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Includes IEEE Std 1003.1™-2001 and IEEE Std 1003.1™-2001/Cor 1-2002**

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Part 4: Rationale

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(POSIX®) —*

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Information Technology — Portable Operating System Interface (POSIX®)

Part 4: Rationale

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of the
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and

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Adopted as an International Standard by the
International Organization for Standardization
and by the
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International Standard ISO/IEC 9945-4:2003(E)

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ISO/IEC 9945-4 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 22, *Programming languages, their environments and system software interfaces*.

This second edition of ISO/IEC 9945-4 is a minor revision and, together with ISO/IEC 9945-1, ISO/IEC 9945-2, and ISO/IEC 9945-3, cancels and replaces ISO/IEC 9945-1:2002, ISO/IEC 9945-2:2002, ISO/IEC 9945-3:2002 and ISO/IEC 9945-4:2002.

ISO/IEC 9945 consists of the following parts, under the general title *Information technology — Portable Operating System Interface (POSIX®)*:

- *Part 1: Base Definitions*
- *Part 2: System Interfaces*
- *Part 3: Shell and Utilities*
- *Part 4: Rationale*



Abstract

This standard is simultaneously ISO/IEC 9945:2003, IEEE Std 1003.1-2001, and forms the core of the Single UNIX Specification, Version 3.

The IEEE Std 1003.1, 2003 Edition includes IEEE Std 1003.1-2001/Cor 1-2002 incorporated into IEEE Std 1003.1-2001 (base document). The Corrigendum addresses problems discovered since the approval of IEEE Std 1003.1-2001. These changes are mainly due to resolving integration issues raised by the merger of the base documents that were incorporated into IEEE Std 1003.1-2001, which is the single common revision to IEEE Std 1003.1TM-1996, IEEE Std 1003.2TM-1992, ISO/IEC 9945-1:1996, ISO/IEC 9945-2:1993, and the Base Specifications of The Open Group Single UNIX[®] Specification, Version 2.

This standard defines a standard operating system interface and environment, including a command interpreter (or “shell”), and common utility programs to support applications portability at the source code level. This standard is intended to be used by both applications developers and system implementors and comprises four major components (each in an associated volume):

- General terms, concepts, and interfaces common to all volumes of this standard, including utility conventions and C-language header definitions, are included in the Base Definitions volume.
- Definitions for system service functions and subroutines, language-specific system services for the C programming language, function issues, including portability, error handling, and error recovery, are included in the System Interfaces volume.
- Definitions for a standard source code-level interface to command interpretation services (a “shell”) and common utility programs for application programs are included in the Shell and Utilities volume.
- Extended rationale that did not fit well into the rest of the document structure, which contains historical information concerning the contents of this standard and why features were included or discarded by the standard developers, is included in the Rationale (Informative) volume.

The following areas are outside the scope of this standard:

- Graphics interfaces
- Database management system interfaces
- Record I/O considerations
- Object or binary code portability
- System configuration and resource availability

This standard describes the external characteristics and facilities that are of importance to applications developers, rather than the internal construction techniques employed to achieve these capabilities. Special emphasis is placed on those functions and facilities that are needed in a wide variety of commercial applications.

Keywords

application program interface (API), argument, asynchronous, basic regular expression (BRE), batch job, batch system, built-in utility, byte, child, command language interpreter, CPU, extended regular expression (ERE), FIFO, file access control mechanism, input/output (I/O), job control, network, portable operating system interface (POSIX[®]), parent, shell, stream, string, synchronous, system, thread, X/Open System Interface (XSI)

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Rationale (Informative)

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Foreword

Structure of the Standard

This standard was originally developed by the Austin Group, a joint working group of members of the IEEE, members of The Open Group, and members of ISO/IEC Joint Technical Committee 1, as one of the four volumes of IEEE Std 1003.1-2001. The standard was approved by ISO and IEC and published in four parts, correlating to the original volumes.

A mapping of the parts to the volumes is shown below:

ISO/IEC 9945 Part	IEEE Std 1003.1 Volume	Description
9945-1	Base Definitions	Includes general terms, concepts, and interfaces common to all parts of ISO/IEC 9945, including utility conventions and C-language header definitions.
9945-2	System Interfaces	Includes definitions for system service functions and subroutines, language-specific system services for the C programming language, function issues, including portability, error handling, and error recovery.
9945-3	Shell and Utilities	Includes definitions for a standard source code-level interface to command interpretation services (a “shell”) and common utility programs for application programs.
9945-4	Rationale	Includes extended rationale that did not fit well into the rest of the document structure, containing historical information concerning the contents of ISO/IEC 9945 and why features were included or discarded by the standard developers.

All four parts comprise the entire standard, and are intended to be used together to accommodate significant internal referencing among them. POSIX-conforming systems are required to support all four parts.

Introduction

Note: This introduction is not part of IEEE Std 1003.1-2001, Standard for Information Technology — Portable Operating System Interface (POSIX).

This standard has been jointly developed by the IEEE and The Open Group. It is simultaneously an IEEE Standard, an ISO/IEC Standard, and an Open Group Technical Standard.

The Austin Group

This standard was developed, and is maintained, by a joint working group of members of the IEEE Portable Applications Standards Committee, members of The Open Group, and members of ISO/IEC Joint Technical Committee 1. This joint working group is known as the Austin Group.³ The Austin Group arose out of discussions amongst the parties which started in early 1998, leading to an initial meeting and formation of the group in September 1998. The purpose of the Austin Group has been to revise, combine, and update the following standards: ISO/IEC 9945-1, ISO/IEC 9945-2, IEEE Std 1003.1, IEEE Std 1003.2, and the Base Specifications of The Open Group Single UNIX Specification.

After two initial meetings, an agreement was signed in July 1999 between The Open Group and the Institute of Electrical and Electronics Engineers (IEEE), Inc., to formalize the project with the first draft of the revised specifications being made available at the same time. Under this agreement, The Open Group and IEEE agreed to share joint copyright of the resulting work. The Open Group has provided the chair and secretariat for the Austin Group.

The base document for the revision was The Open Group's Base volumes of its Single UNIX Specification, Version 2. These were selected since they were a superset of the existing POSIX.1 and POSIX.2 specifications and had some organizational aspects that would benefit the audience for the new revision.

The approach to specification development has been one of “write once, adopt everywhere”, with the deliverables being a set of specifications that carry the IEEE POSIX designation, The Open Group's Technical Standard designation, and an ISO/IEC designation. This set of specifications forms the core of the Single UNIX Specification, Version 3.

This unique development has combined both the industry-led efforts and the formal standardization activities into a single initiative, and included a wide spectrum of participants. The Austin Group continues as the maintenance body for this document.

Anyone wishing to participate in the Austin Group should contact the chair with their request. There are no fees for participation or membership. You may participate as an observer or as a contributor. You do not have to attend face-to-face meetings to participate; electronic participation is most welcome. For more information on the Austin Group and how to participate, see <http://www.opengroup.org/austin>.

3. The Austin Group is named after the location of the inaugural meeting held at the IBM facility in Austin, Texas in September 1998.

Background

The developers of this standard represent a cross section of hardware manufacturers, vendors of operating systems and other software development tools, software designers, consultants, academics, authors, applications programmers, and others.

Conceptually, this standard describes a set of fundamental services needed for the efficient construction of application programs. Access to these services has been provided by defining an interface, using the C programming language, a command interpreter, and common utility programs that establish standard semantics and syntax. Since this interface enables application writers to write portable applications—it was developed with that goal in mind—it has been designated POSIX,⁴ an acronym for Portable Operating System Interface.

Although originated to refer to the original IEEE Std 1003.1-1988, the name POSIX more correctly refers to a family of related standards: IEEE Std 1003.*n* and the parts of ISO/IEC 9945. In earlier editions of the IEEE standard, the term POSIX was used as a synonym for IEEE Std 1003.1-1988. A preferred term, POSIX.1, emerged. This maintained the advantages of readability of the symbol “POSIX” without being ambiguous with the POSIX family of standards.

Audience

The intended audience for this standard is all persons concerned with an industry-wide standard operating system based on the UNIX system. This includes at least four groups of people:

1. Persons buying hardware and software systems
2. Persons managing companies that are deciding on future corporate computing directions
3. Persons implementing operating systems, and especially
4. Persons developing applications where portability is an objective

Purpose

Several principles guided the development of this standard:

- Application-Oriented

The basic goal was to promote portability of application programs across UNIX system environments by developing a clear, consistent, and unambiguous standard for the interface specification of a portable operating system based on the UNIX system documentation. This standard codifies the common, existing definition of the UNIX system.

- Interface, Not Implementation

This standard defines an interface, not an implementation. No distinction is made between library functions and system calls; both are referred to as functions. No details of the implementation of any function are given (although historical practice is sometimes indicated in the RATIONALE section). Symbolic names are given for constants (such as signals and error numbers) rather than numbers.

4. 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.

- Source, Not Object, Portability

This standard has been written so that a program written and translated for execution on one conforming implementation may also be translated for execution on another conforming implementation. This standard does not guarantee that executable (object or binary) code will execute under a different conforming implementation than that for which it was translated, even if the underlying hardware is identical.

- The C Language

The system interfaces and header definitions are written in terms of the standard C language as specified in the ISO C standard.

- No Superuser, No System Administration

There was no intention to specify all aspects of an operating system. System administration facilities and functions are excluded from this standard, and functions usable only by the superuser have not been included. Still, an implementation of the standard interface may also implement features not in this standard. This standard is also not concerned with hardware constraints or system maintenance.

- Minimal Interface, Minimally Defined

In keeping with the historical design principles of the UNIX system, the mandatory core facilities of this standard have been kept as minimal as possible. Additional capabilities have been added as optional extensions.

- Broadly Implementable

The developers of this standard endeavored to make all specified functions implementable across a wide range of existing and potential systems, including:

1. All of the current major systems that are ultimately derived from the original UNIX system code (Version 7 or later)
2. Compatible systems that are not derived from the original UNIX system code
3. Emulations hosted on entirely different operating systems
4. Networked systems
5. Distributed systems
6. Systems running on a broad range of hardware

No direct references to this goal appear in this standard, but some results of it are mentioned in the Rationale (Informative) volume.

- Minimal Changes to Historical Implementations

When the original version of IEEE Std 1003.1 was published, there were no known historical implementations that did not have to change. However, there was a broad consensus on a set of functions, types, definitions, and concepts that formed an interface that was common to most historical implementations.

The adoption of the 1988 and 1990 IEEE system interface standards, the 1992 IEEE shell and utilities standard, the various Open Group (formerly X/Open) specifications, and the subsequent revisions and addenda to all of them have consolidated this consensus, and this revision reflects the significantly increased level of consensus arrived at since the original versions. The earlier standards and their modifications specified a number of areas where consensus had not been reached before, and these are now reflected in this revision. The authors of the original versions tried, as much as possible, to follow the principles below

when creating new specifications:

1. By standardizing an interface like one in an historical implementation; for example, directories
2. By specifying an interface that is readily implementable in terms of, and backwards-compatible with, historical implementations, such as the extended *tar* format defined in the *pax* utility
3. By specifying an interface that, when added to an historical implementation, will not conflict with it; for example, the *sigaction()* function

This revision tries to minimize the number of changes required to implementations which conform to the earlier versions of the approved standards to bring them into conformance with the current standard. Specifically, the scope of this work excluded doing any “new” work, but rather collecting into a single document what had been spread across a number of documents, and presenting it in what had been proven in practice to be a more effective way. Some changes to prior conforming implementations were unavoidable, primarily as a consequence of resolving conflicts found in prior revisions, or which became apparent when bringing the various pieces together.

However, since it references the 1999 version of the ISO C standard, and no longer supports “Common Usage C”, there are a number of unavoidable changes. Applications portability is similarly affected.

This standard is specifically not a codification of a particular vendor’s product.

It should be noted that implementations will have different kinds of extensions. Some will reflect “historical usage” and will be preserved for execution of pre-existing applications. These functions should be considered “obsolescent” and the standard functions used for new applications. Some extensions will represent functions beyond the scope of this standard. These need to be used with careful management to be able to adapt to future extensions of this standard and/or port to implementations that provide these services in a different manner.

- Minimal Changes to Existing Application Code

A goal of this standard was to minimize additional work for the developers of applications. However, because every known historical implementation will have to change at least slightly to conform, some applications will have to change.

This Standard

This standard defines the Portable Operating System Interface (POSIX) requirements and consists of the following volumes:

- Base Definitions
- Shell and Utilities
- System Interfaces
- Rationale (Informative) (this volume)

This Volume

This volume is being published to assist in the process of review. It contains historical information concerning the contents of this standard and why features were included or discarded by the standard developers. It also contains notes of interest to application programmers on recommended programming practices, emphasizing the consequences of some aspects of this standard that may not be immediately apparent.

This volume is organized in parallel to the normative volumes of this standard, with a separate part for each of the three normative volumes.

Within this volume, the following terms are used:

base standard

The portions of this standard that are not optional, equivalent to the definitions of *classic* POSIX.1 and POSIX.2.

POSIX.0

Although this term is not used in the normative text of this standard, it is used in this volume to refer to IEEE Std 1003.0-1995.

POSIX.1b

Although this term is not used in the normative text of this standard, it is used in this volume to refer to the elements of the POSIX Realtime Extension amendment. (This was earlier referred to as POSIX.4 during the standard development process.)

POSIX.1c

Although this term is not used in the normative text of this standard, it is used in this volume to refer to the POSIX Threads Extension amendment. (This was earlier referred to as POSIX.4a during the standard development process.)

standard developers

The individuals and companies in the development organizations responsible for this standard: the IEEE P1003.1 working groups, The Open Group Base working group, advised by the hundreds of individual technical experts who balloted the draft standards within the Austin Group, and the member bodies and technical experts of ISO/IEC JTC 1/SC22/WG15.

XSI extension

The portions of this standard addressing the extension added for support of the Single UNIX Specification.

Participants

IEEE Std 1003.1-2001 was prepared by the Austin Group, sponsored by the Portable Applications Standards Committee of the IEEE Computer Society, The Open Group, and ISO/SC22 WG15.

The Austin Group

At the time of approval, the membership of the Austin Group was as follows:

Andrew Josey, Chair

Donald W. Cragun, Organizational Representative, IEEE PASC

Nicholas Stoughton, Organizational Representative, ISO/SC22 WG15

Mark Brown, Organizational Representative, The Open Group

Cathy Hughes, Technical Editor

Austin Group Technical Reviewers

Peter Anvin

Bouazza Bachar

Theodore P. Baker

Walter Briscoe

Mark Brown

Dave Butenhof

Geoff Clare

Donald W. Cragun

Lee Damico

Ulrich Drepper

Paul Eggert

Joanna Farley

Clive D.W. Feather

Andrew Gollan

Michael Gonzalez

Joseph M. Gwinn

Jon Hitchcock

Yvette Ho Sang

Cathy Hughes

Lowell G. Johnson

Andrew Josey

Michael Kavanaugh

David Korn

Marc Aurele La France

Jim Meyering

Gary Miller

Finnbarr P. Murphy

Joseph S. Myers

Sandra O'Donnell

Frank Prindle

Curtis Royster Jr.

Glen Seeds

Keld Jorn Simonsen

Raja Srinivasan

Nicholas Stoughton

Donn S. Terry

Fred Tydeman

Peter Van Der Veen

James Youngman

Jim Zepeda

Jason Zions

Austin Group Working Group Members

Harold C. Adams	Michael Gonzalez	Sandra O'Donnell
Peter Anvin	Karen D. Gordon	Frank Prindle
Pierre-Jean Arcos	Joseph M. Gwinn	Francois Riche
Jay Ashford	Steven A. Haaser	John D. Riley
Bouazza Bachar	Charles E. Hammons	Andrew K. Roach
Theodore P. Baker	Chris J. Harding	Helmut Roth
Robert Barned	Barry Hedquist	Jaideep Roy
Joel Berman	Vincent E. Henley	Curtis Royster Jr.
David J. Blackwood	Karl Heubaum	Stephen C. Schwarm
Shirley Bockstahler-Brandt	Jon Hitchcock	Glen Seeds
James Bottomley	Yvette Ho Sang	Richard Seibel
Walter Briscoe	Niklas Holsti	David L. Shroads Jr.
Andries Brouwer	Thomas Hosmer	W. Olin Sibert
Mark Brown	Cathy Hughes	Keld Jorn Simonsen
Eric W. Burger	Jim D. Isaak	Curtis Smith
Alan Burns	Lowell G. Johnson	Raja Srinivasan
Andries Brouwer	Michael B. Jones	Nicholas Stoughton
Dave Butenhof	Andrew Josey	Marc J. Teller
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Ming De Zhou	Marc Aurele La France	Michael W. Vannier
Steven J. Dovich	C. Douglass Locke	Eric Vought
Richard P. Draves	Nick MacLaren	Frederick N. Webb
Ulrich Drepper	Roger J. Martin	Paul A.T. Wolfgang
Paul Eggert	Craig H. Meyer	Garrett A. Wollman
Philip H. Enslow	Jim Meyering	James Youngman
Joanna Farley	Gary Miller	Oren Yuen
Clive D.W. Feather	Finnbarr P. Murphy	Janusz Zalewski
Pete Forman	Joseph S. Myers	Jim Zepeda
Mark Funkenhauser	John Napier	Jason Zions
Lois Goldthwaite	Peter E. Obermayer	
Andrew Gollan	James T. Oblinger	

The Open Group

When The Open Group approved the Base Specifications, Issue 6 on 12 September 2001, the membership of The Open Group Base Working Group was as follows:

Andrew Josey, Chair

Finnbarr P. Murphy, Vice-Chair

Mark Brown, Austin Group Liaison

Cathy Hughes, Technical Editor

Base Working Group Members

Bouazza Bachar

Mark Brown

Dave Butenhof

Donald W. Cragun

Larry Dwyer

Joanna Farley

Andrew Gollan

Karen D. Gordon

Gary Miller

Finnbarr P. Murphy

Frank Prindle

Andrew K. Roach

Curtis Royster Jr.

Nicholas Stoughton

Kenjiro Tsuji

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When the IEEE Standards Board approved IEEE Std 1003.1-2001 on 6 December 2001, the membership of the committees was as follows:

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Lowell G. Johnson, Chair

Joseph M. Gwinn, Vice-Chair

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Andrew Josey, Functional Chair

Curtis Royster Jr., Functional Chair

Nicholas Stoughton, Secretary

Balloting Committee

The following members of the balloting committee voted on IEEE Std 1003.1-2001. Balloters may have voted for approval, disapproval, or abstention:

Harold C. Adams	Steven A. Haaser	Frank Prindle
Pierre-Jean Arcos	Charles E. Hammons	Francois Riche
Jay Ashford	Chris J. Harding	John D. Riley
Theodore P. Baker	Barry Hedquist	Andrew K. Roach
Robert Barned	Vincent E. Henley	Helmut Roth
David J. Blackwood	Karl Heubaum	Jaideep Roy
Shirley Bockstahler-Brandt	Nicklas Holsti	Curtis Royster Jr.
James Bottomley	Thomas Hosmer	Stephen C. Schwarm
Mark Brown	Jim D. Isaak	Richard Seibel
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Alan Burns	Michael B. Jones	W. Olin Sibert
Dave Butenhof	Andrew Josey	Keld Jorn Simonsen
Keith Chow	Michael J. Karel	Nicholas Stoughton
Donald W. Cragun	Steven Kramer	Donn S. Terry
Juan Antonio De La Puente	Thomas M. Kurihara	Mark-Rene Uchida
Ming De Zhou	C. Douglass Locke	Scott A. Valcourt
Steven J. Dovich	Roger J. Martin	Michael W. Vannier
Richard P. Draves	Craig H. Meyer	Frederick N. Webb
Philip H. Enslow	Finnbarr P. Murphy	Paul A.T. Wolfgang
Michael Gonzalez	John Napier	Oren Yuen
Karen D. Gordon	Peter E. Obermayer	Janusz Zalewski
Joseph M. Gwinn	James T. Oblinger	

The following organizational representative voted on this standard:

Andrew Josey, X/Open Company Ltd.

IEEE-SA Standards Board

When the IEEE-SA Standards Board approved IEEE Std 1003.1-2001 on 6 December 2001, it had the following membership:

Donald N. Heirman, Chair

James T. Carlo, Vice-Chair

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Harold E. Epstein

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Gerald H. Peterson

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* Member Emeritus

IEEE Std 1003.1-2001/Cor 1-2002 was prepared by the Austin Group, sponsored by the Portable Applications Standards Committee of the IEEE Computer Society, The Open Group, and ISO/IEC JTC 1/SC22/WG15.

The Austin Group

At the time of approval, the membership of the Austin Group was as follows:

Andrew Josey, Chair

Donald W. Cragun, Organizational Representative, IEEE PASC

Nicholas Stoughton, Organizational Representative, ISO/IEC JTC 1/SC22/WG15

Mark Brown, Organizational Representative, The Open Group

Cathy Fox, Technical Editor

Austin Group Technical Reviewers

Theodore P. Baker

Julian Blake

Andries Brouwer

Mark Brown

Dave Butenhof

Geoff Clare

Donald W. Cragun

Ken Dawson

Ulrich Drepper

Larry Dwyer

Paul Eggert

Joanna Farley

Clive D.W. Feather

Cathy Fox

Mark Funkenhauser

Lois Goldthwaite

Andrew Gollan

Michael Gonzalez

Bruno Haible

Ben Harris

Jon Hitchcock

Andreas Jaeger

Andrew Josey

Jonathan Lennox

Nick Maclaren

Jack McCann

Wilhelm Mueller

Joseph S. Myers

Frank Prindle

Kenneth Raeburn

Tim Robbins

Glen Seeds

Matthew Seitz

Keld Jorn Simonsen

Nicholas Stoughton

Alexander Terekhov

Donn S. Terry

Mike Wilson

Garrett A. Wollman

Mark Ziegast

Austin Group Working Group Members

Harold C. Adams
Alejandro Alonso
Jay Ashford
Theodore P. Baker
David J. Blackwood
Julian Blake
Mitchell Bonnett
Andries Brouwer
Mark Brown
Eric W. Burger
Alan Burns
Dave Butenhof
Keith Chow
Geoff Clare
Luis Cordova
Donald W. Cragun
Dragan Cvetkovic
Lee Damico
Ken Dawson
Jeroen Dekkers
Juan Antonio De La Puente
Steven J. Dovich
Ulrich Drepper
Dr. Sourav Dutta
Larry Dwyer
Paul Eggert
Joanna Farley

Clive D.W. Feather
Yaacov Fenster
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Michael Gonzalez
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Joseph M. Gwinn
Steven A. Haaser
Bruno Haible
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Ben Harris
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Karl Heubaum
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Andreas Jaeger
Andrew Josey
Kenneth Lang
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Curtis Royster Jr.
Diane Schleicher
Gil Shultz
Stephen C. Schwarm
Glen Seeds
Matthew Seitz
Keld Jorn Simonsen
Doug Stevenson
Nicholas Stoughton
Alexander Terekhov
Donn S. Terry
Mike Wilson
Garrett A. Wollman
Oren Yuen
Mark Ziegast

The Open Group

When The Open Group approved the Base Specifications, Issue 6, Technical Corrigendum 1 on 7 February 2003, the membership of The Open Group Base Working Group was as follows:

Andrew Josey, Chair

Finnbarr P. Murphy, Vice-Chair

Mark Brown, Austin Group Liaison

Cathy Fox, Technical Editor

Base Working Group Members

Mark Brown

Dave Butenhof

Donald W. Cragun

Larry Dwyer

Ulrich Drepper

Joanna Farley

Andrew Gollan

Finnbarr P. Murphy

Frank Prindle

Andrew K. Roach

Curtis Royster Jr.

Nicholas Stoughton

Kenjiro Tsuji

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When the IEEE Standards Board approved IEEE Std 1003.1-2001/Cor 1-2002 on 11 December 2002, the membership of the committees was as follows:

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Lowell G. Johnson, Chair

Joseph M. Gwinn, Vice-Chair

Jay Ashford, Functional Chair

Andrew Josey, Functional Chair

Curtis Royster Jr., Functional Chair

Nicholas Stoughton, Secretary

Balloting Committee

The following members of the balloting committee voted on IEEE Std 1003.1-2001/Cor 1-2002. Balloters may have voted for approval, disapproval, or abstention:

Alejandro Alonso
Jay Ashford
David J. Blackwood
Julian Blake
Mitchell Bonnett
Mark Brown
Dave Butenhof
Keith Chow
Luis Cordova
Donald W. Cragun
Steven J. Dovich
Dr. Sourav Dutta
Yaacov Fenster

Michael Gonzalez
Scott Gudgel
Charles E. Hammons
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Diane Schleicher
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Gil Shultz
Nicholas Stoughton
Donn S. Terry
Oren Yuen
Juan A. de la Puente

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James T. Carlo, Chair

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Judith Gorman, Secretary

Sid Bennett

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Richard DeBlasio

Harold E. Epstein

Julian Forster*

Howard M. Frazier

Toshio Fukuda

Arnold M. Greenspan

Raymond Hapeman

Donald M. Heirman

Richard H. Hulett

Lowell G. Johnson

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Peter H. Lips

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