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Information technology — Database languages — SQL Technical Reports —

Part 2: SQL Support for Time-Related Information

Technologies de l'information — Langages de base de données — SQL rapports techniques —
Partie 2: Soutien SQL d'information d'horodatage

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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. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. 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.

In exceptional circumstances, when the joint technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide to publish a Technical Report. A Technical Report is entirely informative in nature and shall be subject to review every five years in the same manner as an International Standard.

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ISO/IEC TR 19075-2 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 32, *Data management and interchange*.

ISO/IEC TR 19075 consists of the following parts, under the general title *Information technology — Database languages — SQL Technical Reports*:

— Part 1: XQuery Regular Expression Support in SQL

— Part 2: SQL Support for Time-Related Information

— Part 3: SQL Embedded in Programs Using the Java™ Programming Language

— Part 4: SQL With Routines and Types Using the Java™ Programming Language

— Part 5: Row Pattern Recognition in SQL

NOTE 1 — The individual parts of multi-part technical report are not necessarily published together. New editions of one or more parts may be published without publication of new editions of other parts.

Introduction

The organization of this part of ISO/IEC 19075 is as follows:

1) Clause 1, “Scope”, specifies the scope of this part of ISO/IEC 19075.

2) Clause 2, “Normative references”, identifies additional standards that, through reference in this part of ISO/IEC 19075, constitute provisions of this part of ISO/IEC 19075.

3) Clause 3, “Time-related datatypes, constructs, operators, and predicates”, explains time-related datatypes, operators, and predicates in SQL.

4) Clause 4, “Time-related Tables”, explains how time-related tables are used.

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Information technology — Database languages — SQL Technical Reports —

Part 2:
SQL Support for Time-Related Information

1 Scope

This Technical Report describes the support in SQL for time-related information.

This Technical Report discusses the following features of the SQL language:

— Time-related datatypes

— Operations on time-related data

— Time-related Predicates

— Application-time period tables

— System-versioned tables

— Bitemporal tables

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2 Normative references

The following referenced documents are indispensable for the application 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.

2.1 ISO and IEC standards

[ISO9075-2] ISO/IEC 9075-2:2011, *Information technology — Database languages — SQL — Part 2: Foundation (SQL/Foundation)*.

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3 Time-related datatypes, constructs, operators, and predicates

3.1 Datetime types

There are three *datetime types*, each of which is made up of different datetime fields.

A value of data type TIMESTAMP is made up of the datetime fields YEAR, MONTH, DAY, HOUR, MINUTE, and SECOND. It is always a valid time at a valid Gregorian date.

A value of data type TIME comprises values of the datetime fields HOUR, MINUTE and SECOND. It is always a valid time of day.

A value of data type DATE is made up of the datetime fields YEAR, MONTH, and DAY. It is always a valid Gregorian date.

TIMESTAMP and TIME may be specified with a number of (decimal) digits of fractional seconds precision.

TIMESTAMP and TIME may also be specified as being WITH TIME ZONE, in which case every value has associated with it a time zone displacement. In comparing values of a data type WITH TIME ZONE, the value of the time zone displacement is disregarded.

Table 1, "Fields in datetime values", specifies the fields that can make up a datetime value.

Table 1 — Fields in datetime values

Keyword	**Meaning**
YEAR	Year, between 0001 and 9999
MONTH	Month within year, between 01 and 12
DAY	Day within month, between 1 and 31, but further constrained by the value of MONTH and YEAR fields, according to the rules for well-formed dates in the Gregorian calendar.
HOUR	Hour within day, between 00 and 23
MINUTE	Minute within hour, between 00 and 59
SECOND	Second and possibly fraction of a second within minute, between 00 and 61.999...
TIMEZONE_HOUR	Hour value of time zone displacement, between –14 and 14. The range for time zone intervals is larger than many readers might expect because it is governed by political decisions in governmental bodies rather than by any natural law.

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3.1 Datetime types

Keyword	Meaning
TIMEZONE_MINUTE	Minute value of time zone displacement, between –59 and 59. When the value of TIMEZONE_HOUR is either –14 or 14, the value of TIMEZONE_MINUTE is restricted to be 00 (zeros).

There is an ordering of the significance of these fields. This is, from most significant to least significant: YEAR, MONTH, DAY, HOUR, MINUTE, and SECOND.

Table 2 — Mapping of Datetime fields to Datetime Datatypes

Datatype	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND	TZ HOUR	TZ MINUTE
TIMESTAMP	Y	Y	Y	Y	Y	Y	N	N
TIMESTAMP WITH TZ	Y	Y	Y	Y	Y	Y	Y	Y
TIME	N	N	N	Y	Y	Y	N	N
TIME WITH TZ	N	N	N	Y	Y	Y	Y	Y
DATE	Y	Y	Y	N	N	N	N	N

The surface of the earth is divided into zones, called time zones, in which every correct clock tells the same time, known as *local time*. Local time is equal to UTC (Coordinated Universal Time) plus the *time zone displacement*, which is an interval value that ranges between INTERVAL '–14:00' HOUR TO MINUTE and INTERVAL '+14:00' HOUR TO MINUTE. The time zone displacement is constant throughout a time zone, changing at the beginning and end of Summer Time, where applicable.

A datetime value, of data type TIME WITHOUT TIME ZONE or TIMESTAMP WITHOUT TIME ZONE, may represent a local time, whereas a datetime value of data type TIME WITH TIME ZONE or TIMESTAMP WITH TIME ZONE represents UTC.

Table 3 — Examples of the datetime datatypes

Datatype	Explanation
TIMESTAMP (2)	This a timestamp with a fractional precision of 2 for the seconds field
TIMESTAMP	This is a timestamp with no fractional precision for the seconds field
TIME (2)	This is a time with a fractional precision of 2 for the seconds field
TIME	This is a time with no fractional precision for the seconds field
DATE	This is a date

On occasion, UTC is adjusted by the omission of a second or the insertion of a “leap second” in order to maintain synchronization with sidereal time. This implies that sometimes, but very rarely, a particular minute will contain exactly 59, 61, or 62 seconds. Interval arithmetic that involves leap seconds or discontinuities in calendars will produce implementation-defined results.

For the convenience of users, whenever a datetime value with time zone is to be implicitly derived from one without (for example, in a simple assignment operation), SQL assumes the value without time zone to be local, subtracts the current default time zone displacement of the SQL-session from it to give UTC, and associates that time zone displacement with the result.

Conversely, whenever a datetime value without time zone is to be implicitly derived from one with, SQL assumes the value with time zone to be UTC, adds the time zone displacement to it to give local time, and the result, without any time zone displacement, is local.

Datetime data types will allow dates in the Gregorian format to be stored in the date range 0001–01–01 CE through 9999–12–31 CE.

3.2 DateTime literals

A datetime literal can specify datetime values of the respective datetime datatypes. An datetime literal consists of three parts. The keyword for the datatype, the value in a fixed format and the timezone displacement. The format for the datetime literal is yyyy–mm–dd hh24:mi:ss.ssss. The datatype is automatically assignd to the literals depending on their content and the keyword used.

Table 4 — Examples of datetime literals

Literal	Datatype	Explanation
TIMESTAMP '2014–06–11 09:15:22.03'	TIMESTAMP (2)	This is a timestamp for the 11th of June 2014 at 9 hours, 15 minutes and 22.03 seconds
TIME'12:00:01+01:00'	TIME(0) WITH TIMEZONE	One second after noon in the timezone with a displacement of + 1 hour
DATE '0001–01–01'	DATE	The first of January in year 1. This is the first possible date in SQL

3.3 Interval types

A value of an *interval type* represents the duration of a period of time. There are two classes of intervals. One class, called *year-month intervals*, has an interval precision that includes a YEAR field or a MONTH field, or both. The other class, called *day-time intervals*, has an express or implied interval precision that can include any set of contiguous fields other than YEAR or MONTH.

Table 5, “Fields in year-month INTERVAL values”, specifies the fields that make up a year–month interval.