INTERNATIONAL STANDARD

ISO/IEC 9075-1

Sixth edition
2023-06

Information technology — Database languages — SQL —

Part 1: Framework (SQL/Framework)

Technologies de l'information — Langages de base de données — SQL —

Partie 1: Charpente (SQL/Charpente)

Reference number
ISO/IEC 9075-1:2023(E)

© ISO/IEC 2023



COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2023

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

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

Published in Switzerland

© ISO/IEC 2023 – All rights reserved

Contents

Page

Foreword . . . x
Introduction . . . xii
1 Scope . . . 1
2 Normative references . . . 2
3 Terms and definitions . . . 3
3.1 Definitions taken from ISO/IEC 10646:2020 . . . 3
3.2 Definitions provided in this document . . . 3
4 Concepts . . . 6
4.1 What is SQL? . . . 6
4.2 Use of terms . . . 6
4.3 Caveat . . . 7
4.4 SQL-environments and their components . . . 7
4.4.1 SQL-environments . . . 7
4.4.2 SQL-agents . . . 7
4.4.3 SQL-implementations . . . 7
4.4.3.1 Introduction to SQL-implementations . . . 7
4.4.3.2 SQL-clients . . . 7
4.4.3.3 SQL-servers . . . 8
4.4.4 SQL-client modules . . . 8
4.4.5 User identifiers . . . 8
4.4.6 Roles . . . 8
4.4.7 User mapping concepts . . . 8
4.4.8 Routine mapping concepts . . . 8
4.4.9 Catalogs and schemas . . . 9
4.4.9.1 Catalogs . . . 9
4.4.9.2 SQL-schemas . . . 9
4.4.9.3 Information Schema . . . 9
4.4.9.4 Definition Schema . . . 9
4.4.10 Foreign servers and descriptors . . . 9
4.4.11 Foreign-data wrappers and descriptors . . . 9
4.4.12 SQL-data . . . 10
4.5 Tables . . . 10
4.6 SQL data types . . . 11
4.6.1 General data type information . . . 11
4.6.2 Null value . . . 11
4.6.3 Predefined types . . . 11
4.6.3.1 Numeric types . . . 11
4.6.3.2 Character string types . . . 12

© ISO/IEC 2023 – All rights reserved

4.6.3.3 Binary string types. . . . 12
4.6.3.4 Boolean type. . . . 12
4.6.3.5 Datetime types. . . . 12
4.6.3.6 Interval types. . . . 12
4.6.3.7 XML type. . . . 12
4.6.3.8 JSON type. . . . 13
4.6.4 Constructed atomic types: reference types. . . . 13
4.6.5 Constructed composite types. . . . 13
4.6.5.1 Collection types. . . . 13
4.6.5.2 Row types. . . . 13
4.7 Sites and operations on sites. . . . 13
4.7.1 Sites. . . . 13
4.7.2 Assignment. . . . 13
4.7.3 Nullability. . . . 14
4.8 SQL-schema objects. . . . 14
4.8.1 General SQL-schema object information. . . . 14
4.8.2 Descriptors relating to character sets. . . . 14
4.8.2.1 Character sets. . . . 14
4.8.2.2 Collations. . . . 15
4.8.2.3 Transliterations. . . . 15
4.8.3 Domains and their components. . . . 15
4.8.3.1 Domains. . . . 15
4.8.3.2 Domain constraints. . . . 15
4.8.4 User-defined types. . . . 15
4.8.4.1 Introduction to user-defined types. . . . 15
4.8.4.2 Distinct types. . . . 15
4.8.4.3 Structured types. . . . 16
4.8.5 Base tables and their components. . . . 16
4.8.5.1 Base tables. . . . 16
4.8.5.2 Columns. . . . 16
4.8.5.3 Periods. . . . 16
4.8.5.4 Table constraints. . . . 16
4.8.5.5 Triggers. . . . 17
4.8.6 View definitions. . . . 17
4.8.7 Assertions. . . . 17
4.8.8 SQL-server modules (defined in ISO/IEC 9075-4). . . . 17
4.8.9 Schema routines. . . . 17
4.8.10 Sequence generators. . . . 17
4.8.11 Privileges. . . . 17
4.9 Integrity constraints and constraint checking. . . . 18
4.9.1 Constraint checking. . . . 18
4.9.2 Determinism and constraints. . . . 18
4.9.3 Consistency when deleting and updating multiple rows. . . . 19
4.10 Communication between an SQL-agent and an SQL-server. . . . 19
4.10.1 Host languages. . . . 19
4.10.2 Source language character set. . . . 20
4.10.3 Parameter passing and data type correspondences. . . . 20

 © ISO/IEC 2023 – All rights reserved

4.10.3.1 General parameter passing and data type correspondence information. . . . 20
4.10.3.2 Data type correspondences. . . . 20
4.10.3.3 Locators. . . . 21
4.10.3.4 Status parameters. . . . 21
4.10.3.5 Indicator parameters. . . . 21
4.10.4 Descriptor areas. . . . 21
4.10.5 Diagnostic information. . . . 21
4.10.6 SQL-transactions. . . . 21
4.11 Modules. . . . 22
4.12 Routines. . . . 22
4.12.1 General routine information. . . . 22
4.12.2 Type preserving functions. . . . 23
4.13 SQL-statements. . . . 23
4.13.1 Classes of SQL-statements. . . . 23
4.13.2 SQL-statements classified by function. . . . 24
5 Parts of the ISO/IEC 9075 series. . . . 25
5.1 Overview. . . . 25
5.2 ISO/IEC 9075-1: Framework (SQL/Framework). . . . 25
5.3 ISO/IEC 9075-2 Foundation (SQL/Foundation). . . . 26
5.3.1 Introduction to ISO/IEC 9075-2 Foundation (SQL/Foundation). . . . 26
5.3.2 Bindings methods. . . . 26
5.3.2.1 Introduction to bindings methods. . . . 26
5.3.2.2 Embedded SQL. . . . 26
5.3.2.3 Dynamic SQL. . . . 26
5.3.2.4 Direct invocation of SQL. . . . 26
5.3.3 SQL-statements specified in ISO/IEC 9075-2. . . . 26
5.4 ISO/IEC 9075-3: Call-Level Interface (SQL/CLI). . . . 27
5.5 ISO/IEC 9075-4: Persistent Stored Modules (SQL/PSM). . . . 28
5.5.1 Introduction to SQL/PSM. . . . 28
5.5.2 SQL-statements specified in ISO/IEC 9075-4. . . . 28
5.6 ISO/IEC 9075-9: Management of External Data (SQL/MED). . . . 28
5.7 ISO/IEC 9075-10: Object Language Bindings (SQL/OLB). . . . 28
5.8 ISO/IEC 9075-11: Information and Definition Schemas (SQL/Schemata). . . . 28
5.9 ISO/IEC 9075-13: SQL Routines and Types Using the Java™ Programming Language (SQL/JRT). . . . 29
5.10 ISO/IEC 9075-14: XML-Related Specifications (SQL/XML). . . . 29
5.11 ISO/IEC 9075-15: Multidimensional Arrays (SQL/MDA). . . . 29
5.12 ISO/IEC 9075-16: Property Graph Queries (SQL/PGQ). . . . 29
6 Notation and conventions used in other parts of the ISO/IEC 9075 series. . . . 31
6.1 Notation taken from ISO/IEC 10646:2020. . . . 31
6.2 Notation provided in the ISO/IEC 9075 series. . . . 31
6.3 Conventions. . . . 32
6.3.1 Specification of syntactic elements. . . . 32
6.3.2 Specification of the Information and Definition Schemata. . . . 33
6.3.3 Use of terms. . . . 33
6.3.3.1 Syntactic containment. . . . 33
6.3.3.2 Terms denoting rule requirements. . . . 34
6.3.3.3 Rule evaluation order. . . . 35

© ISO/IEC 2023 – All rights reserved

6.3.3.4 Conditional rules. . . . 36
6.3.3.5 Syntactic substitution. . . . 36
6.3.3.6 Other terms. . . . 37
6.3.3.7 Exceptions. . . . 37
6.3.4 Descriptors. . . . 38
6.3.5 Application of technical corrigenda. . . . 39
6.3.6 Relationships of parts within the ISO/IEC 9075 series. . . . 39
6.3.6.1 Introduction to relationships among parts. . . . 39
6.3.6.2 Clauses 1, 2, and 3. . . . 40
6.3.6.3 New and modified Clauses and Subclauses. . . . 40
6.3.6.4 New and modified Tables, Figures, Examples, and Equations. . . . 41
6.3.6.5 Functions. . . . 41
6.3.6.6 New and modified Format Items. . . . 41
6.3.6.7 New and modified paragraphs and rules. . . . 42
6.3.6.8 Modified Subclause Signatures. . . . 44
6.3.6.9 New and modified Annexes. . . . 44
6.3.6.10 Order of merging an incremental part. . . . 45
6.3.7 Subclauses used as subroutines. . . . 45
6.3.8 Document typography. . . . 46
6.3.9 Index typography. . . . 46
6.3.10 Feature ID and Feature Name. . . . 46
6.3.11 Implementation-defined and implementation-dependent. . . . 47
6.4 Digital artifacts. . . . 48
6.4.1 Introduction to digital artifacts. . . . 48
6.4.2 Language syntax. . . . 48
6.4.3 Condition codes. . . . 48
6.4.4 Feature codes. . . . 49
6.4.5 Implementation-defined items. . . . 50
6.4.6 Implementation-dependent items. . . . 50
6.4.7 Header files. . . . 51
6.4.8 Ada interface. . . . 51
6.4.9 Schema definition. . . . 51
6.4.10 XML Schemata. . . . 52
7 Annexes to the parts of the ISO/IEC 9075 series. . . . 53
7.1 Annexes are informative. . . . 53
7.2 SQL conformance summary. . . . 53
7.3 Implementation-defined elements. . . . 53
7.4 Implementation-dependent elements. . . . 53
7.5 Deprecated features. . . . 53
7.6 Incompatibilities with previous versions. . . . 53
7.7 SQL feature taxonomy. . . . 53
7.8 Defect Reports. . . . 53
8 Status codes. . . . 54
8.1 SQLSTATE. . . . 54
9 Conformance. . . . 55
9.1 Kinds of conformance claims. . . . 55

 © ISO/IEC 2023 – All rights reserved

9.2 Minimum conformance. . . . 55
9.3 Conformance to parts. . . . 55
9.4 Conformance to features. . . . 55
9.5 Extensions and options. . . . 56
9.6 SQL flagger. . . . 56
9.7 Claims of conformance. . . . 57
9.7.1 How conformance is claimed. . . . 57
9.7.2 Requirements for SQL applications. . . . 58
9.7.3 Requirements for SQL-implementations. . . . 58
Annex A (informative) **SQL conformance summary. . . . 59**
Annex B (informative) **Implementation-defined elements. . . . 60**
Annex C (informative) **Implementation-dependent elements. . . . 63**
Annex D (informative) **SQL optional feature taxonomy. . . . 65**
Annex E (informative) **Deprecated features. . . . 66**
Annex F (informative) **Incompatibilities with ISO/IEC 9075:2016. . . . 67**
Annex G (informative) **Defect Reports not addressed in this edition of this document. . . . 68**
Annex H (informative) **Maintenance and interpretation of SQL. . . . 69**
Annex I (informative) **Support for the use of inter-document links in the ISO/IEC 9075 series. . 70**
Bibliography. . . . 71
Index. . . . 72

© ISO/IEC 2023 – All rights reserved

Tables

Table

Page

1 Relationships between externally-invoked and SQL-invoked routines. 22
2 Symbols used in BNF. 31
3 Examples and explanations of paragraph and rule mergers. 43
4 SQLSTATE class and subclass codes. 54
A.1 Feature definitions outside of Conformance Rules. 59
D.1 Feature taxonomy for optional features. 65
I.1 Filename conventions. 70

© ISO/IEC 2023 – All rights reserved

Figures

Figure

Page

1 Relationships between the parts of the ISO/IEC 9075 series. 40

© ISO/IEC 2023 – All rights reserved

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 9075-1:2016), which has been technically revised. It also incorporates the Technical Corrigendum ISO/IEC 9075-1:2016/Cor.1:2022.

The main changes are as follows:

— addition and refinement of the terms and concepts to support new data types required by incremental parts;

— clarification and correction of the merge instructions for Technical Corrigenda and incremental parts;

— 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.

© ISO/IEC 2023 – All rights reserved

This sixth edition of ISO/IEC 9075-1 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 9075-2, 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.

© ISO/IEC 2023 – All rights reserved

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 the ISO/IEC 9075 series.

3) Clause 3, "Terms and definitions", defines terms and definitions used in this document and in other parts of the ISO/IEC 9075 series.

4) Clause 4, "Concepts", describes the concepts used in the ISO/IEC 9075 series.

5) Clause 5, "Parts of the ISO/IEC 9075 series", summarizes the content of each of the parts of the ISO/IEC 9075 series, in terms of the concepts described in Clause 4, "Concepts".

6) Clause 6, "Notation and conventions used in other parts of the ISO/IEC 9075 series", defines notation and conventions used in other parts of the ISO/IEC 9075 series.

7) Clause 7, "Annexes to the parts of the ISO/IEC 9075 series", describes the content of annexes of other parts of the ISO/IEC 9075 series.

8) Clause 8, "Status codes", defines values that identify the status of the execution of SQL-statements and the mechanisms by which those values are returned.

9) Clause 9, "Conformance", specifies requirements that apply to claims of conformance to all or some of the parts of the ISO/IEC 9075 series.

10) Annex A, "SQL conformance summary", is an informative Annex. It summarizes the conformance requirements of the SQL language.

11) 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.

12) 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.

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

14) 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.

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

16) 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 this document. No new problems have been created in the drafting of this edition of this document.

17) Annex H, "Maintenance and interpretation of SQL", is an informative Annex. It describes the formal procedures for maintenance and interpretation of the ISO/IEC 9075 series.

© ISO/IEC 2023 – All rights reserved

18) Annex I, "Support for the use of inter-document links in the ISO/IEC 9075 series", is an informative Annex. It describes conventions that users of the ISO/IEC 9075 series use in order to maximize the facilities provided in the parts of the ISO/IEC 9075 series.

© ISO/IEC 2023 – All rights reserved

Information technology — Database language SQL —

Part 1:
Framework (SQL/Framework)

1 Scope

This document describes the conceptual framework used in other parts of the ISO/IEC 9075 series to specify the grammar of SQL and the result of processing statements in that language by an SQL-implementation.

This document also defines terms and notation used in the other parts of the ISO/IEC 9075 series.

© ISO/IEC 2023 – All rights reserved

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.

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

ISO/IEC 9075-2, *Information technology — Database languages — SQL — Part 2: Foundation (SQL/Foundation)*

ISO/IEC 9075-3, *Information technology — Database languages — SQL — Part 3: Call-Level Interface (SQL/CLI)*

ISO/IEC 9075-4, *Information technology — Database languages — SQL — Part 4: Persistent Stored Modules (SQL/PSM)*

ISO/IEC 9075-9, *Information technology — Database languages — SQL — Part 9: Management of External Data (SQL/MED)*

ISO/IEC 9075-10, *Information technology — Database languages — SQL — Part 10: Object Language Bindings (SQL/OLB)*

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

ISO/IEC 9075-13, *Information technology — Database languages — SQL — Part 13: SQL Routines and Types Using the Java™ Programming Language (SQL/JRT)*

ISO/IEC 9075-14, *Information technology — Database languages — SQL — Part 14: XML-Related Specifications (SQL/XML)*

ISO/IEC 9075-15, *Information technology — Database languages — SQL — Part 15: Multidimensional Arrays (SQL/MDA)*

ISO/IEC 9075-16, *Information technology — Database languages — SQL — Part 16: Property Graph Queries (SQL/PGQ)*

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

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

© ISO/IEC 2023 – All rights reserved

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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 https://www.electropedia.org/

3.1 Definitions taken from ISO/IEC 10646:2020

3.1.1
character
member of a set of elements used for the organization, control, or representation of textual data

Note 1 to entry: This is identical to *abstract character* as defined by The Unicode® Standard. In this document, when the relevant character repertoire is UCS, a character can be thought of as *that which is represented by one code point*.

[SOURCE: ISO/IEC 10646:2020, 3.5]

3.2 Definitions provided in this document

3.2.1
atomic, adj.
incapable of being subdivided

3.2.2
column
field of the row type of a table

3.2.3
compilation unit
segment of executable code, possibly consisting of one or more subprograms

3.2.4
data type
set of representable values

3.2.5
descriptor
coded description of the metadata of an SQL object

3.2.6
field
(field name, data type) pair

Note 1 to entry: A value of a field is a value of its data type.

3.2.7
identifier
object by which something is identified

© ISO/IEC 2023 – All rights reserved