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FIPS PUB 189

FEDERAL INFORMATION PROCESSING STANDARDS PUBLICATION

**PORTABLE OPERATING SYSTEM INTERFACE
(POSIX)—PART 2: SHELL AND UTILITIES**

CATEGORY: SOFTWARE STANDARD

SUBCATEGORY: OPERATING SYSTEMS

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Computer Systems Laboratory
National Institute of Standards and Technology
Gaithersburg, MD 20899-0001

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U.S. Department of Commerce
Ronald H. Brown, Secretary

Technology Administration
Mary L. Good, Under Secretary for Technology

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and Technology
Arati Prabhakar, 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.

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James H. Burrows, Director
Computer Systems Laboratory

Abstract

This publication announces the adoption of International Standard ISO/IEC 9945-2:1993, Information Technology—Portable Operating System Interface (POSIX)—Part 2: Shell and Utilities as a Federal Information Processing Standard (FIPS). ISO/IEC 9945-2:1993 defines a command language interpreter (shell) and a set of utility programs.

This standard is for use by computing professionals involved in system and application software development and implementation and is part of a series of specifications needed for application portability. This standard addresses the Applications Portability Profile functional area that deals with methods by which a person interacts with the operating system.

Key words: API; application portability; data processing; Federal Information Processing Standard (FIPS); open systems; operating system; portable application; POSIX; shell and utilities; user portability.

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**Federal Information
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Announcing the Standard for

**PORTABLE OPERATING SYSTEM INTERFACE (POSIX)—PART 2:
SHELL AND UTILITIES**

Federal Information Processing Standards Publications (FIPS PUBS) are issued by the National Institute of Standards and Technology 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. Portable Operating System Interface (POSIX)—Part 2: Shell and Utilities (FIPS PUB 189).

2. Category of Standard. Software Standard, Operating Systems.

3. Explanation. This publication announces the adoption of International Standard ISO/IEC 9945-2:1993, Information Technology—Portable Operating System Interface (POSIX)—Part 2: Shell and Utilities as a Federal Information Processing Standard (FIPS). ISO/IEC 9945-2:1993 defines a command language interpreter (shell) and a set of utility programs.

This standard is for use by computing professionals involved in system and application software development and implementation and is part of a series of specifications needed for application portability. This standard addresses the Applications Portability Profile functional area that deals with methods by which a person interacts with the operating system.

4. Approving Authority. Secretary of Commerce.

5. Maintenance Agency. U.S. Department of Commerce, National Institute of Standards and Technology, Computer Systems Laboratory.

6. Cross Index. International Standard ISO/IEC 9945-2:1993, Information Technology—Portable Operating System Interface (POSIX)—Part 2: Shell and Utilities.

7. Related Documents.

a. Federal Information Resources Management Regulations subpart 201-20.333, Standards, and subpart 201-39.1002, Federal Standards.

b. Federal Information Processing Standards Publication 151-2 (POSIX).

c. Federal Information Processing Standards Publication 160, C.

d. ISO/IEC 9899: Information Technology—Programming Languages—C.

e. Test Methods for Measuring Conformance to POSIX, IEEE Std 1003.3-1991.

f. Test Methods for Measuring Conformance to POSIX, IEEE Proposed Std 2003 (Draft 5.0), September 1994.

g. Test Methods for Measuring Conformance to POSIX.1, IEEE Std 2003.1-1992.

h. Test Methods for Measuring Conformance to POSIX.2, IEEE Proposed Std 2003.2 (Draft 9), February 1994.

i. Interpretation Procedures for Federal Information Processing Standards for Software, FIPS PUB 29-3, 1992 October 29.

j. NVLAP Program Handbook, Computer Applications Testing POSIX Conformance Testing, NISTIR 4522, March 1991 (latest revision).

k. NIST POSIX Testing Policy—General Information, May 12, 1993 (latest revision).

l. NIST POSIX Testing Policy, Certificate of Validation Requirements, FIPS 151-2, October 1, 1994 (latest revision).

8. Related On-Line Information. Information on the NIST POSIX Testing Program is available on an electronic mail (email) file server system. Documents available are: registers of validated products, general information on NIST POSIX testing policy, and information on requirements for certificates of validation.

To access the system:

You must be able to send and receive email via the Internet. For most email systems, send an email message to `posix@nist.gov`. When the email system prompts you for the "Subject" of the message, you may type anything. The body of the email message should consist of one or more basic commands to the email server, with each command on a separate line. For example, to request the email server to send you a listing of all available files, enter the command: `send index`. To request a brief description of all valid commands, enter the command: `help`. To receive a more detailed explanation on how to use the mail server, enter: `send help`.

After you enter the command(s), indicate that your email message is complete as required by your email system.

The NIST mail server program will read the message and send the requested document(s) and/or information to your email address.

If you need help, contact the Systems and Software Technology Division, B266 Technology Building, NIST, Gaithersburg, MD 20899, telephone: 301-975-3295.

9. Objectives. This FIPS permits Federal departments and agencies to exercise more effective control over the production, management, and use of the Government's information resources. The primary objectives of this FIPS are:

- a. To promote portability of computer application programs at the source code level, thus reducing staff hours required to tailor computer programs for different vendor systems and architectures.
- b. To simplify computer program documentation by the use of a standard portable system interface design.
- c. To increase portability of acquired skills, allowing people to operate a wide range of application platform implementations without additional training or study, resulting in reduced personnel training costs.
- d. To maximize the return on investment in generating or purchasing computer programs by insuring operating system compatibility.

Governmentwide attainment of the above objectives depends upon the widespread availability and use of comprehensive and precise standard specifications.

10. Applicability. This FIPS shall be used for POSIX command language interpreters and utilities that are either developed or acquired for Government use. This FIPS is applicable to the entire range of computer hardware, including:

- a. Notebooks and Subnotebooks,
- b. Laptops,
- c. Micro-computer systems,
- d. Mini-computer systems,
- e. Workstations,
- f. Mainframes, and
- g. Other systems that require POSIX-like command language interfaces.

11. Specifications. The FIPS PUB 189 specifications are the specifications contained in the International Standard ISO/IEC 9945-2:1993, Information Technology—Portable Operating System Interface (POSIX)—Part 2: Shell and Utilities, with the modifications specified below. ISO/IEC 9945-2:1993 defines a command language interpreter (shell) and a set of utility programs. ISO/IEC 9945-2:1993 (hereinafter referred to as POSIX.2) refers to and is a complement to ISO/IEC 9945-1:1990, Information Technology—Portable Operating System Interface (POSIX)—Part 1: System Application Program Interface (API) [C Language].

POSIX.2 contains a number of features that are labelled obsolescent. These features violate the general syntactic guidelines of POSIX.2. They were included in POSIX.2 to provide upward compatibility of existing applications, and may be deleted from POSIX.2 at some future date. The POSIX.2 standard requires that strictly conforming applications do not use any of these features. It is strongly recommended that agencies that require the POSIX.2 FIPS prohibit users from using these features in the development of new applications. Therefore, the following obsolescent features are not required for a system to be compliant with the POSIX.2 FIPS. (For each feature a reference to the associated POSIX.2 text is provided):

- Zero-length prefix in the `PATH` environment variable [See POSIX.2 Section 2.6 Lines 2689-2693]
- The `-` option in the `set` special built-in utility [See POSIX.2 Section 3.14.11 Lines 1584-1585 and 1711-1713]
- The `awk` string function `length` with no argument and no parentheses [See POSIX.2 Section 4.1.7.6.2.2 Lines 618-619]
- The octal number form of the `mode` operand in the `chmod` utility [See POSIX.2 Section 4.7.7 Lines 2083-2084]
- The `-` option in the `ed` utility [See POSIX.2 Section 4.20.1 Lines 3509-3510; Section 4.20.3 Line 3522]
- The `-` option in the `env` utility [See POSIX.2 Section 4.21.1 Lines 4013-4014; Section 4.21.3 Line 4027]
- The `-perm [-]onum` primary in the `find` utility [See POSIX.2 Section 4.24.4 Lines 4335-4342]
- The `egrep` and `fgrep` utilities [See POSIX.2 Section 4.28.1 Lines 4765-4771; Section 4.28.2 Lines 4787-4804; Section 4.28.3 Lines 4822-4823]
- The `-number` option in the `head` utility [See POSIX.2 Section 4.29.1 Lines 4924-4925; Section 4.29.3 Lines 4942-4945]
- The `-j field`, `-j1 field`, and `-j2 field` options and the `-o list` option (where `list` is composed of multiple arguments) in the `join` utility [See POSIX.2 Section 4.31.1 Lines 5104-5106; Section 4.31.3 Lines 5139-5141 and 5153-5155]
- The `-signal_name` and `-signal_number` options in the `kill` utility [See POSIX.2 Section 4.32.1 Lines 5230-5232; Section 4.32.3 Lines 5265-5282]
- The `+pos1` and `-pos2` options in the `sort` utility and the `-o output` option following a `file` operand [See POSIX.2 Section 4.58.1 Lines 9549-9551; Section 4.58.3 Lines 9565-9567, 9584-9586, and 9639-9640; Section 4.58.7 Lines 9710-9726]
- The `-[number] [c|l] [f]` and `+ [number] [c|l] [f]` options in the `tail` utility [See POSIX.2 Section 4.60.1 Lines 10021-10023; Section 4.60.3 Lines 10062-10069]
- The `date_time` operand in the `touch` utility [See POSIX.2 Section 4.63.1 Lines 10301-10302; Section 4.63.4 Lines 10367-10380]
- The `-s` option in the `tty` utility [See POSIX.2 Section 4.66.1 Lines 10625-10626; Section 4.66.3 Lines 10635-10637]
- The octal number form of the `mask` operand in the `umask` utility [See POSIX.2 Section 4.67.4 Lines 10721-10726]
- The `-n` and `+m` options in the `uniq` utility [See POSIX.2 Section 4.69.1 Lines 10856-10857; Section 4.69.3 Lines 10884-10885]

If the User Portability Utilities Option is required, the following obsolescent features are not required for a system to be compliant with the POSIX.2 FIPS:

- The `-` and `+command` options in the `ex` utility [See POSIX.2 Section 5.10.1 Lines 984-985; Section 5.10.3 Lines 1003 and 1027]
- The `-tabstop` and `-tab1, tab2, . . . tabn` options in the `expand` utility [See POSIX.2 Section 5.11.1 Lines 2053-2054; Section 5.11.3 Lines 2080-2082]
- The `+command` option in the `more` utility [See POSIX.2 Section 5.18.1 Lines 2723-2724; Section 5.18.3 Line 2766]
- The `-` option in the `newgrp` utility [See POSIX.2 Section 5.19.1 Lines 3128-3129; Section 5.19.3 Line 3180]
- The `-increment` option in the `nice` utility [See POSIX.2 Section 5.20.1 Lines 3237-3238; Section 5.20.3 Line 3255]
- The `nice_value` operand in the `renice` utility; combinations of the `[-p] pid, -g gid,` and `-u user` options [See POSIX.2 Section 5.24.1 Lines 3787-3790; Section 5.24.3 Lines 3829-3830, 3839-3840, and 3842-3843; Section 5.24.4 Lines 3852-3856]
- The `-line_count` option in the `split` utility [See POSIX.2 Section 5.25.1 Lines 3898-3899; Section 5.25.3 Line 3934]
- The `-` and `-number` options in the `strings` utility [See POSIX.2 Section 5.26.1 Lines 3988-3989; Section 5.26.3 Lines 4002 and 4006]
- The `+command` option in the `vi` utility [See POSIX.2 Section 5.35.1 Lines 4715-4716; Section 5.35.3 Line 4737]

If the C-Language Development Utilities Option is required, the following obsolescent feature is not required for a system to be compliant with the POSIX.2 FIPS:

- The `-c` option in the `lex` utility [See POSIX.2 Section A.2.1 Lines 219-220; Section A.2.3 Line 232]

12. Recommendations. Users of this standard should be aware that it does not require the Portable Operating System Interface (POSIX)—Part 2: Shell and Utilities to be implemented on a FIPS 151-2 conforming implementation. Users should also be aware that certain utilities and functions are optional in ISO/IEC 9945-2:1993. To provide the greatest support for application portability, it is recommended that an implementation conforming to this FIPS also provide the following features:

1. User Portability Utilities Option (POSIX2_UPE, POSIX.2 Section 5) and Full Terminal Operations Option (POSIX2_CHAR_TERM, POSIX.2 Section 2.14).
2. A FIPS 151-2 conforming operating system interface.
3. Software Development Utilities Option (POSIX2_SW_DEV, POSIX.2 Section 6), when software will be developed or source-level software will be installed on the systems being acquired.
4. C-Language Development Utilities Option (POSIX2_C_DEV, POSIX.2 Annex A), when software written in the C language will be developed or installed on the systems being acquired.
5. C-Language Bindings Option (POSIX2_C_BIND, POSIX.2 Annex B), when software written in the C language will be used on the systems being acquired.
6. FORTRAN Development Utilities Option (POSIX2_FORT_DEV, POSIX.2 Annex C), when software written in FORTRAN will be developed or installed on the systems being acquired.
7. FORTRAN Runtime Utilities Option (POSIX2_FORT_RUN, POSIX.2 Annex C), when FORTRAN software will be used on the systems being acquired.

Furthermore, it is strongly recommended that Federal users require Feature 1 and, in addition, ensure that purchased systems are capable of supporting Features 2–5, listed above. Even when these features are not needed at the time of initial purchase, changed requirements may demand some or all of these in the future, either for the development of new applications, for the importing of applications from other systems, or to maximize compatibility among multiple in-house systems.

13. Implementation. This standard becomes effective April 3, 1995. This standard is compulsory and binding for use in all solicitations and contracts for new operating systems and/or applications development where POSIX shell and utility interfaces are required.

a. **Acquisition of Conforming Portable Shell and Utilities.** Organizations developing applications which are to be acquired after the publication date of this standard and which have applications portability as a requirement should consider the use of this FIPS. Conformance to this FIPS should be considered whether the operating system environments are:

1. developed internally,
2. acquired as part of an ADP system procurement,
3. acquired by separate procurement,
4. used under an ADP leasing arrangement, or
5. specified for use in contracts for programming services.

b. **Interpretation of the FIPS for Shell and Utilities.** NIST provides for the resolution of questions regarding the FIPS specifications and requirements, and issues official interpretations as needed. All questions about the interpretation of this FIPS should be addressed to:

Director
 Computer Systems Laboratory
 Attn: POSIX Shell and Utilities FIPS Interpretation
 National Institute of Standards and Technology
 Gaithersburg, MD 20899

c. **Validation of Conforming Operating Systems Environments.** NIST is developing cooperatively with industry a validation suite for measuring conformance to this standard. This suite will be required for testing conformance of POSIX Shell and Utilities implementations. These testing requirements will be announced at a future date.

14. 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 of 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.

15. 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 Institute of Electrical and Electronics Engineers, Incorporated.) When ordering, refer to Federal Information Processing Standards Publication 189 (FIPSPUB189), and title. Payment may be made by check, money order, or deposit account.

APPENDIX A—APPLICATION PORTABILITY PROFILE

FIPS 189 is the second component of a series of specifications needed for the operating system services area of an applications portability profile. FIPS 151-1 (and its replacement, FIPS 151-2) provided the crucial first step by providing a vendor independent interface specification between an application program and an operating system. When fully extended, POSIX will provide the functionality required to support source code portability for a wide range of applications across many different machines and operating systems.

NIST has published Special Publication 500-210, Application Portability Profile (APP), the U.S. Government's Open System Environment Profile, OSE/1, Version 2.0, June 1993. The APP has been developed to provide sufficient functionality to accommodate a broad range of application requirements. The functional components of the APP constitute a framework for organizing standard elements that can be used to develop and maintain portable applications. A key aspect of the APP is that it is based on an open system environment defined by non-proprietary specifications. Components may be added or deleted as technology changes and as Federal Government requirements change.





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