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Information technology — Test methods for measuring conformance to POSIX

*Technologies de l'information — Méthodes d'essai pour mesurer la
conformité à POSIX*



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Information technology—Test methods for measuring conformance to POSIX

Sponsor

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of the
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**International Organization for Standardization
and by the
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Abstract: The general requirements and test methods for measuring conformance to POSIX standards are defined. This document is aimed primarily at working groups developing test methods for POSIX standards, developers of POSIX test methods, and users of POSIX test methods.

Keywords: assertion, assertion test, base assertion, conditional feature, extended assertions, POSIX, POSIX Conformance Document, POSIX Conformance Test Procedure, POSIX Conformance Test Suite, test method, test result code



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International Standard ISO/IEC 13210 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 22, *Programming languages, their environments and system software interfaces*.

Annexes A and B form an integral part of this International Standard.



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Introduction

(This Introduction is not a normative part of ISO/IEC 13210 Information Technology— Test methods for measuring conformance to POSIX, but is included for information only.)

This standard defines the general requirements and test methods for measuring conformance to POSIX standards. This document is aimed primarily at working groups developing test methods for POSIX standards, developers of POSIX test methods, and users of POSIX test methods.

Organization of the Standard

This document is organized into sections and clauses. Some of these, such as 1.1, are mandated by the IEEE and other standards bodies.

The sections are:

- (1) General
 - (2) Terminology and General Requirements
 - (3) Test Methods Conformance to This Standard
 - (4) Testing Levels and Complexity Levels
 - (5) Classification of Assertions
 - (6) Writing Assertions
 - (7) Assertion Test Output
 - (8) Statement of Conformance to a POSIX Standard
- A *Topical Index* points to the definition and/or usage of key words and phrases.

The foreword, introduction, any footnotes, and the informative annexes are not considered part of this International Standard.

Revisions and Supplements to This Standard

No activities to extend this International Standard to address additional requirements are in progress. Extension efforts may be anticipated in the future. This is an outline of how extensions can be incorporated.

Extensions are approved as “amendments” or “revisions” to this document, following the IEEE Standards Procedures.

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Information Technology— Test methods for measuring conformance to POSIX

Section 1: General

1.1 Scope

This International Standard is applicable to the development and use of conformance testing methodologies for POSIX standards. The generic test methods identified in this International Standard shall be used in conjunction with test methods identified for a specific standard.

This International Standard is intended for use by working groups developing test methods for POSIX standards, developers of POSIX test methods, and users of POSIX test methods.

The purpose of this International Standard is to define general rules for developing test assertions and related test methods for measuring conformance of an implementation to POSIX standards. Test methods may include POSIX Conformance Test Suites (PCTS), POSIX Conformance Test Procedures (PCTP), and audits of POSIX Conformance Documents (PCD).

Testing conformance of an implementation to a standard includes testing the claimed capabilities and behavior of the implementation with respect to the conformance requirements of the standard. Test methods are intended to provide a reasonable, practical assurance that the implementation conforms to the standard. Use of these test methods will not guarantee conformance of an implementation to the standard; that normally would require exhaustive testing (see 4.2.1), which is impractical for both technical and economic reasons.

1.2 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard 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.

{1} IEEE Std 729-1983, *IEEE Glossary of Software Engineering Terminology* (ANSI).

{2} ISO/IEC 9945-1: 1990 (ISO/IEC 9945-1: 1990), *Information technology—Portable Operating System Interface (POSIX)—Part 1: System Application Program Interface (API) [C Language]*.

Section 2: Terminology and General Requirements

2.1 Conventions

This International Standard uses the following typographic conventions:

- (1) The *italic* font is used for:
 - The initial appearances of defined terms
 - Cross-references to defined terms within 2.2.1, 2.2.2, and 2.2.3
 - Parameters (option arguments and operands) that are generally substituted with real values by the application
 - C language data types and function names
 - Global external variable names
- (2) The **bold** font is used for:
 - Test result codes
 - Assertion type classification
- (3) The `constant-width` (Courier) font is used:
 - To illustrate examples of system input or output where exact usage is depicted
 - For references to utility names and C language headers
- (4) Symbolic *errno* names returned by functions are represented as [symbolic_name].
- (5) Symbolic constant limits are represented as {symbolic_constant_limit}.
- (6) Symbolic constant options are represented as {Option_name}.
- (7) Notes provided as parts of labeled tables and figures are integral parts of this International Standard (normative). Footnotes and Notes within the body of the text are for information only (informative).
- (8) Defined names that are usually in lowercase, particularly function names, are never used at the beginning of a sentence or anywhere else where regular English usage would require them to be capitalized.
- (9) Mathematical symbols such as <, ≤, etc. are only used in formulas, assertion classification assignments, and conditional clauses preceding conditional assertions.

- (10) In some cases tabular information is presented “inline”; in others it is presented in a separately labeled table. This arrangement was employed purely for ease of typesetting and there is no normative difference between these two cases.
- (11) The conventions listed above are for ease of reading only. Editorial inconsistencies in the use of typography are unintentional and have no normative meaning in this International Standard.
- A summary of typographical conventions is shown in Table 2-1.

Table 2-1 – Typographical Conventions

Reference	Example
C Language Header	<sys/stat.h>
Command Name	awk
Command Option	-c
Command Option With Argument	-w <i>width</i>
Data Types	<i>long</i>
Defined Terms	<i>file</i>
Environment Variables	PATH
Error Number	[EINTR]
File Name	<i>filename</i>
Function Argument Declaration	extern unsigned long int
Function Argument	<i>arg1</i>
Function Declaration	int fstat(int <i>fdes</i> , struct stat * <i>buf</i>);
Function Name	<i>func()</i>
Global External	<i>errno</i>
Implementation-dependent Limit	{MAX_INPUT}
Metavariable	<*>
Operand	<i>file_name</i>
Output	foo
Parameters	< <i>directory pathname</i> >
Section Reference	(see Section 1)
Clause Reference	(see 1.m)
Subclause Reference	(see 1.n.m...)
Special Character	<newline>
Symbolic Constant Limit	{LINK_MAX}
Symbolic Constant Option	{_POSIX_JOB_CONTROL}
Table Reference	Table 6
Variable	<i>st_atime</i>

2.2 Definitions

2.2.1 Terminology

For the purposes of this International Standard, the following definitions apply:

2.2.1.1 may: an option for test methods.

In this International Standard, *need not* is used as the negative of *may*.

74 **2.2.1.2 shall:** A requirement for test methods.

75 **2.2.1.3 should:** A recommended practice for test methods.

76 **2.2.2 General Terms**

77 For the purposes of this International Standard, the following definitions apply:

78 **2.2.2.1 assertion:** A statement of functionality or behavior for a POSIX element
79 that is derived from the POSIX standard being tested and that is true for a con-
80 forming POSIX implementation.

81 **2.2.2.2 assertion number:** The numeric identifier assigned to an assertion.
82 The name of the element and the assertion number together uniquely identify an
83 assertion.

84 **2.2.2.3 assertion test:** The software or procedural methods that ascertain the
85 conformance of a POSIX implementation to an assertion.

86 **2.2.2.4 base assertion:** An assertion that is required to be tested for required
87 features and for implemented conditional features.

88 **2.2.2.5 conditional feature:** A feature or behavior referred to in a POSIX stan-
89 dard that need not be present on all conforming implementations.

90 **2.2.2.6 development system:** The computer system used to compile and
91 configure a PCTS.

92 **2.2.2.7 element:** A functional interface or a namespace allocation.

93 Examples of elements are C functions or utility programs. Examples of
94 namespace allocation include headers or error return value constants.

95 **2.2.2.8 extended assertion:** An assertion that is not required to be tested.

96 **2.2.2.9 POSIX Conformance Document (PCD):** The conformance document
97 required by a POSIX standard.

98 **2.2.2.10 POSIX Conformance Test Procedure (PCTP):** The nonsoftware pro-
99 cedures possibly used in conjunction with other test methods to measure
100 conformance.

101 **2.2.2.11 POSIX Conformance Test Suite (PCTS):** The collection of software
102 possibly used in conjunction with other test methods to measure conformance.

2.2.2.12 required feature: Either a single facility or behavior, or one of a pair of alternative facilities or behaviors, required by a POSIX standard that is always present on a conforming implementation.

2.2.2.13 target system: The combination of the computer system on which the PCTS is executed and the parts of the development system that are used to generate the executable code of a PCTS.

2.2.2.14 test method: The software, procedures, or other means specified by a POSIX standard to measure conformance.

Test methods may include a PCTS, PCTP, or an audit of a PCD.

2.2.2.15 test result code: A value that describes the result of an assertion test.

2.2.3 Abbreviations

For the purposes of this International Standard, the following abbreviations apply:

2.2.3.1 IEEE: The Institute of Electrical and Electronics Engineers.

2.2.3.2 PCD: POSIX Conformance Document.

2.2.3.3 PCTP: POSIX Conformance Test Procedures.

2.2.3.4 PCTS: POSIX Conformance Test Suite.

2.2.3.5 POSIX:¹⁾ Colloquial name for the collection of IEEE 1003 standards, draft standards, and projects.

2.2.3.6 POSIX.n: Term used to refer to a specific IEEE P1003.n project or its products. For example, POSIX.1 represents the P1003.1 project and its associated products, IEEE Std 1003.1-1990, ISO/IEC 9945-1: 1990, and IEEE Std 1003.1c-1993.

2.2.3.7 POSIX.3: This standard.

1) The name POSIX was suggested by Richard Stallman. It is expected to be pronounced *pahz-icks*, as in *positive*, not *poh-six*, or other variations. The pronunciation has been published in an attempt to promulgate a standardized way of referring to a standard operating system interface.

Section 3: Test Methods Conformance to This Standard

3.1 Conformance Criteria

Test methods that conform to POSIX.3 shall meet all of the following criteria:

- The test methods shall document the POSIX.n test method specifications to which they conform.
- The test methods shall test base assertions for required features and implemented conditional features of the POSIX standard for which conformance is being measured. If an assertion lists a set of instances (often separated by the word *or*), the assertion test shall test each specified instance.
- The PCTS shall consist of automated assertion tests to the extent possible.
- The documentation of the PCTS shall include all the information necessary to install, configure, and execute the PCTS.
- The documentation of the test methods shall include, if needed, instructions for performing the PCTP and an audit of the PCD.
- The documentation of the test methods shall describe how to gather and interpret the results.
- Additional criteria shall be specified in applicable POSIX.n standards.

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Section 4: Testing Levels and Complexity Levels

4.1 Introduction

In principle, the objective of conformance testing is to establish whether the implementation being tested conforms to the specification in the relevant standard. Practical limitations make it impossible to be exhaustive, and economic considerations may restrict testing still further.

Due to these limitations, during the design and development of test methods the complexity level of an element will dictate the level of testing that satisfies conformance requirements.

Therefore, this International Standard distinguishes three major levels of testing, according to the extent to which they provide an indication of conformance, and three major levels of element complexity.

The three major levels of testing are:

- Exhaustive Testing
- Thorough Testing
- Identification Testing

The three major levels of element complexity are:

- Simple
- Intermediate
- Complex

4.2 Testing Levels

4.2.1 Exhaustive Testing

Exhaustive testing seeks to verify the behavior of every aspect of an element, including all permutations. For example, exhaustive testing of a given user command would require testing the command with no options, with each option, with each pair of options, and so on, up to every permutation of options.

The various command options and permutations rapidly approach numbers too large to reach execution completion in any realistic time frame. As an example, there are approximately 37 unique error conditions in POSIX.1. The occurrence of one error can (and often does) affect the proper detection of another error. An exhaustive test of the 37 errors would require not just one test per error, but one