Contents

Ordering the Manual

Introduction

Introduction

Concepts

Data Type
Parameter
Table
Column
Index
Synonym
User and Usergroup
Privilege
Database
Distributed Database
Transaction
Session
Data Integrity
Backup and Recovery Concept
SQLMODE
Code Tables

Common Elements

<character>
<literal>
<token>
Names
<column spec>
<parameter spec>
Specifying Values
<function spec>
<set function spec>
<expression>
<predicate>

<search condition>

SQL Statement

SQL Statement

Data Definition

<create table statement>
<drop table statement>
<create synonym statement>
<drop synonym statement>
<create view statement>
<drop view statement>
<create index statement>
<drop index statement>
<comment statement>

Authorization

<grant statement>
<revoke statement>

Data Manipulation

Data Manipulation
<insert statement>
<update statement>
<delete statement>
<set current degree statement>
<set statement>

Data Retrieval

Data Retrieval
<query statement>
<open cursor statement>
<fetch statement>
<close statement>
<single select statement>

Transactions

Transactions

<connect statement>
<commit statement>
<rollback statement>
<lock statement>
<release statement>

Restrictions

Restrictions

Differences

Introduction
Concepts
Common Elements
SQL Statement
Data Definition
Authorization
Data Manipulation
Data Retrieval
Transactions

Error Messages

Error Messages

Syntax

Syntax

Ordering the Manual

Manual Order Number: ESD611-031WOU

This online help is applicable to ADABAS D Version 6.1.1 PE and to all subsequent releases, unless otherwise indicated in new editions or technical newsletters.

Specifications contained herein are subject to change and these changes will be reported in subsequent revisions or editions.

Readers' comments are welcomed. Comments may be addressed to the Documentation Department at the address on the back cover.

Introduction

This online help defines the syntax and semantics of the SQL statements of ADABAS D. An SQL statement performs an operation on an ADABAS database. The used parameters are host variables of a programming language in which the SQL statements are embedded.

The chapter 'Data Type' explains the principles upon which the ADABAS database system is based.
Then follows an explanation of the '<character>' which are used in the SQL statements.
The chapter '<create table statement>' describes the SQL statements for the definition of tables etc.
The chapter '<grant statement>' explains the protective mechanisms against illegal access and illegal modifications to the data.
The chapter 'Data Manipulation' describes the SQL statements for the insertion, update, and deletion of data.
The chapter 'Data Retrieval' deals with the SQL statements for data access.
The chapter 'Transactions' deals with the mechanisms for the maintenance of the consistency as well as for the synchronization of the ADABAS server.
The chapter 'Restrictions' lists the restrictions which generally apply to data types, parameters, identifiers, etc.
The chapter 'Introduction' specifies the differences that exist between the syntax and semantics in ADABAS and the definition of the DB2 Version 3.
The chapter 'Error Messages' lists the error messages which can occur in addition to those specified in the ADABAS online help 'Messages and Codes'.
The chapter 'Syntax' contains all syntax rules listed in alphabetical order.

The syntax notation used in this online help is BNF, with the following conventions:

Keywords are shown in uppercase letters for illustration purposes only. They can be specified in uppercase or lowercase letters.

```
<xyz>
```

Terms enclosed in angle brackets are syntactical units that are explained in this online help. The chapter 'Syntax' contains a list of the syntactical units in alphabetical order.

```
clause ::= rule
```

The SQL statements consist of clauses. The rules describe how simple clauses are assembled into more complex ones and their notation.

```
clause1  clause2
```

The two clauses are written one after the other, separated by at least one blank.

```
[clause]
```

Optional clause: may be omitted without substitution.

`clause1 | clause2 | ... | clausen`

Alternative clauses: only one can be used.

`clause,...`

The clause can be repeated as often as is desired. The individual repetitions must be written one after the other, separated from each other by a comma and any number of blanks.

`clause...`

The clause can be repeated as often as is desired. The individual repetitions must be written directly one after the other without a separating comma or blank.

Data Type

1. A data type is a set of values that can be represented.

2. A value is either a NULL value (undefined value), or the special NULL value, or a non-NULL value.

3. The NULL value is a special value. The comparison of the NULL value with all values is undefined.

4. A special NULL value is a special value which may occur in arithmetical operations when these lead to an overflow or a division by 0. The comparison of a special NULL value with any value is always undefined.

5. A non-NULL value is a character string, a number, a date value, a time value, or a timestamp value.

See also

Character String

Number

Date Value

Time Value

Timestamp Value

Character String

1. A character string is a series of alphanumeric characters. The maximum length of a character string is 254 characters.

2. Each character string has a code attribute (ASCII, EBCDIC, or BYTE). It defines the sort sequence to be used when comparing the values of this column.

3. All character strings with the same code attribute can be compared to each other. Character strings with the different code attributes ASCII and EBCDIC can be compared to each other. Character strings with the code attributes ASCII and EBCDIC can be compared to date, time, and timestamp values.

Number

1. There are fixed point and floating point numbers.

2. A fixed point number is described by the number of significant digits and the scale. The maximum number of significant digits is 18.

3. A floating point number consists of a mantissa and an exponent. The mantissa may have up to 18 significant digits. The valid range of values for floating point numbers consists of the intervals from -9.99999999999999999E+62 to -1E-64 and from +1E-64 to +9.99999999999999999E+62 and the value 0.0.

4. All numbers can be compared to each other.

Date Value

1. A date value is a special character string. A date value can be compared to other date values and to character strings with the code attributes ASCII and EBCDIC.

Time Value

1. A time value is a special character string. A time value can be compared to other time values and to character strings with the code attributes ASCII and EBCDIC.

Timestamp Value

1. A timestamp value is a special character string. A timestamp consists of a date and time value and a microsecond specification. A timestamp value can be compared to other timestamp values and to character strings with the code attributes ASCII and EBCDIC.

Parameter

1. SQL statements for ADABAS can be embedded in programming languages such as COBOL and C, thus allowing the database to be accessed from application programs. The values to be retrieved from or to be stored in the database can be passed within the SQL statements using parameters. The parameters are declared variables (the so-called host variables) within the embedding program.

2. The data type of the host variables is defined when declaring the variables in the programming language. Values of host variables are implicitly converted from the programming language data type to the ADABAS data type, and vice versa, if possible.

3. Each parameter can be combined with an indicator parameter that indicates irregularities (such as differing lengths of value and parameter, NULL value, special NULL value, etc.) that may have occurred during the assignment of values. For the transfer of NULL values and special NULL values, indicator parameters are indispensable. The indicator parameters are declared variables (the so-called indicator variables) within the embedding program.

4. More details about the embedding of SQL statements for ADABAS in programming languages are provided in the precompiler online help.

Table

1. A table is a set of rows.

2. A row is an ordered list of values. The row is the smallest unit of data which can be inserted into or deleted from a table.

3. Each row of a table has the same number of columns and contains a value for each column.

4. A base table is a table which has a permanent memory representation and description.

5. A result table is a temporary table which is generated from one or more base table(s) by executing a SELECT statement.

6. A view table is a table derived from base tables. A view table has a permanent description in the form of a SELECT statement.

7. Each table has a name that is unique within the whole database. To name result tables, names of existing tables can be used.

8. If the qualification of the user name is missing for a table name specification, first the partial catalog of the current user, then the partial catalog of the DBA who created the current user, and subsequently the partial catalog of the SYSDBA of the current user is scanned for the specified table name. A table of another user can only be used when the corresponding privileges have been granted.

Column

1. All values in a table column have the same data type. A value of a column in a row is the smallest unit of data that can be modified or selected from a table or to which functions can be applied.

2. All character strings in an alphanumeric column have the same length.

3. A numeric column is either a floating point column or a fixed point column. All numbers in a fixed point column have the same format; i.e., the same number of digits before and after the decimal point. All numbers in a floating point column have the same mantissa length.

4. Each column in a base table has a name that is unique within the table.

Index

1. Indexes serve to speed up the access to rows of a table. They can be created for a single column or for a sequence of columns. When defining indexes, it is necessary to specify whether the column values of different rows in the indexed columns must be unique or not.

2. A given index name, along with the table name, must be unique.

Synonym

1. A synonym is another name for a table.

2. Every synonym has a name that is unique within the whole database and differs from all the other table names.

User and Usergroup

1. When installing the system, user name/password combinations are defined.

   a) The CONTROLUSER
   controls and monitors the system. He is responsible for backing up the database. For these tasks, the ADABAS component CONTROL has been provided.

   b) The SYSDBA (system database administrator)
   installs the system; i.e., his tasks include creating user accounts. The position of the SYSDBA within the hierarchy of user classes is described in 2d below.

   c) The DOMAINUSER
   maintains the system tables. His name is always DOMAIN. Any password can be chosen.

   For the installation of the system, see the CONTROL online help.

2. There are four hierarchical classes of users in WARM database mode:

   a) STANDARD users
   can only access existing tables for which they have received privileges. For these tables, they can create synonyms and view tables.

   b) RESOURCE users
   have all the rights of a STANDARD user. In addition, they can create private tables and grant privileges for them.

   c) Database administrators (DBA)
   are responsible for the organization of the database system. The DBA has all the rights of a RESOURCE user. Database administrators can create RESOURCE users and STANDARD users.

   d) The system database administrator (SYSDBA)
   installs the system. The system database administrator has all the rights of a DBA. In addition, he can create users with DBA status.
   In a non-distributed database, there is only one SYSDBA.

3. It is possible to create usergroups. All members of a usergroup have the same rights on the data that is assigned to the usergroup.

4. Users can only be defined in the SQLMODEs ADABAS and ORACLE; usergroups can only be defined in SQLMODE ADABAS.

Privilege

1. A privilege is used for imposing restrictions on operations on certain objects.

2. Every user can grant privileges to other users for objects owned by him. Privileges on view tables may only be granted to other users when the user is the owner of the tables on which the view table is based, or when the user has the right to grant the privileges for the base tables to other users. Generally, a user is the owner of an object when he has created it.

3. Users with DBA or RESOURCE status can perform all operations on database objects that they own. The set of possible operations may be restricted for view tables, because not all view tables are updatable. If the user is the owner of a view table but not of all tables on which the view table is based, the set of operations allowed on this view table depends on the set of privileges granted to the user for the tables on which the view table is based. Moreover, users with DBA or RESOURCE status can perform operations on all objects for which they have received the corresponding privileges.

4. STANDARD users can only perform operations on objects if they have received the privileges to do so.

Database

1. A database consists of the catalog and the user data.

2. The catalog consists of metadata. The definitions of database objects such as base tables, view tables, synonyms, indexes, users and usergroups are stored there.

3. The catalog consists of several parts. One part comprises information about the installation of the (distributed) database and the metadata with the definitions of users and usergroups. This part is not assigned to a user or usergroup.
   The catalog contains a part for each user or usergroup where the metadata for the objects, such as base tables, view tables, etc., created by the user or usergroup is stored.

4. A user can only access the metadata of another user or usergroup when he has received the privileges to do so.

5. All rows of all base tables are the user data of a database.

6. If a non-distributed database is concerned, SERVERDB designates the whole database.

Distributed Database

1. A distributed database consists of two or more SERVERDBs which have a common catalog and common user data.

2. There is one system database administrator (SYSDBA) on each SERVERDB. The SYSDBA may drop all users of this SERVERDB, even those not created by him.

3. Each user is assigned one of these SERVERDBs as a HOME SERVERDB. The user data in the base tables that are owned by the user, as well as the partial catalog of the user, are always stored on the HOME SERVERDB of this user.

4. The catalog consists of one part that is copied to all SERVERDBs and of another part that is only stored on one SERVERDB.

5. The partial catalog stored on all SERVERDBs contains the definitions of SERVERDBs, users, and usergroups.

6. The partial catalog that is only stored on one SERVERDB comprises the partial catalogs of all users and usergroups for which this SERVERDB is the HOME SERVERDB. These partial catalogs describe all database objects defined by these users and usergroups, except for the set specified in item 5.

7. A table name specification does not contain any specification of the SERVERDB to which the table is assigned. SQL statements are independent of the SERVERDB to which a user or table is assigned. Each SQL statement can be executed from any SERVERDB as long as all SERVERDBs are in WARM mode and network communication between the SERVERDBs is possible. If one of these requirements is not met, the following conditions apply.

8. (Metadata) Data stored on one SERVERDB can only be modified when this SERVERDB is in WARM mode. If the session (see chapter 'Session') of the user who wants to make these modifications was not started on the SERVERDB where the data to be modified is stored, the two SERVERDBs must be connected to each other within the network.

9. (Metadata) Data stored on all SERVERDBs can be modified even if not all SERVERDBs are in WARM mode or if network communication to some SERVERDBs is interrupted. SERVERDBs that are shut down or not accessible within the network are informed about modifications to the database as soon as they are put into WARM mode by using the Operating / Restart / Warm menu function of the ADABAS component CONTROL or when network communication has been reestablished.

10. Special processing is done if the network of SERVERDBs has split into two subnetworks which can no longer communicate with each other within the network. (Metadata) Data stored on a SERVERDB contained in one of the subnetworks can be modified from any SERVERDB belonging to that subnetwork. (Metadata) Data stored within the other subnetwork cannot be modified.

11. To prevent the two subnetworks from contradictory modifications to the replicated (metadata) data, ADABAS determines the subnetwork with the greater number (the so-called majority) of SERVERDBs within the whole network. The subnetwork containing the majority is then allowed to modify the (metadata) data. This procedure is called the majority concept. For two subnetworks of equal size, ADABAS decides the one that is to represent the majority. The minority subnetwork is not allowed to

modify replicated data. In the case of read-accesses, it may happen that the minority subnetwork does not receive the latest state of (metadata) data updated by the majority. ADABAS displays warnings to inform the user about such a state.

12. Information about which SERVERDBs belong to the majority is contained in the corresponding system tables.

Transaction

1. A transaction is a sequence of database operations which form a unit with regard to data backup and synchronization. Transactions are closed with COMMIT or ROLLBACK. If a transaction is closed with COMMIT, all modifications made to the database within the transaction are kept. If a transaction is aborted with ROLLBACK, all modifications made to the database within this transaction are cancelled. Modifications closed with COMMIT cannot be cancelled with ROLLBACK. COMMIT and ROLLBACK implicitly open a new transaction.

2. ADABAS distinguishes between SHARE and EXCLUSIVE locks. SHARE locks prevent locked tables or table rows from being modified by other users, although read access is still possible. EXCLUSIVE locks prevent the locked data objects from being read or modified by other users, while the user who has specified the lock can modify the objects.

3. The locking of tables and table rows within a transaction is done with a lock mode determined when the user connects to ADABAS.

Session

1. When a user is defined, a password is assigned to him. To be able to work with a database, a combination of user name and password known to the database must be specified.

2. The user is given access to the database if the combination of user name and password is valid. The user opens a session and the first transaction.
   A user can only work with the database within a session. A session is terminated explicitly by the user.

3. The user name specified in order to get access to the database is called the 'current user' if the user is not a member of a usergroup. If the user is a member of a usergroup, then the name of the usergroup is called the 'current user'.

Data Integrity

1. ADABAS provides a rich choice of declarative integrity rules, thus simplifying the programming of applications.

2. A key consisting of one or more columns can be defined for each table. ADABAS ensures that keys in a table are unique. A key can be composed of columns of different data types.

3. In addition, uniqueness can be enforced for the values of other columns or column combinations (UNIQUE definition for 'alternate keys').

4. For single columns, values other than the NULL value can be enforced by specifying NOT NULL.

5. For each column, a value can be predefined (DEFAULT definition).

6. Declarations of referential integrity constraints for delete and existence conditions between the rows of two tables can be made as well.

Backup and Recovery Concept

1. In error situations that do not involve storage medium failures, ADABAS automatically restores the last consistent state of the database on restart. This means that all effects of committed transactions are preserved, while the effects of transactions open at the time of error occurrence are cancelled.

2. Storage medium failures require the loading of a previously backed up version of the database. They may also require the loading of several incremental data backups (see Backup / Save / Updated Pages menu function in the CONTROL online help) to restore the database to a state upon which the last log versions may be re-applied. When these actions are concluded, the last consistent database state has been restored.

3. ADABAS does not support the exchange of storage media. Instead, individual tables can be explicitly unloaded. This function is supported by the ADABAS component LOAD.

4. The ADABAS component CONTROL (see the CONTROL online help) which serves to perform the above-mentioned backup and recovery operations of the database can only be used by the CONTROLUSER. CONTROL can usually only be used once for each SERVERDB at any given time, parallel to normal database operation.

SQLMODE

1. The database system ADABAS is able to perform correct ADABAS applications, as well as applications that are written according to the ANSI standard (ANSI X3.135-1992, Entry SQL), the definition of DB2 Version 3, or the definition of ORACLE7. ADABAS is able to check whether ADABAS applications conform to the above-mentioned definitions. This means in particular that any extension beyond the chosen definition is considered incorrect. However, the support of other SQLMODEs with regard to DDL statements is restricted.
   When connecting to ADABAS, one of the above-mentioned definitions or the SQLMODE ADABAS can be selected. The default is the SQLMODE ADABAS.

2. This online help describes the functionality of the database system ADABAS provided for the SQLMODE DB2. Only those effects of commands are described which refer to database objects that can be created in the selected SQLMODE. If database objects, e.g. tables, are created in one SQLMODE and addressed in another SQLMODE, these tables may contain columns of data types that are unknown in the current SQLMODE and that are therefore not described. Columns with the code attribute ASCII cannot be created in SQLMODE DB2. Nevertheless, they are described because they occur frequently in the database when the corresponding code attribute was chosen during the installation of the system and the database is also used in SQLMODEs other than DB2.

Code Tables

1. The database system ADABAS internally works either with the ASCII code according to ISO 8859/1.2 or with the EBCDIC code CCSID 500, Codepage 500.

2. The ASCII code according to ISO 8859/1.2 uses the following assignments:

DEC	HEX	CHAR	DEC	HEX	CHAR	DEC	HEX	CHAR	DEC	HEX	CHAR
0	00	NUL	32	20	SP	64	40	@	96	60	`
1	01	SOH	33	21	!	65	41	A	97	61	a
2	02	STX	34	22	"	66	42	B	98	62	b
3	03	ETX	35	23	#	67	43	C	99	63	c
4	04	EOT	36	24	$	68	44	D	100	64	d
5	05	ENQ	37	25	%	69	45	E	101	65	e
6	06	ACK	38	26	&	70	46	F	102	66	f
7	07	BEL	39	27	'	71	47	G	103	67	g
8	08	BS	40	28	(	72	48	H	104	68	h
9	09	HT	41	29	)	73	49	I	105	69	i
10	0A	LF	42	2A	*	74	4A	J	106	6A	j
11	0B	VT	43	2B	+	75	4B	K	107	6B	k
12	0C	FF	44	2C	,	76	4C	L	108	6C	l
13	0D	CR	45	2D	-	77	4D	M	109	6D	m
14	0E	SO	46	2E	.	78	4E	N	110	6E	n
15	0F	SI	47	2F	/	79	4F	O	111	6F	o
16	10	DLE	48	30	0	80	50	P	112	70	p
17	11	DC1	49	31	1	81	51	Q	113	71	q
18	12	DC2	50	32	2	82	52	R	114	72	r
19	13	DC3	51	33	3	83	53	S	115	73	s
20	14	DC4	52	34	4	84	54	T	116	74	t
21	15	NAK	53	35	5	85	55	U	117	75	u
22	16	SYN	54	36	6	86	56	V	118	76	v
23	17	ETB	55	37	7	87	57	W	119	77	w
24	18	CAN	56	38	8	88	58	X	120	78	x
25	19	EM	57	39	9	89	59	Y	121	79	y
26	1A	SUB	58	3A	:	90	5A	Z	122	7A	z
27	1B	ESC	59	3B	;	91	5B	[	123	7B	{
28	1C	FS	60	3C	<	92	5C	\	124	7C	|
29	1D	GS	61	3D	=	93	5D	]	125	7D	}
30	1E	RS	62	3E	>	94	5E	^	126	7E	~
31	1F	US	63	3F	?	95	5F	_	127	7F	DEL

DEC	HEX	CHAR	DEC	HEX	CHAR	DEC	HEX	CHAR	DEC	HEX	CHAR
128	80		160	A0	NBSP	192	C0	À	224	E0	à
129	81		161	A1	¡	193	C1	Á	225	E1	á
130	82		162	A2	¢	194	C2	Â	226	E2	â
131	83		163	A3	£	195	C3	Ã	227	E3	ã
132	84		164	A4	¤	196	C4	Ä	228	E4	ä
133	85		165	A5	¥	197	C5	Å	229	E5	å
134	86		166	A6	¦	198	C6	Æ	230	E6	æ
135	87		167	A7	§	199	C7	Ç	231	E7	ç
136	88		168	A8	¨	200	C8	È	232	E8	è
137	89		169	A9	©	201	C9	É	233	E9	é
138	8A		170	AA	ª	202	CA	Ê	234	EA	ê
139	8B		171	AB	«	203	CB	Ë	235	EB	ë
140	8C		172	AC		204	CC	Ì	236	EC	ì
141	8D		173	AD		205	CD	Í	237	ED	í
142	8E		174	AE	®	206	CE	Î	238	EE	î
143	8F		175	AF	¯	207	CF	Ï	239	EF	ï
144	90		176	B0	°	208	D0	Ð	240	F0	ð
145	91		177	B1	±	209	D1	Ñ	241	F1	ñ
146	92		178	B2	²	210	D2	Ò	242	F2	ò
147	93		179	B3	³	211	D3	Ó	243	F3	ó
148	94		180	B4	´	212	D4	Ô	244	F4	ô
149	95		181	B5	µ	213	D5	Õ	245	F5	õ
150	96		182	B6		214	D6	Ö	246	F6	ö
151	97		183	B7	·	215	D7	×	247	F7	÷
152	98		184	B8	¸	216	D8	Ø	248	F8	ø
153	99		185	B9	¹	217	D9	Ù	249	F9	ù
154	9A		186	BA	º	218	DA	Ú	250	FA	ú
155	9B		187	BB	»	219	DB	Û	251	FB	û
156	9C		188	BC	¼	220	DC	Ü	252	FC	ü
157	9D		189	BD	½	221	DD	Ý	253	FD	ý
158	9E		190	BE	¾	222	DE	Þ	254	FE	þ
159	9F		191	BF	¿	223	DF	ß	255	FF	ÿ

▭ possibly set by the operating system

3. The EBCDIC code CCSID 500, Codepage 500 uses the following assignments:

DEC	HEX	CHAR	DEC	HEX	CHAR	DEC	HEX	CHAR	DEC	HEX	CHAR
0	00	NUL	32	20	DS	64	40	SP	96	60	-
1	01	SOH	33	21	SOS	65	41	RSP	97	61	/
2	02	STX	34	22	FS	66	42	â	98	62	Â
3	03	ETX	35	23		67	43	ä	99	63	Ä
4	04	PF	36	24	BYP	68	44	à	100	64	À
5	05	HT	37	25	LF	69	45	á	101	65	Á
6	06	LC	38	26	ETB	70	46	ã	102	66	Ã
7	07	DEL	39	27	ESC	71	47	å	103	67	Å
8	08	GE	40	28		72	48	ç	104	68	Ç
9	09	RLF	41	29		73	49	ñ	105	69	Ñ
10	0A	SMM	42	2A	SM	74	4A	[	106	6A	¦
11	0B	VT	43	2B	CU2	75	4B	.	107	6B	,
12	0C	FF	44	2C		76	4C	<	108	6C	%
13	0D	CR	45	2D	ENQ	77	4D	(	109	6D	_
14	0E	SO	46	2E	ACK	78	4E	+	110	6E	>
15	0F	SI	47	2F	BEL	79	4F	!	111	6F	?
16	10	DLE	48	30		80	50	&	112	70	ø
17	11	DC1	49	31		81	51	é	113	71	É
18	12	DC2	50	32	SYN	82	52	ê	114	72	Ê
19	13	TM	51	33		83	53	ë	115	73	Ë
20	14	RES	52	34	PN	84	54	è	116	74	È
21	15	NL	53	35	RS	85	55	í	117	75	Í
22	16	BS	54	36	UC	86	56	î	118	76	Î
23	17	IL	55	37	EOT	87	57	ï	119	77	Ï
24	18	CAN	56	38		88	58	ì	120	78	Ì
25	19	EM	57	39		89	59	ß	121	79	`
26	1A	CC	58	3A		90	5A	]	122	7A	:
27	1B	CU1	59	3B	CU3	91	5B	$	123	7B	#
28	1C	IFS	60	3C	DC4	92	5C	*	124	7C	@
29	1D	IGS	61	3D	NAK	93	5D	)	125	7D	'
30	1E	IRS	62	3E		94	5E	;	126	7E	=
31	1F	IUS	63	3F	SUB	95	5F	¬	127	7F	"

DEC	HEX	CHAR	DEC	HEX	CHAR	DEC	HEX	CHAR	DEC	HEX	CHAR
128	80	Ø	160	A0	µ	192	C0	{	224	E0	\
129	81	a	161	A1	~	193	C1	A	225	E1	÷
130	82	b	162	A2	s	194	C2	B	226	E2	S
131	83	c	163	A3	t	195	C3	C	227	E3	T
132	84	d	164	A4	u	196	C4	D	228	E4	U
133	85	e	165	A5	v	197	C5	E	229	E5	V
134	86	f	166	A6	w	198	C6	F	230	E6	W
135	87	g	167	A7	x	199	C7	G	231	E7	X
136	88	h	168	A8	y	200	C8	H	232	E8	Y
137	89	i	169	A9	z	201	C9	I	233	E9	Z
138	8A	«	170	AA	¡	202	CA	(SHY)	234	EA	²
139	8B	»	171	AB	¿	203	CB	ô	235	EB	Ô
140	8C	ð	172	AC	Ð	204	CC	ö	236	EC	Ö
141	8D	ý	173	AD	Ý	205	CD	ò	237	ED	Ò
142	8E	þ	174	AE	Þ	206	CE	ó	238	EE	Ó
143	8F	±	175	AF	®	207	CF	õ	239	EF	Õ
144	90	°	176	B0	¢	208	D0	}	240	F0	0
145	91	j	177	B1	£	209	D1	J	241	F1	1
146	92	k	178	B2	¥	210	D2	K	242	F2	2
147	93	l	179	B3	·	211	D3	L	243	F3	3
148	94	m	180	B4	©	212	D4	M	244	F4	4
149	95	n	181	B5	§	213	D5	N	245	F5	5
150	96	o	182	B6		214	D6	O	246	F6	6
151	97	p	183	B7	¼	215	D7	P	247	F7	7
152	98	q	184	B8	½	216	D8	Q	248	F8	8
153	99	r	185	B9	¾	217	D9	R	249	F9	9
154	9A	ª	186	BA		218	DA	¹	250	FA	³
155	9B	º	187	BB	|	219	DB	û	251	FB	Û
156	9C	æ	188	BC	¯	220	DC	ü	252	FC	Ü
157	9D	¸	189	BD	¨	221	DD	ù	253	FD	Ù
158	9E	Æ	190	BE	´	222	DE	ú	254	FE	Ú
159	9F	¤	191	BF	×	223	DF	ÿ	255	FF	EO

<character>

Function

defines the elements of character strings and of key words.

Format

```
<character> ::=
    <digit>
  | <letter>
  | <extended letter>
  | <hex digit>
  | <language specific character>
  | <special character>

<digit> ::=
    0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9

<letter> ::=
    A | B | C | D | E | F | G | H | I | J | K | L | M
  | N | O | P | Q | R | S | T | U | V | W | X | Y | Z
  | a | b | c | d | e | f | g | h | i | j | k | l | m
  | n | o | p | q | r | s | t | u | v | w | x | y | z

<extended letter> ::=
    # | @ | $

<hex digit> ::=
    0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9
  | A | B | C | D | E | F
  | a | b | c | d | e | f

<language specific character> ::=
    Every letter that occurs in a North, Central or South
    European language, but is not contained in <letter>
    (e.g. the German umlauts, French grave accent, etc.).


<special character> ::=
    Every character except <digit>, <letter>, <extended letter>,
    <hex digit>,<language specific character>, and the character
    for the line end in a file.
```

Syntax Rules

none

General Rules

none

<literal>

Function

specifies a non-NULL value.

Format

```
<literal> ::=
    <string literal>
  | <numeric literal>

<string literal> ::=
    ''
  | '<character>...'
  | <hex literal>

<hex literal> ::=
    x''
  | X''
  | x'<hex digit seq>'
  | X'<hex digit seq>'

<hex digit seq> ::=
    <hex digit> <hex digit>
  | <hex digit seq> <hex digit> <hex digit>

<numeric literal> ::=
    <fixed point literal>
  | <floating point literal>

<fixed point literal> ::=
    [<sign>] <unsigned integer>[.<unsigned integer>]
  | [<sign>] <unsigned integer>.
  | [<sign>] .<unsigned integer>

<sign> ::=
    +
  | -

<unsigned integer> ::=
    <digit>



<floating point literal> ::=
    <mantissa>E<exponent>
  | <mantissa>e<exponent>

<mantissa> ::=
    <fixed point literal>

<exponent> ::=
    [<sign>] [ [<digit>] <digit>] <digit>
```

Syntax Rules

1. An apostrophe within a character string is represented by two successive apostrophes.

2. A character string can have up to 254 characters.

3. A hexadecimal character string may comprise up to 508 hexadecimal digits.

General Rules

1. A <string literal> of the type '<character>...' or '' is only valid for a value referring to an alphanumeric column with the code attribute ASCII or EBCDIC (see the chapter '<create table statement>, <column definition>').

2. A <hex literal> is only valid for a value referring to a column with the code attribute BYTE (see the chapter '<create table statement>, <column definition>').

3. A <string literal> of the type '', x'' and X'',   and <string literal>s which only contain blanks are not the same value as the NULL value.

<token>

Function

specifies lexical units.

Format

```
<token> ::=
    <regular token>
  | <delimiter token>

<regular token> ::=
    <literal>
  | <key word>
  | <identifier>
  | <parameter name>

<key word> ::=
    <not restricted key word>
  | <restricted key word>
  | <reserved key word>


<not restricted key word> ::=
  ACCOUNTING   ACTIVATE     ADABAS       ADD_MONTHS   AFTER
  ANALYZE      ANSI

  BAD          BEGINLOAD    BLOCKSIZE    BUFFER

  CACHELIMIT   CACHES       CANCEL       CLEAR        COLD
  COMPLETE     CONFIG       CONSOLE      CONSTRAINTS  COPY
  COSTLIMIT    COSTWARNING  CURRVAL

  DATA         DAYS         DB2          DBA          DBFUNCTION
  DBPROC       DBPROCEDURE  DEGREE       DESTPOS      DEVICE
  DEVSPACE     DIAGNOSE     DISABLE      DIV          DOMAINDEF
  DSETPASS     DUPLICATES   DYNAMIC

  ENDLOAD      ENDPOS       EUR          EXPLAIN      EXPLICIT

  FIRSTPOS     FNULL        FORCE        FORMAT       FREAD
  FREEPAGE     FWRITE


  GATEWAY      GRANTED

  HEXTORAW     HOLD         HOURS

  IMPLICIT     INDEXNAME    INIT         INITRANS     INSTR
  INTERNAL     ISO

  JIS

  KEEP

  LABEL        LASTPOS      LAST_DAY     LOAD
  MAXTRANS      MDECLARE      MDELETE       MFETCH        MICROSECONDS
  MINSERT       MINUTES       MLOCK         MOD           MONITOR
  MONTHS     MONTHS_BETWEEN MSELECT       MUPDATE

  NEW_TIME      NEXTVAL       NEXT_DAY      NOLOG         NORMAL
  NOSORT        NVL

  OFF           OPTIMISTIC    ORACLE        OUT           OVERWRITE

  PAGES         PARAM         PARSE         PARSEID       PARTICIPANTS
  PASSWORD      PATTERN       PCTUSED       PERMLIMIT     POS
  PRIV          PROC          PSM

  QUICK

  RANGE         RAWTOHEX      RECONNECT     REFRESH       REPLICATION
  REST          RESTART       RESTORE       REUSE         RFETCH

  SAME          SAPR3         SAVE          SAVEPOINT     SEARCH
  SECONDS       SEGMENT       SELECTIVITY   SEQUENCE      SERVERDB
  SHUTDOWN      SNAPSHOT      SOUNDS        SOURCEPOS     SQLID
  SQLMODE       STANDARD      STARTPOS      STAT          STATE
  STORAGE       STORE         SUBPAGES      SUBTRANS

  TABID         TABLEDEF      TEMP          TEMPLIMIT     TERMCHAR
  TIMEOUT       TO_CHAR       TO_DATE       TO_NUMBER     TRANSFILE
  TRIGGERDEF

  UNLOAD        UNLOCK        UNTIL         USA           USERID

  VERIFY        VERSION       VSIZE         VTRACE

  WAIT

  YEARS


<restricted key word> ::=
  ABS           ACOS          ACTION        ADDDATE       ADDTIME
  ALPHA         ASC           ASCII         ASIN          AT
  ATAN          ATAN2         AVG

  BEGIN         BINARY        BIT           BOOLEAN       BOTH
  BYTE

  CASCADE       CAST          CATALOG       CEIL          CEILING
  CHAR          CHARACTER     CHECK         CHR           CLOSE
  COMMENT       COMMIT        CONNECT       CONNECTED     CONSTRAINT
  COS           COSH          COT           CREATE        CURDATE
  CURRENT_DATE  CURRENT_TIME  CURTIME

  DATE          DATEDIFF      DAY           DAYNAME       DAYOFMONTH
  DAYOFWEEK     DAYOFYEAR     DBYTE         DEC           DECIMAL
  DECLARE       DECODE        DEFAULT       DEGREES       DESC
  DESCRIBE      DIGITS        DIRECT        DISCONNECT    DOMAIN
  DOUBLE

  EBCDIC        END           ENTRY         ENTRYDEF      EXCLUSIVE
  EXP           EXPAND        EXTRACT

  FALSE         FETCH         FIRST         FIXED         FLOAT
  FLOOR         FOREIGN
  GET           GRAPHIC       GREATEST

  HEX           HOUR

  IDENTIFIED    IFNULL        IGNORE        INDICATOR     INITCAP
  INNER         INT           INTEGER       INTERSECT     ISOLATION

  JOIN

  LANGUAGE      LAST          LCASE         LEADING       LEAST
  LEFT          LENGTH        LEVEL         LFILL         LINK
  LIST          LN            LOCAL         LOCALSYSDBA   LOCK
  LOG           LOG10         LONG          LOWER         LPAD
  LTRIM

  MAKEDATE      MAKETIME      MAPCHAR       MAX           MICROSECOND
  MIN           MINUS         MINUTE        MODE          MODIFY
  MONTH         MONTHNAME

  NATURAL       NEXT          NO            NOROUND       NOW
  NOWAIT        NUM           NUMBER        NUMERIC


  OBJECT        ONLY          OPEN          OPTION        OUTER

  PACKED        PCTFREE       PI            POWER         PRECISION
  PREV          PRIMARY       PROCEDURE     PUBLIC

  RADIANS       RAW           READ          REAL          REFERENCED
  REFERENCES    REJECT        RENAME        REPLACE       RESOURCE
  RESTRICT      REVOKE        RFILL         RIGHT         ROLLBACK
  ROUND         ROW           ROWID         ROWNO         ROWNUM
  ROWS          RPAD          RTRIM

  SCHEMA        SECOND        SELUPD        SHARE         SHOW
  SIGN          SIN           SINH          SMALLINT      SOUNDEX
  SQRT          STAMP         STATISTICS    STDDEV        SUBDATE
  SUBSTR        SUBTIME       SUM           SYSDATE       SYSDBA

  TAN           TANH          TIME          TIMEDIFF      TIMESTAMP
  TIMEZONE      TOIDENTIFIER  TRAILING      TRANSACTION   TRANSLATE
  TRIGGER       TRIM          TRUE          TRUNC         TRUNCATE

  UCASE         UID           UNIQUE        UNKNOWN       UPPER
  USAGE         USERGROUP

  VALUE         VARCHAR       VARCHAR2      VARGRAPHIC    VARIANCE
  VARYING

  WEEKOFYEAR    WHENEVER      WORK          WRITE

  YEAR

  ZONED

<reserved key word> ::=
  ADD           ALL           ALTER         AND           ANY
  AS            AUDIT

  BETWEEN       BUFFERPOOL    BY
  CLUSTER      COLUMN       CONCAT       COUNT        CURRENT
  CURSOR

  DATABASE     DELETE       DISTINCT     DROP

  EDITPROC     ESCAPE       EXCEPT       EXECUTE      EXISTS

  FOR          FROM


  GRANT        GROUP

  HAVING

  IN           INDEX        INSERT       INTO         IS

  KEY

  LIKE

  NOT          NULL

  OBID         OF           ON           OPTIMIZE     OR
  ORDER

  PRIVILEGES

  RELEASE

  SELECT       SET          SOME         SYNONYM

  TABLE        TABLESPACE   TO

  UNION        UPDATE       USER         USING

  VALIDPROC    VALUES       VIEW

  WHERE        WITH

<identifier> ::=
    <simple identifier>
  | <double quotes><special identifier><double quotes>

<simple identifier> ::=
    <first character> [<identifier tail character>...]

<first character> ::=
    <letter>
  | <extended letter>
  | <language specific character>

<identifier tail character> ::=
    <letter>
  | <extended letter>
  | <language specific character>
  | <digit>
  | <underscore>



<underscore> ::=
    _

<delimiter token> ::=
    ( | ) | , | . | + | - | * | /
  | < | > | <> | != | = | <= | >=
  | ¬= | ¬< | ¬> for a computer with the code type EBCDIC
  | ~= | ~< | ~> for a computer with the code type ASCII

<double quotes> ::=
    "

<special identifier> ::=
    <special identifier character>...

<special identifier character> ::=
    Any character.
```

Syntax Rules

1. Each <token> can be followed by any number of blanks. Each <regular token> must be concluded by a <delimiter token> or a blank. Key words and identifiers can be entered in uppercase/lowercase characters.

2. <reserved key word>s must not be used as <simple identifier>s. These are only allowed for <special identifier>s.

3. <double quotes> within a <special identifier> are represented by two successive <double quotes>.

4. For databases to be operated in different SQLMODEs, it is recommended not to use <restricted key word>s as <simple identifier>s because these could cause problems when using another SQLMODE.

General Rules

1. <simple identifier>s are always converted into uppercase characters within the database. Therefore, <simple identifier>s are not case sensitive.

2. If the name of a database object is to contain lowercase characters, special characters or blanks, <special identifier>s must be used.

Names

Function

identify objects.

Format

```
<user name> ::=
    <identifier>

<usergroup name> ::=
    <identifier>

<owner> ::=
    <user name>
  | <usergroup name>

<alias name> ::=
    <identifier>

<column name> ::=
    <identifier>

<index name> ::=
    <identifier>

<reference name> ::=
    <identifier>

<referential constraint name> ::=
    <identifier>

<result table name> ::=
    <identifier>

<synonym name> ::=
    <identifier>

<termchar set name> ::=
    <identifier>



<table name> ::=
    [<owner>.]<identifier>
  | <synonym name>

<parameter name> ::=
    :<identifier>

<indicator name> ::=
    <parameter name>
```

Syntax Rules

1. Names must not be longer than 18 characters.

2. For parameter names, the conventions of the programming language in which the SQL statements of ADABAS are embedded determine the number of significant characters.

3. The <identifier>s for parameter names may contain the characters '.' and '-', but not as the first character.
   Also valid are: <identifier>(<identifier>) and :<identifier> (.<identifier>.).

General Rules

1. A <user name> identifies a user.

2. A <usergroup name> identifies a usergroup.

3. <owner> identifies the owner of an object. <owner> is the user name if the owner does not belong to a usergroup. <owner> is the usergroup name if the owner belongs to a usergroup.

4. A new column name <alias name> defines the name of a column in a view table. It is defined in a <create view statement>.

5. A <column name> identifies a column. An identifier is defined as <column name> by a <create table statement>, <create view statement>, or in a <query statement>.

6. An <index name> identifies an index created by a <create index statement>.

7. An identifier is declared to be a <reference name> for a certain scope and is associated with exactly one table. The scope of this declaration is the entire SQL statement. The same reference name specified in various scopes can be associated with different tables or with the same table.

8. A <referential constraint name> identifies a referential integrity rule which is created by a <referential constraint definition> in the <create table statement> defining delete or existence conditions between two tables.

9. A <result table name> identifies a result table defined by a <query statement>.

10. A <synonym name> is a designation for a table. This designation is only known for one user or usergroup. A <synonym name> is defined by a <create synonym statement>.

11. A <termchar set name> identifies a TERMCHAR SET defined by the ADABAS component CONTROL.

12. A <table name> identifies a table. An identifier is defined as <table name> by a <create table statement>, <create view statement>, or <create synonym statement>. ADABAS uses some <table name>s for internal purposes. The <identifier>s of these <table name>s begin with 'SYS'. To prevent conflicting names, it is recommended not to use <table name>s beginning with 'SYS'.
    If the qualification of the user name is missing for a table name specification, first the partial catalog of the current user, then the partial catalog of the DBA who created the current user, and then the partial catalog of the SYSDBA of the current user is scanned for the specified table name.

13. A <parameter name> identifies a host variable in an application containing SQL statements of ADABAS.

14. An <indicator name> identifies an indicator variable in an application which can be specified together with a <parameter name> whose value indicates irregularities such as the occurrence of a NULL value or of different lengths of value and parameter.

<column spec>

Function

specifies a column in a table.

Format

```
 <column spec> ::=
     <column name>
   | <table name>.<column name>
   | <reference name>.<column name>
```

Syntax Rules

none

General Rules

none

<parameter spec>

Function

specifies a parameter.

Format

```
 <parameter spec> ::=
     <parameter name>[ [INDICATOR] <indicator name>]
```

Syntax Rules

1. The specification of INDICATOR is insignificant.

General Rules

1. A <parameter spec> specifies a parameter which can be followed by an indicator parameter. The indicator parameter must be declared as a variable in the embedding programming language. It must be possible to assign at least four-digit integers to such a variable.

2. Parameters which are to receive values retrieved from the database are called output parameters.

3. Parameters containing values that are to be passed to the database are called input parameters.

4. In the case of input parameters, an indicator parameter having a value greater than or equal to 0 indicates that the parameter value is the value to be passed to the database.

5. In the case of input parameters, an indicator parameter having a value less than 0 indicates that the value represented by the parameter is the NULL value.

6. In the case of output parameters, an indicator parameter having the value 0 indicates that the passed value is the parameter value, not the NULL value.

7. In the case of alphanumeric output parameters, an indicator parameter having a value greater than 0 indicates that the assigned character string was too long and has been truncated. The indicator parameter then indicates the untruncated length of the original output column.

8. In the case of numeric output parameters, an indicator parameter having a value greater than 0 indicates that the assigned value has too many significant digits and decimal positions have been truncated. The indicator parameter then indicates the number of digits of the original value.

9. In the case of output parameters, an indicator parameter having the value -1 indicates that the value represented by the parameter is the NULL value.

10. In the case of numeric output parameters, an indicator parameter having the value -2 indicates that the value represented by the parameter is the special NULL value.

11. The special NULL value is generated by arithmetical operations when these lead to an overflow or to a division by 0. The special NULL value is only valid for output columns and for columns in the <order clause>. If an overflow occurs in an arithmetical operation or a division by 0 at another place, the SQL statement is abnormally terminated. If the special NULL value occurs in an output column, an error message is output and the SQL statement is not terminated abnormally. For sorting, the special NULL value is greater than all non-NULL values, but less than the NULL value.

Specifying Values

Function

specifies a value.

Format

```
<value spec> ::=
    <literal>
  | <parameter spec>
  | NULL
  | USER
  | CURRENT SQLID
  | CURRENT DATE
  | CURRENT TIME
  | CURRENT TIMESTAMP
  | CURRENT TIMEZONE
  | CURRENT DEGREE

<string spec> ::=
    <expression>
```

Syntax Rules

none

General Rules

1. The key word NULL denotes the NULL value.

2. The key word USER denotes the name of the current user.

3. The specification of CURRENT SQLID denotes the name of the current user.

4. The specification of CURRENT DATE denotes the current date.

5. The specification of CURRENT TIME denotes the current time.

6. The specification of CURRENT TIMESTAMP denotes the current timestamp value which consists of date and time and microseconds.

7. The specification of CURRENT TIMEZONE denotes the time zone of the current SERVERDB. This value is currently preset to the value 0 and cannot be changed.

8. The specification of CURRENT DEGREE denotes the currently possible degree of simultaneous processing of <query expression>s. The default for this value is '1'. The <set current degree statement> can be used to set this value to 'ANY'.

9. For a <string spec>, only <expression>s that denote an alphanumeric value as the result are valid.

See also

Date and Time Format

Date and Time Format

Function

specifies the format in which date, time, and timestamp values are represented.

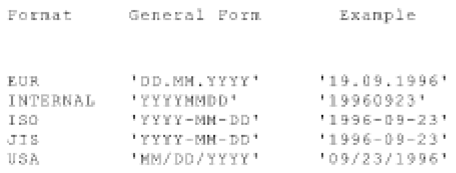
Format

```
 <datetimeformat> ::=
     EUR
   | INTERNAL
   | ISO
   | JIS
   | USA
```

Syntax Rules

1. The representation of a date value depends on the current format. In the list,

```
'YYYY' stands for a four-digit identifier of a year,
'MM'   stands for a two-digit  identifier of a month (01-12),
'DD'   stands for a two-digit  identifier of a day   (01-31).
```

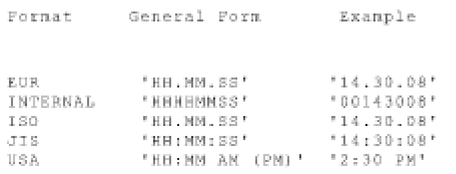


Format	General Form	Example
EUR	'DD.MM.YYYY'	'19.09.1996'
INTERNAL	'YYYYMMDD'	'19960923'
ISO	'YYYY-MM-DD'	'1996-09-23'
JIS	'YYYY-MM-DD'	'1996-09-23'
USA	'MM/DD/YYYY'	'09/23/1996'

In all formats, except INTERNAL, leading zeros may be omitted in the identifiers of the month and day.

2. The representation of a time value depends on the current format. In the list,

```
'HHHH' stands for a four-digit identifier of an hour, or
'HH'   stands for a two-digit  identifier of an hour,
'MM'   stands for a two-digit  identifier of minutes (00-59),
'SS'   stands for a two-digit  identifier of seconds (00-59).
```

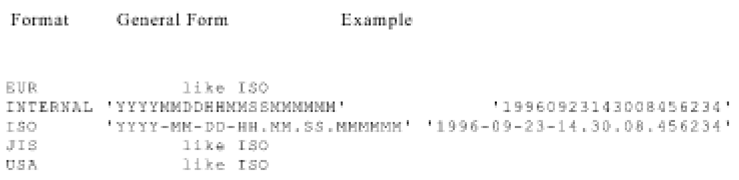


Format	General Form	Example
EUR	'HH.MM.SS'	'14.30.08'
INTERNAL	'HHHHMMSS'	'00143008'
ISO	'HH.MM.SS'	'14.30.08'
JIS	'HH:MM:SS'	'14:30:08'
USA	'HH:MM AM (PM)'	'2:30 PM'

In all time formats, the identifier of the hour must consist of at least one digit. In the time format USA, the identifier of minutes can be omitted completely. In all the other formats, except INTERNAL, the identifiers of minutes and seconds must consist of at least one digit.

3. The representation of a timestamp value depends on the current format. In the list,

```
'YYYY'   stands for a four-digit identifier of a year,
'MM'     stands for a two-digit identifier of a month (01-12),
'DD'     stands for a two-digit identifier of a day   (01-31),
'HH'     stands for a two-digit identifier of an hour (00-24),
'MM'     stands for a two-digit identifier of minutes (00-59),
'SS'     stands for a two-digit identifier of seconds (00-59),
'MMMMMM' stands for a six-digit identifier of microseconds.
```



Format	General Form	Example
EUR	like ISO	
INTERNAL	'YYYYMMDDHHMMSSMMMMMM'	'19960923143008456234'
ISO	'YYYY-MM-DD-HH.MM.SS.MMMMMM'	'1996-09-23-14.30.08.456234'
JIS	like ISO	
USA	like ISO	

In all date and time formats, the identifier of microseconds may be omitted. In all formats, except INTERNAL, the identifiers of the month and day must consist of at least one digit.

General Rules

1. The date and time format determines the representation in which date, time and timestamp values may be included in SQL statements and the way in which results are to be represented.

2. The date and time format is determined during the installation of the database.

3. A user can change the date and time format for his session by specifying the corresponding parameters when using programs.

<function spec>

Function

specifies a value which is obtained by applying a function to an argument.

Format

```
<function spec> ::=
    <arithmetic function>
  | <string function>
  | <extraction function>
  | <special function>
  | <conversion function>
  | <userdefined function>

<userdefined function> ::=
    Each DB function defined by any user.
```

Syntax Rules

none

General Rules

1. The arguments and results of the functions are numeric or alphanumeric values. The date, time and timestamp values are alphanumeric values which are subject to certain restrictions.

2. A <userdefined function> is a DB function which was defined in SQLMODE ADABAS and is available in the other SQLMODEs except ANSI. The result of a <userdefined function> is a numeric, alphanumeric or Boolean value. If a DB function has a name that is the name of a known predefined function in the current SQLMODE, then this function is used and not the DB function.

See also

<arithmetic function>

<string function>

<extraction function>

<special function>

<conversion function>

<arithmetic function>

Function

specifies a function which produces a numeric value as the result.

Format

```
 <arithmetic function> ::=
     INTEGER ( <expression> )
   | DECIMAL ( <expression>[, <unsigned integer>
               [, <unsigned integer>] ] )
   | FLOAT   ( <expression> )
   | LENGTH  ( <expression> )
```

Syntax Rules

none

General Rules

1. INTEGER
   If a is a number, then INTEGER(a) is the integral part of a. The result is a fixed point number. If a is the NULL value, then INTEGER(a) is the NULL value. If a is the special NULL value, then INTEGER(a) is the special NULL value.

2. DECIMAL
   The function DECIMAL(a,p,s) can be used to output the number a in a format of the data type DECIMAL(p,s). Digits after the decimal point are rounded to s digits, if necessary. If a is the NULL value, then the result is the NULL value. If a is the special NULL value, then the result is the special NULL value. If s is not specified, then the value 0 is implicitly assumed for s. If p is not specified, then the value 18 is implicitly assumed for p.

3. FLOAT
   If a is a number, then FLOAT(a) produces the number a in the representation of a floating point number. If a is the NULL value, then FLOAT(a) is the NULL value. If a is the special NULL value, then FLOAT(a) is the special NULL value.

4. LENGTH
   LENGTH can be applied to any data type.
   If a is a character string of length n, then LENGTH(a)=n. The length of a character string is determined without consideration of trailing blanks (code attribute ASCII or EBCDIC) or binary zeros (code attribute BYTE).
   LENGTH indicates the number of bytes needed for the internal representation of the value. If a is the NULL value, then LENGTH(a) is the NULL value. If a is the special NULL value, then LENGTH(a) is the special NULL value.

<string function>

Function

specifies a function which produces an alphanumeric value as the result.

Format

```
 <string function> ::=
     <string spec> || <string spec>
   | <string spec> CONCAT <string spec>
   | SUBSTR    ( <string spec>, <expression>[, <expression>] )
```

Syntax Rules

none

General Rules

1. Concatenation, ||
   If x is a character string of length n and if y is a character string of length m, then x||y is the concatenation xy of length n+m. If a character string comes from a column, then its length is determined without consideration of trailing blanks (code attribute ASCII or EBCDIC) or binary zeros (code attribute BYTE). If an operand of the concatenation is the NULL value, then the result is the NULL value.
   Columns having the same code attribute can be concatenated. Columns having the different code attributes ASCII and EBCDIC can be concatenated. Columns with the code attributes ASCII and EBCDIC can be concatenated with date, time, or timestamp values.

2. Concatenation, CONCAT
   The concatenation x CONCAT y produces the same result as the concatenation x||y.

3. SUBSTR
   If x is a character string of length n, then SUBSTR(x,a,b) is that part of the character string x which begins at the ath character and has a length of b characters.
   SUBSTR(x,a) corresponds to SUBSTR(x,a,n-a+1) and produces all characters of the character string x from the ath character to the last character (nth).
   If b is specified as <unsigned integer>, then a value greater than (n-a+1) is also valid for b. In all the other cases, the value of b must not exceed the value (n-a+1). If b > (n-a+1), then SUBSTR(x,a) is performed internally. As many blanks (code attribute ASCII or EBCDIC) or binary zeros (code attribute BYTE) are appended to the end of this result as are needed to give the result the length b.
   If x, a or b is the NULL value, then SUBSTR(x,a,b) is the NULL value.

<extraction function>

Function

specifies a function which either extracts portions from date, time or timestamp values or which forms a date, time, or timestamp value.

Format

```
<extraction function> ::=
    YEAR        ( <date or timestamp expression> )
  | MONTH       ( <date or timestamp expression> )
  | DAY         ( <date or timestamp expression> )
  | HOUR        ( <time or timestamp expression> )
  | MINUTE      ( <time or timestamp expression> )
  | SECOND      ( <time or timestamp expression> )
  | MICROSECOND ( <expression> )
  | TIMESTAMP   ( <expression>[, <expression> ] )
  | DATE        ( <expression> )
  | TIME        ( <expression> )
  | DAYS        ( <date or timestamp expression> )

<date or timestamp expression> ::=
    <expression>

<time or timestamp expression> ::=
    <expression>
```

Syntax Rules

none

General Rules

1. YEAR
   MONTH
   DAY
   The <date or timestamp expression> in YEAR, MONTH, and DAY must be a date or timestamp value or it must produce a <date duration> as the result.
   The result of YEAR, MONTH or DAY is a numeric value which represents the year or month or day specification made in the <date or timestamp expression>.
   If the parameter is the NULL value, then the result is the NULL value.

2. HOUR
   MINUTE
   SECOND
   The <time or timestamp expression> in HOUR, MINUTE or SECOND must be a time or timestamp value or produce a <time duration> as the result.
   The result of HOUR, MINUTE or SECOND is a numeric value which represents the hour or minute or second specification made in the <time or timestamp expression>.
   If the parameter is the NULL value, then the result is the NULL value.

3. MICROSECOND
   The <expression> in MICROSECOND must be a timestamp value.
   The result of MICROSECOND is a numeric value which represents the microsecond specification made in the <expression>.
   If the parameter is the NULL value, then the result is the NULL value.

4. TIMESTAMP
   If only one <expression> is specified for TIMESTAMP, then this must be a timestamp value or it must produce an alphanumeric value as the result. This value must correspond to the current format of timestamp values. The result of TIMESTAMP then is the timestamp value.
   If two <expression>s are specified for TIMESTAMP, then the first one must be a date value and the second one a time value. Both <expression>s can produce an alphanumeric value as the result. This value must correspond to the current format of date or time values, respectively. The result of TIMESTAMP is a timestamp value formed from the date value, the time value and 0 microseconds.
   If one parameter is the NULL value, then TIMESTAMP produces the NULL value.

5. DATE
   If the <expression> in DATE is a date value or produces an alphanumeric value as the result which corresponds to the current date format, then the result of DATE is this date value.
   If this function is applied to an alphanumeric value, a check is made as to whether the specified value corresponds to the current format of date values.
   If the <expression> in DATE is a timestamp value or produces an alphanumeric value as the result which corresponds to the current format of timestamp values, then the result of DATE is the date value which forms part of the timestamp value.
   If the <expression> in DATE produces either a fixed point number or a floating point number as the result, then the result of DATE is a date value which corresponds to the xth day following the 12/31/0000, where x =INTEGER(<expression>).
   If the parameter is the NULL value, then DATE produces the NULL value. If the parameter is the special NULL value, then an error message is output.

6. TIME
   If the <expression> in TIME is a time value or produces an alphanumeric value as the result which corresponds to the current time format, then the result of TIME is this time value.
   If this function is applied to an alphanumeric value, a check is made as to whether the specified value corresponds to the current format of time values.
   If the <expression> in TIME is a timestamp value or produces an alphanumeric value as the result which corresponds to the current format of timestamp values, then the result of TIME is the time value which forms part of the timestamp value.
   If the parameter is the NULL value, then TIME produces the NULL value.

7. DAYS
   The <date or timestamp expression> in DAYS must be a date or timestamp value or must produce an alphanumeric value as the result which corresponds to the current date format. The result of DAYS is a numeric value which indicates the number of days from the 01/01/0001 to the specified date. If the parameter is the NULL value, then DAYS produces the NULL value.

<special function>

Function

specifies a function which is not limited to specific data types.

Format

```
 <special function> ::=
     VALUE    ( <expression>, <expression>,... )
```

Syntax Rules

none

General Rules

1. VALUE
   The arguments of the VALUE function must be comparable.
   The arguments are evaluated one after the other in the specified order. If an argument is a non-NULL value, then the result of the VALUE function is the first occurring non-NULL value. If every argument is the special NULL value, then the result of the VALUE function is the special NULL value. Otherwise, the result is the NULL value.
   The VALUE function can be used for replacing a NULL value with a non-NULL value.
   An example be 'SALARY + VALUE(BONUS,0)' where SALARY and BONUS are assumed to be column names of one table.

<conversion function>

Function

specifies a function which converts a value of one data type into another data type.

Format

```
 <conversion function> ::=
     DIGITS    ( <expression> )
   | CHAR      ( <expression>[, <datetimeformat> ] )
```

Syntax Rules

none

General Rules

1. DIGITS
   DIGITS can be applied to all fixed point numbers and to all floating point numbers that can be represented as fixed point numbers. DIGITS transforms a fixed point number into a corresponding character string. The result contains no sign and no decimal point. The result contains leading zeros. If DIGITS is applied to a column of data type DECIMAL(p,s), then the result has the length p. Otherwise, the result has the length 18. DIGITS applied to the NULL value produces the NULL value as the result. DIGITS applied to the special NULL value produces an error message.

2. CHAR
   CHAR can only be applied to date, time or timestamp values, or to fixed point numbers.
   If the first parameter is a date, time or timestamp value, then the result of CHAR is a character string which corresponds to the date, time or timestamp value in the format specified in the optional second parameter. If the second parameter is missing, the current date and time format is assumed for <datetimeformat>. The different presentation formats for date, time, and timestamp values are described in the chapter 'Date and Time Format'.
   If the first parameter is a fixed point number, then a second parameter may not be specified. CHAR transforms a fixed point number into a character string which corresponds to the character presentation of this number.
   If the first parameter is the NULL value, then CHAR produces the NULL value as the result.

<set function spec>

Function

specifies a function. The argument of the function is a set of values.

Format

```
<set function spec> ::=
    COUNT (*)
  | <distinct function>
  | <all function>

<distinct function> ::=
    <set function name> ( DISTINCT <expression> )

<all function> ::=
    <all set function name> ( [ALL] <expression> )

<set function name> ::=
    COUNT
  | MAX
  | MIN
  | SUM
  | AVG

<all set function name> ::=
    MAX
  | MIN
  | SUM
  | AVG
```

Syntax Rules

1. The <expression> must not contain a <set function spec>.

General Rules

1. Each <query spec> contains a <table expression>. The <table expression> produces a temporary result table. This temporary result table can be grouped using a <group clause>. The argument of a <distinct function> or an <all function> is created on the basis of a temporary result table or group.

2. The argument of a <distinct function> is a set of values. This set is generated by applying the <expression> to each row of a temporary result table or of a group and by eliminating all NULL values and duplicate values. Special NULL values are not removed. Two special NULL values are assumed to be identical.
   If the set is empty and the <distinct function> is applied to the whole temporary result table, the result of AVG, MAX, MIN, and SUM is the NULL value, and the result of COUNT is 0.
   If there is no group to which the <distinct function> could be applied, the result table is empty.

If the set contains at least one special NULL value, the result of the <distinct function> is the special NULL value.

3. The argument of an <all function> is a set of values. This set is generated by applying the <expression> to each row of the temporary result table or of a group and by eliminating all NULL values from the result. Special NULL values are not removed. Two special NULL values are assumed to be identical.
   If the set is empty and the <all function> is applied to the whole temporary result table, the result of AVG, MAX, MIN, and SUM is the NULL value.
   If there is no group to which the <all function> could be applied, the result table is empty.
   If the set contains at least one special NULL value, the result of the <all function> is the special NULL value.
   The result of an <all function> is independent of whether the key word ALL is specified or not.

4. The result of COUNT(*) is the number of rows in a temporary result table or of a group. The result of COUNT (DISTINCT <expression> is the number of values of the argument in the <distinct function>.
5. The result of MAX is the largest value of the argument. The result of MIN is the smallest value of the argument.

6. SUM can only be applied to numeric values. The result of SUM is the sum of the values of the argument. The result has the data type FLOAT(18).

7. AVG can only be applied to numeric values. The result of AVG is the arithmetical average of the values of the argument. The result has the data type FLOAT(18).

8. Contrary to the usual locking mechanisms, no locks are set for some <set function spec>s, irrespective of the <isolation spec> specified when connecting to the database.

<expression>

Function

specifies a value which is generated, if required, by applying arithmetical operators to values.

Format

```
<expression> ::=
    <arithmetic expression>
  | <datetime expression>
```

Syntax Rules

none

General Rules

none

See also

<arithmetic expression>

<datetime expression>

<arithmetic expression>

Function

specifies a value which is generated, if required, by applying arithmetical operators to values.

Format

```
<arithmetic expression> ::=
    <term>
  | <arithmetic expression> + <term>
  | <arithmetic expression> - <term>

<term> ::=
    <factor>
  | <term> * <factor>
  | <term> / <factor>

<factor> ::=
    [<sign>] <primary>

<sign> ::=
    +

  | -

<primary> ::=
    <value spec>
  | <column spec>
  | <function spec>
  | <set function spec>
  | (<arithmetic expression>)
```

Syntax Rules

none

General Rules

1. The arithmetical operators * and /, as well as + and -, unless they are described in the <datetime expression>, can only be applied to numeric data types.

2. The result of an <arithmetic expression> is either a non-NULL value, the NULL value, or the special NULL value.

3. The result of an <arithmetic expression> is the NULL value if any <primary> has the NULL value.

4. The result of an <arithmetic expression> is the special NULL value if any <primary> has the special NULL value. The result of an <arithmetic expression> is the special NULL value if this <expression> leads to a division by 0 or to an overflow of the internal temporary result.

5. If both operands of an operator are fixed point numbers, then the result is either a fixed point number or a floating point number. The data type of the result depends on the operation as well as on the precision and scale of the operands. Note that the data type of the specified column is used in case of a column name specification, not the precision and scale of the current column value.

   The result of addition, subtraction, and multiplication is generated from a temporary result which can have more than 18 valid digits. If the temporary result has no more than 18 valid digits, the final result is equal to the temporary result. Otherwise, a result is generated as a floating point number with a precision of 18 digits. Digits after the decimal point are truncated, if necessary.

   Let p and s represent the precision and scale of the first operand, p' and s' the corresponding values of the second operand.

   If max(p-s,p'-s') + max(s,s') + 1 <= 18, then addition and subtraction produce a valid result as a fixed point number. The precision of the result obtained by addition and subtraction is max(p-s,p'-s') + max(s,s') + 1, the scale is max(s,s').
   If (p+p') <= 18, then multiplication produces a valid result as a fixed point number. The precision of the result obtained by multiplication is p+p', the scale is s+s'.

   If (p-s+s') <= 18, then division produces a valid result as a fixed point number. The precision of the result obtained by division is 18 and the scale is 18-(p-s+s').
   If the second operand of the division has the value 0,   the result is the special NULL value.

6. If a floating point number occurs in an arithmetical expression, the result is a floating point number.

7. If no parentheses are used, the operators have the following precedence: <sign> has a higher precedence than the multiplicative operators * and / and the additive operators + and -. The multiplicative operators have a higher precedence than the additive operators. The multiplicative operators have the same precedence among each other, and the same applies to the additive operators. Operators with the same precedence are evaluated from left to right.

<datetime expression>

Function

specifies a value which is formed by applying arithmetical operators to date, time or timestamp values.

Format

```
<datetime expression> ::=
    <datetime primary>
  | <datetime expression> + <datetime primary>
  | <datetime expression> - <datetime primary>

<datetime primary> ::=
    <labeled duration>
  | <date duration>
  | <time duration>
  | <column spec>
  | <function spec>
  | <set function spec>
  | (<datetime expression>)

<labeled duration> ::=
    <expression>  <time unit>

<time unit> ::=
    YEAR
  | YEARS
  | MONTH
  | MONTHS
  | DAY
  | DAYS
  | HOUR
  | HOURS
  | MINUTE
  | MINUTES
  | SECOND
  | SECONDS
  | MICROSECOND
  | MICROSECONDS



<date duration> ::=
    [<sign>] <unsigned integer>

<time duration> ::=
    [<sign>] <unsigned integer>
```

Syntax Rules

1. The <unsigned integer> of a <date duration> must have the general format YYYYMMDD, where 'YYYY' stands for the four-digit identifier of a year, 'MM' for the two-digit identifier of a month, and 'DD' for a two-digit identifier of a day.

2. The <unsigned integer> of a <time duration> must have the general format HHMMSS, where 'HH' stands for a two-digit identifier of the hour, 'MM' for the two-digit identifier of the minutes, and 'SS' for the two-digit identifier of the seconds.

General Rules

1. The result of a <datetime expression> is either a non-NULL value or the NULL value.

2. The result of a <datetime expression> is the NULL value if any <datetime primary> has the NULL value.

3. A date string is a <value spec> which corresponds to the current date and time format of date values.
   A DATE value is an <expression> which produces a value of the data type DATE as the result.

4. A time string is a <value spec> which corresponds to the current date and time format of time values.
   A TIME value is an <expression> which produces a value of the data type TIME as the result.

5. A timestamp string is a <value spec> which corresponds to the current date and time format of timestamp values.
   A TIMESTAMP value is an <expression> which produces a value of the data type TIMESTAMP as the result.

6. The result of the following additions and subtractions is a DATE value:

```
DATE value          +  <date duration>
DATE value          +  <labeled duration>
date string         +  <labeled duration>
<labeled duration>  +  DATE value
<labeled duration>  +  date string

DATE value          -  <date duration>
DATE value          -  <labeled duration>
date string         -  <labeled duration>
```

   The <time unit> of the <labeled duration> must be either YEAR, YEARS, MONTH, MONTHS, DAY or DAYS.

   The result must lie between 01/01/0001 and 12/31/9999.

   During the calculation, the day part, the month part and the year part of the result are computed, whereby overflows (e.g., '12/31/1995' + 5 DAYS) and underflows are carried over for each part. If an incorrect date is generated (e.g., '02/29/1997'), a warning is issued and the last valid date of the corresponding month is formed as the result. Therefore, it is not always possible to reverse the arithmetic to date values.

7. The result of the following additions and subtractions is a <date duration> of the data type DECIMAL(8,0):

```
DATE value          -  DATE value
DATE value          -  date string
date string         -  DATE value
```

The result of subtraction is formed by the number of years, months and days between the two date values. If the second date value is greater than the first one, the result can be negative.

8. The result of the following additions and subtractions is a TIME value:

```
TIME value          +  <time duration>
TIME value          +  <labeled duration>
time string         +  <labeled duration>
<labeled duration>  +  TIME value
<labeled duration>  +  time string
<labeled duration>  +  <labeled duration>

TIME value          -  <time duration>
TIME value          -  <labeled duration>
time string         -  <labeled duration>
<labeled duration>  -  <time duration>
<labeled duration>  -  <labeled duration>
```

   The <time unit> of the <labeled duration> must be either HOUR, HOURS, MINUTE, MINUTES, SECOND or SECONDS.

   During the calculation, the second part, the minute part and the hour part of the result are computed, whereby overflows and underflows are carried over for each part. If a negative hour part is computed or if the result contains an hour part >= 24, the result is corrected by taking the hour part modulo 24. Therefore, it is not always possible to reverse the arithmetic to time values. The result is a valid TIME value.

9. The result of the following additions and subtractions is a <time duration> of the data type DECIMAL(6,0):

```
TIME value          -  TIME value
TIME value          -  time string
time string         -  TIME value
```

   The result of subtraction is formed by the number of hours, minutes, and seconds between the two time values. If the second time value is greater than the first one, the result can be negative.

10. The result of the following additions and subtractions is a TIMESTAMP value:

```
TIMESTAMP value     +  <labeled duration>
timestamp string    +  <labeled duration>

TIMESTAMP value     -  <labeled duration>
timestamp string    -  <labeled duration>
```

   Each <time unit> in the <labeled duration> is valid.

   The explanations given for arithmetic with date and time values are valid here, with the restriction that an overflow or underflow of the hour part is carried over into the date part of the TIMESTAMP value.

<predicate>

Function

specifies a condition which is 'true', 'false', or 'unknown'.

Format

```
 <predicate> ::=
     <between predicate>
   | <comparison predicate>
   | <exists predicate>
   | <in predicate>
   | <join predicate>
   | <like predicate>
   | <null predicate>
   | <quantified predicate>
```

Syntax Rules

none

General Rules

1. A predicate specifies a condition which is either 'true' or 'false' or 'unknown'. The result is generated by applying the predicate either to a given table row or to a group of table rows that was formed by the <group clause>.

2. Columns with the same code attribute can be compared to each other. Columns with the different code attributes ASCII and EBCDIC can be compared to each other. Columns of the code attributes ASCII and EBCDIC can be compared to date, time or timestamp values.

See also

<between predicate>

<comparison predicate>

<exists predicate>

<in predicate>

<join predicate>

<like predicate>

<null predicate>

<quantified predicate>

<between predicate>

Function

checks whether a value lies within a given interval.

Format

```
 <between predicate> ::=
     <expression> [NOT] BETWEEN <expression> AND <expression>
```

Syntax Rules

none

General Rules

1. Let x, y, and z be the results of the first, second and third <expression>. The values x, y and z must be comparable with each other.

2. (x BETWEEN y AND z) has the same result as (x>=y AND x<=z).

3. (x NOT BETWEEN y AND z) has the same result as
NOT(x BETWEEN y AND z).

4. If x, y or z are NULL values, then (x [NOT] BETWEEN y AND z) is unknown.

<comparison predicate>

Function

specifies a comparison between two values.

Format

```
<comparison predicate> ::=
    <expression> <comp op> <expression>
  | <expression> <comp op> <subquery>

<comp op> ::=
    < | > | <> | != | = | <= | >=
  | ¬= | ¬< | ¬> for a computer with the code type EBCDIC
  | ~= | ~< | ~> for a computer with the code type ASCII
```

Syntax Rules

1. The <subquery> must produce a single-column result table which contains no more than one row.

General Rules

1. Let x be the result of the first <expression> and y the result of the second <expression> or of the <subquery>. The values x and y must be comparable with each other.

2. Numbers are compared to each other according to their algebraic values.

3. Character strings are compared character by character. If the character strings have different lengths, the shorter one is padded with blanks (code attribute ASCII, EBCDIC) or with binary zeros (code attribute BYTE), so that they have the same length when being compared. If the character strings have the different code attributes ASCII and EBCDIC, one of these character strings is implicitly converted so that they have the same code attribute.

4. Two character strings are identical if they have the same characters in the same positions. If they are not identical, their relation is determined by the first differing character found during comparison from left to right. This comparison is made according to the code attribute (ASCII, EBCDIC, or BYTE) chosen for this column.

5. If x or y are NULL values, or if the result of the <subquery> is empty, then (x <comp op> y) is unknown.

6. The <join predicate> is a special case of the <comparison predicate>. The <join predicate> is described in a separate section.

<exists predicate>

Function

checks whether a result table contains at least one row.

Format

```
<exists predicate> ::=
    EXISTS <subquery>
```

Syntax Rules

none

General Rules

1. The truth value of an <exists predicate> is either true or false.
2. Let T be the result table produced by <subquery>. (EXISTS T) is true if and only if T contains at least one row.

<in predicate>

Function

checks whether a value is contained in a given set of values.

Format

```
 <in predicate> ::=
     <expression> [NOT] IN <subquery>
   | <expression> [NOT] IN (<value spec>,...)
```

Syntax Rule

1. The <subquery> must produce a single-column result table.

General Rules

1. Let x be the result of the <expression> and S be either the result of the <subquery> or the values of the sequence of <value spec>s. S is a set of values. The value x and the values in S must be comparable with each other.

2. If x=s is true for at least one value s of S, then (x IN S) is true.

3. If x=s is not true for any value s of S and x=s is unknown for at least one value s of S, then (x IN S) is unknown.

4. If S is empty or if x=s is false for every value s of S, then (x IN S) is false.

5. (x NOT IN S) has the same result as NOT(x IN S).

<join predicate>

Function

specifies a join.

Format

```
 <join predicate> ::=
     <expression> <comp op> <expression>
```

Syntax Rules

none

General Rules

1. Each <expression> must contain a <column spec>. There must be a <column spec> of the first <expression> and a <column spec> of the second <expression>, so that the <column spec>s refer to different table names or reference names.

2. Let x be the value of the first <expression> and y the value of the second <expression>. The values x and y must be comparable with each other.

3. The same rules apply that are listed for the <comparison predicate>.

4. The <join predicate> is a special case of the <comparison predicate>. The number of <join predicate>s in a <search condition> is limited to 64.

<like predicate>

Function

serves to search for character strings which have a particular pattern.

Format

```
<like predicate> ::=
    <expression> [NOT] LIKE <like expression>
                 [ESCAPE <expression>]

<like expression> ::=
    <expression>
  | '<pattern element>...'

<pattern element> ::=
    <match string>
  | <match set>

<match string> ::=
    %
  | X'1F'

<match set> ::=
    <underscore>
  | X'1E'
  | <match char>

<match char> ::=
    Any character except
    %, X'1F', <underscore>, X'1E'.
```

Syntax Rules

none

General Rules

1. The <expression> of the <like expression> must produce an alphanumeric value, or a date, time or timestamp value.
2. A <match string> stands for a sequence of n characters, where n >= 0.
3. A <match set> is a character.
   Thereby '_' and X'1E' stand for any character, <match char> for itself.
4. Let x be the value of the <expression> and y the value of the <like expression>.
5. If x or y are NULL values, then (x LIKE y) is unknown.
6. If x and y are non-NULL values, then (x LIKE y) is either true or false.

7. (x LIKE y) is true if x can be divided into substrings in such a way that the following is valid:

   a) A substring of x is a sequence of 0, 1, or more contiguous characters, and each character of x belongs to exactly one substring.

   b) If the nth <pattern element> of y is a <match set>, then the nth substring of x is a single character which is contained in the <match set>.

   c) If the nth <pattern element> of y is a <match string>, then the nth substring of x is a sequence of 0 or more characters.

   d) The number of substrings of x and y is identical.

8. If ESCAPE is specified, then the corresponding <expression> must produce an alphanumeric value which consists of just one character. If this escape character is contained in the <like expression>, the subsequent character is considered to be a <match char>; i.e., it stands for itself.
   The use of an escape character is required if <underscore> or '%' or the hexadecimal value X'1E' or X'1F' is to be searched for.

   Example:
      LIKE '*_'
      Any character string having the minimum length of 1 is searched for.

      LIKE '*:_*' ESCAPE ':'
      A character string having any number of characters is searched for, where the character string must contain an <underscore>.

9. (x NOT LIKE y) has the same result as NOT(x LIKE y).

<null predicate>

Function

specifies a check for a NULL value.

Format

```
 <null predicate> ::=
     <expression> IS [NOT] NULL
```

Syntax Rules

none

General Rules

1. The truth value of a <null predicate> is either true or false.

2. Let x be the value of the <expression>. (x IS NULL) is true if and only if x is the NULL value.

3. (x IS NOT NULL) has the same result as NOT(x IS NULL).

<quantified predicate>

Function

compares a value to a single-column result table.

Format

```
<quantified predicate> ::=
    <expression> <comp op> <quantifier> <subquery>

<quantifier> ::=
    ALL
  | <some>

<some> ::=
    SOME
  | ANY
```

Syntax Rules

1. The <subquery> must produce a single-column result table.

General Rules

1. Let x be the result of the <expression> and S the result of the <subquery>. S is a set of values. The value x and the values in S must be comparable with each other.
2. If S is empty or (x <comp op> s) is true for every value s of S, then (x <comp op> ALL S) is true.
3. If (x <comp op> s) is not false for any value s of S and (x <comp op> s) is unknown for at least one value s of S, then (x <comp op> ALL S) is unknown.
4. If (x <comp op> s) is false for at least one value s of S, then (x <comp op> ALL S) is false.
5. If (x <comp op> s) is true for at least one value s of S, then (x <comp op> <some> S) is true.
6. If (x <comp op> s) is not true for any value s of S and (x <comp op> s) is unknown for at least one value s of S, then (x <comp op> <some> S) is unknown.
7. If S is empty or (x <comp op> s) is false for every value s of S, then (x <comp op> <some> S) is false.

<search condition>

Function

combines conditions which can be 'true', 'false', or 'unknown'.

Format

```
<search condition> ::=
    <boolean term>
  | <search condition> OR <boolean term>

<boolean term> ::=
    <boolean factor>
  | <boolean term> AND <boolean factor>

<boolean factor> ::=
    [NOT] <boolean primary>

<boolean primary> ::=
    <predicate>
  | (<search condition>)
```

Syntax Rules

none

General Rules

1. Each specified <predicate> is applied to a given table row or to a group of table rows that was formed by the <group clause>. The results are combined with the specified Boolean operators (AND, OR, NOT) in order to generate the result of the <search condition>.

2. If no parentheses are used, the precedence of the operators is as follows: NOT has a higher precedence than AND and OR, AND has a higher precedence than OR. Operators having the same precedence are evaluated from left to right.

3. The following rules apply to NOT:

   NOT(true) is false.
   NOT(false) is true.
   NOT(unknown) is unknown.

4. The following rules apply to AND:

AND	false	unknown	true
false	false	false	false
unknown	false	unknown	unknown
true	false	unknown	true

5. The following rules apply to OR:

OR	false	unknown	true
false	false	unknown	true
unknown	unknown	unknown	true
true	true	true	true

SQL Statement

Function

specifies any SQL statement.

Format

```
 <sql statement> ::=
     <create table statement>
   | <drop table statement>
   | <create synonym statement>
   | <drop synonym statement>
   | <create view statement>
   | <drop view statement>
   | <create index statement>
   | <drop index statement>
   | <comment statement>
   | <grant statement>
   | <revoke statement>

   | <insert statement>
   | <update statement>
   | <delete statement>
   | <set current degree statement>
   | <set statement>

   | <query statement>
   | <open cursor statement>
   | <fetch statement>
   | <close statement>
   | <single select statement>

   | <connect statement>
   | <commit statement>
   | <rollback statement>
   | <lock statement>
   | <release statement>
```

Syntax Rules

none

General Rules

1. The SQL statements of the 1st block are described in the chapter '<create table statement>'.

2. The SQL statements of the 2nd block are described in the chapter '<grant statement>'.

3. The SQL statements of the 3rd block are described in the chapter 'Data Manipulation'.

4. The SQL statements of the 4th block are described in the chapter 'Data Retrieval'.

5. The SQL statements of the 5th block are described in the chapter 'Transactions'.

6. All SQL statements can be embedded in programming languages. For a detailed description, refer to the online help on the precompilers.

7. All SQL statements, except the <set statement>, can be specified interactively.

<create table statement>

Function

creates a base table.

Format

```
<create table statement> ::=
    CREATE TABLE <table name> (<table description element>,...)
          [<db2 options>]
  | CREATE TABLE <table name> LIKE <source table>

<table description element> :=
    <column definition>
  | <referential constraint definition>
  | <key definition>

<source table> ::=
    <table name>

<db2 options> ::=
    IN [<identifier>.]<identifier>
  | IN DATABASE <identifier>
  | AUDIT NONE
  | AUDIT CHANGES
  | AUDIT ALL
```

Syntax Rules

1. The <create table statement> must contain at least one <column definition>.

2. A table may contain up to 255 <column definition>s. If a table is defined without a key column, ADABAS implicitly creates a key column. In this case, up to 254 additional columns can be defined.

3. The <create table statement> may contain no more than one <key definition>.

General Rules

1. Omitting the <owner> in the <table name> has the same effect as specifying the current user as <owner>. Otherwise, <owner> must be identical to the name of the current user.

2. As a result of a <create table statement>, data describing the table is stored in the catalog. This data is called metadata. Tables generated using the <create table statement> are called base tables.

3. The <table name> must not be identical to the name of an existing table of the current user.

4. The current user must have DBA or RESOURCE status.

5. The current user becomes the owner of the created table. The user obtains the INSERT, UPDATE, DELETE, SELECT, ALTER, and INDEX privilege for this table.

6. <source table> must denote a base table, a view table, or a synonym. Specifying a synonym has the same effect as specifying the table for which the synonym was defined.
The user must have at least one privilege for this table.
If 'LIKE <source table>' is specified, an empty base table is created which, from the point of view of the current user, has the same structure as the table <source table>; i.e., it has all columns with the same column names and definitions as the <source table> that are known to the user. This view need not be identical with the actual structure of the <source table>, since the user may not know all the columns because of privilege limitations.
If all key columns of the <source table> are contained in the newly created table, then these make up the key columns of this table. Otherwise, ADABAS implicitly inserts a key column SYSKEY CHAR(8) FOR BIT DATA which makes up the key of the base table.
The <default spec>s of the accepted columns of the <source table> are also valid for the newly created table. The current user is the owner of the created base table.

7. The <db2 options> are meaningless for ADABAS.

See also

<column definition>

<referential constraint definition>

<key definition>

<column definition>

Function

defines a table column.

Format

```
<column definition> ::=
    <column name> <data type> <column attributes>

<data type> ::=
    CHAR[ACTER] [(<unsigned integer>)] [FOR BIT DATA]
  | VARCHAR [(<unsigned integer>)] [FOR BIT DATA]
  | LONG VARCHAR [FOR BIT DATA]
  | DEC[IMAL] [(<unsigned integer> [,<unsigned integer>])]
  | NUMERIC (<unsigned integer> [,<unsigned integer>])
  | INT[EGER]
  | SMALLINT
  | FLOAT (<unsigned integer>)
  | REAL
  | DOUBLE PRECISION
  | DATE
  | TIME
  | TIMESTAMP
  | GRAPHIC (<unsigned integer>)
  | VARGRAPHIC (<unsigned integer>)
  | LONG VARGRAPHIC

<column attributes> ::=
    NOT NULL [<default spec>]

<default spec> ::=
    WITH DEFAULT

<default value> ::=
    value resulting from the <data type> of the
    <column definition> containing the <default spec>
```

Syntax Rules

none

General Rules

1. The name and data type of each column are defined by <column name> and <data type>. The <column name>s must be unique within a base table.

2. CHAR[ACTER] (n) and VARCHAR (n) define an alphanumeric column with the length attribute n. The length attribute must be greater than 0 and less than or equal to 4000. If the length attribute is omitted, n=1 is assumed.   ADABAS stores the contents of the column as character strings with the code attribute EBCDIC. The specification of FOR

BIT DATA has the effect that the contents of the column are treated as code-independent character strings of bytes (code attribute BYTE), not as EBCDIC character strings.

3. If CHAR[ACTER] (n) is specified, the value n determines whether ADABAS stores the values of this column in fixed length or in variable length. If the values are to be stored in variable length regardless of n, VARCHAR must be specified. Otherwise, specifying VARCHAR has the same effect as CHAR. LONG VARCHAR has the same effect as VARCHAR(x). Here, ADABAS selects x so that a table row assumes the maximum row length (4047 bytes), although x itself does not exceed 4000.

4. DEC[IMAL](p,s) and NUMERIC(p,s) define a fixed point column with the precision p and the scale s. The precision must be greater than 0 and less than or equal to 18. The scale must not be greater than the precision. If s is omitted, the scale is equal to 0. INT[EGER] and SMALLINT are both equivalent to DECIMAL(5) with valid values in the range from -32768 to 32767.

5. FLOAT(p) defines a floating point column with the precision p. The precision must be greater than 0 and less than or equal to 18. REAL is equivalent to FLOAT(15), DOUBLE PRECISION is equivalent to FLOAT(18).

6. DATE defines an alphanumeric column where date values are stored. The function CURRENT DATE can be used to retrieve the current date.

7. TIME defines an alphanumeric column where time values are stored. The function CURRENT TIME can be used to retrieve the current time.

8. TIMESTAMP defines an alphanumeric column where timestamp values are stored. The function CURRENT TIMESTAMP can be used to retrieve the current timestamp value.

9. GRAPHIC (n) defines a character string of graphic characters with the length n. A single graphic character has a length of 2 bytes. The length n must be greater than 0 and less than 128. If no length is specified, GRAPHIC (1) is assumed.

10. VARGRAPHIC (n) defines a character string of graphic characters with the length n, which is stored with variable length. A single graphic character has a length of 2 bytes. The length n must be greater than 0 and less than or equal to 2000. LONG VARGRAPHIC is eqivalent to VARGRAPHIC(x). Here, ADABAS selects x so that a table row assumes the maximum row length (4047 Bytes), although x does not exceed 2000.

11. Columns, which are part of the key, or for which NOT NULL with or without <default spec> was defined, are called NOT NULL columns. The NULL value cannot be inserted into these columns.

12. NOT NULL columns without <default spec>s are called mandatory columns. Whenever rows are inserted, values must be specified for these columns.

13. Columns which are not mandatory are called optional columns. The insertion of a row does not require a value specification for these columns. If a <default spec> exists for the column, the <default value> is stored in the column. If there is no <default spec>, the NULL value is stored in the column.

14. If an index is created for a single optional column, this index contains no rows that have the NULL value in this column. Consequently, for certain requests, the search

strategy that would be the best for performance cannot be applied when this index is used. NOT NULL should therefore be specified for all columns where the NULL value will not occur. For columns where the NULL value could occur, the definition of a <default spec> should be considered, because its value is used instead of the NULL value. Rows having the default value are contained in an index.

15. If a table is defined without a key column, ADABAS implicitly generates the key column SYSKEY CHAR(8) FOR BIT DATA. This column is not visible when SELECT * is performed; but it can be stated explicitly and has the same meaning as a key column. The SYSKEY column can be used to obtain unique keys generated by ADABAS. The keys are in ascending order, thus reflecting the order of insertion into the table. The key values in the column SYSKEY are only unique within a table; i.e., the SYSKEY column in two tables that are different from each other may contain the same values.

16. NOT NULL WITH DEFAULT defines a <default value> which depends on the data type of the column:

```
Numeric column             ==> <default value> = 0
[VAR]CHAR(n)               ==> <default value> = ' '
[VAR]CHAR(n) FOR BIT DATA ==> <default value> = x'00'
DATE                       ==> <default value> = current date
TIME                       ==> <default value> = current time
TIMESTAMP                  ==> <default value> = current
                                                  timestamp
```

17. The following table shows the memory requirements of a column value, in bytes, depending on the various data types:

```
CHAR(n)
          n <=  30    : n + 1
     18.   < n <= 254    : n + 1  for key columns,
                        n + 2  otherwise
    19.    < n           : n + 3
VARCHAR(n)
     20.   < n <= 254    : n + 1  for key columns,
                        n + 2  otherwise
    21.    < n           : n + 3
DECIMAL, NUMERIC(p,s) : (p+1) DIV 2 + 2
FLOAT (p)             : (p+1) DIV 2 + 2
GRAPHIC(n)            : 2 * n + 1
VARGRAPHIC(n)
          n < 128     : 2 * n + 1 for key columns,
                          22.    * n + 2 otherwise
    23.    < n           : 2 * n + 3
DATE                  :  9
TIME                  :  9
TIMESTAMP             : 21
```

The memory requirements of all columns in a table must not exceed 4047 bytes.

<referential constraint definition>

Function

defines existence conditions between the rows of two tables.

Format

```
<referential constraint definition> ::=
    FOREIGN KEY  [<referential constraint name>]
    (<referencing column>,...)
    REFERENCES <referenced table> [<delete rule>]

<referencing column> ::=
    <column name>

<referenced table> ::=
    <table name>

<delete rule> ::=
    ON DELETE CASCADE
  | ON DELETE RESTRICT
  | ON DELETE SET NULL
```

Syntax Rules

none

General Rules

1. The <referential constraint definition> is part of a <create table statement>. In the following rules, the table defined by the <create table statement> is referred to as the referencing table.

2. The referencing table and the <referenced table> must be base tables.

3. The current user must have the ALTER privilege for the <referenced table>.

4. If a <referential constraint name> is specified, it must differ from all existing <referential constraint name>s of the referencing table.

5. If no <referential constraint name> is specified, ADABAS assigns a <referential constraint name> which is unique with respect to the referencing table.

6. The <referencing column>s must denote columns of the referencing table and must be different from each other. They are called foreign key columns.

7. The number of columns of the <referencing column>s must correspond to the number of key columns in the <referenced table>. The nth <referencing column> corresponds to the nth key column of the <referenced table>. The data type and the length of each <referencing column> must match the data type and the length of the corresponding key column.

8. If SET NULL is defined as the <delete rule>, then none of the <referencing column>s can be a NOT NULL column.

9. A table T' is called CASCADE dependent on a table T, if there is a sequence of <referential constraint>s R1,R2,...,Rn with n>=1, so that

   a) T' is the referencing table of R1 and

   b) T is the <referenced table> of Rn and

   c) all <referential constraint definition>s specify CASCADE and

   d) for i=1,...,n-1 and n>1, the <referenced table> of Ri is equal to the referencing table of Ri+1.

   The following graph illustrates an example where n=3:

```
      R1             R2             R3
T' <__________ T1 <__________ T2 <__________ T
     CASCADE        CASCADE        CASCADE
```

10. Let R1 and R2 be two different <referential constraint definition>s with the same referencing table S. T1 denotes the <referenced table> of R1, T2 denotes the <referenced table> of R2.
    If T1 equals T2, or if there is a table T, so that T1 and T2 are CASCADE dependent on T, then R1 and R2 must both specify either CASCADE or RESTRICT.

    Graphic illustration:

```
      R1            CASCADE-dependent
  <__________ T1 <_______________________
S                                         T
  <__________ T2 <_______________________
      R2            CASCADE-dependent
```

    Remark: There are two different sequences of <referential constraint definition>s associating S with T. A <delete statement> on T is followed by an action in S. The above-mentioned restriction for R1 and R2 was chosen so that the result of the <delete statement> is not dependent on which of the two different sequences of <referential constraint definition>s has been processed first.

11. A reference cycle is a sequence of <referential constraint definition>s R1,R2,...,Rn with n>1, so that

    a) for i=1,...,n-1 the <referenced table> of Ri is equal to the referencing table of Ri+1, and

    b) the <referenced table> of Rn is equal to the referencing table of R1.

12. Reference cycles where all <referential constraint definition>s specify CASCADE are not allowed.
    Reference cycles where one <referential constraint definition> does not specify CASCADE and all the other <referential constraint definition>s specify CASCADE are not allowed.

13. A row of the referencing table is called the matching row of a <referenced table> row when the values of the corresponding <referencing column>s and of the key columns are the same.

14. A <referential constraint definition> defines a 1:n relationship between two tables. This means that more than one matching row can exist for each row of the <referenced table>.

15. The <delete rule> defines the effects of the deletion of a row from the <referenced table> on the referencing table.

    Whenever RESTRICT was specified or the <delete rule> was omitted, then the deletion of a row from the <referenced table> fails whenever there are matching rows.

    Whenever CASCADE was specified and a row is deleted from the <referenced table>, all matching rows are deleted.

    Whenever SET NULL was specified and a row is deleted from the <referenced table>, all columns in the <referencing column> are assigned the NULL value for each matching row.

16. The following restrictions apply for the insertion or update of rows in the referencing table:

    Let R be a row to be inserted or updated. Insertion and update are only possible if one of the following conditions is true for each pertinent <referenced table>:

    a) R is a matching row.

    b) R contains a NULL value in one of the <referencing column>s.

17. A <referential constraint definition> is termed self-referencing if the <referenced table> matches the referencing table.

18. In self-referencing <referential constraint definition>s, the processing sequence of a <delete statement> can be significant. This case is illustrated in the description below. The following is a basic description and, therefore, may deviate from the actual implementation.

    If CASCADE was specified, all rows affected by the <delete statement> are deleted first, while the <referential constraint definition> is ignored. Then ADABAS deletes all matching rows of the rows just deleted. This is followed by the deletion of all matching rows related to the immediately preceding deletion procedure, etc.

    If SET NULL is specified, all rows affected by the <delete statement> are deleted first, while the <referential constraint definition> is ignored. Then SET NULL is applied to all matching rows.

<key definition>

Function

defines the key of a table.

Format

```
 <key definition> ::=
     PRIMARY KEY (<column name>,...)
```

Syntax Rules

none

General Rules

1. The <key definition> is part of a <create table statement>; i.e., it refers to a base table. <column name> must always identify a column of this table.
2. The <key definition> defines the key of a table. The <column name>s of the <key definition> are the key columns of the table.
3. The sum of the internal lengths of the key columns must not exceed 255 characters.
4. Key columns are NOT NULL columns.
5. ADABAS ensures that no key column has the NULL value and that no two rows of the table have the same values in all key columns.

<drop table statement>

Function

drops a base table.

Format

```
 <drop table statement> ::=
     DROP TABLE <table name>
```

Syntax Rules

none

General Rules

1. The <table name> must be the name of an existing base table.

2. The current user must be the owner of the base table.

3. All metadata and rows of the base table are dropped. All view definitions, indexes, privileges, synonyms, and <referential constraint definition>s derived from this base table are dropped. All snapshot tables derived from the base table to be dropped remain unaffected. ADABAS marks them in such a way that the <query expression> defining the snapshot tables must be performed again when the <refresh statement> is executed the next time. This means that the <refresh statement> fails if the dropped table has not been recreated in the meantime.

4. To apply the specified <delete rule> to all data linked to the base table by a <referential constraint definition> with corresponding <delete rule>, first a <delete statement> and then the <drop table statement> must be performed for the base table.

<create synonym statement>

Function

defines a synonym for a table name.

Format

```
<create synonym statement> ::=
    CREATE SYNONYM <synonym name> FOR <table name>
```

Syntax Rules

none

General Rules

1. The user must have a privilege on the specified table <table name>.
2. The <synonym name> must not be identical to the name of an existing base table, view table, or the name of a synonym of the current user.
3. The synonym definition expands the set of table synonyms available to this user.
4. The synonym name can be specified anywhere instead of the table name. This has the same effect as specifying the table name for which the synonym was defined.

<drop synonym statement>

Function

drops a synonym for a table name.

Format

```
 <drop synonym statement> ::=
     DROP SYNONYM <synonym name>
```

Syntax Rules

none

General Rules

1. The specified <synonym name> must identify an existing synonym.
2. The synonym definition is removed from the set of table name synonyms available to the user.

<create view statement>

Function

creates a view table.

Format

```
 <create view statement> ::=
     CREATE VIEW <table name> [(<alias name>,...)]
     AS <query expression>
     [WITH CHECK OPTION]
```

Syntax Rules

1. The <query expression> must not contain a parameter specification.

2. The number of <alias name>s must be equal to the number of columns in the result table generated by the <query expression>.

General Rules

1. A table generated by the <create view statement> is called a view table. The execution of the <create view statement> has the effect that metadata describing the view table is stored in the catalog.
   A view table never exists physically but is formed from the rows of the underlying base table(s) when this view table is specified in an <sql statement>.

2. The <table name> must not be identical to the name of an existing table.

3. The user must have the SELECT privilege for all tables which occur in the view definition. The user is the owner of the view table and has at least the SELECT privilege for it. The user may grant the SELECT privilege for the view table when he is authorized to grant the SELECT privilege to other users for all tables that occur in the view definition. The user has the INSERT, UPDATE, or DELETE privilege when he has the corresponding privileges for the table on which the view table is based, and when the view table is updatable. The user may grant any of these privileges to other users when he is authorized to grant the corresponding privilege for the table on which the view table is based.

4. The <alias name>s define the column names of the view table. If no <alias name>s are specified, then the column names of the result table generated by the <query expression> are applied to the view table. The column names of the view table must be unique. Otherwise, <alias name>s must be specified for the result table generated by the <query expression>. The column descriptions for the view table are taken from the corresponding columns in the <query expression>. The <from clause> of the <query expression> may contain one or more tables.

5. The view table is always identical to the table that would be obtained as the result of the <query expression>.

6. A view table is a complex view table if one of the following conditions is satisfied:

   a) The definition of the view table contains DISTINCT or GROUP BY or HAVING.

   b) The <create view statement> contains UNION.

   c) The <search condition> of the <query expression> in the <create view statement> contains a <subquery>.

7. A view table is called updatable if it is based on just one base table, if it is not a complex view table, and if it is not based on a complex view table.

8. The owner of the view table has the INSERT privilege; i.e., the user may specify a view table in the <insert statement> as the table into which insertion is to be made if the following conditions are satisfied:

   a) The view table is updatable.

   b) The owner of the view table has the INSERT privilege for the table in the <from clause> of the <create view statement>.

   c) The <select column>s in the <create view statement> consist of <table columns> or <column name>s, not of <expression>s with more than one <column name>.

   d) The <create view statement> contains all mandatory columns of the table of the <from clause> as <select column>.

9. The owner of the view table has the UPDATE privilege for a column of the view table; i.e., the user may specify a column in the <update statement> as column to be updated if the following conditions are satisfied:

   a) The view table is updatable.

   b) The owner of the view table has the UPDATE privilege for the <table columns> or the <column name> defining the column.

   c) The column is defined by a specification of <table columns> or by a <column name>, but not by an <expression> with more than one <column name>.

10. The owner of the view table has the DELETE privilege for the view table; i.e., the user may specify a view table in the <delete statement> as the table from which a column or row is to be deleted if the following conditions are satisfied:

   a) The view table is updatable.

   b) The owner of the view table has the DELETE privilege for the table of the <from clause> of the <create view statement>.

11. If the <create view statement> contains the WITH CHECK OPTION, then the owner of the view table must have the INSERT, UPDATE, or DELETE privilege for the view table.
    The specification of WITH CHECK OPTION has the effect that the <insert statement> or <update statement> issued on the view table does not create any rows which subsequently could not be selected via the view table; i.e., the <search condition> of the view table must be true for any resulting rows.

The CHECK OPTION is inherited; i.e., if a view table V was defined WITH CHECK OPTION and V occurs in the <from clause> of an updatable view table V1, then only those rows can be inserted or altered using V1 which can be selected using V.

<drop view statement>

Function

drops a view table.

Format

```
 <drop view statement> ::=
     DROP VIEW <table name>
```

Syntax Rules

none

General Rules

1. The table name must denote an existing view table.

2. The user must be the owner of the specified view table.

3. The metadata of the view table and all dependent synonyms, view tables and privileges are dropped. The tables on which the view table was created remain unaffected. All snapshot tables derived from the view table to be dropped remain unaffected. ADABAS marks them in such a way that the <query expression> defining the snapshot tables must be performed again when the <refresh statement> is executed the next time. This means that the <refresh statement> fails if the dropped table has not been recreated in the meantime.

<create index statement>

Function

creates an index for a base table.

Format

```
<create index statement> ::=
    CREATE [UNIQUE] INDEX <index spec>

<index spec> ::=
    <index name> ON <table name> (<index clause>,...)

<index clause> ::=
    <column name> [<order spec>]

<order spec> ::=
    ASC
  | DESC
```

Syntax Rules

1. The <index spec> must not contain more than 16 <column name>s.

General Rules

1. The table identified by <table name> must be an existing base table.
2. The <index name> of an index must not be identical to an existing <index name> of an index for the table.
3. Up to 256 indexes may be created per table.
4. If an index was created on exactly one column, then it is not possible to create another one-column index on this column.
5. If the <index name> is the only difference between the index defined by the <create index statement> and an existing index for the table, then the <create index statement> fails.
6. The sum of the internal lengths of the columns to be indexed must not exceed 255 characters.
7. The current user must be the owner of the table identified by <table name> or have the INDEX privilege for the table.
8. The index is created across the specified table columns. The secondary key consists of the specified columns of the table, in the specified order. The specification of ASC or DESC has the effect that the index values are stored in ascending or descending order. If the specification of ASC or DESC is omitted, ASC is implicitly assumed.

9. The index and the metadata describing the index are stored on the HOME SERVERDB of the table identified by <table name>.

10. If UNIQUE is specified, ADABAS ensures that no two rows of the specified table have the same values in the indexed columns. NULL values in one-column indexes are considered to be non-identical.

11. Indexes facilitate the access via non-key columns. But the maintenance of indexes means additional overhead in connection with <insert statement>s, <update statement>s and <delete statement>s. ASC or DESC can be specified to support the processing in a specific sort sequence that corresponds to the index definition.

<drop index statement>

Function

drops an index and its description.

Format

```
 <drop index statement> ::=
     DROP INDEX <index name> [ON <table name>]
```

Syntax Rules

none

General Rules

1. The specified <table name> must be the name of an existing base table.

2. The specified index must exist.

3. If the <index name> clearly denotes an index, the specification 'ON <table name>' can be omitted.

4. The current user must be the owner of the table identified by <table name> or have the INDEX privilege for the table <table name>.

5. The metadata of the specified index is deleted from the catalog. The storage space occupied by the index is released.

<comment statement>

Function

creates a comment for a table or column.

Format

```
<comment statement> ::=
    COMMENT ON TABLE <table name> IS <string literal>
  | COMMENT ON COLUMN
          <table name>.<column name> IS <string literal>
  | COMMENT ON <table name> ( <column comment>,... )

<column comment> ::=
    <column name> IS <string literal>
```

Syntax Rules

1. The <string literal> may have up to 254 characters.

General Rules

1. The comment is stored in the catalog.

<grant statement>

Function

grants privileges for tables and single columns.

Format

```
<grant statement> ::=
    GRANT <table privileges> ON [TABLE] <table name>,...
    TO <grantee>,... [WITH GRANT OPTION]

<table privileges> ::=
    ALL [PRIVILEGES]
  | <privilege>,...

<privilege> ::=
    INSERT
  | UPDATE [(<column name>,...)]
  | SELECT
  | DELETE
  | INDEX
  | ALTER

<grantee> ::=
    PUBLIC
  | <user name>
  | <usergroup name>
```

Syntax Rules

none

General Rules

1. The <table privileges> define a set of privileges for the table identified by <table name>.
   The user must have the authorization to grant privileges for the specified tables. For base tables, the owner of the table has this authorization.
   For view tables, it may happen that not even the owner is authorized to grant all privileges. Which privileges a user may grant for a view table is determined by ADABAS upon generation of the table. The result depends on the type of the table, as well as on the user's privileges for the tables selected in the view table. The owner of a table can retrieve the privileges he is allowed to grant by selecting the system table DOMAIN.PRIVILEGES.

2. The INSERT privilege allows the user identified by <grantee> to insert rows into the specified tables. The current user must have the authorization to grant the INSERT privilege.

3. The UPDATE privilege allows the user identified by <grantee> to update rows in the specified tables. If <column name>s are specified, the rows may only be updated in

the columns identified by these names. The current user must have the authorization to grant the UPDATE privilege.

4. The SELECT privilege allows the user identified by <grantee> to select rows from the specified tables. The current user must have the authorization to grant the SELECT privilege.

5. The DELETE privilege allows the user identified by <grantee> to delete rows from the specified tables. The current user must have the authorization to grant the DELETE privilege.

6. The INDEX privilege allows the user identified by <grantee> to execute the <create index statement> and the <drop index statement> for the specified table. The INDEX privilege can only be granted for base tables, and the current user must have the authorization to grant the INDEX privilege.

7. The ALTER privilege allows the user identified by <grantee> to alter the table definition of the specified table. Furthermore, the ALTER privilege allows the user identified by <grantee> to specify the table <table name> as <referenced table> in a <referential constraint definition>. The ALTER privilege can only be granted for base tables, and the current user must have the authorization to grant the ALTER privilege.

8. All privileges which the user is authorized to grant for the tables using ALL [PRIVILEGES] are granted to the users identified by the sequence of <grantee>s.

9. <grantee> must not be identical with the <user name> of the current user and the name of the table owner.

10. <grantee> must not denote a member of a usergroup.

11. If PUBLIC is specified, the listed privileges are granted to all users, both to current ones and to any created later.

12. The specification of WITH GRANT OPTION allows the user identified by <grantee> to grant other users the received privileges. The current user must have the authorization to grant the privileges to be passed on.

<revoke statement>

Function

revokes privileges.

Format

```
 <revoke statement> ::=
     REVOKE <table privileges> ON [TABLE] <table name>,...
     FROM <grantee>,...
```

Syntax Rules

none

General Rules

1. The owner of a table can revoke the privileges granted for this table from any user. By specifying ALL, the owner of the table revokes all privileges granted for the table from the user.

2. If a user is not the owner of the table, he may only revoke the privileges he has granted. If a user who is not the owner of the table specifies ALL, he revokes all privileges he has granted for this table from the user identified by <grantee>.

3. The <revoke statement> can cascade; i.e., revoking a privilege from one user can have the effect that this privilege is revoked from other users who may have received this privilege from the user specified in the <revoke statement>. More precisely:
   Let U1, U2, and U3 be users. U1 grants U2 the privilege set P WITH GRANT OPTION, and U2 grants U3 the privilege set P', P' <= P. If U1 revokes the privilege set P'', P'' <= P from the user U2, then the privilege set (P' * P'') is implicitly revoked from U3.

4. If the SELECT privilege is revoked from the owner of a view table for a table occurring in the <table expression> of the view definition, the view table is dropped, along with all view tables, privileges, and synonyms based on this view table.

Data Manipulation

Every SQL statement for data manipulation implicitly sets an EXCLUSIVE lock for each inserted, updated, or deleted row.
Whenever a user holds too many row locks on a table within a transaction, ADABAS tries to convert these row locks into a table lock. If this causes collisions with other locks, ADABAS continues to request row locks. This means that table locks are obtained without waiting periods. The limit beyond which ADABAS tries to transform row locks into table locks depends on the installation parameter MAXLOCKS that indicates the maximum number of possible lock entries.

<insert statement>

Function

inserts rows into a table.

Format

```
 <insert statement> ::=
     INSERT INTO <table name> <insert columns and values>

 <insert columns and values> ::=
     [(<column name>,...)] VALUES (<value spec>,...)
   | [(<column name>,...)] <query expression>
```

Syntax Rules

1. A column specified in the optional sequence of <column name>s is a target column. Target columns can be specified in any order.

2. If no sequence of <column name>s is specified, this has the same effect as the specification of a sequence of <column name>s which contains all columns of the table in the order in which they were defined in the <create table statement> or <create view statement>. In this case, every table column defined by the user is a target column.

3. The number of specified values must equal the number of target columns. The ith <value spec> is assigned the ith column name.

4. The number of <select column>s specified in the <query expression> must equal the number of target columns.

General Rules

1. <table name> must identify an existing base table or view table or a synonym.

2. If <column name>s are specified, all specified column names must identify columns of the table <table name>.
   If the table <table name> was defined without a key; i.e., if the column SYSKEY was implicitly created by ADABAS, the column SYSKEY must not occur in the sequence of <column name>s.
   A column must not occur more than once in a sequence of <column name>s.

3. The user must have the INSERT privilege for the table identified by <table name>.
   If <table name> identifies a view table, it may happen that not even the owner of the view table has the INSERT privilege because the view table is not updatable.

4. All mandatory columns of the table identified by <table name> must be target columns.

5. If <table name> identifies a view table, rows are inserted into the base table, on which

the view table is based. In this case, the target columns of <table name> correspond to the columns of the base table, on which the view table is based. In the following paragraphs, the term target column refers to the corresponding column of the base table.

6. If there is no <query expression> in the <insert statement>, exactly one row is inserted into the table <table name>. The inserted row has the following contents:

   a) All columns of the base table which are target columns of the <insert statement> contain the value assigned to the respective target column.

   b) All columns of the base table which are not target columns of the <insert statement> and for which a <default spec> exists contain the <default value>.

   c) All columns of the base table which are not target columns of the <insert statement> and for which no <default spec> exists contain the NULL value.

7. If there is already a row with the key specified for the row to be inserted, the <insert statement> fails.

8. A <query expression> in the <insert statement> defines a result table whose ith column is assigned to the ith target column. out of each result table row, a row is formed for the table <table name> and inserted into the base table on which <table name> is based. Each of these rows has the following contents:

   a) Each base table column which is the target column of the <insert statement> contains the value of the column in the current result table row assigned to it.

   b) All columns of the base table which are not target columns of the <insert statement> and for which a <default spec> exists contain the <default value>.

   c) All columns of the base table which are not target columns of the <insert statement> and for which no <default spec> exists contain the NULL value.

9. If the base tables into which rows are to be inserted using the <insert statement> are the referencing table of a <referential constraint definition>, ADABAS checks for each row to be inserted, whether the foreign key resulting from the row exists as a key in the corresponding <referenced table>. If this is not the case for at least one row, the <insert statement> fails.

10. Let C be a target column and v a non-NULL value to be stored in C.

11. If C is a numeric column, v must be a number within the permitted range of values of C. If v is the result of a <query expression>, fractional digits are rounded, if necessary.

12. If C is an alphanumeric column with the code attribute ASCII or EBCDIC, then v must be a character string with a length not exceeding the length attribute of C. Trailing blanks are disregarded in determining the length of v. If the length of v is shorter than the length attribute of C, then v is lengthened by the appropriate number of blanks. If an alphanumeric value with the code attribute ASCII (EBCDIC) is assigned to a column with the code attribute EBCDIC (ASCII), the value is implicitly converted prior to its assignment.

13. If C is an alphanumeric column with the code attribute BYTE, then v must be a hexadecimal character string with a length not exceeding the length attribute of C. Trailing binary zeros are disregarded in determining the length of v.

If the length of v is shorter than the length attribute of C, then v is lengthened by the corresponding number of binary zeros.

14. If C is a column of the data type DATE, then v must be a date value in the current date format.

15. If C is a column of the data type TIME, then v must be a time value in the current time format.

16. If C is a column of the data type TIMESTAMP, then v must be a timestamp value in the current timestamp format.

17. The value specified by a <parameter spec> of an <expression> is the value of the parameter identified by this <parameter spec>. If an indicator parameter is specified with a negative value, then the value defined by the <parameter spec> is the NULL value.

18. An <insert statement> sets the third entry of SQLERRD in the SQLCA (see the Precompiler online help) to the number of inserted rows.

19. If errors occur in the process of inserting rows, the <insert statement> fails, leaving the table unmodified.

<update statement>

Function

updates column values in table rows.

Format

```
<update statement> ::=
    UPDATE <table name> [<reference name>]
           <update columns and values>
           [WHERE <search condition>]
  | UPDATE <table name> [<reference name>]
           <update columns and values>
           WHERE CURRENT OF <result table name>

<update columns and values> ::=
    SET <set update clause>,...

<set update clause> ::=
      <column name> = <expression>
```

Syntax Rules

1. Columns whose values are to be updated are called target columns.

2. The <expression> in a <set update clause> must not contain a <set function spec>.

General Rules

1. <table name> must identify an existing base table, view table, or a synonym.

2. All target columns must identify columns of the table <table name>, and each target column may only be listed once.

3. The current user must have the UPDATE privilege for each target column in <table name>.
   If <table name> identifies a view table, it may happen that not even the owner of the view table is able to update column values because the view table is not updatable.

4. If <table name> identifies a view table, column values are only updated in rows which belong to the base table on which the view table is based. In this case, the target columns of <table name> correspond to columns of the base table, on which the view table is based. In the following paragraphs, the term target column always refers to the corresponding column in the base table.

5. Values of key columns defined by a user for a <create table statement> can be updated. The implicit key column SYSKEY, if created, cannot be updated.

6. <update columns and values> identifies one or more target columns and new values for these columns. The optional <search condition> or, in case of CURRENT OF, the

cursor position within the result table <result table name> determines the rows of the specified table to be updated

7. If neither a <search condition> nor CURRENT OF <result table name> is specified, all rows of the specified table are updated.

8. If a <search condition> is specified, the <search condition> is applied to each row of the specified table. The corresponding values are assigned to the target columns of all rows that satisfy the <search condition>.

9. If CURRENT OF <result table name> is specified, the <table name> in the <from clause> of the <query statement> that generated the result table <result table name> must be the same as the <table name> in the <update statement>.

10. If CURRENT OF <result table name> is specified and the cursor is positioned on a row of the result table, the corresponding values are assigned to the target columns of the corresponding row. The corresponding row is the row of the table specified in the <from clause> of the <query statement>, from which the particular result table row was formed. This procedure only works if the result table is updatable, see '<query statement>'.

11. If CURRENT OF <result table name> is specified and the cursor is not positioned on a row of the result table, no row is updated.

12. If no row is found for which the conditions defined by the optional clauses are satisfied, the message 100 - ROW NOT FOUND - is set.

13. For each row in which the values of foreign key columns have been updated using the <update statement>, ADABAS checks whether the respective resulting foreign key exists as a key in the corresponding <referenced table>. If this is not the case for at least one row, the <update statement> fails.

14. Let C be a target column and v a non-NULL value for the modification of C.

15. If C is a numeric column, then v must be a number within the permitted range of values for C. If v is the result of an <expression> which is not made up of a single <numeric literal>, then fractional digits are rounded whenever necessary.

16. If C is an alphanumeric column with the code attribute ASCII or EBCDIC, then v must be a character string with a length that does not exceed the length attribute of C. Trailing blanks are disregarded in determining the length of v. If the length of v is shorter than the length attribute of C, then v is lengthened by the corresponding number of blanks. When assigning an alphanumeric value with the code attribute ASCII (EBCDIC) to a column with the code attribute EBCDIC (ASCII), the value is implicitly converted prior to its assignment.

17. If C is an alphanumeric column with the code attribute BYTE, then v must be a hexadecimal character string with a length that does not exceed the length attribute of C. Trailing binary zeros are disregarded in determining the length of v.
If the length of v is shorter than the length attribute of C, then v is lengthened by the corresponding number of binary zeros.

18. If C is a column of the data type DATE, then v must be a date value in the current date format.

19. If C is a column of the data type TIME, then v must be a time value in the current time

format.

20. If C is a column of the data type TIMESTAMP, then v must be a timestamp value in the current timestamp format.

21. An <update statement> sets the third entry of SQLERRD in the SQLCA (see the Precompiler online help) to the number of updated rows. Rows are also counted as updated when the old value was overwritten with a new but identical value.

22. Should errors occur in the process of updating a row, the <update statement> fails, leaving the table unmodified.

<delete statement>

Function

deletes rows from a table.

Format

```
 <delete statement> ::=
     DELETE FROM <table name> [<reference name>]
            [WHERE <search condition>]
   | DELETE FROM <table name> [<reference name>]
            WHERE CURRENT OF <result table name>
```

Syntax Rules

none

General Rules

1. <table name> must identify an existing base table, view table, or a synonym.

2. The current user must have the DELETE privilege for the table identified by <table name>.
   If <table name> identifies a view table, it may happen that not even the owner of the view table has the DELETE privilege because the view table is not updatable.

3. If <table name> identifies a view table, rows are deleted from the base table, on which the view table is based.

4. The optional <search condition> or, in case of CURRENT OF <result table name>, the cursor position determines the rows of the specified table to be deleted.

5. If neither a <search condition> nor CURRENT OF <result table name> is specified, all rows of the specified table are deleted.

6. If a <search condition> is specified, the <search condition> is applied to each row of the specified table. All rows for which the <search condition> is satisfied are deleted.

7. If CURRENT OF <result table name> is specified, the <table name> in the <from clause> of the <query statement> which generated the result table must be the same as the <table name> in the <delete statement>.

8. If CURRENT OF <result table name> is specified and the cursor is positioned on a row of the result table, the corresponding row is deleted. The corresponding row is the row of the table specified in the <from clause> of the <query statement>, from which the result table row was formed. This procedure requires that the result table is updatable; i.e., that it was created without DISTINCT and without <set function spec>. Afterwards, the cursor is positioned behind the result table row.

9. If a <search condition> applied to a row is not satisfied, this row is not deleted. If

CURRENT OF <result table name> is specified and the cursor is not positioned on a row of the result table, no row is deleted.

10. If no row is found which satisfies the conditions defined by the optional clauses, the message 100 - ROW NOT FOUND - is set.

11. For each row deleted in the course of the <delete statement> which comes from a <referenced table> of at least one <referential constraint definition>, one of the following actions is taken - depending on the <delete rule> of the <referential constraint definition>:

    a) <delete rule> = DELETE CASCADE
    All matching rows in the corresponding foreign key table are deleted.

    b) <delete rule> = DELETE RESTRICT
    If there are matching rows in the corresponding foreign key table, the <delete statement> fails.

    c) <delete rule> = DELETE SET NULL
    The NULL value is assigned to the respective foreign key columns of all matching rows in the corresponding foreign key table.

12. A <delete statement> sets the third entry of SQLERRD in the SQLCA (see the Precompiler online help) to the number of deleted rows. If this counter has the value -1, either a great part of the table or the complete table was deleted by the <delete statement>.

13. If errors occur in the course of the <delete statement>, the statement fails, leaving the table unmodified.

<set current degree statement>

Function

sets the value of the function CURRENT DEGREE.

Format

```
<set current degree statement> ::=
    SET CURRENT DEGREE <degree spec>

<degree spec> ::=
    'ANY'
  | '1'
  | '1  '
  | <parameter name>
```

Syntax Rules

none

General Rules

1. The <set current degree statement> can be used to determine the possible degree of simultaneity of the processing of < query expression>s. If the value is '1' or '1   ', no simultaneous processing is possible.

2. The degree of possible simultaneity can be determined with the function CURRENT DEGREE or by using the <set statement>.

<set statement>

Function

determines the value of a function.

Format

```
 <set statement> ::=
     SET <parameter name> = <special register>

 <special register> ::=
     CURRENT DATE
   | CURRENT DEGREE
   | CURRENT SQLID
   | CURRENT TIME
   | CURRENT TIMESTAMP
   | CURRENT TIMEZONE
   | USER
```

Syntax Rules

none

General Rules

1. The <set statement> can be used to assign the current value of the specified <special register> to the specified <parameter name>.

2. CURRENT DATE indicates the current date; CURRENT TIME indicates the current time; CURRENT TIMESTAMP indicates the current timestamp. CURRENT TIMEZONE indicates the current timezone which is always 0. CURRENT DEGREE can be used to determine the degree of simultaneity for the processing of <query expression>s. USER and CURRENT SQLID denote the current user.

3. The specified parameter must have a data type with a length sufficient to receive the value of the specified <special register>.

4. The <set statement> cannot be used in interactive mode and can only be embedded in a programming language.

Data Retrieval

A network failure in a distributed database can have the effect that not all SERVERDBs of the database can communicate with each other. Data stored on a SERVERDB to which network communication is no longer possible cannot be read nor modified.

If the network of SERVERDBs has divided into two subnetworks because of the failure of network communication, the majority concept is applied. This means that SERVERDBs belonging to the larger subnetwork, the majority, can still modify the replicated (metadata) data. SERVERDBs that could not be accessed when these modifications were made are informed about the modifications after reestablishing the network communication.

As a result, SERVERDBs that do not belong to the majority may only be able to modify local (metadata) data. Data retrieval of local and replicated data is possible. It can happen that data of replicated tables has been modified in the majority and these modifications could not be made in the local copy of data because of the missing network communication, so that the data is no longer up to date. A warning informs the user about such a situation (cf. SQLWARNA in the Precompiler online help).

<query statement>

Function

specifies a result table that can be ordered.

Format

```
<query statement> ::=
    <declare cursor statement>

<declare cursor statement> ::=
    DECLARE <result table name> CURSOR [WITH HOLD] FOR
            <select statement>

<select statement> ::=
    <query expression>
    [<order and update clause>]

<order and update clause> ::=
    <order clause>
  | [<order clause>] FOR FETCH ONLY [<optimize clause>]
  | [<order clause>] <optimize clause> [FOR FETCH ONLY]
  | <update clause> [<optimize clause>]

<optimize clause> ::=
    OPTIMIZE FOR <unsigned integer> ROW
  | OPTIMIZE FOR <unsigned integer> ROWS
```

Syntax Rules

none

General Rules

1. The <declare cursor statement> defines a result table with the <result table name>. To generate this result table, an <open cursor statement> specifying the name of the result table is needed.

2. The order of rows in the result table depends on the internal search strategies of the system and is arbitrary. The only way to obtain a particular ordering of the result rows is by specifying an <order clause>.

3. A result table or, more precisely, the underlying base table, is updatable if the <query statement> satisfies the following conditions:

   a) The <query expression> may only consist of one <query spec>.

   b) One base table or one updatable view table may only be specified in the <from clause> of the <query spec>.

c) DISTINCT, GROUP BY or HAVING must not be specified.

d) <expression>s must not contain a <set function spec>.

4. An <update clause> can only be specified for updatable result tables. For updatable result tables, a position within a particular result table always corresponds to a position in the underlying table and thus, ultimately, to a position in a base table.

5. If a result table is updatable, but not to be used in subsequent <update statement>s or <delete statement>s, the result table can be transformed into a non-updatable result table by a FOR FETCH ONLY specification. If the result is not updatable, the specification of FOR FETCH ONLY has no effect. FOR FETCH ONLY can be useful for performance reasons.

6. If the number of rows to be read from the result table is known, then it may be useful for performance reasons to specify the <optimize clause>. If more rows are read than are specified in the <optimize clause>, the performance of these read operations may deteriorate.

See also

<query expression>

<query spec>

<table expression>

<subquery>

<order clause>

<update clause>

<query expression>

Function

specifies an unordered result table.

Format

```
<query expression> ::=
    <query primary>
  | <query expression> UNION [ALL] <query primary>

<query primary> ::=
    <query spec>
  | (<query expression>)
```

Syntax Rules

none

General Rules

1. A <query expression> specifies a result table. If the <query expression> only consists of one <query spec>, the result of the <query expression> is the unmodified result of the <query spec>.

2. If the <query expression> consists of more than one <query spec>, the number of <select column>s must be the same in all <query spec>s of the <query expression>. The particular ith <select column>s of the <query spec>s must be comparable. Numeric columns can be compared to each other. If all ith <select column>s are numeric columns, the ith column of the result table is a numeric column. Alphanumeric columns with the code attribute BYTE can be compared to each other. Alphanumeric columns with the code attribute ASCII or EBCDIC can be compared to each other and to date, time, and timestamp values.
   If all ith <select column>s are date values, the ith column of the result table is a date value.
   If all ith <select column>s are time values, the ith column of the result table is a time value.
   If all ith <select column>s are timestamp values, the ith column of the result table is a timestamp value.
   In all the other cases, the ith column of the result table is an alphanumeric column. Comparable columns with differing code attributes are converted.
   If columns are comparable but have different lengths, the corresponding column of the result table has the maximum length of the underlying columns.

3. The names of the result table columns are formed from the names of the <select column>s of the first <query spec>.

4. Let T1 be the left operand of UNION, Let T2 be the right operand. Let R be the result of the operation on T1 and T2.

5. If UNION is specified, R contains all rows of T1 and T2.

6. DISTINCT is implicitly assumed for the <query expression>s belonging to T1 and T2 if ALL is not specified. All duplicate rows are removed from R.
   A row is a duplicate of another row if both rows have identical values in each column.
   NULL values are assumed to be identical.

<query spec>

Function

specifies an unordered result table.

Format

```
<query spec> ::=
    SELECT [<distinct spec>] <select column>,...
    <table expression>

<distinct spec> ::=
    DISTINCT
  | ALL

<select column> ::=
    <table columns>
  | <derived column>

<table columns> ::=
    *
  | <table name>.*
  | <reference name>.*

<derived column> ::=
    <expression>
```

Syntax Rules

1. If a <select column> contains a <set function spec>, the sequence of <select column>s to which the <select column> belongs must not contain any <table columns>, and every column name occurring in an <expression> must denote a grouping column.

General Rules

1. A <query spec> specifies a result table. The result table is generated from a temporary result table. The temporary result table is the result of the <table expression>.

2. If DISTINCT is specified as <distinct spec>, all duplicate rows are removed from the result table. If no <distinct spec> or if ALL is specified, duplicate rows are not removed. A row is a duplicate of another row if both have identical values in each column. NULL values are assumed to be identical.

3. The sequence of <select column>s defines the columns of the result table. The columns of the result table are produced from the columns of the temporary result table.
   The columns of the temporary result table are determined by the <from clause> of the <table expression>. The order of the column names of the temporary result table is determined by the order of the table names in the <from clause>.

4. The specification of <table columns> in a <select column> is an abbreviation of the specification of the result table columns.

5. If a <select column> of the format '*' is specified, then this is an abbreviation of the specification of all temporary result table columns. In this case, the result table contains all columns of the temporary result table in an unmodified order.
The implicitly generated column SYSKEY is not passed.

6. The specification of <table name>.* or <reference name>.* is an abbreviation of the specification of all columns of the underlying table. The first column name of the result table is taken from the first column name of the underlying table, the second column name of the result table corresponds to the second column name of the underlying table, etc. The order of the column names of the underlying table corresponds to the order determined when the underlying table is defined.
The implicitly generated column SYSKEY is not passed.

7. The specification of a <derived column> in a <select column> defines a column of the result table. If a column of the result table has the form <expression> and the <expression> is a <column spec> which denotes a column of the temporary result table, then this result table column gets the column name of the temporary result table. If an <expression> is specified and this is not a <column spec>, then the column gets the name 'EXPRESSION_', where '_' denotes a number, starting with 'EXPRESSION1', 'EXPRESSION2', etc.

8. Each column of a result table has exactly the same data type, the same length, the same precision, and the same scale as the <derived column> or the column underlying the <table columns>.
This does not apply to the data types DATE and TIMESTAMP. To enable the representation of any date and time format, the length of the result table column is set to the maximum length required for the representation of a date value (length 10) or a timestamp value (length 26).

9. Every column name specified in a <select column> must uniquely identify a column of one of the tables underlying the <query spec>. If need be, the column name must be qualified by the table identifier.

<table expression>

Function

specifies a simple or a grouped result table.

Format

```
 <table expression> ::=
     <from clause>
     [<where clause>]
     [<group clause>]
     [<having clause>]
```

Syntax Rules

none

General Rules

1. A <table expression> produces a temporary result table. If there are no optional clauses, this temporary result table is the result of the <from clause>. Otherwise, each specified clause is applied to the result of the previous clause and the table is the result of the last specified clause. The temporary result table contains all columns of all tables listed in the <from clause>.

See also

<from clause>

<where clause>

<group clause>

<having clause>

<from clause>

Function

specifies a table that is made up of one or more tables.

Format

```
 <from clause> ::=
     FROM <table spec>,...

 <table spec> ::=
     <table name> [<reference name>]
```

Syntax Rules

none

General Rules

1. Each <table spec> specifies a table identifier.

2. If a <table spec> specifies no <reference name>, the <table name> is the table identifier. If a <table spec> specifies a <reference name>, the <reference name> is the table identifier.

3. Each <reference name> must differ from each <identifier> of each <table name> being a table identifier. Each table identifier must differ from any other table identifier.

4. The scope of validity of the table identifier is the entire <query spec>. If column names are to be qualified within the <query spec>, table identifiers must be used for this purpose.

5. The user must have the SELECT privilege for each specified table.

6. The number of tables underlying a <from clause> is the sum of the tables underlying each <table spec>.
   If a <table spec> denotes a base table, the number of tables underlying this <table spec> is equal to 1.
   If a <table spec> denotes a complex view table, the number of tables underlying this <table spec> is equal to 1.
   If a <table spec> denotes a view table which is not a complex view table, the number of underlying tables is equal to the number of tables underlying the <from clause> of the view table.
   The number of tables underlying a <from clause> must not exceed 16.

7. The <from clause> specifies a table. This table can be derived from base or view tables.

8. The result of a <from clause> is a table which, in principle, is generated from the specified tables in the following way: If the <from clause> consists of a single <table

spec>, the result is the specified table. If the <from clause> contains more than one <table spec>, a result table is built that includes all possible combinations of all rows of the first table with all rows of the second table, etc. Speaking in mathematical terms, the Cartesian product of all tables is formed. This rule describes the effect of the <from clause>, not its actual implementation.

9. <reference name>s are indispensable for the formulation of conditions to join a table to itself. For example, 'FROM HOTEL, HOTEL X' defines the <reference name> 'X' for the second occurrence of the table 'HOTEL'. Furthermore, <reference name>s are sometimes indispensable for the formulation of certain correlated subqueries.

<where clause>

Function

specifies conditions for the result table.

Format

```
 <where clause> ::=
     WHERE <search condition>
```

Syntax Rules

1. An <expression> included in the <search condition> must not contain a <set function spec>.

General Rules

1. Each <column spec> directly contained in the <search condition> must uniquely denote a column from the tables specified in the <from clause> of the <table expression>. If necessary, the column name must be qualified with the table identifier. If <reference name>s were defined for table names in the <from clause>, these <reference name>s must be used as table identifiers in the <search condition>.

2. In the case of a correlated subquery (see chapter 0), a <column spec> can denote a column of a table which was specified in a <from clause> of another <table expression> of the <query spec>.

3. The <search condition> is applied to every row of the temporary result table formed by the <from clause>. The result of the <where clause> is a table that only contains those rows of the result table for which the <search condition> is satisfied.

4. Usually, each <subquery> in the <search condition> is evaluated once. In the case of a correlated subquery, the <subquery> is executed for each row of the result table generated by the <from clause>.

<group clause>

Function

specifies a grouping for the result table.

Format

```
 <group clause> ::=
     GROUP BY <column spec>,...
```

Syntax Rules

none

General Rules

1. Each column name specified in the <group clause> must uniquely denote a column of the tables underlying the <query spec>. If necessary, the column name must be qualified with the table identifier.

2. The <group clause> allows the functions SUM, AVG, MIN, MAX, and COUNT to be applied not only to entire result tables but also to groups of rows within a result table. A group is defined by the grouping columns specified in GROUP BY. All rows of a group have the same values in the grouping columns. Rows containing the NULL value in a grouping column are combined to form a group. The same is true for the special NULL value.

3. GROUP BY generates one row for each group in the result table. Therefore, the <select column>s in the <query spec> may only contain those grouping columns and operations on grouping columns, as well as those <expression>s that use the functions SUM, AVG, MIN, MAX, and COUNT.

4. If there is no row that satisfies the conditions indicated in the <where clause> and a <group clause> was specified, then the result table is empty.

<having clause>

Function

specifies the characteristics of a group.

Format

```
 <having clause> ::=
     HAVING <search condition>
```

Syntax Rules

none

General Rules

1. Each column name that is not specified in the argument of a <set function spec> but occurs in the <search condition> must denote a grouping column.

2. If the <having clause> is used without a preceding <group clause>, the result table built so far is regarded as a group.

3. The <search condition> is applied to each group of the result table. The result of the <having clause> is a table that only contains those groups for which the <search condition> is satisfied.

<subquery>

Function

specifies a result table that can be used in certain predicates.

Format

```
 <subquery> ::=
     (<query expression>)
```

Syntax Rules

1. A <subquery> used in a <comparison predicate>, <in predicate> or <quantified predicate> must only form a single-column result table.

General Rules

1. The result of a <subquery> is a result table.

2. Subqueries can be used in certain predicates such as the <comparison predicate>, <exists predicate>, <in predicate>, and <quantified predicate>.

See also

Correlated Subquery

Correlated Subquery

Certain predicates can contain subqueries. These subqueries, in turn, can contain other subqueries, etc. A <subquery> containing subqueries is at a higher level than the subqueries included.
Within the <search condition> of a <subquery>, column names may occur that belong to tables contained in the <from clause> of higher-level subqueries. A <subquery> of this kind is called a correlated subquery. Tables that are used in subqueries in such a way are called correlated tables. No more than 16 correlated tables are allowed within an SQL statement. Columns that are used in subqueries in such a way are called correlated columns. Their number in an SQL statement is limited to 64.
If the qualifying table name or reference name does not clearly identify a table of a higher level, the table at the lowest level is taken from these non-unique tables.
If the column name is not qualified by the table name or reference name, the tables at higher levels are scanned for it. The column name must be unique in all tables of the <from clause> to which the table found belongs.
If a correlated subquery is used, the values of one or more columns of a temporary result row at a higher level are included in the <search condition> of a <subquery> at a lower level, whereby the result of the subquery is used for the definite qualification of the higher-level temporary result row.

Example:

We look at a table HOTEL which contains the column names NAME, CITY, HNO, and a table ROOM which contains the column names HNO and PRICE. For every city, the names of all hotels are searched which have prices less than the average price of the city concerned.

```
SELECT name, city
FROM   hotel X, room
WHERE  X.hno = room.hno
  AND  room.price < ( SELECT AVG(room.price)
                  FROM   hotel, room
                  WHERE  hotel.hno  = room.hno
                    AND  hotel.city = X.city )
```

<order clause>

Function

specifies a sorting sequence for a result table.

Format

```
<order clause> ::=
    ORDER BY <sort spec>,...

<sort spec> ::=
    <unsigned integer> [<sort option>]
  | <column spec> [<sort option>]

<sort option> ::=
    ASC
  | DESC
```

Syntax Rules

1. The maximum number of <sort spec>s that form the sort criterion is 16.

2. If the <query expression> consists of more than one <query spec>, the specification of a <sort spec> is only allowed in the form <unsigned integer> [<sort option>].

General Rules

1. If a <query spec> is specified with DISTINCT, the total of the internal lengths of all sorting columns must not exceed 246 characters; otherwise, 250 characters.

2. Column names in the <sort spec>s must be columns of the tables specified in the <from clause>.

3. If DISTINCT or a <set function spec> in a <select column> was used, the <sort spec> must denote a column of the result table.

4. A number n specified in the <sort spec> identifies the nth column in the result table. n must be less than or equal to the number of columns in the result table.

5. The specification of an <order clause> defines a sort for the result table.

6. The sort columns specified in the <order clause> determine the sequence of the sort criteria.

7. If ASC is specified, a sort is carried out putting the values in ascending order; if DESC is specified, in descending order. If no specification has been made, ASC is assumed.

8. Values are compared to each other according to the rules for the <comparison predicate> For sorting purposes, NULL values are greater than non-NULL values, and special NULL values are greater than non-NULL values but less than NULL values.

<update clause>

Function

specifies that a result table is to become updatable.

Format

```
 <update clause> ::=
     FOR UPDATE OF <column name>,...
```

Syntax Rules

none

General Rules

1. The specified column names must denote columns in the table underlying the <query spec>. They need not occur in a <select column>.

2. The <query statement> containing the <update clause> must generate an updatable result table.

3. Using the <update clause> has the effect that EXCLUSIVE locks are set for the selected rows

<open cursor statement>

Function

generates the result table previously defined with the specified name.

Format

```
 <open cursor statement> ::=
     OPEN <result table name>
```

Syntax Rules

none

General Rules

1. Existing result tables must be deleted before their names can be used for other result tables.

2. All result tables that were not generated WITH HOLD are implicitly closed at the end of the transaction using the <commit statement> or <rollback statement>. Result tables that were generated WITH HOLD within the current transaction are implicitly closed at end of the transaction using the <rollback statement>.

3. All result tables are implicitly closed at the end of the session using the <release statement>. A <close statement> can be used to close them explicitly beforehand.

4. At any given time during the processing of a result table, there is a position which may be before the first row, on a row, after the last row or between two rows. After generating the result table, this position is before the first row of the result table.

5. According to the search strategy, either all rows of the result table are searched when the <open cursor statement> is executed, the result table being physically generated; or each next result table row is searched when a <fetch statement> is executed, without being physically stored. This must be considered for the time behavior of <open cursor statement>s and <fetch statement>s.

6. If the result table is empty, the return code 100 - ROW NOT FOUND - is set.

7. The number of the result table rows is returned in the third entry of SQLERRD in the SQLCA (see the Precompiler online help). If this counter has the value -1, there is at least one result row.

<fetch statement>

Function

assigns the values of the current result table row to parameters.

Format

```
 <fetch statement> ::=
     FETCH <result table name> INTO <parameter spec>,...
```

Syntax Rules

none

General Rules

1. Let C be the position in the result table. The return code 100 - ROW NOT FOUND - is output and no values are assigned to the parameters if any of the following conditions is satisfied:

   a) The result table is empty.

   b) C is positioned on or after the last result table row.

2. If C is positioned before a row of the result table, then C will be located on this row and the values of this row will be assigned to the parameters.

3. If C is positioned on a row which is not the last row of the result table, then C will be located on the next following row and the values in this row will be assigned to the parameters.

4. The parameters specified by <parameter spec>s are output parameters. The parameter identified by the nth <parameter spec> corresponds to the nth value in the current result table row. If the number of columns in this row exceeds the number of specified parameters, the column values for which no corresponding parameters exist are ignored. If the number of columns in the row is less than the number of specified parameters, no values are assigned to the remaining parameters. An indicator parameter must be specified to assign NULL values or special NULL values.

5. Numbers are converted and character strings are truncated or lengthened, if necessary, to suit the corresponding parameters. If an error occurs when assigning a value to a parameter, the value is not assigned and no further values are assigned to the corresponding parameters for this <fetch statement>. Any values that have already been assigned to parameters remain unaffected.

6. Let p be a parameter and v the corresponding value in the current row of the result table. If v is a number, p must be a numeric parameter and v must lie within the permitted range of values for p. If v is a character string, p must be an alphanumeric parameter.

7. According to the search strategy, either all rows of the result table are searched when the <open cursor statement> is executed, the result table being physically generated; or each next result table row is searched when a <fetch statement> is executed, without being physically stored. This must be considered for the time behavior of <fetch statement>s. Depending on the ISOLATION LEVEL selected, this can also be the reason for locking problems occurring with a FETCH, e.g., error message -913 - LOCK REQUEST TIMEOUT.

<close statement>

Function

closes a result table.

Format

```
 <close statement> ::=
     CLOSE <result table name>
```

Syntax Rules

none

General Rules

1. The result table with the specified name is closed. Its name can be used to denote another result table.

2. Existing result tables must be closed before their names can be used for other result tables.

3. All result tables which were not generated WITH HOLD, are implicitly closed at the end of the transaction using the <commit statement> or <rollback statement>. Result tables which were generated WITH HOLD within the current transaction are implicitly closed at the end of the transaction using the <rollback statement>.

4. All result tables are implicitly closed at the end of the session using the <release statement>.

<single select statement>

Function

specifies a single-row result table and assigns the values of this result table to parameters.

Format

```
 <single select statement> ::=
     SELECT [<distinct spec>] <select column>,...
     INTO <parameter spec>,...
     FROM <table spec>,...
     [<where clause>]
```

Syntax Rules

none

General Rules

1. The number of rows in the result table must not be greater than one. If the result table is empty or contains more than one row, corresponding messages or error codes are issued and no values are assigned to the parameters specified in the <parameter spec>s. For an empty result table, the return code 100 - ROW NOT FOUND - is set.

2. If the result table contains just one row, the values of this row are assigned to the corresponding parameters. The <fetch statement> rules apply for assigning the values to the parameters.

Transactions

A transaction is a sequence of <sql statement>s that are handled by ADABAS as an atomic unit, in the sense that any modifications made to the database by the <sql statement>s are either all reflected in the state of the database, or else none of the database modifications are retained.

When a session is opened using the <connect statement>, this opens the first transaction. A <commit statement> or a <rollback statement> is used to conclude a transaction. When a transaction is successfully concluded using a <commit statement>, all database modifications are retained. When, on the other hand, a transaction is aborted using a <rollback statement>, or if it is aborted in another way, all database modifications performed within the given transaction are rolled back.

The <commit statement> and the <rollback statement> both implicitly open a new transaction.

Since ADABAS permits concurrent transactions on the same database objects, locks on rows, tables and the catalog are necessary to isolate individual transactions. Locks are either implicitly set by ADABAS in the course of processing an <sql statement> or explicitly set using the <lock statement>. These locks are assigned to the transaction that contains the <sql statement> or <lock statement>. ADABAS distinguishes between SHARE locks and EXCLUSIVE locks which either refer to rows or tables. In addition, there are special locks for the metadata of the catalog. These locks, however, are always set implicitly.

Once a SHARE lock is assigned to a transaction for a particular data object, other transactions can access the object but not modify it.

Once an EXCLUSIVE lock is assigned to a transaction for a particular data object, other transactions cannot modify this object. The object can only be accessed by transactions which do not use SHARE locks (see ISOLATION LEVEL 0).

The locks assigned to a transaction are released at the end of the transaction, making the respective database objects accessible again to other transactions.

The following table gives a schematic overview on the possible parallel locks. EXCL means EXCLUSIVE.

	Let a transaction have a(n)					
	EXCL	SHARE	EXCL	SHARE	EXCL	SHARE
Can another transaction	lock on a table		lock on a row		lock on the system catalog	
lock the table in EXCLUSIVE mode?	No	No	No	No	No	Yes
lock the table in SHARE mode?	No	Yes	No	Yes	No	Yes
lock any row of the table in EXCLUSIVE mode?	No	No	---	---	No	Yes
lock the locked row in EXCLUSIVE mode?	---	---	No	No	---	---
lock another row in EXCLUSIVE mode?	---	---	Yes	Yes	---	---
lock any row of the table in SHARE mode?	No	Yes	---	---	No	Yes
lock the locked row in SHARE mode?	---	---	No	Yes	---	---
lock another row in SHARE mode?	---	---	Yes	Yes	---	---
change the definition of the table in the system catalog?	No	No	No	No	No	No
read the definition of the table in the system catalog?	Yes	Yes	Yes	Yes	No	Yes

<connect statement>

Function

opens an ADABAS session and a transaction for a user.

Format

```
<connect statement> ::=
    CONNECT <user spec>
    IDENTIFIED BY <password spec>
    [SQLMODE <sqlmode spec>]
    [<isolation spec>]
    [TIMEOUT <unsigned integer>]
    [CACHELIMIT <unsigned integer>]
    [TERMCHAR SET <termchar set name>]

<user spec> ::=
    <parameter name>
  | <user name>

<password spec> ::=
    <parameter name>

<sqlmode spec> ::=
    ADABAS
  | ANSI
  | DB2
  | ORACLE

<isolation spec> ::=
    ISOLATION LEVEL <unsigned integer>
```

Syntax Rules

1. The <unsigned integer> after ISOLATION LEVEL may only have the values 0, 1, 2 and 3.

General Rules

1. If a valid combination of the <user spec> and <password spec> values is specified, the user opens a session, obtaining access to the database. Thus he is the current user in this session.

2. The database system ADABAS is able to execute correct ADABAS applications and applications which are written according to the ANSI standard (ANSI X3.135-1992, Entry SQL), according to the definition of DB2 Version 3 or according to the definition of ORACLE7. ADABAS is able to check whether new programs comply with one of the definitions specified above. This means in particular that any extension beyond the chosen definition is considered incorrect. The support of DDL statements in other SQLMODEs is, however, limited.
   The specification SQLMODE <sqlmode spec> allows the user to select one of the definitions specified above. The default specification is SQLMODE ADABAS.

This online help describes the functionality of the database system ADABAS which is available in the SQLMODE DB2.

3. A transaction is implicitly opened.

4. The <commit statement> or the <rollback statement> ends a transaction, implicitly opening a new one. At the end of each transaction, all locks assigned to the transaction are released. The <isolation spec> specified in the <connect statement> is applied to each newly opened transaction.

5. Locks can be requested implicitly or explicitly. Locks are requested explicitly using the <lock statement>. Whether a lock must be requested implicitly or explicitly depends on the <isolation spec> in the <connect statement>. How long an implicit SHARE lock is maintained also depends on the <isolation spec>. Implicitly set EXCLUSIVE locks cannot be released within a transaction. Explicit lock requests are always possible, regardless of the <isolation spec>.

6. ISOLATION LEVEL 0 means that rows can be read without requesting SHARE locks; i.e., no SHARE locks are implicitly requested. For this reason, there is no guarantee that a given row will still be in the same state when it is read again within the same transaction as when it was accessed earlier, since it may have been modified in the meantime by a concurrent transaction.
   Furthermore, there is no guarantee that the state of a read row has already been recorded in the database using COMMIT WORK.
   When rows are inserted, updated or deleted, implicit EXCLUSIVE locks are assigned to the transaction for the rows concerned. These cannot be released until the end of the transaction.

7. ISOLATION LEVEL 1 means that a SHARE lock is assigned to the transaction for each read row R1 in a table. When the next row R2 in the same table is read, the lock on R1 is released and a SHARE lock is assigned to the transaction for the row R2.
   For data retrieval by using a <query statement>, ADABAS makes sure that, at the time each row is read, no EXCLUSIVE lock has been assigned to other transactions for the given row. It is, however, impossible to predict whether a <query statement> causes a SHARE lock for a row of the specified table or not and for which row this may occur.
   When rows are inserted, updated or deleted, implicit EXCLUSIVE locks are assigned to the transaction for the rows concerned. These cannot be released until the end of the transaction.

8. ISOLATION LEVEL 2 means that all the tables addressed by the <sql statement> are locked in SHARE mode prior to processing. When the <sql statement> generates a result table which is not physically stored, these locks are only released at the end of the transaction or when the result table is closed. Otherwise, these locks are released immediately once the related <sql statement> has been processed.
   In addition, an implicit SHARE lock is assigned to the transaction for each row read during the processing of an <sql statement>. These SHARE locks can only be released by ending the transaction.
   When rows are inserted, updated or deleted, implicit EXCLUSIVE locks are assigned to the transaction for the rows concerned. These cannot be released until the end of the transaction.

9. ISOLATION LEVEL 3 means that an implicit table SHARE lock is assigned to the transaction for each table addressed by an <sql statement>. These table SHARE locks cannot be released until the end of the transaction.
   When rows are inserted, updated or deleted, implicit EXCLUSIVE locks are assigned to the transaction for the rows concerned. These cannot be released until the end of

the transaction.

10. If the <isolation spec> is omitted, ISOLATION LEVEL 1 is assumed.

11. Which <isolation spec> is selected affects both the degree of concurrency and the guaranteed consistency. A high degree of concurrency is characterized by a state in which a maximum number of concurrent transactions can process a database without long waiting periods for locks to be released. As for consistency considerations, there are three different phenomena to be considered, which can arise through concurrent access to the same database:

    Phenomenon 1 :
    A row is modified in the course of a transaction T1, and a transaction T2 reads this row before T1 has been concluded with a <commit statement>. T1 then executes the <rollback statement>; i.e., T2 has read a row, which never actually existed. This phenomenon is known as the "dirty read" phenomenon.

    Phenomenon 2 :
    A transaction T1 reads a row. A transaction T2 then modifies or deletes this row, concluding with the <commit statement>. If T1 subsequently reads the row again, T1 either receives the modified row or a message saying that the row no longer exists. This phenomenon is known as the "non-repeatable read" phenomenon.

    Phenomenon 3 :
    A transaction T1 executes an <sql statement> S, which reads a set of rows SR which satisfies a <search condition>. A transaction T2 then uses the <insert statement> or the <update statement> to create at least one additional row which also satisfies the <search condition>. If S is subsequently re-executed within T1, the set of read rows will differ from SR. This phenomenon is known as the "phantom" phenomenon.

    The following table specifies which phenomena are possible for which <isolation spec>s :

	ISO 0	ISO 1	ISO 2	ISO 3
Dirty Read	+	-	-	-
Non Repeatable Read	+	+	-	-
Phantom	+	+	+	-

The lower the value of the <isolation spec>, the higher the degree of concurrency and the lower the guaranteed consistency. This makes it always necessary to find the compromise between concurrency and consistency that best suits the requirements of an application.

12. The TIMEOUT value defines the maximum period of inactivity during an ADABAS session. A period of inactivity is considered to be the time interval between the completion of one <sql statement> and the issuing of the next <sql statement>. As soon as the specified maximum TIMEOUT is exceeded, the session is implicitly aborted by using a ROLLBACK WORK RELEASE.

13. TIMEOUT values are specified in seconds. A TIMEOUT value can be specified for every user. The specified TIMEOUT value must be less than or equal to the defined maximum TIMEOUT value.

    a) For any user who was created with a TIMEOUT value, this value is the maximum

TIMEOUT value.

b) For any user who is a member of a usergroup created with a TIMEOUT value, this value is the maximum TIMEOUT value.

c) For all other users, the installation parameter SESSION TIMEOUT represents the maximum TIMEOUT value.

14. If no TIMEOUT value is specified, ADABAS assumes the maximum TIMEOUT value or the SESSION TIMEOUT value, depending on which is smaller. The value of the SESSION TIMEOUT is defined during the installation of ADABAS by using the ADABAS component CONTROL.

15. If 0 is specified as the TIMEOUT value, no check is made for the period of inactivity, the result being that database resources might not be available again, although the corresponding application has finished already, possibly by an abnormal termination; without performing a <release statement>.

16. Users defined with the attribute NOT EXCLUSIVE can open several sessions at the same time. Whenever this is the case, or whenever two users of the same usergroup open a session at the same time, the sessions are considered to be distinct. This means that lock requests of the sessions concerned can collide.

17. The CACHELIMIT value is specified in 4KB units. A CACHELIMIT value can be specified for each user. The specified CACHELIMIT value must be less than or equal to the value of the defined maximum CACHELIMIT value.

    a) For any user created with a CACHELIMIT value, this value is the maximum CACHELIMIT value.

    b) For any user who is a member of a usergroup created with a CACHELIMIT value, this value is the maximum CACHELIMIT value.

    c) For all other users, the maximum CACHELIMIT value is predefined by the installation parameter MAX_TEMP_CACHE (see the CONTROL online help).

    When sessions are started involving the physical creation of large result tables, it is a good idea to create a session-specific cache, so that these temporary, session-specific result tables will not take up the data cache space concurrently used by all users.

18. ADABAS uses either the ASCII code according to ISO 8859/1.2 or the EBCDIC code CCSID 500, Codepage 500. Since these codes include characters that have a different hexadecimal representation on certain terminals, it is possible to define TERMCHAR SETs (see the CONTROL online help). For input and output, these TERMCHAR SETs enable the conversion between the terminal representation of characters and the code used within ADABAS. The <connect statement> can be used to select one of the defined TERMCHAR SETs which is then used for conversion during the session. If no or an unsuitable TERMCHAR SET is selected, it can happen that characters which are contained in the database and which are to be output are not correctly displayed on the terminal.

19. For more detailed information about the call parameters or mechanisms for the assignment of parameter values, refer to the online help on the precompilers, as well as to the manuals of the other components.

<commit statement>

Function

closes the current transaction and starts a new one.

Format

```
 <commit statement> ::=
     COMMIT [WORK]
```

Syntax Rules

none

General Rules

1. The <commit statement> closes the current transaction. This means that the modifications executed within the transaction are recorded, making them visible to concurrent users as well.
   The <commit statement> implicitly opens a new transaction. Any locks set, either implicitly or explicitly, within this new transaction are assigned to this transaction.

2. The locks assigned to the transaction are released.

3. Any result tables which were not generated WITH HOLD are implicitly closed when the related transaction is ended using the <commit statement>.

4. The <isolation spec> declared in the <connect statement> controls the setting of locks in the new transaction.

<rollback statement>

Function

aborts the current transaction and starts a new one.

Format

```
<rollback statement> ::=
    ROLLBACK [WORK]
```

Syntax Rules

none

General Rules

1. The <rollback statement> aborts the current transaction. This means that any database modifications performed within the transaction are undone.
   The <rollback statement> implicitly opens a new transaction. Any locks set, either implicitly or explicitly, within the new transaction are assigned to this transaction.

2. The locks assigned to the transaction are released.

3. Any result tables that were not generated WITH HOLD are implicitly closed when the related transaction is ended using the <rollback statement>. Result tables generated WITH HOLD within the current transaction are implicitly closed when this transaction is ended using the <rollback statement>.

4. The <isolation spec> declared in the <connect statement> controls the setting of locks in the new transaction.

<lock statement>

Function

assigns a lock to the current transaction.

Format

```
<lock statement> ::=
    LOCK TABLE <table name> IN SHARE MODE
  | LOCK TABLE <table name> IN EXCLUSIVE MODE
```

Syntax Rules

none

General Rules

1. The specified table <table name> can be a base table, view table or a synonym. If <table name> identifies a view table, then locks are set on the base tables on which the view table is based. To set SHARE locks, the current user must have the SELECT privilege; to set EXCLUSIVE locks, the user needs the UPDATE, DELETE or INSERT privilege.

2. If the view table identified by <table name> is not updatable, then only a SHARE lock can be set for this view table. As a result of this SQL statement, all base tables underlying the <table name> are subsequently locked in SHARE mode.

3. SHARE defines a SHARE lock for the specified table. If a SHARE lock is set, no concurrent transaction can modify the locked table.

4. EXCLUSIVE defines an EXCLUSIVE lock for the specified table. If an EXCLUSIVE lock is set, no concurrent transaction can modify the locked table. Concurrent transactions can only read-access the locked tables in ISOLATION LEVEL 0.

5. If no lock has been assigned to a transaction for a data object, then a SHARE or EXCLUSIVE lock can be requested within any transaction and the lock is immediately assigned to the transaction.
   If a SHARE lock has been assigned to a transaction T for a data object, and if no lock has been assigned to any concurrent transaction for this data object, then the transaction T can request an EXCLUSIVE lock for this data object and the lock is immediately assigned to this transaction.
   If an EXCLUSIVE lock has been assigned to a transaction for a data object, then a SHARE lock can, but need not, be requested for this transaction.
   The matrix 'Transactions' at the beginning of this chapter shows the possible parallel locks.
   A lock collision exists in the cases which are marked with 'No'; i.e., after having requested a lock within a transaction, the user has to wait for the lock to be released until one of the above situations or one of the situations that are marked with 'Yes' in

the matrix occurs.

6. Locks can be requested either implicitly or explicitly. Explicit lock requests are performed using the <lock statement>. Whether a lock is requested implicitly and how long it remains assigned to the transaction depends on the <isolation spec> in the <connect statement>.

7. The locks assigned to a transaction by a <lock statement> are released at the end of the transaction.

8. In the case of a lock collision, the system waits for locks to be released, until the period specified by the installation parameter REQUEST TIMEOUT has elapsed.
   If ADABAS has to wait too long for locks to be released when setting explicit or implicit locks, it issues an error message to this effect. The user can then respond to this error message, e.g., by terminating the transaction. In these situations, ADABAS does not execute an implicit ROLLBACK WORK.
   Whenever ADABAS recognizes a deadlock caused by explicit or implicit locks, it ends the transaction with an implicit ROLLBACK WORK.

9. If reproducible results are needed for reading rows using a <select statement>, the read objects must be locked and the locks must be kept until reproduction. Reproducibility usually requires that the tables concerned are locked in SHARE mode, either explicitly using one or more <lock statement>s or implicitly by using the ISOLATION LEVEL 3. This ensures that no other user can modify the table.

10. The fewer objects are locked, the more transactions can operate simultaneously on the database without colliding with lock requests of other transactions. For this reason, unnecessary locks should be avoided and set locks should be released as soon as possible.

11. If a transaction implicitly requests too many row locks (SHARE or EXCLUSIVE locks) on a table, ADABAS tries to obtain a table lock instead. If this causes collisions with other locks, ADABAS continues to request row locks. This means that table locks can be obtained without waiting for them. The limit beyond which ADABAS tries to transform row locks into table locks depends on the installation parameter MAXLOCKS.

<release statement>

Function

ends the transaction and the ADABAS session of a user.

Format

```
<release statement> ::=
    COMMIT   [WORK] RELEASE
  | ROLLBACK [WORK] RELEASE
```

Syntax Rules

none

General Rules

1. COMMIT WORK RELEASE concludes the current transaction without opening a new one. The session is ended for the user.

2. If ADABAS has to undo the current transaction implicitly, then COMMIT WORK RELEASE fails, and a new transaction will be opened. The session of the user is not ended in this case.

3. ROLLBACK WORK RELEASE aborts the current transaction without opening a new one. Any database modifications performed during the current transaction are undone. The session of the user is ended. ROLLBACK WORK RELEASE has the same effect as a <rollback statement> followed by COMMIT WORK RELEASE.

4. Ending a session using a <release statement> implicitly deletes all result tables.

5. If the ADABAS accounting is enabled, information concerning the session is inserted in the table SYSACCOUNT of the SYSDBA at the SERVERDB where the session was opened.

Restrictions

Maximum values :

Number of tables	unlimited
Length of an identifier	18 characters
Internal length of a table row	4047 characters
Columns per table (with KEY)	255 columns
Columns per table (without KEY)	254 columns
Number of key columns	127 columns
Precision of numeric values	18 digits
Sum of internal lengths of all key columns	255 characters
Sum of internal lengths of all columns belonging to an index	255 characters
Length of sort columns in SELECT	250 characters
Number of result columns	254 columns
Number of join tables in SELECT	16 tables
Number of join conditions in a WHERE clause of a SELECT	64
Number of named indexes per table	256
Number of correlated columns in an SQL statement	64
Number of correlated tables in an SQL statement	16
Number of SERVERDBs in a distributed database	2048 SERVERDBs
Number of DEVSPACEs	64 DEVSPACEs
Length of an SQL statement	8240 characters
Number of parameters in an SQL statement	300 parameters

Introduction

1. This chapter lists the differences between the syntax and semantics in ADABAS and the definition of DB2 Version 3.

Concepts

1. In ADABAS, there are usergroups, so that it may happen that the <owner> of an object is not a user but a usergroup.

2. In contrast to DB2, ADABAS does not distinguish between 'primary authorization id' and 'secondary authorization id'. A user in ADABAS can only create and drop database objects for himself or for his usergroup, and he can create database objects which are not assigned to a particular user (e.g., indexes). It is not possible to create database objects for other users.

3. ADABAS knows synonyms, no aliases.

4. In contrast to DB2, the maximum precision of numbers is 18 digits in ADABAS, not 31.

5. The range of values of numbers in ADABAS is between -9.99999999999999999E+62 and -1E-64 and between +1E-64 and +9.99999999999999999E+62. In DB2, the range comprises the values between 5.4E-79 and 7.2E+75.

6. In contrast to DB2, data with the code attribute BYTE (BIT DATA) is not filled with blanks in ADABAS, but with binary zeros.

Common Elements

1. In contrast to DB2, all identifiers are long identifiers in ADABAS.

2. In addition to DB2, <extended letter>s and <language specific letter>s can be used in an <identifier> in ADABAS.

3. In contrast to DB2, a <special identifier> in ADABAS can only be enclosed in <double quotes>. A <string literal> can only be enclosed in apostrophes, not in <double quotes>. There is no option which could be used to replace the <double quote> by an apostrophe or vice versa.

4. The following key words are not reserved in ADABAS:

   COLLECTION
   DESCRIPTOR
   END-EXEC ERASE
   FIELDPROC
   GO GOTO
   IMMEDIATE
   LOCKSIZE
   NUMPARTS
   PACKAGE PART PLAN PRIQTY PROGRAM
   SECQTY
   VOLUMES

5. The indication of a 'location name' for a <table name> specification is neither possible nor required in ADABAS.

6. In contrast to DB2, there is no option in ADABAS to ensure that a ',' can be specified instead of the decimal point.

7. In contrast to DB2, all integer value can be specified without a decimal points in ADABAS.

8. In ADABAS, the 'special registers' USER and CURRENT SQLID always contain the same value and have a maximum length of 18 bytes.

9. The 'special register' TIMEZONE always has the value 0 in ADABAS.

10. The 'special registers' CURRENT SERVER and CURRENT PACKAGESET are not supported in ADABAS.

11. The date and time format LOCAL is not supported in ADABAS. In addition to DB2, ADABAS supports the date and time format INTERNAL.

12. KATAKANA and 'mixed data' are not supported in ADABAS.

13. In contrast to DB2, the default value for the precision of the function DECIMAL is always the value 18 in ADABAS.

14. For the result of the <function spec> LENGTH, there are differences between DB2 and ADABAS with regard to all data types except CHAR.

15. In contrast to DB2, ADABAS does not support the specification of a string of 8 or 14

bytes for the <function spec> TIMESTAMP.

16. In ADABAS the functions
    HEX
    VARGRAPHIC
    are not available.

17. In contrast to DB2, there is no need in ADABAS that the <expression> in a <set function spec> contains a <column spec>.

18. In ADABAS, a <set function spec> applied to an empty, grouped result table does not produce a result.

19. In contrast to DB2, it is possible in ADABAS to specify minutes and seconds >= 60 in <time duration>s. Specifications of months > 12 and of days > 31 are possible in <date duration>s. Values that are too large are handled as an overflow.

20. <timestamp duration>s are not supported in ADABAS.

21. In addition to DB2, in ADABAS X'1F' and X'1E' are accepted in the <like expression> as equivalents of '%' and <underscore>.

SQL Statement

1. The following SQL statements are not available in ADABAS:

   CREATE ALIAS
   DROP ALIAS

   ALTER DATABASE
   CREATE DATABASE
   DROP DATABASE
   ALTER INDEX

   ALTER STOGROUP
   CREATE STOGROUP
   DROP STOGROUP

   ALTER TABLE

   ALTER TABLESPACE
   CREATE TABLESPACE
   DROP TABLESPACE

   CONNECT (not available in DB2 syntax)
   EXPLAIN
   LABEL ON
   SET CURRENT PACKAGESET
   SET CURRENT SQLID

Data Definition

1. In contrast to DB2, a table can only have 255 columns in ADABAS.

2. In contrast to DB2, GRAPHIC data in ADABAS is not stored as DBCS data, but with the code attribute BYTE. <string literal>s referring to GRAPHIC data must be specified as <hex literal>s and not in the format used in DB2.

3. The internal length of date, time and timestamp values differs in DB2 and ADABAS.

4. In comparison with DB2, the set of <db2 options> in the <create table statement> is considerably restricted in ADABAS.

5. Field procedures are not supported in ADABAS.

6. In contrast to DB2, a unique, single-column index in ADABAS can contain the NULL value in the particular column in several rows.

7. In ADABAS, the <comment statement> is not available for aliases.

Authorization

1. In ADABAS, the <grant statement> and the <revoke statement> are only available for privileges on base or view tables.

Data Manipulation

1. In contrast to DB2, an <update statement> with CURRENT OF can be used in ADABAS to update all columns for which the user has the corresponding privileges, regardless of whether they are specified in the <update clause> or not.

Data Retrieval

1. In contrast to DB2, a sequence of <select column>s in ADABAS may only definy 254 columns, not 750.

2. In addition to DB2, the <group clause> and the <having clause> can be contained in a <subquery> of a <predicate> in ADABAS.

Transactions

1. In contrast to DB2, in ADABAS, all locks are released at the end of a transaction, even the locks requested by <declare cursor statement>s WITH HOLD specification.

Error Messages

The following error messages have been adopted :

- 530	REFERENTIAL INTEGRITY VIOLATED
- 803	DUPLICATE SECONDARY KEY
- 911	WORK ROLLED BACK
- 913	LOCK REQUEST TIMEOUT

All the other error messages have not been adopted and are specific for the database system ADABAS. The only message with a positive value is 100 ROW NOT FOUND.

Syntax

```
<alias name> ::=
     <identifier>

<all function> ::=
     <all set function name> ( [ALL] <expression> )

<all set function name> ::=
     MAX
   | MIN
   | SUM
   | AVG

<arithmetic expression> ::=
     <term>
   | <arithmetic expression> + <term>
   | <arithmetic expression> - <term>

<arithmetic function> ::=
     INTEGER ( <expression> )
   | DECIMAL ( <expression>[, <unsigned integer>
                [, <unsigned integer>] ] )
   | FLOAT   ( <expression> )
   | LENGTH  ( <expression> )

<between predicate> ::=
     <expression> [NOT] BETWEEN <expression> AND <expression>

<boolean factor> ::=
     [NOT] <boolean primary>

<boolean primary> ::=
     <predicate>
   | (<search condition>)

<boolean term> ::=
     <boolean factor>
   | <boolean term> AND <boolean factor>
<character> ::=
     <digit>
   | <letter>
   | <extended letter>
   | <hex digit>
   | <language specific character>
   | <special character>


<close statement> ::=
     CLOSE <result table name>

<column attributes> ::=
     NOT NULL [<default spec>]

<column comment> ::=
     <column name> IS <string literal>

<column definition> ::=
     <column name> <data type> <column attributes>

<column name> ::=
     <identifier>
```

```
<column spec> ::=
     <column name>
   | <table name>.<column name>
   | <reference name>.<column name>

<comment statement> ::=
     COMMENT ON TABLE <table name> IS <string literal>
   | COMMENT ON COLUMN
           <table name>.<column name> IS <string literal>
   | COMMENT ON <table name> ( <column comment>,... )

<commit statement> ::=
     COMMIT [WORK]

<comp op> ::=
     < | > | <> | != | = | <= | >=
   | ¬= | ¬< | ¬> for a computer with the code type EBCDIC
   | ~= | ~< | ~> for a computer with the code type ASCII

<comparison predicate> ::=
     <expression> <comp op> <expression>
   | <expression> <comp op> <subquery>

<connect statement> ::=
     CONNECT <user spec>
     IDENTIFIED BY <password spec>
     [SQLMODE <sqlmode spec>]
     [<isolation spec>]
     [TIMEOUT <unsigned integer>]
     [CACHELIMIT <unsigned integer>]
     [TERMCHAR SET <termchar set name>]

<conversion function> ::=
     DIGITS    ( <expression> )
   | CHAR      ( <expression>[, <datetimeformat> ] )
<create index statement> ::=
     CREATE [UNIQUE] INDEX <index spec>

<create synonym statement> ::=
     CREATE SYNONYM <synonym name> FOR <table name>

<create table statement> ::=
     CREATE TABLE <table name> (<table description element>,...)>
           [<db2 options>]
   | CREATE TABLE <table name> LIKE <source table>

<create view statement> ::=
     CREATE VIEW <table name> [(<alias name>,...)]
     AS <query expression>
     [WITH CHECK OPTION]

<data type> ::=
     CHAR[ACTER] [(<unsigned integer>)] [FOR BIT DATA]
   | VARCHAR (<unsigned integer>) [FOR BIT DATA]
   | LONG VARCHAR [FOR BIT DATA]
   | DEC[IMAL] [(<unsigned integer> [,<unsigned integer>])]
   | NUMERIC (<unsigned integer> [,<unsigned integer>])
   | INT[EGER]
   | SMALLINT
   | FLOAT (<unsigned integer>)
   | REAL
   | DOUBLE PRECISION
   | DATE
   | TIME
   | TIMESTAMP
   | GRAPHIC (<unsigned integer>)
   | VARGRAPHIC (<unsigned integer>)
   | LONG VARGRAPHIC

<date duration> ::=
     [<sign>] <unsigned integer>

<date or timestamp expression> ::=
     <expression>

<datetime expression> ::=
     <datetime primary>
   | <datetime expression> + <datetime primary>
   | <datetime expression> - <datetime primary>

<datetime primary> ::=
     <labeled duration>
   | <date duration>
   | <time duration>
   | <column spec>
   | <function spec>
   | <set function spec>
   | (<datetime expression>)

<datetimeformat> ::=
     EUR
   | INTERNAL
   | ISO
   | JIS
   | USA

<db2 options> ::=
     IN [<identifier>.]<identifier>
   | IN DATABASE <identifier>
   | AUDIT NONE
   | AUDIT CHANGES
   | AUDIT ALL

<declare cursor statement> ::=
     DECLARE <result table name> CURSOR [WITH HOLD] FOR
             <select statement>

<default spec> ::=
     WITH DEFAULT
<default value> ::=
     value resulting from the <data type> of the
     <column definition> containing the <default spec>

<degree spec> ::=
     'ANY'
   | '1'
   | '1  '
   | <parameter name>

<delete rule> ::=
     ON DELETE CASCADE
   | ON DELETE RESTRICT
   | ON DELETE SET NULL

<delete statement> ::=
     DELETE FROM <table name> [<reference name>]
            [WHERE <search condition>]
   | DELETE FROM <table name> [<reference name>]
            WHERE CURRENT OF <result table name>

<delimiter token> ::=
     ( | ) | , | . | + | - | * | /
   | < | > | <> | != | = | <= | >=
   | ¬= | ¬< | ¬> for a computer with the code type EBCDIC
   | ~= | ~< | ~> for a computer with the code type ASCII

<derived column> ::=
     <expression>

<digit> ::=
     0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9

<distinct function> ::=
     <set function name> ( DISTINCT <expression> )

<distinct spec> ::=
     DISTINCT
   | ALL

<double quotes> ::=
     "

<drop index statement> ::=
     DROP INDEX <index name> [ON <table name>]

<drop synonym statement> ::=
     DROP SYNONYM <synonym name>

<drop table statement> ::=
     DROP TABLE <table name>

<drop view statement> ::=
     DROP VIEW <table name>

<exists predicate> ::=
     EXISTS <subquery>

<exponent> ::=
     [<sign>] [ [<digit>] <digit>] <digit>

<expression> ::=
     <arithmetic expression>
   | <datetime expression>

<extended letter> ::=
     # | @ | $

<extraction function> ::=
     YEAR        ( <date or timestamp expression> )
   | MONTH       ( <date or timestamp expression> )
   | DAY         ( <date or timestamp expression> )
   | HOUR        ( <time or timestamp expression> )
   | MINUTE      ( <time or timestamp expression> )
   | SECOND      ( <time or timestamp expression> )
   | MICROSECOND ( <expression> )
   | TIMESTAMP   ( <expression>[, <expression> ] )
   | DATE        ( <expression> )
   | TIME        ( <expression> )
   | DAYS        ( <date or timestamp expression> )

<factor> ::=
     [<sign>] <primary>

<fetch statement> ::=
     FETCH <result table name> INTO <parameter spec>,...

<first character> ::=
     <letter>
   | <extended letter>
   | <language specific character>

<fixed point literal> ::=
     [<sign>] <unsigned integer>[.<unsigned integer>]
   | [<sign>] <unsigned integer>.
   | [<sign>] .<unsigned integer>

<floating point literal> ::=
     <mantissa>E<exponent>
   | <mantissa>e<exponent>

<from clause> ::=
     FROM <table spec>,...

<function spec> ::=
     <arithmetic function>
   | <string function>
   | <extraction function>
   | <special function>
   | <conversion function>
   | <userdefined function>

<grant statement> ::=
     GRANT <table privileges> ON [TABLE] <table name>,...
     TO <grantee>,... [WITH GRANT OPTION]

<grantee> ::=
     PUBLIC
   | <user name>
   | <usergroup name>

<group clause> ::=
     GROUP BY <column spec>,...

<having clause> ::=
     HAVING <search condition>

<hex digit> ::=
     0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9
   | A | B | C | D | E | F
   | a | b | c | d | e | f

<hex digit seq> ::=
     <hex digit> <hex digit>
   | <hex digit seq> <hex digit> <hex digit>

<hex literal> ::=
     x''
   | X''
   | x'<hex digit seq>'
   | X'<hex digit seq>'
```

```
<identifier> ::=
     <simple identifier>
   | <double quotes><special identifier><double quotes>

<identifier tail character> ::=
     <letter>
   | <extended letter>
   | <language specific character>
   | <digit>
   | <underscore>

<in predicate> ::=
     <expression> [NOT] IN <subquery>
   | <expression> [NOT] IN (<value spec>,...)

<index clause> ::=
     <column name> [<order spec>]

<index name> ::=
     <identifier>

<index spec> ::=
     <index name> ON <table name> ( <index clause>,... )

<indicator name> ::=
     <parameter name>

<insert columns and values> ::=
     [(<column name>,...)] VALUES (<value spec>,...)
   | [(<column name>,...)] <query expression>

<insert statement> ::=
     INSERT INTO <table name> <insert columns and values>


<isolation spec> ::=
     ISOLATION LEVEL <unsigned integer>

<join predicate> ::=
     <expression> <comp op> <expression>

<key definition> ::=
     PRIMARY KEY (<column name>,...)

<key word> ::=
     <not restricted key word>
   | <restricted key word>
   | <reserved key word>

<labeled duration> ::=
     <expression>  <time unit>

<language specific character> ::=
     Every letter that occurs in a North, Central or South
     European language, but is not contained in <letter>
     (e.g. the German umlauts, French grave accent, etc.).

<letter> ::=
     A | B | C | D | E | F | G | H | I | J | K | L | M
   | N | O | P | Q | R | S | T | U | V | W | X | Y | Z
   | a | b | c | d | e | f | g | h | i | j | k | l | m
   | n | o | p | q | r | s | t | u | v | w | x | y | z
```

```
<like expression> ::=
     <expression>
   | '<pattern element>...'

<like predicate> ::=
     <expression> [NOT] LIKE <like expression>
                  [ESCAPE <expression>]

<literal> ::=
     <string literal>
   | <numeric literal>

<lock statement> ::=
     LOCK TABLE <table name> IN SHARE MODE
   | LOCK TABLE <table name> IN EXCLUSIVE MODE

<mantissa> ::=
     <fixed point literal>

<match char> ::=
     Every character except
     %, X'1F', <underscore>, X'1E'.

<match set> ::=
     <underscore>
   | X'1E'
   | <match char>

<match string> ::=
     %
   | X'1F'

<not restricted key word> ::=
   ACCOUNTING   ACTIVATE     ADABAS       ADD_MONTHS   AFTER
   ANALYZE      ANSI

   BAD          BEGINLOAD    BLOCKSIZE    BUFFER

   CACHELIMIT   CACHES       CANCEL       CLEAR        COLD
   COMPLETE     CONFIG       CONSOLE      CONSTRAINTS  COPY
   COSTLIMIT    COSTWARNING  CURRVAL

   DATA         DAYS         DB2          DBA          DBFUNCTION
   DBPROC       DBPROCEDURE  DEGREE       DESTPOS      DEVICE
   DEVSPACE     DIAGNOSE     DISABLE      DIV          DOMAINDEF
   DSETPASS     DUPLICATES   DYNAMIC

   ENDLOAD      ENDPOS       EUR          EXPLAIN      EXPLICIT

   FIRSTPOS     FNULL        FORCE        FORMAT       FREAD
   FREEPAGE     FWRITE

   GATEWAY      GRANTED

   HEXTORAW     HOLD         HOURS

   IMPLICIT     INDEXNAME    INIT         INITRANS     INSTR
   INTERNAL     ISO

   JIS

   KEEP
   LABEL        LASTPOS      LAST_DAY     LOAD

   MAXTRANS     MDECLARE     MDELETE      MFETCH       MICROSECONDS
   MINSERT      MINUTES      MLOCK        MOD          MONITOR
   MONTHS       MONTHS_BETWEEN MSELECT      MUPDATE

   NEW_TIME     NEXTVAL      NEXT_DAY     NOLOG        NORMAL
   NOSORT       NVL

   OFF          OPTIMISTIC   ORACLE       OUT          OVERWRITE

   PAGES        PARAM        PARSE        PARSEID      PARTICIPANTS
   PASSWORD     PATTERN      PCTUSED      PERMLIMIT    POS
   PRIV         PROC         PSM

   QUICK

   RANGE        RAWTOHEX     RECONNECT    REFRESH      REPLICATION
   REST         RESTART      RESTORE      REUSE        RFETCH

   SAME         SAPR3        SAVE         SAVEPOINT    SEARCH
   SECONDS      SEGMENT      SELECTIVITY  SEQUENCE     SERVERDB
   SHUTDOWN     SNAPSHOT     SOUNDS       SOURCEPOS    SQLID
   SQLMODE      STANDARD     STARTPOS     STAT         STATE
   STORAGE      STORE        SUBPAGES     SUBTRANS

   TABID        TABLEDEF     TEMP         TEMPLIMIT    TERMCHAR
   TIMEOUT      TO_CHAR      TO_DATE      TO_NUMBER    TRANSFILE
   TRIGGERDEF

   UNLOAD       UNLOCK       UNTIL        USA          USERID

   VERIFY       VERSION      VSIZE        VTRACE

   WAIT

   YEARS

<null predicate> ::=
     <expression> IS [NOT] NULL

<numeric literal> ::=
     <fixed point literal>
   | <floating point literal>

<open cursor statement> ::=
     OPEN <result table name>

<optimize clause> ::=
     OPTIMIZE FOR <unsigned integer> ROW
   | OPTIMIZE FOR <unsigned integer> ROWS

<order and update clause> ::=
     <order clause>
   | [<order clause>] FOR FETCH ONLY [<optimize clause>]
   | [<order clause>] <optimize clause> [FOR FETCH ONLY]
   | <update clause> [<optimize clause>]

<order clause> ::=
     ORDER BY <sort spec>,...

<order spec> ::=
     ASC
   | DESC

<owner> ::=
     <user name>
   | <usergroup name>

<parameter name> ::=
     :<identifier>

<parameter spec> ::=
     <parameter name>[ [INDICATOR] <indicator name>]

<password spec> ::=
     <parameter name>

<pattern element> ::=
     <match string>
   | <match set>

<predicate> ::=
     <between predicate>
   | <comparison predicate>
   | <exists predicate>
   | <in predicate>
   | <join predicate>
   | <like predicate>
   | <null predicate>
   | <quantified predicate>

<primary> ::=
     <value spec>
   | <column spec>
   | <function spec>
   | <set function spec>
   | (<arithmetic expression>)

<privilege> ::=
     INSERT
   | UPDATE [(<column name>,...)]
   | SELECT
   | DELETE
   | INDEX
   | ALTER

<quantified predicate> ::=
     <expression> <comp op> <quantifier> <subquery>


<quantifier> ::=
     ALL
   | <some>

<query expression> ::=
     <query primary>
   | <query expression> UNION [ALL] <query primary>

<query primary> ::=
     <query spec>
   | (<query expression>)

<query spec> ::=
     SELECT [<distinct spec>] <select column>,...
     <table expression>
```

```
<query statement> ::=
     <declare cursor statement>

<reference name> ::=
     <identifier>

<referenced table> ::=
     <table name>

<referencing column> ::=
     <column name>

<referential constraint definition> ::=
     FOREIGN KEY  [<referential constraint name>]
     (<referencing column>,...)
     REFERENCES <referenced table> [<delete rule>]

<referential constraint name> ::=
     <identifier>

<regular token> ::=
     <literal>
   | <key word>
   | <identifier>
   | <parameter name>

<release statement> ::=
     COMMIT   [WORK] RELEASE
   | ROLLBACK [WORK] RELEASE


<reserved key word> ::=
   ADD          ALL          ALTER        AND          ANY
   AS           AUDIT

   BETWEEN      BUFFERPOOL   BY

   CLUSTER      COLUMN       CONCAT       COUNT        CURRENT
   CURSOR

   DATABASE     DELETE       DISTINCT     DROP

   EDITPROC     ESCAPE       EXCEPT       EXECUTE      EXISTS

   FOR          FROM

   GRANT        GROUP

   HAVING

   IN           INDEX        INSERT       INTO         IS

   KEY

   LIKE

   NOT          NULL

   OBID         OF           ON           OPTIMIZE     OR
   ORDER

   PRIVILEGES
   RELEASE

   SELECT        SET           SOME          SYNONYM

   TABLE         TABLESPACE    TO

   UNION         UPDATE        USER          USING

   VALIDPROC     VALUES        VIEW

   WHERE         WITH

<restricted key word> ::=
   ABS           ACOS          ACTION        ADDDATE       ADDTIME
   ALPHA         ASC           ASCII         ASIN          AT
   ATAN          ATAN2         AVG


   BEGIN         BINARY        BIT           BOOLEAN       BOTH
   BYTE

   CASCADE       CAST          CATALOG       CEIL          CEILING
   CHAR          CHARACTER     CHECK         CHR           CLOSE
   COMMENT       COMMIT        CONNECT       CONNECTED     CONSTRAINT
   COS           COSH          COT           CREATE        CURDATE
   CURRENT_DATE  CURRENT_TIME  CURTIME

   DATE          DATEDIFF      DAY           DAYNAME       DAYOFMONTH
   DAYOFWEEK     DAYOFYEAR     DBYTE         DEC           DECIMAL
   DECLARE       DECODE        DEFAULT       DEGREES       DESC
   DESCRIBE      DIGITS        DIRECT        DISCONNECT    DOMAIN
   DOUBLE

   EBCDIC        END           ENTRY         ENTRYDEF      EXCLUSIVE
   EXP           EXPAND        EXTRACT

   FALSE         FETCH         FIRST         FIXED         FLOAT
   FLOOR         FOREIGN

   GET           GRAPHIC       GREATEST

   HEX           HOUR

   IDENTIFIED    IFNULL        IGNORE        INDICATOR     INITCAP
   INNER         INT           INTEGER       INTERSECT     ISOLATION

   JOIN

   LANGUAGE      LAST          LCASE         LEADING       LEAST
   LEFT          LENGTH        LEVEL         LFILL         LINK
   LIST          LN            LOCAL         LOCALSYSDBA   LOCK
   LOG           LOG10         LONG          LOWER         LPAD
   LTRIM

   MAKEDATE      MAKETIME      MAPCHAR       MAX           MICROSECOND
   MIN           MINUS         MINUTE        MODE          MODIFY
   MONTH         MONTHNAME

   NATURAL       NEXT          NO            NOROUND       NOW
   NOWAIT        NUM           NUMBER        NUMERIC

   OBJECT        ONLY          OPEN          OPTION        OUTER
   PACKED       PCTFREE      PI           POWER        PRECISION
   PREV         PRIMARY      PROCEDURE    PUBLIC


   RADIANS      RAW          READ         REAL         REFERENCED
   REFERENCES   REJECT       RENAME       REPLACE      RESOURCE
   RESTRICT     REVOKE       RFILL        RIGHT        ROLLBACK
   ROUND        ROW          ROWID        ROWNO        ROWNUM
   ROWS         RPAD         RTRIM

   SCHEMA       SECOND       SELUPD       SHARE        SHOW
   SIGN         SIN          SINH         SMALLINT     SOUNDEX
   SQRT         STAMP        STATISTICS   STDDEV       SUBDATE
   SUBSTR       SUBTIME      SUM          SYSDATE      SYSDBA

   TAN          TANH         TIME         TIMEDIFF     TIMESTAMP
   TIMEZONE     TOIDENTIFIER TRAILING     TRANSACTION  TRANSLATE
   TRIGGER      TRIM         TRUE         TRUNC        TRUNCATE

   UCASE        UID          UNIQUE       UNKNOWN      UPPER
   USAGE        USERGROUP

   VALUE        VARCHAR      VARCHAR2     VARGRAPHIC   VARIANCE
   VARYING

   WEEKOFYEAR   WHENEVER     WORK         WRITE

   YEAR

   ZONED

<result table name> ::=
     <identifier>

<revoke statement> ::=
     REVOKE <table privileges> ON [TABLE] <table name>,...
     FROM <grantee>,...

<rollback statement> ::=
     ROLLBACK [WORK]

<search condition> ::=
     <boolean term>
   | <search condition> OR <boolean term>

<select column> ::=
     <table columns>
   | <derived column>

<select statement> ::=
     <query expression>
     [<order and update clause>]


<set current degree statement> ::=
     SET CURRENT DEGREE <degree spec>

<set function name> ::=
     COUNT
   | MAX
   | MIN
   | SUM
   | AVG

<set function spec> ::=
     COUNT (*)
   | <distinct function>
   | <all function>

<set update clause> ::=
     <column name> = <expression>

<set statement> ::=
     SET <parameter name> = <special register>

<sign> ::=
     +
   | -

<simple identifier> ::=
     <first character> [<identifier tail character>...]

<single select statement> ::=
     SELECT [<distinct spec>] <select column>,...
     INTO <parameter spec>,...
     FROM <table spec>,...
     [<where clause>]

<some> ::=
     SOME
   | ANY

<sort option> ::=
     ASC
   | DESC

<sort spec> ::=
     <unsigned integer> [<sort option>]
   | <column spec> [<sort option>]

<source table> ::=
     <table name>


<special character> ::=
     Every character except <digit>, <letter>, <extended letter>,
     <hex digit>, <language specific character> and the character
     for the line end in a file.

<special function> ::=
     VALUE    ( <expression>, <expression>,... )

<special identifier> ::=
     <special identifier character>...

<special identifier character> ::=
     Any character.

<special register> ::=
     CURRENT DATE
   | CURRENT DEGREE
   | CURRENT SQLID
   | CURRENT TIME
   | CURRENT TIMESTAMP
   | CURRENT TIMEZONE
   | USER

<sql statement> ::=
     <create table statement>
   | <drop table statement>
   | <create synonym statement>
   | <drop synonym statement>
   | <create view statement>
   | <drop view statement>
   | <create index statement>
   | <drop index statement>
   | <comment statement>

   | <grant statement>
   | <revoke statement>

   | <insert statement>
   | <update statement>
   | <delete statement>
   | <set current degree statement>
   | <set statement>

   | <query statement>
   | <open cursor statement>
   | <fetch statement>
   | <close statement>
   | <single select statement>

   | <connect statement>
   | <commit statement>
   | <rollback statement>
   | <lock statement>
   | <release statement>

<sqlmode spec> ::=
     ADABAS
   | ANSI
   | DB2
   | ORACLE

<string function> ::=
     <string spec> || <string spec>
   | <string spec> CONCAT <string spec>
   | SUBSTR    ( <string spec>, <expression>[, <expression>] )

<string literal> ::=
     ''
   | '<character>'...
   | <hex literal>

 <string spec> ::=
     <expression>

<subquery> ::=
     (<query expression>)

<synonym name> ::=
     <identifier>

<table columns> ::=
     *
   | <table name>.*
   | <reference name>.*
```

```
<table description element> :=
     <column definition>
   | <key definition>
   | <referential constraint definition>

<table expression> ::=
     <from clause>
     [<where clause>]
     [<group clause>]
     [<having clause>]

<table name> ::=
     [<owner>.]<identifier>


<table privileges> ::=
     ALL [PRIVILEGES]
   | <privilege>,...

<table spec> ::=
     <table name> [<reference name>]

<term> ::=
     <factor>
   | <term> * <factor>
   | <term> / <factor>

<termchar set name> ::=
     <identifier>

<time duration> ::=
     [<sign>] <unsigned integer>

<time or timestamp expression> ::=
     <expression>

<time unit> ::=
     YEAR
   | YEARS
   | MONTH
   | MONTHS
   | DAY
   | DAYS
   | HOUR
   | HOURS
   | MINUTE
   | MINUTES
   | SECOND
   | SECONDS
   | MICROSECOND
   | MICROSECONDS

<token> ::=
     <regular token>
   | <delimiter token>

<underscore> ::=
     _

<unsigned integer> ::=
     <digit>...
```

```
<update clause> ::=
     FOR UPDATE OF <column name>,...

<update columns and values> ::=
     SET <set update clause>,...

<update statement> ::=
     UPDATE <table name> [<reference name>]
            <update columns and values>
            [WHERE <search condition>]
   | UPDATE <table name> [<reference name>]
            <update columns and values>
            WHERE CURRENT OF <result table name>

<user name> ::=
     <identifier>

<user spec> ::=
     <parameter name>
   | <user name>

<userdefined function> ::=
     Each DB function defined by any user.

<usergroup name> ::=
     <identifier>

<value spec> ::=
     <literal>
   | <parameter spec>
   | NULL
   | USER
   | CURRENT SQLID
   | CURRENT DATE
   | CURRENT TIME
   | CURRENT TIMESTAMP
   | CURRENT TIMEZONE
   | CURRENT DEGREE

<where clause> ::=
     WHERE <search condition>
```