U.S. DEPARTMENT OF COMMERCE
National Institute of Standards and Technology

FIPS PUB 120-1

FIPS

FEDERAL INFORMATION PROCESSING STANDARDS PUBLICATION
(Supersedes FIPS PUB 120—1986 April 18)

GRAPHICAL KERNEL SYSTEM (GKS)

CATEGORY: SOFTWARE STANDARD **SUBCATEGORY: GRAPHICS**

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Computer Systems Laboratory
National Institute of Standards and Technology
Gaithersburg, MD 20899

Issued January 8, 1991

U.S. Department of Commerce
Robert A. Mosbacher, Secretary

National Institute of Standards
and Technology
John W. Lyons, Director

Foreword

The Federal Information Processing Standards Publication Series of the National Institute of Standards and Technology (NIST) is the official publication relating to standards and guidelines adopted and promulgated under the provisions of Section 111(d) of the Federal Property and Administrative Services Act of 1949 as amended by the Computer Security Act of 1987, Public Law 100-235. These mandates have given the Secretary of Commerce and NIST important responsibilities for improving the utilization and management of computer and related telecommunications systems in the Federal Government. The NIST through its Computer Systems Laboratory provides leadership, technical guidance, and coordination of Government efforts in the development of standards and guidelines in these areas.

Comments concerning Federal Information Processing Standards Publications are welcomed and should be addressed to the Director, Computer Systems Laboratory, National Institute of Standards and Technology, Gaithersburg, MD 20899.

James H. Burrows, Director
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Abstract

This revision supersedes FIPS PUB 120 and modifies the standard by adding a requirement for validation of GKS implementations that are acquired by Federal agencies. FIPS 120-1 adopts American National Standard Graphical Kernel System (ANS GKS), ANSI X3.124-1985, Functional Description, which consists for four parts (X3.124.1-1985 FORTRAN Binding, X3.124.2-1988 Pascal Binding, X3.124.3-1989 Ada Binding), as a FIPS. ANS GKS specifies a library (or toolbox package) of subroutines for an application programmer to incorporate within a program in order to produce and manipulate two-dimensional pictures. The purpose of the standard is to promote portability of graphics application programs between different installations. The standard is for use by implementors as the reference authority in developing graphics software systems; and by other computer professionals who need to know the precise syntactic and semantic rules of the standard.

Key words: Federal Information Processing Standard (FIPS); Graphical Kernel System (GKS); graphics software standard; language binding; software; validation.

National Institute of Standards and Technology
FIPS PUB 120-1
8 pages (Jan. 8, 1991)
CODEN: FIPPAT

U.S. Government Printing Office
Washington: 1991

For sale by the National Technical Information Service
U.S. Department of Commerce
Springfield, VA 22161

Federal Information Processing Standards Publication 120-1

1991 January 8

Announcing the Standard for

GRAPHICAL KERNEL SYSTEM (GKS)

Federal Information Processing Standards Publications (FIPS PUBS) are issued by the National Institute of Standards and Technology (NIST) after approval by the Secretary of Commerce pursuant to Section 111(d) of the Federal Property and Administrative Services Act of 1949 as amended by the Computer Security Act of 1987, Public Law 100-235.

1. **Name of Standard.** Graphical Kernel System (GKS) (FIPS PUB 120-1).

2. **Category of Standard.** Software Standard, Graphics.

3. **Explanation.** This publication is a revision of FIPS PUB 120. This revision supersedes FIPS PUB 120 and modifies the standard by adding a requirement for validation of GKS implementations that are acquired by Federal agencies.

This publication announces adoption of American National Standard Graphical Kernel System (ANS GKS), ANSI X3.124-1985 which consists of four parts identified in the Specifications section, as a Federal Information Processing Standard (FIPS). ANS GKS specifies a library (or toolbox package) of subroutines for an application programmer to incorporate within a program in order to produce and manipulate two-dimensional pictures. The purpose of the standard is to promote portability of graphics application programs between different installations. The standard is for use by implementors as the reference authority in developing graphics software systems; and by other computer professionals who need to know the precise syntactic and semantic rules of the standard.

4. **Approving Authority.** Secretary of Commerce.

5. **Maintenance Agency.** Department of Commerce, National Institute of Standards and Technology (NIST), Computer Systems Laboratory (CSL).

6. **Cross Index.**

a. American National Standard Graphical Kernel System (ANS GKS) Functional Description, ANSI X3.124-1985.

b. American National Standard Graphical Kernel System (ANS GKS) FORTRAN Binding, ANSI X3.124.1-1985.

c. American National Standard Graphical Kernel System (ANS GKS) Pascal Binding, ANSI X3.124.2-1988.

d. American National Standard Graphical Kernel System (ANS GKS) Ada Binding, ANSI X3.124.3-1989.

e. American National Standard Computer Graphics Metafile (ANS CGM), ANSI X3.122-1986.

f. American National Standard Programmer's Hierarchical Interactive Graphics System (ANS PHIGS), ANSI X3.144&X3.144.1-1988.

7. **Related Documents.**

a. Federal Information Resources Management Regulation 201-39, Acquisition of Federal Information Processing Resources by Contracting.

b. Federal Information Processing Standards Publication 29-2, Interpretation Procedures for Federal Information Processing Standards for Software.

c. Federal Information Processing Standards Publication 128, Computer Graphics Metafile.

d. Federal Information Processing Standards Publication 153, Programmer's Hierarchical Interactive Graphics System (PHIGS).

8. Objectives. The primary objectives of this standard are:

- to allow graphics application programs to be easily transported between installations. This will reduce costs associated with the transfer of programs among different computers and graphics devices, including replacement devices.

- to aid manufacturers of graphics equipment by serving as a guideline for identifying useful combinations of graphics capabilities in a device.

- to encourage more effective utilization and management of graphics application programmers by ensuring that skills acquired on one job are transportable to other jobs, thereby reducing the cost of graphics programmer retraining.

- to aid graphics application programmers in understanding and using graphics methods by specifying well-defined functions and names. This will avoid the confusion of incompatibility common with operating systems and programming languages.

9. Applicability

a. This standard is intended for use in computer graphics applications that are either developed or acquired for government use. It is suitable for use in graphics programming applications that employ a broad spectrum of graphics, from simple passive graphics output (where pictures are produced solely by output functions without interaction with an operator) to interactive applications; and which control a whole range of possible graphics devices, including but not limited to vector and raster devices, microfilm recorders, storage tube displays, refresh displays and color displays. Although this standard was not developed specifically for the Printing/Graphics Arts industry, it may be used in these applications whenever desirable.

b. The use of this standard is strongly recommended when one or more of the following situations exist:

- It is anticipated that the life of the graphics program will be longer than the life of the presently utilized graphics equipment.

- The graphics application or program is under constant review for updating of the specifications, and changes may result frequently.

- The graphics application is being designed and programmed centrally for a decentralized system that employs computers of different makes and models and different graphics devices.

- The graphics program will or might be run on equipment other than that for which the program is initially written.

- The graphics program is to be understood and maintained by programmers other than the original ones.

- The graphics program is or is likely to be used by organizations outside the Federal government (i.e., State and local governments, and others).

c. Non-standard language features should be used only when the needed operation or function cannot reasonably be implemented with the standard features alone. Although non-standard language features can be very useful, it should be recognized that the use of these or any other non-standard language elements may make the interchange of programs and future conversion to a revised standard or replacement processor more difficult and costly.

10. Specifications. American National Standard Graphical Kernel System (ANS GKS), ANSI X3.124-1985, contains the specifications for this standard. The ANS GKS consists of four parts:

- the basic functions for computer graphics programming (ANSI X3.124-1985);
- the FORTRAN programming language binding for GKS (ANSI X3.124.1-1985);
- the Pascal programming language binding for GKS (ANSI X3.124.2-1988); and
- the Ada programming language binding for GKS (ANSI X3.124.3-1989).

The ANS GKS document defines the scope of the specifications, the syntax and semantics of the GKS functions and requirements for a conforming implementation and program. This standard adopts all of these specifications.

The ANS is separated into two parts. Part I represents the functional aspects of GKS. Part 2 contains bindings of GKS functions to actual programming languages. These bindings have been developed in cooperation with the standards committees of the languages to which GKS is bound. Subsequent language bindings may be added to this standard periodically as they become available. After review and adoption by ANSI, each language binding will automatically become part of FIPS GKS.

ANSI X3.124-1985 and the FORTRAN binding (ANSI X3.124.1-1985) were adopted in 1986 when FIPS 120 was approved by the Secretary of Commerce. The Pascal and Ada programming language bindings are adopted by this revision.

11. Implementation. Implementation of this standard involves three areas of consideration: acquisition of GKS software system implementations (or toolbox packages), interpretations of GKS toolbox packages, and validation of GKS implementations.

11.1 Acquisition of Two-Dimensional Graphics Toolbox Packages. This revised standard is effective on January 1, 1991, except for paragraph 11.3. No delayed effective date or transition period is necessary since there are no new technical requirements imposed by this revised standard. Two-dimensional graphics toolbox packages acquired for Federal use should implement this standard. Conformance to this standard should be considered whether GKS toolbox packages are developed internally, acquired as part of an ADP system procurement, acquired by separate procurement, used under an ADP leasing arrangement, or specified for use in contracts for programming services.

11.2 Interpretation of FIPS GKS. Resolution of questions regarding this standard will be provided by NIST. Questions concerning the content and specifications of this FIPS PUB should be addressed to:

Director
Computer Systems Laboratory
ATTN: GKS Interpretation
National Institute of Standards and Technology
Gaithersburg, MD 20899
Telephone: (301) 975-3266

11.3 Validation of GKS Implementations (or Toolbox Packages). The following requirements for validation of GKS implementations with FORTRAN bindings become effective on July 1, 1991. Validation requirements apply only to GKS implementations using the FORTRAN language binding. Additional validation requirements may be added in the future as the GKS Validation Suite is extended to include tests for additional language bindings.

a. The party offering a GKS implementation with a FORTRAN binding (GKS-FORTRAN) to ensure its conformance to FIPS PUB 120-1 shall be responsible for securing validation of the GKS-FORTRAN implementation when it is offered to the Government for purchase, lease, or use in connection with ADP services. The party offering application programs written using FIPS PUB 120-1 with the FORTRAN binding shall be responsible for securing validation of the GKS-FORTRAN implementations used in developing such programs when the programs are offered to the Government for purchase, lease, or use in connection with ADP services.

b. A GKS-FORTRAN implementation which is offered or used by vendors as a result of requirements set forth by Federal agencies in requirements documents, including solicitations, shall meet the specification requirements of this document. To confirm that the specifications of FIPS PUB 120-1 have been met, a GKS-FORTRAN Validation Test Suite has been developed and a GKS-FORTRAN Validation Test Service has been established by the Computer Systems Laboratory (CSL) at the National Institute of Standards and Technology (NIST).

c. Federal agencies shall use the test results of the GKS Validation Test Suite to confirm that a particular GKS-FORTRAN implementation meets the specifications of FIPS PUB 120-1.

d. The CSL will provide for validations of GKS-FORTRAN implementations and will issue certificates as specified in the NIST GKS Information Pack.

e. The requestor is responsible for providing the test facilities necessary to perform the validation. A validation test using the GKS Validation Test Suite is conducted and a Final Test Report is produced summarizing the test results. If the validation results warrant, a Certificate of Validation is issued by the CSL. If a Certificate is issued, then the Final Test Report will become publicly available.

f. Validation is performed on a cost-reimbursable basis. The CSL will send the requestor an estimate of validation cost that must be approved before beginning the validation process.

g. Unresolved questions and/or any ambiguities resulting from the validation process shall be referred to NIST for resolution in accordance with the FIPS PUB 29-2, Interpretation Procedures for Federal Information Processing Standards.

h. Requests for, and questions on, GKS validation services should be addressed to: Director, Computer Systems Laboratory, Attention: GKS Validation Test Service, National Institute of Standards and Technology, Gaithersburg, MD 20899 Telephone: (301) 975-3268 or FTS 975-3268.

i. AGENCY GUIDANCE: *Delayed Validation* —When an agency determines that the nature of the requirement is such that a GKS-FORTRAN implementation may be offered that has not yet been tested, the requirement statement in paragraph (j) below, under terminology option 'Delayed Validation,' shall be included in requirements documents, including solicitations. This alternative allows a vendor to be responsive to the document if a request for validation has been made.

AGENCY GUIDANCE: *Prior Validation Testing* —When an agency determines that it is essential for a GKS-FORTRAN implementation to be previously tested for conformance before being offered, and the nature of the requirement is such that a GKS-FORTRAN implementation may be initially offered that has not yet been fully validated (i.e., has not demonstrated full compliance to FIPS PUB 120-1), the requirement statement in paragraph (j) below, under terminology option 'Prior Validation Testing,' shall be included in requirements documents, including solicitations.

AGENCY GUIDANCE: *Prior Validation* —When an agency determines that it is essential for a GKS-FORTRAN implementation to be validated (i.e., implementation has demonstrated compliance to FIPS PUB 120-1) before being offered, such as a requirement for a validated GKS-FORTRAN implementation for performance evaluation or benchmarking, the requirement statement in paragraph (j) below, under terminology option 'Prior Validation,' shall be included in requirements documents, including solicitations. This latter alternative may tend to restrict competition.

j. Solicitation Wording:

"Validation of GKS-FORTRAN Implementations"

"In addition to the GKS-FORTRAN implementation requirements specified elsewhere in this requirements document, all GKS-FORTRAN implementations that are brought into the Federal inventory as a result of this document for which validation is specified, and those implementations used by vendors to develop programs or provide services shall be validated using the official GKS Validation Test Suite as specified by the Computer Systems Laboratory (CSL). Validation shall be in accordance with CSL validation procedures for FIPS PUB 120-1. The results of validation shall be used to confirm that the GKS-FORTRAN implementation meets the requirements of FIPS PUB 120-1 as specified in this document.To be considered responsive the offeror shall:

(1) Provide validated GKS-FORTRAN implementations through 'Delayed Validation,' 'Prior Validation Testing' or 'Prior Validation' as specified elsewhere in this requirements document.

For 'Delayed Validation' the offeror shall certify in the offer that all GKS-FORTRAN implementations offered in response to this document have been submitted for validation, or have been previously tested or validated and included on the current list of validated products maintained by the Computer Systems Laboratory (CSL). (The CSL list is periodically published when sufficient changes warrant.) Unless specified elsewhere, proof of submission for validation shall be in the form of a letter from CSL scheduling the validation. Proof of testing shall be provided in the form of a CSL registered validation summary report (test report). Proof of validation shall be in the form of a CSL Certificate of Validation.

For 'Prior Validation Testing' the offeror shall certify in the offer that all GKS-FORTRAN implementations offered in response to this document have been previously tested or validated and included on the current list of validated products maintained by the Computer Systems Laboratory (CSL). Unless specified elsewhere, proof of testing shall be provided in the form of a CSL registered validation summary report (test report). Proof of validation shall be in the form of a CSL Certificate of Validation.

For 'Prior Validation' the offeror shall certify in the offer that all GKS-FORTRAN implementations offered in response to this document have been previously validated and included on the current list of validated products maintained by the Computer Systems Laboratory (CSL). Unless specified elsewhere, proof of validation shall be in the form of a CSL Certificate of Validation.

(2) Agree to correct all implementation nonconformance from FIPS PUB 120-1 reflected in the validation summary report not previously covered by a waiver. All areas of nonconformance must be corrected within 12 months from the date of contract award unless otherwise specified elsewhere in this document. If an interpretation of FIPS PUB 120-1 is required that will invoke the procedures set forth in FIPS PUB 29-2, such a request for interpretation shall be made within 30 calendar days after contract award. Any corrections that are required as a result of decisions made under the procedures of FIPS PUB 29-2 shall be completed within 12 months of the date of the formal notification to the contractor of the approval of the interpretation. Proof of correction in either case shall be in the form of a CSL Certificate of Validation or registered validation summary report for the corrected GKS-FORTRAN implementation. Failure to make required corrections within the time limits set forth above shall be deemed a failure to deliver required software. The liquidated damages as specified for failure to deliver the operating system or other software shall apply."

k. If the party offering the GKS-FORTRAN implementation is an activity of the U.S. Government, the particular agency shall be responsible for securing the validation of the GKS-FORTRAN implementation in accordance with this paragraph.

12. Waivers.

Under certain exceptional circumstances, the heads of Federal departments and agencies may approve waivers to Federal Information Processing Standards (FIPS). The head of such agency may redelegate such authority only to a senior official designated pursuant to section 3506(b) of Title 44, U.S. Code. Waivers shall be granted only when:

a. Compliance with a standard would adversely affect the accomplishment of the mission of an operator of a Federal computer system, or

b. Cause a major adverse financial impact on the operator which is not offset by Governmentwide savings.

Agency heads may act upon a written waiver request containing the information detailed above. Agency heads may also act without a written waiver request when they determine that conditions for meeting the standard cannot be met. Agency heads may approve waivers only by a written decision which explains the basis on which the agency head made the required finding(s). A copy of each such decision, with procurement sensitive or classified portions clearly identified, shall be sent to: National Institute of Standards and Technology; ATTN: FIPS Waiver Decisions, Technology Building, Room B-154; Gaithersburg, MD 20899.

In addition, notice of each waiver granted and each delegation of authority to approve waivers shall be sent promptly to the Committee on Government Operations of the House of Representatives and the Committee on Governmental Affairs of the Senate and shall be published promptly in the *Federal Register.*

When the determination on a waiver applies to the procurement of equipment and/or services, a notice of the waiver determination must be published in the *Commerce Business Daily* as a part of the notice of solicitation for offers of an acquisition or, if the waiver determination is made after that notice is published, by amendment to such notice.

A copy of the waiver, any supporting documents, the document approving the waiver and any supporting and accompanying documents, with such deletions as the agency is authorized and decides to make under 5 U.S.C. Sec. 552(b), shall be part of the procurement documentation and retained by the agency.

13. Where to Obtain Copies. Copies of this publication are for sale by the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161. (Sale of the included specifications document is by arrangement with the American National Standards Institute.) When ordering, refer to Federal Information Processing Standards Publication 120-1 (FIPSPUB120-1), and title. Specify microfiche, if desired. Payment may be made by check, money order, or NTIS deposit account.