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IBM 7080 Processor: Autocoder Language

This publication contains specifications for using Autocoder, the basic symbolic language of the 7080 Processor. The types of statements that constitute the Autocoder language include area definitions, switch definitions, one-for-one instructions, macro-instructions, address constants, and instructions to the Processor. All statement types, except macro-instructions, are described in detail. A general discussion of macro-instructions is included. However, the detailed specifications for using them are provided in the publication 7080 Processor: General Purpose Macro-Instructions, Form C28-6356.

The Introduction to this publication reviews some basic aspects of programming, such as symbolic programming systems and the IBM 7080 programming systems. Other features of the manual include descriptions of the following: The organization of the object program deck, the format of the object program card, and the standard and optional documentation produced during an Autocoder program assembly. An extensive sample assembly is also included to illustrate what the 7080 Processor produces. The assembly contains many examples of correct and incorrect language usage.

MINOR REVISION (September 1964)

This publication, Form C28-6263-2, is a minor revision of the previous edition, Form C28-6263-1, and incorporates the contents of the Technical Newsletter N28-1172. This revision does not obsolete either the previous edition or the Technical Newsletter.

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CONTENTS

This manual contains detailed specifications for coding programs using Autocoder, the basic symbolic language of the 7080 Processor. All parts of the language except macro-instructions are fully described. A brief introduction to the general-purpose macro-instructions provided by IBM for 7080 users is provided in this publication; a full explanation may be found in the publication, 7080 Processor: General Purpose Macro-Instructions, Form C28-6356. Procedures for writing new macro-instructions for incorporation into the language are described in the publication, 7080 Processor: Preparation of Macro-Instructions, Form C28-6264.

Just as the Autocoder language described in this publication 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 that distinguish 7080 Autocoder from Autocoder III have been fully integrated into the following pages and may not be apparent, even to long-time users of Autocoder III. Despite this, no attempt has been made in the body of the manual to call attention to the differences; to do so might prove distracting, particularly to readers without a background in Autocoder III. However, significant differences between the two languages have been summarized in the Appendix for the convenience of experienced programmers who want a rapid survey of 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 background discussion that follows assumes that the reader has had little programming experience. Readers already familiar with the IBM 7080 Data Processing System may wish to go directly to the body of the publication. Further information on the IBM 7080 may be found in the reference manual, IBM 7080 Data Processing System, Form A22-6560-2, and in 7080 Systems Summary, Form A22-6775. Other publications that may be of interest to 7080 users are abstracted in the publication, IBM 7080 Bibliography, Form A22-6774.

BASIC ASPECTS OF PROGRAMMING

This explanation is written for the inexperienced programmer. The material is not detailed or 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.

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. The main function of a program is to process these records as specified, and these record-processing routines may be considered the body of the program. They are often called the main-line routines or the main-line coding. However, the program does not consist solely of these routines.

Any program must also 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 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, and locations for the storage area or areas that the records will occupy. Records are usually grouped in blocks; consequently an entire block enters storage at one time. 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 such a 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.

A program must also provide routines for detecting and handling error conditions resulting from input/output 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 assignment
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 is the second of two data processing applications. The first application is the processing or assembly 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 can be used in subsequent data processing applications until it is obsolete, or until it 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 that 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, which is a source-program statement that is eventually replaced by a sequence of machine instructions. 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 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 that 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 that 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 that will occupy it. If it is 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 that makes the reference. Usually, it is desirable to create symbolic addresses that 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 that 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 analyzes 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 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 each time. 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 combinations of 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 into the program. The instructions will not vary from program to program unless the subroutine itself contains macro-instructions. The programmer can 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 that assembles programs written in Autocoder for the IBM 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 interrelated sections, or phases. Each phase is a program which performs one or more of the various assembly functions. The phase 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, 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 various types of information about the program, including 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 Operator's 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 publication) means specifying the data to be operated on or specifying an instruction to be executed. For example, an Autocoder statement that calls for data movement to a work area references the data and the work area; a statement that 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 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 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. In all other cases, 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.

In defining 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 switches, program switches, and console switches. 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.

Referring again to the employee records used as an example in the section on area definitions, suppose 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 numerical characters. The manner in which each record is processed depends on the number of exemptions; the program therefore contains a number of processing routines. As each record is placed in the work area, the data switch becomes the character contained in the exemption field of the records. 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 that 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 the 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; and 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. These switches 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 that is run each week may include a routine that 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 that 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.

An illustration of macro-instruction scope is: 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 the excess positions 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 that lacks one, or replacing the reference made by an instruction. An instruction makes a reference by designating the symbolic address of a data field of another 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 that 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 address portion of the instruction 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 (i.e., 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 CONTROL 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 that handle all input/output functions. IBM 7080 IOCS routines are made available to an Autocoder program when IOCS macro-instructions in the Processor library are used in the program.

Titles, form numbers, and abstracts of available publications dealing with 7080 IOCS may be found in the publication, IBM 7080 Bibliography, Form A22-6774.

HIGHER LANGUAGES OF THE 7080 PROCESSOR

As mentioned earlier, the 7080 Processor accepts program statements written in several higher languages. The languages are: Fortran; Report/File language; Decision language; Arithmetic language, and Table-Creating language. 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 the form of mathematical formulas, using FORTRAN. Both fixed point and floating point calculations are possible.

Report/File language is a set of statements that 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 can be used to request a logical decision to be made on the basis of a test of the various conditions supplied in the statement.

Arithmetic language can be used to request that a series of mathematical computations be performed on the elements supplied in the statement.

Table-Creating language can be used to describe tables suitable for data-searching, along with the associated table entries.

Titles, form numbers, and abstracts of publications dealing with the higher languages of the 7080 Processor may be found in, IBM 7080 Bibliography, Form A22-6774.

Autocoder programs are written on the IBM 7080 Processor Coding Form, Form X28-1636-1, shown in Figure 1. One card is punched for each line of the coding sheet. The card designed for 7080 Autocoder programs is the 7080 Processor Source Card, Electro N14106. 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.

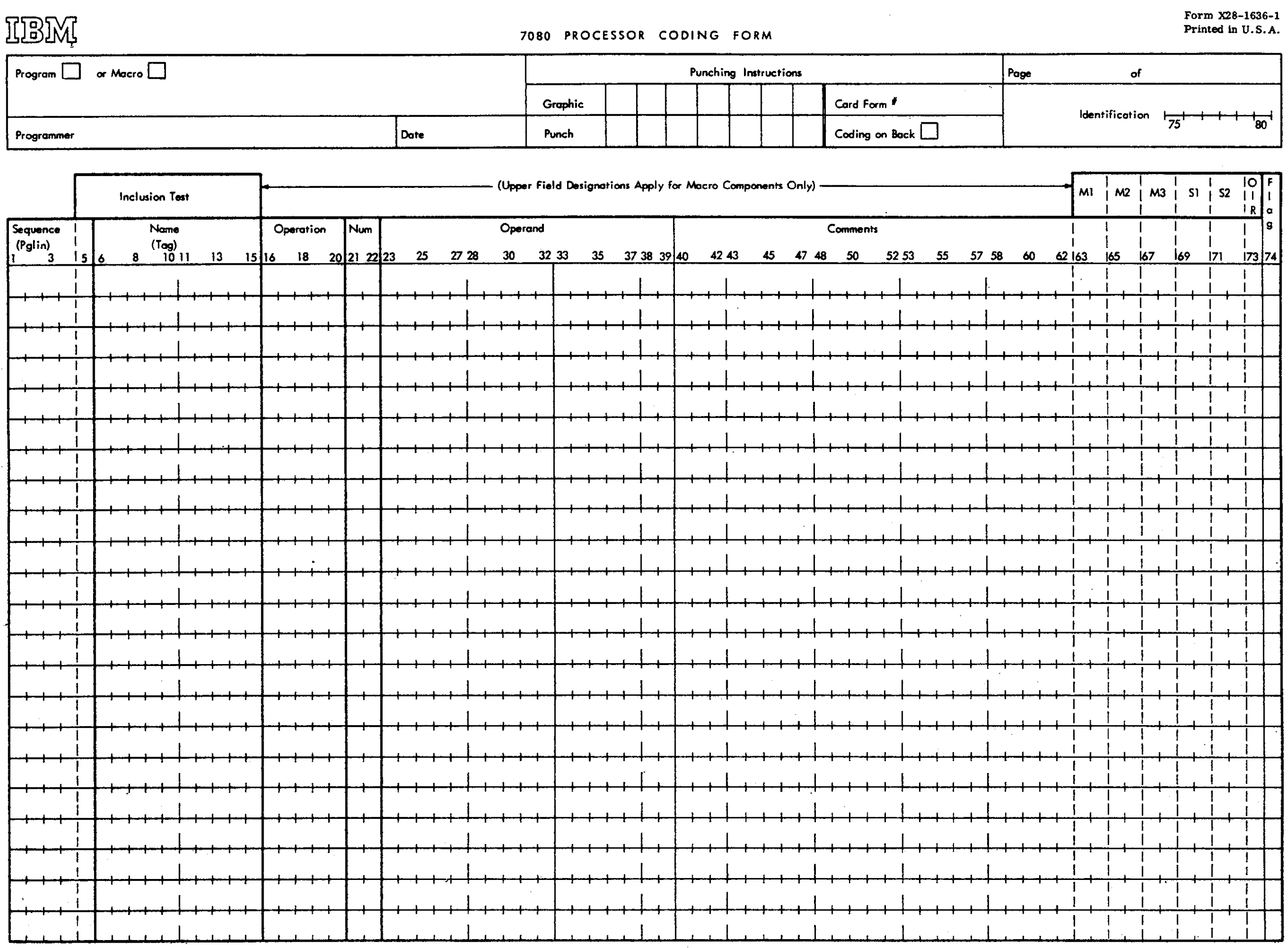
Note: Throughout this publication, the field headed "SEQUENCE (PGLIN)" will be referred to as the pglin field, the field headed "NAME (TAG)" will be referred to as the tag field.

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 entry in these columns. Columns 1 and 2 designate a two-position page number that is used to determine the sequence of the coding sheets.



* A standard card form, IBM electro N14106, is available for punching source statements from this coding form.

Figure 1. IBM 7080 Processor Coding Form

Any alphameric character may be used in the entry. 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.

Columns 3 - 5 designate a three-position line number that is used to determine the sequence of the statements on the coding sheets. Any alphameric character may be used in these positions, although special characters are not normally used. 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 that 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. In the case of three-lines inserted 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 that 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 characters may be alphabetic, numerical, and blanks. A tag may not contain special characters. If composed of numerical 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 numerical tags not be used. It is best to create tags that describe the data fields or the instructions to which they are assigned. Tags should not be assigned unless they are referenced by program statements; unnecessary tags slow the assembly process and produce needless messages. To avoid confusion and possible improper macro generation, it is strongly recommended that no tag begin with either of the following three-letter prefixes: CSF, IBM.

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.

NUM (COLUMNS 21 - 22)

The use of the NUM (numerical) 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 accompany a macro-instruction, 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 the pglin and comments fields.

If the comments do not accompany a macro-instruction, they do not have to be separated from

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

Figure 2. IBM 7080 Collating Sequence

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 (numerical 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 the section "Instructions to the Processor."

AREA DEFINITIONS

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 that 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 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 numerical field. (The operation field is assumed to be blank if column 16 is blank.)

NUMERICAL FIELD: The size of the data field is entered here. A one-digit entry is placed in column 22; it need not be preceded by a zero. When the operation field contains the RCD code, the numerical 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 numerical field. Under these conditions, in effect, the numerical 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 numerical fields containing integers only.
2. A description of an integer and decimal format. This is used to define numerical 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.

Alphameric Fields and Numerical Fields of Integers Only:

Code	Contents of Field
+	Signed numerical data consisting of integers.
N	Unsigned numerical data consisting of integers.
F	Signed numerical 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-point constant appears in storage.
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 should be provided when the subsequent field contains signed numerical data. The low-order position of the field providing left protection must be occupied by one of the following: an alphabetic character, a signed numerical 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.

Numerical 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. (The first method is the preferred use.)

Name (Tag)	Operation	Num	Operand
UNSIGNED	RCD	8	N
ALPHAFIELD		125	A+
SIGNED		13	+
FLOAT		10	F
		1200	A

Figure 3

1. Enumerating the number of integer and decimal positions. Signed numerical fields are represented as #+xx. yy, and unsigned numerical 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 numerical digit is preceded by a zero. The sum of xx and yy must equal the entry in the numerical field. The maximum size data field that 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 signed numerical fields are being defined, a plus sign is placed in the first position of the operand, and is followed by the layout. The operand defining an unsigned numerical field starts with the layout itself. A blank position is <u>not</u> used to indicate unsigned numerical data.

The total number of Xs must equal the entry in the numerical field. Although both the decimal point and the sign occupy positions in the layout, neither is included in the count for the numerical field entry. Neither the point nor the sign exists 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 numerical fields would be defined by each of these methods. Note that SIGNED3 is too large to be defined by a layout.

<u>Indicating the Position of Record Marks and/or Group Marks</u>: This information should be supplied if the record that contains such characters is referenced by a macro-instruction. The position or positions the characters occupy must be defined

Name (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

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 portion of the record that contains the characters. The operand 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.

Name (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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
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 seperate 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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39	40–42
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. The mnemonic code RCD may be omitted in this second statement. Columns 17 - 20 of the operation field may then be used as an extension of the numerical field. No space will be reserved for an RCD of zero length.

Restrictions on an RCD Statement

The size of a data field may not exceed mode memory size minus one. If a single RCD field specifies a larger field size, the Processor will assume a length of one for location and address assignment. (The macro generator will use the actual size specified unless it is greater than 159999. In that case, a size of one will be assumed.)

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 that 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 that 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 numerical field.

NUMERICAL 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 numerical 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 numerical field. Under these conditions, in effect, the numerical 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 numerical 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 numerical field entry specifies fewer positions than those contained in the operand.
2. Supply low-order zeros or blanks when the numerical 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 numerical field for TAG2 indicates that the constant contains nine low-order blanks.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
TAG1	CON	5	ABCDE
TAG2		20	THE DATE IS
TAG3		4	A3‡Z

Figure 12

__Defining a Numerical Constant:__ A constant consisting of signed numerical data must contain a plus sign or a 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 numerical field entry. A signed numerical constant that exceeds 99 integer or 99 decimal positions should not be referenced by a general-purpose macro-instruction.

Unsigned numerical data consisting of integers only is written starting in column 23 of the operand field. Unsigned numerical 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. If this is done, the data 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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
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.

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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
	RCD	33	A
CONSTANT	CON	2	‡

Figure 14

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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
	RCD	42	A
CONSTANT	CON	3	≢≢‡

Figure 15

Restrictions on a CON Statement

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 sign or a minus sign followed by numerical characters is desired, a one-position CON statement should be used to define the sign; another CON should be used to define the numerical characters as an unsigned numerical constant.

The size of a CON statement may not exceed mode memory size minus one. If a single CON field specifies a larger field size, the Processor will assume a length of one for location and address assignment. (The macro generator will use the actual size specified unless it is greater than 159999. In that case, a size of one will be assumed.)

DEFINITION OF A FLOATING POINT NUMBER -- FPN

The function of an FPN statement is to define a data field for constant numerical data and to provide the data in floating-point form. Numerical 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 that is blank in column 16 of the operation field is an FPN statement and treats it accordingly.

NUMERICAL FIELD: This field is left blank. The Processor assumes ten 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. A plus sign indicates that the decimal has been moved to the left; the minus sign indicates that 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 an FPN Statement

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

Fixed Point Form	Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39	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

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 numerical 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 numerical 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-instructions that place the numerical 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 numerical 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 that is blank in column 16 of the operation field is an RPT statement and treats it accordingly.

NUMERICAL 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 numerical data and any commas, decimal points, dollar signs, or any 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 numerical 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 that provide the macro-instructions with additional information about the desired print format.

Three sets of data will be used as examples throughout this section to explain the method of laying out the format. 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 Numerical Characters, Commas, Decimal Point: Xs and Zs are used to indicate the position of each numerical character in the format. If commas and/or a decimal point are desired, the symbols for them are placed in the appropriate positions. The numerical 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 by an X. If the position is defined by a Z, the zero will be retained and printed. If the position 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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
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 that 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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
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. It is requested by an indicator, which is placed immediately after the format layout. The indicator consists of a lozenge, an asterisk, and a lozenge (⌑ * ⌑); it is not included in the count for the numerical column. 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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
INTEGER	RPT	5	XXXXX⌑*⌑
MIXED		8	X,XXX.ZZ⌑*⌑

Figure 19

The position of the decimal point can be indicated to macro-instructions that handle numerical 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 numerical field. This may be seen in Figure 20.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
MIXED	RPT	7	X,XXXDZZ
DECIMAL		3	DZZZ

Figure 20

Indicating the Position and Treatment of Dollar Signs: If the dollar sign is desired in the printed report, it is written to the left of the high-order position of the format layout and is included in the count for the numerical 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 field 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 numerical 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:

1. A floating dollar sign.
2. A fixed dollar sign with asterisk protection.
3. A fixed dollar sign without asterisk protection and with leading zeros converted to blanks.
4. A fixed dollar sign without asterisk protection and with up to three leading zeros retained.
5. No dollar sign but asterisk protection.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
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 that is supplying data to be placed in the RPT field
2. An indication that the field that is supplying data consists of zeros

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

Depending on which set of characters is requested, one or two blank positions must be added to the low-order portion of the format layout. These blank positions must be included in the count for the numerical field entry, and 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 that 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 that 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. If a field sign is being requested, 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⌑

where

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 may be used for either. 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 numerical field entry.

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

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–
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
032570	$325.70-
000000	$.00*
457638	$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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–
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
003955	$***39.55CR
000000	$*****.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 numerical 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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–
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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–
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
00278	00278-
00000	00000
34628	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 converted to blanks. This includes the dollar sign, comma, and decimal-point positions.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–
INTEGER1	RPT	9	$XX,XXX ⌑$⌑⌑**⌑⌑

Figure 26

Blank-If-Zero Option: If this is requested, any defined commas, the decimal point, and floating or fixed dollar signs will be converted to blanks along with the numeric positions when the field contains all zeros. 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.

Name (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 an RPT Statement

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

The numer of positions in the format layout must be identical to the entry in the numerical 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.
2. to specify the final digit or digits of the starting 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 that 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. 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 columns 16, 21, and 22, the entry is assumed to be another NAME statement.

NUMERICAL 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 for the starting location, one of these codes is placed in column 22:

Code	Requests Location Ending In
0 or 5	0 or 5
1 or 6	1 or 6
2 or 7	2 or 7
3 or 8	3 or 8
4 or 9	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 generator. (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 that 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.

Name (Tag)	Operation	Num	Operand
STARTNAME	NAME	0	ENDNAME
FIELD1	RCD	4	N
FIELD2		125	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.

Name (Tag)	Operation	Num	Operand
	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.

Name (Tag)	Operation	Num	Operand
BEGIN	NAME		END
FIELD1	FPN		+03+438
END			+02+67845

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 ($1234\overset{+}{5}$).

COMMENTS FIELD: Comments may be started here. Comments continuation lines are not allowed.

Name (Tag)	Operation	Num	Operand
ALPHA	NAME		ENDALPHA
	CON	1	+
ENDALPHA		5	12345

Figure 31

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 that terminates it. Internal NAMEs may be terminated by the same field that terminates the outer NAME, or they may be terminated by fields that 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.

Name (Tag)	Operation	Num	Operand
OUTERNAME	NAME	0	ENDOUTER
FIELD1	RCD	5	+
FIELD2		150	A+
INNERNAME	NAME		ENDINNER
FIELD3	RCD	12	A+
FIELD4		7	#+04.03
ENDINNER		1	‡
FIELD5	RPT	10	$XX,XXX.ZZ¤X¤
FIELD6	RCD	35	A
ENDOUTER	CON	5	‡‡‡‡‡

Figure 32

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

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–40
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 a NAME Statement

The total number of positions enclosed in a NAME may not exceed mode memory size minus one. If this limit is exceeded, the Processor will assume a length of one for address assignment. (The macro generator will use the actual size specified unless it is greater than 159999. In that case, a size of one will be assumed.)

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.

SWITCH DEFINITIONS

Switches are programming or hardware devices that are 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 a switch definition statement 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 that 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 that indicates whether a character code or a 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 that 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, a 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; it 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 the code is present, the switch is ON. If the switch contains anything other than the designated code, the switch is OFF.

A bit-code switch is set ON by setting the designated bits ON; it 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 the designated bit is ON, the switch is ON, otherwise, the switch is OFF.

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

Suppose, in a similar example, that the switch is a bit-code switch. Let the Surplus condition be represented by turning ON the 1-bit, and let the Deficit condition be represented by turning ON the 2-bit. In this case, 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, for the switch to be ON for both the conditions of Surplus and Deficit.

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 etc.			C_3 etc.

n — is blank when defining a one-position switch, or 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 numerical 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. Note that the switch is enclosed by a NAME statement. The NAME operand indicates that the statement tagged CANCELED terminates the NAME.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
	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 that reference the switch.

Tag	Operation	Num	Operand	LOC	INSTR	SU	ADDRESS
	CHRCD			000343			
BLUE			A				
GREEN			B				
RED			C				
Instructions that reference the switch:							
	CMP	1	GREEN	002129	403U3	01	000343
	CMP	1	RED	002624	403U3	01	000343
	CMP	1	BLUE	002679	403U3	01	000343

Figure 36

Restrictions on a CHRCD Switch

A code should be represented not as a signed numerical character but as the alphabetic character equivalent to the signed numerical 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 that 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 that 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-bit, 4-bit, and A-bit 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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
	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 that 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 that reference the switch.

Tag	Operation	Num	Operand	LOC	INSTR	SU	ADDRESS
	BITCD			000237			
EAST		1					
WEST		2					
NORTH		4					
Instructions that reference the switch:							
	RCVS		EAST	002319	U0237		000237
	RCVS		WEST	002464	U0237		000237
	RCVS		NORTH	002739	U0237		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 that 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 that 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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
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.

Name (Tag) 6 8 10 11 13 15	Operation 16 18 20	Num 21 22	Operand 23 25 27 28 30 32 33 35 37 38 39
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 this chapter describes the basic operands, and the prefix and/or suffix that may be added to each operand. The chapter 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, IBM 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 numerical 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.

Name (Tag) 6 8 10 11 13 15	Operation 16 18 20	Num 21 22	Operand 23 25 27 28 30 32 33 35 37 38 39
FIELD	RCD	13	#+027.06
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.

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 numerical constant is desired, the first character following the literal sign must be a plus sign or a minus sign. In storage, the low-order position of the constant will be signed. If the numerical data is a mixed or pure decimal, the decimal point will not appear in the constant. If an unsigned numerical constant is desired, the first character following the literal sign must be the first character of the numerical 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 numerical 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 705II	705III	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 705II	705III	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 below.				

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

NOTES

[1] Place a 1, 2, 4, 8, A, or B in column 22 to designate the bit (TZB can also have a C). If column 21 is not blank, the Processor assumes that ASU zoning, 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 a 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, four 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 a 5. An RCVT is assigned the high-order address of the field plus nine. 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 a 0.

If the generated address does not end in a 4 or a 9 (RCV) or 9 (RCVT), a 4/9 check or a 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 $0\overset{+}{3}70000000\bar{0}$.

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.

The Processor places all constants that it creates from literal operands in storage areas called literal tables. Literal constants may be placed either in the main literal table or in

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
ONE	RAD		#+50314.27#
TWO	LOD		#798#
THREE	TMT		#LOAD TAPE‡#

Figure 45

multiple literal tables (see "Multiple Literal Tables.") A literal appears only once in a literal table, even when it has been used in several different statements.

The Processor classifies literals and makes literal-table assignments according to whether the literals are signed or unsigned:

1. Any literal containing a sign in the first position is automatically classified as signed. If the signed literal supplies numerical data, it appears in storage as previously described. If the literal contains a non-numerical 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.
3. A literal symbol may not appear within a literal unless it is the first character of the literal. However, the flag character B can be used to allow literal symbols in any literal position (see "Flag Characters and Their Meanings").

Actual

An actual operand is a set of numerical 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 an operand containing less than five numerical characters is used with one of the following operations: BLM, BLMS, CTL, HLT, LIP, LNG, RND, SEL, SET, SHR, SPC, SRC, TRANS. Note in Figure 46 that the SET and BLM instructions have been written two ways.

Restrictions on an Actual Operand

An actual operand greater than the core-storage size specified to the Processor should not be used.

Name (Tag)	Operation	Num	Operand
ONE	ST		@995
TWO	SET		@00005
THREE	SET		5
FOUR	BLM		@00020
FIVE	BLM		20

Figure 46

If such an operand is encountered during assembly, the Processor subtracts the maximum core-storage 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-storage size has been specified, any actual operand in excess of 79999 will have 80000 subtracted from it; the remainder will be used as the operand. The list below indicates the largest actual operand that may be used with each available core-storage size:

Core-Storage Size	Maximum Actual Operand
20, 000	19999
40, 000	39999
80, 000	79999
160, 000	159999

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.

Name (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 that has blanks in the first ten 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.

Name (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 numerical 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.

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.

Name (Tag)	Operation	Num	Operand
EMPLOYEE	RCD	25	A+
		5	+
	RAD		EMPLOYEE+5

Figure 49

Restrictions on Character Adjustment

The numerical portion of a character adjustment cannot exceed six positions, and its absolute value cannot be greater than 159999. If it is greater, 160000 will be subtracted until the absolute value is less than 160,000. If the numeric portion of the adjustment is less than six positions, the position immediately following must be non-numerical.

Name (Tag)	Operation	Num	Operand
	TRP		X+10
	ADD		#+30#
	ST		FIELD

Figure 50

Further restrictions apply to operands that are a location counter, an actual, or a literal. These operands can use only the + or - operators. 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 a - 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 that 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.

Name (Tag)	Operation	Num	Operand
FIELD	RCD	8	N
	LOD	1	L,FIELD

Figure 51

NOTE: If the modifier "S," has been used in Figure 51, the LOD instruction would reference the contents of 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.

Name (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-mode portion of the program, it would have been followed by the generated instructions as shown in Figure 53.

MULTIPLE ADDITIONS TO A BASIC OPERAND

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

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

Figure 53

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.

Name (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.

Name (Tag)	Operation	Num	Operand
ONE	RAD		RECORD1
	TR		I,X+10
TWO	RAD		RECORD2
	TR		COMPUTE

Figure 55

A macro-instruction is a source-program statement which represents multiple operations. When the program is assembled, each macro-instruction is replaced by a sequence 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 publication 7080 Processor: General Purpose Macro-Instructions, Form C28-6356. Procedures for writing new macro-instructions for incorporation into the language are described in the publication, 7080 Processor: Preparation of Macro-Instructions, Form C28-6264. Input/output macro-instructions are a part of the 7080 Input/Output Control System, and are described in the 7080 IOCS publications. The titles, form numbers, and abstracts of references to all publications dealing with macro-instructions for the IBM 7080 may be found in IBM 7080 Bibliography, Form A22-6774.

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 the chapter "One-for-One Instructions." Programmers writing their own macro-instructions may also designate an entry in the numerical 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 IBM publication on the preparation of macro-instruction for the 7080 Processor.

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.

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.

GENERAL-PURPOSE MACRO-HEADER FORMAT

The portion of a macro-instruction that is written as a source-program statement is called a macro-header. Like 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 numerical field are rarely permitted. Those entries 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 that 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 numerical 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 MACRO-HEADER 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.

Tag Operands

The tags may be those of defined data fields, switches, source-program one-for-one instructions, macro-instructions, and address constants. Other tags that may be used as operands are those of Class A subroutine items and generated descriptive tags. Characteristics of items within Class B subroutines are not available to macro-instructions. 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 in Tag Operands

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. That is, 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.

The macro-header operand containing the definition is written in this order: the tag of the data field, a comma, the 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 #bxx.yy.

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.

A generated descriptive tag may not be used as a secondary definition.

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 only numerical fields other than unsigned fractions.

Note that the letter X is the only character that can be used in defining integer and decimal positions.

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 earlier in this manual. This method can be used to define signed or unsigned fields only.

Literal Operands

A literal is actual data enclosed by pound signs (#) (see "One-for-One Instructions"). 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 numerical 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. 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 must never be omitted. If the operand it terminates is omitted, the fixed lozenge is placed back to back with the lozenge that 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 that 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 rapidly 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 omitted, 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 that is defined by either an area definition or a switch definition. In order to generate coding that is proper for the field, the Processor must know the characteristics of the data that 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 that 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 that is used to compare the contents of two fields. The fields may be alphameric or numerical. The one-for-one instructions which should be used to compare alphameric data differ from those which should be used to compare numerical 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 numerical data but as alphameric data.

EXAMPLES OF MACRO-INSTRUCTIONS AND THEIR USE

The balance of this chapter contains examples of several general-purpose macro-instructions in the Processor library. The function and coding format of each macro-instruction is followed by an example that illustrates how it might be used and what instructions would be generated for that use. In Figures 57 through 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 available options have been omitted entirely. Complete specifications are provided only by the macro-instruction manual.

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_{50}□

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

$X_1 \ldots X_{50}$ 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

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

Add -- ADDX

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

Tag	Operation	Num	Operand
T_1	ADDX	1	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 numerical source field; i.e., the field that is the source of one set of data to be added.

X_2 is the tag of the other numerical source field.

X_3 is the tag of the numerical 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

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 that 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. (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

ADDRESS CONSTANTS

An address constant is a numerical 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, the literal, or the 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 that is not created until the program is assembled.

Address constants are used to initialize instructions, a procedure that alters the reference made by an instruction or supplies a reference to an instruction that 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 that references FIRST and an instruction that 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, a literal, an actual, or a location counter. Operand modifiers may be used with a tag or a 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 160,000. 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 ten 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.

Name (Tag) 6 8 10 11 13 15	Operation 16 18 20	Num 21 22	Operand 23 25 27 28 30 32 33 35 37 38 39
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.

Name (Tag) 6 8 10 11 13 15	Operation 16 18 20	Num 21 22	Operand 23 25 27 28 30 32 33 35 37 38 39
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.

Name (Tag) 6 8 10 11 13 15	Operation 16 18 20	Num 21 22	Operand 23 25 27 28 30 32 33 35 37 38 39
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.

Name (Tag) 6 8 10 11 13 15	Operation 16 18 20	Num 21 22	Operand 23 25 27 28 30 32 33 35 37 38 39
	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. Note that the address constant will be signed. The sign of the address constant is not related to the sign of the literal.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
FIELD2	RPT	6	ZZZ.ZZ
TAG2	ACON5		S,FIELD2X2

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 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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
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 for 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 a literal
2. Operand modifier, plus ASU zoning plus a tag or a 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,

NOTE: The modifier and ASU zoning may also be written in the form R@n, L@n, etc., when specifying ASUs 1 through 9.

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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
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, positioned 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, these instructions do not appear in 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. Multiple Literal Tables
   - Literal Start - LITST
   - Literal End - LITND
5. Flags

INSTRUCTIONS TO THE PROCESSOR - 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:

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 main literal table. If no subroutines have been requested by either the source program or the Processor itself, the main literal table is placed after the source program.

Standard "00" transfer control card: The Processor produces this as the terminal card of the object program deck. (The next chapter 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 parts of the object program
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. By 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.
NUMERICAL 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 to 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 numerical 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 before 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., it 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, "Flag Characters and Their Meanings."

In Figure 70, storage assignments are shown to the right of the hand-coded Autocoder statements. Note 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 numerical field.

Tag	Operation	Num	Operand	ASSIGNMENTS
	LASN		@2000	002000
	{			{
				003007
START	NAME	0	END	003010
ONE	RCD	4	+	003013
TWO		7	#+04.03	003020
END	CON	4	‡	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 main 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 main 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 main literal table may be altered by LITOR and SUBOR. These are instructions to the Processor and are explained on subsequent pages. The assignment of multiple literal tables is controlled by LITST and LITND, as explained under "Multiple Literal Tables.")

Restrictions on a LASN Statement

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.

Note that the tag and numerical 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	ASSIGNMENTS
	{			{
	LASN		@2000	002000
	{			{
				002499
	SASN		@3000	003000
	{			{
				004000
	LASN			002500

Figure 71

Restrictions on a SASN Statement

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 cause all references to or within the program to be treated 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 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 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 a SASN; and that both have as operands actual addresses or tags that are similarly positioned with respect to the low-order location.

Tag	Operation	Num	Operand	LOC	INSTR	SU	ADDRESS
	TR		OUT	5004	18004		008004
	LASN		@2000	2000			
	RASN		@300	0300			
TAGA	CMP		CON 1	2004	40343		000343
	TRE		*+25	2009	L0334		000334
	SHR		1	2014	C0001		000001
	TRZ		TAGB	2019	N0329		000329
	TR		TAGA	2024	10304		000304
TAGB	HLT		9999	2029	J9999		009999
	LOD	01	CON 2	2034	803U4	01	000344
	TR		*+10	2039	10349		000349
CON 1	CON	04	XXXX	2043			
CON 2	CON	01	Y	2044			
	LASN			5005			
	LOD	01	CON 2	5009	803U4	01	000344

Figure 72

Tag	Operation	Num	Operand	LOC	INSTR	SU	ADDRESS
REFTAG	TR		OUT	5004	18004		008004
	RASN		TAGAT300	0300			
TAGA	CMP		CON 1	5009	40343		000343
	TRE		*+25	5014	L0334		000334
	SHR		1	5019	C0001		000001
	TRZ		TAGB	5024	N0329		000329
	TR		TAGA	5029	10304		000304
TAGB	HLT		9999	5034	J9999		009999
	LOD	01	CON 2	5039	803U4	01	000344
	TR		*+10	5044	10349		000349
CON 1	CON	04	XXXX	5048			
CON 2	CON	01	Y	5049			
	LASN			5050			
	LOD	01	CON 2	5054	803U4	01	000344

Figure 73

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 numerical fields must be left blank. Comments may be placed in the comments field.

Restrictions on a RASN Statement

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 storage location at which the Processor is to begin assigning addresses is designated in the operand of the SUBRO statement.

NOTE: 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 publication on the preparation of macro-instructions.

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 for consistency adjusted. The tagged statement must precede the SUBOR statement.

Comments may be placed in the commends field.

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

Name (Tag)	Operation	Num	Operand
	SUBOR		@160
	LASN		@5160
RECORD	NAME		ENDRECORD

Figure 74

Restrictions on a 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 main literal table. The LITOR assignment supersedes the standard main literal table placement, which is after the subroutine block or after the last instruction of the program if no subroutines are used. LITOR enables the user to position the main 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 also applies 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 main 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 main literal table is actually placed in storage or that the contents of TAG are placed in storage after the main literal table is no longer needed.

Name (Tag)	Operation	Num	Operand
	LITOR		TAG

Figure 75

Restrictions on a LITOR Statement

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

A LITOR statement cannot be used to position multiple literal tables. The LITST and LITND statements must be used for this purpose.

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 the section "Flag Characters and Their Meanings").

The TCD statement must be followed by Autocoder statements that specify the contents of the card; i.e., by 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, as soon as a "00" card is loaded into storage, it causes the loading program to interrupt the loading procedure and to execute the instructions on the card. 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.

Name (Tag) 6 8 10 11 13 15	Operation 16 18 20	Num 21 22	Operand 23 25 27 28 30 32 33 35 37 38 39
HOUSEKEEP	SEL		0500
ENDHOUSEKP	TR		ZEROCARD
	TCD		
	TR		HOUSEKEEP
ZEROCARD	TR		@00004
	LASN		HOUSEKEEP
CALCULATE	ADDX		ONE⌑TWO⌑THREE⌑

Figure 76

Restrictions on a 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 STEP 1.

Name (Tag) 6 8 10 11 13 15	Operation 16 18 20	Num 21 22	Operand 23 25 27 28 30 32 33 35 37 38 39
	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: a macro-instruction other than ENT80 or LEV80; an INCL that designates a Class A subroutine; a TRANS entry having the tag of another location as an operand.

Restrictions on an 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.
NUMERICAL 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. This operand may not be used in Class B subroutines.

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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
	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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
	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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
	TR		ERROR
	BSP		
ERROR	TRANS		*-5
	RD		AREA

Figure 80

Restrictions on a TRANS Statement

If a TRANS statement has a location counter, an actual operand, an operand modifier, or character adjustment, the statement that references the tag of the TRANS cannot have an operand modifier. In any of these cases, an operand modifier would have no significance.

Source-Program Language -- MODE

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

1. FORTRAN
2. Report/File
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 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.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
	MODE		FORTRAN

Figure 81

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

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

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
	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 or FORTRAN statements. The statement is used whether or not the Autocoder portion also contains Decision, Arithmetic, and Table statements.

Name (Tag) 6–15	Operation 16–20	Num 21–22	Operand 23–39
	MODE		AUTOCODER

Figure 83

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

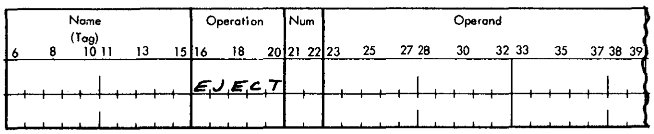


Figure 84

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 the section, "Details of the Program Listing.")

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 (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.

NUMERICAL 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 numerical 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 some 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. The TITLE page of the Operator's Notebook 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 part of the program, to describe it, and to provide a table of contents or an index. The standard listing 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.

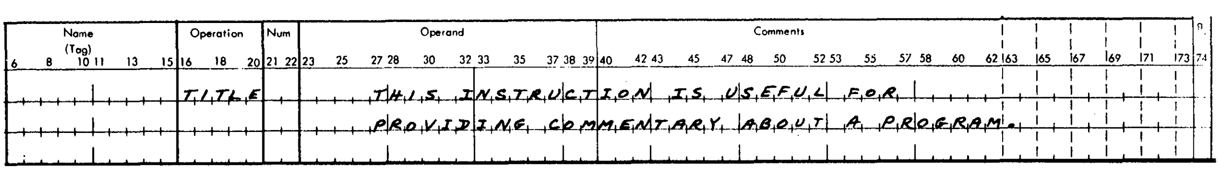


Figure 85

```
TITLE        ABC PAYROLL PROGRAM - FOUR PARTS

             PART 1 CONTAINS THE HOUSEKEEPING
                       ROUTINE, WHICH IS ONLY

EJECT
```

Figure 86

```
       TITLE ABC PAYROLL PROGRAM.  THIS PROGRAM
             CONTAINS FOUR PARTS. THE DETAILS OF
             EACH ARE SUPPLIED AT THE POINTS LISTED BELOW.

PART1        HOUSEKEEPING                      PG LIN 201
PART2        DEFINITIONS AND CONSTANTS         PG LIN 219

       EJECT
```

Figure 87

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.

INSTRUCTIONS TO THE PROCESSOR - MULTIPLE LITERAL TABLES

The Processor can build more than one table of literals and locate these tables in a program at any points requested. When literals are thus inserted into a program, the location counter is incremented by the length of the table of literals. The counter will then contain the location assignment for the entry immediately following the termination of the table. This feature is especially valuable when used with routines that can be overlaid. It makes it possible for a routine to be accompanied by its own literal table, so that both can then be overlaid by another routine.

A multiple literal table is requested by using LITST (Literal Start) and LITND (Literal End) statements. (These instructions to the Processor are described in detail later in this section.) Within the size restrictions noted in the section "Restrictions on Multiple Literals," all literal operands and address constant literal operands that fall between a LITST and a LITND will be placed in one multiple literal table by the Processor. Literals that are not assigned to a multiple literal table will be placed in the main literal table.

Each multiple literal table will normally follow the instruction preceding the LITND statement. If the last instruction is an assignment, the table will be placed at the location specified, as in Figure 88. The assignment of a multiple literal table cannot be changed by a LITOR statement.

Literal Start -- LITST

A LITST statement informs the Processor that all literal and address constant literal operands between it and the next LITND statement are to be placed in one multiple literal table. The format of the LITST statement is as follows:

Tag	Operation	Num	Operand
	LITST		

Comments may be placed in the comments field.

Name (Tag)	Operation	Num	Operand	Comments
	SASN		ANYLOC	SASW TO DESIRED LOCATION OF TABLE
	LITND			
	LASN			RESUME REGULAR ASSIGNMENT

Figure 88

Restrictions on a LITST Statement

A LITST statement may not be referred to by another Autocoder statement.

Literal End -- LITND

A LITND statement informs the Processor that all the literals that refer to the same multiple literal table have been processed. The Processor will not locate the table either at the location following the entry that precedes the LITND, or at the location indicated by an assignment instruction. The format of the LITND statement is as follows:

Tag	Operation	Num	Operand
	LITND		

Comments may be placed in the comments field.

Restrictions on a LITND Statement

A LITND statement may not be referred to by another Autocoder statement.

Restrictions on Multiple Literal Tables

A program may request as many as 9,999 multiple literal tables. The allowable size of a given table will depend on the type of literals specified. If no address constant literals are specified, the guaranteed minimum size of a multiple literal table is 200 literal positions. The guaranteed minimum size of a table that contains address constant literals is 150 positions.

In actual practice, a multiple literal table will probably hold more entries than these minimums. To determine whether all the literals between a LITST and a LITND will fit into a given table, the following formula can be used:

$$(X_1 + 3) \ldots + (X_n + 3) + 17Y = Z$$

where

X_1 is the memory size of the first literal following a LITST.

X_n is the memory size of the last literal before a LITND.

Y is the number of address constant literals requested.

Duplicate literal operands should be counted only once, since they will appear only once in a multiple literal table.

If Z is greater than 650, not all the literals will fit into the table. The maximum size of an internal table used by the Processor when building multiple literal tables is 650. As each literal is encountered, it is placed in the internal table, preceded by a three-position control field. Each address constant literal requires 17 positions in the table. Thus, in Figure 89, the address constant literal and the literal operand will require 24 internal-table positions: 17 positions for the address constant, and 7 positions for the literal operand. (The sign of a literal is not counted.)

Name (Tag)	Operation	Num	Operand
	RAD		L@#+3999#

Figure 89

When the internal table overflows, the literal causing the overflow will be assigned to the main literal table, not to a multiple literal table. Any smaller literals that follow the literal causing the overflow will be placed in the internal table, as long as there is room. If both an address constant literal and its literal operand cannot be located in the internal table (as in Figure 89), both will be included in the main literal table.

It is sometimes desirable to place a literal in the main literal table instead of in a multiple literal table. This can be effected by placing an L flag in column 74 (see "Flag Characters and Their Meanings").

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 they are 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 operand of the entry containing it from right to left, rather than from left to right.

On encountering a left literal symbol in the operand of a one-for-one instruction that contains the B flag, the Processor will then scan from column 73 left to a literal symbol. Everything between the two literal symbols will be considered an unsigned literal. Valid modifiers and character adjustments will be honored.

The B flag with an operand of a macro-header will cause a scan from column 73 left to a lozenge. Everything from column 24 through the column two positions to the left of the lozenge will be treated as an unsigned literal of that length. (The characters in column 23 and the column to the left of the lozenge will be assumed to be literal symbols, and will be dropped.) The operand to be so treated, with this flag, must be on a line (card) that does not contain any other operand.

C -- Entire Card is a Comment

Columns 6 through 73 of an entry containing this flag will be considered a comment. 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 -- Processor Chain Indicator

This flag indicates the beginning and end of a macro-instruction chain. It is used when the chain contains macro suffix tags and/or generated descriptive tag operands. (Its use is explained in the macro-instruction manual.)

G -- Treat Change Entry as Generated Entry

This flag is provided for use with change entries introduced in a high-speed assembly run. It will cause the entries containing it to be considered as generated entries during a subsequent reassembly. That is, during a subsequent reassembly the entries will be deleted, and during a subsequent high-speed assembly 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 a separate page of the Operator's Notebook. The H flag is valid only on one-for-one instructions.

L -- Main Table Literal

This flag is intended for use with statements that have literal or address constant literal operands, and occur between a LITST and a LITND. When the Processor finds such a statement containing an L flag, it will treat the operand as a main-table literal rather than as one belonging in a multiple literal table. The L flag provides a convenient means of preventing repeated generations of the same literal in a program that uses multiple literal tables.

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. The M flag is valid only on one-for-one instructions. When a generated instruction is referenced by another macro-instruction by means of a macro suffix tag, the macro generator automatically places an M flag on the referenced instruction, unless another flag is already present on it.

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: Suppose that when location counter 1 contains 59999, 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.

S -- Suppress Program Cards

An Autocoder entry containing this flag will indicate the beginning of program card suppression. This entry and all following entries will be processed normally, except that program cards will not be produced. A second entry containing this flag will indicate that program card suppression is to end after this entry is processed.

T -- Test-Assembly Entry

Entries containing this flag will be retained during an assembly when the run-type control card so indicates. Otherwise, all entries containing this flag will be deleted automatically. Statements may therefore 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 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 by it very infrequently; therefore, the Processor is to consider that the inner macro-instruction is called one time as a component of the particular outer macro-instruction. 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 the section on statement format. 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. Load program (LD7080)
2. Main 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 main 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:

Program Identification: Six positions. This is the source program identification (ident field on coding sheet).
Serial number: Three 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).
Initial address: Four positions. This indicates the storage location at which the first character on the card is to be placed.
Number of columns: Two 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.
Instructions and/or constants: One to sixty-five positions. This is the actual portion of the object program being supplied by the card. It is placed at the storage location specified as the initial address (see above).

STANDARD 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 below in the section, "Details of the Listing."

Program Listing

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

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.
Main Literal Table: The main 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 a minus sign.)

1. Signed literals, length not a multiple of 5 or 10
2. Signed literals, length a multiple of 5
3. Signed literals, length a multiple of 10
4. Unsigned literals, length a multiple of 10
5. Unsigned literals, length a multiple of 5
6. Unsigned literals, length not a multiple of 5 or 10.
7. Address constant literals, broken down in the following order:
   a. unsigned, length of 6
   b. signed, length of 6
   c. signed, length of 5
   d. unsigned, length of 5
   e. all lengths of 4 ending in a 4 or 9 location

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.

Multiple literal tables are also included in the source program, if they are requested. They are divided into seven parts corresponding to those in the main literal table. However, within the groups of signed and unsigned literals, individual literals are not sorted according to size. Each multiple literal table will begin on a new page of the program listing.

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.
Subroutine Portions of Macro-Instructions: The order of subroutines is the same as that of the macro-headers causing their generation.

Class B Subroutines: The subroutines are inserted alphabetically.
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. Diagnostic messages are described in the publication on 7080 Processor system operation.
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:

TITLES	-- All TITLE statements
C FLAG	-- Comment statements with a C flag
H FLAG	-- Statements with an H flag; all halts
80 SP OP	-- All ENT80, LEV80, ENTIP, LEVIP, SPC, TIP, and LIP statements
80 SP 1	-- All statements in 7080 mode containing indirect address; i.e., the "I," prefix
ASSGNS	-- All LASN, SASN, RASN, and SUBRO statements
SWITCHES	-- All SWN and SWT statements
TRANS	-- All TRANS statements with descriptive operands; i.e., operands that are tags
M FLAG	-- All statements with an M flag; all statements with blank operands

Symbolic Analyzer

This is an index of every hand-coded and generated tag in the program. The tags are listed in collating sequence. Each tag is followed by a list of every instruction, 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 comments, and ASU zoning in address constant literals will not. Entries that refer to undefined tags will be listed separately. When multiple literal tables occur in a program, the symbolic analyzer will contain a section on them preceding the index to descriptive tags.

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 contains 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 or added, or one 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 of Statement
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
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
*	Generated	EIA and Related Instruction, and Multiple Literal Tables

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 numerical field on the coding sheet.

AT: An entry in the AT (address type) 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 the exception of the placement of a prefix to the basic operand. The prefix 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 NU 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.)

APPENDIX

The more significant features that have been incorporated into Autocoder for the 7080 Processor are summarized below, by section 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; 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 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 10 positions unless it is surrounded by literal symbols. 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.

5. If the numeric portion of a character adjustment is less than six positions, the position immediately following the adjustment must be nonnumerical.

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 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 numerical 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. Two statements (LITST and LITND) have been provided for creating multiple literal tables. 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 Output: The listings that are provided have been expanded considerably. This entire section should be reviewed.

SAMPLE ASSEMBLY

```
INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  08-28-63    PATCHES    PG 001  F  LOC    INSTR SU  ADDR  SER  REF
                                                                                                             005449

INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  08-28-63    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    0000A                                            005209
 ¤A09         SIGNED LITERAL    5    0000D                                            005214
 ¤A10         SIGNED LITERAL    5    0021E                                            005219
 ¤A11         SIGNED LITERAL   10    0M5678000&                                       005229

 ¤A12         UNSIGNED LITERAL 50    AGE               CLOSING LIT SYMBOL OMITTED     005279                  002
 ¤A13         UNSIGNED LITERAL 50    THIS LITERAL OVERFLOWS INTO THE NEXT CARD WHICH IS   005329              003
 ¤A14         UNSIGNED LITERAL  5    ABCDE                                            005334
 ¤A15         UNSIGNED LITERAL  5    APPLE                                            005339
 ¤A16         UNSIGNED LITERAL  1    F                                                005340
 ¤A17         UNSIGNED LITERAL  1    G                                                005341
 ¤A18         UNSIGNED LITERAL  1    J                                                005342
 ¤A19         UNSIGNED LITERAL  1    1                                                005343
 ¤A20         UNSIGNED LITERAL  2                                                     005345
 ¤A21         UNSIGNED LITERAL  2    60                                               005347
 ¤A22         UNSIGNED LITERAL  3    300                                              005350
 ¤A23         UNSIGNED LITERAL  4    ABLE                                             005354
 ¤A24         UNSIGNED LITERAL  4    DUPE                                             005358
 ¤A25         UNSIGNED LITERAL  4    0010                                             005362
 ¤A26         UNSIGNED LITERAL  7    1234567                                          005369                  004
 ¤A27         UNSIGNED LITERAL  8    -BALANCE                                         005377
 ¤A28         UNSIGNED LITERAL  9    LOCATIONA                                        005386
 ¤A29         UNSIGNED LITERAL 14    NOT AVAILABLE¤                                   005400

 &A01         NAMEA      RIGHT  6    001099                                           005406                      AC51

 $A01         NAMEA      SIZE   6    00004&                                           005413                      AC51

 *A01         NAMEA      SIZE   5    0004&                                            005419                      AC51

 -A01         NAMEA      RIGHT  5    01099                                            005424                      AC51

 /A01         123D       RIGHT  4     5182                                            005429                      ¤A04
 /A02         *&000025   RIGHT  4     2CI4                                            005434                  005
 /A03         EXIT       RIGHT  4     1599                                            005439                      AF55
 /A04         NAMEA      HI-SP  4     1074                                            005444                      AC51
 /A05         NAMEA      RIGHT  4     1A03                                            005449                      AC51
```

```
INDEX S PGLIN    TAG       CP    NU AT OPERAND 80SMPL-001  08-28-63   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 AAC5  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 AAC9  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 AA69                           CONTINUATION, WILL COMPILE AS A CON BECAUSE IT HAS
AA 70 A AA70                           A BLANK OPERATION AND FOLLOWS A STATEMENT WHOSE
AA 71 A AA71                           OPERATION IS NOT A DATA DEFINITION. IT WILL COMPILE
AA 72 A AA72                           AS N FOLLOWED BY A BLANK.
```

```
INDEX S PGLIN    TAG       CP   NU AT OPERAND 80SMPL-001  08-28-63   COMMENTS    PG 004  F  LOC     INSTR SU  ADDR  SER  REF

AB 01 I AB01  THE FOLLOWING THREE INVALID RCD ENTRIES PRODUCE INCONSISTENT             C
AB 02 I AB02  DATA DEFINITIONS.                                                        C
AB 03 A AB03              RCD     3    &00.03            THIS OPERAND SHOULD HAVE BEEN    000799
AB 04 A AB04                           #&00.03. OMITTING THE # SIGN CAUSED IT TO COMPILE
AB 05 A AB05                           AS A THREE DIGIT SIGNED INTEGER WITH NO INTEGER AND
AB 06 A AB06                           NO DECIMAL POSITIONS.
AB 07 A AB07
AB 08 A AB08                      3    #&0.3             THIS OPERAND SHOULD HAVE BEEN    000802
AB 09 A AB09                           #&00.03. OMITTING THE ZEROS CAUSED IT TO COMPILE
AB 10 A AB10                           AS A THREE POSITION SIGNED INTEGER WITH ONE INTEGER
AB 11 A AB11                           AND NO DECIMAL POSITIONS.
AB 12 A AB12
AB 13 A AB13                      4    #02.02            THIS OPERAND SHOULD HAVE BEEN    000806
AB 14 A AB14                           # 02.02.  OMITTING THE BLANK CAUSED IT TO COMPILE
AB 15 A AB15                           AS A FOUR POSITION UNSIGNED FRACTION WITH 21
AB 16 A AB16                           INTEGER PLACES AND 20 DECIMAL PLACES.

AB 17 I AB17              TITLE              DEFINITION OF A CONSTANT FIELD - CON
AB 18 A AB18  CONA        CCN     5    ABCDE             FIVE POSITION ALPHABETIC, UNSIGNED  000811          007
AB 19 A AB19  CONN5XO             5    00003             NUMERIC, AND MIXED CONSTANTS. WILL  000816
AB 20 A AB20  CONMIXED            5    4JK9*             APPEAR IN MEMORY AS WRITTEN.        000821
AB 21 A AB21
AB 22 A AB22                      6    -123499           SIX POSITION SIGNED INTEGER      000827
AB 23 A AB23                           CONSTANT.  WILL APPEAR AS 12349R IN MEMORY.
AB 24 A AB24
AB 25 A AB25                      6    &1234.99          SIX POSITION SIGNED CONSTANT WITH   000833
AB 26 A AB26                           FOUR INTEGER AND TWO DECIMAL POSITIONS.  WILL
AB 27 A AB27                           APPEAR AS 12349I IN MEMORY.
AB 28 A AB28
AB 29 A AB29                      6    123.45            SIX POSITION CONSTANT WHICH WILL    000839
AB 30 A AB30                           APPEAR AS 123.45 IN MEMORY.
AB 31 A AB31
AB 32 A AB32                      3    A                 THREE POSITION CONSTANT OF WHICH    000842
AB 33 A AB33                           THE FINAL TWO POSITIONS ARE BLANKS.
AB 34 A AB34
AB 35 A AB35                      2    □#                TWO POSITION CONSTANT CONSISTING    000844
AB 36 A AB36                           OF A GROUP MARK AND A RECORD MARK.

AB 37 I AB37                                     INVALID USAGES                        C
AB 38 A AB38  WORSTCASES CCN      2    ABCDE            CON WITH OPERAND OF GREATER LENGTH  000846
AB 39 A AB39                           THAN NUMERIC FIELD STATES. WILL COMPILE AS AB WITH
AB 40 A AB40                           NO MESSAGE.
AB 41 A AB41
AB 42 A AB42                      3    &120              SIGNED CONSTANT WITH OPERAND     000849
AB 43 A AB43                           SHORTER THAN NUMERIC FIELD STATES. IT WAS PUNCHED
AB 44 A AB44                           &12  BUT WILL COMPILE AS 120 WITH THE LAST DIGIT
AB 45 A AB45                           SIGNED PLUS. HERE THE LISTING SHOWS THE ZERO.
AB 46 A AB46
AB 47 A AB47                      0    123               THIS WILL NOT COMPILE BECAUSE THE   000849
AB 48 A AB48                           NUMERIC FIELD STATES A LENGTH OF ZERO POSITIONS.
AB 49 A AB49
AB 50 A AB50                     62    THE NUMERIC FIELD STATES A LENGTH WHICH INCLUDES A   000911          008
AB 51 A AB51                           SECOND CARD. THE FIRST LINE WILL COMPILE, FOLLOWED
AB 52 A AB52                           BY 12 BLANKS. THE REST IS TREATED AS A COMMENT.
AB 53 A AB53
AB 54 A AB54                     14    -59969096439550  THIS CON, INTENDED AS PART OF A     000925
AB 55 A AB55                           MESSAGE AND PUNCHED -ERROR ROUTINE, WAS STRIPPED OF
AB 56 A AB56                           ZONING AND TREATED AS A SIGNED NUMERIC CON BECAUSE
AB 57 A AB57                           THE LEADING DASH  WAS INTERPRETED AS A MINUS SIGN.

AB 58 I AB58              TITLE              DEFINITION OF A FLOATING POINT CONSTANT - FPN
AB 59 A AB59              FPN          &03&123456       REPRESENTS &123.456              000935

AB 60 I AB60  NOTE THAT THE NUMERIC FIELD IS BLANK AND THAT THE MANTISSA IS ONLY       C
AB 61 I AB61  SIX DIGITS. A LENGTH OF TEN WILL BE ASSUMED AND TRAILING ZEROS ADDED     C
AB 62 I AB62  TO MAKE AN EIGHT DIGIT MANTISSA. THE FPN APPEARS IN MEMORY AS            C
AB 63 I AB63  0C12345600 WITH THE UNITS DIGIT SIGNED PLUS. THE LISTING DOES NOT        C
AB 64 I AB64  SHOW THE ADDED ZEROS OR ASSUMED LENGTH.                                  C
AB 65 I AB65                                                                           C
AB 66 I AB66                                     INVALID USAGES                        C
AB 67 A AB67              FPN          &04&9876543210   THIS OPERAND EXCEEDS THE MAXIMUM   000945          009
AB 68 A AB68                           LENGTH. THE MANTISSA IS TRUNCATED TO EIGHT DIGITS.  000955
AB 69 A AB69                           IT APPEARS IN MEMORY AS 0D9876543B.                 000965

AB 70 I AB70  THE TWO ENTRIES IMMEDIATELY ABOVE WERE INTENDED AS COMMENTS              C
AB 71 I AB71  COUTINUATIONS. THIS IS INVALID ON A FPN AND TWO FPNS WERE GENERATED      C
AB 72 I AB72  FROM THE OPERAND FIELDS. THE LISTING ONLY SHOWS THE MEMORY ALLOCATED     C
AB 73 I AB73  BUT THE CARDS SHOW 5E38103850 AND 307751920I.                            C
AB 74 I AB74                                                                           C
AB 75 I AB75  THIS FPN WAS INTENDED TO REPRESENT 123.456. OMITTING THE LEADING         C
AB 76 I AB76  ZERO OF THE CHARACTERISTIC CAUSED IT TO REPRESENT THE NUMBER             C
AB 77 I AB77  234560000000000000000000000000.                                          C
AB 78 A AB78              FPN          &3&123456                                     000975

AB 79 I AB79  THIS OPERAND WAS INTENDED TO REPRESENT 123.456. OMITTING THE SECOND      C
AB 80 I AB80  PLUS SIGN CAUSED IT TO REPRESENT 234.56                                  C
AB 81 A AB81              FPN          &03123456                                     000985
```

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INDEX S PGLIN   TAG       OP    NU AT OPERAND 80SMPL-001  08-28-63   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                                          000994
AC 12 A AC12                     9   XXXXXZZZ                                          001003                 010
AC 13 A AC13                     9   XXXXXXXX                                          001012

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, **, CR 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□                          001025

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 □*□                                   001037
AC 27 A AC27                    12   $XXX,XXZ.ZZ □$□                                   001049

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□□                                    001056

AC 32 I AC32                                   INVALID USAGES                        C
AC 33 A AC33              RPT    9   ZZZXXXXX          ZS AND XS REVERSED              001065                 011

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    001070         001099     AC50
AC 37 A AC37              RCD    2   N                 CONSECUTIVE POSITIONS, THE LAST  001071                       2
AC 38 A AC38                     4   A                 TWO BEING A GROUP MARK AND RECORD 001075                      6
AC 39 A AC39              CCN    3   XXX               MARK. THE CHRCD AND THE BITCD EACH 001078              012    9
AC 40 A AC40                     1                     OCCUPY ONE MEMORY POSITION. SOME 001079                      10
AC 41 A AC41              RPT    8   XXXX.ZZ           SEGMENTS OF THE ENTRY ARE        001087                      18
AC 42 A AC42              RCD    4   &                 SEPARATELY TAGGED. THE A IN THE  001091                      22
AC 43 A AC43              CCN    3                     NUMERIC FIELD OF THE NAME        001094                013   25
AC 44 A AC44              BITCD      2                 STATEMENT POSITIONS THE ENTRY TO 001095                      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   001096                      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    CCN    3    □#               COLLECTIVE ENTRY. NOTE THAT A    001099                      30
 AC51 J       NAMEA                  THIS DEFINITION OCCUPIES     30 CHARACTER POSITIONS 001099
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                                          001100         001129     AC67
AC 60 A AC59  RCDS6X0     RCD    6   &                                                 001105                       6

AC 61 A AC60  NAMEC       NAME       NAMECEND                                          001106         001113     AC63
AC 62 A AC61              RCD    2   N                                                 001107                       8
AC 63 A AC62  NAMECEND           6   A                                                 001113                      14
 AC64 J       NAMEC                  THIS DEFINITION OCCUPIES      8 CHARACTER POSITIONS 001113

AC 65 A AC63  NAMED       NAME       NAMEDEND                                          001114         001136     AC70
AC 66 A AC64              RCD    4   A                                                 001117                      18
AC 67 A AC65  NAMEBEND          12   A                                                 001129                      30
 AC68 J       NAMEB                  THIS DEFINITION OCCUPIES     30 CHARACTER POSITIONS 001129
AC 69 A AC66                     3   N                                                 001132
AC 70 A AC67  NAMEDEND           4   A&                                                001136
 AC71 J       NAMED                  THIS DEFINITION OCCUPIES     23 CHARACTER POSITIONS 001136
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INDEX S PGLIN    TAG        OP    NU AT OPERAND 80SMPL-001  08-28-63   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  001140
AD 03 A AD03               CON     6   &246807        BLANK TAG AND OPERAND, THE ZERO     001145                      014
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 015
 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 A1674    001674 016 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                 017     6
AD 33 A AD29  NOWEND               3   XXX             ENDING SEGMENT.                     001243                         9
AD 34 A AD30               NOP         *               FORCE TERMINATION OF NAMEH          001249 A1249    001249 018
 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 019
 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                 020
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       CP    NU AT CPERAND 80SMPL-001  08-28-63   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 021

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          NCP          *-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 953U2 01 005342      ¤A18

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 853U3 01 005343      ¤A19
 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 953M6 02 005346      ¤A21
 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         SWB                                                       001344 U1285      001285      AE03
 AE32 J                    TZB    B     TESTSW                                                    001349 .1T-9 06 001309 022 AE23
 AE33 J                    TR           EXIT                                                      001354 11599      001599      AF55

AE 34 B AE22               IFON         FEMALE¤TESTSW¤EXIT¤
 AE35 J                    LOD   01     #F#                                                       001359 853U0 01 005340      ¤A16
 AE36 J                    CMP   01     FEMALE                                                    001364 412X3 01 001273      AD55
 AE37 J                    TRE          TESTSW                                                    001369 L1309      001309      AE23
 AE38 J                    TR           EXIT                                                      001374 11599      001599      AF55

AE 39 B AE23               SETOF        SWB¤HOURLY¤WEEKLY¤MONTHLY¤
 AE40 J                    RCVS         SWB                                                       001379 U1285      001285      AE03
 AE41 J                    TMTS   1     #&1#                                                      001384 951X6 01 005176      ¤A02
 AE42 J                    SBN    1     HOURLY                                                    001389 %1KX4 09 001274      AD60
 AE43 J                    SBN    2     WEEKLY                                                    001394 %1KP4 10 001274      AD61
 AE44 J                    SBN    8     MONTHLY                                                   001399 %1074 12 001274      AD63

AE 45 B AE24               IFON         ALTSW912¤TESTSW¤EXIT¤
 AE46 J                    TAB          TESTSW                                                    001404 I13-9 02 001309      AE23
 AE47 J                    TR           EXIT                                                      001409 11599      001599      AF55

AE 48 I AE25                                           INVALID USAGES                          C
AE 49 I AE26  THE FOLLOWING MACRO ATTEMPTS TO SET ON TWO UNDEFINED SWITCHES WHICH              C
AE 50 I AE27  ARE THE TAGS OF CHRCD AND BITCD HEADERS. THEY ARE TREATED AS A-J                 C
AE 51 I AE28  TYPE SWITCHES.                                                                   C

AE 52 B AE29               SETON        SEX¤PAYTYPE¤
 AE53 J                    LOD   01     #&1#                                                      001414 851X6 01 005176 023 ¤A02
 AE54 J                    UNL   01     SEX                                                       001419 712X3 01 001273      AD53
 AE55 J                    UNL   01     PAYTYPE                                                   001424 712X4 01 001274      AD59

AE 56 I AE30  THE NEXT MACRO ATTEMPTS TO SET ON AN ALTSW.                                      C

AE 57 B AE31               SETON        ALTSW916¤

AE 58 I AE32  THE FOLLOWING MACRO ATTEMPTS TO INITIALIZE A BITCD USING MOVE MACRO.             C

AE 59 B AE33               MOVE         #G#¤BAD1¤   A BITCD IS NOT VALID AS A MOVE OPERAND.

 AE60 J                    HLT          @29000                                                    001429 JRC00      029000
 AE61 J                    ADCON        #G#                                                       001434 A5341      005341      ¤A17
 AE62 J                    ADCON        BAD1                                                      001439 A1276      001276      AD70
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INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  08-28-63    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.     001444 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.          001449 B0003      000003       AA41
AF 08 A AF08              LOD         RCDSOX3          LOD ACC WITH VALUE OF RCDSOX3.       001454 80756      000756       AA41

AF 09 I AF09                                    INVALID USAGES                            C
AF 10 A AF10              SND   04    WORST CASES      TAG OPERAND TOO LONG                 001459 /0#00 04 000000
AF 11 A AF11              TR          RD/WR            SPECIAL CHARACTERS ARE INVALID       001464 10000      000000

AF 12 A AF12  GAP         NOP         *                HERE, GAP HAS A LEADING BLANK.       001469 A1469      001469
AF 13 A AF13  GAP         NOP         *                HERE, GAP HAS NO LEADING BLANK.      001474 A1474      001474
AF 14 A AF14  RD/WR       SGN      L, GAP            LEADING BLANK ON GAP IS IGNORED.       001479 T1470      001470 024 AF13

AF 15 I AF15              TITLE                 LITERAL OPERANDS
AF 16 A AF16              RAD         #&00215#         A FIVE DIGIT SIGNED LITERAL          001484 H5219      005219       ¤A10
AF 17 A AF17              LOD         #APPLE#          A FIVE PLACE UNSIGNED LITERAL        001489 85339      005339       ¤A15
AF 18 A AF18              WR          #NOT AVAILABLE¤# A FOURTEEN PLACE LITERAL MESSAGE     001494 R5387      005387       ¤A29
AF 19 A AF19              CMP         #  #             TWO BLANKS                           001499 45345      005345       ¤A20
AF 20 A AF20              LOD   10    #-04&5678#       FPN LITERAL &.00005678               001504 85KK9 10 005229       ¤A11

AF 21 I AF21                                    INVALID USAGES                            C
AF 22 A AF22              ADD         &14#             OPENING LIT SYMBOL OMITTED           001509 G0000      000000
AF 23 A AF23              LOD         #LOCATIONA#      LITERAL INDICATED WITH TAG OPERAND   001514 85386      005386       ¤A28
AF 24 A AF24                                           INTENDED.
AF 25 A AF25              TRE         #DUPE#           TRANSFER TO A LITERAL                001519 L5358      005358       ¤A24
AF 26 A AF26              ADD         #0010#           ADD REQUIRES A SIGNED OPERAND        001524 G5362      005362       ¤A25
AF 27 A AF27              LOD         #AGE             CLOSING LIT SYMBOL OMITTED           001529 85279      005279       ¤A12
AF 28 A AF28              WR          #THIS LITERAL OVERFLOWS INTO THE NEXT CARD WHICH IS   001534 R5280      005280       ¤A13
AF 29 A AF29                          INVALID¤# NOTE THAT ONLY THE FIRST LINE COMPILES.
AF 30 A AF30
AF 31 A AF31              LOD         #-BALANCE#     BECAUSE OF THE DASH THIS LIT WILL      001539 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     001544 B0005      000005 025
AF 35 A AF35              SET         5                INSTRUCTION TO SET ACC TO FIVE.      001549 B0005      000005

AF 36 I AF36                                    INVALID USAGES                            C
AF 37 A AF37              ST          995              ST REQUIRES THE @ SIGN FOR ACTUALS   001554 F0000      000000
AF 38 A AF38
AF 39 A AF39              WR          @82500           82500 IS OUTSIDE THE MEMORY SIZE     001559 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            001564 10123      000123

AF 43 A AF43              LOD         @APPLES          AN ACTUAL IS INDICATED WHEN A        001569 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    001574 81V74 04 001574
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     001579 30004      000004
AF 51 A AF51              EIM                          INSTRUCTIONS. IT IS EITHER IGNORED   001584 ,0#-0 06 000000
AF 52 A AF52              CNO                          OR IS INSERTED BY THE PROCESSOR.     001589 ,0-&0 11 000000
AF 53 A AF53
AF 54 A AF54              ULA   06    EXIT             HERE THE ADDRESS OF THE TR WILL BE   001594 *1VR9 06 001599       AF55
AF 55 A AF55  EXIT        TR                           INITIALIZED BY UNLOADING ASU 06.     001599 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  08-28-63   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    RCDSOX3&3          THESE TWO STATEMENTS REFER TO THE   001604 807E9 03 000759      AA41
AG 04 A AG04               TMTS    3    RCDN2X3A-4         SAME DATA FIELD. THE ADJUSTMENTS    001609 907E6 03 000756 026 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    001614 808#9 01 000809      AB18
AG 09 A AG09               CMP     1    #1234567#-2        TO ADDRESS A POSITION WITHIN A      001619 453W7 01 005367      ¤A26
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.    001624 11694     001694      AG33

AG 13 A AG13               RCVS         *&6                RCVS AT OP CODE OF 2ND INSTRUCTION  001629 U1635     001635
AG 14 A AG14                                               FOLLOWING.
AG 15 A AG15
AG 16 A AG16               SET     6    NAMEA/5            DIVIDE OPERATOR & ADJUSTMENT USED   001634 B0#-6 06 000006      AC51
AG 17 A AG17               SND     6    NAMEA              TO GET SET TO MOVE NAMEA BY SND.    001639 /1#P4 06 001074      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.      001644 81649     001649
AG 22 A AG22
AG 23 A AG23               LDA          *&3                GIVES INVALID ADDRESS FOR LDA.      001649 #1652     001652
AG 24 A AG24
AG 25 A AG25               TMTS    1    NAMEA-0000030      AN ADJUSTMENT CAN NOT HAVE MORE     001654 910W7 01 001067      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    001659 L1669     001669
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            001664 ,1NR9 10 001599      AF55
 AG32 *                    TR           EXIT             TO EXIT LINKAGE ON UNEQUAL            001669 11599     001599      AF55

AG 33 A AG31  CONTINUE     NOP          *                                                  001674 A1674     001674 027
AG 34 A AG32
AG 35 A AG33               LOD          #300#&100         ADJUSTMENTS TO A LITERAL MAY NOT BE  001679 85350     005350      ¤A22
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   001684 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   001689 41029 01 001099      AC51
AG 44 A AG42               CMP     1 L,NAMEA             HAND CHARACTER.                       001694 410X0 01 001070      AC51
AG 45 A AG43               CMP     1 R,NAMEA             REDUNDANT MODIFIER                    001699 41029 01 001099      AC51
AG 46 A AG44
AG 47 A AG45               TMTS    1   NAMEA               TMTS NORMALLY REFERENCES THE LEFT   001704 910X0 01 001070      AC51
AG 48 A AG46               TMTS    1 R,NAMEA             HAND CHARACTER.                       001709 91029 01 001099      AC51
AG 49 A AG47               TMTS    1 L,NAMEA             REDUNDANT MODIFIER                    001714 910X0 01 001070      AC51
AG 50 A AG48
AG 51 A AG49               RCV         NAMEA               RCV NORMALLY REFERENCES THE LEFT    001719 U1074     001074      AC51
AG 52 A AG50               RCVS      H,NAMEA             HAND &4 CHARACTER, RCVS THE LEFT.     001724 U1074     001074      AC51
AG 53 A AG51               RCV       H,NAMEA             REDUNDANT MODIFIER                    001729 U1074     001074      AC51
AG 54 A AG52
AG 55 A AG53               RCVT        NAMEA               RCVT NORMALLY REFERENCES THE LEFT   001734 U1079     001079      AC51
AG 56 A AG54               RCVS      T,NAMEA             HAND &9 CHARACTER, RCVS THE LEFT,     001739 U1079     001079 028  AC51
AG 57 A AG55               RCV       T,NAMEA             AND RCV THE LEFT &4.                  001744 U1079     001079      AC51
AG 58 A AG56               RCVT      T,NAMEA             REDUNDANT MODIFIER                    001749 U1079     001079      AC51
AG 59 A AG57
AG 60 A AG58               SET         NAMEA               SET NORMALLY REFERENCES SIZE.       001754 B0030     000030      AC51
AG 61 A AG59               SET       S,NAMEA             REDUNDANT MODIFIER                    001759 B0030     000030      AC51
AG 62 A AG60               NOP       S,NAMEA             CREATE CONSTANT OF LENGTH OF NAMEA    001764 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.                    001769 853T8 01 005338      ¤A15

AG 65 I AG63                              INVALID USAGES                              C
AG 66 A AG64               TMT       T,NAMEA             THE FIRST FIVE POSITIONS OF NAMEA     001774 91079     001079      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    001779 85TT0 05 005330      ¤A14
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      001784 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         001789 91099     001099      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.    001794 ,1-74 08 001074      AC51
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INDEX S PGLIN    TAG       CP    NU AT OPERAND 80SMPL-001  08-28-63   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       ADCCN       NAMEA            AN ADDRESS CONSTANT                001799 A1C99     001099      AC51
AH 04 A AH04
AH 05 A AH05               LOD    6 I,INDEX1          LOAD ASU 6 AT THE ADDRESS NOW IN     001804 81XRZ C6 001799 029 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.          001809 ,1PR9 10 001799      AH03
 AH10 *                    LOD    6    INDEX1        OPERAND AND COMMENTS REPEAT.          001814 81XR9 C6 001799      AH03

AH 11 I AH09                                      INVALID USAGES                     C

AH 12 A AH10               LEV80
AH 13 A AH11  INDEX3       CON   06    001234                                          001820
AH 14 A AH12               RAD      I,INDEX3          INDEX3 IS NOT IN A 4/9 LOCATION.     001829 H182#     001820 030 AH13
AH 15 A AH13
AH 16 A AH14
AH 17 A AH15               LCD      I,@110234         THE LOCATION OF THE REFERENCED       001834 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               LCA    6   EXIT              THIS LDA-ULA IS INTENDED TO MODIFY 001839 #1VR9 06 001599      AF55
AH 23 A AH21               ULA    6   TAGZ              THE ADDRESS PORTION OF THE LOD.    001844 *1YM9 06 001849      AH25

AH 24 A AH22  TAGZ         LOD      I,INDEX1
 AH25 *       TAGZ         EIA         INDEX1                                          001849 ,1PR9 10 001799      AH03
 AH26 *                    LCD         INDEX1                                          001854 81799    001799      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 001859 ,51K9 02 005129      AK09
AH 30 A AH26               LFC         LASNTAGA&2       ADDRESS IS 4/9 CHECKED.            001864 ,51L1 02 005131      AK09
AH 31 A AH27               LFC    1    LASNTAGA&2       WITH A NUM OF 1 IT IS 1/6  CHECKED 001869 ,51L1 02 005131      AK09
AH 32 A AH28               LFC    1    LASNTAGA         ETC.  SEE MESSAGES.                001874 ,51K9 C2 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.   001879 %-0&0 03 020000
AH 35 A AH31               SBZ    4    @20000                  SB    4 WITH 4 IN COL 22.   001884 %-0&0 03 020000
AH 36 A AH32               SBZ    4    @20000                  SB   4  WITH 4 IN COL 21.   001889 %-C&0 03 020000
AH 37 A AH33               SBZ   04    @20000                  SB   04 REFERENCES 8 BIT    001894 %-#00 04 020000 031
AH 38 A AH34               SBA         @20000                  SB  7 BECOMES SBA           001899 %-#&0 07 020000
AH 39 A AH35               SBN    4    @20000                  SBN 04  REFERENCES 4 BIT    001904 %--&0 11 020000
AH 40 A AH36               SBR   10    @20000                  SBR, NUM IS IGNORED         001909 %--00 08 020000
AH 41 A AH37               SBA   10    @20000                  SBA, NUM IS IGNORED         001914 %-#&0 07 020000

AH 42 I AH38                                      INVALID USAGES                     C
AH 43 A AH39               SBZ    3    @20000                  SB  3                       001919 %-000     020000
AH 44 A AH40               SBZ    5    @20000                  SB  5                       001924 %-000     020000
AH 45 A AH41               SBZ    6    @20000                  SB  6                       001929 %-C00     020000
AH 46 A AH42               SBN    9    @20000                  SB  9                       001934 %-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 NCT SHOWN SINCE THEIR EFFECT IS NOT APPARENT HERE.          C
AH 50 I AH46                                                                         C
AH 51 A AH47               RAD         RCDA             GIVES CAUTIONARY MESSAGE           001939 H0510     000510      AA19
AH 52 A AH48               RAD         RCDA             FLAG D SUPPRESSES THE MESSAGE    D 001944 H0510     000510      AA19
AH 53 A AH49
AH 54 A AH50               RCD    1    A                                               001945
AH 55 A AH51               NCP         *                THIS IS THE ONLY INSTR. ON A CARD  001954 A1954     001954 032
AH 56 A AH52               NCP         *                FLAG @ FORCES THIS ONTO THE NEXT @ 001959 A1959     001959 033
AH 57 A AH53
AH 58 A AH54               NOP         EXIT             THIS SPIN LOOP IS EQUIVALENT TO A M 001964 A1599    001599      AF55
AH 59 A AH55               TR          *-5              HLT. AN INTERRUPT CAN CHANGE THE  H 001969 11964    001964

AH 60 I AH56                     NOP TO TR. FLAG M PUTS THE NOP ON THE M FLAG PAGE     C
AH 61 I AH57                     OF THE NOTEBCCK, FLAG H PUTS THE TR ON THE H FLAG     C
AH 62 I AH58                     PAGE OF THE NCTEBOOK.                                 C
AH 63 I AH59                                                                         C
AH 64 A AH60               LCD         #-BALANCE#       R-L SCAN TREATS - AS DASH NOT NEG.B 001974 85377    005377      ¤A27
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INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  08-28-63   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                                          001979 H0756      000756       AA41
 AI07 J                    ADD         RCDS5X3                                          001984 G0745      000745       AA37
 AI08 J                    ST          RCDS5X3                                          001989 F0745      000745       AA37

AI 09 B AI06               ADDX        RCDS5X3A¤#&98765.43#¤RCDS6X0¤  WITH RND AND LNG
 AI10 J                    RAD         RCDS5X3A                                         001994 H0753      000753       AA38
 AI11 J                    SHR         @000001                                          001999 C0001      000001
 AI12 J                    SET         @000008                                          002004 B0008      000008
 AI13 J                    ADD         #&98765.43#                                      002009 G5200      005200       ¤A07
 AI14 J                    RND         @000002                                          002014 E0002      000002
 AI15 J                    ST          RCDS6X0                                          002019 F1105      001105       AC60

AI 16 B AI07               ADDX        RCDS5X3¤RCDS5X3A¤RCDS5X3¤EXIT¤TRUNCATE¤  OVFLO PROT
 AI17 J                    RAD         RCDS5X3A                                         002024 H0753      000753 034 AA38
 AI18 J                    SET         @000009                                          002029 B0009      000009
 AI19 J                    ADD         RCDS5X3                                          002034 G0745      000745       AA37
 AI20 J                    CMP         XACA        &000008                              002039 44030      004030       AQ12
 AI21 J                    TRH         EXIT                                             002044 K1599      001599       AF55
 AI22 J                    SET         @000008                                          002049 B0008      000008
 AI23 J                    ST          RCDS5X3                                          002054 F0745      000745       AA37

AI 24 B AI08               ADDX        RCDS5X3¤RCDS0X3¤XAC1,#&06.02¤  SECONDARY FIELD DEF
 AI25 J                    RAD         RCDS0X3                                          002059 H0756      000756       AA41
 AI26 J                    SET         @000009                                          002064 B0009      000009
 AI27 J                    ADD         RCDS5X3                                          002069 G0745      000745       AA37
 AI28 J                    RND         @000001                                          002074 E0001      000001
 AI29 J                    ST          XAC1                                             002079 F4C21      004021       AQ11

AI 30 B AI09               MOVE        NAMEB¤NAMEA¤  ALPHA TO ALPHA
 AI31 J                    RCV         NAMEA                                            002084 U1C74      001074       AC51
 AI32 J                    SET         @000006                                          002089 B0006      000006 035
 AI33 J                    SND         NAMEB                                            002094 /1104      001104       AC68

AI 34 B AI10  MOVE1        MOVE        NAMEA¤NAMEB¤  ALPHA TO ALPHA HS
 AI35 J       MOVE1        RCV         NAMEB                                            002099 L1104      001104       AC68
 AI36 J       M00019#01    TMT         NAMEA                                          M 002104 91C74      001074       AC51

AI 37 B AI11               INCRA       MOVE1#1¤#&10#¤  ADDRESS MODIFICATION
 AI38 J                    RAD   15    #&10#                                            002109 H5AG8 15 005178       ¤A03
 AI39 J                    AAM   15    M00019#01                                        002114 @2A&4 15 002104       AI36

AI 40 B AI12               MOVE        CONN5X0¤RCDS6X0¤  5 DIG UNSIGNED TO 6 DIG SIGNED
 AI41 J                    SET         @000005                                          002119 B0005      000005
 AI42 J                    LOD         CONN5X0                                          002124 80816      000816       AB19
 AI43 J                    SET         @000006                                          002129 B0006      000006
 AI44 J                    ST          RCDS6X0                                          002134 F1105      001105       AC60

AI 45 I AI13               TITLE       PROGRAM CARD SUPPRESSION WITH S FLAGS

AI 46 B AI14  TAGA         MOVE        CONA¤CONN5X0¤                                  S
 AI47 J       TAGA         TRANS       *                                                002139
 AI48 J       T00022#02    RCVS        CONN5X0                                        M 002139 U0812      000812       AB19
 AI49 J       T00022#01    TMTS  05    CONA                                           M 002144 90Y#7 05 000807       AB18

AI 50 B AI15  TAGB         MOVE        CONN5X0¤CONMIXED¤                              S
 AI51 J       TAGB         RCVS        CONMIXED                                         002149 U0817      000817 036 AB20
 AI52 J       T00023#01    TMTS  05    CONN5X0                                        M 002154 90Y/2 05 000812       AB19

AI 53 I AI16               TITLE       MACROS WITH F FLAGS

AI 54 B AI17               MOVEA       TAGA#1¤TAGB#1¤                                 F
 AI55 J                    LCA   15    T00022#01                                        002159 #2AD4 15 002144       AI49
 AI56 J                    ULA   15    T00023#01                                        002164 *2AE4 15 002154       AI52

AI 57 B AI18               MOVEA       XACC¤TAGC¤
 AI58 J                    ADD   15    #&00004#                                         002169 G5BA4 15 005214       ¤A09
 AI59 J                    ULA   15    TAGC                                             002174 *2AH9 15 002189       AI63

AI 60 B AI19               ADDA        XACC¤5¤TAGA#2¤                                 F
 AI61 J                    ADD   15    #&00001#                                         002179 G5B&9 15 005209       ¤A08
 AI62 J                    ULA   15    T00022#02                                        002184 *2AC9 15 002139       AI48
AI 63 A AI20  TAGC         TR                                                           002189 10000      000000
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INDEX S PGLIN    TAG       CP   NU AT OPERAND 80SMPL-001  08-28-63   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                                      002197
AJ 04 A AJ04
AJ 05 A AJ05               ADCON      DUMMYTAG        TAG OPERAND            002204 A2197    002197 037 AJ03
AJ 06 A AJ06               ADCON 13   DUMMYTAG        ADCON WITH ASU ZONING. 002209 A2AZ7 13 002197     AJ03
AJ 07 A AJ07               ADCON      DUMMYTAG&4      TAG OPERAND WITH CHARACTER ADJ.   002214 A2201    002201     AJ03
AJ 08 A AJ08               ADCON    L,DUMMYTAG      WITH OPERAND MODIFIER             002219 A2190    002190     AJ03
AJ 09 A AJ09               ADCON      #ABLE#          LITERAL OPERAND                   002224 A5354    005354     ¤A23
AJ 10 A AJ10               ADCON      @43155          ACTUAL OPERAND                    002229 A315N    043155
AJ 11 A AJ11               ADCON      *-55            ADJUSTED LOCATION COUNTER OPERAND 002234 A2179    002179

AJ 12 I AJ12                                INVALID USAGES                    C
AJ 13 A AJ13               ADCON      LASNTAGA*35     VALUE OF OPERAND EXCEEDS 160K.    002239 AZ515    019515     AK09
AJ 14 A AJ14               ADCON  &   @43424          THE & INTERFERES WITH THE ADDRESS 002244 A342M    043424

AJ 15 I AJ15               TITLE         ACON4, ACON5, AND ACON6
AJ 16 A AJ16               ACON4      DUMMYTAG        TAG OPERAND                       002248  2197    002197     AJ03
AJ 17 A AJ17               ACON5      DUMMYTAG        TAG OPERAND                       002253          002197     AJ03
AJ 18 A AJ18               ACON6      DUMMYTAG        TAG OPERAND                       002259          002197     AJ03
AJ 19 A AJ19               ACON4 12   DUMMYTAG        ACON4 WITH ASU ZONING             002263  2A97 12 002197     AJ03
AJ 20 A AJ20               ACON5  &   DUMMYTAG        ACON5 SIGNED PLUS                 002268          002197 038 AJ03
AJ 21 A AJ21               ACON6  -   DUMMYTAG        ACON6 SIGNED MINUS                002274          002197     AJ03
AJ 22 A AJ22               ACON4      DUMMYTAG&8      WITH CHARACTER ADJUSTMENT         002278  2205    002205     AJ03
AJ 23 A AJ23               ACON5    L,DUMMYTAG      WITH OPERAND MODIFIER             002283          002190     AJ03
AJ 24 A AJ24               ACON6    L,DUMMYTAG&2    WITH MODIFIER AND ADJUSTMENT      002289          002192     AJ03
AJ 25 A AJ25               ACON4    S,DUMMYTAG&1    WITH SIZE MODIFIER AND ADJUSTMENT 002293  0009    000009     AJ03
AJ 26 A AJ26               ACON5  -   #&3957#         SIGNED ACON OF LITERAL. NOTE THAT 002298          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     002304          002314
AJ 30 A AJ30               ACON5      @12345          UNSIGNED WITH ACTUAL OPERAND      002309          012345

AJ 31 I AJ31                                INVALID USAGES                    C
AJ 32 A AJ32               ACON4    S,DUMMYTAG-10   ADJUSTMENT IS LARGER THAN S,      002313  0002    000002     AJ03
AJ 33 A AJ33               ACON4  &   @40100          & SIGN INTERFERES WITH ADDRESS    002317  010-    040100
AJ 34 A AJ34               ACON5 15   DUMMYTAG        AN ACON5 CANNOT HAVE ASU ZONING   002322          002197     AJ03
AJ 35 A AJ35               ACON5      @84324          OPERAND TOO LARGE FOR ACON5       002327          004324

AJ 36 I AJ36               TITLE         ADDRESS CONSTANT LITERAL
AJ 37 A AJ37               LCD   04 R@NAMEA         NON-ARITH, NON-4/9 OPERATION IN 80  002334 85L06 04 005406 039 &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    002339 G5413    005413     $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           002344 85U24 04 005424     -A01
AJ 44 A AJ44               ADD      S@NAMEA&10      GIVES 5 DIGITS SIGNED             002349 G5419    005419     *A01
AJ 45 A AJ45
AJ 46 A AJ46               EIA                        4/9 OPERATIONS IN ANY MODE GIVE 4 002354 ,0--0 10 000000
AJ 47 A AJ47               ULA   06 R@EXIT          DIGIT UNSIGNED MACHINE ADDRESSES.  002359 *5UL9 06 005439     /A03
AJ 48 A AJ48               LDA   05 R@12,NAMEA&4    ASU ZONING CAN BE SPECIFIED        002364 #5UU9 05 005449     /A05
AJ 49 A AJ49               LDA   05 R@15,*&25       AN ADCON LIT OF A LOCATION COUNTER 002369 #5UT4 05 005434     /A02
AJ 50 A AJ50               LDA   06 R@#&1234#       ADDRESS OR OF A LITERAL IS VALID.  002374 #5UK9 06 005429     /A01

AJ 51 I AJ51                                INVALID USAGES                    C
AJ 52 A AJ52               TMT      H@NAMEA         THE TMT IS FROM THE ADCON LITERAL   002379 95445    005445     /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        CP      NU AT OPERAND 80SMPL-001  08-28-63   COMMENTS   PG 013  F  LOC    INSTR SU  ADDR  SER  REF

AK 01 I AK01               TITLE       INSTRUCTICNS 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.  002380

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 040

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 041

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 042

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 043

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 044

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 045

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 046

AK 24 A AK24               LASN                      SET BLNK CTR TO BLNK CTR HI ASSIGNMENT  005155
AK 25 A AK25               NOP         *             ASSIGN UNDER BLANK CTR CONTROL        005159 A5159    005159 047

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 048

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 049

AK 31 A AK31               SASN        @5000             SET BELOW LASN BLANK CTR           005000
AK 32 A AK32               NOP         *                 ASSIGN                             005004 A5C04    005004 050

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 051

AK 35 A AK35               SASN        @8000                                                008000
AK 36 A AK36               NOP         *                                                    008004 A8004    008004 052

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 053

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 A1099    001099     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        LCA     06  CUTSIDE           NO EFFECT OUTSIDE RASN RANGE       005004 #5/P9 06 005179 054 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 055 AK45
AK 51 A AK51                                             AFFECTED.
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INDEX S PGLIN    TAG      CP   NU AT OPERAND 80SMPL-001  08-28-63   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 056
AL 10 A AL10               RD            @1000      CARD AND THEN CONTINUES LOADING.    000104 Y1C00    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 B0C#1 01 000001
AL 17 A AL17               SET    2  2                                                  000104 B0C-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 11674    001674     AG33

AL 23 A AL23               LASN                     TERMINATE TCD                       005175

AL 24 I AL24               TITLE          SUBROUTINE CALLS-INCL

AL 25 A AL25               INCL      9HEAD          EACH OF THESE STATEMENTS CALLS

AL 26 A AL26               INCL      8HEAD          FOR A SUBROUTINE FROM THE LIBRARY

AL 27 A AL27               INCL      9HEAD          NOTE THAT EACH SUBROUTINE ONLY

AL 28 A AL28               INCL      8HEAD          APPEARS ONCE IN THE PROGRAM, NO

AL 29 A AL29               INCL      9HEAD          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 057 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.      001099                     AC51
AL 49 A AL49
AL 50 A AL50   TRANSE      TRANS    L,NAMEA&6      MODIFICATION AND ADJUSTMENT          001076                     AC51
AL 51 A AL51
AL 52 A AL52               RCVS  05  TRANSD         THESE FOUR INSTRUCTIONS SHOW THAT   005214 U1#X0 05 001070     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 81099    001099     AC51
AL 55 A AL55               LOD    1 L,TRANSD&4     UNMODIFIED, UNADJUSTED TAG.          005229 810X4 01 001074     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 058 AL39
AL 62 A AL62               LDA    1 R,TRANSE       ADDRESSING.                          005249 #10X6 01 001076     AC51
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INDEX S PGLIN    TAG       CP    NU AT OPERAND 80SMPL-001  08-28-63    COMMENTS    PG 015  F  LOC      INSTR SU  ADDR    SER   REF

AM 01 I AL64              TITLE       MULTIPLE LITERALS - LITST, LITND

AM 02 A AL65              LITST
AM 03 A AL66              RAC             #&1#                                          005254 H5296     005296        AN03
AM 04 A AL67              LCD     05      #ABCDE#                                       005259 85TT4 05 005334        AN10
AM 05 A AL68              LDA     06 R@#&12345#                                         005264 #5T04 C6 005364        AN18
AM 06 A AL69              LCD        L@#WJR111#                                         005269 85354     005354        AN15
AM 07 A AL70              LDA     15 S@OUTSIDE                                          005274 #5CF9 15 005369        AN20
AM 08 A AL71              RAD             #&24#                                         005279 H5298     005298        AN04
AM 09 A AL72              RAD        H@#&2468013579#                                    ^^05284 H5349    005349        AN14
AM 10 A AL73              LCD        T@#ABCDEFGHIJ#                                     005289 85359     005359        AN16
AM 11 A AL74              LDA        R@01,#ABC#                                         005294 #5374     005374        AN22

AM 12 A AL75              LITND
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INDEX S PGLIN    TAG       CP    NU AT OPERAND 80SMPL-001  08-28-63    COMMENTS    PG 016  F  LOC      INSTR SU  ADDR    SER   REF

 AN01 *                               MULTIPLE LITERAL TABLE NUMBER 0001

 AN02 *                         01                                                      005295
 AN03 *       SIGNED LITERAL    01\  A                                                  005296
 AN04 *       SIGNED LITERAL    02   2D                                                 005298
 AN05 *                         01                                                      005299
 AN06 *       SIGNED LITERAL    05   1234E                                              005304                  059
 AN07 *                         05                                                      005309
 AN08 *       SIGNED LITERAL    10   246801357I                                         005319

 AN09 *       UNSIGNED LITERAL 10    ABCDEFGHIJ                                         005329
 AN10 *       UNSIGNED LITERAL 05    ABCDE                                              005334
 AN11 *       UNSIGNED LITERAL 06    WJR111                                             005340
 AN12 *       UNSIGNED LITERAL 03    ABC                                                005343

 AN13 *                         01                                                      005344
 AN14 *       2468013    HI-SP 05    0531D                                              005349                        AN08

 AN15 *       WJR111     LEFT  05    05335                                              005354                        AN11
 AN16 *       ABCDEFG    HISP9 05    05329                                              005359                        AN09

 AN17 *                         01                                                      005360
 AN18 *       1234E      RIGHT 04     5304                                              005364                        AN06
 AN19 *                         01                                                      005365
 AN20 *       OUTSIDE    SIZE  04     0005                                              005369                  060   AK42
 AN21 *                         01                                                      005370
 AN22 *       ABC        RIGHT 04     53U3                                              005374                        AN12
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INDEX S PGLIN    TAG       CP    NU AT OPERAND 80SMPL-001  08-28-63    COMMENTS    PG 017  F  LOC      INSTR SU  ADDR    SER   REF

AO 01 I AM01              TITLE      ASSEMBLY DOCUMENTATION

AO 02 I AM02  THE COMMENTARY ILLUSTRATES THE USE OF TITLE AND COMMENT STATEMENTS       C
AO 03 I AM03  TO ENHANCE PROGRAM DOCUMENTATION.   NOTE THAT TITLE STATEMENTS WHICH     C
AO 04 I AM04  EXTEND BEYOND THE LIMITS OF COL 23 TO COL 73 WILL BE DIVIDED INTO        C
AO 05 I AM05  FIELDS AS IN THE EXAMPLE BELOW WHICH WAS ONE WORD, ENTITLED.             C

AO 06 I AM06           EN TITLE D

AO 07 I AM07  THE COMMENT STATEMENT, A NEW FEATURE OF THE 7080 PROCESSOR, IS           C
AO 08 I AM08  DESIGNATED BY A CODE OF C IN THE FLAG FIELD, COL 74. IT MAY EXTEND       C
AO 09 I AM09  FROM COL 6 TO COL 73 AND IS NOT OVERPRINTED. AN EXTRA SPACE IS GIVEN     C
AO 10 I AM10  BEFORE A COMMENT STATEMENT UNLESS IT FOLLOWS ANOTHER COMMENT ENTRY.      C

AO 11 I AM11              TITLE              OVERFLOW CONTROL

AO 12 I AM12  PAGE-TO-PAGE OVERFLOW IS NORMALLY UNDER THE CONTROL OF A LINE COUNT      C
AO 13 I AM13  WHICH INCLUDES BLANK LINES. IT IS COMPARED TO A MAXIMUM LINE COUNT       C
AO 14 I AM14  SPECIFIED IN THE COMMUNICATION WORD AND WHEN THIS MAXIMUM IS REACHED     C
AO 15 I AM15  AN OVERFLOW OCCURS.                                                      C
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INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  08-28-63   COMMENTS   PG 018  F  LOC    INSTR SU  ADDR  SER  REF

AP 01 I AN01               TITLE           EJECT ENTRY

AP 02 I AN02  THE STATEMENT IMMEDIATELY PRECEDING THE TITLE EJECT ENTRY HAD THE        C
AP 03 I AN03  WORD EJECT IN THE OPERATION FIELD. THIS PRODUCED AN IMMEDIATE PAGE       C
AP 04 I AN04  BREAK REGARDLESS OF THE LINE COUNT.                                      C
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```
INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  08-28-63   COMMENTS   PG 019  F  LOC    INSTR SU  ADDR  SER  REF

 AQ01 K                                THE FOLLOWING ARE CLASS A SUBROUTINES

 AQ02 R AA01  9HEAD       TITLE        THE CLASS A SUBROUTINE WHICH FOLLOWS IS CALLED BY

 AQ03 R AA02                           THE PROCESSOR. IT CONSISTS OF MACRO INSTRUCTIONS

 AQ04 R AA03                           WHICH ARE ONLY GENERATED IF THEY ARE NEEDED.

 AQ05 K 001   XXPRTST     PRTST        XXPRTST01□XXPRTST02□XXPRTST03□XXPRTST04□XXPRTST05□

 AQ06 K 002                            XXPRTST06□XXPRTSTFL$□XXPRTSTWRK□XXPRTSTHLD□

 AQ07 K 003                            XXPRTSTEND□IBM9999999□

 AQ08 K 005               XXACC        XAC□XAC1□XAC2□XAC3□XAC4□XACB□XACA□IBM9999999□
 AQ09 J                   CON     1                                                   004005          061
 AQ10 J       XAC                 8    &00000000                                    D 004013
 AQ11 J       XAC1                8    &00000000                                    D 004021
 AQ12 J       XACA        CON     1    0000000000000000000000000000000000000000       004022
 AQ13 J                   CON     8    9999999999999999999999999999999999999999       004030

 AQ14 K 006               XXACD        XACC□XACC1□IBM9999999□

 AQ15 K 007   XXBSRCH     BSRCH        XXBSRCH01□XXBSRCH02□XXBSRCH03□XXBSRCH04□XXBSRCH05□

 AQ16 K 008                            XXBSRCH06□XXBSRCH07□XXBSRCH08□XXBSRCH09□XXBSRCH10□

 AQ17 K 009                            XXBSRCHEXT□IBM9999999□

 AQ18 K 010   XXSSRCH     SSRCH        XXSSRCH01□XXSSRCH02□XXSSRCH03□XXSSRCH04□XXSSRCH05□

 AQ19 K 011                            XXSSRCH06□XXSSRCHEXT□IBM9999999□

 AQ20 K 012   XXFIX       FIX          XXFIX01□IBM9999999□

 AQ21 K 013   XXFLOAT     FLOAT        XXFLOAT01□IBM9999999□

 AQ22 K 014   IOTYPENTRY  TYPIO        IOTYPEXIT□IBM9999999□

 AQ23 K 015   XXADDENTRY  AITEM        XXADDEXIT□XXDELET02□XXDELET04□XXDELET03□XXDELET07□

 AQ24 K 016                            XXDELET05□XXDELET06□IBM9999999□

 AQ25 K 017   XXDELENTRY  DITEM        XXDELEXIT□XXDELET02□XXDELET03□XXDELET04□XXDELET05□

 AQ26 K 018                            XXDELET06□XXDELET07□IBM9999999□

 AQ27 K 019               ACOMP        XXACOMPTWO□XXACOMPONE□XXACOMPWRK□IBM9999999□
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INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  08-28-63   COMMENTS   PG 020  F  LOC    INSTR SU  ADDR  SER  REF

 AR01 K                                THE FOLLOWING ENTRIES ARE   CLASS B   SUBROUTINES

 AR02 R AA01  BHEAD       TITLE        THIS TITLE BLOCK APPEARS IN LIEU OF A CLASS B

 AR03 R AA02                           SUBROUTINE.
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INDEX S PGLIN     TAG       CP    NU AT OPERAND 80SMPL-001  08-28-63    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
 AB08   AB08                    3       STRIPPED DATA
 AB08   AB08                    3       NUM NOT EQ TO DESIG
 AB13   AB13                    4       STRIPPED DATA
 AB13   AB13                    4       STRIPPED DATA
 AB13   AB13                    4       NUM NOT EQ TO DESIG
 AB42   AB42                    3       STRIPPED CON
 AB54   AB54                   14       STRIPPED CON
 AC33   AC33             RPT    9       IMPR RPT
 AC42   AC42             RCD    4       CHK LEFT PROTECTION                                            22
 AD03   AD03             CCN    6       CHK LEFT PROTECTION
 AD13   AD13             CNC    2    RH                                NO TAG RH
 AD14         NAMEE                     INVAL NAME BEG AD11
 AD35         NAMEH                     INVAL NAME BEG AD26
 AD44         NAMEI                     INVAL NAME BEG AD31
 AE11                    SETCF       OPERND 01 SWITCH TYPE UNKNOWN ASSUME A-J TYPE
 AE52                    SETON       OPERND 01 SWITCH TYPE UNKNOWN ASSUME A-J TYPE
 AE52                    SETON       OPERND 02 SWITCH TYPE UNKNOWN ASSUME A-J TYPE
 AE57                    SETON       OPERND 01 SETOF ALTSW           NO GENERATION
 AE59                    MCVE        IMPROPER DATA DEFINITION NO GEN.
 AE59                    MCVE        IMPROPERLY WRITTEN
 AF10   AF10             SND   04    WORST CASES                       NO TAG WORST CASE
 AF11   AF11             TR          RD/WR                             NO TAG RD
 AF11   AF11             TR             ADJ 0
 AF12   AF12  GAP        NOP            JUST TAG
 AF13   AF13  GAP        NOP         *                                 DUPL TAG AF12
 AF18   AF18             WR          #NOT AVAILABLE #                  0/5 CHECK                  ¤A29
 AF22   AF22             ACD         &14#                              NO TAG &14#
 AF25   AF25             TRE         #DUPE#                            4/9 CHECK                  ¤A24
 AF25   AF25             TRE         #DUPE#                            LIT OPND IMPROPER          ¤A24
 AF26   AF26             ACD         #0010#                            SGN CHK L                  ¤A25
 AF27   AF27             LCD            NO RT LIT                                                 ¤A12
 AF28   AF28             WR             NO RT LIT                                                 ¤A13
 AF31   AF31             LCD            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             LCD            IMPR CPND
 AG21   AG21             LCD         *&80005                           ADDR OVR 079999
 AG23   AG23             LCA         *&3                               4/9 CHECK
 AG35   AG33             LCD            IMPR ADJ TRUNC                                            ¤A22
 AG35   AG33             LOD            ADJ 0                                                     ¤A22
 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             LCD         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
 AI46                    MCVE        MOVING ALPHA TO NUMERIC
 AJ13   AJ13             ACCCN       LASNTAGA*35                       ADDR OVR 079999            AK09
 AJ14   AJ14             ACCCN  &    @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           INVL CPND
 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             RC          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  08-28-63    NO REQS     PG 002  F  LOC   INSTR SU  ADDR        REF

 AB38    AB38   WORSTCASES CCN    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  08-28-63    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
AB 17 I AB17               TITLE           DEFINITION OF A CONSTANT FIELD - CON
AB 58 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
AI 45 I AI13               TITLE      PROGRAM CARD SUPPRESSION WITH S FLAGS
AI 53 I AI16               TITLE      MACROS WITH F FLAGS
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 AL64               TITLE      MULTIPLE LITERALS - LITST, LITND
 AN01 *                                  MULTIPLE LITERAL TABLE NUMBER 0001
AO 01 I AM01               TITLE      ASSEMBLY DOCUMENTATION
AO 06 I AM06            EN TITLE D
AO 11 I AM11               TITLE           OVERFLOW CONTROL
AP 01 I AN01               TITLE           EJECT ENTRY
 AQ02 R AA01   9HEAD       TITLE      THE CLASS A SUBROUTINE WHICH FOLLOWS IS CALLED BY
 AQ03 R AA02                          THE PROCESSOR. IT CONSISTS OF MACRO INSTRUCTIONS
 AQ04 R AA03                          WHICH ARE ONLY GENERATED IF THEY ARE NEEDED.
 AR02 R AA01   BHEAD       TITLE      THIS TITLE BLOCK APPEARS IN LIEU OF A CLASS B
 AR03 R AA02                          SUBROUTINE.
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INDEX S PGLIN    TAG      OP    NU AT OPERAND 80SPPL-001  08-28-63    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 01 I AB01  THE FOLLOWING THREE INVALID RCD ENTRIES PRODUCE INCONSISTENT            C
AB 02 I AB02  DATA DEFINITIONS.                                                       C
AB 37 I AB37                                  INVALID USAGES                          C
AB 60 I AB60  NOTE THAT THE NUMERIC FIELD IS BLANK AND THAT THE MANTISSA IS ONLY      C
AB 61 I AB61  SIX DIGITS. A LENGTH OF TEN WILL BE ASSUMED AND TRAILING ZEROS ADDED    C
AB 62 I AB62  TO MAKE AN EIGHT DIGIT MANTISSA. THE FPN APPEARS IN MEMORY AS           C
AB 63 I AB63  0C12345600 WITH THE UNITS DIGIT SIGNED PLUS. THE LISTING DOES NOT       C
AB 64 I AB64  SHOW THE ADDED ZEROS OR ASSUMED LENGTH.                                 C
AB 65 I AB65                                                                          C
AB 66 I AB66                                  INVALID USAGES                          C
AB 70 I AB70  THE TWO ENTRIES IMMEDIATELY ABOVE WERE INTENDED AS COMMENTS             C
AB 71 I AB71  COUTINUATIONS. THIS IS INVALID ON A FPN AND TWO FPNS WERE GENERATED     C
AB 72 I AB72  FROM THE OPERAND FIELDS. THE LISTING ONLY SHOWS THE MEMORY ALLOCATED    C
AB 73 I AB73  BUT THE CARDS SHOW 5E38103850 AND 307751920I.                           C
AB 74 I AB74                                                                          C
AB 75 I AB75  THIS FPN WAS INTENDED TO REPRESENT 123.456. OMITTING THE LEADING        C
AB 76 I AB76  ZERO OF THE CHARACTERISTIC CAUSED IT TO REPRESENT THE NUMBER            C
AB 77 I AB77  23456000000000000000000000000.                                          C
AB 79 I AB79  THIS OPERAND WAS INTENDED TO REPRESENT 123.456. OMITTING THE SECOND     C
AB 80 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 IMMEDIATELY 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 48 I AE25                                  INVALID USAGES                          C
AE 49 I AE26  THE FOLLOWING MACRO ATTEMPTS TO SET ON TWO UNDEFINED SWITCHES WHICH     C
AE 50 I AE27  ARE THE TAGS OF CHRCD AND BITCD HEADERS. THEY ARE TREATED AS A-J        C
AE 51 I AE28  TYPE SWITCHES.                                                          C
AE 56 I AE30  THE NEXT MACRO ATTEMPTS TO SET ON AN ALTSW.                             C
AE 58 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
```

```
INDEX S PGLIN    TAG      OP    NU AT OPERAND 80SMPL-001  08-28-63    C FLAG     PG 005  F  LOC     INSTR SU  ADDR          REF

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
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
AO 02 I AM02  THE COMMENTARY ILLUSTRATES THE USE OF TITLE AND COMMENT STATEMENTS C
AO 03 I AM03  TO ENHANCE PROGRAM DOCUMENTATION.   NOTE THAT TITLE STATEMENTS WHICH C
AO 04 I AM04  EXTEND BEYOND THE LIMITS OF COL 23 TO COL 73 WILL BE DIVIDED INTO  C
AO 05 I AM05  FIELDS AS IN THE EXAMPLE BELOW WHICH WAS ONE WORD, ENTITLED.       C
AO 07 I AM07  THE COMMENT STATEMENT, A NEW FEATURE OF THE 7080 PROCESSOR, IS     C
AO 08 I AM08  DESIGNATED BY A CODE OF C IN THE FLAG FIELD, COL 74. IT MAY EXTEND C
AO 09 I AM09  FROM COL 6 TO COL 73 AND IS NOT OVERPRINTED. AN EXTRA SPACE IS GIVEN C
AO 10 I AM10  BEFORE A COMMENT STATEMENT UNLESS IT FOLLOWS ANOTHER COMMENT ENTRY. C
AO 12 I AM12  PAGE-TO-PAGE OVERFLOW IS NORMALLY UNDER THE CONTROL OF A LINE COUNT C
AO 13 I AM13  WHICH INCLUDES BLANK LINES. IT IS COMPARED TO A MAXIMUM LINE COUNT C
AO 14 I AM14  SPECIFIED IN THE COMMUNICATION WORD AND WHEN THIS MAXIMUM IS REACHED C
AO 15 I AM15  AN OVERFLOW OCCURS.                                                C
AP 02 I AN02  THE STATEMENT IMMEDIATELY PRECEDING THE TITLE EJECT ENTRY HAD THE  C
AP 03 I AN03  WORD EJECT IN THE OPERATION FIELD. THIS PRODUCED AN IMMEDIATE PAGE C
AP 04 I AN04  BREAK REGARDLESS OF THE LINE COUNT.                                C
```

```
INDEX S PGLIN    TAG      OP    NU AT OPERAND 80SMPL-001  08-28-63    H FLAG     PG 006  F  LOC     INSTR SU  ADDR          REF

 AE60 J                   HLT         @29000                                         001429   J       029000
AH 59 A AH55              TR          *-5                HLT. AN INTERRUPT CAN CHANGE THE  H 001969   1       001964
AL 43 A AL43              HLT         *                  TECHNIQUE FOR WRITING MACRO     005204   J       005204
```

```
INDEX S PGLIN    TAG      OP    NU AT OPERAND 80SMPL-001  08-28-63    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.
```

```
INDEX S PGLIN    TAG      OP    NU AT OPERAND 80SMPL-001  08-28-63    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  08-28-63    ASSGNS     PG 009  F  LOC     INSTR SU  ADDR         REF

AK 08 A AK08               LASN        a5123       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        a5100       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 ASSIGNMENT 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        a5000           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        a8000                                              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        a5000           ASSEMBLE ROUTINE AT 5000           005000          005000
AK 44 A AK44               RASN        a15000          AS IF IT WAS AT 15000              015000          005019
AK 49 A AK49               LASN        a3000           END RASN RANGE                     003000          000131
AL 14 A AL14               LASN                        TERMINATE TCD                      005175          000129
AL 23 A AL23               LASN                        TERMINATE TCD                      005175          004030
```

```
INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  08-28-63    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      0C1299
```

```
INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  08-28-63    TRANS      PG 011  F  LOC     INSTR SU  ADDR         REF

AL 48 A AL48  TRANSD       TRANS        NAMEA          TRANS TO TAG OPERAND IS VALID.     001099                        AC51
AL 50 A AL50  TRANSE       TRANS     L,NAMEA&6     MODIFICATION AND ADJUSTMENT            001076                        AC51
```

```
INDEX S PGLIN    TAG       OP    NU AT OPERAND 80SMPL-001  08-28-63    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.   001599   1       000000
AH 58 A AH54               NOP         EXIT            THIS SPIN LOOP IS EQUIVALENT TO A M 001964  A       001599       AF55
  AI36 J      M00019#01    TMT         NAMEA                                            M 002104   9       001074       AC51
  AI48 J      T00022#02    RCVS        CONN5XO                                          M 002139   L       000812       AB19
  AI49 J      T00022#01    TMTS  05    CONA                                             M 002144   9    05 000807       AB18
  AI52 J      T00023#01    TMTS  05    CONN5XO                                          M 002154   9    C5 000812       AB19
AI 63 A AI20  TAGC         TR                                                             002189   1       000000
AK 47 A AK47  RASNB        LOD   05                    BLANK OPERAND NOT AFFECTED         005014   8    C5 000000
```

```
  DEFINITIONS      REQUESTS                   80SMPL-001  08-28-63            PG 013    SYMBOLIC ANALYZER
SIGNED LITERALS
A          01  AE41  AE53
1&         02  AI38
123D       04  AJ50  AG38
395G       04  AJ26
BALANCN    07  AF31
987654C    07  AI13
0000A      05  AI61
0000D      05  AI58
0021E      05  AF16
0M56780    10  AF20

UNSIGNED LITERALS
AGE        50  AF27
THIS LI    50  AF28
ABCDE      05  AG69
APPLE      05  AG64  AF17
F          01  AE35
G          01  AE61
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
*002394     AJ49         LDA   05
@000000     AF43         LOD
@000001     AI11         SHR         AI28         RND        AL16         SET   1
@000002     AI14         RND         AL17         SET   2
@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
@000100     AL09         SEL
```

```
 DEFINITIONS      REQUESTS                 80SMPL-001  08-28-63             PG 014    SYMBOLIC ANALYZER

a000123     AF42              TR

a000500     AL33 TRANSA       TRANS

a001000     AL10              RD

a003000     AK49              LASN

a005000     AK31              SASN       AK43          LASN

a005100     AK20              LASN

a005123     AK08              LASN

a008000     AK35              SASN

a012345     AJ30              ACON5

a015000     AK44              RASN

a020000     AH34              SBZ    4   AH35          SBZ   4   AH36           SBZ   4   AH37           SBZ   04
            AH38              SBA        AH39          SBN   4   AH40           SBR  10   AH41           SBA   10
            AH43              SBZ    3   AH44          SBZ   5   AH45           SBZ   6   AH46           SBN    9

a028704     AL03              SUBOR

a029000     AE60              HLT

a035000     AL05              LITOR

a040100     AJ33              ACON4  &

a043155     AJ10              ADCON

a043424     AJ14              ADCON  &

a082500     AF39              WR

a084324     AJ35              ACON5

a110234     AH17              LOD
```

```
 DEFINITIONS      REQUESTS                 80SMPL-001  08-28-63             PG 015    SYMBOLIC ANALYZER

MULTIPLE LITERALS

AN03 A          AM03           RAD

AN10 ABCDE      AM04           LOD   05

AN06 1234E      AN18 LITERAL             R,

AN18 1234E      AM05           LDA   06

AN11 WJR111     AN15 LITERAL             L,

AN15 WJR111     AM06           LOD

AN20 OUTSIDE    AM07           LDA   15

AN04 2D         AM08           RAD

AN08 2468013    AN14 LITERAL             H,

AN14 2468013    AM09           RAD

AN09 ABCDEFG    AN16 LITERAL             T,

AN16 ABCDEFG    AM10           LOD

AN12 ABC        AN22 LITERAL             R,

AN22 ABC        AM11           LDA
```

```
  DEFINITIONS      REQUESTS                    80SMPL-001  08-28-63              PG 016    SYMBOLIC ANALYZER

DESCRIPTIVES

*ERR*&14#       AF22            ADD

AD48 AGE

AD70 BAD1       AE62            ADCON

AD71 BAD2

AD62 BIWEEKLY

AD64 COMMISSION AE29            SBZ    A

AB18 CONA       AG08            LOD    1    -000002 AI49 T00022#01  TMTS   05

AC48 CONDP

AC49 CONDQ

AC45 COND1

AC46 COND2

AB20 CONMIXED   AI51 TAGB       RCVS

AB19 CONN5XO    AI42            LOD                AI48 T00022#02  RCVS               AI52 T00023#01  TMTS   05

AG33 CONTINUE   AG12            TR          &000020 AD28 NAMEF1END  ADCON              AL22            TR

AJ03 DUMMYTAG   AJ24            ACON6    L,&000002 AJ08            ADCON    L,        AJ23            ACON5    L,
                AJ32            ACON4    S,-000010 AJ25            ACON4    S,&000001 AJ07            ADCON        &000004
                AJ22            ACON4       &000008 AJ05            ADCON              AJ06            ADCON 13
                AJ16            ACON4              AJ17            ACON5              AJ18            ACON6
                AJ19            ACON4 12           AJ20            ACON5  &           AJ21            ACON6  -
                AJ34            ACON5 15

AF55 EXIT       AJ47            ULA   06 R@        AE33            TR                 AE38            TR
                AE47            TR                 AF54            ULA    06          AG31            EIA
                AG32            TR                 AH22            LDA     6          AH58            NOP
                AI21            TRH

AD55 FEMALE     AE36            CMP   01

AD65 FLAT FEE

AD50 FORTY

AF12 GAP

AF13 GAP        AF14 RD/WR      SGN      L,

AD60 HOURLY     AE42            SBN    1

AH03 INDEX1     AH05            LOD    6 I,        AH09            EIA                AH10            LOD    6
                AH25 TAGZ       EIA                AH26            LOD

AH13 INDEX3     AH14            RAD      I,

AK09 LASNTAGA   AJ13            ADCON       *000035 AH30            LFC         &000002 AH31            LFC    1     &000002
                AK14            LASN   1    &000010 AK10            LASN   1    &000020 AK27            SASN         &000100
                AH29            LFC                AH32            LFC    1           AK18            LASN   1

AK39 LASNTAGB   AK38            LASN

AF50 LOCATIONA

AD54 MALE

AD63 MONTHLY    AE44            SBN    8

AI35 MOVE1

AI36 M00019#01  AI39            AAM   15

AC51 NAMEA      AJ39            ADD      S@&000010 AJ37            LOD   04 R@        AJ44            ADD      S@&000010
                AJ43            LOD   04 R@        AJ52            TMT      H@        AJ48            LDA   05 R@&000004
                AG45            CMP    1 R,        AG48            TMTS   1 R,        AG75            TMT      R,
                AL50 TRANSE     TRANS    L,&000006 AG44            CMP    1 L,        AG49            TMTS   1 L,
                AG52            RCVS     H,        AG53            RCV      H,        AG78            TCT      H,
                AG56            RCVS     T,        AG57            RCV      T,        AG58            RCVT     T,
                AG66            TMT      T,        AG61            SET      S,        AG62            NOP      S,
                AG72            RAD      S,        AG16            SET    6   /000005 AG25            TMTS   1   -000003
                AG17            SND    6           AG43            CMP    1           AG47            TMTS   1
                AG51            RCV                AG55            RCVT               AG60            SET
                AH03 INDEX1     ADCON              AI31            RCV                AI36 M00019#01  TMT
                AK42 OUTSIDE    ADCON              AL48 TRANSD     TRANS
```

```
 DEFINITIONS        REQUESTS                           80SMPL-001  08-28-63             PG 017    SYMBOLIC ANALYZER
AC50 NAMEAEND    AC36 NAMEA       NAME   A
AC68 NAMEB       AI33             SND                AI35 MOVE1      RCV
AC67 NAMEBEND    AC59 NAMEB       NAME
AC64 NAMEC
AC63 NAMECEND    AC61 NAMEC       NAME
AC71 NAMED
AC70 NAMEDEND    AC65 NAMED       NAME
AD14 NAMEE
AD15 NAMEEEND    AD11 NAMEE       NAME
AD24 NAMEF
AD23 NAMEFEND    AD19 NAMEF       NAME   0           AD21 NAMEG      NAME    4
AD29 NAMEF1
AD28 NAMEF1END   AD26 NAMEF1      NAME
AD25 NAMEG
AD35 NAMEH
AD44 NAMEI
AD42 NAMEJ       AD36 NAMEI       NAME
AD41 NAMEJEND    AD39 NAMEJ       NAME
*ERR*NOTEND      AD30 NAMEH       NAME
AD33 NOWEND
AK42 OUTSIDE     AN20 LITERAL            S,          AK45 RASNA      LDA     06           AL02               SUBOR
                 AL06             LITOR
AD59 PAYTYPE     AE55             UNL   01
AK45 RASNA       AK50             LOD
AK47 RASNB       AK46             ULA   06
AA19 RCDA        AH51             RAD                AH52            RAD
AA44 RCDN2X3A    AG04             TMTS   3   -000004
AA41 RCDS0X3     AG03             LOD    3   &000003 AF07            SET                  AF08               LOD
                 AI06             RAD                AI25            RAD
AA37 RCDS5X3     AI07             ADD                AI08            ST                   AI19               ADD
                 AI23             ST                 AI27            ADD
AA38 RCDS5X3A    AI10             RAD                AI17            RAD
AC60 RCDS6X0     AI15             ST                 AI44            ST
*ERR*RD          AF11             TR
AF14 RD/WR
*ERR*RH          AD13             CNO    2
AD53 SEX         AE54             UNL   01
AD51 SIXTY       AE26             RCVS
AD68 SPLIT TAG   AF04             NOP
AE02 SWA         AE24             UNL   01   -000004
AE03 SWB         AE25             UNL   01   -000004 AE31            RCVS                 AE40               RCVS
AE05 SWC         AE12             RCVS
AI47 TAGA
AI51 TAGB
AI63 TAGC        AI59             ULA   15
AH25 TAGZ        AH23             ULA    6
```

```
  DEFINITIONS      REQUESTS                  80SMPL-001  08-28-63            PG 018    SYMBOLIC ANALYZER

AE23 TESTSW    AE32          TZB    B          AE37          TRE              AE46            TAB

AL33 TRANSA    AL35          SEL               AL36          LOD              AL37            SET
               AL59          TMT               AL60          TCT

AL44 TRANSB    AL42          TR

AL39 TRANSC    AL40          NOP               AL61          RD

AL48 TRANSD    AL55          LOD    1 L,&000004 AL53         SET      S,      AL52            RCVS  05
               AL54          LOD

AL50 TRANSE    AL62          LDA    1 R,

AD49 TWENTY

AI49 T00022#01 AI55          LDA   15

AI48 T00022#02 AI62          ULA   15

AI52 T00023#01 AI56          ULA   15

AD61 WEEKLY    AE28          SBZ    2          AE43          SBN     2

*ERR*WORST CASE AF10         SND   04

AB38 WORSTCASES

AQ10 XAC

AQ12 XACA      AI20          CMP       &000008

AQ11 XAC1      AI29          ST

*ERR*995       AF37          ST
```

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, numerical, 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.

Numerical characters: The digits 0 - 9. Numerical 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 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: . ⌑ ‡ & $ * - / , % # @ + †

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