LEVEL II COBOL

LANGUAGE REFERENCE

MANUAL

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Micro Focus Limited

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PREFACE

This manual describes the LEVEL II COBOL language for programming microcomputers. LEVEL II COBOL is based on the ANSI COBOL standard X3.23 (1974) (see Acknowledgement). It also describes the additional LEVEL II COBOL features that exploit the capabilities of microprocessors.

Each release of LEVEL II COBOL is characterized by a two-digit code in the form of

"Version number". "Release number within version"

Note: In the remainder of this manual the full product name LEVEL II COBOL is abbreviated to L/II COBOL. *

AUDIENCE

This manual is intended for programmers already familiar with COBOL on other equipment.

MANUAL ORGANIZATION

Chapters 1 through 4 of the manual apply to all users and describe basic features of the language. Chapters 5 through 7 describe language features for programming the three file organization formats supported: sequential, relative and indexed.

Chapters 8 through 11 apply to all users and describe additional features and facilities available with the standard language. The appendices supply reference information pertinent to all systems.

The manual contains the following chapters and appendices:

"Chapter 1. Introduction", which gives a general description of the language, including a broad outline of ANSI COBOL features included and omitted and additional features of L/II COBOL.

"Chapter 2. COBOL Concepts", which describes general concepts of the COBOL language including program structure, and details of statement components and notation.

"Chapter 3. Nucleus", which describes the nucleus of all COBOL programs and the layout of each program division in the nucleus.

"Chapter 4. Table Handling", which describes the handling of data tables in the Data and Procedure divisions of a COBOL program.

"Chapter 5. Sequential Input and Output", which describes the programming of input and output of data in files with sequential format.

"Chapter 6. Relative Input and Output", which describes the programming of input and output of data in files with relative format.

"Chapter 7. Indexed Input and Output", which describes the programming of input and output of data in files with indexed format.

"Chapter 8. Sort-Merge", which describes the facility to order one or more files of records or to combine two or more identically ordered files of records according to a set of user-specified keys contained within each record.

"Chapter 9. Segmentation", which describes the facility for specifying permanent and independent object program segments.

"Chapter 10. Library", which describes the source library maintenance feature of COBOL.

"Chapter 11. Debug and Interactive Debugging", which describes the basic and interactive debugging features available in L/II COBOL.

"Chapter 12. Interprogram Communication", which describes the ability of L/II COBOL programs to interface during running and to access common data, enabling modular programming.

"Chapter 13. Communication", which describes the facility to communicate through a Message Control System (MCS) with local and remote devices, and to access, process and create messages or portions thereof.

"Chapter 14. Programming Techniques and Sizing", which describes the means available for L/II COBOL programmers to estimate object program size and includes programming techniques in L/II COBOL.

"Appendix A. Reserved Word Table", which lists words reserved for L/II COBOL functions within a program.

"Appendix B. Character Set and Collating Sequence", which lists all characters available and their collating sequence.

"Appendix C. Glossary", which lists specific terms used in L/II COBOL.

"Appendix D. Compile - Time Errors", which lists all errors that can be signalled during program compilation.

"Appendix E. Run-Time Errors", which lists all errors that can be signalled during program execution.

"Appendix F. Syntax Summary", which summarizes the syntax used in L/II COBOL programming.

"Appendix G. Summary of Extensions to ANSI COBOL", which summarizes all extensions to ANSI COBOL provided by L/II COBOL.

"Appendix H. System Dependent Language Features", which describes the system dependent L/II COBOL entries for use with microcomputers and those features not included because of hardware requirements.

"Appendix I. Language Specification", which is an overall specification of the L/II COBOL language.

"Appendix J. IBM Extensions", which describes some L/II COBOL extensions that are compatible with the IBM 8100 DPPX COBOL implementation.

RELATED PUBLICATIONS

No discussion of operating the L/II COBOL Compiler or Run-Time system is incorporated in this manual. Please refer to document:

L/II COBOL Operating Guide
(for use with the relevant Operating System)

NOTATION IN THIS MANUAL

Throughout this manual, the following notation is used to describe the format of COBOL statements:

1. All words printed in capital letters which are underlined must always be present when the functions of which they are a part are used. An error printout will occur during compilation if the underlined words are absent or incorrectly spelled. The underlining is not necessary when writing a COBOL source program.

2. All words printed in capital letters which are not underlined are used for readability only. They may be written, or not, as the programmer wishes.

3. All words printed in small letters are generic terms representing names which will be devised by the programmer.

4. When material is enclosed in braces { } , a choice must be made from the options within them.

5. When material is enclosed in square brackets [ ], it is an indication that the material is an option which may be included or omitted as required.

6. When material is enclosed in square brackets crossed ⁅ ⁆, it is an indication that the material is mandatory when the ANSI switch is set (see Chapter 2) but optional otherwise.

7. Language features that are shaded in the text are language extensions which exceed the ANSI 1974 standard, as are ANSI 1974 features that are treated as for documentary purposes only in LEVEL II COBOL. See note at the end of this Preface.

9. In text, the ellipsis (...) shows the omission of a portion of a source program or a sequence. This meaning becomes apparent in context.

   In the general formats, the ellipsis represents the position at which repetition may occur at the user's option. The portion of the format that may be repeated is determined as follows:

   Given ... in a clause or statement format, scanning right to left, determine the or [immediately to the left of the ...; continue scanning right to left and determine the logically matching or]; the ... applies to the words between the determined pair of delimiters.

10. The term identifier means either a data-name or a subscripted data-name. An identifier takes the following form:

$$\text{data-name-1} \quad \left[\left(\begin{Bmatrix} \text{data-name-2} \\ \text{literal-1} \end{Bmatrix} \right) \right]$$

   data-name-2 or literal-1 must be a positive integer in the range 1 to the number of elements in the table.

Headings are presented in this manual in the following order of importance:

CHAPTER N TITLE	Chapter Heading
ORDER ONE HEADING ORDER TWO HEADING Order Three Heading Order Four Heading	Text two lines down
Order Five Heading:	Text on same line

Numbers one (1) to nine (9) are written in text as letters, e.g. one.

Numbers ten (10) upwards are written in text as numbers, e.g. 12.

The phrase "For documentation purposes only" in the text of this manual means that the associated coding is accepted syntactically by the Compiler, but is ignored when producing the object program.

Bars in the right hand margin indicate differences from CIS COBOL Version 4, and asterisks in the right hand margin indicate deletions.

Changes issued as part of an Addendum are identified by the Addendum number printed at the bottom of the changed page. On these pages the change bars and asterisks indicate only changes since the previous release. Page iii is provided as a record of all amendments to your copy of the manual.

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CHAPTER 1

INTRODUCTION

WHAT IS L/II COBOL?

COBOL (COmmon Business Oriented Language) is the most widely and extensively used language for the programming of commercial and administrative data processing.

L/II COBOL is a compact, interactive and standard COBOL Language System which is designed for use on microprocessor-based computers and intelligent terminals.

It is based on the ANSI COBOL as specified in "American National Standard Programming Language COBOL" (ANSI X3.23 1974). The following modules are fully implemented at Level II:

- Nucleus
- Table Handling
- Sequential Input and Output
- Relative Input and Output
- Indexed Input and Output
- Sort-Merge
- Segmentation
- Library
- Inter-Program Communication
- Debug
- Communications

This manual is intended as a reference work for L/II COBOL programmers and material from the ANSI COBOL language standard document is included.

The package has been proved to meet and exceed the COBOL ANSI standard X3.23 and has been certified by the Federal Compiler Testing Center (FCTC) under the direction of the General Services Administration (GSA) as validated at Federal High Level. The GSA Validation Summary Report is available under the reference FCTC-82/161.

(Addendum 2)

Along with the ANSI implementation L/II COBOL also contains several language extensions specifically oriented to the small computer environment and for compatibility with some larger mainframe applications. These enable a L/II COBOL program to format CRT screens for data input and output (DISPLAY and ACCEPT), READ and WRITE text files efficiently and define external file names at run time.

The programmer wishing to transport an existing COBOL program to run under L/II COBOL must check that the individual language features he has used are supported by L/II COBOL. The COBOL SECTION statements in the Segmentation feature can be performed using the PERFORM statement.

A compile time FLAG directive can be set that flags all LEVEL II COBOL extension features together with ANSI COBOL features at any of the levels specified by the Federal Compiler Testing Center under the direction of the General Services Administration (GSA). (See Chapter 2).

The L/II COBOL compiler is designed to enable programs to be developed in a 64K machine. The Compiler supports sequential, relative and indexed sequential files, as well as interactive communications via the ACCEPT and DISPLAY verbs.

L/II COBOL is part of a family of application development tools that are available for visual programming:

* FORMS-2 that enables the Operator to define screen layouts from a screen "module" and produce automatically the data description for direct inclusion in a L/II COBOL program. This is described in the FORMS-2 Operating Guide

* ANIMATOR brings a program to life on the screen "animating" it by displaying the source code during run time with the cursor moving from COBOL source statement to statement. ANIMATOR is a full interactive symbolic debugging tool that complies with the published GSA certification standard enabling the setting of breakpoints, examination and alteration of data and the changing of the flow of control.

*

L/II COBOL programs are created using a conventional text editor. The Compiler compiles the programs and the Run-Time system links with the compiled output to form a running user program. A listing of the L/II COBOL program is provided by the Compiler during compilation. Error messages are inserted in the listing.

L/II COBOL is designed to be interfaced easily to any microprocessor operating system. Detailed operating characteristics are dependent on the particular host operating system used and are defined in the appropriate Operating Guide.

PROGRAM STRUCTURE

A COBOL program consists of four divisions:

1. IDENTIFICATION DIVISION - An identification of the program

2. ENVIRONMENT DIVISION - A description of the equipment to be used to compile and run the program

3. DATA DIVISION - A description of the data to be processed

4. PROCEDURE DIVISION - A set of procedures to specify the operations to be performed on the data

Each division is divided into sections which are further divided into paragraphs which in turn are made up of sentences.

Within these subdivisions of a COBOL program, further subdivisions exist as clauses and statements. A clause is an ordered set of COBOL elements that specify an attribute of an entry, and a statement is a combination of elements in the Procedure Division that include a COBOL verb and constitute a program instruction.

FORMATS AND RULES

GENERAL FORMAT

A general format is the specific arrangement of the elements of a clause or a statement. Throughout this document a format is shown adjacent to information defining the clause or statement. When more than one specific arrangement is permitted, the general format is separated into numbered formats. Clauses must be written in the sequence given in the general formats. (Clauses that are optional must appear in the sequence shown if they are used). In certain cases, stated explicitly in the rules associated with a given format, the clauses may appear in sequences other than that shown. Applications, requirements or restrictions are shown as rules.

SYNTAX RULES

Syntax rules are those rules that define or clarify the order in which words or elements are arranged to form larger elements such as phrases, clauses, or statements. Syntax rules also impose restrictions on individual words or elements.

These rules are used to define or clarify how the statement must be written, i.e., the order of the elements of the statement and restrictions on what each element may represent.

GENERAL RULES

A general rule is a rule that defines or clarifies the meaning or relationship of meanings of an element or set of elements. It is used to define or clarify the semantics of the statement and the effect that it has on either execution or compilation.

ELEMENTS

Elements which make up a clause or a statement consist of uppercase words, lowercase words, level-numbers, brackets, braces, connectives and special characters (see Chapter 2).

SOURCE FORMAT

The COBOL source format divides each COBOL source record into 72 columns. These columns are used in the following way:

Columns 1 - 6	Sequence number
Column 7	Indicator area
Column 8 - 11	Area A
Columns 12 - 72	Area B

SEQUENCE NUMBER

A sequence number of six digits may be used to identify each source program line. If column 1 contains an asterisk (*) or columns 1 and 2 contain a form feed character followed by an asterisk the entire line will be ignored by the compiler and will not appear in the list file. This facility allows list files to be used as source files.

INDICATOR AREA

An asterisk * in this area marks the line as documentary comment only. Such a comment line can appear anywhere in the program after the Identification Division header. Any characters from the ASCII character set can be included in Area A and Area B of the line.

A stroke /, in the indicator area acts as a comment line above but causes the page to eject before printing the comment.

A "D" in the indicator area represents a debugging line. Areas A and B may contain any valid COBOL sentence.

A "-" in the indicator area represents a continuation of the previous line without spaces or the continuation of a non-numeric literal (see Chapter 2).

AREAS A AND B

Section names and paragraph names begin in Area A and are followed by a period and a space. Level indicators FD, 01 and 66, 77 and 88 begin in Area A and are followed in Area B by the appropriate file and record description.

Program sentences may commence anywhere in Area A and Area B. More than one sentence is permitted in each source record.

Note that TAB characters are not permitted in LEVEL II COBOL source.

Figure 1-1 shows the source format of a typical program.

(Addendum 2)

```
* Level II COBOL  V1.1                B:STOCK1.CBL                       PAGE: 0001
*
000010 IDENTIFICATION DIVISION.                                           011E
000020 PROGRAM-ID. STOCK-FILE-SET-UP.                                     0120
000030 AUTHOR. MICRO FOCUS LTD.                                           0120
000040 ENVIRONMENT DIVISION.                                              0120
000050 CONFIGURATION SECTION.                                             0120
000060 SOURCE-COMPUTER. MDS-800.                                          0120
000070 OBJECT-COMPUTER. MDS-800.                                          0120
000075 SPECIAL-NAMES. CONSOLE IS CRT.                                     0120
000080 INPUT-OUTPUT SECTION.                                              0120
000090 FILE-CONTROL.                                                      018C
000100     SELECT STOCK-FILE ASSIGN "STOCK.IT"                            018E
000110     ORGANIZATION INDEXED                                           018E
000120     ACCESS DYNAMIC                                                 018E
000130     RECORD KEY STOCK-CODE.                                         018E
000140 DATA DIVISION.                                                     01C6
000150 FILE SECTION.                                                      01C6
000160 FD  STOCK-FILE; RECORD 32.                                         01C6
000170 01  STOCK-ITEM.                                                    01C6
000180     02  STOCK-CODE PIC X(4).                                       01C6
000190     02  PRODUCT-DESC PIC X(24).                                    01CA
000200     02  UNIT-SIZE PIC 9(4).                                        01E2
000210 WORKING-STORAGE SECTION.                                           0268 00
000220 01  SCREEN-HEADINGS.                                               0268 00
000230     02  ASK-CODE PIC X(21) VALUE "STOCK CODE     <    >".          0268 00
000240     02  FILLER PIC X(59).                                          027D 15
000250     02  ASK-DESC PIC X(16) VALUE "DESCRIPTION    <".               02B8 50
000260     02  SI-DESC PIC X(25) VALUE "                        >".       02C8 60
000270     02  FILLER PIC X(39).                                          02E1 79
000280     02  ASK-SIZE PIC X(21) VALUE "UNIT SIZE      <    >".          0308 A0
000290  01  ENTER-IT REDEFINES SCREEN-HEADINGS.                           0268 00
000300     02  FILLER PIC X(16).                                          0268 00
000310     02  CRT-STOCK-CODE PIC X(4).                                   0278 10
000320     02  FILLER PIC X(76).                                          027C 14
000330     02  CRT-PROD-DESC PIC X(24).                                   02C8 60
000340     02  FILLER PIC X(56).                                          02E0 78
000350     02  CRT-UNIT-SIZE PIC 9(4).                                    0318 B0
000360     02  FILLER PIC X.                                              031C B4
000370 PROCEDURE DIVISION.                                                0000
000380 SR1.                                                               002E
000390     DISPLAY SPACE.                                                 002F
000400     OPEN I-O STOCK-FILE.                                           0034
000410     DISPLAY SCREEN-HEADINGS.                                       0038
000420 NORMAL-INPUT.                                                      004E
000430     MOVE SPACE TO ENTER-IT.                                        004F
000440     DISPLAY ENTER-IT.                                              0055
000450 CORRECT-ERROR.                                                     006E
000460     ACCEPT ENTER-IT.                                               006F
000470     IF CRT-STOCK-CODE = SPACE GO TO END-IT.                        0088
000480     IF CRT-UNIT-SIZE NOT NUMERIC GO TO CORRECT-ERROR.              0092
000490     MOVE CRT-PROD-DESC TO PRODUCT-DESC.                            009A
000500     MOVE CRT-UNIT-SIZE TO UNIT-SIZE.                               00A0
000510     MOVE CRT-STOCK-CODE TO STOCK-CODE.                             00A6
000520     WRITE STOCK-ITEM; INVALID GO TO CORRECT-ERROR.                 00AC
000530     GO TO NORMAL-INPUT.                                            00B9
000540 END-IT.                                                            00BC
000550     CLOSE STOCK-FILE.                                              00BD
000560     DISPLAY SPACE.                                                 00C1
000570     DISPLAY "END OF PROGRAM".                                      00C6
000580     STOP RUN.                                                      00D8
                                                                          00D9
* Level II COBOL  V1.1 REVISION 6                              URN AA/0000/AA
* Compiler   (C) 1978,1982  MICRO FOCUS LTD.
*
* ERRORS=00000 DATA=01024 CODE=00512 DICT=00426:61868/62294 GSA FLAGS =  OFF
```

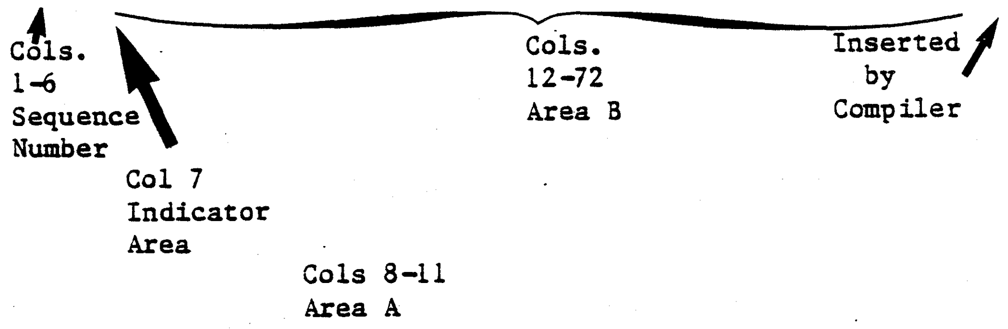


Figure 1-1. Sample Program Listing showing Source Format.

CHAPTER 2

COBOL CONCEPTS

LANGUAGE CONCEPTS

CHARACTER SET

The most basic and indivisible unit of the language is the character. The set of characters used to form L/II COBOL character-strings and separators includes the letters of the alphabet, digits and special characters. The character set consists of the characters defined below:

0 to 9	
A to Z	
a to z (Reserved and User-defined Word Characters read as: A to Z)	
Space	
+	Plus sign
-	Minus sign or hyphen
*	Asterisk
/	Oblique Stroke/Slash
=	Equal sign
$	Dollar sign
.	Full stop or decimal point
,	Comma or decimal point
;	Semicolon
"	Quotation mark
(	Left Parenthesis
)	Right Parenthesis
>	Greater than symbol
<	Less than symbol

The L/II COBOL language is restricted to the above character set, but the content of non-numeric literals, comment lines and data may include any of the characters from the ASCII character set. See Appendix B.

LANGUAGE STRUCTURE

The individual characters of the language are concatenated to form character-strings and separators. A separator may be concatenated with another separator or with a character-string. A character-string may only be concatenated with a separator. The concatenation of character-strings and separators forms the text of a source program.

Separators

A separator is a string of one or more punctuation characters. The rules for formation of separators are:

1. The punctuation character space is a separator. Anywhere a space is used as a separator, more than one space may be used.

2. The punctuation characters comma, semicolon and period, when immediately followed by a space, are separators. These separators may appear in a COBOL source program only where explicitly permitted by the general formats, by format punctuation rules (see FORMATS AND RULES in Chapter 1), by statement and sentence structure definitions (see STATEMENTS AND SENTENCES in this Chapter), or reference format rules (see REFERENCE FORMAT in this Chapter).

3. The punctuation characters right and left parenthesis are separators. Parenthesis may appear only in balanced pairs of left and right parentheses delimiting subscripts, indices, arithmetic expressions, or conditions.

4. The punctuation character quotation mark is a separator. An opening quotation mark must be immediately preceded by a space or left parenthesis; a closing quotation mark must be immediately followed by one of the separators space, comma, semicolon, period, or right parenthesis.

   Quotation marks may appear only in balanced pairs delimiting nonnumeric literals except when the literal is continued. (See CONTINUATION OF LINES in this Chapter).

5. Pseudo-text delimiters are separators. An opening pseudo-text delimiter may be immediately preceded by a space; a closing pseudo-text delimiter must be immediately followed by one of the separators space, comma, semicolon, or period.

   Pseudo-text delimiters may appear only in balanced pairs delimiting pseudo-text. (See Chapter 10. LIBRARY)

6. The separator space may optionally immediately precede all separators except the following:

   a. As specified by reference format rules see REFERENCE FORMAT in this Chapter.

   b. The separator closing quotation mark. In this case, a preceding space is considered as part of the nonnumeric literal and not as a separator.

   c. The opening pseudo-text delimiter, where the preceding space is required.

7. The separator space is optional and can immediately follow any separator except the opening quotation mark. In this case, a following space is considered as part of the nonnumeric literal and not as a separator.

Any punctuation character which appears as part of the specification of a PICTURE character-string (see Chapter 3) or numeric literal is not considered as a punctuation character, but rather as a symbol used in the specification of that PICTURE character-string or numeric literal. PICTURE character-strings are delimited only by the separators space, comma, semicolon, or period.

The rules established for the formation of separators do not apply to the characters which comprise the contents of nonnumeric literals, comment-entries, or comment lines.

Character-Strings

A character-string is a character or a sequence of contiguous characters which forms a L/II COBOL word, a literal, a PICTURE character-string, or a comment-entry. A character-string is delimited by separators.

COBOL Words

A COBOL word is a character-string of not more than 30 characters which forms a user defined word, a system-name, or a reserved word. Within a given source program these classes form disjoint sets; a COBOL word may belong to one and only one of these classes.

User-Defined Words: A user-defined word is a COBOL word that must be supplied by the user to satisfy the format of a clause or statement. Each character of a user-defined word is selected from the set of characters 'A', 'B', 'C', ... 'Z', 'a', 'b', 'c', ...'z' interpreted as upper-case, '0', ...'9', and '-', except that the '-' may not appear as the first or last character. The exception to this rule is an external-file-name-literal which must be a normal alphanumeric literal.

User-defined word types which are implemented are as follows:

alphabet-name
cd-name
condition-name
data-name
external-file-name-literal
file-name
index-name
level-number
library-name
mnemonic-name
paragraph-name
program-name

record-name
routine-name
section-name
segment-number
text-name

Within a given source program, 14 of these 17 types of user-defined words are grouped into 12 disjoint sets. The disjoint sets are:

alphabet-names
cd-names
condition-names, data-names, and record-names
file-names
index-names
library-names
mnemonic-names
paragraph-names
program-names
routine-names
section-names
text-names

All user-defined words, except segment-numbers and level-numbers, can belong to one and only one of these disjoint sets. Further, all user-defined words within a given disjoint set must be unique. (See UNIQUENESS OF REFERENCE in this Section.)

With the exception of paragraph-name, section-name, level-number and segment-number, all user-defined words must contain at least one alphabetic character. Segment-numbers and level-numbers need not be unique; a given specification of a segment-number or level-number may be identical to any other segment-number or level-number and may even be identical to a paragraph-name or section-name.

Condition-Name: A condition-name is a name which is assigned to a specific value, set of values, or range of values, within a complete set of values that a data item may assume. The data item itself is called a conditional variable.

Condition-names may be defined in the Data Division or in the SPECIAL-NAMES paragraph within the Environment Division where a condition-name must be assigned to the ON STATUS or OFF STATUS, or both, of the run time switches.

A condition-name is used only in the RERUN clause or in conditions as an abbreviation for the relation condition; this relation condition posits that the associated conditional variable is equal to one of the set of values to which that condition-name is assigned.

Mnemonic-Name: A mnemonic-name assigns a user-defined word to an implementor-name. These associations are established in the SPECIAL-NAMES paragraph of the Environment Division. (See SPECIAL-NAMES in Chapter 3).

Paragraph-Name: A paragraph-name is a word which names a paragraph in the Procedure Division. Paragraph-names are equivalent if, and only if, they are composed of the same sequence of the same number of digits and/or characters.

Section-Name: A section-name is a word which names a section in the Procedure Division. Section names are equivalent if, and only if, they are composed of the same sequence of the same number of digits and/or characters.

Other User-Defined Names: See the glossary in Appendix C for definitions of all other types of user-defined words.

System-Names: A system-name is a COBOL word which is used to communicate with the operating environment. Each character used in the formation of a system-name must be selected from the set of characters 'A', 'B', 'C', ... 'Z', 'a', 'b' ... 'z', '0', ... '9' and '-', except that the '-' may not appear as the first or last character.

There are three types of system-names:

1. computer-name
2. implementor-name
3. language-name

Within a given implementation these three types of system-names form disjoint sets; a given system-name may belong to one and only one of them.

The system-names listed above are individually defined in the glossary in Appendix C.

Reserved Words: A reserved word is a COBOL word that is one of a specified list of words which may be used in COBOL source programs, but which must not appear in the programs as user-defined words or system-names. Reserved words can only be used as specified in the general formats. (See Appendix A).

There are six types of reserved words:

1. Key words
2. Optional words
3. Connectives

4. Special registers
5. Figurative constants
6. Special-character words

Key Words: A key word is a word whose presence is required when the format in which the word appears is used in a source program. Within each format, such words are uppercase and underlined.

Key words are of three types:

1. Verbs such as ADD, READ, and ENTER.
2. Required words, which appear in statement and entry formats.
3. Words which have a specific functional meaning such as NEGATIVE, SECTION, etc.

Optional Words: Within each format, uppercase words that are not underlined are called optional words and may appear at the user's option. The presence or absence of an optional word does not alter the semantics of the COBOL program in which it appears.

Connectives: There are three types of connectives:

1. Qualifier connectives that are used to associate a data-name, a condition-name, and a text-name, or a paragraph-name with its qualifier: OF, IN.

2. Series connectives that link two or more consecutive operands: , (separator comma) or ; (separator semicolon).

3. Logical connectives that are used in the formation of conditions: AND, OR.

Special Registers: Certain reserved words are used to name and reference special registers. Special registers are certain compiler generated storage areas whose primary use is to store information produced in conjunction with the use of specific COBOL features. These special registers include LINAGE-COUNTER (see Chapter 5) and DEBUG-ITEM (see Chapter 11).

Figurative Constants: Certain reserved words are used to name and reference specific constant values. These reserved words are specified under Figurative Constant Values in this chapter.

Special -Character Words: The arithmetic operators and relation characters are reserved words. (See the glossary - Appendix C).

Literals

A literal is a character-string whose value is implied by an ordered set of characters of which the literal is composed or by specification of a reserved word which references a figurative constant. Every literal belongs to one of two types, nonnumeric or numeric.

Nonnumeric Literals: A nonnumeric literal is a character-string delimited on both ends by quotation marks and consisting of any allowable character in the computer's character set. Allowed are nonnumeric literals of 1 through 128 characters in length. To represent a single quotation mark character within a nonnumeric literal, two contiguous quotation marks must be used. The value of a nonnumeric literal in the object program is the string of characters itself, except:

1. The delimiting quotation marks are excluded, and

2. Each embedded pair of contiguous quotation marks represents a single quotation mark character.

All other punctuation characters are part of the value of the nonnumeric literal rather than separators; all nonnumeric literals are category alpha-numeric. (See The PICTURE Clause in chapter 3). In addition, hexadecimal binary values can be attributed to non-numeric literals by expressing literals as: X"nn", where n is a hexadecimal character in the set 0-9 A-F; nn may be repeated up to 128 times, but the number of hex digits must be even.

Numeric Literals: A numeric literal is a character-string whose characters are selected from the digits '0' through '9', the plus sign, the minus sign, and/or the decimal point. The implementation allows for numeric literals of 1 through 18 digits in length. The rules for the formation of numeric literals are as follows:

1. A literal must contain at least one digit.

2. A literal must not contain more than one sign character. If a sign is used, it must appear as the leftmost character of the literal. If the literal is unsigned, the literal is positive.

3. A literal must not contain more than one decimal point. The decimal point is treated as an assumed decimal point, and may appear anywhere within the literal except as the rightmost character. If the literal contains no decimal point, the literal is an integer.

   If a literal conforms to the rules for the formation of numeric literals, but is enclosed in quotation marks, it is a nonnumeric literal and it is treated as such by the compiler.

4. The value of a numeric literal is the algebraic quality represented by the characters in the numeric literal. Every numeric literal is category numeric. (See THE PICTURE CLAUSE in Chapter 3).

   The size of a numeric literal in standard data format characters is equal to the number of digits specified by the user.

Figurative Constant Values

Figurative Constant Values are generated by the compiler and referenced through the use of the reserved words given below. These words must not be bounded by quotation marks when used as figurative constants. The singular and plural forms of figurative constants are equivalent and may be used interchangeably.

The figurative constant values and the reserved words used to reference them are shown in Table 2-1.

Table 2-1. Figurative Constants and their Reserved Words

CONSTANT	REPRESENTATION
ZERO ZEROS ZEROES	Represents the value '0', or one or more of the character '0' depending on context.
SPACE SPACES	Represents one or more of the character space from the computer's character set.
HIGH-VALUE HIGH-VALUES	Represents one or more of the character that has the highest ordinal position in the program collating sequence. (Hex 7F for the ASCII character set)
LOW-VALUE LOW-VALUES	Represents one or more of the character that has the lowest ordinal position in the program collating sequence. (Hex 00 for the ASCII character set)
QUOTE QUOTES	Represents one or more of the character '"'. The word QUOTE or QUOTES cannot be used in place of a quotation mark in a source program to bound a nonnumeric literal. Thus, QUOTE ABD QUOTE is incorrect as a way of stating the nonnumeric literal "ABD".
ALL literal	Represents one or more characters of the string of characters comprising the literal. The literal must be either a nonnumeric literal or a figurative constant other than ALL literal. When a figurative constant is used, the word ALL is redundant and is used for readability only.

When a figurative constant represents a string of one or more characters, the length of the string is determined by the compiler from context according to the following rules:

1. When a figurative constant is associated with another data item, as when the figurative constant is moved to or compared with another data item, the string of characters specified by the figurative constant is repeated character by character on the right until the size of the resultant string is equal to the size in characters of the associated data item. This is done prior to and independent of the application of any JUSTIFIED clause that may be associated with the data item.

2. When a figurative constant is not associated with another data item, as when the figurative constant appears in a DISPLAY, STRING, STOP or UNSTRING statement, the length of the string is one character.

   DISPLAY SPACE in Format 2 of the DISPLAY statement is, of course, an exception.

A figurative constant may be used wherever a literal appears in a format, except that whenever the literal is restricted to having only numeric characters in it, the only figurative constant permitted is ZERO (ZEROS, ZEROES).

When the figurative constants HIGH-VALUE(S) or LOW-VALUE(S) are used in the source program, the actual character associated with each figurative constant depends upon the program collating sequence specified. (See THE OBJECT-COMPUTER PARAGRAPH, and THE SPECIAL-NAMES PARAGRAPH in Chapter 3).

Each reserved word which is used to reference a figurative constant value is a distinct character-string with the exception of the construction 'ALL literal' which is composed of two distinct character-strings.

PICTURE Character-Strings

A PICTURE character-string consists of certain combinations of characters in the COBOL character set used as symbols. See THE PICTURE CLAUSE in chapter 3 for the PICTURE character-string and for the rules that govern their use.

Any punctuation character which appears as part of the specification of a PICTURE character-string is not considered as a punctuation character, but rather as a symbol used in the specification of that PICTURE character-string.

Comment-Entries

A comment-entry is an entry in the Identification Division that may be any combination of characters from the computer's character set.

CONCEPT OF COMPUTER INDEPENDENT DATA DESCRIPTION

To make data as computer independent as possible, the characteristics or properties of the data are described in relation to a standard data format rather than an equipment-oriented format. This standard data format is oriented to general data processing applications and uses the decimal system to represent numbers (regardless of the radix used by the computer) and the remaining characters in the L/II COBOL character set to describe nonnumeric data items.

Concept of Levels

A level concept is inherent in the structure of a logical record. This concept arises from the need to specify subdivisions of a record for the purpose of data reference. Once a subdivision has been specified, it may be further subdivided to permit more detailed data referral.

The most basic subdivisions of a record, that is, those not further subdivided, are called elementary items; consequently, a record is said to consist of a sequence of elementary items, or the record itself may be an elementary item.

In order to refer to a set of elementary items, the elementary items are combined into groups. Each group consists of a named sequence of one or more elementary items. Groups, in turn, may be combined into groups of two or more groups, etc. Thus, an elementary item may belong to more than one group.

Level-Numbers

A system of level-numbers shows the organization of elementary items and group items. Since records are the most inclusive data items, level-numbers for records start at 01. Less inclusive data items are assigned higher (not necessarily successive) level-numbers not greater in value than 49. A maximum of 49 levels in a record is allowed. There are special level-numbers, 66, 77 and 88 which are exceptions to this rule (see below). Separate entries are written in the source program for each level-number used.

A group includes all group and elementary items following it until a level-number less than or equal to the level-number of that group is encountered. All items which are immediately subordinate to a given group item must be described using identical level-numbers greater than the level-number used to describe that group item. Note that elementary items must not exceed 8191 bytes in length. Group items may be defined as larger (for example for the purpose of being the parent items for large tables) but in such cases they must not be explicitly referenced.

(Addendum 1)

Three types of entries exist for which there is no true concept of level. These are:

1. Entries that specify elementary items or groups introduced by a RENAMES clause

2. Entries that specify noncontiguous working storage and linkage data items

3. Entries that specify condition-names.

Entries describing items by means of RENAMES clauses for the purpose of regrouping data items have been assigned the special level-number 66.

Entries that specify noncontiguous data items, which are not subdivisions of other items, and are not themselves subdivided, have been assigned the special level-number 77.

Entries that specify condition-names, to be associated with particular values of a conditional variable, have been assigned the special level-number 88.

Concept of Classes of Data

The five categories of data items (see THE PICTURE CLAUSE in Chapter 3) are grouped into three classes: alphabetic, numeric, and alphanumeric. For alphabetic and numeric, the classes and categories are synonymous. The alphanumeric class includes the categories of alphanumeric edited, numeric edited and alphanumeric (without editing). Every elementary item except for an index data item belongs to one of the classes and further to one of the categories. The class of a group item is treated at object time as alphanumeric regardless of the class of elementary items subordinate to that group item. Table 2-2 depicts the relationship of the class and categories of data items.

Table 2-2 Data Levels, classes and categories

LEVEL OF ITEM	CLASS	CATEGORY
Elementary	Alphabetic	Alphabetic
	Numeric	Numeric
	Alphanumeric	Numeric Edited Alphanumeric Edited Alphanumeric
Non-Elementary Group	Alphanumeric	Alphabetic Numeric Numeric Edited Alphanumeric Edited Alphanumeric

Selection of Character Representation and Radix

The value of a numeric item may be represented in either binary or decimal form, depending on the equipment. In addition, there are several ways of expressing decimal. Since these representations are actually combinations of bits, they are commonly called binary-coded decimal forms. The four standard formats used for storing numeric data in L/II COBOL are as follows:

1. As alphanumeric characters stored one per byte in ASCII representation.

2. As numeric characters defined by USAGE IS DISPLAY (See The USAGE Clause in Chapter 3) one per byte in ASCII representation. If they are signed and the sign is specified as INCLUDED, bit 6 of the leading or trailing byte of the field is set for negative, depending on the field definition. If a SEPARATE sign is specified as a one byte ASCII + or -, a sign is added as the leading or trailing byte. If no SIGN clause is specified, bit 6 of the trailing digit is set to indicate negative by default.

3. As numeric characters defined by USAGE IS COMP or COMPUTATIONAL in pure binary form. If the field is signed the number is held in its twos-complement form. Storage is then dependent on the number of 9's in the PICTURE clause (see The PICTURE Clause in Chapter 3) and on whether the field is SIGNed or not (see The SIGN Clause in Chapter 3).

   Table 2-3 shows the storage requirements for each COMP(UTATIONAL) PICTURE Clause.

   Table 2-3. Numeric Data Storage for the COMP(UTATIONAL) PICTURE Clause.

Bytes Required	Number of Characters	
	Signed	Unsigned
1	1-2	1-2
2	3-4	3-4
3	5-6	5-7
4	7-9	8-9
5	10-11	10-12
6	12-14	13-14
7	15-16	15-16
8	17-18	17-18

4. As numeric characters defined by USAGE IS COMPUTATIONAL-3 or USAGE IS COMP-3 in packed internal decimal form. Storage is dependent on the number of 9's in the PICTURE clause. The decimal numbers are stored as signed strings of variable length of 1 through 18 digits. The sign of the packed decimal number is always stored in place of the least significant quartet of the low order byte. Each byte contains two decimal positions (four bits per digit) and the digits (0 - 9) are encoded as BCD numbers (0000 - 1001). Numbers are represented in the field as right-justified values with a + or - sign as shown in the example below. The maximum number of digits permitted in arithmetic operands is 18.

EXAMPLE:

a. For COMPUTATIONAL-3 and PICTURE 9999, the number +1234 would be stored as follows:

```
... __0____1____2____3____4____F__

    0000 0001 0010 0011 0100 1111
                        \_______/
                         1 byte
```

where F represents the non-printing plus sign.

b. For COMPUTATIONAL-3 and PICTURE S9999, the number +1234 would be stored as follows:

Storage would be as in a above except that the least significant digit would be replaced by C (1100) representing the plus sign.

c. For COMPUTATIONAL-3 and PICTURE S9999, the number -1234 would be stored as follows:

Storage would be as in a above except that the least significant byte would be replaced by D (1101) representing the minus sign.

Table 2-4 shows the storage requirements for each COMP-3 clause.

Table 2-4. Numeric Data Storage for the COMPUTATION-3 PICTURE Clause.

Bytes Required	Number of Digits (Signed or Unsigned)
1	1
2	2-3
3	4-5
4	6-7
5	8-9
6	10-11
7	12-13
8	14-15
9	16-17
10	18

Algebraic Signs

Algebraic signs fall into two categories: operational signs, which are associated with signed numeric data items and signed numeric literals to indicate their algebraic properties; and editing signs, which appear on edited reports to identify the sign of the item.

The SIGN Clause permits the programmer to state explicitly, the location of the operational sign. The Clause is optional; if it is not used operational signs will be represented as defined by setting bit 6 of the trailing digit for ASCII numbers. (see above).

Editing signs are inserted into a data item through the use of the sign control symbols of THE PICTURE CLAUSE.

Standard Alignment Rules

The standard rules for positioning data within an elementary item depend on the category of the receiving item. These rules are:

1. If the receiving data item is described as numeric:

   a. The data is aligned by decimal point and is moved to the receiving character positions with zero fill or truncation on either end as required.

   b. When an assumed decimal point is not explicitly specified, the data item is treated as if it had an assumed decimal point immediately following its rightmost character and is aligned as in paragraph a. above.

2. If the receiving data item is a numeric edited data item, the data moved to the edited item is aligned by decimal point with zero fill or truncation at either end as required within the receiving character positions of the data item, except where editing requirements cause replacement of the leading zeros.

3. If the receiving data item is alphanumeric (other than a numeric edited data item), alphanumeric edited or alphabetic, the sending data is moved to the receiving character positions and aligned at the leftmost character position in the data item with space fill or truncation to the right, as required.

If the JUSTIFIED Clause is specified for the receiving item, these standard rules are modified as described in THE JUSTIFIED CLAUSE in Chapter 3.

Uniqueness of Reference

Qualification

Every user-specified name that defines an element in a COBOL source program must be unique, either because no other name has the identical spelling and hyphenation, or because the name exists within a hierarchy of names such that references to the name can be made unique by mentioning one or more of the higher levels of the hierarchy. The higher levels are called qualifiers and this process that specifies uniqueness is called qualification. Enough qualification must be mentioned to make the name unique; however, it may not be necessary to mention all levels of the hierarchy. Within the Data Division, all data-names used for qualification must be associated with a level indicator or a level-number. Therefore, two identical data-names must not appear as entries subordinate to a group item unless they are capable of being made unique through qualification. In the Procedure Division two identical paragraph-names must not appear in the same section.

In the hierarchy of qualification, names associated with a level indicator are the most significant, then those names associated with level-number 01, then names associated with level-number 02, ... , 49. A section-name is the highest (and the only) qualifier available for a paragraph-name. Thus, the most significant name in the hierarchy must be unique and cannot be qualified. Subscripted or indexed data-names and conditional variables, as well as procedure-names and data-names, may be made unique by qualification. The name of a conditional variable can be used as a qualifier for any of its condition-names. Regardless of the available qualification, no name can be both a data-name and procedure-name.

Qualification is performed by following a data-name, a condition-name, a paragraph-name, or a text-name by one or more phrases composed of a qualifier preceded by IN or OF. IN and OF are logically equivalent.

The general formats for qualification are:

Format 1

$$\left\{\begin{array}{l}\text{data-name-1}\\\text{condition-name}\end{array}\right\}\left[\left\{\begin{array}{c}\underline{\text{OF}}\\\underline{\text{IN}}\end{array}\right\}\text{data-name-2}\right]\ldots$$

Format 2

$$\text{paragraph-name}\quad\left[\left\{\begin{array}{c}\underline{\text{OF}}\\\underline{\text{IN}}\end{array}\right\}\text{section-name}\right]$$

Format 3

$$\text{text-name}\quad\left[\left\{\begin{array}{c}\underline{\text{OF}}\\\underline{\text{IN}}\end{array}\right\}\text{library-name}\right]$$

The rules for qualification are as follows:

1. Each qualifier must be of a successively higher level and within the same hierarchy as the name it qualifies.

2. The same name must not appear at two levels in a hierarchy.

3. If a data-name or a condition-name is assigned to more than one data item in a source program, the data-name or condition-name must be qualified each time it is referred to in the Procedure, Environment, and Data Divisions (except in the REDEFINES clause where qualification is unnecessary and must not be used.)

4. A paragraph-name must not be duplicated within a section. When a paragraph-name is qualified by a section-name, the word SECTION must not appear. A paragraph-name need not be qualified when referred to from within the same section.

5. A data-name cannot be subscripted when it is being used as a qualifier.

6. A name can be qualified even though it does not need qualifications; if there is more than one combination of qualifiers that ensures uniqueness, then any such set can be used. The complete set of qualifiers for a data-name must not be the same as any partial set of qualifiers for another data-name.

   Qualified data-names may have up to five qualifiers.

7. If more than one COBOL library is available to the compiler during compilation, text-name must be qualified each time it is referenced.

Subscripting

Subscripts can be used only when reference is made to an individual element within a list or table of like elements that have not been assigned individual data-names (see THE OCCURS CLAUSE in Chapter 4).

The subscript can be represented either by a numeric literal that is an integer or by a data-name. The data-name must be a numeric elementary item that represents an integer.

The subscript may be signed and, if signed, it must be positive. The lowest possible subscript value is 1. This value points to the first element of the table. The next sequential elements of the table are pointed to by subscripts whose values are 2, 3, ... The highest permissible subscript value, in any particular case, is the maximum number of occurrences of the item as specified in the OCCURS clause.

Relative subscripting can be used in a similar manner to relative indexing if the ANSI flag is not set.

The subscript, or set of subscripts, that identifies the table element is delimited by the balanced pair of separators left parenthesis and right parenthesis following the table element data-name. The table element data-name appended with a subscript is called a subscripted data-name or an identifier. When more than one subscript is required, they are written in the order of successively less inclusive dimensions of the data organization. In practice there is a limit to the number of subscripts that can be used with a data-name. This is dependent on the length of the subscripts but is of the order of nine. If exceeded, internal buffer overflow results in a compile-time error.

The format is:

$$\left\{\begin{matrix}\text{data-name}\\ \text{condition name}\end{matrix}\right\}\ \text{(subscript-1[, subscript-2[, subscript-3] ...])}$$

Indexing

References can be made to individual elements within a table of like elements by specifying indexing for that reference. An index is assigned to that level of the table by using the INDEXED BY phrase in the definition of a table. A name given in the INDEXED BY phrase is known as an index-name and is used to refer to the assigned index. The value of an index corresponds to the occurrence number of an element in the associated table or any other table. An index-name must be initialized before it is used as a table reference. An index-name can be given an initial value by a SET statement.

Direct indexing is specified by using an index-name in the form of a subscript. Relative indexing is specified when the index-name is followed by the operator + or -, followed by an unsigned integer numeric literal all delimited by the balanced pair of separators left parenthesis and right parenthesis following the table element data-name. The occurrence number resulting from relative indexing is determined by incrementing (where the operator + is used) or decrementing (when the operator - is used), by the value of the literal, the occurrence number represented by the value of the index. When more than one index-name is required, they are written in the order of successively less inclusive dimensions of the data organization.

At the time of execution of a statement which refers to an indexed table element, the value contained in the index referenced by the index-name associated with the table element must neither correspond to a value less than one nor to a value greater than the highest permissible occurrence number of an element of the associated table. This restriction also applies to the value resultant from relative indexing. In practice there is a limit to the number of index-names that can be used with a data-name. This is dependent on the length of the index-names but is of the order of nine. If exceeded, internal buffer overflow results in a compile-time error.

(Addendum 1)

The general format for indexing is:

$$\left\{\begin{array}{l}\text{data-name}\\ \text{condition-name}\end{array}\right\} \left(\left\{\begin{array}{l}\text{index-name-1}\\ \text{literal-1}\end{array} \left[\left\{\pm\right\}\text{ literal-2}\right]\right\}\right.$$

$$\left.\left[\text{, } \left\{\begin{array}{l}\text{index-name-2}\\ \text{literal-3}\end{array} \left[\left\{\pm\right\}\text{ literal-4}\right]\right\} \left[\text{, } \left\{\begin{array}{l}\text{index-name-3}\\ \text{literal-5}\end{array} \left[\left\{\pm\right\}\text{ literal-6}\right]\right\}\right] \ldots\right]\right)$$

Identifier

An identifier is a term used to reflect that a data-name, if not unique in a program, must be followed by a syntactically correct combination of qualifiers, subscripts or indices necessary to ensure uniqueness.

The general formats for identifiers are:

Format 1:

$$\text{data-name-1}\left[\left\{\begin{array}{l}\underline{\text{OF}}\\ \underline{\text{IN}}\end{array}\right\}\text{ data-name-2}\right] \ldots \left[(\text{subscript-1}[\text{,subscript-2}[\text{,subscript-3}]])\right]$$

Format 2:

$$\text{data-name-1}\left[\left\{\begin{array}{l}\underline{\text{OF}}\\ \underline{\text{IN}}\end{array}\right\}\text{data-name-2}\right] \ldots \left[\left(\left\{\begin{array}{l}\text{index-name-1}\\ \text{literal-1}\end{array} \left[\left\{\pm\right\}\text{ literal-2}\right]\right\}\right.\right.$$

$$\left.\left.\left[\text{, } \left\{\begin{array}{l}\text{index-name-2}\\ \text{literal-3}\end{array} \left[\left\{\pm\right\}\text{ literal-4}\right]\right\} \left[\text{, } \left\{\begin{array}{l}\text{index-name-3}\\ \text{literal-5}\end{array} \left[\left\{\pm\right\}\text{literal-6}\right]\right\}\right]\right]\right)\right]$$

Restrictions on subscripting and indexing are:

1. A data-name must not itself be subscripted nor indexed when that data-name is being used as an index, or subscript.

2. Indexing is not permitted where subscripting is not permitted.

3. An index may be modified only by the SET, SEARCH, and PERFORM statements. Data items described by the USAGE IS INDEX clause permit storage of the values associated with index-names as data in a form specified by the implementor. Such data items are called index data items.

4. Literal-1, literal-3, literal-5, in the above format must be positive numeric integers. Literal-2, literal-4, literal-6 must be unsigned numeric integers.

(Addendum 1)

Condition-Name

Each condition-name must be unique, or be made unique through qualification and/or indexing, or subscripting. If qualification is used to make a condition-name unique, the associated conditional variable may be used as the first qualifier. If qualification is used, the hierarchy of names associated with the conditional variable or the conditional variable itself must be used to make the condition-name unique.

If references to a conditional variable require indexing or subscripting, then references to any of its condition-names also require the same combination of indexing or subscripting.

The format and restrictions on the combined use of qualification, subscripting, and indexing of condition-names is exactly that of 'identifier' except that data-name-1 is replaced by condition-name-1.

In the general formats, 'condition-name' refers to a condition-name qualified, indexed or subscripted, as necessary.

EXPLICIT AND IMPLICIT SPECIFICATIONS

There are three types of explicit and implicit specifications that occur in COBOL source programs:

1. Explicit and implicit Procedure Division references

2. Explicit and implicit transfers of control

3. Explicit and implicit attributes.

Explicit and Implicit Procedure Division References

A COBOL source program can reference data items either explicitly or implicitly in Procedure Division statements. An explicit reference occurs when the name of the referenced item is written in a Procedure Division statement or when the name of the referenced item is copied into the Procedure Division by the processing of a COPY statement. An implicit reference occurs when the item is referenced by a Procedure Division statement without the name of the referenced item being written in the source statement. An implicit reference also occurs, during the execution of a PERFORM statement, when the index or data item referenced by the index-name or identifier specified in the VARYING, AFTER or UNTIL phrase is initialized, modified, or evaluated by the control mechanism associated with that PERFORM statement. Such an implicit reference occurs if and only if the data item contributes to the execution of the statement.

Explicit and Implicit Transfers of Control

The mechanism that controls program flow transfers control from statement to statement in the sequence in which they were written in the source program unless an explicit transfer of control overrides this sequence or there is no next executable statement to which control can be passed. The transfer of control from statement to statement occurs without the writing of an explicit Procedure Division statement, and therefore, is an implicit transfer of control.

COBOL provides both explicit and implicit means of altering the implicit control transfer mechanism.

In addition to the implicit transfer of control between consecutive statements, implicit transfer of control also occurs when the normal flow is altered without the execution of a procedure branching statement. COBOL provides the following types of implicit control flow alterations which override the statement-to-statement transfers of control:

1. If a paragraph is being executed under control of another COBOL statement (for example, PERFORM, USE, SORT and MERGE) and the paragraph is the last paragraph in the range of the controlling statement, then an implied transfer of control occurs from the last statement in the paragraph to the control mechanism of the last executed controlling statement. Further, if a paragraph is being executed under the control of a PERFORM statement which causes iterative execution and that paragraph is the first paragraph in the range of that PERFORM statement, an implicit transfer of control occurs between the control mechanism associated with that PERFORM statement and the first statement in that paragraph for each iterative execution of the paragraph.

2. When a SORT or MERGE statement is executed, an implicit transfer of control occurs to any associated input or output procedures.

3. When any COBOL statement is executed which results in the execution of a declarative section, an implicit transfer of control to the declarative section occurs. Note that another implicit transfer of control occurs after execution of the declarative section, as described in (1) above.

4. In any file operation (including OPEN and CLOSE), if a file does not have a FILE STATUS data item declared for it and the file is not explicitly covered by a USE statement then it is covered by an implicit USE statement. The implied USE procedure is equivalent to:-

```
        USE AFTER ERROR PROCEDURE ON file-name.
        IF status-key-1 = 9
                DISPLAY error-message UPON CONSOLE
                STOP RUN.
```

   where error-message is defined in the LEVEL II COBOL Operating Guide.

An explicit transfer of control consists of an alteration of the implicit control transfer mechanism by the execution of a procedure branching or conditional statement. (See STATEMENTS AND SENTENCES later in this Chapter.) An explicit transfer of control can be caused only by the execution of a procedure branching or conditional statement. The execution of the procedure branching statement ALTER does not in itself constitute an explicit transfer of control, but affects the explicit transfer of control that occurs when the associated GO TO statement is executed. The procedure branching statement EXIT PROGRAM causes an explicit transfer of control when the statement is executed in a called program.

In this document, the term 'next executable statement' is used to refer to the next COBOL statement to which control is transferred according to the rules above and the rules associated with each language element in the Procedure Division.

There is no next executable statement following:

1. The last statement in a declarative section when the paragraph in which it appears is not being executed under the control of some other COBOL statement.

2. The last statement in a program when the paragraph in which it appears is not being executed under the control of some other COBOL statement.

Explicit and Implicit Attributes

Attributes may be implicitly or explicity specified. Any attribute which has been explicitly specified is called an explicit attribute. If an attribute has not been specified explicitly, then the attribute takes on the default specification. Such an attribute is known as an implicit attribute.

For example, the usage of a data item need not be specified, in which case a data item's usage is DISPLAY.

PROGRAM STRUCTURE

A L/II COBOL program consists of four divisions:

1. IDENTIFICATION DIVISION - An identification of the program.

2. ENVIRONMENT DIVISION - A description of the equipment to be used to compile and run the program.

3. DATA DIVISION - A description of the data to be processed.

4. PROCEDURE DIVISION - A set of procedures to specify the operations to be performed on the data.

Each division is divided into sections which are further divided into paragraphs, which in turn are made up of sentences.

THE "ANSI SWITCH" COMPILER DIRECTIVE

Some of the 'red-tape' statements required by a strict ANSI interpretation are optional under L/II COBOL. It is possible to force the compiler to insist on a strict ANSI interpretation by using the "FLAG" directive. In the remainder of this Chapter these statements are marked { }. Elsewhere in this manual a reference is made to the ANSI switch when this applies.

If the operator enters the FLAG directive at compile time all L/II COBOL extensions are flagged on the compiler listing together with ANSI COBOL requirements depending on their level as specified by the Federal Compiler Testing Center under the direction of the General Services Administration (GSA). See the description of the Compiler FLAG directive in the L/II COBOL Operating Guide.

IDENTIFICATION DIVISION

GENERAL DESCRIPTION

The Identification Division must be included in every ANSI COBOL source program. This division identifies both the source program and the resultant output listing. In addition, the user may include the date the program is written, the date the compilation of the source program is accomplished and such other information as desired under the paragraphs in the general format shown below.

ORGANIZATION

Paragraph headers identify the type of information contained in the paragraph. The name of the program must be given in the first paragraph, which is the PROGRAM-ID paragraph. The other paragraphs are optional and may be included in this division at the user's choice, in order of presentation shown by the format below.

STRUCTURE

The following is the general format of the paragraphs in the Identification Division and it defines the order of presentation in the source program.

General Format

```
{IDENTIFICATION DIVISION.}

{PROGRAM-ID.   program-name.}

[AUTHOR.  [comment-entry]   ...]

[INSTALLATION.    [comment-entry]     ...]

[DATE-WRITTEN.    [comment-entry]     ...]

[DATE-COMPILED.   [comment-entry]     ...]

[SECURITY.     [comment-entry]     ...]
```

ENVIRONMENT DIVISION

GENERAL DESCRIPTION

The Environment Division specifies a standard method of expressing those aspects of a data processing problem that are dependent upon the physical characteristics of a specific computer. This division allows specification of the configuration of the compiling computer and the object computer. In addition, information relating to input-output control, special hardware characteristics and control techniques can be given.

The Environment Division must be included in every COBOL source program.

ORGANIZATION

Two sections make up the Environment Division: the Configuration Section and the Input-Output Section.

The Configuration Section deals with the characteristics of the source computer and the object computer. This section is divided into three paragraphs: the SOURCE-COMPUTER paragraph, which describes the computer configuration on which the source program is compiled; the OBJECT-COMPUTER paragraph, which describes the computer configuration on which the object program produced by the compiler is to be run; and the SPECIAL-NAMES paragraph, which relates the implemention-names used by the compiler to the mnemonic-names used in the source program.

The Input-Output Section deals with the information needed to control transmission and handling of data between external media and the object program. This section is divided into two paragraphs: the FILE-CONTROL paragraph which names and associates the files with external media; and the I-O-CONTROL paragraph which defines special control techniques to be used in the object program.

STRUCTURE

The following is the general format of the sections and paragraphs in the Environment Division, and defines the order of presentation in the source program.

General Format

```
     { ENVIRONMENT DIVISION. }
     { CONFIGURATION SECTION. }
     { SOURCE-COMPUTER.  source-computer-entry }
     { OBJECT-COMPUTER.  object-computer-entry }
     [ SPECIAL-NAMES.  special-names-entry ]
   [ { INPUT-OUTPUT SECTION. }
       { FILE-CONTROL. }   file-control-entry    ...
     [ I-O-CONTROL.  input-output-control-entry ] ]
```

DATA DIVISION

OVERALL APPROACH

The Data Division describes the data that the object program is to accept as input, to manipulate, to create, or to produce as output. Data to be processed falls into three categories:

1. That which is contained in files and enters or leaves the internal memory of the computer from a specified area or areas.

2. That which is developed internally and placed into intermediate or working storage, or placed into specific format for output reporting purposes.

3. Constants which are defined by the user.

PHYSICAL AND LOGICAL ASPECTS OF DATA DESCRIPTION

Data Division Organization

The DATA DIVISION which is one of the required divisions in a program, is subdivided into sections. These are the File, Working-Storage, Linkage and Communication sections.

The FILE SECTION defines the structure of data files. Each file is defined by a file description entry and one or more record descriptions. Record descriptions are written immediately following the file description entry. The WORKING-STORAGE SECTION describes records and noncontiguous data items which are not part of external data files but are developed and processed internally. It also describes data items whose values are assigned in the source program and do not change during the execution of the object program. The LINKAGE SECTION appears in the called program and describes data items that are to be referred to by the calling program and the called program. Its structure is the same as the WORKING-STORAGE SECTION. The communication section describes the data item in the source program that will serve as the interface between the MCS and the program.

General Format

The following gives the general format of the sections in the Data Division, and defines the order of their presentation in the source program.

```
    { DATA DIVISION. }

  [   FILE SECTION.                                                        ]
  [                                                                        ]
  [ [ file-description-entry      [record-description-entry]     ...    ] ...]
  [ [ Sort-merge-file-description-entry{record-description-entry } ... ]    ]

  [   WORKING-STORAGE SECTION.                                             ]
  [                                                                        ]
  [ [ 77-level-description-entry ]                                         ]
  [ [ record-description-entry   ]   ...                                   ]

  [   LINKAGE SECTION.                                                     ]
  [                                                                        ]
  [ [ 77-level-description-entry ]                                         ]
  [ [ record-description-entry   ]   ...                                   ]

  [   COMMUNICATION SECTION.                                               ]
  [                                                                        ]
  [ [communication-description-entry  [record-description-entry]...] ...   ]
```

PROCEDURE DIVISION

GENERAL DESCRIPTION

The Procedure Division must be included in every COBOL source program. This division may contain declarative procedures.

Declaratives

Declarative sections must be grouped at the beginning of the Procedure Division preceded by the key word DECLARATIVES and followed by the key words END DECLARATIVES. (See descriptions of the USE statement in Chapters 5, 6 and 7 and the Debug Chapter 11).

Procedures

A procedure is composed of a paragraph, or group of successive paragraphs (the first paragraph name is optional), or a section, or a group of successive sections within the Procedure Division. If one paragraph is in a section, then all paragraphs must be in sections. A procedure-name is a word used to refer to a paragraph or section in the source program in which it occurs. It consists of a paragraph-name (which may be qualified), or a section-name.

The end of the Procedure Division and the physical end of the program is that physical position in a COBOL source program after which no further procedures appear.

A section consists of a section header followed by zero, one, or more successive paragraphs. A section ends immediately before the next section or at the end of the Procedure Division or, in the declaratives portion of the Procedure Division, at the key words END DECLARATIVES.

A paragraph consists of a paragraph-name followed by a period and a space and by zero, one, or more successive sentences. A paragraph ends immediately before the next paragraph-name or section-name or at the end of the Procedure Division or, in the declaratives portion of the Procedure Division, at the key words END DECLARATIVES.

A sentence consists of one or more statements and is terminated by a period followed by a space.

A statement is a syntactically valid combination of words and symbols beginning with a COBOL verb.

The term 'identifier' is defined as the word or words necessary to make unique reference to a data item.

Execution

Execution begins with the first statement of the Procedure Division, excluding declaratives. Statements are then executed in the order in which they are presented for compilation, except where the rules indicate some other order.

General Format

Procedure Division Header

The Procedure Division is identified by and must begin with the following header:

```
PROCEDURE DIVISION   [USING data-name-1   [, data-name-2]   ...    ].
```

Procedure Division Body

The body of the Procedure Division must conform to one of the following formats:

Format 1:

```
[ DECLARATIVES.

{ section-name SECTION  [segment-number].   declarative-sentence

  [paragraph-name.   [sentence]   ...]    ... } ...

  END DECLARATIVES. ]

{ section-name SECTION   [segment-number] .

  [sentence] ...

  [paragraph-name.   [sentence]   ...]    ... } ...
```

Format 2:

```
{paragraph-name.} [sentence] ... [ {paragraph-name. [sentence]...}... ]
```

STATEMENTS AND SENTENCES

There are three types of statements:

1. Conditional statements,
2. Compiler directing statements,
3. Imperative statements.

(Addendum 1)

There are three types of sentences:

1. Conditional sentences,
2. Compiler directing sentences,
3. Imperative sentences.

Conditional Statement

A conditional statement specifies that the truth value of a condition is to be determined and that the subsequent action of the object program is dependent on this truth value.

A conditional statement is one of the following:

* An IF, SEARCH or RETURN statement.

* A READ statement that specifies the AT END or INVALID KEY phrase.

* A WRITE statement that specifies the INVALID KEY or END-OF-PAGE phrase.

* A START, REWRITE or DELETE statement that specifies the INVALID KEY phrase.

* An arithmetic statement (ADD, COMPUTE, DIVIDE, MULTIPLY, SUBTRACT) that specifies the SIZE ERROR phrase.

* A RECEIVE statement that specifies a NO DATA phrase.

* A STRING, UNSTRING or CALL statement that specifies the ON OVERFLOW phrase.

Conditional Sentence

A conditional sentence is a conditional statement, optionally preceded by an imperative statement, terminated by a period followed by a space.

Compiler Directing Statement

A compiler directing statement consists of a compiler directing verb and its operands. The compiler directing verbs are COPY, ENTER and USE (see THE COPY STATEMENT in Chapter 10, THE ENTER STATEMENT in Chapter 3, and THE USE STATEMENT in Chapters 5, 6 and 7). A compiler directing statement causes the compiler to take a specified action during compilation.

Compiler Directing Sentence

A compiler directing sentence is a single compiler directing statement terminated by a period followed by a space.

Imperative Statement

An imperative statement indicates a specific unconditional action to be taken by the object program. An imperative statement is any statement that is neither a conditional statement, nor a compiler directing statement. An imperative statement may consist of a sequence of imperative statements, each possibly separated from the next by a separator.

The imperative verbs are:

ACCEPT	ENABLE	RELEASE
ADD[1]	EXIT	REWRITE[2]
ALTER	GO	SEND
CALL[3]	INSPECT	SET
CANCEL	MERGE	SORT
CLOSE	MOVE	START[2]
COMPUTE[1]	MULTIPLY[1]	STOP
DELETE[2]	OPEN	STRING[3]
DISABLE	PERFORM	SUBTRACT[1]
DISPLAY	READ[5]	UNSTRING[3]
DIVIDE[1]	RECEIVE[4]	WRITE[6]

1 - Without the optional SIZE ERROR phrase.
2 - Without the optional INVALID KEY phrase.
3 - Without the optional ON OVERFLOW phrase.
4 - Without the optional NO DATA phrase.
5 - Without the optional AT END phrase or INVALID KEY phrase.
6 - Without the optional INVALID KEY phrase or END-OF-PAGE phrase.

When 'imperative-statement' appears in the general format of statements, 'imperative-statement' refers to that sequence of consecutive imperative statements that must be ended by a period or an ELSE phrase associated with a previous IF statement.

Imperative Sentence

An imperative sentence is an imperative statement terminated by a period followed by a space.

Categories of Statements

Category	Verbs
Arithmetic	ADD COMPUTE DIVIDE INSPECT (TALLYING) MULTIPLY SUBTRACT
Compiler Directing	COPY ENTER USE
Conditional	ADD (SIZE ERROR) CALL (OVERFLOW) COMPUTE (SIZE ERROR) DELETE (INVALID KEY) DIVIDE (SIZE ERROR) IF MULTIPLY (SIZE ERROR) READ (END or INVALID KEY) RECEIVE (NO DATA) RETURN (END) REWRITE (INVALID KEY) SEARCH START (INVALID KEY) STRING (OVERFLOW) SUBTRACT (SIZE ERROR) UNSTRING (OVERFLOW) WRITE (INVALID KEY or END-OF-PAGE)
Data Movement	ACCEPT (DATE, DAY or TIME) ACCEPT MESSAGE COUNT INSPECT (REPLACING) MOVE STRING UNSTRING
Ending	STOP

Category	Verbs
Input-Output	ACCEPT (identifier) CLOSE DELETE DISABLE DISPLAY ENABLE OPEN READ RECEIVE REWRITE SEND START STOP (literal) WRITE
Inter-Program Communicating	CALL CANCEL
Ordering	MERGE RELEASE RETURN SORT
Procedure Branching	ALTER CALL EXIT GO TO PERFORM
Table Handling	SEARCH SET

IF is a verb in the COBOL sense; it is recognised that it is not a verb in English.

REFERENCE FORMAT

GENERAL DESCRIPTION

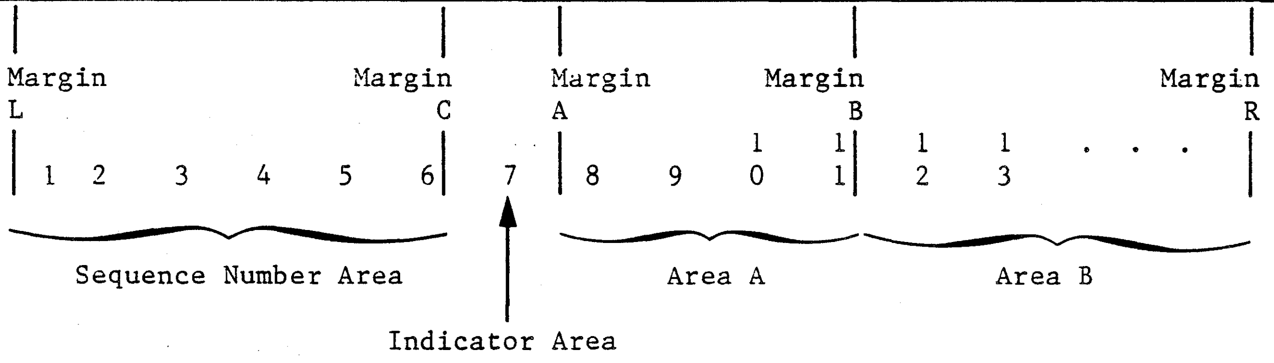
The reference format, which provides a standard method for describing COBOL source programs, is described in terms of character positions in a line on an input-output medium. The L/II COBOL compiler accepts source programs written in reference format and produces an output listing of the source program input in reference format. (See the L/II COBOL Operating Guide for a sample source program.)

The rules for spacing given in the discussion of the reference format take precedence over all other rules for spacing.

The divisions of a source program must be ordered as follows: the Identification Division, then the Environment Division, then the Data Division, then the Procedure Division. Each division must be written according to the rules for the reference format.

REFERENCE FORMAT REPRESENTATION

The reference format for a line is represented as in Figure 2-1.



Margin L is immediately to the left of the leftmost character position of a line.

Margin C is between the 6th and 7th character positions of a line.

Margin A is between the 7th and 8th character positions of a line.

Margin B is between the 11th and 12th character positions of a line.

Margin R is immediately to the right of the rightmost character position of a line.

Figure 2-1. Reference Format for a COBOL Source Line.

The sequence number area occupies six character positions (1-6), and is between Margin L and Margin C.

The indicator area is the 7th character position of a line.

Area A occupies character positions 8, 9, 10 and 11, and is between margin A and margin B.

Area B occupies character positions 12 through 72 inclusive; it begins immediately to the right of Margin B and terminates immediately to the left of Margin R.

Sequence Numbers

A sequence number, consisting of six digits in the sequence area, may be used to label a source program line.

Continuation of Lines

Whenever a sentence, entry, phrase, or clause requires more than one line, it may be continued by starting subsequent line(s) in area B. These subsequent lines are called the continuation line(s). The line being continued is called the continued line. Any word or literal may be broken in such a way that part of it appears on a continuation line.

A hyphen in the indicator area of a line indicates that the first nonblank character in area B of the current line is the successor of the last nonblank character of the preceding line without any intervening space. However, if the continued line contains a nonnumeric literal without closing quotation mark, the first nonblank character in area B on the continuation line must be a quotation mark, and the continuation starts with the character immediately after that quotation mark. All spaces at the end of the continued line are considered part of the literal. Area A of a continuation line must be blank.

If there is no hyphen in the indicator area of a line, it is assumed that the last character in the preceding line is followed by a space.

Blank Lines

A blank line is one that is blank from margin C to margin R, inclusive. A blank line can appear anywhere in the source program, except immediately preceding a continuation line. (See Figure 2-1).

Pseudo-Text

The character-strings and separators comprising pseudo-text may start in either area A or area B. If, however, there is a hyphen in the indicator area of a line which follows the opening pseudo-text delimiter, area A of the line must be blank; and the normal rules for continuation of lines apply to the formation of text words. (See Chapter 10, LIBRARY.)

DIVISION, SECTION, PARAGRAPH FORMATS

Division Header

The division header must start in area A. (See Figure 2-1).

Section Header

The section header must start in area A. (See Figure 2-1).

A section consists of paragraphs in the Environment and Procedure Divisions and Data Division entries in the Data Division.

Paragraph Header, Paragraph-Name and Paragraph

A paragraph consists of a paragraph-name followed by a period and a space and by zero, one or more sentences, or a paragraph header followed by one or more entries. Comment entries may be included within a paragraph. The paragraph header or paragraph-name starts in area A of any line following the first line of a division or a section.

The first sentence or entry in a paragraph begins either on the same line as the paragraph header or paragraph-name or in area B of the next nonblank line that is not a comment line. Successive sentences or entries either begin in area B of the same line as the preceding sentence or entry or in area B of the next nonblank line that is not a comment line.

Note that in LEVEL II COBOL program sentences may begin anywhere in Area A or Area B.

When the sentences or entries of a paragraph require more than one line they may be continued as described in CONTINUATION OF LINES in this Chapter.

DATA DIVISION ENTRIES

Each Data Division entry begins with a level indicator or a level-number, followed by a space, followed by its associated name (except in the Report Section), followed by a sequence of independent descriptive clauses. Each clause, except the last clause of an entry, may be terminated by either the separator semicolon or the separator comma. The last clause is always terminated by a period followed by a space.

There are two types of Data Division entries: those which begin with a level indicator and those which begin with a level-number.

A level indicator is any of the following: FD (see THE FILE DESCRIPTION -COMPLETE ENTRY SKELETON in Chapters 5, 6 and 7), SD (see the SORT MERGE FILE DESCRIPTION - COMPLETE ENTRY SKELETON in Chapter 8), (see the COMMUNICATION DESCRIPTION - COMPLETE ENTRY SKELETON in Chapter 13).

In those Data Division entries that begin with a level indicator, the level indicator begins in area A followed by a space and followed in area B with its associated name and appropriate descriptive information.

Those Data Division entries that begin with level-numbers are called data description entries.

A level-number has a value taken from the set of values 1 through 49, 66, 77 and 88. Level-numbers in the range 1 through 9 may be written either as a single digit or as a zero followed by a significant digit. At least one space must separate a level-number from the word following the level-number.

In those data description entries that begin with level-number 01 or 66, 77 and 88, the level-number begins in area A followed by a space and followed in area B by its associated record-name or item-name and appropriate descriptive information.

Successive data description entries may have the same format as the first or may be indented according to level-number. The entries in the output listing need be indented only if the input is indented. Indentation does not affect the magnitude of a level-number.

When level-numbers are to be indented, each new level-number may begin any number of spaces to the right of margin A. The extent of indentation to the right is determined only by the width of the physical medium.

DECLARATIVES

The key word DECLARATIVES and the key words END DECLARATIVES that precede and follow, respectively, the declaratives portion of the Procedure Division must each appear on a line by themselves. Each must begin in area A and be followed by a period and a space (see Figure 2-1).

COMMENT LINES

A comment line is any line with an asterisk in the continuation indicator area of the line. A comment line can appear as any line in a source program after the Identification Division header. Any combination of characters from the computer's character set may be included in area A and area B of that line (see Figure 2-1). The asterisk and the characters in area A and area B will be produced on the listing but serve as documentation only. A special form of comment line represented by a stroke in the indicator area of the line causes page ejection prior to printing the comment.

Successive comment lines are allowed. Continuation of comment lines is permitted, except that each continuation line must contain an '*' in the indicator area.

RESERVED WORDS

A full list of reserved words is given in Appendix A.

CHAPTER 3

THE NUCLEUS

FUNCTION OF THE NUCLEUS

The Nucleus provides a basic language capability for the internal processing of data within the basic structure of the four divisions of a program.

OVERALL LANGUAGE

NAME CHARACTERISTICS

L/II COBOL data-names need not begin with an alphabetic character; the alphabetic characters may be positioned anywhere within the data-name. Qualification is permitted and all data-names, condition-names, paragraph-names, and text-names need not be unique.

FIGURATIVE CONSTANTS

All the following figurative constants may be used: ZERO, ZEROS, ZEROES, SPACE, SPACES HIGH-VALUE, HIGH-VALUES, LOW-VALUE, LOW-VALUES, QUOTE, QUOTES, and ALL literal.

REFERENCE FORMAT

A word or numeric literal can be broken in such a way that part of it appears on a continuation line.

IDENTIFICATION DIVISION IN THE NUCLEUS

GENERAL DESCRIPTION

The Identification Division must be included in every COBOL source program. This division identifies the source program and the resultant output listing. In addition, the user may include the date the program is written and such other information as desired under the paragraphs in the general format shown below.

ORGANIZATION

Paragraph headers identify the type of information contained in the paragraph. The name of the program must be given in the first paragraph, which is the PROGRAM-ID paragraph. The other paragraphs are optional and may be included in this division at the user's choice, in the order of presentation shown by the general format below.

Structure

The general format of the paragraphs in the Identification Division is given below. Paragraphs can be in any order.

General Format

```
{ IDENTIFICATION DIVISION }

{ PROGRAM-ID.  program-name. }

[ AUTHOR.   [comment-entry]        ...]

[ INSTALLATION.   [comment-entry]   ... ]

[ DATE-WRITTEN.   [comment-entry]   ...]

[ DATE-COMPILED.   [comment-entry]   ...]

[ SECURITY.   [comment-entry]   ... ]
```

Syntax Rules

1. The Identification Division must begin with the reserved words IDENTIFICATION DIVISION followed by a period and a space.

2. The comment-entry may be any combination of the characters from the computer's character set and may be written in Area B on one or more lines. The continuation of the comment-entry by the use of the hyphen in the indicator area is not permitted.

THE PROGRAM-ID PARAGRAPH

Function

The PROGRAM-ID paragraph gives the name by which a program is identified.

General Format

PROGRAM-ID. program-name.

Syntax Rules

1. The program-name must conform to the rules for formation of a user-defined word.

General Rules

1. The PROGRAM-ID paragraph must contain the name of the program and must be present in every program that is compiled with the ANSI switch directive set. If this directive is not set, the paragraph is optional.

2. The program-name identifies the source program and all listings pertaining to a particular program.

THE DATE-COMPILED PARAGRAPH

Function

The DATE-COMPILED paragraph provides the compilation date in the Identification Division source program listing.

General Format

DATE-COMPILED. comment-entry ...

Syntax Rule

The comment-entry may be any combination of the characters from the computer's character set. The continuation of the comment entry by use of the hyphen is not permitted; however, the comment entry may be contained on one or more lines.

General Rule

The paragraph-name DATE-COMPILED causes a date comment entry string to be inserted during program compilation (null comment entries are permitted). If a DATE compiler directive is present, the DATE-COMPILED comment-entry is replaced in its entirety by the date string specified in the command line.

See the L/II COBOL Operating Guide for details of the derivation of the comment-entry replacement string for your COBOL implementation at compile-time.

ENVIRONMENT DIVISION IN THE NUCLEUS

CONFIGURATION SECTION

The SOURCE-COMPUTER Paragraph

Function

The SOURCE-COMPUTER paragraph identifies the computer upon which the program is to be compiled.

General Format

$$\underline{\text{SOURCE-COMPUTER}}.\quad \text{computer-name.}$$

Syntax Rule

Computer-name must be one COBOL word defined by the user.

General Rules

The computer-name provides a means for identifying equipment configuration, in which case the computer-name and its implied configuration are specified by the user. The SOURCE-COMPUTER paragraph is used for documentary purposes only.

The OBJECT-COMPUTER Paragraph

Function

The OBJECT-COMPUTER Paragraph identifies the computer on which the program is to be executed.

General Format

$$\underline{\text{OBJECT-COMPUTER}}.\quad \text{computer-name}\left[,\ \underline{\text{MEMORY}}\ \text{SIZE integer}\ \left\{\begin{array}{l}\underline{\text{WORDS}}\\ \underline{\text{CHARACTERS}}\\ \underline{\text{MODULES}}\end{array}\right\}\right]$$

$$[\text{,PROGRAM COLLATING } \underline{\text{SEQUENCE}} \text{ IS alphabet-name}].$$

Syntax Rule

1. Computer-name must be one COBOL word defined by the user.

General Rules

1. The computer-name provides a means for identifying equipment configuration, in which case the computer-name and its implied

configurations are specified by the user. The configuration definition contains specific information concerning the memory size. The computer-name and the MEMORY SIZE clause are used for documentary purposes only.

2. If the PROGRAM COLLATING SEQUENCE Clause is specified, the collating sequence associated with alphabet-name is used to determine the truth value of any nonnumeric comparisons:

   a. Explicitly specified in relation conditions (see Relation Condition later in this Chapter).

   b. Explicitly specified in condition-name conditions; see Condition Name Condition (Conditional Variable).

3. If the PROGRAM COLLATING SEQUENCE Clause is not specified, the native collating sequence is used. Appendix B lists the full ASCII collating sequence (native) and those characters used in COBOL.

4. If the PROGRAM COLLATING SEQUENCE Clause is specified, the program collating sequence is the collating sequence associated with the alphabet-name specified in that Clause.

5. The PROGRAM COLLATING SEQUENCE Clause is also applied to any nonnumeric merge or sort keys unless the COLLATING SEQUENCE phrase of the respective SORT or MERGE statement is specified.

6. The PROGRAM COLLATING SEQUENCE clause applies only to the program in which it is specified.

The SPECIAL-NAMES Paragraph

Function

The SPECIAL-NAMES paragraph provides a means of relating implementor-names to user-specified mnemonic-names and of relating alphabet-names to character sets and/or collating sequences.

General Format

```
     SPECIAL-NAMES.

     [function-name-1 IS mnemonic-name-1]
          [function-name-2 IS mnemonic-name-2] ...

               ( 0 )
     SWITCH    { . }  [IS  mnemonic-name]
               { : }
               ( 7 )  { ,ON STATUS IS condition-name-1  [,OFF STATUS IS condition-name-2] }
                      { ,OFF STATUS IS condition-name-2 [,ON STATUS IS condition-name-1]  }

   [ , { SYSIN  } IS mnemonic-name-1 ]
   [   { SYSOUT }                    ]

   [, TAB IS mnemonic-name-2]

    [ , alphabet-name IS ( STANDARD-1                                              ) ]
    [                    ( NATIVE            ...                                   ) ]
    [                    (               { THROUGH }  literal-2                    ) ]
    [                    ( literal-1     { THRU    }                               ) ]
    [                    (           ALSO literal-3 [, ALSO literal-4] ...         ) ]
    [                    ( [            [ { THROUGH }  literal-6           ] ]...  ) ]
    [                    ( [ literal-5  [ { THRU    }                      ] ]     ) ]
    [                    ( [            [ALSO literal-7 [, ALSO literal-8] ...] ]  ) ]

       [, CURRENCY SIGN IS literal-9]

       [, DECIMAL-POINT IS COMMA]

       [, CONSOLE IS CRT]

       [, CURSOR IS data-name-1]     .
```

Syntax Rules

1. Mnemonic-names can be any COBOL user-defined word and at least one constituent character must be alphabetic.

2. The literals specified in the literal phrase of the alphabet-name clause:

   a. If numeric, must be unsigned integers and must have a value within the range of one (1) through the maximum number of characters in the native character set.

   b. If nonnumeric and associated with a THROUGH or ALSO phrase, must each be one character in length.

3. If the literal phrase of the alphabet-name clause is specified a given character must not be specified more than once in an alphabet-name clause.

4. The words THRU and THROUGH are equivalent.

General Rules

1. Function-name-1 specifies system devices or functions used by the compiler. The programmer can associate any user-defined COBOL word with a function-name. Mnemonic-name-1, -2, etc can be used in the ACCEPT, DISPLAY or WRITE statements. Function-name-1, -2, etc. can be one of the following:

SYSIN	-	System logical input unit: the CRT keyboard
SYSOUT	-	System logical output unit: the CRT screen
FORMFEED	-	Usually skip to head of form (WRITE ADVANCING)
TAB	-	Skip to next vertical paper movement stop
COMMAND-LINE	-	Command line parameters available to the program

Note that the FORMFEED and TAB functions correspond to the ASCII characters 0C and 0B as sent to the printer. On most printers 0C moves the paper to the Top of Form position and the effect of 0B depends on the individual mode of the printer. Usually a specified number of lines are skipped.

2. The SWITCH clause must have at least one condition-name associated with it. The switch is set at run-time by the operator and the setting may be determined in the program by testing the condition-names. The setting of the switches cannot be changed during execution.

3. The alphabet-name clause provides a means for relating a name to a specified character code set and/or collating sequence. When alphabet-name is referenced in the PROGRAM COLLATING SEQUENCE clause (see <u>THE OBJECT-COMPUTER PARAGRAPH</u> in this Chapter) or the COLLATING SEQUENCE phrase of a SORT or MERGE statement (see THE SORT STATEMENT or THE MERGE STATEMENT in Chapter 8), the alphabet-name clause specifies a collating sequence. When alphabet-name is referenced in a CODE-SET clause in a file description entry (see The File Description - Complete Entry Skeleton in Chapter 5), the alphabet-name clause specifies a character code set.
   a. If the STANDARD-1 phrase is specified, the character code set or collating sequence identified is that defined in American Standard Code for Information Interchange, X3.4-1968. Appendix B defines the correspondence between the characters of the standard character set and the characters of the native character set.
   b. If the NATIVE phrase is specified, the native character code set or native collating sequence is used. The native collating sequence is as in ANSI publication X3.4-1968 (see Appendix B).

4. The character that has the highest ordinal position in the program collating sequence specified is associated with the figurative constant HIGH-VALUE. If more than one character has the highest position in the

program collating sequence, the last character specified is associated with the figurative constant HIGH-VALUE.

5. The character that has the lowest ordinal position in the program collating sequence specified is associated with the figurative constant LOW-VALUE. If more than one character has the lowest position in the program collating sequence, the first character specified is associated with the figurative constant LOW-VALUE.

6. The literal which appears in the CURRENCY SIGN IS literal clause is used in the PICTURE clause to represent the currency symbol. The literal is limited to a single character and must not be one of the following characters.

   * digits 0 thru 9;

   * alphabetic characters A, B, C, D, L, P, R, S, V, X, Z, or the space;

   * special characters '*', '+', '-', ',', '.', ';', '(', ')', '"', '/'or '='.

   If this clause is not present, only the currency sign is used in the PICTURE clause.

7. The clause DECIMAL-POINT IS COMMA means that the function of comma and period are exchanged in the character-string of the PICTURE clause and in numeric literals.

8. The clause CONSOLE IS changes the defaults in the ACCEPT and DISPLAY statements to the L/II COBOL interactive extension that enables data to be accepted or displayed at any specified point on the screen. See THE ACCEPT STATEMENT and the DISPLAY STATEMENT in this Chapter.

9. The clause CURSOR IS specifies the data-name to contain the CRT cursor address as used by the ACCEPT statement. If CURSOR IS is not specified the default cursor position on executing an ACCEPT statement is the 'Home' position at top left of the CRT screen. The CURSOR IS clause enables a program to retain the position at the end of execution of the last ACCEPT statement or to specify the initial position at the start of any ACCEPT statement. This is a useful facility when programming menu-type operator prompts. The operator need then only move the cursor to the selected option prompt and press RETURN or just press RETURN for the default option.

   Data-name contains the name of a PIC 9999 field in which the most significant 99 represents a line count in the range one to the maximum number of lines on the user screen, and the least significant 99 represents a character position in the range one to the maximum positions allowed by the width of the user screen. If data-name is zero, the effect is as if the CURSOR IS clause was not used, i.e., initial cursor position is top left of screen. (See also THE ACCEPT STATEMENT later in this Chapter).

DATA DIVISION IN THE NUCLEUS

WORKING STORAGE SECTION

The Working-Storage Section is composed of the section header, followed by data description entries for noncontiguous data items and/or record description entries. Each Working-Storage Section record name and noncontiguous item name must be unique since it cannot be qualified. Subordinate data-names need not be unique if they can be made unique by qualification.

Noncontiguous Working-Storage

Items and constants in Working-Storage which bear no hierarchical relationship to one another need not be grouped into records, provided they do not need to be further subdivided. Instead, they are classified and defined in a separate data description entry which begins with the special level-number, 77.

The following data clauses are required in each data descriptions entry:

- Level-number 77
- Data-name
- The PICTURE clause or the USAGE IS INDEX clause

Other data description clauses are optional and can be used to complete the description of the item if necessary.

Working-Storage Records

Data elements and constants in Working-Storage which bear a definite hierarchic relationship to one another must be grouped into records according to the rules for formation of record descriptions. All clauses which are used in record descriptions in the File Section can be used in record descriptions in the Working-Storage Section.

Initial Values

The initial value of any item in the Working-Storage Section except an index data item is specified by using the VALUE clause with the data item. The initial value of any index data item is unpredictable.

THE DATA DESCRIPTION - COMPLETE ENTRY SKELETON

Function

A data description entry specifies the characteristics of a particular item of data.

General Format

Format 1:

```
     level-number  {data-name-1}
                   {FILLER     }

          [; REDEFINES data-name-2]

          [; {PICTURE}     IS character-string]
          [  {PIC    }                        ]

          [                 {COMPUTATIONAL  } ]
          [                 {COMP           } ]
          [ ;   [USAGE IS]  {COMPUTATIONAL-3} ]
          [                 {COMP-3         } ]
          [                 {DISPLAY        } ]

          [;   [SIGN IS] {LEADING }   [SEPARATE CHARACTER]]
          [              {TRAILING}                       ]

          [; {SYNCHRONIZED} [LEFT ]]
          [  {SYNC        } [RIGHT]]

          [; {JUSTIFIED}     RIGHT]
          [  {JUST     }          ]

          [;   BLANK WHEN ZERO]

          [;   VALUE IS literal].
```

Format 2:

```
     66 data-name-1; RENAMES data-name-2[{THROUGH} data-name-3] .
                                        [{THRU   }            ]
```

Format 3:

```
     88 condition-name; {VALUE IS  } literal-1 [{THROUGH}  literal-2 ]
                        {VALUES ARE}           [{THRU   }            ]
        [,literal-3[{THROUGH}   literal-4]] ...   .
        [          [{THRU   }            ]]
```

Syntax Rules

1. The level-number in Format 1 may be any number from 01-49 or 77.

2. The clauses may be written in any order with two exceptions: the data-name-1 or FILLER clause must immediately follow the level-number; the REDEFINES clause, when used, must immediately follow the data-name-1 clause.

3. The PICTURE clause must be specified for every elementary item except an index data item, in which case use of this clause is prohibited.

4. The words THRU and THROUGH are equivalent.

General Rules

1. The clauses SYNCHRONIZED, PICTURE, JUSTIFIED, and BLANK WHEN ZERO, must not be specified except for an elementary data item.

2. Format 3 is used for each condition-name. Each condition-name requires a separate entry with level-number 88. Format 3 contains the name of the condition and the value, values, or range of values associated with the condition-name. The condition-name entries for a particular conditional variable must follow the entry describing the item with which the condition-name is associated. A condition-name can be associated with any data description entry which contains a level-number except the following:

   a. Another condition-name.

   b. A level 66 item.

   c. A group containing items with descriptions including JUSTIFIED, SYNCHRONIZED or USAGE (other than USAGE IS DISPLAY).

   d. An index data item (See The USAGE IS INDEX Clause in Chapter 4).

THE BLANK WHEN ZERO CLAUSE

Function

The BLANK WHEN ZERO clause permits the blanking of an item when its value is zero.

General Format

BLANK WHEN ZERO

Syntax Rule

The BLANK WHEN ZERO clause can be used only for an elementary item whose PICTURE is specified as numeric (with implicit or explicit USAGE IS DISPLAY) or numeric edited. (See THE PICTURE CLAUSE later in this Chapter).

General Rules

1. When the BLANK WHEN ZERO clause is used, the item will contain nothing but spaces if the value of the item is zero.

2. When the BLANK WHEN ZERO clause is used for an item whose PICTURE is numeric, the category of the item is considered to be numeric edited.

THE DATA-NAME OR FILLER CLAUSE

Function

A data-name specifies the name of the data being described. The word FILLER specifies an elementary item of the logical record that cannot be referred to explicitly.

General Format

$$\left\{\begin{array}{l}\text{data-name}\\ \underline{\text{FILLER}}\end{array}\right\}$$

Syntax Rule

In the File, Working-Storage, Communication and Linkage Sections, a data-name or the key word FILLER must be the first word following the level-number in each data description entry.

General Rule

The key word FILLER may be used to name an elementary item or group in a record. Under no circumstances can a FILLER item be referred to explicitly. However, the key word FILLER may be used as a conditional variable because such use does not require explicit reference to the FILLER item but to its value.

THE JUSTIFIED CLAUSE

Function

The JUSTIFIED clause specifies non-standard positioning of data within a receiving data item.

General Format

$$\left\{\begin{array}{l}\underline{\text{JUSTIFIED}}\\ \underline{\text{JUST}}\end{array}\right\} \text{ RIGHT}$$

Syntax Rules

1. The JUSTIFIED clause can be specified only at the elementary item level.

2. JUST is an abbreviation for JUSTIFIED.

3. The JUSTIFIED clause cannot be specified for any data item described as numeric or for which editing is specified.

General Rules

1. When a receiving data item is described with the JUSTIFIED clause and the sending data item is larger than the receiving data item, the leftmost characters are truncated. When the receiving data item is described with the JUSTIFIED clause and it is larger than the sending data item, the data is aligned at the rightmost character position in the data item with space fill for the leftmost character positions.

   Note that the contents of the sending data item are not taken into account, i.e. trailing spaces are not suppressed.

   For example

   If a data-item PIC X(4) whose value is A␣␣␣(i.e. A followed by three spaces) is moved into a data-item PIC X(6) JUSTIFIED the result will be␣␣A␣␣␣. If the same data item is moved to one with PIC X(3) JUSTIFIED the result will be ␣␣␣ i.e. the leftmost character is truncated.

2. When the JUSTIFIED clause is omitted, the standard rules for aligning data within an elementary item apply. (See <u>Standard Alignment Rules</u>.)

(Addendum 1)

LEVEL NUMBER

Function

The level-number shows the hierarchy of data within a logical record. In addition, it is used to identify entries for working storage items, linkage items, condition-names, and the RENAMES clause.

General Format

level-number

Syntax Rules

1. A level-number is required as the first element in each data description entry.

2. Data description entries subordinate to an FD, CD, or SD entry must have level-numbers with the values 01-49, 66 or 88. (See THE FILE DESCRIPTION in Chapter 5).

3. Data description entries in the Working-Storage Section and Linkage Section must have level-numbers with the values 01-49, 66, 77 or 88.

4. A level number may be a one or two digit number.

General Rules

1. The level-number 01 identifies the first entry in each record description.

2. Special level numbers have been assigned to certain entries where there is no real concept of level:

   a. The level-number 77 is assigned to identify noncontiguous working storage data items, noncontiguous linkage data items, and can be used only as described by Format 1 of the data description skeleton. (See THE DATA DESCRIPTION - COMPLETE ENTRY SKELETON in this Chapter).

   b. Level number 66 is assigned to identify RENAMES entries and can be used only as described in Format 2 of the data description skeleton earlier in this Chapter.

   c. Level number 88 is assigned to entries which define condition-names associated with a conditional variable and can be used only as described in Format 3 of the data description skeleton earlier in this Chapter.

3. Multiple level 01 entries subordinate to any given level indicator, represent implicit redefinitions of the same area.

THE PICTURE CLAUSE

Function

The PICTURE clause describes the general characteristics and editing requirements of an elementary item.

General Format

$\left\{ \begin{array}{l} \underline{\text{PICTURE}} \\ \underline{\text{PIC}} \end{array} \right\}$ IS character-string

Syntax Rules

1. A PICTURE clause can be specified only at the elementary item level.

2. A character-string consists of certain allowable combinations of characters in the COBOL character set used as symbols. The allowable combinations determine the category of the elementary item.

3. The maximum number of characters allowed in the character-string is 30.

4. The PICTURE clause must be specified for every elementary item except an index data item, in which case use of this clause is prohibited.

5. PIC is an abbreviation for PICTURE.

6. The asterisk when used as the zero suppression symbol and the clause BLANK WHEN ZERO may not appear in the same entry.

General Rules

There are five categories of data that can be described with a PICTURE clause: alphabetic, numeric, alphanumeric, alphanumeric edited, and numeric edited. General rules within these categories are given below:

Alphabetic Data Rules

1. Its PICTURE character-string can only contain the symbols 'A', 'B'; and

2. Its contents when represented in standard data format must be any combination of the twenty-six (26) letters of the Roman alphabet and the space from the COBOL character set. Its length must be between 1 and 8191 characters.

Numeric Data Rules

1. Its PICTURE character-string can only contain the symbols '9', 'P', 'S', and 'V'. The number of digit positions that can be described by the PICTURE character-string must range from 1 to 18 inclusive.

2. If unsigned, the data in standard data format must be a combination of the Arabic numerals '0', '1', '2', '3', '4', '5', '6', '7', '8', and '9'; if signed, the item may also contain a '+', '-', or other representation of an operational sign. (see THE SIGN CLAUSE later in this Chapter).

Alphanumeric Data Rules

1. Its PICTURE character-string is restricted to certain combinations of the symbols 'A', 'X', '9', and the item is treated as if the character-string contained all X's. A PICTURE character-string which contains all A's or all 9's does not define an alphanumeric item; and

2. Its contents when represented in standard data format can consist of any characters in the computer's character set. Its length must be between 1 and 8191 characters.

Alphanumeric Edited Data Rules

1. Its PICTURE character-string is restricted to certain combinations of the following symbols: 'A', 'X', '9', 'B', '0', and '/' as follows:

   a. The character-string must contain at least one 'B' and at least one 'X' or at least one '0' (zero) and at least one 'X' or at least one '/' (stroke) and at least one 'X'; or

   b. The character-string must contain at least one '0' (zero) and at least one 'A' or at least one '/' (stroke) and at least one 'A'; and

2. Its contents when represented in standard data format are allowable characters in the computer's set. Its length must be between 1 and 152 characters.

Numeric Edited Data Rules

1. Its PICTURE character-string is restricted to certain combinations of the symbols 'B', '/', 'P', 'V', 'Z', '0', '9', ',', '.', '*', '+', '-', 'CR', 'DB', and the currency symbol. The allowable combinations are determined from the order of precedence of symbols and the editing rules as follows:

   a. The number of digit positions that can be represented in the PICTURE character-string must range from 1 to 18 inclusive.

   b. The character-string must contain at least one '0', 'B', '/', 'Z', '*', '+', ',', '.', '-', 'CR', 'DB', or currency symbol.

2. The contents of the character positions of these symbols that are allowed to represent a digit in standard data format, must be one of the numerals.

Elementary Item Size

The size of an elementary item, where size means the number of character positions occupied by the elementary item in standard data format, is determined by the number of allowable symbols that represent character positions. An integer which is enclosed in parentheses following the symbols 'A', ',', 'X', '9', 'P', 'Z', '*', 'B', '/', '0', '+', '-', or the currency symbol indicates the number of consecutive occurrences of the symbol. Note that the following symbols may appear only once in a given PICTURE: 'S', 'V', '.', 'CR', and 'DB'.

Symbols Used

The functions of the symbols used to describe an elementary item are explained as follows:

A - Each 'A' in the character-string represents a character position which can contain only a letter of the alphabet or a space.

B - Each 'B' in the character-string represents a character position into which the space character will be inserted.

P - Each 'P' indicates an assumed decimal scaling position and is used to specify the location of an assumed decimal point when the point is not within the number that appears in the data item. The scaling position character 'P' is not counted in the size of the data item. Scaling position characters are counted in determining the maximum number of digit positions (18) in numeric edited items or numeric items. The scaling position character 'P' can appear only to the left or right as a continuous string of 'P's within a PICTURE description; since the scaling position character 'P' implies an assumed decimal point (to the left of 'P's if 'P's are leftmost PICTURE characters and to the right if 'P's are rightmost PICTURE characters), the assumed decimal point symbol 'V' is redundant as either the leftmost or rightmost character within such a PICTURE description. The character 'P' and the insertion character '.' (period) cannot both occur in the same PICTURE character-string. If, in any operation involving conversion of data from one form of internal representation to another, the data item being converted is described with the PICTURE character 'P', each digit position described by a 'P' is considered to contain the value zero, and the size of the data item is considered to include the digit positions so described.

S - The letter 'S' is used in a character-string to indicate the presence, but neither the representation nor, necessarily, the position of an operational sign; it must be written as the leftmost character in the PICTURE. The 'S' is not counted in determining the size (in terms of standard data format characters) of the elementary item unless the entry is subject to a SIGN clause which specifies the optional SEPARATE CHARACTER phrase. (See the SIGN Clause in this Chapter.)

V - The 'V' is used in a character-string to indicate the location of the assumed decimal point and may only appear once in a character-string. The 'V' does not represent a character position and therefore is not counted in the size of the elementary item. When the assumed decimal point is to the right of the rightmost symbol in the string the 'V' is redundant.

X - Each 'X' in the character-string is used to represent a character position which contains any allowable character from the computer's character set.

Z - Each 'Z' in a character-string may only be used to represent the leftmost numeric character positions which will be replaced by a space character when the contents of that character position is zero. Each 'Z' is counted in the size of the item.

9 - Each '9' in the character-string represents a character position which contains a numeral and is counted in the size of the item.

0 - Each '0' (zero) in the character-string represents a character position into which the numeral zero will be inserted. The '0' is counted in the size of the item.

/ - Each '/' (stroke) in the character-string represents a character position into which the stroke character will be inserted. The '/' is counted in the size of the item.

, - Each ',' (comma) in the character-string represents a character position into which the character ',' will be inserted. This character position is counted in the size of the item. The insertion character ',' must not be the last character in the PICTURE character-string.

. - When the character '.' (period) appears in the character-string it is an editing symbol which represents the decimal point for alignment purposes and in addition, represents a character position into which the character '.' will be inserted. The character '.' is counted in the size of the item. For a given program the functions of the period and comma are exchanged if the clause DECIMAL-POINT IS COMMA is stated in the SPECIAL-NAMES paragraph. In this exchange the rules for the period apply to the comma and the rules for the comma apply to the period wherever they appear in a PICTURE clause. The insertion character '.' must not be the last character in the PICTURE character-string.

+, -, CR, DB - These symbols are used as editing sign control symbols. When used, they represent the character position into which the editing sign control symbol will be placed. The symbols are mutually exclusive in any one character-string and each character used in the symbol is counted in determining the size of the data item.

* - Each '*' (asterisk) in the character-string represents a leading numeric character position into which an asterisk will be placed when the contents of that position is zero. Each '*' is counted in the size of the item.

cs - The currency symbol in the character-string represents a character position into which a currency symbol is to be placed. The currency symbol in a character-string is represented by either the currency sign or by the single character specified in the CURRENCY SIGN clause in the SPECIAL-NAMES paragraph. The currency symbol is counted in the size of the item.

Editing Rules

There are two general methods of performing editing in the PICTURE clause, either by insertion or by suppression and replacement. There are four types of insertion editing available. They are:

* Simple insertion
* Special insertion
* Fixed insertion
* Floating insertion

There are two types of suppression and replacement editing:

* Zero suppression and replacement with spaces
* Zero suppression and replacement with asterisks

The type of editing which may be performed upon an item is dependent upon the category to which the item belongs. Table 3-1 specifies which type of editing may be performed upon a given category.

Table 3-1. Editing Types for Data Categories

CATEGORY	TYPE OF EDITING
Alphabetic	Simple insertion 'B' only
Numeric	None
Alphanumeric	None
Alphanumeric Edited	Simple insertion '0', 'B' and '/'
Numeric Edited	All, but see NOTE below

NOTE:

Floating insertion editing and editing by zero suppression and replacement are mutually exclusive in a PICTURE clause. Only one type of replacement may be used with zero suppression in a PICTURE clause.

Simple Insertion Editing

Simple Insertion Editing. The ',' (comma), 'B' (space), '0' (zero), and '/' (stroke) are used as the insertion characters. The insertion characters are counted in the size of the item and represent the position in the item into which the character will be inserted.

Special Insertion Editing

Special Insertion Editing. The '.' (period) is used as the insertion character. In addition to being an insertion character it also represents the decimal point for alignment purposes. The insertion character used for the actual decimal point is counted in the size of the item. The use of the assumed decimal point, represented by the symbol 'V' and the actual decimal point, represented by the insertion character, in the same PICTURE character-string is disallowed. The result of special insertion editing is the appearance of the insertion character in the item in the same position as shown in the character-string.

Fixed Insertion Editing

Fixed Insertion Editing. The currency symbol and the editing sign control symbols, '+', '-', 'CR', 'DB', are the insertion characters. Only one currency symbol and only one of the editing sign control symbols can be used in a given PICTURE character-string. When the symbols 'CR' or 'DB' are used they represent two character positions in determining the size of the item and they must represent the rightmost character positions that are counted in the size of the item. The symbol '+' or '-', when used, must be either the leftmost or rightmost character position to be counted in the size of the item. The currency symbol must be the leftmost character

Table 3-2 Editing Symbols in PICTURE Character-Strings

EDITING SYMBOL IN PICTURE CHARACTER-STRING	RESULT	
	DATA ITEM POSITIVE OR ZERO	DATA ITEM NEGATIVE
+	+	-
-	space	-
CR	2 spaces	CR
DB	2 spaces	DB

Floating Insertion Editing

The currency symbol and editing sign control symbols '+' or '-' are the floating insertion characters and as such are mutually exclusive in a given PICTURE character-string.

Floating insertion editing is indicated in a PICTURE character-string by using a string of at least two of the floating insertion characters. This string of floating insertion characters may contain any of the fixed insertion symbols or have fixed insertion characters immediately to the right of this string. These simple insertion characters are part of the floating string.

The leftmost character of the floating insertion string represents the leftmost limit of the floating symbol in the data item. The rightmost character of the floating string represents the rightmost limit of the floating symbols in the data item.

The second floating character from the left represents the leftmost limit of the numeric data that can be stored in the data item. Non-zero numeric data may replace all the characters at or to the right of this limit.

In a PICTURE character-string, there are only two ways of representing floating insertion editing. One way is to represent any or all of the leading numeric character positions on the left of the decimal point by the insertion character. The other way is to represent all of the numeric character positions in the PICTURE character-string by the insertion character.

If the insertion characters are only to the left of the decimal point in the PICTURE character-string, the result is that a single floating insertion character will be placed into the character position immediately preceding either the decimal point or the first non-zero digit in the data represented by the insertion symbol string, whichever is farther to the left in the PICTURE character-string. The character positions preceding the insertion character are replaced with spaces.

If all numeric character positions in the PICTURE character-string are represented by the insertion character, the result depends upon the value of the data. If the value is zero the entire data item will contain spaces. If the value is not zero, the result is the same as when the insertion character is only to the left of the decimal point.

To avoid truncation, the minimum size of the PICTURE character-string for the receiving data item must be the number of characters in the sending data item, plus the number of non-floating insertion characters being edited into the receiving data item, plus one for the floating insertion character.

Zero Suppression Editing

The suppression of leading zeros in numeric character positions is indicated by the use of the alphabetic character 'Z' or the character '*' (asterisk) as suppression symbols in a PICTURE character-string. These symbols are mutually exclusive in a given PICTURE character-string. Each suppression symbol is counted in determining the size of the item. If 'Z' is used, the replacement character will be the space and if the asterisk is used, the replacement character will be '*'.

Zero suppression and replacement is indicated in a PICTURE character-string by using a string of one or more of the allowable symbols to represent leading numeric character positions which are to be replaced when the associated character position in the data contains a zero. Any of the simple insertion characters embedded in the string of symbols or to the immediate right of this string are part of the string.

In a PICTURE character-string, there are only two ways of representing zero suppression. One way is to represent any or all of the leading numeric character positions to the left of the decimal point by suppression symbols. The other way is to represent all of the numeric character positions in the PICTURE character-string by suppression symbols.

If the suppression symbols appear only to the left of the decimal point, any leading zero in the data which corresponds to a symbol in the string is replaced by the replacement character. Suppression terminates at the first non-zero digit in the data represented by the suppression symbol string or at the decimal point, whichever is encountered first.

If all numeric character positions in the PICTURE character-string are represented by suppression symbols and the value of the data is not zero, the result is the same as if the suppression characters were only to the left of the decimal point. If the value is zero and the suppression symbol is 'Z', the entire data item will be spaces. If the value is zero and the suppression symbol is '*', the data item will be all '*' except for the actual decimal point.

The symbols '+', '-', '*', 'Z', and the currency symbol, when used as floating replacement characters, are mutually exclusive within a given character-string.

Precedence Rules

Table 3-3 shows the order of precedence when using characters as symbols in a character-string. An 'X' at an intersection indicates that the symbol(s) at the top of the column may precede, in a given character-string, the symbol(s) at the left of the row. Arguments appearing in braces indicate that the symbols are mutually exclusive. The currency symbol is indicated by the symbol 'cs'.

At least one of the symbols 'A', 'X', 'Z', '9' or '*', or at least two of the symbols '+', '-' or 'cs' must be present in a PICTURE string.

Table 3-3. PICTURE Character Precedence Chart.

	First Symbol	Non-Floating Insertion Symbols									Floating Insertion Symbols						Other Symbols					
	Second Symbol	B	0	/	,	.	{+ -}	{+ -}	{CR DB}	cs	{Z *}	{Z *}	{+ -}	{+ -}	cs	cs	9	A X	S	V	P	P
Non-Floating Insertion Symbols	B	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x		x		x
	0	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x		x		x
	/	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x		x		x
	,	x	x	x	x	x	x			x	x	x	x	x	x	x	x			x		x
	.	x	x	x	x		x			x	x		x		x		x					
	{+ -}																					
	{+ -}	x	x	x	x	x				x	x	x			x	x	x			x	x	x
	{CR DB}	x	x	x	x	x				x	x	x			x	x	x			x	x	x
	cs						x															
Floating Insertion Symbols	{Z *}	x	x	x	x		x			x	x											
	{Z *}	x	x	x	x	x	x			x	x	x								x		x
	{+ -}	x	x	x	x					x			x									
	{+ -}	x	x	x	x	x				x			x	x						x		x
	cs	x	x	x	x		x								x							
	cs	x	x	x	x	x	x								x	x				x		x
Other Symbols	9	x	x	x	x	x	x			x	x		x		x		x	x	x	x		x
	A X	x	x	x													x	x				
	S																					
	V	x	x	x	x		x			x	x		x		x		x		x		x	
	P	x	x	x	x		x			x	x		x		x		x		x		x	
	P						x			x									x	x		x

In Table 3-3, non-floating insertion symbols '+' and '-', floating insertion symbols 'Z', '*', '+', '-', and 'cs', and other symbol 'P' appear twice in the PICTURE character precedence chart. The leftmost column and uppermost row for each symbol represents its use to the left of the decimal point position. The second appearance of symbol in the row and column represents its use to the right of the decimal point position.

THE REDEFINES CLAUSE

Function

The REDEFINES clause allows the same computer storage area to be described by different data description entries.

General Format

level-number data-name-1; REDEFINES data-name-2

NOTE: Level-number, data-name-1 and the semi-colon are shown in the above format to improve clarity. Level-number and data-name-1 are not part of the REDEFINES clause.

Syntax Rules

1. The REDEFINES clause, when specified, must immediately follow data-name-1 when the ANSI switch is set; otherwise it may follow the PICTURE clause.

2. The level-numbers of data-name-1 and data-name-2 must be identical but must not be 66 or 88.

3. This clause must not be used in level 01 entries in the File Section. (See General Rule 2 of THE DATA RECORDS CLAUSE in Chapter 5.

4. This clause must not be used in level 01 entries in the Communication Section.

5. Data-name-2 may be subordinate to an entry which contains a REDEFINES clause. However data-name-2 may be subordinate to an item whose data description entry contains an OCCURS clause. In this case, the reference to data-name-2 in the REDEFINES clause may not be subscripted or indexed. Neither the original definition nor the redefinition can include an item whose size is variable as defined in the OCCURS clause. (See THE OCCURS CLAUSE in Chapter 4).

6. No entry having a level-number numerically lower than the level-number of data-name-2 and data-name-1 may occur between the data description entries of data-name-2 and data-name-1.

General Rules

1. Redefinition starts at data-name-2 and ends when a level-number less than or equal to that of data-name-2 is encountered.

2. When the level-number of data-name-1 is other than 01, it must specify the same number of character positions that the data item referenced by data-name-2 contains (when the ANSI switch is set). It is important to observe that the REDEFINES clause specifies the redefinition of a storage area, not of the data items occupying the area.

3. Multiple redefinitions of the same character positions are permitted. The entries giving the new descriptions of the character positions must follow the entries defining the area being redefined, without intervening entries that define new character positions. Multiple redefinitions of the same character positions must all use the data-name of the entry that originally defined the area.

4. The entries giving the new description of the character positions must not contain any VALUE clauses except in condition-name entries.

5. Multiple level 01 entries subordinate to any given level indicator represent implicit redefinitions of the same area.

THE RENAMES CLAUSE

Function

The RENAMES clause permits alternative, possibly overlapping, groupings of elementary items.

General Format

$$66\ \text{data-name-1};\ \underline{\text{RENAMES}}\ \text{data-name-2}\ \left[\left\{\begin{matrix}\underline{\text{THROUGH}}\\ \underline{\text{THRU}}\end{matrix}\right\}\ \text{data-name-3}\right]\ .$$

NOTE: Level-number 66, data-name-1 and the semicolon are shown in the above format to improve clarity. Level-number and data-name-1 are not part of the RENAMES clause.

Syntax Rules

1. All RENAMES entries referring to data items within a given logical record must immediately follow the last data description entry of the associated record description entry.

2. Data-name-2 and data-name-3 must be names of elementary items or groups of elementary items in the same logical record, and cannot be the same data-name. A 66 level entry cannot rename another 66 level entry nor can it rename a 77, 88, or 01 entry.

3. Data-name-1 cannot be used as a qualifier, and can only be qualified by the names of the associated level 01, FD, CD or SD entries. Neither data-name-2 nor data-name-3 may have an OCCURS clause in its data description entry nor be subordinate to an item that has an OCCURS clause in its data description entry. (See THE OCCURS CLAUSE in Chapter 4.)

4. The beginning of the area described by data-name-3 must not be to the left of the beginning of the area desribed by data-name-2. The end of the area described by data-name-3 must be the right of the end of the area described by data-name-2. Data-name-3, therefore, cannot be subordinate to data-name-2.

5. Data-name-2 and data-name-3 may be qualified.

6. The words THRU and THROUGH are equivalent.

7. None of the items within the range, including data-name-2 and data-name-3, if specified, can be an item whose size is variable as defined in THE OCCURS CLAUSE in Chapter 4.

General Rules

1. One or more RENAMES entries can be written for a logical record.

2. When data-name-3 is specified, data-name-1 is a group item which includes all elementary items starting with data-name-2 (if data-name-2 is an elementary item) or the first elementary item in data-name-2 (if data-name-2 is a group item), and concluding with data-name-3 (if data-name-3 is an elementary item) or the last elementary item in data-name-3 (if data-name-3 is a group item).

3. When data-name-3 is not specified, data-name-2 can be either a group or an elementary item; when data-name-2 is a group item, data-name-1 is treated as a group item, and when data-name-2 is an elementary item, data-name-1 is treated as an elementary item.

THE SIGN CLAUSE

Function

The SIGN clause specifies the position and the mode of representation of the operational sign when it is necessary to describe these properties explicitly.

General Format

$$[\underline{\text{SIGN}}\ \underline{\text{IS}}] \left\{ \begin{array}{l} \underline{\text{LEADING}} \\ \underline{\text{TRAILING}} \end{array} \right\} [\underline{\text{SEPARATE}}\ \text{CHARACTER}]$$

Syntax Rules

1. The SIGN clause may be specified only for a numeric data description entry whose PICTURE contains the character 'S', or a group item containing at least one such numeric data description entry.

2. The numeric data description entries to which the SIGN clause applies must be described as USAGE IS DISPLAY.

3. At most one SIGN clause may apply to any given numeric data description entry.

4. If the CODE-SET clause is specified, any signed numeric data description entries associated with that file description entry must be described with the SIGN IS SEPARATE clause.

General Rules

1. The optional SIGN clause, if present, specifies the position and the mode of representation of the operational sign for the numeric data description entry to which it applies, or for each numeric data description entry subordinate to the group to which it applies. The SIGN clause applies only to numeric data description entries whose PICTURE contains the character 'S'; the 'S' indicates the presence of, but neither the representation nor, necessarily, the position of the operational sign.

2. A numeric data description entry whose PICTURE contains the character 'S', but to which no optional SIGN clause applies, has an operational sign, but neither the representation nor, necessarily, the position of the operational sign is specified by the character 'S'. In this (default) case, general rules 3 through 5 do not apply to such signed numeric data items. The representation of the default operational sign is defined in Chapter 2 under the heading Selection of Character Representation and Radix.

3. If the optional SEPARATE CHARACTER phrase is not present, then:

   a. The operational sign will be presumed to be associated with the leading (or, respectively, trailing) digit position of the elementary numeric data item.

   b. The letter 'S' in a PICTURE character-string is not counted in determining the size of the item (in terms of standard data format characters).

4. If the optional SEPARATE CHARACTER phrase is present, then:

   a. The operational sign will be presumed to be the leading (or, respectively, trailing) character position of the elementary numeric data item; this character position is not a digit position.

   b. The letter 'S' in a PICTURE character-string is counted in determining the size of the item (in terms of standard data format characters).

   c. The operational signs for positive and negative are the standard data format characters '+' and '-', respectively.

5. Every numeric data description entry whose PICTURE contains the character 'S' is a signed numeric data description entry. If a SIGN clause applies to such an entry and conversion is necessary for purposes of computation or comparisons, conversion takes place automatically.

THE SYNCHRONIZED CLAUSE

Function

The SYNCHRONIZED clause specifies the alignment of an elementary item on the natural boundaries of the computer memory.

General Format

$$\left\{\begin{array}{l}\underline{\text{SYNCHRONIZED}}\\ \underline{\text{SYNC}}\end{array}\right\}\quad\left[\begin{array}{l}\underline{\text{LEFT}}\\ \underline{\text{RIGHT}}\end{array}\right]$$

Syntax Rules

1. This clause may only appear with an elementary item.

2. SYNC is an abbreviation for SYNCHRONIZED.

General Rules

1. The implementation of the SYNCHRONIZED clause depends on the Run Time System for your particular Operation System and hardware; see your LEVEL II COBOL Operating Guide.

2. This clause specifies that the subject data item is to be aligned in the computer such that no other data item occupies any of the character positions between the leftmost and rightmost natural boundaries delimiting this data item. If the number of character positions required to store this data item is less than the number of character positions between those natural boundaries, the unused character positions (or portions thereof) must not be used for any other data item. Such unused character positions, however, are included in:

   a. The size of any group item(s) to which the elementary item belongs; and

   b. The character positions redefined when this data item is the object of a REDEFINES clause.

3. SYNCHRONIZED not followed by either RIGHT or LEFT specifies that the elementary item is to be positioned between natural boundaries in such a way as to effect efficient utilization of the elementary data item.

4. SYNCHRONIZED LEFT specifies that the elementary item is to be positioned such that it will begin at the left character position of the natural boundary in which the elementary item is placed.

5. SYNCHRONIZED RIGHT specifies that the elementary item is to be positioned such that it will terminate on the right character position of the natural boundary in which the elementary item is placed.

6. Whenever a SYNCHRONIZED item is referenced in the source program, the original size of the item, as shown in the PICTURE clause, is used in determining any action that depends on size, such as justification, truncation or overflow.

7. If the data description of an item contains the SYNCHRONIZED clause and an operational sign, the sign of the item appears in the normal operational sign position, regardless of whether the item is SYNCHRONIZED LEFT or SYNCHRONIZED RIGHT.

8. When the SYNCHRONIZED clause is specified in a data description entry of a data item that also contains an OCCURS clause, or in a data description entry of a data item subordinate to a data description entry that contains an OCCURS clause, then:

   a. Each occurrence of the data item is SYNCHRONIZED.

   b. Any implicit FILLER generated for other data items within that same table are generated for each occurrence of those data items.

9. This clause is hardware dependent.

THE USAGE CLAUSE

Function

The USAGE clause specifies the format of a data item in the computer storage.

General Format

$$[\underline{\text{USAGE}}\ \text{IS}]\quad \left\{\begin{array}{l} \underline{\text{COMPUTATIONAL}} \\ \underline{\text{COMP}} \\ \underline{\text{DISPLAY}} \\ \underline{\text{COMPUTATIONAL-3}} \\ \underline{\text{COMP-3}} \end{array}\right\}$$

Syntax Rules

1. The PICTURE character-string of a COMPUTATIONAL or COMPUTATIONAL-3 item can contain only '9's, the operational sign character 'S', the implied decimal point character 'V', one or more 'P's. (See THE PICTURE CLAUSE earlier in this Chapter).

2. COMP is an abbreviation for COMPUTATIONAL.

General Rules

1. The USAGE clause can be written at any level. If the USAGE clause is written at group level, it applies to each elementary item in the group. The USAGE clause of an elementary item cannot contradict the USAGE clause of a group to which the item belongs.

2. This clause specifies the manner in which a data item is represented in the storage of a computer. It does not affect the use of the data item, although the specifications for some statements in the Procedure Division may restrict the USAGE clause of the operands referred to. The USAGE clause may affect the radix or type of character representation of the item.

3. A COMPUTATIONAL or COMPUTATIONAL-3 item is capable of representing a value to be used in computations and must be numeric. If a group item is described as COMPUTATIONAL(-3), the elementary items in the group are COMPUTATIONAL(-3). The group item itself is not COMPUTATIONAL(-3) and cannot be used in computations.

4. The USAGE IS DISPLAY clause indicates that the format of the data is a standard data format.

5. If the USAGE clause is not specified for an elementary item, or for any group to which the item belongs, the usage is implicitly DISPLAY.

6. Space requirements for the various USAGE storage options are given under <u>Selection of Character Representation and Radix</u> in Chapter 2.

THE VALUE CLAUSE

Function

The VALUE clause defines the value of constants, the initial value of working storage items, and the values associated with a condition name.

General Format

Format 1:

$\underline{\text{VALUE}}$ is literal

Format 2:

$$\left\{\begin{array}{l}\underline{\text{VALUE}}\text{ IS}\\ \underline{\text{VALUES}}\text{ ARE}\end{array}\right\}\ \text{literal-1}\ \left\{\begin{array}{l}\underline{\text{THROUGH}}\\ \underline{\text{THRU}}\end{array}\right\}\ \text{literal-2}\ \left[,\ \text{literal-3}\left[\left\{\begin{array}{l}\underline{\text{THROUGH}}\\ \underline{\text{THRU}}\end{array}\right\}\ \text{literal-4}\right]\right]\ldots$$

Syntax Rules

1. The VALUE clause cannot be stated for any items whose size is variable. (See THE OCCURS CLAUSE in Chapter 4).

2. A signed numeric literal must have associated with it a signed numeric PICTURE character-string.

3. All numeric literals in a VALUE clause of an item must have values which are within the range of values indicated by the PICTURE clause, and must not have a value which would require truncation of nonzero digits. Nonnumeric literals in a VALUE clause of an item must not exceed the size indicated by the PICTURE clause.

4. The words THRU and THROUGH are equivalent.

General Rules

1. The VALUE clause must not conflict with other clauses in the data description of the item or in the data description within the hierarchy of the item. The following rules apply:

   a. If the category of the item is numeric, all literals in the VALUE clause must be numeric. If the literal defines the value of a working storage item, the literal is aligned in the data item according to the standard alignment rules. (See Standard Alignment Rules in Chapter 2).

b. If the category of the item is alphabetic, alphanumeric, alphanumeric edited or numeric edited, all literals in the VALUE clause must be nonnumeric literals. The literal is aligned in the data item as if the data item had been described as alphanumeric. (See STANDARD ALIGNMENT RULES in Chapter 2). Editing characters in the PICTURE clause are included in determining the size of the data item (see THE PICTURE CLAUSE earlier in this Chapter) but have no effect on initialization of the data item. Therefore, the VALUE for an edited item is presented in an edited form.

c. Initialization takes place independent of any BLANK WHEN ZERO or JUSTIFIED clause that may be specified.

2. A figurative constant may be substituted in both Format 1 and Format 2 wherever a literal is specified.

Condition-name Rules

1. In a condition-name entry, the VALUE clause is required. The VALUE clause and the condition-name itself are the only two clauses permitted in the entry. The characteristics of a condition-name are implicitly those of its conditional variable.

2. Format 2 can be used only in connection with condition-names. Wherever the THRU phrase is used, literal-1 must be less than literal-2, literal-3 less than literal-4, etc.

Data Description Entries other than Condition-Names

Rules governing the use of the VALUE clause differ with the respective sections of the Data Division:

1. In the File Section, the VALUE clause may be used only in condition-name entries.

2. In the Working-Storage Section, the VALUE clause must be used in condition-name entries. The VALUE clause may also be used to specify the initial value of a data item; in which case the clause causes the item to assume the specified value at the start of the object program. If the VALUE clause is not used in an item's description, the initial value is undefined.

3. In the Linkage Section, the VALUE clause may be used only in condition-name entries.

4. The VALUE clause must not be stated in a data description entry that contains an OCCURS clause, or in an entry that is subordinate to an entry containing an OCCURS clause. This rule does not apply to condition-name entries. (See THE OCCURS CLAUSE in Chapter 4).

5. The VALUE clause may be stated in a data description entry that contains a REDEFINES clause, or in an entry that is subordinate to an entry containing a REDEFINES clause. This rule does not apply to condition-name entries.

6. If the VALUE clause is used in an entry at the group level, the literal must be a figurative constant or a nonnumeric literal, and the group area is initialized without consideration for the individual elementary or group items contained within this group. The VALUE clause cannot be stated at the subordinate levels within this group.

7. The VALUE clause must not be written for a group containing items with descriptions, including JUSTIFIED, SYNCHRONIZED, or USAGE (other than USAGE IS DISPLAY).

ARITHMETIC EXPRESSIONS

Definition of an Arithmetic Expression

An arithmetic expression can be an identifier of a numeric elementary item, a numeric literal, such identifers and literals separated by arithmetic operators, two arithmetic expressions separated by an arithmetic operator, or an arithmetic expression enclosed in parentheses. Any arithmetic expression may be preceded by a unary operator. The permissible combinations of variables, numeric literals, arithmetic operator and parentheses are given in Table 3-4, Combination of Symbols in Arithmetic Expressions.

Those identifiers and literals appearing in an arithmetic expression must represent either numeric elementary items or numeric literals on which arithmetic may be performed.

Arithmetic Operators

There are five binary arithmetic operators and two unary arithmetic operators that may be used in arithmetic expressions. They are represented by specific characters that may be preceded by a space and followed by a space.

Binary Arithmetic Operators	Meaning
+	Addition
-	Subtraction
*	Multiplication
/	Division
**	Exponentiation

Unary Arithmetic Operators	Meaning
+	The effect of multiplication by numeric literal +1
-	The effect of multiplication by numeric literal -1.

Formation and Evaluation Rules

1. Parentheses may be used in arithmetic expressions to specify the order in which elements are to be evaluated. Expressions within parentheses are evaluated first, and within nested parentheses, evaluation proceeds from the least inclusive set to the most inclusive set. When

parentheses are not used, or parenthesized expressions are at the same level of inclusiveness, the following hierarchical order of execution is implied:

1st - Unary plus and minus
2nd - Exponentiation
3rd - Multiplication and division
4th - Addition and subtraction

2. Parentheses are used either to eliminate ambiguities in logic where consecutive operations of the same hierarchical level appear or to modify the normal hierarchical sequence of execution in expressions where it is necessary to have some deviation from the normal precedence. When the sequence of execution is not specified by parentheses, the order of execution of consecutive operations of the same hierarchical level is from left to right.

3. The ways in which operators, variables, and parentheses may be combined in an arithmetic expression are summarized in Table 3-4, where:

   a. The letter 'P' indicates a permissible pair of symbols.

   b. The character '-' indicates an invalid pair.

   c. 'Variable' indicates an identifier or literal.

FIRST SYMBOL	SECOND SYMBOL				
	Variable	* / ** - +	Unary + or -	(	)
Variable	-	P	-	-	P
* / ** + -	P	-	P	P	-
Unary + or -	P	-	-	P	-
(	P	-	P	P	-
)	-	P	-	-	P

Table 3-4. Combination of Symbols in Arithmetic Expressions

4. An arithmetic expression may only begin with the symbol '(', '+', '-', or a variable and may only end with a ')' or a variable. There must be a one-to-one correspondence between left and right parenthesis of an arithmetic expression such that each left parenthesis is to the left of its corresponding right parenthesis.

5. Arithmetic expressions allow the user to combine arithmetic operations without the restrictions on composite of operands and/or receiving data items. See, for example, syntax rule 3 of THE ADD STATEMENT in this Chapter.

CONDITIONAL EXPRESSIONS

Conditional expressions identify conditions that are tested to enable the object program to select between alternate paths of control depending upon the truth value of the condition. Conditional expressions are specified in the IF, PERFORM and SEARCH statements. There are two categories of conditions associated with conditional expressions: simple conditions and complex conditions. Each may be enclosed within any number of paired parentheses, in which case its category is not changed.

Simple Conditions

The simple conditions are the relation, class, condition-name, switch-status, and sign conditions. A simple condition has a truth value of 'true' or 'false'. The inclusion in parentheses of simple conditions does not change the simple truth value.

Relation Condition

A relation condition causes a comparison of two operands, each of which may be the data item referenced by an identifier, a literal or the value resulting from an arithmetic expression. A relation condition has a truth value of 'true' if the relation exists between the operands. Comparison of two numeric operands is permitted regardless of the formats specified in their respective USAGE clauses. However, for all other comparisons the operands must have the same usage. If either of the operands is a group item, the nonnumeric comparison rules apply.

The general format of a relation condition is as follows:

```
                                /IS [NOT]  GREATER THAN\
{identifier-1          }        |IS [NOT]  LESS THAN   |     {identifer-2  }
{literal-1             }        |IS [NOT]  EQUAL TO    |     {literal-2    }
{arithmetic-expression-1}       {IS [NOT]  >           }     {arithmetic-  }
                                |IS [NOT]  <           |     {expression-2 }
                                \IS [NOT]  =           /
```

NOTE: The required relational characters '<', '>', and '=' are not underlined to avoid confusion with other symbols such as '$\underline{>}$' (Greater than or equal to)

The first operand (identifier-1, literal-1 or arithmetic-expression-1) is called the subject of the condition; the second operand (identifier-2 or literal-2 or arithmetic-expression-2) is called the object of the condition. The relation condition must contain at least one reference to a variable.

The relational operator specifies the type of comparison to be made in a relation condition. A space must precede and follow each reserved word comprising the relational operator. When used, 'NOT' and the next key word or relation character are one relational operator that defines the comparison to be executed for truth value; e.g., 'NOT EQUAL' is a truth test for an 'unequal'.

Comparison: 'NOT GREATER' is a truth test for an 'equal' or 'less' comparison. The meaning of the relational operators is as shown in Table 3-5.

Table 3-5. Relational Operators.

Meaning	Relational Operator
Greater than or not greater than	IS NOT GREATER THAN IS NOT >
Less than or not less than	IS NOT LESS THAN IS NOT <
Equal to or not equal to	IS NOT EQUAL TO IS NOT =
The required relational characters '>', '<', and '=' are not underlined to avoid confusion with other symbols such as '≥' (greater than or equal to).	

Comparison of Numeric Operands: For operands whose class is numeric a comparison is made with respect to the algebraic value of the operands. The length of the literal or arithmetic expression operands in terms of number of digits represented, is not significant. Zero is considered a unique value regardless of the sign.

Comparison of these operands is permitted regardless of the manner in which their usage is described. Unsigned numeric operands are considered positive for purposes of comparison.

Comparison of Nonnumeric Operands: For nonnumeric operands, or one numeric and one nonnumeric operand, a comparison is made with respect to a specified collating sequence of characters (see The OBJECT-COMPUTER Paragraph in this Chapter). If one of the operands is specified as numeric, it must be an integer data item or an integer literal and:

1. If the nonnumeric operand is an elementary data item or a nonnumeric literal, the numeric operand is treated as though it were moved to an elementary alphanumeric data item of the same size as the numeric data

item (in terms of standard data format characters), and the contents of this alphanumeric data item were then compared to the nonnumeric operand. (See THE MOVE STATMENT in this Chapter, and the PICTURE Character 'P' under the heading Symbols Used earlier in this Chapter).

2. If the non-numeric operand is a group item, the numeric operand is treated as though it were moved to a group item of the same size as the numeric data item (in terms of standard data format characters), and the contents of this group item were then compared to the nonnumeric operand. (See THE MOVE STATEMENT in this Chapter, and the PICTURE character 'P' under the heading Symbols Used earlier in this Chapter).

3. A non-integer numeric operand cannot be compared to a nonnumeric operand.

The size of an operand is the total number of standard data format characters in the operand. Numeric and nonnumeric operands may be compared only when their usage is the same and the ANSI switch is set. When the ANSI switch is unset, numeric and nonnumeric operands may be compared irrespective of usage.

There are two cases to consider:

1. Operands of equal size - If the operands are of equal size, comparison effectively proceeds by comparing characters in corresponding character positions starting from the high order end and continuing until either a pair of unequal characters is encountered or the low order end of the operand is reached, whichever comes first. The operands are determined to be equal if all pairs of characters compare equally through the last pair, when the low order end is reached.

   The first encountered pair of unequal characters is compared to determine their relative position in the collating sequence. The operand that contains the character that is positioned higher in the collating sequence is considered to be the greater operand.

2. Operands of unequal size - If the operands are of unequal size, comparison proceeds as though the shorter operand were extended on the right by sufficient spaces to make the operands of equal size.

Class Condition

The class condition determines whether the operand is numeric, that is, consists entirely of the characters '0', '1', '2', '3', ..., '9', with or without the operational sign; or alphabetic, that is, consists entirely of the characters 'A', 'B', 'C', ..., 'Z', space. The general format for the class condition is as follows:

$$\text{identifier IS } [\underline{\text{NOT}}] \left\{ \begin{array}{l} \underline{\text{NUMERIC}} \\ \underline{\text{ALPHABETIC}} \end{array} \right\}$$

(Addendum 2)

The usage of the operand being tested must be described as display. When used, 'NOT' and the next key word specify one class condition that defines the class test to be executed for truth value; e.g. 'NOT NUMERIC' is a truth test for determining that an operand is nonnumeric.

The NUMERIC test cannot be used with an item whose data description describes the item as alphabetic or as a group item composed of elementary items whose data description indicates the presence of operational sign(s). If the data description of the item being tested does not indicate the presence of an operational sign, the item being tested is determined to be numeric only if the contents are numeric and an operational sign is not present. If the data description of the item does indicate the presence of an operational sign, the item being tested is determined to be numeric only if the contents are numeric and a valid operational sign is present. Valid operational signs for data items described with the SIGN IS SEPARATE clause are the standard data format characters, '+' and '-'.

The ALPHABETIC test cannot be used with an item whose data description describes the item as numeric. The item being tested is determined to be alphabetic only if the contents consist of any combination of the alphabetic characters 'A' through 'Z' and the space.

Condition-Name Condition (Conditional Variable)

In a condition-name condition, a conditional variable is tested to determine whether or not its value is equal to one of the values associated with a condition-name. The general format for the condition-name condition is as follows:

```
          condition-name
```

If the condition-name is associated with a range or ranges of values, then the conditional variable is tested to determine whether or not its value falls in this range, including the end values.

The rules for comparing a conditional variable with a condition-name value are the same as those specified for relation conditions.

The result of the test is true if one of the values corresponding to the condition-name equals the value of its associated conditional variable.

Switch-Status Condition

A switch-status condition determines the 'on' or 'off' status of an implementor-defined switch. The switch and the 'on' or 'off' value associated with the condition must be named in the SPECIAL-NAMES paragraph of the Environment Division. The general format for the switch-status condition is as follows:

```
     condition-name
```

The result of the test is true if the switch is set to the specified position corresponding to the condition-name.

Sign Condition

The sign condition determines whether or not the algebraic value of an arithmetic expression is less than, greater than or equal to zero. The general format for a sign condition is as follows:

$$\text{arithmetic-expression IS } [\underline{\text{NOT}}] \left\{\begin{array}{l}\underline{\text{POSITIVE}}\\ \underline{\text{NEGATIVE}}\\ \underline{\text{ZERO}}\end{array}\right\}$$

When used, 'NOT' and the next key word specify one sign condition that defines that algebraic test to be executed for truth value; e.g., 'NOT ZERO' is a truth test for a nonzero (positive or negative) value. An operand is positive if its value is greater than zero, negative if its value is less than zero, and zero if its value is equal to zero. The arithmetic expression must contain at least one reference to a variable.

Complex Conditions

A complex condition is formed by combining simple conditions, combined conditions and/or complex conditions with logical connectors (logical operators 'AND' and 'OR') or negating these conditions with logical negation (the logical operator 'NOT'). The truth value of a complex condition, whether parenthesized or not, is that truth value which results from the interaction of all the stated logical operators on the individual truth values of simple conditions, or the intermediate truth values of conditions logically connected or logically negated.

The logical operators and their meanings are:

Logical Operator	Meaning
AND	Logical conjunction; the truth value is 'true' if both of the conjoined conditions are true; 'false' if one or both of the conjoined conditions is false.
OR	Logical inclusive OR; the truth value is 'true' if one or both of the included conditions is true; 'false' if both included conditions are false.
NOT	Logical negation or reversal of truth value; the truth value is 'true' if the condition is false; 'false' if the condition is true.

The logical operators must be preceded by a space and followed by a space.

Negated Simple Conditions: A simple condition is negated through the use of the logical operator 'NOT'. The negated simple condition effects the opposite truth value for a simple condition. Thus the truth value of a negated simple condition is 'true' if and only if the truth value of the simple condition is 'false'; the truth value of a negated simple condition is 'false' if and only if the truth value of the simple condition is 'true'. The inclusion in parentheses of a negated simple condition does not change the truth value.

The general format for a negated simple condition is:

$\underline{\text{NOT}}$ simple-condition

Combined and Negated Combined Conditions: A combined condition results from connecting conditions with one of the logical operators 'AND' or 'OR'. The general format of a combined condition is:

$$\text{condition}\left\{\begin{Bmatrix}\underline{\text{AND}}\\ \underline{\text{OR}}\end{Bmatrix}\text{condition}\right\}\ \ldots$$

where 'condition' may be:

a. A simple condition, or

b. A negated simple condition, or

c. A combined condition, or

d. A negated combined condition; i.e., the 'NOT' logical operator followed by a combined condition enclosed within parentheses, or

e. Combinations of the above, specified according to the rules summarized in table 3-6, Combinations of Conditions, Logical Operators, and Parentheses, located on the next page.

Although parentheses need never be used when either 'AND' or 'OR' (but not both) is used exclusively in a combined condition, parentheses may be used to effect a final truth value when a mixture of 'AND', 'OR' and 'NOT' is used. (See Table 3-6, Combinations of Conditions, Logical Operators, and Parentheses below, and Condition Evaluation Rules earlier in this Chapter.)

Table 3-6 on the next page indicates the ways in which conditions and logical operators may be combined and parenthesized. There must be a one-to-one correspondence between left and right parentheses such that each left parenthesis is matched by a corresponding right parenthesis. The table assumes a left to right sequence of elements.

Table 3-6 Combinations of Conditions, Logical Operators, and Parentheses

Element	Permitted location in conditional expression	Element can be preceded by only:	Element can be followed by only:
simple-condition	Any	OR, NOT, AND, (	OR, AND,)
OR, or AND	Not first or last	simple-condition,)	simple-condition, NOT, (
NOT	Not last	OR, AND, (	simple-condition, (
(	Not last	OR, NOT, AND, (	simple-condition, NOT, (
)	Not first	simple-condition,)	OR, AND,)

Thus, the element pair 'OR NOT' is permissible while the pair 'NOT OR' is not permissible; 'NOT (' is permissible while 'NOT NOT' is not permissible.

Abbreviated Combined Relation Conditions

When simple or negated simple relation conditions are combined with logical connectives in a consecutive sequence such that a succeeding relation condition contains a subject or subject and relational operator that is common with the preceding relation condition, and no parentheses are used within such a consecutive sequence, any relation condition except the first may be abbreviated by:

1. The omission of the subject of the relation condition, or

2. The omission of the subject and relational operator of the relation condition.

The format for an abbreviated combined relation condition is:

$$\text{relation-condition}\left\{\left\{\begin{matrix}\underline{\text{AND}}\\ \underline{\text{OR}}\end{matrix}\right\} [\underline{\text{NOT}}]\ \ [\text{relational-operator}]\ \ \text{object}\right\}\ldots$$

Within a sequence of relation conditions both of the above forms of abbreviation may be used. The effect of using such abbreviations is as if the last preceding stated subject were inserted in place of the omitted subject, and the last stated relational operator were inserted in place of the omitted relational operator. The result of such implied insertion must comply with the rules of Table 3-6, Combinations of Conditions, Logical Operators, and Parentheses. This insertion of an omitted subject and/or relational operator terminates once a complete simple condition is encountered within a complex condition.

The interpretation applied to the use of the word 'NOT' in an abbreviated combined relation condition is as follows:

1. If the word immediately following 'NOT' is 'GREATER', '>', 'LESS', '<', 'EQUAL','=', then the 'NOT' participates as part of the relational operator; otherwise

2. The 'NOT' is interpreted as a logical operator and, therefore, the implied insertion of subject or relational operator results in a negated relation condition.

Some examples of abbreviated combined and negated combined relation conditions and expanded equivalents follow.

Abbreviated Combined Relation Condition	Expanded Equivalent
a > b AND NOT < c OR d	((a > b) AND (a NOT < c)) OR (a NOT < d)
a NOT EQUAL b OR c	(a NOT EQUAL b) OR (a NOT EQUAL c)
NOT a = b OR c	(NOT (a = b)) OR (a = c)
NOT (a GREATER b OR < c)	NOT ((a GREATER b) OR (a < c))
NOT (a NOT > b AND c AND NOT d)	NOT ((((a NOT > b) AND (a NOT > c)) AND (NOT (a NOT > d))))

Condition Evaluation Rules

Parentheses may be used to specify the order in which individual conditions of complex conditions are to be evaluated when it is necessary to depart from the implied evaluation precedence. Conditions within parentheses are evaluated first, and, within nested parentheses, evaluation proceeds from the least inclusive condition to the most inclusive condition. When parentheses are not used, or parenthesized conditions are at the same level of inclusiveness, the following hierarchical order of logical evaluation is implied until the final truth value is determined:

1. Values are established for arithmetic expressions. (See Formation and Evaluation Rules under ARITHMETIC EXPRESSIONS in this Chapter.)

2. Truth values for simple conditions are established in the following order:

   relation (following the expansion of any abbreviated relation condition)
   class
   condition-name
   switch-status
   sign

3. Truth values for negated conditions are established.

4. Truth values for combined conditions are established:

   'AND' logical operators, followed by
   'OR' logical operators.

5. Truth values for negated combined conditions are established.

6. When the sequence of evaluation is not completely specified by parentheses, the order of evaluation of consecutive operations of the same hierarchical level is from left to right.

COMMON PHRASES AND GENERAL RULES FOR STATEMENT FORMATS

In the statement descriptions that follow, several phrases appear frequently: the ROUNDED phrase, the SIZE ERROR phrase and the CORRESPONDING phrase.

These are described below; a resultant-identifier is that identifier associated with the result of an arithmetic operation.

The ROUNDED Phrase

If, after decimal point alignment, the number of places in the fraction of the result of an arithmetic operation is greater than the number of places provided for the fraction of the resultant-identifier, truncation is relative to the size provided for the resultant-identifier. When rounding is requested, the absolute value of the resultant-identifier is increased by one whenever the most significant digit of the the excess is greater than or equal to five.

When the low-order integer positions in a resultant-identifier are represented by the character 'P' in the PICTURE for the resultant-identifier, rounding or truncation occurs relative to the rightmost integer position for which storage is allocated.

The SIZE ERROR Phrase

If, after decimal point alignment, the absolute value of a result exceeds the largest value that can be contained in the associated resultant-identifier, a size error condition exists. Division by zero always causes a size error condition. The size error condition applies only to the final results, except in MULTIPLY and DIVIDE statements, in which case the size error condition applies to the intermediate results as well. If the ROUNDED phrase is specified, rounding takes place before checking for size error. When such a size error condition occurs, the subsequent action depends on whether or not the SIZE ERROR phrase is specified, as follows:

SIZE ERROR Phrase Not Specified

When a size error condition occurs, the value of those resultant-identifier(s) affected is undefined. Values of resultant-identifier(s) for which no size error condition occurs are unaffected by size errors that occur for other resultant-identifier(s) during execution of this operation.

SIZE ERROR Phrase Specified

When a size error condition occurs, then the values of resultant-identifier(s) affected by the size errors are not altered. Values of resultant-identifier(s) for which no size error condition occurs are unaffected by size errors that occur for other resultant-identifier(s) during execution of this operation. After completion of the execution of this operation, the imperative statement in the SIZE ERROR phrase is executed.

For the ADD statement with the CORRESPONDING phrase and the SUBTRACT statement with the CORRESPONDING phrase, if any of the individual operations produces a size error condition, the imperative statement in the SIZE ERROR phrase is not executed until all of the individual additions or subtractions are completed.

The CORRESPONDING Phrase

In the text that follows dl and d2 must each be identifiers that refer to group items. A pair of data items, one from dl and one from d2 correspond if the following conditions exist:

1. A data item in dl and a data item in d2 are not designated by the key word FILLER and have the same data-name and the same qualifiers up to, but not including, dl and d2.

2. At least one of the data items is an elementary data item in the case of a MOVE statement with the CORRESPONDING phrase; and both of the data items are elementary numeric data items in the case of the ADD statement with the CORRESPONDING phrase or the SUBTRACT statement with the CORRESPONDING phrase.

3. The description of dl and d2 must not contain level-number 66, 77, or 88 or the USAGE IS INDEX clause.

4. A data item that is subordinate to dl or d2 and contains a REDEFINES, RENAMES, OCCURS or USAGE IS INDEX clause is ignored, as well as those data items subordinate to the data item that contains the REDEFINES, OCCURS, or USAGE IS INDEX clause. However, dl and d2 may have

   REDEFINES or OCCURS clauses or be subordinate to data items with REDFINES or OCCURS clauses.

Arithmetic Statements

The arithmetic statements are the ADD, COMPUTE, DIVIDE, MULTIPLY, and SUBTRACT statements. Common features are as follows:

1. The data descriptions of the operands need not be the same; any necessary conversion and decimal point alignment are supplied throughout the calculation.

2. The maximum size of each operand is 18 decimal digits. The composite of operands, which is a hypothetical data item resulting from the superimposition of specified operands in a statement aligned on their decimal points (See THE ADD STATEMENT, THE DIVIDE STATEMENT, THE MULTIPLY STATEMENT and THE SUBTRACT STATEMENT later in this Chapter) must not contain more than 18 decimal digits.

Overlapping Operands

When a sending and a receiving item in an arithmetic statement or an INSPECT, MOVE, SET, STRING or UNSTRING statement share a part of their storage areas, the result of the execution of such a statement is undefined.

Multiple Results in Arithmetic Statements

The ADD, COMPUTE, DIVIDE, MULTIPLY, and SUBTRACT statements may have multiple results. Such statements behave as though they had been written in the following way:

1. A statement which performs all arithmetic necessary to arrive at the result to be stored in the receiving items, and stores that result in a temporary storage location.

2. A sequence of statements transferring or combining the value of this temporary location with a single result. These statements are considered to be written in the same left-to-right sequence in which the multiple results are listed.

   The result of the statement

   ```
   ADD a, b, c TO c, d (c), e
   ```

   is equivalent to

   ```
   ADD a, b, c GIVING temp
   ADD temp TO c
   ADD temp TO d (c)
   ADD temp TO e
   ```

   where 'temp' is an intermediate result item provided by the compiler.

Incompatible Data

Except for the class condition (See Class Condition in this Chapter), when the contents of a data item are referenced in the Procedure Division and the contents of that data item are not compatible with the class specified for that data item by its PICTURE clause, then the result of such a reference is undefined.

Signed Receiving Items

When the receiving item in an arithmetic statement or a MOVE statement is a signed numeric or a signed numeric edited item, the sign is moved into the receiving item independently of any truncation of the absolute numeric data. It is possible, therefore, for the numeric value to be zero but for the sign to be negative.

CRT Devices

The CRT is driven directly by the run time system via a buffer. The COBOL programmer moves data into and out of this buffer by means of ACCEPT and DISPLAY statements. Each ACCEPT or DISPLAY action is relative to the start of the CRT buffer unless POSITION is specified. The syntax is limited to inputting to or outputting from a single data name. The data name may be a group item and several such group items may redefine the same area of storage.

The use of FILLER data items in record descriptions used for input or output to a CRT device is subject to special rules. On output, any FILLER item in a record results in suppression of output for the character positions it defines. On input, any FILLER item suppresses operator keying into the character positions it defines.

THE ACCEPT STATEMENT

Function

The ACCEPT statement causes data keyed at the CRT console to be made available to the program in a specified data item

General Formats

Format 1

```
ACCEPT identifier [FROM {mnemonic-name}]
                        {CONSOLE      }
```

Format 2

```
ACCEPT data-name-1 { [AT {data-name-2}]    FROM CRT }
                   {     {literal-1  }              }
                   {                                }
                   {  AT {data-name-2}              }
                   {     {literal-1  }              }
```

Format 3

```
                          {DATE}
ACCEPT identifier FROM    {DAY }
                          {TIME}
```

Syntax Rule

The mnemonic name in Format 1 must also be specified in the SPECIAL NAMES paragraph of the Environment Division and must be associated with the console.

General Rules

1. Format 1 is the standard ANSI ACCEPT statement

   Format 2 is the extended ACCEPT format.

   The two formats are distinguished by their FROM phrases and the default assumes FROM CONSOLE. A user-defined mnemonic-name can be used if this is associated to a system device in the SPECIAL-NAMES paragraph (see The SPECIAL-NAMES Paragraph earlier in this Chapter). The default can, however, be changed by specifying CONSOLE IS CRT in the SPECIAL-NAMES clause so that FROM CRT becomes the default. This changed default is not shown in the syntax above.

Format 1

2. The ACCEPT statement causes the transfer of data from the system console device. This input data replaces the contents of the data item named by the identifier.

3. The data is transferred as an integral number of data records (up to a maximum of 12). The size of a data record is defined by the compiler directive CRTWIDTH (see the LEVEL II COBOL Operating Guide). As each data record is keyed at the console it may be line-edited according to the operating system rules for line-editing (see the User Guide for your operating system). Each data record is terminated by pressing the "accept data" key (normally the RETURN or ENTER key) or by exactly filling the data record. After each data record is transferred, the cursor is moved to the start of the next line (possibly with scrolling).

4. If the size of the data record transferred is the same as the size of the receiving data item, the transferred data is stored in the receiving data item.

5. If the input line is not of the same size as the receiving data item, then:

   a. If the size of the receiving data item (or the portion of the receiving data item not yet currently occupied by transferred data) exceeds the size of the transferred data record, the transferred data is stored aligned to the left in the receiving data item (or the portion of the receiving data item not yet occupied), and an additional data record is requested.

   b. If the size of the transferred data record exceeds the size of the receiving data item (or the portion of the receiving data item not yet occupied by transferred data) only the leftmost characters of the input data are stored in the receiving data item (or the portion remaining). The remaining characters of the input data which do not fit into the receiving data item are ignored.

Format 2

6. The ACCEPT statement causes the transfer of data from the CRT to data-name-1. The contents of data-name-1 are replaced by this data.

7. data-name-1 is taken as a definition of the screen area in which elementary data items correspond to areas on the screen into which the operator can key. FILLER fields correspond to areas on the screen which are inaccessible to the operator. Data-name-1 must not be subscripted.

8. Elementary data items within data-name-1 may be alphanumeric, numeric usage display, or edited. Non-integer numeric items are treated as two separate integer numeric fields, and edited fields are treated as alphanumeric fields except as described in rule 16.

(Addendum 2)

9. AT data-name-2 or literal-1 defines the position on the screen of the leftmost character of the data. Either form must refer to a PIC 9999 field. The most significant 99 is taken as a line count in the range one to the maximum lines on the user screen. The least significant 99 is taken as a character position in the range one to the maximum positions allowed by the screen width of the user CRT.

10. data-name-1 may refer to a record, group or elementary item, but it may not be subscripted. REDEFINES may be used within data-name-1, in which case the first description of the data is used and subsequent descriptions are ignored. OCCURS and nested OCCURS may also be used with the effect that the repeated data-item is expanded into the full number of times it occurs and one definition is thus automatically repeated for many fields.

11. Immediately upon execution of the ACCEPT statement a cursor is displayed in the CRT location corresponding to the leftmost non-FILLER character position in data-name-1. Alternatively, when CURSOR is specified in the SPECIAL-NAMES paragraph, the cursor displays at the position held in the CURSOR data-name. The CURSOR position is stored in CURSOR data-name in the same format as the screen position is held in data-name-2. If the CURSOR data-name has the value SPACE or ZERO, the effect is as if CURSOR was not specified and the CURSOR data-name will not thereafter be updated. If a valid screen position is specified that is not within a non-FILLER item, the cursor is positioned to the next non-FILLER character position. If that position is beyond the final non-FILLER item, the cursor is positioned at the beginning of the first non-FILLER item of the record being accepted. The CURSOR data-name holds the last cursor position at the end of execution of an ACCEPT statement.

12. If neither AT ... nor FROM CRT is specified, the default is FROM CONSOLE (see rule 1 above).

13. As the operator keys characters, the cursor moves to the right one character position at a time in locations corresponding to data fields. The operator always keys into the current cursor position. At the end of a line the cursor moves down one line and to the leftmost non-FILLER character position.

14. If the data item is integer numeric, only numeric characters (0 - 9) will be accepted into that item. Keying the decimal point character (. or , as specified in the DECIMAL POINT phrase) when accepting a numeric item causes the item to be right justified and zero-filled from the left.

15. When the cursor location reaches a position corresponding to a FILLER item in a data-name, it immediately skips to the next non-FILLER character position, or if there is no such position remaining in the portion of the CRT specified by the data-name, it remains in its current position. Any characters then entered will redefine the last character.

(Addendum 1)

16. The operator can terminate input by pressing the CR (carriage return) key at which time control is passed to the next statement after ACCEPT. Before control is passed to the next statement the following takes place:

    a. The numeric value of each numeric-edited data-field is formed internally from only the keyed characters 0 to 9, +, -, . or , and then moved back to the numeric-edited field with the ANSI PICTURE editing applied. The field may thus be different from that shown on the CRT just before the Carriage Return key was pressed.

    b. When CURSOR IS is specified in the SPECIAL-NAMES paragraph, the cursor position when the Carriage Return key is pressed is returned in the data-name specified by the CURSOR IS clause, except when its value at the start of the ACCEPT function causes it to be treated as unspecified.

17. Before keying CR, the operator can reposition the cursor to overwrite data already keyed or to skip character positions by use of the character positioning keys, as shown in Table 3 - 7.

NOTE: The actual key identification and functions shown in this table varies according to the CRT used and the way it is configured (See the L/II COBOL Operating Guide).

Table 3-7. Cursor Repositioning Keys.

KEY:	FUNCTION:
←	Backs up the cursor one position.
↑	Backs up the cursor to the start of the non-FILLER field prior to the current cursor position.
↓	Moves the cursor on to the start of the next non-FILLER field in advance of the current cursor position.
→	Moves the cursor on one position without overwriting existing contents.
↖	Moves the cursor back to the start of the first non-FILLER field in the CRT area corresponding to data-name-1.

Format 3

18. The ACCEPT statement causes the information requested to be transferred to the data item specified by identifier according to the rules of the MOVE statement. DATE, DAY, and TIME are conceptual data items and, therefore, are not described in the COBOL program.

19. DATE is composed of the data elements year of century, month of year, and day of month. The sequence of the data element codes shall be from high to low order (left to right), year of century, month of year, and day of month. Date, when accessed by a COBOL program, behaves as if it had been described in the COBOL program as an unsigned elementary numeric integer data item six digits in length.

20. DAY is composed of the data elements year of century and day of year. The sequence of the data element codes shall be from high order to low order (left to right) year of century, day of year. Therefore, July 1, 1968 would be expressed as 68183. DAY, when accessed by a COBOL program, behaves as if it had been described in a COBOL program as an unsigned elementary numeric integer data item five digits in length.

21. TIME is composed of the data elements hours, minutes, seconds and hundredths of a second. TIME is based on elapsed time after midnight on a 24-hour clock basis -- thus, 2:41 p.m. would be expressed as 14410000. TIME, when accessed by a COBOL program behaves as if it had been described in a COBOL program as an unsigned elementary numeric integer data item eight digits in length. The minimum value of TIME is 00000000; the maximum value of TIME is 23595999. If the hardware does not have the facility to provide fractional parts of TIME, the value is converted to the closest decimal approximation.

THE ADD STATEMENT

Function

The ADD statement causes two or more numeric operands to be summed and the result to be stored.

General Format

Format 1

```
ADD {identifier-1} [, identifier-2]  ...  TO identifier-m   [ROUNDED]
    {literal-1   } [, literal-2   ]

    [,identifier-n [ROUNDED]] ... [; ON SIZE ERROR imperative-statement]
```

Format 2

```
ADD {identifier-1} , {identifier-2}  [, identifier-3]  ...
    {literal-1   }   {literal-2   }  [, literal-3   ]

    GIVING identifier-m   [ROUNDED] [,identifier-n   [ROUNDED]]   ...

    [; ON SIZE ERROR imperative-statement]
```

Format 3

```
ADD {CORRESPONDING}   identifier-1  TO  identifier-2   [ROUNDED]
    {CORR         }
    [; ON SIZE ERROR imperative-statement]
```

Syntax Rules

1. In Formats 1 and 2, each identifier must refer to an elementary numeric item, except that in Format 2 each identifier following the word GIVING must refer to either an elementary numeric item or an elementary numeric edited item. In Format 3, each identifier must refer to a group item.

2. Each literal must be a numeric literal.

3. The composite of operands must not contain more than 18 digits (see Arithmetic Statements in this Chapter).

   a. In Format 1 the composite of operands is determined by using all of the operands in a given statement.

b. In Format 2 the composite of operands is determined by using all of the operands in a given statement excluding the data items that follow the word GIVING.

c. In Format 3 the composite of operands is determined separately for each corresponding pair of data items.

General Rules

1. See The ROUNDED Phrase, The SIZE ERROR Phrase, The CORRESPONDING Phrase, Arithmetic Statements, Overlapping Operands and Multiple Results in Arithmetic Statements in this Chapter.

2. If Format 1 is used, the values of the operands preceding the word TO are added together, then the sum is added to the current value of identifier-m storing the result immediately into identifier-m, and repeating this process respectively for each operand following the word TO.

3. If Format 2 is used, the value of the operands preceding the word GIVING are added together, then the sum is stored as the new value of each identifier-m, identifier-n, ..., the resultant identifiers.

4. If Format 3 is used, data items in identifier-1 are added to and stored in corresponding data items in identifier-2.

5. The compiler ensures that enough places are carried so as not to lose any significant digits during execution.

THE ALTER STATEMENT

Function

The ALTER statement modifies a predetermined sequence of operations.

General Format

```
    ALTER procedure-name-1 TO  [PROCEED TO]   procedure-name-2

         [, procedure-name-3 TO  [PROCEED TO] procedure-name-4 ]...
```

Syntax Rules

1. Each procedure-name-1, procedure-name-3, ..., is the name of a paragraph that contains a single sentence consisting of a GO TO statement without the DEPENDING phrase.

2. Each procedure-name-2, procedure-name-4, ..., is the name of a paragraph or section in the Procedure Division.

General Rules

1. Execution of the ALTER statement modifies the GO TO statement in the paragraph named procedure-name-1, procedure-name-3, ..., so that subsequent executions of the modified GO TO statements cause transfer of control to procedure-name-2, procedure-name-4, ..., respectively. Modified GO TO statements in independent segments may, under some circumstances, be returned to their initial states (see Independent Segments in Chapter 8).

2. A GO TO statement in a section whose segment-number is greater than or equal to 50 must not be referred to by an ALTER statement in a section with a different segment-number.

   All other uses of the ALTER statement are valid and are performed even if procedure-name-1, procedure-name-3 is in an overlayable fixed segment.

THE COMPUTE STATEMENT

Function

The COMPUTE statement assigns to one or more data items the value of an arithmetic expression.

General Format

```
    COMPUTE identifier-1  [ROUNDED]   [, identifier-2  [ROUNDED]]      ...

    = arithmetic-expression  [; ON SIZE ERROR imperative-statement]
```

Syntax Rules

Identifiers that appear only to the left of = must refer to either an elementary numeric item or an elementary numeric edited item.

General Rules

1. See The ROUNDED Phrase, The SIZE ERROR Phrase, Arithmetic Statements, Overlapping Operands and Multiple Results in Arithmetic Statements.

2. An arithmetic expression consisting of a single identifier or literal provides a method of setting the values of identifier-1, identifier-2, etc., equal to the value of the single identifier or literal.

3. If more than one identifier is specified for the result of the operation, that is preceding =, the value of the arithmetic expression is computed, and then this value is stored as the new value of each of identifier-1, identifier-2, etc., in turn.

4. The COMPUTE statement allows the user to combine arithmetic operations without the restrictions on composite of operands and/or receiving data items imposed by the arithmetic statements ADD, SUBTRACT, MULTIPLY, and DIVIDE.

THE DISPLAY STATEMENT

Function

The DISPLAY statement causes data to be transferred from specified data items to the CRT screen.

General Formats

Format 1

```
            ⎧ identifier-1 ⎫   ⎡  ⎧ identifier-2 ⎫⎤
  DISPLAY   ⎨              ⎬   ⎢, ⎨              ⎬⎥...  [ UPON {mnemonic-name} ]
            ⎩ literal-1    ⎭   ⎣  ⎩ literal-2    ⎭⎦            {CONSOLE      }
```

Format 2

```
  DISPLAY {data-name-1}
          {literal-3  }
                      ⎧ ⎡ AT  {data-name-2} ⎤  UPON  {CRT      } ⎫
                      ⎪ ⎣     {literal-4  } ⎦        {CRT-UNDER} ⎪
                      ⎨                                          ⎬
                      ⎪   AT  {data-name-2}                      ⎪
                      ⎩       {literal-4  }                      ⎭
```

Syntax Rules

1. The mnemonic-name in Format-1 must be associated with the console in the SPECIAL-NAMES paragraph in the Environment Division.

2. Each literal may be any figurative constant, except ALL.

3. If the literal is numeric, it must be an unsigned integer.

4. literal-3 must be alphanumeric. literal-4 must be numeric.

5. data-name-1 may refer to a record, group or elementary item, but it must not be subscripted.

General Rules

1. Format 1 is the standard ANSI DISPLAY statement.

   Format 2 is the extended DISPLAY format.

   The two formats are distinguished by their UPON phrases and the default assumes UPON CONSOLE. A user-defined mnemonic-name can be used if this is associated with a system device in the SPECIAL-NAMES paragraph. (See THE SPECIAL-NAMES paragraph in this Chapter). The default can, however, be changed by specifying CONSOLE IS CRT in the SPECIAL-NAMES clause so that UPON CRT becomes the default. This changed default is not shown in the syntax above.

Format 1

2. The DISPLAY statement causes the contents of each operand to be transferred to the console device in the order listed.

3. The data is transferred as an integral number of data records (up to a maximum of 12). The size of a data record is defined by the compiler directive CRTWIDTH (see the LEVEL II COBOL Operating Guide). As each data record is transferred it is displayed on the console from the current cursor position with any trailing space characters removed and the cursor is moved to the start of the next line (possible with scrolling).

4. If a figurative constant is specified as one of the operands, only a single occurrence of the figurative constant is displayed.

5. If the data item (or the portion of the data-item not yet transferred) is the same size as the data record, the data item (or the portion not yet transferred) is transferred.

6. If the data item (or the portion of the data item not yet transferred) is not the same size as the data record, one of the following applies:

   a. If the size of the data item (or the portion of the data item not yet transferred) exceeds the size of the data record, the data item (or the portion not yet transferred) is transferred to the data record, beginning with the leftmost character and continuing until the data record is filled, an additional data record is then requested.

   b. If the size of the data record exceeds the size of the data item (or the portion of the data item not yet transferred), the data item (or the portion not yet transferred) is transferred to the data record beginning with the leftmost character and continuing until the final character of the data item has been transferred. The remaining characters in the data record are space filled.

7. When operands in a DISPLAY statement are USAGE COMP or USAGE COMP-3 such operands are converted to USAGE DISPLAY. The size of the sending item is the sum of the sizes associated with the operands (after possible conversion) and the values of the operand are transferred in the sequence in which they are encountered.

Format 2

8. The DISPLAY statement is used to output data to the CRT in the screen positions specified.

(Addendum 2)

9. data-name-1 is taken as a definition of the screen area into which data items that correspond to areas on the screen are moved. FILLER fields correspond to areas on the screen into which data is not moved.

10. data-name-1 may be an elementary item or may be a group item containing group and/or elementary items. Such elementary items must be defined as USAGE DISPLAY.

11. AT data-name-2 or literal-4 defines the position on the screen of the leftmost character of the data. Either form must refer to a PIC 9999 field. The most significant 99 is taken as a line count in the range one to the maximum number of lines on the user screen. The least significant 99 is taken as a character position in the range one to the maximum of characters per line on the user screen.

12. data-name-1 may refer to a record, group or elementary item, but it may not be subscripted. REDEFINES may be used, in which case the first description of the data is used and subsequent descriptions are ignored. OCCURS and nested OCCURS may also be used with the effect that the repeated data-item is expanded into the full number of times it occurs and one definition is thus automatically repeated for many fields.

13. DISPLAY SPACE has the effect of clearing the screen at run time (i.e. filling the whole screen with spaces). DISPLAY " " (one space character), however, displays only one space character.

14. The CRT-UNDER phrase causes the elementary items moved to the CRT to be displayed with the underline feature present. This feature is dependent on the CRT hardware functions and is not available on all makes of CRT (see the L/II COBOL Operating Guide).

15. DISPLAY LOW-VALUES AT ... has the effect, on most CRT's, of positioning the cursor without disturbing the existing data on the screen.

THE DIVIDE STATEMENT

Function

The DIVIDE statement divides one numeric data item into others and sets the values of data items equal to the quotient.

General Format

Format 1

$$\underline{\text{DIVIDE}}\ \left\{\begin{matrix}\text{identifier-1}\\ \text{literal-1}\end{matrix}\right\}\ \underline{\text{INTO}}\quad \text{identifier-2}\quad [\underline{\text{ROUNDED}}]$$

$$\left[\text{, identifier-3}\quad [\underline{\text{ROUNDED}}]\right]\ \ldots\ [\text{;ON }\underline{\text{SIZE}}\ \underline{\text{ERROR}}\text{ imperative-statement}]$$

Format 2

$$\underline{\text{DIVIDE}}\ \left\{\begin{matrix}\text{identifier 1}\\ \text{literal-1}\end{matrix}\right\}\ \underline{\text{INTO}}\ \left\{\begin{matrix}\text{identifier-2}\\ \text{literal-2}\end{matrix}\right\}$$

$$\underline{\text{GIVING}}\quad \text{identifier-3}\quad [\underline{\text{ROUNDED}}]\ \left[\text{,identifier-4}\quad [\underline{\text{ROUNDED}}]\right]\ \ldots$$

$$[\text{;ON }\underline{\text{SIZE}}\ \underline{\text{ERROR}}\text{ imperative-statement}]$$

Format 3

$$\underline{\text{DIVIDE}}\ \left\{\begin{matrix}\text{identifier-1}\\ \text{literal-1}\end{matrix}\right\}\ \underline{\text{BY}}\ \left\{\begin{matrix}\text{identifier-2}\\ \text{literal-2}\end{matrix}\right\}$$

$$\underline{\text{GIVING}}\quad \text{identifier-3}\quad [\underline{\text{ROUNDED}}]\ \left[\text{, identifier-4}\quad [\underline{\text{ROUNDED}}]\right]\ \ldots$$

$$[\text{;ON }\underline{\text{SIZE}}\ \underline{\text{ERROR}}\text{ imperative-statement}]$$

Format 4

$$\underline{\text{DIVIDE}}\ \left\{\begin{matrix}\text{identifier 1}\\ \text{literal-1}\end{matrix}\right\}\ \underline{\text{INTO}}\ \left\{\begin{matrix}\text{identifier-2}\\ \text{literal-2}\end{matrix}\right\}$$

$$\underline{\text{GIVING}}\quad \text{identifier-3}\quad [\underline{\text{ROUNDED}}]$$

$$\underline{\text{REMAINDER}}\text{ identifier-4}\quad [\text{; ON }\underline{\text{SIZE}}\ \underline{\text{ERROR}}\text{ imperative-statement}]$$

Format 5

```
DIVIDE  { identifier 1 }   BY   { identifier-2 }
        { literal-1    }        { literal-2    }

     GIVING    identifier-3  [ROUNDED]

     REMAINDER identifier-4   [; ON SIZE ERROR imperative-statement]
```

Syntax Rules

1. Each identifier must refer to an elementary numeric item, except that any identifier associated with the GIVING or REMAINDER phrase must refer to either an elementary numeric item or an elementary numeric edited item.

2. Each literal must be a numeric literal.

3. The composite of operands, which is the hypothetical data item resulting from the superimposition of all receiving data items (except the REMAINDER data item) of a given statement aligned on their decimal points, must not contain more than eighteen digits.

General Rules

1. See The ROUNDED Phrase, The SIZE ERROR Phrase, Arithmetic Statements, Overlapping Operands and Multiple Results in Arithmetic Statements in this Chapter for a description of these functions.

2. When Format 1 is used, the value of identifier-1 or literal-1 is divided into the value of identifier-2. The value of the dividend (identifier-2) is replaced by this quotient; similarly for identifier-1 or literal-1 and literal-3, etc.

3. When Format 2 is used, the value of identifier-1 or literal-1 is divided into identifier-2 or literal-2 and the result is stored in identifier-3, identifier-4 etc.

4. When Format 3 is used, the value of identifier-1 or literal-1 is divided by the value of identifier-2 or literal-2 and the result is stored in identifier-3, identifier-4 etc.

5. Formats 4 and 5 are used when a remainder from the division operation is desired, namely identifier-4. The remainder in COBOL is defined as the result of subtracting the product of the quotient (identifier-3) and the divisor from the dividend. If identifier-3 is defined as a numeric edited item, the quotient used to calculate the remainder is an intermediate field which contains the unedited quotient. If ROUNDED is used, the quotient used to calculate the remainder is an intermediate field which contains the quotient of the DIVIDE statement, truncated rather than rounded.

6. In Formats 4 and 5, the accuracy of the REMAINDER data item (identifier-4) is defined by the calculation described above. Appropriate decimal allignment truncation (not rounding) will be performed for the content of the data item referenced by identifier-4, as needed.

7. When the ON SIZE ERROR phrase is used in Formats 4 and 5, the following rules pertain:

   a. If the size error occurs on the quotient, no remainder calculation is meaningful. Thus, the contents of the data items referenced by both identifier-3 and identifier-4 will remain unchanged.

   b. If the size error occurs on the remainder, the contents of the data item referenced by identifier-4 remains unchanged, However, as with other instances of multiple results of arithmetic statements, the user will have to do his own analysis to recognize which situation has actually occurred.

THE ENTER STATEMENT

Function

The ENTER statement provides a means of allowing the use of more than one language in the same program.

General Format

```
     ENTER  language-name     [routine-name]   .
```

Syntax Rule

Language-name and routine-name can be any user-defined word or alphanumeric literal.

General Rule

This statement is treated as if for documentation purposes only.

Access to other languages can be achieved by means of CALL.

THE EXIT STATEMENT

Function

The EXIT statement provides a common end point for a series of procedures.

General Format

EXIT

Syntax Rules

1. The EXIT statement must appear in a sentence by itself.

2. The EXIT sentence must be the only sentence in the paragraph.

General Rule

An EXIT statement serves only to enable the user to assign a procedure-name to a given point in a program. Such an EXIT statement has no other effect on the compilation or execution of the program.

THE GO TO STATEMENT

Function

The GO TO statement causes control to be transferred from one part of the Procedure Division to another.

General Format

Format 1

```
    GO TO     [procedure-name-1]
```

Format-2

```
    GO TO procedure-name-1   [, procedure-name-2] ... , procedure-name-n

       DEPENDING ON identifier
```

Syntax Rules

1. Identifier is the name of a numeric elementary item described without any positions to the right of the assumed decimal point.

2. When a paragraph is referenced by an ALTER statement, that paragraph can consist only of a paragraph header followed by a Format 1 GO TO statement.

3. A Format 1 GO TO statement, without procedure-name-1, can only appear in a single statement paragraph.

4. If a GO TO statement represented by Format 1 appears in a consecutive sequence of imperative statements within a sentence, it appears as the last statement in that sequence.

General Rules

1. When a GO TO statement, represented by Format 1 is executed, control is transferred to procedure-name-1 or to another procedure-name if the GO TO statement has been modified by an ALTER statement.

2. If procedure-name-1 is not specified in Format 1, an ALTER statement, referring to this GO TO statement, must be executed prior to the execution of this GO TO statement.

3. When a GO TO statement represented by Format 2 is executed, control is transferred to procedure-name-1, procedure-name-2, etc., depending on the value of the identifier being 1, 2, ..., n. If the value of the identifier is anything other than the positive or unsigned integers 1, 2, ..., n, then no transfer occurs and control passes to the next statement in the normal sequence for execution.

THE IF STATEMENT

Function

The IF statement causes a condition to be evaluated (see CONDITIONAL EXPRESSIONS in this Chapter). The subsequent action of the object program depends on whether the value of the condition is true or false.

General Format

$$\underline{\text{IF}}\ \text{condition;}\quad \text{THEN}\ \left\{\begin{array}{l}\text{statement-1}\\ \underline{\text{NEXT}}\ \underline{\text{SENTENCE}}\end{array}\right\}\quad \left\{\begin{array}{l}\text{; }\underline{\text{ELSE}}\ \text{statement-2}\\ \text{; }\underline{\text{ELSE}}\ \underline{\text{NEXT}}\ \underline{\text{SENTENCE}}\end{array}\right\}$$

Syntax Rules

1. Statement-1 and statement-2 represent either an imperative statement or a conditional statement, and either may be followed by a conditional statement.

2. The ELSE NEXT SENTENCE phrase may be omitted if it immediately precedes the terminal period of the sentence.

General Rules

1. When an IF statement is executed, the following transfers of control occur:

   a. If the condition is true, statement-1 is executed if specified. If statement-1 contains a procedure branching or conditional statement, control is explicitly transferred in accordance with the rules of that statement. If statement-1 does not contain a procedure branching or conditional statement, the ELSE phrase, if specified, is ignored and control passes to the next executable sentence.

   b. If the condition is true and the NEXT SENTENCE phrase is specified instead of statement-1, the ELSE phrase, if specified, is ignored and control passes to the next executable sentence.

   c. If the condition is false, statement-1 or its surrogate NEXT SENTENCE is ignored, and statement-2, if specified, is executed. If statement-2 contains a procedure branching or conditional statement, control is explicitly transferred in accordance with the rules of that statement. If statement-2 does not contain a procedure branching or conditional statement, control passes to the next executable sentence. If the ELSE statement-2 phrase is not specified, statement-1 is ignored and control passes to the next executable sentence.

d. If the condition is false, and the ELSE NEXT SENTENCE phrase is specified, statement-1 is ignored, if specified, and control passes to the next executable sentence.

2. Statement-1 and/or statement-2 may contain an IF statement. In this case the IF statement is said to be nested.

   IF statements within IF statements may be considered as paired IF and ELSE combinations, proceeding from left to right. Thus, any ELSE encountered is considered to apply to the immediately preceding IF that has not been already paired with an ELSE.

THE INSPECT STATEMENT

Function

The INSPECT statement provides the ability to tally (Format 1), replace (Format 2), or tally and replace (Format 3) occurrences of single characters or group of characters in a data item.

General Format

Format 1

```
INSPECT  identifier-1  TALLYING

  {                       { { ALL     }  { identifier-3 } }
  { , identifier-2 FOR    { , { LEADING }  { literal-1    } }
  {                       {         CHARACTERS             }

          [ { BEFORE }  INITIAL  { identifier-4 } ] }  ...  }  ...
          [ { AFTER  }           { literal-2    } ] }       }
```

Format 2

```
INSPECT  identifier-1  REPLACING

 {  CHARACTERS  BY { identifier-6 } [ { BEFORE }  INITIAL  { identifier-7 } ] }
 {                 { literal-4    } [ { AFTER  }           { literal-5    } ] }
 {                                                                            }
 {  { , { ALL     } { , { identifier-5 }  BY { identifier-6 }                 }
 {  {   { LEADING } {   { literal-3    }     { literal-4    }                 }
 {  {   { FIRST   } {                                                         }
 {                                                                            }
 {          [ { BEFORE }  INITIAL  { identifier-7 } ] }  ...  }  ...          }
 {          [ { AFTER  }           { literal-5    } ] }       }               }
```

Format 3

```
INSPECT identifier-1 TALLYING

 { , identifier-2 FOR { , { {ALL    } {identifier-3} }
 {                    {   { {LEADING} {literal-1   } }
 {                    {   { CHARACTERS               }
 {
 {              [ {BEFORE}  INITIAL {identifier-4} ] }  ...  } ...
 {              [ {AFTER }          {literal-2   } ] }

  REPLACING

 { CHARACTERS BY {identifier-6}     [ {BEFORE}  INITIAL {identifier-7} ]  }
 {               {literal-4   }     [ {AFTER }          {literal-5   } ]  }
 {                                                                         }
 { { , {ALL    } { , {identifier-5} BY {identifier-6}                      }
 { {   {LEADING} {   {literal-3   }    {literal-4   }                      }
 { {   {FIRST  } {                                                         }
 {              [ {BEFORE}  INITIAL {identifier-7} ]  } ... } ...          }
 {              [ {AFTER }          {literal-5   } ]                       }
```

Syntax Rules

All Formats

1. Identifier-1 must reference either a group item or any category of elementary item, described (either implicitly or explicitly) as USAGE IS DISPLAY.

2. Identifier-3 ... identifier-n must reference either an elementary alphabetic, alphanumeric or numeric item described (either implicitly or explicitly) as USAGE IS DISPLAY.

3. Each literal must be nonnumeric and may be any figurative constant, except ALL.

4. Literal-1, literal-2, literal-3, literal-4, and literal-5, and the data items referenced by identifier-3, identifier-4, identifier-5, identifier-6, and identifier-7 can be any number of characters in length up to the limit allowed for literals or data items.

Formats 1 and 3 Only

5. Identifier-2 must reference an elementary numeric data item.

6. If either literal-1 or literal-2 is a figurative constant, the figurative constant refers to an implicit one character data item.

Formats 2 and 3 Only

7. The size of the data referenced by literal-4 or identifier-6 must be equal to the size of the data referenced by literal-3 or identifier-5. When a figurative constant is used as literal-4, the size of the figurative constant is equal to the size of literal-3 or the size of the data item referenced by identifier-5.

8. When the CHARACTERS phrase is used, literal-4, literal-5, or the size of the data item referenced by identifier-6, identifier-7 must be one character in length.

9. When a figurative constant is used as literal-3, the data referenced by literal-4 or identifier-6 must be one character in length.

General Rules

All Formats

1. Inspection (which includes the comparison cycle, the establishment of boundaries for the BEFORE or AFTER phrase, and the mechanism for tallying and/or replacing) begins at the leftmost character position of the data item referenced by identifier-1, regardless of its class, and proceeds from left to right to the rightmost character position as described in general rules 4 through 6.

2. For use in the INSPECT statement, the contents of the data item referenced by identifier-1, identifier-3, identifier-4, identifier-5, identifier-6 or identifier-7 will be treated as follows:

   a. If any of identifier-1, identifier-3, identifier-4, identifier-5, identifier-6 or identifier-7 is described as alphanumeric, the INSPECT statement treats the contents of each such identifier as a character-string.

   b. If any of identifier-1, identifier-3, identifier-4, identifier-5, identifier-6 or identifier-7 is described as alphanumeric edited, numeric edited or unsigned numeric, the data item is inspected as though it had been redefined as alphanumeric (see general rule 2a) and the INSPECT statement had been written to reference the redefined data item.

   c. If any of identifier-1, identifier-3, identifier-4, identifier-5, identifier-6 or identifier-7 is described as signed numeric, the data item is inspected as though it had been moved to an unsigned numeric data item of the same length and then the rules in general rule 2b had been applied. (See THE MOVE STATEMENT later in this Chapter).

3. In general rules 4 through 11 all references to literal-1, literal-2, literal-3, literal-4, and literal-5 apply equally to the contents of the data item referenced by identifier-3, identifier-4, identifier-5, identifier-6, and identifier-7, respectively.

4. During inspection of the contents of the data item referenced by identifier-1, each properly matched occurrence of literal-1 is tallied (Formats 1 and 3) and/or each properly matched occurrence of literal-3 is replaced by literal-4 (Formats 2 and 3). Data items to be referenced by the INSPECT verb should be placed such that they lie within the first 10,000 bytes of intermediate code.

5. The comparison operation to determine the occurrences of literal-1 to be tallied and/or occurrences of literal-3 to be replaced, occurs as follows:

   a. The operands of the TALLYING and REPLACING phrases are considered in the order they are specified in the INSPECT statement from left to right. The first literal-1, literal-3 is compared to an equal number of contiguous characters, starting with the leftmost character position in the data item referenced by identifier-1. Literal-1, literal-3 and that portion of the contents of the data item referenced by identifier-1 match if, and only if, they are equal, character for character.

   b. If no match occurs in the comparison of the first literal-1, literal-3, the comparison is repeated with each successive literal-1, literal-3, if any, until either a match is found or there is no next successive literal-1, literal-3. When there is no next successive literal-1, literal-3, the character position in the data item referenced by identifier-1 immediately to the right of the leftmost character position considered in the last comparison cycle is considered as the leftmost character position, and the comparison cycle begins again with the first literal-1, literal-3.

   c. Whenever a match occurs, tallying and/or replacing takes place as described in general rules 8 through 10. The character position in the data item referenced by identifier-1 immediately to the right of the rightmost character position that participated in the match is now considered to be the leftmost character position of the data item referenced by identifier-1, and the comparison cycle starts again with the first literal-1, literal-3.

   d. The comparison operation continues until the rightmost character position of the data item referenced by identifier-1 has participated in a match or has been considered as the leftmost character position. When this occurs, inspection is terminated.

   e. If the CHARACTERS phrase is specified, an implied one character operand participates in the cycle described in paragraphs 5a through 5d above, except that no comparison to the contents of the data item referenced by identifier-1 takes place. This implied character is considered always to match the leftmost character of the contents of the data item referenced by identifier-1 participating in the current comparison cycle.

6. The comparison operation defined in general rule 5 is affected by the BEFORE and AFTER phrases as follows:

   a. If the BEFORE or AFTER phrase is not specified, literal-1, literal-3 or the implied operand of the CHARACTERS phrase participates in the comparison operation as described in general rule 5.

   b. If the BEFORE phrase is specified, the associated literal-1, literal-3 or the implied operand of the CHARACTERS phrase participates only in those comparison cycles which involve that portion of the contents of the data item referenced by identifier-1 from its leftmost character position up to, but not including, the first occurrence of literal-2, literal-5 within the contents of the data item referenced by identifier-1. The position of this first occurrence is determined before the first cycle of the comparison operation described in general rule 5 is begun. If, on any comparison cycle, literal-1, literal-3 or the implied operand of the CHARACTERS phrase is not eligible to participate, it is considered not to match the contents of the data item referenced by identifier-1. If there is no occurrence of literal-2, literal-5 within the contents of the data item referenced by identifier-1, its associated literal-1, literal-3, or the implied operand of the CHARACTERS phrase participates in the comparison operation as though the BEFORE phrase had not been specified.

   c. If the AFTER phrase is specified, the associated literal-1, literal-3 or the implied operand of the CHARACTERS phrase may participate only in those comparison cycles which involve that portion of the contents of the data item referenced by identifier-1 from the character position immediately to the right of the rightmost character position of the first occurrence of literal-2, literal-5 within the contents of the data item referenced by identifier-1 and the rightmost character position of the data item referenced by identifier-1. The position of this first occurrence is determined before the first cycle of the comparison operation described in general rule 5 is begun. If, on any comparison cycle, literal-1, literal-3 or the implied operand of the CHARACTERS phrase is not eligible to participate, it is considered not to match the contents of the data item referenced by identifier-1. If there is no occurrence of literal-2, literal-5 within the contents of the data item referenced by identifier-1, its associated literal-1, literal-3, or the implied operand of the CHARACTERS phrase is never eligible to participate in the comparison operation.

Format 1

7. The contents of the data item referenced by identifier-2 is not initialized by the execution of the INSPECT statement.

8. The rules for tallying are as follows:

   a. If the ALL phrase is specified, the contents of the data item referenced by identifier-2 are incremented by one for each occurrence of literal-1 matched within the contents of the data item referenced by identifier-1.

   b. If the LEADING phrase is specified, the contents of the data item referenced by identifier-2 are incremented by one for each contiguous occurrence of literal-1 matched within the contents of the data item referenced by identifier-1, provided that the leftmost such occurrence is at the point where comparison began in the first comparison cycle in which literal-1 was eligible to participate.

   c. If the CHARACTERS phrase is specified, the contents of the data item referenced by identifier-2 are incremented by one for each character matched, in the sense of general rule 5e, within the contents of the data item referenced by identifier-1.

Format 2

9. The required words ALL, LEADING, and FIRST are adjectives that apply to each succeeding BY phrase until the next adjective appears.

10. The rules for replacement are as follows:

   a. When the CHARACTERS phrase is specified, each character matched in the sense of general rule 5e in the contents of the data item referenced by identifier-1, is replaced by literal-4.

   b. When the adjective ALL is specified, each occurrence of literal-3 matched in the contents of the data item referenced by identifier-1 is replaced by literal-4.

   c. When the adjective LEADING is specified, each contiguous occurrence of literal-3 matched in the contents of the data item referenced by identifier-1 is replaced by literal-4, provided that the leftmost occurrence is at the point where comparison began in the first comparison cycle in which literal-3 was eligible to participate.

   d. When the adjective FIRST is specified, the leftmost occurrence of literal-3 matched within the contents of the data item referenced by identifier-1 is replaced by literal-4.

Format 3

11. A Format 3 INSPECT statement is interpreted and executed as though two successive INSPECT statements specifying the same identifier-1 had been written with one statement being a Format 1 statement with TALLYING phrases identical to those specified in the Format 3 statement, and the other statement being a Format 2 statement with REPLACING phrases identical to those specified in the Format 3 statement. The general rules given for matching and counting apply to the Format 1 statement and the general rules given for matching and replacing apply to the Format 2 statement.

EXAMPLES

Six examples of the use of the INSPECT statement follow:

INSPECT word TALLYING count FOR LEADING "L" BEFORE INITIAL "A", count-1 FOR LEADING "A" BEFORE INITIAL "L".

Where word = LARGE, count = 1, count-1 = 0.
Where word = ANALYST, count = 0, count-1 = 1.

INSPECT word TALLYING count FOR ALL "L", REPLACING LEADING "A" BY "E" AFTER INITIAL "L".

Where word = CALLAR, count = 2, word = CALLAR.
Where word = SALAMI, count = 1, word = SALEMI.
Where word = LATTER, count = 1, word = LETTER.

INSPECT word REPLACING ALL "A" BY "G" BEFORE INITIAL "X".

Where word = ARXAX, word = GRXAX.
Where word = HANDAX, word = HGNDGX.

INSPECT word TALLYING count FOR CHARACTERS AFTER INITIAL "J" REPLACING ALL "A" BY "B"

Where word = ADJECTIVE, count = 6, word = BDJECTIVE.
Where word = JACK, count = 3, word = JBCK.
Where word = JUJMAB, count = 5, word = JUJMBB.

INSPECT word REPLACING ALL "X" BY "Y", "B" BY "Z", "W" BY "Q" AFTER INITIAL "R".

```
     Where word = RXXBQWY, word = RYYZQQY.
     Where word = YZACDWBR, word = YZACDWZR.
     Where word = RAWRXEB, word = RAQRYEZ.
```

INSPECT word REPLACING CHARACTERS BY "B" BEFORE INITIAL "A".

```
     word before:  1 2   X  Z  A  B  C  D
     word after:   B B B B  B  A  B  C  D
```

THE MOVE STATEMENT

Function

The MOVE statement transfers data, in accordance with the rules of editing, to one or more data areas.

General Format

Format 1

$$\underline{\text{MOVE}} \quad \left\{ \begin{array}{l} \text{identifier-1} \\ \text{literal} \end{array} \right\} \quad \underline{\text{TO}} \quad \text{identifier-2} \quad [\text{, identifier-3}] \ \ldots$$

Format 2

$$\underline{\text{MOVE}} \left\{ \begin{array}{l} \underline{\text{CORRESPONDING}} \\ \underline{\text{CORR}} \end{array} \right\} \quad \text{identifer-1} \quad \underline{\text{TO}} \quad \text{identifier-2}$$

Syntax Rules

1. Identifier-1 and literal represent the sending area; identifier-2, identifier-3, ..., represent the receiving area.

2. CORR is an abreviation for CORRESPONDING.

3. When the CORRESPONDING phrase is used, both identifiers must be group items.

4. An index data item cannot appear as an operand of a MOVE statement. (See THE USAGE CLAUSE in this Chapter).

General Rules

1. If the CORRESPONDING phrase is used, selected items within identifier-1 are moved to selected items within identifier-2, according to the rules given in <u>The CORRESPONDING Phrase</u> in this Chapter. The results are the same as if the user had referred to each pair of corresponding identifiers in separate MOVE statements.

2. The data designated by the literal or identifier-1 is moved first to identifier-2, then to identifier-3, ... The rules referring to identifier-2 also apply to the other receiving areas. Any subscripting or indexing associated with identifier-2, ..., is evaluated immediately before the data is moved to the respective data item.

   Any subscripting or indexing associated with identifier-1 is evaluated only once, immediately before data is moved to the first of the receiving operands. The result of the statement:

```
MOVE a (b) TO b, c (b)
```

is equivalent to:

```
MOVE a (b) TO temp
MOVE temp TO b
MOVE temp TO c (b)
```

where 'temp' is an intermediate result item provided by the compiler.

3. Any MOVE in which the sending and receiving items are both elementary items is an elementary move. Every elementary item belongs to one of the following categories: numeric, alphabetic, alphanumeric, numeric edited, alphanumeric edited. These categories are described in the PICTURE clause. Numeric literals belong to the category numeric, and nonnumeric literals belong to the category alphanumeric. The figurative constant ZERO belongs to the category numeric. The figurative constant SPACE belongs to the category alphabetic. All other figurative constants belong to the category alphanumeric.

   The following rules apply to an elementary move between these categories:

   a. i. The figurative constant SPACE, or an alphanumeric edited, or alphabetic data item must not be moved to a numeric or numeric edited data item.

      ii. A numeric edited data item must not be moved to a numeric edited data item.

   b. A numeric literal, the figurative constant ZERO, a numeric data item or a numeric edited data item must not be moved to an alphabetic data item.

   c. A non-integer numeric literal or a non-integer numeric data item must not be moved to an alphanumeric or alphanumeric edited data item. *

   d. All other elementary moves are legal and are performed according to the rules given in general rule 4.

4. Any necessary conversion of data from one form of internal representation to another takes place during legal elementary moves, along with any editing specified for the receiving data item:

   a. When an alphanumeric edited or alphanumeric item is a receiving item, alignment and any necessary space filling takes place as defined under STANDARD ALIGNMENT RULES in this Chapter. If the size of the sending item is greater than the size of the receiving item, the excess characters are truncated on the right after the receiving item is filled. If the sending item is described as being signed numeric, the operational sign will not be moved; if the operational sign occupies a separate character position (see THE SIGN CLAUSE in this Chapter), that character will not be moved and the size of the sending item will be considered to be one less than its actual size (in terms of standard data format characters).

b. When a numeric or numeric edited item is the receiving item, alignment by decimal point and any necessary zero-filling takes place as defined under the STANDARD ALIGNMENT RULES in Chapter 2, except where zeroes are replaced because of editing requirements.

   When a signed numeric item is the receiving item, the sign of the sending item is placed in the receiving item. (See THE SIGN CLAUSE in this Chapter). Conversion of the representation of the sign takes place as necessary. If the sending item is unsigned, a positive sign is generated for the receiving item.

   When an unsigned numeric item is the receiving item, the absolute value of the sending item is moved and no operational sign is generated for the receiving item.

   When a data item described as alphanumeric is the sending item, data is moved as if the sending item were described as an unsigned numeric integer.

c. When a receiving field is described as alphabetic, justification and any necessary space-filling takes place as defined under the STANDARD ALIGNMENT RULES in Chapter 2. If the size of the sending item is greater than the size of the receiving item, the excess characters are truncated on the right after the receiving item is filled.

5. Any move that is not an elementary move is treated exactly as if it were an alphanumeric to alphanumeric elementary move, except that there is no conversion of data from one form of internal representation to another. In such a move, the receiving area will be filled without consideration for the individual elementary or group items contained within either the sending or receiving area, except as noted in general rule 4 of the OCCURS clause.

6. Data in Table 3-8 summarizes the legality of the various types of MOVE statements. The general rule reference indicates the rule that prohibits the move or the behavior of a legal move.

Table 3-8. MOVE Statement Data Categories.

Category of Sending		Category of Receiving Data Item[1]			
		Alphabetic	Alphanumeric Edited Alphanumeric	Numeric Integer Numeric Non-Integer	Numeric Edited
ALPHABETIC		Yes/4c	Yes/4a	No/3a	No/3a
ALPHANUMERIC		Yes/4c	Yes/4a	Yes/4b	Yes/4b
ALPHANUMERIC EDITED		Yes/4c	Yes/4a	No/3a	No/3a
NUMERIC	INTEGER	No/2b	Yes/4a	Yes/4b	Yes/4b
	NON-INTEGER	No/3b	No/3c	Yes/4b	Yes/4b
NUMERIC EDITED		No/3b	Yes/4a	Yes/4b	No/3a

1 - The relevant rule number is quoted in these columns

THE MULTIPLY STATEMENT

Function

The MULTIPLY statement causes numeric data items to be multiplied and sets the values of data items equal to the results.

General Format

Format 1

$$\underline{\text{MULTIPLY}} \begin{Bmatrix}\text{identifier-1}\\ \text{literal-1}\end{Bmatrix} \ \underline{\text{BY}} \ \text{identifier-2} \quad [\underline{\text{ROUNDED}}]$$

$$\left[\text{, identifier-3} \quad [\underline{\text{ROUNDED}}]\right] \ldots \quad [\text{; ON } \underline{\text{SIZE}} \ \underline{\text{ERROR}} \text{ imperative-statement}]$$

Format 2

$$\underline{\text{MULTIPLY}} \begin{Bmatrix}\text{identifier-1}\\ \text{literal-1}\end{Bmatrix} \ \underline{\text{BY}} \ \begin{Bmatrix}\text{identifier-2}\\ \text{literal-2}\end{Bmatrix} \ \underline{\text{GIVING}} \ \text{identifier-3} \quad [\underline{\text{ROUNDED}}]$$

Syntax Rules

1. Each identifier must refer to a numeric elementary item, except that in Format 2 each identifier following the word GIVING must refer to either an elementary numeric item or an elementary numeric edited item.

2. Each literal must be a numeric literal.

3. The composite of operands, which is that hypothetical data item resulting from the superimposition of all receiving data items aligned on their decimal points must not contain more than 18 digits.

General Rules

1. See The ROUNDED Phrase, The SIZE ERROR Phrase, Arithmetic Statements, Overlapping Operands and Multiple Results in Arithmetic Statements in this Chapter.

2. When Format 1 is used, the value of identifier-1 or literal-1 is multiplied by the value of identifier-2. The value of the multiplier (identifier-2) is replaced by this product; similarly for identifier-1 or literal-1 and identifier-3, etc.

3. When Format 2 is used, the value of identifier-1 or literal-1 is multiplied by identifier-2 or literal-2 and the result is stored in identifier-3, identifier-4, etc.

THE PERFORM STATEMENT

Function

The PERFORM statement is used to transfer control explicitly to one or more procedures and to return control implicitly whenever execution of the specified procedure is complete.

General Format

Format 1

```
PERFORM procedure-name-1  [ { THROUGH }  procedure-name-2 ]
                          [ { THRU    }                   ]
```

Format 2

```
PERFORM procedure-name-1 [ { THROUGH } procedure-name-2 ] { identifier-1 }  TIMES
                         [ { THRU    }                  ] {  integer-1   }
```

Format 3

```
PERFORM procedure-name-1 [ { THROUGH } procedure-name-2 ]   UNTIL condition-1
                         [ { THRU    }                  ]
```

Format 4

```
PERFORM procedure-name-1  [ { THROUGH }  procedure-name-2 ]
                          [ { THRU    }                   ]

      VARYING  { identifier-2 }  FROM  { identifier-3 }
               { index-name-1 }        { index-name-2 }
                                       { literal-1    }

               BY { identifier-4 }  UNTIL  condition-1
                  { literal-2    }

   [   AFTER  { identifier-5 }  FROM  { identifier-6 }
   [          { index-name-3 }        { index-name-4 }
   [                                  { literal-3    }

              BY { identifier-7 }  UNTIL condition-2
                 { literal-4    }

    [  AFTER  { identifier-8 }  FROM  { identifier-9 }
    [         { index-name-5 }        { index-name-6 }
    [                                 { literal-5    }

              BY { identifier-10 }  UNTIL condition-3  ] ]
                 { literal-6     }
```

Syntax Rules

1. Each identifier represents a numeric elementary item described in the Data Division. In Format 2, identifier-1 must be described as a numeric integer.

2. Each literal represents a numeric literal.

3. The words THRU and THROUGH are equivalent.

4. If an index-name is specified in the VARYING or AFTER phrase, then:

   a. The identifier in the associated FROM and BY phrases must be an integer data item.

   b. The literal in the associated FROM phrase must be a positive integer.

   c. The literal in the associated BY phrase must be a non-zero integer.

5. If an index-name is specified in the FROM phrase, then:

   a. The identifier in the associated VARYING or AFTER phrase must be an integer data item.

   b. The identifier in the associated BY phrase must be an integer data item.

   c. The literal in the associated BY phrase must be an integer.

6. The literal in the BY phrase must not be zero.

7. Condition-1, condition-2, condition-3 may be any conditional expression as described under CONDITIONAL EXPRESSIONS in this Chapter.

8. Where procedure-name-1 and procedure-name-2 are both specified and either is the name of a procedure in the declarative section of the program then both must be procedure-names in the same declarative section.

General Rules

1. The data items referenced by identifier-4, identifier-7, and identifier-10 must not have a zero value.

2. If an index-name is specified in the VARYING or AFTER phrase, and an identifier is specified in the associated FROM phrase, then the data item referenced by the identifier must have a positive value.

3. When the PERFORM statement is executed, control is transferred to the first statement of the procedure named procedure-name-1 (except as indicated in general rules 6b, 6c, and 6d). This transfer of control occurs only once for each execution of a PERFORM statement. For those cases where a transfer of control to the named procedure does take place, an implicit transfer of control to the next executable statement following the PERFORM statement is established as follows:

   a. If procedure-name-1 is a paragraph-name and procedure-name-2 is not specified, then the return is after the last statement of procedure-name-1.

   b. If procedure-name-1 is a section-name and procedure-name-2 is not specified, then the return is after the last statement of the last paragraph in procedure-name-1.

   c. If procedure-name-2 is specified and it is a paragraph-name, then the return is after the last statement of the paragraph.

   d. If procedure-name-2 is specified and it is a section-name, then the return is after the last statement of the last paragraph in the section.

4. There is no necessary relationship between procedure-name-1 and procedure-name-2 except that a consecutive sequence of operations is to be executed beginning at the procedure named procedure-name-1 and ending with the execution of the procedure named procedure-name-2. In particular, GO TO and PERFORM statements may occur between procedure-name-1 and the end of procedure-name-2. If there are two or more logical paths to the return point, then procedure-name-2 may be the name of a paragraph consisting of the EXIT statement, to which all of these paths must lead.

5. If control passes to these procedures other than via a PERFORM statement the procedures are executed right through to the next executable statement in the main program as if they were just part of the main program.

6. The PERFORM statements operate as follows with rule 5 above applying to all formats:

   a. Format 1 is the basic PERFORM statement. A procedure referenced by this type of PERFORM statement is executed once and then control passes to the next executable statement following the PERFORM statement.

   b. Format 2 is the PERFORM...TIMES. The procedures are performed the number of times specified by integer-1 or by the initial value of the data item referenced by identifier-1 for that execution. If, at the time of execution of a PERFORM statement, the value of the data item referenced by identifier-1 is equal to zero or is negative, control passes to the next executable statement following the PERFORM statement. Following the execution of the procedures the specified number of times, control is transferred to the next executable statement following the PERFORM statement.

During execution of the PERFORM statement, references to identifier-1 cannot alter the number of times the procedures are to be executed from that which was indicated by the initial value of identifier-1.

c. Format 3 is the PERFORM...UNTIL. The specified procedures are performed until the condition specified by the UNTIL phrase is true. When the condition is true, control is transferred to the next executable statement after the PERFORM statement. If the condition is true when the PERFORM statement is entered, no transfer to procedure-name-1 takes place, and control is passed to the next executable statement following the PERFORM statement.

d. Format 4 is the PERFORM...VARYING. This variation of the PERFORM statement is used to augment the values referenced by one or more identifiers or index-names in an orderly fashion during the execution of a PERFORM statement. In the following discussion, every reference to identifier as the object of the VARYING, AFTER and FROM (current value) phrases also refers to index-names. When index-name appears in a VARYING and/or AFTER phrase, it is initialized and subsequently augmented (as described below) according to the rules of the SET statement. When index-name appears in the FROM phrase and identifier appears in an associated VARYING or AFTER phrase, identifier is initialized according to the rules of the SET statement; subsequent augmentation is as described below.

In Format 4, when one identifier is varied, identifier-2 is set to the value of literal-1 or the current value of identifier-3 at the point of initial execution of the PERFORM statement; then, if the condition of the UNTIL phrase is false, the sequence of procedures, procedure-name-1 through procedure-name-2, is executed once. The value of identifier-2 is augmented by the specified increment or decrement value (the value of identifier-4 or literal-2) and condition-1 is evaluated again. The cycle continues until this condition is true; at which point, control is transferred to the next executable statement following the PERFORM statement. If condition-1 is true at the beginning of execution of the PERFORM statement, control is transferred to the next executable statement following the PERFORM statement.

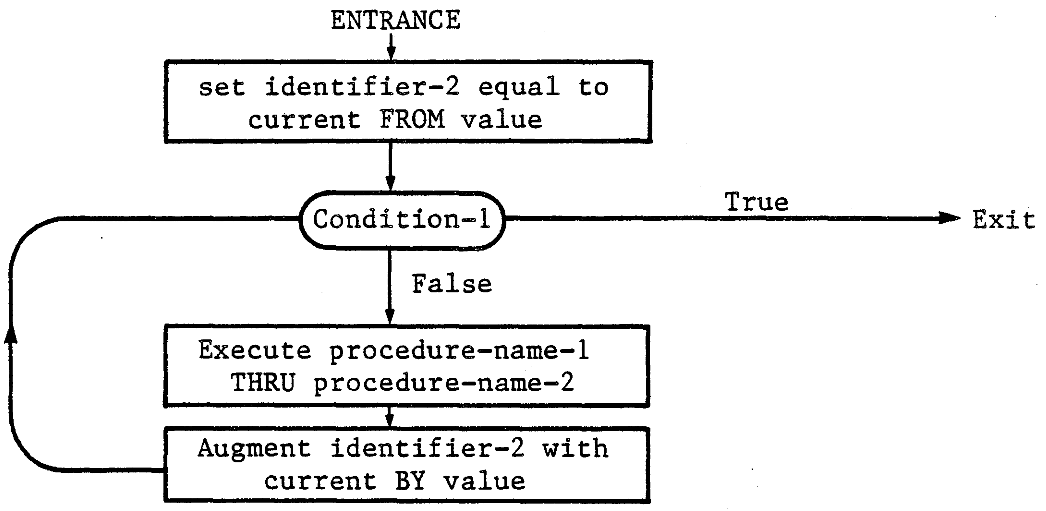

ENTRANCE
set identifier-2 equal to current FROM value
Condition-1
True
Exit
False
Execute procedure-name-1 THRU procedure-name-2
Augment identifier-2 with current BY value

Figure 3-1. Flowchart for VARYING Phrase of a PERFORM Statement Having One Condition.

In Format 4, when two identifiers are varied, identifier-2 and identifier-5 are set to the current value of identifier-3 and identifier-6, respectively. After the identifiers have been set, condition-1 is evaluated; if true, control is transferred to the next executable statement; if false, condition-2 is evaluated. If condition-2 is false, procedure-name-1 through procedure-name-2 is executed once, then identifier-5 is augmented by identifier-7 or literal-4 and condition-2 is evaluated again. This cycle of evaluation and augmentation continues until this condition is true. When condition-2 is true, identifier-5 is set to the value of literal-3 or the current value of identifier-6, identifier-2 is augmented by identifier-4 and condition-1 is re-evaluated. The PERFORM statement is completed if condition-1 is true; if not, the cycles continue until condition-1 is true.

During the execution of the procedures associated with the PERFORM statement, any change to the VARYING variable (identifier-2 and index-name-1), the BY variable (identifier-4), the AFTER variable (identifier-5 and index-name-3), or the FROM variable (identifier-3 and index-name-2) will be taken into consideration and will affect the operation of the PERFORM statement.

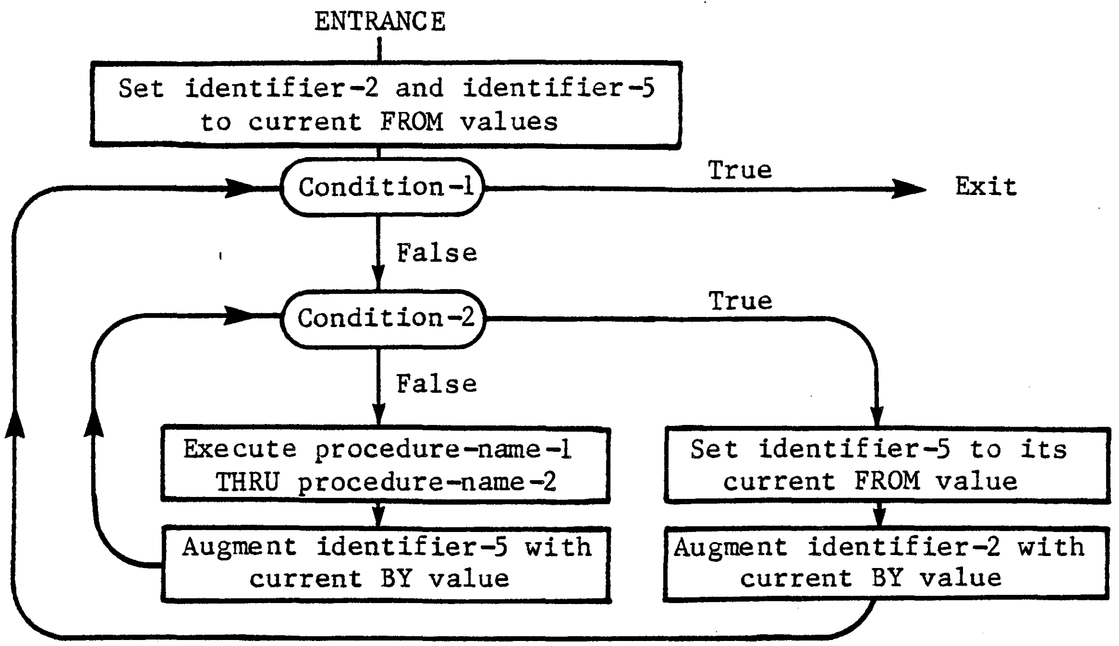

ENTRANCE
Set identifier-2 and identifier-5 to current FROM values
Condition-1
True
Exit
False
Condition-2
True
False
Execute procedure-name-1 THRU procedure-name-2
Augment identifier-5 with current BY value
Set identifier-5 to its current FROM value
Augment identifier-2 with current BY value

Figure 3-2. Flowchart for VARYING Phrase of PERFORM Statement with Two Conditions.

At the termination of the PERFORM statement identifier-5 contains the current value of identifier-6. Identifier-2 has a value that exceeds the last used setting by an increment or decrement value, unless condition-1 was true when the PERFORM statement was entered, in which case identifier-2 contains the current value of identifier-3.

When two identifiers are varied, identifier-5 goes through a complete cycle (FROM, BY, UNTIL) each time identifier-2 is varied.

For three identifiers the mechanism is the same as for two identifiers except that identifier-8 goes through a complete cycle each time that identifier-5 is augmented by identifier-7 or literal-4, which in turn goes through a complete cycle each time identifier-2 is varied.

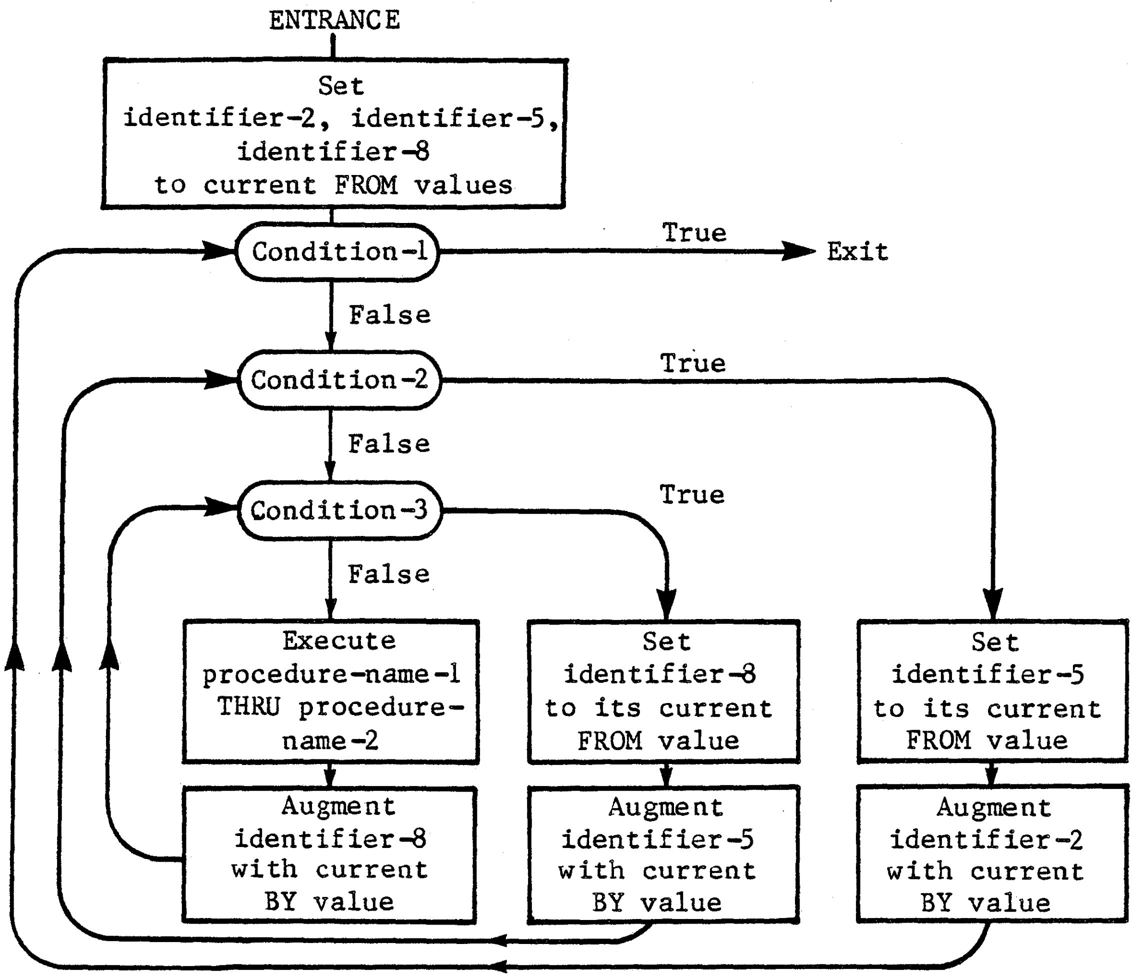

ENTRANCE
Set identifier-2, identifier-5, identifier-8 to current FROM values
Condition-1
True
Exit
False
Condition-2
True
False
Condition-3
True
False
Execute procedure-name-1 THRU procedure-name-2
Set identifier-8 to its current FROM value
Set identifier-5 to its current FROM value
Augment identifier-8 with current BY value
Augment identifier-5 with current BY value
Augment identifier-2 with current BY value

Figure 3-3. Flowchart for VARYING Phrase of PERFORM Statement with Three Conditions.

After the completion of a Format 4 PERFORM statement, identifier-5 and identifier-8 contain the current value of identifier-6 and identifier-9 respectively. Identifier-2 has a value that exceeds its last used setting by one increment or decrement value, unless condition-1 is true when the PERFORM statement is entered, in which case identifier-2 contains the current value of identifier-3.

7. If a sequence of statements referred to by a PERFORM statement includes another PERFORM statement, the sequence of procedures associated with the included PERFORM must itself either be totally included in, or totally excluded from, the logical sequence referred to by the first PERFORM. Thus, an active PERFORM statement, whose execution point begins within the range of another active PERFORM statement, must not allow control to pass to the exit of the other active PERFORM statement; furthermore, two or more such active PERFORM statements may not have a common exit. See Figure 3 - 4.

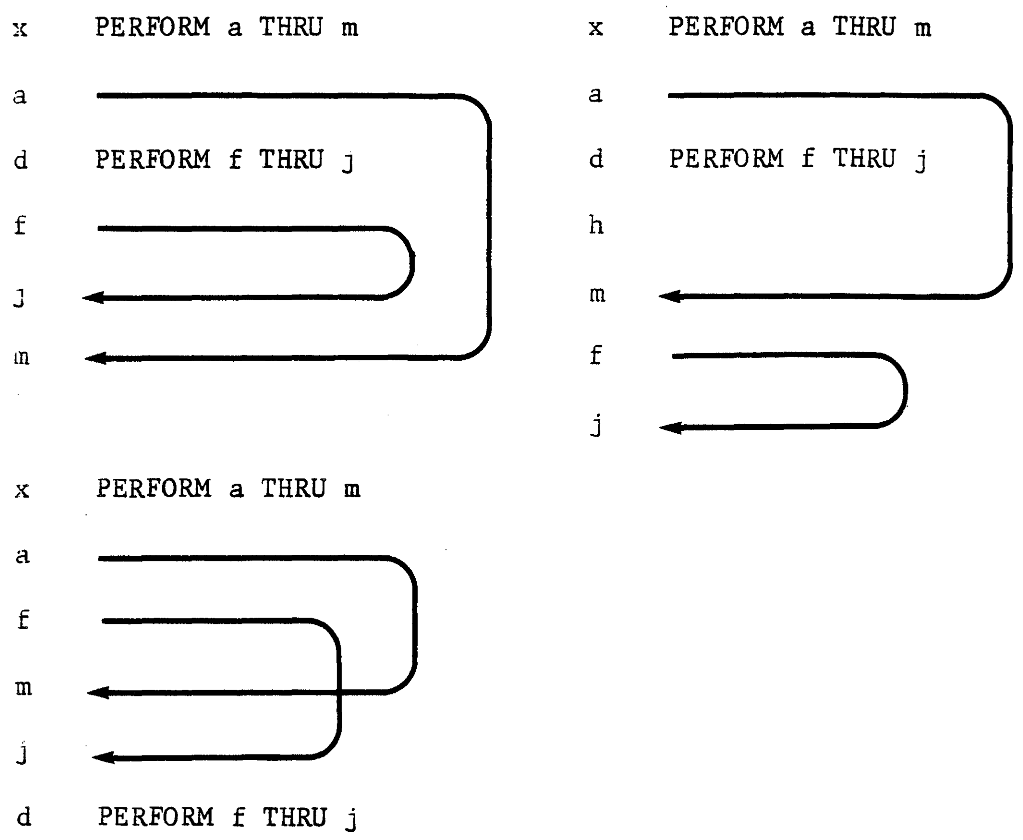


Fig. 3-4. PERFORM Statement in Sequence.

8. A PERFORM statement that appears in a section that is not an independent segment can have within its range, in addition to any declarative sections whose execution is caused within that range, only one of the following:

   a. Sections and/or paragraphs wholly contained in one or more non-independent segments.

   b. Sections and/or paragraphs wholly contained in a single independent segment.

9. A PERFORM statement that appears in an independent segment can have within its range, in addition to any declarative sections whose execution is caused within that range, only one of the following:

   a. Sections and/or paragraphs wholly contained in one or more non-independent segments.

   b. Sections and/or paragraphs wholly contained in the same independent segment as that PERFORM statement.

*

THE STOP STATEMENT

Function

The STOP statement causes a permanent or temporary suspension of the execution of the object program.

General Format

$$\underline{\text{STOP}} \quad \left\{ \begin{array}{l} \underline{\text{RUN}} \\ \text{literal} \end{array} \right\}$$

Syntax Rules

1. The literal may be numeric or non-numeric or may be any figurative constant, except ALL.

2. If the literal is numeric, then it must be an unsigned integer.

3. If a STOP RUN statement appears in a consecutive sequence of imperative statements within a sentence, it must appear as the last statement in that sequence.

General Rules

1. If the RUN phrase is used, then the operating system ending procedure is instituted.

2. If STOP literal is specified, the literal is communicated to the operator. Continuation of the object program begins with the execution of the next executable statement in sequence. Operator action to continue is dependent on the operating system. See your LEVEL II COBOL Operating Guide.

THE STRING STATEMENT

Function

The STRING statement provides juxtaposition of the partial or complete contents of two or more data items into a single data item.

General Format

```
                                                               ( identifier-3 )
STRING  { identifier-1 } [, identifier-2] ... DELIMITED BY     { literal-3    }
        { literal-1    } [, literal-2   ]                      ( SIZE         )

    [ , { identifier-4 } [, identifier-5] ...
    [   { literal-4    } [, literal-5   ]

                                   ( identifier-6 ) ]
                    DELIMITED BY   { literal-6    } ] ...
                                   ( SIZE         ) ]

    INTO  identifier-7  [WITH POINTER identifier-8]

    [; ON OVERFLOW imperative-statement]
```

Syntax Rules

1. Each literal may be any figurative constant without the optional word ALL.

2. All literals must be described as nonnumeric literals, and all identifiers, except identifier-8, must be described implicitly or explicitly as usage is DISPLAY.

3. Identifier-7 must represent an elementary alphanumeric data item without editing symbols or the JUSTIFIED clause.

4. Identifier-8 must represent an elementary numeric integer data item of sufficient size to contain a value equal to the size plus 1 of the area referenced by identifier-7. The symbol 'P' may not be used in the PICTURE character-string of identifier-8.

5. Where identifier-1, identifier-2, ..., or identifier-3 is an elementary numeric data item, it must be described as an integer without the symbol 'P' in its PICTURE character-string.

General Rules

1. All references to identifier-1, identifier-2, identifier-3, literal-1, literal-2, literal-3 apply equally to identifier-4, identifier-5, identifier-6, literal-4, literal-5 and literal-6, respectively, and all recursions thereof.

2. Identifier-1, literal-1, identifier-2, literal-2 , represent the sending items. Identifier-7 represents the receiving item.

3. Literal-3, identifier-3, indicate the character(s) delimiting the move. If the SIZE phrase is used, the complete data item defined by identifier-1, literal-1, identifier-2, literal-2 , is moved. When a figurative constant is used as the delimiter, it stands for a single character nonnumeric literal.

4. When a figurative constant is specified as literal-1, literal-2, literal-3, it refers to an implicit one-character data item where usage is DISPLAY.

5. When the STRING statement is executed, the transfer of data is governed by the following rules:

   a. Those characters from literal-1, literal-2, or from the contents of the data item referenced by identifier-1, identifier-2, are transferred to the contents of identifier-7 in accordance with the rules for alphanumeric to alphanumeric moves, except that no space-filling will be provided. (See THE MOVE STATEMENT.)

   b. If the DELIMITED phrase is specified without the SIZE phrase, the contents of the data item referenced by identifier-1, identifier-2, or the value of literal-1, literal-2, are transferred to the receiving data item in the sequence specified in the STRING statement beginning with the leftmost character and continuing from left to right until the end of the data item is reached, or until the character(s) specified by literal-3, or by the contents of identifier-3 are encountered. The character(s) specified by literal-3, or by the data item referenced by identifier-3 are not transferred.

   c. If the DELIMITED phrase is specified with the SIZE phrase, the entire contents of literal-1, literal-2, or the contents of the data item referenced by identifier-1, identifier-2, are transferred, in the sequence specified in the STRING statement, to the data item referenced by identifier-7 until all data has been transferred or the end of the data item referenced by identifier-7 has been reached.

6. If the POINTER phrase is specified, identifier-8 is explicitly available to the programmer, who is then responsible for setting its initial value. The initial value must not be less than one.

7. If the POINTER phrase is not specified, the following general rules apply as if the user had specified identifier-8 with an initial value of 1.

8. When characters are transferred to the data item referenced by identifier-7, the moves behave as though the characters were moved one at a time from the source into the character position of the data item referenced by identifier-7 designated by the value associated with identifier-8, and then identifier-8 was increased by one prior to the move of the next character. The value associated with identifier-8 is changed during execution of the STRING statement only by the behaviour specified above.

9. At the end of execution of the STRING statement, only the portion of the data item referenced by identifier-7 that was referenced during the execution of the STRING statement is changed. All other portions of the data item referenced by identifier-7 will contain data that was present before this execution of the STRING statement.

10. If at any point at or after initialization of the STRING statement, but before execution of the STRING statement is completed, the value associated with identifier-8 is either less than one or exceeds the number of character positions in the data item referenced by identifier-7, no (further) data is transferred to the data item referenced by identifier-7, and the imperative statement in the ON OVERFLOW phrase is executed, if specified.

11. If the ON OVERFLOW phrase is not specified when the conditions described in general rule 10 above are encountered, control is transferred to the next executable statement.

THE SUBTRACT STATEMENT

Function

The SUBTRACT statement is used to subtract one, or the sum of two or more, numeric data items from one or more items, and set the values of one or more items equal to the results.

General Format

Format 1

$$\underline{\text{SUBTRACT}} \begin{Bmatrix}\text{identifier-1}\\ \text{literal-1}\end{Bmatrix} \left[, \begin{Bmatrix}\text{identifier-2}\\ \text{literal-2}\end{Bmatrix}\right] \ldots \quad \underline{\text{FROM}}$$

$$\text{identifier-m} \quad [\text{ROUNDED}] \quad \left[, \text{ identifier-n} \quad [\underline{\text{ROUNDED}}]\right] \quad \ldots$$

$$[; \text{ ON } \underline{\text{SIZE}} \ \underline{\text{ERROR}} \text{ imperative-statement}]$$

Format 2

$$\underline{\text{SUBTRACT}} \begin{Bmatrix}\text{identifier-1}\\ \text{literal-1}\end{Bmatrix} \left[, \begin{Bmatrix}\text{identifier-2}\\ \text{literal-2}\end{Bmatrix}\right] \ldots \quad \underline{\text{FROM}} \begin{Bmatrix}\text{identifier-m}\\ \text{literal-m}\end{Bmatrix}$$

$$\underline{\text{GIVING}} \text{ identifier-n} \quad [\underline{\text{ROUNDED}}] \quad \left[, \text{ identifier-o} \quad [\underline{\text{ROUNDED}}]\right] \ldots$$

$$[; \text{ ON } \underline{\text{SIZE}} \ \underline{\text{ERROR}} \text{ imperative-statement}]$$

Format 3

$$\underline{\text{SUBTRACT}} \begin{Bmatrix}\underline{\text{CORRESPONDING}}\\ \underline{\text{CORR}}\end{Bmatrix} \text{ identifier-1 } \underline{\text{FROM}} \text{ identifier-2 } [\underline{\text{ROUNDED}}]$$

$$[; \text{ ON } \underline{\text{SIZE}} \ \underline{\text{ERROR}} \text{ imperative-statement}]$$

Syntax Rules

1. Each identifier must refer to a numeric elementary item except that in Format 2, each identifier following the word GIVING must refer to either an elementary numeric item or an elementary numeric edited item, and in Format 3, each identifier must refer to a group item.

2. Each literal must be a numeric literal.

3. The composite of operands must not contain more than 18 digits. (See The Arithmetic Statements in this Chapter).

    a. In Format 1 the composite of operands is determined by using all of the operands in a given statement.

    b. In Format 2 the composite of operands is determined by using all of the operands in a given statement excluding the data items that follow the word GIVING.

    c. In Format 3 the composite operands is determined separately for each pair of corresponding data items.

4. CORR is an abbreviation for CORRESPONDING.

General Rules

1. See The ROUNDED Phrase, The SIZE ERROR Phrase, Arithmetic Statements, Overlapping Operands and Multiple Results in Arithmetic Statements in this Chapter.

2. In Format 1, all literals or identifiers preceding the word FROM are added together and this total is subtracted from the current value of identifier-m storing the result immediately into identifier-m, and repeating this process respectively for each operand following the word FROM.

3. In Format 2, all literals or identifiers preceding the word FROM are added together, the sum is subtracted from literal-m or identifier-m and the result of the subtraction is stored as the new value of identifier-n, identifier-o, etc.

4. If Format 3 is used, data items in identifier-1 are subtracted from and stored into corresponding data items in identifier-2.

5. The compiler ensures enough places are carried so as not to lose significant digits during execution.

THE UNSTRING STATEMENT

Function

The UNSTRING statement causes contiguous data in a sending field to be separated and placed into multiple receiving fields.

General Format

```
UNSTRING identifier-1

[ DELIMITED BY [ALL] { identifier-2 } [ , OR [ALL] { identifier-3 } ] ... ]
                     { literal-1    }              { literal-2    }

  INTO identifier-4 [, DELIMITER IN identifier-5]

  [, COUNT IN identifier-6]

[ , identifier-7 [, DELIMITER IN identifier-8]

  [, COUNT IN identifier-9] ] ...

[WITH POINTER identifier-10] [TALLYING IN identifier-11]

[; ON OVERFLOW imperative-statement]
```

Syntax Rules

1. Each literal must be a nonnumeric literal. In addition, each literal may be any figurative constant without the optional word ALL.

2. Identifier-1, identifier-2, identifier-3, identifier-5, and identifier-8 must be described, implicitly or explicitly, as an alphanumeric data item.

3. Identifier-4 and identifier-7 may be described as either alphabetic (except that the symbol 'B' may not be used in the PICTURE character-string), alphanumeric, or numeric (except that the symbol 'P' may not be used in the PICTURE charatcer-string), and must be described as usage is DISPLAY.

4. Identifier-6, identifier-9, identifier-10, and identifier-11 must be described as elementary numeric integer data items (except that the symbol 'P' may not be used in the PICTURE character-string).

5. No identifier may name a level 88 entry.

6. The DELIMITER IN phrase and the COUNT IN phrase may be specified only if the DELIMITED BY phrase is specified.

General Rules

1. All references to identifier-2, literal-1, identifier-4, identifier-5 and identifier-6, apply equally to identifier-3, literal-2, identifier-7, identifier-8 and identifier-9, respectively, and all recursions thereof.

2. Identifier-1 represents the sending area.

3. Identifier-4 represents the data receiving area. Identifier-5 represents the receiving area for delimiters.

4. Literal-1 or the data item referenced by identifier-2 specifies a delimiter.

5. The data-item referenced by identifier-6 represents the count of the number of characters within the data item referenced by identifier-1 isolated by the delimiters for the move to the data-item referenced by identifier-4. This value does not include a count of the delimiter character(s).

6. The data item referenced by identifier-10 contains a value that indicates a relative character position within the area defined by identifier-1.

7. The data item referenced by identifier-11 is a counter that records the number of data items acted upon during the execution of an UNSTRING statement.

8. When a figurative constant is used as the delimiter, it stands for a single character nonnumeric literal.

   When the ALL phrase is specified, one occurrence or two or more contiguous occurrences of literal-1 (figurative constant or not) or the contents of the data item referenced by identifier-2 are treated as if it were only one occurrence, and this occurrence is moved to the receiving data item according to the rules in general rule 13d.

9. When any examination encounters two contiguous delimiters, the current receiving area is either space or zero filled according to the description of the receiving area.

10. Literal-1 or the contents of the data item referenced by identifier-2 can contain any character in the computer's character set.

11. Each literal-1 or the data item referenced by identifier-2 represents one delimiter. When a delimiter contains two or more characters, all of the characters must be present in contiguous positions of the sending item and in the order given, to be recognized as a delimiter.

12. When two or more delimiters are specified in the DELIMITED BY phrase, an 'OR' condition exists between them. Each delimiter is compared to the sending field. If a match occurs, the character(s) in the sending field is considered to be a single delimiter. No character(s) in the sending field can be considered a part of more than one delimiter.

    Each delimiter is applied to the sending field in the sequence specified in the UNSTRING statement.

13. When the UNSTRING statement is initiated, the current receiving area is the data item referenced by identifier-4. Data is transferred from the data item referenced by identifier-1 to the data item referenced by identifier-4 according to the following rules:

    a. If the POINTER phrase is specified, the string of characters referenced by identifier-1 is examined beginning with the relative character position indicated by the contents of the data item referenced by identifier-10. If the POINTER phrase is not specified, the string of characters is examined beginning with the leftmost character position.

    b. If the DELIMITED BY phrase is specified, the examination proceeds left to right until either a delimiter specified by the value of literal-1 or the data item referenced by identifier-2 is encountered. (See general rule 11.) If the DELIMITED BY phrase is not specified, the number of characters examined is equal to the size of the current receiving area. However, if the sign of the receiving item is defined as occupying a separate character position, the number of characters examined is one less than the size of the current receiving area.

       If the end of the data item referenced by identifier-1 is encountered before the delimiting condition is met, the examination terminates with the last character examined.

    c. The characters thus examined (excluding the delimiting character(s), if any) are treated as an elementary alphanumeric data item, and are moved into the current receiving area according to the rules for the MOVE statement. (See THE MOVE STATEMENT.)

    d. If the DELIMITER IN phrase is specified, the delimiting character(s) are treated as an elementary alphanumeric data item and are moved into the data item referenced by identifier-5 according to the rules for the MOVE statement. (See THE MOVE STATEMENT.) If the delimiting condition is the end of the data item referenced by identifier-1, then the data item referenced by identifier-5 is space-filled.

    e. If the COUNT IN phrase is specified, a value equal to the number of characters thus examined (excluding the delimiter character(s) if any) is moved into the area referenced by identifier-1 according to the rules for an elementary move.

f. If the DELIMITED BY phrase is specified the string of characters is further examined beginning with the first character to the right of the delimiter. If the DELIMITED BY phrase is not specified, the string of characters is further examined beginning with the character to the right of the last character transferred.

g. After data is transferred to the data item referenced by identifier-4, the current receiving area is the data item referenced by identifier-7. The behaviour described in paragraph 13b through 13f is repeated until either all the characters are exhausted in the data item referenced by identifier-1, or until there are no more receiving areas.

14. The initialization of the contents of the data items associated with the POINTER phrase or the TALLYING phrase is the responsibility of the user.

15. The contents of the data item referenced by identifier-10 will be incremented by one for each character examined in the data item referenced by identifier-1. When the execution of an UNSTRING statement with a POINTER phrase is complete, the contents of the data item referenced by identifier-10 will contain a value equal to the initial value plus the number of characters examined in the data item referenced by identifier-1.

16. When the execution of an UNSTRING statement with a TALLYING phrase is completed, the contents of the data item referenced by identifier-11 contains a value equal to its initial value plus the number of data receiving items acted upon.

17. Either of the following situations causes an overflow condition:

a. An UNSTRING is initiated, and the value in the data item referenced by identifier-10 is less than 1 or greater than the size of the data item referenced by identifier-1.

b. If, during execution of an UNSTRING statement, all data receiving areas have been acted upon, and the data item referenced by identifier-1 contains characters that have not been examined.

18. When an overflow condition exists, the UNSTRING operation is terminated. If an ON OVERFLOW phrase has been specified, the imperative statement included in the ON OVERFLOW phrase is executed. If the ON OVERFLOW phrase is not specified, control is transferred to the next executable statement.

19. The evaluation of subscripting and indexing for the identifiers is as follows:

    a. Any subscripting or indexing associated with identifier-1, identifier-10, identifier-11 is evaluated only once, immediately before any data is transferred as the result of the execution of the UNSTRING statement.

    b. Any subscripting or indexing associated with identifier-2, identifier-3, identifier-4, identifier-5, identifier-6 is evaluated immediately before the transfer of data into the respective data item.

CHAPTER 4

TABLE HANDLING

INTRODUCTION TO THE TABLE HANDLING MODULE

The Table Handling module provides a capability for defining tables of contiguous data items and accessing an item relative to its position in the table. Language facilities are provided for specifying how many times an item is to be repeated. Each item may be identified through use of a subscript or an index (see Chapter 2).

Table Handling provides a capability for accessing items in variable length tables of multiple dimensions. The maximum number of multiple dimensions if the ANSI switch is on (see Chapter 2) is restricted to three otherwise it is 49. In practice, however, the maximum number of multiple dimensions is restricted by the maximum size of the Data Division. In addition table handling provides facilities for specifying ascending or descending keys and permits searching a dimension of a table for an item satisfying a specified condition.

DATA DIVISION IN THE TABLE HANDLING MODULE

THE OCCURS CLAUSE

Function

The OCCURS clause eliminates the need for separate entries for repeated data items and supplies information required for the application of subscripts or indices.

General Format

Format 1

```
     OCCURS integer-2 TIMES

        [ { ASCENDING  } KEY IS data-name-2 [, data-name-3]   ...  ] ...
        [ { DESCENDING }                                           ]

           [INDEXED BY index-name-1  [, index-name-2]   ... ]
```

Format 2

```
     OCCURS integer-1 TO integer-2 TIMES DEPENDING ON data-name-1

        [ { ASCENDING  } KEY IS data-name-2   [, data-name-3]   ...  ]...
        [ { DESCENDING }                                             ]

           [INDEXED BY index-name-1  [, index-name-2]  ...]
```

(Addendum 1)

Syntax Rules

1. Where both integer-1 and integer-2 are used, the value of integer-1 must be less than the value of integer-2.
2. The data description of data-name-1 must describe a positive integer.
3. Data-name-1, data-name-2, data-name-3, ... may be qualified.
4. Data-name-2 must either be the name of the entry containing the OCCURS clause or the name of an entry subordinate to the entry containing the OCCURS clause.
5. Data-name-3, etc., must be the name of an entry subordinate to the group item which is the subject of this entry.
6. An INDEXED BY phrase is required if the subject of this entry, or an entry subordinate to this entry, is to be referred to by indexing. The index-name identified by this clause is not defined elsewhere, and not being data, cannot be associated with any data hierarchy. The compiler generates an implicit data-item with USAGE INDEX.
7. A data description entry that contains Format-2 of the OCCURS clause may only be followed, within that record description, by data description entries which are subordinate to it.
8. The OCCURS clause cannot be specified in a data description entry that:

   a. Has 01, 66, 77 or 88 level-number (if the ANSI switch has been set).

   b. Describes an item whose size is variable. The size of an item is variable if the data description of any subordinate item contains Format 2 of the OCCURS clause.
9. In Format 2, the data item defined by data-name-1 must not occupy a character position within the range of the first character position defined by the data description entry containing the OCCURS clause and the last character position defined by the record description entry containing that OCCURS clause.
10. If data-name-2 is not the subject of this entry, then:

    a. All of the items identified by the data-names in the KEY IS phrase must be within the group item which is the subject of this entry.

    b. Items identified by the data-name in the KEY IS phrase must not contain an OCCURS clause.

    c. There must not be any entry that contains an OCCURS clause between the items identified by the data-names in the KEY IS phrase and the subject of this entry.
11. Index-name-1, index-name-2, ... must be unique words within the program.

General Rules

1. The OCCURS clause is used in defining tables and other homogenous sets of repeated data items. Whenever the OCCURS clause is used, the data-name which is the subject of this entry must be either subscripted or indexed whenever it is referred to in a statement other than SEARCH or USE FOR DEBUGGING. Further, if the subject of this entry is the name of a group item, then all data-names belonging to the group must be subscripted or indexed whenever they are used as operands, except as the object of a REDEFINES clause. (See under headings Subscripting, Indexing and Identifier in Chapter 2).

2. Except for the OCCURS clause itself, all data description clauses associated with an item whose description includes an OCCURS clause apply to each occurrence of the item described. (See restriction in general rule 2 under Data Description Entries Other Than Condition Names in Chapter 3).

3. The number of occurrences of the subject entry is defined as follows:

   a. In Format 1, the value of integer-2 representing the exact number of occurrences.

   b. In Format 2, the current value of the data item referenced by data-name-1 represents the number of occurrences.

      This format specifies that the subject of this entry has a variable number of occurrences. The value of integer-2 represents the maximum number of occurrences and the value of integer-1 represents the minimum number of occurrences. This does not imply that the length of the subject of the entry is variable, but that the number of occurrences is variable.

      The value of the data item referenced by data-name-1 must fall within the range of integer-1 through integer-2. Reducing the value of the data item referenced by data-name-1 makes the contents of data items, whose occurrence numbers now exceed the value of the data item referenced by data-name-1, unpredictable.

4. When a group item, having subordinate to it an entry that specifies Format 2 of the OCCURS clause, is referenced, only that part of the table area that is specified by the value of data-name-1 will be used in the operation.

5. The KEY IS phrase is used to indicate that the repeated data is arranged in ascending or descending order according to the values contained data-name-2, data-name-3, etc. The ascending or descending order is determined according to the rules for comparison of operands (see Comparison of Numeric Operands, Comparison of Nonnumeric Operands in Chapter 3). The data-names are listed in their descending order of significance.

THE USAGE CLAUSE

Function

The USAGE clause specifies the format of a data item in the computer storage.

General Format

[USAGE IS] INDEX

Syntax Rules

1. An index data item can be referenced explicitly only in a SEARCH or SET statement, a relation condition, the USING phrase of a Procedure Division header, or the USING phrase of a CALL statement.

2. The SYNCHRONIZED, JUSTIFIED, PICTURE, VALUE and BLANK WHEN ZERO clauses cannot be used to describe group or elementary items described with the USAGE IS INDEX clause.

General Rules

1. The USAGE clause can be written at any level. If the USAGE clause is written at a group level, it applies to each elementary item in the group. The USAGE clause of an elementary item cannot contradict the USAGE clause of a group to which the item belongs.

2. An elementary item described with the USAGE IS INDEX clause is called an index data item and contains a value which must correspond to an occurrence number of a table element. The elementary item cannot be a conditional variable. The compiler will allocate a 2 byte binary field with an implied Picture of 9(4) COMP. If a group item is described with the USAGE IS INDEX clause the elementary items in the group are all index data items. The group itself is not an index data item and cannot be used in the SEARCH or SET statement or in a relation condition.

3. An index data item can be part of a group which is referred to in a MOVE or input-output statement, in which case no conversion will take place.

PROCEDURE DIVISION IN THE TABLE HANDLING MODULE

RELATION CONDITION

Comparisons Involving Index-Names and/or Index Data Items

Relation tests may be made between the following data items:

* Two index-names. The result is the same as if the corresponding occurrence numbers were compared.

* An index-name and a data item (other than an index data item) or literal. The occurrence number that corresponds to the value of the index-name is compared to the data item or literal.

* An index data item and an index-name or another index data item. The actual values are compared without conversion.

* The result of the comparison of an index data item with any data item or literal not specified above is undefined.

OVERLAPPING OPERANDS

When a sending and a receiving item in a SET statement share a part of their storage areas, the result of the execution of such a statement is undefined.

THE SEARCH STATEMENT

Function

The SEARCH statement is used to search a table for a table element that satisfies the specified condition and to adjust the associated index-name to indicate that table element.

General Format

Format 1

```
    SEARCH identifier-1  [VARYING {identifier-2 }]
                                  {index-name-1 }

        [; AT END imperative-statement-1]

         ; WHEN condition-1 {imperative-statement-2 }
                            {NEXT SENTENCE         }

        [; WHEN condition-2 {imperative-statement-3 }]  ...
                            {NEXT SENTENCE         }
```

Format 2

```
SEARCH ALL identifier-1  [; AT END imperative-statement-1]

         { data-name-1  {IS EQUAL TO} {identifier-3           } }
  ; WHEN {              {IS =       } {literal-1              } }
         {                            {arithmetic-expression-1} }
         { condition-name-1                                     }

  [      { data-name-2  {IS EQUAL TO} {identifier-4           } } ]
  [  AND {              {IS =       } {literal-2              } } ]
  [      {                            {arithmetic-expression-2} } ]
  [      { condition-name-2                                     } ]

  {imperative-statement-2}
  {NEXT SENTENCE         }
```

NOTE: The required relational character '=' is not underlined to avoid confusion with other symbols.

Syntax Rules

1. In both Formats 1 and 2, identifier-1 must not be subscripted or indexed, but its description must contain an OCCURS clause and an INDEXED BY clause. The description of identifier-1 in Format 2 must also contain the KEY IS phrase in its OCCURS clause.

2. Identifier-2, when specified, must be described as USAGE IS INDEX or as a numeric elementary item without any positions to the right of the assumed decimal point.

3. In Format 1, condition-1, condition-2, etc., may be any condition as described in CONDITION EXPRESSIONS in Chapter 3.

4. In Format 2, all referenced condition-names must be defined as having only a single value. The data-name associated with a condition-name must appear in the KEY clause of identifier-1. Each data-name-1, data-name-2 may be qualified. Each data-name-1, data-name-2 must be indexed by the first index-name associated with identifier-1 along with other indices or literals as required, and must be referenced in the KEY clause of identifier-1. Identifier-3, identifier-4, or identifiers specified in arithmetic-expression-1, arithmetic-expression-2 must not be referenced in the KEY clause of identifier-1 or be indexed by the first index-name associated with identifier-1.

   In Format 2, when a data-name in the KEY clause of identifier-1 is referenced, or when a condition-name associated with a data-name in the KEY clause of identifier-1 is referenced, all preceding data-names in the KEY clause of identifier-1 or their associated condition-names must also be referenced.

General Rules

1. If Format 1 of the SEARCH is used, a serial type of search operation takes place, starting with the current index setting.

   a. If, at the start of execution of the SEARCH statement, the index-name associated with identifier-1 contains a value that corresponds to an occurrence number that is greater than the highest permissible occurrence number for identifier-1, the SEARCH is terminated immediately. The number of occurrences of identifier-1, the last of which is the highest permissible, is discussed in the occurs clause. (See THE OCCURS CLAUSE in Chapter 4.) Then, if the AT END phrase is specified, imperative-statement-1 is executed; if the AT END phrase is not specified, control passes to the next executable sentence.

   b. If, at the start of execution of the SEARCH statement, the index-name associated with identifier-1 contains a value that corresponds to an occurrence number that is not greater than the highest permissible occurrence number for identifier-1 (the number of occurrences of identifier-1, the last of which is the highest permissible is discussed in the OCCURS clause); the SEARCH statement operates by evaluating the conditions in the order that they are written, making use of the index settings, wherever specified, to determine the occurrence of those items to be tested. If none of the conditions is satisfied, the index-name for identifier-1 is incremented to obtain reference to the next occurrence. The process is then repeated using the new index-name settings unless the new value of the index-name settings for identifier-1 corresponds to a table element outside the permissible range of occurrence values, in which case the search terminates as indicated in 1a above. If one of the conditions is satisfied upon its evaluation, the search terminates immediately and the imperative statement associated with that condition is executed; the index-name remains set at the occurrence which caused the condition to be satisfied.

2. In a Format 2 SEARCH, the results of the SEARCH ALL operation are predictable only when:

   a. The data in the table is ordered in the same manner as described in the ASCENDING/DESCENDING KEY clause associated with the description of identifier-1, and

   b. The contents of the key(s) referenced in the WHEN clause are sufficient to identify a unique table element.

3. If Format 2 of the SEARCH is used, a non-serial type of search operation may take place; the initial setting of the index-name for identifier-1 is ignored and its setting is varied during the search

operation with the restriction that at no time is it set to a value that exceeds the value which corresponds to the last element of the table, or that is less than the value that corresponds to the first element of the table. The length of the table is discussed in the OCCURS clause. If any of the conditions specified in the WHEN clause cannot be satisfied for any setting of the index within the permitted range, control is passed to imperative-statement-1 of the AT END phrase, when specified, or to the next executable sentence when this phrase is not specified; in either case the final setting of the index is not predictable. If all conditions can be satisfied, the index indicates an occurrence that allows the conditions to be satisfied, and control passes to imperative-statement-2.

4. After execution of imperative-statement-1, imperative-statement-2, or imperative-statement-3, that does not terminate with a GO TO statement, control passes to the next executable sentence.

5. In Format 2, the index-name that is used for the search operation is the first (or only) index-name that appears in the INDEXED BY phrase of identifier-1. Any other index-names for identifier-1 remain unchanged.

6. In Format 1, if the VARYING phrase is not used, the index-name that is used for the search operation is the first (or only) index-name that appears in the INDEXED BY phrase of identifier-1. Any other index-names for identifier-1 remain unchanged.

7. In Format 1, if the VARYING index-name-1 phrase is specified, and if index-name-1 appears in the INDEXED BY phrase of identifier-1, that index-name is used for this search. If this is not the case, or if the VARYING identifier-2 phrase is specified, the first (or only) index-name given in the INDEXED BY phrase of identifier-1 is used for the search. In addition, the following operations will occur:

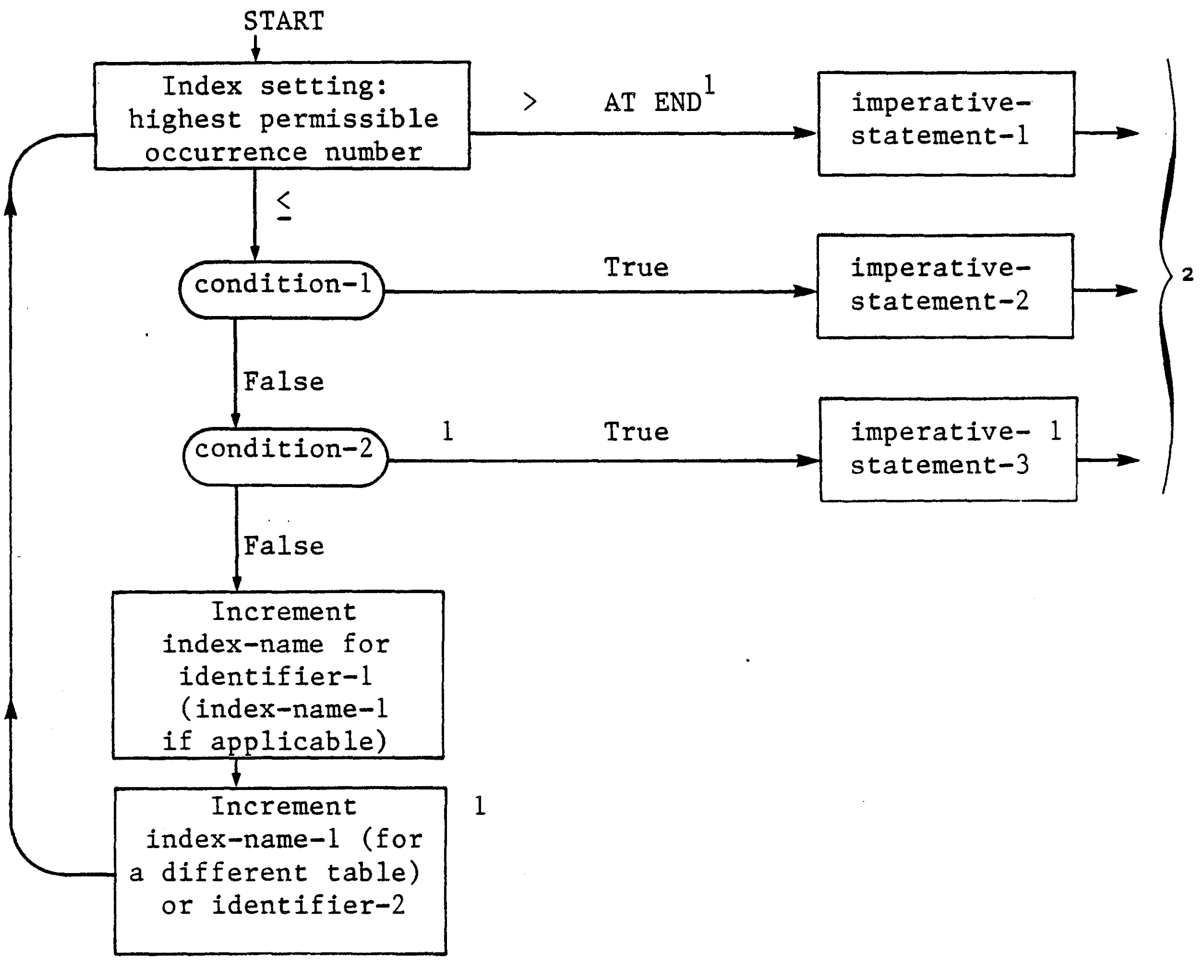
   a. If the VARYING index-name-1 phrase is used, and if index-name-1 appears in the INDEXED BY phrase of another table entry, the occurrence number represented by index-name-1 is incremented by the same amount as, and at the same time as, the index-name associated with identifier-1 is incremented.

   b. If the VARYING identifier-2 phrase is specified, and identifier-2 is an index data item, then the data item referenced by identifier-2 is incremented by the same amount as, and at the same time as, the index associated with identifier-1 is incremented. If identifier-2 is not an index data item, the data item referenced by identifier-2 is incremented by the value (1) at the same time as the index referenced by the index-name associated with identifier-1 is incremented.

8. If identifier-1 is a data item subordinate to a data item that contains an OCCURS clause (providing for a two or three dimensional table), an index-name must be associated with each dimension of the table through the INDEXED BY phrase of the OCCURS clause. Only the setting of the

index-name associated with identifier-1 (and the data item identifier-2 or index-name-1, if present) is modified by the execution of the SEARCH statement. To search an entire two or three dimensional table is not necessary to execute a SEARCH statement several times. Prior to each execution of a SEARCH statement, SET statements must be executed whenever index-names must be adjusted to appropriate settings.

Figure 4-1 shows a flowchart of the Format 1 SEARCH operation containing two WHEN phrases.


START
Index setting: highest permissible occurrence number
>
AT END 1
imperative-statement-1
≤
condition-1
True
imperative-statement-2
False
condition-2
1
True
imperative-statement-3 1
False
Increment index-name for identifier-1 (index-name-1 if applicable)
Increment index-name-1 (for a different table) or identifier-2
1
2

1 - These operations are options included only when specified in the SEARCH statement.

2 - Each of these control transfers is to the next executable sentence unless the imperative-statement ends with a GO TO statement.

Figure 4-1. Flowchart of SEARCH Operation with Two WHEN Phrases.

THE SET STATEMENT

Function

The SET statement establishes reference points for table handling operations by setting index-names associated with table elements.

General Format

Format 1

```
                                                          (identifier-3 )
    SET {identifier-1    [, identifier-2]        ...}  TO {index-name-3 }
        {index-name-1    [, index-name-2]        ...}     (integer-1    )
```

Format 2

```
    SET ( index-name-4    [, index-name-5] )  ... {UP BY  } (identifier-4 )
        ( identifier-5    [, identifier-6] )  ... {DOWN BY} {integer-2    }
                                                            (index-name-6 )
```

Syntax Rules

1. All references to index-name-1, identifier-1, index-name-4 and identifier-5 apply equally to index-name-2, identifier-2, index-name-5 and identifier-6, respectively.

2. Identifier-1, identifier-3 and identifier-5 must name either index data items, or elementary items described as an integer.

3. Identifier-4 must be described as an elementary numeric integer.

4. Integer-1 and integer-2 may be signed. Integer-1 must be positive.

General Rules

1. Index-names are considered related to a given table if the ANSI switch is set and are defined by being specified in the INDEXED BY clause.

2. If index-name-3 is specified, the value of the index before the execution of the SET statement must correspond to an occurrence number of an element in the associated table.

If index-name-4, index-name-5 is specified, the value of the index both before and after the execution of the SET statement must correspond to an occurrence number of an element in the associated table. If index-name-1, index-name-2 is specified, the value of the index after the execution of the SET statement must correspond to an occurrence number of an element in the associated table. The value of the index associated with an index-name after the execution of a SEARCH or PERFORM statement may be undefined. (See THE SEARCH STATEMENT and THE PERFORM STATEMENT in Chapter 3).

3. In Format 1, the following action occurs:

   a. Index-name-1 is set to a value causing it to refer to the table element that corresponds in occurrence number to the table element referenced by index-name-3, identifier-3, or integer-1. If identifier-3 is an index data item, or if index-name-3 is related to the same table as index-name-1, no conversion takes place.

   b. If identifier-1 is an index data item, it may be set equal to either the contents of index-name-3 or identifier-3 where identifier-3 is also an index item; no conversion takes place in either case.

   c. If identifier-1 is not an index data item, it may be set only to an occurrence number that corresponds to the value of index-name-3. Neither identifier-3 nor integer-1 can be used in this case.

   d. The process is repeated for index-name-2, identifier-2, etc., if specified. Each time the value of index-name-3 or identifier-3 is used as it was at the beginning of the execution of the statement. Any subscripting or indexing associated with identifier-1, etc., is evaluated immediately before the value of the respective data item is changed.

4. In Format 2, the contents of index-name-4 are incremented (UP BY) or decremented (DOWN BY) by a value that corresponds to the number of occurrences represented by the value of integer-2 or identifier-4; thereafter, the process is repeated for index-name-5, etc. Each time the value of identifier-4 is used as it was at the beginning of the execution of the statement.

5. Data in Table 4-1 represents the validity of various operand combinations in the SET statement. The general rule reference indicates the applicable general rule.

Table 4-1. SET Statement Valid Operand Combinations.

Sending Item	Receiving Item[1]		
	Integer Data Item	Index-Name	Index Data Item
Integer Literal	No/3c	Valid/3a	No/3b
Integer Data Item	No/3c	Valid/3a	No/3b
Index-Name	Valid/3c	Valid/3a	Valid/3b[2]
Index Data Item	No/3c	Valid/3a[2]	Valid/3b[2]

1 = Rule numbers under General Rules above are referred to.
2 = No conversion takes place

CHAPTER 5

SEQUENTIAL INPUT AND OUTPUT

INTRODUCTION TO THE SEQUENTIAL I-O MODULE

The Sequential I-O module provides a capability to access records of a file in established sequence. The sequence is established as a result of writing the records to the file. It also provides for the specification of re-run points and the sharing of memory areas among files.

LANGUAGE CONCEPTS

Organization

Sequential files are organized such that each record in the file except the first has a unique predecessor record, and each record except the last has a unique successor record. These predecessor-successor relationships are established by the order of WRITE statements when the file is created. Once established, the predecessor-successor relationships do not change except in the case where records are added to the end of the file.

Access Mode

In the sequential access mode, the sequence in which records are accessed is the order in which the records were originally written.

Current Record Pointer

The current record pointer is a conceptual entity used in this document to facilitate specification of the next record to be accessed within a given file. The concept of the current record pointer has no meaning for a file opened in the output mode. The setting of the current record pointer is affected only by the OPEN and READ statements.

I-O Status

If the FILE STATUS clause is specified in a file control entry, a value is placed into the specified two-character data item during the execution of an OPEN, CLOSE, READ, WRITE, or REWRITE statement and before any applicable USE procedure is executed, to indicate to the COBOL program the status of that input-output operation.

Status Key 1

The leftmost character position of the FILE STATUS data item is known as Status Key 1 and is set to indicate one of the following conditions upon completion of the input-output operation.

'0'	-	indicates Successful Completion
'1'	-	indicates At End
'3'	-	indicates Permanent Error
'9'	-	indicates an Operating System Error Message

The meaning of the above indications are as follows:

0 - Successful Completion. The input-output statement was successfully executed.

1 - At End. The sequential READ statement was unsuccessfully executed either as a result of an attempt to read a record when no next logical record exists in the file or as a result of the first READ statement being executed for a file described with the OPTIONAL clause, and that file was not available to the program at the time its associated OPEN statement was executed.

3 - Permanent Error. The input-output statement was unsuccessfully executed as the result of a boundary violation for a sequential file or as the result of an input-output error, such as data check parity error, or transmission error.

9 - Operating System Error Message. The input-output statement was unsuccessfully executed as a result of a condition that is specified by the Operating System Error Message. This value is used only to indicate a condition not indicated by other defined values of status key 1, or by specified combinations of the values of status key 1 and status key 2.

Status Key 2

The rightmost character position of the FILE STATUS data item is known as Status Key 2 and is used to further describe the results of the input-output operation. This character will contain a value as follows:

* If no further information is available concerning the input-output operation, then status key 2 contains a value of '0'.

* When status key 1 contains a value of '3' an irrecoverable error has occurred. This is treated as a fatal error by the Operating System.

* When status key 1 contains a value of '9', the value of status key 2 is the operating system error message number (for those operating systems which designate errors numerically). The LEVEL II COBOL Operating Guide contains details of this status-key-2 representation.
  Note that it is not possible to extract this number directly.

Valid Combinations of Status Keys 1 and 2

The valid permissible combinations of the values of status key 1 and status key 2 are shown in the following table. An 'X' at an intersection indicates a valid permissible combination.

Status Key 1	Status Key 2 No Further Information (0)
Successful Completion (0)	X
At End (1)	X
Permanent Error (3)	X
Implementor Defined (9)	O/S Error Number

The AT END Condition

The AT END condition can occur as a result of the execution of a READ statement. For details of the causes of the condition, see THE READ STATEMENT later in this Chapter.

LINAGE-COUNTER

The reserved word LINAGE-COUNTER is a name for a special register generated by the presence of a LINAGE clause in a file description entry. The implicit description is that of an unsigned integer whose size is equal to integer-1 or the data item referenced by data-name-1 in the LINAGE clause. See THE LINAGE CLAUSE later in this Chapter.

ENVIRONMENT DIVISION IN THE SEQUENTIAL I-O MODULE

INPUT-OUTPUT SECTION

The FILE-CONTROL Paragraph

Function

The FILE-CONTROL paragraph names each file and allows specification of other file-related information.

General Format

```
{FILE-CONTROL.}    {file-control-entry}   ...
```

The FILE CONTROL Entry

Function

The file control entry names a file and may specify other file-related information.

General Format

```
    SELECT    [OPTIONAL]  file-name

        ASSIGN TO {external-file-name-literal} [, {external-file-name-literal}]
                  {file-identifier           } [  {file-identifier           }]

        [; RESERVE integer-1 [AREA ]]
                             [AREAS]

        [; ORGANIZATION IS {SEQUENTIAL     }]
                           {LINE SEQUENTIAL}

        [; ACCESS MODE IS SEQUENTIAL]

        [; FILE STATUS IS data-name-1]   .
```

Syntax Rules

1. The SELECT clause must be specified first in the file control entry. The clauses which follow the SELECT clause may appear in any order.

2. Each file described in the Data Division must be named once and only once as file-name in the FILE-CONTROL paragraph. Each file specified in the file control entry must have a file description entry in the Data Division.

3. If the ACCESS MODE clause is not specified, the ACCESS MODE IS SEQUENTIAL clause is implied.

4. Data-name-1 must be defined in the Data Division as a two-character data item of the category alphanumeric and must not be defined in the File Section or the Communication Section.

5. Data-name-1 may be qualified.

6. When the ORGANIZATION IS SEQUENTIAL clause is not specified, the ORGANIZATION IS SEQUENTIAL clause is implied.

7. The OPTIONAL phrase may only be specified for input files. Its specification is required for input files that are not necessarily present each time the object program is executed.

8. File-identifier is any user-defined word, but must not be the same as file-name.

General Rules

1. The ASSIGN clause specifies the association of the file referenced by file-name to a storage medium. See the L/II COBOL Operating Guide. The first assignment takes effect. Subsequent assignments within any one ASSIGN clause are for documentation purposes only.

2. The RESERVE clause allows the user to specify the number of input-output areas allocated. The RESERVE clause is treated for documentation purposes only, unless the LEVEL II COBOL Operating Guide specific to your operating system indicates otherwise.

3. The ORGANIZATION clause specifies the logical structure of a file. The file organization is established at the time a file is created and cannot subsequently be changed.

4. When LINE SEQUENTIAL ORGANIZATION is specified, the file is treated as consisting of variable length records, each record containing one line of data. The definition of a line of data varies with different operating systems. Some terminate line "records" with the Carriage Return and Line Feed characters, or one of them, and some pad out as fixed length records. LEVEL II COBOL therefore is always compatible with the Editor software in any Operating System in this respect.

5. Records in the file are accessed in the sequence dictated by the file organization. This sequence is specified by predecessor-successor record relationships established by the execution of WRITE statements when the file is created or extended.

6. When the FILE STATUS clause is specified, a value will be moved by the operating system into the data item specified by data-name-1 after the

execution of every statement that references that file either explicitly or implicitly. This value indicates the status of execution of the statement (See I-O STATUS in this Chapter).

7. File-identifier will be implicitly defined if it is not explicitly defined.

The I-O-CONTROL Paragraph

Function

The I-O CONTROL paragraph specifies the points at which re-run is to be established, the memory area which is to be shared by different files, and the location of files on a multiple file reel.

General Format

```
I-O-CONTROL.

                                                  { {[END OF] {REEL}          }              }
                                                  { {         {UNIT}          } OF file-name-2 }
[; RERUN [ON {file-name-1        }] EVERY         { {  integer-1 RECORDS      }              }   ]
             {implementor-name   }                { integer-2 CLOCK-UNITS                    } ...
                                                  { condition-name                            }

[; SAME   [RECORD]  AREA FOR file-name-3 {, file-name-4 } ...  ]   ...

[; MULTIPLE FILE TAPE CONTAINS file-name-5 [POSITION integer-3]

          [file-name-6 [POSITION integer-4]]  ...]...
```

Syntax Rules

1. The I-O-CONTROL paragraph is optional.

2. File-name-1 must be a sequentially organized file.

3. The END OF REEL/UNIT clause may only be used if file-name-2 is a sequentially organized file.

4. When either the integer-1 RECORDS clause or the integer-2 CLOCK-UNITS clause is specified, implementor-name must be given in the RERUN clause.

5. More than one RERUN clause may be specified for a given file-name-2 subject to the following restrictions:

   a. When multiple integer-1 RECORD clauses are specified, no two of them can specify the same file-name-2.

b. When multiple END OF REEL or END OF UNIT clauses are specified, no two of them may specify the same file-name-2.

6. The two forms of the SAME clause (SAME AREA, SAME RECORD AREA) are considered separately in the following:

   More than one SAME clause may be included in a program, however:

   a. a file-name must not appear in more than one SAME AREA clause.

   b. a file-name must not appear in more than one SAME RECORD AREA clause.

   c. If one or more file-names of a SAME AREA clause appear in a SAME RECORD AREA clause, all of the file-names in that SAME AREA clause must appear in the SAME RECORD AREA clause. However, additional file-names not appearing in that SAME AREA clause may also appear in that SAME RECORD AREA clause. The rule that only one of the files mentioned in a SAME AREA clause can be open at any given time takes precedence over the rule that all files mentioned in a SAME RECORD AREA clause can be open at any given time.

7. The files referenced in the SAME AREA or SAME RECORD AREA clause need not all have the same organization or access.

General Rules

1. The RERUN clause is treated as for documentation purposes only.

2. The SAME AREA clause specifies that two or more files that do not represent sort or merge files are to use the same memory area during processing. The area being stored includes all storage area assigned to the files specified; therefore, it is not valid to have more than one of the files open at the same time. (See Syntax Rule 6c).

3. The SAME RECORD AREA clause specifies that two or more files are to use the same memory area for processing of the current logical record. All of the files may be open at the same time. A logical record in the SAME RECORD AREA is considered as a logical record of each opened output file whose file-name appears in this SAME RECORD AREA clause and of the most recently read input file whose file-name appears in this SAME RECORD AREA clause. This is equivalent to an implicit redefinition of the area i.e., records are aligned on the leftmost character position.

4. The MULTIPLE FILE clause is treated as for documentation purposes only.

DATA DIVISION IN THE SEQUENTIAL I-O MODULE

FILE SECTION

In an LEVEL II COBOL program the file description entry (FD) represents the highest level of organization in the File Section. The File Section header is followed by a file description entry consisting of a level indicator (FD), a file-name and a series of independent clauses. The FD clauses specify the size of the logical and physical records, the presence or absence of label records, the value of implementor-defined label items, the names of the data records which comprise the file. The entry itself is terminated by a period.

RECORD DESCRIPTION STRUCTURE

A record description consists of a set of data description entries which describe the characteristics of a particular record. Each data description entry consists of a level-number followed by a data-name if required, followed by a series of independent clauses as required. A record description has a hierarchical structure and therefore the clauses used with an entry may vary considerably, depending upon whether or not it is followed by subordinate entries. The structure of a record description is defined in CONCEPT OF LEVELS in Chapter 2, while the elements allowed in a record description are shown in the Data Description - Complete Entry Skeleton in Chapter 3.

THE FILE DESCRIPTION - COMPLETE ENTRY SKELETON

Function

The file description furnishes information concerning the physical structure, identification, and record names pertaining to a given file.

General Format

```
FD   file-name

   [; BLOCK CONTAINS  [integer-1 TO]    integer-2    {RECORDS   }]
                                                     {CHARACTERS}

    [; RECORD CONTAINS [integer-3 TO] integer-4 CHARACTERS]

   [; LABEL {RECORD IS  } {STANDARD}]
            {RECORDS ARE} {OMITTED }

   [; VALUE OF data-name-1 IS       {data-name-2}
                                    {literal-1  }
          [, data-name-3  IS    {data-name-4}   ] ...]
                                {literal-2  }

   [; DATA {RECORD IS  }
           {RECORDS ARE}  data-name-3   [, data-name-4] ...]

   [; LINAGE IS {data-name-5}  LINES  [, WITH FOOTING AT  {data-name-6}]
                {integer-5  }                             {integer-6  }

     [, LINES AT TOP  {data-name-7}] [, LINES AT BOTTOM  {data-name-8}]]
                      {integer-7  }                      {integer-8  }

   [; CODE-SET IS alphabet-name]  .
```

Syntax Rules

1. The level indicator FD identifies the beginning of a file description and must precede the file-name.

2. The clauses which follow the name of the file are optional in many cases, and their order of appearance is immaterial. All clauses are optional when the ANSI switch is unset (See Chapter 2).

3. One or more record description entries must follow the file description entry.

THE BLOCK CONTAINS CLAUSE

Function

The BLOCK CONTAINS clause specifies the size of a physical record.

General Format

$\underline{\text{BLOCK}}$ CONTAINS [integer-1 $\underline{\text{TO}}$] integer-2 $\left\{\begin{array}{l}\underline{\text{RECORDS}}\\ \text{CHARACTERS}\end{array}\right\}$

General Rule

This clause is required for documentation purposes only.

THE CODE-SET CLAUSE

Function

The CODE-SET clause specifies the character code set used to represent data on the external media.

General Format

$\underline{\text{CODE-SET}}$ IS alphabet-name

Syntax Rules

1. When the CODE-SET clause is specified for a file, all data in that file must be described as usage is DISPLAY and any signed numeric data must be described with the SIGN IS SEPARATE clause.

2. The alphabet-name clause referenced by the CODE-SET clause must not specify the literal phrase.

3. The CODE-SET clause may only be specified for non-disk files.

General Rule

The CODE-SET clause is specified for documentation purposes only.

THE DATA RECORDS CLAUSE

Function

The DATA RECORDS clause serves only as documentation for the names of data records with their associated file.

General Format

$$\underline{\text{DATA}} \left\{ \begin{matrix} \underline{\text{RECORD}}\ \text{IS} \\ \underline{\text{RECORDS}}\ \text{ARE} \end{matrix} \right\} \text{ data-name-1 } \quad [\text{, data-name-2}] \quad \ldots$$

Syntax Rule

Data-name-1 and data-name-2 are the names of data records and should have 01 level-number record descriptions, with the same names, associated with them.

General Rules

1. The presence of more than one data-name indicates that the file contains more than one type of data record. These records may be of differing sizes, different formats, etc. The order in which they are listed is not significant.

2. Conceptually, all data records within a file share the same area. This is in no way altered by the presence of more than one type of data record within the file.

THE LABEL RECORDS CLAUSE

Function

The LABEL RECORDS clause specifies whether labels are present.

General Format

$$\underline{\text{LABEL}} \quad \left\{ \begin{matrix} \underline{\text{RECORD}}\ \text{IS} \\ \underline{\text{RECORDS}}\ \text{ARE} \end{matrix} \right\} \left\{ \begin{matrix} \underline{\text{STANDARD}} \\ \underline{\text{OMITTED}} \end{matrix} \right\}$$

Syntax Rule

This clause is required in every file description entry, when the ANSI switch is set.

General Rule

This clause is used for documentation purposes only.

THE LINAGE CLAUSE

Function

The Linage clause provides a means for specifying the depth of a logical page in terms of number of lines. It also provides for specifying the size of the top and bottom margins on the logical page, and the line number, within the page body, at which the footing area begins.

(Addendum 1)

General Format

```
LINAGE IS {data-name-1} LINES [, WITH FOOTING AT {data-name-2}]
          {integer-1  }                          {integer-2  }

   [,LINES AT TOP {data-name-3}]  [,LINES AT BOTTOM {data-name-4}]
                  {integer-3  }                     {integer-4  }
```

Syntax Rules

1. Data-name-1, data-name-2, data-name-3, data-name-4 must reference elementary unsigned numeric integer data items.

2. The value of integer-1 must be greater than zero.

3. The value of integer-2 must not be greater than integer-1.

4. The value of integer-3, integer-4 may be zero.

General Rules

1. The LINAGE clause provides a means for specifying the size of a logical page in terms of number of lines. The logical page size is the sum of the values referenced by each phrase except the FOOTING phrase. If the LINES AT TOP or LINES AT BOTTOM phrases are not specified, the values for these functions are zero. If the FOOTING phrase is not specified, the assumed value is equal to integer-1, or the contents of the data item referenced by data-name-1, whichever is specified.

   There is not necessarily any relationship between the size of the logical page and the size of a physical page.

2. The value of integer-1 or the data item referenced by data-name-1 specifies the number of lines that can be written and/or spaced on the logical page. The value must be greater than zero. That part of the logical page in which these lines can be written and/or spaced is called the page body.

3. The value of integer-3 or the data item referenced by data-name-3 specifies the number of lines that comprise the top margin on the logical page. The value may be zero.

4. The value of integer-4 or the data item referenced by data-name-4 specifies the number of lines that comprise the bottom margin on the logical page. The value may be zero.

5. The value of integer-2 or the data item referenced by data-name-2 specifies the line number within the page body at which the footing area begins. The value must be greater than zero and not greater than the value of integer-1 or the data item referenced by data-name-1.

   The footing area comprises the area of the logical page between the line represented by the value of integer-2 or the data item referenced by data-name-2 and the line represented by the value of integer-1 or the data item referenced by data-namel, inclusive.

6. The value of integer-1, integer-3, and integer-4, if specified, will be used at the time the file is opened by the execution of an OPEN statement with the OUTPUT phrase, to specify the number of lines that comprise each of the indicated sections of a logical page. The value of integer-2, if specified, will be used at that time to define the footing area. These values are used for all logical pages written for the file during a given execution of the program.

7. The values of the data items referenced by data-name-1, data-name-3, and data-name-4, if specified, will be used as follows:

   a. The values of the data items, at the time an open statement with the OUTPUT phrase is executed for the file, will be used to specify the number of lines that are to comprise each of the indicated sections for the first logical page.

   b. The values of the data items, at the time a WRITE statement with the ADVANCING PAGE phrase is executed or page overflow condition occurs (see THE WRITE STATEMENT), will be used to specify the number of lines that are to comprise each of the indicated sections for the next logical page.

8. The value of the data item referenced by data-name-2, if specified, at the time an OPEN statement with the OUTPUT phrase is executed for the file, will be used to define the footing area for the first logical page. At the time a WRITE statement with the ADVANCING PAGE phrase is executed or a page overflow condition occurs, it will be used to define the footing area for the next logical page.

9. A LINAGE-COUNTER is generated by the presence of a LINAGE clause. The value in the LINAGE-COUNTER at any given time represents the line number at which the device is positioned within the current page body. The rules governing the LINAGE-COUNTER are as follows:

   a. A separate LINAGE-COUNTER is supplied for each file described in the File Section whose file description entry contains a LINAGE clause.

   b. LINAGE-COUNTER may be referenced, but may not be modified, by Procedure Division statements. Since more than one LINAGE-COUNTER may exist in a program, the user must qualify LINAGE-COUNTER by file-name when necessary.

   c. LINAGE-COUNTER is automatically modified, according to the following rules, during the execution of a WRITE statement to an associated file:

      * When the ADVANCING PAGE phrase of the WRITE statement is specified, the LINAGE-COUNTER is automatically reset to one.

* When the ADVANCING identifier-2 or integer phrase of the WRITE statement is specified, the LINAGE-COUNTER is incremented by integer or the value of the data item referenced by identifier-2.

* When the ADVANCING phrase of the WRITE statement is not specified, the LINAGE-COUNTER is incremented by the value one. (See THE WRITE STATEMENT.)

* The value of LINAGE-COUNTER is automatically reset to one when the device is repositioned to the first line that can be written on for each of the succeeding logical pages. (See THE WRITE STATEMENT.)

d. The value of LINAGE-COUNTER is automatically set to one at the time an OPEN statement is executed for the associated file.

10. Each logical page is contiguous to the next with no additional spacing provided.

THE RECORD CONTAINS CLAUSE

Function

The RECORD CONTAINS clause specifies the size of data records.

General Format

```
    RECORD CONTAINS    [ integer-1 TO ]    integer-2 CHARACTERS
```

General Rule

The size of each data record is completely defined within the record description entry, therefore this clause is never required. The RECORD CONTAINS clause is specified for documentation purposes only.

THE VALUE OF CLAUSE

Function

The VALUE OF clause specialises the description of an item in the label records associated with a file.

General Format

```
    VALUE OF data-name-1 IS { data-name-2 }
                            { literal-1   }

         [ , data-name-3  IS { data-name-4 } ] ...
                             { literal-2   }
```

Syntax Rules

1. Data-name-2, data-name-4, etc should be qualified when necessary but cannot be subscripted or indexed, nor can they be items described with the USAGE IS INDEX clause. |

2. Data-name-2, data-name-4, etc must be in the Working-Storage Section. |

General Rules

1. This clause is used for documentation purposes only.

(Addendum 1)

2. On input data-name-1 is checked against data-name-2 or literal-1 as specified and data-name-3 against data-name-4 or literal-2 as specified etc.

   On output data-name-2 or literal-1 are substituted for data-name-1 as specified and data-name-4 or literal-2 from data-name-3 etc.

3. A figurative constant may be substituted in the format above wherever a literal is specified.

PROCEDURE DIVISION IN THE SEQUENTIAL I-O MODULE

THE CLOSE STATEMENT

Function

The CLOSE statement terminates the processing of reels/units and files, with optional rewind and/or lock or removal where applicable.

General Format

$$\underline{\text{CLOSE}}\ \text{file-name-1}\left[\begin{array}{ll}\left\{\begin{array}{l}\underline{\text{REEL}}\\ \underline{\text{UNIT}}\end{array}\right\} & \left[\begin{array}{l}\text{WITH }\underline{\text{NO}}\ \underline{\text{REWIND}}\\ \text{FOR }\underline{\text{REMOVAL}}\end{array}\right]\\ \text{WITH} & \left\{\begin{array}{l}\underline{\text{NO}}\ \underline{\text{REWIND}}\\ \underline{\text{LOCK}}\end{array}\right\}\end{array}\right]$$

$$\left[\ ,\ \text{file-name-2}\left[\begin{array}{ll}\left\{\begin{array}{l}\underline{\text{REEL}}\\ \underline{\text{UNIT}}\end{array}\right\} & \left[\begin{array}{l}\text{WITH }\underline{\text{NO}}\ \underline{\text{REWIND}}\\ \text{FOR }\underline{\text{REMOVAL}}\end{array}\right]\\ \text{WITH} & \left\{\begin{array}{l}\underline{\text{NO}}\ \underline{\text{REWIND}}\\ \underline{\text{LOCK}}\end{array}\right\}\end{array}\right]\right]\ \ldots$$

Syntax Rule

1. The phrases REEL, UNIT, WITH NO REWIND, FOR REMOVAL, etc) must only be used for sequential files. The CLOSE REEL and CLOSE UNIT phrases are syntactically checked and compiled and the run time action is dependent on your run-time system support. If your run-time system does not recognise multi-unit files, the statements CLOSE REEL and CLOSE UNIT are "null" statements i.e., as if they are for documentary purposes only.

2. The files referenced in the CLOSE statement need not all have the same organization or access.

General Rules

Except where otherwise stated in the general rules below, the terms 'reel' and 'unit' are synonymous and completely interchangeable in the CLOSE statement. Treatment of sequential mass storage files is logically equivalent to the treatment of a file on tape or analogous sequential media.

1. A CLOSE statement may only be executed for a file in an open mode.

2. For the purpose of showing the effect of various types of CLOSE statements as applied to various storage media, all files are divided into the following categories:

a. Non-reel/unit. A file whose input or output medium is such that the concepts of rewind and reels/units have no meaning.

b. Sequential single-reel/unit. A sequential file that is entirely contained on one reel/unit.

c. Sequential multi-reel/unit. A sequential file that is contained on more than one reel/unit.

3. The results of executing each type of CLOSE for each category of file are summarized in Table 5-1, Relationship of Categories of Files and Formats of the CLOSE Statment.

CLOSE Statement Format	File Category		
	Non-Reel/Unit	Sequential Single-Reel/Unit	Sequential Multi-Reel/Unit
CLOSE	C	C,G	C,G,A
CLOSE WITH LOCK	C,E	C,G,E	C,G,E,A
CLOSE WITH NO REWIND	X	C,B	C,B,A
CLOSE REEL/UNIT	X	X	F,G
CLOSE REEL/UNIT FOR REMOVAL	X	X	F,D,G
CLOSE REEL/UNIT WITH NO REWIND	X	X	F,B

Table 5-1. Relationship of Categories of Files and the Formats of the CLOSE Statement

The definitions of the symbols in the table are given below. Where the definition depends on whether the file is an input, output or input-output file, alternate definitions are given; otherwise, a definition applies to input, output, and input-output files.

A. Previous Reels/Units Unaffected

<u>Input Files and Input-Output Files:</u>

All reels/units in the file prior to the current reel/unit are processed except those reels/units controlled by a prior CLOSE

REEL/UNIT statement. If the current reel/unit is not the last in the file, the reels/units in the file following the current one are not processed.

Output Files:

All reels/units in the file prior to the current reel/unit are processed except those reels/units controlled by a prior CLOSE REEL/UNIT statement.

B. No Rewind of Current Reel

The current reel/unit is left in its current position.

C. Close File

Input Files and Input-Output Files:

If the file is positioned at its end and label records are specified for the file, the labels are processed according to the operating system standard label convention. The behaviour of the CLOSE statement when label records are specified but not present, or when label records are not specified but are present, is Run-Time System (RTS) dependent. See your LEVEL II COBOL Operating Guide.

Output Files:

If label records are specified for the file, the labels are processed according to the operating system label convention. The behaviour of the CLOSE statement when label records are specified but not present, or when label records are not specified but are present, is RTS dependent. See your LEVEL II COBOL Operating Guide.

D. Reel/Unit Removal

The reel or unit may be accessed again, in its proper order of reels or units within the file, if a CLOSE statement without the REEL or UNIT phrase is subsequently executed for this file followed by the execution of an OPEN statement for the file.

E. File Lock

This file cannot be opened again during this execution of this run unit.

F. Close Reel/Unit

<u>Input Files</u>:

The following operations take place:

1. A reel/unit swap.

2. The standard beginning reel/unit label procedure is executed.

The next executed READ statement for that file makes available the next data record on the new reel/unit.

<u>Output Files and Input-Output Files</u>:

The following operations take place;

1. (For output files only.) The standard ending reel/unit label procedure is executed.

2. A reel/unit swap.

3. The standard beginning reel/unit label procedure is executed.

For input-output files, the next executed READ statement that references that file makes the next logical data record on the next mass storage unit available. For output files, the next executed WRITE statement that references that file directs the next logical data record to the next reel/unit of the file.

G. Rewind

The current reel or analogous device is positioned at its physical beginning.

X. Illegal

This is an illegal combination of a CLOSE option and a file category. The results at object time are undefined.

4. The action taken if the file is in the open mode when a STOP RUN statement is executed is to close the file. The action taken for a file that has been opened in a called program and not closed in that program prior to the execution of a CANCEL statement for that program is to close the file.

5. If the OPTIONAL phrase has been specified for the file in the FILE-CONTROL paragraph of the Environment Division and the file is not present, the standard end-of-file processing is not performed for that file.

6. If a CLOSE statement without the REEL or UNIT phrase has been executed for a file, no other statement (except the SORT or MERGE statements with the USING or GIVING phrases) can be executed that references that file, either explicitly or implicitly, unless an intervening OPEN statement for that file is executed.

7. The WITH NO REWIND and FOR REMOVAL phrases will have no effect at object time if they do not apply to the storage media on which the file resides.

8. Following the successful execution of a CLOSE statement the record area associated with file-name is no longer available. The unsuccessful execution of such a CLOSE statement leaves the availability of the record area undefined.

9. If WITH LOCK is specified, the file cannot be reopened in the current execution of the run unit, provided that your run time system supports locked files. Otherwise a normal CLOSE takes effect.

THE OPEN STATEMENT

Function

The OPEN statement initiates the processing of files. It also performs checking and/or writing of labels and other input-output operations.

General Format

```
       ⎧ INPUT file-name-1 ⎡REVERSED      ⎤                   ⎫
       ⎪                   ⎣WITH NO REWIND⎦                   ⎪
       ⎪                                                      ⎪
       ⎪      ⎡, file-name-2 ⎡REVERSED      ⎤⎤...             ⎪
       ⎪      ⎣              ⎣WITH NO REWIND⎦⎦                ⎪
       ⎪                                                      ⎪
       ⎪ OUTPUT file-name-3 [WITH NO REWIND]                  ⎪
       ⎨                                                      ⎬
       ⎪      [, file-name-4 WITH NO REWIND]...               ⎪  ...
 OPEN  ⎪                                                      ⎪
       ⎪                                                      ⎪
       ⎪ I-O file-name-5     [, file-name-6] ...              ⎪
       ⎪                                                      ⎪
       ⎩ EXTEND file-name-7  [, file-name-8] ...              ⎭
```

Syntax Rules

1. The REVERSED and NO REWIND phrases can only be used with sequential files. NO REWIND is treated as for documentation purposes only.

2. The I-O phrase can be used only for disk files, but not for files in Line Sequential organization.

3. The EXTEND phrase can be used only for sequential files, and Line Sequential files.

4. The EXTEND phrase must not be specified with multiple file reels.

5. The files referenced in the OPEN statement need not all have the same organization or access.

General Rules

1. The successful execution of an OPEN statement determines the availability of the file and results in the file being in an open mode.

2. The successful execution of an OPEN statement makes the associated record area available to the program.

3. Prior to the successful execution of an OPEN statement for a given file, no statement (except for a SORT or MERGE statement with the USING or GIVING phrases) can be executed that references that file, either explicitly or implicitly.

4. An OPEN statement must be successfully executed prior to the execution of any of the permissible input-output statement. In Table 5-1, 'X' at an intersection indicates that the specified statement, used in the sequential access mode, may be used with the sequential file organization and open mode given at the top of the column.

Table 5-1. Permissable Combinations of Statements and OPEN Modes for Sequential I/O.

Statement	Open Mode			
	Input	Output	Input-Output[1]	Extend
READ	X		X	
WRITE		X		X
REWRITE			X	

1 - This OPEN mode is not supported for ORGANIZATION line sequential files.

5. A file may be opened with the INPUT, OUTPUT, EXTEND and I-O phrases in the same program. Following the initial execution of an OPEN statement for a file, each subsequent OPEN statement execution for that same file must be preceded by the execution of a CLOSE statement, for that file.

6. Execution of the OPEN statement does not obtain or release the first data record.

7. The ASSIGNed name in the SELECT statement for a file is processed as follows:

   a. When the INPUT phrase is specified, the execution of the OPEN statement causes the ASSIGNed name to be checked in accordance with the operating system conventions for opening files for input.

   b. When the OUTPUT phrase is specified, the execution of the OPEN statement causes the ASSIGNed name to be written in accordance with the operating system conventions for opening files for output.

8. The file description entry for file-name-1, file-name-2, file-name-5, file-name-6, file-name-7 and file-name-8 must be equivalent to that used when this file was created.

9. If an input file is designated with the OPTIONAL phrase in its SELECT clause, the object program causes an interrogation for the presence or absence of this file. If the file is not present, the first READ statement for this file causes the AT END condition to occur.

10. If the storage medium for the file permits rewinding the following rules apply:

    a. Execution of the OPEN statement causes the file to be positioned at its beginning.

    b. When the REVERSED phrase is specified, the file is positioned at its end by execution of the OPEN statement.

11. When the REVERSED phrase is specified, the subsequent READ statements for the file make the data available in reversed order, i.e., starting with the last record.

12. For files being opened with the INPUT or I-O phrase, the OPEN statement sets the current record pointer to the first record currently existing within the file. If no records exist in the file, the current record pointer is set such that the next executed READ statement for the file will result in an AT END condition. If the file does not exist, OPEN INPUT will cause an error status.

13. When the EXTEND phrase is specified, the OPEN statement positions the file immediately following the last logical record of that file. Subsequent WRITE statements referencing the file will add records to the file as though the file had been opened with the OUTPUT phrase. If the file does not exist it will be created.

14. When the EXTEND phrase is specified and the LABEL RECORDS clause indicates label records are present, the execution of the OPEN statement includes the following steps:

    a. The beginning file labels are processed only in the case of a single reel/unit file.

    b. The beginning reel/unit labels on the last existing reel/unit are processed as though the file was being opened with the INPUT phrase.

    c. The existing ending file labels are processed as though the file is being opened with the INPUT phrase. These labels are then deleted.

    d. Processing then proceeds as though the file had been opened with the OUTPUT phrase.

15. The I-O phrase permits the opening of a file for both input and output operations except for files with ORGANIZATION LINE SEQUENTIAL. If the file does not exist it will be created and used as an empty file for input. An attempt to WRITE it will cause an error.

16. When the I-O phrase is specified and the LABEL RECORDS clause indicates label records are present, the execution of the OPEN statement includes the following steps:

    a. The labels are checked in accordance with the operating system specified conventions for input-output label checking.

    b. The new labels are written in accordance with the operating system specified conventions for input-output label writing.

17. Upon successful execution of an OPEN statement with the OUTPUT phrase specified, a file is created. At that time the associated file contains no data records. If a file of the same name exists it will be deleted. If write-protected an error will occur.

18. The execution of the OPEN statement causes the value of the FILE STATUS data item to be updated (see I-O STATUS in this chapter).

THE READ STATEMENT

Function

The READ statement makes available the next logical record from a file.

General Format

<u>READ</u> file-name RECORD   [<u>INTO</u> identifier] [; AT <u>END</u> imperative-statement]

Syntax Rules

1. The INTO phrase must not be used when the input file contains logical records of various sizes as indicated by their record descriptions. The storage area associated with identifier and the record area associated with file-name must not be the same storage area.

2. The AT END phrase must be specified if no applicable USE procedure is specified for file-name.

General Rules

1. The associated file must be open in the INPUT or I-O mode at the time this statement is executed. (See THE OPEN STATEMENT in this Chapter).

2. The record to be made available by the READ statement is determined as follows:

   a. If the current record pointer was positioned by the execution of the OPEN statement, the record pointed to by the current record pointer is made available.

   b. If the current record pointer was positioned by the execution of a previous READ statement, the current record pointer is updated to point to the next existing record in the file and then that record is made available.

3. The execution of the READ statement causes the value of the FILE STATUS data item, if any, associated with file-name to be updated. (See I-O STATUS in this Chapter).

4. Regardless of the method used to overlap access time with processing time, the concept of the READ statement is unchanged in that a record is available to the object program prior to the execution of any statement following the READ statement.

5. When the logical records of a file are described with more than one record description, these records automatically share the same storage area; this is equivalent to an implicit redefinition of the area. The contents of any data items which lie beyond the range of the current data record are undefined at the completion of the execution of the READ statement.

6. If the INTO phrase is specified, the record being read is moved from the record area to the area specified by identifier according to the rules specified for the MOVE statement without the CORRESPONDING phrase. The implied MOVE does not occur if the execution of the READ statement was unsuccessful. Any subscripting or indexing associated with identifier is evaluated after the record has been read and immediately before it is moved to the data item.

7. When the INTO phrase is used, the record being read is available in both the input record area and the data area associated with identifier.

8. If, at the time of execution of a READ statement, the position of current record pointer for that file is undefined, the execution of that READ statement is unsuccessful.

9. If the end of a reel or unit is recognized during the execution of a READ statement, an end-of-file status condition exists.

   a. The standard ending reel/unit label procedure.

   b. A reel/unit swap.

   c. The standard beginning reel/unit label procedure.

   d. The first data record of the new reel/unit is made available.

10. If a file described with the OPTIONAL clause is not present at the time the file is opened, then at the time of the execution of the first READ statement for the file, the AT END condition occurs and the execution of the READ statement is unsuccessful. The standard end of file procedures are not performed. (See The FILE-CONTROL paragraph and The OPEN and the USE statement descriptions in this Chapter.) Execution of the program then proceeds as in general rule 12.

11. If, at the time of the execution of a READ statement, no next logical record exists in the file, the AT END condition occurs, and the execution of the READ statement is considered unsuccessful. (See I-O STATUS).

12. When the AT END condition is recognized the following actions are taken in the specified order:

a. A value is placed into the FILE STATUS data item, if specified for this file, to indicate an AT END condition. (See I-O STATUS).

b. If the AT END phrase is specified in the statement causing the condition, control is transferred to the AT END imperative-statement. Any USE procedure specified for this file is not executed.

c. If the AT END phrase is not specified, then a USE procedure must be specified, either explicitly or implicitly, for this file and that procedure is executed.

When the AT END condition occurs, execution of the input-output statement which caused the condition is unsuccessful.

13. Following the unsuccessful execution of any READ statement, the contents of the associated record area and the position of the current record pointer are undefined.

14. When the AT END condition has been recognized, a READ statement for that file must not be executed without first executing a successful CLOSE statement followed by the execution of a successful OPEN statement for that file.

THE REWRITE STATEMENT

Function

The REWRITE statement logically replaces a record existing in a disk file.

General Format

```
    REWRITE record-name        [FROM identifier]
```

Syntax Rules

1. Record-name and identifier must not refer to the same storage area.

2. Record-name is the name of a logical record in the File Section of the Data Division and may be qualified.

General Rules

1. The file associated with record-name must be a disk file and must be open in the I-O mode at the time of execution of this statement. (See THE OPEN STATEMENT in this Chapter).

2. The last input-output statement executed for the associated file prior to the execution of the REWRITE statement must have been a successfully executed READ statement. The operating system logically replaces the record that was accessed by the READ statement.

3. The number of character positions in the record referenced by record-name must be equal to the number of character positions in the record being replaced.

4. The logical record released by a successful execution of the REWRITE statement is no longer available in the record area unless the associated file is saved in a SAME RECORD AREA clause. In this case, not only is the record still available to the program in the record area as a record of this file, but as a record of other files named in the SAME RECORD AREA clause.

5. The execution of a REWRITE statement with the FROM phrase is equivalent to the execution of:

   ```
   MOVE identifier TO record-name
   ```

   followed by the execution of the same REWRITE statement without the FROM phrase. The contents of the record area prior to the execution of the implicit MOVE statement have no effect on the execution of the REWRITE statement.

6. The current record pointer is not affected by the execution of a REWRITE statement.

7. The execution of the REWRITE statement causes the value of the FILE STATUS data item, if any, associated with the file to be updated. (See I-O STATUS in this Chapter).

8. The REWRITE statement cannot be used with line sequential files

THE USE STATEMENT

Function

The USE statement specifies procedures for input-output error handling that are in addition to the standard procedures provided by the input-output control system.

General Format

$$\underline{\text{USE}}\ \underline{\text{AFTER}}\ \text{STANDARD} \left\{\begin{array}{l}\underline{\text{EXCEPTION}}\\ \underline{\text{ERROR}}\end{array}\right\}\ \underline{\text{PROCEDURE}}\ \text{ON} \left\{\begin{array}{l} \text{file-name-1 [, file-name-2]...}\\ \underline{\text{INPUT}}\\ \underline{\text{OUTPUT}}\\ \underline{\text{I-O}}\\ \underline{\text{EXTEND}}\end{array}\right\}.$$

Syntax Rules

1. A USE statement, when present, must immediately follow a section header in the declaratives section and must be followed by a period followed by a space. The remainder of the section must consist of zero, one or more procedural paragraphs that define the procedure to be used.

2. The USE statement itself is never executed; it merely defines the conditions calling for the execution of the USE procedures.

3. The same file-name can appear in a different specific arrangement of the format. Appearance of a file-name in a USE statement must not cause the simultaneous request for execution of more than one USE procedure.

4. The words ERROR and EXCEPTION are synonymous and may be used interchangeably.

5. The files implicitly or explicitly referenced in a USE statement need not all have the same organization or access.

General Rules

1. The designated procedures are executed by the input-output system after completing the standard input-output error routine; or upon recognition of the AT END condition, when the AT END phrase has not been specified in the input-output statement.

2. After execution of a USE procedure, control is returned to the invoking routine.

3. Within a USE procedure, there must not be any reference to any nondeclarative procedures. Conversely, in the nondeclarative portion there must be no reference to procedure-names that appear in the declarative portion, except that PERFORM statements may refer to a USE statement or to the procedures associated with such a USE statement.

4. Within a USE procedure, there must not be the execution of any statement that would cause the execution of a USE procedure that had previously been invoked and had not yet returned control to the invoking routine.

THE WRITE STATEMENT

Function

The WRITE statement releases a logical record for an output file. It can also be used for vertical positioning of lines within a logical page.

General Format

```
WRITE record-name   [FROM identifier-1]

 [                        ( {identifier-2} [LINE ] )  ]
 [                        ( {integer     } [LINES] )  ]
 [ {BEFORE}  ADVANCING    {                        }  ]
 [ {AFTER }               {  FORMFEED              }  ]
 [                        (  TAB                   )  ]
 [                        (  mnemonic-name         )  ]
 [                        (  PAGE                  )  ]

 [; AT {END-OF-PAGE}   imperative-statement]
 [     {EOP        }                       ]
```

Syntax Rules

1. Record-name and identifier-1 must not reference the same storage area.

2. When TAB is specified the result is to cause the paper to throw to the standard vertical tabulation position. A user-defined mnemonic-name can be used instead of TAB or FORMFEED if they are associated in the SPECIAL-NAMES paragraph. (See The SPECIAL-NAMES Paragraph earlier in Chapter 3.)

3. The record-name is the name of a logical record in the File Section of the Data Division and may be qualified.

4. When identifier-2 is used in the ADVANCING phrase, it must be the name of an elementary integer data item.

5. Integer, or the value of the data item referenced by identifier-2, may be zero.

6. If the END-OF-PAGE phrase is specified, the LINAGE clause must be specified in the file description entry for the associated file.

7. The words END-OF-PAGE and EOP are equivalent.

8. The ADVANCING TAB phrase cannot be specified when writing a record to a file whose file description entry contains the LINAGE clause.

General Rules

1. The associated file must be open in the OUTPUT or EXTEND mode at the time of the execution of this statement. (See THE OPEN STATEMENT in this Chapter).

2. The logical record released by the execution of the WRITE statement is no longer available in the record area unless the associated file is named in a SAME RECORD AREA clause or the execution of the WRITE statement was unsuccessful due to a boundary violation.

   The logical record is also available to the program as a record of other files referenced in the SAME RECORD AREA clause as the associated output file, as well as to the file associated with record-name.

3. The results of the execution of the WRITE statement with the FROM phrase is equivalent to the execution of:

   a. The statement:

      MOVE identifier-1 TO record-name

      according to the rules specified for the MOVE statement, followed by:

   b. The same WRITE statement without the FROM phrase.

      The contents of the record area prior to the execution of the implicit MOVE statement have no effect on the execution of this WRITE statement.

      After execution of the WRITE statement is complete, the information in the area referenced by identifier-1 is available, even though the information in the area referenced by record-name may not be. (See general rule 2.)

4. The current record pointer is unaffected by the execution of a WRITE statement.

5. The execution of the WRITE statement causes the value of the FILE STATUS data item, if any, associated with the file to be updated. (See I-O STATUS in this Chapter).

6. The maximum record size for a file is established at the time the file is created and must not subsequently be changed.

7. The number of character positions on a disk required to store a logical record in a file may or may not be equal to the number of character positions defined by the logical description of that record in the program.

8. The execution of the WRITE statement releases a logical record to the operating system.

9. Both the ADVANCING phrase and the END-OF-PAGE phrase allows control of the vertical positioning of each line on a representation of a printed page.

   a. With ORGANIZATION SEQUENTIAL if the ADVANCING phrase is not used, automatic advancing is provided when output is directed to a list-device to act as if the user had specified AFTER ADVANCING 1 LINE. If the ADVANCING phrase is used, advancing is provided as follows:

      i. If identifier-2 is specified, the repsentation of the printed page is advanced the number of lines equal to the current value associated with identifier-2.

      ii. If integer is specified, the representation of the printed page is advanced the number of lines equal to the value of integer.

      iii. If mnemonic-name is specified the representation of the printed page is advanced according to the rules specified by the implementor for the hardware device.

      iv. If the BEFORE phrase is used, the line is presented before the representation of the printed page is advanced according to the rules i, ii and iii above.

      v. If the AFTER phrase is used, the line is presented after the representation of the printed page is advanced according to the rules i, ii and iii above.

      vi. If PAGE is specified, the record is presented on the logical page before or after (depending on the phrase used) the device is repositioned to the next logical page. If the record to be written is associated with a file whose file description entry contains a LINAGE clause, the repositioning is to the first line that can be written on the next logical page as specified in the LINAGE clause. If the record to be written is associated with a file whose description entry contains a LINAGE clause, the repositioning is to the first line that can be written on the next logical page as specified in the LINAGE clause.

   b. With ORGANIZATION LINE SEQUENTIAL, if the ADVANCING phrase is not used, automatic advancing of one line is provided to act in accordance with the convention of your operating system text editor (usually as if the user had specified BEFORE ADVANCING 1 LINE).

      If the ADVANCING phrase is used, advancing is provided according to rules 9a(i) through 9a(vi) above.

10. If the logical end of the representation of the printed page is reached during the execution of a WRITE statement with the END-OF-PAGE phrase, the imperative-statement specified in the END-OF-PAGE phrase is executed. The logical end is specified in the LINAGE clause associated with record-name.

11. An end-of-page condition is reached whenever the execution of a given WRITE statement with the END-OF-PAGE phrase occurs when the execution of such a WRITE statement causes the LINAGE-COUNTER to equal or exceed the value specified by integer-2 or the data item referenced by data-name-2 of the LINAGE clause, if specified. In this case, the WRITE statement is executed and then the imperative statement in the END-OF-PAGE phrase is executed.

    An automatic page overflow condition is reached whenever the execution of a given WRITE statement (with or without an END-OF-PAGE phrase) cannot be fully accommodated within the current page body.

    This occurs when a WRITE statement, if executed, would cause the LINAGE-COUNTER to exceed the value specified by integer-1 or the data item referenced by data-name-1 of the LINAGE clause. In this case, the record is presented on the logical page before or after (depending on the phrase used) the device is repositioned to the first line that can be written on the next logical page as specified in the LINAGE clause. The imperative statement in the END-OF-PAGE clause, if specified, is executed after the record is written and the device has been repositioned.

    If integer-2 or data-name-2 of the LINAGE clause is not specified, no end-of-page condition distinct from the page overflow condition is detected. In this case, the end-of-page condition and page overflow condition occur simultaneously.

    If integer-2 or data-name-2 of the LINAGE clause is specified, but the execution of a given WRITE statement would cause LINAGE-COUNTER to simultaneously exceed the value of both integer-2 or the data item referenced by data-name-2 and integer-1 or the data item referenced by data-name-1, then the operation proceeds as if integer-2 or data-name-2 had not been specified.

12. When an attempt is made to write beyond the externally defined boundaries of a sequential file, an exception condition exists and the contents of the record area are unaffected. The following action takes place:

    a. The value of the FILE STATUS data item, if any, of the associated file is set to a value indicating a boundary violation. (See I-O STATUS in this Chapter).

b. If a USE AFTER STANDARD EXCEPTION declarative is explicitly or implicitly specified for the file, that declarative procedure will then be executed.

c. If a USE AFTER STANDARD EXCEPTION declarative is not explicitly or implicitly specified for the file, the result is undefined.

13. After the recognition of an end-of-reel or an end-of-unit of an output file that is contained on more than one physical reel/unit, the WRITE statement performs the following operations:

    a. The standard ending reel/unit procedure.

    b. The reel/unit swap.

    c. The standard beginning reel/unit label procedure.

CHAPTER 6

RELATIVE INPUT AND OUTPUT

INTRODUCTION TO THE RELATIVE I-O MODULE

The Relative I-O module provides a capability to access records of a mass storage file in either a random or sequential manner. Each record in a relative file is uniquely identified by an integer value greater than zero which specifies the record's ordinal position in the file.

LANGUAGE CONCEPTS

Organization

Relative file organization is permitted only on disk devices. A relative file consists of records which are identified by relative record numbers. The file may be thought of as composed of a serial string of areas, each capable of holding a logical record. Each of these areas is denominated by a relative record number. Records are stored and retrieved based on this number. For example, the tenth record area, whether or not records have been written in the first through the ninth record areas.

Access Modes

In the sequential access mode, the sequence in which records are accessed is the ascending order of the relative record numbers of all records which currently exist within the file.

In the random access mode, the sequence in which records are accessed is controlled by the programmer. The desired record is accessed by placing its relative record number in a relative key data item.

In the dynamic access mode, the programmer may change at will from sequential access to random access using appropriate forms of input-output statements.

Current Record Pointer

The current record pointer is a conceptual entity used in this document to facilitate specification of the next record to be accessed within a given file. The concept of the current record pointer has no meaning for a file opened in the output mode. The setting of the current record pointer is affected only by the OPEN, START and READ statements.

I-O Status

If the FILE STATUS clause is specified in a file control entry, a value is placed into the specified two-character data item during the execution of an OPEN, CLOSE, READ, WRITE, REWRITE, DELETE or START statement and before any applicable USE procedure is executed, to indicate to the COBOL program the status of that input-output operation.

Status Key 1

The leftmost character position of the FILE STATUS data item is known as status key 1 and is set to indicate one of the following conditions upon completion of the input-output operation.

'0' - indicates Successful Completion
'1' - indicates At End
'2' - indicates Invalid Key
'3' - indicates Permanent Error
'9' - indicates an Operating System Error Message

The meaning of the above indications are as follows:

'0' - Successful Completion. The input-output statement was successfully executed.

'1' - At End. The Format 1 READ statement was unsuccessfully executed as a result of an attempt to read a record when no next logical record exists in the file.

'2' - Invalid Key. The input-output statement was unsuccessfully executed as a result of one of the following:

* Duplicate Key
* No Record Found
* Boundary Violation

'3' - Permanent Error. The input-output statement was unsuccessfully executed as the reult of an input-output error, such as data check, parity error or transmission error.

'9' - Operating System Error Message. The input-output statement was unsuccessfully executed as the result of a condition that is specified by the Operating System. This value is used only to indicate a condition not indicated by other defined values of status key 1, or by specified combinations of the values of status key 1 and status key 2.

Status Key 2

The rightmost character position of the FILE STATUS data item is known as status key 2 and is used to further describe the reults of the input-output operation. This character contains a value as follows:

* If no further information is available concerning the input-output operation, then status key 2 contains a value of '0'

* When status key 1 contains a value of '2' indicating an INVALID KEY condition, status key 2 is used to designate the cause of that condition by the following values:

2 -	Indicates a duplicate key value. An attempt has been made to write a record that would create a duplicate key in a relative file.
3 -	Indicates no record found. An attempt has been made to access a record, identified by a key, and that record does not exist in the file.
4 -	Indicates a boundary violation. An attempt has been made to write beyond the externally-defined boundaries of a relative file. This is normally treated as a fatal error by the Operation System.

* When status key 1 contains a value of '9' the value of status key 2 is the Operating System Error Message number.

* When status key 1 contains a value of '9', the value of status key 2 is the operating system error message number (for those operating systems which designate errors numerically). The LEVEL II COBOL Operating Guide contains details of the status-key-2 representation.
Note that it is not possible to extract this number directly.

Valid Combinations of Status Keys 1 and 2

The valid permissible combinations of the values of status key 1 and status key 2 are shown in the table. An 'X' at an intersection indicates a valid permissible combination.

Status Key 1	Status Key 2			
	No Further Information (0)	Duplicate Key (2)	No Record Found (3)	Boundary Violation (4)
Successful Completion (0)	X			
At End (1)	X			
Invalid Key (2)		X	X	X
Permanent Error (3)	X			
Implementor Defined (9)	Operating System Error Message Number			

The INVALID KEY Condition

The INVALID KEY condition can occur as a result of the execution of a START, READ, WRITE, REWRITE or DELETE statement. For details of the causes of the condition, see The START Statement, The READ Statement, The WRITE Statement, The REWRITE Statement, and The DELETE Statement later in this chapter.

When the INVALID KEY condition is recognised, the Operating System takes these actions in the following order:

1. A value is placed into the FILE STATUS data item, if specified for this file, to indicate an INVALID KEY condition. (See <u>I-O Status</u> in this Chapter).

2. If the INVALID KEY phrase is specified in the statement causing the condition, control is transferred to the INVALID KEY imperative statement. Any USE procedure specified for this file is not executed.

3. If the INVALID KEY phrase is not specified, but a USE procedure is specified, either explicitly or implicitly, for this file, that procedure is executed.

When the INVALID KEY condition occurs, execution of the input-output statement which recognised the condition is unsuccessful, and the file is not affected.

NOTE:

> INVALID KEY does not trap errors when Status key 1 is set to 9. Such errors must be trapped either by explicitly testing the Status key or by using declaratives instead of the INVALID KEY clause.

The AT END Condition

The AT END condition can occur as a result of the execution of a READ statement. For details of the causes of the condition, see The READ Statement later in this chapter.

ENVIRONMENT DIVISION IN THE RELATIVE I-O MODULE

INPUT-OUTPUT SECTION

The File-Control Paragraph

Function

The FILE-CONTROL paragraph names each file and allows specification of other file-related information. (See also the LEVEL II COBOL Operating Guide).

General Format

```
     FILE-CONTROL  {file-control-entry} ...
```

The File Control Entry

Function

The file control entry names a file and may specify other file-related information.

General Format

```
     SELECT file-name

          ASSIGN TO  {external-file-name-literal}
                     {file-identifier           }
                     [, {external-file-name-literal}]
                     [  {file-identifier           }]

         [; RESERVE  integer-1 [AREA ]]
         [                     [AREAS]]

          ; ORGANIZATION IS RELATIVE

         [                   { SEQUENTIAL  [,RELATIVE KEY IS data-name-1] }]
         [; ACCESS MODE IS   {                                            }]
         [                   { {RANDOM }    ,RELATIVE KEY IS data-name-1  }]
         [                   { {DYNAMIC}                                  }]

          [; FILE STATUS IS data-name-2].
```

Syntax Rules

1. The SELECT clause must be specified first in the file control entry. The clauses which follow the SELECT clause may appear in any order.

2. Each file described in the Data Division must be named once and only once as file-name in the FILE-CONTROL paragraph. Each file specified in the file control entry must have a file description entry in the Data Division.

3. If the ACCESS MODE clause is not specified, the ACCESS MODE IS SEQUENTIAL clause is implied.

4. Data-name-2 must be defined in the Data Division as a two-character data item of the category alphanumeric and must not be defined in the File Section or the Communication Section.

5. Data-name-1 and data-name-2 may be qualified.

6. If a relative file is to be referenced by a START statement, the RELATIVE KEY phrase must be specified for that file.

7. Data-name-1 must not be defined in a record description entry associated with that file-name.

8. The data item referenced by data-name-1 must be defined as an unsigned integer.

9. File-identifier is any user-defined word, but must not be the same as the file-name.

General Rules

1. The ASSIGN clause specifies the association of the file referenced by file-name to a storage medium. See the L/II COBOL Operating Guide. The first assignment takes place. Subsequent assignments within any one ASSIGN clause are for documentation purposes only.

2. The RESERVE clause allows the user to specify the number of input-output areas allocated. The RESERVE clause is treated as for documentation purposes only, unless the LEVEL II COBOL Operating Guide specific to your operating system indicates otherwise.

3. The ORGANIZATION clause specifies the logical structure of a file. The file organization is established at the time a file is created and cannot subsequently be changed.

4. When the access mode is sequential, records in the file are accessed in the sequence dictated by the file organization. This sequence is the order of ascending relative record numbers of existing records in the file.

5. When the FILE STATUS clause is specified, a value will be moved by the operating system into the data item specified by data-name-2 after the execution of every statement that references that file either explicitly or implicitly. This value indicates the status of execution of the statement. (See I-O Status in this Chapter).

6. If the access mode is random, the value of the RELATIVE KEY data item indicates the record to be accessed.

7. When the access mode is dynamic, records in the file may be accessed sequentially and/or randomly. (See General Rules 4 and 6).

8. All records stored in a relative file are uniquely identified by relative record numbers. The relative record number of a given record specifies the record's logical ordinal position in the file. The first logical record has a relative record number of 1, and subsequent logical records have relative record numbers of 2, 3, 4, ...

9. The data item specified by data-name-1 is used to communicate a relative record number between the user and the Operating System.

10. If file-identifier is not explicitly defined it will be implicitly defined.

The I-O-CONTROL Paragraph

Function

The I-O-CONTROL paragraph specifies the points at which rerun is to be established and the memory area which is to be shared by different files.

General Format

```
I-O-CONTROL.
‾‾‾‾‾‾‾‾‾‾‾
                                          ⎧integer-1 RECORDS OF file-name-2⎫
⎡; RERUN ON ⎧file-name-1       ⎫ EVERY    ⎨integer-2 CLOCK-UNITS           ⎬⎤
⎣  ‾‾‾‾‾    ⎩implementor-name  ⎭          ⎩condition-name                  ⎭⎦

[;SAME [RECORD] AREA FOR file-name-3  {, file-name-4} ... ]  ...   .
  ‾‾‾‾  ‾‾‾‾‾‾
```

Syntax Rules

1. The I-O-CONTROL paragraph is optional.

2. File-name-1 must be a sequentially organized file.

3. When either the integer-1 RECORDS clause or the integer-2 CLOCK-UNITS clause is specified, implementor-name must be given in the RERUN clause.

4. When multiple integer-1 RECORDS clauses are specified, no two of them may specify the same file-name-2.

5. Only one RERUN clause containing the CLOCK-UNITS clause may be specified.

6. The two forms of the SAME clause (SAME AREA, SAME RECORD AREA) are considered separately in the following:

   More than one SAME clause may be included in a program, however:

   a. a file-name must not appear in more than one SAME AREA clause.

   b. a file-name must not appear in more than one SAME RECORD AREA clause.

c. If one or more file-names of a SAME AREA clause appear in a SAME RECORD AREA clause, all of the file-names in that SAME AREA clause must appear in the SAME RECORD AREA clause. However, additional file-names not appearing in that SAME AREA clause may also appear in that SAME RECORD AREA clause. The rule that only one of the files mentioned in a SAME AREA clause can be open at any given time takes precedence over the rule that all files mentioned in a SAME RECORD AREA clause can be open at any given time.

7. The files referenced in the SAME AREA or SAME RECORD AREA clauses need not all have the same organization or access.

General Rules

1. The RERUN clause is treated as for documentation purposes only.

2. The SAME AREA clause specifies that two or more files that do not represent sort or merge files are to use the same memory area during processing. The area being shared includes all storage areas (including alternate areas) assigned to the files specified; therefore, it is not valid to have more than one of the files open at the same time.

3. The SAME RECORD AREA clause specifies that two or more files are to use the same memory area for processing of the current logical record. All of the files may be open at the same time. A logical record in the SAME RECORD AREA is considered as a logical record of each opened output file whose file-name appears in this SAME RECORD AREA clause and of the most recently read input file whose file-name appears in this SAME RECORD AREA clause. This is equivalent to an implicit redefinition of the area i.e., records are aligned on the leftmost character position.

DATA DIVISION IN THE RELATIVE I-O MODULE

FILE SECTION

In a COBOL program the file description entry (FD) represents the highest level or organization in the File Section. The File Section header is followed by a file description entry consisting of a level indicator (FD), a file-name and a series of independent clauses. The FD clauses specify the size of the logical and physical records, the presence or absence of label records, the value of implementor-defined label items, and the names of the data records which comprise the file. The entry itself is terminated by a period.

RECORD DESCRIPTION STRUCTURE

A record description consists of a set of data description entries which describe the characteristics of a particular record. Each data description entry consists of a level-number followed by a data-name if required, followed by a series of independent clauses as required. A record description has a hierarchical structure and therefore the clauses used with an entry may vary considerably, depending upon whether or not it is followed by subordinate entries. The structure of a record description is defined in CONCEPTS OF LEVELS in Chapter 2 while the elements allowed in a record description are shown in the DATA DESCRIPTION-COMPLETE ENTRY SKELETON in Chapter 3.

THE FILE DESCRIPTION - COMPLETE ENTRY SKELETON

Function

The file description furnishes information concerning the physical structure, identification, and record names pertaining to a given file.

General Format

```
FD   file-name

   [; BLOCK CONTAINS   [integer-1 TO]  integer-2    {RECORDS   }]
                                                    {CHARACTERS}]

    [;  RECORD CONTAINS [integer-3 TO] integer-4 CHARACTERS]

   [; LABEL {RECORD IS  } {STANDARD}]
            {RECORDS ARE} {OMITTED }]

   [;  VALUE OF data-name-1      IS      {data-name-2}
                                         {literal-1  }

          [, data-name-3 IS      {data-name-4}]        ...]
                                 { literal-2 }]

   [; DATA  {RECORD IS  }   data-name-5    [, data-name-6]     ...] .
            {RECORDS ARE}
```

Syntax Rules

1. The level indicator FD identifies the beginning of a file description and must precede the file-name.

2. The clauses which follow the name of the file are optional in many cases, and their order of appearance is immaterial. All clauses are optional when the ANSI switch is unset.

3. One or more record description entries must follow the file description entry.

THE BLOCK CONTAINS CLAUSE

Function

The BLOCK CONTAINS clause specifies the size of a physical record.

General Format

```
     BLOCK CONTAINS   [integer-1 TO]  integer-2 {RECORDS   }
                                                {CHARACTERS}
```

General Rule

This clause is required for documentation purposes only.

THE DATA RECORDS CLAUSE

Function

The DATA RECORDS clause serves only as documentation for the names of data records with their associated file.

General Format

$$\underline{\text{DATA}} \quad \left\{ \begin{array}{l} \underline{\text{RECORD}}\ \ \text{IS} \\ \underline{\text{RECORDS}}\ \ \text{ARE} \end{array} \right\} \ \text{data-name-1} \quad [,\ \text{data-name-2}] \quad \ldots$$

Syntax Rule

Data-name-1 and data-name-2 are the names of data records and should have 01 level-number record descriptions, with the same names, associated with them.

General Rules

1. The presence of more than one data-name indicates that the file contains more than one type of data record. These records may be of differing sizes, different formats, etc. The order in which they are listed is not significant.

2. Conceptually, all data records within a file share the same area. This is in no way altered by the presence of more than one type of data record within the file.

THE LABEL RECORDS CLAUSE

Function

The LABEL RECORDS clause specifies whether labels are present.

General Format

$$\underline{\text{LABEL}} \quad \left\{ \begin{array}{l} \underline{\text{RECORD}}\ \ \text{IS} \\ \underline{\text{RECORDS}}\ \ \text{ARE} \end{array} \right\} \left\{ \begin{array}{l} \underline{\text{STANDARD}} \\ \underline{\text{OMITTED}} \end{array} \right\}$$

Syntax Rule

This clause is required in every file description entry, when the ANSI switch is set.

General Rule

This clause is used for documentation purposes only.

(Addendum 1)

THE RECORD CONTAINS CLAUSE

Function

The RECORD CONTAINS clause specifies the size of data records.

Format

RECORD CONTAINS [integer-1 TO] integer-2 CHARACTERS

General Rule

The size of each data record is completely defined within the record description entry, therefore this clause is never required.

The RECORD CONTAINS clause is specified for documentation purposes only.

THE VALUE OF CLAUSE

Function

The VALUE of clause specializes the description of an item in the label records associated with a file.

General Format

$$\underline{\text{VALUE OF}}\ \text{data-name-1 IS} \begin{Bmatrix} \text{data-name-2} \\ \text{literal-1} \end{Bmatrix}$$

$$\left[\text{, data-name-3 IS} \begin{Bmatrix} \text{data-name-4} \\ \text{literal-2} \end{Bmatrix} \right] \ldots$$

Syntax Rules

1. Data-names should be qualified when necessary, but cannot be subscripted or indexed, nor can they be items described with the USAGE IS INDEX clause

2. Data-name-2, data-name-4 etc, must be in the Working-Storage Section

General Rules

1. This clause is for documentation purposes only.

   The compiler checks that data-name-1 matches in value data-name-2 or literal-1, data-name-3 matches in value data-name-4 or literal-2, etc, for input files. For output files the value of data-name-2 or literal-1 is substituted for data-name-1, the value of data-name-4 or literal-2 is substituted for data-name-3, etc.

2. A figurative constant may be substituted in the format above wherever a literal is specified.

THE CLOSE STATEMENT

Function

The CLOSE statement terminates the processing of files.

General Format

CLOSE file-name-1 [WITH LOCK] [,file-name-2 [WITH LOCK]] ...

Syntax Rule

The files referenced in the CLOSE statement need not all have the same organization or access.

General Rules

1. A CLOSE statement may only be executed for a file in an open mode.

2. Relative files are classified as belonging to the category of non-sequential single/multi-reel/unit. The results of executing each type of CLOSE for this category of file are summarized in the following table.

CLOSE Statement Format	File Category = Non-sequential Single/Multi-Reel/Unit
CLOSE	A
CLOSE WITH LOCK	A,B

The definitions of the symbols in the table are given below. Where the definition depends on whether the file is an input, output or input-output file, alternate definitions are given; otherwise, a definition applies to input, output, and input-output files.

A. Close File

Input Files and Input-Output Files (Sequential Access Mode):

If the file is positioned at its end and label records are specified for the file, the labels are processed according to the operating system label convention. The behaviour of the CLOSE statement when label records are specified but not present, or when label records are not specified but are present, is undefined. If the file is positioned at its end and label records are not specified for the file, label processing does not take place but other closing operations dependent on the Run-Time System are executed. See your LEVEL II COBOL Operating Guide. If the file is positioned other than at its end, the closing operations dependent on the RTS are executed, but there is no ending label processing.

Input Files and Input-Output Files (Random or Dynamic Access Mode); Output Files (Random, Dynamic, or Sequential Access Mode):

If label records are specified for the file, the labels are processed according to the operating system standard label convention. The behavior of the CLOSE statement when label records are specified but not present, or when label records are not specified but are present, is undefined. If label records are not specified for the file, label processing does not take place but other closing operations dependent on the RTS are executed.

B. File Lock

This file cannot be opened again during this execution of this run unit.

3. The action taken if a file is in the open mode when a STOP RUN statement is executed is to close the file. The action taken for a file that has been opened in a called program and not closed in that program prior to the execution of a CANCEL statement for the program is to close the file.

4. If a CLOSE statement has been executed for a file, no other statement can be executed that references that file, either explicitly or implicitly, unless an intervening OPEN statement for that file is executed.

5. Following the successful execution of a CLOSE statement, the record area associated with file-name is no longer available. The unsuccessful execution of such a CLOSE statement leaves the availability of the record area undefined.

6. If WITH LOCK is specified, the file cannot be reopened in the current execution of the run unit.

THE DELETE STATEMENT

Function

The DELETE statement logically removes a record from a mass storage file.

General Format

```
    DELETE file-name RECORD [;INVALID KEY imperative-statement]
```

Syntax Rules

1. The INVALID KEY phrase must not be specified for a DELETE statement which references a file which is in sequential access mode.

2. The INVALID KEY phrase must be specified for a DELETE statement which references a file which is not in sequential access mode and for which an applicable USE procedure is not specified.

General Rules

1. The associated file must be open in the I-O mode at the time of the execution of this statement. (See THE OPEN STATEMENT later in this Chapter)

2. For files in the sequential access mode, the last input-output statement executed for file-name prior to the execution of the DELETE statement must have been a successfully executed READ statement. The Operating System logically removes from the file the record that was accessed by that READ statement.

3. For a file in random or dynamic access mode, the Operating System logically removes from the file that record identified by the contents of the RELATIVE KEY data item associated with file-name. If the file does not contain the record specified by the key, an INVALID key condition exists. (See The INVALID KEY Condition in this Chapter).

4. After the succesful execution of a DELETE statement, the identified record has been logically removed from the file and can no longer be accessed.

5. The execution of a DELETE statement does not affect the contents of the record area associated with file-name.

6. The current record pointer is not affected by the execution of a DELETE statement.

7. The execution of the DELETE statement causes the value of the specified FILE STATUS data item, if any, associated with the file-name to be updated. See I-O STATUS in this chapter.

THE OPEN STATEMENT

Function

The OPEN statement initiates the processing of files. It also performs checking and/or writing of labels and other input-output operations.

General Format

$$\underline{\text{OPEN}} \quad \left\{ \begin{array}{lll} \underline{\text{INPUT}} & \text{file-name-1} & [\text{,file-name-2}] \ldots \\ \underline{\text{OUTPUT}} & \text{file-name-3} & [\text{,file-name-4}] \ldots \\ \underline{\text{I-O}} & \text{file-name-5} & [\text{,file-name-6}] \ldots \end{array} \right\} \ldots$$

Syntax Rule

The files referenced in the OPEN statement need not all have the same organization or access.

General Rules

1. The successful execution of an OPEN statement determines the availability of the file and results in the file being in an open mode.

2. The successful execution of the OPEN statement makes the associated record area available to the program.

3. Prior to the successful execution of an OPEN statement for a given file, no statement can be executed that references that file, either explicitly or implicitly.

4. An OPEN statement must be successfully executed prior to the execution of any of the permissible input-output statements. In Table 6-1, 'X' at an intersection indicates that the specified statement, used in the access mode given for that row, may be used with the relative file organization and the open mode given at the top of the column.

Table 6-1. Permissible Combinations of Statements and Open Modes for Relative I/O

File Access Mode	Statement	Open Mode		
		Input	Output	Input-Output
Sequential	READ	X		X
	WRITE		X	
	REWRITE			X
	START	X		X
	DELETE			X
Random	READ	X		X
	WRITE		X	X
	REWRITE			X
	START			
	DELETE			X
Dynamic	READ	X		X
	WRITE		X	X
	REWRITE			X
	START	X		X
	DELETE			X

5. A file may be opened with the INPUT, OUTPUT, AND I-O phrases in the same program. Following the initial execution of an OPEN statement for a file, each subsequent execution for that same file must be preceded by the execution of a CLOSE statement, for that file.

6. Execution of the OPEN statement does not obtain or release the first data record.

7. The ASSIGNed name in the SELECT statement for a file is processed as follows:

   a. When the INPUT phrase is specified, the execution of the OPEN statement causes the ASSIGNed name to be checked in accordance with the operating system conventions for opening files for input.

b. When the OUTPUT phrase is specified, the execution of the OPEN statement causes the ASSIGNed name to be written in accordance with the operating system conventions for opening files for output.

8. The file description entry for file-name-1, file-name-2, file-name-5 or file-name-6 must be equivalent to that used when this file was created.

9. For files being opened with the INPUT or I-O phrase, the OPEN statement sets the current record pointer to the first record currently existing within the file. If no records exist in the file, the current record pointer is set such that the next executed Format 1 READ statement for the file will result in an AT END condition. If the file does not exist, INPUT will cause an error status.

10. The I-O phrase permits the opening of a file for both input and output operations. If the file does not exist, it will be created. In sequential access mode it will then be used for input; any attempt to WRITE to it will cause an error.

11. When the I-O phrase is specified and the LABEL RECORDS clause indicates label records are present, the execution of the OPEN statement includes the following steps:

    a. The labels are checked in accordance with the operating system specified conventions for input-output label checking.

    b. The new labels are written in accordance with the operating system specified conventions for input-output label writing.

12. Upon successful execution of an OPEN statement with the OUTPUT phrase specified, a file is created. At the time the associated file contains no data records. If a file of the same number exists it will be deleted. If write protected, an error status occurs.

13. The execution of the OPEN statement causes the value of the FILE STATUS data item to be updated (see I-O STATUS in this chapter).

(Addendum 1)

THE READ STATEMENT

Function

For sequential access, the READ statement makes available the next logical record from a file. For random access, the READ statement makes available a specified record from a mass storage file.

General Format

Format 1

```
READ file-name [NEXT] RECORD [INTO identifier]
     [; AT END imperative-statement]
```

Format 2

```
READ file-name RECORD [INTO identifier] [;INVALID KEY imperative-statement]
```

Syntax Rules

1. The INTO phrase must not be used when the input file contains logical records of various sizes as indicated by their record descriptions. The storage area associated with identifier and the record area associated with file-name must not be the same storage area.

2. Format 1 must be used (without the NEXT phrase) for all files in sequential access mode.

3. Format 1 (with the NEXT phrase) must be specified for files in dynamic access mode, when records are to be retrieved sequentially.

4. Format 2 is used for files in random access mode or for files in dynamic access mode when records are to be retrieved randomly.

5. The INVALID KEY phrase or the AT END phrase must be specified if no applicable USE procedure is specified for file-name.

General Rules

1. The associated files must be open in the INPUT or I-O mode at the time this statement is executed. See THE OPEN STATEMENT in this Chapter

2. The record to be made available by a Format 1 READ statement is determined as follows:

   a. The record, pointed to by the current record pointer, is made available provided that the current record pointer was positioned by the START or OPEN statement and the record is still accessible through the path indicated by the current record pointer; if the record is no longer accessible, which may have been caused by the deletion of the record, the current record pointer is updated to point to the next existing record in the file and that record is then made available.

b. If the current record pointer was positioned by the execution of a previous READ statement, the current record pointer is updated to point to the next existing record in the file and then that record is made available.

3. The execution of the READ statement causes the value of the FILE STATUS data item, if any, associated with file-name to be updated. (See _I-O Status_ in this Chapter).

4. Regardless of the method used to overlap access time with processing time, the concept of the READ statement is unchanged in that a record is available to the object program prior to the execution of any statement following the READ statement.

5. When the logical records of a file are described with more than one record description, these records automatically share the same storage area; this is equivalent to an implicit redefinition of the area. The contents of any data items which lie beyond the range of the current data record are undefined at the completion of the execution of the READ statement.

6. If the INTO phrase is specified, the record being read is moved from the record area to the area specified by identifier according to the rules specified for the MOVE statement without the CORRESPONDING phrase. The implied MOVE does not occur if the execution of the READ statement was unsuccessful. Any subscripting or indexing associated with identifier is evaluated after the record has been read and immediately before it is moved to the data item.

7. When the INTO phrase is used, the record being read is available in both the input record area and the data area associated with identifier.

8. If, at the time of execution of a Format 1 READ statement, the position of current record pointer for that file is undefined, the execution of that READ statement is unsuccessful.

9. If, at the time of the execution of a Format 1 READ statement, no next logical record exists in the file, the AT END condition occurs, and the execution of the READ statement is considered unsuccessful. (See _I-O Status_ in this Chapter).

10. When the AT END condition is recognized the following actions are taken in the specified order:

    a. A value is placed into the FILE STATUS data item, if specified for this file, to indicate an AT END condition. (See _I-O Status_ in this Chapter)

    b. If the AT END phrase is specified in the statement causing the condition, control is transferred to the AT END imperative-statement. Any USE procedure specified for this file is not executed.

    c. If the AT END phrase is not specified, then a USE procedure must be specified, either explicitly or implicitly, for this file, and that procedure is executed.

    When the AT END condition occurs, execution of the input-output statement which caused the condition is unsuccessful.

11. Following the unsuccessful execution of any READ statement, the contents of the associated record area and the position of the current record pointer are undefined.

12. When the AT END condition has been recognised, a Format 1 READ statement for that file must not be executed without first executing one of the following:

    a. A successful CLOSE statement followed by the execution of a successful OPEN statement for that file.

    b. A successful START statement for that file.

    c. A successful Format 2 READ statement for that file.

13. For a file for which dynamic access mode is specified, a Format 1 READ statement with the NEXT phrase specified causes the next logical record to be retrieved from the file as described in general rule 2.

14. If the RELATIVE KEY phrase is specified, the execution of a Format 1 READ statement updates the contents of the RELATIVE KEY data item such that it contains the relative record number of the record made available.

15. The execution of a Format 2 READ statement sets the current record pointer to, and makes available, the record whose relative record number is contained in the data item named in the RELATIVE KEY phrase for the file, If the file does not contain such a record, the INVALID KEY condition exists and execution of the READ statement is unsuccessful. (See The INVALID KEY Condition in this Chapter).

THE REWRITE STATEMENT

Function

The REWRITE statement logically replaces a record existing in a disk file.

General Format

REWRITE record-name [FROM identifier] [; INVALID KEY imperative-statement]

Syntax Rules

1. Record-name and identifier must not refer to the same storage area.

2. Record-name is the name of a logical record in the File Section of the Data Division and may be qualified.

3. The INVALID KEY phrase must not be specified for a REWRITE statement which references a file in sequential access mode.

4. The INVALID KEY phrase must be specified in the REWRITE statement for files in the random or dynamic access mode for which an appropriate USE procedure is not specified.

General Rules

1. The file associated with record-name must be open in the I-O mode at the time of execution of this statement. (See THE OPEN STATEMENT in this Chapter).

2. For files in the sequential access mode, the last input-output statement executed for the associated file prior to the execution of the REWRITE statement must have been a successfully executed READ statement. The Operating System logically replaces the record that was accessed by the READ statement.

3. The number of character positions in the record referenced by record-name must be equal to the number of character positions in the record being replaced.

4. The logical record released by a successful execution of the REWRITE statement is no longer available in the record area unless the associated file is named in a SAME RECORD AREA clause, in which case the logical record is available to the program as a record of other files appearing in the same SAME RECORD AREA clause as the associated I-O file, as well as to the file associated with record-name.

5. The execution of a REWRITE statement with the FROM phrase is equivalent to the execution of:

   MOVE identifier TO record-name

followed by the execution of the same REWRITE statement without the FROM phrase. The contents of the record area prior to the execution of the implicit MOVE statement have no effect on the execution of the REWRITE statement.

6. The current record pointer is not affected by the execution of a REWRITE statement.

7. The execution of the REWRITE statement causes the value of the FILE STATUS data item, if any, associated with the file to be updated. (See I-O STATUS in this Chapter).

8. For a file accessed in either random or dynamic access mode, the Operating System logically replaces the record specified by the contents of the RELATIVE KEY data item associated with the file. If the file does not contain the record specified by the key, the INVALID KEY condition exists. (See THE INVALID KEY CONDITION in this Chapter). The updating operation does not take place and the data in the record area is unaffected.

THE START STATEMENT

Function

The START statement provides a basis for logical positioning within a relative file, for subsequent sequential retrieval of records.

General Format

```
                    ┌        ⎧ IS = EQUAL TO       ⎫           ┐
                    │        ⎪ IS =                ⎪           │
START file-name     │ KEY    ⎨ IS > GREATER THAN   ⎬ data-name │
                    │        ⎪ IS >                ⎪           │
                    │        ⎪ IS < NOT LESS THAN  ⎪           │
                    └        ⎩ IS   NOT <          ⎭           ┘

      [; INVALID KEY imperative-statement]
```

NOTE: The required relational characters '>', and '<' and '=' are not underlined to avoid confusion with other symbols such as '$\geq$' (greater than or equal to).

Syntax Rules

1. File-name must be the name of a file with sequential or dynamic access.

2. Data-name may be qualified.

3. The INVALID KEY phrase must be specified if no applicable USE procedure is specified for file-name.

4. Data-name, if specified, must be the data item specified in the RELATIVE KEY phrase of the associated file control entry.

General Rules

1. File-name must be open in the INPUT or I-O mode at the time that the START statement is executed. (See THE OPEN STATEMENT in this Chapter).

2. If the KEY phrase is not specified the relational operator 'IS EQUAL TO' is implied.

3. The type of comparison specified by the relational operator in the KEY phrase occurs between a key associated with a record in the file referenced by file-name and a data item as specified in general Rule 5.

   a. The current record pointer is positioned to the first logical record currently existing in the file whose key satisfies the comparison.

b. If the comparison is not satisfied by any record in the file, an INVALID KEY condition exists, the execution of the START statement is unsuccessful, and the position of the current record pointer is undefined. (See The INVALID KEY Condition in this Chapter).

4. The execution of the START statement causes the value of the FILE STATUS data item, if any, associated with file-name to be updated. (See I-O STATUS in this Chapter).

5. The comparison described in general rule 3 uses the data item referenced by the RELATIVE KEY clause associated with file-name. A RELATIVE KEY clause must be associated with a filename.

THE USE STATEMENT

Function

The USE statement specifies procedures for input-output error handling that are in addition to the standard procedures provided by the input-output control system.

General Format

$$\underline{\text{USE}}\ \ \underline{\text{AFTER}}\ \ \text{STANDARD}\ \left\{\begin{array}{l}\underline{\text{EXCEPTION}}\\ \\ \underline{\text{ERROR}}\end{array}\right\}\ \underline{\text{PROCEDURE}}\ \text{ON}\ \left\{\begin{array}{l}\text{file-name-1 [,file-name-2] ...}\\ \underline{\text{INPUT}}\\ \underline{\text{OUTPUT}}\\ \underline{\text{I-O}}\end{array}\right\}.$$

Syntax Rules

1. A USE statement, when present, must immediately follow a section header in the declaratives section and must be followed by a period followed by a space. The remainder of the section must consist of zero, one or more procedural paragraphs that define the procedures to be used.

2. The USE statement itself is never executed; it merely defines the conditions calling for the execution of the USE procedures.

3. The same file-name can appear in a different specific arrangement of the format. Appearance of a file-name in a USE statement must not cause the simultaneous request for execution of more than one USE procedure.

4. The words ERROR and EXCEPTION are synonymous and may be used interchangeably.

5. The files implicitly or explicitly referred in a USE statement need not all have the same organization or access.

General Rules

1. The designated procedures are executed by the input-output system after completing the standard input-output error routine, or upon recognition of the INVALID KEY or AT END conditions when the INVALID KEY or AT END phrases have not been specified in the input-output statement.

2. After execution of a USE procedure, control is returned to the invoking routine.

(Addendum 2)

3. Within a USE procedure, there must not be any reference to any nondeclarative procedures. Conversely, in the nondeclarative portion there must be no reference to procedure-names in the declarative portion, except that PERFORM statements may refer to a USE statement or to the procedures associated with such a USE statement.

4. Within a USE procedure, there must not be the execution of any statement that would cause the execution of a USE procedure that had previously been invoked and had not yet returned control to the invoking routine.

THE WRITE STATEMENT

Function

The WRITE statement releases a logical record for an output or input-output file.

General Format

<u>WRITE</u> record-name [<u>FROM</u> identifier]   [; <u>INVALID</u> KEY imperative-statement]

Syntax Rules

1. Record-name and identifier must not reference the same storage area.

2. The record-name is the name of a logical record in the File Section of the Data Division and may be qualified.

3. The INVALID KEY phrase must be specified if an applicable USE procedure is not specified for the associated file.

General Rules

1. The associated file must be open in the OUTPUT or I-O mode at the time of the execution of this statement. (See THE OPEN STATEMENT Chapter).

2. The logical record released by the execution of the WRITE statement is no longer available in the record area unless the associated file is named in a SAME RECORD AREA clause or the execution of the WRITE statement is unsuccessful due to an INVALID KEY condition.

   The logical record is also available to the program as a record of other files referenced in the same SAME RECORD AREA clause as the associated output file, as well as to the file associated with record-name.

3. The results of the execution of the WRITE statement with the FROM phrase is equivalent to the execution of

   a. The statement:

      MOVE identifier TO record-name

      according to the rules specified for the MOVE statement, followed by:

b. The same WRITE statement without the FROM phrase.

   The contents of the record area prior to the execution of the implicit MOVE statement have no effect on the execution of this WRITE statement.

   After execution of the WRITE statement is complete, the information in the area referenced by identifier is available, even though the information in the area referenced by record-name may not be. (See general rule 2 above).

4. The current record pointer is unaffected by the execution of a WRITE statement.

5. The execution of the WRITE statement causes the value of the FILE STATUS data item, if any, associated with the file to be updated. (See <u>I-O Status</u> in this Chapter).

6. The maximum record size for a file is established at the time the file is created and must not subsequently be changed.

7. The number of character positions on a mass storage device required to store a logical record in a file may or may not be equal to the number of character positions defined by the logical description of that record in the program.

8. The execution of the WRITE statement releases a logical record to the operating system.

9. When a file is opened in the output mode, records may be placed into the file by one of the following:

   a. If the access mode is sequential, the WRITE statement will cause a record to be released to the Operating System. The first record will have a relative record number of one and subsequent records released will have relative record numbers of 2, 3, 4, ... If the RELATIVE KEY data item has been specified in the file control entry for the associated file, the relative record number of the record just released will be placed into the RELATIVE KEY data item by the Operating System during execution of the WRITE statement.

   b. If the access mode is random or dynamic, prior to the execution of the WRITE statement the value of the RELATIVE KEY data item must be initialized in the program with the relative record number of be associated with the record in the record area. That record is then released to the Operating System by execution of the WRITE statement.

10. When a file is opened in the I-O mode and the access mode is random or dynamic, records are to be inserted in the associated file. The value of the RELATIVE KEY data item must be initialised by the program with the relative record number to be associated with the record in the record area. Execution of a WRITE statement then causes the contents of the record area to be released to the Operating System.

11. The INVALID KEY condition exists under the following circumstances:

    a. When the access mode is random or dynamic, and the RELATIVE KEY data item specifies a record which already exists in the file, or

    b. When an attempt is made to write beyond the externally defined boundaries of the file.

12. When the INVALID KEY condition is recognised, the execution of the WRITE statement is unsuccessful, the contents of the record area are unaffected, and the FILE STATUS data item, if any, of the associated file is set to a value indicating the cause of the condition. Execution of the program proceeds according to the rules stated in The INVALID KEY Condition in this Chapter see also <u>I-O Status</u> in this Chapter).

CHAPTER 7

INDEXED INPUT AND OUTPUT

INTRODUCTION TO THE INDEXED I-O MODULE

The Indexed I-O module provides a capability to access records of a mass storage file in either a random or sequential manner. Each record in an indexed file is uniquely identified by the value of one or more keys within that record.

LANGUAGE CONCEPTS

Organization

A file whose organization is indexed is a mass storage file in which data records may be accessed by the value of a key. A record description may include one or more key data items, each of which is associated with an index. Each index provides a logical path to the data records according to the contents of a data item within each record which is the record key for that index.

The data item named in the RECORD KEY clause of the file control entry for a file is the prime record key for that file. For purposes of inserting, updating and deleting records in a file, each record is identified solely by the value of its prime record key. This value must, therefore, be unique and must not be changed when updating the record. Key lengths must not exceed 127 bytes, and this may be further restricted depending on your Indexed Sequential file run time module; see your LEVEL II COBOL Operating Guide.

A data item named in the ALTERNATE RECORD KEY clause of the file control entry for a file is an alternative record key for that file. The value of an alternative record key may be non-unique if the DUPLICATES phrase is specified for it. These keys provide alternative access paths for retrieval of records from the file. A maximum number of 80 alternate keys can be specified.

Access Modes

In the sequential access mode, the sequence in which records are accessed is the ascending order of the record key values. The order of retrieval of records within a set of records having duplicate record key values is the order in which the records were written into the set.

In the random access mode, the sequence in which records are accessed is controlled by the programmer. The desired record is accessed by placing the value of its record key in the record key data item.

In the dynamic access mode, the programmer may change at will from sequential access to random access using appropriate forms of input-output statements.

Current Record Pointer

The current record pointer is a conceptual entity used in this document to facilitate specification of the next record to be accessed within a given file. The concept of the current record pointer has no meaning for a file opened only in the output mode. The setting of the current record pointer is affected only by the OPEN, START and READ statements.

I-O Status

If the FILE STATUS clause is specified in a file control entry, a value is placed into the specified two-character data item during the execution of an OPEN, CLOSE, READ, WRITE, REWRITE, DELETE or START statement and before any applicable USE procedure is executed, to indicate to the COBOL program the status of that input-output operation.

Status Key 1

The leftmost character position of the FILE STATUS data item is known as status key 1 and is set to indicate one of the following conditions upon completion of the input-output operation.

'0' - Successful Completion
'1' - At End
'2' - Invalid Key
'3' - Permanent Error
'9' - Operating System Error Message

The meaning of the above indications are as follows:

0 - Successful Completion. The input-output statement was successfully executed.

1 - At End. The Format 1 READ statement was unsuccessfully executed as a result of an attempt to read a record when no next logical record exists in the file.

2 - Invalid Key. The input-output statement was unsuccessfully executed as a result of one of the following:

Sequence Error
Duplicate Key
No Record Found
Boundary Violation

3 - Permanent Error. The input-output statement was unsuccessful as the result of an input-output error, such as data check, parity error, or transmission error.

9 - Operating System Error Message. The input-output statement was unsuccessfully executed as a result of a condition that is specified by the Operating System Error Message number. This value is used only to indicate a condition not indicated by other defined values of status key 1, or by specified combinations of the value of status key 1 and status key 2.

Status Key 2

The rightmost character position of the FILE STATUS data item is known as status key 2 and is used to further describe the results of the input-output operation. This character will contain a value as follows:

If no further information is available concerning the input-output operation, then status key 2 contains a value of '0'.

When status key 1 contains a value of '0' indicating a successful completion, status key 2 may contain a value of '2' indicating a duplicate key. This condition indicates one of two possibilities:

1. For a READ statement, the key value for the current key of reference is equal to the value of that same key in the next record within the current key of reference.

2. For a WRITE or REWRITE statement, the record just written created a duplicate key value for at least one alternate record key for which duplicates are allowed.

When status key 1 contains a value of '2' indicating an INVALID KEY condition, status key 2 contains values to designate the cause of that condition as follows:

1 Indicates a sequence error for a sequentially accessed indexed file. The ascending sequence requirements of successive record key values have been violated (see The WRITE Statement later in this Chapter), or the prime record key value has been changed by the COBOL program between the successful execution of a READ statement and the execution of the next REWRITE statement for that file.

2 Indicates a duplicate key value. An attempt has been made to write or rewrite a record that would create a duplicate key in an indexed file.

3 Indicates no record found. An attempt has been made to access a record, identified by a key, and that record does not exist in the file.

4 Indicates a boundary violation. An attempt has been made to write beyond the externally defined boundaries of an indexed file. This is usually treated as a fatal error by Operating Systems.

When status key 1 contains a value of '9' the value of status key 2 is the operating system error message number (for those operating systems which designate errors numerically). The L/II COBOL Operating Guide specific to your operating system contains details of the status-key-2 representation. Note that it is not possible to extract this number directly.

Valid Combinations of Status Keys 1 and 2

The valid permissible combinations of the value of status key 1 and status key 2 are shown in the following table. An 'X' at an intersection indicates a valid permissible combination.

Status Key 1	Status Key 2				
	No Further Information (0)	Sequence Error (1)	Duplicate Key (2)	No Record Found (3)	Boundary Violation (4)
Successful Completion (0)	X		X		
At End (1)	X				
Invalid Key (2)		X	X	X	X
Permanent Error (3)	X				
Implementor Defined (9)	Operating System Error Message Number				

The INVALID KEY Condition

The INVALID KEY condition can occur as a result of the execution of a START, READ, WRITE, REWRITE or DELETE statement. For details of the causes of the condition see THE START STATEMENT, THE READ STATEMENT, THE WRITE STATEMENT, and THE DELETE STATEMENT later in this Chapter.

When the INVALID KEY condition is recognized, the Operating System takes these actions in the following order:

1. A value is placed into the FILE STATUS data item, if specified for this file, to indicate an INVALID KEY condition. (See I-O Status).

2. If the INVALID KEY phrase is specified in the statement causing the condition, control is transferred to the INVALID KEY imperative statement. Any USE procedure specified for this file is not executed.

3. If the INVALID KEY phrase is not specified, but a USE procedure is specified, either explicitly or implicitly, for this file, that procedure is executed.

   When the INVALID KEY condition occurs, execution of the input-output statement which recognised the condition is unsuccessful and the file is not affected.

The AT END Condition

The AT END condition can occur as a result of the execution of a READ statement. For details of the causes of the condition, see THE READ STATEMENT later in this Chapter.

ENVIRONMENT DIVISION IN THE INDEXED I-O MODULE

INPUT-OUTPUT SECTION

The File Control Paragraph

Function

The FILE-CONTROL paragraph names each file and allows specification of other file-related information. (See also the L/II COBOL Operating Guide).

General Format

```
     FILE-CONTROL. {file-control-entry}...
```

The File Control Entry

Function

The file control entry names a file and may specify other file-related information.

General Format

```
          SELECT file-name

               ASSIGN TO {external-file-name-literal}
                         {file-identifier            }
                       [,{external-file-name-literal}]
                       [ {file-identifier            }]
          [; RESERVE integer-1 [AREA ]]
          [                    [AREAS]]

           ; ORGANIZATION IS INDEXED

          [; ACCESS MODE IS   {SEQUENTIAL}]
          [                   {DYNAMIC   }]
          [                   {RANDOM    }]

           ; RECORD KEY IS data-name-1

          [; ALTERNATE RECORD KEY IS data-name-2 [WITH DUPLICATES]]...

           [; FILE STATUS IS data-name-3]
```

Syntax Rules

1. The SELECT clause must be specified first in the file control entry. The clauses which follow the SELECT clause may appear in any order.

2. Each file described in the Data Division must be named once and only once as file-name in the FILE-CONTROL paragraph. Each file specified in the file control entry must have a file description entry in the Data Division.

3. If the ACCESS MODE clause is not specified, the ACCESS MODE IS SEQUENTIAL clause is implied.

4. Data-name-3 must be defined in the Data Division as a two-character data item of the category alphanumeric and must not be defined in the File Section.

5. Data-name-1, data-name-2 and data-name-3 may be qualified.

6. The data items referenced by data-name-1 and data-name-2 must each be defined as a data item of the category alphanumeric within a record description entry associated with that file-name.

7. Neither data-name-1 nor data-name-2 can describe an item whose size is variable. (See THE OCCURS CLAUSE in Chapter 4).

8. Data-name-2 cannot reference an item whose leftmost character position corresponds to the leftmost character position of an item referenced by data-name-1 or by any other data-name-2 associated with this file.

9. File-identifier is any user-defined word but must not be the same as file-name.

General Rules

1. The ASSIGN clause specifies the association of the file referenced by file-name to a storage medium. See the L/II COBOL Operating Guide. The first assignment takes effect. Subsequent assignments within any one ASSIGN clause are for documentation purposes only.

2. The RESERVE clause allows the user to specify the number of input-output areas allocated. The RESERVE clause is treated as for documentation purposes only, unless the LEVEL II COBOL Operating Guide specific to your operating system indicates otherwise.

3. The ORGANIZATION clause specifies the logical structure of a file. The File organization is established at the time a file is created and cannot subsequently be changed.

4. When the access mode is sequential, records in the file are accessed in the sequence dictated by the file organization. For indexed files this sequence is the order of ascending record key values within a given key of reference.

5. When the FILE STATUS clause is specified, a value will be moved by the operating system into the data item specified by data-name-3 after the execution of every statement that references that file either explicitly or implicitly. This value indicates the status of execution of the statement. (See I-O STATUS in this Chapter).

6. If the access mode is random, the value of the record key data item indicates the record to be accessed.

7. When the access mode is dynamic, records in the file may be accessed sequentially and/or randomly. (See general rules 4 and 6).

8. The RECORD KEY clause specifies the record key that is the prime record key for the file. The values of the prime record key must be unique among records of the file. This prime record key provides an access path to records in an indexed file.

9. An ALTERNATE RECORD KEY clause specifies a record key that is an alternative record key for the file. This alternate record key provides an alternate access path to records in an indexed file.

10. The data description of data-name-1 and data-name-2 as well as relative locations within a record must be the same as that used when the file was created. The number of alternate keys for the file must also be the same as that used when the file was created.

11. The DUPLICATES phrase specifies that the value of the associated alternate record key may be duplicated within any of the records in the file. If the DUPLICATES phrase is not specified, the value of the associated alternate record key must not be duplicated among any of the records in the file.

12. If file-identifier is not explicitly defined it will be implicitly defined.

<u>The I-O Control Paragraph</u>

Function

The I-O-CONTROL paragraph specifies the points at which rerun is to be established and the memory area which is to be shared by different files.

General Format

```
I-O-CONTROL.

[; RERUN ON {file-name-1        }   EVERY  {integer-1 RECORDS OF file-name-2}]
[           {implementor-name   }          {integer-2 CLOCK-UNITS           }]
[                                          {condition-name                  }]  ...

[; SAME [RECORD] AREA FOR file-name-3 {, file-name-4}...] ...     .
```

Syntax Rules

1. The I-O-CONTROL paragraph is optional.

2. File-name-1 must be a sequentially organized file.

3. When either the integer-1 RECORDS clause or the integer-2 CLOCK-UNITS clause is specified, implementor-name must be given in the RERUN clause.

4. When multiple integer-1 RECORDS clauses are specified, no two of them may specify the same file-name-2.

5. Only one RERUN clause containing the CLOCK-UNITS clause may be specified.

6. The two forms of the SAME clause (SAME AREA, SAME RECORD AREA) are considered separately in the following:

   More than one SAME clause may be included in a program, however:

   a. A file-name must not appear in more than one SAME AREA clause.

   b. A file-name must not appear in more than one SAME RECORD AREA clause.

   c. If one or more file-names of a SAME AREA clause appear in a SAME RECORD AREA clause, all of the file-names in the SAME AREA clause must appear in the SAME RECORD AREA clause. However, additional file-names not appearing in that SAME AREA clause may also appear in that SAME RECORD AREA clause. The rule that only one of the files mentioned in a SAME AREA clause can be open at any given time takes precedence over the rule that all files mentioned in a SAME RECORD AREA clause can be open at any given time.

7. The files referenced in the SAME AREA or SAME RECORD AREA clause need not all have the same organization or access.

General Rules

1. The RERUN clause is treated as for documentation purposes only.

2. The SAME AREA clause specifies that two or more files are to use the same memory area during processing. The area shared includes all storage areas assigned to the files specified; therefore, it is not valid to have more than one of the files open at the same time. (See syntax rule 6c.)

3. The SAME RECORD AREA clause specifies that two or more files are to use the same memory area for processing of the current logical record. All of the files may be open at the same time. A logical record in the SAME RECORD AREA is considered as a logical record of each opened output file whose file-name appears in this SAME RECORD AREA clause and of the most recently read input file whose file-name appears in this SAME RECORD AREA clause. This is equivalent to an implicit redefinition of the area, i.e., records are aligned on the leftmost character position.

DATA DIVISION IN THE INDEXED I-O MODULE

FILE SECTION

In a COBOL program the file description entry (FD) represents the highest level of organization in the File Section. The File Section header is followed by a file description entry consisting of a level indicator (FD), a file-name and a series of independent clauses. The FD clauses specify the size of the logical and physical records, the presence or absence of label records, the value of implementor-defined label items, and the names of the data records which comprise the file. The entry itself is terminated by a period.

RECORD DESCRIPTION STRUCTURE

A record description consists of a set of data description entries which describe the characteristics of a particular record. Each data description entry consists of a level-number followed by a data-name if required, followed by a series of independent clauses as required. A record description has a hierarchical structure and therefore the clauses used with an entry may vary considerably, depending upon whether or not it is followed by subordinate entries. The structure of a record description is defined in CONCEPTS OF LEVELS in Chapter 2 while the elements allowed in a record description are shown in THE DATA DESCRIPTION - COMPLETE ENTRY SKELETON in Chapter 3.

THE FILE DESCRIPTION - COMPLETE ENTRY SKELETON

Function

The file description furnishes information concerning the physical structure, identification, and record names pertaining to a given file.

General Format

```
     FD file-name

          [; BLOCK CONTAINS [integer-1] TO integer-2 {RECORDS   }]
                                                     {CHARACTERS}

           [; RECORD CONTAINS [integer-3 TO] integer-4 CHARACTERS]

          [;LABEL        {RECORD IS  } {STANDARD}]
          [              {RECORDS ARE} {OMITTED }]

          [;VALUE OF data-name-1 IS {data-name-2}
                                    {literal-1  }

                [,data-name-3 IS {data-name-4}]            ...  ]
                                 {literal-2  }

     [DATA {RECORD IS  } data-name-5    [,data-name-6]     ...  ] .
           {RECORDS ARE}
```

Syntax Rules

1. The level indicator FD identifies the beginnning of a file description and must precede the file-name.

2. The clauses which follow the name of the file are optional in many cases, and their order of appearance is immaterial. All clauses are optional when the ANSI switch is unset.

3. One or more record description entries must follow the file description entry.

THE BLOCK CONTAINS CLAUSE

Function

The BLOCK CONTAINS clause specifies the size of a physical record.

General Format

BLOCK CONTAINS [integer-1 TO] integer-2 $\left\{\begin{array}{l}\text{RECORDS}\\ \text{CHARACTERS}\end{array}\right\}$

General Rule

This clause is required for documentation purposes only.

THE DATA RECORDS CLAUSE

Function

The DATA RECORDS clause serves only as documentation for the names of data records with their associated file.

General Format

DATA $\left\{\begin{array}{l}\text{RECORD IS}\\ \text{RECORDS ARE}\end{array}\right\}$ data-name-1 [, data-name-2] ...

Syntax Rule

Data-name-1 and data-name-2 are the names of data records and should have 01 level-number record descriptions, with the same names, associated with them.

General Rules

1. The presence of more than one data-name indicates that the file contains more than one type of data record. These records may be of differing sizes, different formats, etc. The order in which they are listed is not significant.

2. Conceptually, all data records within a file share the same area. This is no way altered by the presence of more than one type of data record within the file.

THE LABEL RECORDS CLAUSE

Function

The LABEL RECORDS clause specifies whether labels are present.

General Format

$$\underline{\text{LABEL}} \begin{Bmatrix} \underline{\text{RECORD}}\ \text{IS} \\ \underline{\text{RECORDS}}\ \text{ARE} \end{Bmatrix} \begin{Bmatrix} \underline{\text{STANDARD}} \\ \underline{\text{OMITTED}} \end{Bmatrix}$$

General Rule

This clause is used for documentation purposes only.

THE RECORD CONTAINS CLAUSE

Function

The RECORD CONTAINS clause specifies the size of data records.

General Format

$$\underline{\text{RECORD}}\ \text{CONTAINS}\ [\text{integer-1}\ \underline{\text{TO}}]\ \ \text{integer-2 CHARACTERS}$$

General Rule

The size of each data record is completely defined within the record description entry, therefore this clause is never required. The RECORD CONTAINS clause is specified for documentation purposes only.

THE VALUE OF CLAUSE

Function

The VALUE OF clause specialises the description of an item in the label records associated with a file.

General Format

$$\underline{\text{VALUE}}\ \underline{\text{OF}}\ \text{data-name-1 IS} \begin{Bmatrix} \text{data-name-2} \\ \text{literal-1} \end{Bmatrix}$$

$$\left[\text{[, data-name-3 IS} \begin{Bmatrix} \text{data-name-4} \\ \text{literal-2} \end{Bmatrix} \right] \quad \ldots$$

Syntax Rules

1. Data-name-2, data-name-4, etc., should be qualified when necessary, but cannot be subscripted or indexed, nor can they be items described with the USAGE IS INDEX clause.
2. Data-name-2, data-name-4, etc., must be in the Working-Storage Section.

General Rules

1. This clause is treated as for documentation purposes only.

2. For an input file, the appropriate label routine checks to see if the value of data-name-1 is equal to the value of literal-1, or of data-name-2, whichever has been specified.

   For an output file, at the appropriate time the value of data-name-1 is made equal to the value of literal-1, or of a data-name-2, whichever has been specified.

3. A figurative constant may be substituted in the format above wherever a literal is specified.

PROCEDURE DIVISION IN THE INDEXED I-O MODULE

THE CLOSE STATEMENT

Function

The CLOSE statement terminates the processing of files.

General Format

```
    CLOSE file-name-1  [WITH LOCK] [, file-name-2   [WITH LOCK] ] ...
```

Syntax Rule

The files referenced in the CLOSE statement need not all have the same organization or access.

General Rules

1. A CLOSE statement may only be executed for a file in an open mode.

2. Indexed files are classified as belonging to the category of non-sequential single/multi-reel/unit. The results of executing each type of CLOSE for this category of file are summarized in the following table.

CLOSE Statement Format	File Category = Non-sequential Single/Multi-Reel/Unit
CLOSE	A
CLOSE WITH LOCK	A,B

The definitions of the symbols in the table are given below. Where the definition depends on whether the file is an input, output, or input-output file, alternate definitions are given; otherwise, a definition applies to input, output, and input-output files.

A. Close File

Input Files and Input-Output Files (Sequential Access Mode):

If the file is positioned at its end and label records are specified for the file, the labels are processed according to the operating system standard label convention. The behaviour of the CLOSE statement when label records are specified but not present, or when label records are not specified but are present, is undefined. If the file is positioned at its end and label records are not specified for the file, label processing does not take place but other closing operations dependent on the Run-Time System (RTS) are executed. See the L/II COBOL Operating Guide. If the file is positioned other than at its end, the closing operations specified by the RTS are executed, but there is no ending label processing.

Input Files and Input-Output Files (Random or Dynamic Access Mode); Output Files (Random, Dynamic, or Sequential Access Mode):

If label records are specified for the file, the labels are processed according to the operating system standard label convention. The behaviour of the CLOSE statement when label records are specified but not present, or when label records are not specified but are present, is undefined. If label records are not specified for the file, label processing does not take place but other closing operations dependent on the RTS are executed.

B. File Lock

This file cannot be opened again during this execution of this run unit.

3. The action taken if a file is in the open mode when a STOP RUN statement is executed is to close the file. The action taken for a file that has been opened in a called program and not closed in that program prior to the execution of a CANCEL statement for that program is to close the file.

4. If a CLOSE statement has been executed for a file, no other statement can be executed that references that file, either explicitly or implicitly, unless an intervening OPEN statement for that file is executed.

5. Following the successful execution of a CLOSE statement, the record area associated with file-name is no longer available. The unsuccessful execution of such a CLOSE statement leaves the availability of the record area undefined.

6. If WITH LOCK is specified, the file cannot be reopened in the current execution of the run unit.

THE DELETE STATEMENT

Function

The DELETE statement logically removes a record from a mass storage file.

General Format

<u>DELETE</u> file-name RECORD [; <u>INVALID</u> KEY imperative-statement]

Syntax Rules

1. The INVALID KEY phase must not be specified for a DELETE statement which references a file which is in sequential access mode.

2. The INVALID KEY phrase must be specified for a DELETE statement which references a file which is not in sequential access mode and for which an applicable USE procedure is not specified.

General Rules

1. The associated file must be open in I-O mode at the time of the execution of this statement. (See THE OPEN STATEMENT later in this Chapter).

2. For files in the sequential access mode, the last input-output statement executed for file-name prior to the execution of the DELETE statement must have been a successfully executed READ statement. The Operating System logically removes from the file the record that was accessed by that READ statement.

3. For a file in random or dynamic access mode, the Operating System logically removes from the file the record identified by the contents of the prime record key data item associated with file-name. If the file does not contain the record specified by the key, an INVALID KEY condition exists. (See THE INVALID KEY CONDITION in this Chapter).

4. After the successful execution of a DELETE statement, the identified record has been logically removed from the file and can no longer be accessed.

5. The execution of a DELETE statement does not affect the contents of the record area associated with file-name.

6. The current record pointer is not affected by the execution of a DELETE statement.

7. The execution of the DELETE statement causes the value of the specified FILE STATUS data item, if any, associated with file-name to be updated. (See I-O STATUS in this Chapter).

THE OPEN STATEMENT

Function

The OPEN statement initiates the processing of files. It also performs checking and/or writing of labels and other input-output operations.

General Format

$$\underline{\text{OPEN}} \quad \left\{ \begin{array}{ll} \underline{\text{INPUT}}\ \text{file-name-1} & [,\text{file-name-2}]\ \ldots \\ \underline{\text{OUTPUT}}\ \text{file-name-3} & [,\text{file-name-4}]\ \ldots \\ \underline{\text{I-O}}\ \text{file-name-5} & [,\text{file-name-6}]\ \ldots \end{array} \right\} \ldots$$

Syntax Rule

The files referenced in the OPEN statement need not all have the same organization or access.

General Rules

1. The successful execution of the OPEN statement determines the availability of the file and results in the file being in an open mode.

2. The successful execution of the OPEN statement makes the associated record area available to the program.

3. Prior to the successful execution of an OPEN statement for a given file, no statement can be executed that references that file, either explicitly or implicitly.

4. An OPEN statement must be successfully executed prior to the execution of any of the permissible input-output statements. In Table 7-1, Permissible Statements, 'X' at an intersection indicates that the specified statement, used in the access mode given for that row, may be used with the indexed file organization and the open mode given at the top of the column.

Table 7-1. Permissable Combinations of Statements and Open Modes for Indexed I/O.

File Access Mode	Statement	Open Mode		
		Input	Output	Input-Output
Sequential	READ	X		X
	WRITE		X	
	REWRITE			X
	START	X		X
	DELETE			X
Random	READ	X		X
	WRITE		X	X
	REWRITE			X
	START			
	DELETE			X
Dynamic	READ	X		X
	WRITE		X	X
	REWRITE			X
	START	X		X
	DELETE			X

5. A file may be opened with the INPUT, OUTPUT and I-O phrases in the same program. Following the initial execution of an OPEN statement for a file, each subsequent OPEN statement execution for that same file must be preceded by the execution of a CLOSE statement for that file.

6. Execution of the OPEN statement does not obtain or release the first data record.

7. The assigned name in the select statement for a file is processed as follows:

   a. When the INPUT phrase is specified, the execution of the OPEN statement causes the assigned name to be checked in accordance with the operating system conventions for opening files for input.

   b. When the OUTPUT phrase is specified, the execution of the OPEN statement causes the assigned name to be written in accordance with the operating system conventions for opening files for output.

8. The file description entry for file-name-1, file-name-2, file-name-5, or file-name-6 must be equivalent to that used when this file was created.

9. For files being opened with the INPUT or I-O phrase, the OPEN statement sets the current record pointer to the first record currently existing within the file. For indexed files, the prime record key is established as the key of reference and is used to determine the first record to be accessed. If no records exist in the file, the current record pointer is set such that the next executed Format 1 READ statement for the file will result in an AT END condition. If the file does not exist, INPUT will cause an error status.

10. The I-O phrase permits the opening of a file for both input and output operations. If the file does not exist, it will be created. In sequential access mode it will then be used for input; any attempt to WRITE to it will cause an error.

11. When the I-O phrase is specified and the LABEL RECORDS clause indicates label records are present, the execution of the OPEN statement includes the following steps:

    a. The labels are checked in accordance with the operating system specified conventions for input-output label checking.

    b. The new labels are written in accordance with the operating system specified conventions for input-output label writing.

12. Upon successful execution of an OPEN statement with the output phrase specified, a file is created. At that time the associated file contains no data records. If a file of the same name exists it will be deleted. If write protected, an error status occurs.

13. The execution of the OPEN statement causes the value of the FILE STATUS data item to be updated (see I-O STATUS in this chapter).

THE READ STATEMENT

Function

For sequential access, the READ statement makes available the next logical record from a file. For random access, the READ statement makes available a specified record from a mass storage file.

General Format

Format 1

```
    READ file-name [NEXT]  RECORD  [INTO identifier]

      [;AT END imperative-statement]
```

Format 2

```
    READ file-name RECORD [ INTO identifier ]

      [;KEY IS data-name]

      [;INVALID KEY imperative-statement]
```

Syntax Rules

1. The INTO phrase must not be used when the input file contains logical records of various sizes as indicated by their record descriptions. The storage area associated with identifier and the storage area which is the record area associated with file-name must not be the same storage area.

2. Data-name must be the name of a data item specified as a record key associated with file-name.

3. Data-name may be qualified.

4. Format 1 must be used (without the NEXT phrase) for all files in sequential access mode.

5. Format 1 (with the NEXT phrase) must be specified for files in dynamic access mode, when records are to be retrieved sequentially.

6. Format 2 is used for files in random access mode or for files in dynamic access mode when records are to be retrieved randomly.

7. The INVALID KEY phrase or the AT END phrase must be specified if no applicable USE procedure is specified for file-name.

General Rules

1. The associated file must be open in the INPUT or I-O mode at the time this statement is executed. (See THE OPEN STATEMENT in this Chapter).

2. The record to be made available by a Format 1 READ statement is determined as follows:

   a. The record, pointed to by the current record pointer, is made available provided that the current record pointer was positioned by the START or OPEN statement and the record is still accessible through the path indicated by the current record pointer; if the record is no longer accessible, which may have been caused by the deletion of the record or a change in an ALTERNATE RECORD key. The current record pointer is updated to point to the next existing record within the established key of reference and that record is then made available.

   b. If the current record pointer was positioned by the execution of a previous READ statement, the current record pointer is updated to point to the next existing record in the file with the established key of reference and then that record is made available.

3. The execution of the READ statement causes the value of the FILE STATUS data item, if any, associated with file-name to be updated. (See I-O Status in this Chapter).

4. Regardless of the method used to overlap access time with processing time, the concept of the READ statement is unchanged in that a record is available to the object program prior to the execution of any statement following the READ statement.

5. When the logical records of a file are described with more than one record description, these records automatically share the same storage area; this is equivalent to an implicit redefinition of the area. The contents of any data items which lie beyond the range of the current data record are undefined at the completion of the execution of the READ statement.

6. If the INTO phrase is specified, the record being read is moved from the record area to the area specified by identifier according to the rules specified for the MOVE statement without the CORRESPONDING phrase. The implied MOVE does not occur if the execution of the READ statement was unsuccessful. Any subscripting or indexing associated with identifier is evaluated after the record has been read and immediately before it is moved to the data item.

7. When the INTO phrase is used, the record being read is available in both the input record area and the data area associated with identifier.

8. If, at the time of execution of a Format 1 READ statement, the position of current record pointer for that file is undefined, the execution of that READ statement is unsuccessful.

9. If, at the time of the execution of a Format 1 READ statement, no next logical record exists in the file, the AT END condition occurs, and the execution of the READ statement is considered unsuccessful. (See _I-O Status_ in this Chapter).

10. When the AT END condition is recognised the following actions are taken in the specified order:

    a. A value is placed into the FILE STATUS data item, if specified for this file, to indicate an AT END condition. (See I-O STATUS in this Chapter).

    b. If the AT END phrase is specified in the statement causing the condition, control is transferred to the AT END imperative statement. Any USE procedure specified for this file is not executed.

    c. If the AT END phrase is not specified, then a USE procedure must be specified, either explictly or implicitly, for this file, and that procedure is executed.

    When the AT END condition occurs, execution of the input-output statement which caused the condition is unsuccessful.

11. Following the unsuccessful execution of any READ statement, the contents of the associated record area and the position of the current record pointer are undefined. For indexed files the key of reference is also undefined.

12. When the AT END condition has been recognised, a Format 1 READ statement for that file must not be executed without first executing one of the following:

    a. A successful CLOSE statement followed by the execution of a successful OPEN statement for that file.

    b. A successful START statement for that file.

    c. A successful Format 2 READ statement for that file.

13. For a file for which dynamic access mode is specified, a Format 1 READ statement with the NEXT phrase specified causes the next logical record to be retrieved from that file as described in general rule 2 above.

14. For an indexed file being sequentially accessed, records having the same duplicate value in an alternate record key which is the key of reference are made available in the same order in which they are released by execution of WRITE statements, or by execution of rewrite statements which create such duplicate values.

15. If the KEY phrase is not specified in a Format 2 READ statement, the prime record key is established as the key of reference for this retrieval. If the dynamic access mode is specified, this key of reference is also used for retrievals by any subsequent executions of Format 1 READ statement for the file.

16. For an indexed file if the KEY phrase is specified in a Format 2 READ statement, data-name is established as the key of reference for this retrieval. If the dynamic access mode is specified, this key of reference is also used for retrievals by any subsequent executions of Format 1 READ statements for the file until a different key of reference is established for the file.

17. Execution of a Format 2 READ statement causes the value of the key of reference to be compared with the value contained in the corresponding data item of the stored records in the file, until the first record having an equal value is found. The current record pointer is positioned to this record which is then made available. If no record can be so identified, the INVALID KEY condition exists and execution of the READ statement is unsuccessful. (See The INVALID KEY Condition in this Chapter).

THE REWRITE STATEMENT

Function

The REWRITE statement logically replaces a record existing in a mass storage file.

General Format

REWRITE record-name [FROM identifier] [;INVALID KEY imperative-statement]

Syntax Rules

1. Record-name and identifier must not refer to the same storage area.

2. Record-name is the name of a logical record in the File Section of the Data Division and may be qualified.

3. The INVALID KEY phrase must be specified in the REWRITE statement for files for which an appropriate USE procedure is not specified.

General Rules

1. The file associated with record-name must be open in the I-O mode at the time of execution of this statement. (See THE OPEN STATEMENT in this Chapter).

2. For files in the sequential access mode, the last input-output statement executed for the associated file prior to the execution of the REWRITE statement must have been a successfully executed READ statement. The Operating System logically replaces the record that was accessed by the READ statement.

3. The number of character positions in the record referenced by record-name must be equal to the number of character positions in the record being replaced.

4. The logical record released by a successful execution of the REWRITE statement is no longer available in the record area unless the associated file is named in a SAME RECORD AREA clause, in which case the logical record is available to the program as a record of other files appearing in the same SAME RECORD AREA clause as the associated I-O file, as well as to the file associated with record-name.

5. The execution of a REWRITE statement with the FROM phrase is equivalent to the execution of:

   MOVE identifier TO record-name

followed by the execution of the same REWRITE statement without the FROM phrase. The contents of the record area prior to the execution of the implicit MOVE statement have no effect on the execution of the REWRITE statement.

6. The current record pointer is not affected by the execution of a REWRITE statement.

7. The execution of the REWRITE statement causes the value of the FILE STATUS data item, if any, associated with the file to be updated. (See I-O Status).

8. For a file in the sequential access mode, the record to be replaced is specified by the value contained in the prime record key. When the REWRITE statement is executed the value contained in the prime record key data item of the record to be replaced must be equal to the value of the prime record key of the last record read from this file.

9. For a file in the random or dynamic access mode, the record to be replaced is specified by the prime record key data item.

10. The contents of alternative record key data items of the record being rewritten may differ from those in the record being replaced. The Operating System utilizes the content of the record key data items during the execution of the REWRITE statement in such a way that subsequent access of the record may be made based upon any of those specified record keys.

11. The INVALID KEY condition exists when:

    a. The access mode is sequential and the value contained in the prime record key data item of the record to be replaced is not equal to the value of the prime record key of the last record read from this file or,

    b. The value contained in the prime record key data item does not equal that of any record stored in the file, or

    c. The value contained in an alternate record key data item for which a DUPLICATES clause has not been specified is equal to that of a record already stored in the file.

    The updating operation does not take place and the data in the record area is unaffected. (See The INVALID KEY Condition in this Chapter).

THE START STATEMENT

Function

The START statement provides a basis for logical positioning within an indexed file, for subsequent sequential retrieval of records.

General Format

$$\underline{\text{START}}\ \text{file-name}\ \left[\underline{\text{KEY}}\ \left\{\begin{array}{l}\text{IS } \underline{\text{EQUAL}} \text{ TO}\\ \text{IS} =\\ \text{IS } \underline{\text{GREATER}} \text{ THAN}\\ \text{IS} >\\ \text{IS } \underline{\text{NOT}}\ \underline{\text{LESS}} \text{ THAN}\\ \text{IS } \underline{\text{NOT}} <\end{array}\right\}\ \text{data-name}\right]$$

$$[;\underline{\text{INVALID}}\text{ KEY imperative-statement}]$$

NOTE: The required relational characters '>', '<' and '=' are not underlined to avoid confusion with other symbols such as '$\underline{>}$' (greater than or equal to).

Syntax Rules

1. File-name must be the name of an indexed file.

2. File-name must be the name of a file with sequential or dynamic access.

3. Data-name may be qualified.

4. The INVALID KEY phrase must be specified if no applicable USE procedure is specified for file-name.

5. If file-name is the name of an indexed file, and if the KEY phrase is specified, data-name may reference a data item specified as a record key associated with file-name, or it may reference any data item of category alpanumeric subordinate to the data-name of a data item specified as a record key associated with file-name whose leftmost character position corresponds to the leftmost character position of that record key data item.

General Rules

1. File-name must be open in the INPUT or I-O mode at the time that the START statement is executed. (See THE OPEN STATEMENT in this Chapter).

2. If the KEY phrase is not specified the relational operator 'IS EQUAL TO' is implied.

3. The type of comparison specified by the relational operator in the KEY phrase occurs between a key associated with a record in the file referenced by file-name and a data item as specified in general rule 5. If file-name references an indexed file and the operands are of unequal size, comparison proceeds as though the longer one were truncated on the right such that its length is equal to that of the shorter. All other nonnumeric comparison rules apply except that the presence of the PROGRAM COLLATING SEQUENCE clause will have no effect on the comparison. (See Comparison of Nonnumeric Operands).

   a. The current record pointer is positioned to the first logical record currently existing in the file whose key satisfies the comparison.

   b. If the comparison is not satisfied by any record in the file, an INVALID KEY condition exists, the execution of the START statement is unsuccessful, and the position of the current record pointer is undefined. (See The INVALID KEY Condition in this Chapter)

4. The execution of the START statement causes the value of the FILE STATUS data item, if any, associated with file-name to be updated. (See I-O Status).

5. If the KEY phrase is specified, the comparison described in general rule 3 uses the data item referenced by data-name.

6. If the KEY phrase is not specified, the comparison described in general rule 3 uses the data item referenced in the RECORD KEY clause associated with file-name.

7. Upon completion of the successful execution of the START statement, a key of reference is established and used in subsequent Format 1 READ statements as follows: (See THE READ STATEMENT in this Chapter).

   a. If the KEY phrase is not specified, the prime record key specified for file-name becomes the key of reference.

   b. If the KEY phrase is specified, and data-name is specified as a record key for file-name, that record key becomes the key of reference.

   c. If the KEY phrase is specified, and data-name is not specified as a record key for file-name, the record key whose leftmost character position corresponds to the leftmost character position of the data item specified by data-name, becomes the key of reference.

8. If the execution of the START statement is not successful, the key of reference is undefined.

THE USE STATEMENT

Function

The USE statement specifies procedures for input-output error handling that are in addition to the standard procedures provided by the input-output control system.

General Format

$$\underline{\text{USE}}\ \underline{\text{AFTER}}\ \text{STANDARD} \left\{\begin{array}{l}\underline{\text{EXCEPTION}}\\ \underline{\text{ERROR}}\end{array}\right\}\ \ \underline{\text{PROCEDURE}}\ \text{ON} \left\{\begin{array}{l}\text{file-name-1 [, file-name-2]...}\\ \underline{\text{INPUT}}\\ \underline{\text{OUTPUT}}\\ \underline{\text{I-O}}\end{array}\right\}.$$

Syntax Rules

1. A USE statement, when present, must immediately follow a section header in the declaratives section and must be followed by a period followed by a space. The remainder of the section must consist of zero, one or more procedural paragraphs that define the procedures to be used.

2. The USE statement itself is never executed; it merely defines the conditions calling for the execution of the USE procedures.

3. The same file-name can appear in a different specific arrangement of the format. Appearance of a file-name in a USE statement must not cause the simultaneous request for execution of more than one USE procedure.

4. The words ERROR and EXCEPTION are synonymous and may be used interchangeably.

5. The files implicitly referenced in a USE statement need not all have the same organization or access.

General Rules

1. The designated procedures are executed by the input-output system after completing the standard input-output routine, or upon recognition of the INVALID KEY or AT END condition, when the INVALID KEY phrase or the AT END phrase have not been specified in the input-output statements .

2. After execution of a USE procedure, control is returned to the invoking routine.

3. Within a USE procedure, there must not be any reference to any nondeclarative procedures. Conversely, in the nondeclarative portion there must be no reference to procedure-names that appear in the declarative portion, except that PERFORM statements may refer to a USE statement or to the procedures associated with such a USE statement.

4. Within a USE procedure, there must not be the excecution of any statement that would cause the execution of a USE procedure that had previously been invoked and had not yet returned control to the invoking routine.

THE WRITE STATEMENT

Function

The WRITE statement releases a logical record for an output or input-output file.

General Format

<u>WRITE</u> record-name [<u>FROM</u> identifier][; <u>INVALID</u> KEY imperative-statement]

1. Record-name and identifier must not reference the same storage area.
2. The record-name is the name of a logical record in the File Section of the Data Division and may be qualified.
3. The INVALID KEY phrase must be specified if an applicable USE procedure is not specified for the associated file.

General Rules

1. The associated file must be open in the OUTPUT or I-O mode at the time of the execution of this statement. (See THE OPEN STATEMENT in this Chapter).
2. The logical record released by the execution of the WRITE statement is no longer available in the record area unless the associated file is named in a SAME RECORD AREA clause or the execution of the WRITE statement is unsuccessful due to an INVALID KEY condition. The logical record is available to the program from the file associated with record-name and from other files referenced in the same SAME RECORD AREA clause as the associated output file.
3. The results of the execution of the WRITE statement with the FROM phrase is equivalent to the execution of:

   a. The statement:

      MOVE identifier TO record-name

      according to the rules specified for the MOVE statement, followed by:

   b. The same WRITE statement without the FROM phrase.

   The contents of the record area prior to the execution of the implicit MOVE statement have no effect on the execution of this WRITE statement.

After execution of the WRITE statement is complete, the information in the area referenced by identifier is available, even though the information in the area referenced by record-name may not be. (See general rule 2 above).

4. The current record pointer is unaffected by the execution of a WRITE statement.

5. The execution of the WRITE statement causes the value of the FILE STATUS data item, if any, associated with the file to be updated. (See I-O Status in this Chapter).

6. The maximum record size for a file is established at the time the file is created and must not subsequently be changed.

7. The number of character positions on a mass storage device required to store a logical record in a file may or may not be equal to the number of character positions defined by the logical description of that record in the program.

8. The execution of the WRITE statement releases a logical record to the operating system.

9. Execution of the WRITE statement causes the contents of the record area to be released. The Operating System utilizes the content of the record keys in such a way that subsequent access of the record may be made based upon any of those specified record keys.

10. The value of the prime record key must be unique within the records in the file.

11. The data item specified as the prime record key must be set by the program to the desired value prior to the execution of the WRITE statement.

12. If sequential access mode is specified for the file, records must be released to the Operating System is ascending order of prime record key values.

13. If random or dynamic access mode is specified, records may be released to the Operating System in any program-specified order.

14. When the ALTERNATE RECORD KEY clause is specified in the file control entry for an indexed file, the value of the alternate record key may be non-unique only if the DUPLICATES phrase is specified for that data item. In this case the Operating System provides storage of records such that when records are accessed sequentially, the order of retrieval of those records is the order in which they are released to the Operating System.

15. The INVALID KEY condition exists under the following circumstances:

   a. When sequential access mode is specified for a file opened in the output mode, and the value of the prime record key is not greater than the value of the prime record key of the previous record, or

   b. When the file is opened in the output or I-O mode, and the value of the prime record key is equal to the value of a prime record key of a record already existing in the file, or

   c. When the file is opened in the output or I-O mode, and the value of an alternate record key for which duplicates are not allowed equals the corresponding data item of a record already existing in the file, or

   d. When an attempt is made to write beyond the externally defined boundaries of the file.

16. When the INVALID KEY condition is recognised the execution of the WRITE statement is unsuccessful, the contents of the record area are unaffected and the FILE STATUS data item, if any, associated with file-name of the associated file is set to a value indicating the cause of the condition. Execution of the program proceeds according to the rules stated under THE INVALID KEY CONDITION (See also I-O Status in this Chapter).

CHAPTER 8

SORT-MERGE

INTRODUCTION TO THE SORT-MERGE MODULE

The Sort-Merge module provides the capability to order one or more files of records, or to combine two or more identically ordered files of records, according to a set of user-specified keys contained within each record. Optionally, a user may apply some special processing to each of the individual records by input or output procedures. This special processing may be applied before and/or after the records are ordered by the SORT or after the records have been combined by the MERGE.

RELATIONSHIP WITH SEQUENTIAL I-O MODULE

The files specified in the USING and GIVING phrases of the SORT and MERGE statements must be described implicitly or explicity in the FILE-CONTROL paragraph as having sequential organization. No input-output statement may be executed for the file named in the sort-merge file description.

ENVIRONMENT DIVISION IN THE SORT-MERGE MODULE

INPUT-OUTPUT SECTION

The FILE-CONTROL Paragraph

Function

The FILE-CONTROL paragraph names each file and allows specification of other file-related information.

General Format

```
          FILE CONTROL. {file-control-entry}        ...
```

The File Control Entry

Function

The file control entry names a sort or merge file and specifies the association of the file to a storage medium.

General Format

```
SELECT file-name

ASSIGN TO  {external-file-name-literal}        ... .
           {file-identifier            }
```

Syntax Rules

1. Each sort or merge file described in the Data Division must be named once and only once as file-name in the FILE-CONTROL paragraph. Each sort or merge file specified in the file control entry must have a sort-merge file description entry in the Data Division.

2. Since file-name represents a sort or merge file, only the ASSIGN clause is permitted to follow file-name in the FILE-CONTROL paragraph.

General Rule

The ASSIGN clause specifies the association of the sort or merge file referenced by file-name to a storage medium.

The I-O-CONTROL Paragraph

Function

The I-O-CONTROL paragraph specifies the memory area which is to be shared by different files.

General Format

```
I-O-CONTROL
-----------
  [         { RECORD     }
  [ ; SAME  { SORT       }   AREA FOR file-name-1
  [ ; ----  { ---------- }                        ]
            { SORT-MERGE }                        ]
                                                  ]
                 { , file-name-2 } ...            ]   ... .
```

Syntax Rules

1. The I-O-CONTROL paragraph is optional.

2. In the SAME AREA clause, SORT and SORT-MERGE are equivalent.

3. If the SAME SORT AREA or SAME SORT-MERGE AREA clause is used, at least one of the file-names must represent a sort or merge file. Files that do not represent sort or merge files may also be named in the clause.

4. The three formats of the SAME clause (SAME RECORD AREA, SAME SORT AREA, SAME SORT-MERGE AREA) are considered separately in the following:

   More than one SAME clause may be included in a program, however:

   a. A file-name must not appear in more than one SAME RECORD AREA clause.

   b. A file-name that represents a sort or merge file must not appear in more than one SAME SORT AREA or SAME SORT-MERGE AREA clause.

   c. If a file-name that does not represent a sort or merge file appears in a SAME AREA clause and one or more SAME SORT AREA or SAME SORT-MERGE AREA clauses, all of the files named in that SAME AREA clause must be named in that SAME SORT AREA or SAME SORT-MERGE AREA clauses(s).

5. The files referenced in the SAME SORT AREA, SAME SORT-MERGE AREA, or SAME RECORD AREA clause need not all have the same organization or access.

General Rules

1. The SAME RECORD AREA clause specifies that two or more files are to use the same memory area for processing of the current logical record. All of the files may be open at the same time. A logical record in the SAME RECORD AREA is considered as a logical record of each opened output file whose file-name appears in this SAME RECORD AREA clause and of the most recently read input file whose file-name appears in this SAME RECORD AREA clause. This is equivalent to implicit redefinition of the area, i.e., records are aligned on the leftmost character position.

2. If the SAME SORT AREA or SAME SORT-MERGE AREA clause is used, at least one of the file-names must represent a sort or merge file. Files that do not represent sort or merge files may also be named in the clause. This clause specifies that storage is shared as follows:

   a. The SAME SORT AREA or SAME SORT-MERGE AREA clause specifies a memory area which will be made available for use in sorting or merging each sort or merge file named. Thus any memory area allocated for the sorting or merging of a sort or merge file is available for reuse in sorting or merging any of the other sort or merge files.

   b. In addition, storage areas assigned to files that do not represent sort or merge files may be allocated as needed for sorting or merging the sort or merge files named in the SAME SORT AREA or SAME SORT-MERGE AREA clause.

   c. Files other than sort or merge files do not share the same storage area with each other. If the user wishes these files to share the same storage area with each other, he must also include in the program a SAME AREA or SAME RECORD AREA clause naming these files.

   d. During the execution of a SORT or MERGE statement that refers to a sort or merge file named in this clause, any non sort-merge files named in this clause must not be open.

DATA DIVISION IN THE SORT-MERGE MODULE

FILE SECTION

An SD file description gives information about the size and the names of the data records associated with the file to be sorted or merged. There are no label procedures which the user can control, and the rules for blocking and internal storage are peculiar to the SORT and MERGE statements.

THE SORT-MERGE FILE DESCRIPTION - COMPLETE ENTRY SKELETON

Function

The sort-merge file description furnishes information concerning the physical structure, identification and record names of the file to be sorted or merged.

General Format

$$\underline{\text{SD}}\quad \text{file-name}$$

$$[;\ \underline{\text{RECORD}}\ \text{CONTAINS}\ \ [\text{integer-1}\ \underline{\text{TO}}]\ \ \text{integer-2 CHARACTERS}]$$

$$\left[;\ \underline{\text{DATA}}\left\{\begin{array}{l}\underline{\text{RECORD}}\ \text{IS}\\ \underline{\text{RECORDS}}\ \text{ARE}\end{array}\right\}\ \text{data-name-1}\ \ [,\ \text{data-name-2}]\ \ldots\right]\ .$$

Syntax Rules

1. The level indicator SD identifies the beginning of the sort-merge file description and must precede the file-name.

2. The clauses which follow the name of the file are optional and their order of appearance is immaterial. They are treated as for documentation purposes only.

3. One or more record description entries must follow the sort-merge file description entry, however, no input-output statements may be executed for this file.

THE DATA RECORDS CLAUSE

Function

The DATA RECORDS clause serves only as documentation for the names of data records with their associated file.

General Format

$$\underline{\text{DATA}}\left\{\begin{array}{l}\underline{\text{RECORD}}\ \text{IS}\\ \underline{\text{RECORDS}}\ \text{ARE}\end{array}\right\}\quad \text{data-name-1}\quad [,\ \text{data-name-2}]\quad \ldots$$

Syntax Rule

Data-name-1 and data-name-2 are the names of data records and must have 01 level-number record descriptions, with the same names, associated with them.

General Rules

1. The DATA RECORDS clause is treated as for documentation purposes only.

2. The presence of more than one data-name indicates that the file contains more than one type of data record. These records may be of differing sizes, different formats, etc. The order in which they are listed is not significant.

3. Conceptually, all data records within a file share the same area. This is in no way altered by the presence of more than one type of data record within the file.

THE RECORD CONTAINS CLAUSE

Function

The RECORD CONTAINS clause specifies the size of data records.

General Format

RECORD CONTAINS [integer-1 TO] integer-2 CHARACTERS

General Rule

1. The RECORD CONTAINS clause is treated as for documentation purposes only.

2. The size of each data record is completely defined within the record description entry, therefore this clause is never required. When present, however, the following notes apply:

   a. Integer-2 may not be used by itself unless all the data records in the file have the same size. In this case integer-2 represents the exact number of characters in the data record. If integer-1 and integer-2 are both shown, they refer to the minimum number of characters in the smallest size data records and the maximum number of characters in the largest size data records, respectively.

   b. The size is specified in terms of the number of character positions required to store the logical record, regardless of the types of characters used to represent the items within the logical record. The size of a record is determined by the sum of the number of characters in all fixed length elementary items plus the sum of the maximum number of characters in any variable length item subordinate to the record. This sum may be different from the actual size of the record; see Selection of Character Representation and Radix in Chapter 2; and THE SYNCHRONIZED CLAUSE and THE USAGE CLAUSE in Chapter 3.

PROCEDURE DIVISION IN THE SORT-MERGE MODULE

THE MERGE STATEMENT

Function

The MERGE statement combines two or more identically sequenced files on a set of specified keys, and during the process makes records available, in merge order, to an output procedure or to an output file.

General Format

```
                           { ASCENDING  }
MERGE file-name-1 ON       { DESCENDING } KEY data-name-1 [, data-name-2] ...

      [ON { ASCENDING  } KEY data-name-3 [, data-name-4] ...] ...
      [   { DESCENDING }                                     ]

      [COLLATING SEQUENCE IS alphabet-name]

      USING file-name-2, file-name-3 [, file-name-4] ...

     { OUTPUT PROCEDURE IS section-name-1 [{ THROUGH } section-name-2] }
     {                                    [{ THRU    }               ] }
     {                                                                 }
     { GIVING file-name-5                                              }
```

Syntax Rules

1. File-name-1 must be described in a sort-merge file description entry in the Data Divison.

2. Section-name-1 represents the name of an output procedure.

3. File-name-2, file-name-3, file-name-4, and file-name-5 must be described in a file description entry, not in a sort-merge file description entry, in the Data Division. The actual size of the logical record(s) described for file-name-2, file-name-3, file-name-4, and file-name-5 must be equal to the actual size of the logical record(s) described for file-name-1. If the data descriptions of the elementary items that make up these records are not identical, it is the programmer's responsibility to describe the corresponding records in such a manner so as to cause an equal number of character positions to be allocated for the corresponding records.

4. The words THRU and THROUGH are equivalent.

5. Data-name-1, data-name-2, data-name-3, and data-name-4 are KEY data-names and are subject to the following rules:

   a. The data items identified by KEY data-names must be described in records associated with file-name-1.

   b. KEY data-names may be qualified.

   c. The data items identified by KEY data-names must not be variable length items.

   d. If file-name-1 has more than one record description, then the data items identified by KEY data-names need be described in only one of the record descriptions.

   e. None of the data items identified by KEY data-names can be described by an entry which either contains an OCCURS clause or is subordinate to an entry which contains an OCCURS clause.

6. No more than one file-name from a multiple file reel can appear in the MERGE statement.

7. File-names must not be repeated within the MERGE statement.

8. MERGE statements may appear anywhere except in the declaratives portion of the Procedure Division or in an input or output procedure associated with a SORT or MERGE statement.

<u>General Rules</u>

1. The MERGE statement will merge all records contained on file-name-2, file-name-3, and file-name-4. The files referenced in the MERGE statement must not be open at the time the MERGE statement is executed. These files are automatically opened and closed by the merge operation with all implicit functions performed, such as the execution of any associated USE procedures. The terminating function for all files is performed as if a CLOSE statement, without optional phrases, had been executed for each file.

2. The data-names following the word KEY are listed from left to right in the MERGE statement in order of decreasing significance without regard to how they are divided into KEY phrases. In the format, data-name-1 is the major key, data-name-2 is the next most significant key, etc.

   a. When the ASCENDING phrase is specified, the merged sequence will be from the lowest value of the contents of the data items identified by the KEY data-names to the highest value, according to the rules for comparison of operands in a relation condition.

   b. When the DESCENDING phrase is specified, the merged sequence will be from the highest value of the contents of the data items identified by the KEY data-names to the lowest value, according to the rule for comparison of operands in a relation condition.

3. The collating sequence that applies to the comparison of the nonnumeric key data items specified is determined in the following order of precedence:

   a. First, the collating sequence established by the COLLATING SEQUENCE phrase, if specified, in that MERGE statement.

   b. Second, the collating sequence established as the program collating sequence.

4. The output procedure must consist of one or more sections that appear contiguously in a source program and do not form part of any other procedure. In order to make merged records available for processing, the output procedure must include the execution of at least one RETURN statement. Control must not be passed to the output procedure except when a related SORT or MERGE statement is being executed. The output procedure may consist of any procedures needed to select, modify, or copy the records that are being returned one at a time in merge order, from file-name-1. The restrictions on the procedural statements within the output procedure are as follows:

   a. The output procedure must not contain any transfers of control to points outside the output procedure; ALTER, GO TO and PERFORM statements in the output procedure are not permitted to refer to procedure-names outside the output procedure. COBOL statements are allowed that will cause an implied transfer of control to declaratives.

   b. The output procedures must not contain any SORT or MERGE statements.

   c. The remainder of the Procedure Division must not contain any transfers of control to points inside the output procedures; ALTER, GO TO, and PERFORM statements in the remainder of the Procedure Division are not permitted to refer to procedure-names within the output procedures.

5. If an output procedure is specified, control passes to it during execution of the MERGE statement. The compiler inserts a return mechanism at the end of the last section in the output procedure. When control passes the last statement in the output procedure, the return mechanism provides for termination of the merge, and then passes control to the next executable procedure. The merge procedure has then reached a point at which it can select the next record in merged order when requested. The RETURN statements in the output procedure are the requests for the next record.

6. Segmentation, as defined in Chapter 9, can be applied to programs containing the MERGE statement. However, the following restrictions apply:

   a. If the MERGE statement appears in a section that is not in an independent segment, then any output procedure referenced by that MERGE statement must appear:

      * Totally within non-independent segments, or

      * Wholly contained in a single independent segment.

   b. If a MERGE statement appears in an independent segment, then any output procedure referenced by that MERGE statement must be contained:

      * Totally within non-independent segments, or

      * Wholly within the same independent segment as that MERGE statement.

7. If the GIVING phrase is specified, all the merged records in file-name-1 are automatically written on file-name-5 as the implied output procedure for this MERGE statement.

8. In the case of equal compare, according to the rules for comparison of operands in a relation condition, on the contents of the data items identified by all the KEY data-names between records from two or more input files (file-name-2, file-name-3, file-name-4, ...), the records are written on file-name-5 or returned to the output procedure, depending on the phrase specified, in the order that the associated input files are specified in the MERGE statement.

9. The results of the merge operation are predictable only when the records in the files referenced by file-name-2, file-name-3, ..., are ordered as described in the ASCENDING or DESCENDING KEY clause associated with the MERGE statement.

THE RELEASE STATEMENT

Function

The RELEASE statement transfers records to the initial phase of a SORT operation.

General Format

<u>RELEASE</u> record-name [<u>FROM</u> identifier]

Syntax Rules

1. A RELEASE statement may only be used within the range of an input procedure associated with a SORT statement for a file whose sort-merge file description entry contains record-name. (See The SORT Statement.)

2. Record-name must be the name of a logical record in the associated sort-merge file description entry and may be qualified.

3. Record-name and identifier must not refer to the same storage area.

General Rules

1. The execution of a RELEASE statement causes the record named by record-name to be released to the initial phase of a sort operation.

2. If the FROM phrase is used, the contents of the identifier data area are moved to record-name, then the contents of record-name are released to the sort file. Moving files takes place according to the rules specified for the MOVE statement without the CORRESPONDING phrase. The information in the record area is no longer available, but the information in the data area associated with identifier is available.

3. After the execution of the RELEASE statement, the logical record is no longer available in the record area unless the associated sort-merge file is named in a SAME RECORD AREA clause. The logical record is also available to the program as a record of other files referenced in the same SAME RECORD AREA clause as the associated sort-merge file, as well as to the file associated with record-name. When control passes from the input procedure, the file consists of all those records which were placed in it by the execution of RELEASE statements.

THE RETURN STATEMENT

Function

The RETURN statement obtains either sorted records from the final phase of a SORT operation or merged records during a MERGE operation.

General Format

```
RETURN file-name RECORD [INTO identifier]
                ; AT END imperative-statement
```

Syntax Rules

1. File-name must be described by a sort-merge file description entry in the Data Division.

2. A RETURN statement may only be used within the range of an output procedure associated with a SORT or MERGE statement for file-name.

3. The INTO phrase must not be used when the input file contains logical records of various sizes as indicated by their record descriptions. The storage area associated with identifier and the record area associated with file-name must not be the same storage area.

General Rules

1. When the logical records of a file are described with more than one record descritpion, these records automatically share the same storage area; this is equivalent to an implicit redefinition of the area. The contents of any data items which lie beyond the range of the current data record are undefined at the completion of the execution of the RETURN statement.

2. The execution of the RETURN statement causes the next record, in the order specified by the keys listed in the SORT or MERGE statement, to be made available for processing in the record areas associated with the sort or merge file.

3. If the INTO phrase is specified, the current record is moved from the input area to the area specified by identifier according to the rules for the MOVE statement without the CORRESPONDING phrase. The implied MOVE does not occur if there is an AT END condition. Any subscripting or indexing associated with identifier is evaluated after the record has been returned and immediately before it is moved to the data item.

4. When the INTO phrase is used, the data is available in both the input record area and the data area associated with identifier.

5. If no next logical record exists for the file at the time of the execution of a RETURN statement, the AT END condition occurs. The contents of the record areas associated with the file when the AT END condition occurs are undefined. After the execution of the imperative-statement in the AT END phrase, no RETURN statement may be executed as part of the current output procedure.

THE SORT STATEMENT

Function

The SORT statement creates a sort file by executing input procedures or by transferring records from another file, sorts the records in the sort file on a set of specified keys, and in the final phase of the sort operation, makes available each record from the sort file, in sorted order to some output procedures or to an output file.

General Format

```
SORT file-name-1 ON { ASCENDING  } KEY data-name-1  [, data-name-2] ...
                    { DESCENDING }

               [ ON { ASCENDING  } KEY data-name-3,  [, data-name-4] ... ] ...
               [    { DESCENDING }                                       ]

  [COLLATING SEQUENCE IS alphabet-name]

{ INPUT PROCEDURE IS section-name-1 [ { THROUGH } section-name-2 ] }
{                                   [ { THRU    }                ] }
{                                                                  }
{ USING file-name-2  [, file-name-3] ...                           }

{ OUTPUT PROCEDURE IS section-name-3 [ { THROUGH } section-name-4 ] }
{                                    [ { THRU    }                ] }
{                                                                   }
{ GIVING file-name-4                                                }
```

Syntax Rules

1. File-name-1 must be described in a sort-merge file description entry in the Data Division.

2. Section-name-1 represents the name of an input procedure. Section-name-3 represents the name of an output procedure.

3. File-name-2, file-name-3 and file-name-4 must be described in a file description entry, not in a sort-merge file description entry, in the Data Division. The actual size of the logical record(s) described for file-name-2, file-name-3 and file-name-4 must be equal to the actual size of the logical record(s) described for file-name-1. If the data descriptions of the elementary items that make up these records are not identical, it is the programmer's responsibility to describe the corresponding records in such a manner so as to cause equal amounts of character positions to be allocated for the corresponding records.

4. Data-name-1, data-name-2, data-name-3, and data-name-4 are KEY data-names and are subject to the following rules:

   a. The data items identified by KEY data-names must be described in records associated with file-name-1.

   b. KEY data-names may be qualified.

   c. The data items identified by KEY data-names must not be variable length items.

   d. If file-name-1 has more than one record description, then the data items identified by KEY data-names need be described in only one of the record descriptions.

   e. None of the data items identified by KEY data-names can be described by an entry which either contains an OCCURS clause or is subordinate to an entry which contains an OCCURS clause.

5. The words THRU and THROUGH are equivalent.

6. SORT statements may appear anywhere except in the declaratives portion of the Procedure Division or in an input or output procedure associated with a SORT or MERGE statement.

7. No more than one file-name from a multiple file reel can appear in the SORT statement.

General Rules

1. The Procedure Division may contain more than one SORT statement appearing anywhere except:

   a. In the declaratives portion, or

   b. In the input and output procedures associated with a SORT or MERGE statement.

2. The data-names following the word KEY are listed from left to right in the SORT statement in order of decreasing significance without regard to how they are divided into KEY phrases. In the format, data-name-1 is the major key, data-name-2 is the next most significant key, etc.

   a. When the ASCENDING phrase is specified, the sorted sequence will be from the lowest value of the contents of the data items identified by the KEY data-names to the highest value, according to the rules for comparison of operands in a relation condition.

   b. When the DESCENDING phrase is specified, the sorted sequence will be from the highest value of the contents of the data items identified by the KEY data-names to the lowest value, according to the rules for comparison of operands in a relation condition.

3. The collating sequence that applies to the comparison of the nonnumeric key data items specified is determined in the following order of precedence:

   a. First, the collating sequence established by the COLLATING SEQUENCE phrase, if specified, in the SORT statement.

   b. Second, the collating sequence established as the program collating sequence.

4. The input procedure must consist of one or more sections that appear contiguously in a source program and do not form a part of any output procedure. In order to transfer records to the file referenced by file-name-1, the input procedure must include the execution of at least one RELEASE statement. Control must not be passed to the input procedure when a related SORT statement is being executed. The input procedure can include any procedures needed to select, create, or modify records. The restrictions on the procedural statements within the input procedure are as follows:

   a. The input procedure must not contain any SORT or MERGE statements.

   b. The input procedure must not contain any explicit transfers of control to points outside the input procedure; ALTER, GO TO, and PERFORM statements in the input procedure are not permitted to refer to procedure-names outside the input procedure. COBOL statements are allowed that will cause an implied transfer of control to declaratives.

   c. The remainder of the Procedure Division must not contain any transfers of control to points inside the input procedure; ALTER, GO TO and PERFORM statements in the remainder of the Procedure Division must not refer to procedure-names within the input procedure.

5. If an input procedure is specified, control is passed to the input procedure before file-name-1 is sequenced by the SORT statement. The compiler inserts a return mechanism at the end of the last section in the input procedure and when control passes the last statement in the input procedure, the records that have been released to file-name-1 are sorted.

6. The output procedure must consist of one or more sections that appear contiguously in a source program and do not form part of any input procedure. In order to make sorted records available for processing, the output procedure must include the execution of at least one RETURN statement. Control must not be passed to the output procedure except when a related SORT statement is being executed. The output procedure may consist of any procedures needed to select, modify or copy the records that are being returned, one at a time in sorted order, from the sort file. The restrictions on the procedural statements within the output procedure are as follows:

a. The output procedure must not contain any SORT or MERGE statements.

b. The output procedure must not contain any explicit transfers of control to points outside the output procedure; ALTER, GO TO, and PERFORM statements in the output procedure are not permitted to refer to procedure-names outside the output procedure. COBOL statements are allowed that will cause an implied transfer of control to declaratives.

c. The remainder of the Procedure Division must not contain any transfers of control to points inside the output procedure; ALTER, GO TO and PERFORM statements in the remainder of the Procedure Division are not permitted to refer to procedure-names within the output procedure.

7. If an output procedure is specified, control passes to it after file-name-1 has been sequenced by the SORT statement. The compiler inserts a return mechanism at the end of the last section in the output procedure and when control passes the last statement in the output procedure, the return mechanism provides for termination of the sort and then passes control to the next executable statement after the SORT statement. Before entering the output procedure, the sort procedure reaches a point at which it can select the next record in sorted order when requested. The RETURN statements in the output procedure are the requests for the next record.

8. Segmentation as defined in Chapter 9 can be applied to programs containing the SORT statement. However, the following restrictions apply:

a. If a SORT statement appears in a section that is not in an independent segment, then any input procedures or output procedures referenced by that SORT statement must appear:

* Totally within non-independent segments, or

* Wholly contained in a single independent segment.

b. If a SORT statement appears in an independent segment, then any input procedures or output procedures referenced by that SORT statement must be contained:

* Totally within non-independent segments, or

* Wholly within the same independent segment as that SORT statement.

9. If the USING phrase is specified, all the records in file-name-2 and file-name-3 are transferred automatically to file-name-1. At the times of execution of the SORT statement, file-name-2 and file-name-3 must

not be open. The SORT statement automatically initiates the processing of, makes available the logical records for, and terminates the processing of file-name-2 and file-name-3. These implicit functions are performed such that any associated USE Procedures are executed. The terminating function for all files is performed as if a CLOSE statement, without optional phrases, had been executed for each file. The SORT statement also automatically performs the implicit functions of moving the records from the file area of file-name-2 and file-name-3 to the file area for file-name-1 and the release of records to the initial phase of the sort operation.

10. If the GIVING phrase is specified, all the sorted records in file-name-1 are automatically written on file-name-4 as the implied output procedure for this SORT statement. At the time of execution of the SORT statement file-name-4 must not be open. The SORT statement automatically initiates the processing of, releases the logical records to, and terminates the processing of file-name-4. These implicit functions are performed such that any associated USE procedures are executed. The terminating function is performed as if a CLOSE statement, without optional phrases, had been executed for the file. The SORT statement also automatically performs the implicit functions of the return of the sorted records from the final phase of the sort operation and the moving of the records from the file area for file-name-1 to the file area for file-name-4.

CHAPTER 9

SEGMENTATION

INTRODUCTION TO THE SEGMENTATION MODULE

The Segmentation module provides a capability to specify object program overlay requirements.

Segmentation provides a facility for specifying permanent and independent segments. All segments specified as permanent segments must be contiguous in the source program. Segmentation also allows the intermixing of sections with different segment-numbers and allows the fixed portion of the source program to contain segments that may be overlaid.

GENERAL DESCRIPTION OF SEGMENTATION

COBOL segmentation is a facility that provides a means by which the user may communicate with the compiler to specify object program overlay requirements.

COBOL segmentation deals only with segmentation of procedures. As such, only the Procedure Division is considered in determining segmentation requirements for an object program.

ORGANIZATION

Program Segments

Although it is not mandatory, the Procedure Division for a source program is usually written as a consecutive group of sections, each of which is composed of a series of closely related operations that are designed to collectively perform a particular function. However, when segmentation is used, the entire Procedure Division must be in sections. In addition, each section must be classified as belonging either to the fixed portion or to one of the independent segments of the object program. Segmentation in no way affects the need for qualification of procedure-names to insure uniqueness.

Fixed Portion

The fixed portion is defined as that part of the object program which is logically treated as if it were always in memory. This portion of the program is composed of fixed permanent segments, and fixed overlayable segments.

A fixed permanent segment is a segment in the fixed portion which cannot be overlaid by any other part of the program.

A fixed overlayable segment is a segment in the fixed portion which, although logically treated as if it were always in memory, can be overlaid by another segment to optimize memory utilitization. Variation of the number of fixed permanent segments in the fixed portion can be accomplished by using a special facility called the SEGMENT-LIMIT clause (see SEGMENT-LIMIT in this Chapter). Such a segment, if called for by the program, is always made available in its last used state.

Independent Segments

An independent segment is defined as part of the object program which can overlay, and can be overlaid by either a fixed overlayable segment or another independent segment. An independent segment is in its initial state whenever control is transferred (either implicitly or explicitly) to that segment for the first time during the execution of a program. On subsequent transfers of control to the segment, an independent segment is also in its initial state when:

1. Control is transferred to that segment as a result of the implicit transfer of control between consecutive statements from a segment with a different segment-number.

2. Control is transferred to that segment as the result of the implicit transfer of control between a SORT or MERGE statement, in a segment with a different segment-number, and an associated input or output procedure in that independent segment.

3. Control is transferred explicitly to that segment from a segment with a different segment-number (with the exception noted in paragraph 2 below).

On subsequent transfer of control to the segment, an independent segment is in its last-used state when:

1. Control is transferred implicitly to that segment from a segment with a different segment-number (except as noted in paragraph 1).

2. Control is transferred explicitly to that segment as the result of the execution of an EXIT PROGRAM statement.

SEGMENTATION CLASSIFICATION

Sections which are to be segmented are classified, using a system of segment-numbers and the following criteria:

1. Logic Requirements - Sections which must be available for reference at all times, or which are referred to very frequently, are normally classified as belonging either to one of the overlayable fixed segments or to one of the permanent segments; sections which are used less frequently are normally classified as belonging to one of the independent segments, depending on logic requirements.

2. Frequency of Use - Generally, the more frequently a section is referred to, the lower its segment-number, the less frequently it is referred to, the higher its segment-number.

3. Relationship to Other Sections - Sections which frequently communicate with one another should be given the same segment-numbers.

SEGMENTATION CONTROL

The logical sequence of the program is the same as the physical sequence except for specific transfers of control. Control may be transferred within a source program to any paragraph in a section; that is, it is not mandatory to transfer control to the beginning of a section.

STRUCTURE OF PROGRAM SEGMENTS

SEGMENT-NUMBERS

Section classification is accomplished by means of a system of segment-numbers. The segment-number is included in the section header.

General Format

section-name SECTION [segment-number].

Syntax Rules

1. The segment-number must be an integer ranging in value from 0 through 99.

2. If the segment-number is omitted from the section header, the segment-number is assumed to be 0.

3. Sections in the declaratives must contain segment-numbers less than 50.

General Rules

1. All sections which have the same segment-number constitute a program segment. All sections which have the same segment-number need not be physically contiguous in the source program.

2. Segments with segment-number 0 through 49 belong to the fixed portion of the object program.

*

3. Segments with segment-number 50 through 99 are independent segments.

SEGMENT-LIMIT

General Format

The SEGMENT-LIMIT clause appears in the OBJECT-COMPUTER paragraph and has the following format:

[,SEGMENT-LIMIT IS segment-number]

Syntax Rules

Segment-number must be an integer ranging in value from 1 through 49.

General Rules

1. The SEGMENT-LIMIT clause is treated as for documentation purposes only.

2. When the SEGMENT-LIMIT clause is specified, only those segments having segment-numbers from 0 up to, but not including, the segment-number designated as the segment-limit, are considered as permanent segments of the object program.

3. Those segments having segment-numbers from the segment-limit through 49 are considered as overlayable fixed segments.

4. When the SEGMENT-LIMIT clause is omitted, all segments having segment-numbers from 0 through 49 are considered as permanent segments of the object program.

RESTRICTIONS ON PROGRAM FLOW

When segmentation is used, the following restrictions are placed on the ALTER, PERFORM, MERGE and SORT statements.

THE ALTER STATEMENT

A GO TO statement in a section whose segment-number is greater than or equal to 50 must not be referred to by an ALTER statement in a section with a different segment-number.

All other uses of the ALTER statement are valid and performed even if the GO TO to which the ALTER refers is in a fixed overlayable segment.

THE PERFORM STATEMENT

A PERFORM statement that appears in a section that is not in an independent segment can have within its range, in addition to any declarative sections whose execution is caused within that range, only one of the following:

* Sections and/or paragraphs wholly contained in one or more non-independent segments.

* Sections and/or paragraph wholly contained in a single independent segment.

A PERFORM statement that appears in an independent segment can have within its range, in addition to any declarative sections whose execution is caused within that range, only one of the following:

a. Sections and/or paragraphs wholly contained in one or more non-independent segments.

b. Sections and/or paragraphs wholly contained in the same independent segment as that PERFORM statement.

THE MERGE STATEMENT

If the MERGE statement appears in a section that is not in an independent segment, then any output procedure referenced by that MERGE statement must appear:

a. Totally within non-independent segments, or

b. Wholly contained in a single independent segment.

If a MERGE statement appears in an independent segment, then any output procedure referenced by that MERGE statement must be contained:

a. Totally within non-independent segments, or

b. Wholly within the same independent segment as that MERGE statement.

THE SORT STATEMENT

If a SORT statement appears in a section that is not an independent segment, then any input procedures or output procedures referenced by that SORT statement must appear:

a. Totally within non-independent segments, or

b. Wholly contained in a single independent segment.

If a SORT statement appears in an independent segment, then any input procedures or output prcoedures referenced by that SORT statement must be contained:

a. Totally within non-independent segments, or

b. Wholly within the same independent segment as that SORT statement.

EXTRA INTERMEDIATE CODE FILES

When segmentation is used, extra intermediate code files are generated by the compiler as follows:

filename.Inn	-	Intermediate code files one for each independent segment
filename.ISR	-	Inter-Segment Reference table one per segmented program
filename.Dnn	-	Dictionary files one for each independent segment except the last

where:

filename is the name without the extension of the principal intermediate code file

nn is a segment number that identifies the particular segment

NOTE:
The filename.Dnn files are written and used solely by the compiler, and need not be retained after compilation. The filename.Inn files and the filename.ISR file must be retained as part of the object program and must also be copied when the program is copied.

CHAPTER 10

LIBRARY

INTRODUCTION TO THE LIBRARY MODULE

The Library module provides a capability for specifying text that is to be copied from a source user-library file. This is usually created using any suitable source text editor.

L/II COBOL libraries consist of disk files that contain source to be made available to the compiler. The effect of the interpretation of the COPY statement is to insert text into the source program, where it will be treated by the compiler as part of the source program. All occurrences of a given literal, identifier, word or group of words in the library text can be replaced with alternate text during the copy process. The library module also provides for the availability of more than one COBOL library at compile time.

THE COPY STATEMENT

FUNCTION

The COPY statement incorporates text into a L/II COBOL source program.

GENERAL FORMAT

$$\underline{\text{COPY}}\begin{Bmatrix}\text{text-name}\\ \text{external-file-name-literal}\end{Bmatrix}\left[\begin{Bmatrix}\underline{\text{OF}}\\ \underline{\text{IN}}\end{Bmatrix}\ \text{library-name}\right]$$

$$\left[\ \underline{\text{REPLACING}}\ \left\{,\ \begin{Bmatrix}\text{==pseudo-text-1==}\\ \text{identifier-1}\\ \text{literal-1}\\ \text{word-1}\end{Bmatrix}\ \underline{\text{BY}}\ \begin{Bmatrix}\text{==pseudo-text-2==}\\ \text{identifier-2}\\ \text{literal-2}\\ \text{word-2}\end{Bmatrix}\right\}\ldots\ \right]$$

SYNTAX RULES

1. If more than one COBOL library is available during compilation, text-name must be qualified by the library-name identifying the COBOL library in which the text associated with text-name resides. See your L/II COBOL Operating Guide for details of library files.

2. The COPY statement must be preceded by a space and terminated by the separator period.

3. Pseudo-text-1 must not be null, nor may it consists solely of the character space(s), nor may it consist solely of comment lines.

4. Pseudo-text-2 may be null.

5. Character-strings within pseudo-text-1 and pseudo-text-2 may be continued. However, both characters of a pseudo-text delimiter must be on the same line. (see Continuation of Lines).

6. Word-1 or word-2 may be any single COBOL word.

7. A COPY statement may occur in the source program anywhere a character-string or a separator may occur except that a COPY statement must not occur within a COPY statement.

8. Text-name defines a unique external file name which conforms to the rules for user defined words (note lower case is translated to upper case). External file-name-literal is an alphanumeric literal enclosed in quotes that conforms to the operating system rules for filenames.

GENERAL RULES

1. The compilation of a source program containing COPY statement is logically equivalent to processing all COPY statements prior to the processing of the resulting source program.

2. The effect of processing a COPY statement is that the library text associated with text-name is copied into the source program, logically replacing the entire COPY statement, beginning with the reserved word COPY and ending with the punctuation character period, inclusive.

3. If the REPLACING phrase is not specified, the library text is copied unchanged.

   If the REPLACING phrase is specified, the library text is copied and each properly matched occurrence of pseudo-text-1, identifier-1, word-1, and literal-1 in the library text is replaced by the corresponding pseudo-text-2, identifier-2, word-2, or literal-2.

4. For purposes of matching, identifier-1, word-1, and literal-1 are treated as pseudo-text containing only identifier-1, word-1, or literal-1, respectively.

5. The comparison operation to determine text replacement occurs in the following manner:

   Any separator comma, semicolon and/or space(s) preceding the leftmost library text-word is copied into the source program. Starting with the left-most library text-word and the first pseudo-text-1, the entire REPLACING phrase operand that precedes the reserved word BY is compared to an equivalent number of contiguous library text-words.

   Pseudo-text-1, identifier-1, word-1, or literal-1 match the library text if, and only if, the ordered sequence of text-words that forms pseudo-text-1, identifier-1, word-1 or literal-1 is equal, character for character, to the ordered sequence of library text words. For purposes of matching, each occurrence of a separator comma or semicolon in pseudo-text-1 or in the library text is considered to be a single space except when pseudo-text-1 consists solely of either a separator comma or semicolon, in which case it participates in the match as a text-word. Each sequence of one or more space separators is considered to be a single space.

   If no match occurs, the comparison is repeated with each next successive pseudo-text-1, identifier-1, word-1, or literal-1, if any, in the REPLACING phrase until either a match is found or there is no next successive REPLACING operand.

   When all the REPLACING phrase operands have been compared and no match has occurred, the leftmost library text-word is copied into the source program. The next successive library text-word is then considered as the leftmost library text-word, and the comparison cycle starts again with the first pseudo-text-1, identifier-1, word-1 or literal-1 specified in the REPLACING phrase.

Whenever a match occurs between pseudo-text-1, identifier-1, word-1, or literal-1 and the library text, the corresponding pseudo-text-2, identifier-2, word-2, or literal-2 is placed into the source program. The library text-word immediately following the rightmost text-word that participated in the match is then considered as the leftmost library text-word. The comparison cycle starts again with the first pseudo-text-1, identifier-1, word-1, or literal-1 specified in the REPLACING phrase.

The comparison operation continues until the rightmost text-word in the library text has either participated in a match or been considered as a leftmost library text-word and participated in a complete comparison cycle.

6. A comment line occurring in the library text and pseudo-text-1 us interpreted, for purposes of matching, as a single space. Comment lines appearing in pseudo-text-2 and library text are copied into the source program unchanged.

7. Debugging lines are permitted within library text and pseudo-text-2. Debugging lines are not permitted within pseudo-text-1; text-words within a debugging line participate in the matching rules as if the 'D' did not appear in the indicator area. If a COPY statement is specified on a debugging line, then the text that is the result of the processing of the COPY statement will appear as though it were specified on debugging lines with the following exception: comment lines in library text will appear as comment lines in the resultant source program.

8. The text produced as a result of the complete processing of a COPY statement must not contain a COPY statement.

9. The syntatic correctness of the library text cannot be independently determined. The syntatic correctness of the entire COBOL source program cannot be determined until all COPY statements have been completely processed.

10. Library text must conform to the rules for COBOL reference format.

11. For purposes of compilation, text-words after replacement are placed in the source program according to the rules for reference format as described in Chapter 1.

12. If the unit identifier is not explicitly specified, the default drive will be used. The default is operating system dependent and is described in the LEVEL II COBOL Operating Guide.

CHAPTER 11

DEBUG AND INTERACTIVE DEBUGGING

INTRODUCTION

Standard ANSI COBOL debugging provides a means by which the user can describe the conditions under which procedures are to be monitored during the execution of the object program.

The optional ANIMATOR debugging product is also available, and brings a program to life on the screen "animating" it by displaying the source code during run time with the cursor moving from COBOL source statement to statement. ANIMATOR is a full interactive symbolic debugging tool that complies with the published GSA certification standard enabling the setting of breakpoints, examination and alteration of data and the changing of the flow of control. It is supplied with a manual.

This Chapter describes the standard ANSI '74 COBOL DEBUG module.

STANDARD ANSI COBOL DEBUG

The decisions of what to monitor and what information to display are explicitly in the domain of the user. The COBOL Debug facility simply provides a convenient access to pertinent information.

The features of the language that support the COBOL Debug module are:

* A compile time switch -- WITH DEBUGGING MODE.
* An object time switch.
* A USE FOR DEBUGGING statement.
* A special register -- DEBUG-ITEM.
* Debugging lines.

The reserved word DEBUG-ITEM is the name for a special register generated automatically by the compiler that supports the debugging facility. Only one DEBUG-ITEM is allocated per program. The names of the subordinate data items in DUBUG-ITEM are also reserved words.

COMPILE-TIME SWITCH

The DEBUGGING MODE clause is written as part of the SOURCE-COMPUTER paragraph in the Environment Division. It serves as a compile-time switch over debugging statements written in the program.

When the WITH DEBUGGING MODE clause is specified in a program, all debugging sections and all debugging lines are compiled as specified in this section of the document.

When DEBUGGING MODE is not specified in a program, all the debugging sections and debugging lines are compiled as if they were comment lines and their syntax is not checked.

COBOL DEBUG OBJECT TIME SWITCH

An object time switch dynamically activates the debugging code inserted by the compiler. This switch cannot be addressed in the program; it is controlled outside the COBOL environment. If the switch is 'on', the effects of any USE FOR DEBUGGING statements written in the source program are permitted. If the switch is 'off', all the effects described in the USE FOR DEBUGGING Statement, are inhibited. Recompilation of the source program is not required to provide or take away this facility.

The object time switch has no effect on the execution of the object program if the WITH DEBUGGING MODE clause was not specified in the source program at compile time.

The switch is described in the L/II COBOL Operating Guide.

ENVIRONMENT DIVISION IN COBOL DEBUG

The WITH DEBUGGING MODE Clause

Function

The WITH DEBUGGING MODE clause indicates that all debugging sections and all debugging lines are to be compiled. If this clause is not specified, all debugging lines and sections are compiled as if they were comment lines.

General Format

```
    SOURCE-COMPUTER.   computer-name  [WITH DEBUGGING MODE].
```

General Rules

1. If the WITH DEBUGGING MODE clause is specified in the SOURCE-COMPUTER paragraph of the Configuration Section of a program, all USE FOR DEBUGGING statements and all debugging lines are compiled.

2. If the WITH DEBUGGING MODE clause is not specified in the SOURCE-COMPUTER paragraph of the Configuration Section of a program, any USE FOR DEBUGGING statements and all associated debugging sections, and any debugging lines are compiled as if they were comment statements.

PROCEDURE DIVISION IN COBOL DEBUG

The USE FOR DEBUGGING Statement

Function

The USE FOR DEBUGGING statement identifies the user items that are to be monitored by the associated debugging section.

General Format

$$\text{section-name}\ \underline{\text{SECTION}}\ [\text{segment number}].$$

$$\underline{\text{USE}}\ \text{FOR}\ \underline{\text{DEBUGGING}}\ \text{ON}\ \left\{\begin{array}{l} \text{cd-name-1} \\ \text{[ALL REFERENCES OF]}\ \ \text{identifier-1} \\ \text{file-name-1} \\ \text{procedure-name-1} \\ \underline{\text{ALL}}\ \underline{\text{PROCEDURES}} \end{array}\right\}$$

$$\left[\ ,\ \left\{\begin{array}{l} \text{cd-name-2} \\ \text{[ALL REFERENCES OF] identifier-2} \\ \text{file-name-2} \\ \text{procedure-name-2} \\ \underline{\text{ALL}}\ \underline{\text{PROCEDURES}} \end{array}\right\}\right]\ \ldots\ .$$

Syntax Rules

1. Debugging section(s), if specified, must appear together immediately after the DECLARATIVES header.

2. Except in the USE FOR DEBUGGING statement itself, there must be no reference to any non-declarative procedure within the debugging section.

3. Statements appearing outside of the set of debugging sections must not reference procedure-names defined within the set of debugging sections.

4. Except for the USE FOR DEBUGGING statement itself, statements appearing within a given debugging section may reference procedure-names defined within a different USE procedure only with a PERFORM statement.

5. Procedure-names defined within debugging sections must not appear within USE FOR DEBUGGING statements.

6. Any given identifier, cd-name, file-name, or procedure-name may appear in only one USE FOR DEBUGGING statement and may appear only once in that statement.

7. The ALL PROCEDURES phrase can appear only once in a program.

8. When the ALL PROCEDURES phrase is specified, procedure-name-1, procedure-name-2, ... must not be specified in any USE FOR DEBUGGING statement.

9. If the data description entry of the data item referenced by identifier-1, identifier-2, ..., contains an OCCURS clause or is subordinate to a data description entry that contains an OCCURS clause, identifier-1, identifier-2, ..., must be specified without the subscripting or indexing normally required.

10. References to the special register DEBUG-ITEM are restricted to references from within a debugging section.

General Rules

1. In the following general rules all references to cd-name, identifier-1, procedure-name-1, and file-name-1 apply equally to cd-name-2, identifier-2, procedure-name-2 and file-name-2 respectively.

2. Automatic execution of a debugging section is not caused by a statement appearing in a debugging section.

3. When file-name-1 is specified in a USE FOR DEBUGGING statement, that debugging section is executed:

   a. After the execution of any OPEN or CLOSE statement that references file-name-1, and

   b. After the execution of any READ statement (after any other specified USE procedure) not resulting in the execution of an associated AT END or INVALID KEY imperative statement, and

   c. After the execution of any DELETE or START statement that references file-name-1.

4. When procedure-name-1 is specified in a USE FOR DEBUGGING statement that debugging section is executed:

   a. Immediately before each execution of the named procedure;
   b. Immediately after the execution of an ALTER statement which references procedure-name-1.

5. The ALL PROCEDURES phrase causes the effects described in general rule 4 to occur for every procedure-name in the program, except those appearing within a debugging section.

6. When the ALL REFERENCES OF identifier-phrase is specified, that debugging section is executed for every statement that explicitly references identifier-1 at each of the following times:

   a. In the case of a WRITE or REWRITE statement immediately before the execution of that WRITE or REWRITE statement and after the execution of any implicit move resulting from the presence of the FROM phrase.

   b. In the case of a GO TO statement with a DEPENDING ON phrase, immediately before control is transferred and prior to the execution of any debugging section associated with the procedure-name to which control is to be transferred.

   c. In the case of a PERFORM statement in which a VARYING, AFTER, or UNTIL phrase references identifier-1, immediately after each initialization, modification or evaluation of the contents of the data item referenced by identifier-1.

   d. In the case of any other COBOL statement, immediately after execution of that statement.

   If identifier-1 is specified in a phrase that is not executed or evaluated, the associated debugging section is not executed.

7. When identifier-1 is specified without the ALL REFERENCES OF phrase, that debugging section is executed at each of the following times:

   a. In the case of a WRITE or REWRITE statement that explicitly references identifier-2, immediately before the execution of that WRITE or REWRITE statement and after the execution of any implicit move resulting from the presence of the FROM phrase.

   b. In the case of a PERFORM statement in which a VARYING, AFTER or UNTIL phrase references identifier-1, immediately after each initialization, modification or evaluation of the contents of the data item referenced by identifier-1.

c. Immediately after the execution of any other COBOL statement that explicitly references and causes the contents of the data item referenced by identifier-1 to be changed.

If identifier-1 is specified in a phrase that is not executed or evaluated, the associated debugging section is not executed.

8. The associated debugging section is not executed for a specific operand more than once as a result of the execution of a single statement, regardless of the number of times that operand is explicitly specified. In the case of a PERFORM statement which caused iterative execution of a referenced procedure, the associated debugging section is executed once for each iteration.

   Within an imperative statement, each individual occurrence of an imperative verb identifies a separate statement for the purpose of debugging.

9. When cd-name-1 is specified in a USE FOR DEBUGGING statement, that debugging section is executed:

   a. After the execution of any ENABLE, DISABLE, and SEND statement that references cd-name-1,

   b. After the execution of a RECEIVE statement referencing cd-name-1 that does not result in the execution of the NO DATA imperative-statement, and

   c. After the execution of an ACCEPT MESSAGE COUNT statement that references cd-name-1.

10. A reference to file-name-1, identifier-1, procedure-name-1 or cd-name-1 as a qualifier does not constitute reference to that item for the debugging described in the general rules above.

11. Associated with each execution of a debugging section is the special register DEBUG-ITEM, which provides information about the conditions that caused the execution of a debugging section. DEBUG-ITEM has the following implicit description:

```
01   DEBUG-ITEM.
     02   DEBUG-LINE      PICTURE IS X(6).
     02   FILLER          PICTURE IS X VALUE SPACE.
     02   DEBUG-NAME      PICTURE IS X(30).
     02   FILLER          PICTURE IS X VALUE SPACE.
     02   DEBUG-SUB-1     PICTURE   IS   S9999   SIGN   IS   LEADING   SEPARATE
                          CHARACTER.
     02   FILLER          PICTURE IS X VALUE SPACE
     02   DEBUG-SUB-2     PICTURE   IS   S9999   SIGN   IS   LEADING   SEPARATE
                          CHARACTER.
     02   FILLER          PICTURE IS X VALUE SPACE.
     02   DEBUG-SUB-3     PICTURE   IS   S9999   SIGN   IS   LEADING   SEPARATE
                          CHARACTER.
     02   FILLER          PICTURE IS X VALUE SPACE.
     02   DEBUG-CONTENTS  PICTURE IS X(n).
```

12. Prior to each execution of a debugging section, the contents of the data item referenced by DEBUG-ITEM are space-filled. The contents of data items subordinate to DEBUG-ITEM are then updated, according to the following general rules, immediately before control is passed to that debugging section. The contents of any data item not specified in the following general rules remains spaces.

    Updating is accomplished in accordance with the rules for the MOVE statement, the sole exception being the move to DEBUG-CONTENTS when the move is treated exactly as if it was an alphanumeric to alphanumeric elementary move with no conversion of data from one form of internal representation to another.

13. The contents of DEBUG-LINE is the relevant COBOL source line number. This provides the means of identifying a particular source statement.

14. DEBUG-NAME contains the first 30 characters of the name that caused the debugging section to be executed.

    All qualifiers of the name are separated in DEBUG-NAME by the word IN or OF.

    Subscripts/indices, if any, are not entered into DEBUG-NAME.

15. If the reference to a data item that causes the debugging section to be executed is subscripted or indexed, the occurrence number of each level is entered in DEBUG-SUB-1, DEBUG-SUB-2, DEBUG-SUB-3 respectively as necessary.

16. DEBUG-CONTENTS is a data item that is large enough to contain the data required by the following general rules.

17. If the first execution of the first nondeclarative procedure in the program causes the debugging section to be executed, the following conditions exist:

    a. DEBUG-LINE identifies the first statement of that procedure.

    b. DEBUG-NAME contains the name of that procedure.

    c. DEBUG-CONTENTS contains 'START PROGRAM'.

18. If a reference to procedure-name-1 in an ALTER statement causes the debugging section to be executed, the following conditions exist:

    a. DEBUG-LINE identifies the ALTER statement that references procedure-name-1.

    b. DEBUG-NAME contains procedure-name-1.

    c. DEBUG-CONTENTS contains the applicable procedure-name associated with the TO phrase of the ALTER statement.

19. If the transfer of control associated with the execution of a GO TO statement causes the debugging section to be executed, the following conditions exist:

    a. DEBUG-LINE identifies the GO TO statement whose execution transfers control to procedure-name-1.

    b. DEBUG-NAME contains procedure-name-1.

20. If reference to procedure-name-1 in the INPUT or OUTPUT phrase of a SORT or MERGE statement causes the debugging section to be executed, the following conditions exist:

    a. DEBUG-LINE identifies the SORT or MERGE statement that references prcoedure-name-1.

    b. DEBUG-NAME contains procedure-name-1.

    c. DEBUG-CONTENTS contains:

        i. If the reference to procedure-name-1 is the INPUT phrase of a SORT statement, 'SORT INPUT'.

        ii. If the reference to procedure-name-1 is in the OUTPUT phrase of a SORT statement, 'SORT OUTPUT'.

        iii. If the reference to procedure-name-1 is in the OUTPUT phrase of a MERGE statement, 'MERGE OUTPUT'.

21. If the transfer to control from the control mechanism associated with a PERFORM statement causes the debugging section associated with procedure-name-1 to be executed, the following conditions exist:

    a. DEBUG-LINE identifies the PERFORM statement that references procedure-name 1.

    b. DEBUG-NAME contains procedure-name-1.

    c. DEBUG-CONTENTS contains 'PERFORM LOOP'.

22. If procedure-name-1 is a USE procedure that is to be executed, the following conditions exist:

    a. DEBUG-LINE identifies the statement that causes execution of the USE procedure.

    b. DEBUG-NAME contains procedure-name-1.

    c. DEBUG-CONTENTS contains 'USE PROCEDURE'.

23. If an implicit transfer of control from the previous sequential paragraph to procedure-name-1 causes the debugging section to be executed, the following conditions exist:

    a. DEBUG-LINE identifies the previous statement.

    b. DEBUG-NAME contains procedure-name-1.

    c. DEBUG-CONTENTS contains 'FALL THROUGH'.

24. If references to file-name-1, cd-name-1 causes the debugging section to be executed, then:

    a. DEBUG-LINE identifies the source statement that references file-name-1, cd-name-1.

    b. DEBUG-NAME contains the name of file-name-1, cd-name-1.

    c. For READ, DEBUG-CONTENTS contains the entire record read.

    d. For all other references to file-name-1, DEBUG-CONTENTS contains spaces.

    e. For any reference cd-name-1, DEBUG-CONTENTS contains the contents of the area associated with the cd-name.

25. If a reference to identifier-1 causes the debugging section to be executed, then:

    a. DEBUG-LINE identifies the source statement that references identifier-1.

b. DEBUG-NAME contains the name of identifier-1, and

c. DEBUG-CONTENTS contains the contents of the data item referenced by identifier-2 at the time that control passes to the debugging section (see General Rules 6 and 7).

DEBUGGING LINES

A debugging line is any line with a 'D' in the indicator area of the line. Any debugging line that consists solely of spaces from margin A to margin R is considered the same as a blank line.

The contents of a debugging line must be such that a syntactically correct program is formed with or without the debugging lines being considered as comment lines.

A debugging line will be considered to have all the characteristics of a comment line, if the WITH DEBUGGING MODE clause is not specified in the SOURCE-COMPUTER paragraph.

Successive debugging lines are allowed. Continuation of debugging lines is permitted, except that each continuation line must contain a 'D' in the indicator area, and character-strings may not be broken across two lines.

A debugging line is only permitted in the program after the OBJECT-COMPUTER paragraph.

CHAPTER 12

INTERPROGRAM COMMUNICATION

INTRODUCTION TO THE INTER-PROGRAM COMMUNICATION MODULE

The Inter-Program Communication module provides a facility by which a program can communicate with one or more programs. This provides a programmer with a modular programming capability. Each module when CALLed is loaded dynamically by the Run Time System. Communication is provided by:

* The ability to transfer control from one program to another within a run unit

* The ability for both programs to have access to the same data items.

DATA DIVISION IN THE INTER-PROGRAM COMMUNICATION MODULE

LINKAGE SECTION

The Linkage Section in a program is meaningful if and only if the object program is to function under the control of a CALL statement, and the CALL statement in the calling program contains a USING phrase.

The Linkage Section is used for describing data that is available through the calling program but is to be referred to in both the calling and the called program. No space is allocated in the program for data items referenced by data-names in the Linkage Section of that program. Procedure Division references to these data items are resolved at object time by equating the reference in the called program to the location used in the calling program. In the case of index-names, no such correspondence is established. Index-names in the called and calling program always refer to separate indices.

Data items defined in the Linkage Section of the called program may be referenced within the Procedure Division of the called program only if they are specified as operands of the USING phrase of the Procedure Division header or are subordinate to such operands, and the object program is under the control of a CALL statement that specifies a USING phrase.

The structure of the Linkage Section is the same as that previously described for the Working-Storage Section, beginning with a section header, followed by data description entries for noncontiguous data items and/or record description entries.

Each Linkage Section record-name and noncontiguous item name must be unique within the called program since it cannot be qualified.

Of those items defined in the Linkage Section only data-name-1, data-name-2, ... in the USING phrase of the Procedure Division header, data items subordinate to these data-names, and condition-names and/or index-names associated with such data-names and/or subordinate data items, may be referenced in the Procedure Division.

Noncontiguous Linkage Storage

Items in the Linkage Section that bear no hierarchic relationship to one another need not be grouped into records and are classified and defined as noncontiguous elementary items. Each of these data items is defined in a separate data description entry which begins with the special level-number 77.

The following data clauses are required in each data description entry:

* Level-number 77
* Data-name
* The PICTURE clause or the USAGE IS INDEX clause

Other data description clauses are optional and can be used to complete the description of the item if necessary.

Linkage Records

Data elements in the Linkage Section which bear a definite hierarchic relationship to one another must be grouped into records according to the rules for formation of record descriptions. Any clause which is used in an input or output record description can be used in a Linkage Section.

Initial Values

The VALUE clause must not be specified in the Linkage Section except in condition-name entries (level 88).

PROCEDURE DIVISION IN THE INTER-PROGRAM COMMUNICATION MODULE

THE PROCEDURE DIVISION HEADER

The Procedure Division is identified by and must begin with the following header:

```
    PROCEDURE DIVISION  [USING data-name-1  [, data-name-2] ...]      .
```

The USING phrase is present if and only if the object program is to function under the control of a CALL statement, and the CALL statement in the calling program contains a USING phrase.

Each of the operands in the USING phrase of the Procedure Division header must be defined as a data item in the Linkage Section of the program in which this header occurs, and it must have a 01 or 77 level-number.

Within a called program, Linkage Section data items are processed according to their data descriptions given in the called program.

When the USING phrase is present, the object program operates as if data-name-1 of the Procedure Division header in the called program and data-name-1 in the USING phrase of the CALL statement in the calling program refer to a single set of data that is equally available to both the called and calling programs. Their descriptions must define an equal number of character positions; however they need not be the same name. In like manner, there is an equivalent relationship between data-name-2, ..., in the USING phrase of the called program and data-name-2, ..., in the USING phrase of the CALL statement in the calling program. A data-name must not appear more than once in the USING phrase in the Procedure Division header of the called program; however, a given data-name may appear more than once in the same USING phrase of a CALL statement.

If the USING phrase is specified, the INITIAL clause must not be present in any CD entry. (See THE COMMUNICATION DESCRIPTION - COMPLETE ENTRY SKELETON in Chapter 13).

In LEVEL II COBOL the number of operands in the PROCEDURE DIVISION USING statement and the CALL USING statement may be different. If they are different then the operands in the two statements are matched from left to right until the shorter list of operands is exhausted.

If the remaining unmatched operands are in the CALL statement then they are ignored, if the remaining unmatched operands are in the PROCEDURE DIVISION statement then they are unavailable to the program and if they are referenced at run-time a run-time error will occur.

As any mis-match of operands will be detected only at Run-time the FLAG directive of the compiler will not cause this extension to be flagged.

(Addendum 1)

THE CALL STATEMENT

Function

The CALL statement causes control to be transferred from one object program to another, within the run unit.

General Format

Format 1

```
    CALL     {identifier-1}  [USING dataname1    [, dataname2]  ...]
             {literal-1   }

         [ON OVERFLOW imperative-statement]
```

Format 2

```
    CALL     {literal-2   }  [USING data-name-3    [, data-name-4]   ...]
             {identifier-2}
```

Syntax Rules

1. Literal-1 must be a nonnumeric literal which identifies a file containing the subprogram to be CALLed.

2. Identifier-1 must be defined as an alphanumeric data item usage display.

3. The USING phrase is included in the CALL statement only if there is a USING phrase in the Procedure Division header of the called program and the number of operands in each USING phrase must be identical.

4. Each of the operands in the USING phrase must have been defined as a data item in the File Section, Working-Storage Section, or Linkage Section, and must have a level-number of 01 or 77 if the ANSI switch is set. Data-name-1, data-name-2, ..., may be qualified when they reference data items defined in the File Section or the Communication Section.

5. Literal-2 must be defined as an alphanumeric literal which contains a numeric value.

6. Identifier-2 must be defined as an alphanumeric data item with a numeric value, e.g. CALL "3" or CALL D-NAM where D-NAM is defined as class alphanumeric, and usage display, containing a numeric value.

General Rules

1. The program which is identified by the value of literal-1 or identifier-1 is a called subprogram, the program which is identified by literal-2 or identifier-2 is a called run time subroutine; the program in which the CALL statement appears is the calling program.

(Addendum 2)

2. The execution of a CALL statement causes control to pass to the called program.

3. In format 1, a called intermediate code module is loaded from disk the first time it is called within a run-unit and the first time it is called after a CANCEL to the called program.

   On all other entries into the called program, the state of the program remains unchanged from its state when last exited. This includes all data fields, the status and positioning of all files, and all alterable switch settings.

4. In format 2, a called run time subroutine is always in the state in which it last existed.

5. If during the execution of a CALL statement, it is determined that the available portion of run-time memory is incapable of accomodating the program specified in the CALL statement, the next sequential instruction is executed. If ON OVERFLOW has been specified, the associated imperative statement is executed before the next instruction is executed.

6. Called programs may contain CALL statements. However, a called program must not contain a call statement that directly or indirectly calls the calling program.

7. The data-names, specified by the USING phrase of the CALL statement, indicate those data items available to a calling program that may be referred to in the called program. The order of appearance of the data-names in the USING phrase of the CALL statement and the USING phrase in the Procedure Division header is critical. Corresponding data-names refer to a single set of data which is available to the called and calling program. The correspondence is positional, not by name. In the case of index-names, no such correspondence is established. Index-names in the called and calling program always refer to separate indices.

8. The CALL statement may appear anywhere within a segmented program. Therefore, when a CALL statement appears in a section with a segment-number greater than or equal to 50, that segment is in its last used state when the EXIT PROGRAM statement returns control to the calling program.

THE CANCEL STATEMENT

Function

The CANCEL statement releases the memory areas occupied by the referred to program.

General Format

$$\underline{\text{CANCEL}} \quad \left\{ \begin{array}{l} \text{identifier-1} \\ \text{literal-1} \end{array} \right\} \quad \left[\begin{array}{l} \text{, identifier-2} \\ \text{, literal-2} \end{array} \right] \quad \ldots$$

Syntax Rules

1. Literal-1, literal-2, ..., must each be a nonnumeric literal containing the equivalent value as used in the corresponding CALL statement.

2. Identifier-1, identifier-2, ..., must each be defined as an alphanumeric data item such that its value can be a program name.

General Rules

1. Subsequent to the execution of a CANCEL statement, the program referred to ceases to have any logical relationship to the run unit in which the CANCEL statement appears. A subsequently executed CALL statement naming the same program will result in that program being initiated in its initial state. The memory areas associated with the named programs are released so as to be made available for disposition by the operating system.

2. A program named in the CANCEL statement must not refer to any program that has been called and has not yet executed an EXIT PROGRAM statement.

3. A logical relationship to a cancelled subprogram is established only by execution of a subsequent call statement.

4. A called program is cancelled either by being referred to as the operand of a CANCEL statement or by the termination of the run unit of which the program is a member.

5. No action is taken when a CANCEL statement is executed naming a program that has not been called in this run unit or has been called and is at present cancelled. Control passes to the next statement.

THE EXIT PROGRAM STATEMENT

Function

The EXIT PROGRAM statement marks the logical end of a called program.

General Format

EXIT PROGRAM .

Syntax Rules

1. The EXIT PROGRAM statement must appear in a sentence by itself.

2. The EXIT PROGRAM sentence must be the only sentence in the paragraph.

3. The above two rules apply only if the ANSI switch is set.

General Rule

An execution of an EXIT PROGRAM statement in a called program causes control to be passed to the calling program. Execution of an EXIT PROGRAM statement in a program which is not called behaves as if the statement were an EXIT statement. (See THE EXIT STATEMENT in Chapter 3).

CHAPTER 13

COMMUNICATION

<u>INTRODUCTION TO THE COMMUNICATION MODULE</u>

FUNCTION

The Communication module provides the ability to access, process, and create messages or portions thereof. It provides the ability to communicate through a Message Control System (MCS) with local and remote communication devices.

<u>DATA DIVISION IN THE COMMUNICATION MODULE</u>

COMMUNICATION SECTION

In a COBOL program the communication description entries (CD) represent the highest level of organization in the Communication Section. The Communication Section header is followed by a communication description entry consisting of a level indicator (CD), a data-name and a series of independent clauses. These clauses indicate the queues and sub-queues, the message date and time, the source, the text length, the status and end keys, and message count of input. These clauses specify the destination count, the text length, the status and error keys, and destinations for output. The entry itself is terminated by a period. These record areas may be implicitly redefined by user-specified record description entries following the various communication description clauses.

THE COMMUNICATION DESCRIPTION - COMPLETE ENTRY SKELETON

<u>Function</u>

The communication description specifies the interface area between the MCS and a COBOL program.

General Format

Format 1:

```
     CD  cd-name;
                              [[; SYMBOLIC QUEUE IS data-name-1]
                                    [; SYMBOLIC SUB-QUEUE-1 IS data-name-2]
                                    [; SYMBOLIC SUB-QUEUE-2 IS data-name-3]
                                    [; SYMBOLIC SUB-QUEUE-3 IS data-name-4]
                                    [; MESSAGE DATE IS data-name-5]
     FOR [INITIAL] INPUT            [; MESSAGE TIME IS data-name-6]
                                    [; SYMBOLIC SOURCE IS data-name-7]
                                    [; TEXT LENGTH IS data-name-8]
                                    [; END KEY IS data-name-9]
                                    [; STATUS KEY IS data-name-10]
                                    [; MESSAGE COUNT IS data-name-11]]

                               [data-name-1, data-name-2, ..., data-name-11]
```

Format 2:

```
     CD  cd-name; FOR OUTPUT

          [; DESTINATION COUNT IS data-name-1]
          [; TEXT LENGTH IS data-name-2]
          [; STATUS KEY IS data-name-3]
          [; DESTINATION TABLE OCCURS integer-2 TIMES
               [; INDEXED BY index-name-1 [, index-name-2] ... ]]
          [; ERROR KEY IS data-name-4]
          [; SYMBOLIC DESTINATION IS data-name-5].
```

Syntax Rules

Format 1:

1. A CD must appear only in the Communication Section.

2. Within a single program, the INITIAL clause may be specified in only one CD. The INITIAL clause must not be used in a program that specifies the USING phrase of the Procedure Division Header. (See The Procedure Division Header.)

3. Except for the INITIAL clause, the optional clauses may be written in any order.

4. If neither option in the format is specified, a level 01 data description entry must follow the CD description entry. Either option may be followed by a level 01 data description entry.

5. For each input CD, a record area of 87 contiguous standard data format characters is allocated. This record area is defined to the MCS as follows:

   a. The SYMBOLIC QUEUE clause defines data-name-1 as the name of an elementary alphanumeric data item of 12 characters occupying positions 1-12 in the record.

   b. The SYMBOLIC SUB-QUEUE-1 clause defines data-name-2 as the name of an elementary alphanumeric data item of 12 characters occupying positions 13-24 in the record.

   c. The SYMBOLIC SUB-QUEUE-2 clause defines data-name-3 as the name of an elementary alphanumeric data item of 12 characters occupying positions 25-36 in the record.

   d. The SYMBOLIC SUB-QUEUE-3 clause defines data-name-4 as the name of an elementary alphanumeric data item of 12 characters occupying positions 37-48 in the record.

   e. The MESSAGE DATE clause defines data-name-5 as the name of a data item whose implicit description is that of an integer of 6 digits without an operational sign occupying character positions 49-54 in the record.

   f. The MESSAGE TIME clause defines data-name-6 as the name of a data item whose implicit description is that of an integer of 8 digits without an operational sign occupying character positions 55-62 in the record.

   g. The SYMBOLIC SOURCE clause defines data-name-7 as the name of an elementary alphanumeric data item of 12 characters occupying positions 63-74 in the record.

   h. The TEXT LENGTH clause defines data-name-8 as the name of an elementary data item whose implicit description is that of an integer of 4 digits without an operational sign occupying character positions 75-78 in the record.

   i. The END KEY clause defines data-name-9 as the name of an elementary alphanumeric data item of 1 character occupying position 79 in the record.

   j. The STATUS KEY clause defines data-name-10 as the name of an elementary alphanumeric data item of 2 characters occupying positions 80-81 in the record.

   k. The MESSAGE COUNT clause defines data-name-11 as the name of an elementary data item whose implicit description is that of an integer of 6 digits without an operational sign occupying character positions 82-87 in the record.

The second option may be used to replace the above clauses by a series of data-names which, taken in order, correspond to the data-names defined by these clauses.

Use of either option results in a record whose implicit description is equivalent to the following:

IMPLICIT DESCRIPTION			COMMENT
01	data-name-0.		
02	data-name-1	PICTURE X(12).	SYMBOLIC QUEUE
02	data-name-2	PICTURE X(12).	SYMBOLIC SUB-QUEUE-1
02	data-name-3	PICTURE X(12).	SYMBOLIC SUB-QUEUE-2
02	data-name-4	PICTURE X(12).	SYMBOLIC SUB-QUEUE-3
02	data-name-5	PICTURE 9(06).	MESSAGE DATE
02	data-name-6	PICTURE 9(08).	MESSAGE TIME
02	data-name-7	PICTURE X(12).	SYMBOLIC SOURCE
02	data-name-8	PICTURE 9(04).	TEXT LENGTH
02	data-name-9	PICTURE X.	END KEY
02	data-name-10	PICTURE XX.	STATUS KEY
02	data-name-11	PICTURE 9(06).	MESSAGE COUNT

NOTE:

In the above, the information under 'COMMENT' is for clarification and is not part of the description.

6. Record description entries following an input CD implicitly redefine this record and must describe a record of exactly 87 characters. Multiple redefinitions of this record are permitted; however, only the first redefinition may contain VALUE clauses. However, the MCS will always reference the record according to the data descriptions defined in syntax rule 5.

7. Data-name-1, data-name-2, ..., data-name-11 must be unique within the CD. Within this series, any data-name may be replaced by the reserved word FILLER.

Format 2:

8. A CD must appear only in the Communication Section.

9. If none of the optional clauses of the CD is specified, a level 01 data description entry must follow the CD description entry.

10. For each output CD, a record area of contiguous standard data format characters is allocated according to the following formula: (10 plus 13 times integer-2).

a. The DESTINATION COUNT clause defines data-name-1 as the name of a data item whose implicit description is that of an integer without an operational sign occupying character positions 1-4 in the record.

b. The TEXT LENGTH clause defines data-name-2 as the name of an elementary data item whose implicit description is that of an integer of 4 digits without an operational sign occupying character positions 5-8 in the record.

c. The STATUS KEY clause defines data-name-3 to be an elementary alphanumeric data item of 2 characters occupying positions 9-10 in the record.

d. Character positions 11-23 and every set of 13 characters thereafter will form table items of the following description:

   * The ERROR KEY clause defines data-name-4 as the name of an elementary alphanumeric data item of 1 character.

   * The SYMBOLIC DESTINATION clause defines data-name-5 as the name of an elementary alphanumeric data item of 12 characters.

Use of the above clauses results in a record whose implicit description is equivalent to the following:

```
     IMPLICIT DESCRIPTION                              COMMENT

01   data-name-0.
     02   data-name-1     PICTURE 9(04).           DESTINATION COUNT
     02   data-name-2     PICTURE 9(04).           TEXT LENGTH
     02   data-name-3     PICTURE XX.              STATUS KEY
     02   data-name  OCCURS integer-2 TIMES.       DESTINATION TABLE

          03   data-name-4     PICTURE X.          ERROR KEY
          03   data-name-5     PICTURE X(12).      SYMBOLIC DESTINATION
```

NOTE:

In the above, the information under 'COMMENT' is for clarification and is not part of the description.

11. Record descriptions following an output CD implictly redefine this record. Multiple redefinitions of this record are permitted; however, only the first redefinition may contain VALUE clauses. Note that the MCS will always reference the record according to the data descriptions defined in syntax rule 10.

12. Data-name-1, data-name-2, ..., data-name-5 must be unique within a CD.

13. If the DESTINATION TABLE OCCURS clause is not specified, one ERROR KEY and one SYMBOLIC DESTINATION area is assumed. In this case, neither subscripting nor indexing is permitted when referencing these data items.

14. If the DESTINATION TABLE OCCURS clause is specified, data-name-4 and dataname-5 may only be referred to by subscripting or indexing.

15. There is no restriction on the value of the data item referenced by data-name-1 and integer-2.

General Rules

Format 1:

1. The input CD information constitutes the communication between the MCS and the program as information about the message being handled. This information does not come from the terminal as part of the message.

2. The contents of the data items referenced by data-name-2, data-name-3, and data-name-4, when not being used must contain spaces.

3. The data items referenced by data-name-1, data-name-2, data-name-3, and data-name-4 contain symbolic names designating queues, sub-queues, ... respectively. All symbolic names must follow the rules for the formation of system-names, and must have been previously defined to the MCS.

4. A RECEIVE statement causes the serial return of the 'next' message or a portion of a message from the queue as specified by the entries in the CD.

   If during the execution of a RECEIVE statement, a message from a more specific source is needed, the contents of the data item referenced by data-name-1 can be made more specific by the use of the contents of the data items referenced by data-name-2, data-name-3, and in turn data-name-4. When a given level of the queue structure is specified, all higher levels must also be specified.

   If fewer than all the levels of the queue hierarchy are specified, the MCD determines the 'next' message or portion of a message to be accessed.

   After the execution of a RECEIVE statement, the contents of the data items referenced by data-name-1 through data-name-4 will contain the symbolic names of all the levels of the queue structure.

5. Whenever a program is scheduled by the MCS to process a message, that program establishes a run unit and the symbolic names of the queue structure that demanded this activity will be placed in the data items referenced by data-name-1 through data-name-4 of the CD associated with the INITIAL clause as applicable. In all other cases, the contents of the data items referenced by data-name-1 through data-name-4 of the CD associated with the INITIAL clause are initialized to spaces.

   The symbolic names are inserted or the initialization to spaces is completed prior to the execution of the first Procedure Division statement.

   The execution of a subsequent RECEIVE statement naming the same contents of the data items referenced by data-name-1 through data-name-4 will return the actual message that caused the program to be scheduled. Only at that time will the remainder of the CD be updated.

6. If the MCS attempts to schedule a program lacking an INITIAL clause, the results are undefined.

7. Data-name-5 has the format 'YYMMDD' (year, month, day). Its contents represent the date on which the MCS recognizes that the message is complete.

   The contents of the data item referenced by data-name-5 are only updated by the MCS as part of the execution of a RECEIVE statement.

8. The contents of data-name-6 have the format 'HHMMSSTT' (hours, minutes, seconds, hundredths of a second) and its contents represent the time at which the MCS recognizes that the message is complete.

   The contents of the data item referenced by data-name-6 are only updated by the MCS as part of the execution of the RECEIVE statement.

9. During the execution of a RECEIVE statement, the MCS provides, in the data item referenced by data-name-7, the symbolic name of the communications terminal that is the source of the message being transferred. This symbolic move must follow the rules for the formation of system names. However, if the symbolic name of the communication terminal is not known to the MCS, the contents of the data item referenced by data-name-7 will contain spaces.

10. The MCS indicates via the contents of the data item referenced by data-name-8 the number of character positions filled as a result of the execution of the RECEIVE statement. (See THE RECEIVE STATEMENT later in this Chapter.)

11. The contents of the data item referenced by data-name-9 are set only by the MCS as part of the execution of a RECEIVE statement according to the following rules:

a. When the RECEIVE MESSAGE phrase is specified, then data-name-9 is set to one of the following:

   * If an end of group has been detected, the contents of the data item referenced by data-name-9 are set to 3;

   * If an end of message has been detected, the contents of the data item referenced by data-name-9 are set to 2;

   * If less than a message has been detected, the contents of the data item referenced by data-name-9 are set to 0.

b. When the RECEIVE SEGMENT phrase is specified, data-name-9 is set to one of the following:

   * If an end of group has been detected, the contents of the data item referenced by data-name-9 are set to 3;

   * If an end of message has been detected, the contents of the data item referenced by data-name-9 are set to 2;

   * If an end of segment has been detected, the contents of the data item referenced by data-name-9 are set to 1;

   * If less than a message segment is transferred, the contents of the data item referenced by data-name-9 are set to 0.

c. When more than one of the above conditions is satisfied simultaneously, the rule first satisfied in the order listed determines the contents of the data item referenced by data-name-9.

12. The contents of the data item referenced by data-name-10 indicate the status condition of the previously executed RECEIVE, ACCEPT MESSAGE COUNT, ENABLE INPUT, or DISABLE INPUT statements.

    The actual association between the contents of the data item referenced by data-name-10 and the status condition itself is defined in Table 13-1.

13. The contents of the data item referenced by data-name-11 indicate the number of messages that exist in a queue, sub-queue-1, ... The MCS updates the contents of the data item referenced by data-name-11 only as part of the execution of an ACCEPT statement with the COUNT phrase.

Format 2:

14. The nature of the output CD information is such that it is not sent to the terminal, but constitutes the communication between the program and the MCS as information about the message being handled.

15. During the execution of a SEND, ENABLE OUTPUT, or DISABLE OUTPUT statement, the contents of the data item referenced by data-name-1 will indicate to the MCS the number of symbolic destinations that are to be used from the area referenced by data-name-5.

    The MCS finds the first symbolic destination in the first occurrence of the area referenced by data-name-5, the second symbolic destination in the second occurrence of the area referenced by data-name-5 ... ,m up to and including the occurrence of the area referenced by data-name-5 indicated by the contents of data-name-1.

    If during the execution of a SEND, ENABLE OUTPUT, or DISABLE OUTPUT statement the value of the data item referenced by data-name-1 is outside the range of 1 through integer-2, an error condition is indicated and the execution of the SEND, ENABLE OUTPUT, or DISABLE OUTPUT statement is terminated.

16. It is the responsibility of the user to insure that the value of the data item referenced by data-name-1 is valid at the time of execution of the SEND, ENABLE OUTPUT, or DISABLE OUTPUT statement.

17. As part of the execution of a SEND statement, the MCS will interpret the contents of the data item referenced by data-name-2 to be the user's indication of the number of leftmost character positions of the data item referenced by the associated SEND identififer from which data is to be transferred. (See THE SEND STATEMENT later in this Chapter).

18. Each occurrence of the date item referenced by data-name-5 contains a symbolic destination previously known to the MCS. These symbolic destination names must follow the rules for the formation of system-names.

19. The contents of the data item referenced by data-name-3 indicate the status condition of the previously executed SEND, ENABLE OUTPUT or DISABLE OUTPUT statement.

    The actual association between the contents of the data item referenced by data-name-3 and the status condition itself is defined in Table 13-1.

20. If, during the execution of a SEND, an ENABLE OUTPUT, or a DISABLE OUTPUT statement, the MCS determines that any specified destination is unknown, the contents of the data item referenced by data-name-3 and all occurrences of the data items referenced by data-name-4 are updated.

    The contents of the data item referenced by data-name-4 when equal to 1 indicate that the associated value in the area referenced by data-name-5 has not been previously defined to the MCS. Otherwise, the contents of the data item referenced by data-name-4 are set to zero.

All Formats:

21. Table 13-1 indicates the possible contents of the data items referenced by data-name-10 for Format 1 and by data-name-3 for Format 2 at the completion of each statement shown. An 'X' on a line in a statement column indicates that the associated code shown for that line is possible for that statement.

Table 13-1. Communication Status Key Condition

RECEIVE	SEND	ACCEPT MESSAGE COUNT	ENABLE INPUT (without terminal)	ENABLE INPUT (with terminal)	ENABLE OUTPUT	DISABLE OUTPUT (without terminal)	DISABLE OUTPUT (with terminal)	DISABLE OUTPUT	STATUS KEY CODE	
X	X	X	X	X	X	X	X	X	00	No error detected. Action completed.
	X								10	One or more destinations are disabled. Action completed.
	X				X			X	20	One or more destinations unknown. Action completed for known destinations. No action taken for unknown destinations. Data-name-4 (ERROR KEY) indicates known or unknown.
X		X	X			X			20	One or more queues or sub-queues unknown. No action taken.
				X			X		20	The source is unknown. No action taken.
	X				X			X	30	Content of DESTINATION COUNT invalid. No action taken.
			X	X	X	X	X	X	40	Password invalid. No enabling/disabling action taken.
	X								50	Character count greater than length of sending field. No action taken.
	X								60	Partial segment with either zero character count or no sending area specified. No action taken.

<u>PROCEDURE DIVISION IN THE COMMUNICATION MODULE</u>

THE ACCEPT MESSAGE COUNT STATEMENT

<u>Function</u>

The ACCEPT MESSAGE COUNT statement causes the number of messages in a queue to be made available.

<u>General Format</u>

<u>ACCEPT</u> cd-name MESSAGE <u>COUNT</u>

<u>Syntax Rule</u>

CD-name must reference an input CD.

<u>General Rules</u>

1. The ACCEPT MESSAGE COUNT statement causes the MESSAGE COUNT field specified for cd-name to be updated to indicate the number of messages that exist in a queue, sub-queue-1, ...

2. Upon execution of the ACCEPT MESSAGE COUNT statement, the contents of the area specified by a communication description entry must contain at least the name of the symbolic queue to be tested. Testing the condition causes the contents of the data items referenced by data-name-10 (STATUS KEY) and data-name-1 (MESSAGE COUNT) of the area associated with the communication entry to be appropriately updated. (See THE COMMUNICATION DESCRIPTION - COMPLETE ENTRY SKELETON.)

THE DISABLE STATEMENT

Function

The DISABLE statement notifies the MCS to inhibit data transfer between specified output queues and destinations for output or between specified sources and input queues for input.

General Format

$$\underline{\text{DISABLE}} \left\{ \begin{array}{l} \underline{\text{INPUT}} \quad [\underline{\text{TERMINAL}}] \\ \underline{\text{OUTPUT}} \end{array} \right\} \text{cd-name WITH } \underline{\text{KEY}} \left\{ \begin{array}{l} \text{identifier-1} \\ \text{literal-1} \end{array} \right\}$$

Syntax Rules

1. Cd-name must reference an input CD when the INPUT phrase is specified.

2. cd-name must reference an output CD when the OUTPUT phrase is specified.

3. Literal-1 or the contents of the data item referenced by identifier-1 must be defined as alphanumeric.

General Rules

1. The DISABLE statement provides a logical disconnection between the MCS and the specified sources or destinations. When this logical disconnection is already in existence, or is to be handled by some other means external to this program, the DISABLE statement is not required in this program. The logical path for the transfer of data between the COBOL programs and the MCS is not affected by the DISABLE statement.

2. When the INPUT phrase with the optional word TERMINAL is specified, the logical path between the source and all queues and sub-queues is deactivated. Only the contents of the data item referenced by data-name-7 (SYMBOLIC SOURCE) of the area referenced by cd-name are meaningful.

3. When the INPUT phrase without the optional word TERMINAL is specified, the logical paths for all of the sources associated with the queues and sub-queues specified by the contents of data-name-1 (SYMBOLIC QUEUE) through data-name-4 (SYMBOLIC SUB-QUEUE-3) of the area referenced by cd-name are deactivated.

4. When the OUTPUT phrase is specified, the logical path for destination, or the logical paths for all destinations, specified by the contents of the data item referenced by data-name-5 (SYMBOLIC DESTINATION) of the area referenced by cd-name are deactivated.

5. Literal-1 or the contents of the data-name referenced by identifier-1 will be matched with a password built into the system. The DISABLE statement will be honored only if literal-1 or the contents of the data item referenced by identifier-1 match the system password. When literal-1 or the contents of the data item referenced by identifier-1 do not match the system password, the value of the STATUS KEY item in the area referenced by cd-name is updated.

   The MCS must be capable of handling a password of from one to ten characters inclusive.

6. The MCS will insure that the execution of a DISABLE statement will cause the logical disconnection at the earliest time the source or destination is inactive. The execution of the DISABLE statement will never cause the remaining portion of the message to be terminated during transmission to or from a terminal.

THE ENABLE STATEMENT

Function

The ENABLE statement notifies the MCS to allow date transfer between specified output queues and destinations for output or between specified sources and input queues for input.

General Format

$$\underline{\text{ENABLE}} \left\{ \begin{array}{l} \underline{\text{INPUT}}\quad [\underline{\text{TERMINAL}}] \\ \underline{\text{OUTPUT}} \end{array} \right\} \text{ cd-name WITH } \underline{\text{KEY}} \left\{ \begin{array}{l} \text{identifier-1} \\ \text{literal-1} \end{array} \right\}$$

Syntax Rules

1. cd-name must reference an input CD when the INPUT phrase is specified.

2. Cd-name must reference an output CD when the OUTPUT phrase is specified.

3. Literal-1 or the contents of the data item referenced by identifier-1 must be defined as alphanumeric.

General Rules

1. The ENABLE statement provides a logical connection between the MCS and the specified sources or destinations. When this logical connection is already in existence, or is to be handled by some other means external to this program, the ENABLE statement is not required in this program. The logical path for the transfer of data between the COBOL programs and the MCS is not affected by the ENABLE statement.

2. When the INPUT phrase with the optional word TERMINAL is specified, the logical path between the source and all associated queues and sub-queues which are already enabled is activated. Only the contents of the data item referenced by data-name-7 (SYMBOLIC SOURCE) of the area referenced by cd-name are meaningful to the MCS.

3. When the INPUT phrase without the optional word TERMINAL is specified, the logcal paths for all of the sources associated with the queue and sub-queues specified by the contents of data-name-1 (SYMBOLIC QUEUE) through data-name-4 (SYMBOLIC SUB-QUEUE-3) of the area referenced by cd-name are activated.

4. When the OUTPUT phrase is specified, the logical path for destination, or the logical paths for all destinations, specified by the contents of the data item referenced by data-name-5 (SYMBOLIC DESTINATION) of the area referenced by cd-name are activated.

5. Literal-1 or the contents of the data item referenced by identifier-1 will be matched with a password built into the system. The ENABLE statement will be honored only if literal-1 or the contents of the data item referenced by identifier-1 match the system password. When literal-1 or the contents of the data item referenced by identifier-1 do not match the system password, the value of the STATUS KEY item in the area referenced by cd-name is updated.

   The MCS must be capable of handling a password of from one to ten characters inclusive.

THE RECEIVE STATEMENT

Function

The RECEIVE statement makes available to the COBOL program a message, message segment, or a portion of a message or segment, and pertinent information about that data from a queue maintained by the Message Control System. The RECEIVE statement allows for a specific imperative statement when no data is available.

General Format

$$\underline{\text{RECEIVE}}\ \text{cd-name}\ \left\{\begin{matrix}\underline{\text{MESSAGE}}\\ \underline{\text{SEGMENT}}\end{matrix}\right\}\ \underline{\text{INTO}}\ \text{identifier-1}$$

$$[;\ \underline{\text{NO}}\ \underline{\text{DATA}}\ \text{imperative-statement}]$$

Syntax Rule

Cd-name must reference an input CD.

General Rules

1. The contents of the data items specified by data-name-1 (SYMBOLIC QUEUE) through data-name-4 (SYMBOLIC SUB-QUEUE-3) of the area referenced by cd-name designate the queue structure containing the message. (See THE COMMUNICATION DESCRIPTION - COMPLETE ENTRY SKELETON.)

2. The message, message segment, or portion of a message or segment is transferred to the receiving character positions of the area referenced by identifier-1 aligned to the left without space fill.

3. When during the execution of a RECEIVE statement, the MCS makes data available in the data item referenced by identifier-1, control is transferred to the next executable statement, whether or not the NO DATA phrase is specified.

4. When, during the execution of a RECEIVE statement, the MCS does not make data available in the data item referenced by identifier-1:

   a. If the NO DATA phrase is specified, the RECEIVE operation is terminated with the indication that action is complete (see general rule 5), and the imperative statement in the NO DATA phrase is executed.

   b. If the NO DATA phrase is not specified, execution of the object program is suspended until data is made available in the data item referenced by identifier-1.

   c. If one or more queues or sub-queues is unknown to the MCS, control passes to the next executable statement, whether or not the NO DATA phrase is specified. (See Table 13-1 for Status.)

5. The data items identified by the input CD are appropriately updated by the Message Control System at each execution of a RECEIVE statement.

6. A single execution of a RECEIVE statement never returns to the data item referenced by identifier-1 more than a single message (when the MESSAGE phrase is used) or a single segment (when the SEGMENT phrase is used). However, the MCS does not pass any portion of a message to the object program until the entire message is available in the input queue, even if the SEGMENT phrase of the RECEIVE statement is specified.

7. When the MESSAGE phrase is used, end of segment indicators are ignored, and the following rules apply to the data transfer:

   a. If a message is the same size as the area referenced by identifier-1, the message is stored in the area referenced by identifier-1.

   b. If a message size is less than the area referenced by identifier-1, the message is aligned to the leftmost character position of the area referenced by identifier-1 with no space fill.

   c. If a message size is greater than the area referenced by identifier-1, the message fills the area referenced by identifier-1 left to right starting with the leftmost character of the message. The remainder of the message can be transferred to the area referenced by identififer-1 with subsequent RECEIVE statements referring to the same queue, sub-queue ... . The remainder of the message, for the purposes of applying rules 7a, 7b, and 7c, is treated as a new message.

8. When the SEGMENT phrase is used, the following rules apply:

   a. If a segment is the same size as the area referenced by identifier-1, the segment is stored in the area referenced by identifier-1.

   b. If the segment size is less than the area referenced by identifier-1, the segment is aligned to the leftmost character position of the area referenced by identifier-1 with no space fill.

   c. If a segment size is greater than the area referenced by identifier-1, the segment fills the area referenced by identifier-1 left to right starting with the leftmost character of the segment. The remainder of the segment can be transferred to the area referenced by identifier-1 with subsequent RECEIVE statements calling out the same queue, sub-queue ... . The remainder of the segment, for the purposes of applying rules 8a, 8b and 8c, is treated as a new segment.

   d. If the text to be accessed by the RECEIVE statement has associated with it an end of message indicator or end of group indicator, the existence of an end of segment indicator associated with the text is implied and the text is treated as a message segment according to general rule 8.

9. Once the execution of a RECEIVE statement has returned a portion of a message, only subsequent execution of RECEIVE statements in that run unit can cause the remaining portion of the message to be returned.

10. After the execution of a STOP RUN statement, the disposition of a remaining portion of a message partially obtained in that run unit is defined by the Run-Time System (RTS). (See THE STOP STATEMENT in Chapter 3.)

THE SEND STATEMENT

Function

The SEND statement causes a message, a message segment, or a portion of a message or segment to be released to one or more output queues maintained by the Message Control System.

General Format

Format 1:

```
     SEND  cd-name FROM identifier-1
```

Format 2:

```
                                           ( WITH identifier-2 )
     SEND cd-name    [FROM identifier-1]  {  WITH ESI           }
                                          {  WITH EMI           }
                                           ( WITH EGI           )

  [                           ( {identifier-3}       [LINE ] ) ]
  [ {BEFORE}   ADVANCING      ( {integer     }       [LINES] ) ]
  [ {AFTER }                  (                              ) ]
  [                           ( {mnemonic-name}              ) ]
  [                           ( {PAGE         }              ) ]
```

Syntax Rules

1. CD-name must reference an output CD.

2. Identifier-2 must reference a one character integer without an operational sign.

3. When identifier-3 is used in the ADVANCING phrase, it must be the name of an elementary integer item.

4. When the mnemonic-name phrase is used, the name is identified with a particular feature specified. The mnemonic-name is defined in the SPECIAL-NAMES paragraph of the Environment Division.

5. Integer or the value of the data item referenced by identifier-3 may be zero.

General Rules

All Formats:

1. When a receiving communication device (printer, display screen, card punch, etc.) is oriented to a fixed line size:

   a. Each message or message segment will begin at the leftmost character position of the physical line.

   b. A message or message segment that is smaller than the physical line size is released so as to appear space-filled to the right.

   c. Excess characters of a message or message segment will not be truncated. Characters will be packed to a size equal to that of the physical line and then transmitted to the device. The process continues on the next line with the excess characters.

2. When a receiving communication device (paper tape punch, another computer, etc.) is oriented to handle variable length messages, each message or message segment will begin on the next available character position of the communications device.

3. As part of the execution of a SEND statement, the MCS will interpret the contents of the data item referenced by data-name-2 (TEXT LENGTH) of the area referenced by cd-name to the user's indication of the number of leftmost character positions of the data item referenced by identififer-1 from which data is to be transferred.

   If the contents of the data item referenced by data-name-2 (TEXT LENGTH) of the area referenced by cd-name are zero, no characters of the data item referenced by identifier-1 are transferred.

   If the contents of the data item referenced by data-name-2 (TEXT LENGTH) of the area referenced by cd-name are outside the range of zero through the size of the data item referenced by identifier-1 inclusive, an error is indicated by the value of the data item referenced by data-name-3 (STATUS KEY) of the area referenced by cd-name, and no data is transferred. (See Table 13-1 for Status.)

4. As part of the execution of a SEND statement, the contents of the data item referenced by data-name-3 (STATUS KEY) of the area referenced by cd-name is updated by the MCS. (See THE COMMUNICATION DIVISION - COMPLETE ENTRY SKELETON.)

5. The effect of having special control characters within the contents of the data item referenced by identifier-1 is undefined.

6. A single execution of a SEND statement for Format 1 releases only a single portion of a message or of a message segment to the MCS.

A single execution of a SEND statement of Format 2 never releases to the MCS more than a single message or a single message segment as indicated by the contents of the data item referenced by identifier-2 or by the specified indicator ESI, EMI or EGI.

However, the MCS will not transmit any portion of a message to a communications device until the entire message is placed in the output queue.

7. During the execution of the run unit, the disposition of a portion of a message not terminated by an EMI or EGI is undefined. However, the message does not logically exist for the MCS and hence cannot be sent to a destination.

   After the execution of a STOP RUN statement, any portion of a message transferred from the run unit via a SEND statement, but not terminated by an EMI or EGI, is purged from the system. Thus no portion of the message is sent.

8. Once the execution of a SEND statement has released a portion of a message to the MCS, only subsequent execution of SEND statements in the same run unit can cause the remaining portion of the message to be released.

Format 2:

9. The contents of the data item referenced by identifier-2 indicate that the contents of the data item referenced by identifier-1 are to have associated with it an end of segment indicator, and end of message indicator or an end of transmission indicator according to the following schedule:

If the contents of the data item referenced by identifier-2 is	then the contents of data item referenced by identifier-1 have associated with it	which means
'0'	no indicator	no indicator
'1'	ESI	an end of segment indicator
'2'	EMI	an end of message indicator
'3'	EGI	an end of group indicator
Any character other than '1', '2', or '3' will be interpreted as '0'		
If the contents of the data item referenced by identifier-2 is other than '1', '2', or '3', and identifier-1 is not specified, then an error is indicated by the value in the data item referenced by data-name-3 (STATUS KEY) of the area referenced by cd-name, and no data is transferred.		

10. The ESI indicates to the MCS that the message segment is complete. The EMI indicates to the MCS that the message is complete.

    The EGI indicates to the MCS that the group of messages is complete. The Run-Time System specifies the interpretation that is given to the EGI by the MCS.

    The MCS will recognize these indications and establish whatever is necessary to maintain group, message, and segment control.

11. The hierarchy of ending indicators is EGI, EMI, ESI. An EGI need not be preceded by an ESI or EMI. An EMI need not be preceded by an ESI.

12. The ADVANCING phrase allows control of the vertical positioning of each message or message segment on a communication device where vertical positioning is applicable. If vertical positioning is not applicable on the device, the MCS will ignore the vertical positioning specified or implied.

13. If identifier-2 is specified and the content of the data item referenced by identififer-2 is zero, the ADVANCING phrase is ignored by the MCS.

14. On a device where vertical positioning is applicable and the ADVANCING phrase is not specified, automatic advancing is provided to act as if the user had specified AFTER ADVANCING 1 LINE.

15. If the ADVANCING phrase is implictly or explicitly specified and vertical positioning is applicable, the following rules apply:

    a. If identifier-3 or integer is specified, characters transmitted to the communication device will be repositioned vertically downward the number of lines equal to the value associated with the data item referenced by identifier-3 or integer.

    b. If mnemonic-name is specified, characters transmitted to the communication device will be positioned according to the rules specified for that communication device.

    c. If the BEFORE phrase is used, the message or message segment is represented on the communication device before vertical repositioning according to general rules 15a and 15b above.

    d. If the AFTER phrase is used, the message or message segment is represented on the communication device after vertical repositioning according to general rules 15a and 15b above.

    e. If PAGE is specified, characters transmitted to the communication device will be represented on the device before or after (depending upon the phrase used) the device is repositioned to the next page. If PAGE is specified but page has no meaning in conjunction with a specific device, then advancing is provided to act as if the user had specified BEFORE or AFTER (depending upon the phrase used) ADVANCING 1 LINE.

CHAPTER 14

PROGRAMMING TECHNIQUES, USEFUL HINTS AND PROGRAM SIZING

PROGRAMMING TECHNIQUES

Although COBOL is written in an essentially free form, the user will nevertheless reap many advantages from a few self-imposed disciplines. It is suggested that these should include the following:

1. Use of the first 256 bytes of working-storage for variables which are frequently referenced will produce more compact and efficient code.

2. Use subscripts as sparingly as possible because each subscript has a storage requirement approximately equal to the size of a normal instruction.

3. For ACCEPT and DISPLAY the compiler generates one instruction per elementary item of the data-name being displayed/accepted. Therefore redefine a group of fields as a single field for DISPLAY whenever possible and avoid unnecessary numbers of small fields in ACCEPT.

4. Use FILLER instead of a data-name for any elementary field not referenced explicitly because the word FILLER is compacted to one character in the Data Dictionary.

5. Keep the number of digits in numeric fields as small as possible.

6. Whenever possible move a group instead of several elementary moves.

USEFUL HINTS

When writing interactive programs the following facilities of LEVEL II COBOL should be remembered:

1. By use of the CURSOR IS facility and the ACCEPT statement it is easy to program conditionally depending on the cursor position after a menu type of prompt. The operator need then only move the cursor to the option required to reply to the prompt, or just press RETURN in the default case.

2. By use of the ACCEPT FROM CONSOLE facility it is easy to pass parameters to your program via the Run command line. See THE ACCEPT STATEMENT in Chapter 3.

3. If the STOP "literal" statement is used in a program, execution of the program halts at this statement with the literal displayed on the CRT screen. Execution continues on pressing the Carriage Return (CR) key.

It should be noted that if any string of characters terminated by a CR character has been keyed and is waiting to be read the program will appear not to halt. Examples of this are if the CR key was inadvertently pressed twice at the last command entered or if parameters to the Run command have not yet been read.

SIZING

GENERAL DESCRIPTION

There are three aspects to sizing a program: the source code, the Data Dictionary and the compiled code.

The maximum number of source statements per program is limited, firstly by the space available for the compiler's data dictionary and secondly by that available to load the generated program.

The Data Dictionary contains an entry for every user-defined name in the program. Detailed information is contained in the next section.

The maximum number of bytes available for the user's program and work space for any given configuration, can be found in the appropriate Operating Guide. A guide for calculating the size of the generated program is as follows:

The sum of the Record size for each file in bytes
+ the Record size for each Working-Storage record in bytes
+ the number of characters in all Procedure Division literals
+ 60 bytes per File
+ 300 bytes control area
+ 6 bytes per COBOL instruction with the following qualifiers:

for an ACCEPT/DISPLAY statement add 3 bytes per elementary item within the Accepted/Displayed data-name.

for every subscript used in a statement add 7 bytes

for a comparison add 6 bytes

for an implicitly generated comparison e.g. PERFORM UNTIL, READ AT END, add 6 bytes

DATA DICTIONARY

The Data Dictionary is constructed as the program is compiled. Its size depends on the host operating system. Each user defined name will have an entry in this dictionary. The number of bytes required for each entry is given in Table 14-1.

Table 14-1. Data Dictionary Entry Sizing

User-defined name	Number of Bytes [1]
File-name	18 + n
Record-name	8 + n
Key-name	8 + n
Status-name	8 + n
Paragraph-name	6 + n
Data-name Group	8 + n [2]
Alphanumeric < 32 characters	7 + n [2]
Alphanumeric > 32 characters	8 + n [2]
Numeric integer	7 + n [2]
Numeric non integer	8 + n [2]
Numeric edited	7 + n + x

1 - n = number of characters in user-defined name.

For a FILLER, n = 1.

x = number of characters in PICture, after coalescing repetitions.

```
e.g. 9999.9          = 3 bytes
     9(4).9          = 3 bytes
     Z(2)9(4).9(3)   = 4 bytes
```

2 - Subtract 1 byte if item is in the first 256 bytes of Working-Storage.

Add 4 bytes if item has an OCCURS clause associated with it.

Add 2 bytes if item is subordinate to an item described with OCCURS.

APPENDIX A

RESERVED WORD LIST

This appendix contains a full list of COBOL and L/II COBOL reserved words. A shaded reserved word is a L/II COBOL extension to ANSI COBOL.

The / symbol denotes that the text up to that point is a reserved word, as is the whole word.

e.g., In INDEX/ED, INDEX and INDEXED are reserved words. In SPACE/S, SPACE and SPACES are reserved words.

ACCEPT
ACCESS
ADD
ADVANCING
AFTER
ALL
ALPHABETIC
ALSO
ALTER
ALTERNATE
AND
ARE
AREA/S
ASCENDING
ASSIGN
AT
AUTHOR

BEFORE
BLANK
BLOCK
BOTTOM
BY

CALL
CANCEL
CD
CHARACTER/S
CLOCK-UNITS
CLOSE
COBOL
CODE-SET
COLLATING
COMMA
COMMAND-LINE
COMMUNICATION
COMP/UTATIONAL/-3
COMPUTE
CONFIGURATION
CONSOLE
CONTAINS
COPY
CORR/ESPONDING
COUNT
CRT
CRT-UNDER
CURRENCY
CURSOR

DATA
DATE

DATE-COMPILED
DATE-WRITTEN
DAY
DEBUG-CONTENTS
DEBUG-ITEM
DEBUG-LINE
DEBUG-NAME
DEBUG-SUB-1
DEBUG-SUB-2
DEBUG-SUB-3
DEBUGGING
DECIMAL-POINT
DECLARATIVES
DELETE
DELIMITED
DELIMITER
DEPENDING
DESCENDING
DESTINATION
DISABLE
DISPLAY
DIVIDE
DIVISION
DOWN
DUPLICATES
DYNAMIC

EGI
ELSE
EMI
ENABLE
END
END-OF-PAGE
ENTER
ENVIRONMENT
EOP
EQUAL
ERROR
ESI
EVERY
EXCEPTION
EXCESS-3
EXIT
EXTEND

FD
FILE
FILE-CONTROL
FILLER
FIRST
FOOTING
FOR
FORMFEED
FROM

GIVING
GO
GREATER

HIGH-VALUE/S

I-O/-CONTROL
ID
IDENTIFICATION
IF
IN
INDEX/ED
INITIAL
INPUT/-OUTPUT
INSPECT
INSTALLATION
INTO
INVALID
IS

JUST/IFIED

KEY

LABEL
LEADING
LEFT
LENGTH
LESS
LIMIT/S
LINAGE/-COUNTER
LINE/S
LINKAGE
LOCK
LOW-VALUE/S

MEMORY
MERGE
MESSAGE
MODE
MODULES
MOVE
MULTIPLE
MULTIPLY

NATIVE
NEGATIVE
NEXT

NOT
NUMERIC

OBJECT-COMPUTER
OCCURS
OF
OFF
OMITTED
ON
OPEN
OPTIONAL
OR
ORGANIZATION
OUTPUT
OVERFLOW

PAGE
PAGETHROW
PERFORM
PIC/TURE
POINTER
POSITION
POSITIVE
PROCEDURE/S
PROCEED
PROGRAM/-ID

QUEUE
QUOTE/S

RANDOM
RD
READ
RECEIVE
RECORD/S
REDEFINES
REEL
REFERENCES
RELATIVE
RELEASE
REMAINDER
REMOVAL
RENAMES
REPLACING
RERUN
RESERVE
RETURN
REVERSED
REWIND
REWRITE
RIGHT

ROUNDED
RUN

SAME
SD
SEARCH
SECTION
SECURITY
SEGMENT/-LIMIT
SELECT
SEND
SENTENCE
SEPARATE
SEQUENCE
SEQUENTIAL
SET
SIGN
SIZE
SORT
SORT-MERGE
SOURCE/-COMPUTER
SPACE/S
SPECIAL-NAMES
STANDARD/-1
START
STATUS
STOP
STRING
SUB-QUEUE-1
SUB-QUEUE-2
SUB-QUEUE-3
SUBTRACT
SWITCH
SYMBOLIC
SYNC/HRONIZED
SYSIN
SYSOUT

TAB
TABLE
TALLYING
TAPE
TERMINAL
TEXT
THAN
THEN
THROUGH
THRU
TIME/S
TO
TOP

TRAILING
TYPE

UNIT
UNSTRING
UNTIL
UP
UPON
USAGE
USE
USING

VALUE/S
VARYING

WHEN
WITH
WORDS
WORKING-STORAGE
WRITE

ZERO/ES or S

. (period)
(
-
*
**
)
;
+
/
,
<
=
>

The Report Writer module is not included in LEVEL II COBOL, nor is it required for GSA High Level certification, however the reserved words used in the Report Writer module may be reserved in other inplementations of COBOL and are given here so that they may be avoided by anyone writing portable programs:

CF
CH
CODE
COLUMN
CONTROL/S
DE
DETAIL
FINAL
FOOTING
GENERATE
GROUP
HEADING
INDICATE
INITIATE
LAST
LINE-COUNTER
NUMBER
PAGE-COUNTER
PF
PH
PLUS
PRINTING
REPORT/S
REPORTING
RESET
RF
RH
SUM
SUPPRESS
TERMINATE

APPENDIX B

CHARACTER SETS AND COLLATING SEQUENCE

ASCII	HEX	COBOL
NUL	ØØ	x
SOH	Ø1	x
STX	Ø2	x
ETX	Ø3	x
EOT	Ø4	x
ENQ	Ø5	x
ACK	Ø6	x
BEL	Ø7	x
BS	Ø8	x
HT	Ø9	x
LF	ØA	x
VT	ØB	x
FF	ØC	x
CR	ØD	x
SO	ØE	x
SI	ØF	x
DLE	1Ø	x
DCI	11	x
DC2	12	x
DC3	13	x
DC4	14	x
NAK	15	x
SYN	16	x
ETB	17	x
CAN	18	x
EM	19	x
SUB	1A	x
ESC	1B	x
FS	1C	x
GS	1D	x
RS	1E	x
US	1F	x
space	2Ø	
!	21	x
"	22	
#	23	x
$	24	
%	25	x
&	26	x
'	27	x
(	28	
)	29	
*	2A	
+	2B	
,	2C	
-	2D	
.	2E	
/	2F	
Ø	3Ø	
1	31	
2	32	
3	33	
4	34	
5	35	
6	36	
7	37	
8	38	
9	39	
:	3A	x
;	3B	
<	3C	
=	3D	
>	3E	
?	3F	x
@	4Ø	x
A	41	
B	42	
C	43	
D	44	
E	45	
F	46	
G	47	
H	48	
I	49	
J	4A	
K	4B	
L	4C	
M	4D	
N	4E	
O	4F	
P	5Ø	
Q	51	
R	52	
S	53	
T	54	
U	55	
V	56	
W	57	
X	58	
Y	59	
Z	5A	
	5B	x
	5C	x
	5D	x
	5E	x
	5F	x
	6Ø	x
a	61	
b	62	
c	63	
d	64	
e	65	
f	66	
g	67	
h	68	
i	69	
j	6A	
k	6B	
l	6C	
m	6D	
n	6E	
o	6F	
p	7Ø	
q	71	
r	72	
s	73	
t	74	
u	75	
v	76	
w	77	
x	78	
y	79	
z	7A	
	7B	x
	7C	x
	7D	x
	7E	x
DEL	7F	x

APPENDIX C

GLOSSARY

INTRODUCTION

The terms in this Chapter are defined in accordance with their meaning as used in this document describing L/II COBOL and may not have the same meaning for other languages.

These definitions are also intended to be either reference material or introductory material to be reviewed prior to reading the detailed language specifications that are contained in this manual. For this reason, these definitions are, in most instances, brief and do not include detailed syntactic rules.

DEFINITIONS

Abbreviated Combined Relation Condition. The combined condition that results from the explicit omission of a common subject or a common subject and common relational operator in a consecutive sequence of relation conditions.

Access Mode. The manner in which records are to be operated upon within a file.

Actual Decimal Point. The physical representation, using either of the decimal point characters . (period) or , (comma) of the decimal point position in a data item.

Alphabet-Name. A user-defined word in the SPECIAL-NAMES paragraph of the Environment Division that assigns a name to a specific character set and/or collating sequence.

Alphabetic Character. A character that belongs to the following set of letters: 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 and the space. Also 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 and z which are converted to their upper case equivalents.

Alphanumeric Character. Any character in the computer's character set.

Animator. A COBOL-oriented debugging tool for use with the CIS or Level II COBOL products.

Arithmetic Expression. An arithmetic expression can be an identifier or a numeric elementary item, a numeric literal, such identifiers and literals separated by arithmetic operators, two arithmetic expressions separated by an arithmetic operator, or an arithmetic expression enclosed in parentheses.

Arithmetic Operator. A single character, or a fixed two-character combination, that belongs to the following set:

Character	Meaning
+	Addition
-	Subtraction
*	Multiplication
/	Division
**	Exponentiation

Ascending Key. A key upon the values of which data is ordered starting with the lowest value of key up to the highest value of key in accordance with the rules for comparison of the data items.

Assumed Decimal Point. A decimal point position which does not involve the existence of an actual character in a data item. The assumed decimal point has logical meaning but no physical representation.

At End Condition. A condition caused in one of two circumstances:

1. During the execution of a READ statement for a sequentially accessed file.

2. During the execution of a RETURN statement when no next logical record exists for the associated sort or merge file.

3. During the execution of a SEARCH statement, when the search operation terminates without satisfying the condition specified in any of the associated WHEN phrases.

Block. A physical unit of data that is normally composed of one or more logical records. For mass storage files, a block may contain a portion of a logical record. The size of a block has no direct relationship to the size of the file within which the block is contained or to the size of the logical record(s) that are either continued within the block or that overlap the block. The term is synonymous with physical record.

Cd-Name. A user-defined word that names an MCS interface area described in a communication description entry within the Communication Section of the Data Division.

Called Program. A program which is the object of a CALL statement combined at run time with the calling program to produce a run unit.

Calling Program. A program which executes a CALL to another program.

Character. The basic indivisible unit of the language.

Character Set (L/II COBOL). The complete L/II COBOL character set consists of all characters listed below:

Character	Meaning
0,1,...,9	Numeric digit
A,B,...,Z	Uppercase alphabetic
a,b,...,z	Lowercase alphabetic

(Addendum 2)

+	Plus Sign
-	Minus Sign
*	Asterisk
/	Stroke (Virgule or Slash)
=	Equal Sign
$	Currency Sign
,	Comma
;	Semicolon
.	Period (Decimal Point, Fullstop)
'	Quotation Mark
(	Left Parenthesis
)	Right Parenthesis
>	Greater Than Symbol
<	Less Than Symbol

Character Position. A character position is the amount of physical storage required to store a single standard data format character described as usage in DISPLAY.

Character-String. A sequence of contiguous characters which form a L/II COBOL word, a literal, a PICTURE character-string or a comment-entry.

Class Condition. The proposition, for which a truth value can be determined, that the content of an item is wholly alphabetic or is wholly numeric.

Clause. A clause is an ordered set of consecutive L/II COBOL character-strings whose purpose is to specify an attribute of an entry.

COBOL Word. (See Word)

Collating Sequence. The sequence in which the characters that are acceptable in a computer are ordered for purposes of sorting, merging and or comparing.

Column. A character position within a print line. The columns are numbered from one, by one, starting at the left-most character position of the print line and extending to the right-most character position of the print line.

Combined Condition. A condition that is the result of connecting two or more conditions with the 'AND' or the 'OR' logical operator.

Comment Entry. An entry in the Identification Division that may be any combination of characters from the computer character set.

Comment Line. A source program line represented by an asterisk in the indicator area of the line and any characters from the computer's character set in area A and area B of that line. The comment line serves only for documentation in a program. A special form of comment line represented by a stroke (/) in the indicator area of the line and any characters from the computer's character set in area A and area B of that line causes page ejection before printing the comment.

Communication Description Entry. An entry in the Communication Section of the Data Division that is composed of the level indicator CD, followed by a cd-name, and then followed by a set of clauses as required. It describes the interface between the Message Control System (MCS) and the COBOL program.

Communication Device. A mechanism (hardware or hardware/software) capable of sending data to a queue and/or receiving data from a queue. This mechanism may be a computer or a peripheral device. One or more programs containing communication description entries and residing within the same computer define one or more of these mechanisms.

Communication Section. The section of the Data Division that describes the interface areas between the MCS and the program, composed of one or more CD description entries.

Compile Time. The time at which an L/II COBOL source program is translated by the compiler to an L/II COBOL intermediate code program.

Compiler-Directing Statement. A statement, beginning with a compiler-directing verb, that causes the compiler to take a specific action during compilation.

Complex Condition. A condition in which one or more logical operators act upon one or more conditions. (See Negated Simple Condition, Combined Condition, Negated Combined Condition).

Computer-Name. A system-name that identifies the computer upon which the program is to be compiled or run.

Condition. A status of a program at execution time for which a truth value can be determined. Where the term "condition" (condition-1, condition-2,...) appears in these language specifications in or in reference to "condition" (condition-1, condition-2, ...) of a general format, it is a conditional expression consisting of either a simple condition optionally parenthesised, or a negated simple condition.

Condition Name. The user-defined word assigned to a status of an implementor-defined switch or device.

Condition-Name Condition. The proposition, for which a truth value can be determined, that the value of a conditional variable is a member of the set of values attributed to a condition-name associated with the conditional variable.

*

Conditional Expression. A simple condition specified in an IF, PERFORM or SEARCH statement. (See Simple Condition and Complex Condition.)

Conditional Statement. A conditional statement specifies that the truth value of a condition is to be determined, and that the subsequent action of the run-time program is dependent on this truth value.

Conditional Variable. A data item one or more values of which has a condition-name assigned to it.

Configuration Section. A section of the Environment Division that describes overall specifications of source and run computers.

Connective. A reserved word that is used to:

1. Associate a data-name, paragraph-name, condition-name, or text-name with its qualifier.
2. Link two or more operands written in a series.
3. Form conditions (logical connectives). (See Logical Operator.)

Contiguous Items. Items that are described by consecutive entries in the Data Division, and that bear a definite hierarchic relationship to one another.

Counter. A data item used for storing numbers or number representations in a manner that permits these numbers to be increased or decreased by the value of another number, or to be changed or reset to zero or to an arbitrary positive or negative value.

CRT. An interactive input/output device comprising a cathode ray tube and keyboard by which an Operator can enter and receive visual data.

Currency Sign. The character "$" (dollar sign) in the L/II COBOL character set.

Currency Symbol. The character defined by the CURRENCY SIGN clause in the SPECIAL-NAMES paragraph. If no CURRENCY SIGN clause is present in an L/II COBOL source program, the currency symbol is identical to the currency sign.

Current Record. The record which is available in the record area associated with the file.

Current Record Pointer. A conceptual entity that is used in the selection of the next record.

Cursor. The indicator on a CRT screen that marks the line and character position which the input/output control is currently referencing.

Data Clause. A clause that appears in a data description entry in the Data Division and provides information describing a particular attribute of a data item.

Data Description Entry. An entry in the Data Division that is composed of a level-number followed by a data-name, if required, and then followed by a set of data clauses as required.

Data Dictionary. A dictionary file of user defined names constructed by the Compiler containing the number of bytes for each entry.

Data Item. A character or set of contiguous characters (excluding in either case literals) defined as a unit of data by the L/II COBOL program.

Data-name. A user-defined word that names a data item described in a data description entry in the Data Division. When used in the general formats, "data-name" represents a word which can neither be subscripted, nor indexed unless specifically permitted by the rules for that format.

Debugging Line. A debugging line is any line with "D" in the indicator area of the line.

Debugging Section. A debugging section is a section that contains a USE FOR DEBUGGING statement.

Declaratives. A set of one or more special purpose sections written at the beginning of the Procedure Division, the first of which is preceded by the key word DECLARATIVES and the last of which is followed by the key words END DECLARATIVES. A declarative is composed of a section header, followed by a USE compiler directing sequence, followed by a set of associated paragraphs (0 or more).

Declarative-Sentence. A compiler-directing sentence consisting of a single USE statement terminated by the separator period (.).

Default Disk. The disk from which the compiler or run-time system is loaded and from which, in the absence of a specific drive identifier, any copy file or called code will be loaded if required.

Delimiter. A character (or sequence of contiguous characters) that identifies the end of a string of characters, and separates that string of characters from the following string of characters. A delimiter is not part of the string of characters that it delimits.

Descending Key. A key upon the values of which data is ordered starting with the highest value of key down to the lowest value of key, in accordance with the rules for comparing data items.

Destination. The symbolic identification of the receiver of a transmission from a queue.

Digit Position. A digit position is the amount of physical storage required to store a single digit. This amount varies depending on the usage of the data item describing the digit position. Further characteristics of the physical storage are defined by the implementor.

Division. A set of sections or paragraphs (0 or more) that are formed and combined in accordance with a specific set of rules is called a division body. There are four divisions in an L/II COBOL program: Identification, Environment, Data and Procedure.

Division Header. A combination of words followed by a period and a space that indicate the beginning of a division. The division headers are:

```
IDENTIFICATION DIVISION.
ENVIRONMENT DIVISION.
DATA DIVISION.
PROCEDURE DIVISION [USING data-name-1 [data-name-2] ...] .
```

Dynamic Access. An access mode in which specific logical records can be obtained from or placed into a disk file in a non-sequential manner (see Random Access) and obtained from a file in a sequential manner (see Sequential Access) during the scope of the same OPEN statement.

Editing Character. A single character or a fixed two-character combination belonging to the same set:

Character	Meaning
B	Space
0	Zero
+	Plus
-	Minus
CR	Credit
DB	Debit
Z	Zero Suppress
*	Check Protect
$	Currency Sign
,	Comma
.	Period (Decimal Point)
/	Stroke (Virgule, Slash)

Elementary Item. A data item that is described as not being further logically subdivided.

End of Procedure Division. The physical position in a L/II COBOL source program after which no further procedures appear.

Entry. Any descriptive set of consecutive clauses terminated by a period (.) and written in the Identification Division, Environment Division or Data Division of an L/II COBOL source program.

Environment Clause. A clause that appears as part of an Environment Division entry.

Extend Mode. With the EXTEND phrase specified, the state of a file after execution of an OPEN statement, and before the execution of a CLOSE statement for the file.

Figurative Constant. A compiler-generated value referenced through the use of certain reserved words.

File. A collection of records.

File Clause. A clause that appears as part of any of the following Data Division entries:

File Description (FD)
Sort-Merge File Description (SD)
Communication Description (CD)

FILE-CONTROL. The name of an Environment Division paragraph in which the data files for a given source program are declared.

File Description Entry. An entry in the File Section of the Data Division that is composed of the level indicator FD, followed by a file-name, and then followed by a set of file clauses as required.

File-Name. A user-defined word that names a file described in a file description entry or a sort-merge file description entry within the File Section of the Data Division.

File Organization. The permanent logical file structure established at the time that a file is created.

File Section. The section of the Data Division that contains file description entries together with their associated record descriptions.

Format. A specific arrangement of a set of data.

FORMS-2 Program. A screen formatting program that automatically generates L/II COBOL CRT input/output coding from actual screen layout.

Group Item. A named contiguous set of elementary or group items.

High Order End. The leftmost character of a string of characters.

I-O-CONTROL. The name of an Environment Division paragraph in which object program requirements for specific input/output techniques, rerun points, sharing of same areas by several data files, and multiple file storage on a single input/output device are specified.

I-O Mode. The state of a file after execution of an OPEN statement, with the I-O phrase specified for that file, and before the execution of a CLOSE statement for that file.

Identifier. A data-name, followed as required by the syntactically correct combination of subscripts and indices necessary to make unique reference to a data item.

Imperative Statement. A statement that begins with an imperative verb and specifies an unconditional action to be taken. An imperative statement may consist of a sequence of imperative statements.

Implementor-Name. A system-name that refers to a particular feature available on the implementor's computing system.

Index. A computer storage position or register, the contents of which represent the identification of a particular element in a table.

Index Data Item. A data item in which the value associated with an index-name can be stored in a form specified by the implementor.

Index-Name. A user-defined word that names an index associated with a specific table.

Indexed Data-Name. An identifier that is composed of a data-name, followed by one or more index-names enclosed in parentheses.

Indexed File. A file with indexed organization.

Indexed Organization. The permanent logical file structure in which each record is identified by the value of one or more keys within that record.

Indicator Area. The leftmost parameter position of a L/II COBOL source record that indicates the use of the record.

Input File. A file that is opened in the input mode.

Input Mode. The state of a file after execution of an OPEN statement, with the INPUT phrase specified for that file, and before the execution of a CLOSE statement for that file.

Input-Output File. A file that is opened in the I-O mode.

Input-Output Section. The section of the Environment Division that names the files and the external media used by a program and which provides information required for transmission and handling of data during execution of the run-time program.

Input Procedure. A set of statements that is executed each time a record is released to the sort file.

Integer. A numeric literal or a numeric data item that does not include any character positions to the right of the assumed decimal point. Where the 'integer' appears in general formats, integer must not be a numeric data item, and must not be signed, nor zero unless explicitly allowed by the rules of that format.

Intermediate Code. The code produced by the L/II COBOL compiler from the source code entered, and which the Run Time System 'fast loads' for execution.

Invalid Key Condition. A condition, at object time, caused when a specified value of the key associated with an indexed or relative file is determined to be invalid.

Issue Disk. The flexible diskette on which the L/II COBOL software is supplied to users.

Key. A data item which identifies the location of a record, or a set of data items which serve to identify the ordering of data.

Key of Reference. The key currently being used to access records within an indexed file.

Key Word. A reserved word whose presence is required when the format in which the word appears is used in a source program.

Language-Name. A system-name that specifies a particular programming language.

Level Indicator. Two alphabetic characters that identify a specific type of file or a position in hierarchy.

Level-Number. A user-defined word which indicates the position of a data item in the hierarchical structure of a logical record or which indicates special properties of a data description entry. A level-number is expressed as a one or two digit number. Level-numbers in the range 1 through 49 indicate the position of a data item in the hierarchical structure of a logical record.

Level-numbers in the range 1 through 9 may be written either as a single digit or as a zero followed by a significant digit. Level-numbers 66, 77 and 88 identifies special properties of a data description entry.

Library-Name. A user-defined word that names a L/II COBOL library source file that is to be used by the compiler for a given source program compilation.

Library-Text. A sequence of character-strings and/or separators in a COBOL library.

Line Sequential File Organization. A sequential file containing variable length records separated by the C/R (carriage return) and L/F (line feed) characters.

Linkage Section. The section in the Data Division of the called program that describes data items available from the calling program. These data items may be referred to by both the calling and called program.

Literal. A character-string whose value is implied by the ordered set of characters comprising the string.

Logical Operator. One of the reserved words AND, OR or NOT. In the formation of a condition, both or either of AND and OR can be used as logical connections. NOT can be used for logical negation.

Logical Record. The most inclusive data item. The level-number for a record is 01.

Low Order End. The rightmost character of a string of characters.

MCS. (See Message Control System).

Merge File. A collection of records to be merged by a MERGE statement. The merge file is created and can be used only by the merge function.

Message. Data associated with an end of message indicator or an end of group indicator. (See Message Indicators)

Message Control System (MCS). A communication control system that supports the processing of messages.

Message Count. The count of the number of complete messages that exist in the designated queue of messages.

Message Indicators. EGI (end of group indicator), EMI (end of message indicator), and ESI (end of segment indicator) are conceptual indications that serve to notify the MCS that a specific condition exists (end of group, end of message, end of segment).

Within the hierarchy of EGI, EMI, and ESI, an EGI is conceptually equivalent to an ESI, EMI, and EGI. An EMI is conceptually equivalent to an ESI and EMI. Thus, a segment may be terminated by an ESI, EMI, or EGI. A message may be terminated by an EMI or EGI.

<u>Message Segment</u>. Data that forms a logical subdivision of a message normally associated with an end of segment indicator. (See Message Indicators).

<u>Mnemonic-Name</u>. A user-defined word that is associated in the Environment Division with a specified implementor-name.

<u>Native Character Set</u>. The implementor-defined character set associated with the computer specified in the OBJECT-COMPUTER paragraph.

<u>Native Collating Sequence</u>. The implementor-defined collating sequence associated with the computer specified in the OBJECT-COMPUTER paragraph.

<u>Negated Combined Condition</u>. The 'NOT' logical operator immediately followed by a parenthesized combined condition.

<u>Negated Simple Condition</u>. The 'NOT' logical operator immediately followed by a simple condition.

<u>Next Executable Sentence</u>. The next sentence to which control will be transferred after execution of the current statement is complete.

<u>Next Executable Statement</u>. The next statement to which control will be transferred after execution of the current statement is complete.

<u>Next Record</u>. The record which logically follows the current record of a file.

<u>Noncontiguous Items</u>. Elementary data items, in the Working-Storage and Linkage Sections, which bear no hierarchic relationship to other data items.

<u>Nonnumeric Item</u>. A data item whose description permits its contents to be composed of any combination of characters taken from the computer's character set. Certain categories of nonnumeric items may be formed from more restricted character sets.

<u>Nonnumeric Literal</u>. A character-string bounded by quotation marks. The string of characters may include any character in the computer's character set. To represent a single quotation mark character within a nonnumeric literal, two contiguous quotation marks must be used.

<u>Numeric Character</u>. A character that belongs to the following set of digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.

Numeric Item. A data item whose description restricts its contents to a value represented by characters chosen from the digits '0' through '9'; if signed, the item may also contain a '+', '-', or other representation of an operational sign.

Numeric Literal. A literal composed of one or more numeric characters that also may contain either a decimal point, or an algebraic sign, or both. The decimal point must not be the rightmost character. The algebraic sign, if present, must be the leftmost character.

OBJECT-COMPUTER. The name of an Environment Division paragraph in which the computer environment, within which the run-time program is executed, is described.

Open Mode. The state of a file after execution of an OPEN statement for that file and before the execution of a CLOSE statement for that file. The particular open mode is specified in the OPEN statement as either INPUT, OUTPUT, I-O or EXTEND.

Operand. Whereas the general definition of operand is 'that component which is operated upon', for the purposes of this publication, any lowercase word (or words) that appears in a statement or entry format may be considered to be an operand and, as such, is an implied reference to the data indicated by the operand.

Operational Sign. An algebraic sign, associated with a numeric data item or a numeric literal, to indicate whether its value is positive or negative.

Optional Word. A reserved word that is included in a specified format only to improve the readability of the language and whose presence is optional to the user when the format in which the word appears is used in a source program.

Output File. A file that is opened in either the output mode or extend mode.

Output Mode. The state of a file after execution of an OPEN statement, with the OUTPUT or EXTEND phrase specified for that file and before the execution of a CLOSE statement for that file.

Output Procedure. A set of statements to which control is given during execution of a SORT statement after the sort function is completed, or during execution of a MERGE statement after the merge function has selected the next record in merged order.

Paragraph. In the Procedure Division, a paragraph-name followed by a period and a space and optionally by one, or more sentences. In the Identification and Environment Divisions, a paragraph header followed by zero, one, or more entries.

Paragraph Header. A reserved word, followed by a period and a space that indicates the beginning of a paragraph in the Identification and Environment Divisions. The permissible paragraph headers are:

In the Identification Division:

```
PROGRAM-ID.
AUTHOR.
INSTALLATION.
DATE-WRITTEN.
DATE-COMPILED.
SECURITY.
```

In the Environment Division:

```
SOURCE-COMPUTER.
OBJECT-COMPUTER.
SPECIAL-NAMES.
FILE-CONTROL.
I-O-CONTROL.
```

Paragraph-Name. A user-defined word that identifies and begins a paragraph in the Procedure Division.

Phrase. A phrase is an ordered set of one or more consecutive COBOL character-strings that form a portion of a L/II COBOL procedural statement or of a COBOL clause.

Physical Record. (See Block)

Prime Record Key. A key whose contents uniquely identify a record within an indexed file.

Procedure. A paragraph or group of logically successive paragraphs, or a section or group of logically successive sections, within the Procedure Division.

Procedure-Name. A user-defined word which is used to name a paragraph or section in the Procedure Division. It consists of a paragraph-name or a section-name.

Program-Name. A user-defined word that identifies a COBOL source program.

Pseudo-Text. A sequence of character-strings and/or separators bounded by, but not including, pseudo-text delimiters.

Pseudo-Text Delimiter. Two contiguous equal sign (=) characters used to delimit pseudo-text.

Punctuation Character. A character that belongs to the following set:

Character	Meaning
,	comma
;	semicolon
.	period
"	quotation mark
(	left parenthesis
)	right parenthesis
	space
=	equal sign

Qualified Data-Name. An identifier that is composed of a data-name followed by one or more sets of either of the connectives OF and IN followed by a data-name qualifier.

Qualifier.

1. A data-name which is used in a reference together with another data name at a lower level in the same hierarchy.
2. A section-name which is used in a reference together with a paragraph-name specified in that section.
3. A library-name which is used in a reference together with a text-name associated with that library.

Queue. A logical collection of messages awaiting transmission or processing.

Queue Name. A symbolic name that indicates to the MCS the logical path by which a message or a portion of a completed message may be accessible in a queue.

Random Access. An access mode in which the program-specified value of a key data item identifies the logical record that is obtained from, deleted from or placed into a relative or indexed file.

Record. (see Logical Record)

Record Area. A storage area allocated for the purpose of processing the record described in a record description entry in the File Section.

Record Description. (See Record Description Entry)

Record Description Entry. The total set of data description entries associated with a particular record.

Record Key. A key, either the prime record key or an alternate record key, whose contents identify a record within an indexed file.

Record-Name. A user-defined word that names a record described in a record description entry in the Data Division.

Reference-Format. A format that provides a standard method for describing COBOL source programs.

Relation. (See Relational Operator)

Relation Character. A character that belongs to the following set:

Character	Meaning
>	greater than
<	less than
=	equal to

Relation Condition. The proposition, for which a truth value can be determined, that the value of an arithmetic expression or data item has a specified relationship to the value of another arithmetic expression or data item. (See Relational Operator).

Relational Operator. A reserved word, a relation character, a group of consecutive reserved words, or a group of consecutive reserved words and relation characters used in the construction of a relation condition. The permissible operators and their meaning are:

Relational Operator	Meaning
IS NOT GREATER THAN IS NOT >	Greater than or not greater than
IS NOT LESS THAN IS NOT <	Less than or not less than
IS NOT EQUAL TO IS NOT =	Equal to or not equal to

Relative File. A file with relative organization.

Relative Key. A key whose contents identify a logical record in a relative file.

Relative Organization. The permanent logical file structure in which each record is uniquely identified by an integer value greater than zero, which specifies the record's logical ordinal position in the file.

Reserved Word. A COBOL word specified in the list of words which may be used in COBOL source programs, but which must not appear in the programs as user-defined words or system-names.

Routine-Name. A user-defined word that identifies a procedure written in a language other than COBOL

Run-Time Debug. An option available to L/II COBOL programmers entered as a user option enabling break-point facilities in run-time programs.

Run-Time. The time at which the intermediate code produced by the compiler is interpreted by the Run Time System for execution.

Run-Time-System (RTS). The software that interprets the intermediate code produced by the L/II COBOL compiler and enables it to be executed by providing interfaces to the operating system and CRT.

Run Unit. A set of one or more intermediate code programs which function, at run time, as a unit to provide problem solutions.

Section. A set of none, one, or more paragraphs or entries, called a section body, the first of which is preceded by a section header. Each section consists of the section header and the related section body.

Section Header. A combination of words followed by a period and a space that indicates the beginning of a section in the Environment, Data and Procedure Divisions.

In the Environment and Data Divisions, a section header is composed of reserved words followed by a period and a space. The permissible section headers are:

In the Environment Division:

CONFIGURATION SECTION.
INPUT-OUTPUT SECTION.

In the Data Division:

FILE SECTION.
WORKING-STORAGE SECTION.
LINKAGE SECTION.
COMMUNICATION SECTION.

In the Procedure Division, a section header is composed of a section-name, followed by the reserved word SECTION, followed by a segment-number (optional), followed by a period and a space.

Section-Name. A user-defined word which names a section in the Procedure Division.

Segment-Number. A user-defined word which classifies sections in the Procedure Division for purposes of segmentation. Segment-numbers may contain only the characters '0', '1', ..., '9'. A segment-number may be expressed either as a one or two digit number, and is checked for syntax only.

Sentence. A sequence of one or more statements, the last of which is terminated by a period followed by a space.

Separator. A punctuation character used to delimit character-strings.

Sequential Access. An access mode in which logical records are obtained from or placed into a file in a consecutive predecessor-to-successor logical record sequence determined by the order of records in the file.

Sequential File. A file with sequential organization.

Sequential Organization. The permanent logical file structure in which a record is identified by a predecessor-successor relationship established when the record is placed into the file.

Sign Condition. The proposition, for which a truth value can be determined, that the algebraic value of a data item or an arithmetic expression is either less than, greater than, or equal to zero.

Simple Condition. Any single condition chosen from the set:

relation condition
class condition
switch-status condition
condition-name condition
sign condition
(simple-condition)

Sort File. A collection of records to be sorted by a SORT statement. The sort file is created and can be used by the sort function only.

Sort-Merge File Description Entry. An entry in the File Section of the Data Division that is composed of the level indicator SD, followed by a file-name, and then followed by a set of file clauses as required.

Source. The symbolic definition of the originator of a transmission to a queue.

SOURCE-COMPUTER. The name of an Environment Division paragraph in which the computer environment, within which the source program is compiled, is described.

Source Program. Although it is recognized that a source program may be represented by other forms and symbols, in this document it always refers to a syntactically correct set of COBOL statements beginning with an Identification Division and ending with the end of the Procedure Division. In contexts where there is no danger of ambiguity, the word 'program' alone may be used in place of the phrase 'source program'.

Special Character. A character that belongs to the following set:

Character	Meaning
+	plus sign
-	minus sign
*	asterisk
/	stroke (virgule, slash)
=	equal sign
$	currency sign
,	comma (decimal point)
;	semicolon
.	period (decimal point)
"	quotation mark
(	left parenthesis
)	right parenthesis
>	greater than symbol
<	less than symbol

Special-Character Word. A reserved word which is an arithmetic operator or a relation character.

SPECIAL-NAMES. The name of an Environment Division paragraph in which implementor-names are related to user-specified mnemonic-names.

Special Registers. Compiler generated storage areas whose primary use is to store information produced in conjunction with the user of specified COBOL features.

Standard Data Format. The concept used in describing the characteristics of data in a COBOL Data Division under which the characteristics or properties of the data are expressed in a form oriented to the appearance of the data on a printed page of infinite length and breadth, rather than a form oriented to the manner in which the data is stored internally in the computer, or on a particular external medium.

Statement. A syntactically valid combination of words and symbols written in the Procedure Division beginning with a verb.

Sub-Queue. A logical hierarchical division of a queue.

Subject of Entry. An operand or reserved word that appears immediately following the level indicator or the level-number in a Data Division entry.

Subprogram. (See Called Program).

Subscript. An integer whose value identifies a particular element in a table.

Subscripted Data-Name. An identifier that is composed of a data-name followed by one or more subscripts enclosed in parentheses.

Switch-Status Condition. The proposition, for which a truth value can be determined, that an implementor-defined switch, capable of being set to an 'on' or 'off' status, has been set to a specified status.

Symbol Function. The use of specified characters in the PICTURE clause to represent data types.

System-Name. A COBOL word which is used to communicate with the operating environment.

Syntax. The order in which elements must be put together to form a program.

Table. A set of logically consecutive items of data that are defined in the Data Division by means of the OCCURS clause.

Table Element. A data item that belongs to the set of repeated items comprising a table.

Terminal. The originator of a transmission to a queue, or the receiver of a transmission from a queue.

Text-Name. A user-defined word which identifies library text.

Text-Word. Any character-string or separator, except space, in a COBOL library or in pseudo-text.

Truth Value. The representation of the result of the evaluation of a condition in terms of one of two values

true
false

Unary Operator. A plus (+) or a minus (-) sign, which precedes a variable or a left parenthesis in an arithmetic expression and which has the effect of multiplying the expression by +1 or -1 respectively.

User-Defined Word. A COBOL word that must be supplied by the user to satisfy the format of a clause or statement.

Variable. A data item whose value may be changed by execution of the object program. A variable used in an arithmetic expression must be a numeric elementary item.

Verb. A word that expresses an action to be taken by a COBOL compiler or run time program.

Word. A character-string of not more than 30 characters which forms a user-defined word, a system-name, or a reserved word.

Working-Storage Section. The section of the Data Division that describes working storage data items, composed either of noncontiguous items or of working storage records or of both.

77 Level-Description-Entry. A data description entry that describes a noncontiguous data item with the level-number 77.

APPENDIX D

COMPILE-TIME ERRORS

The error descriptions that correspond to error numbers as printed on listings produced by the L/II COBOL compiler are listed below. In the case of alternative meanings, relevancy is obvious from context.

ERROR	DESCRIPTION
01	Compiler Error; consult your Technical Support Service
02	Illegal format: data-name
03	Illegal format: literal
04	Illegal format: character
05	data-name not unique
06	Too many data or procedure names have been declared
07	Obligatory reserved word missing
08	Nested COPY statement or unknown COPY file specified
09	'.' missing
10	The statement starts in the wrong area of the source line, i.e., reference format violation
21	'.' missing
22	'DIVISION' missing
23	'SECTION' missing
24	'IDENTIFICATION' missing
25	'PROGRAM-ID' missing
26	'AUTHOR' missing
27	'INSTALLATION' missing
28	'DATE-WRITTEN' missing
29	'SECURITY' missing
30	'ENVIRONMENT' missing
31	'CONFIGURATION' missing
32	'SOURCE-COMPUTER' missing
33	MEMORY SIZE/COLLATING SEQUENCE/SPECIAL-NAMES clause in error
34	'OBJECT-COMPUTER' missing
36	'SPECIAL-NAMES' missing
37	SWITCH Clause in error <u>or</u> system-name/mnemonic-name error
38	DECIMAL-POINT Clause in error
39	CONSOLE Clause in error
40	Illegal currency symbol
41	'.' missing
42	'DIVISION' missing
43	'SECTION' missing
44	'INPUT-OUTPUT' missing
45	'FILE-CONTROL' missing

46	'ASSIGN' missing
47	'SEQUENTIAL' or 'INDEXED' or 'RELATIVE' missing
48	'ACCESS' missing on indexed/relative file
49	'SEQUENTIAL/DYNAMIC' missing or >64 alternate keys
50	Illegal combination ORGANIZATION/ACCESS/KEY
51	SELECT Clause phrase unrecognised
52	RERUN Clause syntax error
53	SAME RECORD AREA clash
54	file-name missing or illegal
55	'DATA DIVISION' missing
56	'PROCEDURE DIVISION' missing or unknown statement
57	Collating sequence not defined
58	'EXCLUSIVE', 'AUTOMATIC', or 'MANUAL' missing [1]
59	Non-exclusive lock mode specified for restricted file [1]
62	'DIVISION' missing
63	'SECTION' missing
64	file-name not specified in SELECT statement or invalid CD name
65	RECORD SIZE integer missing or line sequential record > 1024 bytes
66	Illegal level number (01-49), or 01 level required, or level hierarchy incorrect
67	FD, CD or SD qualification contains syntax error
68	'WORKING-STORAGE' missing
69	'PROCEDURE DIVISION' missing or unknown statement
70	Data Description Qualifier or '.' missing
71	Incompatible PICTURE clause and qualifiers (SIGN/USAGE illegal with COMP data-item or unsigned PICTURE data)
72	BLANK is illegal with non-numeric data-item
73	PICTURE clause too long (Numeric 18 Numeric Edited 512 Alphanumeric 8192)
74	VALUE clause with non-elementary data-item, or truncation, or wrong data type
75	'VALUE' in error or illegal for PICTURE type
76	FILLER/SYNCHRONIZED/JUSTIFIED/BLANK clause with non-elementary item
77	Preceding item at this level has > 8192 bytes or 0 bytes
78	REDEFINES of unequal fields or different levels.
79	Data storage exceeds 64K bytes
81	Data Description Qualifier inappropriate or repeated
82	REDEFINES data-name not declared
83	USAGE must be COMP, DISPLAY or INDEX
84	SIGN must be LEADING or TRAILING
85	SYNCHRONIZED must be LEFT or RIGHT
86	JUSTIFIED must be RIGHT
87	BLANK must be ZERO
88	OCCURS must be numeric, non-zero, unsigned or DEPENDING
89	VALUE must be a literal, numeric literal or figurative constant

90	PICTURE string has illegal precedence or illegal character	
91	INDEXED dataname missing or already declared	
92	Numeric-edited PICTURE string is too large	
101	Unrecognized verb	
102	IF ... ELSE mismatch	
103	Wrong data-type or data-name not declared	
104	Procedure-name not unique	
105	Procedure-name same as data-name	
106	Name required	
107	Wrong combination of data types	
108	Conditional statement not allowed in this context; must be an imperative statement	
109	Malformed subscript	
110	ACCEPT/DISPLAY wrong <u>or</u> Communications syntax incorrect	
111	Illegal Syntax used with I-O verb	
112	Invalid arithmetic statement	
113	Invalid arithmetic expression	
114	Procedure Division in memory > 32K	
115	Invalid conditional expression	
116	IF statements nested too deep <u>or</u> too many AFTER phrases in a PERFORM statement	
117	Incorrect structure of Procedure Division e.g. Sections out of order	
118	Reserved Word missing or incorrectly used	
119	Too many subscripts in one statement	
120	Too many operands in one statement	
121	'LOCK' clause specified for 'EXCLUSIVE' file	1
122	'KEPT' specified for uncommitable file	1
123	'KEPT' omitted for commitable file	1
141	Inter-segment procedure name duplication	
142	IF ... ELSE mismatch at end of Source Input	
143	Wrong datatype or data-name not declared	
144	Procedure-name undeclared	
145	Index dataname declared twice	
146	Bad cursor control: illegal AT clause	
147	KEY declaration missing <u>or</u> illegal (alternate key clash <u>or</u> key in wrong place)	
148	STATUS declaration missing	
149	Bad STATUS record	
150	Undefined inter-segment reference or error in ALTERed paragraph	
151	PROCEDURE DIVISION in error	
152	USING parameter not declared in Linkage Section	
153	USING parameter is not level 01 or 77	
154	USING parameter used twice in parameter list	
155	'FD' missing	
157	Incorrect structure of Procedure Division: e.g. Sections out of order	
160	Too many operands in one statement	

1 - Apply to Fileshare optional product syntax.

In addition to these numbered error messages, the following two messages can be displayed with subsequent termination of the compilation:

$$\text{I-O ERROR: } \begin{Bmatrix} \text{filename} \\ \text{OBJECT FILE} \end{Bmatrix}$$

where filename is the erroneous file.
OBJECT FILE is one of .INT, .D??, or.I?? (for segmented programs)

Any intermediate code file produced is not usable.

The following conditions will cause this error:

Disk overflow
File directory overflow
File full
Impossible I-O device usage

Other operating system dependent conditions can also cause this error.

READ ERROR: filename

where filename is the erroneous file.

This error is caused by a spurious carriage-return character (Hex OD) in the file.

(Addendum 2)

APPENDIX E

RUN-TIME ERRORS

Run-time error messages are preceded by the name and segment number of the currently executing intermediate code file.

There are two types of run-time errors: Recoverable and Fatal.

(a) Recoverable errors

If the programmer has selected STATUS for a file then error handling is his responsibility. This will generally only apply to errors that are not considered fatal by the operating system.

(b) Fatal errors

All errors except those above are fatal. They may come from the operating system or from the run-time system. Fatal errors cause a message to be output to the console which includes a three digit error code and reference to the COBOL statement subsequent to that in which the error occurred. These fall into two classes:

(i) Exceptions
These cover arithmetic overflow, subscript out of range, too many levels of perform nesting.

(ii) I-O errors
These exclude those for which STATUS is not selected as above.

Refer to your LEVEL II COBOL Operating Guide for details of selecting and decoding STATUS, and for the list of run-time errors applicable to your implementation of LEVEL II COBOL.

APPENDIX F

SYNTAX SUMMARY

All the syntax for L/II COBOL is summarized below.

E denotes that the feature is a L/II COBOL extension to ANSI COBOL.

D denotes that the feature is documentary only in L/II COBOL.

GENERAL FORMAT FOR IDENTIFICATION DIVISION

```
{IDENTIFICATION DIVISION.}
{PROGRAM-ID.      program name}
 [AUTHOR.                [comment entry] ...]
 [INSTALLATION.          [comment entry] ...]
 [DATE-WRITTEN.          [comment entry] ...]
 [DATE-COMPILED.         [comment entry] ...]
 [SECURITY.              [comment entry] ...]
```

GENERAL FORMAT FOR ENVIRONMENT DIVISION

```
   { ENVIRONMENT DIVISION. }

   { CONFIGURATION SECTION. }

   { SOURCE-COMPUTER.  source-computer-entry  [WITH DEBUGGING MODE]. }

   { OBJECT-COMPUTER.  object-computer-entry

        [                            ( WORDS      ) ]
        [ ,MEMORY SIZE integer       { CHARACTERS } ]
        [                            ( MODULES    ) ]

         [,PROGRAM COLLATING SEQUENCE IS alphabet-name]

         [,SEGMENT-LIMIT IS segment number]. }

   [ SPECIAL-NAMES.

        [ ,( SYSIN  ) IS mnemonic-name-1 ]
        [  ( SYSOUT )                    ]

        [ ,( TAB      ) IS mnemonic-name-2 ]
        [  ( FORMFEED )                    ]
        [              ( Ø )
        [              ( . )
        [ SWITCH       ( . )  [IS mnemonic-name]  ON STATUS IS condition-name-1
        [              (   )                                  ]
        [              ( . )                                  ]
        [              ( 7 )                                  ]
                                                              ]
                    [OFF STATUS IS condition-name-2]          ]
                                                              ]
      [ , alphabet-name IS                                                  ]
      [                                                                     ]
      [          ( STANDARD-1                                             ) ]
      [          ( NATIVE                                                 ) ]
      [          (                                                        ) ]...
      [          (              [( ( THROUGH )                  )]        ) ]
      [          ( literal-1    [( ( THRU    )  literal-2       )]        ) ]
      [          (              [( ALSO literal-3 [, ALSO literal-4] ...)]) ]
      [          (                                                        ) ]
      [          (   [            [( ( THROUGH )                   )]]    ) ]
      [          (   [ literal-5  [( ( THRU    )  literal-6        )]]... ) ]
      [          (   [            [( ALSO literal-7 [, ALSO literal-8])]]  ) ]
         [,CURRENCY SIGN IS literal-9]
         [,DECIMAL-POINT IS COMMA]
         [,CURSOR IS data-name-1]            E
         [,CONSOLE IS CRT]            ].     E
```

```
[{ INPUT-OUTPUT SECTION.}
 { FILE-CONTROL.}
      {file-control-entry}...
[ I-O-CONTROL.
   [ ; RERUN [ON {file-name-1        }]
                 {implementor-name   }
                   {{[END OF]{REEL}     }      OF file-name-2 }]       D
                   {{        {UNIT}     }                     }
             EVERY {{ integer-1 RECORDS }                     }]...
                   {integer-2 CLOCK-UNITS                     }
                   {condition-name                            }

  [ ; SAME    [RECORD    ]  AREA FOR file-name-3 {,file-name-4}... ] ...
              [SORT      ]
              [SORT-MERGE]

  [ ; MULTIPLE FILE TAPE CONTAINS file-name-5    [POSITION integer-3]      D
  [
          [, file-name-6  [POSITION integer-4]  ]       ...]... .]  ]
```

GENERAL FORMAT FOR FILE-CONTROL ENTRY

Sequential SELECT:

```
     SELECT                [ OPTIONAL ] file-name

                                                                       D
     ASSIGN TO {external-file-name-literal}   [, {external-file-name-literal}]
               {file-identifier           }   [  {file-identifier           }]...

     [ ; RESERVE integer-1     [{AREA }]]              D
     [                         [{AREAS}]]

     ;ORGANIZATION IS [{SEQUENTIAL     }]
                      [{LINE SEQUENTIAL}]              E

     [;ACCESS MODE IS SEQUENTIAL]

     [;FILE STATUS IS data-name]  .
```

Relative Select:

```
     SELECT file-name
                                                                         D
     ASSIGN TO    {external-file-name-literal}   [, {external-file-name-literal}]
                  {file-identifier           }   [  {file-identifier           }]...

     [ ; RESERVE integer-1     [{AREA }]]              D
     [                         [{AREAS}]]

     ORGANIZATION IS RELATIVE

    [                 {  SEQUENTIAL      [,RELATIVE KEY IS data-name] } ]
    [;ACCESS MODE IS  { {RANDOM }         ,RELATIVE KEY IS data-name  } ]
    [                 { {DYNAMIC}                                     } ]

     [;FILE STATUS IS data-name]  .
```

Indexed Select:

```
     SELECT file-name
                                                                         D
     ASSIGN TO    {external-file-name-literal}   [, {external-file-name-literal}]
                  {file-identifier           }   [  {file-identifier           }]...

     [ ; RESERVE integer-1     [{AREA }]]              D
     [                         [{AREAS}]]
```

```
;ORGANIZATION IS INDEXED

 ┌                     ┐
 │                ⎧ SEQUENTIAL ⎫ │
 │;ACCESS MODE IS ⎨ RANDOM     ⎬ │
 │                ⎩ DYNAMIC    ⎭ │
 └                     ┘

;RECORD KEY IS data-name-1

[; ALTERNATE RECORD KEY IS data-name-2 [WITH DUPLICATES ] ]  ...

[;FILE STATUS IS data-name-3]  .
```

Sort or Merge Select:

```
SELECT file-name

ASSIGN TO { external-file-name-literal }  ...  .
          { file-identifier            }
```

GENERAL FORMAT FOR THE DATA DIVISION

```
  { DATA DIVISION. }
 [  FILE SECTION.
  [ FD file-name

       [; BLOCK CONTAINS [integer-1 TO] integer-2 {RECORDS   }]
       [                                          {CHARACTERS}]      D

       [; RECORD CONTAINS  [integer-1  TO] integer-2  CHARACTERS]    D

       [; LABEL  {RECORD IS  } {STANDARD}       ]                    D
       [         {RECORDS ARE} {OMITTED }       ]

       [; VALUE OF data-name-1 IS{data-name-2}
       [                         {literal-1  }
                 [, data-name-3 IS{data-name-4}] ...]
                 [                {literal-2  }]    ]
       [; DATA   {RECORD IS  }  data-name-3 [, data-name-4]...]      D
       [         {RECORDS ARE}                                ]

       [; LINAGE IS   {data-name-5}   LINES  [, WITH FOOTING AT  {data-name-6}]
       [              {integer-5  }          [                   {integer-6  }]

            [, LINES AT TOP {data-name-7}][, LINES AT BOTTOM  {data-name-8} ]  ]
            [               {integer-7  }][                   {integer-8  } ]  ]

       [; CODE-SET IS alphabet-name]  .                              D

    [record-description-entry] ... ]...

  [ SD file-name
       [; RECORD CONTAINS  [integer-1 TO]  integer-2 CHARACTERS]         D
       [; DATA{RECORD   IS }   data-name-1   [, data-name-2]   ...] .
       [      {RECORDS ARE }                                      ]
    record-description-entry     ...     ...

  [ WORKING-STORAGE SECTION                ]
  [      [77-level-description-entry]      ]
  [      [record-description-entry  ]  ... ]

  [ LINKAGE SECTION                        ]
  [      [77-level-description-entry]      ]
  [      [record-description-entry  ] ...  ]

  [ COMMUNICATION SECTION                       ]
  [      [communication-description-entry]      ]
  [      [record-description-entry ...    ]...  ]
  [                                             ]
```

GENERAL FORMAT FOR DATA DESCRIPTION ENTRY

Format 1:

```
level-number  {data-name-1}
              {FILLER     }
    [;REDEFINES data-name-2]

    [;{PICTURE} IS picture-string]
    [ {PIC    }                  ]

    [                {COMPUTATIONAL  } ]
    [                {COMP           } ]
    [;[USAGE IS]     {COMPUTATIONAL-3} ]
    [                {COMP-3         } ]
    [                {DISPLAY        } ]
    [                {INDEX          } ]

    [ [; SIGN IS]   {LEADING }   [SEPARATE CHARACTER] ]
    [               {TRAILING}                        ]

    [ ; OCCURS {integer-1   TO integer-2  TIMES   DEPENDING ON data-name-3} ]
    [          {integer-2  TIMES                                          } ]
    [  [{ASCENDING }  KEY IS data-name-4    [,data-name-5]  ...]...         ]
    [  [{DESCENDING}                                           ]            ]
    [       [INDEXED BY index-name-1    [, index-name-2]  ...]              ]

    [;{SYNCHRONIZED}     {LEFT }]                                    D
    [ {SYNC        }     {RIGHT}]

    [;{JUSTIFIED}         RIGHT ]
    [ {JUST     }               ]
    [;BLANK WHEN ZERO]
    [;VALUE IS literal] .
```

Format 2:

```
    66 data-name-1; RENAMES data-name-2   [{THROUGH}  data-name-3]
                                          [{THRU   }             ]
```

Format 3:

```
    88 condition-name; {VALUE IS  } literal-1 [{THROUGH}   literal-2]
                       {VALUES ARE}           [{THRU   }            ]

     [, literal-3  [{THROUGH}  literal-4] ]  ... .
     [             [{THRU   }           ] ]
```

GENERAL FORMAT FOR COMMUNICATION DESCRIPTION ENTRY

FORMAT 1:

```
CD cd-name;
                           ┌ [[; SYMBOLIC QUEUE IS data-name-1]                   ┐
                           │       [; SYMBOLIC SUB-QUEUE-1 IS data-name-2]        │
                           │       [; SYMBOLIC SUB-QUEUE-2 IS data-name-3]        │
                           │       [; SYMBOLIC SUB-QUEUE-3 IS data-name-4]        │
                           │       [; MESSAGE DATE IS data-name-5]                │
FOR  [INITIAL ] INPUT      │       [; MESSAGE TIME IS data-name-6]                │
                           │       [; SYMBOLIC SOURCE IS data-name-7]             │
                           │       [; TEXT LENGTH IS data-name-8]                 │
                           │       [; END KEY IS data-name-9]                     │
                           │       [; STATUS KEY IS data-name-10]                 │
                           │       [; MESSAGE COUNT IS data-name-11]]             │
                           └ [data-name-1, data-name-2, ..., data-name-11]        ┘
```

FORMAT 2:

```
CD cd-name;  FOR OUTPUT

    [; DESTINATION COUNT IS data-name-1]

    [; TEXT LENGTH IS data-name-2]

    [; STATUS KEY IS data-name-3]

   ┌[; DESTINATION TABLE OCCURS integer-2 TIMES                          ┐
   └    [[; INDEXED BY index-name-1    [, index-name-2]  ... ]           ┘

    [; ERROR KEY IS data-name-4]

    [; SYMBOLIC DESTINATION IS data-name-4].
```

GENERAL FORMAT FOR PROCEDURE DIVISION

Declarative format:

```
    PROCEDURE DIVISION [USING data-name-1  [, data-name-2] ...].

  [ DECLARATIVES.
   {section-name SECTION [segment-number]. declarative-sentence
    [{paragraph-name.} [sentence] ... ] ... } ...

    END DECLARATIVES.]
   {section-name SECTION   [segment-number] .
    [{paragraph-name.}[sentence] ... ] ... } ...
```

Non-declarative format:

```
    PROCEDURE DIVISION [ USING  data-name-1   [,data-name-2],  ...] .
     {[paragraph-name.][sentence] ...} ...
```

GENERAL FORMAT FOR VERBS

```
ACCEPT  dataname-1  [AT  {data-name-2}]      FROM CRT                E
                         {literal-1  }

ACCEPT identifier   [FROM CONSOLE]

                          {DATE}
ACCEPT identifier FROM    {DAY }
                          {TIME}

ACCEPT cd-name MESSAGE COUNT                                         D

ADD {identifier-1} [, identifier-2]...  TO  identifier-m  [ROUNDED]
    {literal-1   } [, literal-2   ]

     [, identifier-n [ROUNDED] ... [; ON SIZE ERROR imperative-statement]

ADD {identifier-1} ,{identifier-2}[, identifier-3]...
    {literal-1   }  {literal-2   }[, literal-3   ]

                GIVING identifier-m [ROUNDED] [, identifier-n [ROUNDED]] ...

                [; ON SIZE ERROR  imperative-statement]

ADD {CORRESPONDING} identifier-1  TO  identifier-2  [ROUNDED]
    {CORR         }

                [; ON SIZE ERROR  imperative-statement]

ALTER {procedure-name-1  TO[PROCEED TO] procedure-name-2}        ...

CALL {identifier-1}  USING  data-name-1    [, data-name-2]  ...
     {literal-1   }

                [; ON OVERFLOW  imperative-statement]

CANCEL {identifier-1}  [{,identifier-2}]      ...
       {literal-1   }  [{,literal-2   }]

                   [{REEL}       [WITH NO REWIND]]                  D
                   [{UNIT}       [FOR REMOVAL   ]]
CLOSE file-name-1  [                              ]
                   [ WITH        {NO REWIND}      ]
                   [             {LOCK     }      ]

  [                [{REEL}       [WITH NO REWIND]]    ]
  [                [{UNIT}       [FOR REMOVAL   ]]    ]
  [ , file-name-2  [                              ]    ]        ...
  [                [ WITH        {NO REWIND}      ]    ]
  [                [             {LOCK     }      ]    ]
CLOSE    file-name-1    [WITH LOCK]  [, file-name-2   [WITH LOCK]  ] ...

COMPUTE   identifier-1    [ ROUNDED ]  [, identifier-2 [ROUNDED]  ] ...

    = arithmetic-expression [; ON SIZE ERROR imperative-statement]

DELETE  file-name  RECORD  [; INVALID KEY  imperative-statement]

DISABLE  { INPUT  [TERMINAL] }  cd-name WITH KEY  { identifier-1 }
         { OUTPUT            }                    { literal-1    }

DISPLAY { identifier-1 } [ ,  identifier-2 ]  ... [ UPON CONSOLE ]
        { literal-1    } [ ,  literal-2    ]

DISPLAY { data-name-1 } [ AT { data-name-2 } ]  UPON { CRT       }     E
        { literal-3   } [    { literal-4   } ]       { CRT-UNDER }

DIVIDE { identifier-1 }   INTO  identifier-2   [ROUNDED]
       { literal-1    }

    [, identifier-3 [ROUNDED]] ... [;ON SIZE ERROR imperative-statement]

DIVIDE { identifier-1 }  { INTO }  { identifier-2 } GIVING identifier-3  [ROUNDED]
       { literal-1    }  { BY   }  { literal-2    }

    [, identifier-4 [ROUNDED]] ... [;ON SIZE ERROR imperative-statement]

DIVIDE { identifier-1 }  { INTO }  identifier-2 } GIVING identifier-3  [ROUNDED]
       { literal-1    }  { BY   }  literal-2    }

       REMAINDER identifier-4 [;ON SIZE ERROR  imperative-statement]

ENABLE  { INPUT   [TERMINAL] }  cd-name WITH KEY  { identifier-1 }
        { OUTPUT             }                    { literal-1    }

ENTER  language-name  [routine-name].                  D

EXIT   [PROGRAM].

GO TO[procedure-name].

GO TO procedure-name-1  }, procedure-name-2}...

    DEPENDING ON identifier

IF condition;  THEN { statement-1   }   { ; ELSE statement-2    }          E
                    { NEXT SENTENCE }   { ; ELSE NEXT SENTENCE  }
```

```
INSPECT identifier-1 TALLYING tally-clause (as follows)
  { identifier-2 FOR { , { {ALL    } {identifier-3} }
                     {   { {LEADING} {literal-2   } }
                     {   {       CHARACTERS         }
      [{BEFORE}  INITIAL {identifier-4}] } ...       } ...- (tally-clause)
      [{AFTER }          {literal-3   }] }           }

INSPECT identifier-1 REPLACING  replacing-clause (as follows)
  {   CHARACTERS BY {identifier-6}[{BEFORE}  INITIAL  {identifier-7}]   }
  {                 {literal-4   }[{AFTER }           {literal-5   }]   }
  { { , {ALL    } { , {identifier-5}  BY  {identifier-6}                 }
  { {   {LEADING} {   {literal-3   }      {literal-4   }                 }
  { {   {FIRST  } {                                                      }
  {      [{BEFORE}  INITIAL  {identifier-7}]} ... } ...                  }
  {      [{AFTER }           {literal-5   }]}     }                      }
                                                   - (replacing clause)

INSPECT identifier TALLYING tally-clause REPLACING replacing-clause

MERGE file-name-1 ON {ASCENDING }KEY data-name-1  [, data-name-2]  ...
                     {DESCENDING}

               [ON {ASCENDING }KEY data-name-3  [, data-name-4]  ... ] ...
               [   {DESCENDING}                                      ]

     [COLLATING SEQUENCE IS alphabet-name]

     USING file-name-2, file-name-3 [, file-name-4] ...
    { OUTPUT PROCEDURE IS section-name-1 [{THROUGH}  section-name-2 ] }
    {                                    [{THRU   }                 ] }
    { GIVING file-name-5                                              }

MOVE {identifier-1} TO identifier-2    [,identifier-3]  ...
     {literal-1   }

MOVE  {CORRESPONDING} identifier-1 TO identifier-2
      {CORR         }

MULTIPLY {identifier-1} BY identifier-2  [ROUNDED]
         {literal-1   }

    [, identifier-3 [ROUNDED]] ...  [; ON SIZE ERROR imperative-statement]

MULTIPLY {identifier-1} BY {identifier-2} GIVING identifier-3  [ROUNDED]
         {literal-1   }    {literal-2   }

      [, identifier-4 [ROUNDED]] ...
  [; ON SIZE ERROR  imperative-statement]
```

(Addendum 2)

```
                                                                                      D
      ( INPUT file-name-1 [ REVERSED       ] [, file-name-2 [ REVERSED       ] ] ... )
      (                   [ WITH NO REWIND ]                [ WITH NO REWIND ]       )
OPEN  < OUTPUT file-name-3  [WITH NO REWIND] [,file-name-4 [WITH NO REWIND] ] ...    > ...
      ( I-O file-name-5     [, file-name-6] ...                                      )
      ( EXTEND  file-name-7     [, file-name-8]  ...                                 )

PERFORM  procedure-name-1 [ { THROUGH } procedure-name-2 ]
                          [ { THRU    }                  ]

PERFORM  procedure-name-1 [ { THROUGH } procedure-name-2 ] { identifier-1 }  TIMES
                          [ { THRU    }                  ] { integer-1    }

PERFORM procedure-name-1  [ { THROUGH }      procedure-name-2 ] UNTIL  condition-1
                          [ { THRU    }                       ]

PERFORM procedure-name-1 [ { THROUGH }      procedure-name-2 ]
                         [ { THRU    }                       ]

                    VARYING      { identifier-2 }  FROM { identifier-3 }
                                 { index-name-1 }       { index-name-2 }
                                                        { literal-1    }

                    BY           { identifier-4 }  UNTIL  condition-1
                                 { literal-2    }

                   [ AFTER                              { identifier-6 }
                   [             { identifier-5 }  FROM { index-name-4 }
                   [             { index-name-3 }       { literal-3    }

                    BY           { identifier-7 }  UNTIL condition-2
                                 { literal-4    }

                   [ AFTER       { identifier-8 } FROM  { identifier-9 }
                   [             { index-name-5 }       { index-name-6 }
                   [                                    { literal-5    }

                    BY          { identifier }   UNTIL   condition-3 ] ]
                                { literal-6  }                       ] ]

READ file-name   [NEXT]   RECORD   [INTO identifier]
        [;AT END imperative-statement]

READ file-name  RECORD   [INTO identifier]  [;KEY IS data-name]
        [;INVALID KEY imperative-statement]
```

```
RECEIVE cd-name {MESSAGE} INTO identifier-1  [; NO DATA imperative-statement]
                {SEGMENT}

RELEASE record-name  [FROM identifier]

RETURN file-name RECORD  [INTO identifier]   ; AT END imperative-statement

REWRITE  record-name  [FROM identifier]

         [;INVALID KEY imperative-statement]

SEARCH  identifier-1    [VARYING  {identifier-2}]
                        [         {index-name-1}]

      [;  AT END  imperative-statement-1]

       ; WHEN condition-1       {imperative-statement-2}
                                {NEXT SENTENCE         }

      [; WHEN condition-2       {imperative-statement-3}]        ...
      [                         {NEXT SENTENCE         }]

SEARCH ALL  identifier-1  [; AT END imperative-statement-1]

                       {                {IS EQUAL TO} {identifier-3          }}
      ; WHEN           {  data-name-1   {IS =       } {literal-1             }}
                       {                              {arithmetic-expression-1}}
                       {                                                      }
                       {  condition-name-1                                    }

     [                 {                {IS EQUAL TO} {identifier-4          }}]
     [ AND             {  data-name-2   {IS =       } {literal-2             }}] ...
     [                 {                              {arithmetic-expression-2}}]
     [                 {  condition-name-2                                    }]

     {imperative-statement-2}
     {NEXT SENTENCE         }

SEND cd-name FROM  identifier-1

                                          { WITH identifier-2 }
SEND cd-name   [FROM identifier-1]        { WITH ESI          }
                                          { WITH EMI          }
                                          { WITH EGI          }

    [                   {{identifier-3}       [LINE ]}]
    [ {BEFORE} ADVANCING{{integer     }       [LINES]}]
    [ {AFTER }          {                            }]
    [                   {{mnemonic-name}             }]
    [                   {{PAGE         }             }]
```

```
                                                              (identifier-3 )
SET  {identifier-1   [identifier-2]}  ...    TO               {index-name-3 }
     {index-name-1   [index-name-2]}                          (integer-1    )

                                                              (identifier-4 )
SET  {index-name-4   [, index-name-5]}    {UP BY  }           {integer-2    }
     {identifier-5   [, identifier-6]}... {DOWN BY}           (index-name-6 )       E

SORT  file-name-1  ON {ASCENDING }  KEY data-name-1  [, data-name-2] ...
                      {DESCENDING}

                   [ON {ASCENDING }  KEY data-name-3  [, data-name-4]  ... ] ...
                       {DESCENDING}

    [COLLATING SEQUENCE IS alphabet-name]

    { INPUT PROCEDURE IS  section-name-1 [{THROUGH}  section-name-2] }
    {                                     {THRU   }                  }
    { USING file-name-2   ,[file-name-3] ...                         }

    { OUTPUT PROCEDURE IS section-name-3 [ {THROUGH}  section-name-4.] }
    {                                      {THRU   }                   }
    { GIVING file-name-4                                               }

                              ( IS EQUAL  =         )
                              ( IS =                )
START  file-name  [ KEY       { IS GREATER than     }        data-name ]
                              ( IS >                )
                              ( IS NOT LESS THAN    )
                              ( IS NOT <            )
          [;INVALID  KEY  imperative-statement]

STOP     {RUN    }
         {literal}

                                                                    (identifier-3)
STRING    {identifier-1} [,    {identifier-2}] ... DELIMITED BY     {literal-3   }
          {literal-1   }       {literal-2   }                       (SIZE        )

                                                                     (identifier-6)
      [,  {identifier-4} [,    {identifier-5}] ...  DELIMITED BY     {literal-6   } ] .
          {literal-4   }       {literal-5   }                        (SIZE        )

      INTO   identifier-7        [WITH POINTER  identifier-8]

      [, ON OVERFLOW imperative-statement]

SUBTRACT  {identifer-1} [, {identifier-2}]...      FROM identifier-m     [ROUNDED]
          {literal-1  }    {literal-2   }

          [, identifier-n [ROUNDED] ]  ...

          [; ON SIZE ERROR  imperative-statement]
```

```
SUBTRACT {identifier-1} [, identifier-2] ...  FROM {identifier-m}
         {literal-1   } [, literal-2   ]           {literal-m   }

         GIVING  identifier -n   [ROUNDED] [, identifier-o      [ROUNDED]] ...

         [; ON SIZE ERROR  imperative-statement]

SUBTRACT {CORRESPONDING} identifier-1   FROM  identifier-2  [ROUNDED]
         {CORR         }

      [; ON SIZE ERROR imperative-statement]

UNSTRING identifier-1
   [DELIMITED  BY [ALL]      {identifier-2} [, OR [ALL]  {identifier-3}] ...]
                             {literal-1   }              {literal-2   }

     INTO identifier-4   [, DELIMITER IN identifier-5]  [, COUNT IN identifier-6]

[, identifier-7  [, DELIMITER IN identifier-8][, COUNT IN identifier-9]] ...

     [WITH POINTER identifier-10] [TALLYING IN identifier-11]

     [; ON OVERFLOW imperative-statement]

                                                 (file-name-1   [ , file-name-2 ] ...)
                                                 (INPUT                             )
USE AFTER STANDARD {EXCEPTION} PROCEDURE ON      (OUTPUT                            )
                   {ERROR    }                   (I-O                               )
                                                 (EXTEND                            )

                            (cd-name-1                           )
                            ([ALL REFERENCES OF] identifier-1    )
USE FOR DEBUGGING ON        (file-name-1                         )
                            (procedure-name-1                    )
                            (ALL PROCEDURES                      )

    [      cd-name-2                         ]
    [      [ALL REFERENCES OF] identifier-2  ]
    [ ,    file-name-2                       ]      ...  .
    [      procedure-name-2                  ]
    [      ALL PROCEDURES                    ]

WRITE record-name    [FROM   identifier-1 ]
      [                        (  integer          [LINE ] )]
      [                        (  identifier-2     [LINES] )]
      [ {BEFORE}   ADVANCING   ( {PAGE}                    )]
      [ {AFTER }               ( {TAB }                    )]       E
       [; AT     {END-OF-PAGE}   imperative statement]
                 {EOP        }

WRITE   record-name [FROM   identifier]

          [;INVALID KEY imperative-statement]
```

GENERAL FORM FOR COPY STATEMENT

```
COPY  { text-name                    } [ { OF } library-name ]
      { external-file-name-literal   } [ { IN }              ]

  [            (   { ==pseudo-text-1== }        { ==pseudo-text-2== } )     ]
  [ REPLACING  ( , { identifier-1      }   BY   { identifier-2      } ) ... ]
  [            (   { literal-1         }        { literal-2         } )     ]
  [            (   { word-1            }        { word-2            } )     ]
```

GENERAL FORMAT FOR CONDITIONS

Relation condition:

```
                            { IS [NOT] GREATER THAN }
{ identifier-1            } { IS [NOT] LESS THAN    } { identifier-2            }
{ literal-1               } { IS [NOT] EQUAL to     } { literal-2               }
{ arithmetic-expression-1 } { IS [NOT] >            } { arithmetic-expression-2 }
{ index-name-1            } { IS [NOT] <            } { index-name-2            }
                            { IS [NOT] =            }
```

Class Condition:

```
identifier IS [NOT]   { NUMERIC    }
                      { ALPHABETIC }
```

Sign Condition:

```
                                   { POSITIVE }
arithmetic-expression IS [NOT]     { NEGATIVE }
                                   { ZERO     }
```

Condition-name Condition:

condition-name

Switch-status Condition:

condition-name

Negated Simple Condition:

NOT simple-condition

Combined Condition:

```
condition    { { AND } condition }    ...
             { { OR  }           }
```

Abreviated Combined Relation Condition:

```
relation-condition { { AND } [NOT]   [relational-operator] object } ...
                   { { OR  }                                      }
```

MISCELLANEOUS FORMATS

QUALIFICATION:

$$\left\{\begin{array}{l}\text{data-name-1}\\ \text{condition-name}\end{array}\right\}\quad\left[\left\{\begin{array}{l}\underline{\text{OF}}\\ \underline{\text{IN}}\end{array}\right\}\quad\text{data-name-2}\right]\quad\ldots$$

$$\text{paragraph-name}\quad\left[\left\{\begin{array}{l}\underline{\text{OF}}\\ \underline{\text{IN}}\end{array}\right\}\quad\text{section-name}\right]$$

$$\text{text-name}\quad\left[\left\{\begin{array}{l}\underline{\text{OF}}\\ \underline{\text{IN}}\end{array}\right\}\quad\text{library-name}\right]$$

SUBSCRIPTING:

$$\left\{\begin{array}{l}\text{data-name}\\ \text{condition-name}\end{array}\right\}\quad(\text{subscript-1}\quad\left[,\ \text{subscript-2}\quad\left[,\ \text{subscript-3}\right]\right]\ )$$

INDEXING:

$$\left\{\begin{array}{l}\text{data-name}\\ \text{condition-name}\end{array}\right\}(\quad\left\{\begin{array}{l}\text{index-name-1}\ \left[\left\{\pm\right\}\text{literal-2}\right]\\ \text{literal-1}\end{array}\right\}$$

$$\left[,\ \left\{\begin{array}{l}\text{index-name-2}\ \left[\left\{\pm\right\}\text{literal-4}\right]\\ \text{literal-3}\end{array}\right\}\ \left[,\quad\left\{\begin{array}{l}\text{index-name-3}\ \left[\left\{\pm\right\}\text{literal-6}\right]\\ \text{literal-5}\end{array}\right\}\right]\right])$$

IDENTIFIER: FORMAT 1

$$\text{data-name-1}\quad\left[\left\{\begin{array}{l}\underline{\text{OF}}\\ \underline{\text{IN}}\end{array}\right\}\ \text{data-name-2}\right]\quad\ldots\quad\left[(\text{subscript-1}\quad\left[,\ \text{subscript-2}\right.\right.$$

$$\left.\left.\left[,\ \text{subscript-3}\right]\right]\quad)\right]$$

IDENTIFIER: FORMAT 2

$$\text{data-name-1}\quad\left[\left\{\begin{array}{l}\underline{\text{OF}}\\ \underline{\text{IN}}\end{array}\right\}\ \text{data-name-2}\right]\quad\ldots\quad\left[(\quad\left\{\begin{array}{l}\text{index-name-1}\quad\left[\left\{\pm\right\}\text{literal-2}\right]\\ \text{literal-1}\end{array}\right\}\right.$$

$$\left.\left[,\left\{\begin{array}{l}\text{index-name-2}\quad\left\{\pm\right\}\text{literal-4}\\ \text{literal-3}\end{array}\right\}\quad\left[,\left\{\begin{array}{l}\text{index-name-3}\quad\left[\left\{\pm\right\}\text{literal-6}\right]\\ \text{literal-5}\end{array}\right\}\right]\right]\ )\right]$$

APPENDIX G

SUMMARY OF EXTENSIONS TO ANSI COBOL

L/II COBOL is oriented to microcomputer users with the system close at hand and usually with a CRT. L/II COBOL therefore provides extensions for interactive working, program control of files, text file handling and rapid development and testing. These facilities are summarised below.

SCREEN FORMATTING AND DATA ENTRY

THE ACCEPT STATEMENT

An additional format for the ACCEPT statement is provided as follows:

Format

$$\underline{\text{ACCEPT}}\ \text{data-name-1}\ \left[\underline{\text{AT}}\begin{Bmatrix}\text{data-name-2}\\ \text{literal-1}\end{Bmatrix}\right]\ \ \underline{\text{FROM}}\ \underline{\text{CRT}}$$

data-name-2	allows the start of screen to be changed dynamically. It refers to a PIC 9999 field where the most significant 99 is a line count 1-25 and the least significant 99 is a character position 1-80.
data-name-1	refers to a record, group or elementary item but may not be subscripted.
literal-1	is a numeric literal

NOTE: See Chapter 3 for description. See also Appendix H for Environment Division changes.

THE DISPLAY STATEMENT

An additional format for the DISPLAY statement is provided as follows:

Format

$$\underline{\text{DISPLAY}}\ \begin{Bmatrix}\text{data-name-1}\\ \text{literal-3}\end{Bmatrix}\left[\underline{\text{AT}}\ \begin{Bmatrix}\text{dataname-2}\\ \text{literal1}\end{Bmatrix}\right]\ \ \underline{\text{UPON}}\begin{Bmatrix}\underline{\text{CRT}}\\ \underline{\text{CRT-UNDER}}\end{Bmatrix}$$

literal-3	is an alphanumeric literal
dataname-1	refers to a record, group or elementary item but may not be subscripted
dataname-2	defines the leftmost position on the screen. It refers to a PIC 9999 field where the most significant 99 is a line count 1-25 and the least significant 99 is a character position 1-80.

NOTE: See Chapter 3 for description.

DISK FILES

Two extensions are offered by L/II COBOL file processing; these are as follows:

1. Line sequential files
2. Run time input of filenames

LINE SEQUENTIAL FILES

When LINE SEQUENTIAL ORGANIZATION is specified in the FILE CONTROL paragraph ORGANIZATION IS entry, the file is treated as consisting of variable length records separated by an operating system dependent line delimiter character. On input the delimiter is removed and the record area padded out with spaces as necessary; on output any trailing spaces in the record area are removed.

RUN TIME INPUT OF FILENAMES

The ASSIGNed name in the SELECT statement for a file is processed on OPENing as follows:

When the INPUT or OUTPUT phrase is specified, execution of OPEN causes checking of the file names in accordance with the operating system connections for opening on input or output file. The full operating system features for file reallocation and device control are therefore available to the L/II COBOL program.

LOWER CASE CHARACTERS

The full alphanumeric lower case a to z is available in L/II COBOL. Reserved and user word characters are read as their upper case equivalents (A to Z).

HEXADECIMAL VALUES

Hexadecimal binary values can be attributed to non-numeric literals in L/II COBOL by expressing them as X "xx", where x is a hexadecimal character in the set 0-9, A-F; xx can be repeated up to 128 times, but the number of hexadecimal digits must be even.

APPENDIX H

SYSTEM DEPENDENT LANGUAGE FEATURES

This Appendix summarises those parts of a COBOL program that need to be changed to run them as L/II COBOL programs and those parts that do not need changing specifically but are ignored by the L/II COBOL compiler when generating the object program.

MANDATORY CHANGES

ENVIRONMENT DIVISION

The only statements in the environment division that must be specialised for L/II COBOL are shown below:

Configuration Section

<u>SPECIAL-NAMES</u>. special names entry

special names entry must include the following:

<u>CURSOR</u> IS data-name-1

The CURSOR IS data-name-1 clause specifies the data-name which will contain the CRT cursor address as used by ACCEPT statements. Data-name-1 must be declared in the Working-Storage section as a 4 character item. The interpretation of the 4 characters is given in the ACCEPT statement description.

Input-Output Section

File names must be as described in the L/II COBOL Operating Guide.

STATEMENTS COMPILED AS DOCUMENTATION ONLY

COBOL programs not specifically written for compilation as L/II COBOL on microcomputers can still be compiled. Statements using features that are not available are treated as documentary only, and are not compiled. A summary of these features follows:

ENVIRONMENT DIVISION

I-O-Control Paragraph

The clauses that refer to a real time clock and magnetic tape in this paragraph are ignored by the compiler during compilation but do not cuase compile times errors. These clauses are as follows:

$\underline{\text{END}}$ OF $\left\{\begin{matrix}\underline{\text{REEL}}\\ \underline{\text{UNIT}}\end{matrix}\right\}$ of filename2 (no magnetic tape)

$\text{integer-2 } \underline{\text{CLOCK}}\ \underline{\text{UNITS}}$ (no clock)

DATA DIVISION

File Description Paragraph

The following complete statements in the file description are ignored by the compiler during compilation but do not cause compile time errors:

$$\underline{\text{BLOCK}}\ \text{CONTAINS}\ \ \text{integer-1}\ \ \underline{\text{TO}}\ \ \text{integer-2}\ \left\{\begin{array}{l}\underline{\text{RECORDS}}\\ \underline{\text{CHARACTERS}}\end{array}\right\}$$

$$\underline{\text{CODE-SET}}\ \ \text{IS}\ \ \text{alphabetic-name}$$

$$\underline{\text{LABEL}}\ \left\{\begin{array}{l}\underline{\text{RECORD}}\ \text{IS}\\ \underline{\text{RECORDS}}\ \text{ARE}\end{array}\right\}\ \left\{\begin{array}{l}\underline{\text{STANDARD}}\\ \underline{\text{OMITTED}}\end{array}\right\}$$

$$\begin{array}{l}\underline{\text{VALUE}}\ \underline{\text{OF}}\ \ \text{implementor-name-1}\ \ \text{IS}\ \ \text{literal-1}\\ \qquad [\text{,implementor-name-2}\ \ \text{IS}\ \ \text{literal-2}]\ \ldots\end{array}$$

PROCEDURE DIVISION

CLOSE Statement

The following phrases in the CLOSE statement are ignored by the compiler during compilation but do not cause compiler-time errors:

$\left\{\begin{array}{l}\underline{\text{REEL}}\\ \underline{\text{UNIT}}\end{array}\right\}$ (No magnetic tape)

APPENDIX I

LANGUAGE SPECIFICATION

L/II COBOL is ANSI COBOL as specified in "American National Standard Programming Language COBOL" (ANSI X3.23 1974). The L/II COBOL Implementation has been selected from both levels of ANSI COBOL. The following modules are fully implemented at Level 1 and Level 2:

- Nucleus
- Table Handling
- Sequential Input and Output
- Relative Input and Output
- Indexed Input and Output
- Sort-Merge
- Segmentation
- Library
- Inter-Program Communication
- Debug
- Communications

*

This appendix specifies the implementation of L/II COBOL. The implementation of each of the eight standard COBOL modules listed above is given under the following headings as applicable:

<u>Level 1 Implementation</u>
<u>Level 2 Implementation</u>
<u>L/II COBOL Extensions</u>

Appendix F in this manual is a L/II COBOL syntax summary.

NUCLEUS

Level One Implementation

Fully implemented to Level Two.

Level Two Implementation

Fully implemented to Level Two.

L/II COBOL Extensions

1. Lower case letters a to z are read as upper case letters A to Z.

2. Hexadecimal binary values can be attributed to non-numeric values by expressing literals as X"nn".

3. Reserved word SPACE can be used to clear the whole CRT screen.

4. The ANSI switch unset enables omission of certain ANSI required "red tape" paragraphs and statements.

5. COMPUTATIONAL-3 or COMP-3 can be specified in the USAGE clause to specify packed internal decimal storage, (BCD).

6. ACCEPT data-name-1 $\left[\text{AT}\left\{\begin{array}{l}\text{data-name-2}\\ \text{literal-1}\end{array}\right\}\right]$ FROM CRT

   gives enhanced CRT input features

7. DISPLAY $\left\{\begin{array}{l}\text{data-name-1}\\ \text{literal-1}\end{array}\right\}\left[\text{AT}\left\{\begin{array}{l}\text{data-name-2}\\ \text{literal-2}\end{array}\right\}\right]$ UPON$\left\{\begin{array}{l}\text{CRT}\\ \text{CRT-UNDER}\end{array}\right\}$

   gives enhanced CRT output facilities.

8. 'CURSOR IS data-name' can be specified in SPECIAL-NAMES and 'data-name' in WORKING-STORAGE section to specify CRT cursor address for ACCEPT statements

9. The function names SYSIN, SYSOUT and TAB can be assigned to user specified mnemonic-names in the SPECIAL NAMES paragraph. SYSIN and SYSOUT are equivalent to ACCEPT and DISPAY from and to CONSOLE respectively. TAB is used with the WRITE statement to printer to throw a page. A directive is available in the compiler command line to alter these function names if they are already used in your COPOL program for other purposes.

   In addition the following IBM type extensions are incorporated. Extensions numbered 1 and 2 below are always active unless the ANSI switch directive is set in the compiler command line. Extension number 3 takes effect only when the directive IBM is used in the compiler command line.

1. Redefinition of data names need not be the same length - the compiler reserves the largest area.

2. Level numbers need not be specified in sequence. Thus:
   01 - - - -
   03 - - - -
   02 - - - -
   will be valid - with 03 being treated as if it were 02.

3. Introduction of FILLER group items.

SEQUENTIAL, RELATIVE AND INDEXED I-O

Level One Implementation

Fully implemented to Level One.

Level Two Implementation

Fully implemented to Level Two.

L/II COBOL Extensions

1. Run Time allocation of file-names. See Appendix F in Operating Guide.

2. LINE SEQUENTIAL is an additional file type.

3. All File Description (FD) clauses are optional when the ANSI switch is unset.

4. Tabbing is available, specified by TAB in the WRITE statement. (See note 9 under NUCLEUS L/II COBOL Extensions above.

TABLE HANDLING

Level One Implementation

Fully implemented to Level One.

L/II COBOL Extensions

Fully implemented to Level Two.

SEGMENTATION

Level One Implementation

Fully implemented to Level One

Level Two Implementation

Fully implemented to Level Two.

LIBRARY

Level One Implementation

Fully implemented to Level One

Level Two Implementation

Fully implemented to Level Two.

DEBUG

Level One Implementation

Fully implemented to Level 1.

Level Two Implementation

Fully implemented to Level Two (plus an additional Interactive Run-Time Debug package, and an optional COBOL oriented interactive debugging package known as ANIMATOR).

L/II COBOL Extensions

A powerful Run-Time Debug package is available. See Chapter 3 in the L/II COBOL Operating Guide. A very powerful COBOL oriented debugging package known as ANIMATOR is also available complete with documentation.

INTER-PROGRAM COMMUNICATION

Level One Implementation

Fully implemented to Level One.

Level Two Implementation

Fully implemented to Level Two.

SORT-MERGE

Level One Implementation

Fully implemented to Level One.

Level Two Implementation

Fully implemented to Level Two.

COMMUNICATIONS

Level One Implementation

Fully implemented to Level One.

Level Two Implementation

Fully implemented to Level Two.

APPENDIX J

IBM EXTENSIONS

The following IBM extensions are implemented in the Full L/II COBOL product:

1. "ID" is a synonym for "IDENTIFICATION".

2. In redefinition of data names the areas need not be the same size: the compiler allocates space for the largest.

3. Level number rules are relaxed so that they need not be declared in ascending sequence e.g.:

```
01  ...
    03  ...
    02  ...  is allowed
```

4. FILLER items can be grouped e.g.:

```
03  FILLER
    04  ...
```

5. Apostrophe (Hex 27) can be used in place of quote to delimit alphanumeric literals.

These LEVEL II extensions are only allowed if the ANSI switch is unset in the compiler command line (see the L/II COBOL Operating Guide).