IBM

Reference Manual

IBM 7080 Programming Systems

7080 Processor: Autocoder Language

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PREFACE

This manual contains detailed specifications that permit program coding using Autocoder, the basic symbolic language of the 7080 Processor. All parts of the language, except macro-instructions, are fully described in this publication. The IBM-distributed general purpose macro-instructions, a brief introduction to which is provided in this manual, are explained in the manual, "7058 Processor: General Purpose Macro-Instructions," Form C28-6130, as updated by the bulletin, "7080 Processor: General Purpose Macro-Instructions," Form J28-6266. The method by which new macro-instructions can be written for incorporation into the language is covered in the manual, "7080 Processor: Preparation of Macro-Instructions," Form C28-6264.

Just as the Autocoder described in this manual is the basic language of the 7080 Processor, so is Autocoder III the basic language of the predecessor system, the 7058 Processor. The over-all similarity of the two languages is such that this manual has been modeled after the manual describing Autocoder III. The major improvements in 7080 Autocoder that distinguish it from Autocoder III have been fully integrated into the following pages and may not be apparent, even to longtime users of Autocoder III. Despite this, no attempt has been made in the body of the manual to call attention to the differences, since to do so might prove distracting, particularly to readers without a background in Autocoder III. However, significant differences have been summarized in the Appendix for the convenience of experienced programmers who want to rapidly survey 7080 Autocoder in the light of their knowledge of Autocoder III. But it is expected that every programmer, before writing programs in 7080 Autocoder, will have become familiar with all sections of this manual.

The introduction to this manual assumes that the reader has had little experience in programming. Readers already familiar with the IBM 7080 Data Processing Systems may wish to go directly to Chapter 1. Information on this system may be found in the manuals listed below:

General Information Manual, "7080 Data Processing System," Form D22-6512.

Reference Manual, "7080 Data Processing System," Form A22-6560.

This explanation is written for the inexperienced programmer. The material is not detailed and not comprehensive in scope; it is an outline of basic program requirements, symbolic programming languages, and the program assembly process. These concepts are considered within the framework of the IBM 7080 Data Processing and Programming Systems.

BASIC ASPECTS OF PROGRAMMING

A program is written in order to process data in a specified manner. In commercial data processing, most of the data is in the form of business records, e.g., accounts receivable, sales records, inventories, payrolls, etc. Although the main function of a program is to process these records as specified, the program does not consist solely of record-processing routines. These may be considered the body of the program and are often called the main-line routines or the main-line coding.

Any program must include routines for bringing the records to be processed into core storage and for taking the processed records out of storage. The routines which handle this data movement are called input/output or I/O routines. Although records and programs may be stored on magnetic tape or punched cards, magnetic tape is generally used with large-scale data processing systems.

A program must also contain actual storage locations for each instruction as well as locations for the area or areas the records will occupy. Records are usually grouped in blocks; consequently, an entire block enters storage. Similarly, the processed records are reblocked in storage before being placed on tape. Programs dealing with blocked records generally reserve space for separate input and output areas, the areas being equal to the size of the record block. In this case, a work area equal to the size of one record must also be reserved so that each record can be taken from the input area, moved to the work area for processing, and then placed in the output area. The processing instructions can then be addressed to the work area and do not have to be modified. If the records were to be processed in the input area, the instructions would have to be modified to operate on each record in turn. Consequently, most programs must reserve space for input, output, and work areas.

Certainly, a program must also provide routines for detecting and handling error conditions resulting from I/O operations. Such routines may reread or rewrite the records in error, place the invalid records on a special tape, attempt to determine whether or not the error is in the tape itself, etc. Error detection routines may include the procedure to be executed when an error condition prevents the continuation of processing.

Finally, there are supplementary procedures which must be performed by all programs but which are not directly connected with the main-line processing. They fall into no specific category, although they might be described as procedures which implement the operation of the program. Those which are executed before any main-line processing begins are called housekeeping routines; those which are executed after all main-line processing is completed are called end-of-job routines. Housekeeping operations include such procedures as readying input/output units, setting ASUs, checking and writing tape identifications, and bringing the first block of records into storage. End-of-job routines include such procedures as moving the last block of records from storage to tape, writing tape identifications, rewinding tapes, and writing messages.

To sum up, a program must incorporate at least the following procedures:

1. Data processing
2. Input/output
3. Storage assignments
4. Error detection and correction
5. Housekeeping and end-of-job

SYMBOLIC PROGRAMMING SYSTEMS

A program may be written in the actual (i.e., machine) language of the computer on which it will run, or it may be written in a symbolic language. If it is written in machine language, it can be executed by the computer directly, but if it is written in symbolic language, it must first be translated into machine language before it can be executed. The length and complexity of programs today makes programming in machine language extremely difficult and results in programs which are increasingly liable to error. However, powerful symbolic programming systems have been developed to relieve the programmer of the many burdens involved in machine language programming. A symbolic programming system consists of a symbolic language and a processor. The language provides a method of representing program functions as a series of meaningful statements rather than as a collection of alphameric codes and actual storage locations. The processor converts the symbolic language program into a machine language program, assigns storage locations to the program, and performs various other functions. The symbolic language program is generally called the source program; the machine language program is called the object program. In other words, the source program is the input to the processor, and the object program is the output of the processor.

Thus, processing the data for which a program is written becomes the second of two data processing applications. The first application is the processing or conversion of the source program itself, with the object program as output. The second application is the processing of the actual data by the object program; the output of the second is the solution of the problem for which the program was written. Once the object program is produced, it is used in subsequent data processing applications until it is obsolete or is modified to such an extent that a reassembly is advisable.

Since the programs written in symbolic language need not make location assignments, the order of the statements which compose the program may be changed and the program reassembled without modification. For the same reason, it is easy to insert or delete statements in a symbolic language program. When it is reassembled, a new object program is produced.

The Symbolic Language

Instructions form a major portion of the statements in a symbolic language program just as they do in a machine language program. A symbolic one-for-one instruction contains a mnemonic code representing a machine operation and a symbolic address representing the storage location of data or an instruction. Such instructions are called one-for-one because the processor replaces each one with one machine instruction. An important development in symbolic programming is the macro-instruction, a source program statement which is eventually replaced by more than one machine instruction. Essentially, it is a request for several one-for-one instructions, each of which is subsequently replaced by one machine instruction. A macro-instruction also contains a mnemonic code, but the code does not represent any one machine operation. A macro-instruction usually contains more than one symbolic address; each address represents the storage location of data or of an instruction.

Symbolic languages enable the user to write program statements describing the storage areas which will be occupied by program data. On the basis of the information the processor obtains from these statements, it assigns actual storage locations to the data areas. It also uses this information when generating one-for-one instructions to replace macro-instructions which reference these areas. If the data is to be supplied to the area by input records, the statement indicates the size of the area and the type of data which will occupy it. If not, the statement itself supplies the data, which is placed in storage as a constant.

The programmer is also able to create a symbolic address for each data area or instruction. The symbolic address represents the actual storage location to be assigned by the processor, and it provides the means of referencing an area or an instruction. This is done by using the symbolic address as the operand of the instruction which makes the reference. Usually, it is desirable to create symbolic addresses which describe the areas or instructions to which they are assigned. For instance, an address such as "master file" might be assigned to a data area which will be filled by records from the master tape; an address such as "start" might be assigned to the first instruction to be executed, etc. In converting the source program to machine language, the processor replaces each symbolic address with an actual storage location, just as it replaces each mnemonic code with an actual operation code.

The Processor

The processor of a programming system is a machine language program which converts a symbolic language program into machine language. The process of converting is called assembling the program. In other words, a processor assembles a source program into its object program form. During the assembly, the processor makes an analysis of the source program, generates one-for-one instructions to replace each macro-instruction it encounters, inserts any subroutines requested by the program, substitutes machine language instructions for all one-for-one instructions, and assigns storage locations to the object program.

The processor contains a library of macro-instructions and subroutines. Every macro-instruction contains a set of incomplete one-for-one instructions. When a source program macro-instruction is encountered during assembly, the processor determines which of the one-for-one instructions are appropriate, completes those which it selects, and inserts them into the object program. Selection and completion of the appropriate instructions are done on the basis of information from the program analysis made by the processor. The same macro-instruction may be used many times in a program, but the one-for-one instructions generated from it will not necessarily be the same. The variation results from differences in program requirements or data format.

Library subroutines differ substantially from macro-instructions. A subroutine is a fixed set of instructions; these may be one-for-one instructions or one-for-one instructions and macro-instructions. When a request for a subroutine is encountered during assembly, the set of instructions is taken from the library and inserted in the program. The instructions will not vary from program to program unless the subroutine itself contains macro-instructions. The programmer may write macro-instructions and subroutines and add them to the processor library.

The object program is not the only output of the processor. A sequential listing of the source program is also produced. Each program step in the listing is assigned an index number for reference purposes. The one-for-one instructions in the source program are shown with the corresponding machine language instructions and the storage locations assigned to them. The source program macro-instructions are followed by the one-for-one instructions generated from them, the machine language instructions corresponding to the one-for-one instructions, and the storage locations assigned to the instructions. Location assignments are also shown for all record areas and subroutines.

THE BASIC 7080 PROGRAMMING SYSTEM

A programming system has been defined as a symbolic language and a processor. The basic programming system for the 7080 Data Processing System is composed of Autocoder language and the 7080 Processor.

The 7080 Processor

The 7080 Processor, hereafter called "the Processor," is a machine language program which assembles programs written in Autocoder for the 7080. The Processor operates on the 7080 when it is in 7080 mode. The Processor itself is so large that it must operate through a number of inter-related sections or phases. Each phase is a program which performs one or more of the various assembly functions. The phases may be classified as belonging to one of the two portions of the Processor: the compiler and the assembler. The compiler phases analyze the source program in detail, generate Autocoder statements from higher language statements (explained on pages 11-12), and generate one-for-one instructions from macro-instructions. The assembler phases assign storage locations, replace one-for-one instructions with machine language instructions, and create the Processor output.

The output of the Processor consists of the object program in card form and the program listing with related messages. Both are produced on tape. The listing and messages are the minimum assembly documentation. Additional documentation consisting of the Operator's Notebook and/or the Symbolic Analyzer can be requested.

The Operator's Notebook lists the following:

1. Programmed halts and halt loops
2. Titles of and comments on the various portions of the program
3. A list of special 7080 program statements
4. Specific location assignments requested by the program
5. Program switches set up by the Processor at the request of the program

The Notebook is useful to the programmer in debugging the object program and to the console operator during the object program run. The Symbolic Analyzer is an alphabetical list of the symbolic addresses used in the program. Each symbolic address is followed by a list of the instructions which reference it. All may be easily located in the listing because their index numbers are shown. Referencing a field or an instruction, as used in this manual, means specifying the data to be operated on or specifying an instruction to be executed. An Autocoder statement which calls for data movement to a work area references the data and the work area. A statement which causes the program to transfer to an instruction references that instruction.

The Processor library contains a set of general purpose macro-instructions which cover most commercial data processing functions. Programmers may write their own macro-instructions and subroutines and may insert them in the library. However, the preparation of macro-instructions is a complicated procedure requiring a thorough knowledge of Autocoder and the Processor.

Autocoder Language

Autocoder is the basic symbolic language for programs to be assembled by the Processor. Statements written in the higher languages may be inserted in Autocoder programs. During the assembly, certain phases of the Processor translate these statements into a series of Autocoder statements. Program steps written in Autocoder language are called statements rather than instructions, because the language contains more than a set of processing instructions. There are six types of Autocoder statements:

1. Area definitions
2. Switch definitions
3. One-for-one instructions
4. Macro-instructions
5. Address constants
6. Instructions to the Processor

AREA DEFINITIONS. Area definitions reserve storage space for data which is supplied either by records or by the programmer. If the space will be occupied by data from records, the area definitions also describe the nature of the data. If not, the area definitions specify the constant data to be placed in storage. The storage space reserved by each area definition is generally called a data field. Area definitions may also be used to indicate that a series of adjacent data fields are to be treated as the interior portions of a single unit.

For input/output areas, it is usually necessary to define a data field for a block of records without making any attempt to distinguish one record from another or to identify portions of a record. However, in defining the work area, the opposite is true. Since an individual record will be moved into the work area, it is usually defined as a series of data fields which correspond to the various portions of the record.

Suppose that each record in a file contains the name and yearly salary of an employee and that these records are on tape in blocks of ten. Processing consists of updating the yearly salary. The input (and the output) area is defined as one data field, although it will contain ten records. However, the work area to which each record is moved for processing is defined as two data fields, one for the employee's name, and one for the employee's yearly salary. Only the salary field is referenced by processing instructions, but the entire record is referenced as a unit when it is moved to or from the work area. Consequently, the work area must actually be defined as a data field consisting of two interior fields.

SWITCH DEFINITIONS. Switch definitions describe three types of switches: data, program, and console. All three may be used to control the path of the program, e.g., to determine whether or not all the routines in the program will be executed, to determine the sequence in which routines will be executed, etc.

Data Switch. A data switch is a data field in which alphameric codes are placed. The definition of the switch allows a meaning to be associated with each code. When a data switch is defined as a portion of a record area, the records supply the codes for the switch.

When a data switch is defined independently of a record area, the program itself supplies the codes.

In the employee records used as an example in the section on area definitions, suppose now that each record consists of three fields: name, yearly salary, and number of exemptions of the employee. The work area is defined by area definitions for the name and yearly salary fields and a switch definition for the exemption field. In this case, the codes in the data switch would be numeric characters. The manner in which each record is processed depends on the number of exemptions; therefore, the program contains a number of processing routines. As each record is placed in the work area, the data switch becomes whatever character the exemption field contains. The program tests the switch to determine what code is present and then transfers to the processing routine appropriate for that code.

Program Switch. A program switch is an instruction which causes the program either to continue sequentially or to transfer. When a program switch is ON, the program transfers to an out-of-line instruction. When a switch is OFF, the program executes the next in-line instruction.

Suppose that it is desired to type a message if a certain error condition is detected. The program switch is defined so that when it is OFF, the program proceeds to the next instruction, but when it is ON, the program transfers to the message-writing routine. Initially, the switch is set OFF; as long as it remains OFF, the program continues through the switch to the following instruction. If the error-detection routine encounters the error condition, it sets the switch ON; then, when the program reaches the switch, it transfers to the message-writing routine.

Console Switch. A console switch is one of the six alteration switches on the console. They are numbered 0911-0916, and they must be set manually by the console operator. Console switches are useful when it is desired to execute a routine only for certain object runs. For example, a program which is run each week may include a routine which should be executed only at the end of the month. If a console switch is defined, the program may test the switch and transfer to the end-of-month routine when the switch is ON. The console operator must, of course, set the switch ON prior to each end-of-month run.

ONE-FOR-ONE INSTRUCTIONS. One-for-one instructions are the symbolic equivalents of machine instructions. Coding any portion of a program in one-for-one instructions means much more hand-coding for the programmer than coding the same portion in macro-instructions. This also increases the possibility of error. One-for-one instructions should be used only when it is inadvisable to use macro-instructions.

MACRO-INSTRUCTIONS. A macro-instruction is a powerful programming device; essentially it is a request for those one-for-one instructions which will accomplish the function stated by the macro-instruction. These instructions are selected to suit the characteristics of the data fields and/or the other hand-coded instructions referenced by the macro-instruction. The field characteristics are obtained from the field definition analysis made by the Processor. Whenever a choice exists among the one-for-one instructions to be generated, the Processor selects the most efficient coding.

As an example of the scope of a macro-instruction, the basic coding generated from the ADDX macro-instruction adds the contents of two numeric fields and stores the result in a field designated as the result field. But, if the result contains more decimal positions than the number specified in the result field definition, the generated coding includes instructions either to round or to truncate the excess positions before the result is stored. The choice depends on which process the programmer specifies in the macro-instruction. Also, if the result contains more integer positions than the number specified in the result field definition, the generated coding includes instructions to truncate the excess high-order positions before the result is stored. However, the programmer may request an option which generates instructions to do the following: truncate the excess positions if they contain zeros and store the result; transfer to a routine designated by the programmer if they do not contain zeros. This entire procedure, which obviously involves many one-for-one instructions, is generated from one macro-instruction.

ADDRESS CONSTANTS. An address constant contains the symbolic address of a data field or an instruction. During the program assembly, a constant is created from the actual location assigned to the field or instruction. Address constants are used to initialize an instruction. Initialization is the process of supplying a reference to an instruction which lacks one or replacing the reference made by an instruction. An instruction makes a reference by designating the symbolic address of a data field or an instruction. The symbolic address designated by an address constant is used to initialize the instruction.

Suppose that an input area contains a block of records, each of which must be moved from the area in succession. The input area is given a symbolic address so that the area can be referenced by the instruction which moves the records. Initially, the instruction has as its address portion the symbolic address of the area, thus referencing the first record in the area. However, the instruction's address portion must be modified before it can reference successive records; the modification is generally an increment equal to the size of one record. Eventually, the input area is emptied, and a new block of records is placed in it. But the modified instruction no longer references the first record. At this point, it is necessary to initialize the instruction, that is, to return the instruction to its original form, by means of an address constant. Assume that the address constant has been coded and that it consists of the symbolic address of the input area. Now the address constant can be placed in the address portion of the modified instruction. Once the instruction is initialized, it references the first record in the area again.

INSTRUCTIONS TO THE PROCESSOR. Instructions to the Processor allow the programmer to control certain aspects of the assembly process and to take advantage of the special features of the Processor. The Processor instructions are written as Autocoder statements in the program. When they are encountered during assembly, the Processor performs the operations they request. Instructions to the Processor concern the following aspects of the assembly:

1. The listing of the program
2. Location assignments made by the Processor
3. Coding generated by the Processor

INPUT/OUTPUT SYSTEMS FOR USE WITH AUTOCODER PROGRAMS

Input/Output Control Systems (IOCS) have been developed for the IBM 7080. IOCS consists of a group of routines which handle all input/output functions. These routines are made available to an Autocoder program when IOCS macro-instructions in the Processor library are used in the program. The following IOCS publication is available:

"7080 Input/Output Control System for use with 729 Magnetic Tape Units," Form C28-6237.

HIGHER LANGUAGES OF THE 7080 PROCESSOR FOR USE WITH AUTOCODER PROGRAMS

As mentioned earlier, the 7080 Processor accepts program statements written in several higher languages. The languages are: Report/File Writing; Decision; Arithmetic; Table-Creating. Various Processor phases translate each of these statements into one or more Autocoder statements.

FORTRAN is the name for FORmula TRANslation language. As the name implies, complex problems can be stated in formula form using FORTRAN. Both fixed point and floating point calculations are possible.

Report/File Writing language is a set of statements which may be used to describe the format and contents of a report or file. The routine generated from these statements will create the report or file.

Decision language is one statement. It requests a logical decision to be made on the basis of a test of the various conditions supplied in the statement.

Arithmetic language, also one statement, requests a series of mathematical computations to be performed on the elements supplied in the statement.

Table-Creating language consists of a statement which requests the creation of a table from a set of data. The data itself must accompany the Table statement.

The following higher language publications are available:

1. "FORTRAN," General Information Manual, F28-8074-1.

2. "7058 Processor: Decision, Arithmetic, and Table-Creating Languages," Reference Manual, C28-6226.

3. "7058 Processor: Report/File Language," Reference Manual, J28-6234.

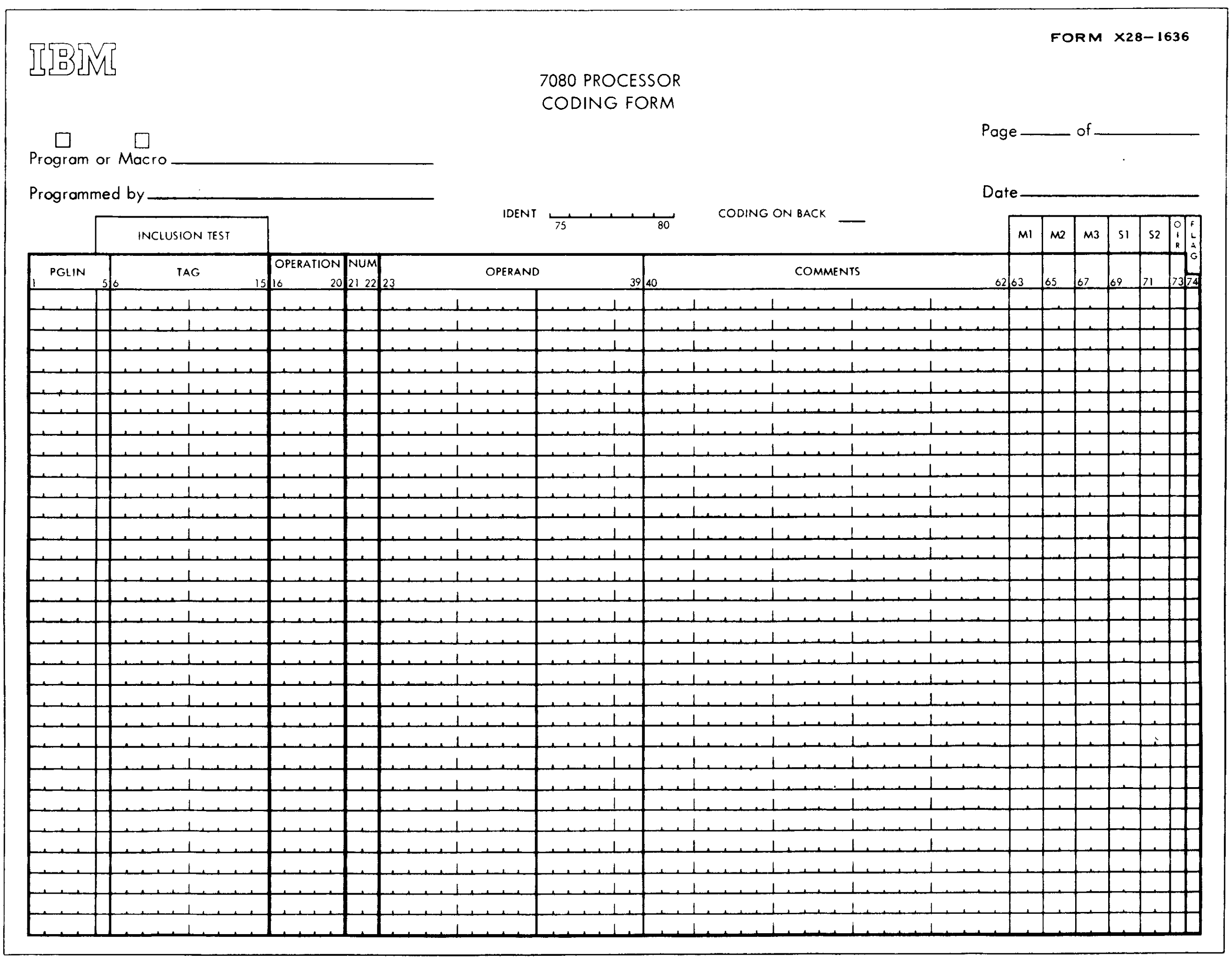
An Autocoder program is written on the IBM 7080 Processor Coding Form, Form X28-1636, shown in Figure 1. One card is punched for each line of the coding sheet. The card designed for Autocoder programs is the IBM Autocoder System Card, Electro 623-111. An Autocoder statement is formed by filling out the appropriate fields on the sheet according to the specifications for the type of statement being written. Some statements may occupy more than one line. The term "field" applies to the character positions included under each heading on the program sheet. The position numbers listed with the field headings correspond to the columns on the card. The lower row of field headings (including "Flag") define the fields for source program statements. The upper headings list special fields that are used in the preparation of user-written macro-instructions.

PROGRAM IDENTIFICATION (COLUMNS 75-80)

The identification is filled in at the top of the coding sheet. It should appear in columns 75-80 of every card punched for an Autocoder statement.

PGLIN (COLUMNS 1-5)

The sequence of the coding sheets and the statements on the coding sheets is designated by the five-position number in these columns. Columns 1 and 2 designate a two-position page number that is used to determine the sequence of the coding sheets. Any alphameric character may be used in the number. Normally, however, special characters are not used. The IBM 7080 collating sequence, shown in Figure 2, is used to determine the order of the pages.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FORM X28-1636

7080 PROCESSOR
CODING FORM

☐ Program or ☐ Macro ____________

Programmed by ____________

Page ____ of ____

Date ____________

IDENT (75–80)   CODING ON BACK ___

PGLIN 1–5	TAG 6–15 (INCLUSION TEST)	OPERATION 16–20	NUM 21–22	OPERAND 23–39	COMMENTS 40–62	M1 63	M2 65	M3 67	S1 69	S2 71	OIR 73	FLAG 74

Figure 1

Blank . ⌑ ⧧ & $ * - / , % # @ $\overset{+}{0}$ A through I $\bar{0}$ J through R ǂ S through Z 0 through 9

Figure 2. IBM 7080 Collating Sequence

Columns 3 to 5 designate a three-position line number that is used to determine the sequence of the statements on the coding sheets. On the front of each sheet, the first two positions are pre-numbered; any alphameric character may be used in the last position, although special characters are not used normally. Ordering should be done according to the 7080 collating sequence. It is recommended that column 5 be left blank except when designating the sequence of insertions.

The back of each sheet may be used for insertions. The insertion page number should be the page number of the statement the insertion is to follow. The insertion line number should be higher than that of the statement preceding the insertion and lower than that of the statement following the insertion. For example, a three-line insertion may be required between two statements numbered 03b and 04b (b represents a blank). The insertions might be numbered 031, 032, and 033, or they might be numbered 03A, 03B, and 03C.

TAG (COLUMNS 6-15)

A tag is the symbolic address which represents the actual location of a data field or an instruction. The field is filled in starting in column 6. When an Autocoder statement references a tag, it refers to the data field or the instruction at the storage location represented by the tag. During assembly, all fields and instructions are assigned storage locations, and all references to tags are replaced with the locations assigned to the tags.

A tag may contain up to ten characters; these may be alphabetic and/or numeric and blanks. A tag may not contain special characters. If composed of numeric characters only, a tag must consist of five or more characters. It is recommended that tags not start with one or more blanks, because the Processor must left-justify them, a time-consuming operation. It is also recommended that pure numeric tags not be used. It is best to create tags which describe the data fields or the instructions to which they are assigned. Tags should not be assigned unless they are referenced by program statements; because unnecessary tags slow the assembly process and produce needless messages.

OPERATION (COLUMNS 16-20)

The mnemonic code of the Autocoder statement is placed in the operation field, starting in column 16. No machine operation code can be used.

NUMERIC (COLUMNS 21-22)

The use of the numeric field varies according to the type of Autocoder statement being written. A one-position entry is placed in column 22.

OPERAND (COLUMNS 23-39)

The use of the operand field varies according to the type of Autocoder statement being written. The field is filled in starting in column 23, and the entry may be continued into the comments field. Macro-instruction operands may be continued from the comments field of one line into the operand and comments fields of succeeding lines of the coding sheet.

COMMENTS (COLUMNS 40-73)

Additional information about an Autocoder statement may be written in the comments field and will appear in the program listing. Comments are useful for explaining the purpose of program statements. The field can begin before or after column 40. The comments may be continued in the comments field on subsequent lines of the coding sheet; there is no limitation on the number of comments continuation lines.

The rules governing comments and comments continuations vary according to whether or not the comments accompany a macro-instruction. If they do, they must be separated from the operand by a minimum of two blank spaces whether the operand terminates in the operand field or continues into the comments field. The comments continuation lines for macro-instructions may not contain entries in any fields except pglin and comments.

If the comments do not accompany a macro-instruction, they do not have to be separated from the operand by blank spaces, and comments continuation lines may contain entries in any columns except 16 (first position of the operation field) and 21-22 (numeric field). However, to make the comments easier to read, it is recommended that the continuation lines be restricted to entries in the pglin and comments fields.

FLAG (COLUMN 74)

Characters written in this column are used for communicating with the Processor. The types of characters that may be placed in this column (and an explanation of their meanings) are described in Chapter 7, "Instructions to the Processor."

Area definition statements describe data fields; the data may be variable data supplied by records or constant data supplied by the area definition statement. The programmer must know the length and composition of the records so that each field may be defined correctly. The Processor uses the information provided by area definitions when it reserves storage space for the fields and when it encounters instructions which reference the fields.

There are five types of area definitions:

1. Definition of a Record - RCD
2. Definition of a Constant Factor - CON
3. Definition of a Floating Decimal Point Number - FPN
4. Definition of a Report Format Field - RPT
5. Definition of a Continuous Portion of Memory - NAME

An area definition statement must contain a tag if the field is to be referenced. The reference is made by using this same tag in the operand of the Autocoder statement making the reference. Since the tag requirement applies to all area definitions, the tag field will not be discussed separately in the remainder of this chapter.

DEFINITION OF A RECORD - RCD

The function of an RCD statement is to define a data field in which a record block, an individual record, or a portion of a record will be placed. The definition specifies the size of the field and the nature of data it will contain. The RCD statement is written as follows:

OPERATION FIELD. The mnemonic code RCD is placed here. In a continuous series of RCD statements, only the first need contain the mnemonic code. The Processor assumes that each immediately subsequent statement with a blank operation field is an RCD and treats it accordingly. This assumption makes it possible in subsequent statements to use columns 17-20 of the operation field as an expansion of the numeric field. (The operation field is assumed to be blank if column 16 is blank.)

NUMERIC FIELD. The size of the data field is entered here. A one-digit entry is placed in column 22 and need not be preceded by a zero. When the operation field contains the RCD code, the numeric field is limited to a two-digit entry. However, when the operation field is blank and the statement has been preceded by another RCD statement, columns 17-20 of the operation field may be used as an expansion of the numeric field. Under these conditions, in effect, the numeric field consists of six positions. Thus, data fields which exceed 99 positions may be defined, but they may not be the first in a series of RCD statements.

OPERAND FIELD. The operand field contains one of the following:

1. A descriptive code. This is used to define alphameric fields or numeric fields containing integers only.
2. A description of an integer and decimal format. This is used to define numeric fields containing mixed or pure decimals.
3. A layout of group marks and/or record marks. This is used to describe the position of group marks and/or record marks in a field.

<u>Alphameric Fields and Numeric Fields of Integers Only.</u>

Code	Contents of Field
+	Signed numeric data consisting of integers. The field may not exceed 99 positions if it is to be referenced by a general purpose macro-instruction.
N	Unsigned numeric data consisting of integers. The field may not exceed 99 positions if it is to be referenced by a general purpose macro-instruction.
F	Signed numeric data in floating point form. The field must consist of ten positions: a two-character exponent, signed in the low-order position, followed by an eight-character mantissa, also signed in the low-order position. This is the form in which a floating decimal point constant appears in storage. See page 19 for further explanation.
A	Alphameric data which may or may not provide left protection for the immediately subsequent field.
A+	Alphameric data which always provides left protection for the immediately subsequent field.

Left protection must be provided when the subsequent field contains signed numeric data and is referenced by a macro-instruction having an arithmetic function. The low-order position of the field providing left protection must be occupied by one of the following: an alphabetic character, a signed numeric character, a blank, or any special character.

Figure 3 shows fields defined with descriptive codes. Notice that the final field cannot be referenced, because it is not tagged.

TAG	OPERATION	NUM.	OPERAND
UNSIGNED	RCD	8	N
ALPHAFIELD	1	25	A+
SIGNED		13	+
FLOAT		10	F
	1.2	00	A

Figure 3

Numeric Fields Containing Mixed or Pure Decimals. The operand must indicate the number of integer and decimal positions in the field and whether the field is signed or unsigned. This may be done in either of the following ways, although the first method is the preferred use:

1. Enumerating the number of integer and decimal positions. Signed numeric fields are represented as #+xx.yy, and unsigned numeric fields as #bxx.yy, where xx and yy represent the number of integer and decimal positions respectively (b represents a blank position). If there are no integer positions, xx is written as 00. If there are less than ten positions on either side of the decimal point, the numeric digit is preceded by a zero. The sum of xx and yy must equal the entry in the numeric field. The maximum size data field which can be defined consists of 99 integer and 99 decimal positions.

2. Showing a layout of the integer and decimal positions. Each integer and decimal position is indicated by an X, with a decimal point placed in the appropriate position. The layout of a pure decimal starts with the decimal point and is followed by the necessary number of Xs to the right of it. When defining signed numeric fields, a plus sign is placed in the first position of the operand and is followed by the layout. The operand defining an unsigned numeric field starts with the layout itself. A blank position is not used to indicate unsigned numeric data.

The total number of Xs must equal the entry in the numeric field. Although both the decimal point and the sign occupy positions in the layout, neither is included in the count for the numeric field entry. The point itself does not exist in the record nor does the sign exist in the record as a separate position. However, the Processor needs this information for various purposes, such as selecting the proper coding to replace macro-instructions.

The definitions in Figure 4 are paired to show how the same numeric fields would be defined by each of these methods. Note that SIGNED3 is too large to be defined by a layout.

TAG	OPERATION	NUM.	OPERAND
SIGNED1	RCD	8	#+05.03
SIGNED1	RCD	8	+XXXXX.XXX
	≀		
UNSIGNED1	RCD	12	# 11.01
UNSIGNED1	RCD	12	XXXXXXXXXXX.X
	≀		
SIGNED2	RCD	13	#+00.13
SIGNED2	RCD	13	+.XXXXXXXXXXXXX
	≀		
UNSIGNED2	RCD	2	# 00.02
UNSIGNED2	RCD	2	.XX
	≀		
SIGNED3	RCD	73	#+47.26

Figure 4

Indicating the Position of Record Marks and/or Group Marks. This information should be supplied if the record which contains such characters is referenced by a macro-instruction. The position or positions the characters occupy must be defined as one field of the record, unless no other information is to be given about the record. The operand must be a layout of the record portion which contains the characters and may indicate one of the following: a terminal group mark, a terminal record mark, or an internal group mark followed by a terminal record mark. The operand may contain the following symbols only:

ǂ record mark
⧧ group mark
b blank

Figure 5 shows two ways in which the position of a terminal group mark could be indicated in defining a record consisting of 31 positions of data, three blanks, and a group mark.

TAG	OPERATION	NUM.	OPERAND
FIRSTWAY	RCD	31	A
		4	⧧
	≀		
SECONDWAY	RCD	34	A
		1	⧧

Figure 5

If the three blanks had been data, the definition for SECONDWAY would have been used. If the blanks had been group marks, the definitions in Figure 6 would have been used.

TAG	OPERATION	NUM.	OPERAND
NEWWAY	RCD	31	A
		4	⧧⧧⧧⧧

Figure 6

If one or more group marks appear within a record, they may be made terminal by defining them as a separate field and giving the field a tag. Figure 7 shows how the four group marks within a 90-position record may be made terminal by being defined as a separate field.

TAG (6–15)	OPERATION (16–20)	NUM. (21–22)	OPERAND (23–)
FIRSTPART	RCD	30	A+
GROUPMARK		4	≢≢≢≢
SECONDPART		56	A+

Figure 7

Figure 8 shows two ways in which a record terminated by three blanks and a record mark could be defined.

TAG (6–15)	OPERATION (16–20)	NUM. (21–22)	OPERAND (23–)
FIRSTWAY	RCD	21	A
		4	‡
	§		
SECONDWAY	RCD	24	A
		1	‡

Figure 8

If the final blank had been a group mark, the record could have been defined in either of the ways shown in Figure 9.

TAG (6–15)	OPERATION (16–20)	NUM. (21–22)	OPERAND (23–)
FIRSTWAY	RCD	21	A
		4	≢‡
	§		
SECONDWAY	RCD	23	A
		2	≢‡

Figure 9

If all the blanks had been group marks, the record would have been defined as shown in Figure 10.

TAG (6–15)	OPERATION (16–20)	NUM. (21–22)	OPERAND (23–)
FIRSTWAY	RCD	21	A
		4	≢≢≢‡

Figure 10

If a record of less than 51 positions is being defined and it is not desired to give any information about the contents other than the location of group marks and/or record marks, the entire record may be defined by a layout operand. Figure 11 shows the definition of a 20-position record which contains a group mark in the fifteenth position and a terminal record mark.

TAG (6–15)	OPERATION (16–20)	NUM. (21–22)	OPERAND (23–)	
MARKSONLY	RCD	20	≢	‡

Figure 11

COMMENTS FIELD. Comments may be started here. If comments continuation lines are written, columns 16, 21, and 22 of the continuation lines must be blank. If the statement following the last continuation line is blank in column 16 (but is not blank in columns 21 and 22), the Processor assumes that the line is another RCD statement.

Using an RCD of Zero Length

If the first data field in a record exceeds 99 positions, its RCD definition may be preceded by an RCD of zero length. In this way, the definition becomes the second in a series of RCD statements, and the mnemonic code RCD may be omitted for the second. Columns 17-20 of the operation field may then be used as an extension of the numeric field. No space will be reserved for an RCD of zero length.

Restrictions on RCD Statements

The size of a data field may not exceed 159,999 positions. If a single RCD statement specifies a larger field size, the Processor will subtract 160,000 from the specified size and use the remainder as the size of the field when reserving storage space. A message to this effect is provided at assembly time.

Definitions of one or more terminal group marks may not indicate internal record marks or internal group marks. Definitions of a terminal record mark may not indicate internal record marks.

DEFINITION OF A CONSTANT FACTOR - CON

The function of a CON statement is to define a data field which will contain constant data and to provide the constant itself. The data may consist of any combination of alphameric characters and/or blanks. The CON statement is written as follows:

OPERATION FIELD. The mnemonic code CON is placed here. In a continuous series of CON statements, only the first need contain the code in the operation field. The Processor assumes that each immediately subsequent statement which is blank in column 16 of the operation field is a CON and treats it accordingly. This assumption makes it possible in subsequent statements to use columns 17-20 of the operation field as an expansion of the numeric field.

NUMERIC FIELD. The size of the constant is entered here. A one-digit entry is placed in column 22 and need not be preceded by a zero. When the operation field contains the CON code, the numeric field is limited to two positions. However, when the operation field is blank and the statement has been preceded by another CON statement, columns 17-20 of the operation field may be used as an expansion of the numeric field. Under these conditions, in effect, the numeric field consists of six positions. Thus, constants which exceed 99 positions may be defined, but they may not be the first in a series of CON statements.

OPERAND FIELD. The constant is entered here. If the entry in the numeric field is not equal to the number of positions specified in the operand, the Processor will do one of the following:

1. Truncate the excess low-order positions when the numeric field entry specifies fewer positions than those contained in the operand.
2. Supply low-order zeros or blanks when the numeric field entry specifies more positions than those contained in the operand. Blanks will be supplied for alphameric fields; zeros will be supplied for signed numeric fields.

In Figure 12, the numeric field for TAG2 indicates that the constant contains nine low-order blanks.

TAG 6–15	OPERATION 16–20	NUM. 21–22	OPERAND 23
TAG1	CON	5	ABCDE
TAG2		20	THE DATE IS
TAG3		4	A3‡Z

Figure 12

Defining a Numeric Constant. A constant consisting of signed numeric data must contain a plus or minus sign in column 23 of the operand field. If the data is a mixed or pure decimal, the decimal point should be placed in the appropriate position. In storage, the low-order position of the field is signed accordingly. However, neither the sign nor the decimal point is included in the count of field positions for the numeric field entry. A signed numeric constant that exceeds 99 integer or 99 decimal positions should not be referenced by a general purpose macro-instruction.

Unsigned numeric data consisting of integers only is written starting in column 23 of the operand field. Unsigned numeric data consisting of mixed or pure decimals should not be specified as a constant if it is to be referenced by an Automatic Decimal Point macro-instruction, because it will be treated as alphameric data containing a period.

In Figure 13, note the following: the TAG3 constant will appear in storage as 8bbb, the TAG4 constant will appear as 64000 with a plus sign over the low-order zero, and the TAG5 constant will appear as 365 with a minus sign over the 5.

TAG 6–15	OPERATION 16–20	NUM. 21–22	OPERAND 23
TAG1	CON	4	+75.25
TAG2		3	845
TAG3		4	8
TAG4		5	+64
TAG5		3	-3.65

Figure 13

Defining a Constant of Record Marks and/or Group Marks. It may be desired to supply a constant of record marks and/or group marks as the terminal field of a record. For example, to follow a 33-position data field with a blank and a record mark, the definition would be written as shown in Figure 14.

TAG 6–15	OPERATION 16–20	NUM. 21–22	OPERAND 23
	RCD	33	A
CONSTANT	CON	2	‡

Figure 14

If a data field containing a 42-position record is to be followed by a constant of two group marks and a record mark, the definitions in Figure 15 would be used:

TAG 6–15	OPERATION 16–20	NUM. 21–22	OPERAND 23
	RCD	42	A
CONSTANT	CON	3	‡‡‡

Figure 15

COMMENTS FIELD. Comments may be started here. If comments continuation lines are written, columns 16, 21, and 22 must be blank. If the statement following the last continuation line is blank in column 16 (but is not blank in columns 21 and 22), the Processor assumes that the line is another CON statement.

Restrictions on CON Statements

A one-position CON statement should be used to supply a plus sign or a minus sign as an alphameric constant. If an alphameric constant consisting of a plus or minus sign followed by numeric characters is desired, a one-position CON statement should be used to define the sign, and another CON should be used to define the numeric characters as an unsigned numeric constant.

DEFINITION OF A FLOATING POINT NUMBER - FPN

The function of an FPN statement is to define a data field for constant numeric data and to provide the data in floating point form. Numeric data should be defined in floating point form when there is a possibility that the limits of the accumulator might be exceeded during arithmetic operations with the data if it were defined in fixed point form.

Floating point form consists of a mantissa and an exponent. The mantissa is a pure decimal with a non-zero high-order digit; the exponent is a number specifying a power of ten. When the mantissa is multiplied by the power of ten that the exponent specifies, the data is produced in fixed point form. The following lists show the same data expressed in both forms.

Fixed	Floating
+9427.38	$+.942738 \times 10^4$
-.3264	$-.3264 \times 10^0$
+.0035	$+.35 \times 10^{-2}$
-623	$-.623 \times 10^3$

The FPN statement is written as follows:

OPERATION FIELD. The mnemonic code FPN is placed here. In a continuous series of FPN statements, only the first need contain the code in the operation field. The Processor assumes that each immediately subsequent statement which is blank in column 16 of the operation field is an FPN statement and treats it accordingly.

NUMERIC FIELD. This is left blank; the Processor assumes 10 positions.

OPERAND FIELD. The exponent and the mantissa, each preceded by a plus or minus sign, are placed here in the following format: ±EE±DDDDDDDD.

The exponent must be a two-position number, as specified by EE. The sign which precedes the exponent indicates the direction in which the decimal has been moved in order to convert the data from fixed point to floating point form. The plus sign indicates the decimal has been moved to the left; the minus sign indicates the decimal has been moved to the right.

As indicated by DDDDDDDD, the mantissa may consist of up to eight digits and is preceded by the sign of the number itself. If fewer than eight digits are specified, the Processor will supply low-order zeros to complete the mantissa; if more than eight are specified, the Processor will truncate the excess low-order digits. When the data is placed in storage, the signs are placed over the low-order positions of the exponent and the mantissa.

Figure 16 shows a list of fixed point numbers, their corresponding FPN definitions, and the constants that would be created from them.

COMMENTS FIELD. Comments may be started here. Comments continuation lines are not allowed. Any continuation line following an FPN is assumed to be another FPN.

Restrictions on FPN Statements

The absolute value of the exponent may not exceed 99. An exponent of 00 is signed +.

FPN definitions may not be referenced by any Automatic Decimal Point macro-instructions. The programmer must provide his own macro-instructions and/or subroutines in order to calculate with floating point numbers, because the Automatic Decimal Point macro-instructions calculate with numeric data in fixed point form only.

DEFINITION OF A REPORT FORMAT - RPT

The function of an RPT statement is to define a data field for numeric data which will be printed in a report and to specify the print format for the data. The RPT field may be referenced by macro-instruc-

Fixed Point Form	TAG (6–15)	OPERATION (16–20)	NUM. (21–22)	OPERAND (23)	Constants Placed in Storage
1. +589.46782		FPN		+03+58946782	1. $0\overset{+}{3}5894678\overset{+}{2}$
2. +.0025				-02+25	2. $0\overset{-}{2}2500000\overset{+}{0}$
3. -4327.9				+04-43279	3. $0\overset{+}{4}4327900\overset{-}{0}$
4. -.063				-01-63	4. $0\overset{-}{1}6300000\overset{-}{0}$
5. -.4792				+00-4792	5. $0\overset{+}{0}4792000\overset{-}{0}$
6. +17482.18936				+05+1748218936	6. $0\overset{+}{5}1748218\overset{+}{9}$

Figure 16

tions which place the numeric data in the field and supply the elements of the desired format. The following elements may be specified in the definition:

1. Commas and/or a decimal point
2. Fixed or floating dollar sign
3. The printing or suppressing of leading zeros
4. Asterisk protection
5. Indication of the numeric field sign
6. The blanking of a field of zeros

The RPT statement is written as follows:

OPERATION FIELD. The mnemonic code RPT is placed here. In a continuous series of RPT definitions, only the first need contain the code. The Processor assumes that each immediately subsequent statement which is blank in column 16 of the operation field is an RPT statement and treats it accordingly.

NUMERIC FIELD. The size of the RPT field is entered here. All positions of the format, as shown by a layout in the operand field, must be counted. The count consists of the positions for the numeric data and any commas, decimal points, dollar signs, and positions reserved for printing the sign of the field.

OPERAND FIELD. The layout of the report format is started here; it consists of the symbols used to define the numeric characters, and the symbols for a dollar sign, a comma, and a decimal point if any are used. The layout may also contain one or two blank positions reserved for printing the sign of the field. Usually, the layout is followed by a set of indicators which provide the macro-instructions with additional information about the desired print format. In explaining the method of laying out the format, three sets of data will be used as examples throughout this section: the first consists of four integer and two decimal positions; the second consists of three decimal positions; the third consists of five integer positions.

Indicating Numeric Characters, Commas, Decimal Point. Xs and Zs are used to indicate the position of each numeric character in the format. If commas and/or a decimal point are desired, the symbols for them are placed in the appropriate positions. The numeric positions of the format are defined as follows:

1. Decimal positions. Zs must be used to define all decimal positions. Any trailing, i.e., significant, zeros in the data entering these positions will be retained and printed.

2. Integer positions. Xs and/or Zs may be used to define integer positions. The treatment of any leading, i.e., insignificant, zeros in the data entering these positions depends on whether the position in which the zero occurs is defined by a Z or an X. If the position is defined by a Z, the zero will be retained and printed; if it is defined by an X, the zero will be converted to a blank. Xs may be used to the left of Zs but not to the right of them. If the format layout does not contain a decimal point, the Processor assumes that a field of integers is being defined.

In Figure 17, the MIXED and INTEGER definitions indicate that any leading zeros are to be replaced by blanks. Notice that no decimal point is specified in the INTEGER field.

TAG 6–15	OPERATION 16–20	NUM. 21–22	OPERAND 23
MIXED	RPT	8	X,XXX.ZZ
DECIMAL		4	.ZZZ
INTEGER		5	XXXXX

Figure 17

If 004320 were placed in the MIXED field defined in Figure 17, it would be printed as bbb43.20 (the comma having been replaced by a blank).

The MIXED and INTEGER fields are redefined in Figure 18 so that leading zeros will be retained. The MIXED definition requests that leading zeros which occur in the two low-order integer positions be printed. The INTEGER definition requests that leading zeros be printed in all but the high-order position.

TAG 6–15	OPERATION 16–20	NUM. 21–22	OPERAND 23
MIXED	RPT	8	X,XZZ.ZZ
INTEGER		5	XZZZZ

Figure 18

If 000120 were placed in the MIXED field defined in Figure 18, it would be printed as bbb01.20, and if 00089 were placed in the INTEGER field, it would be printed as b0089.

Leading zeros may also be replaced by asterisks. This is called asterisk protection and is requested by an indicator which is placed immediately after the format layout. The indicator consists of a lozenge, an asterisk, and a lozenge (¤*¤). In Figure 19, the INTEGER field is defined for complete asterisk protection. The MIXED field, however, is defined for asterisk protection only in the positions defined by Xs.

TAG 6–15	OPERATION 16–20	NUM. 21–22	OPERAND 23
INTEGER	RPT	5	XXXXX¤*¤
MIXED		8	X,XXX.ZZ¤*¤

Figure 19

The position of the decimal point can be indicated to macro-instructions which handle numeric data without having the point appear in the printed report. This is done by placing the symbol D in the appropriate position of the layout. The D is not included in the count of positions for the numeric field. This may be seen in Figure 20.

TAG	OPERATION	NUM.	OPERAND
MIXED	RPT	7	X,XXXDZZ
DECIMAL		3	DZZZ

Figure 20

Indicating the Position and Treatment of Dollar Signs. The dollar sign, if desired in the printed report, is written to the left of the high-order position of the format layout and is included in the count for the numeric field. A fixed or floating dollar sign can be specified as part of the print format through indicators which are placed to the right of the format layout. The indicators are surrounded by lozenge symbols (¤) and are not included in the count for the numerical column, because they are not part of the format layout. A fixed dollar sign is printed in the same position for each use of the data in the report.

If a fixed dollar sign with asterisk protection is desired, the format layout is immediately followed by an indicator consisting of a lozenge, an asterisk, and a lozenge (¤*¤). If a fixed dollar sign without asterisk protection is desired, the format layout is not followed by any dollar sign indicators. If any leading zeros occur in the data, they will be maintained or replaced by blanks, depending on whether Zs or Xs are used in the integer positions of the format layout.

A floating dollar sign is shifted so that it is printed to the left of the first numeric character in each set of data. It is requested by an indicator consisting of a lozenge, a dollar sign, and a lozenge (¤$¤) placed to the immediate right of the format layout.

Figure 21 shows one field as it would be defined to request each of the following: a floating dollar sign; a fixed dollar sign with asterisk protection; a fixed dollar sign without asterisk protection and with leading zeros converted to blanks; a fixed dollar sign without asterisk protection and with up to three leading zeros retained; no dollar sign but asterisk protection.

TAG	OPERATION	NUM.	OPERAND
MIXED1	RPT	9	$X,XXX.ZZ¤$¤
MIXED2		9	$X,XXX.ZZ¤*¤
MIXED3		9	$X,XXX.ZZ
MIXED4		9	$X,ZZZ.ZZ
MIXED5		8	X,XXX.ZZ¤*¤

Figure 21

Assume that 003418 and 000570 are placed in each of the fields defined in Figure 21. The definitions would cause the data to be printed as follows:

MIXED1	$34.18	$5.70
MIXED2	$***34.18	$****5.70
MIXED3	$ 34.18	$ 5.70
MIXED4	$ 034.18	$ 005.70
MIXED5	***34.18	****5.70

Note that the commas in MIXED2 and MIXED3 are converted to an asterisk and a blank respectively. In MIXED4, and MIXED5, the comma is converted to a blank.

Indicating Field Signs and Zero Fields. Sets of characters which occupy one or two positions are available for printing either or both of the following in the report:

1. An indication of the sign of the field supplying data to be placed in the RPT field.
2. An indication that the field supplying data consists of zeros.

The requested characters will be printed to the right of the data.

One or two blank positions, depending on which set of characters is requested, must be added to the low-order portion of the format layout and must be included in the count for the numeric field entry. These blank positions are considered part of the layout. The special characters, called field sign indicators, are written to the right of the dollar sign indicator and its accompanying lozenges. Each character is also followed by a lozenge.

At this point, it is necessary to discuss the lozenges which separate the indicators in the RPT operand. Not only are the indicators significant to the Processor, but the presence or absence of the associated lozenges is also significant. When an option is not desired, the indicator which requests it must be omitted. If no subsequent options are to be requested in the same operand, the lozenge associated with the omitted indicator is also omitted. However, the lozenge is retained and placed back-to-back with the preceding lozenge if subsequent options are requested in the operand. The lozenge placement indicates to the Processor which option or options are not desired. A lozenge which may be omitted when its associated indicator and all subsequent indicators are omitted is called a conditional lozenge.

The lozenges associated with the dollar sign indicator are conditional. When a dollar sign is not included in the format layout or when a fixed dollar sign without asterisk protection is desired, no dollar sign indicator is required. The associated lozenges may be omitted unless a field sign is being requested. In this case, the dollar sign lozenges must be placed back-to-back and must precede all field sign indicators and their associated lozenges.

The field sign lozenges are not conditional. If any field sign indicators are used, the lozenge associated with each indicator must be placed after the indicator itself, or must be placed back-to-back with the preceding lozenge when the indicator is omitted.

The full dollar sign and field sign indicator structure is: ¤X_1¤X_2¤X_3¤X_4¤

X_1 is the dollar sign indicator or is omitted. The lozenges are conditional.

X_2 is the negative field sign indicator or is omitted.

X_3 is the zero field indicator or is omitted.

X_4 is the positive field sign indicator or is omitted.

The field sign indicators are as follows (b designates a blank):

1. One-position indicators: b - * +
2. Two-position indicators: b- b* ** CR DR DB

If indicators from the first set are used, one blank position must appear as the final position of the format layout; if indicators from the second set are used, two blank positions must appear as the final positions of the format layout.

The symbols CR, DB, -, and b- may be used for the negative indicator only. The symbols DR and + may be used for the positive indicator only. The other symbols are interchangeable. A blank is generated in the sign position when the condition associated with an omitted indicator is encountered.

It is possible to leave one blank position as the final position of the format layout, use the dollar sign indicator and its lozenges, but omit all field sign indicators and their associated lozenges. In this case, a blank will be generated in the sign position for both zero and positive fields, and a minus sign will be generated for negative fields. If a dollar sign indicator is not desired, the format layout can be terminated with the blank position, which must be included in the count for the numeric field entry.

The definition in Figure 22 requests a floating dollar sign. It also specifies that the minus, asterisk, and plus symbols are to be printed after negative, zero, and positive fields, respectively. One blank position for sign indication terminates the layout.

TAG	OPERATION	NUM.	OPERAND
MIXED1	RPT	10	$X,XXX.ZZ ¤$¤-¤*¤+¤

Figure 22

Assume that the definition in Figure 22 defines the RPT field for the data shown below:

Data Entering RPT Field	RPT Field Printed
03257$\bar{0}$	$325.70-
00000$\overset{+}{0}$	$.00*
45763$\overset{+}{8}$	$4,576.38+

Figure 23 shows a request for a fixed dollar sign with asterisk protection, with the symbol CR printed after negative fields and the symbol DR printed after positive fields. Two blank positions for sign indication terminate the format layout.

TAG	OPERATION	NUM.	OPERAND
MIXED2	RPT	11	$X,XXX.ZZ ¤*¤CR¤¤DR¤

Figure 23

Assume that the definition in Figure 23 defines the RPT field for the data shown below:

Data Entering RPT Field	RPT Field Printed
00395$\bar{5}$	$***39.55CR
00000$\overset{+}{0}$	$*****.00
413675	$4,136.75DR

Note that the symbol D for the decimal point is not included in the count of the format positions in Figure 24. Only the three numeric character positions and the two blank positions for field sign indication are counted. The sign indicators specify that the dollar sign is omitted and that a negative field is to be indicated by two asterisks.

TAG	OPERATION	NUM.	OPERAND
DECIMAL	RPT	5	DZZZ ¤¤**¤¤¤

Figure 24

The definition in Figure 25 allows one position for field sign indication but does not contain a dollar sign or any sign indicators. Consequently, a minus sign will be generated for a negative field, and a blank will be generated for zero and positive fields. The Zs specify that leading zeros are not to be converted to blanks.

TAG	OPERATION	NUM.	OPERAND
INTEGER1	RPT	6	ZZZZZ

Figure 25

Assume that the definition in Figure 25 defines the RPT field for the data shown below:

Data Entering RPT Field	RPT Field Printed
0027$\bar{8}$	00278-
0000$\overset{+}{0}$	00000
3462$\overset{+}{8}$	34628

Figure 26 specifies a floating dollar sign and two asterisks printed to the right of zero fields. All positions of a zero field except the sign positions will be blanked; this includes the dollar sign, comma, and decimal point positions.

TAG	OPERATION	NUM.	OPERAND
INTEGER1	RPT	9	$XX,XXX ¤$¤¤**¤¤

Figure 26

Blank-If-Zero Option. If this is requested, any defined commas, the decimal point, and a floating dollar sign will be blanked along with the numeric positions when the field contains all zeros. Only a fixed dollar sign will not be blanked. To request the option, the symbol BZ is used as the zero field indicator. All five lozenges must be included whether or not BZ is the only indicator used. This option is independent of the other sign options; consequently, when BZ is the only indicator used, it is not necessary to terminate the format layout with any blank positions.

The definition for MIXED1 in Figure 27 specifies only that the field is to be blanked when it contains all zeros. The definition for MIXED2 calls for a fixed dollar sign with asterisk protection, a minus sign following a negative field, and the Blank-If-Zero option. A positive field will be printed without any field sign indication, and the fixed dollar sign will be retained when a zero field is blanked.

TAG (6–15)	OPERATION (16–20)	NUM. (21–22)	OPERAND (23)	
MIXED1	RPT	7	XXXX.ZZ⌑⌑⌑BZ⌑⌑	
MIXED2	RPT	10	$X,XXX.ZZ ⌑*⌑-⌑BZ	⌑⌑

Figure 27

COMMENTS FIELD. Comments may be started here. If comments continuation lines are written, columns 16, 21, and 22 must be blank. If the statement following the last continuation line is blank in column 16 (but is not blank in columns 21 and 22), the Processor assumes that the line is another RPT statement.

Restrictions on RPT Statements

The format layout of an RPT operand may not exceed 51 positions. One and two-position field sign indicators may not be mixed in the same statement.

The number of positions in the format layout must be identical to the entry in the numeric field. If blank positions for sign indication are included in the layout, it is important to see that no more than two blank positions are allocated. The number of commas in the format layout should not exceed nine.

DEFINITION OF A CONTINUOUS PORTION OF MEMORY - NAME

A NAME has two functions which may be used independently of or in conjunction with each other: (1) To identify a series of adjacent data fields as the interior fields of an area so that they may be treated as a unit; and (2) to specify the final digit or digits of the location to which a data field is assigned.

ENCLOSING ADJACENT FIELDS. A NAME statement which identifies fields as interior to an area may be said to enclose the fields. The following Autocoder statements define fields that may be enclosed by a NAME statement:

1. Area definitions: RCD, CON, FPN, RPT, NAME
2. Switch definitions: CHRCD, BITCD
3. Address constants: ACON4, ACON5, ACON6, ADCON

The interior fields of the NAME area may be referenced individually by their tags or referenced as a unit by the tag of the NAME area. For example, a work area may be defined as a NAME area consisting of four interior fields. Each field may be operated on individually, but the fields may also be moved to and from the work area as a unit rather than one at a time.

SPECIFYING A LOCATION. The location requested by the NAME statement is assigned to the high-order position of the immediately subsequent field. The NAME statement specifies what the final digit or digits of the address may be. The next available location which ends in the requested digit or digits is then assigned to the high-order position of the field defined immediately after the NAME statement. Suppose that a 4/9 location is requested, i.e., that the high-order position of the field should be assigned a location ending in 4 or 9, whichever is available first. If 00012 is the last location assigned prior to the request, location 00014 will be assigned; and if 00017 is the last assignment, then 00019 will be assigned. In either case, if a 00 assignment had been requested, 00100 would have been assigned.

The NAME statement is written as follows:

OPERATION FIELD. The mnemonic code NAME is placed here. If a subsequent entry to the NAME contains a blank in column 16 and a valid numeric character (i.e., 0-4, A-C), the entry is assumed to be another NAME statement.

NUMERIC FIELD. This field is left blank if the Processor is to assign the next available location to the NAME.* If a specific address ending is desired, one of these codes is placed in column 22:

Code	Requests Location Ending In
0	0 or 5
1	1 or 6
2	2 or 7
3	3 or 8
4	4 or 9
A	0
B	00
C	000

*For purposes of location assignment, an X in column 22 has the same effect as a blank. However, if an X is used, the Processor will not make the terminal location of the field available for the macro generation phase. (The X is used for generation of higher languages; preferably, it should not be used in Autocoder.)

OPERAND FIELD. This field is left blank when NAME is used only to request a location assignment. When NAME is used to enclose a series of interior fields, the tag of the interior data field which terminates the NAME is placed in the operand field. If an operand is used, the NAME statement itself must be tagged.

The NAME statement in Figure 28 requests the positioning of FIELD1 starting at the first available address ending in 0. The statement also makes four fields interior to STARTNAME by designating the ENDNAME field as the terminal field.

TAG 6–15	OPERATION 16–20	NUM. 21–22	OPERAND 23
STARTNAME	NAME	A	ENDNAME
FIELD1	RCD	4	N
FIELD2	1	25	A+
FIELD3		5	#+03.02
ENDNAME	CON	1	‡

Figure 28

Figure 29 shows NAME used to position the RPT field ANYTAG in the next available address ending in 2 or 7.

TAG 6–15	OPERATION 16–20	NUM. 21–22	OPERAND 23
	NAME	2	
ANYTAG	RPT	7	$ZZZ.ZZ

Figure 29

NAME is used in Figure 30 to identify the interior fields of the area tagged BEGIN.

TAG 6–15	OPERATION 16–20	NUM. 21–22	OPERAND 23
BEGIN	NAME		END
FIELD1	FPN		+03+4.38
END			+02+6.7845

Figure 30

Figure 31 shows a way of creating the constant +12345 in such a way that it will not appear in storage as 1234E (1234$\overset{+}{5}$).

TAG 6–15	OPERATION 16–20	NUM. 21–22	OPERAND 23
ALPHA	NAME		ENDALPHA
	CON	1	+
ENDALPHA		5	12345

Figure 31

COMMENTS FIELD. Comments may be started here. If comments continuation lines are written, columns 16, 21, and 22 must be blank. If the statement following the last continuation line is blank in column 16 (but is not blank in columns 21 and 22), the Processor assumes that the line is another NAME statement.

Information Provided by the Processor

The Processor counts the total number of positions occupied by the interior fields of a NAME area. A message indicating the total will appear in the listing immediately following the entry specified as the terminal field definition.

Internal NAMEs

One or more NAME areas may be made internal to another NAME. The operand of each internal and outer NAME statement must contain the tag of the field which terminates it. Internal NAMEs may be terminated by the same field which terminates the outer NAME, or they may be terminated by fields which are internal to the outer NAME.

In Figure 32, the OUTERNAME is terminated by the CON field ENDOUTER, while INNERNAME is terminated by the RCD field ENDINNER.

TAG 6–15	OPERATION 16–20	NUM. 21–22	OPERAND 23
OUTERNAME	NAME	0	ENDOUTER
FIELD1	RCD	5	+
FIELD2	1	50	A+
INNERNAME	NAME		ENDINNER
FIELD3	RCD	12	A+
FIELD4		7	#+04.03
ENDINNER		1	‡
FIELD5	RPT	10	$XX,XXX.ZZ¤¤
FIELD6	RCD	35	A
ENDOUTER	CON	5	‡‡‡‡‡

Figure 32

In Figure 33, both FIRSTNAME and SECONDNAME are terminated by the RCD field ENDFIRST.

TAG 6–15	OPERATION 16–20	NUM. 21–22	OPERAND 23	
FIRSTNAME	NAME	0	ENDFIRST	
FIELD1	RCD	25	A+	
		5	+	
SECONDNAME	NAME		ENDFIRST	
	RPT	9	$ZZ,ZZZ ¤¤CR¤¤DR¤	
	RCD	5	N	
ENDFIRST		1	‡	

Figure 33

Restrictions on NAME Statements

The number of positions enclosed in a NAME may not exceed 159,999. If the cumulative limit is exceeded, the Processor will subtract 160,000 from the total and use the remainder when developing the message which specifies the size of the NAME area.

Internal NAME statements should not specify location assignments. The operand (i.e., tag of the termination field) of one NAME statement cannot be the tag of another NAME entry.

The NAME statement itself must be tagged if the operand contains a tag.

No more than 32 NAME areas may be defined concurrently.

Switches are programming or hardware devices used to control the path of a program. Three types of switches may be defined: data switches, program switches, and console switches. The statements used for each type are as follows:

1. Data Switches
   a. Character Code - CHRCD
   b. Bit Code - BITCD
2. Program Switches
   a. Switch Set to Transfer - SWT
   b. Switch Set to No Operation - SWN
3. Console Switches
   a. Alteration Switch - ALTSW

With one exception, the format of switch definition statements varies according to the type of switch being defined. The exception is the comments field. Comments about any switch may be started in the comments field of the definition statement. For those switches which must be defined by a set of statements, comments continuation lines may intervene between the first statement and the remaining statements, or the continuations may be placed in the comments fields of the remaining statements.

DATA SWITCHES

A data switch is a data field. There are two types of data switches: character code and bit code. The character code switch provides a method of relating alphameric codes to various meanings or conditions. The bit code switch provides a method of relating the bits which form a storage position to various meanings or conditions. Both character code and bit code switches are described by a set of statements, the first of which is the switch definition statement. It indicates whether a character code or bit code is being defined. The rest of the character code switch statements specify the alphameric codes which may occupy the switch and the condition which each code represents. The rest of the bit code switch statements designate the various bits of the storage position and the condition each bit represents. A character code switch may occupy one or two positions; a bit code switch may occupy only one position.

A record field may be defined as a data switch, and the switch may be interior to a record area defined by a NAME statement. The switch will be set each time a record is placed in the area. If the data switch is not defined as part of a record area, the program itself must set the switch. The way in which the switch is initially set depends on its use in the program. If the switch definition statement follows an RCD, the statement should not specify the initial setting. The Processor reserves storage space for the switch but does not set it to any code. If an initial setting has been specified, the Processor ignores it. However, the switch definition statement that does not follow an RCD should specify an initial setting. The Processor reserves space for the switch and sets it as specified. If the initial setting has been omitted, the Processor sets the switch to a blank.

Program Branch Control macro-instructions are normally used to set the switches ON or OFF or to test their settings. A character code switch is set ON by placing one of the defined codes in it and is set OFF by placing a blank in it. When a character code switch is tested, it is examined to see whether or not a given code is present. If it is, the switch is ON. If the switch contains anything other than the code designated in the test, the switch is OFF. A bit code switch is set ON by setting the designated bits ON and is set OFF by setting the designated bits OFF. When a bit code switch is tested, it is examined to see whether or not the bit designated in the test is ON. If it is, the switch is ON; otherwise, the switch is OFF.

Suppose that statements for a character code switch specify that codes A and B represent the conditions of Surplus and Deficit, respectively. If the switch is tested for the Surplus condition and A is present, the switch is ON. On the other hand, suppose the switch is tested for the Deficit condition. Now, if B is present, the switch is ON. In other words, the data switch must be tested for a condition which has been specified in its definition. If the code which represents the specified condition is present, the switch is ON. Otherwise, it is OFF.

Now suppose that the switch is a bit code switch and that the Surplus condition is represented by turning ON the 1-bit, while the Deficit condition is represented by turning ON the 2-bit. If the switch is tested for the Surplus condition and the 1-bit is ON, the switch is ON. It does not matter whether the 2-bit is ON or OFF, because the test does not specify the Deficit condition. It is possible, although not logical in this example, that the switch be ON for both conditions.

A character code switch may represent only one condition at any time, whereas a bit code switch may represent multiple conditions simultaneously. In each case, the number of ON states for a data switch is equal to the number of codes or bits specified in the switch definition.

Character Code - CHRCD

A character code switch is defined by a series of statements. The first is the CHRCD statement; its function is to define the switch as a character code switch and to specify the size and initial contents of the switch. The statements which follow the CHRCD statement specify the codes and the conditions they represent. The format of the set of statements is as follows:

Tag	Operation	Num	Operand
	CHRCD	n	X_1
T_1			C_1
T_2			C_2
T_3			C_3
etc.			etc.

n — is blank when defining a one-position switch.
is 2 when defining a two-position switch.

X_1 — is the initial contents of the switch or is blank.

T_1, T_2, T_3,... — are the tags of the codes. They specify the conditions the codes represent.

C_1, C_2, C_3,... — are the codes; any alphameric characters may be used. The codes may be composed of one or two characters, depending on what is specified in the numeric field.

If the CHRCD statement immediately follows an RCD statement, the CHRCD operand should be left blank. If the switch does not follow an RCD field, the operand of the CHRCD statement should specify the initial setting; otherwise, a blank will be placed in the switch.

Figure 34 shows a one-position character code switch defined as a portion of a record area. Notice that the switch is enclosed by a NAME statement. The NAME operand indicates that the statement tagged CANCELED terminates the NAME.

TAG	OPERATION	NUM.	OPERAND
RECORDAREA	NAME		CANCELED
COMPANY	RCD	25	A
	CHRCD		
NEW			N
REGULAR			R
CANCELED			C

Figure 34

In Figure 35, the operand of the CHRCD statement specifies the initial switch setting, i.e., that the switch contains the code 18.

TAG	OPERATION	NUM.	OPERAND
	CHRCD	2	18
NEWYORK			10
BOSTON			06
CHICAGO			18
ATLANTA			27

Figure 35

During the program assembly, the tag of each code is assigned to the storage position occupied by the switch. Suppose that the switch defined in Figure 34 is assigned location 000315. When instructions which reference NEW, REGULAR, and CANCELED are translated into machine language, 000315 will appear as the address portion of each one.

Figure 36 is part of a listing. Notice the machine language portions for both the switch definitions and the instructions which reference the switch.

Tag	Oper.	Nu	Operand	Loc
	CHRCD			000343
BLUE			A	
GREEN			B	
RED			C	
Instructions that reference the switch:				
	CMP	1	GREEN	002129 4 1 000343
	CMP	1	RED	002624 4 1 000343
	CMP	1	BLUE	002679 4 1 000343

Figure 36

RESTRICTIONS ON A CHRCD SWITCH. A code should not be represented as a signed numeric character but as the alphabetic character equivalent to the signed numeric character. For example, A should be used to represent +1, J should be used to represent -1, etc.

The CHRCD statement should not be tagged, since the switch is referenced by the tags of the codes.

Bit Code - BITCD

A bit code switch is defined by a series of statements. The first is the BITCD statement; its function is to define the switch as a bit code switch and to specify the initial setting of the switch. The statements which follow the BITCD statement specify the bits and the conditions they represent. The format of the set of statements is as follows:

Tag	Operation	Num	Operand
	BITCD		X_1
T_1		B_1	
T_2		B_2	
T_3		B_3	
T_4		B_4	

X_1 is the initial setting of the switch or is blank.

$T_1 \ldots T_4$ are the tags of the bits. They specify the conditions which the bits represent when they are ON.

$B_1 \ldots B_4$ are the bit codes 1, 2, 4, and A.

If the BITCD statement immediately follows an RCD statement, the operand should be left blank. If the switch does not follow an RCD field, the operand of the BITCD statement should specify the initial setting. The setting is indicated by the alphameric character created when the desired bits are set ON.

A bit that contains zero (0) is defined as ON; a bit that contains one (1) is defined as OFF. For instance, if the 4-bit should be set ON initially, the operand may be any character that contains a zero in the 4-bit. If the 1, 4, and A bits should be ON, the operand may be any character that contains zeros in those bits. It is recommended that the selected character contain a zero in the 8-bit and a one in the B-bit so that the character in the switch will always be valid for printing purposes.

The bit code switch in Figure 37 indicates various types of payroll deductions and is defined as a portion of a record area. The maximum number of bits has been used.

TAG	OPERATION	NUM.	OPERAND
RECORDAREA	NAME		OTHER
EMPLOYEE	RCD	25	A+
	BITCD		
IRS		1	
FICA		2	
STATE		4	
OTHER		A	

Figure 37

The BITCD definition in Figure 38 specifies that GROSSTOTAL is to be set ON initially. The switch will contain B (12-2), thus setting the 1-bit to zero.

TAG	OPERATION	NUM.	OPERAND
	BITCD		B
GROSSTOTAL		1	
NETTOTAL		2	

Figure 38

During the program assembly, the tag of each defined bit is assigned to the storage position occupied by the switch. Suppose that the switch defined in Figure 38 is assigned location 000100. When instructions which reference GROSSTOTAL and NETTOTAL are translated into machine language, 000100 will appear as the address portion of each one.

Figure 39 is taken from a listing. Notice the machine language portions for both the switch definition and the instructions which reference the switch.

Tag	Oper.	Nu	Operand	Loc		
	BITCD			000237		
EAST		1				
WEST		2				
NORTH		4				

Instructions that reference the switch:

Tag	Oper.	Nu	Operand	Loc		
	RCVS		EAST	002319	U	000237
	RCVS		WEST	002464	U	000237
	RCVS		NORTH	002739	U	000237

Figure 39

RESTRICTIONS ON A BITCD SWITCH. A bit code switch may not be used in a program for the 705 II portion of a 7080 program.

The BITCD statement should not be tagged, since the switch is referenced by the tags of the bits.

PROGRAM SWITCHES

A program switch is an instruction. Each time the switch is encountered, it causes the program to do one of two things:

1. To transfer to a designated instruction when the switch is ON.
2. To execute the next in-line instruction when the switch is OFF.

A program switch is defined by a single statement which specifies the initial switch setting. If the initial setting is ON, the switch statement becomes a Transfer instruction in the object program. If the initial setting is OFF, the statement becomes a No-Operation instruction in the object program.

Program Branch Control macro-instructions are used to set the switches ON or OFF and to test their settings. Setting the switch ON or OFF involves modifying the operation portion of the generated instruction to Transfer or No-Operation, respectively. Testing the switch involves determining whether or not it will cause the program to transfer. All program switch definition statements must be tagged so that the switches can be referenced by macro-instructions.

Switch Set to Transfer - SWT

The function of an SWT statement is to define a program switch which will be ON initially. The format of the SWT statement is as follows:

Tag	Operation	Num	Operand
T_1	SWT		X_1

T_1 is the tag of the switch.
X_1 is the tag of the instruction to which a transfer is to be made when the switch is ON.

As long as the switch is ON, a transfer occurs each time the switch is encountered. When the switch is encountered after it is set OFF, the transfer does not occur; the program proceeds instead to the next in-line instruction.

The SWT statement in Figure 40 indicates that LOOPSWITCH is to be set ON initially and that the transfer point is the instruction tagged STARTLOOP.

TAG (6–15)	OPERATION (16–20)	NUM. (21–22)	OPERAND (23–)
LOOPSWITCH	SWT		STARTLOOP

Figure 40

RESTRICTIONS ON AN SWT SWITCH. A hand-coded Transfer instruction may not be referenced as a program switch with Program Branch Control macro-instructions. Since the hand-coded instruction will not be recognized as a switch, the proper coding will not be generated from any macro-instructions referencing it.

Switch Set to No Operation - SWN

The function of an SWN statement is to define a program switch which will be OFF initially. The format of the SWN statement is as follows:

Tag	Operation	Num	Operand
T_1	SWN		X_1

T_1 is the tag of the switch.
X_1 is the tag of the instruction to which a transfer is to be made after the switch is turned ON.

As long as the switch is OFF, no transfer occurs when the switch is encountered. The program proceeds instead to the next in-line instruction. After the switch is set ON, a transfer occurs each time the switch is encountered.

The SWN statement in Figure 41 indicates that LOOPSWITCH is to be set OFF initially and that when the switch is set ON, the transfer point is the instruction tagged STARTLOOP.

TAG (6–15)	OPERATION (16–20)	NUM. (21–22)	OPERAND (23–)
LOOPSWITCH	SWN		STARTLOOP

Figure 41

RESTRICTIONS ON AN SWN STATEMENT. A hand-coded No-Operation instruction may not be referenced as a program switch with Program Branch Control macro-instructions. Since the hand-coded instruction will not be recognized as a switch, the proper coding will not be generated from any macro-instructions referencing it.

CONSOLE SWITCHES

Console switches are the console alteration switches 0911-0916. Each is identified by one console switch statement. The switches themselves must be set ON or OFF manually by the console operator, either before or during the execution of the program. A console switch statement does not specify the initial switch setting. It merely provides a method of assigning a tag to an alteration switch so that it can be referenced by a Program Branch Control macro-instruction. The switch statement is not translated into a machine language instruction.

Alteration Switches - ALTSW

The function of the ALTSW statement is to designate a console alteration switch. The format of the statement is as follows:

Tag	Operation	Num	Operand
T_1	ALTSW	X_1	

T_1 is the tag of the switch statement.
X_1 is a code identifying the console switch. The codes are as follows:

Code	Switch Being Identified
A	0911
B	0912
C	0913
D	0914
E	0915
F	0916

Figure 42 shows switches 0911 and 0912 being identified.

TAG (6–15)	OPERATION (16–20)	NUM. (21–22)	OPERAND (23–)
WEEKLYRUN	ALTSW	A	
MONTHLYRUN	ALTSW	B	

Figure 42

A one-for-one instruction is a symbolic instruction which is replaced by one machine instruction. It consists of a 7080 operation code and an Autocoder operand. Figure 44 lists the 7080 operation codes. The basic Autocoder operands are as follows:

1. tag
2. literal
3. actual
4. location counter
5. blank

A prefix, a suffix, or both may be added to some of the basic operands:

Prefix	Suffix
operand modifier	character adjustment
indirect address	

The format of an Autocoder one-for-one instruction is summarized in the next section, "One-For-One Instruction Format." The balance of the chapter describes the basic operands and the prefix and/or suffix that may be added to each operand. Chapter 6, entitled "Address Constants," describes a specialized form of Autocoder operand called an address constant literal.

The details of each 7080 operation are supplied in the reference manual, "7080 Data Processing System," Form A22-6560.

ONE-FOR-ONE INSTRUCTION FORMAT

Like other Autocoder statements, a one-for-one instruction is tagged if it is to be referenced. The mnemonic operation code is placed in the operation field. No actual operation codes may be used. If the operation requires designation of the accumulator, an ASU, or a bit, the appropriate entry is placed in the numeric field. A one-for-one instruction has a single entry in the operand field; if necessary, the operand may be continued from the operand field into the comments field. The operand may not, however, be continued onto the next line of the coding sheet. Comments about the instruction may be started in the comments field.

BASIC OPERANDS

A description of the basic Autocoder operands follows:

Tag

The tag may be that of the data field or the source program instruction involved in the operation.

TAG 6–15	OPERATION 16–20	NUM. 21–22	OPERAND 23
FIELD	RCD	13	#+07.06
	⸾		
INSTR	RAD		FIELD

Figure 43

Literal

A literal is actual data enclosed by literal signs (#). It may be any combination of alphameric characters and/or blanks, e.g., #A#, #bb3C#, #0500#, #GO TO END#, #+345#, #-.67#, #1234#, #+9.876#. The Processor creates a constant from a literal operand. The term "literal" is frequently used to refer to the literal operand or to the constant created from the literal.

As an example of the use of a literal operand, it may be necessary to calculate with a constant of +30. The constant could be defined by a CON statement, and the appropriate arithmetic instruction could reference the constant by having the tag of the CON as an operand. On the other hand, it might be desired to omit the CON and supply the constant directly by writing it as the literal operand of the arithmetic instruction. While a literal is a convenient way of supplying an occasional constant, those constants that are used repeatedly throughout the program should be supplied by CON statements.

If a signed numeric constant is desired, the first character following the literal sign must be a plus or minus sign. In storage, the low-order position of the constant will be signed. If the numeric data is a mixed or pure decimal, the decimal point will not appear in the constant. If an unsigned numeric constant is desired, the first character following the literal sign must be the first character of the numeric data. In storage, the constant will appear exactly as it is written in the literal. Thus, the constant created from an unsigned mixed or pure decimal will contain a decimal point. For this reason, unsigned mixed or pure decimals should not be written as the literal operands of arithmetic instructions, e.g., ADD, SUB.

A literal may also supply the floating point form of a signed numeric constant. It must be written in the format of an FPN operand: #±EE±XXXXXXXX#.

Name of Instruction	Mnemonic Code	Use in Programs For Second'y Mode 705 II	705 III	7080
Add	ADD	x	x	x
Add Address to Memory	AAM		x	x
Add to Memory	ADM	x	x	x
Backspace	BSP	x	x	x
Backspace File	BSF		x	x
Blank Memory	BLM		x	x
Blank Memory Serial	BLMS		x	x
Channel Reset	CHR			x
Comma, No Operation	CNO			x
Compare	CMP	x	x	x
Control Read (Read 04)	CRD [2]			x
Control Write (Write 04)	CWR [2]			x
Divide	DIV	x	x	x
Dump Memory (Write 01)	DMP [2]	x	x	x
Enable Compare Backward	ECB			x
Enable Indirect Address	EIA			x
Enter Interrupt Mode	EIM			x
Enter 7080 Mode	EEM			x
Forward Space (Read 01)	FSP [2]	x	x	x
Leave Interrupt Mode	LIM			x
Leave Interrupt Program	LIP			x
Leave 7080 Mode	LEM			x
Lengthen	LNG	x	x	x
Load	LOD	x	x	x
Load Address	LDA		x	x
Load Four Characters	LFC [3]			x
Load Storage Bank	LSB			x
Multiply	MPY	x	x	x
No Operation	NOP	x	x	x
No Operation, Comma	CNO			x
Normalize and Transfer	NTR	x	x	x
Read 00	RD	x	x	x
Read 01 (Forward Space)	FSP [2]	x	x	x
Read 02 (Read Memory Address)	RMA [2]		x	x
Read 03 (Sense Status Trigger)	SST [2]			x
Read 04 (Control Read)	CRD [2]			x
Read 05 (Read Memory Block)	RMB [2]			x
Read Memory Address (Read 02)	RMA [2]		x	x
Read Memory Block (Read 05)	RMB [2]			x
Read While Writing	RWW	x	x	x
Receive	RCV [4]	x	x	x
Receive Serial	RCVS [4]	x	x	x
Receive Ten Characters	RCVT [4]			x
Reset and Add	RAD	x	x	x
Reset and Subtract	RSU	x	x	x
Rewind	RWD	x	x	x
Rewind and Unload	RUN			x
Round	RND	x	x	x
Select	SEL	x	x	x
Send	SND		x	x
Sense Status Trigger (Read 03)	SST [2]			x
Set Bit Alternate	SBA		x	x
Set Bit 1	SBN [1]		x	x
Set Bit Redundant	SBR		x	x
Set Bit 0	SBZ [1]		x	x
Set Control Condition (Write 03)	SCC [2]			x
Set Density High	SDH			x
Set Density Low	SDL			x
Set Left	SET	x	x	x
Set Record Counter (Write 02)	SRC [2]		x	x
Set Starting Point Counter	SPC			x
Shorten	SHR	x	x	x
Sign	SGN	x	x	x
Skip Tape	SKP		x	x

Name of Instruction	Mnemonic Code	Use in Programs For Second'y Mode 705 II	705 III	7080
Stop	HLT	x	x	x
Store	ST	x	x	x
Store for Print	SPR	x	x	x
Subtract	SUB	x	x	x
Suppress Print or Punch	SUP	x	x	x
Ten Character Transmit	TCT			x
Transfer	TR	x	x	x
Transfer Any	TRA	x	x	x
Transfer Auto Restart	TAR			x
Transfer Echo Check	TEC		x	x
Transfer on Equal	TRE	x	x	x
Transfer on High	TRH	x	x	x
Transfer to Interrupt Program	TIP			x
Transfer Instruction Check	TIC		x	x
Transfer Machine Check	TMC		x	x
Transfer Nonstop	TNS			x
Transfer Overflow Check	TOC		x	x
Transfer on Plus	TRP	x	x	x
Transfer Read-Write Check	TRC		x	x
Transfer Ready	TRR		x	x
Transfer Sign Check	TSC		x	x
Transfer on Signal	TRS	x	x	x
Transfer and Store Location	TSL		x	x
Transfer Switch A On (0911)	TAA		x	x
Transfer Switch B On (0912)	TAB		x	x
Transfer Switch C On (0913)	TAC		x	x
Transfer Switch D On (0914)	TAD		x	x
Transfer Switch E On (0915)	TAE		x	x
Transfer Switch F On (0916)	TAF		x	x
Transfer Synchronizer Any	TSA		x	x
Transfer Transmission Check	TTC		x	x
Transfer on Zero	TRZ	x	x	x
Transfer on Zero Bit	TZB [1]		x	x
Transmit	TMT	x	x	x
Transmit Serial	TMTS	x	x	x
Turn off I-O Indicator	IOF	x	x	x
Turn on I-O Indicator	ION	x	x	x
Unload	UNL	x	x	x
Unload Address	ULA		x	x
Unload Four Characters	UFC [3]			x
Unload Storage Bank	USB			x
Write 00	WR	x	x	x
Write 01 (Dump Memory)	DMP [2]	x	x	x
Write 02 (Set Record Counter)	SRC [2]		x	x
Write 03 (Set Control Condition)	SCC [2]			x
Write 04 (Control Write)	CWR [2]			x
Write 05 (Write Multiple Control)	WMC [2]			x
Write and Erase 00	WRE	x	x	x
Write and Erase 01	WRE 01	x	x	x
Write Multiple Control (Write 05)	WMC [2]			x
Write Tape Mark	WTM	x	x	x
IBM 760 Operations				
Read or Write Tape, Early Start	RWT	x	x	x
Read or Write Tape, Write on Printer	RWS	x	x	x
Reset 760 Counter	RST	x	x	x
Write on Printer and Magnetic Tape	PTW	x	x	x
IBM 777 Operations				
Bypass TRC	BPC	x	x	x
Prepare to Read While Writing	PRW	x	x	x
Read Tape to TRC	RTS	x	x	x
Write TRC to Tape	WST	x	x	x

See Notes on page 31

Figure 44. Mnemonic Codes for One-for-One Instructions

NOTES for Figure 44

1 Place a 1, 2, 4, 8, A, or B in column 22 to designate the bit (TZB can also have a C). Note: If columns 21 and 22 are not blank, the Processor assumes that an ASU, valid or invalid, has been designated.

2 Preferred mnemonics; RD 01 to 05 and WR 01 to 05 are also acceptable.

3 A blank or 4 should be placed in column 22 if the Processor is to perform a 4/9 check. If a 1, 2, 3, or 5 is written, a 1/6, 2/7, 3/8, or 0/5 check, respectively, results.

4 The three different Autocoder mnemonics for the receive instruction (RCVS, RCV, and RCVT) indicate to the Processor the type of address to be assigned. If the mnemonic is RCVS, the location assigned is the high-order address of the field specified in the operand of the instruction. For an RCV, 4 is added to the high-order address of the field. Since an RCV is generally used when a 4/9 ending is desired (as with a TMT or SND), the high-order address of the field should end in a 0 or 5. An RCVT is assigned the high-order address of the field plus 9. Since RCVT is used when a 9 ending is desired (i.e., with a TCT), the high-order address of the field should end in 0.

If the generated address does not end in a 4 or 9 (RCV) or 9 (RCVT), a 4/9 check or 9 check message is prepared.

An example of assembled machine language coding for the three forms of the receive instruction is shown below. The field, tagged WORKAREA, has a high-order address of 3750. Note that the machine language operation code (U) is the same for all three statements:

Op	Operand	Op	Address
RCVS	WORKAREA	U	3750
RCV	WORKAREA	U	3754
RCVT	WORKAREA	U	3759

The operands of all forms of the receive instruction can be character adjusted. Thus, if the operands above were WORKAREA-3, the actual addresses would be three less than shown.

Trailing zeros will be supplied when the literal contains fewer than eight mantissa positions. For example, the literal #+03-7# will appear in storage as 0$\overset{+}{3}$7000000$\bar{0}$.

The length of a literal must be a multiple of five when used with an operation which requires a 4 or 9 location. The literal must also contain a record mark in the low-order position if it is used with a TMT operation. Such literals are positioned in the literal table so that the high-order character occupies a 0 or 5 location.

If the literal is used with a TCT instruction, its length must be a multiple of ten with a record mark in the low-order position. The Processor will properly position the literal in a 9 location.

TAG	OPERATION	NUM.	OPERAND
ONE	RAD		#+5034.27#
	⋮		
TWO	LOD		#798#
	⋮		
THREE	TMT		#LOAD TAPE‡#

Figure 45

The Processor places all constants that it creates from literal operands in an area of storage called the literal table. Although the same literal may be used in several statements, it will appear only once in the table. The Processor classifies literals and assigns them to the table according to whether they are signed or unsigned:

1. Any literal containing a sign in the first position is automatically classified as signed. If the signed literal supplies numeric data, it appears in storage as previously described. If the literal contains a non-numeric character in the low-order position, the existing zoning in that character is replaced by the sign.

2. Any literal that does not contain a sign in the first position is automatically classified as unsigned. As previously indicated, the constant appears in storage in exactly the same form in which it is written on the coding sheet.

Actual

An actual operand is a set of numeric characters, usually preceded by the actual address symbol (@), which designates one of the following:

1. An actual storage location
2. A setting for the accumulator or an ASU
3. The size of a block of storage positions

The @ symbol need not be used when the operand contains less than five numeric characters and is used with one of the following operations: BLM, BLMS, CTL, HLT, LIP, LNG, RND, SEL, SET, SHR, SPC, SRC. Notice in Figure 46 that the SET and BLM instructions have been written two ways.

TAG	OPERATION	NUM.	OPERAND
ONE	ST		@995
	⋮		
TWO	SET		@00005
	⋮		
THREE	SET		5
	⋮		
FOUR	BLM		@00020
	⋮		
FIVE	BLM		20

Figure 46

RESTRICTIONS. An actual operand greater than the core-memory size specified to the Processor should not be used. If such an operand is encountered during assembly, the Processor subtracts the maximum core-memory size from the actual and uses the difference as the operand. A message to this effect is provided at assembly time.

For example, if an 80,000 core-memory size has been specified, any actual operand in excess of

79,999 will have 80,000 subtracted from it and the remainder used as the operand. The list below indicates the largest actual operand that may be used with the various core-memory sizes that are available:

Core-Memory Size	Maximum Actual Operand
20,000	19,999
40,000	39,999
80,000	79,999
160,000	159,999

Location Counter

A location counter is represented by the asterisk symbol (*), which designates the low-order position of the instruction in which it appears. Since each instruction occupies five positions in the object program, an instruction containing a location counter references its own low-order position. The effect of the instruction in Figure 47 is to cause the 4 or 9 location assigned to the instruction to be placed in ASU 14.

TAG	OPERATION	NUM.	OPERAND
	LOD	14	*

Figure 47

Note: The versatility of a location counter is more fully utilized when the counter is character-adjusted. This use is explained in the following section, "Additions to Basic Operands."

Blank

A blank operand is one which has blanks in the first 10 columns of the operand field. Blank operands should be used if the instruction is initialized by the program or if the operation itself does not require an address. In the object program, a blank operand is replaced by an appropriate address.

TAG	OPERATION	NUM.	OPERAND
	BSP		
	⋮		
	ULA	14	

Figure 48

ADDITIONS TO BASIC OPERANDS

A description of the suffix and the prefixes that may be added to an Autocoder operand follows.

Character Adjustment

Character adjustment is designated by a suffix to the basic operand. A reference to an untagged field, an untagged instruction, or a particular position within a field or an instruction can be made by using character adjustment. The suffix consists of an arithmetic operator that specifies the type of operation and one or more numeric characters that specify the size of the adjustment. The operators are as follows:

Operator	Meaning
+	Addition
-	Subtraction
*	Multiplication
/	Division

Character adjustment may be used with all basic operands except the blank operand. The operator should appear immediately after the operand; it may not appear beyond column 33 unless the operand itself continues into column 33 or beyond.

In Figure 49, the character-adjusted operand of the RAD instruction references the field that follows EMPLOYEE.

TAG	OPERATION	NUM.	OPERAND
EMPLOYEE	RCD	25	A+
		5	+
	⋮		
	RAD		EMPLOYEE+5

Figure 49

A character-adjusted location counter may be used to bypass in-line instructions. In Figure 50, *+10 references the low-order (4 or 9) position of the ST instruction.

TAG	OPERATION	NUM.	OPERAND
	TRP		*+10
	ADD		*+30*
	ST		FIELD

Figure 50

RESTRICTIONS. The numeric portion of a character adjustment cannot exceed six positions, nor may the value of the adjustment be greater than 159999. In any event, if the value of the adjustment is greater than the core-memory size specified to the Processor, the core-memory size will be subtracted from the overstated adjustment and the difference will be the adjustment.

Further restrictions apply to operands that are a location counter, actual, or literal. These operands can only have a + and - operator. If any other operator is used, both the operator and the adjustment will be ignored.

Literal operands, in addition to being restricted to a + or - operator, cannot have an adjustment value of more than 99. If the adjustment is more than 99, the Processor will use the two low-order digits for the adjustment value. Thus, an adjustment of -156 will be treated as if it were -56.

Operand Modifier

An operand modifier is a two-character prefix which may be used with a tag or a literal operand. It enables the user to reference a particular position of a field or an instruction or to reference the size of a field. The operand modifiers are as follows:

Modifier	Modifier Designates
L,	Left-hand position
R,	Right-hand position
H,	High-speed position
S,	Size
T,	High-speed nine position

In Figure 51, the LOD instruction references the left-hand position of FIELD. When the instruction is executed, the contents of that position, rather than the entire contents of FIELD, are placed in ASU 01.

TAG	OPERATION	NUM.	OPERAND
FIELD	RCD	8	N
	⋮		
	LOD	1	L, FIELD

Figure 51

Note: If the modifier "S," had been used in the preceding example, the LOD instruction would reference the contents of storage location 00008.

Indirect Address

An indirect address is an indirect reference; that is, it is a reference to an operand that references some other operand. It is designated by a two-character prefix to the basic operand. The prefix consists of an I followed by a comma (I,). An indirect address may be used with the following operands: tag, blank, actual, character-adjusted location counter. In Figure 52, BEGIN is the effective transfer point of the first instruction.

TAG	OPERATION	NUM.	OPERAND
MIDDLE	TR		I, END
	⋮		
END	TR		BEGIN

Figure 52

When the Processor encounters an instruction containing "I," in the 7080 mode portion of the program, it generates two instructions: The first is an EIA (Enable Indirect Address). If the one-for-one instruction containing the indirect address is tagged, the Processor transfers the tag to the EIA instruction. The second instruction is the same one-for-one instruction without the hand-coded "I," and without the hand-coded tag. If the first instruction in Figure 52 had been written in the 7080 portion of the program, it would have been followed by the generated instructions, as shown in Figure 53.

Tag	Operation	Num	Operand
MIDDLE	TR		I, END
MIDDLE	EIA		END
	TR		END

Figure 53

MULTIPLE ADDITIONS TO A BASIC OPERAND

The following pairs of additions may be used with either a tag or a literal operand:

1. Operand modifier and character adjustment.
2. Indirect address and character adjustment.

The second pair may also be used with a location counter.

In Figure 54, the operand of the LOD instruction references the second position in FIELD, i.e., the position to the right of the high-order position.

TAG	OPERATION	NUM.	OPERAND
FIELD	RCD	10	A
	⋮		
	LOD		L, FIELD+1

Figure 54

In Figure 55, COMPUTE is the effective transfer point of the first transfer instruction.

TAG	OPERATION	NUM.	OPERAND
ONE	RAD		RECORD1
	TR		I, *+10
TWO	RAD		RECORD2
	TR		COMPUTE

Figure 55

CHAPTER 5. GENERAL PURPOSE MACRO-INSTRUCTIONS

A macro-instruction is a source program statement which represents multiple operations. When the program is assembled, each macro-instruction is replaced by a number of one-for-one instructions; the number varies according to what the macro-instruction is and how it is used. The general purpose macro-instructions in the 7080 Processor library are shown in Figure 56. The purpose of this chapter is to present them as a part of the Autocoder language; consequently, the chapter is limited to an explanation of their basic coding format and a few examples of individual macro-instructions. The specifications for using each general purpose macro-instruction are provided in the reference manual, "7058 Processor: General Purpose Macro-Instructions," Form C28-6130 as updated by the IBM bulletin "7080 Processor: General Purpose Macro-Instructions," Form J28-6266. Hereafter, the aforementioned will be called the macro-instruction manual. (Input/output macro-instructions are a part of the Input/Output Control System, IOCS, and are described in the IOCS reference manual for the 7080.)

In addition to individual specifications and examples of generated coding, the macro-instruction manual provides detailed explanations of the conventions and restrictions governing the use of all the general purpose macro-instructions. It also explains restrictions that may apply to only one type of macro-instruction. It has been necessary to establish certain conventions and restrictions in creating a macro-instruction library to serve a large number of users with a variety of program needs. However, it is possible for programmers to prepare their own macro-instructions and insert them into the library.

Because of the flexibility of the Processor, programmers need not observe most of the restrictions described in the macro-instruction manual when creating macro-instructions to meet their particular requirements. Specifically, they may designate as acceptable operands any of the basic operands and additions to basic operands described in Chapter 4. Programmers writing their own macro-instructions may also designate an entry in the numeric field as the method of supplying an ASU reference or other special information. The process of creating a macro-instruction requires a thorough knowledge of a special language which is described in the reference manual, "7080 Processor: Preparation of Macro-Instructions," Form C28-6264.

The remainder of this chapter is an introduction to the general purpose macro-instructions in the 7080 Processor library; the discussion is based on the conventions and restrictions that apply to these macro-instructions.

ADDRESS MODIFICATION	
Add Address	(ADDA)
Compare Address	(COMPA)
Decrement Address	(DECRA)
Increment Address	(INCRA)
Initialize Address	(INITA)
Move Address	(MOVEA)
Subtract Address	(SUBA)
ASSEMBLY CONTROL	
Enter Interrupt Program	(ENTIP)
Leave Interrupt Program	(LEVIP)
Leave 80 Mode	(LEV80)
Enter 80 Mode	(ENT80)
Speed or Space	(SPEED)
AUTOMATIC DECIMAL POINT	
Absolute Value	(ABSX)
Add	(ADDX)
Decrement	(DECRX)
Diminish	(DIMX)
Divide	(DIVX)
Divide or Halt	(DVHX)
Increment	(INCRX)
Multiply	(MPYX)
Negative Absolute Value	(NABSX)
Negative Divide	(NDIVX)
Negative Divide or Halt	(NDVHX)
Negative Multiply	(NMPYX)
Subtract	(SUBX)
Sign and Zero Test	(TESTX)
DATA TESTING	
Compare	(COMP)
Test for Numeric Field	(IFNUM)
Test if in Range	(RANGE)
DATA TRANSMISSION	
Blank Memory	(BLANK)
Define ASU	(ASU)
Move	(MOVE)
Restore Decimal	(DEC)
Zero Memory	(ZERO)
Define CASU	(CASU)
PROGRAM BRANCH CONTROL	
Alternating NOP	(ALTNP)
Alternating Transfer	(ALTTR)
First Time NOP	(FTNOP)
First Time NOP on a Bit	(FTNPB)
First Time Transfer	(FTTR)
First Time Transfer on a Bit	(FTTRB)
Set Switches OFF	(SETOF)
Set Switches ON	(SETON)
Test Switch	(IFON)
TABLE	
Add an Item	(ADITM)
Delete an Item	(DLITM)
Replace an Item	(RPITM)
Search a Table	(SERCH)
Table Control	(TBCTL)
MISCELLANEOUS	
Dead-End Halt	(STOP)
Link to Subroutine	(LINK)
Transfer Indirect	(TRIN)
Type a Message	(TYPE)

Figure 56. 7080 Processor General Purpose Macro-Instructions for Use in Autocoder Programs

GENERAL PURPOSE MACRO-HEADER FORMAT

The portion of a macro-instruction that is written as a source program statement is called a macro-header. As with other Autocoder statements, a macro-header is tagged if it is to be referenced. The mnemonic code is placed in the operation field. Entries in the numeric field are rarely permitted; those which are permitted do not relate to an ASU number or a bit as they do in a one-for-one instruction. Most macro-headers have two or more entries in the operand field; some may contain up to fifty entries, and a few may have only one. The entries will be called operands throughout this chapter and in the macro-instruction manual. Each operand is terminated by a lozenge (⌑), the same symbol which was previously explained as part of an RPT statement.

Operands may be placed in the operand and comments fields of the line on which the macro-header starts and may be continued in the operand and comments fields of the next 49 lines on the coding sheet. However, an operand may not be written on two lines, i.e., it may not be started in the comments field of one line and continued in the operand field of the next line. Similarly, the lozenge which terminates an operand may not be separated from it. If the positions at the end of a line are insufficient for both an operand and its lozenge, the positions must be left blank and the operand started in column 23 of the next line on the coding sheet. Operand continuation lines must be blank in the tag, operation, and numeric fields.

Comments may be started in the comments field of the line on which the operands terminate, but the comments must be separated from the final lozenge by a minimum of two spaces. Comments may also be continued in the comments field of succeeding lines of the coding sheet.

TYPES OF OPERANDS

The operands of a macro-header designate the data and/or the instructions involved in the operations the macro-instruction represents. Most operands are either tags or literals.

Tags. The tags may be those of defined data fields and source program one-for-one and macro-instructions. (Note: In Chapter 3, a data switch was defined as a field and a program switch as an instruction.) For instance, the function of the IFON macro-instruction is to test a switch and to transfer to one of two specified instructions, depending on the status of the switch. The operands of the IFON macro-header are the tags of the switch to be tested and the tags of the transfer points, i.e., the instructions to which the transfer is made if the switch is ON or OFF. In the generated coding, the tags appear as the operands of the appropriate one-for-one instructions.

In most cases, the tag of an instruction is used as an operand in order to designate the instruction as a transfer point. This is not true of the operands of Address Modification macro-headers. Such operands designate the operands of other instructions rather than the instructions themselves. When an Address Modification macro-header must designate the operand of another macro-header, it may not reference the macro-header by its tag alone. The tag must be written as a special form of operand called the macro suffix tag. This consists of a tag to which a suffix is added. The suffix is of the form #x or #xx where x or xx are numbers that designate one of the operands of the macro-header being referenced. For example, a macro suffix tag designating the first operand of a macro-header tagged MACRO would be written as MACRO#1 or MACRO#01. Similarly, a macro suffix tag designating the third operand would be written as MACRO#3 or MACRO#03. The use of the macro suffix tag is illustrated at the end of this chapter and in the macro-instruction manual. No adjustments are permitted on a macro suffix tag.

Secondary Field Definitions

A secondary field definition is a description of the characteristics of a data field. It is written as part of a macro-header operand that references the field, i.e., the operand is the tag of the field, and it causes the macro-instructions to treat the field as having the characteristics that the secondary field definition provides. Depending on the reason for which a secondary definition is used, it may supply characteristics identical to those previously defined for the field, or it may supply a different set of characteristics. A secondary definition must be used in a macro-header operand that references a data field indirectly, because the defined characteristics of the data field are not available to the Processor in such a situation. (See Example 3.) A generated descriptive tag may not be given a secondary definition.

A secondary field definition may be supplied by the tag of a field, a literal, or either of the RCD forms, #+xx.yy or #xx.yy. The macro-header operand containing the definition is written as follows: the tag of the data field, a comma, the secondary definition:

1. Using the Tag of a Field

A macro-header operand containing the tag of a field as a secondary definition would be one such as TAGA, TAGB ⌑ . The field specified by TAGA will be treated as having the characteristics of the field specified by TAGB.

If a field with the desired characteristics has been defined, its tag may be used to supply the secondary field definition. Otherwise, two fields must be defined with different tags and overlapped by use of a location assignment (LASN). Reference to the field should be made by using the tag of the definition which is appropriate at the time the reference is made.

2. Using a Literal

A macro-header operand containing a literal secondary definition would be one such as TAG, #+XXX.X# ◻. Regardless of the defined characteristics of the field TAG, it is now defined as a signed fraction consisting of three integer positions and one decimal position. This method can be used to define signed numeric fields only.

3. Using the RCD Form

With the RCD form of secondary definition, the example given in item 2 above would be written as TAG, #+03.01 ◻ . This form is fully discussed on page 16 of this manual. This method can be used to define signed or unsigned numeric fields only.

Other tags that may be used as operands are those of Class A subroutines items and generated descriptive tags. Characteristics of items within Class B subroutines are not available to macro-instructions.

Literals. A literal is actual data enclosed by pound signs (#) and is explained in Chapter 4. In the coding generated from macro-headers containing literal operands, the literals appear as the operands of the appropriate one-for-one instructions just as tags appear as one-for-one operands. Whenever the macro-instruction manual designates the tag of a field as an operand, a literal may be used instead.

An unsigned numeric literal supplying a mixed or pure decimal should not be used as the operand of an Automatic Decimal Point macro-header, because the constant created from the literal will contain a special character (the decimal point). Floating point literals may not be used as the operands of Automatic Decimal Point macro-headers for the reason stated in the explanation of FPN (Chapter 2). A literal must not exceed 35 positions, exclusive of the pound signs.

TYPES OF LOZENGES

Lozenges indicate to the Processor the termination of each operand and the position which an omitted operand would normally occupy in relation to the other operands. There are two types of lozenges:

Fixed. A fixed lozenge may never be omitted. If the operand it terminates is omitted, the fixed lozenge is placed back-to-back with the lozenge which terminates the preceding operand.

Conditional. A conditional lozenge may be omitted only if the operand it terminates is omitted and no additional operands are written. If other operands follow an omitted operand, its conditional lozenge must be placed back-to-back with the lozenge which terminates the preceding operand.

OMITTED OPERANDS

The specifications in the macro-instruction manual indicate that certain operands may be omitted. The associated lozenge is assumed to be fixed unless the specifications state that it is conditional.

When the omitted operand is a transfer point, the generated coding provides a transfer to the next in-line source program instruction. This may be most readily seen in those macro-instructions which make some sort of test and then transfer according to the results of the test. The IFON macro-header should be written with two transfer points, one to be used if a tested switch is ON, and the other if it is OFF. The second transfer point may be omitted; if it is, the generated instruction for the OFF condition is a transfer to the next in-line source program instruction

THE IMPORTANCE OF PROPERLY DEFINED DATA FIELDS

A macro-header makes a field reference when it has the tag of a field as an operand. In other words, it references a field which is defined by either an area definition or a switch definition. In order to generate coding which is proper for the field, the Processor must know the characteristics of the data which will occupy the field. Obviously, it is not possible for the Processor to examine the actual data at assembly time. Consequently, the Processor obtains the characteristics from the definition and generates coding which is proper for the field according to its definition. If the data does not conform to these characteristics, it may be improperly processed. However, the generated coding itself is not improper.

The importance of field definitions may be seen in a macro-instruction which is used to compare the contents of two fields. The fields may be alphameric or numeric. The one-for-one instructions which should be used to compare alphameric data differ from those which should be used to compare numeric data. By using the macro-instruction, the programmer is relieved of having to select the proper instructions, but the Processor cannot assume this burden unless the characteristics of the field are available to it. Similarly, if literals are used instead of the tags of fields, the literals must be written in accordance with the standards previously specified. For instance, an unsigned decimal written as a literal will not be treated as numeric data but as alphameric data.

EXAMPLES OF MACRO-INSTRUCTIONS AND THEIR USE

The balance of this chapter contains examples of a few general purpose macro-instructions in the Processor library. The function and coding format of each macro-instruction is followed by an example which illustrates how it might be used and what instructions would be generated for that usage. In Figures 57-60, the macro-headers are overlaid with a band of gray to distinguish them from generated instructions. The explanations should not be considered as the specifications for the macro-instructions. In some examples, certain options which are available have been omitted entirely. Complete specifications are provided only by the macro-instruction manual.

1. Blank Memory: BLANK

The function of BLANK is to place blanks in a field. The basic format of the BLANK macro-header is as follows:

Tag	Operation	Num	Operand
T_1	BLANK		X_1¤X_2¤X_3¤.....X_{20}¤

T_1 is the tag of the macro-header or is omitted.

$X_1 \ldots X_{20}$ are the tags of the fields in which blanks are to be placed. The lozenges are conditional.

In Figure 57, TAG1 indicates that the contents of fields ONE and TWO are to be replaced by blanks.

Tag	Operation	Num	Operand
	NAME	0	
ONE	RCD	5	+
TWO	RPT	8	XXXX. ZZ
TAG1	BLANK		ONE¤TWO¤
TAG1	RCV		ONE
	BLM		@00001
	RCVS		TWO
	BLMS		@00008

Figure 57

2. Test Switch: IFON

The function of IFON is to test a switch and to transfer according to the results of the test. The basic format of the IFON macro-header is as follows:

Tag	Operation	Num	Operand
T_1	IFON		X_1¤X_2¤X_3¤

T_1 is the tag of the macro-header or is omitted.

X_1 is the tag of the switch to be tested.

X_2 is the tag of the ON transfer point, i.e., the instruction to which a transfer should be made if the switch is ON.

X_3 is the tag of the OFF transfer point. The operand may be omitted, in which case a transfer will be made to the next in-line instruction. The lozenge is conditional.

In Figure 58, ON and OFF must be assumed to be the tags of instructions. If OFF and its associated lozenge had been omitted, the final instruction would not have been generated.

Tag	Operation	Num	Operand
	CHRCD		
NEWYORK			A
CHICAGO			B
TAG2	IFON		NEWYORK¤ON¤OFF¤
TAG2	LOD	1	#A#
	CMP	1	NEWYORK
	TRE		ON
	TR		OFF

Figure 58

3. Add: ADDX

The function of ADDX is to add the data in two numeric fields and place the result in a numeric field or an RPT field. The numeric fields may be signed or unsigned. The basic format of the ADDX macro-header is as follows:

Tag	Operation	Num	Operand
T_1	ADDX		X_1¤X_2¤X_3¤

T_1 is the tag of the macro-header or is omitted.

X_1 is the tag of one numeric source field, i.e., the field which is the source of one set of data to be added.

X_2 is the tag of the other numeric source field.

X_3 is the tag of the numeric or RPT result field, i.e., the field in which the result is to be placed.

Tag	Operation	Num	Operand
NINE	RCD	5	#+02.03
TEN		6	#+03.03
TAG3	ADDX		NINE¤#+75.000#¤TEN¤
TAG3	RAD		NINE
	SET		@00006
	ADD		#+75.000#
	ST		TEN

Figure 59

4. Increment Address: INCRA

INCRA is an Address Modification macro-instruction; the function of this type of macro-instruction is to modify other instructions, either macro-instructions or one-for-one instructions. The function of INCRA is to increment a field reference made by another instruction, thus modifying the instruction so that it makes a different field reference. An instruction makes a field reference by having the tag of a field as an operand. INCRA designates the instruction which makes the field reference and the amount by which the reference is to be increased. The basic format of the INCRA macro-header is as follows:

Tag	Operation	Num	Operand
T_1	INCRA		X_1¤X_2¤

T_1 is the tag of the macro-header or is omitted.

X_1 is the tag of an instruction which makes the field reference to be incremented.

X_2 is the increment.

In Figure 60, the first operand of INCRA is a macro suffix tag, designating the second operand of MACRO. Initially, MACRO references FIELD. However, INCRA modifies MACRO so that it subsequently references whatever is located 500 positions above FIELD. For instance, assume that FIELD occupies locations 001000-001002. When MACRO is executed initially, it will cause these locations to be blanked. Once modified by INCRA, it will cause locations 001500-001502 to be blanked. (Note: M00017#02 is a tag generated by the Processor.)

Tag	Operation	Num	Operand
OTHER	RCD	8	A
FIELD		3	A
MACRO	BLANK		OTHER¤FIELD¤
MACRO	RCVS		OTHER
	BLMS		@00008
M00017#02	RCVS		FIELD
	BLMS		@00003
TAG4	INCRA		MACRO#2¤#+500#¤
TAG4	RAD	15	#+500#
	AAM	15	M00017#02

Figure 60

An address constant is a numeric constant consisting of a storage location. An address constant statement designates the storage location by specifying one of four operands: tag, literal, actual, location counter. At assembly time, the location assigned to the tag, literal, or location counter or the location designated by the actual operand is used to create the constant. In effect, the function of an address constant statement is to define a data field that will contain a constant and to designate the constant to be placed in the field. The actual constant is generated by the Processor and placed in the field created for it. Thus, an address constant enables the user to reference a constant which is not created until the program is assembled.

Address constants are used to initialize instructions, a procedure which alters the reference made by an instruction or supplies a reference to an instruction which lacks one. For example, suppose that an instruction must reference two record areas alternately, areas tagged FIRST and SECOND. This means that the operand of the instruction must contain FIRST at certain points in the program and SECOND at other points. To initialize the instruction, i.e., to modify the reference, address constants must be created from each of these tags so that one or the other of them can be placed in the instruction as required. In the assembled program, the address portion of the instruction will alternate between the actual locations assigned to FIRST and SECOND. Note the difference between an instruction which references FIRST and an instruction which references an address constant created from FIRST. In the former case, the instruction references the contents of a record area; in the latter case, the instruction references a constant consisting of the storage location of the record area.

The basic operand of an address constant statement may be a tag, literal, actual, or location counter. Operand modifiers may be used with a tag or literal to request a generated constant:

Modifier	Address Constant Generated From
Right-hand	storage location of the low-order position of a field, instruction, or literal.
Left-hand	storage location of the high-order position of a field, instruction, or literal.
High speed	a left-hand address plus four.
High-speed nine	a left-hand address plus nine.
Size	the number of positions occupied by a field or literal.

If no operand modifier is used, a right-hand address will be generated as the constant. As the preceding list indicates, a right-hand operand modifier may be written, but it is not necessary.

Character adjustments to the basic operand cause numerical adjustment of the address constant. Addition, subtraction, multiplication, or division by a specified amount may be requested. For example, a character adjustment of plus five would cause the constant to be five greater than the storage location referenced.

An address constant may be both operand-modified and character-adjusted. (Such an operand may have to continue into the comments field.) The operand modifier is a prefix to the basic operand; it consists of the appropriate modifier symbol followed by a comma. The character adjustment is a suffix to the basic operand; it consists of the arithmetic operator followed by a number designating the amount of adjustment. The amount may not exceed 160000. The symbols are as follows:

Operand Modifier		Character Adjustment	
R,	Right-hand	+	Add
L,	Left-hand	-	Subtract
H,	High speed	*	Multiply
S,	Size	/	Divide
T,	High-speed nine		

Assume that FIELD, a data field, is assigned to locations 001300-001309. An address constant statement having L, FIELD as its operand will cause 001300 to be created as the address constant. The operand R, FIELD+6 will cause 001315 to be created as an address constant. The same constant would be created from FIELD+6. Since the field occupies 10 positions, the operand S, FIELD will cause a constant of 10 to be created; the operand S, FIELD*5 will create a constant of 50.

Comments about an address constant may be started in the comments field of the address constant statement.

ADCON Address Constant

The function of an ADCON statement is to create an instruction which consists of a four-character, unsigned address constant preceded by the actual code for No Operation. The instruction is positioned in a 4 or 9 location. The ADCON statement is written as follows:

Tag	Operation	Num	Operand
T_1	ADCON	nn	X_1

T_1 is the tag of the address constant.
nn is ASU zoning or is blank.
X_1 is a tag, literal, actual, or location counter.

The ADCON statement creates an instruction of the form Axxxx. A is the actual code for No Operation; xxxx is the address constant. The instruction Axxxx will be positioned so that the low-order character occupies a 4 or 9 location. Any ASU zoning will be properly generated as part of the constant.

The ADCON statement in Figure 61 will cause an address constant to consist of the storage location of the right-hand position of the RECORDONE data field. Instructions referencing the constant do so by referencing its tag, FIRST.

TAG	OPERATION	NUM.	OPERAND
RECORDONE	RCD	35	A+
FIRST	ADCON		RECORDONE

Figure 61

Figure 62 specifies that the left-hand address constant consisting of the location of INSTRCTION is to be zoned for ASU 15.

TAG	OPERATION	NUM.	OPERAND
INSTRCTION	TR		START
TAG1	ADCON	15	L, INSTRCTION

Figure 62

ACON4 Address Constant

The function of an ACON4 statement is to create a four-character, unsigned address constant. The constant is placed in the next four available storage locations without regard to the positioning of its low-order character. ASU zoning, if specified, is properly generated as part of the constant. The format of the ACON4 statement is as follows:

Tag	Operation	Num	Operand
T_1	ACON4	nn	X_1

T_1 is the tag of the address constant.
nn is an ASU number or is blank.
X_1 is a tag, literal, actual, or location counter.

In Figure 63, the ACON4 statement is a request for an address constant consisting of the storage location assigned to FIELD1. Since no operand modifier is specified, the right-hand address will be generated. The constant may be referenced by its tag, TAG1.

TAG	OPERATION	NUM.	OPERAND
FIELD1	RCD	10	+
TAG1	ACON4		FIELDONE

Figure 63

Figure 64 shows that the constant will consist of the location assigned to the RECORDAREA field. Since the operand modifier "H," is used, the high speed address will be generated.

TAG	OPERATION	NUM.	OPERAND
	NAME	0	
RECORDAREA	RCD	35	A+
TAG2	ACON4		H, RECORDAREA

Figure 64

ACON5 Address Constant

The function of an ACON5 statement is to create a five-character address constant, either signed or unsigned. The constant is placed in the next five available storage locations without regard to the positioning of its low-order character. The sign, if specified, is placed over the low-order character. The format of the ACON5 statement is as follows:

Tag	Operation	Num	Operand
T_1	ACON5	s	X_1

T_1 is the tag of the address constant.
s is + for a positive constant, or
is - for a negative constant, or
is blank for an unsigned constant.
X_1 is a tag, literal, actual, or location counter.

The ACON5 statement in Figure 65 specifies that the location of the literal is to be made an address constant. Notice that the address constant will be signed. The sign of the address constant is not related to the sign of the literal.

TAG	OPERATION	NUM.	OPERAND
TAG1	ACON5	+	#+5000#

Figure 65

Figure 66 shows a request for an unsigned constant twice the size of FIELD2. The constant 00012 will be generated.

TAG	OPERATION	NUM.	OPERAND
FIELD2	RPT	6	ZZZ.ZZ
TAG2	ACON5		S, FIELD2*2

Figure 66

Restrictions on an ACON5 Statement. ASU zoning may not be specified in an ACON5 statement.

Any ACON5 should not be specified if there is a possibility that the address from which the constant is created will exceed 79999. In the event that a signed constant is requested for such an address, 80,000 is subtracted from the address. A message to the effect that the constant exceeds the address limit is provided at assembly time.

ACON6 Address Constant

The function of an ACON6 statement is to create a six-character, address constant. The constant is placed in the next six available storage locations without regard to the positioning of its low-order character. The format of the ACON6 statement is as follows:

Tag	Operation	Num	Operand
T_1	ACON6	s	X_1

T_1 is the tag of the address constant.

s is + for a positive constant, or is - for a negative constant, or is blank for an unsigned constant.

X_1 is a tag, literal, actual, or location counter.

In Figure 67, the ACON6 statement requests that 5000 be generated as a constant.

TAG	OPERATION	NUM.	OPERAND
TAG1	ACON6		@5000

Figure 67

Restrictions on an ACON6 Statement. ASU zoning may not be specified in an ACON6 statement.

ADDRESS CONSTANT LITERAL

An address constant literal is an operand with a double function; it is a request for an address constant and an operand that references the constant. The generated address constant is placed in the literal table. For example, when an instruction references a tag as part of an address constant literal, a constant consisting of the location assigned to the tag will be created and placed in the literal table. When the program is assembled, the operand (address constant literal) of the instruction will be replaced by the location assigned to the generated constant. If a program requires many address constants, they should be created with address constant statements. The address constant literal operand is useful in a program that requires an occasional address constant.

Writing an Address Constant Literal Operand

The operand may contain a tag or a literal; operand modifiers must be used with either one to specify the type of address being requested. If ASU zoning is to be generated as part of the constant, the ASU number is placed directly after the operand modifier and is followed by a comma. The basic format of the entire operand is either of the following:

1. Operand modifier plus a tag or literal.
2. Operand modifier plus ASU zoning plus a tag or literal.

The symbols for the operand modifiers and ASU zoning are shown in the following list (nn represents an ASU number):

Address Type	Operand Modifier	Modifier and ASU Zoning
Right-hand	R@	R@nn,
Left-hand	L@	L@nn,
High speed	H@	H@nn,
Size	S@	S@nn,
High speed nine	T@	T@nn

In Figure 68, an address constant is requested for the right-hand address of FIELD. The instruction specifies that the address constant is to be loaded into ASU 15. When the instruction is executed, the right-hand address of FIELD rather than the contents of FIELD will be placed in ASU 15.

TAG	OPERATION	NUM.	OPERAND
FIELD	RCD	35	A+
	‡		
ADCONLIT	LOD	15	R@FIELD

Figure 68

Figure 69 specifies that the address constant consisting of the right-hand address of FIELD be zoned for ASU 5. As in the preceding example, when the instruction is executed, the address constant will be placed in ASU 15.

TAG	OPERATION	NUM.	OPERAND
FIELD	RCD	25	A+
	‡		
ADCONLIT	LOD	15	R@05,FIELD

Figure 69

Arithmetic instructions, such as ADD, SUB, etc., cause a six-position signed constant to be created; the constant is signed plus. In a secondary mode, a five-position constant, signed plus, is created.

All instructions requiring a 4 or 9 address, such as LDA, AAM, TR, TMT, etc., cause a four-position unsigned constant to be created and properly positioned in a 4 or 9 location regardless of the mode. All other instructions cause a four-position unsigned constant, position in a 4 or 9 location, to be created for 705 II mode, a five-position unsigned constant to be created for 705 III mode, and a six-position, unsigned constant to be created for 7080 mode. In each case the maximum constant allowed is dependent on mode memory size.

Restrictions on an Address Constant Literal Operand. Character adjustment may be used for the purpose of modifying the constant itself. If character adjustment is written in an address constant literal operand, it will not be applied to the location of the constant.

If an address constant literal operand is used in a macro-header, it may not designate ASU zoning.

Instructions to the Processor concern the assembly process; they are executed by the Processor at assembly time. Consequently, they do not appear in the object programs, although they are written in the source program wherever they are required. Through these statements, the programmer is able to communicate with the Processor. The instructions to the Processor are listed below according to the aspect of the assembly process that they concern:

1. Standard Assembly Procedures
   Location Assignment - LASN
   Special Assignment - SASN
   Relative Assignment - RASN
   Assignment of Macro-Instruction Subroutines-SUBRO
   Assignment of Library Subroutines - SUBOR
   Assignment of Literals - LITOR
   Transfer Card - TCD
2. Object Program Content
   Include Subroutine - INCL
   Translation - TRANS
   Source Program Language - MODE
3. Object Program Listing
   Skip to New Page - EJECT
   Title for Routine or Comment - TITLE
4. Flags

INSTRUCTIONS TO THE PROCESSOR THAT CONCERN STANDARD ASSEMBLY PROCEDURES

Certain instructions to the Processor may be used to alter standard assembly procedures. To understand how these instructions may be used, it is first necessary to know what the procedures are:

1. Location assignments. The Processor assigns storage locations in ascending order to the object program. In making the assignments, it uses a location counter that is set initially to location 00500. The parts of the object program are assigned in the following sequence: the machine language equivalent of the source program, the library subroutines, the literal table. If no subroutines have been requested by either the source program or the Processor itself, the literal table is placed after the source program.

2. Standard "00" transfer control card. The Processor produces this as the terminal card of the object program deck. (Chapter 8 contains additional information on the object deck.) The standard "00" card contains instructions to set various ASUs. The final instruction on the card is a transfer to the first instruction in the object program. At the time the object program is to be executed (object time), it is placed in storage by a loading program. When the loading program encounters the standard "00" transfer card, it executes the instructions the card contains, thereby transferring control to the object program itself.

The instructions to the Processor explained in this section enable the programmer to direct the Processor to do one or more of the following:

1. To use more than one location counter in making assignments.
2. To assign specific locations designated by the programmer.
3. To alter the order of the object program parts.
4. To provide additional "00" cards and to place them within the object program.

It is often necessary to modify the standard assembly procedure. For example, it must be done when using IOCS (Input/Output Control System), because the IOCS routines occupy a large storage area starting in location 00500. The object program, therefore, must be positioned beyond the IOCS area. The positioning is accomplished by starting the source program with an instruction to the Processor to set the location counter to a location above the IOCS area.

The ability to specify storage assignments allows the programmer to conserve storage space by overlapping assignments, i.e., by assigning the same area of storage to more than one routine or block of data. A housekeeping routine is frequently overlapped with another routine, since the housekeeping routine is only executed once.

With the use of instructions to the Processor, the programmer is able to cause the housekeeping routine to be placed in storage and executed before the other routine is placed in the same area. Another example of overlapping is the assignment of two or more NAME definitions to the same area. This is often desirable when the program is to process sets of records that possess different characteristics but require the same amount of storage space. As long as all the records need not be in storage simultaneously, the same location assignment may be specified for the various NAMEs.

Location Assignment - LASN

The function of a LASN statement is to set a location counter to a specified location; 10 counters are available. A LASN statement may set the designated counter to one of the following:

1. An actual location specified by the programmer.
2. An actual location, unknown to the programmer, that has already been assigned by the Processor to a

field or an instruction.

3. One location beyond the highest location assigned from the counter at any point in the assignment process.

4. Location 00500, the initial location assignment.

5. One location beyond the highest location assigned from a point in the assignment process specified by the programmer.

Each time the Processor encounters a LASN, it sets the designated counter and makes subsequent assignments from that counter. This continues until another LASN is encountered or until the assignment process is completed. Multiple counters are useful when specifying location assignments in a program of many sections, because one counter can be allocated to each section.

The LASN is written as follows:

TAG FIELD. This field must be left blank.

OPERATION FIELD. The mnemonic code LASN is placed here.

NUMERIC FIELD. The counter to be set is designated in column 22 of this field. The column is left blank when designating the Blank counter; each of the other counters is designated by one of the digits 1-9. The Blank counter may be considered the primary counter, since it is used by the Processor in the absence of any LASN statements. Additional information on the Blank counter is supplied in the section "Location Assignments from the Blank Counter."

OPERAND FIELD. To set the counter designated in the numeric field, the entry in this field may be one of the following:

1. An actual operand. The counter is set to the location specified by the operand.

2. The tag of a statement appearing anywhere in the program <u>before</u> the LASN. In other words, the tagged statement must have a lower page and line number than that of the LASN. The counter is set to the location previously assigned to the instruction or field identified by the tag. The tag may be character-adjusted.

3. A blank operand. The counter is set to one location beyond the highest location previously assigned from it.

4. A location counter, with or without adjustment. If there is no adjustment the assignment continues, i.e., starts in the next available location.

To reset the counter to location 00500, from which the standard assignment process starts, leave columns 23-73 blank and place the character R in column 74. When used in column 74 of a LASN statement, this character may be considered the Reset character. (For additional information on the Reset character see the section entitled "Flag Characters and Their Meanings.")

COMMENTS FIELD. When a tag or an actual operand is used, comments about the statement may be placed in this field. When writing comments, column 74 should be examined to make sure it does not contain R. If it does, subsequent use of the counter is affected as described in the section entitled "Flag Characters and Their Meanings."

In Figure 70, storage assignments are shown to the right of the hand-coded Autocoder statements. Notice that the assignments made after the LASN statements are consistent with the requirement of a 4 or 9 location for instructions and with NAME statements that specify a location through an entry in the numeric field.

Tag	Operation	Num	Operand (74)	Assignments
	LASN		@2000	002000
				003007
START	NAME	0	END	003010
ONE	RCD	4	+	003013
TWO		7	#+04.03	003020
END	CON	4	ǂ	003024
	LASN	1	@50000	050000
TAG	ADCON		START	050004
				069994
	LASN	1	TWO	003014
EXTRA	RCD	7	#+05.02	003020
				004000
	LASN	1		069995
	LASN	1	R	000500
	LASN			003025

Figure 70

LOCATION ASSIGNMENTS FROM THE BLANK COUNTER. The Processor uses the Blank counter unless directed by a LASN statement to do otherwise. When the assignment of the machine language version of the source program is completed, the library subroutines must be assigned. The Processor uses the Blank counter to make the assignments. It first sets the Blank counter to one location beyond the highest location previously assigned, no matter what counter was used to make assignment. After it completes the subroutine assignments, it repeats the same process in assigning the literal table, i.e., it sets the Blank counter to one location beyond the highest location previously assigned. If no LASNs have been encountered within a subroutine, the Blank counter itself contains the highest location previously assigned at the time the literal table is to be positioned. The programmer should keep this use of the Blank counter in mind when placing LASN statements in subroutines. (The entire assignment of library subroutines and the literal table may be altered by LITOR and SUBOR. Both are instructions to the Processor and are explained on subsequent pages.)

RESTRICTIONS. A LASN statement may not be referred to by another Autocoder statement.

Special Assignment - SASN

The function of a SASN statement is to set the Blank counter as follows:

1. To an actual assignment specified by the programmer.
2. To an actual location, unknown to the programmer, that has already been assigned by the Processor to a field or an instruction.

SASN is a limited form of LASN. Like LASN, it may be used in library subroutines as well as in programs. However, it differs substantially from LASN in the following respect. The highest location assignment resulting from a SASN is ignored when the Processor sets the Blank counter to one location beyond the highest location previously assigned from the counter. (Such a setting is specified by a LASN with a blank operand.) In effect, location assignments resulting from a SASN are no longer significant once the SASN is terminated. Termination of a SASN results when a LASN is encountered, no matter what counter the LASN designates or what type of operand it contains.

Because the SASN is a limited form of LASN, it does not require a detailed explanation. It is written as follows:

Tag	Operation	Num	Operand
	SASN		X_1

X_1 is an actual operand, or is the tag of a statement appearing anywhere in the program before the SASN, or is a location counter. The tag or location counter may be character-adjusted.

Notice that the tag and numeric fields must be left blank. Comments may be placed in the comments field.

Figure 71 illustrates the fact that SASN assignments are ignored during subsequent LASN assignments.

Tag	Operation	Num	Operand [74]	Location Assigned
	LASN		@2000	002000
				002499
	SASN		@3000	003000
				004000
	LASN			002500

Figure 71

RESTRICTIONS. A SASN statement may not be referred to by another Autocoder statement.

Relative Assignment - RASN

This instruction allows a program or portion of a program to be assembled at one location and to treat all references to or within the program as if they were assembled at a different location. Various subroutines therefore, can be assembled relative to the same location, and at object time one of them can be moved for actual execution.

Locations will be assigned in the normal manner to the entries following a RASN, but references to them or any one of them will effectively be to their relative address.

A relative assignment will be terminated by any LASN, SASN, or TCD.

In Figure 72, the routine beginning with TAGA will be assembled starting at location 2000, but all references to the routine will be assembled as if the routine started at location 0300. The instruction used to move the routine should reference actual location 2000.

In Figure 73, the routine beginning with TAGA will be assembled starting at location 5005, but all references to the routine will be assembled as if the routine started at location 0300. The LASN is used to terminate the RASN. The instruction used to move the routine should reference REFTAG+5.

There are certain limitations to be observed when using a RASN:

1. As with a SASN, a RASN has no effect on the high assignment counters.
2. If location assignment is under control of a LASN or SASN at the time a RASN is encountered, it continues under control of the LASN or SASN.
3. At the time a RASN is encountered, the following, in effect, occurs: The location counter is

TAG	OP	NU	OPERAND	LOC	OP	NU	ADDRESS
	TR		OUT	5004	1		8004
	LASN		@2000	2000			
	RASN		@300	0300			
TAGA	CMP		CON 1	2004	4		0343
	TRE		*+25	2009	L		0334
	SHR		1	2014	C		0001
	TRZ		TAGB	2019	N		0329
	TR		TAGA	2024	1		0304
TAGB	HLT		9999	2029	J		9999
	LOD	01	CON 2	2034	8	01	0344
	TR		*+10	2039	1		0349
CON 1	CON	04	XXXX	2043			
CON 2	CON	01	Y	2044			
	LASN			5005			
	LOD	01	CON 2	5009	8	01	0344

Figure 72

TAG	OP	NU	OPERAND	LOC	OP	NU	ADDRESS
REFTAG	TR		OUT	5004	1		8004
	RASN		TAGAT300	0300			
TAGA	CMP		CON 1	5009	4		0343
	TRE		*+25	5014	L		0334
	SHR		1	5019	C		0001
	TRZ		TAGB	5024	N		0329
	TR		TAGA	5029	1		0304
TAGB	HLT		9999	5034	J		9999
	LOD	01	CON 2	5039	8	01	0344
	TR		*+10	5044	1		0349
CON 1	CON	04	XXXX	5048			
CON 2	CON	01	Y	5049			
	LASN			5050			
	LOD	01	CON 2	5054	8	01	0344

Figure 73

incremented by one, and the high-order location of the operand of the RASN is obtained. The difference between these two must be a multiple of five, or inconsistent results will occur. Therefore, it is recommended that a RASN always be preceded by a LASN or SASN, and both have as operands actual addresses or tags that are similarly positioned with respect to the low-order location.

A RASN statement is written in the format shown below.

Tag	Operation	Num	Operand
	RASN		X_1

X_1 is an actual operand, or
is the tag of a statement appearing anywhere in the program before the RASN, or
is a location counter.
A tag or location counter may be character adjusted.

The tag and numeric fields must be left blank. Comments may be placed in the comments field.

RESTRICTIONS. A RASN statement may not be referred to by another Autocoder statement.

Assignment of Subroutines Within Macro-Instructions - SUBRO

The function of a SUBRO statement is to cause the

Processor to treat the coding that follows it as a subroutine and to locate it out of line. The Processor assigns storage locations to SUBRO routines after it has assigned locations to Class A subroutines. The user designates in the operand of the SUBRO statement the storage location at which the Processor is to begin assigning addresses.

A SUBRO statement must not be written in a source program. It is designed to be used with user-written macro-instructions. A complete explanation of the usage of a SUBRO is given in the IBM manual, "7080 Processor: Preparation of Macro-Instructions," Form C28-6264.

Assignment of Library Subroutines - SUBOR

The function of a SUBOR statement is to specify the starting location for the assignment of library subroutines. The SUBOR assignment supersedes the standard subroutine placement, i.e., after the last instruction in the program. SUBOR enables the user to position the block of subroutines anywhere in storage, and the statement itself may be written at any point in the program. For a program written in two modes, it may be necessary to place the subroutines below the storage limit of the secondary mode. For example, the primary mode of a program is 7080, and the secondary mode may be 705 III. If the 705 III portion of the program must have access to the subroutines, and it is anticipated that the final instruction will occupy a location close to or beyond the storage size of the 705 III, a SUBOR must be used to position the subroutines in the lower portion of storage. This would alter the order of the object program parts so that the block of subroutines would be placed within the machine language equivalent of the source program. It may even be desirable to place the subroutines at the beginning of the object program.

The SUBOR statement is written as follows:

Tag	Operation	Num	Operand
	SUBOR		X_1

X_1 is an actual operand, or
is the tag of an Autocoder statement, or
is a location counter.
The tag or location counter may be character-adjusted. The tagged statement must precede the SUBOR statement.

Comments may be placed in the comments field.

Figure 74 indicates that the programmer assumes the subroutines cannot possibly occupy more than 5,000 positions.

TAG (6–15)	OPERATION (16–20)	NUM. (21–22)	OPERAND (23–)
	SUBOR		@160
	LASN		@5160
RECORD	NAME		ENDRECORD
	⁝		
	⁝		

Figure 74

RESTRICTIONS ON THE SUBOR STATEMENT. A SUBOR statement may not be referred to by another Autocoder statement.

Assignment of Literals - LITOR

The function of a LITOR statement is to specify the starting location for the assignment of the literal table. The LITOR assignment supersedes the standard literal table placement, i.e., after the subroutine block or after the last instruction of the program if no subroutines are used. LITOR enables the user to position the literal table anywhere in storage, and the statement itself may be written at any point in the program. (The previous discussion on the use of SUBOR applies as well to LITOR.)

The LITOR statement is written as follows:

Tag	Operation	Num	Operand
	LITOR		X_1

X_1 is an actual operand, or
is the tag of an Autocoder statement, or
is a location counter.
The tag or location counter may be character-adjusted. The tagged statement must precede the LITOR statement.

Comments may be placed in the comments field.

In Figure 75, the Processor is instructed to start the literal table assignment at the same location already assigned to TAG. It must be assumed either that the contents of TAG are no longer needed when the literal table is actually placed in storage or that the contents of TAG are placed in storage after the literal table is no longer needed.

TAG (6–15)	OPERATION (16–20)	NUM. (21–22)	OPERAND (23–)
	⁝		
	LITOR		TAG
	⁝		

Figure 75

RESTRICTIONS. A LITOR statement may not be referred to by another Autocoder statement.

Transfer Card - TCD

The function of a TCD statement is to create a "00" transfer control card in addition to the standard "00" card that terminates the object program deck. The additional "00" card will be internal to the object program, occupying the same relative position in it that the TCD statement occupies in the source program. If a Z character is placed in column 74 of the TCD statement, the generated TCD "00" transfer control card will be produced at the end of the object program and will replace the standard "00" card (see section "Flag Characters and Their Meanings").

The TCD statement must be followed by Autocoder statements that specify the contents of the card, i.e., the instructions or the instructions and data the card will contain. The last of these Autocoder statements must be a transfer back to the loading program or to another object program instruction that is already in storage. A LASN (or SASN) statement must be used after the final statement supplying the contents of the "00" card. A program may contain more than one TCD statement. Multiple TCDs may be written consecutively or interspersed throughout the program.

The format of the TCD statement is as follows:

Tag	Operation	Num	Operand
	TCD		

Comments about the "00" card may be written in the comments field. A tag is not needed.

THE EFFECT OF THE "00" CARD ON THE LOADING PROCESS. As previously explained, a "00" card causes the loading program to interrupt the loading procedure and to execute the instructions on the card as soon as it is loaded into storage. The area of storage assigned to the contents of any "00" card is the input area used by the loading program, i.e., locations 000080-000159. On the standard "00" card that the Processor automatically produces, the final instruction is a transfer to the first instruction in the object program. A return is not made to the loading program, because the standard "00" card is the final card of the object program deck. In contrast, the "00" card created by a TCD statement is followed by additional object program cards. Consequently, this "00" card must contain as its final instruction a transfer back to the loading program or to some other routine, already in storage, that will ultimately return control to the loading program.

A "00" card is often used to execute an overlapped routine, as shown in Figure 76. As soon as the "00" card is placed in the loading input area, a transfer is made to the HOUSEKEEP routine, which is already in storage. The last instruction of the routine is a transfer back to the "00" card, which transfers in turn to the loading program. When loading is resumed, the HOUSEKEEP routine will be overlapped by the CALCULATE routine.

TAG (6–15)	OPERATION (16–20)	NUM. (21–22)	OPERAND (23)
HOUSEKEEP	SEL		0500
	⋮		
ENDHOUSEKP	TR		ZEROCARD
	⋮		
	TCD		
	TR		HOUSEKEEP
ZEROCARD	TR		@00004
	LASN		HOUSEKEEP
CALCULATE	ADDX		ONE¤TWO¤THREE¤
	⋮		

Figure 76

RESTRICTIONS ON THE TCD STATEMENT. The machine language version of the Autocoder statement specifying the "00" card content may not exceed 65 positions. (A machine language instruction occupies five positions.)

If an object program contains "00" cards created from TCD statements, the input area of the loading program used with the object program must start at location 000080.

INSTRUCTIONS TO THE PROCESSOR THAT CONCERN OBJECT PROGRAM CONTENT

Include Subroutine - INCL

The function of an INCL statement is to designate a library subroutine that the Processor is to insert in the object program. The source program must also contain an instruction or a routine that supplies the linkage to the subroutine designated by an INCL statement. The format of the INCL statement is as follows:

Tag	Operation	Num	Operand
	INCL		X_1

X_1 is the five-character mnemonic identification code of the subroutine to be included.

Comments about the subroutine may be written in the comments field.

The function of the macro-instruction LINK, used in Figure 77, is to provide linkage to a subroutine.

The subroutine is ROOTS; the tag of its entry point is STEP1.

TAG (6–15)	OPERATION (16–20)	NUM. (21–22)	OPERAND (23–)
	LINK		STEP1⌑
	≀		
	INCL		ROOTS

Figure 77

TYPES OF LIBRARY SUBROUTINES. Programmers may write subroutines in Autocoder language and add them to the standard Processor library. Such a subroutine will be included in a program assembly only if it is designated by an INCL statement. The standard library also contains subroutines that are required by macro-instructions, but the Processor automatically supplies these subroutines, and the details of their inclusion are not relevant to the use of INCL.

Two types of subroutines may be written in Autocoder language:

1. Class A. These may contain any Autocoder statement.
2. Class B. These may contain any Autocoder statement, including NAME entries, except the following: macro-instructions other than ENT80 and LEV80, an INCL that designates a Class A subroutine.

RESTRICTIONS ON THE INCL STATEMENT. An INCL statement may not be referenced by another Autocoder statement.

Translation - TRANS

The function of a TRANS statement is to equate the operand of a one-for-one instruction into an actual location derived from the operand of the TRANS.

The TRANS statement designates an actual location and equates it to the reference made by the operand of a one-for-one instruction. More than one instruction may reference the same TRANS statement. In this case, all references will be equated to the location designated by the TRANS.

The TRANS statement is written as follows:

TAG FIELD. The entry in this field must be the tag that appears as the operand of the one-for-one instruction making the reference.

OPERATION FIELD. The mnemonic code TRANS is placed here.

NUMERIC FIELD. This field must be left blank.

OPERAND FIELD. The entry in this field may be one of the following operands:

1. An actual operand. This location will appear as the operand of an object program requesting instruction regardless of the memory orientation of the operation.
2. A location counter without character adjustment (*). The location of the instruction following the TRANS will appear in an object program instruction wherever the tag of the TRANS appears as a source program operand.
3. A location counter with any character adjustment. The location of the instruction immediately following the TRANS with character adjustment applied will appear in an object program instruction wherever the tag of the TRANS appears as a source program operand.
4. A tag of another location including the location of another TRANS. The operand may have a character adjustment and/or an operand modifier other than an address constant literal; such an operand will be treated as an actual operand. The maximum number of TRANS statements with symbolic operands is 50 per Processor run.

COMMENTS FIELD. Comments may be placed here.

In Figure 78, the TRANS statement equates MASTERTAPE to an actual tape address. In the object program listing, the machine language version of the SEL instruction will contain the address 0200.

TAG (6–15)	OPERATION (16–20)	NUM. (21–22)	OPERAND (23–)
	SEL		MASTERTAPE
	≀		
MASTERTAPE	TRANS		0200

Figure 78

Assume that location 05009 is assigned to the first instruction generated from the ADDX macro-instruction in Figure 79. The operand of the TR instruction is also translated to 05009, because the TRANS statement does not exist in the object program. The * operand of a TRANS statement is, in effect, *+5.

TAG (6–15)	OPERATION (16–20)	NUM. (21–22)	OPERAND (23–)
	TR		NEXT
	≀		
NEXT	TRANS		*
	ADDX		ONE⌑TWO⌑THREE⌑

Figure 79

If the RD instruction in Figure 80 is assigned to location 03059, the operand of the TR instruction will be translated to 03054. This results from the fact that the TRANS statement does not appear in the object program. Consequently the BSP instruction is the instruction actually preceding the RD instruction and is assigned to location 03054.

TAG (6–15)	OPERATION (16–20)	NUM. (21–22)	OPERAND (23–)
	TR		ERROR
	~		
	BSP		
ERROR	TRANS		*-5
	RD		AREA

Figure 80

RESTRICTIONS ON THE TRANS STATEMENT. If a TRANS statement has a location counter, actual operand, operand modifier, or adjustment, the statement that references the tag of the TRANS cannot have an operand modifier since it has no significance.

Source Program Language - MODE

An Autocoder program may contain statements written in the following languages:

1. FORTRAN
2. Report/File Writing
3. Decision
4. Arithmetic
5. Table-Creating

The term "higher languages of the 7080 Processor" includes all of the above-listed languages except FORTRAN. MODE statements are instructions to the Processor that indicate a change in the language of the source program, and they must be used in Autocoder programs that contain Report/File Writing statements and/or FORTRAN statements. MODE statements may not be tagged, but comments may be written in the comments field.

FORTRAN MODE STATEMENT. The statement in Figure 81 must precede each Fortran portion of an Autocoder program.

TAG (6–15)	OPERATION (16–20)	NUM. (21–22)	OPERAND (23–)
	MODE		FORTRAN4

Figure 81

The operand FORTRAN indicates that the subsequent statements are in standard FORTRAN format.

REPORT/FILE WRITING MODE STATEMENT. The statement shown in Figure 82 must precede each Report/File Writing portion of an Autocoder program.

TAG (6–15)	OPERATION (16–20)	NUM. (21–22)	OPERAND (23–)
	MODE		REPORT

Figure 82

AUTOCODER MODE STATEMENT. The statement shown in Figure 83 must precede each Autocoder portion of a program if that portion follows Report/File Writing or FORTRAN statements. The statement is used whether or not the Autocoder portion also contains Decision, Arithmetic, and Table-Creating statements.

TAG (6–15)	OPERATION (16–20)	NUM. (21–22)	OPERAND (23–)
	MODE		AUTOCODER

Figure 83

NOTE: This MODE statement is not used when the entire program consists of Autocoder statements alone or in combination with Decision, Arithmetic, and/or Table-Creating statements.

CODING GENERATED IN 7080 MODE

The terms "7080 mode" and "secondary mode" are used throughout this manual. They refer to the object machine for which the Processor produces coding, makes location assignments, etc.

The program mode is communicated to the Processor by using the macro-instructions Leave Eighty Mode (LEV80) and Enter Eighty Mode (ENT80), both of which are described in the macro-instruction manual. The 7080 mode is assumed until a LEV80 is encountered. Of course, if the entire program is in 7080 mode, the LEV80 and ENT80 are not necessary. Since these macro-instructions are Assembly Control macro-instructions, they should be considered along with other instructions to the Processor.

LEV80 and ENT80 affect the coding generated from the statements in the portion of the program that each of them precedes. The Processor generates 7080 instructions until it encounters a LEV80. It then generates 705 II or 705 III coding, depending on which is designated as the secondary mode for the assembly, until ENT80 is encountered. The Processor then resumes generation in 7080 mode. The program mode is a consideration in using address constants, macro-instructions, one-for-one instructions, and instructions to the Processor. For example, the Processor generates an EIA instruction when it encounters an indirect address in the operand of an instruction in the 7080 mode portion of a program. This is true whether the indirect address appears in a hand-coded one-for-one instruction or a generated instruction. As another example, an ACON6 should not be referenced by an instruction outside the 7080 mode portion of a program.

INSTRUCTIONS TO THE PROCESSOR THAT CONCERN THE PROGRAM LISTING

Skip to New Page - EJECT

The function of an EJECT statement is to advance the listing to a new page. The program statement that follows EJECT will be the first statement on the new page. Unless the listing is controlled by EJECT statements, each page will contain 55 lines of print. The statement is written as shown in Figure 84. It may not be tagged, and it may contain only one line of comments.

TAG (6–15)	OPERATION (16–20)	NUM. (21–22)	OPERAND (23–)
	EJECT		

Figure 84

EJECT does not appear on the listing page. However, it is assigned an index number, and the number is one greater than the index number of the statement that precedes the EJECT. (Index numbers are explained in Chapter 8.)

Title for Routine or Comment - TITLE

The function of a TITLE statement is to place lines or paragraphs of descriptive information in the program listing. TITLE may be used in any way the programmer desires; some of the more common uses will be discussed following the specifications for writing the statement.

The TITLE statement is written as follows:

OPERATION FIELD. The mnemonic code TITLE is placed here (see Figure 85). If the information is continued into subsequent lines of the coding sheet, i.e., is written as a paragraph, only the first line must contain TITLE. If a series of paragraphs is written, and each is separated by one or more blank lines on the coding sheet, the lines of the paragraphs will be treated as TITLE continuation lines.

NUMERIC FIELD. This field may contain an entry in the first TITLE line. However, it must be left blank in the continuation lines. It is recommended that the numeric field be left blank at all times.

TAG FIELD, OPERAND FIELD, COMMENTS FIELD. Any or all of these fields may be used for the descriptive information. The commentary does not have to start in the first column of any of the fields, and it does not have to extend to the end of the comments field before a continuation line is started.

COMMON USES OF TITLE. Describing the function of each program portion, summarizing program procedures, and providing a table of contents for the program listing are a few of the uses for TITLE. In addition to appearing in the program listing, all TITLEs are also printed in a special section of the Operator's Notebook, an optional feature of the assembly documentation provided by the Processor. This special page shows each TITLE and its location in the listing. This TITLE page is useful as an index for the program listing. It is often desirable to have information about the program at the start of the listing and/or before each major program portion. TITLE can be combined with EJECT, as in Figures 86 and 87, to provide a page of commentary only.

When planning pages of commentary or describing program parts, it should be remembered that an EJECT statement before each part will cause that part to appear on a new page of the listing. Thus, EJECT and TITLE may be used to separate each program portion, to describe it, and to provide a table of contents or an index. The standard listing

TAG (6–15)	OPERATION (16–20)	NUM (21–22)	OPERAND (23–39)	COMMENTS (40–62)	63	65	67	69	71	73	74
	TITLE		THIS INSTRUCT	ION IS USEFUL FOR							
			PROVIDING COM	MENTARY ABOUT A PROGRAM.							

Figure 85

TAG (6–15)	OPERATION (16–20)	NUM (21–22)	OPERAND (23–39)	COMMENTS (40–62)	63	65	67	69	71	73	74
	TITLE		ABC PAYROLL PR	OGRAM - FOUR PARTS							
			PART 1 CONTAIN	S THE HOUSEKEEPING							
			ROUTINE	, WHICH IS ONLY							
	⌇										
	⌇										
	EJECT										

Figure 86

TAG (6–15)	OPERATION (16–20)	NUM (21–22)	OPERAND (23–39)	COMMENTS (40–62)	63–74
	TITLE		ABC PAYROLL PROGR	AM. THIS PROGRAM	
			CONTAINS FOUR PAR	TS. THE DETAILS OF	
			EACH ARE SUPPLIED	AT THE POINTS LISTED B	ELOW.
PART1			HOUSEKEEPING	PGLIN 201	
PART2			DEFINITIONS AND C	ONSTANTS PGLIN 219	
	≀				
	≀				
	EJECT				

Figure 87

page contains 55 lines unless EJECT is used. In Figure 86, it must be assumed that TITLEs designating the four program parts have been used elsewhere in the program and that this TITLE page is to be the introductory page of the listing.

In Figure 87, it must be assumed that the listing page containing each of the parts is headed by a TITLE describing that part of the program.

FLAG CHARACTERS AND THEIR MEANINGS

Flags are a means of communicating with the Processor. Specific single-character flags, explained below, have been defined for use in column 74 of all input to the Processor except FORTRAN and COBOL statements. Additional flags may be allocated in the future, and they will be made available as soon as completely defined. Should any character be encountered in column 74 when its use is unintentional, inconsistencies may occur in the assembled program.

@ - Force Program Card

This flag will cause the output produced from the entry containing the flag to begin on a new program card.

A - Reduce Location Assignment Phase Assembly Time

This flag is for use within Class B subroutines. It is placed in column 74 of statements which have tags that will be the operands of assignment statements (e.g., LASN, SASN, RASN).

All entries bearing this flag will be placed in a table that is used when assignment statements are encountered. This reduces the assembly time for Class B subroutines (which are processed in the location assignment phase).

B - Scan Entry from Right to Left

This flag will cause the Processor to scan the entry containing it from right to left rather than from left to right, and has two specific uses:

1. To allow the literal operand of a one-for-one statement to contain a literal symbol within it. The literal operand of a statement so flagged will be interpreted as being unsigned, having no decimal positions, and having no character adjustment.

2. To allow the lozenge terminating an operand of a macro-header to be contained within the operand. The specific operand with the flag must be on a separate card; otherwise, all operands on the card will be considered as one, with a length equal to the cumulative lengths of all. The flagged operand will be interpreted as being an unsigned literal, having no decimal positions, and having no character adjustment. The first and last characters in the operand will be assumed to be literal signs and will be dropped even if they are not literal signs.

C - Entire Card is a Comment

Columns 6 through 73 of an entry containing this flag will be considered a comment, and entries so flagged will also be printed, single spaced, on a separate page of the Operator's Notebook. Entries with this flag that are contained in the input to a librarian run will not be treated as components of macro-instructions, and will be removed. Their function in this case is solely for the purpose of listing on an IBM 407.

D - Delete All Messages Created for this Entry

An entry containing this flag will be processed normally but diagnostic messages, if any, will not be produced for it.

F - End of a Chain of Family Macro-Instructions

This flag enables a family macro-header in one chain to contain macro suffix tags or generated descriptive tags that refer to a family macro-instruction in another chain, when both chains are not separated by a nonfamily macro-header. (The use of the F flag is explained in "7080 Processor: General Purpose Macro-Instructions," Form J28-6266.)

G - Treat Change Entry as Generated Entry

This flag is provided for use with change entries introduced in a high-speed reassembly run, and will cause the entries containing it to be considered as generated entries during a subsequent reassembly. That is, during a subsequent reassembly with macro-generation, the entries will be deleted; and, during a subsequent high-speed reassembly, the entries will be retained.

H - Halt Loop

This flag, intended for use in entries that constitute the error-indication portions of a program, will cause entries containing it to be listed on the Halts page of the Operator's Notebook.

M - Operand is to be Modified

This character may be used to flag all entries having operands that are not blank, but are to be initialized and/or modified, and will cause these entries to be printed on the page of the Operator's Notebook containing entries with blank operands.

R - Reset Location Counter

Placing the Reset character (R) in column 74 of a LASN statement containing an actual or a tag operand does not modify the setting designated by the operand. However, it may affect a subsequent setting designated by a blank operand for the same counter, because the Processor will ignore any assignments it made before encountering the statement containing the Reset character.

This may best be seen with an illustration. Suppose that the highest assignment made from counter 1 is location 59999. The Processor then encounters a LASN for counter 1 to location 2000. After setting the counter, the Processor assigns a block of 500 positions, bringing counter 1 to 2499. Now a LASN with a blank operand is encountered for counter 1. The counter is set to location 60000, one location beyond the highest assignment made from the counter up to this point in the assignment process. To return to the beginning of this example, when location counter 1 contains 59999, suppose that the Processor encounters a LASN for counter 1 to location 2000, but the statement also contains R in column 74. As before, the counter is set to 2000, a block of 500 positions is assigned, and the counter is again at 2499. Now a LASN with a blank operand is encountered for counter 1. Because the Reset character destroyed the previous high location (59999), the counter is set to 2500. This is one location beyond the highest assignment made by the Processor after it encountered the Reset character.

T - Test-Assembly Entry

Entries containing this flag will be retained during an assembly when the run-type control card so indicates. If not so indicated, all entries containing this flag will be deleted automatically. Statements, therefore, may be assembled for testing purposes, and easily removed.

Z - Relocate "00" Transfer Control Card

This flag is only used with a TCD statement. It causes the TCD "00" transfer control card to be placed at the end of the program in place of the standard "00" card. If more than one TCD statement contains this flag, the last one encountered prevails.

1 - Weight Inner Macro-Instruction as One

This flag may be used only with macro-headers when they are used as components of macro-instructions. It specifies that regardless of how frequently the macro-instruction containing it is used, the inner macro-instruction will be called so infrequently by it that, as a component of the particular outer macro-instruction, the Processor is to consider that the inner macro-instruction is called one time. Effective use of the flag will cause the Frequency Count Table to more accurately reflect the frequency with which each macro-instruction is used, so that the assignment of memory macro-instructions will be more efficient.

One card is punched for each line of the coding sheet, as explained in Chapter 1. A card-image tape produced from the source program deck is the input to the Processor. The assembly output consists of the object program deck and program documentation. Although the object program deck is produced on a card-image tape, it will be referred to as a deck.

OBJECT PROGRAM DECK

The sequence and contents of the deck is shown in the following list:

1. seven-card load program (LD7080)
2. literal table
3. machine language equivalent of source program
4. Class A subroutines
5. subroutines portions of macro-instructions
6. Class B subroutines
7. standard "00" transfer control card

Note that the literal table, although assigned to storage locations above those of the object program instructions, precedes the instructions into storage.

The format of the object program card is as follows:

1. Program identification (6 positions). This is the source program identification (ident field on coding sheet).
2. Serial number (3 positions). This is the number of the object program card. It is assigned by the Processor and bears no relation to the number of a source program statement (Pglin field on coding sheet).
3. Initial address (4 positions). This indicates the storage location at which the first character on the card is to be placed.
4. Number of columns (2 positions). This is the amount of data being supplied by the card. A maximum of 65 positions may be indicated; this is the space required by 13 instructions. The "00" card contains zeros in these positions.
5. Instructions and/or constants (1-65 positions). This is the actual portion of the object program being supplied by the card. It is placed at the storage location specified by number 3 above.

ASSEMBLY DOCUMENTATION

A listing of the object program itself and diagnostic messages is the minimum assembly documentation; optional documentation consisting of the Operator's Notebook and the Symbolic Analyzer may be requested as additions to the listing. A column-by-column explanation of the listing format appears in a subsequent section of this chapter, "Details of the Listing."

Program Listing

The program listing is provided only on tape. The contents of the listing are as follows:

1. First Page. This page is blank except for a heading line and a notation of the highest memory position used, not resulting from a RASN or SASN.
2. Literal Table. The literal table is divided into seven parts. (A signed literal is a literal in which the first position after the pound sign (#) is occupied by a plus or minus sign.)
   a. signed literals, length not a multiple of 5 or 10.
   b. signed literals, length a multiple of 5.
   c. signed literals, length a multiple of 10.
   d. unsigned literals, length a multiple of 10.
   e. unsigned literals, length a multiple of 5.
   f. unsigned literals, length not a multiple of 5 or 10.
   g. address constant literals.

   The address constant literals are broken down in the following order: unsigned, length of 6; signed, length of 6; signed, length of 5; unsigned, length of 5; and all lengths of 4 ending in a 4 or 9 location.
3. Source Program with Generated Coding. This may be considered the main portion of the program listing. The source program statements appear in their original sequence; any generated coding appears directly after the statement(s) that caused the generation.
4. Class A Subroutines. The subroutines are inserted alphabetically, i.e., according to the mnemonic identification code of each subroutine. Any generated coding appears directly after the statement that caused the generation.
5. Subroutine Portions of Macro-Instructions. The order of subroutines is the same as that of the macro-headers causing their generation.
6. Class B Subroutines. The subroutines are inserted alphabetically.
7. Diagnostic Messages. These messages are produced by the Processor and indicate errors, or possible errors, in source program statements. When the Processor detects a possible error condition, it often makes certain assumptions and generates coding based on them. It also supplies a warning message on the nature of the possible error or the

action taken to correct an error. The reference manual, "7080 Processor-System Operation," Form J28-6265, describes such messages.

8. Unreferenced Tags (NO REQS). On a separate page, hand-coded tags that are not referred to elsewhere in the program are listed.

OPTIONAL DOCUMENTATION

Operator's Notebook

This is an index to the location of certain types of Autocoder statements, both hand-coded and generated, that appear in the program listing. The pages that make up the Notebook are as follows:

1. TITLES
2. C FLAGS -- Comment statements with a C flag
3. 80 SPEC I -- All generated EIA resulting from an "I," prefix (indirect address)
4. TRANS -- All TRANS statements with descriptive operands
5. 80 SPEC OP -- All LEV80, ENT80, ENTIP, LEVIP, SPC, TIP, and LIP statements
6. SWITCHES -- (SWN and SWT)
7. H FLAGS AND HALTS
8. M FLAG and source-program blank operands
9. ASSGNS -- (LASN, SASN, RASN, SUBRO)

Symbolic Analyzer

This is an index of every hand-coded and generated tag in the program. The tags are listed in collating sequence, and each is followed by a list of every instruction, either hand-coded or generated, that references the tag. Tags that are used incorrectly are flagged with an error indicator appearing as *ERR*.

Each program entry that defines a tag will be listed. All entries having operands that reference the tag will be listed, three per line, following the tag definition. Any operand modifier and/or character adjustment in a referencing entry will be included, but ASU zoning in address constant literals, and comments, will not. Entries that refer to undefined tags will be listed separately.

DETAILS OF THE PROGRAM LISTING

The heading of each page in the listing contains the program identification, revision number (if any) and the date (from the date control card) and page number.

The listing page consists of 16 fields. The entries in the PGLIN through the FLAG fields comprise an Autocoder statement. The machine language translation of the statement (i.e., an object program instruction or constant) appears in the INSTR field. Other fields contain information on storage locations, statement sequence, and references to other statements. The fields of the listing are as follows:

INDEX. This is a number that the Processor creates for each line of the listing. A hand-coded statement is assigned a number of the form xxbyy; a generated statement is assigned a number of the form bxxyy. In each case, xx is the listing page number and yy is the line number. On a reassembly, a number of the form xx*yy is assigned to a statement that has been replaced, added, or that follows a deleted statement. The INDEX number is not identical to the pglin number on the coding sheet.

S. Origin of entry (i.e., whether it is a source program statement or a Processor-generated entry) and type of entry. Both items of information are conveyed by a single-character code, as follows:

Code	Origin	Type
A	Source Program	One-for-One
B	Source Program	Macro-Header
E	Source Program	Decision, Arithmetic, Table
F	Source Program	Report/File
G	Source Program	FORTRAN
I	Source Program	TITLE, C flag, and COBOL Statements
J	Generated	One-for-One
K	Generated	Macro-Header
N	Generated	Decision, Arithmetic, Table
O	Generated	Report/File
P	Generated	FORTRAN
R	Generated	TITLE and C flag Statements
*	Generated	EIA and Related Instruction

Note: All subroutine entries are generated.

PGLIN. The entry in this field corresponds to the PGLIN entry on the coding sheet.

TAG. Any hand-coded or generated tag appears in this field, which corresponds to the tag field on the coding sheet.

OP. Any mnemonic code appears in this field, which corresponds to the operation field on the coding sheet.

NU. The entry in this field varies just as it does when hand-coded. The field corresponds to the Num field on the coding sheet.

AT (Address type). An entry in this field is either an operand modifier or an indirect address. On the coding sheet, such entries are written in columns 23-24 of the operand field.

OPERAND. The entry of this field varies just as it does when hand-coded. The field corresponds to the operand field on the coding sheet with this exception: The placement of a prefix to the basic operand; this appears in the AT field explained in the preceding paragraph.

COMMENTS. Any source program comments appear in this field, which corresponds to the comments field on the coding sheet.

F. Flag code.

LOC. The entry in this field is a six-character number designating the location assigned to the object program instruction or constant.

INSTR. The entry is a five-position field containing the actual operation code of the instruction followed by the actual address with ASU zoning.

SU. The entry in this field is an ASU number. It does not necessarily correspond to the num field, which is used for other purposes besides ASU assignments.

ADDR. This field contains the actual address portion of an instruction as six positions.

SER. An entry in this field is the three-character serial number of an object program card. The number appears only in the line containing the first character on the object program card. Subsequent lines with blanks in the SER field contain data that appear on the same card.

REF. An entry in this field is the INDEX number of the operand and serves as a cross-reference. (Within a NAME, the number in this column is the cumulative length of the NAME.)

GLOSSARY OF TERMS

The terms that follow are explained in relation to their use in this manual. No attempt has been made to supply a glossary of basic programming terms. Definitions that appear in the text of the manual are not repeated on this page. The Index supplies page references to such definitions.

Address. Something that designates a storage location. The term "address of an instruction" and the term "address portion" both refer to the portion of a machine language instruction that identifies a storage location.

Alphabetic characters. The letters A-Z. Alphabetic data consists of alphabetic characters.

Alphameric characters. A set of characters comprising the following: alphabetic, numeric, special, blank, Alphameric data consists of any of these characters or any combination of them.

Blank character. The absence of a character. May be designated on the coding sheet by the symbol b.

Coding. Program statements that may or may not form a routine.

Data field. A unit of information consisting of an alphameric character or a set of adjacent alphameric characters.

Decimal positions. The positions to the right of the decimal point in numeric data.

Format layout. A graphic representation on the coding sheet of a specific arrangement of characters. Also referred to as a "layout."

Generated. An adjective describing coding provided by the Processor.

Hand-coded. An adjective describing coding written by the programmer.

Integer positions. The positions to the left of the decimal point in numeric data.

Initialization. A procedure that places an instruction or a switch in an initial condition or restores either one to a previously defined condition. Initialization is a type of modification.

Location. A place in storage. The term may refer to one storage position or the positions occupied by a field or an instruction. Also referred to as "storage location."

Machine language. A language that is intelligible to the computer. Also referred to as "actual language."

Machine language instruction. A 7080 machine instruction consisting of an actual operation code and an address portion.

Mixed decimal. A term used to designate a number containing integer and decimal positions.

Modification. A procedure that alters an instruction or a switch setting. Address modification is the procedure of altering the address portion of an instruction.

Numeric characters. The digits 0-9. Numeric data consists of a combination of digits representing a signed or unsigned integer, pure decimal, or mixed decimal.

Processor library. The portion of the 7080 Processor System tape that contains the elements of each macro-instruction and each subroutine.

Pure decimal. A term used to designate a number containing decimal positions only.

Record. A set of adjacent data fields.

Secondary mode. Any mode other than 7080 mode.

Special characters. The following group of characters: . ⌑ǂ&$*-/,%#@+ǂ

APPENDIX

The more significant features that have been incorporated into Autocoder for the 7080 Processor are summarized below, by chapter headings. The reader can consult the appropriate sections of this manual for details on the changes.

Source programs that could be assembled by the 7058 Processor can also be assembled by the 7080 Processor. However, certain mnemonics which were accepted by the previous processor will not be accepted by the 7080 Processor. These invalid mnemonics are listed below:

1. DRCD, DCON, or DFPN
2. AACON, LACON, or RACON
3. AASN, OASN, or CASN
4. *ASUnn
5. Actual operation codes

In addition, CTL, while it may be used and will be accepted, will cause a warning message to be produced, and it will be assumed that the programmer has indicated the proper operand.

Certain differences between 7058 Autocoder and 7080 Autocoder result from expansion of the language and the incorporation of new features. Those differences are listed below.

1. A character in column 74 of a source statement, except one in FORTRAN or COBOL, will be considered a flag having specific significance to the 7080 Processor. The flag codes are described in the section on flags.

2. A character adjustment following an address constant literal request (e.g., L@TAG+5) will cause an increment to the assembled location of TAG rather than to the assembled location of the address constant.

3. A literal may not be followed by a multiply or divide character adjustment, nor may the amount of the character adjustment be outside the range ±99, i.e., be stated in more than two significant numbers. However, an increment or decrement can be written with leading zeros; e.g., +1 and +001 will cause the same increment, and -55 and -000055 will cause the same decrement.

4. No operand of a macro-header may exceed 35 positions unless it is surrounded by literal symbols; and no literal used as a macro-header operand or in a macro-instruction component may exceed 35 positions including the sign and decimal point, but not including the literal symbols.

Standard Format of Autocoder Statements: A new multipurpose coding form has been developed for use with the 7080 Processor. Column headings have been changed to accommodate certain new features of the Processor.

Area definitions: Area definition length may be specified by a six-digit number, which can be written in columns 17-22. Restrictions on comments continuation lines with area definitions have been altered to reflect the new meaning of the columns. RPT statements are restricted to nine commas in the layout format.

One-for-one instructions: The list of acceptable mnemonics has been expanded and provision has been made for additional numeric codes to accompany various operation codes. The changes are detailed in Figure 44. Restrictions on character adjustment have been expanded, particularly with respect to literal operands. A new operand modifier (T,) has been provided for both one-for-one instructions and address constants.

General Purpose Macro-Instructions: Up to 50 operands can be written in the macro-header. As many as 50 lines in the coding form can be used for the operands of one macro-instruction. Literal operands must not exceed 35 characters excluding the literal (#) signs.

Address constants: An ACON6 can have a sign associated with it. Address constant literal requests of arithmetic operations will be six positions long with a signed plus. Formerly, such address constant literals were five positions. Character adjustment may be used for the purpose of modifying the constant itself.

Instructions to the Processor: The initial setting of the location counter is now 00500. Restrictions on LASN, SASN, SUBOR, and LITOR statements have been eased. The location counter, with or without adjustment, is now a valid operand for these statements. Two new assignment statements (RASN and SUBRO) have been added. A TRANS statement can have the tag of another location as its operand. A TCD statement can now occupy 65 positions. 7080 mode is assumed until a LEV80 is encountered. To return to 7080 mode following a LEV80, the ENT80 macro-instruction is given. Additional instructions to the Processor in the form of Flag characters have been added to the Autocoder language. The use of Flags, particularly the F Flag, should be carefully considered.

Assembly Documentation: The listings that are provided have been expanded considerably. This entire section should be reviewed.

INDEX S PGLIN	TAG	OP	NU AT	OPERAND 80SMPL-001 10-20-62 PATCHES	PG 001 F	LOC	INSTR SU	ADDR	SER	REF
								005439		

INDEX S PGLIN	TAG	OP	NU AT	OPERAND 80SMPL-001 10-20-62	COMMENTS	PG 002 F	LOC	INSTR SU	ADDR	SER	REF
¤A01	SIGNED LITERAL		1				005175			001	
¤A02	SIGNED LITERAL		1	A			005176				
¤A03	SIGNED LITERAL		2	1&			005178				
¤A04	SIGNED LITERAL		4	123D			005182				
¤A05	SIGNED LITERAL		4	395G			005186				
¤A06	SIGNED LITERAL		7	BALANCN			005193				
¤A07	SIGNED LITERAL		7	987654C			005200				
¤A08	SIGNED LITERAL		5	0021E			005209				
¤A09	SIGNED LITERAL		10	0M5678000&			005219				
¤A10	UNSIGNED LITERAL		50	AGE	CLOSING LIT SYMBOL OMITTED		005269			002	
¤A11	UNSIGNED LITERAL		50	THIS LITERAL OVERFLOWS INTO THE NEXT CARD WHICH IS			005319			003	
¤A12	UNSIGNED LITERAL		5	ABCDE			005324				
¤A13	UNSIGNED LITERAL		5	APPLE			005329				
¤A14	UNSIGNED LITERAL		1	F			005330				
¤A15	UNSIGNED LITERAL		1	G			005331				
¤A16	UNSIGNED LITERAL		1	J			005332				
¤A17	UNSIGNED LITERAL		1	1			005333				
¤A18	UNSIGNED LITERAL		2				005335				
¤A19	UNSIGNED LITERAL		2	60			005337				
¤A20	UNSIGNED LITERAL		3	300			005340				
¤A21	UNSIGNED LITERAL		4	ABLE			005344				
¤A22	UNSIGNED LITERAL		4	DUPE			005348				
¤A23	UNSIGNED LITERAL		4	0010			005352				
¤A24	UNSIGNED LITERAL		7	1234567			005359				
¤A25	UNSIGNED LITERAL		8	-BALANCE			005367			004	
¤A26	UNSIGNED LITERAL		9	LOCATIONA			005376				
¤A27	UNSIGNED LITERAL		14	NOT AVAILABLE¤			005390				
&A01	NAMEA	RIGHT	6	001089			005396				AC51
$A01	NAMEA	SIZE	6	00004&			005403				AC51
*A01	NAMEA	SIZE	5	0004&			005409				AC51
-A01	NAMEA	RIGHT	5	01089			005414				AC51
/A01	123D	RIGHT	4	5182			005419				¤A04
/A02	*&000025	RIGHT	4	0&&0			005424				
/A03	EXIT	RIGHT	4	1604			005429				AF55
/A04	NAMEA	HI-SP	4	1064			005434			005	AC51
/A05	NAMEA	RIGHT	4	1&93			005439				AC51

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INDEX S PGLIN    TAG      OP    NU AT OPERAND 80SMPL-001  10-20-62   COMMENTS   PG 003  F  LOC    INSTR SU  ADDR  SER  REF

AA 01 I AA01               TITLE       7080 PROCESSOR - SAMPLE ASSEMBLY

AA 02 I AA02                           INTRODUCTION

AA 03 I AA03  THIS ASSEMBLY ILLUSTRATES CORRECT AND INCORRECT USAGES OF THE 7080      C
AA 04 I AA04  PROCESSOR. SHORT CODING EXAMPLES ARE USED TO SHOW WHAT THE              C
AA 05 I AA05  PROCESSOR PRODUCES, INCLUDING ERROR AND CAUTIONARY MESSAGES, FOR        C
AA 06 I AA06  TYPICAL VALID AND INVALID STATEMENTS. COMMENT AND TITLE STATEMENTS      C
AA 07 I AA07  AND THE COMMENTS FIELD OF ILLUSTRATIVE STATEMENTS, HAVE BEEN USED TO    C
AA 08 I AA08  DESCRIBE THE USAGES. THIS ASSEMBLY IS FOR ILLUSTRATIVE PURPOSES ONLY    C
AA 09 I AA09  AND DOES NOT REPRESENT AN EXECUTABLE PROGRAM. THE OBJECT MACHINE IS     C
AA 10 I AA10  ASSUMED TO BE AN 80K 7080, ASUS 1-6 ARE ASSUMED SET TO LENGTHS OF       C
AA 11 I AA11  1-6 RESPECTIVELY, AND THE OTHER ASUS AND ACC ARE AT SOME RANDOM         C
AA 12 I AA12  LENGTH.                                                                 C

AA 13 I AA13               TITLE       NORMAL ORIGIN

AA 14 I AA14  SINCE NO STARTING LOCATION IS SPECIFIED, THE ORIGIN OF THE              C
AA 15 I AA15  PROGRAM IS ASSUMED TO BE AT LOCATION 0500.                              C
AA 16 A AA16               RCD    1                  TO SHOW STARTING LOCATION.         000500

AA 17 I AA17               TITLE       AREA DEFINITIONS

AA 18 I AA18                                DEFINITION OF A RECORD FIELD - RCD
AA 19 A AA19  RCDA         RCD    10   N             TEN DIGIT UNSIGNED NUMERIC FIELD    000510
AA 20 A AA20
AA 21 A AA21                      17   A             SEVENTEEN POSITION ALPHA-NUMERIC    000527
AA 22 A AA22                           FIELD WHOSE LOW ORDER POSITION MAY NOT PROVIDE
AA 23 A AA23                           LEFT PROTECTION FOR ANY SIGNED NUMERIC FIELD IT
AA 24 A AA24                           PRECEDES.
AA 25 A AA25
AA 26 A AA26                    2 00   A&            TWO HUNDRED POSITION ALPHA-NUMERIC  000727
AA 27 A AA27                           FIELD WHOSE LOW ORDER POSITION WILL ALWAYS SUPPLY
AA 28 A AA28                           LEFT PROTECTION.  NOTE THAT THE LENGTH INDICATION
AA 29 A AA29                           OVERFLOWS INTO THE OPERATION FIELD.  THIS IS
AA 30 A AA30                           PERMISSIBLE ON A CONTINUATION ENTRY AS LONG AS
AA 31 A AA31                           COLUMN 16 IS BLANK.
AA 32 A AA32
AA 33 A AA33                      10   &             TEN DIGIT SIGNED INTEGER.  DECIMAL  000737
AA 34 A AA34                           POINT IS ASSUMED TO RIGHT OF THE LOW ORDER DIGIT.
AA 35 A AA35                           LEFT PROTECTION IS PROVIDED FOR THE FOLLOWING FIELD
AA 36 A AA36
AA 37 A AA37  RCDS5X3              8   &XXXXX.XXX    TWO ALTERNATE DEFINITIONS OF AN     000745
AA 38 A AA38  RCDS5X3A             8   #&05.03       EIGHT DIGIT SIGNED NUMERIC FIELD    000753
AA 39 A AA39                           HAVING FIVE INTEGER AND THREE DECIMAL POSITIONS.
AA 40 A AA40
AA 41 A AA41  RCDS0X3              3   &.XXX         TWO ALTERNATE DEFINITIONS OF A      000756
AA 42 A AA42                       3   #&00.03       THREE DIGIT SIGNED DECIMAL.         000759
AA 43 A AA43
AA 44 A AA44  RCDN2X3A             5   XX.XXX        TWO ALTERNATE DEFINITIONS OF A      000764
AA 45 A AA45                      05   # 02.03       FIVE DIGIT UNSIGNED NUMERIC FIELD   000769
AA 46 A AA46                           WITH TWO INTEGER AND THREE DECIMAL POSITIONS.
AA 47 A AA47
AA 48 A AA48                       1   #             RECORD MARK INDICATION.             000770
AA 49 A AA49
AA 50 A AA50                      10   F             TEN POSITION FLOATING POINT RCD.    000780

AA 51 I AA51                                      INVALID USAGES                      C
AA 52 A AA52               RCD     0                                                    000780
AA 53 A AA53                1000 00   A             ALTHOUGH IT IS VALID TO SPECIFY A   000781
AA 54 A AA54                          SIX DIGIT LENGTH IN THIS FASHION, THE SIZE OF
AA 55 A AA55                          OBJECT MEMORY IS SPECIFIED AS 80K FOR THIS PROGRAM.
AA 56 A AA56                          THIS STATEMENT WOULD BE VALID IF MEMORY SIZE WAS
AA 57 A AA57                          SPECIFIED AS 160K.
AA 58 A AA58
AA 59 A AA59               RCD     4                THIS WILL RESERVE FOUR PLACES BUT   000785
AA 60 A AA60                          WILL BE TREATED AS AN UNDEFINED RCD AREA BECAUSE
AA 61 A AA61                          &, N, A, OR A& ARE NOT INDICATED IN THE OPERAND
AA 62 A AA62
AA 63 A AA63               FIELD  .                 THE WORD FIELD, INTENDED AS A       000794 A0000    000000 006
AA 64 A AA64                          COMMENT CONTINUATION, WAS TREATED AS A NOP BECAUSE
AA 65 A AA65                          IT WAS IN THE OPERATION FIELD AND WAS NOT A VALID
AA 66 A AA66                          OPERATION.
AA 67 A AA67
AA 68 A AA68                       2  N             THIS STATEMENT, INTENDED AS A RCD   000796
AA 69 A AB16                          INTEGER PLACES AND 20 DECIMAL PLACES.

AA 70 I AB17               TITLE            DEFINITION OF A CONSTANT FIELD - CON
AA 71 A AB18  CONA         CON     5  ABCDE         FIVE POSITION ALPHABETIC, UNSIGNED  000801
AA 72 A AB19  CONN5X0              5  00003         NUMERIC, AND MIXED CONSTANTS. WILL  000806
AA 73 A AB20                       5  4JK9*         APPEAR IN MEMORY AS WRITTEN.        000811
AA 74 A AB21
AA 75 A AB22                       6  -123499       SIX POSITION SIGNED INTEGER         000817
AA 76 A AB23                          CONSTANT.  WILL APPEAR AS 12349R IN MEMORY.
AA 77 A AB24
AA 78 A AB25                       6  &1234.99      SIX POSITION SIGNED CONSTANT WITH   000823
AA 79 A AB26                          FOUR INTEGER AND TWO DECIMAL POSITIONS.  WILL
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INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  10-20-62   COMMENTS   PG 004  F  LOC    INSTR SU  ADDR  SER  REF

AB 01 A AB27                        APPEAR AS 12349I IN MEMORY.
AB 02 A AB28
AB 03 A AB29                     6  123.45          SIX POSITION CONSTANT WHICH WILL     000829
AB 04 A AB30                        APPEAR AS 123.45 IN MEMORY.
AB 05 A AB31
AB 06 A AB32                     3  A               THREE POSITION CONSTANT OF WHICH     000832
AB 07 A AB33                        THE FINAL TWO POSITIONS ARE BLANKS.
AB 08 A AB34
AB 09 A AB35                     2  ¤#              TWO POSITION CONSTANT CONSISTING     000834
AB 10 A AB36                        OF A GROUP MARK AND A RECORD MARK.

AB 11 I AB37                                  INVALID USAGES                        C
AB 12 A AB38  WORSTCASES CON     2  ABCDE           CON WITH OPERAND OF GREATER LENGTH  000836
AB 13 A AB39                        THAN NUMERIC FIELD STATES. WILL COMPILE AS AB WITH
AB 14 A AB40                        NO MESSAGE.
AB 15 A AB41
AB 16 A AB42                     3  &120            SIGNED CONSTANT WITH OPERAND        000839
AB 17 A AB43                        SHORTER THAN NUMERIC FIELD STATES. IT WAS PUNCHED
AB 18 A AB44                        &12  BUT WILL COMPILE AS 120 WITH THE LAST DIGIT
AB 19 A AB45                        SIGNED PLUS. HERE THE LISTING SHOWS THE ZERO.
AB 20 A AB46
AB 21 A AB47                     0  123             THIS WILL NOT COMPILE BECAUSE THE   000839
AB 22 A AB48                        NUMERIC FIELD STATES A LENGTH OF ZERO POSITIONS.
AB 23 A AB49
AB 24 A AB50                    62  THE NUMERIC FIELD STATES A LENGTH WHICH INCLUDES A  000901              007
AB 25 A AB51                        SECOND CARD. THE FIRST LINE WILL COMPILE, FOLLOWED
AB 26 A AB52                        BY 12 BLANKS. THE REST IS TREATED AS A COMMENT.
AB 27 A AB53
AB 28 A AB54                    14  -59969096439550  THIS CON, INTENDED AS PART OF A    000915
AB 29 A AB55                        MESSAGE AND PUNCHED -ERROR ROUTINE, WAS STRIPPED OF
AB 30 A AB56                        ZONING AND TREATED AS A SIGNED NUMERIC CON BECAUSE
AB 31 A AB57                        THE LEADING DASH  WAS INTERPRETED AS A MINUS SIGN.

AB 32 I AB58            TITLE           DEFINITION OF A FLOATING POINT CONSTANT - FPN
AB 33 A AB59            FPN         &03&123456      REPRESENTS &123.456                 000925              008

AB 34 I AB60  NOTE THAT THE NUMERIC FIELD IS BLANK AND THAT THE MANTISSA IS ONLY    C
AB 35 I AB61  SIX DIGITS. A LENGTH OF TEN WILL BE ASSUMED AND TRAILING ZEROS ADDED  C
AB 36 I AB62  TO MAKE AN EIGHT DIGIT MANTISSA. THE FPN APPEARS IN MEMORY AS         C
AB 37 I AB63  0C12345600 WITH THE UNITS DIGIT SIGNED PLUS. THE LISTING DOES NOT     C
AB 38 I AB64  SHOW THE ADDED ZEROS OR ASSUMED LENGTH.                               C
AB 39 I AB65                                                                        C
AB 40 I AB66                                  INVALID USAGES                        C
AB 41 A AB67            FPN         &04&9876543210    THIS OPERAND EXCEEDS THE MAXIMUM  000935
AB 42 A AB68                        LENGTH. THE MANTISSA IS TRUNCATED TO EIGHT DIGITS.  000945
AB 43 A AB69                        IT APPEARS IN MEMORY AS 0D9876543B.                 000955

AB 44 I AB70  THE TWO ENTRIES IMMEDIATELY ABOVE WERE INTENDED AS COMMENTS           C
AB 45 I AB71  COUTINUATIONS. THIS IS INVALID ON A FPN AND TWO FPNS WERE GENERATED   C
AB 46 I AB72  FROM THE OPERAND FIELDS. THE LISTING ONLY SHOWS THE MEMORY ALLOCATED  C
AB 47 I AB73  BUT THE CARDS SHOW 5E38103850 AND 307751920I.                         C
AB 48 I AB74                                                                        C
AB 49 I AB75  THIS FPN WAS INTENDED TO REPRESENT 123.456. OMITTING THE LEADING      C
AB 50 I AB76  ZERO OF THE CHARACTERISTIC CAUSED IT TO REPRESENT THE NUMBER          C
AB 51 I AB77  2345600000000000000000000000000.                                      C
AB 52 A AB78            FPN         &3&123456                                           000965

AB 53 I AB79  THIS OPERAND WAS INTENDED TO REPRESENT 123.456. OMITTING THE SECOND   C
AB 54 I AB80  PLUS SIGN CAUSED IT TO REPRESENT 234.56                               C
AB 55 A AB81            FPN         &03123456                                           000975
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INDEX S PGLIN    TAG      OP   NU AT OPERAND 80SMPL-001  10-20-62   COMMENTS    PG 005  F  LOC    INSTR SU  ADDR  SER  REF
AC 01 I AC01             TITLE           DEFINITION OF A REPORT FORMAT - RPT

AC 02 I AC02  THESE ILLUSTRATIONS ALL SHOW EIGHT NUMERIC POSITIONS WITH VARIOUS         C
AC 03 I AC03  PUNCTUATION AND SIGN INDICATIONS.                                         C

AC 04 I AC04

AC 05 I AC05  IN THIS SERIES NO COMMAS, DECIMAL POINTS, DOLLAR SIGNS, OR ASTERISKS      C
AC 06 I AC06  ARE SPECIFIED. ONE POSITION IS RESERVED FOR A BLANK OR MINUS SIGN.       C
AC 07 I AC07  IN THE FIRST FORMAT ALL EIGHT POSITIONS WILL PRINT, LEADING ZEROS         C
AC 08 I AC08  INCLUDED. IN THE SECOND FORMAT LEADING ZEROS IN ANY OF THE FIVE HIGH      C
AC 09 I AC09  ORDER POSITIONS ARE NOT PRINTED. IN THE THIRD FORMAT, NO LEADING          C
AC 10 I AC10  ZEROS WILL PRINT.                                                         C
AC 11 A AC11             RPT    9   ZZZZZZZZ                                             000984                009
AC 12 A AC12                    9   XXXXXZZZ                                             000993
AC 13 A AC13                    9   XXXXXXXX                                             001002

AC 14 I AC14  IN THIS FORMAT VARIOUS EDIT PUNCTUATION IS ADDED. THE DOLLAR SIGN         C
AC 15 I AC15  WILL ALWAYS PRINT EIGHT POSITIONS TO THE LEFT OF THE DECIMAL POINT.       C
AC 16 I AC16  THE COMMA WILL PRINT IF THERE ARE ANY SIGNIFICANT FIGURES TO THE          C
AC 17 I AC17  LEFT OF IT. THE DECIMAL POINT AND THE POSITIONS TO THE RIGHT OF IT        C
AC 18 I AC18  WILL ALWAYS PRINT, EVEN FOR A ZERO AMOUNT. A TWO POSITION SIGN            C
AC 19 I AC19  INDICATOR IS SPECIFIED AS CR, **, OR DR FOR MINUS, ZERO, OR PLUS          C
AC 20 I AC20  AMOUNTS, RESPECTIVELY.                                                    C
AC 21 A AC21             RPT   13   $XXX,XXX.ZZ  ¤¤CR¤**¤DR¤                             001015

AC 22 I AC22  THESE TWO EXAMPLES ILLUSTRATE AMOUNT PROTECTION IN A RPT FORMAT. IN       C
AC 23 I AC23  THE FIRST, THE $ SIGN IS FIXED BUT * WILL PRINT IN ALL SPACES             C
AC 24 I AC24  BETWEEN IT AND THE HI-ORDER DIGIT PRINTED. IN THE SECOND, THE $ SIGN      C
AC 25 I AC25  WILL PRINT IMMEDIATELY TO THE LEFT OF THE HI-ORDER DIGIT PRINTED.         C
AC 26 A AC26             RPT   12   $XXX,XXZ.ZZ ¤*¤                                      001027
AC 27 A AC27                   12   $XXX,XXZ.ZZ ¤$¤                                      001039

AC 28 I AC28  THE OPERAND BZ IN THIS EXAMPLE INDICATES THAT THE ENTIRE FIELD,           C
AC 29 I AC29  INCLUDING THE DECIMAL POINT AND POSITIONS TO THE RIGHT OF IT, IS TO       C
AC 30 I AC30  BE BLANKED IF THE RESULT IS ZERO.                                         C
AC 31 A AC31             RPT   07   XXXX.ZZ¤¤¤BZ¤¤                                       001046

AC 32 I AC32                                  INVALID USAGES                            C
AC 33 A AC33             RPT    9   ZZZXXXXX         ZS AND XS REVERSED                  001055                010

AC 34 I AC34             TITLE           COLLECTIVE AREA DEFINITION - NAME

AC 35 I AC35                                 NORMAL USE

AC 36 A AC36  NAMEA      NAME   A   NAMEAEND         THIS ENTRY CONSISTS OF THIRTY       001060         001089      AC50
AC 37 A AC37             RCD    2   N                CONSECUTIVE POSITIONS, THE LAST     001061                        2
AC 38 A AC38                    4   A                TWO BEING A GROUP MARK AND RECORD   001065                        6
AC 39 A AC39             CON    3   XXX              MARK. THE CHRCD AND THE BITCD EACH  001068                011     9
AC 40 A AC40                    1                    OCCUPY ONE MEMORY POSITION. SOME    001069                       10
AC 41 A AC41             RPT    8   XXXX.ZZ          SEGMENTS OF THE ENTRY ARE           001077                       18
AC 42 A AC42             RCD    4   &                SEPARATELY TAGGED. THE A IN THE     001081                       22
AC 43 A AC43             CON    3                    NUMERIC FIELD OF THE NAME           001084                012    25
AC 44 A AC44             BITCD      2                STATEMENT POSITIONS THE ENTRY TO    001085                       26
AC 45 A AC45  COND1             2                    START AT A 0 LOCATION.  THE
AC 46 A AC46  COND2             A                    OPERAND OF THE NAME HEADER IS THE
AC 47 A AC47             CHRCD                       TAG OF THE LAST SEGMENT OF THE      001086                       27
AC 48 A AC48  CONDP                 P                NAME ENTRY. THE TAG OF THE NAME
AC 49 A AC49  CONDQ                 Q                STATEMENT IS USED TO REFER TO THE
AC 50 A AC50  NAMEAEND   CON    3    ¤#              COLLECTIVE ENTRY. NOTE THAT A       001089                       30
 AC51 J       NAMEA                 THIS DEFINITION OCCUPIES     30 CHARACTER POSITIONS  001089
AC 52 A AC51                        COMMENT CONTINUATION IS BROKEN BY THE GENERATED
AC 53 A AC52                        NAME TRAILER. NOTE ALSO THE USE OF THE REF FIELD
AC 54 A AC53                        OF THE LISTING TO DISPLAY A CUMULATIVE TOTAL OF THE
AC 55 A AC54                        POSITIONS USED WITHIN THE NAME.

AC 56 I AC55  THE FOLLOWING SERIES ILLUSTRATES THE USE OF CONCURRENT NAME               C
AC 57 I AC56  DEFINITIONS. NAMEC IS ENTIRELY WITHIN NAMEB. NAMED IS ONLY PARTLY         C
AC 58 I AC57  WITHIN NAMEB. BOTH USAGES ARE VALID.                                      C

AC 59 A AC58  NAMEB      NAME       NAMEBEND                                             001090         001119      AC67
AC 60 A AC59  RCDS6X0    RCD    6   &                                                    001095                        6

AC 61 A AC60  NAMEC      NAME       NAMECEND                                             001096         001103      AC63
AC 62 A AC61             RCD    2   N                                                    001097                        8
AC 63 A AC62  NAMECEND          6   A                                                    001103                       14
 AC64 J       NAMEC                 THIS DEFINITION OCCUPIES      8 CHARACTER POSITIONS  001103

AC 65 A AC63  NAMED      NAME       NAMEDEND                                             001104         001126      AC70
AC 66 A AC64             RCD    4   A                                                    001107                       18
AC 67 A AC65  NAMEBEND         12   A                                                    001119                       30
 AC68 J       NAMEB                 THIS DEFINITION OCCUPIES     30 CHARACTER POSITIONS  001119
AC 69 A AC66                    3   N                                                    001122
AC 70 A AC67  NAMEDEND          4   A&                                                   001126
 AC71 J       NAMED                 THIS DEFINITION OCCUPIES     23 CHARACTER POSITIONS  001126
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INDEX S PGLIN    TAG        OP    NU AT OPERAND 80SMPL-001  10-20-62   COMMENTS    PG 006  F  LOC    INSTR SU  ADDR   SER  REF

AD 01 I AD01                TITLE                 SPECIAL USES OF NAME STATEMENTS

AD 02 A AD02                NAME   0                         ALTHOUGH THIS NAME STATEMENT HAS A  001130
AD 03 A AD03                CON    6    &246807              BLANK TAG AND OPERAND, THE ZERO     001135                  013
AD 04 A AD04                            IN THE NUMERIC FIELD WILL CAUSE THE CON DEFINITION
AD 05 A AD05                            WHICH FOLLOWS IT TO BEGIN IN THE NEXT 0/5 MEMORY
AD 06 A AD06                            LOCATION RATHER THAN THE NEXT SEQUENTIAL LOCATION.

AD 07 A AD07                NAME   B                         THE B IN THE NUMERIC FIELD OF       001200
AD 08 A AD08                RCD    01                        THIS NAME STATEMENT CAUSES THE RCD  001200
AD 09 A AD09                            WHICH FOLLOWS IT TO BEGIN IN THE NEXT 100 LOCATION.

AD 10 I AD10                                      INVALID USAGES                           C

AD 11 A AD11  NAMEE         NAME        NAMEEEND             THIS NAME IS INVALID BECAUSE IT     001201           001210      AD15
AD 12 A AD12                RCD    2    A                    CONTAINS AN ITEM WHICH IS NOT AN    001202                          2
AD 13 A AD13                CNO    2    RH                   AREA DEFINITION, CON MISSPELLED.    001209 ,0-&0 11 000000 014
 AD14 J       NAMEE                     THIS DEFINITION OCCUPIES          CHARACTER POSITIONS    001209
AD 15 A AD14  NAMEEEND      RCD    1                                                             001210

AD 16 I AD15  THIS NAME ENTRY WILL NOT COMPILE CORRECTLY BECAUSE THE NUMERIC               C
AD 17 I AD16  FIELD OF THE INTERNAL NAME ENTRY SPECIFIES A STARTING LOCATION NOT           C
AD 18 I AD17  IMMEDIATELY FOLLOWING THE PORTION OF THE NAME ENTRY ALREADY DEFINED.         C

AD 19 A AD18  NAMEF         NAME   0    NAMEFEND                                                 001215           001222      AD23
AD 20 A AD19                RCD    2    A                                                        001216                          2

AD 21 A AD20  NAMEG         NAME   4    NAMEFEND                                                 001219           001222      AD23
AD 22 A AD21                RCD    3                                                             001221                          7
AD 23 A AD22  NAMEFEND           . 1    N                                                        001222                          8
 AD24 J       NAMEF                     THIS DEFINITION OCCUPIES       8 CHARACTER POSITIONS     001222
 AD25 J       NAMEG                     THIS DEFINITION OCCUPIES       4 CHARACTER POSITIONS     001222

AD 26 A AD23  NAMEF1        NAME        NAMEF1END            THIS IS INVALID FOR A SIMILAR       001223           001234      AD28
AD 27 A AD24                RCD    4    A                    REASON, THE ADCON BREAKS THE        001226                          4
AD 28 A AD25  NAMEF1END     ADCON       CONTINUE             CONTINUITY OF ASSIGNMENT.           001234 A1679     001679 015 AG33
 AD29 J       NAMEF1                    THIS DEFINITION OCCUPIES      12 CHARACTER POSITIONS     001234

AD 30 A AD26  NAMEH         NAME        NOTEND               THIS WILL NOT COMPILE CORRECTLY     001235
AD 31 A AD27                RCD    4    A                    BECAUSE THE OPERAND OF THE NAME     001238                          4
AD 32 A AD28                CON    2                         DOES NOT SPECIFY THE TAG OF THE     001240                  016     6
AD 33 A AD29  NOWEND               3    XXX                  ENDING SEGMENT.                     001243                          9
AD 34 A AD30                NOP         *                    FORCE TERMINATION OF NAMEH          001249 A1249     001249 017
 AD35 J       NAMEH                     THIS DEFINITION OCCUPIES          CHARACTER POSITIONS    001249

AD 36 A AD31  NAMEI         NAME        NAMEJ                NAMEI IS INVALID BECAUSE IT ENDS    001250           001260      AD42
AD 37 A AD32                RCD    2    A&                   AT THE SAME TAG AT WHICH NAMEJ      001251                          2
AD 38 A AD33                       3    &                    BEGINS.                             001254                          5

AD 39 A AD34  NAMEJ         NAME        NAMEJEND                                                 001255           001260      AD41
AD 40 A AD35                RCD    05   &                                                        001259                         10
AD 41 A AD36  NAMEJEND             1    □                                                        001260                         11
 AD42 J       NAMEJ                     THIS DEFINITION OCCUPIES       6 CHARACTER POSITIONS     001260
AD 43 A AD37                NOP         *                    FORCE TERMINATION OF NAMEI          001269 A1269     001269 018
 AD44 J       NAMEI                     THIS DEFINITION OCCUPIES          CHARACTER POSITIONS    001269

AD 45 I AD38                TITLE       SWITCH DEFINITIONS

AD 46 I AD39                                DATA SWITCHES

AD 47 I AD40                                      CHARACTER CODE - CHRCD
AD 48 A AD41  AGE           CHRCD  2    40                   A TWO DIGIT CODE WHOSE INITIAL      001271
AD 49 A AD42  TWENTY                    20                   VALUE IS 40, AS SPECIFIED BY
AD 50 A AD43  FORTY                     40                   THE NUMERIC AND OPERAND FIELDS
AD 51 A AD44  SIXTY                     60                   OF THE CHRCD STATEMENT.
AD 52 A AD45                RCD    1    N                                                        001272
AD 53 A AD46  SEX           CHRCD                            A ONE POSITION CODE WILL BE SET UP  001273
AD 54 A AD47  MALE                      M                    WITHOUT INITIALIZATION SINCE A
AD 55 A AD48  FEMALE                    F                    CHRCD WHICH FOLLOWS A RCD WITHOUT
AD 56 A AD49                            ANY INTERVENING STATEMENTS CAN NOT SPECIFY AN
AD 57 A AD50                            INITIAL VALUE. IT IS CONSIDERED PART OF THE RCD.

AD 58 I AD51                TITLE                 BIT CODE - BITCD
AD 59 A AD52  PAYTYPE       BITCD       G                    A ONE POSITION BIT CODE FIELD WILL  001274                  019
AD 60 A AD53  HOURLY               1                         BE DEFINED. THE TITLE ENTRY CAUSES
AD 61 A AD54  WEEKLY               2                         THE INITIAL VALUE TO BE VALID.
AD 62 A AD55  BIWEEKLY             4                         ALTHOUGH ALL SIX OF THE SPECIFIED
AD 63 A AD56  MONTHLY              8                         CODES WILL BE SET UP AND CAN BE
AD 64 A AD57  COMMISSION           A                         TESTED, THE USE OF THE B OR 8 BIT
AD 65 A AD58  FLAT FEE             B                         IS QUESTIONABLE SINCE IT MAY
AD 66 A AD59                            RESULT IN CREATING INVALID CHARACTERS IN MEMORY.

AD 67 I AD60                                      INVALID USAGES                           C
AD 68 A AD61  SPLIT TAG     RCD    1    A                                                        001275
AD 69 A AD62                BITCD       G                   THIS BITCD DEFINITION WILL GENERATE  001276
AD 70 A AD63  BAD1                 1                         AND CAN BE REFERENCED BUT WILL NOT
AD 71 A AD64  BAD2                 2                         BE INITIALIZED TO THE VALUE SHOWN.
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INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  10-20-62   COMMENTS    PG 007  F  LOC    INSTR SU  ADDR  SER  REF

AE 01 I AE01              TITLE            PROGRAM SWITCHES
AE 02 A AE02  SWA         SWT         *&15             PROGRAM SWITCH, INITIALLY ON.       001284 11299      001299 020

AE 03 A AE03  SWB         SWN         *&10             PROGRAM SWITCH, INITIALLY OFF.      001289 A1299      001299

AE 04 I AE04                                   INVALID USAGES                         C
AE 05 A AE05  SWC         NOP         *-10             WHILE THIS GENERATES A SWITCH IT    001294 A1284      001284
AE 06 A AE06                          CANNOT BE REFERENCED BY THE BRANCH CONTROL MACROS
AE 07 A AE07                          AND WILL NOT APPEAR IN THE SWITCH LISTING IN THE
AE 08 A AE08                          OPERATORS NOTEBOOK.  IF IT IS REFERENCED BY THE
AE 09 A AE09                          BRANCH CONTROL MACROS IT WILL BE TREATED AS AN A-J
AE 10 A AE10                          SWITCH AS SHOWN BELOW.

AE 11 B AE11              SETOF       SWC¤
 AE12 J                   RCVS        SWC                                                  001299 U1290      001290      AE05
 AE13 J                   TMTS   01   #J#                                                  001304 953T2 01 005332      ¤A16

AE 14 I AE12              TITLE            CONSOLE SWITCHES
AE 15 A AE13  ALTSW911    ALTSW  A                     THE SYMBOLIC VALUE IN THE TAG WILL
AE 16 A AE14  ALTSW912           B                     BE ASSIGNED TO THE HARDWARE SWITCH
AE 17 A AE15  ALTSW913           C                     REPRESENTED BY THE CODE IN THE
AE 18 A AE16  ALTSW914           D                     NUMERIC FIELD.  NOTE THAT
AE 19 A AE17  ALTSW915           E                     CONTINUATIONS ARE VALID.
AE 20 A AE18  ALTSW916           F

AE 21 I AE19              TITLE            BRANCH CONTROL MACRO-INSTRUCTIONS

AE 22 B AE20  TESTSW      SETON       SWA¤SWB¤SIXTY¤WEEKLY¤COMMISSION¤
 AE23 J       TESTSW      LOD    01   #1#                                                  001309 853T3 01 005333      ¤A17
 AE24 J                   UNL    01   SWA-000004                                           001314 712Y0 01 001280      AE02
 AE25 J                   UNL    01   SWB-000004                                           001319 712Y5 01 001285      AE03
 AE26 J                   RCVS        SIXTY                                                001324 U1270      001270      AD51
 AE27 J                   TMTS    2   #60#                                                 001329 953L6 02 005336      ¤A19
 AE28 J                   SBZ     2   WEEKLY                                               001334 %12P4 02 001274      AD61
 AE29 J                   SBZ     A   COMMISSION                                           001339 %1SX4 05 001274      AD64

AE 30 B AE21              IFON        SWB¤TESTSW¤EXIT¤
 AE31 J                   RCVS        *          &000006                                   001344 U1350      001350
 AE32 J                   TMTS   01   SWB                                                  001349 912Y5 01 001285 021 AE03
 AE33 J                   NOP         TESTSW                                               001354 A1309      001309      AE23
 AE34 J                   TR          EXIT                                                 001359 11604      001604      AF55

AE 35 B AE22              IFON        FEMALE¤TESTSW¤EXIT¤
 AE36 J                   LOD    01   #F#                                                  001364 853T0 01 005330      ¤A14
 AE37 J                   CMP    01   FEMALE                                               001369 412X3 01 001273      AD55
 AE38 J                   TRE         TESTSW                                               001374 L1309      001309      AE23
 AE39 J                   TR          EXIT                                                 001379 11604      001604      AF55

AE 40 B AE23              SETOF       SWB¤HOURLY¤WEEKLY¤MONTHLY¤
 AE41 J                   RCVS        SWB                                                  001384 U1285      001285      AE03
 AE42 J                   TMTS    1   #&1#                                                 001389 951X6 01 005176      ¤A02
 AE43 J                   SBN     1   HOURLY                                               001394 %1KX4 09 001274      AD60
 AE44 J                   SBN     2   WEEKLY                                               001399 %1KP4 10 001274      AD61
 AE45 J                   SBN     8   MONTHLY                                              001404 %1B74 12 001274      AD63

AE 46 B AE24              IFON        ALTSW912¤TESTSW¤EXIT¤
 AE47 J                   TAB         TESTSW                                               001409 I13-9 02 001309      AE23
 AE48 J                   TR          EXIT                                                 001414 11604      001604 022 AF55

AE 49 I AE25                                   INVALID USAGES                         C
AE 50 I AE26  THE FOLLOWING MACRO ATTEMPTS TO SET ON TWO UNDEFINED SWITCHES WHICH     C
AE 51 I AE27  ARE THE TAGS OF CHRCD AND BITCD HEADERS. THEY ARE TREATED AS A-J        C
AE 52 I AE28  TYPE SWITCHES.                                                          C

AE 53 B AE29              SETON       SEX¤PAYTYPE¤
 AE54 J                   LOD    01   #&1#                                                 001419 851X6 01 005176      ¤A02
 AE55 J                   UNL    01   SEX                                                  001424 712X3 01 001273      AD53
 AE56 J                   UNL    01   PAYTYPE                                              001429 712X4 01 001274      AD59

AE 57 I AE30  THE NEXT MACRO ATTEMPTS TO SET ON AN ALTSW.                             C

AE 58 B AE31              SETON       ALTSW916¤

AE 59 I AE32  THE FOLLOWING MACRO ATTEMPTS TO INITIALIZE A BITCD USING MOVE MACRO.    C

AE 60 B AE33              MOVE        #G#¤BAD1¤   A BITCD IS NOT VALID AS A MOVE OPERAND.

 AE61 J                   HLT         @29000                                               001434 JR000      029000
 AE62 J                   ADCON       #G#                                                  001439 A5331      005331      ¤A15
 AE63 J                   ADCON       BAD1                                                 001444 A1276      001276      AD70
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INDEX S PGLIN    TAG      OP    NU AT OPERAND 80SMPL-001  10-20-62   COMMENTS   PG 008  F  LOC    INSTR SU  ADDR  SER  REF

AF 01 I AF01              TITLE       ONE-FOR-ONE INSTRUCTIONS

AF 02 I AF02                              BASIC OPERANDS

AF 03 I AF03                                  TAG OPERANDS
AF 04 A AF04              NOP         SPLIT TAG        SINGLE BLANKS ARE VALID IN TAGS.    001449 A1275     001275      AD68

AF 05 I AF05    THE MEANING OF A TAG OPERAND DEPENDS ON THE INSTRUCTION AS WELL AS       C
AF 06 I AF06    THE DATA DEFINITION FOR THE TAG.                                         C
AF 07 A AF07              SET         RCDSOX3          SET ACC TO SIZE OF RCDSOX3.         001454 B0003     000003      AA41
AF 08 A AF08              LOD         RCDSOX3          LOD ACC WITH VALUE OF RCDSOX3.      001459 80756     000756      AA41

AF 09 I AF09                                  INVALID USAGES                             C
AF 10 A AF10              SND    04   WORST CASES      TAG OPERAND TOO LONG                001464 /0#00 04 000000
AF 11 A AF11              TR          RD/WR            SPECIAL CHARACTERS ARE INVALID      001469 10000     000000

AF 12 A AF12    GAP       NOP         *                HERE, GAP HAS A LEADING BLANK.      001474 A1474     001474
AF 13 A AF13    GAP       NOP         *                HERE, GAP HAS NO LEADING BLANK.     001479 A1479     001479 023
AF 14 A AF14    RD/WR     SGN       L, GAP           LEADING BLANK ON GAP IS IGNORED.      001484 T1475     001475      AF13

AF 15 I AF15              TITLE                       LITERAL OPERANDS
AF 16 A AF16              RAD         #&00215#         A FIVE DIGIT SIGNED LITERAL         001489 H5209     005209      ¤A08
AF 17 A AF17              LOD         #APPLE#          A FIVE PLACE UNSIGNED LITERAL       001494 85329     005329      ¤A13
AF 18 A AF18              WR          #NOT AVAILABLE¤# A FOURTEEN PLACE LITERAL MESSAGE    001499 R5377     005377      ¤A27
AF 19 A AF19              CMP         #  #             TWO BLANKS                          001504 45335     005335      ¤A18
AF 20 A AF20              LOD    10   #-04&5678#       FPN LITERAL &.00005678              001509 85KJ9 10 005219      ¤A09

AF 21 I AF21                                  INVALID USAGES                             C
AF 22 A AF22              ADD         &14#             OPENING LIT SYMBOL OMITTED          001514 G0000     000000
AF 23 A AF23              LOD         #LOCATIONA#      LITERAL INDICATED WITH TAG OPERAND  001519 85376     005376      ¤A26
AF 24 A AF24                                           INTENDED.
AF 25 A AF25              TRE         #DUPE#           TRANSER TO A LITERAL                001524 L5348     005348      ¤A22
AF 26 A AF26              ADD         #0010#           ADD REQUIRES A SIGNED OPERAND       001529 G5352     005352      ¤A23
AF 27 A AF27              LOD         #AGE             CLOSING LIT SYMBOL OMITTED          001534 85269     005269      ¤A10
AF 28 A AF28              WR          #THIS LITERAL OVERFLOWS INTO THE NEXT CARD WHICH IS  001539 R5270     005270      ¤A11
AF 29 A AF29                          INVALID¤# NOTE THAT ONLY THE FIRST LINE COMPILES.                          024
AF 30 A AF30
AF 31 A AF31              LOD         #-BALANCE#     BECAUSE OF THE DASH THIS LIT WILL     001544 85193     005193      ¤A06
AF 32 A AF32                          COMPILE AS BALANCN.

AF 33 I AF33              TITLE                       ACTUAL OPERANDS
AF 34 A AF34              SET         @00005           TWO ALTERNATE WAYS OF WRITING AN    001549 B0005     000005
AF 35 A AF35              SET         5                INSTRUCTION TO SET ACC TO FIVE.     001554 B0005     000005

AF 36 I AF36                                  INVALID USAGES                             C
AF 37 A AF37              ST          995              ST REQUIRES THE @ SIGN FOR ACTUALS  001559 F0000     000000
AF 38 A AF38
AF 39 A AF39              WR          @82500           82500 IS OUTSIDE THE MEMORY SIZE    001564 R2500     002500
AF 40 A AF40                                           SPECIFIED FOR THE OBJECT PROGRAM.
AF 41 A AF41
AF 42 A AF42              TR          @0001234         ACTUAL EXCEEDS SIX DIGITS           001569 10123     000123

AF 43 A AF43              LOD         @APPLES          AN ACTUAL IS INDICATED WHEN A       001574 80000     000000
AF 44 A AF44                                           LITERAL IS INTENDED.

AF 45 I AF45              TITLE                       LOCATION COUNTER OPERANDS
AF 46 A AF46              LOD    04   *                THE LOCATION OF THE LOD IS PLACED   001579 81V79 04 001579
AF 47 A AF47                                           IN ASU 04.

AF 48 I AF48    FURTHUR EXAMPLES WILL BE SHOWN UNDER CHARACTER ADJUSTMENT.               C

AF 49 I AF49              TITLE                       BLANK OPERANDS
AF 50 A AF50    LOCATIONA BSP                          NO ADDRESS IS REQUIRED FOR THESE    001584 30004     000004
AF 51 A AF51              EIM                          INSTRUCTIONS. IT IS EITHER IGNORED  001589 ,0#-0 06 000000
AF 52 A AF52              CNO                          OR IS INSERTED BY THE PROCESSOR.    001594 ,0-&0 11 000000
AF 53 A AF53
AF 54 A AF54              ULA    06   EXIT             HERE THE ADDRESS OF THE TR WILL BE  001599 *1W-4 06 001604      AF55
AF 55 A AF55    EXIT      TR                           INITIALIZED BY UNLOADING ASU 06.    001604 10000     000000

AF 56 I AF56    A SPECIAL CASE OF A LASN WITH BLANK OPERAND WILL BE SHOWN LATER.         C
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INDEX S PGLIN   TAG      OP    NU AT OPERAND 80SMPL-001  10-20-62   COMMENTS   PG 009  F  LOC    INSTR SU  ADDR  SER  REF

AG 01 I AG01              TITLE           ADDITIONS TO BASIC OPERANDS

AG 02 I AG02                                     CHARACTER ADJUSTMENT
AG 03 A AG03              LOD    3   RCDS0X3&3         THESE TWO STATEMENTS REFER TO THE   001609 807E9 03 000759 025 AA41
AG 04 A AG04              TMTS   3   RCDN2X3A-4        SAME DATA FIELD. THE ADJUSTMENTS    001614 907E6 03 000756     AA44
AG 05 A AG05                         ARE BASED ON THE POSITION WITHIN THE TAGGED FIELD
AG 06 A AG06                         WHICH EACH INSTRUCTION TYPE NORMALLY ADDRESSES.
AG 07 A AG07
AG 08 A AG08              LOD    1   CONA-2            THESE STATEMENTS USE ADJUSTMENTS    001619 807Z9 01 000799     AA71
AG 09 A AG09              CMP    1   #1234567#-2       TO ADDRESS A POSITION WITHIN A      001624 453V7 01 005357     ¤A24
AG 10 A AG10                         DEFINED FIELD OR WITHIN A LITERAL.
AG 11 A AG11
AG 12 A AG12              TR         CONTINUE&20       TO 4TH INSTR FOLLOWING CONTINUE.    001629 11699    001699     AG33

AG 13 A AG13              RCVS       *&6               RCVS AT OP CODE OF 2ND INSTRUCTION  001634 U1640    001640
AG 14 A AG14                                           FOLLOWING.
AG 15 A AG15
AG 16 A AG16              SET    6   NAMEA/5           DIVIDE OPERATOR & ADJUSTMENT USED   001639 B0#-6 06 000006     AC51
AG 17 A AG17              SND    6   NAMEA             TO GET SET TO MOVE NAMEA BY SND.    001644 /1#04 06 001064     AC51

AG 18 I AG18   CHARACTER ADJUSTMENT TO ADDRESS CONSTANT LITERALS IS A SPECIAL         C
AG 19 I AG19   CASE AND WILL BE ILLUSTRATED LATER.                                    C
AG 20 I AG20                               INVALID USAGES                             C
AG 21 A AG21              LOD        *&80005           EXCEEDS SPECIFIED MEMORY SIZE.      001649 81654    001654
AG 22 A AG22
AG 23 A AG23              LDA        *&3               GIVES INVALID ADDRESS FOR LDA.      001654 #1657    001657
AG 24 A AG24
AG 25 A AG25              TMTS   1   NAMEA-0000030     AN ADJUSTMENT CAN NOT HAVE MORE     001659 910V7 01 001057     AC51
AG 26 A AG26                         THAN SIX DIGITS. THIS WILL BE TRUNCATED TO 000003.
AG 27 A AG27
AG 28 A AG28              TRE        *&10       THE GENERATED EIA UPSETS THIS ADJUSTMENT   001664 L1674    001674
AG 29 A AG29                         CALCULATION. TRE  CONTINUE WOULD BE CORRECT.

AG 30 A AG30              TR          I,EXIT           TO EXIT LINKAGE ON UNEQUAL
 AG31 *                   EIA         EXIT             TO EXIT LINKAGE ON UNEQUAL          001669 ,10-4 10 001604     AF55
 AG32 *                   TR          EXIT             TO EXIT LINKAGE ON UNEQUAL          001674 11604    001604 026 AF55

AG 33 A AG31   CONTINUE   NOP        *                                                     001679 A1679    001679
AG 34 A AG32
AG 35 A AG33              LOD        #300#&100        ADJUSTMENTS TO A LITERAL MAY NOT BE  001684 85340    005340     ¤A20
AG 36 A AG34                         MORE THAN TWO DIGITS. THIS WILL BE TRUNCATED TO 00.
AG 37 A AG35
AG 38 A AG36              SET    6   #&1234#*5         ONLY & AND - ARE VALID ADJUSTMENT   001689 B0#-4 06 000004     ¤A04
AG 39 A AG37                         OPERATORS FOR ADJUSTMENTS TO LITERALS.

AG 40 I AG38              TITLE                  OPERAND MODIFIERS

AG 41 I AG39   THIS SERIES SHOWS THE USE OF MODIFIERS TO CHANGE THE NORMAL ADDRESS    C
AG 42 I AG40   ORIENTATION OF AN INSTRUCTION. NAMEA IS 30 POSITIONS FROM 1070-1099.   C
AG 43 A AG41              CMP    1   NAMEA            CMP NORMALLY REFERENCES THE RIGHT    001694 410Y9 01 001089     AC51
AG 44 A AG42              CMP    1 L,NAMEA            HAND CHARACTER.                      001699 410W0 01 001060     AC51
AG 45 A AG43              CMP    1 R,NAMEA            REDUNDANT MODIFIER                   001704 410Y9 01 001089     AC51
AG 46 A AG44
AG 47 A AG45              TMTS   1   NAMEA             TMTS NORMALLY REFERENCES THE LEFT   001709 910W0 01 001060     AC51
AG 48 A AG46              TMTS   1 R,NAMEA            HAND CHARACTER.                      001714 910Y9 01 001089     AC51
AG 49 A AG47              TMTS   1 L,NAMEA            REDUNDANT MODIFIER                   001719 910W0 01 001060     AC51
AG 50 A AG48
AG 51 A AG49              RCV         NAMEA            RCV NORMALLY REFERENCES THE LEFT    001724 U1064    001064     AC51
AG 52 A AG50              RCVS      H,NAMEA           HAND &4 CHARACTER, RCVS THE LEFT.    001729 U1064    001064     AC51
AG 53 A AG51              RCV       H,NAMEA           REDUNDANT MODIFIER                   001734 U1064    001064     AC51
AG 54 A AG52                                                                                                      027
AG 55 A AG53              RCVT        NAMEA            RCVT NORMALLY REFERENCES THE LEFT   001739 U1069    001069     AC51
AG 56 A AG54              RCVS      T,NAMEA           HAND &9 CHARACTER. RCVS THE LEFT,    001744 U1069    001069     AC51
AG 57 A AG55              RCV       T,NAMEA           AND RCV THE LEFT &4.                 001749 U1069    001069     AC51
AG 58 A AG56              RCVT      T,NAMEA           REDUNDANT MODIFIER                   001754 U1069    001069     AC51
AG 59 A AG57
AG 60 A AG58              SET         NAMEA            SET NORMALLY REFERENCES SIZE.       001759 B0030    000030     AC51
AG 61 A AG59              SET       S,NAMEA           REDUNDANT MODIFIER                   001764 B0030    000030     AC51
AG 62 A AG60              NOP       S,NAMEA           CREATE CONSTANT OF LENGTH OF NAMEA   001769 A0030    000030     AC51

AG 63 I AG61   OPERAND MODIFIERS MAY BE COMBINED WITH CHARACTER ADJUSTMENT.           C
AG 64 A AG62              LOD    1 L,#APPLE#&3        LOAD ASU 1 WITH L.                   001774 853S8 01 005328     ¤A13

AG 65 I AG63                               INVALID USAGES                             C
AG 66 A AG64              TMT       T,NAMEA           THE FIRST FIVE POSITIONS OF NAMEA    001779 91069    001069     AC51
AG 67 A AG65                         WILL NOT BE MOVED.
AG 68 A AG66
AG 69 A AG67              LOD   05 L,#ABCDE#          THE LOAD WILL EXTEND INTO THE NEXT   001784 85TS0 05 005320     ¤A12
AG 70 A AG68                         LITERAL WHICH IS NOT USUALLY PREDICTABLE.
AG 71 A AG69
AG 72 A AG70              RAD       S,NAMEA           THIS IS THE SAME AS RAD @30 WHEN     001789 H0030    000030     AC51
AG 73 A AG71                         WHAT WAS INTENDED WAS RAD #&30#.
AG 74 A AG72
AG 75 A AG73              TMT       R,NAMEA           THIS MOVES ONLY THE LAST FIVE        001794 91089    001089     AC51
AG 76 A AG74                         POSITIONS OF NAMEA.
AG 77 A AG75
AG 78 A AG76              TCT       H,NAMEA           H, INCONSISTENT WITH RCVT AND TCT.   001799 ,1-64 08 001064     AC51
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INDEX S PGLIN    TAG        OP     NU AT OPERAND 80SMPL-001  10-20-62   COMMENTS    PG 010  F  LOC     INSTR SU  ADDR  SER  REF

AH 01 I AH01                TITLE                    INDIRECT ADDRESSING

AH 02 A AH02                LEV80
AH 03 A AH03   INDEX1       ADCON        NAMEA            AN ADDRESS CONSTANT                     001804 A1089     001089 028 AC51
AH 04 A AH04
AH 05 A AH05                LOD      6 I,INDEX1         LOAD ASU 6 AT THE ADDRESS NOW IN        001809 81Y-U 06 001804      AH03
AH 06 A AH06                                              INDEX1.

AH 07 A AH07                ENT80                         SAME INSTRUCTION IN 80 MODE

AH 08 A AH08                LOD      6 I,INDEX1         OPERAND AND COMMENTS REPEAT.
 AH09 *                     EIA          INDEX1         OPERAND AND COMMENTS REPEAT.            001814 ,1Q-4 10 001804      AH03
 AH10 *                     LOD      6   INDEX1         OPERAND AND COMMENTS REPEAT.            001819 81Y-4 06 001804      AH03

AH 11 I AH09                                         INVALID USAGES                      C

AH 12 A AH10                LEV80
AH 13 A AH11   INDEX3       CON     06   001234                                                 001825
AH 14 A AH12                RAD        I,INDEX3           INDEX3 IS NOT IN A 4/9 LOCATION.      001834 H182V     001825 029 AH13
AH 15 A AH13
AH 16 A AH14
AH 17 A AH15                LOD        I,@110234          THE LOCATION OF THE REFERENCED        001839 8&23U     030234
AH 18 A AH16                             ADDRESS IS ABOVE OBJECT MEMORY LIMITS.

AH 19 A AH17                ENT80

AH 20 I AH18   IN 80 MODE THE TAG OF AN I, WILL BE PUT ON THE GENERATED EIA. ANY         C
AH 21 I AH19   ADDRESS MODIFICATION MUST TAKE THIS INTO ACCOUNT.                         C
AH 22 A AH20                LDA      6   EXIT             THIS LDA-ULA IS INTENDED TO MODIFY  001844 #1W-4 06 001604      AF55
AH 23 A AH21                ULA      6   TAGZ             THE ADDRESS PORTION OF THE LOD.     001849 *1YN4 06 001854      AH25

AH 24 A AH22   TAGZ         LOD        I,INDEX1
 AH25 *        TAGZ         EIA          INDEX1                                               001854 ,1Q-4 10 001804      AH03
 AH26 *                     LOD          INDEX1                                               001859 81804    001804      AH03

AH 27 I AH23                TITLE                    SPECIAL MNEMONICS

AH 28 I AH24                                              ADDRESS CHECK ON LFC-UFC
AH 29 A AH25                LFC          LASNTAGA         ON A LFC OR UFC WITH BLANK NUM THE  001864 ,51K9 02 005129      AK09
AH 30 A AH26                LFC          LASNTAGA&2       ADDRESS IS 4/9 CHECKED.             001869 ,51L1 02 005131      AK09
AH 31 A AH27                LFC      1   LASNTAGA&2       WITH A NUM OF 1 IT IS 1/6  CHECKED  001874 ,51L1 02 005131      AK09
AH 32 A AH28                LFC      1   LASNTAGA         ETC.  SEE MESSAGES.                 001879 ,51K9 02 005129      AK09

AH 33 I AH29                TITLE                         NUM ON SET BIT INSTRUCTIONS
AH 34 A AH30                SBZ      4   @20000           NORMAL SBZ    4 WITH 4 IN COL 22.   001884 %-0&0 03 020000
AH 35 A AH31                SBZ      4   @20000                  SB     4 WITH 4 IN COL 22.   001889 %-0&0 03 020000
AH 36 A AH32                SBZ      4   @20000                  SB    4  WITH 4 IN COL 21.   001894 %-0&0 03 020000
AH 37 A AH33                SBZ     04   @20000                  SB    04 REFERENCES 8 BIT    001899 %-#00 04 020000 030
AH 38 A AH34                SBA          @20000                  SB   7 BECOMES SBA           001904 %-#&0 07 020000
AH 39 A AH35                SBN      4   @20000                  SBN 04  REFERENCES 4 BIT     001909 %--&0 11 020000
AH 40 A AH36                SBR     10   @20000                  SBR, NUM IS IGNORED          001914 %--00 08 020000
AH 41 A AH37                SBA     10   @20000                  SBA, NUM IS IGNORED          001919 %-#&0 07 020000

AH 42 I AH38                                         INVALID USAGES                      C
AH 43 A AH39                SBZ      3   @20000                  SB   3                       001924 %-000     020000
AH 44 A AH40                SBZ      5   @20000                  SB   5                       001929 %-000     020000
AH 45 A AH41                SBZ      6   @20000                  SB   6                       001934 %-000     020000
AH 46 A AH42                SBN      9   @20000                  SB   9                       001939 %-000     020000

AH 47 I AH43                TITLE                    FLAG CODES

AH 48 I AH44   THE FLAG CODES C, R, AND Z, ARE SHOWN ELSEWHERE.  CODES 1, A, F,          C
AH 49 I AH45   T, AND G ARE NOT SHOWN SINCE THEIR EFFECT IS NOT APPARENT HERE.           C
AH 50 I AH46                                                                             C
AH 51 A AH47                RAD          RCDA             GIVES CAUTIONARY MESSAGE             001944 H0510     000510      AA19
AH 52 A AH48                RAD          RCDA             FLAG D SUPPRESSES THE MESSAGE      D 001949 H0510     000510      AA19
AH 53 A AH49
AH 54 A AH50                RCD      1   A                                                     001950
AH 55 A AH51                NOP          *                THIS IS THE ONLY INSTR. ON A CARD    001959 A1959     001959 031
AH 56 A AH52                NOP          *                FLAG @ FORCES THIS ONTO THE NEXT   @ 001964 A1964     001964 032
AH 57 A AH53
AH 58 A AH54                NOP          EXIT             THIS SPIN LOOP IS EQUIVALENT TO A M 001969 A1604     001604      AF55
AH 59 A AH55                TR           *-5              HLT. AN INTERRUPT CAN CHANGE THE  H 001974 11969     001969

AH 60 I AH56                       NOP TO TR. FLAG M PUTS THE NOP ON THE M FLAG PAGE     C
AH 61 I AH57                       OF THE NOTEBOOK, FLAG H PUTS THE TR ON THE H FLAG     C
AH 62 I AH58                       PAGE OF THE NOTEBOOK.                                 C
AH 63 I AH59                                                                             C
AH 64 A AH60                LOD          #-BALANCE#       R-L SCAN TREATS - AS DASH NOT NEG.B 001979 85367     005367      ¤A25
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INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  10-20-62    COMMENTS    PG 011  F  LOC     INSTR SU  ADDR   SER  REF

AI 01 I AI01              TITLE         MACRO INSTRUCTIONS

AI 02 I AI02  THE INSTRUCTIONS GENERATED BY A MACRO DEPEND ON THE DATA            C
AI 03 I AI03  CHARACTERISTICS OF THE FIELDS REFERENCED BY THE OPERANDS. THE FIRST C
AI 04 I AI04  CASE, BELOW, ADDS TWO SIMILAR FIELDS AND PLACES THE RESULT IN ONE.  C

AI 05 B AI05              ADDX          RCDS5X3¤RCDS0X3¤RCDS5X3¤  SIMPLE ADD
 AI06 J                   RAD           RCDS0X3                                       001984 H0756     000756      AA41
 AI07 J                   ADD           RCDS5X3                                       001989 G0745     000745      AA37
 AI08 J                   ST            RCDS5X3                                       001994 F0745     000745      AA37

AI 09 B AI06              ADDX          RCDS5X3A¤#&98765.43#¤RCDS6X0¤  WITH RND AND LNG
 AI10 J                   RAD           RCDS5X3A                                      001999 H0753     000753      AA38
 AI11 J                   SHR           @000001                                       002004 C0001     000001
 AI12 J                   SET           @000008                                       002009 B0008     000008
 AI13 J                   ADD           #&98765.43#                                   002014 G5200     005200      ¤A07
 AI14 J                   RND           @000002                                       002019 E0002     000002
 AI15 J                   ST            RCDS6X0                                       002024 F1095     001095      AC60

AI 16 B AI07              ADDX          RCDS5X3¤RCDS5X3A¤RCDS5X3¤EXIT¤TRUNCATE¤  OVFLO PROT
 AI17 J                   RAD           RCDS5X3A                                      002029 H0753     000753 033  AA38
 AI18 J                   SET           @000009                                       002034 B0009     000009
 AI19 J                   ADD           RCDS5X3                                       002039 G0745     000745      AA37
 AI20 J                   CMP           XACA        &000008                           002044 44030     004030      A013
 AI21 J                   TRH           EXIT                                          002049 K1604     001604      AF55
 AI22 J                   SET           @000008                                       002054 B0008     000008
 AI23 J                   ST            RCDS5X3                                       002059 F0745     000745      AA37

AI 24 B AI08              ADDX          RCDS5X3¤RCDS0X3¤XAC1,#&06.02¤  SECONDARY FIELD DEF
 AI25 J                   RAD           RCDS0X3                                       002064 H0756     000756      AA41
 AI26 J                   SET           @000009                                       002069 B0009     000009
 AI27 J                   ADD           RCDS5X3                                       002074 G0745     000745      AA37
 AI28 J                   RND           @000001                                       002079 E0001     000001
 AI29 J                   ST            XAC1                                          002084 F4021     004021      A012

AI 30 B AI09              MOVE          NAMEB¤NAMEA¤  ALPHA TO ALPHA
 AI31 J                   RCV           NAMEA                                         002089 U1064     001064      AC51
 AI32 J                   SET           @000006                                       002094 B0006     000006 034
 AI33 J                   SND           NAMEB                                         002099 /1094     001094      AC68

AI 34 B AI10  MOVE1       MOVE          NAMEA¤NAMEB¤  ALPHA TO ALPHA HS               F
 AI35 J       MOVE1       RCV           NAMEB                                         002104 U1094     001094      AC68
 AI36 J       M00019#01   TMT           NAMEA                                         002109 91064     001064      AC51

AI 37 B AI11              INCRA         MOVE1#1¤#&10#¤  ADDRESS MODIFICATION
 AI38 J                   RAD     15    #&10#                                         002114 H5AG8 15  005178      ¤A03
 AI39 J                   AAM     15    M00019#01                                     002119 @2A&9 15  002109      AI36

AI 40 B AI12              MOVE          CONN5X0¤RCDS6X0¤  5 DIG UNSIGNED TO 6 DIG SIGNED  F
 AI41 J                   SET           @000005                                       002124 B0005     000005
 AI42 J                   LOD           CONN5X0                                       002129 80806     000806      AA72
 AI43 J                   SET           @000006                                       002134 B0006     000006
 AI44 J                   ST            RCDS6X0                                       002139 F1095     001095      AC60
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INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  10-20-62    COMMENTS    PG 012  F  LOC    INSTR SU  ADDR  SER  REF

AJ 01 I AJ01               TITLE       ADDRESS CONSTANTS

AJ 02 I AJ02                                ADCON
AJ 03 A AJ03   DUMMYTAG    RCD     8    A                                                  002147
AJ 04 A AJ04
AJ 05 A AJ05               ADCON        DUMMYTAG          TAG OPERAND                      002154 A2147     002147 035 AJ03
AJ 06 A AJ06               ADCON 13     DUMMYTAG          ADCON WITH ASU ZONING.           002159 A2AU7 13  002147     AJ03
AJ 07 A AJ07               ADCON        DUMMYTAG&4        TAG OPERAND WITH CHARACTER ADJ.  002164 A2151     002151     AJ03
AJ 08 A AJ08               ADCON      L,DUMMYTAG        WITH OPERAND MODIFIER              002169 A2140     002140     AJ03
AJ 09 A AJ09               ADCON       #ABLE#             LITERAL OPERAND                  002174 A5344     005344     ¤A21
AJ 10 A AJ10               ADCON       @43155             ACTUAL OPERAND                   002179 A315N     043155
AJ 11 A AJ11               ADCON       *-55               ADJUSTED LOCATION COUNTER OPERAND  002184 A2129   002129

AJ 12 I AJ12                                  INVALID USAGES                         C
AJ 13 A AJ13               ADCON        LASNTAGA*35       VALUE OF OPERAND EXCEEDS 160K.   002189 AZ515     019515     AK09
AJ 14 A AJ14               ADCON  &     @43424            THE & INTERFERES WITH THE ADDRESS  002194 A342M   043424

AJ 15 I AJ15               TITLE            ACON4, ACON5, AND ACON6
AJ 16 A AJ16               ACON4        DUMMYTAG          TAG OPERAND                      002198  2147     002147     AJ03
AJ 17 A AJ17               ACON5        DUMMYTAG          TAG OPERAND                      002203           002147     AJ03
AJ 18 A AJ18               ACON6        DUMMYTAG          TAG OPERAND                      002209           002147     AJ03
AJ 19 A AJ19               ACON4 12     DUMMYTAG          ACON4 WITH ASU ZONING            002213  2A47 12  002147     AJ03
AJ 20 A AJ20               ACON5  &     DUMMYTAG          ACON5 SIGNED PLUS                002218           002147 036 AJ03
AJ 21 A AJ21               ACON6  -     DUMMYTAG          ACON6 SIGNED MINUS               002224           002147     AJ03
AJ 22 A AJ22               ACON4        DUMMYTAG&8        WITH CHARACTER ADJUSTMENT        002228  2155     002155     AJ03
AJ 23 A AJ23               ACON5      L,DUMMYTAG        WITH OPERAND MODIFIER              002233           002140     AJ03
AJ 24 A AJ24               ACON6      L,DUMMYTAG&2      WITH MODIFIER AND ADJUSTMENT       002239           002142     AJ03
AJ 25 A AJ25               ACON4      S,DUMMYTAG&1      WITH SIZE MODIFIER AND ADJUSTMENT  002243  0009     000009     AJ03
AJ 26 A AJ26               ACON5  -     #&3957#           SIGNED ACON OF LITERAL. NOTE THAT  002248         005186     ¤A05
AJ 27 A AJ27                            THE SIGN OF THE ACON IS OPPOSIT TO THE LIT SIGN.
AJ 28 A AJ28
AJ 29 A AJ29               ACON6        *&10              ACON OF ADJUSTED LOCATION CTR    002254           002264
AJ 30 A AJ30               ACON5        @12345            UNSIGNED WITH ACTUAL OPERAND     002259           012345

AJ 31 I AJ31                                  INVALID USAGES                         C
AJ 32 A AJ32               ACON4      S,DUMMYTAG-10     ADJUSTMENT IS LARGER THAN S,       002263  0002     000002     AJ03
AJ 33 A AJ33               ACON4  &     @40100            & SIGN INTERFERES WITH ADDRESS   002267  010-     040100
AJ 34 A AJ34               ACON5 15     DUMMYTAG          AN ACON5 CANNOT HAVE ASU ZONING  002272           002147     AJ03
AJ 35 A AJ35               ACON5        @84324            OPERAND TOO LARGE FOR ACON5      002277           004324

AJ 36 I AJ36               TITLE            ADDRESS CONSTANT LITERAL
AJ 37 A AJ37               LOD   04 R@NAMEA             NON-ARITH, NON-4/9 OPERATION IN 80   002284 85T96 04 005396 037 &A01
AJ 38 A AJ38                                            MODE GIVES 6 DIGITS UNSIGNED.
AJ 39 A AJ39               ADD        S@NAMEA&10        80 MODE ARITH GIVES 6 DIG SIGNED   002289 G5403     005403     $A01

AJ 40 I AJ40   ON THE STATEMENT ABOVE NOTE THE WAY THE ADJUSTMENT IS APPLIED. THE    C
AJ 41 I AJ41   VALUE OF S,NAMEA IS 30. THE ADJUSTMENT IS ADDED TO THIS VALUE         C

AJ 42 A AJ42               LEV80                          REPEAT SERIES IN 705III MODE.
AJ 43 A AJ43               LOD   04 R@NAMEA             GIVES 5 DIGITS UNSIGNED            002294 85U14 04  005414     -A01
AJ 44 A AJ44               ADD        S@NAMEA&10        GIVES 5 DIGITS SIGNED              002299 G5409     005409     *A01
AJ 45 A AJ45
AJ 46 A AJ46               EIA                            4/9 OPERATIONS IN ANY MODE GIVE 4  002304 ,0--0 10 000000
AJ 47 A AJ47               ULA   06 R@EXIT              DIGIT UNSIGNED MACHINE ADDRESSES.  002309 *5UK9 06  005429     /A03
AJ 48 A AJ48               LDA   05 R@12,NAMEA&4        ASU ZONING CAN BE SPECIFIED        002314 #5UT9 05  005439     /A05
AJ 49 A AJ49               LDA   05 R@15,*&25           AN ADCON LIT OF A LOCATION COUNTER  002319 #5US4 05 005424     /A02
AJ 50 A AJ50               LDA   06 R@#&1234#           ADDRESS OR OF A LITERAL IS VALID.  002324 #5UJ9 06  005419     /A01

AJ 51 I AJ51                                  INVALID USAGES                         C
AJ 52 A AJ52               TMT        H@NAMEA             THE TMT IS FROM THE ADCON LITERAL  002329 95435   005435     /A04
AJ 53 A AJ53                          RATHER THAN FROM H,NAMEA. ALSO A 4/9 INSTR WITH
AJ 54 A AJ54                          H, OR T, ORIENTATION GIVES INCONSISTENT ADDRESSING
AJ 55 A AJ55                          WHEN USED WITH AN ADCON LIT OPERAND.
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INDEX S PGLIN    TAG        OP    NU AT OPERAND 80SMPL-001  10-20-62   COMMENTS   PG 013  F  LOC    INSTR SU  ADDR   SER  REF

AK 01 I AK01                TITLE      INSTRUCTIONS TO THE PROCESSOR

AK 02 I AK02                                ASSIGNMENT STATEMENTS

AK 03 I AK03                                        LASN

AK 04 I AK04  THE FOLLOWING EXAMPLES SHOW THE INDEPENDENCE OF THE LASN COUNTERS OF      C
AK 05 I AK05  EACH OTHER AND THEIR RELATION TO THEIR HIGH ASSIGNMENT COUNTERS AND      C
AK 06 I AK06  TO THE LOCATION COUNTER.                                                 C
AK 07 A AK07                RCD     1  A TO SHOW THE CURRENT VALUE OF THE ASSIGNMENT CTR.  002330

AK 08 A AK08                LASN       @5123         SET BLANK CTR TO 5123                 005123
AK 09 A AK09  LASNTAGA      NOP        *             ASSIGN. NEXT INSTR LOCATION IS 5129   005129 A5129      005129 038

AK 10 A AK10                LASN    1  LASNTAGA&20   SET CTR 1 TO 5145                     005145                       AK09
AK 11 A AK11                NOP        *             ASSIGN UNDER CTR 1 CONTROL            005149 A5149      005149 039

AK 12 A AK12                LASN       *             SET BLANK CTR TO LOCATION CTR         005150
AK 13 A AK13                NOP        *             ASSIGN UNDER BLANK CTR CONTROL        005154 A5154      005154

AK 14 A AK14                LASN    1  LASNTAGA&10   SET CTR 1 TO LOWER VALUE              005135                       AK09
AK 15 A AK15                NOP        *             ASSIGN UNDER CTR 1 CONTROL            005139 A5139      005139 040

AK 16 A AK16                LASN    1                SET CTR 1 TO PREVIOUS HI ASSIGNMENT   005150
AK 17 A AK17                NOP        *             ASSIGN UNDER CTR 1 CONTROL            005154 A5154      005154 041

AK 18 A AK18                LASN    1  LASNTAGA      RESET CTR 1 HI ASSIGNMENT & CTR 1   R 005125                       AK09
AK 19 A AK19                NOP        *             ASSIGN UNDER CTR 1 CONTROL            005129 A5129      005129 042

AK 20 A AK20                LASN       @5100         SET BLANK CTR TO LOWER VALUE          005100
AK 21 A AK21                NOP        *             ASSIGN UNDER BLANK CTR CONTROL        005104 A5104      005104 043

AK 22 A AK22                LASN    1                SET CTR 1 TO NEW HI ASSIGNMENT        005130
AK 23 A AK23                NOP        *             ASSIGN UNDER CTR 1 CONTROL            005134 A5134      005134 044

AK 24 A AK24                LASN                     SET BLNK CTR TO BLNK CTR HI ASSIGNMNT 005155
AK 25 A AK25                NOP        *             ASSIGN UNDER BLANK CTR CONTROL        005159 A5159      005159 045

AK 26 I AK26                TITLE               SASN

AK 27 A AK27                SASN       LASNTAGA&100      SET TO HIGHER THAN LASN BLANK CTR 005225                       AK09
AK 28 A AK28                NOP        *                 ASSIGN                            005229 A5229      005229 046

AK 29 A AK29                LASN                         RETURN TO BLANK CTR HI ASSIGNMENT 005160
AK 30 A AK30                NOP        *                 ASSIGN UNDER BLANK CTR CONTROL    005164 A5164      005164 047

AK 31 A AK31                SASN       @5000             SET BELOW LASN BLANK CTR          005000
AK 32 A AK32                NOP        *                 ASSIGN                            005004 A5004      005004 048

AK 33 A AK33                LASN                         RETURN TO BLANK CTR HI ASSIGNMENT 005165
AK 34 A AK34                NOP        *                 ASSIGN UNDER BLANK CTR CONTROL    005169 A5169      005169 049

AK 35 A AK35                SASN       @8000                                               008000
AK 36 A AK36                NOP        *                                                   008004 A8004      008004 050

AK 37 I AK37                                    INVALID USAGES                         C

AK 38 A AK38                LASN       LASNTAGB          A LASN TO A TAG NOT YET DEFINED IS 005170                      AK39
AK 39 A AK39  LASNTAGB      NOP        *                 EQUIVALENT TO LASN  BLANK.        005174 A5174      005174 051

AK 40 A AK40                SASN                         SASN BLANK IS IGNORED.            005175

AK 41 I AK41                TITLE               RASN
AK 42 A AK42  OUTSIDE       ADCON      NAMEA             PROVIDE TAG OUTSIDE RASN RANGE    005179 A1089      001089     AC51

AK 43 A AK43                LASN       @5000             ASSEMBLE ROUTINE AT 5000          005000

AK 44 A AK44                RASN       @15000            AS IF IT WAS AT 15000             015000
AK 45 A AK45  RASNA         LDA     06 OUTSIDE           NO EFFECT OUTSIDE RASN RANGE      005004 #5/P9 06 005179 052 AK42
AK 46 A AK46                ULA     06 RASNB             NOTE ADDRESS IS SHIFTED 10K       005009 *V#J4 06 015014     AK47
AK 47 A AK47  RASNB         LOD     05                   BLANK OPERAND NOT AFFECTED        005014 80##0 05 000000
AK 48 A AK48                UNL     05 *&25              LOCATION CTR ADS IS AFFECTED      005019 7V#U4 05 015044

AK 49 A AK49                LASN       @3000             END RASN RANGE                    003000
AK 50 A AK50                LOD        RASNA             REF TO TAG IN RASN RANGE IS       003004 8V004      015004 053 AK45
AK 51 A AK51                                             AFFECTED.
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INDEX S PGLIN    TAG      OP    NU AT OPERAND 80SMPL-001  10-20-62   COMMENTS     PG 014  F  LOC     INSTR SU  ADDR   SER  REF

AL 01 I AL01              TITLE                  SUBOR AND LITOR

AL 02 A AL02              SUBOR        OUTSIDE         THESE STATEMENTS ILLUSTRATE WAYS OF  005175                          AK42

AL 03 A AL03              SUBOR        @28704          STATING A STARTING LOCATION FOR      028704

AL 04 A AL04              SUBOR        *&1000          SUBROUTINES AND LITERALS. NOTE       004005

AL 05 A AL05              LITOR        @35000          THAT THE LAST ASSIGNMENT IS THE ONE  035000

AL 06 A AL06              LITOR        OUTSIDE         WHICH IS EFFECTIVE.                  005175                          AK42

AL 07 I AL07              TITLE             GENERATE 00 CARD - TCD

AL 08 A AL08              TCD                            TCD TO BE GENERATED IN MIDDLE OF     000095
AL 09 A AL09              SEL          @100              THE PROGRAM. IT READS A CONTROL      000099 20100      000100 054
AL 10 A AL10              RD           @1000             CARD AND THEN CONTINUES LOADING.     000104 Y1000      001000
AL 11 A AL11              TR           @0004                                                  000109 10004      000004

AL 12 A AL12              CON     5                                                           000114
AL 13 A AL13                     17    READ CONTROL CARD   COMMENT TO GO ON TCD CARD          000131

AL 14 A AL14              LASN                           TERMINATE TCD                        005175

AL 15 A AL15              TCD                            TERMINAL TCD TO REPLACE STANDARD  Z 000095
AL 16 A AL16              SET     1    1                                                      000099 B00#1 01 000001
AL 17 A AL17              SET     2    2                                                      000104 B00-2 02 000002
AL 18 A AL18              SET     3    3                                                      000109 B00&3 03 000003
AL 19 A AL19              SET     4    4                                                      000114 B0#04 04 000004
AL 20 A AL20              SET     5    5                                                      000119 B0##5 05 000005
AL 21 A AL21              SET     6    6                                                      000124 B0#-6 06 000006
AL 22 A AL22              TR           CONTINUE                                               000129 11679      001679      AG33

AL 23 A AL23              LASN                           TERMINATE TCD                        005175

AL 24 I AL24              TITLE             SUBROUTINE CALLS-INCL

AL 25 A AL25              INCL         AHEAD             EACH OF THESE STATEMENTS CALLS

AL 26 A AL26              INCL         BHEAD             FOR A SUBROUTINE FROM THE LIBRARY

AL 27 A AL27              INCL         AHEAD             NOTE THAT EACH SUBROUTINE ONLY

AL 28 A AL28              INCL         BHEAD             APPEARS ONCE IN THE PROGRAM, NO

AL 29 A AL29              INCL         AHEAD             MATTER HOW OFTEN IT IS CALLED.

AL 30 I AL30                                   INVALID USAGES                      C

AL 31 A AL31              INCL         NOTIN             SUBROUTINE NOT IN LIBRARY

AL 32 I AL32              TITLE             DEFINE A TAG - TRANS
AL 33 A AL33  TRANSA      TRANS        500               THE TRANS DEFINES A TAG, WITH AN     000500
AL 34 A AL34                                             ACTUAL, IN THIS CASE.
AL 35 A AL35              SEL          TRANSA            REFERENCES TO THE TAG WILL GET       005179 20500      000500 055 AL33
AL 36 A AL36              LOD          TRANSA            THIS DEFINITION AS THE TAG VALUE.    005184 80500      000500      AL33
AL 37 A AL37              SET          TRANSA                                                 005189 B0500      000500      AL33
AL 38 A AL38
AL 39 A AL39  TRANSC      TRANS        *&10              A TRANS TO A LOCATION COUNTER        005204
AL 40 A AL40              NOP          TRANSC            ADDRESS IS VALID.                    005194 A5204      005204      AL39
AL 41 A AL41
AL 42 A AL42              TR           TRANSB            THIS SERIES ILLUSTRATES A USEFUL     005199 15209      005209      AL44

AL 43 A AL43              HLT          *                 TECHNIQUE FOR WRITING MACRO          005204 J5204      005204
AL 44 A AL44  TRANSB      TRANS        *                 COMPONENTS, OF USING A TAGGED        005209
AL 45 A AL45              NOP          *                 TRANS * TO REFERENCE THE NEXT        005209 A5209      005209
AL 46 A AL46                                             IN LINE INSTRUCTION.
AL 47 A AL47
AL 48 A AL48  TRANSD      TRANS        NAMEA             TRANS TO TAG OPERAND IS VALID.       001089                        AC51
AL 49 A AL49
AL 50 A AL50  TRANSE      TRANS     L,NAMEA&6        MODIFICATION AND ADJUSTMENT              001066                        AC51
AL 51 A AL51
AL 52 A AL52              RCVS  05     TRANSD            THESE FOUR INSTRUCTIONS SHOW THAT    005214 U1#W0 05 001060      AC51
AL 53 A AL53              SET       S,TRANSD         BOTH LENGTH AND LOCATION ARE             005219 B0030      000030      AC51
AL 54 A AL54              LOD          TRANSD            OBTAINED WITH A TRANS TO A TAG.      005224 81089      001089      AC51
AL 55 A AL55              LOD     1 L,TRANSD&4       UNMODIFIED, UNADJUSTED TAG.              005229 810W4 01 001064      AC51

AL 56 I AL56                                   INVALID USAGES                      C
AL 57 I AL57  TAGS DEFINED BY TRANS *, TRANS @, OR A TRANS TO A MODIFIED OR        C
AL 58 I AL58  ADJUSTED TAG, SHOW A FIELD LENGTH OF ZERO. MODIFICATION OF SUCH TAGS C
AL 59 A AL59              TMT          TRANSA            IS MEANINGLESS. USE OF SUCH TAGS     005234 90500      000500      AL33
AL 60 A AL60              TCT          TRANSA            WITH H, T, OR L, ORIENTED            005239 ,0N00 08 000500      AL33
AL 61 A AL61              RD           TRANSC            INSTRUCTIONS MAY GIVE INCONSISTENT   005244 Y5204      005204 056 AL39
AL 62 A AL62              LDA     1 R,TRANSE         ADDRESSING.                              005249 #10W6 01 001066      AC51
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INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  10-20-62   COMMENTS    PG 015  F  LOC    INSTR SU  ADDR  SER  REF

AM 01 I AM01              TITLE       ASSEMBLY DOCUMENTATION

AM 02 I AM02  THE COMMENTARY ILLUSTRATES THE USE OF TITLE AND COMMENT STATEMENTS      C
AM 03 I AM03  TO ENHANCE PROGRAM DOCUMENTATION.   NOTE THAT TITLE STATEMENTS WHICH    C
AM 04 I AM04  EXTEND BEYOND THE LIMITS OF COL 23 TO COL 73 WILL BE DIVIDED INTO       C
AM 05 I AM05  FIELDS AS IN THE EXAMPLE BELOW WHICH WAS ONE WORD, ENTITLED.            C

AM 06 I AM06           EN TITLE D

AM 07 I AM07  THE COMMENT STATEMENT, A NEW FEATURE OF THE 7080 PROCESSOR, IS          C
AM 08 I AM08  DESIGNATED BY A CODE OF C IN THE FLAG FIELD, COL 74. IT MAY EXTEND      C
AM 09 I AM09  FROM COL 6 TO COL 73 AND IS NOT OVERPRINTED. AN EXTRA SPACE IS GIVEN    C
AM 10 I AM10  BEFORE A COMMENT STATEMENT UNLESS IT FOLLOWS ANOTHER COMMENT ENTRY.     C

AM 11 I AM11              TITLE            OVERFLOW CONTROL

AM 12 I AM12  PAGE-TO-PAGE OVERFLOW IS NORMALLY UNDER THE CONTROL OF A LINE COUNT     C
AM 13 I AM13  WHICH INCLUDES BLANK LINES. IT IS COMPARED TO A MAXIMUM LINE COUNT      C
AM 14 I AM14  SPECIFIED IN THE COMMUNICATION WORD AND WHEN THIS MAXIMUM IS REACHED    C
AM 15 I AM15  AN OVERFLOW OCCURS.                                                     C
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INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  10-20-62   COMMENTS    PG 016  F  LOC    INSTR SU  ADDR  SER  REF

AN 01 I AN01              TITLE            EJECT ENTRY

AN 02 I AN02  THE STATEMENT IMMEDIATELY PRECEDING THE TITLE EJECT ENTRY HAD THE       C
AN 03 I AN03  WORD EJECT IN THE OPERATION FIELD. THIS PRODUCED AN IMMEDIATE PAGE      C
AN 04 I AN04  BREAK REGARDLESS OF THE LINE COUNT.                                     C
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INDEX S PGLIN    TAG        OP    NU AT OPERAND 80SMPL-001   10-20-62    COMMENTS    PG 017  F  LOC    INSTR SU  ADDR  SER  REF

A001 K                                 THE FOLLOWING ARE CLASS A SUBROUTINES

A002 R 0001  AHEAD        TITLE        THE CLASS A SUBROUTINE WHICH FOLLOWS IS CALLED BY

A003 R 0002                            THE PROCESSOR.  IT CONSISTS OF MACRO INSTRUCTIONS

A004 R 0003                            WHICH ARE ONLY GENERATED IF THEY ARE NEEDED.

A005 K 001   XXPRTST      PRTST        XXPRTST01¤XXPRTST02¤XXPRTST03¤XXPRTST04¤XXPRTST05¤

A006 K 002                             XXPRTST06¤XXPRTSTFL$¤XXPRTSTWRK¤XXPRTSTHLD¤

A007 K 003                             XXPRTSTEND¤IBM9999999¤

A008 K 004   IOSAS        IORAS        IBM9999999¤

A009 K 005                XXACC        XAC¤XAC1¤XAC2¤XAC3¤XAC4¤XACB¤XACA¤IBM9999999¤
A010 J                    CON     1                                                    004005              057
A011 J       XAC                  8    &00000000                                     D 004013
A012 J       XAC1                 8    &00000000                                     D 004021
A013 J       XACA         CON     1    0000000000000000000000000000000000000000        004022
A014 J                    CON     8    9999999999999999999999999999999999999999        004030

A015 K 006                XXACD        XACC¤XACC1¤IBM9999999¤

A016 K 007   XXBSRCH      BSRCH        XXBSRCH01¤XXBSRCH02¤XXBSRCH03¤XXBSRCH04¤XXBSRCH05¤

A017 K 008                             XXBSRCH06¤XXBSRCH07¤XXBSRCH08¤XXBSRCH09¤XXBSRCH10¤

A018 K 009                             XXBSRCHEXT¤IBM9999999¤

A019 K 010   XXSSRCH      SSRCH        XXSSRCH01¤XXSSRCH02¤XXSSRCH03¤XXSSRCH04¤XXSSRCH05¤

A020 K 011                             XXSSRCH06¤XXSSRCHEXT¤IBM9999999¤

A021 K 012   XXFIX        FIX          XXFIX01¤IBM9999999¤

A022 K 013   XXFLOAT      FLOAT        XXFLOAT01¤IBM9999999¤

A023 K 014   IOTYPENTRY TYPIO          IOTYPEXIT¤IBM9999999¤

A024 K 015   XXADDENTRY AITEM          XXADDEXIT¤XXDELET02¤XXDELET04¤XXDELET03¤XXDELET07¤

A025 K 016                             XXDELET05¤XXDELET06¤IBM9999999¤

A026 K 017   XXDELENTRY DITEM          XXDELEXIT¤XXDELET02¤XXDELET03¤XXDELET04¤XXDELET05¤

A027 K 018                             XXDELET06¤XXDELET07¤IBM9999999¤

A028 K 019                ACOMP        XXACOMPTWO¤XXACOMPONE¤XXACOMPWRK¤IBM9999999¤
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INDEX S PGLIN    TAG        OP    NU AT OPERAND 80SMPL-001   10-20-62    COMMENTS    PG 018  F  LOC    INSTR SU  ADDR  SER  REF

AP01 K                                 THE FOLLOWING ENTRIES ARE   CLASS B   SUBROUTINES

AP02 R 0001  BHEAD        TITLE        THIS TITLE BLOCK APPEARS IN LIEU OF A CLASS B

AP03 R 0002                            SUBROUTINE.
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INDEX S PGLIN     TAG        OP     NU AT OPERAND 80SMPL-001  10-20-62   MESSAGES   PG 001  F  LOC    INSTR SU  ADDR          REF

AA53    AA53               1000 00       AREA OVER MODE MEM
AA63    AA63               FIELD  .      JUST NUM
AA63    AA63               FIELD  .       OP NOT FD
AA63    AA63               FIELD  .      IMPR NUM IGNRD
AA68    AA68                      2      ASSUME CON
AB16    AB42                      3      STRIPPED CON
AB28    AB54                     14      STRIPPED CON
AC33    AC33               RPT    9      IMPR RPT
AC42    AC42               RCD    4      CHK LEFT PROTECTION                                                      22
AD03    AD03               CON    6      CHK LEFT PROTECTION
AD13    AD13               CNO    2   RH                                 NO TAG RH
AD14          NAMEE                      INVAL NAME BEG AD11
AD35          NAMEH                      INVAL NAME BEG AD26
AD44          NAMEI                      INVAL NAME BEG AD31
AE11                       SETOF      OPERND 01 SWITCH TYPE UNKNOWN ASSUME A-J TYPE
AE53                       SETON      OPERND 01 SWITCH TYPE UNKNOWN ASSUME A-J TYPE
AE53                       SETON      OPERND 02 SWITCH TYPE UNKNOWN ASSUME A-J TYPE
AE58                       SETON      OPERND 01 SETOF ALTSW            NO GENERATION
AE60                       MOVE       IMPROPER DATA DEFINITION NO GEN.
AE60                       MOVE       IMPROPERLY WRITTEN
AF10    AF10               SND   04   WORST CASES                        NO TAG WORST CASE
AF11    AF11               TR         RD/WR                              NO TAG RD/WR
AF11    AF11               TR            ADJ 0
AF12    AF12  GAP          NOP           JUST TAG
AF13    AF13  GAP          NOP        *                                  DUPL TAG AF12
AF14    AF14  RD/WR        SGN           OPND JUSTIFIED                                                         AF13
AF18    AF18               WR         #NOT AVAILABLE #                   0/5 CHECK                              ¤A27
AF22    AF22               ADD        &14#                               NO TAG &14#
AF25    AF25               TRE        #DUPE#                             4/9 CHECK                              ¤A22
AF25    AF25               TRE        #DUPE#                             LIT OPND IMPROPER                      ¤A22
AF26    AF26               ADD        #0010#                             SGN CHK L                              ¤A23
AF27    AF27               LOD           NO RT LIT                                                              ¤A10
AF28    AF28               WR            NO RT LIT                                                              ¤A11
AF31    AF31               LOD           IMPR SGND LIT                                                          ¤A06
AF37    AF37               ST         995                                NO TAG 995
AF39    AF39               WR         @82500                             ADDR OVR 079999
AF42    AF42               TR         @0001234                           4/9 CHECK
AF43    AF43               LOD           IMPR OPND
AG21    AG21               LOD        *&80005                            ADDR OVR 079999
AG23    AG23               LDA        *&3                                4/9 CHECK
AG35    AG33               LOD           IMPR ADJ TRUNC                                                         ¤A20
AG35    AG33               LOD           ADJ 0                                                                  ¤A20
AG38    AG36               SET    6      INVAL ADJ OP                                                           ¤A04
AG72    AG70               RAD        S,NAMEA                            SGN CHK                                AC51
AG78    AG76               TCT        H,NAMEA                            9 CHECK                                AC51
AH14    AH12               RAD        I,INDEX3                           4/9 CHECK                              AH13
AH17    AH15               LOD        I,@110234                          ADDR OVR 079999
AH30    AH26               LFC        LASNTAGA&2                         4/9 CHECK                              AK09
AH32    AH28               LFC    1   LASNTAGA                           1/6 CHECK                              AK09
AH36    AH32               SBZ    4      JUST NUM
AH37    AH33               SBZ   04      POSS IMPR NUM
AH43    AH39               SBZ    3      JUST NUM
AH43    AH39               SBZ    3      IMPR BIT
AH44    AH40               SBZ    5      IMPR BIT
AH45    AH41               SBZ    6      IMPR BIT
AH46    AH42               SBN    9      IMPR BIT
AH51    AH47               RAD        RCDA                               SGN CHK                                AA19
AJ13    AJ13               ADCON      LASNTAGA*35                        ADDR OVR 079999                        AK09
AJ14    AJ14               ADCON  &   @43424                             SIGNED ADDR OVER 40K
AJ32    AJ32               ACON4      S,DUMMYTAG-10                      LOWER WRAP ARND                        AJ03
AJ33    AJ33               ACON4  &   @40100                             SIGNED ADDR OVER 40K
AJ34    AJ34               ACON5 15   DUMMYTAG                           ZONE ON ACON5-6                        AJ03
AJ34    AJ34               ACON5 15      IMPR NUM IGNRD                                                         AJ03
AJ35    AJ35               ACON5      @84324                             ADDR OVR 079999
AJ52    AJ52               TMT        H@NAMEA                            4/9 CHECK                              /A04
AK38    AK38               LASN          ASSIGN OPND NOT DEFINED                                                AK39
AK40    AK40               SASN           INVAL OPND
AL31    AL31               INCL          NOT IN CLASS B NAME TABLE
AL59    AL59               TMT        TRANSA                             4/9 CHECK                              AL33
AL60    AL60               TCT        TRANSA                             9 CHECK                                AL33
AL61    AL61               RD         TRANSC                             0/5 CHECK                              AL39
AL62    AL62               LDA    1   R,TRANSE                           4/9 CHECK                              AC51
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INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  10-20-62    NO REQS     PG 002  F  LOC     INSTR SU  ADDR        REF

 AB12    AB38  WORSTCASES CON     2     ABCDE                            TAG NOT REQUIRED
 AC45    AC45  COND1              2                                      TAG NOT REQUIRED
 AC46    AC46  COND2              A                                      TAG NOT REQUIRED
 AC48    AC48  CONDP                    P                                TAG NOT REQUIRED
 AC49    AC49  CONDQ                    Q                                TAG NOT REQUIRED
 AD33    AD29  NOWEND             3     XXX                              TAG NOT REQUIRED                                  9
 AD48    AD41  AGE        CHRCD   2     40                               TAG NOT REQUIRED
 AD49    AD42  TWENTY                   20                               TAG NOT REQUIRED
 AD50    AD43  FORTY                    40                               TAG NOT REQUIRED
 AD54    AD47  MALE                     M                                TAG NOT REQUIRED
 AD62    AD55  BIWEEKLY           4                                      TAG NOT REQUIRED
 AD65    AD58  FLAT FEE           B                                      TAG NOT REQUIRED
 AD71    AD64  BAD2               2                                      TAG NOT REQUIRED
 AF14    AF14  RD/WR      SGN           L, GAP                           TAG NOT REQUIRED                               AF13
 AF50    AF50  LOCATIONA  BSP                                            TAG NOT REQUIRED
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INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  10-20-62     TITLES     PG 003  F  LOC     INSTR SU  ADDR        REF

AA 01 I AA01               TITLE      7080 PROCESSOR - SAMPLE ASSEMBLY
AA 02 I AA02                          INTRODUCTION
AA 13 I AA13               TITLE      NORMAL ORIGIN
AA 17 I AA17               TITLE      AREA DEFINITIONS
AA 18 I AA18                               DEFINITION OF A RECORD FIELD - RCD
AA 70 I AB17               TITLE           DEFINITION OF A CONSTANT FIELD - CON
AB 32 I AB58               TITLE           DEFINITION OF A FLOATING POINT CONSTANT - FPN
AC 01 I AC01               TITLE           DEFINITION OF A REPORT FORMAT - RPT
AC 04 I AC04
AC 34 I AC34               TITLE           COLLECTIVE AREA DEFINITION - NAME
AC 35 I AC35                                    NORMAL USE
AD 01 I AD01               TITLE                SPECIAL USES OF NAME STATEMENTS
AD 45 I AD38               TITLE      SWITCH DEFINITIONS
AD 46 I AD39                               DATA SWITCHES
AD 47 I AD40                                    CHARACTER CODE - CHRCD
AD 58 I AD51               TITLE                BIT CODE - BITCD
AE 01 I AE01               TITLE           PROGRAM SWITCHES
AE 14 I AE12               TITLE           CONSOLE SWITCHES
AE 21 I AE19               TITLE           BRANCH CONTROL MACRO-INSTRUCTIONS
AF 01 I AF01               TITLE      ONE-FOR-ONE INSTRUCTIONS
AF 02 I AF02                               BASIC OPERANDS
AF 03 I AF03                                    TAG OPERANDS
AF 15 I AF15               TITLE                LITERAL OPERANDS
AF 33 I AF33               TITLE                ACTUAL OPERANDS
AF 45 I AF45               TITLE                LOCATION COUNTER OPERANDS
AF 49 I AF49               TITLE                BLANK OPERANDS
AG 01 I AG01               TITLE           ADDITIONS TO BASIC OPERANDS
AG 02 I AG02                                    CHARACTER ADJUSTMENT
AG 40 I AG38               TITLE                OPERAND MODIFIERS
AH 01 I AH01               TITLE                INDIRECT ADDRESSING
AH 27 I AH23               TITLE                SPECIAL MNEMONICS
AH 28 I AH24                                         ADDRESS CHECK ON LFC-UFC
AH 33 I AH29               TITLE                     NUM ON SET BIT INSTRUCTIONS
AH 47 I AH43               TITLE                FLAG CODES
AI 01 I AI01               TITLE      MACRO INSTRUCTIONS
AJ 01 I AJ01               TITLE      ADDRESS CONSTANTS
AJ 02 I AJ02                               ADCON
AJ 15 I AJ15               TITLE           ACON4, ACON5, AND ACON6
AJ 36 I AJ36               TITLE           ADDRESS CONSTANT LITERAL
AK 01 I AK01               TITLE      INSTRUCTIONS TO THE PROCESSOR
AK 02 I AK02                               ASSIGNMENT STATEMENTS
AK 03 I AK03                                    LASN
AK 26 I AK26               TITLE                SASN
AK 41 I AK41               TITLE                RASN
AL 01 I AL01               TITLE                SUBOR AND LITOR
AL 07 I AL07               TITLE           GENERATE 00 CARD - TCD
AL 24 I AL24               TITLE           SUBROUTINE CALLS-INCL
AL 32 I AL32               TITLE           DEFINE A TAG - TRANS
AM 01 I AM01               TITLE      ASSEMBLY DOCUMENTATION
AM 06 I AM06            EN TITLE D
AM 11 I AM11               TITLE           OVERFLOW CONTROL
AN 01 I AN01               TITLE           EJECT ENTRY
 A002 R 0001  AHEAD        TITLE      THE CLASS A SUBROUTINE WHICH FOLLOWS IS CALLED BY
 A003 R 0002                          THE PROCESSOR.  IT CONSISTS OF MACRO INSTRUCTIONS
 A004 R 0003                          WHICH ARE ONLY GENERATED IF THEY ARE NEEDED.
 AP02 R 0001  BHEAD        TITLE      THIS TITLE BLOCK APPEARS IN LIEU OF A CLASS B
 AP03 R 0002                          SUBROUTINE.
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INDEX S PGLIN   TAG     OP   NU AT OPERAND 80SMPL-001  10-20-62   C FLAG    PG 004  F  LOC   INSTR SU  ADDR        REF

AA 03 I AA03  THIS ASSEMBLY ILLUSTRATES CORRECT AND INCORRECT USAGES OF THE 7080      C
AA 04 I AA04  PROCESSOR. SHORT CODING EXAMPLES ARE USED TO SHOW WHAT THE              C
AA 05 I AA05  PROCESSOR PRODUCES, INCLUDING ERROR AND CAUTIONARY MESSAGES, FOR        C
AA 06 I AA06  TYPICAL VALID AND INVALID STATEMENTS. COMMENT AND TITLE STATEMENTS      C
AA 07 I AA07  AND THE COMMENTS FIELD OF ILLUSTRATIVE STATEMENTS, HAVE BEEN USED TO    C
AA 08 I AA08  DESCRIBE THE USAGES. THIS ASSEMBLY IS FOR ILLUSTRATIVE PURPOSES ONLY    C
AA 09 I AA09  AND DOES NOT REPRESENT AN EXECUTABLE PROGRAM. THE OBJECT MACHINE IS     C
AA 10 I AA10  ASSUMED TO BE AN 80K 7080, ASUS 1-6 ARE ASSUMED SET TO LENGTHS OF       C
AA 11 I AA11  1-6 RESPECTIVELY, AND THE OTHER ASUS AND ACC ARE AT SOME RANDOM         C
AA 12 I AA12  LENGTH.                                                                 C
AA 14 I AA14  SINCE NO STARTING LOCATION IS SPECIFIED, THE ORIGIN OF THE              C
AA 15 I AA15  PROGRAM IS ASSUMED TO BE AT LOCATION 0500.                              C
AA 51 I AA51                                  INVALID USAGES                          C
AB 11 I AB37                                  INVALID USAGES                          C
AB 34 I AB60  NOTE THAT THE NUMERIC FIELD IS BLANK AND THAT THE MANTISSA IS ONLY      C
AB 35 I AB61  SIX DIGITS. A LENGTH OF TEN WILL BE ASSUMED AND TRAILING ZEROS ADDED    C
AB 36 I AB62  TO MAKE AN EIGHT DIGIT MANTISSA. THE FPN APPEARS IN MEMORY AS           C
AB 37 I AB63  0C12345600 WITH THE UNITS DIGIT SIGNED PLUS. THE LISTING DOES NOT       C
AB 38 I AB64  SHOW THE ADDED ZEROS OR ASSUMED LENGTH.                                 C
AB 39 I AB65                                                                          C
AB 40 I AB66                                  INVALID USAGES                          C
AB 44 I AB70  THE TWO ENTRIES IMMEDIATELY ABOVE WERE INTENDED AS COMMENTS             C
AB 45 I AB71  COUTINUATIONS. THIS IS INVALID ON A FPN AND TWO FPNS WERE GENERATED     C
AB 46 I AB72  FROM THE OPERAND FIELDS. THE LISTING ONLY SHOWS THE MEMORY ALLOCATED    C
AB 47 I AB73  BUT THE CARDS SHOW 5E38103850 AND 3077519201.                           C
AB 48 I AB74                                                                          C
AB 49 I AB75  THIS FPN WAS INTENDED TO REPRESENT 123.456. OMITTING THE LEADING        C
AB 50 I AB76  ZERO OF THE CHARACTERISTIC CAUSED IT TO REPRESENT THE NUMBER            C
AB 51 I AB77  2345600000000000000000000000.                                           C
AB 53 I AB79  THIS OPERAND WAS INTENDED TO REPRESENT 123.456. OMITTING THE SECOND     C
AB 54 I AB80  PLUS SIGN CAUSED IT TO REPRESENT 234.56                                 C
AC 02 I AC02  THESE ILLUSTRATIONS ALL SHOW EIGHT NUMERIC POSITIONS WITH VARIOUS       C
AC 03 I AC03  PUNCTUATION AND SIGN INDICATIONS.                                       C
AC 05 I AC05  IN THIS SERIES NO COMMAS, DECIMAL POINTS, DOLLAR SIGNS, OR ASTERISKS    C
AC 06 I AC06  ARE SPECIFIED. ONE POSITION IS RESERVED FOR A BLANK OR MINUS SIGN.      C
AC 07 I AC07  IN THE FIRST FORMAT ALL EIGHT POSITIONS WILL PRINT, LEADING ZEROS       C
AC 08 I AC08  INCLUDED. IN THE SECOND FORMAT LEADING ZEROS IN ANY OF THE FIVE HIGH    C
AC 09 I AC09  ORDER POSITIONS ARE NOT PRINTED. IN THE THIRD FORMAT, NO LEADING        C
AC 10 I AC10  ZEROS WILL PRINT.                                                       C
AC 14 I AC14  IN THIS FORMAT VARIOUS EDIT PUNCTUATION IS ADDED. THE DOLLAR SIGN       C
AC 15 I AC15  WILL ALWAYS PRINT EIGHT POSITIONS TO THE LEFT OF THE DECIMAL POINT.     C
AC 16 I AC16  THE COMMA WILL PRINT IF THERE ARE ANY SIGNIFICANT FIGURES TO THE        C
AC 17 I AC17  LEFT OF IT. THE DECIMAL POINT AND THE POSITIONS TO THE RIGHT OF IT      C
AC 18 I AC18  WILL ALWAYS PRINT, EVEN FOR A ZERO AMOUNT. A TWO POSITION SIGN          C
AC 19 I AC19  INDICATOR IS SPECIFIED AS CR, **, OR DR FOR MINUS, ZERO, OR PLUS        C
AC 20 I AC20  AMOUNTS, RESPECTIVELY.                                                  C
AC 22 I AC22  THESE TWO EXAMPLES ILLUSTRATE AMOUNT PROTECTION IN A RPT FORMAT. IN     C
AC 23 I AC23  THE FIRST, THE $ SIGN IS FIXED BUT * WILL PRINT IN ALL SPACES           C
AC 24 I AC24  BETWEEN IT AND THE HI-ORDER DIGIT PRINTED. IN THE SECOND, THE $ SIGN    C
AC 25 I AC25  WILL PRINT IMMIDIATELY TO THE LEFT OF THE HI-ORDER DIGIT PRINTED.       C
AC 28 I AC28  THE OPERAND BZ IN THIS EXAMPLE INDICATES THAT THE ENTIRE FIELD,         C
AC 29 I AC29  INCLUDING THE DECIMAL POINT AND POSITIONS TO THE RIGHT OF IT, IS TO     C
AC 30 I AC30  BE BLANKED IF THE RESULT IS ZERO.                                       C
AC 32 I AC32                                  INVALID USAGES                          C
AC 56 I AC55  THE FOLLOWING SERIES ILLUSTRATES THE USE OF CONCURRENT NAME             C
AC 57 I AC56  DEFINITIONS. NAMEC IS ENTIRELY WITHIN NAMEB. NAMED IS ONLY PARTLY       C
AC 58 I AC57  WITHIN NAMEB. BOTH USAGES ARE VALID.                                    C
AD 10 I AD10                                  INVALID USAGES                          C
AD 16 I AD15  THIS NAME ENTRY WILL NOT COMPILE CORRECTLY BECAUSE THE NUMERIC          C
AD 17 I AD16  FIELD OF THE INTERNAL NAME ENTRY SPECIFIES A STARTING LOCATION NOT      C
AD 18 I AD17  IMMEDIATELY FOLLOWING THE PORTION OF THE NAME ENTRY ALREADY DEFINED.    C
AD 67 I AD60                                  INVALID USAGES                          C
AE 04 I AE04                                  INVALID USAGES                          C
AE 49 I AE25                                  INVALID USAGES                          C
AE 50 I AE26  THE FOLLOWING MACRO ATTEMPTS TO SET ON TWO UNDEFINED SWITCHES WHICH     C
AE 51 I AE27  ARE THE TAGS OF CHRCD AND BITCD HEADERS. THEY ARE TREATED AS A-J        C
AE 52 I AE28  TYPE SWITCHES.                                                          C
AE 57 I AE30  THE NEXT MACRO ATTEMPTS TO SET ON AN ALTSW.                             C
AE 59 I AE32  THE FOLLOWING MACRO ATTEMPTS TO INITIALIZE A BITCD USING MOVE MACRO.    C
AF 05 I AF05  THE MEANING OF A TAG OPERAND DEPENDS ON THE INSTRUCTION AS WELL AS      C
AF 06 I AF06  THE DATA DEFINITION FOR THE TAG.                                        C
AF 09 I AF09                                  INVALID USAGES                          C
AF 21 I AF21                                  INVALID USAGES                          C
AF 36 I AF36                                  INVALID USAGES                          C
AF 48 I AF48  FURTHUR EXAMPLES WILL BE SHOWN UNDER CHARACTER ADJUSTMENT.              C
AF 56 I AF56  A SPECIAL CASE OF A LASN WITH BLANK OPERAND WILL BE SHOWN LATER.        C
AG 18 I AG18  CHARACTER ADJUSTMENT TO ADDRESS CONSTANT LITERALS IS A SPECIAL          C
AG 19 I AG19  CASE AND WILL BE ILLUSTRATED LATER.                                     C
AG 20 I AG20                                  INVALID USAGES                          C
AG 41 I AG39  THIS SERIES SHOWS THE USE OF MODIFIERS TO CHANGE THE NORMAL ADDRESS     C
AG 42 I AG40  ORIENTATION OF AN INSTRUCTION. NAMEA IS 30 POSITIONS FROM 1070-1099.    C
AG 63 I AG61  OPERAND MODIFIERS MAY BE COMBINED WITH CHARACTER ADJUSTMENT.            C
AG 65 I AG63                                  INVALID USAGES                          C
AH 11 I AH09                                  INVALID USAGES                          C
AH 20 I AH18  IN 80 MODE THE TAG OF AN I, WILL BE PUT ON THE GENERATED EIA. ANY       C
AH 21 I AH19  ADDRESS MODIFICATION MUST TAKE THIS INTO ACCOUNT.                       C
AH 42 I AH38                                  INVALID USAGES                          C
AH 48 I AH44  THE FLAG CODES C, R, AND Z, ARE SHOWN ELSEWHERE.  CODES 1, A, F,        C
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INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  10-20-62     C FLAG      PG 005  F  LOC      INSTR SU  ADDR          REF

AH 49 I AH45  T, AND G ARE NOT SHOWN SINCE THEIR EFFECT IS NOT APPARENT HERE.            C
AH 50 I AH46                                                                              C
AH 60 I AH56                    NOP TO TR. FLAG M PUTS THE NOP ON THE M FLAG PAGE        C
AH 61 I AH57                    OF THE NOTEBOOK, FLAG H PUTS THE TR ON THE H FLAG        C
AH 62 I AH58                    PAGE OF THE NOTEBOOK.                                    C
AH 63 I AH59                                                                              C
AI 02 I AI02  THE INSTRUCTIONS GENERATED BY A MACRO DEPEND ON THE DATA                   C
AI 03 I AI03  CHARACTERISTICS OF THE FIELDS REFERENCED BY THE OPERANDS. THE FIRST        C
AI 04 I AI04  CASE, BELOW, ADDS TWO SIMILAR FIELDS AND PLACES THE RESULT IN ONE.         C
AJ 12 I AJ12                                   INVALID USAGES                            C
AJ 31 I AJ31                                   INVALID USAGES                            C
AJ 40 I AJ40  ON THE STATEMENT ABOVE NOTE THE WAY THE ADJUSTMENT IS APPLIED. THE         C
AJ 41 I AJ41  VALUE OF S,NAMEA IS 30. THE ADJUSTMENT IS ADDED TO THIS VALUE              C
AJ 51 I AJ51                                   INVALID USAGES                            C
AK 04 I AK04  THE FOLLOWING EXAMPLES SHOW THE INDEPENDENCE OF THE LASN COUNTERS OF       C
AK 05 I AK05  EACH OTHER AND THEIR RELATION TO THEIR HIGH ASSIGNMENT COUNTERS AND        C
AK 06 I AK06  TO THE LOCATION COUNTER.                                                   C
AK 37 I AK37                                   INVALID USAGES                            C
AL 30 I AL30                                   INVALID USAGES                            C
AL 56 I AL56                                   INVALID USAGES                            C
AL 57 I AL57  TAGS DEFINED BY TRANS *, TRANS @, OR A TRANS TO A MODIFIED OR              C
AL 58 I AL58  ADJUSTED TAG, SHOW A FIELD LENGTH OF ZERO. MODIFICATION OF SUCH TAGS       C
AM 02 I AM02  THE COMMENTARY ILLUSTRATES THE USE OF TITLE AND COMMENT STATEMENTS         C
AM 03 I AM03  TO ENHANCE PROGRAM DOCUMENTATION.   NOTE THAT TITLE STATEMENTS WHICH       C
AM 04 I AM04  EXTEND BEYOND THE LIMITS OF COL 23 TO COL 73 WILL BE DIVIDED INTO          C
AM 05 I AM05  FIELDS AS IN THE EXAMPLE BELOW WHICH WAS ONE WORD, ENTITLED.               C
AM 07 I AM07  THE COMMENT STATEMENT, A NEW FEATURE OF THE 7080 PROCESSOR, IS             C
AM 08 I AM08  DESIGNATED BY A CODE OF C IN THE FLAG FIELD, COL 74. IT MAY EXTEND         C
AM 09 I AM09  FROM COL 6 TO COL 73 AND IS NOT OVERPRINTED. AN EXTRA SPACE IS GIVEN       C
AM 10 I AM10  BEFORE A COMMENT STATEMENT UNLESS IT FOLLOWS ANOTHER COMMENT ENTRY.        C
AM 12 I AM12  PAGE-TO-PAGE OVERFLOW IS NORMALLY UNDER THE CONTROL OF A LINE COUNT        C
AM 13 I AM13  WHICH INCLUDES BLANK LINES. IT IS COMPARED TO A MAXIMUM LINE COUNT         C
AM 14 I AM14  SPECIFIED IN THE COMMUNICATION WORD AND WHEN THIS MAXIMUM IS REACHED       C
AM 15 I AM15  AN OVERFLOW OCCURS.                                                        C
AN 02 I AN02  THE STATEMENT IMMIDIATELY PRECEDING THE TITLE EJECT ENTRY HAD THE          C
AN 03 I AN03  WORD EJECT IN THE OPERATION FIELD. THIS PRODUCED AN IMMEDIATE PAGE         C
AN 04 I AN04  BREAK REGARDLESS OF THE LINE COUNT.                                        C
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INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  10-20-62     H FLAG      PG 006  F  LOC      INSTR SU  ADDR          REF

 AE61 J                    HLT         @29000                                             001434    J        029000
AH 59 A AH55               TR          *-5                 HLT. AN INTERRUPT CAN CHANGE THE  H 001974    1        001969
AL 43 A AL43               HLT         *                   TECHNIQUE FOR WRITING MACRO        005204    J        005204
```

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INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  10-20-62    80 SP OP    PG 007  F  LOC    INSTR SU  ADDR          REF

AH 02 A AH02               LEV80
AH 07 A AH07               ENT80                             SAME INSTRUCTION IN 80 MODE
AH 12 A AH10               LEV80
AH 19 A AH17               ENT80
AJ 42 A AJ42               LEV80                             REPEAT SERIES IN 705III MODE.
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INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  10-20-62    80 SP I     PG 008  F  LOC    INSTR SU  ADDR          REF

AG 30 A AG30               TR          I,EXIT             TO EXIT LINKAGE ON UNEQUAL
AH 08 A AH08               LOD      6  I,INDEX1           OPERAND AND COMMENTS REPEAT.
AH 24 A AH22   TAGZ        LOD         I,INDEX1
```

```
INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  10-20-62    ASSGNS      PG 009  F  LOC    INSTR SU  ADDR          REF

AK 08 A AK08               LASN        @5123      SET BLANK CTR TO 5123                  005123             005129
AK 10 A AK10               LASN     1  LASNTAGA&20  SET CTR 1 TO 5145                    005145             005149       AK09
AK 12 A AK12               LASN        *          SET BLANK CTR TO LOCATION CTR          005150             005154
AK 14 A AK14               LASN     1  LASNTAGA&10  SET CTR 1 TO LOWER VALUE             005135             005139       AK09
AK 16 A AK16               LASN     1             SET CTR 1 TO PREVIOUS HI ASSIGNMENT    005150             005154
AK 18 A AK18               LASN     1  LASNTAGA   RESET CTR 1 HI ASSIGNMENT & CTR 1    R 005125             005129       AK09
AK 20 A AK20               LASN        @5100      SET BLANK CTR TO LOWER VALUE           005100             005104
AK 22 A AK22               LASN     1             SET CTR 1 TO NEW HI ASSIGNMENT         005130             005134
AK 24 A AK24               LASN                   SET BLNK CTR TO BLNK CTR HI ASSIGNMNT  005155             005159
AK 27 A AK27               SASN        LASNTAGA&100     SET TO HIGHER THAN LASN BLANK CTR  005225             005229       AK09
AK 29 A AK29               LASN                         RETURN TO BLANK CTR HI ASSIGNMENT  005160             005164
AK 31 A AK31               SASN        @5000            SET BELOW LASN BLANK CTR           005000             005004
AK 33 A AK33               LASN                         RETURN TO BLANK CTR HI ASSIGNMENT  005165             005169
AK 35 A AK35               SASN        @8000                                               008000             008004
AK 38 A AK38               LASN        LASNTAGB         A LASN TO A TAG NOT YET DEFINED IS 005170             005174       AK39
AK 40 A AK40               SASN                         SASN BLANK IS IGNORED.             005175             005179
AK 43 A AK43               LASN        @5000            ASSEMBLE ROUTINE AT 5000           005000             005000
AK 44 A AK44               RASN        @15000           AS IF IT WAS AT 15000              015000             005019
AK 49 A AK49               LASN        @3000            END RASN RANGE                     003000             000131
AL 14 A AL14               LASN                         TERMINATE TCD                      005175             000129
AL 23 A AL23               LASN                         TERMINATE TCD                      005175             004030
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INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  10-20-62    SWITCHES    PG 010  F  LOC    INSTR SU  ADDR          REF

AE 02 A AE02   SWA         SWT         *&15             PROGRAM SWITCH, INITIALLY ON.      001284   1         001299
AE 03 A AE03   SWB         SWN         *&10             PROGRAM SWITCH, INITIALLY OFF.     001289   A         001299
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```
INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  10-20-62    TRANS       PG 011  F  LOC    INSTR SU  ADDR          REF

AL 48 A AL48   TRANSD      TRANS       NAMEA            TRANS TO TAG OPERAND IS VALID.     001089                         AC51
AL 50 A AL50   TRANSE      TRANS     L,NAMEA&6        MODIFICATION AND ADJUSTMENT          001066                         AC51
```

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INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  10-20-62    M FLAG      PG 012  F  LOC    INSTR SU  ADDR          REF

AA 63 A AA63               FIELD                        THE WORD FIELD, INTENDED AS A      000794   A         000000
AF 55 A AF55   EXIT        TR                           INITIALIZED BY UNLOADING ASU 06.   001604   1         000000
AH 58 A AH54               NOP            EXIT          THIS SPIN LOOP IS EQUIVALENT TO A M 001969  A         001604       AF55
AK 47 A AK47   RASNB       LOD    05                    BLANK OPERAND NOT AFFECTED         005014   8      05 000000
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SIGNED LITERALS
A          01  AE42  AE54
1&         02  AI38
123D       04  AJ50  AG38
395G       04  AJ26
BALANCN    07  AF31
987654C    07  AI13
0021E      05  AF16
0M56780    10  AF20

UNSIGNED LITERALS
AGE        50  AF27
THIS LI    50  AF28
ABCDE      05  AG69
APPLE      05  AG64  AF17
F          01  AE36
G          01  AE62
J          01  AE13
1          01  AE23
           02  AF19
60         02  AE27
300        03  AG35
ABLE       04  AJ09
DUPE       04  AF25
0010       04  AF26
1234567    07  AG09
-BALANC    08  AH64
LOCATIO    09  AF23
NOT AVA    14  AF18

ACTUALS
*002344    AJ49           LDA   05
@000000    AF43           LOD
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@000003    AL18           SET   3
@000004    AL11           TR         AL19       SET   4
@000005    AF34           SET        AF35       SET        AI41       SET        AL20       SET   5
@000006    AI32           SET        AI43       SET        AL21       SET   6
@000008    AI12           SET        AI22       SET
@000009    AI18           SET        AI26       SET
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@000123    AF42           TR
@000500    AL33 TRANSA    TRANS
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@005123	AK08	LASN										
@008000	AK35	SASN										
@012345	AJ30	ACON5										
@015000	AK44	RASN										
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	AH38	SBA		AH39	SBN	4	AH40	SBR	10	AH41	SBA	10
	AH43	SBZ	3	AH44	SBZ	5	AH45	SBZ	6	AH46	SBN	9
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@029000	AE61	HLT										
@035000	AL05	LITOR										
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@043155	AJ10	ADCON										
@043424	AJ14	ADCON	&									
@082500	AF39	WR										
@084324	AJ35	ACON5										
@110234	AH17	LOD										

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