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IBM 7080 Input/Output Control System

for Use with 729 Magnetic Tape Units

This manual is a major revision of the Reference
Manual, "IBM 7080 Input/Output Control for Use
with 729 Magnetic Tape Units--IOCS80, "Form
C28-6237, which is now obsolete. The revision in-
corporates documentation of major changes to the
system, which is now designated 729 IOCS and sup-
plied in the form of library material to the 7080
Processor, rather than a preassembled system.
These changes were initially described in Technical
Newsletter N28-1054, dated February 4, 1963, which
is now obsolete. The manual also incorporates minor
changes and/or additions throughout the text.

The manual details the various functions per-
formed by the 729 IOCS. The publication describes
macro-instructions, the required and/or optional
procedures for using the IOCS, the waiting loops and
messages that may occur during its use, the avail-
able versions of the IOCS, and the relationship of the
7080/729 IOCS to the 705 III IOCS.

PREFACE

This manual has been prepared to give programmers a thorough working knowledge of the 7080 Input/Output Control System for 729 Magnetic Tape Units, hereafter called "729 IOCS." (Formerly called IOCS80.) A definite effort was made to avoid going into detail on the internal workings of the system. This was done in order that the manual might better accomplish its two main purposes:

1. To explain the programming functions that IOCS will accomplish for an object program.
2. To explain how the programmer may use IOCS in conjunction with his object program.

To simplify the description and eliminate unnecessary details, this manual further assumes a prior knowledge of the 7080 Processor, the 7080 Data Processing System, and tape format specifications for the 7080.

Anyone without this prior knowledge is advised to read the following publications before attempting to read this manual:

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

Reference Manual, "7080 Processor: Autocoder Language," Form C28-6263

Bulletin, "7080 Processor: System Operation," Form J28-6265

Bulletin, "IBM 705/7080 Applied Programming Tape Format and Labeling Standards," Form J28-6123

A knowledge of the contents of the Reference Manual, "Input/Output Control System for the IBM 705 III," Form C28-6109, which contains a complete presentation of the concepts of that system, will facilitate the study of this manual, because the two systems are compatible to a great degree. However, since there is not 100 per cent compatibility, the user should obtain the details required to use 729 IOCS from this manual.

Users of the 705 III IOCS wishing to adapt their programs to use of the 729 IOCS are referred at this point to Appendix 1 of this manual, "Relationship of 7080/729 IOCS to 705 III IOCS." This section outlines, in detail, the major differences between the two systems, and the necessary procedure for conversion of programs using the 705 III IOCS (IOPKGB) to the 729 IOCS.

The 7080 Input/Output Control System is a group of routines which can be used in conjunction with an object program to handle all input/output functions through the channels of the 7080.

The use of IOCS will eliminate much of the time and effort normally required for machine-oriented programming. This increases the effectiveness of a programming staff by permitting it to devote a greater portion of its time and efforts to installation-oriented programming. Savings can also be effected in both programmer time and machine time by the virtual elimination of the debugging normally required for input/output routines.

In addition, IOCS uses programming and operating standards that facilitate communication among programmers and that enable console operators to familiarize themselves more readily with certain conditions which are identical for every program.

Techniques employed in IOCS are based on the experience gained by DS Programming Systems, both in its own programming efforts and in its contacts with a large number of established installations, and with the engineers who designed and built the 7080. These techniques are directed toward providing efficient programming steps, efficient use of the interrupt feature and buffering capabilities of the 7080, and accurate detection and correction of errors.

WHAT IS 729 IOCS?

The 7080 Input/Output Control System for use with 729 Magnetic Tape Units (729 IOCS) is the control system that handles all input/output functions for 729 tape units. The various IOCS routines are contained in seven component sections of 729 IOCS; six of them are generated from the Define IOCS (DIOCS) macro-instruction, which the programmer must code to describe the IOCS required. The seventh, which is optional, is incorporated into the user's program when it is assembled.

These sections are listed below, along with a brief description of their corresponding functions. A more detailed explanation of each section is provided later in the manual.

Data Travel System (CSDTS)

This section of IOCS executes or schedules for execution (depending on the availability of the channels) all input/output operations required for data tape records. It also checks these operations for errors, tape marks and reflective spots. Should any of

these conditions exist, CSDTS will link to another section of IOCS for execution of the appropriate routines.

Error Correction (CSERR)

If an error is detected following the execution of an input/output operation by IOCS, this section of IOCS will perform the appropriate corrective procedures.

Tape Reel Control System (CSTRS)

This section of IOCS checks and positions each tape used by the object program.

End of File and End of Reel (CSEOF)

This section of IOCS performs all necessary operations when end of file and/or end of reel is reached on input and output tapes.

Memory Record (CSMRD)

This section of IOCS records on tape the status of the computer at specified points during a production run so that, if necessary, the computer and program may subsequently be restored to their exact status at the time the tape record was made.

Get/Put

Get/Put provides for the movement of data records between work areas and input/output areas. One of its most important functions is the deblocking of input data records and the blocking of output data records. It also provides for automatic handling of input/output area alternation and reading and writing of tape records.

Get/Put is an optional feature of IOCS, and differs from other sections in that it is not a part of the IOCS generated by the DIOCS macro-instruction. If Get/Put is specified by the user, it is incorporated into his object program at assembly time.

Housekeeping (CSHSK)

This section of IOCS handles all phases of input/output initialization required by the object program. It also initializes all component sections of IOCS.

729 IOCS, 7080 IOCS, AND THE 7080 PROCESSOR

The 729 IOCS is one of five control systems for input/output devices that may be attached to a 7080. The

others are for the following IBM devices: 1301 Disk Storage, 1414 Model 6 Input/Output Synchronizer, 7340 Hypertape Drives, and 7750 Programmed Transmission Control. Together these systems form the 7080 Input/Output Control System. The routines of each IOCS are provided in macro-instruction form and constitute a portion of the library material for the 7080 Processor. The Processor generates the IOCS from the DIOCS macro-instructions which the programmer codes. The Get/Put routines are not generated from DIOCS, but from the IOFTB macro-instruction. Any of the systems or any combination of them may be assembled together, either with a program that will use them or independently of any program. The assembled control system may be used by any program assembled by the 7080 Processor.

Since the routines of each control system in 7080 IOCS are provided as macro-instructions, the macro-generation facility of the Processor enables the generation of a 7080 IOCS tailored to the requirements of the program or programs using it. These requirements are defined by the DIOCS macro-instruction. For example, a 7080 IOCS consisting of the 729 and 1301 IOCSs may be assembled for use by two programs, of which one requires only the 729 IOCS, and the other both of the IOCSs. Furthermore, programs previously assembled for use with 729 IOCS only need not be reassembled in order to use a 7080 IOCS containing other IOCSs in addition to the 729 IOCS. However, the 729 IOCS assembled in combination with the other IOCSs must be positioned to start at the same location at which the original 729 IOCS was assembled.

Although any one control system in 7080 IOCS or any combination of them can be assembled with a program, it is anticipated that the normal usage will be to assemble the IOCS independently of any program. Thus, the programmer will be coding programs for use with a preassembled IOCS; i.e., one which has been previously assembled and for which certain characteristics are available. The only coding required to assemble the IOCS independently is the appropriate DIOCS macro-instructions.

The hierarchy of generation of 7080 IOCS; i.e., the order in which the IOCSs are generated when two or more are assembed together is as follows: 729, 1301, 7340, 1414-6 and 7750.* The hierarchy of generation is significant in that all 7080 IOCSs generated together are able to share certain routines, such as the routines that provide messages and check for redundant characters, thus avoiding the presence of multiple routines with duplicate functions. A generalized routine is provided in such cases and is placed in the first IOCS generated. Therefore, all shared routines are placed in 729 IOCS whenever it is assembled in combination with any of the other IOCSs. Similarly, certain linkage points that are common to all IOCSs, such as IORETURNTO and IORETURNNO, are also included in the first IOCS generated.

All 7080 IOCSs that will occupy memory at the same time must be assembled together; i.e., in one run. However, it is not necessary to assemble them at consecutive storage locations. The requirement results from such considerations as the fact that certain routines and the common linkage points to them are shared by all 7080 IOCSs. If several IOCSs were to be assembled separately for placement in memory at the same time, the combination would result in duplicate linkage points and routines.

VERSIONS OF 729 IOCS

This manual describes all the functions performed by the complete versions of the 729 IOCS. Smaller versions are available and can be obtained by specifying MINIMAL as the third operand of the DIOCS macro-instruction. A description of the minimal versions and the requirements that must be met when using them appears in Appendix 2 at the end of this manual. It is important to note that some IOCS macro-instructions may not be used with a minimal IOCS; the permissible macro-instructions are listed in Appendix 2 as well as designated in the individual descriptions of the macro-instructions.

Since this manual describes the complete 729 IOCS, the reader should remember that many references to certain options and features of IOCS, as well as descriptions of functions performed by IOCS, may not necessarily apply to a minimal IOCS.

POSITIONING 729 IOCS IN MEMORY

The IOCS may be assembled for any storage location desired. Throughout this manual, actual locations have been designated where pertinent; these locations are based on the assumption that the nonerasable portion of IOCS begins at location 500; i.e., that the fifth operand of the DIOCS macro-instruction is either omitted or is @500. If the nonerasable portion is assembled at a different location, the reader should remember that such addresses will be adjusted accordingly.

729 IOCS AND THE OBJECT PROGRAM

Since IOCS is an established group of routines, some sort of communication must be established between it

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* Prior to the release of the Hypertape (7340) IOCS, erasable housekeeping for 729 IOCS will be generated immediately after the nonerasable IOCS. After the release of the 7340 IOCS, erasable housekeeping for any tape IOCS (729 and/or 7340) will be generated after all other IOCSs.

and the source program if the programmer wishes to use IOCS. This communication is provided mainly in four ways by the user in his source program:

1. Tape
2. File Tables
3. Functional Linkage
4. Specialized Routines

Tape Table

The Tape Table describes the use of each tape drive which can be attached to the 7080 channels, and is assembled with the source program.

File Tables

File tables contain all information required by IOCS for each file used by the source program, and are assembled with the source program.

Functional Linkage

Functional linkage is provided by means of special macro-instructions. The coding of these macro-instructions at logical points in the source program will result in the generation of appropriate linkages into IOCS during object program time for all input/output or other tape movement requests.

Specialized Routines

At various stages of a program run, IOCS exists to these routines, which are coded by the user as part of his object program. They will contain specific operations the user wishes to perform at certain points in a program, such as beginning or end of file, beginning or end of reel, or error correction, etc.

EFFICIENT USE OF THE INTERRUPT FEATURE

When IOCS is used in conjunction with an object program, full use is made of the automatic interrupt feature of the 7080.

Most IOCS processing occurs with the 7080 in interrupt program status. When an input/output (read or write) request is made, main program processing will not be held up waiting for the I/O operation to be completed.

In most cases, the I/O operation will be started, and main program processing resumed while the I/O operation is being executed. When an input/output operation is completed, an automatic interrupt will occur, generally resulting in the next scheduled I/O operation being started.

In other words, IOCS will see to it that maximum use is made of all tape drives in the program, and that as much overlapping of I/O time and processing time as possible is effected.

A BASIC USE OF 729 IOCS

The following description of a typical program using the IOCS at object program time is provided to give the reader a broad picture of the relation between the object program and IOCS. To make the description as simple and brief as possible, a number of assumptions are made. For example, it is assumed that standard labels and the Get/Put mode of data movement are used by the object program, and that priming of input areas has been specified. In such a case, the program would proceed as follows (see Figure 1):

The object program first links to CSHSK through the macro-instruction IOLNK to CSHSK. (The execution of IOCS housekeeping is required prior to any functional linkage to IOCS.) CSHSK checks and makes various modifications to the tape table, file tables, and IOCS itself.

On each input tape, the header label is checked to make certain that this is the required input file. The first "N" records are then read into the input areas. (N is the number of input areas specified in the file table.)

On each output tape, the old header label is checked to make certain that this tape can be used for current output. A new header is then created.

On conclusion of the housekeeping functions, control is returned to the object program, just beyond the linkage into CSHSK.

Since input areas have been primed, the object programmer now need only move a record from the input area to the work area to begin processing. This may be done by means of the special macro-instruction IOGET. In addition to moving a record from the input area into the work area, the IOGET macro will also issue read requests to IOCS when required. In the case of unblocked records, this will occur each time the IOGET macro is executed. In the case of blocked records, this will occur when the final record in the block is moved from the input area to the work area.

After the record is moved to the work area, control is returned to the object program, and processing begins. Upon completion of processing by the object program, the record may be moved from the work area to an output area by means of the IOPUT macro-instruction. This macro functions in the same manner as the IOGET macro, keeping track of blocked records, and issuing write requests when required. (In the case of unblocked records, write requests are issued each time the macro is executed; in the case of blocked records, a write
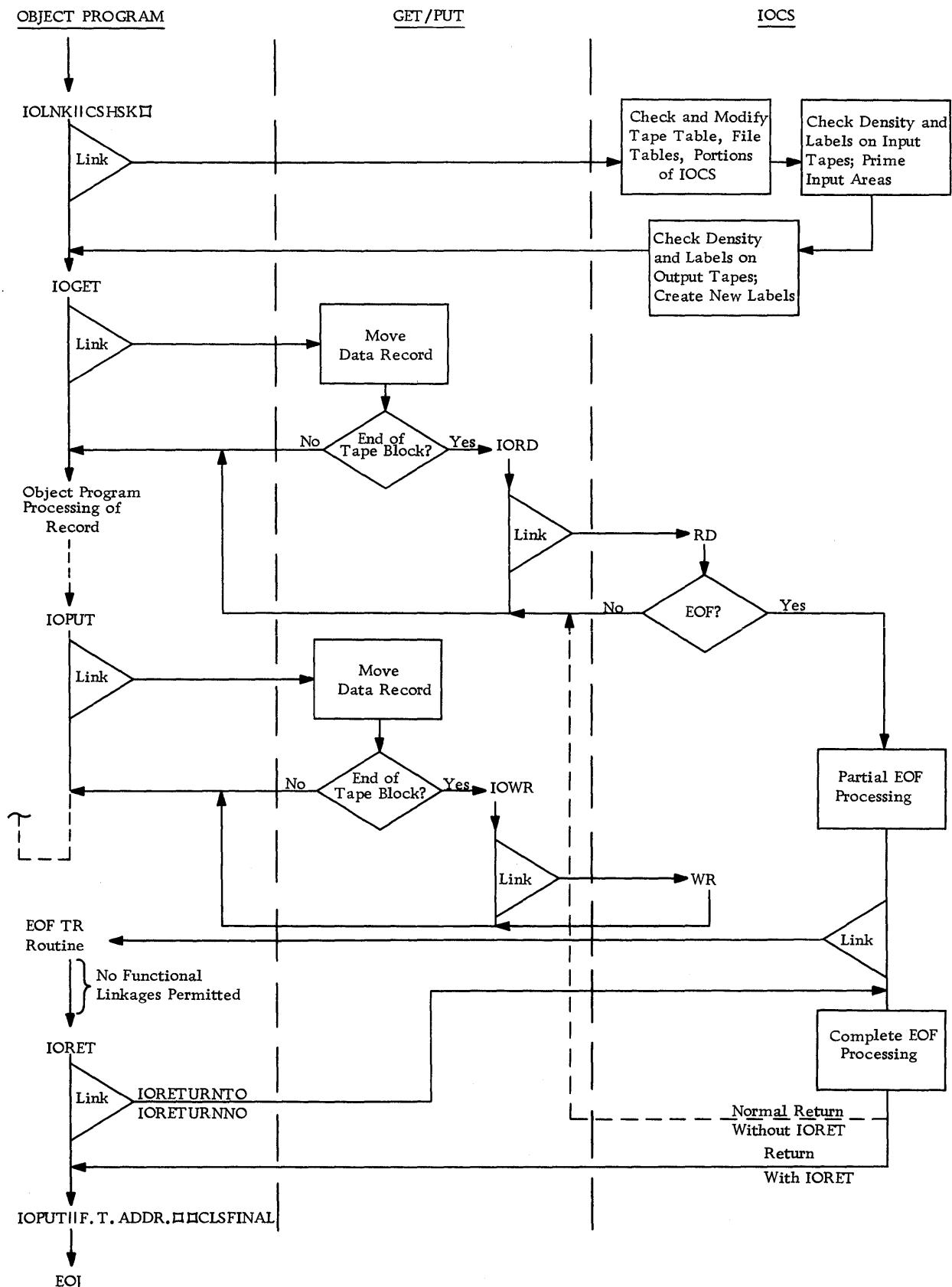
This flow chart illustrates a typical program using the IOCS, and indicates the relationship between the object program, the Get/Put System, and the end-of-file routines. Certain routines are omitted, and the routines shown are not all in the exact sequence.

Figure 1

request is issued only when the movement of a record from the work area causes the output area to be filled.)

When the processed record has been moved out of the work area, control is returned to the object program, which may then request a new data record (IOGET).

The flow of data and processing may continue in this fashion (IOGET, process, IOPUT) until an end of file is reached. (Tape records are read and written automatically by the Get/Put System.)

When an end-of-file condition is reached, IOCS will transfer to the End-of-File Transfer Address specified in the associated file table. The object program routine which starts at the EOF Transfer Address must be terminated by a return to IOCS at entry points tagged IORETURNTO or IORETURNNO, and must not include any functional linkage to IOCS.

The subsequent return to the object program from IOCS is normally just beyond the linkage to IOCS which caused the end of file (IOGET).

Should the object programmer wish a return from IOCS at some other point, he will find the IORET macro-instruction useful. IORET is coded at the end of the object program routine which starts at the EOF Transfer Address, and takes care of the necessary return to IOCS at IORETURNTO or IORETURNNO. In addition, however, it will modify IOCS so that the subsequent return to the object program from IOCS will be just beyond the IORET macro rather than just beyond the IOGET which caused the end of file.

Functional linkages to IOCS may be made beyond the IORET macro. When end of file constitutes end of job, the object program may close the output files through the macro-instruction IOPUT with a third operand of CLSFINAL.

If the object program requirements of data movement fit into the pattern described above, the object programmer need know little more about IOCS than has been mentioned. Some additional knowledge will be required in the handling of labels, particularly if nonstandard labels are used.

In the approach presented, IOCS will fully utilize the buffering capabilities of the 7080. If the Get/Put System of data movement is not used, a more complete knowledge of IOCS will be required.

A CHECKLIST FOR THE USE OF 729 IOCS

There are a number of basic requirements which the programmer must meet before he is able to make use of the IOCS. Consideration must be given to these requirements at three points:
1. At coding time
2. At assembly time
3. At object time

This portion of the manual is concerned primarily with providing the programmer with a convenient checklist to which he may refer at these various points. The specific requirements are merely referenced, and no details are provided here as to how to fulfill these requirements. Details are provided elsewhere in this manual.

At Coding Time

To code an IOCS for independent assembly, only item 1 below is required. To code a program, whether it will use a preassembled IOCS or will be assembled with the IOCS, all items apply.

1. Specify 7080 IOCS: The first IOCS macro-instruction used in the source program must be DIOCS, whether the source program is the IOCS alone, is the user's program alone, or is a combination of the two.

2. Setup Tape Table: This table may be set up by means of the IOTA and IOTS macro-instructions at any point in the object program following the DIOCS macro-instruction. It must begin at location CSB3001 (@500).

3. Setup File Tables: These tables may be set up by means of the IOFTA, IOFTB and IOFTC macro-instructions at any point in the object program following the DIOCS macro-instruction. They may be located anywhere in memory above the Tape Table, except in IOCS (000500-025000) and the last 2,000 positions of memory.

4. Enter Eighty and Interrupt Mode: No functional linkage to IOCS should be made unless the 7080 is in 7080 and interrupt mode. The object program must not leave interrupt mode.

5. Execute Housekeeping: IOCS housekeeping must be executed before any functional linkage is made to IOCS except IOTYP or IODEC. That is, IOLNK to CSHSK (or CSPHASEHSK) must be the first functional linkage to 729 IOCS other than the IOTYP or IODEC macro-instructions.

6. Check Record Format: If Get/Put or Record Length Checking is used by the object program, records must be defined in accordance with tape format specifications. Maximum tape record size is 9995.

7. Code Specialized Routines: Any special operations the user wishes to perform at beginning or end of reel, beginning or end of file, etc., must be coded at the appropriate IOCS transfer address or exit point. These routines must terminate with a return to IOCS at IORETURNTO or IORETURNNO (or, in certain cases, IOTRSEXIT).

8. Code IOCS Macro-Instructions: Any channel tape operations must be accomplished when required by the object programmer through IOCS macro-instructions which generate the necessary functional

linkages to IOCS. These macro-instructions must not be coded within specialized routines.

9. Programming Considerations: Check the list of Important Programming Considerations in the following section.

At Assembly Time

1. Create System Tape: A librarian run on the 7080 Processor must be performed with the 729 IOCS library material as input.

2. Assemble the IOCS: The system tape (as created above) must be used to assemble the 7080 IOCS. No advantage is obtained by specifying a machine size of 80K in the 7080 Processor MODEL control card used with the assembly of an IOCS. If a 160K machine is specified, the object program using the IOCS will run equally well on an 80K or 160K machine. If an 80K machine is specified, the program will run properly on an 80K machine; it may or may not run properly on a 160K machine. Furthermore, during the assembly the 7080 Processor will produce certain diagnostic messages to indicate such information as addresses over 80K. These messages can be ignored if the program is to operate on an 80K machine.

3. Assemble the Object Program: The system tape must be used to assemble the object program.

Note: The object program and the IOCS may be assembled separately or together, as previously explained. It is anticipated that in most instances they will be assembled separately and that one IOCS will be assembled for use with many object programs.

At Object Time

1. Loading Sequence: If the IOCS and object program have been assembled separately, they may be combined and readied for loading as follows:
   a. The loading program
   b. Preassembled IOCS
   c. Object program
   d. "00" card

Should the user wish to load IOCS and the object program separately, he may do so by placing a "00" card after IOCS in addition to the "00" card following the object program. However, IOCS must still be loaded prior to the object program. If desired, IOCS may be left in memory from one program to the next.

2. Prepare Control Cards: If any tapes contain standard headers, control cards must be prepared by the user and loaded in the card reader or on the tape specified by an IOTS macro-instruction.

IMPORTANT PROGRAMMING CONSIDERATIONS

1. When using IOCS, the 7080 must be in the 7080 and interrupt modes. The object program must not leave the interrupt mode (LIM).

2. All channel tape operations must be accomplished through IOCS.

3. IOCS uses tags which begin with the letters IO or CS. Object programmers should therefore avoid the use of such tags to prevent duplication.

4. The macro-instruction DIOCS must precede any other IOCS macro-instructions in each assembly.

5. The IOCS may be assembled by itself (preassembled) or together with the source program. If a preassembled IOCS is used, the object program must be assembled separately. After assembly, the two decks are either combined and loaded (729 IOCS first), or the object program is loaded after IOCS is in memory. Since there will be operands in the object program which refer to IOCS tags, a table of associated tags will be included in the assembly of the object program through the generation of the DIOCS macro-instruction.

6. Any programmer using the IOCS who wishes to use Interrupt Keys 252 and 253 to permit operator decisions, should use the IODEC macro-instruction for this purpose rather than an object program routine.

7. The Leave Eighty Mode instruction (LEM) should be used only with great caution. If the object programmer must Leave Eighty Mode, he must Enter Eighty Mode (EEM) again prior to any functional linkage to IOCS.

8. Unlike IOCS (entry and exit via TIP and LIP), the Get/Put system does not preserve the setting of the starting point counter. The functions of Get and Put are accomplished outside of interrupt program. If the Get/Put system is used and the starting point counter must be preserved for the object program, the programmer must use the SAVE operand in the IOGET, IOPUT and IOBSD macro-instructions. In this case, the macro-generator will include the coding necessary to save and restore the starting point counter. All indicators except MAC II will be restored on all functional linkages other than IOGET, IOPUT, and IOBSD.

9. The object programmer should avoid the use of Storage Banks 2 (the Channel Word Set) and 3 (the Channel Auxiliary Storage Units--CASUs), except as noted below, since IOCS will make extensive use of these storage banks.

10. The object program must not leave interrupt program (LIP) nor issue a functional linkage to IOCS when it (the object program) receives control from IOCS to execute a specialized routine (header transfer address, end-of-reel and end-of-file transfer address, IOTRSOPLBL, IOREDUNCHK). Since the 7080 is in interrupt program at this point, the starting point counter is set above 2,000. In these cases, the object programmer should use CASUs 9, 13 and 14 for any storage requirements he may have during the execution of these routines. These CASUs may be used in any way the programmer desires, provided they are not set to lengths which would destroy other CASUs. If more storage is required, CASUs 1-6 may be used, provided their settings are restored to 1-6 respectively.

To satisfy any additional storage needs, the object programmer must save and restore Storage Banks 0, 1 or 3. Banks 2 and 4 may not be used under any circumstances; if an IODEC or IOTYP linkage is made during a routine and Bank 3 has been saved, it must be restored prior to the linkage.

The Tape Table defines the function of every tape unit attached to each channel used by the object program. The table consists of two sections.

The first section is the main section, and is 200 positions in length, providing for forty 5-character entries. Each entry refers to a specific tape unit, and specifies whether the unit contains a base tape, an alternate tape, or an unassigned tape. The base tape entry, in addition, specifies the memory address of a file table. (The file table contains all necessary information about the associated file, and is described in detail in another section of this manual, "729 IOCS File Tables.")

The second section of the Tape Table is the special tape section. This section is 25 positions in length, and provides for five 5-character entries. Each entry refers to a special function which may or may not be required by the object program. The entry specifies whether or not a tape has been assigned to perform the special function.

The Tape Table may be set up by means of the macro-instructions IOTA and IOTS, described elsewhere in this manual.

The Tape Table makes it possible to change (include, exclude or modify) the use of a tape unit completely without modifying a single instruction in the object program. The Tape Table also makes it easy to decrease the number of channels used by a program.

TAPE TABLE DETAILS

Location and Length

The main section of the Tape Table is located in memory positions 000500-000699. A 5-character terminating field is defined by IOCS in memory positions 000700-000704. When less than 40 tapes are used, a terminating field must also follow the last significant tape entry. The tape entries for a file are arranged with the base tape entry first, followed immediately by all associated alternate tape entries, placed in the sequence in which they are to be used.

The special tape section of the Tape Table is located in memory positions 000705-000729, and is followed by a 5-character terminating field. Five entries must be defined with either a base tape entry or an unassigned entry. A base tape entry is specified when a tape has been assigned for a special function; an unassigned entry is specified when no tape has been assigned for a special function. The special functions and the memory location of their associated tape entries are shown in Figure 2. Detailed information on the various functions (checkpoint, dumping, control cards) may be found elsewhere in this manual.

	Special Function Tape	Memory Location for Tape Entry
(1)	Checkpoint Output Tape	000705-000709
(2)	Checkpoint Work Tape	000710-000714
(3)	Dump Tape (for recording error records)	000715-000719
(4)	Message Output Tape	000720-000724
(5)	Control Card Tape (for reading Standard Header control cards)	000725-000729

Figure 2. Special Functions Defined in Special Tape Section

If no tapes are to be used for any of the functions specified in Figure 2, no entries need be prepared for this section. IOCS will then define all entries in this section as unassigned.

In addition, one base tape entry may be specified for several functions. For example, referring to Figure 2, the same entry may be specified for (2), (3), (4), and (5). A base tape entry in the main section of the Tape Table can also be specified in the special tape section, such as when checkpoint records are to be written at the beginning of each reel of an output file. However, when more than one entry specifies the same file table, the associated select address for each entry must also be the same.

Figure 3 shows the Tape Table as defined in memory by 729 IOCS.
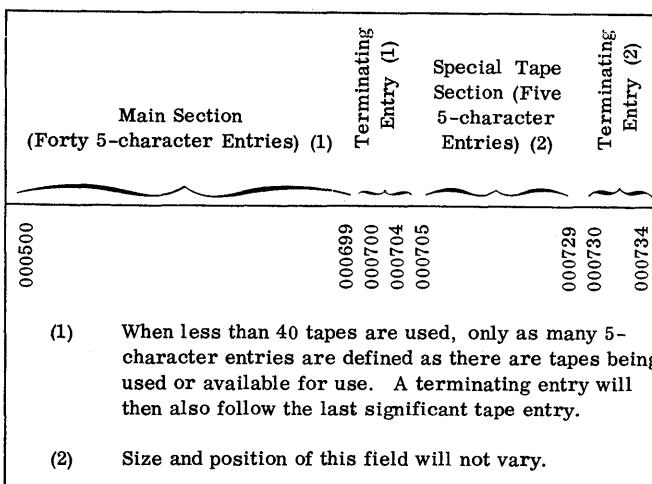
Figure 3. Structure of 729 IOCS Tape Table

Tape Table Entries

Base Tape Entry

A base tape entry is placed in the main section of the Tape Table for each tape unit on which the first reel of a file is mounted, and in the special tape section if tapes on the file have been assigned a special function. Each base tape entry must refer to a file table containing the information to be used by the base tape unit and any associated alternate tape units. The base tape entry generated is composed as follows (see macro-instructions IOTA, IOTS):

Position 1: The tape number (0-9; never zoned)

Positions 2-5: The four-character high-speed transmit address of the file table + 100. In addition, position 4 will include the following zoning to designate the channel number:

00	Channel 0
01	Channel 1
10 (-)	Channel 2
11 (+)	Channel 3

Example: If the high-speed transmit address of the file table for base tape 2209 is 029904, the following entry will be generated:

$$9\overset{+}{0}0\overset{-}{0}4$$

Alternate Tape Entry

If a file consists of several reels of tape, some of which are to be mounted on tape units other than the base tape unit, the additional units are known as alternates. Up to four alternates may be associated with a base tape. The alternate tape entries must immediately follow the base tape entry in the main section of the Tape Table, and must be placed in the order of their use. (An alternate entry is never valid in the special tape section of the Tape Table.) Each alternate entry specifies the tape select address, and may be assigned on any channel. However, alternates should be assigned on the same channel wherever possible.

The alternate tape entry generated is composed as follows (see macro-instruction IOTA):

Position 1: A blank (b) to indicate alternate entry

Positions 2-5: The tape select address

Example: The following entry will be generated for alternate tape 2106:

b2106

Unassigned Tape Entry

There are two types of unassigned tape entries. One type is specified in the main section of the Tape Table, and indicates a particular tape unit is not used by the object program, but is available for use (free tape). The second type is specified in the special tape section of the Tape Table, and indicates that no tape has been assigned to perform a specific function in the object program.

The first position of an unassigned tape entry is a minus (-) sign. To designate a free tape in the main section of the Tape Table, IOCS will generate the tape select address in positions 2-5. To designate no tape assigned to a special function in the special tape section, IOCS will generate four blanks (bbbb) in positions 2-5. * (See macro-instructions IOTA, IOTS.)

Examples: To designate tape 2104 as a free tape, the following entry will be generated in the main section of the Tape Table:

-2104

To designate no tape assigned for the message output function, the following entry will be generated in the special tape section (memory positions 000720-000724):

-bbbb

Terminating Entry

Terminating entries must always appear in memory positions 000700-000704, and 000730-000734, following the main section and special tape section, respectively, of the Tape Table. If less than 40 tapes are used, a terminating entry must also follow the last significant tape entry in the main section.

Terminating entries are defined by IOCS as follows:

Memory Positions	000700-000704:	Abbb‡
Memory Positions	000730-000734:	Abbb⧺
After Last Significant Tape Entry in Main Section (Less than 40 Tapes used):		$\overset{+}{0}$bbb ‡

Figure 4a shows a sample tape configuration; Figure 4b shows the Tape Table for it as defined by 729 IOCS.

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* An exception occurs in the case of no tape assigned to the error dump function (positions 000715-000719), in which case -000$\overset{+}{0}$ will be generated as a counter for the number of records dumped on the typewriter. In case no tape is assigned as the checkpoint work tape, the number of the octant to be used will be generated in position 000714.

| File	Tapes	File Table Address*
Master Input	2104-2106	25004
Transaction Input	2000-2001	25204
Reference Tables (Input)	2100	25404
Master Output	2101-2103	25604
Transaction Listing (Output)	2004	25804
Error Dump & Checkpoint Work	2005	26004
Checkpoint Records	2101-2103	25604
Free Tapes	2002, 2006-2008	

*High-speed address +100.

Figure 4a. Sample Tape Configuration

Assembling the Tape Table

The Tape Table for the IOCS is assembled with the object program. The table must start at the same memory location as specified in X5 of the DIOCS macro-instruction used to assemble the IOCS. If X5 was omitted, the Tape Table must start at location 500. The initial location for the Tape Table is, in any event, tagged CSB3001.

The following entries will establish the required Tape Table·

```
LASN  |  | CSB3001
IOTA  |  |        ┐
  .   |  |        │ as many as
  :   |  |        │ required
IOTA  |  | END  ──┘
IOTS  |  |
```
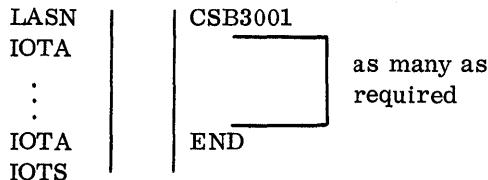
The Main section of the Tape Table must be 200 characters or less in length (the total length is variable).

Modifying or Patching the Tape Table

The IOCS has been designed to facilitate reassignment of physical tape units or deletion of special tape functions by means of simple changes to the Tape Table. For example, placing a minus sign (-) in the high order position of any Tape Table entry effectively deletes it from the table. (The IOCS makes no reference to tapes designated as free.) Deleting an entry from the special section of the Tape Table completely deletes that function from the IOCS. Thus, if a minus sign is present at L, CSW18 (@ 705) at the time housekeeping is executed, the IOCS is modified so that no checkpoints are taken. Any requests for checkpoints at EOR or EOF or any IOLNK to CSMRD macro-instructions in the user's program are ignored. Moreover, any operator options for restart at a permanent error message

Position	Entry	Type of Entry
500-504	- 01 45004	Base
505-509	b2105	Alternate
510-514	b2106	Alternate
515-519	- 00 05204	Base
520-524	b2001	Alternate
525-529	- 01 05404	Base
530-534	- 01 15604	Base
535-539	b2102	Alternate
540-544	b2103	Alternate
545-549	- 00 45804	Base
550-554	- 00 56004	Base
555-559	-2002	Free
560-564	-2006	Free
565-569	-2007	Free
570-574	-2008	Free
575-579	+ 0bbb‡	Terminating
.		
.		
.		
.		
700-704	Abbb‡	Terminating
705-709	- 01 15604	Base
710-714	- 00 56004	Base
715-719	- 00 56004	Base
720-724	-bbbb	Unassigned
725-729	-bbbb	Unassigned
730-734	Abbb‡	Terminating

Figure 4b. Sample 729 IOCS Tape Table Entries

(30219, 30220, 30222) will result in the operation in error being retried.

Deleting the message tape entry will cause any message that would have been written on tape to be written on the typewriter instead; similarly deleting dump tape entries will cause any erroneous record to be written on the typewriter.

Referring to the example in Figures 4a and 4b suppose that, on a given day, only six tapes are available on channel 21 and it is desired to run with only one alternate tape for the master input file. In this case, if location 510 is patched with a minus sign, the entry for tape 2106 will be effectively deleted from the Tape Table and will not be used by the program. If the change were to be made permanent, it would also be desirable to patch the number of alternate tapes specified in the file table (see FT-1024 in the section, "729 IOCS File Tables") or to avoid typing message 10284 by changing its Message Class Code.

Again referring to Figures 4a and 4b, if it is desired to experiment to determine whether the program might run more efficiently with the master output file on channel 20 and the transaction output file on 21, thus putting the master input and output files on different channels, the Tape Table might be altered as follows:

Location	Contents
530-534	6N604
535-539	b2007
540-544	b2008
545-549	1N8‡4
705-709	6N604

Note that since the master output file is also being used as the checkpoint output tape, the checkpoint entry must also be changed.

File tables contain descriptions of specific tape files to be handled by IOCS. When using single-reel files and multireel files, one file table is required for each file. When using a multifile reel, all files on the reel should be described by one file table. However, the user must provide any necessary or desired programming to alter the file table information from file to file.

A file is related to a physical tape unit (or units) by placing the address of its file table in a Tape Table base tape entry. The base tape entry also specifies the tape select address.

The file tables may be defined through the macro-instructions IOFTA, IOFTB and IOFTC, described elsewhere in this manual. These macro-instructions must always follow one another consecutively.

The following features of the file tables help make 729 IOCS a fast, flexible system:

1. Tables are moved to a work area to avoid time-consuming modification of IOCS instructions.
2. Information in the file tables is divided into two types:
   a. That which is required only at beginning and end of reel and beginning and end of file.
   b. That which is required each time an input/output operation is executed.

One file table must be assembled with the object program for each tape file to be used by that program. The file tables may be located anywhere in memory above the Tape Table, except in IOCS (i. e., from 000500 to 025000) and in the last 2,000 positions of memory. If a preassembled IOCS is used, the file tables are generated during the assembly of the object program from the IOFTA, IOFTB, and IOFTC macro-instructions. The preparation of these macro-instruction headers may be accomplished simply by using Form X22-6913-1, which was prepared for this purpose.

COMPOSITION OF THE FILE TABLES

A file table consists of two sections. Section I is unconditionally 95 characters in length, and contains information for use at beginning and end of reel and beginning and end of file. Section II is variable in length (minimum, 35 characters) and contains information required each time an input/output operation is executed. The high-speed transmit address of Section II + 5 is the file table address, and is specified as the base tape entry.

The file tables may be located anywhere in memory above the Tape Table (except in IOCS and the last 2,000 positions of memory), and need not be grouped together.

In the following description of file table fields, the memory positions each field is to occupy in the file table work area (000800-000919) follows the field designation (FT number) and name. The associated tag (if reference is provided in the 729 IOCS Linkage Points and Work Areas) will be specified following the memory positions. The file table work area is tagged CSF0000.

FILE TABLE FIELDS--SECTION I

FT-101: CSDTS Address for Read/Write Routine (000800-000804)

IOFTA unconditionally generates 10000 for this field.

CSHSK initializes the address portion of this field with the appropriate CSDTS address based on the channel on which the file is contained and type of open operation specified by the file table (FT-3013). It is also altered when the file is closed, so that a subsequent reopen may be successfully performed.

FT-1024: Total Number of Alternate Tape Units (000805)

See IOFTA operand X7.

This field is an unsigned number ranging from 0 to 4. It specifies the total number of alternate tapes used by the file (i. e., those tapes used in addition to the base tape).

The number may be altered by CSHSK to specify the actual number of alternate tape entries which follow the associated base tape entry in the Tape Table (the number will never be greater than 4).

FT-1022: Current Select Address (000806-000807)

IOFTA unconditionally generates bb for this field.

CSHSK initializes this field to specify the hundreds and units position of the select address for the base tape specified in the Tape Table. When an end-of-reel condition occurs and alternate tapes are specified, the address of the next tape to be used (FT-102) is placed in this field.

FT-102: First Alternate Select Address (000808-000809)

IOFTA unconditionally generates bb for this field.

If one or more alternate tapes are specified in the Tape Table, CSHSK initializes this field to specify the hundreds and units position of the select address for the first alternate tape. When an end-of-reel condition occurs, FT-1022 (if one alternate is specified) or FT-1033 (if more than one alternate is specified) is placed in this field.

FT-1033: Second Alternate Select Address (000810-000811)

IOFTA unconditionally generates bb for this field.

If two or more alternates are specified in the Tape Table, CSHSK initializes this field to specify the hundreds and units position of the select address for the second alternate tape. When an end-of-reel condition occurs, FT-1022 (if two alternates are specified) or FT-1031 (if more than two alternates are specified) is placed in this field.

FT-1031: Third Alternate Select Address (000812-000813)

IOFTA unconditionally generates bb for this field.

If three or more alternates are specified in the Tape Table, CSHSK initializes this field to specify the hundreds and units position of the select address for the third alternate tape. When an end-of-reel condition occurs, FT-1022 (if three alternates are specified) or FT-3014 (if four alternates are specified) is placed in this field.

FT-3014: Fourth Alternate Select Address (000814-000815)

IOFTA unconditionally generates bb for this field.

If four alternates are specified in the Tape Table, CSHSK initializes this field to specify the hundreds and units position of the select address for the fourth alternate tape. When an end-of-reel condition occurs, FT-1022 is placed in this field.

FT-3013: Open Type Indicator (000816)

See IOFTA operand X19.

This field specifies whether or not the base tape of the file is to be opened immediately in CSHSK. If the open operation is to be delayed until the object program first links to IOCS for an input/output operation on this file, the base tape need not be in Ready status in CSHSK. One of the following codes is generated by IOFTA:

    b   Immediate Open
    S   Delay Open

The bit structure of the Open Type Indicator is as follows:

    2 bit ON   Immediate Open
          OFF   Delay Open

The remaining bits of this character are used by CSHSK.

FT-3022: Data Tape Record Counter (000817-000822), CSF0003022

IOFTA unconditionally generates $00000\overset{+}{0}$ for this field.

CSHSK initializes this field at $00000\overset{+}{0}$ unless FT-5064 specifies the base tape is not to be rewound.

This counter is increased by one each time a data tape record is read, forward spaced, or written. The counter is decreased by one each time a data tape record is backspaced.

The counter is reset to $00000\overset{+}{0}$ when an end-of reel or intermediate or final end-of-file condition is encountered, or when a delay open or reopen operation is performed.

FT-302: Noise/Skip Counter (000823-000824), CSF000302

IOFTA unconditionally generates $0\overset{+}{0}$ for this field.

CSHSK initializes this field at $0\overset{+}{0}$ unless FT-5064 specifies the base tape is not to be rewound.

For input files, this counter is increased by one each time a noise record is encountered in attempting to read a data tape record. For output files, this counter is increased by one each time a Skip operation is executed in attempting to write a data tape record.

The counter is reset to $0\overset{+}{0}$ at each end-of-reel and final end-of-file condition.

FT-3032: File Count per Reel (000825-000827), CSF0003032

IOFTA unconditionally generates $00\overset{+}{0}$ for this field.

CSHSK initializes this field at $00\overset{+}{0}$ unless FT-5064 specifies the base tap is not to be rewound.

The counter is increased by one each time a file on the tape is opened.

The counter is reset to $00\overset{+}{0}$ at each end-of-reel or final end-of-file condition.

FT-303: Error Correction Entry Counter (000828-000829), CSF000303

IOFTA unconditionally generates $0\overset{+}{0}$ for this field.

CSHSK initializes this field at $0\overset{+}{0}$ unless FT-5064 specifies the base tape is not to be rewound.

The counter is increased by one each time an entry is made to the error correction routine.

The counter is reset to $0\overset{+}{0}$ at each end-of-reel or final end-of-file condition.

FT-3043: Permanent Error Counter (000830-000831), CSF0003043

IOFTA unconditionally generates $0\overset{+}{0}$ for this field.

CSHSK initializes this field at $0\overset{+}{0}$ unless FT-5064 specifies the base tape is not to be rewound.

For input files, this counter is increased by one each time a record is accepted with redundancies replaced by IOCS or the console operator, and processing is continued; or when the dump record option is selected. For output files, the counter is increased by one each time a record is accepted when a PCT persists (no redundancies are present in memory), and processing is continued.

The counter is reset to $0\overset{+}{0}$ at each end-of-reel or final end-of-file condition.

FT-304: Last Noise Record Counter (000832-000834), CSF000304

IOFTA unconditionally generates $00\overset{+}{0}$ for this field.

CSHSK initializes this field at $00\overset{+}{0}$ unless FT-5064 specifies the base tape is not to be rewound.

Each time a noise record is encountered, this field is altered to specify the three low-order positions of the record counter for the file.

The counter is reset to $00\overset{+}{0}$ when an end-of-reel or intermediate or final end-of-file condition is encountered, or when a delay open or reopen operation is performed.

FT4014: Label Indicator (000835), CSF0004014

See IOFTA operands X10, X11, and X12.

This field specifies the type of labels used for the file. Codes are generated by IOFTA as shown in Figure 5.

The bit structure* of the Label Indicator is as follows:

1 bit ON	A tape mark does not follow a header.
OFF	A tape mark follows a header.
2 bit ON	A standard trailer is not used.
OFF	A standard trailer is used.
4 bit ON	No trailer is used.
OFF	A trailer is used.
A bit ON	No header is used.
OFF	A header is used.

---

* 4 bit ON and 2 bit OFF indicate Special Standard Trailer.

B bit ON	A standard header is used.
OFF	A standard header is not used.

FT-401: Header Transfer Address (000836-000839), CSF000401

See IOFTA operand X3.

This field contains the address of the first instruction of the user's specialized beginning-of-reel and beginning-of-intermediate-file routine. If there is no routine specified, IOFTA will generate the address IORETURNTO. A transfer will be made to this address in any of the following cases:

1. During execution of CSHSK for the first reel of the file, or during execution of a delay open operation.
2. At the beginning of each alternate reel of the file.
3. During execution of an IOMFO (Multifile Open) operation.
4. On a multifile input tape, when either
   a. an intermediate standard header has been encountered following a tape mark, or
   b. a tape mark has been encountered and standard headers are not used, and the specialized end-of-reel routine has determined that the condition existing is not end of reel.

Label Type	Code
Standard Header and Standard Trailer	X
Standard Header and Special Standard Trailer	T
Standard Header and Nonstandard Trailer	V
Standard Header and No Trailer	/
Nonstandard Header followed by Tape Mark and Standard Trailer	G
Nonstandard Header followed by Tape Mark and Special Standard Trailer	C
Nonstandard Header followed by Tape Mark and Nonstandard Trailer	E
Nonstandard Header followed by Tape Mark and No Trailer	A
Nonstandard Header not followed by Tape Mark and Standard Trailer	F
Nonstandard Header not followed by Tape Mark and Special Standard Trailer	B
Nonstandard Header not followed by Tape Mark and Nonstandard Trailer	D
Nonstandard Header not followed by Tape Mark and No Trailer	+
No Header and Standard Trailer	O
No Header and Special Standard Trailer	K
No Header and Nonstandard Trailer	M
No Header and No Trailer	—

Figure 5

FT-4024: Checkpoint Indicator (000840),
CSF0004024

See IOFTA operands X9 and X17.

This field specifies whether or not the file is connected in any way with checkpoint. A minus (-) in this field indicates this file has no connection with checkpoint. If the file is connected in any way with checkpoint, this field also specifies one or more of the following:

1. Tapes of an input file contain checkpoint records.
2. If a checkpoint should be taken when an end-of-reel condition occurs for the file.
3. If a checkpoint should be taken when an intermediate or final end-of-file condition occurs for this file.

Codes generated by IOFTA are shown in Figure 6.

If this file table has been specified by the checkpoint output tape entry in the special tape section of the Tape Table, CSHSK will alter the code to one of the following:

Separate Checkpoint Output Tape	A
Checkpoint Output at Beginning of Each Reel	C

Input Files	Code	Valid, Separate Ckpt. O/P	Valid, Ckpt. Each O/P Reel
(1) Contains checkpoint records at beginning of each reel	A	X	X
(2) Take a checkpoint at end of reel	B	X	
(3) Take a checkpoint at intermediate or final end of file	D	X	
(4) Combination of (1) and (2)	C	X	
(5) Combination of (1) and (3)	E	X	
(6) Combination of (2) and (3)	F	X	
(7) Combination of (1), (2) and (3)	G	X	
(8) No connection with checkpoint	-	X	X
Output Files			
(1) Take a checkpoint at end of reel	B	X	X
(2) Take a checkpoint at intermediate or final end of file	D	X	
(3) Combination of (2) and (3)	F	X	
(4) No connection with checkpoint	-	X	X

Figure 6

The bit structure of the Checkpoint Indicator is as follows:

1 bit	ON	This file does not contain checkpoint records.
	OFF	If input, checkpoint records (followed by a tape mark) precede the first data tape record on each reel of this file. If output, checkpoint records will be written on tapes of this file.
2 bit	ON	Do not take a checkpoint at an end-of-reel condition for this file.
	OFF	Take a checkpoint at an end-of-reel condition for this file.
4 bit	ON	Do not take a checkpoint at an end-of-file condition for this file.
	OFF	Take a checkpoint at an intermediate or final end-of-file condition for this file.
A bit	ON	This file has no connection with checkpoint.
	OFF	This file has a checkpoint function (as specified by the 1, 2 and 4 bits).

FT-402: End-of-Reel Transfer Address (000841-000844), CSF000402

See IOFTA operand X4.

This field contains the address of the first instruction of the user's specialized end-of-reel routine. If there is no routine specified, IOFTA will generate the address IORETURNTO. (If a nonstandard trailer or no trailer is used on an input tape, and the end of a tape reel is to be accepted as an end-of-file condition without any specialized routine, IORETURNNO may be specified for this field.)

A transfer is made to this address under any of the following conditions:

1. A tape mark has been encountered and
   a. a standard end-of-reel trailer has been encountered on an input tape; or
   b. special standard trailers are specified; or
   c. standard trailers are not used.
2. A reflective spot is sensed on an output tape.
3. An IOFER (Force Output End of Reel) operation has been issued.

FT-4034: File Type Code (000845), CSF0004034

See IOFTA operands X8, X15, and X16.

This field specifies whether the file is on single file or multifile tape(s); whether the file is handled sequentially or nonsequentially; whether or not a

tape is to be unloaded after rewinding at an end-of-reel or final end-of-file condition; and whether an end-of-reel condition is to be handled in Mode 1 or Mode 2. Codes are generated by IOFTA as shown in Figure 7.

Type of File	Mode 1		Mode 2	
	RWD	RWD-UNL	RWD	RWD-UNL
Single File				
Sequentially handled	C	G	L	P
Nonsequentially handled	A	E	J	N
Multifile				
Sequentially handled	B	F	K	O
Nonsequentially handled	+	D	-	M

Figure 7

Specification of sequential or nonsequential handling determines the positioning of the tape when an intermediate or final end-of-file condition occurs on an input tape.

1. Sequential Handling: When a final end-of-file condition occurs on a single or multifile input tape, the tape will be rewound. When an intermediate end-of-file condition occurs on a multifile tape, the next file will be opened.

2. Nonsequential Handling: When a final end-of-file condition occurs on a single or multifile input tape, or when an intermediate end-of-file condition occurs on a multifile tape, the tape is positioned immediately preceding the tape mark which caused the end-of-file condition.

Specification of Mode 1 or Mode 2 determines when a transfer will be made to the object program EOR Transfer Address routine. (See CSEOF section of this manual.)

The bit structure of the File Type Code is as follows:

1 bit ON   The file is on multifile tapes.
     OFF   The file is on single-file tapes.

2 bit ON   Tapes of an input file are to be handled nonsequentially at an intermediate or final end-of-file condition.
     OFF   Tapes of an input file are to be handled sequentially at an intermediate or final end-of-file condition.

4 bit ON   Do not unload tapes of this file after rewinding at an end-of-reel or final end-of-file condition.
     OFF   Unload tapes of this file after rewinding at an end-of-file condition.

A bit ON   Tapes of this file are to be handled in Mode 2 at an end-of-reel condition.
     OFF   Tapes of this file are to be handled in Mode 1 at an end-of-reel condition.

FT-403: End-of-File Transfer Address (000846-000849), CSF000403

See IOFTA operand X5.

This field contains the address of the first instruction of the user's specialized final end-of-file routine. If there is no routine specified, IOFTA will generate the address IORETURNTO.

A transfer will be made to this address if any of the following conditions occur:

1.   A standard end-of-file trailer has been encountered on an input tape.

2.   When special standard trailers are used, or when standard trailers are not used on an input tape, and the end-of-reel or header routine (for intermediate end-of-file) has determined that a final end-of-file condition exists.

3.   An IOCLS (Close a Tape File) operation has been issued for an output tape.

4.   An IOMFC (Multifile Close) has been issued for an output tape.

In addition, CSEOF uses the A bit over the tens position of this address.

FT-5011: Current Tape Serial Number (000850-000853), CSF0005011

IOFTA unconditionally generates 0000 for this field.

If standard headers are specified for the file, the field specifies (during processing) the tape serial number of the reel currently being processed. Each time a standard header is read at beginning of reel, the tape serial number in the header is saved here.

Field Separator (000854)

IOFTA unconditionally generates a slash (/) as a field separator between FT-5011 and FT-5021.

FT-5021: File Serial Number (000855-000858), CSF0005021

IOFTA unconditionally generates 0000 for this field.

If standard headers are specified for the file, the file serial number is identical to the tape serial number of the first reel of a file. For output, the file serial number is obtained from the tape serial number on the header label of the first output reel. This number will be used as the file serial number

for each beginning-of-reel header for the file. The file serial number is reset to 0000 when a delay open operation is performed for an output tape.

Since the input data is contained on different physical tape reels each time a program is run, the appropriate input file serial number is obtained from control cards by CSHSK (or by updating of this field by the object program). It is used to check whether input reels are mounted on the correct tape units.

Field Separator (000859)

IOFTA unconditionally generates a dash (-) as a field separator between FT-502 and FT-5032.

FT-5032: Reel Sequence Number (000860-000862), CSF0005032

IOFTA unconditionally generates 000 for this field.

CSHSK initializes this field to 001 unless FT-5064 specifies the base tape is not to be rewound.

The reel sequence number is increased by one at an end-of-reel condition. If standard headers are specified, this number is used to check whether input tapes have been mounted in the proper sequence, and to specify the sequence in which output tapes are created. The reel sequence number is reset to 001 when a delay open operation is performed for an output tape.

Field Separator (000863)

IOFTA unconditionally generates a blank (b) as a field separator between FT-5032 and FT-5051.

FT-5051: File Identification Name (000864-000873), CSF0005051

See IOFTA operand X1

This field is any ten-character alphanumeric name desired to distinguish a file, such as "INVENTRANS" or "PAYROLLREC." In addition, the three high-order positions can be used to represent a current cycle number. In this case, the three high-order positions must be completely numeric and the name or number may be placed in the seven low-order positions, such as "001PAYROLL." If standard headers are specified for the file, this field is used to check whether input reels are mounted on the correct tape units. The file identification name is written on each output header of the file. This field is also used by CSHSK to associate standard header control cards with the appropriate file table.

Field Separator (000874)

IOFTA unconditionally generates a blank (b) as a field separator between FT-5051 and FT-5064.

FT-5064: Tape Type Code (000875)

See IOFTA operands X6, X13, and X14.

This field specifies whether the base tape of a file is to be rewound by CSHSK; whether input areas are to be primed at the beginning of a file and after execution of an IOPOS, IOBSP, or IOFSP; for output, the density which is to be used for creation of the file. Codes generated by IOFTA are as shown in Figure 8.

Handling Characteristics	Low Density	High Density
Rewind Base Tape, CSHSK 1. Output Tape; Input Tape — do not prime any areas 2. Input Tape, prime all input areas *	B, F, or 0̇ +, D, or H	K, O, or 0̄ —, M, or Q
Do not Rewind Base Tape, CSHSK 1. Output Tape; Input Tape — do not prime any areas 2. Input Tape, prime all input areas *	C, G, or . A, E, or I	L, P, or $ J, N, or R

* This code can also be used for a tape which is originally output, but with subsequent use as input with desired priming.

Figure 8

The bit structure of the Tape Type Code is as follows:

1 bit ON	Rewind base tape during CSHSK.
OFF	Do not rewind base tape during CSHSK. (Usually used when a tape has been left in a fixed position by the previous program. The tape unit must be in Ready status during CSHSK.)
2 bit ON	Prime all input areas.
OFF	Do not prime input areas.
A bit ON	Tapes of an output file are to be created in high density.
OFF	Tapes of an output file are to be created in low density.

FT-5063: Automatic Dump Indicator (000876)

See IOFTA operand X18.

This field specifies whether or not data tape records which are determined to be permanently in error are to be automatically dumped (a dump tape must be provided), or whether a waiting loop is to be executed to allow a console decision.

IOFTA will generate one of the following codes:
- Automatically dump permanent error records.

K Effect waiting loop to allow console option.

The bit structure of the Automatic Dump Indicator is as follows:

2 bit ON   Automatically dump permanent error records.

   OFF   Effect waiting loop to allow console option.

In addition, the following use is made of this character:

A bit ON   No connection with message tape.

   OFF   This file table has been specified by the message output tape entry in the special tape section (second section) of the tape table. (Set by CSHSK.)

FT-506: Number of Days in Retention Cycle 000877-000879), CSF000506

See IOFTA operand X2.

This field indicates the number of calendar days following the creation day this output file is to be saved, if standard headers are specified. If 000 is specified in this field, the tape is considered available for use (i. e., immediately erasable) as an output tape. 000 is indicated for an input file.

FT-5074: Type of Record Length (000880)

See IOFTB operand X9.

This field specifies the type of record length for both data records and data tape records. F is specified in this field if both data records and tape records are fixed in length; V is specified if either data records or tape records are variable in length.

Field Separator (000881)

IOFTB unconditionally generates a dash (-) as a field separator between FT-5074 and FT-5084.

FT-5084: Data Record Length (000882-000885)

See IOFTB operand X10.

This field specifies the data record length of fixed-length records; or the maximum data record length of variable-length records.

Field Separator (000886)

IOFTB unconditionally generates a dash (-) as a field separator between FT-5084 and FT-5094.

FT-5094: Tape Record Format Description (000887-000890)

See IOFTB operand X11.

This field specifies whether data records are blocked or unblocked and, if blocked, the tape rec-

ord length. This field will contain one of the following entries:

1. 0000 for fixed length, unblocked data records not ending in a record mark.
2. 0001 for fixed length, unblocked data records ending in a record mark; and for variable length, unblocked data records.
3. The data tape record length for fixed length, blocked data records; or the maximum data tape record length for variable length, blocked data records.

FT-5092 (000892-000893)

IOFTB unconditionally generates bb for this field.

Section I Terminating Record Mark (000894)

IOFTB automatically generates a record mark (‡) to terminate Section I of the file table, for use in transmitting the fixed length section.

FILE TABLE FIELDS--SECTION II

FT-2014: File Code (000895)

This field is included unconditionally. See IOFTB operands X2 and X3.

This field specifies the relative volume of the file, and whether tapes of this file are to be used as data tapes, work tapes (i. e., tapes for which Class B are ignored), or program tapes.

Codes generated by IOFTB are shown in Figure 9.

Type of File	Code
Normal Data File	
Low Volume	A
.	B
.	C
.	D
.	E
.	F
.	G
.	H
High Volume	I
Work Tapes	
Low Volume	J
.	K
.	L
.	M
.	N
.	O
.	P
.	Q
High Volume	R
Program Tape	b (blank)

Figure 9

The bit structure of this code is as follows:

> B bit ON Tapes are to be used as program tapes.
>
> OFF Tapes are not to be used as program tapes.
>
> A bit ON Tapes are to be used as work tapes.
>
> OFF Tapes are not to be used as work tapes.

The 1, 2, 4, and 8 bits are used to indicate relative volume. (The highest volume file indication is 9; the lowest, 1.)

FT-201: Get/Put Address (000896-000899)

This field is included unconditionally

If Get/Put is not to be used for this file, IOFTB will generate the following coding in this field:

    A C O N 4   *

If Get/Put is to be used for this file, IOFTB will generate the address of the Get/Put routine for the file.

FT-2034: Status Code (000900), CSF0002034

This field is included unconditionally. See IOFTB operands X1, X9, and X12.

This field specifies whether tapes of the file are to be used as input or output; whether records are of fixed or variable length, and whether or not Get/Put routines are to be used with this file. Codes generated by IOFTB are as shown in Figure 10.

Type of File	Code	
	G/P	No G/P
Input		
Fixed-Length Records	M	–
Variable-Length Records	O	K
Output		
Fixed-Length Records	N	J
Variable-Length Records	P	L

Figure 10

The bit structure of the Status Code is as follows:

> 1 bit ON Tapes of this file are to be used as input.
>
> OFF Tapes of this file are to be used as output.
>
> 2 bit ON Data records of this file are fixed length.
>
> OFF Data records of this file are variable length.

> 4 bit ON Get/Put is not to be used with this file.
>
> OFF Get/Put is to be used with this file.

> A bit ON The tape currently being processed is at load point; FT-101 has been modified to effect an open operation when the next entry is made to CSDTS for an input/output operation for this file.
>
> OFF FT-101 has not been modified to effect an open operation.

FT-203: Select Address (000901-000904), CSF000203*

This field is included unconditionally. See IOFTB operand X4.

This field will contain the following information:

1. The numeric portion of this field is initialized by CSHSK and will contain the current tape select address, based on the associated tape table entry. (When an end-of-reel condition occurs and alternate tapes are specified, the address of the next alternate tape to be used is placed in this field.)

2. The zoning over the tens and hundreds positions (comparable to ASU zoning) serves as a counter, called the Force Counter. This counter is initialized to the 16's complement of the number of input/output areas specified (FT-2054) when each file is opened. During processing this counter is the 16's complement of the number of input/output areas whose contents are available for use by the object program.

3. The zoning over the units position specifies whether the Initiate or Stacking mode of CSDTS is to be used for this file, and whether or not a Forward Space or Backspace File operation for this file is in progress.

The zoning of the units position specifies the following:

> B bit ON Use Initiate mode for this file.
>
> OFF Use Stacking mode for this file.

> A bit ON No Forward Space or Backspace File operation is in progress for this file.
>
> OFF Forward Space or Backspace File operation is in progress for this file.

---

* CSF000203 is defined as a 5-position field, 000900-000904.

(000905)

This field is included unconditionally. IOFTB generates an N or an E in this field. N is generated if this file is in Initiate Mode (FT-203) and has a single input/output area; otherwise, E is generated. The 4 bit is also used by CSEOF and the Get/Put routines.

FT-202: Location of Section I (000906-000909)

In this field, IOFTB will generate the four-character high-speed transmit address of Section I of the file table.

FT-204: Transfer to Update Routine (000910-000914)

This field is included unconditionally.

In this field, IOFTB will generate a transfer instruction (000910) and the address of the routine (000911-000914) included in the file table (FT-214) which steps the tape record counter (FT-3022) and rotates the input/output areas (FT-205, FT-206).

FT-2054: Total Number of Input/Output Areas (000915)

This field is included unconditionally. See IOFTB operand X7 and IOFTC operand X1.

This field is an unsigned number ranging from 0 to 8 which specifies the total number of input/output areas to be used with this file.

FT-205: Next Input/Output Area (000916-000919)

This field is included unconditionally.

IOFTC generates the address of the first input/output area specified (FT-206). During processing, this field contains the four-character address of the next input/output area to be used.

Zoning over the tens position specifies the following:

B bit ON An area-compare check is to be performed by CSMRS.

OFF No area-compare check is to be performed by CSMRS.

A bit ON This is not the first input/output area to be used for this file.

OFF This is the first input/output area to be used for this file.

Zoning over the hundreds position specifies the following:

A bit ON Do not perform record-length checking for data tape records of this file.

OFF Perform record-length checking for data tape records of this file.

The B bit is used by IOCS for error checking.

FT-206: Input/Output Areas Used by File (Never in Work Area)

This field is not included unconditionally. If included, its length is variable (5 to 40 positions). See IOFTC operands X6-X13.

If FT-2054 is zero, this field is not included. One five-position field is included for each input/output area specified (maximum of eight fields). Fields are arranged in the order of their use. The last five-position field is always identical to FT-205.

Each five-position field is composed as follows:

Position 1: The total number of input/output areas (FT-2054).

Positions 2-5: The input/output address (must end in 0 or 5). Zoning over the tens and hundreds position is as noted in FT-205.

FT-214: Update Routine (Never in Work Area)

This field is included unconditionally; its length is variable (10-30 positions).

If FT-2054 is zero, the following routine is generated:

| ADM | 07 | FT-3022 | Data Tape Record Counter |
| TR | | CSD003001 | Common Exit Point from Update Routine |

If FT-2054 ranges from one to six, the following routine is generated:

(01)	RCV	(01-06)	FT-205	Next Input/Output Area
(02)	SND		FT-205+5	ASU zoning is 01-06 for area numbers one to six respectively.
(03)	SND	01	FT-205	
(04)	ADM	07	FT-3022	
(05)	TR		CSD003001	

If FT-2054 is seven or eight, the following instruction is included in the routine between (02) and (03):

| SND | (01-02) | FT-205+35 | ASU zoning is 01 for seven areas; 02 for eight areas. |

This section describes, in detail, each macro-instruction used with the 729 IOCS. In the descriptions, a working knowledge of the 7080 Processor is presumed.

The macro-instructions connected with IOCS may be divided into three broad categories: Descriptive Macro-Instructions, Functional Linkages and Modification Macro-Instructions.

DESCRIPTIVE MACRO-INSTRUCTIONS

These macro-instructions describe the IOCS desired and the object program features on which the IOCS needs information. They are as follows:

DIOCS -- must precede all other macro-instructions in the assembly. It describes the characteristics of the IOCS.

IOFTA, IOFTB, IOFTC -- describe the files of the object program, and are used to generate file tables, associated Get/Put routines and I/O areas.

IOTA, IOTS -- describe the tape drives used by the object program, and are used to generate the Tape Table.

FUNCTIONAL LINKAGES

These macro-instructions link the object program to IOCS. They are coded where needed in the object program to perform specific functions. They will result in appropriate linkages into IOCS at object time to execute necessary input/output and other tape movement operations.

The functional linkages may be further divided into four separate groups: Data Movement macro-instructions, Tape Movement macro-instructions, Decision Point macro-instructions, and miscellaneous macro-instructions.

Data Movement Macro-Instructions

These macro-instructions cause the movement of data within memory and between memory and tape. They are as follows:

IOGET -- moves a data record from an input area to a work area (deblocking), and will also issue read requests when required.

IOPUT -- moves a data record from a work area to an output area (blocking), and will also issue write requests when required.

IORD -- is used to read a record from tape into an area specified in the file table. Record length checking will be performed, if specified in the file table.

IOWR -- is used to write a record on tape from an area specified in the file table. Record length checking will be performed, if specified in the file table.

IORDS -- is used to read a record from tape into an area specified in the macro-instruction.

IOWRS -- is used to write a record on tape from an area specified in the macro-instruction.

IODMP -- is used to write a record on tape from an address specified in the macro-instruction through to the end of the octant.

Tape Movement Macro-Instructions

These macro-instructions, used for tape positioning purposes, cause tapes to be moved but do not cause the movement of data between tapes and memory (except through priming). They are as follows:

IOBSD -- is used to modify the Get or Put routines to effect a backspace of a data record.

IOPOS -- is used to position a tape within a file by either forward spacing or backspacing over a specified number of records.

IOFSP -- is used to forward space a tape one or more tape records within a file.

IOBSP -- is used to backspace a tape one or more tape records within a file.

IOFSF -- is used to forward space a multifile tape to the beginning of a file.

IOBSF -- is used to backspace a multifile tape to the beginning of a file.

Decision Point Macros

These macro-instructions are used at points in the object program when a decision must be made by the programmer before proceeding any further. These decision points occur when a tape mark is encountered or is to be written, when a reflective spot is encountered, at load point, and at the end of a reel. The decision point macro-instructions are as follows:

IOCLS -- is used to terminate operations on either an input tape or an output tape.

IOMFO -- is used to start operations on a new file of a multifile output tape (other than at load point).

IOMFC -- is used to terminate operations on an output file without rewinding the tape.

IOFER -- is used to force an end-of-reel condition regardless of whether or not a reflective spot is sensed.

IORWD -- is used to rewind a tape.

IORUN -- is used to rewind and unload a tape.

Miscellaneous

This group of Functional Linkage macro-instructions results in the generation of linkages into IOCS for the execution of a variety of operations. They are as follows:

IOTYP -- is used to type a message without an associated operator decision. The message may be written on a message tape or ignored.

IODEC -- is used to type a message and either (1) enter a waiting loop anticipating the use of the manual interrupt keys 252 or 253 or (2) automatically execute an option associated with an interrupt key. If the macro-instruction is used for automatic execution of an interrupt key option, the message may be written on a message tape or ignored.

IOHLD -- is used to insure that all input/output operations on a particular file have been completed and checked. It is also used (with a second operand of OPEN) to reopen an input file which has been closed or to open an input file for which a delayed-open option is specified.

IOLNK -- is used to link to specific routines within IOCS other than CSDTS.

MODIFICATION MACRO-INSTRUCTIONS

These IOCS macro-instructions are used to modify existing specifications or conditions in IOCS or the object program. They are as follows:

IODCH -- is used to alter the Message Class Code of IOCS or object program messages, and/or to prespecify an option to be taken at decision messages.

IOIOF -- is used to turn the tape unit I/O indicator OFF.

IOION -- is used to turn the tape unit I/O indicator ON.

IOMIP -- is used to modify the file code of a file table so that it specifies input instead of output.

IOMOP -- is used to modify the file code of a file table so that it specifies output instead of input.

IORET -- is used to modify the IOCS return address so that when an object program specialized routine returns to IOCS, the IOCS will later return control to the address following the specialized routine rather than to the address following the original linkage into IOCS.

Note: The following operations will not be executed if the tape has not been opened, or if it is at load point after having been rewound: IOCLS, IOFER, IOMFC, IOMFO, IORUN, IORWD and IOHLD without a second operand.

WRITING OR OMITTING OPERANDS AND LOZENGES

The macro-instructions are written in standard 7080 Autocoder format. Each macro-instruction operand is followed by a lozenge (⊐). When it is desired to omit an operand, the associated lozenge may also be omitted if no additional operands are written; i.e., if the operand preceding the omitted operand is the last operand to be written. However, when additional operands are to follow the omitted operand, its associated lozenge must be written back-to-back with the lozenge of the preceding operand.

This procedure applies to all 729 IOCS macro-instructions except IOFTA and IOFTB, for which special coding forms have been provided. Lozenge usage for these macro-instructions varies slightly in that the lozenges associated with omitted operands must be written, in certain cases, even though no subsequent operands are coded. These requirements are detailed in the specifications for IOFTA and IOFTB.

DETAILED DESCRIPTION

All macro-instructions used in conjunction with 729 IOCS are described in detail in the rest of this section. The macro-instructions are arranged in alphabetical order for ease of reference.

DIOCS: Define IOCS

Function

The function of this macro-instruction is to describe to the 7080 Processor the type of IOCS required. Two forms of the DIOCS macro-instruction are necessary.

The first form describes the desired characteristics of 729 IOCS itself, and the terminal form indicates whether the IOCS is to be generated or is already assembled. These DIOCS macro-instructions, plus any other DIOCS macro-instructions such as those required if 1301 Disk IOCS is part of the IOCS, must be written consecutively and must precede all other IOCS macro-instructions in the program. The terminal form DIOCS macro-instruction must always be the final DIOCS in the sequence and must appear only once in a program. If an operand is omitted, its associated lozenge must be written back-to-back with the preceding lozenge, unless no subsequent operands are written. The format of the DIOCS macro-instructions is as follows:

Tag	Operation	Num	Operand
	DIOCS		X1 ⋈ X2 ⋈ X3 ⋈ ... X7 ⋈

X1
is 729 TAPE

X2
is 2 if the IOCS is to operate on channels 20 and 21 only, or
is 4 if the IOCS is to operate on channels 20-23.
If the operand is omitted, 4 will be assumed.

X3
is COMPLETE if a complete IOCS is desired, or is MINIMAL if an IOCS containing only those routines essential to the use of the Get/Put system is desired. (See Appendix 2 for description of the restrictions on the use of a minimal IOCS.) If X3 is omitted, COMPLETE will be assumed.

X4
is CHKPT if X3 is MINIMAL but an IOCS with checkpoint routines is desired. It is omitted if X3 is COMPLETE or is MINIMAL but an IOCS without checkpoint routines is desired.

X5
is the address, either descriptive or actual, of the first location to be used by the nonerasable portion of IOCS; i.e., the portion that stays in storage during execution of the object program. If a descriptive tag is used, it must have been previously defined in the source program. If actual, it must be a 0 or 5 location.
The operand may be omitted, in which case location at 500 will be assumed.

X6
is the address, either descriptive or actual, of the first location to be used by erasable housekeeping. If

a descriptive tag is used, it must have been previously defined in the source program. If actual, it must be a 0 or 5 location.
The operand may be omitted, in which case location at 20,000 will be assumed.

X7
is 705CONVERT if the object program is to operate in a 705 mode, or is omitted. If the operand is used, each linkage macro-instruction will generate ENT80 and EEM instructions preceding the actual linkage and LEM and LEV80 instructions following the linkage. (See Appendix 1 for the relationship between 705 III and 729 IOCS.)

Restrictions: If the DIOCS describes a previously assembled IOCS, operands X1-X6 must be the same, or provide the same information, as operands X1-X6 of the DIOCS used to assemble the IOCS.

Terminal Form DIOCS Instruction Format

Tag	Operation	Num	Operand
	DIOCS	X0	X1 ⋈ X2 ⋈

X0
is blank or 1-9, designating the Blank LASN counter or one of the LASN counters 1-9.
If a LASN counter other than the Blank counter is specified in the DIOCS, all LASNs generated from the DIOCS macro-instruction will use the counter; otherwise they will use the Blank counter.

X1
is GEN if it is desired to assemble the IOCS.
is NOGEN if a previously assembled IOCS is to be used. In this case, operands X1-X6 of the first form DIOCS must provide the same information as those of the DIOCS macro-instruction used to assemble the IOCS.

X2
is HSKONLY to obtain only the erasable housekeeping portion of the IOCS. Otherwise, it is omitted.
If this operand is used, X1 must be GEN, and operands X1-X5 of the first DIOCS must provide the same information as those of the DIOCS used to assemble the IOCS originally. Moreover, DIOCS macro-instructions for other IOCSs must be identical in both assemblies.
The ability to obtain erasable houskeeping is provided for use in situations where the IOCS to be used is left in memory for a subsequent program, or phase of a program, but housekeeping has been erased. The use of HSKONLY causes the IOCS to be assembled but program cards to be provided only for the erasable housekeeping portion.

NOTE: A program using this feature; i.e., containing a terminal DIOCS with a second operand of HSKONLY, will have to be reassembled any time that the IOCS is reassembled.

When the first operand is GEN, the standard "00" card produced by the 7080 Processor to terminate the object program must transfer control to the first instruction of the object program rather than to the IOCS. This can be done by starting the source program with a transfer to the first instruction or by using the Autocoder TCD instruction with a Z flag, as explained in the reference manual, "7080 Processor: Autocoder Language," Form C28-6263. Moreover, when GEN is used, a LITOR * instruction will be generated following the last entry of the nonerasable portion of IOCS. If an IOCS in addition to 729 IOCS is being assembled, or if an object program is being assembled with the IOCS, care must be taken to ensure that the literals are not destroyed by coding that overlaps them. This can be achieved through the use of the Autocoder LITOR instruction after the DIOCS macro-instructions.

IOBSD: Backspace Data Record

Function

To provide linkage from the object program to an IOCS routine which will modify the counters of the Get or Put routine to effect the backspace of a data record. Operand X16 of the IOFTB macro-instruction for the reference file must be BSD or WBSD.

Instruction Format

Tag	Operation	Num	Operand
T1	IOBSD		X1 ⋈ X2 ⋈ X3 ⋈

T1
   is any tag or may be left blank.

X1
   is the descriptive file table address. This operand must be the tag of an IOFTA macro-instruction.

X2
   is either GET or PUT, specifying which routine is affected.

X3
   is SAVE if the setting of the starting point counter is required by the object program.
   Operand X3 may be omitted.

Restriction: IOBSD may not be used with a minimal system (DIOCS operand X3 is MINIMAL).

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Examples of IOBSD

IOBSD will cause the modification of the counters of the counters of the Get/Put routines to reflect a previous record so that a subsequent IOGET or IOPUT will move the previous record to the Get work area or the output area, rather than moving the currently scheduled record. Repeated IOBSD linkages may be used to effect multiple backspaces.
   The following examples illustrate the use of IOBSD.

Example 1: An input area contains six blocked records, and at the time the IOBSD macro-instruction is issued, record 5 is in the Get work area, as follows:

Input Area						Get Work Area
1‡	2‡	3‡	4‡	5‡	6‡	5‡

a. If the sequence IOBSD, IOGET is executed, record 5 will be placed in the work area specified by the IOGET linkage. If none is specified, the work area address given in the file table will be used.

b. If the sequence IOBSD, IOBSD, IOBSD, IOGET is executed, record 3 will be placed in the specified work area.

Example 2: An output area set up to receive six blocked records is partially completed, and contains four records, while the fifth record is in the Put work area, as follows:

Output Area				Put Work Area
1‡	2‡	3‡	4‡	5‡

a. If the sequence IOBSD, IOPUT is executed, the output area will be modified as follows:

   1‡   2‡   3‡   5‡

b. If the sequence IOBSD, IOBSD, IOBSD, IOPUT is executed, the output area will be modified as follows:

   1‡   5‡

The Get/Put routines will backspace tape as required to accomplish these ends. The object programmer must exercise caution, however, to avoid backspacing data records beyond the limits of the file or of a reel. That is, he should not attempt to IOBSD beyond the first data record of a file or reel since the results will not be consistent.

IOBSF: Backspace File (On a Multifile Input Tape)

Function

To provide linkage from the object program to an
IOCS routine which will perform a backspace file
operation on a multifile input tape. IOBSF will also
provide linkage to a file identification routine which
can be written and included, if desired, by the user.
IOBSF may not be used on a file which has alternate
tapes on different channels.

Instruction Format

Tag	Operation	Num	Operand
T1	IOBSF		X1 ⊐ X2 ⊐ X3 ⊐

T1
  is any tag or may be left blank.

X1
  is the file table address, either descriptive or
actual, of the tape that will be backspaced. If an
actual address is used, the units digit must be 4
or 9.

X2
  is the address, either descriptive or actual, of
the file identification routine, if one is included. If
an actual address is used, the units digit must be 4
or 9.
  If a file identification routine is not included,
operand X2 must be omitted. In this case, the tape
will be backspaced to the beginning of the file in
which it is positioned when the IOBSF is executed
and an exit made to the Header Transfer Address.

X3
  is HOLD if the operation is to be completed prior
to a return to the object program. If omitted, a
return will be made to the object program prior to
the completion of the request. (If operand X3 is
omitted, an IOHLD linkage must be executed prior
to any further IORD or IOGET requests for this
file.)

Restriction: IOBSF may not be used with a minimal
system (DIOCS operand X3 is MINIMAL).

File Identification Routine

The file identification routine is a specialized rou-
tine to determine (i.e., by means of a "counter" or
a "header comparison") whether or not a multifile
tape is positioned at a desired file. When a file

identification routine is used, IOBSF functions as
follows:
  The tape is backspaced to the beginning of the
current file and the header label (if any) is read into
the IOTRSHLBL area. A transfer is then made to
the file identification routine, as specified in the
second operand. The specialized routine then deter-
mines whether the tape is positioned at the desired
file and, according to this determination, transfers
back to IOCS at either IORETURNTO or
IORETURNNO.
  If the tape is positioned at the desired file, the
transfer must be to IORETURNTO. In this case,
IOCS will adjust the necessary file table counters,
fill input areas if priming is designated, and then
return to the object program.
  If the tape is not positioned at the desired file, the
transfer must be to IORETURNNO. In this case,
the IOBSF routine will position the tape at the be-
ginning of the preceding file, read the header label
(if any) of the file, and transfer again to the file
identification routine to check the file. If load point
is reached and the file identification routine returns
to IORETURNNO, the operation is automatically
converted to a Forward Space File (see IOFSF). If
a file identification routine is used and end of tape
may be reached, standard trailers must be used by
the file.

Special Use of the File Identification Routine: To
avoid the IOCS exit to the Header Transfer Address
when the tape is to be backspaced to the beginning of
the file in which it is positioned when the IOBSF is
executed, operand X2 should specify IORETURNTO.

NOTE: Exit is made to the file identification routine
under the same circumstances as with the specialized
Header Transfer Address, End-of-Reel Transfer
Address routines, etc. In other words, the ma-
chine will be in interrupt program, and the starting
point counter will be set above 2,000. The routine
must not reference Bank 2, CASUs 7, 8, 10, 11, 12,
or 15, and must preserve the settings of CASUs 1-6.
Any IOTYP or IODEC linkages given must have 3rd
or 4th operands, respectively, of INTERRUPT, un-
less the routine is preceded by an ENTIP macro-
instruction.

IOBSP: Backspace Tape Records

Function

To provide linkage from the object program to an
IOCS routine that will backspace over a specified
number of tape records.

Instruction Format

Tag	Operation	Num	Operand
T1	IOBSP		X1 ⊏ X2 ⊏

T1
　is any tag or may be left blank.

X1
　is the file table address, either descriptive or actual, of the tape that will be backspaced. If an actual address is used, the units digit must be 4 or 9.

X2
　is the literal number of records to be backspaced, or the descriptive or actual address of a field containing the number. The field which specifies the number of records must appear in memory as a three-character signed field with left protection.
　If only one record is to be backspaced, operand X2 may be omitted.

Restriction: IOBSP may not be used with a minimal system (DIOCS operand X3 is MINIMAL).

NOTE: IOBSP is intended for compatibility with the IOCS for the 705 III. For new programs, see the macro-instruction IOPOS. IOBSP may not be used to backspace beyond the first record of a file or a reel.

IOCLS: Close a Trap File

Function

To provide linkage from the object program to an IOCS routine that will perform close file operations. For output files, IOCLS will write a tape mark, an end-of-file trailer and another tape mark. For both input and output files, IOCLS will check the file table indicator and either rewind or rewind-unload the tape. For output files, IOCLS will take a checkpoint (if checkpoint at end-of-file is specified in the file table for the file being closed). This operation will not be executed if the tape has not been opened, or if it is at load point after having been rewound.

Instruction Format

Tag	Operation	Num	Operand
T1	IOCLS		X1 ⊏

T1
　is any tag or may be left blank.

X1
　is the file table address, either descriptive or actual, of the tape containing the file that is to be closed. If an actual address is used, the units digit must be 4 or 9.

IODCH: Change Message Class Code

Function

To change the Message Class Code of a message and/or to specify or alter a predetermined option to accompany a decision message.

Instruction Format

Tag	Operation	Num	Operand
T1	IODCH		X1 ⊏ X2 ⊏ X3 ⊏

T1
　is any tag or may be left blank.

X1
　specifies the message for which the class is to be changed and/or a predetermined option is to be supplied. X1 may be:
　1. The tag of the IODEC or IOTYP macro-instruction that designates the message.
　2. The tag of an IOCS message. The tags are of the form CSMxxxxx and are listed together with the numbers of the messages on which they appear in the section, "Loop/Message Tags."

X2
　specifies the Message Class Code to be altered and/or the predetermined action. X2 may be:
　1. The Message Class Code (A, B, C, or D) if the message is not a decision message for which a predetermined action is being specified.
　2. The Message Class Code (A, B, C, or D) followed by a character designating the action to accompany the message, if it is a decision message for which a predetermined action is being specified or altered. The character may be:
　　b -- no predetermined action
　　2 -- predetermined action is 252 routine
　　3 -- predetermined action is 253 routine.

X3
　is INTERRUPT if IODCH is coded when the SPC is above 2,000, or is omitted if it is coded elsewhere. The operand may be omitted when IODCH is coded in the interrupt program, provided the general-purpose macro-instruction ENTIP has been coded prior to it and that the LEVIP macro-instruction has not intervened.

NOTE: Changing the Message Class Code and/or the associated action of one IOCS message will, in certain cases, affect more than one message. This results from the fact that some IOCS message tags pertain to several messages. The tag CSM10230, for example, appears on messages 10230, 10231, 20230, and 20231. For a discussion of this consideration, see "Changing Message Classes" under "Type Subroutine."

IODEC: Type, Then Wait for Decision

Function

To provide a message, specify the course of action that is to accompany it, and provide linkage to an IOCS routine that will type the message and execute the desired action. The action may be either of the following:

1. Operator action. The message is typed and a waiting loop entered to await a decision from the console. The operator may select one of two alternate courses of action by depressing Interrupt Key 252 or 253. The selected option will be indicated by the message "2" or "3".

2. Predetermined action. The message may be typed, written on a message tape, or ignored, and a designated routine is automatically executed. The designated routine may be the one associated with Interrupt Key 252 or 253.

The instruction immediately following the IODEC linkage will be considered the first instruction of the routine associated with Interrupt Key 252. The routine associated with Interrupt Key 253, if one is desired, is designated by the programmer. When an operation decision is required, the 252 routine will be executed if the operator presses Interrupt Key 252; it will also be executed if he should press 253 when no routine has been designated for that key. If a predetermined action is specified, the routine (252 or 253) designated as the action is executed automatically.

It is recommended that a decision message requiring operator action be clearly identified as such in the message text. A general description of Message Class Codes and how to set up messages and routines associated with Interrupt Keys is included in the discussion of the Type Subroutine elsewhere in this manual.

Instruction Format

Tag	Operation	Num	Operand
T1	IODEC		X1 ⊐ X2 ⊐ X3 ⊐ X4 ⊐

T1
is any tag or may be left blank.

X1
is the descriptive or actual address of the message or is a literal containing the message. The message field must be terminated by a group mark. If an actual address is used, it must be that of the left-hand position of the message.

X2
is the address, either descriptive or actual, of the routine which will be executed if Interrupt Key 253 is depressed. It may be omitted, in which case the routine associated with 252 will be executed regardless of which key is depressed.

X3
is the Message Class Code and the action to accompany the message. It is written as xy, where x is the Message Class Code (A, B, C, or D) and y is as follows:
b -- if not specifying a predetermined action
2 -- if specifying the 252 routine
3 -- if specifying the 253 routine
If the operand is omitted, the message will be assumed to be Class A, and will be typed, and a predetermined action will not accompany it.

X4
is INTERRUPT if the IODEC linkage is made from the interrupt program; i.e., if it is made from any of the specialized routines (end of reel, end of file, header transfer address routines, IOREDUNCHK, CSA90, IOTRSPLBL). Otherwise, it is omitted. It may also be omitted when the IODEC linkage is made from the interrupt program provided the macro-instruction ENTIP has been coded prior to it and that the LEVIP macro-instruction has not intervened.

Restriction: IODEC may not be used in an interrupt program other than an IOCS exit.

IODMP: Dump on Tape

Function

To provide linkage from the object program to an IOCS routine that will dump (WR01) on tape from an address specified by the macro-instruction. The write operation can be checked immediately if desired (Hold mode).

Instruction Format

Tag	Operation	Num	Operand
T1	IODMP		X1 ⊐ X2 ⊐ X3 ⊐

T1

    is any tag or may be left blank.

X1

    is the file table address, either descriptive or actual, of the output tape. If an actual address is used, the units digit must be 4 or 9.

X2

    is the address, either descriptive or actual, from which the record will be dumped. If an actual address is used, the units digit must be 0 or 5.

X3

    is HOLD if the write operation is to be checked immediately.

    If the write operation is not to be checked immediately, operand X3 should be omitted.

Restriction: IODMP may not be used with a minimal system (DIOCS operand X3 is MINIMAL).

IOFER: Force Output End of Reel

Function

To provide linkage from the object program to an IOCS routine that will force an end-of-reel condition on an output tape, regardless of whether or not the reflective spot is sensed. This operation will not be executed if the tape has not been opened, or if it is at load point after having been removed.

Instruction Format

Tag	Operation	Num	Operand
T1	IOFER		X1 ⊔

T1

    is any tag or may be left blank.

X1

    is the file table address, either descriptive or actual, of the output tape. If an actual address is used, the units digit must be 4 or 9.

Restriction: IOFER may not be used with a minimal system (DIOCS operand X3 is MINIMAL).

IOFSF: Forward Space File (On a Multifile Input
          Tape)

Function

To provide linkage from the object program to an IOCS routine that will Forward Space File on a multifile input tape. IOFSF will also provide linkage to a file identification routine which can be written

and included, if desired, by the user. IOFSF cannot be used on a file that has alternate tapes on different channels.

Instruction Format

Tag	Operation	Num	Operand
T1	IOFSF		X1 ⊔ X2 ⊔ X3 ⊔

T1

    is any tag or may be left blank.

X1

    is the file table address, either descriptive or actual, of the tape that will be forward spaced. If an actual address is used, the units digit must be 4 or 9.

X2

    is the address, either descriptive or actual, of the file identification routine, if one is included. If an actual address is used, the units digit must be 4 or 9.

    If a file identification routine is not included, operand X2 must be omitted. In this case, the tape will be forward spaced to the beginning of the next file and an exit made to the Header Transfer Address.

X3

    is HOLD if the operation is to be completed prior to a return to the object program. If omitted, a return will be made to the object program prior to the completion of the request. (If operand X3 is omitted, an IOHLD linkage must be executed prior to any further IORD or IOGET requests for this file.)

Restriction: IOFSF may not be used with a minimal system (DIOCS operand X3 is MINIMAL).

File Identification Routine

The file identification routine is a specialized routine to determine (i.e., by means of a "counter" or a "header comparison") whether or not a multifile tape is positioned at a desired file. When a file identification routine is used, IOFSF functions as follows:

    1. The tape is forward spaced to the beginning of the next file, and the header label (if any) is read into the IOTRSHLBL area. A transfer is then made to the file identification routine, as specified in the second operand. The specialized routine then determines whether the tape is positioned at the desired file and, according to this determination, transfers back to IOCS at either IORETURNTO or IORETURNNO.

2. If the tape is positioned at the desired file, the transfer must be to IORETURNTO. In this case, IOCS will adjust the necessary file table counters, will fill input areas if priming is designated, and then return to the object program.

3. If the tape is not positioned at the desired file, the transfer must be to IORETURNNO. In this case, the IOFSF routine will position the tape at the beginning of the next file, read the header label (if any) of the file, and transfer again to the file identification routine to check the file. If a file identification routine is used and end of tape may be reached, standard trailers must be used by the file. If an end-of-file trailer is encountered, the tape will be rewound and re-searched from the beginning of the reel. If the correct file has not been found after the tape has been completely searched, loop/message 20211 will be executed. If an end-of-reel trailer is encountered, tapes will be alternated, an exit made to the Header Transfer Address, and the tape will then be forward spaced to the first intermediate header on the next reel.

Special Use of the File Identification Routine

To avoid the IOCS exit to the Header Transfer Address when the tape is to be forward spaced to the beginning of the next file, operand X2 should specify IORETURNTO.

NOTE: Exit is made to the file identification routine under the same circumstances as with the specialized Header Transfer Address, End-of-Reel Transfer Address routines, etc. In other words, the machine will be in interrupt program, and the starting point counter will be set above 2,000. The routine must not reference Bank 2, CASUs 7, 8, 10, 11, 12, or 15, and must preserve the settings of CASUs 1-6. Any IOTYP or IODEC linkages given must have 3rd or 4th operands, respectively, of INTERRUPT, unless the routine is preceded by the ENTIP macro-instruction.

IOFSP: Forward Space Tape Records

Function

To provide linkage from the object program to an IOCS routine that will forward space over a specified number of tape records.

Instruction Format

Tag	Operation	Num	Operand
T1	IOFSP		X1 ⋈ X2 ⋈

T1
   is any tag or may be left blank.

X1
   is the file table address, either descriptive or actual, of the tape that will be forward spaced. If an actual address is used, the units digit must be 4 or 9.

X2
   is the literal number of records to be forward spaced or the descriptive or actual address of the number. The field which specifies the number of records must appear in memory as a three-character signed field with left protection.

   If only one record is to be forward spaced, operand X2 may be omitted.

   IOFSP is intended for compatibility with the IOCS for the 705 III. For new programs, see the macro-instruction IOPOS.

Restriction: IOFSP may not be used with a minimal system (DIOCS operand X3 is MINIMAL).

Notes on Writing IOFTA, IOFTS, and IOFTC

The macro-instructions on the following pages -- IOFTA, IOFTB and IOFTC -- may be used in preparing the file tables. To simplify the preparation of these macro-instruction headers, a form has been prepared and is available in pad form. The form number is X22-6913-1. These forms may be completed by filling in the page number and simply crossing out the choice of parameters which do not apply. These forms may then be used for key punching.

   The macro-instruction IOFTB must be preceded immediately by the macro-instruction IOFTA. If operand X8 of IOFTB is AREAGIV, then IOFTB must be followed by the macro-instruction IOFTC, which names the I/O areas for the file. If operand X8 of IOFTB is GENAREA or omitted, IOFTC must not be used.

   Certain IOFTA and IOFTB operands will be assumed if a minimal system (DIOCS operand X3 is MINIMAL) is being used. That is, the IOCS will be generated for these operands whether or not they are the operands coded.

IOFTA: First Section of File Table

Function

To generate the first section of a file table. If it is desired to omit operands X10-X19, only nine operands and their associated lozenges need be coded. Otherwise, all 19 lozenges must be written, even though some of the operands X10-X19 are omitted.

Instruction Format

Tag	Operation	Num	Operand
T1	IOFTA		X1 ⊔ X2 ⊔ X3 ⊔ . . . X19 ⊔

T1

is the tag of the file table and must not be blank.

X1

is the file identification and must not be omitted or blank. If the first three characters are numerical, Cycle Checking will be assumed (see CSTRS section of this manual).

X2

is the number of days in the retention cycle; i.e., how many days or cycles this file is to be retained beyond the creation date. This field contains three unsigned numerical characters. If "000" is specified, the tape is available for use. The "000" should be used for input files.

X3

is the 10-character tag of the Header Transfer Address. A transfer will be made to the routine starting at this address at the following times:
1. During CSHSK.
2. At the beginning of each new reel.
3. At the beginning of each file on a multifile tape.
4. At the end of a multifile tape if standard trailers are not used.

If no special processing is desired at these times, IORETURNTO should be specified in this operand.

X4

is the 10-character tag of the End-of-Reel Transfer Address. A transfer will be made to the routine starting at this address at the following times:
1. If a standard trailer with an "R" in the sixth position is encountered.
2. If a standard trailer with an "F" in the sixth position is encountered when special handling is designated (see X12).
3. If a nonstandard trailer is encountered.
4. If a tape mark is encountered on an input tape which contains no trailer records.
5. If a reflective spot is encountered on an output tape.

If no special handling is desired at these times, IORETURNTO should be specified in this operand.

X5

is the 10-character tag of the End-of-File Transfer Address. A transfer will be made to the routine starting at this address at the following times:
1. If a standard input trailer with an "F" in the sixth position is encountered.
2. If a close request is issued specifying an output file.

3. If a specialized input EOR routine for a nonstandard trailer, special standard trailer, or no trailer file has told IOCS that an end-of-file condition exists.
4. If a multifile close request is issued, specifying an output file.

If no special handling is desired at these times, IORETURNTO should be specified in this operand.

Note: See the sections of this manual on the Tape Reel Control System (CSTRS), the End-of-File and End-of-Reel routines (CSEOF), and IOCS Exits to Specialized Routines, for a detailed discussion of the exit conditions regarding X3, X4 and X5.

X6

specifies the desired density for output tapes through the following specific operands:
  HIb -- where high density is desired.
  LOb -- where low density is desired.

X7

is the number of alternate drives desired. This operand must specify an unsigned digit (0-4).

X8

specifies end-of-reel and end-of-file handling through the following specific operands:
  RWD1 -- do not unload after rewinding, Mode 1 EOR handling.
  RWD2 -- do not unload after rewinding, Mode 2 EOR handling.
  RUN1 -- unload after rewinding, Mode 1 EOR handling.
  RUN2 -- unload after rewinding, Mode 2 EOR handling.

If a minimal system is being used, Mode 2 will be assumed for input tapes and Mode 1 for output tapes (see CSEOF section of this manual for a discussion of end-of-reel modes).

X9

is the checkpoint indicator, and specifies the occurrence of checkpoints through the following specific operands:
  EORb -- take checkpoints at the end of each reel of this file. The checkpoints may occur on either a separate checkpoint tape or at the beginning of each reel of this file (must be an output file).
  EOFb -- take checkpoints at end of file for this file. The checkpoints must occur on a separate checkpoint output tape.
  BOTH -- take a checkpoint at both end of reel and at end of file for this file. The checkpoints must occur on a separate checkpoint output tape.
  NONE -- this file has no relationship to the occurrence of checkpoints.

If X9 is omitted or blank, NONE will be assumed (see CSMRD section of this manual for a discussion of checkpoint. See also the macro-instruction IOTS).

X10

specifies the header type through the following specific operands:

STANDARD
NONSTAND -- An object program routine must create nonstandard output header labels and check nonstandard input header labels (see CSTRS section of this manual).
NONHEADER

If X10 is omitted or blank, STANDARD will be assumed.

X11

indicates whether or not a tape mark follows the header label. The following specific operands may be used:

TMbb -- this operand must be used if X10 is STANDARD.
NOTM -- this operand must be used if X10 is NOHEADER.

If X11 is omitted or blank, TMbb will be assumed.

X12

specifies the trailer type through the following specific operands:

STANDARD
SPECSTAND -- This file contains standard trailer labels, but an object program routine is to make end-of-reel or end-of-file determination (see CSEOF section of this manual).
NONSTANDb -- An object program routine must create nonstandard output trailer labels and check nonstandard input trailer labels (see CSEOF section of this manual).
NOTRAILER -- An object program routine must determine whether the tape mark just encountered constitutes an end-of-reel or an end-of-file condition (see CSEOF section of this manual).

If X12 is omitted or blank, STANDARD will be assumed. It will also be assumed if a minimal system is being used.

X13

indicates whether or not the tape is to be rewound during IOCS Housekeeping through the following specific operands:

HSKRWD
NORWDb -- When this operand is used, the file table and associated file will be initialized by CSHSK except for label checking and the initialization of the record, error and end-of-reel counters. Priming will occur if indicated in the file table. Files which contain any header labels and are positioned at load point must be indicated as HSKRWD files. NORWD may not be used if X19 specifies DELAYOPEN (see CSHSK section of this manual for a further discussion of NORWD).

If X13 is omitted or blank, HSKRWD will be assumed. It will also be assumed if a minimal system is being used.

X14

indicates whether or not priming is to occur on this file during CSHSK and at the completion of certain special operations (see summary table in CSDTS section). The following specific operands may be used:

PRIME
NOPRI -- The Data Travel System assumes that priming precedes the normal processing of an input file. If NOPRI is indicated in X14, the object program must fulfill this function by giving as many IORD linkages as there are I/O areas, prior to the processing of any data from this file.

If X14 is omitted or blank, PRIME will be assumed.

X15

specifies single or multifile through the following specific operands:

SINGLE
MULTI -- X12 must not be NOTRAILER.

If X15 is omitted or blank, SINGLE will be assumed. It will also be assumed if a minimal system is being used (see CSEOF section of this manual for a discussion of multifile requirements).

X16

specifies sequential or nonsequential handling of the file through the following specific operands:

SEQUEN
NONSEQ

If X16 is omitted or blank, SEQUEN will be assumed. It will also be assumed if a minimal system is being used (see CSEOF section of this manual for a discussion of nonsequential handling).

X17

indicates the presence or absence of checkpoint records on input files through the following specific operands:

    CKPTRCDSb

    NOCKPTRCD -- This operand must be used for output files.

If X17 is omitted or blank, NOCKPTRCD is assumed. It will also be assumed if a minimal system is being used (see CSMRD section of this manual concerning the use of output files for the recording of checkpoints).

X18

indicates the handling of records when permanent read or write errors occur. The following specific operands may be used:

    DUMP -- Tape records containing permanent redundancies will be automatically dumped. A dump tape must be specified (see macro-instruction IOTS).

    NODP -- Do not dump records automatically.

If X18 is omitted or blank, NODP is assumed. It will also be assumed if a minimal system is being used (see CSERR section of this manual concerning permanent read/write errors and the automatic dump option).

X19

specifies a delayed open through the specific operand DELAYOPEN. Housekeeping for files operating under the delayed-open option will be incomplete in that label checking or label creation and priming will not occur. The file table will be initialized in all respects, including updating of the label control information; i. e., label control cards will be required for input files.

Files operating under the delayed-open option may be opened as follows:

1. Input files -- through the functional linkage IOHLD with a second operand of OPEN. (The functional linkage IORD will result in the loss of the first record if priming is specified.)

2. Output files -- through a normal output request (IOWR or IOPUT resulting in IOWR).

NODELAY in operand X19 specifies the file is to be opened completely during the execution of IOCS Housekeeping. If operand X19 is omitted or blank, NODELAY is assumed. (A further discussion of the delayed-open option is contained in the CSHSK section of this manual.)

IOFTB: Second Section of File Table

Function

To generate the second section of a file table. If Get/Put is used, IOFTB must have 16 operands and

their associated lozenges; the final operand, X17, and its associated lozenge are optional. If Get/Put is not used, IOFTB must have 11 operands and their associated lozenges. That is, operands X12-17 and their lozenges are omitted.

Instruction Format

Tag	Operation	Num	Operand
	IOFTB		X1⊐ X2⊐ X3⊐ ... X16⊐

X1

is either IP or OP, specifying input or output, respectively.

X2

is DATA, WORK or PROG.

If DATA, the file is a normal input or output file.

If WORK, the file is a data file but is not normally removed between programs. For example, an output file which will be used subsequently as an input file, or an input file which will be used subsequently as a scratch (output) tape. Class B messages will be ignored on a work tape. This is the only distinction that the IOCS makes between data and work tapes. If a minimal system is used and WORK is specified, DATA will be assumed.

If PROG, the file table is for the program tape.

X3

is the relative file volume. The digits 1 through 9 should be used to describe the volume of this file as compared to other files in the same program. The largest volume file indication is 9, the smallest 1.

X4

is either INITb or STACK, describing the operating mode of the file. STACK will be assumed if a minimal system is being used (see IODTS section of this manual for a discussion of the Initiate and Stacking modes of operation).

X5

is either CKLNG or NOCHK.

If CKLNG, the length of all records read or written will be checked, except for records read or written through the IORDS, IOWRS and IODMP linkages. Record lengths may be checked for IORDS or IOWRS depending upon the parameters of the linkage. The requirements of input/output area definition for record length checking should be noted in the CSDTS section of this manual.

If NOCHK, no record length checking will occur on reading and writing (except IORDS and IOWRS as noted above).

X6

indicates the availability of input/output for the areas checking of the repositioning of tapes during restart operations. Tapes are repositioned during restart through the file counter and record counter. As a cross check, it is desirable to compare a portion of the last record read or written to the record in memory at the time memory was recorded. If the input area is not modified, this comparison may be made; for output files, CMPCK may always be specified. The availability of areas for this checking is indicated through the following specific operands:

CMPCK
NOCMP

X7

specifies the number of input/output areas to be used with this file. An unsigned, single digit 0 through 8 may be used. "C" should be specified if this file is to share three input/output areas with another file (see "Area Rotation" under "Counters and Indicators Used by CSDTS"). If this file is describing the message or dump tape file, zero areas should be specified.

X8

indicates whether or not input/output areas are to be generated by the macro-generator (including record length checking fields) through the following specific operands:

GENAREA -- Generate areas with the file table.
AREAGIV -- Areas given (see IOFTC -- operands X6-X13).
If operand X8 is omitted or blank, GENAREA is assumed.

X9

indicates type of record length through the following specific operands:

F -- fixed-length records.
V -- variable-length records.

X10

is a four-digit unsigned parameter that indicates the data record length for fixed-length records or the maximum data record length for variable-length records.

X11

describes the record format through the following specific operands:

0000 -- Fixed length, unblocked records not ending in a record mark. (If this operand is used for Get files, the work area must be divisible by five and at least five characters bigger than the record; if it is used for Put files, both a group mark and a record mark must be provided in the work area.)
0001 -- Fixed-length, unblocked records ending in a record mark, or (if Get/Put is not used) variable-length, unblocked records.
xxxx -- A four-digit, unsigned parameter indicating the tape record length for fixed-length, blocked records; the maximum tape record length for variable-length, blocked records, or (if Get/Put is used) the maximum tape record length for variable-length, unblocked records.
Note: Operands X12-X16 must be specified only if the Get/Put routines are used.

X12

specifies the use of Get/Put routines with this file through the following operands:

GETb
PUTb
BOTH -- Both a Get and a Put routine may be used in conjunction with a single file table by changing the file code through the macro-instructions IOMIP and IOMOP, and using the proper IOGET or IOPUT linkage.

X13

is the tag of the major work area associated with this file.
If all work areas are given in the IOGET or IOPUT linkages, the specific operand NOWORKAREA should be used.
If operand X13 is NOWORKAREA, operand X16 must be WORK or WBSD.

X14

indicates several options concerning blocking and padding through the following specific operands:

PAD9 or PADb -- The last tape record of this fixed-length data record file is to be filled with 9's padding or blanks padding, respectively. It should be noted that the use of blanks padding will produce out-of-sequence data records in the final block. Files containing errors in sequence may not be used as input to MER80.

NOPA -- No padding is desired for this fixed-
length data record file. This option is
in conflict with record length checking
(IOFTB, operand X5). Some type of
padding must be used with record
length checking.

00xx -- The maximum blocking of variable
length data records may be specified
as 00xx. This parameter will permit
blocking for 720 Printer operations or
eliminate the possibility of exceeding
the maximum variable length blocking
of 99 (0099).

NONE -- if X14 is otherwise unused.

If this IOFTB is describing a purely Get file,
operand X14 should be NONE.

X15

is DELET if this file is being prepared for 720
printer operation. In this case, the record mark of
the final record in a block will be deleted. (A file
with deleted record marks is not acceptable input to
the Get routines.)

is EOF9S if the Get routine is to check for 9's
padding records and enter the end-of-file routine
when such padding is found.

is BOTH if both of the above parameters apply.

is NONE if none of the above parameters are
applicable.

X16

is BSDb if the Backspace Data Record (IOBSD)
linkage is ever used with this file.

is WORK if work areas other than the work area
designated by IOFTB operand X13 are ever used in
the IOGET or IOPUT linkage for this file.

is WBSD if both of the above parameters apply.

is NONE if none of the above parameters are
applicable.

X17

is TCT if it is desired that the Get/Put routines
use the Ten Character Transmit instruction for data
movement. In this case, the user must insure that
the following conditions are met:

1. All data records must be divisible by 10 and
must end in a record mark.
2. All work areas used must begin in a 0 location.
(This should be done by means of a NAME
entry with an A, B, or C in column 22.)
3. If operand 8 is AREAGIV, the I/O areas de-
fined by the subsequent IOFTC macro must
begin in either:
   a. A 0 location if operand 9 is F, or
   b. A 5 location if operand 9 is V.

is omitted if the TCT method of data movement is
not desired. (The 17th lozenge need not be punched.)

NOTE: The TCT method of data movement will be
used even when operand 17 is omitted, if the follow-
ing conditions are met:

1. Operand 8 is GENAREA.
2. Operand 9 is F.
3. Operand 10 is divisible by 10.
4. Operand 11 is not 0000.
5. Operand 13 is the tag of a field defined by a
NAME A, NAME B, or NAME C entry.
6. Operand 16 is NONE or BSD.

IOFTC: Third Section of File Table

Function

To name the input or output areas if they are not
generated through IOFTB. IOFTC is not required if
the input/output areas are generated.

Instruction Format

Tag	Operation	Num	Operand
	IOFTC	X0	X1 ⋈ X2 ⋈ X3 ⋈ ... X13 ⋈

X0

is the object program LASN counter (column 22).
The last entry generated by IOFTC will be LASN
with a blank operand on this counter. If multiple
LASN counters are not used, this field may be blank.

X1

specified the number of input/output areas to be
used with this file (see IOFTB operand X7).

X2

is CKLNG or NOCHK (see IOFTB operand X5).

X3

indicates the availability of input/output areas for
restart checking through the specific operands
CMPCK or NOCMP (see IOFTB operand X6).

X4

is GP if a Get or Put routine is used with this file.

is NO if no Get or Put routine is used with this
file.

X5

indicates type of record length through the follow-
ing specific operands:

F -- fixed-length records.
V -- variable-length records.

X6--X13

are the descriptive tags of the input/output areas.
Only as many operands as there are input/output
areas must be specified.

IOGET: Get a Data Record

Function

To provide linkage from the object program to an IOCS routine that will move the next input data record to the specified work area. The buffered reading of a tape record will occur when an input area is depleted. IOGET can only be used with files which are in the Get/Put mode of operation.

Instruction Format

Tag	Operation	Num	Operand
T1	IOGET		X1 ⊔ X2 ⊔ X3 ⊔

T1
is any tag or may be left blank.

X1
is the descriptive file table address. This operand must be the tag of an IOFTA macro-instruction.

X2
is the high-speed transmit address of the work area to be used, either actual or descriptive. If X2 is omitted, the work area address given in the file table will be used.
If X2 is supplied, operand X16 of the IOFTB macro-instruction must be WORK or WBSD.

X3
is SAVE if the object program requires the setting of the starting point counter. Operand X3 may be omitted.

IOHLD: Hold

Function

To provide linkage from the object program to an IOCS routine that will perform a HOLD operation. All other machine operations are held up while the HOLD makes certain that the last operation on the specified file has been completed and checked for errors. If Stacking is specified for this file, all other machine operations are held up until the HOLD also clears the stacking table of all operations for this file; i.e., executes and checks those operations.

Instruction Format

Tag	Operation	Num	Operand
T1	IOHLD		X1 ⊔ X2 ⊔

T1
is any tag or may be left blank.

X1
is the file table address, either descriptive or actual, of the tape containing the file for which the HOLD operation is to be performed.

X2
is EOFCK if the IOCS end-of-file routine is to be entered when a tape mark is encountered during a read operation, and the last-filled read-in area is yet to be processed.
is OPEN if the IOHLD macro-instruction is intended to open a tape file which is at load point. This operand may be used when the IOHLD macro-instruction is intended to perform a hold operation. OPEN should not be specified with an IOHLD which is intended to insure the completion of an IORD on a single-area Initiate file, an IORDS, or an IOFSF without a second operand, since such operations may result in an end of file. OPEN will be assumed if IOHLD is used with a minimal system (DIOCS operand X3 is MINIMAL).
If omitted, the IOCS end-of-file routine is to be entered when all areas have been processed. (This is the normal mode of operation.) A tape file which is at load point will <u>not</u> be opened by 729 IOCS if X2 of the IOHLD macro-instruction is omitted.

Example of IOHLD with Operand X2 of EOFCK

When, in order to process properly the last data record in a tape record, it is necessary that the next tape record be in memory (i.e., when, for sequencing purposes, the last data record of one tape record must be compared to the first data record of the next tape record), then IOHLD with the operand EOFCK should be used just prior to handling the last data record of a particular tape record.

IOHLD will make certain that the read operation pertaining to the next tape record is completed and checked before processing of the last data record is begun. The operand EOFCK will cause the IOCS end-of-file routine to be entered if a tape mark is encountered during the read operation. Since the IOCS end-of-file routine will be entered before the last data record preceding the tape mark is processed, the object program specialized end-of-file routine should provide for processing of this record. (End-of-File Transfer Address.)

NOTE: If the IOHLD request with a second operand specifies a file which had previously been closed or a file on which a delayed-open option was indicated during the execution of IOCS Housekeeping, that file

will be opened (including label checking and priming, if specified in the file table). Input files operating under the delayed-open option should be opened through this use of IOHLD. The use of the IORD linkage (with a file positioned at load point) will cause the loss of the first data-tape record (if priming is specified). Output files operating under the delayed-open option may be opened with either an IOHLD or any functional linkage which would cause the writing of a data tape record. IOHLD will not perform the function described if the second operand is omitted or blank.

IOIOF: Tape Unit I/O Indicator Off

Function

To turn off the I/O Indicator of the tape unit on which the tape containing the specified file is mounted.

Instruction Format

Tag	Operation	Num	Operand
T1	IOIOF		X1 �

T1

is any tag or may be left blank.

X1

is the file table address, either descriptive or actual, of the specified file. If an actual address is used, the units digit must be 4 or 9.

NOTE: This macro-instruction should not be used with the 729 IOCS. It is included in the library only for compatibility with the 705 III IOCS.

IOION: Tape Unit I/O Indicator On

Function

To turn on the I/O Indicator of the tape unit on which the tape containing the specified file is mounted.

Instruction Format

Tag	Operation	Num	Operand
T1	IOION		X1 ⫿

T1

is any tag or may be left blank.

X1

is the file table address, either descriptive or actual, of the specified file. If an actual address is used, the units digit must be 4 or 9.

NOTE. This macro-instruction should not be used with the 729 IOCS. It is included in the library only for compatibility with the 705 III IOCS.

IOLNK: Link to IOCS

Function

To provide linkage from the object program to each of the component IOCS routines.

Linkage to Housekeeping Routine

This linkage is to a routine that executes all housekeeping functions. This linkage (or linkage to CSPHASEHSK) must be made before any other linkage to IOCS except IODEC or IOTYP.

Instruction Format

Tag	Operation	Num	Operand
T1	IOLNK		CSHSK ⫿

T1

is any tag or may be left blank.

Linkage to Checkpoint Routine

This linkage should be used only in conjunction with a separate checkpoint tape system. It may be used with a minimal system only if DIOCS operand X4 is CHKPT.

Instruction Format

Tag	Operation	Num	Operand
T1	IOLNK		CSMRD ⫿

T1

is any tag or may be left blank.

Linkage to Initialization Routine

This linkage is to a routine that will initialize the CASUs (clear Bank 3; set CASUs 1-6 at 1-6, respectively; set CASUs 7 and 8 to 1 and load them with 1 and 5, respectively) and reset all error triggers.

Instruction Format

Tag	Operation	Num	Operand
T1	IOLNK		CSINIT ⊔

T1

    is any tag or may be left blank.

Linkage to Phase-to-Phase Housekeeping

This linkage is to a routine that executes all housekeeping functions except control card checking.

Instruction Format

Tag	Operation	Num	Operand
T1	IOLNK		CSPHASEHSK ⊔

T1

    is any tag or may be left blank.

Linkage to Restart Routine

This linkage is to a routine that will initiate a restart from the last checkpoint. The Restart program (CSMRS) must be available on the unit specified in the program tape entry (CSW21). It may be used with a minimal system only if DIOCS operand X4 is CHKPT.

Instruction Format

Tag	Operation	Num	Operand
T1	IOLNK		CSMRS ⊔

T1

    is any tag or may be left blank.

IOMFC: Multifile Close an Output Tape

Function

To provide linkage from the object program to an IOCS routine that will close a file on a multifile output tape. A tape mark, an end-of-file trailer and another tape mark will be written. The tape will be positioned immediately following the last data record written. If an IOMFO is subsequently issued to write another file on the tape, a tape mark, an intermediate header label (if designated), and another tape mark (if designated) will be written after the last data record, thus writing over the tape mark, end-of-file trailer and tape mark. If a subsequent file is not written, the records will be properly terminated. This operation will not be executed if the tape has not been opened, or if it is at load point after having been rewound.

Instruction Format

Tag	Operation	Num	Operand
T1	IOMFC		X1 ⊔

T1

    is any tag or may be left blank.

X1

    is the file table address, either descriptive or actual, of the output tape containing the file to be closed. If an actual address is used, the units digit must be 4 or 9.

Restriction: IOMFC may not be used with a minimal system (DIOCS operand X3 is MINIMAL).

IOMFO: Multifile Open and Output Tape

Function

To provide linkage from the object program to an IOCS routine that will terminate one file on a multifile output tape and position the tape to receive records of the next file. A tape mark, an intermediate header label (if designated) and another tape mark (if designated) will be written. This operation will not be executed if the tape has not been opened, or if it is at load point after having been rewound.

Instruction Format

Tag	Operation	Num	Operand
T1	IOMFO		X1 ⋈

T1

is any tag or may be left blank.

X1

is the file table address, either descriptive or actual, of the output tape containing the file to be opened. If an actual address is used, the units digit must be 4 or 9.

Restriction: IOMFO may not be used with a minimal system (DIOCS operand X3 is MINIMAL).

IOMIP: Change Function of Output Tape to Input

Function

To make the file code indicate that the tape is to be used as input for subsequent operations. (This implies that the tape had been used as output prior to this point.)

Instruction Format

Tag	Operation	Num	Operand
T1	IOMIP		X1 ⋈

T1

is any tag or may be left blank.

X1

is the file table address, either descriptive or actual, of the tape to be changed from output to input. If an actual address is used, the units digit must be 4 or 9.

IOMOP: Change Function of Input Tape to Output

Function

To make the file code indicate that the tape is to be used as output for subsequent operations. (This implies that the tape has been used as input prior to this point.)

Instruction Format

Tag	Operation	Num	Operand
T1	IOMOP		X1 ⋈

T1

is any tag or may be left blank.

X1

is the file table address, either descriptive or actual, of the tape to be changed from input to output. If an actual address is used, the units digit must be 4 or 9.

IOPOS: Position Tape

Function

To provide linkage from the object program to an IOCS routine that will position a tape by either backspacing or forward spacing over a specified number of tape records.

Instruction Format

Tag	Operation	Num	Operand
T1	IOPOS		X1 ⋈ X2 ⋈

T1

is any tag or may be left blank.

X1

is the file table address, either descriptive or actual, of the tape that will be positioned. If an actual address is used, the units digit must be 4 or 9.

X2

is the signed literal number of records to be backspaced or forward spaced over, or the descriptive or actual address of a field containing the number. The field which specifies the number of records must appear in memory as a three-character signed field with left protection.

Restriction: IOPOS may not be used with a minimal system (DIOCS operand X3 is MINIMAL).

IOPOS is designed to replace both IOBSP and
IOFSP. The IOPOS routine assumes that input
areas have been primed. In using IOPOS, the pro-
grammer should assume that the tape is positioned
after the last record processed, as indicated by the
last IORD or IOWR linkage given. Thus, if the pro-
gram has given an IORD linkage after processing
record 3 and, while processing record 4, gives a
linkage:

          IOPOS   FILE A ¤ # + 002 # ¤

IOCS will position the tape before record 6 and then
prime, starting with area 1. Under the same cir-
cumstances,

          IOPOS   FILE A ¤ # - 002 # ¤

will position the tape before record 2 and then
prime, starting with area 1. Through use of the
IOPOS macro-instruction, both input and output
files for an application can be properly repositioned
by specifying the same counter in operand 2 of the
IOPOS linkages.

IOCS will count, but will not execute, any opera-
tions which are present in the stacking table. There-
fore, if an IOPOS is issued to backspace an output
tape in order to read in the record just written on
this tape, an IOHLD should be given to insure that
the last operation (the write) has been completed
and checked.

If priming is specified in the file table, IOCS will
prime the input areas after having positioned the
tape (i.e., in the first example above, record 6 will
be read into area 1, record 7 into area 2, etc.; in
the second example, record 2 will be read into area
1, record 3 into area 2, etc.).
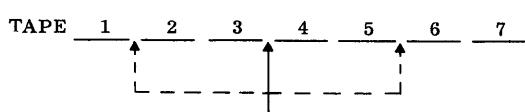
3	4

Input areas before IOPOS
(IORD which will cause the
overlay of 3 has been made)

6	7

Input areas after IOPOS
+ 002 (with priming)

2	3

Input areas after IOPOS
- 002 (with priming)

Solid arrow is assumed
tape position before IOPOS.
Broken arrows indicate
tape position after IOPOS,
but prior to priming (this
is the new assumed posi-
tion of the tape after
priming.)

IOPUT: Put a Data Record

Function

To provide linkage from the object program to an
IOCS routine that will move a data record from a
specified work area to an output block. The buffered
writing of a tape record will occur when a block is
completed. IOPUT can only be used with files which
are in the Get/Put mode of operation.

Instruction Format

Tag	Operation	Num	Operand
T1	IOPUT		X1 ¤ X2 ¤ X3 ¤ X4 ¤

T1

is any tag or may be left blank.

X1

is the descriptive file table address. This
operand must be the tag of an IOFTA macro-
instruction.

X2

is the high-speed transmit address of the work
area from which the data is to come, either
descriptive or actual. If X2 is omitted, the
work-area address given in the file table will be
used.

If X2 is supplied, operand X16 of the IOFTB
macro-instruction must be work or WBSD.

X3

is omitted if the IOPUT is to move a data record
into an output area.

is CLSFINAL if this IOPUT is used to close the
file after the writing of the final record (with pad-
ding, if required). When this operand is specified
in an IOPUT, the IOCLS macro-instruction is no
longer required to close a file.

is FINAL if this IOPUT is used to write out the
last tape record (with padding, if required). This
operand is suggested for use on a multifile tape,
since it will not result in the tape being rewound.
Otherwise, an IOCLS will still be required. To
close a file on a multifile tape, IOPUT with a third
operand of FINAL, followed by an IOMFO, should
be used.

If X3 is CLSFINAL or FINAL, a data record will not be moved by this IOPUT.

X4

is SAVE if the object program requires the setting of the starting point counter. Operand X4 may be omitted.

IORD: Read Tape

Function

To provide linkage from the object program to an IOCS routine that will read records from tape. Record length checking will be included if the file table indicates this option. The read operation can be checked immediately if desired (hold mode).

Instruction Format

Tag	Operation	Num	Operand
T1	IORD		X1 ⋈ X2 ⋈

T1

is any tag or may be left blank.

X1

is the file table address, either descriptive or actual, of the input tape. If an actual address is used, the units digit must be 4 or 9.

X2

is HOLD if the read operation is to be checked immediately.

If the read operation is to be overlapped with processing, operand X2 should be omitted.

NOTE: If priming is specified, IORD should not be used to open a file which is at load point due to a delayed-open option or previous functional linkage which resulted in a rewind of the tape. (See Note under IOHLD.) IORD may be used to open such a file if priming is not specified.

IORDS: Read Tape Special

Function

To provide linkage from the object program to an IOCS routine that will read records from tape into an address specified in the macro-instruction rather

than in the file table. The read operation can be checked immediately if desired (hold mode).

Instruction Format

Tag	Operation	Num	Operand
T1	IORDS		X1 ⋈ X2 ⋈ X3 ⋈ X4 ⋈

T1

is any tag or may be left blank.

X1

is the file table address, either descriptive or actual, of the input tape. If an actual address is used, the units digit must be 4 or 9.

X2

is the address, either descriptive or actual, into which records will be read. If an actual address is used, the units digit must be 0 or 5.

X3

is HOLD if the read operation is to be checked immediately.

If the read operation is to be overlapped with processing operand X3 should be omitted.

X4

is CKLNG if record length checking is desired. If record length checking is not desired, operand X4 should be omitted.

If CKLNG is specified, the input area (operand X2) must conform to specifications for length checking, and the type of record length (fixed or variable) must be the same as that specified in the file table.

Restriction: IORDS may not be used with a minimal system (DIOCS operand X3 is MINIMAL).

IORET: Change Object Program Return Point

Function

To allow an object program specialized routine (end of reel, end of file, header) to change the IOCS return address for the object program.

Normally, when object program linkages are executed for an IORD, IOWR, IOGET or IOPUT, IOCS will return control (at the completion of its functions) to the instruction immediately following the linkage.

However, the specialized routine can use IORET as its last instruction to execute the required return (IORETURNTO or IORETURNNO) to IOCS. At the completion of the IOCS functions, control will be returned to the object program at the instruction following the macro-instruction IORET.

The following points should be considered when using IORET:

1. IORET is intended principally for use in the End-of-File Transfer Address on input files.

2. IORET cannot be used in the End-of-Reel Transfer Address for an output tape.

3. IORET cannot be used in the End-of-Reel Transfer Address if Mode 1 end-of-reel handling is specified in the file table.

4. IORET cannot be used on an Initiate mode file with a single input area unless the Get/Put system is used exclusively.

5. IORET cannot be used on a file on which either of the following is used: IORDS with the third operand omitted, or IOFSF with both the second and third operands omitted.

6. An IORET which is encountered during the execution of IOCS Housekeeping will not affect the return point to the object program, which is always after the IOLNK macro-instruction. Thus, if it is anticipated that an input file may contain no records (and Get/Put is not being used), either DELAYOPEN (operand 19 of IOFTA) or NOPRI (operand 14 of IOFTA) should be specified, or IORET should not be used.

Instruction Format

Tag	Operation	Num	Operand
T1	IORET		X1 ⊟

T1

is any tag or may be left blank.

X1

is IORETURNNO if the return to IOCS is to be at IORETURNNO.

X1 should be omitted if the return to IOCS is to be at IORETURNTO.

IORUN: Rewind-Unload Tape

Function

To rewind-unload a tape. A linkage is generated from the object program to an IOCS routine which

will perform this operation regardless of the file table specification (of RWD or RUN). This operation will not be executed if the tape has not been opened, or if it is at load point after having been rewound.

Instruction Format

Tag	Operation	Num	Operand
T1	IORUN		X1 ⊟

T1

is any tag or may be blank.

X1

is the file table address, either descriptive or actual, of the tape to be rewound and unloaded. If an actual address is used, the units digit must be 4 or 9.

Restriction: IORUN may not be used with a minimal system (DIOCS operand X3 is MINIMAL).

IORWD: Rewind Tape

Function

To rewind a tape. A linkage is generated from the object program to an IOCS routine which will perform this operation regardless of the file table specification (of RWD or RUN). This operation will not be executed if the tape has not been opened, or if it is at load point after having been rewound.

Instruction Format

Tag	Operation	Num	Operand
T1	IORWD		X1 ⊟

T1

is any tag or may be left blank.

X1

is the file table address, either descriptive or actual, of the tape to be rewound. If an actual address is used, the units digit must be 4 or 9.

Restriction: IORWD may not be used with a minimal system (DIOCS operand X3 is MINIMAL).

IOTA: Tape Table A

Function

To generate Tape Table entries as part of the current assembly. An IOTA macro-instruction must be supplied to indicate the base tape and any associated alternates for each file used in a program. In addition, the IOTA macro-instruction should be used to specify any free tapes which could be assigned functions in the program.

Instruction Format

Tag	Operation	Num	Operand
T1	IOTA		X1 ⊨ X2 ⊨ X3 ⊨ ... X6 ⊨

T1

is any tag or omitted.

If IOTA is describing a base tape,
X1

is the file table address, either descriptive or actual. If an actual address is used, the units digit must be 4 or 9.

X2

is the select address of the base tape in the form 2x0y, where x is the channel number and y is the tape number within the channel.

X3-X6

are the select addresses of all the alternate tapes for this file in sequence used. If no alternates are used, X3 through X6 may be omitted.

If IOTA is describing a free tape,
X1

is FREE.

X2-X6

are the select addresses of up to five free entries in the form 2x0y, where x is the channel number and y is the tape number within the channel. If less than five free tapes are described, the latter operands may be omitted.

If IOTA is closing the Tape Table.
X1

is END.

X2-X6

should be omitted.

NOTE: The first IOTA is normally preceded by LASN CSB3001. This tag describes the same location as operand X5 of the DIOCS macro-instruction.

IOTS: Specify Tapes with Special Functions

Function

To specify tapes which have been assigned the following functions: checkpoint output, checkpoint work, dump (for recording of error records), or secondary output for messages. This macro-instruction establishes the special tape section of the Tape Table.

Instruction Format

Tag	Operation	Num	Operand
	IOTS	X0	X1 ⊨ X2 ⊨ X3 ⊨ ... X10 ⊨

X0

is the object program current LASN counter assignment. The last entry generated by IOTS will be a LASN with a blank operand on this counter. If multiple LASN counters are not used, this field should be blank.

X1

is the file table address of the checkpoint output tape, either descriptive or actual. If an actual address is used, the units digit must be 4 or 9. This operand should be omitted if checkpoints are not to be taken.

X2

is the select address of the base tape to be used as the checkpoint output tape, in the form 2x0y, where x is the channel number and y is the tape number within the channel. This operand must be omitted if operand X1 is omitted.

X3

is the file table address of the checkpoint work tape, either descriptive or actual. If an actual address is used, the units digit must be 4 or 9. This operand must be omitted if operand X1 is omitted.

X3 may also be used to indicate the octant to be used as the checkpoint work area if no checkpoint work tape is indicated, but checkpoints are to be taken. This should be an unsigned numeric character (1-8). If this operand is omitted, the last octant will be assumed. Only the last 1,025 positions of the specified octant will be used.

X4

is the select address of the base tape to be used as the checkpoint work tape, in the form 2x0y, where x is the channel number and y is the tape number within the channel. This operand must be omitted or blank if X3 designates a work-area octant. It also must be omitted if operand X1 is omitted.

X5

is the file table address of the dump tape, either descriptive or actual. If actual, the units digit must be 4 or 9. This operand may be omitted if a dump tape is not to be specified, in which case records that the operator elects to dump will be dumped on the typewriter.

X6

is the select address of the base tape which will contain dumped records, in the form 2x0y, where x is the channel number and y is the tape number within the channel. This operand must be omitted if operand X5 is omitted.

X7

is the file table address of the base tape which will be used as the message tape, either descriptive or actual. If actual, the units position must be 4 or 9. This operand may be omitted if it is not desired to specify a message tape. In this case, messages for which the control work specifies placement on tape will be typed.

X8

is the select address of the base tape which will contain the secondary output messages, in the form 2x0y, where x is the channel number and y is the tape number within the channel. This operand must be omitted if operand X7 is omitted.

X9

is the file table address, either descriptive or actual, of the base tape which will contain the label control cards. If actual, the address must end in 4 or 9. This operand may be omitted if control cards are to be read from the card reader.

X10

is the select address of the control card base tape, in the form 2x0y, where x is the channel number and y is the tape number within the channel. This operand should be omitted if X9 is omitted.

Restriction: Operands X5 through X8 must be omitted if using a minimal system (DIOCS operand X3 is MINIMAL).

IOTYP: Type a Message

Function

To designate a message and provide linkage to an IOCS routine that will type the message, put it on tape, or ignore it. The message treatment is determined by the control word for the Message Class Code to which the message is assigned.

A general description of Message Class Codes and message setup is included in the discussion of the Type Subroutine later in this manual.

Instruction Format

Tag	Operation	Num	Operand
T1	IOTYP		X1 ⊔ X2 ⊔ X3 ⊔

T1

is any tag or is omitted.

X1

is the address of the message, either descriptive or actual, or is the literal message. If an actual address is used, it must be the left-hand address of the message field.

X2

is the Message Class Code (A, B, C, or D) or is omitted. If operand X2 is omitted, Class A will be assumed.

X3

is INTERRUPT if the IOTYP linkage is made from any of the specialized routines (end of reel, end of file, Header Transfer Address routines, IOREDUNCHK, CSA90, or IOTRSOPLBL). Otherwise, operand X3 must be omitted. It may also be omitted if the ENTIP macro-instruction has preceded the IOTYP linkage.

Restriction: IOTYP may not be used in an interrupt program other than an IOCS exit.

IOWR: Write Tape

Function

To provide linkage from the object program to an IOCS routine that will write records on tape. Record length checking will be included if the file table indicates this option. The write operation can be checked immediately if desired (Hold mode). Write requests must never be addressed to a group mark.

Instruction Format

Tag	Operation	Num	Operand
T1	IOWR		X1 ⋈ X2 ⋈

T1

is any tag or may be left blank.

X1

is the file table address, either descriptive or actual, of the output tape. If an actual address is used, the units digit must be 4 or 9.

X2

is HOLD if the write operation is to be checked immediately.

If the write operation is to be overlapped with processing, operand X2 should be omitted.

IOWRS: Write Tape Special

Function

To provide linkage from the object program to an IOCS routine that will write records on tape from an address specified in the macro-instruction rather than in the file table. The write operation can be checked immediately if desired (Hold mode). Write requests must never be addressed to a group mark.

Instruction Format

Tag	Operation	Num	Operand
T1	IOWRS		X1 ⋈ X2 ⋈ X3 ⋈ X4 ⋈

T1

is any tag or may be left blank.

X1

is the file table address, either descriptive or actual, of the output tape. If an actual address is used, the units digit must be 4 or 9.

X2

is the address, either descriptive or actual, from which records will be written. If an actual address is used, the units digit must be 0 or 5.

X3

is HOLD if the write operation is to be checked immediately.

If the write operation is to be overlapped with processing, operand X3 should be omitted.

X4

is CKLNG if record length checking is desired.

If record length checking is not desired, operand X4 should be omitted.

If CKLNG is specified, the output area (operand X2) must conform to specifications for length checking, and the type of record length (fixed or variable) must be the same as that specified in the file table.

Restriction: IOWRS may not be used with a minimal system (DIOCS operand X3 is MINIMAL).

The procedures used by an installation or in a specific program may make it necessary and/or desirable for a user to supplement certain IOCS functions with specialized routines. This is particularly true in connection with beginning of file, beginning of reel, end of file, end of reel, and redundancy checking. To facilitate linkage to specialized routines at these points, the following exits are provided in IOCS:

File Table Exits

1. End-of-Reel Transfer Address
2. End-of-File Transfer Address
3. Header Transfer Address

Common Linkage Exits

1. IOTRSOPLBL
   (The associated label, if any, is in the IOTRSHLBL area; the associated file table is in the CSF0000 area.)
2. IOREDUNCHK
3. CSA90 - Control Card Exit

IOCS always transfers to these exits in interrupt program. The starting point counter is set in Bank 3. The object programmer should use CASUs 9, 13 and 14. CASUs 1-6 will be set 1-6, respectively, CASU 7 set to 1 contains 1, and CASU 8 set to 1 contains 5. The contents of CASUs 1-6 are destructible, but the settings should not be destroyed. If an operation requiring the use of an accumulator is necessary, the object programmer must save the contents of Bank 0, 1, or 3 before executing this operation, and restore the contents when the operation is complete. Banks 2 and 4 may not be used under any circumstances; if an IODEC or IOTYP linkage is made during a routine and Bank 3 has been saved, it must be restored prior to the linkage. The object program must not leave the interrupt program during the execution of specialized routines. The starting point counter must be set above 2,000 on the return to IOCS.

The entry placed in the file table fields or the common linkage fields either specifies the address of a specialized routine to be transferred to by IOCS, or specifies that no specialized routine is required or desires. If a specialized routine is used, it must be terminated by a transfer back to IOCS at IORETURNTO or IORETURNNO. If a specialized routine is not used, IORETURNTO or IORETURNNO must be specified in the exit field so that IOCS will continue properly. It should be noted that no linkage to IOCS can be made during the execution of a specialized routine, except for linkages to the typing and decision routines. (See macro-instructions IOTYP and IODEC.)

The following series of charts are grouped according to exit point and label type (where applicable), and describe the exit conditions, necessary specialized routine processing, and return points.

Header Transfer Address -- Standard Header, Beginning-of-Reel Routines

INPUT TAPE

Exit Condition:	The exit is made when a standard header has been read and completely checked by IOCS. *
Necessary Processing:	Processing will be required if information in the miscellaneous field of the header must be checked.
Return Point:	If no information is to be checked in the miscellaneous field, or if the routine has determined that the information is correct, re-entry should be at IORETURNTO. IOCS will then continue positioning the tape. If the routine has determined that the information in the miscellaneous field is incorrect, the routine should effect a loop to allow the operator to mount the correct reel. When the reel has been mounted, re-entry should be at IORETURNNO. IOCS will then check the new reel.

OUTPUT TAPE

Exit Condition:	The exit is made when a standard header has been created in the IOTRSHLBL area.
Necessary Processing:	None.
Return Point:	Re-entry must be at IORETURNTO. IOCS will then write the header (from IOTRSHLBL area) and a tape mark.

* An exit can also be made to the Header Transfer Address by pressing Interrupt Key 253 at loop/message 30291. In this case, there will not be a valid header in IOTRSHLBL. If necessary, the specialized routine can determine whether or not a valid header has been read by interrogating the A bit at CSW13. This bit is set 1 if there is a missing label condition.

Header Transfer Address -- Nonstandard Header, Beginning-of-Reel Routines

INPUT TAPE

Exit Condition:	The exit is made when the first record on tape has been read. *
Necessary Processing:	The routine must determine whether or not the record is a header, and whether the information in the header is correct.
Return Point:	If the routine has determined that the record is a header and that the information contained is correct, re-entry should be at IORETURNTO. IOCS will then continue positioning the tape. If the routine has determined that the record is not a header, re-entry should be at IORETURNNO. IOCS will then effect loop/ message 30291. (If the record is a header, but the information in the header is incorrect, the

* An exit can also be made to the Header Transfer Address by pressing Interrupt Key 253 at loop/message 30290 or 30291. In this case, there will not be a valid header in IOTRSHLBL. If necessary, the specialized routine can determine whether or not a valid header has been read by interrogating the A bit at CSW13. This bit is set 1 if there is a missing label condition.

INPUT TAPE (Cont)
Return Point:

routine must make provisions for handling this error condition. If the error procedure involves mounting a new reel, re-entry can be made at IOTRSEXIT after the reel has been mounted, and IOCS will then check the new reel.)

OUTPUT TAPE
Exit Condition: The exit is made when the first record on tape has been read. *

Necessary
Processing: The routine must determine whether or not the record is a header, and whether the information in the header is correct. The new header must be created in the IOTRSHLBL area.

Return Point: If the routine has determined that the record is a header and that the information contained is correct, re-entry should be at IORETURNTO. IOCS will then write the new header (from IOTRSHLBL area) and a tape mark, if specified.
If the routine has determined that the record is not a header, re-entry should be at IORETURNNO. IOCS will then effect loop/ message 30290. (If the record is a header, but the information in the header is incorrect, the routine must make provisions for handling this error condition. If the error procedure involves mounting a new reel, re-entry can be made at IOTRSEXIT after the reel has been mounted, and IOCS will then check the new reel.)

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* An exit can also be made to the Header Transfer Address by pressing Interrupt Key 253 at loop/message 30290 or 30291. In this case, there will not be a valid header in IOTRSHLBL. If necessary, the specialized routine can determine whether or not a valid header has been read by interrogating the A bit at CSW13. This bit is set 1 if there is a missing label condition.

Header Transfer Address -- No Header, Beginning-of-Reel Routines

INPUT TAPE
Exit Condition: The exit is made when the tape has been checked; the tape is at load point.

Necessary
Processing: None.
Return Point: Re-entry must be at IORETURNTO.
OUTPUT TAPE
Exit Condition: The exit is made when the tape has been checked; the tape is at load point.

Necessary
Processing: None.
Return Point: Re-entry must be at IORETURNTO.

Header Transfer Address -- Standard Header, Intermediate End-of-File Routines*

INPUT MULTIFILE TAPE
Exit Condition: The exit is made when a tape mark and a standard header have been read, and when processing for the file has been completed. **

Necessary
Processing: None.
Return Point: Re-entry must be at IORETURNTO. IOCS will then continue positioning the tape for sequential or nonsequential handling, as specified.

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OUTPUT MULTIFILE TAPE
Exit Condition: The exit is made only when an IOMFO is issued. A tape mark has been written, and a standard header has been created in the IOTRSHLBL area.

Necessary
Processing: None.
Return Point: Re-entry must be at IORETURNTO. IOCS will then write a header (from IOTRSHLBL area) and a tape mark.

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* On multifile tapes, the specialized Header Transfer Address routine can determine whether exit is being made at beginning of reel or intermediate end of file by interrogating the file counter (CSF0003032) for zero.
** An exit can also be made to the Header Transfer Address routine by pressing Interrupt Key 253 at loop/message 30295. In this case, there will not be a valid header in IOTRSHLBL. If necessary, the specialized routine can determine whether or not a valid header has been read by interrogating the A bit at CSW13. This bit is set 1 on a missing label condition.

Header Transfer Address -- Nonstandard Header, Intermediate End-of-File Routines*

INPUT MULTIFILE TAPE
Exit Condition: The exit is made when a tape mark and the following record have been read and when processing for the file has been completed. **
If a standard trailer is specified, IOCS has determined that the record is not a trailer. If a nonstandard trailer is specified, the user's end-of-reel routine has determined that the record is not an end-of-reel trailer.

Necessary
Processing: The routine must determine whether or not the record is a header.
Return Point: If the routine has determined that the record is a header, re-entry should be at IORETURNTO. IOCS will then continue positioning the tape for sequential or nonsequential handling, as specified.
If a standard trailer is specified and the routine has determined that the record is not a header, re-entry should be at IORETURNNO. IOCS will then treat the record as a data record and will continue positioning the tape for sequential or nonsequential handling, as specified.
If a nonstandard trailer is specified and the routine has determined that the record is not a header, re-entry should be at IORETURNNO. IOCS will then link to the End-of-File Transfer Address.

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* On multifile tapes, the specialized Header Transfer Address routine can determine whether exit is being made at beginning of reel or intermediate end of file by interrogating the file counter (CSF0003032) for zero.
** An exit can also be made to the Header Transfer Address routine by pressing Interrupt Key 253 at loop/message 30295. In this case, there will not be a valid header in IOTRSHLBL. If necessary, the specialized routine can determine whether or not a valid header has been read by interrogating the A bit at CSW13. This bit is set 1 on a missing label condition.

OUTPUT MULTIFILE TAPE

Exit Condition: The exit is made only when an IOMFO is issued. A tape mark has been written.

Necessary Processing: The header must be created in the IOTRSHLBL area.

Return Point: Re-entry must be at IORETURNTO. IOCS will then write the new header (from IOTRSHLBL area) and a tape mark, if specified.

Header Transfer Address -- No Header, Intermediate End-of-File Routines*

INPUT MULTIFILE TAPE

Exit Condition: The exit is made when a tape mark has been read and when processing for the file has been completed. If the record following the tape mark is 95 characters or less and is not a tape mark, it is in the IOTRSHLBL area. If the record following the tape mark is more than 95 characters in length, the A bit at CSW13 has been set 1.
If a standard trailer is specified, IOCS has determined that the record is not a trailer. If a nonstandard trailer is specified, it has been determined that the record is not an end-of-reel trailer.

Necessary Processing: If a standard trailer is specified, none.
If a nonstandard trailer is specified, the routine must determine whether or not the record is a data record (as opposed to an end-of-file trailer).

Return Point: If a standard trailer is specified, re-entry must be at IORETURNTO. IOCS will then continue positioning the tape for sequential or nonsequential handling, as specified.
If a nonstandard trailer is specified and the routine has determined that the record is a data record, re-entry should be at IORETURNTO. IOCS will then continue positioning the tape for sequential or nonsequential handling, as specified.
If a nonstandard trailer is specified and the routine has determined that the record is not a data record, re-entry should be at IORETURNNO. IOCS will then link to the End-of-File Transfer Address.

OUTPUT MULTIFILE TAPE

Exit Condition: The exit is made only when an IOMFO is issued. A tape mark has been written.

Necessary Processing: None.

Return Point: Re-entry must be at IORETURNTO.

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* On multifile tapes, the specialized Header Transfer Address routine can determine whether exit is being made at beginning of reel or intermediate end of file by interrogating the file counter (CSF0003032) for zero.

End-of-File Transfer Address -- Standard Trailer

INPUT TAPE

Exit Condition: The exit is made when the processing for the file has been completed, and a tape mark and a standard end-of-file trailer have been read. *

Necessary Processing: None.

Return Point: Re-entry must be at IORETURNTO. The IOCS end-of-file routines will be executed next.

OUTPUT TAPE

Exit Condition: The exit is made when an IOCLS or an IOMFC is issued, and a standard end-of-file trailer has been created in the IOTRSHLBL area. The tape is positioned immediately after the last data tape record written.

Necessary Processing: None.

Return Point: Re-entry must be at IORETURNTO. IOCS will then write a tape mark, the end-of-file trailer (from IOTRSHLBL area), and a tape mark.

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* An exit can also be made to the End-of-File Transfer Address by pressing Interrupt Key 253 at loop/message 30293 or 30295. In this case, there will not be a valid trailer in IOTRSHLBL. If necessary, the specialized routine can determine whether a valid trailer has been read by interrogating the A bit at CSW13. This bit is set 1 on a missing label condition.

End-of-File Transfer Address -- Nonstandard Trailer

INPUT TAPE

Exit Condition: The exit is made when the processing for the file has been completed, and a tape mark and the following record have been read. *

Necessary Processing: The routine must determine whether an end-of-file condition or a missing label condition exists.

Return Point: If the routine has determined that an end-of-file condition exists, re-entry should be at IORETURNTO. The IOCS end-of-file routines will be executed next.
If the routine has determined that a missing label condition exists, re-entry should be at IORETURNNO. IOCS will then execute loop/message 30293 (if single file tape) or 30295 (if multifile tape).

OUTPUT TAPE

Exit Condition: The exit is made when an IOCLS or an IOMFC is issued (a standard end-of-file trailer has been created in the IOTRSHLBL area). The tape is positioned immediately after the last data tape record written.

Necessary Processing: The nonstandard trailer must be created in the IOTRSHLBL area.

Return Point: Re-entry must be at IORETURNTO. IOCS will then write a tape mark, the end-of-file trailer (from IOTRSHLBL area), and a tape mark.

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* An exit can also be made to the End-of-File Transfer Address by pressing Interrupt Key 253 at loop/message 30293 or 30295. In this case, there will not be a valid trailer in IOTRSHLBL. If necessary, the specialized routine can determine whether a valid trailer has been read by interrogating the A bit at CSW13. This bit is set 1 on a missing label condition.

End-of-File Transfer Address -- No Trailer

INPUT TAPE

Exit Condition: The exit is made when the processing for the file has been completed, and a tape mark has been read.

Necessary Processing: None.

Return Point: Re-entry must be at IORETURNTO. The IOCS end-of-file routines will be executed next.

OUTPUT TAPE

Exit Condition:	The exit is made when an IOCLS or an IOMFC is issued. The tape is positioned immediately after the last data tape record written.
Necessary Processing:	None.
Return Point:	Re-entry must be at IORETURNTO. IOCS will then write a tape mark, end-of-file trailer, and a tape mark.

End-of-Reel Transfer Address -- Standard Trailer

INPUT TAPE

Exit Condition:	The exit is made under one of the following conditions:
	1. Standard trailers are specified and a standard end-of-reel trailer has been read. *
	2. Special standard trailers are specified and a tape mark and a standard end-of-reel or end-of-file trailer have been read. *
Necessary Processing:	Processing is necessary only if special standard trailers are specified, in which case the routine must determine whether an end-of-reel or an end-of-file conditions exists.
Return Point:	1. If standard trailers are specified, IOCS must be re-entered at IORETURNTO. The IOCS end-of-reel routines will be executed next.
	2. If special standard trailers are specified and the routine has determined that an end-of-reel condition exists, re-entry should be at IORETURNTO. The IOCS end-of-reel routines will be executed next.
	If special standard trailers are specified and the routine has determined that an end-of-file condition exists, re-entry should be at IORETURNNO. A transfer to the End-of-File Transfer Address will be executed by IOCS when the processing for the file has been completed.

OUTPUT TAPE

Exit Condition:	The exit is made when a reflective spot has been sensed on the output tape or when an IOFER is issued. A standard end-of-reel trailer has been created in the IOTRSHLBL area. The tape is positioned immediately after the last data tape record written.
Necessary Processing:	Processing will be required if, under certain circumstances, the end-of-reel condition is to be ignored (i. e. , the user may desire to write additional records on the tape before writing a tape mark).
Return Point:	If the end-of-reel condition is to be accepted, re-entry should be at IORETURNTO. IOCS will then write a tape mark, the end-of-reel trailer (from IOTRSHLBL area), and a tape mark. If the end-of-reel condition is to be ignored, re-entry should be at IORETURNNO. IOCS will then return to the object program. (Each subsequent write operation for the file will result in an exit to the End-of-Reel Transfer Address until the end-of-reel condition is accepted.)

* An exit can also be made to the End-of-Reel Transfer Address by pressing Interrupt Key 252 at loop/message 30293. In this case, there will not be a valid trailer in IOTRSHLBL. If necessary, the routine can determine whether a valid trailer has been read by interrogating the A bit at CSW13. This bit is set 1 on a missing label condition.

End-of-Reel Transfer Address -- Nonstandard Trailer

INPUT TAPE

Exit Condition:	The exit is made when a tape mark and the following record have been read. *
Necessary Processing:	The routine must determine whether an end-of-reel or an end-of-file condition exists.
Return Point:	If the routine has determined that an end-of-reel condition exists, re-entry should be at IORETURNTO. The IOCS end-of-reel routines will be executed next.
	If the routine has determined that an end-of-file condition exists, re-entry should be at IORETURNNO. If the tape is a single-file tape, a transfer to the End-of-File Transfer Address will be executed by IOCS when processing for the file has been completed. If the tape is a multifile tape, a transfer to the Header Transfer Address will be executed by IOCS when processing for the file has been completed.

OUTPUT TAPE

Exit Condition:	The exit is made when a reflective spot has been sensed on the output tape, or when an IOFER is issued (a standard end-of-reel trailer has been created in the IOTRSHLBL area). The tape is positioned after the last data tape record written.
Necessary Processing:	Processing will be required if, under certain circumstances, the end-of-reel condition is to be ignored (i. e. , the user may desire to write additional records on the tape before writing a tape mark). If the end-of-reel condition is to be accepted, the nonstandard trailer must be created in the IOTRSHLBL area.
Return Point:	If the end-of-reel condition is to be accepted, re-entry should be at IORETURNTO. IOCS will then write a tape mark, the end-of-reel trailer (from IOTRSHLBL area), and a tape mark. If the end-of-reel condition is to be ignored, re-entry should be at IORETURNNO. IOCS will then return to the object program. (Each subsequent write operation for the file will result in an exit to the End-of-Reel Transfer Address until the end-of-reel condition is accepted.)

* An exit can also be made to the End-of-Reel Transfer Address by pressing Interrupt Key 252 at loop/message 30293. In this case there will not be a valid trailer in IOTRSHLBL. If necessary, the routine can determine whether a valid trailer has been read by interrogating the A bit at CSW13. This bit is set 1 on a missing label condition.

End-of-Reel Transfer Address -- No Trailer

INPUT TAPE

Exit Condition:	The exit is made when a tape mark has been read.
Necessary Processing:	The routine must determine whether an end-of-reel or an end-of-file condition exists.
Return Point:	If the routine has determined that an end-of-reel condition exists, re-entry should be at IORETURNTO. The IOCS end-of-reel routine will be executed next.
	If the routine has determined that an end-of-file condition exists, re-entry should be at IORETURNNO. A transfer to the End-of-File Transfer Address will be executed by IOCS when processing for the file has been completed.

OUTPUT TAPE

Exit Condition: The exit is made when a reflective spot has been sensed on the output tape, or when an IOFER is issued. The tape is positioned immediately after the last data tape record written.

Necessary Processing: Processing will be required if, under certain circumstances, the end-of-reel condition is to be ignored (i. e. , the user may desire to write additional records on the tape before writing a tape mark).

Return Point: If the end-of-reel condition is to be accepted, re-entry should be at IORETURNTO. IOCS will then write a tape mark, end-of-reel trailer, and a tape mark.
If the end-of-reel condition is to be ignored, re-entry should be at IORETURNNO. IOCS will then return to the object program. (Each subsequent write operation for the file will result in an exit to the End-of-Reel Transfer Address until the end-of-reel condition is accepted.)

IOTRSOPLBL (Output Tape Only)

Exit Condition: The exit is made when the tape is at load point and a standard header is specified in the file table. If there was a standard label on the tape, it will be in the label work area (CSB0000 or IOTRSHLBL). If there was no standard header on the tape, loop/message 30290 will have been given and Option 2 taken, and the A-bit of CSW13 will be OFF (as will the A-bit of IOTRSLNG99+4) to indicate that a valid label is not in the label area. (Exit is made by putting the address of the special routine in IOTRSOPLBL @ 1189.)

Necessary Processing: If the object program wishes to fill in a tape serial number when no standard label is on the tape, processing will be required (otherwise a tape serial number of **** will be created). If a tape serial number is to be filled in, a four-position unsigned number should be placed in CSB0002 (or IOTRSHTSER @ 925-928). This number will be used as the tape serial number for the tape being processed.

Return Point: If the output header is correct, or if a new tape serial number has been placed in the label, re-entry is at IORETURNTO. IOCS will then create a new header label.
If the routine has determined that the information is incorrect, the routine should give an IODEC linkage to allow the operator to mount the correct reel. When a new reel has been mounted, re-entry should be at IOTRSEXIT. IOCS will then check the new reel.

IOREDUNCHK

Exit Condition: One hundred unsuccessful attempts to read a record, or five unsuccessful attempts to write a record, have been made by CSERR; or a memory redundancy has been found prior to the writing of a checkpoint record by CSMRD. The memory area involved is being searched, and a redundant character has been found; the bit structure has been typed. (An exit will be made for each redundant character found in the area concerned).

The following information is available in the five-position field IOREDUNAD:

1. High-order position
The IOCS-converted character which will replace the redundant character if re-entry is at IORETURNTO.

2. Address portion
The memory location of the redundant character. The bit structure of the redundant character is not changed at this point.

Necessary Processing: If the IOCS-converted character is to replace the redundant character, no processing is necessary. (IOCS reverses the C-bit of the redundant character to create a valid character, or if the character has no bits or a C-bit only, it is replaced with an asterisk.)

Return Point: If the IOCS-converted character is to replace the redundant character, re-entry should be IORETURNTO.
If the routine has replaced the redundant character at the memory location specified with a valid 7080 character, re-entry should be at IORETURNNO. The bit structure of the character will not be changed by IOCS. (However, the character will be checked for validity.)
When the entire memory area concerned has been searched and each redundant character has been replaced, loop/message 30210, 30211, or 30940 will be executed, unless automatic dumping has been specified.

CSA90 (Control Card Exit)

Exit Condition: The exit is made when a correct label control card has been read.

Necessary Processing: The routine may obtain information from the card which may be used by the object program.

Return Point: Re-entry must be at IORETURNTO.

NOTE: No exit is made for a Date or End control card.

IOTRSHLBL -- Label Work Area

The label work area (CSB0000) is 95 positions in length, and will contain the header or trailer labels, if such are indicated, when IOCS transfers to the Header, EOR, or EOF Transfer Addresses. The fields in the label work area will be set up as follows:

Tag	Positions	Information Contained
IOTRSHIDFR	1-5	Label Identifier (1 * * * b or 10064)
IOTRSHTSER	6-9	Tape Serial Number
	10	Slash (/) field separator
IOTRSHFSER	11-14	File Serial Number
	15	Dash (-) field separator
IOTRSHRSEQ	16-18	Reel Sequence Number
	19	blank
IOTRSHFIDN	20-29	File Identification Name
	30	blank
IOTRSHYEAR	31-32	Creation Year
IOTRSHDAY	33-35	Creation Day
	36	Dash (-) field separator

Tag	Positions	Information Contained
IOTRSHRET	37-39	Retention Cycle
	40	blank
	41-52	Record Format
IOTRSCIND	53	Checkpoint Indicator
	54	blank
IOTRSHMISC	55-95	For special information (55-59 Reserved for IOCS)

This is the format of standard headers, and may be checked when an exit is made to the Header Transfer Address.

LINKAGE POINTS AND WORK AREAS

If the first operand of the terminal DIOCS macro-instruction is NOGEN, a table of Common Linkage Points and Work Areas and their associated tags will be generated. (If the operand is GEN, the tagged Linkage Points and Work Areas are generated at the appropriate points in the IOCS routines; no separate table is provided.)

The label work area (IOTRSHLBL or CSB0000) with associated tags is described in the section, "Exits to Specialized Routines. " The file table work area (CSF0000) with associated tags is described in the section, "729 IOCS File Tables. "

A description of the Common Linkage Points and Work Areas follows:

Tag	Positions	Description
CSB3001	5	First entry in the Tape Table.
CSW18	5	Tape Table entry for the checkpoint file table.
CSW21	5	Tape Table entry for the program tape.
CSW02	5	Current date.
CSW03	6	Program identification.
CSM10210	5	Message 10210.
CSW091	1	1 bit 0: Do not type Class B messages. *
CSW092		1 and 2 bit 0: Ignore Class B messages. *
CSW101	1	1 bit 0: Do not type Class C messages. *
CSW102		1 and 2 bit 0: Ignore Class C messages. *

Tag	Positions	Description
CSW111	1	1 bit 0: Do not type Class D messages. *
CSW112		1 and 2 bit 0: Ignore Class D messages. *
CSFCSSxIGN	1	Character code D: Ignore Class X (B, C, or D) messages. *
CSFCSSxTAP	1	Character code G: Place Class X (B, C, or D) messages on tape. *
CSFCSSxTYP	1	Character code F: Type Class X (B, C, or D) messages. *
CSW12	1	1 bit 0: 160K machine. 1 bit 1: 80K machine.
CSW13 (IOTRSLNG99+4)	1	A bit 1: Missing label.
CSW14	2	Size of stacking table.
CSW15 (IOSPC)	4	Starting point counter.
CSW16	5	Card reader address.
CSD005501	1	Channel ready switch. This switch may be interrogated at any time (e. g. , before loading another phase of a program) to ascertain whether or not all I/O operations are complete. If this location contains a minus sign (-), the IOCS has completed all scheduled operations.
CSA01	5	Entry to the Housekeeping routines (CSHSK).
CSA02	5	Entry to Phase-to-Phase Housekeeping (CSPHASEHSK).
CSA90	5	Exit from Control Card routine.
IOTRSEXIT	5	Re-entry from IOTRSOPLBL routine.
IOTRSOPLBL	5	Exit to examine standard output header.
CSRETURNAD (CSD0099) (IORETURNAD)	5	Exit point from 7080 IOCS.
IORETURNNO	5	Re-entry from special object program routines (answer is no).
IORETURNTO	5	Re-entry from special object program routines (answer is yes).
CSG02	5	Object program entry to checkpoint.
CSH01	5	Normal restart entry from memory.

* CSFCSSBIGN, CSFCSSBTAP, CSFCSSBTYP, CSW091, and CSW092 occupy the same position. Similarly, CSFCSSCIGN, CSFCSSCTAP, CSFCSSCTYP, CSW101 and CSW102 occupy one position, as do CSFCSSDIGN, CSFCSSDTAP, CSFCSSDTYP, CSW111, and CSW112.

CSHSK -- HOUSEKEEPING

The CSHSK routine handles all phases of input/output initialization, and will perform the following functions:
1. Initialize IOCS routines.
2. Check Tape Table and file tables.
3. Read control cards.
4. Check header labels.
5. Fill input areas.
6. Take a checkpoint at the end of CSHSK.

Initialization of IOCS Routines

Switches and addresses for all routines are initialized to allow IOCS to remain in memory while changing from one program to another.

Checking of Tape Table and File Tables

Information indicated in the Tape Table is compared to the file tables, and the file tables are initialized. Initialization of file tables includes:
1. Setting up the select address.
2. Setting up alternate tape addresses.
3. Initialization of error and end-of-reel counters.
4. Setting up of the scheduler transfer address.

Reading of Control Cards

Control cards must be provided for each input tape with standard headers. If headers appear only on output tapes, only a Date Card and an End Card need be provided. Control cards may be either of two types: file serial and cycle checking. The format of the control cards is as follows:

Date Card*

Card Columns	Information Needed
1 - 6	Object program identification.
7	blank.
8 - 9	Current year (00-99).
10 - 12	Current calendar day (001-366).
13 - 80	Not used by IOCS.

*The Date Card must precede the header control cards. If a valid date is present at CSW02, a Date Card will not be read.

File Serial Header Control Cards

Card Columns	Information Needed
1 - 10	File Identification Name. (Must be identical to the file identification in the file table.)
11	blank.
12 - 15	File Serial Number which each header label of the specified input file is to contain.
16 - 80	Not used by IOCS.

The control card is read and a search is made for an input file table containing a File Identification Name identical to the one specified in columns 1 - 10 of the control card. When this file table is found, the file serial number in columns 12 - 15 of the control card is placed in the file serial number field of the file table.

Cycle Header Control Cards

Card Columns	Information Needed
1 - 3	Cycle Number. (The three-digit number which the header label on the first reel of the specified input file is to contain.)
4 - 10	File Identification Name. (Must be identical to the File Identification Name specified by the seven low-order positions of the File Identification field of the file table.)
11	* or blank. (An asterisk is punched in this column if the cycle number specified in columns 1 - 3 is to be increased by one and placed in the three high-order positions of every output file table.) Column 11 is left blank if the cycle number specified by columns 1 - 3 is to be increased by one and placed only in the three high-order positions of the output file table which contains a File Identification Name identical to the one specified in columns 4 - 10 of the control card.
12 - 15	blank.
16 - 80	Not used by IOCS.

If columns 1 - 3 contain a numerical field and columns 12 - 15 are blank, a search is made for an input file table containing a File Identification Name identical to the one specified in columns 4 - 10 of the file identification field. When this input file table is found, the cycle number in columns 1 - 3 is placed in the three high-order positions.

After the cycle number is placed in the input file table, it is increased by one and placed in an output file table(s) according to the contents of column 11 of the control card.

End Control Card

This must be the last card of the control card deck.

Card Columns	Information Needed
1 - 6	Object Program Identification.
7 - 15	blank.
16 - 18	END.
19 - 80	Not used by IOCS.

The End Card specifies that all control cards have been read. IOCS then checks all input files containing standard headers to determine whether or not a control card has been supplied.

If any file tables have not been updated, a message will be typed, and control cards must be supplied before CSHSK can continue.

Label Checking

See CSTRS section of this manual.

Priming

If the tape is an input tape, the input areas will be filled by CSHSK if priming is specified in the file table. If priming is not specified, each input area should be primed before processing is begun.

Taking of Checkpoint

An automatic linkage to the checkpoint routine will be given at the completion of CSHSK if a checkpoint tape is specified.

Special Considerations

NORWDb Files

If operand X13 of the file table macro-instruction is NORWDb, specifying that the associated tape is not to be rewound during Housekeeping, CSHSK will perform the following functions:

1. Initialize the File Table
   a. Set up the select address.
   b. Set up the alternate tape addresses.
   c. Error, record, file and other counters will not be initialized.
   d. Set up the scheduler transfer address.
2. Prime Input Files, if Indicated in the File Table Label checking will not occur. It is assumed that any NOWRDb tape is positioned immediately prior to data; i. e. , not in front of a label. If a NORWDb tape is improperly positioned, an input label will be read as data and an output label will be destroyed by data.

DELAYOPEN Option

Operand X19 of the file table macro-instruction IOFTA may specify a delayopen option. This option may be useful when it is not known during Housekeeping whether or not a particular file will be used.

Housekeeping for files operating under the delay-open option will be incomplete in that label checking or label creation and priming will not occur. The file table will be initialized in all respects including the updating of label control information; i. e. , label control cards will be required for input files. When the tape is opened, it will be rewound and the label checked. NORWD may not be specified for a delay-open file.

Files operating under the delay-open option must be represented in the Tape Table through a base tape entry, and may be opened in the following manner:

1. Input Files: Through the functional linkage IOHLD with a second operand of OPEN or a second operand of EOFCK. (Note: if the functional linkage IORD is used and priming is specified, the priming will precede the execution of the IORD request. Hence, the first record will have been lost. The IOGET linkage must not be used to open such a file.)
2. Output Files: Through a normal output request IOWR, or any series of requests (e. g. , IOPUT) that result in the normal output request IOWR. (Note: IOPUT cannot be used to open a file which has previously been closed.) Output files may also be opened through the functional linkage IOHLD with a second operand of OPEN.

The operations IORWD, IORUN, IOCLS, IOFER, IOMFC, IOMFO, and IOHLD without a second operand will be ignored if addressed to a file which has not been opened, or is at load point after having been closed. Any other functional linkage except IOGET, IOPUT or IOBSD will cause the opening of the file.

NOTE: CSHSK automatically opens all files in the sequence given in the Tape Table.

CSDTS -- DATA TRAVEL SYSTEM

The main function of CSDTS is to execute all input/output operations pertaining to nonerror handling of data records. This function includes scheduling input/output operations (depending on the availability of the channels), and checking such operations for the possibility of errors, tape marks, and reflective spots. In addition, CSDTS contains linkage to other sections of IOCS to perform certain special functions. Since the correct application of CSDTS will result in full utilization of the simultaneous read/write/process features of the 7080, CSDTS is the most important section of IOCS.

Commands Executed by CSDTS

Every input/output function involving tapes connected to the 7080 through channels will be performed by CSDTS. To call for the execution of a particular function, the user need only insert a simple macroinstruction at the appropriate point in main-line processing.

Beginning of File Operations

In all cases when a file is being handled for the first time (i.e., during CSHSK or at the beginning of each new file on a multifile tape), the file table will be modified so that the next records read or written will use the input/output areas in the sequence given in the file table. That is, the first record will use area one, the second record will use area two, etc.

If priming is specified in the file table, the first "n" records of the input file will be read into the "n" input areas specified for the file. If a tape mark is encountered during priming, CSEOF will be entered. If the tape mark is also the first record and an end-of-file condition exists, a transfer will be made by CSEOF to the appropriate specialized routine. The programmer can ascertain the occurrence of this last.condition by verifying that the Record Counter is zero.

If priming is not specified for an input file, CSDTS assumes that all input areas will be filled by a series of read linkages which will be given in the object program before any processing is performed on the file. It also assumes that the number of such read linkages will be equal to the number of input areas given in the file table.

When to Issue a Read or Write Command

The only contact CSDTS has with main-line processing is through the linkages used to call for the execution of an I/O function. To make certain that correct processing is performed in the areas of execution of functions, keeping of counts, and checking for errors, it is absolutely necessary that a call to read be given as soon as an input area becomes available to receive a new record and a call to write be given as soon as an output area is filled. These calls must be given before any additional processing is started. Use of Get/Put will insure that read and write requests are issued as soon as they are required.

Modes of Operation

All files are operated under either of the following four modes:
1. Stacking.
2. Initiate
3. Get/Put with initiate input/output.
4. Get/Put with stacked input/output.

Stacking Mode

When a read or write request is made for a file which is operating in the stacking mode, in most cases a record will be made of the request in the stacking table associated with the channel specified, and an immediate return made to the object program. Exception to this procedure occurs under two conditions:
1. When the associated channel is not busy.
2. If there is no input/output area associated with this file available to main-line processing.

If the associated channel is not busy, the requested operation will be started. A return will be made to main-line processing at this time. If there is no input/output area available, control will not be returned to main-line processing until an area is available. This condition is called a force condition.

Only reading and writing requests based on input/output area addresses given in the file table are subject to stacking. Any other type of request addressed to a file operating in the stacking mode will, in effect, cause the immediate execution and checking of all stacked requests for this file. The current request will be initiated. It will be checked prior to a return to the object program (except IORDS, IOWRS, IORWD, IORUN, IOFSF, IOBSF and IODMP).

The number of requests which are subject to stacking at any time is equal to the number of input/output

areas used by the file minus one. CSDTS checks to see that the limit of the stacking tables is not exceeded prior to the addition of a request. If the limits of the table would be exceeded by the new entry, the first entry in the table will be executed prior to the addition of the new entry and the subsequent return to the object program.

Initiate Mode

Under the initiate mode, any operation called for by linkage from main-line processing will be started regardless of the availability of the channel. If the associated channel is not ready, CSDTS will overlap the waiting time by permitting other channels to interrupt. In addition to starting the new operation, a linkage under the initiate mode always checks the last operation performed on the channel (unless it had already been checked).

Although an operation is started under the initiate mode, it may not be completed before a return is made to main-line processing, unless HOLD is specified in the linkage. This immediate return to main-line processing permits tape start time and RD/WR time to be overlapped with processing time.

If two or more input/output areas are assigned to a file operating in the initiate mode and each request must be started prior to a return to the object program, there will always be an input/output area available to the object program. If an initiate mode file uses only one input/output area and HOLD is not specified in the read/write linkage, a return may be made to the object program prior to the completion (and checking) of the request. Prior to processing any data from such an area, a linkage should be made to IOCS (IOHLD) to check the operation.

There is no advantage to the use of initiate mode if more than one area is assigned to the file.

Get/Put Mode

The Get/Put mode provides for the automatic deblocking of input data records and blocking of output data records, and will handle any records which conform to tape format specifications. The necessary reading and writing of tape records and input/output area alteration are handled automatically. Each IOGET linkage will produce a record in the work area. Each IOPUT linkage will cause a record to be moved from a work area to an output area.

The following options may be used with the Get/Put routines and are specified in the file table macro-instruction IOFTB:

1. Both a Get and a Put routine may be associated with a single file table. This permits the input/output nature of the file to be reversed (see IOMIP and IOMOP) and the Get/Put requests to be executed without using two file tables.
2. A single work-area address may be specified in the file table. The object programmer may effect certain efficiencies by restricting his work area usage to this single area. Additional work areas may be used if necessary. These areas are specified in the individual Get/Put linkages (IOGET, IOPUT). However, this additional area usage must be indicated in IOFTB operand X16.
3. A Backspace Data Record request, IOBSD, may be made of IOCS. This linkage permits the object programmer to obtain records previously handled.
4. The final output tape record may be padded with either blanks or nines (fixed-length data records). The object programmer may avoid the handling of input padding records (see IOFTB operand X15). Padding may be avoided entirely, if desired.
5. Records may be prepared for 720 printer operation. A maximum blocking factor may be specified, even for variable-length data records. The record mark of the final data record of each block may be deleted as required for 720 printer operation.

Input files operating in the Get/Put mode are normally closed automatically by linking (IOGET) to the Get/Put routine once after the last data record has been processed. The end-of-file condition is indicated by an IOCS transfer to the object program end-of-file routine.

Input files may be prematurely closed by using the IOCLS (close) macro-instruction.

Output files operating in the Get/Put mode are closed after having placed the last data record in the output area (through an IOPUT request) by an additional IOPUT linkage with a third operand of CLSFINAL. If padding is required, it will be added to the final block. This block will then be written and the file closed.

An IOCLS (close) request specifying an output file operating in the Get/Put mode will cause an immediate close of that file without having written the final record. This is an improper use of the IOCLS linkage.

A Backspace Data Record request, IOBSD, may be made of IOCS. This linkage will cause the modification of the Get/Put counters so that a subsequent IOGET or IOPUT request will cause the movement of a previous record. No data record is moved by the IOBSD linkage.

The Get/Put routines use CASUs 10 and 11 and, therefore, must move the starting point counter. On

return to the object program, the starting point counter is restored to the contents of CSW15. This field is initialized as 0000. If SAVE is specified as the third or fourth operand, respectively, of a GET or PUT linkage, coding is generated to save the current setting of the starting point counter in this field.

Counters and Indicators Used by CSDTS

Record Counter

The record counter contained in each file table is updated by CSDTS each time an I/O operation which passes over data tape records is executed. At any given time, therefore, the counter specifies the exact position of the tape. The counter is initially set to zero. The record counter for an input tape is increased by one each time a record is read or a forward space command is issued; the record counter for an output tape is increased by one each time a record is written. The record counter for an input or output tape is decreased by one each time the file is issued a backspace command. The record counter is reset to zero at the beginning of each reel of a multireel file, and whenever a tape is repositioned to the beginning of a reel (RWD) or the beginning of a file (BSF).

Force Counter

The force counter specifies the number of I/O areas available for processing at any given time, and enables CSDTS to perform the following functions:

1. Automatically make certain that the object program always has an input record or output area available if the stacking mode is used. A return will not be made to the object program until this condition is satisfied.

2. Automatically make certain that all records are processed before the object program is made aware that it has reached an input end-of-reel, if Mode 2 end-of-reel handling is specified, or that it has reached an input end of file. This checking is performed for files using either the stacking mode or the initiate mode. If a tape mark and trailer (or a header on a multifile tape) is encountered, the force counter is interrogated. If the counter is not zero, areas remain to be processed. Even though the tape mark was read correctly, the force counter will not be stepped down as it would be for a normally checked operation.

A return will be made to the object program without a prior transfer to the end-of-reel or end-of-file specialized routines. As additional requests are made for this file, the force counter will be stepped up until all data has been processed. At this time a transfer will be made to the special end-of-reel or end-of-file routine specified in the file table.

For a file operating in the Get/Put mode, a transfer will not be made to the end-of-reel routine if Mode 2, or end-of-file routine, until an IOGET request is made subsequent to the IOGET which produced the final data record in the work area; i. e. , the object program will have processed all of the data for the file before the transfer is made to the End-of-File or End-of-Reel Transfer Address.

Area Rotation

CSDTS automatically keeps track of the next input/output area address to be used in the file table. The areas are used in circular fashion; i. e. , after the last area is used, the rotation routine is such that the first area will be used next. If the Get/Put system is not used, the object program must contain the mechanics required to use the areas in exactly the same sequence and to initialize the area usage rotation according to the requirements indicated in the table under "Effects of Functional Linkages."

It is possible to share the same three input/output areas between an input and an output file by specifying a C in operands X7 of the IOFTB and X1 of the IOFTC macro-instructions for both files. In this case, the areas must be defined by the object programmer through the use of the IOFTC macros. The same three areas should be listed in the same order in each IOFTC. IOCS will read and write records from the three areas in the proper sequence, but will prime only two of them. For this procedure to work properly, the programmer must after processing a record, give the IOWR request before the IORD request; the Get/Put mode may not be used.

Generally, all functional linkages which cause tape movement with no transfer of data between memory and tape will be handled in the Hold mode (except IORWD, IORUN, IOBSF and IOFSF). At the completion of such requests (including IORWD, IORUN, IOBSF and IOFSF, but not IOFER), the associated file table will be initialized. This initialization will include area rotation (the next record will use area one); priming, if indicated in the file table (except IORWD, IORUN and IOFER); and initialization of Get/Put.

Effects of Functional Linkages

Operation Class	Operation	Operation Subject to Stacking	Stacking Table Cleared Prior to Execution	Initialization of Force Counter and Area Rotation after Execution	Automatic Open on Following Operation	Priming (If Indicated in File Table) Concludes Execution of this Operation	Operation Buffered after Clearing the Stacking Table	Operation may be used with EOR Mode 2	Operation may be used with Alternate Reels on Different Channels
1	IORD	Yes	No	No	No	No	Yes (1)	Yes	Yes
	IOWR	Yes	No	No	No	No	Yes (1)	Yes	Yes
	IODMP	No	Yes	No	No	No	Yes (1)	No	Yes
	IORDS	No	Yes	No	No	No	Yes (1)	No	Yes
	IOWRS	No	Yes	No	No	No	Yes (1)	No	Yes
2	IOBSP	No	Yes	Yes	No	Yes	No	No	No
	IOBSF	No	Yes (2)	Yes	No	Yes	Yes (1)	No	No
	IOFSP	No	Yes	Yes	No	Yes	No	No	No
	IOFSF	No	Yes (2)	Yes	No	Yes	Yes (1)	No	No
	IOPOS	No	Yes (2)	Yes	No	Yes	No	No	No
3	IOCLS	No	Yes	No (3)	Yes (3)	No	No (4)	Yes	Yes
	IOFER	No	Yes	No	No	No	No	Yes	Yes
	IOMFC	No	Yes	No	No	No	No	Yes	Yes
	IOMFO	No	Yes	Yes	No	No	No	Yes	Yes
4	IOHLD (5)	No	Yes	No	No	No	No	Yes	Yes
	IORWD	No	Yes	No (3)	Yes (3)	No	No (4)	Yes	Yes
	IORUN	No	Yes	No (3)	Yes (3)	No	No (4)	Yes	Yes
5	IOGET	No	No	No	No	No	No (6)	Yes	Yes
	IOPUT	No	No	No	No	No	No (6)	Yes	Yes
	IOBSD (7)	No	No	No	No	No	No	Yes	Yes

NOTES:

1. If the functional linkage contains the operand HOLD, the requested operation will be completed and checked prior to a return to the object program. To this extent, the operation may be considered to be unbuffered.

2. In these cases, any stacked requests for the file involved will be removed but not executed.

3. Any Class 1 or 2 request specifying a file previously closed will cause that file to be reopened (including label checking and priming, if specified in the file table). The initialization of the force counter and area usage indication will take place on the succeeding open.

4. Control will be returned to the object program when the rewind has begun.

5. The IOHLD request addressed to a file which was previously closed, or to a file on which a delayed open was indicated during the execution of Housekeeping, will cause that file to be opened (including label checking and priming, if specified in the file table). This function is performed only if the second operand of IOHLD is not omitted or blank.

6. Input/output operations are buffered, but not data record movement.

7. May not use count control.

Record Length Checking

CSDTS provides for checking the length of data tape records read or written as a result of any of the following linkages:
1. IORD or IOWR, if CKLNG is specified in the file table.
2. IOGET or IOPUT, if CKLNG is specified in the file table.
3. IORDS or IOWRS, if CKLNG is the fourth operand of the macro-instruction.

This checking is performed before the check for error and end-of-file conditions, and also after each retry if an error is detected. If any record read exceeds the size of the input area and ten-character buffer, a message will be typed and a waiting loop entered.

Fixed-Length Records

Each I/O area must be preceded by the four-character address of the position immediately following the area. Each I/O area must be followed by a group mark and a buffer area of at least ten characters, ending in a 4 or 9 position.

EXAMPLE 1: A 33-position area for fixed-length records is defined as follows:

Tag	Operation	Num	Operand	Comments
	NAME	1		
	ACON4		T3	
T1	NAME	0	T2	
T2	RCD	33		
T3	CON	1	‡	
		11		Buffer

EXAMPLE 2: An 80-position area for fixed-length records is defined as follows:

Tag	Operation	Num	Operand	Comments
	NAME	1		
	ACON4		T3	
T1	NAME	0	T2	
T2	RCD	80		
T3	CON	1	‡	
		9		Buffer

Variable-Length Records

The first three characters of each variable-length data tape record must contain a tape length count, constructed as follows:

1. The length of the record is converted into a four-character address.
2. Since variable-length records must be divisible by five, the units position can be only 0 or 5. If the units position is 0, minus zoning must be placed over the tens position. If the units position is 5, plus zoning must be placed over the tens position.
3. Place the thousands, hundreds, and tens positions as the first three characters in the tape record.

Example of Converting Lengths				
5-Character Length of Tape Record	4-Character Length of Tape Record	Proper Zoning Over Tens Position	Characters Placed in Tape Record
00105	0105	01$\overset{+}{0}$5	01$\overset{+}{0}$
02000	2000	20$\overset{-}{0}$0	20$\overset{-}{0}$
09995	9995	99$\overset{+}{9}$5	99I

Variable length input and output areas should be defined so that the total area will include a ten-character buffer area as the last ten characters. The total area should equal the maximum record length plus ten.

CSTRS -- TAPE REEL CONTROL SYSTEM

CSTRS checks and positions each tape used by the object program. IOCS will process tapes which contain standard header labels, nonstandard header labels or no header labels. It is recommended that standard header labels be used on all input and output tapes to maximize the automatic handling of tapes at beginning of file and beginning of reel.

Standard Header Labels

When a tape is to be used as a data tape or program tape, the appropriate standard data tape header or program tape header, followed by a tape mark, must be written on it. The format of these header labels is as shown in Figure 11.

Field 1

This field identifies the record as a header label. The data tape header contains "1***b" in this field, and the program tape header contains "10064". The characters in this field are also used for the following purposes:

1. The "1" in the first position of either header identifier will cause skipping to channel one when writing the label on a printer under program control.
2. The program tape identifier "10064" will cause a transfer to memory location 00064 when the LOAD key is depressed.

Field 2

This field contains the tape serial number, file serial number, and reel sequence number (xxxx/xxxx-xxx)

1. The four-digit tape serial number is the number initially assigned to the tape when it enters the system.
2. The four-digit file serial number is the tape serial number of the first reel of the associated file. For example, if the tape serial number for the first reel of a file is 0255, the file serial number field in the header label for the first reel and for each succeeding reel in the file will contain 0255.
3. The three-digit reel sequence number specifies the order of the reel within a given file, i.e., 001, 002, 003, etc.

Field No.	Positions	Contents	Description	Example
1	1-5	1***b or 10064	Header Identifier	1 ***b (data tape) 10064 (program tape)
2	6-18	xxxx/xxxx-xxx	Tape Serial Number, File Serial Number, and Reel Sequence Number	0123/0255-003
	19	blank		
3	20-19	xxxxxxxxxx	File Identification	PAYRLMASTR
	30	blank		
4	31-39	xxxxx-xxx	Creation Date and Retention Cycle	60107-030
	40	blank		
5	41-53	x-xxxx-xxxx-x	Record Format	F-0080-0001-C
6	54	blank		
	55-59		These 26 positions can be used for any special information desired on data tape header labels. Positions 61-80 can be used for instructions on program tape header labels.	
7	60-80	Miscellaneous		

Figure 11. Standard Header Label Format

Field 3

This field contains the file identification (xxxxxxxxxx), which is a distinct, ten-character name identifying the file. The first three positions of this file name may be a three-digit cycle number, in which case the other seven positions may be used for the distinct identification. If cycle numbering is used, a file is given the cycle number 001 when it is initially created; each time the file is updated the cycle number is increased by one.

Field 4

This field contains the creation date and retention cycle (xxxxx-xxx).
1. The first two digits of the five-digit field specify the year (00-99) in which the file was created. The remaining three digits specify the number of the calendar day (001-366) on which the file was created.
2. The three-digit field specifies the number of days the file is to be retained after the creation date.

Field 5

This field contains information pertaining to the records in a file (x-xxxx-xxxx-x).

1. The first position specifies whether the file consists of fixed-length records or variable-length records. "F" is entered for fixed-length records and "V" for variable-length records.
2. The first four-digit field specifies the data record length for fixed-length records or the maximum data record length for variable-length records.
3. The second four-digit field specifies tape record length and/or format as follows:
   a. For fixed-length unit tape records not ending in record marks, this field contains 0000.
   b. For fixed-length unit tape records ending in record marks, and for variable-length unit tape records, this field contains 0001.
   c. For fixed-length blocked tape records, this field contains the tape record length (data record length multiplied by blocking factor).
   d. For variable-length blocked tape records, this field contains maximum tape record length.
4. The last position specifies whether or not the tape is a checkpoint tape. If the tape contains or will contain checkpoint records, this position contains C. If the tape is not a checkpoint tape, the position contains a blank.

Field 7

This field (21 positions) can be used in any way desired by an installation. (See "729 IOCS Exits to Specialized Routines.")

In addition to the standard header label and tape mark which are at the beginning of each reel, a standard header followed by a tape mark must precede each data file on a multifile tape. The intermediate header format is shown in Figure 12.

Field No.	Posi-tions	Contents	Description
1	1-5	1***b	Header Label Identification
2	6	blank	
3	7-19	Record Count per file Skip Count per reel File Count per reel Error Count per reel	
	20-80	Same as Standard Header	

Figure 12. Intermediate Header Label Format

Nonstandard Header Labels

A nonstandard header may be any record which is not a tape mark and is between 15 and 95 characters long.

IOTRS will read nonstandard headers from input tapes and write nonstandard headers on output tapes. However, routines must be provided in the object program to check these headers and to create nonstandard headers for output tapes. (See Header Transfer Address, "729 IOCS Exits to Specialized Routines.")

In addition to the nonstandard header label at the beginning of each reel, a nonstandard header must precede each file on a multifile tape.

No Header Labels

IOTRS will process tapes which do not contain header labels at the beginning of each reel or file. (See "729 IOCS Exits to Specialized Routines.")

CSEOF -- END OF FILE AND END OF REEL

CSEOF performs operations which are necessary when a tape mark is encountered in reading data tape records, or when a reflective spot is sensed in writing data tape records. CSEOF also performs operations that are necessary as a part of special

end-of-file functions requested by macro-instructions IOCLS, IOMFC, IOMFO, IOFER, IORWD and IORUN.

IOCS will process tapes which contain standard labels, nonstandard labels, or no labels. It is recommended that standard labels be used on all input and output tapes to maximize automatic handling of tapes.

Standard Trailer Labels

In a standard labeling system, a tape mark, a label, and another tape mark are written after the last data tape record of a file or reel. The format of the standard trailer label is shown in Figure 13. Standard labels on input tapes are read and checked automatically by CSEOF; standard labels on output tapes are created and written automatically. If standard labels are used, but special handling is specified (i.e., operand X12 of IOFTA is SPECSTAND), CSEOF transfers to the object program end-of-reel routine whenever a trailer is read. There the object programmer determines whether an end-of-file or an end-of-reel condition exists. If return is IORETURNTO, CSEOF assumes this is an end-of-reel condition. If return is to IORETURNNO, CSEOF assumes this is an end-of-file condition.

Field No.	Posi-tions	Contents	Description
1	1-5	1ⴄⴄⴄb	Trailer Label Identification
2	6	R or F	Termination Code
3	7-19	Record Count per file Skip Count per reel File Count per reel Error Count per reel	
4	20-22		Reserved for future use by IOCS
5	23-80	Miscellaneous	

Figure 13. Standard Trailer Label Format

Nonstandard Trailer Labels

In this case, a tape mark, a nonstandard label, and another tape mark must follow the last tape record of a file or reel. A nonstandard label may be any record that is not a tape mark and is 95 characters or less in length. CSEOF will write nonstandard labels which are created by the object program in

the IOTRSHLBL area. Routines must be provided by the user to check nonstandard trailers on input tapes and to determine whether the tape is at end of file or end of reel.

No Trailer Labels

CSEOF will not process multifile tapes that do not contain trailers. CSEOF will, however, process single-file tapes which do not contain trailer labels. In this case, the user must provide routines for each input tape to determine whether the tape is at end of file or end of reel.

When nonstandard or no trailer labels are used, CSEOF will transfer to the object program end-of-reel routine when a tape mark is encountered on an input tape. The object program must indicate an end-of-reel or end-of-file condition to CSEOF by a return to IORETURNTO or IORETURNNO, respectively.

General CSEOF Procedures

The sequence of operations performed varies according to the linkage by which CSEOF is entered. The processing necessary in the special end-of-file, end-of-reel and header routines is described more fully in the section, "729 IOCS Exits to Specialized Routines."

End-of-Reel Procedures

Input Tape

There are two end-of-reel modes which may be processed by 729 IOCS. The object programmer should indicate the mode he desires in the file table end-of-reel-mode indicator. If Mode 2 is indicated, the programmer should consult the table in the CSDTS section of this manual before using special operational requests.

Under Mode 1, when an end-of-reel condition is recognized, CSEOF transfers immediately to the object program end-of-reel routine. At this time, the trailer, if any, is in the IOTRSHLBL area.

Under Mode 2, when an end-of-reel condition is recognized, CSEOF will not transfer to the object program end-of-reel routine until all of the areas have been processed. This condition is determined by testing the force counter. (See "force counter" in the CSDTS section of this manual.) When all the areas have been processed, CSEOF transfers to the object program end-of-reel routine. At this time, the trailer, if any, is in the IOTRSHLBL area.

After the transfer to the object program end-of-reel routine, end-of-reel handling is the same for

both modes. If return from the end-of-reel routine is to IORETURNTO, CSEOF will rewind or rewind-unload the reel, reset the tape record counter, file counter, skip counter and redundancy counter to zero, and select the alternate reel, which may be on any channel. If no alternate is specified, or if an alternate is specified and not found, a message is typed and IOCS will wait for another reel of tape to be mounted. At end of reel, processing of I/O areas may be continued as if the end-of-reel condition had not occurred. When all end-of-reel operations have been performed, a checkpoint is taken if specified in the file table and a separate checkpoint tape is indicated.

The number of data tape records processed is compared to the number of data tape records indicated in the trailer before CSEOF transfers to the End-of-Reel Transfer Address. If the counts are not equal, a message will indicate the respective counts. The object programmer has two options: to continue end-of-reel processing, or to restart from the last checkpoint.

Output Tape

End of reel on an output tape is recognized when a reflective spot is sensed. It may be forced prematurely by the macro-instruction IOFER. In either case, the sequence of operations is the same. A standard end-of-reel trailer is created in the IOTRSHLBL area. If Mode 1 is specified, CSEOF transfers to the object program end-of-reel routine; if Mode 2 is specified, IOCS performs all operations which were requested on this file before transferring to the object program end-of-reel routine. If return is to IORETURNNO, CSEOF transfers to the object program. If return is to IORETURNTO, CSEOF writes a tape mark, a trailer, if desired, and another tape mark. A rewind or rewind-unload operation is executed as indicated in the file table, and the tape record, skip, file, and redundancy counters are reset to zero/ The alternate is selected and a header is written, if specified in the file table. If there is no alternate specified or if none is found, a message is typed and IOCS will wait for another reel to be mounted. Checkpoint is taken if specified for end of reel. If checkpoint records are written at the beginning of an output reel, and alternate reels are on different channels, Mode 2 end-of-reel handling must be specified for this file.

End-of-File Procedures

Single-File Input Tape

When a tape mark has been read and CSEOF determines that an end-of-file condition exists, CSEOF

checks the force counter to determine whether all input areas have been processed before transferring to the object program end-of-file routine.

CSEOF waits until this condition exists. When all areas have been processed, CSEOF compares the number of records processed to the number of tape records written on this tape. If they are not equal, a message will be typed indicating the value of the respective counters. Two options are given at this time: to continue normal end-of-file operations, or to link to CSMRS to restart from the last checkpoint. If the counters are equal, or if the option to continue with normal end-of-file processing is taken, CSEOF transfers to the object program end-of-file routine. At this time, the trailer has been read into the IOTRSHLBL area. If return is to IORETURNTO, CSEOF will continue with end-of-file processing. If nonsequential handling is specified, CSEOF positions the tape before the first tape mark. If sequential handling is specified, the tape record, file, error and skip counters in the file table are reset to zero. CSEOF will rewind or rewind-unload the tape as indicated in the file table. When end-of-file processing is complete, a checkpoint is taken if indicated for end of file and if there is a separate checkpoint tape.

IOCLS--Input Tape

The macro-instruction IOCLS indicates to CSEOF that the object programmer wishes to close a tape file. The tape record, noise, permanent read error, file, and redundancy counters are reset to zero and the tape is rewound, or rewound and unloaded, as specified in the file table.

Multifile Input Tape

When a tape mark is recognized and CSEOF determines that an end-of-file condition exists on a multifile tape, before continuing with end-of-file procedures, the force counter is tested to see that all areas have been processed. When all areas have been processed, CSEOF compares the number of records processed to the number of tape records indictated in the label. If they are not equal, a message will be typed indicating the value of the respective counters. Two options are given at this time: to continue normal end-of-file operations, or to link to CSMRS to restart from the last checkpoint. If the counters are equal, or if the option to continue is chosen, CSEOF transfers to the object program header routine.

If return is to IORETURNTO and the tape is handled sequentially, the next file on the tape is opened, the tape record counter is reset to zero, the file

counter is incremented by one, and the I/O areas are primed, if priming is indicated in the file table. At end of file, the I/O areas are initialized so that processing begins from the first area for the next file. A record will not be moved to the Get/Put work area.

If return is to IORETURNTO and the tape is handled nonsequentially, the tape is positioned before the first tape mark. Checkpoint is taken if specified for end of file and if a separate checkpoint tape is indicated.

IOCLS--Output Tape

The macro-instruction IOCLS indicates to CSEOF that the object programmer wishes to close a tape file. A standard end-of-file trailer is created in the IOTRSHLBL area and CSEOF transfers to the object program end-of-file routine. Return must be to IORETURNTO. CSEOF will then write a tape mark, an end-of-file trailer if desired, and another tape mark. The tape record, skip, file, and error counters are reset to zero for this file. CSEOF will then rewind or rewind and unload the tape as indicated in the file table. Checkpoint is taken if specified for end of file in the file table.

IOMFC--Output Tape

The macro-instruction IOMFC indicates to CSEOF that the object programmer wishes to close a file on a multifile tape. A standard end-of-file trailer is created in the IOTRSHLBL area and CSEOF transfers to the object program end-of-file routine. Return must be to IORETURNTO. CSEOF will then write a tape mark, trailer (if desired), and another tape mark, and position the tape before the first tape mark. CSEOF does not check for sequential handling when the macro-instruction IOMFC is given. The tape is always positioned after the last data tape record. If the object programmer wishes to write another file on this tape, he should use the macro-instruction IOMFO, which is explained below. If the object programmer does not wish to write again on this reel, the file is closed and macro-instructions IORWD or IORUN may be used to rewind the tape. Checkpoint will be taken at end of file if indicated in the file table.

IOMFO--Output Tape

The macro-instruction IOMFO will terminate one file on a multifile output tape and position the tape to

	Tape Record Counter Setting	Noise or Skip Counter Setting	File Counter Setting	Redundancy Counter Setting	Permanent RD/WR Counter Setting	Last Noise Counter Setting
Input						
EOR	000000	00	000	00	00	000
IOCLS	000000	00	000	00	00	000
EOF (single)	000000	00	000	00	00	000
EOF (multi)	000000	—	Increment-ed by 1	—	—	000
Output						
IOFER	000000	00	000	00	00	000
EOR	000000	00	000	00	00	000
IOCLS	000000	00	000	00	00	000
IOMFC	—	—	—	—	—	—
IOMFO	000000	—	Increment-ed by 1	—	—	000
Input or Output						
IORWD	000000	00	000	00	00	000
IORUN	000000	00	000	00	00	000

Counters Altered by CSEOF

receive records for the next file. A standard inter-mediate header, which serves as a trailer to the pre-ceding file and a header to the file following it on the tape, is created in the IOTRSHLBL area (Figure 6). CSEOF will then write a tape mark, label (if desired), and another tape mark. The record counter is reset to zero and the file counter is incremented by one.

End-of-File, End-of-Reel Messages

When an end-of-reel condition or an end-of-file con-dition occurs, an indicative message may be typed, ignored, or placed on the secondary output unit ac-cording to the Message Type Code. (See "Type Subroutine.") These messages will include the rec-ord counter, skip counter, or noise record counter, number of entries into the redundancy correction routine, and the number of permanent redundancies.

CSERR--ERROR CORRECTION

All input/output operations performed by IOCS are checked for error and end-of-file conditions. CSERR first checks for record length errors, and then tape or channel errors. If an error has occurred, an appropriate corrective procedure is executed. When no error has occurred, or when the corrective pro-cedure has been completed, CSERR interrogates the I/O indicator and transfers to CSEOF if the indicator is on.

All tape records, including redundant tape records, are checked for length, if length checking is spec-ified in the file table.

The error correction routines follow the recom-mendations of the engineering staff which designed the 729 II, IV, V, and VI tape drives and the 7080 channel controls, and comply with the Programming Systems tape handling standards.

General Correction Procedures

Record Length Errors

If a record length error occurs when reading a rec-ord, CSERR first determines, in the case of a fixed-length record, whether the computed length of the record exceeds the specified length by more than

ten characters. In the case of variable-length records, CSERR determines whether the computed length exceeds the specified maximum record length by more than ten characters. If so, a message is typed to indicate this error. The object programmer has two options: (1) to attempt to reread or rewrite the record, or (2) to restart from the last checkpoint. Caution should be observed in choosing to re-execute the operation, since a record which exceeds the specified length by more than ten characters may have destroyed a part of memory. If, however, the length error is less than ten characters, a check is made to see whether the record was redundant. If a redundancy has occurred, CSERR follows the correction procedure outlined for a redundant record. If no redundancy has occurred, two attempts are made to re-execute the operation which resulted in the length error. If the length is still in error, message 30214/5 is typed, which gives the exact record length. The object programmer has two options: (1) to re-execute the operation, or (2) to proceed to message 30222/3. The options following 30222/3 are explained on the following pages. The buffer areas terminating the I/O areas are restored before each retry.

Redundancies

PCT Checks on a Read: If a PCT check, or a combination of a PCT check and a length error occurs, CSERR determines whether the record was a noise record or a redundant tape mark. If neither, nine successive attempts are made to read the record correctly. On each retry, a check is made for correct record length, if record length checking has been specified. After nine retries, if the record is still redundant, a tape cleaner routine is executed, unless the tape is less than three records from load point or a noise record has been detected in the past three records. After the tape cleaner routine has been executed, one more attempt is made to read the record. This routine (i.e., nine retries and tape cleaner routine) is executed nine more times if the redundancy persists. If the record is still redundant, it is a permanent read error and the record is searched for redundancies. When a redundancy is found, CSERR transfers to IOREDUNCHK. At this time, the character as corrected by CSERR (C-bit reversed) and its location are in IOREDUNAD. If the object programmer accepts the IOCS-corrected character, he must return at IORETURNTO and the corrected character will replace the redundant character in memory. If he has replaced the redundant character with another character, he must return at IORETURNNO. When the entire area has been searched, if automatic dumping is specified, the

record is dumped. If no redundancies were found, loop/message 30211 is executed. The console operator may take the option to re-execute the operation or the option to execute loop/message 30223. Following loop/message 30223, the console operator has the option of either dumping the record or accepting the record as it is in memory. If redundancies are found, loop/message 30221 is executed. The console operator may take the option of re-executing the operation or of executing loop/message 30223. (The options of loop/message 30223 are explained above.)

PCT Checks on a Write: When a PCT check, or a combination of a PCT check and a length error occurs on a write, a backspace is executed and an attempt is made to rewrite the record. The record length is checked on every retry, if length checking is specified in the file table. If the first attempt to rewrite the record is unsuccessful, the tape is backspaced, a skip is executed and another attempt is made to write the record. The skip is executed four more times if the redundancy persists. If the record is still redundant, a search is executed to determine whether there are any redundant characters in memory. When a redundancy is found, CSERR transfers to IOREDUNCHK. At this time, the character, as corrected by CSERR (C-bit reversed), and its location are in IOREDUNAD. If the object programmer accepts the IOCS-corrected character, he must return at IORETURNTO. If he has replaced the redundant character with another character, he must return at IORETURNNO. When the entire area is searched and no redundancies are found, the foregoing sequence (i.e., five skips and a redundancy search) is repeated until a total of twenty-five skips have been performed in attempting to correct the redundancy. If no redundancies are found during the final redundancy search, loop/message 30210 is executed. The console operator may take the option to re-execute the operation or the option to execute loop/message 30222. Following loop/message 30222, the console operator has the option of either restarting from the last checkpoint or accepting the record as it now appears on tape. If redundancies are found, loop/message 30220 is executed; the console operator has the option of (1) re-executing the operation, thus writing a corrected record on the tape, or (2) restarting from the last checkpoint.

NOTE: If a record is both redundant and of incorrect length, and the 253 option is executed at loop/message 30210, 30211, or 30221, loop/message 30214 or 30215 will be executed before loop/message 30222 or 30223.

PCT Checks on IOFSF, IOBSF, IOFSP or IOPOS:
When a PCT check occurs during a tape-positioning operation, a test is made to determine whether the record just passed over was a noise record or a redundant tape mark. If the record was neither of these, the PCT is ignored, since it is assumed that this record is not to be used at present. If the record was a noise record or a redundant tape mark, loop/message 30213 or 30217, respectively, will be executed. (See "729 IOCS Waiting Loops and Messages" for available options.)

Automatic Dumping

This option gives the object programmer a means of dumping unreadable records automatically without the need for an operator decision.

Status Triggers

The condition of the status triggers will be indicated in the following situations:
1. Alteration Switch 916 is ON. (Loop/message 10212/10213.)
2. A permanent RD/WR error has occurred. (Loop/messages 30210/30211, 30220/30221.)

CSMRD--MEMORY RECORD

Purpose of CSMRD

The funtion of CSMRD is to record the status of the computer at specified points, called checkpoints, during a production run. The recorded status (memory record) includes the contents of memory, the contents of storage, the setting of the alteration switches, and the position of all tape drives connected through the 7080 channels. This memory record is created so that, if necessary, the Memory Restore System for the IBM 7080 (CSMRS) can subsequently re-establish the machine and program to the same status it was in when the memory record was written. CSMRS is the restart program to be used in conjunction with and object program that uses 729 IOCS.

CSMRD and CSMRS make it possible to:
1. Terminate the processing of a program at a point of partial completion, then, subsequently, continue the program from this intermediate point.
2. Resume processing from an intermediate point rather than from the beginning of a job when an impassable error occurs.

Tape Requirements

Checkpoint records may be placed on a special tape which contains only checkpoint records, or at the beginning of an output reel (alternate reels must be on the same channel).
1. When checkpoint records are placed on a special tape, the recording of memory may automatically occur at either of the following points in a program (based on parameters given in the file tables):
   a. Any input or output end of reel.
   b. Any input or output end of file.
   In addition, memory may be recorded at any time desired through use of the macro-instruction IOLNK to CSMRD.
2. If checkpoint records are to be placed at the beginning of an output reel, the recording of memory may occur only at the beginning of a single specified file. Memory may not be recorded at any other time. (IOLNK to CSMRD may not be used.)

Memory Requirements

CSMRD requires the temporary use of the final 1025 positions of memory in order to record the contents of the storage banks. If the object program uses these positions, it may specify any output file as the checkpoint work tape (see IOTS macro-instruction). In this case, the 1025 memory positions are recorded on the work tape during the recording of memory. At the conclusion of the checkpoint routine, the 1025 memory positions are restored from the work tape and the tape is repositioned so that, as far as the object program is concerned, the work tape was unused during the recording.

If no work tape is specified, it will be assumed that the 1025 memory positions may be used destructively.

Restart Requirements

The restart program (CSMRS) must be available at the time the restart is attempted; that is, it must be in the card reader or on a tape. If it is on tape, the user must place the select address of the tape in the location tagged CSW21. The reference manual, "IBM 7080 Memory Restore System CSMRS," Form C28-6199, provides the requisite information on using CSMRS.

The type subroutine is included in the IOCS, and will accept functional linkages from either IOCS or the object program. Typing requirements of the object program should be satisfied through the IOCS type subroutine to avoid conflicting messages and options at the console. Messages may be typed, placed on tape, or suppressed (ignored), according to a Message Class Code which is specified in the linkage. The precise handling of each Message Class is determined from switches contained in the IOCS control word. If messages are to be placed on a tape, operands X7 and X8 of the IOTS macro-instruction designate the tape to be used.

MESSAGE CLASS CODE

Messages may be split into four categories, Class A, B, C, or D. For each category there is a control word that indicates the method of handling the message class; i.e., indicates that it is to be typed, placed on the message tape, or ignored.

Class A messages must be typed. All messages which require decisions or action from the console will be typed. Classes B, C, and D will be typed unless the user desires other treatment, in which case they may be set up for a message tape or may be ignored altogether, according to the needs of the object program. All IOCS messages will be originally set up as Class A and Class B messages, but may be changed by the IODCH macro-instruction.

Class B messages from the IOCS will include information messages such as end-of-reel and end-of-file messages. The output of Class B messages will be dependent upon the control word indicator and on whether or not the associated file is a work tape (see IOFTB operand X2). If the associated file is a work tape, the message will be ignored. If it is a non-work tape, the message will be handled as specified in the control word for Class B messages; that is, the control word specifies whether the message is to be typed, placed on the message tape, or ignored.

For messages typed from the object program, the Message Class Code will be one of the operands of the IOTYP or IODEC macro-instructions. Any of the four classes may be specified. However, if a decision is required, the message will be put on the typewriter to inform the console operator that a waiting loop has been entered, regardless of the Message Class Code.

Changing Message Class Codes

The macro-instruction IODCH may be used to change the Message Class Code of any message. The following

designations may be used in the IODCH macro-instruction to change the handling of any message:
1. To designate the handling of messages which do not involve a decision, or for which no option is specified.
   a. A or Ab -- Message must be typed.
   b. B, Bb, C, Cb, D, or Db -- These messages may be typed, placed on tape, or ignored, according to the control word designation.
2. To designate a Message Class Code and specify the execution of the 252 option (routine associated with Interrupt Key 252) without entering a waiting loop: A2, B2, C2, or D2.
3. To designate a Message Class Code and specify the execution of the 253 option (routine associated with Interrupt Key 253) without entering a waiting loop: A3, B3, C3, or D3.

Thus, a message which was originally typed may be changed to be put on tape, or ignored altogether, and a decision message for which the option may be decided in advance may be altered to avoid entering a loop to wait for a decision from the console.

IOCS messages will originally be set up as Class A and Class B messages with no options specified. However, a list of tags to be used with the IODCH macro-instruction is provided at the end of this section so that they may be changed according to the needs of an installation or a particular program. These tags are included in the user's program by the DIOCS macro-instruction. It may be noted that, in many cases, one tag refers to several messages; consequently, changing the Message Class or predetermined option for one such message makes the same change to all of them. For example, if it is desired automatically to accept a missing-label condition on output tapes, coding IODCH CMS30290 ¤ D3 ¤ before linking to housekeeping will also cause input tapes with missing labels to be accepted automatically (the 253 option at 30291). * Two other facts should be borne in mind:
1. Prespecifying an option has no effect on a nondecision message.
2. Decision messages for which an option has not been specified will always be typed.

Thus, IODCH CSM10230 ¤ A2 ¤ will have no effect on messages 10230 and 10231; and IODCH CSM10230 ¤ D ¤ will have no effect on messages 20230 and 20231 (Class D messages to be ignored).

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* The problem might be avoided by specifying DELAYOPEN for the output files and coding the IODCH macro-instruction after the linkage to housekeeping. In other cases, it might be desired to code the IODCH macro-instructions in the Header, EOR, or EOF Transfer Address routines.

SETUP OF CONTROL WORD

The control word specifies the treatment for each
Message Class (A, B, C, and D) and originally in-
dicates typing for all classes. Class A messages
must be put on the typewriter, but the treatment for
Classes B, C, and D may be altered by the user's
program. If it is desired to place a Message Class
on tape or ignore it, the control word may be changed
at any time. This can be done in either of the follow-
ing ways:

1. Using the SETON macro-instruction:
    CSFCSSxTYP, CSFCSSxTAP, and/or
    CSFCSSxIGN are used as the operand(s)
    of the SETON macro-instruction, where
    x is B, C, or D, depending on what Message
    Class is being specified. Thus, to place
    Class B messages on tape, the operand
    CSFCSSBTAP would be used, while
    CSFCSSCIGN would be used to ignore Class
    C messages:

SETON		CSFCSSBTAP ⊐ CSFCSSCIGN ⊐

2. Using the SBZ instruction:
    a. To put Class B messages on tape:
        SBZ   1   CSW091
    b. To ignore Class B messages:
        SBZ   1   CSW091
        SBZ   2   CSW092
    c. To put Class C messages on tape:
        SBZ   1   CSW101
    d. To ignore Class C messages:
        SBZ   1   CSW101
        SBZ   2   CSW102
    e. To put Class D messages on tape:
        SBZ   1   CSW111
    f. To ignore Class D messages:
        SBZ   1   CSW111
        SBZ   2   CSW112

NOTE: The operands listed in items 1 and 2 above
appear in the Table of Common Linkage Points and
Work Areas previously described.

MESSAGE SETUP

All messages must be terminated by a group mark.
If messages are always typed, they may be set up
in any position desired or as literal operands in the
macro-instructions. However, if a message tape is
used, any messages which may be put on it <u>must</u>
start in a 1 or 6 position and <u>must</u> be preceded by a
blank or another carriage control character in the
0/5 location, as shown in Example 1. Messages
which were set up for 705 III IOCS need not be
changed, but they will be assigned to Class A (be-
cause operand X2 of the IOTYP is omitted) and will
always be written on the typewriter (see Example 2).

Example 1

Tag	Operation	Num	Operand
TAG	NAME CON CON	0 01 xx	MESSAGE ‡

Example 2

Tag	Operation	Num	Operand
	IOTYP		TAG ⊐

TWO-OPTION DECISIONS

Two-option decisions will be set up by using Inter-
rupt Keys 252 and 253. For decision messages with
only one option, the option associated with 252 should
always be used. For messages with two options, the
252 option will be the normal return.

Decision messages will be set up to go into a two-
instruction loop to await a decision from the console.
For messages from the object program and from
IOCS, a NOP-TR loop will be executed.

Decision messages from the object program should
be clearly indicated to the machine operator to avoid
unnecessary waiting in the loop.

THE STANDARDIZED SYSTEM

To simplify the operation of IBM programs and programming systems, a standardized Waiting Loop/Message system has been developed for use in IOCS and other programs. This system includes the following standards:

1. All waiting loops must be accompanied by a message, numbered according to the established standards.

2. Numbering of messages without waiting loops is left to the programmer's direction. If numbered, the message must conform to the established standards.

3. A five-digit Identification Code, which is the loop/message number and must be the same as the address of the loop/message, must be set up in the format outlined below:

a. Ten-Thousands Position: The digit in this position indicates the condition that exists at the time the loop/message occurs. It also specifies the linkages which follow:

0 Indicates a "cannot-proceed" condition, or dead end loop. Both a loop and message occur, and continuation of the program is not advised. The loop is always followed by an unconditional transfer back to itself, so that the program will not continue if either Interrupt Key 252 or 253 is depressed.

1 indicates that a routine of particular significance has been executed, and is used only when no operator action is required. In IOCS, the message is not accompanied by a waiting loop, and the next routine is entered automatically after the message is written.

2 indicates an "await-action" condition, and both a loop and message occur. It is used when a single course of action, such as correcting a control card, must be followed by the programmer in order to continue the program. Of course, the operator also has the option of terminating the program. The action for continuation is given in the list of loops and messages. The programmed loop in an "await-action" condition is always followed by linkage to the routine to be executed next. Although the loop/message section in most cases only mentions depressing Interrupt Key 252 to execute this linkage, depressing Interrupt Key 253 will give the same result.

3 indicates an "await-decision" condition, and both a loop and message occur. It is used when alternate courses of action to continue the program are available, and the operator must make a decision between them. One option is executed by depressing Interrupt Key 252; the other by depressing Interrupt Key 253. The operator may also terminate the program.

b. Thousands Position: The digit in the thousands position indicates the phase or section of the program with which the loop and/or message is associated. The digit zero is used by IOCS, as well as all other generalized routines developed by IBM.

c. Hundreds Position: The digit in the hundreds position is used to designate the specific programming system involved. The digit "2" is used to specify IOCS. Other designations currently in use are "4" for Utility Programs and "7" for Processor.

d. Tens and Units Positions: These positions are assigned by the project itself, and contain an arbitrarily assigned number which differentiates various loops and/or messages which start with the same three digits. An odd number indicates an input unit is involved; an even number indicates an output unit is involved.

DETERMINING IOCS MESSAGE IDENTIFICATION CODES AND MESSAGE CLASS CODES

The five-digit identification code appears as the first five characters of each message. It is not, therefore, listed in a separate column. The majority of the messages are Class A; the few that are Class B have been identified as such in the message explanation.

How To Use Interrupt Words 252 and 253

Any program that uses IOCS and that requires the use of Interrupt Keys 252 and 253 to permit operator decisions must use the IODEC macro-instruction for this purpose, rather than an object program routine.

Each time IOCS types a decision message, Interrupt Words 252 and 253 will be modified to enter an IOCS routine. The previous contents of these words will not be saved. If the console operator accidentally depresses Interrupt Key 252 or 253 while no decision is pending, the character 2 or 3, respectively, will be typed and control returned to the object program as if it had not been interrupted.

Tag	Loop/Message Number(s)	Tag	Loop/Message Number(s)
CSM00226	00226, 00227	CSM20271	20271
CSM00250	00250	CSM20273	20273
CSM00252	00252, 00253	CSM20275	20275
CSM00254	00254	CSM20280	20280, 20281
CSM00259	00259	CSM20282	20282
CSM10211	10211	CSM30210	30210, 30211
CSM10212	10212, 10213	CSM30213	30213, 30217
CSM10230	10230, 10231, 20230, 20231	CSM30214	30214, 30215, 30218, 30219
CSM10232	10232, 10233	CSM30220	30220, 30221
CSM10240	10240	CSM30222	30222, 30223
CSM10271	10271	CSM30224	30224, 30225
CSM10273	10273	CSM30227	30227
CSM10275	10275	CSM30241	30241
CSM10280	10280, 10281	CSM30260	00260, 30260
CSM10283	10283	CSM30271	30271
CSM10284	10284, 10285	CSM30273	30273
CSM10288	10288	CSM30280	30280
CSM10289	10289	CSM30282	30282, 30283
CSM10291	10291	CSM30290	30290, 30291
CSM10298	10298	CSM30293	30293
CSM10299	10299	CSM30295	30295
CSM20211	20211, 20212	CSM30296	30296, 30298, 30299
CSM20226	20226, 20227		

Figure 14

Loop/Message Tags

A table of the tags of IOCS loops and messages to
which the object program may refer will be in-
cluded by the DIOCS macro-instruction.

The tags and associated loop/message numbers
are shown in Figure 14.

CANNOT-PROCEED LOOPS AND MESSAGES

00226-xy-I/O AREA zzzzzz
    A linkage has been given to 729 IOCS to execute a write
    operation on tape 2x0y from an output area whose address
    does not end in 0 or 5. The output area location is zzzzzz.
    Action: Obtain a memory printout.

00227-xy-I/O AREA zzzzzz
    A linkage has been given to 729 IOCS to execute a read
    operation from tape 2x0y into an input area whose
    address does not end in 0 or 5. The input area location
    is zzzzzz.
    Action: Obtain a memory printout.

00250
    A linkage which calls for a special operation has been
    made from the object program to IOCS; the subroutine
    necessary to perform the special operation is not
    included with the object program or IOCS.
    Action: Obtain a memory printout. The address of the
            improper linkage is located in CSD0099.

00252-xy-IMPROPER OP
    A linkage which calls for a read operation on output tape
    2x0y has been made from the object program to IOCS.
    Action: Obtain a memory printout.

00253-xy-IMPROPER OP
    A linkage which calls for a write operation on input tape
    2x0y has been made from the object program to IOCS.
    Action: Obtain a memory printout.

00254-IMPLNK @ zzzzzz
    An improper linkage has been given to 7080 IOCS at
    location zzzzzz.
    Action: Obtain a memory printout.

00259-TT ERROR
    The Tape Table specifies a file table address which does
    not end in 4 or 9; or no file table is located at a specified
    address. This loop/message will be preceded by either
    10288-xy-INCOR FT ADDR or 10289-xy-NO FT.
    Action: Obtain a memory printout, and examine the
            Tape for errors.

00260-DISCONTINUE
    Interrupt Key 253 has been depressed following loop/
    message 30260 indicating a desire to discontinue the
    program temporarily. All tapes have been rewound.
    Action: Dismount all tapes used by the object program,
            labeling them carefully so that the program may
            be restarted correctly.

00265-xy-TM TROUBLE
A restart has just been completed and it has been found that no tape mark follows the checkpoint file, indicating that the checkpoint tape is improperly positioned.
Action: Try restarting again, from a previous check-point if desired.

SUCCESSFUL COMPLETION MESSAGES

10210-xx yy
This message is typed at the beginning of a run for identification purposes: xx is the version number; yy indicates the modification level.

10211-aaaaaa xxyyy
This message specifies the program name and the current date specified on the first control card: aaaaaa is the program name, xx specifies the year, and yyy indicates the calendar day.

10212-xy-st
Alteration Switch 916 is ON, and the error correction routine has been entered to correct an error which has occurred on output tape 2x0y. The condition of the Status Triggers is indicated by st.

10213-xy-st
Alteration Switch 916 is ON, and the error correction routine has been entered to correct an error which has occurred on input tape 2x0y. The condition of the Status Triggers is indicated by st.

10230-xy-F, nnn
File nnn of output tape 2x0y has been closed. (Class B)

10230-xy-R, nnn
An end of reel has occurred on output tape 2x0y, and the next alternate tape for the file is now being used. The completed reel is reel number nnn of the output file. (Class B)

10230-xy-C, nnn
An IORWD or IORUN has been executed on output tape 2x0y. The file count is nnn. (Class B)

10231-xy-F, nnn
An end of file has occurred on file nnn of input tape 2x0y. (Class B)

10231-xy-R, nnn
An end of reel has occurred on input tape 2x0y, and the next alternate tape for the file is now being used. The completed reel is reel number nnn of the input file. (Class B)

10231-xy-C, nnn
An IORWD, IORUN or IOCLS operation has been executed on input tape 2x0y. The file count is nnn. (Class B)

10232-xy-zzzzzz rr ss ee
This message follows message 10230, and contains error statistics for output tape reel 2x0y: rr redundancies, ss skips and ee permanent write errors have occurred on this reel. The tape record counter is zzzzzz. (Class B)

10233-xy-zzzzzz rr nn ee
This message follows message 10231, and contains error statistics for input tape reel 2x0y: rr redundancies, nn noise records and ee permanent read errors have occurred on this reel. The tape record counter is zzzzzz. (Class B)

10240-xy-zzzzzz
Checkpoint number zzzzzz is being taken on output tape 2x0y.

10271-FT, aaaaaaaaaa
A control card with file identification aaaaaaaaaa has been read. No file table with this file identification was found. The label control card has been ignored.

10273-CYC CK NONUM
Cycle checking was indicated in the file table, but the three high-order positions of the file identification are non-numeric; therefore, the control card has been ignored.

10275-CC, aaaaaaaaaa
No control card has been found for the input file with file identification aaaaaaaaaa. This message will be followed by loop/message 20275.

10280-xy-NOT READY
Output tape 2x0y is not Ready. This message will be followed by loop/message 20282-CK NON RDY TAPES.

10281-xy-NOT READY
Input tape 2x0y is not Ready. This message will be followed by loop/message 20282-TPS NOT READY.

10284-xy-NEW ALT TOT
The file table alternate total field for output base tape 2x0y has been modified to specify the same number of alternate tapes as the Tape Table. All associated alternate tapes specified in the Tape Table will be listed below the message in the following format:
-xy-#n, ab
where 2x0y is the base tape, n is the alternate sequence number, and 2a0b is the alternate tape.

10285-xy-NEW ALT TOT
The file table alternate total field for input base tape 2x0y has been modified to specify the same number of alternate tapes as the Tape Table. All associated alternate tapes specified in the Tape Table will be listed below the message in the following format:
-xy-#n, ab
where 2x0y is the base tape, n is the alternate sequence number, and 2a0b is the alternate tape.

10288-xy-INCOR FT ADDR
    The base tape entry for tape 2x0y in the Tape Table speci-
fies an address which does not end in 4 or 9. This mes-
sage will be followed by loop/message 00259.

10289-xy-NO FT
    No file table has been found at the address specified in
the base tape entry for tape 2x0y in the Tape Table. This
message will be followed by loop/message 00259.

10291-xy-L
    The file table label type indicator specifies that a tape
mark should follow the header. No tape mark follows
the header on input tape 2x0y. The record following the
header will be treated as a data record, and processing
will continue.

xxxx/xxxx-xxx xxxxxxxxxx xxxxx-xxx
10298-xy-L
    A standard header has been created for the first file of
output tape 2x0y. A portion of the header has been typed
as the first line of this message.

xxxx/xxxx-xxx xxxxxxxxxx xxxxx-xxx
10299-xy-L
    A standard header has been read for the first file of input
tape 2x0y. A portion of the header has been typed as the
first line of this message.

AWAIT-ACTION LOOPS AND MESSAGES

20211-xy-FILE NOT FND
    A "search file" operation with a file identification rou-
tine has been performed on input tape 2x0y. The entire
tape has been searched and the correct file has not been
found.
    Action: Depress Interrupt Key 252 to search the current
             reel or a newly mounted reel on tape unit 2x0y.

20226-xy-PCT ON RMA
       -or-
no message
    A PCT check has occurred during the execution of a
RD02 which was initiated to turn off the error triggers.
Output tape 2x0y was selected.
    Action: 1. If machine is in manual status, press
                 START to repeat the RMA.
            2. If machine is in AUTOMATIC, press Inter-
                 rupt Key 252 to repeat the RMA.

20227-xy-PCT ON RMA
    A PCT check has occurred during the execution of a
RD02 which was initiated to turn off the error triggers.
Input tape 2x0y was selected.
    Action: Press Interrupt Key 252 to repeat the RMA.

20230-xy-R, nnn
    An end of reel has occurred on output tape 2x0y which was
reel nnn of the file. No alternate has been specified.
    Action: Mount a new tape on 2x0y, then press Interrupt
             Key 252 to resume processing.

20231-xy-R, nnn
    An end of reel has occurred on input tape 2x0y which was
reel nnn of the file. No alternate has been specified.
    Action: Mount a new tape on 2x0y, then press Interrupt
             Key 252 to resume processing.

20271-902-CC
    A 902 error occurred while trying to read a label control
card from the card reader.
    Action: Correct the control card which caused the error
             and replace it in the card reader; then press
             Interrupt Key 252 to reread the card.

20273-INCOR CC
    The date control card is incorrect; or, if the control cards
are on tape, a record other than 80 characters in length
was encountered.
    Action: 1. If the date card is incorrect, replace it with
                 a correct card in the card reader; then press
                 Interrupt Key 252 to reread the card.
            2. If the control cards are on tape and any more
                 control cards are to be read, place them in
                 the card reader; then press Interrupt Key
                 252.

20275-SUPPLY CCS
    One or more input files have no standard header control
card. This loop/message is preceded by message 10275,
which lists the file identification(s) of the file table(s)
requiring a control card.
    Action: Load the card reader with the missing standard
             header control card, followed by an END card;
             then press Interrupt Key 252 to read the card(s)
             from the card reader.

20280-xy-NOT READY
    Output tape 2x0y is not ready.
    Action: Get the tape ready. Press Interrupt Key 252 to
             recheck the ready status of this tape.

20281-xy-NOT READY

Input tape 2x0y is not ready.

Action:　Get the tape ready.　Press Interrupt Key 252 to recheck the ready status of this tape.

20282-TPS NOT READY

A loop in CSHSK, which waits for all tapes to become ready, has been executed.　Prior to this loop/message, the nonready tapes have been listed (see messages 10280, 10281).

Action:　Get the specified tapes ready.　Press Interrupt Key 252 to recheck all tapes.

AWAIT-DECISION LOOPS AND MESSAGES

30210-xy-r, aaa zzzzzz st

The standard number of skips (25) has been executed in attempting to correct a redundancy in writing on tape 2x0y from the output area at location zzzzzz, and the record is still redundant.　r identifies the routine* which is attempting to execute operation aaa; st indicates the condition of the Status Triggers.　The output area has been checked for redundancies, but none were found.　CSERR will not execute any skips beyond the reflective spot at end of reel; it will only backspace and rewrite.

Action:　1.　To re-execute the operation, press Interrupt Key 252.
2.　To reach loop/message 30222 (or 30214), press Interrupt Key 253.　(See note following "PCT Checks on a Write," in the "CSERR-Error Correction" section of this manual.)

30211-xy-r, aaa zzzzzz st

100 attempts have been made to read a record from input tape 2x0y into an input area at location zzzzzz.　The tape cleaner routine has been executed, if applicable (see CSERR-Read Redundancies).　The input area has been searched for redundancies, but none were found.　The r identifies the routine (1) which is attempting to execute operation aaa; st indicates the condition of the Status Triggers.

Action:　1.　To re-execute the operation, press Interrupt Key 252.
2.　To reach loop/message 30223 (or 30215), press Interrupt Key 253.　(See note following "PCT Checks on a Write," in the "CSERR-Error Correction" section of this manual.)

* The r is either "C", "L", or blank.
"C" indicates this operation was requested by CSMRD.
"L" indicates this operation was requested by CSTRS.
Blank indicates this operation was requested by the object program.

30213-xy-zzzzzz

A noise record* has been detected in reading from tape 2x0y.　The input area address is zzzzzz.

Action:　1.　To ignore this noise record and continue with normal processing, press Interrupt Key 252.
2.　To reread this record, press Interrupt Key 253.

30213-xy-FSP

A noise record* has been detected in forward spacing tape 2x0y.

Action:　1.　To ignore this noise record and continue with normal processing, press Interrupt Key 252.
2.　To reforward space this tape, press Interrupt Key 253.

30214-xy-zzzzzz nnnnnn

A record length error has occurred in writing on output tape 2x0y.　A total of three attempts have been made to write this record correctly.　The output area is at location zzzzzz, and the exact length of the record written is nnnnnn.

Action:　1.　To re-execute the operation, press Interrupt Key 252.
2.　To reach loop/message 30222, press Interrupt Key 253.

* A noise record is a nondata pulse which is picked up by the read heads and causes a PCT check.　(Nondata pulses may be caused by line noises from the tape unit, by foreign particles or improper coating on the tape, by creases or tears in the tape, etc.).　Since it is estimated that a noise record will not exceed nine characters, IOERR assumes that a noise record has been read if the calculated length is less than ten characters and causes a PCT check.

After reading a record from tape, the tape is positioned a short distance beyond the last character read.　After reading a noise record, therefore, the tape will normally be positioned between the noise record and the next tape record which was to be read.　The tape may also be positioned at a point within that tape record, or in rare instances, completely beyond it.　The position depends upon the character density of the tape and the "first-character pickup" gating of the channel, as well as the relative position and size of the noise record and the tape records which precede and follow it.

According to the particular position of the tape after reading a noise record, pressing Interrupt Key 252 after Halt 30213 can result in any one of the following:
1.　Correctly reading the next tape record.
2.　A PCT when reading the tape record.
3.　Bypassing the record and reading the following records.

Pressing Interrupt Key 253 can result in any one of the following:
1.　Correctly reading the record which follows the noise record.
2.　Rereading the noise record.
3.　Rereading the record which precedes the noise record.

The operator should be aware of these possibilities in choosing an option.

30215-xy-zzzzzz nnnnnn

A record length error has occurred in reading from input tape 2x0y. A total of three attempts have been made to read this record correctly. The input area is at location zzzzzz, and the exact length of the record read is nnnnnn.

Action: 1. To re-execute the operation, press Interrupt Key 252.
2. To reach loop/message 30223, press Interrupt Key 253.

30217-xy-zzzzzz

A redundant tape mark* has been encountered in reading from tape 2x0y into the input area at location zzzzzz.

Action: 1. To effect a transfer to the end-of-file routine, press Interrupt Key 252.
2. To reread this record, press Interrupt Key 253.

30217-xy-FSP

A redundant tape mark** has been encountered in forward spacing tape 2x0y.

Action: 1. To effect a transfer to the end-of-file routine, press Interrupt Key 252.
2. To reforward space tape, press Interrupt Key 253.

30219-xy-zzzzzz nnnnnn

A read operation has been executed from input tape 2x0y into the input area at location zzzzzz. The calculated record length is nnnnnn. This calculated length exceeds the input area by 11 or more characters, and has therefore destroyed the buffer following it.

Action: 1. To restart from the last checkpoint, press Interrupt Key 252.
2. To re-execute the read operation, press Interrupt Key 253.*

---

* Extreme caution should be taken in re-executing this read operation. As noted above, a portion of memory required by the programmer may have been destroyed by this length error.

**A redundant tape mark is a noise record of less than three characters in length which turns on both the PCT indicator and the tape unit I/O indicator. (The I/O indicator is turned ON whenever a one-character or a two-character record contains a character which has the 8421 bit structure of a tape mark.)

According to the particular position of the tape after reading a noise record, pressing Interrupt Key 253 after loop/message 30217 can result in:
1. Correctly reading the record which follows the noise record.
2. Rereading the noise record.
3. Rereading the record which precedes the noise record.
The operator should be aware of these possibilities in choosing an option.

30220-xy-r aaa st

Five consecutive skips have been executed on output tape 2x0y. The output area has been searched for redundancies, and one or more redundant characters were found. The r indicates the routine attempting to execute operation aaa.† When this message occurs, these redundant characters have been corrected by the IOCS (C-bit reversed) or replaced by the object program and are now valid characters in memory. The condition of the Status Trigger is indicated by st.

Action: 1. To re-execute the operation, press Interrupt Key 252.
2. To restart from the last checkpoint, press Interrupt Key 253.

30221-xy-r aaa st

100 attempts have been made to read a record from input tape 2x0y. The input area has been searched for redundancies, and one or more redundant characters were found. The r indicates the routine attempting to execute operation aaa. † When this message occurs, redundant characters have been corrected by the IOCS (C-bit reversed) or replaced by the object program and are now valid characters in memory.

Action: 1. To re-execute the operation, depress Interrupt Key 252.
2. To reach loop/message 30223 (or 30215), depress Interrupt Key 253. (See Note following "PCT Checks on a Write," in the "CSERR-Error Correction" section of this manual.)

30222-xy-zzzzzz

This loop/message occurs when Interrupt Key 253 is pressed following loop/message 30210 or 30214. Twenty-five skips on tape 2x0y have been executed and a PCT error persists. The output area beginning at zzzzzz has been searched for redundancies, and none were found.

Action: 1. To restart from the last checkpoint, press Interrupt Key 252.
2. To accept the record as written on tape and continue processing, press Interrupt Key 253.

30223-xy-zzzzzz

This loop/message occurs when Interrupt Key 253 is pressed following loop/message 30211, 30215, or 30221. There have been 100 attempts made to read this record from tape 2x0y, and a PCT error persists. The input area beginning at location zzzzzz has been searched for redundancies and either none were found or they were found and corrected.

Action: 1. To dump this record, press Interrupt Key 252.
2. To accept the record as it has been read, and continue processing, press Interrupt Key 253.

---

† The r is either "C", "L", or blank.
"C" indicates this operation was requested by CSMRD.
"L" indicates this operation was requested by CSTRS.
blank indicates this operation was requested by the object program.

30224-xy-zz

The redundancy routine has been entered a total of zz
times for output reel 2x0y. The possibility of tape drive
failure should be considered in choosing an option at
this time.

Action: 1. To continue processing, press Interrupt
Key 252.

2. To restart from the last checkpoint, press
Interrupt Key 253.

30225-xy-zz

The redundancy routine has been entered a total of zz
times for input reel 2x0y. The possibility of tape drive
failure should be considered in choosing an option at this
time.

Action: 1. To continue processing, press Interrupt
Key 252.

2. To restart from the last checkpoint, press
Interrupt Key 253.

30227-xy-zzzzzz yyyyyy

The tape record count in the file table does not equal the
tape record count in the label on input tape 2x0y. The
value of the label tape record count is zzzzzz and the
value of the file table tape record count is yyyyyy.

Action: 1. To continue processing, press Interrupt
Key 252.

2. To restart from the last checkpoint, press
Interrupt Key 253.

30241-xy-BSP FAIL

Part of memory has been dumped from the end of an octant
to checkpoint work tape 2x0y to allow taking of a check-
point record. In attempting to read this record back into
the end of the octant, CSMRD has found that SMAC does
not end in 0000, and thus that memory has not been
properly restored.

Action: 1. To attempt another read into the end of the
octant, press Interrupt Key 252.

2. To restart from the last checkpoint, press
Interrupt Key 253.

30260-DISCONTINUE

A checkpoint has just been completed. Alteration Switch
916 is ON, indicating that the program is to be tempo-
rarily discontinued.

Action: 1. If the program is to be temporarily discon-
tinued, press Interrupt Key 253 to rewind
all tapes. Message 00260 will then be
executed.

2. To continue processing, press Interrupt
Key 252. If this loop/message is not de-
sired after every checkpoint, Alteration
Switch 916 should be turned OFF.

30269-REDUN

Redundancies have been found in memory prior to
taking a checkpoint. All redundancies found have
been corrected.

Action: 1. To continue processing, press
Interrupt Key 252.

2. To restart from the last checkpoint,
press Interrupt Key 253.

30271-F, CC

An end of file has occurred reading standard header con-
trol cards from the card reader. The cards should be
terminated by an END control card.

Action: 1. If more control cards are to be read, place
them in the card reader, followed by an END
control card, and press Interrupt Key 252.

2. If no more control cards are to be read,
press Interrupt Key 253. The program will
proceed as though an END card had been
read.

30273-xy-F, CC

An end of file has occurred reading standard header con-
trol cards from tape 2x0y. The cards should be termi-
nated by an END control card.

Action: 1. If more control cards are to be read, place
them in the card reader, followed by an
END control card, and press Interrupt
Key 252.

2. If no more control cards are to be read,
press Interrupt Key 253. The program will
proceed as though an END card had been
read.

30280-xy-ION

The I/O indicator on output tape 2x0y has been left on.

Action: 1. To recheck, press Interrupt Key 252. It is
assumed that a new tape has been mounted. *

2. To turn indicator off and continue, press
Interrupt Key 253.

30281-xy-ION

The I/O indicator on input tape 2x0y has been left on.

Action: 1. To recheck, depress Interrupt Key 252. It
is assumed that a new tape has been
mounted. *

2. To turn indicator off and continue, press
Interrupt Key 253.

30282-xy-PCT RCD 1

A PCT has occurred in forward spacing over the first
record on output tape 2x0y. The PCT may be caused by
two tape dial settings specifying the same unit, or by an
incorrect density setting.

Action: 1. If duplicate dial settings exist, set them
correctly; then press Interrupt Key 252 to
recheck. *
If it is suspected that the density is set
wrong, the density must be changed at the
tape drive. (If 729 Model V and VI tapes
are used, it may also be necessary to
change the setting of the density switch on
the 7621 Tape Adapter Unit.) Press Inter-
rupt Key 252 to recheck. *

2. To ignore the PCT and coninue, press Inter-
rupt Key 253. The density setting may be
manually changed, if desired, before con-
tinuing the program.

---

* If this loop/message occurs during the execution of CSHSK, all
base tapes will be rechecked.

30283-xy-PCT RCD 1

A PCT has occurred in forward spacing over the first record on input tape 2x0y. The PCT may be caused by two tape dial settings specifying the same unit, or by an incorrect density setting.

Action: 1. If duplicate dial settings exist, set them correctly; then press Interrupt Key 252 to recheck. *

If it is suspected that the density is set wrong, the density must be changed at the tape drive. (If 729 Model V and VI tapes are used, it may also be necessary to change the setting of the density switch on the 7621 Tape Adapter Unit.) Press Interrupt Key 252 to recheck. *

2. To ignore the PCT and continue, press Interrupt Key 253. The density setting may be manually changed, if desired, before continuing the program.

30290-xy-L

A standard or nonstandard header specified for output tape 2x0y is missing.

Action: 1. Mount a new reel on 2x0y; then press Interrupt Key 252 to recheck. *

2. To accept the tape without a header, press Interrupt Key 253. If a standard header is specified, IOCS will create a header for the tape; if a nonstandard header is specified, the specialized routine will develop the header.

30291-xy-L

A standard or nonstandard header specified for input tape 2x0y is missing.

Action: 1. Mount a new reel on 2x0y; then press Interrupt Key 252 to recheck. *

2. To accept the tape without a header, press Interrupt Key 253. The record will be treated as a data record.

30293-xy-L

The record following a tape mark on single-file input tape 2x0y is not a valid trailer.

Action: 1. To effect transfer to the End-of-Reel Transfer Address, press Interrupt Key 252.

2. To effect transfer to the End-of-File Transfer Address, press Interrupt Key 253.

30295-xy-L

The record following a tape mark on multifile input tape 2x0y is not a valid label.

Action: 1. To effect transfer to the Header Transfer Address, press Interrupt Key 252.

2. To effect transfer to the End-of-File Transfer Address, press Interrupt Key 253.

xxxx/xxxx-xxx xxxxxxxxxx xxxxx-xxx

30296-xy-L

No header has been specified for output tape 2x0y. However, the tape contains a standard header, a portion of which is typed as the first line of this message.

Action: 1. Mount a new reel on tape unit 2x0y; then press Interrupt Key 252 to recheck. *

2. To accept the tape for output, press Interrupt Key 253. No header will be created for the tape, and the standard header existing on the tape will be destroyed.

xxxx/xxxx-xxx xxxxxxxxxx xxxxx-xxx

30298-xy-L

The retention cycle and creation date in the standard header label on output tape 2x0y indicate that the tape should not be written on at this time; or the creation date in the header is invalid. A portion of the header is printed as the first line of this message.

Action: 1. Mount a new reel on tape unit 2x0y; then press Interrupt Key 252 to recheck. *

2. To accept the tape for output, press Interrupt Key 253.

xxx xxxxxxxxxx (c) or xxxx-xxx xxxxxxxxxx (FS)
xxxx/xxxx-xxx xxxxxxxxxx xxxxx-xxx

30299-xy-L

The standard header label on input tape 2x0y is incorrect.

If cycle checking is being used, the correct reel sequence number, cycle number, and file identification are typed as the first line of the message. (This format occurs only in CSHSK since the file serial check is added for subsequent reels.) If file serial checking is being used, the correct file serial, reel sequence, cycle number (if any) and file identification are typed as the first line of the message.

A portion (including the incorrect fields) of the header label which is actually on tape 2x0y is typed as the second line of the message.

Action: 1. Mount the reel which contains the correct header label (first line) on tape unit 2x0y; then press Interrupt Key 252 to recheck. *

2. To accept the header label on tape 2x0y, press Interrupt Key 253. The file serial, reel sequence and file identification fields in the file table will be updated accordingly.

---

* If this loop/message occurs during the execution of CSHSK, all base tapes will be rechecked.

APPENDIX 1: RELATIONSHIP of 7080/729 IOCS TO 705 III IOCS

The 7080/729 IOCS has been specified to retain as high a degree of compatibility as possible with the 705 III IOCS. Changes have been made to permit the inclusion of improvements and, in some cases, to accommodate machine hardware advancements.

A reassembly of object programs using the 705 III IOCS will be a necessary prerequisite to the use of the 729 IOCS. This is primarily due to the desirability of using the TIP linkage rather than the RCVS-TSL type of linkage. Because the necessity of a reassembly was accepted by the users of the 705 III IOCS, it was felt that the channel tables and file tables should also be modified to permit improvements.

The macro-instruction headers and the execution of the requests initiated by functional linkages have remained basically the same. Exceptions are noted below and in the section of this manual which defines macro-instructions.

The 705 III IOCS Get/Put linkages in all cases included the address of the work area. The file table in the 729 IOCS includes one Get/Put work area address. A certain amount of efficiency may be gained in using only this work area. If it is necessary to use additional work areas, the Get/Put routine is expanded to handle this requirement. If the object programmer indicates that only one work area is used, the work area address given in the 705 III Get/Put linkages IOGET and IOPUT, operand X2, must be eliminated. A wasted assembly will result if there is a conflict in these concepts.

A number of 705 III IOCS users have expressed their desire to alternate reels of a file between tape transports attached to different channels. Although the variable format of the 729 Tape Table (705 III IOCS Channel Tables) permits such alternation, it should be used only when absolutely necessary.

It will be necessary in converting from 705 III to 729 IOCS to use the new Tape Table rather than the Channel Tables. This change may be accomplished by removing the existing Channel Table definitions and substituting definitions as required through the IOTA and IOTS macro-instructions.

The file table changes may likewise be accomplished by deleting the old definitions and substituting the macro-instruction headers IOFTA, IOFTB and IOFTC, as required. The file tables have been changed to permit a more integrated approach to the areas of Get/Put and input/output area definitions. The Get/Put system used with the 705 III IOCS was designed after the completion of the IOCS. The Get/Put functions are an integral part of the 729 IOCS (the file tables in particular). The improvements to the file tables include:

1. The possible inclusion of both a Get and Put routine with any file table and the semiautomatic transition from output to input (i.e., IOPUT to IOGET or vice-versa) through the macro-instructions IOMIP and IOMOP.

2. The generation of input/output areas including record length checking fields with the file table generation. It should be noted that the definition of input/output areas has been modified regarding record length checking requirements.

3. Improved statistical accounting of tape error occurrences according to IBM tape handling standards.

In the 705 III IOCS, it was necessary to include in each assembly as the first I/O macro-instruction the macro-instruction IODEF. This macro-instruction must be deleted and the macro-instruction DIOCS inserted in its place.

The 705 III IOCS macro-instructions IODEF, IOHSK, IOSAS and IOSYS (having to do with the assembly of an IOCS) are unused in the 729 IOCS.

Compatibility of 705 III IOCS and 7080/729 IOCS Macro-Instructions

The table on the next page summarizes the macro-instructions used in the 705 III IOCS and the 7080/729 IOCS according to the compatibility of header format and function. The handling of obsolete macro-instructions is indicated, as are new macro-instructions. This table should be used as a key to further study of changes to the system as noted in the section, "729 IOCS Macro-Instructions," and the latter portion of this section, "Conversion of Programs Using 705 III IOCS to 729 IOCS."

In the following table, N indicates "NO", Y indicates "YES", and numbers in parentheses refer to notes following the table.

Macro	Applies to 705 III IOCS	Applies to 7080 IOCS	Header Format Changed	Old Header Compatible	Function Changed
IOBSD	N	Y	--	--	--
IOBSF	Y	Y	Y	N	Y - Operation buffered
IOBSP	Y	Y(1)	N	Y	N
IOCLS	Y	Y	N	Y	N - (2)
IOCHK	Y	Y(1)	N	Y	Y - Only file specified is held
IOCS	N	Y	--	--	--
IODCH	N	Y	--	--	--
IODEC	Y	Y	Y	Y	Y - See macro-instruction
IODEF	Y	N	--	N	Y - (3)
IODMP	Y	Y	N	Y	N
IOFER	Y	Y	N	Y	N - (2)
IOFSF	Y	Y	Y	N	Y - Operation buffered
IOFSP	Y	Y(1)	N	Y	N
IOFTA	N	Y	--	--	--
IOFTB	N	Y	--	--	--
IOFTC	N	Y	--	--	--
IOGET	Y	Y	Y	Y	Y - Work area need not be specified
IOGP	Y	N	--	N	Y - (3)
IOHLD	Y	Y	N	N(4)	Y - Only file specified is held
IOHSK	Y	N	--	N	Y - (3)
IOIGP	Y	N	--	N	Y - (3)
IOIOF	Y	Y	N	Y	N
IOION	Y	Y	N	Y	N
IOLNK to					
IOHSK	Y	Y	N	Y	N
IOMRD	Y	Y	N	Y	N
IOCHANTEST	Y	N	--	Y	Y - (3)
IOERR	Y	N	--	N	Y - (3)
IOEOF	Y	N	--	N	Y - (3)
ASUSAVE	Y	N	--	Y	Y - (3)
ASURESTORE	Y	N	--	Y	Y - (3)
IOMFC	Y	Y	N	N	Y - Will always write EOF trailer
IOMFO	Y	Y	N	Y	N
IOMIP	Y	Y	Y	Y	Y - See macro-instruction
IOMOP	Y	Y	Y	Y	Y - See macro-instruction
IOOPN	Y	N	--	N	Y - (3)
IOPOS	N	Y	--	--	--
IOPUT	Y	Y	Y	Y	Y - See macro-instruction
IORET	N	Y	--	--	--
IORD	Y	Y	N	Y	N
IORDC	Y	Y(1)	N	Y	Y - (5)
IORDS	Y	Y	Y	Y	Y - Check length may be specified
IORUN	N	Y	--	--	--
IORWD	Y	Y	N	Y	N
IOSAS	Y	N	--	N	Y - (3)
IOSYS	Y	N	--	N	Y - (3)
IOTA	N	Y	--	--	--
IOTS	N	Y	--	--	--
IOTYP	Y	Y	Y	Y	Y - See macro-instruction
IOWR	Y	Y	N	Y	N
IOWRC	Y	Y(1)	Y	Y	Y - (5)
IOWRS	Y	Y	Y	Y	Y - Check length may be specified

NOTES:

1. Included for compatibility only.
2. Tape may be rewound/unloaded, I/O Indicator will not be left on.
3. Macro-instruction invalid with 729 IOCS; must be removed from program.
4. If the second operand of this macro-instruction is omitted or blank, this will not cause a file to be opened by 729 IOCS.
5. Record Length Checking must be specified in the file table.

Conversion of Programs Using 705 III IOCS to 7080/729 IOCS

The 729 IOCS has been written in order to preserve compatibility with the 705 III IOCS as much as possible. Certain changes will have to be made, however, to 705 programs before they can be reassembled to run with the 729 IOCS.

Major Changes

The first I/O macro-instruction in the program must be DIOCS with 705CONVERT as operand X7. The DIOCS macro-instruction will call in the common entry points and will cause all subsequent I/O linkage macro-instructions to generate linkages to the 729 IOCS rather than the 705 III IOCS.

The operand 705CONVERT will also cause each linkage macro-instruction to generate an ENT80, EEM, preceding the actual linkage, and a LEM, LEV80, following it. In addition, if the operand of 705CONVERT is used and the program is not under control of ENT80, the IOTYP and IODEC macro-instructions will generate an ENT80, EEM, preceding the actual linkage, and a LEM, LEV80, following it. The IODEF macro-instruction must be removed.

The Channel Tables must be replaced by IOTA macro-instructions to generate the Tape Table; if the program makes any changes to the Channel Tables, as in phase-to-phase conversion, these changes must be replaced by the corresponding changes to the Tape Tables in accordance with the new format. If it is necessary to modify the Tape Table at object time, it will probably be advisable to assemble Tape Table components or alternate Tape Tables in input or output areas and move the desired table, or assemble components at actual location 000500 prior to the execution of CSHSK.

The file tables and IOGP macro-instructions must be replaced by IOFTA, IOFTB and IOFTC macro-instructions; any changes made to, or tests made of, the file tables must also be replaced by macro-instructions that will be provided for this purpose.

The EOR, EOF and Header Transfer Address routines may have to be modified to account for the fact that the 729 IOCS will transfer to these exit points in 7080 mode, interrupt program, and with the starting point counter at 3,000. This will probably require the addition of SPC, USB, LEM, EEM, SPC, LSB (but <u>not</u> LIP or TIP) instructions at the beginning or end of these routines as needed. CASUs 9, 13 and 14 may be used during the execution of these routines.

If record length checking is specified, the I/O areas must be rewritten to conform to the new standards. IORDC and IOWRC macro-instructions will generate the same linkage as IORD and IOWR macro-instructions, respectively. If record length checking is desired, it must be specified in the IOFTB and IOFTC macro-instructions.

Changes to Specific Linkage Macro-Instructions

IOMFC:	The 729 IOCS will always interpret an IOMFC linkage as requesting that an EOF trailer be written. Therefore, all IOMFC macro-instructions which are addressed to a file specifying sequential handling, must be changed to an IOMFO macro-instruction.
IOGET and IOPUT:	IOGET and IOPUT linkages may destory the setting of the starting point counter. Therefore, if the program requires that the contents of the accumulator be available after an IOGET or IOPUT, the macro-instruction must be modified by the addition of a third or fourth operand, respectively, of SAVE. Note also that the first operand of an IOGET or IOPUT macro-instruction must be the tag of an IOFTA macro-instruction and not an actual address.
IOHLD:	The execution of the IOHLD function has been modified so that only the file named in the linkage will be affected. If all operations for that file have been completed and checked, no other action will be taken. The stacking table will be

cleared of all requests for the named files. This differs from 705 III IOCS in that all channels were previously stopped by the IOHLD request. In order to open a tape file, the IOHLD macro must have a second operand of OPEN.

IOCHK:	The IOCHK macro-instruction will produce an IOHLD linkage.
IOLNK to CHANTEST:	Because of the interrupt feature of the 7080, this linkage is no longer meaningful. No linkage will be generated.
IOBSF and IOFSF:	The execution of these requests may be buffered with the 729 IOCS. If these requests must be completed prior to a return to the object program, a second parameter of HOLD should be added to these headers.

Other Comments

All tapes, which in the 705 III IOCS were rewound and left with the indicator on (as at EOF), will be rewound and unloaded by the 729 IOCS.

The 729 IOBSP routine has been improved so that if an IOBSP linkage is given after an EOF is recognized, but before all input areas have been processed, IOCS will recalculate the number of backspaces to be performed in order to reposition the tape correctly.

The 705 III IOCS made extensive use of ASUs 1 through 5, and set these ASUs accordingly. Since the 729 IOCS does not use Storage Banks 0 and 1, the ASUs will not be set by CSHSK.

Users of 705 III IOCS who incorporated the Get/Put system into their programs should note the following improvements in the timing relationship between the Get/Put routines and IOCS end-of-file and end-of-reel routines:

In 705 III IOCS, one data record remained to be processed by the object program when an IOCS exit was made at end of file (End-of-File Transfer Address). In the 729, IOCS will not exit at end of file until the last data record is processed, or at end of reel, except when Mode 1 is specified. Therefore, the Model III end-of-file routines must be modified to reflect this change.

APPENDIX 2: AVAILABLE VERSIONS OF 7080 IOCS

Six versions of 7080 IOCS for use with 729 Magnetic Tape Units are available as shown in the table at the bottom of the page.

If operand X3 of the DIOCS macro-instruction is MINIMAL, the following restrictions on the use of the IOCS must be observed:

1. Standard trailers must be used.
2. Single-file tapes must be used.
3. Stacking mode is assumed.
4. Mode 2 end-of-reel handling is assumed for input tapes; Mode 1 end-of-reel handling is assumed for output tapes.
5. Special operation macro-instructions may not be used. In addition to the descriptive macro-instructions (DIOCS, IOFTA, IOFTB, IOFTC, IOTA, IOTS), only the following

macro-instructions may be used with a minimal system: IOLNK,* IOGET, IOPUT, IORD, IOWR, IOCLS, IOHLD,** IOTYP, IODEC, IODCH, IORET, IOMIP, IOMOP, IOION, IOIOF.

6. Error records may not be dumped on tape. No automatic dumping on a per-file basis will be performed (i. e. , X18 of the IOFTA macro-instruction will be assumed to be NODP).
7. Messages may only be typed or ignored; they cannot be written on tape. No special handling is provided for Class B messages.
8. Alteration of tapes between channels is not permitted.
9. Certain coding in IOCS, provided for the detection and correction of object-program errors, has been deleted. For example, improper linkages, improperly defined input areas, improper operations, will not be detected.
10. Rewind of tapes in Housekeeping and sequential handling is assumed.

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* Operands of CSMRD and CSMRS may be used only if X4 of the DIOCS is CHKPT.

**A second operand of OPEN will be assumed.

Version	DIOCS Operand X2	DIOCS Operand X3	DIOCS Operand X4	Memory Positions Req. by Nonerasable IOCS	Memory Positions Req. by Erasable Housekeeping
1	4 or omitted	COMPLETE	CHKPT or omitted	19,500	3,500
2	2	COMPLETE	CHKPT or omitted	16,500	3,400
3	4 or omitted	MINIMAL	CHKPT	14,500	3,200
4	4 or omitted	MINIMAL	omitted	13,000	2,600
5	2	MINIMAL	CHKPT	12,500	3,200
6	2	MINIMAL	omitted	11,000	2,600

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