

# Dr. DeeBee<sup>®</sup> ODBC Driver Kit (Silver Edition)

## Overview

The Dr. DeeBee ODBC Driver Kit (Silver Edition) contains the complete C/C++ source code for a fully functional ODBC driver (Level 1 API, minimum SQL grammar). Programmers can modify this source code to provide ODBC access their own proprietary databases.

The source code provides a complete ODBC driver implementation. The driver has the following limitations:

- Only minimum level SQL is supported, with some additional core level SQL functionality. See Appendix A for the SQL grammar supported.
- Only the level 1 ODBC API calls are supported, plus a few additional level 2 functions (like SQLPrimaryKeys and SQLForeignKeys)
- Column and table names are not case-sensitive (this can easily be changed). String data comparisons are case sensitive.
- Character and binary values supplied for parameterized queries (SELECT \* FROM EMP WHERE NAME = ?) are limited to 255 bytes.
- Qualifiers or owners are not allowed on databases, tables, etc.
- There is limited query optimization. No indexes are used, although there are hooks in place to allow you to use indexes.

In the source code provided, simple dBASE files (dBASE files without indexes or memos) are used as the underlying database. All dBASE specific code is isolated to two modules: ISAM.C and DBASE.C.

Our initial testing shows that this driver will work with off-the-shelf applications such as Access, Visual Basic, PowerBuilder, MFC, Visual C/C++, etc. If you encounter problems, please let us know.

## New Features in the Silver Edition

This release adds the following new features to the Bronze Edition:

- Transactions.
- Nested sub-selects.
- Outer joins (including multi-tier outer joins).
- Scalar functions.
- CREATE INDEX and DROP INDEX.

- `SQLForeignKeys()` and `SQLPrimaryKeys()`.
- The code can be compiled as C or C++.
- The + operator can be used in SQL statements for string concatenation
- Scientific notation (1.23E+45) can be used.

See Appendix B for notes on how to migrate from the Bronze Edition to the Silver Edition.

## What You Need

In addition to the Dr. DeeBee ODBC Driver Kit (Silver Edition), you will need the following to build and distribute your ODBC driver:

- A C/C++ compiler such as Microsoft Visual C++.
- The ODBC SDK. The ODBC SDK is available directly from Microsoft as part of MSDN Level 2. Call Microsoft at 1-800-759-5474 or 1-206-882-8080 for more information. At the time of this writing, the ODBC SDK was also posted on the Microsoft web site at <http://www.microsoft.com/odbc/download/>.

It is assumed that the user has working knowledge of what ODBC is, the ODBC API, how to use ODBC, etc. Recommended reading in these areas is:

- *Windows Multi-DBMS Programming*; Ken North; John Wiley & Sons; 1995
- *Inside ODBC*; Kyle Geiger; MS Press; expected June 1995
- *The ODBC Solution*; Robert Signore, John Creamer, Micheal O. Stegman; McGraw-Hill; 1995
- *Microsoft ODBC 2.0 Programmer's Reference and SDK Guide*; Microsoft Press; 1994

## SYWARE Support

Included with your purchase is one hour of telephone support at 617-497-1300. Additional telephone support is available on a fee-per-event basis. Questions can also be E-mailed to [support@syware.com](mailto:support@syware.com).

If you find bugs or have other feedback, we welcome your comments. Please E-mail them to [support@syware.com](mailto:support@syware.com).

## Installing the Dr. DeeBee ODBC Driver Kit (Silver Edition)

### **WARNING:**

**If you are installing over a previous version of the kit, backup any old installation of the kit before installing. The installation overwrites everything in any previous installation without making any backup files.**

To install the Dr. DeeBee ODBC Driver Kit (Silver Edition), do the following:

- Install your C compiler.
- Install the ODBC SDK.
- Put the installation disk in drive A: and run SETUP.EXE.

Once installed, you will see the following:

C:\DRDBDR	- Your installation directory (the default)
C:\DRDBDR\SOURCE	- ODBC driver source code
C:\DRDBDR\SETUP	- 16-bit ODBC driver DLL and installer
C:\DRDBDR\SETUP32	- 32-bit ODBC driver DLL and installer

C:\DRDBDR\SETUP\DRDBDR.DLL is a 16-bit compiled version of the source code found in C:\DRDBDR\SOURCE. C:\DRDBDR\SETUP32\DRDBDR32.DLL is a 32-bit compiled version of the source code found in C:\DRDBDR\SOURCE.

## Getting Started

You will probably want to start by rewriting ISAM.C to read and write data from your database (rather than dBASE files). Once this is done, you will have an ODBC driver for your DBMS or file format with the same limitations specified in the Overview section above. See Appendix C for a suggested strategy on how to implement ISAM.C.

After this is done, you can add functionality to your driver by modifying the rest of the code.

## Distributing Your Driver

Except for DRDBDR.DLL and DRDBDR32.DLL; none of the components in the Dr. DeeBee ODBC Driver Kit (Silver Edition) are redistributable. The driver you create using the kit (in the form of a DLL) is redistributable royalty-free in most cases. See your license (Appendix D) for more details.

If you copy C:\DRDBDR\SETUP\\*. \* to a diskette, you will have a setup disk that will load the 16-bit Dr. DeeBee ODBC Sample Driver. If you copy C:\DRDBDR\SETUP32\\*. \* to a diskette, you will have a setup disk that will load the 32-bit Dr. DeeBee ODBC Sample Driver. However, your license agreements with SYWARE only allows you to redistribute DRDBDR.DLL and DRDBDR32.DLL. Your right to redistribute the other components in C:\DRDBDR\SETUP and C:\DRDBDR\SETUP32 can be obtained from your ODBC SDK license.

To create a setup disk for your 16-bit driver, do the following:

- Delete C:\DRDBDR\SETUP\DRDBDR.DLL.
- Copy your DLL into C:\DRDBDR\SETUP.
- Edit C:\DRDBDR\SETUP\ODBC.INF as follows:
  - In the section [Dr. DeeBee Sample Driver 16], change DRDBDR.DLL to the name of your DLL, change 1997-05-01 to the date on your DLL, and change 233808 to the size of your DLL.
  - Search for "Dr. DeeBee" elsewhere in the ODBC.INF and make the appropriate changes.

To create a setup disk for your 32-bit driver, do the same in the C:\DRDBDR\SETUP32 directory.

## Using C++

The kit, as installed, assumes C (not C++) compiles. If your underlying database API happens to be C++, you might want to compile the driver kit as C++. The code was written such that it will compile either way. All you have to do is change the module names from \*.C to \*.CPP. Two batch files (C\_TO\_CPP.BAT and CPP\_TO\_C.BAT) are provided for this purpose.

## ODBC Data Types

The Dr. DeeBee ODBC Driver Kit (Silver Edition) can support any of the ODBC data types (SQL\_CHAR, SQL\_INTEGER, etc.) The data types your driver will support depends on your underlying database. As installed, the Dr. DeeBee ODBC Driver Kit (Silver Edition) supports the dBase data types (SQL\_BIT, SQL\_CHAR, SQL\_DATE, and SQL\_DECIMAL).

There is a table of types in SQLTYPE.C, one entry for each ODBC datatype. Specify which types your driver supports by modifying this table. If your underlying database does not support one of the ODBC datatypes in this table, **do not remove the entry from this table**. Instead, just set the value of the 'supported' element in the structure to FALSE.

If your database has two datatypes that you want to map onto the same ODBC type (this happens sometimes, you'll know when it does), add extra entries to the table. Just make sure that the "more general" entry for any given ODBC data type comes first.

See the comments in `SQLTYPE.C` for more details.

## Sorting

Sorting is used to implement the `ORDER BY` and `GROUP BY` clauses of a `SELECT` statement. The Dr. DeeBee ODBC Driver Kit (Silver Edition) sorts in two ways: pushdown sorts and upper-level sorts.

The pushdown sort is implemented by pushing the sorting functionality down to the ISAM layer. If the upper layers of the system determine that a pushdown sort can be used, it calls `ISAMSort()`. If the ISAM layer can implement the sort, the ISAM layer returns a status of `NO_ISAM_ERR` and a pushdown sort is done.

If the upper layers of the system determine that a pushdown sort cannot be used, or if an `ISAMSort()` call of a pushdown sort returns a status other than `NO_ISAM_ERR`, an upper-level sort is done.

## Use of Indexes

To solve a query, the upper levels of the system opens a table and retrieves the records in the table. For each record retrieved, it tests the selection criteria specified and filters out the records that do not meet the criteria. This filtering can be pushed down to the ISAM layer. When this is done, the query would take less time to execute since fewer records would have to be processed by the upper levels.

This section describes this pushdown mechanism in general terms. For details, see the documentation of `ISAM.H` (in particular, `ISAMOpenTable()`, `ISAMRestrict()`, `ISAMNextRecord()`, and the declaration of `COLUMNDEF`).

When the upper levels of the system calls the ISAM layer to open a table, the ISAM layer returns the name and type of each of the columns. In addition to this information, the ISAM layer also returns the selectivity of each column. The selectivity is an indication of how selective the column is (for example, `RECORD_ID` would be very selective, `NAME` would be moderately selective, `ZIPCODE` would not be very selective).

When the upper levels of the system receives a query, it walks the predicate to find the selective clauses (based on the selectivity specified when the table was opened). After the upper levels of the system open the table, but before any records are retrieved from the table, it passes these clauses down to the ISAM layer to tell the ISAM layer "you only need to return records that satisfy this criteria". It then starts to retrieve the records from the ISAM layer. A typical ISAM implementation will use its indexes to decide which records should returned.

For example, suppose the query is:

```
SELECT * FROM ORDERS, ITEMS WHERE ORDER.ID = ITEM.ORDERID
```

the tables are:

ORDERS		ITEMS	
NAME	ID	ORDERID	ITEM
-----	--	-----	-----
FRED	77	77	MILK
BILL	99	77	CHEESE
		99	EGGS

Also assume that the selectivity of ITEMS.ORDERID (as return by ISAMOpenTable()) is non-zero.

In this case, the system would generate the following sequence of ISAM calls:

```
ISAMOpenTable(ORDERS)
ISAMOpenTable(ITEMS)
ISAMRewind(ORDERS)
  ISAMNextRecord(ORDERS) (which positions to FRED's record)
  ISAMRestrict(ITEMS, ORDERID == 77)
  ISAMRewind(ITEMS)
    ISAMNextRecord(ITEMS) (which positions to the MILK record)
    ISAMNextRecord(ITEMS) (which positions to the CHEESE record)
    ISAMNextRecord(ITEMS) (which returns end-of-file)
  ISAMNextRecord(ORDERS) (which positions to BILL's record)
  ISAMRestrict(ITEMS, ORDERID == 99)
  ISAMRewind(ITEMS)
    ISAMNextRecord(ITEMS) (which positions to the EGGS record)
    ISAMNextRecord(ITEMS) (which returns end-of-file)
  ISAMNextRecord(ORDERS) (which returns end-of-file)
ISAMCloseTable(ORDERS)
ISAMCloseTable(ITEMS)
```

## Transactions

Transactions are supported to the extent they are supported by the underlying database. For example, if you were building a driver for a true relational engine (such as Oracle or SQL Server), the transaction mechanism implemented by the engine could be used to implement transactions in the driver. On the other hand, if you were building a driver for simple text files, transactions would not be supported since regular file input/output does not support transaction operations such as commit or rollback.

Exposing the underlying database's transaction capabilities is relatively straight forward. Initially, you specify the transaction capabilities of your underlying system. There are a variety of options ranging from "transactions are not supported" to "full transaction support". If you specify that transactions are supported, they are initiated implicitly by calls to ISAM layer. The ISAM layer receives explicit calls to commit or rollback a transaction.

Transactions are described in detail in ISAM.H.

## Passthrough SQL

Before an SQL query is processed by the upper levels of the system, it is first passed to ISAMPrepare(). This gives the ISAM layer the option of passing it to a SQL backend or having the upper levels of the system process it.

ISAMPrepare() responds in one of three ways:

1. It indicates that the upper levels of the system should process the query.
2. It indicates that the query will be processed by the backend and no result set will be returned (for example, an INSERT statement).
3. It indicates that the query will be processed by the backend and a result set will be returned (for example, a SELECT statement).

If a result set is returned, it is returned like any other table. The ISAMPrepare() call returns the name of this virtual table. The upper level of the system will process a "SELECT \* FROM <virtual-table>" to retrieve the values.

After ISAMPrepare() is called, ISAMExecute() is called to actually run the query. ISAMExecute() may be called several times after a single call to ISAMPrepare(). When the upper levels of the system no longer needs the query, ISAMFreeStatement() is called.





- SQLColumnPrivileges
- SQLSpecialColumns
- SQLPrimaryKeys
- SQLForeignKeys
- SQLProcedures
- SQLProcedureColumns

CONNECT.C - ODBC entry points for database connection functions:

- SQLAllocEnv
- SQLAllocConnect
- SQLConnect
- SQLDriverConnect
- SQLBrowseConnect
- SQLDisconnect
- SQLFreeConnect
- SQLFreeEnv

EXECUTE.C - ODBC entry points for SQL execution functions:

- SQLExecute
- SQLExecDirect
- SQLNativeSql
- SQLParamData
- SQLPutData
- SQLCancel

INFO.C - ODBC entry points for informational functions:

- SQLGetInfo
- SQLGetTypeInfo
- SQLGetFunctions

OPTIONS.C - ODBC entry points for connection and statement option functions:

- SQLSetConnectOption
- SQLSetStmtOption
- SQLGetConnectOption
- SQLGetStmtOption

PREPARE.C - ODBC entry points for query preparation setup functions:

- SQLAllocStmt
- SQLFreeStmt
- SQLPrepare
- SQLBindParameter
- SQLDescribeParam
- SQLParamOptions

SQLNumParams  
SQLSetScrollOptions  
SQLSetCursorName  
SQLGetCursorName

RESULTS.C - ODBC entry points for result retrieval functions:

SQLNumResultCols  
SQLDescribeCol  
SQLColAttributes  
SQLBindCol  
SQLFetch  
SQLGetData  
SQLMoreResults  
SQLRowCount  
SQLSetPos  
SQLExtendedFetch  
SQLError

SORT.C - Sorting operations.

TRANSACTION.C - ODBC entry points for transaction functions:

SQLTransact

DLL.C - LibMain, etc.

PARSE.C - Parses SQL statement (as a text string) and creates a parse tree. This module implements a recursive descent parser for SQL.

SEMANTIC.C - Check a parse tree for semantic correctness. This module also contains a routine to display parse trees on the debug monitor.

OPTIMIZE.C - Query optimizer. Currently the only optimization done is to find restrictions on tables to cut down the search space.

EVALUATE.C - Evaluates SQL expressions and executes SQL statements.

COLDEFS.C - This module contains the definition of the columns returned by the virtual tables returned by the catalog functions and SQLGetTypeInfo(). It is unlikely you will ever need to modify these.

SQLTYPE.C - Definition of the SQL types supported by the driver. As installed, the Dr. DeeBee ODBC Driver Kit (Silver Edition) supports SQL\_BIT, SQL\_CHAR, SQL\_DATE,

and SQL\_DECIMAL. If you want your driver to support other types, modify the entries in the tables in this module. See the comments in SQLTYPE.C.

BCD.C- Operations to compare, negate, add, subtract, multiply, and divide Binary Coded Decimal values.

SCALAR.C- Implementation of scalar functions.

ISAM.C - Low level record access interface. The majority of the work needed to access data in a format other than dBASE is done in this module. Routines that are new in the Silver Edition are in **boldface**. The driver writer is expected to provide the implementation of the following routines (as documented in ISAM.H):

- ISAMOpen
- ISAMGetTableList
- ISAMGetNextTableName
- ISAMFreeTableList
- ISAMForeignKeys**
- ISAMCreateTable
- ISAMAddColumn
- ISAMCreateIndex**
- ISAMDeleteIndex**
- ISAMOpenTable
- ISAMRewind
- ISAMSort
- ISAMRestrict
- ISAMNextRecord
- ISAMGetData
- ISAMPutData
- ISAMInsertRecord
- ISAMUpdateRecord
- ISAMDeleteRecord
- ISAMGetBookmark
- ISAMPosition
- ISAMCloseTable
- ISAMDeleteTable
- ISAMPrepare
- ISAMParameter
- ISAMExecute
- ISAMFreeStatement
- ISAMClose
- ISAMSetTxnInfo**
- ISAMCommitTxn**

## **ISAMRollbackTxn**

ISAMGetErrorMessage

ISAMGetColumnType

ISAMCaseSensitive

ISAMName

ISAMVersion

ISAMDriver

ISAMMaxTableNameLength

ISAMMaxColumnNameLength

ISAMUser

ISAMDatabase

UTIL.C - Utility functions:

CharToDouble - Converts strings to doubles

CharToDate - Converts strings to dates

CharToTime - Converts strings to times

CharToTimestamp - Converts strings to timestamps

DoubleToChar - Converts doubles to strings

DateToChar - Converts dates to strings

TimeToChar - Converts times to strings

TimestampToChar - Converts timestamps to strings

ReturnString - Copies strings and their length

ReturnStringD - Copies strings and their length

ConvertSqlToC - Converts data from one type to another

PatternMatch - Wildcard pattern matching

TrueSize - Determines size of a string

DBASE.C - Routines to read and write records in dBASE files. This module is only used by ISAM.C.

TRACE.C - Tracing facilities. To enable tracing, set ISAM\_TRACE to TRUE in UTIL.H (not TRACE.H), delete all your .OBJ and .PCH files, and recompile. Setting ISAM\_TRACE to TRUE will trace every ISAM.C call. The output is sent to the debug window (DBWIN.EXE).

## **Tips and Tricks**

The following tips and tricks will make your development easier:

1. Before modifying ISAM.C or any other modules, create a project (see Appendix C for a list of files your project should include) and recompile the system. This will allow you

find problems in your development environment independently of bugs you might enter into the code.

2. Run SETUP.EXE in C:\DRDBDR\SETUP or C:\DRDBDR\SETUP32 to install the driver and create a datasource (MYSOURCE) using the driver. When creating the new datasource, be sure to use the "Database" edit control to specify the name of the directory that holds the .DBF files.

Once you do this, redirect the MYSOURCE datasource to use the DLL created by your compiler rather than the one in the Windows system directory. To do this...

...in Windows 3.x - Using a text editor, such as NOTEPAD, edit C:\WINDOWS\ODBC.INI. Look for the [MYSOURCE] section and change the <file> designated by the "Driver=<file>" keyword/value pair to specify the complete pathname of the .DLL file created by your compilation.

...in Windows NT/Win95 - Using the registry editor change the value of /HKEY\_CURRENT\_USER/Software/ODBC/ODBC.INI/MYSOURCE/Driver to specify the complete pathname of the .DLL file created by your compilation.

Once you do this, you will not have to reinstall after each compilation of your driver, since the MYSOURCE datasource will always be pointing at the DLL just created.

3. If you are using Microsoft Visual C++ to create a 16-bit driver, set "Calling Program" under Options | Debug to be C:\ODBCSDK\BIN\ODBCTEST.EXE. You can then set breakpoints in your driver, and run (DEBUG | GO).
4. If you are using Microsoft Visual C++ to create a 32-bit driver, set the executable to use when running under the debugger to C:\ODBCSDK\BIN32\ODBCTE32.EXE. You can then set breakpoints in your driver, and run (DEBUG | GO).
5. You can easily generate a trace of the calls to ISAM.C by setting the ISAM\_TRACE flag to TRUE and recompiling. This flag is declared in UTIL.H.



## Appendix A: SQL Grammar supported

(Grammar that is new in the Silver Edition is in **boldface**)

statement ::= CREATE create | DROP drop | SELECT select orderby | INSERT insert |  
DELETE delete | UPDATE update | passthroughSQL

passthroughSQL ::= any statement supported by the backend

create ::= TABLE tablename ( createcols ) |  
**INDEX indexname ON tablename ( indexcolumns )**

**indexcolumns ::= indexcolumn | indexcolumn , indexcolumns**

**indexcolumn ::= columnname asc**

createcols ::= createcol , createcols | createcol

createcol ::= columnname datatype | columnname datatype ( integer ) |  
columnname datatype ( integer , integer )

drop ::= TABLE tablename | **INDEX indexname**

select ::= selectcols FROM tablelist where groupby having

delete ::= FROM tablename where

insert ::= INTO tablename insertvals

update ::= tablename SET setlist where

setlist ::= set | setlist , set

set ::= columnname = NULL | columnname = expression

insertvals ::= ( columnlist ) VALUES ( valuelist ) | VALUES ( valuelist ) |  
**( columnlist ) VALUES ( SELECT select ) |**  
**VALUES ( SELECT select )**

columnlist ::= columnname , columnlist | columnname

valuelist ::= NULL , valuelist | expression , valuelist | expression | NULL

selectcols ::= selectallcols \* | selectallcols selectlist

selectallcols ::= | ALL | DISTINCT

selectlist ::= selectlistitem , selectlist | selectlistitem

selectlistitem ::= expression | expression aliasname | expression AS aliasname

where ::= | WHERE boolean

having ::= | HAVING boolean

boolean ::= and | and OR boolean

and ::= not | not AND and

not ::= comparison | NOT comparison

comparison ::= ( boolean ) | colref IS NULL | colref IS NOT NULL |  
expression LIKE pattern | expression NOT LIKE pattern |  
expression IN ( valuelist ) | expression NOT IN ( valuelist ) |  
expression op expression | **EXISTS ( SELECT select )** |  
**expression op selectop ( SELECT select )** |  
**expression IN ( SELECT select )** |  
**expression NOT IN ( SELECT select )**

**selectop ::= | ALL | ANY**

op ::= > | >= | < | <= | = | <>

pattern ::= string | ? | USER

expression ::= expression + times | expression - times | times

times ::= times \* neg | times / neg | neg

neg ::= term | + term | - term

term ::= ( expression ) | colref | simpleterm | aggterm | **scalar**

**scalar ::= scalarescape | scalarshorthand**

**scalarescape ::= --\*(VENDOR(MICROSOFT),PRODUCT(ODBC) FN fn )\*--**



**scalarshorthand ::= { FN fn }**

**fn ::= functionname ( valuelist ) | functionname ( )**

aggterm ::= COUNT ( \* ) | AVG ( expression ) | MAX ( expression ) |  
MIN ( expression ) | SUM ( expression )

simpleterm ::= string | realnumber | ? | USER | date | time | timestamp

groupby ::= | GROUP BY groupbyterms

groupbyterms ::= colref | colref , groupbyterms

orderby ::= | ORDER BY orderbyterms

orderbyterms ::= orderbyterm | orderbyterm , orderbyterms

orderbyterm ::= colref asc | integer asc

asc ::= | ASC | DESC

colref ::= aliasname . columnname | columnname

tablelist ::= tablelistitem , tablelist | tablelistitem

tablelistitem ::= tableref | **outerjoin**

**outerjoin ::= ojescape | ojshorthand**

**ojescape ::= --\*(VENDOR(MICROSOFT),PRODUCT(ODBC) OJ oj)\*--**

**ojshorthand ::= { OJ oj }**

**oj := tableref LEFT OUTER JOIN tableref ON boolean |  
tableref LEFT OUTER JOIN oj ON boolean**

tableref ::= tablename | tablename aliasname

**indexname ::= identifier**

**functionname ::= identifier**

tablename ::= identifier

datatype ::= identifier

columnname ::= identifier

aliasname ::= identifier

identifier ::= an identifier (identifiers containing spaces must be enclosed in double quotes)

string ::= a string (enclosed in single quotes)

realnumber ::= a non-negative real number (**including E notation**)

integer ::= a non-negative integer

date ::= datescape | dateshorthand

datescape ::= --\*(VENDOR(MICROSOFT),PRODUCT(ODBC) d dateval)\*--

dateshorthand ::= { d dateval }

dateval ::= a date in yyyy-mm-dd format in single quotes (for example, '1996-02-05')

time ::= timescape | timeshorthand

timescape ::= --\*(VENDOR(MICROSOFT),PRODUCT(ODBC) t timeval)\*--

timeshorthand ::= { t timeval }

timeval ::= a time in hh:mm:ss format in single quotes (for example, '10:19:48')

timestamp ::= timestampescape | timestampshorthand

timestampescape ::= --\*(VENDOR(MICROSOFT),PRODUCT(ODBC) ts timestampval)\*--

timestampshorthand ::= { ts timestampval }

timestampval ::= a timestamp in yyyy-mm-dd hh:mm:ss[.ffffff] format in single quotes  
(for example, '1996-02-05 10:19:48.529')

## Appendix B: Migrating from the Bronze Edition to the Silver Edition

If you implemented your old driver by only modifying ISAM.C and DBASE.C, for the most part, the ISAM.C and DBASE.C you implemented for the Bronze Edition can be used with only minor changes in the Silver Edition. If you modified any other code you will have to re-implement those changes.

In ISAM.C there are seven changes you must make:

1. The `fReserved` entry in the ISAM structured has been renamed to `fTxnCapable`.

If your underlying database does not support transactions, you should continue to set this to `SQL_TC_NONE` (i.e., zero). If you set this to `SQL_TC_NONE`, you can safely ignore the other transaction related elements.

If your underlying database supports transactions, there is a detailed description of what you have to do at the ISAM layer to implement transactions in ISAM.H. Search for `SQL_TC_NONE`.

Note: To preserve the semantics of the Bronze edition, set this value to `SQL_TC_NONE`.

2. The `fIsKey` entry in the ISAMCOLUMNDEF structured has been renamed to `fKeyComponent`. In the Bronze Edition, `fIsKey` was a boolean value specifying whether or not the column was part of the primary key. In the Silver Edition, `fKeyComponent` is an integer value. If it is zero, the column is not part of the key. If it is non-zero, it specifies the ordinal position of the column in the key.

For example, if you had a key that was "last name, first name" (in that order), `fKeyComponent` would be one for last name (designating that it is the first component of the key) and two for first name (designating that it is the second component of the key).

Note: To preserve the semantics of the Bronze edition, set this value to 1 for the first key field, two for the second, etc.

3. `szPrimaryKeyName` has been added to ISAMTABLEDEF. This is the name of the primary key designated by the `fKeyComponent` values in the ISAMCOLUMNDEF structures. If there is no primary key, or if the primary key does not have a name, set this to a zero length string.

Note: To preserve the semantics of the Bronze edition, set this value to a zero length string.

4. A new function has been added: `ISAMForeignKey()`. This function describes the primary key/foreign key relationship between two tables. If there is no foreign key relationship, it returns `ISAM_EOF`.

Note: To preserve the semantics of the Bronze edition, this function should always return `ISAM_EOF`.

5. A new function has been added: `ISAMCreateIndex()`. This function creates a new index in the database.

Note: To preserve the semantics of the Bronze edition, this function should always return `ISAM_NOTSUPPORTED`.

6. A new function has been added: `ISAMDeleteIndex()`. This function removes an index from the database.

Note: To preserve the semantics of the Bronze edition, this function should always return `ISAM_NOTSUPPORTED`.

7. Three new transaction related functions have been added: `ISAMSetTxnIsolation()`, `ISAMCommitTxn()`, and `ISAMRollbackTxn()`. See the documentation in `ISAM.H` for a description of these functions.

Note: These functions will not be called if `fTxnCapable` in `ISAM` was set to `SQL_TC_NONE`. To preserve the semantics of the Bronze edition, these functions should always return `ISAM_NOTSUPPORTED`.

## Appendix C: Implementation Strategy for ISAM.C

The first thing you want to do is create a project to build your driver with. If you happen to be building a 16-bit driver using Microsoft Visual C/C++ 1.5, you can use the DRDBDR.MAK file provided. If you happen to be building a 32-bit driver using Microsoft Visual C/C++ 2.0, 3.0, or 4.0 you can use the DRDBDR32.MAK file provided. Otherwise you will have to build your own project containing the following files:

BCD.C	SCALAR.C	PARSE.H
CATALOG.C	SEMANTIC.C	SCALAR.H
COLDEFS.C	SETUP.C	SEMANTIC.H
CONNECT.C	SORT.C	SQLTYPE.H
DBASE.C	SQLTYPE.C	TRACE.H
DLL.C	TRACE.C	UNIXDEFS.H
DRDBDR.C	TRANSACT.C	UTIL.H
EVALUATE.C	UTIL.C	
EXECUTE.C		DRDBDR.RC
INFO.C	BCD.H	DRDB.ICO
ISAM.C	DBASE.H	
OPTIMIZE.C	DRDBDR.H	ODBCINST.LIB (if 16-bit)
OPTIONS.C	EVALUATE.H	ODBCCP32.LIB (if 32-bit)
PARSE.C	ISAM.H	
PREPARE.C	OPTIMIZE.H	DRDBDR.DEF (if 16-bit)
RESULTS.C		DRDBDR32.DEF (if 32-bit)

Once your project is set up, it is suggested that you use the following code...test...code...test...code...test strategy when rewriting ISAM.C to connect to your database. The testing can be done using ODBC Test (from the ODBC SDK). The testing assumes that there is a table called EMP with a column called NAME and a column called SALARY:

### *Step 1: Connecting:*

```
Code: ISAMOpen()  
      ISAMClose()  
      ISAMGetErrorMessage()
```

```
Test: Connect | Full Connect  
      Connect | Full Disconnect
```

Note: For now, disable transactions by setting fTxnCapable in LPISAM to SQL\_TC\_NONE.

*Step 2: Get driver description:*

Code: ISAMCaseSensitive()  
ISAMMaxColumnNameLength()  
ISAMMaxTableNameLength()  
ISAMName()  
ISAMVersion()  
ISAMDriver()  
ISAMUser()  
ISAMDatabase()

Test: Connect | Full Connect  
Connect | SQLGetInfo(SQL\_IDENTIFIER\_CASE)  
Connect | SQLGetInfo(SQL\_MAX\_COLUMN\_NAME\_LEN)  
Connect | SQLGetInfo(SQL\_MAX\_TABLE\_NAME\_LEN)  
Connect | SQLGetInfo(SQL\_DBMS\_NAME)  
Connect | SQLGetInfo(SQL\_DBMS\_VER)  
Connect | SQLGetInfo(SQL\_DRIVER\_NAME)  
Connect | SQLGetInfo(SQL\_USER\_NAME)  
Connect | SQLGetInfo(SQL\_DATABASE\_NAME)  
Connect | Full Disconnect

*Step 3: List of tables:*

Code: ISAMGetTableList()  
ISAMGetNextTableName()  
ISAMFreeTableList()

Test: Connect | Full Connect  
Catalog | SQLTables  
Results | GetDataAll  
Connect | Full Disconnect

*Step 4: List of columns for a table:*

Code: ISAMOpenTable()  
ISAMCloseTable()

Test: Connect | Full Connect  
Catalog | SQLColumns(EMP)

Results | GetDataAll  
Connect | Full Disconnect

*Step 5: Simple select:*

Code: ISAMRewind()  
ISAMNextRecord()  
ISAMGetData()

Test: Connect | Full Connect  
Statement | SQLExecDirect("select \* from EMP")  
Results | GetDataAll  
Connect | Full Disconnect

*Step 6: Select with restriction:*

Code: ISAMRestrict()

Test: Connect | Full Connect  
Statement | SQLExecDirect("select \* from EMP where NAME = 'FRED'")  
Results | GetDataAll  
Connect | Full Disconnect

Note: ISAMRestrict() will only be called if ISAMTableOpen() returns a non-zero value for fSelectivity for the NAME column.

*Step 7: Select with ORDER BY clause using an upper-level sort:*

Code: ISAMGetBookmark()  
ISAMPosition()

Test: Connect | Full Connect  
Statement | SQLExecDirect("select \* from EMP order by NAME")  
Results | GetDataAll  
Connect | Full Disconnect

Note: Suppress pushdown sorts by implementing ISAMSort() as:

```
if (count != 0)
    return ISAM_NOTSUPPORTED;
else
    return NO_ISAM_ERR;
```

*Step 8: Select with ORDER BY clause using a pushdown sort:*

Code: ISAMSort()

Test: Connect | Full Connect  
Statement | SQLExecDirect("select \* from EMP order by NAME")  
Results | GetDataAll  
Connect | Full Disconnect

*Step 9: Modifying data:*

Code: ISAMPutData()  
ISAMUpdateRecord()

Test: Connect | Full Connect  
Statement | SQLExecDirect("update EMP set SALARY = 20000")  
Connect | Full Disconnect

*Step 10: Inserting records:*

Code: ISAMInsertRecord()

Test: Connect | Full Connect  
Statement | SQLExecDirect(  
"insert into EMP(NAME, SALARY) values ('CRAIG', 20000)")  
Connect | Full Disconnect

*Step 11: Deleting records:*

Code: ISAMDeleteRecord()

Test: Connect | Full Connect  
Statement | SQLExecDirect("delete from EMP where NAME ='CRAIG'")  
Connect | Full Disconnect

*Step 12: Creating a table:*



Code: ISAMCreateTable()  
ISAMAddColumn()

Test: Connect | Full Connect  
Statement | SQLExecDirect(  
"create table EMP2(NAME CHAR(10), SALARY DECIMAL(14,2))")  
Connect | Full Disconnect

*Step 13: Deleting a table:*

Code: ISAMDeleteTable()

Test: Connect | Full Connect  
Statement | SQLExecDirect("drop table EMP2")  
Connect | Full Disconnect

*Step 14: Passthrough SQL:*

Code: ISAMPrepare()  
ISAMParameter()  
ISAMExecute()  
ISAMFreeStatement()

Test: Connect | Full Connect  
Statement | SQLExecDirect(<<SQL to be passed to the back end >>)  
If the query returns a result set: Results | GetDataAll  
Connect | Full Disconnect

*Step 15: Creating an index:*

Code: ISAMCreateIndex()

Test: Connect | Full Connect  
Statement | SQLExecDirect("create index EMPINDEX on EMP(NAME)")  
Connect | Full Disconnect

*Step 16: Deleting an index:*

Code: ISAMDeleteIndex()

Test: Connect | Full Connect  
Statement | SQLExecDirect("drop index EMPINDEX")  
Connect | Full Disconnect

*Step 17: Foreign Keys:*

Code: ISAMForeignKey()

Test: Connect | Full Connect  
Catalog | SQLForeignKeys(EMP)  
Results | GetDataAll  
Connect | Full Disconnect

*Step 18: Transactions:*

Code: ISAMSetTxnIsolation()  
ISAMCommitTxn()  
ISAMRollbackTxn()

Test: Connect | Full Connect  
Statement | SQLExecDirect(  
    "insert into EMP(NAME, SALARY) values ('CRAIG', 20000)")  
If you are using the ODBC 3 SDK:  
    Environment | SQLEndTran(SQL\_ROLLBACK)  
If you are using the ODBC 2 SDK:  
    Misc | SQLTransact(SQL\_ROLLBACK)  
Connect | Full Disconnect

Note: Don't forget to enable transactions by setting fTxnCapable in LPISAM to something other than SQL\_TC\_NONE.

# Appendix D: SYWARE License Agreement

## Dr. DeeBee ODBC Driver Kit (Silver Edition)

---

### SYWARE SOFTWARE LICENSE

1. GRANT OF LICENSE. SYWARE grants you the right to use the enclosed SYWARE software product in the manner provided below:

a. You may use one copy of the SYWARE software product identified above, which includes "online" or electronic documents (the "SOFTWARE") on a single computer. The SOFTWARE is in "use" on a computer when it is loaded into temporary memory (i.e., RAM) or installed into permanent memory (e.g., hard disk, CD-ROM, or other storage device) of that computer. However, installation on a network server for the sole purpose of internal distribution to one or more other computer(s) shall not constitute "use" for which a separate license is required, provided you have a separate license for each computer to which the SOFTWARE is distributed.

b. Solely with respect to the electronic documents, you may make unlimited number of copies (either in hardcopy or electronic form), provided that such copies shall be used only for internal purposes and are not republished or distributed beyond the user's premises.

2. If the SOFTWARE is an upgrade from a SYWARE product, you may now use that upgraded product only in accordance with this License.

3. COPYRIGHT. The SOFTWARE (including any images, "applets", photographs, animations, video, audio, music, and text incorporated in the SOFTWARE) is owned by SYWARE or its suppliers and is protected by United States copyright laws and international treaty provisions. Therefore you must treat the SOFTWARE like any other copyrighted material (e.g. a book or recording) except that you may either (a) make one copy of the SOFTWARE solely for backup or archival purposes, or (b) transfer the software to a single hard disk provided you keep the original solely for backup or archival purposes. You may not copy the printed materials accompanying the SOFTWARE.

4. OTHER RESTRICTIONS. You may not rent or lease the SOFTWARE. **You may not transfer the SOFTWARE.** You may not reverse engineer, decompile, or disassemble the SOFTWARE except to the extent such foregoing restriction is expressly prohibited by applicable law.

5. REDISTRIBUTABLE COMPONENTS.

a. **Sample Code.** Notwithstanding Section 1, SYWARE grants you the right to use and modify the source code version of the SOFTWARE located in \DRDBDR\SOURCE ("SAMPLE CODE") provided you comply with Section 5.c. You may not distribute SAMPLE CODE, or any modified version of SAMPLE CODE, in source code form.

b. **Redistributable Files.** Notwithstanding Section 1, SYWARE grants you a non-exclusive right to reproduce and distribute the object code version of those portions of the SAMPLE CODE, \DRDBDR\SETUP16\DRDBDR.DLL, and \DRDBDR\SETUP32\DRDBDR32.DLL (collectively called the REDISTRIBUTABLES), provided you comply with Section 5.c. and that the object code version of the SAMPLE CODE, or any modified version of the SAMPLE CODE, is an ODBC driver and is only capable of accessing a single DBMS or file format.

c. **Redistribution Requirements.** If you redistribute the REDISTRIBUTABLES, you must (i) not use SYWARE's name, logo, trademarks, to market your software application product; (ii) include a valid copyright notice on your software product; (iii) agree to indemnify, hold harmless, and defend SYWARE from and against any claims or lawsuits, including attorney's fees, that arise or result from the use or distribution of your software application product; and (iv) do not permit further distribution of the REDISTRIBUTABLES by your end-user.

The license in this section to distribute the REDISTRIBUTABLES is royalty-free.

6. EXPORT RESTRICTIONS. You agree that neither you nor your customers intends to or will, directly or indirectly, export or transmit (i) the SOFTWARE or related documentation and technical data or (ii) your software product as described in section 5 of this License (or any part thereof), or process, or service that is the direct product of the SOFTWARE, to any country to which such export or transmission is restricted by any applicable U.S. regulation or statute, without prior written consent, if required, of the Bureau of Export Administration of the U.S. Department of Commerce, or such other governmental entity as may have jurisdiction over such export or transmission.

---

### LIMITED WARRANTY

LIMITED WARRANTY. **Except with respect to the REDISTRIBUTABLES, which are provided "as-is", without warranty of any kind,** SYWARE warrants that (a) the SOFTWARE will perform substantially in accordance with the accompanying written materials for a period of ninety (90) days from the date of receipt, and (b) any hardware accompanying the SOFTWARE will be free from defects in materials and workmanship under normal use and service for a period of one (1) year from date of receipt. Any implied warranties on the SOFTWARE and hardware are limited to ninety (90) days and one (1) year, respectively. Some states/jurisdictions do not allow limitations on duration of an implied warranty, so the above limitation may not apply to you.

CUSTOMER REMEDIES. SYWARE's and its suppliers' entire liability and your exclusive remedy shall be, at SYWARE's option, either (a) return of the price paid, or (b) repair or replacement of the SOFTWARE or hardware that does not meet SYWARE's Limited Warranty and which is returned to SYWARE with a copy of your receipt. This Limited Warranty is void if failure of the SOFTWARE or hardware has resulted from accident, abuse, or misapplication. Any replacement SOFTWARE or hardware will be warranted for the remainder of the original warranty period or thirty (30) days, whichever is longer. **Outside the United States, neither these remedies nor any product support services offered by SYWARE are not available without proof of purchase from an authorized U.S. source.**

**NO OTHER WARRANTIES.** To the maximum extent permitted by applicable law, SYWARE and its suppliers disclaim all other warranties, either express or implied, including, but not limited to, implied warranties of merchantability and fitness for a particular purpose, with regard to the SOFTWARE, the accompanying written materials, and any accompanying hardware.

This limited warranty gives you specific legal rights. You may have others, which vary from state/jurisdiction to state/jurisdiction.

**NO LIABILITY FOR CONSEQUENTIAL DAMAGES.** To the maximum extent permitted by applicable law, in no event shall SYWARE or its suppliers be liable for any damages whatsoever (including, without limitation, damages for loss of business profits, business interruption, loss of business information, or any other pecuniary loss) arising out of the use of or inability to use this SYWARE product, even if SYWARE has been advised of the possibility of such damages. Because some states/jurisdictions do not allow the exclusion or limitation of liability for consequential or incidental damages, the above limitation may not apply to you.

This Agreement is governed by the laws of the Commonwealth of Massachusetts.

For Licensee: \_\_\_\_\_  
X \_\_\_\_\_  
Name/Title: \_\_\_\_\_  
Date: \_\_\_\_\_

For SYWARE:  
X \_\_\_\_\_  
Seymour A. Danberg, President  
Date: \_\_\_\_\_