

# ISO/IEC 9075-9:2023-06 (E)

## Information technology - Database languages SQL - Part 9: Management of External Data (SQL/MED)

---

### Contents

### Page

Foreword . . . . .	xiii
Introduction . . . . .	xv
<b>1 Scope . . . . .</b>	<b>1</b>
<b>2 Normative references . . . . .</b>	<b>2</b>
<b>3 Terms and definitions . . . . .</b>	<b>3</b>
<b>4 Concepts . . . . .</b>	<b>6</b>
4.1 Notations and conventions . . . . .	6
4.1.1 Notations . . . . .	6
4.2 Data types . . . . .	6
4.2.1 Naming of predefined types . . . . .	6
4.2.2 Data type terminology . . . . .	6
4.3 Columns, fields, and attributes . . . . .	6
4.4 Tables . . . . .	7
4.4.1 Introduction to tables . . . . .	7
4.4.2 Base tables . . . . .	7
4.4.2.1 Foreign tables . . . . .	7
4.4.3 Unique identification of tables . . . . .	7
4.4.4 Table descriptors . . . . .	7
4.4.5 Syntactic analysis of derived tables and cursors . . . . .	7
4.5 Functional dependencies . . . . .	8
4.5.1 Known functional dependencies in a foreign table . . . . .	8
4.6 SQL-schemas . . . . .	8
4.7 SQL-statements . . . . .	8
4.7.1 SQL-statements classified by function . . . . .	8
4.7.1.1 SQL-schema statements . . . . .	8
4.7.1.2 SQL-session statements . . . . .	9
4.8 Basic security model . . . . .	9
4.8.1 Privileges . . . . .	9
4.9 SQL-transactions . . . . .	9
4.9.1 Properties of SQL-transactions . . . . .	9
4.10 SQL-sessions . . . . .	9
4.10.1 SQL-session properties . . . . .	9
4.11 Introduction to SQL/CLI . . . . .	10
4.12 Foreign servers . . . . .	10
4.13 Foreign-data wrappers . . . . .	11
4.14 User mappings . . . . .	12
4.15 Routine mappings . . . . .	12
4.16 Generic options . . . . .	13

4.17	Capabilities and options information.....	13
4.18	Datalinks.....	14
4.18.1	Introduction to datalinks.....	14
4.18.2	Operations involving datalinks.....	17
4.18.2.1	Operators that operate on datalinks.....	17
4.18.2.2	Other operators involving datalinks.....	18
4.19	Foreign-data wrapper interface.....	18
4.19.1	Introduction to foreign-data wrapper interface.....	18
4.19.2	Handles.....	18
4.19.3	Foreign server sessions.....	20
4.19.4	Foreign-data wrapper interface routines.....	20
4.19.4.1	Introduction to foreign-data wrapper interface routines.....	20
4.19.4.2	Handle routines.....	20
4.19.4.3	Initialization routines.....	24
4.19.4.4	Access routines.....	24
4.19.4.5	Termination routines.....	25
4.19.4.6	Decomposition and pass-through modes.....	26
4.19.4.7	Sequence of actions during the execution of foreign server requests.....	26
4.19.5	Return codes.....	38
4.19.6	Foreign-data wrapper diagnostics areas.....	38
4.19.7	Null pointers.....	40
4.19.8	Foreign-data wrapper descriptor areas.....	40
<b>5</b>	<b>Lexical elements.....</b>	<b>44</b>
5.1	<token> and <separator>.....	44
5.2	Names and identifiers.....	46
<b>6</b>	<b>Scalar expressions.....</b>	<b>48</b>
6.1	<data type>.....	48
6.2	<cast specification>.....	51
6.3	<value expression>.....	52
6.4	<string value function>.....	53
6.5	<datalink value expression>.....	57
6.6	<datalink value function>.....	58
<b>7</b>	<b>Query expressions.....</b>	<b>61</b>
7.1	<table reference>.....	61
<b>8</b>	<b>Additional common rules.....</b>	<b>68</b>
8.1	Retrieval assignment.....	68
8.2	Store assignment.....	69
8.3	Result of data type combinations.....	70
8.4	Type precedence list determination.....	71
8.5	Determination of identical values.....	72
8.6	Equality operations.....	73
8.7	Grouping operations.....	74
8.8	Multiset element grouping operations.....	75
8.9	Ordering operations.....	76
<b>9</b>	<b>Additional common elements.....</b>	<b>77</b>
9.1	<generic options>.....	77

9.2	<alter generic options>.....	78
<b>10</b>	<b>Schema definition and manipulation.....</b>	<b>80</b>
10.1	<schema definition>.....	80
10.2	<drop schema statement>.....	81
10.3	<table definition>.....	82
10.4	<unique constraint definition>.....	83
10.5	<check constraint definition>.....	84
10.6	<alter column data type clause>.....	85
10.7	<drop column definition>.....	86
10.8	<domain definition>.....	87
10.9	<assertion definition>.....	88
10.10	<user-defined type definition>.....	89
10.11	<SQL-invoked routine>.....	90
10.12	<drop routine statement>.....	91
10.13	<user-defined cast definition>.....	92
10.14	<user-defined ordering definition>.....	93
10.15	<foreign table definition>.....	94
10.16	<alter foreign table statement>.....	97
10.17	<add basic column definition>.....	98
10.18	<alter basic column definition>.....	99
10.19	<drop basic column definition>.....	100
10.20	<drop foreign table statement>.....	102
<b>11</b>	<b>Access control.....</b>	<b>104</b>
11.1	<privileges>.....	104
11.2	<revoke statement>.....	105
11.3	<user mapping definition>.....	106
11.4	<alter user mapping statement>.....	108
11.5	<drop user mapping statement>.....	109
<b>12</b>	<b>SQL-client modules.....</b>	<b>110</b>
12.1	<SQL-client module definition>.....	110
12.2	<externally-invoked procedure>.....	111
12.3	<SQL procedure statement>.....	114
12.4	Data type correspondences.....	115
<b>13</b>	<b>Additional data manipulation rules.....</b>	<b>118</b>
13.1	Effect of deleting rows from base tables.....	118
13.2	Effect of inserting tables into base tables.....	119
13.3	Effect of replacing rows in base tables.....	121
<b>14</b>	<b>Session management.....</b>	<b>123</b>
14.1	<set passthrough statement>.....	123
<b>15</b>	<b>Dynamic SQL.....</b>	<b>125</b>
15.1	Description of SQL descriptor areas.....	125
15.2	<prepare statement>.....	126
15.3	<deallocate prepared statement>.....	128
15.4	<describe statement>.....	129
15.5	<input using clause>.....	131

15.6	<output using clause>.....	135
15.7	<execute statement>.....	138
15.8	<dynamic declare cursor>.....	139
15.9	<allocate extended dynamic cursor statement>.....	140
15.10	<allocate received cursor statement>.....	141
15.11	<dynamic open statement>.....	142
15.12	<dynamic fetch statement>.....	143
15.13	<dynamic close statement>.....	144
<b>16</b>	<b>Embedded SQL.....</b>	<b>145</b>
16.1	<embedded SQL Ada program>.....	145
16.2	<embedded SQL C program>.....	147
16.3	<embedded SQL COBOL program>.....	148
16.4	<embedded SQL Fortran program>.....	149
16.5	<embedded SQL MUMPS program>.....	150
16.6	<embedded SQL Pascal program>.....	151
16.7	<embedded SQL PL/I program>.....	152
<b>17</b>	<b>Diagnostics management.....</b>	<b>153</b>
17.1	<get diagnostics statement>.....	153
<b>18</b>	<b>Call-Level Interface specifications.....</b>	<b>155</b>
18.1	<CLI routine>.....	155
18.2	Implicit DESCRIBE USING clause.....	156
18.3	Description of CLI item descriptor areas.....	157
18.4	Other tables associated with CLI.....	158
18.5	SQL/CLI data type correspondences.....	160
<b>19</b>	<b>SQL/CLI routines.....</b>	<b>162</b>
19.1	BuildDataLink().....	162
19.2	GetDataLinkAttr().....	163
19.3	GetInfo().....	165
<b>20</b>	<b>URLs.....</b>	<b>166</b>
20.1	URL format.....	166
<b>21</b>	<b>Catalog manipulation.....</b>	<b>169</b>
21.1	<foreign server definition>.....	169
21.2	<alter foreign server statement>.....	171
21.3	<drop foreign server statement>.....	172
21.4	<foreign-data wrapper definition>.....	174
21.5	<alter foreign-data wrapper statement>.....	176
21.6	<drop foreign-data wrapper statement>.....	177
21.7	<import foreign schema statement>.....	178
21.8	<routine mapping definition>.....	180
21.9	<alter routine mapping statement>.....	181
21.10	<drop routine mapping statement>.....	182
<b>22</b>	<b>SQL/MED common specifications.....</b>	<b>183</b>
22.1	Description of foreign-data wrapper item descriptor areas.....	183
22.2	Implicit foreign-data wrapper cursor.....	187
22.3	Implicit DESCRIBE INPUT USING clause for external data.....	189

22.4	Implicit DESCRIBE OUTPUT USING clause for external data.....	192
22.5	Implicit EXECUTE USING and OPEN USING clauses for external data.....	196
22.6	Implicit FETCH USING clause for external data.....	199
22.7	Character string retrieval for external data.....	203
22.8	Binary string retrieval for external data.....	204
22.9	Tables used with SQL/MED.....	205
<b>23</b>	<b>Foreign-data wrapper interface routines.....</b>	<b>216</b>
23.1	<foreign-data wrapper interface routine>.....	216
23.2	<foreign-data wrapper interface routine> invocation.....	221
23.3	AdvanceInitRequest().....	223
23.4	AllocQueryContext().....	224
23.5	AllocWrapperEnv().....	225
23.6	Close().....	227
23.7	ConnectServer().....	228
23.8	FreeExecutionHandle().....	230
23.9	FreeFSConnection().....	232
23.10	FreeQueryContext().....	233
23.11	FreeReplyHandle().....	234
23.12	FreeWrapperEnv().....	235
23.13	GetNextReply().....	236
23.14	GetNumReplyBoolVE().....	237
23.15	GetNumReplyOrderBy().....	238
23.16	GetNumReplySelectElems().....	239
23.17	GetNumReplyTableRefs().....	240
23.18	GetOpts().....	241
23.19	GetReplyBoolVE().....	243
23.20	GetReplyCardinality().....	244
23.21	GetReplyDistinct().....	245
23.22	GetReplyExecCost().....	246
23.23	GetReplyFirstCost().....	247
23.24	GetReplyOrderElem().....	248
23.25	GetReplyReExecCost().....	249
23.26	GetReplySelectElem().....	250
23.27	GetReplyTableRef().....	251
23.28	GetSPDHandle().....	252
23.29	GetSRDHandle().....	253
23.30	GetStatistics().....	254
23.31	GetWPDHandle().....	256
23.32	GetWRDHandle().....	257
23.33	InitRequest().....	258
23.34	Iterate().....	262
23.35	Open().....	264
23.36	ReOpen().....	265
23.37	Execution of Open().....	266
23.38	TransmitRequest().....	270
23.39	AllocDescriptor().....	273
23.40	FreeDescriptor().....	274

23.41	GetAuthorizationId()	275
23.42	GetBoolVE()	276
23.43	GetDescriptor()	277
23.44	GetDistinct()	279
23.45	GetNumBoolVE()	280
23.46	GetNumChildren()	281
23.47	GetNumOrderByElems()	282
23.48	GetNumRoutMapOpts()	283
23.49	GetNumSelectElems()	284
23.50	GetNumServerOpts()	285
23.51	GetNumTableColOpts()	286
23.52	GetNumTableOpts()	288
23.53	GetNumTableRefElems()	289
23.54	GetNumUserOpts()	290
23.55	GetNumWrapperOpts()	291
23.56	GetOrderByElem()	292
23.57	GetRoutMapOpt()	293
23.58	GetRoutMapOptName()	295
23.59	GetRoutineMapping()	297
23.60	GetSelectElem()	298
23.61	GetSelectElemType()	299
23.62	GetServerName()	300
23.63	GetServerOpt()	301
23.64	GetServerOptByName()	303
23.65	GetServerType()	305
23.66	GetServerVersion()	306
23.67	GetSQLString()	307
23.68	GetTableColOpt()	308
23.69	GetTableColOptByName()	310
23.70	GetTableOpt()	312
23.71	GetTableOptByName()	313
23.72	GetTableRefElem()	315
23.73	GetTableRefElemType()	316
23.74	GetTableRefTableName()	317
23.75	GetTableServerName()	318
23.76	GetTRDHandle()	319
23.77	GetUserOpt()	320
23.78	GetUserOptByName()	322
23.79	GetValExprColName()	324
23.80	GetValueExpDesc()	325
23.81	GetValueExpKind()	326
23.82	GetValueExpName()	327
23.83	GetValueExpTable()	328
23.84	GetVEChild()	329
23.85	GetWrapperLibraryName()	330
23.86	GetWrapperName()	331
23.87	GetWrapperOpt()	332

23.88	GetWrapperOptByName()	334
23.89	SetDescriptor()	336
23.90	GetDiagnostics()	341
<b>24</b>	<b>Information Schema</b>	<b>345</b>
24.1	Information Schema digital artifact	345
24.2	ATTRIBUTES view	345
24.3	COLUMN_OPTIONS view	346
24.4	COLUMNS view	347
24.5	FOREIGN_DATA_WRAPPER_OPTIONS view	348
24.6	FOREIGN_DATA_WRAPPERS view	349
24.7	FOREIGN_SERVER_OPTIONS view	350
24.8	FOREIGN_SERVERS view	351
24.9	FOREIGN_TABLE_OPTIONS view	352
24.10	FOREIGN_TABLES view	353
24.11	ROUTINE_MAPPING_OPTIONS view	354
24.12	ROUTINE_MAPPINGS view	355
24.13	USER_MAPPING_OPTIONS view	356
24.14	USER_MAPPINGS view	357
24.15	Short name views	358
<b>25</b>	<b>Definition Schema</b>	<b>362</b>
25.1	Definition Schema digital artifact	362
25.2	COLUMN_OPTIONS base table	362
25.3	DATA_TYPE_DESCRIPTOR base table	364
25.4	FOREIGN_DATA_WRAPPER_OPTIONS base table	371
25.5	FOREIGN_DATA_WRAPPERS base table	372
25.6	FOREIGN_SERVER_OPTIONS base table	373
25.7	FOREIGN_SERVERS base table	374
25.8	FOREIGN_TABLE_OPTIONS base table	375
25.9	FOREIGN_TABLES base table	376
25.10	ROUTINE_MAPPING_OPTIONS base table	377
25.11	ROUTINE_MAPPINGS base table	378
25.12	SQL_SIZING base table	379
25.13	TABLES base table	380
25.14	USAGE_PRIVILEGES base table	381
25.15	USER_MAPPING_OPTIONS base table	382
25.16	USER_MAPPINGS base table	383
<b>26</b>	<b>Status codes</b>	<b>384</b>
26.1	SQLSTATE	384
<b>27</b>	<b>Conformance</b>	<b>387</b>
27.1	Claims of conformance to SQL/MED	387
27.2	Additional conformance requirements for SQL/MED	387
<b>Annex A</b>	<b>(informative) SQL conformance summary</b>	<b>390</b>
<b>Annex B</b>	<b>(informative) Implementation-defined elements</b>	<b>408</b>
<b>Annex C</b>	<b>(informative) Implementation-dependent elements</b>	<b>422</b>
<b>Annex D</b>	<b>(informative) SQL optional feature taxonomy</b>	<b>427</b>

<b>Annex E</b> (informative) <b>Deprecated features</b> .....	<b>429</b>
<b>Annex F</b> (informative) <b>Incompatibilities with ISO/IEC 9075:2016</b> .....	<b>430</b>
<b>Annex G</b> (informative) <b>Defect Reports not addressed in this edition of this document</b> .....	<b>431</b>
<b>Annex H</b> (informative) <b>Example header files</b> .....	<b>432</b>
H.1 C header file sqlcli.h.....	432
H.2 COBOL library item SQLCLI.....	433
<b>Annex I</b> (informative) <b>SQL/MED model</b> .....	<b>435</b>
<b>Bibliography</b> .....	<b>439</b>
<b>Index</b> .....	<b>440</b>

## Tables

<b>Table</b>	<b>Page</b>
1 Valid datalink file control options.....	16
2 Sequence of actions during the execution of foreign server requests.....	26
3 Fields used in foreign-data wrapper diagnostics areas.....	39
4 Fields in foreign-data wrapper descriptor areas.....	41
5 Data type correspondences for Ada.....	115
6 Data type correspondences for C.....	115
7 Data type correspondences for COBOL.....	116
8 Data type correspondences for Fortran.....	116
9 Data type correspondences for M.....	116
10 Data type correspondences for Pascal.....	116
11 Data type correspondences for PL/I.....	117
12 Codes used for SQL data types in Dynamic SQL.....	125
13 SQL-statement codes.....	153
14 Abbreviated SQL/CLI generic names.....	155
15 Codes used for implementation data types in SQL/CLI.....	157
16 Codes used for application data types in SQL/CLI.....	157
17 Codes used to identify SQL/CLI routines.....	158
18 Codes and data types for implementation information.....	158
19 Codes used for datalink attributes.....	158
20 Data types of attributes.....	158
21 SQL/CLI data type correspondences for Ada.....	160
22 SQL/CLI data type correspondences for C.....	160
23 SQL/CLI data type correspondences for COBOL.....	160
24 SQL/CLI data type correspondences for Fortran.....	161
25 SQL/CLI data type correspondences for M.....	161
26 SQL/CLI data type correspondences for Pascal.....	161
27 SQL/CLI data type correspondences for PL/I.....	161
28 Codes used for <table reference> types.....	205
29 Codes used for <value expression> kinds.....	205
30 Codes used for foreign-data wrapper diagnostic fields.....	205
31 Codes used for foreign-data wrapper descriptor fields.....	206

32	Codes used for foreign-data wrapper handle types.....	208
33	Ability to retrieve foreign-data wrapper descriptor fields.....	208
34	Ability to set foreign-data wrapper descriptor fields.....	210
35	Foreign-data wrapper descriptor field default values.....	213
36	Codes used for the format of the character string transmitted by GetSQLString0.....	215
37	SQLSTATE class and subclass codes.....	384
38	Implied feature relationships of SQL/MED.....	389
D.1	Feature taxonomy for optional features.....	427
I.1	Legend for SQL/MED interfaces.....	436
I.2	Legend for SQL/MED information flow.....	437

## Figures

Figure	Page
1     SQL/MED interfaces.....	435
2     SQL/MED information flow.....	437