynamic hierarchical graphics to be easily portable between installations,
- b) to aid the understanding and use of dynamic hierarchical graphics methods by application programmers;
- c) to reduce program development costs and time; many of the functions currently performed by the application program will now be performed by PHIGS;
- d) to serve manufacturers of graphics equipment as a guideline in providing useful combinations of graphics capabilities in a device.

To meet these objectives, a number of design principles were adopted: