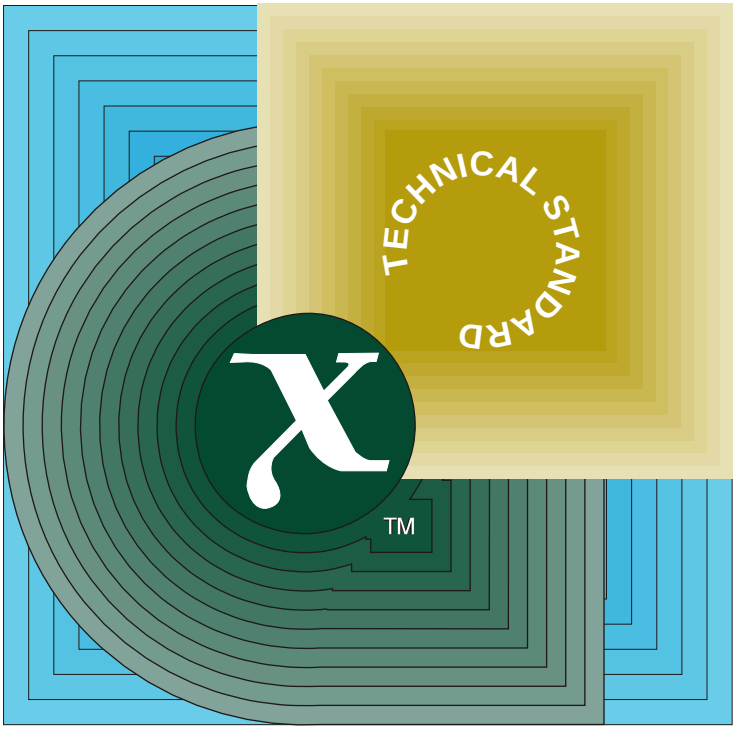
Technical Standard

Data Management:
SQL Call Level Interface (CLI)



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X/Open CAE Specification

Data Management:
SQL Call Level Interface (CLI)

X/Open Company Ltd.

X/Open CAE Specification

Data Management: SQL Call Level Interface (CLI)

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Any comments relating to the material contained in this document may be submitted to X/Open at:

X/Open Company Limited
Apex Plaza
Forbury Road
Reading
Berkshire, RG1 1AX
United Kingdom

or by Electronic Mail to:

XoSpecs@xopen.co.uk

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Preface

X/Open

X/Open is an independent, worldwide, open systems organisation supported by most of the world's largest information systems suppliers, user organisations and software companies. Its mission is to bring to users greater value from computing, through the practical implementation of open systems.

X/Open's strategy for achieving this goal is to combine existing and emerging standards into a comprehensive, integrated, high-value and usable open system environment, called the Common Applications Environment (CAE). This environment covers the standards, above the hardware level, that are needed to support open systems. It provides for portability and interoperability of applications, and so protects investment in existing software while enabling additions and enhancements. It also allows users to move between systems with a minimum of retraining.

X/Open defines this CAE in a set of specifications which include an evolving portfolio of application programming interfaces (APIs) which significantly enhance portability of application programs at the source code level, along with definitions of and references to protocols and protocol profiles which significantly enhance the interoperability of applications and systems.

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X/Open Technical Publications

X/Open publishes a wide range of technical literature, the main part of which is focussed on specification development, but which also includes Guides, Snapshots, Technical Studies, Branding/Testing documents, industry surveys, and business titles.

There are two types of X/Open specification:

- *CAE Specifications*

  CAE (Common Applications Environment) specifications are the stable specifications that form the basis for X/Open-branded products. These specifications are intended to be used widely within the industry for product development and procurement purposes.

  Anyone developing products that implement an X/Open CAE specification can enjoy the benefits of a single, widely supported standard. In addition, they can demonstrate compliance with the majority of X/Open CAE specifications once these specifications are referenced in an X/Open component or profile definition and included in the X/Open branding programme.

  CAE specifications are published as soon as they are developed, not published to coincide with the launch of a particular X/Open brand. By making its specifications available in this way, X/Open makes it possible for conformant products to be developed as soon as is practicable, so enhancing the value of the X/Open brand as a procurement aid to users.

- *Preliminary Specifications*

  These specifications, which often address an emerging area of technology and consequently are not yet supported by multiple sources of stable conformant implementations, are released in a controlled manner for the purpose of validation through implementation of products. A Preliminary specification is not a draft specification. In fact, it is as stable as X/Open can make it, and on publication has gone through the same rigorous X/Open development and review procedures as a CAE specification.

  Preliminary specifications are analogous to the *trial-use* standards issued by formal standards organisations, and product development teams are encouraged to develop products on the basis of them. However, because of the nature of the technology that a Preliminary specification is addressing, it may be untried in multiple independent implementations, and may therefore change before being published as a CAE specification. There is always the intent to progress to a corresponding CAE specification, but the ability to do so depends on consensus among X/Open members. In all cases, any resulting CAE specification is made as upwards-compatible as possible. However, complete upwards-compatibility from the Preliminary to the CAE specification cannot be guaranteed.

In addition, X/Open publishes:

- *Guides*

  These provide information that X/Open believes is useful in the evaluation, procurement, development or management of open systems, particularly those that are X/Open-compliant. X/Open Guides are advisory, not normative, and should not be referenced for purposes of specifying or claiming X/Open conformance.

- *Technical Studies*

  X/Open Technical Studies present results of analyses performed by X/Open on subjects of interest in areas relevant to X/Open's Technical Programme. They are intended to communicate the findings to the outside world and, where appropriate, stimulate discussion and actions by other bodies and the industry in general.

- *Snapshots*

  These provide a mechanism for X/Open to disseminate information on its current direction and thinking, in advance of possible development of a Specification, Guide or Technical Study. The intention is to stimulate industry debate and prototyping, and solicit feedback. A Snapshot represents the interim results of an X/Open technical activity. Although at the time of its publication, there may be an intention to progress the activity towards publication of a Specification, Guide or Technical Study, X/Open is a consensus organisation, and makes no commitment regarding future development and further publication. Similarly, a Snapshot does not represent any commitment by X/Open members to develop any specific products.

Versions and Issues of Specifications

As with all *live* documents, CAE Specifications require revision, in this case as the subject technology develops and to align with emerging associated international standards. X/Open makes a distinction between revised specifications which are fully backward compatible and those which are not:

- a new *Version* indicates that this publication includes all the same (unchanged) definitive information from the previous publication of that title, but also includes extensions or additional information. As such, it *replaces* the previous publication.

- a new *Issue* does include changes to the definitive information contained in the previous publication of that title (and may also include extensions or additional information). As such, X/Open maintains *both* the previous and new issue as current publications.

Corrigenda

Most X/Open publications deal with technology at the leading edge of open systems development. Feedback from implementation experience gained from using these publications occasionally uncovers errors or inconsistencies. Significant errors or recommended solutions to reported problems are communicated by means of Corrigenda.

The reader of this document is advised to check periodically if any Corrigenda apply to this publication. This may be done either by email to the X/Open info-server or by checking the Corrigenda list in the latest X/Open Publications Price List.

To request Corrigenda information by email, send a message to info-server@xopen.co.uk with the following in the Subject line:

```
request corrigenda; topic index
```

This will return the index of publications for which Corrigenda exist.

SQL Access Group moved into X/Open

Until the fourth quarter of 1994, the SQL Access Group was a separate body operating in the U.S.A., working with X/Open under a joint development and publishing agreement. It developed SQL-related specifications in collaboration with the X/Open Data Management Group.

During the fourth quarter of 1994, the SQL Access Group transferred all its assets and current activities to X/Open. These activities are now continuing in a technical working group within X/Open, called the X/Open SQL Access Group.

Much of the development work on this SQL CLI CAE Specification was achieved before the transfer of the SQL Access Group to X/Open. Under the joint agreement which applied before this transfer, this joint CLI development work resulted in joint publication of the SQL CLI Snapshot (S203) in October 1992, followed by the SQL CLI Preliminary Specification (P303) in October 1993. The Acknowledgements section of this publication expresses recognition of this progression, which has now resulted in publication of this SQL CLI CAE Specification.

This Document

This document is a CAE Specification (see above). It is intended for application programmers using the SQL Call Level Interface (CLI), which is an application programming interface (API) for database access.

Readers are expected to be familiar with the X/Open **SQL** specification to enable them to understand the definition of a database and the intended result of executing SQL statements.

This document is structured as follows:

- Chapter 1 is an introduction to CLI.
- Chapter 2 describes concepts and conventions of CLI.
- Chapter 3 describes the CLI data structures.
- Chapter 4 presents an overview of the interface.
- Chapter 5 discusses diagnostics.

- Chapter 6 presents an overview of the concise functions.
- Chapter 7 presents an overview of the deprecated functions.
- Chapter 8 contains detailed descriptions of each function.
- Appendix A cross-references error codes and functions.
- Appendix B contains state tables.
- Appendix C contains language-specific header files.
- Appendix D contains two sample C programs.
- Appendix E provides mappings to and from X/Open embedded SQL.
- A glossary and index are provided at the end of the book.

Typographical Conventions

The following typographical conventions are used throughout this document:

- **Bold** font is used in text for filenames, keywords, type names, data structures and their members.
- *Italic* font is used for emphasis or to identify the first instance of a word requiring definition. Italics in text also denote:
  - — variable names, for example, substitutable argument prototypes
  - — functions; these are shown as follows: *name*( ).
- Normal font is used for the names of constants and literals.
- The notation **<file.h>** indicates a C-language header file.
- Names surrounded by braces, for example, {ARG_MAX}, represent C-language symbolic limits or configuration values, which may be declared in appropriate header files by means of the C **#define** construct.
- The notation [ABCD] is used to identify a C-language coded return value.
- Error classes are indicated by 5-character character-string literals; where these occur in text, they are shown in SQL syntax, for example, '**HY**001'.
- Syntax, code examples and user input in interactive examples are shown in `fixed width` font.
- Variables within syntax statements are shown in *`italic fixed width font`*.
- Shading is used, with margin notation, in the following cases:

DE — Discussions of deprecated features.

EX — Discussions of features that are extensions to features of the X/Open **SQL** specification.

OP — Discussions of optional features.

Refer to Section 1.5 on page 8 for details.

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Acknowledgements

X/Open gratefully acknowledges past collaboration with and contributions from members of the SQL Access Group, which transferred its activities and assets to X/Open in the fourth quarter of 1994. Its activities are now continuing in a technical working group within X/Open, called the X/Open SQL Access Group.

Referenced Documents

The following documents are referenced in this specification:

ANSI CLI
: X3H2-93-082, ISO Working Draft — SQL Call Level Interface (CLI) (Addendum 1 to SQL-92).

DTP
: X/Open Guide, November 1993, Distributed Transaction Processing: Reference Model, Version 2 (ISBN: 1-85912-019-9, G307).

Internationalisation Guide
: X/Open Guide, July 1993, Internationalisation Guide, Version 2 (ISBN: 1-859120-02-4, G304).

ISO C
: ISO/IEC 9899:1990, Programming Languages — C (technically identical to ANSI standard X3.159-1989).

ISO SQL
: ISO/IEC 9075:1992, Information Technology — Database Language SQL (technically identical to ANSI standard X3.135-1992).

RDA
: X/Open CAE Specification, August 1993, Data Management: SQL Remote Database Access (ISBN: 1-872630-98-7, C307).

SQL
: X/Open CAE Specification, August 1992, Structured Query Language (SQL) (ISBN: 1-872630-58-8, C201).

SQL Technical Corrigendum
: SQL Technical Corrigendum, December 1994, to ISO/IEC 9075:1992, Information Technology — Database Language SQL.

TX
: X/Open Preliminary Specification, October 1992, Distributed Transaction Processing: The TX (Transaction Demarcation) Specification (ISBN: 1-872630-65-0, P209).

XA
: X/Open CAE Specification, December 1991, Distributed Transaction Processing: The XA Specification (ISBN: 1-872630-24-3, C193 or XO/CAE/91/300).

Chapter 1

Introduction

The SQL Call Level Interface (CLI) is an application programming interface (API) for database access. CLI is an alternative invocation technique to dynamic SQL that provides essentially equivalent operations. CLI is a set of functions that application programs call directly using normal function call facilities, whereas embedded SQL is typically converted by a preprocessor.

The definition of CLI relies heavily on the referenced X/Open **SQL** specification, which defines a database and the intended result of executing SQL statements.

This chapter traces the development of CLI, explains its relationship to the X/Open **SQL** specification and the ISO SQL standard, and defines terms used to gauge compliance with this specification.

1.1 Development of CLI

SQL was originally developed as a way to embed, in an application program, static or dynamic operations on a database. Embedded SQL code is typically converted by an implementation-specific preprocessor into code that is compiled and executed.

Dynamic SQL makes SQL more flexible and applies it to cases where the desired database operations are not known at the time the application program is written. For example, in fourth-generation languages, the desired database operations are often based on interaction with the user. Dynamic SQL lets SQL statement text reside in host-language character strings. The application generates them and the SQL implementation interprets them dynamically during the course of the program's execution. Dynamic SQL is still an embedded invocation technique and still typically works through a preprocessor. The X/Open **SQL** specification specifies both static and dynamic SQL.

CLI gives SQL even more flexibility. It addresses several developments in the database industry:

- **Client/server architecture**

  Databases are increasingly structured as clients and servers. Both the ISO SQL standard and the X/Open **SQL** specification conceptualise SQL in terms of client and server operations. When clients and servers are separated, the application writer may not know what operations are desired or even what the structure of the database is.

  CLI is ideally suited for a client/server environment, in which the target database is not known when the application program is built. CLI is totally symmetric with regard to database operations, providing the same syntax to execute any SQL data definition or data manipulation statement.

- **Preprocessor-independence**

  Embedded SQL's assumption of a preprocessor typically requires that portable applications are distributed as source code. Developers are reluctant to disclose proprietary source code.

  CLI permits the production of portable object modules containing SQL database operations. There are no implementation-specific transformations on source code; implementation-specific features and added value reside in the vendor's CLI run-time library.

  A goal of CLI is binary compatibility of object modules. Binary compatibility may be restricted by factors outside the scope of this document, such as choice of the processor,

operating system and, sometimes, memory model.

- **Concurrent processing**

  Applications are increasingly specifying concurrent processing, including concurrent database operations. The existence of global data areas in SQL raises the question of the scope and visibility of each change to such data.

  CLI eliminates global data areas, associating all implementation data that is accessible to the application with a specific handle that the implementation passes to the application.

- **Distributed transaction processing (DTP)**

  DTP distributes work between processors, with the guarantee that either all operations or none are committed (global atomicity). The referenced X/Open **DTP**, **XA** and **Transaction Demarcation** specifications address this topic.

  The X/Open **SQL** specification delimits transactions using the COMMIT and ROLLBACK statements. A transaction begins implicitly when the application operates on a database. The X/Open **SQL** specification mentions a technique to permit SQL work to be completed atomically with non-SQL work, and to permit the application more precisely to delimit transactions.

  However, the X/Open **SQL** specification assumes a model of a single transaction active on a single connection. In more general models, the COMMIT and ROLLBACK statements do not specify to which work they pertain.

  The transaction model in CLI is a basic model in which the application completes all active work in the database environment. An alternative model, in which the application can complete transactions on individual connections, is allowed as an implementation option.

1.2 Relation to Other X/Open Documents

1.2.1 Conceptual Differences from Embedded SQL

CLI introduces a new style of application program binding for SQL that contains elements of X/Open embedded SQL and of direct invocation as defined in the referenced ISO SQL standard. However, CLI is conceptually different from prior SQL implementations in the following ways:

- **Execution model**

  CLI introduces a new model for the execution of any SQL statement that is preparable in dynamic SQL. CLI does not require explicit declaration of cursors, nor does it require a different SQL verb (OPEN as opposed to EXECUTE) depending on the SQL text.

- **Cursor**

  The CLI cursor model is a mixture of the current dynamic and direct invocation binding styles. Executing a *cursor-specification*[1] can return multiple rows even though the application does not explicitly declare a cursor. The application can also use the normal cursor fetch model on such *cursor-specifications*; it can also use positioned UPDATE and DELETE statements. This follows from the rule that any preparable SQL statement can be executed using CLI.

- **Statement handles**

  A statement handle is a variable that refers to an implementation-defined data structure used to contain all information related to an SQL statement. The statement handle corresponds roughly to the diagnostics area and SQLSTATE of embedded SQL (see Section 3.1 on page 26).

- **Environment, connection and descriptor handles**

  These other handles take the place of all remaining global variables, of connection-specific state, and of SQL descriptor areas in embedded SQL (see Section 3.1 on page 26).

- **Automatic sizing of data structures**

  For data structures with a variable number of records, such as a diagnostics area or an SQL descriptor, the CLI implementation takes any necessary action to accommodate however many records are written to the data structure. The application does not have to declare the desired number of records when it allocates the data structure.

- **Automatic data conversion**

  In CLI, the application can specify the host-language buffer format for dynamic parameters and column data. If this differs from the format used for communication with the server, the client automatically converts data when it sends dynamic arguments to the database and when it fetches columns from the database.

---

1. Throughout this specification, *cursor-specification* refers to the entire syntax of the *cursor-specification* (SELECT statement) defined in the X/Open **SQL** specification. This does not include the SELECT...INTO syntax of the dynamic FETCH statement.

1.2.2 Feature Extensions over Embedded SQL

CLI is an alternative method for application programs to gain access to the features described in the X/Open **SQL** specification. CLI might be implemented by adapting an existing embedded SQL implementation. For this reason, this edition of CLI generally confines itself to features contained in the X/Open **SQL** specification.

The exceptions to this rule are listed below. They represent cases where the X/Open **SQL** specification has not yet embraced features of the ISO SQL standard. This edition specifies the feature based on its definition in the ISO SQL standard:

- Semantics for date/time/timestamp appear in this document (see Section 4.8.3 on page 60). CLI does not yet specify intervals.
- The SQL_CATALOG_NAME characteristic, obtained by calling *GetInfo*( ) indicates whether the server uses three-part object naming. This specification lets implementations support a subset of three-part naming (see **Naming** on page 54); the X/Open **SQL** specification does not address this possibility.
- The application can determine the type of SQL statement that was most recently executed, by calling *GetDiagField*( ). This corresponds to the DYNAMIC_FUNCTION field of the diagnostics area in the ISO SQL standard.
- OP An application can obtain information on the properties of any dynamic parameters in a prepared statement. This optional capability corresponds to the <describe input statement> in the ISO SQL standard.
- The criteria by which the implementation selects a diagnostic record to appear first in the diagnostic area are different from those described in the X/Open **SQL** specification and reflect modifications to the ISO SQL standard documented in the ISO SQL Technical Corrigendum.
- OP A statement attribute lets the application specify that cursors are sensitive or are insensitive to changes made to a result set by another cursor.
- The *FetchScroll*( ) function permits the cursor to be moved to a row of a result set other than
OP the next sequential row, provided the application has successfully set an attribute of a statement handle to enable the ‘‘scrollable cursors’’ feature.

In the following case, CLI includes semantics that do not correspond to anything in either the X/Open **SQL** specification or the ISO SQL standard:

- The *Statistics*( ) function may return information associated with an index but not available by querying the INDEXES system view.

Eventually, equivalent semantics will be added to the X/Open **SQL** specification and X/Open CLI will reference those descriptions.

EX Discussions of features that are extensions to features of the X/Open **SQL** specification are shaded with the EX margin notation, as shown here.

1.3 Relation to Standards

X/Open is aware of the discrepancies between this document and the ISO CLI Draft International Standard in the following list:

- The X/Open **SQL** specification aligns with Entry Level SQL as defined in the ISO SQL standard. The ISO SQL standard defines other levelling rules and thereby provides features not present in X/Open SQL. The ISO CLI Draft International Standard takes advantage of some of these features, while X/Open CLI does not. Examples are the BIT, BIT VARYING, and INTERVAL data types.
- X/Open CLI contains a set of metadata functions that are not present in the ISO CLI Draft International Standard.
- Certain other minor discrepancies exist, for which X/Open intends to propose corrections to the ISO CLI Draft International Standard.

Where other discrepancies remain between this CAE specification and the eventual International Standard (for instance, in cases of oversights or editorial errors), X/Open intends to issue a statement explicitly deferring to the International Standard, so that it is the authority by which any discrepancies are resolved.

X/Open's goal is that implementations be able to conform both to X/Open CLI and to the eventual International Standard, and that application writers have clear guidelines for writing applications with maximum portability.

1.4 Compliance Policy

1.4.1 Language Binding

This document describes a set of CLI functions that are callable from C and COBOL. Some CLI products support additional languages.

The goal of this X/Open specification is the ability to write portable programs. Conformance to this specification means that the CLI implementation must include bindings to an X/Open-compliant COBOL or C implementation. It is implementation-defined whether bindings to both COBOL and C are provided, and to which other languages an implementation provides bindings. X/Open intends to publish, for each SQL product it brands, the extent to which purchasers can use the product to write portable applications.

1.4.2 SQL Statement Text

This specification gives applications a way to provide SQL statement text for execution. The SQL statement text is typically a statement from the database language specified in the X/Open **SQL** specification. Compliance with this document is separate from, and does not presume, compliance with the X/Open **SQL** specification. However, X/Open recommends that implementations comply with both this specification and the X/Open **SQL** specification.

On an implementation that complies with both this specification and the X/Open **SQL** specification, valid SQL statement text for execution using CLI is defined as any SQL statement that can be prepared in dynamic SQL, as specified by the X/Open **SQL** specification: CREATE, *cursor-specification*, searched DELETE, dynamic positioned DELETE, DROP, GRANT, INSERT, REVOKE, searched UPDATE, dynamic positioned UPDATE and the vendor escape clause. The COMMIT and ROLLBACK statements of dynamic SQL are specifically excluded from execution using CLI, as this specification provides other methods of transaction delimitation (see Section 4.9).

In addition, any dynamic arguments must appear so that their data type can be deduced, and prefixes, terminators, comments and embedded variable names are prohibited. Refer, in the X/Open **SQL** specification, to the explanation of the '**42**000' diagnostic for the PREPARE statement.

1.4.3 Distributed Transaction Delimitation

Section 4.9 on page 63 discusses transactions, which are sequences of database operations with certain collective characteristics such as atomicity. Transaction **delimitation** must exist in order to define the grouping of database operations into transactions.

All transactions must be delimited in exactly one of the following ways, selected based on implementation-defined criteria:

- A transaction begins when an application operates on a database, as defined in Section 4.9 on page 63. The transaction ends when the application calls *EndTran*( ).
- A transaction begins when an application executes the *tx_begin*( ) function described in the X/Open **TX** specification; and ends when it executes *tx_end*( ).
- An implementation-defined transaction delimitation interface is used.

The application must mark the end of a transaction using the same technique it used to mark the start of a transaction.

X/Open-compliant CLI implementations that also comply with the X/Open **XA** specification support the second option for all transactions. The *tx_begin*( ) and *tx_end*( ) functions call a

transaction manager, which coordinates completion of SQL and non-SQL work so as to provide global atomicity. The CLI implementation supports the X/Open XA interface, in the role of a Resource Manager (RM). The XA interface lets the transaction manager inform the CLI implementation of the delimitation and disposition of transactions.

1.5 Compliance Terminology

The following compliance terms convey the same meanings as defined in the X/Open **SQL** specification.

Optional features

An optional feature serves as guidance to implementors on the preferred syntax for a feature that is not yet widespread. Implementors are currently free not to implement the feature, but if they implement it, they should do so as specified in this document. X/Open does not currently enforce the implementation of optional features, but intends to make them mandatory in future issues of the XPG, in the manner in which they are specified in this edition. At that time, implementations will be required to provide the feature.

X/Open may test implementations to see if they implement optional features as specified in this document. X/Open would make the results available to prospective purchasers.

Application writers may use optional features that are known to be available on the implementation in use, at the risk of reduced portability.

Discussions of optional features are shaded with the OP margin notation, as shown below.

OP The following features are optional:

— The ability to have the implementation describe dynamic parameters in prepared statements.

— An application's ability to request scrollable cursors.

— An application's ability to specify that cursors are either sensitive or insensitive (to changes made to a result set by another cursor).

Deprecated features

Deprecated features include syntax that X/Open views as obsolete or non-optimal. Implementors must provide features labelled deprecated, in the interest of backward-compatibility. Application writers using deprecated features are advised that X/Open intends to remove them from future issues of this specification.

Each deprecated feature lists a preferred method of performing the same function. X/Open's policy on deprecated features is to maintain the deprecated designation for at least one issue of the XPG. This gives application writers adequate notice to change their coding to the recommended method. When X/Open reissues the XPG with a feature omitted, implementations may remove support for the feature.

Currently, the only deprecated features in CLI are the functions described in Chapter 7.

Compliance

A CLI implementation is X/Open-compliant if it supports all the assertions this document makes that are not labelled optional. The implementation may also support the features labelled optional, or other features not specifically identified in this document.

An application program is X/Open-compliant if it uses only the syntax contained in this document that is not labelled optional.

Implementation-defined

Implementation-defined means that the resolution of the issue in question may vary between implementations, and that each X/Open-compliant implementation must publish information on how it resolves that issue.

Undefined

Undefined means that the resolution of the issue in question may vary between

implementations, and that an X/Open-compliant implementation need not publish information on how it resolves that issue.

Footnotes are used as a technique to improve readability of the main text. However, information in footnotes is as much a part of this specification as information in the main text.

Chapter 2

Concepts and Conventions

This chapter describes substantive concepts of CLI that must be understood prior to encountering the CLI functions in Chapter 4.

Concepts presented in this chapter include syntactic characteristics of CLI (the naming and variants of CLI functions), use of host-language data types, and semantic conventions.

2.1 Syntactic Characteristics

2.1.1 Function Variants

This specification defines generic CLI functions. Each function has a *by-value* variant and a *by-reference* variant.

When using the by-value variant, the application provides each input argument as an actual value.[2] By-value variants begin with the prefix SQL; for example, *SQLAllocHandle*( ). The C examples in the reference manual pages use by-value variants. They typically simplify coding because constants can be coded as input arguments. If the binding language is a language other than C, then it is implementation-defined whether by-value CLI variants are available.

When using the by-reference variant, the application provides a pointer to each input argument and deferred input argument. By-reference CLI variants begin with the prefix SQLR; for example, *SQLRAllocHandle*( ). The COBOL examples in the reference manual pages use by-reference variants. It is implementation-defined whether by-reference variants are available in C.

For output parameters in both variants, the application provides a pointer to the output argument.

2.1.2 Short Function Names

In any programming environment where the CLI function names published in this document cannot be used (because of their length or because some are made identical by truncation), the published function names must cause the generation of the abbreviated names for the CLI functions listed in Table 2-1 on page 12.

2. An exception is made for arguments that supply the value of a deferred descriptor field (see Section 3.5.5 on page 36). For these, pointers are used in both the by-value and by-reference variants.

Table 2-1 Abbreviations for CLI Function Names

Published Generic Name		Abbreviation	
		by-Value Variant	by-Reference Variant
AllocConnect( )	DE	SQLAC	SQRAC
AllocEnv( )	DE	SQLAE	SQRAE
AllocHandle( )		SQLAH	SQRAH
AllocStmt( )	DE	SQLAS	SQRAS
BindCol( )		SQLBC	SQRBC
BindParam( )		SQLBP	SQRBP
Cancel( )		SQLCAN	SQRCAN
CloseCursor( )		SQLCC	SQRCC
ColAttribute( )	DE	SQLCO	SQRCO
Columns( )		SQLCOL	SQRCOL
Connect( )		SQLCON	SQRCON
CopyDesc( )		SQLCD	SQRCD
DataSources( )		SQLDS	SQRDS
DescribeCol( )		SQLDC	SQRDC
Disconnect( )		SQLDIS	SQRDIS
EndTran( )		SQLET	SQRET
Error( )	DE	SQLER	SQRER
ExecDirect( )		SQLED	SQRED
Execute( )		SQLEX	SQREX
Fetch( )		SQLFT	SQRFT
FetchScroll( )		SQLFTS	SQRFTS
FreeConnect( )	DE	SQLFC	SQRFC
FreeEnv( )	DE	SQLFE	SQRFE
FreeHandle( )		SQLFH	SQRFH
FreeStmt( )	DE	SQLFS	SQRFS
GetConnectAttr( )		SQLGCA	SQRGCA
GetConnectOption( )	DE	SQLGCO	SQRGCO
GetCursorName( )		SQLGCN	SQRGCN
GetData( )		SQLGDA	SQRGDA
GetDescField( )		SQLGDF	SQRGDF
GetDescRec( )		SQLGDR	SQRGDR
GetDiagField( )		SQLGXF	SQRGXF
GetDiagRec( )		SQLGXR	SQRGXR
GetEnvAttr( )		SQLGEA	SQRGEA
GetFunctions( )		SQLGFU	SQRGFU
GetInfo( )		SQLGI	SQRGI
GetStmtAttr( )		SQLGSA	SQRGSA
GetStmtOption( )	DE	SQLGSO	SQRGSO
GetTypeInfo( )		SQLGTI	SQRGTI
NumResultCols( )		SQLNRC	SQRNRC
ParamData( )		SQLPRD	SQRPRD
Prepare( )		SQLPR	SQRPR
PutData( )		SQLPTD	SQRPTD
RowCount( )	DE	SQLRC	SQRRC
SetConnectAttr( )		SQLSCA	SQRSCA
SetConnectOption( )	DE	SQLSCO	SQRSCO
SetCursorName( )		SQLSCN	SQRSCN

Published Generic Name		Abbreviation	
		by-Value Variant	**by-Reference Variant**
SetDescField( )		SQLSDF	SQRSDF
SetDescRec( )		SQLSDR	SQRSDR
SetEnvAttr( )		SQLSEA	SQRSEA
SetParam( )	DE	SQLSP	SQRSP
SetStmtAttr( )		SQLSSA	SQRSSA
SetStmtOption( )	DE	SQLSSO	SQRSSO
SpecialColumns( )		SQLSC	SQRSC
Statistics( )		SQLSTA	SQRSTA
Tables( )		SQLTAB	SQRTAB
Transact( )	DE	SQLTR	SQRTR

2.1.3 Case Sensitivity

Names specified in this document use both upper-case and lower-case letters. The capitalisation of names helps indicate the function of the name, as described in the next section. An application must exactly follow this document's use of capitalisation if the base programming environment is case-sensitive. In programming environments that are not case-sensitive, a CLI name such as:

```
SQLAllocHandle
```

may be written:

```
SQLALLOCHANDLE
```

In programming environments that do not support lower-case letters, names must be capitalised even though this document shows them containing lower-case letters.

2.1.4 COBOL Naming Variations

This document refers to values and to their symbolic names using the symbols defined for the C language. (These symbols are defined in the header file presented in Section C.1 on page 247.)

In COBOL programs, different symbols are used for the reasons explained in this section. (The symbols for COBOL are defined in the header file presented in Section C.2 on page 258.)

Underscore

This document defines symbolic names using the underscore character, such as SQL_SUCCESS_WITH_INFO. In languages such as COBOL that do not use the underscore character, the hyphen is used instead: SQL-SUCCESS-WITH-INFO.

Multiple Names for Different Data Types

In some cases, a symbolic name is valid in contexts that call for an SQL SMALLINT data type and in other contexts that call for an SQL INTEGER data type. The COBOL language requires different constants for the respective contexts. The entire set of these COBOL symbolic names appears below.

C Symbol Used in This Document	COBOL Symbol for SMALLINT Contexts	COBOL Symbol for INTEGER Contexts
SQL_ATTR_*suffix*	SQL-OPT-*suffix*	SQL-ATTR-*suffix*
SQL_FALSE	SQL-FALSE	SQL-FALSEL
SQL_NTS	SQL-NTS	SQL-NTSL
SQL_TRUE	SQL-TRUE	SQL-TRUEL

2.2 Use of Data Types

The following sections discuss the data types used in the reference manual pages in Chapter 8.

2.2.1 Generic Data Types for Function Parameters

The generic parameter types are defined in order to relate to SQL data types. This permits bindings to programming languages other than C and COBOL.

The ANY generic parameter type represents a function parameter whose type is not fixed but may vary between other data types from invocation to invocation.

The following table shows the most nearly equivalent C and COBOL data types to the generic CLI function parameters.

Generic Parameter Type	C Data Type	COBOL Data Type
CHAR(*L*)	**unsigned char**[*L*+1]	PICTURE X(*L*)
SMALLINT	**short**	PICTURE S9(4) BINARY
INTEGER	**long**	PICTURE S9(9) BINARY
ANY	**void** * (see above)	(see above)

Table 2-2 Generic Parameter Data Types: Correspondences for C and COBOL

Certain situations and COBOL implementations may require the use of different PICTURE specifications. (See the X/Open **SQL** specification for alternative PICTURE specifications.)

2.2.2 Data Types for C

The C-language synopsis for CLI uses the following symbolic names for all C data types. For binary compatibility of object modules, applications must use symbolic data types defined as follows (see, for example, the **<sqlcli.h>** header file in Appendix C):

Symbolic Data Type	C Type	Typical Usage in CLI
SQLCHAR	**unsigned char**	Representation of CHAR and VARCHAR column data.
EX SQLDATE	**unsigned char**	Representation of DATE column data.
SQLDECIMAL	**unsigned char**	Representation of DECIMAL column data.
SQLDOUBLE	**double**	Representation of FLOAT and DOUBLE PRECISION column data.
SQLHDBC	**long**	Handle referencing connection information.
SQLHDESC	**long**	Handle referencing descriptor information.
SQLHENV	**long**	Handle referencing environment information.
SQLHSTMT	**long**	Handle referencing statement information.
SQLINTEGER	**long**	Length of buffers for column data and representation of INTEGER column data.
SQLNUMERIC	**unsigned char**	Representation of NUMERIC column data.
SQLPOINTER	**void ***	Representation of data types determined at run time.
SQLREAL	**float**	Representation of REAL column data.
SQLRETURN	**short**	Return code from CLI functions.
SQLSMALLINT	**short**	Column numbers, dynamic parameter numbers, and representation of SMALLINT column data.
EX SQLTIME	**unsigned char**	Representation of TIME column data.
EX SQLTIMESTAMP	**unsigned char**	Representation of TIMESTAMP column data.

Table 2-3 Uses of C Data Types

2.2.3 Data Types for COBOL

Programs in COBOL use the following PICTURE specifications to support CLI. Although the symbolic names in the left column are not used in COBOL, they are included in the following table for comparison with the C data types:

	Symbolic Data Type (C)	COBOL PICTURE	Typical Usage in CLI
	SQLCHAR	PIC X(*n*)	Representation of CHAR and VARCHAR column data.
EX	SQLDATE	PIC X(10)	Representation of DATE column data.
	SQLDECIMAL	PIC S9(*p*-*s*)V9(*s*) PACKED-DECIMAL	Representation of DECIMAL column data. (*p* = precision; *s* = scale)
	SQLDOUBLE	PIC X(*n*)	Representation of DOUBLE column data.
	SQLHDBC	PIC S9(9) BINARY	Handle referencing connection information.
	SQLHDESC	PIC S9(9) BINARY	Handle referencing descriptor information.
	SQLHENV	PIC S9(9) BINARY	Handle referencing environment information.
	SQLHSTMT	PIC S9(9) BINARY	Handle referencing statement information.
	SQLINTEGER	PIC S9(9) BINARY	Length of buffers for column data and representation of INTEGER column data.
	SQLNUMERIC	PIC S9(*p*-*s*)V9(*s*) DISPLAY SIGN LEADING SEPARATE	Representation of NUMERIC column data. (*p* = precision; *s* = scale)
	SQLPOINTER	not used in COBOL	
	SQLREAL	PIC X(*n*)	Representation of REAL column data.
	SQLRETURN	PIC S9(4) BINARY	Return code from CLI functions.
	SQLSMALLINT	PIC S9(4) BINARY	Column numbers, dynamic parameter numbers, and representation of SMALLINT column data.
EX	SQLTIME	PIC X(*n*)	Representation of TIME column data.*
EX	SQLTIMESTAMP	PIC X(*n*)	Representation of TIMESTAMP column data.*

Table 2-4 Uses of COBOL PICTUREs

* The length *n* is 8 for SQLTIME and 19 for SQLTIMESTAMP if there is no fractional seconds component. See Section 4.8.3 on page 60 for the exact format and length of these data types.

2.3 Semantic Conventions

2.3.1 Direction of Parameters

Each parameter is either an input or an output parameter.

- Input parameters, denoted by the legend (input) in the parameter list in the reference manual pages, let the application pass data to the CLI implementation. In cases where a specific function call does not require a given input parameter, the implementation ignores the argument that the application passes.
- Output parameters, denoted by (output) in the parameter list, let the implementation return values to the application. In cases where a specific function call does not use an output parameter, the value returned in that parameter is undefined.

Parameters that supply a value of a deferred descriptor field (see Section 3.5.5 on page 36) are a special case, since the input or output argument is a pointer to the actual data.

There are no combined input/output parameters; no CLI function modifies its input arguments. This lets the by-value and by-reference variants use the same parameter list.

2.3.2 Null Pointers

In a programming language that lets the application use pointers, passing a null pointer (see **Null Pointer** on page 21) as an argument to a CLI function has the following effects:

- In some metadata functions (see Section 4.6 on page 53), input string parameters specify a basis for qualifying the query. Passing a null pointer or a zero-length string in these cases inhibits qualification of the query on that basis.
- In certain other cases specified in Chapter 8, passing a null pointer as an argument for an output parameter inhibits the implementation from returning a value to the application. This effect is restricted to output length parameters (see **Null Pointer** on page 21) and to other cases explicitly specified in Chapter 8.

For diagnostics pertaining to invalid uses of null pointers, see Section 5.4.8 on page 75.

2.3.3 Output Arguments in Non-success Cases

Except where otherwise noted in the reference manual pages, whenever a CLI function produces a return value of [SQL_ERROR], [SQL_INVALID_HANDLE] or [SQL_NO_DATA], all output arguments are undefined.

2.3.4 International Character Data

The characters used in database data, in SQL statement text, and in CLI string arguments, are taken from one or more character sets.

Rationale

Historically, character sets have been defined such that each character requires one byte of storage. By contrast, this specification also permits character sets in which each character requires multiple bytes of storage, and permits character sets in which various characters require different amounts of storage. (For additional background, see the X/Open **Internationalisation Guide**.)

This specification avoids the use of the term byte. It uses the term *octet* as a fixed measure of storage space, and the term *character* to denote a character independent of the required storage

space.

The embedded SQL database language deals in units of characters and generally conceals storage requirements from the application programmer. CLI always specifies in octets the length of character data passed between the application and the implementation. Some additional CLI features deal in units of characters. For example, CLI lets the application measure the length or maximum length of table columns in characters. Additional operations that measure strings in terms of characters (such as the CHAR_LENGTH and POSITION scalar functions) are available from CLI using SQL statement text.

Character Set

It is undefined how an application or CLI implementation determines the character set and null character for a string.

2.3.5 Variable-length Input Parameters

Input parameters that reference variable-length character data (such as column names, dynamic parameters and string attribute values) have an associated length parameter. If the application terminates strings with the null character, as is typical in C, then it provides as an argument either the length in octets of the string (not including the null terminator) or SQL_NTS (Null-terminated String).

Thus, a non-negative length argument specifies the actual length of the associated string. The length argument may be 0 to specify a zero-length string, which is distinct from a null value. The negative value SQL_NTS directs the implementation to determine the length of the string by locating the null terminator.

The application's ability to specify SQL_NTS for input arguments is independent of whether it has specified null termination for output arguments (see **String Termination**).

2.3.6 Variable-length Output Parameters

Output parameters that reference variable-length character data have two associated length parameters:

- The application uses the associated input parameter to describe the length in octets of the buffer the application allocated.
- The implementation uses a separate output parameter to describe the length in octets of the data it generated (whether or not it fits in the allocated buffer).

(For database fetches, CLI returns separately the other information for which embedded SQL uses indicator variables; this information is not combined with length information.)

String Termination

The application has two alternatives for termination of output character strings:

- By default, the implementation terminates with a null character every string that it writes to a variable-length output parameter. The null character is defined by the character set that specifies the interpretation of the string. In this case, the application must allocate enough space to hold the maximum number of characters it expects, plus the null terminator. For example, assuming a single-byte character set, if the application expects a 10-character string from the database, it allocates and specifies a buffer size of 11 (one for the null terminator).

  A buffer size equal to the length of the null terminator obtains the null terminator and nothing else. A buffer shorter than the length of the null terminator is invalid; such a buffer

cannot even transfer a zero-length string. However, in languages that support pointers, the application can prevent the setting of the output string argument by supplying a null pointer (see Section 2.3.2 on page 18).

- As an environment attribute (see Section 3.2 on page 28), the application can disable null termination of variable-length output data. In this case, the application allocates a buffer exactly as long as the longest string it expects, and a one-character buffer is meaningful. COBOL applications typically use this alternative.

  A buffer size of 0 is valid in this case and prevents the implementation from setting the associated output string argument.

The examples in this specification assume that C programs enable null termination and COBOL programs disable it. For this reason, in some examples, the lengths of buffers vary depending on the programming language.

String Truncation

If the data the implementation generates does not fit in the application's buffer, the CLI implementation returns in the associated output parameter the length of the data generated, not of the data returned, indicating truncation to the application.

That is, the size of the string the implementation can fit in the buffer is the argument value for the input length parameter (minus the size of any null terminator, as described above). If the implementation returns a greater number in the output length parameter, it means the implementation has truncated one or more characters from the string it placed in the buffer.

For example, assume a single-byte character set and suppose the buffer can hold 10 characters. (If null termination is in effect, this requires an 11-character buffer.) If the database value actually contains 20 characters, the implementation writes the first 10 characters into the buffer and returns an output length of 20. The returned length of 20 informs the application that it must allocate a 20-character buffer (21 characters if null termination is in effect) to obtain the entire data value without truncation.

Truncation is also indicated by the fact that the CLI function returns [SQL_SUCCESS_WITH_INFO] and by additional diagnostic information obtainable by calling *GetDiagField*( ) or *GetDiagRec*( ).[3]

If a fetch operation indicates truncation, the application compares the output length and input length value of each column to see which columns were truncated.

If, on the other hand, the value (including any null terminator) fits within the output buffer, then the output length argument accurately describes the string returned to the application (not including any null terminator). The CLI implementation leaves any remaining space in the buffer unchanged.

3. This paragraph does not apply to the two functions it names. They do not return [SQL_SUCCESS_WITH_INFO] even if they truncate an output argument.

Null Pointer

If the application passes a null pointer for the output length parameter, the implementation does not return an output length. This is typical when the application's buffers are known to be large enough to accommodate any data the implementation returns. The application locates the null terminator to determine the length of the output. In languages that do not support pointers, this feature is not available. This feature should not be used when the function might truncate string data, because the function does not then inform the application of the length of the string before truncation.

If the application uses a null pointer, but the implementation needed a non-null pointer in order to return the value SQL_NULL_DATA, the attempt to fetch the column fails (see *Fetch*( ) on page 137 and *BindCol*( ) on page 97).

2.3.7 Interpretation of Strings

Normally, the CLI implementation interprets string arguments in a case-sensitive manner and does not trim any spaces from the values. Any exceptions to this appear in the appropriate reference manual pages.

2.3.8 Identifiers

SQL identifiers such as table names, column names and cursor names are arguments of some CLI functions. The X/Open **SQL** specification discusses these identifiers in the broader category of user-defined names. The X/Open **SQL** specification defines restrictions on user-defined names. CLI applications are also bound by these restrictions when they generate identifiers.

Length

The X/Open **SQL** specification imposes a portability requirement limiting the length of user-defined names to 18 characters. (C programs should use the symbolic constant {SQL_MAX_ID_LENGTH}.) However, the referenced ISO SQL standard permits identifiers to have lengths to and including 128 characters. Portable applications should allocate enough space to accommodate identifiers of 128 characters returned by the implementation.

Delimited Identifiers

The X/Open **SQL** specification permits identifiers to be enclosed in double quotes ("). The body of these *delimited* user-defined names can contain characters that the syntax of SQL would not permit or would interpret specially, including blanks and reserved keywords, and is treated in a case-sensitive manner.

The CLI implementation interprets an input argument as a delimited identifier if, after trimming leading and trailing spaces, the first character is a double quote and the last character is a double quote.

The CLI implementation never encloses in double quotes any SQL identifier that it returns as an output argument.

2.4 Database System

2.4.1 Clients and Servers

The operation of a database system effectively involves two processors, a **client** and a **server**. The terms client and server in this document always mean SQL client and SQL server. The *Connect*( ) function manages the associations between a client and one or more servers.

When a program is active, it is bound in an implementation-defined manner to a single client that processes the first implicit or explicit *Connect*( ) call. The client communicates with one or more servers, manages connections to servers, maintains the diagnostics area, and allocates data structures and handles. The server processes other CLI functions, including all operations on the database. Following these operations, diagnostic information is passed (in an undefined way) into the diagnostics area of the client.

Number and Location of Servers

It is implementation-defined whether there can be more than one server.

X/Open CLI provides location transparency: the application has no notion of whether the server is local or remote.

2.4.2 Metadata and Data

Each server provides a **database**, which consists of **metadata** and **data**.

- Metadata is the definitions of all active base tables, viewed tables, indexes, privileges and user names. (An item of metadata is active if it has been defined and has not subsequently been dropped.)
- Data comprises every value in every active table.

Schemata

A **schema** is a collection of related objects. A schema may contain base tables, and contains any indexes that are defined on the base tables. Namespace issues and ownership of schemata are discussed in the X/Open **SQL** specification.

2.4.3 Three-part Object Naming

A server may support catalogs, in which case every schema resides in a catalog. An application can uniquely identify a table or index by qualifying the table or index identifier (preceding it with its catalog and schema name). The use of catalog, schema, and object name is called three-part naming. Periods separate the catalog, schema, and object name.

It is implementation-defined which of the following object naming systems is supported[4] as valid syntax for the qualifier:

- *catalog-name.schema-name*

4. An application can determine whether the server supports catalog names by obtaining the SQL_CATALOG_NAME characteristic from a call to *GetInfo*( ).

EX

- *schema-name*

On servers that support catalog names, there may be a catalog that does not have a name.

Certain CLI metadata functions return result sets whose TABLE_CAT column indicates the catalog name of an object. For objects that do not have a catalog name, this column contains a zero-length string, except that if the implementation does not support catalog names, the column may instead be null.

The *catalog-name* and *schema-name* are each syntactically a *user-defined-name*. Other implementation-defined object naming systems may also be supported. In all cases, use of qualification is optional for the application program.

(Some implementations impose other restrictions on qualification; see the X/Open **SQL** specification.)

Chapter 3

Data Structures

This chapter describes the data structures of CLI. Handles are described generally in Section 3.1 on page 26. Subsequent sections describe each type of data structure for which a handle exists.

Section 3.6 on page 38 describes cursors and cursor names.

3.1 Handle Overview

A handle is a variable that refers to a data structure within the CLI implementation. CLI defines the following types of handle:

SQLHENV	Reference to an environment (see Section 3.2 on page 28).
SQLHDBC	Reference to a connection (see Section 3.3 on page 29).
SQLHSTMT	Reference to an SQL statement (see Section 3.4 on page 30).
SQLHDESC	Reference to a descriptor (see Section 3.5 on page 32).

Calling *AllocHandle*( ) allocates a handle of a specified type. In most cases the application specifies a parent handle of a different type. *AllocHandle*( ) allocates memory for, and defines, whatever data structures the implementation needs to manage the corresponding functions, and assigns a value to the handle that refers to these data structures. Once allocated, the application can pass a handle to subsequent CLI functions to indicate the environment, connection, statement or descriptor on which the function should act. The application should not perform any other operation on a handle, such as analysing or modifying its contents.

Null values are defined for each type of handle. *AllocHandle*( ) returns the null handle as one type of error indication.

The application calls *FreeHandle*( ) to deallocate a handle that it has allocated.

This specification uses handle parameter names colloquially to refer to the data structure referred to by the handle. For example, ''preparing *StatementHandle*'' technically means preparing the statement associated with *StatementHandle*.

3.1.1 Attributes

Attributes are defined for environments, connections, and statements. Some attributes are intrinsic properties of the implementation; others can be used to affect the subsequent behaviour of the implementation. The application can obtain the value of any attribute by providing the corresponding handle. The application can change the value of an attribute if it is described as a settable attribute.

A list of attributes appears in this chapter in the sections that discuss environments, connections, and statements. Attributes are described using the symbolic name for the SQL INTEGER value that C programs use to specify them. Within each list, each attribute is marked (read-only) or (settable).

Settable attributes may carry restrictions on the application's ability to set the attribute's value; see **Timing of Attempts to Set Attributes** on page 74.

3.1.2 Rationale

Handles obviate global variables. There is no global information in CLI; the application gains access to all information through a handle. This avoids problems with global variables that arise when asynchronous processing occurs within an application, as is the case for asynchronous statement processing and in multi-threaded environments. The application need not protect this global memory nor synchronise with other threads or processes to prevent unsolicited updates to global information.

Any implementation-defined limits on the maximum number of a given type of data structure are enforced by returning an error on any call to *AllocHandle*( ) that would exceed the limit.

All cases where only one data structure can be used at a time (such as for the current connection to a server) can be handled by the implementation without the application's knowledge, by performing implicit switching based on the handles the application provides as CLI function

arguments.

Handles make error reporting more logical. Certain diagnostics apply only to a given connection or only to the execution of a single SQL statement. Because there are handles for these concepts, diagnostic information in CLI is bound to the relevant data structure. The *GetDiagField*( ) and *GetDiagRec*( ) functions return any associated diagnostic information. When an implementation produces diagnostic information, it overwrites any previous information associated with the same handle, but it does not destroy unrelated diagnostic information, as is the case when diagnostic variables are global.

The only lexical restrictions on the use of handle variables are the scope rules of the relevant programming language. The domain in which the value of a handle can be used to refer to the associated data structure is implementation-defined.

3.1.3 Handle Type Identifier

Handle values do not necessarily self-describe their handle type, and the values of handles of different types are not necessarily allocated without duplication. For example, the value of both an environment handle and a statement handle might be 1.

In cases where a function's parameter accepts an argument of multiple handle types, a separate input argument specifies the handle type. The manual pages for those functions specify a diagnostic for the case where the application passes an invalid handle type identifier.

For each handle type, each handle value is unique across the CLI implementation, not just in its context. For example, two statement handles cannot have the same value even if allocated on different connections or environments. Thus, a handle, along with its handle type identifier, uniquely identifies that handle throughout the CLI implementation.

3.2 Environment

An environment is a global context for database access. Associated with the environment handle is any data that must be global to the application. This includes attributes (see below), the defined connections (see Section 3.3 on page 29), and information on which connection is current.

It is implementation-defined whether an application may allocate more than one environment. In cases where multiple environments are allowed, the effects on transaction semantics are discussed in Section 4.9 on page 63.

Environment Attribute

The following attribute is associated with each environment handle, and affects the behaviour of CLI functions in that environment:

SQL_ATTR_OUTPUT_NTS (type: INTEGER) (settable)
: This attribute controls the implementation's use of null termination in output arguments. (See also **String Termination** on page 19.)

  If this attribute has the value SQL_TRUE, then the implementation uses null termination to indicate the length of output character strings. (This setting is appropriate for programs written in C.) If this attribute has the value SQL_FALSE, then the CLI implementation does not use null-termination. (COBOL applications typically must specify this behaviour.)

  The initial value is SQL_TRUE.

  The CLI functions affected by this attribute are all functions called for the environment (and for any connection allocated under the environment) that have character-string parameters.

An implementation may define additional environment attributes.

The application can specify the value of any settable environment attribute by calling *SetEnvAttr*( ) and can obtain the current attribute value by calling *GetEnvAttr*( ).

3.3 Connection

A connection is a method of gaining access to a particular database (metadata plus data). In client/server implementations, a connection represents the application's access to a particular server. Associated with the connection handle is any data that must be global to the server; namely, general status information, transaction state and certain diagnostic information.

Any connection allocated is within the context of a single environment.

An application can be connected to several servers at the same time, and can establish several distinct connections to the same server. Only one connection is current at any time. All other connections are dormant.

A connection is active if transaction work is being performed over it. This is defined in Section 4.9 on page 63.

Transaction semantics in the case where work is simultaneously pending over several connections are discussed in Section 4.9 on page 63.

Connection Attributes

The application allocates a connection handle before specifying a server to which to connect. Each connection attribute has one of the following characteristics:

(CA1)
(Reserved for future use.) The application can manipulate the attribute at any time that the connection handle is allocated. For example, this characteristic will apply to future attributes that influence the selection of servers or the process of connecting to a server.

(CA2)
The application can manipulate the attribute only during the time that it is actually connected to a server, since the value of the attribute varies among servers. When not connected (that is, before the application has specified the next server to which to connect), this attribute is unavailable.

(CA3)
(Reserved for future use.) The settable attribute not only varies among servers, as in (CA2) above, but changing its value incompatibly with the connected server causes the connection to immediately fail.

The following attributes are associated with each connection handle:

SQL_ATTR_AUTO_IPD (type: INTEGER) (read-only) (CA2)
If this attribute has the value SQL_TRUE, then the CLI implementation is capable of populating an implementation parameter descriptor as the result of a call to *Prepare*( ).

This attribute is initially set during *Connect*( ) and its initial value is implementation-defined.

SQL_ATTR_METADATA_ID (type: INTEGER) (settable) (CA2)
This value is used as the default for the attribute by the same name at the statement level (see **Statement Attributes** on page 30).

This attribute is initially set during *Connect*( ) and its initial value is SQL_FALSE.

An implementation may define additional connection attributes.

The application can specify the value of any settable connection attribute by calling *SetConnectAttr*( ) and can obtain the current attribute value by calling *GetConnectAttr*( ).

3.4 Statement

A statement handle refers to a data structure that tracks the execution of a single SQL statement. Associated with the statement handle is information on the statement's execution: dynamic arguments, bindings for dynamic parameters and columns, result values and status information.

When a statement is executed repeatedly, the information associated with the handle reflects the most recent execution of the statement.

The application can reuse a statement handle to prepare a different SQL statement. However, if the application has specified dynamic arguments or bindings for dynamic parameters, they persist and may be inappropriate in number or type for the new SQL statement (see Section 4.3 on page 46).

Any statement handle allocated is within the context of a single connection (and thus within a single environment).

Limitations

There may be an implementation-defined limit on the number of concurrent activities. This is the number of statement handles that may simultaneously be interacting with the server. This limit can be obtained as described in *GetInfo*( ) on page 176.

Statement Attributes

The following attributes are associated with each statement handle, and affect the behaviour of CLI functions on that statement:

SQL_ATTR_APP_ROW_DESC (type: INTEGER) (settable)
: The value of this attribute is a descriptor handle (see Section 3.5 on page 32) that serves as the application row descriptor for subsequent fetches on the statement handle. If the attribute's value is SQL_NULL_HDESC, there is no application row descriptor associated with the statement handle.

  The initial value of this attribute is a descriptor implicitly allocated when the statement is allocated.

SQL_ATTR_APP_PARAM_DESC (type: INTEGER) (settable)
: The value of this attribute is a descriptor handle (see Section 3.5 on page 32) that serves as the application parameter descriptor for subsequent calls to *Execute*( ) and *ExecDirect*( ) on the statement handle. If the attribute's value is SQL_NULL_HDESC, there is no application parameter descriptor associated with the statement handle.

  The initial value of this attribute is a descriptor implicitly allocated when the statement is allocated.

SQL_ATTR_CURSOR_SCROLLABLE (type: INTEGER) (settable)
: The application sets this attribute to specify what level of support for scrollable cursors it requires. Setting this attribute affects subsequent calls to *ExecDirect*( ) and *Execute*.( ) The attribute's value is one of the following:

  SQL_FALSE
  : Scrollable cursors are not required on the statement handle; if the application calls *FetchScroll*( ) on this handle, the only mode it will specify is SQL_FETCH_NEXT (which gives the same effect as *Fetch*( )).

EX OP SQL_TRUE
: Scrollable cursors are required on the statement handle; when calling *FetchScroll*( ), the application may specify any valid value of *FetchOrientation*, achieving cursor

positioning in modes other than the sequential mode.

The initial value of the attribute is SQL_FALSE.

SQL_ATTR_CURSOR_SENSITIVITY (type: INTEGER)
This attribute's value is one of the following:

SQL_UNSPECIFIED
It is unspecified whether cursors on the statement handle make visible the changes made to a result set by another cursor. Cursors on the statement handle may make visible none, some, or all of such changes.

EX OP SQL_INSENSITIVE
All cursors on the statement handle show the result set without reflecting any changes made to it by any other cursor.

SQL_SENSITIVE
All cursors on the statement handle make visible all changes made to a result set by another cursor.

Setting this attribute affects subsequent calls to *ExecDirect*( ) and *Execute.*( ) An application can read back the value of this attribute to obtain its initial state or its state as most recently set by the application.

The initial value of this attribute is SQL_UNSPECIFIED.

SQL_ATTR_IMP_ROW_DESC (type: INTEGER) (read-only)
The value of this attribute is a descriptor handles (see Section 3.5 on page 32) that serves as the implementation row descriptor.

The initial value of this attribute is a descriptor implicitly allocated when the statement is allocated.

SQL_ATTR_IMP_PARAM_DESC (type: INTEGER) (read-only)
The value of this attribute is a descriptor handles (see Section 3.5 on page 32) that serves as the implementation parameter descriptor.

The initial value of this attribute is a descriptor implicitly allocated when the statement is allocated.

SQL_ATTR_METADATA_ID (type: INTEGER) (settable)
This attribute has one of the following values:

SQL_TRUE
This specifies that the metadata functions (see Section 4.6 on page 53) treat certain arguments as identifiers. This means that the values are folded to upper case unless they are delimited (by enclosing the value in double quotes).

SQL_FALSE
This specifies that the metadata functions do not treat arguments as identifiers and enables treatment as pattern-values in the cases specified in **Qualification by Pattern-values** on page 55.

This attribute is initially set when the statement is allocated and its initial value is that of the connection attribute by the same name (see **Connection Attributes** on page 29).

An implementation may define additional statement attributes.

The application can specify the value of any settable statement attribute by calling *SetStmtAttr*( ) and can obtain the current attribute value by calling *GetStmtAttr*( ).

3.5 Descriptor

A descriptor handle refers to a data structure that holds information about either columns or dynamic parameters. A CLI descriptor is analogous to the SQL descriptor area in embedded SQL. ‘‘Descriptor’’ in this document means the CLI data structure, not the data structure from embedded SQL.

3.5.1 Types of Descriptor

A descriptor is used to describe one of the following:

1. A set of zero or more dynamic parameters. A parameter descriptor can be used for:

   — the *application parameter buffer*, which contains the dynamic arguments as set by the application

   — the *implementation parameter buffer*, which contains the same dynamic arguments after any data conversion the application may specify.*

   The application must operate on an application parameter descriptor before executing any SQL statement that contains dynamic parameter markers. The application may specify different data types from those in the implementation parameter descriptor to achieve data conversion of dynamic arguments.

2. A single row of database data. A row descriptor can be used for:

   — the *implementation row buffer*, which contains the row from the database*

   — the *application row buffer*, which contains the row, following any data conversion the application may specify, in which form the data is presented to the application.

   The application operates on the application row descriptor in any case where column data from the database must appear in application variables. The application may specify different data types from those in the implementation row descriptor to achieve data conversion of column data.

The following table summarises the descriptor types:

	Rows	**Dynamic Parameters**
Application Buffer	Application Row Descriptor	Application Parameter Descriptor
Implementation Buffer	Implementation Row Descriptor	Implementation Parameter Descriptor

Table 3-1 The Four Types of Descriptor

For either the parameter or row buffers, if the application specifies different data types in corresponding records of the implementation and application descriptors, the CLI implementation performs data conversion when it uses the descriptors. For example, it may convert numeric and date/time values to character-string format. For valid combinations and

* The implementation buffers are conceptually the data as written to, or read from, the database. However, X/Open does not specify the stored form of database data, and an implementation (server) could perform additional conversion on the data from its form in the implementation buffer.

their effects, see Section 4.8.3 on page 60.

A descriptor may perform different roles. Different statements can share any descriptor that the application explicitly allocates. A row descriptor in one statement can serve as a parameter descriptor in another statement.[5]

It is always known whether a given descriptor is an application descriptor or an implementation descriptor, even if the descriptor has not yet been used in a database operation. For the descriptors that the implementation automatically allocates, the implementation records the predefined role relative to the statement handle. Any descriptor the application allocates using *AllocHandle*( ) is an application descriptor.

3.5.2 Header Fields of the Descriptor

A descriptor contains a single copy of the fields listed below, as well as zero or more descriptor records,[6] as described in the following section.

COUNT
: The COUNT field specifies how many records contain data. In general, whichever component (application or CLI implementation) sets the data structure must also set the COUNT field to show how many records are significant.

  Unlike embedded SQL, an application does not have to specify, when it allocates an instance of this data structure, how many records to reserve room for. As the application specifies the contents of records, the CLI implementation takes any required action to ensure that the descriptor handle refers to a data structure of adequate size.

ALLOC_TYPE
: The ALLOC_TYPE field specifies whether the descriptor was allocated automatically by the CLI implementation or explicitly by the application. The application can obtain but not modify this field.

3.5.3 Fields of the Descriptor Records

Each record contains the following fields, which are defined in the X/Open **SQL** specification:

TYPE
LENGTH
PRECISION
SCALE
NULLABLE
NAME
UNNAMED

Since dynamic parameters are always nullable and do not have names, in an implementation parameter descriptor, the NULLABLE field always has the value SQL_NULLABLE and the UNNAMED field always has the value SQL_UNNAMED.

---

5. By reusing a row descriptor that contains a fetched row of a table as a parameter descriptor of an INSERT statement, an application could copy rows between tables without specifying copying of the data at the application level. However, an application can copy rows between different databases in this way only if the implementation supports simultaneous access to multiple connections, because the descriptor is valid only while connected.

6. These records correspond to the *item descriptor areas* in the SQL descriptor area of embedded SQL.

EX Each record also has the following fields:

DATETIME_INTERVAL_CODE
: An integer date/time subcode whose value distinguishes the types DATE, TIME and TIMESTAMP.

OCTET_LENGTH
: The length in octets of a character-string data type. Depending on the data type, this is the length or maximum length of the string. This value always excludes any null terminator.

For values whose type is TIME or TIMESTAMP, the PRECISION field is the precision of the fractional seconds component, in decimal digits. For values whose type is DATE, TIME or TIMESTAMP, the LENGTH field is the length in characters of the character-string representation of the date/time value (see **Transfers with Conversion to/from String** on page 62) and OCTET_LENGTH is the length in octets of that character string representation.

Each record also contains the following fields, which are deferred fields (see Section 3.5.5 on page 36)[7] and correspond to certain fields defined in the X/Open **SQL** specification:

INDICATOR_PTR
: Corresponds to the INDICATOR field in the item descriptor area of embedded SQL.

DATA_PTR
: Corresponds to the DATA field in the item descriptor area of embedded SQL.

OCTET_LENGTH_PTR
: Indicates the length in octets of a dynamic argument (see Section 4.3 on page 46) or of a bound column value (see Section 4.5 on page 50).

The data type of each field is specified in *SetDescField*( ) on page 205.

3.5.4 Operations on Descriptors

Automatic Allocation/Freeing

When an application allocates a statement handle, the implementation automatically allocates one set of four descriptors.[8] The application can obtain the handles of these automatically-generated descriptors as attributes of the statement handle. When the application frees the statement handle, the implementation frees all automatically-generated descriptors on that handle.

7. The deferred fields, which an application associates with its own variables, are present but not used in implementation descriptors.
8. The implementation has the option of deferring allocation of any descriptor until the point at which it is actually used.

Explicit Allocation/Freeing

The application can explicitly allocate an application descriptor on a connection at any time it is actually connected to a database. By specifying that descriptor handle as an attribute of a statement handle using *SetStmtAttr*( ), the application directs the implementation to use that descriptor in place of the respective automatically-generated application descriptor. (The application cannot specify alternative implementation descriptors.)

The application can associate an explicitly-allocated descriptor with more than one statement. The application can free such a descriptor explicitly, or implicitly by freeing its connection.

Obtaining a Descriptor Handle

The application obtains the handle of any explicitly-allocated descriptor as an output argument of the call to *AllocHandle*( ). The handle of an automatically-generated descriptor is available by calling *GetStmtAttr*( ).

Initialisation of Fields

When an application row descriptor record is first used, the initial value of its TYPE field is SQL_DEFAULT. This provides for a standard treatment of database data for presentation to the application (see **Default Transfers** on page 60). The application may specify different treatment of the data by modifying fields of the descriptor record.

Access to Fields

The application can call *GetDescField*( ) to obtain a single field of a descriptor record. *GetDescField*( ) gives the application access to all the descriptor fields defined in the X/Open **SQL** specification. *GetDescField*( ) returns one field per call. The function is extensible, using additional argument values, to return future or implementation-defined information.

To modify fields of a descriptor, the application can call *SetDescField*( ), an extensible function that sets a single descriptor field per call.[9]

When setting fields individually, the application should follow a sequence as defined in *SetDescField*( ) on page 205. Setting some fields causes the CLI implementation to set other fields. These cases, directly analogous to cases defined in the X/Open **SQL** specification, ensure that a descriptor is always ready to use once the application has specified a data type. When the application sets the DATA_PTR field, the implementation checks that other fields that specify the type are valid and consistent (see the General Diagnostic in Section 5.4.9 on page 75).

The *CopyDesc*( ) function copies all information except ALLOC_TYPE from one descriptor to another.

More information on operations on parameter descriptors, in context, appears in Section 4.3 on page 46. More information on row descriptors appears in Section 4.5 on page 50.

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9. The application cannot set the NAME, NULLABLE and UNNAMED fields. They are not used for parameter descriptors; in row descriptors, they contain column properties that applications cannot override.

   The *GetData*( ) function also modifies the TYPE field in an application row descriptor.

3.5.5 Deferred Fields

The DATA_PTR, INDICATOR_PTR and OCTET_LENGTH_PTR fields of a descriptor record are *deferred*. When the application sets these fields by calling *SetDescField*( ), the implementation does not use the current value of the application variables, but saves the addresses of the variables in the descriptor for a deferred effect as follows:

- For an application parameter descriptor, the implementation uses the contents of the variables at the time of the call to *ExecDirect*( ) or *Execute*( ).
- For an application row descriptor, the implementation assigns values to the variables at the time of the fetch.

When a descriptor is allocated, the deferred fields of each descriptor record initially have a null value. The meaning of the null value is as follows:

- If DATA_PTR has the null value, the record is unbound (see Section 3.5.6 on page 37).
- If INDICATOR_PTR has the null value:
  - — For an application parameter descriptor, there is no indicator information for the descriptor record. This means the application cannot use the buffer to specify null dynamic arguments.
  - — For an application row descriptor, a null INDICATOR_PTR prevents the implementation from returning indicator information for that column. (As in embedded SQL, the implementation needs an indicator to report the fetch of a null value; in this case, failure to bind INDICATOR_PTR is an error.)
- If OCTET_LENGTH_PTR has the null value:
  - — For an application parameter descriptor, OCTET_LENGTH_PTR indicates the length in octets of character-string dynamic arguments. A null value directs the implementation to assume the string is null-terminated. (Setting and changing OCTET_LENGTH_PTR for character-string dynamic arguments is discussed in Section 4.3 on page 46. If TYPE does not indicate a character-string dynamic argument, OCTET_LENGTH_PTR is ignored.)
  - — For an application row descriptor, the implementation does not return length information for that column.

In a language that supports pointers, the application can obtain the value of a deferred field by calling *GetDescField*( ). Such a call returns not the actual data but a pointer to the associated application variable (or the null pointer if the field is not associated with an application variable). A routine that takes as an argument a descriptor handle could call *GetDescField*( ) to obtain pointers to the data, indicator or length of any descriptor record.

Once the application has associated a deferred field with an application pointer, it can specify a different application pointer, or specify the null pointer to return the deferred field to the initial, unbound state. To reuse the same application descriptor with a different number and position of bound records, an application can free the descriptor and allocate a new one, or overwrite the previous bindings and change the COUNT field.

The application must not deallocate or discard variables used for deferred fields between the time it associates them with the fields and the time the CLI implementation reads or writes them.

3.5.6 Bound Descriptor Records

When the application sets the DATA_PTR field of a descriptor record, so that it no longer contains the null value, the record is said to be *bound*.

If the descriptor is an application parameter descriptor, which describes dynamic arguments to an SQL statement, then each bound record constitutes a *bound parameter*. The application must bind a parameter for each dynamic parameter marker in the SQL statement before executing the statement (see Section 4.3 on page 46).

If the descriptor is an application row descriptor, which describes a row of database data, then each bound record constitutes a *bound column*. The application retrieves data from bound and unbound columns using different methods (see Section 4.5 on page 50).

3.6 Cursors

A cursor is a movable pointer into a derived table by which the application can retrieve, update and delete rows. (This process is described in Section 4.5 on page 50.) Cursors have names by which the application can reference them. Each cursor name within a given connection is unique. The scope of a cursor name is the connection in which it is defined.

In embedded SQL, a cursor is declared and named by the non-executable DECLARE CURSOR statement. In CLI, the application executes a *cursor-specification* (specifying a result set to which the cursor applies) without declaring a cursor. If the application has not already provided a cursor name for the statement handle, then the implementation generates a cursor name, starting with 'SQLCUR' or 'SQL_CUR' and guaranteed to be unique within the relevant connection, and executes an implicit DECLARE CURSOR statement.

The application can specify a cursor name and can retrieve any cursor name the implementation has generated. This lets the application generate text for positioned DELETE and UPDATE statements using that cursor (see Section 4.5.1 on page 52).

Chapter 4

Interface Overview

This chapter introduces the CLI functions and gives an overview of their use.

Table 4-1 on page 40 lists the functions available and gives section references for further information; for detailed information, see the appropriate reference manual page in Chapter 8.

Section 4.1 on page 42 provides flowcharts showing the basic flow of control for the use of CLI functions. Subsequent sections describe the usage of CLI functions, grouped by functional category. There are sections devoted to executing SQL statements, specifying dynamic arguments, analysing a prepared statement, fetching data or metadata, data conversion and transaction management.

The functions that return diagnostic information are discussed in Chapter 5.

Types of CLI Function

In some cases CLI provides multiple functions that achieve comparable effects. Some functions are designed for ease of use by application writers in common situations; others are designed for complete access to the underlying data structure and for extensibility to additional forms defined by X/Open in the future or by implementations. Functions that are part of such a pair are marked by (concise) or (extensible) as appropriate. For an overview of the concise CLI functions, see Chapter 6.

In addition, this document defines additional functions for compatibility with APIs commonly used in existing applications. These functions are deprecated. For an overview of the deprecated functions, see Chapter 7.

The interface overview in this chapter describes use of the extensible functions. Citation of a specific extensible function in this chapter does not imply that an application could not instead use a concise or deprecated function to achieve the same effect.

Table 4-1 CLI Functions

CLI Function		Description	Overview Section
Allocate and Deallocate			
AllocConnect( )	DE	Allocate a connection handle.	Chapter 7
AllocEnv( )	DE	Allocate an environment handle.	Chapter 7
AllocHandle( )		Allocate a handle.	Section 3.1 on page 26
AllocStmt( )	DE	Allocate a statement handle.	Chapter 7
FreeConnect( )	DE	Free a connection handle.	Chapter 7
FreeEnv( )	DE	Free an environment handle.	Chapter 7
FreeHandle( )		Free a handle.	Section 3.1 on page 26
FreeStmt( )	DE	Free a statement handle.	Chapter 7
Get and Set Attributes			
GetConnectAttr( )		Get the value of a connection attribute.	Section 3.3 on page 29
GetConnectOption( )	DE	Get the value of a connection attribute.	Chapter 7
GetEnvAttr( )		Get the value of an environment attribute.	Section 3.2 on page 28
GetStmtAttr( )		Get the value of a statement attribute.	Section 3.4 on page 30
GetStmtOption( )	DE	Get the value of a statement attribute.	Chapter 7
SetConnectAttr( )		Set a connection attribute.	Section 3.3 on page 29
SetConnectOption( )	DE	Set a connection attribute.	Chapter 7
SetEnvAttr( )		Set an environment attribute.	Section 3.2 on page 28
SetStmtAttr( )		Set a statement attribute.	Section 3.4 on page 30
SetStmtOption( )	DE	Set a statement attribute.	Chapter 7
Connection			
Connect( )		Open a connection to a server.	
Disconnect( )		Close a connection to a server.	
Descriptor Access			
CopyDesc( )		Copy a descriptor.	Section 3.5 on page 32
GetDescField( )		Get a descriptor field (extensible).	Section 3.5 on page 32
GetDescRec( )		Get a descriptor record (concise).	Chapter 6
SetDescField( )		Set a descriptor field (extensible).	Section 3.5 on page 32
SetDescRec( )		Set a descriptor record (concise).	Chapter 6
ColAttribute( )	DE	Get an implementation row descriptor field.	Chapter 7
Executing SQL Statements			
BindParam( )		Bind a dynamic parameter (concise).	Chapter 6
ExecDirect( )		Execute an SQL statement directly.	Section 4.2.2 on page 45
Execute( )		Execute a prepared SQL statement.	Section 4.2.1 on page 44
GetCursorName( )		Get the name of a cursor.	Section 3.6 on page 38
ParamData( )		Address the next dynamic parameter requiring data.	Section 4.3.2 on page 48
Prepare( )		Prepare an SQL statement for execution.	Section 4.2.1 on page 44
PutData( )		Send part or all of a dynamic argument at execute time.	Section 4.3.2 on page 48
SetCursorName( )		Set the name of a cursor.	Section 4.2.1 on page 44
SetParam( )	DE	Synonym for *BindParam*( )	Chapter 7

CLI Function	Description	Overview Section
Receiving Results		
BindCol( )	Bind a column in a result set (concise).	Chapter 6
CloseCursor( )	Close a cursor.	
DescribeCol( )	Describe a column of a result set (concise).	Chapter 6
Fetch( )	Fetch the next row of a result set.	Section 4.5 on page 50
FetchScroll( )	Move the cursor to, and fetch, a specified row of a result set.	Section 4.5 on page 50
GetData( )	Retrieve one column of a row of the result set.	Section 4.5 on page 50
NumResultCols( )	Get the number of columns in a result set (concise).	Chapter 6
RowCount( ) DE	Get the number of rows affected by a statement.	Chapter 7
Metadata Functions		
Columns( )	Get column information.	Section 4.6 on page 53
SpecialColumns( )	Get unique row identifier for a table.	Section 4.6 on page 53
Statistics( )	Get index information for a base table.	Section 4.6 on page 53
Tables( )	Get table information.	Section 4.6 on page 53
Introspection		
DataSources( )	Get a list of server names.	Section 4.7 on page 57
GetFunctions( )	Determine whether a function is supported.	Section 4.7 on page 57
GetInfo( )	Get information about the CLI implementation and the currently-connected server.	Section 4.7 on page 57
GetTypeInfo( )	Get information on server data types.	Section 4.7 on page 57
Transaction Control		
EndTran( )	Commit or roll back a transaction.	Section 4.9 on page 63
Transact( ) DE	Commit or roll back a transaction.	Section 4.9 on page 63
Diagnostic Information		
GetDiagField( )	Return diagnostic information (extensible).	Section 5.2 on page 69
GetDiagRec( )	Return diagnostic information (concise).	Section 5.2 on page 69
Error( ) DE	Return diagnostic information.	Chapter 7
Function Cancellation		
Cancel( )	Attempt to cancel a CLI operation.	Section 4.3.2 on page 48

4.1 Overview of Control Flow

The following diagrams show the basic flow of control for the use of CLI functions. These diagrams assume (and do not illustrate) that the application performs error checking where appropriate using the *GetDiagField*( ) or *GetDiagRec*( ) functions.

For more detailed information concerning control flow and function sequencing rules, refer to the state transition tables in Appendix B.

4.1.1 Basic Control Flow

The following figure shows the initiation sequence, the termination sequence and an overview of transaction completion.

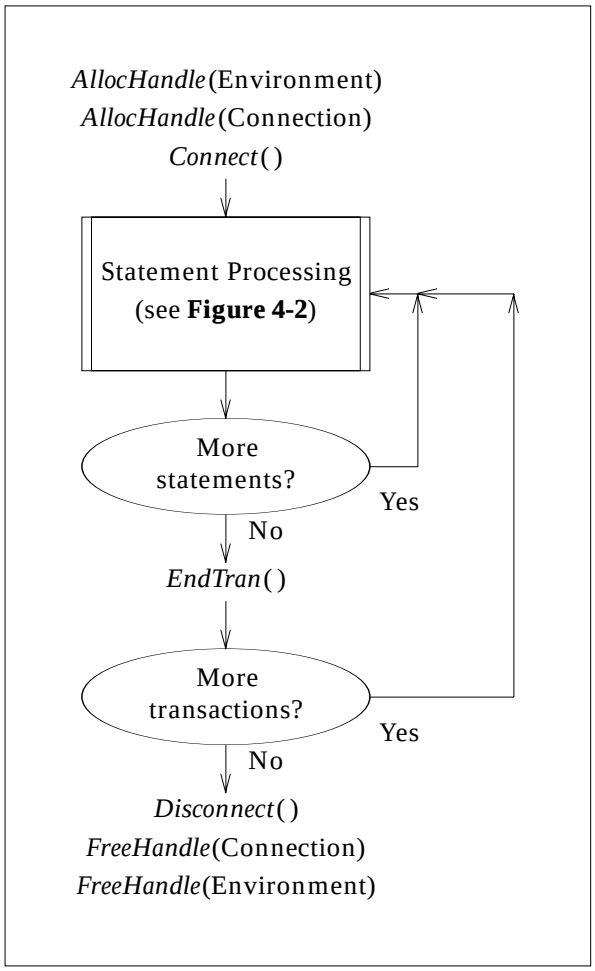

Figure 4-1 Initiation, Termination and Transaction Completion

4.1.2 Example Control Flow for SQL Statement Processing

Figure 4-2 shows typical control flow for processing SQL statements, including the allocation and release of a statement handle.

While this is the basic control flow for SQL statements executed interactively, there are other valid sequences, such as modifying the buffer descriptor between successive fetches.

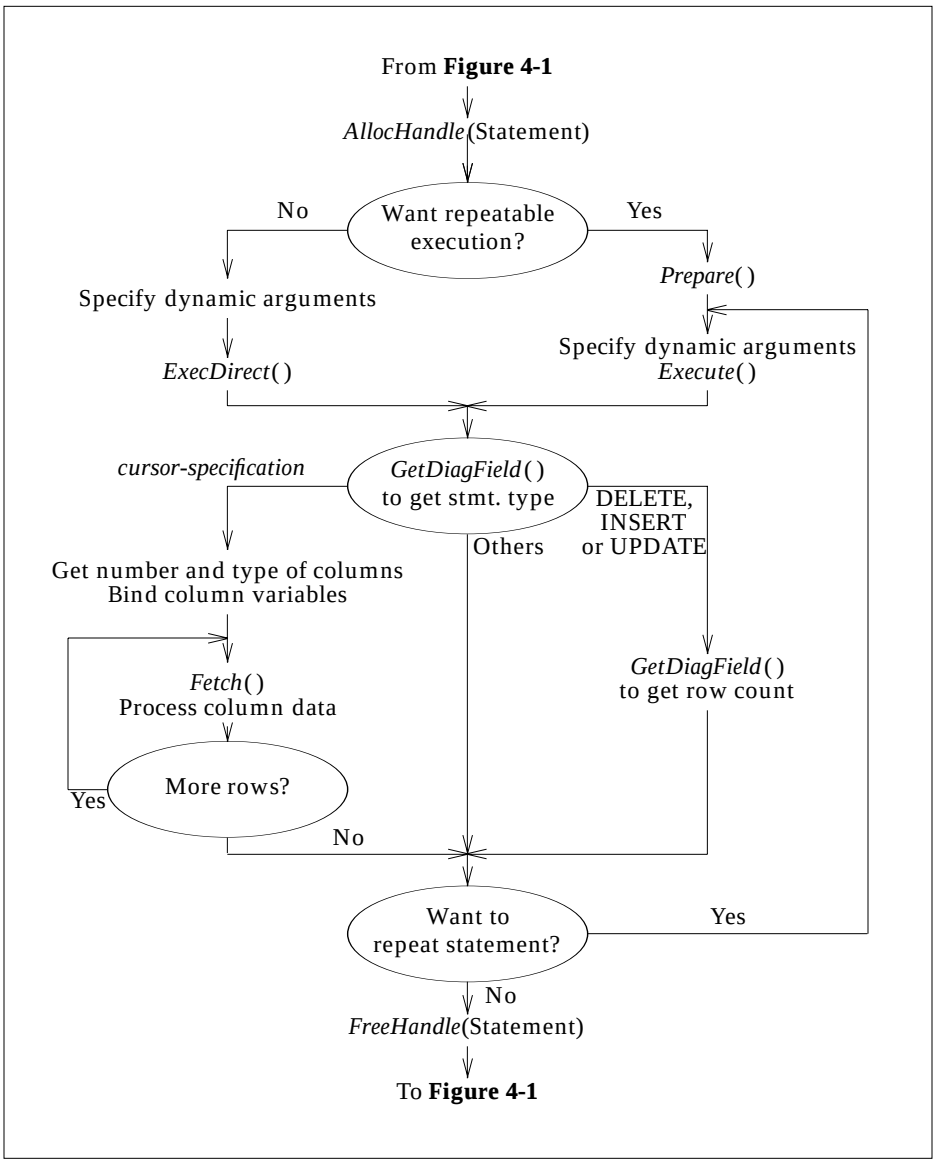

Figure 4-2 Example Control Flow for Statement Processing

4.2 Executing SQL Statements

There are two different ways in CLI to specify and execute SQL statements:

1. Call *Prepare*( ) and then call *Execute*( ).
2. Call *ExecDirect*( ).

These methods roughly correspond to PREPARE/EXECUTE and EXECUTE IMMEDIATE respectively in embedded SQL. Method 1 allows the prepared statement to be executed multiple times without duplicating the work of preparing the statement.

The application can use either method to execute any statement that the X/Open **SQL** specification allows in the PREPARE statement. An important addition is that CLI also allows a *cursor-specification* to be input to either method. Embedded SQL requires the use of the OPEN statement to execute a *cursor-specification*. Moreover, both CLI methods allow the use of dynamic parameters; in embedded SQL, dynamic parameters are not permitted in EXECUTE IMMEDIATE.

4.2.1 Prepare( ) and Execute( )

The application prepares an SQL statement for execution and possible repetition by taking the following steps:

1. It prepares the SQL statement by calling *Prepare*( ).
2. It defines dynamic arguments (see Section 4.3 on page 46).
3. If the SQL statement is a *cursor-specification*, the application can declare a cursor name by calling *SetCursorName*( ). Otherwise, the implementation generates a cursor name. CLI uses cursor names only in positioned UPDATE and DELETE statements.
4. It executes the prepared statement by calling *Execute*( ). After execution, the application can assign new dynamic arguments and execute the statement again.

This method separates the specification of the SQL text from its execution. It is advisable when any of the following is true:

- The application must gain access to row descriptors (that is, column names, types and lengths) after preparing and before executing the statement.
- The application must gain access to parameter descriptors after preparing and before executing the statement.[10]
- The application wants highest performance in repeated executions of the same SQL statement text. Preparing the text typically compiles the SQL statement; the faster, compiled form is used by all calls to *Execute*( ).

10. Portable applications that require a particular data type conversion for dynamic parameters should use *Prepare*( ) and *Execute*( ). On some implementations, *Prepare*( ) populates the implementation parameter descriptor (see Section 4.3.1 on page 47). The application can specify different field values after calling *Prepare*( ).

4.2.2 ExecDirect( )

Calling *ExecDirect*( ) is preferable for a single execution of an SQL statement. Use this method when all of the following are true:

- The application does not need to gain access to row descriptors until after execution of a *cursor-specification*.
- The SQL statement is executed only once.

COMMIT and ROLLBACK are not preparable statements, and thus cannot be input to either *Prepare*( ) or *ExecDirect*( ). Transaction completion in CLI is discussed in Section 4.9 on page 63.

4.3 Specifying Dynamic Arguments

An SQL statement executed under CLI may contain question mark (?) characters. Each of these is a *dynamic parameter marker*. A dynamic parameter marker represents a position in the SQL statement (a *dynamic parameter*) where the application is to provide a value (a *dynamic argument*).

The application must provide a dynamic argument for each dynamic parameter in the SQL statement before it executes the statement. Information for each parameter remains in effect until overridden, or until the application drops the statement handle or application parameter descriptor handle. To prepare a statement with the same statement handle that has a different number of dynamic parameter markers, the application must revise the affected descriptors or allocate new ones in order to specify the correct number and type of dynamic arguments.

The application provides dynamic arguments by using an application parameter descriptor (see Section 3.5 on page 32). The application can use the automatically-generated application parameter descriptor (and obtain its handle by calling *GetStmtAttr*( )), or can allocate a separate descriptor by calling *AllocHandle*( ) and declare it the application parameter descriptor of the statement by calling *SetStmtAttr*( ).

Each record of the application parameter descriptor describes one dynamic argument. Within each record, the application sets various fields, binding some of them to application variables:

- It sets the DATA_PTR field to a variable that, at execute time, will contain the value of the dynamic argument.
- It sets other fields to define the data type, type attributes and indicator information.

  If the data type is character string, the application sets the LENGTH field to the maximum number of characters of the parameter and sets the OCTET_LENGTH_PTR field to a variable that, at execute time, will describe the length in octets of the dynamic argument.[11] (The OCTET_LENGTH field of parameter descriptors is not used.)

The application can call *BindParam*( ) or *SetDescRec*( ) to make a complete specification for a dynamic parameter, or can call *SetDescField*( ) to set individual descriptor fields. Using *BindParam*( ), the application can specify a number of characters for the dynamic argument below the maximum allowed by the data type.

---

11. If OCTET_LENGTH_PTR is not bound to an application variable, the dynamic argument must be null-terminated. If OCTET_LENGTH_PTR is bound and the variable contains the value SQL_NTS[L], the dynamic argument must be null-terminated. Otherwise, the application variable, at execute time, must contain the length in octets of the dynamic argument, excluding any null terminator.

    This rule allows applications using null-terminated strings as dynamic arguments to avoid using the OCTET_LENGTH_PTR field.

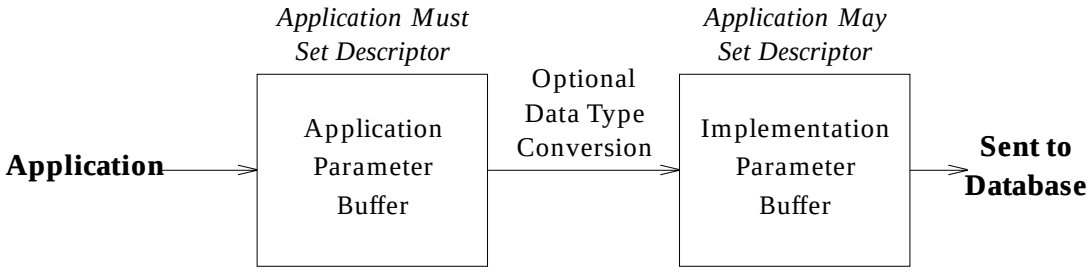

Figure 4-3 Transfer / Conversion of Dynamic Arguments

If the application executes the SQL statement repeatedly without changing the application parameter descriptor, then the implementation uses the same pointer to storage on each execution. However, the application may change the information at that storage location from one execution to another, resulting in different dynamic arguments. (If the length of a dynamic argument changes from one execution to another, the application must ensure that, at each execution, the respective descriptor record's OCTET_LENGTH_PTR field, and any application variable it is bound to, continues to define correctly the length of the dynamic argument, as described above.)

4.3.1 Use of Implementation Parameter Descriptor

If the application does not require type conversion of the dynamic arguments in its variables, it need not reference the implementation parameter descriptor.

OP On some implementations, preparing a statement sets the fields of an implementation parameter descriptor to indicate the data type and type attributes of the dynamic parameters. (This corresponds to support for the DESCRIBE INPUT statement of embedded SQL.) The application can configure dynamic arguments based on this information by following this sequence:

- Prepare the statement by calling *Prepare*( ).
- Call *CopyDesc*( ) to copy the fields of the automatically-generated implementation parameter descriptor to the application parameter descriptor. (The application obtains the handles of any descriptor it did not allocate by calling *GetStmtAttr*( )).
- Bind the deferred fields of the application parameter descriptor to application variables as required. If desired, change data type and type attribute fields (from the values copied from the implementation parameter descriptor) to specify any permitted type conversion of dynamic arguments.
- Execute the statement by calling *Execute*( ).

The application must explicitly set fields of the implementation parameter descriptor if either of the following is true:

- The application uses *ExecDirect*( ) instead of *Prepare*( ) and *Execute*( ) but requires the implementation to perform data conversion of any dynamic parameters. In this case, the application must set the implementation parameter descriptor explicitly before calling *ExecDirect*( ). The implementation parameter descriptor is unaffected by a call to *ExecDirect*( ).
- The implementation does not populate the implementation parameter descriptor during a call to *Prepare*( ). (The application can test for this feature by obtaining the SQL_ATTR_AUTO_IPD connection attribute.) In this case, the implementation does not modify the implementation parameter descriptor.

The application may also set fields in the implementation parameter descriptor in other cases, in order to achieve conversions of dynamic arguments from the type of data in the application parameter buffer.

4.3.2 Specifying Parameter Values at Execute Time

An application may specify values for specific bound parameters at execute time rather than providing values in memory for all bound parameters before calling *Execute*( ) or *ExecDirect*( ). This is especially useful for passing sizable dynamic arguments in pieces.

To indicate that a bound parameter will be a data-at-execute parameter, the application does the following:

- Sets the OCTET_LENGTH_PTR field in the corresponding record of the application parameter descriptor to a variable that, at execute time, will contain the value SQL_DATA_AT_EXEC.
- If there is more than one such field, it sets each DATA_PTR field to some value that it will recognise as uniquely identifying the field in question.

(The application can make these settings directly by calling *SetDescField*( ) or *SetDescRec*( ), or by providing suitable *StrLen_or_Ind* and *ParameterValue* arguments in a call to *BindParam*( )).

When the application calls *ExecDirect*( ) or *Execute*( ), if there are any data-at-execute parameters, the call returns [SQL_NEED_DATA]. The application responds as follows:

1. It calls *ParamData*( ) to advance to the first such parameter. This function returns [SQL_NEED_DATA] and provides the contents of the DATA_PTR field of the application parameter descriptor to identify the information required.
2. It calls *PutData*( ) to pass the actual data for the parameter. Long dynamic arguments can be sent in pieces by calling *PutData*( ) repeatedly.
3. It calls *ParamData*( ) again after it has provided the complete dynamic argument.

   If more data-at-execute parameters exist, *ParamData*( ) returns [SQL_NEED_DATA] and the application repeats steps 2 and 3 above.

   When no more data-at-execute parameters exist, *ParamData*( ) completes execution of the SQL statement. The *ParamData*( ) function produces a return value and diagnostics as the original *ExecDirect*( ) or *Execute*( ) statement would have produced.

The following flowchart illustrates this technique:

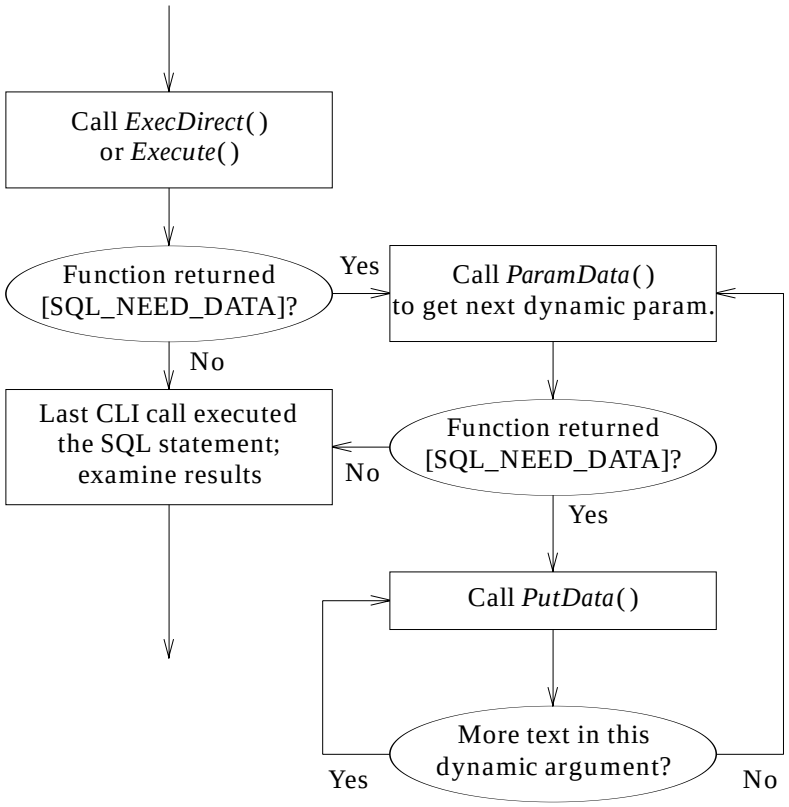

Figure 4-4 Providing Parameter Data at Execute Time

An example of this technique in the C language is provided in Section D.3 on page 272.

While the data-at-execute dialogue is in progress, the only CLI functions the application can call are:

- The *ParamData*( ) and *PutData*( ) functions, as discussed above
- The *Cancel*( ) function, to cancel the data-at-execute dialogue and force an orderly exit from the loop shown above without executing the SQL statement
- The diagnostic functions.

Moreover, the application cannot end the transaction (see Section 4.9 on page 63) nor set any connection attribute that would have an impact on the treatment of the statement handle.

4.4 Analysing a Prepared Statement

EX After preparing a statement by calling *Prepare*( ), or executing it by calling *ExecDirect*( ), an application can call *GetDiagField*( ) to examine the string SQL_DIAG_DYNAMIC_FUNCTION field or integer SQL_DIAG_DYNAMIC_FUNCTION_CODE field, and thus determine the type of statement that was prepared. If the statement was a *cursor-specification*, the application can examine the implementation row descriptor by calling *GetDescField*( ) to determine the number of columns that will appear in the result set. The application can then retrieve information on any such column by further analysing the descriptor with *GetDescField*( ). This analysis is especially useful if the statement text is generated at execute time (for example, typed by the user).

To determine the type of an executed SQL statement, see Section 5.3.1 on page 72. To obtain the count of rows that were affected by a searched DELETE, INSERT or searched UPDATE, see Section 5.3.2 on page 72.

4.5 Fetching Data

Executing a *cursor-specification* defines a result set. The application fetches individual rows of the result set by calling *Fetch*( ) or *FetchScroll*( ). The *Fetch*( ) function always moves the cursor to the next row in sequence and fetches that row. The *FetchScroll*( ) function can move the cursor to
EX OP any specified row of the result set and fetches that row. To use the features of *FetchScroll*( ) that provide modes of cursor movement other than the sequential mode, the application must use a statement attribute to enable scrollable cursors before preparing or executing the *cursor-specification*.

The application obtains data from a fetched row of the result set in one of the following ways:

- If it has used an application row descriptor to bind columns (see Section 3.5 on page 32), then column data is present in the application variables to which the respective columns are bound.
- If the columns are unbound, it can read database values by calling *GetData*( ).
- It may use both the above techniques if some columns are bound and some are unbound.

Bound Columns

To bind columns to application variables, the application sets the DATA_PTR field of the corresponding records of the application row descriptor. The application sets other descriptor fields to define the data type, type attributes and variables that will hold indicator and length information.

The application can call *BindCol*( ) or *SetDescRec*( ) to make a complete specification for a column of the result set, or can call *SetDescField*( ) to set individual descriptor fields.

If the application row descriptor specifies different data types or type attributes from the implementation row descriptor, the CLI implementation performs type conversion on affected columns when it fetches the row (see Section 4.8.3 on page 60).

Unbound Columns

If the application elects not to bind any columns, it need not reference the row descriptor. It can obtain column data by simply calling *GetData*( ).

Bound and Unbound Columns

If binding some but not all columns of a row, the application must reference the row descriptor, but need not specify any field of a record that pertains to an unbound column.

During a fetch, the implementation implicitly copies database information for bound columns to the application variables to which the columns are bound, and may perform type conversion of the bound column data, as described above.

For unbound columns following the highest-numbered bound column, portable applications obtain the column data by calling *GetData*( ) in ascending order of column number (from left to right). It is implementation-defined whether an application can obtain column data in a different sequence. It is implementation-defined whether column data for lower-numbered, unbound columns is available.[12]

The application can achieve type conversion of the column data by specifying in the call to *GetData*( ) either the desired target type or the value SQL_ARD_TYPE, which means that the application row descriptor indicates the desired target type even though the column is unbound.

Length of Application Buffers

For bound columns, the application uses its knowledge of the column (perhaps discerned as described in Section 4.4 on page 50) to allocate the maximum memory the column value could occupy, in order to avoid truncation of the value. For unbound columns, the column can be arbitrarily long. If the length of the column value exceeds the length of the application's buffer, a feature of *GetData*( ) lets the application use repeated calls to obtain the value of a single column of CHAR or VARCHAR type in pieces of manageable size.

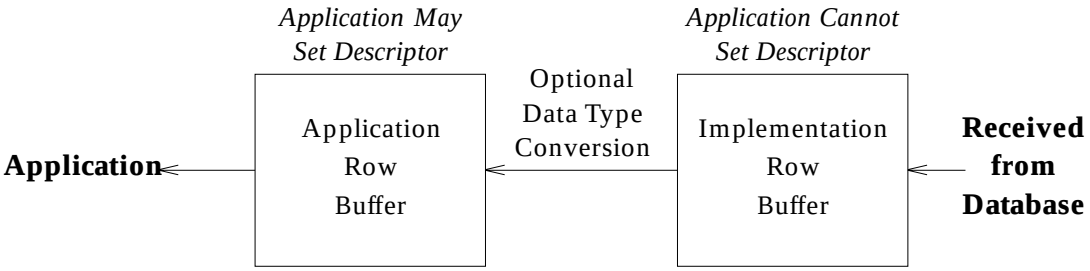

Figure 4-5 Transfer / Conversion of Bound Column Data

12. The SQL_GETDATA_EXTENSIONS characteristic, available by calling *GetInfo*( ), indicates whether the implementation supports these features. Implementations may omit these features so that the client does not have to buffer an entire row of data.

4.5.1 Updating Fetched Data

To update a row that has been fetched, the application uses two statement handles, one for the fetch and one for the update. The application calls *GetCursorName*( ) to obtain the cursor name used for the fetch. (The implementation generates this name for handles that pertain to *cursor-specification*s, but the application can specify a cursor name by calling *SetCursorName*( ) before preparing the *cursor-specification*.) The application generates text of a positioned UPDATE (or DELETE), including the same cursor name used by the fetch, and executes that SQL statement using the second statement handle. (The application cannot reuse the fetch statement handle to execute a positioned UPDATE; this would discard the result set fetched.)

Update during Fetch

A portable application should not try to update a row until it has fetched all necessary information from unbound columns of the row. If a fetched row is updated (by the same application or by some other process) and the application then calls *GetData*( ) to obtain additional unbound columns, the call to *GetData*( ) does one of the following:

- Obtains data including any intervening updates.
- Returns the value of the specified unbound columns as they existed at the time of the fetch.
- Returns an implementation-defined error.

This implementation variability does not exist for bound columns. At the time of the fetch, the implementation copies information for all bound columns to the application variables to which the columns are bound.

Cursor Name

A cursor name exists for a statement handle when the application successfully calls *SetCursorName*( ). If the application has not called *SetCursorName*( ) before calling *Prepare*( ), then *Prepare*( ) generates the cursor name.

4.6 Metadata Functions

An application may query a database's metadata (for example, the names of tables or columns) as well as the data itself with the CLI *metadata functions*. They operate by returning to the application a result set through a statement handle. After calling these functions, the application can fetch individual rows of the result set, and can process the metadata as it would process column data from an ordinary fetch.

The X/Open **SQL** specification defines a number of *system views*, read-only views from which the application can retrieve metadata. If the implementation complies with both this specification and the X/Open **SQL** specification, another way to get metadata is to perform queries on the system views.

The metadata functions are conceptually the same (so, for instance, they have the same effect on the state tables) as the execution, using *ExecDirect*( ), of a query on the X/Open system views. However, the result set of a metadata function does not necessarily have the same columns in the same sequence as the system views of the X/Open **SQL** specification. It is undefined how the CLI implementation actually obtains the metadata.

Metadata Function	**Conceptual Equivalent Embedded SQL Query on System Views**
Columns( )	SELECT...FROM COLUMNS
SpecialColumns( )	*no conceptual equivalent; see below*
Statistics( )	SELECT...FROM INDEXES *(and see below)*
Tables( )	SELECT...FROM TABLES

Table 4-2 Metadata Functions: Embedded SQL Equivalent Queries

The *Columns*( ) and *SpecialColumns*( ) functions both return information about the columns of a specified table.

- The *Columns*( ) function returns a set of columns that would be returned by a query on the COLUMNS system view of embedded SQL. The columns are limited to those specified when an application created or altered the table. The query may be qualified by name.
- The *SpecialColumns*( ) function returns a set of columns that uniquely identifies a row from the specified table. The *SpecialColumns*( ) function can obtain information on *pseudo-columns* — that is, columns that an implementation may automatically create in addition to those the application specifies, such as a row identifier.

  For each row queried, *SpecialColumns*( ) returns in its result set a COLUMN_NAME column. This name is intended to be the name that the application would use in a *cursor-specification* or WHERE clause to specify most efficiently the row in question.

The *Statistics*( ) function returns information available from the INDEXES system view and may also return other information on indexes unavailable through INDEXES.

Result Set Definition

The manual pages for the metadata functions define the result set that the functions return. The X/Open columns of the result set always occur first and in the specified order. There may be additional, implementation-defined columns in the result set. Any such columns occur following the X/Open columns.

Naming

As described in Section 2.4.3 on page 22, the application can qualify the names of tables and other objects by prepending a schema name and, on some implementations, a catalog name. An implementation that does not support the use of catalog names rejects a metadata function argument that would restrict the result set based on catalog name.

Constraints

Different users may be entitled to view different amounts of the metadata. The metadata functions may thus return different result sets to different CLI users. These *constraints* on metadata are identical to those defined in the X/Open **SQL** specification for the corresponding system view.

4.6.1 Parameters of Metadata Functions

The following table summarises the treatment of certain string input parameters of the metadata functions. The **OA**, **ID**, **VL** and **PV** legends are explained in the following sections.

Metadata Function	**Parameter Name**				
	Catalog-Name	*Schema-Name*	*Table-Name*	*Table-Type*	*Column-Name*
Columns( )	**OA/ID**	**PV/ID**	**PV/ID**		**PV/ID**
SpecialColumns( )	**OA/ID**	**OA/ID**	**OA/ID**		
Statistics( )	**OA/ID**	**OA/ID**	**OA/ID**		
Tables( )	**PV/ID**	**PV/ID**	**PV/ID**	**VL**	

Table 4-3 Treatment of Parameters of Metadata Functions

Ordinary Arguments

Parameters with the **OA** legend in Table 4-3 are treated as ordinary arguments if the SQL_ATTR_METADATA_ID attribute of the relevant statement handle is SQL_FALSE. (Otherwise, see **Treatment as Identifier**.)

The corresponding argument is taken literally and the case of letters is significant.

The argument does not qualify a query but rather specifies the metadata desired. The
EX application cannot pass a null pointer or otherwise avoid making this specification except when specifying *CatalogName* in a case where the implementation does not support catalog names.

Treatment as Identifier

Parameters with the **ID** legend in Table 4-3 are treated as identifiers if the SQL_ATTR_METADATA_ID attribute of the relevant statement handle is SQL_TRUE.

Identifiers, including delimited identifiers, are discussed in Section 2.3.8 on page 21. A metadata function interprets an argument as an identifier by conceptually performing the following operations:

- It removes any leading and trailing spaces.
- Then, if the first character is a double quote and the last character is a double quote, the argument is a delimited identifier and the characters between the first and the last character constitute the value of the argument. Otherwise, the entire string, with any lower-case letters

converted to the corresponding upper-case letter, is the value of the argument.

The argument does not qualify a query but rather specifies the metadata desired. The
EX application cannot pass a null pointer or otherwise avoid making this specification except when specifying *CatalogName* in a case where the implementation does not support catalog names.

Qualification — General Rules

When an argument qualifies a metadata query, it excludes non-matching rows from the result set, as though the equivalent embedded SQL queries in the above table were qualified by a WHERE clause.

If the application passes a null pointer as a string input argument, it inhibits qualification of the query and does not restrict the result set.

When an application uses more than one qualification of a metadata function, the qualifications apply conjunctively, as though the WHERE clauses in the equivalent embedded SQL query were joined by AND. A row appears in the result set only if it meets all the qualifications.

Qualification by Value List

For parameters with the **VL** legend in Table 4-3 on page 54, the corresponding argument can contain a value list. This is a list of one or more acceptable values (server attributes or table types). Acceptable values are defined on the respective reference manual page.

Values must be specified in upper case. Multiple values are separated by commas. The value % matches any result and thus keeps that argument from qualifying the result set.* Multiple values in a value list are applied disjunctively; a row is qualified to appear in the result set if it matches any of the values in the list.

Redundant value lists (lists in which a value is repeated, or in which % is present along with one or more discrete values) are valid but do not produce multiple copies of rows in the result set. The implementation ignores values that it does not recognise and processes the value list as though any such values were not present.

Quotes are not used in value lists, either to enclose the value list or to enclose a single list item.

Qualification by Pattern-values

Parameters with the **PV** legend in Table 4-3 on page 54 are treated as pattern-values if the SQL_ATTR_METADATA_ID attribute of the relevant statement handle is SQL_FALSE. (Otherwise, see **Treatment as Identifier**).

The corresponding arguments function as a *pattern-value* does in the X/Open **SQL** specification. That is:

- The underscore character (_) stands for any single character.
- The percent character (%) stands for any sequence of zero or more characters.*
- All other characters stand for themselves.

The case of a letter is significant.

---

* Passing a null pointer or a zero-length string as the argument has the same effect.

In embedded SQL, an application would achieve comparable qualification by using a LIKE predicate as follows, where the question mark is a dynamic parameter marker:

```
column LIKE ?
```

Some implementations support an *escape character*. The escape character is not treated as part of the pattern, and causes the following character in *pattern-value* to be taken literally (without the special effects for _ and % described above). The escape character itself can be specified in a pattern by including it twice in succession. An application can extract the SQL_SEARCH_PATTERN_ESCAPE characteristic by calling *GetInfo*( ). This indicates whether an escape character is supported and, if so, what the escape character is.

4.7 Introspection

An application may use the *introspection functions* described below to find out about the characteristics and capabilities of both a CLI implementation and servers enabled through that implementation. These functions are of particular use to generic applications that are written to customise themselves to adapt to and to take advantage of the facilities provided by a range of CLI implementations and DBMS (Database Management System) servers.

The following introspection functions are defined:

DataSources( )
: Returns a list of server names to which the application may be able to connect, and may return a description of each such server.

GetFunctions( )
: Returns a true/false result that indicates whether the implementation supports a specified CLI function.

EX *GetInfo*( )
: Obtains implementation-defined limit values. The application specifies one limit, for which it seeks the implementation-defined value, on each call to *GetInfo*( ). Certain limits are enforced by the client or server. The information available from *GetInfo*( ) is in addition to the information obtained using the analogous SERVER_INFO system view of embedded SQL.

GetTypeInfo( )
: Obtains information about data types supported by a server, in the form of a result set.

4.8 Data Conversion

Data in CLI moves between application buffers and implementation buffers (which the CLI implementation exchanges with the database). Application descriptors and implementation descriptors describe the data in the respective buffer. (Section 4.3 on page 46 describes this process when the application uses dynamic arguments to move information into the database. Section 4.5 on page 50 describes this process when the application uses row descriptors to extract information from the database.)

Fields of the respective descriptors specify data type and type attributes. Section 4.8.1 describes the use of the TYPE field in implementation descriptors. Section 4.8.2 on page 58 describes the use of the TYPE field in application descriptors.

When the implementation and application descriptors specify different data types or type attributes, transferring data results in data conversion. Section 4.8.3 on page 60 specifies the permitted combinations and Section 4.8.4 on page 61 specifies their effects.

4.8.1 Specifying SQL Data Types

Implementation descriptors have fields that describe data from the standpoint of the database. The integer values that are valid for the TYPE field denote one of the SQL data types. (They use the same values defined in the X/Open **SQL** specification and the ISO SQL standard.) For some data types, other descriptor fields specify attributes such as length, precision and scale. For date/time values, CLI uses an integer *date/time subcode* based on the ISO SQL standard. To specify these integer values, applications should use the symbols shown in the centre and right columns in the following table. The application can also use implementation-defined values.

SQL Data Type	Integer Data Type Identifier	Date/Time Type Subcode
CHARACTER(*n*)	SQL_CHAR	
EX DATE	SQL_DATETIME	SQL_CODE_DATE
DECIMAL	SQL_DECIMAL	
DOUBLE PRECISION	SQL_DOUBLE	
FLOAT	SQL_FLOAT	
INTEGER	SQL_INTEGER	
NUMERIC	SQL_NUMERIC	
REAL	SQL_REAL	
SMALLINT	SQL_SMALLINT	
EX TIME	SQL_DATETIME	SQL_CODE_TIME
EX TIMESTAMP	SQL_DATETIME	SQL_CODE_TIMESTAMP
CHARACTER VARYING(*n*)	SQL_VARCHAR	

Table 4-4 Integers Specifying SQL Data Types

The *BindCol*(), *BindParam*() and *DescribeCol*() functions do not have a parameter for the date/time type subcode. However, the application can specify date/time types to these functions and indicate the correct subcode by using the data type identifier in the left column of the following table:

Special Integer Data Type Identifier	Resulting Integer Date Type Identifier	Resulting Date/Time Type Subcode
SQL_TYPE_DATE	SQL_DATETIME	SQL_CODE_DATE
SQL_TYPE_TIME	SQL_DATETIME	SQL_CODE_TIME
SQL_TYPE_TIMESTAMP	SQL_DATETIME	SQL_CODE_TIMESTAMP

Table 4-5 Integers Specifying Date/Time Subtypes

4.8.2 Specifying Application Buffer Types

Application descriptors have fields that describe data from the standpoint of the application. The tables below give the values that specify particular application data types, and recapitulate (from Section 2.2.2 on page 16 and Section 2.2.3 on page 17) the specific data types the application uses.

The application can also use implementation-defined values.

C Language

In C programs, the application descriptor's TYPE field denotes one of the generic C data types defined in Section 2.2.2 on page 16. Applications should set the descriptor's TYPE field to one of the values from the centre column of the following table:

Symbolic Data Type	Integer Data Type Identifier	C Data Type
SQLCHAR	SQL_CHAR	**unsigned char**
EX SQLDATE	SQL_CHAR	**unsigned char**
SQLDECIMAL	SQL_CHAR	**unsigned char**
SQLDOUBLE	SQL_DOUBLE	**double**
SQLFLOAT	SQL_DOUBLE	**double**
SQLINTEGER	SQL_INTEGER	**long**
SQLNUMERIC	SQL_CHAR	**unsigned char**
SQLREAL	SQL_REAL	**float**
SQLSMALLINT	SQL_SMALLINT	**short**
EX SQLTIME	SQL_CHAR	**unsigned char**
EX SQLTIMESTAMP	SQL_CHAR	**unsigned char**
SQLVARCHAR	SQL_CHAR	**unsigned char**

Table 4-6 Integers Specifying Application Buffers in C

COBOL

In COBOL programs, the application descriptor's TYPE field denotes one of the generic COBOL data types defined in Section 2.2.3 on page 17. Applications should set the descriptor's TYPE field to one of the values from the centre column of the following table:

Symbolic Data Type	Integer Data Type Identifier	COBOL Data Type
SQLCHAR	SQL-CHAR	PIC X(*n*)
EX SQLDATE	SQL-CHAR	PIC X(10)
SQLDECIMAL	SQL-DECIMAL	PIC S9(*p*-*s*)V9(*s*) PACKED-DECIMAL
SQLDOUBLE	SQL-CHAR	PIC X(*n*)
SQLFLOAT	SQL-CHAR	PIC X(*n*)
SQLINTEGER	SQL-INTEGER	PIC S9(9)
SQLNUMERIC	SQL-NUMERIC	PIC S9(*p*-*s*)V9(*s*) DISPLAY SIGN LEADING SEPARATE
SQLREAL	SQL-CHAR	PIC X(*n*)
SQLSMALLINT	SQL-SMALLINT	PIC S9(4)
EX SQLTIME	SQL-CHAR	PIC X(*n*)
EX SQLTIMESTAMP	SQL-CHAR	PIC X(*n*)
SQLVARCHAR	SQL-CHAR	PIC X(*n*)

Table 4-7 Integers Specifying Application Buffers in COBOL

4.8.3 Permitted Combinations

For a given dynamic argument or database column value, the implementation and application data types must be compatible, as defined below. (Compatibility is only relevant when there are separate implementation and application descriptors and they specify different data types.)

Implementations' use of data types may vary. No correspondence is guaranteed to be exact; any data value may change precision and scale when moving between the application and implementation. Limits on precision and scale, as well as truncation and rounding rules for type conversions, follow the rules of the X/Open **SQL** specification. Truncation of values to the right of the decimal point for numeric values returns a truncation warning, whereas truncation to the left of the decimal point returns an error.

Direct Transfers

The following combinations are valid and do not result in data conversion:

Integer Describing SQL Data Type		Integer Describing Application Buffer Type C	COBOL
SQL_CHAR	←→	SQL_CHAR	SQL-CHAR
SQL_DECIMAL	←→	no direct transfer in C	SQL-DECIMAL
SQL_DOUBLE	←→	SQL_DOUBLE	no direct transfer in COBOL
SQL_INTEGER	←→	SQL_INTEGER	SQL-INTEGER
SQL_NUMERIC	←→	no direct transfer in C	SQL-NUMERIC
SQL_REAL	←→	SQL_REAL	no direct transfer in COBOL
SQL_SMALLINT	←→	SQL_SMALLINT	SQL-SMALLINT
SQL_VARCHAR	←→	SQL_CHAR	SQL-CHAR

Table 4-8 Buffer Combinations not Resulting in Data Conversion

No direct transfer for SQL_FLOAT is shown in the table above because neither C nor COBOL has a floating-point data type whose precision can be stated specifically, as in SQL. Except as noted below, the C programmer must assume that the FLOAT value of interest can reasonably fit a C **double** variable; but any transfer in either direction between an FLOAT column and a C **double** variable may result in loss of precision, depending on the precision of the FLOAT column.

DATE, TIME and TIMESTAMP have no standard host-language support in either C or COBOL, and values for such columns must therefore be both supplied and retrieved as character strings (see **Transfers with Conversion to/from String** on page 62).

Default Transfers

The application can specify SQL_DEFAULT as a data type. This tells the implementation to assume a data type for the application buffer based on the data type in the implementation descriptor.

- If the application provides SQL_DEFAULT in an application parameter descriptor or in *BindParam*( ), then the dynamic argument is interpreted based on the data type of the corresponding dynamic parameter, as specified in the following table, and data conversion may occur.
- If the application provides SQL_DEFAULT in an application row descriptor or in *BindCol*( ), then columns fetched from the database are placed in the application buffer in a data type that depends on their data type in the database according to the following table.

SQL_DEFAULT is the initial value when a record of an application row descriptor is created.

Data Type of Database Value	Implied Data Type of Application Data
SQL_CHAR	SQL_CHAR (no conversion)
SQL_DECIMAL	SQL_CHAR
SQL_DOUBLE	SQL_DOUBLE (no conversion)
SQL_INTEGER	SQL_INTEGER (no conversion)
SQL_NUMERIC	SQL_CHAR
SQL_REAL	SQL_REAL (no conversion)
SQL_SMALLINT	SQL_SMALLINT (no conversion)
SQL_VARCHAR	SQL_CHAR (no conversion)

Table 4-9 Implied Application Data Types under SQL_DEFAULT

Cautions on Use of SQL_DEFAULT

At the time of the transfer, the implementation replaces SQL_DEFAULT in the TYPE field of the descriptor with an integer that describes the result of the transfer. Thus, to specify SQL_DEFAULT semantics again for the next transfer, the application must reset the TYPE field of the descriptor.

Specifying this type of default semantics from COBOL when the database type is REAL or DOUBLE inhibits data conversion, as shown in the table. Since REAL and DOUBLE are not COBOL data types, transferring such data without conversion typically results in misinterpretation by the receiver.

To retrieve column data successfully, the application must determine correctly the length and starting point of the data in the application buffer. When the application specifies an explicit buffer type, application misconceptions are readily detected. However, when the application specifies SQL_DEFAULT, the transfer can be applied to a column of a different data type from the one intended by the application, either from changes to the metadata or by applying the code to a different column. In this case, the application may fail to determine the start or length of the fetched column data. This can lead to unreported data errors or memory violations.

Other Transfers

It is implementation-defined what other combinations of SQL data types and application buffer types are allowed. For example, an implementation might support a transfer from the INTEGER SQL data type into an application buffer type of SQL_DOUBLE. In these cases, the criteria under which truncation warnings, truncation errors and overflow errors occur are implementation-defined.

4.8.4 Transfers and Conversions

String-to-String Transfers

When assigning a character-string value to a character-string table column or application buffer, the length of the source may differ from the length of the destination:

- If the source is shorter than the destination, and the destination is of type CHARACTER, remaining trailing characters of the destination are filled with blanks. (If the destination is of type CHARACTER VARYING, and the source is shorter than the maximum length of the destination, assignment occurs, determined by the length of the source, and there is no

blank-padding.)

- If the source is longer than the destination, trailing characters of the source are truncated. This may produce diagnostics; see Section 5.4.10 on page 76.

These same rules apply when a non-character value is converted to string because the application specifies assignment to a character-string target.

Transfers with Conversion to/from String

The application can transfer a value of any SQL data type by specifying SQL_CHAR as the application buffer type. For numeric or date/time SQL data types, this implies a conversion. That is, when retrieving a numeric or date/time value, the implementation moves the value's character-string representation to the application's buffer. When supplying a numeric or date/time value, the application's buffer must contain a valid character-string representation of that value. Transfers in both directions follow the rules for literals of the respective type:

- The rules for numeric literals are specified in the X/Open **SQL** specification. Conversion between numeric and string formats depends on two attributes, precision and scale, discussed below.

EX
- The rules for date/time literals are as follows:

  — Valid dates (SQLDATE) have a length of 10 characters (SQL_DATE_LEN), follow the sequence year, month, day, and have the following format: `yyyy-mm-dd`.

  — Valid times (SQLTIME) have a length of 8 characters (SQL_TIME_LEN) or greater (see below), follow the sequence hour, minute, second, and have the following format: `hh:mm:ss`.

  — Valid timestamps (SQLTIMESTAMP) have a format that concatenates the format of SQLDATE, one space as a separator, and the format of SQLTIME. Thus a timestamp's length is 19 characters (SQL_TIMESTAMP_LEN) or greater (see below).

  For SQLTIME and SQLTIMESTAMP, the precision attribute refers to the fractional part of the seconds component. If the precision is 0, the seconds component does not have a fractional part and the length and format of the data are as specified above. If the precision is greater than 0, then it specifies a number of decimal digits for the fractional part of the seconds component. The data type's length in characters is that specified above, plus 1 character for a decimal point, plus the precision. An example timestamp with a precision of 2 characters is:

```
1993-12-31 23:59:59.99
```

EX C programs must specify SQL_CHAR, forcing string conversion, for SQL data types DATE, TIME, TIMESTAMP, DECIMAL and NUMERIC, because there is no direct equivalent for DECIMAL and NUMERIC in C. COBOL programs must likewise specify SQL-CHAR for SQL
EX data types DATE, TIME, TIMESTAMP, DOUBLE, FLOAT and REAL. The application must also compute a buffer size in octets sufficient to hold strings of the length in characters given above.

For conversion of numeric data, the application uses additional descriptor fields to specify precision and scale. (For conversion of times and timestamps, the application specifies precision only. This refers to the seconds component, as described above.) For example, to provide a dynamic argument defined as the SQL type DECIMAL(5,3), a C application might specify:

```
SetDescField(ImpParamDesc, RecNumber, SQL_DESC_TYPE, SQL_DECIMAL, 0);
SetDescField(ImpParamDesc, RecNumber, SQL_DESC_PRECISION, 5,      0);
SetDescField(ImpParamDesc, RecNumber, SQL_DESC_SCALE,     3,      0);
```

Concise alternatives using *SetDescRec*( ) and *BindCol*( ) are discussed in Section 6.3 on page 81.

4.9 Transaction Management

A transaction is a recoverable unit of work, which may include SQL database operations, that is to be completed atomically (to have an all-or-nothing effect). In embedded SQL, a transaction begins implicitly and ends when the application executes either the COMMIT or ROLLBACK statement. In CLI, a transaction also begins implicitly when an application that does not already have an active transaction operates on a database.[13] The connection over which the application executes the statement is now *active*.

The transaction completes when the application calls *EndTran*( ). (The transaction may complete in other ways discussed below.) The application must not specify the COMMIT and ROLLBACK statements in *Prepare*( ) or *ExecDirect*( ).) When the transaction is completed, the relevant connections are no longer active.

Effects within a Connection

Completing a transaction has the following effects on CLI data structures:

- It is implementation-defined whether prepared SQL statements survive transactions. A portable application should prepare statements again in order to execute them as part of a new transaction.
- Cursor names, bound dynamic parameters and column bindings survive transactions. However, completing a transaction closes any open cursors.

Effects across Connections

Within an environment, it is implementation-defined whether multiple connections can be active. On implementations that allow this, it is implementation-defined which of the following is true:

- A transaction is local to a single connection; completing a transaction on an environment commits or rolls back work done in each connection as a unit, but independent of the success of commitment on any other connection.
- A transaction spans all affected connections in the environment (those on which the application has operated on a database). Completing a transaction on an environment either enacts all work done in the environment since the start of the transaction, or undoes it all.

---

13. The application operates on a database in any of the following ways:

— by preparing an SQL statement that operates on a database, using the CLI functions *Prepare*( ) or *ExecDirect*( ) (the X/Open **SQL** specification defines which SQL statements operate on a database)

— by executing a metadata function (see Section 4.6 on page 53)

— it is implementation-defined whether SQL data definition statements (operations on metadata) obey the same transaction semantics — the variety of current implementations is discussed in the X/Open **SQL** specification.

For some implementations, a transaction may have begun even if one of the above calls fails. After such a failure, portable applications should call *EndTran*( ) to ensure that a transaction is not active.

CLI calls concerning connection, allocation and specification of dynamic arguments do not operate on a database, nor do the *Cancel*( ), *GetDiagField*( ), *GetDiagRec*( ) and *EndTran*( ) calls.

To maximise portability, an application should complete a transaction before switching to another connection.

Effects across Environments

In implementations that allow the application to use more than one environment, the application can complete transactions on each environment separately; for example, by calling *EndTran*( ). In the case where the application connects to the same database through two or more environments, it is implementation-defined which of the following is true:

- Work performed in several environments is within a single transaction context and is committed atomically.
- Work performed in each environment constitutes a separate transaction and the implementation provides no implicit coordination of commitment between the transactions.

A portable application should allocate only one environment.

Errors

Any attempt to start or to complete a transaction may fail for implementation-defined reasons. A transaction may fail for implementation-defined reasons any time during a connection, and it is possible that the application can detect the failure only after its next operation on the database. In addition, a transaction can be rolled back even if the call to *EndTran*( ) specified commitment. These topics are discussed in Section 5.4.4 on page 74.

4.9.1 Explicit Transaction Demarcation

CLI can be used in conjunction with transaction demarcation APIs, provided that the application ends each transaction using the same API that it used to begin that transaction. If an application calls a function from such an API explicitly to start a transaction, it must do so before operating on a database. If an application begins a transaction implicitly (by operating on a database as described above), it must call *EndTran*( ) to complete the transaction. It is implementation-defined which, if any, explicit transaction demarcation APIs are supported.

For example, the X/Open **TX** specification specifies a non-SQL-specific API with functions that start, commit and roll back a global transaction. These global transaction control functions allows SQL work to be coordinated with non-SQL work.

4.9.2 Distributed Transaction Processing

When the application starts a transaction, it is either global or local according to implementation-defined rules.

A local transaction pertains only to the connection through which the application operated on the database.

In a global transaction, the work can be coordinated with other work, so that the work is either all committed or all rolled back; this means the success of an application's work may depend on other work that the application does not control.

CLI does not define a way for the application to specify local *versus* global, nor to refer to a particular transaction. An application using CLI refers to global transaction work (with the *EndTran*( ) call) only by specifying the environment. If the application uses an explicit transaction demarcation API, that API may let the application participate further in the definition of transactions.

For example, the X/Open **TX** specification defines a global transaction identifier and specifies that the basis on which work is considered part of a global transaction is the fact that the work is performed by the same application thread of control. This and other X/Open Distributed Transaction Processing (DTP) documents describe methods of coordinating databases so that changes to any recoverable resources are committed or rolled back atomically.

Chapter 5

Diagnostics

This chapter explains how CLI reports diagnostic information to the application.

Each CLI function returns a basic diagnostic as the function return value, as described in Section 5.1. The *GetDiagField*( ) function provides more detailed diagnostic information, as described in Section 5.2 on page 69. This arrangement lets applications handle the basic flow of control simply, but lets an application, at its option, determine specific causes of failure.

Other information that is present in the diagnostics area for historical reasons is presented in Section 5.3 on page 72. General diagnostics in Section 5.4 on page 73 cover warning and failure situations, common to many CLI functions, which are not repeated on the individual reference manual pages.

Diagnostics whose value or significance is specific to a CLI function appear on the respective manual page in Chapter 8.

5.1 Return Value

Syntactic Form of Return Value

The definition of all CLI functions includes a return value of the SMALLINT generic type. In the reference manual pages in Chapter 8, the generic definition of all functions includes:

```
RETURNS (SMALLINT)
```

For example, the CLI function *Execute*( ) is called in C as follows:

```
ReturnCode = SQLExecute(StatementHandle);
```

In programming languages such as COBOL where called subroutines do not return a value, the status code is an additional explicit output parameter of the CLI function. For example, when called in COBOL, *Execute*( ) is instead defined as follows:

```
CALL "SQLRExecute" USING STATEMENTHANDLE, RETURNCODE.
```

All references in this specification to the result of a CLI function should be interpreted in COBOL environments as referring to the output value of this last parameter.

Defined Return Values

The header file (see Appendix C) defines symbolic names for result values of a CLI function that a portable application should use:

[SQL_SUCCESS]
The function completed successfully. (This includes the case where null column values are fetched.)

[SQL_SUCCESS_WITH_INFO]
The function completed successfully; warning or additional information is available by calling *GetDiagField*( ). For example, truncation of column values (except in *GetDiagField*( )) produces this warning outcome.

[SQL_NO_DATA]

DataSources( )
There are no more server names to retrieve.

Error( )
No further diagnostic records exist for the specified handle.

Execute( ), *ExecDirect*( ) and *ParamData*( )
The executed SQL statement produced the **No data** outcome. These cases are enumerated in the X/Open **SQL** specification. Additional implementation-defined diagnostic information may be available, which the application can obtain by calling *GetDiagField*( ).

Fetch( )
There are no rows in the result set, or previous calls have fetched all rows from the result set.

FetchScroll( )
The specified row of the result set does not exist.

GetData( )
The preceding fetch operation returned [SQL_NO_DATA].

GetDescField( ), *GetDescRec*( ), *GetDiagField*( ), *GetDiagRec*( )
The caller asked for information from a record number that exceeds the number of records available.

[SQL_ERROR]
The function failed; call *GetDiagField*( ) for more specific failure information.

[SQL_INVALID_HANDLE]
The function failed due to an invalid handle passed as an input argument. This indicates a programming error. No further information is available from *GetDiagField*( ).

[SQL_NEED_DATA]
The application tried to execute a SQL statement but the implementation lacks parameter data that the application had indicated would be passed at execute time (see Section 4.3.2 on page 48).

In error cases where *AllocHandle*( ) cannot allocate or gain access to the relevant handle, it uses other semantics to report errors; see *AllocHandle*( ) on page 92.

5.2 Detailed Diagnostic Information

Most CLI calls produce diagnostic information describing the outcome of the call. The diagnostic information includes a header with general information pertaining to the CLI function's execution, and zero or more *status records*[14] each describing one condition or event related to the call's execution. Each status record contains the following:

- A five-character, standardised SQLSTATE diagnostic code. Values of SQLSTATE are shown in this manual in the format '**CC**SSS', where **CC** is the class code and SSS is the subclass. The format, values, and usage are the same as in the X/Open **SQL** specification, except that additional, CLI-specific codes are defined as class '**HY**'. (See Appendix A for a list of CLI SQLSTATE values with cross-references.)

  Implementation-defined conditions or events are reported with class codes or subclass codes in the implementation-defined range listed in the X/Open **SQL** specification.

- An implementation-defined numeric code.
- An implementation-defined message.
- Strings that indicate the document that defines the class and the subclass portion of the SQLSTATE value in this record.
- Strings that specify the connection name and the server name that the diagnostic record pertains to.

Status records may also contain other implementation-defined data.

All types of handle accommodate a diagnostics data structure containing such records. Any CLI function that writes diagnostic information to a handle's data structure (even a success indication) writes the entire data structure without regard for its previous contents.

If *Cancel*( ) was called to cancel the execution of a CLI function that is running in another process or thread, and it succeeded in cancelling the execution, a status record with '**HY**008' appears in the diagnostic data structure of the associated statement handle to indicate this.

Number of Status Records

If a function returns [SQL_SUCCESS], there are no status records; the corresponding SQLSTATE ('**00**000') from embedded SQL is not used in CLI.

If a function returns [SQL_INVALID_HANDLE], there is no valid handle with which to associate diagnostic information.

If a function returns [SQL_ERROR] or [SQL_SUCCESS_WITH_INFO], then there is at least one status record.

If a function returns [SQL_NO_DATA], there is no status record corresponding to the SQLSTATE ('**02**000') from embedded SQL, but there may be one or more implementation-defined status records in class '**02**'.

14. The corresponding term in the X/Open **SQL** specification is *exception information item*.

Sequence of Status Records

If there are two or more status records, they occur in an undefined order, except that if one of the records contains the value that X/Open embedded SQL would place in the SQLSTATE variable, then that record appears first in the diagnostic data structure.

Consistent with the ISO SQL standard, this initial record can be defined for CLI as the highest-ranking condition using the following ranking:

1. **Errors.** If two or more status records describe the same condition, then the standardised or X/Open-defined SQLSTATE (classes from '**03**' to and including '**HZ**') outranks the implementation-defined SQLSTATE.[15]
2. **Implementation-defined No Data values** in class '**02**'.
3. **Warnings** — values in class '**01**'. If two or more status records describe the same condition, then the standardised or X/Open-defined SQLSTATE outranks the implementation-defined SQLSTATE.

If the implementation generates two or more status records that all have the highest rank of any status record generated, then it is undefined which of these is the first record.

In the remainder of the diagnostics data structure, an application cannot assume that errors precede warnings. Applications should scan the entire diagnostic data structure to obtain complete information on the non-success outcome of a CLI function.

Obtaining Diagnostic Information

The application obtains diagnostic information by specifying the handle and the number of the desired status record.

A call to *GetDiagField*( ) obtains a single field of the specified diagnostic record. *GetDiagField*( ) is extensible and can return diagnostic information defined in the future or by implementations.

GetDiagField( ) returns [SQL_NO_DATA] if the application specifies a record number in excess of the available diagnostic records. Therefore, the application can scan the entire set of status records by calling *GetDiagField*( ) repeatedly, incrementing the desired record number until the function returns [SQL_NO_DATA].

5.2.1 Error Codes from the X/Open SQL Specification

The X/Open **SQL** specification (SQLSTATE Status Variable) reserves all class and subclass codes starting with 0-4 or A-H for definition by an international standard. RDA-specific errors are in class '**HZ**'.

The X/Open **SQL** specification (SQLSTATE Values) is the authoritative reference for a description of each SQLSTATE code. Using CLI to execute SQL text whose syntax or usage violates the X/Open **SQL** specification produces the error code specified by the X/Open **SQL** specification.

15. In addition, records that indicate a failure or possible failure of the transaction outrank records that indicate statement failure.

5.2.2 CLI-specific Errors

Error class '**HY**' covers all CLI-specific errors. Implementation-defined errors pertaining to the application's use of CLI specify class '**HY**' and subclasses '500' to '9ZZ' inclusive and 'I00' to 'ZZZ' inclusive. (X/Open reserves subclass codes 'S00' to 'SZZ' inclusive.)

5.3 Other Information in the Diagnostics Data Structure

Certain non-diagnostic information is present in the diagnostic data structure for the historical reason that it appears in the diagnostic area in embedded SQL.

5.3.1 Type of SQL Statement

EX The implementation stores, in the diagnostic data structure, the identity of the SQL statement executed by a call to *ExecDirect*( ) or *Execute*( ). The application can obtain this information, as a string or as an integer, by calling *GetDiagField*( ) with *DiagIdentifier* set to SQL_DIAG_DYNAMIC_FUNCTION or SQL_DIAG_DYNAMIC_FUNCTION_CODE respectively.

5.3.2 Row Count

After executing a statement by calling *Execute*( ) or *ExecDirect*( ), the diagnostics data structure associated with the statement handle contains a *row count* that specifies the number of rows that the statement affected. To obtain the row count, an application calls *GetDiagField*( ) with *DiagIdentifier* set to SQL_DIAG_ROW_COUNT.

If the statement was searched DELETE, INSERT or searched UPDATE, the row count is the same statistic that is available in embedded SQL by executing:

```
GET DIAGNOSTICS variable = ROW_COUNT
```

- For the searched DELETE statement, this is the number of rows deleted from the table.
- For the INSERT statement, this is the number of rows inserted into the table.
- For the searched UPDATE statement, this is the number of rows updated in the table.

If the statement was not one of the above types, the resulting row count is undefined.

The count does not include any rows in other tables that the statement may have affected.

OP X/Open encourages implementations to define the row count for additional SQL statements as follows:

a. For any positioned UPDATE and positioned DELETE statement, the row count is 1.

b. For any other SQL statement, the row count is 0.

A portable application cannot assume these semantics, and should not use the row count unless the SQL statement executed was INSERT, searched UPDATE or searched DELETE.

5.4 General Diagnostics

Each CLI function description includes a **DIAGNOSTICS** section that describes error and warning outcomes. The following information describes errors that pertain to many CLI functions. This information is not repeated in function descriptions.

5.4.1 Connection Errors

Disconnection can occur independently of the application because of communication errors, administrative action or other events. *Disconnect*( ), plus an implementation-defined set of CLI functions,[16] can report the following:

- There is no current connection ('**08**003').
- There is no current connection because of an event that occurred independently of the application ('**08**006').[17]

Any disconnection of the current connection rolls back any active transaction. The diagnostics associated with the connection handle report both the rollback and the loss of the connection.

5.4.2 Change of Connection

When the application passes the handle of a dormant connection to a CLI function, it implicitly makes that connection current and all other connections dormant. When the application passes a statement handle to a CLI function, the same applies if the connection on which the statement handle was allocated is dormant. Connection and statement context (that is, information associated with the SQLHDBC and SQLHSTMT defined in Section 3.1 on page 26) persist across a period of dormancy.

It is implementation-defined whether a single transaction may encompass more than one connection. If an implementation disallows this, then specifying an SQLHDBC that implies a change of connection, when a transaction is active, fails ('**0A**001'). The CLI function also fails if the new connection has been disconnected, as described in the previous section.

5.4.3 State Transition Errors

The application must call CLI functions in a strict order ('**HY**010'). Although many cases of invalid calling sequences are listed on the respective reference manual pages, the state tables in Appendix B authoritatively define this type of error.

Valid sequences for CLI function calls when the data-at-execute dialogue is in progress are specified in Section 4.3.2 on page 48 and Table B-3 on page 244.

---

16. Generally, the set of functions that take a connection handle as an argument.

17. The implementation may instead return the SQLSTATE code '**40**003' (Statement completion unknown) or '**08**007' (Transaction state unknown). See the X/Open **SQL** specification (general diagnostics for connection statements) for details.

    If *Disconnect*( ) reports this condition, it reports a warning ('**01**002') instead of an error because the disconnection succeeds.

Timing of Attempts to Set Attributes

Certain attributes can be set only at certain times ('**HY**011'). This diagnostic covers the following cases:

- The application cannot set any environment attribute while a connection handle is allocated on that environment.
- Certain statement attributes cannot be set when there is a prepared statement or an open cursor on the statement handle (see the **DIAGNOSTICS** for *SetStmtAttr*( )).
- Implementation-defined attributes may carry implementation-defined restrictions on the application's ability to set the attribute's value. Any such restrictions reflect cases in which processing on the handle has progressed to the point that changing the specified attribute's value would be meaningless or erroneous.

5.4.4 Transaction Errors

Start of Transaction

When a CLI function call starts a transaction on a database (see Section 4.9 on page 63), and there is already work in progress over a different connection, the function may fail ('**0A**001') for the following reasons:

- There are insufficient resources to add another connection to the current transaction.
- The implementation does not support global transactions.

Spontaneous Rollback

Any CLI function, including *EndTran*( ), that contacts a server to access the database (that is, any function that could acquire a lock in the database) can report that a rollback has been executed against the current transaction. (The SQLSTATE class is '**40**' and the subclass is one of those specified in Appendix A.) A program cannot assume that any changes are made to the database until a call to *EndTran*( ) that specifies commitment returns successfully. The transaction may fail for various reasons, including communication errors, action taken by the server to prevent deadlock, and server failure. In all of these cases, it is possible that the transaction is rolled back.

5.4.5 Inability to Access Handle

In some small-system environments, processing of handles can fail under extreme low memory conditions. Any CLI function may thus report that it cannot gain access to the handle ('**HY**013').* Any CLI function may also report a memory allocation failure ('**HY**001').*

---

* In a failure where the CLI function cannot gain access to the handle, there is no way to return the specified SQLSTATE value. There are additional error semantics in the case of *AllocHandle*( ); see **RETURN VALUE** in *AllocHandle*( ) on page 92.

5.4.6 Cancellation

A CLI function may fail ('**HY**008') because it tried to execute an SQL statement that was cancelled by use of the *Cancel*( ) function during its operation. See *Cancel*( ) on page 105 for details.

5.4.7 String Lengths

Except as noted in the reference manual pages, an argument denoting the length of an input string must be non-negative or SQL_NTS[L]. Moreover, a length of 0 is not valid ('**HY**090') except in the following cases:

- to specify a zero-length dynamic argument
- as the server name, user identifier and authentication string in *Connect*( ), where a zero length indicates an implementation-defined default value
- as a qualification parameter of a metadata function (see Section 4.6.1 on page 54), where a zero-length string inhibits qualification of the query on that basis.

If null termination of output strings is in effect in the environment, the input argument describing the length in octets of an output string must be at least the number of octets of the null terminator (see Section 2.3.6 on page 19) ('**HY**090').

5.4.8 Null Pointers

In a programming language that allows the application to use pointers, the application must not supply a null pointer ('**HY**009')* except in the following cases:

- to specify a zero-length dynamic argument
- as the server name, user identifier and authentication string in *Connect*( ), where a null pointer indicates an implementation-defined default value
- as a qualification parameter of a metadata function (see Section 4.6.1 on page 54), where a null pointer inhibits qualification of the query on that basis
- any other case explicitly permitted in the reference manual pages in Chapter 8.

5.4.9 Descriptor Record Consistency

Application Descriptors

Whenever the application sets the DATA_PTR field of a descriptor, the implementation checks that the value of the TYPE field and the values of fields applicable to that TYPE are valid and consistent ('**HY**021'):[18]

- The TYPE field must be one of the values listed in Section 4.8.2 on page 58 or an implementation-defined value.

---

* In a failure where the CLI function cannot gain access to the handle, there is no way to return the specified SQLSTATE value. There are additional error semantics in the case of *AllocHandle*( ); see **RETURN VALUE** in *AllocHandle*( ) on page 92.

18. The comparable SQLSTATE values in embedded SQL are '**07**001' for parameters and '**07**002' for rows. However, in CLI, the eventual use of the descriptor record is not known at the time this check is made.

- All other fields that apply to the data type that the descriptor specifies must be valid and consistent.

Implementation Descriptors

The application does not normally set the DATA_PTR field of an implementation descriptor. The application can do so, however, to force the following checking to occur ('**HY**021'):

- The TYPE field must be one of the values listed in Table 4-4 on page 58 or an implementation-defined value.
- EX If the TYPE field is SQL_DATETIME, then the DATETIME_INTERVAL_CODE field must be one of the integer Date/Time Type Subcode values listed in Table 4-4 on page 58 or an implementation-defined value.
- All other fields that apply to the data type that the descriptor specifies must be valid (for example, the precision may not be negative) and consistent.

5.4.10 Data Conversion and Assignment Diagnostics

Any CLI function that assigns values to application row buffers or to database columns can produce the diagnostics described below.

String Truncation

When assigning a character string (or the string representation of non-character data), and the target length does not completely hold the string, trailing characters are truncated.

- When assigning to a table column, the string value must be such that no non-blank character is truncated ('**22**001'). Truncation of blank characters does not produce a diagnostic.
- When assigning to an application buffer, the **Success with warning** outcome occurs if any characters (even blanks) are truncated ('**01**004').

Character Representation of Non-Character Data

When assigning a non-character value to a character-string target, there must exist a representation of a literal with the value of the source in the character set defined by the implementation ('**22**018').

Numeric Assignments

When assigning a non-null numeric value to an exact numeric target, there must be a representation of the numeric value in the target data type that does not cause the whole part of the number (that is, the leading significant digits) to be truncated ('**22**003'). The fractional part of the number (that is, the trailing significant digits) may be truncated and it is implementation-defined whether warning flags or indicator variables are set.

When assigning a non-null numeric value to an approximate numeric table column or application buffer, the numeric value must be within the range of magnitude of the destination field ('**22**003'). The result is an approximation of the source numeric value that has the precision of the destination field.

Date/Time Assignments

EX When the target data type is a date/time type, the source must contain only valid characters ('**22**007'). (Currently, X/Open defines date/time assignments only for transfers from application parameter buffers to the database.)

Unspecified Transfers

For any combination of source and target data types not specified in this document, it is implementation-defined which of the following occurs:

- An implementation-defined conversion is performed.
- The implementation generates the '**07**006' error to indicate that the combination is invalid.
- The implementation generates the '**HY**C00' error to indicate that the combination is valid but unsupported.

Chapter 6

Concise CLI Functions

This chapter describes a group of concise CLI functions.

CLI functions that get and set fields have been defined with extensibility in mind. These functions deal with a single field per call. In each function, one argument specifies the desired field. This technique allows future editions of this X/Open specification to define new fields while maintaining backward compatibility with existing applications. It also allows implementations to define proprietary fields whose values can be obtained using the standard interface.

The concise functions are designed to simplify application coding and decrease the required number of CLI functions in many typical cases. They provide a standard higher-level interface to other CLI functions. In many cases, use of the concise functions can keep the application from having to allocate, and obtain the value of, a descriptor.

Most of the concise functions return a set of commonly-used fields of a CLI record, such as a descriptor record. These functions are not designed to be extensible either to yet-to-be-defined fields or to implementation-defined fields. Moreover, the concise functions provide access to an arbitrary selection of fields. An application that needs access to other fields may use the extensible functions, or may supplement use of the concise functions with one or more calls to the extensible functions.

6.1 Inventory of Concise Functions

The concise functions provided, and the underlying functions in whose terms the concise functions are defined, are as follows:

Concise Function	Underlying Function(s)
BindCol( )	*SetDescField*( )
BindParam( )	*SetDescField*( )
DescribeCol( )	*GetDescField*( )
GetDescRec( )	*GetDescField*( )
GetDiagRec( )	*GetDiagField*( )
NumResultCols( )	*GetDescField*( )
SetDescRec( )	*SetDescField*( )

Table 6-1 Basis of Concise CLI Functions

6.2 Definition of Concise Functions

Although complete reference manual pages are provided in Chapter 8, the essential conceptual definition of a concise CLI function is in terms of the underlying function(s) shown above. Implementations are not required to implement a concise function in terms of these underlying functions, but are required to produce results as though that were the case.

This conceptual definition minimises ambiguity about side-effects of functions. It explicitly permits applications to mix calls to concise and extensible functions as they see fit.

6.3 Overview of Concise Functions

BindCol()

Section 3.5 on page 32 explains descriptors and Section 4.5 on page 50 explains binding columns and fetching data from the database.

BindCol( ) allows the application to bind columns of a result set to application variables without having to use descriptors. A single call to *BindCol*( ) sets most of the common fields of the application row descriptor associated with the specified statement handle.

BindCol( ) facilitates and standardises application coding in most common cases. It does not give the application access to future or implementation-defined descriptor fields.

BindParam()

Section 3.5 on page 32 explains descriptors and Section 4.3 on page 46 explains how to use them to bind dynamic parameters to application variables.

BindParam( ) allows the application to bind dynamic parameters to application variables without having to use descriptors. *BindParam*( ) specifies the type and attributes of a dynamic parameter and associates the deferred fields of the application parameter descriptor with specified application variables. *BindParam*( ) sets most of the common fields of the descriptor record in a single call.

BindParam( ) facilitates and standardises application coding in most common cases. It does not give the application access to future or implementation-defined descriptor fields.

DescribeCol()

Section 3.5 on page 32 explains descriptors and Section 4.5 on page 50 explains fetching data from the database.

DescribeCol( ) lets the application obtain the type and attributes of a column of a result set without having to use descriptors. *DescribeCol*( ) retrieves several fields of the implementation row descriptor in a single call.

DescribeCol( ) facilitates and standardises application coding in most common cases. It does not accommodate the case where the application needs to obtain additional fields from the implementation row descriptor. It does not give the application access to future or implementation-defined descriptor fields. It does not return column data from the result set.

GetDescRec()

Section 3.5 on page 32 explains descriptors. Chapter 4 gives several cases where descriptors are used but the description and examples assume the application obtains a single descriptor field per CLI call.

GetDescRec( ) obtains all the commonly used fields of a descriptor in a single call. This includes the name (used only when reading the implementation row descriptor), data type and subtype, length, precision, scale and nullable attributes.

GetDescRec( ) facilitates and standardises application coding in most common cases. It does not give the application access to future or implementation-defined descriptor fields.

GetDiagRec( )

Section 5.2 on page 69 explains CLI diagnostic information. The description assumes the application obtains a single piece of diagnostic information at a time by calling *GetDiagField*( ).

GetDiagRec( ) obtains all the commonly used fields of a diagnostic record in a single call. *GetDiagRec*( ) gives the application access to the SQLSTATE code, the implementation-defined native error, and the implementation-defined message text.

GetDiagRec( ) facilitates and standardises application coding in most common cases. It does not give the application access to future or implementation-defined diagnostic information fields. It does not give the application access to some currently-defined fields of the diagnostic data structure that are less frequently used, such as the row count or the identity of the SQL statement executed.

NumResultCols( )

Section 3.5 on page 32 explains descriptors. Chapter 4 gives several cases where descriptors are used but the description and examples assume the application obtains a single descriptor field per CLI call.

NumResultCols( ) lets the application obtain the number of columns of a result set without having to use descriptors.

SetDescRec( )

SetDescRec( ) is the counterpart to *GetDescRec*( ). It sets commonly used fields of a descriptor, including the deferred fields for data, string length and indicator. See also the discussion of *GetDescRec*( ) above.

Chapter 7

Deprecated CLI Functions

DE This chapter, which describes a group of deprecated CLI functions, should be regarded as completely shaded and subject to the DE margin legend.

The functions described in this chapter do not provide additional capabilities, nor do they reflect the concise/extensible distinction as do the functions described in Chapter 6. However, the functions have entered widespread use based on proprietary CLI implementations that predated the publication of X/Open CLI. X/Open includes those functions in this document, and thereby requires that all X/Open-compliant CLI implementations provide those functions, for the convenience of the CLI applications that have already been written.

However, by marking these functions as deprecated, X/Open recommends that applications move toward use of the CLI functions described in earlier chapters. The reference manual pages for the deprecated functions advise application programmers on the equivalent non-deprecated call that should be used instead.

X/Open intends to remove the deprecated functions from a future issue of this document.

7.1 Inventory of Deprecated Functions

The deprecated functions provided, and the functions to be used in preference to them, are as follows:

Deprecated Function	Preferred Function
AllocConnect( )	*AllocHandle*(SQL_HANDLE_DBC)
AllocEnv( )	*AllocHandle*(SQL_HANDLE_ENV)
AllocStmt( )	*AllocHandle*(SQL_HANDLE_STMT)
ColAttribute( )	*GetDescField*( )
Error( )	*GetDiagRec*( )
FreeConnect( )	*FreeHandle*(SQL_HANDLE_DBC)
FreeEnv( )	*FreeHandle*(SQL_HANDLE_ENV)
FreeStmt( )	*FreeHandle*(SQL_HANDLE_STMT)
GetConnectOption( )	*GetConnectAttr*( )
GetStmtOption( )	*GetStmtAttr*( )
RowCount( )	*GetDiagField*(SQL_DIAG_ROW_COUNT)
SetConnectOption( )	*SetConnectAttr*( )
SetParam( )	*BindParam*( )
SetStmtOption( )	*SetStmtAttr*( )
Transact( )	*EndTran*(SQL_HANDLE_STMT)

Table 7-1 Table of Deprecated Functions

7.2 Definition of Deprecated Functions

Although complete reference manual pages are provided in Chapter 8, the essential conceptual definition of a deprecated CLI function is in terms of the preferred function(s) shown above. Implementations are not required to implement a deprecated function in terms of its preferred function, but are required to produce results as though that were the case.

This conceptual definition minimises ambiguity about side-effects of functions. It explicitly permits applications to mix calls to deprecated and non-deprecated functions as they see fit.

X/Open encourages implementations to implement deprecated functions as calls to, or macros of, the corresponding preferred functions.

7.3 Overview of Deprecated Functions

Explicit Allocate and Free Functions

The preferred *AllocHandle*( ) and *FreeHandle*( ) functions take an argument of the SMALLINT data type that indicates the handle type to be allocated or freed. These functions are thus extensible to future or implementation-defined handle types.

For three of the handle types, the following deprecated CLI functions to allocate and free that specific handle type are in widespread use:

AllocConnect( )
AllocEnv( )
AllocStmt( )
FreeConnect( )
FreeEnv( )
FreeStmt( ) (see below)

Five of these cases correspond directly to a call to *AllocHandle*( ) or *FreeHandle*( ) with appropriate arguments. Applications should replace calls to the functions listed above with calls to *AllocHandle*( ) or *FreeHandle*( ).

The *FreeStmt*( ) function is an exception. The *Option* argument lets the application specify four different behaviours, only one of which corresponds directly to a call to *FreeHandle*( ). Two of the behaviours return descriptor records to the unbound state. The only way to achieve these effects with non-deprecated functions is to free and reallocate the descriptor.

Handle Option Functions

The following handle option functions are comparable to the CLI attribute functions, such as *GetConnectAttr*( ), but align with CLI implementations in which attributes are known as *options*:

GetConnectOption( )
GetStmtOption( )
SetConnectOption( )
SetStmtOption( )

These handle option functions do not have parameters that indicate the length of the attribute value. When retrieving character-string attributes using these functions, the application must either know the exact length in octets of the attribute or allocate the maximum size for the output buffer and initialise it before retrieving the attribute.

Functions *GetEnvOption*( ) and *SetEnvOption*( ) are not provided because CLI implementations that support options do not define any environment options.

Descriptor Function

The *ColAttribute*( ) function is included in this document because it is in widespread use. The function is equivalent to *GetDescField*( ).

Diagnostic Functions

The following deprecated CLI functions that obtain diagnostic information are included because they are in widespread use:

Error( )
RowCount( )

A sequence of calls to *Error*( ) corresponds to a sequence of calls to *GetDiagRec*( ). Whereas *GetDiagRec*( ) can obtain information from the diagnostics area in random order, each call to *Error*( ) returns one record and removes that record from the set of records subsequently available through *Error*( ).

In X/Open-compliant systems, applications are allowed to intermix calls to *Error*( ) and *GetDiagRec*( ). Thus, a compliant implementation of *Error*( ) must not modify the diagnostic area. One model of a compliant implementation is to use a counter as *RecNumber*, which is reset on any statement that writes the diagnostics area and is incremented on each call to *Error*( ).

The *RowCount*( ) function corresponds to a call to *GetDiagField*( ) that specifies the SQL_DIAG_ROW_COUNT diagnostic field. This is the row count (see Section 5.3.2 on page 72) resulting from the most recent call to *ExecDirect*( ) or *Execute*( ).

Transaction Management Function

The deprecated *Transact*( ) function is included because it is in widespread use. It is comparable to the preferred *EndTran*( ) function. The *Transact*( ) function uses a connection handle and takes an environment handle and connection handle as arguments. The application can specify null handle values to indicate the scope of transaction completion. By contrast, the preferred *EndTran*( ) function uses an argument of the SQLSMALLINT data type to indicate the handle type and thus the scope of work to be completed.

Synonym Function

The deprecated function *SetParam*( ) is similar to the preferred function *BindParam*( ).

Implementations must support both functions, but may do so by implementing one as a macro of the other.

Chapter 8

Reference Manual Pages

This chapter contains reference manual pages for the functions in the CLI interface in alphabetical order.

The synopsis for the generic function is provided at the top of each manual page. At the end of the manual page there are prototype function calls, including allocation of variables, for:

- the by-value variant as called from C
- the by-reference variant as called from COBOL.

The **DESCRIPTION** section of each function includes a list of all function parameters. The legend (input) means the parameter passes information from the application to the implementation. The legend (output) means the parameter returns information from the implementation to the application. General semantic information for CLI appears in Section 2.3 on page 18.

The **RETURN VALUE** section lists all return values the function may return. Section 5.1 on page 67 describes the meaning of each return value and explains the syntax of the return value parameter in languages where called subroutines do not return a value.

A **DIAGNOSTICS** section lists any specific errors and warnings that a call to the function can produce. The application can obtain the five-character SQLSTATE values listed (in the format '**CC**SSS') by calling *GetDiagField*( ) or *GetDiagRec*( ). All **DIAGNOSTICS** sections should be read in conjunction with the **General Diagnostics** discussed in Section 5.4 on page 73.

Where applicable, the manual pages include comments concerning application usage, and include usage examples in C and COBOL. In several cases of variable-length output parameters, the appropriate COBOL PICTURE depends on the context; this is illustrated with a placeholder in italics, as in the following example:

```
01 VALUE PICTURE type.
```

Each manual page also includes a list of any closely-related functions.

NAME

AllocConnect — Allocate a connection handle (deprecated)

SYNOPSIS

DE
```
FUNCTION AllocConnect
 (EnvironmentHandle INTEGER,
  ConnectionHandle INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The *AllocConnect*( ) function allocates a connection within the environment specified by *EnvironmentHandle* and returns a handle to the connection in *ConnectionHandle*. The function has the following parameters:

EnvironmentHandle (input)
The environment handle with which *ConnectionHandle* is to be associated.

ConnectionHandle (output)
The handle for the newly-allocated connection.

The connection handle provides for management of information related to the connection, including general status information, transaction state and error information. The application can pass *ConnectionHandle* to *Connect*( ) to connect the application to a server, and then pass it to *AllocHandle*( ) or *AllocStmt*( ) to allocate statement handles associated with that connection.

Using a handle that was already allocated as *ConnectionHandle* is an application programming error. Implementations are not required to detect this error, and typically overwrite the handle value without regard to its previous contents. Specifically, implementations are not required to dispose of resources that the old handle referenced.

The *AllocConnect*( ) function sets all attributes for the allocated handle to their initial values. Initial values of connection attributes are specified in **Connection Attributes** on page 29.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR] or [SQL_INVALID_HANDLE].

If *AllocConnect*( ) returns [SQL_ERROR], *ConnectionHandle* contains SQL_NULL_HDBC and additional diagnostic information is associated with *EnvironmentHandle*.

DIAGNOSTICS

The application must not already have allocated the implementation-defined maximum number of connections ('**HY**014').

APPLICATION USAGE

If *AllocConnect*( ) returns [SQL_ERROR], applications should not use *ConnectionHandle* further. Passing the null handle to a subsequent CLI function makes that function fail with [SQL_INVALID_HANDLE].

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN ReturnCode;
SQLHENV   EnvironmentHandle;
SQLHDBC   ConnectionHandle;
 ...
ReturnCode = SQLAllocConnect(EnvironmentHandle, &ConnectionHandle);
```

EXAMPLE USAGE (COBOL)

```
01 ENVIRONMENTHANDLE   PICTURE S9(9) BINARY.
01 CONNECTIONHANDLE    PICTURE S9(9) BINARY.
```

```
01 RETURNCODE          PICTURE S9(4) BINARY.
 ...
CALL "SQLRAllocConnect" USING ENVIRONMENTHANDLE, CONNECTIONHANDLE,
    RETURNCODE.
```

SEE ALSO

AllocHandle( ), *FreeConnect*( ), *FreeHandle*( )

NAME

AllocEnv — Allocate an environment handle (deprecated)

SYNOPSIS

DE
```
FUNCTION AllocEnv
 (EnvironmentHandle INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The *AllocEnv*( ) function creates an environment and returns a handle to it in *EnvironmentHandle*. The function has the following parameter:

EnvironmentHandle (output)
The handle for the newly-allocated environment.

The environment handle provides for management of global information such as valid connections and the current connection. The application can pass *EnvironmentHandle* to a subsequent call to *AllocHandle*( ) or *AllocConnect*( ) to allocate a connection.

Using a handle that was already allocated as *EnvironmentHandle* is an application programming error. Implementations are not required to detect this error, and typically overwrite the handle value without regard to its previous contents. Specifically, implementations are not required to dispose of resources that the old handle referenced.

The *AllocEnv*( ) function sets all attributes for the allocated handle to their initial values. Initial values of environment attributes are specified in Section 3.2 on page 28.

RETURN VALUE

[SQL_SUCCESS] or [SQL_ERROR].

If *AllocEnv*( ) cannot allocate memory for an environment, it returns [SQL_ERROR], *EnvironmentHandle* contains SQL_NULL_HENV, and there is no handle with which to associate additional diagnostic information. If *AllocEnv*( ) fails to allocate an environment handle for any other reason, it returns [SQL_ERROR] and *EnvironmentHandle* contains a *restricted handle* to a *skeleton environment*. The application can use this handle only on CLI calls that obtain diagnostic information or that free the handle.

DIAGNOSTICS

The application must not already have allocated the implementation-defined maximum number of environments ('**HY**014'). In this case, *EnvironmentHandle* is a restricted handle (see **RETURN VALUE**).

APPLICATION USAGE

If *AllocEnv*( ) returns [SQL_ERROR], applications should not use *EnvironmentHandle* further, except as described in RETURN VALUE above. Passing the null handle to a subsequent CLI function or passing the restricted handle except as described above, makes that function fail with [SQL_INVALID_HANDLE].

Many implementations support only one environment. Portable applications should only allocate one environment handle at a time.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN ReturnCode;
SQLHENV   EnvironmentHandle;
 ...
ReturnCode = SQLAllocEnv(&EnvironmentHandle);
```

EXAMPLE USAGE (COBOL)

```
       01 ENVIRONMENTHANDLE   PICTURE S9(9) BINARY.
       01 RETURNCODE          PICTURE S9(4) BINARY.
        ...
       CALL "SQLRAllocEnv" USING ENVIRONMENTHANDLE, RETURNCODE.
```

SEE ALSO

AllocHandle( ), *FreeEnv*( ), *FreeHandle*( )

NAME

AllocHandle — Allocate a handle

SYNOPSIS

```
FUNCTION AllocHandle
 (HandleType SMALLINT,
  InputHandle INTEGER,
  OutputHandle INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The *AllocHandle*( ) function has the following parameters:

HandleType (input)
: A handle type identifier that describes the handle type of *OutputHandle*. It must contain one of the following values:

  SQL_HANDLE_ENV
  : *AllocHandle*( ) creates an environment and returns a handle to it in *OutputHandle*. *InputHandle* should be SQL_NULL_HANDLE since an environment handle does not exist in the context of any other handle.

  SQL_HANDLE_DBC
  : *AllocHandle*( ) allocates a connection within the environment specified by the environment handle *InputHandle* and returns a handle to the connection in *OutputHandle*.

  SQL_HANDLE_STMT
  : *AllocHandle*( ) allocates a statement within the connection specified by the connection handle *InputHandle* and returns a handle to the statement in *OutputHandle*.

  SQL_HANDLE_DESC
  : *AllocHandle*( ) allocates a descriptor, associates it with the connection handle *InputHandle* and returns a handle to the descriptor in *OutputHandle*.

InputHandle (input)
: The handle that describes the data structure in whose context the new data structure is to be allocated; except that, if *HandleType* is SQL_HANDLE_ENV, this is SQL_NULL_HANDLE.

OutputHandle (output)
: The handle for the newly allocated data structure.

The application can pass *OutputHandle* to subsequent CLI functions to indicate a data structure on which they should operate. In the case of environment handles and connection handles, the application can pass the value of *OutputHandle* to a subsequent call to *AllocHandle*( ) as the *InputHandle* argument, to allocate additional, subsidiary data structures.

Using a handle that was already allocated as *OutputHandle* is an application programming error. Implementations are not required to detect this error, and typically overwrite the handle value without regard to its previous contents. Specifically, implementations are not required to dispose of resources that the old handle referenced.

Handle Attributes

If attributes are defined for the handle type of *OutputHandle*, calling *AllocHandle*( ) sets all attributes to their initial values specified in Chapter 3.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR] or [SQL_INVALID_HANDLE].

When allocating a handle other than an environment handle, if *AllocHandle*( ) returns [SQL_ERROR], *OutputHandle* contains SQL_NULL_HDBC, SQL_NULL_STMT or SQL_NULL_DESC (depending on *HandleType*), and additional diagnostic information is associated with *InputHandle*. This would occur, for example, if *AllocHandle* fails before it allocates *OutputHandle* (which is typical for some memory allocation errors and produces '**HY**001').

When allocating an environment handle, if the application provides a null pointer for *OutputHandle* or if *AllocHandle*( ) cannot allocate memory for *OutputHandle*, *AllocHandle*( ) returns [SQL_ERROR], *OutputHandle* contains SQL_NULL_HENV (unless the application provided a null pointer), and there is no handle with which to associate additional diagnostic information. If *AllocHandle*( ) fails to allocate an environment handle for any other reason, it returns [SQL_ERROR] and *OutputHandle* contains a *restricted handle* to a *skeleton environment*. The application can use this handle only on CLI calls that obtain diagnostic information or that free the handle.

DIAGNOSTICS

Depending on the timing and nature of a diagnostic event, the diagnostic may be returned on *InputHandle* or on *OutputHandle*; see **RETURN VALUE** above.

HandleType must be one of the values defined above ('**HY**092', returned on *InputHandle*).

The application must not already have allocated the implementation-defined maximum number of data structures corresponding to type *HandleType* ('**HY**014'). If this occurs and *HandleType* is SQL_HANDLE_ENV, then *OutputHandle* is a restricted handle (see **RETURN VALUE**).

When allocating a statement or descriptor handle on a connection, the connection must be open ('**08**003').

APPLICATION USAGE

If *AllocHandle*( ) returns [SQL_ERROR], applications should not use *OutputHandle* further, except as described in **RETURN VALUE** above. Passing the null handle to a subsequent CLI function, or passing the restricted handle except as described above, makes that function fail with [SQL_INVALID_HANDLE].

Many implementations support only one environment. Portable applications should only allocate one environment handle at a time.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN ReturnCodeEnv;
SQLRETURN ReturnCodeDbc;
SQLRETURN ReturnCodeStmt;
SQLRETURN ReturnCodeDesc;
SQLHENV   EnvironmentHandle;
SQLHDBC   ConnectionHandle;
SQLHSTMT  StatementHandle;
SQLHDESC  DescriptorHandle;
 ...
ReturnCodeEnv  = SQLAllocHandle(SQL_HANDLE_ENV,
```

```
  SQL_NULL_HANDLE, &EnvironmentHandle);
 ...
ReturnCodeDbc  = SQLAllocHandle(SQL_HANDLE_DBC,
  EnvironmentHandle, &ConnectionHandle);
 ...
ReturnCodeStmt = SQLAllocHandle(SQL_HANDLE_STMT,
  ConnectionHandle, &StatementHandle);
 ...
ReturnCodeDesc = SQLAllocHandle(SQL_HANDLE_DESC,
  ConnectionHandle, &DescriptorHandle);
```

EXAMPLE USAGE (COBOL)

```
01 ENVIRONMENTHANDLE PICTURE S9(9) BINARY.
01 CONNECTIONHANDLE  PICTURE S9(9) BINARY.
01 STATEMENTHANDLE   PICTURE S9(9) BINARY.
01 DESCRIPTORHANDLE  PICTURE S9(9) BINARY.
01 RETURNCODEENV     PICTURE S9(4) BINARY.
01 RETURNCODEDBC     PICTURE S9(4) BINARY.
01 RETURNCODESTMT    PICTURE S9(4) BINARY.
01 RETURNCODEDESC    PICTURE S9(4) BINARY.
 ...
CALL "SQLRAllocHandle" USING SQL-HANDLE-ENV,
  SQL-NULL-HANDLE, ENVIRONMENTHANDLE, RETURNCODEENV.
 ...
CALL "SQLRAllocHandle" USING SQL-HANDLE-DBC,
  ENVIRONMENTHANDLE, CONNECTIONHANDLE, RETURNCODEDBC.
 ...
CALL "SQLRAllocHandle" USING SQL-HANDLE-STMT,
  CONNECTIONHANDLE, STATEMENTHANDLE, RETURNCODESTMT.
 ...
CALL "SQLRAllocHandle" USING SQL-HANDLE-DESC,
  CONNECTIONHANDLE, DESCRIPTORHANDLE, RETURNCODEDESC.
```

SEE ALSO

FreeHandle( )

NAME

AllocStmt — Allocate a statement handle (deprecated)

SYNOPSIS

DE
```
FUNCTION AllocStmt
 (ConnectionHandle INTEGER,
  StatementHandle INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The *AllocStmt*( ) function allocates a statement within the connection specified by *ConnectionHandle* and returns a handle to the statement in *StatementHandle*. The function has the following parameters:

ConnectionHandle (input)
The connection handle with which *StatementHandle* is to be associated.

StatementHandle (output)
The handle for the newly-allocated statement.

The statement handle provides for management of information related to the processing of SQL statements, including descriptors, result values, and status information. The application can pass *StatementHandle* to subsequent CLI functions to indicate a data structure on which they should operate.

Using a handle that was already allocated as *StatementHandle* is an application programming error. Implementations are not required to detect this error, and typically overwrite the handle value without regard to its previous contents. Specifically, implementations are not required to dispose of resources that the old handle referenced.

The *AllocStmt*( ) function sets all attributes for the allocated handle to their initial values. Initial values of statement attributes are specified in **Statement Attributes** on page 30.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR] or [SQL_INVALID_HANDLE].

If *AllocStmt*( ) returns [SQL_ERROR], *StatementHandle* contains SQL_NULL_STMT and additional diagnostic information is associated with *ConnectionHandle*.

DIAGNOSTICS

The application must not already have allocated the implementation-defined maximum number of statements ('**HY**014').

The connection specified by *ConnectionHandle* must be open ('**08**003').

APPLICATION USAGE

If *AllocStmt* returns [SQL_ERROR], applications should not use *StatementHandle* further. Passing the null handle to a subsequent CLI function makes that function fail with [SQL_INVALID_HANDLE].

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN ReturnCode;
SQLHDBC   ConnectionHandle;
SQLHSTMT  StatementHandle;
 ...
ReturnCode = SQLAllocStmt(ConnectionHandle, &StatementHandle);
```

EXAMPLE USAGE (COBOL)

```
01 CONNECTIONHANDLE   PICTURE S9(9) BINARY.
01 STATEMENTHANDLE    PICTURE S9(9) BINARY.
01 RETURNCODE         PICTURE S9(4) BINARY.
 ...
CALL "SQLRAllocStmt" USING CONNECTIONHANDLE, STATEMENTHANDLE,
    RETURNCODE.
```

SEE ALSO

AllocHandle( ), *FreeHandle*( ), *FreeStmt*( )

NAME

BindCol — Bind a column in a result set (concise)

SYNOPSIS

```
FUNCTION BindCol
 (StatementHandle INTEGER,
  ColumnNumber SMALLINT,
  TargetType SMALLINT,
  TargetValue ANY,
  BufferLength INTEGER,
  StrLen_or_Ind INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The *BindCol*( ) function binds a column of a result set to an application variable, enabling implicit data transfer and optional data conversion when a row of the result set is fetched. The function has the following parameters:

StatementHandle (input)
Statement handle.

ColumnNumber (input)
Column number. Columns are numbered sequentially from left to right and the leftmost is number 1.

TargetType (input)
The application data type of *TargetValue*. Specifying SQL_DEFAULT provides that a buffer type from Table 4-9 on page 61 will be selected at fetch time based on the SQL data type of the column being bound. Specifying SQL_CHAR, if the database value is a date/time or numeric value, results in string data conversion as described in Section 4.8.3 on page 60.

TargetValue (deferred output)
A variable that the implementation loads with column data when the fetch occurs.

BufferLength (input)
If *TargetType* specifies a character-string data type (or is SQL_DEFAULT and this implies a character-string data type), then this is the maximum number of octets to store in *TargetValue*. Otherwise, it is ignored.

StrLen_or_Ind (deferred output)
A variable the implementation sets, when the fetch occurs, to one of the following:

- the value SQL_NULL_DATA if the data value for the column is null
- the length in octets of the data value for the column (even if it does not entirely fit in *TargetValue*), excluding any null terminator, if *TargetType* is SQL_CHAR (or *TargetType* is SQL_DEFAULT and the database column is of type CHAR or VARCHAR)
- an undefined value (but not SQL_NULL_DATA) in all other cases.

The implementation assigns values to *TargetValue* and *StrLen_or_Ind* whenever a fetch occurs on *StatementHandle*. The implementation performs any data conversion specified in the call to *BindCol*( ).

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

[SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

DIAGNOSTICS

ColumnNumber must be 1 or greater ('**07**009').

TargetType must be one of the Integer Data Type Identifier values listed in Section 4.8.2 on page 58, SQL_DEFAULT or an implementation-defined value ('**HY**003').

Any descriptor implicitly referenced (see the conceptual description under **APPLICATION USAGE**) must be valid ('**HY**023').

The subsequent *Fetch*( ) call may produce the data conversion diagnostics specified in Section 5.4.10 on page 76.

APPLICATION USAGE

The application can call *BindCol*( ) to set in a single call all the descriptor fields commonly used when retrieving a value from the database. Conceptually, *BindCol*( ) performs the following steps in sequence:

- Calls *GetStmtAttr*( ) to obtain the application row descriptor handle.
- Calls *GetDescField*( ) to get this descriptor's COUNT field, and if *ColumnNumber* exceeds the value of COUNT, calls *SetDescField*( ) to increase the value of COUNT to *ColumnNumber*.
- Calls *SetDescField*( ) multiple times to assign values to the following fields of the application row descriptor:
  - — sets TYPE to the value of *TargetType*
  - — sets OCTET_LENGTH to the value of *BufferLength*
  - — sets DATA_PTR to the value of *TargetValue*
  - — sets INDICATOR_PTR to the value of *StrLen_or_Ind* (see below)
  - — sets OCTET_LENGTH_PTR to the value of *StrLen_or_Ind* (see below).

  The variable that *StrLen_or_Ind* references is used for both indicator and length information. If a fetch encounters a null value for the column, it stores SQL_NULL_DATA in this variable; otherwise it stores the data length in this variable. Passing a null pointer as *StrLen_or_Ind* keeps the fetch operation from returning the data length, but makes the fetch fail if it encounters a null value and has no way to return SQL_NULL_DATA.

The application must call *BindCol*( ) before starting a fetch operation for any columns to be bound on the first fetch. The application may call *BindCol*( ) thereafter to change the binding of those columns for subsequent fetches, or to bind additional columns for subsequent fetches. In languages that allow the use of pointers, the application may unbind a column by providing a null pointer for *TargetValue* to set the DATA_PTR field of the record in the row descriptor to a null pointer. To unbind all columns, the application calls *FreeStmt*( ) with the SQL_UNBIND option, or sets the COUNT field of the application row descriptor to zero.

The application must allocate enough storage for *TargetValue* to accommodate the longest data value the implementation might store there, taking into account any specified data conversion, or truncation will occur at the time of the fetch, causing the fetch to return [SQL_SUCCESS_WITH_INFO]. The application can detect that a fetch truncated the value in a bound column by comparing the value the implementation stored in that column's *StrLen_or_Ind* to the buffer length the application declared in the call to *BindCol*( ), minus the length of the null terminator if applicable (see Section 2.3.6 on page 19).

Cautions Regarding SQL_DEFAULT

To retrieve column data successfully, the application must determine correctly the length and starting point of the data in the application buffer. When the application specifies an explicit

TargetType, application misconceptions are readily detected. However, when the application specifies a *TargetType* of SQL_DEFAULT, *BindCol*( ) can be applied to a column of a different data type from the one intended by the application, either from changes to the metadata or by applying the code to a different column. In this case, the application may fail to determine the start or length of the fetched column data. This can lead to unreported data errors or memory violations.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLHSTMT    StatementHandle;
SQLSMALLINT ColumnNumber;
SQLSMALLINT TargetType;
SQLPOINTER  TargetValue;
SQLINTEGER  BufferLength;
SQLINTEGER  StrLen_or_Ind;
 ...
ReturnCode = SQLBindCol(StatementHandle, ColumnNumber,
  TargetType, TargetValue, BufferLength, &StrLen_or_Ind);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE PICTURE S9(9) BINARY.
01 COLUMNNUMBER    PICTURE S9(4) BINARY.
01 TARGETTYPE      PICTURE S9(4) BINARY.
01 TARGETVALUE     PICTURE type.
01 BUFFERLENGTH    PICTURE S9(9) BINARY.
01 STRLEN-OR-IND   PICTURE S9(9) BINARY.
01 RETURNCODE      PICTURE S9(4) BINARY.
 ...
CALL "SQLRBindCol" USING STATEMENTHANDLE, COLUMNNUMBER,
  TARGETTYPE, TARGETVALUE, BUFFERLENGTH, STRLEN-OR-IND, RETURNCODE.
```

SEE ALSO

Fetch( ), *FetchScroll*( ), *SetDescField*( ), *SetDescRec*( )

NAME

BindParam, SetParam — Bind a dynamic parameter (concise)

SYNOPSIS

```
FUNCTION BindParam
 (StatementHandle INTEGER,
  ParameterNumber SMALLINT,
  ValueType SMALLINT,
  ParameterType SMALLINT,
  LengthPrecision INTEGER,
  ParameterScale SMALLINT,
  ParameterValue ANY,
  StrLen_or_Ind INTEGER)
RETURNS (SMALLINT)
```

DE

```
FUNCTION SetParam
 (StatementHandle INTEGER,
  ParameterNumber SMALLINT,
  ValueType SMALLINT,
  ParameterType SMALLINT,
  LengthPrecision INTEGER,
  ParameterScale SMALLINT,
  ParameterValue ANY,
  StrLen_or_Ind INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The *BindParam*( ) function binds a parameter in an SQL statement to an application variable, enabling implicit data transfer and optional data conversion when the statement is executed.

The *SetParam*( ) function is similar to *BindParam*( ). (Differences appear with shading within this entry.)

The function has the following parameters:

StatementHandle (input)
Statement handle.

ParameterNumber (input)
Parameter number. Parameters are numbered sequentially from left to right and the leftmost is number 1.

ValueType (input)
The application data type of *ParameterValue*. Specifying SQL_DEFAULT provides that a buffer type from Table 4-9 on page 61 will be selected at execute time based on the SQL data type specified in *ParameterType*. Specifying SQL_CHAR, if the parameter is a date/time or numeric value, results in string data conversion as described in Section 4.8.3 on page 60.

ParameterType (input)
The SQL data type of the parameter. Integer Data Type identifier values are listed in Table 4-4 on page 58. For the date/time data types, the application can specify SQL_TYPE_DATE, SQL_TYPE_TIME, or SQL_TYPE_TIMESTAMP.

LengthPrecision (input)
Maximum size of the parameter. Its interpretation depends on the following values of *ParameterType*:

SQL_CHAR or SQL_VARCHAR
The maximum length in characters of the parameter.

SQL_DECIMAL or SQL_NUMERIC
The maximum decimal precision.

SQL_FLOAT
The maximum binary precision.

SQL_TYPE_TIME
LengthPrecision is ignored and the precision of the TIME data is assumed to be 0.

SQL_TYPE_TIMESTAMP

— For *BindParam*( ), the value of *LengthPrecision* can be from 0 up to and including 6, and is interpreted as the length in characters of the fractional part of the seconds component of the timestamp.

DE — For *SetParam*( ), the value of *LengthPrecision* can be from 16 up to and including 26, and is interpreted as the total length in characters of the character representation of the timestamp.

(Other values)
LengthPrecision is ignored.

ParameterScale (input)
If *ParameterType* is SQL_DECIMAL or SQL_NUMERIC, this is the scale of the parameter (the
DE total number of digits to the right of the decimal point). For *SetParam*( ), if *ParameterType* is SQL_TYPE_TIMESTAMP, this is the length in characters of the fractional part of the seconds component of the timestamp. Otherwise, *ParameterScale* is ignored.

ParameterValue (deferred input)
A variable whose value is used as the parameter data when *StatementHandle* is executed.

If the dynamic argument is to be supplied at execute time by calling *ParamData*( ) and *PutData*( ), the application should set *ParameterValue* to an arbitrary value that uniquely identifies the dynamic parameter. This value will be returned to the application by *ParamData*( ).

StrLen_or_Ind (deferred input)
A variable whose value is interpreted when *StatementHandle* is executed.

— If a null value is to be used as the parameter, *StrLen_or_Ind* must contain the value SQL_NULL_DATA.

— If the dynamic argument is to be supplied at execute time by calling *ParamData*( ) and *PutData*( ), *StrLen_or_Ind* must contain the value SQL_DATA_AT_EXEC.

— If *ValueType* is SQL_CHAR and the data in *ParameterValue* contains a null-terminated string, *StrLen_or_Ind* must either contain the length in octets of the string in *ParameterValue* or contain the value SQL_NTS.

— If *ValueType* is SQL_CHAR and the data in *ParameterValue* is not null-terminated, *StrLen_or_Ind* must contain the length in octets of the string in *ParameterValue*.

— Otherwise, *StrLen_or_Ind* is ignored.

Deferred Effects

The implementation evaluates *ParameterValue* and *StrLen_or_Ind* when *StatementHandle* is executed. At that time, *StrLen_or_Ind* must indicate the length in octets of the value in

ParameterValue or have one of the special values listed above. If *StrLen_or_Ind* is neither SQL_NULL_DATA nor SQL_DATA_AT_EXEC, then *ParameterValue* must at this time contain the actual data to use in place of parameter *ParameterNumber*.

The implementation performs any data conversion implied by the combination of *ValueType* and *ParameterType* (without modifying *ParameterValue*) and sends the resulting value to the server in place of the parameter marker.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

[SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

DIAGNOSTICS

ParameterNumber must be 1 or greater ('**07**009').

ValueType must be one of the Integer Data Type Identifier values listed in Section 4.8.2 on page 58, SQL_DEFAULT or an implementation-defined value ('**HY**003').

ParameterType must be one of the values discussed above in the **DESCRIPTION**, or an implementation-defined value ('**HY**004').

The specified *ValueType* and *ParameterType* must be compatible. The permitted combinations are defined in Section 4.8.3 on page 60 ('**07**006').

If *ParameterType* is SQL_TIME_TIMESTAMP, *LengthPrecision* must be as specified above in **DESCRIPTION** ('**HY**104').

Any descriptor implicitly referenced (see the conceptual description under **APPLICATION USAGE**) must be valid ('**HY**023').

The descriptor's consistency is checked; see Section 5.4.9 on page 75.

Execution of the SQL statement may produce the data conversion diagnostics specified in Section 5.4.10 on page 76.

APPLICATION USAGE

The application can call *BindParam*( ) to set in a single call all the descriptor fields commonly used when defining a parameter. Conceptually, *BindParam*( ) performs the following steps in sequence:

- calls *GetStmtAttr*( ) to obtain the application parameter descriptor handle
- calls *GetDescField*( ) to get this descriptor's COUNT field, and if *ColumnNumber* exceeds the value of COUNT, calls *SetDescField*( ) to increase the value of COUNT to *ColumnNumber*
- calls *SetDescField*( ) multiple times to assign values to the following fields of the application parameter descriptor:

  — sets TYPE to the value of *ValueType*

  — sets DATA_PTR to the value of *ParameterValue*

  — sets OCTET_LENGTH_PTR to the value of *StrLen_or_Ind*

  — sets INDICATOR_PTR also to the value of *StrLen_or_Ind*.

  The *StrLen_or_Ind* parameter specifies both the indicator information and the length for the parameter value.

- calls *GetStmtAttr*( ) to obtain the implementation parameter descriptor handle

- calls *GetDescField*( ) to get this descriptor's COUNT field, and if *ColumnNumber* exceeds the value of COUNT, calls *SetDescField*( ) to increase the value of COUNT to *ColumnNumber*
- calls *SetDescField*( ) multiple times to assign values to the following fields of the implementation parameter descriptor:
  - — sets TYPE to the value of *ParameterType*, except that if *ParameterType* is one of the date/time identifiers SQL_TYPE_DATE, SQL_TYPE_TIME, or SQL_TYPE_TIMESTAMP, it sets TYPE to SQL_DATETIME and sets DATETIME_INTERVAL_CODE to SQL_CODE_DATE, SQL_CODE_TIME, or SQL_CODE_TIMESTAMP, respectively
  - — sets LENGTH or PRECISION or both (as appropriate for *ParameterType*)[19]
  - — sets SCALE to the value of *ParameterScale*.

To specify a nonzero PRECISION for a parameter of type TIME, the application must explicitly set the descriptor fields by calling *SetDescField*( ) or *SetDescRec*( ).

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN     ReturnCode;
SQLHSTMT      StatementHandle;
SQLSMALLINT   ParameterNumber;
SQLSMALLINT   ValueType;
SQLSMALLINT   ParameterType;
SQLINTEGER    LengthPrecision;
SQLSMALLINT   ParameterScale;
SQLPOINTER    ParameterValue;
SQLINTEGER    StrLen_or_Ind;
 ...
ReturnCode = SQLBindParam(StatementHandle, ParameterNumber,
  ValueType, ParameterType, LengthPrecision, ParameterScale,
  ParameterValue, &StrLen_or_Ind);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE   PICTURE S9(9) BINARY.
01 PARAMETERNUMBER   PICTURE S9(4) BINARY.
01 VALUETYPE         PICTURE S9(4) BINARY.
01 PARAMETERTYPE     PICTURE S9(4) BINARY.
01 LENGTHPRECISION   PICTURE S9(9) BINARY.
01 PARAMETERSCALE    PICTURE S9(4) BINARY.
01 PARAMETERVALUE    PICTURE type.
01 STRLEN-OR-IND     PICTURE S9(9) BINARY.
01 RETURNCODE        PICTURE S9(4) BINARY.
 ...
```

---

19. For the following date/time data types, the effect depends on the value of *ParameterType* as follows:

SQL_TYPE_TIME
LENGTH is set to 8 and PRECISION is set to 0.

SQL_TYPE_TIMESTAMP

— For *BindParam*( ), LENGTH is set to 19 (or to 20 + *LengthPrecision*, if *LengthPrecision* > 0) and PRECISION is set to *LengthPrecision*.

DE — For *SetParam*( ), LENGTH is set to *LengthPrecision* and PRECISION is set to *ParameterScale*.

```
CALL "SQLRBindParam" USING STATEMENTHANDLE, PARAMETERNUMBER,
  VALUETYPE, PARAMETERTYPE, LENGTHPRECISION, PARAMETERSCALE,
  PARAMETERVALUE, STRLEN-OR-IND, RETURNCODE.
```

SEE ALSO

ExecDirect( ), *Execute*( ), *ParamData*( ), *Prepare*( ), *PutData*( ), *SetDescField*( ), *SetDescRec*( )

NAME

Cancel — Attempt to cancel a CLI operation

SYNOPSIS

```
FUNCTION Cancel
 (StatementHandle INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The application can call *Cancel*( ) to cancel CLI operations in the following situations:

1. An application can call *Cancel*( ) to force an orderly exit from the data-at-execute dialogue described in Section 4.3.2 on page 48.

   The SQL statement defined on *StatementHandle* is not executed. If the application had prepared the SQL statement by calling *Prepare*( ), then *StatementHandle* returns to the **prepared** state shown in Table B-2 on page 242. Otherwise (if the application had called *ExecDirect*( )), *StatementHandle* returns to the **allocated** state.

   The *Cancel*( ) function does not affect the contents of any descriptor. The implementation discards any application data previously provided during the data-at-execute dialogue.

2. When an application initiates concurrent processing, one process or thread can call *Cancel*( ) to try to cancel execution of an SQL statement by another process or thread that is using the same connection. If the implementation accepts the cancel request and succeeds in cancelling the specified work, the CLI function that initiated the work returns [SQL_ERROR] and the diagnostics area for *StatementHandle* includes '**HY**008'.

   Calling *Cancel*( ) does not delete any diagnostic information that execution of the statement has buffered for return to the application.

Otherwise — if *StatementHandle* is neither in a data-at-execute dialogue nor associated with a currently-executing SQL statement — *Cancel*( ) has no effect.

The function has the following parameter:

StatementHandle (input)
The statement handle representing the work to be cancelled.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

In case 2 above, a return value of [SQL_SUCCESS] indicates only that the implementation has accepted the cancel request; if an SQL statement is executing on *StatementHandle*, [SQL_SUCCESS] does not guarantee that the execution will be aborted.

[SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

DIAGNOSTICS

The server may decline the cancel request ('**HY**018'). For example, communication errors might occur between a client and a server. Additional, implementation-defined diagnostics are also possible.

APPLICATION USAGE

The intent of case 2 above is to provide a way to cancel long-running queries. This document does not specify whether or how an application could get control of the processor during SQL statement execution in order to call *Cancel*( ).

Case 2 works as specified only if a process or thread is executing an SQL statement at the time the second process calls *Cancel*( ). Calling *Cancel*( ) at other times could produce the effects described in case 1. This could result in a function sequence error ('**HY**010') in the affected process or thread.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN ReturnCode;
SQLHSTMT  StatementHandle;
 ...
ReturnCode = SQLCancel(StatementHandle);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE PICTURE S9(9) BINARY.
01 RETURNCODE      PICTURE S9(4) BINARY.
 ...
CALL "SQLRCancel" USING STATEMENTHANDLE, RETURNCODE.
```

SEE ALSO

Execute( ), *ExecDirect*( )

NAME

CloseCursor — Close a cursor

SYNOPSIS

```
FUNCTION CloseCursor
 (StatementHandle INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The *CloseCursor*( ) function closes the open cursor on a statement handle after execution of a *cursor-specification*. The function has the following parameter:

StatementHandle (input)
Statement handle.

Calling *CloseCursor*( ) closes any cursor associated with *StatementHandle* and discards any pending results. The application can re-execute the statement associated with the cursor, with the same or different dynamic arguments. If no open cursor is associated with *StatementHandle*, the function has no effect.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_INVALID_HANDLE] or [SQL_SUCCESS_WITH_INFO].

[SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN ReturnCode;
SQLHSTMT  StatementHandle;
 ...
ReturnCode = SQLCloseCursor(StatementHandle);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE PICTURE S9(9) BINARY.
01 RETURNCODE      PICTURE S9(4) BINARY.
 ...
CALL "SQLRCloseCursor" USING STATEMENTHANDLE, RETURNCODE.
```

NAME

ColAttribute — Get an implementation row descriptor field (deprecated)

SYNOPSIS

DE
```
FUNCTION ColAttribute
 (StatementHandle INTEGER,
  ColumnNumber SMALLINT,
  FieldIdentifier SMALLINT,
  CharacterAttribute ANY,
  BufferLength SMALLINT,
  StringLength SMALLINT,
  NumericAttribute ANY)
RETURNS  (SMALLINT)
```

DESCRIPTION

The *ColAttribute*( ) function has the following parameters:

ConnectionHandle (input)
Statement handle.

ColumnNumber (input)
The record number from which the specified field in the descriptor is to be retrieved. The first record is number 1.

FieldIdentifier (input)
The identifier of the field to be retrieved. This can be one of the following:

Header Fields

SQL_DESC_COUNT (type: SMALLINT)
Ignore *ColumnNumber*. Set *NumericAttribute* to the number of records in the implementation row descriptor.

Fields of a Descriptor Record

SQL_DESC_TYPE (type: SMALLINT)
Set *NumericAttribute* to the TYPE field of *ColumnNumber*. This is one of the Integer Data Type Identifier values in Table 4-4 on page 58, except that, if the TYPE field is SQL_DATETIME, it is SQL_TYPE_DATE, SQL_TYPE_TIME, or SQL_TYPE_TIMESTAMP, depending on the value of the DATETIME_INTERVAL_CODE field (see also Table 4-5 on page 58).

SQL_DESC_LENGTH (type: INTEGER)
Set *NumericAttribute* to the LENGTH field of *ColumnNumber*.

SQL_DESC_OCTET_LENGTH (type: INTEGER)
Set *NumericAttribute* to the OCTET_LENGTH field of *ColumnNumber*.

SQL_DESC_PRECISION (type: SMALLINT)
Set *NumericAttribute* to the PRECISION field of *ColumnNumber*.

SQL_DESC_SCALE (type: SMALLINT)
Set *NumericAttribute* to the SCALE field of *ColumnNumber*.

SQL_DESC_NULLABLE (type: SMALLINT)
Set *NumericAttribute* to the NULLABLE field of *ColumnNumber*. This is SQL_NULLABLE if the column's definition allows null values, and SQL_NO_NULLS otherwise.

SQL_DESC_NAME (type: CHAR(128))
Set *CharacterAttribute* to the NAME field of *ColumnNumber*.

SQL_DESC_UNNAMED (type: SMALLINT)
Set *NumericAttribute* to the UNNAMED field of *ColumnNumber*. This is SQL_NAMED if the NAME field is an actual name, or SQL_UNNAMED if the NAME field is an implementation-generated column name that X/Open does not define (for example, where the subject column represents the UNION of two columns with different names).

CharacterAttribute (output)
The value of *FieldIdentifier* of *ColumnNumber*, if the field is a character string; otherwise, unused.

BufferLength (input)
The maximum number of octets to store in *CharacterAttribute*, if the field is a character string; otherwise, ignored.

StringLength (output)
Length in octets of the output data (even if it does not entirely fit in *CharacterAttribute*), if the field is a character string; otherwise, unused.

NumericAttribute (output)
The value of *FieldIdentifier* of *ColumnNumber*, if the field is an integer; otherwise unused.

The *ColAttribute*( ) function returns in *CharacterAttribute* or *NumericAttribute* one field of *ColumnNumber* from the implementation row descriptor associated with *StatementHandle*. If *FieldIdentifier* denotes a character string, then the implementation does not set *NumericAttribute*; otherwise the implementation ignores *BufferLength* and does not set *CharacterAttribute* nor *StringLength*.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO], [SQL_INVALID_HANDLE] or [SQL_NO_DATA].

[SQL_NO_DATA] is returned if *ColumnNumber* is greater than the number of descriptor records.

DIAGNOSTICS

The [SQL_SUCCESS_WITH_INFO] outcome occurs if the returned data is truncated ('**01**004') or if implementation-defined warnings are produced.

FieldIdentifier must be one of the valid values or an implementation-defined value ('**HY**091').

When *FieldIdentifier* indicates a field from a record, *ColumnNumber* must be 1 or greater ('**07**009').

The prepared statement associated with *StatementHandle* must be a *cursor-specification* ('**07**005').

The application must call *ExecDirect*( ) or *Prepare*( ) before calling this function ('**HY**010').

APPLICATION USAGE

The application can obtain fields of any record of the implementation row descriptor, in arbitrary order, by repeated calls to *ColAttribute*( ).

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN       ReturnCode;
SQLHSTMT        StatementHandle;
SQLSMALLINT     ColumnNumber;
SQLSMALLINT     FieldIdentifier;
SQLPOINTER      CharacterAttribute;
```

```
SQLSMALLINT     BufferLength;
SQLSMALLINT     StringLength;
SQLPOINTER      NumericAttribute;
 ...
ReturnCode = SQLColAttribute(StatementHandle, ColumnNumber,
  FieldIdentifier, CharacterAttribute, BufferLength &StringLength,
  NumericAttribute);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE    PICTURE S9(9) BINARY.
01 COLUMNNUMBER       PICTURE S9(4) BINARY.
01 FIELDIDENTIFIER    PICTURE S9(4) BINARY.
01 CHARACTERATTRIBUTE PICTURE type.
01 BUFFERLENGTH       PICTURE S9(4) BINARY.
01 STRINGLENGTH       PICTURE S9(4) BINARY.
01 NUMERICATTRIBUTE   PICTURE type.
01 RETURNCODE         PICTURE S9(4) BINARY.
 ...
CALL "SQLRColAttribute" USING STATEMENTHANDLE, COLUMNNUMBER,
  FIELDIDENTIFIER, CHARACTERATTRIBUTE, BUFFERLENGTH, STRINGLENGTH,
  NUMERICATTRIBUTE, RETURNCODE.
```

SEE ALSO

GetDescField( )

NAME

Columns — Get column information

SYNOPSIS

```
FUNCTION Columns
 (StatementHandle INTEGER,
  CatalogName CHAR,
  NameLength1 SMALLINT,
  SchemaName CHAR,
  NameLength2 SMALLINT,
  TableName CHAR,
  NameLength3 SMALLINT,
  ColumnName CHAR,
  NameLength4 SMALLINT)
RETURNS (SMALLINT)
```

DESCRIPTION

The *Columns*( ) function obtains column information. The function has the following parameters:

StatementHandle (input)
Statement handle.

CatalogName (input)
Buffer containing catalog name to qualify the tables of the result set. If the SQL_ATTR_METADATA_ID attribute of *StatementHandle* is SQL_TRUE, then this is interpreted as an identifier (see **Treatment as Identifier** on page 54).

NameLength1 (input)
Length in octets of *CatalogName*.

SchemaName (input)
Buffer that may qualify the result set by schema name. If the SQL_ATTR_METADATA_ID attribute of *StatementHandle* is SQL_TRUE, then this is interpreted as an identifier (see **Treatment as Identifier** on page 54); otherwise, it is a *pattern-value* (see **Qualification by Pattern-values** on page 55).

NameLength2 (input)
Length in octets of *SchemaName*.

TableName (input)
Buffer that may qualify the result set by table name. If the SQL_ATTR_METADATA_ID attribute of *StatementHandle* is SQL_TRUE, then this is interpreted as an identifier (see **Treatment as Identifier** on page 54); otherwise, it is a *pattern-value* (see **Qualification by Pattern-values** on page 55).

NameLength3 (input)
Length in octets of *TableName*.

ColumnName (input)
Buffer that may qualify the result set by column name. If the SQL_ATTR_METADATA_ID attribute of *StatementHandle* is SQL_TRUE, then this is interpreted as an identifier (see **Treatment as Identifier** on page 54); otherwise, it is a *pattern-value* (see **Qualification by Pattern-values** on page 55).

NameLength4 (input)
Length in octets of *ColumnName*.

EX Column information is returned in the form of a result set on *StatementHandle*, where each column is represented by one row of the result set. The result set contains many differences, in column names and content, from the COLUMNS system view specified in the X/Open **SQL** specification.

The result set has at least these columns in the following order:

Column Name	Type	Meaning
TABLE_CAT	VARCHAR(128)	The name of the catalog containing TABLE_SCHEM. See **APPLICATION USAGE** below.
TABLE_SCHEM	VARCHAR(128) NOT NULL	The name of the schema containing TABLE_NAME.
TABLE_NAME	VARCHAR(128) NOT NULL	The name of the table or view.
COLUMN_NAME	VARCHAR(128) NOT NULL	The name of the column of the specified table or view.
DATA_TYPE	SMALLINT NOT NULL	Identifies the type of the column and contains one of the Integer Data Type identifier values listed in Table 4-4 on page 58. If the identifier is SQL_DATETIME, the date/time subtypes can be distinguished by analysing the TYPE_NAME or DATETIME_CODE columns.
TYPE_NAME	VARCHAR(128) NOT NULL	The textual name of the column's data type, which is one of the following values: 'CHARACTER' 'CHARACTER VARYING' 'DATE' 'DECIMAL' 'DOUBLE PRECISION' 'FLOAT' 'INTEGER' 'NUMERIC' 'REAL' 'SMALLINT' 'TIME' 'TIMESTAMP'
COLUMN_SIZE	INTEGER	If DATA_TYPE is SQL_CHAR or SQL_VARCHAR, then this column contains the maximum length in characters of the column. For date/time data types, this is the total number of characters required to display the value when converted to character. For numeric data types, this is

Column Name	Type	Meaning
		either the total number of digits or the total number of bits allowed in the column, according to NUM_PREC_RADIX (see below).
BUFFER_LENGTH	INTEGER	The number of octets that would be required to hold the column data if SQL_DEFAULT were specified (see **Default Transfers** on page 60). This length excludes any null terminator. For exact numeric data types, this length accounts for the decimal point and the sign.
DECIMAL_DIGITS	SMALLINT	Defines the total number of significant digits to the right of the decimal point. For the date / time subtypes TIME and TIMESTAMP, this is the number of digits in the fractional seconds component. For the INTEGER and SMALLINT data types, it is 0. For the CHARACTER, CHARACTER VARYING, FLOAT, REAL and DOUBLE PRECISION data types, it is null.
NUM_PREC_RADIX	SMALLINT	If DATA_TYPE is an approximate numeric data type, this column contains the value 2 because COLUMN_SIZE specifies a number of bits. For exact numeric data types, this column contains the value 10 because COLUMN_SIZE specifies a number of decimal digits. Otherwise, this column is null. By combining the precision with the radix, an application can calculate the maximum number that the column can hold.
NULLABLE	SMALLINT NOT NULL	The value SQL_NULLABLE if the column accepts null values; otherwise, the value SQL_NO_NULLS.
REMARKS	VARCHAR(254)	May contain descriptive information about the column.
COLUMN_DEF	VARCHAR(254)	The column's default value, using legal syntax for *default-value* in the *column-definition* of the CREATE TABLE statement. If the default value is a character string, then this column is that string enclosed in single quotes. If the default value is a numeric literal, then this column contains the original character representation with no enclosing single quotes. If the default value is a date-time literal, then this column contains the

Column Name	Type	Meaning
		appropriate keyword (DATE, TIME or TIMESTAMP) followed by the *date-value* and/or *time-value* enclosed in single quotes. If the default value is a *pseudo-literal*, then this column contains the keyword, such as CURRENT_DATE, with no enclosing single quotes. If NULL was specified as the default value, then this column is the word NULL, not enclosed in quotes. If the default value cannot be represented without truncation, then this column contains TRUNCATED with no enclosing single quotes. If no default value was specified, then this column is null. The value of COLUMN_DEF is suitable for use in generating a new *column-definition*, except when it contains the value TRUNCATED.
DATETIME_CODE	INTEGER	For date/time data types, this column is the subtype code, using the same values as the DATETIME_INTERVAL_CODE field of the SQL descriptor of dynamic SQL. For other data types, this column is null.
CHAR_OCTET_LENGTH	INTEGER	Contains the maximum length in octets for a character data type column. For all other data types it is null. (For single-octet character sets, this is the same as COLUMN_SIZE.)
ORDINAL_POSITION	INTEGER NOT NULL	The ordinal position of the column in the table. The first column in the table is number 1.
IS_NULLABLE	VARCHAR(254)	Contains the value 'NO' if the column is known to be not nullable, according to the rules in the ISO SQL standard; and 'YES' otherwise.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

[SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

DIAGNOSTICS

There must not be an open cursor on *StatementHandle* ('**24**000').

If the implementation does not support qualification by catalog name, then the value of *CatalogName* must be a null pointer or a zero-length string ('**HY**C00').

APPLICATION USAGE

In languages that allow the use of pointers, the application can provide a null pointer for any *pattern-value*, in order to inhibit qualification of the result set on the respective basis.

The TABLE_CAT column may be null or may contain an empty string for several reasons discussed in Section 2.4.3 on page 22. If TABLE_CAT contains an empty string, the application should take care to not append '.' when forming a fully-qualified object name for use in an SQL statement.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLHSTMT    StatementHandle;
SQLCHAR    *CatalogName;
SQLSMALLINT NameLength1;
SQLCHAR    *SchemaName;
SQLSMALLINT NameLength2;
SQLCHAR    *TableName;
SQLSMALLINT NameLength3;
SQLCHAR    *ColumnName;
SQLSMALLINT NameLength4;
 ...
ReturnCode = SQLColumns (StatementHandle,
  CatalogName, NameLength1,
  SchemaName, NameLength2,
  TableName, NameLength3,
  ColumnName, NameLength4);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE  PICTURE S9(9) BINARY.
01 CATALOGNAME      PICTURE X(128).
01 NAMELENGTH1      PICTURE S9(4) BINARY.
01 SCHEMANAME       PICTURE X(128).
01 NAMELENGTH2      PICTURE S9(4) BINARY.
01 TABLENAME        PICTURE X(128).
01 NAMELENGTH3      PICTURE S9(4) BINARY.
01 COLUMNNAME       PICTURE X(128).
01 NAMELENGTH4      PICTURE S9(4) BINARY.
01 RETURNCODE       PICTURE S9(4) BINARY.
 ...
CALL "SQLRColumns" USING STATEMENTHANDLE,
  CATALOGNAME, NAMELENGTH1,
  SCHEMANAME, NAMELENGTH2,
  TABLENAME, NAMELENGTH3,
  COLUMNNAME, NAMELENGTH4, RETURNCODE.
```

RELATION TO STANDARDS

This function is not present in the ISO CLI Draft International Standard.

NAME

Connect — Open a connection to a server

SYNOPSIS

```
FUNCTION Connect
 (ConnectionHandle INTEGER,
  ServerName CHAR,
  NameLength1 SMALLINT,
  UserName CHAR,
  NameLength2 SMALLINT,
  Authentication CHAR,
  NameLength3 SMALLINT)
RETURNS (SMALLINT)
```

DESCRIPTION

Calling *Connect*( ) connects the application to a server. The function has the following parameters:

ConnectionHandle (input)
: Connection handle.

ServerName (input)
: Buffer containing server name. All leading and trailing blanks are significant. This is a literal, not an identifier, and the value is not enclosed in quotes (either single or double). If *ServerName* is a zero-length string, a null pointer or DEFAULT, then it indicates the default server. The length of *ServerName* must not exceed 128 characters.

NameLength1 (input)
: Length in octets of *ServerName*.

UserName (input)
: Buffer containing user identifier. The implementation trims any leading and trailing spaces and, unless the result begins and ends with double quotes (in which case it is a delimited identifier—see **Delimited Identifiers** on page 21), converts lower-case letters to upper case.

NameLength2 (input)
: Length in octets of *UserName*. This must be 0 if *ServerName* specifies the default server; for other servers, a value of 0 means that an undefined method is used to determine the user identifier.

Authentication (input)
: Buffer containing authentication string. All leading and trailing blanks are significant.

NameLength3 (input)
: Length in octets of *Authentication*. This must be 0 if *ServerName* specifies the default server; for other servers, a value of 0 means that an undefined method is used to determine the authentication string.

Calling *Connect*( ) establishes a connection to *ServerName*. The mapping from *ServerName* (or from the default server) to a physical database is implementation-defined.

The specified server uses the values of *UserName* and *Authentication* and may apply other criteria when the application calls *Connect*( ) to determine whether to accept or reject the connection. If the server accepts the connection, then *UserName* becomes the name of its current user. It is implementation-defined how the server selects a default catalog and schema.

The application can establish more than one connection, but only one connection can be current at one time. The connection that *Connect*( ) establishes becomes the current connection. If

another connection is already current and there is a transaction active on that connection, then it is implementation-defined whether the connection can be switched.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

[SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

DIAGNOSTICS

There must not be a connection associated with *ConnectionHandle* ('**08**002').

If *ServerName* specifies the default server, the default connection must not be current or dormant ('**08**002').

If *ServerName* specifies the default server, then *NameLength2* and *NameLength3* must be 0 ('**HY**090').

The value of *UserName* with leading and trailing spaces removed must be a valid *user-name* as defined by the X/Open **SQL** specification, and must not violate any implementation-defined restrictions ('**28**000').

On implementations that do not allow connections to be switched within a transaction, a transaction must not already be active on *ConnectionHandle* ('**0A**001').

The function may fail because the client cannot establish a connection ('**08**001') or because the server rejects the connection for implementation-defined reasons ('**08**004').

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLHDBC     ConnectionHandle;
SQLCHAR    *ServerName;
SQLSMALLINT NameLength1;
SQLCHAR    *UserName;
SQLSMALLINT NameLength2;
SQLCHAR    *Authentication;
SQLSMALLINT NameLength3;
 ...
ReturnCode = SQLConnect(ConnectionHandle, ServerName, NameLength1,
  UserName, NameLength2, Authentication, NameLength3);
```

EXAMPLE USAGE (COBOL)

```
01 CONNECTIONHANDLE PICTURE S9(9) BINARY.
01 SERVERNAME       PICTURE X(128).
01 NAMELENGTH1      PICTURE S9(4) BINARY.
01 USERNAME         PICTURE X(18).
01 NAMELENGTH2      PICTURE S9(4) BINARY.
01 AUTHENTICATION   PICTURE X(254).
01 NAMELENGTH3      PICTURE S9(4) BINARY.
01 RETURNCODE       PICTURE S9(4) BINARY.
 ...
CALL "SQLRConnect" USING CONNECTIONHANDLE,
  SERVERNAME, NAMELENGTH1, USERNAME, NAMELENGTH2,
  AUTHENTICATION, NAMELENGTH3, RETURNCODE.
```

SEE ALSO

Disconnect( )

NAME

CopyDesc — Copy a descriptor

SYNOPSIS

```
FUNCTION CopyDesc
 (SourceDescHandle INTEGER,
  TargetDescHandle INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The *CopyDesc*( ) function has the following parameters:

SourceDescHandle (input)
Source descriptor handle.

TargetDescHandle (input)
Target descriptor handle.

The function copies the fields of the data structure associated with *SourceDescHandle* to the data structure associated with *TargetDescHandle*. Any existing data in the data structure associated with *TargetDescHandle* is overwritten, except that the ALLOC_TYPE field of *TargetDescHandle* (which indicates whether the target descriptor was allocated automatically or by the application) is not changed.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_INVALID_HANDLE] or [SQL_SUCCESS_WITH_INFO].

[SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

DIAGNOSTICS

All diagnostics are associated with *TargetDescHandle*.

TargetDescHandle cannot reference an implementation row descriptor ('**HY**016').

APPLICATION USAGE

Handles for the automatically-generated row and parameter descriptors of a statement can be obtained by calling *GetStmtAttr*( ).

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLHDESC    SourceDescHandle;
SQLHDESC    TargetDescHandle;
 ...
ReturnCode = SQLCopyDesc(SourceDescHandle, TargetDescHandle);
```

EXAMPLE USAGE (COBOL)

```
01 SOURCEDESCHANDLE  PICTURE S9(9) BINARY.
01 TARGETDESCHANDLE  PICTURE S9(9) BINARY.
01 RETURNCODE        PICTURE S9(4) BINARY.
 ...
CALL "SQLRCopyDesc" USING SOURCEDESCHANDLE,
  TARGETDESCHANDLE, RETURNCODE.
```

SEE ALSO

AllocHandle( ), *GetStmtAttr*( ), *FreeHandle*( )

NAME

DataSources — Get a list of server names

SYNOPSIS

```
FUNCTION DataSources
 (EnvironmentHandle INTEGER,
  Direction SMALLINT,
  ServerName CHAR,
  BufferLength1 SMALLINT,
  NameLength1 SMALLINT,
  Description CHAR,
  BufferLength2 SMALLINT,
  NameLength2 SMALLINT)
RETURNS (SMALLINT)
```

DESCRIPTION

The *DataSources*( ) function retrieves names of accessible servers. The function may also return information describing these servers.

The function has the following parameters:

EnvironmentHandle (input)
Environment handle.

Direction (input)
Used by the application to control the manner in which it gains access to the list of servers. This may be one of the following:

SQL_FETCH_FIRST
The function returns information on the first server in the list.

SQL_FETCH_NEXT
The function returns information on the next sequential server in the list; except that if the application has never successfully called *DataSources*( ) on *EnvironmentHandle* before, or if the previous call to *DataSources*( ) on *EnvironmentHandle* returned [SQL_NO_DATA], then the function returns the first server in the list.

ServerName (output)
The server name.

BufferLength1 (input)
Maximum number of octets to store in *ServerName*.

NameLength1 (output)
Length in octets of the output server name (even if it does not entirely fit in *ServerName*).

Description (output)
The description associated with *ServerName*. If no information is available for the current server, then this is a zero-length string.

BufferLength2 (input)
Maximum number of octets to store in *Description*.

NameLength2 (output)
Length in octets of the output description (even if it does not entirely fit in *Description*).

The application can call this function at any time that *EnvironmentHandle* is allocated.

RETURN VALUE

[SQL_SUCCESS], [SQL_SUCCESS_WITH_INFO], [SQL_INVALID_HANDLE], [SQL_NO_DATA] or [SQL_ERROR].

The [SQL_NO_DATA] outcome occurs if there are no more server names to retrieve.

DIAGNOSTICS

The [SQL_SUCCESS_WITH_INFO] outcome occurs if a returned string value is truncated ('**01**004') or if implementation-defined warnings are produced.

Direction must have one of the values listed above ('**HY**103').

APPLICATION USAGE

The application typically calls *DataSources*( ) repeatedly to retrieve information on all servers in the list of accessible servers. The application sets *Direction* to SQL_FETCH_FIRST on the first call in this series, and to SQL_FETCH_NEXT on subsequent calls.

The application might display a list and description of available servers, obtained by repeated calls to *DataSources*( ), to prompt the user to select a desired data source.

The set of servers whose names are available from *DataSources*( ) is not necessarily the complete set to which the application can connect. Moreover, the fact that *DataSources*( ) provides the name of a server does not constitute a guarantee that the application can successfully connect to the server; for example, the server may require authentication information that the application does not have.

It is undefined how server information is added to the database that *DataSources*( ) draws upon.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN    ReturnCode;
SQLHENV      EnvironmentHandle;
SQLSMALLINT  Direction;
SQLCHAR     *ServerName;
SQLSMALLINT  BufferLength1;
SQLSMALLINT  NameLength1;
SQLCHAR     *Description;
SQLSMALLINT  BufferLength2;
SQLSMALLINT  NameLength2;
 ...
ReturnCode = SQLDataSources (EnvironmentHandle, Direction,
  ServerName, BufferLength1, &NameLength1, Description,
  BufferLength2, &NameLength2);
```

EXAMPLE USAGE (COBOL)

```
       01 ENVIRONMENTHANDLE    PICTURE S9(9) BINARY.
       01 DIRECTION            PICTURE S9(4) BINARY.
       01 SERVERNAME           PICTURE X(128).
       01 BUFFERLENGTH1        PICTURE S9(4) BINARY.
       01 NAMELENGTH1          PICTURE S9(4) BINARY.
       01 DESCRIPTION          PICTURE X(254).
       01 BUFFERLENGTH2        PICTURE S9(4) BINARY.
       01 NAMELENGTH2          PICTURE S9(4) BINARY.
       01 RETURNCODE           PICTURE S9(4) BINARY.
        ...
       CALL "SQLRDataSources" USING ENVIRONMENTHANDLE, DIRECTION,
         SERVERNAME, BUFFERLENGTH1, NAMELENGTH1, DESCRIPTION,
         BUFFERLENGTH2, NAMELENGTH2, RETURNCODE.
```

NAME

DescribeCol — Describe a column of a result set (concise)

SYNOPSIS

```
FUNCTION DescribeCol
 (StatementHandle INTEGER,
  ColumnNumber SMALLINT,
  ColumnName CHAR,
  BufferLength SMALLINT,
  NameLength SMALLINT,
  DataType SMALLINT,
  ColumnSize INTEGER,
  DecimalDigits SMALLINT,
  Nullable SMALLINT)
RETURNS (SMALLINT)
```

DESCRIPTION

The *DescribeCol*( ) function describes a selected column from a result set. The function has the following parameters:

StatementHandle (input)
Statement handle.

ColumnNumber (input)
Column number. Columns are numbered sequentially from left to right and the leftmost is number 1.

ColumnName (output)
Column name.

BufferLength (input)
Length in octets of *ColumnName* buffer.

NameLength (output)
Actual number of octets in *ColumnName*.

DataType (output)
The SQL data type of the column. This is one of the Integer Data Type Identifier values listed in Table 4-4 on page 58 or an implementation-defined value. If the TYPE field is SQL_DATETIME, it is SQL_TYPE_DATE, SQL_TYPE_TIME, or SQL_TYPE_TIMESTAMP, depending on the value of the DATETIME_INTERVAL_CODE field. (see also Table 4-5 on page 58).

ColumnSize (output)
Length or precision for column's data type in the database. If *DataType* is SQL_CHAR or SQL_VARCHAR, then *ColumnSize* is the maximum length in octets of the column. For approximate numeric data types, *ColumnSize* is the precision in bits. For exact numeric data types, *ColumnSize* is the precision in decimal digits. For TIME and TIMESTAMP, *ColumnSize* is the precision of the fractional part of the seconds component, in decimal digits. Otherwise *ColumnSize* is ignored.

DecimalDigits (output)
For SQL_DECIMAL and SQL_NUMERIC, *DecimalDigits* is the total number of digits to the right of the decimal point. For SQL_INTEGER and SQL_SMALLINT, *DecimalDigits* is 0. Otherwise *DecimalDigits* is undefined.

Nullable (output)
The function sets this parameter to one of the following:

SQL_NO_NULLS
The column's definition does not allow null values.

SQL_NULLABLE
The column's definition allows null values.

Calling *DescribeCol*( ) obtains descriptor information (describing the column's name, type and length) for column number *ColumnNumber* of the result set.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_INVALID_HANDLE] or [SQL_SUCCESS_WITH_INFO].

DIAGNOSTICS

The [SQL_SUCCESS_WITH_INFO] outcome occurs if the column name is truncated ('**01**004') or if implementation-defined warnings are produced.

The application must prepare *StatementHandle* (by calling *Prepare*( ) or *ExecDirect*( )) before calling *DescribeCol*( ) ('**HY**010').

ColumnNumber must be in the range from 1 to and including the number of columns in the result set ('**07**009').

The prepared statement associated with *StatementHandle* must be a *cursor-specification* ('**07**005').

APPLICATION USAGE

The application may retrieve column descriptions in any order by repeated calls to *DescribeCol*( ).

The application can call *DescribeCol*( ) to retrieve, in a single call, all the descriptor fields commonly used when retrieving data from the database. Conceptually, *DescribeCol*( ) performs the following steps in sequence:

1. Calls *GetStmtAttr*( ) to obtain the implementation row descriptor handle.
2. Calls *GetDescField*( ) multiple times for that handle to retrieve values from the following fields of the implementation row descriptor:
   - sets *ColumnName* to the value of the NAME field and sets *NameLength* to the value of the *StringLength* parameter returned by *GetDescField*( )
   - sets *DataType* depending on the value of the TYPE field
   - sets *ColumnSize* to the value of the OCTET_LENGTH or PRECISION field (as appropriate for the TYPE field)
   - sets *DecimalDigits* to the value of the SCALE field
   - sets *Nullable* to the value of the NULLABLE field.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLHSTMT    StatementHandle;
SQLSMALLINT ColumnNumber;
SQLCHAR    *ColumnName;
SQLSMALLINT BufferLength;
SQLSMALLINT NameLength;
SQLSMALLINT DataType;
SQLINTEGER  ColumnSize;
SQLSMALLINT DecimalDigits;
SQLSMALLINT Nullable;
```

```
 ...
ReturnCode = SQLDescribeCol(StatementHandle,
  ColumnNumber, ColumnName, BufferLength, &NameLength,
  &DataType, &ColumnSize, &DecimalDigits, &Nullable);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE PICTURE S9(9) BINARY.
01 COLUMNNUMBER    PICTURE S9(4) BINARY.
01 COLUMNNAME      PICTURE X(128).
01 BUFFERLENGTH    PICTURE S9(4) BINARY.
01 NAMELENGTH      PICTURE S9(4) BINARY.
01 DATATYPE        PICTURE S9(4) BINARY.
01 COLUMNSIZE      PICTURE S9(9) BINARY.
01 DECIMALDIGITS   PICTURE S9(4) BINARY.
01 NULLABLE        PICTURE S9(4) BINARY.
01 RETURNCODE      PICTURE S9(4) BINARY.
 ...
CALL "SQLRDescribeCol" USING STATEMENTHANDLE, COLUMNNUMBER,
  COLUMNNAME, BUFFERLENGTH, NAMELENGTH, DATATYPE,
  COLUMNSIZE, DECIMALDIGITS, NULLABLE, RETURNCODE.
```

SEE ALSO

BindCol( ), *Fetch*( ), *FetchScroll*( ), *GetDescField*( ), *GetDescRec*( ), *NumResultCols*( )

NAME

Disconnect — Close a connection to a server

SYNOPSIS

```
FUNCTION Disconnect
 (ConnectionHandle INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The *Disconnect*( ) function has the following parameter:

ConnectionHandle (input)
Connection handle.

The function closes the connection associated with *ConnectionHandle*. Disconnecting a connection that is not the current connection makes no change to the context of the current connection.

If an application calls *Disconnect*( ) before freeing all statement handles and descriptor handles associated with *ConnectionHandle*, any such handles that are still allocated are freed if *Disconnect*( ) successfully returns, but are not freed if the disconnection fails (for example, if the current transaction is incomplete).

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

DIAGNOSTICS

The transaction associated with *ConnectionHandle* cannot be active ('**25**000').

[SQL_SUCCESS_WITH_INFO] can occur if errors occur performing the disconnection ('**01**002'), or if the connection was disconnected before the call to *Disconnect*( ) because of an event that occurred independently of the application ('**01**002'), or if implementation-defined warnings are produced.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN ReturnCode;
SQLHDBC   ConnectionHandle;
 ...
ReturnCode = SQLDisconnect(ConnectionHandle);
```

EXAMPLE USAGE (COBOL)

```
01 CONNECTIONHANDLE PICTURE S9(9) BINARY.
01 RETURNCODE       PICTURE S9(4) BINARY.
 ...
CALL "SQLRDisconnect" USING CONNECTIONHANDLE, RETURNCODE.
```

SEE ALSO

Connect( )

NAME

EndTran — Commit or roll back a transaction

SYNOPSIS

```
FUNCTION EndTran
 (HandleType SMALLINT,
  Handle INTEGER,
  CompletionType SMALLINT)
RETURNS (SMALLINT)
```

DESCRIPTION

The *EndTran*( ) function completes (commits or rolls back) a transaction, enacting or undoing any changes to the database performed on any connection within *Handle* since the transaction began (see Section 4.9 on page 63).

The function has the following parameters:

HandleType (input)
A handle type identifier. It must contain SQL_HANDLE_ENV if *Handle* is an environment handle, or SQL_HANDLE_DBC if *Handle* is a connection handle.

Handle (input)
The handle indicating the scope of work to be completed.

CompletionType (input)
The desired completion outcome. This may be one of the following:

SQL_COMMIT
Work done is to be committed.

SQL_ROLLBACK
Work done is to be rolled back.

Successful completion of a transaction closes any open cursors.

It is implementation-defined whether a transaction can span connections. On an implementation where transactions can span connections, the following aspects of coordination of multiple-connection transactions are implementation-defined:

- the sequence in which the connections have their transaction completed
- the effect that the success or failure of commitment over one connection has on the success or failure over any other.

If the work at some connections is committed and the work at others is rolled back, administrative action is typically necessary to assess or restore the integrity of the database.

The effect of calling *EndTran*( ) is implementation-defined if *HandleType* is SQL_HANDLE_DBC (see **Effects across Connections** on page 63).

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

[SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

DIAGNOSTICS

HandleType must be SQL_HANDLE_ENV or SQL_HANDLE_DBC ('**HY**092').

CompletionType must have one of the values listed above ('**HY**012').

The function may fail because the connection fails ('**08**007'). In this case, the application might not be able to determine whether the requested transaction outcome took effect before the failure.

The server can decide to roll back the transaction even though the call to *EndTran*( ) specified SQL_COMMIT. (The SQLSTATE class is '**40**' and the subclass is one of those specified in Appendix A.)

Errors for Global Transaction Control

The *EndTran*( ) function may fail for any of the following reasons:

- The implementation is not able to guarantee that all work in the global transaction can be completed atomically. Under implementation-defined criteria, either the transaction is still active ('**25**S02') or all work in the transaction active in *Handle* is rolled back ('**25**S03').
- One or more of the connections in *Handle* fails to complete the transaction with the outcome the application specified ('**25**S01'). The transaction state is unknown.

The application must not complete by calling *EndTran*( ) a global transaction it started by calling a function from an explicit transaction demarcation API, such as the X/Open Distributed Transaction Processing (DTP) function *tx_begin*( ) ('**2D**000').

APPLICATION USAGE

X/Open Distributed Transaction Processing (DTP) documents describe methods of coordinating databases so that changes to any recoverable resources are committed or rolled back atomically. For example, the emerging **Transaction Demarcation API** specifies functions by which an application declares the start, commitment or rollback of a global transaction. An application may use these functions in place of the implicit start of transactions described above, and in place of *Transact*( ), in order to coordinate SQL work with non-SQL work.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLSMALLINT HandleType;
SQLHENV     Handle;    /* or SQLHDBC */
SQLSMALLINT CompletionType;
 ...
ReturnCode = SQLEndTran(HandleType, Handle, CompletionType);
```

EXAMPLE USAGE (COBOL)

```
01 HANDLETYPE        PICTURE S9(4) BINARY.
01 HANDLE            PICTURE S9(9) BINARY.
01 COMPLETIONTYPE    PICTURE S9(4) BINARY.
01 RETURNCODE        PICTURE S9(4) BINARY.
 ...
CALL "SQLREndTran" USING HANDLETYPE, HANDLE,
  COMPLETIONTYPE, RETURNCODE.
```

RELATION TO STANDARDS

The ability to specify SQL_HANDLE_HDBC as *HandleType* represents an extension to the ISO CLI Draft International Standard, which only permits *EndTran*( ) to be applied to the entire environment.

NAME

Error — Return error information associated with a handle

SYNOPSIS

DE
```
FUNCTION Error
 (EnvironmentHandle INTEGER,
  ConnectionHandle INTEGER,
  StatementHandle INTEGER,
  Sqlstate CHAR,
  NativeError INTEGER,
  MessageText CHAR,
  BufferLength SMALLINT,
  TextLength SMALLINT)
RETURNS (SMALLINT)
```

DESCRIPTION

An application calls *Error*( ) to obtain several commonly-used pieces of error or warning status from a previous call to a CLI function, especially one that returned [SQL_ERROR] or [SQL_SUCCESS_WITH_INFO]. (This function is referred to below as the underlying function.)

The data structure associated with each handle for an environment, connection and statement contains a diagnostics area. The area consists of header information and zero or more status records. Each status record includes values of *Sqlstate*, *NativeError* and *MessageText* / *TextLength*. Each status record describes a specific event in the execution of the underlying function.

The first three parameters to *Error*( ) specify a single handle from which the application seeks information from the diagnostic area:

EnvironmentHandle [input]
Environment handle.

ConnectionHandle [input]
Connection handle.

StatementHandle [input]
Statement handle.

To obtain status on an SQL statement, pass a valid statement handle as *StatementHandle*. To obtain status on a connection, set *StatementHandle* to SQL_NULL_HSTMT and pass a valid connection handle as *ConnectionHandle*. To obtain status on an environment, set *StatementHandle* to SQL_NULL_HSTMT, set *ConnectionHandle* to SQL_NULL_HDBC and pass a valid environment handle as *EnvironmentHandle*.

The remaining parameters convey the status information to the application:

Sqlstate [output]
A string of 5 characters. The first 2 indicate error class; the next 3 indicate subclass. The values are identical to SQLSTATE values in the X / Open **SQL** specification.

NativeError [output]
An implementation-defined error code. Portable applications should not base their behaviour on the value of *NativeError*.

MessageText [output]
Implementation-defined message text. Its length in octets never exceeds {SQL_MAX_MESSAGE_LENGTH} minus the number of octets in the null terminator if applicable.

BufferLength [input]
Maximum number of octets to store in *MessageText*.

TextLength [output]
Length in octets of the output data (even if it does not entirely fit in *MessageText*).

RETURN VALUE

The function uses the following return values (instead of generated diagnostics) to report the outcome of its own execution:

[SQL_SUCCESS]
The function successfully returned error information.

[SQL_INVALID_HANDLE]
The combination of *EnvironmentHandle*, *ConnectHandle* and *StatementHandle* did not specify a valid handle.

[SQL_ERROR]
The *BufferLength* argument is negative (or *BufferLength* is zero and the environment attribute SQL_ATTR_OUTPUT_NTS is true).

[SQL_NO_DATA]
No further diagnostic records exist for the specified handle.

The function does not return [SQL_SUCCESS_WITH_INFO] even if it truncates a string output argument. No implementation-defined diagnostics are possible.

DIAGNOSTICS

None. This function never generates information in any handle's diagnostic area to describe its own execution. This function is never the underlying function as defined in **DESCRIPTION** above. Any diagnostics are reported using the **RETURN VALUE** (see above).

APPLICATION USAGE

Production of status records by the underlying function is discussed in Section 5.2 on page 69.

The application obtains one status record at a time by each successive call to *Error*( ). Each such call returns [SQL_SUCCESS], returns the status record and removes that record from the list of records available via *Error*( ) using the specified handle.

If a valid call to *Error*( ) does not obtain a status record, either because previous calls to *Error*( ) obtained them all or because the underlying CLI function for the specified handle returned success or [SQL_NO_DATA], then *Error*( ) returns [SQL_NO_DATA]; *Sqlstate* is '**00**000', *NativeError*, *MessageText*, and *TextLength* are undefined. However, if the call to *Error*( ) returns [SQL_ERROR] or [SQL_INVALID_HANDLE], all output parameters are undefined.

The Error function retrieves only diagnostic information most recently associated with the specified handle. If an application calls a another CLI function that writes diagnostic information to the same handle (even a success indication), any diagnostic information from previous calls is lost.

In languages that allow the use of pointers, the application can provide a null pointer for any of *Sqlstate*, *NativeError* and *MessageText*, in order to inhibit return of that information.

An application can call *Error*( ), *GetDiagField*( ) or *GetDiagRec*( ) to obtain status information for a handle. These functions are implemented so that they do not interfere with the sequence of status records that the other functions return.

Even though the message text field in the X/Open SQL diagnostic area is specified as CHAR(254), some implementations may generate more than 254 octets of message text. A portable application should set aside a buffer whose length in octets is {SQL_MAX_MESSAGE_LENGTH}.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLHENV     EnvironmentHandle;
SQLHDBC     ConnectionHandle;
SQLHSTMT    StatementHandle;
SQLCHAR     Sqlstate[6];
SQLINTEGER  NativeError;
SQLCHAR    *MessageText;
SQLSMALLINT BufferLength;
SQLSMALLINT TextLength;
 ...
ReturnCode = SQLError(EnvironmentHandle, ConnectionHandle,
  StatementHandle, Sqlstate, &NativeError,
  MessageText, BufferLength, &TextLength);
```

EXAMPLE USAGE (COBOL)

```
01 ENVIRONMENTHANDLE PICTURE S9(9) BINARY.
01 CONNECTIONHANDLE  PICTURE S9(9) BINARY.
01 STATEMENTHANDLE   PICTURE S9(9) BINARY.
01 SQLSTATE          PICTURE X(5).
01 NATIVEERROR       PICTURE S9(9) BINARY.
01 MESSAGETEXT       PICTURE X(512).
01 BUFFERLENGTH      PICTURE S9(4) BINARY.
01 TEXTLENGTH        PICTURE S9(4) BINARY.
01 RETURNCODE        PICTURE S9(4) BINARY.
 ...
CALL "SQLRError" USING ENVIRONMENTHANDLE, CONNECTIONHANDLE,
  STATEMENTHANDLE, SQLSTATE, NATIVEERROR, MESSAGETEXT,
  BUFFERLENGTH, TEXTLENGTH, RETURNCODE.
```

SEE ALSO

GetDiagField( ), *GetDiagRec*( ), *RowCount*( )

NAME

ExecDirect — Execute an SQL statement directly

SYNOPSIS

```
FUNCTION ExecDirect
 (StatementHandle INTEGER,
  StatementText CHAR,
  TextLength INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The *ExecDirect*( ) function effects a one-time execution of an SQL statement. The function has the following parameters:

StatementHandle (input)
Statement handle.

StatementText (input)
SQL text string, using question-mark (?) characters as dynamic parameter markers.

TextLength (input)
Length in octets of *StatementText*.

Calling the function executes the SQL statement in *StatementText*, using the current values of any variables bound to dynamic parameters. These values may be converted before being used as dynamic arguments depending on the TYPE field of the corresponding descriptor record. If the TYPE field is SQL_DEFAULT, then the value is converted from a type given by Table 4-9 on page 61 based on the data type of the dynamic parameter.

ExecDirect( ) populates the implementation row descriptor with information describing the columns of the result set.

Dynamic Parameters

OP It is implementation-defined which of the following occurs during a call to *ExecDirect*( ):

- The implementation sets the fields of the implementation parameter descriptor to describe the number, data type and type attributes of dynamic parameters in the SQL statement (this corresponds to the DESCRIBE INPUT feature of embedded SQL). If there are no dynamic parameters, the descriptor's COUNT field is set to 0.
- The implementation does not modify the implementation parameter descriptor.

Section 4.3.1 on page 47 describes the cases in which the application must gain access to the implementation parameter descriptor.

For a *cursor-specification*, *ExecDirect*( ) generates a cursor name, unless one already exists, and opens the cursor.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_INVALID_HANDLE], [SQL_NEED_DATA], [SQL_SUCCESS_WITH_INFO] or [SQL_NO_DATA].

DIAGNOSTICS

[SQL_SUCCESS_WITH_INFO] can result if the parameter data is truncated ('**01**004') or when implementation-defined warnings are produced.

There must not be an open cursor on *StatementHandle* ('**24**000').

If the application has specified an application parameter descriptor, its COUNT field must be non-negative (’**07**008’).

The CLI implementation evaluates dynamic arguments only when it executes the SQL statement. At this time:

- The application must have provided a dynamic argument for each dynamic parameter in the SQL statement using the application parameter descriptor (’**07**001’).
- For character-string dynamic arguments, the variable indicated by the LENGTH_PTR field (from which the implementation determines the argument’s length as specified in Section 4.3 on page 46) must be valid (’**22**005’).
- The variable indicated by the DATA_PTR field (which contains the actual data to use as the dynamic argument) must be in the stored format specified by the TYPE and related fields. This checking may produce the diagnostics specified in Section 5.4.10 on page 76.
- If the application has set any fields of the implementation parameter buffer, the types and type attributes defined there must be compatible with the corresponding fields of the application parameter buffer. The permitted combinations are defined in Section 4.8.3 on page 60 (’**07**006’).

Statement Preparation Diagnostics[20]

The statement text must be a valid SQL statement other than COMMIT or ROLLBACK (’**42**000’).

For a dynamic positioned DELETE or a dynamic positioned UPDATE statement, the cursor referenced by the statement must be open and must be defined on a separate statement handle under the same connection handle (’**34**000’).

The following diagnostics, defined in the X/Open **SQL** specification, can occur based on the value of *StatementText*:

	Cardinality violation
‘**21**S01’	— Insert value does not match column list.
’**21**S02’	— Degree of derived table does not match column list.
’**42**000’	**Syntax error or access violation**†
’**42**S01’	— Base table or view already exists.
’**42**S02’	— Base table or view not found.
’**42**S11’	— Index already exists.
’**42**S12’	— Index not found.
’**42**S21’	— Column already exists.
’**42**S22’	— Column not found.

20. **Statement Preparation Diagnostics** are those also listed for *Prepare*( ). **Statement Execution Diagnostics** are those also listed for *Execute*( ). The classification is not normative and the distinction is not visible to the caller of *ExecDirect*( ).

† The codes of the form ’**42**S*nn*’ are ’**S0**0*nn*’ in the X/Open **SQL** specification.

Statement Execution Diagnostics

The SQL statement must not contain a dynamic parameter ('**07**001') or literal ('**42**000') whose value is incompatible with the data type of the associated table column.

A character string assigned to a character-string table column must not exceed the maximum length in characters of the column ('**22**001').

The following diagnostics, defined in the X/Open **SQL** specification, can occur based on the value of *StatementText*:

	Success with warning [SQL_SUCCESS_WITH_INFO]
'**01**006'	— Privilege not revoked.
'**01**007'	— Privilege not granted.
	Data exception
'**22**012'	— Division by zero.
'**23**000'	**Integrity constraint violation**
'**24**000'	**Invalid cursor state**

Execution of the SQL statement may produce the data conversion diagnostics specified in Section 5.4.10 on page 76.

APPLICATION USAGE

The function returns [SQL_NO_DATA] if the SQL statement specified is searched DELETE, INSERT or searched UPDATE and the row count (see Section 5.3.2 on page 72) is zero.

The return value [SQL_NEED_DATA] asks the application to supply dynamic arguments by calling *ParamData*( ) and *PutData*( ), as described in Section 4.3.2 on page 48.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLHSTMT    StatementHandle;
SQLCHAR    *StatementText;
SQLINTEGER  TextLength;
 ...
ReturnCode = SQLExecDirect(StatementHandle,
  StatementText, TextLength);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE PICTURE S9(9) BINARY.
01 STATEMENTTEXT   PICTURE type.
01 TEXTLENGTH      PICTURE S9(9) BINARY.
01 RETURNCODE      PICTURE S9(4) BINARY.
 ...
CALL "SQLRExecDirect" USING STATEMENTHANDLE,
  STATEMENTTEXT, TEXTLENGTH, RETURNCODE.
```

SEE ALSO

CloseCursor( ), *Execute*( ), *Fetch*( ), *FetchScroll*( ), *ParamData*( ), *Prepare*( ), *PutData*( ), *SetCursorName*( )

NAME

Execute — Execute a prepared SQL statement

SYNOPSIS

```
FUNCTION Execute
 (StatementHandle INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The *Execute*( ) function executes a prepared SQL statement. The function has the following parameter:

StatementHandle (input)
Statement handle.

Calling *Execute*( ) executes *StatementHandle*, as prepared by a previous call to *Prepare*( ), using the current values of any variables bound to dynamic parameters. These values may be converted before being used as dynamic arguments depending on the TYPE field of the corresponding descriptor record. If the TYPE field is SQL_DEFAULT, then the value is converted from a type given by Table 4-9 on page 61 based on the data type of the dynamic parameter.

For a *cursor-specification*, calling *Execute*( ) opens the cursor using the cursor name generated by *Prepare*( ) or *SetCursorName*( ).

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_INVALID_HANDLE], [SQL_NEED_DATA] [SQL_SUCCESS_WITH_INFO] or [SQL_NO_DATA].

DIAGNOSTICS

[SQL_SUCCESS_WITH_INFO] can result if the parameter data is truncated ('**01**004') or when implementation-defined warnings are produced.

The application must have successfully prepared *StatementHandle* (by calling *Prepare*( )) before the call to *Execute*( ) ('**HY**010'). Certain **DIAGNOSTICS** noted by * in the *Prepare*( ) manual page are not detected on some implementations until the call to *Execute*( ).

There must not be an open cursor on *StatementHandle* ('**24**000').

If the application has specified an application parameter descriptor, its COUNT field must be non-negative ('**07**008').

The CLI implementation evaluates dynamic arguments only when it executes the SQL statement. At this time:

- The application must have provided a dynamic argument for each dynamic parameter in the SQL statement using the application parameter descriptor ('**07**001').
- For character-string dynamic arguments, the variable indicated by the LENGTH_PTR field (from which the implementation determines the argument's length as specified in Section 4.3 on page 46) must be valid ('**22**005').
- The variable indicated by the DATA_PTR field (which contains the actual data to use as the dynamic argument) must be in the stored format specified by the TYPE and related fields. This checking may produce the diagnostics specified in Section 5.4.10 on page 76.
- If the application has set any fields of the implementation parameter buffer, the types and type attributes defined there must be compatible with the corresponding fields of the application parameter buffer. The permitted combinations are defined in Section 4.8.3 on page 60 ('**07**006').

A character string assigned to a character-string table column must not exceed the maximum length in characters of the column ('**22**001').

The SQL statement must not contain a dynamic parameter ('**07**001') or literal ('**42**000') whose value is incompatible with the data type of the associated table column.

The following diagnostics, defined in the X/Open **SQL** specification, can occur based on the value of *StatementText*:

	Success with warning [SQL_SUCCESS_WITH_INFO]
'**01**006'	— Privilege not revoked.
'**01**007'	— Privilege not granted.
	Data exception
'**22**012'	— Division by zero.
'**23**000'	**Integrity constraint violation**
'**24**000'	**Invalid cursor state**

Execution of the SQL statement may produce the data conversion diagnostics specified in Section 5.4.10 on page 76.

APPLICATION USAGE

The function returns [SQL_NO_DATA] if the SQL statement specified is searched DELETE or searched UPDATE and the row count (see Section 5.3.2 on page 72) is zero.

After the application processes (or discards) all results, it can call *Execute*( ) again, with the same or different dynamic arguments.

The return value [SQL_NEED_DATA] asks the application to supply dynamic arguments by calling *ParamData*( ) and *PutData*( ), as described in Section 4.3.2 on page 48.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN ReturnCode;
SQLHSTMT  StatementHandle;
 ...
ReturnCode = SQLExecute(StatementHandle);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE PICTURE S9(9) BINARY.
01 RETURNCODE      PICTURE S9(4) BINARY.
 ...
CALL "SQLRExecute" USING STATEMENTHANDLE, RETURNCODE.
```

SEE ALSO

CloseCursor( ), *ExecDirect*( ), *Fetch*( ), *FetchScroll*( ), *ParamData*( ), *Prepare*( ), *PutData*( ), *SetCursorName*( )

NAME

Fetch — Fetch the next row of a result set

SYNOPSIS

```
FUNCTION Fetch
 (StatementHandle INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The *Fetch*( ) function has the following parameter:

StatementHandle (input)
Statement handle.

When a *cursor-specification* has been executed on *StatementHandle*, the application can call *Fetch*( ) to fetch the next row from the result set. This modifies any bound variables to reflect the values in the new row.

Data conversion of column data may occur before assignment to the bound variables depending on the TYPE field of the corresponding descriptor record. If the TYPE field is SQL_DEFAULT, then the column data is converted to a type given by Table 4-9 on page 61 based on the data type of the column.

If the row contains more columns than have been bound, fetching the row also makes unbound columns available for retrieval using *GetData*( ).

RETURN VALUE

[SQL_SUCCESS], [SQL_INVALID_HANDLE], [SQL_ERROR], [SQL_NO_DATA] or [SQL_SUCCESS_WITH_INFO].

The [SQL_NO_DATA] outcome occurs if there is no next row of the result set. In the case of [SQL_ERROR] or [SQL_NO_DATA], the resulting values of any bound variables are undefined.

DIAGNOSTICS

The [SQL_SUCCESS_WITH_INFO] outcome occurs if a returned string value is truncated ('**01**004') or if implementation-defined warnings are produced.

The last SQL statement executed on *StatementHandle* must be a *cursor-specification* ('**24**000').

If the application has specified an application row descriptor:

- Its COUNT field must be non-negative ('**07**008') and must not exceed the number of columns of the result set ('**07**002').
- The data type of each column must be assignment-compatible with the buffer type specified by the corresponding descriptor record ('**07**006'). Retrieving a value may produce the data conversion diagnostics described in Section 5.4.10 on page 76.
- If the column value for any bound column is null, the INDICATOR_PTR field of the corresponding descriptor record must not be a null pointer ('**22**002').

Retrieving a value from an arithmetic expression, and applying any specified conversion, must not result in a division by zero ('**22**012'), either at the time of assignment or in computing an intermediate result.

The function can fail if the server terminates the current transaction to prevent deadlock

('**40**001'). In this case, the transaction is rolled back.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN ReturnCode;
SQLHSTMT  StatementHandle;
 ...
ReturnCode = SQLFetch(StatementHandle);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE PICTURE S9(9) BINARY.
01 RETURNCODE      PICTURE S9(4) BINARY.
 ...
CALL "SQLRFetch" USING STATEMENTHANDLE, RETURNCODE.
```

SEE ALSO

Execute( ), *ExecDirect*( ), *FetchScroll*( ), *GetData*( )

NAME

FetchScroll — Move the cursor to, and fetch, a specified row of a result set

SYNOPSIS

```
FUNCTION FetchScroll
 (StatementHandle INTEGER,
  FetchOrientation SMALLINT,
  FetchOffset INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The *Fetch*( ) function has the following parameters:

StatementHandle (input)
Statement handle.

FetchOrientation (input)
The cursor positioning operation to be performed before fetching a row of the result set. This can be one of the following:

SQL_FETCH_NEXT
Move to the row following the current cursor position.

SQL_FETCH_FIRST
Move to the first row of the result set.

SQL_FETCH_LAST
Move to the last row of the result set.

SQL_FETCH_PRIOR
Move to the row preceding the current cursor position.

SQL_FETCH_ABSOLUTE
If *FetchOffset* is positive, move to row number *FetchOffset* of the result set, where the first row is number 1.

If *FetchOffset* is negative, it specifies a move relative to the last row of the result set, which is row –1. If the cardinality of the result set is *n*, then the cursor moves to row *n* + *FetchOffset* + 1. For example, if *FetchOffset* is –5 in a result set with 100 rows, the cursor moves to row 100 + (–5) + 1 or 96.

For the case where *FetchOffset* = 0, see **RETURN VALUE** below.

SQL_FETCH_RELATIVE
If *FetchOffset* is positive, advance the cursor that number of rows.

If *FetchOffset* is negative, back up the cursor –*FetchOffset* rows.

If *FetchOffset* is zero, do not move the cursor.

FetchOffset
When *FetchOrientation* is SQL_FETCH_ABSOLUTE, this is an absolute row number of the result set, as described above. When *FetchOrientation* is SQL_FETCH_RELATIVE, this is an offset to the current cursor position, as described above. Otherwise, *FetchOffset* is ignored.

When a *cursor-specification* has been executed on *StatementHandle*, the application can call *FetchScroll*( ) to move the cursor as specified by *FetchOrientation* and *FetchOffset*, and to fetch from the result set the row to which the cursor then points. This modifies any bound variables to reflect the values in the new row.

Data conversion of column data may occur before assignment to the bound variables depending on the TYPE field of the corresponding descriptor record. If the TYPE field is SQL_DEFAULT, then the column data is converted to a type given by Table 4-9 on page 61 based on the data type of the column.

If the row contains more columns than have been bound, fetching the row also makes unbound columns available for retrieval using *GetData*( ).

RETURN VALUE

[SQL_SUCCESS], [SQL_INVALID_HANDLE], [SQL_ERROR], [SQL_NO_DATA] or [SQL_SUCCESS_WITH_INFO].

The [SQL_NO_DATA] outcome occurs if there is no such row as the specified row of the result set. This generally indicates one of the following cases where the specified cursor motion exceeded the bounds of the result set:[21]

- An absolute fetch when *FetchOffset* is 0, or when the absolute value of *FetchOffset* is greater than the number of rows of the result set.
- A relative fetch, including SQL_FETCH_NEXT and SQL_FETCH_PRIOR, where the specified number of rows to move is more than the remaining rows of the result set in the specified direction.

In the case of [SQL_ERROR] or [SQL_NO_DATA], the resulting values of any bound variables are undefined.

DIAGNOSTICS

The [SQL_SUCCESS_WITH_INFO] outcome occurs if a returned string value is truncated (’**01**004’) or if implementation-defined warnings are produced.

The last SQL statement executed on *StatementHandle* must be a *cursor-specification* (’**24**000’).

EX OP *FetchOrientation* must be one of the valid values. If *FetchOrientation* is any value other than SQL_FETCH_NEXT, the application must set the SQL_ATTR_CURSOR_SCROLLABLE statement attribute to SQL_TRUE before preparing or executing *StatementHandle*(’**HY**106’).

If the application has specified an application row descriptor:

- Its COUNT field must be non-negative (’**07**008’) and must not exceed the number of columns of the result set (’**07**002’).
- The data type of each column must be assignment-compatible with the buffer type specified by the corresponding descriptor record (’**07**006’). Retrieving a value may produce the data conversion diagnostics described in Section 5.4.10 on page 76.
- If the column value for any bound column is null, the INDICATOR_PTR field of the corresponding descriptor record must not be a null pointer (’**22**002’).

Retrieving a value from an arithmetic expression, and applying any specified conversion, must not result in a division by zero (’**22**012’), either at the time of assignment or in computing an intermediate result.

---

21. The cursor position resulting from the [SQL_NO_DATA] outcome is before the first row of the result set if the specified cursor movement was excessive and backward; or after the last row of the result set if the specified cursor movement was excessive and forward. When the application specifies an absolute move to the nonexistent row 0, the cursor moves before the first row.

The function can fail if the server terminates the current transaction to prevent deadlock ('**40**001'). In this case, the transaction is rolled back.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLHSTMT    StatementHandle;
SQLSMALLINT FetchOrientation;
SQLINTEGER  FetchOffset;
 ...
ReturnCode = SQLFetchScroll(StatementHandle, FetchOrientation,
  FetchOffset);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE  PICTURE S9(9) BINARY.
01 FETCHORIENTATION PICTURE S9(4) BINARY.
01 FETCHOFFSET      PICTURE S9(9) BINARY.
01 RETURNCODE       PICTURE S9(4) BINARY.
 ...
CALL "SQLRFetchScroll" USING STATEMENTHANDLE, FETCHORIENTATION,
  FETCHOFFSET, RETURNCODE.
```

SEE ALSO

Execute( ), *ExecDirect*( ), *Fetch*( ), *GetData*( )

NAME

FreeConnect — Free a connection handle (deprecated)

SYNOPSIS

DE
```
FUNCTION FreeConnect
 (ConnectionHandle INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The *FreeConnect* function frees the connection handle *ConnectionHandle*. The function has the following parameter:

ConnectionHandle (input)
The connection handle to be freed.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR] or [SQL_INVALID_HANDLE].

If *FreeConnect*( ) returns [SQL_ERROR], *ConnectionHandle* is still valid.

DIAGNOSTICS

The application must call *Disconnect*( ) before trying to free a connection handle ('**HY**010').

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN ReturnCode;
SQLHDBC   ConnectionHandle;
 ...
ReturnCode = SQLFreeConnect(ConnectionHandle);
```

EXAMPLE USAGE (COBOL)

```
01 CONNECTIONHANDLE  PICTURE S9(9) BINARY.
01 RETURNCODE        PICTURE S9(4) BINARY.
 ...
CALL "SQLRFreeConnect" USING CONNECTIONHANDLE, RETURNCODE
```

SEE ALSO

AllocConnect( ), *AllocHandle*( ), *FreeHandle*( ), *Disconnect*( )

NAME

FreeEnv — Free an environment handle (deprecated)

SYNOPSIS

DE
```
FUNCTION FreeEnv
 (EnvironmentHandle INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The *FreeEnv* function frees *EnvironmentHandle*. The function has the following parameter:

EnvironmentHandle (input)
The environment handle to be freed.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR] or [SQL_INVALID_HANDLE].

If *FreeEnv*( ) returns [SQL_ERROR], *EnvironmentHandle* is still valid.

DIAGNOSTICS

The application must release all subsidiary handles and other resources before trying to free an environment handle ('**HY**010').

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN ReturnCode;
SQLHENV   EnvironmentHandle;
 ...
ReturnCode = SQLFreeEnv(EnvironmentHandle);
```

EXAMPLE USAGE (COBOL)

```
01  ENVIRONMENTHANDLE PICTURE S9(9) BINARY.
01  RETURNCODE       PICTURE S9(4) BINARY.
 ...
CALL "SQLRFreeEnv" USING ENVIRONMENTHANDLE, RETURNCODE.
```

SEE ALSO

AllocEnv( ), *AllocHandle*( ), *FreeHandle*( )

NAME

FreeHandle — Free a handle

SYNOPSIS

```
FUNCTION FreeHandle
 (HandleType SMALLINT,
  Handle INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The *FreeHandle*( ) function has the following parameters:

HandleType (input)
A handle type identifier that describes the handle type of *Handle*. It must contain one of the following values:

SQL_HANDLE_ENV
FreeHandle( ) frees the environment handle *Handle*.

SQL_HANDLE_DBC
FreeHandle( ) frees the connection handle *Handle*.

SQL_HANDLE_STMT
FreeHandle( ) frees the statement handle *Handle*, closing any open cursor on *Handle*. It also frees any automatically-generated descriptors associated with *Handle*.

SQL_HANDLE_DESC
FreeHandle( ) frees the descriptor handle *Handle*. *FreeHandle*( ) does not release any memory allocated by the application that may be referenced by the deferred fields of any descriptor record of *Handle*.

Handle (input)
The handle to be freed.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR] or [SQL_INVALID_HANDLE].

If *FreeHandle*( ) returns [SQL_ERROR], *Handle* is still valid.

DIAGNOSTICS

HandleType must be one of the values defined above ('**HY**092').

The application must release all subsidiary handles and other resources before trying to free a handle ('**HY**010'). For example, the application must call *Disconnect*( ), freeing all subsidiary handles, before trying to free a connection handle.

Handle must not identify an automatically-generated descriptor ('**HY**017').

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN ReturnCodeEnv;
SQLRETURN ReturnCodeDbc;
SQLRETURN ReturnCodeStmt;
SQLRETURN ReturnCodeDesc;
SQLHENV   EnvironmentHandle;
SQLHDBC   ConnectionHandle;
SQLHSTMT  StatementHandle;
SQLHDESC  DescriptorHandle;
 ...
```

```
ReturnCodeStmt = SQLFreeHandle(SQL_HANDLE_STMT, StatementHandle);
 ...
ReturnCodeDesc = SQLFreeHandle(SQL_HANDLE_DESC, DescriptorHandle);
 ...
ReturnCodeDbc  = SQLFreeHandle(SQL_HANDLE_DBC, ConnectionHandle);
 ...
ReturnCodeEnv  = SQLFreeHandle(SQL_HANDLE_ENV, EnvironmentHandle);
```

EXAMPLE USAGE (COBOL)

```
01 ENVIRONMENTHANDLE PICTURE S9(9) BINARY.
01 CONNECTIONHANDLE  PICTURE S9(9) BINARY.
01 STATEMENTHANDLE   PICTURE S9(9) BINARY.
01 DESCRIPTORHANDLE  PICTURE S9(9) BINARY.
01 RETURNCODEENV     PICTURE S9(4) BINARY.
01 RETURNCODEDBC     PICTURE S9(4) BINARY.
01 RETURNCODESTMT    PICTURE S9(4) BINARY.
01 RETURNCODEDESC    PICTURE S9(4) BINARY.
 ...
CALL "SQLRFreeHandle" USING SQL-HANDLE-STMT,
  STATEMENTHANDLE, RETURNCODESTMT.
 ...
CALL "SQLRFreeHandle" USING SQL-HANDLE-DESC,
  DESCRIPTORHANDLE, RETURNCODEDESC.
 ...
CALL "SQLRFreeHandle" USING SQL-HANDLE-DBC,
  CONNECTIONHANDLE, RETURNCODEDBC.
 ...
CALL "SQLRFreeHandle" USING SQL-HANDLE-ENV,
  ENVIRONMENTHANDLE, RETURNCODEENV.
```

SEE ALSO

AllocHandle( )

NAME

FreeStmt — Free a statement handle (deprecated)

SYNOPSIS

DE
```
FUNCTION FreeStmt
 (StatementHandle INTEGER,
   Option SMALLINT)
RETURNS (SMALLINT)
```

DESCRIPTION

The *FreeStmt*( ) function frees the statement handle *StatementHandle* or performs other operations on *StatementHandle* as specified by *Option*. The function has the following parameters:

StatementHandle (input)
The statement handle to be processed.

Option (input)
An option parameter that specifies the function to be performed on *StatementHandle*. This must be one of the following:

SQL_CLOSE
Closes any cursor associated with *StatementHandle* and discards any pending results. The application can re-execute the statement associated with the cursor, with the same or different dynamic arguments. If no open cursor is associated with *StatementHandle*, this option has no effect.

SQL_DROP
Frees *StatementHandle*, closes any open cursor on *StatementHandle* and frees any automatically-generated descriptors associated with *StatementHandle*.

SQL_UNBIND
Unbinds all descriptor records in the application row descriptor associated with *StatementHandle*.

SQL_RESET_PARAMS
Unbinds all descriptor records in the application parameter descriptor associated with *StatementHandle*.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR] or [SQL_INVALID_HANDLE].

If *FreeStmt*( ) returns [SQL_ERROR], *StatementHandle* is still valid.

DIAGNOSTICS

Option must be one of the defined options ('**HY**092').

EXAMPLE USAGE(C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLHSTMT    StatementHandle;
SQLSMALLINT Option;
 ...
ReturnCode = SQLFreeStmt(StatementHandle, Option);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE  PICTURE S9(9) BINARY.
01 OPTION           PICTURE S9(4) BINARY.
01 RETURNCODE       PICTURE S9(4) BINARY.
 ...
```

```
CALL "SQLRFreeStmt" USING STATEMENTHANDLE, OPTION, RETURNCODE.
```

SEE ALSO

AllocHandle( ), *AllocStmt*( ), *FreeHandle*( )

NAME

GetConnectAttr — Get the value of a connection attribute

SYNOPSIS

```
FUNCTION GetConnectAttr
 (ConnectionHandle INTEGER,
  Attribute INTEGER,
  Value ANY,
  BufferLength INTEGER,
  StringLength INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The application can call *GetConnectAttr*( ) to obtain a value of an attribute for *ConnectionHandle*.

The function has the following parameters:

ConnectionHandle (input)
Connection handle.

Attribute (input)
The desired connection attribute. For a list of valid attributes, see **Connection Attributes** on page 29.

Value (output)
The current value of the attribute specified by *Attribute*. The type of the value returned depends on *Attribute*.

BufferLength (input)
Maximum number of octets to store in *Value*, if the attribute value is a character string; otherwise, unused.

StringLength (output)
Length in octets of the output data (even if it does not entirely fit in *Value*), if the attribute value is a character string; otherwise, unused.

If *Attribute* does not denote a string, then the implementation ignores *BufferLength* and does not set *StringLength*.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

DIAGNOSTICS

The [SQL_SUCCESS_WITH_INFO] outcome occurs if the returned data is truncated ('**01**004') or if implementation-defined warnings are produced.

Attribute must be one of the defined attributes or an implementation-defined value ('**HY**092').

If *Attribute* is SQL_ATTR_AUTO_IPD, then a connection must be established on *ConnectionHandle* ('**08**003').

APPLICATION USAGE

GetConnectAttr( ) can be called at any time between the allocation and the freeing of *ConnectionHandle*. It obtains the current value of the connection attribute.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN  ReturnCode;
SQLHDBC    ConnectionHandle;
```

```
SQLINTEGER Attribute;
SQLPOINTER Value;
SQLINTEGER BufferLength;
SQLINTEGER StringLength;
 ...
ReturnCode = SQLGetConnectAttr(ConnectionHandle,
  Attribute, Value, BufferLength, &StringLength);
```

EXAMPLE USAGE (COBOL)

```
01 CONNECTIONHANDLE  PICTURE S9(9) BINARY.
01 ATTRIBUTE         PICTURE S9(9) BINARY.
01 VALUE             PICTURE type.
01 BUFFERLENGTH      PICTURE S9(9) BINARY.
01 STRINGLENGTH      PICTURE S9(9) BINARY.
01 RETURNCODE        PICTURE S9(4) BINARY.
 ...
CALL "SQLRGetConnectAttr" USING CONNECTIONHANDLE,
  ATTRIBUTE, VALUE, BUFFERLENGTH, STRINGLENGTH, RETURNCODE.
```

SEE ALSO

AllocHandle( ), *SetConnectAttr*( )

NAME

GetConnectOption — Get the value of a connection attribute (deprecated)

SYNOPSIS

DE
```
FUNCTION GetConnectOption
 (ConnectionHandle INTEGER,
  Option SMALLINT,
  Value ANY)
RETURNS  (SMALLINT)
```

DESCRIPTION

The application can call *GetConnectOption*( ) to obtain a value of an attribute for *ConnectionHandle*. The function has the following parameters:

ConnectionHandle (input)
Connection handle.

Option (input)
The desired connection attribute. For a list of valid attributes, see **Connection Attributes** on page 29.

Value (output)
The current value of the attribute specified by *Option*. Depending on the value of *Option*, this points either to a 32-bit integer or to a character string.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE]. The [SQL_SUCCESS_WITH_INFO] outcome occurs if implementation-defined warnings are produced.

DIAGNOSTICS

Option must be one of the defined attributes or an implementation-defined value ('**HY**092').

If *Option* is SQL_ATTR_AUTO_IPD, then a connection must be established on *ConnectionHandle* ('**08**003').

APPLICATION USAGE

The application can call *GetConnectOption*( ) at any time between the allocation and the freeing of *ConnectionHandle*. It obtains the current value of the connection attribute.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLHDBC     ConnectionHandle;
SQLSMALLINT Option;
SQLPOINTER  Value;
 ...
ReturnCode = SQLGetConnectOption(ConnectionHandle,
  Option, Value);
```

EXAMPLE USAGE (COBOL)

```
01 CONNECTIONHANDLE  PICTURE S9(9) BINARY.
01 OPTION            PICTURE S9(4) BINARY.
01 VALUE             PICTURE type.
01 RETURNCODE        PICTURE S9(4) BINARY.
 ...
CALL "SQLRGetConnectOption" USING CONNECTIONHANDLE,
  OPTION, VALUE, RETURNCODE.
```

SEE ALSO

AllocHandle( ), *GetConnectAttr*( ), *SetConnectOption*( )

NAME

GetCursorName — Get the name of a cursor

SYNOPSIS

```
FUNCTION GetCursorName
 (StatementHandle INTEGER,
  CursorName CHAR,
  BufferLength SMALLINT,
  NameLength SMALLINT)
RETURNS (SMALLINT)
```

DESCRIPTION

The *GetCursorName*( ) function returns a cursor name associated with a statement handle. The function has the following parameters:

StatementHandle (input)
Statement handle.

CursorName (output)
Cursor name.

BufferLength (input)
Maximum number of octets to store in *CursorName*.

NameLength (output)
Length in octets of the output data (even if it does not entirely fit in *CursorName*).

Calling *GetCursorName*( ) sets *CursorName* to the cursor name associated with *StatementHandle*. The application can specify a cursor name explicitly by calling *SetCursorName*( ); otherwise the cursor name is the one the implementation created (see **Cursor Name** in Section 4.5.1 on page 52). Implicit cursor names always start with 'SQLCUR' or 'SQL_CUR'.

RETURN VALUE

[SQL_SUCCESS], [SQL_SUCCESS_WITH_INFO], [SQL_INVALID_HANDLE] or [SQL_ERROR].

DIAGNOSTICS

The [SQL_SUCCESS_WITH_INFO] result occurs if the implementation truncated the cursor name ('**01**004') or if implementation-defined warnings are produced.

There must be a cursor name on *StatementHandle* ('**HY**015').[22]

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLHSTMT    StatementHandle;
SQLCHAR     CursorName[SQL_MAX_ID_LENGTH+1];
SQLSMALLINT BufferLength;
SQLSMALLINT NameLength;
 ...
ReturnCode = SQLGetCursorName(StatementHandle,
  CursorName, BufferLength, &NameLength);
```

22. If the implementation implicitly generates a cursor name when the statement handle is allocated, this error never occurs.

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE PICTURE S9(9) BINARY.
01 CURSORNAME      PICTURE X(18).
01 BUFFERLENGTH    PICTURE S9(4) BINARY.
01 NAMELENGTH      PICTURE S9(4) BINARY.
01 RETURNCODE      PICTURE S9(4) BINARY.
 ...
CALL "SQLRGetCursorName" USING STATEMENTHANDLE,
  CURSORNAME, BUFFERLENGTH, NAMELENGTH, RETURNCODE.
```

SEE ALSO

Prepare( ), *SetCursorName*( ), *Execute*( ), *ExecDirect*( )

NAME

GetData — Retrieve one column of a row of the result set

SYNOPSIS

```
FUNCTION GetData
 (StatementHandle INTEGER,
  ColumnNumber SMALLINT,
  TargetType SMALLINT,
  TargetValue ANY,
  BufferLength INTEGER,
  StrLen_or_Ind INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

After fetching a new row of a result set, the application can call *GetData*( ) to obtain result data for part or all of a single unbound column. The function has the following parameters:

StatementHandle (input)
Statement handle.

ColumnNumber (input)
Column number. The first column is number 1.

TargetType (input)
The data type of *TargetValue* in the application row buffer. This must be one of the following:

- The Integer Data Type Identifiers listed in Table 4-6 on page 59 or Table 4-7 on page 59.
- SQL_DEFAULT, to select a buffer type from Table 4-9 on page 61 based on the SQL data type of the source.
- SQL_ARD_TYPE, to use a buffer type that has been specified in the application row descriptor.

TargetValue (output)
Destination for the output data.

BufferLength (input)
Maximum number of octets to store in *TargetValue*, if the application row descriptor specifies a character-string data type; otherwise, ignored.

StrLen_or_Ind (output)
A variable whose value is interpreted as follows:

- If the output data is null, this is set to SQL_NULL_DATA.
- Otherwise, if the data type of the application buffer is SQL_CHAR, this is set to the length in octets of the output data (even if it does not entirely fit in *TargetValue*). This value excludes any data from this column that the application has already obtained from previous calls to *GetData*( ).
- Otherwise, the value is undefined.

In a programming language that supports pointers, the application can provide a null pointer to inhibit return of the above information.

This function retrieves data one column at a time. The application may also call *GetData*( ) to retrieve large data values in pieces.

Data conversion of column data may occur before assignment to the bound variables depending on the TYPE field of the corresponding descriptor record. If the TYPE field is SQL_DEFAULT, then the column data is converted to a type given by Table 4-9 on page 61 based on the data type of the column.

RETURN VALUE

[SQL_SUCCESS], [SQL_INVALID_HANDLE], [SQL_ERROR], [SQL_NO_DATA] or [SQL_SUCCESS_WITH_INFO].

The [SQL_NO_DATA] outcome occurs if the preceding fetch returned [SQL_NO_DATA]. In the case of [SQL_ERROR] and [SQL_NO_DATA], the resulting values of the output parameters are undefined.

DIAGNOSTICS

The [SQL_SUCCESS_WITH_INFO] outcome occurs if the column data is truncated ('**01**004'). See **APPLICATION USAGE** below. [SQL_SUCCESS_WITH_INFO] can also result when implementation-defined warnings are produced.

The application must fetch a row before it calls *GetData*( ) to obtain columns ('**HY**010').

The value of *ColumnNumber* must conform to the following requirements ('**07**009'):

- The value must be in the range from 1 to and including the number of columns in the result set.
- The value must be higher than the number of the highest bound column.*
- If the application called *GetData*( ) previously for a column of the same row:
  - — The value must not specify a lower column number.*
  - — The value must not specify the same column number if the previous call retrieved all the data for that column.*

If the application has specified an application row descriptor, then:

- Its COUNT field must be non-negative ('**07**008').
- *ColumnNumber* must not exceed COUNT ('**07**009') and the TYPE field in the descriptor record identified by *ColumnNumber* must be one of the Integer Data Type Identifier values listed in Section 4.8.2 on page 58, SQL_DEFAULT or an implementation-defined value ('**HY**003').
- The data type of each column must be assignment-compatible with the buffer type specified by the corresponding descriptor record ('**07**006'). Retrieving a value may produce the data conversion diagnostics described in Section 5.4.10 on page 76.
- If the column value is null, then *StrLen_or_Ind* must not be a null pointer ('**22**002').
- If the descriptor record corresponding to *ColumnNumber* specifies a character-string data type, then *BufferLength* must be valid (see **String Termination** on page 19) ('**HY**090').

Retrieving a value from an arithmetic expression, and applying any specified conversion, must not result in a division by zero ('**22**012'), either at the time of assignment or in computing an intermediate result.

---

* Implementations that support more permissive retrieval rules are not required to produce this error in this case.

APPLICATION USAGE

On a call that retrieves a character string and truncates it, the application can call *GetData*( ) again with the same *ColumnNumber*, to get subsequent data from the same unbound column, starting at the point of truncation. To obtain the entire column, the application repeats such calls until the function returns [SQL_SUCCESS].

Alternatively, the application may call *GetData*( ) with an incremented value of *ColumnNumber*, or fetch another row. This effectively discards the rest of the truncated column. The implementation also discards a truncated column if the application sets any field of the application row descriptor (even an ineffective change, such as changing between an explicit data type and a use of SQL_DEFAULT that effectively specifies the same data type).

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLHSTMT    StatementHandle;
SQLSMALLINT ColumnNumber;
SQLSMALLINT TargetType;
SQLPOINTER  TargetValue;
SQLINTEGER  BufferLength;
SQLINTEGER  StrLen_or_Ind;
 ...
ReturnCode = SQLGetData(StatementHandle, ColumnNumber,
  TargetType, TargetValue, BufferLength, &StrLen_or_Ind);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE PICTURE S9(9) BINARY.
01 COLUMNNUMBER    PICTURE S9(4) BINARY.
01 TARGETTYPE      PICTURE S9(4) BINARY.
01 TARGETVALUE     PICTURE type.
01 BUFFERLENGTH    PICTURE S9(9) BINARY.
01 STRLEN-OR-IND   PICTURE S9(9) BINARY.
01 RETURNCODE      PICTURE S9(4) BINARY.
 ...
CALL "SQLRGetData" USING STATEMENTHANDLE, COLUMNNUMBER,
  TARGETTYPE, TARGETVALUE, BUFFERLENGTH, STRLEN-OR-IND,
  RETURNCODE.
```

SEE ALSO

Execute( ), *ExecDirect*( )

NAME

GetDescField — Get a descriptor field (extensible)

SYNOPSIS

```
FUNCTION GetDescField
 (DescriptorHandle INTEGER,
  RecNumber SMALLINT,
  FieldIdentifier SMALLINT,
  Value ANY,
  BufferLength INTEGER,
  StringLength INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The *GetDescField*( ) function has the following parameters:

DescriptorHandle (input)
Descriptor handle.

RecNumber (input)
The record number from which the specified field in the descriptor is to be retrieved. The first record is number 1.

FieldIdentifier (input)
The identifier of the field to be retrieved. This can be one of the following:

Header Fields

SQL_DESC_COUNT (type: SMALLINT)
Ignore *RecNumber*. Get the number of records in the descriptor.

SQL_DESC_ALLOC_TYPE (type: SMALLINT)
Ignore *RecNumber*. Store in *Value* either SQL_DESC_ALLOC_USER if the application explicitly allocated *DescriptorHandle* by calling *AllocHandle*( ), or SQL_DESC_ALLOC_AUTO if the implementation automatically allocated *DescriptorHandle* for some statement handle. (The application cannot modify this field by calling *SetDescField*( ).)

Fields of a Descriptor Record

SQL_DESC_TYPE (type: SMALLINT)
Get the TYPE field of *RecNumber*. For application descriptors, *Value* is set to one of the Integer Data Type Identifier values in Section 4.8.2 on page 58. For implementation descriptors, *Value* is set to one of the Integer Data Type Identifier values in Table 4-4 on page 58.

SQL_DESC_LENGTH (type: INTEGER)
Get the LENGTH field of *RecNumber*.

SQL_DESC_OCTET_LENGTH (type: INTEGER)
Get the OCTET_LENGTH field of *RecNumber*.

SQL_DESC_PRECISION (type: SMALLINT)
Get the PRECISION field of *RecNumber*.

SQL_DESC_SCALE (type: SMALLINT)
Get the SCALE field of *RecNumber*.

EX SQL_DESC_DATETIME_INTERVAL_CODE (type: SMALLINT)
Get the DATETIME_INTERVAL_CODE field of *RecNumber*. *Value* is set to SQL_CODE_DATE, SQL_CODE_TIME or SQL_CODE_TIMESTAMP. See also Table 4-4 on page 58.

SQL_DESC_NULLABLE (type: SMALLINT)
Get the NULLABLE field of *RecNumber*. For implementation row descriptors, *Value* is set to SQL_NULLABLE if the column's definition allows null values, and to SQL_NO_NULLS otherwise. For implementation parameter descriptors, *Value* is always set to SQL_NULLABLE.

SQL_DESC_NAME (type: CHAR(128))
Get the NAME field of *RecNumber*.

SQL_DESC_UNNAMED (type: SMALLINT)
Get the UNNAMED field of *RecNumber*. For implementation row descriptors, *Value* is set to SQL_NAMED if the NAME field is an actual name, or SQL_UNNAMED if the NAME field is an implementation-generated column name that X/Open does not define (for example, where the subject column represents the UNION of two columns with different names). For implementation parameter descriptors, *Value* is always set to SQL_UNNAMED.

In addition, *FieldIdentifier* may be one of the following to specify deferred fields. In a language that supports pointers, *GetDescField*( ) returns a pointer to an application variable (or the null pointer if the application has not set the field), through which the application can obtain data, length or indicator information.

SQL_DESC_DATA_PTR (type: SQLPOINTER)
Get the DATA_PTR field of *RecNumber*.

SQL_DESC_OCTET_LENGTH_PTR (type: SQLPOINTER)
Get the OCTET_LENGTH_PTR field of *RecNumber*.

SQL_DESC_INDICATOR_PTR (type: SQLPOINTER)
Get the INDICATOR_PTR field of *RecNumber*.

Value (output)
The value for *FieldIdentifier* of *RecNumber*.

BufferLength (input)
Maximum number of octets to store in *Value*, if the field is a character string; otherwise, unused.

StringLength (output)
Length in octets of the output data (even if it does not entirely fit in *Value*), if the field is a character string; otherwise, unused.

The function returns in *Value* one field of *RecNumber* from the descriptor associated with *DescriptorHandle*. If *FieldIdentifier* does not denote a string, then the implementation ignores *BufferLength* and does not set *StringLength*.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO], [SQL_INVALID_HANDLE] or [SQL_NO_DATA].

[SQL_NO_DATA] is returned if *RecNumber* is greater than the number of descriptor records.

DIAGNOSTICS

The [SQL_SUCCESS_WITH_INFO] outcome occurs if the returned data is truncated ('**01**004') or

if implementation-defined warnings are produced.

FieldIdentifier must be one of the defined values or an implementation-defined value ('**HY**091').

When *FieldIdentifier* indicates a header field, *RecNumber* must be zero; when *FieldIdentifier* indicates a field from a record, *RecNumber* must be 1 or greater ('**07**009').

If *DescriptorHandle* is an implementation row descriptor, the associated statement handle must be in the **prepared** or **executed** state ('**HY**007').

APPLICATION USAGE

The application can obtain any field of any record in the descriptor, in arbitrary order, by repeated calls to *GetDescField*( ).

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN     ReturnCode;
SQLHDESC      DescriptorHandle;
SQLSMALLINT   RecNumber;
SQLSMALLINT   FieldIdentifier;
SQLPOINTER    Value;
SQLINTEGER    BufferLength;
SQLINTEGER    StringLength;
 ...
ReturnCode = SQLGetDescField(DescriptorHandle, RecNumber,
  FieldIdentifier, Value, BufferLength, &StringLength);
```

EXAMPLE USAGE (COBOL)

```
01 DESCRIPTORHANDLE PICTURE S9(9) BINARY.
01 RECNUMBER        PICTURE S9(4) BINARY.
01 FIELDIDENTIFIER  PICTURE S9(4) BINARY.
01 VALUE            PICTURE type.
01 BUFFERLENGTH     PICTURE S9(9) BINARY.
01 STRINGLENGTH     PICTURE S9(9) BINARY.
01 RETURNCODE       PICTURE S9(4) BINARY.
 ...
CALL "SQLRGetDescField" USING DESCRIPTORHANDLE, RECNUMBER,
  FIELDIDENTIFIER, VALUE, BUFFERLENGTH, STRINGLENGTH, RETURNCODE.
```

SEE ALSO

GetDescRec( )

NAME

GetDescRec — Get a descriptor record (concise)

SYNOPSIS

```
FUNCTION GetDescRec
 (DescriptorHandle INTEGER,
  RecNumber SMALLINT,
  Name CHAR,
  BufferLength SMALLINT,
  NameLength SMALLINT,
  Type SMALLINT,
EX SubType SMALLINT,
  Length INTEGER,
  Precision SMALLINT,
  Scale SMALLINT,
  Nullable SMALLINT)
RETURNS (SMALLINT)
```

DESCRIPTION

The *GetDescRec*( ) function has the following parameters:

DescriptorHandle (input)
Descriptor handle.

RecNumber (input)
The record number from which the description in the descriptor is to be retrieved. The first record is number 1.

Name (output)
The NAME field for the record.

BufferLength (input)
Maximum number of octets to store in *Name*.

NameLength (output)
Length in octets of the output data (even if it does not entirely fit in *Name*).

Type (output)
The TYPE field for the record. For application descriptors, this is one of the Integer Data Type Identifier values in Section 4.8.2 on page 58. For implementation descriptors, this is one of the Integer Data Type Identifier values in Table 4-4 on page 58.

EX *SubType* (output)
The DATETIME_INTERVAL_CODE field, for records whose TYPE is SQL_DATETIME.

Length (output)
The OCTET_LENGTH field for the record.

Precision (output)
The PRECISION field for the record.

Scale (output)
The SCALE field for the record.

Nullable (output)
The NULLABLE field for the record.

Calling *GetDescRec*( ) sets the output arguments to describe *RecNumber* of the descriptor associated with *DescriptorHandle*.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO], [SQL_INVALID_HANDLE] or [SQL_NO_DATA].

[SQL_NO_DATA] is returned if *RecNumber* is greater than the number of descriptor records.

DIAGNOSTICS

The [SQL_SUCCESS_WITH_INFO] outcome occurs if the returned data is truncated ('**01**004') or if implementation-defined warnings are produced.

RecNumber must be 1 or greater ('**07**009').

If *DescriptorHandle* is an implementation row descriptor, the associated statement handle must be in the **prepared** or **executed** state ('**HY**007').

APPLICATION USAGE

In languages that allow the use of pointers, the application can provide a null pointer for any of *Name*, *Type*, *SubType*, *Length*, *Precision*, *Scale* or *Nullable*, in order to inhibit return of that information.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN     ReturnCode;
SQLHDESC      DescriptorHandle;
SQLSMALLINT   RecNumber;
SQLCHAR      *Name;
SQLSMALLINT   BufferLength;
SQLSMALLINT   NameLength;
SQLSMALLINT   Type;
SQLSMALLINT   SubType;
SQLINTEGER    Length;
SQLSMALLINT   Precision;
SQLSMALLINT   Scale;
SQLSMALLINT   Nullable;
 ...
ReturnCode = SQLGetDescRec(DescriptorHandle, RecNumber,
  Name, BufferLength, &NameLength, &Type, &SubType, &Length,
  &Precision, &Scale, &Nullable);
```

EXAMPLE USAGE (COBOL)

```
01 DESCRIPTORHANDLE  PICTURE S9(9) BINARY.
01 RECNUMBER         PICTURE S9(4) BINARY.
01 NAME              PICTURE X(128).
01 BUFFERLENGTH      PICTURE S9(4) BINARY.
01 NAMELENGTH        PICTURE S9(4) BINARY.
01 TYPE              PICTURE S9(4) BINARY.
01 SUBTYPE           PICTURE S9(4) BINARY.
01 LENGTH            PICTURE S9(9) BINARY.
01 PRECISION         PICTURE S9(4) BINARY.
01 SCALE             PICTURE S9(4) BINARY.
01 NULLABLE          PICTURE S9(4) BINARY.
01 RETURNCODE        PICTURE S9(4) BINARY.
 ...
CALL "SQLRGetDescRec" USING DESCRIPTORHANDLE, RECNUMBER,
  NAME, BUFFERLENGTH, NAMELENGTH, TYPE, SUBTYPE, LENGTH,
  PRECISION, SCALE, NULLABLE, RETURNCODE.
```

SEE ALSO

GetDescField( )

NAME

GetDiagField — Return diagnostic information (extensible).

SYNOPSIS

```
FUNCTION GetDiagField
 (HandleType SMALLINT,
  Handle INTEGER,
  RecNumber SMALLINT,
  DiagIdentifier SMALLINT,
  DiagInfo ANY,
  BufferLength SMALLINT,
  StringLength SMALLINT)
RETURNS (SMALLINT)
```

DESCRIPTION

An application calls *GetDiagField*( ) to obtain a single piece of error or warning status from a previous call to a CLI function, especially one that returned [SQL_ERROR] or [SQL_SUCCESS_WITH_INFO]. (This is referred to below as the underlying function.)

The data structure associated with each handle contains a diagnostics area. The area consists of header information and zero or more status records. Header information (which includes the number of status records) pertains at large to the function's execution, while each status record describes a specific event in the execution.

The function has the following parameters:

HandleType (input)
A handle type identifier that describes the handle type of *Handle*. Valid values are the same as for *AllocHandle*( ).

Handle (input)
A handle for which diagnostic information is desired.

RecNumber (input)
Indicates the status record from which the application seeks information. The first record is number 1. If the value of *DiagIdentifier* indicates header information, then *RecNumber* must be 0. If the value of *DiagIdentifier* indicates a field from a record, then *RecNumber* must be 1 or greater.

DiagIdentifier (input)
Indicates the desired piece of diagnostic information, and implicitly indicates whether the information comes from the header or from record *RecNumber*. *DiagIdentifier* must contain one of the following values:

Header Fields

SQL_DIAG_RETURNCODE (type: SMALLINT)
Return in *DiagInfo* the return code that the underlying function returned. This is one of [SQL_SUCCESS], [SQL_SUCCESS_WITH_INFO], [SQL_NO_DATA] or [SQL_ERROR]. (It is never [SQL_INVALID_HANDLE].)

SQL_DIAG_NUMBER (type: INTEGER)
Return in *DiagInfo* the number of diagnostic records that are available for the specified handle (see **Number of Status Records** on page 69).

SQL_DIAG_ROW_COUNT (type: INTEGER)
If *HandleType* is SQL_HANDLE_STMT, return in *DiagInfo* the row count (see Section 5.3.2 on page 72).

If *Handle* is not a statement handle (or in certain other cases described in Section 5.3.2 on page 72), the value of *DiagInfo* is undefined.

EX SQL_DIAG_DYNAMIC_FUNCTION (type: CHAR(254))

If *HandleType* is SQL_HANDLE_STMT and the underlying function was *ExecDirect*( ) or *Execute*( ), return in *DiagInfo* a string* describing the SQL statement that the underlying function executed, using values defined below; otherwise the value is a zero-length string.

EX

SQL Statement Executed	Value of SQL_DIAG_DYNAMIC_FUNCTION
ALTER TABLE	ALTER TABLE
CREATE INDEX	CREATE INDEX
CREATE TABLE	CREATE TABLE
CREATE VIEW	CREATE VIEW
cursor-specification	SELECT CURSOR
searched DELETE	DELETE WHERE
dynamic positioned DELETE	DYNAMIC DELETE CURSOR
DROP INDEX	DROP INDEX
DROP TABLE	DROP TABLE
DROP VIEW	DROP VIEW
GRANT	GRANT
INSERT	INSERT
REVOKE	REVOKE
searched UPDATE	UPDATE WHERE
dynamic positioned UPDATE	DYNAMIC UPDATE CURSOR

EX SQL_DIAG_DYNAMIC_FUNCTION_CODE (type: INTEGER)

If *HandleType* is SQL_HANDLE_STMT and the underlying function was *ExecDirect*( ) or *Execute*( ), return in *DiagInfo* a numeric code* describing the SQL statement that the underlying function executed (from the list of dynamic function codes in Appendix C); otherwise the value is SQL_UNKNOWN_STATEMENT.

Fields of a Status Record

SQL_DIAG_SQLSTATE (type: CHAR(5))

Return in *DiagInfo* a 5-character SQLSTATE code pertaining to diagnostic record *RecNumber*. The first 2 characters indicate class; the next 3 indicate subclass. The SQLSTATE code provides a portable diagnostic indication. See Appendix A for a list of X/Open-defined SQLSTATE codes.

SQL_DIAG_NATIVE (type: INTEGER)

Return in *DiagInfo* an implementation-defined error code pertaining to diagnostic record *RecNumber*. Portable applications should not base their behaviour on this value.

---

* This value must not reflect any SQL statements that a CLI implementation may have executed invisibly to the application. For example, this value never reports execution of a SET CONNECTION statement, which some CLI implementations may call from time to time based on the application's use of connection handles. The value never reports execution of a FETCH statement based on a CLI fetch operation. Metadata functions, such as *Columns()*( ), return a zero-length string.

If the above conditions are met but the relevant SQL statement was not recognised or was an implementation-defined SQL statement, the value returned is implementation-defined and can vary based on implementation-defined criteria.

SQL_DIAG_MESSAGE_TEXT (type: CHAR(254))
Return in *DiagInfo* implementation-defined message text pertaining to diagnostic record *RecNumber*.

SQL_DIAG_CLASS_ORIGIN (type: CHAR(254))
Return in *DiagInfo* a string that identifies the defining source of the class portion of the SQLSTATE code in *RecNumber*. Its value is 'ISO 9075' if the ISO SQL standard defines the class. Otherwise, its value is implementation-defined and must not be 'ISO 9075'.

SQL_DIAG_SUBCLASS_ORIGIN (type: CHAR(254))
Return in *DiagInfo* a string with the same format and valid values as SQL_DESC_CLASS_ORIGIN above, that identifies the defining source of the subclass portion of the SQLSTATE code in *RecNumber*.

SQL_DIAG_CONNECTION_NAME (type: CHAR(128))
Return in *DiagInfo* the connection name for the connection that the diagnostic record relates to. The connection name helps identify the connection in the case that there are multiple connections to the same server. In embedded SQL, the application can specify a connection name. In CLI, the application uses connection handles instead of names, and the value of this field is implementation-defined. However, for diagnostics associated with an environment handle, and for diagnostics that do not relate to any server, this field is a zero-length string.

SQL_DIAG_SERVER_NAME (type: CHAR(128))
Return in *DiagInfo* the server name that the diagnostic record relates to, as it was supplied as the *ServerName* parameter in the call to *Connect*( ) that established the connection. The server name is also available as SQL_DATA_SOURCE_NAME by calling *GetInfo*( ).

For diagnostics that relate to the default server, this field is the actual server name. For diagnostics associated with an environment handle, and for diagnostics that do not relate to any server, this field is a zero-length string.

Additional values of *DiagIdentifier* may be defined in the future, or may be implementation-defined, to return other diagnostic information. The definition of these values specifies the type and meaning of the data returned in *DiagInfo*.

DiagInfo (output)
Buffer for diagnostic information.

BufferLength (input)
Length in octets of *DiagInfo*, if the requested diagnostic data is a character string; otherwise, unused.

StringLength (output)
Length in octets of complete diagnostic information (even if it does not entirely fit in *DiagInfo*), if the requested diagnostic data is a character string; otherwise, unused.

If *DiagInfo* does not denote a string, then the implementation ignores *BufferLength* and does not set *StringLength*.

RETURN VALUE

The function uses the following return values (instead of generating diagnostics) to report the outcome of its own execution:

[SQL_SUCCESS]
The function successfully returned diagnostic information.

[SQL_INVALID_HANDLE]
HandleType and *Handle*, taken together, do not denote a valid handle.

[SQL_ERROR]
One of the following occurred:

- *DiagIdentifier* is not one of the values listed above.
- *DiagIdentifier* is SQL_DIAG_ROW_COUNT but *Handle* is not a statement handle on which an SQL statement has been executed.
- *RecNumber* is negative or 0 when *DiagIdentifier* indicates a field from a record; or *RecNumber* is non-zero when *DiagIdentifier* indicates header information.
- The value requested is a character string and *BufferLength* is invalid (see **String Termination** on page 19).

[SQL_NO_DATA]
RecNumber is greater than the number of diagnostic records that exist for *Handle*.[23]

The function does not return [SQL_SUCCESS_WITH_INFO] even if it truncates a string output argument. No implementation-defined diagnostics are possible.

DIAGNOSTICS

None. This function never generates information in any handle's diagnostics area to describe its own execution. This function is never the underlying function as defined in **DESCRIPTION** above. Any diagnostics are reported using the **RETURN VALUE** (see above).

APPLICATION USAGE

Production of status records by the underlying function is discussed in Section 5.2 on page 69.

GetDiagField( ) retrieves only the diagnostic information most recently associated with *Handle*. If an application calls another CLI function that writes diagnostic information to the same handle (even a success indication), any diagnostic information from previous calls is lost. For example, the sequence *Execute*( ), *GetCursorName*( ), *GetDiagField*(SQL_DIAG_ROW_COUNT) fails to obtain the row count because *GetCursorName*( ) has become the underlying function.

For the fields specified as CHAR(254), especially SQL_DIAG_MESSAGE_TEXT, some implementations may generate more than 254 characters of text. Truncation of this text is not reported. A portable application should set aside a buffer whose length in octets is {SQL_MAX_MESSAGE_LENGTH}. If, despite doing so, the application retrieves character-string data that entirely fills the buffer, it should call *GetDiagField*( ) again with a larger buffer to ensure retrieval of the complete text.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLSMALLINT HandleType;
SQLHENV     Handle;       /* or SQLHDBC, SQLHSTMT or SQLHDESC */
SQLSMALLINT RecNumber;
SQLSMALLINT DiagIdentifier;
SQLPOINTER  DiagInfo;
```

23. The error conditions described in the previous list items take precedence. The function also returns [SQL_NO_DATA] for any positive *RecNumber* if there are no diagnostic records for *Handle*. An application can scan all diagnostic records by looping, incrementing *RecNumber*, as long as the function returns [SQL_SUCCESS].

```
SQLSMALLINT BufferLength;
SQLSMALLINT StringLength;
 ...
/* Example uses environment handle */
HandleType = SQL_HANDLE_ENV;
ReturnCode = SQLGetDiagField(HandleType, Handle, RecNumber,
  DiagIdentifier, DiagInfo, BufferLength, &StringLength);
```

EXAMPLE USAGE (COBOL)

```
01 HANDLETYPE     PICTURE S9(4) BINARY.
01 HANDLE         PICTURE S9(9) BINARY.
01 RECNUMBER      PICTURE S9(4) BINARY.
01 DIAGIDENTIFIER PICTURE S9(4) BINARY.
01 DIAGINFO       PICTURE type.
01 BUFFERLENGTH   PICTURE S9(4) BINARY.
01 STRINGLENGTH   PICTURE S9(4) BINARY.
01 RETURNCODE     PICTURE S9(4) BINARY.
 ...
* EXAMPLE USES ENVIRONMENT HANDLE
MOVE SQL-HANDLE-ENV TO HANDLETYPE.
CALL "SQLRGetDiagField" USING HANDLETYPE, HANDLE, RECNUMBER,
  DIAGIDENTIFIER, DIAGINFO, BUFFERLENGTH, STRINGLENGTH, RETURNCODE.
```

SEE ALSO

GetDiagRec( )

NAME

GetDiagRec — Return diagnostic information (concise).

SYNOPSIS

```
FUNCTION GetDiagRec
 (HandleType SMALLINT,
  Handle INTEGER,
  RecNumber SMALLINT,
  Sqlstate CHAR,
  NativeError INTEGER,
  MessageText CHAR,
  BufferLength SMALLINT,
  TextLength SMALLINT)
RETURNS (SMALLINT)
```

DESCRIPTION

An application calls *GetDiagRec*( ) to obtain several commonly-used pieces of error or warning status from a previous call to a CLI function, especially one that returned [SQL_ERROR] or [SQL_SUCCESS_WITH_INFO]. (This is referred to below as the underlying function.)

The data structure associated with each handle contains a diagnostics area. The area consists of header information and zero or more status records. (Header information is available by calling *GetDiagField*( ).) Each status record includes values of *Sqlstate*, *NativeError* and *MessageText* / *TextLength*. Each status record describes a specific event in the execution of the underlying function.

The function has the following parameters:

HandleType (input)
: A handle type identifier that describes the handle type of *Handle*. Valid values are the same as for *AllocHandle*( ).

Handle (input)
: A handle for which diagnostic information is desired.

RecNumber (input)
: Indicates the status record from which the application seeks information. The first record is number 1.

Sqlstate (output)
: A 5-character SQLSTATE code pertaining to diagnostic record *RecNumber*. The first 2 characters indicate class; the next 3 indicate subclass. The SQLSTATE code provides a portable diagnostic indication. See Appendix A for a list of X/Open-defined SQLSTATE codes.

NativeError (output)
: An implementation-defined error code pertaining to diagnostic record *RecNumber*. Portable applications should not base their behaviour on this value.

MessageText (output)
: Implementation-defined message text pertaining to diagnostic record *RecNumber*.

BufferLength (input)
: Maximum number of octets to store in *MessageText*.

TextLength (output)
: Length in octets of the output data (even if it does not entirely fit in *MessageText*).

RETURN VALUE

The function uses the following return values (instead of generating diagnostics) to report the outcome of its own execution:

[SQL_SUCCESS]
The function successfully returned diagnostic information.

[SQL_INVALID_HANDLE]
HandleType and *Handle*, taken together, do not denote a valid handle.

[SQL_ERROR]
One of the following occurred:

- *RecNumber* is negative or 0.
- *BufferLength* is negative (or *BufferLength* is zero and the environment attribute SQL_ATTR_OUTPUT_NTS is true).

[SQL_NO_DATA]
RecNumber is greater than the number of diagnostic records that exist for *Handle*.[24]

The function does not return [SQL_SUCCESS_WITH_INFO] even if it truncates a string output argument. No implementation-defined diagnostics are possible.

DIAGNOSTICS

None. This function never generates information in any handle's diagnostics area to describe its own execution. This function is never the underlying function as defined in **DESCRIPTION** above. Any diagnostics are reported using the **RETURN VALUE** (see above).

APPLICATION USAGE

Production of status records by the underlying function is discussed in Section 5.2 on page 69.

In languages that allow the use of pointers, the application can provide a null pointer for any of *Sqlstate*, *NativeError* and *MessageText*, in order to inhibit return of that information.

GetDiagRec( ) retrieves only the diagnostic information most recently associated with *Handle*. If an application calls another CLI function that writes diagnostic information to the same handle (even a success indication), any diagnostic information from previous calls is lost.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLSMALLINT HandleType;
SQLHENV     Handle;       /* or SQLHDBC, SQLHSTMT or SQLHDESC */
SQLSMALLINT RecNumber;
SQLCHAR     Sqlstate[6];
SQLINTEGER  NativeError;
SQLCHAR    *MessageText;
SQLSMALLINT BufferLength;
SQLSMALLINT TextLength;
 ...
/* Example uses environment handle */
```

24. The error conditions described in the previous list items take precedence. The function also returns [SQL_NO_DATA] for any positive *RecNumber* if there are no diagnostic records for *Handle*. An application can scan all diagnostic records by looping, incrementing *RecNumber*, as long as the function returns [SQL_SUCCESS].

```
HandleType = SQL_HANDLE_ENV;
ReturnCode = SQLGetDiagRec(HandleType, Handle, RecNumber,
  Sqlstate, &NativeError, MessageText, BufferLength, &TextLength);
```

EXAMPLE USAGE (COBOL)

```
01 HANDLETYPE   PICTURE S9(4) BINARY.
01 HANDLE       PICTURE S9(9) BINARY.
01 RECNUMBER    PICTURE S9(4) BINARY.
01 SQLSTATE     PICTURE X(5).
01 NATIVEERROR  PICTURE S9(9) BINARY.
01 MESSAGETEXT  PICTURE X(512).
01 BUFFERLENGTH PICTURE S9(4) BINARY.
01 TEXTLENGTH   PICTURE S9(4) BINARY.
01 RETURNCODE   PICTURE S9(4) BINARY.
 ...
* EXAMPLE USES ENVIRONMENT HANDLE
MOVE SQL-HANDLE-ENV TO HANDLETYPE.
CALL "SQLRGetDiagRec" USING HANDLETYPE, HANDLE, RECNUMBER,
  SQLSTATE, NATIVEERROR, MESSAGETEXT, BUFFERLENGTH,
  TEXTLENGTH, RETURNCODE.
```

SEE ALSO

GetDiagField( )

NAME

GetEnvAttr — Get the value of an environment attribute

SYNOPSIS

```
FUNCTION GetEnvAttr
 (EnvironmentHandle INTEGER,
  Attribute INTEGER,
  Value  ANY,
  BufferLength INTEGER,
  StringLength INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The application can call *GetEnvAttr*( ) to obtain the value of an attribute for *EnvironmentHandle*.

The function has the following parameters:

EnvironmentHandle (input)
Environment handle.

Attribute (input)
The desired environment attribute. For a list of valid attributes, see **Environment Attribute** on page 28.

Value (output)
The current value of the attribute specified by *Attribute*. The type of the value returned depends on *Attribute*.

BufferLength (input)
Maximum number of octets to store in *Value*, if the attribute value is a character string; otherwise, unused.

StringLength (output)
Length in octets of the output data (even if it does not entirely fit in *Value*), if the attribute value is a character string; otherwise, unused.

If *Attribute* does not denote a string, then the implementation ignores *BufferLength* and does not set *StringLength*.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

DIAGNOSTICS

The [SQL_SUCCESS_WITH_INFO] outcome occurs if the returned data is truncated ('**01**004') or if implementation-defined warnings are produced.

Attribute must be one of the defined attributes or an implementation-defined value ('**HY**092').

APPLICATION USAGE

GetEnvAttr( ) can be called at any time between the allocation and the freeing of *EnvironmentHandle*. It obtains the current value of the environment attribute. The manual page for *SetEnvAttr*( ) specifies the environment attributes and their effects. If the application has called *SetEnvAttr*( ) since calling a CLI function affected by the attribute, then the value *GetEnvAttr*( ) returns might not be the value that affected that CLI function.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN  ReturnCode;
```

```
SQLHENV    EnvironmentHandle;
SQLINTEGER Attribute;
SQLPOINTER Value;
SQLINTEGER BufferLength;
SQLINTEGER StringLength;
 ...
ReturnCode = SQLGetEnvAttr(EnvironmentHandle,
  Attribute, Value, BufferLength, &StringLength);
```

EXAMPLE USAGE (COBOL)

```
01 ENVIRONMENTHANDLE PICTURE S9(9) BINARY.
01 ATTRIBUTE         PICTURE S9(9) BINARY.
01 VALUE             PICTURE type.
01 BUFFERLENGTH      PICTURE S9(9) BINARY.
01 STRINGLENGTH      PICTURE S9(9) BINARY.
01 RETURNCODE        PICTURE S9(4) BINARY.
 ...
CALL "SQLRGetEnvAttr" USING ENVIRONMENTHANDLE,
  ATTRIBUTE, VALUE, BUFFERLENGTH, STRINGLENGTH, RETURNCODE.
```

SEE ALSO

AllocHandle( ), *SetEnvAttr*( )

NAME

GetFunctions — Determine whether a function is supported

SYNOPSIS

```
FUNCTION GetFunctions
 (ConnectionHandle INTEGER,
  FunctionId SMALLINT,
  Supported SMALLINT)
RETURNS (SMALLINT)
```

DESCRIPTION

The application can call *GetFunctions*( ) to find out whether or not the implementation supports a specified CLI function.

The function has the following parameters:

ConnectionHandle (input)
Connection handle.

FunctionId (input)
A number that represents the CLI function in question. The following values represent the functions described in this document:

SQL_API_SQLALLOCCONNECT
SQL_API_SQLALLOCENV
SQL_API_SQLALLOCHANDLE
SQL_API_SQLALLOCSTMT
SQL_API_SQLBINDCOL
SQL_API_SQLBINDPARAM
SQL_API_SQLCANCEL
SQL_API_SQLCLOSECURSOR
SQL_API_SQLCOLATTRIBUTE
SQL_API_SQLCOLUMNS
SQL_API_SQLCONNECT
SQL_API_SQLCOPYDESC
SQL_API_SQLDATASOURCES
SQL_API_SQLDESCRIBECOL
SQL_API_SQLDISCONNECT
SQL_API_SQLENDTRAN
SQL_API_SQLERROR
SQL_API_SQLEXECDIRECT
SQL_API_SQLEXECUTE
SQL_API_SQLFETCH
SQL_API_SQLFETCHSCROLL
SQL_API_SQLFREECONNECT
SQL_API_SQLFREEENV
SQL_API_SQLFREEHANDLE
SQL_API_SQLFREESTMT
SQL_API_SQLGETCONNECTATTR
SQL_API_SQLGETCONNECTOPTION
SQL_API_SQLGETCURSORNAME
SQL_API_SQLGETDATA
SQL_API_SQLGETDESCFIELD
SQL_API_SQLGETDESCREC
SQL_API_SQLGETDIAGFIELD

SQL_API_SQLGETDIAGREC
SQL_API_SQLGETENVATTR
SQL_API_SQLGETFUNCTIONS
SQL_API_SQLGETINFO
SQL_API_SQLGETSTMTATTR
SQL_API_SQLGETSTMTOPTION
SQL_API_SQLGETTYPEINFO
SQL_API_SQLLANGUAGES
SQL_API_SQLNUMRESULTCOLS
SQL_API_SQLPARAMDATA
SQL_API_SQLPREPARE
SQL_API_SQLPUTDATA
SQL_API_SQLRELEASEENV
SQL_API_SQLROWCOUNT
SQL_API_SQLSERVERINFO
SQL_API_SQLSETCONNECTATTR
SQL_API_SQLSETCONNECTOPTION
SQL_API_SQLSETCURSORNAME
SQL_API_SQLSETDESCFIELD
SQL_API_SQLSETDESCREC
SQL_API_SQLSETENVATTR
SQL_API_SQLSETPARAM
SQL_API_SQLSETSTMTATTR
SQL_API_SQLSETSTMTOPTION
SQL_API_SQLSPECIALCOLUMNS
SQL_API_SQLSTATISTICS
SQL_API_SQLTABLES
SQL_API_SQLTRANSACT

Supported (output)
The value SQL_TRUE if the CLI implementation supports *FunctionId*; otherwise, the value SQL_FALSE.

RETURN VALUE

[SQL_SUCCESS], [SQL_SUCCESS_WITH_INFO], or [SQL_INVALID_HANDLE]. [SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

APPLICATION USAGE

The application can call *GetFunctions*( ) at any time that *ConnectionHandle* is in the connected state. It is called for a single CLI function at a time and obtains information about whether of not that CLI function is supported.

If *GetFunctions*( ) returns SQL_TRUE in the *Supported* argument, it asserts that both the CLI client and server components active on *ConnectionHandle* are equipped to support a valid call to the specified function.

COMPLIANCE POLICY

X/Open includes *GetFunctions*( ) in this document to let applications adapt to partial or extended CLI implementations. However, its presence does not affect the compliance requirements for CLI functions. X/Open-compliant CLI implementations must return SQL_TRUE when queried regarding any function in this document not marked as optional.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
```

```
SQLRETURN     ReturnCode;
SQLHDBC       ConnectionHandle;
SQLSMALLINT   FunctionId;
SQLSMALLINT   Supported;
 ...
ReturnCode = SQLGetFunctions(ConnectionHandle,
 FunctionId, &Supported);
```

EXAMPLE USAGE (COBOL)

```
01 CONNECTIONHANDLE PICTURE S9(9) BINARY.
01 FUNCTIONID       PICTURE S9(4) BINARY.
01 SUPPORTED        PICTURE S9(4) BINARY.
01 RETURNCODE       PICTURE S9(4) BINARY.
 ...
CALL "SQLRGetFunctions" USING CONNECTIONHANDLE,
  FUNCTIONID, SUPPORTED, RETURNCODE.
```

NAME

GetInfo — Get information about the CLI implementation and the currently-connected server

SYNOPSIS

EX
```
FUNCTION GetInfo
 (ConnectionHandle INTEGER,
  InfoType SMALLINT,
  InfoValue ANY,
  BufferLength SMALLINT,
  StringLength SMALLINT)
RETURNS (SMALLINT)
```

DESCRIPTION

The application can call *GetInfo*( ) to find information about the support of various characteristics provided by a currently-connected server. The application specifies a value that identifies a specific characteristic and receives information about the support of that characteristic.

The function has the following parameters:

ConnectionHandle (input)
Connection handle.

InfoType (input)
The type of information being requested. It must be one of the following values or another value that the implementation recognises:

SQL_ACCESSIBLE_TABLES (type: CHAR(1))
This is 'Y' if the user is guaranteed SELECT privileges to all tables that *SQLTables*( ) returns, and 'N' otherwise.

SQL_ALTER_TABLE (type: INTEGER)
This indicates the clauses of ALTER TABLE that the server supports. The value returned is a 32-bit bitmask with the low-order bits identified as follows:

SQL_AT_ADD_COLUMN
SQL_AT_DROP_COLUMN
SQL_AT_ALTER_COLUMN
SQL_AT_ADD_CONSTRAINT
SQL_AT_DROP_CONSTRAINT

SQL_CATALOG_NAME (type: CHAR(1))
This is either 'Y' if the server supports catalog names, or 'N' if it does not. Object naming is discussed in Section 2.4.3 on page 22.

SQL_COLLATION_SEQ (type: CHAR(254))
The assumed ordering of the character set for this server. Examples are 'ISO 8859-1' and 'EBCDIC'.

SQL_CURSOR_COMMIT_BEHAVIOR (type: SMALLINT)
This indicates the effect on cursors and prepared statements of transaction commitment. It contains one of the following values:

SQL_CB_DELETE
Commitment closes cursors and deletes prepared statements.

SQL_CB_CLOSE
Commitment destroys cursors, and retains prepared statements.

SQL_CB_PRESERVE
Commitment retains cursors and prepared statements.

SQL_CURSOR_SENSITIVITY: (type: INTEGER)
This indicates the support for cursor sensitivity. Its value is one of the following:

SQL_INSENSITIVE
Cursor sensitivity is unsupported

SQL_UNSPECIFIED
Support for cursor sensitivity is unspecified

SQL_SENSITIVE
Cursor sensitivity is supported.

SQL_DATA_SOURCE_NAME (type: CHAR(128))
This is the name used as the *ServerName* argument to the *Connect*( ) call that established the connection to *ConnectionHandle*. An application routine might require this information when a separate routine has made the connection.

SQL_DATA_SOURCE_READ_ONLY (type: CHAR(1))
This is 'Y' if data from the connected data source can only be read, or 'N' if data can both be read and updated.

SQL_DBMS_NAME (type: CHAR(254))
This is the name of the server product in use on *ConnectionHandle*.

SQL_DBMS_VER (type: CHAR(254))
This is the version number of the server product in use on *ConnectionHandle*. The format is:

mm.nn.rrrr [*opt*]

where *mm* is the major version, *nn* is the minor version, *rrrr* is the release version (these fields are exclusively numeric), and *opt* represents an implementation-specific release identification.

SQL_DEFAULT_TXN_ISOLATION (type: INTEGER)
This is the server's default isolation level. The following values indicate the four levels described in the X/Open **SQL** specification:

SQL_TXN_READ_UNCOMMITTED
SQL_TXN_READ_COMMITTED
SQL_TXN_REPEATABLE READ
SQL_TXN_SERIALIZABLE

SQL_DESCRIBE_PARAMETER (type: CHAR(1))
This indicates the implementation's support for a capability analogous to the DESCRIBE INPUT statement of the X/Open **SQL** specification. Its value is either 'Y' if dynamic parameters can be described, or 'N' otherwise.

SQL_FETCH_DIRECTION (type: INTEGER)
This indicates the type of cursor movement the implementation supports. The value is a 32-bit bitmask with the low-order bits identified as follows:

SQL_FD_ABSOLUTE
SQL_FD_FIRST
SQL_FD_LAST
SQL_FD_NEXT
SQL_FD_PRIOR
SQL_FD_RELATIVE

SQL_GETDATA_EXTENSIONS (type: INTEGER)
This indicates whether the implementation supports certain extensions to *GetData*( ). This is a 32-bit bitmask.

SQL_GD_ANY_COLUMN
GetData( ) can be called for to obtain columns that precede the last bound column.
SQL_GD_ANY_ORDER
GetData( ) can be called for columns in any order.

SQL_IDENTIFIER_CASE (type: SMALLINT)
An indication of what the server does when placing a non-delimited identifier into the catalog. The values are:

SQL_IC_UPPER
Store in upper case, as X/Open specifies

SQL_IC_LOWER
Store in lower case

SQL_IC_SENSITIVE
Store in mixed case

SQL_IC_MIXED
Store in mixed case but treat as CASE INSENSITIVE when used.

SQL_IDENTIFIER_QUOTE_CHAR (type: CHAR(1))
An indication of the character that delimits a delimited identifier. It is blank if the implementation does not support delimited identifiers. X/Open-compliant implementations return the quote (") character.

SQL_INTEGRITY (type: CHAR(1))
This is 'Y' if the server supports the Integrity Enhancement Feature (IEF) of the X/Open **SQL** specification, or 'N' otherwise.

SQL_MAX_CATALOG_NAME_LEN (type: SMALLINT)
This is the maximum size in characters that the server supports for a catalog name, or zero if this is unknown.

SQL_MAX_COLUMN_NAME_LEN (type: SMALLINT)
This is the maximum length in characters of a column name.

SQL_MAX_COLUMNS_IN_GROUP_BY (type: SMALLINT)
This is the maximum number of columns that the server supports in a GROUP BY clause, or zero if there is no limit.

SQL_MAX_COLUMNS_IN_INDEX (type: SMALLINT)
This is the maximum number of columns that the server supports in an index, or zero if there is no limit.

SQL_MAX_COLUMNS_IN_ORDER_BY (type: SMALLINT)
This is the maximum number of columns that the server supports in an ORDER BY clause, or zero if there is no limit.

SQL_MAX_COLUMNS_IN_SELECT (type: SMALLINT)
This is the maximum number of columns that the server supports in a select list, or zero if there is no limit.

SQL_MAX_COLUMNS_IN_TABLE (type: SMALLINT)
This is the maximum number of columns that the server supports in a base table, or zero if there is no limit.

SQL_MAX_CONCURRENT_ACTIVITIES (type: SMALLINT)
This is the maximum number of statement handles on *ConnectionHandle* that can either be in a need-data state or have pending results, or 0 if this is unknown or not a constant.

SQL_MAX_CURSOR_NAME_LEN (type: SMALLINT)
This is the maximum length in characters of a cursor name.

SQL_MAX_DRIVER_CONNECTIONS (type: SMALLINT)
This is the maximum number of active connections of the same type as *ConnectionHandle* that the application can obtain, or 0 if this is unknown or is not a constant.

A response to this request type may obtain information on limitations of the server or of any internal mechanism used to gain access to the server. The response reflects the most restrictive of these limits that applies. This limit does not constitute a guarantee that that number of calls to *Connect*( ) will succeed, as either type of limit may vary dynamically based on availability of resources or on other connections the application may make.

SQL_MAX_IDENTIFIER_LEN (type: SMALLINT)
The maximum size in characters that the server supports for user-defined names.

SQL_MAX_INDEX_SIZE (type: SMALLINT)
This is the maximum size that the server supports for the combined columns in an index, or zero if there is no limit. The units are the standard storage units described in the X/Open **SQL** specification.

SQL_MAX_ROW_SIZE (type: INTEGER)
This is the maximum length that the server supports in single row of a base table, or zero if there is no limit. The units are the standard storage units described in the X/Open **SQL** specification.

SQL_MAX_SCHEMA_NAME_LEN (type: SMALLINT)
This is the maximum size in characters that the server supports for a schema name, or zero if this is unknown.

SQL_MAX_STATEMENT_LEN (type: INTEGER)
This is the maximum length in characters of an SQL statement string, or zero if this is unknown.

SQL_MAX_TABLE_NAME_LEN (type: SMALLINT)
This is the maximum length in characters of an unqualified table name.

SQL_MAX_TABLES_IN_SELECT (type: SMALLINT)
This is the maximum number of table names allowed in a FROM clause in a *query-specification*.

SQL_MAX_USER_NAME_LEN (type: SMALLINT)
This is the maximum size in characters allowed for a user identifier, or zero if this is unknown.

SQL_NULL_COLLATION (type: SMALLINT)
This is SQL_NC_HIGH if null values sort high, or SQL_NC_LOW if null values sort low.

SQL_OJ_CAPABILITIES (type: CHAR(1))
This is zero, one or more of the following values:

SQL_OJ_LEFT
The implementation supports LEFT OUTER JOIN.

SQL_OJ_RIGHT
The implementation supports RIGHT OUTER JOIN.

SQL_OJ_FULL
The implementation supports FULL OUTER JOIN.

SQL_OJ_NESTED
The implementation supports nested OUTER JOINs.

SQL_OJ_NOT_ORDERED
The order of the tables underlying the columns in the ON clause need not be in the same order as tables in the JOIN clause. This bit must be set for all X/Open-compliant implementations that support OUTER JOIN.

SQL_OJ_INNER
The inner table of an OUTER JOIN can also be an inner join. This bit must be set for all X/Open-compliant implementations that support OUTER JOIN.

SQL_OJ_ALL_COMPARISON_OPS
Any predicate may be used in the ON clause. This bit must be set for all X/Open-compliant implementations that support OUTER JOIN. If this bit is not set, the = (equality) operator is the only valid comparison operator in the ON clause.

SQL_ORDER_BY_COLUMNS_IN_SELECT (type: CHAR(1))
This is 'Y' if columns in ORDER BY clauses must be in the select list, as specified in the X/Open **SQL** specification, or 'N' otherwise.

SQL_SCROLL_CONCURRENCY (type: INTEGER)
This indicates the concurrency control capabilities that the implementation supports for scrollable cursors. The value is a 32-bit bitmask with the low-order bits identified as follows:

SQL_SCCO_READ_ONLY
The cursor can be read, but no updates are allowed.

SQL_SCCO_LOCK
The cursor can use the lowest level of locking that ensures that the row can be updated.

SQL_SCCO_OPT_ROWVER
The cursor can use optimistic concurrency with row identifiers or timestamps.

SQL_SCCO_OPT_VALUES
The cursor can use optimistic concurrency comparing values.

SQL_SEARCH_PATTERN_ESCAPE (type: CHAR(1))
This is the character to be used as the escape character in the search patterns of the metadata functions, or an empty string if such an escape character is not supported.

SQL_SERVER_NAME (type: CHAR(128))
This is the actual name of the server that is being accessed via the connection. This can be different than the value that was specified for *ServerName* in *Connect( )*.

SQL_SPECIAL_CHARACTERS (type: CHAR(254))
This is a character string that contains all the characters that the server allows in identifiers other than non-delimited identifiers. Upper-case letters, lower-case letters, numerals, and '_' are not included in this string and are always permitted in such identifiers.

SQL_TXN_CAPABLE (type: SMALLINT) This indicates any transaction restrictions the server imposes. The value is one of the following:

SQL_TC_ALL
Transactions can contain both DML and DDL without restriction.

SQL_TC_DDL_COMMIT
Transactions can contain only DML. Execution of a DDL statement during a transaction causes the completion of the transaction before the DDL statement.

SQL_TC_DDL_IGNORE
Transactions can contain only DML. Any DDL statement is ignored.

SQL_TC_DML
Transactions can contain only DML. Any DDL in a transaction results in an error.

SQL_TC_NONE
Transactions are not supported at all. Each statement is self-committing.

An X/Open-compliant implementation returns either SQL_TC_ALL, SQL_TC_DDL_COMMIT or SQL_TC_DML.

SQL_TXN_ISOLATION_OPTION (type: INTEGER)
This indicates the isolation levels the server supports. The value is a 32-bit bitmask with the low-order bits identified as follows:

SQL_TXN_READ_UNCOMMITTED
SQL_TXN_READ_COMMITTED
SQL_TXN_REPEATABLE READ
SQL_TXN_SERIALIZABLE

These four transaction isolation levels are defined in the X/Open **SQL** specification.

SQL_USER_NAME (type CHAR(128))
This is the current user name. It is the same value as the USER pseudo-literal, but can be obtained without executing a *cursor-specification*.

SQL_XOPEN_CLI_YEAR
This is the year of publication of the X/Open specification with which the CLI implementation fully complies. To indicate compliance with this document, the value is '1995'. If the implementation does not fully comply with any published X/Open specification, the value is an empty string.

InfoValue (output)
The current value of the characteristic specified by *InfoType*. The type of the value returned depends on *InfoType*.

BufferLength (input)
The maximum number of octets to store in *InfoValue*, if *Value* is a character string; otherwise, unused.

StringLength (output)
The length in octets of the output data (even if it does not entirely fit into *InfoValue*) if *InfoValue* is a character string; otherwise, unused.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO], or [SQL_INVALID_HANDLE].

DIAGNOSTICS

The [SQL_SUCCESS_WITH_INFO] outcome occurs if the returned data is truncated ('**01**004') or if implementation-defined warnings are produced.

InfoType argument must be one of the defined values or an implementation-defined value ('**HY**096').

APPLICATION USAGE

The application can call *GetInfo*( ) at any time that *ConnectionHandle* is in the connected state. It is called for a single characteristic at a time and obtains information about the support of that characteristic on the server.

Many types of information returned by *GetInfo*( ) describe implementation-defined characteristics. Applications that require particular values inhibit their own portability.

COMPLIANCE POLICY

X/Open includes *GetInfo*( ) in this document to let applications adapt to partial or extended CLI implementations. However, its presence does not affect the CLI compliance requirements. X/Open constrains the values that compliant implementations can report for some of the *GetInfo*( ) characteristics. See the X/Open **SQL** specification.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLHDBC     ConnectionHandle;
SQLSMALLINT InfoType;
SQLPOINTER  InfoValue;
SQLSMALLINT BufferLength;
SQLSMALLINT StringLength;
 ...
ReturnCode = SQLGetInfo(ConnectionHandle,
  InfoType, InfoValue, BufferLength, &StringLength);
```

EXAMPLE USAGE (COBOL)

```
01 CONNECTIONHANDLE PICTURE S9(9) BINARY.
01 INFOTYPE         PICTURE S9(4) BINARY.
01 INFOVALUE        PICTURE type.
01 BUFFERLENGTH     PICTURE S9(4) BINARY.
01 STRINGLENGTH     PICTURE S9(4) BINARY.
01 RETURNCODE       PICTURE S9(4) BINARY.
 ...
CALL "SQLRGetInfo" USING CONNECTIONHANDLE,
  INFOTYPE, INFOVALUE, BUFFERLENGTH, STRINGLENGTH, RETURNCODE.
```

NAME

GetStmtAttr — Get the value of a statement attribute

SYNOPSIS

```
FUNCTION GetStmtAttr
 (StatementHandle INTEGER,
  Attribute INTEGER,
  Value ANY,
  BufferLength INTEGER,
  StringLength INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The application can call *GetStmtAttr*( ) to obtain the value of an attribute for *StatementHandle*.

The function has the following parameters:

StatementHandle (input)
Statement handle.

Attribute (input)
The desired statement attribute. For a list of valid attributes, see **Statement Attributes** on page 30.

Value (output)
The current value of the attribute specified by *Attribute*. The type of the value returned depends on *Attribute*.

BufferLength (input)
Maximum number of octets to store in *Value*, if the attribute value is a character string; otherwise, unused.

StringLength (output)
Length in octets of the output data (even if it does not entirely fit in *Value*), if the attribute value is a character string; otherwise, unused.

If *Attribute* does not denote a string, then the implementation ignores *BufferLength* and does not set *StringLength*.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

DIAGNOSTICS

The [SQL_SUCCESS_WITH_INFO] outcome occurs if the returned data is truncated ('**01**004') or if implementation-defined warnings are produced.

Attribute must be one of the defined attributes or an implementation-defined value ('**HY**092'). (If *Attribute* is an attribute defined in this document but marked optional, and if the implementation does not support that option, the diagnostic is '**HY**C00'.)

APPLICATION USAGE

GetStmtAttr( ) can be called at any time between the allocation and the freeing of *StatementHandle*. It obtains the current value of the statement attribute. The manual page for *SetStmtAttr*( ) specifies the point in time at which statement attributes affect processing of *StatementHandle*; if *SetStmtAttr*( ) has been called since this time, the attribute value that a subsequent *GetStmtAttr*( ) returns might not be the value that affected the processing of the statement text associated with *StatementHandle*.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN  ReturnCode;
SQLHSTMT   StatementHandle;
SQLINTEGER Attribute;
SQLPOINTER Value;
SQLINTEGER BufferLength;
SQLINTEGER StringLength;
 ...
ReturnCode = SQLGetStmtAttr(StatementHandle,
  Attribute, Value, BufferLength, &StringLength);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE PICTURE S9(9) BINARY.
01 ATTRIBUTE       PICTURE S9(9) BINARY.
01 VALUE           PICTURE type.
01 BUFFERLENGTH    PICTURE S9(9) BINARY.
01 STRINGLENGTH    PICTURE S9(9) BINARY.
01 RETURNCODE      PICTURE S9(4) BINARY.
 ...
CALL "SQLRGetStmtAttr" USING STATEMENTHANDLE,
  ATTRIBUTE, VALUE, BUFFERLENGTH, STRINGLENGTH, RETURNCODE.
```

SEE ALSO

SetStmtAttr( )

NAME

GetStmtOption — Get the value of a statement attribute (deprecated)

SYNOPSIS

DE
```
FUNCTION GetStmtOption
 (StatementHandle INTEGER,
  Option SMALLINT,
  Value ANY)
RETURNS  (SMALLINT)
```

DESCRIPTION

The application can call *GetStmtOption*( ) to obtain a value of an attribute for *StatementHandle*. The function has the following parameters:

StatementHandle (input)
Statement handle.

Option (input)
The desired statement attribute. For a list of valid attributes, see **Statement Attributes** on page 30.

Value (output)
The current value of the attribute specified by *Option*. Depending on the value of *Option*, this points either to a 32-bit integer value or to a character string.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO], or [SQL_INVALID_HANDLE]. The [SQL_SUCCESS_WITH_INFO] outcome occurs if implementation-defined warnings are produced.

DIAGNOSTICS

Option must be one of the defined attributes or an implementation-defined value ('**HY**092'). (If *Option* is an attribute defined in this document but marked optional, and if the implementation does not support that option, the diagnostic is '**HY**C00'.)

APPLICATION USAGE

The application can call *GetStmtOption*( ) at any time between the allocation and the freeing of *StatementHandle*. It obtains the current value of the statement attribute. The manual page for *SetStmtAttr*( ) specifies the point in time at which statement attributes affect processing of *StatementHandle*; if *SetStmtAttr*( ) or *SetStmtOption*( ) has been called since this time, the attribute value that a subsequent *SetStmtOption*( ) returns might not be the value that affected processing of the statement text associated with *StatementHandle*.

EXAMPLE USAGE(C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLHSTMT    StatementHandle;
SQLSMALLINT Option;
SQLPOINTER  Value;
 ...
ReturnCode = SQLGetStmtOption(StatementHandle, Option
  Value);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE PICTURE S9(9) BINARY.
01 OPTION          PICTURE S9(4) BINARY.
01 VALUE           PICTURE type.
```

```
01 RETURNCODE      PICTURE S9(4) BINARY.
 ...
CALL "SQLRGetStmtOption" USING STATEMENTHANDLE,
  OPTION, VALUE, RETURNCODE.
```

SEE ALSO

AllocHandle( ), *GetStmtAttr*( ), *SetStmtOption*( )

NAME

GetTypeInfo — Get information on server data types

SYNOPSIS

```
FUNCTION GetTypeInfo
 (StatementHandle INTEGER,
  DataType SMALLINT)
RETURNS (SMALLINT)
```

DESCRIPTION

The application can call *GetTypeInfo*( ) to find what data types are supported by the server represented by the connection on which *StatementHandle* was allocated. The application specifies a single data type or requests information on all data types.

The function has the following parameters:

StatementHandle (input)
Statement handle.

DataType (input)
The SQL data type being queried. It must be one of the following values or a value that the implementation supports:

SQL_ALL_TYPES
SQL_CHAR
SQL_DECIMAL
SQL_DOUBLE
SQL_FLOAT
SQL_INTEGER
SQL_NUMERIC
SQL_REAL
SQL_SMALLINT
SQL_TYPE_DATE
SQL_TYPE_TIME
SQL_TYPE_TIMESTAMP
SQL_VARCHAR

Data type information is returned in the form of a result set on *StatementHandle*, where each data type is represented by at least one row of the the result set.

If there is more than one name by which the data type can be specified (as *data-type* in the CREATE TABLE or ALTER TABLE statement), then there may be one row for each name in the result set. For example, for SQL_VARCHAR, there may be a row for VARCHAR and one for CHARACTER VARYING.

The result set has at least these columns in the following order:

Column Name	Type	Meaning
TYPE_NAME	VARCHAR(128) NOT NULL	A name for the SQL data type identified by *DataType*.
DATA_TYPE	SMALLINT NOT NULL	The value of data type as it should be specified for the *DataType* parameter. This is the actual *DataType* argument unless the argument is SQL_ALL_TYPES. See also the SQL_DATA_TYPE column.

Column Name	Type	Meaning
PRECISION	INTEGER	The maximum precision / length that the server supports for this data type: For numeric data, this is the maximum precision. For string data, this is the length in characters. For date / time data types, this is the length in characters of the string representation (assuming the maximum allowed precision of the fractional seconds component). For some implementation-defined data types, this column may be null.
LITERAL_PREFIX	VARCHAR(128)	Character or characters that the implementation recognises as a prefix for a literal of this data type for the server. This column is null for data types where a literal prefix is not applicable.
LITERAL_SUFFIX	VARCHAR(128)	Character or characters that the implementation recognises as a suffix for a literal of this data type for the server. This column is null for data types where a literal suffix is not applicable.
CREATE_PARAMS	VARCHAR(128)	The text of this column contains a list of keywords, separated by commas, corresponding to each parameter the application may specify in parentheses when using the name in TYPE_NAME as a *data-type* in X / Open SQL. The keywords in the list can be any of the following: LENGTH, PRECISION, SCALE. They appear in the order that the syntax requires that they be used. If the application would never follow the data type by parenthesised parameters, then this column is null.
NULLABLE	SMALLINT NOT NULL	This column contains the value SQL_NULLABLE if the data type accepts null values; it contains SQL_NO_NULLS if the data type cannot accept null values; and it contains SQL_NULLABLE_UNKNOWN if it is not known whether the data type accepts null values. For all the data types defined in this document, the value is SQL_NULLABLE.
CASE_SENSITIVE	SMALLINT NOT NULL	This column contains the value SQL_TRUE if the data type can be treated as case-sensitive for collation purposes; otherwise, it contains SQL_FALSE.
SEARCHABLE	SMALLINT NOT NULL	Specifies the types of predicate where the data type can be used. Its value is a bitwise-inclusive OR of zero or more of the following: SQL_PRED_CHAR The data type can be used in the LIKE predicate SQL_PRED_BASIC The data type can be used in the comparison, quantified comparison, BETWEEN, DISTINCT, IN, MATCH and UNIQUE predicates.

Column Name	Type	Meaning
		If none of the above bits are set, this column's value is SQL_PRED_NONE.
UNSIGNED_ATTRIBUTE	SMALLINT	This column contains the value SQL_TRUE if the data type is unsigned; otherwise, it contains the value SQL_FALSE. If sign is not applicable (such as for non-numeric data types), this column is null.
FIXED_PREC_SCALE	SMALLINT NOT NULL	This column contains the value SQL_TRUE if the data type is exact numeric and has a fixed precision and scale; otherwise, it contains the value SQL_FALSE.
AUTO_INCREMENT	SMALLINT	This column contains SQL_TRUE if a column of this data type is automatically set to a unique value when a row is inserted.* Otherwise, this column contains SQL_FALSE.
LOCAL_TYPE_NAME	VARCHAR(128)	This column contains any localised (native language) name for the data type that is different from the regular name of the data type. If there is no localised name, this column is null. This column is intended for display only. The character set of the string is locale-dependent and is typically the default character set of the server.
MINIMUM_SCALE	INTEGER	The minimum scale of the data type. For data types with a fixed scale, MINIMUM_SCALE and MAXIMUM_SCALE are the same. For date/time data types, this column's value is 0. If sign is not applicable (such as for non-numeric data types), this column is null.
MAXIMUM_SCALE	INTEGER	The maximum scale of the data type. For data types with a fixed scale, MINIMUM_SCALE and MAXIMUM_SCALE are the same. For the date/time data types TIME and TIMESTAMP, this is the maximum value of the precision of the fractional seconds component. If sign is not applicable (such as for non-numeric data types), this column is null.
SQL_DATA_TYPE	SMALLINT NOT NULL	The value of the data type as it appears in the TYPE field in the descriptor. This column is the same as DATA_TYPE except for the date/time data types.
SQL_DATETIME_SUB	SMALLINT	When the value in SQL_DATA_TYPE is SQL_DATETIME, this column contains the date/time subcode, as it appears in the DATETIME_INTERVAL_CODE field in the descriptor. For data types other than date/time types, this column is null.
NUM_PREC_RADIX	INTEGER	If DATA_TYPE is an approximate numeric data type, this column contains the value 2 because NUM_PREC specifies a number of bits. For exact numeric data types, this column contains the value 10 because NUM_PREC specifies a number of decimal digits. Otherwise, this column is null. By combining

Column Name	Type	Meaning
		the precision with the radix, an application can calculate the maximum number that the column can hold.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

[SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

DIAGNOSTICS

There must not be an open cursor on *StatementHandle* ('**24**000').

The *DataType* argument must be one of the defined values or an implementation-defined value ('**HY**004').

APPLICATION USAGE

The application can call *GetTypeInfo*() at any time that the connection handle on which *StatementHandle* was allocated is in the connected state. It may be called for a single data type or for all data types supported by the server. The result set may contain more than one row for a single SQL data type.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN     ReturnCode;
SQLHSTMT      StatementHandle;
SQLSMALLINT   DataType;
 ...
ReturnCode = SQLGetInfo(StatementHandle, DataType);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE PICTURE S9(9) BINARY.
01 DATATYPE        PICTURE S9(4) BINARY.
01 RETURNCODE      PICTURE S9(4) BINARY.
 ...
CALL "SQLRGetTypeInfo" USING STATEMENTHANDLE, DATATYPE, RETURNCODE.
```

---

* Columns of this data type are generally not updatable and the value remains constant for the life of the row.

NAME

NumResultCols — Get the number of columns in a result set (concise)

SYNOPSIS

```
FUNCTION NumResultCols
 (StatementHandle INTEGER,
  ColumnCount SMALLINT)
RETURNS (SMALLINT)
```

DESCRIPTION

The *NumResultCols*( ) function has the following parameters:

StatementHandle (input)
Statement handle.

ColumnCount (output)
Number of columns in the result set.

Calling *NumResultCols*( ) sets the value of *ColumnCount* to the number of columns in the result set associated with *StatementHandle*, or to zero if the statement cannot return columns.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

[SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

DIAGNOSTICS

The application must have prepared *StatementHandle* (by calling *Prepare*( ) or *ExecDirect*( )) before the call to *NumResultCols*( ) ('**HY**010').

APPLICATION USAGE

The application can call *NumResultCols*( ) to retrieve the number of columns in a result set without having to obtain a separate descriptor handle. Conceptually, *NumResultCols*( ) calls *GetStmtAttr*( ) to obtain the implementation row descriptor handle, then calls *GetDescField*( ) to retrieve the COUNT field from that descriptor.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLHSTMT    StatementHandle;
SQLSMALLINT ColumnCount;
 ...
ReturnCode = SQLNumResultCols(StatementHandle, &ColumnCount);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE PICTURE S9(9) BINARY.
01 COLUMNCOUNT     PICTURE S9(4) BINARY.
01 RETURNCODE      PICTURE S9(4) BINARY.
 ...
CALL "SQLRNumResultCols" USING STATEMENTHANDLE, COLUMNCOUNT,
  RETURNCODE.
```

SEE ALSO

SetDescField( ), *SetDescRec*( ), *DescribeCol*( ), *BindCol*( )

NAME

ParamData — Address the next dynamic parameter requiring data at execution time

SYNOPSIS

```
FUNCTION ParamData
 (StatementHandle INTEGER,
  Value ANY)
RETURNS (SMALLINT)
```

DESCRIPTION

An application calls *ParamData*( ) in conjunction with *PutData*( ) to supply dynamic arguments that it has previously indicated will be specified at execute time.

If there are additional dynamic parameters for which execute-time data is required, *ParamData*( ) identifies to the application the next such dynamic parameter, in increasing order of parameter number. If no additional dynamic parameter requires data, *ParamData*( ) completes the execution of the SQL statement previously specified by *ExecDirect*( ) or *Execute*( ).

The function has the following parameters:

StatementHandle (input)
Statement handle.

Value (output)
If the function returns [SQL_NEED_DATA], this returns the contents of the DATA_PTR field of the record in the application parameter descriptor that relates to the dynamic parameter for which the implementation requires information. For any other return value, *Value* is undefined.

RETURN VALUE

[SQL_SUCCESS], [SQL_NEED_DATA], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO], [SQL_NO_DATA] or [SQL_INVALID_HANDLE]. [SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

The return value [SQL_NEED_DATA] indicates that the implementation is ready to receive the next execute-time dynamic argument. The *Value* argument returns the DATA_PTR field of the related record in the application parameter descriptor. If *BindParam*( ) was used to set DATA_PTR in the application parameter descriptor, the *Value* argument is set to the value the application had passed as the *ParamValue* argument of *BindParam*( ).

The return values [SQL_INVALID_HANDLE] and [SQL_ERROR] (with the **DIAGNOSTICS** listed below) indicate errors in the call.

The return values [SQL_SUCCESS], [SQL_SUCCESS_WITH_INFO], [SQL_NO_DATA] or [SQL_ERROR] (with **DIAGNOSTICS** other than those listed below) can be produced if provision of dynamic arguments is complete and the call to *ParamData*( ) executed the original SQL statement. In this case the return value is the return value that *ExecDirect*( ) would have returned if called directly.

DIAGNOSTICS

If no additional dynamic arguments are required, *ParamData*( ) executes the original SQL statement, and can produce any of the diagnostics listed in *ExecDirect*( ).

A previous call to *ExecDirect*( ) or *Execute*( ) must have returned [SQL_NEED_DATA], indicating that additional dynamic arguments are required before the statement associated with *StatementHandle* can be executed ('**HY**010').

The most recent function call on *StatementHandle* must not be another call to *ParamData*( )('**HY**010').

The application cannot perform any other operation with *StatementHandle* while a data-at-execute dialogue is in progress; nor can it call *EndTran*( ) nor set any connection attribute that would have an impact on the treatment of the statement handle ('**HY**010').

APPLICATION USAGE

The implementation requests that the application call *ParamData*( ) when a previous call to *ExecDirect*( ) or *Execute*( ) returns [SQL_NEED_DATA] or a previous call to *PutData*( ) returns [SQL_SUCCESS]. This is always based on a prior declaration by the application that certain dynamic arguments will be passed at execute time. (For an overview of passing dynamic arguments at execute time, see Section 4.3.2 on page 48.)

If the application specifies more than one dynamic parameter whose value will be passed at execute time, it should set the DATA_PTR field of each such record of the application parameter descriptor to a unique value. The application can set this field directly by calling *SetDescField*( ) or *SetDescRec*( ), or by using the *ParamValue* argument on a call to *BindParam*( ). Each call to *ParamData*( ) returns this value as the *Value* argument, indicating the dynamic parameter for which the implementation seeks data on this occasion. The application may use the DATA_PTR field as a means of passing arbitrary information to the routine that supplies dynamic arguments at execute time.

In programming languages where the application cannot use DATA_PTR, the application cannot use the *Value* parameter to obtain meaningful identification of the dynamic argument needed on this occasion. However, the application can still supply data at execute time by relying on the rule that *ParamData*( ) requests dynamic arguments in increasing order of parameter number.

The application can call *Cancel*( ) to prematurely terminate the data-at-execute dialogue.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN  ReturnCode;
SQLHSTMT   StatementHandle;
SQLPOINTER Value;
 ...
ReturnCode = SQLParamData(StatementHandle, &Value);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE PICTURE S9(9) BINARY.
01 VALUE           PICTURE type.
01 RETURNCODE      PICTURE S9(4) BINARY.
 ...
CALL "SQLRParamData" USING STATEMENTHANDLE, VALUE, RETURNCODE.
```

SEE ALSO

BindParam( ), *PutData*( ), *SetDescField*( ), *SetDescRec*( )

NAME

Prepare — Prepare an SQL statement for execution

SYNOPSIS

```
FUNCTION Prepare
 (StatementHandle INTEGER,
  StatementText CHAR,
  TextLength INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The *Prepare*( ) function has the following parameters:

StatementHandle (input)
Statement handle.

StatementText (input)
SQL text string, using question-mark (?) characters as dynamic parameter markers.

TextLength (input)
Length in octets of *StatementText*.

Calling *Prepare*( ) prepares the SQL statement text in *StatementText* for execution. The application can subsequently refer to the SQL statement using *StatementHandle*.

Prepare( ) populates the implementation row descriptor with information describing the columns of the result set.

Dynamic Parameters

OP It is implementation-defined which of the following occurs during a call to *Prepare*( ):

- The implementation sets the fields of the implementation parameter descriptor to describe the number, data type and type attributes of dynamic parameters in the SQL statement (this corresponds to the DESCRIBE INPUT feature of embedded SQL). If there are no dynamic parameters, the descriptor's COUNT field is set to 0.
- The implementation does not modify the implementation parameter descriptor.

Section 4.3.1 on page 47 describes the cases in which the application must gain access to the implementation parameter descriptor.

For a *cursor-specification*, *Prepare*( ) generates a cursor name unless one already exists.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

[SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

DIAGNOSTICS

The statement text must be a valid SQL statement other than COMMIT or ROLLBACK ('**42**000').

The current user must have any privileges required to execute the SQL statement ('**42**000').*

---

* It is implementation-defined whether the call to *Prepare*( ) reports violations of the rule(s) in this paragraph. If it does not, then the subsequent call to *Execute*( ) reports such violations.

There must not be an open cursor on *StatementHandle* ('**24**000').

For a dynamic positioned DELETE or a dynamic positioned UPDATE statement, the cursor referenced by the statement must be open and must be defined on a separate statement handle under the same connection handle ('**34**000').*

The following diagnostics, defined in the X/Open **SQL** specification, can occur based on the value of *StatementText*:*

	Cardinality violation
'**21**S01'	— Insert value does not match column list.
'**21**S02'	— Degree of derived table does not match column list.
'**42**000'	**Syntax error or access violation**†
'**42**S01'	— Base table or view already exists.
'**42**S02'	— Base table or view not found.
'**42**S11'	— Index already exists.
'**42**S12'	— Index not found.
'**42**S21'	— Column already exists.
'**42**S22'	— Column not found.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLHSTMT    StatementHandle;
SQLCHAR    *StatementText;
SQLINTEGER  TextLength;
 ...
ReturnCode = SQLPrepare(StatementHandle,
  StatementText, TextLength);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE PICTURE S9(9) BINARY.
01 STATEMENTTEXT   PICTURE type.
01 TEXTLENGTH      PICTURE S9(9) BINARY.
01 RETURNCODE      PICTURE S9(4) BINARY.
 ...
CALL "SQLRPrepare" USING STATEMENTHANDLE,
  STATEMENTTEXT, TEXTLENGTH, RETURNCODE.
```

SEE ALSO

SetCursorName( ), *Execute*( ), *ExecDirect*( )

† The codes of the form '**42**S*nn*' are '**S0**0*nn*' in the X/Open **SQL** specification.

NAME

PutData — Send part or all of a dynamic argument at execute time

SYNOPSIS

```
FUNCTION PutData
 (StatementHandle INTEGER,
  Data ANY,
  StrLen_or_Ind INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

An application calls *PutData*( ), after calling *ParamData*( ), to supply part or all of a dynamic argument at execute time. The function has the following parameters:

StatementHandle (input)
Statement handle.

Data (input)
All or part of a dynamic argument to be used in execution of a statement on *StatementHandle*.

StrLen_or_Ind (input)
A variable whose value is interpreted as follows:

- If a null value is to be used as the parameter, *StrLen_or_Ind* must contain the value SQL_NULL_DATA.
- If the *ValueType* specified when binding the parameter is SQL_CHAR:
  - — If the data in *Data* contains a null-terminated string, *StrLen_or_Ind* must either contain the length in octets of the string in *Data* or contain the value SQL_NTS.
  - — If the data in *Data* is not null-terminated, *StrLen_or_Ind* must contain the length in octets of the string in *Data*.
- Otherwise, *StrLen_or_Ind* is ignored.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE]. [SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

DIAGNOSTICS

The last call to *ExecDirect*( ), *Execute*( ) or *ParamData*( ) on *StatementHandle* must have returned [SQL_NEED_DATA], indicating that the implementation needs the application to provide dynamic arguments ('**HY**010').

Previous consecutive calls to *PutData*( ) must not have occurred since the call that reported [SQL_NEED_DATA] unless the application data type of the dynamic parameter is character string ('**HY**019').

The following diagnostics relate to interpreting, converting, and assigning the dynamic argument. It is implementation-defined whether they are reported by *PutData*( ), by the next call to *ParamData*( ), or by the call to *ParamData*( ) that ultimately executes the SQL statement:

- The length in octets of the string in *Data* must not exceed the maximum length of the dynamic parameter ('**22**001').
- The value of *Data* must be compatible with the data type of the column ('**07**001').

- A date / time dynamic argument specified as text must contain only valid characters ('**22**007').
- Other data conversion diagnostics specified in Section 5.4.10 on page 76 may occur.

If the application calls *PutData*( ) more than once since the call that returned [SQL_NEED_DATA], none of those calls may specify a null value ('**HY**020').

APPLICATION USAGE

After one or more calls to *PutData*( ), the application calls *ParamData*( ) on the same *StatementHandle*. This declares that the transfer of the given dynamic argument is complete and informs the application whether there are other dynamic parameters for which the implementation requires values.

If the application calls *PutData*( ) more than once before the call to *ParamData*( ) that completes the transfer of a dynamic argument, the implementation concatenates the data passed as the *Data* argument on the sequential calls to *PutData*( ) to obtain the dynamic argument.

For an overview of passing dynamic arguments at execute time, see Section 4.3.2 on page 48.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN  ReturnCode;
SQLHSTMT   StatementHandle;
SQLPOINTER Data;
SQLINTEGER StrLen_or_Ind;
 ...
ReturnCode = SQLPutData(StatementHandle, Data, StrLen_or_Ind);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE PICTURE S9(9) BINARY.
01 DATA            PICTURE type.
01 STRLEN-OR-IND   PICTURE S9(9) BINARY.
01 RETURNCODE      PICTURE S9(4) BINARY.
 ...
CALL "SQLRPutData" USING STATEMENTHANDLE, DATA, STRLEN-OR-IND,
  RETURNCODE.
```

SEE ALSO

BindParam( ), *ParamData*( ), *SetDescField*( ), *SetDescRec*( )

NAME

RowCount — Get the number of rows affected by an SQL statement

SYNOPSIS

DE
```
FUNCTION RowCount
 (StatementHandle INTEGER,
  RowCount INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The *RowCount*( ) function has the following parameters:

StatementHandle [input]
Statement handle.

RowCount [output]
The count of rows affected.

Calling *RowCount*( ) sets *RowCount* to the row count (see Section 5.3.2 on page 72) resulting from the most recent call to *ExecDirect*( ) or *Execute*( ).

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR] or [SQL_INVALID_HANDLE].

DIAGNOSTICS

The *RowCount*( ) function cannot be called prior to calling *ExecDirect*( ) or *Execute*( ) for *StatementHandle* (’**HY**010’).

APPLICATION USAGE

An application cannot use both *RowCount*( ) and *GetDiagField*( )/*GetDiagRec*( ) to obtain status information for a statement handle. An application should fetch all status information for the statement handle before calling *RowCount*( ), since *RowCount*( ) always resets the diagnostic area for the statement handle.

An application can call *RowCount*( ) even if it has called other CLI functions since the call to *ExecDirect*( ) or *Execute*( ).

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN  ReturnCode;
SQLHSTMT   StatementHandle;
SQLINTEGER RowCount;
 ...
ReturnCode = SQLRowCount(StatementHandle, &RowCount);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE PICTURE S9(9) BINARY.
01 ROWCOUNT        PICTURE S9(9) BINARY.
01 RETURNCODE      PICTURE S9(4) BINARY.
 ...
CALL "SQLRRowCount" USING STATEMENTHANDLE, ROWCOUNT, RETURNCODE.
```

SEE ALSO

ExecDirect( ), *Execute*( ), *GetDiagField*( )

NAME

SetConnectAttr — Set a connection attribute

SYNOPSIS

```
FUNCTION SetConnectAttr
 (ConnectionHandle INTEGER,
  Attribute INTEGER,
  Value ANY,
  StringLength INTEGER)
RETURNS  (SMALLINT)
```

DESCRIPTION

The application can call *SetConnectAttr*( ) to set an attribute for *ConnectionHandle* in order to affect the subsequent processing of CLI functions associated with *ConnectionHandle*. The function has the following parameters:

ConnectionHandle (input)
Connection handle.

Attribute (input)
The attribute whose value is to be set. It must be a settable attribute. For a list of valid attributes, see **Connection Attributes** on page 29.

Value (input)
The desired value for *Attribute*. The application must provide an argument of an appropriate type for *Attribute*.

StringLength (input)
Length in octets of *Value*, if the attribute value is a character string; otherwise ignored.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

[SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

DIAGNOSTICS

Attribute must be one of the defined attributes or an implementation-defined value ('**HY**092').

Value must be one of the defined values for the specified *Attribute* ('**HY**024').

APPLICATION USAGE

The application can call *SetConnectAttr*( ) at any time between the allocation and the freeing of *ConnectionHandle*. The only other function that can change the values of any connection attributes is *Connect*( ). Allocating a connection handle sets the values of some attributes to default values.

The application can set any connection attribute more than once. Each subsequent call overrides the value specified by any previous calls for the same attribute and connection handle. The operative value of the connection attribute is the attribute's value at the time the application calls an affected CLI function.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN  ReturnCode;
SQLHDBC    ConnectionHandle;
SQLINTEGER Attribute;
SQLPOINTER Value;
SQLINTEGER StringLength;
```

```
 ...
ReturnCode = SQLSetConnectAttr(ConnectionHandle,
  Attribute, Value, StringLength);
```

EXAMPLE USAGE (COBOL)

```
01 CONNECTIONHANDLE  PICTURE S9(9) BINARY.
01 ATTRIBUTE         PICTURE S9(9) BINARY.
01 VALUE             PICTURE type.
01 STRINGLENGTH      PICTURE S9(9) BINARY.
01 RETURNCODE        PICTURE S9(4) BINARY.
 ...
CALL "SQLRSetConnectAttr" USING CONNECTIONHANDLE,
  ATTRIBUTE, VALUE, STRINGLENGTH, RETURNCODE.
```

SEE ALSO

AllocHandle( ), *GetConnectAttr*( ), *SetConnectOption*( )

NAME

SetConnectOption — Set a connection attribute (deprecated)

SYNOPSIS

DE
```
FUNCTION SetConnectOption
 (ConnectionHandle INTEGER,
  Option SMALLINT,
  Value ANY)
RETURNS  (SMALLINT)
```

DESCRIPTION

The application can call *SetConnectOption*( ) to set an attribute for *ConnectionHandle* in order to affect the subsequent processing of CLI functions associated with *ConnectionHandle*. The function has the following parameters:

ConnectionHandle (input)
Connection handle.

Option (input)
The desired connection attribute.

Value (input)
The appropriate value for the attribute specified by *Option*. Depending on the value of *Option*, this points either to a 32-bit integer value or to a character string.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

[SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

DIAGNOSTICS

Option must be one of the defined attributes or an implementation-defined value ('**HY**092').

Value must be one of the defined values for the specified *Attribute* ('**HY**024').

APPLICATION USAGE

The application can call *SetConnectOption*( ) at any time between the allocation and the freeing of *ConnectionHandle*. The only other function that may change the values of a connection attribute is *Connect*( ), since it is possible that an attribute set prior to *Connect*( ), or left over from a previous connection, may no longer be valid for the new connection. Allocating a connection handle sets the values of some attributes to default values.

The application can set any connection attribute more than once. Each subsequent call overrides the value specified by any previous calls for the same attribute and connection handle. The operative value of the connection attribute is the attribute's value at the time the application calls an affected CLI function.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLHDBC     ConnectionHandle;
SQLSMALLINT Option;
SQLPOINTER  Value;
 ...
ReturnCode = SQLSetConnectOption(ConnectionHandle,
  Option, Value);
```

EXAMPLE USAGE (COBOL)

```
01 CONNECTIONHANDLE  PICTURE S9(9) BINARY.
01 OPTION            PICTURE S9(4) BINARY.
01 VALUE             PICTURE type.
01 RETURNCODE        PICTURE S9(4) BINARY.
 ...
CALL "SQLRSetConnectOption" USING CONNECTIONHANDLE,
  OPTION, VALUE, RETURNCODE.
```

SEE ALSO

AllocHandle( ), *SetConnectAttr*( ), *GetConnectOption*( )

NAME

SetCursorName — Set the name of a cursor

SYNOPSIS

```
FUNCTION SetCursorName
 (StatementHandle INTEGER,
  CursorName CHAR,
  NameLength SMALLINT)
RETURNS (SMALLINT)
```

DESCRIPTION

The application can call *SetCursorName*( ) to assign a name to a cursor. This is an optional step; the implementation implicitly gives each cursor a name (starting with 'SQLCUR' or 'SQL_CUR') when it creates the cursor.

The function has the following parameters:

StatementHandle (input)
Statement handle.

CursorName (input)
Cursor name. The implementation trims any leading and trailing spaces and, unless the result begins and ends with double quotes (in which case it is a delimited identifier; see **Delimited Identifiers** on page 21), converts lower-case letters to upper case.

NameLength (input)
Length in octets of *CursorName*.

Calling *SetCursorName*( ) associates the name *CursorName* with *StatementHandle*.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

[SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

DIAGNOSTICS

StatementHandle must be in the **allocated** or **prepared** state (see Table B-2 on page 242) ('**HY**010').

The conceptual result of evaluating *CursorName* as an identifier (see **DESCRIPTION** above) must satisfy the following tests:

- It must be a valid *cursor-name* as defined by the X/Open **SQL** specification ('**34**000').
- It must not start with 'SQLCUR' or 'SQL_CUR' (in order to avoid inadvertent duplication of names generated by the implementation) ('**34**000').
- If it exceeds {SQL_MAX_ID_LENGTH} characters in length, then the implementation uses only the first {SQL_MAX_ID_LENGTH} characters ('**01**004').
- No cursor with the same name may be already defined within the connection associated with *StatementHandle* ('**34**000').

APPLICATION USAGE

The cursor name that the application specifies is used for any subsequent cursors prepared with *StatementHandle* (until the application specifies a different cursor name by calling *SetCursorName*( ) again on *StatementHandle*).

If a name has not yet been set for a statement handle when a cursor is prepared, the implementation generates a unique cursor name. As long as that statement remains in the

prepared state, the application may call *SetCursorName*( ) to override the generated name.

For efficient processing, applications should not include any leading or trailing spaces in *CursorName*; if *CursorName* contains a delimited identifier, applications should position the first double quote as the first character in *CursorName*.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLHSTMT    StatementHandle;
SQLCHAR    *CursorName;
SQLSMALLINT NameLength;
 ...
ReturnCode = SQLSetCursorName(StatementHandle,
  CursorName, NameLength);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE PICTURE S9(9) BINARY.
01 CURSORNAME      PICTURE X(18).
01 NAMELENGTH      PICTURE S9(4) BINARY.
01 RETURNCODE      PICTURE S9(4) BINARY.
 ...
CALL "SQLRSetCursorName" USING STATEMENTHANDLE,
  CURSORNAME, NAMELENGTH, RETURNCODE.
```

SEE ALSO

Prepare( ), *GetCursorName*( ), *Execute*( ), *ExecDirect*( )

NAME

SetDescField — Set a descriptor field (extensible)

SYNOPSIS

```
FUNCTION SetDescField
 (DescriptorHandle INTEGER,
  RecNumber SMALLINT,
  FieldIdentifier SMALLINT,
  Value ANY,
  BufferLength INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The *SetDescField*( ) function sets the value of one field of a specified descriptor record associated with *DescriptorHandle*.

The application can call the function to set a field of a descriptor record beyond the records enumerated by the descriptor's COUNT field. In this case, the function implicitly increases the value of the COUNT field to *RecNumber*.

The function has the following parameters:

DescriptorHandle (input)
Descriptor handle.

RecNumber (input)
The record number for which the specified field in the descriptor is to be set. The first record is number 1.

FieldIdentifier (input)
The identifier of the field to be set. This can be one of the following:

SQL_DESC_COUNT (type: SMALLINT)
Ignore *RecNumber*. Set the number of records in the descriptor.

SQL_DESC_TYPE (type: SMALLINT)
Set the TYPE field of *RecNumber*.

SQL_DESC_LENGTH (type: INTEGER)
Set the LENGTH field of *RecNumber*. If *Type* specifies a character-string data type, this is the maximum number of characters to store in *Data*.

SQL_DESC_OCTET_LENGTH (type: INTEGER)
Set the OCTET_LENGTH field of *RecNumber*. If *Type* specifies a character-string data type, this is the maximum number of octets to store in *Data*, including the null terminator if applicable.

SQL_DESC_OCTET_LENGTH_PTR (type: SQLPOINTER)
Set the OCTET_LENGTH_PTR field of *RecNumber*. *Value* must point to an application variable whose type is INTEGER. For an application row descriptor, this is the variable that will receive the length in octets of character-string output data (even if it does not entirely fit in the output buffer). For an application parameter descriptor, this is the variable that will describe the length in octets of a character-string dynamic argument.

SQL_DESC_PRECISION (type: SMALLINT)
Set the PRECISION field of *RecNumber*.

SQL_DESC_SCALE (type: SMALLINT)
Set the SCALE field of *RecNumber*.

EX SQL_DESC_DATETIME_INTERVAL_CODE (type: SMALLINT)
Set the DATETIME_INTERVAL_CODE field of *RecNumber*.

SQL_DESC_INDICATOR_PTR (type: SQLPOINTER)
Set the INDICATOR_PTR field of *RecNumber*. *Value* must point to an application variable whose value is SMALLINT.

SQL_DESC_DATA_PTR (type: SQLPOINTER)
Set the DATA_PTR field of *RecNumber*. If *Value* points to an application variable, the descriptor record becomes bound to that variable. If *Value* is a null pointer, the descriptor record becomes unbound.

Value (input)
The desired value for *FieldIdentifier*. The application must provide an argument of an appropriate type for *FieldIdentifier*.

BufferLength (input)
Length in octets of *Value*.

If *FieldIdentifier* does not denote a string, then the implementation ignores *BufferLength*.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE]. The [SQL_SUCCESS_WITH_INFO] outcome occurs if implementation-defined warnings are produced.

DIAGNOSTICS

For all values of *FieldIdentifier* except SQL_DESC_COUNT, *RecNumber* must be 1 or greater ('**07**009').

FieldIdentifier must be one of the defined values or an implementation-defined value ('**HY**091'). Not all fields retrievable through *GetDescField*( ) are settable by *SetDescField*( ).

DescriptorHandle must not identify an implementation row descriptor ('**HY**016').

If *FieldIdentifier* is SQL_DESC_DATA_PTR, the descriptor's consistency is checked; see Section 5.4.9 on page 75.

APPLICATION USAGE

When *SetDescField*( ) specifies a value for any field other than COUNT and the deferred fields DATA_PTR, INDICATOR_PTR and OCTET_LENGTH_PTR, the record becomes unbound. When *SetDescField*( ) specifies a value for the TYPE field, some other fields for the record receive default values as indicated below and the remaining fields are set to undefined values:

Application Sets TYPE to:	Other Fields Implicitly Set
SQL_CHAR or SQL_VARCHAR	LENGTH is set to 1.
EX SQL_DATETIME	PRECISION is set to 0.
SQL_DECIMAL or SQL_NUMERIC	SCALE is set to 0; PRECISION is set to the implementation-defined default precision for the respective data type.
SQL_FLOAT	PRECISION is set to the implementation-defined default precision for FLOAT.

EX For a descriptor whose TYPE field is SQL_DATETIME, when *SetDescField*( ) specifies a value for the DATETIME_INTERVAL_CODE field, the PRECISION field for the record receives a default value as indicated below and sets the remaining fields to undefined values:

Application Sets DATETIME_INTERVAL_CODE to:	Other Field Implicitly Set
SQL_CODE_DATE	PRECISION is set to 0.
SQL_CODE_TIME	PRECISION is set to 0.
SQL_CODE_TIMESTAMP	PRECISION is set to 6.

When an application uses *SetDescField*( ) instead of *SetDescRec*( ) to set fields of a descriptor record, it must first declare the data type. Then, if the values implicitly set (as described above) are unacceptable, it can call *SetDescField*( ) to explicitly specify applicable data type attributes.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN     ReturnCode;
SQLHDESC      DescriptorHandle;
SQLSMALLINT   RecNumber;
SQLSMALLINT   FieldIdentifier;
SQLPOINTER    Value;
SQLINTEGER    BufferLength;
 ...
ReturnCode = SQLSetDescField(DescriptorHandle, RecNumber,
  FieldIdentifier, Value, BufferLength);
```

EXAMPLE USAGE (COBOL)

```
01 DESCRIPTORHANDLE     PICTURE S9(9) BINARY.
01 RECNUMBER            PICTURE S9(4) BINARY.
01 FIELDIDENTIFIER      PICTURE S9(4) BINARY.
01 VALUE                PICTURE type.
01 BUFFERLENGTH         PICTURE S9(9) BINARY.
01 RETURNCODE           PICTURE S9(4) BINARY.
 ...
CALL "SQLRSetDescField" USING STATEMENTHANDLE, RECNUMBER,
  FIELDIDENTIFIER, VALUE, BUFFERLENGTH, RETURNCODE.
```

SEE ALSO

SetDescRec( )

NAME

SetDescRec — Set a descriptor record (concise)

SYNOPSIS

```
FUNCTION SetDescRec
 (DescriptorHandle INTEGER,
  RecNumber SMALLINT,
  Type SMALLINT,
EX SubType SMALLINT,
  Length INTEGER,
  Precision SMALLINT,
  Scale SMALLINT,
  Data ANY,
  StringLength INTEGER,
  Indicator SMALLINT)
RETURNS (SMALLINT)
```

DESCRIPTION

The *SetDescRec*( ) function initialises a descriptor record associated with *DescriptorHandle*.

The application can call the function to set a field of a descriptor record beyond the records enumerated by the descriptor's COUNT field. In this case, the function implicitly increases the value of the COUNT field to *RecNumber*.

The function has the following parameters:

DescriptorHandle (input)
Descriptor handle.

RecNumber (input)
The record number from which the description in the descriptor is to be set. The first record is number 1.

Type (input)
The TYPE field for the record.

EX *SubType* (input)
The DATETIME_INTERVAL_CODE field, for records whose TYPE is SQL_DATETIME.

Length (input)
The OCTET_LENGTH field for the record.

Precision (input)
The PRECISION field for the record.

Scale (input)
The SCALE field for the record.

Data (deferred)
The DATA_PTR field for the record.

StringLength (deferred)
The OCTET_LENGTH_PTR field for the record.

Indicator (deferred)
The INDICATOR_PTR field for the record.

If *Type* specifies a character-string data type, *SetDescRec*( ) sets LENGTH to indicate the number of characters the character string can contain. This is the largest number of characters that can be represented in *Length* octets, after reserving space for an optional null terminator; except that

the resulting value is limited to the largest valid length for a CHARACTER VARYING data type.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

The [SQL_SUCCESS_WITH_INFO] outcome occurs if implementation-defined warnings are produced.

DIAGNOSTICS

RecNumber must be 1 or greater ('**07**009').

DescriptorHandle must not identify an implementation row descriptor ('**HY**016').

The descriptor's consistency is checked; see Section 5.4.9 on page 75.

APPLICATION USAGE

In languages that allow the use of pointers, the application can provide a null pointer for any of *Data*, *Indicator* and *StringLength*, in order to set the respective field of the descriptor record to a null pointer. For example, using *Data* to set the DATA_PTR field to a null pointer unbinds the record.

The application can set other fields of the descriptor record, by using calls to *SetDescField*( ).

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN     ReturnCode;
SQLHDESC      DescriptorHandle;
SQLSMALLINT   RecNumber;
SQLSMALLINT   Type;
SQLSMALLINT   SubType;
SQLINTEGER    Length;
SQLSMALLINT   Precision;
SQLSMALLINT   Scale;
SQLPOINTER    Data;
SQLINTEGER    StringLength;
SQLSMALLINT   Indicator;
 ...
ReturnCode = SQLSetDescRec(DescriptorHandle, RecNumber,
  Type, SubType, Length, Precision, Scale, Data,
  &StringLength, &Indicator);
```

EXAMPLE USAGE (COBOL)

```
01 DESCRIPTORHANDLE  PICTURE S9(9) BINARY.
01 RECNUMBER         PICTURE S9(4) BINARY.
01 TYPE              PICTURE S9(4) BINARY.
01 SUBTYPE           PICTURE S9(4) BINARY.
01 LENGTH            PICTURE S9(9) BINARY.
01 PRECISION         PICTURE S9(4) BINARY.
01 SCALE             PICTURE S9(4) BINARY.
01 DATA              PICTURE type.
01 STRINGLENGTH      PICTURE S9(9) BINARY.
01 INDICATOR         PICTURE S9(4) BINARY.
01 RETURNCODE        PICTURE S9(4) BINARY.
 ...
```

```
CALL "SQLRSetDescRec" USING DESCRIPTORHANDLE, RECNUMBER,
  TYPE, SUBTYPE, LENGTH, PRECISION, SCALE, DATA,
  STRINGLENGTH, INDICATOR, RETURNCODE.
```

SEE ALSO

SetDescField( )

NAME

SetEnvAttr — Set an environment attribute

SYNOPSIS

```
FUNCTION SetEnvAttr
 (EnvironmentHandle INTEGER,
  Attribute INTEGER,
  Value ANY,
  StringLength INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The application can call *SetEnvAttr*( ) to set an attribute for *EnvironmentHandle* in order to affect the subsequent processing of CLI functions for *EnvironmentHandle*.

The function has the following parameters:

EnvironmentHandle (input)
Environment handle.

Attribute (input)
The attribute whose value is to be set. It must be a settable attribute. For a list of valid attributes, see **Environment Attribute** on page 28.

Value (input)
The desired value for *Attribute*. The application must provide an argument of an appropriate type for *Attribute*.

StringLength (input)
Length in octets of *Value*, if the attribute value is a character string; otherwise, unused.

If *Attribute* does not denote a string, then the implementation ignores *StringLength*.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

[SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

DIAGNOSTICS

Applications cannot set environment attributes while connections are allocated on *EnvironmentHandle* ('**HY**011').

Attribute must be one of the defined attributes or an implementation-defined value ('**HY**092').

Value must be one of the defined values for the specified *Attribute* ('**HY**024').

APPLICATION USAGE

No other CLI function changes the value of any environment attribute except that *AllocHandle*( ) sets some attributes to default values, as described above, for the environment handle it allocates. *SetEnvAttr*( ) can be called more than once for any environment attribute; each subsequent call overrides the value specified by any previous calls for the same attribute and *EnvironmentHandle*. The operative value of the environment attribute is the attribute's value at the time the application calls an affected CLI function.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN  ReturnCode;
SQLHENV    EnvironmentHandle;
```

```
SQLINTEGER Attribute;
SQLPOINTER Value;
SQLINTEGER StringLength;
 ...
ReturnCode = SQLSetEnvAttr(EnvironmentHandle,
  Attribute, Value, StringLength);
```

EXAMPLE USAGE (COBOL)

```
01 ENVIRONMENTHANDLE PICTURE S9(9) BINARY.
01 ATTRIBUTE         PICTURE S9(9) BINARY.
01 VALUE             PICTURE type.
01 STRINGLENGTH      PICTURE S9(9) BINARY.
01 RETURNCODE        PICTURE S9(4) BINARY.
 ...
CALL "SQLRSetEnvAttr" USING ENVIRONMENTHANDLE,
  ATTRIBUTE, VALUE, STRINGLENGTH, RETURNCODE.
```

SEE ALSO

AllocHandle( ), *GetEnvAttr*( )

NAME

SetParam — Bind a dynamic parameter (concise)

SYNOPSIS

DE

```
FUNCTION SetParam
 (StatementHandle INTEGER,
  ParameterNumber SMALLINT,
  ValueType SMALLINT,
  ParameterType SMALLINT,
  LengthPrecision INTEGER,
  ParameterScale SMALLINT,
  ParameterValue ANY,
  StrLen_or_Ind INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

Refer to *BindParam*( ).

NAME

SetStmtAttr — Set a statement attribute

SYNOPSIS

```
FUNCTION SetStmtAttr
 (StatementHandle INTEGER,
  Attribute INTEGER,
  Value ANY,
  StringLength INTEGER)
RETURNS (SMALLINT)
```

DESCRIPTION

The application can call *SetStmtAttr*( ) to set an attribute for *StatementHandle* in order to affect subsequent CLI function calls associated with *StatementHandle*.

The function has the following parameters:

StatementHandle (input)
Statement handle.

Attribute (input)
The attribute whose value is to be set. It must be a settable attribute. For a list of valid attributes, see **Statement Attributes** on page 30.

Value (input)
The desired value for *Attribute*. The application must provide an argument of an appropriate type for *Attribute*.

StringLength (input)
Length in octets of *Value*, if the attribute value is a character string; otherwise, unused.

If *Attribute* does not denote a string, then the implementation ignores *StringLength*.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

[SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

DIAGNOSTICS

Attribute must be one of the defined attributes or an implementation-defined value ('**HY**092'). (If *Attribute* is an attribute defined in this document but marked optional, and if the implementation does not support that option, the diagnostic is '**HY**C00'.)

Value must be one of the defined values for the specified *Attribute* ('**HY**024'). For example, the values for the read-only options described in *GetStmtAttr*( ) cannot be used.

If *Attribute* is SQL_ATTR_CURSOR_SENSITIVITY or SQL_ATTR_CURSOR_SCROLLABLE, there must not be a prepared statement or an open cursor on *StatementHandle* ('**HY**011').

If *Attribute* is SQL_ATTR_APP_ROW_DESC or SQL_ATTR_APP_PARAM_DESC, and if *Value* is a descriptor handle obtained by a call to *GetStmtAttr*( ), then the values of *Attribute* and *StatementHandle* must be the same as they were on the call to *GetStmtAttr*( ) ('**HY**017').

APPLICATION USAGE

SetStmtAttr( ) can be called at any time between the allocation and the freeing of *StatementHandle*. No other CLI function changes the value of any statement attribute except that *AllocHandle*( ) may set some attributes to default values for the statement handle it allocates. *SetStmtAttr*( ) can be called more than once for any statement attribute; each subsequent call

overrides the value specified by any previous calls for the same attribute and statement handle. Setting attributes for a statement handle is independent of associating text of an SQL statement with that handle. The operative value of the statement attribute is the attribute's value at the time the application calls the relevant CLI function (*Fetch*( ), *FetchScroll*( ), *Prepare*( ), *Execute*( ) or *ExecDirect*( ), depending on the attribute in question).

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN  ReturnCode;
SQLHSTMT   StatementHandle;
SQLINTEGER Attribute;
SQLPOINTER Value;
SQLINTEGER StringLength;
 ...
ReturnCode = SQLSetStmtAttr(StatementHandle,
  Attribute, Value, StringLength);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE PICTURE S9(9) BINARY.
01 ATTRIBUTE       PICTURE S9(9) BINARY.
01 VALUE           PICTURE type.
01 STRINGLENGTH    PICTURE S9(9) BINARY.
01 RETURNCODE      PICTURE S9(4) BINARY.
 ...
CALL "SQLRSetStmtAttr" USING STATEMENTHANDLE,
  ATTRIBUTE, VALUE, STRINGLENGTH, RETURNCODE.
```

SEE ALSO

AllocHandle( ), *GetStmtAttr*( ), *Prepare*( )

NAME

SetStmtOption — Set a statement attribute (deprecated)

SYNOPSIS

DE
```
FUNCTION SetStmtOption
 (StatementHandle INTEGER,
  Option SMALLINT,
  Value ANY)
RETURNS  (SMALLINT)
```

DESCRIPTION

The application can call *SetStmtOption*( ) to set an attribute for *StatementHandle* in order to affect the subsequent processing of CLI functions associated with *StatementHandle*. The function has the following parameters:

StatementHandle (input)
Statement handle.

Option (input)
The attribute whose value is to be set. It must be a settable attribute. For a list of valid attributes, see **Statement Attributes** on page 30.

Value (input)
The appropriate value for the attribute specified by *Option*. Depending on the value of *Option*, this points either to a 32-bit integer value or to a character string.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

[SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

DIAGNOSTICS

Option must be one of the defined attributes or an implementation-defined value ('**HY**092'). (If *Option* is an attribute defined in this document but marked optional, and if the implementation does not support that option, the diagnostic is '**HY**C00'.)

Value must be one of the defined values for the specified *Option* ('**HY**024').

If *Option* is SQL_ATTR_CURSOR_SENSITIVITY or SQL_ATTR_CURSOR_SCROLLABLE, there must not be a prepared statement or an open cursor on *StatementHandle* ('**HY**011').

If *Option* is SQL_ATTR_APP_ROW_DESC or SQL_ATTR_APP_PARAM_DESC, and if *Value* is a descriptor handle obtained by a call to *GetStmtOption*( ), then the values of *Option* and *StatementHandle* must be the same as they were on the call to *GetStmtOption*( ) ('**HY**017').

APPLICATION USAGE

The application can call *SetStmtOption*( ) at any time between the allocation and the freeing of *StatementHandle*. Allocating a statement handle sets the values of some attributes to default values.

The application can set any statement attribute more than once. Each subsequent call overrides the value specified by any previous calls for the same attribute and statement handle. The operative value of the statement attribute is the attribute's value at the time the application calls an affected CLI function.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
```

```
SQLRETURN   ReturnCode;
SQLHSTMT    StatementHandle;
SQLSMALLINT Option;
SQLPOINTER  Value;
 ...
ReturnCode = SQLSetStmtOption(StatementHandle, Option, Value);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE  PICTURE S9(9) BINARY.
01 OPTION           PICTURE S9(4) BINARY.
01 VALUE            PICTURE type.
01 RETURNCODE       PICTURE S9(4) BINARY.
 ...
CALL "SQLRSetStmtOption" USING STATEMENTHANDLE,
  OPTION, VALUE, RETURNCODE.
```

SEE ALSO

AllocHandle( ), *SetStmtAttr*( ), *GetStmtOption*( )

NAME

SpecialColumns — Get a unique row identifier for a table

SYNOPSIS

```
FUNCTION SpecialColumns
 (StatementHandle INTEGER,
  IdentifierType SMALLINT,
  CatalogName CHAR,
  NameLength1 SMALLINT,
  SchemaName CHAR,
  NameLength2 SMALLINT,
  TableName CHAR,
  NameLength3 SMALLINT,
  Scope SMALLINT,
  Nullable SMALLINT)
RETURNS (SMALLINT)
```

DESCRIPTION

The *SpecialColumns*( ) function retrieves a result set that uniquely identifies a row of the specified table. The *SpecialColumns*( ) function can obtain information on *pseudo-columns* — that is, columns that an implementation may automatically create in addition to those the application specifies, such as a row identifier.

The function has the following parameters:

StatementHandle (input)
Statement handle.

IdentifierType (input)
Reserved for future definition by X/Open in order to support additional types of special columns. Must be set to SQL_ROW_IDENTIFIER.

CatalogName (input)
Buffer containing catalog name of table. If the SQL_ATTR_METADATA_ID attribute of *StatementHandle* is SQL_TRUE, then this is interpreted as an identifier (see **Treatment as Identifier** on page 54).

NameLength1 (input)
Length in octets of *CatalogName*.

SchemaName (input)
Buffer containing schema name of table. If the SQL_ATTR_METADATA_ID attribute of *StatementHandle* is SQL_TRUE, then this is interpreted as an identifier (see **Treatment as Identifier** on page 54).

NameLength2 (input)
Length in octets of *SchemaName*.

TableName (input)
Buffer containing name of table. If the SQL_ATTR_METADATA_ID attribute of *StatementHandle* is SQL_TRUE, then this is interpreted as an identifier (see **Treatment as Identifier** on page 54).

NameLength3 (input)
Length in octets of *TableName*.

Scope (input)
The application sets this argument to specify the period of time for which it requires that

the name returned in COLUMN_NAME be valid. Valid values for *Scope* are:

SQL_SCOPE_CURROW
SQL_SCOPE_TRANSACTION
SQL_SCOPE_SESSION

Nullable (input)
Set to SQL_NO_NULLS to restrict the result set of *SpecialColumns*( ) to describe only those columns of *TableName* that are not nullable; or to SQL_NULLABLE to not thus restrict the result set.

The *SpecialColumns*( ) functions returns a result set in which each row represents one column in *TableName*, including implementation-defined pseudo-columns that may exist in addition to the columns the application specified in the CREATE TABLE statement.

- If there is more than one column or set of columns that uniquely identifies a row of the table, then *SpecialColumns*( ) selects a row identifier using implementation-defined criteria.
- If there are no qualifying columns, then *SpecialColumns*( ) returns an empty result set.
- If *TableName* does not exist, then the result set is empty.
- If *TableName* is a view, then it is undefined whether the result set is empty.

The result set has at least these columns in the following order, and its rows are sorted by SCOPE:

Column Name	Type	Meaning
SCOPE	SMALLINT	The duration for which the name in COLUMN_NAME is guaranteed to point to the same row. Valid values are the same as for the *Scope* argument. The rows in the result set are constrained by the *Scope* argument such that the value of SCOPE always indicates a duration at least as long as that indicated by *Scope*.
COLUMN_NAME	VARCHAR(128) NOT NULL	Name of the row identifier or name of the column that is or is part of the table's primary key.
DATA_TYPE	SMALLINT NOT NULL	Identifies the type of the column and contains one of the Integer Data Type identifier values listed in Table 4-4 on page 58, except that, for the date/time data types, the column contains one of the Special Integer Data Type Identifiers listed in Table 4-5 on page 58. in
TYPE_NAME	VARCHAR(128) NOT NULL	The textual name of the column's data type; this can be an implementation-defined name for DATA_TYPE.

Column Name	Type	Meaning
COLUMN_SIZE	INTEGER	If DATA_TYPE is SQL_CHAR or SQL_VARCHAR, then this column contains the maximum length in characters of the column. For date/time data types, this is the total number of characters required to display the value when converted to character. For numeric data types, this is the total number of digits.
BUFFER_LENGTH	INTEGER	The size in octets of the buffer that would be required to fetch the column if SQL_DEFAULT were specified (see Table 4-9 on page 61). This length excludes any null terminator. For exact numeric data types, this length accounts for the decimal point and the sign.
DECIMAL_DIGITS	SMALLINT	Defines the total number of significant digits to the right of the decimal point. For the date/time subtypes TIME and TIMESTAMP, this is the number of digits in the fractional seconds component. For the INTEGER and SMALLINT data types, it is 0. For the CHARACTER, CHARACTER VARYING, FLOAT, REAL and DOUBLE PRECISION data types, it is null.
PSEUDO_COLUMN	SMALLINT	Indicates whether or not the column is a pseudo-column, such as a row identifier, which would not be returned in *Columns*( ). May be one of the following values: SQL_PC_NOT_PSEUDO The column is not a pseudo-column. SQL_PC_PSEUDO The column is a pseudo-column. SQL_PC_UNKNOWN It is unknown whether the column is a pseudo-column.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

[SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

DIAGNOSTICS

There must not be an open cursor on *StatementHandle*('**24**000').

If the implementation does not support qualification by catalog name, then *CatalogName* must be a null pointer or a zero-length string ('**HY**C00').

Scope must be SQL_SCOPE_CURROW, SQL_SCOPE_TRANSACTION or SQL_SCOPE_SESSION ('**HY**092').

IdentifierType must be SQL_ROW_IDENTIFIER ('**HY**092').

Nullable must be SQL_NO_NULLS or SQL_NULLABLE ('**HY**092').

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN    ReturnCode;
SQLHSTMT     StatementHandle;
SQLSMALLINT  IdentifierType;
SQLCHAR     *CatalogName;
SQLSMALLINT  NameLength1;
SQLCHAR     *SchemaName;
SQLSMALLINT  NameLength2;
SQLCHAR     *TableName;
SQLSMALLINT  NameLength3;
SQLSMALLINT  Scope;
SQLSMALLINT  Nullable;
 ...
ReturnCode = SQLSpecialColumns(StatementHandle, IdentifierType,
  CatalogName, NameLength1, SchemaName, NameLength2, TableName,
  NameLength3, Scope, Nullable);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE PICTURE S9(9) BINARY.
01 IDENTIFIERTYPE  PICTURE S9(4) BINARY.
01 CATALOGNAME     PICTURE X(128).
01 NAMELENGTH1     PICTURE S9(4) BINARY.
01 SCHEMANAME      PICTURE X(128).
01 NAMELENGTH2     PICTURE S9(4) BINARY.
01 TABLENAME       PICTURE X(128).
01 NAMELENGTH3     PICTURE S9(4) BINARY.
01 SCOPE           PICTURE S9(4) BINARY.
01 NULLABLE        PICTURE S9(4) BINARY.
01 RETURNCODE      PICTURE S9(4) BINARY.
 ...
CALL "SQLRSpecialColumns" USING STATEMENTHANDLE, IDENTIFIERTYPE,
  CATALOGNAME, NAMELENGTH1, SCHEMANAME, NAMELENGTH2, TABLENAME,
  NAMELENGTH3, SCOPE, NULLABLE, RETURNCODE.
```

RELATION TO STANDARDS

This function is not present in the ISO CLI Draft International Standard.

SEE ALSO

Statistics( ), *Tables*( )

NAME

Statistics — Get index information for a base table

SYNOPSIS

```
FUNCTION Statistics
 (StatementHandle INTEGER,
  CatalogName CHAR,
  NameLength1 SMALLINT,
  SchemaName CHAR,
  NameLength2 SMALLINT,
  TableName CHAR,
  NameLength3 SMALLINT,
  Unique SMALLINT,
  Reserved SMALLINT)
RETURNS (SMALLINT)
```

DESCRIPTION

The *Statistics*( ) function retrieves information on indexes for a given base table. The function has the following parameters:

StatementHandle (input)
Statement handle.

CatalogName (input)
Buffer containing catalog name of table. If the SQL_ATTR_METADATA_ID attribute of *StatementHandle* is SQL_TRUE, then this is interpreted as an identifier (see **Treatment as Identifier** on page 54).

NameLength1 (input)
Length in octets of *CatalogName*.

SchemaName (input)
Buffer containing schema name of table. If the SQL_ATTR_METADATA_ID attribute of *StatementHandle* is SQL_TRUE, then this is interpreted as an identifier (see **Treatment as Identifier** on page 54).

NameLength2 (input)
Length in octets of *SchemaName*.

TableName (input)
Buffer containing name of table. If the SQL_ATTR_METADATA_ID attribute of *StatementHandle* is SQL_TRUE, then this is interpreted as an identifier (see **Treatment as Identifier** on page 54).

NameLength3 (input)
Length in octets of *TableName*.

Unique (input)
Set to SQL_INDEX_UNIQUE to direct *Statistics*( ) to return only unique indexes, or set to SQL_INDEX_ALL to obtain all indexes.

Reserved (input)
Reserved for future definition by X/Open. Must be set to 0.

The *Statistics*( ) function returns index information in the form of a result set on the statement handle where each index column is represented by one row of the result set.

- If *TableName* does not exist, then the result set is empty.

- If *TableName* is a view, then it is undefined whether the result set is empty.

The result set has at least these columns in the following order, and its rows are sorted by NON_UNIQUE, TYPE, INDEX_QUALIFIER, INDEX_NAME and ORDINAL_POSITION, in that order:

Column Name	Type	Meaning
TABLE_CAT	VARCHAR(128)	The name of the catalog containing TABLE_SCHEM. See **APPLICATION USAGE** below.
TABLE_SCHEM	VARCHAR(128) NOT NULL	The name of the schema containing TABLE_NAME.
TABLE_NAME	VARCHAR(128) NOT NULL	The name of the table.
NON_UNIQUE	SMALLINT	Contains the value SQL_TRUE if the index values can be non-unique, or SQL_FALSE if the index values must be unique.
INDEX_QUALIFIER	VARCHAR(128)	The string that would be used to qualify the index name in the DROP INDEX statement. Appending a dot and the INDEX_NAME (see below) produces a full specification of the index. If the implementation does not support index qualifiers, this column is null.
INDEX_NAME	VARCHAR(128) NOT NULL	The name of the index.
TYPE	SMALLINT	The type of index returned: SQL_INDEX_CLUSTERED, SQL_INDEX_HASHED, or SQL_INDEX_OTHER. The meaning of these values is implementation-defined. Other implementation-defined values may be returned; in this case, the meanings of all other columns of the result set may be different from that specified here.
ORDINAL_POSITION	SMALLINT NOT NULL	Ordinal position of the column within the index. The first column is number 1.
COLUMN_NAME	VARCHAR(128) NOT NULL	The name of the column in the index.
ASC_OR_DESC	CHAR(1)	Contains the value 'A' if the order of the referenced column is ascending and 'D' if the order of the referenced column is descending.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

[SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

DIAGNOSTICS

There must not be an open cursor on *StatementHandle* ('**24**000').

If the implementation does not support qualification by catalog name, then the value of *CatalogName* must be a null pointer or a zero-length string ('**HY**C00').

The value of *Unique* must be SQL_INDEX_UNIQUE or SQL_INDEX_ALL; and the value of *Reserved* must be 0 ('**HY**092').

APPLICATION USAGE

The TABLE_CAT column may be null or may contain an empty string for several reasons discussed in Section 2.4.3 on page 22. If TABLE_CAT contains an empty string, the application should take care to not append '.' when forming a fully-qualified object name for use in an SQL statement.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN    ReturnCode;
SQLHSTMT     StatementHandle;
SQLCHAR     *CatalogName;
SQLSMALLINT  NameLength1;
SQLCHAR     *SchemaName;
SQLSMALLINT  NameLength2;
SQLCHAR     *TableName;
SQLSMALLINT  NameLength3;
SQLSMALLINT  Unique;
SQLSMALLINT  Reserved;
 ...
ReturnCode = SQLStatistics(StatementHandle, CatalogName,
  NameLength1, SchemaName, NameLength2, TableName,
  NameLength3, Unique, Reserved);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE PICTURE S9(9) BINARY.
01 CATALOGNAME     PICTURE X(128).
01 NAMELENGTH1     PICTURE S9(4) BINARY.
01 SCHEMANAME      PICTURE X(128).
01 NAMELENGTH2     PICTURE S9(4) BINARY.
01 TABLENAME       PICTURE X(128).
01 NAMELENGTH3     PICTURE S9(4) BINARY.
01 UNIQUE          PICTURE S9(4) BINARY.
01 RESERVED        PICTURE S9(4) BINARY.
01 RETURNCODE      PICTURE S9(4) BINARY.
 ...
CALL "SQLRStatistics" USING STATEMENTHANDLE, CATALOGNAME,
  NAMELENGTH1, SCHEMANAME, NAMELENGTH2, TABLENAME,
  NAMELENGTH3, UNIQUE, RESERVED, RETURNCODE.
```

RELATION TO STANDARDS

This function is not present in the ISO CLI Draft International Standard.

SEE ALSO

SpecialColumns( ), *Tables*( )

NAME

Tables — Get table information

SYNOPSIS

```
FUNCTION Tables
 (StatementHandle INTEGER,
  CatalogName CHAR,
  NameLength1 SMALLINT,
  SchemaName CHAR,
  NameLength2 SMALLINT,
  TableName CHAR,
  NameLength3 SMALLINT,
  TableType CHAR,
  NameLength4 SMALLINT)
RETURNS (SMALLINT)
```

DESCRIPTION

The *Tables*( ) function retrieves information on tables available through the connection on which *StatementHandle* was allocated. The function has the following parameters:

StatementHandle (input)
Statement handle.

CatalogName (input)
Buffer that may qualify the result set by catalog name. If the SQL_ATTR_METADATA_ID attribute of *StatementHandle* is SQL_TRUE, then this is interpreted as an identifier (see **Treatment as Identifier** on page 54); otherwise, it is a *pattern-value* (see **Qualification by Pattern-values** on page 55).

NameLength1 (input)
Length in octets of *CatalogName*.

SchemaName (input)
Buffer that may qualify the result set by schema name. If the SQL_ATTR_METADATA_ID attribute of *StatementHandle* is SQL_TRUE, then this is interpreted as an identifier (see **Treatment as Identifier** on page 54); otherwise, it is a *pattern-value* (see **Qualification by Pattern-values** on page 55).

NameLength2 (input)
Length in octets of *SchemaName*.

TableName (input)
Buffer that may qualify the result set by table name. If the SQL_ATTR_METADATA_ID attribute of *StatementHandle* is SQL_TRUE, then this is interpreted as an identifier (see **Treatment as Identifier** on page 54); otherwise, it is a *pattern-value* (see **Qualification by Pattern-values** on page 55).

NameLength3 (input)
Length in octets of *TableName*.

TableType (input)
Buffer that may contain a value list (see **Qualification by Value List** on page 55) to qualify the result set by table type. Valid table types include BASE TABLE, VIEW and implementation-defined table types.

NameLength4 (input)
Length in octets of *TableType*.

Table information is returned in the form of a result set on the statement handle where each table is represented by one row of the result set. It is implementation-defined whether or not a user has SELECT privileges to any of these tables. The result set returned by *Tables*( ) has at least these columns in the following order:

Column Name	Type	Meaning
TABLE_CAT	VARCHAR(128)	The name of the catalog containing TABLE_SCHEM. See **APPLICATION USAGE** below.
TABLE_SCHEM	VARCHAR(128) NOT NULL	The name of the schema containing TABLE_NAME.
TABLE_NAME	VARCHAR(128) NOT NULL	The name of the table or view.
TABLE_TYPE	VARCHAR(254) !NOT NULL	Identifies the type of the table or view. It can have the values ′BASE TABLE′ or ′VIEW′ or other implementation-defined values.
REMARKS	VARCHAR(254)	May contain descriptive information about the table.

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE].

[SQL_SUCCESS_WITH_INFO] can result when implementation-defined warnings are produced.

DIAGNOSTICS

There must not be an open cursor on *StatementHandle* (’**24**000’).

If the implementation does not support qualification by catalog name, then the value of *CatalogName* must be a null pointer or a zero-length string (’**HY**C00’).

APPLICATION USAGE

In languages that allow the use of pointers, the application can provide a null pointer for any of *CatalogName*, *SchemaName*, *TableName* and *TableType*, in order to inhibit qualification of the result set on the respective basis.

The TABLE_CAT column may be null or may contain an empty string for several reasons discussed in Section 2.4.3 on page 22. If TABLE_CAT contains an empty string, the application should take care to not append ’.’ when forming a fully-qualified object name for use in an SQL statement.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLHSTMT    StatementHandle;
SQLCHAR    *CatalogName;
SQLSMALLINT NameLength1;
SQLCHAR    *SchemaName;
SQLSMALLINT NameLength2;
SQLCHAR    *TableName;
SQLSMALLINT NameLength3;
SQLCHAR    *TableType;
```

```
SQLSMALLINT NameLength4;
 ...
ReturnCode = SQLTables(StatementHandle,
  CatalogName, NameLength1,
  SchemaName, NameLength2,
  TableName, NameLength3,
  TableType, NameLength4);
```

EXAMPLE USAGE (COBOL)

```
01 STATEMENTHANDLE  PICTURE S9(9) BINARY.
01 CATALOGNAME      PICTURE X(128).
01 NAMELENGTH1      PICTURE S9(4) BINARY.
01 SCHEMANAME       PICTURE X(128).
01 NAMELENGTH2      PICTURE S9(4) BINARY.
01 TABLENAME        PICTURE X(128).
01 NAMELENGTH3      PICTURE S9(4) BINARY.
01 TABLETYPE        PICTURE X(128).
01 NAMELENGTH4      PICTURE S9(4) BINARY.
01 RETURNCODE       PICTURE S9(4) BINARY.
 ...
CALL "SQLRTables" USING STATEMENTHANDLE, CATALOGNAME, NAMELENGTH1,
  SCHEMANAME, NAMELENGTH2, TABLENAME, NAMELENGTH3, TABLETYPE,
  NAMELENGTH4, RETURNCODE.
```

RELATION TO STANDARDS

This function is not present in the ISO CLI Draft International Standard.

NAME

Transact — Commit or roll back a transaction (deprecated)

SYNOPSIS

DE
```
FUNCTION Transact
 (EnvironmentHandle INTEGER,
  ConnectionHandle INTEGER,
  CompletionType SMALLINT)
RETURNS (SMALLINT)
```

DESCRIPTION

The *Transact*( ) function completes (commits or rolls back) a transaction, enacting or undoing any changes to the database performed on any connection with the specified handle since the transaction began (see Section 4.9 on page 63).

The function has the following parameters:

EnvironmentHandle (input)
Environment handle.

ConnectionHandle (input)
Connection handle.

CompletionType (input)
The desired completion outcome. This may be one of the following:

SQL_COMMIT
Work done is to be committed.

SQL_ROLLBACK
Work done is to be rolled back.

To complete a transaction on a single connection, the application passes a valid connection handle as *ConnectionHandle*. To complete a transaction that spans multiple connections, the application sets *ConnectionHandle* to SQL_NULL_HDBC and passes a valid environment handle as *EnvironmentHandle*.

Successful completion of a transaction closes any open cursors.

It is implementation-defined whether a transaction can span connections. On an implementation where transactions can span connections, the following aspects of multiple-connection transactions are implementation-defined:

- the sequence in which the connections have their transactions completed
- the effect that the success or failure of commitment over one connections has on the success or failure over any other.

If the work at some connections is committed and the work at others is rolled back, administrative action is typically necessary to assess or restore the integrity of the database.

The effect of calling *Transact*( ) is implementation-defined if a valid connection handle is specified as *ConnectionHandle* (see **Effects across Connections** on page 63).

RETURN VALUE

[SQL_SUCCESS], [SQL_ERROR], [SQL_SUCCESS_WITH_INFO] or [SQL_INVALID_HANDLE]. The [SQL_SUCCESS_WITH_INFO] outcome occurs if implementation-defined warnings are produced.

DIAGNOSTICS

The *CompletionType* argument must be one of the values listed above ('**HY**012').

The function may fail because the connection fails ('**08**007'). In this case, the application might not be able to determine whether the requested transaction outcome took effect before the failure.

The server can decide to roll back the transaction even though the call to *Transact*( ) specified SQL_COMMIT. (The SQLSTATE class is '**40**' and the subclass is one of those specified in Appendix A.)

Errors for Global Transaction Control

The *Transact*( ) function may fail for any of the following reasons:

- The implementation is not able to guarantee that all work in the global transaction can be completed atomically. Under implementation-defined criteria, either the transaction is still active ('**25**S02') or all work in the transaction active in the specified handle is rolled back ('**25**S03').
- One or more of the connections in the specified handle fails to complete the transaction with the outcome the application specified ('**25**S01'). The transaction state is unknown.

The application must not complete by calling *Transact*( ) a global transaction it started by calling a function from an explicit transaction demarcation API, such as the X/Open Distributed Transaction Processing (DTP) function *tx_begin*( ) ('**2D**000').

APPLICATION USAGE

X/Open Distributed Transaction Processing (DTP) documents describe methods of coordinating databases so that changes to any recoverable resources are committed or rolled back atomically. For example, the emerging **Transaction Demarcation API** specifies functions by which an application declares the start, commitment or rollback of a global transaction. An application may use these functions in place of the implicit start of transactions described above, and in place of *Transact*( ), in order to coordinate SQL work with non-SQL work.

EXAMPLE USAGE (C)

```
#include <sqlcli.h>
SQLRETURN   ReturnCode;
SQLHENV     EnvironmentHandle;
SQLHDBC     ConnectionHandle;
SQLSMALLINT CompletionType;
 ...
ReturnCode = SQLTransact(EnvironmentHandle, ConnectionHandle,
  CompletionType);
```

EXAMPLE USAGE (COBOL)

```
01 ENVIRONMENTHANDLE PICTURE S9(9) BINARY.
01 CONNECTIONHANDLE  PICTURE S9(9) BINARY.
01 COMPLETIONTYPE    PICTURE S9(4) BINARY.
01 RETURNCODE        PICTURE S9(4) BINARY.
 ...
CALL "SQLRTransact" USING ENVIRONMENTHANDLE, CONNECTIONHANDLE,
  COMPLETIONTYPE, RETURNCODE.
```

RELATION TO STANDARDS

This function is not present in the ISO CLI Draft International Standard, but the preferred equivalent, *EndTran*( ), is. However, the ability to specify a connection handle represents an

extension to the ISO CLI Draft International Standard, which only permits *EndTran*( ) to be applied to the entire environment.

SEE ALSO

EndTran( )

Appendix A

Diagnostic Cross-reference

This appendix lists the *Sqlstate* diagnostic codes that CLI functions can return. Notes on the various columns are as follows:

Description

The wordings in the descriptions are not normative or visible to the application. They are generally based on the ISO SQL standard but sometimes have been adapted to use X/Open terminology. A change in wording should not be construed as defining a different diagnostic from the ISO SQL standard.

Reference

The **Reference** column is meant to be a complete list of CLI functions that return a given code, for the benefit of application writers; except that for codes returned by many CLI functions, the column gives a section reference within this document instead.

Many of the diagnostics that reference *Prepare*( ) can instead be raised by *Execute*( ) in some implementations; see *Prepare*( ) on page 194 for details.

The following codes occur in the **Reference** column:

[E] The code can be returned by any function that executes an SQL statement: *ExecDirect*( ), *Execute*( ) and *ParamData*( ).

[F] The code can be returned by any function that fetches a row of a result set: *Fetch*( ) and *FetchScroll*( ).

Sqlstate	**Description**	**Reference**
'**00**000'	**Success** Not used in CLI; function returns [SQL_SUCCESS].	Section 5.1 on page 67
	Success with warning	
'**01**002'	— Disconnect error.	*Disconnect*( )
'**01**004'	— String data, right truncation.	Section 5.4.10 on page 76, *ColAttribute*( ), *DescribeCol*( ), [E], [F], *GetConnectAttr*( ), *GetCursorName*( ), *GetData*( ), *GetDescField*( ), *GetDescRec*( ), *GetEnvAttr*( ), *GetInfo*( ), *GetStmtAttr*( )
'**01**006'	— Privilege not revoked.	[E]
'**01**007'	— Privilege not granted.	[E]
'**02**000'	**No data** Not used in CLI; function returns [SQL_NO_DATA].	Section 5.1 on page 67
	Dynamic SQL error	
'**07**001'	— Parameter descriptor does not match parameter(s) in quantity or type.	[E], *PutData*( )
'**07**002'	— COUNT field incorrect.	[F]
'**07**005'	— Prepared statement not a *cursor-specification*	*ColAttribute*( ), *DescribeCol*( )
'**07**006'	— Restricted data type attribute violation.	Section 5.4.10 on page 76, *BindParam*( ), [E], [F] *GetData*( )
'**07**008'	— Invalid descriptor count.	[E], [F], *GetData*( )
'**07**009'	— Invalid descriptor index.	*BindCol*( ), *BindParam*( ), *DescribeCol*( ), *GetData*( ), *GetDescField*( ), *GetDescRec*( ), *SetDescField*( ), *SetDescRec*( )
	Connection exception	
'**08**001'	— Client unable to establish connection.	*Connect*( )
'**08**002'	— Connection name in use.	*Connect*( )
'**08**003'	— Connection does not exist.	Section 5.4.1 on page 73, *AllocHandle*( ), *FreeStmt*( ), *GetConnectAttr*( )
'**08**004'	— Server rejected the connection.	*Connect*( )
'**08**006'	— Connection failure.	Section 5.4.1 on page 73
'**08**007'	— Transaction state unknown.	Section 5.4.1 on page 73, *EndTran*( ), *Transact*( )

Sqlstate	**Description**	**Reference**
'**0A**001'	**Feature not supported** — Multiple-server transaction.	Section 5.4.2 on page 73, Section 5.4.4 on page 74, *Connect*( )
'**21**S01'	**Cardinality violation** — Insert value list does not match column list.	*ExecDirect*( ), *Prepare*( )
'**21**S02'	— Degree of derived table does not match column list.	*ExecDirect*( ), *Prepare*( )
'**22**001'	**Data exception** — String data, right truncation.	Section 5.4.10 on page 76, [E], *PutData*( )
'**22**002'	— Indicator variable required but not supplied.	[F], *GetData*( )
'**22**003'	— Numeric value out of range.	Section 5.4.10 on page 76
'**22**005'	— Error in length assignment	*ExecDirect*( ), *Execute*( )
'**22**007'	— Invalid date / time format.	Section 5.4.10 on page 76, *PutData*( )
'**22**012'	— Division by zero.	[E], [F]
'**22**018'	— Invalid character value.	Section 5.4.10 on page 76
'**23**000'	**Integrity constraint violation**	[E]
'**24**000'	**Invalid cursor state**	*Columns*( ), [E], [F], *GetTypeInfo*( ), *Prepare*( ), *SpecialColumns*( ), *Statistics*( ), *Tables*( )
'**25**000'	**Invalid transaction state**	*Disconnect*( ), Section 5.4.4 on page 74
'**25**S01'	— Transaction state unknown.	*EndTran*( ), *Transact*( )
'**25**S02'	— Transaction is still active.	*EndTran*( ), *Transact*( )
'**25**S03'	— Transaction is rolled back.	*EndTran*( ), *Transact*( )
'**28**000'	**Invalid authorisation specification**	*Connect*( )
'**2D**000'	**Invalid transaction termination**	*EndTran*( ), *Transact*( )
'**34**000'	**Invalid cursor name**	*ExecDirect*( ), *Prepare*( ), *SetCursorName*( )
'**40**000'	**Transaction rollback**	Section 5.4.4 on page 74, [F], *EndTran*( ), *Transact*( )
'**40**001'	— Serialisation failure.	[F]
'**40**003'	— Statement completion unknown.	Section 5.4.1 on page 73
'**40**500'- '**40**9ZZ'	— Implementation-defined.	Section 5.4.4 on page 74
'**40**I00'- '**40**ZZZ'	— Implementation-defined.	Section 5.4.4 on page 74

Sqlstate	**Description**	**Reference**
'**42**000'	**Syntax error or access violation**	*ExecDirect*( ), *Prepare*( )
'**42**S01'	— Base table or view already exists.*	*ExecDirect*( ), *Prepare*( )
'**42**S02'	— Base table or view not found.*	*ExecDirect*( ), *Prepare*( )
'**42**S11'	— Index already exists.*	*ExecDirect*( ), *Prepare*( )
'**42**S12'	— Index not found.*	*ExecDirect*( ), *Prepare*( )
'**42**S21'	— Column already exists.*	*ExecDirect*( ), *Prepare*( )
'**42**S22'	— Column not found.*	*ExecDirect*( ), *Prepare*( )
	CLI-specific error	
'**HY**001'	— Memory allocation error.	Section 5.4.5 on page 74
'**HY**003'	— Invalid data type in application descriptor.	*BindCol*( ), *BindParam*( ), *GetData*( )
'**HY**004'	— Invalid data type (in other context).	*BindParam*( ), *GetTypeInfo*( )
'**HY**007'	— Associated statement is not prepared.	*GetDescField*( ), *GetDescRec*( )
'**HY**008'	— Operation cancelled.	Section 5.4.6 on page 75
'**HY**009'	— Invalid use of null pointer.	Section 5.4.8 on page 75
'**HY**010'	— Function sequence error.	Appendix B
'**HY**011'	— Attribute cannot be set now.	Section 5.4.3 on page 73, *SetEnvAttr*( ), *SetStmtAttr*( ), *SetStmtOption*( )
'**HY**012'	— Invalid transaction operation code.	*EndTran*( ), *Transact*( )
'**HY**013'	— Memory management error.	Section 5.4.5 on page 74
'**HY**014'	— Limit on number of handles exceeded.	*Alloc**( )
'**HY**015'	— No cursor name available.	*GetCursorName*( )
'**HY**016'	— Cannot modify an implementation row descriptor.	*CopyDesc*( ), *SetDescField*( ), *SetDescRec*( )
'**HY**017'	— Invalid use of an automatically-allocated descriptor handle.	*FreeHandle*( ), *SetStmtAttr*( ), *SetStmtOption*( )
'**HY**018'	— Server declines cancel request.	*Cancel*( )
'**HY**019'	— Non-character data sent in pieces.	*PutData*( )
'**HY**020'	— Attempt to concatenate a null value.	*PutData*( )
'**HY**021'	— Inconsistent descriptor information.	Section 5.4.9 on page 75

* Implementations may raise '**42**000' instead of this code if, for example, the application is not entitled to obtain this metadata. The codes '**42**S*nn*' are '**S0**0*nn*' in the X/Open **SQL** specification.

Sqlstate	**Description**	**Reference**
	CLI-specific error (continued)	
'**HY**023'	— Descriptor invalid on indirect reference.	*BindCol*( ), *BindParam*( )
'**HY**024'	— Invalid attribute value.	*SetConnectAttr*( ), *SetConnectOption*( ), *SetEnvAttr*( ), *SetStmtAttr*( ), *SetStmtOption*( )
'**HY**090'	— Invalid string length or buffer length.	Section 5.4.7 on page 75, *Connect*( ), *GetData*( )
'**HY**091'	— Invalid descriptor field identifier.	*ColAttribute*( ), *GetDescField*( ), *SetDescField*( )
'**HY**092'	— Invalid attribute/option identifier.	*AllocHandle*( ), *EndTran*( ), *FreeHandle*( ), *FreeStmt*( ), *Get*Attr*( ), *Get*Option*( ), *Set*Attr*( ), *Set*Option*( ), *SpecialColumns*( ), *Statistics*( )
'**HY**096'	— Invalid information type.	*GetInfo*( )
'**HY**103'	— Invalid retrieval code.	*DataSources*( )
'**HY**104'	— Invalid *LengthPrecision* value.	*BindParam*( )
'**HY**106'	— Invalid fetch orientation.	*FetchScroll*( )
'**HY**500'- '**HY**9ZZ'	— Implementation-defined.	All
'**HY**C00'	— Optional feature not implemented.	Section 5.4.10 on page 76, *Columns*( ), *GetStmtAttr*( ), *GetStmtOption*( ), *SetStmtAttr*( ), *SetStmtOption*( ), *SpecialColumns*( ), *Statistics*( ), *Tables*( )
'**HY**I00'- '**HY**ZZZ'	— Implementation-defined.	All

Appendix B

State Tables

The two tables in this appendix show the effect of each CLI function on the states of the various CLI handles. Table B-1 on page 241 describes valid state transitions for environment handles and connection handles. Table B-2 on page 242 describes legal state transitions for statement handles.

Interpretation of the Tables

An entry under a particular state in the table asserts that it is not a sequencing error to call the CLI function from that state. (Calling the CLI function may produce some other error, as described on the appropriate reference manual page.) If the call is successful, the state table entry shows the resulting state.

Invalid State Errors

A blank entry asserts that it is a sequencing error to call the CLI function in that state. The function sets SQLSTATE to '**HY**010' (**Function sequence error**); unless a more explicit error code applies, such as '**24**000' (**Invalid cursor state**). These cases are described on the reference manual pages and the SQLSTATE value appears in Table B-2 on page 242.

A state table error could be caused by passing to a CLI function an invalid handle — a null or unallocated handle or a handle of the wrong type. In these cases, the function returns [SQL_INVALID_HANDLE]. Corresponding state table columns (describing attempted operations on an unallocated handle) have the legend INV_H.

Cancel( ) is not included in the tables because it does not cause any state transition. Its only effect is to cause the function active at the time *Cancel*( ) was called to return an error if the operation was cancelled. See *Cancel*( ) on page 105 for details.

Notation

The tables describe input to the CLI function in parentheses, even though that may not be the exact syntax used. The tables denote output from the routine, including return status, using an arrow (→) followed by the specific output.

A general state table entry (one that does not show inputs or outputs) describes all remaining cases of calls to that routine. These general entries assume the routine returns success. Calls that return failure do not make state transitions, except where described by specific state table entries.

The boldfaced headings of some state table columns, such as **prepared**, are referenced elsewhere in this specification; but the wording of these column headings is not normative.

B.1 Environment State Transitions

A CLI environment can be in one of only two states: allocated and unallocated.

In the unallocated state, the only valid function on the environment is *AllocHandle*( ) (which changes the environment's state to allocated).[25]

In the allocated state, the application can call *FreeHandle*( ), *GetEnvAttr*( ) and *SetEnvAttr*( ) on the environment. None of these changes the state of the environment except that calling *FreeHandle*( ) changes its state to unallocated.

In the allocated state, the application can also allocate connections, as described in Section B.2 on page 241.

25. As described on the reference manual page, certain calls to *AllocHandle*( ) return a restricted handle that the application can use only to obtain diagnostic information. The restricted handle is not a separate state of the environment handle, since invalid uses of the restricted handle return [SQL_INVALID_HANDLE] rather than the function sequence error '**HY**010'.

B.2 Connection State Transitions

Each connection handle can be in one of the following states:

C_0 Unallocated.

C_1 Allocated.

C_2 Allocated and connected to a database.

The initial state is C_0.

	Connection States		
	C_0	C_1	C_2
Function	**connection unallocated**	**connection allocated**	**allocated and connected**
AllocHandle(Connection)	C_1		
GetConnectAttr( ), *GetConnectOption*( ), *GetInfo*( ), *SetConnectAttr*( ), *SetConnectOption*( )	INV_H	C_1 [1]	C_2
DataSources( ), *GetEnvAttr*( ), *GetFunctions*( )	INV_H	C_1	C_2
Connect( )	INV_H	C_2	'**08**002'
AllocHandle(Descriptor), *AllocHandle*(Statement)	INV_H	'**08**003'	C_2
Disconnect( )	INV_H	'**08**003'	C_1
FreeHandle(Connection)	INV_H	C_0	

Table B-1 State Table for Connection Handles

Notes:

[1] If the operation (getting or setting the specified connection attribute, or getting the specified *GetInfo*( ) item) requires an existing connection, then a call from this connection state raises '**08**003'.

When a connection is in state C_2, the application can allocate statement handles whose states are governed by Table B-2 on page 242, and can allocate descriptor handles whose states are discussed in Section B.4 on page 245.

B.3 Statement Transitions

A statement handle (of type SQLHSTMT) can be in one of the following states:

S_0 Not allocated.

S_1 Allocated.

S_2 Prepared (whether or not the dynamic parameters are set and columns are bound).

S_3 Executed, or cursor open but not positioned on a row.

S_4 Cursor positioned on a row.

S_5 through S_7 refer to the data-at-execute dialogue and jump to the state table in Section B.3.1 on page 244.

All statement handles are initially in state S_0.

The numbers in [ ] refer to the notes following the table.

	Statement Handle States				
	S_0	S_1	S_2	S_3	S_4
Function	**not allocated**	**allocated**	**prepared**	**executed**	**cursor positioned**
AllocHandle(Statement) [1]	S_1				
SetCursorName( )	INV_H	S_1	S_2		
GetCursorName( )	INV_H	S_1	S_2	S_3	S_4
BindCol( ), *BindParam*( ) *GetStmtAttr*( ), *GetStmtOption*( ), *SetParam*( ), *SetStmtAttr*( ), *SetStmtOption*( )	INV_H	S_1	S_2	S_3	S_4
Prepare( ) [2]	INV_H	S_2	S_2	S_2[3]	'**24**000'
ColAttribute( ), *DescribeCol*( ), *NumResultCols*( )	INV_H		S_2	S_3	S_4
Execute( ) → [SQL_NEED_DATA] [5]	INV_H		S_5	S_5[3]	'**24**000'
Execute( ) [5]	INV_H		S_3	S_3[3]	'**24**000'
ExecDirect( ) → [SQL_NEED_DATA] [5]	INV_H	S_5	S_5	S_5[3]	'**24**000'
ExecDirect( ) [5]	INV_H	S_3	S_3	S_3[3]	'**24**000'
RowCount( )				S_3	S_4
Fetch( ), *FetchScroll*( )	INV_H			S_4	S_4
GetData( )	INV_H				S_4
CloseCursor( )	INV_H	S_1	S_2	S_2	S_2
Result-set Functions [4]	INV_H	S_3	S_3	S_3[3]	'**24**000'
FreeHandle(Statement)	INV_H	S_0	S_0	S_0	S_0
EndTran( ), *Transact*( ) [6]	S_0	S_1	S_1	S_1	S_1
Disconnect( ) [6]	S_0	S_0	'**25**000'	'**25**000'	'**25**000'

Table B-2 State Table for Statement Handles

Notes:

[1] The connection handle that *AllocHandle*( ) references must be in state C_2; see Table B-1 on page 241.

[2] For WHERE CURRENT OF *cursor*, the separate statement handle that was used to open *cursor* must be in state S_3 or S_4 for *Prepare*( ). After *Prepare*( ), that statement handle remains in the same state.

[3] In state S_3, a statement may be reprepared, and a CLI function that returns a result set [4] can be called, only if there are no open cursors (that is, only if any *cursor-specification* or CLI function that returns a result set [4] on the statement handle has been followed by a *CloseCursor*( )).

[4] Result-set functions include the metadata functions described in Section 4.6 on page 53 and *GetTypeInfo*( ).

[5] For WHERE CURRENT OF *cursor*, the separate statement handle that was used to open *cursor* must be in state S_4. After *Execute*( ) or *ExecDirect*( ), that statement handle remains in state S_4.

[6] These functions do not explicitly specify a statement handle. The entry for *EndTran*( ) and *Transact*( ) show state transitions for all statement handles allocated in the scope (environment or connection) specified in the call. The entry for *Disconnect*( ) (which specifies a connection) shows state transitions for all statement handles allocated on that connection.

B.3.1 Data-at-Execute Dialogue

An application may set an application parameter descriptor to declare that it will pass the actual data for one or more dynamic parameters at execute time. When an application calls *ExecDirect*( ) and *Execute*( ) and there is at least one dynamic parameter that needs data, the data-at-execute dialogue begins. (See Section 4.3.2 on page 48 for an overview.) Table B-2 on page 242 illustrates these cases by showing the return value → [SQL_NEED_DATA] and the resulting state S_5.

The following states are involved in the data-at-execute dialogue:

S_5 The application is due to call *ParamData*( ) to determine the identity of the first dynamic parameter for which data is needed.

S_6 The application is due to call *PutData*( ) to supply the first part (or all of) a dynamic argument.

S_7 The application has called *PutData*( ) at least once for the current dynamic parameter.

The initial state in this table is S_5.

The numbers in [] refer to the notes following the table.

	Statement Handle States		
	S_5	S_6	S_7
Function	**identify parameter needing data**	**provide first piece**	**other calls to** *PutData*( )
ParamData( ) → [SQL_NEED_DATA]	S_6		S_6
ParamData( )	[7]		S_4
PutData( )		S_7	S_7
Cancel( )	S_1, S_2[8]	S_1, S_2[8]	S_1, S_2[8]
Disconnect( ) [9]			

Table B-3 State Table for Statement Handles (Data-at-Execute Dialogue)

Notes:

[7] Not applicable. When called in S_5 (that is, just after *ExecDirect*( ) or *Execute*( ) returned [SQL_NEED_DATA]), *ParamData*( ) always returns [SQL_NEED_DATA].

[8] This line illustrates the use of *Cancel*( ), typically by the same application, to cancel the data-at-execute dialogue. The statement handle state reverts to the state from which it entered this table: The resulting state is S_1 (**allocated**) if it was *ExecDirect*( ) that originally returned [SQL_NEED_DATA], or S_2 (**prepared**) if it was *Execute*( ).

[9] This function does not explicitly specify a statement handle. This entry in the table illustrates that it is a state error to disconnect a connection on which there is any statement handle involved in the data-at-execute dialogue.

B.4 Descriptor State Transitions

A descriptor can be in one of only two states: allocated and unallocated.

In the unallocated state, the only valid function on the descriptor is *AllocHandle*( ) (which changes the descriptor's state to allocated).

In the allocated state, the application can call *CopyDesc*( ), *FreeHandle*( ), *GetDescField*( ), *GetDescRec*( ), *SetDescField*( ) and *SetDescRec*( ) on the descriptor. None of these changes the state of the descriptor except that calling *FreeHandle*( ) changes its state to unallocated.

Calling *Disconnect*( ) frees (changes to the unallocated state) all descriptor handles allocated on the connection.

Appendix C

Language-specific Header Files

This appendix contains the source of a C-language header file and a COBOL header file.

C.1 C-language File <sqlcli.h>

```
/* sqlcli.h  Header File for SQL CLI.
 * The actual header file must contain at least the information
 * specified here, except that the comments may vary.
 */

/* API declaration data types */
typedef unsigned char   SQLCHAR;
typedef long            SQLINTEGER;
typedef short           SQLSMALLINT;
typedef double          SQLDOUBLE;
typedef double          SQLFLOAT;
typedef float           SQLREAL;
typedef void *          SQLPOINTER;
typedef unsigned char   SQLDATE;
typedef unsigned char   SQLTIME;
typedef unsigned char   SQLTIMESTAMP;
typedef unsigned char   SQLVARCHAR;
typedef unsigned char   SQLDECIMAL;
typedef unsigned char   SQLNUMERIC;

/* function return type */
typedef SQLSMALLINT     SQLRETURN;

/* generic data structures */
typedef SQLINTEGER      SQLHENV;    /* environment handle */
typedef SQLINTEGER      SQLHDBC;    /* connection handle */
typedef SQLINTEGER      SQLHSTMT;   /* statement handle */
typedef SQLINTEGER      SQLHDESC;   /* descriptor handle */

/* special length/indicator values
 * The value of SQL_NULL_DATA, despite being a #define, should
 * not be changed; it was chosen for compatibility with the
 * ISO SQL definition of the value returned to indicate a null value.
 */
#define SQL_NULL_DATA             -1
#define SQL_DATA_AT_EXEC          -2

/* return values from functions
 * These codes, despite being #defines, should not be changed;
 * they were chosen for compatibility with the ISO SQL definition
 * of SQLCODE.
 */
#define SQL_SUCCESS                0
#define SQL_SUCCESS_WITH_INFO      1
#define SQL_NO_DATA              100
#define SQL_ERROR                 -1
#define SQL_INVALID_HANDLE        -2

#define SQL_NEED_DATA             99
```

```
/* test for SQL_SUCCESS or SQL_SUCCESS_WITH_INFO */
#define SQL_SUCCEEDED(rc) (((rc)&(~1))==0)

/* flags for null-terminated string */
#define SQL_NTS                   -3
#define SQL_NTSL                  -3L

/* maximum message length
 * Vendors may increase this constant, but its value must be at least 512.
 */
#define SQL_MAX_MESSAGE_LENGTH    512

/* maximum identifier length */
#define SQL_MAX_ID_LENGTH         18

/* date/time length constants */
#define SQL_DATE_LEN              10
#define SQL_TIME_LEN               8  /* add P+1 if precision is nonzero */
#define SQL_TIMESTAMP_LEN         19  /* add P+1 if precision is nonzero */

/* handle type identifiers */
#define SQL_HANDLE_ENV             1
#define SQL_HANDLE_DBC             2
#define SQL_HANDLE_STMT            3
#define SQL_HANDLE_DESC            4

/* environment attribute */
#define SQL_ATTR_OUTPUT_NTS    10001

/* connection attribute */
#define SQL_ATTR_AUTO_IPD      10001

/* connection and schema attributes */
#define SQL_ATTR_METADATA_ID   10014

/* statement attributes */
#define SQL_ATTR_APP_ROW_DESC       10010
#define SQL_ATTR_APP_PARAM_DESC     10011
#define SQL_ATTR_IMP_ROW_DESC       10012
#define SQL_ATTR_IMP_PARAM_DESC     10013
#define SQL_ATTR_CURSOR_SCROLLABLE  -1
#define SQL_ATTR_CURSOR_SENSITIVITY -2

/* identifiers of fields in the SQL descriptor */
#define SQL_DESC_COUNT             1001
#define SQL_DESC_TYPE              1002
#define SQL_DESC_LENGTH            1003
#define SQL_DESC_OCTET_LENGTH_PTR  1004
#define SQL_DESC_PRECISION         1005
#define SQL_DESC_SCALE             1006
#define SQL_DESC_DATETIME_INTERVAL_CODE  1007
#define SQL_DESC_NULLABLE          1008
#define SQL_DESC_INDICATOR_PTR     1009
#define SQL_DESC_DATA_PTR          1010
#define SQL_DESC_NAME              1011
#define SQL_DESC_UNNAMED           1012
#define SQL_DESC_OCTET_LENGTH      1013
#define SQL_DESC_ALLOC_TYPE        1099

/* identifiers of fields in the diagnostics area */
#define SQL_DIAG_RETURNCODE        1
#define SQL_DIAG_NUMBER            2
#define SQL_DIAG_ROW_COUNT         3
#define SQL_DIAG_SQLSTATE          4
```

```
#define SQL_DIAG_NATIVE            5
#define SQL_DIAG_MESSAGE_TEXT      6
#define SQL_DIAG_DYNAMIC_FUNCTION  7
#define SQL_DIAG_CLASS_ORIGIN      8
#define SQL_DIAG_SUBCLASS_ORIGIN   9
#define SQL_DIAG_CONNECTION_NAME  10
#define SQL_DIAG_SERVER_NAME      11
#define SQL_DIAG_DYNAMIC_FUNCTION_CODE  12

/* dynamic function codes
 * These codes, despite being #defines, should not be changed;
 * they were chosen for compatibility with the ISO SQL definition
 * of dynamic function codes.
 */
#define SQL_DIAG_ALTER_TABLE            4
#define SQL_DIAG_CREATE_INDEX          -1
#define SQL_DIAG_CREATE_TABLE          77
#define SQL_DIAG_CREATE_VIEW           84
#define SQL_DIAG_DELETE_WHERE          19
#define SQL_DIAG_DROP_INDEX            -2
#define SQL_DIAG_DROP_TABLE            32
#define SQL_DIAG_DROP_VIEW             36
#define SQL_DIAG_DYNAMIC_DELETE_CURSOR  38
#define SQL_DIAG_DYNAMIC_UPDATE_CURSOR  81
#define SQL_DIAG_GRANT                 48
#define SQL_DIAG_INSERT                50
#define SQL_DIAG_REVOKE                59
#define SQL_DIAG_SELECT_CURSOR         85
#define SQL_DIAG_UNKNOWN_STATEMENT      0
#define SQL_DIAG_UPDATE_WHERE          82

/* SQL data type codes
 * These codes, despite being #defines, should not be changed;
 * they were chosen for compatibility with the ISO SQL definition
 * of data type codes.
 */
#define SQL_CHAR            1
#define SQL_NUMERIC         2
#define SQL_DECIMAL         3
#define SQL_INTEGER         4
#define SQL_SMALLINT        5
#define SQL_FLOAT           6
#define SQL_REAL            7
#define SQL_DOUBLE          8
#define SQL_DATETIME        9
#define SQL_VARCHAR        12

/* One-parameter shortcuts for date/time data types */
#define SQL_TYPE_DATE      91
#define SQL_TYPE_TIME      92
#define SQL_TYPE_TIMESTAMP 93

/* Statement attribute values for cursor sensitivity */
#define SQL_UNSPECIFIED     0
#define SQL_INSENSITIVE     1
#define SQL_SENSITIVE       2

/* GetTypeInfo() request for all data types */
#define SQL_ALL_TYPES       0

/* Default conversion code for BindCol(), BindParam() and GetData() */
#define SQL_DEFAULT        99
```

```
/* GetData() code indicating that the application row descriptor
 * specifies the data type
 */
#define SQL_ARD_TYPE      -99

/* SQL date/time type subcodes
 * These codes, despite being #defines, should not be changed;
 * they were chosen for compatibility with the ISO SQL definition
 * of date/time type subcodes.
 */
#define SQL_CODE_DATE       1
#define SQL_CODE_TIME       2
#define SQL_CODE_TIMESTAMP  3

/* CLI option values */
#define SQL_FALSE           0
#define SQL_TRUE            1

/* values of NULLABLE field in descriptor
 * These codes, despite being #defines, should not be changed;
 * they were chosen for compatibility with the ISO SQL definition
 * of the NULLABLE descriptor field.
 */
#define SQL_NO_NULLS        0
#define SQL_NULLABLE        1

/* Value returned by GetTypeInfo() to denote that it is
 * not known whether or not a data type supports null values.
 */
#define SQL_NULLABLE_UNKNOWN  2

/* Values returned by GetTypeInfo() to show WHERE clause
 * supported
 */
#define SQL_PRED_NONE     0
#define SQL_PRED_CHAR     1
#define SQL_PRED_BASIC    2

/* values of UNNAMED field in descriptor
 * These codes, despite being #defines, should not be changed;
 * they were chosen for compatibility with the ISO SQL definition
 * of the UNNAMED descriptor field.
 */
#define SQL_NAMED           0
#define SQL_UNNAMED         1

/* values of ALLOC_TYPE field in descriptor */
#define SQL_DESC_ALLOC_AUTO 1
#define SQL_DESC_ALLOC_USER 2

/* FreeStmt() options */
#define SQL_CLOSE           0
#define SQL_DROP            1
#define SQL_UNBIND          2
#define SQL_RESET_PARAMS    3

/* Codes used for FetchOrientation in FetchScroll(), and in DataSources() */
#define SQL_FETCH_NEXT      1
#define SQL_FETCH_FIRST     2

/* Other codes used for FetchOrientation in FetchScroll() */
#define SQL_FETCH_LAST      3
#define SQL_FETCH_PRIOR     4
#define SQL_FETCH_ABSOLUTE  5
```

```
#define SQL_FETCH_RELATIVE  6

/* EndTran() options */
#define SQL_COMMIT          0
#define SQL_ROLLBACK        1

/* null handles returned by AllocHandle() */
#define SQL_NULL_HENV       0
#define SQL_NULL_HDBC       0
#define SQL_NULL_HSTMT      0
#define SQL_NULL_HDESC      0

/* null handle used in place of parent handle when allocating HENV */
#define SQL_NULL_HANDLE     0L

/* Values that may appear in the result set of SpecialColumns() */
#define SQL_SCOPE_CURROW    0
#define SQL_SCOPE_TRANSACTION 1
#define SQL_SCOPE_SESSION   2

#define SQL_PC_UNKNOWN      0
#define SQL_PC_NON_PSEUDO   1
#define SQL_PC_PSEUDO       2

/* Reserved value for the IdentifierType argument of SpecialColumns() */
#define SQL_ROW_IDENTIFIER  1

/* Reserved values for UNIQUE argument of Statistics() */
#define SQL_INDEX_UNIQUE    0
#define SQL_INDEX_ALL       1

/* Values that may appear in the result set of Statistics() */
#define SQL_INDEX_CLUSTERED 1
#define SQL_INDEX_HASHED    2
#define SQL_INDEX_OTHER     3

/* GetFunctions() values to identify CLI functions */
#define SQL_API_SQLALLOCCONNECT          1
#define SQL_API_SQLALLOCENV              2
#define SQL_API_SQLALLOCHANDLE        1001
#define SQL_API_SQLALLOCSTMT             3
#define SQL_API_SQLBINDCOL               4
#define SQL_API_SQLBINDPARAM            22
#define SQL_API_SQLCANCEL                5
#define SQL_API_SQLCLOSECURSOR        1003
#define SQL_API_SQLCOLATTRIBUTE          6
#define SQL_API_SQLCOLUMNS              40
#define SQL_API_SQLCONNECT               7
#define SQL_API_SQLCOPYDESC           1004
#define SQL_API_SQLDATASOURCES          57
#define SQL_API_SQLDESCRIBECOL           8
#define SQL_API_SQLDISCONNECT            9
#define SQL_API_SQLENDTRAN            1005
#define SQL_API_SQLERROR                10
#define SQL_API_SQLEXECDIRECT           11
#define SQL_API_SQLEXECUTE              12
#define SQL_API_SQLFETCH                13
#define SQL_API_SQLFETCHSCROLL        1021
#define SQL_API_SQLFREECONNECT          14
#define SQL_API_SQLFREEENV              15
#define SQL_API_SQLFREEHANDLE         1006
#define SQL_API_SQLFREESTMT             16
#define SQL_API_SQLGETCONNECTATTR     1007
```

```
#define SQL_API_SQLGETCONNECTOPTION     42
#define SQL_API_SQLGETCURSORNAME        17
#define SQL_API_SQLGETDATA              43
#define SQL_API_SQLGETDESCFIELD       1008
#define SQL_API_SQLGETDESCREC         1009
#define SQL_API_SQLGETDIAGFIELD       1010
#define SQL_API_SQLGETDIAGREC         1011
#define SQL_API_SQLGETENVATTR         1012
#define SQL_API_SQLGETFUNCTIONS         44
#define SQL_API_SQLGETINFO              45
#define SQL_API_SQLGETSTMTATTR        1014
#define SQL_API_SQLGETSTMTOPTION        46
#define SQL_API_SQLGETTYPEINFO          47
#define SQL_API_SQLLANGUAGES          2001
#define SQL_API_SQLNUMRESULTCOLS        18
#define SQL_API_SQLPARAMDATA            48
#define SQL_API_SQLPREPARE              19
#define SQL_API_SQLPUTDATA              49
#define SQL_API_SQLRELEASEENV         1015
#define SQL_API_SQLROWCOUNT             20
#define SQL_API_SQLSERVERINFO         2002
#define SQL_API_SQLSETCONNECTATTR     1016
#define SQL_API_SQLSETCONNECTOPTION     50
#define SQL_API_SQLSETCURSORNAME        21
#define SQL_API_SQLSETDESCFIELD       1017
#define SQL_API_SQLSETDESCREC         1018
#define SQL_API_SQLSETENVATTR         1019
#define SQL_API_SQLSETPARAM             22
#define SQL_API_SQLSETSTMTATTR        1020
#define SQL_API_SQLSETSTMTOPTION        51
#define SQL_API_SQLSPECIALCOLUMNS       52
#define SQL_API_SQLSTATISTICS           53
#define SQL_API_SQLTABLES               54
#define SQL_API_SQLTRANSACT             23

/* Information requested by GetInfo() */
#define SQL_MAX_DRIVER_CONNECTIONS            0
#define SQL_MAX_CONCURRENT_ACTIVITIES         1
#define SQL_DATA_SOURCE_NAME                  2
#define SQL_FETCH_DIRECTION                   8
#define SQL_SERVER_NAME                      13
#define SQL_SEARCH_PATTERN_ESCAPE            14
#define SQL_DBMS_NAME                        17
#define SQL_DBMS_VER                         18
#define SQL_ACCESSIBLE_TABLES                19
#define SQL_CURSOR_COMMIT_BEHAVIOR           23
#define SQL_DATA_SOURCE_READ_ONLY            25
#define SQL_DEFAULT_TXN_ISOLATION            26
#define SQL_IDENTIFIER_CASE                  28
#define SQL_IDENTIFIER_QUOTE_CHAR            29
#define SQL_MAX_COLUMN_NAME_LEN              30
#define SQL_MAX_CURSOR_NAME_LEN              31
#define SQL_MAX_SCHEMA_NAME_LEN              32
#define SQL_MAX_CATALOG_NAME_LEN             34
#define SQL_MAX_TABLE_NAME_LEN               35
#define SQL_SCROLL_CONCURRENCY               43
#define SQL_TXN_CAPABLE                      46
#define SQL_USER_NAME                        47
#define SQL_TXN_ISOLATION_OPTION             72
```

```
#define SQL_INTEGRITY                        73
#define SQL_GETDATA_EXTENSIONS               81
#define SQL_NULL_COLLATION                   85
#define SQL_ALTER_TABLE                      86
#define SQL_ORDER_BY_COLUMNS_IN_SELECT       90
#define SQL_SPECIAL_CHARACTERS               94
#define SQL_MAX_COLUMNS_IN_GROUP_BY          97
#define SQL_MAX_COLUMNS_IN_INDEX             98
#define SQL_MAX_COLUMNS_IN_ORDER_BY          99
#define SQL_MAX_COLUMNS_IN_SELECT           100
#define SQL_MAX_COLUMNS_IN_TABLE            101
#define SQL_MAX_INDEX_SIZE                  102
#define SQL_MAX_ROW_SIZE                    104
#define SQL_MAX_STATEMENT_LEN               105
#define SQL_MAX_TABLES_IN_SELECT            106
#define SQL_MAX_USER_NAME_LEN               107
#define SQL_OJ_CAPABILITIES                 115
#define SQL_XOPEN_CLI_YEAR                10000
#define SQL_CURSOR_SENSITIVITY            10001
#define SQL_DESCRIBE_PARAMETER            10002
#define SQL_CATALOG_NAME                  10003
#define SQL_COLLATION_SEQ                 10004
#define SQL_MAX_IDENTIFIER_LEN            10005

/* SQL_ALTER_TABLE  bitmasks */
#define SQL_AT_ADD_COLUMN                    0x00000001L
#define SQL_AT_DROP_COLUMN                   0x00000002L
#define SQL_AT_ALTER_COLUMN                  0x00000004L
#define SQL_AT_ADD_CONSTRAINT                0x00000008L
#define SQL_AT_DROP_CONSTRAINT               0x00000010L

/* SQL_CURSOR_COMMIT_BEHAVIOR  values */
#define SQL_CB_DELETE                                0
#define SQL_CB_CLOSE                                 1
#define SQL_CB_PRESERVE                              2

/* SQL_FETCH_DIRECTION  bitmasks */
#define SQL_FD_FETCH_NEXT                  0x00000001L
#define SQL_FD_FETCH_FIRST                 0x00000002L
#define SQL_FD_FETCH_LAST                  0x00000004L
#define SQL_FD_FETCH_PRIOR                 0x00000008L
#define SQL_FD_FETCH_ABSOLUTE              0x00000010L
#define SQL_FD_FETCH_RELATIVE              0x00000020L

/* SQL_GETDATA_EXTENSIONS  bitmasks */
#define SQL_GD_ANY_COLUMN                  0x00000001L
#define SQL_GD_ANY_ORDER                   0x00000002L

/* SQL_IDENTIFIER_CASE  values */
#define SQL_IC_UPPER                                 1
#define SQL_IC_LOWER                                 2
#define SQL_IC_SENSITIVE                             3
#define SQL_IC_MIXED                                 4

/* SQL_OJ_CAPABILITIES  bitmasks */
#define SQL_OJ_LEFT                        0x00000001L
#define SQL_OJ_RIGHT                       0x00000002L
#define SQL_OJ_FULL                        0x00000004L
#define SQL_OJ_NESTED                      0x00000008L
#define SQL_OJ_NOT_ORDERED                 0x00000010L
#define SQL_OJ_INNER                       0x00000020L
#define SQL_OJ_ALL_COMPARISON_OPS          0x00000040L
```

```
/* SQL_SCROLL_CONCURRENCY bitmasks */
#define SQL_SCCO_READ_ONLY                  0x00000001L
#define SQL_SCCO_LOCK                       0x00000002L
#define SQL_SCCO_OPT_ROWVER                 0x00000004L
#define SQL_SCCO_OPT_VALUES                 0x00000008L

/* SQL_TXN_CAPABLE values */
#define SQL_TC_NONE                                  0
#define SQL_TC_DML                                   1
#define SQL_TC_ALL                                   2
#define SQL_TC_DDL_COMMIT                            3
#define SQL_TC_DDL_IGNORE                            4

/* SQL_TXN_ISOLATION_OPTION bitmasks */
#define SQL_TXN_READ_UNCOMMITTED            0x00000001L
#define SQL_TXN_READ_COMMITTED              0x00000002L
#define SQL_TXN_REPEATABLE_READ             0x00000004L
#define SQL_TXN_SERIALIZABLE                0x00000008L

SQLRETURN  SQLAllocConnect(SQLHENV EnvironmentHandle,
           SQLHDBC *ConnectionHandle);

SQLRETURN  SQLAllocEnv(SQLHENV *EnvironmentHandle);

SQLRETURN  SQLAllocHandle(SQLSMALLINT HandleType,
           SQLINTEGER InputHandle, SQLINTEGER *OutputHandle);

SQLRETURN  SQLAllocStmt(SQLHDBC ConnectionHandle,
           SQLHSTMT *StatementHandle);

SQLRETURN  SQLBindCol(SQLHSTMT StatementHandle, SQLSMALLINT ColumnNumber,
           SQLSMALLINT TargetType, SQLPOINTER TargetValue,
           SQLINTEGER BufferLength, SQLINTEGER *StrLen_or_Ind);

SQLRETURN  SQLBindParam(SQLHSTMT StatementHandle,
           SQLSMALLINT ParameterNumber, SQLSMALLINT ValueType,
           SQLSMALLINT ParameterType, SQLINTEGER LengthPrecision,
           SQLSMALLINT ParameterScale, SQLPOINTER ParameterValue,
           SQLINTEGER *StrLen_or_Ind);

SQLRETURN  SQLCancel(SQLHSTMT StatementHandle);

SQLRETURN  SQLCloseCursor(SQLHSTMT StatementHandle);

SQLRETURN  SQLColAttribute (SQLHSTMT StatementHandle,
           SQLSMALLINT ColumnNumber, SQLSMALLINT FieldIdentifier,
           SQLPOINTER CharacterAttribute, SQLSMALLINT BufferLength,
           SQLSMALLINT *StringLength, SQLPOINTER NumericAttribute);

SQLRETURN  SQLColumns(SQLHSTMT StatementHandle,
           SQLCHAR *CatalogName, SQLSMALLINT NameLength1,
           SQLCHAR *SchemaName, SQLSMALLINT NameLength2,
           SQLCHAR *TableName, SQLSMALLINT NameLength3,
           SQLCHAR *ColumnName, SQLSMALLINT NameLength4);

SQLRETURN  SQLConnect(SQLHDBC ConnectionHandle,
           SQLCHAR *ServerName, SQLSMALLINT NameLength1,
           SQLCHAR *UserName, SQLSMALLINT NameLength2,
           SQLCHAR *Authentication, SQLSMALLINT NameLength3);

SQLRETURN  SQLCopyDesc(SQLHDESC SourceDescHandle,
           SQLHDESC TargetDescHandle);

SQLRETURN  SQLDataSources(SQLHENV EnvironmentHandle,
           SQLSMALLINT Direction, SQLCHAR *ServerName,
           SQLSMALLINT BufferLength1, SQLSMALLINT *NameLength1,
```

```
            SQLCHAR *Description, SQLSMALLINT BufferLength2,
            SQLSMALLINT *NameLength2);

SQLRETURN   SQLDescribeCol(SQLHSTMT StatementHandle,
            SQLSMALLINT ColumnNumber, SQLCHAR *ColumnName,
            SQLSMALLINT BufferLength, SQLSMALLINT *NameLength,
            SQLSMALLINT *DataType, SQLINTEGER *ColumnSize,
            SQLSMALLINT *DecimalDigits, SQLSMALLINT *Nullable);

SQLRETURN   SQLDisconnect(SQLHDBC ConnectionHandle);

SQLRETURN   SQLEndTran(SQLSMALLINT HandleType, SQLINTEGER Handle,
            SQLSMALLINT CompletionType);

SQLRETURN   SQLError(SQLHENV EnvironmentHandle,
            SQLHDBC ConnectionHandle, SQLHSTMT StatementHandle,
            SQLCHAR *Sqlstate, SQLINTEGER *NativeError,
            SQLCHAR *MessageText, SQLSMALLINT BufferLength,
            SQLSMALLINT *TextLength);

SQLRETURN   SQLExecDirect(SQLHSTMT StatementHandle,
            SQLCHAR *StatementText, SQLINTEGER TextLength);

SQLRETURN   SQLExecute(SQLHSTMT StatementHandle);

SQLRETURN   SQLFetch(SQLHSTMT StatementHandle);

SQLRETURN   SQLFetchScroll(SQLHSTMT StatementHandle,
            SQLSMALLINT FetchOrientation, SQLINTEGER FetchOffset);

SQLRETURN   SQLFreeConnect(SQLHDBC ConnectionHandle);

SQLRETURN   SQLFreeEnv(SQLHENV EnvironmentHandle);

SQLRETURN   SQLFreeHandle(SQLSMALLINT HandleType, SQLINTEGER Handle);

SQLRETURN   SQLFreeStmt(SQLHSTMT StatementHandle,
            SQLSMALLINT Option);

SQLRETURN   SQLGetConnectAttr(SQLHDBC ConnectionHandle,
            SQLINTEGER Attribute, SQLPOINTER Value,
            SQLINTEGER BufferLength, SQLINTEGER *StringLength);

SQLRETURN   SQLGetConnectOption(SQLHDBC ConnectionHandle,
            SQLSMALLINT Option, SQLPOINTER Value);

SQLRETURN   SQLGetCursorName(SQLHSTMT StatementHandle,
            SQLCHAR *CursorName, SQLSMALLINT BufferLength,
            SQLSMALLINT *NameLength);

SQLRETURN   SQLGetData(SQLHSTMT StatementHandle,
            SQLSMALLINT ColumnNumber, SQLSMALLINT TargetType,
            SQLPOINTER TargetValue, SQLINTEGER BufferLength,
            SQLINTEGER *StrLen_or_Ind);

SQLRETURN   SQLGetDescField(SQLHDESC DescriptorHandle,
            SQLSMALLINT RecNumber, SQLSMALLINT FieldIdentifier,
            SQLPOINTER Value, SQLINTEGER BufferLength,
            SQLINTEGER *StringLength);

SQLRETURN   SQLGetDescRec(SQLHDESC DescriptorHandle,
            SQLSMALLINT RecNumber, SQLCHAR *Name,
            SQLSMALLINT BufferLength, SQLSMALLINT *StringLength,
            SQLSMALLINT *Type, SQLSMALLINT *SubType, SQLINTEGER *Length,
            SQLSMALLINT *Precision, SQLSMALLINT *Scale,
            SQLSMALLINT *Nullable);
```

```
SQLRETURN  SQLGetDiagField(SQLSMALLINT  HandleType, SQLINTEGER Handle,
           SQLSMALLINT RecNumber, SQLSMALLINT DiagIdentifier,
           SQLPOINTER DiagInfo, SQLSMALLINT BufferLength,
           SQLSMALLINT *StringLength);

SQLRETURN  SQLGetDiagRec(SQLSMALLINT  HandleType, SQLINTEGER Handle,
           SQLSMALLINT RecNumber, SQLCHAR *Sqlstate,
           SQLINTEGER *NativeError, SQLCHAR *MessageText,
           SQLSMALLINT BufferLength, SQLSMALLINT *TextLength);

SQLRETURN  SQLGetEnvAttr(SQLHENV  EnvironmentHandle,
           SQLINTEGER Attribute, SQLPOINTER Value,
           SQLINTEGER BufferLength, SQLINTEGER *StringLength);

SQLRETURN  SQLGetFunctions(SQLHDBC  ConnectionHandle,
           SQLSMALLINT FunctionId, SQLSMALLINT *Supported);

SQLRETURN  SQLGetInfo(SQLHDBC ConnectionHandle,
           SQLSMALLINT InfoType, SQLPOINTER InfoValue,
           SQLSMALLINT BufferLength, SQLSMALLINT *StringLength);

SQLRETURN  SQLGetStmtAttr(SQLHSTMT  StatementHandle,
           SQLINTEGER Attribute, SQLPOINTER Value,
           SQLINTEGER BufferLength, SQLINTEGER *StringLength);

SQLRETURN  SQLGetStmtOption(SQLHSTMT  StatementHandle,
           SQLSMALLINT Option, SQLPOINTER Value);

SQLRETURN  SQLGetTypeInfo(SQLSTMT  StatementHandle,
           SQLSMALLINT DataType);

SQLRETURN  SQLNumResultCols(SQLHSTMT  StatementHandle,
           SQLSMALLINT *ColumnCount);

SQLRETURN  SQLParamData(SQLSTMT  StatementHandle,
           SQLPOINTER *Value);

SQLRETURN  SQLPrepare(SQLHSTMT  StatementHandle,
           SQLCHAR *StatementText, SQLINTEGER TextLength);

SQLRETURN  SQLPutData(SQLSTMT  StatementHandle,
           SQLPOINTER Data, SQLINTEGER StrLen_or_Ind);

SQLRETURN  SQLRowCount(SQLHSTMT  StatementHandle, SQLINTEGER *RowCount);

SQLRETURN  SQLSetConnectAttr(SQLHDBC  ConnectionHandle,
           SQLINTEGER Attribute, SQLPOINTER Value,
           SQLINTEGER StringLength);

SQLRETURN  SQLSetConnectOption(SQLHDBC  ConnectionHandle,
           SQLSMALLINT Option, SQLPOINTER Value);

SQLRETURN  SQLSetCursorName(SQLHSTMT  StatementHandle,
           SQLCHAR *CursorName, SQLSMALLINT NameLength);

SQLRETURN  SQLSetDescField(SQLHDESC  DescriptorHandle,
           SQLSMALLINT RecNumber, SQLSMALLINT FieldIdentifier,
           SQLPOINTER Value, SQLINTEGER BufferLength);

SQLRETURN  SQLSetDescRec(SQLHDESC  DescriptorHandle,
           SQLSMALLINT RecNumber, SQLSMALLINT Type,
           SQLSMALLINT SubType, SQLINTEGER Length,
           SQLSMALLINT Precision, SQLSMALLINT Scale,
           SQLPOINTER Data, SQLINTEGER *StringLength,
           SQLSMALLINT *Indicator);

SQLRETURN  SQLSetEnvAttr(SQLHENV  EnvironmentHandle,
           SQLINTEGER Attribute, SQLPOINTER Value,
```

```
            SQLINTEGER StringLength);

#define     SQLSetParam    SQLBindParam

SQLRETURN   SQLSetStmtAttr(SQLHSTMT  StatementHandle,
            SQLINTEGER Attribute, SQLPOINTER Value,
            SQLINTEGER StringLength);

SQLRETURN   SQLSetStmtOption(SQLHSTMT  StatementHandle,
            SQLSMALLINT Option, SQLPOINTER Value);

SQLRETURN   SQLSpecialColumns(SQLSTMT  StatementHandle,
            SQLSMALLINT IdentifierType, SQLCHAR *CatalogName,
            SQLSMALLINT NameLength1, SQLCHAR *SchemaName,
            SQLSMALLINT NameLength2, SQLCHAR *TableName,
            SQLSMALLINT NameLength3, SQLSMALLINT Scope,
            SQLSMALLINT Nullable);

SQLRETURN   SQLStatistics(SQLSTMT  StatementHandle,
            SQLCHAR *CatalogName, SQLSMALLINT NameLength1,
            SQLCHAR *SchemaName, SQLSMALLINT NameLength2,
            SQLCHAR *TableName, SQLSMALLINT NameLength3,
            SQLSMALLINT Unique, SQLSMALLINT Reserved);

SQLRETURN   SQLTables(SQLHSTMT  StatementHandle,
            SQLCHAR *CatalogName, SQLSMALLINT NameLength1,
            SQLCHAR *SchemaName, SQLSMALLINT NameLength2,
            SQLCHAR *TableName, SQLSMALLINT NameLength3,
            SQLCHAR *TableType, SQLSMALLINT NameLength4);

SQLRETURN   SQLTransact(SQLHENV  EnvironmentHandle,
            SQLHDBC ConnectionHandle, SQLSMALLINT CompletionType);
```

C.2 COBOL File SQLCLI.CBH

COBOL applications include the typical header file **SQLCLI.CBH** by containing the following statement:

```
COPY SQLCLI.CBH
```

The following file does not include prototypes of the CLI functions because COBOL applications are not required to specify them.

```
* SPECIAL LENGTH/INDICATOR VALUES
01 SQL-NULL-DATA             PIC S9(9) BINARY VALUE IS -1.
01 SQL-DATA-AT-EXEC          PIC S9(9) BINARY VALUE IS -2.

* RETURN VALUES FROM FUNCTIONS
01 SQL-SUCCESS               PIC S9(4) BINARY VALUE IS 0.
01 SQL-SUCCESS-WITH-INFO     PIC S9(4) BINARY VALUE IS 1.
01 SQL-NO-DATA               PIC S9(4) BINARY VALUE IS 100.
01 SQL-ERROR                 PIC S9(4) BINARY VALUE IS -1.
01 SQL-INVALID-HANDLE        PIC S9(4) BINARY VALUE IS -2.
01 SQL-NEED-DATA             PIC S9(4) BINARY VALUE IS 99.

* FLAGS FOR NULL-TERMINATED STRING
01 SQL-NTS                   PIC S9(4) BINARY VALUE IS -3.
01 SQL-NTSL                  PIC S9(9) BINARY VALUE IS -3.

* MAXIMUM MESSAGE LENGTH
* VENDORS MAY INCREASE THIS CONSTANT, BUT ITS VALUE MUST BE AT LEAST 512.
01 SQL-MAX-MESSAGE-LENGTH    PIC S9(4) BINARY VALUE IS 512.

* MAXIMUM IDENTIFIER LENGTH
01 SQL-MAX-ID-LENGTH         PIC S9(4) BINARY VALUE IS 18.

* DATE/TIME LENGTH CONSTANTS
* ADD P+1 FOR TIME AND TIMESTAMP IF PRECISION IS NONZERO
01 SQL-DATE-LEN              PIC S9(4) BINARY VALUE IS 10.
01 SQL-TIME-LEN              PIC S9(4) BINARY VALUE IS 8.
01 SQL-TIMESTAMP-LEN         PIC S9(4) BINARY VALUE IS 19.

* ENVIRONMENT ATTRIBUTE
01 SQL-ATTR-OUTPUT-NTS       PIC S9(9) BINARY VALUE IS 10001.
01 SQL-OPT-OUTPUT-NTS        PIC S9(4) BINARY VALUE IS 10001.

* CONNECTION ATTRIBUTE
01 SQL-ATTR-AUTO-IPD         PIC S9(9) BINARY VALUE IS 10001.
01 SQL-OPT-AUTO-IPD          PIC S9(4) BINARY VALUE IS 10001.

* CONNECTION AND STATEMENT ATTRIBUTES
01  SQL-ATTR-METADATA-ID     PIC S9(9) BINARY VALUE IS 10014.

* HANDLE TYPE IDENTIFIERS
01 SQL-HANDLE-ENV            PIC S9(4) BINARY VALUE IS 1.
01 SQL-HANDLE-DBC            PIC S9(4) BINARY VALUE IS 2.
01 SQL-HANDLE-STMT           PIC S9(4) BINARY VALUE IS 3.
01 SQL-HANDLE-DESC           PIC S9(4) BINARY VALUE IS 4.

* STATEMENT ATTRIBUTES
01 SQL-ATTR-APP-ROW-DESC       PIC S9(9) BINARY VALUE IS 10010.
01 SQL-ATTR-APP-PARAM-DESC     PIC S9(9) BINARY VALUE IS 10011.
01 SQL-ATTR-IMP-ROW-DESC       PIC S9(9) BINARY VALUE IS 10012.
01 SQL-ATTR-IMP-PARAM-DESC     PIC S9(9) BINARY VALUE IS 10013.
01 SQL-ATTR-CURSOR-SCROLLABLE  PIC S9(9) BINARY VALUE IS -1.
01 SQL-ATTR-CURSOR-SENSITIVITY PIC S9(9) BINARY VALUE IS -2.
01 SQL-OPT-APP-ROW-DESC        PIC S9(4) BINARY VALUE IS 10010.
```

```
01 SQL-OPT-APP-PARAM-DESC      PIC S9(4) BINARY VALUE IS 10011.
01 SQL-OPT-IMP-ROW-DESC        PIC S9(4) BINARY VALUE IS 10012.
01 SQL-OPT-IMP-PARAM-DESC      PIC S9(4) BINARY VALUE IS 10013.
01 SQL-OPT-CURSOR-SCROLLABLE   PIC S9(4) BINARY VALUE IS -1.
01 SQL-OPT-CURSOR-SENSITIVITY  PIC S9(4) BINARY VALUE IS -2.

* IDENTIFIERS OF FIELDS IN THE SQL DESCRIPTOR
01 SQL-DESC-COUNT             PIC S9(4) BINARY VALUE IS 1001.
01 SQL-DESC-TYPE              PIC S9(4) BINARY VALUE IS 1002.
01 SQL-DESC-LENGTH            PIC S9(4) BINARY VALUE IS 1003.
01 SQL-DESC-OCTET-LENGTH-PTR  PIC S9(4) BINARY VALUE IS 1004.
01 SQL-DESC-PRECISION         PIC S9(4) BINARY VALUE IS 1005.
01 SQL-DESC-SCALE             PIC S9(4) BINARY VALUE IS 1006.
01 SQL-DESC-DATETIME-INTERVAL-CODE  PIC S9(4) BINARY VALUE IS 1007.
01 SQL-DESC-NULLABLE          PIC S9(4) BINARY VALUE IS 1008.
01 SQL-DESC-INDICATOR-PTR     PIC S9(4) BINARY VALUE IS 1009.
01 SQL-DESC-DATA-PTR          PIC S9(4) BINARY VALUE IS 1010.
01 SQL-DESC-NAME              PIC S9(4) BINARY VALUE IS 1011.
01 SQL-DESC-UNNAMED           PIC S9(4) BINARY VALUE IS 1012.
01 SQL-DESC-OCTET-LENGTH      PIC S9(4) BINARY VALUE IS 1013.
01 SQL-DESC-ALLOC-TYPE        PIC S9(4) BINARY VALUE IS 1099.

* IDENTIFIERS OF FIELDS IN THE DIAGNOSTICS AREA
01 SQL-DIAG-RETURNCODE        PIC S9(4) BINARY VALUE IS 1.
01 SQL-DIAG-NUMBER            PIC S9(4) BINARY VALUE IS 2.
01 SQL-DIAG-ROW-COUNT         PIC S9(4) BINARY VALUE IS 3.
01 SQL-DIAG-SQLSTATE          PIC S9(4) BINARY VALUE IS 4.
01 SQL-DIAG-NATIVE            PIC S9(4) BINARY VALUE IS 5.
01 SQL-DIAG-MESSAGE-TEXT      PIC S9(4) BINARY VALUE IS 6.
01 SQL-DIAG-DYNAMIC-FUNCTION  PIC S9(4) BINARY VALUE IS 7.
01 SQL-DIAG-CLASS-ORIGIN      PIC S9(4) BINARY VALUE IS 8.
01 SQL-DIAG-SUBCLASS-ORIGIN   PIC S9(4) BINARY VALUE IS 9.
01 SQL-DIAG-CONNECTION-NAME   PIC S9(4) BINARY VALUE IS 10.
01 SQL-DIAG-SERVER-NAME       PIC S9(4) BINARY VALUE IS 11.
01 SQL-DIAG-DYNAMIC-FUNCTION-CODE  PIC S9(4) BINARY VALUE IS 12.

* DYNAMIC FUNCTION CODES
01 SQL-DIAG-ALTER-TABLE           PIC S9(9) BINARY VALUE IS  4.
01 SQL-DIAG-CREATE-INDEX          PIC S9(9) BINARY VALUE IS -1.
01 SQL-DIAG-CREATE-TABLE          PIC S9(9) BINARY VALUE IS 77.
01 SQL-DIAG-CREATE-VIEW           PIC S9(9) BINARY VALUE IS 84.
01 SQL-DIAG-DELETE-WHERE          PIC S9(9) BINARY VALUE IS 19.
01 SQL-DIAG-DROP-INDEX            PIC S9(9) BINARY VALUE IS -2.
01 SQL-DIAG-DROP-TABLE            PIC S9(9) BINARY VALUE IS 32.
01 SQL-DIAG-DROP-VIEW             PIC S9(9) BINARY VALUE IS 36.
01 SQL-DIAG-DYNAMIC-DELETE-CURSOR  PIC S9(9) BINARY VALUE IS 38.
01 SQL-DIAG-DYNAMIC-UPDATE-CURSOR  PIC S9(9) BINARY VALUE IS 81.
01 SQL-DIAG-GRANT                 PIC S9(9) BINARY VALUE IS 48.
01 SQL-DIAG-INSERT                PIC S9(9) BINARY VALUE IS 50.
01 SQL-DIAG-REVOKE                PIC S9(9) BINARY VALUE IS 59.
01 SQL-DIAG-SELECT-CURSOR         PIC S9(9) BINARY VALUE IS 85.
01 SQL-DIAG-UNKNOWN-STATEMENT     PIC S9(9) BINARY VALUE IS  0.
01 SQL-DIAG-UPDATE-WHERE          PIC S9(9) BINARY VALUE IS 82.

* SQL DATA TYPE CODES
01 SQL-CHAR                   PIC S9(4) BINARY VALUE IS 1.
01 SQL-NUMERIC                PIC S9(4) BINARY VALUE IS 2.
01 SQL-DECIMAL                PIC S9(4) BINARY VALUE IS 3.
01 SQL-INTEGER                PIC S9(4) BINARY VALUE IS 4.
01 SQL-SMALLINT               PIC S9(4) BINARY VALUE IS 5.
01 SQL-FLOAT                  PIC S9(4) BINARY VALUE IS 6.
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```
01 SQL-REAL                  PIC S9(4) BINARY VALUE IS 7.
01 SQL-DOUBLE                PIC S9(4) BINARY VALUE IS 8.
01 SQL-DATETIME              PIC S9(4) BINARY VALUE IS 9.
01 SQL-VARCHAR               PIC S9(4) BINARY VALUE IS 12.

* ONE-PARAMETER SHORTCUTS FOR DATE/TIME DATA TYPES
01 SQL-TYPE-DATE             PIC S9(4) BINARY VALUE IS 91.
01 SQL-TYPE-TIME             PIC S9(4) BINARY VALUE IS 92.
01 SQL-TYPE-TIMESTAMP        PIC S9(4) BINARY VALUE IS 93.

* STATEMENT ATTRIBUTE VALUES FOR CURSOR SENSITIVITY
01 SQL-UNSPECIFIED           PIC S9(9) BINARY VALUE IS 0.
01 SQL-INSENSITIVE           PIC S9(9) BINARY VALUE IS 1.
01 SQL-SENSITIVE             PIC S9(9) BINARY VALUE IS 2.

* SQLRGETTYPEINFO() REQUEST FOR ALL DATA TYPES
01 SQL-ALL-TYPES             PIC S9(4) BINARY VALUE IS 0.

* DEFAULT CONVERSION CODE FOR SQLRBINDCOL() AND SQLRBINDPARAM()
01 SQL-DEFAULT               PIC S9(4) BINARY VALUE IS 99.

* SQLRGETDATA() CODE INDICATING THAT APPLICATION ROW DESCRIPTOR
* SPECIFIES THE DATA TYPE
01 SQL-ARD-TYPE              PIC S9(4) BINARY VALUE IS -99.

* DATE/TIME TYPE SUBCODES
01 SQL-CODE-DATE             PIC S9(4) BINARY VALUE IS 1.
01 SQL-CODE-TIME             PIC S9(4) BINARY VALUE IS 2.
01 SQL-CODE-TIMESTAMP        PIC S9(4) BINARY VALUE IS 3.

* CLI OPTION VALUES
01 SQL-FALSE                 PIC S9(4) BINARY VALUE IS 0.
01 SQL-FALSEL                PIC S9(9) BINARY VALUE IS 0.
01 SQL-TRUE                  PIC S9(4) BINARY VALUE IS 1.
01 SQL-TRUEL                 PIC S9(9) BINARY VALUE IS 1.

* VALUES OF NULLABLE FIELD IN DESCRIPTOR
01 SQL-NO-NULLS              PIC S9(4) BINARY VALUE IS 0.
01 SQL-NULLABLE              PIC S9(4) BINARY VALUE IS 1.

*VALUE RETURNED BY SQLRGETTYPEINFO() TO DENOTE THAT IT IS
*NOT KNOWN WHETHER OR NOT A DATA TYPE SUPPORTS NULL VALUES.
01 SQL-NULLABLE-UNKNOWN      PIC S9(4) BINARY VALUE IS 2.

*VALUES RETURNED BY SQLRGETTYPEINFO() TO SHOW SUPPORT IN
*WHERE CLAUSE
01 SQL-PRED-NONE             PIC S9(4) BINARY VALUE IS 0.
01 SQL-PRED-CHAR             PIC S9(4) BINARY VALUE IS 1.
01 SQL-PRED-BASIC            PIC S9(4) BINARY VALUE IS 2.

* VALUES OF UNNAMED FIELD IN DESCRIPTOR
01 SQL-NAMED                 PIC S9(4) BINARY VALUE IS 0.
01 SQL-UNNAMED               PIC S9(4) BINARY VALUE IS 1.

* VALUES OF ALLOC-TYPE FIELD IN DESCRIPTOR
01 SQL-DESC-ALLOC-AUTO       PIC S9(4) BINARY VALUE IS 1.
01 SQL-DESC-ALLOC-USER       PIC S9(4) BINARY VALUE IS 2.

* SQLRFREESTMT OPTIONS
01 SQL-CLOSE                 PIC S9(4) BINARY VALUE IS 0.
01 SQL-DROP                  PIC S9(4) BINARY VALUE IS 1.
01 SQL-UNBIND                PIC S9(4) BINARY VALUE IS 2.
01 SQL-RESET-PARAMS          PIC S9(4) BINARY VALUE IS 3.

* CODES USED FOR FETCHORIENTATION IN SQLRFETCHSCROLL(),
* AND IN SQLRDATASOURCES()
```

```
01 SQL-FETCH-NEXT            PIC S9(4) BINARY VALUE IS 1.
01 SQL-FETCH-FIRST           PIC S9(4) BINARY VALUE IS 2.

* OTHER CODES USED FOR FETCHORIENTATION IN SQLRFETCHSCROLL()
01 SQL-FETCH-LAST            PIC S9(4) BINARY VALUE IS 3.
01 SQL-FETCH-PRIOR           PIC S9(4) BINARY VALUE IS 4.
01 SQL-FETCH-ABSOLUTE        PIC S9(4) BINARY VALUE IS 5.
01 SQL-FETCH-RELATIVE        PIC S9(4) BINARY VALUE IS 6.

* SQLRENDTRAN OPTIONS
01 SQL-COMMIT                PIC S9(4) BINARY VALUE IS 0.
01 SQL-ROLLBACK              PIC S9(4) BINARY VALUE IS 1.

* NULL HANDLES RETURNED BY SQLRALLOCHANDLE()
01 SQL-NULL-HENV             PIC S9(9) BINARY VALUE IS 0.
01 SQL-NULL-HDBC             PIC S9(9) BINARY VALUE IS 0.
01 SQL-NULL-HSTMT            PIC S9(9) BINARY VALUE IS 0.
01 SQL-NULL-HDESC            PIC S9(9) BINARY VALUE IS 0.

* NULL HANDLE USED IN PLACE OF PARENT HANDLE WHEN ALLOCATING HENV
01 SQL-NULL-HANDLE           PIC S9(9) BINARY VALUE IS 0.

* VALUES THAT MAY APPEAR IN THE RESULT SET OF SQLRSPECIALCOLUMNS()
01 SQL-SCOPE-CURROW          PIC S9(4) BINARY VALUE IS 0.
01 SQL-SCOPE-TRANSACTION     PIC S9(4) BINARY VALUE IS 1.
01 SQL-SCOPE-SESSION         PIC S9(4) BINARY VALUE IS 2.

01 SQL-PC-UNKNOWN            PIC S9(4) BINARY VALUE IS 0.
01 SQL-PC-NON-PSEUDO         PIC S9(4) BINARY VALUE IS 1.
01 SQL-PC-PSEUDO             PIC S9(4) BINARY VALUE IS 2.

* RESERVED VALUE FOR THE IDENTIFIERTYPE ARGUMENT OF SQLRSPECIALCOLUMNS()
01 SQL-ROW-IDENTIFIER        PIC S9(4) BINARY VALUE IS 1.

* RESERVED VALUES FOR UNIQUE ARGUMENT OF SQLRSTATISTICS()
01 SQL-INDEX-UNIQUE          PIC S9(4) BINARY VALUE IS 0.
01 SQL-INDEX-ALL             PIC S9(4) BINARY VALUE IS 1.

* VALUES THAT MAY APPEAR IN THE RESULT SET OF SQLRSTATISTICS()
01 SQL-INDEX-CLUSTERED       PIC S9(4) BINARY VALUE IS 1.
01 SQL-INDEX-HASHED          PIC S9(4) BINARY VALUE IS 2.
01 SQL-INDEX-OTHER           PIC S9(4) BINARY VALUE IS 3.

* SQLRGETFUNCTIONS() VALUES TO IDENTIFY CLI FUNCTIONS
01 SQL-API-SQLALLOCCONNECT     PIC S9(4) BINARY VALUE IS 1.
01 SQL-API-SQLALLOCENV         PIC S9(4) BINARY VALUE IS 2.
01 SQL-API-SQLALLOCHANDLE      PIC S9(4) BINARY VALUE IS 1001.
01 SQL-API-SQLALLOCSTMT        PIC S9(4) BINARY VALUE IS 3.
01 SQL-API-SQLBINDCOL          PIC S9(4) BINARY VALUE IS 4.
01 SQL-API-SQLBINDPARAM        PIC S9(4) BINARY VALUE IS 22.
01 SQL-API-SQLCANCEL           PIC S9(4) BINARY VALUE IS 5.
01 SQL-API-SQLCLOSECURSOR      PIC S9(4) BINARY VALUE IS 1003.
01 SQL-API-SQLCOLATTRIBUTE     PIC S9(4) BINARY VALUE IS 6.
01 SQL-API-SQLCOLUMNS          PIC S9(4) BINARY VALUE IS 40.
01 SQL-API-SQLCONNECT          PIC S9(4) BINARY VALUE IS 7.
01 SQL-API-SQLCOPYDESC         PIC S9(4) BINARY VALUE IS 1004.
01 SQL-API-SQLDATASOURCES      PIC S9(4) BINARY VALUE IS 57.
01 SQL-API-SQLDESCRIBECOL      PIC S9(4) BINARY VALUE IS 8.
01 SQL-API-SQLDISCONNECT       PIC S9(4) BINARY VALUE IS 9.
01 SQL-API-SQLENDTRAN          PIC S9(4) BINARY VALUE IS 1005.
01 SQL-API-SQLERROR            PIC S9(4) BINARY VALUE IS 10.
01 SQL-API-SQLEXECDIRECT       PIC S9(4) BINARY VALUE IS 11.
01 SQL-API-SQLEXECUTE          PIC S9(4) BINARY VALUE IS 12.
01 SQL-API-SQLFETCH            PIC S9(4) BINARY VALUE IS 13.
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01 SQL-API-SQLFETCHSCROLL       PIC S9(4) BINARY VALUE IS 1021.
01 SQL-API-SQLFREECONNECT       PIC S9(4) BINARY VALUE IS 14.
01 SQL-API-SQLFREEENV           PIC S9(4) BINARY VALUE IS 15.
01 SQL-API-SQLFREEHANDLE        PIC S9(4) BINARY VALUE IS 1006.
01 SQL-API-SQLFREESTMT          PIC S9(4) BINARY VALUE IS 16.
01 SQL-API-SQLGETCONNECTATTR    PIC S9(4) BINARY VALUE IS 1007.
01 SQL-API-SQLGETCONNECTOPTION  PIC S9(4) BINARY VALUE IS 42.
01 SQL-API-SQLGETCURSORNAME     PIC S9(4) BINARY VALUE IS 17.
01 SQL-API-SQLGETDATA           PIC S9(4) BINARY VALUE IS 43.
01 SQL-API-SQLGETDESCFIELD      PIC S9(4) BINARY VALUE IS 1008.
01 SQL-API-SQLGETDESCREC        PIC S9(4) BINARY VALUE IS 1009.
01 SQL-API-SQLGETDIAGFIELD      PIC S9(4) BINARY VALUE IS 1010.
01 SQL-API-SQLGETDIAGREC        PIC S9(4) BINARY VALUE IS 1011.
01 SQL-API-SQLGETENVATTR        PIC S9(4) BINARY VALUE IS 1012.
01 SQL-API-SQLGETFUNCTIONS      PIC S9(4) BINARY VALUE IS 44.
01 SQL-API-SQLGETINFO           PIC S9(4) BINARY VALUE IS 45.
01 SQL-API-SQLGETSTMTATTR       PIC S9(4) BINARY VALUE IS 1014.
01 SQL-API-SQLGETSTMTOPTION     PIC S9(4) BINARY VALUE IS 46.
01 SQL-API-SQLGETTYPEINFO       PIC S9(4) BINARY VALUE IS 47.
01 SQL-API-SQLLANGUAGES         PIC S9(4) BINARY VALUE IS 2001.
01 SQL-API-SQLNUMRESULTCOLS     PIC S9(4) BINARY VALUE IS 18.
01 SQL-API-SQLPARAMDATA         PIC S9(4) BINARY VALUE IS 48.
01 SQL-API-SQLPREPARE           PIC S9(4) BINARY VALUE IS 19.
01 SQL-API-SQLPUTDATA           PIC S9(4) BINARY VALUE IS 49.
01 SQL-API-SQLRELEASEENV        PIC S9(4) BINARY VALUE IS 1015.
01 SQL-API-SQLROWCOUNT          PIC S9(4) BINARY VALUE IS 20.
01 SQL-API-SQLSERVERINFO        PIC S9(4) BINARY VALUE IS 2002.
01 SQL-API-SQLSETCONNECTATTR    PIC S9(4) BINARY VALUE IS 1016.
01 SQL-API-SQLSETCONNECTOPTION  PIC S9(4) BINARY VALUE IS 50.
01 SQL-API-SQLSETCURSORNAME     PIC S9(4) BINARY VALUE IS 21.
01 SQL-API-SQLSETDESCFIELD      PIC S9(4) BINARY VALUE IS 1017.
01 SQL-API-SQLSETDESCREC        PIC S9(4) BINARY VALUE IS 1018.
01 SQL-API-SQLSETENVATTR        PIC S9(4) BINARY VALUE IS 1019.
01 SQL-API-SQLSETPARAM          PIC S9(4) BINARY VALUE IS 22.
01 SQL-API-SQLSETSTMTATTR       PIC S9(4) BINARY VALUE IS 1020.
01 SQL-API-SQLSETSTMTOPTION     PIC S9(4) BINARY VALUE IS 51.
01 SQL-API-SQLSPECIALCOLUMNS    PIC S9(4) BINARY VALUE IS 52.
01 SQL-API-SQLSTATISTICS        PIC S9(4) BINARY VALUE IS 53.
01 SQL-API-SQLTABLES            PIC S9(4) BINARY VALUE IS 54.
01 SQL-API-SQLTRANSACT          PIC S9(4) BINARY VALUE IS 23.

* INFORMATION REQUESTED BY SQLRGETINFO()
01 SQL-MAX-DRIVER-CONNECTIONS   PIC S9(4) BINARY VALUE IS 0.
01 SQL-MAX-CONCURRENT-ACTIVITIES  PIC S9(4) BINARY VALUE IS 1.
01 SQL-DATA-SOURCE-NAME         PIC S9(4) BINARY VALUE IS 2.
01 SQL-FETCH-DIRECTION          PIC S9(4) BINARY VALUE IS 8.
01 SQL-SERVER-NAME              PIC S9(4) BINARY VALUE IS 13.
01 SQL-SEARCH-PATTERN-ESCAPE    PIC S9(4) BINARY VALUE IS 14.
01 SQL-DBMS-NAME                PIC S9(4) BINARY VALUE IS 17.
01 SQL-DBMS-VER                 PIC S9(4) BINARY VALUE IS 18.
01 SQL-ACCESSIBLE-TABLES        PIC S9(4) BINARY VALUE IS 19.
01 SQL-CURSOR-COMMIT-BEHAVIOR   PIC S9(4) BINARY VALUE IS 23.
01 SQL-DATA-SOURCE-READ-ONLY    PIC S9(4) BINARY VALUE IS 25.
01 SQL-DEFAULT-TXN-ISOLATION    PIC S9(4) BINARY VALUE IS 26.
01 SQL-IDENTIFIER-CASE          PIC S9(4) BINARY VALUE IS 28.
01 SQL-IDENTIFIER-QUOTE-CHAR    PIC S9(4) BINARY VALUE IS 29.
01 SQL-MAX-COLUMN-NAME-LEN      PIC S9(4) BINARY VALUE IS 30.
01 SQL-MAX-CURSOR-NAME-LEN      PIC S9(4) BINARY VALUE IS 31.
01 SQL-MAX-SCHEMA-NAME-LEN      PIC S9(4) BINARY VALUE IS 32.
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01 SQL-MAX-CATALOG-NAME-LEN     PIC S9(4) BINARY VALUE IS 34.
01 SQL-MAX-TABLE-NAME-LEN       PIC S9(4) BINARY VALUE IS 35.
01 SQL-SCROLL-CONCURRENCY       PIC S9(4) BINARY VALUE IS 43.
01 SQL-TXN-CAPABLE              PIC S9(4) BINARY VALUE IS 46.
01 SQL-USER-NAME                PIC S9(4) BINARY VALUE IS 47.
01 SQL-TXN-ISOLATION-OPTION     PIC S9(4) BINARY VALUE IS 72.
01 SQL-INTEGRITY                PIC S9(4) BINARY VALUE IS 73.
01 SQL-GETDATA-EXTENSIONS       PIC S9(4) BINARY VALUE IS 81.
01 SQL-NULL-COLLATION           PIC S9(4) BINARY VALUE IS 85.
01 SQL-ALTER-TABLE              PIC S9(4) BINARY VALUE IS 86.
01 SQL-ORDER-BY-COLUMNS-IN-SELECT  PIC S9(4) BINARY VALUE IS 90.
01 SQL-SPECIAL-CHARACTERS       PIC S9(4) BINARY VALUE IS 94.
01 SQL-MAX-COLUMNS-IN-GROUP-BY  PIC S9(4) BINARY VALUE IS 97.
01 SQL-MAX-COLUMNS-IN-INDEX     PIC S9(4) BINARY VALUE IS 98.
01 SQL-MAX-COLUMNS-IN-ORDER-BY  PIC S9(4) BINARY VALUE IS 99.
01 SQL-MAX-COLUMNS-IN-SELECT    PIC S9(4) BINARY VALUE IS 100.
01 SQL-MAX-COLUMNS-IN-TABLE     PIC S9(4) BINARY VALUE IS 101.
01 SQL-MAX-INDEX-SIZE           PIC S9(4) BINARY VALUE IS 102.
01 SQL-MAX-ROW-SIZE             PIC S9(4) BINARY VALUE IS 104.
01 SQL-MAX-STATEMENT-LEN        PIC S9(4) BINARY VALUE IS 105.
01 SQL-MAX-TABLES-IN-SELECT     PIC S9(4) BINARY VALUE IS 106.
01 SQL-MAX-USER-NAME-LEN        PIC S9(4) BINARY VALUE IS 107.
01 SQL-OJ-CAPABILITIES          PIC S9(4) BINARY VALUE IS 115.
01 SQL-XOPEN-CLI-YEAR           PIC S9(4) BINARY VALUE IS 10000.
01 SQL-CURSOR-SENSITIVITY       PIC S9(4) BINARY VALUE IS 10001.
01 SQL-DESCRIBE-PARAMETER       PIC S9(4) BINARY VALUE IS 10002.
01 SQL-SQL-CATALOG-NAME         PIC S9(4) BINARY VALUE IS 10003.
01 SQL-SQL-COLLATION-SEQ        PIC S9(4) BINARY VALUE IS 10004.
01 SQL-SQL-MAX-IDENTIFIER-LEN   PIC S9(4) BINARY VALUE IS 10005.

/* SQL-ALTER-TABLE values */
01 SQL-AT-ADD-COLUMN            PIC S9(9) BINARY VALUE IS 1.
01 SQL-AT-DROP-COLUMN           PIC S9(9) BINARY VALUE IS 2.
01 SQL-AT-ALTER-COLUMN          PIC S9(9) BINARY VALUE IS 4.
01 SQL-AT-ADD-CONSTRAINT        PIC S9(9) BINARY VALUE IS 8.
01 SQL-AT-DROP-CONSTRAINT       PIC S9(9) BINARY VALUE IS 16.

/* SQL-CURSOR-COMMIT-BEHAVIOR values */
01 SQL-CB-DELETE                PIC S9(4) BINARY VALUE IS 0.
01 SQL-CB-CLOSE                 PIC S9(4) BINARY VALUE IS 1.
01 SQL-CB-PRESERVE              PIC S9(4) BINARY VALUE IS 2.

/* SQL-FETCH-DIRECTION values */
01 SQL-FD-FETCH-NEXT            PIC S9(9) BINARY VALUE IS 1.
01 SQL-FD-FETCH-FIRST           PIC S9(9) BINARY VALUE IS 2.
01 SQL-FD-FETCH-LAST            PIC S9(9) BINARY VALUE IS 4.
01 SQL-FD-FETCH-PRIOR           PIC S9(9) BINARY VALUE IS 8.
01 SQL-FD-FETCH-ABSOLUTE        PIC S9(9) BINARY VALUE IS 16.
01 SQL-FD-FETCH-RELATIVE        PIC S9(9) BINARY VALUE IS 32.

/* SQL-GETDATA-EXTENSIONS values */
01 SQL-GD-ANY-COLUMN            PIC S9(9) BINARY VALUE IS 1.
01 SQL-GD-ANY-ORDER             PIC S9(9) BINARY VALUE IS 2.

/* SQL-IDENTIFIER-CASE values */
01 SQL-IC-UPPER                 PIC S9(4) BINARY VALUE IS 1.
01 SQL-IC-LOWER                 PIC S9(4) BINARY VALUE IS 2.
01 SQL-IC-SENSITIVE             PIC S9(4) BINARY VALUE IS 3.
01 SQL-IC-MIXED                 PIC S9(4) BINARY VALUE IS 4.

/* SQL-OJ-CAPABILITIES values */
01 SQL-OJ-LEFT                  PIC S9(9) BINARY VALUE IS 1.
```

```
01 SQL-OJ-RIGHT                PIC S9(9) BINARY VALUE IS 2.
01 SQL-OJ-FULL                 PIC S9(9) BINARY VALUE IS 4.
01 SQL-OJ-NESTED               PIC S9(9) BINARY VALUE IS 8.
01 SQL-OJ-NOT-ORDERED          PIC S9(9) BINARY VALUE IS 16.
01 SQL-OJ-INNER                PIC S9(9) BINARY VALUE IS 32.
01 SQL-OJ-ALL-COMPARISON-OPS   PIC S9(9) BINARY VALUE IS 64.

/* SQL-SCROLL-CONCURRENCY  values */
01 SQL-SCCO-READ-ONLY          PIC S9(9) BINARY VALUE IS 1.
01 SQL-SCCO-LOCK               PIC S9(9) BINARY VALUE IS 2.
01 SQL-SCCO-OPT-ROWVER         PIC S9(9) BINARY VALUE IS 4.
01 SQL-SCCO-OPT-VALUES         PIC S9(9) BINARY VALUE IS 8.

/* SQL-TXN-CAPABLE  values */
01 SQL-TC-NONE                 PIC S9(4) BINARY VALUE IS 1.
01 SQL-TC-DML                  PIC S9(4) BINARY VALUE IS 2.
01 SQL-TC-ALL                  PIC S9(4) BINARY VALUE IS 3.
01 SQL-TC-DDL-COMMIT           PIC S9(4) BINARY VALUE IS 4.
01 SQL-TC-DDL-IGNORE           PIC S9(4) BINARY VALUE IS 5.

/* SQL-TXN-ISOLATION-OPTION  values */
01 SQL-TXN-READ-UNCOMMITTED    PIC S9(9) BINARY VALUE IS 1.
01 SQL-TXN-READ-COMMITTED      PIC S9(9) BINARY VALUE IS 2.
01 SQL-TXN-REPEATABLE-READ     PIC S9(9) BINARY VALUE IS 4.
01 SQL-TXN-SERIALIZABLE        PIC S9(9) BINARY VALUE IS 8.
```

Appendix D

Sample C Programs

This appendix contains three sample functions that use CLI.

- The first example (in Section D.1) creates a table, inserts data into the table, and selects the inserted data.
- The second example (in Section D.2 on page 268) shows interactive *ad hoc* query processing.
- The third example (in Section D.3 on page 272) illustrates providing long parameter data at execute time.

Actual applications include more complete error checking following calls to CLI functions. That material is omitted from this appendix for the sake of clarity.

D.1 Create Table, Insert, Select

This example function creates a table, inserts data into the table, and selects the inserted data.

The example illustrates the execution of SQL statement text both using the *Prepare*( ) and *Execute*( ) method, and using the *ExecDirect*( ) method.

The example illustrates both the case where the application uses the automatically-generated descriptors and the case where the application allocates a descriptor of its own and associates this descriptor with the SQL statement.

Code comments include the equivalent statements in embedded SQL to show how embedded SQL operations correspond to CLI function calls.

```
#include <stddef.h>
#include <sqlcli.h>
#include <string.h>

#define NAMELEN  50

int print_err(SQLSMALLINT handletype, SQLINTEGER handle);

int example1(SQLCHAR *server, SQLCHAR *uid, SQLCHAR *pwd)
{
SQLHENV     henv;
SQLHDBC     hdbc;
SQLHDESC    hdesc;
SQLHDESC    hdesc1;
SQLHDESC    hdesc2;
SQLHSTMT    hstmt;

SQLINTEGER  id;
SQLSMALLINT idind;
SQLCHAR     name[NAMELEN+1];
SQLINTEGER  namelen;
SQLSMALLINT nameind;

/* EXEC SQL CONNECT TO :server USER :uid USING :pwd; */

/* allocate an environment handle */
```

```
SQLAllocHandle(SQL_HANDLE_ENV,  SQL_NULL_HANDLE,  &henv);
/* allocate a connection handle */
SQLAllocHandle(SQL_HANDLE_DBC,  henv, &hdbc);

/* connect to database */
if (SQLConnect(hdbc,  server,  SQL_NTS,  uid,  SQL_NTS,  pwd,  SQL_NTS)
      != SQL_SUCCESS)
   return(print_err(SQL_HANDLE_DBC,  hdbc));

/* allocate a statement handle */
SQLAllocHandle(SQL_HANDLE_STMT,  hdbc, &hstmt);

/* EXEC SQL CREATE TABLE NAMEID (ID integer, NAME varchar(50));  */
{
   SQLCHAR create[] ="CREATE TABLE NAMEID (ID integer,"
                                          " NAME varchar(50))";

   /* execute the CREATE TABLE statement */
   if (SQLExecDirect(hstmt,  create,  SQL_NTS)  != SQL_SUCCESS)
      return(print_err(SQL_HANDLE_STMT,  hstmt));
}

/* EXEC SQL COMMIT WORK; */
/* commit CREATE TABLE */
SQLEndTran(SQL_HANDLE_ENV,  henv,  SQL_COMMIT);
/* EXEC SQL INSERT INTO NAMEID VALUES ( :id, :name ); */
{
   SQLCHAR insert[]= "INSERT INTO NAMEID VALUES (?, ?)";

   /* show the use of SQLPrepare/SQLExecute  method */
   /* prepare the INSERT */
   if (SQLPrepare(hstmt,  insert,  SQL_NTS)  != SQL_SUCCESS)
      return(print_err(SQL_HANDLE_STMT,  hstmt));
   /* application parameter descriptor */
   SQLGetStmtAttr(hstmt,  SQL_ATTR_APP_PARAM_DESC,  &hdesc1,  0L,
         (SQLINTEGER *)NULL);
   SQLSetDescRec(hdesc1,  1,  SQL_INTEGER,  0,  0L,  0,  0,
         (SQLPOINTER)&id,  (SQLINTEGER *)NULL,  (SQLSMALLINT *)NULL);
   SQLSetDescRec(hdesc1,  2,  SQL_CHAR,  0,  NAMELEN,  0,  0,
         (SQLPOINTER)name,  (SQLINTEGER *)NULL,  (SQLSMALLINT *)NULL);
   /* implementation parameter descriptor */
   SQLGetStmtAttr(hstmt,  SQL_ATTR_IMP_PARAM_DESC,  &hdesc2,  0L,
         (SQLINTEGER *)NULL);
   SQLSetDescRec(hdesc2,  1,  SQL_INTEGER,  0,  0L,  0,  0,
         (SQLPOINTER)NULL,  (SQLINTEGER *)NULL,  (SQLSMALLINT *)NULL);
   SQLSetDescRec(hdesc2,  2,  SQL_VARCHAR,  0,  NAMELEN,  0,  0,
         (SQLPOINTER)NULL,  (SQLINTEGER *)NULL,  (SQLSMALLINT *)NULL);

   /* assign parameter values and execute the INSERT */
   id=500;
   (void)strcpy(name,  "Babbage");
   if (SQLExecute(hstmt)  != SQL_SUCCESS)
      return(print_err(SQL_HANDLE_STMT,  hstmt));
}
/* EXEC SQL COMMIT WORK; */
SQLEndTran(SQL_HANDLE_ENV,  henv,  SQL_COMMIT); /* commit inserts */

/* EXEC SQL DECLARE c1 CURSOR FOR SELECT ID, NAME FROM NAMEID; */
/* EXEC SQL OPEN c1; */
```

```
/* The application doesn't specify "declare c1 cursor for" */
{
   SQLCHAR select[]= "select ID, NAME from NAMEID";
   if (SQLExecDirect(hstmt, select, SQL_NTS) != SQL_SUCCESS)
      return(print_err(SQL_HANDLE_STMT, hstmt));
}

/* EXEC SQL FETCH c1 INTO :id, :name; */
/* this time, explicitly allocate an application row descriptor */
SQLAllocHandle(SQL_HANDLE_DESC, hdbc, &hdesc);
SQLSetDescRec(hdesc, 1, SQL_INTEGER, 0, 0L, 0, 0,
   (SQLPOINTER)&id, (SQLINTEGER *)NULL, (SQLSMALLINT *)&idind);
SQLSetDescRec(hdesc, 2, SQL_CHAR, 0, NAMELEN, 0, 0,
   (SQLPOINTER)name, (SQLINTEGER *)&namelen, (SQLSMALLINT *)&nameind);
/* associate descriptor with statement handle */
SQLSetStmtAttr(hstmt, SQL_ATTR_APP_ROW_DESC, &hdesc, 0);
/* execute the fetch */
SQLFetch(hstmt);

/* EXEC SQL COMMIT WORK; */
/* commit the transaction  */
SQLEndTran(SQL_HANDLE_ENV, henv, SQL_COMMIT);

/* EXEC SQL CLOSE c1; */
SQLCloseCursor(hstmt);
/* free the statement handle */
SQLFreeHandle(SQL_HANDLE_STMT, hstmt);

/* EXEC SQL DISCONNECT; */
/* Disconnect from the database.  This frees the descriptor handles. */
SQLDisconnect(hdbc);
/* free connection handle */
SQLFreeHandle(SQL_HANDLE_DBC,  hdbc);
/* free environment handle */
SQLFreeHandle(SQL_HANDLE_ENV,  henv);

return(0);
}
```

D.2 Interactive Query

The following sample function, based on the flowchart in Figure 4-2 on page 43, uses the concise CLI functions to interactively execute an SQL statement supplied as an argument. For an overview of the concise CLI functions, see Chapter 6.

In the case where the user types a *cursor-specification*, the function fetches and displays all rows of the result set.

This example illustrates the use of *GetDiagField*( ) to identify the type of SQL statement executed and, for SQL statements where the row count is defined on all implementations, the use of *GetDiagField*( ) to obtain the row count.

```
/*
 * Sample program - uses concise CLI functions to execute
 * interactively an ad-hoc statement.
 */
#include <stddef.h>
#include <sqlcli.h>
#include <string.h>
#include <stdlib.h>

#define  MAXCOLS   100

#define  max(a,b) (a>b?a:b)
int print_err(SQLSMALLINT handletype, SQLINTEGER handle);
int build_indicator_message(SQLCHAR *errmsg, SQLPOINTER *data,
   SQLINTEGER collen, SQLINTEGER *outlen, SQLSMALLINT colnum);
SQLINTEGER display_length(SQLSMALLINT coltype, SQLINTEGER collen,
   SQLCHAR *colname);

example2(SQLCHAR *server, SQLCHAR *uid, SQLCHAR *pwd, SQLCHAR *sqlstr)
{
 int         i;
 SQLHENV     henv;
 SQLHDBC     hdbc;
 SQLHSTMT    hstmt;
 SQLCHAR     errmsg[256];
 SQLCHAR     colname[32];
 SQLSMALLINT coltype;
 SQLSMALLINT colnamelen;
 SQLSMALLINT nullable;
 SQLINTEGER  collen[MAXCOLS];
 SQLSMALLINT scale;
 SQLINTEGER  outlen[MAXCOLS];
 SQLCHAR    *data[MAXCOLS];
 SQLSMALLINT nresultcols;
 SQLINTEGER  rowcount;
 SQLINTEGER  stmttype;
 SQLRETURN   rc;

 /* allocate an environment handle */
 SQLAllocHandle(SQL_HANDLE_ENV,  SQL_NULL_HANDLE, &henv);

 /* allocate a connection handle */
 SQLAllocHandle(SQL_HANDLE_DBC,  henv, &hdbc);

 /* connect to database */
 if (SQLConnect(hdbc, server, SQL_NTS, uid, SQL_NTS, pwd, SQL_NTS)
```

```
      != SQL_SUCCESS )
   return(print_err(SQL_HANDLE_DBC,  hdbc));

/* allocate a statement handle */
SQLAllocHandle(SQL_HANDLE_STMT,  hdbc, &hstmt);

/* execute the SQL statement */
if (SQLExecDirect(hstmt,  sqlstr, SQL_NTS) != SQL_SUCCESS)
   return(print_err(SQL_HANDLE_STMT,  hstmt));

/* see what kind of statement it was */
SQLGetDiagField(SQL_HANDLE_STMT,  hstmt, 0, SQL_DIAG_DYNAMIC_FUNCTION_CODE,
      (SQLPOINTER)&stmttype,  0, (SQLSMALLINT *)NULL);

switch (stmttype) {
   /* SELECT statement */
   case SQL_SELECT_CURSOR:
      /* determine number of result columns */
      SQLNumResultCols(hstmt,  &nresultcols);
      /* display column names */
      for (i=0; i<nresultcols; i++) {
         SQLDescribeCol(hstmt,  i+1, colname, sizeof(colname),
            &colnamelen, &coltype, &collen[i], &scale, &nullable);
         /* assume there is a display_length function which computes
            correct length given the data type  */
         collen[i] = display_length(coltype,  collen[i], colname);
         (void)printf("%*.*s",  collen[i], collen[i], colname);
         /* allocate memory to bind column */
         data[i] = (SQLCHAR *) malloc(collen[i]);
         /* bind columns to program vars, converting all types to CHAR*/
         SQLBindCol(hstmt,  i+1, SQL_CHAR, data[i], collen[i],
            &outlen[i]);
      }
      /* display result rows */
      while (SQL_SUCCEEDED(rc=SQLFetch(hstmt) )) {
         errmsg[0] = '\0';
         if (rc == SQL_SUCCESS_WITH_INFO)  {
            for (i=0; i<nresultcols; i++) {
               if (outlen[i] == SQL_NULL_DATA || outlen[i] >= collen[i])
                  build_indicator_message(errmsg,
                     (SQLPOINTER *)&data[i], collen[i], &outlen[i], i);
               (void)printf("%*.*s ", outlen[i], outlen[i], data[i]);
            } /* for all columns in this row  */
            /* print any truncation messages */
            (void)printf("\n%s",  errmsg);
         }
      } /* while rows to fetch */
      SQLCloseCursor(hstmt);
      break;

   /* searched DELETE, INSERT or searched UPDATE statement */
   case SQL_DELETE_WHERE:
   case SQL_INSERT:
   case SQL_UPDATE_WHERE:
      /* check rowcount */
      SQLGetDiagField(SQL_HANDLE_STMT,  hstmt, 0, SQL_DIAG_ROW_COUNT,
         (SQLPOINTER)&rowcount,  0, (SQLSMALLINT *)NULL);
      if (SQLEndTran(SQL_HANDLE_ENV,  henv, SQL_COMMIT)
            == SQL_SUCCESS) {
```

```
            (void) printf("Operation successful\n");
         }
         else {
            (void) printf("Operation failed\n");
         }
         (void)printf("%ld rows affected\n", rowcount);
         break;

      /* other statements */
      case SQL_ALTER_TABLE:
      case SQL_CREATE_INDEX:
      case SQL_CREATE_TABLE:
      case SQL_CREATE_VIEW:
      case SQL_DROP_INDEX:
      case SQL_DROP_TABLE:
      case SQL_DROP_VIEW:
      case SQL_DYNAMIC_DELETE_CURSOR:
      case SQL_DYNAMIC_UPDATE_CURSOR:
      case SQL_GRANT:
      case SQL_REVOKE:
         if (SQLEndTran(SQL_HANDLE_ENV, henv, SQL_COMMIT)
               == SQL_SUCCESS) {
            (void) printf("Operation successful\n");
         }
         else {
            (void) printf("Operation failed\n");
         }
         break;

      /* implementation-defined statement */
      default:
         (void)printf("Statement type=%ld\n", stmttype);
         break;
   }

   /* free data buffers */
   for (i=0; i<nresultcols; i++) {
      (void)free(data[i]);
   }

   /* free statement handle */
   SQLFreeHandle(SQL_HANDLE_STMT, hstmt);
   /* disconnect from database */
   SQLDisconnect(hdbc);
   /* free connection handle */
   SQLFreeHandle(SQL_HANDLE_DBC, hdbc);
   /* free environment handle */
   SQLFreeHandle(SQL_HANDLE_ENV, henv);

   return(0);
}

/*********************************************************
The following functions are given for completeness, but are
not relevant for understanding the database processing nature of CLI
*********************************************************/

#define MAX_NUM_PRECISION 15
/* define maximum length in characters of char string representation of
```

```
no. as: = max(precision) + leading sign + E + exp sign + max exp length
        =  15            + 1            + 1 + 1        + 2
        =  15 + 5
*/
#define MAX_NUM_STRING_SIZE (MAX_NUM_PRECISION + 5)

SQLINTEGER  display_length(SQLSMALLINT  coltype, SQLINTEGER collen,
   SQLCHAR *colname)
{
switch (coltype) {

  case SQL_VARCHAR:
  case SQL_CHAR:
      return(max(collen,strlen( (char *)colname)));
      break;

  case SQL_FLOAT:
  case SQL_DOUBLE:
  case SQL_NUMERIC:
  case SQL_REAL:
  case SQL_DECIMAL:
      return(max(MAX_NUM_STRING_SIZE,strlen( (char *)colname)));
      break;

  case SQL_DATETIME:
      return(max(SQL_TIMESTAMP_LEN,strlen( (char *)colname)));
      break;

  case SQL_INTEGER:
      return(max(10,strlen( (char *)colname)));
      break;

  case SQL_SMALLINT:
      return(max(5,strlen( (char *)colname)));
      break;

  default:
      (void)printf("Unknown  datatype, %d\n", coltype);
      return(0);
      break;
  }
}

int build_indicator_message(SQLCHAR  *errmsg, SQLPOINTER *data,
   SQLINTEGER collen, SQLINTEGER *outlen, SQLSMALLINT colnum)
{
  if (*outlen == SQL_NULL_DATA) {
        (void)strcpy( (char *)data, "NULL");
        *outlen=4;
  }
  else {
     sprintf( (char *)errmsg+strlen( (char *)errmsg),
           "%d chars truncated, col %d\n", *outlen-collen+1, colnum);
     *outlen=255;
  }
}
```

D.3 Providing Long Dynamic Arguments at Execute Time

In the following example, an application prepares an SQL statement to insert data into the EMPLOYEE table. The statement contains parameters for the NAME, ID, and PHOTO columns. For each parameter, the application calls *BindParam*( ) to specify the C and SQL data types of the parameter. It also specifies that the data for the first and third parameters will be passed at execute time, and passes the values 1 and 3 for later retrieval by *ParamData*( ). These values will identify which parameter is being processed.

The application calls *GetNextID* to get the next available employee ID number. It then calls *Execute*( ) to execute the statement. The *Execute*( ) function returns [SQL_NEED_DATA] when it needs data for the first and third parameters. The application calls *ParamData*( ) to retrieve the value it stored with *BindParam*( ); it uses this value to determine which parameter to send data for. For each parameter, the application calls *InitUserData*( ) to initialise the data routine. It repeatedly calls *GetUserData*( ) and *PutData*( ) to get and send the parameter data. Finally, it calls *ParamData*( ) to indicate it has sent all the data for the parameter and to retrieve the value for the next parameter. After data has been sent for both parameters, *ParamData*( ) returns SQL_SUCCESS.

For the first parameter, *InitUserData*( ) does not do anything and *GetUserData*( ) calls a routine to prompt the user for the employee name. For the third parameter, *InitUserData*( ) calls a routine to prompt the user for the name of a file containing a bitmap photo of the employee and opens the file. *GetUserData*( ) retrieves the next MAX_DATA_LEN octets of photo data from the file. After it has retrieved all the photo data, it closes the photo file.

Note that some application routines are omitted for clarity.

```
/*
 * Sample program - uses ParamData and PutData to pass long data at
 * execute time.
 */
#include <sqlcli.h>
#include <stdio.h>
#include <string.h>

#ifndef NULL
#define NULL 0
#endif

#define NAME_LEN            30
#define MAX_FILE_NAME_LEN  256
#define MAX_PHOTO_LEN    32000
#define MAX_DATA_LEN      1024

int print_err(SQLSMALLINT handletype, SQLINTEGER handle);
SQLINTEGER GetNextID();
void InitUserData(SQLSMALLINT sParam, SQLPOINTER InitValue);
SQLSMALLINT GetUserData(SQLPOINTER InitValue, SQLSMALLINT sParam,
                        SQLCHAR *Data, SQLINTEGER *StrLen_or_Ind);

example3(SQLCHAR *server, SQLCHAR *uid, SQLCHAR* pwd)
{
SQLHENV     henv;
SQLHDBC     hdbc;
SQLHSTMT    hstmt;
SQLRETURN   rc;
SQLINTEGER  NameParamLength, IDLength = 0, PhotoParamLength, StrLen_or_Ind;
SQLINTEGER  ID;
```

```
SQLSMALLINT Param1=1, Param3=3;
SQLPOINTER  pToken, InitValue;
SQLCHAR     Data[MAX_DATA_LEN];

/* Allocate an environment handle */
SQLAllocHandle(SQL_HANDLE_ENV,  SQL_NULL_HANDLE,  &henv);

/* Allocate a connection handle */
SQLAllocHandle(SQL_HANDLE_DBC,  henv, &hdbc);

/* Connect to database */
rc = SQLConnect(hdbc,  server, SQL_NTS, uid, SQL_NTS, pwd, SQL_NTS);
if (rc != SQL_SUCCESS && rc != SQL_SUCCESS_WITH_INFO)
        return(print_err(SQL_HANDLE_DBC,  hdbc));

/* Allocate a statement handle */
SQLAllocHandle(SQL_HANDLE_STMT,  hdbc, &hstmt);

/* Prepare the INSERT statement */
rc = SQLPrepare(hstmt,
          "INSERT INTO EMPLOYEE (NAME, ID, PHOTO) VALUES (?, ?, ?)",
          SQL_NTS);
if (rc == SQL_SUCCESS) {

        /* Bind the parameters. For parameters 1 and 3, pass the       */
        /* parameter number in rgbValue instead of a buffer address.   */

        SQLBindParam(hstmt,  1, SQL_CHAR,  SQL_CHAR,
                     NAME_LEN,  0, &Param1,  &NameParamLength);
        SQLBindParam(hstmt,  2, SQL_INTEGER,  SQL_INTEGER,
                     sizeof(ID),  0, &ID,  &IDLength);
        SQLBindParam(hstmt,  3, SQL_CHAR,  SQL_CHAR,
                     MAX_PHOTO_LEN,  0, &Param3,  &PhotoParamLength);

        /* Set values so data for parameters 1 and 3 will be passed  */
        /* at execution.                                             */

        NameParamLength  = PhotoParamLength  = SQL_DATA_AT_EXEC;

        ID = GetNextID();  /* Get next available employee ID number. */

        rc = SQLExecute(hstmt);

        /* For data-at-execution parameters, call SQLParamData to get the */
        /* parameter number set by SQLBindParam. Call InitUserData.   */
        /* Call GetUserData and SQLPutData repeatedly to get and put all  */
        /* data for the parameter. Call SQLParamData to finish processing */
        /* this parameter and start processing the next parameter.        */

        while (rc == SQL_NEED_DATA) {
            rc = SQLParamData(hstmt,  &pToken);
            if (rc == SQL_NEED_DATA) {
                InitUserData(pToken,  InitValue);
                while (GetUserData(InitValue,  pToken, Data, &StrLen_or_Ind) )
                    SQLPutData(hstmt,  Data, StrLen_or_Ind);
                }
        }

/* Commit the transaction. */
```

```
SQLEndTran(SQL_HANDLE_ENV,  henv, SQL_COMMIT);

/* Free the Statement handle. */
SQLFreeHandle(SQL_HANDLE_STMT,  hstmt);

/* Disconnect from the database */
SQLDisconnect(hdbc);

/* Free the Connection handle */
SQLFreeHandle(SQL_HANDLE_DBC,  hdbc);

/* Free the Environment handle */
SQLFreeEnv(SQL_HANDLE_ENV,  henv);

return(0);
}

/*****************************************************************
The following functions are given for completeness, but are not
relevant for understanding the database processing nature of CLI
*****************************************************************/

void InitUserData(SQLSMALLINT  sParam, SQLPOINTER InitValue)
{
SQLCHAR  szPhotoFile[MAX_FILE_NAME_LEN];

switch sParam {
        case 3:

                /* Prompt user for bitmap file containing employee photo.    */
                /* OpenPhotoFile opens the file and returns the file handle. */

                PromptPhotoFileName(szPhotoFile);
                OpenPhotoFile(szPhotoFile,  (FILE *)InitValue);
                break;
}
}

SQLSMALLINT GetUserData(SQLPOINTER  InitValue,
                        SQLSMALLINT sParam,
                        SQLCHAR *Data,
                        SQLINTEGER *StrLen_or_Ind)

{
switch sParam {
        case 1:
                /* Prompt user for employee name. */

                PromptEmployeeName(Data);
                *StrLen_or_Ind = SQL_NTS;
                return (1);

        case 3:
                /* GetNextPhotoData returns the next piece of photo data and  */
                /* the number of octets of data returned (up to MAX_DATA_LEN). */

                Done = GetNextPhotoData( (FILE *)InitValue, Data,
                                         MAX_DATA_LEN,  StrLen_or_Ind);
                if (Done) {
```

```
                        ClosePhotoFile( (FILE *)InitValue);
                        return(1);
                }
                return(0);
        }
        return(0);
        }
```

Appendix E

Mappings to and from X/Open SQL

This appendix maps CLI functions to and from the embedded SQL specified in the X/Open **SQL** specification.

The forms shown in this appendix are not necessarily the actual syntax; they are meant only to illustrate classes of syntax that map to one another.

CLI dynamic arguments correspond generally to host variables in embedded SQL.

E.1 CLI to X/Open Embedded SQL

The following table indicates which of the X/Open **SQL** specification statements, if any, correspond to the CLI functions. The numbers in [ ] refer to the notes following the table.

CLI Function	X/Open SQL Statement	Comments
AllocConnect( )	none	
AllocEnv( )	none	
AllocHandle( )	ALLOCATE DESCRIPTOR	[1]
AllocStmt( )	none	
BindCol( )	none	
BindParam( )	SET DESCRIPTOR	
Cancel( )	none	
CloseCursor( )	CLOSE	
ColAttribute( )	GET DESCRIPTOR	
Columns( )	SELECT...FROM COLUMNS	CLI has additional columns.
Connect( )	CONNECT	
CopyDesc( )	DESCRIBE	
DataSources( )	none	
DescribeCol( )	GET DESCRIPTOR	
Disconnect( )	DISCONNECT	
EndTran( )	COMMIT/ROLLBACK	
Error( )	GET DIAGNOSTICS	
ExecDirect( )	EXECUTE IMMEDIATE	[2, 3]
Execute( )	EXECUTE	[2]
Fetch( )	FETCH	
FetchScroll( )	FETCH	
FreeConnect( )	none	
FreeEnv( )	none	
FreeHandle( )	DEALLOCATE DESCRIPTOR	[1]
FreeStmt( )	none	
GetConnectAttr( )	none	
GetConnectOption( )	none	
GetCursorName( )	none	
GetData( )	GET DESCRIPTOR ... DATA	Can also get a long column in pieces.

CLI Function	X/Open SQL Statement	Comments
GetDescField( )	GET DESCRIPTOR	[4]
GetDescRec( )	GET DESCRIPTOR	[4]
GetDiagField( )	GET DIAGNOSTICS	
GetDiagRec( )	GET DIAGNOSTICS	
GetEnvAttr( )	none	
GetFunctions( )	none	
GetInfo( )	none	
GetStmtAttr( )	none	
GetStmtOption( )	none	
GetTypeInfo( )	none	
NumResultCols( )	GET DESCRIPTOR ... COUNT	
ParamData( )	none	
Prepare( )	PREPARE	Statement forms legal in *Prepare*( ) are less restrictive than in PREPARE.
PutData( )	none	
RowCount( )	GET DIAGNOSTICS	
SetConnectAttr( )	none	
SetConnectOption( )	none	
SetCursorName( )	none	
SetDescField( )	SET DESCRIPTOR	[4]
SetDescRec( )	SET DESCRIPTOR	[4]
SetEnvAttr( )	none	
SetParam( )	SET DESCRIPTOR	
SetStmtAttr( )	none	
SpecialColumns( )	none	
Statistics( )	SELECT...FROM INDEXES	CLI has different columns.
Tables( )	SELECT...FROM TABLES	CLI has additional columns.
Transact( )	COMMIT/ROLLBACK	

Notes:

[1] CLI data structures other than descriptors have no analog in embedded SQL. Embedded SQL client data structures other than descriptors are allocated and freed implicitly.

[2] If the SQL text being prepared or executed is a *cursor-specification*, this function maps to DECLARE CURSOR followed by OPEN.

[3] If the text being prepared contains dynamic parameter markers and it is not a *cursor-specification*, this function maps to PREPARE followed by EXECUTE.

[4] In CLI, descriptors are also used to specify dynamic arguments.

E.2 X/Open Embedded SQL to CLI

This table describes which CLI functions, if any, correspond to the embedded SQL statements in the X/Open **SQL** specification. The numbers in [ ] refer to the notes following the table.

X/Open SQL Statement	CLI Function	Comments
Cursor Declarations		
DECLARE CURSOR	none	[1]
Dynamic DECLARE CURSOR	none	[1]
Data Definition Statements		
CREATE INDEX	none	[2]
CREATE TABLE	none	[2]
CREATE VIEW	none	[2]
DROP INDEX	none	[2]
DROP TABLE	none	[2]
DROP VIEW	none	[2]
GRANT	none	[2]
REVOKE	none	[2]
Data Manipulation Statements		
CLOSE	*CloseCursor*( )	
Positioned DELETE	none	[1,3]
Searched DELETE	none	[2]
FETCH	*Fetch*( )	
INSERT	none	[2]
OPEN	none	[1]
SELECT	not supported	[5]
Positioned UPDATE	none	[1,3]
Searched UPDATE	none	[2]
Dynamic SQL Statements		
ALLOCATE DESCRIPTOR	*AllocHandle*(Descr.)	
Dynamic CLOSE	*CloseCursor*( )	
DEALLOCATE DESCRIPTOR	*FreeHandle*(Descr.)	
Dynamic Positioned DELETE	*ExecDirect*( )	[2]
DESCRIBE	*CopyDesc*( )	
EXECUTE	*Execute*( )	
EXECUTE IMMEDIATE	*ExecDirect*( )	
Dynamic FETCH	*Fetch*( )	
GET DESCRIPTOR	*GetDescField*( )	COUNT form or single field.
	GetDescRec( )	Entire item descriptor area.
Dynamic OPEN	*Execute*( )	
Prepare	*Prepare*( )	
SET DESCRIPTOR	*SetDescField*( )	COUNT form or single field.
	SetDescRec( )	Entire item descriptor area.
Dynamic Positioned UPDATE	*ExecDirect*( )	[2]

X/Open SQL Statement	CLI Function	Comments
Transaction Control Statements		
COMMIT ROLLBACK	*EndTran*(SQL_COMMIT) *EndTran*(SQL_ROLLBACK)	
Connection Statements		
CONNECT DISCONNECT SET CONNECTION	*Connect*( ) *Disconnect*( ) none	 CLI does not support DISCONNECT ALL. [4]
Diagnostics Statement		
GET DIAGNOSTICS	*GetDiagField*( ) *GetDiagRec*( )	Gets any single diagnostic field; extensible. Gets SQLSTATE, native code and message text.

Notes:

[1] The CLI implementation implicitly declares and opens a cursor if the application passes a *cursor-specification* to *Execute*( ) or *ExecDirect*( ). To set a name for the cursor, use *SetCursorName*( ). To retrieve a cursor name, use *GetCursorName*( ).

[2] CLI does not provide direct equivalents for these SQL statements, but they can be prepared by *Prepare*( ) and then executed by *Execute*( ), or executed directly using *ExecDirect*( ).

[3] The application obtains the implementation-generated cursor name by first calling *GetCursorName*( ).

[4] The CLI implementation tracks which connection is current and switches to a different connection if the application uses a handle specifying or implying a different connection.

[5] The *Columns*( ) and *Tables*( ) functions are equivalent to a *cursor-specification* on a system view.

Glossary

This Glossary is intended to assist understanding and is not a substantive part of this specification.

active connection
A current or dormant connection on which any SQL statement has been successfully executed during the current transaction.

application
The end-user program written to operate on a database. This term is used to distinguish that program from the implementation (the CLI product) when discussing the calling interface.

application row buffer
An area provided by the application into which the implementation returns database data.

application parameter buffer
An area provided by the application into which the application places dynamic arguments.

application parameter descriptor
A descriptor that describes the elements of the application parameter buffer.

application row descriptor
A descriptor that describes the elements of the application row buffer.

argument
A value the application passes into a function when invoking that function.

authentication string
A string that is used to validate the user identifier.

base table
A table that is not a view. See also *View*.

binding
The act of associating a parameter, variable or other placeholder with an actual value.

bound parameter
A dynamic parameter whose value has been specified by association with a bound descriptor record. See Section 3.5.6 on page 37.

bound column
A column reference that is described by a descriptor record in the associated bound descriptor. See Section 3.5.6 on page 37.

by reference
An argument that will reflect changes made within the body of that function outside the scope of that function.

by value
An argument that will not reflect changes made within the body of the function outside the scope of that function.

byte
An octet. This specification avoids the term *byte*. It uses *octet* to refer to an amount of storage, and *character* to refer to a component of character-string data independent of the amount of storage.

character
A component of character-string data, which requires one or more octets of storage. See Section 2.3.4 on page 18.

client
The component of a database application that requests data for processing.

column attribute
An item of information about a column, such as the column length.

current connection
The connection on which a function operates.

cursor
A movable pointer into a result set.

cursor-specification
Throughout this specification, *cursor-specification* refers to the entire syntax of the *cursor-specification* (SELECT statement) defined in the X/Open **SQL** specification. This does not include the SELECT...INTO syntax of the dynamic FETCH statement of embedded SQL.

data-at-execute parameter
A bound dynamic parameter whose fields are set to indicate that the application will provide the dynamic argument when the statement is executed (see Section 4.3.2 on page 48).

database handle
A handle that identifies the context of a connection to a server. All data that is pertinent to the server is associated with this handle.

deadlock
A condition under which an activity may not proceed because it is dependent on exclusive resources that are owned by some other activity, which in turn is dependent on exclusive resources in use by the original activity.

deferred field
A field of a descriptor that the application specifies at one time and for which the implementation retrieves or supplies the value at a later time.

delimited identifier
A double-quoted string that identifies an object within a database. All text within the double quotes is assumed to be part of the identifier and is interpreted literally.

deprecated feature
A term used in discussing X/Open-compliance; see the full discussion of compliance in Section 1.5 on page 8.

descriptor
A data structure inside the implementation that contains information about one or more columns or dynamic arguments.

dormant connection
A connection that the application has established previously and has not disconnected, but is not using in the current database activity.

dynamic SQL
An execution model in which the actual SQL statement is not known until run time.

dynamic parameter
A position in an SQL statement that represents a literal value the application must define before executing the statement.

dynamic argument
The value that is bound to a dynamic parameter of an SQL statement.

embedded SQL
An execution model in which SQL statements are included as part of the compilable source code of a program.

environment handle
A handle that identifies the global context for database access. All data that is pertinent to all objects in the environment is associated with this handle.

error condition
A condition in the execution of a function that indicates failure to perform the requested operation. Contrast *warning condition*.

error status
A return code from a function that reports an *error condition*.

escape character
A character that disables special interpretation of the character that follows it in a *pattern-value*. See **Qualification by Pattern-values** on page 55.

function
One of the CLI functions that this specification defines, unless a different meaning is evident in context.

handle
A variable that refers to a data structure within the implementation. Handles hide implementation-defined data structures.

identifier
A text string, whose content is subject to certain rules, that identifies an object in a database, such as a cursor, table or user.

implementation
The X/Open-compliant CLI product. This term is used to distinguish the CLI product from the application (the end-user program) when discussing the calling interface.

implementation-defined
A term used in discussing X/Open-compliance; see the full discussion of compliance in Section 1.5 on page 8.

implementation parameter buffer
The area in the implementation that contains the dynamic arguments in a form in which they will be passed to the database.

implementation parameter descriptor
A descriptor that describes the elements of the implementation parameter buffer.

implementation row buffer
The area in the implementation that contains data read from the database.

implementation row descriptor
A descriptor that describes the elements of the implementation row buffer.

implicit descriptor
A descriptor that the implementation creates when the application allocates a statement handle. Implicit descriptors are associated with exactly one statement handle and may not be re-associated with any other statement handle. An implicit descriptor is destroyed when the application frees its statement handle.

metadata
The definitions of all active base tables, viewed tables, indexes, privileges and user names in a database.

metadata function
One of the CLI functions that query the metadata (the structure of a database) rather than the data.

octet
A discrete unit of memory accommodating at least 8 bits. An octet is the unit this specification uses to measure the memory requirements of a character.

open connection
A connection that is either active or dormant.

optional feature
A term used in discussing X/Open-compliance; see the full discussion of compliance in Section 1.5 on page 8.

parameter
The abstract representation of the function arguments.

parameter number
The ordinal position of a dynamic parameter.

pending transaction
A transaction that has not been completed.

positioned update
An UPDATE statement in SQL that operates on data identified by a cursor.

positioned delete
A DELETE statement in SQL that operates on data identified by a cursor.

precision
The number of bits or digits representing a number.

pseudo-column
A column in a table other than those specified by an application using the CREATE TABLE or ALTER TABLE statements of embedded SQL. Pseudo-columns are undefined by this document. An example of a pseudo-column is a row identifier.

qualification
An application's optional use of a schema name and, on some implementations, a catalog name, to make unique the reference to a database object. See Section 2.4.3 on page 22.

RDA
(Remote Database Access) A mechanism by which clients and servers communicate to carry out application database requests; specified in the X/Open **RDA** specification.

restricted handle
A handle returned by *AllocHandle*( ) that the application can use only to obtain diagnostic information or to free the handle.

result set
A derived table produced as the result of SQL statement or CLI function execution. It is this table from which rows are fetched.

scale
The number of bits or digits representing the fractional part of a number.

schema
A collection of related objects in a database.

SELECT statement
See *cursor-specification*.

server
The component of a database application that provides data on request.

skeleton environment
An environment referenced by a *restricted handle*. The only valid use of this environment is to obtain diagnostic information.

SQL
(Structured Query Language) A standard language for codifying database queries and updates as text, specified in the X/Open **SQL** specification.

statement handle
A handle that identifies the context of a single SQL statement.

status record
A record of some error or warning event maintained by the implementation. The application can retrieve elements of the status record using *GetDiagRec*( ) or *GetDiagField*( ).

stored routine
A routine (procedure or function) that resides on the server, which the client can invoke.

system view
A view, defined in the X/Open **SQL** specification, that provides metadata.

transaction
An action or series of actions that are *atomic*; that is, such that either all actions take permanent effect or none do. Transactions are defined more precisely, and their effects are discussed, in the X/Open **Distributed Transaction Processing Reference Model**.

two-phase commit
A protocol for ensuring that a transaction is atomic (see *transaction*) among all sites (for example, servers) where the actions take place. For more information, see the X/Open **Distributed Transaction Processing Reference Model**.

type convertible
Data types whose values may be assigned to objects of another data type.

unbound column
A column value whose associated descriptor record is not bound.

unbound parameter
A dynamic parameter reference whose dynamic argument value has yet to be supplied by associating it with a bound descriptor record.

undefined
A term used in discussing X/Open-compliance; see the full discussion of compliance in Section 1.5 on page 8.

user identifier
The string that represents the security identity under whose auspices the connection is established.

view
A derived table with a name that is defined in terms of other tables. Conceptually, a base table is a table that is stored; a view is a table that is computed.

warning condition
A condition in the execution of a function that does not imply a failure to perform the requested operation but provides the application with additional information. Contrast *error condition*.

warning status
A return code from a function that reports a *warning condition*.

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