INTERNATIONAL STANDARD

ISO/IEC 9899

Fourth edition
2018-07

Information technology — Programming languages — C

Technologies de l'information — Langages de programmation — C

Reference number
ISO/IEC 9899:2018(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Foreword

1 ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are member 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.

2 The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

3 Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

4 Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

5 For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see the following URL: www.iso.org/iso/foreword.html.

6 This document was prepared by Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 22, *Programming languages, their environments and system software interfaces*.

7 This fourth edition cancels and replaces the third edition, ISO/IEC 9899:2011, which has been technically revised. It also incorporates the Technical Corrigendum ISO/IEC 9899:2011/Cor 1:2012.

8 There are no major changes in this edition, only technical corrections and clarifications.

9 A complete change history can be found in Annex M.

Introduction

1 With the introduction of new devices and extended character sets, new features could be added to this document. Subclauses in the language and library clauses warn implementors and programmers of usages which, though valid in themselves, could conflict with future additions.

2 Certain features are *obsolescent*, which means that they could be considered for withdrawal in future revisions of this document. They are retained because of their widespread use, but their use in new implementations (for implementation features) or new programs (for language [6.11] or library features [7.31]) is discouraged.

3 This document is divided into four major subdivisions:

— preliminary elements (Clauses 1–4);

— the characteristics of environments that translate and execute C programs (Clause 5);

— the language syntax, constraints, and semantics (Clause 6);

— the library facilities (Clause 7).

4 Examples are provided to illustrate possible forms of the constructions described. Footnotes are provided to emphasize consequences of the rules described in that subclause or elsewhere in this document. References are used to refer to other related subclauses. Recommendations are provided to give advice or guidance to implementors. Annexes define optional features, provide additional information and summarize the information contained in this document. A bibliography lists documents that were referred to during the preparation of this document.

5 The language clause (Clause 6) is derived from "The C Reference Manual".

6 The library clause (Clause 7) is based on the *1984 /usr/group Standard*.

7 The Working Group responsible for this document (WG 14) maintains a site on the World Wide Web at `http://www.open-std.org/JTC1/SC22/WG14/` containing ancillary information that may be of interest to some readers such as a Rationale for many of the decisions made during its preparation and a log of Defect Reports and Responses.

INTERNATIONAL STANDARD ©ISO/IEC ISO/IEC 9899:2018

Programming languages — C

1. Scope

1 This document specifies the form and establishes the interpretation of programs written in the C programming language.[1)] It specifies

- the representation of C programs;
- the syntax and constraints of the C language;
- the semantic rules for interpreting C programs;
- the representation of input data to be processed by C programs;
- the representation of output data produced by C programs;
- the restrictions and limits imposed by a conforming implementation of C.

2 This document does not specify

- the mechanism by which C programs are transformed for use by a data-processing system;
- the mechanism by which C programs are invoked for use by a data-processing system;
- the mechanism by which input data are transformed for use by a C program;
- the mechanism by which output data are transformed after being produced by a C program;
- the size or complexity of a program and its data that will exceed the capacity of any specific data-processing system or the capacity of a particular processor;
- all minimal requirements of a data-processing system that is capable of supporting a conforming implementation.

[1)] This document is designed to promote the portability of C programs among a variety of data-processing systems. It is intended for use by implementors and programmers. Annex J gives an overview of portability issues that a C program might encounter.

2. Normative references

1 The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

2 ISO/IEC 2382:2015, *Information technology — Vocabulary*. Available from the *ISO online browsing platform* at `http://www.iso.org/obp`

3 ISO 4217, *Codes for the representation of currencies and funds*

4 ISO 8601, *Data elements and interchange formats — Information interchange — Representation of dates and times*

5 ISO/IEC 10646, *Information technology — Universal Coded Character Set (UCS)*. Available from the ISO/IEC Information Technology Task Force (ITTF) web site at `http://isotc.iso.org/livelink/livelink/fetch/2000/2489/Ittf_Home/PubliclyAvailableStandards.htm`

6 IEC 60559:1989, *Binary floating-point arithmetic for microprocessor systems* (previously designated IEC 559:1989)

7 ISO 80000–2, *Quantities and units — Part 2: Mathematical signs and symbols to be used in the natural sciences and technology*

3. Terms, definitions and symbols

1 For the purposes of this document, the terms and definitions given in ISO/IEC 2382, ISO 80000–2, and the following apply.

2 ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at `https://www.iso.org/obp`

— IEC Electropedia: available at `http://www.electropedia.org/`

3 Additional terms are defined where they appear in *italic* type or on the left side of a syntax rule. Terms explicitly defined in this document are not to be presumed to refer implicitly to similar terms defined elsewhere.

3.1

1 **access (verb)**

⟨execution-time action⟩ to read or modify the value of an object

2 **Note 1 to entry:** Where only one of these two actions is meant, "read" or "modify" is used.

3 **Note 2 to entry:** "Modify" includes the case where the new value being stored is the same as the previous value.

4 **Note 3 to entry:** Expressions that are not evaluated do not access objects.

3.2

1 **alignment**

requirement that objects of a particular type be located on storage boundaries with addresses that are particular multiples of a byte address

3.3

1 **argument**

actual argument

DEPRECATED: actual parameter

expression in the comma-separated list bounded by the parentheses in a function call expression, or a sequence of preprocessing tokens in the comma-separated list bounded by the parentheses in a function-like macro invocation

3.4

1 **behavior**

external appearance or action

3.4.1

1 **implementation-defined behavior**

unspecified behavior where each implementation documents how the choice is made

2 **Note 1 to entry:** J.3 gives an overview over properties of C programs that lead to implementation-defined behavior.

3 **EXAMPLE** An example of implementation-defined behavior is the propagation of the high-order bit when a signed integer is shifted right.

3.4.2

1 **locale-specific behavior**

behavior that depends on local conventions of nationality, culture, and language that each implementation documents