IBM

Programming Systems Analysis Guide
IBM 7080 Input/Output Control System

Preface

This manual was prepared by IBM Programming Systems to provide detailed information on the internal logic of the 7080 Input/Output Control System. It is intended for technical personnel who are responsible for diagnosing the system operation or for adapting the programming system to special usage. A general understanding of the 7080 IOCS and the Autocoder III system is assumed.

The pertinent publications are:

Reference Manual—IBM 7080 Input/Output Control System for Use with 729 Magnetic Tape Units, Form C28-6237.

Reference Manual—IBM 7080 Memory Restore System, Form C28-6199.

Reference Manual—IBM 705/7080, Programming Systems, 7058 Processor: Autocoder III Language, Form C28-6224.

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

A program listing of the 7080 IOCS may be obtained by sending a 2,400 foot tape to:

Data Processing Program Information Department
IBM Corporation
112 East Post Road
White Plains, New York

Please address comments concerning this manual to:

IBM Corporation
Programming Systems
Program Analysis, Dept. 758
Poughkeepsie, New York

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The Input/Output Control System is a program which, in effect, relieves the user of the responsibility of programming the intricacies of tape record handling. Reading and writing, error detection and correction, label checking, end-of-file and end-of-reel procedures, checkpoint taking, and restarting are all handled by IOCS.

To the main program, IOCS is a giant subroutine. The system is divided into several major routines that are further subdivided into many subroutines. These subroutines, regardless of size, have as their objective the performance of a specific function or set of functions. Therefore, it is possible for the main program to link to an internal section of IOCS for the performance of a particular operation.

IOCS cannot be presented as several solid blocks of programming each with a specific function, because one section may use other sections in achieving an objective. For example, in reading and checking tapes in initial housekeeping for a run, the housekeeping routine uses other routines.

IOCS COMPONENTS

The complete control system is made up of several general areas, as follows:

- CSHSK Housekeeping. Initializes tape addresses, checks tape tables and file tables, positions tapes.
- CSDTS Data travel system. Executes all input/output functions.
- CSERR Error correction routine. Handles record length errors, PCT errors, noise records.
- CSEOF, CSEOR End of file, end of reel. Executes closing procedures necessary when tape marks or reflective spots are encountered.
- CSMRD Memory record. A checkpoint routine to record the status of the program and machine at an error-free point.
- CSMRS Memory restore. Linkage to the CSMRS restart program to restore the program and machine to a given checkpoint.
- CSTRS Tape reel control system. Identifies and controls tape type, labels, sequence.

This guide describes IOCS in the following ways:

1. Chart and narrative showing the relation between IOCS routines (Chart AA).
2. Treatment of file tables from the file table work area point of view.
3. Charts and explanations of:
   a. Housekeeping, Charts BA, BB, BC.
   b. Data travel system, Charts CA, CB, CC, CD, CE, CF, CG.
   c. Error correction, Charts DA, DB, DC, DD, DE, DF.
   d. End of file and end of reel, Charts EA, EB, EC, ED, EE, EF, EG, EH.
   e. Label handling, Chart FA.
   f. Checkpoint and restart, Chart GA.

COMMUNICATIONS

NOTE: Most 7080 IOCS tags begin with the letters CS. In this manual, the suffix is dropped for brevity's sake. Thus, tag CSF000401 is shown as F000401. Those few tags which begin with the letters IO are referred to in full. An X in a tag indicates either channel 20, 21, 22 or 23.

Because IOCS is a preassembled program loaded into memory with the main program it complements, communication between the two programs is necessary. IOCS and the main program communicate in six different ways:

Tape tables
File tables
Functional linkages
Specialized transfer address routines
Control cards
Loops and messages

Tape Tables: The tape table defines the function of every tape unit attached to each channel used by the main program. The table consists of two sections, a main section and a special section.

The main section provides for a 5-character entry for each tape unit. Each entry specifies whether the unit contains a base tape, an alternate tape, or an unassigned tape. In addition, the base tape entry specifies the memory address of a file table.

The special section provides for five 5-character entries, each referring to a special function which may or may not be required by the main program. Each entry specifies whether a tape has been assigned to perform one of the special functions: checkpoint, error dump, messages, or control cards. The tape table makes it possible to change completely (include, exclude, or modify) the use of a tape unit without modifying a single instruction in the main program.

File Tables: 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 are described by one file table.

A file is related to a tape unit (or units) by placing the tape select address and the address of the file table in a tape table base tape entry. The file table is defined through macro-instructions IOFTA, IOFTB, and IOFTC.

A file table consists of two sections, fixed and variable. The fixed section is always 95 characters in length, and contains information for use at beginning and end of reel, and at beginning and end of file. The variable section contains information required each time an input/output operation is executed. The high-speed transmit address of the variable section plus five is the file table address, and is specified in the tape table base tape entry.

Functional Linkages: Functional linkages are in the form of macro-instructions. The inclusion of these macro-instructions at a logical point in the main program produces an appropriate linkage to IOCS for all input/output requests. The usual generated coding includes a TIP to an IOCS routine, but sometimes a RCV — TSL is used.

Specialized Transfer Address Routines: For some applications, the user may need to supplement IOCS with special routines of his own. To facilitate linkage to such routines, IOCS provides the following exits:

1. Header transfer address: Located in file table section 4, word 1 (F000401). The address of the first instruction of the user's beginning-of-reel and beginning-of-file (multifile tape) routine. The 10-character tag of the header transfer address is specified in operand 3 of the file table macro, IOFTA. If no special processing is desired, IORETURNTO is specified.
2. End-of-reel transfer address: Located in file table section 4, word 2 (F000402). The address of the first instruction of the user's end-of-reel routine. The 10-character tag of the end-of-reel transfer address is specified in operand 4 of the file table macro, IOFTA. If no special processing is desired, IORETURNTO is specified.
3. End-of-file transfer address: Located in file table section 4, word 3 (F000403). The address of the first instruction of the user's end-of-file routine. The 10-character tag of the end-of-file transfer address is specified in operand 5 of the file table macro, IOFTA. If no special processing is desired, IORETURNTO is specified.
4. A90 (control card exit): A receive to W005+1 (an IOCS common entry point) and TSL to CCEXIT permits the programmer to pick up control card columns not used by IOCS.
5. TRSOPLBL: The address of a user's routine to create labels on new tapes without going card-to-tape.
6. IOREDUNCHK: The address of a user's routine to decide the disposition of errors.

Control Cards: Control cards are read and processed by HSK if standard header labels are specified for at least one input or output file; otherwise, control cards are not required. The cards are used to update file tables and establish constants for use in the subsequent processing of standard header labels.

Loops and Messages: Messages alert the operator to program status, improper usage, errors, etc. Some are typed on the console typewriter; others may be written on a secondary output unit. The program enters a waiting loop following messages which require operator decision or action.

Relation Between IOCS and the Main Program

Chart AA illustrates both the relationship between IOCS and the main program and the relationship among the various IOCS routines.

Block AA01: It is necessary to execute housekeeping on files for the system before using IOCS to perform input/output functions. This block causes linkage via a TIP to A01, to housekeeping (CSHSK). Tag A01 is a pivot in the common entry points which provides entry to housekeeping at A0100.

Block AA02: CSHSK checks and initializes all tape tables and file tables. It reads control cards if standard labels are used, and updates the control word and label areas. It tests for ready, and checks the labels, if specified. If the current file is a shared input checkpoint tape, the checkpoint records are spaced over to avoid treating them as input data. Input areas are primed and, if specified, a checkpoint is written. Many of these operations are performed in other sections of IOCS such as CSTRS and "little DTS." Control returns to the main program.

Block AA03: This block represents linkage to the get/put routines in the file table.

Block AA04: The get/put routine moves the next data record to or from the work area. It tests whether the last data record position of the I/O area is used. If the last position is used, entrance is made to DTS to request an area.

Block AA05: An IORD or IOWR macro is given, signaling that an area has been processed and a new area is needed. Linkage is made to the request entry of main DTS by a TIP to the scheduler transfer address in the file table of that file.

Block AA06, D2X01: A read/write operation is requested. If the channel is ready, control passes to block AA08 to start the requested operation. If the channel is not ready, the file is tested for stacking mode.

If it is not stacking mode (initiate mode), or no areas are available for the file (force condition), or the stacking table is full of requests, a loop delays action on this file until the channel becomes free. The next interrupt on this channel allows entry to the channel interrupt routine (block AA07) to start the requested operation. If the previous conditions are not present, the request is entered in the stacking table and a return is allowed to the main program.

Block AA07, D2X03: An interrupt occurred on this channel. Information concerning the previous operation is still in the channel work area. This information is tested to determine if a length check is to be made of the last operation. If it is, the record length is tested and, if found correct, a test is made for other abnormal conditions (I/O indicate or error). If one of these conditions is detected (record length error, multiplexor check, or I/O indicate), the TSA common entry routine is entered where control is routed to a routine to process the condition. If the last operation is normal, and a request is waiting, control passes to block AA08 to start the operation. If stacking mode is detected in an unforced condition, however, the stacking table is moved up, bringing the next requested entry into operating position. If no requests are waiting, control returns to the main program. Otherwise, control passes to block AA08 to start the new operation.

Block AA08, D2X05: The next request is initiated by moving the request entry and the information necessary for its performance into a channel work area. The new operation is then started.

Switches are tested to detect a force condition in stacking mode for the file. This condition indicates that an area is not available to the main program, so control passes to the loop to wait for the next interrupt. Otherwise, control passes through the loop to return to the main program.

Block AA09: A special operation is requested. The macro requesting this operation may be any of the following: IOBSF, IOBSP, IOCLS, IODMP, IOFER, IOFSF, IOFSP, IOHLD (or HOLD parameter in another macro-instruction), IOMFC, IOMFO, IOPOS, IORDS, IORUN, IORWD, or IOWRS. Control passes to the special operation DTS by a TIP to D7001 (special operation DTS) to initialize for the operation.

Block AA10, D70: These special operations cannot be performed in stacking mode, so the stacking table is cleared of all entries for this file. The operations from the stacking table are performed if the request is not IOFSF, IOBSF, or IOPOS. In these three cases, the requests are counted only. The various operations are handled in this manner:

1. If the operation is IOHLD, or a macro with a HOLD parameter, it is completed in this routine.
2. If the operation is IOPOS, IORDS, IOFSF, etc., control passes to a special subroutine which executes the operation.
3. If the operation is concerned with end-of-reel functions (IOCLS, IOFER, IOMFC, IOMFO, IORWD, or IORUN), entrance is made to the TSA common entry routine to initiate the operation.

Block AA11: A number of subroutines are available for special operations. These subroutines are not needed in memory if their respective special operations are unused by the main program. Therefore, memory space is conserved by including them as class B subroutines if these operations are called for. The subroutines schedule the operations and perform them or, for IORDS or IOWRS, release control to main DTS for their performance.

Block AA12, C01: The TSA common entry routine is entered if a multiplexor check, length error check, or unusual condition (I/O indicate, etc.) is detected. This routine makes a more detailed check on the type of unusual condition and directs control to the proper routine. It may pass control to the error routine or to the EOF/EOR routine.

Block AA13, C01: The error routine is entered when a tape error is recognized. This routine is used to backspace and retry the operation. If the operation is still in error, the routine repeats the backspace and retry a predetermined number of times (100 for read or 25 for write). If retry operations are unsuccessful, the redundancy routine is entered to search the I/O area for redundant characters. If they are found, their location and bit structure are typed and the operator is given the option of altering the characters or of accepting IOCS's repair (reversal of C bit). When all errors have been corrected, return is made to the routine that forced entry to the error routine.

Block AA14, D60: Little DTS performs all internal tape operations for IOCS. It does the operation in hold mode by entering a loop and waiting for interrupt on that channel. After interrupt, the operation is checked for errors (if necessary) and exit is made either to the routine that requested the operation (normal exit) or to the error routine (error exit).

Block AA15, B01: This block represents a routine that fills the input areas of a file in preparation for usage of those areas.

Block AA16, E01: Normal end-of-file procedures are performed, including label operations and file closing.

Block AA17, A15: Between-reel functions are performed, including closing tape files, alternating tape reels, opening these files, and returning to the proper routine.

Block AA18: This block represents a linkage to the checkpoint routine by a TIP to G02.

Block AA19, G01: At error-free points in the program, the checkpoint routine records all machine conditions and the contents of storage and memory, and places this information in tape records on a specified output tape. The checkpoint routine and the restart program make it possible to:

1. Terminate the program at an intermediate point (checkpoint), and subsequently restart the program at this point.
2. Restart processing at the last checkpoint rather than at beginning of job on an irreparable error condition.

Block AA20: This block represents a type routine linkage consisting of a RCV — TSL or a TIP to S7001, S7002, S7003, or S7004, depending on IOTYP or IODEC parameters.

Block AA21, S01: This routine sets up the given message and types it. For IODEC, control enters a loop in the macro to allow the operator a choice of two options depending on the parameters of the macro-instruction. IOTYP returns to the instruction following the macro.

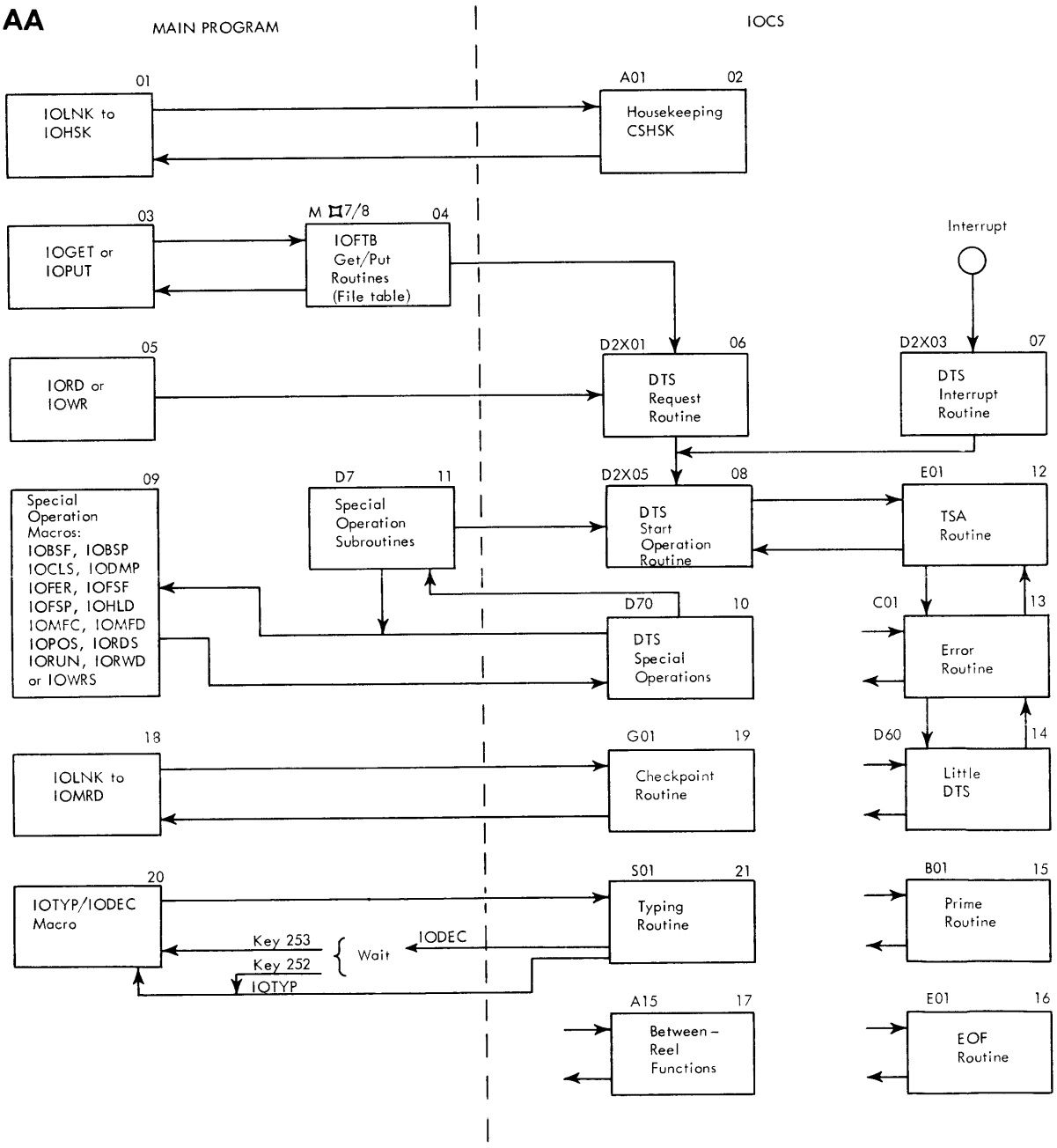


Chart AA. Correlation Between IOCS Routines

File Tables

A means of communication between the main program and IOCS, file tables contain descriptions of specific tape files to be handled. A file table relates to a file, whether it is contained on a single reel or on multiple reels. One file table is required for each file and is related to a physical tape unit by placing the address of its file table in a tape table base tape entry. This base tape entry also specifies the select address of the tape unit. Thus, the tape table and file table form a twofold communication path between the main program and IOCS.

A complete treatment of file tables and tape tables is included in the *Reference Manual — IBM 7080 Input/Output Control System for use with 729 Magnetic Tape Units,* Form C28-6237.

The following description is of file tables as they relate to the file table work area.

File tables are defined by the programmer with the macro-instructions IOFTA, IOFTB, and IOFTC. These tables may be located anywhere in memory with the following limitations:

1. Not within IOCS.
2. Not in the last 2,000 positions of memory (reserved for use by the checkpoint routine if no work tape is specified).

The file tables need not be grouped together. Good practice requires that a file table begin at an even hundred or thousand position in memory to facilitate memory print investigations.

A file table is variable in length, depending on the requirements specified by the programmer. The table is divided into two sections, the first of fixed length and the second of variable length.

File Table Work Area: During the operation of IOCS, significant portions of the fixed section of the file table and of the 25-character DTS part of the variable section of the file table are moved into a 120-position work area known as the file table work area.

File Table Work Area Tags: Like most 7080 IOCS tags, those of the file table work area begin with the letters CS. The third character of the tag is F. The next two digits are zero (denoting a common or work area). The sixth and seventh digits relate to the section of the file table work area as follows:

01 Housekeeping
02 Data travel system
03 Error correction
04 End of file and end of reel
05 Tape reel control system

Each section in the file table work area is divided into 5-character words. The high-order position of each word is character 4. A tag referring to an entire 5-position field contains only nine digits, the tenth position is a blank. The tens and hundreds positions of a file table work area tag refer to the word within the section. All file table work area words contain five characters, with two exceptions. Section 1 of the fixed section of the file table work area is 16 positions in length. Thus, it is made up of three 5-character words and a 16th character which is actually character 3 of the 4-character word 1 in section 3.

The tenth digit of a file table work area tag refers to the character within the word. If this position is a blank, the tag refers to the entire 5-position field. For example:

CS F 00 01 02 4 Number of Alternate Tapes
CS F 00 01 01 Scheduler Transfer Address
CS = Common to all 7080 IOCS tags
F = File table
00 = Work area
01 = Section
01, 02 = Word
4 = Character

Main Program Tags: The assembly program (7058/7080 Processor) generates tags for file table references. These tags have the format M□xxxyyyyy where the x's refer to the file table section and word and the y's are assigned by the assembly program in the numeric sequence in which the macros were processed.

Thus, the IOCS tag F000101 appears in the main program as tag M□101yyyyy. The last five digits are identical for all tags relating to the same macro. That is, if the main program tag for the select address of a given file is M□20312345, the tag of the scheduler transfer address of that same file would be M□10112345.

FIXED SECTION

The fixed section is always 95 characters in length, and contains information for use at beginning and end of reel and end of file. The address of the fixed section (F000202) is the high-speed transmit address of this 95-character field. For example, if a given file table has been placed by the programmer at a memory location beginning at 084000, the address of the fixed section would be 084004.

The fixed section is further divided into four areas, each containing specific information needed at particular times by the control system. These four areas are: housekeeping, error correction, end of file, and label processing.

In the following description, each field is explained in detail (Figures 1-6). The file table is related to its work area. It is in the file table work area that the major interrogation and modification of the file table occurs.

FT-101, Scheduler Transfer Address (F000101): This field consists of an unconditional transfer operation

code and the address of the first instruction of a DTS routine based on the channel to which the file is assigned.

FT-1024, Total Number of Alternate Tape Units (F0001024): This field gives the total number of alternate tape units used by the file. A maximum of four alternates is allowed.

FT-1022, Current Select Address (F0001022): This shows the hundreds and units positions of the select address of the base tape specified in the tape table. Thus, if tape unit 2307 is specified for this particular file, this field would contain 37 (channel 23, tape unit 7). 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 (F0001021): This gives the units and hundreds positions of the select address for the first alternate tape unit.

FT-1033, Second Alternate Select Address: This field gives the units and hundreds positions of the select address of the second alternate tape unit.

FT-1031, Third Alternate Select Address: This gives the units and hundreds positions of the select address for the third alternate tape unit.

FT-103, Fourth Alternate Select Address (F000103): This gives the units and hundreds positions of the select address of the fourth alternate tape unit.

FT-3013, Open Type Indicator (F0003013): This field specifies whether the base tape of the file is to be opened immediately in CSHSK. The programmer is given the option of delaying the opening of the file until the main program first links to IOCS for an input/output operation for this file.

FT-3022, Data Tape Record Counter (F0003022): This 6-position 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 zero on an end-of-reel, intermediate or final end-of-file condition, or for a delay-open operation.

FT-302, Noise/Skip Counter (F000302): This 2-position counter is a noise counter for input files or a skip counter for output files. For input files, this counter is increased by one each time a noise record is encountered in attempting to read a tape record. For output files, this counter is increased by one each time a skip operation is executed in attempting to rewrite a tape record. The counter is reset to zero at each end-of-reel or final end-of-file condition.

FT-3032, File Counter (F0003032): This 3-position counter is increased by one each time a file is opened. It is reset to zero at each end-of-reel or final end-of-file condition.

FT-303, Error Correction Entry Counter (F000303): Called "number of redundancies" in the listing, this 2-position counter is increased by one each time an entry is made to the error correction routine. An initial error that is finally corrected after n retries is counted as one entry in this counter, not as $n+1$ entries. The counter is reset to zero at each end-of-reel or final end-of-file condition.

FT-3043, Permanent Error Counter (F0003043): For input files, this counter is increased by one when the dump option is used, or each time a record is accepted with redundancies replaced by IOCS or the console operator, and processing is continued. For output files, the counter is increased by one each time a persistent error record is accepted (no redundancies are present in memory), and processing is continued. The counter is reset to zero at each end-of-reel or final end-of-file condition.

FT-304, Last Noise Record Counter (F000304): This 3-position field is an indicator rather than a counter. Each time a noise record is encountered, this field is altered to specify the three low-order positions of the data tape record counter for this file. Thus, at any given time, the field will contain the record counter location of the last noise record encountered on the file. It will not count the number of noise records. The field is reset to zero on an end-of-reel, intermediate or final end-of-file condition, or for a delay-open operation.

FT-4014, Label Indicator (F0004014): This field specifies the types of labels used for the file.

FT-401, Header Transfer Address (F000401): This contains the address of the user's specialized beginning-of-reel and intermediate beginning-of-file routine. If none is specified, IORETURNTO is placed here by the file table macro-generator.

FT-4024, Checkpoint Indicator (F0004024): This character specifies whether the file is connected in any way with checkpoint. A minus (−) in this field indicates this file has no connection with checkpoint.

FT-402, End-of-Reel Transfer Address (F000402): This field contains the address of the first instruction of the user's specialized end-of-reel routine. If none is specified, IORETURNTO is placed here by the file table macro-generator.

FT-4034, File Type Code (F0004034): This character specifies (a) whether the file is on a single- or multifile reel, (b) whether the file is handled sequentially or non-sequentially, (c) whether the tape is to be unloaded after rewinding at an end-of-reel or final end-of-file condition, and (d) whether end of reel is to be handled in mode 1 or mode 2.

FT-403, End-of-File Transfer Address (F000403): This field contains the address of the first instruction

of the user's specialized end-of-file routine. If none is specified, IORETURNTO is placed here by the file table macro-generator.

FT-5011, Current Tape Serial Number (F0005011): If standard headers are specified for the file, this 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 in this field. If standard headers are not specified, the field is zero.

Field Separator: This is always a slash (/).

FT-5021, File Serial Number (F0005021): This field contains the file serial number. If standard headers are specified for the file, the file serial number is identical to the tape serial number of the first reel of the file. For output, it is obtained from the tape serial number in the header label of the first output reel. This number is used as the file serial number for each beginning-of-reel header for the file. The file serial number is reset to zero on a delay-open operation for an output tape. Because the input data are 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 the updating of this field by the main program. If standard headers are not used, the field is zero.

Field Separator: This is always a minus (−).

FT-5032, Reel Sequence Number (F0005032): This 3-position field is initialized to zero by CSHSK and is increased by one at a beginning-of-reel condition.

Field Separator: This position is always a blank.

FT-5051, File Identification Name (F0005051): This field contains any 10-character alphameric name desired to distinguish a file. The three high-order positions may be numeric for use in cycle checking.

Field Separator: This is always a blank.

FT-5064, Tape Type Code (F0005064): This character indicates the model type, bit density, and the prime and rewind options for housekeeping.

FT-5063, Automatic Dump Indicator (F0005063): This field specifies whether data tape records that are found to be permanently in error are to be automatically dumped. (A dump tape must be provided.)

FT-506, Number of Days in Retention Cycle (F000506): This field indicates the number of calendar days the 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. The field is zero for an input file.

FT-5074, Type of Record Length (F0005074): This character specifies the type of record; F for fixed-length records, V for variable-length records.

Field Separator: This is always a minus.

FT-5084, Data Record Length (F0005084): For fixed-length records, this field specifies the data record length; for variable-length records, the maximum data record length.

Field Separator: This is always a minus.

FT-5094, Tape Record Format Description (F0005094): This 4-position field specifies whether data records are blocked or unblocked and, if blocked, the tape record length.

Field Separator: This is always a blank.

FT-5092, Checkpoint Indicator (F0005092): This field contains C if tapes of an input file contain checkpoint records; if not, it contains a blank.

Field Separator: This is always a blank.

Record Mark: This position contains a record mark to end the fixed section of the file table.

VARIABLE SECTION

The variable section of the file table contains information required each time an input/output operation is executed. The address of the file table as specified in the base tape entry of the tape table is the high-speed address of section 2 plus five. Another way of stating the address of the file table is the initial location plus 104. Thus, if a given file table starts at memory position 084000, the fixed section of the file table would be located from 084000 to 084094, inclusively. The variable section would be located beginning at 084095. The address of the file table would then be 084104.

The variable section of the file table is further divided into five sections, depending on the file specifications. The sections are named data travel system, constants, get, put, and I/O areas.

FT-2014, File Code (F0002014): The zone coding of this 1-character field indicates the type of file (data, work, or program tape). The numeric portion refers to the relative volume of the file, and indicates the volume priority (highest volume is nine) which may be used in proposed supervisory program systems.

FT-201, Get/Put Address (F000201): If get/put is used for this file, the field contains the address of this routine for the file.

FT-2034, Status Code (F0002034): This character specifies whether the file is input or output, whether records are of fixed or variable length, and whether get/put routines are used with the file.

FT-203, Select Address (F000203): The numeric portion of this field is initialized by CSHSK and contains 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 select address of the next alternate tape to be used is placed in this field. The zoning over the tens and hundreds positions (comparable to ASU zoning) serves as the force counter, as

explained in detail in the DTS section of this manual. The zoning over the units position specifies whether initiate or stacking mode is used. The B bit zero indicates initiate mode; B bit one means stacking mode.

Field Separator: This field is always a blank.

FT-202, Address of Fixed Section (F000202): This field contains the high-speed transmit address of the fixed section of the file table. Thus, if the programmer places a file table at 030000 this field contains $\overset{+}{0}004$, or 030004.

FT-204, Transfer to Area Routine (F000204): This field is an unconditional transfer to the address of a routine (see FT-214) which steps the tape record counter and rotates the input/output areas in a circular fashion starting with the first I/O area specified.

FT-2054, Number of I/O Areas (F0002054): This field contains the total number of I/O areas as specified by the programmer. The maximum allowable is eight.

FT-205, Area in Use (F000205): This field is initialized with the address of the first I/O area. During an actual read or write operation on this file, this field contains the current I/O area address. During processing, it contains the address of the next area to be used.

FT-206, Addresses of I/O Areas (Never in Work Area): The field will be from 5 to 40 positions in length, one 5-character entry for each of the one to eight I/O areas allowable. The areas are arranged in the order of their use. During processing, the last 5-character entry is always identical to that found in FT-205. Each entry has in its high-order position the total number of I/O areas. The other four characters contain the address of the I/O area and must end in 0 or 5. If FT-2054 is zero, the field is excluded.

FT-214, Area Routine (Never in Work Area): This field contains the actual instructions of the routine that rotates the I/O areas in a circular fashion as they are used. This routine may include from two to six instructions, depending on the number of I/O areas to be rotated.

1. If the total number of areas is zero (FT-2054 equals zero), the following routine is generated:

```
ADM     07      FT-3022     Add 1 to record counter
TR              D003001     Common exit
```

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

```
                RCV             FT-205      Next I/O area
01=1 area       SND     01 to 06 FT-205+5   Move address fields left
02=2 areas, etc. SND    01      FT-205      Move old area to rear
                ADM     07      FT-3022     Add 1 to record counter
                TR              D003001
```

3. If FT-2054 is 7 or 8, the following is generated:

```
                RCV             FT-205
01=7 areas      SND     06      FT-205+5
02=8 areas      SND     01 or 02 FT-205+35
                SND     01      FT-205
                ADM     07      FT-3022
                TR              D003001
```

FT-206 to FT-213, Area Addresses: FT-206, the sixth word of the DTS section of the file table, may be followed by from one to seven entries. Thus, the first field is tagged FT-206, the second is considered FT-207, and the eighth and last field is FT-213. Therefore, the next field in line is FT-214, the 14th word of the DTS section. If fewer than eight I/O areas are specified by the programmer, FT-214 follows the last I/O area address.

For example, assuming three I/O areas, a memory print may show:

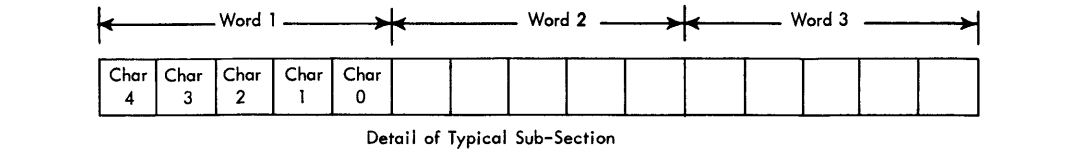
```
          (a)       (b)       (c)       (d)       (e)
FT-205    FT-206    "FT-207"  "FT-208"  FT-214    Area Routine
```

a. The second I/O area address.
b. The third I/O area address. The field is not tagged because of the method used to rotate the areas.
c. The first I/O area address. The address at the end of the string of addresses is always identical to FT-205.
d. FT-214 is the tag of this field even though fields 9 through 13 are missing (areas 4-8 are not specified). Because there are three areas to be rotated, the 25-character field "e" consists of the following five instructions:

```
RCV         FT-205
SND   03    FT-205+5    Move FT-206, FT-207, and FT-208 to the left
SND   01    FT-205      Put FT-206 where FT-208 was
ADM   07    FT-3022     Add 1 to record counter
TR          D003001     Transfer to exit
```

The FT operands shown in these examples of coding are related to the file table fields for explanatory purposes. In the main program, they appear as M□ tags. Thus, the area addresses are rotated in a circular fashion. The address of the area to be used next is now in FT-205.

File Table Work Area Addresses: The standard, preassembled IOCS is the full, 4-channel system. In this listing, the tape tables are located at 000500, the file table work area starts at 000800, etc. (Future releases or local changes may relocate the program.) A file table work area field such as data tape record counter, is located at 000822 in the standard system. If the entire program is relocated so that the tape tables start at 120500 instead of 000500, this field would be at 120822. If the entire program is relocated so that the tape tables start at nnnnnn, the field would be at nnnnnn+322.



Detail of Typical Sub-Section

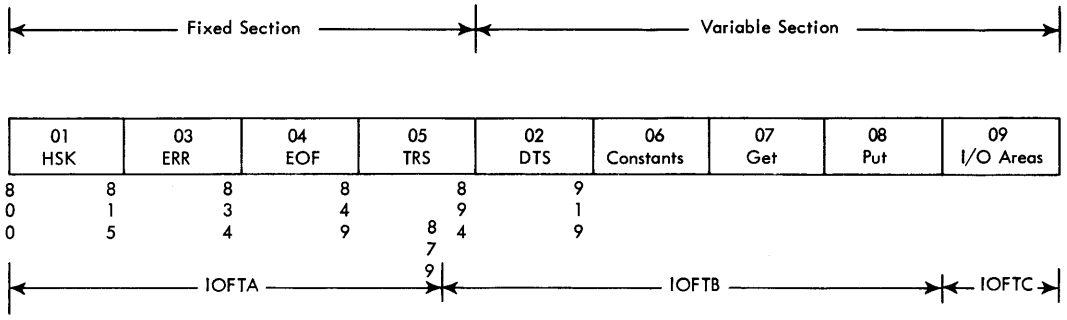


Figure 1. File Table Layouts

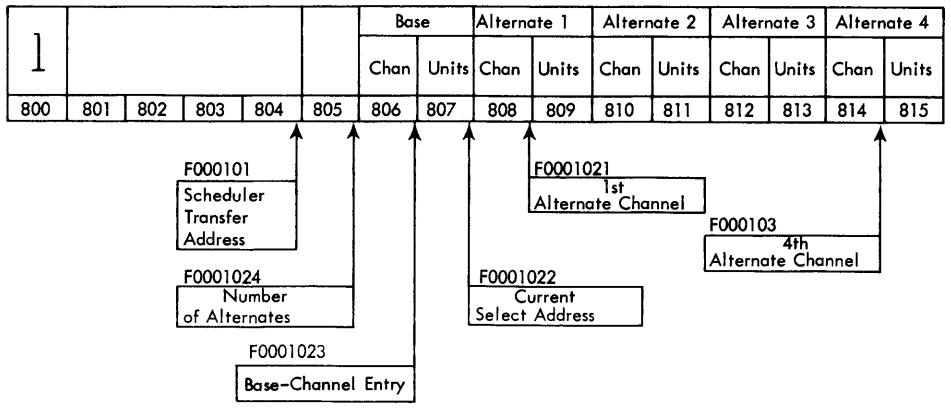


Figure 2. File Table Work Area, Section 1–HSK

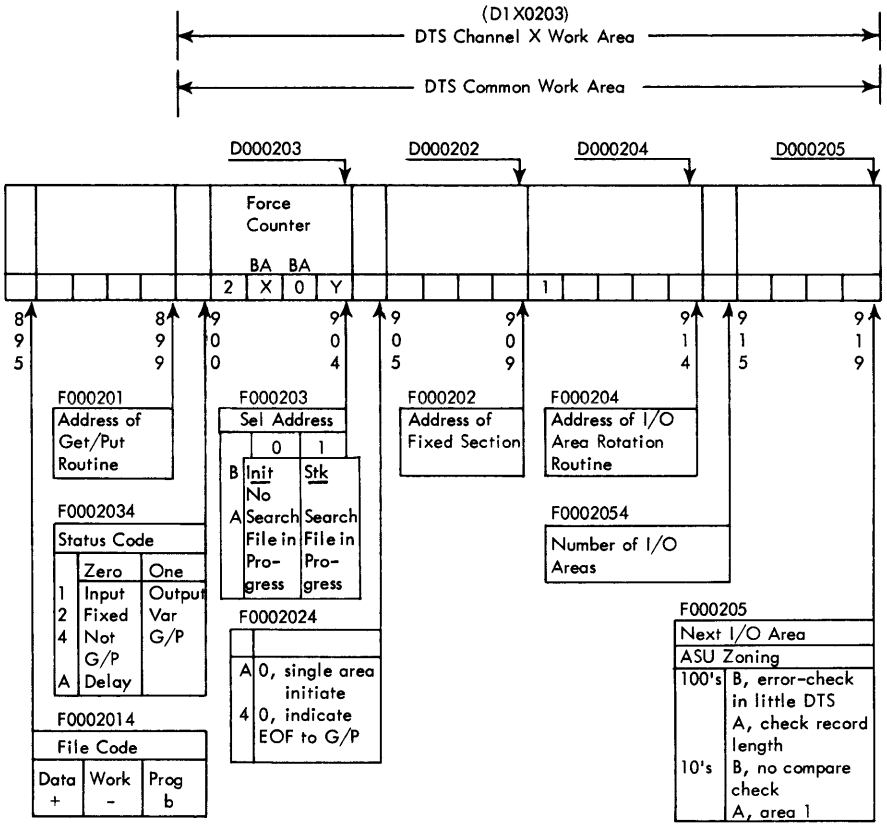


Figure 3. File Table Work Area, Section 2–DTS

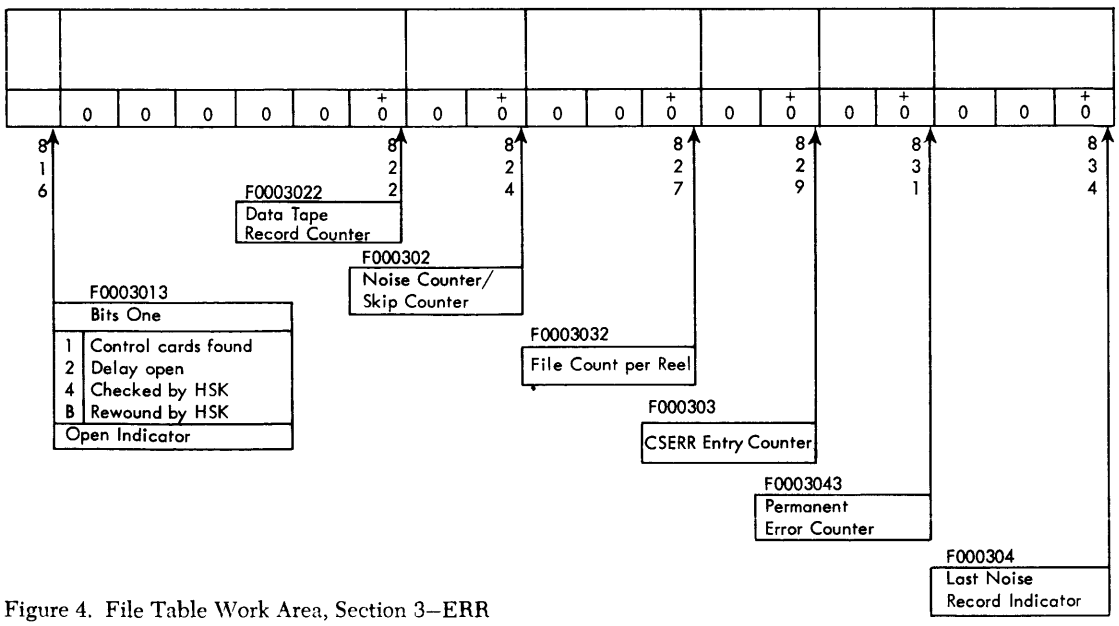


Figure 4. File Table Work Area, Section 3–ERR

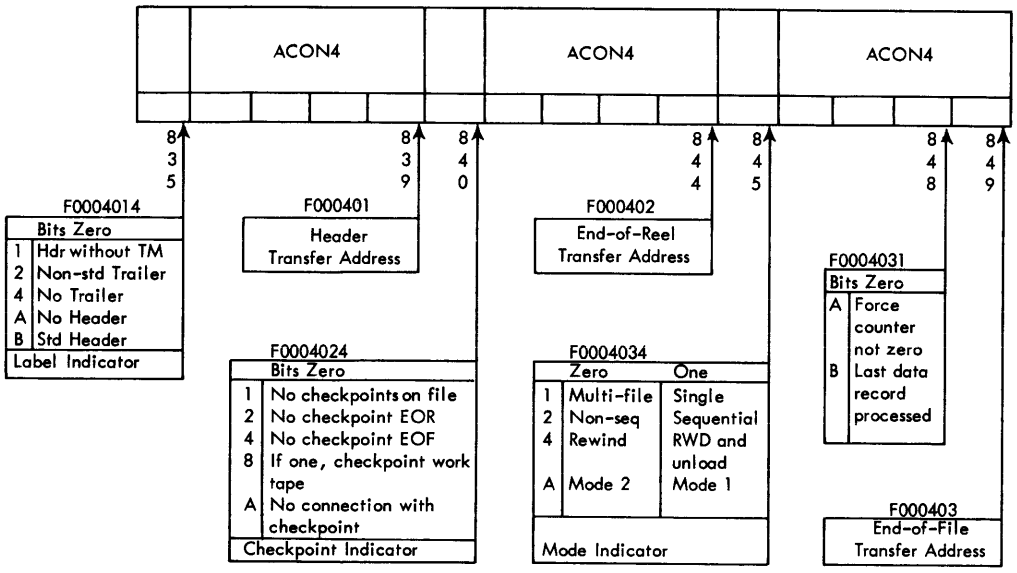


Figure 5. File Table Work Area, Section 4–EOF

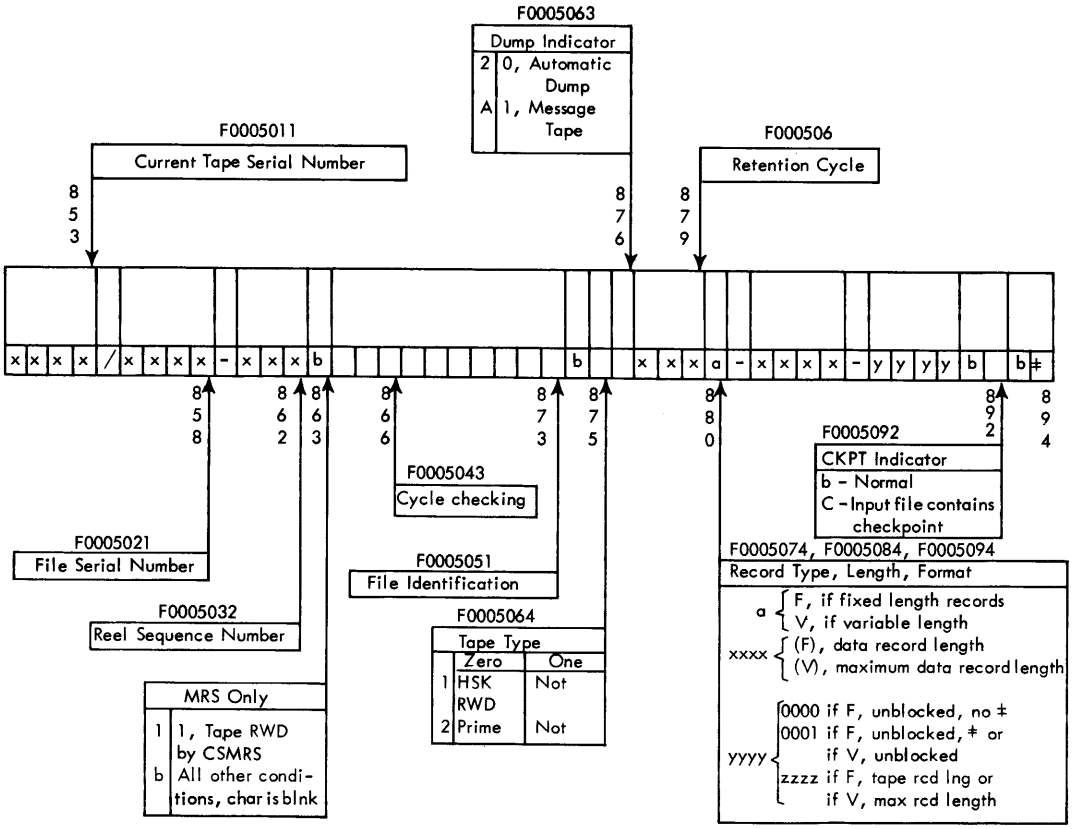


Figure 6. File Table Work Area, Section 5–TRS

Housekeeping (CSHSK)

All phases of input/output initialization are performed by CSHSK; tape tables and file tables are checked and initialized, base tapes are checked and positioned for main program processing, and component sections of IOCS are modified (based on file table and tape table information). Linkage from the main program to CSHSK is provided by the macro-instruction IOLNK.

When housekeeping is completed, the memory positions occupied by the routine may be overlaid by the main program. The erasable portion of IOCS begins at A028005.

Charts BA, BB, and BC illustrate the housekeeping routine. Chart BA shows the general CSHSK operation; Chart BB is a detail of block BA07 showing the checking and initialization of tape tables and file tables; Chart BC shows the priming routine.

Housekeeping performs the following functions:

Sets CASU's 01-06 to 1-6, respectively. Sets CASU 07 to +1 and CASU 08 to +5.

Sets up the channel communication words.

Processes tape tables by placing channel numbers in appropriate work areas.

Processes file tables:

1. Checks for proper format and addressing.
2. Initializes select addresses and scheduler transfer addresses.
3. Checks the assignment of alternate tapes and produces an alternate tape log, if needed.

Checks base tapes for ready and alerts the operator to those not ready. Checks I/O indicators and rewinds tapes.

Checks tape labels and reads control cards, if any. Positions tapes properly to read or receive the first record.

Sets up a message tape, if specified.

Primes input areas, if specified.

Takes a checkpoint, if specified, before transferring control to the main program.

Housekeeping Operations

INITIALIZE

Block BA01, A0100: Switch A0111 is set TR and the 8 bit of A0104 is set zero to allow the reading of control cards and the writing of identification message 10210 if IOCS remains in memory between runs. At A0101, control links to A501001 where CASU's 01-06 are set to 1-6, respectively. A +1 is loaded into CASU 07 and a +5 into CASU 08.

Block BA02: By means of a TIP to the channel interrupt tag D2X03 and the LIP 2X00 already there, the address of the first instruction of each channel interrupt program (channel X, word 0) is set up in communications storage bank 2.

Block BA03, A0103: The fifth TIP transfers control from the channel word routine to A0103 where an all-channel hold is performed in a subroutine at D6502. The all-channel hold insures that no tapes are moving when housekeeping begins. The 1 bit of S0050041 is set zero to allow housekeeping messages to appear on the typewriter, not on tape. IOCS identification message 10210-xx yy is written. The assembly number is xx; yy indicates the number of patches included.

The instruction at A0104 is changed from TSL to TMTS 01 to avoid repeating message 10210 in case CSHSK remains in the machine between phases of a program. The instruction at A500106 is changed from TSL to TMTS 01 to bypass the routine that moves part of the file table to the file table work area.

SCAN

Block BA04: Control links to a subroutine at A0500101 to scan the tape tables for base tape entries.

NOTE: A tape table entry is a five-position field. For a base tape entry, the high-order position contains the tape unit number and is unzoned. The second part of the entry contains the four-character high-speed transmit address of the file table plus 100. In addition, the tens position of the field contains zoning to designate the channel number:

00	channel 20
01	channel 21
10 (−)	channel 22
11 (+)	channel 23

A base tape entry is placed in the special section of the tape table if tapes on the file have been assigned a special function.

For an alternate tape entry, the high-order position is blank (A bit zoning). The second part of the entry contains the tape select address. An alternate entry is never valid in the special section of the tape table.

For a free or unassigned tape entry, the high-order position is a minus sign (B zoning). The second part

of the entry contains the tape select address. To designate no tape assigned to a given special function in the special tape section, IOCS generates four blanks in the second part of that special tape entry.

Terminating entry Abbb≠ always appears as the last or 41st entry of the main section of the tape table. If fewer than 40 tapes are used, terminating entry $\overset{+}{0}$bbb≠ follows the last significant tape entry in the main section. Terminating entry Abbb≠ appears as the last or sixth entry of the special section of the tape table.

If no dump tape is assigned, the dump entry in the special section is used to count the number of records dumped on the typewriter.

If no checkpoint work tape is assigned, the number of the octant which is to contain the checkpoint work area is generated in the low-order position of the work tape entry.

The scan of the main section of the tape table begins by locating the first entry of the tape table. The address of the memory position preceding the first entry is contained as an ADCON at A500110. (For the preassembled IOCS, this address is 000499.) The address is placed at A500111 and 4 is subtracted from it. The result (000495) is placed at A500103. A500111 and A500103 are increased by 5. The result (000500) is the address of the high-order position of the first tape entry.

Block BA05: The high-order position, located at A500103, is interrogated to determine the type of entry: base, free, alternate, or terminating. If the entry is unassigned or an alternate entry (B bit one or A bit one), control transfers to A500102 where the address of the next entry (A500111) is obtained.

If the tape entry is not a base, an alternate, or a free entry (that is, the high order zoning is plus), it must be a terminating entry of the main section of the tape table. To indicate this, the A bit status is reversed in the hundreds position of the scan exit address at A500199. Because this bit is zero at the beginning of the regular tape table scan, and is alternated when any terminating entry is found, the bit is one after either the Abbb≠ entry (end of the main section) or the $\overset{+}{0}$bbb≠ entry (end of the main section if less than 40 entries) is encountered.

After the regular tape table scan is complete, the address (W18-1) of the first entry in the special tape table is loaded into CASU 06 and control transfers to A5001011 to scan the special section of the tape table.

When the Abbb≠ terminating entry in the special tape table is found, the A bit in the hundreds position of the scan exit address at A500199 is again alternated. The bit goes from one to zero and now indicates the end of the entire tape table scan. Control transfers to the scan exit at A500199 and then returns to the TSL+5 of the originating linkage at A0104+30.

The tens position of scan exit A500199 is interrogated to determine if any file table addressing errors have been found (block BB02). The B bit one at A500199+3 indicates file table error; B bit zero means no file table error. Message 00259-TT ERROR is written to inform the operator that a basic file table error exists. Pressing either interrupt key 252 or 253 gives the same message.

The 8 bit at A500106−4 is set to zero. This restores the operation code at A500106 to TSL to allow a file table to be sent to the file table work area. (See block BA03.)

Block BA06, A500011: If the entry is a base tape entry (no zoning), control passes to A500111 where the address of the entry is loaded into CASU 06. Control links to a subroutine at A500601 to move the entire fixed section and the 5-word DTS portion of the variable section of the file table into the file table work area.

Block BA07, A500112: If a base tape entry is found, the scan exit is an indirect transfer to the TSL+5 of the originating linkage. This is an effective transfer to A0250, the beginning of a routine (Chart BB) that checks the tape tables and initializes the file tables of the base tape entries found in the scan.

Blocks BA08 and BA09, A0110: Control again passes to the scan routine at A500101 to locate base tape entries. As each base entry is found, an indirect transfer is made to the ADCON at A0110+10.

Block BA10, A0300: The open type indicator field, F0003013, is interrogated to determine whether the base tape of the file is to be opened immediately in housekeeping. If the open operation is to be delayed until the main program first links to IOCS for an input/output operation on this file, the base tape need not be in ready status in CSHSK. The 2 bit one at F0003013 indicates delay open; 2 bit zero means that the tape is to be opened in housekeeping.

Block BA11, A0302: If the base tape is not to be opened during housekeeping, the following file table counters in the file table work area are initialized to zero: data tape record counter, F0003022; noise/skip counter, F000302; file count per reel counter, F0003032; error correction entry counter, F000303; permanent error counter, F0003043; and the last noise record counter, F000304. The reel sequence number, F0005032, is initialized to 001.

Control links to a subroutine at B02155 to return the updated file table from the work area to its original location in the main program. Control then transfers to A500102 to continue the tape table scan.

Block BA12, A0303: If the base tape is to be opened in housekeeping, the B bit of the open type indicator, F0003013, is set to zero to show that the base tape has

not been positioned by housekeeping. The 4 bit at F0003013 is set to zero to indicate that a ready check has not been performed. The A bit of the status code field, F0002034, is set to one to indicate that the tape is opened; that is, FT-101 has not been modified to effect a delay-open operation. The base tape is selected by an indirect select of F000203.

Block BA13: If the I/O indicator of the base tape has been left on, message 30280/1-xy-ION is written. Pressing interrupt key 253 causes an indirect transfer to the second ADCON of the message format. This is an effective transfer to A0308 where the I/O indicator is turned off and control transfers to A0304 to continue housekeeping.

Pressing interrupt key 252 results in a direct transfer to ADCON A0308; control transfers first to A0110 and then to A500101 to scan the entire tape table again. Thus, all base tapes are rechecked.

REWIND

Block BA14, A0304: The tape type code field, F0005063, is interrogated to determine if the base tape is to be rewound during housekeeping. The 1 bit zero at F0005064 indicates that rewinding is specified; 1 bit one means that it is not.

Blocks BA15 and BA16, A0305: If the base tape is to be rewound in housekeeping, a TRR interrogates tape ready. If the tape is ready, control transfers to A0306 to rewind the tape and to effect a transfer to A0302 (block BA11) to locate the next base tape entry. If the tape is not ready, control passes directly to A0302.

NOTE: A ready loop does not occur at this point because all tape rewinding is to be completed before control cards are ready. A ready loop occurs in the ready test section of the label-checking routine.

Block BA17: If the base tape is not to be rewound during housekeeping, a TRR interrogates tape ready. If the tape is ready, control transfers to A500102 (block BA08) to continue the scan for base tape entries. If the tape is not ready, message 20280/1-xy-NOT READY is written. After a no-rewind base tape is dialed on-line, pressing either interrupt key 252 or 253 effects a transfer to A0110 (block BA08) where the entire tape table is searched again. Rechecking is necessary because the operator may have misdialed another tape.

MODIFY CHECKPOINT

Block BA18, A0110+15: After the second tape table scan, housekeeping begins to initialize CSERR, CSTRS, and CSMRD. Switch E0002 is set to NOP to avoid checkpoint if no checkpoint output tape is specified. Switch C0606 is set to TR to indicate that no dump tape is specified.

The special tape table dump tape entry, W20, is interrogated to determine if a dump tape is specified. If a dump tape is specified, the special tape table dump tape entry is compared to the checkpoint output tape entry, W18. If the dump entry is not also the checkpoint entry, switch C0606 is set to NOP to allow immediate dumping on tape. At A01101, restart options which may occur during housekeeping are crippled. If the same tape is used for both special functions, switch C0606 is left set to TR to provide dumping on the typewriter.

The checkpoint routine is initialized by first determining whether the 7080 memory size is 80K or 160K. This is done by loading A01102+79999 into CASU 01. The 80K result is the loading of the tens position of the TRE instruction at A01102. The 160K result is the loading of the character in this position plus 80000.

An SBA instruction to the tens position of the TRE at A01102 is then executed and the result is compared to A01102+79999. The results of the 160K comparison are equal because the character is unchanged; the results of the 80K comparison are unequal because it is now between the tens position of A01102 and the character which was changed because of wrap-around.

If the memory size is 160K, control transfers to A01104 where the high limit of memory search field at G0023 is changed from 079999 to 159999. The number of octants to be recorded during checkpoint (G0013) is initialized at 8. If memory size is 80K, the 1 bit of control word switch W18 is set to one. Regardless of memory size, the high-order position of the checkpoint output tape entry W18 in the special tape table is interrogated to determine if a tape is assigned to this special function.

If no checkpoint output tape is specified, the CSMRD main program entry (G02) is converted to a LIP 9 to ignore all requests for checkpoint. Control transfers to A011027 to begin the label-checking routine.

If a checkpoint output tape is specified, control passes to A01108 to initialize the checkpoint routine. The 1 and A bits of checkpoint indicator field F0004024 are set to one to indicate that the tape is used as a checkpoint output tape. The main program entry point to CSMRD is set up by placing the address G0201 into G02. The CON at E0002 is changed from a TR operation code to a TZB. The address of the checkpoint tape file table is loaded into CASU 06. Control links to A500601 to move the file table to the file table work area. The updated file table is then returned to its main program location.

The address of the card reader or tape unit which contains the restart program is placed in G0018. If the restart is from tape, the instructions at G00181 and G0019 are converted to IOF and RWD, respectively. If

the restart is from the card reader, the instructions are left NOP.

Switches G0102, G0105, and G0901 are set to NOP if a checkpoint work tape is specified; they are set to TR if no work tape is specified.

CSMRD requires the temporary use of the final 1,025 positions of memory to record the 1,024-character contents of the storage banks, and the 1-character settings of alteration switches 0911-0915. The setting of alteration switch 0916 is not recorded because the switch is used in the restart program. If a checkpoint work tape is specified, the 1,025 memory positions are written on the work tape during checkpoint and are read back into memory after checkpoint. The tape is then repositioned.

If no work tape is specified, it is assumed that the final 1,025 memory positions may be used destructively. Therefore, further initialization of the checkpoint routine is required at this point in housekeeping. If no tape is assigned as the checkpoint work tape, operand 3 of the tape table macro IOTS specifies the octant to be used as the checkpoint work area. If this operand is omitted, the last octant is assumed. That is, the checkpoint work area is 078975-079999 for an 80K machine, and 158975-159999 for a 160K machine.

The number of the octant to be used is located at W19, the units position of the checkpoint work tape entry in the special section of the tape table. At A011026, the address of the last position of the octant specified is computed and is loaded into CASU 06. This address (159999 in the case of a 160K machine) is placed in G01045 and is used during checkpoint to save the settings of alteration switches 0911-0915. The quantity 256 is then subtracted successively to obtain the addresses to locate the storage banks in upper memory.

The areas are initialized as follows:

TAG	FIELD	LOCATION
G01045	Alteration-switches character	159999
G01044	Storage bank 3	159743-159998
G01041	Storage bank 2	159487-159742
G01042	Storage bank 1	159231-159486
G01043	Storage bank 0	158975-159230

Address 158975 is also placed in G0042 and becomes the starting address of the work area which contains the contents of storage and the alteration-switches character.

This completes the housekeeping initialization of the checkpoint routine when a checkpoint tape is not specified.

At A011027, the first tag (B0100) of the regular open routine is placed in CSTRS recheck exit B91 to provide a recheck address for message and control card tapes. At A0111, control transfers to A0400 to begin the housekeeping label-checking routine. NOTE: Switch A0111 is set to TR upon entry into CSHSK (block BA01).

Block BA19, A0400: Another tape table scan is performed to locate each base tape entry. When a base entry is found, the exit from the scan is an indirect transfer to the ADCON at A0400+10. This is an effective transfer to A0402 where control transfers to read the control cards if standard headers are specified for any base tape. Control cards are used to update file tables and to establish constants for use in the subsequent processing of standard header labels.

When the entire tape table has been searched for base entries, the exit is a direct transfer to the ADCON at A0400+10. At A0401, switch A0111 is set to NOP to bypass any further entries to the control card read routine, and control transfers to A01111 to continue the housekeeping routine (block BA22).

At A0402, the label indicator field, F0004014, is interrogated to determine if standard headers are specified. The B bit zero at F0004014 indicates that standard headers are specified; B bit one means that they are not.

If standard headers are not specified for a base tape found by the scan, control passes back to the scan at A500102 to search for another base tape. If any base tape contains standard headers, control transfers to A0403 to read and process all control cards at this time.

READ CONTROL CARDS

Block BA20, A0410: Control cards are read from either the card reader or from tape. If special tape table entry W17 specifies a control card tape, control transfers to A0450 where the tape is opened and is positioned to read the control cards. Control cards are read in the following order:

1. Date control card.
2. File serial header control cards and/or cycle header control cards.
3. End control card.

At A0410, the 5-character date field, W02, of the control word is compared to 61000. If the date is valid (higher than January 1, 1961), the date control card is not read. The date may already be in W02 if CSHSK remains in the machine between runs or where the user inserts it beforehand to reduce card reader time.

If there is no date in W02, control links to A500401 to read the date control card. The date field is stripped of any zoning to determine if the date is numeric. If the date field contains any non-numeric character, if the date is earlier than 61000 (January 1, 1961), or if the day field exceeds 366, message 20273-INCORRECT CONTROL CARD is written to inform the operator that an incorrect date control card has been read.

At A0413, if the control card date is valid, the program identification field from the control card is placed in the message area at A048002 and in the control word at W03. The date field from the control card is placed in the message area at A048003 and in the control word at W02. Message 10211, containing the 6-character program name and the 5-character date information, is written.

At A0414, control links to A500401 to read the file serial or cycle cards. As each card is read, the information in columns 16-18 is interrogated to determine if the card is an end control card. An end card has the word "end" in this field; the other control cards contain blanks in this field. The file identification field from the control card is placed in A0400511 of the control card work area, and control links to the tape table scan routine at A500101 to search for a base tape entry. When the base entry is found, control transfers to A0415 where the status code field, F0002034, is interrogated to determine if the base tape is an input or an output. If the tape is an output, control transfers back to the scan to search for another base tape entry.

If an input base tape entry is found by the tape table scan, control passes to A0416 where the file identification field in the file table is compared to the file identification field just read from the serial/cycle control card.

NOTE: For file control cards, the comparison is between file identification field, F0005051, and all ten identification characters from columns 1-10 of the control card; for cycle control cards, because the file identification field is only seven characters long, the comparison is between those characters and the seven low-order characters of file table identification field, F0005051.

If the file identification fields of the control card and the base tape file table do not match, control transfers back to the scan routine to search for another base tape entry.

If the two file identification fields match, the file serial field of the control card (A0400512 in the control card work area) is placed in the file serial field, F0005021. If the control card is a cycle card, the cycle number from columns 1-3 of the card is placed in the three high-order positions of file identification field, F0005051. The 1 bit of the open type indicator field, F0003013, is set to one to indicate that a control card has been found and processed for this base tape with specified standard headers.

Control passes to a subroutine at B02155 to return the updated file table to its main program location. At A04186, control transfers to A0422 and then to A0414 to read the next control card.

Block BA21, A0440: At A0414, when the end control card is read, control transfers to A0440 where the control card tape, if used, is freed by setting to one the B bit of the high-order position of control card tape entry W17 in the special tape table. At this point, housekeeping determines whether a control card has been supplied for each base tape using standard headers. This is done by again scanning the tape table for base entries. When one is found, control transfers to A0441 where the status code field, F0002034, is interrogated to determine whether the tape is an input or an output. The 1 bit zero at F0002034 indicates an input tape; 1 bit one means an output tape.

If the tape is an output, control transfers back to the scan to search for another base tape entry. If the tape is an input, control transfers to A0442 where the label indicator field, F0004014, is interrogated to determine if the input tape uses standard headers. The B bit zero at F0004014 indicates that standard headers are specified; B bit one means that they are not.

If the tape is an input not using standard headers, a transfer is made back to the tape table scan to search for another base tape entry. If the tape is an input using standard headers, control transfers to A0443 where the 1 bit of the open type indicator field, F0003013, is interrogated to determine whether a control card has been found and processed for this tape. The 1 bit one at F0003013 indicates that a control card was processed; 1 bit zero means that no control card was found.

MISSING CONTROL CARDS

If a header control card has not been supplied for any base tape using standard headers, control transfers to A0445 where message 10275-CC,aaaaaaaaaa (file identification) is written. The B bit of the tens position of the tape table scan routine exit, A0500199, is set to one to cause message 20275-SUPPLY CC when the entire tape table has been scanned and all base input tapes using standard headers have been checked to determine that header control cards were supplied for them.

When the entire tape table has been scanned, the B bit of the tens position of the scan routine exit (A500199−1) is interrogated to determine if all input base tapes using standard headers are accompanied by associated control cards. The B bit zero indicates that all such tapes are accompanied by control cards; control passes to A0401 where the control card read routine entry switch, A0111, is set to NOP to avoid the rereading of the cards. A transfer is then made to A01111 to continue the housekeeping routine. The B bit one means that at least one input base tape using standard headers is not accompanied by an associated

control card; message 20275-SUPPLY CONTROL CARDS is written. When the missing header control card and an end card are loaded in the card reader, pressing either interrupt key 252 or 253 effects a transfer to A0414 to read the cards.

Block BA22, A01111: The exit from the control card routine is at A0440+25. If no base tape standard headers are specified, or after all base tapes using standard headers have had their file tables updated by the control cards, control transfers to A0401 where the control card read routine entry switch, A0111, is set to NOP to avoid rereading the cards. Control transfers to A01111 where the high-order position of message tape entry, W22, is interrogated to determine whether a message tape is specified. The B bit zero at W22 indicates that a base tape has been assigned to this special function; B bit one means that there is no message tape.

If no message tape is specified, control passes to A0112, block BA23. If a message tape is specified, it is opened before any other tapes in order that it may be ready to accept messages should they occur while the other tapes are opened. Control transfers to A0501 where the message tape file table is sent to the file table work area.

If the message tape is to be rewound during housekeeping (1 bit zero at F0005064), control transfers to A0504 where the 1 bit is set to one to prevent another rewind when the same tape unit is processed later in housekeeping as a base tape entry in the main section of the tape table. Control then passes to B0100 in the TRS section of IOCS to open the message tape and to position it to receive the first message.

NOTE: If message 30282-PCT RECORD 1 occurs during the opening of the message tape, pressing interrupt key 252 causes the message tape alone to be rechecked.

After the message tape is opened, control returns to the TSL+5 of the originating linkage at A0504. Here, control passes to A0502 where the 1 bit of F00050041 is set to one to allow messages on tape. The A bit is set to one in the automatic dump indicator field, F0005063, to indicate that this file table has been specified by the message output tape entry in the special section of the tape table. Control transfers to B02155 to send the updated file table back to its main program location.

READY CHECK

Block BA23, A0112: The tape table is scanned again to locate base tape entries. As each base tape entry is found, an indirect transfer is made to the ADCON of the search linkage format. This is an effective transfer to A0310 where the tape type code field, F0005064, is interrogated to determine whether the base tape is specified to be rewound by housekeeping. The 1 bit zero at F0005064 indicates that the tape is to be rewound in housekeeping; 1 bit one means that it is not.

If the base tape is not to be rewound by housekeeping, control passes back to A500102 to continue the tape table scan. If the base tape is to be rewound by housekeeping, the open type indicator field, F0003013, is interrogated to determine whether an immediate open or a delay open is specified for this file. The 2 bit zero at F0003013 indicates an immediate open; 2 bit one means a delay open.

If a delay open is specified, control passes to A500102 to continue the tape table scan. If an immediate open has been specified, control transfers to A0311 where the B bit of the open type indicator field, F0003013, is interrogated to determine if the tape is properly positioned. The B bit one at F0003013 indicates that the tape is positioned; B bit zero means that it is not. If the tape is already positioned, control passes back to A500102 to continue the tape table scan. If the tape has not been previously positioned, control passes to A0312 to test for ready.

At A0312, the tape is selected by indirectly addressing the select address field, F000203. CASU 09 is initialized to 3440367 for use in a waiting loop. If the tape is not ready before CASU 09 is reduced to zero, control transfers back to the loop. If CASU 09 is reduced to zero before the tape becomes ready, control transfers to A0316 where the entire tape table is scanned again. When base tape entries are found this time, control passes to A0317. Here, if the tape is to be immediately opened, control transfers to A0319 where the 4 bit of the open type indicator field, F0003013, is set to one to indicate that the tape has been checked for ready. The tape is again selected and another TRR is executed. If the tape is ready, control returns to A500102 to continue the tape table scan. If the tape is not ready, message 10280/1-NOT READY, is written for each base tape found to be not ready.

At A0316, when the tape table scan is complete, control transfers directly to the ADCON of the linkage. Message 20282-TAPES NOT READY is written to inform the operator that base tapes mentioned in preceding messages 10280 or 10281 are not ready.

At A03165, pressing either interrupt key 252 or 253 transfers control to A0110 (block BA08) to recheck all base tapes.

OPEN

Block BA24, A0315: At A0313, if all base tapes are in ready status before housekeeping, control transfers to A0315 where the B bit of the open type indicator field, F0003013, is set to one. Control then links to the

open routine at B01002 to check the header label, if any, of the base tape and to position the tape.

NOTE: Because CSHSK reads at least one record from each base tape, any new tape containing no bits, or an extremely long record, appears to run away.

Block BA25, A0112+35: After all base tapes have been checked and positioned, control transfers directly to the ADCON of the originating linkage at A0112+25. Control transfers to A500101 to perform another tape table scan. As each base entry is found, control transfers indirectly to the ADCON of the linkage, resulting in an effective transfer to A0320. If the tape is specified delay-open, control returns to the tape table scan.

If the base tape is specified immediate-open, control passes to A0321 where the 4 bit of the open type indicator field, F0003013, is interrogated to determine if the tape has been primed. The 4 bit one at F0003013 indicates that the tape has been primed; 4 bit zero means it has not. If the tape has been primed, control returns to A500102 to continue the tape table scan. If the tape has not been primed, control passes to A0323 where the 4 bit of F0003013 is set to one. Control then links to A0901 to prime the input areas.

Block BA26, A0150: If a checkpoint output tape has been specified, control transfers to A0150 where switches A0011011 and A0011012 are set to NOP. If a dump take is specified in W20, switch C0606 is set to NOP to allow the dumping of error records on tape.

Control transfers to G02, an effective transfer to G0201 where a checkpoint is taken. The exit from the checkpoint routine is at G0109. Here, if alteration switch 0916 is off, control transfers to D6601 in the DTS routine to execute an all-channel restart.

Initialize File Tables and Tape Tables

CHECK FORMAT

Block BB01, A0250: The channel number, determined by testing the zoning over the tens position of the base tape table entry, is placed at A0243 of the select address work area and at F0001023, the base tape channel entry in the file table work area.

The units position of a base tape select address is the high-order position of the base tape entry. This tape unit number is placed at A0245 of the select address work area and at F0001022, the base tape units entry in the file table work area.

Block BB02, A0251: Because the four low-order positions of a base tape entry contain the address of the file table, the units position of the entry is checked to determine if the address of the file table ends in 4 or 9. If it does not, message 10288-INCORRECT FILE TABLE ADDRESS is written. At A0252, the B bit of the tens position of the instruction at A500199 is set to one to force cannot-proceed message 00259 when the tape table scan is completed. Control passes to A500102 (block BA04) to continue the scan.

Block BB03, A0254: If the file table address ends in 4 or 9, the next test is to determine whether the fixed section of the file table ends in a record mark. The address of the record mark is found by subtracting 10 from the high-speed transmit address +100.

For example, if a file table is located starting at 084000, the high-speed transmit address of the file table is 084004; the address of the file table as shown in the base tape entry is 084104; the record mark terminating the fixed section is at 084094.

If the fixed section does not end in a record mark, message 10289-NO FILE TABLE is written. At A0252, the B bit of the tens position of the instruction at A500199 is set to one to force cannot-proceed message 00259 when the tape table scan is completed. Control passes to A500102 (block BA04) to continue the scan.

UPDATE FILE TABLES

Block BB04, A0255: The file table referenced by the base tape entry is moved into the file table work area to be updated. (See block BA06.)

Block BB05: The tape select address is placed at F000203 in the file table work area. The initiate/stacking zoning is placed over the units position of the select address.

Block BB06, A0257: The locations of the scheduler transfer address for each channel read-write request entry are at B0040. The appropriate scheduler transfer address is placed at F000101 in the file table work area.

Block BB07, A0258: The channel number at A0243 is placed at F0001023; the tape unit number at A0245 is placed at F0001022. Thus, the hundreds and units positions of the select address of the base tape are placed in the current select address field, F0001022.

ALTERNATES

Block BB08, A0259: The A bit zero at A500199+2 indicates a scan of the regular tape table. Control passes to A02587. If a delay open is indicated, the scheduler transfer address is stepped down 10 and the new address is placed at F000101. The next tape table entry is located by adding 5 to the address of the last entry. This next entry is interrogated to determine whether it is an alternate to the base tape just initialized. Since the high-order position of an alternate tape entry contains a blank, the A bit one at A0260 indicates an alternate; the A bit zero means that it is not an alternate.

Block BB09, A0264: If the next tape table entry is an alternate entry, control transfers to A0264 where

CASU 01 (initialized zero at A02587) is used to count alternate entries. The file table is initialized with the channel and tape unit number of the alternate; control passes back to A0259 to continue the search for additional alternate tape entries. Because the maximum allowable number of alternates is four, the search for alternates stops when CASU 01 goes to 4.

Block BB10, A02605: If four alternates are found, or if the entry following the base entry is not an alternate, the total number of alternates field, F0001024, is compared to the count in CASU 01. If the number of alternate entries found in the search does not equal the number specified in the file table, the file table alternate total field for the base tape is modified to specify the number of alternate tapes found in the tape table.

Message 10284/5-NEW ALTERNATE TOTAL is written. Then an alternate tape log is typed, showing the base tape channel and tape unit number, the alternate tape sequence number, and the channel and tape unit number of the alternate tape.

NOTE: If the file table specifies a total number of alternates greater than zero, and no alternates are found, the file table total alternate field is modified to zero, but no further indication other than message 10284/5 is written.

Block BB11, A03025: If the number of alternates specified agrees with the number of alternates found, or after the alternate log is written, control passes to A03025 where control links to B02155 to return the updated file table to the main program. Control then passes to A500102 (block BA04) to continue the tape table scan.

Priming Routine

The priming routine is entered from the housekeeping, end-of-file, end-of-reel, or open routines. Priming fills input areas with input records. The priming routine has two entries, A091 and A0903; the exit is A0999. Entry A0901 is used to place the first record into input area 1, the second record into area 2, and so on. Entry A0902 is used to place the first record into the input area shown in the next area in use field, F000205, and the following records into the next areas, in sequence. To place the first record into input area 1, the addresses of the input areas are rotated to locate the address of input area 1. At A0901, the 2 bit of switch W0020 is set to zero to indicate that the priming routine is busy.

Control links to A500506 to move the transfer-to-update-routine field, FT-204, and the next input/output area field FT-205, into F000204 and F000205, respectively. At A0901+15, the A bit of the tens position of the input area address is interrogated to determine if it is area 1. The A bit one at F0002051 indicates the area is area 1; the A bit zero means it is not.

If the input area at F000205 is not area 1, control transfers to A09013 where the update routine, F000204, is entered to rotate the input areas. Control then transfers to A0901 to examine the next input area. This loop continues until area 1 is located.

When input area 1 is located, the compare check switch is turned off by setting the B bit of F0002051 to one. This switch is located in the tens position of the next input/output area field, F000205. It is used in restart program CSMRS to check tape positioning.

The status code field, F0002034, is interrogated to determine if get/put is used with this file. The 4 bit one at F0002034 indicates that get/put is included; 4 bit zero means that it is not. If get/put is used, control links to the get/put area rotation routine in section 6 of the file table to obtain input area 1. When the address of the first input area has been placed in the next input area field, F000205, control passes to A0903 (block BC03).

Block BC01, A0902: The 2 bit of switch W0020 is set to zero to indicate that the priming routine is busy.

AREA ADDRESS

Block BC02: Control links to A500506 to move the transfer-to-update-routine field, FT-204, and the next input/output area field, FT-205, into F000204 and F000205, respectively, of the file table work area. Thus, the area located in F000205 is primed first.

Block BC03, A0903: The force counter is set to zero by removing the zoning from the tens and hundreds positions of the select address field, F000203. The A bit of switch E10012 is set to zero to indicate that the force counter is not assumed zero. The 1 and 2 bits of switch A090003 are set to one.

Block BC04, A09031: The status code field, F0002034, is interrogated to determine whether the tape is an input or an output. The 1 bit one at F0002034 indicates an output tape; the 1 bit zero means input.

Block BC05, A09031: For output tapes, the priming routine is entered to update the force counter, making it reflect the number of output areas available to be filled. At A09031, the total number of output areas, F0002054, is loaded into CASU 01, to be used as a counter.

Block BC06, A0904: Force counter updating is complete when CASU 01 goes to zero. For example, if seven areas are specified, force counter ASU zoning is 09, the 16's complement of the total number of areas.

Block BC07: If CASU 01 is not zero, the force counter is updated by adding to it the equivalent of ASU 15 zoning. For example, the force counter may have ASU 13 zoning, indicating three available areas. The binary

addition of ASU 15 zoning results in ASU 12 zoning, indicating four available areas.

Block BC08: Each time the force counter is updated, the count of output areas is reduced by one. When the force counter updating is complete (CASU 01=0), control passes to A0998, block BA22.

Block BC09: If the tape is input, the tape type code field, F0005064, is interrogated to determine if priming is specified. The 2 bit zero at F0005064 indicates that priming is specified; 2 bit one means that it is not.

EOR MODE 2

Block BC10: An input tape using mode 2 EOR handling (switch A090003 4 bit zero) is primed. If priming is not specified, the first reel is not primed.

Block BC11, A0905: CASU 01 is initialized with the total number of input areas, F0002054.

Block BC12, A0906: The total number of input areas is unloaded into counter A0935 which maintains a current count of the number of input areas remaining to be filled.

Block BC13: At A0906+10, control links to a subroutine beginning at A500501 and ending at A500599. Priming is done in this subroutine, shown in blocks BC13-BC15. At A500501, the B bit of F0002052 is set to one to allow error checking in little DTS.

Block BC14: The status code field, F0002034, is interrogated to determine whether the tape is input or output. The 1 bit zero at F0002034 indicates an input tape; 1 bit one means output.

PRIME

Block BC15, A500503: If the tape is input, priming is done in little DTS through linkage to D6010. If a tape mark is read during priming, a TRS effects a transfer to E0206 (block EB02). The TSL+5 return from the priming subroutine is to A0906+15.

Block BC16, A0906+15: After the input area is filled, control links to a subroutine starting at A500504 and ending at A500599; the subroutine is shown in blocks BC16-BC20. At A500504, the force counter is updated as described in block BC07.

Blocks BC17 and BC18: Linkage is made to the transfer-to-update-routine field, F000204, of the file table work area to rotate the input areas, and to increase by 1 the data tape record counter, F0003022.

Block BC19, A500506: The address of the next input area is brought to the file table work area, as described in block BC02.

Block BC20, A0906+25: Counter A0935 (blocks BC11 and BC12) maintains a count of input areas remaining to be filled. The count is reduced by 1.

Block BC21: If counter A0935 contains a number greater than zero, additional input areas are to be primed. Control transfers to block BC12 where the priming subroutine is entered to read the next record into the next sequential input area.

Block BC22, A0998: When all input areas have been primed (CASU 01=0), the 2 bit of switch W0020 is set to one to indicate the end of the priming routine.

Block BC23: Subroutine B02155 returns the updated file table to the main program. At A0999, control returns to the TSL+5 of the originating linkage to the priming routine.

Block BC24: During mode 1 EOR with the alternate tape on a different channel, the priming subroutine (blocks BC13-BC15) is entered to locate read/write requests from the stacking table of the EOR channel, and to perform the operations on the alternate channel.

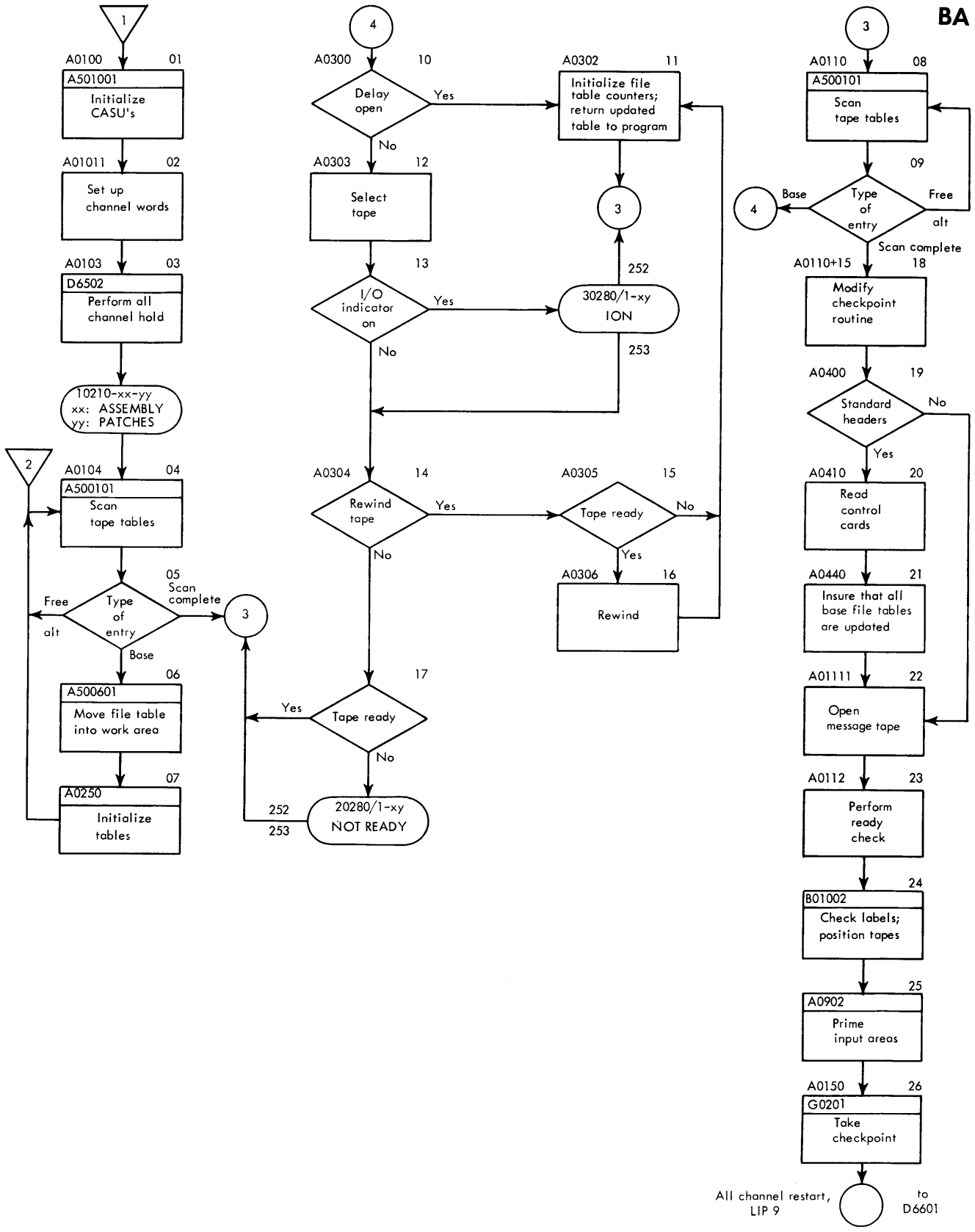


Chart BA. Housekeeping—CSHSK

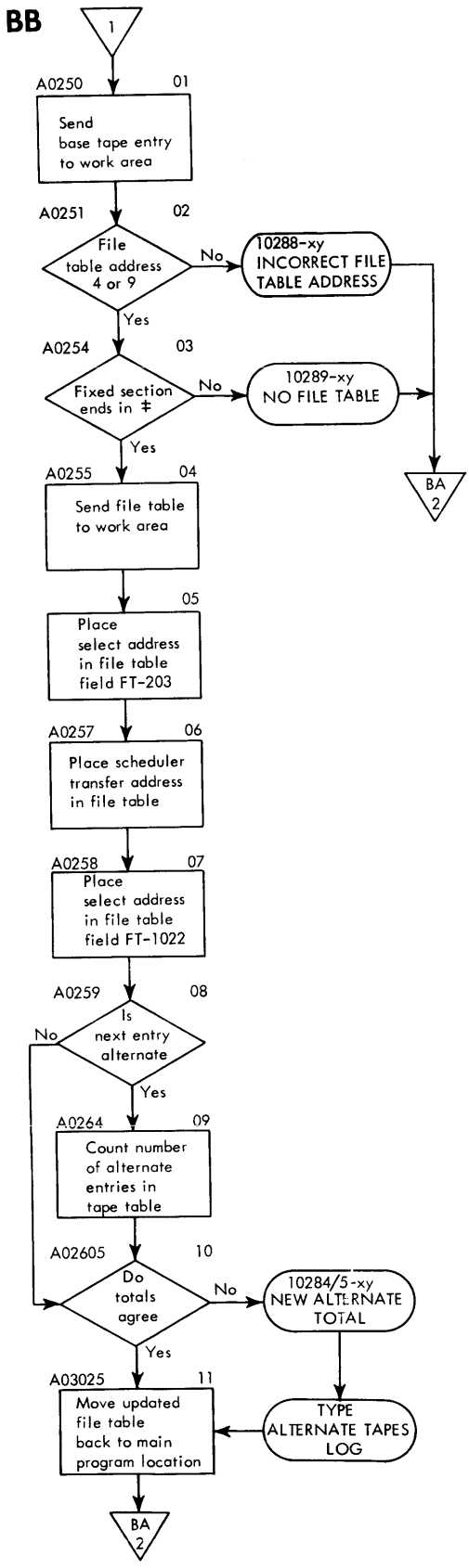


Chart BB. Initialize Tape Tables and File Tables

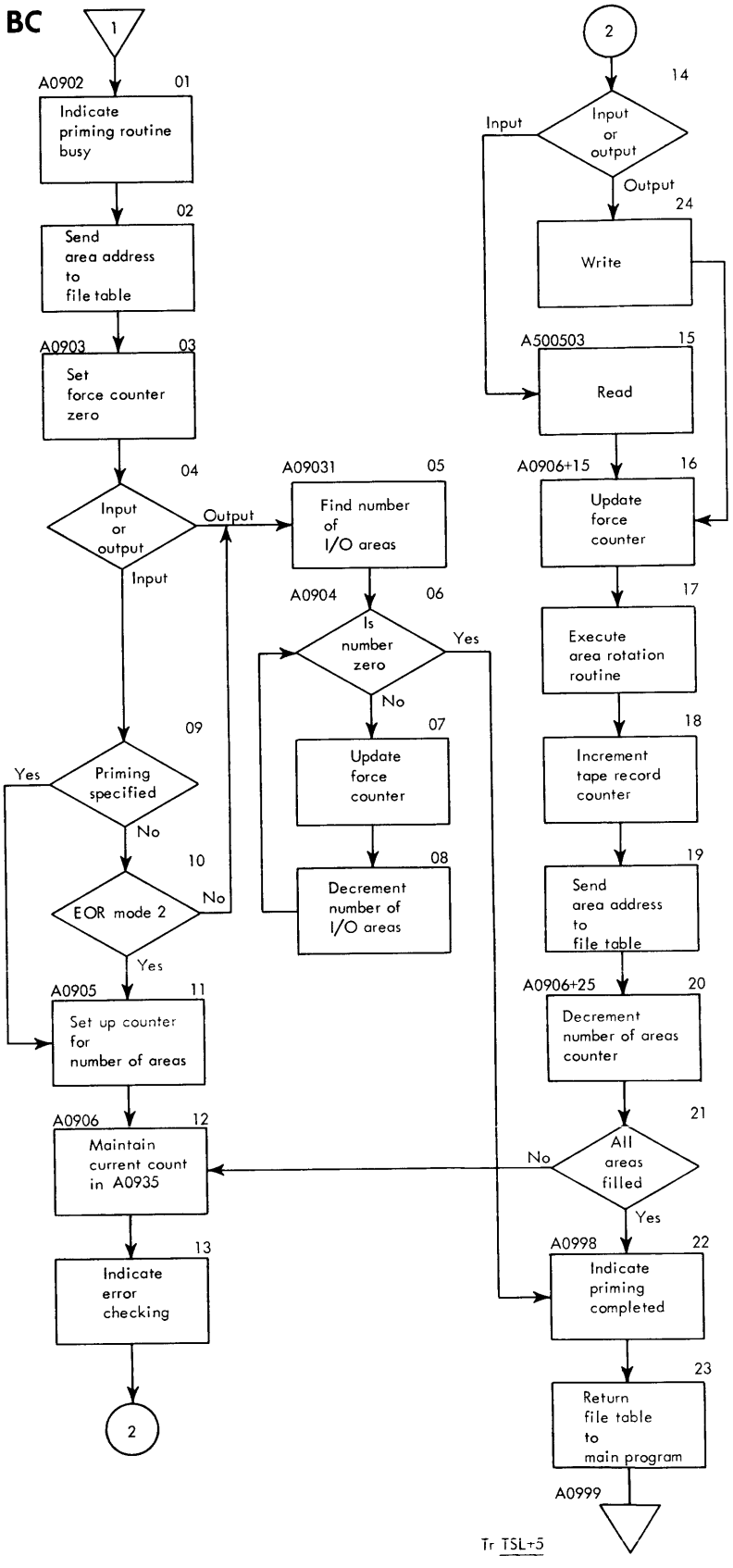


Chart BC. Priming Routine

CSDTS controls the scheduling of all tape unit operations and consequently has the greatest usage of all IOCS routines. IOCS applies CSDTS to obtain full utilization of the interrupt feature of the IBM 7080 in the control of tape operations.

Every input/output function involving data records on channels is performed by CSDTS. To call for the execution of a particular function, the user need only insert one macro-instruction at the appropriate point in the main program.

The function of CSDTS is to execute all input/output operations pertaining to non-error handling of data records. This includes scheduling input/output operations and checking such operations for the possibility of error, tape marks, and reflective spots.

CSDTS contains three major routines:

1. Main DTS – Schedules and performs all RD 00 and WR 00 operations requested by the main program. Operation is shown on Charts CA and CB.
2. Little DTS – Performs all internal tape operations for IOCS (label operations, retries, etc.). Operation is shown on Chart CC.
3. Special DTS – Schedules operations involving tape files (except IORD, IOWR, and those associated with IOGET and IOPUT) in conjunction with subroutines for some special operations. Special operation is shown on Chart CD. Special operation subroutines are shown on Charts CE, CF, and CG.

Main DTS Operational Modes

All tape files are operated in either initiate or stacking mode. The desired mode is determined by the setting of the B bit over the units position of section 2, word 3, in the file table (select address location). B bit one specifies stacking mode; B bit zero specifies initiate mode.

INITIATE MODE

In initiate mode, any operation called for by linkage from main-line programming is started regardless of the availability of the channel. If the associated channel is not ready, CSDTS utilizes the waiting time by allowing interrupt on other channels. Although an operation is started under the initiate mode, it will not be completed before a return is made to main-program processing unless a hold parameter is specified in the main program macro-instruction or an IOHLD macro-instruction is used afterward.

STACKING MODE

When a file is processed in stacking mode, a return is made to the main-line processing before the operation is executed unless:

1. The associated channel is in ready status.
2. I/O areas associated with this file are not available for main-line processing.

Program Components

If the channel is busy and an I/O area is available for processing, an entry is made in a stacking (waiting operation) table. Each entry in this table consists of five characters that include a 1-character code in the high-order position, indicating the desired operation, and the 4-character address of the associated file table. These characters are taken from the CON-ACON4 of the macro. A stacking table is associated with each channel (e.g., the table for channel 20 is in the DTS channel 20 work area at D105002).

STACKING TABLE

The function of a stacking table is to stack, or temporarily retain, I/O requests for subsequent execution in the event that a channel is busy at the time the request is made. The operation of a stacking table can be pictured as a vertical table where a new request is put on the bottom of the stack and a previous request is taken from the top of the stack and executed.

The empty table consists of nine 5-position entries, each containing four blanks and a record mark. The record mark is used for transmit purposes and entry recognition.

The ninth entry of the stacking table is tagged D1X50040. The 2 bit in the units position of this field is interrogated to determine if the stacking table is full; that is, if the last entry contains a request, the units position will always be 4 or 9 (as it is a file-table address) and the 2 bit will be zero. Therefore, the table is considered full and the first entry in the table is moved up and out to be executed.

The 5-position field following the last entry is used

as a programming device which allows the entries to be moved up in the stack when the top entry is removed for execution. An outline of the operation follows.

A request from the main program is brought into work 1 (request work area located in the channel work area). If a force condition (no I/O areas available) exists, this request is executed immediately. If not, the request is moved from the work area to the stacking table (the request goes on the bottom). Therefore, the request may be put anywhere from the first to the last, or ninth position. The 2 bit in the low order of the last position is then tested. If the table is not full, exit is allowed to the main program to continue processing. If the table is full (2 bit zero), exit to the main program is delayed by a LIP 9 to a closed loop. After an interrupt on this channel and acceptance of a valid previous operation, the first entry in the table is moved into work 1 and all other entries are moved up in the table. The transmit is stopped by the record mark in a 5-character constant following the last entry.

The request in work 1 is then sent to the channel operating work area (work 2). (This destroys the loop switch located in work 1 as an A bit one in the tens position.) The request is then executed and control returns to the main program. The next request in line is at the top of the stack and the one last requested is at the bottom of the stack.

FORCE COUNTER

The force counter indicates the number of I/O areas available for processing at any given time. This counter is indicated as zoning (comparable to ASU zoning) over the tens and hundreds positions of the select address (section 2, word 3) in each file table. An I/O area is considered available for processing from the time a record has been read into or written from the area and checked, until the time a new read or write request is given for that area.

At the start of the main program, the force counter must be set to the 16's complement of the number of areas available. This is accomplished by housekeeping for output files and by internal priming for input files. If priming is not specified, the programmer's preparatory IORD's perform the operation.

The force counter contains the 16's complement of the number of areas available to the program. As an operation request is entered, ASU 01 zoning is added to the counter, decrementing it by one. After an interrupt, and after the previous operation is found to be error-free, ASU 15 zoning is added to the force counter of the file, incrementing it by one. As the last area is used, the force counter is decremented from ASU 15 to ASU 00. Because this is the only condition when the B bit in the tens position is zero (maximum of eight areas allowed), a transfer on B bit zero indicates that no areas are available and a force condition is indicated.

LINKAGES

Inclusion of a single Autocoder source statement during assembly generates the necessary linkage to CSDTS where the actual operation is accomplished. (See Figure 7.)

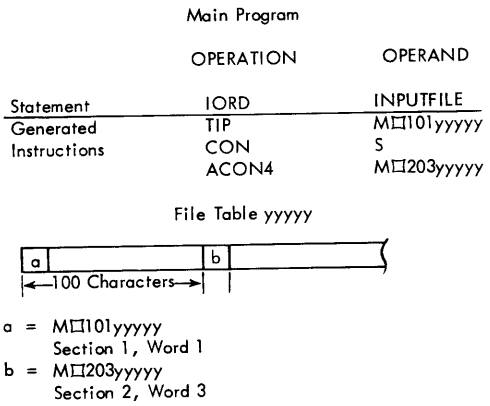


Figure 7. Macro Linkages

M□101yyyyy is the scheduler transfer address and acts as a pivot to the request entry of main DTS for this channel.

M□203yyyyy is the send address of section 2, word 3, in the file table. This word and the following three words are moved to the channel work area for the actual operation on the channel.

The CON-ACON4 is moved into work 1 in the channel work area after entry into DTS.

Request and Start Operation

REQUEST ENTRY

Block CA01, D2X01: DTS initialization consists of unloading four characters from SPC 3700 (instruction counter field of CASU 15) into the return exit (D0099). These four characters locate the constants in the macro that contain the operation code and the file table address for that file. The constants (CON-ACON4) are moved to work 1 during operation (work 1 holds the request).

The loop address is placed into CASU 15 (IC). The return exit to the main program is then stepped by 5 to advance it to the instruction after the macro. The

force counter is decremented by 1 by adding to memory (AAM) the ASU equivalent of 01.

Block CA02: The channel ready switch (X bit at location D1X5501) is tested to determine if a new operation may be started at this time. If the switch is off (X bit one), control passes to block CA03 for further testing. If the switch is on, no other requests are pending for this channel, so control passes to block CA10 to start the requested operation.

Block CA03: The mode (units position B bit in the file table select address) is tested by addressing work 1 indirectly. If initiate mode is detected (bit zero), control passes to block CA07, bypassing the stacking operations.

Block CA04: The force counter is moved from the file table to the DTS work area and is tested for available areas. This test is on the B bit of D0050152 (high order of force counter). Because the maximum count possible in the force counter at this time is 7, the B bit is one if any areas are available. If the force counter is zero, it reflects the ASU equivalent of 00, with the B bit zero.

Block CA05, D2X0110: The CON-ACON4 from the macro is placed into the first (next) position of the stacking table, and the stacking table address is stepped to the next position.

Block CA06: The stacking table is tested to determine if it is full. The test is a TZB on the 2 bit of D1X50040 (ninth position of the stacking table). If the table is not full, this character is a record mark and the TZB does not transfer. If the table is full, the character is 4 or 9 (legitimate file table address) and the transfer is made.

Block CA07, D2X0205: The wait switch is turned on. This forces a tape operation for this (requested) file after the next interrupt on this channel.

Block CA08: A new record is necessary for this file before returning to the main program. The loop switch is turned on to prevent further operation until the record is available.

Block CA09, D2X0211: This block represents the loop that delays return to the main program until a record is made available. It is entered via a LIP 9; the exit is to the instruction after the macro which forced entry to IOCS.

START NEW OPERATION

Block CA10, D2X0501: Control enters to start the new operation on this channel. The routine is initialized by moving the file table address from the channel work 1 into work 2 and addressing this work area indirectly to move 20 characters from section 2 of the file table to the channel work area. Setting work 2 to the new file table address resets the wait and loop switches (B and A bits, respectively, tens position).

Block CA11: The tape is selected by indirectly selecting D1X0203.

Block CA12: The status code in the channel work area is tested for input or output, and the operation code in work 2 is tested for read or write. If any discrepancies exist between these codes, control enters the message routine where the cannot-proceed message 00252/3-XY-IMPROPER OP is typed.

Block CA13: A TRS instruction tests the I/O indicator on this file. The transfer is to the common TSA routine. If no signal is recognized, control passes to block CA15.

Blocks CA14 and CA15: Tape operation is initiated for this file by indirectly addressing D1X0205 (area in use). Control then passes to block CA16.

Block CA16, D2X0591: The channel ready switch for this channel is turned off to prevent further operation on this channel until it again becomes free. This switch is one of four bits (one for each channel) at D1X5501. Bit status one indicates that the channel is not ready.

Block CA17: This file is tested for a force condition. B bit zero of the tens position of the force counter indicates a force condition. The counter at this time contains the ASU equivalent of 00. Recognition of no-force condition passes control to block CA19.

Block CA18, D2X0595: The mode is tested. Stacking mode is indicated by B bit one at D1X02030. Recognition of B bit zero (initiate mode) passes control to block CA19; if the B bit is one, control passes to block CA08.

Block CA19: This block is normally a transfer to the LIP 9. It may be modified for a special operation to return to the special operation routine. The LIP 9 returns to the point in the non-interrupt program at which the interrupt occurred.

Interrupt Entry

Block CB01, D2X0301: Control enters this block when an interrupt occurs on this channel. The channel ready switch is turned on to indicate that this channel is no longer in use.

Block CB02, D2X0302: The tape unit for this operation is selected by an indirect select operation on D1X0203.

Block CB03: A test is made to determine if a record length check is to be made. This option is indicated by the A bit at D1X02052. If the bit is zero, no length check is to be made and control passes to block CB06.

Block CB04: The record length check is made. This check is both a check of the setting of the data memory address (communication storage, word 1) and a check of the last character for no group mark and/or the fol-

lowing character for a group mark. If the length is correct, control passes to block CB06.

Block CB05: The record length error switch is turned on by letting the 2 bit at D1X41024 to zero.

Block CB06, D2X0309: A TSA instruction is executed to test the channel for an error condition. If an error occurred, control passes to the TSA common entry routine.

Block CB07: The areas are stepped. This routine is located in the file table and is simply one receive and several send operations that rotate the area addresses, setting up a new area for the next operation on this file. The routine also increments the record counter by one. Because the tape operation was correctly performed, the force counter is incremented one by an AAM (of an equivalent of ASU 15).

Block CB08: The wait switch may be on or off, or modified for a single-channel or all-channel hold. The switch is turned on if a force condition (no records available on request) exists, if an operation is requested in initiate mode and the channel is busy, or if a specific operation is in work 1 awaiting execution. The wait switch is modified to an exit for special operations. Single-channel hold is executed if messages are written on tape or if records are dumped. All-channel hold is executed during housekeeping or at checkpoint.

Block CB09: The stacking table is moved up one entry placing the next request in work 1 (D1X5001).

Block CB10: A test is made of the low-order 2 bit of work 1 (D1X5001), the entry moved from the stacking table. If the table is not empty, this character is a 4 or 9 (not a record mark) and control transfers via a TZB to block CB11. If the table is empty (record mark has a 2 bit), control passes to CB12.

Block CB11: The stacking table address used to insert requests is stepped down by five with an AAM 159995; this sets the address to the next available table location for the next request. Control passes via Chart CA, connector 1 to start the new operation.

Block CB12: Because the stacking table is empty, the loop switch is turned off (set to zero) and control exits from the data travel system to the main program.

Little Data Travel System

These routines perform all internal IOCS tape operations. The operations performed are mainly label and retry operations for the TSA routine.

Entrance to little DTS is made through eight individual routines, one for each type of tape operation. Entry is made by means of a RCV – TSL where the receive references the normal (error-free) exit of little DTS.

Internal Operations

Block CC01: This block represents a composite of the entries to little DTS. The necessary tape operation is performed by an indirect select of F000203 (select address in the file table work area). The operation is performed indirectly on F000205 (area in use), if necessary. (See table on Chart CC.)

Block CC02, D6095: A character code representing the operation in progress is placed into the DTS common bit switch area at D006001. This code controls operation in the little DTS after interrupt.

Block CC03: A test is made on the channel code (hundreds position of the select address) in the file table work area at F0002032. Control transfers to an individual channel routine by a series of TZB's on the channel character.

Blocks CC04 and CC05 represent one of the four per-channel routines.

Block CC04, D2X6101: The channel ready switch for this channel is turned off by setting the associated bit at D1X5501 to one.

Block CC05: Re-entry to little DTS is assured after interrupt by setting the little DTS exit in the main DTS (interrupt entry +10 for this channel) to a transfer.

Block CC06, D6151: The transfer-out of the loop (D6201) is set to NOP. If the loop exit has not been set (A bit zero at D6201+2), CASU 15 and the loop-exit addresses are then interchanged so that a LIP to the main program passes to the loop. The LIP 9 is then executed.

Block CC07, D6201: This block represents a loop located at the common entry points where the program waits for an interrupt in non-interrupt program. At the interrupt on this channel, control passes to main DTS and then returns to little DTS via the little DTS exit (interrupt entry +10).

Block CC08: The loop exit modification switch (A bit, hundreds position of D6201) is turned on (set to one) after leaving the loop. This indicates that the loop exit is used and must be modified before re-use. Exit from this block is to the main program.

Block CC09, D2X6105: Entry to this block is from the little DTS exit in the channel interrupt routine of main DTS. This exit is restored by altering its operation code to a NOP by SBN operations on the A and B bits.

Block CC10, D6301: The loop (block CC07) is reset to allow escape on the final LIP. This is done by a SGN operation on the NOP, altering it to a transfer.

Block CC11: The tape unit is selected indirectly on F000203 (file table work area, select address).

Block CC12: The 2 bit at D006001 (operation code) is tested by a TZB instruction. When the 2 bit is zero, a backspace, backspace file, or skip operation is indicated

and control passes to the normal exit. If the 2 bit is one, control passes to block CC13.

Block CC13: A TZB on the A bit of F0002052 (no record length checking) transfers control to block CC18.

Block CC14: Further examination is made of the bits in D006001 (operation code). If a forward space or a write tape mark operation is requested, or the I/O indicator is on after a read operation, control passes to block CC18.

Block CC15: SMAC is adjusted for a write operation. This adjustment is necessary to allow the length checking routines to use identical coding for both read and write. The adjustment is −6 for fixed length fields and −10 for variable length fields.

Block CC16, D400101 (Fixed), D400201 (Variable): SMAC is tested for correctness and the length of the record is checked by calculating the correct length and testing the last character for no group mark. For fixed length records, the character after the record is also tested to determine if it remains a group mark.

Block CC17, D6430: The record length error switch is turned on by setting the 2 bit of E10024 to zero.

Block CC18, D6310: A TTC instruction is executed to determine if a parallel character transmission error (PCT) has occurred. If no error is indicated, control passes to the normal exit for a return to the routine that requested the tape operation.

Block CC19, D6370: The PCT error switch is turned on by setting the 1 bit of E10024 to zero. A RD 03 (SST) is executed; it is followed by a TSA forcing a wait until the operation is completed. This makes the status code available to the message routine. The redundancy routine is used to test the characters resulting from the SST operation because a valid error check cannot be made on a RD 03.

Block CC20: A test is made on the bit switch (B bit) in the file table work area at F0002052. This switch is on (zero) if error checking is not desired in little DTS. If it is on, control passes to the normal exit for a return to the routine that requested the operation. If the switch is off, control passes to the internal entry of the TSA routine via Chart DA, connector 4.

Special Operation Data Travel System

The special operation Data Travel System prepares for scheduling all operations other than IORD, IOWR, IOGET, and IOPUT. Control enters this routine from the macro in the main program by a TIP to D7001. The macro contains a code for the type of operation requested and information necessary to perform that operation.

The special operation DTS clears the stacking table of requests for this file and performs the requested operations, if necessary. It also tests the channel status and takes necessary action if unusual conditions are detected. It then decodes the operation and passes control to the proper subroutine where the requested operation is performed.

Special Operations

Block CD01, D700101: This routine is initialized by extracting the TIP location +5 from CASU 15 and placing it in the exit pivot (D0099) of the routine. This address is used indirectly to send the CON-ACON4 in the macro to the DTS common work area. The address in the exit pivot is then incremented by five to bypass the constants in the macro on the return.

Block CD02: Operations after this block are controlled by per-channel routines (i.e., a separate routine for each channel). The specific routine for a channel is found by locating the scheduler transfer address in the file table entry and decrementing by 5. This modified address (special operation channel entry) is placed in a transfer operation (D7005) and the transfer is executed.

Block CD03, D2X7001: The address of the loop (block CD11) is loaded into CASU 15 to force a wait for an interrupt after a LIP 9.

Block CD04, D7105: Blocks CD04, CD05, and CD06 form a subroutine which searches the stacking table for requests on this file. This subroutine is entered by a RCV — TSL followed by three ADCON's containing: the address of the first position of the stacking table, the work area address for the CON-ACON4 of a requested operation, and an alternate exit to address indirectly if the table has been completely searched. The normal exit (entry found this file) is a direct transfer to the first ADCON allowing control to pass through it.

Zone bits are stripped from the file table address of the ACON4 and this address is compared to the file table address in the stacking table. An equal comparison indicates that the entry in the stacking table is for this file and control passes to block CD06.

Block CD05: The next entry is located by adding 5 to the stacking table address. The units position of this entry is tested for 2 bit zero. An effected transfer indicates that this entry is a legitimate file table address (units position is 4 or 9); control returns to block CD04 to test this new entry.

Block CD06, D7110: The request indicated by this entry is sent to work 1 (D1X5001). The entry is overlaid by moving up the remaining portion of the stacking table. Control then passes from the subroutine to the per-channel routine.

Block CD07: The stacking table operating address located in the stacking routine (main DTS) is stepped down 5 because an entry has been removed.

Block CD08: A test is made on the operation code

(D0070014) to determine if the operation requested is IOPOS, IOBSF, or IOFSF. If one of these operations is indicated (2 bit zero), performance of the requested operation is unnecessary and control passes to block CD09.

Block CD09, D7012: The number of operations skipped is counted by stepping the space counter (D007301) by 1. Control then returns to the stacking table search routine (block CD05) to test the next entry.

Block CD10, D2X0205: This block represents entrance to DTS by a RCV—TSL, the receive referencing the special operation exit in the main DTS start new operation routine, block CA19. In main DTS, the switches located in work 2 (D1X5101) are set to loop and wait (the bit is set to one) and the channel ready switch (D1X5501) is turned off (the bit is set to one.) The per-channel loop is entered by a transfer to the LIP 9 in the common entry pivots.

Block CD11, D2X0211: Control remains in the loop until an interrupt occurs on this channel. The interrupt causes entry to the DTS routine (Chart CB, connector 1) where normal tests are made on the previous operation. The operation specified in work 1, location D1X5001 (entry removed from the stacking table), is then started (wait switch on forces this operation). Exit is made from the main DTS via block CA19 (Chart CD, connector 3) to block CD04.

Block CD12, D2X7020: The test is made on the operation code (D0070014) for 8 bit zero and 2 bit zero (hold condition). If this condition is recognized, control passes to block CD13.

Block CD13: If the channel ready switch is on (D1X5501, bit zero), the operation has been completed and control returns to the main program via the LIP to loop at D994822.

Block CD14: The address of the fixed section of the file table in the channel work area is compared to that in the DTS common work area. An unequal comparison indicates that the operation started for the requested file has been completed. Recognition of this condition returns control to the main program.

Block CD15: The loop switch (D1X51011) is turned on (A bit one) and the channel ready switch (D1X5501) is turned off (bit one). A LIP 9 is made and control passes to the loop (block CD11). It will remain in the loop until the operation is completed and checked.

Block CD16, D2X7201: The per-channel ADCON's are sent to a common work area. These ADCON's are the addresses for this channel, of work 2, the LIP to loop, the restart channel entry, the restore address for the special operation exit from main DTS, and the linkage address for the error routine. These addresses are used as linkages to operations for this channel.

Block CD17: The channel ready switch (D1X5501) is tested. If it is off (bit one), control passes to the pivots D7190, D007203, and then to D2X0205 to hold the channel until ready. (This linkage is necessary to set up return linkages and get to the proper per-channel routine.)

Block CD18, D2X0211: This block represents a hold for this channel. This is accomplished in the per-channel routine where the loop switch (D1X51011) is set on (bit one) and the per-channel loop is entered to wait for the interrupt.

Block CD19: The channel number is obtained from the select address of the file table and any zone bits are stripped from it. Zone bits are also stripped from the select address in the DTS common work area.

Block CD20: The channel number in the DTS common work area is compared to that from the file table select address. If the results of the comparison are equal, the file has not been switched to another channel and control passes to block CD22 to bypass restart of the idle channel.

Block CD21: The restart ADCON (D007204) in the DTS common work area is used to return to the old channel and resume operations on that channel. After starting the operation or if the stacking table is empty, control passes to block CD16 to send the ADCON's of the new channel to the common work area.

Block CD22, D7210: The operation code and file table address are moved to the per-channel work 2 (D1X5101). The special operation file table is then moved to the per-channel file table work area.

Block CD23: The operation code (D0070014) is tested by a series of TZB's. The TZB's allow entry to the specific routines which perform the requested operation. The linkage for end-of-reel functions is in the common DTS work area at D007206. Linkage to other special operations are located at the common entry points as follows:

D7301 – IOPOS, IOBSP, IOFSP
D7304 – IORDS, IOWRS, IODMP
D7306 – IOHLD with EOFCK
D7401 – IOFSP, IOBSP (Primary Entry)
D7402 – FOFSP, IOBSP (Secondary Entry)

Special Operation Subroutines

These subroutines are included after the main program if special operation macro-instructions requiring them are used in the main program. The subroutines are entered by pivots in the common entry points. If the subroutine is not included on assembly, its pivot contains linkage to the type subroutine where the message, 00250 NO SUBRO, is written. When the subroutine is included, a SASN – LASN overlays the pivot with the address of the subroutine entry.

Read Special, Write Special, and Dump Subroutines

Block CE01, D730401: Because all operations using this subroutine require a special area address for the operation, the areas must not be rotated. For this reason, the area routine address in the file table portion of the DTS common work area is replaced with the address of a special routine (D730430) which steps the record counter but does not rotate areas.

Block CE02: The address of the area in use (located in the DTS common work area at D000205) is replaced with the address of the operation requested (ADCON in the macro).

Block CE03, D730402: The hundreds position of the ACON4 containing the file table address from the macro is tested for B bit zero. This bit is generated at assembly when no hold parameter is given. If the TZB occurs, the special operation is in hold mode and control passes to block CE05.

Block CE04: The special operation is not in hold mode. Buffered operation is allowed by setting the high-order B bit of the force counter to one. This simulates an unforced condition in main DTS and allows immediate exit to the main program.

Block CE05: Stacking mode is indicated by setting the B bit of the units position of the select address (D000203) to one. This alteration (stacking mode) in the common work area applies to the next operation. The start-new-operation entry (D007205) in the DTS common work area is stepped by 10 to bypass the operations that move work 1 to work 2.

Block CE06: For read-special or write-special operations, a TZB on the C bit in the operation code transfers to the pivot at D007205 to allow entry to main DTS at D200501+10.

Block CE07: The DMP operation is executed indirectly on the ADCON from the macro at D007002 in the DTS common work area.

Block CE08: The file table for this file is moved from the DTS common work area to the per-channel work area. This file table indicates the proper operation in progress.

Block CE09: The LIP-to-loop pivot in the DTS common work area is stepped by 10 to prevent alteration of the loop and wait switches.

Block CE10: The channel ready switch is turned off (D1X5501, bit one) and the LIP to loop returns control to the main program.

Block CE11, D730400: This routine, entered from the interrupt routine in main DTS, is used in place of the normal area routine. The record counter location for this file is calculated and is incremented by 1. Control then returns to the channel interrupt routine.

Position Tape Subroutine

Block CF01, D730101: The number of space operations requested by the macro is added to the space counter in the DTS common work area (D007301). As the number of available areas is considered in the calculation of the total number of spacing operations to be completed, the force counter is moved into the work area at D007001.

Block CF02: The 2 bit of the operation code is tested for zero status. If the bit is zero (IOPOS), control passes to block CF03 for further calculations on the number of spacing operations.

Block CF03: Because the stacking table has been cleared, the force counter, for input files, reflects the total number of areas available for the file, provided that the I/O indicator is off. If these conditions are satisfied (input, I/O indicator off), the number of areas for the file is added to the result in the space counter. The sign of this result is examined by a TZB on the A bit. If backward spacing is indicated, the A bit of the operation code is set to one, to make it a backspace operation.

Block CF04, D730120: A TRS operation is performed. If the I/O indicator is on, control passes to block CF16.

Block CF05: The select address is placed in the DTS common work area if end of reel had been reached, and the file is altered to a different tape address. The tape is then selected by addressing D1X0203 indirectly.

Block CF06: The space counter containing the number of operations to be performed is reset-added into CASU 03. This CASU is then interrogated with a TRZ operation. If the transfer is effected, it indicates that the spacing operations have been completed and control passes to block CF15 via connector 1.

Block CF07: Because spacing operations have not been completed, the space counter is decremented by 1 and the record counter address in the file table is calculated. This counter is then loaded into a CASU in preparation for the test at block CF10.

Block CF08: A test is made on the A bit in the operation code. If the TZB is effected, the operation is a forward space, and control passes to block CF09; for A bit one (backspace), control passes to block CF10.

Block CF09, D730140: The forward space operation is executed.

Block CF10: The record counter is tested for zero. If it is zero, load point or beginning of file has been reached and control passes to block CF15 to prepare for area priming.

Block CF11: The record counter is reduced by 2. (This is done because DTS steps the record counter up one after interrupt.)

Block CF12, D730127: The tape is backspaced. Control passes to block CF13 to prepare for the interrupt.

Block CF13, D730129: MAC II is set to the area routine address in the per-channel work area by a RCV—SND operation. The address at this location is replaced with the address of the routine in the positioning subroutine that steps the record counter without rotating areas. The LIP 9 is made to allow entrance to the loop to wait for the interrupt.

Block CF14, D2X0211: Control remains in this loop until an interrupt occurs on this channel. At this time, control enters the main DTS where normal checking of the operation takes place until the special operation exit in the interrupt routine is reached. Control passes to block CF20 on its return to the position tape subroutine.

Block CF15, D730180: The wait switch, loop switch, and force-counter-equals-zero switch are reset off and the prime switch is turned on by send operations. These switches are located in the per-channel work 2 (D1X5101) and in the following character. Control passes via the per-channel linkage to the common error routine to initialize for priming.

Block CF16, D730160: A test is made on the A bit of the operation code. If the bit is zero (position forward or forward space), control passes via Chart CF, connector 1 to block CF15 to prepare for the end-of-reel routine.

Block CF17: Execution of this block takes place if a tape has reached a tape mark, and a backspace or position backward macro-instruction was given. The number of backspaces to be made are computed as follows: The force counter is decremented to zero and its count is extracted. This count is subtracted from the number of areas for the file. The result is then subtracted from the number of operations requested. Control passes to block CF18 to test the result.

Block CF18: A TRZ tests if the force counter is zero. If the transfer is effected (proper positioning), control passes to block CF15 to prepare to enter the end-of-reel routine.

Block CF19: The I/O indicator is turned off and record-counter stepping is prevented for the next operation by setting the 2 bit of the ADM instruction in the record-counter stepping routine (D730190) to zero. This changes the ADM to a CMP. Control returns to D730127 (block CF12) to backpace over the tape mark.

Block CF20: Control enters this block after the interrupt from the main DTS special operation exit (block CB08). The exit (transfer to start new operation) is restored to normal.

Block CF21: The 2 bit of the units position of this per-channel work 2 (D1X5101) is tested. This bit is in one status if end of file was reached. At EOF, no further spacing operations are to be performed and control passes to block CF22. If the 2 bit is zero, control returns via Chart CF, connector 2 for the next spacing operation.

Block CF22: The per-channel switches (loop switch and wait switch) are reset by sending the CON-ACON4 from the macro to that field. Control passes to the channel restart entry (Chart CB, connector 2), to start the channel and return to the main program.

Block CF23, D730190: Control enters this block after an interrupt to main DTS via the area routine address (D1X0204) in the channel work area. This block steps the record counter for the file by indirectly addressing the previously computed address. Control returns to main DTS to continue operation.

Space File Subroutine

These routines are entered on recognition of a space file operation in the special operation per-channel routine. Blocks CG01 through CG05 are located in the special operation routine. The remaining blocks refer to the space file subroutine which is included if the user specifies a space file operation.

Block CG01, D2X7030: The B bit of D007401 is tested for zero; this condition indicates that the search file routine is busy. If it is not busy (B bit one), control transfers to block CG03 to initialize for entry to the routine.

Block CG02, D74022: The 1 bit of L,D007402 is set to zero to indicate a hold situation. Control transfers to the secondary entry of the space file subroutine via pivot D7402.

Block CG03: A RCV—SND 03 moves the per-channel ADCON to the work area. These ADCON's provide specific addresses in the DTS per-channel routines.

Block CG04: A test is made on the X bit of D1X4401. The bit zero (1 bit for channel 21, etc.) indicates that the channel is ready and control transfers to block CG06.

Block CG05: The X bit of L,D007402 is set to zero to turn off the channel ready switch.

Block CG06, D740101: A RCV—SND 02 is used to move the CON-ACON4-ADCON of the macro to the work area. The select instruction for the routine is initialized (not shown) by placing the file table address in the select operation. The A bit of D007411 is set to zero to indicate that a space file operation is in progress. This is necessary because the space file operation is initiated and control is returned to the main program to continue processing during the operation.

Block CG07: The B bit of D007411+2 is tested for

zero; this condition indicates hold. If hold is not recognized, control transfers to block CG12.

Block CG08, D7460: The stacking table size (W14) is placed into CASU 02. This CASU is used to count requests as the entries in the stacking table are processed. The address of the per-channel stacking table is loaded into CASU 06 and +24 is added to it to calculate the address of the first entry in the stacking table. The resultant address is unloaded into the SBN operation of block CG09.

Block CG09: The loop switch of the last (next) entry in the stacking table is turned on with a SBN A operation. The address of this operation is then incremented by 5 so that it addresses the next entry in the stacking table. CASU 02 is decremented by 1 to indicate the present number of entries.

Block CG10: CASU 02 is tested to determine if it is plus. If it is plus, control returns to block CG09 to process the next stacking table entry.

Block CG11: A +5 is loaded into CASU 02. This results in a hold after the exit from this routine by turning the loop switch or before performing a LIP to loop.

Block CG12, D7403: The exit pivot address at D007403 is incremented by an AAM 02 operation. CASU 02 normally contains +10; however, for a hold operation, CASU 02 contains +5. If 10 is added to the address, the switch setting is bypassed before the LIP to loop; if 5 is added, the loop switch is set on before entering the loop.

Block CG13: The channel busy switch (A bit of D007402) is tested for zero. If it is zero (busy), control passes to the exit pivot at D007403. For a hold situation, the loop switch is on and control stays in the loop until the next interrupt; for a non-hold situation, no switches are set and control returns to the main program.

Block CG14, D40201: This block represents the secondary entry to the space file subroutine. The principal uses of this entry are from the channel schedulers when the stacking table is empty and another operation may be initiated for a buffered space file operation. The secondary entry is also used when the search routine is busy on another operation and a space file operation is requested. When this condition occurs, a hold is necessary and control must wait in the loop until the last operation is completed. A test is made for the 1 bit zero of E007402. If no hold condition is recognized (A bit of D007402 set to zero), control passes to block CG16.

Block CG15, D7450: The exit at D007403 is decreased ten so that the loop and wait switches are set after exit to hold control in the loop. The 1 bit of L,D007402 is set to one to turn the hold switch on and the A bit of L,D007402 is set to zero to indicate channel busy.

Block CG16: The operation code and file table address from the macro are moved to the per-channel work 2 field. A SND 03 is used to move the section 2 portion of the file table to the per-channel file table.

Block CG17: The literal 000-0 is sent to the next 5-character position after the per-channel file table to set the length check bit to zero. The tape is selected indirectly.

Block CG18: This block represents a switch that transfers control to block CG20 on the first pass, and to the exit (CG19) on all other passes.

Block CG19, D7410: This block is an exit that is modified by the receive of linkage to the LIP to loop and causes entry to block CG23, CG24, CG25, CG27, or CG28 depending on the point of exit.

Block CG20: The first pass switch (block CG18) is turned on by setting the 2 bit of L,D007402 to one.

Block CG21: A TSA operation is made to test the I/O indicator. If the I/O indicator is not on, control passes to block CG23.

Block CG22, D7440: The I/O indicator is turned off and a backspace operation is initiated to backspace over the tape mark. Control links to the exit which sets up the re-entry to connector 6.

Block CG23, D7415: The A bit of the operation code (D007411) is tested for zero. If a forward space file condition (zero status) is not recognized, control passes to block CG25.

Block CG24, D7430: A forward space operation is initiated. Control links to the LIP to loop and the receive references the exit (block CG19) to return control to connector 7.

Block CG25, D7420: A backspace file operation is initiated.

Block CG26: The 4 bit of L,D007402 is set to one status to indicate a backspace file operation to the restart program. Control links to the LIP to loop, the receive referencing the exit at block CG19 to return control to connector 9.

Block CG27: A forward space operation is initiated to test for a tape mark. The 4 bit of L,D007402 is set to zero to turn off the backspace file indicator to indicate the condition to the restart program. Exit is made to the LIP to loop which sets up entry connector 10 for return to this routine.

Block CG28: The operation at block CG27 was not a tape mark. A backspace operation is initiated and linkage is made to the exit to set up connector 8 on return, to retry the operation.

Get and Put Routines

A get or put macro enters the get or put section of the file table with a RCV—TSL operation. The basic operations (fixed length records) performed in the file table are:

1. If get, the current data record is moved to the work area; if put, the work area is moved to the record area.

2. The record counter is stepped by 1. This counter was initialized to a constant equal to: − (blocking factor −1).

3. The record counter is tested for a change of sign (TZB on A bit). If the transfer is effected (counter negative), the last data record has not been used. After the last data record is used, the counter sign changes to plus. Control then falls through the TZB to a TIP to the scheduler transfer address (request entry).

4. Control enters the area routine from main DTS and the next area is made available. This routine rotates area addresses that locate the first data record of each area. The addresses are used to move the data records. The record counter is then reset to − (blocking factor −1) and control returns to the main program.

5. If the transfer on zero bit (data record counter sign) was effected, the data record length is added to the send address for data records to obtain the address of the next data record.

The data-moving portions of the get/put routines lie in the main program in sections 7 (get) and 8 (put) of the file table. These routines are generated by macro-generators and are of many configurations. Each given configuration is dependent on the parameters of the macro IOFTB. These parameters govern the inclusion or exclusion of many small single-utility routines and the linkages to them.

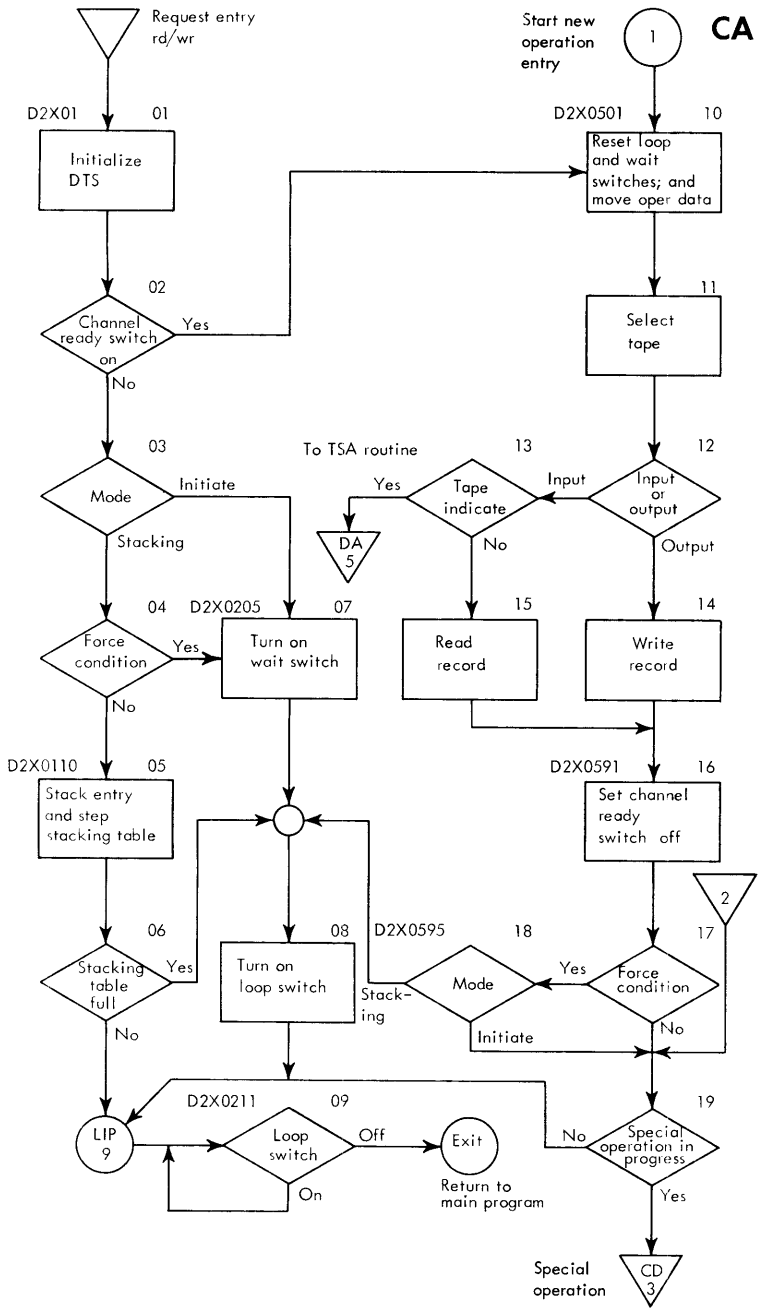


Chart CA. Data Travel System (Channel X)

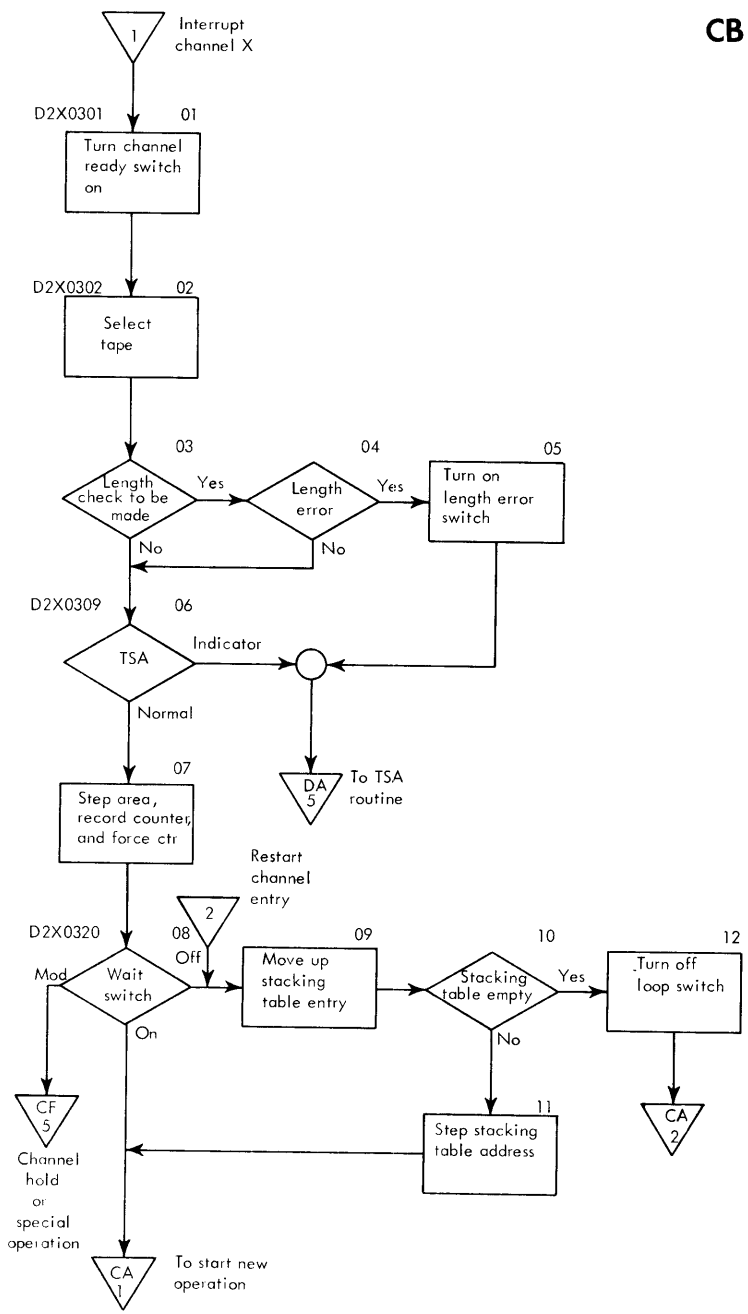


Chart CB. Data Travel System (Channel X), continued

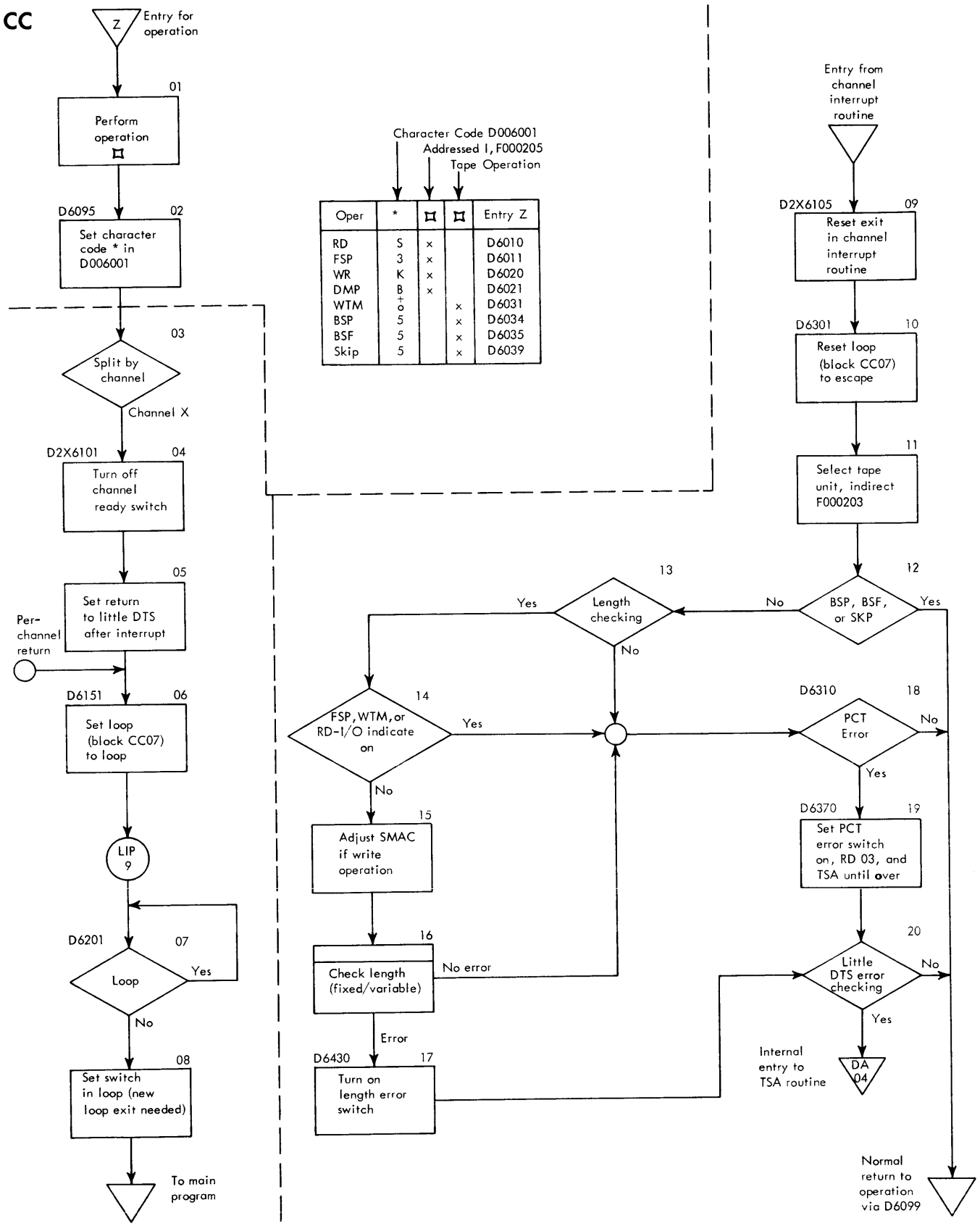


Chart CC. Little Data Travel System

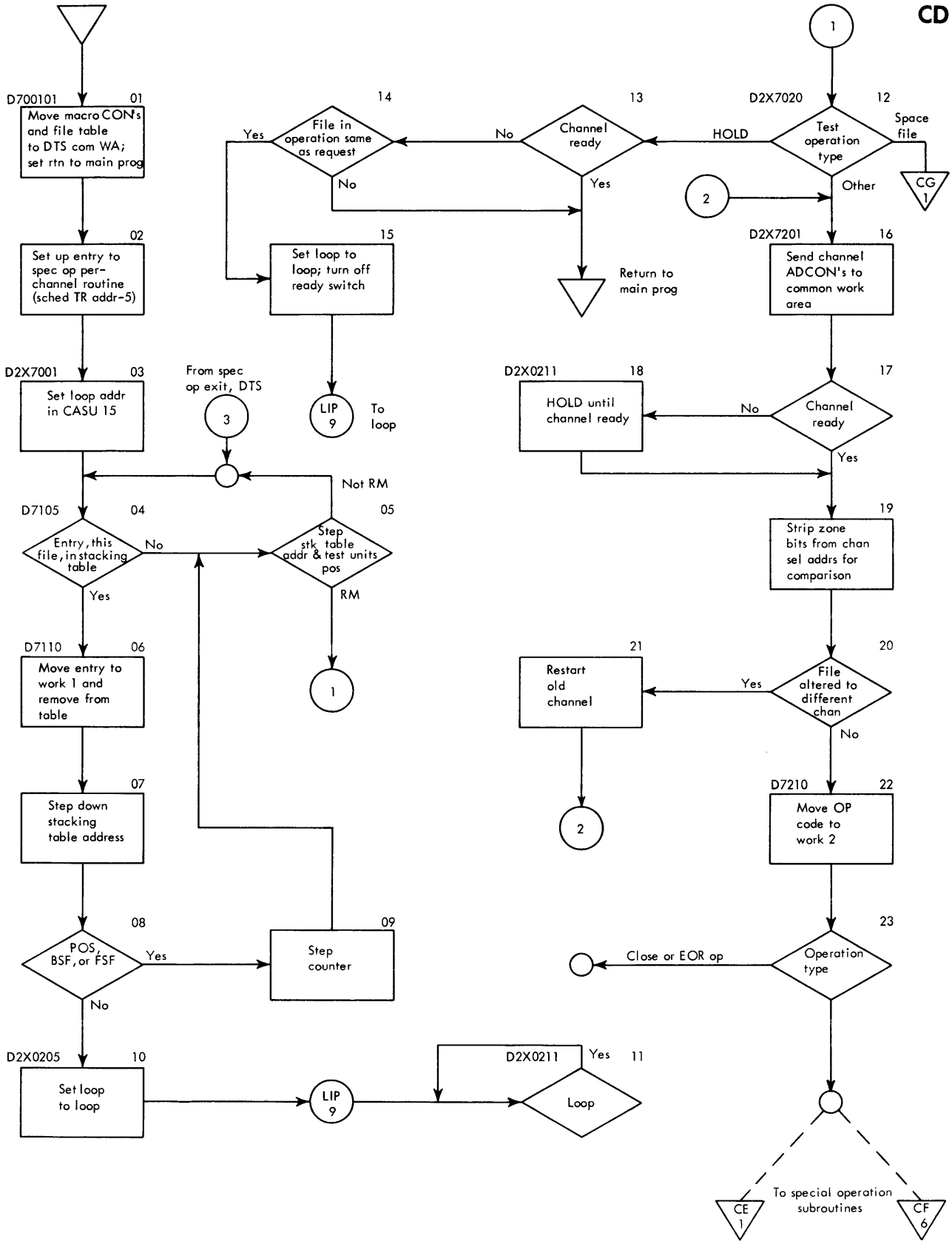


Chart CD. Special Operations DTS

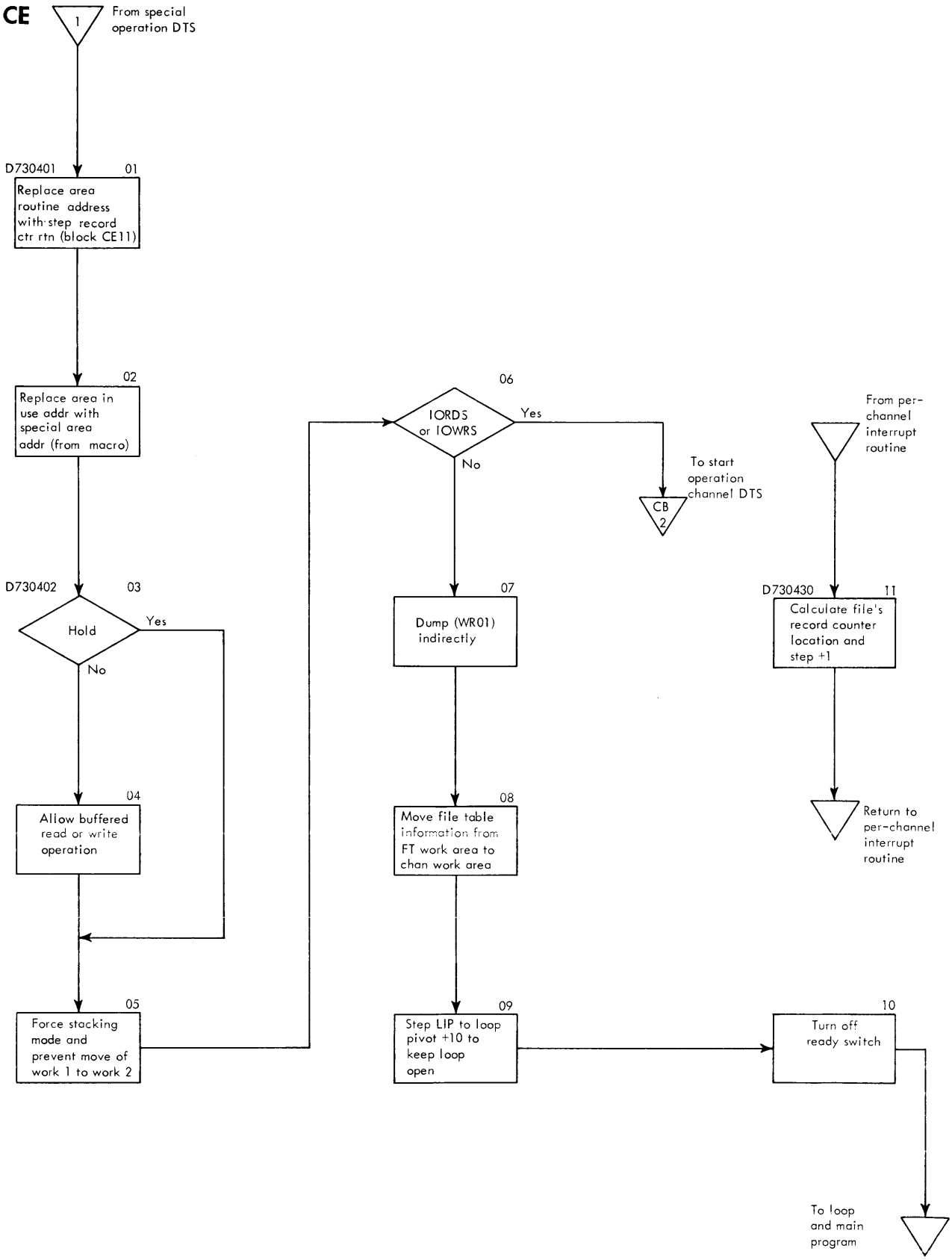


Chart CE. IORDS, IOWRS, and IODMP Subroutine

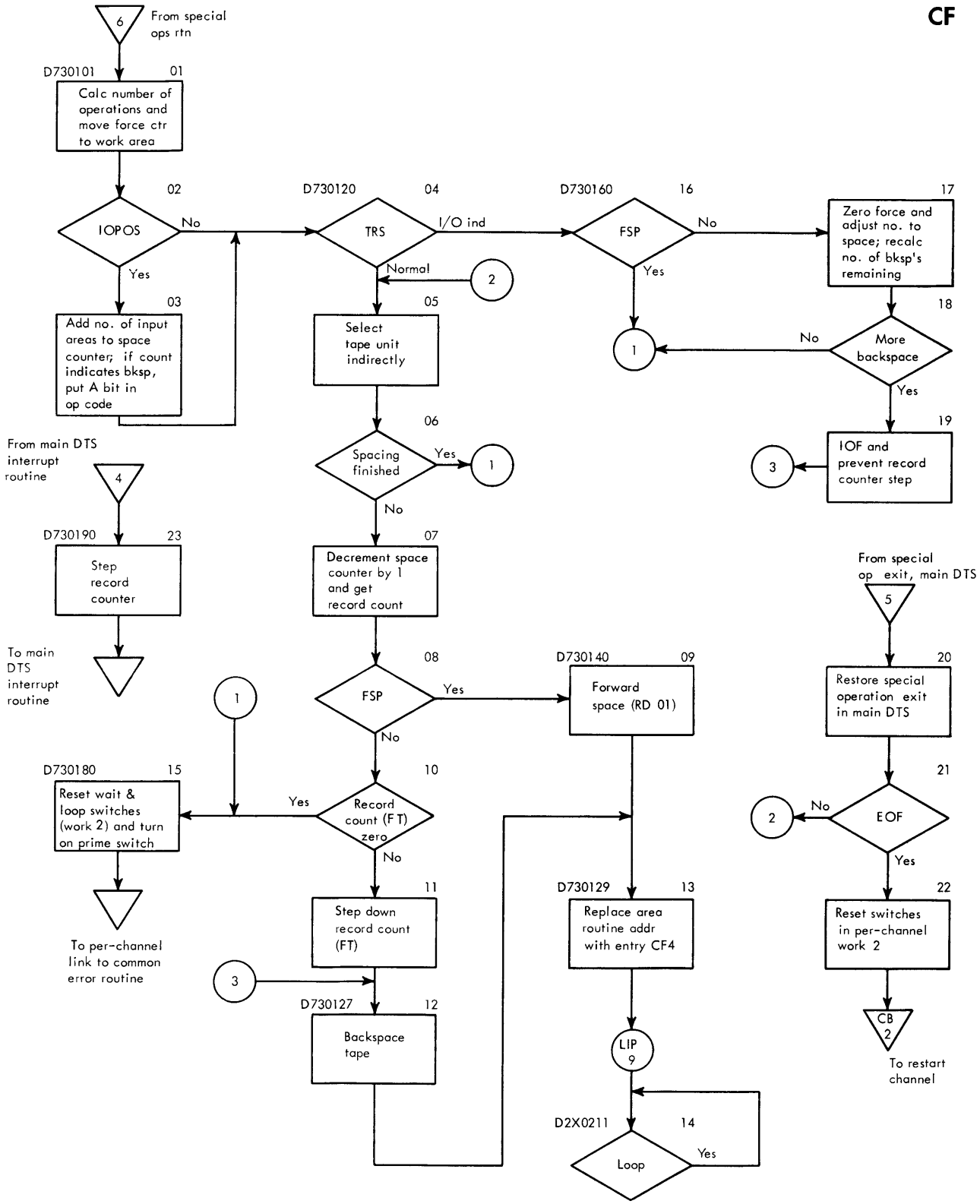


Chart CF. IOPOS, IOBSP, and IOFSP Subroutine

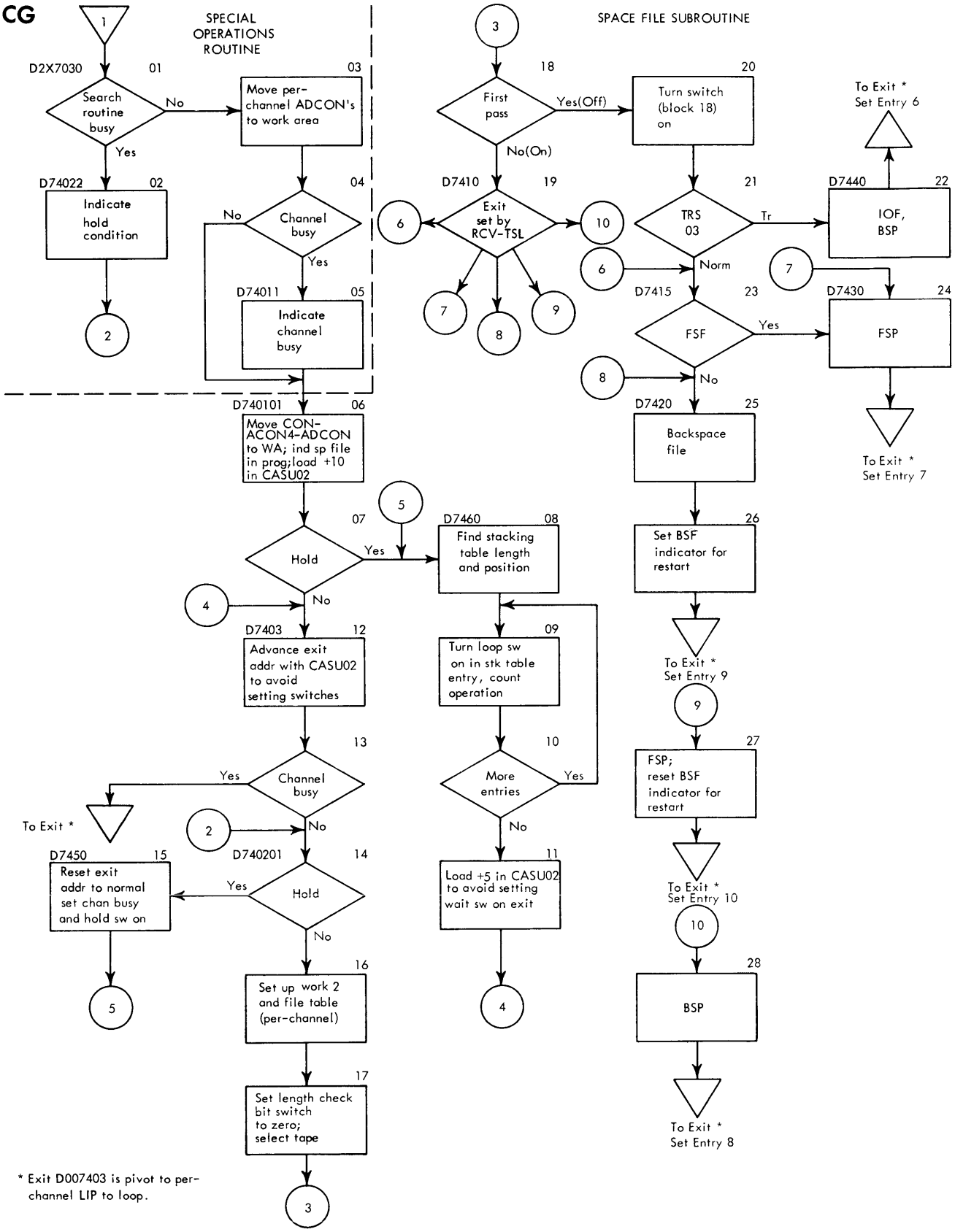


Chart CG. IOFSF and IOBSF Subroutine

CSDTS detects errors; CSERR processes the error conditions in the following order:

1. Incorrect record length (if record length checking is specified).
2. Channel check caused by a read PCT or write PCT.

If no error occurs or after an error is corrected, CSERR interrogates the I/O indicator and transfers to CSEOF if the indicator is on.

The CSERR section of IOCS is discussed in two ways: 1) The relationship between the common error handling routine and the channel interrupt or the little DTS error detection routines (Chart DA), and 2) The individual routines that process the various error conditions (Charts DB-DF).

TSA—DTS Relationship

CHANNEL INTERRUPT

Block DA01, D2X03: An automatic interrupt occurs when any of the following operations is completed: RD, FSP, WR, DMP, WTM, SKP, BSP, or BSF. Control passes to the interrupt program of the channel on which the operation took place.

Each channel has a channel interrupt routine as well as other routines that are necessary for per-channel operation. These routines are usually identical except for the tags. Example: the entry tag of channel 20 interrupt routine is D2003; that of the channel 21 interrupt routine is D2103. All references to a typical channel in this flow chart are to channel 2X. To locate the same routine for another channel, substitute the channel number for the second digit of the tag and look up the tag in the symbolic analyzer. To conserve memory space, the channel interrupt program is initalized during the erasable part of housekeeping. By means of a TIP to the channel interrupt tag D2X03 and the LIP 2X00 there, the channel X word 0 (storage location 2X00) is set up with the address of the second instruction of the channel interrupt routine. This becomes the interrupt entry.

On entry into the channel interrupt routine, the channel ready switch is turned on by setting the associated bit of D1X5501 to zero. The channel is selected to enable the interrogation of error conditions.

Block DA02, D2X0302: Record length checking is specified by an A bit one in the hundreds position of file table section 2, word 5. The test here is on the A bit of D1X02052 in the DTS channel work area. The A bit one indicates that record length checking is specified.

If length checking is desired, the data memory address (SMAC) is saved at D004002 in the DTS common work area for use in computing the record length.

If the operation is read, control passes to the TRS instruction in block DA03 where the I/O indicator of the selected tape is interrogated.

If the operation is write, SMAC is adjusted to that of a read operation and entry is made into the common record length checking subroutine at block DA04. The address of the first character of the record is loaded into CASU 06. Thus, both the beginning and the ending addresses of the record are obtained prior to entry to the subroutine.

Block DA03: If the I/O indicator of the selected tape is on, the A bit of switch D1X41024 is set to zero to indicate that some type of error occurred. The indicator on is not an error condition, as such. However, at this point in the interrupt program, all three conditions — length error, PCT .check, and I/O indicator — are lumped together. Later, in the TSA common entry routine, the conditions are individually interpreted and handled.

Tape indicator on means that a tape mark was read, so length-checking is bypassed.

Block DA04, D2X0450: Record length checking is done in a closed subroutine represented by this block. Control enters via a RCV—TSL link from the interrupt routine.

Block DA05: If no length error is found, the transfer from the length checking subroutine (D400199) is directly to the ADCON below the linkage (D2X0450).

Block DA06, D2X0465: If a length error is found, the transfer to the ADCON is indirect and control passes to D2X0465 where the length error switch is turned on by setting to zero the 2 bit of switch D1X41024 in the DTS channel work area.

Block DA07, D2X0309: If no length checking is performed, or if no length error is found, the channel interrupt routine proceeds to the TSA at D2X0309. Here, a channel check and/or I/O indicator on causes a transfer to block DA08 where the A bit of switch D1X41024 is set to zero to indicate an error.

If no length error is detected, or if no TSA transfer occurs, DTS proceeds to start any pending operation on the channel. The exit from this chart is made to block CB07 of the DTS chart. These are not the usual exit or entry points to either channel interrupt programming or DTS programming. They are mentioned only as a means of relating the two charts. The TSA instruction in block DA07 is identical to the TSA in block CB06.

Block DA08: Switch D1X41024 has thus far been set to indicate the following conditions on this channel:

I/O indicator on — A bit zero
Channel check — A bit zero
Length error — 2 bit zero

In the next block, the TSA condition is analyzed to determine whether it was caused by an I/O indicator or a channel check.

NOTE: Switch D1X41024 is reset off by loading a G into it, thus setting the interrogated bits to one. One use of the switch is to differentiate between an entry as a result of an error condition and an entry effected in order to restart the channel after a single-channel hold.

Blocks DA09 and DA10, D2X0415: If a PCT exists, the 1 bit of switch D1X41024 is set to zero and becomes the MPX error switch. Switch D1X41024 (block DA08) now reflects the following conditions:

I/O indicator on — A bit zero
Channel check — 1 bit zero
Length error — 2 bit zero

Block DA11, D2X0490: The error switch for this particular channel is turned on by setting the A bit at D1X4001 to zero. The error switches for all four channels are actually bit coding in this memory position. The A, 1, 2, and 4 bits relate to channels 20, 21, 22, and 23, respectively.

Block DA12: There are four channel interrupt routines but only one common error routine for the four channels to share on the usual 21-22-23-20 priority. This means that the TSA routine may be processing an error or an EOF/EOR condition from another channel at the time the interrupt occurs. If so, the handling of the error on the interrupting channel must wait until the TSA routine is available.

The first instruction of the error routine (TSA common entry, block DA13) turns on a bit switch to indicate that the routine is busy handling an error situation. This TSA busy switch is the A bit of tag W0020. If the A bit is zero, the switch is on (busy); if the A bit is one, the switch is off. If the TSA routine is free to handle the error situation, control transfers to the TSA common entry routine to begin handling the error or EOF/EOR condition. If the error routine is busy (W0020 A bit zero), the channel interrupt routine next tests to determine if a single channel hold exists in DTS (4 bit zero at D2X0320). If it does, control passes to block CB08, the wait switch of the channel involved. If no single channel hold is in process (4 bit one at D2X0320), a LIP to loop occurs to await the completion of the current error handling. The following example illustrates what happens to the waiting error condition.

Assume that the TSA routine is busy handling a channel 20 error situation when channel 21 interrupts and needs to use the TSA routine.

Regardless of the type of error, the channel 20 retry operation eventually proceeds to E0109 (block DA20) to test for an error on the retry. Assume further that the retry was successful. Control passes into the end-of-file routine, transferring out at C0802+50. Thus, at E0210, another transfer would take place to E0623. At E0624, a test is made to determine if any TSA entries are pending.

In this example, channel 21 is waiting, so the A bit of D994822-2 is set to zero. This converts the LIP 9 at D994822 to a CNO. Control transfers to E011001 where the TSA busy switch is turned off by setting the A bit of W0020 to one.

Control then passes to a common pivot, E1004, which effects a transfer back to DTS to start another operation on channel 20. This time, when DTS goes to the loop at D994822, the LIP 9 is a CNO. The LIP 9 is restored and control passes to the error routine (E0101) to handle the channel 21 error condition.

The DTS channel 21 work area contains all necessary information concerning the operation which was just completed and which awaits checking. The operation code and file table address are located in work 2. This 5-position location may be thought of as a single-entry TSA stacking table, a place where the I/O operation to be checked for errors is kept until the TSA routine is available to perform the necessary error handling.

TSA COMMON ENTRY

Block DA13, E0101: The TSA busy switch is set on (W0020 A bit zero) to indicate that the routine is in the process of handling an error for a particular channel and that it cannot be called on to handle an error on another channel until the current error-checking procedures are completed.

Block DA14, E0105: Once the proper switches have been set to reflect the error conditions found, the program can proceed to a more detailed investigation. The objective at this time is to gather into a work area all information needed for processing an error or end-of-file condition and then to proceed to the particular routine which handles that condition.

Channel error-handling priority is 21-22-23-20. Thus, control passes to the routine which handles channel X procedures. The channel error switch turned on in

block DA11 is now turned off by setting the appropriate bit of D004001 to one.

Block DA15: Next, information about the channel and the file is set up in work areas prior to entry into the redundancy routine. The last five 5-character entries in the DTS channel work area are moved into the TSA channel entry work area. These entries are:

1. Work 2: The operation code and the file table address of the operation in progress. (The tape operation is completed at this time, but it is considered to be in progress until checked for errors.)

2. Error switch, SMAC: The 1-position error switch, D1X41024, referred to in block DA08, and the 4-character data memory address (SMAC) of this channel as found in the channel communication word.

3, 4. Two ADCON's: Return addresses in particular circumstances (explained in the "End-of-Reel Routine" section of this manual).

5. A transfer instruction: The normal return to the channel interrupt program following error correction.

Block DA16, E0106: The first four 5-character fields of the DTS channel work area are moved into the last 20 positions of the file table work area (words 3, 2, 4, and 5 of the DTS section of the work area). These fields are:

1. Operation code, select address: The operation code and the select address of the file being checked for error. The select address is zoned to reflect initiate/stacking mode and force counter status.

2. File table address: The address of the fixed section of the file table. This is the high-order address of the memory field occupied by the main program file table.

3. Area routine address: An unconditional transfer operation code and the address of the routine which rotates or advances the I/O area addresses. (See FT-214 in the "File Table" section.)

4. Area in use: The high-order position contains the total number of areas and the other four positions contain the address of the current area.

After a G has been unloaded into bit switch D1X41024, the entire fixed section of the file table is moved by an indirect transmit from F000202. Thus, sections 1, 3, 4, and 5 of the file table are moved into the work area.

By adding 95 to the address of the fixed section, the high-speed address of the variable section of the file table is obtained. Then, 20 characters (words 1, 3, 2, and 4) of the DTS section of the file table are placed adjacent to the fixed section of the work area.

NOTE: Everything except FT-205 (area in use) is picked up from the main program file table; FT-205 comes from the DTS work area. This is to provide for special operations involving I/O areas other than those specified in the file table.

Block DA17, E010802: The address of the I/O area is checked to determine if it ends in a 0 or 5.

If the area is improperly addressed, message 00226-I/O AREA ZZZZZZ is typed and an endless loop entered; i.e., pressing either interrupt key 252 or 253 causes a transfer to E010901 where the message is repeated.

Block DA18: Three switches are set to NOP: C0301, shown in block DB14, to allow one backspace-rewrite before skipping if a write PCT is encountered; C0201, the redundancy routine entry switch, to allow the next entry to count as an initial entry so that one is added to the entry counter; and C020502, to allow a load point check in the tape cleaner routine.

Block DA19: At E010801, five retry counters are initialized to negative amounts by unloading QRJMM into tag C10031, as follows:

C1001 – 8	Read counter for PCT retries
C10014 – 9	Backspace loops for read redundancy
C1003 – 1	Length error counter
C1002 – 4	Write PCT counter for retries
C10031 – 4	Number of skip loops

Block DA20: Now that the proper work areas are set up and the necessary switches and counters are initialized, switch E10024 is tested to determine the type of indication that caused entry into the TSA routine.

If the 1 bit of E10024 is zero, a PCT has occurred; if the 2 bit is zero, a record length error has been detected. Control passes to the redundancy routine where the errors are handled in separate routines.

Block DA21: If no errors have occurred, a test is made to determine if the entry to the TSA common routine is an internal entry; that is, if it was from little DTS. The A bit zero of C00050 indicates an internal entry and control passes to C0803 where the B bit of F0002052 is set to one to indicate little DTS error checking. The internal entry switch is turned off by setting the A bit at C00050 to one. The original operation code, saved in C10012 (see block DA24), is replaced at E10014 in the TSA work area. Control transfers to the little DTS exit point set up at C0804 (block DA22).

If the entry to the TSA routine is not an internal entry, the program proceeds to handle EOF/EOR conditions.

INTERNAL ENTRY

Block DA22, C0801: The exit from the little DTS checking routine is at D6099. The address in this exit is placed at C0804. After the common error routine handles the error found in the little DTS checking routine (D6301, block CC10), this exit address is used to return to the routine that requested the operation.

Block DA23: The little DTS no error check switch is turned on by setting the B bit of F000205 to zero. The

internal entry switch is turned off by setting the A bit of C00050 to zero.

Block DA24: The IOCS operation at E10014 in the TSA channel entry work area is saved at C10012. As described in block DA15, this is the operation code of the I/O request in work 2. This may be thought of as the parent operation code. In order to execute this instruction, handle its errors, etc., other operation codes may be involved through little DTS. For example, an original S operation code of an I/O read request may later involve, in little DTS, another S (read), 5 (backspace), 3 (forward space), etc.

The little DTS operation code saved at D006001 is placed in E10014 of the TSA channel entry work area.

Now that the error routine has recognized that the entry is an internal entry, and has set up the operation codes where they may be interrogated, control passes to the main error routine to handle the error conditions found in little DTS.

Redundancy Routine

The redundancy routine is the heart of the error correction section of IOCS. Its purposes are:

To determine which of the following caused the error indication: incorrect record length, write PCT, read PCT, or noise.

To re-execute the operation successfully.

To search for and to correct redundancies if retries fail.

To alert the operator of these redundancies and to provide him with the following options: re-execute, accept the IOCS-validated character, provide a correct character, dump the error record, ignore the error, or restart.

To execute these options.

For explanation, the redundancy routine has been divided into two parts: part 1 deals with the first three items above, part 2 with the last two items. Parts 1 and 2 are shown on Charts DB and DC, respectively. Other charts of subroutines which support the redundancy routine are: Chart DD, noise routine; Chart DE, redundancy search; Chart DF, record length checking.

Redundancy Routine, Part 1

Block DB01, C0201: There are two types of entries into the redundancy routine for a given error condition: the first-time entry, and all other entries.

For the initial entry, switch C0201 is NOP (block DA19); it is set to TR. The error correction entry counter, F000303, is incremented by 1. On subseqeunt entries for the same redundancy routine, the counter is not incremented because switch C0201 is TR.

Block DB01.5: A read type operation contains a B bit and/or 2 bit zero at E10014, the operation code; a write type does not.

Block DB02, C0202: If the operation involved is of the read type, the entry counter is compared to 51, the maximum allowable redundancy routine entries for an input tape.

Block DB03: If the operation involved is of the write type, the entry counter is compared to 30, the maximum allowable redundancy routine entries for an output tape.

Block DB04, C020104: The maximum number of entries into the redundancy routine for input and output tapes is specified to provide a warning to the operator that there are possible tape reel or tape unit troubles. Message 30224/5-xy-zz alerts him that the redundancy routine has been entered zz times for reel xy. Pressing interrupt key 253 causes a restart at the last checkpoint. Pressing interrupt key 252 continues processing.

Block DB05, C020101: If the maximum number of entries is not reached or if the operator chooses to continue processing, a test is made to determine if a record length error has occurred on the retry. The 2 bit zero of retry error indicator E10024 means that a record length error has been detected, and control transfers to the common record length error routine, Chart DE, connector 1.

Block DB06: If no length error exists, the error must have been caused by a PCT (block DA20) of which there are three types: a write PCT, a read PCT, or a noise record. Each type is handled separately.

The IOCS operation (work 2) at E10014 of the TSA channel entry work area is interrogated by a TZB on the B bit to determine whether the operation is read or write. As seen from the chart of macro operation codes (Figure 17) write type codes contain B bit one while read type codes contain B bit zero.

Block DB07, C020202: A noise record is a redundant non-data pulse which is picked up by the read head of the tape unit. A noise record seldom exceeds nine characters; therefore, CSERR assumes that a noise record has been read if the calculated length of a PCT record is ten or less.

NOTE: IBM Programming Systems standards establish a minimum tape record length of 15 characters.

Block DB08, C0205: If the record is not a noise record, a test is made to determine if the operation is a position tape operation (one which moves tape but does not move data). The 1 bit one of E10014 (block DA24) indicates a position tape operation. No retries are necessary on these operations, so control transfers to the TSA common entry routine, Chart DA, connector 5. However, before the transfer is made, a RCV—TSL

links to C0305 where an RMA instruction turns off the channel X error triggers. A PCT on the RMA operation results in message 20226/7-xy-PCT ON RMA.

Interrupt key 252 causes a direct transfer to C0390 to repeat the RMA. Pressing interrupt key 253 results in an 0900 check because the indirect transfer to C0390 is an effective transfer to C10013, an address ending in 5.

NOTE: During the routine which writes messages and dumps records on tape (D8101), an RMA instruction is used to turn off the interrupt call trigger and the channel check indicator. A PCT during this operation causes a transfer to D8120 where halt 20226 occurs. This is the only halt in IOCS; it is an indication of machine trouble. Pressing the start key re-executes the RMA.

Block DB09: If the operation is not a position tape operation, the PCT counter (the A bit of C1001) is tested to determine if nine retries have been made. The counter is initialized to −8 in block DA19. Each time a retry is executed, +1 is added to the counter as part of the re-execution routine, block DB10.

After the ninth retry, the PCT counter goes from negative to positive. The field now has BA zoning and a TZB on the A bit can determine if the ninth retry has occurred.

Block DB10, C0206: If the maximum number of retries has not been reached, the read operation is re-executed in a subroutine at C0502.

The RCV − TSL at C0206 is the initial linkage. At C0502, the read counter for PCT retries, C1001, is updated. At C0501, the record is backspaced via linkage to little DTS. Because the operation is a read type, control transfers at C0504 to C050401 where the read operation is re-executed via linkage to little DTS. Control then passes to C050405 where the operation code is placed in the message.

NOTE: During the re-execution of the read operation in little DTS, a RD 03 (SST) placed the status trigger characters in E1003 of the TSA channel entry work area. At C0506, if switch 0916 is on, these two characters are placed in message 10212/3-xy-st which is typed after every retry.

Control then returns to the initial TSL+5 at C0206 where control passes to E010803 in the TSA common entry routine.

NOTE: Any error occurring on the reread is indicated in E10024 by the error checking routines of little DTS. If a length error or channel check is indicated, the redundancy routine is entered again and additional retries are made until the maximum number of retries is reached.

Block DB11, C020502: If an error persists after the ninth re-execution of the read operation, the tape cleaner routine is performed.

The purpose of the tape cleaner routine is to move the tape back over the shaver head in an attempt to dislodge any foreign material. The routine consists of three backspaces followed by two forward spaces and a read; this is the tenth retry or the eleventh read. The entry switch, C020502, is set TR to allow only one execution of the tape cleaner routine. The routine is not performed if 1) the tape is within three records from load point, determined by the data record counter, or 2) if a noise record is detected in the past three records, determined by the last noise record indicator.

Block DB12: If the record is still redundant after the tape cleaner routine has been executed, the program proceeds through the TSA common entry as before; this time switch C020502 of the tape cleaner routine is set TR. Therefore, control passes to C020503 where +1 is added to C10014, the read retry loop counter used to execute 100 rereads (counting the tape cleaner reads). The operation is similar to that using counter C10031 to execute 25 skips and rewrites. The read retry loop counter is reset and is tested. (See blocks DA19 and DB09, respectively.)

The following is a summary of the four retry counters:

C1001	RCD	01	Read counter for PCT retries
C10014		01	No. of BSP loops for read redundancies
C1002		01	Write PCT counter for retries
C10031		01	Number of skip loops

If the record is still in error after ten retry loops, the redundancy search routine (Chart DE) is entered to search for redundancies in the I/O area.

NOTE: Counting the initial read and the ten loops of nine rereads plus the tape cleaner rereads, the total number of read attempts is 101.

Block DB13, C0318: Because the redundancy search routine is used for both read and write, block DB13 is discussed later, in its proper context.

Blocks DB14 and DB15, C0301: If the operation is write, a backspace is executed and an attempt is made to rewrite the record. Switch C0301 assures only one rewrite. The record length is checked on every retry if length checking is specified in the file table (Chart DE).

Blocks DB16 and DB17, C0303: 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. This is done four more times if the PCT persists.

Block DB13, C0318: If five skips have been executed in block DB16 (six rewrites), control passes to the re-

dundancy search routine where the I/O area is searched. If redundancies are found, control passes to Chart DC, connector 2 of the redundancy routine, part 2.

Blocks DB18 and DB19: If no redundancies are found, a second retry counter located at tag C10031 is used to assure more backspace-skip-rewrite operations before the record is considered a permanent error. C10031 is called "number of skip loops" in the listing. The additional skips are made as follows.

After each group of five skips, the search is executed. If no redundancies are found, the skip loop counter at C10031 is incremented by 1 and another group of five backspace-skip-rewrite operations is attempted. After the fifth loop (the 25th skip), control passes to Chart DC, connector 1 of the redundancy routine, part 2.

Procedure: switch C0301 was set on during the first rewrite, it transfers control to C0302 where the write retry counter is interrogated to determine if five skips have occurred. The counter is initialized to −4 (M) at block DA19 and is incremented and interrogated. (See block CB09.)

If the maximum number of five skips has not been reached, the skip counter F000302 and the write retry counter C1002 are incremented by 1. The backspace is executed at D6034, the skip at D6039. The rewrite operation begins as a RCV—TSL at C0304. The execution of the write is at C050403 and D6020. Control transfers to C050405 where the operation code is placed in the message. Return linkage is to the initial TSL+5 at C0304 where control passes to E0109 in the TSA common entry routine.

NOTE: Any error occurring in the little DTS rewrite is indicated in bit switch E10024 by the error-checking routines of little DTS. If a record length error or channel check is indicated, the redundancy routine is entered once again and additional retries are made until the maximum is reached.

Redundancy Routine, Part 2

Block DC01, C0319: If 25 backspace-skip-rewrite operations are executed and the record is still redundant, but no redundancies are found in the output area, message 30210-xy-r, aaa zzzzzz st is typed. The tape is xy; r is the routine (C=CSMRD, L=CSMRS, b=main program) attempting to execute operation aaa; the I/O area is zzzzzz; and the condition of the status triggers is indicated by st.

If ten read retry loops have been executed and the record is still redundant, but no redundancies are found in the input area, message 30211-xy-r, aaa zzzzzz st is typed. IOCS then gives the operator two options:

1. Pressing interrupt key 252 to perform the retry loops again, or
2. Pressing interrupt key 253 to proceed to accept-or-dump options.

Block DC02, C0309: Message 30220-xy-r aaa st occurs after five backspace-skip-rewrite operations have been executed and a redundancy is found in the output area. Message 30221-xy-r aaa st occurs after ten read retry loops are executed and redundancies are found in the input area.

The locations and bit configurations of redundant characters are typed prior to the message (see block DE23). These characters have been validated by IOCS or replaced by the main program's specialized error routine, and are now valid characters in memory.

IOCS validation is accomplished by reversal of the C-bit, IOCS then gives the operator two options:

1. Pressing interrupt key 252 to perform the retry loops again.
2. Pressing interrupt key 253 to restart (if write) or to proceed to accept or dump options (if read).

Block DC03, C0311: If interrupt key 252 is pressed following message 30220/1, ADCON C0313 or ADCON C0312 is NOP; the program proceeds to C0311 where additional backspace-skip-rewrite or backspace-reread loops are executed; that is, 100 more rereads or 25 more rewrites are performed. At C031101, an asterisk is placed in the message to flag it as an additional correction attempt. Repeated pressing of interrupt key 252 causes repeated loop operations to occur, but only one asterisk appears in the message.

NOTE: At C031101+25, linkage is made to C0501 where the operation is re-executed. This time, however, the return to the TSA common entry is to E010801, not to E0109, the usual retry return. Thus, the PCT and loop counters are reset as shown in block DA19.

Block DC04: If interrupt key 253 is pressed following message 30220/1, an indirect transfer is made to ADCON C0312. At C0312, the B bit of E10014 in the TSA channel work area is tested to determine whether the operation code is read or write. The B bit one indicates write; B bit zero indicates read. If the operation is write, control passes through C0105 to H0101, the beginning of the restart routine.

Block DC05, C0313: If interrupt key 253 is pressed following message 30210, 30211, or 30221, control passes to C0313 where linkage is made to C0305 to execute an RMA to turn off the channel error triggers (block DB08).

Block DC06: The A bit one of F0002052 indicates that record length checking is desired. This location is part of the field containing the 4-character address

of the input/output area currently in use, it indicates that record length checking is specified. If record length checking is specified, the address of the current input/output area is saved in CASU 06 and control transfers to the record length checking routine located in little DTS at D6440.

Block DC07, D400101 (Fixed), D400201 (Variable): A SMAC test is performed; the length of the record is checked by calculating the correct record length and testing the last character for no group mark. On fixed length records, the character after the record is also tested to determine if it remains a group mark; that is, whether it was overlaid by a long record.

Block DC08: If a record length error is detected, control transfers indirectly to ADCON C010801. If no record length error is detected, control transfers directly to ADCON C010801; control then passes to C0314 (block DC10).

Block DC09, C010801: Control links to C0601 where the 2 bit of F0005063 is tested to determine if automatic dumping of permanent read/write errors is specified. If dumping is specified (2 bit zero), control transfers to C0603; if dumping is not specified, control passes to the TSL+5 of the originating linkage.

Block DC10, C0314: If no length error occurred, the same automatic dump test is made, as described in block DC09.

Block DC11, C0601: If automatic dumping is specified, control enters a common dump routine. The initial RCV – TSL is at C0314 or C010801. At C0601, the dump indicator, 2 bit at F0005064, is interrogated. If the 2 bit is zero (automatic dumping), control transfers to C0603. If the entry is not from the checkpoint routine (CSMRD), or from the label-handling section of IOCS (CSTRS), the operation code, E10014, is tested at C0604.

If the operation is write, no automatic dumping occurs. The return linkage is to the original TSL+5. If the operation is read, control passes to C0605 where the character at the SMAC location is saved at C10011. A group mark is placed at the SMAC address to terminate the field when dumping the record. The permanent read/write error counter, F0003043, is increased by 1.

If no dump tape is specified, switch C0606 is set TR in housekeeping, causing error records to be dumped on the typewriter. The special tape table entry for a dump tape, W20, counts the records dumped. If a dump tape is specified, switch C0606 is NOP, causing error records to be written by a DTS routine at D8102.

At C0620, the dumped record is replaced via linkage to D6010 in little DTS. The data tape record counter, F0003022, is updated and control returns to the TSA common entry routine.

Block DC12: If a record length error is detected and auto dumping is not specified, message 30214/5-xy-zzzzzz nnnnnn is written to inform the operator that a record length error has occurred on tape 2x0y. A total of three attempts have been made to execute the operation. The I/O area is at location zzzzzz, and the exact length of the record read or written is nnnnnn.

Pressing interrupt key 252 transfers control to C031101 where an asterisk is placed in the message area. The I/O operation is re-executed via linkage to C0501. Control then transfers to E010801 (block DA19) where the retry counters are initialized to allow an additional 100 reads or 25 writes.

Block DC13, C0317: Pressing interrupt key 253 following message 30214/5 causes an indirect transfer to C0317, the second ADCON of the message format. At C0317, message 30222/3 is written.

Message 30222-xy-zzzzzz means that 25 skips have been executed on output tape 2x0y and that no redundancies were found in output area zzzzzz, but a PCT error persists.

Message 30223-xy-zzzzzz means that 100 attempts have been made to read tape 2x0y, but a PCT error persists. Input area zzzzzz has been searched for redundancies; either none was found or those found were corrected. The operator has the following options:

1. Pressing interrupt key 252 to dump the error record (if read) or to restart (if write).
2. Pressing interrupt key 253 to accept the record and continue.

Block DC14, C030403: Pressing interrupt key 253 causes an indirect transfer to C030403 where the permanent error counter, F0003043, is increased by 1. Control then returns to C0802 (block DA21) in the TSA common entry routine.

Block DC15, C0604: Pressing interrupt key 252 following message 30222/3 causes a direct transfer to ADCON C030403. If the operation is read, a RCV – TSL to C0603 executes the dumping operation outlined in block DC11. If the operation is write, control returns to the TSL+5 where control transfers to the restart routine.

Noise Routine

A noise record is a non-data pulse which is picked up by the read head and causes a PCT check. (Non-data 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.) Because a noise record seldom exceeds ten characters, CSERR assumes that a noise record has been read if the calculated length of the PCT record is ten or less. (IBM Programming Systems' standards specify that no tape record may be less than 15 characters in length.) Disposition of noise records is left to the operator following message 30213/7. IOCS notes the location of the

last noise record and keeps a count of the number of noise records. Noise records are not included in the data tape record count.

NOTE: A noise record is any PCT record of ten or fewer characters. IOCS does not differentiate between a true noise record (non-data pulse) and a PCT record less than 11 characters in length.

Block DD01, C020202: Blocks DD01-DD03 determine if the record is more than ten characters in length. First, the starting address of the I/O area is loaded into CASU 06 and +10 is added to it.

Block DD02, C020203: CASU 06 now contains the address of the minimum length record. The address is unloaded into C1005 and compared to the data memory address (SMAC).

Block DD03: If SMAC is high, the record is more than ten characters in length and therefore is not a noise record. Control transfers to C0205. If the operation is a position tape operation, the error triggers are turned off via linkage to C0305, and control passes to C0802, block DA21. If the operation is not a position tape operation, control transfers to C020501, block DB09. If SMAC is equal to or lower than the address of the minimum length record, the record is considered a noise record.

NOTE: Block DD03 is identical to block DB07. It is repeated here for clarity.

Block DD04: If the record is noise, the three low-order digits of the data tape record counter, F0003022, are placed in the last noise record counter, F000304. Thus, the location of the last noise record encountered in the file is kept in the file table work area at F000304 to be used in the tape cleaner routine, block DB11.

Block DD05: The noise record is considered to be a redundant tape mark if it is less than three characters in length and turns on both the channel check and the I/O indicator. (The I/O indicator is turned on whenever a 1-character or a 2-character record contains a character which includes the 8421 bit structure of a tape mark.)

Blocks DD06 and DD07: If the I/O indicator is off, the record is a noise record and message 30213 is set up. If the I/O indicator is on, the record is considered to be a redundant tape mark, and the message number is changed to 30217 by setting the 4 bit of C0042 to one.

Block DD08, C020701: Message 30213-xy-zzzzzz is typed, indicating that a noise record has been detected in reading from tape 2x0y into the input area at zzzzzz. If a redundant tape mark is found, message 30217-xy-zzzzzz is typed.

Pressing interrupt key 252 following message 30213/7 ignores the noise record or accepts the redundant tape mark; pressing interrupt key 253 re-executes the read operation. However, console action following these messages should be carefully considered because of the nature of noise records. The following are possible deviations from normal operations: After a read operation, the tape is positioned a short distance beyond the last character read. Thus, after a noise record is read, the tape is normally positioned between the noise record and the next tape record to be read. The tape may also be positioned at a point within the next tape record however, or, in rare instances, completely beyond it. The position depends on the bit density of the tape and the first-character 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 message 30213/7 can result in any one of the following:

1. Correctly reading the next tape record.
2. A PCT when reading the next tape record.
3. Bypassing the next record and reading the following record.

Pressing interrupt key 253 after message 30213 can result in any of the following:

1. Correctly reading the next record.
2. Rereading the noise record.
3. Rereading the record which precedes the noise record.

According to the particular position of the tape after reading a noise record, pressing interrupt key 253 after 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.

Block DD09, C0311: If interrupt key 253 is pressed following message 30213/7, control transfers indirectly to ADCON C0311 to re-execute the read operation via linkage to C0501; that is, the tape is backspaced, reread, and checked in little DTS. Control returns to the TSA common entry routine to test for any errors found by little DTS.

Block DD10: If interrupt key 252 is pressed following message 30213/7, control transfers directly to ADCON C0311. The noise counter, F000302, is increased by 1.

Block DD11: The 4 bit one at C0042 indicates a redundant tape mark accepted as a valid tape mark in block DD08. Control proceeds through the TSA common entry routine to the end-of-file routine.

Block DD12, C020702: The 4 bit zero at C0042 indicates that the noise record to be ignored is not a redundant tape mark. A TZB to C020702 links to C0504 in little DTS to re-execute the read operation. Control then returns to the TSA common entry.

NOTE: The purpose of block DD09 is to retry the operation that resulted in the noise record; therefore, the tape is backspaced and reread. The purpose of block DD12 is to obtain the next record; therefore, the tape is not backspaced, only read.

Thus, the return points to the TSA common entry routine are different: to E010801, Chart DA, connector 6, for block DD09; to C010902, Chart DA, connector 3, for block DD12.

Redundancy Search Subroutine

The purpose of the redundancy search subroutine is to search the I/O area for redundant characters and to correct them. The subroutine is entered under one of the following conditions:

1. Ninety read retries and ten tape cleaner routine reads have been executed, but a PCT persists.
2. Five skip-write retries have been executed but a PCT persists.
3. A validity check is performed on the channel status trigger characters brought out by the RD 03(SST) in little DTS. The channel check trigger is already on at the time, so the two characters are checked in the search routine.)
4. In CSMRD, an octant to be written contains redundancies.

Redundancies are located by C bit reversal. If none is found, the exit from the subroutine is direct to the TSL+5. If redundancies are found:

1. The addresses of all redundancies and their bit configurations are listed on the typewriter.
2. The redundant characters are validated by IOCS (C bit reversed). They are accepted or replaced by the main program and become valid characters in memory.
3. The exit from the routine is indirectly to the TSL+5.

NOTE: If a set bit redundant instruction (SBR) is performed on a valid character, the resultant character is invalid, but the 0901 error trigger does not come on. Therefore, a TMC following an SBR of a valid character does not effect a transfer.

Block DE01, C0702: The low limit of the search is the starting address of the I/O area currently used by the operation being checked. This address is located at F000205 in the file table work area. It was saved in CASU 09 at C0318 (block DB13). This low limit is placed in C10001.

The high limit of the search is the data memory address (SMAC) as found at E1002 in the TSA channel entry work area. This address is loaded in CASU 06 at C0318 (block DB13). This high limit is saved in C1005.

NOTE: Because SMAC can be from 1-5 memory positions higher than the last character read and from 6-10 memory positions higher than the last character written, the area searched is larger than the I/O area.

Block DE02: The exit from the redundancy search routine consists of two instructions, a CNO at C07991 followed by a TR at C0799. The address of the latter instruction is filled in by the TSL of the linkage to the redundancy search. The exit is made direct by assuring ASU 11 zoning of the instruction at C07991, making it a CNO (comma 11). This is done by setting the A bit of the tens position of the instruction address to one.

Block DE03, C0703: The 0901 indicator is turned off by a TMC to the next instruction. Next, the redundancy search routine builds a fence around itself to prohibit searching for redundancies within itself. The fence extends from C0702 through C0719+5, including the entire 106-instruction routine, because the program would hang on a 0900 check when the SBR instruction made redundant the subsequent TMC instruction. The need for this self-protection is not evident in the case of an I/O area search. Because part of the redundancy search routine may be used by the checkpoint routine to search the octant of memory containing the search routine, this self-protection is necessary.

The address of the character to be tested is held at C10001. Initially, this field is set to the low limit of the search, the starting address of the I/O area.

Block DE04, C070201: The actual redundancy test is performed here with an indirect SBR on C10001 (IOREDUNAD).

Block DE05: If the character tested was redundant before the SBR instruction, the 0901 trigger is on; control transfers to C0707.

Block DE06, C0707: Because a redundancy is found, the exit from the redundancy search routine is made indirect by converting the CNO instruction at C07991 to an EIA instruction. This is done by setting the A bit of the tens position to zero, changing the ASU zoning from 11 to 10.

Blocks DE07 and DE08: The C bit of the tested character is reversed again. If the initial character was a void or a C bit only, the 0901 trigger would be on and the TMC would cause a transfer to C07011.

Block DE09: If the tested character is a void or a C bit only, an asterisk is placed at L,C10001 (IOREDUNAD). A group mark replaces the B in the bb-bBA8421 message area. Thus, message 30220/1 involving a void or a C bit only types out zzzzzz-b.

Block DE10: If the character was initially redundant, but not a void or a C bit only, the C bit is reversed for the third time (it is now in a status opposite to its original status) and the 0901 indicator is turned off. A C is placed in CASU 01 and ++0 (ASU 15 zoning) in CASU 03 to prepare for the modification of the bit test.

Blocks DE11 and DE12, C0708: The bit structure is tested in the following order: CBA8421. This is done by altering the ASU zoning of the TZB instruction which tests the bit structure causing first a TZB 07, then a TZB 06, and so forth. At C0708, the C bit is tested first by an indirect RCVS of C10001 and a TZB.

Block DE13, C0710: If the character initially contained a C bit, the TZB 07 at C070801 effects a transfer to C0710 where the C stored in CASU 01 is placed in the bit structure message at C0032+3, replacing the blank.

Block DE14, C070803: MAC II is set to C0032+3, the address of the C bit in the message save area. A blank is loaded into CASU 01.

Block DE15: A 1 is added to C070803, in effect, a stepping to the right of the bb-BBA8421 message area as shown at C0032. With an AAM instruction, the ASU 15 zoning previously loaded in CASU 03 is added to C070801, stepping the TZB ASU coding down one to test the next bit; i.e., TZB 07 (test C bit) becomes a TZB 06 (test B bit), and so forth.

Block DE16: The end of the test is indicated by the group mark at C0033 which follows the bb-BBA8421 at C0032. If the group mark has not yet been reached, a TZB on the A or the 8 bit returns to test the remaining bits of the structure. When the group mark is reached, no transfer results from either TZB instruction.

Block DE17: When the structure test is completed, the two instructions at C070801 and C070803 are restored to their original state:

```
C070801    TZB     C    C0710
C070803    RCVS         C0032 + 3
```

Thus, the coding is ready to test the bit structure of the next character, beginning with the C bit.

Block DE18: By an indirect single-character transmit from C10001, the validated character is placed in L,IOREDUNAD.

Block DE19: The character in the search area is restored to its original redundant condition by an indirect SBR on C10001. The 0901 indicator is turned off by a TMC to self plus five.

Block DE20, C0709: The 2 bit zero of F0005063 specifies that permanent error records are to be dumped.

Block DE21, C071703: This test determines whether the entry was caused by a PCT during checkpoint or label-handling routines. In checkpoint (CSMRD), a C is placed in F0002054 by a 5-character transmit in that routine. In the label-handling routine (CSTRS), an L is placed at the same location. Thus, a test of the B bit of F0002054 determines whether the entry was from CSMRD or CSTRS, or neither.

Block DE22, C070901: The message routine is alerted to handle the bit configuration type-out as a special message; that is, the six digits in the message refer to a character address, not a message number.

Block DE23: The address of redundant character is in C10001; the address is now placed in the message at C0031+2.

Block DE24: The type routine is entered by a RCV — TSL to S60. The message consists of the location and bit configuration of the redundant character. An asterisk is used to denote a void or C bit only.

Block DE25, C070902: The message area contains the bit configuration of the redundant character. This area is initialized with bb-BBA8421 to prepare the area for the bit configuration of the next redundant character.

Block DE26: When a redundant character has been found and validated, and a message containing its address and bit configuration has been typed, control links to the user's specialized redundancy routine, if one is provided. The linkage is as follows:

```
RCVS     W005 + 1
EIA
TSL      W006
ADCON    C071702
```

The receive address is the address of the transfer instruction at W005 in the common entry points. The location of ADCON C071702 is placed here. If the user has a specialized redundancy routine, W006 is a pivot point to the first instruction of the routine.

NOTE: The main program tag IOREDUNCHK and the IOCS tag W006 refer to the same memory location. The main program tag IOREDUNAD and the IOCS tag C10001 refer to the same memory location. The validated character is at C1009. The address of the redundant character is at C10001.

Thus, the user can determine what and where the character is. If the user accepts the IOCS-validated character, his return point to IOCS is at IORETURNTO (W002). Here, the A bit of W004-1 is set to one, assuring a CNO and a direct transfer to the ADCON; hence, the program continues to the next instruction. If no user's specialized redundancy routine is specified, the return is also to W002.

If the user chooses to replace the redundant character at the location specified with a valid character, re-entry is at IORETURNNO. Here, the instruction at W004 is made EIA, and the resulting indirect transfer is to the address portion of the ADCON, or to C071702. To summarize:

1. If the return is to IORETURNNO, control passes to C071702 where the address of the character is placed in CASU 04. Control then transfers to C070201 where the user's replacement character is checked for validity (blocks DE04, DE05).

2. If the return is to IORETURNTO, the subroutine continues to the next instruction.

Block DE27: Because the address of the character is at C10001 and the corrected character itself is at C1009, an indirect receive to the former and a 1-character transmit from the latter replaces the redundant character in the I/O area with the corrected character. The following examples show how first a valid character and then an invalid character are handled in Chart DE:

The tested character is a 6

BLOCK	BIT STRUCTURE
(START)	4-2
4	C-4-2
5	No transfer
28	4-2
29-31	Prepare to test next character

The tested character is an 8 bit only

BLOCK	BIT STRUCTURE
(START)	8
4	C-8
5	Transfer
7	8
8	No transfer
10	C-8
19	8
26	Accept correction
27	Put C-8 back in memory
29-31	Prepare to test next character

Block DE28: If the main program's replacement character passed the validity test via the SBR—TMC combination, another SBR restores the character to its initially valid condition.

Block DE29, C0704: The address of the character tested is placed in CASU 06.

Block DE30, C070401: If the address of the character tested is equal to or higher than the address of the high limit of the search, the search is over.

NOTE: The TRE—TRH instruction sequence is used in place of a TRE instruction to terminate the search in case of a wrap-around.

Control transfers to C0717 where control returns to the TSL+5 of the original linkage to the redundancy search routine.

Block DE31: Because the search is not completed, the address of the tested character (now in CASU 06) is placed in C10001 where 1 is added to it; in effect, the address of the next character to be tested is obtained. The search continues with a transfer to C0703, block DE03.

Record Length Error Routine

Length-checking of data tape records read or written is performed before the check for error and end-of-file conditions (and also after each retry if an error is detected). The following points are important in length-checking.

Fixed Length Records: Each I/O area must be preceded by a four-character address of the memory 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 and ending in a 4 or 9 position.

Variable Length Records: The first three characters of each variable length data tape record must contain a tape length count, constructed as follows: (a) The length of the record is converted into a 4-character address. (b) Because variable length records must be divisible by five, the units position can only be zero or five. If the units position is zero, minus zoning is placed over the tens position. If the units position is five, plus zoning is placed over the tens position. (c) The tens, hundreds, and thousands positions of this 4-character address constitute the first three characters in the tape record. Variable length input and output areas are defined so that the total area includes a 10-character buffer area as the last ten characters. The total area therefore equals the maximum record length plus ten.

Block DF01, C0101: The IOCS operation code at E10014 is interrogated to determine whether the operation is RD or WR. The A bit one at E10014 indicates a read operation; A bit zero means write. (A previous read-type or write-type test was made at C0201, Chart DB, connector 1.)

Block DF02: The type of record length field, F0005074, is interrogated to determine whether fixed length or variable length data tape records are specified. An 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. Therefore, the 2 bit one indicates fixed length records; 2 bit zero means variable.

Block DF03: The address of the ACON4 giving the address of the group mark at the end of the I/O area is obtained by subtracting 1 from the address of the next input/output area, F000205. The address of the group mark is placed at C0504011 in the re-execution routine which begins at C0502. The address of the group mark is also placed at C1006 in the CSERR work area.

Block DF04: The maximum length error allowable is found by subtracting 14 from the data memory address (SMAC), E1002.

NOTE: SMAC may be from zero to four memory positions greater than the location of the last character read, or from six to ten memory positions greater than the location of the last character written.

Block DF05: The adjusted data memory address is compared to the address of the group mark at the end of the I/O area. If the adjusted SMAC is greater than the

address of the group mark, the length error is greater than 14.

Block DF06, C0106: If the operation is write, or if the length error of a read operation does not exceed 14, switch E10024 is interrogated to determine if a PCT error was detected in little DTS. The 1 bit zero at E10024 indicates a PCT error; 1 bit one means no PCT error.

Block DF07: As described in block DA19, C1003 is used as a length error retry counter. It is initialized at −1 and therefore counts to 2. (See block DB08 for a description of this counter.)

C1003 is interrogated to determine if the maximum number of two retries of this length error operation has been made. The A bit one at C1003 indicates that the maximum has been reached; A bit zero means that it has not.

Block DF08, C010109: If the maximum number of retries of this length error operation has not been reached, control transfers to C0503 to re-execute the operation. Control then passes to E0109 in the TSA common entry routine to test for errors on the re-execution.

Block DF09, C0111: The beginning address of the input area is obtained from the next input/output area field, F000205, and is saved in C1006, the same location shown in block DF03 to save the address of the group mark for fixed records.

Block DF10: The units position of the tape record format description field, F0005094, is interrogated to determine whether the variable length records are blocked or unblocked. For variable length unblocked data records, the field contains 0001. For variable length blocked data records, the field contains the maximum data tape record length. The units position is compared to the 1 in CASU 07. An equal condition indicates unblocked records; an unequal condition means blocked records.

NOTE: It may appear that a maximum data tape record length ending in 1 results in an unequal condition and thereby indicates unblocked records when the records are blocked. Because variable records must have lengths divisible by 5, the units position can be only 0 or 5.

Block DF11, C0113: If the variable length records are unblocked, the maximum data record length in the data record length field, F0004084, is loaded into CASU 04.

Block DF12: If the variable length records are blocked, the maximum data tape record length in the tape record format description field, F0005094, is loaded into CASU 04.

NOTE: The length of a blocked data tape record is equal to the sum of the data records between inter-record gaps.

Block DF13, C0112: The address of the end of the I/O area is found by adding to the beginning address of the I/O area (saved in C1006) either (a) the maximum data record length, in the case of unblocked records, or (b) the maximum tape record length, in the case of blocked records.

The address of the end of the buffer which follows the I/O area is found by adding 10 to the address of the end of the I/O area. This address is the location of the 4 or 9 position at the end of the buffer area, and is compared to the data memory address (SMAC) which was saved in E1002. If SMAC is greater than the address of the I/O area plus the buffer, the record read exceeded the buffer area and therefore destroyed the buffer.

If the buffer is not destroyed, control transfers to C0106, block DF06. Here, if no channel check has occurred, the read operation is re-executed by IOCS.

If the buffer has been destroyed, this means that the record read is at least 11 characters too long, and therefore has overlaid the beginning of the next I/O area. IOCS does not automatically re-execute the read operation; rather, it gives the operator the option of re-execution or of restarting from the last checkpoint.

Block DF14, C0104: Control links to a subroutine at C0401 to calculate the exact record length. First, however, the address of the input area is placed in message 30219.

The data memory address (SMAC) is placed in CASU 06. The address of the end of the area is determined by subtracting 4 from SMAC if the operation is RD, and 6 if WR. Thus, the adjusted data memory address lies within the last block of characters read or written. Counter C10041 is initialized to −4 to search the last group of characters for a group mark. If the last 5-position block contains fewer than five characters, the group mark which follows the last character to be read or written is searched for. If the last 5-position block contains a full five characters, the group mark searched for is the one which follows the last character in the block; i.e., the group mark at the beginning of the buffer.

When the group mark is found, a TRE at C0404+5 effects a transfer to C0406 where the address of the I/O area is subtracted from the address of the group mark to obtain the exact length of the record. The computed record length is placed in the message area at C0023.

Block DF15: Message 30219-xy-zzzzzz-nnnnnn is written. The tape is xy; the input area is zzzzzz; the calculated record length is nnnnnn. The message indicates that a read operation has exceeded the input area by 11 or more characters, and has therefore destroyed the buffer following the area. The operator has the option of re-executing the read operation (interrupt

key 253) or of restarting from the last checkpoint (interrupt key 252).

Block DF16, C010801: If the maximum number of retries has not been reached, control links to C0601 where the automatic dump indicator, F0005063, is interrogated to determine if the automatic dumping of error records is specified. The 2 bit zero at F0005063 indicates automatic dumping; 2 bit one means no automatic dumping.

If automatic dumping is specified, control passes to C0601 where the error record is dumped and a new record is read to replace it.

Block DF17: If no automatic dumping is specified, control links to C0401 to compute the exact record length (block DF14).

Block DF18: Message 30214/5-xy-zzzzzz-nnnnnn is written. The tape is xy; the location of I/O area is zzzzzz; the exact length of the record is nnnnnn.

Message 30214 indicates that three unsuccessful attempts have been made to write the record, but a length error persists. Message 30215 indicates that three unsuccessful attempts have been made to read the record, but a length error persists.

The operator has two options: pressing interrupt key 252 transfers control to C031101 where the operation is re-executed; pressing interrupt key 253 returns control to C0317 (Chart DC, connector 6) where message 30222/3 is written.

NOTE: Message 30222/3, preceded by message 30214/5, gives the operator an additional option of accepting the record as read or written and continuing processing, or of restarting (if WR) or dumping the error record (if RD). This combination of messages does not mean that 100 read retries or 25 skip-rewrites have occurred.

DA

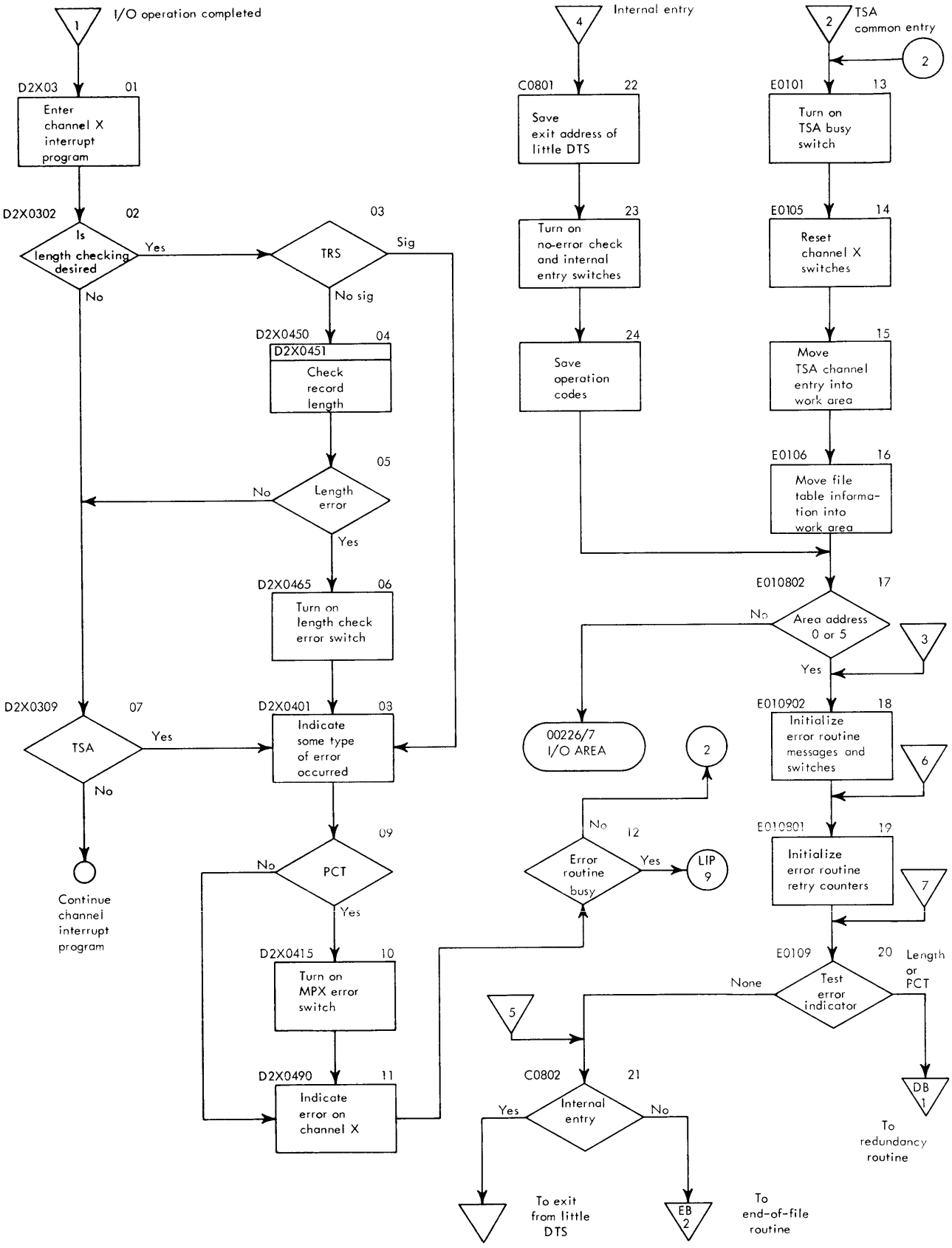


Chart DA. Relationship Between the DTS and the Error Routine

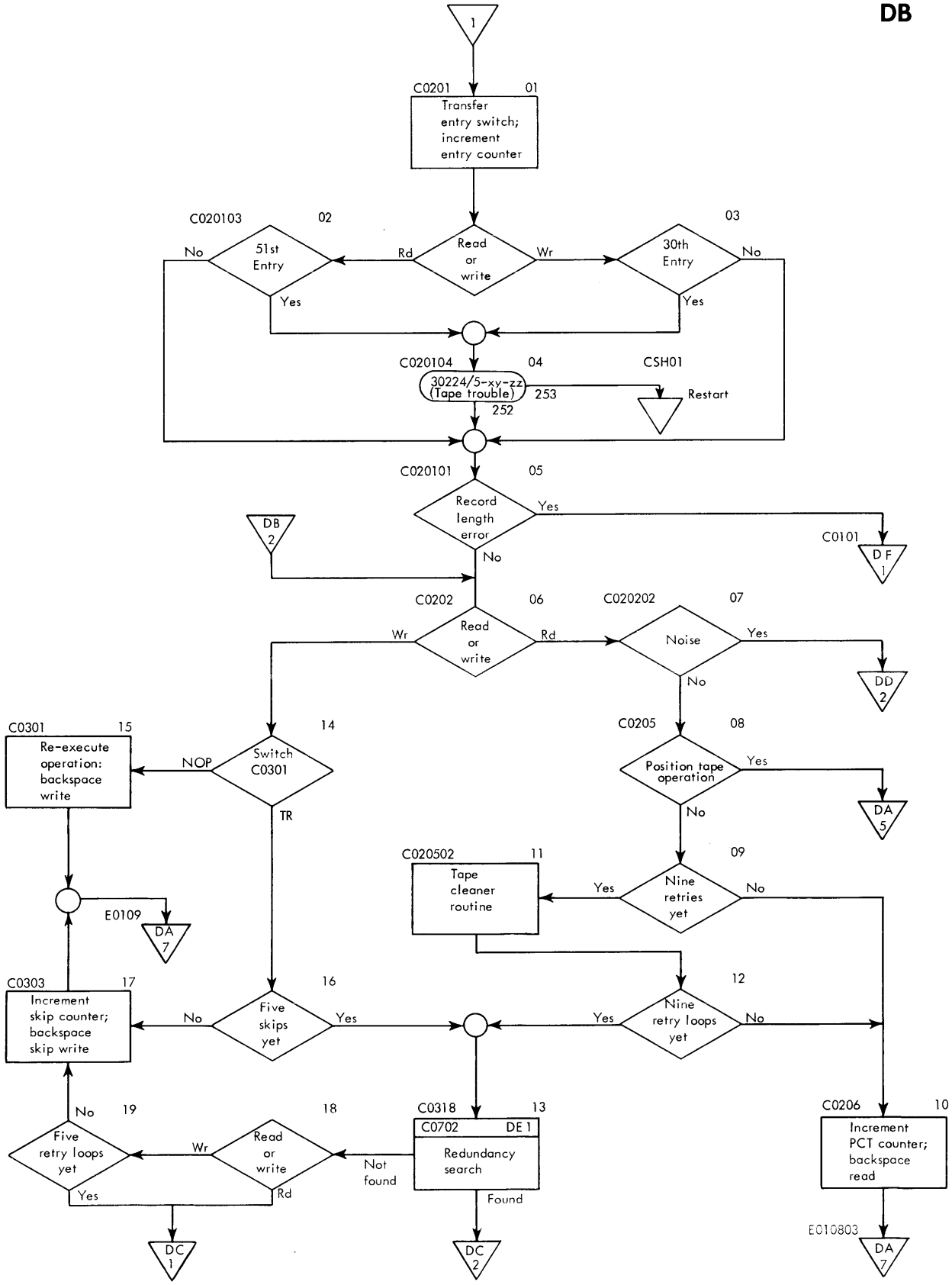


Chart DB. Redundancy Routine, Part 1

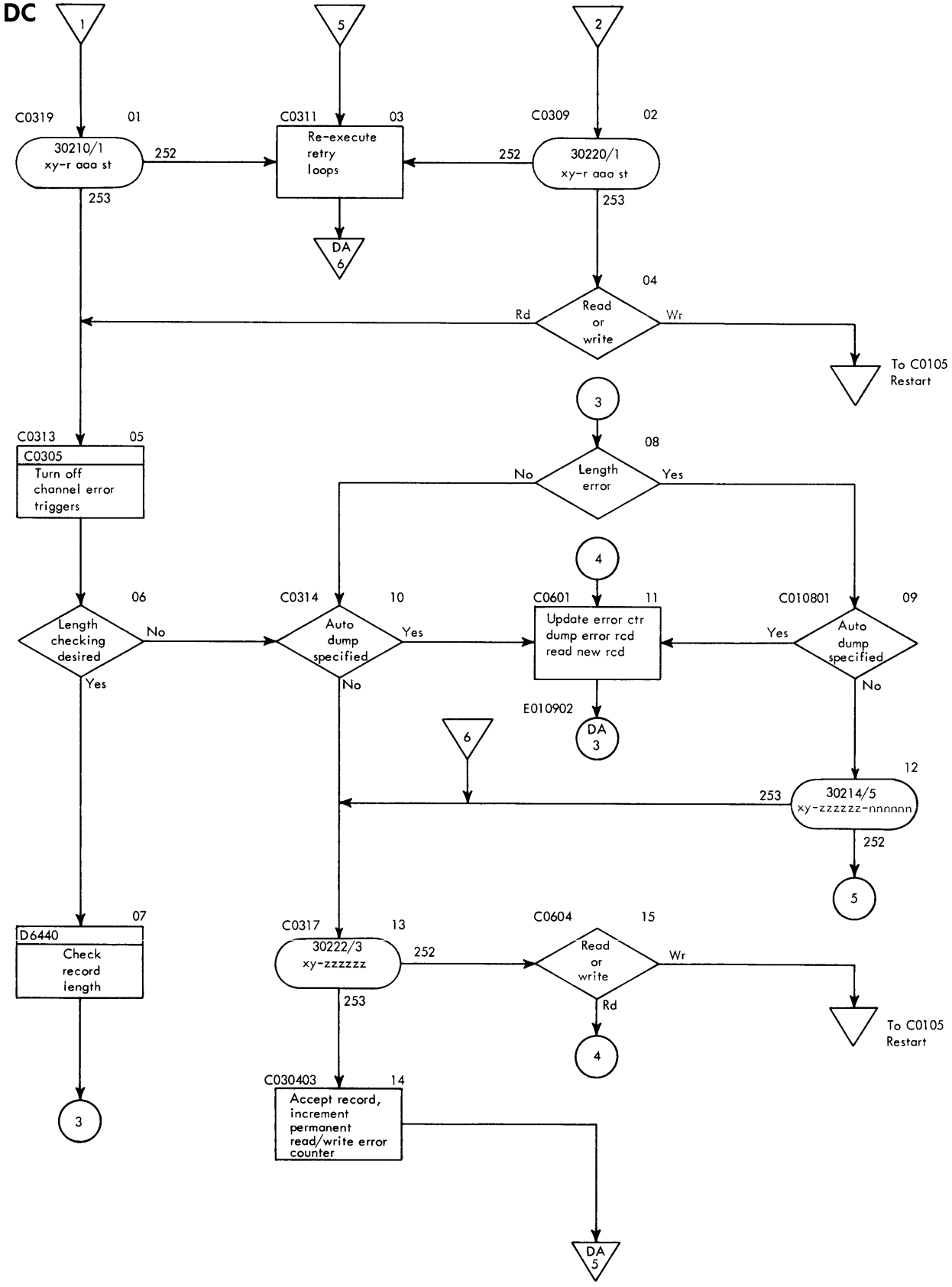


Chart DC. Redundancy Routine, Part 2

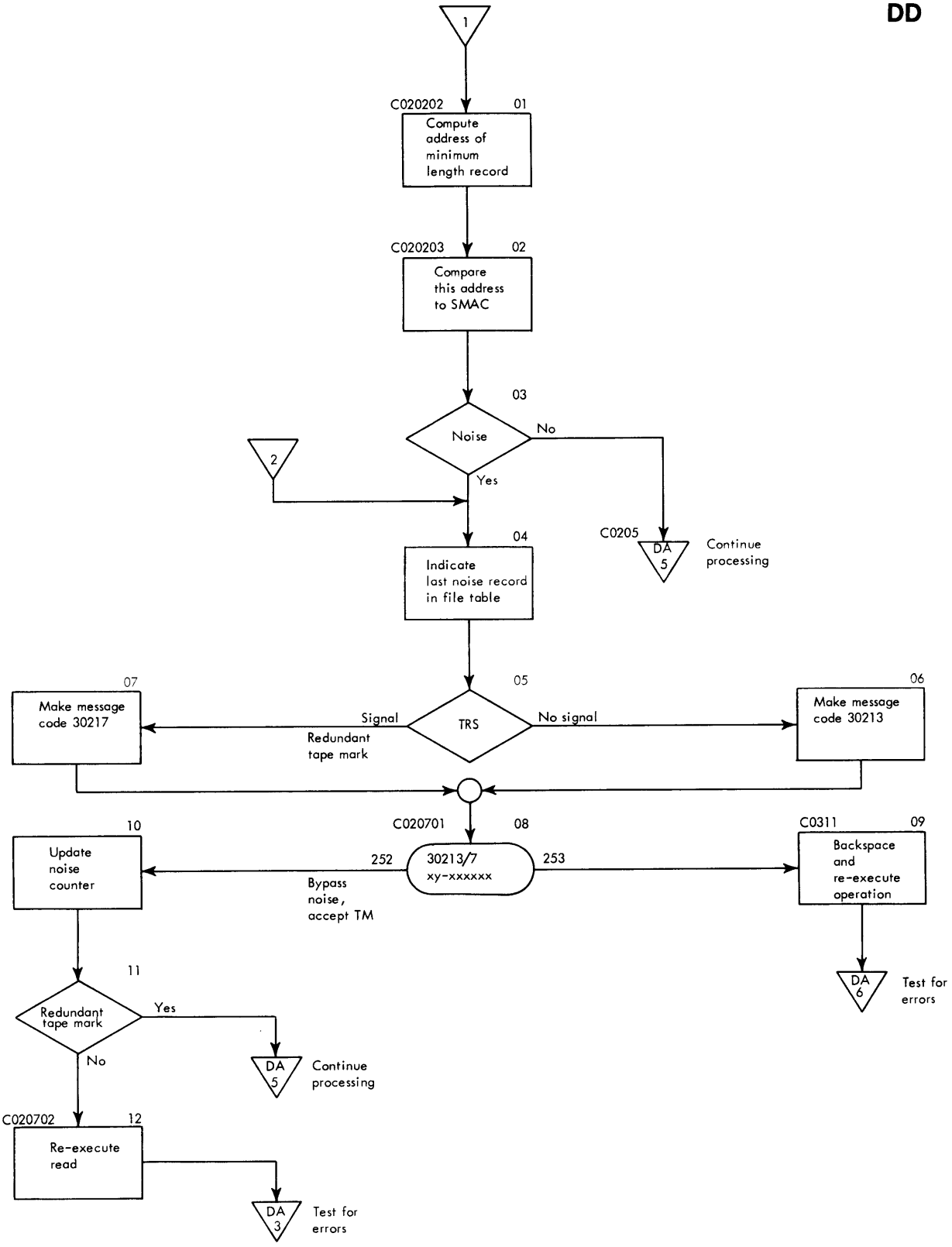


Chart DD. Noise Routine

DE

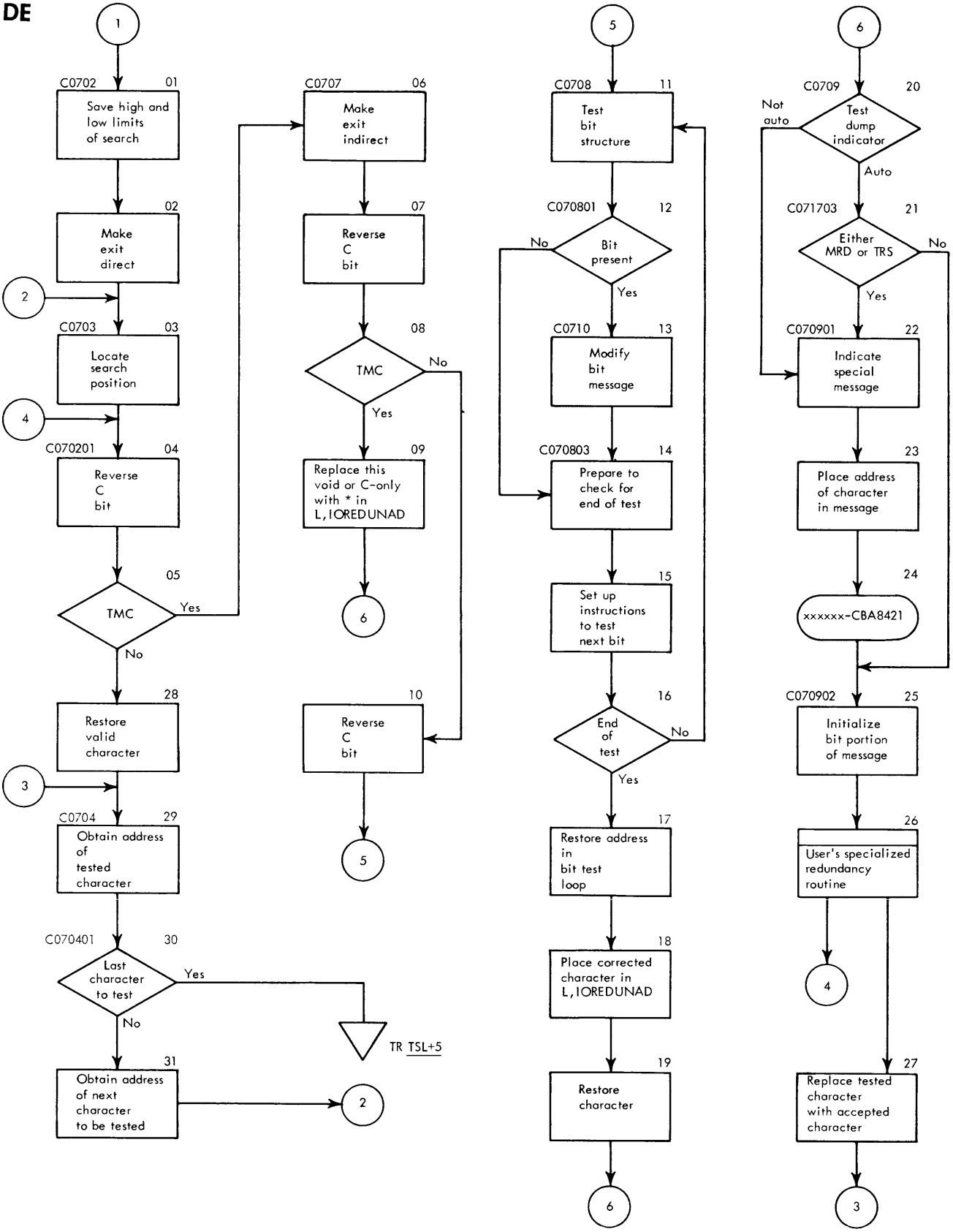


Chart DE. Redundancy Search Routine

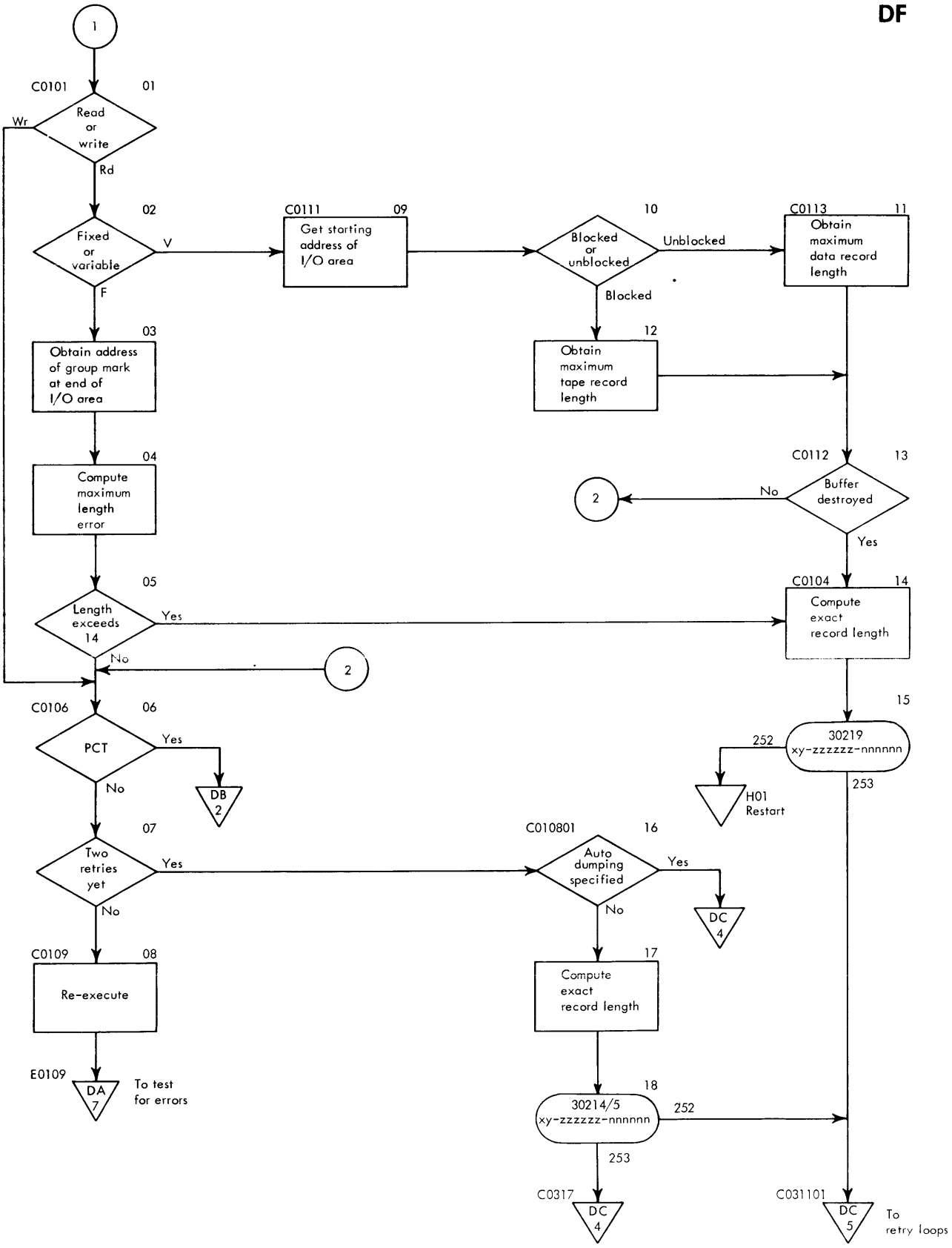


Chart DF. Record Length Error Routine

End of File and End of Reel (CSEOF)

The CSEOF routine performs operations necessary when a tape mark is encountered in reading data tape records or when a reflective spot is sensed in writing data tape records. When a channel error and/or an end-of-file or end-of-reel condition is encountered by CSDTS in the reading or writing of tape records, control links to CSERR. If no error occurred, or if an error has been corrected and end of file has occurred, CSERR transfers control to CSEOF.

CSEOF also performs operations necessary as a part of special end-of-file functions requested by the following macro-instructions: IOCLS (close a tape file), IOFER (force end of reel), IOMFC (multifile close), IOMFO (multifile open), IORWD (rewind), and IORUN (rewind and unload).

Chart EA shows the general flow of EOF/EOR process- and is not accompanied by description. Input EOF/EOR processing begins on Chart EB; processing common to both input and output is shown on Charts EC and ED; output EOF/EOR processing begins on Chart EE. Charts EF, EG, and EH show supporting subroutines.

EOF/EOR, Part 1

Block EB01, C0802: As shown on Chart DA, C0802 is the no-error exit from the TSA common entry routine to the end-of-file and end-of-reel routine.

If the I/O indicator of the selected tape is off, two of the three TSA switches are reset by unloading a G into E1100 and a C into E1101. Note that the 1 bit of E1100 is left in one status to indicate a force output end-of-reel operation; that is, an end-of-reel condition with the I/O indicator off must mean an FER operation.

After the TSA switches are reset, the prime switch, E10024, is interrogated to determine if priming is necessary as a result of the special operation. The 4 bit zero at E10024 indicates priming after the special operation; 4 bit one means no priming.

Macro operation codes of special operations that do not involve priming contain a 4 bit in one status. Thus, a test of the 4 bit of E10014 determines if a special operation end-of-file condition exists. The 4 bit one at E10014 indicates a special operation EOR; 4 bit zero means no special operation EOR.

If an end-of-file condition is forced because of a special operation, the operation code of E1005 is set to TR to allow a return to DTS at the force-counter-not-zero entry point. If the special operation is force output end of reel, control passes to E0207, (block EB02).

If the special operation is either rewind or rewind and unload, the A bit of switch E1101 is set to zero. The scheduler transfer address is stepped down 10; this is indicated by setting the A bit of F0002034 to zero. If the operation is rewind, control transfers to E0604 where the tape is rewound (block ED11). If the operation is rewind and unload, control passes to E0603 where the tape is rewound and unloaded (block ED11).

If the special operation is neither FER, RWD, or RUN, the operation is a close, and this is indicated by setting the A bit of switch E1100 to zero. If the operation is either a multifile close or a multifile open, control transfers to E020102. The 4 bit of E1100 is set zero to indicate a multifile close; the 2 bit of E1100 is set zero to indicate a multifile open. Control then passes to E0207 (block EB02).

The only remaining special operation is close. The scheduler transfer address is stepped down 10; this is indicated by setting the A bit of F0002034 to zero. Control then passes to E0207 (block EB02).

If no special operation EOF is involved, control passes to E0210. Here, if a single-channel restart is indicated, the operation code at E1005 is made TR to set up a force-counter-not-zero transfer back to DTS. Then, control transfers to E0623 where the file table is restored and the program continues to DTS to start another operation on this channel. Thus, if the I/O indicator is off, the EOF/EOR routine is bypassed.

Block EB02, E0206: If the I/O indicator of the selected tape is on, the two TSA switches mentioned in block EB01 are reset by unloading an F into E1100 and a C into E1101. At E0207, the I/O indicator is turned off and switch E060903 is set NOP.

Position E0011023 in the EOF message area is initialized to F to indicate an end-of-file condition. Later, if an end-of-reel condition is found, this position is changed to R.

If the EOR occurs on the message tape (A bit one at F0005063), the 1 bit of S0050041 is set to zero to cause further messages to appear on the console typewriter rather than on the message tape.

The file count found in F0003032 is placed in the EOF message area at E001102. The status code position in the file table work area is tested to determine whether the EOF condition occurred on an input or an output tape. The 1 bit zero at F0002034 indicates input; 1 bit one means output.

Block EB03, E0401: The A bit zero at E1100 indi-

cates a close operation. Note that the A bit is set to one by the unloading of an F into E1100 in block EB02. A close operation sets the A bit at C0802 to zero as part of the interrogation of the special operation codes.

Block EB04, E0423: If the operation is close, control transfers to E0423 where the A bit of E1101 is set zero to allow the typing of tape closed messages 10230 and 10232 at E060502 in Chart ED.

The following counters are placed in the message area beginning at C0062: data tape record counter (F0003022), error correction entry counter (F000303), noise/skip counter (F000302), and the permanent error counter (F0003043). Control transfers to Chart ED, connector 4.

Block EB05: Any non-close operation is indicated by an A bit one at E1100. The program tests the EOR mode of handling. (Mode 1 means an immediate transfer to the specialized EOR routine; mode 2 means that all I/O areas are processed before the transfer to the specialized EOR routine.) The A bit one at F0004034 indicates mode 1; A bit zero means mode 2.

Block EB06: F0004031 is the tens position of the end-of-file transfer address, F0004034. The A bit at F0004031 is variously used by the EOF routine as a bit switch to indicate either label checked, I/O indicator on, or force counter not zero.

At this time, the A bit zero at F0004031 indicates that a force-counter-zero condition is not awaited, so control passes to block EB11 and then to the label checking routine.

Block EB07: The A bit one at F0004031 indicates that a force-counter-zero condition is awaited. The 1 bit of E1101 is set zero to indicate that the tape is properly positioned (after the tape mark).

Block EB08, E040101: Bit switch E10012 is used to indicate force counter zero, or the assuming of force counter zero. At E040101, control links to a subroutine (blocks EB08 through EB10) to determine the status of the switch.

The subroutine is shown as three blocks because of the additional entries at blocks EB09 and EB10. The subroutine has two exits: to E0414 and to TSL+5.

NOTE: This subroutine is also used at three other points in IOCS: blocks EC08, EC27, and EC28. The A bit of switch E10012 is set to one to indicate force counter zero in block EB22; the A bit is set to zero to indicate force counter not zero in block BC03.

The A bit zero at E10012 is the force counter not-zero or not-assumed zero condition; control passes to block EB18 where the force counter is tested. The A bit one at E10012 is the force counter zero or assumed-zero condition; control passes from block EB10 to the TSL+5 of the original linkage.

Block EB09, E0412: If the force counter is zero or assumed zero, the operation code of the instruction at E1004 is made TR, thus activating the exit to the DTS transfer address for force counter zero.

Block EB10: The A bit of F0004031 is set to zero to indicate that the label has not been checked. (See block EB06 for other uses of this bit switch.)

Block EB11, E040103: The counter-zero exit from the subroutine is to the TSL+5 of the linkage to it. Thus, at E040103, the 8 bit of the operation code at E10014 is tested to determine if the operation is search file. The 8 bit one indicates a search file operation; 8 bit zero means a non-search file operation.

Block EB12: Before the tape can be properly positioned, the operation code (E10014) is tested to determine if the operation is BSF. The A bit one at E10014 means BSF; A bit zero means not BSF.

If the operation is BSF, the file counter is decreased by 1. If a tape mark follows the header (1 bit one at F0004014), two backspaces are performed at D6034 in little DTS to position the tape.

Block EB13, E040102: During a tape operation, F000205 contains the address of the I/O area currently in use. The address is saved at E1007 in the TSA channel entry work area because a label read-in area address is put in F000205 by the label-checking routine.

Block EB14: If a trailer label is specified, the 4 bit of F0004014 is one. The program proceeds to read and check the label. If no trailer is specified, the 4 bit of F0004014 is zero and control transfers to the end-of-reel transfer address.

Block EB15, E0402: If a trailer is specified, the A bit of F0004031 is set to one to indicate that the label has been checked. The check is then made, as shown on Chart EF.

Block EB16: The subroutine exit is direct to the TSL+5 if the length is correct, and indirect if the length is incorrect.

Block EB17: The address of the I/O area, saved at E1007 in block EB13, is restored to the file table work area.

Block EB18, E0414: If, in block EB08, it is determined that the force counter is not to be assumed zero, the force counter is tested. The B bit zero at F0002032 indicates that the counter has gone from ASU 15 zoning to zero zoning; B bit one means that the force counter is not zero.

Block EB19, E0415: If the force counter is zero, control transfers to E0415 where the status code field, F0002034, is examined to determine if get/put is used. The 4 bit one means that get/put is used; 4 bit zero means that get/put is not used.

Block EB20: F000201 is the address of the pivot point to the get/put routine address and is regarded as a switch. If the switch is set to NOP, the entire record

has been deblocked. If the switch is set to TR, the record has not been deblocked. A TZB on the A bit determines whether the tested character is 1 or A.

Block EB21: If the entire record has been deblocked, the get/put switch is set TR by an indirect SGN instruction.

Block EB22: The A bit of E10012 is set to one to indicate that the force counter is zero.

Block EB23, E0416: If get/put is used, and the entire record is not deblocked, the get/put switch is set NOP by indirectly unloading an A into F000201.

Block EB24: The operation code of the exit pivot is made TR, thus activating the DTS transfer address for force counter zero (E1004).

Block EB25, E0441: The A bit one at F0004034 indicates that mode 1 EOR is specified; A bit zero means mode 2.

Block EB26: The 1 bit zero at E1101 indicates that the tape is positioned properly after the first tape mark. The 1 bit one means that it is not, so a backspace is executed in little DTS.

Block EB27, E04410: The tape is selected by an indirect select of F000203, and the I/O indicator is turned on.

Block EB28: The DTS transfer address for force counter not zero (E1005) is set up by making the operation code TR.

Block EB29: A priming end-of-file condition occurs when a tape mark is read during the input area priming. The 2 bit zero at W0020 indicates that the priming routine is busy; if it is interrogated during the EOF routine, 2 bit zero means that the EOF occurred during priming, and control passes back to the priming routine.

Block EB30, E0623: The 1 bit zero at W0020 indicates that the end-of-reel condition occurred on the checkpoint tape. Control transfers to the checkpoint routine.

If the EOR did not occur on the checkpoint tape, the 1 bit of S00050041 is set to one to allow messages to be written on the checkpoint tape if it also served as the message tape. Control passes to Chart ED, connector 2.

EOF/EOR, Part 2

Block EC01, E0402: If the first five characters of the trailer found at B0001 in the label work area are equal to 1□□□□b, the trailer is standard.

A 2 bit zero at F0004014 means that a standard trailer is not specified. Because it follows the 5-character comparison just mentioned, this test determines whether a nonstandard trailer is specified. Thus, 2 bit zero indicates a nonstandard trailer. If the trailer type is neither standard nor nonstandard, there is no trailer.

Block EC02, E0502: The 4 bit at F0004014 is tested to determine whether standard trailers are specified; the 4 bit zero means yes and the 4 bit one means no.

Block EC03: An end-of-file trailer contains an F in the sixth position; an end-of-reel trailer contains an R. If the trailer is EOR, an indirect TSL to the end-of-reel transfer address in the file table work area (F000402) is an effective transfer to the first instruction of the user's specialized end-of-reel routine.

Block EC04, E050202: The 2 bit of E1101 is set to zero to indicate that an end-of-file trailer is found.

Block EC05: A general discussion of the use of the EOR transfer address may be found under "Specialized Routines."

Block EC06: A return to IOCS at IORETURNTO results in a direct transfer to the ADCON following the linkage to the specialized routine. Then a subroutine follows which checks the number of records read against the number of records in the file. (This subroutine is described in blocks EC09-EC14.)

Block EC07, E0601: The end-of-reel message is set up by replacing the F (block EB02) with an R and by placing the reel sequence number found in F0005032 in the message. The program then continues to Chart ED, entry point 4 to execute the IOCS end-of-reel routines.

Block EC08, E0503: A re-entry at IORETURNNO results in an indirect transfer to the ADCON following the linkage to the routine. Eventually, control passes to the EOF specialized routines. At E0503, control links to a subroutine to test the condition of the force counter (see blocks EB08-EB10). The counter-zero exit from this subroutine is to TSL+5; the not-zero exit is to E0414 (block EB18).

Block EC09, E0550: The program links to a subroutine shown in blocks EB09-EB14. The purpose is to determine if the number of records read are equal to the number of records contained in the file, as reflected in the data tape record counter (F0003022). The exit when the counts are equal is to TSL+5; when the counts are unequal, to message 30227.

At E0550, the label indicator, F0004014, is tested to determine if standard labels are specified. The 2 bit one indicates that a standard trailer is used; B bit zero means that a standard header is used.

Block EC10, E05502: If both a standard header and a standard trailer are specified, the condition of switch W13 is tested to determine if the label length is correct. The A bit one of W13 indicates that the label is missing or is of incorrect length; A bit zero indicates a valid label.

Block EC11, E0553: If the label is valid, control passes to E0553 where the current operation code is tested to determine if it is a search file operation. The 8 bit one at E10014 indicates a search file operation;

8 bit zero means a nonsearch file operation. (See the Macro Operation Codes in the "Programming Condition Analysis Aids" section.)

Block EC12, E0554: If the current operation is not a search file operation, control transfers to E0554 where the data tape record count in the file table is compared to the record count in the label work area at B0023 (positions 7 through 12 of the trailer).

Block EC13: If the counts do not agree (block EC12), message 30227-xy-zzzzzz yyyyyy is written. The tape is xy; the label tape record count is zzzzzz, and the file table tape record count is yyyyyy. The operator has the option of restarting (253) from the last checkpoint or of continuing (252) the IOCS end-of-reel processing.

Block EC14, E05501: If interrupt key 252 is pressed, or if the tape record counts agree, the following counters are placed in the statistics message area: data tape record counter (F0003022), error correction entry counter (F000303), noise/skip counter (F000302), and the permanent error counter (F0003043). Control then exits from the record counts checking subroutine to block EC15, the TSL+5 of the originating linkage at E05034+10, block EC08.

Block EC15: The file type field, F0004034, is tested to determine whether the file is on a single-file or a multifile tape. The 1 bit zero indicates multifile; 1 bit one means single-file. If the file is located on a single-file tape, control transfers immediately to the specialized end-of-file routine.

Block EC16, E0504: If the file is located on a multifile tape, the IOCS operation code is tested to determine if the operation is a file identification operation. If the 8 bit is one and the B bit is zero at E10014, a file identification operation is indicated.

Block EC17, E050421: The label indicator, F0004014, is tested to determine if a standard trailer is used. The 2 bit one indicates that a standard trailer is used; 2 bit zero means that it is not. If a standard trailer is not used, control passes immediately to the user's specialized header routine.

Block EC18: If a standard trailer is used, a test is made to determine whether the label is an intermediate header or an end-of-file trailer. The 2 bit zero at E1101 indicates trailer; 2 bit one means header.

If the label is neither an end-of-file trailer nor an end-of-reel trailer (blocks EC03 and EC05), the label is an intermediate header serving as a trailer for the preceding file. Control passes immediately to the specialized header routine.

Block EC19, E0403: If no trailer is used, the file type code field, F0004034, is tested to determine whether the file is located on a single-file tape or on a multifile tape. The 1 bit one at F0004034 indicates single-file; 1 bit zero means multifile.

Block EC20: If the tape is multifile, control transfers to E0420 where the label indicator is tested to determine whether a standard header, a nonstandard header, or no header, is specified. The B bit zero at F0004014 indicates a standard header is used; B bit one means a standard header is not used. The A bit zero indicates no header is used; A bit one means some type of header is used. A nonstandard header is specified if both the A and the B bits are one.

Block EC21, E0422: If a standard header is specified, the first five positions of the label are compared to 1***b to determine if the header found is a standard data header. If it is, control transfers to the E0503 (block EC08), and eventually to the specialized header routine.

Block EC22: If the standard header found is not a standard data header, the first five positions of the header are compared to 10064 to determine if the header found is a standard program header. If it is, control transfers to E0503 (block EC08), and eventually to the specialized header routine.

Block EC23: If a nonstandard header is specified, switch W13 is tested to determine whether the label is missing or is of improper length. The A bit zero at W13 indicates that the label length is correct, and control passes to the specialized end-of-file routine; A bit one means that the label is invalid. Thus, when standard trailers and nonstandard headers are specified, and a nonstandard header is read, control passes eventually either to DTS if the force counter is not zero, to the file identification routine if the operation is search file, or to the specialized header routine.

Block EC24, E0403: If no trailer is found on a single-file tape, and one is specified, the A bit of W13 is set to one to indicate a missing label.

Block EC25, E0406: If labels are specified, and a trailer is missing on a single-file tape, or the intermediate header on a multifile tape is either missing or of improper length, a loop-message is typed alerting the operator and giving him control over further end-of-file or end-of-reel processing. First, it must be determined whether the file is located on a single-file tape or on a multifile tape. The 1 bit one at F0004034 (file type code) indicates single-file; tape 1 bit zero means multifile.

Block EC26: Message 30293-xx-L indicates that the record following a tape mark on single-file input tape 2x0y is not a valid trailer; that is, the trailer is either missing or of incorrect length. If interrupt key 252 is pressed, control transfers directly to ADCON E0404 of the message format, followed by a transfer to the specialized end-of-reel routine.

Block EC27, E0404: If interrupt key 253 is pressed, control transfers indirectly to ADCON E0404 where link-

age is made to a subroutine to test force counter zero (see blocks EB08-EB10). If a not-zero condition is found, control transfers to Chart EB, connector 2. If a zero condition is found, control transfers immediately to the specialized end-of-file routine.

Block EC28: If a single-file trailer is either missing or of incorrect length, control enters the force counter subroutine mentioned in blocks EB08-EB10. If a not-zero condition is found, control transfers to Chart EB, connector 2.

Block EC29: If the force counter zero condition is found, message 30295-xy-L is typed to indicate that the record following the tape mark is not a valid trailer.

If interrupt key 252 is pressed, control transfers directly to the second ADCON of the record format. Control then passes to block EC16.

If interrupt key 253 is pressed, control transfers indirectly to the second ADCON of the record format, or effectively to the specialized end-of-file routine.

EOF/EOR, Part 3

Block ED01, E050301: The use of the end-of-file transfer address is discussed under "Specialized Routines" in the Programming Condition Analysis Aids section of this manual.

File table field F000403 contains the address of the first instruction of the specialized end-of-file routine. A RCVS W005+1 and an indirect TSL to F000403 transfers control to the routine.

If the re-entry is at IORETURNNO, control transfers indirectly to ADCON E0406, resulting in an effective transfer to E0406 (Chart EC, connector 6). If the re-entry is at IORETURNTO, control transfers directly to ADCON E0406.

Block ED02: The 8 bit one at E10014, the current IOCS operation code, indicates a space file operation; 8 bit zero means the operation is other than space file.

Block ED03, E050304: The file type code field, F0004034, is interrogated to determine whether sequential or nonsequential handling is specified. The type of handling determines the positioning of the tape when an end-of-file condition occurs. The 2 bit one at F0004034 indicates sequential handling; 2 bit zero means nonsequential handling.

Block ED04, E050504: The label indicator, F0004014, is interrogated to determine if a trailer is specified. The 4 bit one at F0004014 indicates a trailer is used; 4 bit zero means no trailer.

Block ED05, E050506: If a trailer is used, a backspace operation is executed in little DTS.

Block ED06, E050505: Control enters little DTS to backspace the tape once more. This positions the tape before the tape mark that caused the end-of-file condition.

Block ED07, E0609: Output end-of-file message 10230 is followed by statistics message 10232; input end-of-file message 10231 is followed by statistics message 10233. The variations of these messages follow:

1. Message 10230-xy-F,nnn means that file nnn of output tape 2x0y has been closed.
2. Message 10230-xy-R,nnn means that 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.
3. Message 10230-xy-C,nnn means that an IORWD or IORUN has been executed on output tape 2x0y. The file count is nnn.
4. Message 10231-xy-F,nnn means that an end of file has occurred on file nnn of input tape 2x0y.
5. Message 10231-xy-R,nnn means that 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.
6. Message 10231-xy-C,nnn means that an IORWD, IORUN, or IOCLS operation has been executed on input tape 2x0y. The file count is nnn.
7. Message 10232-xy-zzzzzz rr ss ee means that rr redundancies, ss skips, and ee permanent write errors have occurred on output tape reel 2x0y. The tape record counter is zzzzzz.
8. Message 10233-xy-zzzzzz rr nn ee means that rr redundancies, nn noise records, and ee permanent read errors have occurred on input tape reel 2x0y. The tape record counter is zzzzzz.

Block ED08, E060904: The end-of-file condition is indicated to the get/put routine by setting the 4 bit of F0002024 to zero.

If a checkpoint tape is specified, E0002 is initialized in housekeeping with a period (TZB operation code); if no checkpoint tape is specified, E0002 is initialized with a 1 (TR). The operation code at E0002 is unloaded into E0011012 (block ED18). Thus, the instruction at E0011012 becomes either TR 03 E1004 or TZB 03 E1004. The former returns control to DTS; the latter interrogates the checkpoint indicator (4 bit of F0004024), and transfers control to the checkpoint routine if checkpoint is specified.

Switch E060903 is set to NOP during end-of-file initialization at E0206, block EB02. It is set to TR in block ED31. If switch E060903 is NOP, control bypasses single file tape priming; if TR, the switch allows multifile tape priming. The priming routine is described in Chart EG.

Block ED09, E0623: If an end of reel occurs on the checkpoint tape, the MRD entry switch is reset by setting the 1 bit at W0020 to one; control transfers to the checkpoint routine to write the checkpoint message.

At E0623, if there is no checkpoint end of reel, the

updated work file table is moved back to its original location in the main program file table area. This is done at B02155 where an indirect RCV at F000202 addresses the main program location of the file table. A TMT from F000101 moves the entire fixed section of the file table work area (sections 1, 3, 4 and 5) to that location. Then, a SND 03 puts the first three words of the DTS section of the file table immediately after the fixed section. Thus, that part of the main program file table which was moved into the file table work area during the TSA common entry routine (block DA16) is updated and returned to its location in the main program.

Block ED10, E050305: In block ED02, if the IOCS operation is a space file, the A bit of F000203 (select address units position) is set to zero. This updates the file table work area to indicate that the space file operation for this file is completed. Also, G is unloaded into D007401 to indicate that the space file operation for this file is no longer in progress.

The channel scheduler transfer address is stepped down 10. As seen in a typical read-write request entry (D2001), this means that an open operation (B01) is performed when the next entry is made to DTS for an input/output operation on this file.

The A bit of F0002034 is set zero to indicate that the scheduler transfer address has been modified to effect the open operation.

Block ED11, E06011: The tape is rewound or rewound and unloaded depending on the status of the 4 bit at F0004034. Bit zero indicates rewind; bit one means rewind and unload. The following file table counters are set to zero: noise/skip counter (F000302), file count per reel (F0003032), error correction entry counter (F000303), and the permanent read/write error counter (F0003043).

Block ED12, E060503: The 4 bit of E1101 is set to one to indicate that end-of-file processing on the file is complete.

Block ED13: The character at E0011023-1 in the message area is initialized to F (block EB02); if the tape is at end of reel, the character is changed to R. Thus, F indicates end of file; R means end of reel.

Block ED14: See block ED07.

Block ED15: The operation code of the instruction at E0011011 is changed from TR to TZB to provide for a later test for checkpoint at end of reel (see block ED19). Then, control links to a housekeeping subroutine at A1501 to alternate tapes and prime input areas according to file table specifications. Chart EG describes this subroutine.

Because switch E060501 is set to NOP (block EE02) at output end of reel, control returns from the priming subroutine to E060501+5 where the data tape record counter, F0003022, is set to −1. (Later in DTS, the counter is increased by 1, thus effectively setting the counter to zero.)

Block ED16, E0624: As noted in blocks DA11 and DA12, a waiting TSA condition on a channel is indicated by a zero setting of the 1, 2, 4, or A bit of error switch D004001. Thus, at E0624, if this switch is compared to a G, an equal condition indicates no TSA entries are awaiting handling by the error routines; an unequal condition means at least one entry is waiting.

Block ED17: Switch D994822 is changed from a LIP 9 operation code to a CNO to allow the subsequent transfer to E0101 (the TSA common entry routine) where the waiting error channel is serviced.

Block ED18, C011001: If no other error conditions await handling, the TSA busy switch is turned off by setting the A bit of W0020 to one. A test is made to determine if end-of-reel processing is completed. The 4 bit one at E1101 indicates that EOR processing is complete (block ED12); 4 bit zero means that it is not. If additional records are to be processed, control transfers to DTS at E1004 to continue processing.

Block ED19, E0011011: As noted in block ED15, the operation code at E0011011 is a TZB on the 2 bit of F0004024, the checkpoint indicator in the file table work area. The 2 bit one indicates that an end-of-reel checkpoint is desired; 2 bit zero means that it is not. If a checkpoint is specified, a transfer is effected to the checkpoint routine at G01. If checkpoint is not specified, a return is made to DTS to continue processing.

Block ED20, E050401: A general discussion of the use of the header transfer address may be found under "Specialized Routines." File table field F000401 contains the address of the first instruction of the user's specialized beginning-of-reel and beginning-of-intermediate-file routine. A RCVS W005+1 and an indirect TSL to F000401 transfers control to this specialized routine.

Block ED21, E0513: If the return from the specialized header routine is at IORETURNNO, an indirect transfer is made to ADCON E0513 where the label indicator field (F0004014) of the file table work area is interrogated to determine if a standard trailer is used. A 2 bit one at F0004014 indicates that a standard trailer is used; 2 bit zero means that a standard trailer is not used.

If a standard trailer is not specified, control returns immediately to the specialized end-of-file routine in block ED01.

Block ED22, E055201: If a standard trailer is used, the file type code field (F0004034) in the file table work area is interrogated to determine whether the file is handled sequentially or non-sequentially. A 2 bit one

at F0004034 indicates sequential handling; 2 bit zero means that non-sequential handling is specified.

Block ED23, E0514: If non-sequential handling is specified, the tape is positioned immediately preceding the tape mark which caused the end-of-file condition. The type of positioning to be done depends on whether a header is present. The missing label switch, W13, is interrogated to determine if a header is present. The A bit zero at W13 indicates that a header is present; A bit one means that the label is missing.

Block ED24, E050506: If a header is present, control passes to E050506 where a linkage is made to D6034 in little DTS to backspace over the label.

Block ED25, E050505: An additional linkage is made to D6034 in little DTS to backspace over the tape mark. Control then passes to block ED07 to write the end-of-file messages.

Block ED26: Referring to block ED20, if the return from the specialized header routine is at IORETURNTO, control transfers directly to ADCON E0513. The IOCS operation code saved at E10014 is tested to determine if the operation was a space file operation. The 8 bit one at E10014 indicates a space file operation; 8 bit zero means a non-space file operation. If the IOCS operation was not a space file operation, control passes to block ED22.

Block ED27, E050407: If the IOCS operation was a space file operation, the A bit of F000203 (select address) is set to zero to indicate that the space file operation is complete.

L,D007401 is used as the space file operation switch. If either the A, 1, 2, or 4 bit is zero, it indicates to other IOCS routines that a space file operation is in progress. If a G is unloaded into L,D007401, these bits are set to zero status; thus, the switch is reset off. The 8 bit at E10014 (IOCS operation code) is set to zero, making it a non-search file operation code.

Block ED28, E050409: The tape is now positioned by a subroutine beginning at E0510 and ending at B99+1.

At E0510, the label indicator field (F0004014) of the file table work area is interrogated to determine if a header is specified for the file. The A bit one at F0004014 indicates that a header is used; A bit zero means no header is used.

If a header is indicated, W13 is interrogated to determine if a valid label has been found or if the label is missing. The A bit zero at W13 indicates that a valid label has been found; A bit one means that the label is missing. If a valid label has been found, control transfers to B0209 to open the next file.

At E0511, if no header is specified, or if a specified header is missing, control links to D6034 in little DTS to execute a backspace. This positions the tape after the tape mark that caused the end-of-file condition. Control passes to B0209 to open the next file. At B0209, the label indicator field, F0004014, is interrogated to determine if a tape mark follows the specified header. The 1 bit one at F0004014 indicates that a tape mark follows the header; 1 bit zero means that it does not.

If the label indicator shows that a tape mark should follow the header, the B bit of F0002052 is set one to allow error checking in DTS. Control links to D6011 in little DTS to execute a forward space operation. If a tape mark does follow the header, the I/O indicator comes on. If the I/O indicator is on, a TRS effects a transfer to B0210 where the I/O indicator is turned off. The tape is now positioned after the tape mark which follows the header label.

If the file table specifies that a tape mark is to follow the header, and the tape mark is missing, control links to D6034 in little DTS to backspace the tape. The tape is now positioned after the header label.

Message 10291 is written to inform the operator that the tape mark specified to follow the header is missing. The record following the header is treated as a data record.

Block ED29: At B0205, the file count per reel, F0003032, is interrogated. File count zero indicates that the tape is at load point, and the checkpoint indicator field, F0004024, is checked to determine if the file contains checkpoint records. The 1 bit one indicates that the file contains checkpoint; 1 bit zero means that it does not.

If the file contains checkpoint, the B bit of F0002052 is set to one to allow error checking in DTS. Control links to D6011 in little DTS to forward space the tape. Forward spacing continues over the individual parts of the checkpoint record until the first tape mark is reached. At that time, a TRS executes a transfer to B0208 where the I/O indicator is turned off. If the tape did not contain a checkpoint file, or when the tape is positioned after the checkpoint file, control passes to B0215. Here, the data record counter, F0003022, and the last noise record indicator, F000304, are set to zero. The file count per reel, F0003032, is increased by 1.

Block ED30: Control links to a subroutine at C0305 where the tape is selected and an RMA turns off the channel error triggers. A TTC instruction tests the channel check indicator. If a channel check occurs, message 20226/7-PCT ON RMA is written.

NOTE: At D8195 in the special write routine for messages and dumped records, another RMA is used to turn off error triggers. If a PCT occurs here, halt 20226 (the only halt in IOCS) occurs, but no message is written. The machine may be in either manual or automatic status, depending on the setting of the nonstop switch. If the machine is in manual status, pressing the start

key transfers control to C0390 to repeat the RMA. If the machine is in automatic, pressing either interrupt key 252 or 253 repeats the RMA.

Once the channel error triggers are reset, control returns from subroutine C0305 to B02155 where the entire fixed section of the updated file table work area and the first three words of the DTS section of the file table work area are returned to the main program.

Now that the subroutine described in blocks ED28, ED29, and ED30 has positioned the tape, reset the counters, and turned off the channel error triggers, control passes to the TSL+5 in block ED27.

Block ED31, E050409+10: Switch E060903 is set to TR to allow a transfer to E060904, thus enabling priming of the input areas following a space file operation or during sequential handling of a multifile tape at intermediate end of file. Now that end-of-file considerations involving space file operations or sequential tape handling are completed, control passes to block ED07.

Begin Output EOF/EOR

Block EE01, E0207: The sole entry to this chart is from block EB02 where the 1 bit one in the status code field, F0002034, indicated an output tape.

E1100 is interrogated to determine if the current operation is a force end-of-reel operation. The 1 bit one at E1100 indicates an FER operation; 1 bit zero means a non-FER operation.

Block EE02, E030102: If the operation is not FER, the data record tape counter, F0003022, is increased by 1. Switch E060501 is set to NOP (see block ED15). Control then passes to E0623, block EB30.

Block EE03, E030101: A standard trailer label is created in the IOTRSHLBL area, B0000. The label is initialized as an EOF trailer by placing 1□□□bF in B0001+1 to serve as the label identifier.

Block EE04: Switch E1100 is interrogated to determine if the IOCS operation is a close operation. The A bit zero at E1100 indicates a close operation; A bit one means any non-close operation.

Block EE05: If the IOCS operation is not close, the file type code field, F0004034, is interrogated to determine whether the tape is to be handled in mode 1 or mode 2 at an end-of-reel condition. The A bit one at F0004034 indicates mode 1; A bit zero means mode 2.

Block EE06: If mode 2 EOR handling is specified, control links to A0922 in housekeeping to clear the stacking table.

Block EE07, E030104: An R is placed in B0022 to change the label to an end-of-reel label.

Block EE08, E030104: Control links to a subroutine at E05503 where the following counters are placed in the label area at B0023: data tape record counter (F0003022), skip counter (F000302), file count per reel (F0003032), and the error correction entry counter (F000303). Sixty blanks are placed in the trailer work area beginning at B0027. Control passes to E05501 where the following counters are placed in the message area beginning at C0062: data tape record counter (F0003022), error correction entry counter counter (F000303), skip counter (F000302), and the permanent error counter (F0003043).

Block EE09: The use of the end-of-reel transfer address is discussed under "Specialized Routines" in the Program Condition Analysis Aids section of this manual. File table field F000402 contains the address of the first instruction of the user's specialized end-of-reel routine. A RCVS W005+1 and an indirect TSL to F000402 effects a transfer to this specialized routine.

NOTE: For an output tape, a return from the specialized end-of-reel routine at IORETURNTO indicates that the end-of-reel condition is accepted; a return at IORETURNNO means that the end-of-reel condition is ignored.

Block EE10, E0306: A return from the specialized end-of-reel routine at IORETURNNO effects an indirect transfer to ADCON E0306. The tape is selected and the I/O indicator is turned on.

The A bit of the tens position of the end-of-file transfer address, F000403, is set to one to indicate to the restart program that the tape indicator is on. This bit switch has other uses as shown in blocks EB06 and EB10.

Block EE11: EOF bit switch E1100 is interrogated to determine if the request is force output end of reel. The 1 bit one at E1100 indicates that the operation is force output end of reel; 1 bit zero means that it is not.

If the operation is force output end of reel, control passes to Chart ED, connector 2.

Block EE12, E030601: If the operation is not force output end of reel, control transfers to E030601 where 1 is subtracted from the data tape record counter, F0003022. Control then passes to Chart ED, connector 2 (block ED09).

Block EE13, E0302: If the block EE04 interrogation determines that the operation is close, control links to subroutine E005503 to place the various file table work area counters in the label and in the message area (block EE08).

Block EE14: Switch E1100 is interrogated to determine if the operation is a multifile open. The 2 bit zero at E1100 indicates that the operation is multifile open, 2 bit one means that it is not.

Block EE15, E0304: If the operation is multifile open, a blank is moved into B0022 of the label work area, the field which ordinarily designates a label as R for end of reel or F for end of file.

Block EE16: Control links to a CSTRS subroutine at B53035 to write a tape mark.

Control links to E0305 to write the label created in blocks EE13 and EE15, an intermediate header label which serves as both a trailer record for the preceding file and as a header record for the following file. A tape mark is written after the label.

Block EE17: Although priming is not involved with output files, control links to A0901 in the housekeeping priming routine to update the force counter. The 2 bit of W0020 is set to zero to indicate that the priming routine is busy. Control links to A500506 where 110 is added to the high-speed transmit address of the file table to locate the field containing the address of the first instruction of the I/O area rotation routine. (The field is located 114 positions above the starting position of the file table in the main program.)

The last two fields of the DTS section of the file table, FT-204 and FT-205, are placed in the file table work area at F000204 and F000205, respectively. The file table work area now contains the address of the I/O area rotation routine and the address of the area in use.

The I/O area addresses are rotated by the I/O area routine until the address of area 1 appears in the area-in-use field, F000205. (The address of area 1 contains an A bit one in the tens position.) If get/put is included, the I/O area addresses of the get/put routine are initialized.

If get/put is not included, control transfers to A0903 where the force counter is set to zero. The A bit of E10012 is set to zero to indicate that the force counter is not assumed zero. The 1 and 2 bits of switch A090003 are set to one to indicate that the operation involves neither an EOR mode 1 routine nor a first read EOR mode 1. Because the tape is output, the priming routine is ignored.

At A09031, the force counter is updated to reflect the number of I/O areas. At A0998, the 2 bit of W0020 is set to one to indicate the end of the priming routine. A subroutine at B02155 (described in block ED09) returns the updated file table to the main program. At A0999, control exits to the TSL+5 of the originating linkage where a transfer is effected to E060503, Chart ED, connector 6.

Block EE18: Control exits to the user's specialized end-of-file routine when an IOCLS or an IOMFC is issued for an output tape. The re-entry should be IORETURNTO, but a re-entry at IORETURNNO has the same effect.

Block EE19, E0307: When an output end-of-reel condition is accepted (block EE09), or a nonstandard trailer has been created following a close operation (block EE18), CSTRS subroutine B53035 is entered to write a tape mark, the end-of-reel trailer, and another tape mark. A single tape mark is written if the file table specifies no trailer.

Block EE20: Switch E1100 is interrogated to determine if the operation is close. The 4 bit zero at E1100 indicates that the operation is multifile close; 4 bit one means that it is not.

Block EE21, E0314: If the operation is multifile close, control links to D6034 in little DTS to backspace over the last tape mark written.

Block EE22: The 4 bit of switch E1101 is set to one to indicate that end-of-file processing is complete. Control then passes to E050506, Chart ED, connector 5.

Block EE23: The test distinguishes between end of file and end of reel. EOR (A bit one at E1101) may be caused by writing over the reflective spot or by IOFER. EOF (A bit zero at E1101) may be caused by IOCLS, IOMFC, or IOMFO.

Block EE24: If an EOR condition exists, control passes to E0601 where an R is placed in the message area.

Block EE25: The reel sequence number, F0005032, is placed in this EOR message area (message 10230, block ED14).

Control then passes to E06011, Chart ED, connector 4 (block ED11).

Label Subroutine

Block EF01, B5201: The missing label switch is restored by setting the A bit of W13 to zero. The A bit zero at W13 indicates that a valid label has been found; A bit one means that a specified label is missing.

Block EF02: The B bit of F0002052 is set to one to allow error checking in little DTS.

Block EF03, B52015: A subroutine at D6011 in little DTS executes a RD 01 to check the length of the label, if any.

Block EF04: If the tape record read during the FSP was a tape mark, control passes to block EF07.

Block EF05: The record is checked for proper length. A valid label has a record length between 11 and 95 characters. The data memory address (SMAC) from the FSP operation is placed in storage and compared to 95. A successful TRH indicates that the record length is 95 or less.

Block EF06: The data memory address (SMAC) is compared to 10. A successful TRH indicates that the record length is 11 or greater.

Block EF07, B5202: If the I/O indicator came on during the reading of the label, or if the label is less than 11 or more than 95 characters in length, the I/O indicator is turned off.

Block EF08: If the label record is between 11 and 95 characters in length, control passes to B5204 where the hundreds position of the next input/output area field,

F0002052, is interrogated to determine if the tape is an output tape with no header. The B bit zero at F0002052 indicates that the tape is output with no header; B bit one means it is not.

Block EF09: If the tape is output with no header, control passes to B52046 where a TTC instruction interrogates the channel check indicator.

Block EF10, B5203: Label length is considered incorrect for any of the following conditions:

1. The record is a tape mark.
2. The record is more than 95 characters in length.
3. The record is less than 11 characters in length.
4. A PCT occurred on the read.

The A bit of W13 is set to one to indicate that the label length is incorrect. The length-incorrect exit from Chart EF is indirectly to the TSL+5 of the originating linkage.

Block EF11, B52043: The record is a valid label to be read into memory, so a backspace is executed in little DTS at D6034. (The RD 01 in block EF03 did not read the label into memory.)

Block EF12: The label work area address is placed in the next I/O area address field, F000205. This 5-character field consists of a CON of L and an ACON4 of L,B0000. (The L is not an operation code. Rather, it is a flag character used to designate a label read operation to the error routine.)

Block EF13: Control links to D6010 in little DTS to read the label into the label read-in area (B0000) set up in block EF12. When the label has been read and checked by little DTS, control transfers directly to B5299, the length-correct exit of Chart EF.

If the label length is correct, therefore, control transfers directly to the TSL+5 of the originating linkage; if the label length is incorrect, control transfers indirectly to the TSL+5 of the originating linkage.

Alternate and Prime

The following is a description of the housekeeping subroutine which alternates tapes and primes input areas at end of reel. The subroutine entry is at A1501, the exit is at A1999.

Block EG01, A1501: The A bit of A090003 is set to one to set the alternate channel indicator to show that the alternate is on the same channel as the base tape.

The total number of alternate tape units field (F0001024) of the file table work area is interrogated to determine if alternates are specified. If no alternates are specified, control transfers to A1601 where message 20230/1 is constructed and written to inform the operator that end of reel has occurred on a base tape which does not have an alternate. After a new reel is mounted, pressing either interrupt key 252 or 253 transfers control to block EG05 where processing is resumed.

Block EG02, A1502: A RCVS at F0001023 and a 9-character transmit from F0001021 moves the first alternate select address into the current select address field. The second alternate select address is moved into the first alternate field, the third alternate select address is moved into the second alternate select address field, etc. In this manner, the next alternate select address is moved into the current select address field.

Block EG03, A1504: The channel number of the current select address (F0002032) is saved at A1505. The units position of the current select address (F000203) is saved at A1506. The channel number and units position of the alternate tape select address are placed in the current select address field, F000203.

Block EG04, A1508: The zoning over the tens and hundreds positions (comparable to ASU zoning) and over the units position of the old select address is restored to the new select address. The zoning over the tens and hundreds positions serves as the force counter. The zoning over the units position specifies the DTS mode and whether a forward space file operation is in progress for this file.

Block EG05, A1901: If the alternate tape is on the same channel as its base tape, the reel sequence number of the file on which the end-of-reel condition occurred is updated by adding 1 to the reel sequence number, F0005032.

Block EG06: Control passes to CSTRS to open the alternate tape file. The subroutine is entered at B0100. The exit is at B99+1.

Block EG07: The 2 bit zero at W0020 at this time means that a tape mark was read during a priming operation. F0004034 is interrogated to determine the EOR mode. The A bit one at A1903 indicates mode 1; A bit zero means mode 2.

Block EG08, A1903: If mode 2 EOR is specified, control transfers to A1903 where the status code field, F0002034, is interrogated to determine whether the tape is input or output. The 1 bit one at F0002034 indicates an output tape; 1 bit zero means input. If the tape is an output tape, control transfers to the TSL+5 of the original linkage.

Block EG09: If the tape is input, the 4 bit of switch A090003 is set to zero to indicate priming EOR mode 2. Control links to the priming routine at A0902 to fill the input areas.

Block EG10, A0910: The 2 bit of W0020 is set to zero to indicate that the priming routine is busy. Switch A090003 is set as shown in block EE17.

Block EG11: The status code field, F0002034, is interrogated to determine whether the tape is input

or output. The 1 bit zero at F0002034 indicates an input tape; 1 bit one means output.

Block EG12, A0940: If the tape is input, the IOCS operation code field, E10014, is interrogated to determine if the operation is forward space or position. The A bit zero at E10014 indicates that the operation is forward space or position; A bit one means that it is not.

Block EG13: If the alternate tape is on the same channel, control links to A0928 where the address of the area in use (previously saved in E1007) is placed in F000205. The B bit of F0002052 is set one to allow error checking in little DTS. Control then links to D6010 in little DTS to prime the input areas. A priming end-of-file condition is detected by a TRS instruction and control passes to block EB02.

Block EG14, A0941: If the IOCS operation is a forward space or position, control transfers to A0941 where the B bit of F0002052 is set to one to allow error checking in little DTS. The 1 bit of switch A090003 is set to zero.

Control links to D6011 in little DTS to execute a forward space operation. A priming end-of-file condition is detected by a TRS instruction and control passes to block ED02. The 1 bit of switch A090003 is set to one.

Block EG15, A0998: If the tape is an output, or after priming is accomplished for an input tape, the 2 bit of W0020 is set to one to indicate the end of the priming routine.

Block EG16: Control links to B02155 (shown in block ED09) to return the updated file table to its original location in the main program. The exit from the subroutine is to the TSL+5 of the originating linkage.

EOF on File Identification Search

Control enters from block EC16 on recognition of a search file identification operation.

Block EH01, E050404: A test is made on the 2 bit of E1101. This bit is set to zero status if the last label contains F in the termination code field. Recognition of 2 bit zero indicates that a final trailer was found on the tape; control transfers to block EH12. An intermediate header contains a blank in the termination code field and indicates a new file identification is ready to be tested.

Block EH02, E050408: The user's file identification routine is entered via the file identification address from the macro. The user is expected to determine if the file in question is the file he desires by testing the identification in the label. If it is, the return to IOCS is at IORETURNTO and control passes to Chart ED, connector 8. If it is not the correct file, the return to IOCS is at IORETURNNO and control passes to block EH03 to continue searching for the file.

Block EH03, E050406: A test is made for A bit zero of E10014. This condition indicates a forward space file operation and transfers control to block EH07.

Block EH04: A backspace file operation was requested. The first pass switch (block CG18) in the space file subroutine is reset (off condition). This switch prevents an exit on first entering the routine.

Block EH05: The file count field in the file table is tested for zero. A non-zero count indicates that more files may be backspaced and control passes to Chart ED, connector 9, to continue the search.

Block EH06, E050502: Because a backspace file operation cannot be done (tape is at load point), the A bit of L,D007411 is set to zero to force the forward space file operation. The file limit indicator (B bit D007401-2) is set on (zero) to indicate the load point was reached.

Block EH07, E050503: The 4 bit of bit switch E1101 is set to zero to prevent taking a checkpoint for this operation.

Block EH08, E050508: Control links to the routine at E0510. In this routine the label indicator field (F0004014) of the file table work area is interrogated to determine if a header is specified for the file. The A bit one at F0004014 indicates a header; A bit zero indicates no header.

If a header is indicated, W13 is interrogated to determine if a valid label was found or if the label is missing. The A bit zero at W13 indicates a valid label; A bit one indicates that the label is missing.

If a valid label was found, control transfers to B0209 to open the file. At E0511, if no header is specified, or if the specified header is missing, control links to D6034 in little DTS to execute a backspace which positions the tape at load point. Control then transfers to B0229 to open the file.

At B0209, the label indicator field (F0004014) of the file table work area is interrogated to determine if a tape mark follows the specified header. The 1 bit one at F0004014 indicates that a tape mark follows the header; 1 bit zero indicates no tape mark.

If the label indicator shows that a tape mark should follow the header, the B bit of F0002052 is set to one to allow error checking in DTS. Control links to D6011 in little DTS to execute a forward space operation. If a tape mark follows the header, the I/O indicator comes on. If the I/O indicator is on, a TRS effects a transfer to B0210 where the I/O indicator is turned off. The tape is now positioned after the tape mark which follows the header label.

If the file table specified that a tape mark is to follow the header, and the tape mark is missing, control links to D6034 in little DTS to backspace the tape. The tape is now positioned after the header. Message 10291

is written to inform the operator that the tape mark specified to follow the header is missing. The record following the header is treated as a data record.

Block EH09, E0215: The file count per reel (F0003032) is interrogated. If the file count is zero, indicating the tape is at load point, the checkpoint indicator field (F0004024) of the file table work area is checked to determine if the file contains checkpoint records. The 1 bit one indicates that the file contains checkpoints; 1 bit zero indicates no checkpoint.

If the file contains checkpoints, the B bit of F0002052 is set to one to allow error checking in DTS. Control links to D6011 in little DTS to forward space the tape. Forward spacing continues over the individual parts of the checkpoint record until the first tape mark is reached. At that time, a TRS executes a transfer to B0208 where the I/O indicator is turned off. If the tape did not contain a checkpoint file, or when the tape is positioned after the checkpoint file, control passes to B0215. At B0215, the data record counter (F0003022) and the last noise record indicator (F000304) are set to zero and the file count per reel (F0003032) is incremented by one.

Block EH10, C0305: The tape is selected and an RMA is executed to turn off the channel error trigger. A TTC instruction tests the previously selected channel check indicator. If a channel check occurred, message 20226/7 is written.

When the channel error triggers are reset, control returns from the subroutine at C0305 to B02155 where the entire fixed section of the updated file table work area and the first three words of the DTS section of the file table work area are returned to their original locations in the main program.

Block EH11: The 8 bit of L,E050508 (linkage to the positioning routine) is set to zero, restoring the linkage to normal (TSL). This is necessary if the reel was rewound and the file was opened. Control passes to Chart ED, connector 10 to continue processing.

Block EH12, E050405: The B bit of D007401+2 is tested for zero. This condition (zero status) indicates that the end-of-file trailer was reached for the second time, and all files have been searched; control transfers to the loop message at block EH14.

Block EH13, E050303: The file limit indicator is turned on by setting the B bit of D007401−2 to zero. This indicates all files have been searched.

Block EH14: The message, 20211-XY-FILE NOT FND, is typed.

Block DH15: The linkage to the position tape routine at block EH08 is disabled by setting the 8 bit of the TSL operation code on, thereby changing the operation to a TMT.

Block EH16: The open file switch at block EH18 is set to transfer by a SGN operation. This forces an open operation after the tape is rewound.

Block EH17: The tape is rewound and the skip, file, error, and permanent read/write error counters are reset to zero.

Block EH18, E060502: Control transfers to E0606 to initialize for an open operation.

Block EH19, E0606: The open file switch at block EH18 is reset to a NOP for normal operation.

Block EH20: The 2 bit of W13 is set to one to indicate a special open to the open routine. This prevents normal label checking and exit to the header transfer address in the open routine.

Block EH21: Control links via a RCV—TSL to B0100 to open the file.

EA

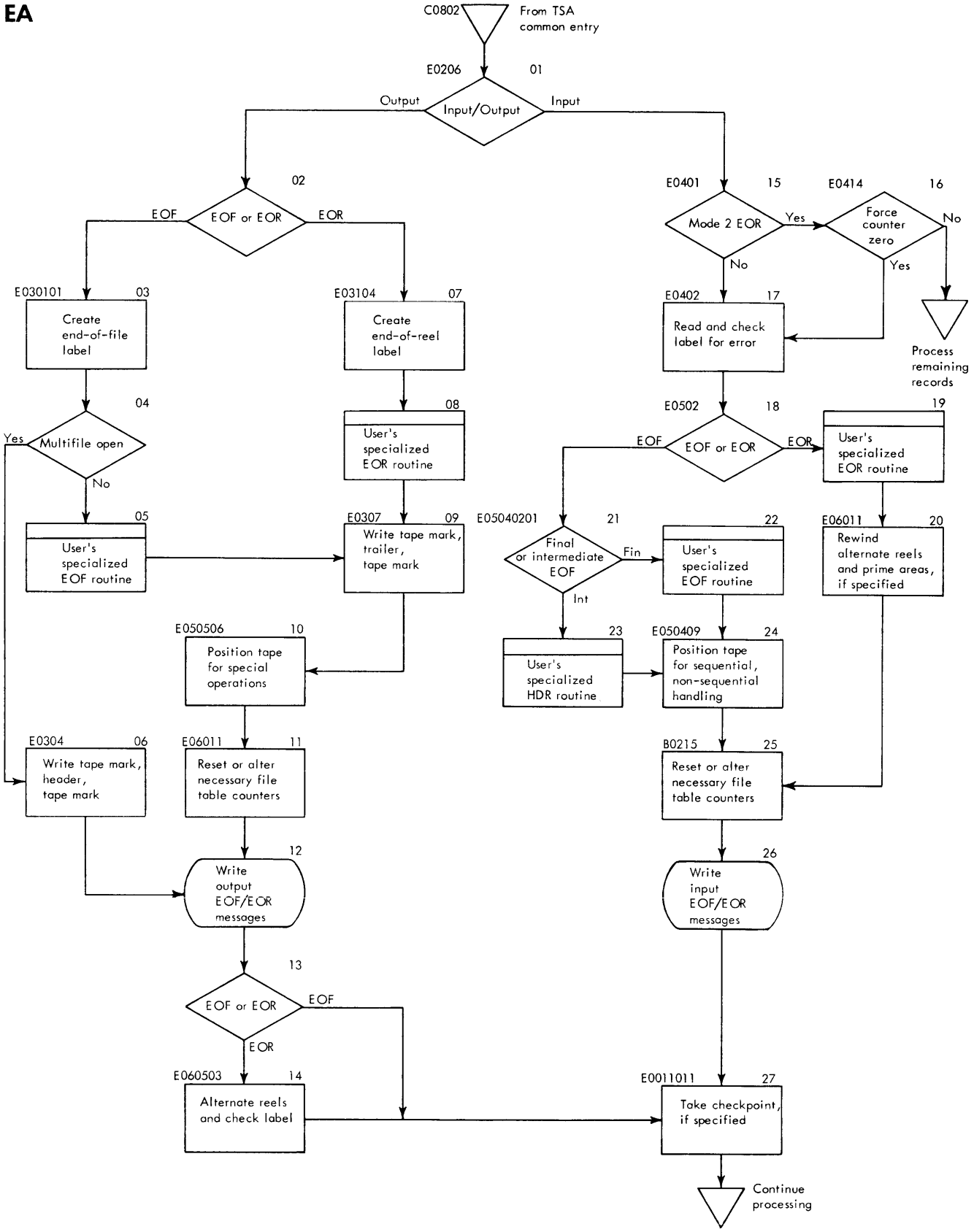


Chart EA. EOF/EOR General Flow

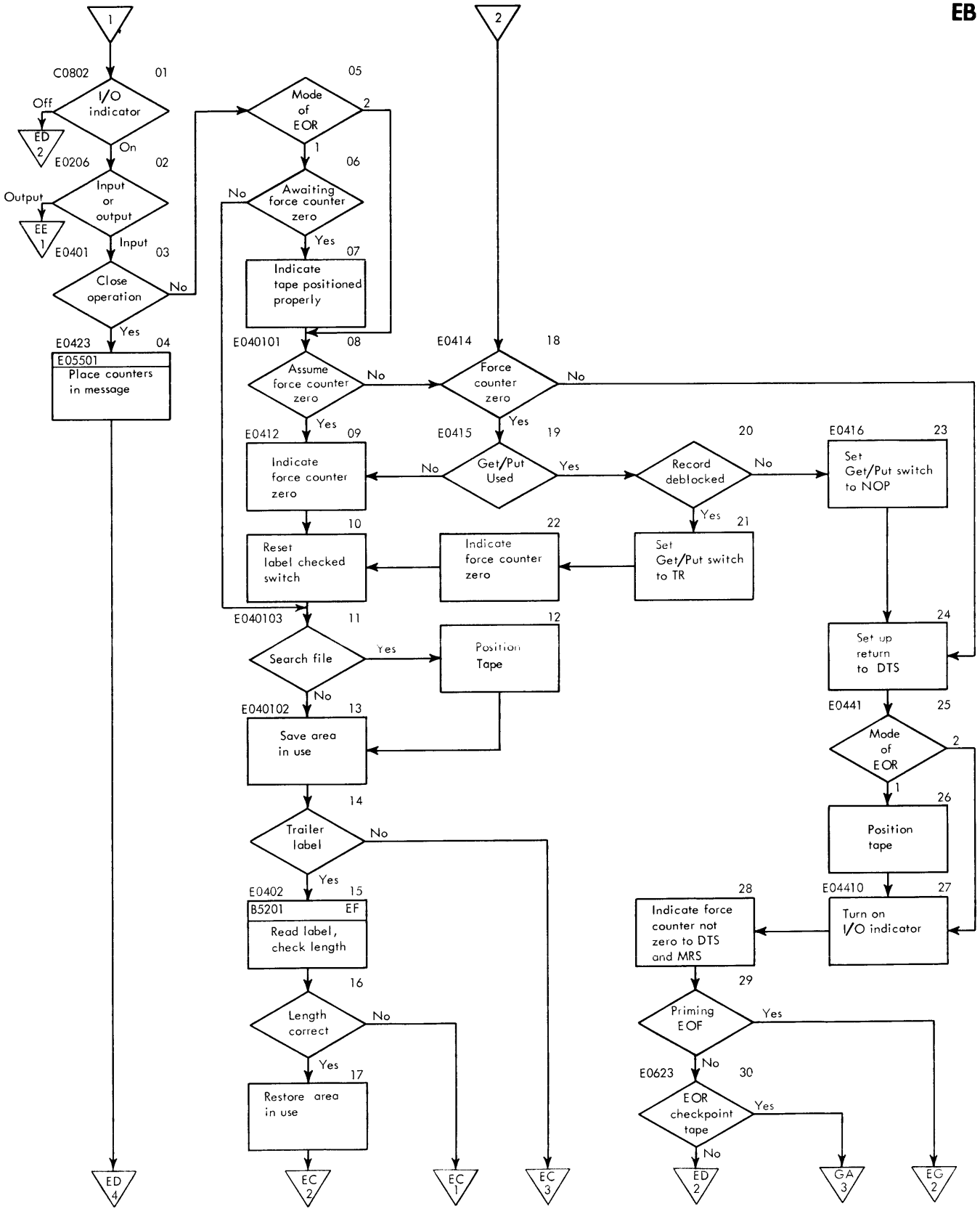


Chart EB. End of File and End of Reel, part one of four

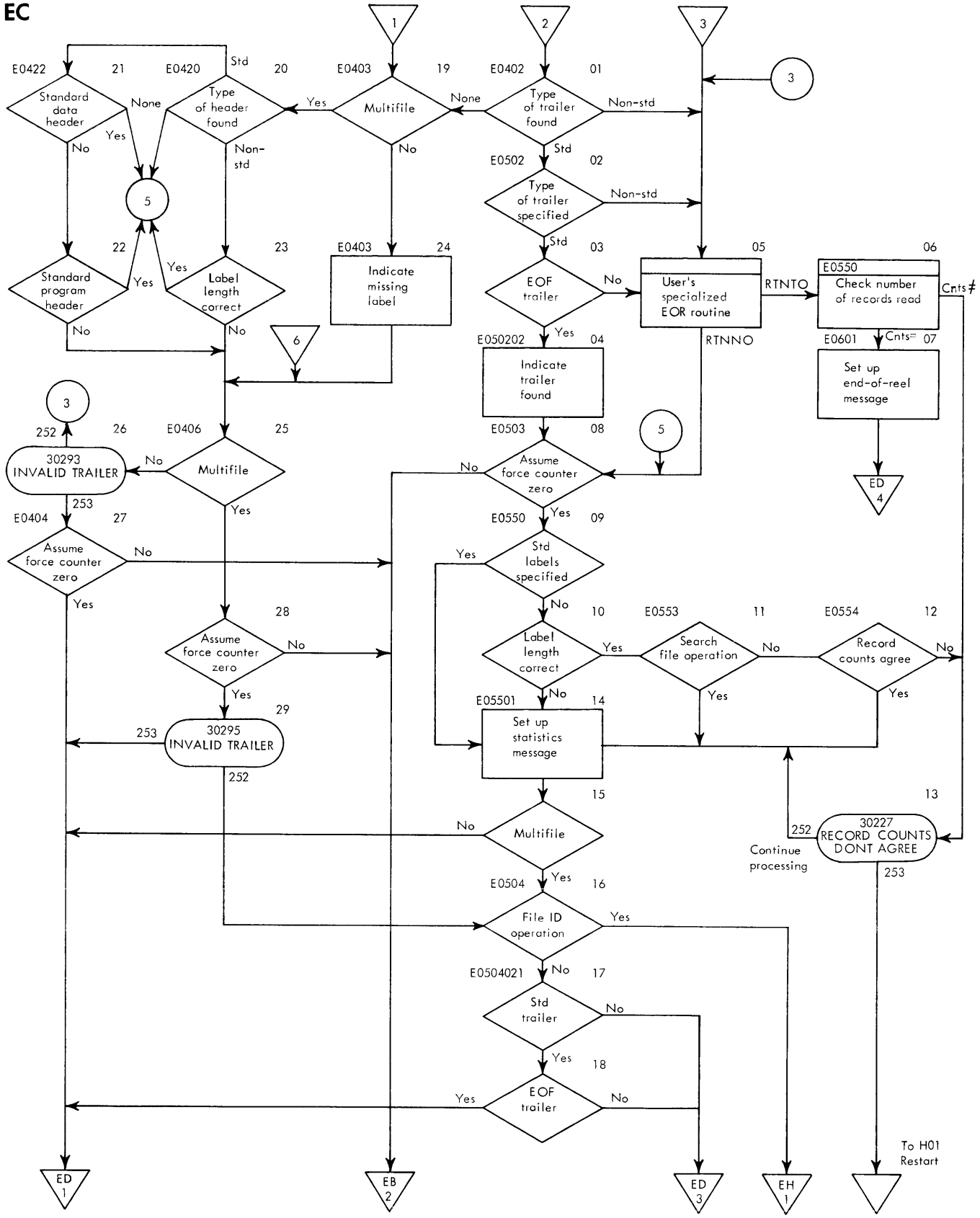


Chart EC. End of File and End of Reel, part two of four

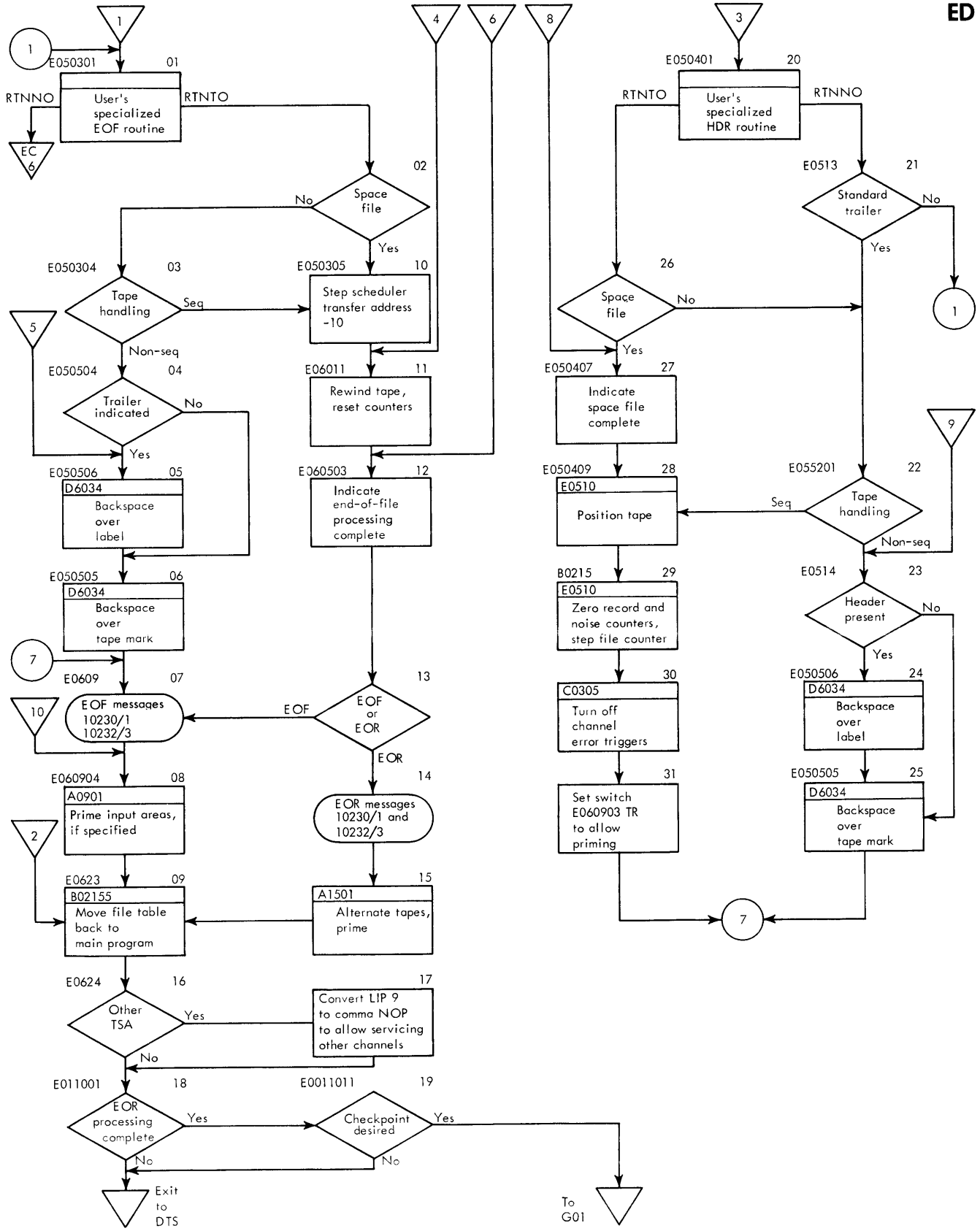


Chart ED. End of File and End of Reel, part three of four

EE

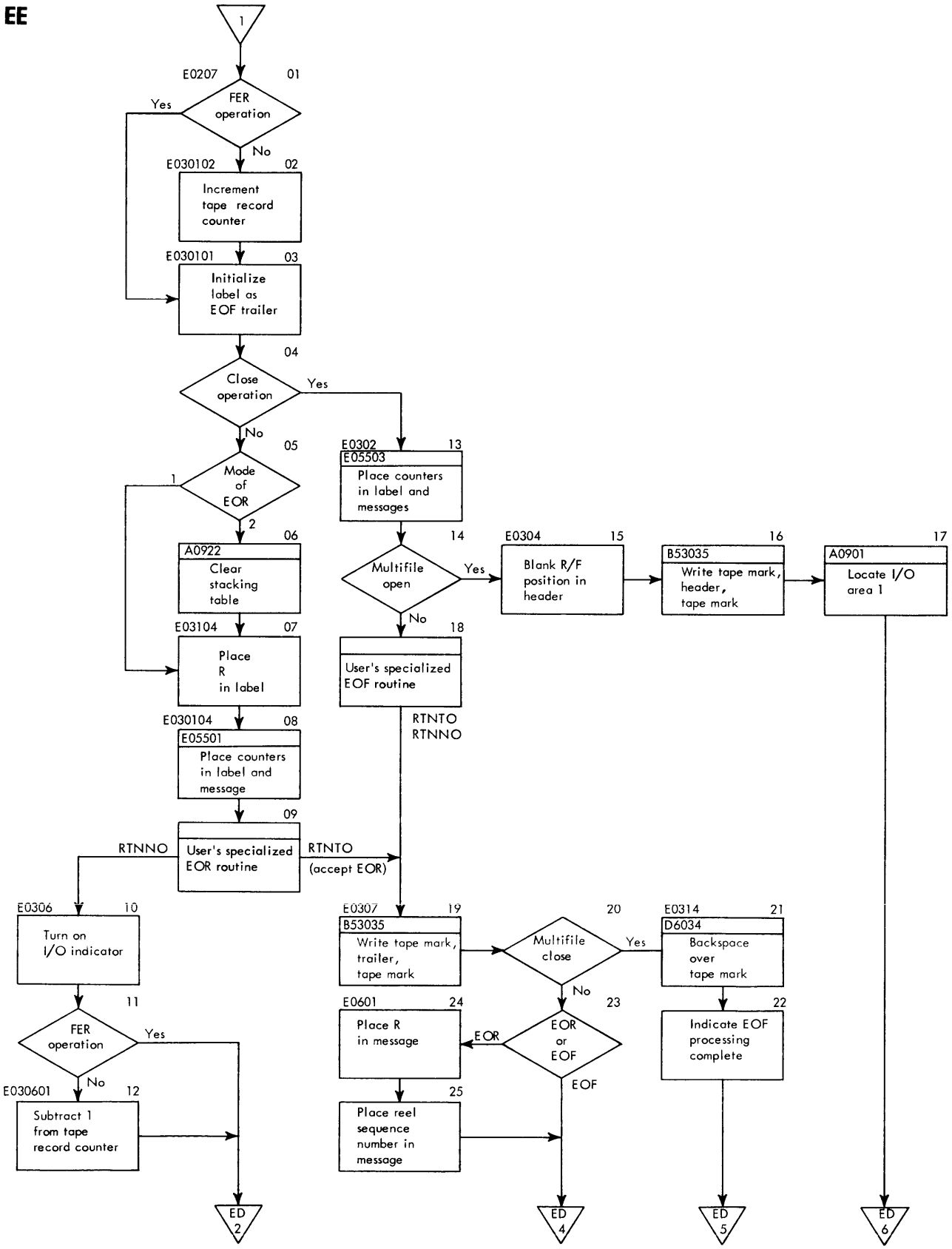


Chart EE. End of File and End of Reel, part four of four

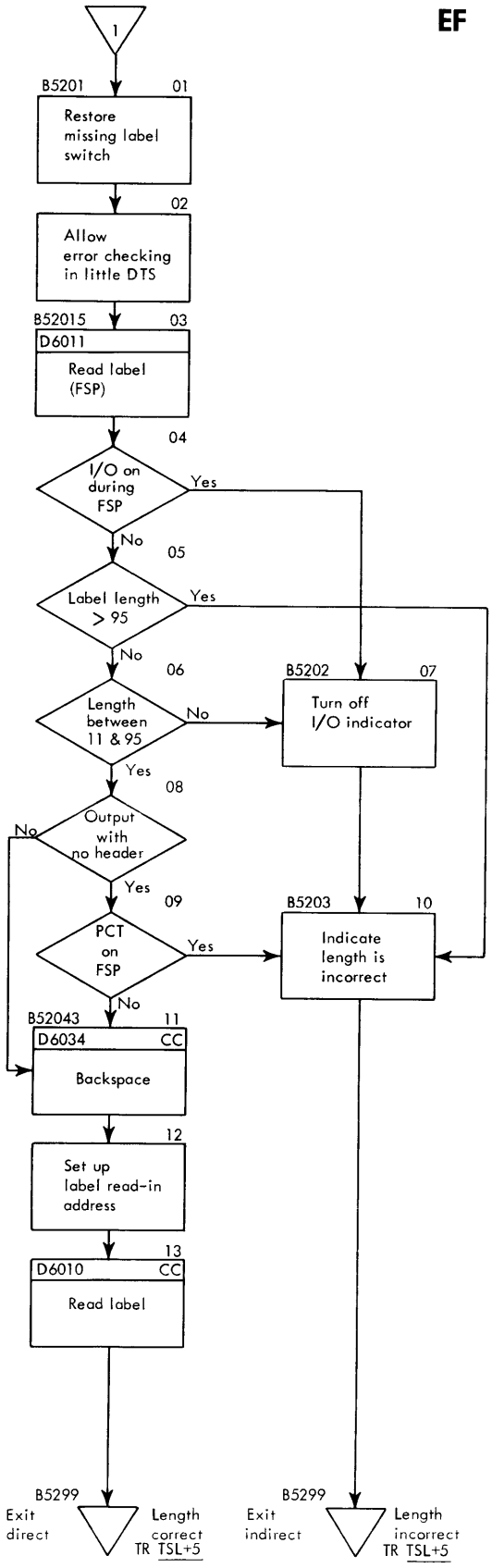


Chart EF. Read Label and Check Length Subroutine

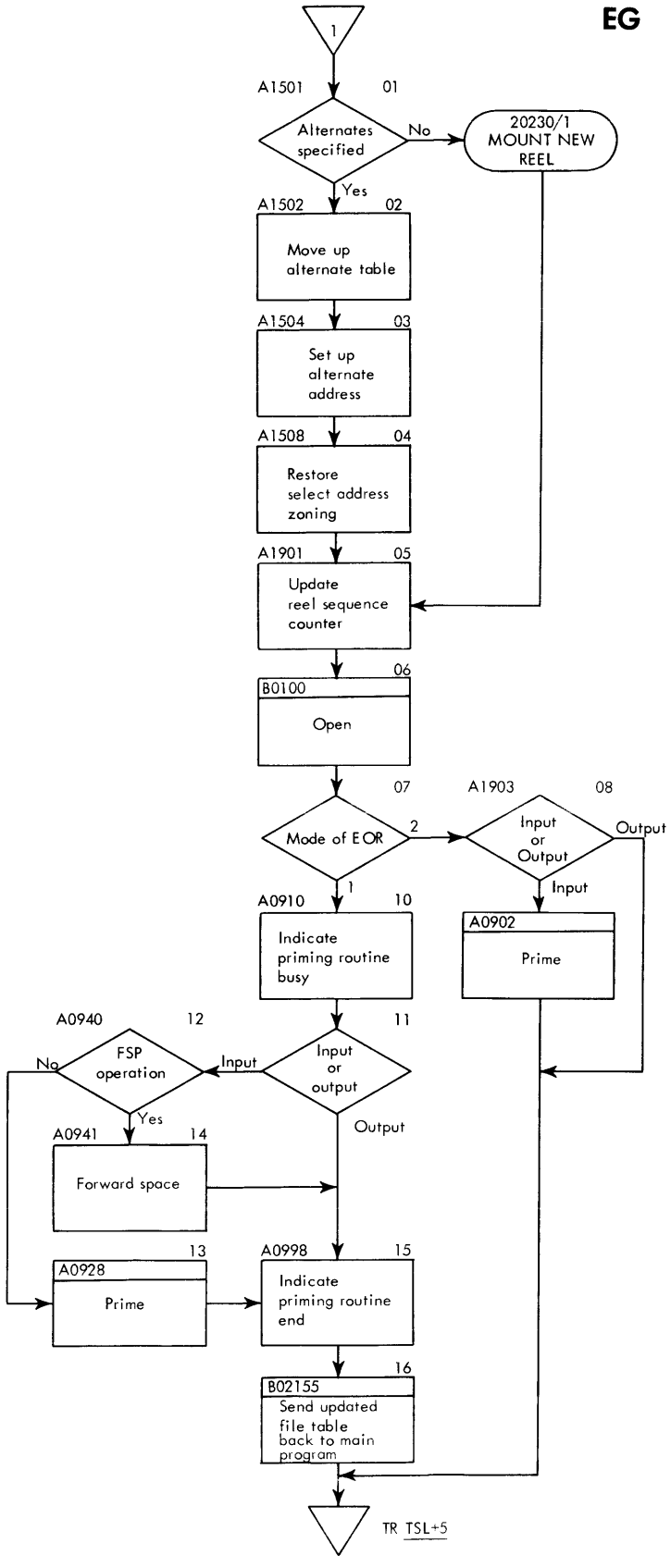


Chart EG. Alternate and Prime

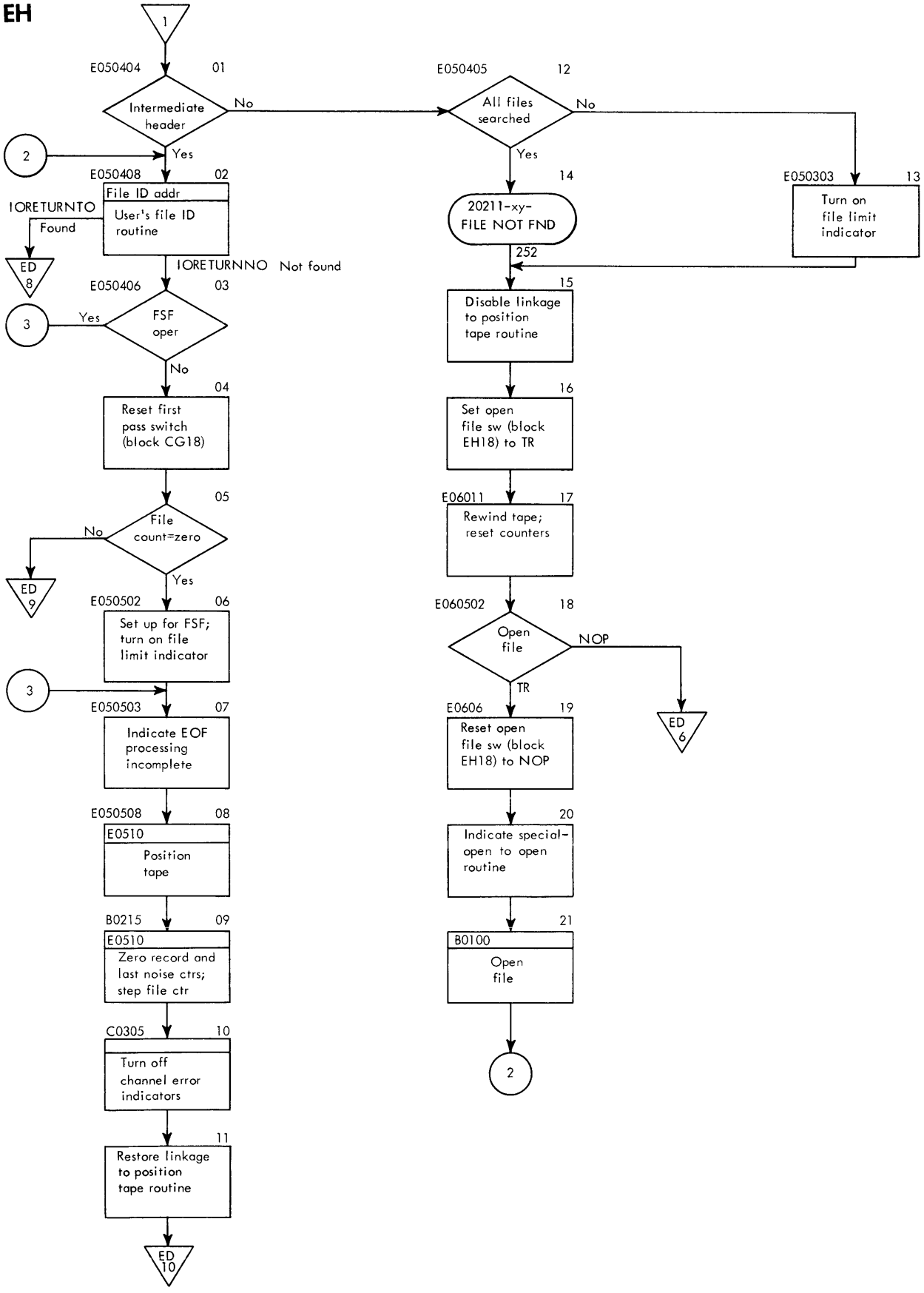


Chart EH. EOF for File Identification Search

The TRS section of 7080 IOCS handles beginning-of-file conditions for tapes containing either standard or nonstandard headers. CSTRS performs the following operations:

B01, B02	Delay-open a tape file
B100	Open a tape file
B0201	Check header label
B0206	Position tape after checkpoint file
B0215	Reset file table counters
B0301	Process header label, position tape
B5201	Check header label length
B5301	Write header label

It is linked to and used by other component sections of IOCS as follows:

HSK	To check all base tapes
EOF/EOR	To open alternate tape files
DTS	To open tape files

CSTRS CHARTS

The main TRS chart, Chart FA, shows the regular open operation and is accompanied by a block-by-block description. The delay-open operation is described, but no chart is included. Chart EF, showing the label length-checking routine, is used to support the EOF/EOR section.

Regular Open Routine

The purpose of an open routine is to check the header label, to verify that the correct tape for the file is being used, to create and to write an output header if necessary, and to position an input tape to read the first record of a file.

The regular open routine immediately opens the tape file during housekeeping, EOF/EOR, etc. During housekeeping, the entry is at B01002. At other times, when tape readiness is doubtful, the entry is at B0100.

Block FA01, B0100: The tape is selected by indirectly addressing F000203. A ready loop is executed. If the tape is not ready after approximately 2 seconds, message 20280/1-XY-NOT READY is written. When the tape is made ready, pressing either interrupt key 252 or 253 results in a transfer to B91 to recheck the tape.

NOTE: IOCS common entry point B91 is the recheck exit from CSTRS. The address is originally initialized in CSHSK as A0110 to insure that all tapes are rechecked in housekeeping when any tape is not ready (see block BA08). Later in housekeeping (block BA18), the common entry point B91 is initialized to B0100, the first instruction of the open routine. Therefore, any ready rechecking after housekeeping is completed involves only the tape mentioned in the message.

When the tape is ready, it is rewound at B01002. The A bit of status code field, F0002034, is set to one to indicate a regular open operation. Little DTS error checking is avoided by setting the B bit of next input/output area field, F0002052, to zero. The first tape record is forward spaced over by linkage to D6011.

Block FA02: If the I/O indicator came on during the RD 01, it is turned off.

If a PCT occurs in forward spacing over the first record, control transfers to B1111 to write message 30282/3. This informs the operator that the PCT may be caused by two tape dial settings specifying the same unit, or by an incorrect density setting.

NOTE: Because a record written in a density of 200 bpi may, under unusual circumstances, appear to be a valid 1-character record when read in a higher density, a SMAC check is performed to detect this type of error. As the RD 01 address in block FA01 is 0000, SMAC is always greater than 0005, if record length standards are adhered to. Therefore, if SMAC equals 0005, control transfers to B1111 where message 30282/3 is written.

Block FA03, B0201: If the PCT or SMAC error is to be ignored, pressing interrupt key 253 results in a transfer to B0103. Pressing interrupt key 252 effects a transfer to B0100 (block FA01) to re-execute the forward space. If no error occurs, control passes to B0103, where the tape is rewound.

At B0201, the A bit of the label indicator field, F0004014, is interrogated to determine if a header is specified for the file. The A bit one indicates that a header is used; A bit zero means it is not.

Block FA04: If a header is specified, the header is read and its length is checked through linkage to B5201, as described in Chart EF.

If the label length is correct, exit from the check routine is direct to the ADCON of the originating linkage at B0201. If the length is incorrect, the ADCON is transferred to indirectly, resulting in an effective transfer to B0218 where the tape is backspaced and message 30290/1 is written (see block FA09).

Block FA05: The 1 bit of the status code field, F0002034, is interrogated to determine whether the file is input or output. The 1 bit zero at F0002034 indicates input; 1 bit one means output.

Block FA06, B02015: If the tape is output, it is backspaced through linkage to D6034.

Block FA07: The output tape density is set as specified in the tape type code field, F0005064, of the file table work area.

Block FA08, B0202: The B bit of the label indicator field, F0004014, is interrogated to determine whether a standard header is used. The B bit zero indicates that a standard header is used, B bit one means it is not.

Block FA09, B0301: A valid standard header contains either 1***b or 10064 as its 5-character identifier.

If the label is valid, control transfers to B0302 to continue the processing of the header label. If the label is invalid, message 30290/1 is written to inform the operator that a specified header is missing. Pressing interrupt key 252 effects a transfer to B0100 (block FA01) to recheck the label. The tape may be accepted without a header by pressing interrupt key 253.

Block FA10: The 1 bit of the status code field, F0002034, is interrogated to determine whether the tape is input or output. The 1 bit zero indicates input; 1 bit one means output. If the tape is input, control passes to the header transfer address.

Block FA11: The first five positions of the label read-in area at B0000 are blanked in order to set up a compare-equal situation in block FA09 if the output tape does not contain a header.

Block FA12: If the output tape contains a header label (even though none is specified for the file), the label is read and checked through linkage to B5201, as described on Chart EF.

Block FA13, B0302: The 2 bit of W13 is interrogated to determine whether the open operation is a regular open or a special input open. The 2 bit zero at W13 indicates a regular open; 2 bit one means an input open.

An input open is used to open the control cards tape without going to the header transfer address. If the open is of this type, the remainder of the label-checking operation is bypassed by transferring to B0204.

If the operation is a regular open, the 1 bit of the status code field, F0002034, is interrogated to determine whether the tape is input or output. The 1 bit zero at F0002034 indicates input; 1 bit one means output.

Block FA14, B0317: The file identification name field, F0005051, is compared to the file identification field, B0005, of the tape just read.

Block FA15: If the two file identification fields are not identical, message 30299 is written. The tape may be rechecked by pressing interrupt key 252; the header label may be accepted by pressing interrupt key 253.

Block FA16, B0319: If the proper tape is mounted, the following fields are moved from the tape label read-in area to the file table work area: tape serial number, file serial number, reel sequence number, and file identification.

Block FA17, B0313: The file count per reel field, F0003032, is interrogated to determine whether the header is an intermediate header or is located at load point. If the file counter is zero, the header is the first record of the reel; if the file counter is not zero, the header is an intermediate header.

Message 10299, accompanied by a portion of the header, is written for only the first file of an input tape.

Blocks FA18 and FA18.1: If a valid header is found on an output tape, the A bit of the label indicator field, F0004014, is interrogated to determine if a header is specified for the file. The A bit one indicates that a header is used; A bit zero means that it is not.

If no header is specified for the file on which a header is found, message 30296 is written to give the operator the option of mounting a new reel or of accepting the tape for output. In the latter case, the standard header existing on the tape is destroyed, and no header is created for the tape.

Block FA19: If a specified output header label is found, the retention cycle and creation date fields of the label are examined to determine if the tape may be written on. Message 30298 is written under the following circumstances:

1. The date as found in the header (B0007) is greater than the current date (W02).
2. The retention cycle (B0008) plus the creation date (B0007) exceeds the current day, W02.
3. The retention cycle number exceeds 999, if the creation date indicates the tape is more than 999 days old.

Block FA20, B0309: If the output tape is erasable, control passes to B0309 where linkage is made to B90, an exit to examine the output header. The return to IOCS must be at IORETURNTO.

At B03095, if the file code field, F0002014, contains a blank, the program header identifier 10064 is placed in B0001 of the label work area; if the file code is not a blank, the data header identifier 1***b is placed there. At B03105, file counter zero indicates a load point header; file counter not-zero means an intermediate header.

Block FA21, B0315: If the header is a beginning-of-reel header for the file, a transfer is made to B0315 where the current tape serial number and file serial number are placed in F0005011 and F0005021, respectively.

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 in the header label of the first output reel. This number is used as a

file serial number for each beginning-of-reel header for the file. An input file serial number is usually obtained from control cards in housekeeping.

Block FA22: At B0316, the following file table fields are moved from the file table work area to the label work area: current tape serial number (F0005011), file serial number (F0005021), reel sequence number (F0005032), and file identification name (F0005051). Control then passes to B0311. At B0311−10, if the header is an intermediate header, the file table identification field, F0005051, is placed in the header file identification field, B0005. At B0311, the 71-position area following the file identification (B0006) is blanked.

The latter portion of the header is created as follows: the year-day constant from control word field W01 is moved into the date field, B0006. The retention cycle, as found in file table work area field F000506, follows the date field. A group mark is placed after the retention cycle field. The next fields to be moved in are type of record length (F0005074), data record length (F0005084), and tape record format description (F0005094). A group mark is placed after the record format field.

The checkpoint indicator field (F0005092), the first of the two characters immediately preceding the file table section 1 terminating record mark, is interrogated to determine if the file contains checkpoint records. The file table macro IOFTB generates Cb for this field if the tape contains the checkpoint records, and bb if it does not. Therefore, the 1 bit one at F0005092 indicates that the tape contains checkpoint records; 1 bit zero means it does not. If the tape contains checkpoint records, a C is placed in the checkpoint indicator field of the header, B00091.

At B0312, S022 is initialized 0 to specify a class A message.

Block FA23, B0313: If the file counter field, F0003032, is zero, the label is a load point header; that is, the header of the first file of the reel. If the file counter is not zero, the label is an intermediate header.

Because only one message per reel is necessary, message 10298 is written if the label is a load point header. The following parts of the header are typed as the first line of the message: tape serial number, file serial number, reel sequence number, file identification, and retention cycle.

At B0314, the group mark placed after the retention cycle field is replaced with a blank.

Block FA24, B0212: The use of the header transfer address is discussed under "Specialized Routines." File table field F000401 contains the address of the first instruction of the specialized beginning-of-reel and beginning-of-intermediate-file routine. A RCVS W005+1 and an indirect TSL F000401 effect a transfer to this specialized routine.

If the return to IOCS is at IORETURNTO, ADCON B0217 is transferred to directly, and control passes to the next sequential instruction at B0213.

If the return to IOCS is at IORETURNNO, ADCON B0217 is transferred to indirectly, resulting in an effective transfer to B0217.

At B0217, if the header is standard (B bit zero at F0004014), the label is rechecked via a transfer to B91, in which housekeeping has placed the address of the open routine, B0100 (block FA01).

At B0218, if the header is not standard, the tape is backspaced at D6034, the I/O indicator is turned off, and message 30290/1 is written (see block FA09).

Block FA25, B0213: If the return to IOCS is at IORETURNTO, the 1 bit of the status code field, F0002034, is interrogated to determine whether the tape is input or output. The 1 bit zero indicates input; 1 bit one means output.

Block FA26: If the tape is input, control transfers to B0204 where control passes to B0209 to position the tape to read the first record of the file, depending on whether the header is followed by a tape mark, and whether checkpoint records are contained on the file.

At B0209, the 1 bit of label indicator field, F0004014, is interrogated to determine if a tape mark follows the input header. The 1 bit one at F0004014 indicates that a tape mark follows the header; 1 bit zero means it does not.

If a tape mark follows the input header, the B bit of F0002052 is set to one to allow error checking in little DTS. The tape record following the header is forward spaced over through linkage to D6011. If the I/O indicator does not come on during the forward space operation, the tape is positioned after the header through linkage to the backspace routine at D6034.

Message 10291 is written to inform the operator that a tape mark specified to follow the input header is missing. (The record following the header is treated as a data record, and processing is continued.) Control then passes to B0205.

If a tape mark follows the input header, control transfers to B0210, to turn off the I/O indicator, and then to B0205.

Now that the tape is positioned according to the presence or absence of a tape mark following the input header, a test is made to determine if checkpoint records are contained on the file.

At B0205, the file counter zero indicates a load point header; control transfers to B0206 to determine if the tape contains checkpoint records.

If the 1 bit at F0004024 is one (indicating checkpoint), linkages are made to the forward space routine at D6011 to space over the several tape records of the checkpoint file. This forward space loop continues until the tape mark terminating the checkpoint file is detected. Then, control transfers to B0208, to turn off the I/O indicator, and then to B0215, block FA28.

Block FA27, B0213+10: The A bit of label indicator field, F0004014, is interrogated to determine if a header is specified. The A bit one at F0004014 indicates that a header is specified; A bit zero means that it is not.

If no header is specified, the header-writing routine is bypassed and control transfers to B0215, block FA28. If a header is specified, control links to B5301 to write the header label. If a tape mark is specified to follow the header (1 bit one at F0004014), control transfers to B5303 where the label is written through linkage to D6020. At B5304, the tape mark is written through linkage to D6031.

At B5399, control returns to the TSL+5 of the originating linkage. At B5301, if a tape mark is not specified, control transfers to B5302 where the TSL instruction at B5304 is converted to a TMT instruction, thus avoiding a linkage to the write tape mark routine.

Block FA28, B0215: After an input tape is positioned to read the first record of a file, or a header is written on an output tape, control passes to B0215 to complete tape label processing.

The data tape record counter (F0003022) and the last noise record counter (F000304) are set to zero; the file counter (F0003032) is increased by 1. The channel error triggers are turned off through linkage to C0305 (block DB08).

At B02155, the updated file table is returned to its main program location. The exit from the open routine is located at B99 where control transfers to the TSL+5 of the originating linkage.

Delay Open

A delay-open operation opens the tape file when the main program first links to IOCS for an input/output operation on the file. In this case, the base tape need not be ready in housekeeping.

Files operating under the delay-open option must be represented in the tape table by a base tape entry; delay-open files are usually opened in the following manner:

1. Input files: Through the functional linkage IOHLD with a second operand of OPEN.

2. Output files: Through a normal output request IOWR, or any series of requests; e.g., IOPUT, which results in the normal output request IOWR. Output files may also be opened through the functional linkage IOHLD with a second operand of OPEN.

NOTE: IOHLD with a second operand of EOFCK also opens the file. If IORD is used and priming is specified, the priming precedes the execution of the IORD request. Hence, the first record is lost. IOGET must not be used to open a file. IOPUT must not be used to open a file previously closed.

The routine begins at B02; the exit is at B09+15 where control transfers to D6601 to execute an all-channel restart. The delay-open routine, at B08, links to the regular open routine to position the tape. Therefore, the regular open routine is a subroutine of the delay-open routine.

B02 is the delay-open routine entry used by special operations. The operation code of the special operation is at D0070014. The ACON4 of the special operations file table follows at D0070010. At B02, the operation code of the special operation is loaded into CASU 01. If CASU 01 is zero, (1) the location of the file table address (D0099) is saved in the accumulator, (2) a transfer is made to D994822, the DTS loop exit to the main program.

At B02+15, after the 0 special operation code (IOHOLD with no second operand) is handled, the 4 bit of the special operation code (D0070014) is interrogated to determine if the particular special operation requires that the file be opened. The 4 bit zero at D0070014 results in a transfer to B01 to open the file; 4 bit one causes an exit to the DTS loop.

CASU 15 contains the location of the next main program instruction to be executed; that is, the instruction following the functional linkage which caused entry into IOCS. Because the file is operated under a delay-open option, this functional linkage causes a delay-open operation. The request is not yet performed — so that it may be performed, CASU 15 must be changed to reflect the location of the functional linkage, and not that of the instruction which follows it.

At B01, the main program location, found in CASU 15, is placed in D0099, a pivot transfer instruction. The location of the pivot is placed in CASU 15 by a LFC of B01+5. An all-channel hold is performed through linkage to D6502. The file table is moved to the file table work area through linkage to A500601.

The main program location (instruction counter) now saved in pivot instruction D0099, is stepped down 5 by adding 159995 to D0099. Thus, when control returns to the main program, the request re-enters IOCS and is executed.

The 1 bit of the status code field, F0002034, is interrogated to determine whether the tape is input or output. The 1 bit zero at F0002034 indicates input tape; 1 bit one means output. If the tape is output, the reel sequence number is reset to 001, and the file serial number is reset to 0000.

At B08, the input or output tape is positioned through linkage to B0100, the first instruction of the regular open routine (Chart FA).

When the tape is opened, the input areas are primed through linkage to A0901, the priming routine entry, if input areas are initialized (Chart BC).

Now that the delay-open operation is complete, control transfers to D6601 to execute an all-channel restart. After channel 23 is restarted, a subsequent transfer to pivot point D994822 results in a LIP 9. At this time, CASU 15 contains the address of the IOCS pivot instruction, D0099, mentioned at the beginning of this section; it is set to the instruction counter location of the main program I/O request. Thus, the request reenters IOCS at this time, and is executed.

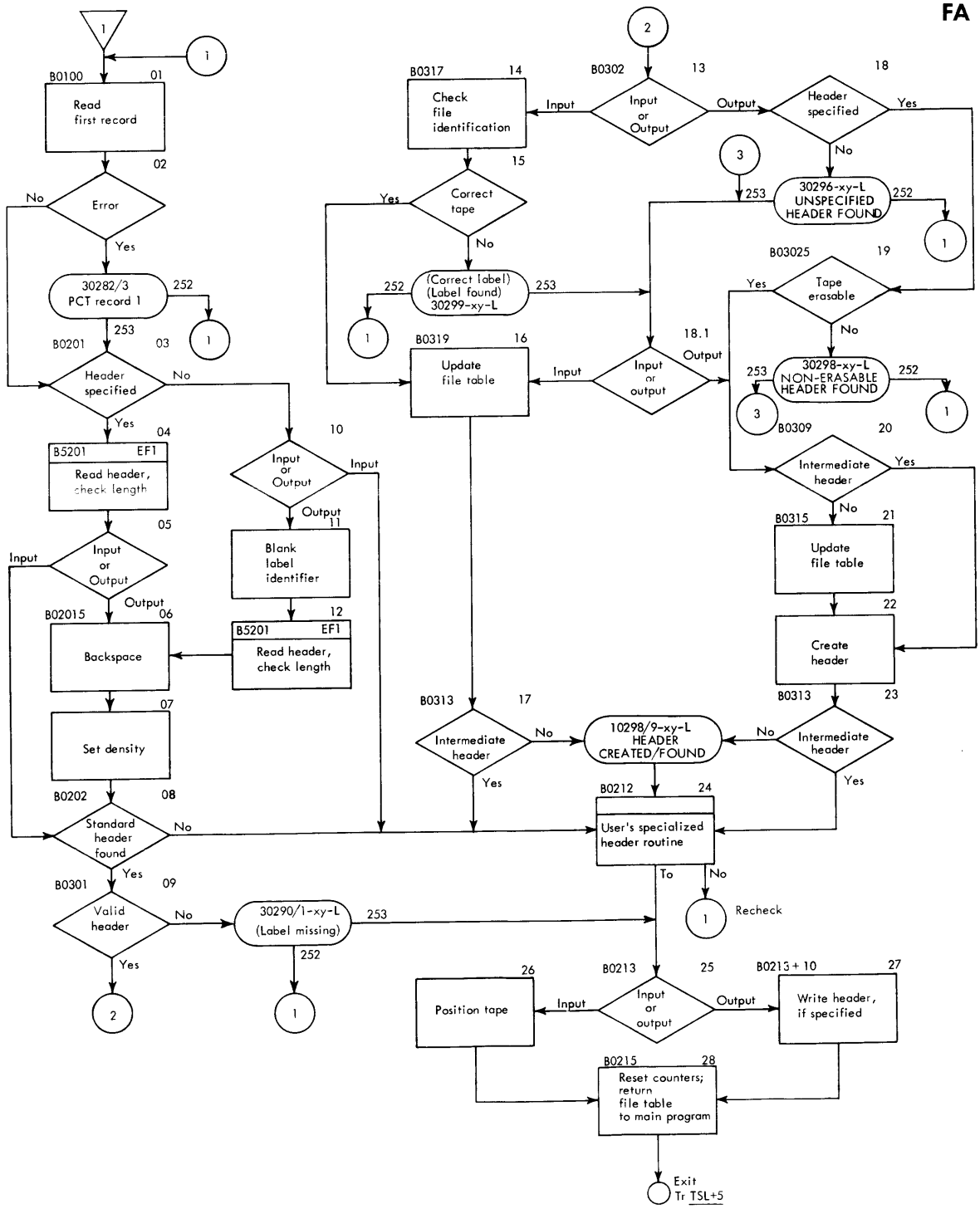


Chart FA. Open Routine—CSTRS

Memory Record (CSMRD)

CSMRD records the status of a computer at certain error-free points (checkpoints) during a production run. The recorded status (memory record) includes the contents of memory, the contents of the storage banks, the settings of alteration switches 0911-0915, and the position of all channel tape units. This memory record is created so that, if required, the restart program (CSMRS) can subsequently return the machine and the program to the status they were in when the checkpoint was taken.

The memory record routine (CSMRD) and the memory restore program (CSMRS) make it possible to:

1. Terminate the processing of a program at a point of partial completion, and subsequently restart the program from that point.
2. Resume processing from an intermediate point, rather than from the beginning of a job, when an impassable error occurs.

CSMRD requires that a checkpoint tape be specified in the checkpoint output tape entry, W18, of the special tape table. If no checkpoint tape is specified, CSMRD is never entered.

When checkpoint records are placed on a special tape, the recording of memory may occur at the following points in a program (based on parameters given in the file table):

1. Any input or output end of reel.
2. Any input or output final end of file or intermediate end of file.
3. Memory may be recorded at any time through the macro-instruction, IOLNK to CSMRD.

If an output tape is designated as the checkpoint output tape, the recording of memory occurs only when an end of reel on the checkpoint output tape is encountered. (The checkpoint is actually written at the beginning of the next reel, which must be on the same channel.)

If either a separate tape or an output tape is used as the checkpoint output tape, a checkpoint is automatically executed at the completion of CSHSK.

Checkpoint Routine

Block GA01, G02: Whether the checkpoint routine is entered from within IOCS or through linkage from the main program, pivot point G02 is used to transfer to G0201, the first instruction of the checkpoint routine.

At G0201, the all-channel hold switch is turned on by setting the 2 bit of D006502 to one. At G01, the 1 bit of G0015 is set to zero to indicate that the checkpoint routine is busy. An all-channel hold is executed through linkage to D6501. The purpose of the hold is to insure that channel operations are complete and that all channels are ready.

Block GA02: The checkpoint number in message 10240 is updated by adding 1 to G0050-1.

Block GA03: The checkpoint counter, G0014, in the checkpoint load control record is increased by 1.

Block GA04, G03: Each octant, 20K section, of memory is searched for redundancies before it is written on the checkpoint output tape.

Octant validity-checking is a two-part operation performed by the error correction section of IOCS. The first redundancy search begins at C0701 to determine if a given octant contains redundancies. If redundancies are located within an octant, control transfers to C0703 to locate and to correct the redundancies (see Chart DE).

An RWW—SND sequence of instructions performs a high-speed validity check (groups of five characters) on the contents of the octant, starting at the address of the first position of the octant and continuing to the end of the 20K block. Any invalid characters detected in the memory block cause the 0901 check indicator to be turned on, but do not cause a stop regardless of the setting of the 0901 switch.

As in any search, the high limit and the low limit of the search must be determined. In this octant-by-octant search, however, two sets of limits are involved. The low limit of memory is 000000; the high limit of memory is either 079999 or 159999. The low limit of an octant is XX0000; the high limit of an octant is XX9999.

At G03, the high limit (G0023) of memory, as determined in block FA18, is loaded into CASU 06. The low limit of memory (initially 000000) is loaded into CASU 09. Control then links to the redundancy search routine which begins at C0701 and ends at C0799+1.

At C0701, the MRD entry switch is turned on by setting the 1 bit of C0050 to zero. The 0901 indicator is turned off by a TMC to self plus 5. The high search address is saved in C1007. The low search address is saved in C10001. The low search address (000000) is also put into CASU 06.

At C0713, a 4 is added to the low address to obtain the send address at C0715. The send address of the low limit is increased by 19995 to obtain the high limit of this particular octant. The first time through, this is 19995; the second time 39995, etc. The high address of the octant to be scanned is placed in C1005 and is compared to C1007, the high search address. If this is the last octant to be scanned, this is indicated at C0716 where the 4 bit of C00050 is set to one; if it is not, the 4 bit is set to zero.

C0714 and C0715 contain the RWW and SND instructions, respectively, used to validity-check an octant. Because the send address is initialized to the beginning of the octant, this sequence of instructions checks the validity of the entire octant.

Block GA05, C0715+5: If a redundancy occurs within the octant, control passes to C0703 where each redundancy is located and corrected (Chart DE).

Block GA06, C0717: If no redundancies are found, the 4 bit at C00050 is interrogated to determine if all octants have been searched. The 4 bit one indicates that all octants have been searched; 4 bit zero means that at least one more octant remains to be searched.

If another search is indicated, control transfers to C071501 where 1 is added to CASU 06 to obtain the starting address of the next octant to be scanned. This modified address is placed in C10001. At C0713, the send instruction operand is obtained by adding 4 to the starting address. After all octants have been searched, the 1 bit at C00050 is interrogated to determine if the MRD entry switch is on. The 1 bit zero at C00050 indicates that the switch is on; 1 bit one means that it is off. This switch is turned on when the redundancy search routine is used by the checkpoint routine. Its purpose is to allow a direct return to CSMRD, and thus avoid the possible indirect transfer at C07991.

NOTE: Switch C00050 is located in the CSERR switch area. It is used both as a MRD entry switch and as the internal entry switch (shown in block DA21). The 1 bit zero indicates that the MRD entry switch is on; 1 bit one means that it is off. The A bit one indicates that the internal entry switch is on; A bit zero means that it is off. The 4 bit zero indicates that more octants remain to be scanned; 4 bit one means that no octants remain.

Because the MRD entry switch was turned on when the transfer was made to this CSERR redundancy search routine, control transfers at C0717+10 to C0719 to turn off the MRD entry switch and to transfer directly to the address at C0799. The transfer is to the TSL+5 of the originating linkage or to G0102 in the checkpoint routine.

WORK TAPE

Block GA07, G0102: During the housekeeping initialization of the checkpoint routine, switches G0102, G0105, and G0901 are set to NOP if a checkpoint work tape is specified, and to TR if no work tape is specified.

Block GA08: If a checkpoint work tape has been specified, control links to A500601 to move the work tape file table into the work area.

Address 078975 or 158975, placed at G0042 during the checkpoint initialization in block FA18, is the starting address of the work area which contains the 1,024-character contents of storage and the alteration-switches character. These latter 1,025 positions of memory are saved by first placing the starting address in the output area address field, F000205, and then linking to D6021 to dump this memory field on the checkpoint work tape.

Block GA09: The work tape is positioned to read in this 1,025-character record through linkage to D6034, the backspace routine.

Block GA10, G0103: After the upper memory work area is saved on the work tape, or if no work tape is specified, control passes to G0103 where the file table for the checkpoint output tape is put into the file table work area.

The 1 bit of S0050041 is set to zero to insure that all messages during checkpoint are to be written on the typewriter, not on the message tape.

Message 10240-xy-zzzzzz is written to inform the operator that checkpoint zzzzzz is being taken on output tape xy.

The 2 bit of G0015 is set to one to indicate to the subsequent restart program (CSMRS) that the nonstop switch is on. Then a TRA 07 (interrogate nonstop switch) is executed. If the nonstop switch is off, no transfer is effected and the next instruction sets the 2 bit zero to indicate that the switch is off. If the nonstop switch is on, control transfers around the SBZ instruction.

LOAD CONTROL RECORD

Block GA11: The A bit of G0015 is set to zero to indicate that a checkpoint is being written. The starting address of the checkpoint load control record is placed in the output area address field, F000205. The 85-character checkpoint load control record (Figures 8 and 9) is written on the checkpoint output tape through linkage to D6020.

If an end of reel occurs, control transfers to G0901 where, if a checkpoint work tape is being used, the 1,025-position upper memory work area previously written on the work tape is restored.

At G0902, a BSF is executed on the checkpoint output tape. If the I/O indicator comes on during the opera-

Location	Tag	Purpose of Field
2755-2759		An EEM instruction.
2760-2764		A RCV 1004 instruction. This is the CSMRS label work area.
2765-2769		A TMT 0024 instruction used to save control information in the last 65 characters of this 85-character load control record.
2770-2774		A TIP 1024 instruction to load the CSMRS program.
2775	G0011	The checkpoint indicator of the checkpoint output tape.
2776-2779	G0012	The select address of the checkpoint output tape.
2780	G0013	The number of octants to be recorded.
2781-2784	G0014	Checkpoint counter.
2785	G0015	Bit switches: A = 0, checkpoint in process; 4 = 1, restart call from memory; 2 = 1, non-stop switch on; 1 = 0, CSMRD busy.
2786-2789		The IOCS address to which control will be returned when restart is complete. An ACON4 of CSH0991.
2790	G0016	The label indicator of the checkpoint output tape.
2791-2794	G00161	The starting location of the tape tables.
2795		A select operation code.
2796-2799	G0018	The select address of the restart program tape.
2800-2804	G00181	This field contains a NOP instruction if the restart is from the card reader. If the restart is from tape, the field contains an IOF instruction to turn off the I/O indicator.
2805-2809		A NOP instruction that may be used to set tape density, if desired.
2810-2814	G0019	This field contains a NOP instruction if the restart is from card reader, and a RWD instruction if the restart is from tape.
2815-2819		A RD0000 instruction to begin loading the CSMRS program.
2820-2824		A TSA 0004 instruction to insure a read and hold condition if the restart program is on tape.
2825-2829		A TR 0004 instruction to begin the CSMRS program.
2830-2834		1***C: A checkpoint header label.
2835-2839		bMRS#: Restart identification, followed by a record mark to stop transmission.
2840		A group mark to stop a write.

Note: The above memory addresses refer only to the preassembled program.

Figure 8. Checkpoint Load Control Record

tion, indicating that load point is reached, control transfers to G0904. If the backspace file is not at load point, control links to D6011 to forward space over the tape mark just detected. If the I/O indicator comes on during this operation, control transfers to G0904.

If the I/O indicator does not come on during the forward space over the alleged tape mark, control links to D6034 to backspace over what is suspected to be a noise record. Control then passes to G0902 to retry the backspace file. (A BSF operation is terminated by any 2-character record.)

At G0904, control links to D6031 to write a tape mark on the checkpoint output tape. The low limit address of the octant, G0045, is initialized to 000000. Control transfers to E020502 where the 1 bit of W0020 is set to zero to indicate the end-of-reel condition on the checkpoint output tape. Control then passes to E0206, block EB02.

Block GA12, G01041: Storage bank 2 is unloaded into G0037. At G01042, storage bank 1 is unloaded into G0036. At G01043, storage bank 0 is unloaded into G0035. At G01044, storage bank 3 is unloaded into G0038.

Block GA13: The alteration-switches character is prepared as follows: A group mark is placed at G0024, the work area for the alteration-switches character. This initializes all bits one, indicating that alteration switches 0911-0915 are on.

If 0911 is off, the 1 bit is set to zero. If 0912 is off, the 2 bit is set to zero. If 9013 is off, the 4 bit is set to zero. If 0914 is off, the 8 bit is set to zero. If 0915 is off, the A bit is set to zero. At G01045, the alteration-switches character is moved from the work area to the output area (either 079999 or 159999).

STORAGE BANKS

Block GA14: The address of the 1,025-character work area is placed in the output area address field, F000205. Control links to D6021 to dump the record containing the storage banks and alteration-switches character on the checkpoint output tape. An end-of-reel condition occurring during the write operation is handled as described in block GA11.

Block GA15, G0105: If a work tape is specified (switch G0105 NOP), control links to G0501 to restore the 1,025-position upper memory area previously written on the work tape. The checkpoint output tape file table is returned to the main program, and the checkpoint work tape file table is placed in the file table work area.

If no work tape is specified (switch G0105 TR), control transfers to G0106 where the number of octants to be dumped (G0013) is saved at G0024. Control then passes to G0107, block GA17.

Block GA16: At G0502, the work area starting address saved in G0042 is placed in the input area address field, F000205. Control links to D6010 to read the work tape, thus restoring the last 1,025 memory positions.

The data memory address (SMAC) is loaded into CASU 04 and compared to zero. If all 1,025 characters are read from the work tape, SMAC is 0000. If SMAC is

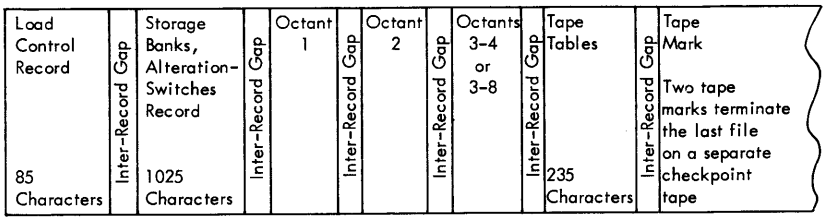


Figure 9. Checkpoint File Image

not zero, control passes to G0509, where message 30241-xy-BSP FAIL is written to inform the operator that memory is not properly restored. Pressing interrupt key 253 causes a restart from the last checkpoint. Pressing interrupt key 252 causes a backspace and reread of the work tape in another attempt to restore memory.

If the 1,025-position memory address is properly restored (SMAC=0000), the work tape is repositioned through linkage to the backspace routine at D6034. The checkpoint output tape file table is moved into the file table work area.

At G0599, control transfers to the TSL+5 of the originating linkage. The return is to G0106 where the number of octants to be dumped (G0013) is saved in G0024.

DUMP OCTANTS

Block GA17, G0107: The starting address of a given octant (initially 0000) is placed in the output area address field F000205 of the file table work area. The first octant is dumped on the checkpoint output tape through linkage to D6021.

An end-of-reel condition occurring during the write operation is handled as described in block GA11.

Block GA18: The number of octants to be dumped (G0024) is decreased by 1. If there are remaining octants to be dumped, the dump address (G0045) is stepped by 20K. Control returns to G0107 to dump the next octant. This loop continues until all octants have been written on the checkpoint output tape.

TAPE TABLES

Block GA19, G0108: After all octants have been dumped, the dump address G0045 is initialized to 000000.

The starting address of the tape tables (G00161) is placed in the output area address field, F000205. The 235-character tape table record is written on the checkpoint output tape through linkage to D6020. The write operation includes both the regular tape table and the special tape table and is terminated by the group mark at the end of the special tape table. Note that the program tape entry W21 is not written. An end-of-reel condition occurring during the write operation is handled as described in block GA11.

TAPE MARKS

Block GA20: The first of two tape marks is written on the checkpoint output tape through linkage to D6031. The second of the two tape marks is written on the checkpoint output tape through linkage to D6031. An end-of-reel condition occurring during the write operation is handled as described in block GA11.

Block GA21: The checkpoint output tape is backspaced via linkage to D6034 to position the tape between the two tape marks. When the next checkpoint is written, the second tape mark is overlaid. Therefore, every checkpoint file except the latest is terminated by one tape mark.

Block GA22, G01081: The checkpoint-in-process indicator is turned off by setting the A bit of G0015 to one. The 1 bit of S0050041 is set to one to allow messages on tape. The CSMRD busy switch is turned off by setting the 1 bit of G0015 to one. The checkpoint output file table is returned to the main program via linkage to B02155.

If alteration switch 0916 is on, control transfers to G0198 where message 30260-DISCONTINUE is written to inform the operator that a checkpoint has been completed, and that the program may be temporarily discontinued. If the program is to be discontinued, pressing interrupt key 253 causes the rewinding of all tapes and the writing of message 00260-DISCONTINUE.

At G0109, if alteration switch 0916 is off or processing is to be continued and interrupt key 252 is pressed following message 30260, control transfers to D6601 to execute an all-channel restart. The all-channel restart routine begins at D6610. After channel 23 is restarted, a subsequent transfer to pivot point D994822 results in a LIP 9. Thus, the checkpoint operation is complete, and control returns to the main program instruction found in CASU 15.

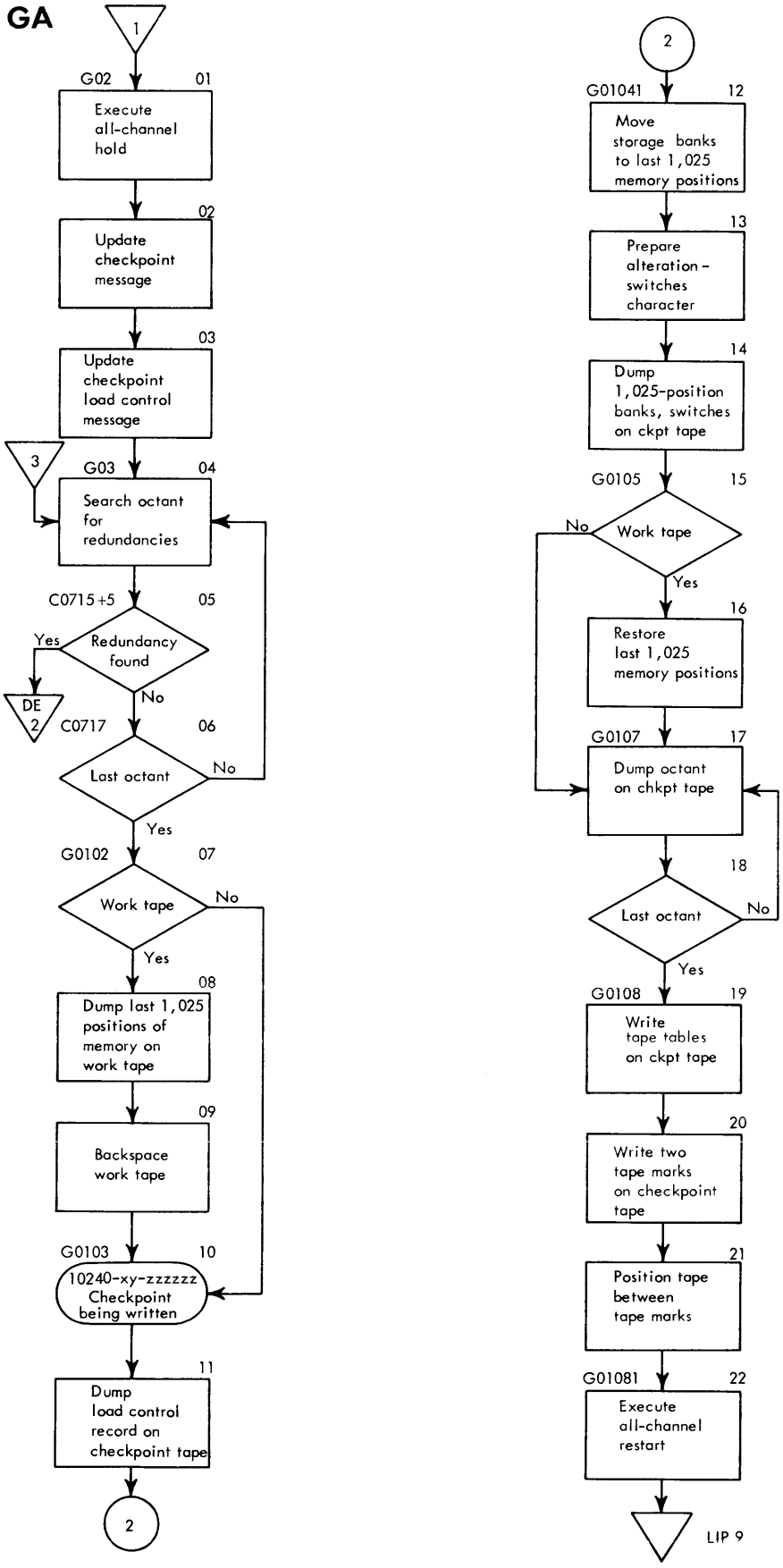


Chart GA. Checkpoint–CSMRD

The Memory Restore System for the IBM 7080 (CSMRS) is a restart program used in conjunction with an object program using the 7080 Input/Output Control System. The version of 7080 IOCS used must contain the Memory Record section (CSMRD).

CSMRS restarts a program at a previous checkpoint. It re-establishes the machine and the program to the status they were in when the memory record was written. IOCS contains two routines which work with CSMRS to restart a program. The routine beginning at H0101 is used when restarting from memory (when the contents of memory have not been destroyed, and an impassable error has occurred). The routine beginning at H0991 is used when restarting from tape (when processing of the program has been discontinued).

Restarting From Memory

A restart from memory during a production run is initiated in any of the following ways:

1. By a TR (if in interrupt program) or a TIP (if not in interrupt program) to H01 in the IOCS80 common entry points. At H01, control transfers to H0101 to begin the restart operation. Here, the 4 bit is set to one at G0015 in the checkpoint load control record to indicate to the restart program that the restart is from memory. The autoload of the checkpoint load control record is simulated by moving the 85-character record into memory positions 0000-0084, and transferring to 0004 to begin the restart operation.
2. By the IOLNK to CSMRS macro-instruction, which effects a transfer to H01.
3. By taking option 252 at message 30219 or message 30222. The former effects a transfer to H01; the latter a transfer to C0105, which is a transfer to H01.
4. By taking option 253 at messages 30220, 30224, 30225, 30227, or 30241. The first effects a transfer to C0105, which is a transfer to H01; the others effect a transfer to H01.

CSMRS RESTART PROGRAM

This program performs the six following functions:

Locates the desired checkpoint file.

Positions all tapes.

Verifies the settings of alteration switches 0911-0915.

Restores the storage banks.

Restores all octants of memory that were recorded at checkpoint.

NOTE: the last octant is read by a routine which is located in the IOCS tape table area.

Transfers control to the exit address, H0991, located in the checkpoint load control record.

H0991 is the location of the first instruction of the IOCS end-of-restart routine. The purpose of this routine is to complete the restoration of memory and to return control to the main program.

At H0991, the starting address of the tape tables (L,B3001 in the load control record) is placed in F000205, the area-in-use field. Control links to D6010 to read the tape tables from the checkpoint output tape into memory.

At H0991+20, because the tape tables are the last record of the checkpoint file, control links to the FSP routine at D6011 to determine if the file contains a tape mark. If no tape mark is found, message 00265-XY-TM TROUBLE is written to inform the console operator that the checkpoint file is improperly terminated. Pressing either interrupt key 252 or 253 causes the message to be written again; the program cannot proceed.

NOTE: Though the machine and the program may have been properly restored at this point, the absence of a tape mark on the checkpoint file suggests possible trouble on the checkpoint output tape.

If the terminating tape mark is found, control transfers to H0994 where the I/O indicator is turned off. Control then transfers to G01081 where the checkpoint-in-process indicator is turned off by setting the A bit of G0015 to one. Messages on tape are again allowed by setting the 1 bit of S0050041 to one. The MRD busy switch in the load control record is turned off by setting the 1 bit of G0015 to one. Control links to B02155 to return the checkpoint output file table to its main program location.

If alteration switch 0916 is on, control transfers to G0198 where message 30260-DISCONTINUE is written to give the operator the 253 option of discontinuing the program (in which case all tapes are rewound and the cannot-proceed message 00260 is written), or the 252 option of continuing processing.

If alteration switch 0916 is off, or option 252 is taken following message 30260, control passes to G0109 where a transfer is made to D6601 to execute an all-channel restart. After channel 23 is restarted, a subsequent transfer to the DTS pivot point, D994822, results in a LIP 9. Thus, the restart operation is complete, and control returns to the main program instruction as found in CASU 15.

Programming Condition Analysis Aids

This section contains information common to all versions of IOCS. Figure 10 shows the size relationship among the four versions of IOCS.

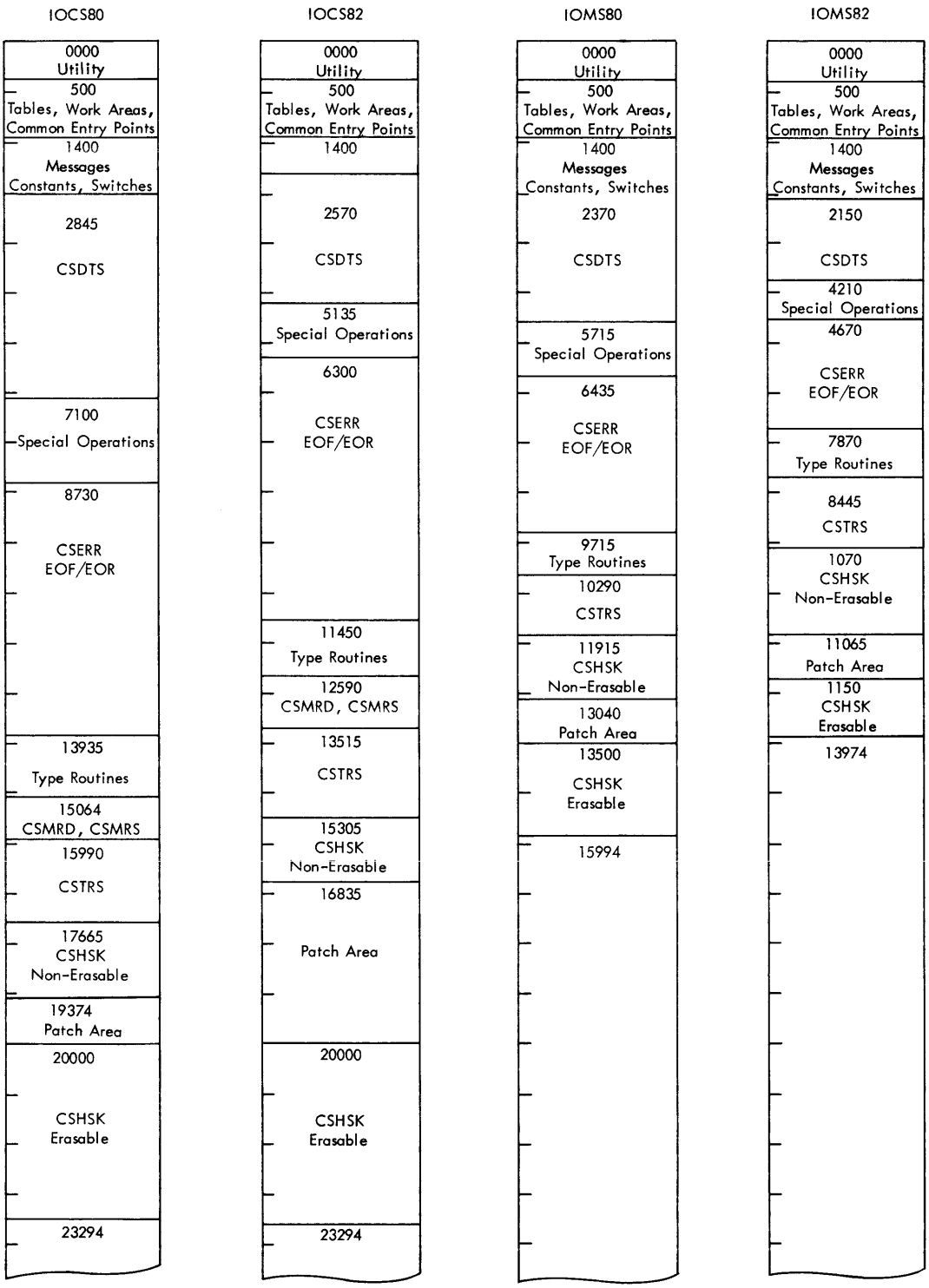


Figure 10. Storage Layouts

Storage Maps

IOCS80

Shown below is the storage map for the IOCS80. Memory locations refer to the pre-assembled program; the tags are valid for all versions and listings. (See Figure 11.)

Symbolic Location, if any		
From	To	Comments
-- 0000	-- 500	Utility programs
B3001 500	-- 699	Regular tape table entries for up to 4(tape units
-- 700	-- 704	Terminating entry, Abbb‡
W18 705	W17 729	Special tape table; up to 5 functions
-- 730	-- 734	Terminating entry, Abbb ‡
W21 735	-- 739	Program tape entry
W21 740	W16 779	Control word
-- 780	-- 799	Not used
F000101 800	F000205 919	File table work area
B0001 920	B0011 1034	Header and intermediate end-of-file label work area
B0020 920	B0027 999	Trailer label work area
A0400501 920	A0400504 999	Date control card work area
A0400511 920	A0400513 999	File serial header control card work area
A0400521 920	A0400523 999	Cycle header control card work area
D000203 1035	D007412 1129	DTS common work area
C1009 1130	C10010 1134	IOREDUNAD
J01 1135	X10+5 1399	Common entry points
C0093 1400	B028001 1829	Messages
D004001 1830	D006502 1836	DTS common bit switches
-- 1837	-- 1839	Not used
D003599 1840	-- 2014	CSDTS constants
C00014 2015	E0002 2079	CSERR constants
G0023 2080	G0045 2104	MRD constants
B0040 2105	B0044 2129	TRS constants
D004002 2130	-- 2579	DTS channel work areas
E10014 2580	E1008 2614	TSA channel entry work area
C1001 2615	C10013 2649	CSERR work area

Symbolic Location, if any		
From	To	Comments
S0000 2650	S0010 2690	Message work area
S006001 2691	S005010 2754	Constant and save areas
G0010 2755	-- 2840	Checkpoint load control record
-- 2841	-- 2844	Not used
D2001 2845	-- 2979	Read-write request entry channel 20
D200110 2980	-- 3009	Stack, channel 20
D200205 3010	-- 3029	LIP to loop, channel 20
D200211 3030	D200213 3044	Loop, channel 20
D2003 3045	-- 3154	Interrupt entry, channel 20
D200320 3155	-- 3219	Wait switch, move up stacking table, channel 20
D200501 3220	-- 3359	Start new operation, channel 20
D200451 3360	D200465 3409	Link to common length check routine, channel 20
D200401 3410	-- 3474	Link to common error routine
D200350 3475	-- 3574	EOF, force counter zero, channel 20
D2101 3575	-- 4304	DTS routines, channel 21; similar to channel 20
D2201 4305	-- 5034	DTS routines, channel 22; similar to channel 20
D2301 5035	-- 5764	DTS routines, channel 23; similar to channel 20
D400101 5765	D400199 5889	Length check routine for fixed length records
D400201 5890	-- 5989	Length check routine for variable length records
D4520 5990	-- 6059	Improper operation messages
D6010 6060	-- 6104	Little DTS, read
D6011 6105	-- 6129	Little DTS, forward space
D6020 6130	-- 6144	Little DTS, write
D6021 6145	-- 6159	Little DTS, dump
D6031 6160	-- 6174	Little DTS, write tape mark
D6034 6175	-- 6184	Little DTS, backspace

Figure 11. Storage Map, IOCS80, page 1 of 2

Symbolic Location, if any		
From	To	Comments
D6035 6185	-- 6194	Little DTS, backspace file
D6039 6195	D6095 6229	Little DTS, skip
-- 6230	-- 6259	Split by channel
D6151 6260	D6159 6304	Little DTS, LIP to loop
D6301 6305	-- 6549	Little DTS, checking routine
D206101 6550	-- 6579	Channel 20 routine for little DTS
D216101 6580	-- 6609	Channel 21 routine for little DTS
D226101 6610	-- 6639	Channel 22 routine for little DTS
D236101 6640	-- 6669	Channel 23 routine for little DTS
D6502 6670	D6595+10 6859	All channel hold routine
D6610 6860	-- 6914	All channel restart routine
D206701 6915	D6799 7079	Single channel hold routines
D700101 7100	D7005 7189	Special operations, DTS
D207001 7190	-- 7409	Special operations, channel 20
D217001 7410	-- 7624	Special operations, channel 21
D227001 7625	-- 7839	Special operations, channel 22
D237001 7840	-- 8054	Special operations, channel 23
D7101 8055	D74022+5 8199	Search stacking table routine
D7190 8200	-- 8499	Special operations decoding
D8101 8500	-- 8719	Write messages, and dump records
D8120 8720	-- 8729	Halt, PCT on RMA
E0101 8730	C0802+5 9074	TSA common entry
C0802+10 9075	-- 9344	EOF initialization
E030101-10 9345	-- 11534	EOF/EOR processing
C0101 11535	-- 11814	Record length error routine
C0201 11815	C030403+5 12784	Redundancy routine
C0401 12785	C0405+5 12914	Routine to calculate exact record length
C0502 12915	-- 13299	Re-execute operation routine
C0702 13300	C0716+5 13854	Redundancy search routine

Symbolic Location, if any		
From	To	Comments
C0803 13855	C020703+5 13934	Internal entry and exit
S01 13935	S61+5 14209	IOCS type subroutine
S8001 14210	-- 15009	Decision routine
A501001 15010	A501099 15059	Subroutine to set up CASU's
G0201 15064	-- 15884	Checkpoint routine
H0101 15885	-- 15904	Beginning of restart routine
H0991 15905	H0993 15989	End of restart routine
B02 15990	-- 16139	Delayed open operation
B0100 16140	B5399 17664	Regular open operation
A500601 17665	A500699 17704	Send file table to work area
A500101 17705	A500110 17819	Subroutine to separate tape table entries
A0901 17820	A09013+10 18004	Prime, areas initialized
A0902 18005	-- 18159	Prime, areas not initialized
A0910 18160	A1999 19374	Prime, EOR mode 1
-- 19374	-- 19999	Reserved for patches
A028005 20000	A038007 20256	CSHSK messages, erasable
-- 20257	-- 20259	Not used
A0100 20260	-- --	Begin erasable CSHSK
A0100 20260	-- 20454	Initialize channels
-- 20455	-- 20539	Initialize CSERR, CSTRS routines
-- 20540	-- 21134	Checkpoint initialization
A0221 21135	A0245 21144	Tape table work areas
A0250 21145	-- 21719	Check tape tables, initialize file tables
A0300 21720	-- 22134	Reset counters, rewind
A0351 22135	-- 22269	Recheck standard output headers
A9000 22270	-- 22369	CSHSK constants
A9101 22370	-- 23319	Control card routine
A9108 23320	A9109 23328	CSHSK constants

Figure 11. Storage Map, IOCS80, page 2 of 2

IOCS82

Shown below is the storage map for the IOCS82. Memory locations refer to the pre-assembled program; the tags are valid for all versions and listings. (See Figure 12.)

Symbolic Location, if any		
From	To	Comments
-- 0000	-- 500	Utility programs
B3001 500	-- 699	Regular tape table entries for up to 40 tape units
-- 700	-- 704	Terminating entry, Abbb‡
W18 705	W17 729	Special tape table; up to 5 functions
-- 730	-- 734	Terminating entry, Abbb ‡
W21 735	-- 739	Program tape entry
W21 740	W16 779	Control word
-- 780	-- 799	Not used
F000101 800	F000205 919	File table work area
B0001 920	B0011 1034	Header and intermediate end-of-file label work area
B0020 920	B0027 999	Trailer label work area
A0400501 920	A0400504 999	Date control card work area
A0400511 920	A0400513 999	File serial header control card work area
A0400521 920	A0400523 999	Cycle header control card work area
D000203 1035	D007412 1129	DTS common work area
C1009 1130	C10010 1134	IOREDUNAD
J01 1135	X10+5 1399	Common entry points
C0093 1400	B028001 1829	Messages
D004001 1830	D006502 1836	DTS common bit switches
-- 1837	-- 1839	Not used
D003599 1840	-- 1934	CSDTS constants
C00014 1935	E0002 1999	CSERR constants
G0023 2000	G0045 2024	MRD constants
B0040 2025	B0042 2039	TRS constants
D004002 2040	-- 2289	DTS channel work areas
E10014 2290	E1008 2339	TSA channel entry work area
C1001 2340	C10013 2374	CSERR work area
S0002 2375	S0010 2415	Message work area

Symbolic Location, if any		
From	To	Comments
S006001 2416	S005010 2479	Constant and save areas
G0010 2480	-- 2565	Checkpoint load control record
-- 2566	-- 2569	Not used
D2001 2570	-- 2704	Read-write request entry, channel 20
D200110 2705	-- 2734	Stack, channel 20
D200205 2735	-- 2754	LIP to loop, channel 20
D200211 2755	D200213 2769	Loop, channel 20
D2003 2770	-- 2879	Interrupt entry, channel 20
D200320 2880	-- 2944	Wait switch, move up stacking table, channel 20
D200501 2945	-- 3084	Start new operation, channel 20
D200451 3085	D200465 3134	Link to common length check routine, channel 20
D200401 3135	-- 3199	Link to common error routine
D200350 3200	-- 3299	EOF, force counter zero, channel 20
D2101 3300	-- 4029	DTS routines, channel 21; similar to channel 20
D400101 4030	D400199 4154	Length check routine for fixed length records
D400201 4155	-- 4254	Length check routine for variable length records
D4520 4255	-- 4324	Improper operation messages
D6010 4325	-- 4369	Little DTS, read
D6011 4370	-- 4394	Little DTS, forward space
D6020 4395	-- 4409	Little DTS, write
D6021 4410	-- 4424	Little DTS, dump
D6031 4425	-- 4439	Little DTS, write tape mark
D6034 4440	-- 4449	Little DTS, backspace
D6035 4450	-- 4459	Little DTS, backspace file
D6039 4460	D6095 4494	Little DTS, skip
-- 4495	-- 4509	Split by channel
D6151 4510	D6159 4554	Little DTS, LIP to loop
D6301 4555	-- 4799	Little DTS, checking routine

Figure 12. Storage Map, IOCS82, page 1 of 2

Symbolic Location, if any		
From	To	Comments
D206101 4800	-- 4829	Channel 20 routine for little DTS
D216101 4830	-- 4859	Channel 20 routine for little DTS
D6502 4860	D6595+10 5004	All channel hold routine
D6610 5005	-- 5039	All channel restart routine
D206701 5040	D6799 5134	Single channel hold routines
D700101 5135	D7005 5224	Special operations, DTS
D207001 5225	-- 5444	Special operations, channel 20
D217001 5445	-- 5659	Special operations, channel 21
D7101 5660	D74022+5 5804	Search stacking table routine
D7190 5805	-- 6089	Special operations decoding
D8101 6090	-- 6289	Write messages, dump records
D8120 6290	-- 6299	Halt, PCT on RMA
E0101 6300	C0802+5 6564	TSA common entry
C0802+10 6665	-- 6834	EOF initialization
E030101-10 6835	-- 9049	EOF/EOR processing
C0101 9050	-- 9329	Record length error routine
C0201 9330	C030403+5 10299	Redundancy routine
C0401 10300	C0405+5 10429	Routine to calculate exact record length
C0502 10430	-- 10814	Re-execute operation routine
C0702 10815	C0716+5 11369	Redundancy search routine
C0803 11370	C020703+5 11449	Internal entry and exit
S01 11450	-- 12539	IOCS type subroutine
A501001 12540	A501099 12589	Subroutine to set up CASU's
G0201 12590	-- 13409	Checkpoint routine
H0101 13410	-- 13429	Beginning of restart routine
H0991 13430	H0993 13514	End of restart routine
B02 13515	-- 13664	Delay-open operation
B0100 13665	B5399 15304	Regular open operation

Symbolic Location, if any		
From	To	Comments
A500601 15305	A500699 15344	Send file table to work area
A500101 15345	A500110 15459	Subroutine to separate tape table entries
A0901 15460	A09013+10 15644	Prime, areas initialized
A0902 15645	-- 15799	Prime, areas not initialized
A0910 15800	A1999 16834	Prime, EOR mode 1
-- 16835	-- 19999	Reserved for patches
A028005 20000	A03007 20256	CSHSK messages, erasable
-- 20257	-- 20259	Not used
A0100 20260	-- --	Begin erasable CSHSK
A0100 20260	-- 20444	Initialize channels
-- 20445	-- 20529	Initialize CSERR, CSTRS
-- 20530	-- 21124	Checkpoint initialization
A0221 21125	A0245 21134	Tape table work areas
A0250 21135	-- 21684	Check tape tables, initialize file tables
A0300 21685	-- 22099	Reset counters, rewind
A0351 22100	-- 22234	Recheck standard output headers
A9000 22235	-- 22334	CSHSK constants
A9101 22335	-- 23284	Control card routine
A9108 23285	A9109 23293	CSHSK constants

Figure 12. Storage Map, IOCS82, page 2 of 2

IOMS80

Shown below is the storage map for the IOMS80. Memory locations refer to the pre-assembled program; the tags are valid for all versions and listings. (See Figure 13.)

Symbolic Location, if any		
From	To	Comments
--	--	Utility programs
0000	500	
B3001	--	Regular tape table entries for up to 40
500	699	tape units
--	--	Terminating entry, Abbb‡
700	704	
W18	W17	Special tape table; up to 5 functions
705	729	
--	--	Terminating entry, Abbb ‡
730	734	
W21	--	Program tape entry
735	739	
W21	W16	Control word
740	779	
--	--	Not used
780	799	
F000101	F000205	File table work area
800	919	
B0001	B0011	Header and intermediate end-of-file
920	1034	label work area
B0020	B0027	Trailer label work area
920	999	
A0400501	A0400504	Date control card work area
920	999	
A0400511	A0400513	File serial header control card work area
920	999	
A0400521	A0400523	Cycle header control card work area
920	999	
D000203	D007412	DTS common work area
1035	1129	
C1009	C10010	IOREDUNAD
1130	1134	
J01	X10+5	Common entry points
1135	1399	
C0093	B028001	Messages
1400	1689	
D004001	D006502	DTS common bit switches
1690	1695	
--	--	Not used
1696	1699	
D003599	--	CSDTS constants
1700	1754	
C00014	E0001	CSERR constants
1755	1818	
--	--	Not used
1819	1820	
D004002	--	DTS channel work areas
1821	2254	
E10014	E1008	TSA channel entry work area
2255	2289	
C1001	C10013	CSERR work area
2290	2314	
S0002	S0010	Message work area
2315	2350	
S006001	S005010	Constant and save areas
2351	2369	

Symbolic Location, if any		
From	To	Comments
D2001	--	Read-write request entry channel 20
2370	2469	
D200110	--	Stack, channel 20
2470	2499	
D200205	--	LIP to loop, channel 20
2500	2514	
D200211	D200213	Loop, channel 20
2515	2529	
D2003	--	Interrupt entry, channel 20
2530	2639	
D200320	--	Wait switch, move up stacking table,
2640	2694	channel 20
D200501	--	Start new operation, channel 20
2695	2789	
D200451	D200465	Link to common length check routine,
2790	2839	channel 20
D200401	--	Link to common error routine
2840	2884	
D200350	--	EOF, force counter zero, channel 20
2885	2959	
D2101	--	DTS routines, channel 21; similar to
2960	3539	channel 20
D2201	--	DTS routines, channel 22; similar to
3540	4119	channel 20
D2301	--	DTS routines, channel 23; similar to
4120	4699	channel 20
D400101	D400199	Length check routine for fixed length
4700	4824	records
D400201	--	Length check routine for variable
4825	4924	length records
D6010	--	Little DTS, read
4225	4964	
D6011	--	Little DTS, forward space
4965	4989	
D6020	--	Little DTS, write
4990	5004	
D6031	--	Little DTS, write tape mark
5005	5019	
D6034	--	Little DTS, backspace
5020	5029	
D6039	D6095	Little DTS, skip
5030	5064	
--	--	Split by channel
5065	5094	
D6151	D6159	Little DTS, LIP to loop
5095	5139	
D6301	--	Little DTS, checking routine
5140	5384	
D206101	--	Channel 20 routine for little DTS
5385	5414	
D216101	--	Channel 21 routine for little DTS
5415	5444	
D226101	--	Channel 22 routine for little DTS
5445	5474	
D236101	--	Channel 23 routine for little DTS
5475	5504	

Figure 13. Storage Map, IOMS80, page 1 of 2

Symbolic Location, if any		
From	To	Comments
D6502 5505	D6595+10 5659	All channel hold routine
D6610 5660	-- 5714	All channel restart routine
D700101 5715	D7005 5779	Special operations, DTS
D207001 5780	-- 5909	Special operations, channel 20
D217001 5910	-- 6039	Special operations, channel 21
D227001 6040	-- 6169	Special operations, channel 22
D237001 6170	-- 6299	Special operations, channel 23
D7101 6300	D7119 6434	Search stacking table routine
E0101 6435	C0802+5 6719	TSA common entry
C0802+10 6720	-- 6794	EOF initialization
E030101-25 6795	E011001+5 7599	EOF/EOR processing
C0101 7600	-- 7869	Record length error routine
C0201 7870	C030403+5 8794	Redundancy routine
C0401 8795	C0405+5 8924	Routine to calculate exact record length
C0502 8925	-- 9239	Re-execute operation routine
C0702 9240	C0799 9634	Redundancy search routine
C0803 9635	C020703+5 9714	Internal entry and exit
S01 9715	-- 9964	IOCS type subroutine
S8001 9965	-- 10289	Decision routine
B02 10290	-- 10429	Delay-open operation
B0100 10430	B5399 11914	Regular open operation
A500601 11915	A500699 11954	Send file table to work area
A500101 11955	A500110 12069	Subroutine to separate tape table entries
A0901 12070	A09013+10 12244	Prime, areas initialized
A0902 12245	A1999 13039	Prime, areas not initialized
-- 13040	-- 13499	Reserved for patches
A028005 13500	A038007 13756	CSHSK messages, erasable
-- 13757	-- 13759	Not used
A0100 13760	--	Begin erasable CSHSK

Symbolic Location, if any		
From	To	Comments
-- 13760	-- 14079	Initialize channels
A0221 14080	A0245 14089	Tape table work areas
A0250 14090	-- 14619	Check tape tables, initialize file tables
A0300 14620	-- 14929	Reset counters, rewind
A0350 14930	-- 15004	Recheck standard output headers
A9000 15005	-- 15044	CSHSK constants
A9101 15045	-- 15994	Control card routine

Figure 13. Storage Map, IOMS80, page 2 of 2

IOMS82

Shown below is the storage map for the IOMS82. Memory locations refer to the pre-assembled program; the tags are valid for all versions and listings. (See Figure 14.)

Symbolic Location, if any		
From	To	Comments
-- 0000	-- 500	Utility programs
B3001 500	-- 699	Regular tape table entries for up to 40 tape units
-- 700	-- 704	Terminating entry, Abbb‡
W18 705	W17 729	Special tape table; up to 5 functions
-- 730	-- 734	Terminating entry, Abbb ‡
W21 735	-- 739	Program tape entry
W21 740	W16 779	Control word
-- 780	-- 799	Not used
F000101 800	F000205 919	File table work area
B0001 920	B0011 1034	Header and intermediate end-of-file label work area
B0020 920	B0027 999	Trailer label work area
A0400501 920	A0400504 999	Date control card work area
A0400511 920	A0400513 999	File serial header control card work area
A0400521 920	A0400523 999	Cycle header control card work area
D000203 1035	D007412 1129	DTS common work area
C1009 1130	C10010 1134	IOREDUNAD
J01 1135	X10+5 1399	Common entry points
C0093 1400	B028001 1689	Messages
D004001 1690	D006502 1695	DTS common bit switches
-- 1696	-- 1699	Not used
D003599 1700	-- 1734	CSDTS constants
C00014 1735	E0002 1798	CSERR constants
-- 1799	-- 1800	Not used
D004002 1801	-- 2034	DTS channel work areas
E10014 2035	E1008 2069	TSA channel entry work area
C1001 2070	C10013 2094	CSERR work area
S0002 2095	S0010 2130	Message work area
S006001 2131	S005010 2149	Constant and save areas

Symbolic Location, if any		
From	To	Comments
D2001 2150	-- 2249	Read-write request entry channel 20
D200110 2250	-- 2279	Stack, channel 20
D200205 2280	-- 2294	LIP to loop, channel 20
D200211 2295	D200213 2309	Loop, channel 20
D2003 2310	-- 2419	Interrupt entry, channel 20
D200320 2420	-- 2474	Wait switch, move up stacking table, channel 20
D200501 2475	-- 2569	Start new operation, channel 20
D200451 2570	D200465 2619	Link to common length check routine, channel 20
D200401 2620	-- 2664	Link to common error routine
D200350 2665	-- 2739	EOF, force counter zero, channel 20
D2101 2740	-- 3319	DTS routines, channel 21; similar to channel 20
D400101 3320	D400199 3444	Length check routine for fixed length records
D400201 3445	-- 3544	Length check routine for variable length records
D6010 3545	-- 3584	Little DTS, read
D6011 3585	-- 3609	Little DTS, forward space
D6020 3610	-- 3624	Little DTS, write
D6031 3625	-- 3639	Little DTS, write tape mark
D6034 3640	-- 3649	Little DTS, backspace
D6039 3650	D6095 3684	Little DTS, skip
-- 3685	-- 3699	Split by channel
D6151 3700	D6159 3744	Little DTS, LIP to loop
D6301 3745	-- 3989	Little DTS, checking routine
D206101 3990	-- 4019	Channel 20 routine for little DTS
D216101 4020	-- 4049	Channel 21 routine for little DTS
D6502 4050	D6595+10 4174	All channel hold routine
D6610 4175	-- 4209	All channel restart routine
D700101 4210	D7005 4274	Special operations, DTS
D207001 4275	-- 4404	Special operations, channel 20
D217001 4405	-- 4534	Special operations, channel 21

Figure 14. Storage Map, IOMS82, page 1 of 2

Symbolic Location, if any		
From	To	Comments
D7101 4535	D7119 4669	Search stacking table routine
E0101 4670	C0802+5 4874	TSA common entry
C0802+10 4875	-- 4949	EOF initialization
E030101-25 4950	E11001+5 5754	EOF/EOR processing
C0101 5755	-- 6024	Record length error routine
C0201 6025	C030403+5 6949	Redundancy routine
C0401 6950	C0405+5 7079	Routine to calculate exact record length
C0502 7080	-- 7394	Re-execute operation routine
C0702 7395	C0799 7789	Redundancy search routine
C0803 7790	C020703+5 7869	Internal entry and exit
S01 7870	-- 8119	IOCS type subroutine
S8001 8120	-- 8444	Decision routine
B02 8445	-- 8584	Delay-open operation
B0100 8585	B5399 10069	Regular open operation
A500601 10070	A500699 10109	Send file table to work area
A500101 10110	A500110 10224	Subroutine to separate tape table entries
A0901 10225	A09013+10 10399	Prime, areas initialized
A0902 10400	-- 11064	Prime, areas not initialized
-- 11065	-- 11500	Reserved for patches
A028005 11500	A038007 11756	CSHSK messages, erasable
-- 11757	-- 11759	Not used
A0100 11760	-- --	Begin erasable CSHSK
-- 11760	-- 12069	Initialize channels
A0221 12070	A0245 12079	Tape table work areas
A0250 12080	-- 12609	Check tape tables, initialize file tables
A0300 12610	-- 12919	Reset counters, rewind
A0350 12920	-- 12984	Recheck standard output headers
A9000 12985	-- 13024	CSHSK constants
A9101 13025	-- 13974	Control card routine

Figure 14. Storage Map, IOMS82, page 2 of 2

General Information

IOCS Tags

With few exceptions, 7080 IOCS tags consist of three letters followed by up to seven numbers. The first two letters are CS to indicate that the tag is a 7080 IOCS tag. The third letter is a code referring to the section of the program in which the tag is located as shown in the following chart.

CSA	Housekeeping
CSB	Tape reel control system
CSC	Error correction
CSD	Data travel system
CSE	End of file
CSF	File table work area
CSG	Checkpoint
CSH	Restart
CSJ	Get/Put
CSM	Message
CSS	Type routines
CSW	Control word
CSX	Supervisor

Page and Line Index Numbers

IOCS80 is a preassembled, four-channel, all-option program. A reassembly is necessary to obtain any of the other versions (IOCS82, IOMS80, and IOMS82). The listing index numbers vary from one program to another; however, the PGLIN column on a new listing contains the index numbers of the original IOCS80 listing. This cross-reference between listing index numbers can be used to relate the routines from a revised IOCS to the complete, preassembled IOCS80.

Messages

All messages are originally set up to appear on the console typewriter. However, the programmer can change the message types, and thus place certain messages on a secondary output unit, or even ignore them.

To place all messages on the typewriter (for example, during a program investigation):

1. Save the four characters beginning at W08.
2. Store GGGG in their place.

All IOCS messages with the usual interrupt key 252/253 options are programmed in the same manner. If interrupt key 253 is used, control transfers indirectly to the second ADCON. If interrupt key 252 is used, control transfers directly to the second ADCON.

RCVS	CSS99+1 (message routine exit)
TSL	CSS02 (message routine entry)
ADCON	L, Tag (left hand end of message)
ADCON	Tag (253 option transfer address)

Message Pairing

Message numbers in flow charts and the listings are sometimes paired. For example, 30210/1 means message 30210 for an output tape and message 30211 for an input tape. Do not think of these as write/read, because a read error can occur on an output tape while reading a label, etc.

Interrupt Programs 252, 253

At S8003, the main program's 252 and 253 interrupt program location addresses are saved at S006005 and S006006, respectively. The 252, 253 interrupt program status bits are saved at S006008 and S006010, respectively.

The IOCS interrupt 252 program begins at S8010. This address is placed in the main program 252 interrupt location, SPC 2520. The IOCS interrupt 253 program begins at S8015. This address is placed in the main program 253 interrupt location, SPC 2530.

Both 252 and 253 interrupt program status bits are initialized at -&-- (7080 mode bit on, all others off). The main program 252, 253 interrupt program locations and status bits are restored (SPC 2520, 2524 and SPC 2530, 2534) after the option message is typed (S801001+30).

DTS Work Areas

The DTS common work area and the per-channel work area are shown in Figures 15 and 16, respectively. The internal operation codes (the CON of the CON-ACON4 resulting from an IOCS macro) appear in Figure 17.

Stacking Tables

At the completion of housekeeping, all input areas are assumed to be filled. The force counter is set to indicate this condition, whether priming is specified or not.

A run usually begins with a clear memory and channel reset. IOCS (including CSHSK) may remain in the machine between runs to save loading time. In this case, it is assumed that the stacking tables have all been cleared before EOJ on the previous run. If a run is discontinued with requests still in the stacking tables, IOCS should be reloaded because any old requests will be executed during the new run.

Channel Loops

The purpose of a IOCS waiting loop is to enable the machine to await the completion of an operation or console action. Loops are executed in the non-interrupt program because a channel interrupt must be able to break the loop.

A typical channel loop operation is shown in the listing at D2001, the read-write request entry for channel 20. The starting point counter is set to 3700 and a subsequent LFC instruction places the IC of the transfer instruction in the channel loop coding into CASU 15. Thus, a LIP 9 effectively transfers to D200213,

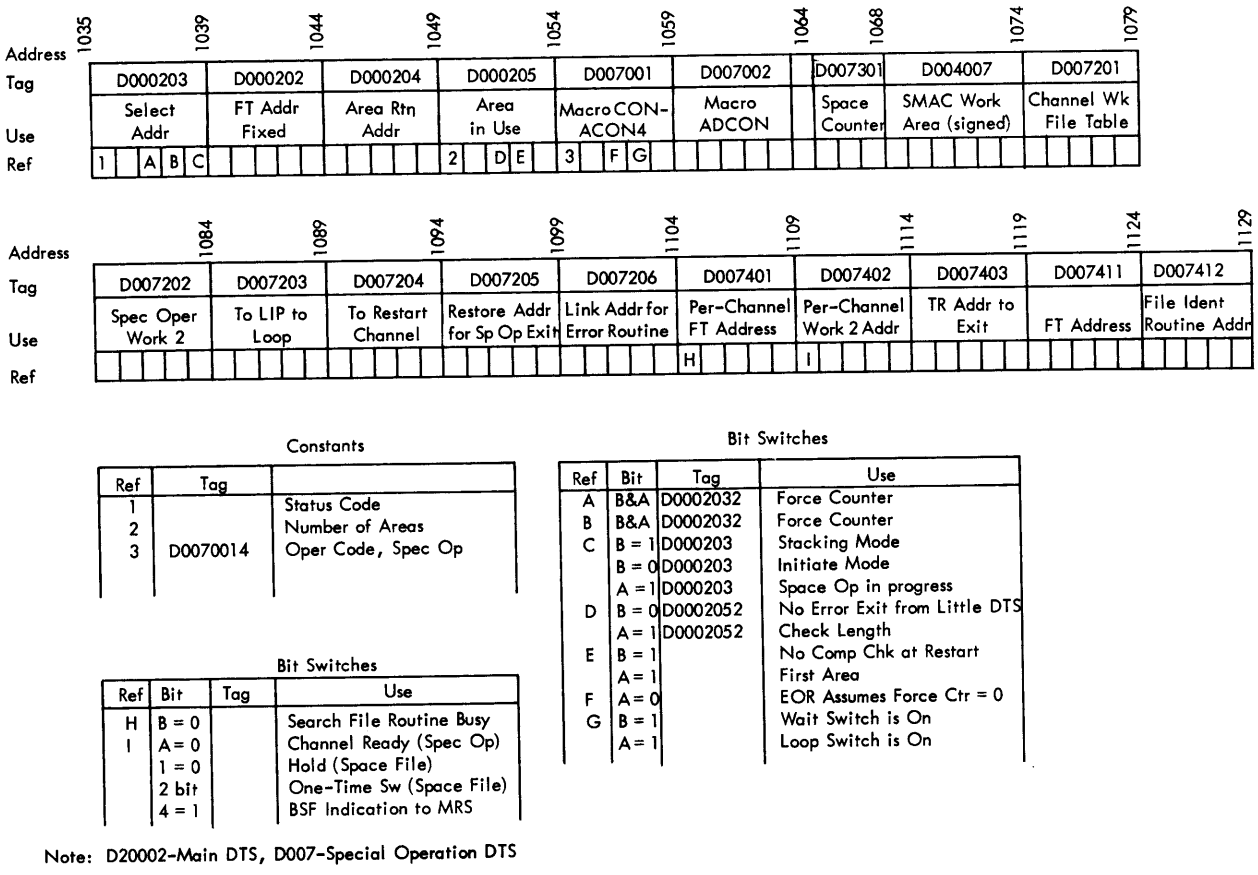


Figure 15. DTS Common Work Area

which is a transfer to D200211, the beginning of the loop. If the A bit of D1051011 was previously set to one status (this is the on condition of the loop switch over work 2), this 3-instruction coding loops until broken by a channel interrupt.

If the interrupt is on channel 20, the loop switch is turned off when the new ACON4 is placed in work 2. Thus, the next LIP 9 effectively transfers to D200211 again, but this time the TZB causes a transfer to D0099. This is the location of the main program IC+5 which was previously set up at D2001. Therefore, a LIP 9 now effects a transfer back to the next instruction in the main program.

If the interrupt occurred on another channel, a subsequent LIP 9 would effectively transfer back to the channel 20 loop. Other channels are thereby serviced.

Main Loop

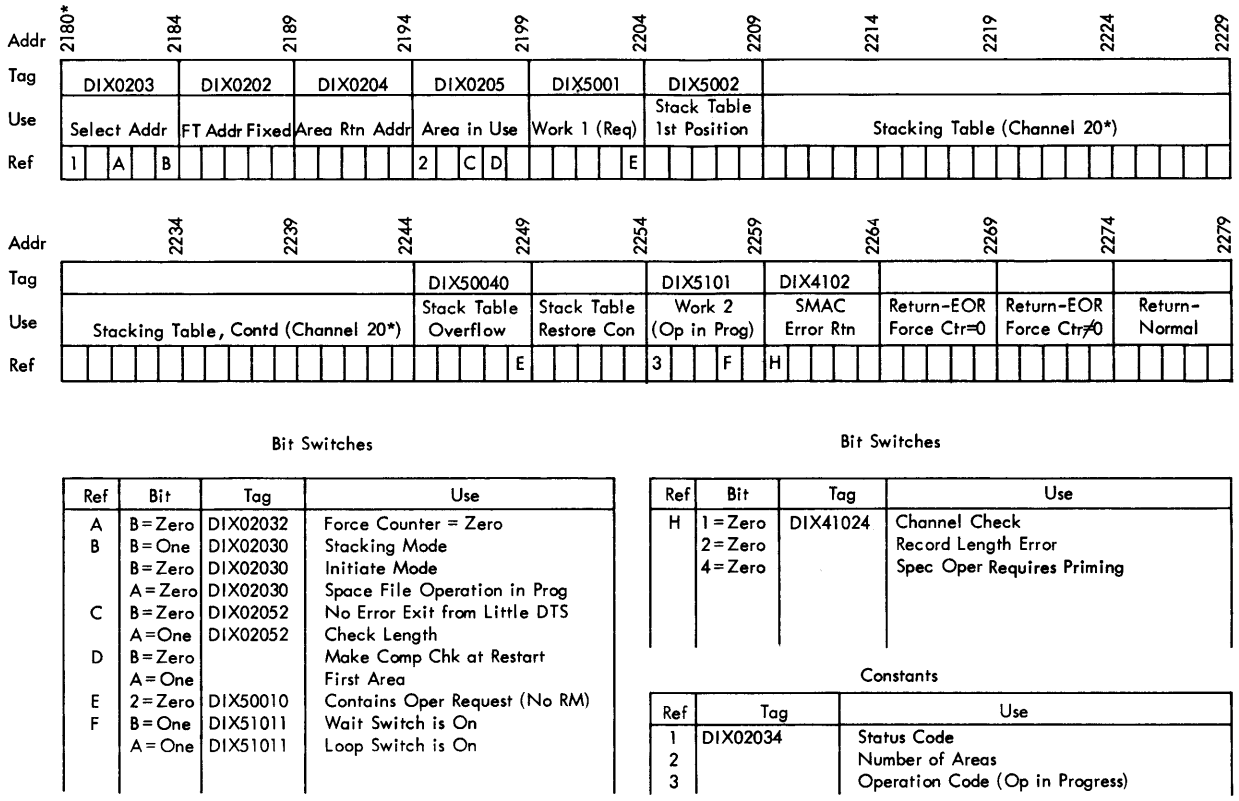
The 2-instruction main loop is located at D6201 and consists of a NOP followed by a transfer back to the NOP. The entry to the loop is at D994822. A LIP 9, or a transfer to D994822, returns control to CASU 15 where the address portion of the transfer instruction at D6202 is stored. This, effectively, is a transfer from the main program to D6202 which is a transfer to the preceding instruction at D6201. D6201 is the loop switch. When a DTS routine resets it (changes it from NOP to TR), the loop is broken.

Position D994822 is also used to indicate that an error condition is awaiting handling by the TSA routine. (See block DA12.) In this case, the LIP 9 at D994822 becomes a CNO to allow transfer to E0101 where the error is processed.

The IOCS type subroutine uses the main loop at D994822 to await console action following a message. The macro IODEC uses a loop of its own.

User's Specialized Routines

The user's specialized end-of-file, end-of-reel, and header routines are entered from and return to IOCS under a variety of conditions. The use of standard, nonstandard, or no labels determines the condition. This manual does not attempt to show how these routines are used in all circumstances; rather, particular uses are described as they appear in the charts of the major flow of the program.



Bit Switches

Ref	Bit	Tag	Use
A	B=Zero	DIX02032	Force Counter = Zero
B	B=One	DIX02030	Stacking Mode
	B=Zero	DIX02030	Initiate Mode
	A=Zero	DIX02030	Space File Operation in Prog
C	B=Zero	DIX02052	No Error Exit from Little DTS
	A=One	DIX02052	Check Length
D	B=Zero		Make Comp Chk at Restart
	A=One		First Area
E	2=Zero	DIX50010	Contains Oper Request (No RM)
F	B=One	DIX51011	Wait Switch is On
	A=One	DIX51011	Loop Switch is On

Bit Switches

Ref	Bit	Tag	Use
H	1=Zero	DIX41024	Channel Check
	2=Zero		Record Length Error
	4=Zero		Spec Oper Requires Priming

Constants

Ref	Tag	Use
1	DIX02034	Status Code
2		Number of Areas
3		Operation Code (Op in Progress)

* X = Channel Number Units Position. Chan 21 starts at 2280, 22 starts at 2380, 23 starts at 2480

Figure 16. DTS Per-Channel Work Area

NOTE: IOCS always transfers to a user's specialized routine in the interrupt program. The main program must not leave interrupt mode during the execution of the specialized routine.

SPC is set in bank 3.

The entry placed in the file table fields or the common linkage fields specifies (a) the address of a specialized routine to be transferred to by IOCS or (b) specifies that no specialized routine is desired.

A specialized routine is usually terminated by a transfer back to IOCS at IORETURNTO or IORETURNNO (see W002 through W006 in common entry points).

If no specialized routine is used, IORETURNTO is specified in the exit field.

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).

Usually, where a decision is made in the specialized routines, the yes exit is to IORETURNTO; the no exit is to IORETURNNO.

Linkages to specialized routines take the form of a RCVS W005+1 and an indirect TSL to the file table work area field containing the specialized routine transfer address. A return to IOCS at IORETURNTO results in a direct transfer to W005; a return at IORETURNNO results in an indirect transfer to W005. This is done by changing the CNO operation code at W004 to an EIA instruction when IORETURNNO is specified.

Channel Status Triggers Character

IOCS uses a RD 03 (Sense Status Triggers — SST) to recognize the particular error condition causing a channel check. At D6375, little DTS places the channel status trigger characters in tag E1003 (located in the TSA channel entry work area) on every retry of an operation in error. The two status trigger characters are typed as part of the following messages:

1. Message 30210/1
2. Message 30220/1
3. Message 10212/3

A no-error condition in the 7621 tape control unit is reflected as 88 in the two status trigger characters. However, a length error (with buffer not destroyed) also results in an 88 type-out.

Status trigger characters 8b and b8 may appear. The former indicates a possible timing failure in the

Operation	Operation Code (CON)	Bit Configuration						ADCON in Macro	HOLD in Operand	Includes Subroutine (Class B) Named
		B	A	8	4	2	1			
IORD	S		X			X			X	
IORDS	S		X			X		X	X	CS734
IOWR	K	X				X			X	
IOWRS	K	X				X		X	X	CS734
IODMP	B	X	X			X		X	X	CS734
IOFSP	3					X	X	X		CS731
IOBSP	T		X			X	X	X		CS731
IOPOS	1						X	X		CS731
IOFSF	R	X		X			X		X	CS740
IOFSF and Search	9			X			X	X	X	CS740
IOBSF	I	X	X	X			X		X	CS740
IOBSF and Search	Z		X	X			X	X	X	CS740
IOHLD (EOFCK)	2					X				CS736
IOHLD (OPEN)	#	X		X		X	X			
IOHLD/HOLD Opnd	0			X		X				
IORWD	W		X		X	X				
IORUN	F	X	X		X	X				
IOCLS	X		X		X	X	X			
CLSFINAL (Put Operand)	X		X		X	X	X			
IOMFC	P	X			X	X	X			
IOMFO	7				X	X	X			
IOFER	6				X	X		X		

Figure 17. Macro Operation Codes

WTC/SAR 8 check area; the latter indicates check character trouble.

Control Word

The control word is a 60-position field located between the tape tables and the file table work area.

The control word contains information relating to the object program as follows:

- W01, W02 — A 2-position year and 3-position day field read from columns 8-12 of the date control card.
- W03 — A 6-position field for program identification read from columns 1-6 of the date control card.
- W04 — A field containing IOCS identification information.
- W08 — A 4-position field relating to message types.
- W12 — A 1-position field, set up in housekeeping, relating to machine size.
- W13 — A 1-position field containing information needed by the label handling routines.
- W14 — A 2-position field relating to the size of stacking tables.
- W15 — An ACON4, used to save SPC, when specified by a SAVE operand of a get/put macro.
- W16 — An ADCON of the card reader address. A 20-position blank field follows.

Memory Print

A memory print of a program using IOCS contains much information which is necessary to understand the relationship between IOCS and the main program. By recognizing the key areas of IOCS, the trained observer can rapidly analyze the condition of the program at the time the memory print was made.

Regardless of the version of IOCS used, the first several hundred positions of memory (0500-1134 in the pre-assembled version) are almost identical, and a large part of the remainder of IOCS is very similar because of the per-channel routines. (See Figure 18.)

The following is a description of a sample memory print. Though not typical of a memory print taken of a large production run, this sample print illustrates the location and appearance of most of the important parts of IOCS such as the tape tables, the several work areas, select addresses, stacking tables, error counters, etc.

A memory print of any program which locates IOCS at address XX0500 contains the various areas in the same relative positions as shown in the sample print

Description of Memory Print

MEMORY POSITIONS	COMMENTS
0000-0500	Reserved for utility programs.
0500-0699	Regular tape table entries. There is room for 40 five-character entries.
0500-0524	Five tape entries: base tape unit 2001, file table high-speed transmit address is 031104; tape unit 2105 first alternate to tape unit 2001; base tape unit 2102, file table address 031904; tape unit 2103, first alternate to tape unit 2102; tape unit 2104, second alternate to tape unit 2102.
0525-0529	Terminating entry after last significant tape entry in main section. The record mark means the entry terminates the regular section when fewer than 40 tapes are used.
0700-0704	Terminating entry following the regular section of the tape table.
0705-0729	Special function tape entries.
0705-0709	Checkpoint output tape entry, unused in this sample program.
0710-0714	Checkpoint work tape entry, unused in this program.
0715-0719	Dump tape entry. Because no tape is assigned, these positions are used to count error records dumped on the typewriter.
0720-0724	Message tape entry, unused in this sample program.
0725-0729	Control card tape entry, unused in this sample program.
0730-0734	Terminating entry. The group mark at 0734 means the entry terminates the special section of the tape table.
0735-0739	Program tape entry, unused in this sample program.
0740-0779	Control word.
0740-0744	Year-day.
0745-0750	Program identification.
0751-0755	IOCS identification message 10210.
0756-0757	The IOCS assembly number is 10.
0758	Blank.
0759-0760	The number of patches is 17.
0761	A group mark to end the message 10210 write operation.
0762	Blank.
0763-0766	Message class codes. GGGG means all messages are written on the typewriter.
0767	B means 160K. The 1 bit one means 80K.
0768	Bit switches for open routine.
0769-0770	Size of stacking tables, eight entries.
0771-0774	ACON4 of starting point counter.
0775-0779	ADCON of card reader address.
0780-0799	Blank.
0800-0919	File table work area.
0800-0804	F000101. Scheduler transfer address, a TR 3609 instruction.
0805	F0001024. Total number of alternates, 2.
0806-0807	F0001022. Current select address, tape unit 2102.
0808-0809	F000102. First alternate select address, tape unit 2103.
0810-0811	F0001033. Second alternate select address, tape unit 2104.
0812-0813	F0001031. Third alternate select address, unused in this sample program.
0814-0815	F000103. Fourth alternate select address, unused in this sample program.
0816	F0003013. Open tape indicator. The D (2 bit zero) means immediate-open.
0817-0822	F0003022. Data tape record counter, 0001.
0823-0824	F000302. Noise/skip counter, 50.
0825-0827	F0003032. File count per reel, 001.
0828-0829	F000303. Error correction entry counter, 02.
0830-0831	F0003043. Permanent error counter, 01.
0832-0834	F000304. Last noise record counter, 000.
0835	F0004014. Label indicator. The minus means that no labels are used.
0836-0839	F000401. Header transfer address, IORETURNTO. If a specialized header routine is used, the address of the first instruction of that routine is found here.
0840	F0004024. Checkpoint indicator. The minus means that the file has no connection with checkpoint.
0841-844	F000402. End-of-reel transfer address, IORETURNTO. If a specialized end-of-reel routine is used, the address of the first instruction of that routine is found here.
0845	F0004034. File type code. The P means single-file, sequential, mode 2 EOR.
0846-0849	F000403. End-of-file transfer address, IORETURNTO. If a specialized end-of-file routine is used, the address of the first instruction of that routine is found here.
0850-0853	F0005011. Current tape serial number, 0000.
0854	Field separator, a slash.
0855-0858	F0005021. File serial number, 0000.
0859	Field separator, a dash.
0860-0862	F0005032. Reel sequence number, 001.
0863	Field separator, a blank.
0864-0873	F0005051. File identification name, OUTPUT FILE.
0874	Field separator, a blank.
0875	F0005064. Tape type code. The D means a low density, HSK rewind, and primed input base tape.
0876	F0005063. Automatic dump indicator. The K means do not dump, but go into waiting loop to await console option.
0877-0879	F000506. Retention cycle, 000.
0880	F0005074. Type of record length. The F means fixed length records.
0881	Field separator, a dash.
0882-0885	F0005084. Data record length, 0040.
0886	Field separator, a dash.
0887-0890	F0005094. Tape record format description. The 0200 means the data tape record length (the data record length at F0005084 is 40, so the blocking factor must be 5).
0891	Field separator, a dash.
0892-0893	F0005092. Input file checkpoint indicator. The two blanks here mean that no checkpoint files are on input tapes.
0894	A record mark to terminate the fixed section of the file table work area.
0895	F0002014. File code. The I means a high-volume, data file.
0896-0899	F000201. The get/put routine address, 031965.
0900	F0002034. Status code. The E means an out-file using get/put, immediate open, fixed length records.
0901-0904	F000203. Select address. The 2A−K means tape unit 2102, force counter set to 14, stacking mode, no forward space or backspace file operation in progress.
0905	The E means not single-area-initiate.
0906-0909	F000202. Address of fixed section, 031804. The 4-character high-speed address of the fixed section of the file table.

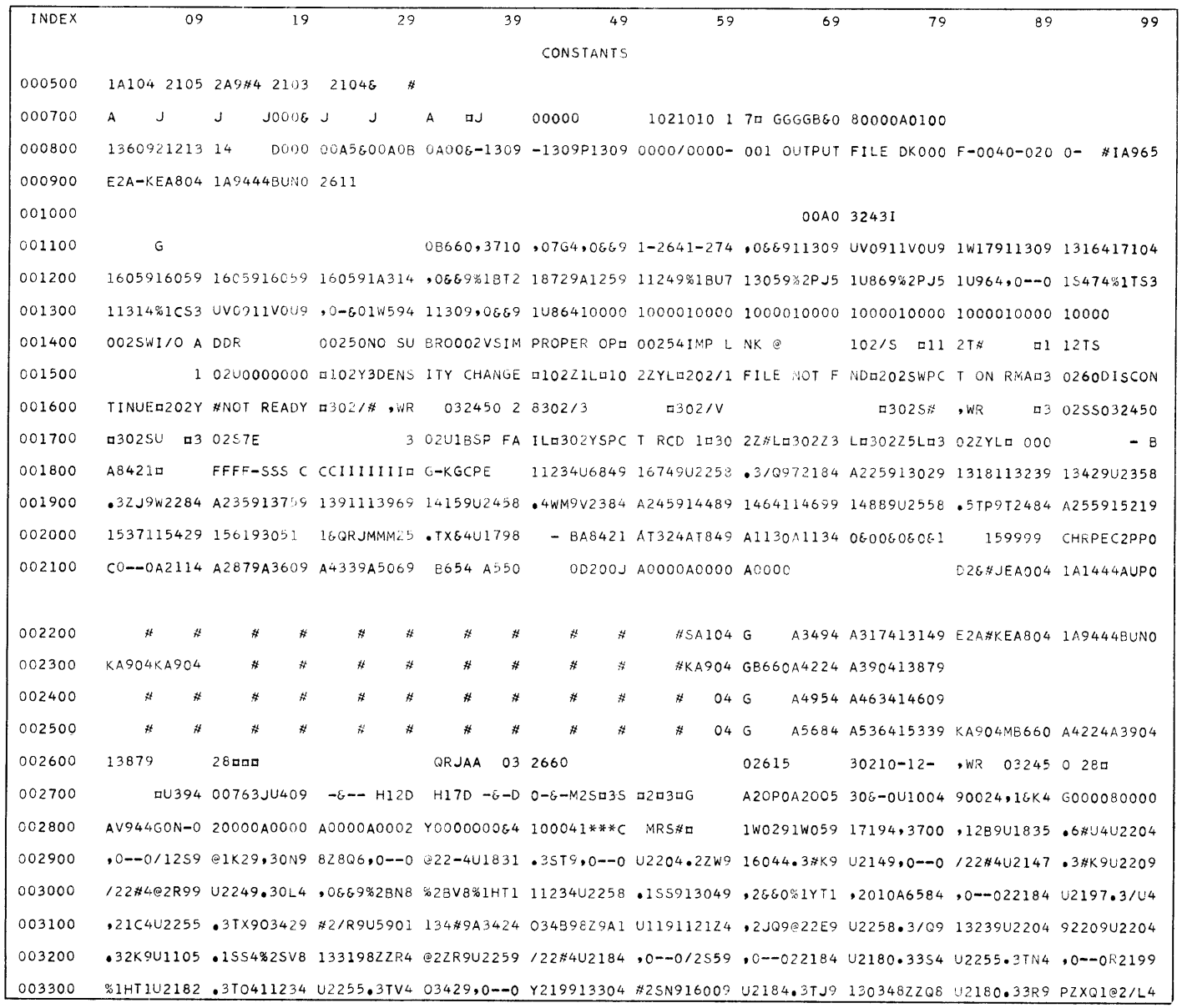
MEMORY POSITIONS	COMMENTS
0910-0914	F000204. Transfer to update routine, 1A944. A transfer instruction to 031944 where the area rotation routine begins.
0915	F0002054. The total number of I/O areas, 4.
0916-0919	F000205. The next I/O area to be used, located at 032250. The tens position zoning means this is the first I/O area and no area-compare check is to be made by CSMRS. The hundreds position zoning means record length checking is desired. (Hundreds position B bit zero means no little DTS error checking.)
0920-1034	Header and intermediate end-of-file label work area.
0920-0999	Trailer label work.
0920-0999	Control card work area.
1035-1129	DTS common work areas.
1066-1068	Special operations counters.
1069-1074	SMAC, signed: 032439
1130-1134	IOREDUNAD. The corrected redundant character is at L,IOREDUNAD (CSC1009). The four low-order positions are the search-area address of the character, 032660.
1135-1394	IOCS common entry points.
1135-1149	Save SPC routine for get/put.
1150-1154	Entry to CSHSK, not erasable.
1155-1159	Entry to CSHSK, erasable.
1160-1164	A LIP 9 instruction.
1165-1169	Control card exit. Initialized to a TR IORETURNTO instruction.
1170-1179	Linkage to a subroutine to reset CASU's.
1180-1184	Recheck exit from CSTRS.
1185-1189	Exit to examine standard output header, initialized to IORETURNTO.
1190-1194	A transfer instruction to the file area routine which starts at 003164.
1195-1199	A TR 7104 instruction, a transfer to the first instruction of the special operations routine.
1200-1224	Five TR D4550 instructions for special operations.
1225-1229	A return address, 031314.
1230-1244	Three instructions which enable waiting error conditions to be handled before a return to the main program. The first instruction, a LIP 9, is changed to a CNO when an error is awaiting handling, allowing a transfer to the error routine at E0101.
1245-1254	A 2-instruction waiting loop as described in the "Analysis Aids" section of this manual.
1255-1264	Two instructions which are used to transfer program control to IC 3059 when the above waiting loop is broken.
1265-1284	Typing operation instructions.
1285-1294	An EIA and a TR instruction to enable an indirect transfer to 012474.
1295-1304	IORETURNNO. Enables an indirect transfer to the address at W005, 016594.
1305-1334	IORETURNTO. Enables a direct transfer to the address at W005.
1335-1339	The main program entry to CSMRD. This sample program does not use checkpoint so a LIP 9 instruction is in this memory area to return control to the main program when a checkpoint is called for. Thus, the request for a checkpoint is ignored.
1340-1344	The entry to CSMRS when restarting from memory. The location of tag H0101 (014864 in this program).
1345-1394	Ten transfer pivots, unused in this sample program.

MEMORY POSITIONS	COMMENTS
1395-1399	Blank.
1400-1785	IOCS messages.
1786-1789	One CON of blank and three CON's of zero.
1790-1794	Message area for redundant characters. Contains the location of the character.
1795-1804	A 10-position field containing bb-bBA8421 for use in determining the bit structure of a a redundant character.
1805	A group mark to stop the write.
1806-1809	Blank.
1810-1829	Part of a header label, used in open routine messages.
1830	Channel error bit switches.
1831	Channel ready bit switches.
1832	Operation code for little DTS. The K means IOWR.
1833	End-of-file bit switches. The G means an FER operation, but not MFO, MFC, or close.
1834	End-of-file bit switches. The C means that all conditions shown in the listing are off.
1835	End-of-file bit switches. The P means EOR priming, and all other listing conditions are off.
1836	End-of-file bit switches. The E means a special entry from housekeeping, and all other listing conditions are off.
1837-1839	Blank.
1840-1854	DTS constants.
1855-1894	DTS channel 20 constants.
1870-1874	Work 2, 002259.
1875-1879	LIP to loop.
1890-1894	Link to common error routine.
1895-1934	DTS channel 21 constants.
1910-1914	Work 2, 002359.
1915-1919	LIP to loop.
1930-1934	Link to common error routine.
1935-1974	Channel 22 constants.
1950-1954	Work 2, 002459.
1955-1959	LIP to loop.
1970-1974	Link to common error routine.
1975-2014	Channel 23 constants.
1990-1994	Work 2, 002559.
1995-1999	LIP to loop.
2010-2014	Link to common error routine.
2015-2079	TSA constants.
2015-2016	Maximum number of write redundancies, 30.
2017-2018	Maximum number of read redundancies, 51.
2019	Blank.
2020-2021	Minimum record length, 10.
2022	A Q to initialize the read retry counter to −8 to provide for nine retries.
2023	An R to initialize the backspace loops counter to −9 to provide for ten loops.
2024	A J to initialize the length error retry counter to −1 to provide for two retries.
2025	An M to initialize the CSERR skip counter to −4 to provide for five skips.
2026	An M to initialize the skip loop counter to −4 to provide for five loops.
2027	An M to initialize to −4 the counter used to search four positions for a group mark. Used in length checking.
2028-2029	Number of skips for special write package.
2050-2054	Low address of search area.
2055-2059	High address of search area.
2060-2064	ADCON of L,IOREDUNAD
2065-2069	ADCON OF R,IOREDUNAD
2080-2082	Blank.
2083-2088	High limit of memory search: 079999 for 80K, and 159999 for 160K.

MEMORY POSITIONS	COMMENTS
2090-2094	The starting address of the 1,025-position CSMRD work area which is used to handle the 1,024-position storage banks field and the character showing the settings of the alteration switches: 158975 for 160K, and 078975 for 80K.
2096-2099	ACON4 of the starting address (002755) of the 85-position checkpoint load control record.
2100-2104	Dump address used in writing the checkpoint file.
2105-2129	CSTRS constants. ADCON's of the four channel scheduler transfer addresses.
2130-2179	DTS work areas.
2131-2134	SMAC for length check, 032654.
2136-2139	SMAC compare field, 031550.
2141-2144	Work area for variable length check.
2147	Bit switch. The B bit zero means force counter zero.
2150-2154	ADCON of stacking table.
2155-2159	ADCON of work 1.
2165-2169	Address of file table for special write package.
2175-2179	Address of step record counter routine.
2180-2279	DTS channel 20 work areas, 100 positions.
2180	Status code. The D means input file, fixed-length records, get/put is used, immediate-open.
2181-2184	Select address 2001. ASU zoned for a force counter setting 14. Unit position zoned for stacking mode (B bit one).
2185-2189	Address of fixed section of the file table, 031004.
2190-2194	Transfer instruction to the area routine, located at 031144.
2195	Number of I/O areas.
2196-2199	Address of area in use, 031470. The A bit zoning over the hundreds position means record length checking is desired. (Hundreds position B bit zero means no error check is desired in little DTS). The B bit zoning over the tens position means no area-compare check is to be performed in CSMRS. This area is not area 1 because the tens position A bit is zero.
2200-2204	Work 1. The CON-ACON4 of the I/O request from the main program.
2205-2244	Channel 20 stacking table. Eight 5-position entries, each initialized to four blanks and a record mark.
2245-2249	Stacking table overflow entry.
2250-2254	Stacking table restoring entry.
2255-2259	Work 2. Contains the next I/O request to be done. In this sample program, contains the request: Read from tape whose file table address is 031104.
2260	Channel 20 error switch. The G means that all error conditions are reset off.
2261-2264	SMAC, the data memory address as found in the channel 20 communication word at SPC 2010.
2265-2269	Channel 20 DTS force-counter zero exit.
2270-2274	Channel 20 DTS force-counter not-zero exit.
2275-2279	Channel 20 normal DTS exit.
2280-2379	DTS channel 21 work areas, 100 positions.
2380-2479	DTS channel 22 work areas, 100 positions.
2480-2579	DTS channel 23 work areas, 100 positions.
2300-2304	Channel 21, work 1. Because the top entry of the stacking table is moved up into work 1, the two entries are identical. The request shown is a write special on the tape whose file table address is 031904.
2355-2359	Channel 21, work 2, the next request to be done. In this case the tape referred to in work 1 is the tape to be written on next. (Work 1 always contains the current request; work 2 the next request.)
2361-2364	SMAC, the channel 21 data memory address (032660) as found in the channel 21 communication word, SPC 2110.
2580-2614	TSA channel entry work area.
2580-2584	Work 2 of the last channel processed in TSA. The KA904 shown means that the last operation checked was the write special on the tape whose file table is located at 031904.
2585	Error indicator. The M means that a PCT check and record length error occurred on the write special.
2586-2589	SMAC, the data memory address setting at the completion of the write operation, 032660.
2590-2604	The three DTS transfer address exits, force-counter zero, force-counter not-zero, and normal.
2605-2609	Save location for area in use.
2610-2611	Save area for status bits of the last operation. The 28 means a register A VRC error condition exists.
2615-2649	CSERR work area. These fields contain much information about the error handling on the file.
2616	Read counter for PCT retries.
2617	Number of backspace loops for read redundancy.
2618	Length error counter.
2619	Write counter for PCT retries.
2620	Number of skip loops.
2621	Counter for locating a group mark within a four-character field, used in record length checking.
2622	Last character of dump record.
2623-2628	Six-position address of high limit of search.
2629-2634	Six-position address of group mark.
2635-2640	Six-position high-limit address of CSMRD search.
2641	Save area for internal entry operation.
2645-2649	Used as an address for the RMA instruction which turns off error triggers.
2650-2690	Message work area. The last message written is shown in 2670-2693.
2691-2754	Constants and save area for messages and interrupt programs 252 and 253.
2755-2843	The 85-character checkpoint load control record.
2845-3044	Channel 20 read/write request entry.
2845-2849	Scheduler transfer address minus 15. A transfer instruction to the delay-open routine.
2850-2854	Scheduler transfer address minus 10. A transfer instruction to the regular-open routine.
2855-2859	Scheduler transfer address minus 5. A transfer instruction to the special operations routine.
2860-2864	Scheduler transfer address, channel 20.
3045-3219	Channel 20 interrupt entry.
3220-3359	Channel 20, start new operation.

Sample Memory Print

Figure 18 shows part of a sample memory print, taken from a small practice run used to illustrate the basic operation of IOCS. This memory print serves as an introduction to the memory print of any program using IOCS.



INDEX	09	19	29	39	49	59	69	79	89	99
					CONSTANTS					
000500	1A104 2105	2A9#4 2103	2104& #							
000700	A J	J J000&	J J	A ¤J	00000	1021010 1	7¤ GGGGB&0	80000A0100		
000800	1360921213	14 D000	00A5&00A0B	0A00&-1309	-1309P1309	0000/0000-	001 OUTPUT	FILE DK000	F-0040-020	0- #IA965
000900	E2A-KEA804	1A9444BUN0	2611							
001000							00A0	3243I		
001100	G		0B660,3710	,07G4,0&&9	1-2641-274	,0&&911309	UV0911V0U9	1W17911309	1316417104	
001200	1605916059	1605916059	160591A314	,0&&9%1BT2	18729A1259	11249%1BU7	13059%2PJ5	1U869%2PJ5	1U964,0--0	1S474%1TS3
001300	11314%1CS3	UV0911V0U9	,0-&01W594	11309,0&&9	1U86410000	1000010000	1000010000	1000010000	1000010000	10000
001400	002SWI/O A	DDR	00250NO SU	BRO002VSIM	PROPER OP¤	00254IMP L	NK @	102/S ¤11	2T# ¤1	12TS
001500	1	02U0000000	¤102Y3DENS	ITY CHANGE	¤102Z1L¤10	2ZYL¤202/1	FILE NOT F	ND¤202SWPC	T ON RMA¤3	0260DISCON
001600	TINUE¤202Y	#NOT READY	¤302/# ,WR	032450 2	8302/3	¤302/V		¤302S# ,WR	¤3	02SS032450
001700	¤302SU ¤3	02S7E	3	02U1BSP FA	IL¤302YSPC	T RCD 1¤30	2Z#L¤302Z3	L¤302Z5L¤3	02ZYL¤ 000	- B
001800	A8421¤	FFFF-SSS C	CCIIIIIII¤	G-KGCPE	11234U6849	16749U2253	,3/Q972184	A225913029	1318113239	13429U2358
001900	,3ZJ9W2284	A2359137?9	1391113969	14159U2458	,4WM9V2384	A245914489	1464114699	14889U2558	,5TP9T2484	A255915219
002000	1537115429	156193051	1&QRJMMM25	,TX&4U1798	- BA8421	AT324AT849	A1130A1134	0&00&0&0&1	159999	CHRPEC2PP0
002100	C0--0A2114	A2879A3609	A4339A5069	B654 A550	0D200J	A0000A0000	A0000		D2&#JEA004	1A1444AUP0
002200	# #	# #	# #	# #	# #	# #	#SA104 G	A3494	A317413149	E2A#KEA804 1A9444BUN0
002300	KA904KA904	# #	# #	# #	# #	# #	#KA904 GB660	A4224	A390413879	
002400	# #	# #	# #	# #	# #	# #	# 04 G	A4954	A463414609	
002500	# #	# #	# #	# #	# #	# #	# 04 G	A5684	A536415339	KA904MB660 A4224A3904
002600	13879	28¤¤¤		QRJAA 03	2660		02615	30210-12-	,WR 03245	0 28¤
002700	¤U394	00763JU409	-&-- H12D	H17D -&-D	0-&-M2S¤3S	¤2¤3¤G	A20P0A2005	30&-0U1004	90024,1&K4	G000080000
002800	AV944G0N-0	20000A0000	A0000A0002	Y000000064	100041***C	MRS#¤	1W0291W059	17194,3700	,12B9U1835	,6#U4U2204
002900	,0--0/12S9	@1K29,30N9	8Z8Q6,0--0	@22-4U1831	,3ST9,0--0	U2204,2ZW9	16044,3#K9	U2149,0--0	/22#4U2147	,3#K9U2209
003000	/22#4@2R99	U2249,30L4	,0&&9%2BN8	%2BV8%1HT1	11234U2258	,1SS913049	,2&&0%1YT1	,2010A6584	,0--022184	U2197,3/U4
003100	,21C4U2255	,3TX9O3429	#2/R9U5901	134#9A3424	O34B98Z9A1	U119112IZ4	,2JQ9@22E9	U2258,3/Q9	13239U2204	92209U2204
003200	,32K9U1105	,1SS4%2SV8	133198ZZR4	@2ZR9U2259	/22#4U2184	,0--0/2S59	,0--022184	U2180,33S4	U2255,3TN4	,0--0R2199
003300	%1HT1U2182	,3TO411234	U2255,3TV4	O3429,0--0	Y219913304	#2SN916009	U2184,3TJ9	130348ZZQ8	U2180,33R9	PZXQ1@2/L4

Figure 18. Sample Memory Print of IOCS

Appendix

Glossary

ACON4: See CON-ACON4.

ADCON: A 4-character address constant preceded by an A (NOP) and ending in a 4 or 9. As used in the IOCS message format, the address of the message, and the interrupt key 253 transfer point.

ALL-CHANNEL HOLD: An operation that suspends program activity until all channel tape motion has ceased.

ALL-CHANNEL RESTART: To begin DTS operations on all channels.

ALTERNATE TAPE ENTRY: A 5-character field in the tape table referring to a tape which has been designated as an alternate to a base tape.

AREA ROUTINE: A routine to rotate or advance the I/O area addresses.

BACKSPACE LOOP: A counter used in read retry routines.

BASE TAPE ENTRY: A 5-character field in the tape table containing the tape select address and the address of the file table of the tape unit on which the first reel of a file is mounted.

BIT SWITCH: A single bit used as a switch; considered on if a transfer out of in-line operation results. Bit zero indicates switch on; bit one means switch off.

BLOCKED RECORDS: A group of data tape records (each ending in a record mark) appearing between two inter-record gaps.

BLOCKING FACTOR: The number of data records making up a tape record.

BUFFER: As used in IOCS, the 10-position area immediately following an I/O area. Used in record length checking.

CHECKPOINT: A reference point at which error-free operation of the program has been verified and to which the program may return for restart in the event of subsequent failure. Also refers to the IOCS routine which writes the checkpoint record.

CHECKPOINT WORK TAPE: The output tape used by the checkpoint routine to temporarily store the last 1,025 positions of memory.

CLOSE: To terminate a file. For output files: write a tape mark and, if specified, an end-of-file trailer and another tape mark. For both input and output files: rewind the tape, turn on I/O indicator (unless the tape is a work tape), take a checkpoint, if specified, and reset file table counters and indicators.

CON-ACON4: As used in CSDTS, the operation code and the address of the file table on which the operation is to be performed.

CONTROL CARDS: Cards containing information needed to update standard header labels.

CONTROL: Used in referring to the next instruction to be executed, by such phrases as "control passes" and "control transfers."

CONTROL WORD: A 60-position field between the tape tables and the file table work area. Contains main program specifications relating to machine size, message classes, card reader address, etc.

CYCLE CARD: A control card used in cycle checking.

CYCLE CHECKING: A local, optional scheduling device. For a main program run, a counter is stepped by one each time the program is completed. This run cycle number is put in the header label and also appears in the control cards. The next time the program is run, IOCS checks to see that the proper input tapes (output from the previous run) are used. (Note: Cycle checking has nothing to do with "retention cycle.")

DATA FILE: A data file (tape file) consists of a group of records which may include:

1. File identification records (headers).
2. Data records followed by a tape mark.
3. File termination records (trailers).

A tape file contained on more than one reel of tape is known as a multireel file.

DATA RECORD: A data record is defined as a group of data pertaining to a single item in a file. There may be one (single) or more (blocked) data records in a tape record. Blocked data records are terminated by a record mark, and their length is a multiple of five.

DATA TAPE RECORD: Any tape record containing one or more data records.

DATE CONTROL CARD: The card containing the year-day information needed to update standard headers.

DELAY OPEN: The opening of a file at the time of the first request on that file.

DUMPING: The writing of permanent error records on a separate tape for consideration at a later time.

END CONTROL CARD: The last card of the control card deck. Tells IOCS that all control cards have been read.

END-OF-FILE CONDITION: An end of file is encountered when a tape is positioned after the last data record of the associated data file. EOF occurs:

1. At the end of a single reel file.
2. At the end of the last reel of a multireel file.
3. At the end of each file of a multifile tape.

END-OF-REEL CONDITION: An end-of-reel condition is encountered on all reels of a multireel file except the last. An end-of-reel condition is also encountered when the last file of a multifile reel continues on another tape.

FILE SERIAL HEADER CONTROL CARDS: Control cards used to update file serial information in standard header labels.

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.

FILE TABLE WORK AREA: A 120-position memory field to which parts of a file table are moved. The file table work area contains information about the file being handled.

FIXED LENGTH DATA RECORDS: Data records within a tape file all of which contain the same number of characters.

FORCE CONDITION: An indication that there is no record in the input area available for processing or that the output area is unavailable to receive information. When this condition exists, IOCS fills the input area or writes from the output area, thus freeing it for processing.

FORCE COUNTER: Indicates the number of I/O areas available for processing at any given time.

HEADER CONTROL CARDS: Control cards used to update standard headers labels. May be file serial header control cards or cycle header control cards.

HEADER LABEL: A tape record appearing at the beginning of each tape file, and at the beginning of each additional reel of a tape file. Used to identify the contents of the data file.

HOLD: A mode of channel tape operation. All other machine operations are held up while IOCS makes certain that the last operation on the related channel has been completed and checked for errors.

HOUSEKEEPING: Erasable housekeeping is a series of one-time routines which initialize other sections of IOCS and position and check tapes before a production run starts. Non-erasable housekeeping is a series of routines which perform housekeeping functions during the production run.

IMMEDIATE OPEN: The opening of a tape file during housekeeping or at the beginning of a new reel. Also called regular-open.

INITIALIZATION: The resetting of counters, switches, and addresses at specified times in a program. Most IOCS initialization occurs during housekeeping.

INITIATE MODE: A type of DTS operation in which a read or write operation is initiated before control returns to the main program.

INTERMEDIATE HEADER LABEL: A label record other than the first or last on a multifile reel, which serves as: (1) the header record for the tape file it precedes, and (2) the trailer record for the tape file it follows.

INTERNAL ENTRY: An entry to the common error routine from little DTS after a retry, as opposed to an entry from the main program via channel interrupt.

L,: Address of the left-hand character in the memory field specified.

LABEL: A tape record used to identify beginning of reel, end of reel, or end of file. See header label, intermediate header label, and trailer label.

LINKAGE: A series of instructions (usually RCV–TSL) which enable a transfer to and return from programming routines.

LITTLE DTS: The DTS routines which perform all internal tape operations for IOCS.

LOOP: A series of instructions which delay program operation pending interrupt or console action.

LOOP-MESSAGE: An IOCS message followed by a loop awaiting console action.

MACRO: An open-ended sequence of machine instructions produced by a processor on recognition of a source-language statement. The instructions perform the function defined by the parameters given in the source statement.

MACRO-INSTRUCTION: A source-language statement to a processor resulting in the production of a variable number of instructions in machine language.

MAIN PROGRAM: The running production program. If produced by the IBM 7058 Processor, the object program.

MEMORY PRINT: The printed output of the memory print program. Contains the contents of memory, storage, settings of switches and indicators, and other information relating to the status of the program and of the machine.

MODE 1, 2: A method of handling EOR operations. Mode 2 insures that all records are processed before transferring to the specialized end-of-reel routine. Mode 1 specifies an immediate transfer to the routine.

MULTIFILE TAPE (OR REEL): When more than one tape file is contained on a single reel of tape, this reel is called a multifile tape. Each file may contain:

1. An identifying record (header).
2. Data records followed by a tape mark.

A terminating record (trailer) must be included after the last file on the tape.

MULTIPLEXOR CHECK: The indicator turned on when a channel check or tape adapter unit (TAU) check occurs in a communication channel.

MULTIREEL FILE: See tape file.

NOISE RECORD: A redundant non-data pulse which is picked up by the read head. In IOCS, any PCT record of ten or fewer characters.

OCTANT: A 20K block of memory.

OPEN: To check a tape, process the header label (if any), and position the tape at the first data record of the file.

PARAMETER: A field in the operand of a macro-instruction, used to direct the generation of instructions for a unique function.

PERMANENT R/W ERROR: For input files, a record accepted with redundancies replaced by IOCS and approved by the operator (or a record dumped); processing is continued. For output files, a record accepted as it is when a PCT persists (no redundancies present in memory) and processing is continued.

PREASSEMBLED IOCS: The fixed-location IOCS program released by IBM Programming Systems.

PRIME: To fill input areas with input records.

PRIME EOF: A premature or false end-of-file condition occurring when a tape mark is read following the header label when opening a file, or while priming input areas.

R,: Address of the right-hand character in the memory field specified.

REDUNDANCY: A character whose vertical bit count is odd.

REGULAR TAPE TABLE: The first part of the tape table; refers to base and alternate tapes assigned by the program.

REQUEST: The I/O operation performed by IOCS.

RESTART: To resume program operation from a checkpoint. Also, short for the restart program, CSMRS.

RETENTION CYCLE: The number of calendar days, following the creation day, that a file is to be saved.

SCAN: To search the tape table for base tape entries.

SCHEDULER TRANSFER ADDRESS: The address of the first instruction of the channel DTS routine.

SKIP LOOP: A counter used in write retry routines.

SMAC: Synchronizer Memory Address Counter. A 705 III term referring to a location in memory where tape data is next placed. Sometimes used synonymously with the data memory address field of the communication channel.

SPECIALIZED ROUTINE: A routine written by the customer and linked to by IOCS to perform certain operations, usually at beginning of reel, end of reel, or when redundant characters are found.

SPECIAL OPERATION: Any I/O request except IORD and IOWR.

SPECIAL TAPE TABLE: The second part of the tape table; refers to special tape functions assigned by the program.

STACKING: A mode of tape operation in which a given request may be temporarily placed in a stacking table to await channel availability.

STACKING TABLE: An area of memory set aside to contain or stack requests awaiting channel availability.

STANDARD LABEL: A header or trailer complying with the format outlined in *IBM 705/7080 Applied Programming Tape Format and Labeling Standards,* Form J28-6123.

SUBROUTINE: A common routine used to perform a specific function. Linked to by a RCV–TSL. The usual return is to TSL+5.

SUPERVISOR: An IBM program which calls other programs into the computer.

TAPE CLEANER ROUTINE: A series of three backspace and two forward space instructions which move a tape record back over the shaver head in an attempt to dislodge foreign material from the surface of the tape or to smooth out wrinkles or creases in the tape.

TAPE FILE: A tape file (data file) consists of a group of records which may include:

1. File identification record (header).
2. Data records followed by a tape mark.
3. File termination record (trailer).

If a tape file is contained on more than one reel of tape, it is known as a multireel file.

TAPE RECORD: The information contained between two successive inter-record gaps.

TAPE TABLE: A 235-position table describing the use of each tape unit which can be attached to the 7080 channels.

TRAILER LABEL: A tape record appearing as the last record of a tape reel. Used to indicate whether there are additional records of the data file on succeeding tapes.

TSA COMMON ENTRY ROUTINE: The routine which determines what type of error occurred. Transfers control to other routines to handle particular error conditions.

VARIABLE-LENGTH DATA RECORDS: Data records within a tape file, at least two of which do not contain the same number of characters.

VARIABLE-LENGTH TAPE RECORDS: Data tape records in a tape file containing variable length data records, or data tape records in a tape file at least two of which have different blocking factors.

WORK 1: A 5-position field immediately preceding the stacking tables. Contains the current I/O request.

WORK 2: A 5-position field immediately following the stacking tables. Contains the next I/O request.

Abbreviations

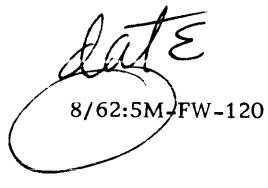
Addr	address
Bsp	backspace
Chan, Chnl	channel
Char	character
Ck	check
Ckpt	checkpoint
Cnt	count
Ctr	counter
Dmp	dump
DTS	data travel system
EOF	end of file
EOR	end of reel
Err	error
FC	force counter
FSP	forward space
Hdr	header
Hld	hold
HSK	housekeeping
I/O	input or output
LDTS	little data travel system
Lng	length
MPX	multiplexor
Msg	message
PCT	parallel character transfer check
Pgm	program
Rcd	record
R/W	read or write
Sel	select
SMAC	storage memory address counter, date memory address
Spec	special
Sp Ops	special operations (data travel system)
Std	standard
Stk	stacking
Stk Tbl	stacking table
Sw	switch
TM	tape mark
Trlr	trailer
TRS	tape reel control system
WA	work area

Message Index

Tag Index

Tag	Block Location
D2X0591	CA16
D2X0595	CA18
D2X6101	CC04
D2X6105	CC09
D2X7001	CD03
D2X7020	CD12
D2X7030	CG01
D2X7201	CD16
D6010	EF13
D6011	EF03
D6034	ED25, EE21
D6095	CC02
D6151	CC06
D6201	CC07
D6301	CC10
D6310	CC18
D6370	CC19
D6440	DC07
D6502	BA03
D6601	BA26
D700101	CD01
D7105	CD04
D7110	CD06
D7210	CD22
D730101	CF01
D730120	CF04
D730127	CF12
D730129	CF13
D730140	CF09
D730160	CF16
D730180	CF15
D730401	CE01
D730402	CE03
D730430	CE11
D740101	CG06
D74011	CG05
D740201	CG14
D74022	CG02
D7403	CG12
D7410	CG19
D7415	CG23
D7420	CG25
D7430	CG24
D7440	CG22
D7450	CG15
D7460	CG08
E0011011	EA27, ED19
E0101	DA13
E0105	DA14
E0106	DA16
E010801	DA19, DD09
E010802	DA17
E0109	DA20
E0109	DB15
E010902	DA18
E011001	ED18
E0206	EA01, EB02
E0207	EE01
E030101	EA03, EE03
E030102	EE02
E030104	EE08
E0302	EE13
E0304	EA06, EE15
E0306	EE10
E030601	EE12
E0307	EA09, EE19
E03104	EA07, EE07
E0314	EE21
E0401	EA15
E040101	EB08
E040102	EB13
E040103	EB11
E0402	EA17, EB15, EC01
E0403	EC19, EC24
E0404	EC27
E0406	EC25
E0412	EB09

Tag	Block Location
E0414	EA16, EB18
E0415	EB15
E0416	EB23
E0420	EC20
E0422	EC21
E0441	EB25
E04410	EB27
E0502	EA18
E050202	EC08
E050301	ED01
E050303	EH13
E050304	ED03
E0504	EC16
E050401	ED20
E05040201	EA21
E0504021	EC17
E050404	EH01
E050405	EH12
E050406	EH03
E050407	ED27
E050408	EH02
E050409	EA24, ED28
E050502	EH06, EH07
E050504	ED04
E050506	EA10
E050506	ED05
E050506	ED24
E050508	EH08
E0510	ED28
E0513	ED21
E0514	ED23
E0550	EC06, EC09
E05501	EC14, EE08
E055201	ED22
E0553	EC11
E0554	EC12
E0601	EC07, EE24
E06011	EA11, EA20, EH17
E060502	EH18
E060503	EA14
E0606	EH19
E0609	ED07
E060904	ED08
E0623	EB30, ED09
E0624	ED16
E502	EC02
G0102	GA07
G0103	GA10
G01041	GA12
G0105	GA15
G0107	GA17
G0108	GA19
G01081	GA22
G02	GA01
G0201	BA26
G03	GA04
IOREDUNCHK	DE25



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