CA IDMS™ SQL

Programming Guide

Release 18.5.00

CA Technologies Product References

This guide references to the following CA products:

- CA ADS™ For CA IDMS™
- CA ADS™ Option for APPC
- CA ADS™ Batch Option
- CA ADS™ Alive Option
- CA ADS™ Trace Option
- CA IDMS™ Database Dictionary Module Editor Option
- CA IDMS™ Database Dictionary Migrator Option

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Documentation Changes

The following documentation updates were made for the 18.5.00 release of this documentation:

- Requirements and Options for Host Languages (see page 87)—This chapter now indicates that the use of embedded SQL requires a full SQL license.

Contents

Chapter 1: Introduction

This section contains the following topics:

Who Should Use This Guide

This guide is for CA IDMS users who are responsible for designing and developing application programs using embedded SQL. It also documents aspects of CA IDMS that are specific to application programming with SQL, including precompiler options and data type conversions between the database and the program language.

Users of this guide should be experienced in using the program language and should have a working knowledge of SQL. Users should also be familiar with concepts of CA IDMS.

For users new to SQL, completion of the *CA IDMS SQL Self-Training Guide* is recommended before using this guide. For more information, see the *CA IDMS Release Summary*.

How examples are presented in this guide

All program examples are in COBOL unless otherwise indicated.

Most examples of access to an SQL-defined database refer to a test database of employee information that is supplied as part of CA IDMS installation. Partial documentation of this database appears in Test Database (see page 217).

The term CA IDMS is used to refer to any one of the following CA IDMS components:

- CA IDMS/DB—The database management system
- CA IDMS/DC—The data communications system and proprietary teleprocessing monitor
- CA IDMS UCF—The universal communications facility for accessing CA IDMS database and data communications services through another teleprocessing monitor, such as CICS
- CA IDMS DDS—The distributed database system

The actual product names are used for CA IDMS/DB, CA IDMS/DC, CA IDMS UCF, DC/UCF, and CA IDMS DDS to identify the specific CA IDMS component only when it is important to your understanding of the product.

Syntax Diagram Conventions

The syntax diagrams presented in this guide use the following notation conventions:

`UPPERCASE OR SPECIAL CHARACTERS`

Represents a required keyword, partial keyword, character, or symbol that must be entered completely as shown.

`lowercase`

Represents an optional keyword or partial keyword that, if used, must be entered completely as shown.

`italicized lowercase`

Represents a value that you supply.

`lowercase bold`

Represents a portion of the syntax shown in greater detail at the end of the syntax or elsewhere in the document.

Points to the default in a list of choices.

Indicates the beginning of a complete piece of syntax.

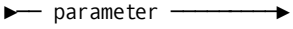
Indicates the end of a complete piece of syntax.

Indicates that the syntax continues on the next line.

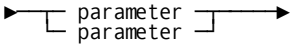
Indicates that the syntax continues on this line.

Indicates that the parameter continues on the next line.

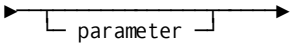
Indicates that a parameter continues on this line.



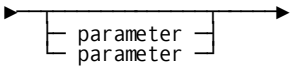
Indicates a required parameter.



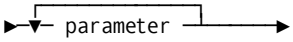
Indicates a choice of required parameters. You must select one.



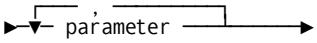
Indicates an optional parameter.



Indicates a choice of optional parameters. Select one or none.



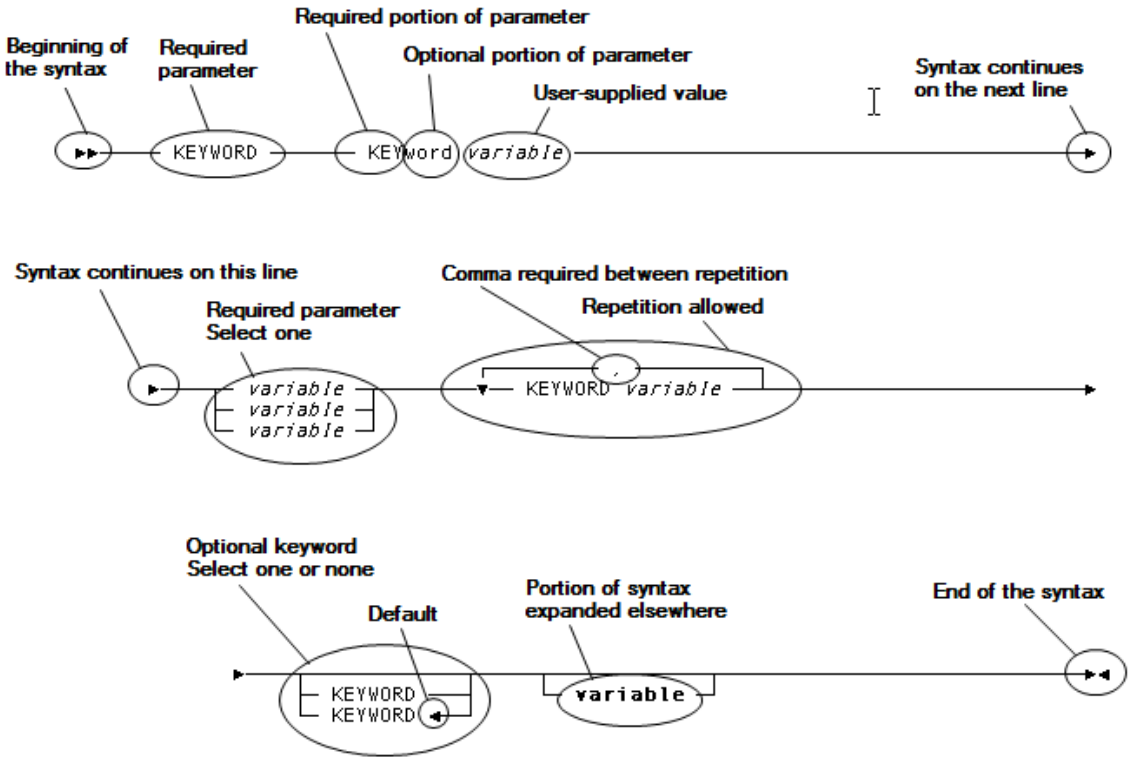
Indicates that you can repeat the parameter or specify more than one parameter.



Indicates that you must enter a comma between repetitions of the parameter.

Sample Syntax Diagram

The following sample explains how the notation conventions are used:



Chapter 2: SQL Application Development in CA IDMS

This section contains the following topics:

Accessing Data Using SQL

You embed SQL statements in an application program to access the database. SQL allows you to access the database without reference to its physical characteristics.

A database defined with SQL DDL includes constraints that govern data manipulation. The DBMS enforces constraints at runtime.

SQL Data Access

Tables and Views

Data accessed through SQL is perceived as tables made up of rows and columns. A table is a **base** table.

An application program accesses an SQL-defined database by issuing SQL statements that refer to one or more base tables, or to a predefined view of one or more base tables.

Schema and Area

A **schema** is a named collection of tables and views. The rows of a table are stored in the **area** that is specified in the CREATE TABLE statement or, if not specified, in the default area for the schema.

Concurrent access to data can be controlled at the area level and the table row level.

SELECT Statement

A SELECT statement requests the DBMS to retrieve data. The table of values returned to the program on a select is a **result** table. Typically, a result table is a subset of the row and column values in one or more base tables.

Cursor

A cursor is an SQL programming construct that is used to process data in a result table. The cursor defines the result table, and the program can retrieve each row of the result table one at a time with a FETCH statement.

The cursor row whose values are available to the program represents the **cursor position**. Each FETCH statement advances the cursor position to the next row of the result table.

Updateable Cursor

If the cursor definition meets certain requirements, it is an **updateable** cursor. The program can update or delete the row on which an updateable cursor is positioned, (that is, the row most recently fetched).

INSERT, UPDATE, and DELETE

The SQL statement to add a row to a table is INSERT and to delete a row is DELETE. The statement to modify one or more column values in a row is UPDATE.

Host Variables

A host variable is a program variable that is referenced in an SQL statement. Host variables are used to receive data retrieved from the database and to supply data to be added to the database.

Local Variables

A local variable of an SQL routine is a program variable declared in a compound statement of an SQL routine. Local variables can be used to receive data retrieved from the database and to supply data to be added to the database.

Routine Parameter

A routine parameter of an SQL routine is a program variable declared in the parameter definition of an SQL routine. Routine parameters provide for the mechanism of passing data between an SQL routine and its invoker, but they can also be used to receive data retrieved from the database and to supply data to be added to the database.

CALL

The CALL procedure is the SQL statement that invokes an external procedure's program or an SQL procedure using a remote procedure paradigm. Input values are passed from CA IDMS to the program or SQL procedure. The output values are returned into the host variables of the program or into the local variables or routine parameters of the SQL procedure specified in the procedure reference.

Bulk Processing

Bulk processing is a CA IDMS extension to the SQL standard that allows the program to select, fetch, or insert a group of rows using a host variable array.

Temporary Table

An application program can create a temporary table, populate it, and manipulate the data in it. A temporary table exists only for the duration of the SQL transaction in which it is created.

Prepared Statement

A program can **prepare**, or compile, certain SQL statements at runtime. This allows the program to execute an SQL statement that is not known until runtime.

Integrity Constraints

Integrity rules are enforced by the DBMS using **constraints** that are specified as part of the database definition.

Unique Constraint

A unique constraint requires that each row of a table be unique with respect to the value of a column or combination of columns. A unique constraint is defined when an index or CALC key is defined with the UNIQUE parameter.

It is possible to define any number of unique constraints on a table.

Primary Key

The primary key is a column or combination of columns for which a unique constraint has been defined and which has been defined as not null. Consequently, the primary key uniquely identifies each row and prevents duplicate rows from being stored. For example, in the DEPARTMENT table of the demonstration database, DEPT_ID is the primary key.

A table usually has one and only one primary key.

Referential Constraint

A referential constraint is a relationship between two tables. A referential constraint identifies a **foreign key** in one of the tables, the **referencing** table. A foreign key is a column or combination of columns whose value must exist as the value of the primary key in a row of the related table, the **referenced** table.

When a referential constraint has been created, a row cannot be stored in the referencing table unless its foreign key value already exists as a primary key in the referenced table. Conversely, a row in the referenced table cannot be deleted or have its primary key value altered if the primary key value exists as a foreign key in the referencing table. This assures referential integrity between the tables.

Referential Constraint Illustration

The following example identifies two referential constraints between the DEPARTMENT table and the EMPLOYEE table:

1. A value cannot be stored in the DEPT_ID column of the EMPLOYEE table unless the value exists in the DEPT_ID column of the DEPARTMENT table
2. A value cannot be stored in the DEPT_HEAD_ID column of the DEPARTMENT table unless the value exists in the EMP_ID column of the EMPLOYEE table

DEPARTMENT table

DEPT_ID	DEPT_NAME	DIV_CODE	DEPT_HEAD_ID
3510	APPRAISAL - USED CARS	D02	3082
4500	HUMAN RESOURCES	D09	3222
2210	SALES - NEW CARS	D04	2010
5000	CORPORATE ACCOUNTING	D09	2466
3520	APPRAISAL NEW CARS	D04	3769
4600	MAINTENANCE	D06	2096
4200	LEASING - NEW CARS	D04	1003
5100	BILLING	D06	2598
6000	LEGAL	D09	1003
1100	PURCHASING - USED CARS	D02	2246
3530	APPRAISAL – SERVICE	D06	2209
5200	CORPORATE MARKETING	D09	2894
1110	PURCHASING - NEW CARS	D04	1765
3000	CUSTOMER SERVICE	D09	4321
6200	CORPORATE ADMINISTRATION	D09	2461
2200	SALES - USED CARS	D02	2180
1120	PURCHASING - SERVICE	D06	2004
4900	MIS	D09	2466

EMPLOYEE (DEPT_ID)
references DEPARTMENT (DEPT_ID)

EMPLOYEE table

DEPT_ID	EMP_LNAME	EMP_ID
1100	FORDMAN	5008
1100	HALLORAN	4703
1100	HAMEL	2246
1110	ALEXANDER	1765
1110	WIDMAN	2106
1120	JOHNSON	2004
1120	JOHNSON	3294
1120	UMIDY	2898
1120	WHITE	3338
2200	ALBERTINI	2180
.	.	.
.	.	.
.	.	.

DEPARTMENT
(DEPT_HEAD_ID)

EMPLOYEE
(EMP_ID)

Domain Constraint

A domain constraint restricts column values and is part of the table definition. The types of domain constraint are:

- **Data type**—Restricts column values to the data type of the column (for example, INTEGER restricts column values to the set of integers)
- **Check constraint**—Restricts column values to a range of values that satisfies a search condition
- **Not null constraint**—Requires that each column of a row contain an actual value and not the absence of a value

Constraint Violation

If the DBMS detects a constraint violation when processing an SQL statement, it returns an error.

Accessing Non-SQL Defined Databases

What You Can Do

CA IDMS provides the ability to use SQL to access a non-SQL defined database. The SQL statements used to access such a database are the same as those used to access a database that is defined with SQL DDL. Programming considerations such as session management and concurrency control are also the same.

Note: For more information about accessing a non-SQL defined database using SQL, see the *CA IDMS SQL Reference Guide*.

You can use a **table procedure**, a **procedure**, or a **user-defined function** to process non-SQL defined data in a relational way even though the data does not conform to the rules established for such access.

A **table procedure** is a user-written program which allows any data accessible through CA IDMS to be viewed and processed as a table. The parameters passed to and from the program are treated as the columns of a table which can be manipulated using SQL DML commands. The specifics of how the database is accessed in servicing these requests is hidden within the table procedure. A table procedure can:

- Provide full update capability on member records that do not contain foreign keys
- Access data with multiple definitions
- Access data that does not conform to the data type defined in the non-SQL schema
- Translate special data values into null values

A **procedure** is a user-written program and can be used to process and access a non-SQL-defined database. Procedures provide a method for implementing the remote call procedure paradigm.

When a procedure is invoked, it is called only once for each set of input values regardless of the type of statement containing the procedure reference. Within the single call, the procedure must use the input values, perform the expected action, and return the appropriate output values. This differs from a table procedure that can be called multiple times for a given set of input values depending upon the type of statement containing the procedure reference. Procedures are much easier to write and to interface with than table procedures.

A **user-defined-function** is invoked through a qualified or unqualified function identifier together with an optional set of parameter values and returns a single value. An external user-defined function has an associated user-written program that can be used to process and access a non-SQL-defined database.

Note: For more information about using table procedures, procedures, and user-defined functions to access non-SQL databases, see the *CA IDMS SQL Reference Guide*.

Requirements

Before you can access a non-SQL defined database through SQL, you must define a schema with the SQL statement CREATE SCHEMA that references the non-SQL defined schema. Then you can reference the records defined in the non-SQL defined schema as tables in SQL DML statements.

Tables and Columns

Once an SQL schema has been defined that references a non-SQL defined schema, each record in the non-SQL defined schema is represented as a table and each record element is represented as a column. Some elements, such as group elements, do not appear as columns in tables representing non-SQL defined records.

These transformations are applied to the names of record elements:

- All hyphens ('-') are translated to underscores ('_')
- Elements occurring a fixed number of times are suffixed with an occurrence count to distinguish individual items

No transformations are applied to the names of records. If the name does not comply to the rules for non-delimited SQL identifiers (for example, because it contains a hyphen), the name has to be delimited in double quotation marks.

Conditions Imposed by Database Design

The design of your non-SQL defined database may impose conditions on the use of some SQL DML statements:

- INSERT, UPDATE and DELETE statements are governed by the rules of referential integrity if the table being operated on represents a record that participates in a set defined with primary and foreign keys in the non-SQL defined schema
- When joining two tables representing records linked through a set in which the member record does not physically contain the owner's key value (that is, there are no embedded foreign keys), you must specify the set name in the join criteria

Limitations Imposed by Database Design

The design of your non-SQL defined database may impose limitations on the use of some SQL DML statements:

- DELETE of a table row representing a record occurrence is disallowed if that record occurrence is the owner of any non-empty set
- INSERT is disallowed on a table representing a record if that record participates in an automatic set for which foreign keys have not been defined in the non-SQL defined schema

SQL Application Development

Given the design of the database and the application, and the description of the data, you take these steps to develop an SQL application in the CA IDMS environment:

1. Design the application
2. Model the database access using SQL submitted through the command facility
3. Write the application
4. Create executable modules
5. Execute the application
6. Test and debug the application

Writing the Application

Program Language

In the program language, you write everything that the application program requires except database access and the structures needed to handle database access. Embedding SQL in the program does not affect any rules that apply to using the program language.

Embedded SQL

Within the application program, you can embed SQL statements to:

- Access the database
- Access the dictionary
- Define the structures needed to transfer data between the program and the DBMS
- Manage SQL sessions and transactions

Note: For more information about the complete syntax for all CA IDMS SQL statements, see the *CA IDMS SQL Reference Guide*.

Creating Executable Modules

Since the application program contains an embedded sublanguage, you precompile the program to create a module of the SQL statements (an RCM) that is separate from program source. You also create an access module that contains an optimized access strategy for the SQL statements in one or more RCMs.

Precompiling the Program

The precompiler converts embedded SQL statements to internal form and stores them in a module called an RCM. It replaces embedded SQL in the source module with calls to the DBMS. These calls, unlike the SQL statements they replace, are intelligible to the language compiler.

The precompiler checks the syntax of the embedded SQL. If there are syntax errors, it issues an error report instead of storing the RCM.

Compiling the Program

After the program precompiles successfully, you compile and link the modified source program to create an executable program load module.

Creating an Access Module

The load module that is executed when the program requests database access is the access module. You must create the access module before executing the program.

An access module is built using one or more RCMs. Each RCM represents the SQL statements from a single source program or CA ADS dialog.

When you create an access module, the optimizer performs these functions on each SQL statement from each RCM that you include in the access module:

- Validates table and column references in the statement against the dictionary
- Selects the most efficient database access strategy for the statement

What Information the Optimizer Uses

To develop an optimized access strategy for an SQL statement, the optimizer considers:

- The type of statement
- The selection criteria
- The physical structure of the database as defined in the dictionary
- Statistics stored in the dictionary as a result of running the UPDATE STATISTICS utility

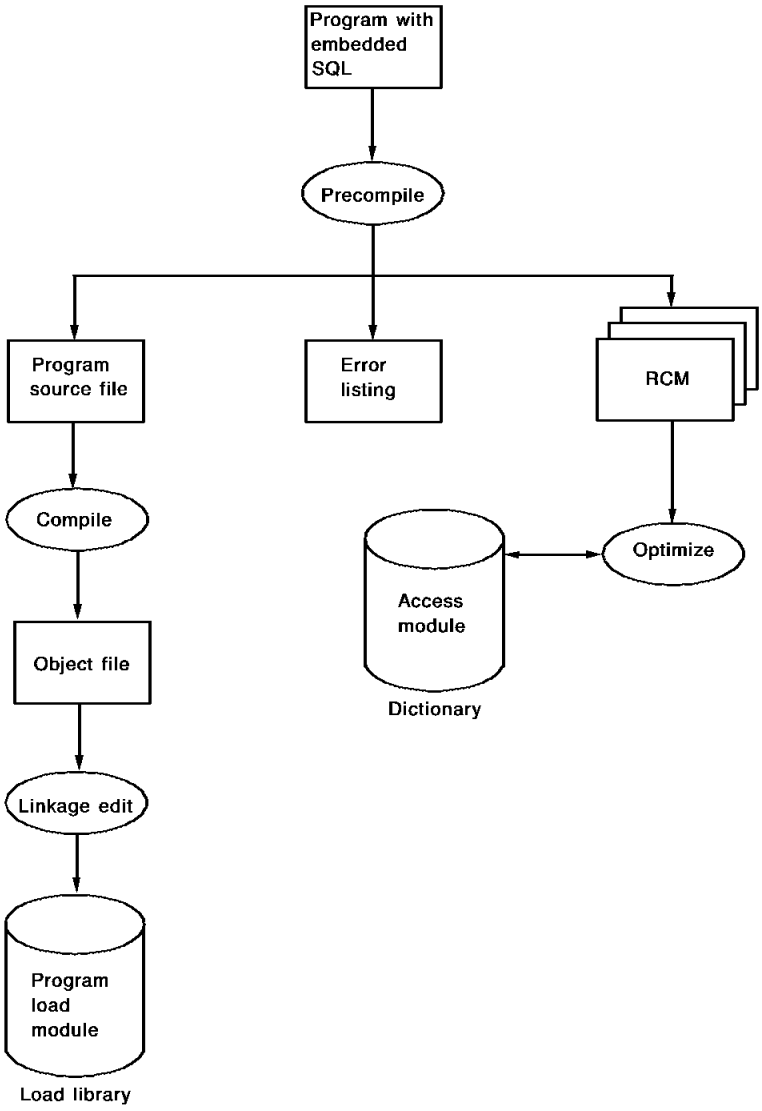
Summary of Program Preparation

These are the steps you take to make the application executable:

1. Precompile the programs
2. Compile and link the programs
3. Create the access module

For more information about how you take these steps, see Preparing and Executing the Program (see page 131).

The next flow chart shows the result of each step in the process:



Executing the Application

SQL Statement Processing

When the program executes at runtime, the program load module and access module are loaded as necessary. The access module is loaded the first time the program calls the DBMS to access data in the database.

The DBMS attempts to validate the definition of a table to be accessed—that is, it verifies the table definition has not changed since the access module was created. If validation fails, the DBMS automatically recreates the access module if you have defined the access module to allow this.

Concurrency Control

When the application executes in a multiuser processing environment, the DBMS controls concurrent access to the same set of data by setting **retrieval** or **update locks**. The DBMS determines the type, level, and duration of the lock from the activities and the **isolation level** of the database transaction.

The CA IDMS defaults for locking favor the greatest possible concurrency that can be maintained while guaranteeing the integrity of the data. You can change the system defaults for locking by specifying a different isolation level and/or a different **ready mode** for an accessed area.

Note: For more information about specifying isolation level and ready mode, see Concurrency Control and Isolation Levels.

Execution Environments

CA IDMS application programs can execute in the DC/UCF region, a batch region, or other region such as a CICS region. Except for a local mode job, all processing of SQL statements occurs under the **central version**, the DC system component that manages multiuser, concurrent access to the database.

Local mode is a single-user batch processing environment that manages access to areas of the database independent of the central version. It is normally used for retrieval-only batch jobs and large-volume update applications that tend to monopolize an area of the database.

The central version performs automatic recovery for programs that end abnormally. No automatic recovery is performed for a local mode program.

Testing and Debugging the Application

Testing SQL Access

You can use the CA IDMS Command Facility to test SQL statements online and to verify conditions of the database. When you successfully test a statement, you can save it in the dictionary.

Note: For more information about using the Command Facility, see the *CA IDMS Common Facilities Guide*.

Debugging Embedded SQL

Besides using CA IDMS debugging tools for the host language program, you can debug embedded SQL by:

- Displaying values in fields of SQL Communication Areas (SQLCAs), where the DBMS returns information about the executing program and about SQL statement execution

  Note: For more information about displaying SQLCA fields, see SQL Status Checking and Error Handling.

- Requesting a trace of all SQL commands issued from a batch application

  Note: For more information about the SQL trace facility, see SQL Trace Facility.

- Issuing GET DIAGNOSTICS SQL statements to request diagnostic information from the DBMS about the last executed SQL statement

  Note: For more information about the GET DIAGNOSTICS statement, see the *CA IDMS SQL Reference Guide*.

Chapter 3: Writing an SQL Program

This section contains the following topics:

Accessing One or More Databases with SQL

Databases can be accessed with SQL using any of the following methods:

- Host variables—Variables that can be referenced in SQL statements in application programs
- Local variables and routine parameters—Variables that can be referenced in SQL statements in SQL routines
- SQL transaction—A database transaction initiated by an SQL statement
- SQL session—A connection to a dictionary that enables SQL access to a database
- SQL Communications Areas—Data structures the program uses to check the status of SQL statement execution

Host Variables

A host variable is a program variable that is referenced in an SQL statement. It is the only kind of variable that you can use in an SQL statement embedded in application programs.

Host variables are necessary for the program to receive data from the database and in most cases for the program to modify data in the database.

How Host Variables Are Used

Host variables are used to:

- Receive column values specified in a SELECT or FETCH statement
- Supply column values specified in an UPDATE statement, INSERT statement, or other statements containing a search condition
- Supply information for dynamically executed statements. For more information, see Chapter 8, Using Dynamic SQL.

Host Variable Example

In this example, DEPT-ID, EMP-LNAME, and EMP-ID are host variables. DEPT-ID and EMP-LNAME receive column values and EMP-ID supplies a column value used in the search condition of the statement:

```
EXEC SQL
  SELECT DEPT_ID,
         EMP_LNAME
    INTO :DEPT-ID,
         :EMP-LNAME
    FROM EMPLOYEE
    WHERE EMP_ID = :EMP-ID
END-EXEC.
```

Indicator Variable

An indicator variable is a host variable used to manipulate null values.

CA IDMS sets an indicator variable to -1 if the column value in the associated host variable is null.

An indicator variable should be defined for each column accessed by the program that could contain a null value. If the program retrieves a null value from a column that has no indicator variable, CA IDMS returns an error.

In a host variable array for use in bulk processing, the data type of an indicator variable must be declared with a usage SQLIND.

Null Value

A null value is the absence of a value and is not the same as spaces or numeric zeros, which are actual values. In an SQL-defined database, a column, regardless of data type, can contain a null value unless the column definition specifically disallows them.

SQL Declare Sections

In SQL Standard, you define host variables within an SQL declare section. You begin and end an SQL declare section with these statements:

```
EXEC SQL
  BEGIN DECLARE SECTION
END-EXEC.
 .
 .
 .
EXEC SQL
  END DECLARE SECTION
END-EXEC.
```

A CA IDMS extension of the SQL standard allows you to continue an SQL declaration section statement on the following line after any keyword.

What You Can Do

You can include any number of host variable declarations in an SQL declare section. You can include any number of SQL declare sections in a single application program.

Host Variable Declaration Example

In this example, the SQL declare section defines host variables, including one indicator variable, using standard COBOL data declarations.

```
WORKING-STORAGE SECTION.
 .
 .
 .
EXEC SQL BEGIN DECLARE SECTION END-EXEC.
  01  EMP-ID           PIC S9(8)     USAGE COMP.
  01  EMP-LNAME        PIC X(20).
  01  SALARY-AMOUNT    PIC S9(6)V(2) USAGE COMP-3.
  01  PROMO-DATE       PIC X(10).
  01  PROMO-DATE-I     PIC S9(4)     USAGE COMP.
EXEC SQL END DECLARE SECTION END-EXEC.
```

INCLUDE TABLE Directive

INCLUDE TABLE Statement

You can use the INCLUDE TABLE statement, a CA IDMS extension of the SQL standard, to define a host language data structure for table columns. INCLUDE TABLE is a precompiler directive that defines host variables for all columns of a table, view, table procedure, procedure or function, or for a subset of columns that you specify in the statement.

If INCLUDE TABLE falls within the scope of an SQL declare section, embedded SQL statements can reference the variables defined by the precompiler as host variables.

Statement Example

The following INCLUDE statement directs the precompiler to define host variables for the DIVISION table, which has columns DIV_CODE, DIV_NAME, and DIV_HEAD_ID:

```
WORKING-STORAGE SECTION.
 .
 .
 .
EXEC SQL
   INCLUDE TABLE DIVISION
END-EXEC.
```

Structure Example

When the precompiler processes the INCLUDE TABLE statement in the prior example, it defines this structure:

```
*EXEC SQL
*   INCLUDE TABLE DIVISION
*END-EXEC.
 01   DIVISION.
         03   DIV-CODE              PIC X(3).
         03   DIV-HEAD-ID           PIC S9(4) COMP.
         03   DIV-HEAD-ID-I         COMP PIC S9(8).
*                                   SQLIND.
         03   DIV-NAME.
               49   DIV-NAME-LEN    PIC S9(4) COMP.
               49   DIV-NAME-TEXT   PIC X(40).
```

INCLUDE Statement Options

You can use options on the INCLUDE statement to perform the following:

- Override the default element level
- Direct the precompiler not to group elements under a structure
- Specify the columns to be included
- Specify names for the generated record and element definitions
- Specify a prefix or suffix for an element name
- Direct the precompiler to generate a multiply-occurring array

Note: For more information about INCLUDE statement syntax and options, see the *CA IDMS SQL Reference Guide*.

Including an Array

You can use the INCLUDE statement to generate a host variable array by specifying the NUMBER OF ROWS parameter. A host variable array is used in bulk processing.

Note: For more information about bulk processing, see Bulk Processing (see page 75).

Host Variable Array Structure

When the precompiler generates a host variable array, it creates a structure using three levels. In the next example, a structure has been generated by an INCLUDE TABLE statement with NUMBER OF ROWS = 100:

```
DIVISION.
    02   DIVISION-BULK OCCURS 100 TIMES.
         03   DIV-CODE              PIC X(3).
         03   DIV-HEAD-ID           PIC S9(4) COMP.
         03   DIV-HEAD-ID-I         COMP PIC S9(8).
*                                   SQLIND.
         03   DIV-NAME.
               49   DIV-NAME-LEN    PIC S9(4) COMP.
               49   DIV-NAME-TEXT   PIC X(40).
```

Usefulness of INCLUDE TABLE

The INCLUDE TABLE statement is a programming tool. It assures that host variable definitions correspond to current table column definitions in the dictionary: the data types are equivalent, and indicator variables are declared for all columns that allow null values.

When Not to Use INCLUDE TABLE

Using INCLUDE TABLE is not appropriate if:

- The program must conform to the SQL standard
- The host variable declaration is for temporary table columns

Referring to Host Variables

Reference Requirements

These syntax requirements apply when you refer to a host variable in an embedded SQL statement:

- To refer to any host variable in an embedded SQL statement, prefix the host variable name with a colon (:)
- To associate an indicator variable with a host variable, place the reference to the indicator variable after the host variable, with *no comma* or other separator character

  Note: You can use the optional keyword INDICATOR as a separator.

Reference Example

In the following example, information from the BENEFITS table is selected for a given employee ID value, which the program has assigned to the host variable EMP-ID. BENEFITS table information is retrieved into host variables VAC-TAKEN and SICK-TAKEN. VAC-TAKEN-I and SICK-TAKEN-I are indicator variables.

```
EXEC SQL
   SELECT VAC_TAKEN,
          SICK_TAKEN
     INTO :VAC-TAKEN INDICATOR :VAC-TAKEN-I,
          :SICK-TAKEN INDICATOR :SICK-TAKEN-I
     FROM BENEFITS
     WHERE EMP_ID = :EMP-ID
END-EXEC.
```

Local Variables and Routine Parameters

Local variables and routine parameters are program variables of SQL routines. These variables can be used as any program variable and are necessary for the SQL routine to receive data from the database and to modify data in the database. In addition to their role as program variables, routine parameters are mainly used to pass input values from and output values to the invoker of the SQL routine.

Local variables are defined in the DECLARE statement of a compound SQL statement. Routine parameters are defined in the parameter-definition clause of the CREATE PROCEDURE or CREATE FUNCTION statements.

How Local Variables and Routine Parameters Are Used

Local variables and routine parameters are used as follows:

- Receive column values specified in a SELECT or FETCH statement
- Supply column values specified in an UPDATE statement, INSERT statement, or other statements containing a search condition
- Supply information for dynamically executed statements

  Note: For more information about dynamically executed statements, see Using Dynamic SQL (see page 181).

Local Variable Example

In the following example, DEPT_ID, EMP_LNAME, and EMP_ID are local variables defined in a compound statement with label MAIN_BLOCK. DEPT_ID and EMP_LNAME receive column values and EMP_ID supplies a column value used in the search condition of the statement:

```
SELECT EMPLOYEE.DEPT_ID, EMPLOYEE.EMP_LNAME INTO MAIN_BLOCK.DEPT_ID,
MAIN_BLOCK.EMP_LNAME
 FROM EMPLOYEE
WHERE EMPLOYEE.EMP_ID = MAIN_BLOCK.EMP_ID;
```

Null Value

A null value is the absence of a value and is not the same as spaces or numeric zeros which are actual values. Local variables and routine parameters are always nullable. However, as these are SQL variables, null support is built-in and null indicators must not be used.

Note: For more information, see the *CA IDMS SQL Reference Guide*.

SQL Sessions

An SQL session is a logical connection between the executing application and the DBMS. It begins when the application connects to a dictionary and ends when the application disconnects from the dictionary. The dictionary contains the definition of the data accessed using SQL.

Beginning and Ending an SQL Session

Beginning an SQL Session

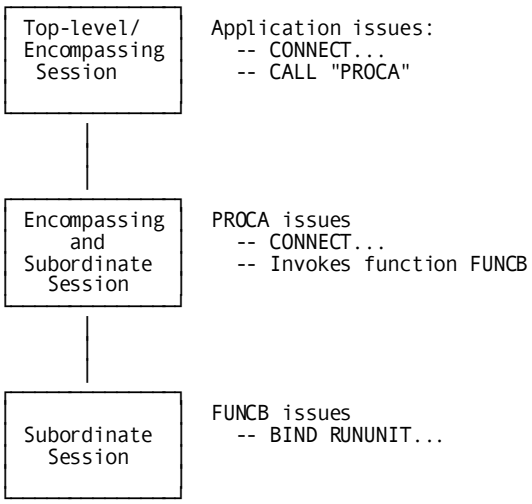
An SQL session begins when the program submits its first SQL statement. If that statement is a CONNECT, the session is connected to the dictionary specified by the statement and the session is said to be *explicitly connected*.

If the first statement is not a CONNECT, the session is *automatically connected* to a default dictionary.

Session Hierarchy

A hierarchy of database sessions occurs when an SQL invoked routine (an SQL procedure, table procedure, or function) starts its own session to access the database.

A database session that is started by a program executing as part of an SQL invoked routine is is a *subordinate session* since it is under the control of the SQL session within which the routine was invoked. The controlling session is referred to as the subordinate session's *encompassing session*. A *top-level* session is one that has no encompassing session.



Default Dictionary

When establishing an automatically connected SQL session, CA IDMS connects the session to a default dictionary.

The default dictionary for a top-level session is established by:

- SYSIDMS DICTNAME parameter for a batch application
- Value of the DICTNAME attribute for the user session, as set by one of the following:
  - User profile
  - System profile
  - Default dictionary defined by the DBNAME table
  - DCUF SET DICTNAME system task
  - Call to IDMSIN01 to set the DICTNAME attribute

Note: For more information about SYSIDMS parameters and calling IDMSIN01, see the *CA IDMS Common Facilities Guide*.

The default dictionary for a subordinate session is determined by the initiating routine definition's DEFAULT DATABASE parameter.

- If DEFAULT DATABASE CURRENT was specified, the default dictionary is the dictionary to which the encompassing SQL session is connected.
- If DEFAULT DATABASE NULL was specified (or defaulted), the default dictionary is determined in the same way as for a top-level session.

Note: For more information about the DEFAULT DATABASE parameter of the CREATE PROCEDURE, CREATE TABLE PROCEDURE or CREATE FUNCTION statements, see the *CA IDMS SQL Reference Guide*.

SQL Statements that End a Session

If the SQL session began automatically (that is, no CONNECT statement was issued), it ends when the program issues one of these statements:

- COMMIT
- ROLLBACK
- COMMIT RELEASE
- ROLLBACK RELEASE
- RELEASE

If a CONNECT statement was executed to start the session, it ends when the program issues one of these statements:

- COMMIT RELEASE
- ROLLBACK RELEASE
- RELEASE

If an encompassing session ends, all of its subordinate sessions end also.

Automatic Session Termination

If a batch application program terminates execution by returning control to the operating system, SQL sessions still in progress are terminated automatically as if the application had issued a ROLLBACK RELEASE statement.

If a program returns control to a teleprocessing system or issues certain teleprocessing statements, such as FINISH TASK, SQL sessions still in progress may or may not be terminated depending on the event or statement issued and whether the session is suspended.

Note: For more information about the effect of teleprocessing statements on SQL sessions, see Effect of Teleprocessing Statements and Events (see page 41).

Database Transactions

A database transaction is a unit of recovery representing work done by one or more database sessions. All access to CA IDMS data from within an SQL session is done under the control of a database transaction.

Transactions can be associated with one or more database sessions. A transaction can be associated with more than one session only if a session is eligible to share its transaction with other sessions. Transactions started by sessions that are not eligible to share their transaction are called *nonshareable transactions*.

Managing Nonshareable Transactions

Beginning a Transaction

A nonshareable transaction is started when the program submits an SQL statement that results in access to either user data or a dictionary, unless the session is already associated with a transaction.

Transaction Hierarchy

Just as sessions can be related in a hierarchical way, their associated transactions can also be related hierarchically. If a session is subordinate to another session, its transaction is subordinate to the encompassing session's transaction.

Note: For more information about session hierarchies, see Beginning and Ending an SQL Session (see page 34).

When a transaction is committed or rolled back, all of its direct and indirect subordinates are also committed or rolled back.

Ending a Transaction

If a session's transaction is not shareable, it ends when:

- A COMMIT statement is executed.
- A ROLLBACK statement is executed.
- The SQL session is terminated.

When a transaction ends, all open cursors are closed, all temporary tables are dropped, and all prepared statements are dropped.

More Information

- For more information about cursors, see Using a Cursor (see page 67).
- For more information about temporary tables, see Creating and Using a Temporary Table (see page 167).
- For more information about prepared statements, see Executing Prepared SELECT Statements (see page 187).

Committing Changes

Changes made through an SQL session are committed when an SQL COMMIT statement is executed or when a teleprocessing statement is executed that results in the committing of database updates. If changes are not committed in one of these ways, updates made through an SQL session are backed out, either as the result of an explicit ROLLBACK request or automatically as the result of a teleprocessing statement or event.

Note: For more information about the effect of teleprocessing statements on database transactions, see Effect of Teleprocessing Statements and Events (see page 41).

Transaction sharing impacts the committing of database changes.

Note: For more information about the impact that sharing database transactions has on committing changes, see Sharing Transactions Among Sessions (see page 38).

Preserving Session State after a Commit

Normally when a transaction is committed, the state of the session is reset: cursors are closed, prepared statements are deleted and temporary tables are dropped. However, a CA IDMS extension to the SQL standard allows you to commit updates but preserve the session state as it was prior to the commit. This extension is the CONTINUE parameter of the COMMIT statement:

```
EXEC SQL
   COMMIT CONTINUE
END-EXEC.
```

The CONTINUE parameter limits the effect of a COMMIT to committing updates and downgrading or releasing update locks held for the transaction.

Sharing Transactions Among Sessions

Sharing a Transaction

A transaction can be shared by multiple database sessions, both SQL sessions and non-SQL sessions (rununits). By sharing a transaction, sessions will not deadlock among themselves even if they access and update the same data.

Enabling Transaction Sharing

An SQL session is eligible to share its transaction if transaction sharing is in effect when the database session is started.

Transaction sharing is in effect for a top-level session if:

- TRANSACTION_SHARING=ON is specified in the SYSIDMS file for a batch application.

  Note: For more information about SYSIDMS parameters, see the *CA IDMS Common Facilities Guide*.

- IDMSCINT or CICSOPT parameter specified TXNSHR=ON for CICS applications.

  Note: For more information about IDMSCINT and CICSOPT parameters, see the *CA IDMS System Operations Guide*.

- Transaction sharing has been enabled for the executing DC/UCF task by means of a SYSGEN or DCMT command.
- Transaction sharing has been enabled though a call to IDMSIN01.

For subordinate sessions, transaction sharing is controlled through the TRANSACTION SHARING parameter of the SQL invoked routine's definition unless overridden by a call to IDMSIN01 from within the routine.

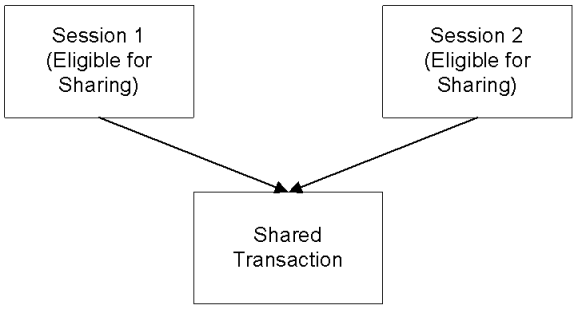
- If TRANSACTION SHARING ON is specified, transaction sharing is enabled for all sessions started by the routine.
- If TRANSACTION SHARING OFF is specified, transaction sharing is disabled for all sessions started by the routine.
- If TRANSACTION SHARING DEFAULT is specified (or defaulted), the transaction sharing state that was in effect before the routine was called applies to all sessions started by the routine.

Note: For more information about the TRANSACTION SHARING parameter of the CREATE PROCEDURE, CREATE TABLE PROCEDURE or CREATE FUNCTION statements, see the *CA IDMS SQL Reference Guide*.

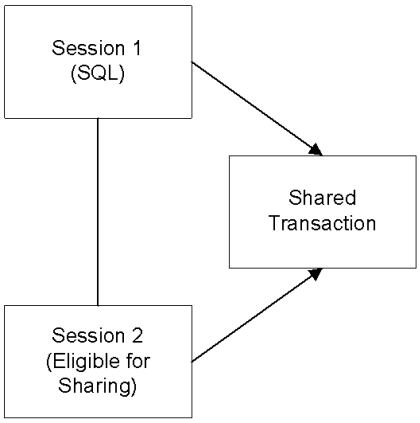
Whether transaction sharing is enabled for a remote SQL session is determined by the attribute in effect in the CA IDMS environment in which the session-initiating statement is issued. (A remote session is one that is connected to a dictionary residing on a central version different from where the application is executing.)

Regardless of how transaction sharing is enabled, if it is in effect at the time a database session is started, then that database session is eligible to share its transaction with other database sessions started by the same task or user session. The following rules determine whether two sessions will share a transaction.

- A top-level database session will share its transaction with another top-level session if they are both eligible for transaction sharing.



- A subordinate database session that is eligible for transaction sharing will share its encompassing session's transaction even if the encompassing session is not eligible to share its transaction.



Application Programming Considerations

Transaction sharing affects applications in the following ways:

- An update made through a database session may impact other database sessions sharing the same transaction.
- A rollback issued within one database session affects all sessions that share the same transaction.
- A commit issued by a database session whose transaction is shared has no affect on the transaction unless all other sharing sessions have also been committed.

Inter-session Conflicts

Database sessions that share a transaction can impact each other in ways that would not be possible without transaction sharing since locking would prevent such interactions. For example, a record can be deleted by one database session while it is current of another database session that is sharing the same transaction. This can result in new and possibly unexpected error conditions. If a database session's currency is impacted by an update made through another database session, that currency is invalidated. If a subsequent DML request, such as a FETCH from a cursor, relies on that invalidated currency, an error is returned.

- For SQL, the application receives an SQLCODE of -4 (statement failure) and an SQLRSN of 1087 (conflicting activity within a shared transaction).
- For navigational DML, an error status of xx03 is returned to the application.

Before enabling transaction sharing for an application, you should ensure that affected programs handle these errors appropriately.

Effect of Rollback Requests

If multiple database sessions share a transaction and one of those sessions issues a rollback request, all changes made within the transaction are immediately rolled out. Other sessions sharing the transaction must issue their own rollback requests before issuing any other DML requests. Issuing another DML request instead of a rollback will result in an error:

- For SQL, the application receives an SQLCODE of -5 (transaction failure) and an SQLRSN of 1088 (transaction forced to backout)
- For navigational DML, the run unit is terminated and an error status of xx19 is returned to the application.

Effect of Commit Requests

If multiple top level database sessions share a transaction and one of those sessions issues a commit request, no changes are committed until:

- All top-level sharing sessions that have had activity since the last commit, rollback or start of a transaction have issued a commit, or,
- Until a teleprocessing commit is issued.

The term "commit" refers to any DML command that would normally result in committing changes (COMMIT RELEASE, COMMIT CONTINUE, FINISH, and so forth).

A commit issued through a subordinate session has no impact on its transaction if it is shared since such a transaction can only be committed through the encompassing session.

Unless a COMMIT CONTINUE request is issued (for which currency locks are retained), all currencies owned by the issuing database session are immediately released. However, implicit exclusive locks and explicit locks acquired by the database session remain until the transaction is committed, even if the request terminates the database session.

Effect of Teleprocessing Statements and Events

Effect of Task-level DML Statements and Events

In a batch or DC/UCF environment, task-level commit and rollback statements and task-termination events affect the status of database transactions and SQL sessions, as the following table shows. Their effect on a subordinate SQL session is the same as their effect on its encompassing session.

Statement	Effect on Top-level SQL Sessions	Effect on Top-level Database Sessions
COMMIT TASK	Equivalent to issuing a COMMIT CONTINUE on all nonsuspended SQL sessions	Commits changes made through all transactions except nonshareable transactions whose session is suspended.
COMMIT TASK ALL	Equivalent to issuing a COMMIT on all nonsuspended SQL sessions.	Commits changes made through all transactions except nonshareable transactions whose session is suspended.
FINISH TASK	Equivalent to issuing a COMMIT RELEASE on all nonsuspended SQL sessions	Commits changes made through all transactions except nonshareable transactions whose session is suspended.
ROLLBACK TASK CONTINUE	Equivalent to issuing a ROLLBACK on all nonsuspended SQL sessions. All suspended sessions whose shareable transaction is rolled back are marked as requiring rollback.	Rolls back changes made through all transactions except nonshareable transactions whose session is suspended.
ROLLBACK TASK	Equivalent to issuing a ROLLBACK RELEASE on all nonsuspended SQL sessions. All suspended sessions whose shareable transaction is rolled back are marked as requiring rollback.	Rolls back changes made through all transactions except nonshareable transactions whose session is suspended.
Normal task termination	Equivalent to issuing a ROLLBACK RELEASE on all nonsuspended SQL sessions. All suspended sessions whose shareable transaction is rolled back are marked as requiring rollback.	Rolls back changes made through all transactions except those for which all associated sessions are suspended.
Abnormal Task Termination Signoff CA ADS Application Error Termination	Equivalent to issuing a ROLLBACK RELEASE on all SQL sessions	Rolls back updates made by all transactions associated with the task or user session.

A task-level commit or rollback statement has no affect on transactions whose database sessions are suspended and for which transaction sharing is not in effect.

CICS Syncpoint and Backout Operations

The effect of a CICS syncpoint or backout operation on an SQL session depends on the parameters used to generate the version of the IDMSCINT interface module with which the program was link-edited and the CICSOPT parameters used to generate its corresponding IDMSINTC interface module.

The options in effect for a program that starts an SQL session determine how that session and its transaction are impacted by CICS syncpoint and backout operations. The parameters that impact their semantics are:

- AUTOCMT: Enabling this option makes the work done by the database session eligible to be included in a CICS UOW (Unit of Work). If included, CICS syncpoint and backout operations affect the changes made by the session. Whether the changes made by a session are actually included in the CICS UOW is determined by the AUTONLY setting and whether the application issues its own commit or rollback DML requests prior to the CICS syncpoint or backout operation.
- AUTONLY: Enabling this option in conjunction with the AUTOCMT option forces the work done by the database session to be included in the CICS UOW. DML statements that would normally commit work (such as FINISH TASK or COMMIT) do not cause changes to be committed even if the session itself is terminated. The session's changes are committed only when the CICS syncpoint occurs. On the other hand, if the changes made by a session for which AUTONLY is enabled are backed out, either as the result of a DML ROLLBACK request or because of some environmental condition such as a deadlock, the entire CICS UOW will eventually be backed out. This ensures consistent behavior across all resources updated by the application.

  If AUTONLY is not enabled but AUTOCMT is, the work done by the database session is included in the CICS UOW only if the application does not issue commit or rollback DML requests prior to the CICS syncpoint operation.

  Enabling AUTONLY without AUTOCMT has no impact on syncpoint operations.

  Note: If transaction sharing is enabled, AUTONLY and AUTOCMT are always enabled.
- ONCOMT: This option specifies the effect that a CICS syncpoint operation has on a database session whose work is included in the CICS UOW. The session can optionally be treated as if a COMMIT RELEASE, COMMIT, or COMMIT CONTINUE were issued, meaning that it can be terminated, remain active but have currencies cleared or remain active with currencies left intact.

- ONBACK: This option specifies the effect that a CICS backout operation has on a database session whose work is included in the CICS UOW. The session can optionally be treated as if a ROLLBACK RELEASE or a ROLLBACK were issued, meaning that it can be terminated or remain active but have its currencies cleared.

All of these options can be specified through both IDMSCINT and CICSOPT parameters. The CICSOPT parameters can either override their IDMSCINT counterparts or be used as a default.

Note: For more information about these parameters, see the *CA IDMS System Operations Guide*.

A CICS syncpoint operation occurs when a CICS SYNCPOINT statement is executed by the application and when the CICS task terminates normally. A CICS backout operation occurs when a CICS BACKOUT statement is executed by the application and when the CICS task terminates abnormally.

The following table summarizes the impact of CICS syncpoint and backout operations and task-termination events on SQL sessions and their transactions.

Operation or Event	Effect
SYNCPOINT Operation	If AUTOCMT is not in effect for a session, the SYNCPOINT operation has no impact on the session and its transaction. If AUTOCMT is in effect for a session, the uncommitted changes made by the session are committed. The impact on the session is determined by the session's ONCOMT option.
BACKOUT Operation	If AUTOCMT is not in effect for a session, the BACKOUT operation has no impact on the session and its transaction. If AUTOCMT is in effect for a session, the uncommitted changes made by the session are backed out. The impact on the session is determined by the session's ONBACK option.
Normal CICS Task Termination	All nonsuspended SQL sessions are treated as if a ROLLBACK RELEASE were issued (although their changes may have been committed by the preceding syncpoint operation). Their uncommitted changes are backed out.
Abnormal CICS Task Termination	All SQL sessions are treated as if a ROLLBACK RELEASE were issued. Their uncommitted changes are backed out.

Effect of Task-level DML Statements in CICS

In a CICS environment, task-level commit and rollback statements have the same effect on sessions as in a DC/UCF environment. However, a task-level commit request (COMMIT TASK, COMMIT TASK ALL, or FINISH task) does not commit the work done by sessions whose AUTONLY and AUTOCMT options are enabled.

Just as in a DC/UCF environment, a task-level rollback request (ROLLBACK TASK or ROLLBACK TASK CONTINUE) affects all transactions except nonshareable transactions whose session is suspended.

Concurrency Control and Isolation Levels

Concurrency Control

CA IDMS manages concurrent access to the same set of data with a system of locks. The degree of concurrent access allowed by a database transaction is determined by the isolation level of the transaction and the ready mode of the areas it accesses.

Locks

CA IDMS provides two types of lock:

- A **retrieval lock** prevents updates but allows retrieval of data by another database transaction
- An **update lock** prevents both updates and retrieval of data by another database transaction

Isolation Levels and Locking

CA IDMS supports two isolation levels. The following descriptions explain how the system performs locking under each isolation level assume the least restrictive ready mode for areas accessed by the database transaction:

- Cursor stability—Under cursor stability, the DBMS places a retrieval lock on the row on which an updateable cursor is positioned until the cursor position changes. It places a retrieval lock on the row accessed by a SELECT statement that accesses only one row (a single-row select) until the SQL transaction accesses another row from the same table. It releases update locks when the transaction either terminates or issues a COMMIT CONTINUE.
- Transient read—Under transient read, the DBMS:
  - Places no locks on rows accessed by the transaction
  - Allows the transaction to retrieve locked rows
  - Prevents the transaction from performing updates

Concurrency Under Cursor Stability

Cursor stability provides the greatest possible concurrency while guaranteeing the integrity of data read by the transaction. Under cursor stability:

- The row on which an updateable cursor is positioned cannot be updated by another database transaction before the cursor position changes.
- A single row retrieved by a SELECT statement cannot be updated by another database transaction until the original transaction accesses another row of the table.

Cursor stability does not prevent other database sessions that are sharing the same transaction from updating a session's current cursor position or its most-recently retrieved row of a single row select.

Cursor stability is the CA IDMS default. It is appropriate for high-volume transaction environments.

Concurrency Under Transient Read

Transient read provides no protection from the effects of concurrent database transactions. It allows a database transaction to read data that has not been committed and allows concurrent database transactions to update the data.

Transient read is appropriate when the transaction is retrieval only and does not require the data to be consistent and entirely accurate.

Specifying the Isolation Level

You can specify the default isolation level with the DEFAULT ISOLATION parameter of the CREATE ACCESS MODULE statement.

Note: For more information about how to create the access module, see Creating the Access Module (see page 139).

A program can override the default isolation level for the access module by issuing a SET TRANSACTION statement. The specification on this statement remains in effect until the end of the transaction.

Note: For more information about the SET TRANSACTION statement, see the *CA IDMS SQL Reference Guide*.

Area Ready Mode

You can control concurrent access at the area level using the READY parameter of the CREATE ACCESS MODULE statement. This parameter allows you to specify what type of retrieval or update lock the DBMS sets on an area that the program accesses. The type of lock, in combination with the PRECLAIM or INCREMENTAL option, determines how long the DBMS holds the lock for the transaction.

Note: For more information about the READY parameter of the CREATE ACCESS MODULE statement, see the *CA IDMS SQL Reference Guide*.

Repeatability

If you specify a ready mode of protected retrieval or protected update, the DBMS will prevent concurrent update access in the specified areas for the duration of a database transaction. This gives the transaction running under cursor stability the ability to repeat a read of the specified area or areas without changes to the data by other transactions.

Note: For more information about the lock management system, see the *CA IDMS Database Administration Guide*.

SQL Status Checking and Error Handling

When CA IDMS executes an SQL statement, it returns information about the status of statement execution to a data structure called the SQLCA. Your program should contain logic to handle exceptional conditions resulting from statement execution. This logic takes the form of checking SQLCA information. An alternative to checking the SQLCA is the use of the GET DIAGNOSTICS statement that provides for enhanced diagnostic information.

SQLCA

The SQL Communication Area (SQLCA) is a data structure to which the DBMS returns information about the execution of an SQL statement.

SQLSTATE

SQLSTATE is a five-character string in which CA IDMS returns the status of the last SQL statement executed. It is divided into a two-character class and a three-character subclass. Standard values are associated with each class and subclass, which minimizes the need for vendors to define their own values and makes applications more portable from one environment to another.

The following list displays the SQLSTATE values that CA IDMS can return. It is divided into sections based on the class (the first 2 characters of the SQLSTATE value). Each subclass (the last 3 characters of the SQLSTATE value) is listed under its associated class.

- **SQL standard values**—Class and subclass values beginning with the characters A-H and 0-4 are established by the SQL standards organizations.
- **CA IDMS-defined values**—Class and subclass values beginning with the characters I-Z and 5-9 are vendor-defined. In this case, they are specific to CA IDMS. (Any subclass value associated with a vendor-defined class is also defined by that vendor.)

SQLSTATE Values

```
00 Successful completion
   000  No subclass

01 Warning
   000  No subclass
   004  String data, right truncation
   00C  SQL-invoked procedure returned result sets
   00D  Additional result sets returned
   00E  Attempt to return too many result sets
   010  Column cannot be mapped
   600  Inconsistent or invalid option
   602  Entity or association already exists
   605  Entity not defined in Catalog
   606  Invalid option for physical DDL
   607  Invalid option for DMCL
   608  Connecting to a dictionary which is missing either or
        or both of DDLCAT/DDLDML areas
   610  Database is inconsistent with request
   611  SQL routine parse error
   612  ADS compilation for an SQL routine failed
   613  Drop of SQL routine completed with warnings
   638  Warning returned from table procedure

02 No data
   000  No subclass

07 Dynamic SQL error
   000 No subclass
   001 USING clause does not match dynamic parameter specification
   002 USING clause does not match target specification
   003 Cursor specification cannot be executed
   004 USING clause required for dynamic parameters

08 Connection exception
   000  No subclass
```

```
   004  SQL-server rejected establishment of SQL-connection
   006  Connection failure

0M Invalid SQL-invoked procedure reference
   000  No subclass

0N SQL/XML Mapping Error
   000  No subclass
   001  Unmappable XML name
   002  Invalid XML character

21 Cardinality violation
   000  No subclass

22 Data Exception
   000  No subclass
   001  String data, right truncation
   002  Null value, no indicator parameter
   003  Numeric value out of range
   005  Error in assignment
   007  Invalid datetime format
   008  Datetime field overflow
   00J  Nonidentical notations with the same name
   00K  Nonidentical unparsed entities with the same name
   00L  Not an XML document
   00M  Invalid XML document
   00N  Invalid XML content
   00R  XML value overflow
   00S  Invalid comment
   00T  Invalid processing instruction
   011  Substring error
   012  Division by zero
   019  Invalid escape character

23 Constraint violation
   000  No subclass
   501  Duplicate key violation

24 Invalid cursor state
   000  No subclass

25 Invalid transaction state
   000  No subclass
   006  Read-only SQL-transaction

26 Invalid SQL statement name
```

```
   000  No subclass

28 Invalid authorization specification
   000  No subclass
   602  Entity or association already defined
   605  Entity or association not previously defined
   607  Authorization ids not specified

2C Invalid character set name
   000  No subclass

34 Invalid cursor name
   000  No subclass

37 Syntax error or access rule violation
   000  No subclass

38 External routine exception
   000  No subclass
   999  ADS dialog failed or dialog does not exist

39 External routine invocation exception
   000  No subclass

3F Invalid schema name
   000  No subclass

40 Transaction rollback
   000  No subclass
   001  Serialization failure

42 Syntax error or access rule violation
   000  No subclass
   500  Table not found
   501  Column not found
   502  Entity already defined
   503  Authorization failure
   504  Cursor not declared or previously declared
   505  Entity not found
   506  Invalid identifier
   507  Keyword used as identifier
   600  Invalid statement
   601  Statement not valid in this context
   603  Statement not valid for this schema
```

```
   604  Invalid data type
   606  Invalid statement option
   607  Missing statement option
   609  Invalid constraint definition
   610  Invalid number of columns

50 CA-defined errors
   000  No subclass
   002  Limit exceeded
   003  Space exceeded
   00B  Internal error
   00I  Schema mismatch
   00J  Invalid entity definition
   00K  Uncategorized error
   00L  Invalid calling parameters

60 &U$IDMS. specific errors
   000  No subclass
   001  Problem with load module or synchronization stamps
   002  Database error
   003  Rollback failed
   004  Failure while opening or describing a received cursor
   005  Unexpected error from GET/PUT SCRATCH

64 &U$IDMS. Physical DDL error
   000  No subclass

6U &U$IDMS. Utility error
   000  No subclass
```

SQLCODE

For status checking, another important field in the SQLCA structure is SQLCODE. The following table shows the values that the DBMS may return to this field.

Value	Meaning
< 0	The SQL statement returned an error (see the following error values)
0	The SQL statement was executed successfully
1	The SQL statement was executed successfully with a warning
100	There are no more rows associated with the current query, or no rows satisfied the search criteria in a searched update or delete **Note:** The SQL standard only defines meaning to the values of **0** and **100**. Negative SQLCODE values signify an error; however, specific values are not standardized as with SQLSTATE.

SQLCODE Error Values

The following table associates SQLCODE error values with one of the three kinds of SQL statement failure and suggests the appropriate error-handling strategy for each category of error:

Value	Level of failure	Meaning
-7	Task	An internal error caused a task abend, leading to rollback and termination of the SQL transaction and termination of the SQL session
-6	SQL session	An error caused an SQL session failure, leading to rollback, termination of the SQL transaction and termination of the SQL session. A program intending to retry the SQL statements should first terminate the SQL session with one of these statements: ■ ROLLBACK RELEASE ■ RELEASE ■ The equivalent TP monitor command
-5	SQL transaction	An error has caused an SQL transaction failure, leading to rollback and termination of the SQL transaction. A program intending to retry the SQL statements should first terminate the transaction with one of these statements: ■ ROLLBACK ■ ROLLBACK RELEASE ■ RELEASE ■ The equivalent TP monitor command
-4	SQL statement	An error has caused failure of the SQL statement to execute; the effect of the statement, if any, on the database has been rolled out. Unless the reason for the error is one that the program can handle, the program should terminate the session or transaction.

SQLCERC

If an error is returned, the DBMS also returns a value in the SQLCERC field of the SQLCA. The value in this field is the SQL error code.

In certain cases, you can use this information to recover from error conditions. For example, if 1038 is returned to SQLCERC, a deadlock has occurred. The application program can handle the deadlock by first terminating the database transaction and then resuming processing after the last commit or start of transaction.

SQLCERC values correspond to the last four digits of the CA IDMS/DB runtime messages. To determine the meaning of a particular SQLCERC value, refer to the text and description of the equivalent DB message.

Note: For more information about the documentation of DB messages, see the *CA IDMS Messages and Codes Guide*, or issue a DCMT DISPLAY MESSAGE DB*nnnnnn* statement, as documented in the *CA IDMS System Tasks and Operator Commands Guide*.

Other SQLCA Fields

For error checking and reporting, these are other useful SQLCA fields:

Field	Description of contents
SQLCLNO	Source file line number from which the SQL statement was obtained
SQLCSER	Offset into the SQL statement buffer where a syntax error was recognized
SQLCNRP	Number of rows processed by the SQL statement
SQLCERM	Text of the error message
SQLCERL	Length of error message text
SQLCNRRS	Actual number of results sets that an SQL invoked procedure returns

How SQLCA Is Initialized

The DBMS initializes SQLCA values on every SQL statement execution. If the program accesses the SQLCA after issuing an SQL statement, all SQLCA values refer to that statement.

SQLPIB Fields

When you display or log error information, you may wish to include information in fields of the SQL Program Information Block (SQLPIB):

Field	Description of contents
SQLDTS	Date and time the program was compiled
SQLPGM	Name of the RCM that is the source of the SQL statement

Displaying SQL Communication Area Fields

SQLCA Structure

The technique used by the program to access and display SQLCA information may depend on the SQLCA structure and the rules governing use of the host program language.

For example, in the COBOL SQLCA structure, SQLCODE is defined as PIC S9(9) USAGE COMPUTATIONAL. To display any possible SQLCODE value, including a negative value, you should first move the SQLCODE value to a work field defined as PIC -9(4).

Note: For more information about the SQLCA structure, see Requirements and Options for Host Languages (see page 87).

Displaying an SQL Message

To display an SQL error message, you use the IDMSIN01 entry point to the IDMS module to call a function that formats error message data using information in the SQLERM and SQLCERL fields.

Note: For more information about the requirements for calling IDMSIN01 to display SQL messages, see the *CA IDMS Callable Services Guide*.

Error Handling

Using WHENEVER SQLERROR

If the program handles most or all errors by branching to one routine, consider using the WHENEVER precompiler directive statement that specifies the SQLERROR condition. The precompiler adds the logic requested by a WHENEVER statement immediately after every SQL statement that follows the WHENEVER statement.

In this example, if an SQL statement that follows the WHENEVER statement returns an error, processing branches to the routine labeled ERROR-EXIT:

```
EXEC SQL
   WHENEVER SQLERROR GOTO :ERROR-EXIT
END-EXEC.
```

Overriding WHENEVER

Once the program issues a WHENEVER SQLERROR statement, it can override the statement only with:

- Another WHENEVER SQLERROR statement that specifies different branching logic
- A WHENEVER SQLERROR CONTINUE statement, which directs the precompiler not to add logic after subsequent SQL statements

Note: For more information about the WHENEVER statement, see the *CA IDMS SQL Reference Guide*.

Checking Specific Errors

When To Do It

In certain situations the program should check for specific errors before directing processing to a generalized error routine.

This guide discusses when to code specific error-checking logic in Chapter 4, Data Manipulation with SQL, and other chapters that present SQL programming techniques.

How to Do It

You write a conditional program statement to check for a specific SQL error following the SQL statement. The conditional statement must also account for all other errors if the test for the specific error fails:

```
EXEC SQL
  INSERT
    INTO DIVISION
    VALUES (:DIVISION-CODE,
            :DIVISION-NAME,
            :DIV-HEAD-ID)
END-EXEC.

IF SQLSTATE = '23501' PERFORM EXISTING-DIVISION
ELSE IF SQLCODE < 0 GOTO ERROR-ROUTINE.
```

Using WHENEVER SQLERROR

To perform specific error checking after the program has issued a WHENEVER SQLERROR statement, you can:

- Override the previous WHENEVER statement before issuing the SQL statement:

```
EXEC SQL
  WHENEVER SQLERROR CONTINUE
END-EXEC.

EXEC SQL
  INSERT
 .
 .
 .
END-EXEC.

IF SQLSTATE = '23501' PERFORM EXISTING-DIVISION
ELSE IF SQLCODE < 0 GOTO ERROR-ROUTINE.

EXEC SQL
  WHENEVER SQLERROR GOTO ERROR-ROUTINE
END-EXEC.
```

- Place the specific error-handling logic in the generalized routine:

```
ERROR-ROUTINE.

IF SQLSTATE = '23501' PERFORM EXISTING-DIVISION.
 .
 .
 .
```

Using GET DIAGNOSTICS

The use of GET DIAGNOSTICS instead or in addition to checking SQLCA offers the following advantages:

- Better portability because of the SQL standards compliance
- Availability of more diagnostic information
- Independent of host language
- Built-in formatting of all diagnostic information

Note: For more information about GET DIAGNOSTICS, see the *CA IDMS SQL Reference Guide*.

Chapter 4: Data Manipulation with SQL

This section contains the following topics:

Data Manipulation Operations

When SQL is used in a host language program, you will need to perform data manipulation. There are several ways that the program can take advantage of SQL DML in CA IDMS.

SQL DML Statements

Use the following SQL statements in data manipulation operations:

- SELECT—To retrieve data
- INSERT—To add data
- UPDATE—To modify data
- DELETE—To delete data
- CALL—To invoke an SQL invoked procedure or table procedure.

SQL data manipulation statements provide the following capabilities:

- One statement can manipulate data in many rows
- One statement can perform both computation and data manipulation
- One statement can retrieve data from many tables

Consequently, you have several options for performing each type of data manipulation.

Retrieving Data

Using SELECT

In a program, you use the SELECT statement in one of these ways to retrieve data from the database:

- With an INTO clause that specifies **host variable**, local variables, or routine parameters names, to retrieve a single row into working storage
- With a BULK clause that specifies the name of a **host variable array**, to retrieve multiple rows into working storage
- In a DECLARE CURSOR statement to define a **cursor** that you can use to retrieve multiple rows and then fetch each row one at a time into working storage
- In an INSERT statement to select from one or more other tables the data to be inserted

When embedding a SELECT statement, specify each column even if you mean to select all columns. Using SELECT * to select all columns can cause a program error if, for example, a column is added to the table.

Single-row SELECT Statement

If the result of a SELECT statement will be one and only one row, you can issue a SELECT statement with an INTO clause.

A result table will contain only one row when:

- The WHERE clause specifies a primary key value as the search condition:

```
EXEC SQL
  SELECT EMP_ID,
         EMP_LNAME,
         DEPT_ID
    INTO :EMP-ID,
         :EMP-LNAME,
         :DEPT-ID
    FROM EMPLOYEE
    WHERE EMP_ID = :EMP-ID
END-EXEC.
```

- All column values result from aggregate functions and no GROUP BY clause has been specified:

```
EXEC SQL
   SELECT COUNT(P.EMP_ID) INTO :TOT-EMPLOYEES,
          SUM(B.SALARY_AMOUNT) INTO :TOT-SALARIES,
          (SUM(B.VAC_ACCRUED) - SUM(B.VAC_TAKEN))
             INTO :UNUSED-VAC
      FROM POSITION P, BENEFITS B
      WHERE P.EMP_ID = B.EMP_ID
            AND P.SALARY_AMOUNT IS NOT NULL
            AND P.FINISH_DATE IS NULL
END-EXEC.
```

Checking Single-row Select Status

If the number of rows returned by a SELECT statement with an INTO clause is greater than 1, the DBMS returns a *cardinality violation* error. No data is moved to the host variables named in the INTO clause.

If no row is found that matches the selection criteria, the DBMS returns a *no rows found* warning and moves 100 to SQLCODE.

Updating the Single Row

Under cursor stability if the program performs single-row select that specifies the primary key in the search condition, the DBMS locks the base row from which the resulting row is derived. This prevents any update by a concurrent database transaction. The lock is maintained until one of these events occurs:

- The database transaction ends
- The database session is suspended
- The database transaction accesses a different row from the same table

Until one of these events occurs, the SQL transaction can update the row without a need to check whether a concurrent transaction has modified the row.

Note: For more information about updating rows, see Modifying Data (see page 62).

Multiple-row SELECT

If the result table of a SELECT statement potentially has multiple rows, the program must declare a cursor or perform bulk processing to process retrieved data.

Note: For more information about retrieving multiple rows, see Data Manipulation with SQL (see page 57).

Adding Data

Using INSERT

In a program, you use an INSERT statement to add data to the database in one of the following ways:

- INSERT with a VALUES clause to add a single row to a table by listing the column values in the statement
- INSERT with a SELECT statement to add one or more rows using existing data
- INSERT with a BULK clause to add multiple rows to a table from a host variable array

Single-row INSERT

To add a single row to a table, issue an INSERT statement with a VALUES clause that specifies a value for each column in the column list:

```
EXEC SQL
  INSERT INTO DIVISION
              (DIV_CODE, DIV_NAME)          <-- Column list
     VALUES (:DIV-CODE, :DIV-NAME)
END-EXEC.
```

Multiple-row INSERT with SELECT

One way to add multiple rows to a table is to insert the result table of a SELECT statement.

In this example, a result table of data from the EMPLOYEE table is inserted into a table named TEMP_MGR:

```
EXEC SQL
  INSERT INTO TEMP_MGR
  SELECT DISTINCT E.MANAGER_ID,
         M.EMP_FNAME,
         M.EMP_LNAME
    FROM EMPLOYEE E, EMPLOYEE M
    WHERE E.MANAGER_ID = M.EMP_ID
END-EXEC.
```

Guidelines for INSERT

Apply these guidelines when formulating an INSERT statement:

- An INSERT statement must supply a value for each column in the column list, even if the value is null
- The order of column values must match the order of the column list

- An INSERT statement must supply values for *all* columns of the named table if the column list is omitted:

```
EXEC SQL
  INSERT INTO DIVISION
     VALUES ('D06', 'ADVANCED RESEARCH', NULL)
            -- Division head id is null --
END-EXEC.
```

  When embedding an INSERT statement with a VALUES clause, you should include a column list even if you mean to insert values into all columns. Using a VALUES clause but omitting a column list can cause a program error if, for example, a column has been added to the table.

- A column list must include any table columns that are defined as not null and as *not* having a default value

  If an INSERT statement omits a table column from the column list, the DBMS:

  - Stores the default value for the column, if one has been defined
  - Stores a null value if the column allows nulls
  - Returns a *data exception* error if no default value has been defined and nulls are not allowed

Checking INSERT Status

Since the DBMS enforces integrity constraints, the program can test SQLCERC for a *constraint violation*:

- 1023—Check constraint
- 1058—Unique constraint
- 1060—Referential constraint
- 1002—Null constraint
- 1031—Page group violation

  Note: Referential constraints defined as linked clustered are not permitted to not cross page group boundaries.

Here is an example for a specific test for a check constraint violation:

```
IF SQLCERC = 1023 PERFORM INVALID-DATA
ELSE IF SQLCODE < 0 GOTO ERROR-ROUTINE.
```

If an INSERT statement that uses a SELECT statement executes successfully but adds no rows, the DBMS returns 100 to SQLCODE and 0 to SQLCNRP.

Inserting Multiple Rows

You can add a set of rows to a table using one INSERT statement with a BULK clause.

Note: For more information about using bulk processing to insert, see Bulk Processing (see page 75).

Modifying Data

Using UPDATE

You modify data in a table using an UPDATE statement. There are two types of UPDATE statement:

- If the WHERE clause contains a search condition, the statement modifies any row that meets the search condition—this is a **searched update**
- If the UPDATE statement specifies WHERE CURRENT OF *cursor-name*, the statement modifies only the row on which the cursor is positioned—this is a **positioned update**

Note: For information about positioned updates, see Using a Cursor (see page 67).

Checking UPDATE Status

As with an INSERT statement, the DBMS enforces integrity constraints when the program issues an UPDATE statement.

Note: For more information about checking statement execution for constraint violation, see Adding Data (see page 60).

Searched Updates

A searched update statement contains:

- A SET clause that specifies a value for each column to be updated
- A WHERE clause containing the criteria for choosing the rows to be updated

Searched Updates Using Host Variables

In this example, the UPDATE statement uses a host variable (SALARY-AMOUNT) to transfer a new data value to the database and another host variable (EMP-ID) supplies the column value that is the criterion for choosing the row to update:

```
EXEC SQL
   UPDATE POSITION
      SET SALARY_AMOUNT = :SALARY-AMOUNT
      WHERE EMP_ID = :EMP-ID
END-EXEC.
```

The statement in the example updates only one row because the search condition is restricted by the value of a primary key (EMP_ID).

The statement in the following example updates multiple rows if more than one employee does the job represented by the value in JOB-ID:

```
EXEC SQL
   UPDATE POSITION
      SET SALARY_AMOUNT = :SALARY-AMOUNT
      WHERE JOB_ID = :JOB-ID
END-EXEC.
```

Searched Updates Without Host Variables

A searched update may operate on existing column values without using host variables. This statement gives a 10 percent raise to all employees with a current salary in a specified range:

```
EXEC SQL
   UPDATE POSITION
      SET SALARY_AMOUNT = 1.1 * (SALARY_AMOUNT)
      WHERE SALARY_AMOUNT BETWEEN 20000 AND 40000
END-EXEC.
```

No Matching Rows

If no rows satisfy the selection criteria in the WHERE clause of a searched update, SQLCODE will be set to 100.

Automatic Rollback

If the attempt to update one row of a searched update fails:

- Statement execution halts
- The DBMS returns an error value to SQLCODE
- The results of the UPDATE statement are automatically rolled back

Deleting Data

Using DELETE

You erase rows from a table using a DELETE statement. As with UPDATE, there are two types of DELETE statement:

- If the WHERE clause contains a search condition, the statement deletes any row that meets the search condition—this is a **searched delete**
- If the DELETE statement specifies WHERE CURRENT OF *cursor-name*, the statement deletes only the row on which the cursor is positioned—this is a **positioned delete**

Note: For more information about positioned deletes, see Using a Cursor (see page 67).

Searched Deletes

The statement in this example deletes all rows from the BENEFITS table for a fiscal year that precedes the one specified in the :FISCAL-YEAR host variable:

```
EXEC SQL
  DELETE FROM BENEFITS
    WHERE FISCAL_YEAR < :FISCAL-YEAR
END-EXEC.
```

If no rows satisfy the selection criteria in the WHERE clause of a searched delete, SQLCODE will be set to 100.

Checking DELETE Status

The DBMS disallows an attempt to delete a row from a referenced table in a relationship if a row with a matching foreign key exists in a referencing table.

For example, since a referential constraint has been created between the EMPLOYEE table and the POSITION table (with column EMP_ID in POSITION referencing column EMP_ID in EMPLOYEE), you cannot delete employee 1234 from the EMPLOYEE table if employee 1234 exists in the POSITION table.

To detect a referential constraint violation on a DELETE statement, test for SQLCERC = 1060:

```
IF SQLCERC = 1060 PERFORM REFERENTIAL-ERROR
ELSE IF SQLCODE < 0 GOTO ERROR-ROUTINE.
```

Automatic Rollback

If the attempt to delete one row of a searched delete fails:

- Statement execution halts
- The DBMS returns an error value to SQLCODE
- The results of the DELETE statement are automatically rolled back

Important! When you issue a DELETE, be sure that the statement includes a WHERE clause. If the WHERE clause is omitted, CA IDMS deletes all rows from the named table.

Using Indicator Variables in Data Manipulation

Indicator Variables in SELECT or FETCH

When a column value is retrieved into a host variable that has an associated indicator variable, the DBMS assigns a value to the indicator variable:

Indicator variable value	Meaning
-1	The value assigned to the host variable was null. The actual content of the host variable is unpredictable.
0	The host variable contains a non-null value that has not been truncated.
1 or greater	The host variable contains a truncated value. The value in the indicator variable is the length in bytes of the original untruncated value.

Retrieving a Null Value

Since a null value is not valid in the program language, the program must test for -1 in the indicator variable and direct processing to handle null value retrieval as needed if the test is true.

Null Retrieval Example

In the following example, the program initializes two numeric host variables to zero:

```
MOVE ZERO TO VAC-TAKEN.
MOVE ZERO TO SICK-TAKEN.
```

If the next statement now retrieves null values from the VAC_TAKEN and SICK_TAKEN columns, the value of VAC-TAKEN and SICK-TAKEN are still zero because the actual content of the host variables is unchanged when nulls are retrieved:

```
EXEC SQL
   SELECT VAC_TAKEN,
          SICK_TAKEN
     INTO :VAC-TAKEN INDICATOR :VAC-TAKEN-I,
          :SICK-TAKEN INDICATOR :SICK-TAKEN-I
     FROM BENEFITS
     WHERE EMP_ID = :EMP-ID
END-EXEC.
```

Indicator Variables in Inserts and Updates

When the program issues a statement to store a value contained in a host variable, the statement optionally can name the associated indicator variable.

If the statement names the indicator and the indicator variable value is 0, the DBMS stores the actual content of the host variable. If the indicator variable value is -1, the DBMS stores a null value instead of the actual content of the host variable.

Update Examples With Indicator Variables

In the next example, the program assigns 0 to the indicator variable after changing the value of the host variable VAC-TAKEN. CA IDMS stores the actual content of VAC-TAKEN on the subsequent update:

```
ADD INPUT-VAC-TAKEN TO VAC-TAKEN.
MOVE ZERO TO VAC-TAKEN-I.
 .
 .
 .
EXEC SQL
   UPDATE BENEFITS
     SET VAC_TAKEN = :VAC-TAKEN INDICATOR :VAC-TAKEN-I
     WHERE EMP_ID = :EMP-ID
END-EXEC.
```

By omitting reference to the indicator variable in the UPDATE statement, the program can achieve the same result of storing the actual content of the host variable:

```
ADD INPUT-VAC-TAKEN TO VAC-TAKEN.
 .
 .
 .
EXEC SQL
   UPDATE BENEFITS
     SET VAC_TAKEN = :VAC-TAKEN
     WHERE EMP_ID = :EMP-ID
END-EXEC.
```

Similarly, the program can store a null value without naming the indicator variable:

```
EXEC SQL
   UPDATE BENEFITS
     SET VAC_TAKEN = NULL
     WHERE EMP_ID = :EMP-ID
END-EXEC.
```

Using a Cursor

In application programming, a cursor is an SQL construct that the program uses to process data in a result table. The cursor declaration defines the result table. Once the program declares the cursor, the program can open the cursor and sequentially fetch one row at a time from the result table.

Declaring a Cursor

How You Declare a Cursor

You define a cursor by issuing a DECLARE CURSOR statement. The DECLARE CURSOR statement contains a SELECT statement:

```
EXEC SQL
   DECLARE EMP_SUM CURSOR FOR
     SELECT EMP_ID,
            MANAGER_ID,
            EMP_FNAME,
            EMP_LNAME,
            DEPT_ID
         FROM EMPLOYEE
         ORDER BY DEPT_ID
END-EXEC.
```

Updateable Cursors

If the program updates the current cursor row, the cursor declaration must contain the FOR UPDATE OF clause, specifying the result table columns that may be updated. In the definition of an updateable cursor:

- Only one table is named in the FROM clause of the SELECT statement
- The named table must be a base table, an updateable view or a table procedure
- The outer select may not contain a UNION, ORDER BY, or GROUP BY clause

Note: For more information about all criteria that an updateable cursor must meet, see the documentation of the DECLARE CURSOR statement in the *CA IDMS SQL Reference Guide*.

Updateable Cursor Declaration Example

In this example, the EMP_SUM cursor is declared to allow the program to update the MANAGER_ID and DEPT_ID columns:

```
EXEC SQL
   DECLARE EMP_SUM CURSOR FOR
     SELECT EMP_ID,
            MANAGER_ID,
            EMP_FNAME,
            EMP_LNAME,
            DEPT_ID
        FROM EMPLOYEE
        FOR UPDATE OF MANAGER_ID,
                      DEPT_ID
END-EXEC.
```

Fetching a Row

Opening the Cursor

Before the program can fetch cursor rows, it must open the cursor with an OPEN statement:

```
EXEC SQL
  OPEN EMP_SUM
END-EXEC.
```

How You Fetch a Row

The program fetches a row with a FETCH statement that names the cursor and includes an INTO clause that specifies the host variables to receive the fetched row:

```
EXEC SQL
  FETCH EMP_SUM
    INTO :EMP-ID,
         :MANAGER-ID :MANAGER-ID-I,
         :EMP-FNAME,
         :EMP-LNAME,
         :DEPT-ID
END-EXEC.
```

Cursor Position

Cursor position refers to a current position relative to a row of the cursor. When a FETCH statement is executed, the values assigned to the host variables are retrieved from the row that follows the cursor position.

When the program opens the cursor, cursor position is before the first row of the result table. When a row is fetched, the cursor position moves to that row and the column values for that row are moved into the host variables.

If another FETCH statement is executed while the cursor remains open, cursor position moves to the next row.

When There Are No More Rows

Cursor position advances row by row with each FETCH. If there is no row following the cursor position and a FETCH statement is executed, the DBMS returns 100 to SQLCODE. When this condition occurs, the program should end iterative logic for fetching cursor rows.

Testing for No More Cursor Rows

To test for no more cursor rows, test for SQLCODE = 100. If the test result is true, set a variable to indicate this condition, as shown in the use of END-FETCH in the following example.

Referencing a variable such as END-FETCH in subsequent program logic is recommended because the program controls the variable value, whereas the DBMS controls the value of SQLCODE.

```
WORKING-STORAGE SECTION.


     77   END-FETCH    PIC X VALUE 'N'.
  .
  .
  .
PROCEDURE DIVISION.
  .
  .
  .
    ***** Perform paragraph until no more cursor rows to process
     PERFORM FETCH-CURSOR UNTIL END-FETCH = Y.
  .
  .
  .
FETCH-CURSOR.

     EXEC SQL
       FETCH EMP_SUM INTO
         EMP-ID,
         MANAGER-ID MANAGER-ID-I,
         EMP-FNAME,
         EMP-LNAME,
         DEPT-ID
     END-EXEC.

    ***** Test for no more cursor rows
     IF SQLCODE = 100 MOVE 'Y' TO END-FETCH.
  .
  .
  .
```

Closing a Cursor

The program can close a cursor with the CLOSE statement:

```
EXEC SQL
  CLOSE EMP_SUM
END-EXEC.
```

Automatic Closing of a Cursor

The COMMIT and ROLLBACK statements automatically close all open cursors used by the application program.

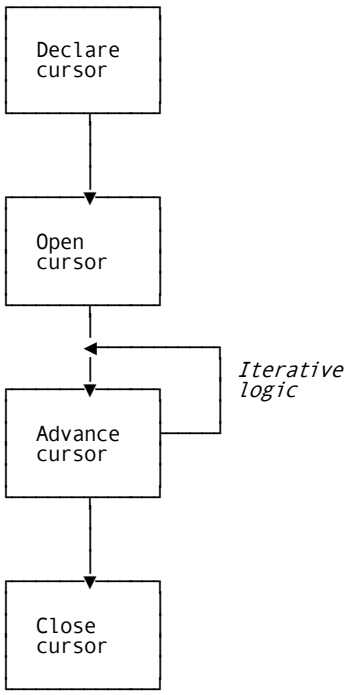
Invalid Cursor State

The DBMS returns an *invalid cursor state* condition and ignores the statement if the program issues:

- An OPEN statement for a cursor that is open
- A CLOSE statement for a cursor that is closed
- A FETCH statement for a cursor that is closed
- A FETCH statement when the cursor position is after the last row (which means that the DBMS already returned 100 to SQLCODE)

Summary of Cursor Management

This diagram summarizes how the program uses a cursor:



Executing a Positioned Update or Delete

A positioned update modifies one or more column values of the current row of an updateable cursor. The statement takes this form:

```
EXEC SQL
UPDATE table-name
  SET column-name = value-specification
  ...
  WHERE CURRENT OF cursor-name
END-EXEC.
```

Requirements for a Positioned Update

To execute a positioned update, the program must declare a cursor that:

- Is updateable
- Contains a FOR UPDATE OF clause

Advantage of an Updateable Cursor

When the database transaction running under cursor stability fetches a row from an updateable cursor, the DBMS places a lock on the row and maintains it until one of these events occurs:

- The program fetches the next cursor row
- The cursor is closed
- The database transaction ends

In this way, CA IDMS guarantees the base row is not modified or deleted by another transaction while it is the current cursor row.

The DBMS maintains the lock on the current row of an updateable cursor during a suspended SQL session. This feature is designed for pseudoconversational programming.

Note: For more information about pseudoconversational programming with embedded SQL, see 7.2, Pseudoconversational Programming.

Checking Positioned Update Status

If the program attempts to execute a positioned update when the referenced cursor is not updateable or does not contain a FOR UPDATE OF clause, the DBMS returns an *invalid cursor state* error.

Note: For more information about checking the status of UPDATE statements in general, see Modifying Data (see page 62).

Positioned Update Example

In the following example, the program declares a cursor to retrieve current data for vacation and sick days taken by employees. The program adds input values to the values retrieved for the employee in the current cursor row. Then the program issues a positioned update.

```
EXEC SQL

  DECLARE VAC_SICK_CURSOR CURSOR FOR
     SELECT EMP_ID,
            VAC_TAKEN,
            SICK_TAKEN
       FROM BENEFITS
       FOR UPDATE OF VAC_TAKEN,
                     SICK_TAKEN
END-EXEC.
 .
 .
 .
EXEC SQL
  OPEN VAC_SICK_CURSOR
END-EXEC.
 .
 .
 .
EXEC SQL
  FETCH VAC_SICK_CURSOR INTO
    :EMP-ID,
    :VAC-TAKEN INDICATOR VAC-TAKEN-I,
    :SICK-TAKEN INDICATOR SICK-TAKEN-I
END-EXEC.
 .
 .
 .
ADD INPUT-VAC-TAKEN TO VAC-TAKEN
ADD INPUT-SICK-TAKEN TO SICK-TAKEN
 .
 .
 .
EXEC SQL
  UPDATE BENEFITS
    SET VAC_TAKEN = :VAC-TAKEN,
        SICK_TAKEN = :SICK-TAKEN
    WHERE CURRENT OF VAC-SICK-CURSOR
END-EXEC.
 .
 .
 .
EXEC SQL
   CLOSE VAC_SICK_CURSOR
END-EXEC.
```

Positioned Deletes

You can delete the current row of an updateable cursor simply by naming the table and the cursor in the DELETE statement:

```
DELETE FROM table-name WHERE CURRENT OF cursor-name
```

A cursor must be updateable to perform a positioned delete, but the FOR UPDATE OF clause is not required in the cursor declaration.

Checking Positioned Delete Status

If the program attempts to execute a positioned delete when the referenced cursor is not updateable, the DBMS returns an *invalid cursor state* error.

Note: For more information about checking the status of DELETE statements in general, see Deleting Data (see page 64).

Positioned Delete Example

In this example, the program declares an updateable cursor. After fetching a row, the program conditionally executes a positioned delete.

```
EXEC SQL

  DECLARE DEL_POSITION CURSOR FOR
     SELECT EMP_ID,
            JOB_ID
       FROM POSITION
END-EXEC.
 .
 .
 .
EXEC SQL
  OPEN DEL_POSITION
END-EXEC.
 .
 .
 .
  EXEC SQL
    FETCH DEL_POSITION INTO
      :EMP-ID,
      :JOB-ID
  END-EXEC.
 .
 .
 .
IF INPUT-ACTION = 'D&rq.
EXEC SQL
  DELETE FROM POSITION
    WHERE CURRENT OF DEL_POSITION
END-EXEC.
 .
 .
 .
EXEC SQL
   CLOSE DEL_POSITION
END-EXEC.
```

Bulk Processing

A CA IDMS extension of the SQL standard allows you to transfer multiple rows of data between the database and the program using a single SELECT, FETCH, or INSERT statement with a BULK clause.

To issue a bulk select, fetch, or insert, the program must declare a host variable array.

Note: For more information about declaring a host variable array in CA ADS, COBOL and PL/I see Requirements and Options for Host Languages (see page 87).

Executing a Bulk Fetch

A bulk fetch is a FETCH statement that retrieves multiple rows from a cursor into a host variable array.

To execute a bulk fetch:

1. Declare a host variable array
2. Open the cursor
3. Issue a FETCH statement with the BULK clause

Note: For more information about the FETCH statement, see the *CA IDMS SQL Reference Guide*.

Cursor Position

The first execution of a FETCH BULK statement retrieves the first set of rows from the cursor result table. After statement execution, cursor position is on the last row fetched. If the FETCH BULK statement is executed again before the cursor is closed, the next set of rows retrieved begins with the row following the cursor position. Fetching proceeds sequentially through the cursor result table until no more rows are found.

How Many Rows Are Fetched?

If you do not specify a ROWS parameter in the BULK clause, the FETCH statement retrieves as many rows as will fit between the starting row of the array and the end of the array.

If you specify a ROWS parameter in the BULK clause, the FETCH statement retrieves a number of rows equal to the value in the ROWS. This value must be less than or equal to the number of rows between the starting row of the array and the end of the array.

Maximum Rows Example

In this example, the program assigns a ROWS value that corresponds to the number of rows that can be displayed on a given display terminal:

```
EXEC SQL  BEGIN DECLARE SECTION  END-EXEC.

01 BULK-DIVISION.
   02 BULK-DIV OCCURS 100 TIMES.
      03 DEPT-ID         PIC   9(4).
      03 DEPT-NAME       PIC   X(40).
01 DIV-CODE              PIC   X(3).
01 WS-SCREEN-LENGTH      PIC   S9(4) COMP.
 .
 .
 .
EXEC SQL
  DECLARE DIV_DEPT CURSOR FOR
    SELECT DEPT_ID, DEPT_NAME
      FROM DEPARTMENT
      WHERE DIV_CODE = :DIV-CODE
END-EXEC.
ACCEPT SCREENSIZE INTO WS-SCREEN-LENGTH.
SUBTRACT 4 FROM WS-SCREEN-LENGTH.
IF WS-SCREEN-LENGTH > 100 MOVE 100 TO
WS-SCREEN LENGTH.
 .
 .
 .
MOVE INPUT-DIV-CODE TO DIV-CODE.

EXEC SQL
OPEN DIV_DEPT
END-EXEC.

FETCH-PARAGRAPH.

EXEC SQL
  FETCH DIV_DEPT
    BULK :BULK-DIVISION ROWS :WS-SCREEN-LENGTH
END-EXEC.

IF SQLCODE=100 MOVE 'Y' TO END-FETCH.
 .
 .
 .
(Iterate paragraph until no more rows)
```

Specifying a Starting Row

The DBMS assigns the first row of the result table to the first row of the array unless you include the START parameter on the BULK clause. The START value corresponds to the subscript value of the array occurrence.

Checking Statement Execution

If program logic calls for repeating the FETCH BULK statement until no more rows are found, the program must test for SQLCODE = 100, as described in Using a Cursor (see page 67). The DBMS always sets the value of SQLCNRP equal to the number of rows returned unless an error occurs during processing.

The following table shows the possible combination of values returned to SQLCODE and SQLCNRP on a FETCH BULK statement:

SQLCODE and SQLCNRP Values

Result of bulk fetch	SQLCODE value	SQLCNRP value
No rows are returned	100	0
At least one row is returned but fewer rows than the maximum allowed	100	Equals the number of rows returned
The number of rows returned matches the maximum allowed	0	Equals the number of rows returned

Advantages of a Bulk Fetch

Using a BULK clause with a FETCH statement minimizes resources to retrieve data.

Unlike a bulk select, the program can retrieve an unlimited number of result rows by repeating a bulk fetch.

Bulk Fetch Considerations

- With a bulk fetch, the program generally cannot perform current or cursor operations such as a positioned update or delete because the cursor is always positioned on (or after) the last row fetched
- If an error occurs during the processing of a bulk fetch, the contents of the host variable array are unpredictable
- If a bulk fetch results in retrieval of a null value, the contents of the host variable for the corresponding column is unpredictable

Bulk Fetch Example

In this example, the program issues an INCLUDE TABLE statement to declare a host variable array for several columns of the EMPLOYEE table. Then it declares a cursor to select the column values from all rows of the table.

```
EXEC SQL  BEGIN DECLARE SECTION  END-EXEC.

EXEC SQL
  INCLUDE TABLE EMPLOYEE AS BULK-EMPLOYEE
  (EMP_ID, EMP_FNAME, EMP_LNAME, DEPT_ID)
  NUMBER OF ROWS 50
  PREFIX 'BULK-'
END-EXEC.
EXEC SQL  END DECLARE SECTION  END-EXEC.
 .
 .
 .
EXEC SQL
  DECLARE EMP_CRSR CURSOR FOR
    SELECT EMP_ID,
           EMP_FNAME,
           EMP_LNAME,
           DEPT_ID
      ORDER BY 4, 3, 2
END-EXEC.
```

When the FETCH statement is executed, the first 50 rows of the cursor result table are assigned to the BULK-EMPLOYEE array, because the default starting row assignment is 1 and the default number of rows assigned is the array size. If the FETCH statement is repeated, the next 50 rows of the result table are assigned to the array.

```
EXEC SQL
  OPEN EMP_CRSR
END-EXEC.
 .
 .
 .
EXEC SQL
  FETCH EMP_CRSR
    BULK :BULK-EMPLOYEE
END-EXEC.

IF SQLCODE = 100 MOVE 'Y' TO END-FETCH.
```

Executing a Bulk Select

A bulk select is a SELECT statement that retrieves multiple rows from the database into a host variable array:

1. Declare a host variable array
2. Issue the SELECT statement with a BULK clause, as in this example:

```
EXEC SQL
   SELECT DEPT_ID,
          DEPT_NAME,
          DIV-CODE,
          DEPT_HEAD_ID
      BULK :BULK-DEPARTMENT
      FROM DEPARTMENT
END-EXEC.
```

Checking the Status of a Bulk Select

A successful bulk select returns 100 to SQLCODE. A value of 100 will be returned if there are fewer result rows than entries in the bulk array or if the number of result rows is the same as the number of entries. If the array is too small for the result table, the statement returns a *cardinality violation* error.

The following table shows the possible combinations of SQLCODE and SQLCNRP values on a bulk select:

Result of bulk select	SQLCODE value	SQLCNRP value
No rows are returned	100	0
At least one row is returned but fewer rows than the maximum allowed	100	Greater than 0 and less than or equal to the maximum allowed
The number of rows returned exceeds the maximum allowed	Less than 0	Equal to the maximum allowed

Advantage of a Bulk Select

A bulk select retrieves a set of rows using fewer resources than a series of single-row SELECT statements to retrieve the same rows.

Bulk Select Considerations

A bulk select:

- Cannot retrieve more rows than there are occurrences in the host variable array
- Retrieves the same set of rows, not the next set of rows, if the statement is reissued within the database transaction
- Causes the contents of the host variable array to be unpredictable if an error occurs during processing

A bulk select is appropriate only when selecting from a table with a number of rows that you consider fixed, such as a table of the 50 states and their mailing codes.

If the size of the host variable array may be too small for the result table, you should declare a cursor for the SELECT statement and use a bulk fetch.

Executing a Bulk Insert

A bulk insert is an INSERT statement that adds multiple rows in a host variable array to the database.

To execute a bulk insert:

1. Declare a host variable array
2. Assign values to the host variable array
3. Issue the INSERT statement with the BULK clause

Specifying the START and ROWS Parameters

A bulk insert adds as many rows from the host variable array as are specified in the ROWS parameter, starting from the row specified in the START parameter. If START and ROWS are not specified, these are the defaults:

- The starting row is the first entry in the array
- The number of rows inserted is the number of occurrences defined for the array

Note: If the array is not full, specify a ROWS parameter value equal to the number of occurrences in the array that contain data. This ensures that the DBMS will not attempt to insert array occurrences that contain no data.

Bulk Insert Example

In this example, the program declares a host-variable array with an INCLUDE TABLE statement. After values are assigned to the array, the program issues a statement to insert all of the data in the array:

```
EXEC SQL

   INCLUDE TABLE SKILL AS BULK-SKILL
     NUMBER OF ROWS 100
     PREFIX 'BULK-'
END-EXEC.
 .
 .
 .
(Assign values to BULK-SKILL array)
 .
 .
 .
EXEC SQL
   INSERT INTO SKILL
     BULK :BULK-SKILL
       ROWS :NUM-ROWS
END-EXEC.

IF SQLCODE < 0
  MOVE SQLCNRP TO FAILING-ROW-NUM
  PERFORM ERROR-ROUTINE.
```

Checking Bulk Insert Status

To detect unsuccessful execution of a bulk insert, test for SQLCODE < 0.

If the result of the test is true, the value of SQLCNRP equals the relative row number (from the specified starting row) of the row which caused the failure. The DBMS rolls back the results of the failing row but not the results of the prior rows.

The following table shows the possible combinations of SQLCODE and SQLCNRP values on a bulk insert:

Result of bulk insert	SQLCODE value	SQLCNRP value
Fewer rows than the number of rows specified are inserted because the insert failed on a row	Less than 0	Equal to the relative row number of the failing row
The number of rows inserted matches the number of rows specified	0	Equal to the number of rows inserted

Advantage of a Bulk Insert

A bulk insert adds a group of rows using fewer resources than if the program issues a separate INSERT statement for each row.

Invoking Procedures

There are two types of SQL invoked procedures: a procedure and a table procedures. Both types can be invoked using either a CALL statement or a SELECT statement. This section describes the results of invoking procedures in each of these ways.

CALL Statement

In a program, you can use the CALL statement to invoke a (table) procedure. The following sections describe the results of invoking each type of procedure using a CALL statement.

Note: For more information about SQL procedures and table procedures, see the *CA IDMS SQL Reference Guide*.

CALL of a Procedure

A procedure always returns zero or one result sets of parameters.

```
EXEC SQL
     CALL DEMOEMPL.GET_BONUS
      (1234, :BONUS-AMOUNT, :BONUS-CURRENCY)
END-EXEC
```

If the CALL is successful, indicated by an SQLSTATE of '00000' the host variables BONUS-AMOUNT and BONUS-CURRENCY will contain valid data, returned by the invoked routine for EMP-ID 1234, the input value supplied for the first parameter.

CALL of a Table Procedure

A table procedure can return zero or more result sets of parameters. Therefore, a simple CALL statement can not be used to invoke and return all the result sets of the table procedure; a cursor is required.

Declaration of the Cursor

```
EXEC SQL
     DECLARE C_BONUS_SET CURSOR
             FOR CALL DEMOEMPL.GET_BONUS_SET
             ( EMP_ID =1234 )
END-EXEC.
```

Opening the Cursor

```
EXEC SQL
     OPEN C_BONUS_SET
END-EXEC.
```

Fetching the Result Sets

```
EXEC SQL
     FETCH C_BONUS_SET INTO
           :EMP-ID,
           :BONUS-AMOUNT,
           :BONUS-CURRENCY
END-EXEC.
```

Host variables for all parameters specified in the table procedure definition should be provided.

Note: For more information about using cursors, see Using a Cursor (see page 67).

SELECT Statement

The SELECT statement can be used as an alternative to the CALL statement to invoke a (table) procedure. The following sections describe the results of invoking each type of procedure using a SELECT statement.

SELECT of a Procedure

A procedure always returns zero or one result sets of parameters, therefore, a SELECT ... INTO is used.

```
EXEC SQL
     SELECT BONUS_AMOUNT,
            BONUS_CURRENCY
     FROM DEMOEMPL.GET_BONUS(1234)
          INTO :BONUS-AMOUNT,
               :BONUS_CURRENCY
END-EXEC
```

If the SELECT is successful, indicated by an SQLSTATE of '00000' the host variables BONUS-AMOUNT and BONUS-CURRENCY will contain valid data, returned by the invoked routine for EMP-ID 1234, the input value supplied for the first parameter.

SELECT of a Table Procedure

A table procedure can return zero or more result sets of parameters. Therefore, a SELECT ... INTO statement is only used when the SELECT returns zero or only one result set. A cursor is required if more than one row is returned to the result set.

Declaration of the Cursor

```
EXEC SQL
     DECLARE C_BONUS_SET CURSOR
             FOR SELECT BONUS_AMOUNT, BONUS_CURRENCY
             FROM DEMOEMPL.GET_BONUS_SET
             ( EMP_ID =1234 )
END-EXEC.
```

Opening the Cursor

```
EXEC SQL
     OPEN C_BONUS_SET
END-EXEC.
```

Fetching the Result Sets

```
EXEC SQL
     FETCH C_BONUS_SET
     INTO :BONUS-AMOUNT,
          :BONUS-CURRENCY
END-EXEC.
```

Note: For more information about using cursors, see Using a Cursor (see page 67).

Chapter 5: Requirements and Options for Host Languages

There are requirements and options that apply to a particular host language when you embed SQL in an application program to access CA IDMS.

Note: The SQL Web Connect feature allows all IDMS customers limited use of dynamic SQL. The use of static, precompiled SQL requires a full SQL license.

This section contains the following topics:

Using SQL in a CA ADS Application

This section presents information that is specific to embedding SQL in a CA ADS application program.

Note: Refer to the following manuals for documentation of all aspects of CA ADS application programming:

- *CA ADS User Guide*
- *CA ADS Reference Guide*

Embedding SQL Statements

Requirements

To embed an SQL statement in a CA ADS program, you must:

- Observe CA ADS margin requirements (columns 1 to 72)
- Use SQL statement delimiters

Options

You can use the SQL convention to insert comments in an SQL statement.

You can use the CA ADS convention to continue an SQL statement on the next line.

Delimited, Continued, and Commented Statements

How You Delimit a Statement

When you embed an SQL statement in a CA ADS application program, you must use these statement delimiters:

- Begin each SQL statement with **EXEC SQL**
- End each SQL statement with **END-EXEC.**

Statement Delimiter Example

The following example shows the use of SQL statement delimiters:

```
EXEC SQL
  INSERT INTO DIVISION VALUES ('D07','LEGAL',1234)
END-EXEC.
```

The statement text can be on the same line as the delimiters.

Continuing Statements

You can write an SQL statement on more than one line if you do one of the following:

- Split the statement before or after any keyword, value, or delimiter
- Code through column 72 of one line and continue in column 1 of the next line

Continued Statement Example

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7-
EXEC SQL
   INSERT INTO SKILL VALUES (5678, 'TELEMARKETING', 'PRESENT SALES SCRIP
T OVER THE TELEPHONE, INPUT RESULTS')
END-EXEC.
```

How to Put Comments in SQL Statements

To include comments within SQL statements embedded in a CA ADS program, you can use the SQL comment characters, two consecutive hyphens (--), on an SQL statement line following the statement text.

Restrictions on Comments

- Do not insert a comment in the middle of a string constant or delimited identifier
- Do not use the CA ADS comment character ! to insert a comment in an embedded SQL statement

SQL Comment Example

The following example shows two comments within an embedded SQL statement:

```
EXEC SQL
-- Perform update on active employees only
   UPDATE BENEFITS
     SET VAC_ACCRUED = VAC_ACCRUED + 10,   -- Add 10 hours vacation
         SICK_ACCRUED = SICK_ACCRUED + 1   -- Add 1 sick day
     WHERE EMP_ID IN
         (SELECT EMP_ID FROM EMPLOYEE
            WHERE STATUS = 'A')
END-EXEC.
```

Placing an SQL Statement

Where You Can Put Statements

These are the rules for placing an SQL statement in a CA ADS program:

- Only a WHENEVER directive or a DECLARE CURSOR statement may appear in a declaration module
- All SQL statements *except* for INCLUDE TABLE are valid for premap and response processes

Order of Compilation

Dialog modules are compiled in this order:

1. Declaration module
2. Premap process module
3. Response process modules

The order of compilation of response process modules is not guaranteed. Therefore, if a WHENEVER condition or the availability of a cursor must span modules, you should place the WHENEVER statement or cursor declaration in a declaration module.

Declaration Module

CA ADS uses a declaration module, if it exists, when you compile the dialog.

The declaration module can contain WHENEVER directives and DECLARE CURSOR statements.

WHENEVER and DECLARE CURSOR are not executable statements, and a declaration module is not executable. The scope of a WHENEVER or DECLARE CURSOR is the entire dialog.

A WHENEVER directive or DECLARE CURSOR statement is valid in a premap or response process, but the scope of the statement is not global.

Scope of WHENEVER

The scope of a WHENEVER condition in a premap or response is the rest of that premap or response or until another WHENEVER statement that changes the condition is encountered within the process.

A WHENEVER declaration in a premap or response overrides (for the duration of its scope) the global declaration in the declaration module.

Scope of DECLARE CURSOR

The scope of a DECLARE CURSOR statement is from the moment that the declaration is encountered in dialog compilation to the end of that compilation.

Defining Host Variables

What You Declare

You implicitly declare host variables for a CA ADS dialog when:

- You associate a record or a table with the dialog using the WORK RECORD screen of ADSC
- You associate a map or subschema, and thus its records, with the dialog

Any record element that is valid for a CA ADS MOVE command is valid as a host variable.

Note: For more information about ADSC and the MOVE command, see the *CA ADS Reference Guide*.

Equivalent Column Data Types

All CA IDMS data types are supported by CA ADS.

This table shows definitions of CA ADS host variable data types and the equivalent CA IDMS table column data types:

CA ADS PICTURE and USAGE clause	CA IDMS data type
PIC X(*n*) USAGE DISPLAY	CHAR(*n*)

CA ADS PICTURE and USAGE clause	CA IDMS data type
01 *name* 49 *name*-LEN PIC S9(4) COMP 49 *name*-TEXT PIC X(*n*)	VARCHAR(*n*)
PIC S9(*p-s*)V9(*s*) USAGE COMP-3	DECIMAL(*p*,*s*)
PIC 9(*p-s*)V9(*s*) USAGE COMP-3	UNSIGNED DECIMAL(*p*,*s*)[1]
USAGE COMP-2	DOUBLE PRECISION
USAGE COMP-1	REAL
USAGE COMP-1	FLOAT
PIC S9(*n*) USAGE COMP (where *n*<5)	SMALLINT
PIC S9(*n*) USAGE COMP (where *n*>4 and *n*<10)	INTEGER
PIC S9(*n*) USAGE COMP (where *n*>9)	LONGINT or BIGINT
PIC S9(*p-s*)V9(*s*) USAGE DISPLAY	NUMERIC(*p*,*s*)
PIC 9(*p-s*)V9(*s*) USAGE DISPLAY	UNSIGNED NUMERIC(*p*,*s*)[1]
PIC X(*n*) USAGE DISPLAY	BINARY(*n*)
PIC G(*n*) USAGE DISPLAY-1	GRAPHIC(*n*)[1]
01 *name* 49 *name*-LEN PIC S9(4) COMP 49 *name*-TEXT PIC G(*n*) DISPLAY-1	VARGRAPHIC(*n*)[1]
PIC X(10) USAGE DISPLAY	DATE
PIC X(8) USAGE DISPLAY	TIME
PIC X(26) USAGE DISPLAY	TIMESTAMP
PIC X(8) USAGE DISPLAY	TID[1]

Note: [1] This data type is a CA IDMS extension of the SQL standard. For more information about documentation of CA IDMS data types, see the *CA IDMS SQL Reference Guide*.

Including Tables

You include an SQL table in a CA ADS dialog by specifying the table on the WORK RECORD screen of ADSC.

ADSC creates host variable structures using these data type equivalents when directed to include a table on the Work Record Screen:

CA IDMS data type	Data type in included table
BINARY(*n*)	PIC X(*n*)
CHARACTER(*n*)	PIC X(*n*)
VARCHAR(*n*)	-LEN PIC S9(4) COMP -TEXT PIC X(*n*)
GRAPHIC(*n*)	PIC G(*n*) DISPLAY-1
VARGRAPHIC(*n*)	-LEN PIC S9(4) COMP -TEXT PIC G(*n*) DISPLAY-1
DECIMAL(*p*,*s*)	PIC S9(*p*-*s*)V9(*s*) COMP-3
UNSIGNED DECIMAL(*p*,*s*)	PIC 9(*p*-*s*)V9(*s*) COMP-3
NUMERIC(*p*,*s*)	PIC S9(*p*-*s*)V9(*s*) DISPLAY
UNSIGNED NUMERIC(*p*,*s*)	PIC 9(*p*-*s*)V9(*s*) DISPLAY
DOUBLE PRECISION	COMP-2
FLOAT(*n*) where *n* <= 24 *n* > 24	 COMP-1 COMP-2
REAL	COMP-1
DATE	PIC X(10)
TIME	PIC X(8)
TIMESTAMP	PIC X(26)
SMALLINT	PIC S9(4) COMP
INTEGER	PIC S9(8) COMP
LONGINT	PIC S9(18) COMP
Indicator variable	PIC S9(4) COMP or PIC S9(8) COMP
TID	PIC X(8)

Defining Bulk Structures

A bulk structure is a group element or a record which contains a subordinate array for holding multiple occurrences of input or output values. Bulk structures are used in bulk SELECT, INSERT, and FETCH statements for retrieving or storing multiple rows of data.

Format of a Bulk Structure

A bulk structure consists of three levels:

- The highest level is the structure itself (level 01 through 47).
- The second level is a multiply occurring group item (level 02 through 48).
- The third level consists of elementary or variable length data items (variable length data items are group elements consisting of a halfword length field followed by a character or graphics field).

  The number, type and order of data items at the lowest level must correspond to the number, data type, and order of column values being retrieved or inserted.

All data descriptions used by CA ADS are defined within the dictionary.

Bulk Structure Example

The following is an example of a valid bulk structure definition using IDD syntax:

```
ADD ELEMENT EMP-ID PIC 999.
ADD ELEMENT EMP-NAME PIC X(30).
ADD ELEMENT DEPT-NAME PIC X(30).
ADD ELEMENT BULK-ROW SUB ELEMENTS ARE
    (EMP-ID EMP-NAME DEPT-NAME).
ADD ELEMENT BULK-DATA SUB ELEMENT
    BULK-ROW OCCURS 20.
```

Referring to a Bulk Structure

When referring to a bulk structure in a SELECT, FETCH, or INSERT statement, the name of the highest level is used:

```
EXEC SQL
  FETCH EMPCURS BULK :BULK-DATA
END-EXEC.
```

Restrictions

The following restrictions apply to bulk structures defined for use with CA ADS:

- The following clauses may not appear within the lowest level element definitions:
  - BLANK WHEN ZERO IS ON
  - JUSTIFY IS ON
  - OCCURS
  - (R) indicating redefinition
  - SIGN IS LEADING/TRAILING
  - SYNC
- Indicator variables cannot be defined for elements within the bulk structure
- The bulk structure must be either a record or the first element within the record

Referring to Host Variables

What You Can Do

CA IDMS supports references to host variables in SQL statements. The host variable name must be preceded with a colon (:).

Note: For more information about host variables, see Referring to Host Variables (see page 32).

Qualifying Host Variable Names

CA IDMS supports two methods of qualifying CA ADS host variable names in an SQL statement.

For example, assume these host variable definitions:

```
01 EMP
     03 HIRE-DATE
  .
  .
  .
01 MGR
     03 HIRE-DATE
  .
  .
  .
```

The methods of qualifying HIRE-DATE in both of the following examples are valid:

```
EXEC SQL
  SELECT...
    INTO :HIRE-DATE OF EMP

----------------

EXEC SQL
  SELECT...
    INTO :EMP.HIRE-DATE
```

Including SQL Communication Areas

Automatically Included

The SQL Communications Areas (SQLCAs) are included automatically in a CA ADS dialog that contains embedded SQL. You make no declaration of these data structures in the CA ADS modules you create.

SQLCA Structure

This is the CA ADS format of the SQLCA:

COBOL/CA ADS SQLCA

```
01  SQLCA.
    02  SQLCAID                PIC X(8).
    02  SQLCODE                PIC S9(9) COMP.
    02  SQLCSID                PIC X(8).
    02  SQLCINFO.
     03  SQLCERC               PIC S9(9) COMP.
     03  FILLER                PIC S9(9) COMP.
     03  SQLCNRP               PIC S9(9) COMP.
     03  FILLER                PIC S9(9) COMP.
     03  SQLCSER               PIC S9(9) COMP.
     03  FILLER                PIC S9(9) COMP.
     03  SQLCLNO               PIC S9(9) COMP.
     03  SQLCMCT               PIC S9(9) COMP.
     03  SQLCARC               PIC S9(9) COMP.
     03  SQLCFJB               PIC S9(9) COMP.
     03  FILLER                PIC S9(9) COMP.
     03  FILLER                PIC S9(9) COMP.
    02  SQLCINF2 REDEFINES SQLCINFO.
     03  SQLERRD               PIC S9(9) COMP
                               OCCURS 12.
    02  SQLCMSG.
     03  SQLCERL               PIC S9(9) COMP.
     03  SQLERM                PIC X(256).
    02  SQLCMSG2 REDEFINES SQLCMSG.
     03  FILLER                PIC X(2).
     03  SQLERRM.
      04  SQLCERRML            PIC S9(4) COMP.
      04  SQLERRMC             PIC X(256).
    02  SQLSTATE               PIC X(5).
    02  SQLCRNF                PIC X(1).
    02  SQLCNRRS               PIC S9(4) COMP.
    02  FILLLER                PIC X(8).
                                         ┌──┐
    02  SQLWORK                PIC X(16). │
    02  SQLCWRK2 REDEFINES SQLWORK.       │
     03  SQLERRP.                         │
      04  SQLCVAL              PIC X(5).  │  Included by the
      04  FILLER               PIC X(3).  │  precompiler for
     03  SQLWARN.                         │  DB2 compatibility;
      04  SQLWARN0             PIC X(1).  │  not used by CA IDMS
      04  SQLWARN1             PIC X(1).  │
      04  SQLWARN2             PIC X(1).  │
      04  SQLWARN3             PIC X(1).  │
      04  SQLWARN4             PIC X(1).  │
      04  SQLWARN5             PIC X(1).  │
      04  SQLWARN6             PIC X(1).  │
      04  SQLWARN7             PIC X(1).  │
                                         └──┘
```

Using SQL in a COBOL Application Program

This section presents information that is specific to embedding SQL in a COBOL application program.

Note: For more information documenting all aspects of COBOL application programming in the CA IDMS environment, see the *CA IDMS DML Reference Guide for COBOL*.

Embedding SQL Statements

Requirements

To embed an SQL statement in a COBOL program, you must:

- Place the statement in the proper division of the program
- Observe COBOL margin requirements (columns 8 to 72)
- Use statement delimiters

Options

You can use SQL conventions to:

- Continue an SQL statement on the next line
- Insert comments in an SQL statement

You can use a precompiler-directive statement to copy SQL statements in a module from the dictionary into the program.

Note: SQL statements cannot be embedded using the COBOL INCLUDE or BASIS statement.

Delimited, Continued, and Commented Statements

Using SQL Statement Delimiters

When you embed an SQL statement in a COBOL application program, you must use these statement delimiters:

- Begin each SQL statement with **EXEC SQL**
- End each SQL statement with **END-EXEC.**

Note: The period following END-EXEC is optional. Include it wherever you would normally terminate a COBOL statement with a period.

The following example shows the use of SQL statement delimiters:

```
EXEC SQL
  INSERT INTO DIVISION VALUES ('D07','LEGAL',1234)
END-EXEC.
```

The statement text can be on the same line as the delimiters.

Continuing Statements

You can write SQL statements on one or more lines. No special character is required to show that a statement continues on the next line if you split the statement before or after any keyword, value, or delimiter.

You can use the COBOL continuation character, a hyphen (-), in column 7 when a string constant in an embedded SQL statement is split at column 72 and continued on the next line:

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7-
       EXEC SQL
         INSERT INTO SKILL
           VALUES (5678,'TELEMARKETING','PRESENT SALES SCRIPT OVER THE
      -'TELEPHONE, INPUT RESULTS')
       END-EXEC.
```

Inserting SQL Comments

To include comments within SQL statements embedded in a COBOL program, you can:

- Use the COBOL comment character * in column 7
- Use the SQL comment characters, two consecutive hyphens (--), on an SQL statement line following the statement text

A comment that begins with the SQL comment characters (--) terminates at the end of the line (column 72).

You cannot use SQL comment characters to insert a comment in the middle of a string constant or delimited identifier.

The following example shows both methods of inserting comments within an embedded SQL statement:

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7-
       EXEC SQL
      *********  PERFORM UPDATE ON ACTIVE EMPLOYEES ONLY
         UPDATE BENEFITS
           SET VAC_ACCRUED = VAC_ACCRUED + 10,  -- Add 10 hours vacation
               SICK_ACCRUED = SICK_ACCRUED + 1  -- Add 1 sick day
           WHERE EMP_ID IN
             (SELECT EMP_ID FROM EMPLOYEE
             WHERE STATUS = 'A')
 END-EXEC.
```

Placing an SQL Statement

Where You Can Put Statements

These are the rules for placing an SQL statement in a COBOL program:

- The INCLUDE statement must be in the DATA DIVISION
- The WHENEVER can be in the DATA DIVISION or the PROCEDURE DIVISION
- The DECLARE CURSOR and DECLARE EXTERNAL CURSOR statements can be in the DATA DIVISION or the PROCEDURE DIVISION but must precede the OPEN statement that references the cursor
- All other statements must be in the PROCEDURE DIVISION

Versions Prior to VS COBOL II

If your program is written for a version of COBOL that is prior to VS COBOL II, observe these guidelines:

- Do not include an SQL statement within the scope of a COBOL IF statement
- Use the THRU construction for a PERFORM statement that references a section containing an SQL statement

COBOL Version Examples

This example is valid in VS COBOL II and later versions:

```
IF I < 100
  EXEC SQL
    SELECT EMP_LNAME,
           DEPT_ID
      INTO :EMP-LNAME,
           :DEPT-ID
      WHERE EMP_ID = :WK-EMP-ID
  END-EXEC.
  COMPUTE A = A + 1.
```

For a version of COBOL prior to VS COBOL II, the procedure above can be written:

```
IF I < 100
  PERFORM  PARAGRAPH-B THRU PARAGRAPH-B-END
  COMPUTE A = A + 1.

PARAGRAPH-B.
  EXEC SQL
    SELECT EMP_LNAME,
           DEPT_ID
      INTO :EMP-LNAME,
           :DEPT-ID
      WHERE EMP_ID = :WK-EMP-ID
  END-EXEC.
PARAGRAPH-B-END.
```

Defining Host Variables

Host variables are defined using COBOL data declarative statements appearing in SQL declare sections.

CA IDMS extensions offer the alternative methods of using the INCLUDE TABLE precompiler directive or copying record descriptions from the data dictionary.

A host variable definition may appear anywhere a legal data item definition can appear.

Using COBOL Data Declarations

What You Declare

Within an SQL declare section, you specify the name, level, and data type of host variables using standard COBOL data declarative statements and observing these guidelines:

- A host variable **name** must conform to COBOL rules for forming variable names
- The level number is in the range of 01 to 49, or 77

  A CA IDMS extension of the SQL standard allows level numbers in the range of 02 to 49.
- The data type of the host variable as defined in the PICTURE and USAGE clauses

Equivalent Column Data Types

All CA IDMS data types can be supported in a COBOL program.

This table shows types of COBOL host variables and the equivalent CA IDMS table column data types:

COBOL PICTURE and USAGE clause	CA IDMS data type
PIC X(*n*) USAGE DISPLAY	CHAR(*n*)
01 *name* 49 *name*-LEN PIC S9(4) COMP 49 *name*-TEXT PIC X(*n*)	VARCHAR(*n*)
PIC S9(*p-s*)V9(*s*) USAGE COMP-3	DECIMAL(*p*,*s*)
PIC 9(*p-s*)V9(*s*) USAGE COMP-3	UNSIGNED DECIMAL(*p*,*s*)[1]
USAGE COMP-2	DOUBLE PRECISION
USAGE COMP-1	REAL
USAGE COMP-1	FLOAT
PIC S9(*n*) USAGE COMP (where *n*<5)	SMALLINT
PIC S9(*n*) USAGE COMP (where *n*>4 and *n*<10)	INTEGER
PIC S9(*n*) USAGE COMP (where *n*>9)	LONGINT or BIGINT
PIC S9(*p-s*)V9(*s*) USAGE DISPLAY	NUMERIC(*p*,*s*)

COBOL PICTURE and USAGE clause	CA IDMS data type
PIC 9(*p-s*)V9(*s*) USAGE DISPLAY	UNSIGNED NUMERIC(*p*,*s*)[1]
PIC X(*n*) USAGE SQLBIN	BINARY(*n*)
PIC G(*n*) USAGE DISPLAY-1	GRAPHIC(*n*)[1]
01 *name* 49 *name*-LEN PIC S9(4) COMP 49 *name*-TEXT PIC G(*n*) DISPLAY-1	VARGRAPHIC(*n*)[1]
PIC X(10) USAGE DISPLAY	DATE
PIC X(8) USAGE DISPLAY	TIME
PIC X(26) USAGE DISPLAY	TIMESTAMP
PIC X(8) USAGE SQLBIN	TID[1]

Note: [1]This data type is a CA IDMS extension of the SQL standard. For more information about CA IDMS data types, see the *CA IDMS SQL Reference Guide*.

Host Variable Declaration Example

In this example, the SQL declare section defines host variables, including one indicator variable, using standard COBOL data declarations. The example is annotated to show the equivalent column data type for each variable and to identify an indicator variable:

```
WORKING-STORAGE SECTION.
 .
 .
 .
EXEC SQL BEGIN DECLARE SECTION END-EXEC.
  01  EMP-ID           PIC S9(8)     USAGE COMP.    <- INTEGER
  01  EMP-LNAME        PIC X(20).                   <- CHARACTER
  01  SALARY-AMOUNT    PIC S9(6)V(2) USAGE COMP-3.  <- DECIMAL
  01  PROMO-DATE       PIC X(10).                   <- DATE
  01  PROMO-DATE-I     PIC S9(4)     USAGE COMP.    <- Indicator variable
EXEC SQL END DECLARE SECTION END-EXEC.
```

Declaring an indicator variable

An indicator variable must be either a 2 or 4 byte computational (binary) data type. In the example above, PROMO-DATE-I is a valid indicator variable.

SQLIND data type

You can declare an indicator variable with the data type SQLIND:

```
05  PROMO_DATE       PIC X(10).          <- DATE
05  PROMO_DATE_I     SQLIND.             <- Indicator variable
```

The precompiler will substitute PIC S9(8) USAGE COMP in the output source.

The SQLIND data type is primarily for use within bulk structure definitions. In other cases its use is optional.

Allowable Host Variable Definitions

A host variable definition may contain:

- PICTURE clause
- USAGE clause
  - DISPLAY
  - DISPLAY SIGN LEADING SEPARATE
  - COMP
  - COMP-1[1]
  - COMP-2[1]
  - COMP-3[1]
  - SQLIND[1]
  - SQLBIN[1]
  - SQLSESS[1]
- VALUE clause[1]
- 88 *condition-name*[1] (any legal COBOL clause)
- OCCURS[1] clause (except within a non-bulk structure)

  Within a bulk structure definition, the occurs clause is allowed only on the second-level group element. The following subclauses are also supported but only on the second level group element of a bulk structure:

  - DEPENDING ON

    Note: The DEPENDING ON variable is not used in determining the number of rows in the bulk structure.
  - ASCENDING/DESCENDING KEY
  - INDEXED BY
- REDEFINES[1] clause (except within a bulk or non-bulk structure)
- BLANK WHEN ZERO[1] (except within a bulk or non-bulk structure)
- SYNCHRONIZED[1] (except within a bulk or non-bulk structure)

([1] This support is a CA IDMS extension of the SQL standard.)

Using INCLUDE TABLE

Output of INCLUDE TABLE

The CA IDMS precompiler uses these data type equivalents when directed by an INCLUDE TABLE statement to create a host variable declaration.

CA IDMS data type	COBOL data type on INCLUDE TABLE
BINARY(*n*)	PIC X(*n*)
CHARACTER(*n*)	PIC X(*n*)
VARCHAR(*n*)	-LEN PIC S9(4) COMP -TEXT PIC X(*n*)
GRAPHIC(*n*)	PIC G(*n*) DISPLAY-1
VARGRAPHIC(*n*)	-LEN PIC S9(4) COMP -TEXT PIC G(*n*) DISPLAY-1
DECIMAL(*p*,*s*)	PIC S9(*p*-*s*)V9(*s*) COMP-3
UNSIGNED DECIMAL(*p*,*s*)	PIC 9(*p*-*s*)V9(*s*) COMP-3
NUMERIC(*p*,*s*)	PIC S9(*p*-*s*)V9(*s*) DISPLAY
UNSIGNED NUMERIC(*p*,*s*)	PIC 9(*p*-*s*)V9(*s*) DISPLAY
DOUBLE PRECISION	COMP-2
FLOAT(*n*) where *n* <= 24 *n* > 24	 COMP-1 COMP-2
REAL	COMP-1
DATE	PIC X(10)
TIME	PIC X(8)
TIMESTAMP	PIC X(26)
SMALLINT	PIC S9(4) COMP
INTEGER	PIC S9(8) COMP
LONGINT	PIC S9(18) COMP
SQLIND	COMP PIC S9(8)
TID	PIC X(8) USAGE SQLBIN

Default Structure

The default structure created by the INCLUDE statement has these features:

- An 01-level element for the table
- A subordinate element named for each table column, defined with the equivalent program language data type
- An additional element, with the suffix '-I', for each column that allows null values, to be available as an indicator variable
- All element names generated with hyphens to replace underscores that appear in column names, to conform to COBOL naming standards

  If you specify a table without a schema name qualifier, you must supply a schema name with a precompiler option.

  Note: For more information about precompiler options, see Preparing and Executing the Program (see page 131).

Defining Bulk Structures

A bulk structure is a group element or a record which contains a subordinate array for holding multiple occurrences of input or output values. Bulk structures are used in bulk SELECT, INSERT, and FETCH statements for retrieving or storing multiple rows of data.

Format of a Bulk Structure

A bulk structure consists of three levels:

- The highest level is the structure itself (level 01 through 47).
- The second level is a multiply occurring group item (level 02 through 48).
- The third level consists of elementary or variable length data items (variable length data items are group elements consisting of a halfword length field followed by a character or graphics field).

  The number, type and order of data items at the lowest level must correspond to the number, data type, and order of column values being retrieved or inserted.

Bulk Structure Example

The following is an example of a valid bulk structure:

```
EXEC SQL  BEGIN DECLARE SECTION   END-EXEC.
  02  BULK-DATA.
    04  BULK-ROW OCCURS 20 TIMES.
      05  EMP-ID    PIC 999.
      05  EMP-NAME  PIC X(30).
      05  DEPT-NAME PIC X(30).
EXEC SQL  END DECLARE SECTION    END-EXEC.
```

Referring to a Bulk Structure

When referring to a bulk structure in a SELECT, FETCH, or INSERT statement, the name of the highest level is used:

```
EXEC SQL
  FETCH EMPCURS BULK :BULK-DATA
END-EXEC.
```

Indicator Variables

An indicator variable can be associated with a data item within the structure as follows:

- The indicator variable must immediately follow the data item with which it is associated
- The picture of the indicator variable must be S9(n) where n is between 4 and 8
- The usage of the indicator variable must be SQLIND

  On encountering the SQLIND usage, the precompiler interprets the variable as an indicator associated with the preceding variable. SQLIND is replaced with COMP in the generated source.

Restrictions

The following COBOL clauses must not appear within a bulk structure definition:

- BLANK WHEN ZERO
- JUSTIFIED
- OCCURS (except at the second level)
- REDEFINES
- SIGN
- SYNCHRONIZED

Fillers may appear within the structure; however, their data content is not preserved across a bulk SELECT or FETCH.

Using INCLUDE TABLE

A bulk structure can be defined for a given table by using the INCLUDE TABLE statement with a NUMBER OF ROWS clause. The statement in this example will generate a bulk structure capable of holding 20 entries:

```
EXEC SQL
  INCLUDE TABLE EMPLOYEE NUMBER OF ROWS 20
END-EXEC.
```

Non-bulk Structures and Indicator Arrays

About Non-bulk Structures

A non-bulk structure is a group element or record which is used to represent a list of host variables within an SQL statement. When reference is made to a non-bulk structure, it is interpreted as a reference to all of the subordinate elements within the structure.

About Indicator Arrays

An indicator array is a group element or record which contains one multiply occurring subordinate element used as an array of indicator variables. Indicator arrays hold indicator values for items within a non-bulk structure.

Format of a Non-bulk Structure

A non-bulk structure consists of two levels:

- The highest level is the structure itself (level 01 through 48)
- The second level consists of elementary or variable length data items (variable length data elements are group elements which consist of a halfword length field followed by a character or graphics field)

The number, type, and order of data items at the lowest level must correspond to the number, data type, and order of column values being retrieved or inserted.

Non-bulk Structure Example

This is an example of a valid non-bulk structure:

```
EXEC SQL  BEGIN DECLARE SECTION   END-EXEC.
  01  EMP-INFO.
      05  EMP-ID    PIC 999.
      05  EMP-NAME  PIC X(30).
      05  DEPT-NAME PIC X(30).
EXEC SQL  END DECLARE SECTION    END-EXEC.
```

Format of an Indicator Array

An indicator array consists of two levels:

- The highest level represents the entire array (level 01 through 48)
- The second level is a multiply occurring element that defines a halfword or fullword field

This is an example of a valid indicator array:

```
EXEC SQL  BEGIN DECLARE SECTION   END-EXEC.
  02  INDS.
    04  IND SQLIND OCCURS 20 TIMES.
EXEC SQL  END DECLARE SECTION    END-EXEC.
```

Referring to a Non-bulk Structure

A non-bulk structure can be referred to anywhere a list of host variables can be specified:

- The INTO clause of a SELECT or FETCH statement; for example:

  ```
  EXEC SQL
    FETCH EMPCURS INTO :EMP-INFO
  END-EXEC.
  ```

- The VALUES clause of an INSERT statement

Unlike bulk processing, a single SQL statement can contain more than one reference to a non-bulk structure. Each such reference is interpreted as a list of host variable references. The union of all such host variables together with any elementary host variables must correspond to a single result row (or input row, in the case of an INSERT statement).

Referring to an Indicator Array

To associate indicator variables with the elements of the non-bulk structure, the name of an indicator array is specified immediately following the name of the non-bulk structure:

```
EXEC SQL
  FETCH EMPCURS INTO :INFO :INDS
END-EXEC.
```

Note: Either the name of the group or its subordinate element may be used to refer to an indicator array.

Association of Indicator Variables and Non-bulk Structure Elements

The number of occurrences in the indicator array need not be the same as the number of elements in the non-bulk structure with which it is used. If there are more indicators than elements, the remaining indicators are ignored, although their contents are not necessarily preserved. If there are fewer indicators than elements, an indicator is associated with each element in the structure until all indicators are assigned. The remaining elements do not have associated indicators. This may result in an error if an attempt is made to return a null value into an element with no associated indicator.

Restrictions

The following COBOL clauses must not appear within a non-bulk structure definition:

- BLANK WHEN ZERO
- JUSTIFIED
- OCCURS
- REDEFINES
- SIGN
- SYNCHRONIZED

Fillers having a character data type may appear within the structure. However, their data content is not preserved across a SELECT or FETCH.

Note: Unless the included table has no nullable columns an INCLUDE TABLE table-name precompiler directive cannot be used to define the non-bulk structure; any nullable column would cause the precompiler to insert an associated indicator variable which makes the structure unusable for reference in the FETCH statement.

Referring to Host Variables

What You Can Do

CA IDMS supports references to host variables in SQL statements. The host variable name must be prefixed with a colon (:).

Note: For more information, see Referring to Host Variables (see page 32).

CA IDMS also supports references to:

- Subordinate elements which may require qualification for uniqueness
- Subscripted elements

Qualifying Host Variable Names

CA IDMS supports two methods of qualifying host variable names.

For example, assume these host variable definitions:

```
01 EMP
     03 HIRE-DATE
  .
  .
  .
01 MGR
     03 HIRE-DATE
  .
  .
  .
```

The method of qualifying HIRE-DATE in either of the following examples is valid:

```
EXEC SQL
  SELECT...
    INTO :HIRE-DATE OF EMP

----------------

EXEC SQL
  SELECT...
    INTO :EMP.HIRE-DATE
```

Subscripted Variable Names

A CA IDMS extension of the SQL standard supports host variable arrays for use in bulk processing. By further extension of the SQL standard, CA IDMS supports reference to a subscripted variable in a host variable array.

All of the following are valid host variable references:

- :DIV-CODE(1)
- :DIV-CODE (15)
- :DIV-CODE(SUB1)
- :DIV-CODE(SUB1,SUB2)

Including SQL Communication Areas

Declaring SQL Communication Areas

CA IDMS provides these ways of including the SQL Communication Areas in a COBOL program:

- The program can declare the host variable SQLSTATE in the WORKING-STORAGE SECTION:

  ```
  01   SQLSTATE      PIC X(5).
  ```

  Note: SQLSTATE does not have to be defined inside an SQL declare section.

- The program can declare the host variable SQLCODE in the WORKING-STORAGE SECTION:

  ```
  01   SQLCODE      PIC S9(8)
                    USAGE COMP.
  ```

  Note: SQLCODE does not have to be defined inside an SQL declare section.

- The precompiler automatically includes the communication areas at the end of the WORKING-STORAGE section in any program that contains embedded SQL statements

- The program can issue this precompiler directive:

  ```
  EXEC SQL
    INCLUDE SQLCA
  END-EXEC.
  ```

Using the INCLUDE statement to declare the SQLCA is a CA IDMS extension of the SQL standard.

SQLCA Structure

This is the COBOL format of the SQLCA:

COBOL/CA ADS SQLCA

```
01  SQLCA.
    02  SQLCAID                PIC X(8).
    02  SQLCODE                PIC S9(9) COMP.
    02  SQLCSID                PIC X(8).
    02  SQLCINFO.
     03  SQLCERC               PIC S9(9) COMP.
     03  FILLER                PIC S9(9) COMP.
     03  SQLCNRP               PIC S9(9) COMP.
     03  FILLER                PIC S9(9) COMP.
     03  SQLCSER               PIC S9(9) COMP.
     03  FILLER                PIC S9(9) COMP.
     03  SQLCLNO               PIC S9(9) COMP.
     03  SQLCMCT               PIC S9(9) COMP.
     03  SQLCARC               PIC S9(9) COMP.
     03  SQLCFJB               PIC S9(9) COMP.
     03  FILLER                PIC S9(9) COMP.
     03  FILLER                PIC S9(9) COMP.
    02  SQLCINF2 REDEFINES SQLCINFO.
     03  SQLERRD               PIC S9(9) COMP
                               OCCURS 12.
    02  SQLCMSG.
     03  SQLCERL               PIC S9(9) COMP.
     03  SQLERM                PIC X(256).
    02  SQLCMSG2 REDEFINES SQLCMSG.
     03  FILLER                PIC X(2).
     03  SQLERRM.
      04  SQLCERRML            PIC S9(4) COMP.
      04  SQLERRMC             PIC X(256).
    02  SQLSTATE               PIC X(5).
    02  SQLCRNF                PIC X(1).
    02  SQLCNRRS               PIC S9(4) COMP.
    02  FILLLER                PIC X(8).
                                         ┌──┐
    02  SQLWORK                PIC X(16). │
    02  SQLCWRK2 REDEFINES SQLWORK.       │
     03  SQLERRP.                         │
      04  SQLCVAL              PIC X(5).  │  Included by the
      04  FILLER               PIC X(3).  │  precompiler for
     03  SQLWARN.                         │  DB2 compatibility;
      04  SQLWARN0             PIC X(1).  │  not used by CA IDMS
      04  SQLWARN1             PIC X(1).  │
      04  SQLWARN2             PIC X(1).  │
      04  SQLWARN3             PIC X(1).  │
      04  SQLWARN4             PIC X(1).  │
      04  SQLWARN5             PIC X(1).  │
      04  SQLWARN6             PIC X(1).  │
      04  SQLWARN7             PIC X(1).  │
                                         └──┘
```

Copying Information from the Dictionary

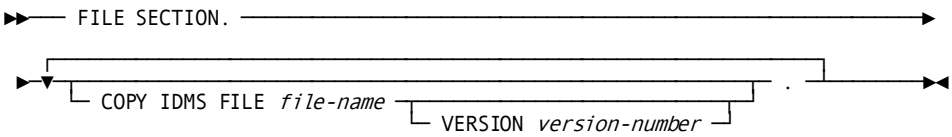
You can use these precompiler directives to instruct the precompiler to copy entities from the dictionary into the COBOL application program:

- COPY IDMS FILE
- COPY IDMS RECORD
- COPY IDMS MODULE
- INCLUDE *module-name*

COPY IDMS FILE Statement

The COPY IDMS FILE statements copy file descriptions from the dictionary into the program. Each COPY IDMS FILE statement generates the file definition that includes record size, block size, and recording mode from the dictionary. Any records included in the file through the Integrated Data Dictionary (IDD) facilities are also copied.

Syntax



Parameters

file-name

Copies the description of a non-CA IDMS file into the DATA DIVISION. *File-name* is either the primary name or a synonym for a file defined in the dictionary.

VERSION *version-number*

Qualifies *file-name* with a version number. *Version-number* must be an integer in the range 1 through 9999 and defaults to the highest version number defined in the dictionary for *file-name*.

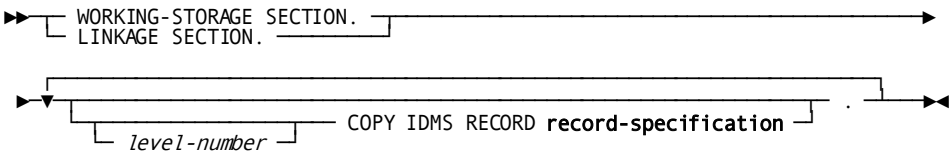
Usage

The FILE SECTION of the DATA DIVISION can include one or more COPY IDMS FILE statements.

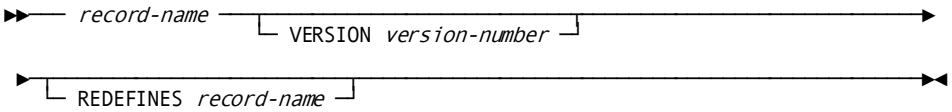
COPY IDMS RECORD Statement

The COPY IDMS RECORD statement allows you to copy a record description from the dictionary into the DATA DIVISION of a COBOL program at the location of the COPY IDMS statement.

Syntax



Expansion of Record-specification



Parameters

level-number

Instructs the precompiler to copy the descriptions into the program at a level other than that originally specified for the description in the dictionary. *Level-number* must be an integer in the range 01 through 48.

If *level-number* is specified, the first level will be copied to the level specified by *level-n*; all other levels will be adjusted accordingly. If *level-n* is not specified, the descriptions copied will have the same level numbers as originally specified in the dictionary.

record-name

Specifies the name of the record to be copied. *Record-name* can be either the primary name or a synonym for a record stored in the dictionary.

version-number

Qualifies dictionary records with a version number. *Version-number* must be an integer in the range 1 through 9999.

If *version-number* is not specified, the record that is copied will be the record synonym for the named record that is the highest version defined for COBOL.

REDEFINES *record-name*

Copies a record description to an area previously defined by another record description. Therefore, two record descriptions can provide alternative definitions of the same storage location.

Usage

Invalid Descriptors

The program can copy a record definition from the dictionary and use the record elements as host variables in embedded SQL.

If you declare host variables by copying a record description from the dictionary, you must observe all rules regarding host variable declarations.

Placement

You can place COPY IDMS RECORD statements in any area of the DATA DIVISION that COBOL allows record definitions.

VALUE Clauses

If the dictionary record is to be copied into the LINKAGE SECTION and includes VALUE clauses, the VALUE clauses are not copied.

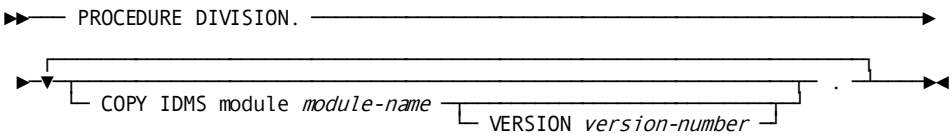
Using COPY IDMS RECORD for Host Variables

If the record to copy contains fields that the program may reference as host variables, you must include the COPY IDMS RECORD statement in an SQL declaration section.

COPY IDMS MODULE Statement

The COPY IDMS MODULE statement copies source statements from a module stored in the data dictionary into the source program.

Syntax



Parameters

module-name

Specifies the name of a module previously defined in the dictionary.

version-number

Qualifies *module-name* with a version number. *Version-number* must be an integer in the range 1 through 9999.

If *version-number* is not specified, the record copied will be the highest version of the named module defined in the dictionary for COBOL.

Usage

Placement

The unmodified module is placed into the program by the precompiler at the location of the request. The location of the request is usually in the PROCEDURE DIVISION, but it can be anywhere that is appropriate for the contents of the module to be included in the program.

Nesting Modules

COPY IDMS MODULE statements can be nested (that is, a statement invoked by a COPY IDMS MODULE entry can itself be a COPY IDMS MODULE statement). However, you must ensure that a copied module does not, in turn, copy itself.

INCLUDE Module-name Statement

The INCLUDE *module-name* statement is equivalent to a COPY IDMS MODULE statement in which the version number is omitted.

Note: For more information about this statement, see the *CA IDMS SQL Reference Guide*.

Non-SQL Precompiler Directives

The CA IDMS precompiler accepts several directives that are not associated with SQL statements and host variable declarations. These include:

- RETRIEVAL—Specifies that the precompiler should ready the area of the dictionary containing data definitions in retrieval mode, allowing concurrent update of the area by other transactions
- PROTECTED—Specifies that the precompiler should ready the area of the dictionary containing data definitions in update mode, preventing concurrent update of the area by other transactions
- NO-ACTIVITY-LOG—Suppresses the logging of program activity statistics
- DMLIST/NODMLIST—Specifies generation or no generation of a source listing for the statements that follow

Note: For more information about non-SQL precompiler directives, see Precompiler Directives (see page 283).

Using SQL in a PL/I Application Program

This section presents information that is specific to embedding SQL in a PL/I application program.

Note: For more information about documentation of all aspects of PL/I application programming in the CA IDMS environment, see the *CA IDMS DML Reference Guide for PL/I*.

Embedding SQL Statements

Requirements

To embed an SQL statement in a PL/I program, you must:

- Include an SQLXQ1 declaration
- Observe PL/I margin requirements (columns 2 to 72)
- Use statement delimiters

Options

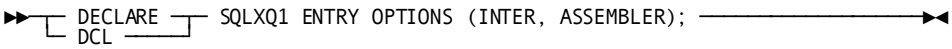
You can use SQL conventions to:

- Continue an SQL statement on the next line
- Insert comments in an SQL statement

You can use a precompiler-directive statement to copy SQL statements in a module from the dictionary into the program.

Declaring SQLXQ1

PL/I applications with embedded SQL must include the SQLXQ1 ENTRY statement. The syntax for this statement is:



Delimited, Continued, and Commented Statements

Using SQL Statement Delimiters

When you embed an SQL statement in a PL/I application program, you must use these statement delimiters:

- Begin each SQL statement with **EXEC SQL**
- End each SQL statement with **;**

An EXEC SQL delimiter must be preceded by either a PL/I label or the ; character.

The following example shows the use of SQL statement delimiters:

```
EXEC SQL  INSERT INTO DIVISION VALUES ('D07','LEGAL',1234) ;
```

The statement text can be on the same line as the delimiters.

Continuing Statements

You can write SQL statements on one or more lines. No special character is required to show that a statement continues on the next line if you split the statement before or after any keyword, value, or delimiter.

Inserting SQL Comments

To include comments within SQL statements embedded in a PL/I program, you can:

- Use the PL/I comment delimiters **/*** and ***/**
- Use the SQL comment characters, two consecutive hyphens (--), on an SQL statement line following the statement text

A comment that begins with the SQL comment characters (--) terminates at the end of the line (column 72).

You cannot use SQL comment characters to insert a comment in the middle of a string constant or delimited identifier.

The following example shows both methods of inserting comments within an embedded SQL statement:

```
EXEC SQL
/*********  PERFORM UPDATE ON ACTIVE EMPLOYEES ONLY  ********/
  UPDATE BENEFITS
    SET VAC_ACCRUED = VAC_ACCRUED + 10,  -- Add 10 hours vacation
        SICK_ACCRUED = SICK_ACCRUED + 1  -- Add 1 sick day
    WHERE EMP_ID IN
      (SELECT EMP_ID FROM EMPLOYEE
      WHERE STATUS = 'A') ;
```

Defining Host Variables

What You Declare

Within an SQL declare section, you specify the name, level, and data type of host variables using standard PL/I data declarative statements and observing these guidelines:

- A host variable **name** must conform to PL/I rules for forming variable names
- The **level** number is in the range of 1 to 255
- The **data type** of the host variable

Using PL/I Declarations

Equivalent Column Data Types

This table shows data types of PL/I host variables that are valid in an SQL declare section and equivalent to CA IDMS table column data types:

Equivalent PL/I data type	CA IDMS data type
CHAR (*n*)	CHAR(*n*)
CHAR (*n*) VAR	VARCHAR(*n*)
FIXED DECIMAL (*p*,*s*)	DECIMAL(*p*,*s*)
FLOAT BINARY (*n*) where *n* <= 24 where *n* > 24	 REAL DOUBLE PRECISION
FLOAT DECIMAL (*n*) where *n* <= 6 where *n* > 6	 REAL DOUBLE PRECISION
FIXED BINARY (15)	SMALLINT
FIXED BINARY (31)	INTEGER
CHAR (*n*)	BINARY(*n*)
GRAPHIC (*n*)	GRAPHIC(*n*)[1]
GRAPHIC (*n*) VAR	VARGRAPHIC(*n*)[1]
CHAR (10)	DATE
CHAR (8)	TIME
CHAR (26)	TIMESTAMP
SQLBIN (*n*)	BINARY(*n*)

Equivalent PL/I data type	CA IDMS data type
CHAR(8)	TID[1]

Note: [1] This data type is a CA IDMS extension of the SQL standard. For more information about CA IDMS data types, see the *CA IDMS SQL Reference Guide*.

Data Types Not Supported

The following table shows CA IDMS data types for which there are no equivalent data types in PL/I that are valid in an SQL declare section. The table shows *compatible* PL/I data types that are valid in host variable declarations; however, accessing a column that has no equivalent data type may result in an error if a data value is not convertible between the two data types.

Compatible PL/I data type	CA IDMS data type
FIXED BINARY (31)	LONGINT or BIGINT
FIXED DECIMAL (*p*,*s*)	NUMERIC(*p*,*s*)
FIXED DECIMAL (*p*,*s*)	UNSIGNED NUMERIC(*p*,*s*)
FIXED DECIMAL (*p*,*s*)	UNSIGNED DECIMAL(*p*,*s*)

Host Variable Declaration Example

In this example, the SQL declare section defines host variables, including one indicator variable, using standard PL/I data declarations. The example is annotated to show the equivalent column data type for each variable and to identify an indicator variable:

```
WORKING-STORAGE SECTION.
  .
  .
  .
EXEC SQL BEGIN DECLARE SECTION ;
DECLARE 1  EMP_ID           FIXED BINARY (31) ;       ← INTEGER
DECLARE 1  EMP_LNAME        CHAR (20) ;               ← CHARACTER
DECLARE 1  SALARY_AMOUNT    FIXED DECIMAL (6,2) ;     ← DECIMAL
DECLARE 1  PROMO_DATE       CHAR (10) ;               ← DATE
DECLARE 1  PROMO_DATE_I     FIXED BINARY (31) ;       ← Indicator variable
EXEC SQL END DECLARE SECTION ;
```

Declaring an Indicator Variable

An indicator variable must be either FIXED BINARY (15) or FIXED BINARY (31) data type. In the example above, PROMO_DATE_I is an indicator variable for PROMO_DATE.

SQLIND Data Type

You can declare an indicator variable with the data type SQLIND:

```
DECLARE 1  PROMO_DATE       CHAR (10) ;               ← DATE
DECLARE 1  PROMO_DATE_I     SQLIND ;                  ← Indicator variable
```

The precompiler will substitute a FIXED BINARY (31) in the output source.

Note: The SQLIND data type is primarily for use within bulk structure definitions. In other cases its use is optional.

Allowable Host Variable Definitions

A host variable definition must contain a data type declaration and may contain an occurrence count. No other declarations are supported.

Using INCLUDE TABLE

Output of INCLUDE TABLE

The CA IDMS precompiler uses these data type equivalents when directed by an INCLUDE TABLE statement to create a host variable declaration.

CA IDMS data type	PL/I data type on INCLUDE TABLE
BINARY(*n*)	CHAR (*n*)
CHARACTER(*n*)	CHAR (*n*)
VARCHAR(*n*)	CHAR (*n*) VAR
GRAPHIC(*n*)	GRAPHIC (*n*)
VARGRAPHIC(*n*)	GRAPHIC (*n*) VAR
DECIMAL(*p*,*s*)	FIXED DECIMAL (*p*,*s*)
UNSIGNED DECIMAL(*p*,*s*)	FIXED DECIMAL (*p*,*s*)
NUMERIC(*p*,*s*)[1]	FIXED DECIMAL (*p*,*s*)
UNSIGNED NUMERIC(*p*,*s*)	FIXED DECIMAL (*p*,*s*)
DOUBLE PRECISION	FLOAT BINARY (53)
FLOAT (*n*) where *n* <= 24 where *n* > 24	 FLOAT BINARY (21) FLOAT BINARY (53)
REAL	FLOAT BINARY (21)
DATE	CHAR (10)
TIME	CHAR (8)
TIMESTAMP	CHAR (26)
SMALLINT	FIXED BINARY (15)
INTEGER	FIXED BINARY (31)

CA IDMS data type	PL/I data type on INCLUDE TABLE
LONGINT	FIXED BINARY (31)
SQLIND	FIXED BINARY (31)
TID	CHAR(8)

Default Structure

The default structure created by the INCLUDE statement has these features:

- A level 1 element for the table
- A level 2 subordinate element named for each table column, defined with the equivalent program language data type
- An additional level 2 element, with the suffix '_I', for each column that allows null values, to be available as an indicator variable

  If you specify a table without a schema name qualifier, you must supply a schema name with a precompiler option in the JCL.

  Note: For more information about precompiler options, see Precompiler Directives (see page 283).

Defining Bulk Structures

A bulk structure is a group element or a record which contains a subordinate array for holding multiple occurrences of input or output values. Bulk structures are used in bulk SELECT, INSERT, and FETCH statements for retrieving or storing multiple rows of data.

Format of a Bulk Structure

A bulk structure consists of three levels:

- The highest level is the structure itself (level 01 through 253)
- The second level is a multiply-occurring group item (level 02 through 254)
- The third level consists of elementary or variable length data items

  The number, type and order of data items at the lowest level must correspond to the number, data type, and order of column values being retrieved or inserted.

Bulk Structure Example

The following is an example of a valid bulk structure:

```
EXEC SQL  BEGIN DECLARE SECTION;
DCL  1  BULK_DATA,
     4  BULK_ROW (20),
     5  EMP_ID  FIXED DECIMAL(3),
     5  EMP_NAME  CHAR(30),
     5  DEPT_NAME CHAR(30);
EXEC SQL  END DECLARE SECTION;
```

Referring to a Bulk Structure

When referring to a bulk structure in a SELECT, FETCH, or INSERT statement, the name of the highest level is used:

```
EXEC SQL
  FETCH EMPCURS BULK :BULK_DATA;
```

Indicator Variables

An indicator variable can be associated with a data item within the structure as follows:

- The indicator variable must immediately follow the data item with which it is associated
- The data type of the indicator variable must be SQLIND

  On encountering the SQLIND data type, the precompiler interprets the variable as an indicator associated with the preceding variable. SQLIND is replaced with BINARY FIXED(31) in the generated source.

Restrictions

A subscripted data element may not appear within the lowest level of a bulk structure.

Using INCLUDE TABLE

A bulk structure can be defined for a given table by using the INCLUDE TABLE statement with a NUMBER OF ROWS clause. The statement in this example will generate a bulk structure capable of holding 20 entries:

```
EXEC SQL
  INCLUDE TABLE EMPLOYEE NUMBER OF ROWS 20;
```

Referring to Host Variables

What You Can Do

CA IDMS supports references to host variables in SQL statements. The host variable name must be prefixed with a colon (:).

Note: For more information, see Data Manipulation with SQL (see page 57).

CA IDMS also supports references to:

- Subordinate elements which may require qualification for uniqueness
- Subscripted elements

Qualifying host variable names

You can use the group name to qualify the element name of a host variable.

For example, assume these host variable definitions:

```
DECLARE 1 EMP,
         2 HIRE_DATE
  .
  .
  .
DECLARE 1 MGR,
         2 HIRE_DATE
  .
  .
  .
```

You can qualify HIRE_DATE as in this example:

```
EXEC SQL
  SELECT...
    INTO :EMP.HIRE_DATE ;
```

Subscripted Variable Names

A CA IDMS extension of the SQL standard supports host variable arrays for use in bulk processing. By further extension of the SQL standard, CA IDMS supports reference to a subscripted variable in a host variable array.

All of the following are valid host variable references:

- :DIV-CODE(1)
- :DIV-CODE (15)
- :DIV-CODE(SUB1)
- :DIV-CODE(SUB1,SUB2)

Including SQL Communication Areas

Declaring SQL Communication Areas

CA IDMS provides these ways of including the SQL Communication Areas in a PL/I program:

- The program can declare the host variable SQLSTATE:

```
EXEC SQL BEGIN DECLARE SECTION ;
DECLARE    SQLSTATE      CHARACTER(5) ;
EXEC SQL END DECLARE SECTION ;
```

- The program can declare the host variable SQLCODE:

```
EXEC SQL BEGIN DECLARE SECTION ;
DECLARE    SQLCODE       FIXED BINARY (31) ;
EXEC SQL END DECLARE SECTION ;
```

- The program can issue this directive:

```
EXEC SQL  INCLUDE SQLCA ;
```

Using the INCLUDE statement to declare the SQLCA is a CA IDMS extension of the SQL standard.

SQLCA Structure

This is the PL/I format of the SQLCA:

PL/I SQLCA

```
DECLARE 1  SQLCA,
          2  SQLCAID          CHARACTER (8),
          2  SQLCODE          FIXED BINARY (31),
          2  SQLCSID          CHARACTER (8),
          2  SQLCINFO,
            3  SQLCERC        FIXED BINARY (31),
            3  FILLERnnnn     FIXED BINARY (31),
            3  SQLCNRP        FIXED BINARY (31),
            3  FILLERnnnn     FIXED BINARY (31),
            3  SQLCSER        FIXED BINARY (31),
            3  FILLERnnnn     FIXED BINARY (31),
            3  SQLCLNO        FIXED BINARY (31),
            3  SQLCMCT        FIXED BINARY (31),
            3  SQLCARC        FIXED BINARY (31),
            3  SQLCFJB        FIXED BINARY (31),
            3  FILLERnnnn     FIXED BINARY (31),
            3  FILLERnnnn     FIXED BINARY (31),
          2  SQLCMSG,
            3  SQLCERL        FIXED BINARY (31),
            3  SQLCERM        CHARACTER (256),
          2  SQLSTATE         CHARACTER (5),
          2  SQLCRNF          CHARACTER (1),
          2  SQLCNRRS         FIXED BINARY (15),
          2  FILLERnnnn       CHARACTER (8),
          2  SQLWORK          CHARACTER (16) ;

DECLARE 1 SQLCINF2 BASED (ADDR(SQLCINFO)),
          2  SQLERRD   FIXED BINARY (31),

DECLARE 1 SQLCMSG2 BASED(ADDR(SQLCMSG)),
          2  FILLERnnnn        CHARACTER (2),
          2  SQLERRM,
            3  SQLERRML        FIXED BINARY (15).
            3  SQLERRMC        CHARACTER (256) ;
                                                  ┌──┐
DECLARE 1 SQLCWRK2 BASED(ADDR(SQLWORK)),          │  │
          2  SQLERRP,                             │  │
            3  SQLCVAL         CHARACTER (5),     │  │ Included by the
            3  FILLERnnnn      CHARACTER (3),     │  │ precompiler for
          2  SQLWARN,                             │  │ DB2 compatibility;
            3  SQLWARN0  CHARACTER (1),           │  │ not used by CA IDMS.
            3  SQLWARN1  CHARACTER (1),           │  │
            3  SQLWARN2  CHARACTER (1),           │  │
            3  SQLWARN3  CHARACTER (1),           │  │
            3  SQLWARN4  CHARACTER (1),           │  │
            3  SQLWARN5  CHARACTER (1),           │  │
            3  SQLWARN6  CHARACTER (1),           │  │
            3  SQLWARN7  CHARACTER (1) ;          │  │
                                                  └──┘
```

Including Information from the Dictionary

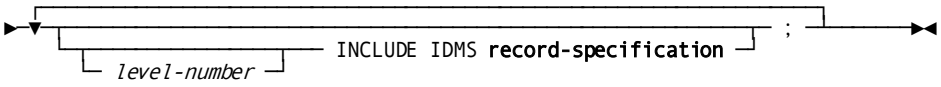
You can use these precompiler directive statements to instruct the precompiler to copy entities from the dictionary into the PL/I application program:

- INCLUDE IDMS *record-name*
- INCLUDE IDMS MODULE *module-name*
- INCLUDE *module-name*

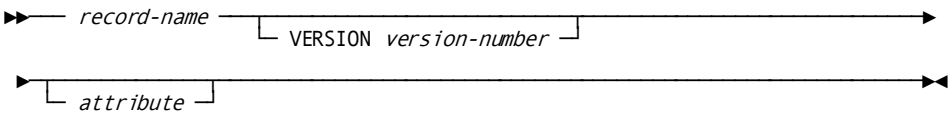
INCLUDE IDMS Record Statement

The INCLUDE IDMS Record statement is used to copy record descriptions into the program and can be coded in your application program.

Syntax



Expansion of Record Specification



Parameters

***level-number* INCLUDE IDMS**

Instructs the precompiler to copy one or more record descriptions into your program at the location of the INCLUDE IDMS statement.

The optional *level-number* clause instructs the precompiler to copy descriptions into your program at a different level than the level specified in the data dictionary. *Level-number* must be an integer in the range 01 through 99. If your program specifies *level-number*, the DML precompiler copies the first level of code to the level specified by *level-number* and adjusts all other levels accordingly. If your program does not specify *level-number*, the descriptions copied by the DML precompiler have the same level numbers as originally specified in the dictionary.

record-name

Specifies the name of the record to be copied. It can be the primary name of a record stored in the data dictionary, or a synonym.

VERSION *version-number*

Optionally qualifies IDD records with a version number. *Version-number* must be an integer in the range 1 through 9999. *Version-number* defaults to the highest version number of the record defined in the data dictionary for the language and operating mode under which the program compiles.

attribute

Optionally allows you to instruct the DML precompiler to include PL/I attributes in the PL/I DECLARE statement. The DML precompiler generates the PL/I DECLARE statement for the record that you specify in *record-name*.

Usage

Using Included Records as Host Variables

The program can copy a record definition from the dictionary and use the record elements as host variables in embedded SQL.

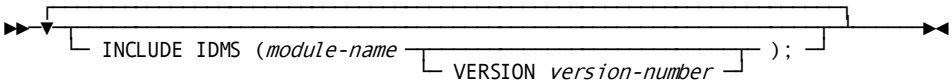
If you declare host variables by copying a record description from the dictionary, the following descriptors should not appear in the record definition:

- REDEFINES
- SYNC

INCLUDE IDMS MODULE statement

The INCLUDE IDMS *(module-name)* statement copies procedure source statements defined by the database administrator as modules in the dictionary.

Syntax



Parameters

INCLUDE IDMS (*module-name*)

Copies procedure source statements defined by the DBA as modules in the dictionary. *Module-name* specifies the name of a module previously defined using the DDDL compiler.

Note: For more information about the DDDL compiler, see the *CA IDMS IDD DDDL Reference Guide*.

The available PL/I standard modules are:

- IDMS_STATUS
- IDMS_STATUS (mode is IDMS_DC)

The DML precompiler inserts the module into your program at the location of the INCLUDE IDMS MODULE statement, without modification.

You can nest INCLUDE IDMS MODULE statements. Code invoked by an INCLUDE IDMS MODULE entry can itself contain INCLUDE IDMS MODULE statements. However, make sure that a copied module does not copy itself.

VERSION *version-number*

Optionally qualifies *module-name* with a version number. *Version-number* must be an integer in the range 1 through 9999.

There are two defaults for *version-number*, depending on whether:

- There is a version of the module that you name with *module-name* which is operating-mode-specific. In this case, the default is the version number of this module. If there are two or more mode-specific versions of the module, *version-number* defaults to the highest version number among these versions.
- There is a version of the module that you name with *module-name* which is non-operating-mode-specific, and there exists no operating-mode-specific version. In this case, the default is the version number of this module. If there are two or more non-mode-specific versions of the module, *version-number* defaults to the highest version number among these versions.

If no version of the module exists in the dictionary, an error condition results.

INCLUDE Module-name Statement

The INCLUDE *module-name* statement is equivalent to an INCLUDE IDMS MODULE statement in which the version number is omitted.

Note: For more information about this statement, see the *CA IDMS SQL Reference Guide*.

Non-SQL Precompiler Directives

The CA IDMS precompiler accepts several directives that are not associated with SQL statements and host variable declarations. These include:

- RETRIEVAL—Specifies that the precompiler should ready the area of the dictionary containing data definitions in retrieval mode, allowing concurrent update of the area by other transactions
- PROTECTED—Specifies that the precompiler should ready the area of the dictionary containing data definitions in update mode, preventing concurrent update of the area by other transactions
- NO-ACTIVITY-LOG—Suppresses the logging of program activity statistics
- DMLIST/NODMLIST—Specifies generation or no generation of a source listing for the statements that follow

Note: For more information about non-SQL precompiler directives, see Precompiler Directives (see page 283).

Chapter 6: Preparing and Executing the Program

This section contains the following topics:

Creating an Executable Form

To put your source program into executable form, take the following steps:

1. Precompile the program
2. Compile and link edit the program
3. Create the access module
4. Execute and debug the program

If you are using CA ADS, the CA ADS compiler ADSC performs steps 1 and 2.

Precompiling the Program

You precompile the program to separate SQL statements from the rest of the program and to replace the SQL statements in the source program module with calls to the DBMS.

About the Precompiler

Why You Precompile

SQL is a database sublanguage that is not known to the language compiler. The CA IDMS precompiler:

- Checks the syntax of embedded SQL statements
- Modifies the source code by:
  - Replacing SQL statements in the source program with program language calls to the DBMS
  - Executing precompiler directives
- Stores a relational command module (RCM) for the program if no errors occur in precompiling

When to Precompile

Once you have precompiled a program, you must precompile it again after any changes to either host language or embedded SQL statements. When you precompile a program that was previously precompiled, the DBMS rebuilds the RCM only if one or more SQL statements in the program have changed.

After a program has been precompiled, you can make global changes to the schema-name qualifiers of tables and views in embedded SQL statements when you create the access module. If instead you modify the SQL statements in the source program, you must precompile the program again.

Note: For more information and documentation about the schema-name mapping for tables and views, see Creating the Access Module (see page 139).

How You Precompile

You precompile the program by submitting a batch job.

For precompiler JCL, see Sample JCL (see page 203).

You can specify parameters in the precompiler JCL that determine how the precompiler executes.

For documentation of precompiler parameters, see Precompiler Options (see page 133).

Authorization

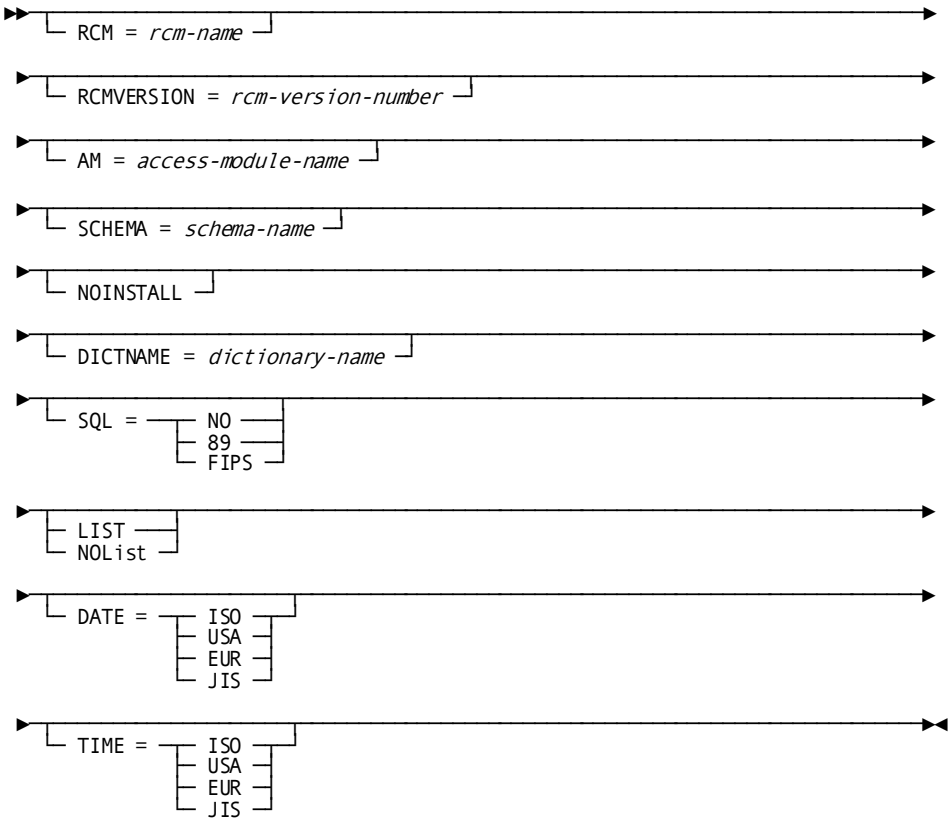
To execute the precompiler, you must have:

- The authority to precompile the program if program registration is in effect for the dictionary
- User authority to precompile against the dictionary
- SELECT privilege on tables named in INCLUDE TABLE statements

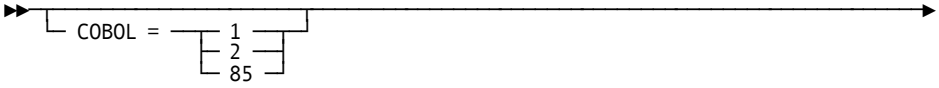
Precompiler Options

Syntax

This is the expansion of *precompiler-options* in the precompiler EXEC PGM statement in JCL. These are not positional parameters:



COBOL precompiler only



Parameters

RCM = *rcm-name*

Specifies the name of the RCM created for the program by the precompiler.

This parameter must be specified for all host language programs except COBOL.

If this RCM is not specified to the COBOL precompiler, the RCM name is the program name identified in the program source. If the name is not identified in the program, you must specify an RCM parameter.

RCMVERSION = *rcm-version-number*

Specifies the version number of the RCM created for the program by the precompiler.

If RCMVERSION is not specified, the version number defaults to 1. If an RCM with the same version number already exists in the dictionary, the precompiler replaces the existing RCM.

AM = *access-module-name*

Specifies the name of the access module to be executed for the program at runtime.

The program can override this specification at runtime by issuing a SET ACCESS MODULE statement.

If this parameter is not specified, the access module name defaults to *rcm-name*.

The access module specified in *access-module-name* does need not exist when the program is precompiled. However, if the access module does not exist when the program is executed, an *invalid SQL statement identifier* error occurs.

SCHEMA = *schema-name*

Specifies the default schema-name qualifier for the precompiler to use when processing an INCLUDE TABLE statement that does not supply a qualifier.

If an INCLUDE TABLE statement supplies a qualifier, the SCHEMA parameter is ignored for that table.

If SCHEMA is not specified and an INCLUDE TABLE statement does not supply a qualifier, the precompiler returns an error.

NOINSTALL

Specifies that the precompiler should only check syntax.

If this parameter is specified, the precompiler does not store the RCM.

If this parameter is not specified and the precompiler executes without errors, the precompiler stores the RCM.

DICTNAME = *dictionary-name*

Specifies the name of the dictionary the precompiler should access.

If this parameter is not specified, the precompiler defaults to the dictionary specified in the DICTNAME parameter of the SYSIDMS statement in the precompiler JCL.

Note: For more information about sample precompiler JCL, see Sample JCL (see page 203).

If this parameter is not specified and there is no SYSIDMS DICTNAME parameter, the CA IDMS returns an error at runtime.

SQL =

Specifies the SQL syntax standard that the precompiler should apply when checking the validity of SQL statements in the program.

The precompiler issues a warning if it detects an SQL statement that does not comply with the standard specified in this parameter.

If this parameter is not specified, the default is the same as specifying SQL = NO.

NO

Specifies that compliance with a named SQL standard is not checked or enforced, and all CA IDMS extensions are permitted.

89

Directs the precompiler to use ANSI X3.135-1989 (Rev), *Database Language SQL with integrity enhancement*, as the standard for compliance.

FIPS

Directs the precompiler to use FIPS PUB 127-1, *Database Language SQL*, as the standard for compliance.

LIST

Directs the precompiler to create a listing of the program with precompiler messages.

If this parameter is specified, the program listing is written to the SYSLST file.

If this parameter is not specified, the default is the same as specifying NOList.

The precompiler directive NODMLIST, included in the program source, overrides the EXEC PGM parameter LIST.

Note: For more information about NODMLIST, see Precompiler Directives (see page 283).

NOList

Directs the compiler not to create a listing of the program with precompiler messages.

The precompiler directive DMLIST, included in the program source, overrides the EXEC PGM parameter NOList.

Note: For more information about DMLIST, see Precompiler Directives (see page 283).

COBOL =

Specifies the version of COBOL with which COBOL statements generated by the precompiler must comply.

If this parameter is not specified, the default is the same as specifying COBOL = 2.

1

Directs the precompiler to comply with versions of COBOL that precede VS-COBOL II when generating COBOL statements.

2

Directs the precompiler to comply with VS-COBOL II when generating COBOL statements.

DATE =

Specifies the format of the DATE data type to be used for communication between the program and the database when the access module is executed.

TIME =

Specifies the format of the TIME data type to be used for communication between the program and the database when the access module is executed.

Note: You can use the DATE and TIME parameters to override the default for the installation.

ISO

Specifies that the format of the DATE data type should comply with the standard of the International Standards Organization. Formats used when ISO is specified are:

Data type	Format	Example
DATE	*yyyy-mm-dd*	1990-12-15
TIME	*hh.mm.ss*	16.43.17
TIMESTAMP	*yyyy-mm-dd-hh.mm.ss.nnnn*	1990-12-15-16.43.17.123456

USA

Specifies that the format of the DATE data type should comply with the standard of the IBM USA standard. Formats used when USA is specified are:

Data type	Format	Example
DATE	*mm/dd/yyyy*	12/15/1990
TIME	*hh*:*mm* AM *hh*:*mm* PM	4:43 PM
TIMESTAMP	*yyyy-mm-dd-hh.mm.ss.nnnn*	1990-12-15-16.43.17.123456

EUR

Specifies that the format of the DATE data type should comply with the standard of the IBM European standard. Formats used when EUR is specified are:

Data type	Format	Example
DATE	*dd.mm.yyyy*	15.12.1990
TIME	*hh.mm.ss*	16.43.17
TIMESTAMP	*yyyy-mm-dd-hh.mm.ss.nnnn*	1990-12-15-16.43.17.123456

JIS

Specifies that the format of the DATE data type should comply with the standard of the Japanese Industrial Standard Christian Era. Formats used when JIS is specified are:

Data type	Format	Example
DATE	*yyyy-mm-dd*	1990-12-15
TIME	*hh*:*mm*:*ss*	16:43:17
TIMESTAMP	*yyyy-mm-dd-hh.mm.ss.nnnn*	1990-12-15-16.43.17.123456

Compiling the Program

CA IDMS Precompiler

The CA IDMS precompiler modifies the program that you submit. CA IDMS comments out SQL statements and substitutes calls to the DBMS. The entire source program is now in compilable form.

Here is an example of an SQL statement that has been commented out by the precompiler, and the code that the precompiler has substituted:

```
011200*    EXEC SQL

011300*         FETCH CURS1 BULK :EMPDATA
011400*           START :INDEX-CNTR ROWS :NUM-ROWS
011500*    END-EXEC.
                MOVE 4 TO SQLCLNO
                MOVE 16 TO SQLCMD
                MOVE 1 TO SQLARG
                MOVE 4 TO SQLSID
                MOVE 278 TO SQLTBL
                MOVE 6 TO SQLMRO
                MOVE INDEX-CNTR TO SQLSRO
                MOVE NUM-ROWS TO SQLNRO
                CALL 'IDMSSQL' USING
                             SQLRPB
                             SQLCA
                             SQLCA
                             SQLCIB
                             SQLPIB
                             SQLCA
                             EMPDATA
                             SQLCA
                             SQLCA
                             SQLCA
                             SQLCA
                .
```

Language Compiler

To compile the program, you submit the source program, as successfully modified by the precompiler, to the language compiler. Output from the compiler consists of an object program and a source listing.

Link Editing

The linkage editor edits the object program into a specified load library. Output from the linkage editor consists of a load module and a link map.

Note: For JCL and more information about compiling and link editing a program see Sample JCL (see page 203).

Creating the Access Module

An access module is the executable form of the SQL statements that a program issues. When you create an access module, you also invoke the optimizer. The optimizer automatically determines the most efficient access to the data requested by the SQL statements. CA IDMS stores the access strategy in the access module.

How You Create an Access Module

You create an access module with an SQL statement, CREATE ACCESS MODULE. If you accept all defaults, the access module you create:

- Is qualified with the name of the default schema for the user session
- Is stored in the DDLCATLOD area of the application dictionary to which you are connected
- Is created as version 1 if no access module of the same name and version exists in the dictionary
- Has no schema-name mapping to replace existing table or view qualifiers in SQL statements in the RCMs that the access module contains
- Is defined with AUTO RECREATE ON, which means that the DBMS will attempt to re-create the access module at runtime if a change has been made to the definition of a table accessed the module or if the RCM has been re-created since it was included in the access module
- Is defined with VALIDATE ALL, which means that the DBMS will check the definition for each table in the access module before executing the first statement in the access module
- Will execute with a default isolation of cursor stability and allow a transaction to perform updates
- Will execute with a ready mode of shared retrieval on all areas it accesses

Overriding Access Module Defaults

Access Module Name Qualifier

Qualify the access module name if you want to associate the access module with a schema that is not the default for the SQL session in which the CREATE ACCESS MODULE statement is issued.

Ownership of the schema that qualifies the access module affects authority to use the access module under CA IDMS internal security. The owner of the schema must have authority to execute the statements in the access module, and the authorities must be grantable for another user to execute the access module.

Note: For more information and specific rules regarding schema ownership and authority to execute access modules under CA IDMS security, see the *CA IDMS Security Administration Guide*.

Access Module Version Number

Specify an access module version number according to site standards.

You can use the version number of the access module to represent the version of the application that you want to execute at runtime.

Note: For more information, see Executing the Application (see page 144).

Schema-name Mapping for Tables and Views

Supply schema-name mapping to specify a qualifier that should replace a table or view qualifier in the RCMs that the access module contains. Schema-name mapping allows you to specify the database that the access module accesses.

In this example, unqualified table and view names, and table and view names qualified with EMP_SCH, are mapped to a schema called EMP_TSTSCH. When the access module executes, a reference to the EMPLOYEE table or the EMP_SCH.EMPLOYEE will change to the EMP_TSTSCH.EMPLOYEE table:

```
EXEC SQL
  CREATE ACCESS MODULE EMPINFO1
     FROM EMPDICT.EMPDSP01,
          EMPDICT.EMPDSP02,
          EMPDICT.EMPDSP03,
          EMPDICT.EMPADD01,
          EMPDICT.EMPUPD01,
          EMPDICT.EMPUPD02,
          EMPDICT.EMPDEL01
     MAP EMP_SCH TO EMP_TSTSCH,     <-- Schema-name mapping
     MAP NULL TO EMP_TSTSCH
END-EXEC.
```

You can subsequently change the schema-name mapping by creating a new access module or altering an existing one. This lets you change the database that the application accesses without precompiling the programs again.

Note: For more information about altering an access module, see Altering an Access Module (see page 143).

Automatic Access Module Re-creation

At runtime, if the DBMS detects that the database definition of a table specified in the access module has changed since the access module was created, it automatically recreates the access module unless the access module was defined with AUTO RECREATE OFF.

If the AUTO RECREATE option is OFF at runtime, the DBMS returns an error with an SQLCERC value of 1014.

Table Definition Timestamp Validation

The DBMS validates the definition timestamp of every table accessed by statements in the access module before executing the access module unless you specify VALIDATE BY RCM or VALIDATE BY STATEMENT. Validation failure is a condition that requires re-creation of the access module.

BY RCM causes validation only for tables accessed by statements in the RCM to be executed. BY STATEMENT causes validation only for tables accessed by the statement to be executed.

One of these specifications may be appropriate if the application contains sections of code that are infrequently executed.

Transaction State

The default transaction state is READ WRITE unless you specify the READ ONLY parameter. READ ONLY will cause an error to be returned at runtime attempts to perform an update. The combination of READ ONLY and a ready mode of update will cause an error when you create the access module (see **Ready mode**).

A program can override the transaction state specified for the access module with the SET TRANSACTION statement.

SET TRANSACTION must precede most statements in the transaction. For more information, see the *CA IDMS SQL Reference Guide*.

A transaction with an isolation level of transient read is automatically a READ ONLY transaction. A specification of READ WRITE for the access module or the transaction is ignored when the isolation level of the transaction is transient read.

Isolation Level

Specify the DEFAULT ISOLATION parameter only if cursor stability is not the appropriate isolation level for executing the application.

Note: For more information about the effect of isolation level, see Writing an SQL Program (see page 27).

Ready Mode

With the READY parameter, you can specify ready mode for one, some, or all areas.

Ready mode refers to the type of area lock the DBMS sets for the database transaction. The effect of the area lock differs depending on whether the execution environment is the central version or local mode. For example, for a program running under the central version, a ready mode of protected retrieval prevents concurrent transactions from updating data in the area, but for a local mode program, it does not prevent concurrent updates.

If you specify the PRECLAIM option for an area, the DBMS sets area locks on the first database access statement (to any area) in the transaction. If you do not specify PRECLAIM for an area, the default is INCREMENTAL, meaning that the area lock is set on the first access to that area.

Default Ready Mode

You should accept the default ready mode unless experience proves there is a reason to override it.

Note: For more information about ready mode options, see:

- Documentation of the CREATE ACCESS MODULE statement in the *CA IDMS SQL Reference Guide*
- *CA IDMS Database Administration Guide*

Actual Ready Mode

The actual ready mode at runtime depends on the interaction of transaction state, specified ready mode, and the status of the area (initially defined in the DMCL).

The following two tables present the actual ready mode in each possible interaction.

READ ONLY Ready Modes

This table presents the actual ready modes when the transaction state is READ ONLY:

Specified ready mode	Area status	Actual ready mode
(No specification)	Transient retrieval	Transient retrieval
	Retrieval	Shared retrieval
	Update	Shared retrieval
Any retrieval mode	Transient retrieval	Transient retrieval
	Retrieval	As specified
	Update	Shared retrieval

Specified ready mode	Area status	Actual ready mode
Any update mode	Transient retrieval	Transient retrieval
	Retrieval	Shared retrieval
	Update	Shared retrieval

READ WRITE Ready Modes

This table presents the actual ready modes when the transaction state is READ WRITE:

Specified ready mode	Area status	Actual ready mode
(No specification)	Transient retrieval	Transient retrieval
	Retrieval	Shared retrieval
	Update	Shared update
Any retrieval mode	Transient retrieval	Transient retrieval
	Retrieval	As specified
	Update	As specified
Any update mode	Transient retrieval	(Runtime error)
	Retrieval	(Runtime error)
	Update	As specified

Altering an Access Module

What You Can Change

With an ALTER ACCESS MODULE statement, you can change any specification that you made on the CREATE ACCESS MODULE statement. You can add, drop, or replace RCMs.

Note: For more information about altering an access module, see the ALTER ACCESS MODULE statement in the *CA IDMS SQL Reference Guide*.

Changing Schema-name Mapping

To change the schema-name mapping for the access module, you must reprocess all RCMs by specifying the REPLACE ALL parameter, as in this example:

```
EXEC SQL
  ALTER ACCESS MODULE EMPINFO1
     REPLACE ALL
       MAP EMP_SCH TO EMP_PRODSCH,
       MAP NULL TO EMP_PRODSCH
END-EXEC.
```

Executing the Application

Batch Jobs

You can execute a batch job under the central version or in local mode.

JCL for executing an SQL application program in batch is presented in Sample JCL (see page 203).

SYSIDMS Parameters

In batch JCL, you can tailor certain aspects of the runtime environment by specifying SYSIDMS parameters. The following table lists the options specific to SQL processing:

SYSIDMS parameter	What it does
SQLTRACE	Activates or deactivates the facility that traces all SQL requests made by the application
PROCTRACE=ON/OFF	ON activates a trace of key user blocks that participate in an SQL PROCEDURE call. OFF is the default.
SQL_CACHE_ENTRIES=n	n specifies the max number of entries that will be used in the dynamic SQL cache. One entry holds one cached SQL statement. With n set to 0, dynamic SQL caching will be disabled. The theoretical max value for n is 2,147,483,647, but the real maximum is determined by available address space. The default is 200.
SQL_INTLSORT=ON/OFF	Allows you to force the internal IDMS sort to be used in local mode. If ON is specified, an internal SORT rather than an operating system SORT will be performed on SQL commands issued in a local batch job that contains an ORDER BY clause. In many cases, an internal SORT is faster than an operating system SORT when you are not dealing with a large amount of data. OFF is the default, indicating an operating system SORT will be used.

Note: For more information and the complete list of available SYSIDMS parameters, see the *CA IDMS Common Facilities Guide*.

Execution Privilege

The privileges required to access a CA IDMS database using SQL depends on how CA IDMS database resources are secured.

If CA IDMS internal security is in effect, authority to access the database through the program derives from ownership of the schema that qualifies the access module name.

Note: For more information about qualifying the access module name, see Overriding Access Module Defaults (see page 139).

If CA IDMS resources are secured by an external security system, the executing user must hold appropriate privileges on all resources that the application program accesses. The schema name has no significance except as a qualifier.

Note: For more information about privileges required to access CA IDMS, see your security administrator.

Testing the Access Module

Which Access Module Executes

The default access module that is executed at runtime is the access module associated with the program that issues the first SQL statement executed within the SQL session.

A program is associated with an access module when the program is precompiled.

Note: For more information about associating a program with an access module, see Precompiling the Program (see page 131).

There are two ways to override at runtime the access module default that is set at precompile time:

- The program issues a SET ACCESS MODULE statement before the database transaction begins

  Note: For more information about using the SET ACCESS MODULE statement, see Preparing and Executing the Program (see page 131).

- A different version of the access module is used because a test version option has been set for the DC session in which the program is executing

Test Versions

If there is a version of the access module that matches the test version setting, the matching version is executed. If an access module with a matching version is not found at runtime, version 1 of the access module is executed.

Note: For more information about test versions, see documentation of DCUF TEST in the *CA IDMS System Tasks and Operator Commands Guide*.

Debugging the Application

CA IDMS provides these tools that you can use to debug the SQL portion of the application program:

- Command Facility
- SQL trace facility
- EXPLAIN statement

Command Facility

The Command Facility is a tool for a user to issue ad hoc SQL statements in an interactive online environment or in batch mode.

You can use this facility to test SQL statement syntax and to test conditions of the database both when you are designing the application and, if necessary, while debugging.

Note: You can use CA OLQ to access CA IDMS with SQL. For more information, see the *CA OLQ Reference Guide*.

This example shows a query submitted online to the Command Facility and the result table returned. A successful SELECT statement, such as the one shown here, can be declared as a cursor with no change to the syntax.

```
                        OCF nn.n ONLINE IDMS NO ERRORS                    1/16
SELECT
PROJ_ID,
EST_START_DATE,
PROJ_DESC
FROM DEMOPROJ.PROJECT
WHERE EST_START_DATE > CURRENT DATE
ORDER BY 2;
*+
*+ PROJ_ID     EST_START_DATE      PROJ_DESC
*+ -------     --------------      ---------
*+ C203        1998-02-01          Consumer study
*+ C240        1998-06-01          Service study
*+ C200        1999-01-15          New brand research
*+ D880        1999-11-01          Systems Analysis
*+ P634        2000-02-01          TV ads - WTVK
*+ P200        2000-09-01          Christmas media
*+

*+ 6 rows processed
```

Note: For more information about using the Command Facility, see the *CA IDMS Common Facilities Guide*.

SQL Trace Facility

You can use the SQL trace facility to trace execution of the SQL statements in a batch program.

You activate the SQL trace facility by specifying the SYSIDMS parameter SQLTRACE=ON.

In this example, the SQL trace facility reports on the SQL processing for a SELECT statement submitted through IDMSBCF, the batch Command Facility. The trace facility shows the steps in dynamically executing the SELECT, including an automatic CONNECT.

```
 SELECT R.REFTABLE AS "PARENT",
        K.REFCOLUMN AS "PARENT COLUMN",
        R.NAME AS "RELATIONSHIP"
    FROM SYSTEM.CONSTRAINT R,
         SYSTEM.CONSTKEY   K
    WHERE R.SCHEMA = K.SCHEMA
      AND R.NAME = K.NAME
      AND R.SCHEMA = 'REL'
      AND R.TABLE     = 'C_EMPLOYEE'
      AND R.UNIQUE >= ' '
      OR  R.COMPRESS <= ' ' ;
Verb=07  CONNECT TO SYSSQL                                          Caller=IDMSBCF   SQLSEQ=000001  *** S Q L
Verb=20  PREPARE-➔  SELECT R.REFTABLE AS "PARENT",                  Caller=IDMSBCF   SQLSEQ=000008  *** S Q L
Verb=11  DESCRIBE                                                  Caller=IDMSBCF   SQLSEQ=000005  *** S Q L
Verb=19  OPEN                                                       Caller=IDMSBCF   SQLSEQ=000007  *** S Q L
Verb=16  FETCH                                                      Caller=IDMSBCF   SQLSEQ=000006  *** S Q L
  S Q L  SQLCODE=0100  REASON CODE=0000
Verb=03  CLOSE                                                      Caller=IDMSBCF   SQLSEQ=000002  *** S Q L

PARENT              PARENT COLUMN                   RELATIONSHIP

C_DEPARTMENT        C_DEPT_ID                       DEPT_EMPLOYEE
C_PROJECT           C_PROJ_ID                       EMP_PROJECT

2 rows processed
Verb=05  COMMIT continue                                            Caller=IDMSBCF   SQLSEQ=000003  *** S Q L
 .
 .
 .
```

You can activate and deactivate the SQL trace facility within the logic of the program. You do this by issuing calls to the IDMSIN01 entry point to the IDMS module.

Note: For more information about the requirements for calling IDMSIN01 to activate or deactivate the SQL trace facility, see the *CA IDMS Callable Services Guide*.

EXPLAIN Statement

You can use the EXPLAIN statement to analyze the optimized access strategy for an SQL statement. An aspect of database definition or the formulation of the SQL statement can result in a relatively inefficient strategy for a given SQL statement. The information produced by the EXPLAIN statement can suggest corrective measures.

Note: For more information about the EXPLAIN statement and its use, see the *CA IDMS SQL Reference Guide*.

Online Debugger

You can debug online application program execution using the CA IDMS online debugger. The online debugger allows you to:

- Set breakpoints in the program
- Stop execution of the program at a breakpoint

- Examine and optionally alter conditions that exist at the breakpoint
- Resume program execution

Note: For more information about debugging online application programs, see the *CA IDMS Online Debugger Guide*.

Chapter 7: SQL Programming Techniques

Programming techniques that increase the processing capability of the program and reduce the demand for system resources are necessary for optimum performance. In several cases, you can achieve these results because of CA IDMS SQL extensions.

This section contains the following topics:

Modularized Programming

You can design an SQL application using modularized programming techniques. CA IDMS provides extensions to the SQL standard that allow a program to:

- Share a cursor that was opened by another program
- Specify the access module that is to be executed for the program

Sharing a Cursor

A shared cursor is declared and opened in one program and accessed in another program.

Requirements

These are the requirements for declaring and using a shared cursor:

- The cursor declaration in the first program must specify the GLOBAL parameter.

In this example, program EMPGET declares and opens a global cursor to select benefits information:

```
IDENTIFICATION DIVISION.
PROGRAM-ID.  EMPGET.
 .
 .
 .
DATA DIVISION.
WORKING-STORAGE SECTION.

EXEC SQL
  DECLARE EMP_CRSR GLOBAL CURSOR FOR
    SELECT EMP_ID,
           JOB_ID,
           SALARY_AMOUNT,
           BONUS_PERCENT
      FROM BENEFITS
      WHERE EMP_ID = :EMP-ID
END-EXEC.
 .
 .
 .
PROCEDURE DIVISION.

EXEC SQL
  OPEN EMP_CRSR
END-EXEC.
```

- Only the program that contains the global cursor declaration can contain the OPEN statement for the global cursor.
- A program that shares the cursor must make an external cursor declaration.

  In the following example, program EMPUPD declares an external cursor to share the global cursor declared in EMPGET:

```
IDENTIFICATION DIVISION.
PROGRAM-ID.  EMPUPD.
 .
 .
 .
DATA DIVISION.
WORKING-STORAGE SECTION.

EXEC SQL
  DECLARE EMP_CRSR EXTERNAL CURSOR
END-EXEC.
```

- Any number of programs that execute within the same database transaction can share a global cursor.
- All programs that share a cursor must be part of the same access module.

The GLOBAL parameter is not valid for cursors associated with dynamically-compiled SELECT statements.

Verifying External Cursors

The precompiler does not verify the validity of a DECLARE EXTERNAL CURSOR statement. The programmer has the responsibility of verifying that programs meet the requirements for declaring and accessing a global cursor.

Shared Cursor Example

In this example, EMPGET declares EMP_CRSR as an updateable global cursor, opens the cursor, and fetches the row. After checking the results of the fetch, EMPGET passes control to EMPUPD. EMPUPD declares EMP_CRSR as an external cursor and performs a positioned update using input values for the updateable columns.

```
IDENTIFICATION DIVISION.
PROGRAM-ID.  EMPGET.
 .
 .
 .

DATA DIVISION.
WORKING-STORAGE SECTION.

EXEC SQL
  DECLARE EMP_CRSR GLOBAL CURSOR FOR
    SELECT EMP_ID,
           JOB_ID,
           SALARY_AMOUNT,
           BONUS_PERCENT
      FROM BENEFITS
      WHERE EMP_ID = :EMP-ID
      FOR UPDATE OF SALARY_AMOUNT,
                    BONUS_PERCENT
END-EXEC.
 .
 .
 .

PROCEDURE DIVISION.

EXEC SQL
  OPEN EMP_CRSR
END-EXEC.

PERFORM FETCH-ROUTINE UNTIL END-FETCH='Y'

FETCH-ROUTINE.

EXEC SQL
  FETCH EMP_CRSR
    INTO :EMP-ID,
         :JOB-ID,
         :SALARY-AMOUNT INDICATOR SALARY-AMOUNT-I,
         :BONUS-PERCENT INDICATOR BONUS-PERCENT-I
END-EXEC.

IF SQLCODE = 100 MOVE 'Y' TO END-FETCH.
IF SALARY-AMOUNT-I = -1 OR BONUS-PERCENT-I = -1
   PERFORM INITIALIZE-NULL-VARIABLES.

CALL EMPUPD.

-----------------------------------------------------------------
```

```
IDENTIFICATION DIVISION.
PROGRAM-ID.  EMPUPD.
 .
 .
 .
DATA DIVISION.
WORKING-STORAGE SECTION.

EXEC SQL
  DECLARE EMP_CRSR EXTERNAL CURSOR
END-EXEC.
 .
 .
 .

PROCEDURE DIVISION.
 .
 .
 .

MOVE INPUT-SALARY-AMOUNT TO SALARY-AMOUNT.
MOVE INPUT-BONUS-PERCENT TO BONUS-PERCENT.

EXEC SQL
  UPDATE BENEFITS
    SET SALARY_AMOUNT = :SALARY-AMOUNT,
        BONUS_PERCENT = :BONUS-PERCENT
    WHERE CURRENT OF EMP_CRSR
END-EXEC.
```

Using the SET ACCESS MODULE Statement

Why You Use It

You use a SET ACCESS MODULE statement to specify in the program what access module should be executed for a database transaction. SET ACCESS MODULE overrides the default access module specification for the duration of the transaction.

Default Access Module Specification

The default access module specification is the one associated with the program that initiates the SQL session—that is, the first program to issue an SQL statement.

Note: For information about how an access module is associated with a program, see Preparing and Executing the Program (see page 131).

The default access module is the access module that is executed unless the program issues a SET ACCESS MODULE statement. The SET ACCESS MODULE specification remains in effect until the database transaction ends. After the database transaction ends, the default access module is re-established.

When to Issue SET ACCESS MODULE

The SET ACCESS MODULE statement is valid only if the program issues it in the transaction before it issues an SQL statement requesting dictionary or database access.

Note: For more information and a list of statements that can precede SET ACCESS MODULE in a database transaction, see the *CA IDMS SQL Reference Guide*.

Using a Host Variable

You can specify the access module name in a host variable on the SET ACCESS MODULE. This allows the specification of an access module to be decided by conditions not known until runtime.

Note: When you define a host variable for the access module name, an eight-byte character field suffices because an access module name is limited to eight characters.

SET ACCESS MODULE Example

In this example, program EMPACT declares a global cursor and issues a SET ACCESS MODULE statement before starting a transaction with an OPEN statement:

```
IDENTIFICATION DIVISION.
PROGRAM-ID.  EMPACT.
 .
 .
 .

DATA DIVISION.
WORKING-STORAGE SECTION.

EXEC SQL
  DECLARE EMP_CRSR GLOBAL CURSOR FOR
    SELECT EMP_ID
      FROM EMPLOYEE
      WHERE STATUS = 'A'
END-EXEC.
 .
 .
 .

PROCEDURE DIVISION.

MOVE 'EMPAPPL3' TO AM-NAME.

EXEC SQL
  SET ACCESS MODULE :AM-NAME
END-EXEC.

EXEC SQL
  OPEN EMP_CRSR
END-EXEC.
 .
 .
 .
```

Pseudoconversational Programming

Pseudoconversational programming is an online programming technique that frees certain resources while the system waits for a response from the online user. This permits an online environment to support more concurrent processing by conserving limited resources such as storage pool and program pool space.

To facilitate pseudoconversational programming in an SQL application, CA IDMS supports the SUSPEND SESSION and RESUME SESSION statements.

Updating After a Pseudoconverse

The online user's response may call for modification of data that was retrieved by the program. This section discusses techniques for updating after a pseudoconverse, including consideration of whether the program needs to verify that the data has not changed since it was retrieved.

Using SUSPEND SESSION and RESUME SESSION

What SUSPEND SESSION Does

When the program issues a SUSPEND SESSION statement, the DBMS releases all resources associated with the SQL session *except* those needed to resume the current session and transaction:

- The database connection
- Cursor currencies
- Locks held by any currently active transaction
- Temporary tables
- Dynamically prepared SQL statements

SUSPEND SESSION does not cause a commit or rollback of work.

What RESUME SESSION Does

RESUME SESSION reestablishes the active SQL session and database transaction. All characteristics and cursor positions of the session and transaction are restored to what they were when the program issued the SUSPEND SESSION statement.

In a pseudoconversational program, RESUME SESSION must be the first SQL statement the application issues after a SUSPEND SESSION statement.

Advantages of Suspending and Resuming

Since a suspended session preserves database transaction and SQL session characteristics, you can use SUSPEND SESSION and RESUME SESSION in these types of applications:

- Scrolling through a list of result rows
- Updating a row with user input

The following sections discuss how to use SUSPEND SESSION and RESUME SESSION in these types of processing.

Scrolling Through a List of Rows

Retrieval List Using Bulk Fetch

You can use a bulk fetch and a suspended session to develop an online application for scrolling through a list of rows. Each fetch statement retrieves a screen display of rows. The session is suspended before the pseudoconverse and resumed when the user requests the next set of rows to display. Since the DBMS has maintained cursor position during the suspended session, the next execution of the fetch statement automatically retrieves the next set of rows in the cursor result table.

Retrieval List Example

In this example, having already declared a host variable array with as many occurrences as there are rows in a screen display, the program declares and opens the POSITION_CRSR cursor to retrieve data about employees by department:

```
EXEC SQL
  DECLARE POSITION_CRSR CURSOR FOR
    SELECT P.EMP_ID,
           E.DEPT_ID,
           P.JOB_ID,
           P.SALARY_AMOUNT,
      FROM POSITION P, EMPLOYEE E
      WHERE P.EMP_ID = E.EMP_ID
        AND E.DEPT_ID = :DEPT-ID
END-EXEC.

EXEC SQL
  OPEN POSITION_CRSR
END-EXEC.
```

The program then iterates the following logic until the online user exits this thread of the application. The first fetch uses the value of INPUT-DEPT-ID. The second fetch retrieves the next set of employees for the department because the DBMS has maintained the cursor position during the suspended session:

```
EXEC SQL
  FETCH POSITION_CRSR
    BULK :BULK-POSITION
END-EXEC.

IF SQLCODE = 100 MOVE 'Y' TO END-FETCH.

EXEC SQL
  SUSPEND SESSION
END-EXEC.

(Move retrieved values to display fields)

MAP OUT ...

(Pseudoconverse)

MAP IN ...

EXEC SQL
  RESUME SESSION
END-EXEC.

IF END-FETCH = 'Y' ...  <-- Close cursor and either
                            select a new department or exit
```

Scrolling Backwards

Scrolling backwards through an online retrieval list requires pageable map processing. If necessary, you can manage pageable map processing by using:

- The CA IDMS scratch area and scratch management statements to temporarily store and re-access retrieved data
- CA ADS pageable mapping in a CA ADS application

Note: For more information about scratch area management, see the applicable CA IDMS program language reference manual.

Updating a Row After a Pseudoconverse

Using an Updateable Cursor

During a suspended session, the DBMS maintains the cursor position of an open cursor and also the lock on the current cursor row. Therefore, a program running under the cursor stability isolation level can resume the suspended session and perform a positioned update without checking whether the row has been updated by a concurrent database transaction.

Updateable Cursor Example

In this example, the program fetches a row from the BENEFITS_CRSR cursor, suspends the session, and displays the row to the online user. Following user input, the program resumes the session and performs a positioned update with user input:

```
EXEC SQL
  DECLARE BENEFITS_CRSR FOR
    SELECT JOB_ID,
           SALARY_AMOUNT,
           BONUS_PERCENT
      FROM BENEFITS
      WHERE EMP_ID = :EMP-ID
END-EXEC.

EXEC SQL
  OPEN BENEFITS_CRSR
END-EXEC.

EXEC SQL
  FETCH BENEFITS_CRSR
    INTO :JOB_ID,
         :SALARY_AMOUNT,
         :BONUS_PERCENT
END-EXEC.

EXEC SQL
  SUSPEND SESSION
END-EXEC.

(Move retrieved values to display fields)

MAP OUT ...

(Pseudoconverse)

MAP IN...

(Program moves input data to host variables)

EXEC SQL
  RESUME SESSION
END-EXEC.

EXEC SQL
  UPDATE BENEFITS
    SET SALARY_AMOUNT = :SALARY-AMOUNT,
        BONUS_PERCENT = :BONUS-PERCENT
    WHERE CURRENT OF BENEFITS_CRSR
END-EXEC.

EXEC SQL
  COMMIT
END-EXEC.
```

Searched Update After a Pseudoconverse

When a database transaction running under the default isolation mode of cursor stability suspends the session, the DBMS releases any lock it set on the base row(s) of a single-row SELECT result. No locks are maintained on rows resulting from bulk selects in this situation, and only the lock on the last row fetched in a bulk fetch is maintained under cursor stability during a suspended session.

A concurrent database transaction can update the data retrieved by a single-row SELECT statement or FETCH BULK statement while the session of the original transaction is suspended. In these situations, the program should check whether the data has been modified since it was retrieved before applying an update after the pseudoconverse.

Checking Whether the Row Was Modified

To be able to check whether a row has been modified, your processing environment can create and maintain a column for a last-update timestamp value. An alternative is to compare the values of all fields to be updated with the values that were retrieved.

Maintaining a Last-Update Timestamp

To maintain a last-update timestamp for a table row, use these procedures:

1. Define a last-update column for each table with data type TIMESTAMP and NOT NULL WITH DEFAULT
2. In the program, define the host variable for the last-update timestamp column as a character field with length 26
3. Set the last-update timestamp column to the value of the special register CURRENT TIMESTAMP when modifying the row

You can add a last-update column to an existing table using the ALTER TABLE statement.

Note: For more information about the ALTER TABLE, see the *CA IDMS SQL Reference Guide*.

How You Check the Row Before Updating

To determine whether a row has been modified since the program retrieved it, you attempt a searched update with a search condition that includes a comparison to verify that the last-update timestamp value has not changed.

Searched Update Example

In this example, the program issues a single-row SELECT statement from the POSITION table using the primary key of the table. The program suspends the SQL session and displays the retrieved row to the online user:

```
MOVE MAP-EMP-ID TO EMP-ID.
MOVE MAP-JOB-ID TO JOB-ID.

EXEC SQL
  SELECT EMP_ID,
         JOB_ID,
         SALARY_AMOUNT,
         LAST_UPDATED
    INTO :EMP-ID,
         :JOB-ID,
         :SALARY-AMOUNT,
         :LAST-UPDATED
    FROM POSITION
    WHERE EMP_ID = :EMP-ID
END-EXEC.

EXEC SQL
  SUSPEND SESSION
END-EXEC.
 .
 .
 .
MAP OUT ...

(Pseudoconverse)
```

Following the pseudoconverse, the program issues an update to the single row using input from the online user. The update executes only if the row has not been modified since it was retrieved:

```
MAP IN ...

MOVE MAP-SALARY-AMOUNT TO SALARY-AMOUNT.

EXEC SQL
  RESUME SESSION
END-EXEC.

EXEC SQL
  UPDATE POSITION
    SET SALARY_AMOUNT = :SALARY-AMOUNT,
        LAST_UPDATED = CURRENT TIMESTAMP
    WHERE EMP_ID = :EMP-ID
      AND JOB_ID = :JOB-ID
      AND LAST_UPDATED = :LAST-UPDATED
END-EXEC.

IF SQLCODE = 100 PERFORM ROW-CHANGED.
```

Managing Concurrent Sessions

The ability to maintain concurrent active sessions allows the program to access multiple databases with parallel database transactions. For example, one session can retrieve data from one database and, using that data, perform an update operation on another database.

Caution When Transaction Sharing Is Not in Effect

If an application attempts to access the *same* database in concurrent sessions, there is an inherent risk of deadlock; however, transaction sharing can be used to avoid such deadlocks.

Note: For more information about the use of transaction sharing, see Writing an SQL Program (see page 27) and the *CA IDMS Database Administration Guide*.

Session Management Concepts

Concurrent Session Identifier

When a session begins, CA IDMS assigns an identifier to the session and maintains the session identifier internally. All SQL statements implicitly reference the session identifier during execution.

If there are multiple concurrent sessions, each session has its own session ID. To manage multiple sessions, an application must manipulate the session identifier directly.

Data Declaration Requirements

To manipulate the session identifier, the program must first:

- Declare one host variable of usage SQLSESS
- Define a variable in working storage for each of the multiple sessions that the program will maintain

When the program begins an SQL session, CA IDMS returns the session identifier to the SQLSESS host variable that the program has defined. The program must save the SQLSESS value of each concurrent session.

How CA IDMS Uses the SQLSESS Variable

If the program declares an SQLSESS host variable, all calls to CA IDMS pass the SQLSESS host variable as a parameter to indicate the session to which the SQL statements should be directed.

CA IDMS does not alter the session ID value in this parameter unless the statement being executed terminates the session (that is, on a COMMIT, RELEASE, or ROLLBACK RELEASE). If the session is terminated, CA IDMS initializes the SQLSESS host variable.

What the Program Must Do

Before executing an SQL statement, the application must ensure that the correct session ID value has been moved to the SQLSESS host variable.

Implementing Concurrent Sessions

Declaring the SQLSESS Host Variable

To implement concurrent sessions, the program must declare a host variable to which CA IDMS assigns the session identifier of the active SQL session:

```
EXEC SQL
  BEGIN DECLARE SECTION
END-EXEC.

01   IDMS-SESS-ID    USAGE SQLSESS.

EXEC SQL
  END DECLARE SECTION
END-EXEC.
```

Saving the Session ID Value

The precompiler expands the SQLSESS host variable to an 8-byte character field. Therefore, to save session ID values, the application program must define work fields that also are 8-byte character fields:

```
WS-SESSION-IDS.
     05  SESS1-ID          PIC X(8).
     05  SESS2-ID          PIC X(8).
```

Multiple Session Steps

These are the steps in a typical scenario for managing multiple sessions:

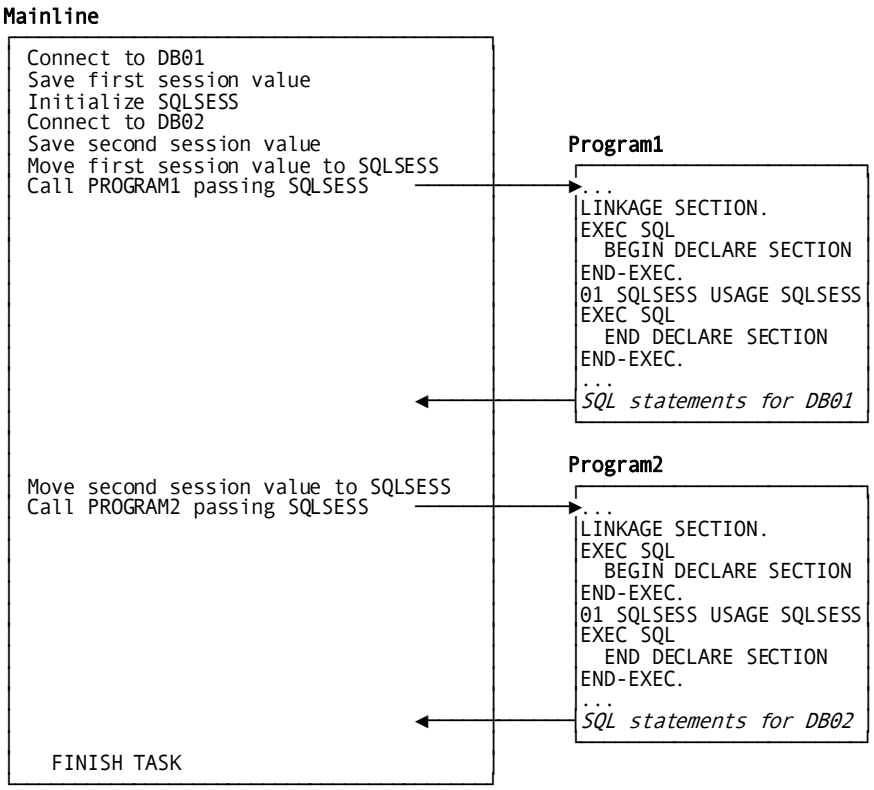
1. Begin a session accessing Database 1
2. Move IDMS-SESS-ID to SESS1-ID
3. Initialize IDMS-SESS-ID by moving spaces to it
4. CONNECT TO Database 2
5. Move IDMS-SESS-ID to SESS2-ID

At this point, the current session ID value is the one representing the second session. To make the first session the current session, the application program would move the value in SESS1-ID to IDMS-SESS-ID.

Multiple Sessions Started by One Program

The following diagram illustrates a scenario in which a program manages session IDs to maintain multiple concurrent sessions.

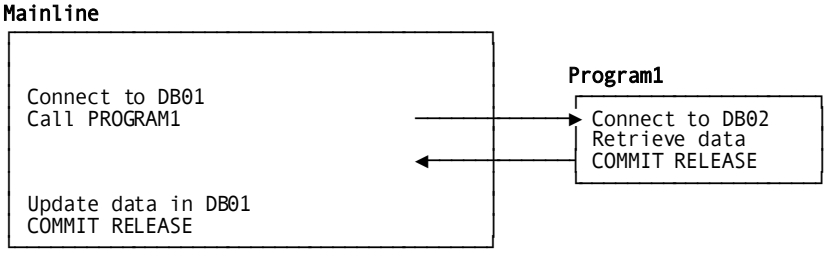
In this case, the mainline program initiates both sessions and passes the appropriate session ID to each subordinate program to indicate which session the subprogram should process. Each subprogram must also declare a session identifier to hold the value passed from the mainline program.



Multiple Sessions Started by Different Programs

The following diagram illustrates a scenario in which multiple sessions are begun by multiple programs.

In this case, Program 1 must declare a session ID to indicate that a separate session is desired; otherwise, the CONNECT statement will return an error. However, no manipulation of the session ID is required.



Creating and Using a Temporary Table

A temporary table differs from a database table in these ways:

- A temporary table exists only as long as the database transaction in which it is created
- You cannot create an index on a temporary table
- A temporary table cannot be referenced in a view or a referential constraint
- A temporary table cannot be accessed by another database transaction

With the above exceptions, a program can access a temporary table and manipulate temporary table data as it does with a database table.

Why Use a Temporary Table

A temporary table can be useful for certain processing requirements, such as to:

- Take a snapshot of information in the database
- Avoid re-accessing base tables multiple times to retrieve the same information, to process efficiently and assure that the information does not change
- Perform certain operations that cannot be done with a single SQL statement, such as inserting rows into a table using data retrieved from the same table

Caution Using a Temporary Table

Since you cannot create an index on a temporary table, access to a temporary table is always serial. Accessing data in a temporary table with many rows may degrade the performance of the program.

How You Create a Temporary Table

You create a temporary table in the procedural section of the program by issuing a CREATE TEMPORARY TABLE statement. This statement requires:

- A temporary table name
- Column names
- Column definitions

CA IDMS maintains temporary tables in the scratch area. The program does not supply information about the physical characteristics of a temporary table.

Note: For more information about creating temporary tables in particular, see the *CA IDMS SQL Reference Guide*. For more information about creating tables in general, see the *CA IDMS Database Administration Guide*.

Naming a Temporary Table

When you create a temporary table, you should name it in a way that cannot match the name of any table or view that may be created. If a temporary table name matches the name of a base table or view, the optimizer will assume the name refers to the base table or view, and the temporary table will not be accessed.

Cursor for a Temporary Table

The program can declare a cursor for a temporary table. However, when you create the access module for the program, the optimizer issues a warning in response to any reference to the temporary table other than in the CREATE TEMPORARY TABLE statement.

The programmer has the responsibility of verifying that the cursor declaration and the CREATE TEMPORARY TABLE statement are compatible.

Temporary Table Example

In this example, the program creates a temporary table of manager names and ids using information in the EMPLOYEE table. (The EMPLOYEE table itself associates the id of a manager with the name of the subordinate employee, not the name of the manager.) Using a cursor, the program accesses a row of the temporary table and selects employees from the EMPLOYEE table who report to the manager identified in the temporary table row.

This is the cursor declaration and the statement to create the temporary table:

```
WORKING STORAGE SECTION.

EXEC SQL
DECLARE TEMP_CRSR CURSOR FOR
  SELECT *
    FROM TEMP_MGR
    ORDER BY 3
END EXEC
 .
 .
 .
PROCEDURE DIVISION.

EXEC SQL
  CREATE TEMPORARY TABLE TEMP_MGR
         (TEMP_MGR_ID            INTEGER,
         TEMP_FNAME             CHAR(20),
         TEMP_LNAME             CHAR(20))
END-EXEC.
```

This statement adds manager information to the temporary table:

```
EXEC SQL
  INSERT INTO TEMP_MGR
  SELECT DISTINCT E.MANAGER_ID,
         M.EMP_FNAME,
         M.EMP_LNAME
    FROM EMPLOYEE E, EMPLOYEE M
    WHERE E.MANAGER_ID = M.EMP_ID
END-EXEC.
```

This statement establishes a current cursor row for the temporary table:

```
EXEC SQL
  FETCH TEMP_CRSR
    INTO :MGR-ID,
         :MGR-FNAME,
         :MGR-LNAME
END-EXEC.
```

This statement performs a bulk select of employees who report to the manager in the current cursor row. Depending on processing requirements, this statement could be a bulk fetch:

```
EXEC SQL
  SELECT EMP_FNAME,
         EMP_LNAME,
         DEPT_ID
    BULK :BULK-EMPLOYEE
    FROM EMPLOYEE
    WHERE MANAGER_ID = :MGR-ID
      AND TERMINATION_DATE IS NULL
END-EXEC.
```

Bill-of-materials Explosion

This section presents a sample program that performs a bill-of-materials explosion. A discussion of the concepts involved precedes the sample program.

What to Do

Maximum Level

The sample program establishes a value of 100 as the limit of levels for the explosion in its use of the MAX-LEVELS variable. A limit of 100 is for illustration only; a program can set a higher or lower limit.

```
LIMITS-AND-CONSTANTS.
    02  NUMBER-OF-CURSORS  PIC S9    COMP VALUE 3.
    02  MAX-LEVELS         PIC S9(4) COMP VALUE 100.
    02  NULL-KEY-VALUE     PIC 9(7)       VALUE 0.
```

Cursor Declarations

The program declares three different cursors with identical definitions. The cursor issues a join of the PART and COMPONENT tables that produces a result table of component parts for each part.

```
EXEC SQL  DECLARE CURSOR1 CURSOR FOR
    SELECT COMPONENT_PART,
           QUANTITY,
           PART_NAME
      FROM COMPONENT C,
           PART P
     WHERE C.PART = :CURRENT-KEY
       AND C.COMPONENT_PART > :PREVIOUS-COMPONENT
       AND P.NUMBER = C.PART
     ORDER BY COMPONENT_PART
END-EXEC

EXEC SQL  DECLARE CURSOR2 CURSOR FOR
    SELECT COMPONENT_PART,
           QUANTITY,
           PART_NAME
      FROM COMPONENT C,
           PART P
     WHERE C.PART = :CURRENT-KEY
  .
  .
  .
```

The minimum number of cursors needed is two. Theoretically, the program could declare more cursors with identical definitions, up to a number of cursors equal to the maximum level for the explosion. However, for most bill-of-material explosions, it is more practical and efficient to add program logic that allows the three cursors to be reused as illustrated in the sample program later in this section.

Getting the First Row

The GET-FIRST-ROW section of the program issues a single-row select from the PART table. The search condition equates an input part number (TOP-KEY), the part to be exploded, with PART_NUMBER, the unique key of the PART table.

This select verifies the existence of the part and also retrieves its name.

```
EXEC SQL
  SELECT  PART_NUMBER,  PART_NAME
    INTO :CURRENT-KEY, :COMPONENT-NAME
    FROM  PART
    WHERE PART_NUMBER = :TOP-KEY
END-EXEC.
```

Going to the First Level

In the FETCH-NEXT-ROW section, the program opens a cursor to retrieve the component parts that make up the current part, whose number it has assigned to CURRENT-KEY. The program fetches the first row of the cursor result table.

```
FETCH-NEXT-ROW SECTION.
    PERFORM OPEN-CURRENT-CURSOR.

    IF      CURRENT-CURSOR = 1
       EXEC SQL
          FETCH CURSOR1 INTO
            :COMPONENT-KEY, :QTY, :COMPONENT-NAME
       END-EXEC
    ELSE IF CURRENT-CURSOR = 2
 .
 .
 .
```

Going Down More Levels

If the first fetch succeeds, the program executes the DOWN-ONE-LEVEL section. In this section, the program:

- Assigns the part number in the first row fetched to CURRENT-KEY
- Increments the current level by 1
- Increments the current cursor by 1 if the current cursor is less than 3

Because the program reuses the three cursors, it attempts to close a cursor in the CLOSE-CURRENT-CURSOR section before it opens the cursor in the OPEN-CURRENT-CURSOR section. For the first three levels of the explosion, the DBMS will ignore the CLOSE statement because the specified cursor has not yet been opened.

Using the part number retrieved in the fetch by the previous cursor, the program now fetches the first component part of the next level down by opening the current cursor and fetching from it. This logic is repeated until a fetch returns an SQLCODE of 100 (in effect, no more levels) or the defined maximum level is reached.

Saved Keys

Each time it goes down a level, the program saves the part number used in the fetch:

```
DOWN-ONE-LEVEL SECTION.
    IF CURRENT-LEVEL > MAX-LEVELS
       NEXT SENTENCE
    ELSE
       MOVE COMPONENT-KEY TO CURRENT-KEY
       MOVE COMPONENT-KEY TO SAVE-KEY (CURRENT-LEVEL)
 .
 .
 .
```

By saving the key, the program can later retrieve the part number for a level and execute the backup logic described below.

When There Are No More Levels

When there are no more levels, the program executes the BACKUP-ONE-LEVEL section. It subtracts 1 from the level number and retrieves the saved keys for the current and previous levels.

```
BACKUP-ONE-LEVEL SECTION.
    SUBTRACT 1 FROM CURRENT-LEVEL.
    IF CURRENT-LEVEL > 0
       MOVE SAVE-KEY (CURRENT-LEVEL) TO PREVIOUS-COMPONENT.
    IF CURRENT-LEVEL > 1
       MOVE SAVE-KEY (CURRENT-LEVEL - 1) TO CURRENT-KEY
.
.
.
```

Since the cursor result tables are ordered by component part number and one of the conditions of each is C.COMPONENT_PART > :PREVIOUS-COMPONENT, the program re-establishes cursor position in the list of components by limiting the rows selected to those not yet processed. Each time a cursor is re-opened, the first row of the result table is the next component to be processed,

This allows the program both to reuse a cursor and to fetch the next row for the previous level.

Completing the Explosion

The process of going down a level until there are no more levels, going back one level, and attempting to go down again is repeated until backing up reaches the top level. The bill-of-materials explosion is now complete.

Sample Program

```
IDENTIFICATION DIVISION.
 PROGRAM-ID.    EXPLODE.

 ENVIRONMENT DIVISION.

 DATA DIVISION.
 WORKING-STORAGE SECTION.

 01  SQLMSGS.
     02  SQLMMAX            PIC S9(8) COMP VALUE +6.
     02  SQLMSIZE           PIC S9(8) COMP VALUE +80.
     02  SQLMCNT            PIC S9(8) COMP.
     02  SQLMLINE           OCCURS 6 TIMES PIC X(80).

 01  REQ-WK.
     02  REQUEST-CODE       PIC S9(8) COMP.
     02  REQUEST-RETURN     PIC S9(8) COMP.

01  LIMITS-AND-CONSTANTS.
    02  NUMBER-OF-CURSORS  PIC S9    COMP VALUE 3.
    02  MAX-LEVELS         PIC S9(4) COMP VALUE 100.
    02  NULL-KEY-VALUE     PIC 9(7)       VALUE 0.

01  CURSOR-FLAGS.
    02  CURSOR-FLAG  OCCURS 3 TIMES PIC X.

01  KEY-TABLE.
    02  SAVE-KEY     OCCURS 100 TIMES PIC 9(7).

01  WORK-FIELDS.
    02  CURRENT-LEVEL      PIC S9(4) COMP.
    02  CURRENT-CURSOR     PIC S9(4) COMP.
    02  DISPLAY-LEVEL      PIC ZZ9.
    02  WARNING-MSG        PIC X(40).
    02  SQLVALUE           PIC ----9.

EXEC SQL    BEGIN DECLARE SECTION        END-EXEC
01  DBNAME                 PIC X(8).
01  PREVIOUS-COMPONENT     PIC S9(7) COMP-3.
01  TOP-KEY                PIC S9(7) COMP-3.
01  CURRENT-ROW.
    02  CURRENT-KEY        PIC S9(7) COMP-3.
    02  COMPONENT-KEY      PIC S9(7) COMP-3.
    02  QTY                PIC S9(5)V99 COMP-3.
    02  COMPONENT-NAME     PIC X(30).
EXEC SQL    END   DECLARE SECTION          END-EXEC.
```

```
*******************************************************
*****         DECLARE CURSORS                     *****

 EXEC SQL  DECLARE CURSOR1 CURSOR FOR
     SELECT COMPONENT_PART,
            QUANTITY,
            PART_NAME
       FROM COMPONENT C,
            PART P
      WHERE C.PART = :CURRENT-KEY
        AND C.COMPONENT_PART > :PREVIOUS-COMPONENT
        AND P.NUMBER = C.PART
      ORDER BY COMPONENT_PART
 END-EXEC

 EXEC SQL  DECLARE CURSOR2 CURSOR FOR
     SELECT COMPONENT_PART,
            QUANTITY,
            PART_NAME
       FROM COMPONENT C,
            PART P
      WHERE C.PART = :CURRENT-KEY
        AND C.COMPONENT_PART > :PREVIOUS-COMPONENT
        AND P.NUMBER = C.PART
      ORDER BY COMPONENT_PART
 END-EXEC

 EXEC SQL  DECLARE CURSOR3 CURSOR FOR
     SELECT COMPONENT_PART,
            QUANTITY,
            PART_NAME
       FROM COMPONENT C,
            PART P
      WHERE C.PART = :CURRENT-KEY
        AND C.COMPONENT_PART > :PREVIOUS-COMPONENT
        AND P.NUMBER = C.PART
      ORDER BY COMPONENT_PART
 END-EXEC
*******************************************************


 PROCEDURE DIVISION.

 EXEC SQL
   WHENEVER SQLERROR GO TO SQL-ERROR
 END-EXEC.
```

```
 MAINLINE SECTION.
     ACCEPT DBNAME.
     ACCEPT TOP-KEY.
*  INITIALIZE VARIABLES TO GET US STARTED
     MOVE 1 TO CURRENT-LEVEL.
     MOVE 1 TO CURRENT-CURSOR.
     MOVE SPACES TO CURSOR-FLAGS.
     MOVE NULL-KEY-VALUE TO PREVIOUS-COMPONENT.
*
     PERFORM GET-FIRST-ROW.
     PERFORM FETCH-NEXT-ROW
       UNTIL CURRENT-LEVEL = 0.
     EXEC SQL  COMMIT RELEASE   END-EXEC.
     GOBACK.


 GET-FIRST-ROW SECTION.
     EXEC SQL  CONNECT TO :DBNAME         END-EXEC.
     EXEC SQL
       SELECT  PART_NUMBER,  PART_NAME
         INTO :CURRENT-KEY, :COMPONENT-NAME
         FROM  PART
         WHERE PART_NUMBER = :TOP-KEY
     END-EXEC.

     IF SQLCODE = 100
        MOVE 0 TO CURRENT-LEVEL
        DISPLAY '***** INVALID PART NUMBER: '
                 TOP-KEY
     ELSE
        DISPLAY '***** BILL OF MATERIALS FOR '
                'PART: ' CURRENT-KEY ' '
                COMPONENT-NAME ' *****'
        DISPLAY '**********************************'
                '**********************************'
                '**********************************'.
```

```
FETCH-NEXT-ROW SECTION.
    PERFORM OPEN-CURRENT-CURSOR.

    IF      CURRENT-CURSOR = 1
       EXEC SQL
          FETCH CURSOR1 INTO
            :COMPONENT-KEY, :QTY, :COMPONENT-NAME
       END-EXEC
    ELSE IF CURRENT-CURSOR = 2
       EXEC SQL
          FETCH CURSOR2 INTO
            :COMPONENT-KEY, :QTY, :COMPONENT-NAME
       END-EXEC
    ELSE IF CURRENT-CURSOR = 3
       EXEC SQL
          FETCH CURSOR3 INTO
            :COMPONENT-KEY, :QTY, :COMPONENT-NAME
       END-EXEC.

    IF SQLCODE = 100
       PERFORM BACKUP-ONE-LEVEL
    ELSE
       PERFORM PRINT-CURRENT-ROW
       PERFORM DOWN-ONE-LEVEL.


OPEN-CURRENT-CURSOR SECTION.
    IF CURSOR-FLAG (CURRENT-CURSOR) NOT = 'O'
       MOVE 'O' TO CURSOR-FLAG (CURRENT-CURSOR)
       IF      CURRENT-CURSOR = 1
          EXEC SQL
             OPEN CURSOR1
          END-EXEC
       ELSE IF CURRENT-CURSOR = 2
          EXEC SQL
             OPEN CURSOR2
          END-EXEC
       ELSE IF CURRENT-CURSOR = 3
          EXEC SQL
             OPEN CURSOR3
          END-EXEC.
```

```
CLOSE-CURRENT-CURSOR SECTION.

    IF CURSOR-FLAG (CURRENT-CURSOR) = 'O'
       MOVE ' ' TO CURSOR-FLAG (CURRENT-CURSOR)
       IF      CURRENT-CURSOR = 1
          EXEC SQL
             CLOSE CURSOR1
          END-EXEC
       ELSE IF CURRENT-CURSOR = 2
          EXEC SQL
             CLOSE CURSOR2
          END-EXEC
       ELSE IF CURRENT-CURSOR = 3
          EXEC SQL
             CLOSE CURSOR3
          END-EXEC.


DOWN-ONE-LEVEL SECTION.
    IF CURRENT-LEVEL > MAX-LEVELS
       NEXT SENTENCE
    ELSE
       MOVE COMPONENT-KEY TO CURRENT-KEY
       MOVE COMPONENT-KEY TO SAVE-KEY (CURRENT-LEVEL)
       MOVE NULL-KEY-VALUE TO PREVIOUS-COMPONENT
       ADD 1 TO CURRENT-LEVEL
       IF CURRENT-CURSOR = MAX-CURSORS
          MOVE 1 TO CURRENT-CURSOR
          PERFORM CLOSE-CURRENT-CURSOR
       ELSE
          ADD 1 TO CURRENT-CURSOR
          PERFORM CLOSE-CURRENT-CURSOR.


BACKUP-ONE-LEVEL SECTION.
    SUBTRACT 1 FROM CURRENT-LEVEL.
    IF CURRENT-LEVEL > 0
       MOVE SAVE-KEY (CURRENT-LEVEL) TO PREVIOUS-COMPONENT.
    IF CURRENT-LEVEL > 1
       MOVE SAVE-KEY (CURRENT-LEVEL - 1) TO CURRENT-KEY
    ELSE
       MOVE TOP-KEY TO CURRENT-KEY.
    PERFORM CLOSE-CURRENT-CURSOR.
    IF CURRENT-CURSOR = 1
       MOVE MAX-CURSORS TO CURRENT-CURSOR
    ELSE
       SUBTRACT 1 FROM CURRENT-CURSOR.
```

```
PRINT-CURRENT-ROW SECTION.

     MOVE CURRENT-LEVEL TO DISPLAY-LEVEL.
     IF CURRENT-LEVEL > MAX-LEVELS
        MOVE 'MAXIMUM LEVEL, COMPONENTS NOT LISTED'
             TO WARNING-MSG
     ELSE
        MOVE SPACES TO WARNING-MSG.
     DISPLAY '   ' DISPLAY-LEVEL
             '  PART: ' COMPONENT-KEY
             '  '       COMPONENT-NAME
             '  QTY: '  QTY
             '  '       WARNING-MSG.
 SQL-ERROR         SECTION.
     DISPLAY '****************** ERROR IN SQL STATEMENT'
             ' ******************'.
     DISPLAY 'PROGRAM          ' SQLPGM
     DISPLAY 'COMPILED         ' SQLDATE
     MOVE SQLCLNO TO SQLVALUE.
     DISPLAY 'SQL LINE NUMBER  ' SQLVALUE
     MOVE SQLCODE TO SQLVALUE.
     DISPLAY 'SQLCODE          ' SQLVALUE
     MOVE SQLCERC  TO SQLVALUE.
     DISPLAY 'REASON CODE      ' SQLVALUE
     MOVE SQLCERC  TO SQLVALUE.
     DISPLAY 'ERROR CODE       ' SQLVALUE
     MOVE SQLCNRP  TO SQLVALUE.
     DISPLAY 'ROWS PROCESSED   ' SQLVALUE

     MOVE 4 TO REQUEST-CODE.
     CALL 'IDMSIN01' USING SQLRPB, REQ=WK,
          SQLCA, SQLMSGS.
     IF REQUEST-RETURN NOT = 4
       MOVE 1 TO LINE-CNT
       PERFORM DISP=MSG UNTIL LINE-CNT > SQLMCNT.

 DISP-MSG SECTION.
     DISPLAY SQLMLINE (LINE-CNT).
     ADD 1 TO LINE-CNT.
```

Chapter 8: Using Dynamic SQL

This section contains the following topics:

Dynamic SQL

Depending on the processing requirement of the program and the capabilities of the programming language, you will need to implement dynamic SQL.

Dynamic SQL refers to an SQL statement that is not known to the program at precompile time and therefore is compiled dynamically when the program executes. CA IDMS provides dynamic SQL to allow the program to formulate, compile, and execute a DML statement at runtime.

To Insert, Update, or Delete

You implement dynamic SQL with a small set of SQL statements. For SQL DML other than SELECT or CALL, these statements are:

- EXECUTE IMMEDIATE—Dynamically compiles and executes the statement
- PREPARE—Dynamically compiles the statement
- EXECUTE—Executes a prepared statement

If the statement to be dynamically compiled could be issued more than once in the program, you should use the combination of PREPARE and EXECUTE statements.

To Select

To dynamically compile and execute a SELECT statement, you take these steps:

1. Formulate the statement
2. Prepare the statement and optionally describe the result table to CA IDMS
3. Declare or allocate a cursor using the dynamically compiled SELECT statement

To CALL an SQL Invoked Procedure

To dynamically compile and execute a CALL statement, you take these steps:

1. Formulate the statement
2. Prepare the statement and optionally describe the result table to CA IDMS
3. Declare or allocate a cursor using the dynamically compiled CALL statement

Host Language Dependency

If the number and type of columns in a dynamic SELECT or CALL are not known at compile time, the host language must provide explicit support for dynamic storage allocation because the variable storage requirements for the data to be retrieved can be derived only from information returned to the SQLDA when the SELECT statement is prepared.

No Host Variables, Local Variables, or Routine Parameters

A dynamic SQL statement that is prepared or executed using an EXECUTE IMMEDIATE statement cannot reference host variables, local variables, or routine parameters within the text of the statement. If you want to repeatedly execute a statement, such as an UPDATE, using different update values each time, you must use dynamic parameters in place of variables or parameters.

Note: For more information about dynamic parameters, see the *CA IDMS SQL Reference Guide*.

Precompiling with NOINSTALL

A program that consists entirely of dynamic SQL statements, session and transaction management statements, requires no RCM. Therefore, you may precompile such a program with the NOINSTALL option. This directs the precompiler to check syntax and not to store an RCM, thus eliminating the need for updating the dictionary. If SQL requests will be issued from more than one program within a single transaction, each such program must have its RCM included in the access module being used. This requirement holds, regardless of whether all of the statements within a program are dynamic or not. As general practice, you should avoid specifying the NOINSTALL option.

Dynamic Insert, Update, and Delete Operations

You can perform a dynamic insert, update, or delete using EXECUTE or EXECUTE IMMEDIATE. EXECUTE is valid only when the statement has been dynamically compiled with a PREPARE statement.

Using EXECUTE IMMEDIATE

When to Use It

Use EXECUTE IMMEDIATE to dynamically compile and execute a statement that will be issued only once in the transaction.

If a program consists mainly of dynamic SQL statements, consider using EXECUTE IMMEDIATE for the few remaining SQL statements. You can precompile the program with the NOINSTALL option, eliminating an RCM and an access module to execute the program. This may be more efficient in your processing environment.

EXECUTE IMMEDIATE example

In this example, the program builds an INSERT statement in working storage and moves the complete statement to a host variable, STATEMENT-TEXT. The program issues an EXECUTE IMMEDIATE statement on the text contained in the host variable:

```
DATA DIVISION.
WORKING-STORAGE SECTION.

01   INSERT-STATEMENT-TEXT.
     02 FILLER           PIC X(21)  VALUE
        "INSERT INTO C_DIVISION VALUES ('".
     02 DIV-CODE-TEXT    PIC X(3).
     02 FILLER           PIC X(3)  VALUE
        "','".
     02 DIV-NAME-TEXT    PIC X(40).
     02 FILLER           PIC X(2)  VALUE
        "',".
     02 DIV-HEAD-ID-TEXT  PIC X(4).
     02 FILLER           PIC X(3)  VALUE
        ")".

EXEC SQL BEGIN DECLARE SECTION END-EXEC.
01   STATEMENT-TEXT    PIC X(76).
EXEC SQL END DECLARE SECTION   END-EXEC.


PROCEDURE DIVISION.

MOVE INPUT-DIV-CODE TO DIV-CODE-TEXT.
MOVE INPUT-DIV-NAME TO DIV-NAME-TEXT.
MOVE INPUT-DIV-HEAD-ID TO DIV-HEAD-ID-TEXT.
MOVE INSERT-STATEMENT-TEXT TO STATEMENT-TEXT.

EXEC SQL
EXECUTE IMMEDIATE :STATEMENT-TEXT
END-EXEC.
```

Error-checking

There is no error-checking technique that is specific to EXECUTE IMMEDIATE. Check for SQLCODE < 0, or check for a specific SQLSTATE value if appropriate.

Using PREPARE

Why You Use PREPARE

You use the PREPARE statement to dynamically compile an SQL statement that is formulated at runtime. You should prepare the statement if:

- The statement may be issued more than once during a transaction
- The statement may be a SELECT

Determining Information About the Prepared Statement

You can use either the DESCRIBE option of the PREPARE statement or a separate DESCRIBE statement to determine the following information:

- Whether the prepared statement is a SELECT
- If the prepared statement is a SELECT, the number of result columns to be returned and the name and format of each of the result columns
- The format of any dynamic parameters that must be supplied as input values when the statement is executed or an associated cursor is opened

To retrieve this information, you must allocate at least one SQL descriptor area. You need to allocate two descriptor areas if you want to retrieve information about both result columns and dynamic parameters.

Note: Descriptor areas must be defined using the SQLDA structure.

Declaring SQLDA

The program can declare the default descriptor area SQLDA with an INCLUDE statement:

```
EXEC SQL
  INCLUDE SQLDA
    NUMBER OF COLUMNS 20
END-EXEC.
```

Declaring SQLDA in CA ADS

If you are using descriptor areas in CA ADS, you can create a work record layout through IDD as described in the *CA ADS User Guide*. This work record must match the SQLDA layout and the initial values should conform to the data types.

The following example displays the CA ADS format of the SQLDA:

```
SQLDA.
      05  SQLDAID             PIC X(8).
      05  SQLN                PIC S9(9) COMP
                              VALUE  +n .
      05  SQLD                PIC S9(9) COMP.
      05  SQLVAR              OCCURS n.
          10  SQLLEN          PIC S9(9) COMP.
          10  SQLTYPE         PIC S9(4) COMP.
          10  SQLSCALE        PIC S9(4) COMP.
          10  SQLPRECISION    PIC S9(4) COMP.
          10  SQLALN          PIC S9(4) COMP.
          10  SQLNALN         PIC S9(4) COMP.
          10  SQLNULL         PIC S9(4) COMP.
          10  SQLNAME         PIC X(32).
```

where n is the maximum number of occurrences of SQLVAR

SQLDA Values

An SQL descriptor area used to retrieve information about the output of the prepared statement contains the following values:

The value in SQLD indicates whether the statement is:

- A SELECT statement if the value is greater than 0
- Not a SELECT statement if the value is equal to 0

  If greater than 0, SQLD is the number of columns in the result table of the SELECT statement.

The value in SQLN indicates the maximum number of columns the descriptor area can describe:

- The number specified in the NUMBER OF COLUMNS parameter of the INCLUDE statement
- If SQLD is greater than SQLN, the descriptor area is too small to describe the result table.

SQLVAR is a structure that occurs SQLN times. Each occurrence contains information about a result column.

Note: For more information, see the *CA IDMS SQL Reference Guide*.

PREPARE Example

In this example, the program has formulated an SQL statement and has moved the character string into the host variable STATEMENT-STRING:

```
EXEC SQL
  PREPARE DYNAMIC_STATEMENT
    FROM :STATEMENT-STRING
    DESCRIBE INTO SQLDA
END-EXEC.
```

Error-checking

If a PREPARE statement fails to execute at runtime, CA IDMS returns a negative value to SQLCODE.

If the SQLCODE value is -4, there may be a syntax error in the statement. If there is, the offset within the statement at which the syntax error occurred is returned to the SQLCSER field of the SQLCA.

Using EXECUTE

Why You Use EXECUTE

You use EXECUTE to execute a dynamically compiled (prepared) statement other than SELECT. This is the format of the EXECUTE statement:

```
EXEC SQL
  EXECUTE statement-name
END-EXEC.
```

The parameter *statement-name* must correspond to the value in the same parameter of a PREPARE statement that has already been issued in the same transaction.

EXECUTE Example

In this example, the statement prepared in an earlier example is executed:

```
EXEC SQL
  EXECUTE DYNAMIC_STATEMENT
END-EXEC.
```

Error-checking

There is no error-checking technique that is specific to EXECUTE. Check for SQLCODE < 0, or check for a specific SQLSTATE value if appropriate.

Repeating EXECUTE

You can repeat an EXECUTE statement in the same transaction because CA IDMS retains all dynamically compiled statements for the duration of the transaction.

If the program prepares more than one statement in a database transaction using the same statement name, an EXECUTE issued for the statement name will execute the most recently prepared statement.

Executing Prepared SELECT Statements

This section presents a sample program that prepares a SELECT statement and executes it dynamically. A discussion of the concepts involved precedes the sample program.

What to Do

Declaring a Cursor

To execute a prepared SELECT statement, the program must first declare a cursor for the prepared statement.

The sample program declares this cursor:

```
EXEC SQL
      DECLARE CURSOR1 CURSOR FOR SELECT_STATEMENT
END-EXEC.
```

Preparing the Statement

Before opening a cursor defined with a dynamic SQL statement, the program must prepare the statement.

The sample program issues this PREPARE statement:

```
EXEC SQL
   PREPARE SELECT_STATEMENT FROM :STATEMENT-TEXT
END-EXEC.
```

Building the Statement Text

In the sample program, the host variable STATEMENT-TEXT contains a character string consisting of a fixed portion of the statement to which input text is added when the program executes.

The fixed portion of the statement specifies table and columns from which data is selected. This part of the statement is initialized in working storage:

```
FIRST-PART-OF-STATEMENT.
    02  FILLER            PIC X(32)  VALUE
        'SELECT EMP_ID, EMP_FNAME,'.
    02  FILLER            PIC X(32)  VALUE
        ' EMP_LNAME, DEPT_ID,'.
    02  FILLER            PIC X(32)  VALUE
        ' MANAGER_ID, START_DATE '.
    02  FILLER            PIC X(32)  VALUE
        ' FROM DEMO.EMPL_VIEW_1 '.
```

The variable portion of the statement, which can specify additional selection criteria such as an ORDER BY or a WHERE clause, is completed when BUILD-SQL-STATEMENT section of the program executes.

Declaring a Host Variable Array

The sample program performs a bulk fetch after it opens the cursor. The bulk fetch requires a host variable array to receive the data.

The sample program declares the host variable array within an SQL declaration section using this INCLUDE statement:

```
FETCH-BUFFER.
EXEC SQL
   INCLUDE TABLE DEMO.EMPL_VIEW_1
             (EMP_ID, EMP_FNAME, EMP_LNAME,
               DEPT_ID, MANAGER_ID, START_DATE)
             NUMBER OF ROWS 50
             LEVEL 02
END-EXEC.
```

Executing the Fetch

After the program builds the statement text, prepares the statement, and opens the cursor, it issues the bulk fetch:

```
FETCH-ROWS SECTION.
     EXEC SQL
        FETCH CURSOR1
           BULK :FETCH-BUFFER
     END-EXEC.
     MOVE 1 TO ROW-CTR.
     PERFORM DISPLAY-ROW
        UNTIL ROW-CTR > SQLCNRP.
```

Sample Program

```
IDENTIFICATION DIVISION.
PROGRAM-ID.    EMPVIEW1.

ENVIRONMENT DIVISION.

DATA DIVISION.
WORKING-STORAGE SECTION.

01  SQLMSGS.
    02  SQLMMAX            PIC S9(8) COMP VALUE +6.
    02  SQLMSIZE           PIC S9(8) COMP VALUE +80.
    02  SQLMCNT            PIC S9(8) COMP.
    02  SQLMLINE           OCCURS 6 TIMES PIC X(80).

01  REQ-WK.
    02  REQUEST-CODE       PIC S9(8) COMP.
    02  REQUEST-RETURN     PIC S9(8) COMP.
01  LIMITS-AND-CONSTANTS.
    02  MAX-TEXT-LINES     PIC S9  COMP VALUE 5.

01  FIRST-PART-OF-STATEMENT.
    02  FILLER             PIC X(32)  VALUE
        'SELECT EMP_ID, EMP_FNAME,'.
    02  FILLER             PIC X(32)  VALUE
        ' EMP_LNAME, DEPT_ID,'.
    02  FILLER             PIC X(32)  VALUE
        ' MANAGER_ID, START_DATE '.
    02  FILLER             PIC X(32)  VALUE
        ' FROM DEMO.EMPL_VIEW_1 '.

01  HEADING-LINE.
    02  FILLER             PIC X(31)  VALUE
        'ID #    FIRST NAME '.
    02  FILLER             PIC X(23)  VALUE
        'LAST NAME '.
    02  FILLER             PIC X(31)  VALUE
        'DEPT    MGR     START DATE'.
01  DETAIL-LINE.
    02  EMP-ID             PIC 9(5).
    02  FILLER             PIC X(3)   VALUE SPACES.
    02  EMP-FNAME          PIC X(20).
    02  FILLER             PIC X(3)   VALUE SPACES.
    02  EMP-LNAME          PIC X(20).
    02  FILLER             PIC X(3)   VALUE SPACES.
    02  DEPT-ID            PIC 9(5).
    02  FILLER             PIC X(3)   VALUE SPACES.
```

```
    02  MANAGER-ID         PIC 9(5).
    02  FILLER             PIC X(3)   VALUE SPACES.
    02  START-DATE         PIC X(10).
01  WORK-FIELDS.
    02  ROW-CTR            PIC S99 COMP.
    02  TEXT-CTR           PIC S99 COMP.
    02  INPUT-LINE.
        03  END-CHAR       PIC X.
          88 END-STATEMENT    VALUE ';'.
        03  FILLER         PIC X(79).
    02  SQLVALUE           PIC ----9.

01  STATEMENT-TXT2.
    02  FIXED-PART         PIC X(128).
    02  VARIABLE-PART.
        03  TEXT-LINES OCCURS 5 TIMES PIC X(80).
EXEC SQL    BEGIN  DECLARE SECTION           END-EXEC
77  DBNAME                 PIC X(8).
01  STATEMENT-TEXT         PIC X(641).
01  FETCH-BUFFER.
EXEC SQL
   INCLUDE TABLE DEMO.EMPL_VIEW_1
             (EMP_ID, EMP_FNAME, EMP_LNAME,
               DEPT_ID, MANAGER_ID, START_DATE)
             NUMBER OF ROWS 50
             LEVEL 02
END-EXEC.

EXEC SQL    END   DECLARE SECTION           END-EXEC

*********************************************************
*****         DECLARE CURSORS                       *****

EXEC SQL
     DECLARE CURSOR1 CURSOR FOR SELECT_STATEMENT
END-EXEC
*********************************************************


PROCEDURE DIVISION.

EXEC SQL
  WHENEVER SQLERROR GO TO SQL-ERROR
END-EXEC.
```

```
MAINLINE SECTION.
    ACCEPT DBNAME.
    MOVE FIRST-PART-OF-STATEMENT TO FIXED-PART.
    MOVE 1 TO TEXT-CTR.
    PERFORM BUILD-SQL-STATEMENT
       UNTIL TEXT-CTR > MAX-TEXT-LINES.
    IF END-STATEMENT
       PERFORM PREPARE-AND-OPEN-CURSOR
       PERFORM FETCH-ROWS
         UNTIL SQLCODE = 100
       EXEC SQL  COMMIT RELEASE   END-EXEC.
    GOBACK.



BUILD-SQL-STATEMENT SECTION.
    IF NOT END-STATEMENT
       ACCEPT INPUT-LINE
       DISPLAY INPUT-LINE.
    IF NOT END-STATEMENT
       MOVE INPUT-LINE TO TEXT-LINE (TEXT-CTR)
    ELSE
       MOVE SPACES     TO TEXT-LINE (TEXT-CTR).
    ADD 1 TO TEXT-CTR.


PREPARE-AND-OPEN-CURSOR SECTION.
    EXEC SQL                  -- CONNECT TO DATABASE
       CONNECT TO :DBNAME
    END-EXEC.

    EXEC SQL                  -- SET ISOLATION MODE
       SET TRANSACTION TRANSIENT READ
    END-EXEC.

    MOVE STATEMENT-TXT2 TO STATEMENT-TEXT.
    EXEC SQL                  -- PREPARE THE SELECT
       PREPARE SELECT_STATEMENT FROM :STATEMENT-TEXT
    END-EXEC.

    EXEC SQL                  -- OPEN THE CURSOR
       OPEN CURSOR1
    END-EXEC.

    DISPLAY ' '.
```

```
    DISPLAY ' '.
    DISPLAY HEADING-LINE.
    DISPLAY ' '.


FETCH-ROWS SECTION.
    EXEC SQL
       FETCH CURSOR1
          BULK :FETCH-BUFFER
    END-EXEC.
    MOVE 1 TO ROW-CTR.
    PERFORM DISPLAY-ROW
       UNTIL ROW-CTR > SQLCNRP.


DISPLAY-ROW SECTION.
    MOVE CORRESPONDING EMPL-VIEW-1 (ROW-CTR) TO DETAIL-LINE.
    DISPLAY DETAIL-LINE.
    ADD 1 TO ROW-CTR.



SQL-ERROR         SECTION.
    DISPLAY '****************** ERROR IN SQL STATEMENT'
            ' ******************'.
    DISPLAY 'PROGRAM          ' SQLPGM
    DISPLAY 'COMPILED         ' SQLDTS
    MOVE SQLCLNO TO SQLVALUE.
    DISPLAY 'SQL LINE NUMBER  ' SQLVALUE
    MOVE SQLCODE TO SQLVALUE.
    DISPLAY 'SQLCODE          ' SQLVALUE
    MOVE SQLCERC  TO SQLVALUE.
    DISPLAY 'REASON CODE      ' SQLVALUE
    MOVE SQLCERC  TO SQLVALUE.
    DISPLAY 'ERROR CODE       ' SQLVALUE
    MOVE SQLCNRP  TO SQLVALUE.
    DISPLAY 'ROWS PROCESSED   ' SQLVALUE

    MOVE 4 TO REQUEST-CODE.
    CALL 'IDMSIN01' USING SQLRPB, REQ-WK,
          SQLCA, SQLMSGS.
    IF REQUEST-RETURN NOT = 4
      MOVE 1 TO LINE-CNT
      PERFORM DISP-MSG UNTIL LINE-CNT > SQLMCNT

DISP-MSG SECTION.
    DISPLAY SQLMLINE (LINE-CNT).
    ADD 1 TO LINE-CNT.
```

Executing Prepared CALL Statements

This section presents a sample program that prepares a CALL statement and executes it dynamically. A discussion of the concepts involved precedes the sample program.

What to Do

Declaring a Cursor

To execute a prepared CALL statement, the program must first declare a cursor for the prepared statement. The sample program declares this cursor:

```
EXEC SQL
     DECLARE CURSOR1 CURSOR FOR CALL_STATEMENT
END-EXEC.
```

Preparing the Statement

Before opening a cursor defined with a dynamic SQL statement, the program must prepare the statement. The sample program issues this PREPARE statement:

```
EXEC SQL
     PREPARE CALL_STATEMENT FROM :STATEMENT-TEXT
END-EXEC.
```

Building the Statement Text

In the sample program, the host variable STATEMENT-TEXT contains a character string consisting of a fixed portion of the statement to which input text is added when the program executes.

The fixed portion of the statement specifies the CALL statement. This part of the statement is initialized in working storage:

```
01 FIRST-PART-OF-STATEMENT.
   02 FILLER PIC X(8) VALUE 'CALL '.
```

The variable portion of the statement, which specifies the *procedure-reference* in the form of [schema].procedure [parameters], is completed when BUILD-SQL-STATEMENT section of the program executes.

Declaring Host Variables for 3 Parameters

The sample program performs a fetch into 3 host variables after it opens the cursor.

The sample program declares the following host variables within an SQL declaration:

```
01 DETAIL-LINE.
   02 P1          PIC 9(10).
   02 FILLER      PIC X(3)  VALUE SPACES.
   02 P2          PIC 9(10).
   02 FILLER      PIC X(3)  VALUE SPACES.
   02 P3          PIC X(32) VALUE SPACES.
   02 FILLER      PIC X(3)  VALUE SPACES.
01 DBNAME         PIC X(8).

01 STATEMENT-TEXT PIC X(641).
```

Executing the Fetch

After the program builds the statement text, prepares the statement, and opens the cursor, it issues the fetch:

```
FETCH-ROWS SECTION.

EXEC SQL
     FETCH CURSOR1 INTO :P1,
                        :P2,
                        :P3
END-EXEC.

MOVE 1 TO ROW-CTR.
PERFORM DISPLAY-ROW UNTIL
        ROW-CTR > SQLCNRP.
```

Sample Program

```
       IDENTIFICATION DIVISION.
       PROGRAM-ID.    DYNCALL.
      *-------------------------------------------------------*
      *                                                       *
      *                                                       *
      * DYNCALL will read a procedure-reference and execute it  *
      * dynamically.                                          *
      *                                                       *
      *   It is assumed that the procedure has 3 parameters,    *
      *   P1 and P2 are numeric, P3 is alphanumeric.          *
      *-------------------------------------------------------*
```

```
ENVIRONMENT DIVISION.
DATA DIVISION.
WORKING-STORAGE SECTION.

01  SQLMSGS.
    02  SQLMMAX            PIC S9(8) COMP VALUE +6.
    02  SQLMSIZE           PIC S9(8) COMP VALUE +80.
    02  SQLMCNT            PIC S9(8) COMP.
    02  SQLMLINE           OCCURS 6 TIMES PIC X(80).

01  REQ-WK.
    02  REQUEST-CODE       PIC S9(8) COMP.
    02  REQUEST-RETURN     PIC S9(8) COMP.

77  LINE-CNT               PIC S9(8) COMP.

01  LIMITS-AND-CONSTANTS.
    02  MAX-TEXT-LINES     PIC S9  COMP VALUE 5.

01  FIRST-PART-OF-STATEMENT.
    02  FILLER             PIC X(8)  VALUE
        'CALL '.

01  HEADING-LINE.
    02  FILLER             PIC X(13)  VALUE
        'P1 PIC 9(10)'.
    02  FILLER             PIC X(13)  VALUE
        'P2 PIC 9(10)'.
    02  FILLER             PIC X(33)  VALUE
        'P3 X(32)'.

EXEC SQL    BEGIN   DECLARE SECTION          END-EXEC
01  DETAIL-LINE.
    02  P1                 PIC 9(10).
    02  FILLER             PIC X(3)   VALUE SPACES.

    02  P2                 PIC 9(10).
    02  FILLER             PIC X(3)   VALUE SPACES.
    02  P3                 PIC X(32)  VALUE SPACES.
    02  FILLER             PIC X(3)   VALUE SPACES.

01  DBNAME                 PIC X(8).
01  STATEMENT-TEXT         PIC X(641).

EXEC SQL    END   DECLARE SECTION          END-EXEC
```

```
  01  WORK-FIELDS.
      02  ROW-CTR            PIC S99 COMP.
      02  TEXT-CTR           PIC S99 COMP.
      02  INPUT-LINE.
          03  END-CHAR       PIC X.
            88 END-STATEMENT    VALUE ';'.
          03  FILLER         PIC X(79).
      02  SQLVALUE           PIC ----9.


  01  STATEMENT-TXT2.
      02  FIXED-PART         PIC X(8).
      02  VARIABLE-PART.
          03  TEXT-LINES OCCURS 5 TIMES PIC X(80).

*********************************************************
*****         DECLARE CURSORS                       *****

  EXEC SQL

       DECLARE CURSOR1 CURSOR FOR CALL_STATEMENT
  END-EXEC
*********************************************************

  PROCEDURE DIVISION.

  EXEC SQL
    WHENEVER SQLERROR GO TO SQL-ERROR
  END-EXEC.



  MAINLINE SECTION.
      ACCEPT DBNAME.
      MOVE FIRST-PART-OF-STATEMENT TO FIXED-PART.
      MOVE 1 TO TEXT-CTR.
      PERFORM BUILD-SQL-STATEMENT
         UNTIL TEXT-CTR > MAX-TEXT-LINES.
      IF END-STATEMENT
         PERFORM PREPARE-AND-OPEN-CURSOR
```

```
           PERFORM FETCH-ROWS
             UNTIL SQLCODE = 100
           EXEC SQL  COMMIT RELEASE   END-EXEC.
        GOBACK.

    BUILD-SQL-STATEMENT SECTION.
        IF NOT END-STATEMENT
           ACCEPT INPUT-LINE
           DISPLAY INPUT-LINE.
        IF NOT END-STATEMENT
           MOVE INPUT-LINE TO TEXT-LINES(TEXT-CTR)

        ELSE
           MOVE SPACES     TO TEXT-LINES(TEXT-CTR).
        ADD 1 TO TEXT-CTR.



    PREPARE-AND-OPEN-CURSOR SECTION.
        EXEC SQL                  -- CONNECT TO DATABASE
           CONNECT TO :DBNAME
        END-EXEC.

        EXEC SQL                  -- SET ISOLATION MODE

           SET TRANSACTION TRANSIENT READ
        END-EXEC.

        MOVE STATEMENT-TXT2 TO STATEMENT-TEXT.
        EXEC SQL                  -- PREPARE THE CALL
           PREPARE CALL_STATEMENT FROM :STATEMENT-TEXT
        END-EXEC.

        EXEC SQL                  -- OPEN THE CURSOR
           OPEN CURSOR1
        END-EXEC.


        DISPLAY ' '.
        DISPLAY ' '.
        DISPLAY HEADING-LINE.
        DISPLAY ' '.


    FETCH-ROWS SECTION.
        EXEC SQL
           FETCH CURSOR1
             INTO :P1, :P2, :P3
```

```
    END-EXEC.
    MOVE 1 TO ROW-CTR.
    PERFORM DISPLAY-ROW
       UNTIL ROW-CTR > SQLCNRP.

DISPLAY-ROW SECTION.
    DISPLAY DETAIL-LINE.
    ADD 1 TO ROW-CTR.

SQL-ERROR         SECTION.
    DISPLAY '****************** ERROR IN SQL STATEMENT'
            ' ******************'.
    DISPLAY 'PROGRAM          ' SQLPGM
    DISPLAY 'COMPILED         ' SQLDTS
    MOVE SQLCLNO TO SQLVALUE.
    DISPLAY 'SQL LINE NUMBER  ' SQLVALUE
    MOVE SQLCODE TO SQLVALUE.
    DISPLAY 'SQLCODE          ' SQLVALUE
    MOVE SQLCERC  TO SQLVALUE.
    DISPLAY 'REASON CODE      ' SQLVALUE

    MOVE SQLCERC  TO SQLVALUE.
    DISPLAY 'ERROR CODE       ' SQLVALUE
    MOVE SQLCNRP  TO SQLVALUE.
    DISPLAY 'ROWS PROCESSED   ' SQLVALUE

    MOVE 4 TO REQUEST-CODE.
    CALL 'IDMSIN01' USING SQLRPB, REQ-WK,

         SQLCA, SQLMSGS.
    IF REQUEST-RETURN NOT = 4
      MOVE 1 TO LINE-CNT
      PERFORM DISP-MSG UNTIL LINE-CNT > SQLMCNT.

DISP-MSG SECTION.
    DISPLAY SQLMLINE (LINE-CNT).
    ADD 1 TO LINE-CNT.
```

Dynamic SQL Caching

Dynamic SQL caching is a common technique used to improve performance in an SQL environment. Caching works in the following manner: when a dynamic SQL statement is compiled, a copy of the SQL statement and the result of the SQL compilation are saved in a cache. For each subsequent SQL compilation request, the cache is searched. If the statement is found, the matching compiled structures are used instead of recompiling the statement. This improves performance by eliminating the I/O requests to read the catalog and the CPU usage required to invoke the SQL optimizer for subsequent executions of the same dynamic SQL statement.

In most cases, the savings in resource consumption due to bypassing the SQL compilation are significantly greater than the extra cost associated with caching the SQL source, access plans, and related structures.

Note: At this time, only the SELECT, UPDATE, and DELETE SQL statements are cacheable.

Searching the Cache

When a search is made in the cache for a matching SQL statement, a cache hit occurs when a matching entry is found. The following factors are considered in determining whether an SQL statement matches a cache entry:

- The text of the statement
- The default schema in effect for the SQL session
- The dictionary to which the SQL session is connected
- Whether the statement references temporary tables

A literal comparison of the statement's text is made against each cache entry until a match is found. A literal comparison avoids the overhead of parsing but has the consequence that an entry may not match because of differences in such things as case and spacing. For example, the following three statements are considered different if using a literal comparison:

```
Select * from EMPLOYEE
Select * from   EMPLOYEE
select * from employee
```

Specifying values as literals instead of as dynamic parameters can also result in unequal comparisons. The following two statements would be textually identical if a dynamic parameter had been used in place of the numeric values 100 and 101:

```
select * from DEMOEMPL.EMPLOYEE where EMP_ID = 100
select * from DEMOEMPL.EMPLOYEE where EMP_ID = 101
```

Note: While the use of dynamic parameters can increase the frequency of finding a matching cache entry, it may occasionally prevent the optimizer from choosing the most efficient access strategy.

When a dynamic statement that relies on a default schema is cached, both the statement text and the default schema are saved. When the cache is searched for a statement that relies on a default schema, both the statement's text and the session's default schema must be equal to their cached equivalents for the entry to match. Consider the following two statements. The first will match a cached entry regardless of the default schema in effect for the SQL session. The second will match only if the default schema in effect for the SQL session is the same as that in the cache:

```
select * from DEMOEMPL.EMPLOYEE
select * from EMPLOYEE
```

The name of the dictionary to which an SQL session is connected is always saved in the cache and compared to the session's dictionary during a search of the cache. If the two are not the same, then the cache entry does not match.

If an SQL statement references a temporary table, it will not be cached since each temporary table instance can be structurally different from others of the same name. Therefore, no statement that references a temporary table will match a cache entry.

Impact of Database Definition Changes

Database definition changes may or may not be detected automatically based on whether the database is SQL-defined or non-SQL-defined. This has consequences for dynamic SQL caching as explained next.

SQL-Defined Databases and Caching

Because SQL-defined databases have an associated catalog and because areas for SQL-defined databases have timestamps, CA IDMS is able to automatically detect definitional changes that impact cached SQL statements. Whenever a statement needs recompilation, CA IDMS automatically detects this condition and recompiles the affected statement dynamically.

Non-SQL-Defined Databases and Caching

Non-SQL-defined databases do not have timestamps for automatically determining whether a database's definition accurately describes the underlying data. Consequently, when changing the structure of a non-SQL-defined database, it is the administrator's responsibility to ensure that all SQL statements impacted by the change are recompiled. If dynamic SQL caching is not used, then this entails recompiling access modules that reference the affected database. If dynamic SQL caching is used, then it also entails purging the cache of statements that reference the affected database. This can be done by deleting rows from the SYSCA.DSCCACHE or SYSCA.DSCCACHEV tables.

Note: For more information about these tables, see the *CA IDMS SQL Reference Guide*.

It is also recommended that dynamic SQL caching be disabled during the transition period in which the definitional changes are being implemented. For information on how to do this, see Controlling the Cache (see page 201).

CA IDMS will detect the need to recompile cached SQL statements if a change is made to the referencing SQL schema through which a non-SQL-defined schema is referenced. It does this by comparing the update stamp of the referencing SQL schema to the compile stamp of the cached statement.

Controlling the Cache

There are various ways that an individual user and a DBA can control dynamic SQL caching. Three ways are discussed following:

- Establishing caching attributes for an individual SQL session by issuing a SET SESSION statement
- Establishing default caching attributes for a central version through a system generation SQL CACHE statement
- Establishing default caching attributes for a local mode job by specifying a SYSIDMS SQL_CACHE_ENTRIES parameter.

Note: For more information about the SET SESSION statement, the various tables that control caching and examples of how to display and control the cache using SQL, see the *CA IDMS SQL Reference Guide*. For more information about the SQL CACHE system generation statement, see the *CA IDMS System Generation Guide*. For more information about SYSIDMS parameter SQL_CACHE_ENTRIES, see the *CA IDMS Common Facilities Guide*.

Appendix A: Sample JCL

Sample JCL or commands for executing the precompile, access module creation, compile, and link edit steps on four operating systems are provided in this section.

This section contains the following topics:

z/OS

The following sample JCL streams contain the steps required to make a host language source program with embedded SQL into the form of executable modules. The first example is for execution under the central version, and the second example is for execution in local mode.

The host language for the examples is COBOL 1. Change the specification of precompiler name, precompiler options, and compiler name according to the host language and version of your program.

Following the second example is a table that gives the meaning of variables used in the examples.

Central Version JCL

```
//*****************************************************************
//**                  PRECOMPILE COBOL PROGRAM                   **
//*****************************************************************
//precomp  EXEC PGM=IDMSDMLC,REGION=1024K,
//             PARM='optional precompiler parameters'
//STEPLIB  DD   DSN=idms.dba.loadlib,DISP=SHR
//         DD   DSN=idms.loadlib,DISP=SHR
//sysctl   DD   DSN=idms.sysctl,DISP=SHR
//dcmsg    DD   DSN=idms.sysmsg.ddldcmsg,DISP=SHR

//SYS001   DD   UNIT=disk,SPACE=(TRK,(10,10))
//SYS002   DD   UNIT=disk,SPACE=(TRK,(10,10))
//SYS003   DD   UNIT=disk,SPACE=(TRK,(10,10))
//SYSPCH   DD   DSN=&.&.source,DISP=(NEW,PASS),
//             UNIT=disk,SPACE=(TRK,(10,5),RLSE),
//             DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)
//SYSLST   DD   SYSOUT=A
//SYSIDMS  DD   *
```

```
DMCL=dmcl-name
DICTNAME=dictionary-name
Additional SYSIDMS parameters, as appropriate

/*
//SYSIPT   DD   *
Host language source statements with embedded SQL
/*
//*****************************************************************
//**                  CREATE ACCESS MODULE                       **
//*****************************************************************

//accmod   EXEC PGM=IDMSBCF,REGION=1024K
//STEPLIB  DD   DSN=idms.dba.loadlib,DISP=SHR
//         DD   DSN=idms.loadlib,DISP=SHR
//sysctl   DD   DSN=idms.sysctl,DISP=SHR
//dcmsg    DD   DSN=idms.sysmsg.ddldcmsg,DISP=SHR
//SYSLST   DD   SYSOUT=A
//SYSIDMS  DD   *
DMCL=dmcl-name
DICTNAME=dictionary-name
Additional SYSIDMS parameters, as appropriate

/*
//SYSIPT   DD   *
CREATE ACCESS MODULE statement ;
COMMIT WORK RELEASE ;
/*
//*****************************************************************
//**                  COMPILE COBOL PROGRAM                      **
//*****************************************************************
//compile   EXEC PGM=IKFCBL00,REGION=240K,
//             PARM='DECK,NOLOAD,NOLIB,BUF=500000,SIZE=150K'

//STEPLIB  DD   DSN=sys1.cobol.linklib,DISP=SHR
//SYSUT1   DD   UNIT=disk,SPACE=(TRK,(10,5))
//SYSUT2   DD   UNIT=disk,SPACE=(TRK,(10,5))
//SYSUT3   DD   UNIT=disk,SPACE=(TRK,(10,5))
//SYSUT4   DD   UNIT=disk,SPACE=(TRK,(10,5))
//SYSPUNCH DD   DSN=&.&.object,DISP=(NEW,PASS),
//             UNIT=disk,SPACE=(TRK,(10,5),RLSE),
//             DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)
```

```
//SYSPRINT DD   SYSOUT=A
//SYSIN    DD   DSN=&.&.source,DISP=(OLD,DELETE)

//*****************************************************************
//**                  LINK PROGRAM MODULE                        **
//*****************************************************************
//link     EXEC PGM=IEWL,REGION=300K,PARM='LET,LIST,XREF'
//SYSUT1   DD   UNIT=disk,SPACE=(TRK,(20,5))
//SYSLIB   DD   DSN=sys1.coblib,DISP=SHR
//loadlib  DD   DSN=idms.loadlib,DISP=SHR
//SYSLMOD  DD   DSN=user.loadlib,DISP=SHR

//SYSPRINT DD   SYSOUT=A
//SYSLIN   DD   DSN=&.&.object,DISP=(OLD,DELETE)
//         DD   *
 INCLUDE loadlib(IDMS)          <---------- Non-CICS only
 INCLUDE loadlib(IDMSCINT)      <---------- CICS only
 ENTRY   userentry
 NAME    userprog(R)
/*
//*
```

Local Mode JCL

```
//*****************************************************************
//**                  PRECOMPILE COBOL PROGRAM                   **
//*****************************************************************
//precomp  EXEC PGM=IDMSDMLC,REGION=1024K,
//             PARM='precompiler parameters'
//STEPLIB  DD   DSN=idms.dba.loadlib,DISP=SHR
//         DD   DSN=idms.loadlib,DISP=SHR
//dictb    DD   DSN=idms.appldict.ddldml,DISP=SHR
//dloddb   DD   DSN=idms.appldict.ddldclod,DISP=SHR
//sqldd    DD   DSN=idms.syssql.ddlcat,DISP=SHR
//sqlxdd   DD   DSN=idms.syssql.ddlcatx,DISP=SHR
//sqllod   DD   DSN=idms.syssql.ddlcatl,DISP=SHR

//dcmsg    DD   DSN=idms.sysmsg.ddldcmsg,DISP=SHR
//sysjrnl  DD   DSN=idms.tapejrnl,DISP=(NEW,CATLG,UNIT=tape
//SYS001   DD   UNIT=disk,SPACE=(TRK,(10,10))
//SYS002   DD   UNIT=disk,SPACE=(TRK,(10,10))
//SYS003   DD   UNIT=disk,SPACE=(TRK,(10,10))
//SYSPCH   DD   DSN=&.&.source,DISP=(NEW,PASS,DELETE),
//             UNIT=disk,SPACE=(TRK,(10,5),RLSE),
//             DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)
//SYSLST   DD   SYSOUT=A
```

```
//SYSIDMS  DD   *
DMCL=dmcl-name
DICTNAME=dictionary-name
Additional SYSIDMS parameters, as appropriate
/*
//SYSIPT   DD   *
Host language source statements with embedded SQL
/*
//*****************************************************************
//**                  CREATE ACCESS MODULE                       **
//*****************************************************************

//accmod   EXEC PGM=IDMSBCF,REGION=1024K
//STEPLIB  DD   DSN=idms.dba.loadlib,DISP=SHR
//         DD   DSN=idms.loadlib,DISP=SHR
//dictb    DD   DSN=idms.appldict.ddldml,DISP=SHR
//dloddb   DD   DSN=idms.appldict.ddldclod,DISP=SHR
//sqldd    DD   DSN=idms.syssql.ddlcat,DISP=SHR
//sqlxdd   DD   DSN=idms.syssql.ddlcatx,DISP=SHR
//sqllod   DD   DSN=idms.syssql.ddlcatl,DISP=SHR
//dcmsg    DD   DSN=idms.sysmsg.ddldcmsg,DISP=SHR
//sysjrnl  DD   DSN=idms.tapejrnl,DISP=(NEW,CATLG,UNIT=tape

//SYSLST   DD   SYSOUT=A
//SYSIDMS  DD   *
DMCL=dmcl-name
DICTNAME=dictionary-name
Additional SYSIDMS parameters, as appropriate
/*
//SYSIPT   DD   *
CREATE ACCESS MODULE statement ;
COMMIT WORK RELEASE ;
/*

//*****************************************************************
//**                  COMPILE COBOL PROGRAM                      **
//*****************************************************************
//compile  EXEC PGM=IKFCBL00,REGION=240K,
//            PARM='DECK,NOLOAD,NOLIB,BUF=500000,SIZE=150K'
//STEPLIB  DD   DSN=sys1.cobol.linklib,DISP=SHR
//SYSUT1   DD   UNIT=disk,SPACE=(TRK,(10,5))
//SYSUT2   DD   UNIT=disk,SPACE=(TRK,(10,5))
//SYSUT3   DD   UNIT=disk,SPACE=(TRK,(10,5))
```

```
//SYSUT4   DD   UNIT=disk,SPACE=(TRK,(10,5))
//SYSPUNCH DD   DSN=&.&.object,DISP=(NEW,PASS,DELETE),
//             UNIT=disk,SPACE=(TRK,(10,5),RLSE),
//             DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)
//SYSPRINT DD   SYSOUT=A
//SYSIN    DD   DSN=&.&.source,DISP=(OLD,DELETE)
//*****************************************************************
//**                  LINK PROGRAM MODULE                        **
//*****************************************************************

//link     EXEC PGM=IEWL,REGION=300K,PARM='LET,LIST,XREF'
//SYSUT1   DD   UNIT=disk,SPACE=(TRK,(20,5))
//SYSLIB   DD   DSN=sys1.coblib,DISP=SHR
//loadlib  DD   DSN=idms.loadlib,DISP=SHR
//SYSLMOD  DD   DSN=user.loadlib,DISP=SHR
//SYSPRINT DD   SYSOUT=A
//SYSLIN   DD   DSN=&.&.object,DISP=(OLD,DELETE)

//         DD   *
 INCLUDE loadlib(IDMS)          <-------------- Non-CICS only
 INCLUDE loadlib(IDMSCINT)      <-------------- CICS only
 ENTRY   userentry
 NAME    userprog(R)
/*
//*
```

Note: The link of CICS application programs that use IDMSCINT must incorporate JCL to resolve external reference DFHEI1. The particular JCL depends on the nature and language of your application. For more information, see the appropriate IBM CICS application programming documentation.

Variable Definitions

Variable	Definition
accmod	Stepname for batch Command Facility execution of the CREATE ACCESS MODULE statement
compile	Stepname for the compile step
dcmsg	DDname of the system message area (DDLDCMSG)
dictb	DDname of the application dictionary definition area (DDLDML)
dictionary-name	Name of the dictionary containing the SQL definition areas
disk	Symbolic device name for workfiles
dloddb	DDname of the application dictionary definition load area (DDLDCLOD)

Variable	Definition
dmcl-name	Name of the DMCL
idms.appldict.ddldclod	Data set name of the application dictionary definition load area (DDLDCLOD)
idms.appldict.ddldml	Data set name of the application dictionary definition area (DDLDML)
idms.dba.loadlib	Data set name of the load library containing the DMCL and database name table load modules
idms.loadlib	Data set name of the load library containing the CA IDMS executable modules
idms.sysctl	Data set name of the SYSCTL file
idms.sysmsg.ddldcmsg	Data set name of the system message area (DDLDCMSG)
idms.syssql.ddlcat	Data set name of the SQL definition area (DDLCAT) of the application dictionary
idms.syssql.ddlcatl	Data set name of the SQL definition load area (DDLCATLOD) of the application dictionary
idms.syssql.ddlcatx	Data set name of the SQL definition index area (DDLCATX) of the application dictionary
idms.tapejrnl	Data set name of the tape journal file
loadlib	DDname of the load library containing the CA IDMS executable modules
precomp	Stepname for the precompile step
sqldd	DDname of the SQL definition area (DDLCAT) of the application dictionary
sqllod	DDname of the SQL definition load area (DDLCATLOD) of the application dictionary
sqlxdd	DDname of the SQL definition index area (DDLCATX) of the application dictionary
sysctl	DDname of the SYSCTL file
sysjrnl	DDname of the tape journal file
sys1.cobol.linklib	Data set name of the library containing the host language compiler module
sys1.coblib	Data set name of the library containing host language compiler subroutines
tape	Symbolic device name for tape journal file
userentry	Entry point for the user program

Variable	Definition
user.loadlib	Data set name of the load library containing executable modules for user programs
userprog	Name of the user program
&.&object.	Host language compiler output to be passed to the linkage editor
&.&source.	Precompiler output to be passed to the host language compiler

z/VSE

The following sample JCL stream contains the steps required to make a host language source program with embedded SQL into form of executable modules. Complete JCL for central version execution is presented, followed by modifications for local mode execution.

The host language for the examples is COBOL. Change the specification of precompiler name, precompiler options, and compiler name according to the host language and version of your program.

Following the sample JCL is a table that gives the meaning of variables used in the examples along with a set of usage notes.

Central Version JCL

```
*****************************************************************
**                  PRECOMPILE COBOL PROGRAM                   **
*****************************************************************
// EXEC PROC=IDMSLBLS
// DLBL     idmspch,temp.dmlc,0
// EXTENT   SYS020,nnnnnn,,,ssss,llll
// ASSGN    SYS020,DISK,VOL=nnnnnn,SHR
// EXEC     IDMSDMLC
Optional precompiler parameters
/*

DMCL=dmcl-name
DICTNAME=dictionary-name
Additional SYSIDMS parameters, as appropriate
/*
Host language source statements with embedded SQL
/*
*****************************************************************
**                  CREATE ACCESS MODULE                       **
*****************************************************************
```

```
// EXEC     IDMSBCF
DMCL=dmcl-name
DICTNAME=dictionary-name
Additional SYSIDMS parameters, as appropriate
/*
CREATE ACCESS MODULE statement ;
COMMIT WORK RELEASE ;
/*
*****************************************************************
**                  COMPILE COBOL PROGRAM                      **
*****************************************************************

// DLBL     IJSYSIN,temp.dmlc,0
// EXTENT   SYSIPT,nnnnnn
// ASSGN    SYSIPT,DISK,VOL=nnnnnn,SHR
// OPTION   CATAL,NODECK,NOSYM
// PHASE    userprog,*
// EXEC     FCOBOL
*****************************************************************
**                  LINK PROGRAM MODULE                        **

*****************************************************************
// CLOSE    SYSIPT,SYSRDR
INCLUDE IDMS                    <---------- Non-CICS only
INCLUDE IDMSCINT                <---------- CICS only
ENTRY(userentry)
// EXEC     LNKEDT
/*
```

Variable Definitions

Variable	Definition
dictionary-name	Name of the dictionary containing the SQL definitions
dmcl-name	Name of the DMCL
f	File number of the tape journal file
idmspch	Host language compiler output to be passed to the linkage editor
idms.tapejrnl	File ID of the tape journal file
llll	Number of tracks (CKD) or blocks (FBA) of disk extent
nnnnnn	Volume serial identifier of appropriate disk volume
ssss	Starting track (CKD) or block (FBA) of disk extent
sysjrnl	Filename of the tape journal file
temp.dmlc	File ID of the precompiler output

Variable	Definition
userentry	Entry point for the user program
userprog	Name of the user program

Local Mode JCL

To execute in local mode, add these statements to the precompile step:

```
// TLBL     sysjrnl,'idms.tapejrnl',nnnnnn,,f
// ASSGN    SYS009,TAPE,VOL=nnnnnn
```

Note: The link of CICS application programs that use IDMSCINT must incorporate JCL to resolve external reference DFHEI1. The particular JCL depends on the nature and language of your application. See the appropriate IBM CICS application programming documentation for details.

Usage

IDMSLBLS Procedure

IDMSLBLS is a procedure provided during a CA IDMS z/VSE installation. It contains file definitions for these CA IDMS components:

- Dictionaries
- Demonstration databases
- Disk journal files
- SYSIDMS file

Individual file definitions for these components do not appear in the sample JCL. The IDMSLBLS procedure should be tailored to reflect site-specific names and CA IDMS z/VSE job streams.

Logical Unit Assignments

These logical unit assignments appear in the sample JCL:

- SYS020—Precompiler output
- SYS009—Journal file (local mode)

COBOL Internal Sort

For programs that include a COBOL internal sort, place these statements in the compile step before the EXEC statement:

- ACTION NOAUTO—Prevents multiple inclusions of IDMS
- INCLUDE IDMS—IDMS interface for use with COMRG
- INCLUDE IDMSOPTI—IDMSOPTI module

  If IDMSOPTI is included, place this statement after the EXEC PROC=IDMSLBLS statement:

  `// UPSI b`

  where *b* is the appropriate one- through eight-character UPSI switch.
- INCLUDE IDMSCANC—For local mode, abort entry point

z/VM

The sample command sequence that follows contains the steps required to make a host language source program with embedded SQL into form of executable modules.

The host language for the example is COBOL. Change the specification of precompiler name, precompiler options, and compiler name according to the host language and version of your program.

Following the example is a table that gives the meaning of variables used in the examples and a set of usage notes.

Commands for Central Version Execution

```
/*****************************************************************/
/**                  PRECOMPILE COBOL PROGRAM                   **/
/*****************************************************************/

FILEDEF sysipt1 DISK program source a
FILEDEF sysidms1 DISK sysidms1 parms a
FILEDEF syspch DISK progname COBOL A3

FILEDEF SYSLST PRINTER
OSRUN IDMSDMLC PARM='optional precompiler parameters'

/*****************************************************************/
/**                  CREATE ACCESS MODULE                       **/
/*****************************************************************/
```

```
FILEDEF sysipt2 DISK create accmod a
FILEDEF sysidms2 DISK sysidms2 parms a
OSRUN IDMSBCF

/*****************************************************************/
/**                  COMPILE COBOL PROGRAM                      **/
/*****************************************************************/


FILEDEF TEXT DISK progname TEXT A3
COBOL progname (OSDECK APOST LIB
TXTLIB DEL utextlib progname
TXTLIB ADD utextlib progname

/*****************************************************************/
/**                  LINK PROGRAM MODULE                        **/
/*****************************************************************/


FILEDEF SYSLST PRINTER
FILEDEF SYSLMOD uloadlib LOADLIB A6 (RECFM V LRECL 1024 BLKSIZE 1024
FILEDEF objlib DISK utextlib TXTLIB a
FILEDEF SYSLIB DISK coblibvs TXTLIB p
LKED linkctl (LIST XREF LET MAP RENT NOTERM PRINT SIZE 512K 64K
```

Linkage editor control statements (in *linkctl*):

```
INCLUDE objlib(progname)
INCLUDE objlib1(IDMS)
ENTRY   progname
NAME    progname(R)
```

Variable Definitions

Variable	Definition
coblibvs *TEXTLIB* p	Filename, filetype, and filemode of the library that contains host language compiler modules
create accmod a	Filename of the file containing the CREATE ACCESS MODULE statement
linkctl	Filename of the file that contains the linkage editor control statements
loadlib	DDname of the load library containing the CA IDMS executable modules
objlib	DDname of the user object library

Variable	Definition
objlib1	DDname of the CA IDMS object library
program *COBOL A3*	Filename, filetype, and filemode of the precompiler output
progname	Name of the user program
program source a	Filename of the file containing the program source
sysidms1	DDname for the file of SYSIDMS parameters for the precompiler step
sysidms1 parms a	Filename of the file containing SYSIDMS parameters for the precompiler step
sysidms2	DDname for the file of SYSIDMS parameters for the step to create the access module
sysidms2 parms a	Filename of the file containing SYSIDMS parameters for the step to create the access module
sysipt1	DDname for the program source file
sysipt2	DDname for the file containing the CREATE ACCESS MODULE statement
syspch	DDname for the precompiler output
uloadlib *LOADLIB A6*	Filename, filetype, and filemode of the user load library
utextlib *TXTLIB* a	Filename, filetype, and filemode of the user text library

Usage

Local Mode

To specify that the precompiler is executing in local mode, perform one of the following:

- Link the program with an IDMSOPTI program that specifies local execution mode
- Specify *LOCAL* as the first input parameter of the filename, type and mode identified by idmspass input a in the IDMSFD exec.
- Modify the OSRUN statement:

  ```
  OSRUN IDMSDMCL PARM='*LOCAL*'
  ```

  Note: This option is valid only if the OSRUN command is issued from a System Product interpreter or an EXEC2 file.

A local mode job should contain file definitions to include the following in the precompile step and the step to create the access module:

Variable Definitions

Variable	Definition
dcmsg	DDname of the system message area (DDLDCMSG)
dictb	DDname of the application dictionary definition area (DDLDML)
dloddb	DDname of the application dictionary definition load area (DDLDCLOD)
idms.appldict.ddldclod	File name of the application dictionary definition load area (DDLDCLOD)
idms.appldict.ddldml	File name of the application dictionary definition area (DDLDML)
idms.sysmsg.ddldcmsg	File name of the system message area (DDLDCMSG)
idms.syssql.ddlcat	File name of the SQL definition area (DDLCAT) of the application dictionary
idms.syssql.ddlcatl	File name of the SQL definition load area (DDLCATLOD) of the application dictionary
idms.syssql.ddlcatx	File name of the SQL definition index area (DDLCATX) of the application dictionary
idms.tapejrnl	File name of the tape journal file
sqldd	DDname of the SQL definition area (DDLCAT) of the application dictionary
sqllod	DDname of the SQL definition load area (DDLCATLOD) of the application dictionary
sqlxdd	DDname of the SQL definition index area (DDLCATX) of the application dictionary
sysjrnl	DDname of the tape journal file

A local mode job should contain file definitions to include the following in the step to create the access module:

SYSIPT File

To create a sysipt file:

1. Type **XEDIT** *sysipt data a* **(NOPROF** on the z/VM command line and press Enter
2. Type **INPUT** on the XEDIT command line and press Enter
3. Type in the IDMSPASS input parameters in input mode
4. Press Enter to exit input mode
5. Type **FILE** on the XEDIT command line and press Enter

SYSIDMS File

To execute the precompiler and create the access module, you should include these SYSIDMS parameters:

- DMCL=*dmcl-name*, to identify the DMCL
- DICTNAME=*dictionary-name*, to identify the dictionary whose catalog component contains the database definitions

To create a file of SYSIDMS parameters:

1. Type **XEDIT** *sysidms data a* **(NOPROF** on the z/VM command line and press Enter
2. Type **INPUT** on the XEDIT command line and press Enter
3. Type in the SYSIDMS parameters in input mode
4. Press Enter to exit input mode
5. Type **FILE** on the XEDIT command line and press Enter

Note: For more information about documentation of SYSIDMS parameters,. see the *CA IDMS Common Facilities Guide*.

Appendix B: Test Database

Complete information about the data in the test database, supplied with CA IDMS, to which most of the sample programs in this guide refer, is presented in this section. You can use this information to develop SQL programs that access the test database.

This section contains the following topics:

Table Names and Descriptions

This section contains information for the following tables:

- ASSIGNMENT
- BENEFITS
- CONSULTANT
- COVERAGE
- DEPARTMENT
- DIVISION
- EMPLOYEE
- EXPERTISE
- INSURANCE_PLAN
- JOB
- POSITION
- PROJECT
- SKILL

ASSIGNMENT

EMP_ID	Employee ID
PROJ_ID	ID of project to which employee is assigned
START_DATE	Date employee was assigned to the project

END_DATE	Date employee completed work on the project

BENEFITS

FISCAL_YEAR	Fiscal year for which this data applies
EMP_ID	Employee ID
VAC_ACCRUED	Vacation **hours** accrued to date
VAC_TAKEN	Vacation **hours** taken to date
SICK_ACCRUED	Sick **days** accrued to date
SICK_TAKEN	Sick **days** taken to date
STOCK_PERCENT	Percentage of earnings allocated to stock purchase
STOCK_AMOUNT	Year-to-date amount deducted for stock purchase
LAST_REVIEW_DATE	Date of last employee review
REVIEW_PERCENT	Percent increase at last review
PROMO_DATE	Date of last promotion
RETIRE_PLAN	Retirement fund identifier: STOCK, BONDS, 401K
RETIRE_PERCENT	Percentage of earnings deducted for retirement
BONUS_AMOUNT	Amount of last bonus
COMP_ACCRUED	**Hours** of compensation time accrued
COMP_TAKEN	**Hours** of compensation time taken
EDUC_LEVEL	Level of education: GED, HSDIP, JRCOLL, COLL, MAS, PHD
UNION_ID	Union identification number
UNION_DUES	Amount of dues deducted **per pay period**

CONSULTANT

CON_ID	Unique consultant ID
CON_FNAME	Consultant's first name
CON_LNAME	Consultant's last name
MANAGER_ID	Employee ID of consultant's manager
DEPT_ID	ID of department to which consultant is assigned

PROJ_ID	ID of project to which consultant is assigned
STREET	Consultant's street address
CITY	Consultant's city
STATE	Consultant's state
ZIP_CODE	Consultant's zip code
PHONE	Consultant's phone
BIRTH_DATE	Birth date
START_DATE	Consultant's date of hire
SS_NUMBER	Social security number
RATE	Hourly rate of pay

COVERAGE

PLAN_CODE	Code of insurance plan providing the coverage
EMP_ID	Employee ID of employee having the coverage
SELECTION_DATE	Date employee selected this insurance plan
TERMINATION_DATE	Date employee terminated this insurance plan; if null, plan is still in force
NUM_DEPENDENTS	Number of **dependents** covered under this insurance plan

DEPARTMENT

DEPT_ID	Unique department ID
DEPT_HEAD_ID	Employee ID of department head
DIV_CODE	Code of the division to which this department belongs
DEPT_NAME	Department name

DIVISION

DIV_CODE	Unique division ID
DIV_HEAD_ID	Employee ID of division head

DIV_NAME	Division name

EMPLOYEE

EMP_ID	Unique employee ID
MANAGER_ID	Employee ID of employee's manager
EMP_FNAME	Employee's first name
EMP_LNAME	Employee's last name
DEPT_ID	ID of department to which employee is assigned
STREET	Employee's street address
CITY	Employee's city
STATE	Employee's state
ZIP_CODE	Employee's zip code
PHONE	Employee's phone
STATUS	Status of employee: (A) Active; (S) Short-term disability; (L) Long term disability
SS_NUMBER	Social security number
START_DATE	Employee's date of hire
TERMINATION_DATE	Date of termination
BIRTH_DATE	Birth date

EXPERTISE

EMP_ID	Employee ID
SKILL_ID	Skill ID
SKILL_LEVEL	Level of ability in this skill: 01 (low) to 04 (high)
EXP_DATE	Date this level of ability was achieved

INSURANCE_PLAN

PLAN_CODE	Unique plan code for company offering the insurance

COMP_NAME	Name of insurance company
STREET	Street address of insurance company
CITY	City address of insurance company
STATE	State address of insurance company
ZIP_CODE	Zip code of insurance company
PHONE	Telephone number of insurance company
GROUP_NUMBER	Commonwealth's group number for this insurance company
DEDUCT	Dollar amount deductible **per year** for this insurance plan
MAX_LIFE_BENEFIT	Maximum dollar amount to be paid to insured employee
FAMILY_COST	Amount deducted **per paycheck** for family coverage
DEP_COST	Additional amount deducted per paycheck per dependent
EFF_DATE	Date this coverage plan became effective

JOB

JOB_ID	Unique job ID
JOB_TITLE	Job title
MIN_RATE	Minimum salary/hourly rate for this job
MAX_RATE	Maximum salary/hourly rate for this job
SALARY_IND	Indicator for type of salary: (S) salaried; (H) hourly
NUM_OF_POSITIONS	Total number of positions for this job
NUM_OPEN	Number of positions currently open
EFF_DATE	Date this job became effective
JOB_DESLINE_1	First line of job description
JOB_DESLINE_2	Second line of job description

POSITION

EMP_ID	Employee ID
JOB_ID	Job ID associated with this employee
START_DATE	Date employee began this job

FINISH_DATE	Date employee ended this job (null if current)
HOURLY_RATE	Hourly rate earned while in this job (if hourly position)
SALARY_AMOUNT	Yearly salary earned while in this job (if salaried position)
BONUS_PERCENT	Bonus percent amount for this position (if sales position)
COMM_PERCENT	Commission percent for this position (if sales position)
OVERTIME_RATE	Overtime rate for this position (if hourly position)

PROJECT

PROJ_ID	Unique project ID
PROJ_LEADER_ID	Employee ID of project leader
EST_START_DATE	Estimated date project is to begin
EST_END_DATE	Estimated date project is to end
ACT_START_DATE	Actual date project began
ACT_END_DATE	Actual date project ended
EST_MAN_HOURS	Total number of hours estimated for project
ACT_MAN_HOURS	Actual number of hours required for project
PROJ_DESC	Project description

SKILL

SKILL_ID	Unique skill ID
SKILL_NAME	Skill name
SKILL_DESC	Skill description

Test Data

This section lists the test data stored in the test database for the following:

- Departments
- Divisions

- Insurance Plans
- Jobs
- Projects
- Skills

Departments

Code	Name	Division code	Head ID
3510	Appraisal - Used cars	D02	3082
2200	Sales - Used cars	D02	2180
1100	Purchasing - Used cars	D02	2246
3520	Appraisal - New cars	D04	3769
2210	Sales - New cars	D04	2010
4200	Leasing - New cars	D04	1003
1110	Purchasing - New cars	D04	1765
1120	Purchasing - Service	D06	2004
4600	Maintenance	D06	2096
3530	Appraisal - Service	D06	2209
5100	Billing	D06	2598
6200	Corporate Administration	D09	2461
5200	Corporate Marketing	D09	2894
5000	Corporate Accounting	D09	2466
4900	MIS	D09	2466
6000	Legal	D09	1003
4500	Human Resources	D09	3222

Divisions

Division code	Division name	Head ID
D02	Used cars	2180
D04	New cars	2010

Division code	Division name	Head ID
D06	Service	4321
D09	Corporate	1003

Insurance Plans

Plan ID	Name
PLI	Providential Life Insurance
HHM	Homeostasis Health Maintenance Program
HGH	Holistic Group Health Association
DAS	Dental Associates

Jobs

Job ID	Name	Minimum salary	Maximum salary	Salaried/ hourly	No.
8001	Vice president	90000	136000	S	1
4023	Accountant	44000	120000	S	1
2051	AP Clerk	8.80	14.60	H	2
2053	AR Clerk	8.80	14.60	H	3
2077	Purch Clerk	17000	30000	S	3
3029	Computer Operator	25500	44000	S	1
3051	Data Entry Clerk	8.50	11.45	H	1
6011	Manager - Acctng	59400	121000	S	1
4560	Mechanic	11.45	21.00	H	7
4666	Sr Mechanic	41000	91000	S	1
4734	Mkting Admin	25000	62000	S	2
3333	Sales Trainee	21600	39000	S	4
5555	Salesperson	30000	79500	S	9
6004	Manager - HR	66000	138000	S	1
6021	Manager - Mktng	76000	150000	S	1

Job ID	Name	Minimum salary	Maximum salary	Salaried/ hourly	No.
2055	PAYROLL CLERK	17000	30000	S	1
4025	Writer - Mktng	31000	50000	S	1
9001	President	111000	190000	S	1
4123	Recruiter	35000	56000	S	1
4130	Benefits Analyst	35000	56000	S	1
4012	Admin Asst	21000	44000	S	4
5111	CUST SER REP	27000	54000	S	4
4700	Purch Agent	33000	60000	S	5
5890	Appraisal Spec	45000	70000	S	5
5110	CUST SERVICE MGR	40000	108000	S	1

Projects

Project ID	Description
P634	TV ads - WTVK
C200	New brand research
P400	Christmas media
C203	Consumer study
C240	Service study
D880	System analysis

Skills

Skill ID	Name
4444	Assembly
3333	Bodywork
3088	Brake work
3065	Electronics
1030	Acct Mgt

Skill ID	Name
5130	Basic math
5160	Calculus
4250	Data entry
4370	Filing
5200	General Acctng
5500	General Mktng
5430	Mktng Writing
5420	Writing
4490	Gen Ledger
4430	Interviewing
1000	Management
4420	Telephone
5180	Statistics
4410	Typing
5309	Appraising
6770	Purchasing
7000	Sales
6666	Billing
6650	Diesel Engine Repair
6670	Gas Engine Repair
6470	Window Installation

Test Database DDL

This section contains the SQL DDL that creates the demonstration database provided with the installation of CA IDMS.

```
*********************************************************************
*  Create schema for the following tables.  Then set session qualifier
*  for that schema
*********************************************************************
   CREATE SCHEMA DEMOEMPL;
   SET SESSION CURRENT SCHEMA DEMOEMPL;
*********************************************************************
*  Create the tables that belong to the schema DEMOEMPL.  Each
*  table is associated with an area in the segment DEMOEMPL.
*********************************************************************

   CREATE TABLE         BENEFITS
  (FISCAL_YEAR          UNSIGNED NUMERIC(4,0)         NOT NULL,
   EMP_ID               UNSIGNED NUMERIC(4,0)         NOT NULL,
   VAC_ACCRUED          UNSIGNED DECIMAL(6,2)   NOT NULL WITH DEFAULT,
   VAC_TAKEN            UNSIGNED DECIMAL(6,2)   NOT NULL WITH DEFAULT,
   SICK_ACCRUED         UNSIGNED DECIMAL(6,2)   NOT NULL WITH DEFAULT,
   SICK_TAKEN           UNSIGNED DECIMAL(6,2)   NOT NULL WITH DEFAULT,
   STOCK_PERCENT        UNSIGNED DECIMAL(6,3)   NOT NULL WITH DEFAULT,
   STOCK_AMOUNT         UNSIGNED DECIMAL(10,2) NOT NULL WITH DEFAULT,

   LAST_REVIEW_DATE     DATE                            ,
   REVIEW_PERCENT       UNSIGNED DECIMAL(6,3)          ,
   PROMO_DATE           DATE                           ,
   RETIRE_PLAN          CHAR(6)                        ,
   RETIRE_PERCENT       UNSIGNED DECIMAL(6,3)          ,
   BONUS_AMOUNT         UNSIGNED DECIMAL(10,2)        ,
   COMP_ACCRUED         UNSIGNED DECIMAL(6,2)   NOT NULL WITH DEFAULT,
   COMP_TAKEN           UNSIGNED DECIMAL(6,2)   NOT NULL WITH DEFAULT,

   EDUC_LEVEL           CHAR(06)                         ,
   UNION_ID             CHAR(10)                         ,
   UNION_DUES           UNSIGNED DECIMAL(10,2)           ,
   CHECK ( (RETIRE_PLAN IN ('STOCK', 'BONDS', '401K') ) AND
           (EDUC_LEVEL IN ('GED', 'HSDIP', 'JRCOLL', 'COLL',
            'MAS', 'PHD') ) ) )
      IN SQLDEMO.EMPLAREA;

*********************************************************************
```

```
   CREATE TABLE         COVERAGE
  (PLAN_CODE         CHAR(03)                              NOT NULL,
   EMP_ID            UNSIGNED NUMERIC(4,0)                 NOT NULL,
   SELECTION_DATE    DATE                       NOT NULL WITH DEFAULT,
   TERMINATION_DATE  DATE                                          ,
   NUM_DEPENDENTS    UNSIGNED NUMERIC(2,0)      NOT NULL WITH DEFAULT)
      IN SQLDEMO.EMPLAREA;

*********************************************************************

   CREATE TABLE         DEPARTMENT
  (DEPT_ID           UNSIGNED NUMERIC(4,0)      NOT NULL,
   DEPT_HEAD_ID      UNSIGNED NUMERIC(4,0)               ,
   DIV_CODE          CHAR(03)                   NOT NULL,
   DEPT_NAME         CHAR(40)                   NOT NULL)
      IN SQLDEMO.INFOAREA;
*********************************************************************

*********************************************************************

   CREATE TABLE         DIVISION
  (DIV_CODE          CHAR(03)                 NOT NULL,
   DIV_HEAD_ID       UNSIGNED NUMERIC(4,0)             ,
   DIV_NAME          CHAR(40)                 NOT NULL)
      IN SQLDEMO.INFOAREA;

*********************************************************************

   CREATE TABLE         EMPLOYEE
  (EMP_ID            UNSIGNED NUMERIC(4,0)       NOT NULL,

   MANAGER_ID        UNSIGNED NUMERIC(4,0)                ,
   EMP_FNAME         CHAR(20)                    NOT NULL,
   EMP_LNAME         CHAR(20)                    NOT NULL,
   DEPT_ID           UNSIGNED NUMERIC(4,0)       NOT NULL,
   STREET            CHAR(40)                    NOT NULL,
   CITY              CHAR(20)                    NOT NULL,
   STATE             CHAR(02)                    NOT NULL,
```

```
   ZIP_CODE            CHAR(09)                    NOT NULL,
   PHONE               CHAR(10)                            ,
   STATUS              CHAR                        NOT NULL,
   SS_NUMBER           UNSIGNED NUMERIC(9,0)       NOT NULL,
   START_DATE          DATE                        NOT NULL,
   TERMINATION_DATE    DATE                                ,
   BIRTH_DATE          DATE                                ,
   CHECK ( ( EMP_ID <= 8999 ) AND (STATUS IN ('A', 'S', 'L', 'T') ) ) )
      IN SQLDEMO.EMPLAREA;

*********************************************************************

  CREATE TABLE         INSURANCE_PLAN
 (PLAN_CODE            CHAR(03)                NOT NULL,
  COMP_NAME            CHAR(40)                NOT NULL,
  STREET               CHAR(40)                NOT NULL,
  CITY                 CHAR(20)                NOT NULL,
  STATE                CHAR(02)                NOT NULL,
  ZIP_CODE             CHAR(09)                NOT NULL,

  PHONE                CHAR(10)                NOT NULL,
  GROUP_NUMBER         UNSIGNED NUMERIC(4,0)   NOT NULL,
  DEDUCT               UNSIGNED DECIMAL(9,2)           ,
  MAX_LIFE_BENEFIT     UNSIGNED DECIMAL(9,2)           ,
  FAMILY_COST          UNSIGNED DECIMAL(9,2)           ,
  DEP_COST             UNSIGNED DECIMAL(9,2)           ,
  EFF_DATE             DATE                    NOT NULL)
      IN SQLDEMO.INFOAREA;

*********************************************************************

   CREATE TABLE         JOB
  (JOB_ID               UNSIGNED NUMERIC(4,0)       NOT NULL,
   JOB_TITLE            CHAR(20)                    NOT NULL,
   MIN_RATE             UNSIGNED DECIMAL(10,2)              ,
   MAX_RATE             UNSIGNED DECIMAL(10,2)              ,
   SALARY_IND           CHAR(01)                            ,
   NUM_OF_POSITIONS     UNSIGNED DECIMAL(4,0)               ,
```

```
   EFF_DATE            DATE                              ,
   JOB_DESC_LINE_1     VARCHAR(60)                       ,
   JOB_DESC_LINE_2     VARCHAR(60)                       ,
   CHECK ( SALARY_IND IN ('S', 'H') ) )
      IN SQLDEMO.INFOAREA;

*********************************************************************

   CREATE TABLE        POSITION
  (EMP_ID              UNSIGNED NUMERIC(4,0)        NOT NULL,

   JOB_ID              UNSIGNED NUMERIC(4,0)        NOT NULL,
   START_DATE          DATE                         NOT NULL,
   FINISH_DATE         DATE                                 ,
   HOURLY_RATE       UNSIGNED   DECIMAL(7,2)                ,
   SALARY_AMOUNT     UNSIGNED   DECIMAL(10,2)               ,
   BONUS_PERCENT     UNSIGNED   DECIMAL(7,3)                ,
   COMM_PERCENT      UNSIGNED   DECIMAL(7,3)                ,
   OVERTIME_RATE     UNSIGNED   DECIMAL(5,2)                ,
   CHECK ( (HOURLY_RATE IS NOT NULL AND SALARY_AMOUNT IS NULL)

      OR (HOURLY_RATE IS NULL AND SALARY_AMOUNT IS NOT NULL) ) )
      IN SQLDEMO.EMPLAREA;

*********************************************************************

*********************************************************************

   CREATE SCHEMA  DEMOPROJ;
   SET SESSION CURRENT SCHEMA DEMOPROJ;

*********************************************************************

*  Create the tables that belong to the schema DEMOPROJ.  Each
*  table is associated with an area in the segment PROJSEG.
*********************************************************************

   CREATE TABLE        ASSIGNMENT
  (EMP_ID            UNSIGNED NUMERIC(4,0)       NOT NULL,
   PROJ_ID           CHAR(10)                    NOT NULL,
   START_DATE        DATE                        NOT NULL,
   END_DATE          DATE                                )
      IN  PROJSEG.PROJAREA;
```

```
************************************************************************

   CREATE TABLE         CONSULTANT
  (CON_ID               UNSIGNED NUMERIC(4,0)       NOT NULL,
   CON_FNAME            CHAR(20)                    NOT NULL,
   CON_LNAME            CHAR(20)                    NOT NULL,
   MANAGER_ID           UNSIGNED NUMERIC(4,0)       NOT NULL,
   DEPT_ID              UNSIGNED NUMERIC(4,0)       NOT NULL,
   PROJ_ID              CHAR(10)                            ,
   STREET               CHAR(40)                            ,
   CITY                 CHAR(20)                    NOT NULL,

   STATE                CHAR(02)                    NOT NULL,
   ZIP_CODE             CHAR(09)                    NOT NULL,
   PHONE                CHAR(10)                            ,
   BIRTH_DATE           DATE                                ,
   START_DATE           DATE                        NOT NULL,
   SS_NUMBER            UNSIGNED NUMERIC(9,0)       NOT NULL,
   RATE                 UNSIGNED DECIMAL(7,2)               ,
   CHECK ( (CON_ID >= 9000 AND CON_ID <= 9999) ) )
      IN PROJSEG.PROJAREA;

************************************************************************


   CREATE TABLE         EXPERTISE
  (EMP_ID               UNSIGNED NUMERIC(4,0)       NOT NULL,
   SKILL_ID             UNSIGNED NUMERIC(4,0)       NOT NULL,
   SKILL_LEVEL          CHAR(02)                            ,
   EXP_DATE             DATE                                )
      IN PROJSEG.PROJAREA;

************************************************************************

************************************************************************


   CREATE TABLE         PROJECT
  (PROJ_ID              CHAR(10)                  NOT NULL,
   PROJ_LEADER_ID       UNSIGNED NUMERIC(4,0)             ,
   EST_START_DATE       DATE                              ,
   EST_END_DATE         DATE                              ,
   ACT_START_DATE       DATE                              ,
   ACT_END_DATE         DATE                              ,
   EST_MAN_HOURS        UNSIGNED DECIMAL(7,2)             ,
```

```
   ACT_MAN_HOURS        UNSIGNED DECIMAL(7,2)              ,
   PROJ_DESC            VARCHAR(60)                NOT NULL)
      IN PROJSEG.PROJAREA;

*********************************************************************

   CREATE TABLE         SKILL
  (SKILL_ID             UNSIGNED NUMERIC(4,0)       NOT NULL,
   SKILL_NAME           CHAR(20)                    NOT NULL,
   SKILL_DESC           VARCHAR(60)                          )

      IN PROJSEG.PROJAREA;

*********************************************************************
*  Name calc keys for above tables (in order that they were defined)
*********************************************************************
   CREATE UNIQUE CALC KEY ON DEMOEMPL.DEPARTMENT(DEPT_ID);

   CREATE UNIQUE CALC KEY ON DEMOEMPL.DIVISION(DIV_CODE);

   CREATE UNIQUE CALC KEY ON DEMOEMPL.EMPLOYEE(EMP_ID);

   CREATE UNIQUE CALC KEY ON DEMOEMPL.INSURANCE_PLAN(PLAN_CODE);


   CREATE UNIQUE CALC KEY ON DEMOEMPL.JOB(JOB_ID);

   CREATE UNIQUE CALC KEY ON DEMOPROJ.CONSULTANT(CON_ID);

   CREATE UNIQUE CALC KEY ON DEMOPROJ.PROJECT(PROJ_ID);

   CREATE UNIQUE CALC KEY ON DEMOPROJ.SKILL(SKILL_ID);

*********************************************************************

*  Create unique indexes for tables in order in which they were defined
*********************************************************************
  CREATE UNIQUE INDEX AS_EMPROJ_NDX ON
         DEMOPROJ.ASSIGNMENT(EMP_ID,PROJ_ID);

  CREATE UNIQUE INDEX EX_EMPSKILL_NDX ON
         DEMOPROJ.EXPERTISE(EMP_ID, SKILL_ID);

*********************************************************************
```

```
*  Create nonunique indexes for tables in order in which they
*  were defined
*****************************************************************
   CREATE INDEX CO_CODE_NDX ON DEMOEMPL.COVERAGE(PLAN_CODE)
         IN SQLDEMO.INDXAREA;

   CREATE INDEX DE_CODE_NDX ON DEMOEMPL.DEPARTMENT(DIV_CODE);

   CREATE INDEX DI_HEAD_NDX ON DEMOEMPL.DIVISION(DIV_HEAD_ID);

   CREATE INDEX DE_HEAD_NDX ON DEMOEMPL.DEPARTMENT(DEPT_HEAD_ID);


   CREATE INDEX EM_MANAGER_NDX ON DEMOEMPL.EMPLOYEE(MANAGER_ID)
         IN SQLDEMO.INDXAREA;

   CREATE INDEX EM_NAME_NDX ON DEMOEMPL.EMPLOYEE(EMP_LNAME, EMP_FNAME)
         IN SQLDEMO.INDXAREA;

   CREATE INDEX EM_DEPT_NDX ON DEMOEMPL.EMPLOYEE(DEPT_ID)
         IN SQLDEMO.INDXAREA;


   CREATE INDEX IN_NAME_NDX ON DEMOEMPL.INSURANCE_PLAN(COMP_NAME)
          COMPRESSED;

   CREATE INDEX PO_JOB_NDX ON DEMOEMPL.POSITION(JOB_ID)
         IN SQLDEMO.INDXAREA;

   CREATE INDEX CN_NAME_NDX
          ON DEMOPROJ.CONSULTANT(CON_LNAME,CON_FNAME);

*****************************************************************

*  Create referential constraints
*****************************************************************

   CREATE CONSTRAINT EMP_BENEFITS
          DEMOEMPL.BENEFITS  (EMP_ID)  REFERENCES
          DEMOEMPL.EMPLOYEE  (EMP_ID)
               LINKED CLUSTERED
               ORDER BY (FISCAL_YEAR DESC);

   CREATE CONSTRAINT INSPLAN_COVERAGE
```

```
        DEMOEMPL.COVERAGE        (PLAN_CODE)  REFERENCES
        DEMOEMPL.INSURANCE_PLAN  (PLAN_CODE)
             UNLINKED;

CREATE CONSTRAINT EMP_COVERAGE
        DEMOEMPL.COVERAGE  (EMP_ID) REFERENCES
        DEMOEMPL.EMPLOYEE  (EMP_ID)
             LINKED CLUSTERED
             ORDER BY ( PLAN_CODE) UNIQUE;

CREATE CONSTRAINT DIVISION_DEPT

        DEMOEMPL.DEPARTMENT  (DIV_CODE)  REFERENCES
        DEMOEMPL.DIVISION    (DIV_CODE)
             UNLINKED;

CREATE CONSTRAINT EMP_DEPT_HEAD
        DEMOEMPL.DEPARTMENT  (DEPT_HEAD_ID)  REFERENCES
        DEMOEMPL.EMPLOYEE    (EMP_ID)
             UNLINKED;

CREATE CONSTRAINT EMP_DIV_HEAD

        DEMOEMPL.DIVISION  (DIV_HEAD_ID)  REFERENCES
        DEMOEMPL.EMPLOYEE  (EMP_ID)
        UNLINKED;

CREATE CONSTRAINT DEPT_EMPLOYEE
        DEMOEMPL.EMPLOYEE   (DEPT_ID)  REFERENCES
        DEMOEMPL.DEPARTMENT (DEPT_ID)
        UNLINKED;

CREATE CONSTRAINT MANAGER_EMP

        DEMOEMPL.EMPLOYEE  (MANAGER_ID)  REFERENCES
        DEMOEMPL.EMPLOYEE  (EMP_ID)
        UNLINKED;

CREATE CONSTRAINT SKILL_EXPERTISE
        DEMOPROJ.EXPERTISE  (SKILL_ID)  REFERENCES
        DEMOPROJ.SKILL      (SKILL_ID)
             LINKED CLUSTERED;

CREATE CONSTRAINT EMP_POSITION
        DEMOEMPL.POSITION  (EMP_ID)  REFERENCES
```

```
        DEMOEMPL.EMPLOYEE  (EMP_ID)
             LINKED CLUSTERED
             ORDER BY (JOB_ID) UNIQUE;

   CREATE CONSTRAINT JOB_POSITION
        DEMOEMPL.POSITION  (JOB_ID)  REFERENCES
        DEMOEMPL.JOB       (JOB_ID)
             UNLINKED;

   CREATE CONSTRAINT PROJECT_ASSIGN

        DEMOPROJ.ASSIGNMENT  (PROJ_ID)  REFERENCES
        DEMOPROJ.PROJECT   (PROJ_ID)
             LINKED CLUSTERED;

   CREATE CONSTRAINT PROJECT_CONSULT
        DEMOPROJ.CONSULTANT  (PROJ_ID)  REFERENCES
        DEMOPROJ.PROJECT     (PROJ_ID)
             LINKED INDEX
             ORDER BY (PROJ_ID);


**********************************************************************
*  Alter tables to remove default indexes as necessary
**********************************************************************
   ALTER TABLE DEMOEMPL.COVERAGE
        DROP DEFAULT INDEX;

   ALTER TABLE DEMOEMPL.DEPARTMENT
        DROP DEFAULT INDEX;

   ALTER TABLE DEMOEMPL.DIVISION

        DROP DEFAULT INDEX;

   ALTER TABLE DEMOEMPL.EMPLOYEE
        DROP DEFAULT INDEX;

   ALTER TABLE DEMOEMPL.INSURANCE_PLAN
        DROP DEFAULT INDEX;

   ALTER TABLE DEMOEMPL.POSITION
```

```
        DROP DEFAULT INDEX;

   ALTER TABLE DEMOPROJ.ASSIGNMENT
        DROP DEFAULT INDEX;

   ALTER TABLE DEMOPROJ.CONSULTANT
        DROP DEFAULT INDEX;

   ALTER TABLE DEMOPROJ.EXPERTISE

        DROP DEFAULT INDEX;

*********************************************************************
*   Create views
*********************************************************************

   CREATE VIEW DEMOEMPL.EMP_VACATION
          (EMP_ID, DEPT_ID, VAC_TIME)
          AS SELECT E.EMP_ID, DEPT_ID, SUM(VAC_ACCRUED) - SUM(VAC_TAKEN)
             FROM DEMOEMPL.EMPLOYEE E, DEMOEMPL.BENEFITS B
             WHERE E.EMP_ID = B.EMP_ID
             GROUP BY DEPT_ID, E.EMP_ID;


   CREATE VIEW DEMOEMPL.OPEN_POSITIONS
          (JOB_ID, JOB_NAME, OPEN_POS)
          AS SELECT J.JOB_ID, J.JOB_TITLE,
                   (J.NUM_OF_POSITIONS - COUNT(P.JOB_ID))
             FROM DEMOEMPL.JOB J, DEMOEMPL.POSITION P
             WHERE P.FINISH_DATE IS NULL AND P.JOB_ID = J.JOB_ID
                   PRESERVE DEMOEMPL.JOB
             GROUP BY J.JOB_ID, J.JOB_TITLE, J.NUM_OF_POSITIONS
             HAVING (J.NUM_OF_POSITIONS - COUNT(P.JOB_ID)) > 0;

*********************************************************************

*   Create updatable views
*********************************************************************

   CREATE VIEW DEMOEMPL.EMP_HOME_INFO
          AS SELECT EMP_ID, EMP_LNAME, EMP_FNAME, STREET, CITY, STATE,

                    ZIP_CODE, PHONE
             FROM DEMOEMPL.EMPLOYEE;

   CREATE VIEW DEMOEMPL.EMP_WORK_INFO
          AS SELECT EMP_ID, MANAGER_ID, START_DATE, TERMINATION_DATE
             FROM DEMOEMPL.EMPLOYEE;
```

Demo Data

```
**********************************************************************
INSERT INTO DEMOEMPL.DIVISION
       VALUES ('D02', NULL, 'USED CARS');
INSERT INTO DEMOEMPL.DIVISION
       VALUES ('D04', NULL, 'NEW CARS');
INSERT INTO DEMOEMPL.DIVISION
       VALUES ('D06', NULL, 'SERVICE');
INSERT INTO DEMOEMPL.DIVISION
       VALUES ('D09', NULL, 'CORPORATE');

INSERT INTO DEMOEMPL.DEPARTMENT
       VALUES (3510, NULL, 'D02', 'APPRAISAL - USED CARS');
INSERT INTO DEMOEMPL.DEPARTMENT
       VALUES (2200, NULL, 'D02', 'SALES - USED CARS');
INSERT INTO DEMOEMPL.DEPARTMENT
       VALUES (1100, NULL, 'D02', 'PURCHASING - USED CARS');
INSERT INTO DEMOEMPL.DEPARTMENT
       VALUES (3520, NULL, 'D04', 'APPRAISAL NEW CARS');
INSERT INTO DEMOEMPL.DEPARTMENT
       VALUES (2210, NULL, 'D04', 'SALES - NEW CARS');
INSERT INTO DEMOEMPL.DEPARTMENT
       VALUES (4200, NULL, 'D04', 'LEASING - NEW CARS');
INSERT INTO DEMOEMPL.DEPARTMENT
       VALUES (1110, NULL, 'D04', 'PURCHASING - NEW CARS');
INSERT INTO DEMOEMPL.DEPARTMENT
       VALUES (1120, NULL, 'D06', 'PURCHASING - SERVICE');
INSERT INTO DEMOEMPL.DEPARTMENT
       VALUES (4600, NULL, 'D06', 'MAINTENANCE');
INSERT INTO DEMOEMPL.DEPARTMENT
       VALUES (3530, NULL, 'D06', 'APPRAISAL - SERVICE');
INSERT INTO DEMOEMPL.DEPARTMENT
       VALUES (5100, NULL, 'D06', 'BILLING');
INSERT INTO DEMOEMPL.DEPARTMENT
       VALUES (6200, NULL, 'D09', 'CORPORATE ADMINISTRATION');
INSERT INTO DEMOEMPL.DEPARTMENT
       VALUES (5200, NULL, 'D09', 'CORPORATE MARKETING');
INSERT INTO DEMOEMPL.DEPARTMENT
       VALUES (5000, NULL, 'D09', 'CORPORATE ACCOUNTING');
INSERT INTO DEMOEMPL.DEPARTMENT
       VALUES (4900, NULL, 'D09', 'MIS');
INSERT INTO DEMOEMPL.DEPARTMENT
       VALUES (6000, NULL, 'D09', 'LEGAL');
```

```
INSERT INTO DEMOEMPL.DEPARTMENT
       VALUES (4500, NULL, 'D09', 'HUMAN RESOURCES');
INSERT INTO DEMOPROJ.PROJECT
       values ('P634', 3411, '2000-02-01', '2000-03-01',
              null, null, 320, null, 'TV ads - WTVK');
INSERT INTO DEMOPROJ.PROJECT
       values ('C200', 3411, '1999-01-15', '2000-04-30', '1999-01-15',
             '2000-04-30', 1776, 2010, 'New brand research');
INSERT INTO DEMOPROJ.PROJECT
       values ('P400', null, '2000-09-01', '2000-12-10',
              null, null, 2960, null, 'Christmas media' );
INSERT INTO DEMOPROJ.PROJECT
       values ('C203', 2894, '1998-02-01', '1998-03-15', '1998-02-10',
             '1998-03-10', 960, 901.50, 'Consumer study' );
INSERT INTO DEMOPROJ.PROJECT
       values ('C240', 4358, '1998-06-01', '1998-07-01', '1998-06-01',
              '1998-08-15', 320, 722.75, 'Service study');
INSERT INTO DEMOPROJ.PROJECT
       values ('D880', 2466, '1999-11-01', '2001-02-01',
              null, null, 960, null, 'Systems analysis' );

INSERT INTO DEMOEMPL.JOB
       values (8001, 'Vice President', 90000, 136000, 'S', 1,
              '1988-01-01',
  'Takes overall responsibility upon president absence',
  'Oversees coordination among divisions and departments');
INSERT INTO DEMOEMPL.JOB
       values (4023, 'Accountant', 44000, 120000, 'S', 1,
  '1985-01-01', 'Responsible for quarterly and final reports',
' Works with outside consultants on taxes');
INSERT INTO DEMOEMPL.JOB
       values (2051, 'AP Clerk', 8.80, 14.60, 'H', 2,
             '1989-03-01',
       'Responds to incoming invoices by sending out issued checks',
              'Files invoices');
INSERT INTO DEMOEMPL.JOB
       values (2053, 'AR Clerk', 8.80, 14.60, 'H', 3,
            '1989-03-01', 'Sends out customer invoices',
      'Sends out monthly statements and accepts payments');
INSERT INTO DEMOEMPL.JOB
       values (2077, 'Purch Clerk', 17000, 30000, 'S', 3,
              '1989-03-01',
 'Responsible for soliciting quotes from vendors', null);
INSERT INTO DEMOEMPL.JOB
       values (3029, 'Computer Operator', 25000, 44000, 'S', 1,
              '1993-06-01',
        'Responsible for regular operation of computer system',
            'Calls outside maintenance as necessary');
```

```
INSERT INTO DEMOEMPL.JOB
       values (3051, 'Data Entry Clerk', 8.50, 11.45, 'H', 1,
              '1993-06-02', 'Enters A/P and A/R data as necessary',
               null);
INSERT INTO DEMOEMPL.JOB
       values (6011, 'Manager - Acctng', 59400, 121000, 'S', 1,
              '1988-01-01',
  'RESPONSIBILITY FOR ACCOUNTING INCLUDING A/P AND A/R',
             null);
INSERT INTO DEMOEMPL.JOB
       values (4560, 'Mechanic', 11.45, 21.00, 'H', 7,
              '1984-01-01',
'Works under supervision of senior mechanic to repair cars', null);
INSERT INTO DEMOEMPL.JOB
       values (4666, 'Sr Mechanic', 41000, 91000, 'S', 1,
              '1988-06-01',
   'Oversees maintenance of all cars under warranty or not',
              null);
INSERT INTO DEMOEMPL.JOB
       values (4734, 'Mktng Admin', 25000, 62000, 'S', 2,
              '1994-06-01',
'Provides marketing plans and ideas for marketing', null);
INSERT INTO DEMOEMPL.JOB
       values (3333, 'Sales Trainee', 21600, 39000, 'S', 4,
              '1994-10-01',
     'Initial sales position for incoming salespeople',
              'Works under supervision of salesperson');
INSERT INTO DEMOEMPL.JOB
       values (5555, 'Salesperson', 30000, 79000, 'S', 9,
              '1984-01-01',
    'Primary responsibility to sell new or used cars', null);
INSERT INTO DEMOEMPL.JOB
       values (6004, 'Manager - HR', 66000, 138000, 'S', 1,
              '1990-06-01',
    'Responsible for hiring, benefits, and education',
               'Also responsible for OSHA compliance');
INSERT INTO DEMOEMPL.JOB
       values (6021, 'Manager - Mktng', 76000, 150000, 'S', 1,
              '1992-01-02',
 'Responsible for all marketing for used and new cars', null);
INSERT INTO DEMOEMPL.JOB
     VALUES (2055, 'PAYROLL CLERK', 17000, 30000, 'S',1,'1989-03-01',
  'Issue payroll checks to employees and maintains records', null);
```

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INSERT INTO DEMOEMPL.JOB
       values (4025, 'Writer - Mktng', 31000, 50000, 'S', 1,
'1996-06-01', 'Writes marketing material based on marketingplans',
                     null);
INSERT INTO DEMOEMPL.JOB
       values (9001, 'President', 111000, 190000, 'S', 1,
   '1984-01-01', 'Overall responsibility for well-beingof company',
              null);

INSERT INTO DEMOEMPL.JOB
       values (4123, 'Recruiter', 35000, 56000, 'S', 1,
              '1994-03-01',
 'Posts job openings and submits newspaper ads for openings', null);
INSERT INTO DEMOEMPL.JOB
       values (4130, 'Benefits Analyst', 35000, 56000, 'S', 1,
              '1994-03-01',
  'Maintains benefits information, conforms to govt regulations',
 null);
INSERT INTO DEMOEMPL.JOB
       values (4012, 'Admin Asst', 21000, 44000, 'S', 4,
              '1994-03-01', 'Assists managers as necessary',
              'Answers phone, files, writes letters, etc.');
INSERT INTO DEMOEMPL.JOB
       VALUES (5111, 'CUST SER REP', 27000, 54000, 'S',4,
              '1989-06-01',
    'Provides customer support-takes care of complaints',
   'Provides information for customers over the phone');
INSERT INTO DEMOEMPL.JOB
       values (4700, 'Purch Agnt', 33000, 60000, 'S', 5,
              '1993-06-01',
'Responsible for purchasing decisions for parts and vehicles', null);
INSERT INTO DEMOEMPL.JOB
       values (5890, 'Appraisal Spec', 45000, 70000, 'S', 5,
              '1993-06-01',
   'Responsible for assessing value of vehicles traded in', null);
INSERT INTO DEMOEMPL.JOB
    VALUES (5110, 'CUST SER MGR', 40000, 108000, 'S',1, '1989-06-01',
      'Responsible for overseeing all customer support', null);

INSERT INTO DEMOPROJ.SKILL
       values (4444, 'Assembly', 'Auto body assembly experience' );
INSERT INTO DEMOPROJ.SKILL
       values (3333, 'Bodywork',
        'Experience in repairing auto bodies' );
```

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INSERT INTO DEMOPROJ.SKILL
       values (3088, 'Brake work', 'Brake diagnosis and repair' );
INSERT INTO DEMOPROJ.SKILL
       values (3065, 'Electronics',
        'Electronic diagnosis and repair' );
INSERT INTO DEMOPROJ.SKILL
       values (1030, 'Acct Mgt',
       'Experience in managing acctng activities' );
INSERT INTO DEMOPROJ.SKILL
       values (5130, 'Basic Math',
        'Knowledge of basic math functions' );

INSERT INTO DEMOPROJ.SKILL
       values (5160, 'Calculus',
       'Knowledge of advanced mathematics' );
INSERT INTO DEMOPROJ.SKILL
       values (4250, 'Data Entry',
        'Familiarity with computer keyboard' );
INSERT INTO DEMOPROJ.SKILL
       values (4370, 'Filing',
       'Ability to organize correspondence/invoices' );
INSERT INTO DEMOPROJ.SKILL
       values (5200, 'Gen Acctng',
       'Familiarity with basic AR and AP' );
INSERT INTO DEMOPROJ.SKILL
       values (5500, 'Gen Mktng',
        'Knowledge of basic marketing concepts' );
INSERT INTO DEMOPROJ.SKILL
       values (5430, 'Mktng Writing',
       'Background in promotional writing' );
INSERT INTO DEMOPROJ.SKILL
       values (5420, 'Writing', 'General writing skills' );
INSERT INTO DEMOPROJ.SKILL
       values (4490, 'Gen Ledger',
       'Experience with general ledger' );
INSERT INTO DEMOPROJ.SKILL
       values (4430, 'Interviewing',
        'Basic interviewing experience' );
INSERT INTO DEMOPROJ.SKILL
       values (1000, 'Management', 'Experience managing people' );
INSERT INTO DEMOPROJ.SKILL
       values (4420, 'Telephone', 'Basic customer support' );
INSERT INTO DEMOPROJ.SKILL
       values (5180, 'Statistics',
        'Creating & evaluating statistics' );
```

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INSERT INTO DEMOPROJ.SKILL
       values (4410, 'Typing', 'Minimum 60 wpm' );
INSERT INTO DEMOPROJ.SKILL
       values (5309, 'Appraising', 'Used car evaluation' );
INSERT INTO DEMOPROJ.SKILL
       values (6770, 'Purchasing',
       'Basic buying & negotiation procedures' );
INSERT INTO DEMOPROJ.SKILL
       values (7000, 'Sales', 'Background in sales techniques' );
INSERT INTO DEMOPROJ.SKILL
       values (6666, 'Billing', 'Basic billing procedures' );
INSERT INTO DEMOPROJ.SKILL
       values (6650, 'Diesel Engine Repair',
                     'Experience in diesel engine repair' );
INSERT INTO DEMOPROJ.SKILL
       values (6670, 'Gas Engine Repair',
              'Experience in gasoline engine repair' );
INSERT INTO DEMOPROJ.SKILL
       values (6470, 'Window Installation',
              'Installation of automotive windows' );

INSERT INTO DEMOEMPL.EMPLOYEE
       values (1003, null, 'James', 'Baldwin', 6200,
              '21 South St', 'Boston', 'MA', '02010',
              '6173295757', 'A', 076598765, '1984-02-01',
              null, '1951-08-02' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (3222, 1003, 'Louise', 'Voltmer', 4500,
              '28 Hayden St', 'Brookline', 'MA', '02066',
              '6176635520', 'A', 090588361, '1993-01-07',
              null, '1968-12-27' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (4321, 1003, 'George', 'Bradley', 6200,
              '344 East Main St', 'Grover', 'MA', '02976',
              '5087463300', 'A', 082999642, '1996-08-04',
              null, '1966-10-31' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (1234, 1003, 'Thomas', 'Mills', 6200,
              '14 Pleasant St', 'Brookline', 'MA', '02066',
              '6176646602', 'A', 055711009, '1985-03-14',
              null, '1969-10-19' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (2466, 1003, 'Patricia', 'Bennett', 5000,
             '152B Central St', 'Medford', 'MA', '02432',
             '5089487709', 'A', 098339556, '1991-10-29',
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              null, '1963-12-23');
INSERT INTO DEMOEMPL.EMPLOYEE
       values (2894, 1003, 'William', 'Griffin', 5200,
               '390 Sherman St', 'Taunton', 'MA', '02678',
               '5088449008', 'A', 077442111, '1992-05-11',
               null, '1966-07-10' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (2174, 3222, 'Jonathan', 'Zander', 4500,
               '54 Bradford St', 'Brookline', 'MA', '02066',
               '6176633854', 'A', 032423789, '1997-09-30',
               null, '1969-05-17' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (3118, 3222, 'Alan', 'Wooding', 4500,
               '196 School St', 'Canton', 'MA', '02020',
               '5083766984', 'A', 098746783, '1992-11-18',
               null, '1969-05-17' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (2461, 1234, 'Alice', 'Anderson', 6200,
              '534 Newton St', 'Medford', 'MA', '02432',
              '5083873664', 'A', 068338909, '1991-09-09',
              null, '1966-07-01');
INSERT INTO DEMOEMPL.EMPLOYEE
       values (3841, 2461, 'Michelle', 'Cromwell', 6200,
               '452 Great Rd', 'Boston', 'MA', '02010',
               '6173298763', 'A', 055848876, '1994-10-25',
               null, '1971-05-20' );

INSERT INTO DEMOEMPL.EMPLOYEE
       values (4002, 2461, 'Linda', 'Roy', 6200,
               '29 Westville Ave', 'Wilmington', 'MA', '02476',
               '5088477701', 'A', 098354660, '1995-12-11',
               null, '1972-12-13' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (5103, 2466, 'Adele', 'Ferguson', 5000,
               '12 York Dr', 'Brookline', 'MA', '02066',
               '6176600684', 'A', 095877432, '1999-10-11',
               null, '1977-04-19' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (3449, 2466, 'Cynthia', 'Taylor', 5000,
               '201 Washington St', 'Concord', 'MA', '01342',
               '5082684508', 'A', 088930884, '1993-12-07',
               null, '1968-06-02' );
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INSERT INTO DEMOEMPL.EMPLOYEE
       values (3411, 2894, 'Catherine', 'Williams', 5200,
               '566 Lincoln St', 'Boston', 'MA', '02010',
               null, 'A', 083356561, '1993-09-30',
               null, '1967-10-28' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (4358, 2894, 'Judith', 'Robinson', 5200,
               '139 White St', 'Wilmington', 'MA', '02476',
               '5087488011', 'A', 075399870, '1996-09-13',
               null, '1964-10-24' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (2781, 4358, 'Joseph', 'Thurston', 5200,
               '4 Birch St', 'Stoneham', 'MA', '02928',
               '6173286008', 'A', 087700466, '1992-04-12',
               null, '1968-11-29' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (2246, 2466, 'Marylou', 'Hamel', 1100,
               '11 Main St', 'Medford', 'MA', '02432',
               '5083457789', 'A', 059975848, '1998-12-07',
               null, '1968-10-24' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (4703, 2246, 'Martin', 'Halloran', 1100,
               '27 Elm St', 'Brookline', 'MA', '02066',
               '6176648290', 'A', 054475888, '1997-03-19',
               null, '1971-12-28' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (5008, 2246, 'Timothy', 'Fordman', 1100,
               '60 Boston Rd', 'Brookline', 'MA', '02066',
               '6176642209', 'A', 033767754, '1998-01-31',
               null, '1973-06-07' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (3082, 2894, 'John', 'Brooks', 3510,
               '129 Bedford St', 'Camden', 'MA', '02113',
               '5089273644', 'A', 098234567, '1992-07-03',
               null, '1970-09-02' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (4773, 3082, 'Janice', 'Dexter', 3510,
               '399 Pine St', 'Medford', 'MA', '02432',
               '5083847566', 'A', 089675632, '1997-06-14',
               null, '1969-11-19' );
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INSERT INTO DEMOEMPL.EMPLOYEE
       values (2180, 2894, 'Joan', 'Albertini', 2200,
              '501 Piper Rd', 'Medford', 'MA', '02432',
              '5083145366', 'A', 066783225, '1989-10-27',
              null, '1964-03-26' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (4660, 2180, 'Bruce', 'MacGregor', 2200,
              '254 Waterside Rd', 'Camden', 'MA', '02113',
              '5092344620', 'A', 098363389, '1997-01-20',
              null, '1965-10-28' );

INSERT INTO DEMOEMPL.EMPLOYEE
       values (3767, 2180, 'Frank', 'Lowe', 2200,
              '25 Rutland St', 'Natick', 'MA', '02364',
              '5082844094', 'A', 066985009, '1994-08-31',
              null, '1964-12-08' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (2448, 2180, 'David', 'Lynn', 2200,
              '93 Hubbard St', 'Natick', 'MA', '02364',
              '5082844736', 'A', 028448958, '1991-09-01',
              null, '1961-03-02' );

INSERT INTO DEMOEMPL.EMPLOYEE
       values (3704, 2448, 'Richard', 'Moore', 2200,
              '130 Swanson St', 'Dedham', 'MA', '02026',
              '6177739440', 'A', 095435467, '1994-04-10',
              null, '1961-11-23' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (1765, 2466, 'David', 'Alexander', 1110,
              '18 Cross St', 'Grover', 'MA', '02976',
              '5087394772', 'A', 048903743, '1985-10-23',
              null, '1955-11-13' );

INSERT INTO DEMOEMPL.EMPLOYEE
       values (2106, 1765, 'Susan', 'Widman', 1110,
              '43 Oak St', 'Medford', 'MA', '02432',
              '5083346364', 'A', 109857893, '1989-05-01',
              null, '1971-05-11' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (3769, 2894, 'Julie', 'Donelson', 3520,
              '14 Atwood Rd', 'Grover', 'MA', '02976',
              '5084850432', 'A', 067783532, '1994-08-31',
              null, '1967-08-15' );
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INSERT INTO DEMOEMPL.EMPLOYEE
       values (2010, 2894, 'Cora', 'Parker', 2210,
               '2 Spring St', 'Boston', 'MA', '02010',
               null, 'A', 086574983, '1988-03-18',
               null, '1962-05-25' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (4001, 2010, 'Jason', 'Thompson', 2210,
               '3 Flintlock St', 'Natick', 'MA', '02364',
               '5082649956', 'A', 054578957, '1995-12-11',
               null, '1964-08-15' );

INSERT INTO DEMOEMPL.EMPLOYEE
       values (4008, 2010, 'Robert', 'Clark', 2210,
               '54 Tenny St', 'Brookline', 'MA', '02066',
               null, 'A', 198546272, '1996-01-23',
               null, '1959-11-01' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (4962, 2010, 'Peter', 'White', 2210,
               '1440 Mass Ave', 'Boston', 'MA', '02010',
               '6177732280', 'A', 123395857, '1997-10-04',
               null, '1959-07-01' );

INSERT INTO DEMOEMPL.EMPLOYEE
       values (3764, 2010, 'Deborah', 'Park', 2210,
               '379 Center St', 'Brookline', 'MA', '02066',
               '6179458377', 'A', 034222564, '1994-08-25',
               null, '1960-03-08' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (5090, 2010, 'Stephen', 'Wills', 2210,
               '34 Avon Dr', 'Canton', 'MA', '02020',
               '5083389935', 'A', 012434452, '1998-07-12',
               null, '1972-04-25' );

INSERT INTO DEMOEMPL.EMPLOYEE
       values (3991, 2010, 'Fred', 'Wilkins', 2210,
               '344 Stevens St', 'Taunton', 'MA', '02678',
               '5081840883', 'A', 026475929, '1994-11-12',
               null, '1963-03-29' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (4027, 3991, 'Cecile', 'Courtney', 2210,
               '99 West Main St', 'Natick', 'MA', '02364',
               '5089445386', 'A', 012209982, '1996-04-01',
               null, '1967-07-07' );
```

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INSERT INTO DEMOEMPL.EMPLOYEE
       values (3778, 2466, 'Jane', 'Ferndale', 5100,
               '15 Dawson St', 'Medford', 'MA', '02432',
               '6173450099', 'A', 10477822, '1994-09-07',
               null, '1962-11-30' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (2598, 3778, 'Mary', 'Jacobs', 5100,
               '24A Main St', 'Camden', 'MA', '02113',
               null, 'A', 339000022, '1992-01-03',
               null, '1974-05-02' );

INSERT INTO DEMOEMPL.EMPLOYEE
       values (2004, 2466, 'Eleanor', 'Johnson', 1120,
               '225 Fisk St', 'Medford', 'MA', '02432',
               '5089253998', 'A', 01010885, '1988-02-28',
               null, '1952-12-23' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (3294, 2004, 'Carolyn', 'Johnson', 1120,
               '79 High St', 'Brookline', 'MA', '02066',
               '6175567551', 'A', 038800922, '1993-02-19',
               null, '1967-10-05' );

INSERT INTO DEMOEMPL.EMPLOYEE
       values (3338, 2004, 'Mark', 'White', 1120,
               '560 Camden St', 'Canton', 'MA', '02020',
               '6179238844', 'A', 055002432, '1993-07-02',
               null, '1964-08-15' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (2209, 2894, 'Michael', 'Smith', 3530,
               '201 Summer St', 'Brookline', 'MA', '02066',
               '6175563331', 'A', 093666540, '1990-06-17',
               null, '1959-12-13' );

INSERT INTO DEMOEMPL.EMPLOYEE
       values (3341, 2209, 'Carl', 'Smith', 3530,
               '18 South St', 'Newton', 'MA', '02576',
               '6179658099', 'A', 033970385, '1993-07-02',
               null, '1962-02-03' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (2096, 4321, 'Thomas', 'Carlson', 4600,
              '23 Hemmingway Ln', 'Brookline', 'MA', '02066',
              '6175553643', 'A', 041783445, '1989-01-26',
             null, '1964-04-14');
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INSERT INTO DEMOEMPL.EMPLOYEE
       values (2437, 2096, 'Henry', 'Thompson', 4600,
               '1467 West Ave', 'Boston', 'MA', '02030',
               '6179264105', 'S', 44622905, '1991-08-06',
               null, '1966-10-12' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (3433, 2096, 'Herbert', 'Crane', 4600,
               '20 W Bloomfield Ave', 'Newton', 'MA', '02456',
               '6178653440', 'A', 209338445, '1993-11-01',
               null, '1958-05-30' );

INSERT INTO DEMOEMPL.EMPLOYEE
       values (1034, 2096, 'James', 'Gallway', 4600,
              '12 East Speen St', 'Stoneham', 'MA', '02928',
              '6172251178', 'A', 067775312, '1984-02-01',
             null, '1951-11-23');
INSERT INTO DEMOEMPL.EMPLOYEE
       values (2424, 1034, 'Ronald', 'Wilder', 4600,
               '30 Heron Ave', 'Natick', 'MA', '02178',
               '5083347700', 'A', 056668338, '1991-07-24',
               null, '1948-09-09' );

INSERT INTO DEMOEMPL.EMPLOYEE
       values (4456, 1034, 'Thomas', 'Thompson', 4600,
               '32 South Broadway', 'Newton', 'MA', '02576',
               '6179660089', 'A', 077492347, '1997-01-04',
               null, '1978-09-13' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (3288, 1034, 'Ralph', 'Sampson', 4600,
               '99 Vale Ave', 'Newton', 'MA', '02576',
               '6179654443', 'A', 077447333, '1993-01-29',
               null, '1962-09-30' );

INSERT INTO DEMOEMPL.EMPLOYEE
       values (2299, null, 'Samuel', 'Spade', 4600,
               '47 London St', 'Canton', 'MA', '02020',
               null, 'L', 033892200, '1991-02-04',
               null, '1958-01-09' );

INSERT INTO DEMOEMPL.EMPLOYEE
       values (3199, null, 'Martin', 'Loren', 4600,
               '401 Cross St', 'Grover', 'MA', '02976',
               null, 'L', 098884332, '1992-12-05',
               null, '1962-10-19' );
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INSERT INTO DEMOEMPL.EMPLOYEE
       values (2145, null, 'Martin', 'Catlin', 5200,
               '44 Smithville Hts', 'Wilmington', 'MA', '02476',
               '5087486625', 'L', 044895224, '1989-09-24',
               null, '1954-03-02' );
INSERT INTO DEMOEMPL.EMPLOYEE
       values (2898, null, 'Mary', 'Umidy', 1120,
               '895A Braintree Circle', 'Medford', 'MA', '02432',
               '6173458860', 'S', 056906868, '1992-05-11',
               null, '1962-05-11' );

INSERT INTO DEMOEMPL.POSITION
       values (4773, 5890, '1997-06-14', null, null,  45240.00,
               null, null, null );
INSERT INTO DEMOEMPL.POSITION
       values (1234, 8001, '1985-03-14', null, null,  117832.68,
               null, null, null );
INSERT INTO DEMOEMPL.POSITION
       values (3082, 5890, '1992-07-03', null, null,  68016.00,
               null, null, null );

INSERT INTO DEMOEMPL.POSITION
       values (2180, 5555, '1990-04-18', null, null,  76961.00,
               null, null, null );
INSERT INTO DEMOEMPL.POSITION
       values (4660, 5555, '1997-03-31', null, null,  36400.00,
               .25, .157, null );
INSERT INTO DEMOEMPL.POSITION
       values (3767, 5555, '1995-01-11', null, null,  50440.50,
               .23, .125, null );

INSERT INTO DEMOEMPL.POSITION
       values (2448, 5555, '1991-09-01', null, null, 70720.00,
               .255, .157, null );
INSERT INTO DEMOEMPL.POSITION
       values (3704, 3333, '1994-04-10', null, null, 22880.00,
               null, .105, null );
INSERT INTO DEMOEMPL.POSITION
       values (4703, 2077, '1997-03-19', null, null, 24857.00,
               null, null, null );

INSERT INTO DEMOEMPL.POSITION
       values (2246, 4700, '1993-09-28', null, null, 59488.00,
               null, null, null );
INSERT INTO DEMOEMPL.POSITION
       values (5008, 4700, '1998-01-31', null, null, 47944.00,
               null, null, null );
INSERT INTO DEMOEMPL.POSITION
       values (3769, 5890, '1994-08-31', null, null,  41600.00,
               null, null, null );
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INSERT INTO DEMOEMPL.POSITION
       values (4001, 5555, '1995-12-11', null, null, 36921.00,
              .23, .125, null );

INSERT INTO DEMOEMPL.POSITION
       values (4008, 3333, '1996-01-23', null, null, 24441.00,
              null, .99, null );
INSERT INTO DEMOEMPL.POSITION
       values (4962, 3333, '1997-10-04', null, null, 30680.00,
              null, .125, null );

INSERT INTO DEMOEMPL.POSITION
       values (2010, 5555, '1988-03-18', null, null, 76440.00,
              .275, .180, null );
INSERT INTO DEMOEMPL.POSITION
       values (3764, 5555, '1995-10-02', null, null, 54184.00,
              .26, .170, null );
INSERT INTO DEMOEMPL.POSITION
       values (5090, 5555, '1998-07-12', null, null, 48568.48,
              .205, .135, null );

INSERT INTO DEMOEMPL.POSITION
       values (4027, 3333, '1996-04-01', null, null, 28081.40,
              null, .120, null );
INSERT INTO DEMOEMPL.POSITION
       values (3991, 5555, '1995-06-06', null, null, 42016.00,
              .235, .125, null );
INSERT INTO DEMOEMPL.POSITION
       values (1765, 4700, '1992-06-10', null, null, 47009.34,
              null, null, null );

INSERT INTO DEMOEMPL.POSITION
       values (2106, 2077, '1989-05-01', null, null, 23920.00,
              null, null, null );
INSERT INTO DEMOEMPL.POSITION
       values (2096, 4666, '1994-10-10', null, null, 85280.00,
              null, null, null );
INSERT INTO DEMOEMPL.POSITION
       values (2437, 4560, '1991-08-06', null, 14.55, null,
              null, null, 21.83 );
INSERT INTO DEMOEMPL.POSITION
       values (2598, 2053, '1992-01-03', null, 10.50, null,
              null, null, 15.00 );
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INSERT INTO DEMOEMPL.POSITION
       values (3433, 4560, '1993-11-01', null, 19.15, null,
               null, null, 28.00 );
INSERT INTO DEMOEMPL.POSITION
       values (3778, 2053, '1994-09-07', null, 9.98,  null,
               null, null, 14.00 );
INSERT INTO DEMOEMPL.POSITION
       values (1034, 4560, '1984-02-01', null, 20.93, null,
               null, null, 29.50 );

INSERT INTO DEMOEMPL.POSITION
       values (2424, 4560, '1991-07-24', null, 13.60, null,
               null, null, 19.40 );
INSERT INTO DEMOEMPL.POSITION
       values (2004, 4700, '1993-11-19', null, null, 59280.00,
               null, null, null );
INSERT INTO DEMOEMPL.POSITION
       values (4456, 4560, '1997-01-04', null, 14.58, null,
               null, null, 19.87 );

INSERT INTO DEMOEMPL.POSITION
       values (3288, 4560, '1993-01-29', null, 16.40, null,
               null, null, 23.60 );
INSERT INTO DEMOEMPL.POSITION
       values (3341, 5890, '1993-07-02', null, null, 48465.80,
               null, null, null );
INSERT INTO DEMOEMPL.POSITION
       values (2209, 5890, '1990-06-17', null, null, 66144.00,
               null, null, null );

INSERT INTO DEMOEMPL.POSITION
       values (3294, 4700, '1993-02-19', null, null, 53665.56,
               null, null, null );
INSERT INTO DEMOEMPL.POSITION
       values (3338, 2077, '1993-07-02', null, null, 22048.84,
               null, null, null );
INSERT INTO DEMOEMPL.POSITION
       values (2174, 4123, '1989-09-30', null, null, 49921.76,
               null, null, null );
INSERT INTO DEMOEMPL.POSITION
       values (3118, 4130, '1992-11-18', null, null, 45241.94,
               null, null, null );
```

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INSERT INTO DEMOEMPL.POSITION
       values (3222, 6004, '1993-01-07', null, null,  110448.00,
               null, null, null );
INSERT INTO DEMOEMPL.POSITION
       values (4321, 5110, '1996-08-04', null, null, 56977.80,
               null, null, null );
INSERT INTO DEMOEMPL.POSITION
       values (2461, 4012, '1991-09-09', null, null,  43784.00,
               null, null, null );
INSERT INTO DEMOEMPL.POSITION
       values (3841, 4012, '1994-10-25', null, null, 33800.00,
               null, null, null );

INSERT INTO DEMOEMPL.POSITION
       values (4002, 4012, '1995-12-11', null, null, 28601.80,
               null, null, null );
INSERT INTO DEMOEMPL.POSITION
       values (1003, 9001, '1984-02-01', null, null, 146432.00,
               null, null, null );
INSERT INTO DEMOEMPL.POSITION
       values (5103, 2051, '1999-10-11', null, 7.13, null,
               null, null, 11.70 );
INSERT INTO DEMOEMPL.POSITION
       values (2466, 6011, '1991-10-29', null, null,  94953.52,
               null, null, null );

INSERT INTO DEMOEMPL.POSITION
       values (3449, 4023, '1993-12-07', null, null, 74776.00,
               null, null, null );
INSERT INTO DEMOEMPL.POSITION
       values (2781, 4025, '1992-04-12', null, null, 43888.00,
               null, null, null );

INSERT INTO DEMOEMPL.POSITION
       values (2894, 6021, '1992-05-11', null, null, 111593.00,
               null, null, null );
INSERT INTO DEMOEMPL.POSITION
       values (3411, 4734, '1995-04-02', null, null, 53665.00,
               null, null, null );
```

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INSERT INTO DEMOEMPL.POSITION
       values (4358, 4734, '1996-09-13', null, null, 57824.50,
               null, null, null );
INSERT INTO DEMOEMPL.POSITION
       VALUES (3764, 3333, '1994-08-25', '1995-10-01', NULL, 28912.00,
               null, null, null );
INSERT INTO DEMOEMPL.POSITION
       values (3991, 3333, '1994-11-12', '1995-06-05', null, 27976.00,
               null, null, null );
INSERT INTO DEMOEMPL.POSITION
       values (2246, 2077, '1990-12-07', '1993-09-27', null, 29536.00,
               null, null, null );

INSERT INTO DEMOEMPL.POSITION
       values (2096, 4560, '1989-01-26', '1994-10-09', 17.90, null,
               null, null, 28.85 );
INSERT INTO DEMOEMPL.POSITION
       values (3767, 3333, '1994-08-31', '1995-01-10', null, 2200.00,
              null, .105, null);
INSERT INTO DEMOEMPL.POSITION
       values (2180, 3333, '1997-10-27', '1990-04-17', null, 19000.10,
              null, .09, null);
INSERT INTO DEMOEMPL.POSITION
       values (4660, 3333, '1997-01-20', '1997-03-30', null, 24000.00,
              null, .11, null);

INSERT INTO DEMOEMPL.POSITION
       values (1765, 2077, '1985-10-23', '1992-06-10', null, 18001.00,
              null, null, null);
INSERT INTO DEMOEMPL.POSITION
       values (2004, 2053, '1988-02-28', '1993-11-18', 9.50, null,
              null, null, 13.50);
INSERT INTO DEMOEMPL.POSITION
       values (3411, 4012, '1993-09-30', '1995-04-01', null, 44001.40,
              null, null, null);
INSERT INTO DEMOPROJ.EXPERTISE
       values (4773, 5309, '02', '1995-10-14' );

INSERT INTO DEMOPROJ.EXPERTISE
       values (1234, 1000, '04', '1988-06-01' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (3082, 5309, '04', '1994-06-03' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (2180, 7000, '04', '1993-01-01' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (4660, 7000, '03', '1995-10-09' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (3767, 7000, '04', '1994-09-20' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (2448, 7000, '03', '1991-06-10' );
```

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INSERT INTO DEMOPROJ.EXPERTISE
       values (3704, 7000, '01', '1993-08-21' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (4703, 4250, '03', '1996-11-20' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (2246, 1000, '03', '1993-10-01' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (2246, 6670, '04', '1990-03-29' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (5008, 6770, '04', '1998-01-31' );

INSERT INTO DEMOPROJ.EXPERTISE
       values (4703, 5130, '03', '1998-03-30' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (3769, 5309, '04', '1992-10-04' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (4001, 7000, '03', '1994-12-11' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (4008, 4420, '01', '1994-12-14' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (4962, 5130, '02', '1992-11-01' );

INSERT INTO DEMOPROJ.EXPERTISE
       values (2010, 7000, '03', '1988-02-18' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (3764, 7000, '03', '1992-01-01' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (5090, 7000, '03', '1997-02-12' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (4027, 7000, '01', '1995-03-19' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (3991, 7000, '03', '1995-01-01' );

INSERT INTO DEMOPROJ.EXPERTISE
       values (1765, 6770, '04', '1985-10-23' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (2106, 6770, '03', '1991-10-01' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (2096, 3333, '02', '1995-03-03' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (2096, 3065, '03', '1998-04-01' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (2437, 3333, '04', '1995-03-15' );
INSERT INTO DEMOPROJ.EXPERTISE
```

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       values (2437, 4444, '04', '1997-05-01' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (2598, 6666, '03', '1997-07-25' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (3433, 6650, '02', '1991-10-01' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (3778, 5200, '03', '1998-01-21' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (3778, 6666, '04', '1998-05-15' );

INSERT INTO DEMOPROJ.EXPERTISE
       values (1034, 6470, '02', '1984-02-21' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (2424, 6470, '03', '1989-04-18' );

INSERT INTO DEMOPROJ.EXPERTISE
       values (2004, 6770, '04', '1988-02-28' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (4456, 6670, '01', '1993-06-02' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (4456, 3065, '02', '1993-09-01' );

INSERT INTO DEMOPROJ.EXPERTISE
       values (3288, 6650, '02', '1993-06-12' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (3288, 6670, '01', '1994-12-01' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (3288, 3333, '04', '1993-12-01' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (3341, 5309, '03', '1993-10-02' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (2209, 5309, '04', '1992-08-12' );

INSERT INTO DEMOPROJ.EXPERTISE
       values (3294, 6770, '01', '1989-09-21' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (3338, 6770, '03', '1994-12-11' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (2174, 4430, '04', '1995-03-30' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (3118, 5180, '03', '1995-07-23' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (3222, 1000, '04', '1995-10-01' );
```

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INSERT INTO DEMOPROJ.EXPERTISE
       values (3222, 4430, '04', '1996-12-01' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (4321, 4430, '04', '1997-03-24' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (4321, 1000, '03', '1998-06-01' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (2461, 4370, '04', '1994-03-12' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (2461, 4250, '04', '1997-03-01' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (2461, 5180, '03', '1997-06-01' );

INSERT INTO DEMOPROJ.EXPERTISE
       values (3841, 4370, '03', '1995-10-10' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (3841, 4410, '02', '1996-06-01' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (4002, 4370, '03', '1996-02-15' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (4002, 4410, '04', '1999-01-15' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (1003, 1000, '04', '1984-02-01' );

INSERT INTO DEMOPROJ.EXPERTISE
       values (5103, 5200, '04', '1997-10-11' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (2466, 1030, '04', '1991-10-29' );

INSERT INTO DEMOPROJ.EXPERTISE
       values (2466, 5200, '04', '1999-06-01' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (2466, 4490, '03', '1999-12-01' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (3449, 5200, '03', '1993-09-29' );

INSERT INTO DEMOPROJ.EXPERTISE
       values (2781, 5430, '01', '1995-09-27' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (2781, 5420, '02', '1996-12-01' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (2894, 1000, '04', '1995-11-12' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (2894, 5500, '04', '1996-12-15' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (3411, 5500, '04', '1997-01-30' );
INSERT INTO DEMOPROJ.EXPERTISE
       values (4358, 5500, '03', '1996-12-30' );
```

```
INSERT INTO DEMOPROJ.CONSULTANT
       values (9443, 'Diane', 'Jones', 2466, 5200, 'D880',
               '183 Hawthorne Ln', 'Medford', 'MA', '02432',
               '5084475583', '1957-01-23', '1999-08-08', 089393334,
               50.00 );
INSERT INTO DEMOPROJ.CONSULTANT
       values (9439, 'Charles', 'Miller', 2466, 4900, 'D880',
               '85 St. James St', 'Brookline', 'MA', '02066',
               '6174800873', '1963-09-12', '1999-02-18', 085763854,
               47.00 );

INSERT INTO DEMOPROJ.CONSULTANT
       values (9388, 'Linda', 'Candido', 2466, 5200, 'D880',
               '54 Church St', 'Newton', 'MA', '02456',
               '6179943082', '1959-08-30', '1997-12-21', 033006132,
               76.00 );
INSERT INTO DEMOPROJ.CONSULTANT
       values (9000, 'James', 'Legato', 1003, 6000, null,
               '85 North Rd', 'Newton', 'MA', '02456',
               '6179964874', '1970-05-20', '1994-03-20', 095578460,
              148.00 );

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 4773, 68, 68, 8.00, 5.00, 0   ,0
                , '2000-10-15', .05, null,
                NULL, NULL, 900.00,0 ,0,
                'COLL', null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 3082, 68, 52, 8, 8, 0   ,0
                , '2000-10-20', .055, null,
                '401K', .08, 1400.00,0 ,0,
                'JRCOLL', null, null);

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 2180, 92.50, 0, 8.00, 4.00, 0   ,0
                , '2000-10-30', .06, null,
                'STOCK', .05, 2100.00, 16,   0 ,
                'COLL', null, null);

INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 4660, 68, 56, 8.00, 0, .07,
                3095, '2000-01-13', .06, null,
                '401K', .05, 850.68,0,0,
                'HSDIP', null, null);
```

```
INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 3767, 68, 68, 8.00, 0, .07,
                2250, '2000-09-22', .045, null,
                '401K', .05, 1350.50, 16, 16,
                'JRCOLL', null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 2448, 68, 20.50, 8.00, 3, .075,
                6600, '2000-07-13', .05, null,
                'BONDS', .08, 2100.00, 0,0,
                'COLL', null, null);

INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 3704, 68, 48, 8.00, 8.00, .05,
                3470, '2000-04-30', .045, null,
                'BONDS', .04, 1800.00, 8, 8,
                'JRCOLL', null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 4703, 46.75, 16, 8.00, 14.5, .05,
                3010, '2000-03-10', .08, null,
                NULL, NULL, 1107.50,0,0,
                'HSDIP', null, null);

INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 2246, 92.50, 72, 8.00, 5, .05,
                4500, '2000-12-15', .08, '1993-09-27',
                null, null, 2300.00, 24.5, 16.00,
                'HSDIP', null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 5008, 46.5, 40, 8.00, 0, .10,
                2000, '2000-01-29', .06, null,
                '401K', .05, 307.50,0,0,
                'COLL', null, null);

INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 3769, 68, 0, 8.00, 6.00, .10,
                6600, '2000-10-01', .04, null,
                '401K', .03, 1356.70,0,0,
                'HSDIP', null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 4001, 68, 40, 8.00, 2.5, 0,0
                , '2000-12-20', .04, null,
                NULL, NULL, 1756.50,0,0,
                'HSDIP', null, null);
```

```
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 4008, 68, 0, 8.00, 3.5,0,0
                , '2000-01-14', .05, null,
                '401K', .05, 1750.00,0,0,
                'COLL', null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 4962, 68, 16, 8.00, 7.5, 0,0
                , '2000-10-04', .06, null,
                '401K', .06, 1307.80, 8.5, 8.5,

                'COLL', null, null);

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 2010, 92.75, 16.00, 8.00, 2.5,0,0
                , '2000-03-18', .05, null,
                'STOCK', .05, 2450.50, 0,0,
                'COLL', null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 3764, 68, 80, 8.00, 5.00, .08,
                3060, '2000-06-11', .065, '1991-05-10',
                'STOCK', .06, 1406.90, 32.5, 16.0,
                'COLL', null, null);

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 5090, 46, 0, 8.00, 0,0,0
                , '2000-07-14', .04, null,
                NULL, NULL, 0,0,0,
                'JRCOLL', null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 4027, 68, 40, 8.00, 4.00, .08,
                3000, '2000-07-19', .035, null,
                '401K', .04, 1750.00,0,0,
                'COLL', null, null);

INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 3991, 68, 68, 8.00, 3.00, .08,
                4500, '2000-11-12', .055, '1995-06-05',
                '401K', .06, 1354.60, 8.0, 0,
                'COLL', null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 1765, 92.5, 32, 8.00, 0, .10,
                7600, '2000-10-23', .07, null,
                '401K', .08, 2500.00, 32, 0,
                'COLL', null, null);
```

```
INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 2106, 92.5, 32, 8.00, 1.00, .08,
                5500, '2000-04-16', .06, '1999-08-17',
                'BONDS', .04, 2100.00, 0,0,
                'HSDIP', null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 2096, 92.5, 80, 8.00, 5.00, .05,
                5300, '2000-02-28', .055,
                 '1998-10-09','STOCK', .05, 2300.00, 0,0,
                'HSDIP', NULL, NULL);

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 2437, 68, 0, 8.00, 4.5, 0,0
                , '2000-08-16', .04, null,
                NULL, NULL, 2100.00, 0,0,
                'GED', 'MC655-690l', 90.55);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000,2598, 60, 8, 20.00, 8.5,  0  ,0
                , '2000-01-26', .035, null,
                NULL, NULL, 2300.00, 0,0,
                'HSDIP', 'HP302-7409', 50.50);

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 3433, 68, 40, 8.00, 4.00,0,0
                , '2000-10-23', .05, null,
                NULL, NULL, 1456.70,0,0,
                'JRCOLL', 'MC655-7487', 90.55);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 3778, 68, 40, 8.00, 4,0,0
                , '2000-09-24', .06, null,
                NULL, NULL, 1350.50,0,0,
                'HSDIP', 'HP302-7487', 50.50);

INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 1034, 92.5, 72, 8.00, 2.5, .10,
                5540, '2000-01-24', .05, null,
                'BONDS', .06, 2900.00, 0,0,
                'HSDIP', 'MC655-4490', 90.55);
INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 2424, 92.5, 48, 8.00, 3.5, .05,
                2460, '2000-07-19', .04, null,
                NULL, NULL, 2100.00, 0,0,
                'HSDIP', 'MC655-5571', 90.55);
```

```
INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 2004, 92.5, 40, 8.00, 0, .05,
                2300, '2000-02-28', .03, null,
                '401K', .04, 2450.50,0,0,
                'JRCOLL', null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 4456, 68, 40, 8.00, 7.00,0,0
                , '2000-01-05', .03, null,
                NULL, NULL, 906.50,0,0,
                'HSDIP', 'MC655-6680', 90.55);

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 3288, 68, 56, 8.00, 2.00,0,0
                , '2000-01-05', .04, null,
                NULL, NULL, 1500.00, 0,0,
                'HSDIP', 'MC655-4402', 90.55);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 3341, 68, 32.5, 8.00, 3.00,0,0
                , '2000-10-05', .045, null,
                '401K', .07, 1500.00, 0,0,
                'COLL', null, null );

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 2209, 92.50, 32, 8.00, 5.5,0,0
                , '2000-06-14', .06, null,
                '401K', .06, 2300.00, 16.00, 16.00,
                'COLL', null, null );
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 3294, 68, 16, 8.00, 3.00,0,0
                , '2000-02-28', .055, null,
                '401K', .03, 1500.00, 0,0,
                'COLL', null, null );

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 3338, 68, 0, 8.00, 1.5,0,0
                , '2000-07-02', .05, null,
                NULL, NULL, 1450.50,0,0,
                'HSDIP', null, null );
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 2174, 92, 48, 8.00, 9.00,0,0
                , '2000-09-27', .06, null,
                '401K', .04, 2100.00, 0,0,
                'JRCOLL', null, null );
```

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INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 3118, 68, 8, 8.00, 7.00, .05,
                2010, '2000-11-24', .045, null,
                'BONDS', .08, 1500.00, 8.5, 8.00,
                'COLL', null, null );
INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 3222, 68, 0, 8.00, 2.5, .05,
                2240, '2000-01-02', .07, '1999-06-08',
                '401K', .09, 1350.50, 32, 8,
                'MAS', null, null );

INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 4321, 68, 48, 8.00, 3.00, .05,
                1991, '2000-08-02', .05, null,
                NULL, NULL, 1200.00, 0,0,
                'JRCOLL', null, null );
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 2461, 68, 40, 8.00, 1.5,0,0
                , '2000-09-13', .04, null,
                NULL, NULL, 2100.00,0 ,0,
                'HSDIP', null, null );

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 3841, 68, 0, 8.00, 2.00,0,0
                , '2000-10-10', .06, null,
                NULL, NULL, 1300.00, 0,0,
                'JRCOLL', null, null );
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 4002, 68, 40, 8.00, 4.5,0,0
                , '2000-12-15', .045, null,
                NULL, NULL, 1750.50,0,0,
                'HSDIP', null, null );

INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 1003, 92, 0, 8.00, 0, .10,
                12340, null, .05, null,
                '401K', .10, NULL,0,0,
                'MAS', null, null );
INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 5103, 46, 0, 8, 0, .05,
                530, '2000-10-11', .05, null,
                NULL, NULL, NULL,0,0,
                'HSDIP', 'HP302-8403', 50.50);
```

```
INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 2466, 92.5, 40, 8.00, 3.5, .05,
                3400, '2000-10-30', .055, null,
                '401K', .05, 2100.00, 16, 16,
                'COLL', null, null );

INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 3449, 68, 56, 8.00, 10.5, .07,
                3700, '2000-12-02', .045, null,
                '401K', .03, 1453.70,0,0,
                'COLL', null, null );

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 2781, 68, 60, 8.00, 7.00,0,0
                , '2000-04-25', .05, null,
                '401K', .03, 2105.90,0,0,
                'COLL', null, null );
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 2894, 68, 0, 8.00, 2.5,0,0
                , '2000-05-04', .055, null,
                'STOCK', .08, 2155.30, 16.5, 8,
                'MAS', null, null );

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (2000, 3411, 68, 68, 8, 8,0,0
                , '2000-09-30', .05, NULL,
                '401K', .03, 1400.00, 0,0,
                'JRCOLL', null, null );
INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 4358, 68, 0, 8.00, 6.5, .07,
                1430, '2000-09-27', .055, null,
                NULL, NULL, 950.50,0,0,
                'HSDIP', null, null );

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 4773, 80, 80, 15, 1, 0   ,0, '1999-07-02',
                 .04, NULL, NULL, NULL, 600.00, 0,0,  'COLL',
                 null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 4773, 80, 48, 10, 10, 0   ,0, '1998-07-05',
                .03, NULL, NULL, NULL, 500.00, 0,0,  'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 4773, 24, 24, 4.5, 0, 0   , 0   , NULL, NULL,
                NULL, NULL, NULL, NULL,0,0,         'COLL', NULL,
                null);
```

```
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 3082, 120, 120, 15, 8, 0   ,0, '1999-10-12',
         .05, NULL, NULL, NULL, 1100.00, 0,0,  'JRCOLL', NULL,
              null);
INSERT INTO DEMOEMPL.BENEFITS
      VALUES (1998, 3082, 120, 120, 15, 4.5,  0  ,0,
       '1998-01-09',
           .05, NULL, NULL, NULL, 1000.00,0 ,0,  'JRCOLL', NULL,
               NULL);

INSERT INTO DEMOEMPL.BENEFITS
       VALUES (1997, 3082, 120, 120, 15, 2,   0 ,  0   , '1997-10-01',
                .05, NULL, NULL, NULL, 1000.00, 0,0,  'JRCOLL',
                null, null);

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 2180, 160, 160, 15, 6,   0 ,0, '1999-10-17',
                .05, NULL, 'STOCK', .05, 2000.00, 0,0,  'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
      VALUES (1998, 2180, 120, 120, 15, 2.5,  0  ,0, '1998-10-25',
                .055, NULL, 'STOCK', .05, 1900.00, 0,0,  'COLL',
                null, null);

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 2180, 120, 120, 15, 7,   0 ,0, '1997-10-02',
                .05, NULL, 'STOCK', .05, 2000.00, 0,0,  'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1999, 4660, 80, 80, 15, 10, .05, 2060, '1999-01-15',
               .055, NULL, '401K', .05, 750.60,   0 ,0    , 'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 4660, 80, 80, 10, 5,  0  ,0, '1998-01-30',
        .04, NULL, '401K', .05, 500.00,0 ,0,  'HSDIP', NULL,
                null);

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 4660, 48, 48, 8, 2.5, 0   , 0   , NULL, NULL,
                NULL, '401K', .04, 400.00, 0,0,  'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1999, 3767, 120, 120, 15, 0, .07, 2400, '1999-08-17',
               .05, NULL, '401K', .05, 1000.00, 0,0,  'JRCOLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1998, 3767, 120, 120, 15, 0, .07, 2200, '1998-08-10',
                .05, NULL, '401K', .05, 1000.00, 0,0,
                'JRCOLL', null, null);
```

```
INSERT INTO DEMOEMPL.BENEFITS
        values (1997, 3767, 120, 120, 15, 0, .07, 2000, '1997-08-01',
               .05, NULL, '401K', .05, 1350.00,0,0, 'JRCOLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 2448, 120, 120, 15, 8,0 ,0, '1999-09-18',
                .04, NULL, 'BONDS', .08, 1700.00,0 ,0,  'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 2448, 120, 120, 15, 15, 0,0, '1998-09-15',
                .035, NULL, 'BONDS', .08, 1500.00,0,0 ,  'COLL',
                null, null);

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 2448, 120, 120, 15, 5, 0,0, '1997-08-30',
                .03, NULL, 'BONDS', .08, 1500.00,0 ,0,  'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1999, 3704, 120, 120, 15, 15, .04, 2800, '1999-04-24',
              .045, NULL, 'BONDS', .04, 1700.00, 0,0,  'JRCOLL',
                null, null);

INSERT INTO DEMOEMPL.BENEFITS
        values (1998, 3704, 120, 120, 15, 15, .03, 2200, '1998-04-30',
               .04, NULL, 'BONDS', .04, 1500.00, 0,0,  'JRCOLL',
                null, null);

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 3704, 120, 120, 15, 15, 0,0, '1997-04-20',
                .035, null, null, null, 1300.00, 12, 12, 'JRCOLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1999, 4703, 80, 80, 15, 1, .04, 2300, '1999-03-10',
                .065, NULL, NULL, NULL, 950.00,0,0, 'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
       values (1998, 4703, 80, 80, 10,  2.5, .04, 2010, '1998-03-30',
                .05, NULL, NULL, NULL, 800.00,0 ,0,  'HSDIP',
                null, null);
```

```
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 4703, 36, 36, 6, 0, 0   , 0   , NULL, NULL,
                NULL, NULL, NULL, NULL,0,0, 'HSDIP', NULL,
                null);
INSERT INTO DEMOEMPL.BENEFITS
     values (1999, 2246, 160, 160, 15, 3, .04, 3500, '1999-12-06',
           .07, '1993-09-27', NULL, NULL, 2100.00,0 ,0,  'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 2246, 120, 120, 15, 3,0 ,0, '1998-12-01',
          .065, '1993-09-27', NULL, NULL, 1700.00, 0,0,  'HSDIP',
                null, null);

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 2246, 120, 120, 15, 5,0 ,0, '1997-12-20',
        .06, '1993-09-27', NULL, NULL, 1600.00, 0,0,  'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1999, 5008, 80, 80, 10, 6, .10, 1700, '1999-02-07',
                .04, NULL, NULL, NULL, 200.00, 0,0,  'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1998, 5008, 48, 48, 8, 7, .10, 1500, null, null,
                NULL, '401K', .05, NULL,0,0, 'COLL',
                null, null);

INSERT INTO DEMOEMPL.BENEFITS
      VALUES (1999, 3769, 120, 120, 15, 14,0 ,0, '1999-09-17',
                .04, NULL, '401K', .03, 1200.00,0 ,0,  'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
     VALUES (1998, 3769, 120, 120, 15, 8.5,0 ,0, '1998-09-01',
                .04, NULL, '401K', .04, 1100.00,0 ,0,  'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
       VALUES (1997, 3769, 120, 120, 15, 3, 0,0, '1997-09-06',
                .04, NULL, '401K', .04, 1000.00,0 ,0,  'HSDIP',
                null, null);
```

```
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 4001, 120, 120, 15, 3,0 ,0, '1999-12-01',
                .045, NULL, NULL, NULL, 1500.00,0 ,0,  'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 4001, 80, 80, 15, 8,0 ,0, '1998-12-18',
                .04, NULL, NULL, NULL, 1200.00,0 ,0,  'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 4001, 80, 80, 15, 3, 0,0, '1997-12-10',
                .04, NULL, NULL, NULL, 1000.00, 0,0,  'HSDIP',
                null, null);

INSERT INTO DEMOEMPL.BENEFITS
       VALUES (1999, 4008, 120, 120, 15, 2, 0,0, '1999-01-15',
                 .04, NULL, '401K', .05, 1500.00,0 ,0,  'COLL',
                 null, null);
INSERT INTO DEMOEMPL.BENEFITS
         VALUES (1998, 4008, 80, 80, 15, 1, 0,0, '1998-01-31',
               .035, NULL, '401K', .05, 1350.00,0,0, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 4008, 80, 72, 15, 0, 0,0, '1997-01-30',
                .035, NULL, NULL, NULL, 1100.00,0 ,0,  'COLL',
                null, null);

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 4962, 80, 80, 15, 4.5,0 ,0, '1999-10-10',
                .06, NULL, '401K', .05, 1150.50,0,0, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 4962, 80, 80, 10, 1,0 ,0, '1998-10-16',
                .05, null, '401K', .05, 1000.00, 2, 2, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1997, 4962, 12, 0, 2, 0, .05, 3000, null, null,
                NULL, NULL, NULL, NULL,0,0, 'COLL',
                null, null);
```

```
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 2010, 160, 160, 15, 4,0 ,0, '1999-03-01',
                .055, NULL, 'STOCK', .05, 2100.00,0 ,0,  'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
      VALUES (1998, 2010, 160, 152.5, 15, 3, 0,0, '1998-03-30',
                .05, NULL, 'STOCK', .05, 2000.00,0 ,0,  'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 2010, 160, 160, 15, 3,0 ,0, '1997-03-10',
                .05, null, 'BONDS', .05, 1600.00, 2, 2, 'COLL',
                null, null);

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 3764, 120, 120, 15, 2, 0,0, '1999-08-01',
                .055, '1991-05-10', 'STOCK', .06, 1500.00,0 ,0,
                'COLL', null, null);

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 3764, 120, 120, 15, 3, 0,0, '1998-08-30',
             .05, '1991-05-10', 'STOCK', .05, 1200.00, 14, 14,
              'COLL',   NULL,NULL);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 3764, 120, 120, 15, 5, 0,0, '1997-08-17',
    .045, '1991-05-10', 'STOCK', .05, 1000.00,0 ,0,  'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 5090, 80, 80, 15, 2,0 ,0, '1999-07-30',
                .035, NULL, NULL, NULL, 800.00,0 ,0,  'JRCOLL',
                NULL,NULL);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 5090, 24, 24, 4, 2,  0  , 0   , NULL, NULL,
                NULL, NULL, NULL, NULL,0,0, 'JRCOLL',
                null, null);

INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 4027, 120, 120, 15, 8,0 ,0, '1999-03-15',
                .03, null, null, null, 1500.00, 16, 16, 'COLL',
                null, null);
```

```
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 4027, 120, 120, 15, 0, 0,0, '1998-04-30',
                .03, NULL, NULL, NULL, 1200.00, 0,0,  'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 4027, 80, 80, 10, 2.5,0 ,0, '1997-04-01',
                .03, NULL, NULL, NULL, 1000.00, 0,0,  'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1999, 3991, 120, 120, 15, 8, .08, 4000, '1999-12-04',
       .05, '1995-06-05', '401K', .05, 1300.00, 0,0,  'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
      VALUES (1998, 3991, 120, 116, 15, 2,   0 , 0   , '1998-11-28',
             .045, '1995-06-05', '401K', .05, 1100.00, 8, 8, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 3991, 120, 120, 15, 8, 0,0, '1997-11-30',
          .045, '1995-06-05', NULL, NULL, 1000.00,0,0, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1999, 1765, 160, 160, 15, 0, .10, 7000, '1999-11-15',
                .07, null, '401K', .08, 2500.50, 36, 0, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1998, 1765, 160, 160, 15, 0, .10, 6500, '1998-11-01',
      .07, null, '401K', .08, 2500.00, 88, 0, 'COLL', null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1997, 1765, 160, 160, 15, 0, .10, 6000, '1997-10-30',
                .065, null, '401K', .07, 2400.00, 72, 0, 'COLL',
                null, null);

INSERT INTO DEMOEMPL.BENEFITS
       values (1999, 2106, 160, 160, 15, 9.5, .07, 4500, '1999-05-01',
                .055, '1999-08-17', 'BONDS', .04, 1800.00, 0   , 0   ,
                 'HSDIP', null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 2106, 160, 160, 15, 3,0 ,0, '1998-05-15',
                .05, null, 'BONDS', .05, 1800.00, 8, 8, 'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 2106, 120, 120, 15, 8, 0,0, '1997-04-30',
                .03, NULL, NULL, NULL, 1700.00, 0,0 ,
                'HSDIP', null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1999, 2096, 160, 128, 15, 3, .04, 4500, '1999-02-18',
                .05, '1998-10-09', 'STOCK', .05, 2000.00, 0,0 ,
                'HSDIP', null, null);
```

```
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 2096, 160, 160, 15, 3,0 ,0, '1998-02-01',
                .05, '1998-10-09', 'STOCK', .05, 2500.00,0 ,0 ,
                'HSDIP', null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 2096, 120, 104, 15, 3,0 ,0, '1997-02-15',
                .06, NULL, NULL, NULL, 1700.00, 0,0 , 'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
      VALUES (1999, 2437, 120, 16, 15, 11.5,0 ,0, '1999-08-01',
               .035, NULL, NULL, NULL, 1800.00, 0,0 , 'GED',
                'MC655-6901', 84.05);
INSERT INTO DEMOEMPL.BENEFITS
      VALUES (1998, 2437, 120, 120, 15, 6.5,0 ,0, '1998-08-30',
                .03, NULL, NULL, NULL, 1200.00, 0,0 , 'GED',
                'MC655-6901', 79.62);
INSERT INTO DEMOEMPL.BENEFITS
      VALUES (1997, 2437, 120, 120, 15, 15, 0,0, '1997-08-16',
                .03, NULL, '401K', .05, 1100.00,0 ,0 , 'GED',
                'MC655-6901', 70.00);
INSERT INTO DEMOEMPL.BENEFITS
     VALUES (1999, 2598, 120, 120, 15, 15, 0,0, '1999-01-30',
                .035, NULL, NULL, NULL, 2150.50, 0,0 , 'HSDIP',
                'HP302-7409', 54.86);
INSERT INTO DEMOEMPL.BENEFITS
      VALUES (1998, 2598, 120, 120, 15, 14, 0,0, '1998-01-15',
                .03, NULL, NULL, NULL, 1800.00,0 ,0 , 'HSDIP',
                'HP302-7409', 50.00);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 2598, 120, 120, 15, 6, 0,0, '1997-02-01',
                .03, NULL, NULL, NULL, 1700.00, 0,0 , 'HSDIP',
                'HP302-7409', 45.75);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 3433, 120, 120, 15, 8,0 ,0, '1999-10-17',
                .05, NULL, NULL, NULL, 1400.00, 0, 0, 'JRCOLL',
                'MC655-7487', 84.05);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 3433, 120, 120, 15, 4, 0,0, '1998-10-30',
                .05, NULL, NULL, NULL, 1300.00, 0   ,0   , 'JRCOLL',
                'MC655-7487', 79.62);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 3433, 120, 120, 15, 4,0 ,0, '1997-10-15',
                .055, NULL, NULL, NULL, 1200.00,0 ,0 , 'JRCOLL',
                'MC655-7487', 70.00);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 3778, 120, 120, 15, 0,0 ,0, '1999-09-01',
                .055, NULL, NULL, NULL, 1240.50,0 ,0 , 'HSDIP',
                'HP302-7487', 54.86);
```

```
INSERT INTO DEMOEMPL.BENEFITS
       VALUES (1998, 3778, 120, 120, 15, 14,0 ,0, '1998-09-26',
                .05, NULL, NULL, NULL, 1100.00, 0,0 , 'HSDIP',
                'HP302-7487', 50.00);
INSERT INTO DEMOEMPL.BENEFITS
      VALUES (1997, 3778, 120, 120, 15, 10, 0,0, '1997-09-18',
                .05, NULL, NULL, NULL, 1000.00,0 ,0 , 'HSDIP',
                'HP302-7487', 45.75);
INSERT INTO DEMOEMPL.BENEFITS
        values (1999, 1034, 160, 112, 15, 6, .10, 5000, '1999-02-01',
                .05, NULL, 'BONDS', .06, 2850.60, 0, 0, 'HSDIP',
                'MC655-4490', 84.05);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 1034, 160, 112, 15, 15, 0,0, '1998-02-17',
                .05, NULL, 'BONDS', .06, 2720.80,0 ,0 , 'HSDIP',
                'MC655-4490',79.62);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 1034, 160, 48, 15, 8.5, 0,0, '1997-02-15',
                .05, NULL, NULL, NULL, 2500.00, 0,0 , 'HSDIP',
                'MC655-4490', 70.00);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 2424, 120, 120, 15, 15,0 ,0, '1999-06-25',
               .04, NULL, NULL, NULL, 1900.00, 0,0 , 'HSDIP',
               'MC655-5571', 84.05);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 2424, 120, 120, 15, 7, 0,0, '1998-07-01',
                .035, NULL, NULL, NULL, 1700.00,0 ,0 , 'HSDIP',
                'MC655-5571', 79.62);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 2424, 120, 120, 15, 3,0 ,0, '1997-07-17',
                .035, NULL, NULL, NULL, 1500.00,0 ,0 , 'HSDIP',
                'MC655-5571', 70.00);
INSERT INTO DEMOEMPL.BENEFITS
        values (1999, 2004, 160, 160, 15, 8, .04, 1550, '1999-02-17',
               .03, NULL, '401K', .04, 1850.00,   0 , 0   , 'JRCOLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
       VALUES (1998, 2004, 160, 160, 15, 2, 0,0, '1998-02-01',
              .035, NULL, '401K', .04, 1700.00,0 ,0 , 'JRCOLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
     VALUES (1997, 2004, 160, 160, 15, 3.5, 0,0, '1997-02-15',
                .03, NULL, NULL, NULL, 1600.00,0 ,0 , 'JRCOLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 4456, 80, 80, 15, 3, 0,0, '1999-02-05',
                .03, NULL, NULL, NULL, 650.00,0 ,0 , 'HSDIP',
                'MC655-6680', 84.05);
```

```
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 4456, 80, 80, 10, 0, 0,0, '1998-02-17',
                .02, NULL, NULL, NULL, 700.00,0 ,0 , 'HSDIP',
                'MC655-6680', 79.62);
INSERT INTO DEMOEMPL.BENEFITS
        values (1997, 4456, 48, 48, 8, 1, 0   , 0   , null, null,
                NULL, NULL, NULL, NULL, 0,0 , 'HSDIP',
                'MC655-6680', 70.00);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 3288, 120, 120, 15, 9,0 ,0, '1999-02-01',
                .035, NULL, NULL, NULL, 1380.00,0 ,0 , 'HSDIP',
                'MC655-4402', 84.05);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 3288, 120, 120, 15, 8,0 ,0, '1998-02-03',
                .035, NULL, NULL, NULL, 1250.00,0 ,0 , 'HSDIP',
                'MC655-4402', 79.62);
INSERT INTO DEMOEMPL.BENEFITS
       VALUES (1997, 3288, 120, 120, 15, 11,0 ,0, '1997-01-28',
                .03, NULL, NULL, NULL, 1000.00, 0,0 , 'HSDIP',
                'MC655-4402', 70.00);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 3341, 120, 120, 15, 9,0 ,0, '1999-07-25',
                .05, NULL, '401K', .06, 1350.00,0,0, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 3341, 120, 116, 15, 8, 0,0, '1998-07-26',
                .06, null, '401K', .05, 1400.00, 16, 16, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
      VALUES (1997, 3341, 120, 120, 15, 6.5, 0,0, '1997-07-15',
                .04, NULL, NULL, NULL, 900.00, 0,0 , 'JRCOLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 2209, 120, 120, 15, 6, 0,0, '1999-07-02',
                .05, NULL, '401K', .05, 1200.00,0,0, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 2209, 120, 120, 15, 7,0 ,0, '1998-06-17',
                .05, NULL, '401K', .05, 1200.00,0,0, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 2209, 120, 120, 15, 3, 0,0, '1997-06-28',
                .045, null, null, null, 1550.80, 8, 8, 'COLL',
                null, null);

INSERT INTO DEMOEMPL.BENEFITS
       VALUES (1999, 3294, 120, 120, 15, 10, 0,0, '1999-02-20',
                .05, NULL, '401K', .03, 1380.00,0,0, 'COLL',
                null, null);
```

```
INSERT INTO DEMOEMPL.BENEFITS
       VALUES (1998, 3294, 120, 120, 15, 13, 0,0, '1998-01-28',
                .05, NULL, '401K', .03, 1100.00,0,0, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 3294, 120, 120, 15, 3, 0,0, '1997-02-04',
                .05, NULL, '401K', .02, 1150.00,0,0, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 3338, 120, 120, 15, 0, 0,0, '1999-07-17',
                .05, NULL, NULL, NULL, 1200.00, 0,0 , 'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 3338, 120, 120, 15, 1,0 ,0, '1998-07-19',
                .045, NULL, NULL, NULL, 1130.00,0 ,0 , 'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 3338, 120, 120, 15, 2, 0,0, '1997-07-08',
                .05, NULL, NULL, NULL, 950.70, 0,0 , 'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 2174, 160, 160, 15, 9, 0,0, '1999-09-26',
                .055, NULL, '401K', .04, 1900.00,0 ,0 , 'JRCOLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 2174, 160, 160, 15, 11, 0,0, '1998-09-10',
                .05, NULL, '401K', .03, 1600.00, 0,0 , 'JRCOLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 2174, 120, 120, 15, 8, 0,0, '1997-09-09',
                .06, NULL, NULL, NULL, 1120.90, 0,0 , 'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1999, 3118, 120, 120, 15, 3, .05, 2000, '1999-11-02',
                .04, NULL, 'BONDS', .08, 1350.60,0,0, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 3118, 120, 112, 15, 8, 0,0, '1998-11-16',
                .04, NULL, 'BONDS', .07, 1200.00,0,0, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 3118, 120, 120, 15, 6,0 ,0, '1997-11-30',
                .04, NULL, 'STOCK', .06, 1100.00,0,0, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1999, 3222, 120, 120, 15, 6, .04, 1780, '1999-01-16',
               .06, '1999-06-08', '401K', .06, 1200.00, 32, 16, 'MAS',
                null, null);
```

```
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 3222, 120, 120, 15, 4,0 ,0, '1998-01-28',
               .06, null, '401K', .06, 1150.00, 48, 8.5, 'MAS',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 3222, 120, 120, 15, 7, 0,0, '1997-01-13',
                .05, null, '401K', .05, 980.00, 16, 16, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1999, 4321, 120, 96, 15, 2, .05, 1720, '1999-08-24',
                .055, null, null, null, 1100.00, 16, 16, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 4321, 80, 80, 15, 4, 0,0, '1998-08-29',
                .05, NULL, NULL, NULL, 980.00,0,0, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 4321, 80, 80, 10, 4,0 ,0, '1997-08-08',
                .04, NULL, NULL, NULL, 850.00,0,0, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 2461, 120, 112, 15, 0, 0,0, '1999-09-18',
                .05, NULL, NULL, NULL, 1950.00, 0,0 , 'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 2461, 120, 120, 15, 4, 0,0, '1998-09-01',
                .04, null, null, null, 1830.00, 48, 48, 'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 2461, 120, 120, 15, 3, 0,0, '1997-09-18',
                .035, NULL, NULL, NULL, 1600.00,0 ,0 , 'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 3841, 120, 120, 15, 1,0 ,0, '1999-10-05',
               .06, NULL, 'BONDS', .05, 1200.00,0 ,0 , 'JRCOLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 3841, 120, 120, 15, 3,0 ,0, '1998-10-31',
                .05, NULL, 'BONDS', .05, 1020.00,0  ,0 , 'JRCOLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 3841, 80, 80, 15, 2,0 ,0, '1997-10-11',
                .07, NULL, NULL, NULL, 980.00,0  ,0 , 'JRCOLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
       VALUES (1999, 4002, 120, 120, 15, 3,0 ,0, '1999-12-01',
                .05, NULL, NULL, NULL, 1630.00,0 ,0 , 'HSDIP',
                null, null);
```

```
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 4002, 120, 120, 15, 6, 0,0, '1998-12-05',
                .04, NULL, NULL, NULL, 1400.00, 0,0 , 'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 4002, 80, 80, 15, 5, 0,0, '1997-12-01',
                .04, NULL, NULL, NULL, 1380.00,0 ,0 , 'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1999, 1003, 160, 56, 15, 0, .10, 11500, null,
                .05, NULL, '401K', .10, NULL, 0,0 , 'MAS',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1998, 1003, 160, 80, 15, 0, .10, 10000, null,
                .05, NULL, '401K', .10, NULL, 0,0 , 'MAS',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1997, 1003, 160, 40, 15, 0, .10, 10000, null,
                .05, NULL, '401K', .10, NULL, 0, 0, 'MAS',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1999, 5103, 12, 12, 2, 0, 0   , 0   , null, null,
                NULL, NULL, NULL, NULL, 0,0 , 'HSDIP',
                'HP302-8403', 54.86);
INSERT INTO DEMOEMPL.BENEFITS
        values (1999, 2466, 120, 120, 15, 9, .05, 2650, '1999-10-26',
                .05, null, '401K', .03, 1800.00, 16, 16, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
      VALUES (1998, 2466, 120, 112, 15, 11, 0,0, '1998-10-18',
                .04, NULL, NULL, NULL, 1300.00,0,0, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
      VALUES (1997, 2466, 120, 120, 15, 10,0 ,0, '1997-10-10',
                .035, NULL, NULL, NULL, 980.00,0  ,0 , 'JRCOLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 3449, 120, 120, 15, 8, 0,0, '1999-12-08',
                .04, NULL, NULL, NULL, 240.50,0,0, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 3449, 120, 104, 15, 8, 0,0, '1998-12-02',
                .05, NULL, NULL, NULL, 1100.00,0,0, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 3449, 120, 112, 15, 9,0 ,0, '1997-12-18',
                .03, NULL, NULL, NULL, 080.00,0,0, 'COLL',
                null, null);
```

```
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 2781, 120, 120, 15, 8, 0,0, '1999-04-11',
                .05, NULL, '401K', .03, 1700.00,0,0, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 2781, 120, 96, 15, 15, 0,0, '1998-04-26',
                .05, NULL, '401K', .03, 1450.80,0,0, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 2781, 120, 120, 15, 2,0 ,0, '1997-04-18',
                .05, NULL, NULL, NULL, 1100.00,0,0, 'COLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 2894, 120, 48, 15, 1,0 ,0, '1999-05-01',
                .05, null, 'STOCK', .08, 1920.00, 16, 0, 'MAS',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1998, 2894, 120, 40, 15, 0,0 ,0, '1998-05-18',
                .08, null, 'STOCK', .08, 1750.00, 32, 32, 'MAS',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1997, 2894, 120, 0, 15, 0, 0,0, '1997-05-11',
                .06, null, 'STOCK', .08, 1600.00, 16, 8, 'MAS',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        VALUES (1999, 3411, 120, 120, 15, 3, 0,0, '1999-10-10',
                .04, NULL, '401K', .03, 1350.00,0  ,0 , 'JRCOLL',
                null, null );
INSERT INTO DEMOEMPL.BENEFITS
       VALUES (1998, 3411, 120, 120, 15, 15, 0,0, '1998-09-10',
               .04, NULL, '401K', .03, 1250.00, 0 ,0 , 'JRCOLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
      VALUES (1997, 3411, 120, 120, 15, 15,0 ,0, '1997-09-28',
                .03, NULL, NULL, NULL, 1100.00,0 ,0 , 'JRCOLL',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1999, 4358, 120, 112, 15, 2, .07, 1300, '1999-10-01',
                .055, NULL, NULL, NULL, 790.80, 0,0 , 'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1998, 4358, 120, 80, 15, 0, .07, 1230, '1998-09-15',
                .055, NULL, NULL, NULL, 820.00, 0,0 , 'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1997, 4358, 80, 80, 15, 14.5, .06, 980, '1997-09-26',
                .055, NULL, NULL, NULL, 700.00,0 ,0 , 'HSDIP',
                null, null);
```

```
INSERT INTO DEMOEMPL.BENEFITS
        values (2000, 1234, 92, 40, 8, 12, .05, 9800, '2000-04-18',
             .06, '1998-07-10', 'BONDS', .10, 1750.00, 72, 0, 'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1999, 1234, 160, 16, 15, 0, .05, 8870, '1999-04-26',
            .07, '1998-07-10', 'BONDS', .08, 1600.00, 48, 0, 'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1998, 1234, 160, 32, 15, 0, .05, 8440, '1998-04-10',
             .06, '1998-07-10', 'BONDS', .07, 1600.00, 56, 0, 'HSDIP',
                null, null);
INSERT INTO DEMOEMPL.BENEFITS
        values (1997, 1234, 160, 0, 15, 0, .05, 7690, '1997-04-01',
                .06, null, 'BONDS', .06, 1580.50, 48, 0, 'HSDIP',
                null, null);

INSERT INTO DEMOEMPL.INSURANCE_PLAN
      values ('PLI', 'Providential Life Insurance',
              '950 Gibraltar Ave', 'Lisbon', 'VA', '03097',
         '7033548300', 7815, null, 1000000, null, null, '1988-02-01');
INSERT INTO DEMOEMPL.INSURANCE_PLAN
      values ('HHM', 'Homeostasis Health Maintenance Program',
              '57 Goodwill Blvd', 'Bellingham', 'MA', '01988',
            '5083535600', 2867, 300, 100000, 30, NULL, '1992-01-03');
INSERT INTO DEMOEMPL.INSURANCE_PLAN
      values ('HGH', 'Holistic Group Health Association',
              '2 Technology Park', 'Winnetka', 'IL', '06060',
              '9413865700', 9471, NULL, 900000, 10, 5, '1992-01-08');
INSERT INTO DEMOEMPL.INSURANCE_PLAN
      values ('DAS', 'Dental Associates',
              '52 Dedham Pl', 'Medford', 'MA', '03032',
            '6174445362', 5598, 50, 15000, NULL, NULL, '1993-01-04');
INSERT INTO DEMOEMPL.COVERAGE values ('PLI', 2096, '1995-03-03',
 null, 1);
INSERT INTO DEMOEMPL.COVERAGE values ('HHM', 2096, '1995-03-03',
 null, 3);
INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 2096, '1995-03-03',
 null, 3);
INSERT INTO DEMOEMPL.COVERAGE values ('HHM', 2437, '1995-03-15',
 null, 2);
INSERT INTO DEMOEMPL.COVERAGE values ('HGH', 2598, '1997-07-25',
 null, 1);
INSERT INTO DEMOEMPL.COVERAGE values ('HGH', 3433, '1993-12-31',
 null, 1);
INSERT INTO DEMOEMPL.COVERAGE values ('HHM', 3433, '1993-11-01',
```

```
 '1993-12-31', 1)  ;
INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 3433, '1993-12-31',
 null, 1);
INSERT INTO DEMOEMPL.COVERAGE values ('HHM', 3778, '1998-01-21',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 3778, '1998-01-21',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE values ('HHM', 1034, '1992-06-01',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 1034, '1993-12-01',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE values ('HHM', 2424, '1993-07-24',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE values ('HGH', 4456, '1994-01-04',
 null, 1);
INSERT INTO DEMOEMPL.COVERAGE values ('HHM', 3288, '1993-06-12',
 null, 1);

INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 3288, '1993-12-01',
 null, 1);
INSERT INTO DEMOEMPL.COVERAGE values ('HHM', 3341, '1993-10-02',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 3341, '1997-01-01',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE values ('HGH', 2209, '1992-08-12',

 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 2209, '1993-12-01',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE values ('HHM', 3294, '1993-02-19',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE values ('HHM', 3338, '1994-12-11',
 null, 2);
INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 2299, '1996-01-01',
 null, 1);
INSERT INTO DEMOEMPL.COVERAGE values ('PLI', 3199, '1995-10-20',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE values ('HHM', 3199, '1995-10-20',
 null, 2);
INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 3199, '1995-10-20',
```

```
 null, 2);
INSERT INTO DEMOEMPL.COVERAGE values ('PLI', 4001, '1995-12-11',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE values ('HGH', 4001, '1997-01-01',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE values ('PLI', 4008, '1996-01-23',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 4008, '1996-01-23',
 null, 1);
INSERT INTO DEMOEMPL.COVERAGE values ('PLI', 4962, '1997-10-04',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 4962, '1997-12-01',
 null, 4);
INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 3764, '1994-08-25',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE values ('HHM', 5090, '1998-07-12',
 null, 3);
INSERT INTO DEMOEMPL.COVERAGE values ('PLI', 4027, '1996-04-01',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE values ('HHM', 3991, '1994-11-12',
 '1995-12-31',5) ;

INSERT INTO DEMOEMPL.COVERAGE values ('HGH', 3991, '1996-01-01',
 null, 5);
INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 3991, '1994-11-12',
 null, 5);
INSERT INTO DEMOEMPL.COVERAGE values ('HGH', 1765, '1992-06-01',
 null, 2);
INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 1765, '1993-12-01',
 null, 2);
INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 4773, '1995-10-14',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE values ('PLI', 3767, '1994-09-20',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE values ('HHM', 3767, '1994-09-20',
 null, 2);
INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 3767, '1995-01-01',
 null, 2);
INSERT INTO DEMOEMPL.COVERAGE values ('PLI', 2448, '1992-01-01',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 2448, '1993-12-01',
 null, 3);
```

```
INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 3704, '1997-01-01',
 null, 3);
INSERT INTO DEMOEMPL.COVERAGE VALUES ('HGH', 4703, '1997-03-19',
 null, 1);
INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 4703, '1997-03-19',
 null, 1);
INSERT INTO DEMOEMPL.COVERAGE values ('HHM', 2246, '1992-06-01',
 null, 2);
INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 2246, '1998-01-01',
 null, 2);
INSERT INTO DEMOEMPL.COVERAGE values ('HHM', 5008, '1998-01-31',
 null, 2);
INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 5008, '1998-01-31',
 null, 2);
INSERT INTO DEMOEMPL.COVERAGE values ('HHM', 1234, '1993-06-01',
 null, 5);
INSERT INTO DEMOEMPL.COVERAGE values ('HGH', 2174, '1995-03-30',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE values ('HGH', 3118, '1995-07-23',
 null, 1);
INSERT INTO DEMOEMPL.COVERAGE values ('DAS', 3222, '1995-10-01',
 null, 2);
INSERT INTO DEMOEMPL.COVERAGE VALUES ('PLI', 1003, '1988-02-01',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE VALUES ('HHM', 1003, '1992-06-01',
 null, 3);
INSERT INTO DEMOEMPL.COVERAGE VALUES ('DAS', 1003, '1993-12-01',
 null, 3);
INSERT INTO DEMOEMPL.COVERAGE VALUES ('PLI', 5103, '1999-10-11',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE VALUES ('HHM', 5103, '1999-10-11',
 null, 1);
INSERT INTO DEMOEMPL.COVERAGE VALUES ('DAS', 5103, '1999-10-11',
 null, 1);
INSERT INTO DEMOEMPL.COVERAGE VALUES ('PLI', 2781, '1995-09-27',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE VALUES ('DAS', 2781, '1998-01-01',
 null, 2);
INSERT INTO DEMOEMPL.COVERAGE VALUES ('PLI', 2894, '1995-11-12',
 NULL, 0   );
INSERT INTO DEMOEMPL.COVERAGE VALUES ('HGH', 2894, '1995-11-12',
 null, 3);
INSERT INTO DEMOEMPL.COVERAGE VALUES ('DAS', 2894, '1995-11-12',
 null, 3);
INSERT INTO DEMOEMPL.COVERAGE VALUES ('HGH', 3411, '1997-01-30',
null, 3);
INSERT INTO DEMOEMPL.COVERAGE VALUES ('DAS', 3411, '1997-01-30',
null, 3);
```

```
INSERT INTO DEMOEMPL.COVERAGE VALUES ('HHM', 4358, '1996-09-13',
null, 1);
INSERT INTO DEMOEMPL.COVERAGE VALUES ('DAS', 4358, '1996-09-13',
null, 1);

INSERT INTO DEMOPROJ.ASSIGNMENT
        VALUES (2466, 'D880', '1999-11-01', NULL);
INSERT INTO DEMOPROJ.ASSIGNMENT
        values (2894, 'P634', '2000-02-15', null);
INSERT INTO DEMOPROJ.ASSIGNMENT
        values (3411, 'P634', '2000-03-01', null);
INSERT INTO DEMOPROJ.ASSIGNMENT
        VALUES (4358, 'C240', '1998-06-01', '1998-08-15') ;

UPDATE DEMOEMPL.DIVISION
      SET DIV_HEAD_ID =2180
      WHERE  DIV_CODE = 'D02';
UPDATE DEMOEMPL.DIVISION
      SET DIV_HEAD_ID =2010
      WHERE  DIV_CODE = 'D04';
UPDATE DEMOEMPL.DIVISION
      SET DIV_HEAD_ID =4321
      WHERE  DIV_CODE = 'D06';
UPDATE DEMOEMPL.DIVISION
      SET DIV_HEAD_ID =1003
      WHERE  DIV_CODE = 'D09';
UPDATE DEMOEMPL.DEPARTMENT
      SET DEPT_HEAD_ID =3082
      WHERE  DEPT_ID = 3510 ;
UPDATE DEMOEMPL.DEPARTMENT
      SET DEPT_HEAD_ID =2180
      WHERE  DEPT_ID = 2200 ;
UPDATE DEMOEMPL.DEPARTMENT
      SET DEPT_HEAD_ID =2246
      WHERE  DEPT_ID = 1100 ;
UPDATE DEMOEMPL.DEPARTMENT
      SET DEPT_HEAD_ID =3769
      WHERE  DEPT_ID = 3520 ;
UPDATE DEMOEMPL.DEPARTMENT
      SET DEPT_HEAD_ID =2010
      WHERE  DEPT_ID = 2210 ;
UPDATE DEMOEMPL.DEPARTMENT
      SET DEPT_HEAD_ID =1003
      WHERE  DEPT_ID = 4200 ;
UPDATE DEMOEMPL.DEPARTMENT
      SET DEPT_HEAD_ID =1765
      WHERE  DEPT_ID = 1110 ;
```

```
UPDATE DEMOEMPL.DEPARTMENT
      SET DEPT_HEAD_ID =2004
      WHERE  DEPT_ID = 1120 ;
UPDATE DEMOEMPL.DEPARTMENT
      SET DEPT_HEAD_ID =2096
      WHERE  DEPT_ID = 4600 ;
UPDATE DEMOEMPL.DEPARTMENT
      SET DEPT_HEAD_ID =2209
      WHERE  DEPT_ID = 3530 ;
UPDATE DEMOEMPL.DEPARTMENT
      SET DEPT_HEAD_ID =2598
      WHERE  DEPT_ID = 5100 ;
UPDATE DEMOEMPL.DEPARTMENT
      SET DEPT_HEAD_ID =2461
      WHERE  DEPT_ID = 6200 ;
UPDATE DEMOEMPL.DEPARTMENT
      SET DEPT_HEAD_ID =2894
      WHERE  DEPT_ID = 5200 ;
UPDATE DEMOEMPL.DEPARTMENT
      SET DEPT_HEAD_ID =2466
      WHERE  DEPT_ID = 5000 ;
UPDATE DEMOEMPL.DEPARTMENT
      SET DEPT_HEAD_ID =2466
      WHERE  DEPT_ID = 4900 ;
UPDATE DEMOEMPL.DEPARTMENT
      SET DEPT_HEAD_ID =1003
      WHERE  DEPT_ID = 6000 ;
UPDATE DEMOEMPL.DEPARTMENT
      SET DEPT_HEAD_ID =3222
      WHERE  DEPT_ID = 4500 ;

COMMIT WORK RELEASE;
```

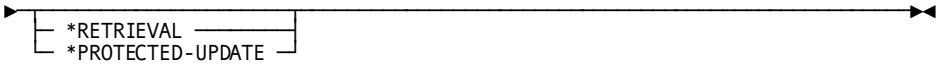
Appendix C: Precompiler Directives

Information about CA IDMS precompiler directives that are not associated with SQL statements and host variable declarations is presented in this section.

This section contains the following topics:

Overriding DDLDML Area Ready Mode

Syntax



Parameters

***RETRIEVAL**

Overrides the default ready mode for the DDLDML area of the dictionary by specifying that the area is to be readied for retrieval only. This allows concurrent database transactions to access the area in shared retrieval, shared update, protected retrieval, or protected update modes.

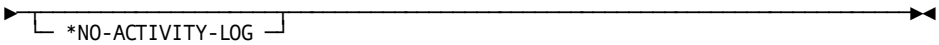
***PROTECTED-UPDATE**

Overrides the default ready mode for the DDLDML area of the dictionary by specifying that the area is to be readied for both retrieval and update. This allows concurrent database transactions to ready the area in shared retrieval mode only. The protected update usage mode prevents concurrent update of the area.

The dictionary ready override statement is printed on the source listing but is not passed to the COBOL compiler.

No Logging of Program Activity Statistics

Syntax



Parameters

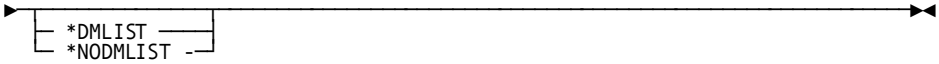
***NO-ACTIVITY-LOG**

Suppresses the logging of program activity statistics. The precompiler generates and logs the following program activity statistics unless the *NO-ACTIVITY-LOG option is specified:

- Program name
- Language
- Date last compiled
- Number of lines
- Number of compilations
- Date created
- Schema name
- File statistics
- Database access statistics

Generating a Source Listing

Syntax



Parameters

***DMLIST**

Specifies that the source listing is to be generated for the statements that follow.

*DMLIST overrides a previous *NODMLIST directive and the NOLIST precompiler parameter.

***NODMLIST**

Specifies that the source listing is not to be generated for the statements that follow.

*NODMLIST overrides a previous *DMLIST directive and the LIST precompiler parameter.

Usage

Column Position

Precompiler directives must be coded beginning in column 7.

Default Ready Mode

The default ready for the DDLDML area mode is shared update. Shared update readies the area for both retrieval and update and allows concurrent database transactions to ready the DDLDML area in shared update or shared retrieval.

Program Activity Statistics

Program activity statistics will not be logged if the DDLDML area is readied for retrieval only.

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