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Foreword

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.

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 or www.iec.ch/members_experts/refdocs).

ISO and IEC draw attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO and IEC take no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO and IEC have not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents and https://patents.iec.ch. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

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

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 www.iso.org/iso/foreword.html. In the IEC, see www.iec.ch/understanding-standards.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 32, *Data management and interchange*.

This sixth edition cancels and replaces the fifth edition (ISO/IEC 9075-2:2016), which has been technically revised. It also incorporates the Technical Corrigenda ISO/IEC 9075-2:2016/Cor.1:2019 and ISO/IEC 9075-2:2016/Cor.2:2022.

The main changes are as follows:

— native JSON datatype;

— more types of numeric literals;

— additional SQL functions:

  — ANY_VALUE,
  — BTRIM,
  — GREATEST,
  — JSON_SCALAR,
  — JSON_SERIALIZE,

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  - LEAST,
  - LPAD,
  - LTRIM,
  - RPAD,
  - RTRIM;

- improve the presentation and accuracy of the summaries of implementation-defined and implementation-dependent aspects of this document;

- introduction of several digital artifacts;

- alignment with updated ISO house style and other guidelines for creating standards.

This sixth edition of ISO/IEC 9075-2 is designed to be used in conjunction with the following editions of other parts of the ISO/IEC 9075 series, all published 2023:

- ISO/IEC 9075-1, sixth edition;

- ISO/IEC 9075-3, sixth edition;

- ISO/IEC 9075-4, seventh edition;

- ISO/IEC 9075-9, fifth edition;

- ISO/IEC 9075-10, fifth edition;

- ISO/IEC 9075-11, fifth edition;

- ISO/IEC 9075-13, fifth edition;

- ISO/IEC 9075-14, sixth edition;

- ISO/IEC 9075-15, second edition;

- ISO/IEC 9075-16, first edition.

A list of all parts in the ISO/IEC 9075 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

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Introduction

The organization of this document is as follows:

1) Clause 1, "Scope", specifies the scope of this document.
2) Clause 2, "Normative references", identifies additional standards that, through reference in this document, constitute provisions of this document.
3) Clause 3, "Terms and definitions", defines the terms and definitions used in this document.
4) Clause 4, "Concepts", presents concepts used in the definition of SQL.
5) Clause 5, "Lexical elements", defines the lexical elements of the language.
6) Clause 6, "Scalar expressions", defines the elements of the language that produce scalar values.
7) Clause 7, "Query expressions", defines the elements of the language that produce rows and tables of data.
8) Clause 8, "Predicates", defines the predicates of the language.
9) Clause 9, "Additional common rules", specifies the rules for assignments that retrieve data from or store data into SQL-data, and formation rules for set operations.
10) Clause 10, "Additional common elements", defines additional language elements that are used in various parts of the language.
11) Clause 11, "Schema definition and manipulation", defines facilities for creating and managing a schema.
12) Clause 12, "Access control", defines facilities for controlling access to SQL-data.
13) Clause 13, "SQL-client modules", defines SQL-client modules and externally-invoked procedures.
14) Clause 14, "Data manipulation", defines the data manipulation statements.
15) Clause 15, "Additional data manipulation rules", defines additional rules for data manipulation.
16) Clause 16, "Control statements", defines the SQL-control statements.
17) Clause 17, "Transaction management", defines the SQL-transaction management statements.
18) Clause 18, "Connection management", defines the SQL-connection management statements.
19) Clause 19, "Session management", defines the SQL-session management statements.
20) Clause 20, "Dynamic SQL", defines the SQL dynamic statements.
21) Clause 21, "Embedded SQL", defines the host language embeddings.
22) Clause 22, "Direct invocation of SQL", defines direct invocation of SQL language.
23) Clause 23, "Diagnostics management", defines the diagnostics management facilities.
24) Clause 24, "Status codes", defines values that identify the status of the execution of SQL-statements and the mechanisms by which those values are returned.
25) Clause 25, "Conformance", defines the criteria for conformance to this document.
26) Annex A, "SQL conformance summary", is an informative Annex. It summarizes the conformance requirements of the SQL language.

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27) Annex B, "Implementation-defined elements", is an informative Annex. It lists those features for which the body of this document states that the syntax, the meaning, the returned results, the effect on SQL-data and/or schemas, or other aspect is partly or wholly implementation-defined.

28) Annex C, "Implementation-dependent elements", is an informative Annex. It lists those features for which the body of this document states that the syntax, the meaning, the returned results, the effect on SQL-data and/or schemas, or other aspect is partly or wholly implementation-dependent.

29) Annex D, "SQL optional feature taxonomy", is an informative Annex. It identifies the optional features of the SQL language specified in this document by an identifier and a short descriptive name. This taxonomy is used to specify conformance.

30) Annex E, "Deprecated features", is an informative Annex. It lists features that the responsible Technical Committee intends not to include in a future edition of this document.

31) Annex F, "Incompatibilities with ISO/IEC 9075:2016", is an informative Annex. It lists incompatibilities with the previous edition of this document.

32) Annex G, "Defect Reports not addressed in this edition of this document", is an informative Annex. It describes the Defect Reports that were known at the time of publication of this document. Each of these problems is a problem carried forward from the previous edition of the ISO/IEC 9075 series. No new problems have been created in the drafting of this edition of this document.

33) Annex H, "SQL mandatory feature taxonomy", is an informative Annex. It identifies mandatory features and subfeatures of the SQL language specified in this document by an identifier and a short descriptive name. This taxonomy is used to specify conformance to Core SQL.

In the text of this document, in Clause 5, "Lexical elements", through Clause 24, "Status codes", Subclauses begin new pages. Any resulting blank space is not significant.

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Information technology — Database language SQL —

Part 2:
Foundation (SQL/Foundation)

1 Scope

This document defines the data structures and basic operations on SQL-data. It provides functional capabilities for creating, accessing, maintaining, controlling, and protecting SQL-data.

This document specifies the syntax and semantics of a database language:

— for specifying and modifying the structure and the integrity constraints of SQL-data;

— for declaring and invoking operations on SQL-data and cursors;

— for declaring database language procedures;

— for embedding SQL-statements in a compilation unit that is otherwise written in a particular programming language (host language);

— for deriving an equivalent compilation unit in the host language. In that equivalent compilation unit, each embedded SQL-statement has been replaced by one or more statements in the host language, some of which invoke an SQL externally-invoked procedure that, when executed, has an effect equivalent to executing the SQL-statement;

— for direct invocation of SQL-statements;

— to support dynamic preparation and execution of SQL-statements.

This document provides a vehicle for portability of data definitions and compilation units between SQL-implementations.

This document provides a vehicle for interconnection of SQL-implementations.

Implementations of this document can exist in environments that also support application programming languages, end-user query languages, report generator systems, data dictionary systems, program library systems, and distributed communication systems, as well as various tools for database design, data administration, and performance optimization.

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2 Normative references

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. [1]

ISO/IEC 646, *Information technology — ISO 7-bit coded character set for information interchange*

ISO/IEC 1539-1:2018, *Information technology — Programming languages — Fortran — Part 1: Base language*

ISO 1989:2014, *Information technology — Programming languages — COBOL*

ISO 6160:1979, *Programming languages — PL/I (Endorsement of ANSI X3.53-1976)*

ISO/IEC 6429, *Information technology — Control functions for coded character sets*

ISO 7185:1990, *Information technology — Programming languages — Pascal*

ISO 8601-1:2019, *Date and time — Representations for information interchange — Part 1: Basic rules*

ISO/IEC 8652:2012, *Information technology — Programming languages — Ada*

ISO/IEC 8652:2012/Cor.1:2016, *Information technology — Programming languages — Ada — Technical Corrigendum 1*

ISO/IEC 8859-1, *Information technology — 8-bit single-byte coded graphic character sets — Part 1: Latin alphabet No. 1*

ISO/IEC 9075-1, *Information technology — Database languages — SQL — Part 1: Framework (SQL/Framework)*

ISO/IEC 9075-11, *Information technology — Database languages — SQL — Part 11: Information and Definition Schemas (SQL/Schemata)*

ISO/IEC 9579, *Information technology — Remote database access for SQL with security enhancement*

ISO/IEC 9899:2018, *Information technology — Programming languages — C*

ISO/IEC 10206:1991, *Information technology — Programming languages — Extended Pascal*

ISO/IEC 10646:2020, *Information technology — Universal Multi-Octet Coded Character Set (UCS)*

ISO/IEC 11756:1999, *Information technology — Programming languages — M*

ISO/IEC 14651:2020, *Information technology — International string ordering and comparison — Method for comparing character strings and description of the common template tailorable ordering*

ECMA International. *ECMA-262 — ECMAScript® Language Specification 5.1 Edition* [online]. [Place of publication unknown]: Available at `https://262.ecma-international.org/5.1/-ECMA-262.pdf`

1 In this document, ECMAScript Language Specification 5.1 Edition is referenced for the purpose of defining the lexical elements of the SQL/JSON path language specified in Subclause 9.45, "SQL/JSON path language: lexical elements", and Subclause 9.46, "SQL/JSON path language: syntax and semantics". There are no intentions to update this reference to a newer edition of ECMA-262.

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Internet Engineering Task Force (IETF) RFC 8259 *The JavaScript Object Notation (JSON) Data Interchange Format*. Edited by: Miller, Matthew December 2018
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