INTERNATIONAL STANDARD

ISO/IEC 16509

IEEE Std 2000.1

First edition
1999-10-15

Information technology — Year 2000 terminology

Technologie de l'information — Terminologie de l'an 2000

Reference number
ISO/IEC 16509:1999(E)
IEEE
Std 2000.1, 1998 edition

ISO
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 734 10 79
E-mail copyright@iso.ch

Abstract: This standard provides concepts, definitions, remediation techniques, and other supporting terms fundamental to a lexicon for Year 2000 terminology. It addresses key topics pertinent to the development of resolutions to the Year 2000 problem. The core of this standard is the definitions Clause which contains the definition for Year 2000 compliance. Two critical aspects of this definition are: first, the acknowledgment of the significance of documentation associated with technology, and, second, the recognition that compliance is a two-way street, i.e., the proper exchange of date data is paramount for technology to remain compliant.
Keywords: date exchange, remediation techniques, Year 2000 compliant

The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

Print: ISBN 0-7381-1803-6 SH94784
PDF: ISBN 0-7381-1804-4 SS94784

IEEE Standards documents are developed within the IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (IEEE-SA) Standards Board. Members of the committees serve voluntarily and without compensation. They are not necessarily members of the Institute. The standards developed within IEEE represent a consensus of the broad expertise on the subject within the Institute as well as those activities outside of IEEE that have expressed an interest in participating in the development of the standard.

Use of an IEEE Standard is wholly voluntary. The existence of an IEEE Standard does not imply that there are no other ways to produce, test, measure, purchase, market, or provide other goods and services related to the scope of the IEEE Standard. Furthermore, the viewpoint expressed at the time a standard is approved and issued is subject to change brought about through developments in the state of the art and comments received from users of the standard. Every IEEE Standard is subjected to review at least every five years for revision or reaffirmation. When a document is more than five years old and has not been reaffirmed, it is reasonable to conclude that its contents, although still of some value, do not wholly reflect the present state of the art. Users are cautioned to check to determine that they have the latest edition of any IEEE Standard.

Comments for revision of IEEE Standards are welcome from any interested party, regardless of membership affiliation with IEEE. Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments.

Interpretations: Occasionally questions may arise regarding the meaning of portions of standards as they relate to specific applications. When the need for interpretations is brought to the attention of IEEE, the Institute will initiate action to prepare appropriate responses. Since IEEE Standards represent a consensus of all concerned interests, it is important to ensure that any interpretation has also received the concurrence of a balance of interests. For this reason, IEEE and the members of its societies and Standards Coordinating Committees are not able to provide an instant response to interpretation requests except in those cases where the matter has previously received formal consideration.

Comments on standards and requests for interpretations should be addressed to:

Secretary, IEEE-SA Standards Board
445 Hoes Lane
P.O. Box 1331
Piscataway, NJ 08855-1331
USA

Note: Attention is called to the possibility that implementation of this standard may require use of subject matter covered by patent rights. By publication of this standard, no position is taken with respect to the existence or validity of any patent rights in connection therewith. The IEEE shall not be responsible for identifying patents for which a license may be required by an IEEE standard or for conducting inquiries into the legal validity or scope of those patents that are brought to its attention.

International Standard ISO/IEC 16509:1999(E)

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 16509 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 to C of this International Standard are for information only.

International Organization for Standardization/International Electrotechnical Commission
Case postale 56 • CH-1211 Genève 20 • Switzerland

ANSI/IEEE 2000.1-1998

This introduction provides background on the rationale used to develop this international standard. This information is meant to aid in the understanding and usage of this standard.

This international standard addresses the key industry concern over the existence of multiple terms and lexicons that carry varied meanings. IEEE has designed this standard to assist individuals and organizations in their efforts to develop Year 2000 solutions. Having a base-line set of terms and definitions that can serve as a foundation for such efforts is vital.

Participants

PASC Sponsor Executive Committee

Chair:	Lowell G. Johnson
Vice-Chair:	Joseph Gwinn
Functional Chairs:	Andrew Josey
	Jay Ashford
	Curtis Royster
Secretary:	Nick Stoughton

At the time the IEEE Portable Applications Standards Committee revised this standard, the Year 2000 Terminology Working Group had the following membership:

Kevin Lewis, *Technical Editor*

Michael Aisenberg
Steve Allen
Michael Berens
Leonard Brush
George Cherry
Cory Claymon
Joseph K. Clema
Robert Cohen
Johnetta Colbert
Eldon Colby
Donald Cragun
John Davies
Christina Drukala
Amy Fliegelman-Olli
Trutz Foelsche
Lee Gallagher
Robert Gniewkowski
Debbie Goldberg
Joeseph M. Gwinn
Tim Harris
JoAnn Henderson
Richard Holleman
Vincent Hung
James D. Isaak
Petr Janecek
Margaret Jedlicka
Andrew Josey
Yong Kim
C. W. Klein
Thomas Koenig
Cheryl Lai
Rex Lint
Mickey Lynn
Austin J. Maher
Robert Martin
Roger Martin
Richard McLean
James Murray
John Napier
Alan Peltzman
Carolyn Price
Bill Pritchett
Bill Putnam
Larry Schwartz
Philip Simons
Terrill J. Slocum
Nick Stoughton
Robert Swartz
Keith Thurston
John Tyler
Roger Tyler
Richard Vasquez
Michael Wheatley
Laurence Wolfe
Dave Wong
Gary Young

The following persons were on the balloting committee:

Ida M. Berchtold
Adam Block
Mark Brown
Joseph K. Clema
Donald Cragun
Philip H. Enslow
Michel Gien
Lawrence M. Gunther
Charles E. Hammons
Andy Harrison
Barry Hedquist
Jim D. Isaak
Richard Jaenicke
Jerry L. Johnson
Lowell G. Johnson
Andrew Josey
Leon A. Kappelman
Judith S. Kerner
Lorraine C. Kevra
Thomas Koenig
Kenneth C. Kung
Thomas M. Kurihara
Kevin Lewis
Austin J. Maher
James W. Moore
Finnbarr P. Murphy
John Napier
James T. Oblinger
Marc A. Pearl
Alan Peltzman
Roy Reed
Francois Riche
Curtis Royster
Alan Russel
Michael D. Shapiro
Keith Shillington
Terrill J. Slocum
William R. Smith
Sandra Swearingen
Andrew D. Tait
Roger Tyler
Michael W. Vannier
Dale W. Way
Thomas Williams
Darren Wolf
Paul A. Wolfgang
Jordan S. Wouk
Oren Yuen

When the IEEE-SA Standards Board approved this standard on 25 June 1998, it had the following membership:

Richard J. Holleman, *Chair* **Donald N. Heirman,** *Vice Chair*
Judith Gorman, *Secretary*

Satish K. Aggarwal
Clyde R. Camp
James T. Carlo
Gary R. Engmann
Harold E. Epstein
Jay Forster*
Thomas F. Garrity
Ruben D. Garzon
James H. Gurney
Jim D. Isaak
Lowell G. Johnson
Robert Kennelly
E. G. "Al" Kiener
Joseph L. Koepfinger*
Stephen R. Lambert
Jim Logothetis
Donald C. Loughry
L. Bruce McClung
Louis-François Pau
Ronald C. Petersen
Gerald H. Peterson
John B. Posey
Gary S. Robinson
Hans E. Weinrich
Donald W. Zipse

*Member Emeritus

Noelle D. Humenick
IEEE Standards Project Editor

Note that editorial changes were made to the IEEE standard to accomodate concerns raised during the ISO/IEC/JTC 1 balloting process. These are indicated in the text by a change bar (such as shown at the left of this paragraph.)

Contents

Information technology—Year 2000 terminology

1. Overview

The Year 2000 issue appears to be a simple problem that is intuitively understood. However, when examined closely, the solutions are varied and complex in nature. The essence of this problem is the representation of the year as a two-digit number in hardware and software elements of computer systems and other technologies. This representation may, for example, cause hardware or software malfunctions to occur when a system date or application date crosses the year 2000 boundary (whether that is the actual arrival of the date or for date processing purposes) or when the system or application must refer to a date that occurs on, before, or after 1 January 2000. These malfunctions can include the following:

— Incorrect arithmetic calculation, comparison, sorting, or sequencing resulting in the failure of logical, relational, and set-membership operations;
— Incorrect recognition of leap year;
— Conflict with values in data fields used for non-date purposes, e.g., “no date provided,” or “never expires”; and
— Date data field overflow.

The two-digit date may not be the sole cause of these malfunctions. They may also result from poor programming practices or a lack of full understanding of the Gregorian calendar. The consequences of these malfunctions could range from immediate system failures to more insidious long-term data corruptions.

The impact of the Year 2000 problem is potentially significant to virtually any segment of the global digital infrastructure and the economies it supports. Among the environments in which critical applications may be affected by Year 2000 issues are:

— Bio-medical
— Telecommunications/transportation
— Finance/banking
— Aviation/aerospace
— National security/law enforcement
— Other critical infrastructure

As this standard is being prepared, many organizations are in various stages of addressing this problem. Some are just beginning to assess the impact on their own information technology (IT) environments. Others

have already begun to implement solutions. The rising need for solutions has created a market environment wherein there are a growing number of organizations offering such solutions. These organizations have also created a diverse set of terms. Many of the terms may seem similar, but will actually have multiple meanings within differing environments, which brings the potential for confusion to what should be an easily understood problem.

This standard identifies common terms, definitions, and related concepts that have broad applicability to this area of work. Those presented herein may be applied wholly or in part to fit a specific requirement.

A lexicon within which the common terms, definitions, and related concepts are understood is vital. The IT industry's use of the terms defined in this standard will minimize confusion. In addition, having common terms, definitions, and related concepts will speed the development of urgently needed solutions. This standard describes what these terms, definitions, and related concepts mean, not how to implement or verify Year 2000 compliance.

It is not the intent of this standard to specify how Year 2000 compliance should be implemented or verified.

1.1 Scope

This standard identifies terms and concepts pertinent to the resolution of the Year 2000 issue, including the rollover from the year 1999 to 2000, incorrect recognition of leap years, and values in date fields used for non-date purposes, and provides definitions of these terms and descriptions of these concepts.

This standard does not specifically address operating system anomalies such as might occur in the year 2038.

1.2 Purpose

This standard provides a common lexicon with descriptions and definitions for the Year 2000 issue. These descriptions and definitions may be applied in whole or in part depending on the requirement.

This standard is composed of a Definitions Clause (3), a Concepts Clause (4), and two Annexes (A and B).

1.2.1 Concepts

A concept is a set of interrelated ideas pertaining to the Year 2000 issue. This standard offers a description of these concepts. This is not an exhaustive list.

1.2.2 Definitions

These are focused meanings of terms fundamental to the resolution of the Year 2000 issue.

1.2.3 Annex A

This annex outlines remediation techniques currently being used to make system elements Year 2000 compliant. This list of techniques is not exhaustive. It presents only those techniques acknowledged as having gained a significant amount of industry consensus. Along with the techniques is a list of supporting terms and their explanation. In addition, the annex briefly explains the role of special dates in the development of solutions for the Year 2000 problem. This annex is informative.

1.2.4 Annex B

This is a bibliography listing other related publications.

1.3 Conformance

Vendors who claim that their products conform to this standard declare that their use of the term "Year 2000 Compliant" is in accordance with the definition in this standard.

2. References

No other publication is required for use with this standard.

3. Definitions

3.1 date exchange: The interchange of date data between two or more systems or system elements. In order to facilitate proper date data exchange between two or more systems or system elements, defined formats should be identified and documented by the suppliers of systems or system elements. Such formats may be specified by the standards or other publications listed in Annex B, other generally accepted industry date representations, or other documented methods of date representation. Depending upon the date formats selected, additional information such as, but not limited to, valid date interval, pivot year, and encoding technique may also need to be documented.

3.2 date processing: The processing of date data within a system or system element, which may include receiving, manipulating, and providing date data.

3.3 technology: Hardware, software, and firmware systems and system elements including, but not limited to, information technology, embedded systems, or any other electro-mechanical or processor-based systems.

3.4 Year 2000 compliant[1]: Year 2000 compliant technology shall correctly process date data within and between the 20th and 21st centuries, provided that:

a) The technology is used in accordance with its associated documentation, and
b) All other technology used with it properly exchanges date data with it.

4. Concepts

The term "system element," where used in this standard, refers to any individual component of a computer- or microprocessor-based system that participates systematically in a specific process. System elements may include hardware components, firmware routines, operating systems, middleware components, application programs, system utilities and subroutines, scripts, and the like.

4.1 Valid date interval (also known as compliance date range)

This is the period of time, expressed by a range of dates, over which the system will provide correct date data processing. The system elements or other factors may limit this interval or may introduce multiple intervals. For example, on a system capable of operation between 1970 and 2038, applications may be capable of correctly processing date data over a much wider range of dates such as 1970 through the year 2069.

[1]This definition requires date data to be processed consistently, predictably, and accurately within the valid date interval(s) (see 4.1). This includes date data for the years 1999 and 2000.

4.2 Time horizon to failure (also known as event horizon)

This is the time from a specific date until a point in time beyond which a system element will fail to process consistently, predictably, or accurately. An application that processes dates up to 12 months in the future might fail on or after 1 January 1999 (1999-01-01) if it was unable to process dates beyond 31 December 1999 (1999-12-31). Therefore, on 1 September 1998 (1998-09-01), the time horizon to failure for this application is four months. Since each element of a system potentially has its own unique horizon, the horizon of the entire system is that of the earliest-failing element within it.

4.3 Year 2000 life cycle

The Year 2000 Life Cycle is a process for addressing Year 2000 issues. The following is an example of a model composed of five phases, each representing a major Year 2000 activity. Both the private and public sectors have used this model in addressing their respective Year 2000 issues. The five phases are described simply and very briefly as follows:

— *Planning and awareness:* Define the Year 2000 problem and gain executive level support and sponsorship for establishing the problem as a high priority item for resolution. Research and establish a project plan, and obtain budget and resources. Note that the planning activities are also relevant to the other phases described below.

— *Assessment (inventory):* Evaluate the Year 2000 impact on the enterprise; develop contingency plans to handle data exchange issues and system failures (dysfunction or system crashes); prioritize systems by identifying those that are critical.

— *Remediation (renovation):* Convert, replace, eliminate, or work around one or more system elements; modify interfaces.

— *Validation:* Test, certify, and validate all system elements that have been converted or replaced.

— *Implementation:* Place into production all system elements that have been converted or replaced.

Annex A—Techniques, terms, and special dates

(informative)

This annex is informative and contains more detailed information about selected Year 2000 concepts, terms, and remediation techniques that are becoming commonly used in the IT community. This is not intended to be either a comprehensive or a preferred listing of approaches.

A.1 Remediation

This concept embodies one or more processes to repair or eliminate malfunctions relating to Year 2000 date data processing under a predetermined set of criteria. The following is a non-exhaustive list of techniques or strategies that have been employed in the remediation process. These techniques are not necessarily mutually exclusive and not necessarily sufficient in and of themselves to solve the problem:

— Bridge—employing a date data bridge that converts date formats
— Elimination—retiring the system
— Encoding—encoding four-digit year information into an existing field
— Field expansion—expanding the year field to four digits
— Replacement—replacing one or more system elements
— Windowing—using a 100-year logic window

A.1.1 Remediation techniques

There is general agreement within the industry that there is *no single* method of remediation that can be applied to all situations. In any given situation, the method chosen will depend on the operating environment and other factors such as the prevalence of interfaces with other applications and the amount of date data processed within or between applications. The following methods include some of the most common fixes being implemented in the industry. This list does not describe a number of low usage or proprietary remediation methods in use.

A.1.1.1 Bridge technique

This is a conversion mechanism that changes data elements to reconcile format differences between system elements. Date-related bridges format dates in such a way that they can be accepted and acted upon properly. For example, a bridge might be a program that is invoked to change a two-digit date field in a sending application to a four-digit date field in a receiving application when date data is transferred between the two system elements.

A.1.1.2 Elimination technique

This is the retirement of a system or application no longer deemed necessary.

A.1.1.3 Encoding technique (also called encryption, offset counter format, or integer date format)

Unlike field expansion, encoding allows current field sizes to be maintained by storing additional information into existing fields. A more efficient use of bits may allow inclusion of century information. This may be accomplished, for example, by using unused bits in an existing representation to encode century information, or by converting the data type from ASCII to binary in order to allow larger numbers to be represented

in the same field. Similarly, if the numbering system was changed from decimal to hexadecimal, two-digit year values greater than 99 could be stored.

A.1.1.4 Field expansion technique

This is a technique that converts existing data and programs by lengthening the year fields from two-digits to four-digits.

A.1.1.5 Replacement technique

This is the retirement of a system or system element that is not Year 2000 compliant and replacement of it by another system or system element that is Year 2000 compliant.

A.1.1.6 Windowing technique (also called logic fix)

This is any of several procedural techniques based upon the addition of logic that uses a specified 100-year interval to interpret a two-digit year value as an unambiguous four-digit year. The procedural techniques commonly used are typically categorized into "Fixed Windowing," "Movable Windowing," and "Sliding Windowing." Use of this method of remediation depends on knowledge of:

— The date format used across interfaces between two or more system elements;
— The pivot year used (see A.2.2);
— The method of changing or "sliding" the pivot year, where applicable; and
— A description of the error handling/reporting when exchanged date data is not in the expected format.

A.1.1.6.1 Fixed windowing

This is a procedural technique in which two-digit year values are interpreted within a fixed 100-year window. The window is typically documented in terms of a range of years (for example, 1950 to 2049) or in terms of a pivot year (for example, a pivot year of 1950 causes values between 50 and 99 to be interpreted as 1950 to 1999, and values between 00 and 49 to be interpreted as 2000 to 2049).

A.1.1.6.2 Movable windowing

This is a procedural technique in which two-digit year values are interpreted within a 100-year window, which may be user- or installation-specified. The range of years in the window or the pivot year can be specified when the system is installed or started.

A.1.1.6.3 Sliding windowing

This is a procedural technique in which two-digit year values are interpreted within a 100-year window that is defined in terms of the current date. With this technique, as the current date moves forward, year to year, the window also moves or "slides" forward. Sliding windows are sometimes documented by specifying a value (usually called a "slider") that, when added to the current year, defines the pivot year of the 100-year window. Thus, for example, a sliding window operating on a current date of 2 February 1998 (1998-02-02) with a "slider" defined as "–40" would result in a pivot year of 1958 (1998-40) and a window range of 1958–2057. On 2 February 1999 (1999-02-02), the pivot year would be 1959 (1999-40) and a new window range of 1959–2058.

A.2 Supporting terms

A.2.1 leap year[2]: A year is a leap year if the number of the year is a multiple of 400, or if it is a multiple of 4 *and not* a multiple of 100. Thus, 1996, 2000, and 2004 are leap years, but 1900, 1997, and 2100 are not.

A.2.2 pivot year: A pivot year is a value that is used to specify the beginning of a 100-year window and to interpret two-digit year dates within that window. In a window that spans the year 2000 boundary, any two-digit year value greater than or equal to the last two digits of the pivot year is interpreted as having a prefix of "19," while any two-digit year value less than the last two digits of the pivot year as having a prefix of "20." Thus, for example, in a system supporting a 1950 to 2049 window, a pivot year of 1950 causes two-digit year values between 50 and 99 to be interpreted as 1950 to 1999, and two-digit year values between 00 and 49 to be interpreted as 2000 to 2049.

A.3 Special dates

There are two forms of special dates: reserved dates and test dates.

Some or all of the dates listed need not be appropriate for the testing of a specific system element because the system element may not be date sensitive or does not represent dates as calendar dates (for example, using ordinal dates or system clock values instead), or because the dates are outside the system element's valid date range.

A.3.1 Reserved dates

Reserved dates are dates with special meaning such as using 9999 in a year field signifying an entry in a database that never expires. They consist of special values that are equivalent in their type to dates, but are composed of non-date values such as spaces, 000000, or 999999 in date fields. Reserved dates have been used frequently in the past to represent items that never expire, or have other special meanings. There are occasions when valid date values that have special meanings are stored and used as flags.

A.3.2 Test dates

Test dates are dates to be used by organizations to determine if a system element performs correctly. Some examples follow:

- 1 January 1999 (1999-01-01)—First day affecting systems that were programmed to recognize nines in the year field in a special way.
- 9 September 1999 (1999-09-09)—A date whose value may have been used for non-date purposes.
- 31 December 1999 (1999-12-31)—Last day before the year 2000.
- 1 January 2000 (2000-01-01)—First day affecting systems that were programmed to handle only the years up to and including 1999. First date with a "00" abbreviated year.
- 29 February 2000 (2000-02-29)—First leap day after year 1999.
- 1 March 2000 (2000-03-01)—The first day after the year 2000 leap day.
- 31 December 2000 (2000-12-31)—The last day in the year 2000.
- 1 January 2001 (2001-01-01)—The first day in the year 2001.
- 29 February 2004 (2004-02-29)—The first leap day after the year 2000.

[2]This explanation only applies to dates after the Gregorian calendar went into effect. The Gregorian calendar was adopted over a period of years and, presently, is still not universally accepted.

Annex B—Bibliography

(informative)

[B1] ANSI X3.30: 1998, Representation for Calendar Date and Ordinal Date for Information Interchange[3].

[B2] DISC PD2000-1: 1998, A Definition of Year 2000 Conformity Requirements (a British Standards Institution publication).[4]

[B3] DISC PD2000-4, Guidance and Information on PD2000-1: 1998, A Definition of Year 2000 Conformity Requirements (A British Standards Institution publication).

[B4] FIPS PUB 4-1, Representation for Calendar Date and Ordinal Date for Information Interchange, Change Number 1, March 25, 1996.[5]

[B5] General Services Administration Federal Acquisition Rule (FAR) 39.002, (Federal Register 66 FR44830), August 22, 1997, 48 CFR Parts 39 and 52, [FAC 97-01; FAR Case 96-607; Item XVII], RIN 9000-AG90.

[B6] General Services Administration White Paper entitled “Year 2000,” August 1997, FEDSIM Project Number 88025GSE-07.

[B7] ISO 8601: 1988, Data elements and interchange formats—Information interchange—Representation of dates and times.[6]

[3]ANSI publications are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA (http://www.ansi.org/).

[4]DISC publications are available from the British Standards House, 389 Chiswick High Road, London, W4 4AL, United Kingdom (http://www.bsi.org.uk)

[5]FIPS publications are available from the National Technical Information Service (NTIS), U. S. Dept. of Commerce, 5285 Port Royal Rd., Springfield, VA 22161 (http://www.ntis.org/).

[6]ISO publications are available from the ISO Central Secretariat, Case Postale 56, 1 rue de Varembé, CH-1211, Genève 20, Switzerland/Suisse (http://www.iso.ch/). ISO publications are also available in the United States from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA (http://www.ansi.org/).

ICS 01.120; 35.020

Price based on 8 pages