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February 21, 1961

USS Computers (80/90)
Library Memo 26

The X-6 Assembly System Programmer's Guide, is a detailed reference for the X-6 Assembly System. Flow-charts for the system are included. For users of either Univac Solid-State 80 card or tape system, it represents the necessary documentation for use of the associated program deck, X6C80. For users of the Univac Solid-State 90 tape system, it relates to the forth coming program deck, X6A93. The earlier manual, U 1741.9-Rev.1, is still applicable for users of the USS 90 card system and the X6D90 program deck.

The Linear Programming System, developed under contract with Bonner and Moore Associates, is now available for USS 80 users. It consists of the following sub-routines: LOD, MATLOD, SOLVE, BASIS, SHADOW, PUNCH, CHANGE and MATPR.

USS 80 users also can use the new monitor (print and execute) routine, MON01-8T00. Since the routine can be used on either card or tape computers, it should be considered as a replacement for MON01-8C00. This program was developed by H.A. Griffen, Jr. and R.K. Marshall, Jr. of the Univac Engineering Computer Center, Philadelphia.

RN501 will generate five digit numbers in random sequence. It is entered each time another number is desired.

Paul H. Hertel of the Remington Rand Univac Sales Office, Philadelphia, developed the USS 90 Multiple Regression routine, MRA01. This routine will handle a set of n observations of dependent variable and up to 70 independent variables for each dependent variable.

Remington Rand Univac DIVISION OF SPERRY RAND CORPORATION 315 PARK AVENUE SOUTH, NEW YORK 10, N.Y.

U-1462 REV. 1

All requests for individual routines, complete sets of routines, or program decks should be directed to the Remington Rand Univac Branch Manager. To submit routines for publication, address: Manager, Program Library Services, Remington Rand Univac, 315 Park Avenue South, New York 10, N. Y.

Joe Horner, Manager
Program Library Services

TO LISTS: 10A-23-361-362-44-52-59 and Univac System Routines, Tab 11.

ATTACHMENTS: U 1778.1 Rev.3 and U 1778.100 Rev.3 to all lists. Remainder to Univac System Routines, Tab 11, only.

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REMINGTON RAND UNIVAC

Univac Solid-State 80 Routines
Table of Contents

February, 1961

Volume 1

Volume 1 (Cont.)

ITC00-OT00 (U 1775.26)	Controls the transfer of items from an input tape file to working storage, and from working storage to an output tape file. Index Registers are used.
SR012 (U 1775.35)	Sorts into ascending sequence a file of randomly ordered items containing twelve alphanumeric words on the basis of a key which may range from one to one hundred twenty digits in length
PROGRAM TESTING U 1776	
PTA01-8C00 (U 1776.7)	A self-loading routine designed to aid in program testing. It can fill memory with stop orders, load a program deck in standard one instruction per card format, and search memory for a specified combination of characters.
PTR01-8C00 (U 1776.8)	A High-Speed Reader routine, designed for use in program testing, that feeds and senses one card at a time. It utilizes Automatic Translation.
MPR01-8C00 (U 1776.9 Rev.1)	A self-loading memory print routine. Prints the contents of the memory without destroying any of the program being printed.
MON01-8T00 (U 1776.12)	A self-loading program testing aid which prints each instruction and the contents of registers A, X, L, B_1, B_2, B_3 prior to execution and then executes the instruction.
SERVICE U 1777	
CON01-8C00 (U 1777.7)	Condenses the contents of three cards in standard one-instruction per card format, to one card.
CDET1-8C00 (U 1777.9)	Produces an edited High-Speed Printer listing of any program.
PDL02-8C00 (U 1777.16)	A self-loading routine which loads a program deck prepared in standard three instruction per card foramt. It utilizes Automatic Translation but no Index Reters.
PLST1-8C00 (U 1777.8)	A self-loading routine which produces a High-Speed Printer listing of the page, line and suffix of each location used in a program. It utilizes Automatic Translation.
REP01-8C00 (U 1777.13)	Reproduces without alteration a previously punched deck deck of cards.
LINEAR PROGRAMMING U 2287	
LOD (U 2287.12)	A sub-routine of the Linear Programming System. Loads the machine coded instruction decks which comprise the Linear Programming System.
MATLOD (U 2287.13)	A sub-routine of the Linear Programming System. Loads the matrix data [$(m+2)\times(m+2)\leq 4300$].
SOLVE (U 2287.14)	A sub-routine of the Linear Programming System. Provides solution to a Direct, Dual or Composite simplex problem.
BASIS (U 2287.15)	A sub-routine of the Linear Programming System. Interprets the basis and lists the activities of each basis variable at solution. In addition, it develops range of optimality for each of these variables.
SHADOW (U 2287.16)	A sub-routine of the Linear Programming System. Interprets the shadow price of each non-basis variable and develops its range of feasibility.
PUNCH (U 2287.17)	A sub-routine of the Linear Programming System. Records the solution matrix on blank cards in the Read Punch Unit.
CHANGE (U 2287.18)	A sub-routine of the Linear Programming System. Provides a means of changing the elements of the current solution matrix without changing the original input.
MATPR (U 2287.19)	A sub-routine of the Linear Programming System. Provides a complete HSP listing of the current matrix without destroying the matrix or any of the pertinent constants.

MATHEMATICAL U 1876

ARS01 (U 1876.31)	Calculates the arc sine of a number. Fixed Point.
ARS02 (U 1876.32)	Coded in X-6 Relative Coding. Calculates the arcsine of a number. Fixed Point.
ASC01 (U 1876.16)	Calculates the arc sine and arc cosine of a number. Floating Point.
ASC02 (U 1876.17)	Coded in X-6 Relative Coding. Calculates the arc sine and arc cosine of a number. Floating Point.
ATN01 (U 1876.18)	Calculates the arc tangent of a number. Floating Point.
ATN02 (U 1876.19)	Coded in X-6 Relative Coding. Calculates the arc tangent of a number. Floating Point.
ATN03 (U 1876.33)	Calculates the arc tangent of a ratio. Fixed Point.
ATN04 (U 1876.53)	Coded in X-6 Relative Coding. Calculates the arc tangent of a number. Fixed Point.
CAS01 (U 1876.35)	Complex number addition and subtraction. Fixed Point.
CAS02 (U 1876.45)	Complex number addition and subtraction. Floating Point.
CBR01 (U 1876.6)	Calculates the cube root of a number. Floating Point.
CBR02 (U 1876.7)	Coded in X-6 Relative Coding. Calculates the cube root of a number. Floating Point.
CBR03 (U 1876.36)	Calculates the cube root of a number. Fixed Point.
CMD01 (U 1876.38)	Complex number multiplication and division. Fixed Point.
CMD02 (U 1876.46)	Complex number multiplication and division. Floating Point.
CPC01 (U 1876.42)	Converts polar coordinates to rectangular. Fixed Point.
CRP01 (U 1876.41)	Converts rectangular to polar coordinates. Fixed Point.
CRP02 (U 1876.55)	Converts rectangular to polar coordinates. Floating point.
CSR01 (U 1876.70)	Calculates the square root of a complex number using floating point notation. It utilizes one Index Register.
DAS01 (U 1876.51)	Double precision addition and subtraction. Fixed point.
DEF01 (U 1876.56)	Calculates the solution of a first order differential equation. Floating Point.
DEF02 (U 1876.57)	Calculates the solution of a set of simultaneous differential equations. Floating Point.
DPM01 (U 1876.54)	Double precision multiplication. Fixed Point.
EXP01 (U 1876.8)	Calculates e raised to a power. Floating Point.
EXP02 (U 1876.9)	Coded in X-6 Relative Coding. Calculates e raised to a power. Floating Point.
EXP03 (U 1876.39)	Calculates e raised to a power. Fixed Point.
FLP01 (U 1876.1 Rev.2)	Performs arithmetic operations on one word, XS-50, floating decimal numbers.
FLP02 (U 1876.3)	Coded in X-6 Relative Coding. Performs arithmetic operations on one word, XS-50, floating decimal numbers.
FLX01 (U 1876.43)	Converts one word, XS-50, floating decimal numbers to Fixed Point.
FLX02 (U 1876.48)	Converts one word, XS-50, floating decimal numbers to Fixed Point.
FNI01 (U 1876.47)	Calculates the numerical integration of a function using Simpson's Rule. Floating Point.
FXL01 (U 1876.44)	Converts fixed point numbers to one word XS-50, floating decimal form.
FXL02 (U 1876.49)	Converts fixed point numbers to one word, XS-50, floating decimal form.
GMF01 (U 1876.40)	Evaluates the Gamma Function. Fixed Point.
LGN01 (U 1876.12)	Calculates the logarithm to the base e or to the base 10. Floating Point.

Volume 2 (Cont.)

LGN02 (U 1876.13)	Coded in X-6 Relative Coding. Calculates the logarithm to the base e or to the base 10. Floating Point.
LOG01 (U 1876.28)	Calculates the logarithm to the base 10. Fixed Point.
LOG02 (U 1876.29)	Coded in X-6 Relative Coding. Calculates the logarithm to the base ten of a positive number. Fixed Point.
LNE01 (U 1876.37)	Calculates the logarithm to the base e. Fixed Point.
MSD01 (U 1876.50)	Calculates the mean and standard deviation. Fixed Point.
NPF01 (U 1876.22)	Calculates the area under the normal probability curve. Floating Point.
NPF02 (U 1876.23)	Coded in X-6 Relative Coding. Calculates the area under the normal probability curve. Floating Point.
NRT01 (U 1876.74)	Calculates the nth root of a number using a floating point notation.
NRT02 (U 1876.72)	Coded in X-6 Relative Coding. Calculates the nth root of a number using one word floating point notation.
PLY01 (U 1876.20)	Evaluates the polynomial sum. Floating Point.
PLY02 (U 1876.21)	Coded in X-6 Relative Coding. Evaluates the polynomial sum. Floating Point.
PLY03 (U 1876.34)	Evaluates the polynomial sum. Floating Point.
QEQ01 (U 1876.69)	Calculates the roots of a quadratic equation using floating point notation. It utilizes one Index Register.
RN501 (U 1876.76)	Generates 5 digit random numbers.
SLE02-8C00 (U 1876.65)	Solves a system of n simultaneous linear equations using floating point notation ($2 \leq n \leq 7$). It utilizes three Index Registers.
SNC01 (U 1876.14)	Calculates the sine or cosine of an angle (radians). Floating Point.
SNC02 (U 1876.15)	Coded in X-6 Relative Coding. Calculates the sine or cosine of an angle (radians). Floating Point.
SNC03 (U 1876.30)	Calculates the sine or cosine of an angle (radians). Fixed Point.
SNC04 (U 1876.52)	Coded in X-6 Relative Coding. Calculates the sine and cosine of an angle. Fixed Point.
SQR01 (U 1876.4)	Calculates the square root of a number. Floating Point.
SQR02 (U 1876.5)	Coded in X-6 Relative Coding. Calculates the square root of a number. Floating Point.
SQR03 (U 1876.24)	Calculates the square root of a number. Fixed Point.
SQR04 (U 1876.25)	Coded in X-6 Relative Coding. Calculates the square root of a number. Fixed Point.
SQR05 (U 1876.68)	Calculates the positive square root of any positive number using floating point notation.
TNP01 (U 1876.10)	Calculates the value of 10 raised to a power. Floating Point.
TNP02 (U 1876.11)	Coded in X-6 Relative Coding. Calculates the value of 10 raised to a power. Floating Point.
TNP03 (U 1876.26)	Calculates the value of 10 raised to a power. Fixed Point.
TNP04 (U 1876.27)	Coded in X-6 Relative Coding. Calculates ten to a power. Fixed Point.

TECHNICAL FACTS U 1778

PROGRAM LIBRARY SERVICES
REMINGTON RAND UNIVAC

Table of Contents
Univac Solid-State 90 Routines

February, 1961

Volume 1

Volume 1 (Cont.)

PTRO2 (U 1776.4)	A High-Speed Reader routine designed for use in program testing. It feeds and senses one card at a time.
MPRO2 (U 1776.3)	A self-loading memory print routine. Prints the contents of memory on the High-Speed Printer.
MONO1-9COO (U 1776.6 Rev.1)	A self-loading monitor routine which prints each instruction and the contents of the registers prior to execution and then executes the instruction.
SERVICE U 1777	
ANLY1 (U 1777.1)	Produces a High-Speed Printer listing of the coding of a subject program showing cross-references among instructions.
CONO1 (U 1777.2)	Condenses three instruction cards in standard one-instruction format to one card (standard production format).
SLDO1 (U 1777.3)	Creates a self-loading deck in machine code from a deck in standard one-instruction format.
CDET1 (U 1777.4)	Produces an edited High-Speed Printer listing of the coding of any program.
PDLO1-9COO (U 1777.6)	Loads a program deck which is in the standard three-instruction per card format.
MACO1 (U 1777.5)	Prints a listing of unused memory locations or punches restrict cards in the format required by the X-6 Assembly System.
PLST1-9COO (U 1777.10)	Prints the page, line and suffix of each location used in a program.
LINEAR PROGRAMMING U 2287	
LOD (U 2287.2 Rev.3)	A sub-routine of the Linear Programming System. Loads the machine coded instruction decks which comprise the Linear Programming System.
MATLOD (U 2287.3 Rev.1)	A sub-routine of the Linear Programming System. Loads the matrix data $\lfloor (m+2)\times(n+2)\leq 4300 \rfloor$.
SOLVE (U 2287.4Rev.1)	A sub-routine of the Linear Programming System. Provides solution to a Direct, Dual or Composite simplex problem.
BASIS (U 2287.5)	A sub-routine of the Linear Programming System. Interprets the basis and lists the activities of each basis variable at solution. In addition, it develops range of optimality for each of these variables.
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FLX02 (U 1876.48)	Converts one word, XS-50, floating decimal numbers to Fixed Point.
FNI01 (U 1876.47)	Calculates the numerical integration of a function using Simpson's Rule. Floating Point.
FXL01 (U 1876.44)	Converts fixed point numbers to one word XS-50, floating decimal form.
FXL02 (U 1876.49)	Converts fixed point numbers to one word, XS-50, floating decimal form.
GED01 (U 1876.75)	Plots a set of graphs on the High-Speed Printer from numerical data.
GMF01 (U 1876.40)	Evaluates the Gamma Function. Fixed Point.

Volume 2 (Cont.)

LGN01 (U 1876.12)	Calculates the logarithm to the base e or to the base 10. Floating Point.
LGN02 (U 1876.13)	Coded in X-6 Relative Coding. Calculates the logarithm to the base e or to the base 10. Floating Point.
LOG01 (U 1876.28)	Calculates the logarithm to the base 10. Fixed Point.
LOG02 (U 1876.29)	Coded in X-6 Relative Coding. Calculates the logarithm to the base ten of a positive number. Fixed Point.
LNE01 (U 1876.37)	Calculates the logarithm to the base e. Fixed Point.
MIX01 (U 2287.8)	Solves a 10th order linear system or inverts a matrix. Floating Point.
MRA01 (U 1876.67)	Calculates the regression coefficients and analysis of variance for a set of points, using floating point notation.
MSD01 (U 1876.50)	Calculates the mean and standard deviation. Fixed Point.
NPF01 (U 1876.22)	Calculates the area under the normal probability curve. Floating Point.
NPF02 (U 1876.23)	Coded in X-6 Relative Coding. Calculates the area under the normal probability curve. Floating Point.
NRT01 (U 1876.74)	Calculates the nth root of a number using a floating point notation.
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PLY03 (U 1876.34)	Evaluates the polynomial sum. Floating Point.
QEQ01 (U 1876.69)	Calculates the roots of a quadratic equation using floating point notation. It utilizes one Index Register.
RN501 (U 1876.76)	Generates 5 digit random numbers.
SLE01-9C00 (U 1876.71)	Obtains the solutions of a system of simultaneous linear equations using the "Crout Reduction Method".
SNC01 (U 1876.14)	Calculates the sine or cosine of an angle (radians). Floating Point.
SNC02 (U 1876.15)	Coded in X-6 Relative Coding. Calculates the sine or cosine of an angle (radians). Floating Point.
SNC03 (U 1876.30)	Calculates the sine or cosine of an angle (radians). Fixed Point.
SNC04 (U 1876.52)	Coded in X-6 Relative Coding. Calculates the sine and cosine of an angle. Fixed Point.
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SQR04 (U 1876.25)	Coded in X-6 Relative Coding. Calculates the square root of a number. Fixed Point.
SQR05 (U 1876.68)	Calculates the positive square root of any positive number using floating point notation.
TNP01 (U 1876.10)	Calculates the value of 10 raised to a power. Floating Point.
TNP02 (U 1876.11)	Coded in X-6 Relative Coding. Calculates the value of 10 raised to a power. Floating Point.
TNP03 (U 1876.26)	Calculates the value of 10 raised to a power. Fixed Point.
TNP04 (U 1876.27)	Coded in X-6 Relative Coding. Calculates ten to a power. Fixed Point.

TECHNICAL FACTS U 1778

PROGRAM LIBRARY SERVICES

UNIVAC
Solid-State 80
MONO1-8T00

MONITOR ROUTINE

PURPOSE

MON01-8T00 is a program testing aid which prints each instruction and the contents of the registers prior to execution and then executes the instruction.

DESCRIPTION

This routine is a self-loading routine which functions entirely in band 00. It should be used in conjunction with PTR01-8C00 which reads one card at a time, and in which a "72" instruction is followed immediately by a "96" instruction. MON01-8T00 will not operate with a continuous feed routine such as HSR01-8C00. Each line of print contains, from left to right, the address of the instruction, the instruction, and the contents rA, rL, rX, rB_1, rB_2, and rB_3. The undigits are printed as follows:

Digit	Printed Character
0101	-
0110	blank
0111	)
1101	(
1110	;
1111	'

MON01 is divided into two sections, the Load Section and the Monitor Section.

I. Load Section

The Load Section loads the Monitor Section into the memory. This section must be entered manually by executing a "72" and a "96" instruction and transferring control to memory location 0003.

II. Monitor Section

The Monitor Section prints and executes each instruction either all or part of the main program.[1] If part of the program is being Monitored, this section is entered manually by storing the contents of the registers; by placing

[1] Upon execution of the tape buffer test instruction, C7, in the first block condition, MON01-8T00 will continuously print the C7 instruction.

the address of the first instruction to be monitored in rA in the form 00 aaaa 0000; by placing the address following the last instruction to be monitored in rX in the form 00 xxxx 0000[2]; and by transferring control to location 0102. When the last instruction being monitored is reached, control is returned to the program and normal operation is resumed. To monitor the entire program, substitute 00 9999 0000 for the word in rX.

If a "27" instruction is used in the program being monitored, it will find the High-Speed Printer free (i.e. select the m address).

OPERATING PROCEDURES

I. Loading Procedures

A. Normal Procedures

1. Place the MON01-8C00 in the input magazine of the HSR unit.

2. Set computer on one instruction.

3. Key 72 0000 000⁴/₁ into rC.

4. Key 96 0000 0003 into rA.

5. Set computer on continuous.

6. Depress the Run button.

7. If the computer stops on a 67 HHHH 0102, MON01-8T00 is loaded.

B. Error Procedure

If the computer stops on a 67 0001 0001, a read error has occurred, or the deck is out of order. Correct the error in the program deck, if one exists, and start loading from the beginning.

II. Monitor

A. Normal Procedures

1. To prepare for monitoring:

a. Set the computer on one instruction.

b. If the contents of the registers are important:

(1) Store (rA) in 0134.

---

[2] Location "xxxx" is not monitored.

(2) Store (rL) in 0103.

(3) Store (rX) in 0125.

2. To monitor part of a program:

   a. Key 00 aaaa 0000 into rA, where aaaa is address of the first instruction to be monitored.

   b. Key 00 xxxx 0000 into rX, where, xxxx follows the last instruction to be monitored.

   c. Set computer on continuous.

   d. Depress Run button (starting at 0102).

3. To monitor entire program:

   a. Key 00 aaaa 0000, into rA, where aaaa is the first instruction in the program.

   b. Key 00 9999 0000 into rX.

   c. Set computer on continuous.

   d. Depress Run button (starting at 0102).

   e. If the computer stops on a 67 HHHH 0102, the program or sub-routine has been monitored. To continue the program from this point, transfer control to rL. If the contents of the registers are important, restore the registers and transfer control to the a address indicated by the m portion of (rL) at the time of the stop. The registers are restored as follows:

      (1) rA from 0134

      (2) rL from 0103

      (3) rX from 0125

4. If the computer stops on a 67 mmmm 0033, a stop order exists in the program or sub-routine being monitored. mmmm is the m portion of the instruction in the program or sub-routine. To continue at c, select c, and depress Run button, to continue at m, key 00 0000 0074 into rC, select c and depress Run button.

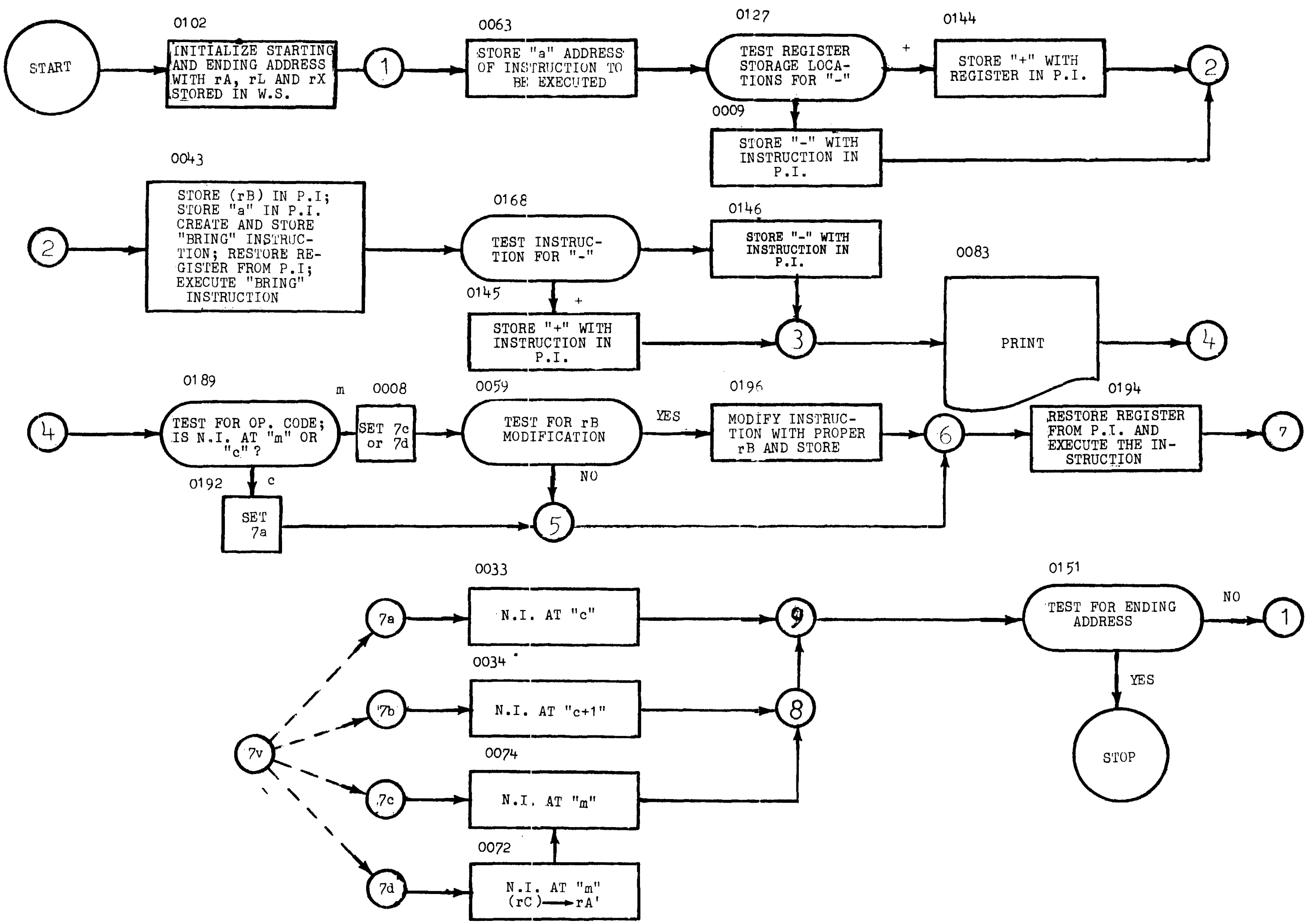
B. Error Procedures

If the computer stops on 67 1100 0083 during the run of the program, a printer error has occurred. Correct the printer trouble, set next instruction at c, and depress the Run button.

Date: 1-23-61

MON01-8T00
GENERAL PROCESS CHART

4



U 1776.12

CODING

Page	Line	a	Op	m	c	Key
001	01	0102	65	0153	0063	
001	02	0063	60	0066	0127	
001	03	0127	05	0129	0132	
001	04	0129	BB	BBBB	BBBA	
001	05	0132	30	0134	0136	
001	06	0136	25	0138	0140	
001	07	0138	CC	CCCC	CCCC	
001	08	0140	87	0144	0143	
001	09	0143	30	0009	0011	
001	10	0009	BB	BBBB	BBBB	
001	11	0011	50	0050	0052	
001	12	0144	65	0050	0052	
001	13	0052	30	0103	0105	
001	14	0105	87	0110	0109	
001	15	0109	30	0009	0012	
001	16	0012	50	0018	0020	
001	17	0110	65	0018	0020	
001	18	0020	30	0125	0128	
001	19	0128	87	0133	0131	
001	20	0131	30	0009	0013	

CODING

Page	Line	a	Op	m	c	Key
002	01	0013	50	0041	0043	
002	02	0133	65	0041	0043	
002	03	0043	07	0000	0047	1
002	04	0047	20	0049	0051	
002	05	0049	00	0000	BBBB	
002	06	0051	60	0094	0096	
002	07	0096	07	0000	0100	2
002	08	0100	20	0049	0053	
002	09	0053	60	0178	0182	
002	10	0182	07	0000	0090	3
002	11	0090	20	0049	0054	
002	12	0054	60	0062	0064	
002	13	0064	25	0066	0068	
002	14	0068	20	0049	0056	
002	15	0056	60	0000	0002	
002	16	0002	25	0004	0006	
002	17	0004	30	0000	0030	
002	18	0006	20	0066	0069	
002	19	0069	60	0165	0167	
002	20	0167	30	0103	0106	

[3] Although the coding appears here in standard form, MON01-8T00 is a self-loading deck, punched in machine code.

CODING

Page	Line	a	Op	m	c	Key
003	01	0106	05	0125	0135	
003	02	0135	25	0134	0165	
003	03	0030	50	0165	0168	
003	04	0168	25	0138	0141	
003	05	0141	87	0146	0145	
003	06	0145	05	0009	0137	
003	07	0146	05	0129	0137	
003	08	0137	65	0081	0083	
003	09	0083	11	0002	0189	
003	10	0190	67	1100	0083	
003	11	0189	25	0191	0193	
003	12	0191	H8	0000	0000	
003	13	0193	35	000B	0197	
003	14	0197	30	0199	0001	
003	15	0199	27	0000	0000	
003	16	0001	82	0008	0007	
003	17	0007	30	0067	0070	
003	18	0067	22	0000	0000	
003	19	0070	82	0115	0073	
003	20	0073	30	0075	0077	

CODING

Page	Line	a	Op	m	c	Key
004	01	0075	42	0000	0000	
004	02	0077	82	0115	0080	
004	03	0080	30	0082	0084	
004	04	0082	C2	0000	0000	
004	05	0084	82	0115	0087	
004	06	0087	30	0089	0091	
004	07	0089	C7	0000	0000	
004	08	0091	82	0115	0095	
004	09	0095	30	0097	0101	
004	10	0097	23	0000	0000	
004	11	0101	82	0115	0104	
004	12	0104	30	0107	0111	
004	13	0107	92	0000	0000	
004	14	0111	82	0115	0114	
004	15	0114	30	0116	0118	
004	16	0116	26	0000	0000	
004	17	0118	82	0195	0121	
004	18	0121	30	0123	0126	
004	19	0123	06	0000	0000	
004	20	0126	82	0195	0142	

CODING

Page	Line	a	Op	m	c	Key
005	01	0142	30	0147	0149	
005	02	0147	31	0000	0000	
005	03	0149	82	0195	0152	
005	04	0152	30	0154	0156	
005	05	0154	36	0000	0000	
005	06	0156	82	0195	0159	
005	07	0159	30	0161	0163	
005	08	0161	86	0000	0000	
005	09	0163	82	0195	0166	
005	10	0166	30	0169	0171	
005	11	0169	87	0000	0000	
005	12	0171	82	0195	0174	
005	13	0174	30	0176	0179	
005	14	0176	82	0000	0000	
005	15	0179	82	0195	0180	
005	16	0180	31	0186		
005	17	0186	82	0195	0192	
005	18	0192	25	0165	0172	
005	19	0172	35	0175	0177	
005	20	0175	HH	HHHH	0000	

CODING

Page	Line	a	Op	m	c	Key
006	01	0177	20	0181	0185	
006	02	0181	00	0000	0033	
006	03	0185	60	0187	0194	
006	04	0194	30	0103	0112	
006	05	0112	05	0125	0148	
006	06	0148	25	0134	0187	
006	07	0008	20	0010	0003	
006	08	0010	00	0072	0072	
006	09	0115	20	0117	0003	
006	10	0117	00	0072	0033	
006	11	0195	20	0198	0003	
006	12	0198	00	0074	0033	
006	13	0003	60	0187	0059	
006	14	0059	25	0165	0164	
006	15	0164	30	0014	0078	
006	16	0014	04	0000	0000	
006	17	0078	35	000B	0085	
006	18	0085	82	0196	0088	
006	19	0088	30	0138	0092	
006	20	0092	87	0194	0196	

CODING

Page	Line	a	Op	m	c	Key
007	01	0196	05	000A	0021	
007	02	0021	20	0024	000A	
007	03	0024	07	0000	0028	
007	04	0028	30	000A	0032	
007	05	0032	25	0006	0036	
007	06	0036	20	0038	0040	
007	07	0038	02	0000	0194	
007	08	0040	20	000B	0044	
007	09	0044	60	0048	0057	
007	10	0057	25	0165	0188	
007	11	0188	35	0015	0017	
007	12	0015	04	HHHH	0000	
007	13	0017	20	0019	000A	
007	14	0019	07	0000	0025	
007	15	0025	05	000A	0029	
007	16	0029	25	0165	0022	
007	17	0022	35	0026	0031	
007	18	0026	HH	0000	HHHH	
007	19	0031	20	000C	0035	
007	20	0035	60	0165	0048	

CODING

Page	Line	a	Op	m	c	Key
008	01	0033	60	0134	0150	
008	02	0150	25	0165	0027	
008	03	0027	37	0400	0037	
008	04	0037	35	0039	0042	
008	05	0039	00	HHHH	0000	
008	06	0042	50	0103	0113	
008	07	0113	65	0125	0151	
008	08	0151	30	0153	0155	
008	09	0155	82	0184	0063	
008	10	0184	67	HHHH	0102	
008	11	0034	60	0134	0157	
008	12	0157	50	0103	0119	
008	13	0119	25	0058	0045	
008	14	0058	08	0000	0000	
008	15	0045	35	0165	0060	
008	16	0060	31	0065		
008	17	0065	82	0158	0071	
008	18	0071	30	0108	0120	
008	19	0108	05	0000	0000	
008	20	0120	82	0158	0124	

CODING

Page	Line	a	Op	m	c	Key
009	01	0158	30	0103	0160	
009	02	0124	30	0103	0122	
009	03	0122	25	0165	0162	
009	04	0162	60	0134	0061	
009	05	0160	25	0165	0061	
009	06	0061	70	0079	0027	
009	07	0079	00	0000	0001	
009	08	0072	25	0165	0074	
009	09	0074	60	0134	0076	
009	10	0076	25	0165	0037	
009	11	0005	22	0000	0000	
009	12	0099	22	0000	0000	
009	13	0183	22	0000	0000	
009	14	0023	00	0000	0000	
009	15	0046	00	0000	0000	
009	16	0055	00	0000	0000	
009	17	0086	00	0000	0000	
009	18	0130	00	0000	0000	
009	19	0139	00	0000	0000	
009	20	0170	00	0000	0000	

PROGRAM LIBRARY SERVICES

UNIVAC Solid-State 90

MRA01-9C00

MULTIPLE REGRESSION ANALYSIS

PURPOSE

MRA01 is a Univac Solid-State 90 routine designed to calculate the Linear Regression Coefficients and Analysis of Variance.

DESCRIPTION

MRA01 uses the one word, XS-50, floating decimal format.[1] Given a set of n observations of a dependent variable (y_i), and its corresponding m independent variables ($x_{i_1}, x_{i_2}, \ldots, x_{im}$), where m may vary from 2 to 70; if the dependent variable is assumed to be a linear combination of the independent variables in the form:

$$y = \sum_{j=0}^{m} a_j x_j \qquad (x_0 = 1)$$

then the "best fit" equation (the determination of the a_j's to best describe the given data) is obtained by MRA01. In addition, an analysis of the results is given (variance reductions and variance errors resulting from using the "best fit" equation). In actuallity, MRA01 is made up of three phases:

I. Summation Phase

This phase formulates the elements of the Normal Equation (those equations used in determining the a_j's) Coefficient Matrix. After the raw data has been read into the computer, the coefficients of the normal Equation are calculated and punched to be used as input in the second phase if the Inversion Phase does not immediately follow the Summation Phase.

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[1]See FLP01 for floating point conventions.

II. Inversion Phase

This phase performs the inversion of the Normal Equation Coefficient Matrix, obtaining the Regression Coefficients. The coefficients of the normal equations are printed, together with the coefficients after the forward Doolittle solution is performed. This is followed by a printed table of the regression coefficients, variance reduction due to the particular independent variable, the cumulative variance before removing the variance due to that particular variable, and the ratio of the variance reduction to the variance remaining.

The regression coefficients are punched to be used as input for the prediction phase.

III. Prediction Phase

For each set of raw input data (point), this phase calculates and prints the estimated value of the dependent variable, assuming the use of the calculated regression coefficients and the values of the input independent variables (assuming that the independent variables are weighted according to the regression coefficients); and compares the estimated value with the input value of the dependent variable, obtaining the difference and the cumulative sum of the difference and printing these results.

These three phases must be executed in sequential order; however, they need not be executed without interruption. Provision is made to restart at the beginning of the second and third phase (see OPERATING PROCEDURES).

PARAMETERS

In addition to the program deck as provided, two cards (in the standard one instruction per card format) must be added in order to supply the routine with this required information:

Location	Contents	Remarks
4000	00 00vv 0000	v = m-1 = number of independent variables.
4100	NN nnnn nnnn	n = total number of points in one word, XS-50, floating decimal form.

INPUT AND OUTPUT FORMAT

Input

The input to the Summation Phase is a series of data cards, containing the elements of the dependent variable and independent variables in one word XS-50 floating decimal form. The elements are grouped according to observations. The elements of each observation are arranged beginning with the dependent variable followed by the independent variables (the order of the independent variables must be the same for each group). Each card contains a maximum of 5 elements, in order, and the location of the first element. The elements of each group will be stored into the memory in the following way:

Element	Location
y_i	0200
x_{i1}	0201
x_{i2}	0202
$\vdots$	$\vdots$
x_{im}	0200+m
Point Identification No.	0201+m

The "Point Identification" (any number to identify a particular point) must follow the last variable of each group or point. Each new dependent variable must start a new card.

The format of each card is as follows:

Column	Item	Format	
3-6	1111	1111	Location of first element on the card (e.g., 0200, 0205).
10	$n (n \leq 5)$	n	Number of elements on the card.
11-20	$y.yyyyyyy \times 10^{YY-50}$ or $x.xxxxxxx \times 10^{XX-50}$	YYyyyyyyyy or XXxxxxxxxx	First element in XS-50, floating decimal excluding form sign. Zeros need not be punched.
21-30	$x.xxxxxxx \times 10^{XX-50}$	XXxxxxxxxx	Element 2, excluding sign.
31-40	"	"	Element 3, excluding sign.

Column	Item	Format	Remarks
46-55	$x.xxxxxxx \times 10^{XX-50}$	XXxxxxxxxx	Element 4, excluding sign.
56-65	"	"	Element 5, excluding sign.
41	+ or -	Blank or 2	Key of element 1.
42	+ or -	Blank or 2	Key of element 2.
43	+ or -	Blank or 2	Key or element 3.
44	+ or -	Blank or 2	Key of element 4.
45	+ or -	Blank or 2	Key or element 5.

The input to the Inversion Phase is the output of the Summation Phase, if the Inversion Phase does not immediately follow the Summation Phase.

The input to the Predction Phase is the punched output of the Inversion Phase, if the Prediction Phase does not immediately follow the Inversion Phase.

Output

I. Summation Phase

The only output of the Summation Phase is a series of punched cards which contain the elements (or coefficients) of the Normal equations. These cards are to be the input of the Inversion Phase, if the Inversion Phase does not immediately follow the Summation Phase.

II. Inversion Phase.

The output of the Inversion Phase is as follows:

A. Printed listing (see Sample Output, page).

1. The matrix of the Normal equations (Summation Matrix) is listed according to row and column with the elements in one word, XS-50, floating decimal form

only the upper half of the matrix is shown, since the matrix is symmetric with respect to the diagonal. The first column contains the constants of the Normal equations.

2. The elements of the Auxiliary matrix (output from using the Forward Doolittle Method on the Summation Matrix) is listed in the same form as the Summation Matrix.

3. A table of the Analysis of Variance follows, containing, in particular, the following quantities:

   a. Variable Identification (number representing the particular variable).

   b. Regression Coefficients.

   c. Variance Reductions due to the particular variable.

   d. Cumulative Total Variance, reducing the value each time by the Variance Reduction due to the previous variable.

5. Ratios of the Variance Reduction over the Cumulative Total Variance.

B. Punched Output

The punched output of the Inversion Phase is a series of cards containing the Regression Coefficients, to be used as input to the Prediction Phase if the Prediction Phase does not immediately follow the Inversion Phase.

III. Prediction Phase

The output of the Prediction Phase is a printed table, containing for each point the following information:

A. Point Identification

B. Actual value of the dependent variable (as given in the input).

C. Predicted value of the dependent variable (calculated from the Regression Coefficients and the input values for the independent variables).

D. The difference between the Predicted value and Actual value of the dependent variable (Actual value - Predicted value).

E. The cumulative sum of these differences.

METHOD

Given a set of n observations of a dependent variable (y_i) and its corresponding m independent varibles ($x_{i1}, x_{i2}, \ldots, x_{im}$), where m may vary from 2 to 70; if the dependent variable is assumed to be a linear combination of the independent variables in the form:

$$(1) \qquad y = \sum_{j=0}^{m} a_j x_j \qquad (x_0 = 1)$$

then the "best fit" equation (the determination of the a_j's to best describe the given data) is determined in the following way.

Consider the set of equations:

$$(2) \qquad y_i = \sum_{j=0}^{m} a_j x_{ij} \quad \text{where } (x_0 = 1)$$

then the set of a_j's are to be determined by the minimization of the following function:

$$(3) \qquad F = \sum_{i=1}^{n} \left[y_i - \sum_{j=0}^{m} a_j x_{ij} \right]^2$$

This function is to be differentiated with respect to each of the coefficients, a_j's, and equated to zero. The resultant set of equations:

$$(4) \qquad \sum_{j=0}^{m} a_j \sum_{i=1}^{n} x_{ik} \; x_{ij} = \sum_{i=1}^{n} x_{ik} y_i \qquad (k=0,1,2,\ldots,m)$$

called the Normal equations in then formed to be solved for the a_j's. The Coefficient matrix of this set of equations is symmetric and the Forward Doolittle method is used for the calculation of the regression coefficients, a_j's.

OPERATING PROCEDURES

I. Summation Phase

A. Normal Procedures

1. Clear the memory to zeros. The following way is suggested:

   a. Set computer on one instruction.

   b. Key 70 000T 000K into rA and 60 4999 000K into rC.

   c. Depress Run button.

   d. Key 00 0000 0000 in rL
      00 0001 0000 in rX
      50 0000 4999 in rA.

   e. Set computer on continuous.

   f. Depress Run button.

   g. The computer will stall on 00 0000 0000 for a successful clearing to zero.

2. Using PTA02, load Summation Phase as supplied with the cards containing the number of variables and the number of points just before the sentinel card. (Do not memory fill with stop orders.)

3. Place input deck in the HSR Input Magazine.

4. Set computer on one instruction.

5. Key 00 4001 0000 into rC.

6. Set computer on continuous.

7. Depress Run button.

8. If the computer stops with a 67 9999 0120, this indicates that this phase has been completed.

B. Error Procedures

1. If the computer stops with a 67 0100 4751, this indicates that the characteristic becomes greater than 99 during the calculation of the cross products or during the summation. This indicates that some of the points fall outside the range of this routine; it is suggested that these points be either removed with proper modification to 4100, or re-arranged. It is also possible to make a transformation of the entire system.

2. If the computer stops with a 67 4048 4317, this indicates that the cards are out of sequence; remove all the cards in the output stacker beginning with the first card of that specific point, correct the sequence, place these cards at the bottom of the input magazine and depress the Run button, causing the computer to reprocess the entire data point information.

3. If the computer stops with a 67 0002 4048 in rC, this indicates that a read check error has occurred. To continue, place error card at the bottom of input magazine and depress Run button, causing a reread of the error card.

4. If the computer stalls on 96 0800 4051, this indicates that the input magazine is empty and that all of the cards have not been fed. Place remainder of the input deck in the input magazine and to continue loading:

   a. Set the computer on one instruction.

   b. Key 00 4048 0000 into rC.

   c. Set computer on continuous.

   d. Depress Run button.

5. If the computer stops with a 67 4819 4245 in rC, this indicates that an abnormal condition has occurred in the Read Punch Unit. Correct the abnormality and depress the Run button.

   If it is desired to repunch the entire output:

   a. Set the computer on one instruction.

   b. Key 00 4256 0000 into rC.

   c. Set computer on continuous.

   d. Depress Run button.

C. Arbitrary Stopping and Restarting Procedure

Occasionally it becomes necessary to stop the computer before the first phase is completed. To conserve the results that have already been computed up to this point, the following procedure must be followed:

1. To stop:

   a. Set the computer on one instruction.

   b. Remove the cards from the input magazine; mark these cards as NOT USED.

c. Remove the cards from the output stacker; mark these cards as USED.

d. Set computer on continuous.

e. Depress Run button.

f. If the computer stalls on a 96 0600 4101, to cause punching of the results up to this point:

(1) Set the computer on one instruction.

(2) Key 00 4256 0000 into rC.

(3) Set the computer on continuous.

(4) Depress Run button.

2. To restart:

a. Reload the program as outlined in A(1. and 2.).

b. Place the cards in the input magazine in the following order:

(1) Punched output from the "To Stop" section.

(2) The cards marked NOT USED.

c. Set computer on one instruction.

d. Key 00 4002 0000 into rC.

e. Set computer on continuous.

f. Depress Run button to continue:

II. Inversion Phase

A. Normal Procedures

1. Inversion Phase immediately following Summation Phase.

a. Using PTA02, load the Inversion Phase deck.

b. Set computer on one instruction.

c. Key 00 4001 0000 into rC.

d. Set computer on continuous.

e. Depress Run button.

f. If the computer stops with a 67 8888 0120, this indicates that this phase has come to a successful completion.

g. Remove and save printing from the HSP.

h. Remove and save (for Prediction Phase) cards from the RPU.

2. Inversion Phase not immediately following Summation Phase.

   a. Clear memory drum to zeros.

   b. Load Inversion Phase deck using PTA02.

   c. Place the punched output from the Summation Phase in the input magazine of the HSR.

   d. Set computer on one instruction.

   e. Key 00 4002 0000 into rC.

   f. Set computer on continuous.

   g. Depress Run button.

   h. If the computer stops with a 67 8888 0120 in rC, this indicates that this phase has come to a successful completion.

   i. Remove and save printing from the HSR.

   j. Remove and save (for Prediction Phase) cards from the RPU.

B. Error Procedures

1. If the computer stops with a 67 0100 4751 or 67 0000 4764 this indicates that the characteristic of the result of an arithmetic operation is greater than 99 or that the divisor, prior to division, is equivalent to zero.[1]

2. If the computer stops with a 67 4135 4024, this indicates that an abnormal condition has occurred in the High-Speed Printer.

   a. To continue, printing the line in error:

      (1) Correct abnormality.

      (2) Set next instruction at m.

      (3) Depress Run button.

   b. To continue, repeating the entire row now being printed:

      (1) Correct abnormality.

      (2) Depress Run button.

3. If the computer stops with a 67 0001 xxxx, where xxxx is a variable address, this indicates that an abnormal condition has occurred in the High-Speed Printer. To continue, correct abnormality and depress Run button.

4. If the computer stops with a 67 0002 4396, this indicates that a readcheck error has occurred in the High-Speed Reader. To continue:

    a. Place error card (top one in stacker) at the bottom in the input magazine.

    b. Depress Run button to reread error card.

5. If the computer stops with a 67 4521 4595, this indicates that an abnormal condition has occurred in the Read Punch Unit. To continue:

    a. Correct abnormality.

    b. Depress Run button.

    To repunch entire output:

    a. Correct abnormality.

    b. Set computer on one instruction.

    c. Key 00 4955 0000 into rC.

    d. Set computer on continuous.

    e. Depress Run button.

III. Prediction Phase

A. Normal Procedures

1. Prediction Phase immediately following Inversion Phase.

    a. Using PTA02, load the Prediction Phase deck.

    b. Place input to the Summation Phase in the HSR input magazine.

    c. Set computer on one instruction.

    d. Key 00 4001 0000 into rC.

    e. Set computer on continuous.

    f. Depress Run button.

    g. if the computer stalls on 96 0600 4801, this indicates that this phase has come to a successful completion.

    h. Remove and save printing from the HSP.

2. Prediction Phase Not Immediately following Inversion Phase.

a. Clear memory drum to zeros.

b. Load Prediction Phase using PTA02.

c. Place output from Inversion Phase followed by input to Summation Phase in the HSR input magazine.

d. Set computer on one instruction.

e. Key 00 4002 0000 into rC.

f. Set the computer on continuous.

g. Depress Run button.

h. If the computer stalls on 96 0600 4801, this indicates that this phase has come to a successful completion.

B. Error Procedures

1. If the computer stops with a 67 0100 4751 or 96 0000 4764, this indicates that the characteristic of the result of an arithmetic operation is greater than 99 or that the divisor, prior to division, is equivalent to zero.[1]

2. If the computer stops with a 67 4357 4026, this indicates that the cards are out of sequence. To continue:

   a. Start with first card of a specific point in error, correct sequence and place in input magazine of HSR.

   b. Depress Run button to reread the entire data point information.

3. If the computer stops with a 67 0002 4357 in rC, this indicates that a readcheck error has occurred. To continue:

   a. Place error card and all those following at the bottom of the HSR input magazine.

   b. Depress Run button to reread the error card.

4. If the computer stalls on 96 0600 4801, this indicates that the input magazine of the HSR is empty. To continue reading:

   a. Place the rest of the cards (if any) in the input magazine of the HSR.

   b. Set the computer on one instruction.

   c. Key 00 4357 0000 into rC.

d. Set computer on continuous.

e. Depress Run button.

5. If the computer stops with a 67 0001 xxxx, where xxxx is a variable address, this indicates that an abnormal condition has occurred in the High-Speed Printer. To continue, correct abnormality and depress Run button.

6. If the computer stops with a 67 4385 4110, this indicates that an abnormal condition has occurred in the High-Speed Printer. To print line causing the error.

   a. Correct abnormality.

   b. Set next instruction at m.

   c. Depress Run button.

NOTE: Questions concerning this routine should be directed to Manager, Program Library Services, Remington Rand Univac, 315 Park Avenue South, New York 10, N. Y.

Date: 12/30/60

SUMMATION MATRIX

ROW 1	5112000000	5136000000	5213600000	5257600000	5212400000
ROW 2	5213600000	5257600000	5325840000	5245200000	0000000000
ROW 3	5325840000	5411976000	5319200000	0000000000	0000000000
ROW 4	5456656000	5387200000	0000000000	0000000000	0000000000

AUXILIARY MATRIX

ROW 1	5112000000	5030000000	5111333333	5148000000	5110333333
ROW 2	5128000000	5060000004	5130571429	5028571432	0000000000
ROW 3	5134666600	5090000173	5010000000	0000000000	0000000000
ROW 4	5130851000	4933339600	0000000000	0000000000	0000000000

VARIABLE IDENTITY	REGRESSION COEFF	VARIANCE REDUCTION DUE TO VARIABLE	VARIANCE BEFORE REMOVING EFFECT OF VARIABLE	FRACTION REMAINING VARIANCE REMOVED
0000000000	5029989350	5312813332	5315503000	4982650661
0000010000	5046681712	5222857148	5226896680	4984981299
0000020000	5020005698	5134666600	5140395320	4985818357
0000030000	4933339600	5034291778	5057287200	4959859407
0000040000	0000000000	0000000000	5022995422	0000000000

PREDICTION

IDENTITY	ACTUAL VALUE	PREDICTED VALUE	DELTA	SUM DELTA
0000010000	5064000000	5059999324	4940006760	4940006760
0000020000	5056000000	5059999324	- 4939993240	4613520000
0000030000	5060000000	5059999324	4567600000	4620280000
0000040000	5075000000	5070001658	4949983420	4950003700
0000050000	5065000000	5070001658	- 4950016580	- 4612880000
0000060000	5083000000	5080000130	4929998700	4929985820
0000070000	5077000000	5080000130	- 4930001300	- 4615480000
0000080000	5111700000	5110999847	4970015300	4969999820
0000090000	5110300000	5110999847	- 4969984700	4615120000
0000100000	5117600000	5118000046	- 4940004600	- 4939989480
0000110000	5118000000	5118000046	- 4546000000	- 4939994080
0000120000	5118400000	5118000046	4939995400	4513200000

U 1876.67

PART I

MRA019C00 - Summation Phase

CARD NO	PAGE	LINE	A	OP	M	C	K
0001	001	010	46	26	46 3	0	1
0002	001	020	4602	20	000T	4906	
0003	001	030	4603	75	000T	4609	1
0004	001	040	4607	05	4659	4821	1
0005	001	050	4608	TT	0000	0000	1
0006	001	060	4609	05	000K	4613	
0007	001	070	4610	87	4813	4713	1
0008	001	080	4612	49	0000	0000	1
0009	001	090	4613	25	000Y	4817	
0010	001	100	4615	05	000K	4619	1
0011	001	110	4619	26	4622	0000	1
0012	001	120	4620	05	4672	4915	
0013	001	130	4622	20	000Y	4826	
0014	001	140	4623	25	4633	4797	1
0015	001	150	4625	77	0000	4778	
0016	001	160	4632	05	4634	4821	1
0017	001	170	4634	00	0000	0097	1
0018	001	180	4635	65	4637	4639	1
0019	001	190	4639	35	4691	4643	
0020	001	200	4640	87	4743	4694	1

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0021	002	010	4643	05	000K	4647	1
0022	002	020	4645	60	4797	4799	1
0023	002	030	4647	25	000Y	4851	
0024	002	040	4649	05	000K	4703	1
0025	002	050	4650	05	4654	4821	1
0026	002	060	4651	35	4653	4655	1
0027	002	070	4652	87	4605	4607	1
0028	002	080	4653	1T	0000	0000	1
0029	002	090	4654	00	0000	0094	1
0030	002	100	4655	75	000T	4660	1
0031	002	110	4657	38	0200	4861	
0032	002	120	4658	0T	0000	0000	2
0033	002	130	4659	00	0000	0093	1
0034	002	140	4660	17	0000	4663	1
0035	002	150	4662	05	4665	4821	1
0036	002	160	4663	12		4866	
0037	002	170	4664	85	000T	4700	1
0038	002	180	4665	00	0000	0092	1
0039	002	190	4667	33	0300	4773	1
0040	002	200	4666	08	0000	0000	1

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0041	003	010	4669	00	0000	0091	1
0042	003	020	4670	87	4623	4673	1
0043	003	030	4672	00	0000	0099	1
0044	003	040	4673	32	0200	4678	1
0045	003	050	4675	38	0100	4878	1
0046	003	060	4676	20	4680	4682	1
0047	003	070	4680	32	0000	4705	1
0048	003	080	4682	77	0000	4685	1
0049	003	090	4685	25	4637	4689	1
0050	003	100	4687	36	0100	4790	1
0051	003	110	4689	37	0200	000Y	1
0052	003	120	4693	38	0100	4746	1
0053	003	130	4694	05	4896	4821	
0054	003	140	4695	60	4797	4600	1
0055	003	150	4699	26	4702	0000	1
0056	003	160	4700	31	4803	0000	1
0057	003	170	4701	05	4704	0001	
0058	003	180	4702	20	000T	4706	1
0059	003	190	4703	25	000Y	4657	1
0060	003	200	4704	67	0000	4764	1

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0061	004	010	4705	05	000K	4709	1
0062	004	020	4706	35	4708	4710	1
0063	004	030	4708	1T	0000	0000	1
0064	004	040	4709	25	4633	4735	1
0065	004	050	4710	05	000K	4714	1
0066	004	060	4711	38	0100	4814	1
0067	004	070	4713	06	4616	0000	1
0068	004	080	4714	26	4717	0000	1
0069	004	090	4716	87	4719	4620	1
0070	004	100	4717	20	000Y	4721	1
0071	004	110	4718	00	0000	0050	1
0072	004	120	4719	38	0100	4722	1
0073	004	130	4720	26	4797	0000	1
0074	004	140	4721	35	4774	4780	1
0075	004	150	4722	87	4725	4776	1
0076	004	160	4723	01	1000	0000	1
0077	004	170	4725	38	0100	4728	
0078	004	180	4728	87	4931	4632	
0079	004	190	4731	60	4633	4785	1
0080	004	200	4732	05	4751	0001	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0081	005	010	4734	87	4637	4788	1
0082	005	020	4735	37	0200	4740	1
0083	005	030	4736	00	1000	0000	1
0084	005	040	4737	TT	0000	0000	1
0085	005	050	4739	70	000Y	4796	1
0086	005	060	4740	70	000T	4945	
0087	005	070	4741	65	4793	4895	1
0088	005	080	4743	38	0100	4846	
0089	005	090	4745	38	0200	4749	1
0090	005	100	4746	87	4650	4899	1
0091	005	110	4749	05	000K	4753	1
0092	005	120	4751	67	0100	4751	1
0093	005	130	4752	87	4607	4755	1
0094	005	140	4753	25	000Y	4757	1
0095	005	150	4755	38	0100	4858	1
0096	005	160	4756	30	4758	4810	1
0097	005	170	4757	38	0100	4760	1
0098	005	180	4758	0T	0000	0000	1
0099	005	190	4760	35	4762	4764	1
0100	005	200	4761	38	0100	4864	1

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0101	006	010	4762	0T	TTTT	TTTT	1
0102	006	020	4763	06	4916		
0103	006	030	4764	30	000T	4768	1
0104	006	040	4766	87	4770	4769	1
0105	006	050	4767	05	4669	4821	1
0106	006	060	4768	55	000K	4700	1
0107	006	070	4769	38	0100	4872	1
0108	006	080	4770	05	4672	4865	
0109	006	090	4771	33	0200	4775	1
0110	006	100	4772	00	4961		
0111	006	110	4773	20	4777	4775	1
0112	006	120	4774	TT	0000	0000	1
0113	006	130	4775	77	0000	4828	1
0114	006	140	4776	05	4779	4821	1
0115	006	150	4777	01	2000	0000	1
0116	006	160	4778	36	4981		
0117	006	170	4779	00	0000	0098	1
0118	006	180	4780	75	000T	4786	
0119	006	190	4781	20	4633	4935	
0120	006	200	4783	20	4736	4775	1

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0121	007	010	4784	87	4788	4687	1
0122	007	020	4785	70	4787	4940	
0123	007	030	4786	70	4888	4991	
0124	007	040	4787	99	0000	0000	1
0125	007	050	4788	05	4792	4821	1
0126	007	060	4789	70	000Y	4797	1
0127	007	070	4790	87	4694	4693	1
0128	007	080	4791	65	4793	4645	1
0129	007	090	4792	00	0000	0096	1
0130	007	100	4795	60	4797	4613	
0131	007	110	4796	26	4797	0000	1
0132	007	120	4798	05	4751	0001	
0133	007	130	4799	26	4602	0000	1
0134	007	140	4803	87	4756	4856	
0135	007	150	4805	38	0100	4808	1
0136	007	160	4808	87	4711	4662	1
0137	007	170	4810	87	4763	4863	1
0138	007	180	4813	38	0100	4716	1
0139	007	190	4814	87	4720	4767	1
0140	007	200	4816	75	4718	4771	1

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0141	008	010	4817	36	4820	0000	
0142	008	020	4820	87	4823	4873	
0143	008	030	4821	33	0200	4625	1
0144	008	040	4822	06	4876		
0145	008	050	4823	20	000T	4827	
0146	008	060	4826	70	000T	4731	
0147	008	070	4827	87	4631	4830	
0148	008	080	4828	36	4781		
0149	008	090	4830	65	4633	4835	
0150	008	100	4831	50	4633	4635	
0151	008	110	4835	50	4637	4639	1
0152	008	120	4837	38	0100	4640	1
0153	008	130	4840	26	4797	0000	1
0154	008	140	4841	25	4793	4745	1
0155	008	150	4845	38	0200	4649	1
0156	008	160	4846	87	4849	4650	
0157	008	170	4849	38	0100	4652	1
0158	008	180	4851	35	4653	4655	
0159	008	190	4856	30	4658	4610	
0160	008	200	4858	87	4662	4761	1

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0161	009	010	4860	75	4612	4615	1
0162	009	020	4861	77	0000	4664	
0163	009	030	4863	38	0100	4766	1
0164	009	040	4864	87	4767	4797	1
0165	009	050	4865	70	4718	4821	
0166	009	060	4866	30	4668	4670	
0167	009	070	4872	87	4776	4675	1
0168	009	080	4873	20	000T	4927	
0169	009	090	4876	32	0300	4783	
0170	009	100	4876	87	4632	4881	1
0171	009	110	4881	38	0100	4784	1
0172	009	120	4885	70	4787	4840	1
0173	009	130	4888	50			
0174	009	140	4891	TT			
0175	009	150	4895	60	4797	4699	1
0176	009	160	4896	00	0000	0095	
0177	009	170	4899	38	0100	4752	1
0178	009	180	4906	35	4608	4860	
0179	009	190	4908	70	000Y	4913	1
0180	009	200	4915	75	4718	4821	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0181	010	010	4916	70	4718	4771	
0182	010	020	4921	20	4723	4775	
0183	010	030	4927	87	4830	4831	
0184	010	040	4931	38	0100	4734	1
0185	010	050	4935	35	4737	4789	1
0186	010	060	4940	26	4797		
0187	010	070	4941	25	4793	4845	
0188	010	080	4945	00	4700		
0189	010	090	4946	77	0000	4949	
0190	010	100	4949	36	4952		
0191	010	110	4952	20	4954	4956	
0192	010	120	4954			0500	
0193	010	130	4956	70	000Y	4961	
0194	010	140	4961	06	4966		
0195	010	150	4962	06	4667		
0196	010	160	4966	33	0300	4921	
0197	010	170	4981	20	4633	4985	1
0198	010	180	4985	35	4737	4739	1
0199	010	190	4991	60	4633	4885	
0200	010	200	4992	05	4751	0001	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0201	011	010	4050	05	4052	4004	
0202	011	020	4052	00	0200	0201	
0203	011	030	4004	25	4006	4008	
0204	011	040	4006	30	1001	4003	
0205	011	050	4003	05	4005	4007	
0206	011	060	4007	25	4009	4795	
0207	011	070	4009	60	1001	4053	
0208	011	080	4053	30	1002	4054	
0209	011	090	4054	05	0201	4103	
0210	011	100	4103	25	4055	4795	
0211	011	110	4055	60	1002	4104	
0212	011	120	4104	25	4053	4105	
0213	011	130	4105	70	4057	4010	
0214	011	140	4010	60	4053	4155	
0215	011	150	4155	25	4054	4056	
0216	011	160	4056	70	4057	4060	
0217	011	170	4060	60	4054	4106	
0218	011	180	4106	25	4055	4107	
0219	011	190	4107	70	4057	4110	
0220	011	200	4110	60	4055	4157	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0221	012	010	4157	30	4059	4011	
0222	012	020	4011	82	4014	4053	
0223	012	030	4014	25	4016	4018	
0224	012	040	4018	60	4053	4205	
0225	012	050	4205	25	4207	4109	
0226	012	060	4109	60	4054	4156	
0227	012	070	4156	25	4058	4160	
0228	012	080	4160	60	4055	4257	
0229	012	090	4257	30	1002	4154	
0230	012	100	4154	05	0200	4102	
0231	012	110	4102	25	4204	4795	
0232	012	120	4204	60	1002	4254	
0233	012	130	4254	25	0200	4152	
0234	012	140	4152	60	0201	4153	
0235	012	150	4153	30	0201	4203	
0236	012	160	4203	05	0201	4253	
0237	012	170	4253	25	4255	4791	
0238	012	180	4255	77		4108	
0239	012	190	4108	05	1003	4305	
0240	012	200	4305	25	4307	4795	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0241	013	010	4307	60	1003	4355	
0242	013	020	4355	25	4203	4405	
0243	013	030	4405	70	4057	4210	
0244	013	040	4210	60	4203	4455	
0245	013	050	4455	25	4108	4260	
0246	013	060	4260	70	4057	4310	
0247	013	070	4310	60	4108	4360	
0248	013	080	4360	25	4307	4159	
0249	013	090	4159	70	4057	4410	
0250	013	100	4410	60	4307	4209	
0251	013	110	4209	30	4061	4013	
0252	013	120	4013	82	4066	4153	
0253	013	130	4066	25	4153	4505	
0254	013	140	4505	70	4057	4460	
0255	013	150	4460	60	4153	4555	
0256	013	160	4555	25	4357	4259	
0257	013	170	4259	60	4203	4605	
0258	013	180	4605	25	4357	4309	
0259	013	190	4309	70	4057	4510	
0260	013	200	4510	60	4357	4359	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0261	014	010	4359	25	4061	4063	
0262	014	020	4063	70	4015	4068	
0263	014	030	4066	60	4061	4113	
0264	014	040	4113	25	4015	4017	
0265	014	050	4017	75	4057	4560	
0266	014	060	4560	60	4015	4067	
0267	014	070	4067	30	4019	4021	
0268	014	080	4021	82	4024	4153	
0269	014	090	4074	30	4100	4202	
0270	014	100	4202	25	1001	4303	
0271	014	110	4303	82	4256	4206	
0272	014	120	4206	25	4158	4910	
0273	014	130	4910	60	4153	4855	
0274	014	140	4855	25	4407	4409	
0275	014	150	4409	60	4203	4955	
0276	014	160	4955	25	4457	4459	
0277	014	170	4459	60	4108	4960	
0278	014	180	4960	25	4012	4064	
0279	014	190	4064	60	4307	4509	
0280	014	200	4509	25	4111	4163	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0281	015	010	4163	60	4015	4117	
0282	015	020	4117	25	4069	4071	
0283	015	030	4071	60	4061	4213	
0284	015	040	4213	25	4065	4167	
0285	015	050	4167	60	4357	4050	
0286	015	060	4150	05	4252	4304	
0287	015	070	4252	00	1000	0999	
0288	015	080	4304	25	4306	4206	
0289	015	090	4306	67	9999	0120	
0290	015	100	4001	30	4000	4302	
0291	015	110	4302	50	4015	4217	
0292	015	120	4217	50	4111	4263	
0293	015	130	4263	25	4058	4161	
0294	015	140	4161	70	Y	4116	
0295	015	150	4116	60	4059	4211	
0296	015	160	4211	25	4061	4313	
0297	015	170	4313	70	Y	4118	
0298	015	180	4118	70	Y	4023	
0299	015	190	4023	60	4061	4363	
0300	015	200	4363	60	4069	4121	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0301	016	010	4121	25	4457	4559	
0302	016	020	4559	70	Y	4114	
0303	016	030	4114	60	4457	4759	
0304	016	040	4759	60	4108	4261	
0305	016	050	4261	25	4012	4164	
0306	016	060	4164	70	Y	4119	
0307	016	070	4119	60	4012	4214	
0308	016	080	4214	60	4307	4809	
0309	016	090	4809	25	4257	4859	
0310	016	100	4859	70	Y	4264	
0311	016	110	4264	60	4257	4909	
0312	016	120	4909	25	4204	4356	
0313	016	130	4356	70	Y	4311	
0314	016	140	4311	60	4204	4406	
0315	016	150	4406	25	4152	4354	
0316	016	160	4354	70	Y	4959	
0317	016	170	4959	60	4152	4404	
0318	016	180	4404	25	Y	4258	
0319	016	190	4258	06	4361		
0320	016	200	4361	32	400	4168	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0321	017	010	4168	70	4052	4456	
0322	017	020	4456	60	4052	4454	
0323	017	030	4454	25	Y	4306	
0324	017	040	4358	32	400	4115	
0325	017	050	4115	85	K	4020	
0326	017	060	4020	25	T	4124	
0327	017	070	4124	70	Y	4029	
0328	017	080	4029	60	4031	4033	
0329	017	090	4033	30	4035	4037	
0330	017	100	4037	55	4031	4044	
0331	017	110	4044	32	500	4352	
0332	017	120	4352	77		4506	
0333	017	130	4506	25	4252	4504	
0334	017	140	4504	70	Y	4411	
0335	017	150	4411	60	4252	4050	
0336	017	160	4005	50	1000	0000	
0337	017	170	4057	00	0001	0000	
0338	017	180	4016	30	1002	4054	
0339	017	190	4207	05	0201	4103	
0340	017	200	4058	60	1002	4104	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0341	018	010	4061	60	1004	4355	
0342	018	020	4357	05	0202	4253	
0343	018	030	4065	05	0202	4253	
0344	018	040	4158	30	0201	4203	
0345	018	050	4407	05	0201	4253	
0346	018	060	4457	05	1003	4305	
0347	018	070	4012	60	1003	4355	
0348	018	080	4035	20	0000	0000	
0349	018	090	4019	00	0000	0000	
0350	018	100	4308	70	4461	4314	
0351	018	110	4314	77		4267	
0352	018	120	4267	60	4000	4358	
0353	018	130	4256	05	4408	4511	
0354	018	140	4511	25	4413	4208	
0355	018	150	4413	05	4252	4150	
0356	018	160	4024	30	0200	4402	
0357	018	170	4402	05	0200	4452	
0358	018	180	4452	25	4554	4791	
0359	018	190	4554	77		4507	
0360	018	200	4507	05	1000	4502	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0361	019	010	4502	25	4604	4795	
0362	019	020	4604	60	1000	4074	
0363	019	030	4002	05	4408	4561	
0364	019	040	4561	25	4463	4008	
0365	019	050	4463	30	4000	4552	
0366	019	060	4552	25	Y	4556	
0367	019	070	4556	32	400	4513	
0368	019	080	4513	85	K	4218	
0369	019	090	4218	25	T	4022	
0370	019	100	4022	70	Y	4027	
0371	019	110	4027	60	4031	4083	
0372	019	120	4083	30	4035	4087	
0373	019	130	4087	55	4031	4094	
0374	019	140	4094	32	500	4802	
0375	019	150	4802	70	4252	4606	
0376	019	160	4606	05	K	4611	
0377	019	170	4611	25	4563	4008	
0378	019	180	4563	25	4000	4852	
0379	019	190	4852	75	4461	4364	
0380	019	200	4364	60	4000	4001	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0381	020	010	4461	00	0002	0000	
0382	020	020	4408	00	4000	4000	
0383	020	030	4008	60	4661	4913	
0384	020	040	4913	65	4165	4317	
0385	020	050	4317	25	4165	4367	
0386	020	060	4417	32	400	4174	
0387	020	070	4174	37	400	4081	
0388	020	080	4081	60	4133	4085	
0389	020	090	4085	60	4137	4039	
0390	020	100	4039	32	200	4144	
0391	020	110	4144	65	4046	4048	
0392	020	120	4048	72	4048	4853	
0393	020	130	4853	96	0800	4051	
0394	020	140	4051	96	0600	4101	
0395	020	150	4101	25	0801	4353	
0396	020	160	4353	05	0806	4458	
0397	020	170	4458	12		4811	
0398	020	180	4811	77		4414	
0399	020	190	4414	25	0611	4963	
0400	020	200	4963	05	0616	4268	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0401	021	010	4268	12		4171	
0402	021	020	4171	82	4274	4224	
0403	021	030	4274	32	400	4131	
0404	021	040	4131	37	400	4038	
0405	021	050	4038	30	4137	4089	
0406	021	060	4089	82	4092	4042	
0407	021	070	4092	32	200	4047	
0408	021	080	4047	65	4049	4151	
0409	021	090	4151	25	0681	4183	
0410	021	100	4183	05	0686	4088	
0411	021	110	4088	12		4041	
0412	021	120	4041	77		4194	
0413	021	130	4194	25	0691	4043	
0414	021	140	4043	05	0696	4098	
0415	021	150	4098	12		4201	
0416	021	160	4201	82	4754	4224	
0417	021	170	4754	60	4656	4508	
0418	021	180	4508	25	0821	4073	
0419	021	190	4073	05	0826	4028	
0420	021	200	4028	12		4181	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0421	022	010	4181	77		4034	
0422	022	020	4034	25	0631	4233	
0423	022	030	4233	05	0636	4138	
0424	022	040	4138	12		4091	
0425	022	050	4091	82	4244	4224	
0426	022	060	4244	60	4901	4403	
0427	022	070	4403	25	0841	4093	
0428	022	080	4093	05	0846	4148	
0429	022	090	4148	12		4251	
0430	022	100	4251	77		4804	
0431	022	110	4804	25	0651	4453	
0432	022	120	4453	05	0656	4558	
0433	022	130	4556	12		4911	
0434	022	140	4911	82	4464	4224	
0435	022	150	4464	60	4902	4806	
0436	022	160	4806	25	0661	4514	
0437	022	170	4514	05	0666	4318	
0438	022	180	4318	12		4221	
0439	022	190	4221	77		4324	
0440	022	200	4324	25	0671	4123	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0441	023	010	4123	05	0676	4078	
0442	023	020	4078	12		4231	
0443	023	030	4231	82	4084	4224	
0444	023	040	4084	60	4903	4557	
0445	023	050	4557	25	0902	4707	
0446	023	060	4707	05	0907	4062	
0447	023	070	4062	12		4215	
0448	023	080	4215	77		4368	
0449	023	090	4368	25	0712	4564	
0450	023	100	4564	05	0717	4169	
0451	023	110	4169	12		4072	
0452	023	120	4072	82	4025	4224	
0453	023	130	4025	60	4904	4807	
0454	023	140	4807	25	0922	4374	
0455	023	150	4374	05	0927	4079	
0456	023	160	4079	12		4032	
0457	023	170	4032	77		4135	
0458	023	180	4135	25	0732	4134	
0459	023	190	4134	05	0737	4139	
0460	023	200	4139	12		4142	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0461	024	010	4142	82	4045	4224	
0462	024	020	4045	60	4905	4857	
0463	024	030	4857	25	4656	4958	
0464	024	040	4958	31	4112		
0465	024	050	4112	82	4315	4265	
0466	024	060	4265	35	4467	4219	
0467	024	070	4219	82	4172	4122	
0468	024	080	4122	26	4075		
0469	024	090	4075	75	4901	4907	
0470	024	100	4907	60	4901	4172	
0471	024	110	4172	25	4656	4162	
0472	024	120	4162	35	4614	4166	
0473	024	130	4166	82	4319	4269	
0474	024	140	4269	26	4222		
0475	024	150	4222	75	4902	4957	
0476	024	160	4957	60	4902	4319	
0477	024	170	4319	25	4656	4212	
0478	024	180	4212	35	4914	4216	
0479	024	190	4216	82	4419	4369	
0480	024	200	4369	26	4272		

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0481	025	010	4272	75	4903	4262	
0482	025	020	4262	60	4903	4419	
0483	025	030	4419	25	4656	4312	
0484	025	040	4312	35	4964	4266	
0485	025	050	4266	82	4519	4469	
0486	025	060	4469	26	4322		
0487	025	070	4322	75	4904	4362	
0488	025	080	4362	60	4904	4519	
0489	025	090	4519	25	4656	4412	
0490	025	100	4412	35	4365	4517	
0491	025	110	4517	82	4315	4070	
0492	025	120	4070	26	4173		
0493	025	130	4173	75	4905	4462	
0494	025	140	4462	60	4905	4315	
0495	025	150	4315	25	4567	4569	
0496	025	160	4569	70	4137	4040	
0497	025	170	4040	60	4192	4294	
0498	025	180	4294	70	4049	4503	
0499	025	190	4503	77		4512	
0500	025	200	4512	25	4901	4192	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0501	026	010	4192	60	9999	4301	
0502	026	020	4301	25	4512	4415	
0503	026	030	4415	70	4617	4120	
0504	026	040	4120	60	4512	4465	
0505	026	050	4465	25	4192	4344	
0506	026	060	4344	70	4617	4170	
0507	026	070	4170	60	4192	4394	
0508	026	080	4394	82	4097	4512	
0509	026	090	4097	25	4099	4351	
0510	026	100	4351	60	4512	4515	
0511	026	110	4515	25	4137	4189	
0512	026	120	4189	70	4049	4553	
0513	026	130	4553	60	4137	4239	
0514	026	140	4239	75	4617	4220	
0515	026	150	4220	30	4046	4198	
0516	026	160	4198	82	4061	4048	
0517	026	170	4854	67	0001	4048	
0518	026	180	4224	67	0002	4048	
0519	026	190	4042	67	4048	4317	
0520	026	200	4467	00	000T	0000	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0521	027	010	4614	00	0000	T000	
0522	027	020	4914	00	0000	0T00	
0523	027	030	4964	00	0000	00T0	
0524	027	040	4365	00	0000	000T	
0525	027	050	4099	25	4901	4192	
0526	027	060	4567	60	0000	4301	
0527	027	070	4617	00	0001	0000	
0528	027	080	4367	06	4417		
0529	027	090	4208	60	4562	4565	
0530	027	100	4565	65	4667	4819	
0531	027	110	4819	25	4667	4869	
0532	027	120	4869	06	4372		
0533	027	130	4372	32	400	4129	
0534	027	140	4129	37	400	4036	
0535	027	150	4036	60	4188	4090	
0536	027	160	4090	60	4242	4444	
0537	027	170	4444	32	200	4149	
0538	027	180	4149	65	4401	4953	
0539	027	190	4953	25	4401	4712	
0540	027	200	4712	75	4242	4095	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0541	028	010	4095	30	4147	4199	
0542	028	020	4199	87	4862	4812	
0543	028	030	4812	82	4862	4715	
0544	028	040	4862	25	4242	4494	
0545	028	050	4494	70	4096	4249	
0546	028	060	4249	17		4912	
0547	028	070	4912	60	0908	4765	
0548	028	080	4765	65	0913	4815	
0549	028	090	4815	25	4917	4919	
0550	028	100	4919	70	4242	4145	
0551	028	110	4145	60	4197	4299	
0552	028	120	4299	25	4451	4965	
0553	028	130	4965	70	4967	4270	
0554	028	140	4270	60	4422	4424	
0555	028	150	4424	30	4422	4197	
0556	028	160	4197	25	9999	4501	
0557	028	170	4501	60	4901	4316	
0558	028	180	4316	25	4197	4349	
0559	028	190	4349	70	4551	4366	
0560	028	200	4366	60	4197	4399	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0561	029	010	4399	25	4501	4416	
0562	029	020	4416	70	4551	4466	
0563	029	030	4466	60	4501	4516	
0564	029	040	4516	82	4969	4197	
0565	029	050	4969	25	4451	4566	
0566	029	060	4566	60	4501	4616	
0567	029	070	4616	26	4320		
0568	029	080	4320	60	4900	4666	
0569	029	090	4666	31	4370		
0570	029	100	4370	25	4901	4418	
0571	029	110	4418	87	4321	4271	
0572	029	120	4271	82	4321	4474	
0573	029	130	4474	05	K	4128	
0574	029	140	4128	25	4900	4468	
0575	029	150	4468	70	4420	4223	
0576	029	160	4223	60	4900	4518	
0577	029	170	4518	25	T	4321	
0578	029	180	4321	17		4524	
0579	029	190	4524	60	0928	4030	
0580	029	200	4030	65	0933	4185	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0581	030	010	4185	31	4238		
0582	030	020	4238	25	4902	4568	
0583	030	030	4568	87	4421	4371	
0584	030	040	4371	82	4421	4574	
0585	030	050	4574	05	K	4178	
0586	030	060	4178	25	4900	4618	
0587	030	070	4618	70	4470	4273	
0588	030	080	4273	60	4900	4818	
0589	030	090	4818	25	T	4421	
0590	030	100	4421	17		4624	
0591	030	110	4624	60	0948	4200	
0592	030	120	4200	65	0953	4868	
0593	030	130	4868	31	4471		
0594	030	140	4471	25	4903	4918	
0595	030	150	4918	87	4571	4521	
0596	030	160	4521	82	4571	4674	
0597	030	170	4674	05	K	4228	
0598	030	180	4228	25	4900	4968	
0599	030	190	4968	70	4520	4323	
0600	030	200	4323	60	4900	4570	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0601	031	010	4570	25	T	4571	
0602	031	020	4571	17		4724	
0603	031	030	4724	60	0968	4870	
0604	031	040	4870	65	0973	4125	
0605	031	050	4125	31	4278		
0606	031	060	4278	25	4904	4920	
0607	031	070	4920	87	4423	4373	
0608	031	080	4373	82	4423	4026	
0609	031	090	4026	05	K	4080	
0610	031	100	4080	25	4900	4970	
0611	031	110	4970	70	4472	4175	
0612	031	120	4175	60	4900	4621	
0613	031	130	4621	25	T	4423	
0614	031	140	4423	17		4076	
0615	031	150	4076	60	0918	4671	
0616	031	160	4671	65	0923	4225	
0617	031	170	4225	31	4326		
0618	031	180	4326	25	4905	4871	
0619	031	190	4871	87	4674	4824	
0620	031	200	4824	82	4674	4077	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0621	032	010	4077	05	K	4281	
0622	032	020	4281	25	4900	4971	
0623	032	030	4971	70	4473	4126	
0624	032	040	4126	60	4900	4522	
0625	032	050	4522	25	T	4874	
0626	032	060	4874	17		4127	
0627	032	070	4127	60	0938	4140	
0628	032	080	4140	65	0943	4195	
0629	032	090	4195	25	4900	4572	
0630	032	100	4572	17		4275	
0631	032	110	4275	60	0988	4190	
0632	032	120	4190	65	0993	4245	
0633	032	130	4245	81	0600	4922	
0634	032	140	4922	25	4242	4544	
0635	032	150	4544	70	4967	4972	
0636	032	160	4972	60	4242	4594	
0637	032	170	4594	25	4401	4523	
0638	032	180	4523	75	4242	4295	
0639	032	190	4295	31	4246		
0640	032	200	4246	87	4953	4601	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0641	033	010	4601	82	4953	4562	
0642	033	020	4923	67	4619	4245	
0643	033	030	4715	06	4573		
0644	033	040	4573	70	4551	4973	
0645	033	050	4973	32	400	4130	
0646	033	060	4130	70	4242	4345	
0647	033	070	4345	17		4298	
0648	033	080	4298	60	0908	4924	
0649	033	090	4924	65	0913	4974	
0650	033	100	4974	12		4177	
0651	033	110	4177	75	4242	4395	
0652	033	120	4395	37	400	4325	
0653	033	130	4325	70	4451	4375	
0654	033	140	4375	60	4422	4425	
0655	033	150	4425	26	4378		
0656	033	160	4378	60	4902	4475	
0657	033	170	4475	60	4903	4525	
0658	033	180	4525	60	4904	4575	
0659	033	190	4575	60	4905	4825	
0660	033	200	4825	25	4917	4875	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0661	034	010	4875	70	4242	4445	
0662	034	020	4445	60	4197	4424	
0663	034	030	4147	00	0004	0000	
0664	034	040	4551	00	0001	0000	
0665	034	050	4096	00	0000	0005	
0666	034	060	4451	60	4901	4316	
0667	034	070	4420	00	0002	0000	
0668	034	080	4470	00	0000	2000	
0669	034	090	4520	00	0000	0200	
0670	034	100	4472	00	0000	0020	
0671	034	110	4473	00	0000	0002	
0672	034	120	4917	25	0000	4501	
0673	034	130	4967	00	0005	0000	
0674	034	140	0676	67	4002	4001	

PART II

MRA019C00 - Inversion Phase

CARD NO	PAGE	LINE	A	OP	M	C	K
0001	001	010	4600	26	4603	0000	
0002	001	020	4602	20	000T	4906	
0003	001	030	4603	75	000T	4609	
0004	001	040	4607	05	4659	4821	
0005	001	050	4608	TT	0000	0000	
0006	001	060	4609	05	000K	4613	
0007	001	070	4610	87	4613	4713	
0008	001	080	4612	49	0000	0000	
0009	001	090	4613	25	000Y	4817	
0010	001	100	4615	05	000K	4619	
0011	001	110	4619	26	4622	0000	
0012	001	120	4620	05	4672	4915	
0013	001	130	4622	20	000Y	4826	
0014	001	140	4623	25	4633	4797	
0015	001	150	4625	77	0000	4778	
0016	001	160	4632	05	4634	4821	
0017	001	170	4634	00	0000	0097	
0018	001	180	4635	65	4637	4639	
0019	001	190	4639	35	4691	4643	
0020	001	200	4640	87	4743	4694	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0021	002	010	4643	05	000K	4647	
0022	002	020	4645	60	4797	4799	
0023	002	030	4647	25	000Y	4851	
0024	002	040	4649	05	000K	4703	
0025	002	050	4650	05	4654	4821	
0026	002	060	4651	35	4653	4655	
0027	002	070	4652	87	4605	4607	
0028	002	080	4653	11	0000	0000	
0029	002	090	4654	00	0000	0094	
0030	002	100	4655	75	000T	4660	
0031	002	110	4657	38	0200	4861	
0032	002	120	4658	0T	0000	0000	2
0033	002	130	4659	00	0000	0093	
0034	002	140	4660	17	0000	4663	
0035	002	150	4662	05	4665	4821	
0036	002	160	4663	12		4866	
0037	002	170	4664	85	000T	4700	
0038	002	180	4665	00	0000	0092	
0039	002	190	4667	33	0300	4773	
0040	002	200	4668	08	0000	0000	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0041	003	010	4669	00	0000	0091	
0042	003	020	4670	87	4623	4673	
0043	003	030	4672	00	0000	0099	
0044	003	040	4673	32	0200	4678	
0045	003	050	4675	36	0100	4876	
0046	003	060	4676	20	4680	4682	
0047	003	070	4680	32	0000	4705	
0048	003	080	4682	77	0000	4685	
0049	003	090	4685	25	4637	4689	
0050	003	100	4687	38	0100	4790	
0051	003	110	4689	37	0200	000Y	
0052	003	120	4693	38	0100	4746	
0053	003	130	4694	05	4696	4821	
0054	003	140	4695	60	4797	4600	
0055	003	150	4699	26	4702	0000	
0056	003	160	4700	31	4603	0000	
0057	003	170	4701	05	4704	0001	
0058	003	180	4702	20	000T	4706	
0059	003	190	4703	25	000Y	4657	
0060	003	200	4704	67	0000	4764	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0061	004	010	4705	05	000K	4709	
0062	004	020	4706	35	4708	4710	
0063	004	030	4708	TT	0000	0000	
0064	004	040	4709	25	4633	4735	
0065	004	050	4710	05	000K	4714	
0066	004	060	4711	38	0100	4814	
0067	004	070	4713	06	4816	0000	
0068	004	080	4714	26	4717	0000	
0069	004	090	4716	87	4719	4620	
0070	004	100	4717	20	000Y	4721	
0071	004	110	4718	00	0000	0050	
0072	004	120	4719	38	0100	4722	
0073	004	130	4720	26	4797	0000	
0074	004	140	4721	35	4774	4780	
0075	004	150	4722	87	4725	4776	
0076	004	160	4723	01	1000	0000	
0077	004	170	4725	38	0100	4728	
0078	004	180	4726	87	4931	4632	
0079	004	190	4731	60	4633	4785	
0080	004	200	4732	05	4751	0001	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0081	005	010	4734	87	4637	4788	
0082	005	020	4735	37	0200	4740	
0083	005	030	4736	00	1000	0000	
0084	005	040	4737	TT	0000	0000	
0085	005	050	4739	70	000Y	4796	
0086	005	060	4740	70	000T	4945	
0087	005	070	4741	65	4793	4895	
0088	005	080	4743	36	0100	4846	
0089	005	090	4745	36	0200	4749	
0090	005	100	4746	87	4650	4899	
0091	005	110	4749	05	000K	4753	
0092	005	120	4751	67	0100	4751	
0093	005	130	4752	87	4607	4755	
0094	005	140	4753	25	000Y	4757	
0095	005	150	4755	38	0100	4858	
0096	005	160	4756	30	4758	4810	
0097	005	170	4757	36	0100	4760	
0098	005	180	4758	0T	0000	0000	
0099	005	190	4760	35	4762	4764	
0100	005	200	4761	36	0100	4864	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0101	006	010	4762	0T	1TTT	TTT1	
0102	006	020	4763	06	4916		
0103	006	030	4764	30	000T	4768	
0104	006	040	4766	87	4770	4769	
0105	006	050	4767	05	4669	4821	
0106	006	060	4768	55	000K	4700	
0107	006	070	4769	36	0100	4872	
0108	006	080	4770	05	4672	4865	
0109	006	090	4771	33	0200	4775	
0110	006	100	4772	00	4961		
0111	006	110	4773	20	4777	4775	
0112	006	120	4774	TT	0000	0000	
0113	006	130	4775	77	0000	4828	
0114	006	140	4776	05	4779	4821	
0115	006	150	4777	01	2000	0000	
0116	006	160	4778	36	4981		
0117	006	170	4779	00	0000	0098	
0118	006	180	4780	75	000T	4786	
0119	006	190	4781	20	4633	4935	
0120	006	200	4783	20	4736	4775	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0121	007	010	4784	87	4788	4687	
0122	007	020	4785	70	4787	4940	
0123	007	030	4786	70	4888	4991	
0124	007	040	4787	99	0000	0000	
0125	007	050	4788	05	4792	4821	
0126	007	060	4789	70	000Y	4797	
0127	007	070	4790	87	4694	4693	
0128	007	080	4791	65	4793	4645	
0129	007	090	4792	00	0000	0096	
0130	007	100	4795	60	4797	4613	
0131	007	110	4796	26	4797	0000	
0132	007	120	4798	05	4751	0001	
0133	007	130	4799	26	4602	0000	
0134	007	140	4803	87	4756	4856	
0135	007	150	4805	36	0100	4808	
0136	007	160	4808	87	4711	4662	
0137	007	170	4810	87	4763	4863	
0138	007	180	4813	38	0100	4716	
0139	007	190	4814	87	4720	4767	
0140	007	200	4816	75	4718	4771	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0141	008	010	4817	36	4820	0000	
0142	008	020	4820	87	4823	4873	
0143	008	030	4821	33	0200	4625	
0144	008	040	4822	06	4676		
0145	008	050	4823	20	000T	4827	
0146	008	060	4826	70	000T	4731	
0147	008	070	4827	87	4631	4830	
0148	008	080	4828	36	4781		
0149	008	090	4830	65	4633	4835	
0150	008	100	4831	50	4633	4635	
0151	008	110	4835	50	4637	4639	
0152	008	120	4837	38	0100	4640	
0153	008	130	4840	26	4797	0000	
0154	008	140	4841	25	4793	4745	
0155	008	150	4845	36	0200	4649	
0156	008	160	4846	87	4849	4650	
0157	008	170	4849	38	0100	4652	
0158	008	180	4851	35	4653	4655	
0159	008	190	4856	30	4658	4610	
0160	008	200	4858	87	4662	4761	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0161	009	010	4860	75	4612	4615	
0162	009	020	4861	77	0000	4664	
0163	009	030	4863	38	0100	4766	
0164	009	040	4864	87	4767	4797	
0165	009	050	4865	70	4718	4821	
0166	009	060	4866	30	4668	4670	
0167	009	070	4872	87	4776	4675	
0168	009	080	4873	20	000T	4927	
0169	009	090	4876	32	0300	4783	
0170	009	100	4876	87	4632	4881	
0171	009	110	4881	38	0100	4784	
0172	009	120	4885	70	4787	4840	
0173	009	130	4888	50			
0174	009	140	4891	TT			
0175	009	150	4895	60	4797	4699	
0176	009	160	4896	00	0000	0095	
0177	009	170	4899	38	0100	4752	
0178	009	180	4906	35	4608	4860	
0179	009	190	4908	70	000Y	4913	
0180	009	200	4915	75	4718	4821	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0181	010	010	4916	70	4718	4771	
0182	010	020	4921	20	4723	4775	
0183	010	030	4927	87	4630	4831	
0184	010	040	4931	38	0100	4734	
0185	010	050	4935	35	4737	4789	
0186	010	060	4940	26	4797		
0187	010	070	4941	25	4793	4845	
0188	010	080	4945	00	4700		
0189	010	090	4946	77	0000	4949	
0190	010	100	4949	36	4952		
0191	010	110	4952	20	4954	4956	
0192	010	120	4954			0500	
0193	010	130	4956	70	000Y	4961	
0194	010	140	4961	06	4966		
0195	010	150	4962	06	4067		
0196	010	160	4966	33	0300	4921	
0197	010	170	4981	20	4633	4985	
0198	010	180	4985	35	4737	4739	
0199	010	190	4991	60	4633	4885	
0200	010	200	4992	05	4751	0001	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0201	011	010	4633				
0202	011	020	4637				
0203	011	030	4793				
0204	011	040	4797				
0205	011	050	4047	30	1001	4003	
0206	011	060	4003	05	1002	4004	
0207	011	070	4004	25	4006	4791	
0208	011	080	4006	30	1002	4054	
0209	011	090	4054	05	K	0608	
0210	011	100	0608	25	0610	4791	
0211	011	110	0610	30	4012	0614	
0212	011	120	0614	05	K	0618	
0213	011	130	0616	25	0620	4795	
0214	011	140	0620	60	4012	0664	
0215	011	150	0664	30	4016	0668	
0216	011	160	0668	25	4020	0672	
0217	011	170	0672	82	4075	4025	
0218	011	180	4075	30	1001	0603	
0219	011	190	0603	05	4012	0814	
0220	011	200	0814	25	4066	4695	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0221	012	010	4066	60	1001	0803	
0222	012	020	0803	25	4075	0627	
0223	012	030	0627	70	4029	0632	
0224	012	040	0632	60	4075	0677	
0225	012	050	0677	25	4066	0718	
0226	012	060	0718	70	4029	0733	
0227	012	070	0733	60	4066	4018	
0228	012	080	4025	25	4047	0799	
0229	012	090	0799	70	4051	0604	
0230	012	100	0604	60	4047	0649	
0231	012	110	0649	25	4003	0655	
0232	012	120	0655	70	4007	0660	
0233	012	130	0660	60	4003	0705	
0234	012	140	0705	25	4006	0758	
0235	012	150	0758	70	4007	0810	
0236	012	160	0810	60	4006	0658	
0237	012	170	0658	25	4051	0703	
0238	012	180	0703	75	4029	0734	
0239	012	190	0734	60	4051	0753	
0240	012	200	0753	75	4029	0783	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0241	013	010	0783	60	4007	0609	
0242	013	020	0609	25	4016	0818	
0243	013	030	0818	70	4029	0832	
0244	013	040	0832	60	4016	4047	
0245	013	050	4018	30	4070	0723	
0246	013	060	0723	25	4125	0728	
0247	013	070	0728	82	4031	0731	
0248	013	080	0731	25	4033	0735	
0249	013	090	0735	60	4047	0749	
0250	013	100	0749	25	4101	0754	
0251	013	110	0754	60	4003	0605	
0252	013	120	0605	25	4057	0809	
0253	013	130	0809	60	4006	0858	
0254	013	140	0858	70	4029	0682	
0255	013	150	0682	60	4057	4009	
0256	013	160	4009	25	4011	0713	
0257	013	170	0713	60	4051	0954	
0258	013	180	0954	25	4056	0759	
0259	013	190	0759	60	4007	0612	
0260	013	200	0612	25	4029	0633	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0261	014	010	0633	60	4016	0868	
0262	014	020	0868	25	4070	0872	
0263	014	030	0872	70	4029	0882	
0264	014	040	0882	60	4070	4022	
0265	014	050	4031	30	1002	4104	
0266	014	060	4104	05	1001	0804	
0267	014	070	0804	25	4106	4741	
0268	014	080	4106	60	1002	0805	
0269	014	090	0805	25	4031	0833	
0270	014	100	0833	70	4029	0683	
0271	014	110	0683	60	4031	0934	
0272	014	120	0934	25	4106	0959	
0273	014	130	0959	70	4029	0784	
0274	014	140	0784	60	4106	0808	
0275	014	150	0808	25	4010	0812	
0276	014	160	0812	70	4029	0634	
0277	014	170	0634	60	4010	0662	
0278	014	180	0662	30	4125	0877	
0279	014	190	0877	82	0680	4031	
0280	014	200	0680	25	4031	0935	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0281	015	010	0935	70	4029	0984	
0282	015	020	0984	60	4031	0834	
0283	015	030	0834	25	4106	0659	
0284	015	040	0659	70	4029	0883	
0285	015	050	0883	60	4106	0706	
0286	015	060	0706	25	4104	0756	
0287	015	070	0756	70	4125	0778	
0288	015	080	0778	60	4104	0607	
0289	015	090	0607	25	4029	0635	
0290	015	100	0635	60	4010	0862	
0291	015	110	0862	25	4125	0678	
0292	015	120	0678	30	4030	0684	
0293	015	130	0684	82	0687	4037	
0294	015	140	0687	00	4001		
0295	015	150	4037	25	4033	0785	
0296	015	160	0785	60	4047	0999	
0297	015	170	0999	25	4151	0807	
0298	015	180	0807	60	4003	0855	
0299	015	190	0855	70	4029	0884	
0300	015	200	0884	60	4151	0704	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0301	016	010	0704	25	4156	0709	
0302	016	020	0709	60	4006	0760	
0303	016	030	0760	70	4029	0985	
0304	016	040	0985	60	4156	0613	
0305	016	050	0613	25	4101	0653	
0306	016	060	0653	70	4029	0685	
0307	016	070	0685	60	4101	0904	
0308	016	080	0904	25	4206	0909	
0309	016	090	0909	60	4057	0960	
0310	016	100	0960	70	4029	0786	
0311	016	110	0786	60	4206	0813	
0312	016	120	0813	26	0617		
0313	016	130	0617	60	4070	0622	
0314	016	140	0622	25	4020	0673	
0315	016	150	0673	70	4029	0885	
0316	016	160	0885	60	4020	0724	
0317	016	170	0724	25	4125	0779	
0318	016	180	0779	75	4029	0835	
0319	016	190	0835	60	4125	4009	
0320	016	200	4059	30	4000	0755	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0321	017	010	0755	50	4051	0615	
0322	017	020	0615	50	4011	0663	
0323	017	030	0663	25	Y	0667	
0324	017	040	0667	75	4029	0887	
0325	017	050	0867	60	4007	0710	
0326	017	060	0710	60	4056	0761	
0327	017	070	0761	60	4125	0979	
0328	017	080	0979	25	4075	0827	
0329	017	090	0827	70	Y	0637	
0330	017	100	0637	60	4075	0878	
0331	017	110	0878	25	4066	0719	
0332	017	120	0719	70	Y	0924	
0333	017	130	0924	60	4066	0766	
0334	017	140	0766	25	4031	0986	
0335	017	150	0986	70	Y	0791	
0336	017	160	0791	60	4031	0837	
0337	017	170	0837	25	4104	0657	
0338	017	180	0657	70	Y	0863	
0339	017	190	0863	60	4104	0706	
0340	017	200	0706	25	4106	0961	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0341	018	010	0961	70	Y	0766	
0342	018	020	0766	60	4106	4008	
0343	018	030	4008	30	1002	4154	
0344	018	040	4154	05	1001	0815	
0345	018	050	0815	25	4017	4741	
0346	018	060	4017	60	1002	0817	
0347	018	070	0817	25	4008	0860	
0348	018	080	0860	70	4029	0688	
0349	018	090	0688	60	4008	0910	
0350	018	100	0910	25	4017	0919	
0351	018	110	0919	70	4029	0736	
0352	018	120	0736	60	4017	0769	
0353	018	130	0769	25	4010	0619	
0354	018	140	0619	70	4029	0638	
0355	018	150	0638	60	4010	0864	
0356	018	160	0864	30	4011	0714	
0357	018	170	0714	82	0720	4006	
0358	018	180	0720	25	4029	0931	
0359	018	190	0931	60	4010	4047	
0360	018	200	4012				

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0361	019	010	4016	00	0001	0000	
0362	019	020	4029	00	0001	0000	
0363	019	030	4070	00	0001	0000	
0364	019	040	4033	30	1001	4003	
0365	019	050	4101	05	1002	4004	
0366	019	060	4057	30	1003	4054	
0367	019	070	4151	05	1003	4004	
0368	019	080	4156	30	1003	4054	
0369	019	090	4206	30	1004	4054	
0370	019	100	4020	00	0001	0000	
0371	019	110	4030	00	0002	0000	
0372	019	120	4010	00	0001	0000	
0373	019	130	4022	06	0725		
0374	019	140	0725	65	4012	4047	
0375	019	150	4097	30	1000	0602	
0376	019	160	0602	05	Y	0819	
0377	019	170	0819	25	0622	4791	
0378	019	180	0822	30	K	4026	
0379	019	190	4026	05	1001	0820	
0380	019	200	0820	25	4072	4791	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0381	020	010	4072	60	0500	0905	
0382	020	020	0905	25	4097	0949	
0383	020	030	0949	70	4201	0955	
0384	020	040	0955	60	4097	0600	
0385	020	050	0600	25	4026	0628	
0386	020	060	0628	70	4080	0838	
0387	020	070	0838	60	4026	0679	
0388	020	080	0679	25	4072	0925	
0389	020	090	0925	70	4027	0730	
0390	020	100	0730	60	4072	0774	
0391	020	110	0774	25	4080	0788	
0392	020	120	0788	75	4027	0630	
0393	020	130	0630	60	4080	0888	
0394	020	140	0888	25	4201	0906	
0395	020	150	0906	75	4027	0930	
0396	020	160	0930	60	4201	0956	
0397	020	170	0956	30	0599	0802	
0398	020	180	0802	82	4005	4097	
0399	020	190	4005	30	0599	4251	
0400	020	200	4251	05	0500	4052	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0401	021	010	4052	25	0711	4795	
0402	021	020	0711	60	0599	0623	
0403	021	030	0623	30	4175	0828	
0404	021	040	0826	25	4251	0853	
0405	021	050	0853	70	4027	0880	
0406	021	060	0880	60	4251	0911	
0407	021	070	0911	82	0914	4005	
0408	021	080	0914	00	4116		
0409	021	090	4166	30	4000	0763	
0410	021	100	0763	25	4097	0800	
0411	021	110	0800	70	Y	0823	
0412	021	120	0823	60	4097	0849	
0413	021	130	0849	25	Y	0654	
0414	021	140	0654	75	4027	0689	
0415	021	150	0689	60	4201	0715	
0416	021	160	0715	50	4080	0436	
0417	021	170	0936	25	4175	0780	
0418	021	180	0780	70	Y	0789	
0419	021	190	0789	60	4175	4097	
0420	021	200	4027	00	0001	0000	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0421	022	010	4175	05	0499	4052	
0422	022	020	0599	00	0000	0000	
0423	022	030	4049	25	0999	4301	
0424	022	040	4301	60	0398	4050	
0425	022	050	4050	30	0996	4048	
0426	022	060	4048	05	0398	4100	
0427	022	070	4100	25	0624	4791	
0428	022	080	0624	30	K	4028	
0429	022	090	4028	05	0397	0824	
0430	022	100	0824	25	4076	4795	
0431	022	110	4076	60	0397	0625	
0432	022	120	0625	30	4077	0629	
0433	022	130	0629	25	4081	0639	
0434	022	140	0639	82	4042	0642	
0435	022	150	0642	70	4044	0647	
0436	022	160	0647	60	4081	0889	
0437	022	170	0889	25	4050	0915	
0438	022	180	0915	75	4044	0748	
0439	022	190	0748	60	4050	0764	
0440	022	200	0764	25	4046	0825	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0441	023	010	0825	75	4044	0847	
0442	023	020	0847	60	4048	4050	
0443	023	030	4042	30	0997	4099	
0444	023	040	4099	05	0397	0829	
0445	023	050	0829	25	4131	4695	
0446	023	060	4131	60	0397	0830	
0447	023	070	0830	30	4077	0879	
0448	023	080	0879	25	4181	0690	
0449	023	090	0690	82	0693	4043	
0450	023	100	0693	00	4045		
0451	023	110	4043	25	4050	0964	
0452	023	120	0964	75	4216	0969	
0453	023	130	0969	60	4050	0839	
0454	023	140	0839	25	4041	0643	
0455	023	150	0643	60	4048	0650	
0456	023	160	0650	25	4028	0890	
0457	023	170	0890	75	4044	0697	
0458	023	180	0697	60	4028	0738	
0459	023	190	0738	25	4076	0980	
0460	023	200	0960	75	4044	0798	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0461	024	010	0798	60	4076	0640	
0462	024	020	0640	25	4042	0644	
0463	024	030	0644	75	4046	0850	
0464	024	040	0850	60	4042	0694	
0465	024	050	0694	25	4099	0701	
0466	024	060	0701	75	4044	0750	
0467	024	070	0750	60	4099	0840	
0468	024	080	0840	25	4131	0692	
0469	024	090	0692	75	4044	0897	
0470	024	100	0897	60	4131	0739	
0471	024	110	0739	25	4077	0781	
0472	024	120	0781	70	4044	0842	
0473	024	130	0842	60	4077	0892	
0474	024	140	0892	25	4046	0698	
0475	024	150	0698	70	4044	0950	
0476	024	160	0950	60	4046	0843	
0477	024	170	0843	25	4044	0898	
0478	024	180	0898	60	4081	4050	
0479	024	190	4116	30	4000	0844	
0480	024	200	0844	25	4301	0854	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0481	025	010	0854	70	Y	0859	
0482	025	020	0859	60	4301	0716	
0483	025	030	0716	25	4048	0751	
0484	025	040	0751	70	Y	0765	
0485	025	050	0765	60	4048	0645	
0486	025	060	0645	25	4028	0893	
0487	025	070	0893	70	Y	0699	
0488	025	080	0699	60	4028	0939	
0489	025	090	0939	25	4076	0981	
0490	025	100	0981	70	Y	0989	
0491	025	110	0989	60	4076	0845	
0492	025	120	0845	25	4099	0652	
0493	025	130	0652	70	Y	0857	
0494	025	140	0857	60	4099	0901	
0495	025	150	0901	25	4131	0740	
0496	025	160	0740	70	Y	0745	
0497	025	170	0745	60	4131	0790	
0498	025	180	0790	25	4041	0648	
0499	025	190	0648	70	Y	0665	
0500	025	200	0665	60	4041	0894	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0501	026	010	0894	25	Y	0899	
0502	026	020	0899	75	4351	0916	
0503	026	030	0916	60	4181	0940	
0504	026	040	0940	25	Y	0744	
0505	026	050	0744	32	400	0951	
0506	026	060	0951	85	K	0865	
0507	026	070	0865	25	T	0669	
0508	026	080	0669	70	Y	0674	
0509	026	090	0674	60	4126	0695	
0510	026	100	0695	30	4147	0700	
0511	026	110	0700	55	4126	0848	
0512	026	120	0848	32	100	0852	
0513	026	130	0852	30	K	0867	
0514	026	140	0867	25	4049	0920	
0515	026	150	0920	70	Y	0726	
0516	026	160	0726	60	4049	0965	
0517	026	170	0965	25	4050	0869	
0518	026	180	0869	70	Y	0874	
0519	026	190	0874	60	4050	0721	
0520	026	200	0721	25	4042	0944	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0521	027	010	0944	70	Y	0966	
0522	027	020	0966	60	4042	4049	
0523	027	030	4077	00	0001	0000	
0524	027	040	4081	00	0001	0000	
0525	027	050	4044	00	0001	0000	
0526	027	060	4216	00	0003	0000	
0527	027	070	4041	05	0398	4100	
0528	027	080	4181	00	0000	0000	
0529	027	090	4046	00	0003	0000	
0530	027	100	4147	20	0000	0000	
0531	027	110	4351	00	0002	0000	
0532	027	120	4401	60	4053	0670	
0533	027	130	0670	65	4122	4024	
0534	027	140	4024	25	4122	0926	
0535	027	150	0926	06	0729		
0536	027	160	0729	32	400	0741	
0537	027	170	0741	37	400	0770	
0538	027	180	0770	60	4172	0974	
0539	027	190	0974	60	4176	0990	
0540	027	200	0990	26	0793		

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0541	028	010	0793	32	200	0870	
0542	028	020	0870	65	4222	4074	
0543	028	030	4074	25	4222	0929	
0544	028	040	0929	75	4176	0991	
0545	028	050	0991	30	4093	0795	
0546	028	060	0795	87	4098	0873	
0547	028	070	0873	82	4098	4226	
0548	028	080	4098	25	4176	0941	
0549	028	090	0941	70	4143	0746	
0550	028	100	0746	17		0970	
0551	028	110	0970	60	4481	0794	
0552	028	120	0794	65	4486	0675	
0553	028	130	0675	25	4127	0895	
0554	028	140	0743	60	4095	0771	
0555	028	150	0895	70	4176	0743	
0556	028	160	0771	25	4023	0775	
0557	028	170	0775	70	4177	0994	
0558	028	180	0994	60	4096	4148	
0559	028	190	4148	30	4096	4095	
0560	028	200	4095	25	9999	4451	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0561	029	010	4451	60	4901	4103	
0562	029	020	4103	25	4095	0875	
0563	029	030	0875	70	4227	0900	
0564	029	040	0900	60	4095	0971	
0565	029	050	0971	25	4451	0921	
0566	029	060	0921	70	4227	0945	
0567	029	070	0945	60	4451	0773	
0568	029	080	0773	82	0776	4095	
0569	029	090	0776	25	4023	0946	
0570	029	100	0946	60	4451	0975	
0571	029	110	0975	31	0995		
0572	029	120	0995	25	4901	0976	
0573	029	130	0976	87	4129	4079	
0574	029	140	4129	06	4032		
0575	029	150	4032	65	4565	0796	
0576	029	160	0796	50	4570	4272	
0577	029	170	4079	82	4129	0996	
0578	029	180	0996	05	4198	4150	
0579	029	190	4150	30	4102	4032	
0580	029	200	4272	17		4225	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0581	030	010	4225	60	4450	4152	
0582	030	020	4152	65	4455	4107	
0583	030	030	4107	31	4060		
0584	030	040	4060	25	4902	4204	
0585	030	050	4204	87	4207	4157	
0586	030	060	4207	06	4110		
0587	030	070	4110	65	4534	4036	
0588	030	080	4036	50	4539	4091	
0589	030	090	4157	82	4207	4160	
0590	030	100	4160	05	4198	4300	
0591	030	110	4300	30	4102	4110	
0592	030	120	4091	17		4094	
0593	030	130	4094	60	4418	4120	
0594	030	140	4120	65	4423	4275	
0595	030	150	4275	31	4078		
0596	030	160	4078	25	4903	4055	
0597	030	170	4055	87	4108	4058	
0598	030	180	4108	06	4061		
0599	030	190	4061	65	4503	4105	
0600	030	200	4105	50	4508	4210	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0601	031	010	4056	82	4108	4111	
0602	031	020	4111	05	4198	4350	
0603	031	030	4350	30	4102	4061	
0604	031	040	4210	17		4013	
0605	031	050	4013	60	4441	4193	
0606	031	060	4193	65	4446	4246	
0607	031	070	4246	31	4501		
0608	031	080	4501	25	4904	4256	
0609	031	090	4256	87	4159	4109	
0610	031	100	4159	06	4062		
0611	031	110	4062	65	4525	4277	
0612	031	120	4277	50	4530	4082	
0613	031	130	4109	82	4159	4112	
0614	031	140	4112	05	4198	4500	
0615	031	150	4500	30	4102	4062	
0616	031	160	4082	17		4035	
0617	031	170	4035	60	4409	4161	
0618	031	180	4161	65	4414	4266	
0619	031	190	4266	31	4019		
0620	031	200	4019	25	4905	4257	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0621	032	010	4257	87	4310	4260	
0622	032	020	4236	65	4359	4059	
0623	032	030	4090	67	0001	4188	
0624	032	040	4434	67	0001	4580	
0625	032	050	4310	06	4063		
0626	032	060	4063	65	4494	4146	
0627	032	070	4146	50	4499	4551	
0628	032	080	4260	82	4310	4113	
0629	032	090	4113	05	4198	4550	
0630	032	100	4550	30	4102	4063	
0631	032	110	4551	17		4254	
0632	032	120	4254	60	4578	4130	
0633	032	130	4130	65	4583	4085	
0634	032	140	4135	11	4402	4039	
0635	032	150	4039	25	4176	4128	
0636	032	160	4128	70	4177	4180	
0637	032	170	4180	60	4176	4178	
0638	032	180	4178	25	4222	4124	
0639	032	190	4124	75	4176	4179	
0640	032	200	4179	31	4132		

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0641	033	010	4132	87	4074	4185	
0642	033	020	4185	82	4074	4053	
0643	033	030	4040	67	4135	4024	
0644	033	040	4226	06	4229		
0645	033	050	4229	70	4227	4230	
0646	033	060	4230	32	400	4087	
0647	033	070	4087	70	4176	4279	
0648	033	080	4279	17		4182	
0649	033	090	4182	60	4481	4083	
0650	033	100	4083	65	4486	4038	
0651	033	110	4036	12		4141	
0652	033	120	4141	75	4176	4329	
0653	033	130	4329	37	400	4086	
0654	033	140	4066	70	4023	4276	
0655	033	150	4276	60	4096	4298	
0656	033	160	4296	26	4601		
0657	033	170	4601	60	4902	4304	
0658	033	180	4304	60	4903	4155	
0659	033	190	4155	60	4904	4306	
0660	033	200	4306	60	4905	4307	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0661	034	010	4307	25	4127	4379	
0662	034	020	4379	70	4176	4429	
0663	034	030	4429	60	4095	4146	
0664	034	040	4093	00	0004	0000	
0665	034	050	4143			5	
0666	034	060	4227	00	0001	0000	
0667	034	070	4177	00	0005	0000	
0668	034	080	4127	25	0000	4451	
0669	034	090	4023	60	4901	4103	
0670	034	100	4198	00	0000	0010	
0671	034	110	4102				
0672	034	120	4400				
0673	034	130	4405				
0674	034	140	4462				
0675	034	150	4467				
0676	034	160	4085	06	4088		
0677	034	170	4086	65	4481	4133	
0678	034	180	4133	65	4486	4135	
0679	034	190	4001	26	0303		
0680	034	200	4202	60	4354	4356	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0681	035	010	4356	06	4259		
0682	035	020	4259	32	400	4316	
0683	035	030	4316	75	4068	4021	
0684	035	040	4021	60	4073	4375	
0685	035	050	4375	25	4327	4479	
0686	035	060	4479	70	4073	4326	
0687	035	070	4326	60	4228	4280	
0688	035	080	4280	25	4232	4034	
0689	035	090	4034	05	4136	4138	
0690	035	100	4138	60	4200	4252	
0691	035	110	4252	65	4205	4357	
0692	035	120	4357	25	4309	4211	
0693	035	130	4211	05	4163	4015	
0694	035	140	4015	60	4281	4183	
0695	035	150	4183	65	4286	4188	
0696	035	160	4186	11	4202	4089	
0697	035	170	4089	25	4191	4243	
0698	035	180	4243	05	4145	4197	
0699	035	190	4197	60	4200	4302	
0700	035	200	4302	65	4205	4407	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0701	036	010	4407	25	4359	4261	
0702	036	020	4261	70	4213	4366	
0703	036	030	4366	60	4359	4311	
0704	036	040	4311	17		4014	
0705	036	050	4014	35	4416	4118	
0706	036	060	4118	62		4322	
0707	036	070	4322	60	4281	4233	
0708	036	080	4233	65	4286	4238	
0709	036	090	4236	11	4202	4139	
0710	036	100	4139	05	4228	4380	
0711	036	110	4380	25	4282	4401	
0712	036	120	4282	25	4226	4430	
0713	036	130	4430	70	4354	4457	
0714	036	140	4457	70	4073	4376	
0715	036	150	4376	60	4226	4480	
0716	036	160	4480	25	4354	4406	
0717	036	170	4406	75	4158	4361	
0718	036	180	4361	60	4354	4456	
0719	036	190	4456	25	4073	4025	
0720	036	200	4425	75	4068	4071	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0721	037	010	4071	60	4073	4475	
0722	037	020	4475	31	4278		
0723	037	030	4278	82	4231	4407	
0724	037	040	4231	25	4283	4235	
0725	037	050	4235	60	4232	4084	
0726	037	060	4084	25	4186	4288	
0727	037	070	4288	60	4136	4338	
0728	037	080	4338	25	4190	4092	
0729	037	090	4092	60	4278	4580	
0730	037	100	4580	16	04	4433	
0731	037	110	4232	SU	FMAT	ION	3
0732	037	120	4136	SU	FMAT	ION	5
0733	037	130	4309		FATR	IX	3
0734	037	140	4163		FATR	IX	5
0735	037	150	4263	AU	XILI	ARY	3
0736	037	160	4186	AU	XILI	ARY	5
0737	037	170	4191		R	U*	3
0738	037	180	4145		R	U*	5
0739	037	190	4359	00	0000	0000	
0740	037	200	4213	01	0000	0000	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0741	038	010	4416	TT	0000	0000	
0742	038	020	4327	00	1001	1001	
0743	038	030	4158	00	0001	0000	
0744	038	040	4066	00	0000	0001	
0745	038	050	4190	82	4166	4407	
0746	038	060	4140	67	0001	4293	
0747	038	070	4433	06	4236		
0748	038	080	4045	26	4348		
0749	038	090	4346	60	4200	4352	
0750	038	100	4352	60	4205	4507	
0751	038	110	4507	60	4281	4333	
0752	038	120	4333	60	4286	4388	
0753	038	130	4388	25	4240	4142	
0754	038	140	4142	05	4144	4196	
0755	038	150	4196	60	4250	4402	
0756	038	160	4402	65	4255	4557	
0757	038	170	4557	25	4459	4411	
0758	038	180	4411	05	4263	4065	
0759	038	190	4065	60	4218	4170	
0760	038	200	4170	65	4223	4575	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0761	039	010	4575	25	4377	4529	
0762	039	020	4529	05	4331	4483	
0763	039	030	4483	60	4241	4343	
0764	039	040	4343	65	4246	4398	
0765	039	050	4398	60	4209	4461	
0766	039	060	4461	65	4214	4466	
0767	039	070	4466	25	4168	4220	
0768	039	080	4220	05	4372	4174	
0769	039	090	4174	60	4378	4630	
0770	039	100	4630	65	4383	4285	
0771	039	110	4285	16	10	4438	
0772	039	120	4438	11	4201	4289	
0773	039	130	4289	26	4192		
0774	039	140	4192	60	4250	4452	
0775	039	150	4452	60	4255	4707	
0776	039	160	4707	60	4218	4270	
0777	039	170	4270	60	4223	4825	
0778	039	180	4825	25	4427	4579	
0779	039	190	4579	05	4381	4533	
0780	039	200	4533	60	4241	4393	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0781	040	010	4393	65	4246	4448	
0782	040	020	4448	25	4750	4502	
0783	040	030	4502	05	4404	4506	
0784	040	040	4506	60	4209	4511	
0785	040	050	4511	65	4214	4516	
0786	040	060	4516	25	4268	4320	
0787	040	070	4320	05	4422	4224	
0788	040	080	4224	60	4378	4730	
0789	040	090	4730	65	4383	4335	
0790	040	100	4335	11	4201	4389	
0791	040	110	4389	25	4291	4443	
0792	040	120	4443	05	4195	4247	
0793	040	130	4247	60	4250	4552	
0794	040	140	4552	65	4255	4807	
0795	040	150	4807	25	4509	4561	
0796	040	160	4561	05	4313	4115	
0797	040	170	4115	60	4218	4420	
0798	040	180	4420	65	4223	4875	
0799	040	190	4875	25	4477	4629	
0800	040	200	4629	05	4431	4683	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0801	041	010	4683	60	4241	4493	
0802	041	020	4493	65	4246	4498	
0803	041	030	4498	25	4800	4802	
0804	041	040	4802	05	4454	4556	
0805	041	050	4556	60	4209	4611	
0806	041	060	4611	65	4214	4566	
0807	041	070	4566	25	4377	4679	
0808	041	080	4679	05	4331	4733	
0809	041	090	4733	60	4378	4880	
0810	041	100	4880	65	4383	4385	
0811	041	110	4385	11	4201	4489	
0812	041	120	4489	26	4242		
0813	041	130	4242	60	4250	4852	
0814	041	140	4852	60	4255	4857	
0815	041	150	4857	60	4218	4470	
0816	041	160	4470	60	4223	4925	
0817	041	170	4925	25	4240	4292	
0818	041	180	4292	05	4144	4296	
0819	041	190	4296	60	4241	4543	
0820	041	200	4543	65	4246	4548	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0821	042	010	4548	25	4850	4153	
0822	042	020	4153	05	4305	4907	
0823	042	030	4907	60	4209	4661	
0824	042	040	4661	65	4214	4616	
0825	042	050	4616	25	4318	4520	
0826	042	060	4520	05	4472	4274	
0827	042	070	4274	60	4378	4930	
0828	042	080	4930	65	4383	4435	
0829	042	090	4435	11	4201	4589	
0830	042	100	4589	26	4342		
0831	042	110	4342	60	4250	4203	
0832	042	120	4203	60	4255	4957	
0833	042	130	4957	60	4218	4870	
0834	042	140	4870	60	4223	4975	
0835	042	150	4975	60	4241	4593	
0836	042	160	4593	60	4246	4598	
0837	042	170	4598	60	4378	4980	
0838	042	180	4980	60	4383	4485	
0839	042	190	4485	25	4240	4392	
0840	042	200	4392	05	4144	4346	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0841	043	010	4346	60	4209	4811	
0842	043	020	4811	65	4214	4666	
0843	043	030	4666	11	4201	4889	
0844	043	040	4889	00	4341		
0845	043	050	4341	26	4194		
0846	043	060	4194	60	3995	4297	
0847	043	070	4297	25	0400	4253	
0848	043	080	4253	60	3996	4648	
0849	043	090	4648	25	0500	4353	
0850	043	100	4353	60	3997	4149	
0851	043	110	4149	31	4403		
0852	043	120	4403	25	3995	4347	
0853	043	130	4347	82	4601	4950	
0854	043	140	4801	25	1000	4453	
0855	043	150	4453	60	3998	4950	
0856	043	160	4950	30	3997	4199	
0857	043	170	4199	05	3998	4951	
0858	043	180	4951	25	4553	4741	
0859	043	190	4553	60	3999	4853	
0860	043	200	4853	05	4355	4208	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0861	044	010	4208	25	4360	4401	
0862	044	020	4360	30	3998	4953	
0863	044	030	4953	05	3997	4249	
0864	044	040	4249	25	4504	4695	
0865	044	050	4504	60	3998	4554	
0866	044	060	4554	25	4297	4349	
0867	044	070	4349	70	4004	4256	
0868	044	080	4256	60	4297	4399	
0869	044	090	4399	25	4648	4754	
0870	044	100	4754	70	4004	4358	
0871	044	110	4358	60	4648	4804	
0872	044	120	4804	25	3995	4397	
0873	044	130	4397	70	4004	4408	
0874	044	140	4408	60	3995	4447	
0875	044	150	4447	30	4000	4854	
0876	044	160	4854	82	4456	4297	
0877	044	170	4558	25	4000	4505	
0878	044	180	4505	06	4956		
0879	044	190	4956	32	400	4165	
0880	044	200	4165	70	0350	4555	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0881	045	010	4555	05	K	4559	
0882	045	020	4559	25	4911	4363	
0883	045	030	4911	67	6688	0120	
0884	045	040	4240	V	ARIA	BLE	3
0885	045	050	4144	V	ARIA	BLE	5
0886	045	060	4291	I	DENT	ITY	3
0887	045	070	4195	I	DENT	ITY	5
0888	045	080	4459	RE	GRES	SION	3
0889	045	090	4263	RE	GRES	SION	5
0890	045	100	4509		COEF	F	3
0891	045	110	4313		COEF	F	5
0892	045	120	4377	V	ARIA	NCE	3
0893	045	130	4331	V	ARIA	NCE	5
0894	045	140	4427	RE	DUCT	ION	3
0895	045	150	4361	RE	DUCT	ION	5
0896	045	160	4477	D	UE	TO	3
0897	045	170	4431	D	UE	TO	5
0898	045	180	4750		BEFO	RE	3
0899	045	190	4404		BEFO	RE	5
0900	045	200	4800	R	EMOV	ING	3

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0901	046	010	4454	R	EMOV	ING	5
0902	046	020	4850	EF	FECT	OF	3
0903	046	030	4305	EF	FECT	OF	5
0904	046	040	4166	F	RACT	ION	3
0905	046	050	4372	F	RACT	ION	5
0906	046	060	4268	RE	MAIN	ING	3
0907	046	070	4422	RE	MAIN	ING	5
0908	046	080	4318	R	EMOV	ED	3
0909	046	090	4472	R	EMOV	ED	5
0910	046	100	4439	67	0001	4285	
0911	046	110	4290	67	0001	4438	
0912	046	120	4390	67	0001	4335	
0913	046	130	4490	67	0001	4385	
0914	046	140	4590	67	0001	4435	
0915	046	150	4890	67	0001	4666	
0916	046	160	4355	00	3995	3999	
0917	046	170	4604	00	0001	0000	
0918	046	180	0350	00	0400	0400	
0919	046	190	4456	25	4000	4605	
0920	046	200	4605	75	0351	4855	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0921	047	010	4855	60	4000	4955	
0922	047	020	4955	05	0357	4606	
0923	047	030	4606	25	4558	4363	
0924	047	040	0351	00	0002	0000	
0925	047	050	0357	00	4000	4000	
0926	047	060	4449	60	4656	4759	
0927	047	070	4759	65	4162	4064	
0928	047	080	4064	25	4162	4114	
0929	047	090	4164	32	400	4121	
0930	047	100	4121	37	400	4328	
0931	047	110	4328	60	4531	4833	
0932	047	120	4833	60	4535	4137	
0933	047	130	4137	32	200	4442	
0934	047	140	4442	65	4244	4396	
0935	047	150	4396	72	4396	4909	
0936	047	160	4909	96	0800	4806	
0937	047	170	4806	96	0600	4809	
0938	047	180	4809	25	0801	4859	
0939	047	190	4859	05	0606	4959	
0940	047	200	4959	12		4212	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0941	048	010	4212	77		4215	
0942	048	020	4215	25	0611	4413	
0943	048	030	4413	05	0616	4368	
0944	048	040	4368	12		4171	
0945	048	050	4171	82	4374	4324	
0946	048	060	4374	32	400	4581	
0947	048	070	4581	37	400	4486	
0948	048	080	4486	30	4535	4187	
0949	048	090	4187	82	4440	4340	
0950	048	100	4440	32	200	4245	
0951	048	110	4245	65	4497	4549	
0952	048	120	4549	25	0681	4883	
0953	048	130	4883	05	0686	4538	
0954	048	140	4538	12		4391	
0955	048	150	4391	77		4344	
0956	048	160	4344	25	0691	4843	
0957	048	170	4843	05	0696	4698	
0958	048	180	4698	12		4410	
0959	048	190	4410	82	4463	4324	
0960	048	200	4463	60	4265	4067	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0961	049	010	4067	25	0821	4123	
0962	049	020	4123	05	0626	4428	
0963	049	030	4428	12		4631	
0964	049	040	4631	77		4134	
0965	049	050	4134	25	0631	4933	
0966	049	060	4588	12		4491	
0967	049	070	4933	05	0636	4588	
0968	049	080	4491	82	4394	4324	
0969	049	090	4394	60	4901	4460	
0970	049	100	4460	25	0641	4893	
0971	049	110	4893	05	0646	4748	
0972	049	120	4748	12		4510	
0973	049	130	4510	77		4513	
0974	049	140	4513	25	0651	4560	
0975	049	150	4560	05	0656	4960	
0976	049	160	4960	12		4563	
0977	049	170	4563	82	4117	4324	
0978	049	180	4117	60	4902	4312	
0979	049	190	4312	25	0861	4913	
0980	049	200	4913	05	0666	4468	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0981	050	010	4468	12		4221	
0982	050	020	4221	77		4424	
0983	050	030	4424	25	0671	4173	
0984	050	040	4173	05	0676	4478	
0985	050	050	4478	12		4681	
0986	050	060	4681	82	4184	4324	
0987	050	070	4184	60	4903	4362	
0988	050	080	4362	25	0902	4412	
0989	050	090	4412	05	0907	4512	
0990	050	100	4512	12		4315	
0991	050	110	4315	77		4518	
0992	050	120	4518	25	0712	4264	
0993	050	130	4264	05	0717	4069	
0994	050	140	4069	12		4522	
0995	050	150	4522	82	4426	4324	
0996	050	160	4426	60	4904	4562	
0997	050	170	4562	25	0922	4474	
0998	050	180	4474	05	0927	4729	
0999	050	190	4729	12		4332	
1000	050	200	4332	77		4585	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
1001	051	010	4585	25	0732	4234	
1002	051	020	4234	05	0737	4189	
1003	051	030	4189	12		4492	
1004	051	040	4492	82	4295	4324	
1005	051	050	4295	60	4905	4712	
1006	051	060	4712	25	4265	4167	
1007	051	070	4167	31	4920		
1008	051	080	4920	82	4323	4273	
1009	051	090	4273	35	4476	4528	
1010	051	100	4528	82	4432	4382	
1011	051	110	4382	26	4336		
1012	051	120	4336	75	4901	4812	
1013	051	130	4812	60	4901	4432	
1014	051	140	4432	25	4265	4217	
1015	051	150	4217	35	4119	4271	
1016	051	160	4271	82	4574	4524	
1017	051	170	4524	26	4527		
1018	051	180	4527	75	4902	4862	
1019	051	190	4862	60	4902	4574	
1020	051	200	4574	25	4265	4317	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
1021	052	010	4317	35	4169	4321	
1022	052	020	4321	82	4674	4624	
1023	052	030	4624	26	4577		
1024	052	040	4577	75	4903	4912	
1025	052	050	4912	60	4903	4674	
1026	052	060	4674	25	4265	4367	
1027	052	070	4367	35	4219	4371	
1028	052	080	4371	82	4824	4724	
1029	052	090	4724	26	4627		
1030	052	100	4627	75	4904	4963	
1031	052	110	4963	60	4904	4824	
1032	052	120	4824	25	4265	4417	
1033	052	130	4417	35	4269	4421	
1034	052	140	4421	82	4323	4874	
1035	052	150	4874	26	4677		
1036	052	160	4677	75	4905	4314	
1037	052	170	4314	60	4905	4323	
1038	052	180	4323	25	4526	4628	
1039	052	190	4628	70	4535	4638	
1040	052	200	4638	60	4540	4542	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
1041	053	010	4542	70	4497	4364	
1042	053	020	4364	77		4517	
1043	053	030	4517	25	4901	4540	
1044	053	040	4540	60	9999	4464	
1045	053	050	4464	25	4517	4319	
1046	053	060	4319	70	4471	4924	
1047	053	070	4924	60	4517	4369	
1048	053	080	4369	25	4540	4592	
1049	053	090	4592	70	4471	4974	
1050	053	100	4974	60	4540	4642	
1051	053	110	4642	82	4345	4517	
1052	053	120	4345	25	4547	4599	
1053	053	130	4599	60	4517	4419	
1054	053	140	4419	25	4535	4237	
1055	053	150	4237	70	4497	4514	
1056	053	160	4514	60	4535	4287	
1057	053	170	4287	75	4471	4576	
1058	053	180	4576	30	4244	4496	
1059	053	190	4496	82	4656	4396	
1060	053	200	4910	67	0001	4396	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
1061	054	010	4324	67	0002	4396	
1062	054	020	4340	67	4396	4064	
1063	054	030	4476	00	000T	0000	
1064	054	040	4119	00	0000	T000	
1065	054	050	4169	00	0000	0T00	
1066	054	060	4219	00	0000	00T0	
1067	054	070	4269	00	0000	000T	
1068	054	080	4547	25	4901	4540	
1069	054	090	4526	60	0000	4464	
1070	054	100	4471	00	0001	0000	
1071	054	110	4114	00	4164		
1072	054	120	4363	60	4415	4567	
1073	054	130	4567	65	4469	4521	
1074	054	140	4521	25	4469	4571	
1075	054	150	4571	06	4626		
1076	054	160	4626	32	400	4983	
1077	054	170	4983	37	400	4690	
1078	054	180	4690	60	4692	4444	
1079	054	190	4444	60	4546	4848	
1080	054	200	4848	32	200	4564	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
1081	055	010	4564	65	4617	4519	
1082	055	020	4519	25	4617	4569	
1083	055	030	4569	75	4546	4999	
1084	055	040	4999	30	4614	4867	
1085	055	050	4867	87	4621	4970	
1086	055	060	4970	82	4621	4373	
1087	055	070	4621	25	4546	4896	
1088	055	080	4896	70	4914	4917	
1089	055	090	4917	17		4671	
1090	055	100	4671	60	0908	4964	
1091	055	110	4964	65	0913	4465	
1092	055	120	4465	25	4967	4819	
1093	055	130	4819	70	4546	4515	
1094	055	140	4515	60	4568	4871	
1095	055	150	4871	25	4473	4676	
1096	055	160	4676	70	4928	4482	
1097	055	170	4482	60	4284	4386	
1098	055	180	4386	30	4284	4568	
1099	055	190	4568	25	9999	4715	
1100	055	200	4715	60	4901	4765	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
1101	056	010	4765	25	4568	4971	
1102	056	020	4971	70	4523	4726	
1103	056	030	4726	60	4568	4572	
1104	056	040	4572	25	4715	4618	
1105	056	050	4618	70	4523	4926	
1106	056	060	4926	60	4715	4818	
1107	056	070	4818	82	4922	4568	
1108	056	080	4922	25	4473	4976	
1109	056	090	4976	60	4715	4868	
1110	056	100	4868	26	4972		
1111	056	110	4972	60	4900	4815	
1112	056	120	4815	31	4918		
1113	056	130	4918	25	4901	4965	
1114	056	140	4965	87	4669	4966	
1115	056	150	4966	82	4669	4573	
1116	056	160	4573	05	K	4727	
1117	056	170	4727	25	4900	4919	
1118	056	180	4919	70	4923	4877	
1119	056	190	4877	60	4900	4969	
1120	056	200	4969	25	T	4869	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
1121	057	010	4869	17		4973	
1122	057	020	4973	60	0928	4532	
1123	057	030	4532	65	0933	4436	
1124	057	040	4436	31	4239		
1125	057	050	4239	25	4902	4977	
1126	057	060	4977	87	4782	4582	
1127	057	070	4582	82	4782	4536	
1128	057	080	4536	05	K	4990	
1129	057	090	4990	25	4900	4978	
1130	057	100	4978	70	4632	4586	
1131	057	110	4586	60	4900	4829	
1132	057	120	4829	25	T	4782	
1133	057	130	4782	17		4636	
1134	057	140	4636	60	0948	4879	
1135	057	150	4879	65	0953	4929	
1136	057	160	4929	31	4682		
1137	057	170	4882	25	4903	4979	
1138	057	180	4979	87	4982	4932	
1139	057	190	4932	82	4982	4686	
1140	057	200	4686	05	K	4541	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
1141	058	010	4541	25	4900	4384	
1142	058	020	4384	70	4636	4839	
1143	058	030	4839	60	4900	4484	
1144	058	040	4484	25	T	4982	
1145	058	050	4962	17		4886	
1146	058	060	4886	60	0968	4584	
1147	058	070	4584	65	0973	4684	
1148	058	080	4684	31	4337		
1149	058	090	4337	25	4904	4834	
1150	058	100	4834	87	4437	4387	
1151	058	110	4387	82	4437	4591	
1152	058	120	4591	05	K	4395	
1153	058	130	4395	25	4900	4884	
1154	058	140	4884	70	4936	4939	
1155	058	150	4939	60	4900	4934	
1156	058	160	4934	25	T	4437	
1157	058	170	4437	17		4641	
1158	058	180	4641	60	0918	4984	
1159	058	190	4984	65	0923	4986	
1160	058	200	4986	31	4989		

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
1161	059	010	4989	25	4905	4487	
1162	059	020	4487	87	4742	4691	
1163	059	030	4691	82	4742	4544	
1164	059	040	4544	05	K	4948	
1165	059	050	4948	25	4900	4537	
1166	059	060	4537	70	4842	4445	
1167	059	070	4445	60	4900	4587	
1168	059	080	4587	25	T	4742	
1169	059	090	4742	17		4495	
1170	059	100	4495	60	0938	4892	
1171	059	110	4892	65	0943	4545	
1172	059	120	4545	25	4900	4887	
1173	059	130	4887	17		4942	
1174	059	140	4942	60	0988	4943	
1175	059	150	4943	65	0993	4595	
1176	059	160	4595	81	0600	4937	
1177	059	170	4937	25	4546	4998	
1178	059	180	4998	70	4928	4987	
1179	059	190	4987	60	4546	4688	
1180	059	200	4688	25	4617	4738	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
1181	060	010	4738	75	4546	4838	
1182	060	020	4838	31	4993		
1183	060	030	4993	87	4519	4596	
1184	060	040	4596	82	4519	4415	
1185	060	050	4936	67	4521	4595	
1186	060	060	4373	06	4988		
1187	060	070	4966	70	4523	4594	
1188	060	080	4594	32	400	4644	
1189	060	090	4644	70	4546	4744	
1190	060	100	4744	17		4597	
1191	060	110	4597	60	0908	4794	
1192	060	120	4794	65	0913	4844	
1193	060	130	4844	12		4697	
1194	060	140	4697	75	4546	4894	
1195	060	150	4894	37	400	4944	
1196	060	160	4944	70	4473	4994	
1197	060	170	4994	60	4284	4995	
1198	060	180	4995	26	4646		
1199	060	190	4646	60	4902	4696	
1200	060	200	4696	60	4903	4996	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
1201	061	010	4996	60	4904	4747	
1202	061	020	4747	60	4905	4847	
1203	061	030	4847	25	4967	4897	
1204	061	040	4897	70	4546	4947	
1205	061	050	4947	60	4568	4386	
1206	061	060	4614	00	0004	0000	
1207	061	070	4523	00	0001	0000	
1208	061	080	4914	00	0000	0005	
1209	061	090	4473	60	4901	4765	
1210	061	100	4923	00	0002	0000	
1211	061	110	4832	00	0000	2000	
1212	061	120	4836	00	0000	0200	
1213	061	130	4936	00	0000	0020	
1214	061	140	4842	00	0000	0002	
1215	061	150	4967	25	0000	4715	
1216	061	160	4928	00	0005	0000	
1217	061	170	4002	05	4997	0399	
1218	061	180	0399	25	0300	4449	
1219	061	190	0300	25	4000	0302	
1220	061	200	0302	77		0306	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
1221	062	010	0306	32	0400	0313	
1222	062	020	0313	85	000K	0301	
1223	062	030	0301	25	000T	0305	
1224	062	040	0305	70	000Y	0310	
1225	062	050	0310	60	0312	0314	
1226	062	060	0314	30	0316	0318	
1227	062	070	0318	55	0312	0320	
1228	062	080	0320	32	0500	0329	
1229	062	090	0329	70	0331	0334	
1230	062	100	0334	05	000K	0338	
1231	062	110	0338	25	4001	4449	
1232	062	120	4997	00	4000	4000	
1233	062	130	0316	20	0000	0000	
1234	062	140	0331	00	1000	0999	
1235	062	150	0303	60	4365	0367	
1236	062	160	0367	60	4370	0372	
1237	062	170	0372	60	4250	0347	
1238	062	180	0347	60	4255	0358	
1239	062	190	0358	60	4334	0336	
1240	062	200	0336	60	4339	0341	

M[illegible]19C00

CARD NO	PAGE	LINE	A	OP	M	C	K
1241	063	010	0341	60	4218	0307	
1242	063	020	0307	60	4223	0398	
1243	063	030	0398	60	4303	0304	
1244	063	040	0304	60	4308	0311	
1245	063	050	0311	60	4241	0324	
1246	063	060	0324	60	4246	0321	
1247	063	070	0321	60	4325	0327	
1248	063	080	0327	60	4330	0333	
1249	063	090	0333	60	4209	0361	
1250	063	100	0361	60	4214	0366	
1251	063	110	0366	60	4294	0396	
1252	063	120	0396	60	4299	0317	
1253	063	130	0317	60	4378	0330	
1254	063	140	0330	60	4383	0356	
1255	063	150	0356	60	4262	0364	
1256	063	160	0364	60	4267	0370	
1257	063	170	0370	25	4000	4202	
1258	063	180	1256	67	4002	4001	

PART III

MRA019C00 - Prediction Phase

CARD NO	PAGE	LINE	A	OP	M	C	K
0001	001	010	4600	26	4603	0000	
0002	001	020	4602	20	000T	4906	
0003	001	030	4603	75	000T	4609	
0004	001	040	4607	05	4659	4621	
0005	001	050	4608	TT	0000	0000	
0006	001	060	4609	05	000K	4613	
0007	001	070	4610	87	4813	4713	
0008	001	080	4612	49	0000	0000	
0009	001	090	4613	25	000Y	4817	
0010	001	100	4615	05	000K	4619	
0011	001	110	4619	26	4622	0000	
0012	001	120	4620	05	4672	4915	
0013	001	130	4622	20	000Y	4826	
0014	001	140	4623	25	4633	4797	
0015	001	150	4625	77	0000	4778	
0016	001	160	4632	05	4634	4821	
0017	001	170	4634	00	0000	0097	
0018	001	180	4635	65	4637	4639	
0019	001	190	4639	35	4691	4643	
0020	001	200	4640	87	4743	4694	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0021	002	010	4643	05	000K	4647	
0022	002	020	4645	60	4797	4799	
0023	002	030	4647	25	000Y	4851	
0024	002	040	4649	05	000K	4703	
0025	002	050	4650	05	4654	4821	
0026	002	060	4651	35	4653	4655	
0027	002	070	4652	87	4605	4607	
0028	002	080	4653	TT	0000	0000	
0029	002	090	4654	00	0000	0094	
0030	002	100	4655	75	000T	4660	
0031	002	110	4657	38	0200	4861	
0032	002	120	4658	0T	0000	0000	2
0033	002	130	4659	00	0000	0093	
0034	002	140	4660	17	0000	4663	
0035	002	150	4662	05	4665	4821	
0036	002	160	4663	12		4866	
0037	002	170	4664	85	000T	4700	
0038	002	180	4665	00	0000	0092	
0039	002	190	4667	33	0300	4773	
0040	002	200	4668	08	0000	0000	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0041	003	010	4669	00	0000	0091	
0042	003	020	4670	87	4623	4673	
0043	003	030	4672	00	0000	0099	
0044	003	040	4673	32	0200	4676	
0045	003	050	4675	38	0100	4878	
0046	003	060	4676	20	4680	4682	
0047	003	070	4680	32	0000	4705	
0048	003	080	4682	77	0000	4685	
0049	003	090	4685	25	4637	4689	
0050	003	100	4687	38	0100	4790	
0051	003	110	4689	37	0200	000Y	
0052	003	120	4693	36	0100	4746	
0053	003	130	4694	05	4696	4821	
0054	003	140	4695	60	4797	4600	
0055	003	150	4699	26	4702	0000	
0056	003	160	4700	31	4603	0000	
0057	003	170	4701	05	4704	0001	
0058	003	180	4702	20	000T	4706	
0059	003	190	4703	25	000Y	4657	
0060	003	200	4704	67	0000	4764	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0061	004	010	4705	05	000K	4709	
0062	004	020	4706	35	4708	4710	
0063	004	030	4708	TT	0000	0000	
0064	004	040	4709	25	4633	4735	
0065	004	050	4710	05	000K	4714	
0066	004	060	4711	38	0100	4814	
0067	004	070	4713	06	4616	0000	
0068	004	080	4714	26	4717	0000	
0069	004	090	4716	87	4719	4620	
0070	004	100	4717	20	000Y	4721	
0071	004	110	4718	00	0000	0050	
0072	004	120	4719	38	0100	4722	
0073	004	130	4720	26	4797	0000	
0074	004	140	4721	35	4774	4780	
0075	004	150	4722	87	4725	4776	
0076	004	160	4723	01	1000	0000	
0077	004	170	4725	38	0100	4728	
0078	004	180	4728	87	4931	4632	
0079	004	190	4731	60	4633	4785	
0080	004	200	4732	05	4751	0001	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0081	005	010	4734	87	4837	4788	
0082	005	020	4735	37	0200	4740	
0083	005	030	4736	00	1000	0000	
0084	005	040	4737	TT	0000	0000	
0085	005	050	4739	70	000Y	4796	
0086	005	060	4740	70	000T	4945	
0087	005	070	4741	65	4793	4895	
0088	005	080	4743	36	0100	4846	
0089	005	090	4745	38	0200	4749	
0090	005	100	4746	87	4650	4899	
0091	005	110	4749	05	000K	4753	
0092	005	120	4751	67	0100	4751	
0093	005	130	4752	87	4607	4755	
0094	005	140	4753	25	000Y	4757	
0095	005	150	4755	38	0100	4858	
0096	005	160	4756	30	4758	4810	
0097	005	170	4757	38	0100	4760	
0098	005	180	4758	0T	0000	0000	
0099	005	190	4760	35	4762	4764	
0100	005	200	4761	38	0100	4864	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0101	006	010	4762	0T	TTTT	TTT1	
0102	006	020	4763	06	4916		
0103	006	030	4764	30	000T	4768	
0104	006	040	4766	87	4770	4769	
0105	006	050	4767	05	4669	4821	
0106	006	060	4768	55	000K	4700	
0107	006	070	4769	38	0100	4872	
0108	006	080	4770	05	4672	4865	
0109	006	090	4771	33	0200	4775	
0110	006	100	4772	00	4961		
0111	006	110	4773	20	4777	4775	
0112	006	120	4774	TT	0000	0000	
0113	006	130	4775	77	0000	4828	
0114	006	140	4776	05	4779	4821	
0115	006	150	4777	01	2000	0000	
0116	006	160	4778	36	4981		
0117	006	170	4779	00	0000	0098	
0118	006	180	4780	75	000T	4786	
0119	006	190	4781	20	4633	4935	
0120	006	200	4783	20	4736	4775	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0121	007	010	4784	87	4788	4687	
0122	007	020	4785	70	4787	4940	
0123	007	030	4786	70	4888	4991	
0124	007	040	4787	99	0000	0000	
0125	007	050	4788	05	4792	4821	
0126	007	060	4789	70	000Y	4797	
0127	007	070	4790	87	4694	4693	
0128	007	080	4791	65	4793	4645	
0129	007	090	4792	00	0000	0096	
0130	007	100	4795	60	4797	4613	
0131	007	110	4796	26	4797	0000	
0132	007	120	4798	05	4751	0001	
0133	007	130	4799	26	4602	0000	
0134	007	140	4803	87	4756	4856	
0135	007	150	4805	38	0100	4808	
0136	007	160	4806	87	4711	4662	
0137	007	170	4810	87	4763	4863	
0138	007	180	4813	38	0100	4716	
0139	007	190	4814	87	4720	4767	
0140	007	200	4816	75	4718	4771	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0141	008	010	4817	36	4820	0000	
0142	008	020	4820	87	4623	4873	
0143	008	030	4821	33	0200	4625	
0144	008	040	4822	06	4676		
0145	008	050	4823	20	000T	4827	
0146	008	060	4826	70	000T	4731	
0147	008	070	4827	87	4631	4830	
0148	008	080	4828	36	4781		
0149	008	090	4830	65	4633	4835	
0150	008	100	4831	50	4633	4635	
0151	008	110	4835	50	4637	4639	
0152	008	120	4837	38	0100	4640	
0153	008	130	4840	26	4797	0000	
0154	008	140	4841	25	4793	4745	
0155	008	150	4845	38	0200	4649	
0156	008	160	4846	87	4649	4650	
0157	008	170	4849	38	0100	4652	
0158	008	180	4851	35	4653	4655	
0159	008	190	4856	30	4658	4810	
0160	008	200	4858	87	4662	4761	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0161	009	010	4860	75	4612	4615	
0162	009	020	4861	77	0000	4664	
0163	009	030	4863	38	0100	4766	
0164	009	040	4864	87	4767	4797	
0165	009	050	4865	70	4718	4821	
0166	009	060	4866	30	4668	4670	
0167	009	070	4872	87	4776	4675	
0168	009	080	4873	20	000T	4927	
0169	009	090	4876	32	0300	4783	
0170	009	100	4878	87	4632	4881	
0171	009	110	4881	38	0100	4784	
0172	009	120	4885	70	4787	4840	
0173	009	130	4888	50			
0174	009	140	4891	TT			
0175	009	150	4895	60	4797	4699	
0176	009	160	4896	00	0000	0095	
0177	009	170	4899	38	0100	4752	
0178	009	180	4906	35	4608	4860	
0179	009	190	4908	70	000Y	4913	
0180	009	200	4915	75	4718	4821	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0181	010	010	4916	70	4718	4771	
0182	010	020	4921	20	4723	4775	
0183	010	030	4927	87	4830	4831	
0184	010	040	4931	38	0100	4734	
0185	010	050	4935	35	4737	4789	
0186	010	060	4940	26	4797		
0187	010	070	4941	25	4793	4845	
0188	010	080	4945	00	4700		
0189	010	090	4946	77	0000	4949	
0190	010	100	4949	36	4952		
0191	010	110	4952	20	4954	4956	
0192	010	120	4954			0500	
0193	010	130	4956	70	000Y	4961	
0194	010	140	4961	06	4966		
0195	010	150	4962	06	4667		
0196	010	160	4966	33	0300	4921	
0197	010	170	4981	20	4633	4985	
0198	010	180	4985	35	4737	4739	
0199	010	190	4991	60	4633	4885	
0200	010	200	4992	05	4751	000T	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0201	011	010	4633				
0202	011	020	4637				
0203	011	030	4793				
0204	011	040	4797				
0205	011	050	4047	05	4049	4051	
0206	011	060	4049	00	0200	0201	
0207	011	070	4051	25	4016	4018	
0208	011	080	4016	25	0400	4052	
0209	011	090	4052	60	3997	4099	
0210	011	100	4099	30	0401	4003	
0211	011	110	4003	05	0201	4053	
0212	011	120	4053	25	4005	4791	
0213	011	130	4005	77		4008	
0214	011	140	4008	05	3997	4149	
0215	011	150	4149	25	4101	4795	
0216	011	160	4101	60	3997	4199	
0217	011	170	4199	25	4099	4151	
0218	011	180	4151	70	4103	4006	
0219	011	190	4006	60	4099	4201	
0220	011	200	4201	25	4003	4055	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0221	012	010	4055	70	4103	4056	
0222	012	020	4056	60	4003	4105	
0223	012	030	4105	30	4007	4009	
0224	012	040	4009	82	4012	4099	
0225	012	050	4012	25	4064	4066	
0226	012	060	4066	60	4099	4251	
0227	012	070	4251	25	4153	4155	
0228	012	080	4155	60	4003	4205	
0229	012	090	4205	25	0201	4203	
0230	012	100	4203	60	3995	4097	
0231	012	110	4097	25	0200	4102	
0232	012	120	4102	60	3996	4048	
0233	012	130	4048	77		4301	
0234	012	140	4301	05	3997	4249	
0235	012	150	4249	25	4351	4695	
0236	012	160	4351	60	3998	4050	
0237	012	170	4050	77		4253	
0238	012	180	4253	05	3999	4401	
0239	012	190	4401	25	4303	4795	
0240	012	200	4303	60	3999	4451	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0241	013	010	4451	05	4353	4255	
0242	013	020	4255	25	4047	4299	
0243	013	030	4002	05	4004	4106	
0244	013	040	4106	25	4058	4018	
0245	013	050	4058	25	4000	4152	
0246	013	060	4152	06	4305		
0247	013	070	4305	32	400	4062	
0248	013	080	4062	70	4114	4017	
0249	013	090	4017	60	4114	4116	
0250	013	100	4116	05	K	4020	
0251	013	110	4020	25	4001	4018	
0252	013	120	4001	25	4007	4059	
0253	013	130	4059	70	4000	4403	
0254	013	140	4403	60	4007	4109	
0255	013	150	4109	25	4000	4425	
0256	013	160	4425	06	4501		
0257	013	170	4501	32	0400	4930	
0258	013	180	4930	70	4049	4453	
0259	013	190	4453	60	4049	4551	
0260	013	200	4551	25	4205	4057	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0261	014	010	4057	70	4000	4553	
0262	014	020	4553	60	4205	4107	
0263	014	030	4107	26	4010		
0264	014	040	4010	60	4400	4202	
0265	014	050	4202	60	4405	4157	
0266	014	060	4157	60	4481	4033	
0267	014	070	4033	60	4486	4038	
0268	014	080	4038	60	4565	4067	
0269	014	090	4067	60	4570	4022	
0270	014	100	4022	60	4450	4252	
0271	014	110	4252	60	4455	4207	
0272	014	120	4207	60	4534	4036	
0273	014	130	4036	60	4539	4041	
0274	014	140	4041	60	4418	4070	
0275	014	150	4070	60	4423	4025	
0276	014	160	4025	60	4503	4355	
0277	014	170	4355	60	4508	4060	
0278	014	180	4060	60	4525	4027	
0279	014	190	4027	60	4530	4032	
0280	014	200	4032	60	4409	4011	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0281	015	010	4011	60	4414	4166	
0282	015	020	4166	60	4494	4046	
0283	015	030	4046	60	4499	4601	
0284	015	040	4601	60	4578	4030	
0285	015	050	4030	60	4583	4035	
0286	015	060	4035	60	4462	4164	
0287	015	070	4164	60	4467	4469	
0288	015	080	4469	60	3999	4019	
0289	015	090	4019	25	4021	4023	
0290	015	100	4023	05	4075	4077	
0291	015	110	4077	60	4441	4043	
0292	015	120	4043	65	4446	4098	
0293	015	130	4098	11	4402	4039	
0294	015	140	4039	25	4091	4093	
0295	015	150	4093	05	4045	4147	
0296	015	160	4147	60	4450	4302	
0297	015	170	4302	65	4455	4257	
0298	015	180	4257	25	4159	4061	
0299	015	190	4061	05	4013	4015	
0300	015	200	4015	60	4418	4120	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0301	016	010	4120	65	4423	4125	
0302	016	020	4125	25	4127	4029	
0303	016	030	4029	05	4031	4083	
0304	016	040	4083	60	4441	4143	
0305	016	050	4143	65	4446	4148	
0306	016	060	4148	25	4100	4352	
0307	016	070	4352	05	4054	4156	
0308	016	080	4156	60	4409	4111	
0309	016	090	4111	65	4414	4216	
0310	016	100	4216	25	4068	4170	
0311	016	110	4170	05	4072	4024	
0312	016	120	4024	60	4578	4080	
0313	016	130	4080	65	4583	4085	
0314	016	140	4085	11	4406	4089	
0315	016	150	4089	26	4042		
0316	016	160	4042	60	4450	4402	
0317	016	170	4402	60	4455	4307	
0318	016	180	4307	60	4409	4161	
0319	016	190	4161	60	4414	4266	
0320	016	200	4266	25	4118	4220	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0321	017	010	4220	05	4122	4074	
0322	017	020	4074	60	4418	4270	
0323	017	030	4270	65	4423	4175	
0324	017	040	4175	60	4441	4193	
0325	017	050	4193	65	4446	4198	
0326	017	060	4198	25	4100	4452	
0327	017	070	4452	05	4054	4206	
0328	017	080	4206	60	4578	4130	
0329	017	090	4130	65	4583	4135	
0330	017	100	4135	11	4401	4139	
0331	017	110	4139	00	4047		
0332	017	120	4103	00	0001	0000	
0333	017	130	4007	05	0201	4053	
0334	017	140	4064	30	0401	4003	
0335	017	150	4153	05	0201	4053	
0336	017	160	4353	00	3995	3999	
0337	017	170	4114	00	0400	0400	
0338	017	180	4004	00	4000	4000	
0339	017	190	4104	00	0002	0000	
0340	017	200	4040	67	0001	4098	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0341	018	010	4090	67	0001	4085	
0342	018	020	4140	67	0001	4135	
0343	018	030	4021	PR	EDIC	TION	3
0344	018	040	4075	PR	EDIC	TION	5
0345	018	050	4091	I	DENT	ITY	3
0346	018	060	4045	I	DENT	ITY	5
0347	018	070	4159		ACTU	AL	3
0348	018	080	4013		ACTU	AL	5
0349	018	090	4118		VAL	UE	3
0350	018	100	4122		VAL	UE	5
0351	018	110	4127	P	REDI	CTED	3
0352	018	120	4031	P	REDI	CTED	5
0353	018	130	4100		DEL	TA	3
0354	018	140	4054		DEL	TA	5
0355	018	150	4068		SU	M	3
0356	018	160	4072		SU	M	5
0357	018	170	4018	60	4320	4172	
0358	018	180	4172	65	4124	4026	
0359	018	190	4026	25	4124	4076	
0360	018	200	4126	32	400	4133	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0361	019	010	4133	37	400	4190	
0362	019	020	4190	60	4092	4044	
0363	019	030	4044	60	4096	4248	
0364	019	040	4248	32	200	4853	
0365	019	050	4853	65	4505	4357	
0366	019	060	4357	72	4357	4210	
0367	019	070	4210	96	0600	4801	
0368	019	080	4801	96	0600	4951	
0369	019	090	4951	25	0601	4953	
0370	019	100	4953	05	0606	4108	
0371	019	110	4108	12		4261	
0372	019	120	4261	77		4214	
0373	019	130	4214	25	0611	4063	
0374	019	140	4063	05	0616	4168	
0375	019	150	4168	12		4071	
0376	019	160	4071	82	4224	4174	
0377	019	170	4224	32	400	4081	
0378	019	180	4081	37	400	4088	
0379	019	190	4088	30	4096	4298	
0380	019	200	4298	82	4552	4502	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0381	020	010	4552	32	200	4407	
0382	020	020	4407	65	4209	4311	
0383	020	030	4311	25	0681	4183	
0384	020	040	4183	05	0686	4138	
0385	020	050	4138	12		4141	
0386	020	060	4141	77		4094	
0387	020	070	4094	25	0691	4243	
0388	020	080	4243	05	0696	4348	
0389	020	090	4348	12		4802	
0390	020	100	4802	82	4555	4174	
0391	020	110	4555	60	4457	4259	
0392	020	120	4259	25	0621	4073	
0393	020	130	4073	05	0626	4028	
0394	020	140	4028	12		4131	
0395	020	150	4131	77		4034	
0396	020	160	4034	25	0631	4233	
0397	020	170	4233	05	0636	4188	
0398	020	180	4188	12		4191	
0399	020	190	4191	82	4144	4174	
0400	020	200	4144	60	4901	4154	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0401	021	010	4154	25	0641	4293	
0402	021	020	4293	05	0646	4398	
0403	021	030	4398	12		4852	
0404	021	040	4852	77		4605	
0405	021	050	4605	25	0651	4204	
0406	021	060	4204	05	0656	4158	
0407	021	070	4158	12		4361	
0408	021	080	4361	82	4264	4174	
0409	021	090	4264	60	4902	4254	
0410	021	100	4254	25	0661	4113	
0411	021	110	4113	05	0666	4218	
0412	021	120	4218	12		4121	
0413	021	130	4121	77		4274	
0414	021	140	4274	25	0671	4123	
0415	021	150	4123	05	0676	4078	
0416	021	160	4078	12		4181	
0417	021	170	4181	82	4084	4174	
0418	021	180	4084	60	4903	4855	
0419	021	190	4855	25	0702	4304	
0420	021	200	4304	05	0707	4309	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0421	022	010	4309	12		4112	
0422	022	020	4112	77		4065	
0423	022	030	4065	25	0912	4314	
0424	022	040	4314	05	0917	4069	
0425	022	050	4069	12		4222	
0426	022	060	4222	82	4225	4174	
0427	022	070	4225	60	4904	4256	
0428	022	080	4256	25	0722	4324	
0429	022	090	4324	05	0727	4079	
0430	022	100	4079	12		4082	
0431	022	110	4082	77		4185	
0432	022	120	4185	25	0932	4134	
0433	022	130	4134	05	0937	4189	
0434	022	140	4189	12		4142	
0435	022	150	4142	82	4095	4174	
0436	022	160	4095	60	4905	4507	
0437	022	170	4507	25	4457	4359	
0438	022	180	4359	31	4162		
0439	022	190	4162	82	4165	4115	
0440	022	200	4115	35	4117	4119	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0441	023	010	4119	82	4322	4272	
0442	023	020	4272	26	4275		
0443	023	030	4275	75	4901	4354	
0444	023	040	4354	60	4901	4322	
0445	023	050	4322	25	4457	4459	
0446	023	060	4459	35	4411	4163	
0447	023	070	4163	82	4366	4316	
0448	023	080	4316	26	4169		
0449	023	090	4169	75	4902	4955	
0450	023	100	4955	60	4902	4366	
0451	023	110	4366	25	4457	4509	
0452	023	120	4509	35	4461	4213	
0453	023	130	4213	82	4466	4416	
0454	023	140	4416	26	4219		
0455	023	150	4219	75	4903	4306	
0456	023	160	4306	60	4903	4466	
0457	023	170	4466	25	4457	4559	
0458	023	180	4559	35	4511	4263	
0459	023	190	4263	82	4566	4516	
0460	023	200	4516	26	4269		

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0461	024	010	4269	75	4904	4557	
0462	024	020	4557	60	4904	4566	
0463	024	030	4566	25	4457	4759	
0464	024	040	4759	35	4561	4313	
0465	024	050	4313	82	4165	4616	
0466	024	060	4616	26	4319		
0467	024	070	4319	75	4905	4208	
0468	024	080	4208	60	4905	4165	
0469	024	090	4165	25	4167	4369	
0470	024	100	4369	70	4096	4349	
0471	024	110	4349	60	4404	4356	
0472	024	120	4356	70	4209	4212	
0473	024	130	4212	77		4215	
0474	024	140	4215	25	4901	4404	
0475	024	150	4404	60	9999	4454	
0476	024	160	4454	25	4215	4217	
0477	024	170	4217	70	4419	4372	
0478	024	180	4372	60	4215	4267	
0479	024	190	4267	25	4404	4406	
0480	024	200	4406	70	4419	4422	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0481	025	010	4422	60	4404	4456	
0482	025	020	4456	82	4809	4215	
0483	025	030	4809	25	4611	4363	
0484	025	040	4363	60	4215	4317	
0485	025	050	4317	25	4096	4448	
0486	025	060	4448	70	4209	4262	
0487	025	070	4262	60	4096	4498	
0488	025	080	4498	75	4419	4472	
0489	025	090	4472	30	4505	4707	
0490	025	100	4707	82	4320	4357	
0491	025	110	4211	67	0001	4357	
0492	025	120	4174	67	0002	4357	
0493	025	130	4502	67	4357	4026	
0494	025	140	4117	00	0001	0000	
0495	025	150	4411	00	0000	1000	
0496	025	160	4461	00	0000	0100	
0497	025	170	4511	00	0000	0010	
0498	025	180	4561	00	0000	0001	
0499	025	190	4611	25	4901	4404	
0500	025	200	4167	60	0000	4454	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0501	026	010	4419	00	0001	0000	
0502	026	020	4076	06	4126		
0503	026	030	4299	60	4504	4506	
0504	026	040	4506	65	4258	4110	
0505	026	050	4110	25	4258	4160	
0506	026	060	4160	06	4413		
0507	026	070	4413	32	400	4370	
0508	026	080	4370	37	400	4177	
0509	026	090	4177	60	4129	4231	
0510	026	100	4231	60	4283	4235	
0511	026	110	4235	26	4238		
0512	026	120	4238	32	200	4343	
0513	026	130	4343	65	4145	4197	
0514	026	140	4197	25	4145	4247	
0515	026	150	4247	75	4283	4086	
0516	026	160	4086	30	4288	4240	
0517	026	170	4240	87	4443	4393	
0518	026	180	4393	82	4443	4146	
0519	026	190	4443	25	4283	4285	
0520	026	200	4285	70	4037	4290	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0521	027	010	4290	17		4493	
0522	027	020	4493	60	4481	4333	
0523	027	030	4333	65	4486	4338	
0524	027	040	4338	25	4340	4192	
0525	027	050	4192	70	4283	4136	
0526	027	060	4136	60	4388	4390	
0527	027	070	4390	25	4242	4194	
0528	027	080	4194	70	4196	4399	
0529	027	090	4399	60	4554	4556	
0530	027	100	4556	30	4554	4388	
0531	027	110	4388	25	9999	4604	
0532	027	120	4604	60	4901	4754	
0533	027	130	4754	25	4388	4440	
0534	027	140	4440	70	4292	4195	
0535	027	150	4195	60	4388	4490	
0536	027	160	4490	25	4604	4606	
0537	027	170	4606	70	4292	4245	
0538	027	180	4245	60	4604	4656	
0539	027	190	4656	82	4859	4388	
0540	027	200	4859	25	4242	4244	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0541	028	010	4244	60	4604	4806	
0542	028	020	4806	31	4909		
0543	028	030	4909	25	4901	4804	
0544	028	040	4804	87	4857	4807	
0545	028	050	4857	06	4260		
0546	028	060	4260	65	4565	4367	
0547	028	070	4367	50	4570	4522	
0548	028	080	4807	82	4857	4310	
0549	028	090	4310	05	4312	4364	
0550	028	100	4364	30	4066	4260	
0551	028	110	4522	17		4325	
0552	028	120	4325	60	4450	4854	
0553	028	130	4854	65	4455	4907	
0554	028	140	4907	31	4360		
0555	028	150	4360	25	4902	4957	
0556	028	160	4957	87	4460	4410	
0557	028	170	4460	06	4463		
0558	028	180	4463	65	4534	4186	
0559	028	190	4186	50	4539	4241	
0560	028	200	4410	82	4460	4513	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0561	029	010	4513	05	4312	4464	
0562	029	020	4464	30	4666	4463	
0563	029	030	4241	17		4294	
0564	029	040	4294	60	4418	4420	
0565	029	050	4420	65	4423	4375	
0566	029	060	4375	31	4128		
0567	029	070	4128	25	4903	4308	
0568	029	080	4308	87	4611	4661	
0569	029	090	4811	06	4514		
0570	029	100	4514	65	4503	4358	
0571	029	110	4358	50	4508	4510	
0572	029	120	4661	82	4611	4564	
0573	029	130	4564	05	4312	4614	
0574	029	140	4614	30	4666	4514	
0575	029	150	4510	17		4563	
0576	029	160	4563	60	4441	4543	
0577	029	170	4543	65	4446	4548	
0578	029	180	4548	31	4408		
0579	029	190	4408	25	4904	4458	
0580	029	200	4458	87	4362	4911	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0581	030	010	4362	06	4265		
0582	030	020	4265	65	4525	4227	
0583	030	030	4227	50	4530	4132	
0584	030	040	4911	82	4362	4914	
0585	030	050	4914	05	4312	4964	
0586	030	060	4964	30	4666	4265	
0587	030	070	4132	17		4335	
0588	030	080	4335	60	4409	4412	
0589	030	090	4412	65	4414	4417	
0590	030	100	4417	31	4470		
0591	030	110	4470	25	4905	4558	
0592	030	120	4558	87	4562	4512	
0593	030	130	4562	06	4315		
0594	030	140	4315	65	4494	4246	
0595	030	150	4246	50	4499	4958	
0596	030	160	4512	82	4562	4365	
0597	030	170	4365	05	4312	4415	
0598	030	180	4415	30	4666	4315	
0599	030	190	4956	17		4712	
0600	030	200	4712	60	4578	4180	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0601	031	010	4180	65	4583	4535	
0602	031	020	4535	26	4488		
0603	031	030	4488	60	4481	4433	
0604	031	040	4433	60	4486	4385	
0605	031	050	4385	11	4402	4589	
0606	031	060	4589	25	4283	4435	
0607	031	070	4435	70	4196	4449	
0608	031	080	4449	60	4283	4485	
0609	031	090	4485	25	4145	4297	
0610	031	100	4297	75	4283	4236	
0611	031	110	4236	31	4239		
0612	031	120	4239	87	4197	4342	
0613	031	130	4342	82	4197	4504	
0614	031	140	4590	67	4385	4110	
0615	031	150	4146	06	4549		
0616	031	160	4549	70	4292	4295	
0617	031	170	4295	32	400	4959	
0618	031	180	4959	70	4283	4286	
0619	031	190	4286	17		4289	
0620	031	200	4289	60	4481	4383	

MRA019C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0621	032	010	4383	65	4486	4438	
0622	032	020	4438	12		4291	
0623	032	030	4291	75	4283	4336	
0624	032	040	4336	37	400	4593	
0625	032	050	4593	70	4242	4345	
0626	032	060	4345	60	4554	4560	
0627	032	070	4560	26	4913		
0628	032	080	4913	60	4902	4910	
0629	032	090	4910	60	4903	4960	
0630	032	100	4960	60	4904	4812	
0631	032	110	4812	60	4905	4862	
0632	032	120	4862	25	4340	4392	
0633	032	130	4392	70	4283	4386	
0634	032	140	4386	60	4388	4556	
0635	032	150	4288	00	0004	0000	
0636	032	160	4037			5	
0637	032	170	4292	00	0001	0000	
0638	032	180	4196	00	0005	0000	
0639	032	190	4340	25	0000	4604	
0640	032	200	4242	60	4901	4754	

MRAU19C00

CARD NO	PAGE	LINE	A	OP	M	C	K
0641	033	010	4312	00	0000	0070	
0642	033	020	4666				
0643	033	030	4400				
0644	033	040	4405				
0645	033	050	4462				
0646	033	060	4467				
0647	033	070	0647	67	4002	4001	

PROGRAM LIBRARY SERVICES

UNIVAC®
Solid-State 80/90

RN501

RANDOM NUMBER GENERATOR ROUTINE

PURPOSE

RN501 is a Univac Solid State 90 or 80 routine designed to generate random numbers.

DESCRIPTION

RN501 generates 5 digit random numbers. Enter at memory location 1494 with the instruction to be executed upon exit in rA. The random number will be found in the first 5 digits of rA. The band level at time of exit from routine is 0196. The contents of registers A, X and L are destroyed by this routine. This routine must be entered each time a new random number is desired. The computer will stop after generating about 30,000,000 numbers. With proper modification, the routine may be made to generate 300,000,000 random numbers (see MODIFICATIONS).

PROGRAMMING PROCEDURES

Own Coding	Routine Coding	Remarks
a Op m c	a Op m c	
25 aaaa 1494		Enter at location 1494 with the next instruction in rA. Exit Band Level is 0196.
aaaa [Next Inst]		
	1494 [RN501 Inst]	

INPUT AND OUTPUT FORMAT

Output Format

Number Format	Location	Remarks
nnnnn00000	rA	nnnnn is a five digit random number.

TIMING REQUIREMENTS

The timing for this routine is 102 word times.

LENGTH

The routine uses 14 locations in bands 14, 44 and 46.

MODIFICATIONS

If it is desired to generate up to 300,000,000 random numbers, the following modifications must be made:

Page	Line	Location	Instruction
001	070	1543	001438907
001	130	4636	001438907

METHOD

The routine takes the initial number, 0040353607 (or 7^9) and multiplies this number with the constant, 0040353607; stores the ten least significant digits of the product (to replace the initial multiplicand for obtaining the next random number); and extracts the first five digits (of the ten least significant digits) as the first random number. The output random number appears in rA with five zeros following.

When entered subsequently, the routine multiplies the new multiplicand with the constant, 0040353607; stores the ten least significant digits of the product to replace the previous multiplicand in obtaining the next random number, and extracts the first five digits (of the ten least significant digits) as the output random number.

OPERATING PROCEDURES

Error Conditions:

If the computer stops with a 67 1538 0000, this indicates that this method would fail to produce any more random numbers. It is possible to produce additional random numbers by modifying the initial number and the constant (See MODIFICATIONS).

CODING

PAGE	LINE	a	Op	m	c	Key
001	01	1494	60	4596	1530	
001	02	1530	25	1532	1534	
001	03	1532	00	0000	0002	
001	04	1534	30	4636	1538	
001	05	1538	87	1542	1541	
001	06	1541	85	1543	1584	
001	07	1543	00	4035	3607	
001	08	1584	65	4636	1588	
001	09	1588	25	000T	1592	T = [1111]
001	10	1592	35	1594	4596	
001	11	1594	TT	TTT0	0000	T = [1111]
001	12	4636	00	4035	3607	
001	13	1542	67	1538	0000	

UNIVAC® SOLID-STATE COMPUTER - MEMORY CHART

PROGRAM:

BAND: 14			
1400 TO 1499		1500 TO 1599	
00	50	00	50
01	51	01	51
02	52	02	52
03	53	03	53
04	54	04	54
05	55	05	55
06	56	06	56
07	57	07	57
08	58	08	58
09	59	09	59
10	60	10	60
11	61	11	61
12	62	12	62
13	63	13	63
14	64	14	64
15	65	15	65
16	66	16	66
17	67	17	67
18	68	18	68
19	69	19	69
20	70	20	70
21	71	21	71
22	72	22	72
23	73	23	73
24	74	24	74
25	75	25	75
26	76	26	76
27	77	27	77
28	78	28	78
29	79	29	79
30	80	30 01-02	80
31	81	31	81
32	82	32 01-03	82
33	83	33	83
34	84	34 01-04	84 01-08
35	85	35	85
36	86	36	86
37	87	37	87
38	88	38 01-05	88 01-09
39	89	39	89
40	90	40	90
41	91	41 01-06	91
42	92	42 01-13	92 01-10
43	93	43 01-07	93
44	94 01-01	44	94 01-11
45	95	45	95
46	96	46	96
47	97	47	97
48	98	48	98
49	99	49	99

BAND: 44 & 46			
4500 TO 4599		4600 TO 4699	
00	50	00	50
01	51	01	51
02	52	02	52
03	53	03	53
04	54	04	54
05	55	05	55
06	56	06	56
07	57	07	57
08	58	08	58
09	59	09	59
10	60	10	60
11	61	11	61
12	62	12	62
13	63	13	63
14	64	14	64
15	65	15	65
16	66	16	66
17	67	17	67
18	68	18	68
19	69	19	69
20	70	20	70
21	71	21	71
22	72	22	72
23	73	23	73
24	74	24	74
25	75	25	75
26	76	26	76
27	77	27	77
28	78	28	78
29	79	29	79
30	80	30	80
31	81	31	81
32	82	32	82
33	83	33	83
34	84	34	84
35	85	35	85
36	86	36 01-12	86
37	87	37	87
38	88	38	88
39	89	39	89
40	90	40	90
41	91	41	91
42	92	42	92
43	93	43	93
44	94	44	94
45	95	45	95
46	96 01-01s	46	96
47	97	47	97
48	98	48	98
49	99	49	99

PROGRAM LOAD ROUTINE

PURPOSE

The LOD sub-routine loads the machine coded instruction decks which comprise the Linear Programming System for the Univac Solid-State 80.[1]

DESCRIPTION

LOD is a self-loading routine which will read all program phases (or segments of a phase) of the system. It is designed to process these cards at a maximum High-Speed Reader rate, segregating them to Stacker 0. LOD remains in memory throughout the running of each remaining phase of the program. Restart of any phase is facilitated by a transfer of control to LOD (at address 4800) when necessary. A transfer card follows the last active card of each segment and causes control to be transferred to the start of the segment just loaded. Thus, whenever a segment is completely loaded, the computation performed by the segment is automatically executed.[2] When the segment is completed, control is automatically returned to LOD which in turn reads the next segment.

INPUT FORMAT

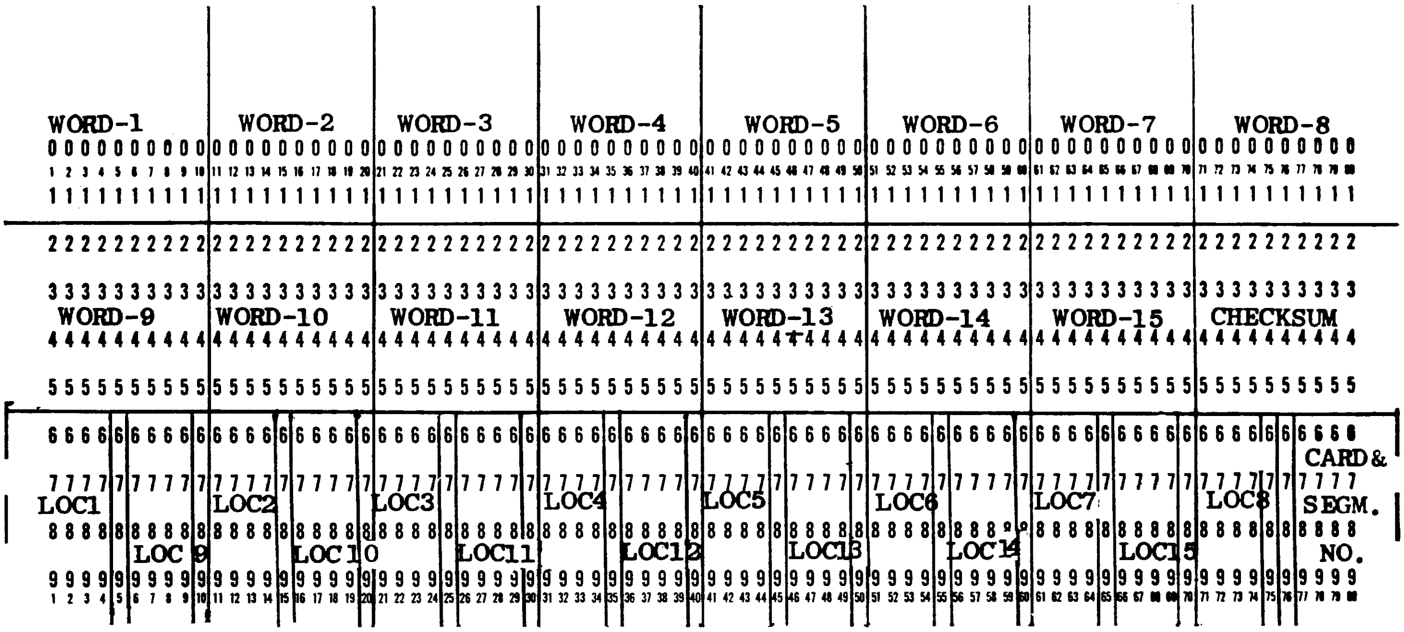
I. The input format of the program decks to be loaded is shown in the diagram on the following page. Each card contains 15 instruction (or constant) words and their corresponding locations. Each instruction word is of the form

Op mmmm cccc

---

[1] The Linear Programming System was developed by Bonner and Moore Engineering Associates under contract with Remington Rand Univac.

[2] To prevent loss of card images at time of transfer each segment is followed by two trailer cards.



and is punched in machine code, i.e. with 5-4-2-1 bits reading from top to bottom respectively, within the designated word field. Each location field includes a four-digit address and a sign column. Any punch in the sign column denotes a negative word.

Column 76 contains an 8 and 9 punch on all machine language cards; a checksum of all words on the card is included to be used in performing a validity check during reading; and the card and segment number is punched (in machine code) as described below.

II. The sub-routines comprising the Linear Programming System are as follows:

Sub-routine	Segment Number	Card Number
LOD	00[3]	00-10[3]
MATLOD	01	00-10[4]
SOLVE		
Delta J(1)	02	00-13[4]
Simplex (1)	03	01-31[4]
Delta J(2)	05	01-13[4]
Simplex (2)	08	01-31[4]
BASIS		
Phase I	09	00-11
Print	10	01-08[4]
Header	11	01-02[5]
Phase II	12	01-13[4]

[3]Segment and card numbers do not appear on these cards.

[4]These cards are followed by a transfer card and 2 trailer cards.

[5]These cards are followed by a transfer card and 1 trailer card.

Sub-routine	Segment Number	Card Number
SHADOW		
Phase I	13	00-11
Print	14	01-08[4]
Header	15	01-02[5]
Phase II	16	01-13[4]
PUNCH	17	00-12[4]
MATPR	18	00-18[4]
CHANGE		
Phase I	19	00-04[4]
Phase II	20	01-32[4]

OPERATING PROCEDURES

A. Normal Procedures.

Set paper in HSP with five spaces as top margin.

1. Place LOD, MATLOD, input matrix, and remaining phases of the Linear Programming System in the input magazine.
2. General Clear.
3. Set computer on one instruction.
4. Key 96 4600 4603 into rA.
5. Key 72 0000 0004/1 into rC.
6. Set next instruction at c.
7. Set computer on continuous.
8. Depress Run button to load LOD and start running the program.

B. Error Procedures (during running).

Error Indication	Explanation	Action
67 0000 4800	Off normal condition in the HSR.	Correct condition, reload from last acceptable stopping point, restart from 4800.

MATRIX LOAD ROUTINE

PURPOSE

The MATLOD sub-routine loads the matrix data for the Linear Programming System for the Univac Solid-State 80.[1]

DESCRIPTION

MATLOD loads the matrix data in either card code or machine code.[2] Data input for MATLOD consists of a Matrix Header Card, followed by cards defining the elements of the matrix. Matrix data cards punched in card code are segregated from the program cards by selecting output Stacker 1. Program cards will be segregated to Stacker 0.[3]

Location 4299 is the first location of the matrix area. The matrix is stored column-wise, starting from the first location and continuing toward the low-order end of the memory. This arrangement allows the most active column (the basis vector) to reside in high-speed access, thus improving the speed of solution. The first column of the matrix is the basis-variable-identification vector. The second column is the basis vector. The third column is the first vector of the structural matrix, etc.. The last element of each column is followed by the first element of the next column.

MATLOD loads the Matrix Header Card, clears the entire matrix area to zeros, and then loads the Matrix Cards. Only non-zero elements of the matrix need to be entered.

---

[1]The Linear Programming System was developed by Bonner and Moore Engineering Associates under contract with Remington Rand Univac.

[2]Machine code matrix data is produced by the PUNCH sub-routine of the Linear Programming System.

[3]Machine code data cards will fall into Stacker 0 together with the program. In this case only the Header Card is segregated to output Stacker 1.

INPUT FORMAT

1. Indexing

   In addition to the m x n structural matrix, two additional rows and columns are required.[4] Each variable has a four digit identification and a five digit cost combined into a single word in the form iiii0ccccc. One row and one column are used to store these identification-cost complexes.

   The basis vector and the shadow price vector require one column and one row, respectively. The maximum input matrix is $(m+2)\times(n+2)\leq 4300$.

   Each column is referred to by a three digit index, starting with 000. The basis variable-identification vector is indexed by 000; the basis vector by 001; etc. With a three digit index, the largest number of columns is 1000, which means that 998 is the maximum number of structural variables that can be handled by the program.

   Row indexing follows the same system as that for columns. The first row, the non-basis-variable-identification vector is indexed by 000. The shadow price vector, indexed by 001, is the second row. The first row of the structural matrix is the third row of the stored matrix and has the index 002. As before, the three digit index limits the number of constraints to 998 or less.

   The location of any element of the matrix can be defined by its row and column indices. For example, the first element of the basis vector has 002001 as its row-column index.

   In preparing the initial matrix, each element is supplied with the appropriate symbolic matrix location in terms of row-column indices. The initial basis-variable-identifications will have a column index of 000. The initial non-basis variable-identification will have a row index 000. Since the shadow price vector is computed by the program, it is unnecessary to enter these elements with the initial matrix. Thus, there should be no matrix elements with 001 as their row indices.

2. Variable Identification and Objective Function Coefficients

   In order to conserve memory, these two factors are combined and stored as a single 10 digit element.[5] In addition to the stored matrix indices, each variable may be identified

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[4] A sample of the standard Simplex Tableau and the version required by this program is on page 6.

[5] A similar procedure is to be followed for the basis identification-cost complex.

by a combination of four digits. Each variable should be uniquely identified to avoid confusion. This four digit identification is placed in the most significant digits of the words comprising the identification-cost complex.

If the variable has a non-zero objective function coefficient, it is added to the identification as a five digit number, with the implied decimal point three places to the left. This limits the coefficients to the range ±99.999. These five digit coefficients are placed in the least significant digit positions of the words comprising the identification-cost complex.

The sign of this 10-digit word applies to the objective function coefficient. The form of these elements is iiii0ccccc±.

3. Structural Matrix Elements and Scaling

The arithmetic used in this program assumes that the decimal point lies four places to the right of each 10-digit word (i.e. 0123456789 = 123.456789). This limits the range of the matrix element within ± 9999.999999.

Since the calculations are done in fixed point mode, scaling of the matrix elements is of prime importance. After formulating the problem to be solved, rows and/or columns should be multiplied by appropriate powers of 10 to bring the magnitude of each element as close to unity as possible. As problem size increases, scaling becomes increasingly important. A record of the scaling factor applied to each row and column of the matrix should be maintained in order to properly interpret the output of the program.

4. Matrix Header Card[6]

The Matrix Header Card supplies the program with the matrix dimensions and problem identification. The format is as follows:

Columns	Information	Explanation
1-10	Optional	Problem Identification. Any ten alphanumeric and special characters are permissible.

[6] A sample of a pre-printed matrix input form appears on Page 7. Such a form may be used to prepare data for key punching.

Columns	Information	Explanation
11	0 (zero)	
12-14	mmm	The number of rows of the matrix ($001 \leq mmm \leq 998$).
15	0 (zero)	
16-18	nnn	The number of columns of the matrix ($001 \leq nnn \leq 998$).
19-20	00 (zeros)	
21-80	Optional	Available to user.

5. Matrix Cards

The Matrix Cards have the following format when punched in card code:

Columns	Information	Explanation
1-4	Optional	Available to user.
5-7	mmm	Row Index
8-10	nnn	Column Index
11-20	iiiiOccccc or eeeeeeeeee	Identification-cost or Matrix Element
21	Blank or 11-punch.	Sign of word with 11-punch for negative.
22-80	Optional	Available to user.

OPERATING PROCEDURES

A. Normal Procedures.

1. Place the Matrix Header Card immediately following the trailer cards of the MATLOD deck.
2. Place the Matrix Cards immediately following the Header Card.
3. MATLOD will be loaded by LOD automatically. MATLOD will in turn load the matrix, after clearing the matrix area to zero, and return control to LOD.

B. Error Procedures (during running)

Error Indication	Explanation	Action
67 1001 4800	No m and n specified on Matrix Header Card.	Correct Matrix Header Card, reload MATLOD and data cards and restart at c.
67 1002 4800	(m+2)x(n+2)>4300	Correct row and/or column counts (may require reformulation of problem), re-load MATLOD and data cards and restart at c.
67 1003 4651	Off-normal on HSR.	Correct condition, reload last three cards from Stacker 1, and restart at c.
67 1100 4800	Row-Column Index in error.	Correct invalid Row-Column Index (third from top of Stacker 1), reload MATLOD and data cards and restart at c.

NOTE: Questions concerning this routine should be directed to Manager, Program Library Services, Remington Rand Univac, 315 Park Avenue South, New York 10, N. Y.

Date: 12/30/60

SAMPLE PROBLEM

Original Matrix: (Simplex Tableau)

C_i of basis	Basis	C_j:	0	-M	-5	0	38	4	8
		Vector:	B	A_1	A_2	A_3	A_4	A_5	A_6
-M	A_1		10	1	0	0	1	0	2
-5	A_2		14	0	1	0	-5	-7	2
0	A_3		4	0	0	1	1	6	-4

Revised Matrix: (Tableau Less Identity Matrix)

C_i of basis	Basis	C_j:	0	38.0	4.0	8.0
		Vector:	0003	0004	0005	0006
-100[1]	0001		1.0[2]	1		2
- 5	0002		1.4	-5	-7	2
0	0003		.4	1	6	-4

[1]A high negative value is arbitrary assigned to M.

[2]Vector is scaled to approximate unity.

Final Form of Input Matrix: (Showing Row and Column Indices)

0	1	2	3	4	
0000000000+	0000000000+	0004038000+	0005004000+	0006008000+	0
0000000000+	0000000000+	0000000000+	0000000000+	0000000000+	1
0001100000-	0001000000+	0001000000+	0000000000+	0002000000+	2
0002005000-	0001400000+	0005000000-	0007000000-	0002000000+	3
0003000000+	0000400000+	0001000000+	0006000000+	0004000000-	4

UNIVAC SOLID STATE 80

LINEAR PROGRAMMING INPUT

CARD COLUMN	1 - 10	11	12 - 14	15	16 - 18	19.20
HEADER CARD	PROBLEM IDENTIFICATION		m		n	
		0		0		0 0

CARD COLUMN	1 - 4	5 - 7	8 - 10	11 - 20	21
DETAIL CARD	CARD ID	i	j	I I I I 0 c c.c c c or	SIGN

UNIVAC Solid-State 80 Linear Programming

SOLVE

PROGRAM LIBRARY SERVICES

MATRIX SOLUTION

PURPOSE

SOLVE, a sub-routine of the Linear Programming System for the Univac Solid-State 80, provides a solution to a Direct, Dual or Composite simplex problem.[1]

DESCRIPTION

One of the outstanding features of this Linear Programming system is its ability to handle Composite problems. The program does not, however, contain a Composite algorithm per se. Instead, a Composite problem is automatically perturbed and solved as a non-feasible optimal problem (Dual Simplex). The perturbation is removed, producing a feasible non-optimal (Primal) status which is then optimized, effecting the solution of the Composite problem. To accomplish this two-step mechanism, two identical solution programs comprise the SOLVE phase. Should the problem be either Direct or Dual (as originally formulated), the first half of SOLVE is sufficient to provide a solution. The second half of SOLVE in these latter cases, is not active and is merely read into the computer without being executed. In these instances, it is not necessary to make any changes to the program. The type of problem being solved is determined by the program and all necessary action follows automatically.

The solution technique employed is a modification of the basic Simplex Algorithm. It includes the substitution of program logic in place of storing the identity matrix associated with the basic variables. The Dickson-Frederick selection algorithm has been incorporated in the place of the usual "minimum shadow price" rule for choosing the variable to enter the basis (on Direct problems).

Each of the identical halves of SOLVE is composed of two segments. The first of these performs the calculating of initial shadow prices and certain constants used by the second

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[1]The Linear Programming System was developed by Bonner and Moore Engineering Associates under contract with Remington Rand Univac.

segment. In doing so, the type of problem (Direct, Dual or Composite) is determined, and the sequence of operations to be performed on that type of problem is fixed. In the case of a Composite, the problem is perturbed to a Dual type for the first half of SOLVE. When the first segment of the second half is executed, the perturbation is removed to produce a Direct model. When the initial problem is Direct or Dual in nature, the second half is inactive except for sensing of this fact.

The second segment of each half of SOLVE contains the solution algorithm. Whether it proceeds in Direct or Dual Simplex mode is determined by the first segment. At the conclusion of each iteration, a line is printed on the High-Speed Printer which records pertinent information concerning that iteration.[2] Appearing from left to right are the following quantities:

1. Problem identification.
2. Iteration number.
3. Current objective function value.
4. Identification-cost complex of the variable which left the basis.
5. Identification-cost complex of the variable which entered the basis.
6. The pivot element for the iteration.

Each of these six quantities is printed as a full 10-digit number. Only the objective function and pivot element will show a negative sign if needed. All others are printed without sign indicated. If the problem identification is alphanumeric, it will appear as such.

Near-Zero and Minimum-Pivot Tolerances

The program is provided with two parameters which can have an effect on the accuracy of the solution and even, in extreme cases, make the difference between obtaining a solution and not obtaining one.

The most important of these is the "Near-Zero" tolerance. Every number which is stored as a matrix element during the solution phase, must be of greater magnitude than 0.0002. If it is not, a zero is stored in its place. If any number is less than this tolerance, it is considered to be zero and has resulted from rounding-error build up.

The other tolerance, "Minimum-Pivot" tolerance, is associated with the selection of the variable to leave and enter the basis. The purpose of restricting the lower limit of pivot magnitude is to prevent iterating with very small pivots, which can lead to overflow and/or inaccurate results.

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[2] See page 7 for sample HSP listing.

After selecting a pair of variables for a given iteration, the pivot magnitude is compared to the Minimum-Pivot tolerance. The value for this parameter is 0.005. Should the pivot be smaller, a selection of the next-best pair of variables is initiated, and so on until an acceptable pivot is found. If no acceptable pivot exists, a recognizable halt will occur (see Error Procedures).

In the case of Direct and Dual problems, the effect of this false termination would be to produce a psuedo unbounded or infeasible solution. Such cases can be readily recognized by the presence of negative shadow prices or activities, respectively. Composite problems, where a false termination takes place during the first phase of solution, will most likely overflow during the second phase. The probability of false termination is however, extremely small.

Degeneracy

When selecting the variable to leave the basis (Direct mode) a tie for minimum ratio is broken by picking the ratio resulting from the largest denominator. If the denominators are also equal, the program chooses the last of the tied ratios to be developed.

Overflow during running.

When overflow occurs and data or scaling cannot be shown to be the cause, solution path is most often the cause. Changing the solution path will almost always get around such difficulties. Perturbing either the basis or objective function will change the solution path. If, for example, it is known that a certain variable is very likely to appear in the basis at solution, its objective function coefficient can be set as some arbitrary, but large positive value, thus, forcing the variable into the basis and holding it there. The solution with this perturbation may not be the same as without it, but the true solution can be obtained by a post-optimal change to remove the perturbation.

Problems which have highly degenerate initial bases can cause overflow. Perturbing the original basis to remove some or all of the zero elements will, in most instances, eliminate an overflow which occurred on the unperturbed problem. Again the solution of the perturbed problems must be changed by post-optimal manipulation to produce a true solution. In addition, problems with degenerate bases can often be solved more efficiently as perturbed problems. Removing original degeneracy can be used to reduce solution time by reducing the number of iterations required to reach optimality. The size of the perturbation should not be so large as to drastically distort the model. Constants, ranging in value from 0.1 to 0.4 may be used, although smaller values may serve as well. However, very small perturbations may not produce the desired effects.

OPERATING PROCEDURES

A. Normal Procedures

Load SOLVE immediately following matrix data cards.

B. Error Procedures (during running)

Error Indication	Explanation	Action
67 0010 4800	Overflow on $\Sigma c_i a_{ij}$	Discontinue run, check data for errors and scaling.
67 0002 4800	Overflow on ADDa_{ij}	Same as above.
67 0001 4800	Overflow on MPYa_{rj}	Same as above.
67 0001 0001	Unbounded Direct Solution.	Discontinue run, check for data errors (may require reformulation of problem).
67 0002 0001	Unbounded Dual Solution.	Same as above.
67 0003 0001	Unbounded Composite Solution.	Same as above.
67 0003 4394	Printer off normal.	Correct condition select "c" address and start.
67 0004 4303	Printer off normal.	Same as above.
67 0005 4777	False termination - no acceptable pivot.	Initiate card reading for next program block by selecting "c" address and starting.[3]

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[3] If it is desired to reduce the magnitude of the Minimum-Pivot tolerance and initiate another search, store the desired tolerance in location 4675 and restart by transfer to 4700. Although such action may be successful, reducing this tolerance to very small magnitude will lead to overflow and/or gross inaccuracies. Problem scaling and structuring or changing the solution path is recommended as a better way to avoid this trouble.

NOTE: Questions concerning this routine should be directed to Manager, Program Library Services, Remington Rand Univac, 315 Park Avenue South, New York 10, N. Y.

Date: 12/30/60

Sample of Iteration Printing

BIGPROB 00	0000000001	0000642600	5100010000	0109000000	0001000000
BIGPROB 00	0000000002	0000642600	7203000000	0209000000	0000300000
BIGPROB 00	0000000003	0000642600	5200010000	0207000000	0016666670
BIGPROB 00	0000000004	0000642600	7403000000	0409000000	0000300000
BIGPROB 00	0000000005	0000642600	5400010000	0405000000	0014333336
BIGPROB 00	0000000006	0000642600	7321000000	0309000000	0000500000
BIGPROB 00	0000000007	0000642600	7302000000	0305000000	0007050000
BIGPROB 00	0000000008	0000642600	5300010000	7321000000	0001120567
BIGPROB 00	0000000009	0014585710	1009000000	6000004376	0000925848
BIGPROB 00	0000000010	0039702104	0409000000	0410000000	0000356971
BIGPROB 00	0000000011	0045364067	1010000000	0219000068	0001981484
BIGPROB 00	0000000012	0069244443	1007000000	0413000000	0000076093
BIGPROB 00	0000000013	0073157082	1013000000	0202000000	0021026902
BIGPROB 00	0000000014	0080272724	7211000000	7403000000	0000061369
BIGPROB 00	0000000015	0089197826	8101000000	0102000000	0001753465
BIGPROB 00	0000000016	0095771503	1005000000	0319000068	0004980598
BIGPROB 00	0000000017	0101003320	8321000000	0402000000	0000156985
BIGPROB 00	0000000018	0102821364	1002000000	0119000068	0005196286
BIGPROB 00	0000000019	0104630148	7113000000	0419000068	0000154970
BIGPROB 00	0000000020	0108527740	0202000000	0201000000	0001175609
BIGPROB 00	0000000021	0111533334	1040000000	7203000000	0000979050

PROGRAM LIBRARY SERVICES

UNIVAC
Solid-State 80
Linear Programming
BASIS

BASIS ACTIVITY ROUTINE

PURPOSE

BASIS, a sub-routine of the Linear Programming System for the Univac Solid-State 80, interprets the basis and lists the activities of each basis variable at solution. In addition, it develops the range of optimality for each of these variables.[1]

DESCRIPTION

BASIS consists of two segments. The first segment builds a list of the basis-variable identifications which is then sorted into numerical sequence. Certain constants and addresses are developed for use in the second segment. It also prints on the High-Speed Printer a heading line which identifies the problem, indicates the "m" and "n" dimensions, the number of iterations and the final value of the objective function.[2] The heading line is followed by a second line which identifies each column of the array printed by the second segment.

The second segment does the actual analysis. The sorted list, prepared by the first segment, is used to control the output of the analysis of each variable in ascending order of identification. Information pertaining to a variable appears on a single line. The following items are shown:

1. Variable identification (IDENT).
2. Objective function coefficient (COST).
3. Activity.
4. Shadow price.
5. Limits on range of optimality (RANGE 1).
6. Limits on range of optimality (RANGE 2).

No entries will appear in the shadow price column since basis variables have zero shadow prices by definition.

---

[1]The Linear Programming System was developed by Bonner and Moore Associates under contract with Remington Rand Univac.

[2]See page 5 for sample HSP listing.

The range of optimality is presented as two increments which indicate the limits of this range. They define the variations in the objective function coefficient which can occur without destroying optimality. In other words, this range provides a measure of the sensitivity of the solution to changes in the objective function coefficient of a given variable. If the objective function coefficient were changed by more than either of these increments, the solution would not be optimal.

Since these ranges are increments, the absolute range can be obtained by adding RANGE 1 and RANGE 2 to the objective function coefficient of the variable in question. In cases where there is no limit, the particular range will appear as 9999.999999 with the proper sign. With an infinitely large range, no change would be great enough to affect the activity.

OPERATING PROCEDURES

A. Normal Procedures

Load BASIS immediately following SOLVE or SHADOW.

B. Error Procedures (during running).

Error Indication	Explanation	Action
67 5001 4799	HSP off normal.	Correct condition, select c, and depress Run button.
67 5001 4796	HSP off normal.	Same as above.
67 7000 4800	HSP off normal.	Reload last three program cards, select c, and depress Run button.
67 7777 4503	More than 99[3] identifications.	Restarting at 4503 results in printing only the first 99 variables or constraints.

[3]Although the solution phase is equipped to handle matrices with more than 99 rows or columns, the interpretations can handle no more than 99.

NOTE: Questions concerning this routine should be directed to Manager, Program Library Services, Remington Rand Univac, 315 Park Avenue South, New York 10, N. Y.

Date: 12/30/60

Sample of BASIS Output

BIGPROB 00		116.785781	44	43	34	BIGPROB 00
IDENT	COST	ACTIVITY	SHADOW PRICE	RANGE 1	RANGE 2	BIGPROB 00
101	.	.259163		.046177-	16.568114	BIGPROB 00
109	.	.858949		.001812-	2.264726	BIGPROB 00
201	.	1.023747		.015640-	.000126	BIGPROB 00
207	.	.174226		.000126-	.016134	BIGPROB 00
223	. 35-	4.123334		.015297-	2.324264	BIGPROB 00
301	.	.689005		.094183-	.046296	BIGPROB 00
305	.	.182078		81.036125-	.132823	BIGPROB 00
309	.	2.089478		.311611-	.001812	BIGPROB 00
310	.	.679941		.001744-	.299860	BIGPROB 00
401	.	.500558		.000126-	.015643	BIGPROB 00
402	.	1.598404		.006737-	50.167785	BIGPROB 00
404	.	.028422		.017222-	1.618559	BIGPROB 00
405	.	4.578082		.132819-	81.303130	BIGPROB 00
407	.	.205773		.016134-	.000126	BIGPROB 00
410	.	5.400055		.014950-	.069770	BIGPROB 00
413	.	3.440000		.015912-	9999.999999	BIGPROB 00
423	. 35-	2.172751		.046761-	.015289	BIGPROB 00
1025	2.140	.151076		80.732733-	3.988604	BIGPROB 00

PROGRAM LIBRARY SERVICES

UNIVAC Solid-State 80
Linear Programming
SHADOW

SHADOW PRICE ROUTINE

PURPOSE

SHADOW, a sub-routine of the Linear Programming System for the Univac Solid-State 80, interprets the shadow price of each non-basis variable and develops its range of feasibility.[1]

DESCRIPTION

SHADOW consists of two segments. The first segment builds a list of the non-basis-variable identifications which is then sorted into numerical sequence. Certain constants and addresses are developed for use in the segment. It also prints on the High-Speed Printer a heading line which identifies the problem, indicates the "m" and "n" dimensions, the number of iterations and the final value of the objective funtion.[2]

The second segment does the actual analysis. The sorted list, prepared by the first segment, is used to control the output of the analysis of each variable in ascending order of identification. Information pertaining to a variable appears on a single line. The following items are shown:

1. Variable identification (IDENT).
2. Objective function coefficient (COST).
3. Activity
4. Shadow price.
5. Limits on range of feasibility (RANGE 1).
6. Limits on range of feasibility (RANGE 2).

Since non-basis variables are at zero activity, this entry is left blank.

---

[1] The Linear Programming System was developed by Bonner and Moore Engineering Associates under contract with Remington Rand Univac.

[2] See page 5 for sample HSP listing.

The range of feasibility is presented as two increments which define the limits of this range. They reflect the variation in activity level which could occur without destroying feasibility. In other words, this range indicates the limit of deviation from the optimal solution involving the variable in question. A greater deviation would violate some constraint of the model, and produce an infeasibility. Infinite limits are shown as plus or minus 9999.999999.

OPERATING PROCEDURES

A. Normal Procedures

Load SHADOW immediately following SOLVE or BASIS.

B. Error Procedures (during running).

Error Indication	Explanation	Action
67 5001 4799	HSP off normal.	Correct condition, select c, and depress Run button.
67 5001 4796	HSP off normal.	Same as above.
67 8000 4800	HSP off normal.	Reload last three program cards, select c, and depress Run button.
67 7777 4503	More than 99 identifications.[3]	Restarting at 4503 results in printing the first 99 variables or constraints.[3]

C. Optional Procedure

Due to the fact that the objective function cost and shadow prices are iterated in the same manner as all other rows of the matrix, there is a possibility that the objective function cost in the solution printout may be affected by round-off. Greater accuracy, although with subsequent sacrifice of time, may be obtained by recalculating with the following procedure:

1. General Clear.
2. Set on one instruction.
3. Key 00 0003 0000 into rA.
4. Key 60 4476 4476 into rC.
5. Depress Run button. The contents of location 4476 will be changed to 00 0003 0000 and this will be displayed in rC.

---

[3]Although the solution phase is equipped to handle matrices with more than 99 rows or columns, the interpretations can handle no more than 99.

6. Place SOLVE, BASIS, and SHADOW in the input magazine.
7. Key 00 0000 4800 into rC.
8. Set next instruction at c.
9. Set computer on continuous.
10. Depress Run button.

A new solution printout with objective function cost and shadow prices recalculated will be obtained.

NOTE: Question conerning this routine should be directed to Manager, Program Library Services, Remington Rand Univac, 315 Park Avenue South, New York 10, N. Y.

Date: 12/30/60

Sample of SHADOW Output

BIGPROB 00		116.785781	44	43	34	
IDENT	COST	ACTIVITY	SHADOW PRICE	RANGE 1	RANGE 2	BIGPROB 00
102	.		.077087	.332931-	.281892	BIGPROB 00
110	.		.001744	1.413428-	.679849	BIGPROB 00
113	.		.332025	.226550-	.191820	BIGPROB 00
117	. 83-		.681956	.067528-	.196529	BIGPROB 00
119	. 68-		.072737	.221637-	.187660	BIGPROB 00
122	. 53-		.190385	.273794-	.231821	BIGPROB 00
202	.		.006737	.731985-	.866882	BIGPROB 00
204	.		.017220	.043195-	.028425	BIGPROB 00
209	.		.326963	.181619-	.214503	BIGPROB 00
210	.		.014950	.188030-	.222074	BIGPROB 00
213	.		.015912	2.110951-	2.932910	BIGPROB 00
219	. 68-		.064615	2.749228-	2.270353	BIGPROB 00
222	. 53-		.100237	.665683-	1.046068	BIGPROB 00
302	.		.051615	.305674-	.258814	BIGPROB 00
313	.		.333012	.227028-	.192224	BIGPROB 00
317	. 83-		.681156	.067536-	.196928	BIGPROB 00
319	. 68-		.072230	.221270-	.187349	BIGPROB 00
322	. 53-		.189946	.273284-	.231389	BIGPROB 00
409	.		.311621	.446849-	.378347	BIGPROB 00
419	. 68-		.049351	.492283-	.416816	BIGPROB 00
422	. 53-		.084846	.665418-	2.043219	BIGPROB 00

UNIVAC
Solid-State 80
Linear Programming
PUNCH

PROGRAM LIBRARY SERVICES

PUNCH ROUTINE

PURPOSE

PUNCH, a sub-routine of the Linear Programming System for the Univac Solid-State 80, records the solution matrix on blank cards in the Read Punch Unit.[1]

DESCRIPTION

PUNCH makes it possible to save the solution matrix, its identification, and its size by producing a deck of reloadable cards containing the non-zero matrix elements and their locations in memory.

Prior to punching the matrix itself, PUNCH reproduces a Matrix Header Card for this matrix. The header will be identical to the original header. It contains a problem identification and the row and column counts, "m" and "n" all in card code.

The matrix cards are punched in machine code, six-per-card. Only the non-zero matrix elements are punched. The "a" address for each element is also punched in machine code. The format of these cards is the same as that for the fifteen word program cards. A checksum is accumulated and punched on the cards.[2] This is checked by the PUNCH routine after punching takes place.

The punched matrix with its header card can be loaded, using MATLØD, in the same manner as an original matrix. However, any blank cards produced before or after the punched matrix should be removed before loading. Punching a matrix does not destroy the matrix or any of the pertinent constants. Thus, a matrix can be solved and punched to preserve the initial solution as a base case for several different avenues of exploration.

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[1] The Linear Programming System was developed by Bonner and Moore Associates under contract with Remington Rand Univac.

[2] See page 2, LØD, U 2287.12.

OPERATING PROCEDURES

A. Normal Procedures.

Load PUNCH following SOLVE, BASIS, or SHADOW.

B. Error Procedures (during running).

Error Condition	Explanation	Action
67 6000 4800	Checksum mismatch.	Reload PUNCH, select c, and depress Run button.
67 9001 4782	RPU off normal.	Correct condition, select c, and depress Run button.
67 9002 4698	RPU off normal.	Same as above.

NOTE: Questions concerning this routine should be directed to Manager, Program Library Services, Remington Rand Univac, 315 Park Avenue South, New York 10, N. Y.

Date: 12/30/60

MATRIX CHANGE

PURPOSE

CHANGE, a subroutine of the Linear Programming System for the Univac Solid-State 80, provides a means of changing the elements of the current solution matrix without changing the original input.[1]

DESCRIPTION

With the exception of variable identifications, any element of a matrix can be changed from its original value. All such changes can be made on the current solution matrix, e.g. an original objective function coefficient may be revised to another value after a solution to the original problem has been obtained without changing the original input card and starting over. Making such a change to an optimal matrix and reoptimizing is much more efficient than resolving from the original matrix. Of course, if there are a great number of such changes, then at some point it becomes practical to restate the problem.

Modification of Original Basis

There are three categories of changes which can be handled by CHANGE. The first of these is a modification of an original basis element. This is done by specifying an original basis variable identification and the increment to be added. The increment can be positive or negative; the variable does not have to be currently in the basis. The function of this type of change is to allow post-optimal adjustment of an original stipulation (e.g. increasing a capacity limit on a process unit represented in a refinery simulation model).

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[1] The Linear Programming System was developed by Bonner and Moore Associates under contract with Remington Rand Univac.

Cost Change

The second category of changes is the revision of an objective function coefficient. In this case, the change is one of replacing the previous coefficient with a new one, rather than adjusting the original. Since these coefficients are carried as the low-order five digits of the identification-cost complex, the change is effected by a simple search-and-overlay routine. The only information needed is the variable identification and the new objective function coefficient.

Modification of Structural Matrix

The third category of changes is the modification of an element of the original structural matrix. Identification of such an element requires naming two variables, one an original basis variable, and the other an original non-basis variable. The intersection of the row and column, thus defined, locates the element to be changed.

At solution there are four possible conditions that pertain to a matrix element:

1. The variables at whose intersection it lies are in their original status, namely, the original basis variable is currently in the basis set and the original non-basis variable is currently non-basic.

2. The variables in question are currently both non-basic.

3. The variables in question are both currently in the basis set, and

4. The variables in question are in reverse relationship to their original status.

From a computational standpoint, the last of these four situations is the worst. The matrix algebra required to modify an element of the original structural matrix in such a case, is equivalent to an iteration in the solution algorithm. For this reason, such an operation will require processing time which varies with the kind of matrix algebra being performed. Thus, data cards may not be handled at a uniform rate.

For an element in status 1, the application of an increment amounts to a simple addition to the original structural matrix element in question. The application of such a change to an element whose variables are both non-basic (Status 2) requires the vector addition of the original basis variable vector times the increment, to the original non-basis variable vector. This latter operation can be recognized as the same type of vector combination as that used in an operation involving a modification of an original basis element where the variable is not in the basis. The modification of an original basis element is a special case of the modification of an element of the original structural matrix.

Clearing the Basis

An additional option available with CHANGE is the clearing of the basis vector to zero. There are times when a completely new basis is to be imposed on an already-formulated model. In such cases, it is easier to introduce the new basis elements, rather than to modify the existing basis. With the basis elements all set to zero, this becomes a matter of making each increment of the original basis the full value of each new basis element.

Input Data

Data cards for this routine are placed immediately following the last program card of CHANGE (the second "trailer" card). They may be inserted in any desired order. The routine segregates data cards from program cards by selecting output Stacker 1 for data cards.

The normal operation to follow any changes will be SOLVE; thus, SOLVE may be stacked on top of the last data card for CHANGE. If no program is placed in the input hopper to follow CHANGE, a program stop will occur after the last data card has been processed. If program cards follow the last data card, the first program card read will be recognized as such and continuous loading will proceed.

All changes must reflect the same scaling that applied to the original matrix. The ten digit field for entering the factor has the same decimal placement as used in the rest of the system. Since objective function coefficients are carried as five digit numbers, with three places to the right of the implied decimal, making changes with more than three figures to the right or two figures to the left of the implied decimal point in the factor will not give the desired results. During a cost change operation the factor is truncated at both the low and high order end. Note that a new cost is entered in the form 00xx.xxx000, not 00000xx.xxx. The shifting required to insert a new cost is handled automatically by the program.

An erroneous or mispunched identification will cause the program to halt. If this occurs, the last card in Stacker 1 contains the error. Since CHANGE reads cards one at a time, only the top card of Stacker 1 should be reread.

Output Indication

One print line will be printed for each data card which is successfully processed by CHANGE. This record lists the problem identification and the first 30 columns of the card just processed. These four ten-digit fields will appear in print words 1, 3, 5, and 7. If the card is a cost change card, the old identification-cost complex will also be listed and will appear in print word 10.

Problem Identification

Each time this routine is used, the problem identification is incremented by one in the low-order position. Because of this feature, it is necessary that the two low-order positions of the identification (Matrix Header Card) be set to zero or some other numeric value.[2] This feature serves to provide a distinctive identification for sub-cases run on a given model.

INPUT FORMAT

All three types of changes, as well as clearing the basis, utilize the same data card format:

Columns	Information	Explanation
1-6	Optional	Available to user.
7-10	iiii	Identification of variable in question.[3]
11-20	xxxx.xxxxxx	Factor, increment, or modification.
21	Δ or 11-punch	Sign of factor (11-punch for negative).
22	1, 2, 3, or 9	Type of operation to be performed: 1=original basis modification. 2=cost change 3=structural matrix modification. 9=clear basis.[4]

---

[2]See MATLOD U 2287.3 for discussion of Matrix Header Card.

[3]In the case of modification of element of the original structural matrix, this is the <u>original basis</u> variable identification.

[4]A card which clears the basis vector needs only a "9" in column 22; the rest of the card is not interrogated by the program.

Columns	Information	Explanation
23-26	iiii or ΔΔΔΔ	Identification of original non-basis variable, used only with Type 3 cards.
27-80	Optional	Available to user.

OPERATING PROCEDURES

A. Normal Procedures

1. For use immediately following solution when final matrix remains in memory:

   a. Place CHANGE immediately following the last segment used (e.g., after SOLVE, BASIS, or SHADOW).

   b. Place CHANGE data cards immediately following the trailer cards of CHANGE.

   c. Place SOLVE and any other desired segments in the input hopper.

2. For use in making changes when final matrix has been punched on cards via PUNCH:

   a. Load punched matrix cards with MATLOD.

   b. Place CHANGE immediately following matrix cards.

   c. Repeat steps 1b and 1c above.

B. Error Procedures (during running)

Error Indication	Explanation	Action
67 2000 4543	Printer off normal.	Correct condition, select "c" address and depress Run button.
67 2001 4552	Printer off normal.	Same as above.
67 2001 4503	Printer off normal.	Same as above.
67 2002 4503	Change type other than 1, 2, 3, or 9.	Correct Column 22 of last card in Stacker 1, reload corrected card, select "c" address and depress Run button.

Error Indication	Explanation	Action
67 2003 4503	No such variable identification.	Correct either columns 7-10 or 23-26 of last card in Stacker 1, reload corrected card, select "c" address, and depress Run button.
67 2004 4800	Overflow during matrix adjustment.	If due to data error, matrix must be reloaded before corrected card is processed.[5]
67 2005 4556	Printer off normal.	Correct condition, select "c" addres, and depress Run button.
67 2006 4503	Overflow on structural matrix modification (Status 4).	If due to data error, correct card, reload select "c" address, and depress Run button.[6]
67 2007 4503	$1+\Delta A_{kr}=0$, where A_{ij} denotes an element of the structural matrix (Status 4).[7]	Select "c" address and depress Run button.
67 2008 4800	Overflow during updating of a change in the structural matrix.	See 67 2004 4800 above.

NOTE: Questions concerning this routine should be directed to Manager, Program Library Services, Remington Rand Univac, 315 Park Avenue South, New York 10, N. Y.

Date: 12/30/60

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[5]Should the data card be without error, some type of more drastic correction action will be necessary. See SOLVE, U 2287.14.

[6]If data is not in error, reprocessing of card may be possible after other changes. If this error is persistent, the problem may require reformulation. See SOLVE, U 2287.14.

[7]The modification in question is attempting to change the problem as if an original non-zero element were changed to zero. This is the same as attempting the inversion of a singular matrix.

MATRIX LISTING

PURPOSE

MATPR, a subroutine of the Linear Programming System for the Univac Solid-State 80, provides a complete High-Speed Printer listing of the current matrix without destroying the matrix or any of the pertinent constants.[1]

DESCRIPTION

Each page of the matrix listing contains up to six columns. For matrices containing 53 rows or less, the first six columns of the current matrix are listed on the first page, the next six columns on the second page, and so on. If the matrix contains more than 53 rows, then rows after the 53rd will appear on the succeeding page. A sample listing for the first six columns of a matrix containing 17 rows is presented on page 3.

All non-zero elements appear with a decimal point six digits from the right. Negative elements are indicated with trailing minus signs. Zero elements are replaced with blanks in the print line.

OPERATING PROCEDURES

A. Normal Procedure

Place MATPR immediately following that phase of the system for which the current matrix listing is desired.

B. Error Procedures (during running)

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[1] The Linear Programming System was developed by Bonner and Moore Associates under contract with Remington Rand Univac.

Error Indication	Explanation	Action
67 9500 4631	HSP off normal.	Correct condition, select "c" address and depress Run button.
67 9500 4584	"	Same as above.
67 9501 4489	"	"
67 9502 4563	"	"

NOTE: Questions concerning this routine should be directed to Manager, Program Library Services, Remington Rand Univac, 315 Park Avenue South, New York 10, N. Y.

Date: 12/30/60

U 2287.19

FEED MIX 1	000	001	002	003	004	005
000			1.002715-	2.002638-	3.001140-	4.002640-
001						
002	1013.000000	3.280000-	.248000-	.080000-	.016000-	.220000-
003	1023.000000	2.600000-	.174000-	.063000-		.182000-
004	1033.000000	14.600000-	.671000-	.801000-	.457000-	.763000-
005	1043.000000	.152000-	.672000-	.801000-	.401000-	.722000-
006	1053.000000	.750000-	.066000-	.038000-	.004000-	.018000-
007	1063.000000	1.500000	.142000	.021000	.360000	.088000-
008	1073.000000	.400000-	.030000-	.004000-	.001000-	.003000-
009	1078.000000	.600000	.030000	.004000	.001000	.003000
010	1083.000000	1.200000-	.044000-	.025000-	.002000-	.086000-
011	73.000000	.040000-				
012	95.010000-	.200000				
013	103.000000	.400000-				
014	138.000000	2.000000				
015	178.000000	.200000				
016	7003.010000-	20.000000	1.000000	1.000000	1.000000	1.000000

• *Generalized Programming Routines*
• *Automatic Programming Systems*
• *Copies of Program Tapes and Decks*
• *Programming Information Exchange*

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April 10,1961

Programming Information Exchange
Univac Systems, General
Bulletin 1

It is a recognized fact that the interchange of programming information provides great benefits to the parties concerned. However, the value of the information exchanged is greatly dependent upon its depth and content. The existance of an operating program deck or tape is meaningless without information as to its use. The description of a program is meaningless if the terms used do not convey to the reader its function. The briefer the content of the information presented about any one program, the less useful the program; the less standard the presentation of the information, the less meaningful.

It is a common occurrence that one or more programmers may be desirous of developing the same type of program. Mutual interests are best served, however, if duplication of effort is eliminated. To accomplish this though, it is essential that the interested parties be continually advised of the progress being made by the programmer developing the program. Regardless of the terms used to define the progress, it is necessary that all have a common understanding of one simple, but frequently misused concept: that of completeness; in what state will the routine be when the programmer considers his job to be done. It is of course, reasonable to expect that a program cannot be deemed complete until it has actually been tested. However, it is equally incomplete if no documentation is available on its purpose and operation.

I. Listed below are the areas that comprise a "completed" Remington Rand Univac software product. Since there are, in effect, two basic differences in the complexity of programming routines, the required information is defined on two levels; those routines (i.e. Compilers, Assemblers) that produce a machine coded program as output; and those routines which process data or are incorporated into another program which processes data.

Remington Rand Univac DIVISION OF SPERRY RAND CORPORATION 315 PARK AVENUE SOUTH, NEW YORK 10, N.Y.

U-1462 REV. 1

A. The following are required for a major routine:

1. All runs or phases are stored on a master instruction tape or deck.

2. Each run thoroughly tested individually on fabricated test data.

3. Minimum of three fabricated source programs successfully run through the entire system.

4. Minimum of two actual source programs successfully run through the entire system.

5. The resulting two object programs run on actual data.

6. Technical documentation prepared including written functional description of the program, its environmental requirements or hardware configuration, programming instructions, operating instructions, system charts, process charts, flow charts, source program, object program, edited record, analyzed or annotated coding, and test input data and results.

B. For minor routines; those that process data or perform computations, the amount of testing is less since there is no source program.

1. All routines prepared in standard program deck or tape formats. If desired unique formats may be prepared (i.e. multiple instruction program decks) in addition to the standard formats.

2. Each phase tested individually on fabricated test data.

3. The routine (or subroutine and all compatible subroutines) run on at least one set of fabricated data and one set of actual data.

4. Technical documentation prepared including written functional description of the program, its environmental requirements, programming instructions, operating instructions, process charts, flow charts, sample printed output, analyzed or annotated coding, and test input data and results.

II. It is necessary that detailed documentation be prepared on every program. Adherence to standards of format and terminology facilitates understanding just as adherence to standards of programming conventions facilitates use of a program. Each routine to be released by Program Library Services should use the format outlined in the attached sample.

Joe Horner, Manager
Program Library Services

TO LISTS: Univac System Routines, Tabs R-5-10-11-12-13-14-15-16-17-18-19-20

TABLE OF CONTENTS

Whenever the written material (excluding charts and listings) exceeds 10 pages in length, a Table of Contents for the routine description should precede the write-up.

TITLE

The first information specified about a routine should include the name of the routine. The information is usually contained in the upper right hand corner of the first page on the origina document. If the name is coded, an English title should also be shown on the first page.

PURPOSE

A brief two or three sentence description of the basic function of the routine is presented next. Included in this brief description should be a statement about the basic or minimal hardware configuration for which the routine was designed.

DESCRIPTION

The description of the routine should be as comprehensive as possible. It should contain a detailed statement of its function, any information required to make use of the routine, and the method used by the routine, whether data processing or mathematical, to achieve solution of the problem. Only when the method is presented elsewhere and can be referenced is it permissible to omit a discussion of the method.

The use of the standard outline notation for each paragraph is strongly recommended since it aids understanding and facilitates cross referencing. This standard is as follows:

```
I.
   A.
      1.
         a.
            (1)
               (a)
```

Abbreviations should be avoided if possible, however, if not, they should first be defined (e.g., First Pass Own Coding (FPOC)).

PROGRAMMING PROCEDURES

The major portion of any write-up on a complex routine will be devoted to a description of the programming procedures; a detailed analysis of the source language, its use and examples. For the less complex routines the "Programming Procedures" becomes a summary of much of the material previously mentioned in the "Description".

Where relevant, the following items should be included in "Programming Procedures":

1. Entrances
2. Exits
3. Format and location of data upon entrance.
4. Format and location of data upon exit.
5. Registers affected or used during execution.
6. Parameters and an explanation of their contents and use.
7. Number and location of temporary storage locations.
8. List of other routines executed by this routine.
9. Length of routine.
10. Execution time of routine.
11. All other information that must be supplied, loaded, or made use of by the programmer prior to executing the routine on the computer or incorporating the routine along with other routines for either compilation or use on the computer.

OPERATING PROCEDURES

The operating procedures should be a step by step outline of the procedures to be followed when actually using the routine on the computer. If the routine detects error conditions during its execution, a statement of the error indication, an explanation of the condition causing the error, and the corrective procedures to be followed should be included. Where either the operating procedures or the error indications are extensive (e.g., MASCOT, OMNIFLEX), they should also be summerized in table form.

Name of Programmer

Location of Programmer

Date of Completion
(or Revision)

FLOW CHARTS

Flow charts should be prepared for every routine, and in the case of the more complex routines, prepared to represent several different levels. They not only assist the reader in understanding the function of the routine but also serve as a guide to follow when modifying the routine. The degree to which the charts may be understood is dependent upon the degree of standard notation used; listed below are considerations in the development of the charts.

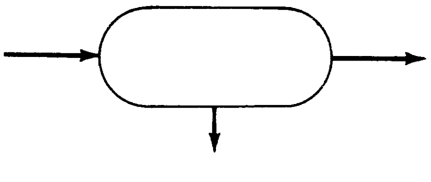
1. Block charts should be prepared for any major routine or program. They show the structure of the interrelationships between the significant parts. Depending upon the size and complexity of the routine, no block chart or a series of block charts at different levels of detail may be required.

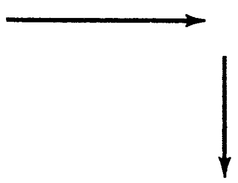
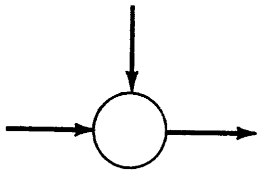
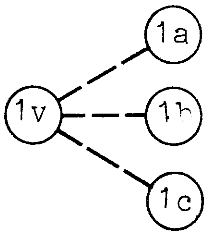
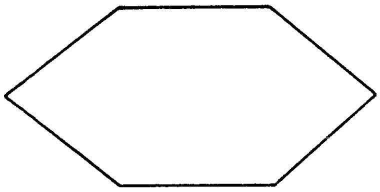
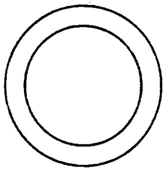
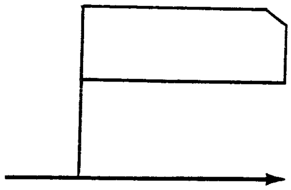
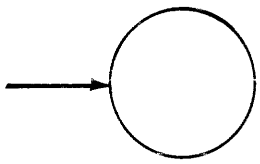
2. Flow charts should be prepared to show the detailed processing sequence within a routine. But a flow chart should never be so detailed as to relate directly to machine instructions at every step. Operations on a flow chart should be self-explanatory. English statements should be used in decision boxes and operation boxes in preference to symbolic statements.

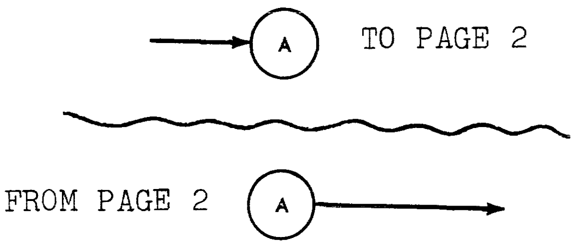
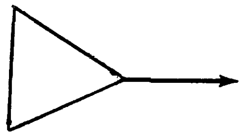
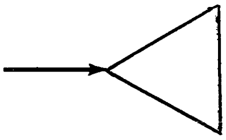
3. If a major routine uses a subroutine that has been completely documented, the detailed flow chart of the subroutine should be omitted. Only the name of the subroutine should be indicated.

4. Flow charts should be related to the coding the machine address or source code tag, label, sequence or operation number at the beginning of each non-branching path on the chart.

5. The following symbols are now being considered as standard throughout Remington Rand Univac and will be used in all P.L.S. publications.

SYMBOL	PURPOSE
	To describe an operation on date or an operation on a routine's control mechanism such as setting a switch.
	Comparison, test, or binary decision.

SYMBOL	PURPOSE
	Indicates the direction of flow. Flow paths in general should be from left to right and top to bottom of page, but this rule may be violated to avoid the use of too many connectors, or to allow for less complicated chart design.
	Connector. Indicates the juncture of two or more flow paths.
	Variable connector, or switch.
	Subroutine. The execution of a separately-defined, closed subroutine at a point in the flow. This symbol implies further definition of the subroutine in the documentation of the run of which it is a part. The identification or name of the subroutine should be written within the symbol.
	Subroutine. This symbol implies the use of a "canned" subroutine which is not further documented in the run of which it is a part, but which is defined in its own documentation. The identification or name of the subroutine should be written within the symbol.
	Assertion or explanation.
	Start, Stop, Alarm Stop. The circle used for this symbol should be larger than the circles used for connectors. The word START or STOP should be printed within the symbol.

SYMBOL	PURPOSE
	Remote connectors. Used when flow path must be broken because of space limitations. If remote connectors are on different pages of a chart, TO and FROM page nos. should be written beside the connectors.
	Entrance to a closed subroutine.
	Exit from a closed subroutine.

CODING

It is a minimal requirement that a listing or edited listing be prepared for every program. These listings serve several purposes: they enable the user to obtain a detailed knowledge of the routine, provide a means of checking the program deck or tape, may be used when modifying the routine, and may be used as a source to prepare program decks or tapes when copying facilities are not available.

Whenever possible, these listings should be printed directly from the media (e.g. cards, tape) on which the coding is stored for computer use. In the case that listings are produced as a byproduct of a major routine, this form is preferable. If an analyzer routine exists for the hardware configuration, or if an annotated listing has been created during the development of the routine, the inclusion of this information in the documentation is preferable to a straight listing. When coding is being annotated, the comments should indicate the tasks performed, not describe the instructions used at each step in the routine.

ALLOCATION CHARTS

Where relevant, allocation charts should be created to specify the exact locations used by the routine and to serve as a means for locating individual lines of coding.

UNIVAC
Solid-State
80/90 Tape

TECOO-OTOO

TAPE ERROR ROUTINE

PURPOSE

TECOO-OTOO re-executes tape Read instructions when the read error condition is program correctable.

DESCRIPTION

TECOO-OTOO is entered automatically by the Tape File Control Routine after detection of an error which occurred during the execution of a tape read or write instruction.[1] The routine handles read instructionsin either a forward or backward direction and in either Univac or USS mode. The routine may also be used to reload the buffer in case of an erroneous tape buffer to memory transfer. TECOO will not handle rewind instructions, tape Read instructions in other than normal gain, nor will it attempt to correct tape Write instructions. By examining the error indicators in rL,[2] TECOO determines whether or not the error is program correctable.

I. Program Correctable Errors

If the error is a program correctable Read, TECOO will try to re-execute the instruction by reading the tape in a direction opposite to that of the original read and then attempting to read the tape, once again, in the original direction. This procedure is attempted at least three times (in normal, low and then high gain) or until the tape has been successfully re-read. The computer is brought to a stop if unsuccessful after three tries. If at any time the process cannot be continued, for example, a two or more block read while trying to reposition a tape, the computer is brought to a definitive stop (see OPERATING PROCEDURES for Stops).

Besides a check on each execution of the original tape order, a check is made to determine that all repositioning tape movements have accomplished their purpose.

---

[1]TECOO-OTOO is used in conjunction with TFCOO-OTOO or with programmers own Tape Control Routine. In the latter case see PROGRAMMING PROCEDURES for required information.

[2]Digit positions from MSD to LSD of rL, are 1 to 10.

II. The following Read tape errors are correctable utilizing TECOO-OTOO:

Digit Position (rL)	Bit Position	Explanation
2	4	Erroneous (TB)⟶m transfer.
3	5	Greater than 720 (1100) character count.
4	5	Less than 720 (1100) character count.
5	5	1OPC parity error during reading.
6	5	Hash Pulses between blocks.
7	5	Synchronizer overflow during read.

III. Program Uncorrectable Errors

The following tape errors are not correctable using TECOO. An attempt should be made to correct the error manually:

Digit Position (rL)	Bit Position	Explanation
2	5	Greater than 1121, (739) check.
2	4	Erroneous (TB)⟶Synchronizer transfer.
5	4	Write comparison check.
5	5	1OPC parity error during writing.
7	5	Synchronizer underflow during write.
8	5	Control check. Tapes not responding.
10	5	FIR-BIR check.

In addition the following, although not necessarily indications of tape errors, are treated as uncorrectable and yield the same stop order as the above errors:

9	4	Interrupt operation switch energized.
9	5	Manual tape ending switch energized.

PROGRAMMING PROCEDURES (Not required when using TFC00-OT00)

The following information must be supplied if the user's tape file control routine, is to be used in conjunction with TEC00.

I. Prior to Entrance to TEC00-OT00.

A. Two lines of coding are sufficient to detect a tape read or write error.

a	C7	m_1	a
m_1	87	m_2	c

If m_2 is taken there has been an error; if c is taken no error is indicated. A special stop is provided if the last tape operation was a write instruction.

B. The tape instruction last executed is stored in location 1835.

C. Zeros are stored in location 1822 <u>only</u> if the last tape instruction was a write on tape in 1st block (rewound) condition. Otherwise 1822 should be anything other than all zeros.

D. To use TEC00-OT00 to attempt correction of erroneous tape buffer to memory transfers, after the occurance of c+1 condition upon unloading (TB)⟶m, control should be transferred to that tape buffer test (C7) which was used to detect the presence of tape errors for the file concerned. The result will be a detection of the erroneous (TB)⟶m transfer and a re-read of the particular tape.

E. Nothing of value should be in rA, rL, rX. The contents of these registers are destroyed.

II. Own Coding a Op m c	Routine Coding a Op m c	Remarks
[Own Inst.] 1800	1800 [TEC00-OT00 Inst.]	Entrance if HSR Stop routine is used.
[Own Inst.] 1806	1806 [TEC00-OT00 Inst.]	Entrance if HSR Stop routine is not used.
	[TEC00-OT00 Inst.] 1812	Exit from routine upon successful re-execution of tape order. rL contains all zeros. Specific stops are provided for all other conditions.
1812 26[m_1] 0000		Returns control to main program after error has been corrected.

MODIFICATIONS

TECOO includes an entrance to the HSR Stop routine. Care should be taken that the "c" portion refers to the particular HSR Stop routine being used. It is as follows:

Page	Line	a
01	01	1800

LENGTH

TECOO occupies 75 locations in band 18.

OPERATING PROCEDURES

A. Normal Procedures

Load TECOO-OTOO, a TFC routine; and other program decks.

B. Error Procedures

The following error indications are provided by TECOO-OTOO. Upon execution, rA will contain the original tape instruction that is to be corrected; and rL, the error flip-flops:

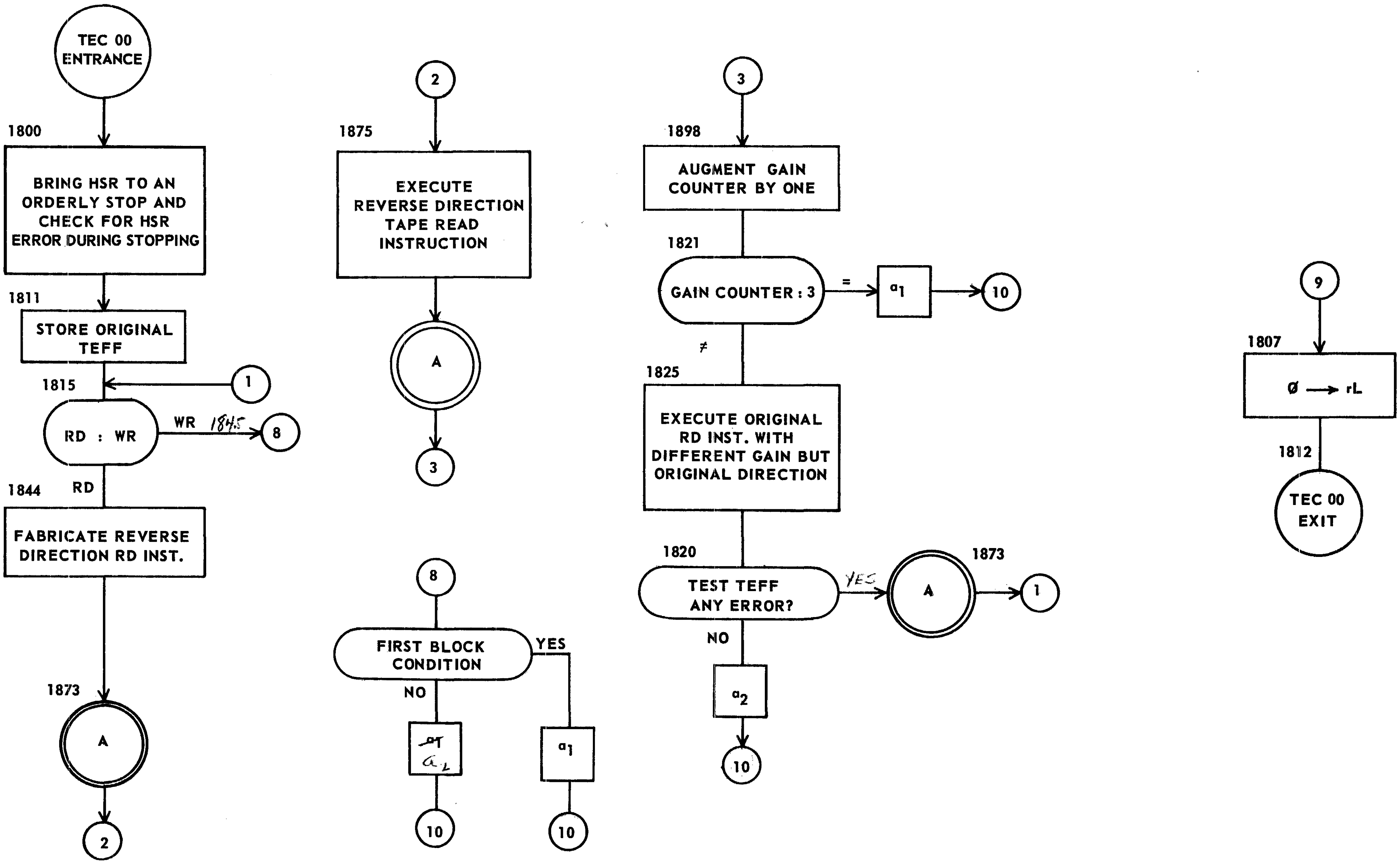
Stop Identification	Explanation	Action
67 8002 1807	The original read operation is uncorrectable. The tape has not been moved since error was detected.	If error condition can be corrected manually (block in question in tape buffer), depress Run button.
67 8003 1807	Repositioning read instruction unsuccessful. TEFF for this read appear on SYNCHRONIZER.	If original read can be executed manually, i.e., buffer successfully loaded with proper block from tape, depress Run button.
67 8004 1807	All three gains have been tried with no success. The tape is positioned so that a Read in the original direction will bring the block in error into the tape buffer.	"

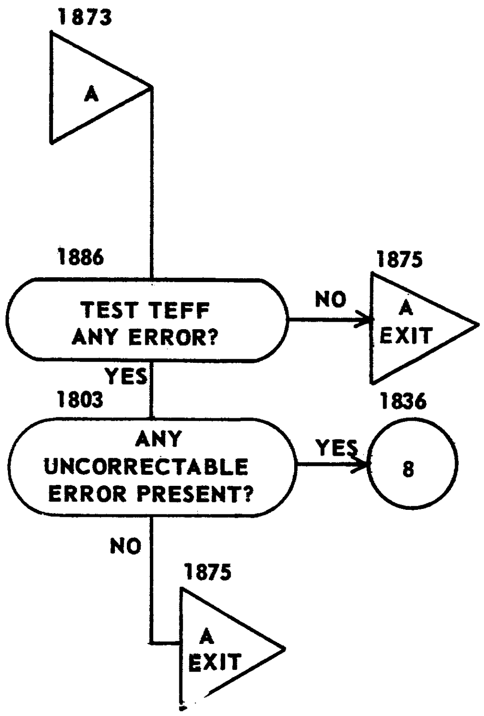
Stop Identification	Explanation	Action
67 8005 1807	Uncorrectable error trying to read in original direction but at different gain.	If original read can be executed manually, i.e., buffer successfully loaded with proper block from tape, depress Run button.
67 8006 000A	Error trying to write in first block condition.	Rewind tape manually. To try to Write again, depress Run button.
67 8010 1807	Write error, other than first block condition.	Restart or Rerun.

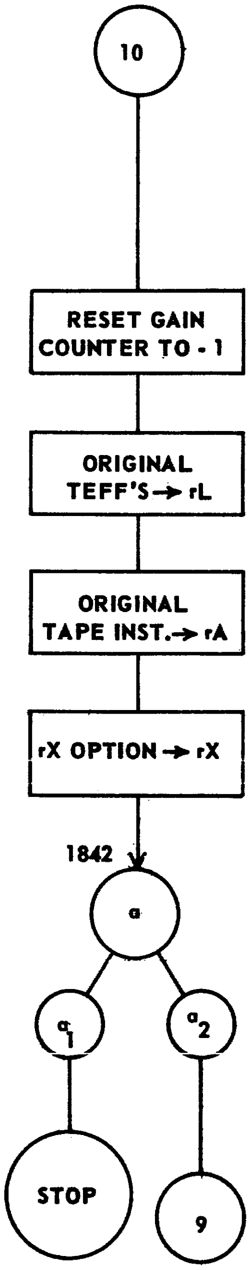
NOTE: Questions concerning this routine should be directed to Manager, Program Library Services, Remington Rand Univac, 315 Park Avenue South, New York 10, N. Y.

Date: 8/30/60

RD


TEC 00
ENTRANCE
1800
BRING HSR TO AN ORDERLY STOP AND CHECK FOR HSR ERROR DURING STOPPING
1811
STORE ORIGINAL TEFF
1815
1
RD : WR
WR 1845
8
1844
RD
FABRICATE REVERSE DIRECTION RD INST.
1873
A
2
2
1875
EXECUTE REVERSE DIRECTION TAPE READ INSTRUCTION
A
3
8
FIRST BLOCK CONDITION
YES
NO
a1 a2
a1
10
10
3
1898
AUGMENT GAIN COUNTER BY ONE
1821
GAIN COUNTER : 3
=
a1
10
≠
1825
EXECUTE ORIGINAL RD INST. WITH DIFFERENT GAIN BUT ORIGINAL DIRECTION
1820
TEST TEFF ANY ERROR?
YES
A
1873
1
NO
a2
10
9
1807
Ø → rL
1812
TEC 00
EXIT


1873
A
1886
TEST TEFF
ANY ERROR?
NO
1875
A
EXIT
YES
1803
ANY
UNCORRECTABLE
ERROR PRESENT?
YES
1836
8
NO
1875
A
EXIT


10
RESET GAIN
COUNTER TO - 1
ORIGINAL
TEFF'S→ rL
ORIGINAL
TAPE INST.→ rA
rX OPTION → rX
1842
a
a1
a2
STOP
9

TEC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0001	001	010	1800	05	1802	0419	
0002	001	020	1802	31	1801	0000	
0003	001	030	1801	82	1806	1804	
0004	001	040	1804	05	1806	000A	
0005	001	050	1806	C7	1811	1806	
0006	001	060	1811	50	1813	1815	
0007	001	070	1815	25	LAST INST 1835	1837	
0008	001	080	1837	30	1839	1841	
0009	001	090	1839	HF	FFFF	FFFF	
0010	001	100	1841	87	1844	1845	
0011	001	110	1844	30	1846	1848	
0012	001	120	1846	HH	HHH4	HHHH	
0013	001	130	1848	20	000B	1852	
0014	001	140	1852	87	1856	1855	
0015	001	150	1855	25	1857	1860	
0016	001	160	1857	00	0005	0000	
0017	001	170	1856	25	1858	1860	
0018	001	180	1858	00	0995	0000	
0019	001	190	1860	70	1835	1861	
0020	001	200	1861	35	1863	1865	

TEC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0021	002	010	1863	HG	HHHH	0000	
0022	002	020	1865	20	1867	1869	
0023	002	030	1867	00	0000	1891	
0024	002	040	1869	05	1871	1873	
0025	002	050	1871	67	8002	1807	
0026	002	060	1891	05	1894	1896	
0027	002	070	1894	67	8003	1807	
0028	002	080	1896	25	1898	1873	
0029	002	090	1898	25	1805	1810	
0030	002	100	1805	00	0001	0000	2
0031	002	110	1810	75	1853	1862	
0032	002	120	1853	00	0001	0000	2
0033	002	130	1862	60	1805	1817	
0034	002	140	1817	30	1819	1821	
0035	002	150	1819	00	0003	0000	
0036	002	160	1821	82	1826	1825	
0037	002	170	1826	05	1828	1836	
0038	002	180	1828	67	8004	1807	
0039	002	190	1825	70	1835	1843	
0040	002	200	1843	35	1863	1866	

TEC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0041	003	010	1866	20	1868	000A	
0042	003	020	1868	00	0000	1887	
0043	003	030	1887	05	1892	1899	
0044	003	040	1892	67	8005	1807	
0045	003	050	1899	C7	1814	1899	
0046	003	060	1814	87	1936	1820	
0047	003	070	1936	25	1815	1873	
0048	003	080	1873	60	1875	1877	
0049	003	090	1877	C7	1886	1877	
0050	003	100	1886	87	1889	1875	
0051	003	110	1889	25	000B	1893	
0052	003	120	1893	30	1895	1897	
0053	003	130	1895	HC	HHHH	HC3C	
0054	003	140	1897	20	000B	1803	
0055	003	150	1803	82	1875	1836	
0056	003	160	1836	65	1842	1850	
0057	003	170	1850	05	1853	1859	
0058	003	180	1859	65	1805	1809	
0059	003	190	1809	30	1813	1816	
0060	003	200	1816	25	1835	1838	

TEC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0061	004	010	1838	05	1840	1842	
0062	004	020	1840	00	1840	0000	
0063	004	030	1820	05	1807	1836	
0064	004	040	1807	31	1812	0000	
0065	004	050	1845	31	1849	0000	
0066	004	060	1849	25	1822	1824	
0067	004	070	1824	82	1827	1937	
0068	004	080	1827	05	1830	1836	
0069	004	090	1830	67	8006	000A	
0070	004	100	1937	05	1939	1836	
0071	004	110	1939	67	8010	1807	

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April 25, 1961

USS Computers (80/90)
Library Memo 28

The following routines have been added to the library:

MASCOT - An integrated set of service routines for the Univac Solid-State Tape System. Within its context, it establishes two basic instruction tape formats, and provides a complete set of basic and recurring functions required to create, maintain, and use such tapes. It is a dynamic system, providing for the easy assimilation of new service routines developed as the need arises.

Please apply the following correction to page 29, OPERATING INSTRUCTIONS, 3:

b. Key G2 0100 000A into rC.

c. Key F6 0000 0001 into rA.

Set the computer on continuous and depress Run button.

RRN01-OT00 - Designed to initiate a rerun using a memory dump in the format produced by TFC01 and TFC02. Three Index Registers are used.

A revision of TEC00-OT00 - Re-executes tape read when an error condition is program correctable and indicates write errors via coded stop orders.

RPU04-9T00 - Designed to punch blank cards and verify them not using backup storage. Automatic Translation and one Index Register are used.

All requests for individual routines, complete sets of routines or program decks should be directed to the Remington Rand Univac Branch Manager. To submit routines for publication, address: Manager, Program Library Services, Remington Rand Univac, 315 Park Avenue South, New York 10, N. Y.

Joe Horner, Manager

TO LISTS: 10A-23-361-362-44-52-59 and Univac System Routines, Tab 11.

ATTACHMENTS: to Univac System Routines, Tab 11, only.

PLS PROGRAM LIBRARY SERVICES

UNIVAC Solid-State 80/90 Tape

ITCOO-OTOO

ITEM CONTROL ROUTINE

PURPOSE

ITCOO-OTOO controls the transfer of items from an input tape file to working storage, and from working storage to an output tape file. It assumes the presence of a Tape File Control (TFC) routine and one or more sets of item transfer instructions.

DESCRIPTION

The prime function of this routine is to up-date and provide information to both the Tape File Control routine and/or item transfer instructions, so that they can operate properly. This includes maintaining a record of the next item position of input and output files, checking for end-of-block sentinels on an input tape and supplying end-of-block sentinels on an output tape. In addition to supplying information, ITCOO-OTOO will maintain all necessary communication with TFC and item transfer instructions. Therefore, complete control of the entire tape input/output portion of a program may be effected solely by contact with the Item Control routine (ITC).

The use of ITCOO-OTOO requires the storing of two words of information concerning each file prior to commencement of operation. These two parameters include details on item address and item transfer (see PARAMETERS Section). Similarly, the TFC routine requires specific parameters which must also be stored.

ITCOO-OTOO can provide controls for a maximum of ten files. Each file may contain an item size not larger than one hundred words.

ITCOO-OTOO is composed of seven sections:

1. Initiate Input File (INI)[1]

   This section is employed once for each input file being used.

---

[1]Each section has been assigned a symbolic three digit name. By appending the letters E or X, the entrance or exit line can be represented. Each symbolic line signifies an actual location.

It obtains the band number of the input area for the file and transfers control to the item transfer instructions. When the item is transferred, control is returned to INI. The input item level indicator is incremented and the first item is available for processing. If the item contains an end-of-block sentinel, control is retained by INI until a valid input item is available.

INI is entered at location 1001 (INIE) with Index Register 1 (rB_1) containing the input file number in the form 000f and Index Register 2 (rB_2) containing the location bbll (in high-speed storage) of the working storage area into which the numeric portion of the first word of the item is to be stored.

INI transfers control to the item transfer instructions at location ITIX as specified in the parameters with rB_2 containing the location of the working storage area in the form bbll, and rB_3 containing the location of the item available in the input block. Control is to be returned to INI at location 1602 (ITIE) with the input item in working storage.

Upon execution of this section, control will normally be returned at location 1184 (INIX) with the three Index Registers loaded as indicated above and the contents of registers A, L, and X destroyed.

If an end-of-file sentinel is detected during the execution of INI, control will be returned at location 1046 (NDIX) with rB_1 and rB_2 as they were upon entrance, and the contents of registers B_3, A, L, and X destroyed.

2. Initiate Output File (IN<u>O</u>)

This section is employed once for each output file being used. It obtains the band number of the output area for the file.

IN<u>O</u> is entered at location 1009 (IN<u>O</u>E) with rB_1 containing the output file number in the form 000f.

Upon execution of this section, control will be returned at location 1173 (IN<u>O</u>X) with rB_1 as loaded upon entrance, rB_2 and rB_3 unchanged, and the contents of registers A, L, and X destroyed.

3. Advance Input Item (ADI)

This section is employed to procure a new input item of a given file. It first tests to see whether an input item is available. If one is, control is sent to the item transfer instructions. When the item is transferred, control is returned to ADI. The input item level indicator is incremented. If the item contains an end-of-block sentinel, control is retained until a valid input item is available.

If the input block is exhausted, a new one is read, the band number of the input area is obtained, and the same procedure outlined above is followed.

ADI is entered at location 1696 (ADIE) with rB_1 containing the input file number in the form 000f and rB_2 containing the location bbll (in high-speed storage) of the working storage area into which the numeric portion of the first word of the item is to be stored.

ADI transfers control to the item transfer instructions at location ITIX as specified in the parameters with rB_2 containing the location of the working storage area in the form bbll, and rB_3 containing the location of the item available in the input block. Control is to be returned to ADI at location 1602 (ITIE) with the input item in working storage.

Upon execution of this section, control will normally be returned at location 1668 (ADIX) with the three index registers loaded as indicated in the text and the contents of registers A, L and X destroyed.

If an end-of-file sentinel is detected during the execution of ADI, control will be returned at location 1046 (NDIX) with rB_1 and rB_2 as they were upon entrance, and the contents of registers B_3, A, L, and X destroyed.

4. Advance Output Item (ADO)

This section is employed to advance an item of a given file to output. Control is sent to the item transfer instructions. When the item is transferred, control is returned to ADO. The output item level indicator is incremented and a test is made to see whether an item position is available in the output block. If none is, control is retained by ADO until the output block is written and the band number of the output area is obtained.

ADO is entered at location 1797 (ADOE) with rB_1 containing the output file number in the form 000f and rB_2 containing the location bbll (in high-speed storage) of the working storage area in which the numeric portion of first word of the item can be found.

ADO transfers control to the item transfer instructions at location ITOX as specified in the parameters with rB_2 containing the location of the working storage area in the form bbll, and rB_3 containing the location of item position available in the output block. Control is to be returned to ADO at location 1697 (ITOE) with the item in the output block.

Upon execution of this section, control will normally be returned at location 1761 (ADOX) with the three index registers loaded as indicated in the text and the contents of registers A, L and X destroyed.

If the capacity of the output tape is reached during the execution of ADO, control will be returned at location 1017 (FULX) with the three index registers loaded as indicated in the text, and the contents of registers A, L, and X destroyed.

5. Place End-of-Block Sentinel (PSF)

This section is employed to place an end-of-block sentinel in the numeric portion of the first word of the current unused item position in the output block.[2]

The output block is written and the band number of the output area is obtained. PSF will generally be used prior to terminating an output file on tape.

PSF is entered at location 1015 (PSFE) with rB_1 containing the output file number in the form 000f.

Upon execution of this section, control will normally be returned at location 1164 (PSFX) with rB_1 containing the output file number in the form 000f, the contents of rB_2 are undisturbed, the contents of registers B_3, A, L, and X are destroyed.

If the capacity of the output tape is reached during the exexecution of PSF, control will be returned at location 1017 (FULX) with registers as indicated above for the normal exit.

6. Terminate an Output Tape (ENT)

This section is employed to terminate one output tape, alternate servos and begin a new one. The band number of the output area is obtained.

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[2]Conventional end-of-block sentinel is FFFFFFFF10 where F = undigit 1101.

ENT is entered at location 1020 (ENTE) with rB_1 containing the output file number in the form 000f.

Upon execution of this section, control will be returned at location 1087 (ENTX) with rB_1 as it was upon entrance, rB_2 and rB_3 are not used, registers A, L, and X are destroyed.

7. Terminate an Output File (ENF)

This section is employed to terminate an output file.

ENF is entered at location 1026 (ENFE) with rB_1 containing the output file number in the form 000f.

Upon execution of this section, control will be returned at location 1089 (ENFX) with rB_1 as it was upon entrance, rB_2 and rB_3 are not used, registers A, L, and X are destroyed.

PROGRAMMING PROCEDURES

Own Coding a Op m c	Routine Coding a Op m c	Remarks
1. Initiate Input File (INI)		
02 000f aaaa		Entrance to INI.
aaaa 02 bbll 1001	1001[ITC00-OT00 Inst.]	Checks label and reads first block of file specified by f in rB_1. rB_2 contains address of input working storage as bbll.
	[ITC00-OT00 Inst.]ITIX	Exit line from INI. ITIX is address of input item transfer instructions. rB_2 contains address of input working storage as bbll, rB_3 contains address of first item in input block as bbll.
[Item Transfer Inst.] 1602	1602[ITC00-OT00 Inst.]	Re-entrance to INI. First input item has been transferred to working storage.

Own Coding a Op m c	Routine Coding a Op m c	Remarks
	[ITC00-OT00 Inst.]1184	Normal exit from INI. rB_1, rB_2, and rB_3 as loaded, rA, rL and rX destroyed.
	[ITC00-OT00 Inst.]1046	End-of-file exit from INI. rB_1 and rB_2 as loaded, rB_3, rA, rL and rX destroyed.

2. Initiate Output File (IN<u>O</u>)

Own Coding	Routine Coding	Remarks
02 000f 1009	1009[ITC00-OT00 Inst.]	Entrance to IN<u>O</u>. Writes output label and stores band number of output block.
	[ITC00-OT00 Inst.]1173	Exit from IN<u>O</u>. rB_1 as loaded, rB_2 and rB_3 not used rA, rL rX destroyed.

3. Advance Input Item (ADI)

Own Coding	Routine Coding	Remarks
02 000f aaaa aaaa 02 bbll 1696	1696[ITC00-OT00 Inst.]	Entrance to ADI. Procures new input item from files specified by f in rB_1; rB_2 contains address of input working storage as bbll.
	[ITC00-OT00 Inst.]ITIX	Exit line from ADI. ITIX is address of input item transfer instruction. rB_1, rB_2, as loaded; rB_3 contains address of current item in input block as bbll.
[Item Transfer Inst.] 1602	1602[ITC00-OT00 Inst.]	Re-entrance to ADI. Input item is in working storage. Item level, incremented and stored. Current item tested for end-of-block sentinel.

Own Coding a Op m c	Routine Coding a Op m c	Remarks
	[ITC00-OT00 Inst.]1668	Normal exit from ADI. rB_1, rB_2, and rB_3 as loaded, rA, rL and rX destroyed.
	[ITC00-OT00 Inst.]1046	End-of-input file exit from ADI. rB_1 rB_2 as loaded, rB_3, rA, rL and rX, destroyed.

4. Advance Output Item (ADO)

02 000f aaaa aaaa 02 bbll 1797	1797[ITC00-OT00 Inst.]	Entrance to ADO. rB_1 contains the output file number, rB_2 contains the address of input working storage as bbll.
	[ITC00-OT00 Inst.]ITOX	Exit line from ADO. rB_1 contains the output file number, rB_2 contains the address of input working storage, rB_3 contains the output item address.
[Item Transfer Inst.] 1697	1697[ITC00-OT00 Inst.]	Re-entrance to ADO. An output item has been transferred from working storage to output. Item level incremented and stored. Test is made to determine whether output block full. If necessary, output block is written and a new output band stored.
	[ITC00-OT00 Inst.]1761	Exit from ADO. rB_1, rB_2, and rB_3 as loaded rA, rL, and rX destroyed.

Own Coding a Op m c	Routine Coding a Op m c	Remarks
	[ITC00-OT00 Inst.]1017	Output tape full exit from ADO. rB_1, rB_2, and rB_3 as loaded, rA, rL, and rX destroyed.

5. Place End-of-Block Sentinel (PSF)

Own Coding	Routine Coding	Remarks
02 000f 1015	1015[ITC00-OT00 Inst.]	Entrance to PSF. Current output item of file number in rB_1 is filled with end-of-block sentinels. Block is written and new output band stored.
	[ITC00-OT00 Inst.]1164	Exit from PSF. rB_1 as loaded, rB_2 not used, rB_3, rA, rL, and rX destroyed.
	[ITC00-OT00 Inst.]1017	Output tape full exit from PSF. rB_1 as loaded rB_2 not used, rB_3, rA, rL, and rX destroyed.

6. Terminate an Output Tape (ENT)

Own Coding	Routine Coding	Remarks
02 000f 1020	1020[ITC00-OT00 Inst.]	Entrance to ENT. Writes end-of-tape sentinels on output tape of file number in rB_1. Rewinds output tape, alternates uniservos, writes output label on new tape, and stores output band number.
	[ITC00-OT00 Inst.]1087	Exit from ENT. rB_1 as loaded, rB_2 and rB_3, not used, rA, rL, and rX destroyed.

Own Coding a Op m c	Routine Coding a Op m c	Remarks

7. Terminate an Output File (ENF)

Own Coding	Routine Coding	Remarks
02 000f 1026		Entrance to ENF.
	1026[ITC00-OT00 Inst.]	Writes end-of-file sentinels on output tape of file number in rB_1 and rewinds tape.
	[ITC00-OT00 Inst.]1089	Exit from ENF. rB_1 as loaded, rB_2 and rB_3 not used, rA, rL, and rX destroyed.

PARAMETERS

1. Item Address Prameters

A list of parameters must be prepared initially. These will be used by ITC00-OT00 to record the number of items in a block that have been transferred either from input to working storage or from working storage to output. The ten word list (one word per file used) is to be located in 4200 through 4209.

ITC00-OT00 will select the parameter for a given file by equating the parameter position to a number between zero and nine provided in Index Register one, in the form 000f. e.g. the parameter for file 0002 would be located in 4202.

Parameter format is as follows:

a	Op	m	c	k
420f	02	0000	{ITIX / ITOX}	3

where ITIX is the computer address of the entrance to item transfer instructions which advance an item to working storage if file f is an input file. For best latency, it should be at level 165.

ITOX is the computer address of the entrance to item transfer instructions which advance an item from working storage to output if file f is an output file. For best latency, it should be at level 15.

All parameters are stored negatively, hence the loading key of 3. ITC00-OT00 will use the "m" portion of the parameter to record the address of either:

a. The next input item to be advanced to working storage.

b. The next position in the output block to receive an item from working storage.

An appropriate band number, supplied by the TFC routine is inserted into "m"; the two least significant digits are set equal to 01, the level of word zero of the first (zero item). These digits are incremented by 02 each time a new item is called for.

2. Item Limits Parameters

These parameters are used to test for either a full input block or for a full output block. They are supplied initially. The ten word list is to be located in 1715 through 1724. The limit for each file used must be placed at a position in this list, relative to the one assigned in the ITEM ADDRESS list. Parameter form is as follows:

a	Op	m	c	k
1715+f	00	0111	0000	6

where 0111 is the level of the numeric portion of the first word of the <u>last</u> item in the interlace of a given item size. e.g. the parameter for a 12 word input or output file would be set as,

00 0015 0000 with a key of 6.

The incremented "m" portion of the ITEM ADDRESS parameter is tested against the parallel ITEM LIMIT parameter to determine whether an item or item position is available.

MODIFICATIONS

1. ITC00-OT00 incorporates HSR buffer tests. Care should be taken that the "m" portion of these instructions refers to the particular HSR routine being used. The following is a list of locations of the "42" instructions within ITC00-OT00:

Page	Line	a
03	07	1635
05	08	1650

2. The operation of the ADI section of ITC may be modified to procure the address of the current input item, test the item for an end-of-block sentinel, and return directly to the main program at ADIX bypassing the transfer instructions.

The address of the numeric portion of word zero of the input item will be in rB_3 as bbll upon exit. The item may then be tested in the input area in order to determine whether it need be transferred:

a. to working storage

b. to output area

c. or not transferred

Transfer to item transfer instructions will be effected from the main program. If condition "a" exists, load rB_2 with the address of the numeric portion of word zero of the working storage area and send control to the transfer instructions at ITIX; control should be returned to the main program at ADIX to process the item when the transfer is completed. If condition "b" exists, store the contents of rB_3 in rB_2 and enter ADO which procures the address of the current output area, stores it in rB_3, and returns to the main program at ADOX. The item should then be transferred from the input area as indicated in rB_2 to the output area as indicated in rB_3. If condition "c" exists, enter ADI again.

Insert the following card into the ITC deck after the card page 001 line 080:

Page	Line	a	Op	m	c	Key
001	081	1798	30	0000	1656	3

The Item Address Parameter for any input file to be handled in the manner described above must take the following format:

a	Op	m	c	Key
420f	02	0000	1798	3

The Item Address Parameter for any output file which may have more than one set of transfer instructions associated with it should take the form:

a	Op	m	c	Key
420f	02	0000	1697	3

Setting the parameter as above alters the function of ADO in that transfer to output item advance instructions is bypassed. ADO will store the address of the numeric portion of word zero of the current output item area in rB_3 and test to see whether the output block is full. It will then exit to the main program at ADOX unless the output tape is full.

TIMING REQUIREMENTS AND MEMORY LENGTH

No realistic timing estimates can be made since the timing for a given section might include the time of execution for either item transfer instructions or a TFC function and in some cases the times for both of these.[3] In general ITC00-OT00 will seldom exceed 1/2 a drum revolution before transferring, to TFC, to item transfer instructions, or to an exit line.

ITC00-OT00 uses a total of 94 locations in bands 10 and 16. The two lists of parameters may require a maximum of 20 additional locations, 10 in band 42 and 10 in band 16.

OPERATING PROCEDURES

Load ITC00-OT00 with TFC and TEC routines, a set or sets of item transfer instructions. The parameter cards should be loaded after the ITC00-OT00 deck.

NOTE: Questions concerning this routine should be directed to Manager, Program Library Services, Remington Rand Univac, 315 Park Avenue South, New York 10, N. Y.

Date: 8/30/60

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[3] Transfer routines should take R+1/4 revolutions to transfer from input to working storage and R+1/2 revolutions to transfer from working storage to output in order to fit into the framework of ITC00-OT00 with optimum latency.

SUMMARY OF ENTRANCES AND EXITS

		EXIT	1184	1173	bb+165	1668	1046
		NAME	INIX	INOX	ITIX	ADIX	NDIX
		EXIT CONDITIONS	rB_1: 000f rB_1: bbll (w.s.) rB_3: bbll (input (item address) rA,rL,rX:destroyed	rB_1: 000f rB_2,rB_3: not used. rA,rL,rX:destroyed	rB_1: 000f rB_2: bbll (w.s.) rB_3: bbll (input (item address)	rB_1: 000f rB_2: bbll (w.s.) rB_3: bbll (input (item address) rA,rL,rX:destroyed	rB_1: 000f rB_2: bbll (w.s.) rB_3,rA,rL,rX: destroyed
ENTRANCE	NAME	ENTRANCE CONDITIONS					
1001	INIE	rB_1: 000f rB_2: bbll (w.s.)			Transfer First Input Item		End-of-file
1009	INOE	rB_1: 000f		Normal			
1696	ADIE	rB_1: 000f rB_2: bbll (w.s.)			Normal		End-of-File
1602	ITIE	Input Item in W.S. rB_1: 000f rB_2: bbll (w.s.) rB_3: bbll (input (item address)	First Input Item Item Transferred			Normal	

SUMMARY OF ENTRANCES AND EXITS

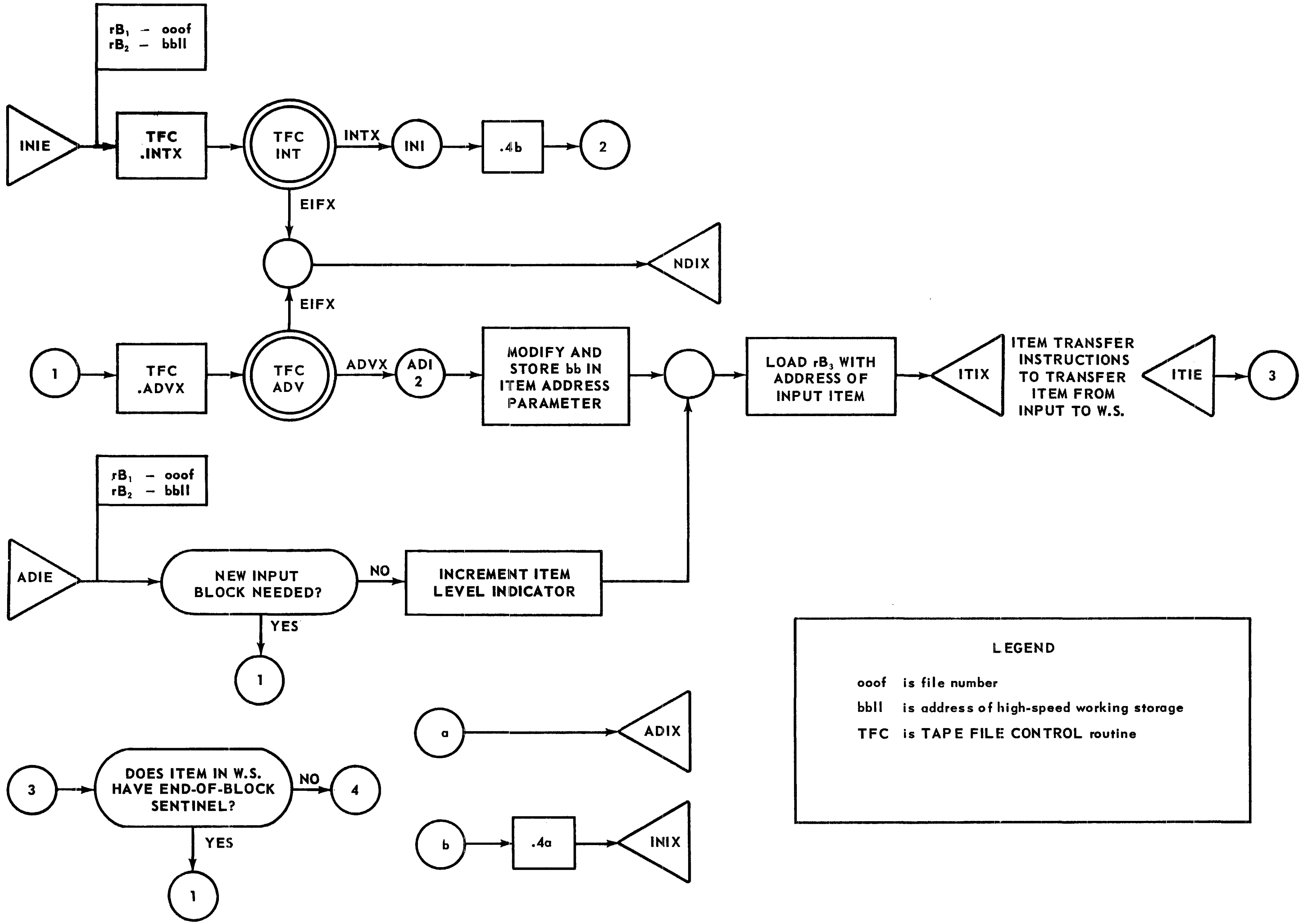
		EXIT	bb+15	1761	1164	1087	1089	1017
		NAME	ITOX	ADOX	PSFX	ENTX	ENFX	FULX[4]
		EXIT CONDITIONS	rB_1: 000f rB_2: bbll (w.s.) rB_3: bbll (output (item address)	rB_1: 000f rB_2: bbll (w.s.) rB_3: bbll (output (item address) rA,rL,rX:destroyed	rB_1: 000f rB_2: not used. rB_3,rA,rL,rX: destroyed.	rB_1: 000f rB_2;rB_3: not used. rA, rL,rX:destroyed	rB_1: 000f rB_2,rB_3:not used. rA,rL,rX:destroyed	rB_1: 000f rB_2: bbll (w.s.) rB_3: bbll (output item address) rA,rL,rX:destroyed
ENTRANCE	NAME	ENTRANCE CONDITIONS						
1797	ADOE	rB_1: 000f rB_2: bbll (w.s.)	Normal					
1697	ITOE	Output Item in Output Area rB_1: 000f rB_2: bbll (w.s.) rB_3: bbll (output item address)		Normal				End-of-Tape
1015	PSFE	rB_1: 000f			Normal			End-of-Tape
1020	ENTE	rB_1: 000f				Normal		
1026	ENFE	rB_1: 000f					Normal	

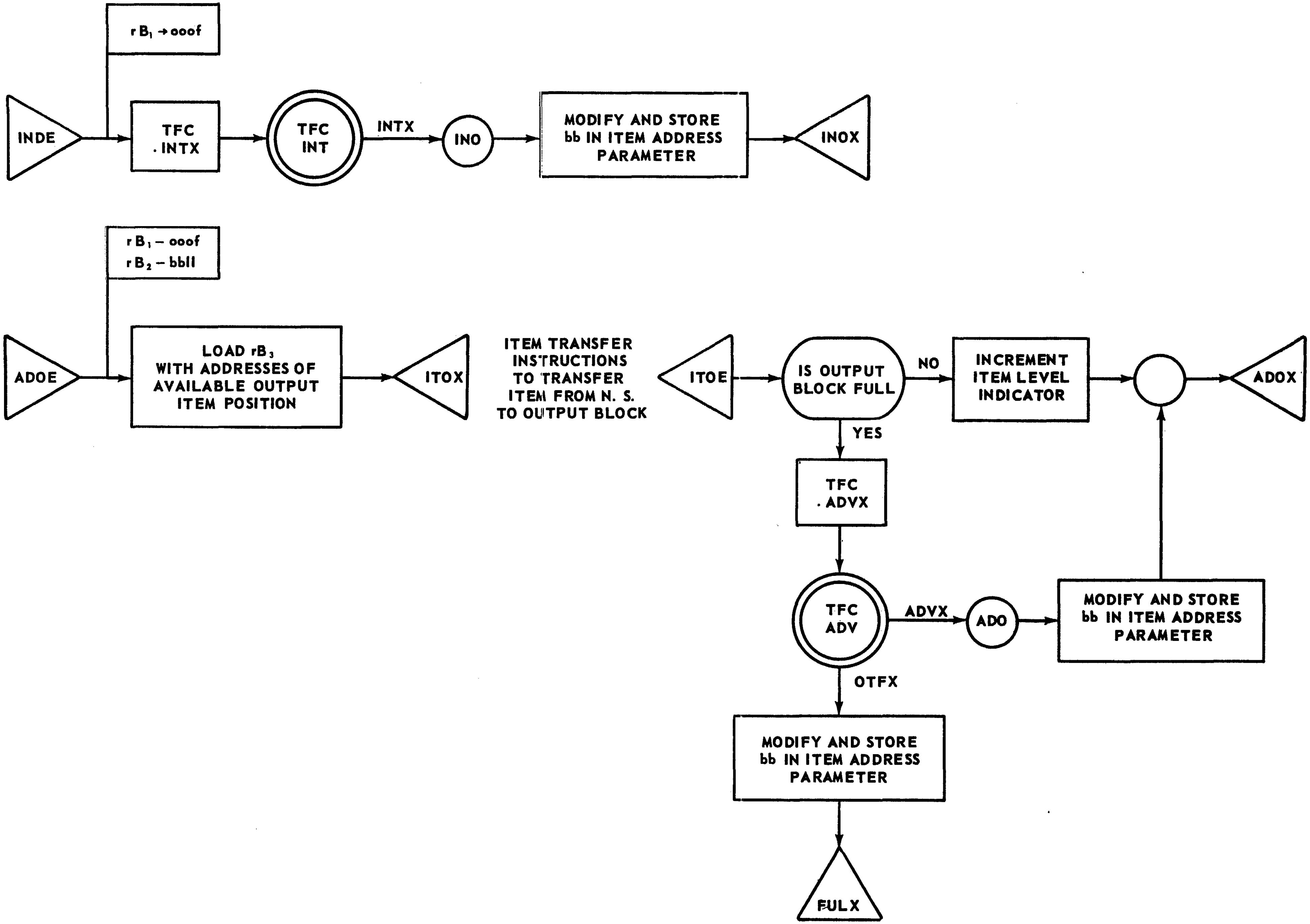
[4]The conditions shown are those associated with ITOE. The conditions for PSFE are as follows:

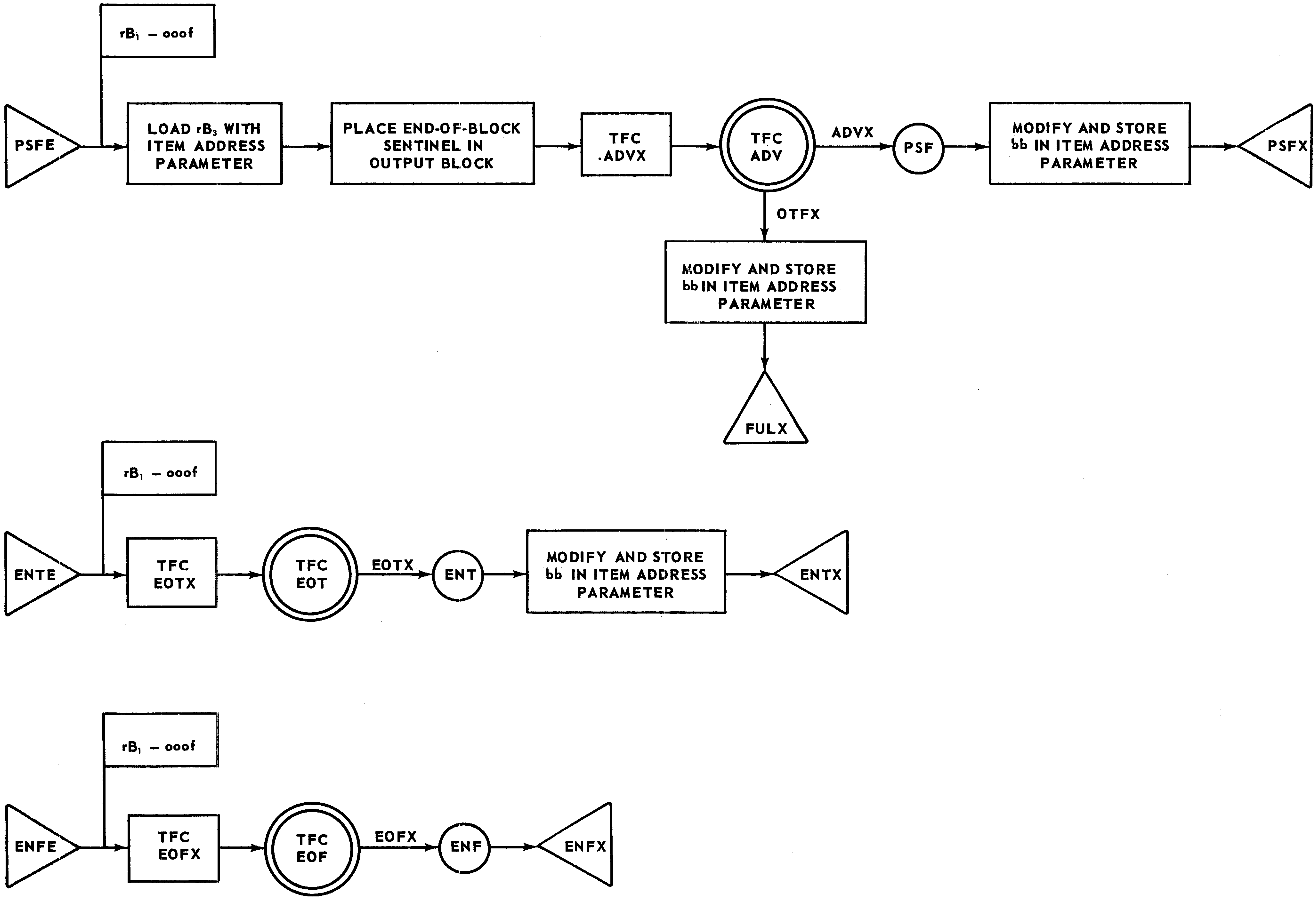
r$_1$: 000f

rB_2: not used

Registers B_3, A, L and X destroyed.


rB1 – ooof
rB2 – bbll
INIE
TFC .INTX
TFC INT
INTX
INI
.4b
2
EIFX
NDIX
EIFX
1
TFC .ADVX
TFC ADV
ADVX
ADI 2
MODIFY AND STORE bb IN ITEM ADDRESS PARAMETER
LOAD rB3 WITH ADDRESS OF INPUT ITEM
ITIX
ITEM TRANSFER INSTRUCTIONS TO TRANSFER ITEM FROM INPUT TO W.S.
ITIE
3
rB1 – ooof
rB2 – bbll
ADIE
NEW INPUT BLOCK NEEDED?
NO
INCREMENT ITEM LEVEL INDICATOR
YES
1
a
ADIX
3
DOES ITEM IN W.S. HAVE END-OF-BLOCK SENTINEL?
NO
4
YES
1
b
.4a
INIX
LEGEND
ooof is file number
bbll is address of high-speed working storage
TFC is TAPE FILE CONTROL routine


rB₁ → ooof
INDE
TFC
. INTX
TFC
INT
INTX
INO
MODIFY AND STORE
bb IN ITEM ADDRESS
PARAMETER
INOX
rB₁ – ooof
rB₂ – bbll
ADOE
LOAD rB₃
WITH ADDRESSES OF
AVAILABLE OUTPUT
ITEM POSITION
ITOX
ITEM TRANSFER
INSTRUCTIONS
TO TRANSFER
ITEM FROM N. S.
TO OUTPUT BLOCK
ITOE
IS OUTPUT
BLOCK FULL
NO
INCREMENT
ITEM LEVEL
INDICATOR
ADOX
YES
TFC
. ADVX
TFC
ADV
ADVX
ADO
MODIFY AND STORE
bb IN ITEM ADDRESS
PARAMETER
OTFX
MODIFY AND STORE
bb IN ITEM ADDRESS
PARAMETER
FULX


rB₁ – ooof
PSFE
LOAD rB₃ WITH ITEM ADDRESS PARAMETER
PLACE END-OF-BLOCK SENTINEL IN OUTPUT BLOCK
TFC .ADVX
TFC ADV
ADVX
PSF
MODIFY AND STORE bb IN ITEM ADDRESS PARAMETER
PSFX
OTFX
MODIFY AND STORE bb IN ITEM ADDRESS PARAMETER
FULX
rB₁ – ooof
ENTE
TFC EOTX
TFC EOT
EOTX
ENT
MODIFY AND STORE bb IN ITEM ADDRESS PARAMETER
ENTX
rB₁ – ooof
ENFE
TFC EOFX
TFC EOF
EOFX
ENF
ENFX

ITC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0001	001	010	1696	30	4200	1711	1
0002	001	020	1711	25	1715	1726	1
0003	001	030	1726	20	000B	1730	
0004	001	040	1730	82	1734	1733	
0005	001	050	1733	25	000B	1737	
0006	001	060	1737	70	1742	1747	
0007	001	070	1742	00	0002	0000	6
0008	001	080	1747	60	4200	000A	1
0009	001	090	1602	30	0000	1656	2
0010	001	100	1656	25	1658	1660	
0011	001	110	1658	0F	FFFF	FFF1	
0012	001	120	1660	37	0100	1665	
0013	001	130	1665	82	1734	1668	
0014	001	140	1734	25	1738	1741	
0015	001	150	1738	00	1640	0000	
0016	001	160	1741	60	1036	1099	
0017	001	170	1640	25	4200	1661	1
0018	001	180	1661	35	1666	1673	
0019	001	190	1673	20	000C	1680	
0020	001	200	1680	20	1683	1686	

ITC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0021	002	010	1683	00	0001	0000	
0022	002	020	1686	60	4200	000A	1
0023	002	030	1797	25	4200	000A	1
0024	002	040	1697	30	4200	1712	1
0025	002	050	1712	25	1715	1727	1
0026	002	060	1727	20	000B	1731	
0027	002	070	1731	82	1736	1735	
0028	002	080	1735	25	000B	1739	
0029	002	090	1739	70	1742	1745	
0030	002	100	1745	60	4200	1761	1
0031	002	110	1736	25	1600	1603	
0032	002	120	1600	00	1641	0000	
0033	002	130	1603	60	1036	1099	
0034	002	140	1641	25	4200	1662	1
0035	002	150	1662	35	1666	1670	
0036	002	160	1666	HH	0000	HHHH	
0037	002	170	1670	20	000C	1676	
0038	002	180	1676	20	1683	1685	
0039	002	190	1685	60	4200	1761	1
0040	002	200	1001	25	1605	1607	

0041	003	010	1605	00	1620	0000	
0042	003	020	1607	60	1038	1188	
0043	003	030	1620	25	1665	1674	
0044	003	040	1674	70	1677	1682	
0045	003	050	1677	00	0000	0022	
0046	003	060	1682	60	1665	1635	
0047	003	070	1635	42	0573	1640	
0048	003	080	1690	25	1665	1667	
0049	003	090	1667	75	1677	1681	
0050	003	100	1681	60	1665	1184	
0051	003	110	1009	25	1612	1614	
0052	003	120	1612	00	1643	0000	
0053	003	130	1614	60	1038	1188	
0054	003	140	1643	25	4200	1663	1
0055	003	150	1663	20	0000	1672	
0056	003	160	1672	20	1683	1687	
0057	003	170	1687	60	4200	1173	1
0058	003	180	1700	25	4200	1762	1
0059	003	190	1762	35	1764	1766	
0060	003	200	1764	HH	0000	HHHH	

ITC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0061	004	010	1766	20	000C	1770	
0062	004	020	1770	20	1772	1774	
0063	004	030	1772	00	0001	0000	
0064	004	040	1774	60	4200	1017	1
0065	004	050	1072	00	1046	0000	
0066	004	060	1098	00	1700	0000	
0067	004	070	1026	00	1084	0000	
0068	004	080	1054	00	1089	0000	
0069	004	090	1020	00	1093	0000	
0070	004	100	1042	25	4200	1760	1
0071	004	110	1760	35	1764	1767	
0072	004	120	1767	20	1772	1775	
0073	004	130	1775	20	000C	1779	
0074	004	140	1779	60	4200	1087	1
0075	004	150	1015	25	4200	1611	1
0076	004	160	1611	35	1613	1615	
0077	004	170	1613	HH	HHHH	0000	
0078	004	180	1615	20	1617	000A	
0079	004	190	1617	00	0000	1622	
0080	004	200	1622	25	1624	1626	

ITC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0081	005	010	1624	0F	FFFF	FFF1	
0082	005	020	1626	37	0100	1630	
0083	005	030	1630	05	1632	1634	
0084	005	040	1632	00	1740	0000	
0085	005	050	1740	50	0000	1746	3
0086	005	060	1634	65	1036	1638	
0087	005	070	1638	60	0000	1650	3
0088	005	080	1650	42	0573	1099	
0089	005	090	1746	25	4200	1768	1
0090	005	100	1768	35	1666	1684	
0091	005	110	1684	20	000C	1688	
0092	005	120	1688	20	1772	1785	
0093	005	130	1785	60	4200	1164	1

U 1775.26

UNIVAC® SOLID-STATE COMPUTER - MEMORY CHART

PROGRAM: ITC00-OT00

BAND: 10			
10 00 TO 10 99		11 00 TO 11 99	
00	50	00	50
01 02-20	51	01	51
02	52	02	52
03	53	03	53
04	54 04-08	04	54
05	55	05	55
06	56	06	56
07	57	07	57
08	58	08	58
09 03-11	59	09	59
10	60	10	60
11	61	11	61
12	62	12	62
13	63	13	63
14	64	14	64 PSFX
15 04-15	65	15	65
16	66	16	66
17 FULX	67	17	67
18	68	18	68
19	69	19	69
20 04-09	70	20	70
21	71	21	71
22	72 04-05	22	72
23	73	23	73 INOX
24	74	24	74
25	75	25	75
26 04-07	76	26	76
27	77	27	77
28	78	28	78
29	79	29	79
30	80	30	80
31	81	31	81
32	82	32	82
33	83	33	83
34	84	34	84 INIX
35	85	35	85
36	86	36	86
37	87 ENTX	37	87
38	88	38	88
39	89 ENFX	39	89
40	90	40	90
41	91	41	91
42 04-10	92	42	92
43	93	43	93
44	94	44	94
45	95	45	95
46 NDIX	96	46	96
47	97	47	97
48	98 04-06	48	98
49	99	49	99

BAND: 16			
16 00 TO 16 99		17 00 TO 17 99	
00 02-12	50 05-08	00 03-18	50
01	51	01	51
02 01-09	52	02	52
03 02-13	53	03	53
04	54	04	54
05 03-01	55	05	55
06	56 01-10	06	56
07 03-02	57	07	57
08	58 01-11	08	58
09	59	09	59
10	60 01-12	10	60 04-11
11 04-16	61 01-18	11 01-02	61 ADOX
12 03-12	62 02-15	12 02-05	62 03-19
13 04-17	63 03-15	13	63
14 03-13	64	14	64 03-20
15 04-18	65 01-13	15 P2f0	65
16	66 02-16	16 P2f1	66 04-01
17 04-19	67 03-09	17 P2f2	67 04-12
18	68 ADIX	18 P2f3	68 05-10
19	69	19 P2f4	69
20 03-03	70 02-17	20 P2f5	70 04-02
21	71	21 P2f6	71
22 04-20	72 03-16	22 P2f7	72 04-03
23	73 01-19	23 P2f8	73
24 05-01	74 03-04	24 P2f9	74 04-04
25	75	25	75 04-13
26 05-02	76 02-18	26 01-03	76
27	77 03-05	27 02-06	77
28	78	28	78
29	79	29	79 04-14
30 05-03	80 01-20	30 01-04	80
31	81 03-10	31 02-07	81
32 05-04	82 03-06	32	82
33	83 02-01	33 01-05	83
34 05-06	84 05-11	34 01-14	84
35 03-07	85 02-19	35 02-08	85 05-13
36	86 02-02	36 02-11	86
37	87 03-17	37 01-06	87
38 05-07	88 05-12	38 01-15	88
39	89	39 02-09	89
40 01-17	90 03-08	40 05-05	90
41 02-14	91	41 01-16	91
42	92	42 01-07	92
43 03-14	93	43	93
44	94	44	94
45	95	45 02-10	95
46	96 01-01	46 05-09	96
47	97 02-04	47 01-08	97 02-03
48	98	48	98
49	99	49	99

P2=Item limits parameter
f0,f1,...fn=File number.
U 1775.26

UNIVAC® SOLID-STATE COMPUTER - MEMORY CHART

PROGRAM: ITC00-OT00

BAND: 42			
42 00 TO 42 99		43_00 TO _4399	
00 P1f0	50	00	50
01 P1f1	51	01	51
02 P1f2	52	02	52
03 P1f3	53	03	53
04 P1f4	54	04	54
05 P1f5	55	05	55
06 P1f6	56	06	56
07 P1f7	57	07	57
08 P1f8	58	08	58
09 P1f9	59	09	59
10	60	10	60
11	61	11	61
12	62	12	62
13	63	13	63
14	64	14	64
15	65	15	65
16	66	16	66
17	67	17	67
18	68	18	68
19	69	19	69
20	70	20	70
21	71	21	71
22	72	22	72
23	73	23	73
24	74	24	74
25	75	25	75
26	76	26	76
27	77	27	77
28	78	28	78
29	79	29	79
30	80	30	80
31	81	31	81
32	82	32	82
33	83	33	83
34	84	34	84
35	85	35	85
36	86	36	86
37	87	37	87
38	88	38	88
39	89	39	89
40	90	40	90
41	91	41	91
42	92	42	92
43	93	43	93
44	94	44	94
45	95	45	95
46	96	46	96
47	97	47	97
48	98	48	98
49	99	49	99

BAND:			
00 TO 99		00 TO 99	
00	50	00	50
01	51	01	51
02	52	02	52
03	53	03	53
04	54	04	54
05	55	05	55
06	56	06	56
07	57	07	57
08	58	08	58
09	59	09	59
10	60	10	60
11	61	11	61
12	62	12	62
13	63	13	63
14	64	14	64
15	65	15	65
16	66	16	66
17	67	17	67
18	68	18	68
19	69	19	69
20	70	20	70
21	71	21	71
22	72	22	72
23	73	23	73
24	74	24	74
25	75	25	75
26	76	26	76
27	77	27	77
28	78	28	78
29	79	29	79
30	80	30	80
31	81	31	81
32	82	32	82
33	83	33	83
34	84	34	84
35	85	35	85
36	86	36	86
37	87	37	87
38	88	38	88
39	89	39	89
40	90	40	90
41	91	41	91
42	92	42	92
43	93	43	93
44	94	44	94
45	95	45	95
46	96	46	96
47	97	47	97
48	98	48	98
49	99	49	99

P1=Item Address Parameter.
f0,f1,...,fn=File number.

DEMAND TAPE CONTROL ROUTINE

PURPOSE

TFCOO-OTOO is designed to transfer one block of data from tape to computer memory or from computer memory to tape upon demand. It utilizes one index register.

DESCRIPTION

TFCOO-OTOO controls all tape operations associated with a computer run, and, in addition, performs the following functions associated with almost all tape data processing runs:

A. Checking of input file label.

B. Writing and incrementing of output file label.

C. Alternating Uniservos for each file.

D. Maintaining block count (including label block, data blocks, bypassed blocks, and first sentinel block) for input and output tapes.

E. Comparing input block count with block count read from input tape.

F. Controlling number of blocks written output tapes.

G. Detecting end-of-tape and end-of-file sentinels on input tapes.

H. Fabricating end-of-tape and end-of-file sentinel blocks and writing them on output tapes.

TFCOO-OTOO is used in conjunction with a tape error control routine (TECOO-OTOO or TECO1-OTOO) and may be used in conjunction with an HSR, RPU or STP routine. No standby storage bands are used. Each file is assigned one and only one input or output band.

The use of TFCOO-OTOO requires the loading and storing of six information words for each file prior to commencement of run. These six words per file comprise the parameters for TFCOO-OTOO and include details about the specific run such as tape labels, Uniservoes used, block limits, etc..[1]

---

[1]See PARAMETERS section for a complete listing of required specifications.

TFC00-OT00 is divided into four sections according to the functions performed: They are as follows:

I. Initializing a File (INT)[2]

To start the flow of data to or from the first or successive tapes of a file, certain functions must be performed. This involves:

A. Setting the block count (always associated with the current tape of the file) equal to zero.

B. Alternating the Uniservo number for the file (as defined in the Identification Block).

C. Accessing, incrementing and restoring the label for each tape.

D. If the file is input, checking the label on the tape against the label stored in memory.

E. If the file is output, writing the Identification block containing the incremented label on tape.

INT is entered directly once for the start of each file only. All succeeding entrances are accomplished under control of TFC00-OT00 itself.

INT is entered once for each file being used in the program.[3] It is entered at location 1188 (INTE) with the file number in Index Register 1 (rB_1) in the form 000f. If f is an input file, the Identification[1] block will be read and checked and the first block of data transferred from tape to a band in memory (see STORAGE ALLOCATION). If f is an output file, the Identification block will be written. Upon execution of this section, control will normally be returned at location 1038 (INTX), with the band number for the file located in rX in the form 00bb000000 and the file number located in rB_1 in the form 000f. The contents of Index Registers 2 and 3 (rB_2, rB_3) will not be changed. The contents of rA and rL will be destroyed.

If an end-of-file sentinel (see TERMINATING A FILE, Section IV) is detected upon entering INT, control is returned at location 1072 (EIFX) with the file number located in rB_1 in the form 000f. In this instance the contents of rB_2 and rB_3 will not be changed and the contents of rA, rX and rL, destroyed.

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[2]Each section has been assigned a symbolic three digit name. By appending the letters E or X, the entrance or exit line can be represented. Each symbolic line signifies an actual machine location.

[3]If an HSR routine is used, it should be initiated prior to initiating any tape file.

II. Advancing a File (ADV)

This section is entered each time it is necessary to transfer a block from an input file tape to a band in memory (see STORAGE ALLOCATION) or from a band in memory to an output file tape. In the case of advancing an output block, write-compute time can be overlapped after the write instruction is initiated. However, in the case of advancing an input block, no processing may take place until data is in memory. The actual tape advance is preceded by a repeatedly executed tape buffer test (until passed) and, if the previous tape operation was a write, an examination of the tape error flip-flops. If the previous tape instruction was a read, the tape error flip-flops for this operation were tested prior to exit from the section. When a tape error condition is indicated, control is transferred to the tape error control routine (TEC00-OT00 or TEC01-OT00).

ADV is entered at location 1099 (ADVE) with rB_1 containing the file number in the form 000f. f is the number of the file to be advanced. If an input file is to be advanced, the data previously stored in the band for this file must have been processed. If an output file, the data must be stored in the band as desired prior to entry. Upon execution of this section, control will normally be returned at location 1036 (ADVX) with the band number for the file located in rX in the form 00bb000000 and the file number in rB_1 in the form 000f.[4] The contents of rB_2 and rB_3 will not be changed. The contents of rA and rL are destroyed.

If an end-of-file sentinel (see TERMINATING A FILE, Section IV) is detected upon entering ADV, control will be returned at location 1072 (EIFX) with the file number located in rB_1 in the form 000f. In this instance the contents of rB_2 and rB_3 will not be changed and the contents of rA, rX and rL, destroyed.

When ADV is entered to advance an output block, and that block causes the output block limit to be reached (as specified in parameters), control will be returned once at location 1098 (OTFX) with the band number for the file located in rX into form 00bb000000 and the file number in rB_1 in

---

[4]If desired, this exit location (or any other exit line) may be programmed to contain a single instruction which, depending upon the file being advanced, will transfer control to the processing instructions for the related file. Since rB_1 contains 000f, a skip instruction, keyed to be modified by rB_1 would send control to location xxxx+000f. Location xxxx+000f could then contain the first processing instruction for file f.

the form 000f. The contents of rB_2 and rB_3 will not be changed and the contents of rA and rL, destroyed. The output tape, normally, is then terminated by entering EOT (see TERMINATING A FILE, Section IV). However it is possible to ignore the previously specified block limit and transfer more data to tape by re-entering ADV. However, control will not be returned to OTFX again.

III. Demand Advance (DMN)

This section is entered to execute a read, write or rewind tape instruction associated with a Uniservo not specified as used for a data file in the parameters (e.g. overlaying instructions in memory from instructions on tape). In addition, it is employed internally by TFC00-OT00 when a bypass sentinel is detected on an input tape or when an identification or sentinel block is being handled (see TERMINATING A FILE, Section IV). During the execution of DMN, neither read-compute nor write-compute time is overlapped. The functions normally performed by TFC00-OT00 (e.g. checking of input file label, writing and incrementing of output file label, etc.) are not executed when DMN is entered.[5]

When using DMN, the tape instruction and the buffer transfer instruction must be supplied with 0000 in the c portions. DMN is entered at location 1077 (DMNE) with an F2, G2 or H2 instruction in rA and an C6 or F6 instruction in rX (if an F2 instruction is stored in rA, no instruction is stored in rX). Upon execution of this section, control is returned at location 1178 (DMNX). The contents of rB_1, rB_2 and rB_3 will not be changed; the contents of rA, rL, and rX, destroyed.

IV. Terminating a File

The termination of a file, or tape within a file, is dependent upon functions performed by other sections. ADV maintains block counts for input (and output) tapes, checking for a "full" tape as specified by the block limit in the parameters for the output tapes and by detecting sentinel blocks on input tapes. For input tapes, these functions are performed for each block after it has been successfully transferred to memory. For output tapes, they are performed during transfer of data from the buffer to tape before returning control at the exit line.

A. Input Files

The termination of input tapes and files is a function of ADV or INT. A test is made for three types of sentinels: end-of-tape, end-of-file, and bypass.

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[5]See list of functions on page 1.

1. The bypass sentinel, indicating temporary termination of input data, (FFFFFFFF20, where F equals the undigit 1101, at level 019 of data band) when detected, causes a series of read instructions to be executed by automatically entering the Demand Advance section (see above). When a second bypass sentinel is detected, control is automatically returned to the Advance Section, and a block of valid data is transferred to memory.

2. The end-of-tape sentinel (FFFFFFFF30, where F equals the undigit 1101 at level 019 of data band), when detected, causes rewind of the tape and initiation of the next tape of the associated file and advance of the first block following the Identification Block.

3. The end-of-file sentinel (FFFFFFFF40), where F equals the undigit 1101 at level 019 of data band) when detected, causes the tape to be rewound and control returned to location 1072 (EIFX).

B. Output Files (EOT, EOF)

The indication that output tapes or files are to be terminated is a function of ADV. However, the actual termination is a function of the end-of-tape (EOT) or end-of-file (EOF) sub-sections.

The end-of-tape on output files is determined by reaching equality between the block count and the block limit. Unless more blocks are to be added to the output tape, EOT is to be entered. As a result, two end-of-tape sentinel blocks will be written and the tape will be rewound.[6] The next output tape will then be initiated automatically. EOT is entered at location 1093 (EOTE) with rB_1 containing the file number in the form 000f. Upon execution, control will be returned at location 1042 (EOTX) with the band number of the file in rX in the form 00bb000000 and the file number in rB_1 in the form 000f. The contents of rB_2 and rB_3 will not be changed; the contents of rA, rX and rL, destroyed.

When all data for a file has been processed, EOF is entered. Two end-of-file sentinel blocks will be written

[6] The data band for the first sentinel block will contain the sentinel, FFFFFFFF30 at level 019. The data band for both sentinel blocks will contain the block count for this tape, bbbb000000, at level 081.

on the tape in question and it will be rewound.[7] EOF is entered at location 1084 with rB_1 containing the file number in the form 000f. Upon execution, control will be returned at location 1054 (EOFX) with the file number in rB_1 in the form 000f. The contents of rA, rX and rL, destroyed.

PROGRAMMING PROCEDURES

Own Coding a Op m c	Routine Coding a Op m c	Remarks
I. Initialize a File (INT)		
02 000f 1188		Entrance to INT.
	1188 [TFC00-OT00 Inst.]	Initializes file specified by f in rB_1.
	[TFC00-OT00 Inst.] 1038	Normal exit from INT. rX contains band number; rB_1, file number.[8,9]
	[TFC00-OT00 Inst.] 1072	End-of-input-file exit from INT, rB_1 contains file number.[8,10]
II. Advancing a File (ADV)		
02 000f 1099		Entrance to ADV.
	1099 [TFC00-OT00 Inst.]	Advances block for file specified by f in rB_1.
	[TFC00-OT00 Inst.] 1036	Normal exit from ADV. rX contains band number; rB_1, file number.[8,9]
	[TFC00-OT00 Inst.] 1072	End-of-input file exit from ADV. rB_1 contains file number.[8,10]
	[TFC00-OT00 Inst.] 1098	Output Block limit exit from ADV. rX contains band number; rB_1 file number.[8,9]

[7] The data band for the first sentinel block will contain the sentinel, FFFFFFFF40 at level 019. The data band for both sentinel blocks will contain the block count for this tape, bbbb000000, at level 081.

[8] rB_2, rB_3 not used.

[9] rA, rL, destroyed.

[10] rA, rX, rL destroyed.

Own Coding a Op m c	Routine Coding a Op m c	Remarks
II. Demand Advance (DMN)		
25 aaaa bbbb aaaa [Tape Inst.] 0000 bbbb 05 cccc 1077 cccc [Buffer Inst.] 0000	1077 [TFC00-OT00 Inst.]	Entrance to DMN. Executes G2 or H2 as specified in rA, and C6 or F6 as specified in rX; or F2 as specified in rA (rX not used).
	[TFC00-OT00 Inst.] 1178	Exit from DMN.[8,10] rB_1, not used.
IV. Terminating a File		
A. Input File		
	[TC00-OT00 Inst.] 1072	Exit from either INT or ADV when an end-of-file sentinel is detected on input tape (see I and II above).[8,10]
B. Output Files (EOT, EOF)		
	[TFC00-OT00 Inst.] 1098	Exit from ADV when block limit is reached for output tape. rX contains band number; rB_1, file number (see II above).[8,9]
02 000f 1093	1093 [TFC00-OT00 Inst.]	Entrance to EOT to terminate tape of file specified by f in rB_1 and initialize alternate tape.
	[TFC00-OT00 Inst.] 1042	Exit from EOT. rX contains band number; rB_1, file number.[8,9]
02 000f 1084	1084 [TFC00-OT00 Inst.]	Entrance to EOF to terminate file specified by f in rB_1.
	[TFC00-OT00 Inst.] 1054	Exit from EOF. rB_1 contains file number.[8,10]

PARAMETERS

The six words listed below must be stored in the locations indicated, one set per file. The location (level) used, represents the file number (f). The LSD of the address for all parameters for a specific file is the same. It is suggested that level x0 be used for the first file, x1 for the second, etc.; file numbers starting at zero and numbered in sequence. If a file number is omitted; i.e. a specific file is not to be used in a computer run, zeros must be substituted for the parameters in the related locations. A total of ten files may be specified in a program ($0 \leq f \leq 9$). The parameters are as follows:

Location	Content	Explanation
110f	xxxxxxxxxx	File label or identification.[11] f = file number ($0 \leq f \leq 9$).
111f	$t\Delta s_1 s_2 mr\Delta\Delta\Delta\Delta$	where, t=type of file. =G for input files. =H for output files. $s_1 s_2$ =Uniservos used. s_1 =Initial Uniservo for this file. s_2 =Alternate Uniservo for this file. $=s_1$, if only one Uniservo for this file. m=Mode and density =0 for USS mode, 250 cpi =5 for Univac mode, 250 cpi[12] =6 for Univac mode, 235 cpi[12] r=Rewind information. =0, for rewind without interlock. =2, for rewind with interlock.

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[11] The label of each input tape will be checked. A label block will be written on each output tape. One will be added to the least significant digit of the file label for each incoming or outgoing reel of the file prior to checking or writing. Therefore, at least the LSD should be a zero if label discrepancies are to be avoided. If, during processing the predicted input file label does not match the actual tape label, the computer is brought to a halt. TFC00 is designed to allow the replacement of the predicted file label by the actual file label at this point. This feature provides for the acceptance of all subsequent tapes belonging to the same file.

[12] While TFC00 is designed to be used with tapes observing USS conventions, 720 character blocks can be written and read.

Location	Content	Explanation
112f	e△△aaa△△△△	where, e = F designates this file has the highest file number. = C for all other files. aaa = band level of file label in identification block (level 017 and 111 are used by the sort routines).
113f	cccc△△llll	where, cccc = 0000 (cccc is used by TFC00 to store block count during processing). llll = Block limit for output tapes. = 0000 for input tapes.
114f[13]	F6bb001003	Tape buffer instruction for input file where bb= band used for file.
	or	
	C6bb001053	Tape buffer instruction for output file where bb=band used for file.
135f	G2s_1s_2m01071	Tape instruction for input file. s_1s_2m = s_1s_2m as specified in location 111f.
	or	
	H2s_1s_2m01197	Tape instruction for output file. s_1s_2m = s_1s_2m as specified in location 111f.

---

[13] The band (bb) in these locations may be changed by programmed modifications, if required. Prior to entering ADV, store the F6 or C6 instruction in location 114f. This instruction will be executed by TFC00 until modified again. In this way it is possible to write directly from several "input" bands, thus facilitating the programming of such runs as a general merge.

STORAGE ALLOCATION

A band number must be specified in the parameters for each file used in the program. TFCOO reads or writes using the standard tape interlace which is as follows:

TAPE WORD PAIR	BAND LEVEL	TAPE WORD PAIR	BAND LEVEL	TAPE WORD PAIR	BAND LEVEL	TAPE WORD PAIR	BAND LEVEL
00	001, 006	25	051, 056	50	101, 106	75	151, 156
01	059, 064	26	109, 114	51	159, 164	76	009, 014
02	117, 122	27	167, 172	52	017, 022	77	067, 072
03	175, 180	28	025, 030	53	075, 080	78	125, 130
04	033, 038	29	083, 088	54	133, 138	79	183, 188
05	091, 096	30	141, 146	55	191, 196	80	041, 046
06	149, 154	31	199, 004	56	049, 054	81	099, 104
07	007, 012	32	057, 062	57	107, 112	82	157, 162
08	065, 070	33	115, 120	58	165, 170	83	015, 020
09	123, 039	34	173, 178	59	023, 028	84	073, 078
10	181, 186	35	031, 036	60	081, 086	85	131, 136
11	039, 044	36	089, 094	61	139, 144	86	189, 194
12	097, 102	37	147, 152	62	197, 002	87	047, 052
13	155, 160	38	005, 010	63	055, 066	88	105, 110
14	013, 018	39	063, 068	64	113, 118	89	163, 168
15	071, 076	40	121, 126	65	171, 176	90	021, 026
16	129, 134	41	179, 184	66	029, 034	91	079, 089
17	187, 192	42	037, 042	67	087, 092	92	137, 142
18	045, 050	43	095, 100	68	145, 150	93	195, 000
19	103, 108	44	153, 158	69	003, 008	94	053, 058
20	161, 166	45	011, 016	70	061, 066	95	111, 116
21	019, 024	46	069, 074	71	119, 124	96	169, 174
22	077, 082	47	127, 132	72	177, 182	97	027, 032
23	135, 140	48	185, 190	73	035, 040	98	085, 090
24	193, 198	49	043, 048	74	093, 098	99	143, 148

MODIFICATIONS

A. TFCOO assumes the use of either HSR01 (Stop Section) for TUSS-90 or STP01-8C00 for TUSS-80.

1. If the Stop section or routine is not used the following additions must be made:

	Page	Line	Location	Instruction
TUSS-90	017	020	0674	26 000C 0000
TUSS-80	017	020	0419	26 000C 0000

2. Control is transferred to the HSR Stop section or routine at:

Page	Line	a
09	18	1393

TFCOO-OTOO incorporates a number of HSR buffer tests. Care should be taken that the "m" portion of these instructions refers to the particular HSR routine being used. The following is a list of locations of all "42" instructions within TFC00-OT00:

Page	Line	a	Page	Line	a
01	03	1004	07	17	1996
02	03	1228	08	03	1268
02	04	1180	09	13	1387
02	20	1293	11	01	1390
03	08	1190	11	03	1259
03	09	1099	12	07	1160
05	16	1022	13	05	1213
05	17	1031	14	01	1236
06	02	1374	14	13	1391
06	03	1032	14	16	1093
06	15	1041	14	12	1084
07	02	1926	15	16	1284
07	12	1925	16	13	1918

B. TFC00 does not assume the use of an RPU routine and therefore, does not include any "22" instructions. If required, they should be inserted in TFC00 every nine drum revolutions.

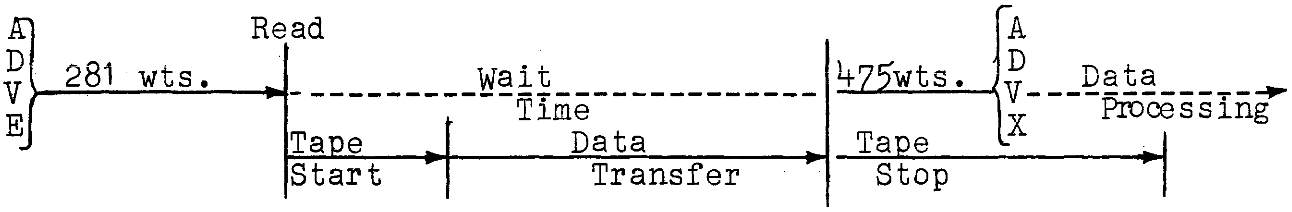
LENGTH

TFC00 occupies 331 locations in bands 10, 12 and 18. In addition, up to 60 locations in bands 10 and 12 may be used by PARAMETERS.

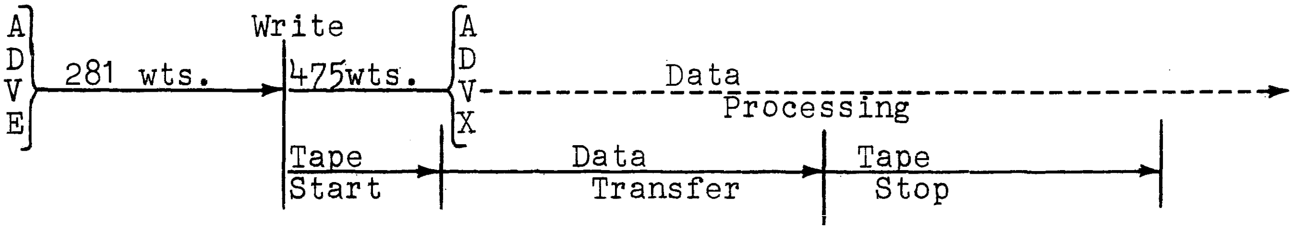
TIMING

A. Advancing a file when previous write instruction not still in progress:

1. Input



2. Output



B. If a previous write instruction is still in progress, there will be a delay until the tape buffer and servos become available. As soon as available, timing will be as above.

C. Demand Advance:

1. 304 wts. + Tape Start Time + Data Transfer Time + 148 wts. (The 148 wts. are overlapped with Tape Stop Time).

2. If a previous instruction was a write which was executed during ADV, there is an increase of 200 wts.

OPERATING PROCEDURES

A. Normal Procedures

Load TFC00-OT00, the cards containing the TFC00 PARAMETERS, either TEC00 or TEC01, and if used, HSR, STP or RPU routines.

B. Error Procedures

1. The following error indications are provided by TFC00:

Stop Identification	Explanation	Action
67 8021 000A	The rewind instruction was improperly executed. The rewind instruction is in rA.	Depress Run button to attempt repeat execution of rewind instruction. To bypass incorrect rewind indication, key 00 0000 000C into rC, set next instrucion at c, and depress Run button.
67 803s 1956	Block count does not check on current input tape. File number is in rB_1; machine block count, in rA; and tape block count in rL. s = Uniservo number.	To assume block count is correct, key 00 0000 000C into rC, set next instruction at c, and depress Run button. Otherwise, restart.

Stop Identification	Explanation	Action
67 804s 1324	Label does not check. Predicted label is in rA. Actual tape label is in rL. s = Uniservo number.	To accept actual tape label, key 00 0000 000C into rC, set next instruction at c, and depress Run button. Otherwise, rewind Uniservo and remount proper tape. Depress Run button.

2. Should a loop which consists of the instructions, F6 and 42, be entered, the computer should be brought to a stop on one instruction (after the HSR has ceased feeding cards). Key 00 0000 1165 into rC, set next instruction at c., set computer on continuous and depress Run button. This may allow the run to continue. The loop is caused by a tape buffer error.

3. If TFC00 is being used during program testing, and if the program is being executed on "one instruction", no write instruction can be properly carried out since the tape buffer is loaded after initiation of the write instruction. To write the desired information, set computer on stop compare when the write instruction appears in rC. Upon stopping at the next compare instruction, execution on one instruction may resumed.

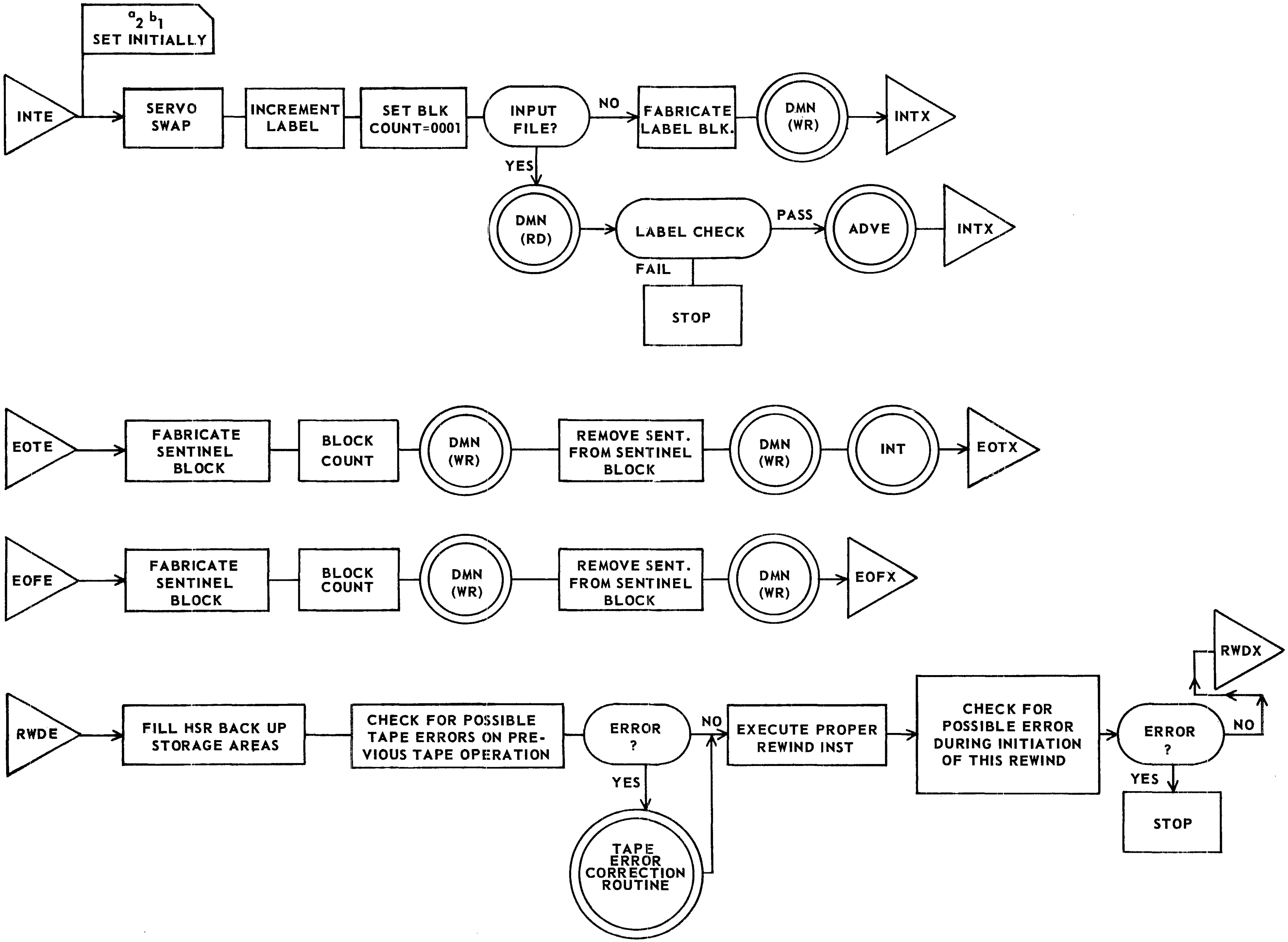
4. If rerun or restart is required, TFC00-OT00 and its parameters must be reloaded.

NOTE: Questions concerning this routine should be directed to Manager, Program Library Services, Remington Rand Univac, 315 Park Avenue South, New York 10, N. Y.

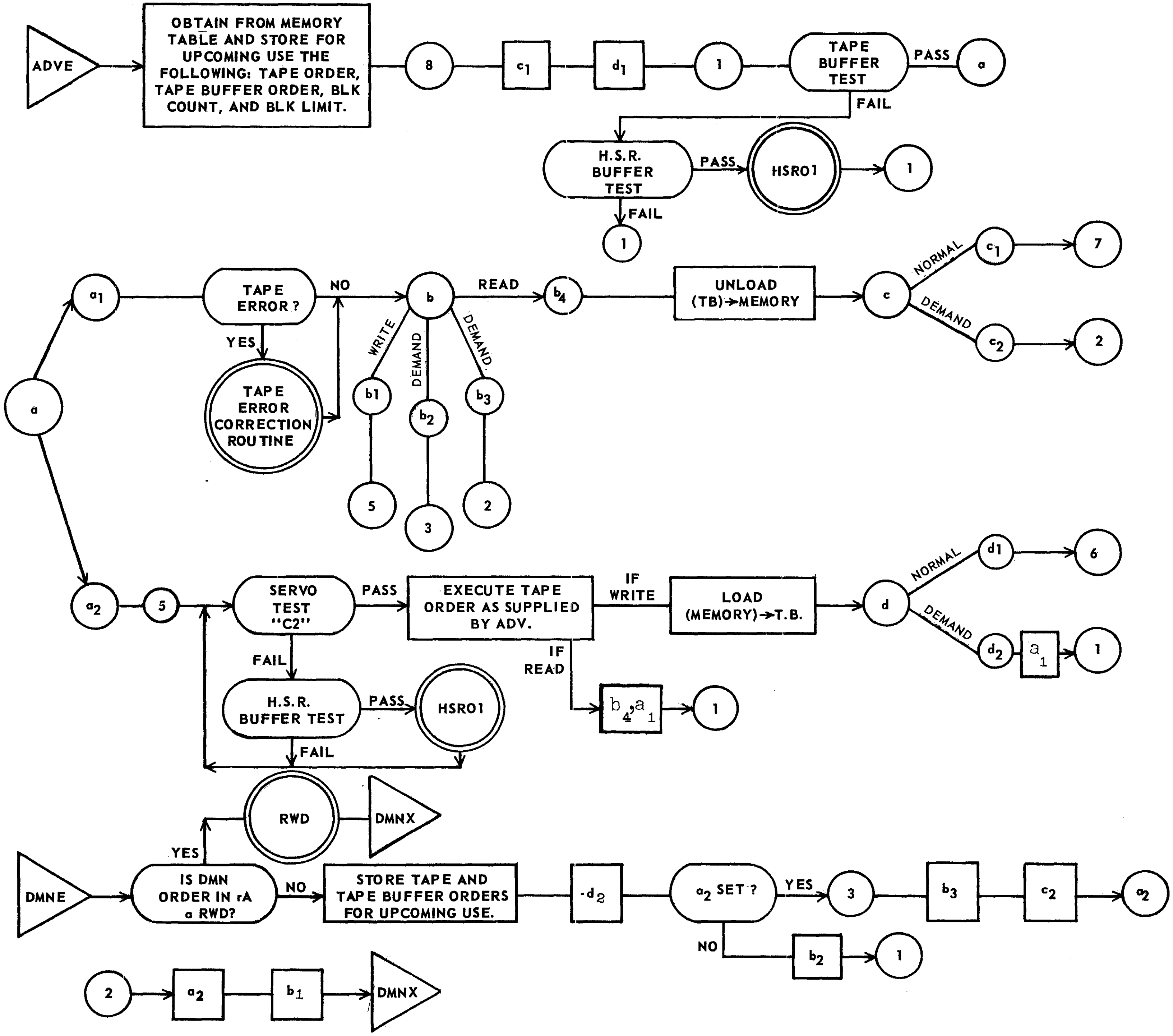
Date: 6/15/60
Revised: 8/10/60

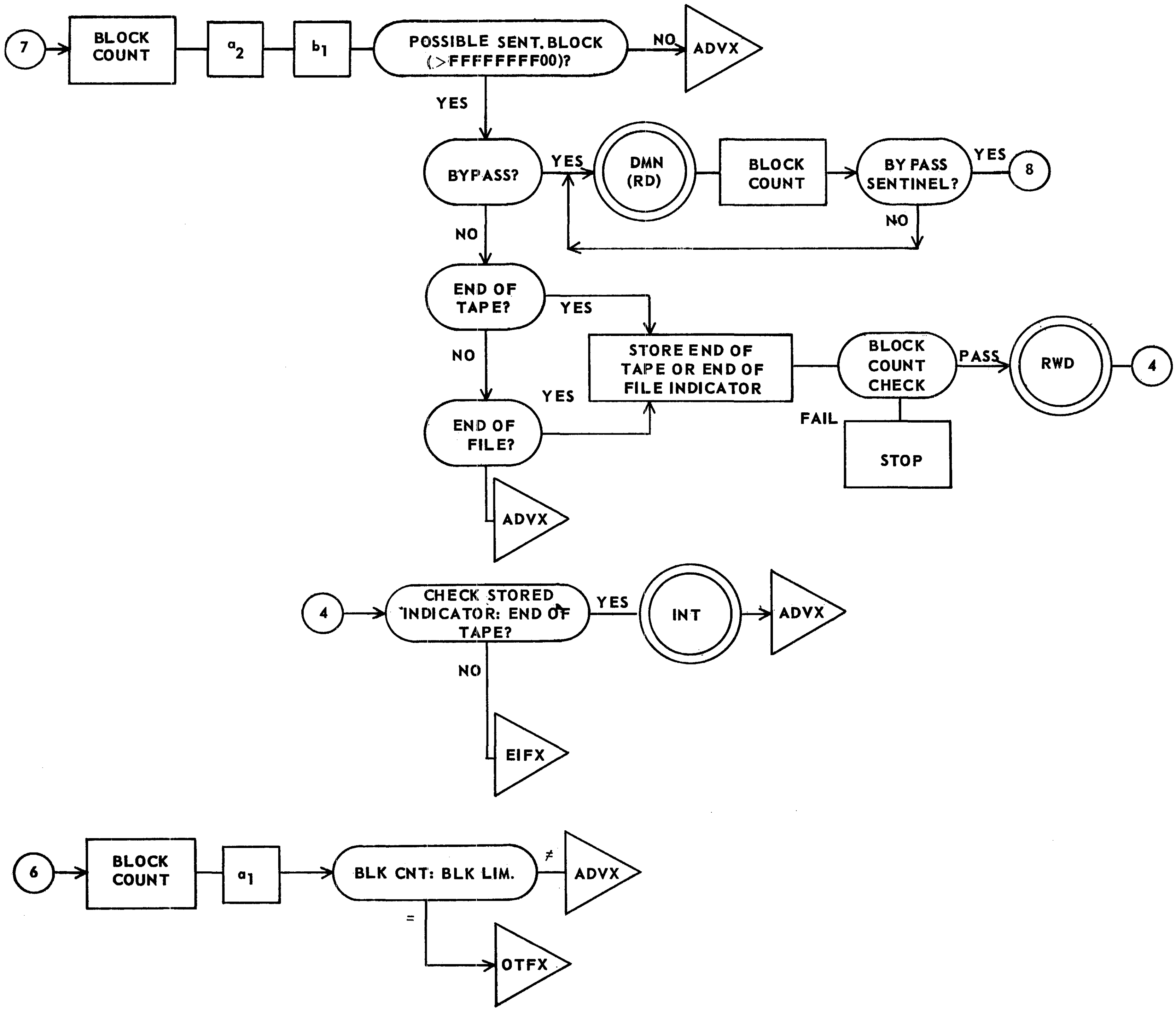
PROGRAMMING PROCEDURES (SUMMARY)

		Exit	1038	1036	1072	1098	1178	1042	1054
		Name	INTX	ADVX	EIFX	OTFX	DMNX	EOTX	EOFX
		Exit Conditions	rX: 00bb000000 rB_1: 000f rB_2,rB_3:not used. rA,rL: destroyed	rX: 00bb000000 rB_1: 000f rB_2,rB_3:not used. rA,rL: destroyed	rB_1: 000f rB_2,rB_3:not used. rA,rX,rL:destroyed	rX: 00bb000000 rB_1: 000f rB_2,rB_3:not used. rA,rL:destroyed	rB_1,rB_2,rB_3:not used. rA,rX,rL: destroyed	rX: 00bb000000 rB_1: 000F rB_2,rB_3:not used. rA,rL: destroyed	rB_1: 000f rB_2,rB_3:not used. rA,rX,rL:destroyed
Entrance	Name	Entrance Conditions							
1188	INTE	rB_1: 000f	Normal		End-of-file				
1099	ADVE	rB_1: 000f		Normal	End-of-file	Output block limit			
1077	DMNE	rX: C6bb000000 or F6bb000000 rA: G20xyz0000 or H20xy00000 or F20xy00000					Normal		
1093	EOTE	rB_1: 000f						Normal	
1084	EOFE	rB_1: 000f							Normal



a2 b1 SET INITIALLY
INTE
SERVO SWAP
INCREMENT LABEL
SET BLK COUNT=0001
INPUT FILE?
NO
FABRICATE LABEL BLK.
DMN (WR)
INTX
YES
DMN (RD)
LABEL CHECK
PASS
ADVE
INTX
FAIL
STOP
EOTE
FABRICATE SENTINEL BLOCK
BLOCK COUNT
DMN (WR)
REMOVE SENT. FROM SENTINEL BLOCK
DMN (WR)
INT
EOTX
EOFE
FABRICATE SENTINEL BLOCK
BLOCK COUNT
DMN (WR)
REMOVE SENT. FROM SENTINEL BLOCK
DMN (WR)
EOFX
RWDE
FILL HSR BACK UP STORAGE AREAS
CHECK FOR POSSIBLE TAPE ERRORS ON PREVIOUS TAPE OPERATION
ERROR ?
NO
YES
TAPE ERROR CORRECTION ROUTINE
EXECUTE PROPER REWIND INST
CHECK FOR POSSIBLE ERROR DURING INITIATION OF THIS REWIND
ERROR ?
NO
YES
STOP
RWDX


ADVE
OBTAIN FROM MEMORY TABLE AND STORE FOR UPCOMING USE THE FOLLOWING: TAPE ORDER, TAPE BUFFER ORDER, BLK COUNT, AND BLK LIMIT.
8
c1
d1
1
TAPE BUFFER TEST
PASS
a
FAIL
H.S.R. BUFFER TEST
PASS
HSRO1
1
FAIL
1
a
a1
TAPE ERROR ?
NO
YES
TAPE ERROR CORRECTION ROUTINE
b
READ
b4
UNLOAD (TB)→MEMORY
c
NORMAL
c1
7
DEMAND
c2
2
WRITE
DEMAND
DEMAND
b1
b2
b3
5
3
2
a2
5
SERVO TEST "C2"
PASS
EXECUTE TAPE ORDER AS SUPPLIED BY ADV.
IF WRITE
LOAD (MEMORY)→T.B.
d
NORMAL
d1
6
DEMAND
d2
a1
1
IF READ
b4,a1
1
FAIL
H.S.R. BUFFER TEST
PASS
HSRO1
FAIL
RWD
DMNX
YES
DMNE
IS DMN ORDER IN rA a RWD?
NO
STORE TAPE AND TAPE BUFFER ORDERS FOR UPCOMING USE.
-d2
a2 SET ?
YES
3
b3
c2
a2
NO
b2
1
2
a2
b1
DMNX


7
BLOCK COUNT
a_2
b_1
POSSIBLE SENT. BLOCK (>FFFFFFFF00)?
NO
ADVX
YES
BYPASS?
YES
DMN (RD)
BLOCK COUNT
BY PASS SENTINEL?
YES
8
NO
NO
END OF TAPE?
YES
NO
STORE END OF TAPE OR END OF FILE INDICATOR
BLOCK COUNT CHECK
PASS
RWD
4
FAIL
STOP
YES
END OF FILE?
ADVX
4
CHECK STORED INDICATOR: END OF TAPE?
YES
INT
ADVX
NO
EIFX
6
BLOCK COUNT
a_1
BLK CNT: BLK LIM.
≠
ADVX
=
OTFX

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0001	001	010	1165	67	1175	1180	
0002	001	020	1172	87	1914	1175	
0003	001	030	1004	42	0573	1197	
0004	001	040	1003	25	1055	1058	
0005	001	050	1058	70	1063	1067	
0006	001	060	1063	00	0100	0000	
0007	001	070	1067	60	1130	1151	1
0008	001	080	1151	30	1153	1155	
0009	001	090	1153	87	1914	1175	
0010	001	100	1155	05	1161	1163	
0011	001	110	1161	67	1175	1180	
0012	001	120	1163	65	1165	1167	
0013	001	130	1167	50	1172	1174	
0014	001	140	1174	25	1197	1199	
0015	001	150	1199	35	1202	1204	
0016	001	160	1202	00	HH00	0000	
0017	001	170	1204	05	000A	1208	
0018	001	180	1208	20	1210	000A	
0019	001	190	1210	30	0019	1021	
0020	001	200	1021	25	1023	1225	

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0021	002	010	1023	FF	FFFF	FF00	
0022	002	020	1225	87	1228	1028	
0023	002	030	1228	42	0573	1036	
0024	002	040	1180	42	0573	000C	
0025	002	050	1175	C2	1179	1190	
0026	002	060	1053	25	1055	1057	
0027	002	070	1057	30	1059	1061	
0028	002	080	1061	70	1063	1066	
0029	002	090	1066	60	1130	1150	1
0030	002	100	1150	35	1152	1157	
0031	002	110	1152	HH	HH00	0000	
0032	002	120	1157	05	1159	1162	
0033	002	130	1159	67	1172	1180	
0034	002	140	1162	65	1165	1182	
0035	002	150	1182	82	1385	1194	
0036	002	160	1385	25	1197	1285	
0037	002	170	1285	35	1287	1289	
0038	002	180	1287	00	HH00	0000	
0039	002	190	1289	05	000A	1293	
0040	002	200	1293	42	0573	1098	

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0041	003	010	1194	25	1197	1200	
0042	003	020	1200	35	1202	1223	
0043	003	030	1223	05	000A	1228	
0044	003	040	1071	25	1002	1168	
0045	003	050	1002	87	1914	1197	
0046	003	060	1168	60	1172	1183	
0047	003	070	1183	05	1159	000C	
0048	003	080	1190	42	0573	1175	
0049	003	090	1099	42	0573	1319	
0050	003	100	1319	05	1321	1323	
0051	003	110	1321	05	1140	000A	1
0052	003	120	1323	25	1325	1327	
0053	003	130	1325	25	1350	1177	1
0054	003	140	1327	30	1130	000C	1
0055	003	150	1177	60	1179	1185	
0056	003	160	1185	65	1197	1399	
0057	003	170	1399	25	000B	1005	
0058	003	180	1005	37	0600	1014	
0059	003	190	1014	50	1055	1257	
0060	003	200	1257	60	1059	1069	

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0061	004	010	1069	05	1165	000C	
0062	004	020	1077	30	1279	1301	
0063	004	030	1279	G2	FFFF	FFFF	
0064	004	040	1301	87	1335	1304	
0065	004	050	1335	35	1339	1341	
0066	004	060	1339	F2	0000	1242	
0067	004	070	1341	60	1349	1154	
0068	004	080	1154	25	1158	1380	
0069	004	090	1158	05	1374	1349	
0070	004	100	1304	30	1308	1310	
0071	004	110	1308	HF	FFFF	FFFF	
0072	004	120	1310	87	1313	1314	
0073	004	130	1313	20	1315	1317	
0074	004	140	1315	00	0000	1071	
0075	004	150	1317	32	0F00	1330	
0076	004	160	1330	20	1332	1361	
0077	004	170	1332	00	0000	1031	
0078	004	180	1314	20	1316	1318	
0079	004	190	1316	00	0000	1197	
0080	004	200	1318	32	0F00	1334	

TFCOOOTOO

CARD NO	PAGE	LINE	A	OP	M	C	K
0081	005	010	1334	20	1338	1361	
0082	005	020	1338	00	0000	1183	
0083	005	030	1361	30	1165	1367	
0084	005	040	1367	65	1179	1381	
0085	005	050	1381	05	1383	1187	
0086	005	060	1383	07	1175	1180	
0087	005	070	1187	60	1197	1999	
0088	005	080	1999	25	0000	1007	
0089	005	090	1007	82	1025	1010	
0090	005	100	1010	25	1012	1016	
0091	005	110	1012	87	1914	1022	
0092	005	120	1016	60	1172	1069	
0093	005	130	1025	25	1027	1029	
0094	005	140	1027	87	1914	1031	
0095	005	150	1029	60	1172	1175	
0096	005	160	1022	42	0573	1025	
0097	005	170	1031	42	0573	1034	
0098	005	180	1034	25	1153	1156	
0099	005	190	1156	30	1161	1363	
0100	005	200	1363	50	1165	1369	

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0101	006	010	1369	60	1172	1374	
0102	006	020	1374	42	0573	1178	
0103	006	030	1032	42	0573	1197	
0104	006	040	1028	70	1030	1033	
0105	006	050	1030	00	0000	0010	
0106	006	060	1033	70	1235	1238	
0107	006	070	1235	00	0000	0010	
0108	006	080	1238	82	1041	1244	
0109	006	090	1244	70	1246	1249	
0110	006	100	1246	00	0000	0010	
0111	006	110	1249	82	1253	1252	
0112	006	120	1252	70	1254	1258	
0113	006	130	1254	00	0000	0010	
0114	006	140	1258	82	1261	1228	
0115	006	150	1041	42	0573	1045	
0116	006	160	1045	25	000C	1049	
0117	006	170	1049	20	1051	1270	
0118	006	180	1051	30	0019	1998	
0119	006	190	1270	77	0000	1073	
0120	006	200	1073	50	1922	1924	

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0121	007	010	1924	25	1926	1928	
0122	007	020	1926	42	0573	1923	
0123	007	030	1928	60	1374	1076	
0124	007	040	1076	05	1078	1080	
0125	007	050	1078	05	1350	1212	1
0126	007	060	1080	25	1140	000C	1
0127	007	070	1212	35	1214	1216	
0128	007	080	1214	HH	HHHH	0000	
0129	007	090	1216	32	0F00	1229	
0130	007	100	1229	35	1214	1304	
0131	007	110	1923	25	1925	1927	
0132	007	120	1925	42	0573	1178	
0133	007	130	1927	60	1374	1922	
0134	007	140	1998	25	1063	1065	
0135	007	150	1065	70	1130	1997	1
0136	007	160	1997	60	1130	1996	1
0137	007	170	1996	42	0573	1221	
0138	007	180	1221	25	1023	1226	
0139	007	190	1226	70	1230	1233	
0140	007	200	1230	00	0000	0020	

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0141	008	010	1233	82	1099	1924	
0142	008	020	1253	65	1266	1268	
0143	008	030	1268	42	0573	1271	
0144	008	040	1271	25	000C	1275	
0145	008	050	1275	20	1277	000A	
0146	008	060	1277	30	0081	1283	
0147	008	070	1283	25	1130	1941	1
0148	008	080	1941	35	1152	1360	
0149	008	090	1360	82	1376	1365	
0150	008	100	1365	60	1366	1364	
0151	008	110	1364	50	1371	1909	
0152	008	120	1909	25	1911	1380	
0153	008	130	1911	25	1350	1952	1
0154	008	140	1952	35	1368	1995	
0155	008	150	1995	32	0200	1913	
0156	008	160	1913	20	1929	1954	
0157	008	170	1929	67	8030	1956	
0158	008	180	1954	60	1956	1958	
0159	008	190	1958	05	1376	1910	
0160	008	200	1910	25	1386	1912	

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0161	009	010	1912	30	1371	1956	
0162	009	020	1376	25	1378	1380	
0163	009	030	1378	05	1345	1347	
0164	009	040	1345	25	1349	1262	
0165	009	050	1261	30	1023	1264	
0166	009	060	1264	50	1266	1268	
0167	009	070	1262	30	1266	1269	
0168	009	080	1269	05	1276	1281	
0169	009	090	1276	00	1259	0000	
0170	009	100	1281	87	000C	1072	
0171	009	110	1380	60	1382	1384	
0172	009	120	1384	C7	1389	1387	
0173	009	130	1387	42	0573	1384	
0174	009	140	1389	87	1392	1393	
0175	009	150	1392	25	1394	1396	
0176	009	160	1394	00	1384	0000	
0177	009	170	1396	60	1612	1165	
0178	009	180	1393	05	1395	0419	
0179	009	190	1395	31	1340	0000	
0180	009	200	1340	82	1343	1348	

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0181	010	010	1348	05	1343	000A	
0182	010	020	1343	25	1192	1206	
0183	010	030	1192	26	1172	0000	
0184	010	040	1206	60	1812	1382	
0185	010	050	1347	25	1350	1366	1
0186	010	060	1366	35	1368	1370	
0187	010	070	1368	00	0H00	0000	
0188	010	080	1370	77	0000	1373	
0189	010	090	1373	25	1110	1329	1
0190	010	100	1329	35	1331	1333	
0191	010	110	1331	00	000H	0000	
0192	010	120	1333	37	0100	1337	
0193	010	130	1337	20	1339	1342	
0194	010	140	1342	20	000B	1346	
0195	010	150	1346	60	1349	000A	
0196	010	160	1242	C7	1248	1242	
0197	010	170	1248	87	1300	000C	
0198	010	180	1300	25	1349	1170	
0199	010	190	1170	67	8021	000A	
0200	010	200	1188	25	1390	1397	

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0201	011	010	1390	42	0573	1237	
0202	011	020	1397	60	1228	1259	
0203	011	030	1259	42	0573	1307	
0204	011	040	1307	25	1110	1322	1
0205	011	050	1322	77	0000	1326	
0206	011	060	1326	35	1202	1205	
0207	011	070	1205	06	1008	0000	
0208	011	080	1008	32	0700	1018	
0209	011	090	1018	37	0800	1231	
0210	011	100	1231	20	000C	1035	
0211	011	110	1035	32	0200	1040	
0212	011	120	1040	05	000A	1044	
0213	011	130	1044	25	000B	1048	
0214	011	140	1048	35	1050	1052	
0215	011	150	1050	HH	00HH	HHHH	
0216	011	160	1052	20	000C	1056	
0217	011	170	1056	60	1110	1328	1
0218	011	180	1328	25	1350	1362	1
0219	011	190	1362	35	1050	1090	
0220	011	200	1090	20	000C	1094	

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0221	012	010	1094	60	1350	1096	1
0222	012	020	1096	25	1130	1037	1
0223	012	030	1037	35	1039	1241	
0224	012	040	1039	00	00HH	HHHH	
0225	012	050	1241	20	1063	1921	
0226	012	060	1921	60	1130	1160	1
0227	012	070	1160	42	0573	1082	
0228	012	080	1082	25	1100	1081	1
0229	012	090	1081	70	1083	1086	
0230	012	100	1083	00	0000	0001	
0231	012	110	1086	60	1100	1091	1
0232	012	120	1091	05	000A	1095	
0233	012	130	1095	25	1308	1311	
0234	012	140	1311	87	1320	1324	
0235	012	150	1320	30	1372	1280	
0236	012	160	1372	60	1622	1194	
0237	012	170	1280	25	1120	1191	1
0238	012	180	1191	35	1193	1195	
0239	012	190	1193	00	0HHH	0000	
0240	012	200	1195	70	1140	1198	1

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0241	013	010	1198	35	1201	1203	
0242	013	020	1201	00	HHHH	0000	
0243	013	030	1203	20	1207	000A	
0244	013	040	1207	65	0000	1213	
0245	013	050	1213	42	0573	1217	
0246	013	060	1217	26	1220	0000	
0247	013	070	1220	60	1822	1073	
0248	013	080	1324	30	1344	1073	
0249	013	090	1344	25	1197	1000	
0250	013	100	1000	35	1202	1211	
0251	013	110	1211	05	000A	1278	
0252	013	120	1278	25	1120	1377	1
0253	013	130	1377	35	1193	1312	
0254	013	140	1312	70	000C	1215	
0255	013	150	1215	20	1218	000A	
0256	013	160	1218	30	0000	1224	
0257	013	170	1224	25	1100	1209	1
0258	013	180	1209	82	1099	1219	
0259	013	190	1219	60	1222	1232	
0260	013	200	1232	50	1234	1236	

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0261	014	010	1236	42	0573	1239	
0262	014	020	1239	25	1243	1380	
0263	014	030	1243	25	1350	1930	1
0264	014	040	1930	32	0200	1994	
0265	014	050	1994	35	1331	1931	
0266	014	060	1931	20	1933	1282	
0267	014	070	1933	67	8040	1324	
0268	014	080	1282	60	1932	1934	
0269	014	090	1934	25	1222	1227	
0270	014	100	1227	30	1234	1247	
0271	014	110	1247	05	1286	1932	
0272	014	120	1237	25	1391	1398	
0273	014	130	1391	42	0573	1036	
0274	014	140	1398	60	1228	1038	
0275	014	150	1286	50	1100	1099	1
0276	014	160	1093	42	0573	1303	
0277	014	170	1303	25	1305	1309	
0278	014	180	1305	00	0000	0030	
0279	014	190	1084	42	0573	1088	
0280	014	200	1088	25	1291	1309	

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0281	015	010	1291	00	0000	0040	
0282	015	020	1309	60	1312	1336	
0283	015	030	1336	25	1140	1240	1
0284	015	040	1240	35	1287	1290	
0285	015	050	1290	20	1292	1294	
0286	015	060	1292	60	0019	1250	
0287	015	070	1294	77	0000	1297	
0288	015	080	1297	70	1299	1302	
0289	015	090	1299	00	0062	0034	
0290	015	100	1302	05	000A	1306	
0291	015	110	1306	25	1312	1375	
0292	015	120	1375	70	1023	000B	
0293	015	130	1250	25	1130	1251	1
0294	015	140	1251	70	1063	1267	
0295	015	150	1267	35	1152	000C	
0296	015	160	1284	42	0573	1288	
0297	015	170	1288	25	1291	1295	
0298	015	180	1295	30	1312	1379	
0299	015	190	1379	82	1245	1388	
0300	015	200	1245	25	1256	1260	

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0301	016	010	1256	05	1274	1347	
0302	016	020	1274	00	1054	0000	
0303	016	030	1388	25	1255	1260	
0304	016	040	1255	05	1916	1347	
0305	016	050	1260	60	1166	1265	
0306	016	060	1265	25	000C	1273	
0307	016	070	1273	70	1263	1270	
0308	016	080	1263	10	0061	9988	2
0309	016	090	1296	30	1298	1073	
0310	016	100	1298	25	1166	1380	
0311	016	110	1166	05	1916	1347	
0312	016	120	1916	25	1918	1920	
0313	016	130	1918	42	0573	1917	
0314	016	140	1920	60	1228	1259	
0315	016	150	1917	25	1391	1919	
0316	016	160	1919	60	1228	1042	
0317	016	170	1070	35	1272	000A	
0318	016	180	1272	32	0000	HHHH	
0319	016	190	1914	05	1350	1915	1
0320	016	200	1915	65	1635	1800	

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0321	017	010	1812	26	1172	0000	

UNIVAC® SOLID-STATE COMPUTER - MEMORY CHART

PROGRAM: TFC00-OT00

BAND: 10			
10 00 TO 10 99		11 00 TO 11 99	
00 13-10	50 11-15	00 P0f0	50 02-10
01	51 06-18	01 P0f1	51 01-08
02 03-05	52 11-16	02 P0f2	52 02-11
03 01-04	53 02-06	03 P0f3	53 01-09
04 01-03	54 EOFX	04 P0f4	54 04-08
05 03-18	55 03-19s	05 P0f5	55 01-10
06	56 11-17	06 P0f6	56 05-19
07 05-09	57 02-07	07 P0f7	57 02-12
08 11-08	58 01-05	08 P0f8	58 04-09
09	59 03-20s	09 P0f9	59 02-13
10 05-10	60	10 P1f0	60 12-07
11	61 02-08	11 P1f1	61 01-11
12 05-11	62	12 P1f2	62 02-14
13	63 01-06	13 P1f3	63 01-12
14 03-19	64	14 P1f4	64
15	65 07-15	15 P1f5	65 01-01
16 05-12	66 02-09	16 P1f6	66 16-11
17	67 01-07	17 P1f7	67 01-13
18 11-19	68	18 P1f8	68 03-06
19	69 04-01	19 P1f9	69
20	70 16-17	20 P2f0	70 10-19
21 01-20	71 03-04	21 P2f1	71
22 05-16	72 EIFX	22 P2f2	72 01-02
23 02-01	73 06-20	23 P2f3	73
24	74	24 P2f4	74 01-14
25 05-13	75	25 P2f5	75 02-05
26	76 07-04	26 P2f6	76
27 05-14	77 04-02	27 P2f7	77 03-15
28 06-04	78 07-05	28 P2f8	78 DMNX
29 05-15	79	29 P2f9	79 03-15s
30 06-05	80 07-06	30 P3f0	80 02-04
31 05-17	81 12-09	31 P3f1	81
32 06-03	82 12-08	32 P3f2	82 02-15
33 06-06	83 12-10	33 P3f3	83 03-07
34 05-18	84 14-19	34 P3f4	84
35 11-11	85	35 P3f5	85 03-16
36 ADVX	86 12-11	36 P3f6	86
37 12-03	87	37 P3f7	87 05-07
38 INTX	88 14-20	38 P3f8	88 10-20
39 12-04	89	39 P3f9	89
40 11-12	90 11-20	40 P4f0	90 03-08
41 06-15	91 12-12	41 P4f1	91 12-18
42 EOTX	92	42 P4f2	92 10-03
43	93 14-16	43 P4f3	93 12-19
44 11-13	94 12-01	44 P4f4	94 03-01
45 06-16	95 12-13	45 P4f5	95 12-20
46	96 12-02	46 P4f6	96
47	97	47 P4f7	97 03-16s
48 11-14	98 OTFX	48 P4f8	98 13-01
49 06-17	99 03-09	49 P4f9	99 01-15

BAND: 12			
12 00 TO 12 99		13 00 TO 13 99	
00 03-02	50 15-13	00 10-18	50 P5f0
01 13-02	51 15-14	01 04-04	51 P5f1
02 01-16	52 06-12	02 15-10	52 P5f2
03 13-03	53 08-02	03 14-17	53 P5f3
04 01-17	54 06-13	04 04-10	54 P5f4
05 11-07	55 16-04	05 14-18	55 P5f5
06 10-04	56 16-01	06 15-11	56 P5f6
07 13-04	57 03-20	07 11-04	57 P5f7
08 01-18	58 06-14	08 04-11	58 P5f8
09 13-18	59 11-03	09 15-02	59 P5f9
10 01-19	60 16-05	10 04-12	60 08-09
11 13-11	61 09-05	11 12-14	61 05-03
12 07-07	62 09-07	12 13-14	62 11-19
13 13-05	63 16-08	13 04-13	63 05-20
14 07-08	64 09-06	14 04-18	64 08-11
15 13-15	65 16-06	15 04-14	65 08-10
16 07-09	66 09-06s	16 04-19	66 10-06
17 13-06	67 15-15	17 04-15	67 05-04
18 13-16	68 08-03	18 04-20	68 10-07
19 13-19	69 09-08	19 03-10	69 06-01
20 13-07	70 06-19	20 12-15	70 10-08
21 07-18	71 08-04	21 03-11	71 08-11s
22 13-19s	72 16-18	22 11-05	72 12-16
23 03-03	73 16-07	23 03-12	73 10-09
24 13-17	74 16-02	24 13-08	74 06-02
25 02-02	75 08-05	25 03-13	75 15-12
26 07-19	76 09-09	26 11-06	76 09-02
27 14-10	77 08-06	27 03-14	77 13-13
28 02-03	78 13-12	28 11-18	78 09-03
29 07-10	79 04-03	29 10-10	79 15-19
30 07-20	80 12-17	30 04-16	80 09-11
31 11-10	81 09-10	31 10-11	81 05-05
32 13-20	82 14-08	32 04-17	82 09-11s
33 08-01	83 08-07	33 10-12	83 05-06
34 13-20s	84 15-16	34 05-01	84 09-12
35 06-07	85 02-17	35 04-05	85 02-16
36 14-01	86 14-15	36 15-03	86 08-10s
37 14-12	87 02-18	37 10-13	87 09-13
38 06-08	88 15-17	38 05-02	88 16-03
39 14-02	89 02-19	39 04-06	89 09-14
40 15-04	90 15-05	40 09-20	90 11-01
41 12-05	91 15-01	41 04-07	91 14-13
42 10-16	92 15-06	42 10-14	92 09-15
43 14-03	93 02-20	43 10-02	93 09-18
44 06-09	94 15-07	44 13-09	94 09-16
45 15-20	95 15-18	45 09-04	95 09-19
46 06-10	96 16-09	46 10-15	96 09-17
47 14-11	97 15-08	47 10-05	97 11-02
48 10-17	98 16-10	48 10-01	98 14-14
49 06-11	99 15-09	49 04-07s	99 03-17

Note: P0, P1, P2...P5 = Parameter Number.
f0, f1...fx = File Number.

UNIVAC® SOLID-STATE COMPUTER - MEMORY CHART

PROGRAM: TFC00-0T00

BAND: 18

18 00 TO 18 99				19_00 TO 19_99			
00		50		00		50	
01		51		01		51	
02		52		02		52	08-14
03		53		03		53	
04		54		04		54	08-18
05		55		05		55	
06		56		06		56	08-18s
07		57		07		57	
08		58		08		58	08-19
09		59		09	08-12	59	
10		60		10	08-20	60	
11		61		11	08-13	61	
12	17-01	62		12	09-01	62	
13		63		13	08-16	63	
14		64		14	16-19	64	
15		65		15	16-20	65	
16		66		16	16-12	66	
17		67		17	16-15	67	
18		68		18	16-13	68	
19		69		19	16-16	69	
20		70		20	16-14	70	
21		71		21	12-06	71	
22		72		22	06-20s	72	
23		73		23	07-11	73	
24		74		24	07-01	74	
25		75		25	07-12	75	
26		76		26	07-02	76	
27		77		27	07-13	77	
28		78		28	07-03	78	
29		79		29	08-17	79	
30		80		30	14-04	80	
31		81		31	14-06	81	
32		82		32	14-08s	82	
33		83		33	14-07	83	
34		84		34	14-09	84	
35		85		35		85	
36		86		36		86	
37		87		37		87	
38		88		38		88	
39		89		39		89	
40		90		40		90	
41		91		41	08-08	91	
42		92		42		92	
43		93		43		93	
44		94		44		94	14-05
45		95		45		95	08-15
46		96		46		96	07-17
47		97		47		97	07-16
48		98		48		98	07-14
49		99		49		99	05-08

BAND:

00 TO 99		00 TO 99	
00	50	00	50
01	51	01	51
02	52	02	52
03	53	03	53
04	54	04	54
05	55	05	55
06	56	06	56
07	57	07	57
08	58	08	58
09	59	09	59
10	60	10	60
11	61	11	61
12	62	12	62
13	63	13	63
14	64	14	64
15	65	15	65
16	66	16	66
17	67	17	67
18	68	18	68
19	69	19	69
20	70	20	70
21	71	21	71
22	72	22	72
23	73	23	73
24	74	24	74
25	75	25	75
26	76	26	76
27	77	27	77
28	78	28	78
29	79	29	79
30	80	30	80
31	81	31	81
32	82	32	82
33	83	33	83
34	84	34	84
35	85	35	85
36	86	36	86
37	87	37	87
38	88	38	88
39	89	39	89
40	90	40	90
41	91	41	91
42	92	42	92
43	93	43	93
44	94	44	94
45	95	45	95
46	96	46	96
47	97	47	97
48	98	48	98
49	99	49	99

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April 12, 1961

Univac III System
Programming Information Exchange
Bulletin 4

All users of the Univac III Data-Processing System will be provided with a comprehensive programming package and extensive programming support. The initial package will be available by the time the first production model of the Univac III System leaves the factory for full installation. At this time, final testing will have been completed on an engineering prototype and on the first manufactured system. The initial package will include the following:

1. An English language compiler system.

   A government sponsored Basic COBOL (COmmon Business Oriented Language) has been described a Department of Defense publication, dated April 1960. The compiler for the Univac III system will accept this language and, in addition, will contain extensions of Basic COBOL which are of major benefit to the users of this new tool.

2. The SALT Assembler/Compiler

   This assembly system uses a language which is much closer to the machine language than Basic COBOL. It will accept symbolic operands and addresses as well as incorporating a library of subroutines which may be called upon by the user.

3. An Executive Routine (CHIEF).

   CHIEF controls any set of concurrent programs as long as they may be accommodated by the physical facilities. It executes all requests for input/output functions, controls the sequence of the runs, locates and loads each run, attempts to provide corrective measures in the event that hardware malfunction occurs, provides facilities to institute rerun procedures and creates a log of all activities.

Remington Rand Univac DIVISION OF SPERRY RAND CORPORATION 315 PARK AVENUE SOUTH, NEW YORK 10, N.Y.

.1462 REV. 1

4. SALT Library

Programmed in SALT language, there will be a number of data processing routines which will provide the necessary instructions to handle reading of data from cards or tape, punching of data on cards, writing of data on tape, and printing of information on the High-Speed Printer. In addition there will be a continually growing number of specialized and general purpose subroutines which may be called upon by the SALT program.

5. Sort and Merge Routines

The Sequenced Ordering of DAta (SODA) routines produce one or more tapes of sequenced items of a data file from an input of randomly ordered items. Provisions are made for the inclusion of "own coding" within these routines.

6. Utility Routines

The Double UTilitY (DUTY) library serves two basic areas: routines required to up-date, change and, in general, maintain instruction and data tapes; and routines which are used during the testing phase of program development. Both will facilitate and systematize the creation and testing of programs at every Univac III Installation.

Continuing programming support (considerably above the level of our competitors) will be supplied for all Univac III installations. It will cover the following areas:

1. Program maintenance.

Any Univac III program supplied as part of the initial programming package or accepted by Remington Rand Univac for distribution will be maintained on a continuing basis. This means that minor revisions suggested as a result of field experience or major revisions coded by Univac III customers will be properly checked out. The test problems used will be fully documented and distributed to Univac III users in the field. Remington Rand Univac will be in a position to answer technical inquiries about the nature of all accepted routines and, therefore, the originator need not be concerned about continual requests for information.

2. Additional routines based on customer demand.

Subsequent to the development of the initial package, other routines will be programmed and distributed to customers based upon their requests. For example, an algebraic language compiler is not included in the planned programming package. However, if there should be a sufficient demand for such a compiler from customers and prospects, it will be provided.

3. Program Distribution.

PLS will not only provide complete documentation on Univac III programs as they are developed and tested, but will also disseminate advance information on programs being developed both by Remington Rand Univac or customer installations. P.I.E. bulletins and status reports will be distributed to the field on a regular basis.

Customer cooperation is, of course, essential for the success of this operation. Experience with Univac I and Univac II Customers has shown that this is a highly desirable service and that practically all customers cooperate in making it successful.

4. Testing and Exchange of customer prepared routines.

Quite often a customer prepares a routine for his own use but is willing to turn it over to other customers as well. Sometimes minor modifications will make such a routine much more useful to the majority of customers. Remington Rand Univac is prepared to test and, if desirable, modify these routines in the interest of all users of the Univac III System.

Joe Horner, Manager
Program Library Services

TO LISTS: 10A-23-361-362-44-52-59 and Univac System Routines, Tab 20

Everett McClellan

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January 19, 1961

Univac Solid-State Computers
Programming Information
Exchange Bulletin 21

The addition of tapes to the Univac Solid-State Computer requires that programming techniques and conventions be developed to take advantage of the hardware features they provide.

One of the first areas of programming concern is that of internal manipulation of the large volume of data that this input/output hardware introduces. Some of the basic thinking about this aspect and a resultant programming approach is being reported.

Joe Horner, Manager
Program Library Services

Distributions to Univac System Routines, Tabs 11, 15, and 16, only.

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INTRODUCTION

The addition of tape input and output facilities to the Univac Solid-State computer affords a means of introducing and producing a greater volume of information than could be done when restricted entirely to punched card input and output.

Careful attention must be paid to the techniques employed to make optimum use of tape hardware. Just as the High-Speed Reader and Read Punch Unit required the use of Reserve Storage to maintain maximum speed on these units, an approach can be found which will provide similar efficiencies for the tape units.

The tape hardware is not as subject to the timing considerations encountered in using the card equipment. The external speed of the tape mechanism will be related primarily to the efficiency with which the data introduced is manipulated (as opposed to processed) internally.

Since one thousand characters can either be read or written as a unit (the block), it is likely that this large unit will be segmented into a number of smaller units of related data (items). Further, each item will be identical in format, that is, each field, (sub-units that compose an item) will contain the same type of information and represent it in the same manner as that of similarly positioned fields in any other item.

The internal manipulation of data introduced from tape in the Univac Solid-State computers involve several considerations. These relate to the format of the data being processed and the type of processing involved.

The format of most items is fixed (each is composed of a specific number of alphabetic and numeric words). Therefore, by accounting for the particular words being manipulated, instructions can be tailored to provide the most efficient method of handling them. A twelve word item composed entirely of alphanumeric fields requires twenty four transfers, two for each word. A twelve word item with four alphabetic and eight numeric words requires only sixteen transfers, two for each alphabetic word and one for each numeric word.

Since a generalized transfer routine would treat the broad case of a completely alphanumeric item, such a routine might introduce unnecessary inefficiencies. For this reason, the programming of instructions designed to transfer items from an input area to working storage and from working storage to an output area is dependent upon the format of the data for each specific computer run.

It is assumed that such instructions would be integrated with the Tape File Control (TFC) and Item Control (ITC) routines provided through Program Library Services.

DATA INTERLACE

Assuming that the input and output data will be both arranged and processed in an orderly sequence, (usually ascending) it can be observed that data arranged in this fashion on tape will be introduced into the computer with an interval of fifty eight word times between the numeric portions of consecutive words.

It would be advantageous from the standpoint of accessing consecutive words to reduce this time interval. This can be achieved by placing the data on tape in a non-consecutive pattern; one designed to present a more efficient relationship between consecutive words of a block. Since the majority of the tapes used on the Solid-State computer are prepared initially from card input, it is a simple matter to arrange the data in the desired manner before transferring it to tape.

A formula has been developed which can be used to establish a pattern for any item size ≤ 100. It is as follows:

$$b = 001+2(nw+(i-1))=2nw+2i-1$$

Where, b=the band level for each numeric word ($001 \leq b \leq 199$)

(b+5) mod 200 = the band level for the corresponding zone word.

w = the word number (w=0 ,1,2,...,k-1 for a k word item).

i = the item number (i=1,2,3,...,[100/k]).

n = the number of items, n=100/k.

Unused words should be grouped at the end of a block. Items should never be permitted to overlap blocks.

An interlace for a twelve word item computed using the formula above is shown on Chart 1, page 11. The routine ITC00-OT00 assumes that all data, both input and output will be in a pattern derived from the formula. The transfer instructions illustrated are designed to process data in this format.

BASIC CONSIDERATIONS

Item transfer instructions fall into two categories:

a. those that transfer from input to working storage.

b. those that transfer from working storage to output.[1]

---

[1]A third possibility is that class which will transfer from input storage directly to output storage. A discussion of this technique will be the subject of a future report.

In both categories the following basic considerations exist:

a. size of item

b. item interlace

c. location of input and/or output area

d. location of working storage

All of these basic considerations are resolved within the contents of ITC and TFC. These routines offer a systematic method of providing this information and do so in a manner which simplifies the programming of item transfer instructions.

ENTRANCES AND EXITS

Execution of the programmers transfer instructions is a function of ITC00. Within ITC, the entrances to sets of item transfer instructions are provided for each file. When necessary, ITC uses rB_1, to determine which file it is dealing with and which set of instructions to transfer to.

In order to establish a good latency relationship between ITC and the transfer instructions the following should be observed:

a. Input transfer instructions should begin at level 165.

b. Output transfer instructions should begin at level 015.

Optimizing latency when returning control to ITC from transfer instructions can be accomplished in the following manner:

a. Instructions which transfer items from input to working storage should take r+1/4 revolutions: (R=some number of full revolutions).

b. Instructions which transfer items from working storage to output should take R+1/2 revolutions (R=some number of full revolutions).

TRANSFER INSTRUCTIONS

ITC assumes that the data being processed is arranged in a standard interlace pattern computed according to the formula given on page 2. There is an interval of two between the numeric portions of each word zero; the numeric portion of word zero of the first item is at level 01. ITC sets the band addresses it receives to level 01 initially and increments the level by 02 for each succeeding call for another item until the block is exhausted. The zone portion of each word follows five word times after its numeric portion.

ITC always provides the absolute computer address of the numeric portion of word zero of the current item, input or output. The absolute working storage address (numeric portion of word zero) is supplied by the programmer upon entry to ITC. These appear in index registers according to the following patterns:

a. Prior to executing the input item transfer instructions:

rB_3 contains current input item address.

rB_2 contains working storage address into which the input item is to be transferred.

b. Prior to executing the output item transfer instructions:

rB_3 contains current output item address.

rB_2 contains working storage address from which an item is to be transferred.

Item transfer instructions can make use of index register modification to establish the addresses of the words within any current item involved in a transfer. To accomplish this, transfer coding will contain base addresses equal to interlace values of the first item minus one and made relative to the 00 band.

EXAMPLE A.

Chart 1 on page 11 shows the standard interlace as computed for a twelve word item. Using this chart, levels for all words of the <u>first</u> item can be extracted and set up in a table as follows:[2]

TABLE 1

ORDER OF TRANSFER	INPUT ITEM LEVEL	INPUT TRANSFER INSTRUCTION LEVEL
11	0177	0176
11'	0182	0181
2	0033	0032
2'	0038	0037
5	0081	0080
5'	0086	0085
8	0129	0128
8'	0134	0133
0	0001	0000
0'	0006	0005
3	0049	0048
3'	0054	0053
6	0097	0096
6'	0102	0101
9	0145	0144
9'	0150	0149
1	0017	0016
1'	0022	0021
4	0065	0064
4'	0070	0069
7	0113	0112
7'	0118	0117
10	0161	0160
10'	0166	0165

---

[2] The order of transfer of the words within an item should be selected so as to minimize the time necessary to transfer all words. See page 8.

The transfer instructions may be constructed using base addresses from the "INPUT TRANS. INST. LEVEL" column to refer to working storage, the input item and output item. In addition, the interval between words for the working storage areas should be identical to that of the input or output items. Working storage need only be large enough to store a single item and should be located in High-Speed storage. If numeric words exist in the input, provision must be made to insure that the equivalent zone portions be set to zero initially in both working storage and the output area. The level at which the working storage interlace begins must be selected carefully so as to satisfy latency requirements introduced by the transfer instructions.

Assume the following:

a. The last word of a 12 word item input block is an alphabetic field.

b. rB_3 is equal to 3203 (the input area is in band 32; 03 indicates that the second item of the eight twelve word items is being processed).

c. rB_2 is equal to 4031 (the working storage area is in High-Speed band 40; 31 is the level assigned to the numeric portion of word zero of the area). The working storage interlace is shown on page 12.

The coding to transfer both the numeric and zoned portion of the last word (word 11) of the input item to working storage might be as follows:

LOCATION a	WORD Op	m	c	KEY	REMARKS
2170	30	2172	2174		(2172)⟶rL. The "m" of 2172 contains input interlace word 11 zone level (0181).
[2172	30	0181	2199]	3	
2174	05	0176	000B	3	a. (2174) is modified by rB_3, 0176 becomes 3379, address of input word 11 numeric. (3379)⟶rX b. (rL) is modified by rB_3, 0181 becomes 3384, address of input word 11 zone. (3384)⟶rL
2199	25	2001	2003		(2001)⟶rA. The "m" of 2001 contains working storage word 11 zone level (0181).
[2001	50	0181	2026]	2	
2003	65	0176	000A	2	a. (2003) is modified by rB_2, 0176 becomes 4007, address of W.S. word 11 numeric. (rX)⟶4007

b. (rA) is modified by rB[3], 0181 becomes 4012, address of W.S. word 11 zone. (rL)⟶4012.

EXAMPLE B

The working storage interlace is as shown on Chart 2 page 12. Notice that although the numeric portion of word 0 is assigned to level 31, the relationship among the numeric portions of all words is identical to that established for the input interlace as shown on Chart 1. An increment of sixteen separates each word.

Zone portions are located by adding an increment of five to a corresponding numeric portion. Using this chart the levels for all words of the working storage area can be extracted and set up in a table as follows:[3]

ORDER OF TRANSFER	INPUT ITEM LEVEL	OUTPUT TRANSFER INSTRUCTION LEVEL
3	0079	0048
3'	0084	0053
6	0127	0096
6'	0132	0101
9	0175	0144
9'	0180	0149
0	0031	0000
0'	0036	0005
4	0095	0064
4'	0100	0069
7	0143	0112
7'	0148	0117
10	0191	0160
10'	0196	0165
1	0047	0016
1'	0052	0021
5	0111	0080
5'	0116	0085
8	0159	0128
8'	0164	0133
11	0007	0176
11'	0012	0181
2	0063	0032
2'	0068	0037

TABLE 2

[3]Just as for the transfer from input to W.S., the order in which words will be transferred from W.S. to output must be selected so as to minimize the time necessary to transfer all words. See page 10.

The table above has been derived to make clear the fact that the same relationship exists between the input interlace and the working storage interlace as that of working storage and output. The levels that will be index register modified in the output transfer instructions are identical to those used in the input transfer instructions.

Assume that the index register content is as follows:

a. rB_2 is equal to 4031 (working storage).

b. rB_3 is equal to 2205 (output area in band 22; 05 indicates that the third item of the eight twelve-word output items is being filled.

The coding to transfer both the numeric and zoned portion of the fourth word (word 4) of the item in working storage to output might be as follows:

LOCATION a	WORD Op	m	c	KEY	REMARKS
1422	25	1424	1426		(1424)→rA. The "m" of 1424 contains W.S. word 3 zone level (0053).
[1424	25	0053	1441]	2	
1426	05	0048	000A	2	a. (1426) is modified by rB_2, 0048 becomes 4079, address of W.S. word 3 numeric. (4079)→rX. b. (rA) is modified by rB_2, 0053 becomes 4084, address of W.S. word 3 zone. (4084)→rA.
1441	30	1443	1445		(1443)→rL. The "m" of 1443 contains output word 3 zone level (0053).
[1443	60	0053	1470]	3	
1445	65	0048	000B	3	a. (1445) is modified by rB_3, 0048 becomes 2253, address of output word 3 numeric. (rX)→2253. b. (rL)→is modified by rB_3, 0053 becomes 2258, address of output word 3 zone. (rA)→2258.

The coding for the entire output transfer on page 13, will serve to emphasize the significance that the order in which words are transferred has in relation to latency considerations. The annotated coding above demonstrates the reason working storage must appear in high speed storage. The address of the numeric portion of word 3, 4079, is transferred to the numeric portion of word 3 of the output interlace 2253. If working storage were in normal access, it would take 174 word times to effect the transfer. Only 24 word times are required in the case where working storage is located in high speed storage.

DESIGNING TRANSFER INSTRUCTIONS

The working storage method of transferring items, as exemplified, is one approach to the problem. The determination to advocate this technique is based on the following principles:

1. Use as little high speed storage as possible.
2. Keep the number of lines of transfer coding to a minimum.
3. Use a technique general enough to be applied to any situation.
4. Minimize the time necessary to effect the transfer without violating the above precepts.

The index register modification technique, demonstrated in the annoted coding segments that precede, suggest the word order scheme to be selected. Since there are eight twelve word items in a block and ITC keeps track of them by establishing the level of the numeric portion of the current word zero (01, 03, 05, ..., 15), it can be seen that the "m" portions modified by index register 3 will vary according to an increment ranging from one to fifteen. The increment fifteen will locate the words of the eighth item.

The table below shows the lowest and highest level of the range that each of the twelve numeric portions of the words of an item can have.

WORD	LEVEL RANGE
0	1-15
1	17-31
2	33-47
3	49-63
4	65-79
5	81-95
6	97-111
7	113-127
8	129-143
9	145-159
10	161-175
11	177-191

TABLE 3

The zone portions of each of the highest levels would be five word times greater than the values shown.

The following can be concluded from the coding on page 5:

1. It takes two word times to locate the first instruction (2170).
2. The first instruction (2170) requires four word times to execute.
3. Of the second instruction (2174), it take three word times to staticize, index register modify, and locate "m".

Totaling all these word times provides a picture of the time required to pick up both the numeric and zone portion of any word of an item.

2 wt's	to locate first inst.
4 "	to execute first inst.
3 "	to locate the numeric portion
5 "	to locate the zone portion
14 wt's	

Fourteen is the minimum amount of word times that will be expended to pick up the numeric and zone of each word. Adding 14 to 15, the level for the numeric portion of word zero of the eighth item, yields 29, an approximate level at which working storage could be assigned in order to obtain good latency. Examination of the coding that transfers from working storage to output demonstrates that this approximate level would not be suitable. The best starting level for working storage is actually 031.[4] This becomes apparent if an attempt is made to substitute a lesser starting level in the sample coding.

The same factor of fourteen holds for the placing of the words into working storage locations. Therefore, adding 14 to each level of the working storage pattern reveals the level at which the instructions to transfer the next word of the item could be executed and hence demonstrates which word of an item is available for processing. Since ITC prescribes that an input item transfer begin at level 165, using Table 3 on page 8, it can be seen that the input word closest to this level is word 11, which ranges from 177-191.

Using word 11 as a starting point, proceed in the following manner:[5]

---

[4]It can be observed when coding the transfer from working storage to output, that working storage could begin at levels 32, 33, 34, or 35 and still permit good transfer time to be achieved. In effect, five different working storage areas can be used.

[5]Working storage levels are shown on Chart 2.

Word	W.S. Level		Next Available Word	
11	007	+14 = 021	2	[33-47]
2	063	+14 = 077	5	[81-95]
5	111	+14 = 125	8	[129-143]
8	159	+14 = 173	0	[1-15][6]
0	031	+14 = 035	3	[49-63]
3	079	+14 = 093	6	[97-111]
6	127	+14 = 141	9	[145-159]
9	175	+14 = 189	1	[17-31]
1	047	+14 = 061	4	[65-79]
4	095	+14 = 109	7	[113-127]
7	143	+14 = 157	10	[161-175]
10	is the last word to be transferred.			

Determing the order of transfer for words from W.S. to output can be approached in the same manner. To establish a starting point note that ITC prescribes that output transfer instructions start at level 015 in normal storage. Since working storage is in High-Speed memory, levels 65, 115, and 165 are accessible. Working storage words three (level 79), six (level 127), and nine (level 175) are all possible starting points. However, the level of transfer coding after both the numeric and zone portions of word 3 are stored in registers is 032, and coding to transfer register contents to output could begin at level 034. The output range for word 3 (49-63) is the most accessible. The order of transfer can be computed using the level of W.S. word 3 as follows:

Word	W.S. Level		Next Available Word	
3	079	+14 = 093	6	[97-111]
6	127	+14 = 141	9	[145-159]
9	175	+14 = 189	0	[1-15]
0	031	+14 = 045	4	[65-79]
4	095	+14 = 109	7	[113-127]
7	143	+14 = 157	10	[161-175]
10	191	+14 = 015	1	[17-31]
1	047	+14 = 061	5	[81-95]
5	111	+14 = 125	8	[129-143]
8	159	+14 = 173	11	[177-191]
11	007	+14 = 021	2	[33-47]
2	is the last word to be transferred.			

The approach described may be used as the basis for coding transfer instructions for any size item arranged according to the standard interlace pattern.

---

[6] Although word 11 is the best choice, it has already been selected, the next best is word zero.

Key to Interlace

i-w

where i=Item (1-8)

w=Word (0-11)

Numeric words only are shown.

Zones are five word times after their respective numerics.

BAND: STANDARD 12 WORD ITEM INTERLACE			
00 TO 99		_100 TO _199	
00	50	00	50
01 1-0	51 2-3	01 3-6	51 4-9
02	52	02	52
03 2-0	53 3-3	03 4-6	53 5-9
04	54	04	54
05 3-0	55 4-3	05 5-6	55 6-9
06	56	06	56
07 4-0	57 5-3	07 6-6	57 7-9
08	58	08	58
09 5-0	59 6-3	09 7-6	59 8-9
10	60	10	60
11 6-0	61 7-3	11 8-6	61 1-10
12	62	12	62
13 7-0	63 8-3	13 1-7	63 2-10
14	64	14	64
15 8-0	65 1-4	15 2-7	65 3-10
16	66	16	66
17 1-1	67 2-4	17 3-7	67 4-10
18	68	18	68
19 2-1	69 3-4	19 4-7	69 5-10
20	70	20	70
21 3-1	71 4-4	21 5-7	71 6-10
22	72	22	72
23 4-1	73 5-4	23 6-7	73 7-10
24	74	24	74
25 5-1	75 6-4	25 7-7	75 8-10
26	76	26	76
27 6-1	77 7-4	27 8-7	77 1-11
28	78	28	78
29 7-1	79 8-4	29 1-8	79 2-11
30	80	30	80
31 8-1	81 1-5	31 2-8	81 3-11
32	82	32	82
33 1-2	83 2-5	33 3-8	83 4-11
34	84	34	84
35 2-2	85 3-5	35 4-8	85 5-11
36	86	36	86
37 3-2	87 4-5	37 5-8	87 6-11
38	88	38	88
39 4-2	89 5-5	39 6-8	89 7-11
40	90	40	90
41 5-2	91 6-5	41 7-8	91 8-11
42	92	42	92
43 6-2	93 7-5	43 8-8	93
44	94	44	94
45 7-2	95 8-5	45 1-9	95
46	96	46	96
47 8-2	97 1-6	47 2-9	97
48	98	48	98
49 1-3	99 2-6	49 3-9	99

CHART 1

Working Storage interlace must be located in High-Speed storage.

Numeric words only are shown. Zones are five word times after their respective numerics.

BAND:							
00 TO 99				1 00 TO 1 99			
00		50		00		50	
01		51		01		51	
02		52		02		52	
03		53		03		53	
04		54		04		54	
05		55		05		55	
06		56		06		56	
07	11	57		07		57	
08		58		08		58	
09		59		09		59	8
10		60		10		60	
11		61		11	5	61	
12		62		12		62	
13		63	2	13		63	
14		64		14		64	
15		65		15		65	
16		66		16		66	
17		67		17		67	
18		68		18		68	
19		69		19		69	
20		70		20		70	
21		71		21		71	
22		72		22		72	
23		73		23		73	
24		74		24		74	
25		75		25		75	9
26		76		26		76	
27		77		27	6	77	
28		78		28		78	
29		79	3	29		79	
30		80		30		80	
31	0	81		31		81	
32		82		32		82	
33		83		33		83	
34		84		34		84	
35		85		35		85	
36		86		36		86	
37		87		37		87	
38		88		38		88	
39		89		39		89	
40		90		40		90	
41		91		41		91	10
42		92		42		92	
43		93		43	7	93	
44		94		44		94	
45		95	4	45		95	
46		96		46		96	
47	1	97		47		97	
48		98		48		98	
49		99		49		99	

CHART 2

INPUT TO W.S. TRANSFER

a	Op	m	c	Key	
2170	30	2172	2174		
2172	30	0181	2199	3	Transfer Word 11
2174	05	0176	000B	3	
2199	25	2001	2003		
2001	50	0181	2026	2	
2003	65	0176	000A	2	
2026	30	2028	2030		
2028	30	0037	2055	3	Transfer Word 2
2030	05	0032	000B	3	
2055	25	2057	2059		
2057	50	0037	2074	2	
2059	65	0032	000A	2	
2074	30	2076	2078		
2076	30	0085	2103	3	
2078	05	0080	000B	3	Transfer Word 5
2103	25	2105	2107		
2105	50	0085	2122	2	
2107	65	0080	000A	2	
2122	30	2124	2126		
2124	30	0133	2151	3	
2126	05	0128	000B	3	Transfer Word 8
2151	25	2153	2155		
2153	50	0133	2194	2	
2155	65	0128	000A	2	
2194	30	2196	2198		Transfer Word 0

a	Op	m	c	Key	
2196	30	0005	2023	3	
2198	05	0000	000B	3	Transfer Word 0
2023	25	2025	2027		
2025	50	0005	2042	2	
2027	65	0000	000A	2	
2042	30	2044	2046		
2044	30	0053	2071	3	
2046	05	0048	000B	3	Transfer Word 3
2071	25	2073	2075		
2073	50	0053	2090	2	
2075	65	0048	000A	2	
2090	30	2092	2094		
2092	30	0101	2119	3	
2094	05	0096	000B	3	Transfer Word 6
2119	25	2121	2123		
2121	50	0101	2138	2	
2123	65	0096	000A	2	
2138	30	2140	2142		
2140	30	0149	2167	3	
2142	05	0144	000B	3	Transfer Word 9
2167	25	2169	2171		
2169	50	0149	2186	2	Test HSR Buffer
2171	65	0144	000A	2	
2189	30	2191	2193		
2191	30	0021	2039	3	

a	Op	m	c	Key	
2193	05	0016	000B	3	
2039	25	2041	2043		Transfer Word 1
2041	50	0021	2058	2	
2043	65	0016	000A	2	
2058	30	2060	2062		
2060	30	0069	2087	3	
2062	05	0064	000B	3	Transfer Word 4
2087	25	2089	2091		
2089	50	0069	2106	2	
2091	65	0064	000A	2	
2106	30	2108	2110		
2108	30	0117	2135	3	
2110	05	0112	000B	3	Transfer Word 7
2135	25	2137	2139		
2137	50	0117	2154	2	
2139	65	0112	000A	2	
2154	30	2156	2158		
2156	30	0165	2183	3	
2158	05	0160	000B	3	Transfer Word 10
2183	25	2185	2187		
2185	50	0165	EXIT	2	Exit level is at 002
2187	65	0160	000A	2	
2165	42	0573	2170		Initial buffer test before first Transfer.
2186	42	0573	2189		Intermediate buffer test given in gap between word 9 and word 1.

W.S. TO OUTPUT TRANSFER

a	Op	m	c	Key	
1422	25	1424	1426		
1424	25	0053	1441	2	
1426	05	0048	000A	2	Transfer Word 3
1441	30	1443	1445		
1443	60	0053	1470	3	
1445	65	0048	000B	3	
1470	25	1472	1474		
1472	25	0101	1489	2	
1474	05	0096	000A	2	Transfer Word 6
1489	30	1491	1493		
1491	60	0101	1518	3	
1493	65	0096	000B	3	
1518	25	1520	1522		
1520	25	0149	1537	2	
1522	05	0144	000A	2	Transfer Word 9
1537	30	1539	1541		
1539	60	0149	1566	3	Test HSR buffer
1541	65	0144	000B	3	
1574	25	1576	1578		
1576	25	0005	1593	2	
1578	05	0000	000A	2	Transfer Word 0
1593	30	1595	1597		
1595	60	0005	1438	3	
1597	65	0000	000B	3	
1438	25	1440	1442		

a	Op	m	c	Key	
1440	25	0069	1457	2	
1442	05	0064	000A	2	
1457	30	1459	1461		Transfer Word 4
1459	60	0069	1486	3	
1461	65	0064	000B	3	
1486	25	1488	1490		
1488	25	0117	1505	2	
1490	05	0112	000A	2	
1505	30	1507	1509		Transfer Word 7
1507	60	0117	1534	3	
1509	65	0112	000B	3	
1534	25	1536	1538		
1536	25	0165	1553	2	
1538	05	0160	000A	2	
1553	30	1555	1557		Transfer Word 10
1555	60	0165	1590	3	
1557	65	0160	000B	3	
1590	25	1592	1594		
1592	25	0021	1409	2	
1594	05	0016	000A	2	
1409	30	1411	1413		Transfer Word 1
1411	60	0021	1454	3	
1413	65	0016	000B	3	
1454	25	1456	1458		
1456	25	0085	1473	2	Transfer Word 5

a	Op	m	c	Key	
1458	05	0080	000A	2	
1473	30	1475	1477		
1475	60	0085	1502	3	
1477	65	0080	000B	3	
1502	25	1504	1506		
1504	25	0133	1521	2	
1506	05	0128	000A	2	Transfer Word 8
1521	30	1523	1525		
1523	60	0133	1550	3	
1525	65	0128	000B	3	
1550	25	1552	1554		
1552	25	0181	1569	2	
1554	05	0176	000A	2	
1569	30	1571	1573		Transfer Word 11
1571	60	0181	1406	3	
1573	65	0176	000B	3	
1406	25	1408	1410		
1408	25	0037	1425	2	
1410	05	0032	000A	2	
1425	30	1427	1429		Transfer Word 2
1427	60	0037	1455	3	
1429	65	0032	000B	3	
1566	42	0573	1574		Buffer test given in gap between word 9 and Word 0.
1455	42	0573	EXIT		Final buffer test, exit level is at 097.

PROGRAM LIBRARY SERVICES

UNIVAC Solid-State 80/90 Tape

TFC00-OT00

DEMAND TAPE CONTROL ROUTINE

PURPOSE

TFC00-OT00 is designed to transfer one block of data from tape to computer memory or from computer memory to tape upon demand. It utilizes one index register.

DESCRIPTION

TFC00-OT00 controls all tape operations associated with a computer run, and, in addition, performs the following functions associated with almost all tape data processing runs:

A. Checking of input file label.

B. Writing and incrementing of output file label.

C. Alternating Uniservos for each file.

D. Maintaining block count (including label block, data blocks, bypassed blocks, and first sentinel block) for input and output tapes.

E. Comparing input block count with block count read from input tape.

F. Controlling number of blocks written output tapes.

G. Detecting end-of-tape and end-of-file sentinels on input tapes.

H. Fabricating end-of-tape and end-of-file sentinel blocks and writing them on output tapes.

TFC00-OT00 is used in conjunction with a tape error control routine (TEC00-OT00 or TEC01-OT00) and may be used in conjunction with an HSR, RPU or STP routine. No standby storage bands are used. Each file is assigned one and only one input or output band.

The use of TFC00-OT00 requires the loading and storing of six information words for each file prior to commencement of run. These six words per file comprise the parameters for TFC00-OT00 and include details about the specific run such as tape labels, Uniservoes used, block limits, etc..[1]

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[1]See PARAMETERS section for a complete listing of required specifications.

TFC00-OT00 is divided into four sections according to the functions performed: They are as follows:

I. Initializing a File (INT)[2]

To start the flow of data to or from the first or successive tapes of a file, certain functions must be performed. This involves:

A. Setting the block count (always associated with the current tape of the file) equal to zero.

B. Alternating the Uniservo number for the file (as defined in the Identification Block).

C. Accessing, incrementing and restoring the label for each tape.

D. If the file is input, checking the label on the tape against the label stored in memory.

E. If the file is output, writing the Identification block containing the incremented label on tape.

INT is entered directly once for the start of each file only. All succeeding entrances are accomplished under control of TFC00-OT00 itself.

INT is entered once for each file being used in the program.[3] It is entered at location 1188 (INTE) with the file number in Index Register 1 (rB) in the form 000f. If f is an input file, the Identification[1] block will be read and checked and the first block of data transferred from tape to a band in memory (see STORAGE ALLOCATION). If f is an output file, the Identification block will be written. Upon execution of this section, control will normally be returned at location 1038 (INTX), with the band number for the file located in rX in the form 00bb000000 and the file number located in rB_1 in the form 000f. The contents of Index Registers 2 and 3 (rB_2, rB_3) will not be changed. The contents of rA and rL will be destroyed.

If an end-of-file sentinel (see TERMINATING A FILE, Section IV) is detected upon entering INT, control is returned at location 1072 (EIFX) with the file number located in rB_1 in the form 000f. In this instance the contents of rB_2 and rB_3 will not be changed and the contents of rA, rX and rL, destroyed.

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[2]Each section has been assigned a symbolic three digit name. By appending the letters E or X, the entrance or exit line can be represented. Each symbolic line signifies an actual machine location.

[3]If an HSR routine is used, it should be initiated prior to initiating any tape file.

II. Advancing a File (ADV)

This section is entered each time it is necessary to transfer a block from an input file tape to a band in memory (see STORAGE ALLOCATION) or from a band in memory to an output file tape. In the case of advancing an output block, write-compute time can be overlapped after the write instruction is initiated. However, in the case of advancing an input block, no processing may take place until data is in memory. The actual tape advance is preceded by a repeatedly executed tape buffer test (until passed) and, if the previous tape operation was a write, an examination of the tape error flip-flops. If the previous tape instruction was a read, the tape error flip-flops for this operation were tested prior to exit from the section. When a tape error condition is indicated, control is transferred to the tape error control routine (TEC00-OT00 or TEC01-OT00).

ADV is entered at location 1099 (ADVE) with rB_1 containing the file number in the form 000f. f is the number of the file to be advanced. If an input file is to be advanced, the data previously stored in the band for this file must have been processed. If an output file, the data must be stored in the band as desired prior to entry. Upon execution of this section, control will normally be returned at location 1036 (ADVX) with the band number for the file located in rX in the form 00bb000000 and the file number in rB_1 in the form 000f.[4] The contents of rB_2 and rB_3 will not be changed. The contents of rA and rL are destroyed.

If an end-of-file sentinel (see TERMINATING A FILE, Section IV) is detected upon entering ADV, control will be returned at location 1072 (EIFX) with the file number located in rB_1 in the form 000f. In this instance the contents of rB_2 and rB_3 will not be changed and the contents of rA, rX and rL, destroyed.

When ADV is entered to advance an output block, and that block causes the output block limit to be reached (as specified in parameters), control will be returned once at location 1098 (OTFX) with the band number for the file located in rX into form 00bb000000 and the file number in rB_1 in

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[4] If desired, this exit location (or any other exit line) may be programmed to contain a single instruction which, depending upon the file being advanced, will transfer control to the processing instructions for the related file. Since rB_1 contains 000f, a skip instruction, keyed to be modified by rB_1 would send control to location xxxx+000f. Location xxxx+000f could then contain the first processing instruction for file f.

the form 000f. The contents of rB_2 and rB_3 will not be changed and the contents of rA and rL, destroyed. The output tape, normally, is then terminated by entering EOT (see TERMINATING A FILE, Section IV). However it is possible to ignore the previously specified block limit and transfer more data to tape by re-entering ADV. However, control will not be returned to OTFX again.

III. Demand Advance (DMN)

This section is entered to execute a read, write or rewind tape instruction associated with a Uniservo not specified as used for a data file in the parameters (e.g. overlaying instructions in memory from instructions on tape). In addition, it is employed internally by TFC00-OT00 when a bypass sentinel is detected on an input tape or when an identification or sentinel block is being handled (see TERMINATING A FILE, Section IV). During the execution of DMN, neither read-compute nor write-compute time is overlapped. The functions normally performed by TFC00-OT00 (e.g. checking of input file label, writing and incrementing of output file label, etc.) are not executed when DMN is entered.[5]

When using DMN, the tape instruction and the buffer transfer instruction must be supplied with 0000 in the c portions. DMN is entered at location 1077 (DMNE) with an F2, G2 or H2 instruction in rA and an C6 or F6 instruction in rX (if an F2 instruction is stored in rA, no instruction is stored in rX). Upon execution of this section, control is returned at location 1178 (DMNX). The contents of rB_1, rB_2 and rB_3 will not be changed; the contents of rA, rL, and rX, destroyed.

IV. Terminating a File

The termination of a file, or tape within a file, is dependent upon functions performed by other sections. ADV maintains block counts for input (and output) tapes, checking for a "full" tape as specified by the block limit in the parameters for the output tapes and by detecting sentinel blocks on input tapes. For input tapes, these functions are performed for each block after it has been successfully transferred to memory. For output tapes, they are performed during transfer of data from the buffer to tape before returning control at the exit line.

A. Input Files

The termination of input tapes and files is a function of ADV or INT. A test is made for three types of sentinels: end-of-tape, end-of-file, and bypass.

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[5]See list of functions on page 1.

1. The bypass sentinel, indicating temporary termination of input data, (FFFFFFFF20, where F equals the undigit 1101, at level 019 of data band) when detected, causes a series of read instructions to be executed by automatically entering the Demand Advance section (see above). When a second bypass sentinel is detected, control is automatically returned to the Advance Section, and a block of valid data is transferred to memory.

2. The end-of-tape sentinel (FFFFFFFF30, where F equals the undigit 1101 at level 019 of data band), when detected, causes rewind of the tape and initiation of the next tape of the associated file and advance of the first block following the Identification Block.

3. The end-of-file sentinel (FFFFFFFF40), where F equals the undigit 1101 at level 019 of data band) when detected, causes the tape to be rewound and control returned to location 1072 (EIFX).

B. Output Files (EOT, EOF)

The indication that output tapes or files are to be terminated is a function of ADV. However, the actual termination is a function of the end-of-tape (EOT) or end-of-file (EOF) sub-sections.

The end-of-tape on output files is determined by reaching equality between the block count and the block limit. Unless more blocks are to be added to the output tape, EOT is to be entered. As a result, two end-of-tape sentinel blocks will be written and the tape will be rewound.[6] The next output tape will then be initiated automatically. EOT is entered at location 1093 (EOTE) with rB_1 containing the file number in the form 000f. Upon execution, control will be returned at location 1042 (EOTX) with the band number of the file in rX in the form 00bb000000 and the file number in rB_1 in the form 000f. The contents of rB_2 and rB_3 will not be changed; the contents of rA, rX and rL, destroyed.

When all data for a file has been processed, EOF is entered. Two end-of-file sentinel blocks will be written

[6] The data band for the first sentinel block will contain the sentinel, FFFFFFFF30 at level 019. The data band for both sentinel blocks will contain the block count for this tape, bbbb000000, at level 081.

on the tape in question and it will be rewound.[7] EOF is entered at location 1084 with rB_1 containing the file number in the form 000f. Upon execution, control will be returned at location 1054 (EOFX) with the file number in rB_1 in the form 000f. The contents of rA, rX and rL, destroyed.

PROGRAMMING PROCEDURES

Own Coding (a Op m c)	Routine Coding (a Op m c)	Remarks
I. Initialize a File (INT)		
02 000f 1188		Entrance to INT.
	1188 [TFC00-0T00 Inst.]	Initializes file specified by f in rB_1.
	[TFC00-0T00 Inst.] 1038	Normal exit from INT. rX contains band number; rB_1, file number.[8,9]
	[TFC00-0T00 Inst.] 1072	End-of-input-file exit from INT, rB_1 contains file number.[8,10]
II. Advancing a File (ADV)		
02 000f 1099		Entrance to ADV.
	1099 [TFC00-0T00 Inst.]	Advances block for file specified by f in rB_1.
	[TFC00-0T00 Inst.] 1036	Normal exit from ADV. rX contains band number; rB_1, file number.[8,9]
	[TFC00-0T00 Inst.] 1072	End-of-input file exit from ADV. rB_1 contains file number.[8,10]
	[TFC00-0T00 Inst.] 1098	Output Block limit exit from ADV. rX contains band number; rB_1 file number.[8,9]

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[7]The data band for the first sentinel block will contain the sentinel, FFFFFFFF40 at level 019. The data band for both sentinel blocks will contain the block count for this tape, bbbb000000, at level 081.

[8]rB_2, rB_3 not used.

[9]rA, rL, destroyed.

[10]rA, rX, rL destroyed.

Own Coding a Op m c	Routine Coding a Op m c	Remarks
II. Demand Advance (DMN)		
25 aaaa bbbb aaaa [Tape Inst.] 0000 bbbb 05 cccc 1077 cccc [Buffer Inst.] 0000		Entrance to DMN. Executes G2 or H2 as specified in rA, and C6 or F6 as specified in rX; or F2 as specified in rA (rX not used).
	1077 [TFC00-OT00 Inst.]	
	[TFC00-OT00 Inst.] 1178	Exit from DMN.[8,10] rB_1, not used.
IV. Terminating a File		
A. Input File		
	[TC00-OT00 Inst.] 1072	Exit from either INT or ADV when an end-of-file sentinel is detected on input tape (see I and II above).[8,10]
B. Output Files (EOT, EOF)		
	[TFC00-OT00 Inst.] 1098	Exit from ADV when block limit is reached for output tape. rX contains band number; rB_1, file number (see II above).[8,9]
02 000f 1093	1093 [TFC00-OT00 Inst.]	Entrance to EOT to terminate tape of file specified by f in rB_1 and initialize alternate tape.
	[TFC00-OT00 Inst.] 1042	Exit from EOT. rX contains band number; rB_1, file number.[8,9]
02 000f 1084	1084 [TFC00-OT00 Inst.]	Entrance to EOF to terminate file specified by f in rB_1.
	[TFC00-OT00 Inst.] 1054	Exit from EOF. rB_1 contains file number.[8,10]

PARAMETERS

The six words listed below must be stored in the locations indicated, one set per file. The location (level) used, represents the file number (f). The LSD of the address for all parameters for a specific file is the same. It is suggested that level x0 be used for the first file, x1 for the second, etc.; file numbers starting at zero and numbered in sequence. If a file number is omitted; i.e. a specific file is not to be used in a computer run, zeros must be substituted for the parameters in the related locations. A total of ten files may be specified in a program ($0 \leq f \leq 9$). The parameters are as follows:

Location	Content	Explanation
110f	xxxxxxxxxx	File label or identification.[11] f = file number ($0 \leq f \leq 9$).
111f	$t\Delta s_1 s_2 mr\Delta\Delta\Delta\Delta$	where, t=type of file. =G for input files. =H for output files. $s_1 s_2$=Uniservos used. s_1=Initial Uniservo for this file. s_2=Alternate Uniservo for this file. =s_1, if only one Uniservo for this file. m=Mode and density =0 for USS mode, 250 cpi =5 for Univac mode, 250 cpi[12] =6 for Univac mode, 235 cpi[12] r=Rewind information. =0, for rewind without interlock. =2, for rewind with interlock.

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[11]The label of each input tape will be checked. A label block will be written on each output tape. One will be added to the least significant digit of the file label for each incoming or outgoing reel of the file prior to checking or writing. Therefore, at least the LSD should be a zero if label discrepancies are to be avoided. If, during processing the predicted input file label does not match the actual tape label, the computer is brought to a halt. TFC00 is designed to allow the replacement of the predicted file label by the actual file label at this point. This feature provides for the acceptance of all subsequent tapes belonging to the same file.

[12]While TFC00 is designed to be used with tapes observing USS conventions, 720 character blocks can be written and read.

Location	Content	Explanation
112f	eΔΔaaaΔΔΔΔ	where, e = F designates this file has the highest file number. = C for all other files. aaa = band level of file label in identification block (level 017 and 111 are used by the sort routines).
113f	ccccΔΔ1111	where, cccc = 0000 (cccc is used by TFC00 to store block count during processing). 1111 = Block limit for output tapes. = 0000 for input tapes.
114f[13]	F6bb001003	Tape buffer instruction for input file where bb= band used for file.
	or	
	C6bb001053	Tape buffer instruction for output file where bb=band used for file.
135f	G2s_1s_2m01071	Tape instruction for input file. s_1s_2m = s_1s_2m as specified in location 111f.
	or	
	H2s_1s_2m01197	Tape instruction for output file. s_1s_2m = s_1s_2m as specified in location 111f.

[13] The band (bb) in these locations may be changed by programmed modifications, if required. Prior to entering ADV, store the F6 or C6 instruction in location 114f. This instruction will be executed by TFC00 until modified again. In this way it is possible to write directly from several "input" bands, thus facilitating the programming of such runs as a general merge.

STORAGE ALLOCATION

A band number must be specified in the parameters for each file used in the program. TFC00 reads or writes using the standard tape interlace which is as follows:

TAPE WORD PAIR	BAND LEVEL	TAPE WORD PAIR	BAND LEVEL	TAPE WORD PAIR	BAND LEVEL	TAPE WORD PAIR	BAND LEVEL
00	001, 006	25	051, 056	50	101, 106	75	151, 156
01	059, 064	26	109, 114	51	159, 164	76	009, 014
02	117, 122	27	167, 172	52	017, 022	77	067, 072
03	175, 180	28	025, 030	53	075, 080	78	125, 130
04	033, 038	29	083, 088	54	133, 138	79	183, 188
05	091, 096	30	141, 146	55	191, 196	80	041, 046
06	149, 154	31	199, 004	56	049, 054	81	099, 104
07	007, 012	32	057, 062	57	107, 112	82	157, 162
08	065, 070	33	115, 120	58	165, 170	83	015, 020
09	123, 039	34	173, 178	59	023, 028	84	073, 078
10	181, 186	35	031, 036	60	081, 086	85	131, 136
11	039, 044	36	089, 094	61	139, 144	86	189, 194
12	097, 102	37	147, 152	62	197, 002	87	047, 052
13	155, 160	38	005, 010	63	055, 066	88	105, 110
14	013, 018	39	063, 068	64	113, 118	89	163, 168
15	071, 076	40	121, 126	65	171, 176	90	021, 026
16	129, 134	41	179, 184	66	029, 034	91	079, 089
17	187, 192	42	037, 042	67	087, 092	92	137, 142
18	045, 050	43	095, 100	68	145, 150	93	195, 000
19	103, 108	44	153, 158	69	003, 008	94	053, 058
20	161, 166	45	011, 016	70	061, 066	95	111, 116
21	019, 024	46	069, 074	71	119, 124	96	169, 174
22	077, 082	47	127, 132	72	177, 182	97	027, 032
23	135, 140	48	185, 190	73	035, 040	98	085, 090
24	193, 198	49	043, 048	74	093, 098	99	143, 148

MODIFICATIONS

A. TFC00 assumes the use of either HSR01 (Stop Section) for TUSS-90 or STP01-8C00 for TUSS-80.

1. If the Stop section or routine is not used the following additions must be made:

	Page	Line	Location	Instruction
TUSS-90	017	020	0674	26 000C 0000
TUSS-80	017	020	0419	26 000C 0000

2. Control is transferred to the HSR Stop section or routine at:

Page	Line	a
09	18	1393

TFC00-0T00 incorporates a number of HSR buffer tests. Care should be taken that the "m" portion of these instructions refers to the particular HSR routine being used. The following is a list of locations of all "42" instructions within TFC00-0T00:

Page	Line	a	Page	Line	a
01	03	1004	07	17	1996
02	03	1228	08	03	1268
02	04	1180	09	13	1387
02	20	1293	11	01	1390
03	08	1190	11	03	1259
03	09	1099	12	07	1160
05	16	1022	13	05	1213
05	17	1031	14	01	1236
06	02	1374	14	13	1391
06	03	1032	14	16	1093
06	15	1041	14	12	1084
07	02	1926	15	16	1284
07	12	1925	16	13	1918

B. TFC00 does not assume the use of an RPU routine and therefore, does not include any "22" instructions. If required, they should be inserted in TFC00 every nine drum revolutions.

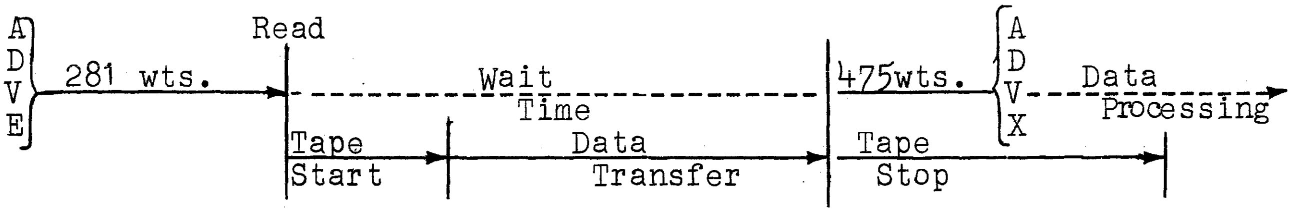
LENGTH

TFC00 occupies 331 locations in bands 10, 12 and 18. In addition, up to 60 locations in bands 10 and 12 may be used by PARAMETERS.

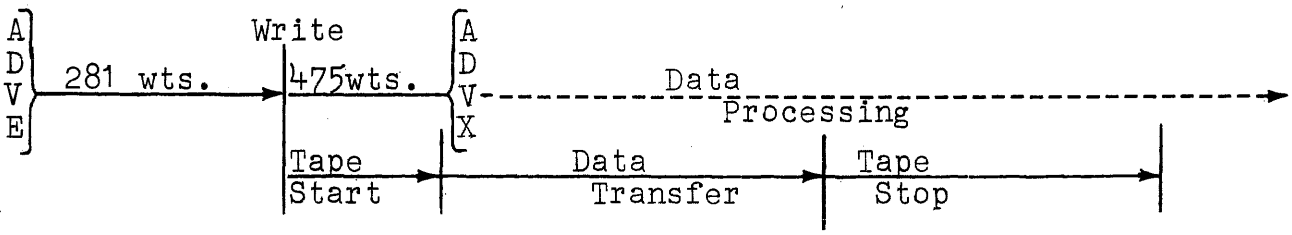
TIMING

A. Advancing a file when previous write instruction not still in progress:

1. Input



2. Output



B. If a previous write instruction is still in progress, there will be a delay until the tape buffer and servos become available. As soon as available, timing will be as above.

C. Demand Advance:

1. 304 wts. + Tape Start Time + Data Transfer Time + 148 wts. (The 148 wts. are overlapped with Tape Stop Time).

2. If a previous instruction was a write which was executed during ADV, there is an increase of 200 wts.

OPERATING PROCEDURES

A. Normal Procedures

Load TFCOO-OTOO, the cards containing the TFCOO PARAMETERS, either TECOO or TECO1, and if used, HSR, STP or RPU routines.

B. Error Procedures

1. The following error indications are provided by TFCOO:

Stop Identification	Explanation	Action
67 8021 000A	The rewind instruction was improperly executed. The rewind instruction is in rA.	Depress Run button to attempt repeat execution of rewind instruction. To bypass incorrect rewind indication, key 00 0000 000C into rC, set next instrucion at c, and depress Run button.
67 803s 1956	Block count does not check on current input tape. File number is in rB_1; machine block count, in rA; and tape block count in rL. s = Uniservo number.	To assume block count is correct, key 00 0000 000C into rC, set next instruction at c, and depress Run button. Otherwise, restart.

Stop Identification	Explanation	Action
67 804s 1324	Label does not check. Predicted label is in rA. Actual tape label is in rL. s = Uniservo number.	To accept actual tape label, key 00 0000 000C into rC, set next instruction at c, and depress Run button. Otherwise, rewind Uniservo and remount proper tape. Depress Run button.

2. Should a loop which consists of the instructions, F6 and 42, be entered, the computer should be brought to a stop on one instruction (after the HSR has ceased feeding cards). Key 00 0000 1165 into rC, set next instruction at c, set computer on continuous and depress Run button. This may allow the run to continue. The loop is caused by a tape buffer error.

3. If TFC00 is being used during program testing, and if the program is being executed on "one instruction", no write instruction can be properly carried out since the tape buffer is loaded after initiation of the write instruction. To write the desired information, set computer on stop compare when the write instruction appears in rC. Upon stopping at the next compare instruction, execution on one instruction may resumed.

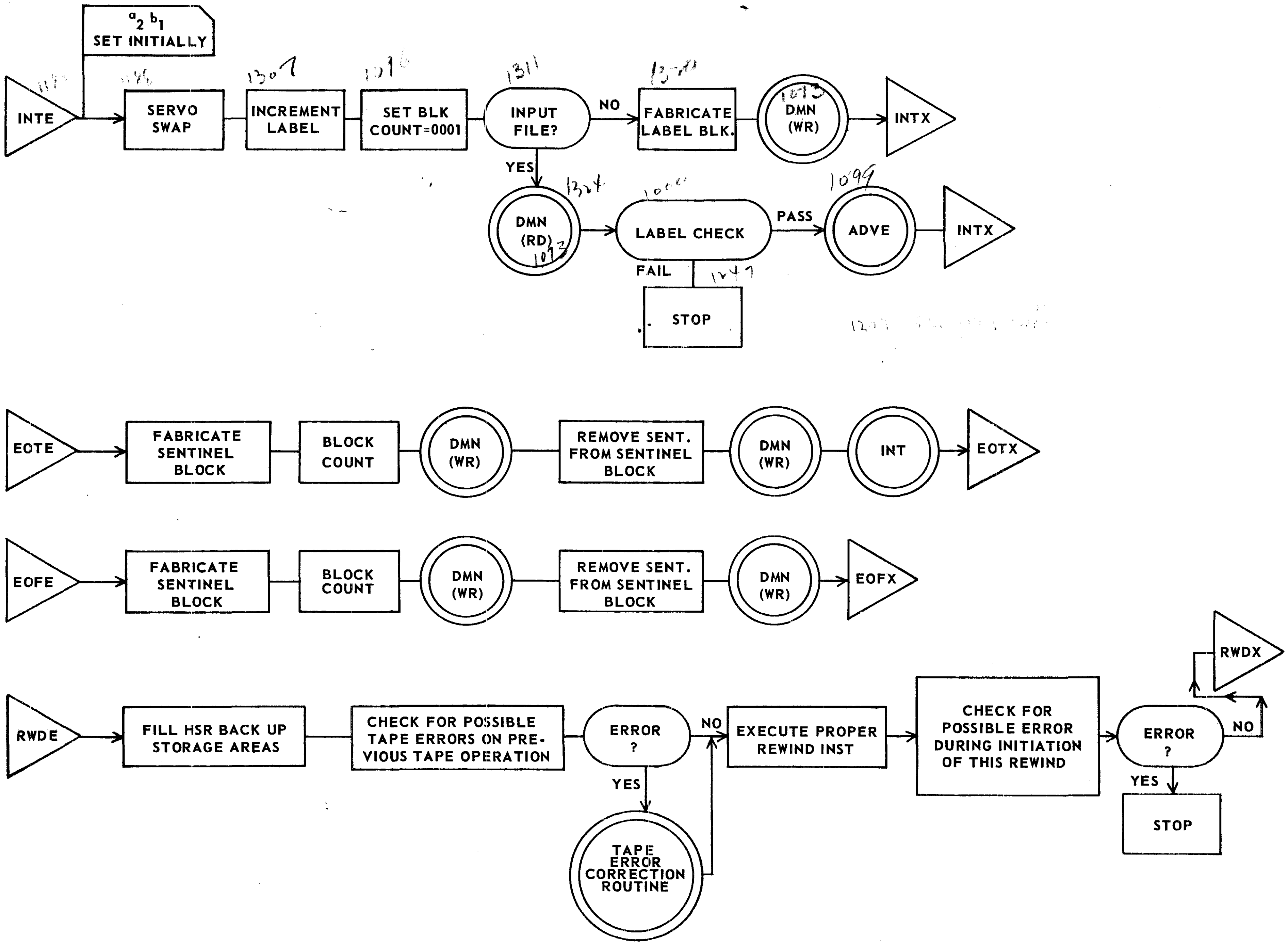
4. If rerun or restart is required, TFC00-OT00 and its parameters must be reloaded.

NOTE: Questions concerning this routine should be directed to Manager, Program Library Services, Remington Rand Univac, 315 Park Avenue South, New York 10, N. Y.

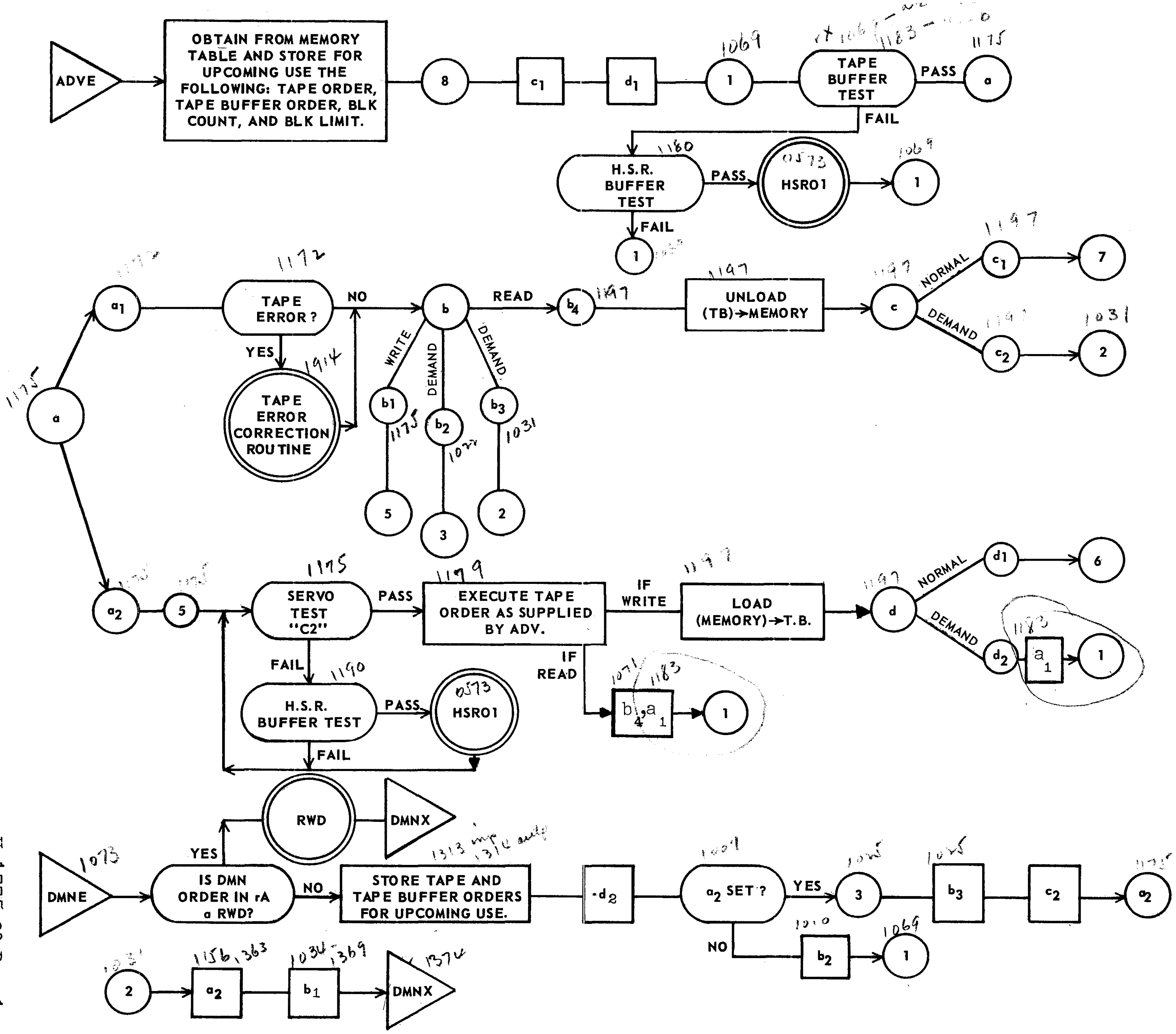
Date: 6/15/60
Revised: 8/10/60

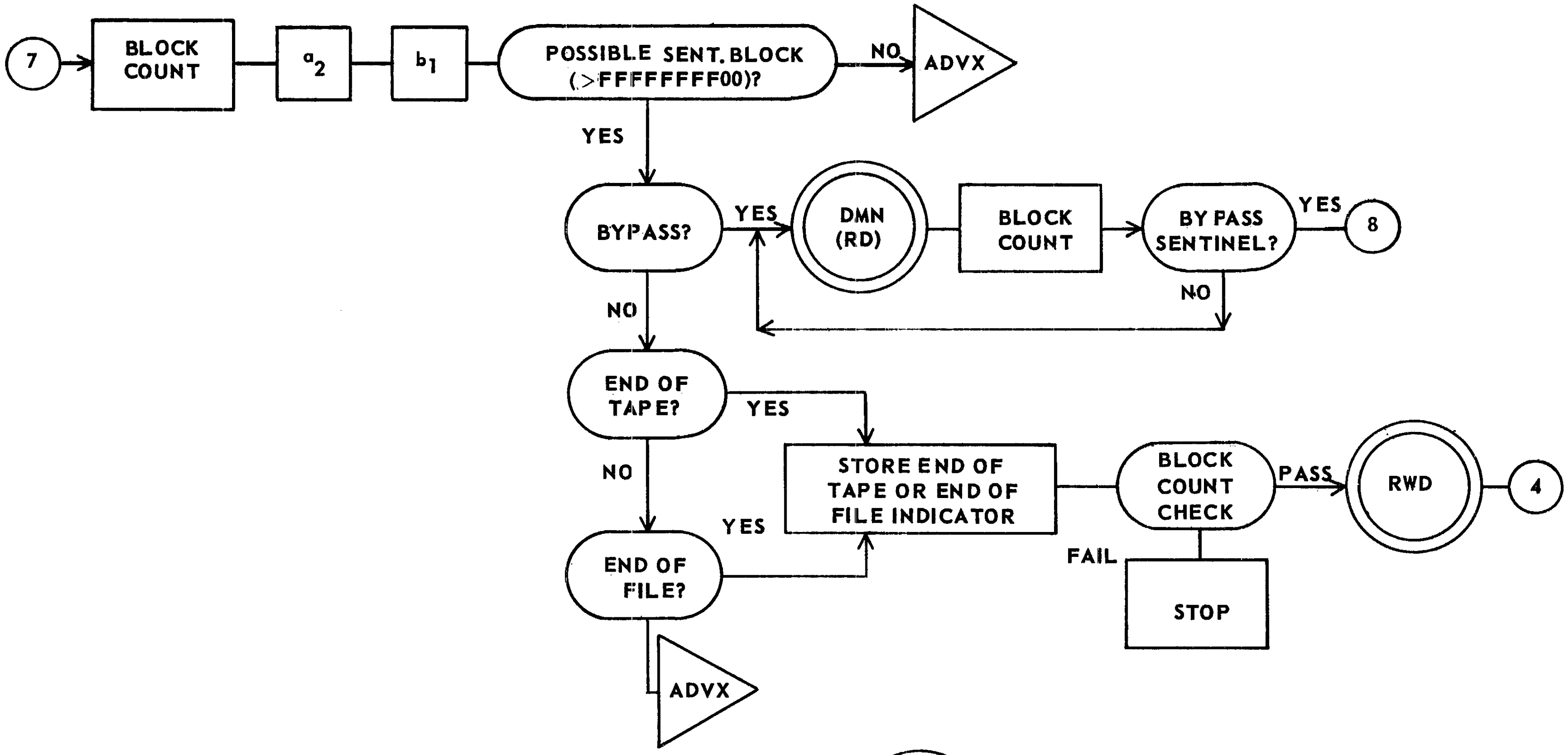
PROGRAMMING PROCEDURES (SUMMARY)

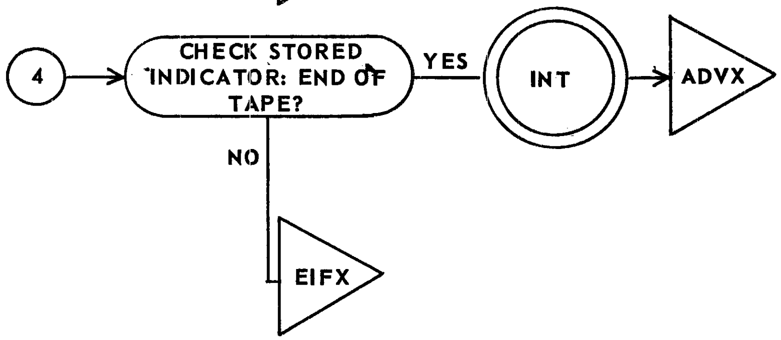
		Exit	1038	1036	1072	1098	1178	1042	1054
		Name	INTX	ADVX	EIFX	OTFX	DMNX	EOTX	EOFX
		Exit Conditions	rX: 00bb000000 rB_1: 000f rB_2,rB_3:not used. rA,rL: destroyed	rX: 00bb000000 rB_1: 000f rB_2,rB_3:not used. rA,rL: destroyed	rB_1: 000f rB_2,rB_3:not used. rA,rX,rL:destroyed	rX: 00bb000000 rB_1: 000f rB_2,rB_3:not used. rA,rL:destroyed	rB_1,rB_2,rB_3:not used. rA,rX,rL: destroyed	rX: 00bb000000 rB_1: 000F rB_2,rB_3:not used. rA,rL: destroyed	rB_1: 000f rB_2,rB_3;not used. rA,rX,rL:destroyed
Entrance	Name	Entrance Conditions							
1188	INTE	rB_1: 000f	Normal		End-of-file				
1099	ADVE	rB_1: 000f		Normal	End-of-file	Output block limit			
1077	DMNE	rX: C6bb000000 or F6bb000000 rA: G20xyz0000 or H20xy00000 or F20xy00000					Normal		
1093	EOTE	rB_1: 000f						Normal	
1084	EOFE	rB_1: 000f							Normal

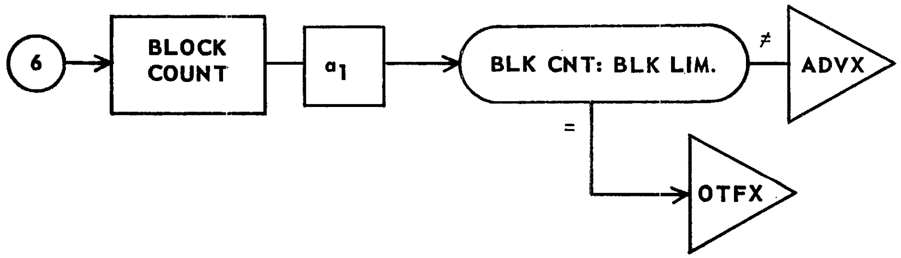


a_2 b_1 SET INITIALLY
INTE
SERVO SWAP
INCREMENT LABEL
SET BLK COUNT=0001
INPUT FILE?
NO
FABRICATE LABEL BLK.
DMN (WR)
INTX
YES
DMN (RD)
LABEL CHECK
PASS
ADVE
INTX
FAIL
STOP
EOTE
FABRICATE SENTINEL BLOCK
BLOCK COUNT
DMN (WR)
REMOVE SENT. FROM SENTINEL BLOCK
DMN (WR)
INT
EOTX
EOFE
FABRICATE SENTINEL BLOCK
BLOCK COUNT
DMN (WR)
REMOVE SENT. FROM SENTINEL BLOCK
DMN (WR)
EOFX
RWDE
FILL HSR BACK UP STORAGE AREAS
CHECK FOR POSSIBLE TAPE ERRORS ON PREVIOUS TAPE OPERATION
ERROR ?
NO
YES
TAPE ERROR CORRECTION ROUTINE
EXECUTE PROPER REWIND INST
CHECK FOR POSSIBLE ERROR DURING INITIATION OF THIS REWIND
ERROR ?
NO
RWDX
YES
STOP


ADVE
OBTAIN FROM MEMORY TABLE AND STORE FOR UPCOMING USE THE FOLLOWING: TAPE ORDER, TAPE BUFFER ORDER, BLK COUNT, AND BLK LIMIT.
8
c1
d1
1
TAPE BUFFER TEST
PASS
FAIL
a
H.S.R. BUFFER TEST
PASS
HSRO1
1
FAIL
1
a1
TAPE ERROR ?
NO
YES
TAPE ERROR CORRECTION ROUTINE
b
READ
WRITE
DEMAND
DEMAND
b4
UNLOAD (TB)→MEMORY
c
NORMAL
DEMAND
c1
7
c2
2
b1
b2
b3
5
3
2
a
a2
5
SERVO TEST "C2"
PASS
EXECUTE TAPE ORDER AS SUPPLIED BY ADV.
IF WRITE
LOAD (MEMORY)→T.B.
d
NORMAL
d1
6
DEMAND
d2
a1
1
IF READ
b4,a1
1
FAIL
H.S.R. BUFFER TEST
PASS
HSRO1
FAIL
RWD
DMNX
YES
DMNE
IS DMN ORDER IN rA a RWD?
NO
STORE TAPE AND TAPE BUFFER ORDERS FOR UPCOMING USE.
d2
a2 SET ?
YES
3
b3
c2
a2
NO
b2
1
2
a2
b1
DMNX
1069
1175
1180
1197
1031
1172
1914
1179
1190
0573
1183
1073
1069


7
BLOCK COUNT
a_2
b_1
POSSIBLE SENT. BLOCK (>FFFFFFFF00)?
NO
ADVX
YES
BYPASS?
YES
DMN (RD)
BLOCK COUNT
BY PASS SENTINEL?
YES
8
NO
NO
END OF TAPE?
YES
STORE END OF TAPE OR END OF FILE INDICATOR
BLOCK COUNT CHECK
PASS
RWD
4
FAIL
STOP
NO
YES
END OF FILE?
ADVX


4
CHECK STORED INDICATOR: END OF TAPE?
YES
INT
ADVX
NO
EIFX


6
BLOCK COUNT
a_1
BLK CNT: BLK LIM.
≠
ADVX
=
OTFX

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K	
0001	001	010	1165	67	1175	1180		a [illegible]
0002	001	020	1172	87	1914	1175		b_1 init 87 1914 [illegible] = b_2
0003	001	030	1004	42	0573	1197		87 1914 1031 = b_3 87 1914 1197 = b_4
0004	001	040	1003	25	1055	1058		
0005	001	050	1058	70	1063	1067		
0006	001	060	1063	00	0100	0000		
0007	001	070	1067	60	1130	1151	1	
0008	001	080	1151	30	1153	1155		
0009	001	090	1153	87	1914	1175		
0010	001	100	1155	05	1161	1163		
0011	001	110	1161	67	1175	1180		
0012	001	120	1163	65	1165	1167		
0013	001	130	1167	50	1172	1174		
0014	001	140	1174	25	1197	1199		
0015	001	150	1199	35	1202	1204		
0016	001	160	1202	00	HH00	0000		
0017	001	170	1204	05	000A	1208		
0018	001	180	1208	20	1210	000A		
0019	001	190	1210	30	0019	1021		
0020	001	200	1021	25	1023	1225		

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K	
0021	002	010	1023	FF	FFFF	FF00		
0022	002	020	1225	87	1228	1028		
0023	002	030	1228	42	0573	1036		Var=42 0573 1237
0024	002	040	1180	42	0573	000C		HSR Branch Test
5 0025	002	050	1175	C2	1179	1190		Servotest a_2
0026	002	060	1053	25	1055	1057		
0027	002	070	1057	30	1059	1061		
0028	002	080	1061	70	1063	1066		
0029	002	090	1066	60	1130	1150	1	
0030	002	100	1150	35	1152	1157		
0031	002	110	1152	HH	HH00	0000		
0032	002	120	1157	05	1159	1162		
0033	002	130	1159	67	1172	1180		
0034	002	140	1162	65	1165	1182		
0035	002	150	1182	82	1385	1194		
0036	002	160	1385	25	1197	1285		
0037	002	170	1285	35	1287	1289		
0038	002	180	1287	00	HH00	0000		
0039	002	190	1289	05	000A	1293		
0040	002	200	1293	42	0573	1098		

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0041	003	010	1194	25	1197	1200	
0042	003	020	1200	35	1202	1223	
0043	003	030	1223	05	000A	1228	
0044	003	040	1071	25	1002	1168	
0045	003	050	1002	87	1914	1197	
0046	003	060	1168	60	1172	1183	
0047	003	070	1183	05	1159	000C	
0048	003	080	1190	42	0573	1175	
0049	003	090	1099	42	0573	1319	
0050	003	100	1319	05	1321	1323	
0051	003	110	1321	05	1140	000A	1
0052	003	120	1323	25	1325	1327	
0053	003	130	1325	25	1350	1177	1
0054	003	140	1327	30	1130	000C	1
0055	003	150	1177	60	1179	1185	
0056	003	160	1185	65	1197	1399	
0057	003	170	1399	25	0008	1005	
0058	003	180	1005	37	0600	1014	
0059	003	190	1014	50	1055	1257	
0060	003	200	1257	60	1059	1069	

.b4

Tape Buffer Test

Block Count

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0061	004	010	1069	65	1165	000C	
0062	004	020	1077	30	1279	1301	
0063	004	030	1279	G2	FFFF	FFFF	
0064	004	040	1301	87	1335	1304	
0065	004	050	1335	35	1339	1341	
0066	004	060	1339	F2	0000	1242	
0067	004	070	1341	60	1349	1154	
0068	004	080	1154	25	1158	1380	
0069	004	090	1158	05	1374	1349	
0070	004	100	1304	30	1308	1310	
0071	004	110	1308	HF	FFFF	FFFF	
0072	004	120	1310	87	1313	1314	
0073	004	130	1313	20	1315	1317	
0074	004	140	1315	00	0000	1071	
0075	004	150	1317	32	0F00	1330	
0076	004	160	1330	20	1332	1361	
0077	004	170	1332	00	0000	1031	
0078	004	180	1314	20	1316	1318	
0079	004	190	1316	00	0000	1197	
0080	004	200	1318	32	0F00	1334	

Input file

Output file

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K	
0081	005	010	1334	20	1338	1361		
0082	005	020	1338	00	0000	1183		
0083	005	030	1361	30	1165	1367		C7 1175 1180 a?
0084	005	040	1367	65	1179	1381		
0085	005	050	1381	05	1383	1187		
0086	005	060	1383	C7	1175	1180		
0087	005	070	1187	60	1197	1999		
0088	005	080	1999	25	000C	1007		
0089	005	090	1007	82	a_2 1025	a_1 1010		a_2 set?
0090	005	100	1010	25	1012	1016		NO - a_2 not set
0091	005	110	1012	87	1914	1022		• b_2
0092	005	120	1016	60	1172	1069		→ 1
3 0093	005	130	1025	25	1027	1029		YES - a_2 set
0094	005	140	1027	87	1914	1031		• b_3
0095	005	150	1029	60	1172	1175		→ Sens test 5 a_2
0096	005	160	1022	42	0573	1025		
2 0097	005	170	1031	42	0573	1034		HSR Buffer test
0098	005	180	1034	25	1153	1156		87 1914 1175
0099	005	190	1156	30	1161	1363		C7 1175 1180
0100	005	200	1363	50	1165	1369		• a_2

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0101	006	010	1369	60	1172	1374	. b1
0102	006	020	1374	42	0573	1178	or 42 0573 1923 DMNX
0103	006	030	1032	42	0573	1197	
0104	006	040	1028	70	1030	1033	
0105	006	050	1030	00	0000	0010	
0106	006	060	1033	70	1235	1238	
0107	006	070	1235	00	0000	0010	
0108	006	080	1238	82	1041	1244	
0109	006	090	1244	70	1246	1249	
0110	006	100	1246	00	0000	0010	
0111	006	110	1249	82	1253	1252	
0112	006	120	1252	70	1254	1258	
0113	006	130	1254	00	0000	0010	
0114	006	140	1258	82	1261	1228	
0115	006	150	1041	42	0573	1045	
0116	006	160	1045	25	000C	1049	
0117	006	170	1049	20	1051	1270	
0118	006	180	1051	30	0019	1998	
0119	006	190	1270	77	0000	1073	
0120	006	200	1073	50	1922	1924	DMNE

1922 [25 1197 1000] DMN(RS)
[60 1822 1194] DMN(WE)

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K	
0121	007	010	1924	25	1926	1928		Set DMN-
0122	007	020	1926	42	0573	1923		for return
0123	007	030	1928	60	1374	1076		to INT-E
0124	007	040	1076	05	1078	1080		
0125	007	050	1078	05	1350	1212	1	Tape unit [illegible]
0126	007	060	1080	25	1140	000C	1	Tape buffer count [illegible]
0127	007	070	1212	35	1214	1216		
0128	007	080	1214	HH	HHHH	0000		
0129	007	090	1216	32	0F00	1229		vA<->vK
0130	007	100	1229	35	1214	1304		
0131	007	110	1923	25	1925	1927		
0132	007	120	1925	42	0573	1178		DMN-1
0133	007	130	1927	60	1374	1922		
0134	007	140	1998	25	1063	1065		00010
0135	007	150	1065	70	1130	1997	1	Blk count wd + vB
0136	007	160	1997	60	1130	1996	1	
0137	007	170	1996	42	0573	1221		Buffer Test
0138	007	180	1221	25	1023	1226		FF FFFF FF00
0139	007	190	1226	70	1230	1233		
0140	007	200	1230	00	0000	0020		

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0141	008	010	1233	82	1099	1924	
0142	008	020	1253	65	1266	1268	
0143	008	030	1268	42	0573	1271	
0144	008	040	1271	25	000C	1275	
0145	008	050	1275	20	1277	000A	
0146	008	060	1277	30	0081	1283	
0147	008	070	1283	25	1130	1941	1
0148	008	080	1941	35	1152	1360	
0149	008	090	1360	82	1376	1365	
0150	008	100	1365	60	1366	1364	
0151	008	110	1364	50	1371	1909	
0152	008	120	1909	25	1911	1380	
0153	008	130	1911	25	1350	1952	1
0154	008	140	1952	35	1368	1995	
0155	008	150	1995	32	0200	1913	
0156	008	160	1913	20	1929	1954	
0157	008	170	1929	67	8030	1956	
0158	008	180	1954	60	1956	1958	
0159	008	190	1958	05	1376	1910	
0160	008	200	1910	25	1386	1912	

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0161	009	010	1912	30	1371	1956	
0162	009	020	1376	25	1378	1380	
0163	009	030	1378	05	1345	1347	
0164	009	040	1345	25	1349	1262	
0165	009	050	1261	30	1023	1264	
0166	009	060	1264	50	1266	1268	
0167	009	070	1262	30	1266	1269	
0168	009	080	1269	05	1276	1281	
0169	009	090	1276	00	1259	0000	
0170	009	100	1281	87	000C	1072	EOF - Input INT-X
0171	009	110	1380	60	1382	1384	
0172	009	120	1384	C7	1389	1387	
0173	009	130	1387	42	0573	1384	
0174	009	140	1389	87	1392	1393	
0175	009	150	1392	25	1394	1396	
0176	009	160	1394	00	1384	0000	
0177	009	170	1396	60	1612	1165	
0178	009	180	1393	05	1395	0419	
0179	009	190	1395	31	1340	0000	
0180	009	200	1340	82	1343	1348	

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0181	010	010	1348	05	1343	000A	
0182	010	020	1343	25	1192	1206	
0183	010	030	1192	26	1172	0000	
0184	010	040	1206	60	1812	1382	
0185	010	050	1347	25	1350	1366	1
0186	010	060	1366	35	1368	1370	
0187	010	070	1368	00	0H00	0000	
0188	010	080	1370	77	0000	1373	
0189	010	090	1373	25	1110	1329	1
0190	010	100	1329	35	1331	1333	
0191	010	110	1331	00	000H	0000	
0192	010	120	1333	37	0100	1337	
0193	010	130	1337	20	1339	1342	
0194	010	140	1342	20	000B	1346	
0195	010	150	1346	60	1349	000A	
0196	010	160	1242	C7	1248	1242	
0197	010	170	1248	87	1300	000C	
0198	010	180	1300	25	1349	1170	
0199	010	190	1170	67	8021	000A	
0200	010	200	1188	25	1390	1397	

INT-E

INTE rB1 = file no

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K	
0201	011	010	1390	42	0573	1237		constant - HSR Buffer Test
0202	011	020	1397	60	1228	1259		
0203	011	030	1259	42	0573 yes	1307 no		Buffer Test
0204	011	040	1307	25	1110	1322	1	Tape Control word + rB1
0205	011	050	1322	77	0000	1326		$t \Delta S_1 S_2 m r \Delta\Delta\Delta\Delta$ for test card #23K
0206	011	060	1326	35	1202	1205		00HH 00 0000
0207	011	070	1205	06	1008	0000		
0208	011	080	1008	32	0700	1018		Servo Swap
0209	011	090	1018	37	0800	1231		ΔS_1
0210	011	100	1231	20	000C	1035		$S_2 S_1$
0211	011	110	1035	32	0200	1040		$\Delta\Delta S_2 S_1$
0212	011	120	1040	05	000A	1044		
0213	011	130	1044	25	000B	1048		
0214	011	140	1048	35	1050	1052		
0215	011	150	1050	HH	00HH	HHHH		
0216	011	160	1052	20	000C	1056		
0217	011	170	1056	60	1110	1328	1	
0218	011	180	1328	25	1350	1362	1	Input file control + rB1
0219	011	190	1362	35	1050	1090		$G2 S_1 S_2 m$ 0107-1
0220	011	200	1090	20	000C	1094		Servo Swap

TFC000T00

Servo Swap

CARD NO	PAGE	LINE	A	OP	M	C	K	
0221	012	010	1094	60	1350	1096	1	
0222	012	020	1096	25	1130	1037	1	Block count + r B_1
0223	012	030	1037	35	1039	1241		
0224	012	040	1039	00	00HH	HHHH		1 → Block Count
0225	012	050	1241	20	1063	1921		00 010 → 0
0226	012	060	1921	60	1130	1160	1	
0227	012	070	1160	42	0573	1082		Buffer Test
0228	012	080	1082	25	1100	1081	1	Label Word + r B_1
0229	012	090	1081	70	1083	1086		Label + 1 → Lab
0230	012	100	1083	00	0000	0001		
0231	012	110	1086	60	1100	1091	1	
0232	012	120	1091	05	000A	1095		A → X
0233	012	130	1095	25	1308	1311		HF $\xrightarrow{rA}$ F : ± Δ $S_1 S_2$ m r ... ; S - input, H - output
0234	012	140	1311	87	1320 (output) >	1324 (input) S		
0235	012	150	1320	30	1372	1280		→ L
0236	012	160	1372	60	1622	1194		0110
0237	012	170	1280	25	1120	1191	1	Label Word + r B_1
0238	012	180	1191	35	1193	1195		Fabricate Label Block
0239	012	190	1193	00	0HHH	0000		
0240	012	200	1195	70	1140	1198	1	Tape buffer test

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K	
0241	013	010	1198	35	1201	1203		
0242	013	020	1201	00	HHHH	0000		
0243	013	030	1203	20	1207	000A		
0244	013	040	1207	65	0000	1213		
0245	013	050	1213	42	0573	1217		
0246	013	060	1217	26	1220	0000		0 → A
0247	013	070	1220	60	1822	1073		→ DMN (WB)
0248	013	080	1324	30	1344	1073		→ DMN (RD)
0249	013	090	1344	25	1197	1000		F6 C6
0250	013	100	1000	35	1202	1211		HH0 → 0
0251	013	110	1211	05	000A	1278		
0252	013	120	1278	25	1120	1377	1	
0253	013	130	1377	35	1193	1312		
0254	013	140	1312	70	000C	1215		F6 XXXX C6
0255	013	150	1215	20	1218	000A		
0256	013	160	1218	30	0000	1224		F6 XXXX C6
0257	013	170	1224	25	1100	1209	1	
0258	013	180	1209	82	1099	1219		
0259	013	190	1219	60	1222	1232		
0260	013	200	1232	50	1234	1236		

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K	
0261	014	010	1236	42	0573	1239		Program Test
0262	014	020	1239	25	1243	1380		
0263	014	030	1243	25	1350	1930	1	Tape continue [illegible]
0264	014	040	1930	32	0200	1994		
0265	014	050	1994	35	1331	1931		[illegible]
0266	014	060	1931	20	1933	1282		
0267	014	070	1933	67	8040	1324		
0268	014	080	1282	60	1932	1934		
0269	014	090	1934	25	1222	1227		1937 67 804m 1324 [illegible]
0270	014	100	1227	30	1234	1247		[illegible]
0271	014	110	1247	05	1286	1932		Stop
0272	014	120	1237	25	1391	1398		
0273	014	130	1391	42	0573	1036		
0274	014	140	1398	60	1228	1038		Normal INT-x
0275	014	150	1286	50	1100	1099	1	
0276	014	160	1093	42	0573	1303		
0277	014	170	1303	25	1305	1309		
0278	014	180	1305	00	0000	0030		
0279	014	190	1084	42	0573	1088		
0280	014	200	1088	25	1291	1309		

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0281	015	010	1291	00	0000	0040	
0282	015	020	1309	60	1312	1336	
0283	015	030	1336	25	1140	1240	1
0284	015	040	1240	35	1287	1290	
0285	015	050	1290	20	1292	1294	
0286	015	060	1292	60	0019	1250	
0287	015	070	1294	77	0000	1297	
0288	015	080	1297	70	1299	1302	
0289	015	090	1299	00	0062	0034	
0290	015	100	1302	05	000A	1306	
0291	015	110	1306	25	1312	1375	
0292	015	120	1375	70	1023	000B	
0293	015	130	1250	25	1130	1251	1
0294	015	140	1251	70	1063	1267	
0295	015	150	1267	35	1152	000C	
0296	015	160	1284	42	0573	1288	
0297	015	170	1288	25	1291	1295	
0298	015	180	1295	30	1312	1379	
0299	015	190	1379	32	1245	1388	
0300	015	200	1245	25	1256	1260	

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0301	016	010	1256	05	1274	1347	
0302	016	020	1274	00	1054	0000	
0303	016	030	1388	25	1255	1260	
0304	016	040	1255	05	1916	1347	
0305	016	050	1260	60	1166	1265	
0306	016	060	1265	25	000C	1273	
0307	016	070	1273	70	1263	1270	
0308	016	080	1263	10	0061	9988	2
0309	016	090	1296	30	1298	1073	
0310	016	100	1298	25	1166	1380	
0311	016	110	1166	05	1916	1347	
0312	016	120	1916	25	1918	1920	
0313	016	130	1918	42	0573	1917	
0314	016	140	1920	60	1228	1259	
0315	016	150	1917	25	1391	1919	
0316	016	160	1919	60	1228	1042	
0317	016	170	1070	35	1272	000A	
0318	016	180	1272	32	0000	HHHH	
0319	016	190	1914	05	1350	1915	1
0320	016	200	1915	65	1635	1800	

TFC000T00

CARD NO	PAGE	LINE	A	OP	M	C	K
0321	017	010	1812	26	1172	0000	

PROGRAM LIBRARY SERVICES

UNIVAC
Solid-State
80/90 Tape
SR012

SORT ROUTINE (12 WORD ITEM)

PURPOSE

Sorts into ascending sequence a file of randomly ordered items containing twelve alphanumeric words on the basis of a key which may range from one to one hundred twenty digits in length.

DESCRIPTION

SR012 accepts as input, a file of 12-word items in the standard interlace from a tape written in USS mode. It produces as output the same items in sequence, in the standard interlace, on a tape written in USS mode. One full reel may be sorted at a time; however, the input data may appear on more than one tape. Both input and output tapes adhere to standard tape conventions (labels, sentinels, block counts, etc.).

METHOD

The method of sorting employed by SR012 involves two distinct phases, an internal phase and an external phase. The external is composed of two parts, ascending and descending, each of which may be used many times.

Any phase or part of a phase requires a complete "pass" over the data being sorted. A pass may be defined as a situation where the entire set of input data is introduced into the computer, processed, and transferred to an output device, in this case, magnetic tape.

Each item of the data is ordered on the basis of some factor or factors which permit a sequential relationship to be established among all items. These factors are called sorting keys.[1]

The input data is dispersed during the sort run alternately on one of two sets of blank tapes. Since the data on one set is collated together and transferred to the other set, these tapes are called collation tapes. In order to differentiate between the two sets, one is denoted as A collation tapes, the other as B collation tapes.

---

[1]The first sorting key of an item may not be greater than ZZZZZZZZZV nor less than)))))))))4. Undigits F(1101) and H(1111) in the sorting key may cause the output to be improperly sorted. If these undigits do appear, and the zone of every item to be sorted is identical in the digit position of their appearance, they will not affect the accuracy of SR012 output.

SR012 is composed of six sections of coding (loads). They are as follows:

a. Initial Load
b. Rerun Load
c. Inter-Pass Control Load
d. A Pass Load
e. B Pass Load
f. First Pass Load

They appear on tape in the order indicated above. An understanding of the operation of each load will provide a picture of both the operation of the sort and of the sorting method used.

1. Initial Load

   Instructions for loads b through e are copied onto an A collation tape and a B collation tape. The B collation tape is rewound and may be replaced by an input tape at this time. The First Pass Load is read into memory.

2. First Pass Load (Internal Phase)

   The First Pass Load follows immediately after the Initial Load and operates as follows:

   a. The instruction tape, mounted on Servo 1 is rewound. It may be replaced with an input tape or an alternate B collation tape at this time.

   b. As many blocks of input data as possible are introudced into the memory. One item is paired off with another and each pair is tested to determine which has the smaller key. The smaller keyed items are similarly paired and tested and again the smaller items are selected. This procedure continues until the smallest of all the items is found. It is transferred to output storage.

      During the sequence of pairings a set of ordered relationships is established among all the items remaining in the testing area. A new input item, from a standby input block, is selected to replace the item sent to output storage and the testing resumes. Whenever the input block from which the replacement items are taken is exhausted, a new input block is read. Any new item introduced into the testing scheme having a key smaller than the last item sent to output storage is temporarily excluded from the testing. As a block of output storage is filled, it is written on an A collation tape.

When all the items remaining in the testing area have keys smaller than the last item sent to output storage, a sentinel is written on the A tape, indicating that a "string" of ordered items just written on it has been terminated.[2] A new string is then begun in the same manner as above and written on an alternate A collation tape. (See Example 1 on page 4 .)

The testing, writing of strings and alternation of A tapes, continues until all of the input data has been processed. The input tape will be rewound with interlock at this time and may be replaced with an alternate B collation tape.

At the completion of the first pass, all of the input, represented by a number of strings of ordered items, is present on the A collation tapes. The tapes are left extended (not rewound) at the completion of the internal pass.

3. Inter-Pass Control Load

   This load operates after the First Pass Load to do the following:

   a. Writes information necessary to accomplish rerun on the end of an A collation tape.

   b. Determines whether one complete string has been produced (the data is sorted). If yes, terminates the run, rewinding all tapes.

   c. If the sort is not complete, reads instructions for B Pass Load into memory and transfers control to B Pass instructions.

4. The A Pass Load and the B Pass Load together comprise the External Phase of the sort.

   The external phase deals entirely with the collation of strings of ordered items. That is, each string written on a collation tape is collated together with a corresponding string on the other collation tapes producing a new series of strings; each as large as the total number of items in all the strings collated.

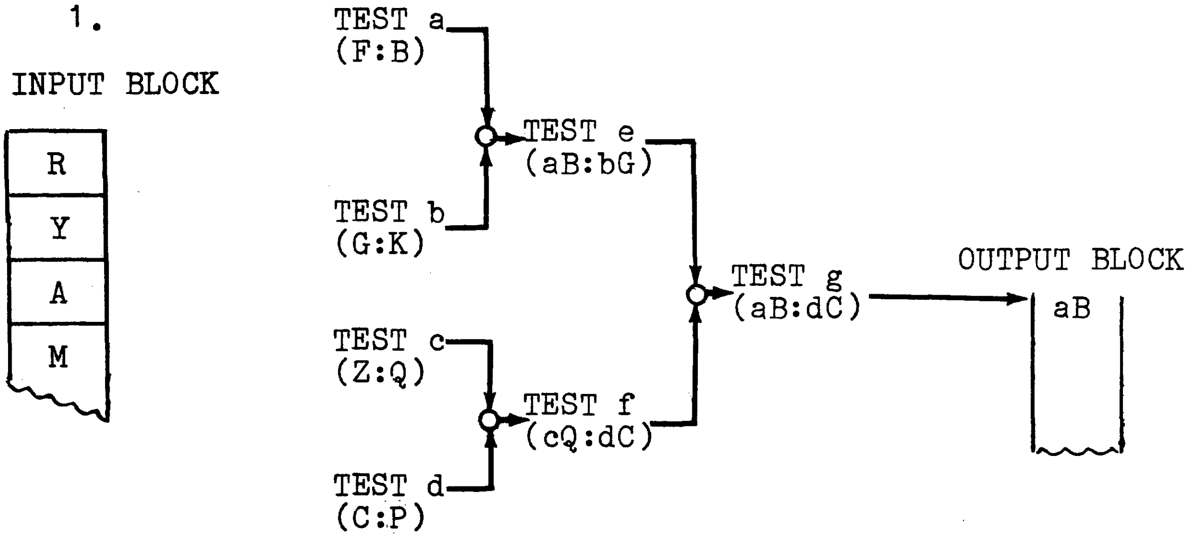
---

[2]If at no time does the situation arise where items introduced into the testing area have keys smaller than the last item sent to output, one completely ordered ascending string is produced in one pass and the run is terminated. In effect, by replacing the item sent to output with a new item, and continuing to create a string until it is no longer possible to do so, advantage is taken of any ascending bias that may exist in the input data.

EXAMPLE 1

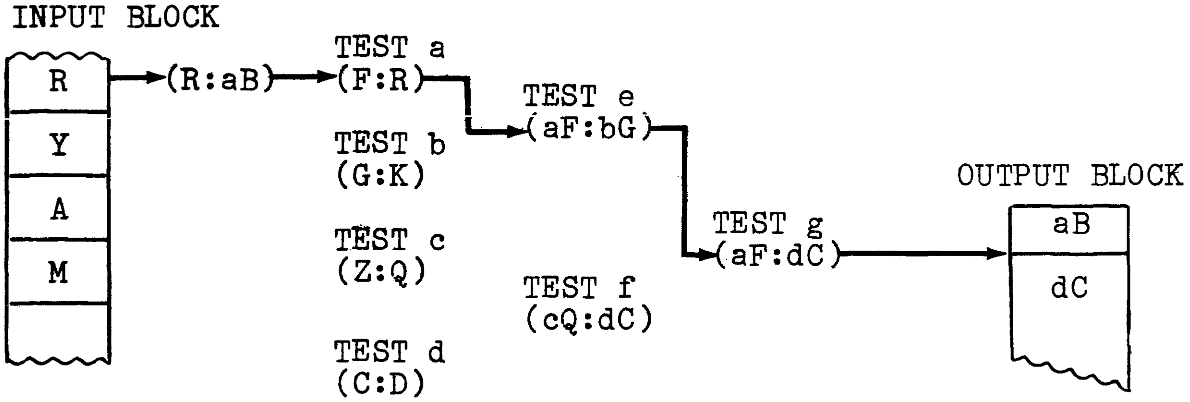
A simplified picture of the operation of a "tournament" might be represented as follows:[3]

1.



Notice seven tests are required to select the smallest keyed of eight items.

2.

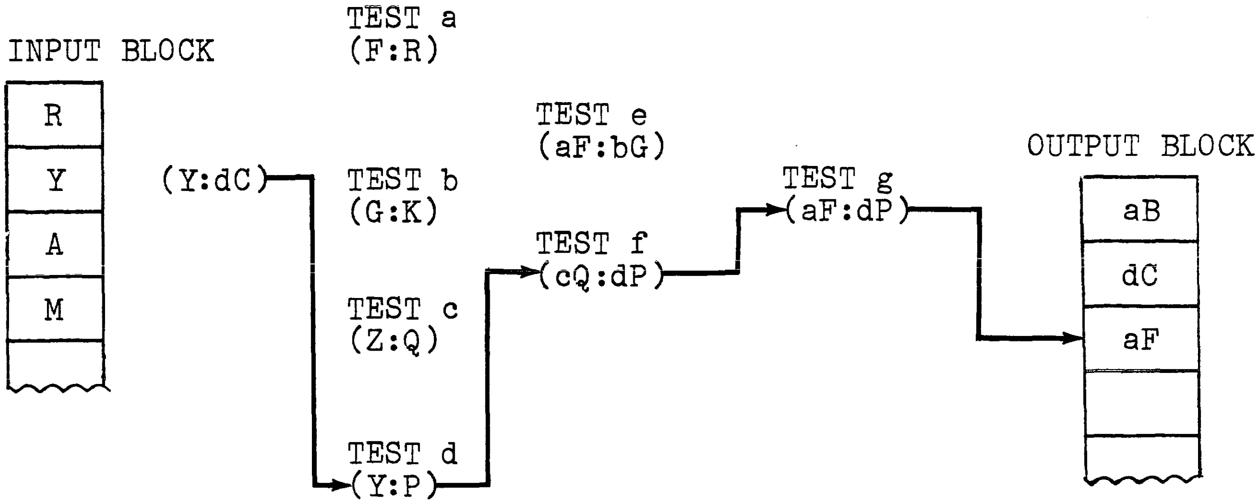


A new (replacement) item R is tested against aB the previous smallest key. It is larger, indicating it will fit on the current string, thus it replaces the item aB in tournament scheme. Counting this test, a total of four is required to select the smallest keyed of eight items.

---

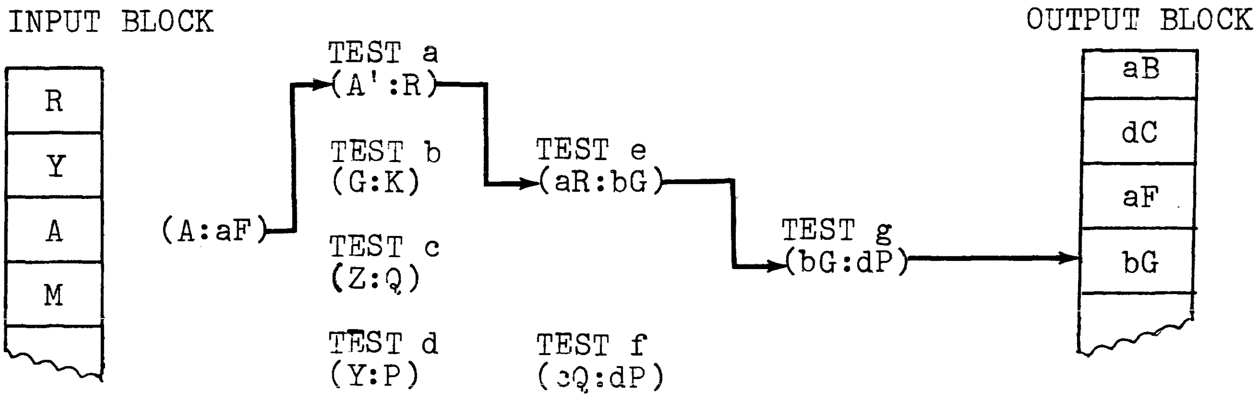
[3]Symbols have the following meanings - (:) indicates a test. Capital letters indicate the key of an item. Lower case letters indicate a particular test. When a lower case letter precedes a Capital letter in a test, this indicates that this key (Capital) was found to be smaller as the result of the test (lower case). Lines are used to indicate the flow of tests made during a particular sequence. A prime affixed to a key indicates that it has been forced to be higher in value than any key not primed.

3.



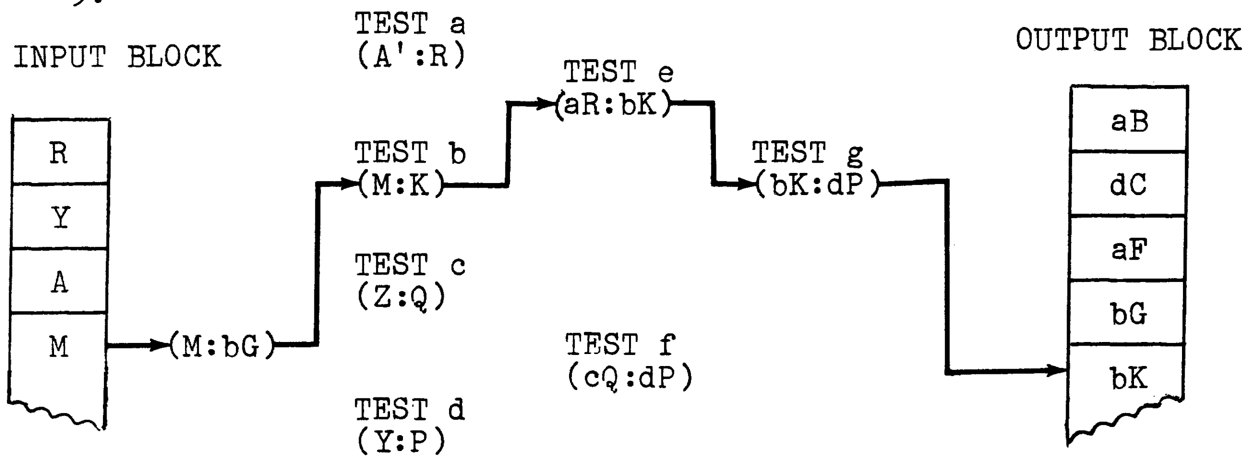
Again, only four tests are required to select the smallest keyed of eight items.

4.



When replacement item A is found to be smaller than aF, the last item sent to output, this indicates that item A will not fit on the current string. Item A is primed, made artificially larger than any item not so primed. Primed items will not be advanced to output until every unprimed item has been advanced and replaced by a primed item.

5.



Again, only four tests are required to select the smallest key of eight items.

The procedure is continued until a primed item is selected as having the lowest key. The current string is terminated. A new string is initiated on a new collation servo beginning with the lowest of the primed items. At this time, all primes are removed from the items in the tournament area.

Example 2:

As the result of an ascending pass, strings appear on two collation tapes as follows (tapes are left extended):

TAPE A	
SENTINEL	
A	
D	
F	
H	STRING A1
J	
L	
R	
SENTINEL	
M	
N	
P	
U	STRING A2
W	
V	
Y	
SENTINEL	

TAPE A'	
SENTINEL	
B	
E	
G	
O	STRING A'1
Q	
S	
Z	
SENTINEL	
C	
I	
K	STRING A'2
T	
X	
SENTINEL	

Collating ascending strings A1 and A'1, A2 and A'2 in a descending pass onto two other collation tapes would produce strings as follows (read backward on tapes A and A', write forward on tapes B and B'):

TAPE B	
SENTINEL	
Y	
X	
W	
V	
U	
T	STRING B1
P	
N	
M	
K	
I	
C	
SENTINEL	

TAPE B'	
SENTINEL	
Z	
S	
R	
Q	
O	
L	
J	
H	STRING B'1
G	
F	
E	
D	
B	
A	
SENTINEL	

Notice string B1 contains all of the items formerly in strings A1 and A'1 and string B'1 contains all of the items in strings A2 and A'2. One more ascending collation using tapes B and B' would result in one ordered string on an A collation tape and the sort would be terminated.

5. B Pass Load (Descending Pass)

This pass collates the strings, reading backward on the A collation tapes. At the conclusion of a descending pass the strings are in descending order on the B collation tapes and the tapes are left extended.

6. Inter-Pass Control Load

This load operates after each B Pass Load to do the following:

a. If a rerun point was requested and has not yet been provided, it is offered at this point. (See 9, Rerun Points and PARAMETERS 5, field p.)

b. Reads instructions for A Pass Load into memory and transfers control to A Pass instructions.

7. A Pass Load (Ascending Pass)

This pass collates the strings, reading backward on the B collation tapes. At the conclusion of an ascending pass the strings are in ascending order on the A collation tapes and the tapes are left extended.

8. Inter-Pass Control Load

This load operates after each A Pass Load to do the following:

a. Writes information necessary to accomplish rerun on the end of an A collation tape.

b. Determines whether one complete string has been produced (the data is sorted). If yes, terminates the run, rewinding all tapes .

c. If the sort is not complete, reads instructions for B Pass Load into memory and transfers control to B Pass instructions.

9. Rerun Points

When at the conclusion of a B Pass Load the Inter-Pass Control load determines that a rerun point is to be established, the following series of events occur:

a. Instructions from the A collation tape are copied to a B collation tape and the A collation tapes are rewound with interlock.

b. The A collation tapes are removed, labeled and saved, and replaced with blank tapes.

c. Instructions are copied from a B collation tape to a blank A collation tape.

d. The Inter-Pass Control Load then reads instructions for A Pass Load into memory and transfers control to A Pass instructions.

The description of operation of the Rerun load will be deferred to Operating Instructions, Rerun.

There are several elements in SR012 which may be controlled optionally, these include, servo allocation, rewind instructions, tape labels, number of key words, number of blocks to be sorted etc..

PARAMETERS

SR012 makes use of six words of information to govern the operation of a particular sort run.

The parameters are to be stored in locations 0221 through 0226.

1. Servo Allocation - Location 0221

Format: $A_0A_1A_2A_3I_1I_2B_0B_1B_2B_3$

$A_0A_1A_2A_3$ designates a set of A collation servos used for output of the First Pass Load and A Pass Loads. At least two servos, A_0 and A_1 must be specified.

Servo A_1 will contain the final output tape.

Unused digits are to be filled with H (undigit 1111).

A may be 0-9

I_1I_2 designates the input servo(s). If only one servo is assigned, I_2=I_1. One input servo may share the same servo assignment as the instruction tape, Servo 1. Input tapes are rewound with interlock at the completion of the first pass.

$B_0B_1B_2B_3$ designates a set of B collation servos used for output of B Pass Loads. At least two servos, B_0 and B_1 must be specified. B_1 or any alternate B servo may share the same servo assignment as the Instruction Tape, Servo 1. B_0 which is used during the Initial Load may be rewound and replaced by an alternate Input tape (see Parameter 2, digit r_6). It must be remounted at the completion of the first Pass Load.

Unused digits are to be filled with H (undigit 1111).

B may be 0-9

The variation in servo assignment is provided so that maximum advantage can be made of the number of servos available. A minimum of four servos is required to use SR012. It is sometimes desirable to allow for the greatest number of collation servos possible.[4] Example: If four servos are available, allowing for a two way collation, each collation pass can at best halve the number of strings.

If six servos are available, allowing for a three way collation, each collation pass would at best cut the number of strings by 2/3. A greater power of collation frequently requires fewer passes to sort the same amount to data.

Where an odd number of servos are available (five for example) the larger number of servos should be assigned to B collation tapes (three to B and two to A).

The most efficient servo allocation where four servos (the minimum) are available would be as follows:

Assume one servo for input.

SERVOS

	1	2	3	4
Initial Load	Instructions[5] SR012	A_0	A_1	B_0
First Pass Load	Input[6]	A_0	A_1	B_0
B Pass Load	B_1	A_0	A_1	B_0

2. Rewind Instructions - Location 0222

Format: $r_0 r_1 r_2 r_3 r_4 r_5 r_6 r_7 r_8 r_9 r_{10}$

$r_1 r_2 r_3 r_4$ Final rewind instructions for $A_0 A_1 A_2 A_3$ respectively.

$r_7 r_8 r_9 r_{10}$ Final rewind instructions for $B_0 B_1 B_2 B_3$ respectively.

$$r_n \begin{array}{l} = 0 \text{ to rewind without interlock} \\ = 2 \text{ to rewind with interlock} \end{array} \Big\} \; n \neq 5,6$$

r_5 Optional check read on the final output tape (A_1)

r_5 = 0 to check read.
= 2 to not check read.

---

[4] When the volume of data is small, actual sorting time must be compared with set up time (i.e. mounting servos).

[5] Instruction tape is rewound with interlock after Initial Load when specified in Parameter 6, field q.

[6] Input tapes are automatically rewound with interlock.

r_6 Intermediate rewind for B_0.

$r_6 = 0$ to rewind B_0 without interlock.

$= 2$ to rewind B_0 with interlock.

3. Input Label - Location 0223

Format: Arbitrary

However, the least significant digit of the input label is incremented by one before the first input label is checked and each time a new input tape is read. Therefore, the least significant digit of the label should be a numeric. It should be set initially to be a value one less than that assigned to the label on the first reel of input.

4. Output Label - Location 0224

Format: Arbitrary

This label will appear on the final output tape (A_1) without incrementation, that is, exactly as specified here. If this tape is to be input for a future sort, the considerations necessary in designing an input label should also be followed here.

5. General Information - Location 0225

Format: aaabbbRRRp

aaa actual band level at which the input label can be found.

bbb assigned band level from which the output label should be written (bbb may not equal 017 or 111).

RRR Run ID, now equals 012. May be altered only if all SR012 load blocks are altered identically. See MODIFICATIONS I.b..

p number of rerun points desired. (p may equal 0, 1,...,9). (See OPERATING INSTRUCTIONS, Rerun.)

6. General Information - Location 0226

Format: hhnntqywww

hh highest numbered word in the sorting key. (hh may equal 00, 02,...,11).

nn input block count limit. nn-hundred blocks of input will be processed. nn should be a maximum of 48 for plastic tape input and 28 for metallic tape input.

t indicates the manner in which tape sentinels are to be handled.

t = 0 when all sentinels are to be treated conventionally.

t = 1 when it is desired to countermand the conventional meaning of sentinels. For example, in the case of a multi-reel file, all intermediate reels would contain end-of-tape sentinels. SR012 will normally execute a servo swap when such a sentinel is located; however, since only one full tape can be sorted at one time, SR012 should be made to treat this sentinel as end-of-file.

q optional rewind of the instruction tape (Servo 1).

q = 0 to have the instruction tape rewound with interlock following the initial read in of instructions. (e.g. when it is necessary to use this Servo for an input tape.)

q = 1 to leave the instruction tape extended (not rewound) (e.g. SR012 is one of many runs on a Master Instruction Tape).

y indicates optional alteration of parameters desired.

y = 0 when no change to parameters (initial stop) is desired.

y = 1 when it is desired to specify parameters before sorting begins.

www = 012

MODIFICATIONS

I. a. SR012 currently has a set of sort parameters specified. Field y of parameter 0226 is set so that an initial stop will be provided to permit insertion of new parameters via manual key-in. To place the desired parameters directly on tape, use MASCOT to make corrections to Block 8, Entry Numbers 221, 222, 223, 224, 225, 226.

Block 8, Entry numbers 221-226 are currently set as follows:

ENTRY	PARAMETER
221	43HH2265HH
222	0200200000
223	0000000000
224	0000000000
225	0190190120
226	0048001012

b. SR012 load blocks currently contain the SR012 run ID. It is a four digit numeric, the first three digits of which are 012. The fourth digit, is used to identify a particular load. Parameter 0225 contains, in field RRR, the first three digits of the ID (012).

If desired, for purposes of filing the sort routine on a master instruction tape, the run ID may be altered. In assigning a new ID, two rules must be observed:

1. The least significant digit of the ID for the first load must be zero and increased by one for each succeeding load (0,1,...,5). The final or locator block must have a least significant ID number of 9.
2. Every load block is to be altered and the new ID must be specified in field RRR of parameter 0225.

   Load blocks can be altered using a MASCOT copy with correction, band format, option. Corrections in each case are applied to level 0199. Only digits one, two and three of the m portion (as indicated by xxx below) may be changed. They reflect the new run ID. No other information may be altered.

LOAD	BLOCK	LEVEL 0199	CURRENT m PORTION
INITIAL	1	77 xxx0 2017	0120
RERUN	14	77 xxx1 2100	0121
INTER-PASS CONTROL	27	77 xxx2 2000	0122
A PASS	47	77 xxx3 0512	0123
B PASS	75	77 xxx4 0512	0124
FIRST PASS	103	77 xxx5 0341	0125

When SR012 is given a new Run ID a new locator block must be generated using MASCOT to replace the SR012 locator in block 128. The new locator will reflect the new Run ID as xxx9 and provide any one of the standard locator options available.

The SR012 locator currently on tape in block 128 will provide a stop to permit specification of some run via key in to rA. It will normally relocate the first load of SR012.

II. Coding to control and edit input items, prior to their being supplied to the First Pass for sorting, may be integrated with SR012. This First Pass Own Coding (FPOC) can exercise complete control over the introduction of items to the sort and may be used to accomplish some of the following:

a. Alter the format and/or position of sort keys.

b. Edit item sizes larger or smaller than 12 words into the 12 word size required by SR012.

c. Delete input items.

d. Add items.

FPOC will replace portions of two sections of SR012 coding which deal with:

a. Item Advance Control (including contact with a routine that reads input blocks from tape).

b. Transfer of input items from the input block to a working storage.

The SR012 coding that can be modified is annotated and listed on pages 32 to 36. A flow-chart of its operation appears on page 31.

A. A general description of the operation of the two sections of SR012 follow:

1. Item Advance Control (IAC).

a. Items are delivered to the First Pass for sorting one at a time. SR012 enters IAC at 0753 each time it requires an item. SR012 selects one of 112 12 word working storage areas and loads the address of the numeric portion of word zero of the working storage into rB_2 prior to entering 0753.

On initial entrance, the input label block has been checked but the first input block has not been read into memory.

b. IAC controls the advance of 12 word input items by adding 0002 to the m portion of line 4558 which is used to indicate the address minus one of the numeric portion of word zero of the current item in the input block. For the first item, (4558) is set equal to 00 0000 0000. All blocks of input are read into the 00 band. The actual address of the numeric portion of word zero of the first 12 word item is 0001.

c. Each time 0002 is added to (4558) it is tested against a limit of 0016 which is stored as the m portion of (0776). When equal, eight items have been transferred, a new block of input is procured by transferring control to SR012 Sort File Control routine (SFC) at 1981.

d. IAC loads rB_1 with the address of the numeric portion of word zero of the current input item. It transfers control to the Input Item Transfer section at 0810.

2. Input Item Transfer Section.

a. This section transfers a 12 word item from the input block into a working storage location. It makes use of rB_1 and rB_2 to establish the address of the input and working storage areas respectively.

b. After the item is transferred it places the first sort key, word zero of the item, into registers X and L as follows: the numeric portion of the key is stored in rX; the zone portion of the key is stored in rL.

c. After the item has been transferred and the first key placed in registers, it is examined for an End-of-Block sentinel. The item is delivered to SR012 for sorting by transferring control to 4759.

B. Any FPOC which either replaces or modifies the above SR012 sections must continue to perform the following functions:

1. The coding that replaces IAC must:

a. Completely control the procurement of input blocks via SFC.

b. Keep track of the input item within each block that is to be delivered to SR012 at the next call.

c. Set 0753 to 00 1425 0000 when the last input item to be sorted has been delivered to SR012. (See C.a. below.)

d. Test each item for an End-of-Block sentinel (FFFFFFFF10) before giving it to SR012 for sorting.

2. The coding that replaces 12 word item transfer must:

   a. Place a 12 word item into the working storage area. The address minus one for the numeric portion of word zero of this item is in rB_2.

   b. Place the numeric portion of the first sort key into rX, place its zone portion into rL.

   c. Return to IAC at B,1.d above.

C. Modifying the IAC Coding.

1. Most of the IAC coding may be replaced or modified. When replacing IAC, the following locations and addresses <u>must</u> retain their function.

   a. 0753 SR012 always enters at this location when a new input item is required. Therefore, any FPOC must begin at this location. When FPOC has no more items to be sorted, 0753, should be set equal to 00 1425 0000.

   b. 1981 This is the entrance to the SFC routine which reads a block of input from tape into the 00 band of memory.

   c. 0230 This is the exit from SFC when an input block is available. FPOC processing of a new input block should begin here.

   d. 1915 This is the exit from SFC when no more input blocks are available. FPOC to set (0753) to 00 1425 0000 should appear here.

   e. 4759 This is the entrance to SR012 used when an input item is available in working storage and registers X and L contain the first sorting key. This should be the FPOC exit.

2. The following registers are used by SR012 and may not be altered:

   rB_2 contains the address minus one of the numeric word zero of the working storage area in which SR012 expects an input item to be delivered. It is in the form bbll.

   rB_3 contains information vital to SR012. It has no relevance to FPOC.

   All other registers are available for use in FPOC.

3. IAC can be modified to control the advance of input item sizes other than 12 word.

   a. The item limit parameter in location 0776 may be altered to equal the limit of some input item size other than 12 word. The limit actually represents the number of items in a block multiplied by two.

      e.g. If the input item size is 20 word, five items appear in each block, the limit is 2x5, parameter 0776 would be 00 0010 0000.

   b. Parameter 4558 is initially set to be two less than the limit in 0776. Therefore, 4558 would contain 00 0008 0000 if 0776 were modified for a 20 word input item size.

   If IAC is modified in this manner, the 12 word item transfer coding beginning at 0810 will have to be replaced. SR012 can only process 12 word items.

D. Replacing Item Transfer Coding

   Where the input item size is 12 word, the SR012 item transfer coding need not be altered. Two choices are available for the insertion of editing coding:

   1. It may be executed before the item is transferred to working storage. (e.g. referenced in the input block).

   2. It may be executed after the item is transferred to working storage and after the End-of Block sentinel check but before the item is given to SR012.

   The inclusion of FPOC may necessitate that the SR012 input item transfer coding be replaced by a combination editing and transfer routine.

The item transfer and editing coding may perform any functions desired on each input item before it is given to SR012 for sorting. This coding must perform the minimum functions outlined in Section B.2.

A chart showing the locations of the eight working storage areas for each of 14 blocks that might be indicated to receive an input item is shown on page 39.

E. All of the locations used by the coding listed on pages 32 to 36 may be used for FPOC. Memory allocation charts on page 37 to 38 indicate additional locations available for FPOC.

F. Adding FPOC to SR012

Prepare FPOC and place it on cards in the PTA01 format required by MASCOT.

Use MASCOT to convert the cards to tape.

Use MASCOT to copy 127 blocks of SR012 (scatter format) making a correction to block 127 entry 268. A word of zeros should be placed in entry 268 of block 127. The converted blocks of FPOC may be copied on the tape following 127 blocks of SR012 coding.

One more block, block 128, of SR012 may be copied on the tape following the last block of FPOC. Block 128 is SR012's locator block. Block 129 is a hash block and need not be included.

TIMING

The formula given is based on one alpha numeric key. If two or more keys are used, the following should be considered:

a. If there is no equality on the first key, sorting will take approximately the same time as for a one word key sort.

b. If there is equality on every first key, sorting will take approximately twice the time needed for a comparable one word key sort.

FORMULA

$$t = \frac{n(f+me+r)}{60,000} + 1+m$$

t = sort time in minutes.

n = total number of items to be sorted.

f = time for the First Pass. f in formula should be 77, the time in milliseconds to process each item.

m = number of pairs of collation passes.[7]

e = time to process each item per pair of collation passes. e in formula should be 48.4 the time in milliseconds.

r = rewind time per item. r in formula should equal 7, the time in milliseconds to rewind each item.

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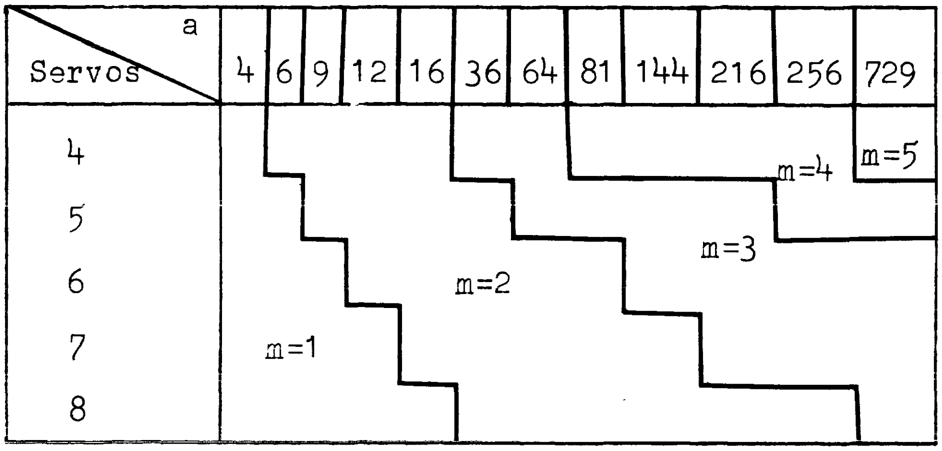
[7]Compute m as follows.

Derive the number of strings, a, by dividing n by 224. Use table below to select value of m based on number of strings and number of collation servos that will be employed.

TABLE



OPERATING INSTRUCTIONS

1. Mount SR012 Instructions on Servo 1.

   Mount Input Tapes, A and B collation tapes, as indicated in the parameters.

2. Initial Read

   a. Set computer on one instruction.

   b. Key G2 0100 000A into rC.

   c. Key F6 0000 0147 into rA.

   d. Set computer on continuous. Depress Run button.

3. RUNNING STOPS - NORMAL

STOP	EXPLANATION	ACTION
67 2500 2500 67 2501 2501	Initial stop to permit parameter changes. Occurs only when field y of parameter in 226 is equal to 1.	Parameters are in registers as follows: Parameter 221 in rA 222 in rX 223 in rL Key in changes as required. Depress Run button and computer stops on 67 2501 2501. Parameter 224 in rA 225 in rX 226 in rL Key in changes as required. Depress Run button.
67 0328 1915	Input tape sentinel has been detected. Stop occurs only if countermand option, field t of parameter in 226 equals 1. First Pass.	Regardless of sentinel detected: 1. Press m to treat as end-of-tape. 2. Press c to treat as end-of-file.

STOP	EXPLANATION	ACTION
67 3660 3517	A rerun point has been established. Inter-Pass Control Load. (See Operating Instructions 4. Rerun, for details.)	The number of rerun points still to be established is in rA in the form - 000000000p. 1.a. Remove and label uniquely tapes from "A"servos, indicating rerun point and servo number. b. Mount blank tapes on the "A" servos. c. If the number of additional rerun points desired should be something other than p. Key the desired p into rA as 000000000p. Depress Run button. d. To continue, depress Run button. 2. If this rerun point is not desired, remove interlock from A servos and follow procedure c or d.
67 3394 3395	Final Stop. Sort run is completed.	1. To locate an inter-run locator, depress Run button. 2. Other, as desired.

ABNORMAL STOPS DURING RUNNING

STOP	EXPLANATION	ACTION
67 000C 3515	Servo malfunction on a rewind order. Rerun Load or Inter-Pass Control Load.	The rewind order is in rX. 1. Depress m and Run button to execute rewind again. 2. Rewind tape manually. General Clear. Transfer control to the c address of the instruction in rX.

STOP	EXPLANATION	ACTION
67 8002 1807 67 8003 1807[8] 67 8004 1807 67 8005 1807[8] 67 8006 000A[8] 67 8010 1807	Tape error indications associated with TEC00-OT00. Can occur during any of the 6 loads.	See TEC00-OT00 (U 1775.24) B. Error Procedures.
67 1111 1111	Uncorrectable tape error while loading instructions. Can occur during any of the 6 loads.	1. Rerun. 2. Restart.
67 0001 0001	Tape error while loading instructions. Read-Write head is positioned after the bad block. Can occur during any of the 6 loads.	1. Reposition tape and an attempt to load bad block into buffer manually. If successful after a forward read order, transfer control to location 0197. If last pass was B, position Servo A_o, otherwise, B_o. 2. Rerun. 3. Restart.
67 1925 1985	Input label discrepancy. First Pass.	The expected label is in rA, the tape label is in rL.. 1. To accept tape label, depress m. 2. If wrong tape is mounted, rewind manually and mount correct tape. Depress c.
67 0287 0286	Input block count discrepancy. First Pass.	The computer block count is in rA, the tape block count is in rL, both are in the form - bbbb000000 1. To continue despite discrepancy, depress m. 2. Restart.

---

[8]See page 25 for detailed explanation.

STOP	EXPLANATION	ACTION
67 0275 0276	The number of input blocks exceeds the nn-hundred block limit specified in the parameters. First Pass.	1. To continue sorting, at the risk that sorted output may exceed one full tape, press m. 2. Reduce the volume of data to be sorted and restart.
6G HC3a 0633	A block count discrepancy has been discovered on a collation tape. A or B Pass Load. ("a" may equal 0,1,2,3.)	The computer block count is in rA, the tape block is in rL, both are in the form - bbbb000000. 1. Sorting may continue but some blocks of data may be lost or duplicated. Press c. 2. Rerun. 3. Restart.

NON-CORRECTABLE ABNORMAL STOPS

STOP	EXPLANATION	ACTION
67 4025 4025 67 3500 3500 67 2063 2063 67 2037 2037 67 4674 4674 67 4730 4730 67 4607 4607 67 4684 4684 67 4610 4610 67 8021 000A 67 803s 1956 67 804s 1324	Program or Machine Error. $0 < s < 9$	1. Restart. If stop recurs, record contents of all registers, obtain memory print at time of stop. Notify and supply information to: Manager, Program Library Services Remington Rand Univac 315 Park Avenue South New York 10, N. Y. Retain all tapes.

4. Rerun

Digit p of the parameter in location 225 indicates the number of rerun points desired. At the completion of a descending (B) pass the Inter-Pass Control Load determines whether a rerun point is to be established on the basis of p. If required, a memory dump is written on A_0 and the computer is brought to a stop with 67 3660 3517 in rC and all A collation tapes rewound with interlock. These tapes contain both the input, represented by a set of ascending strings, and the information needed to reprocess this input should rerun become necessary.

All A tapes should be removed and labeled with an indication of the rerun point and servo from which they were produced. Since the input on these tapes has already been processed to the B collation tapes, they can be replaced with blank tapes.

5. Operating Instructions - Rerun

a. Mount the "A" collation tapes, removed after the last rerun point established, on servos as indicated by their labels.

   Mount blank tapes on B collation servos as indicated in the parameters. An option to alter servo allocation for B tapes other than B_0 will be provided.

b. Initial Read A_0

   (1) Set computer on one instruction.

   (2) Key G2 0s00 000A into rC, s=Servo on which A_0 is mounted.

   (3) Key F6 0000 0147 into rA.

   (4) Set computer on continuous. Depress Run button.

6. RUNNING STOPS DURING RERUN - NORMAL

STOP	EXPLANATION	ACTION
67 4550 4550	Option to change B collation servos other than B_0.	B collation tape servo numbers are located in rA and rL in the form 0000000xxx. Undigit H (1111) denotes an unused servo.

STOP	EXPLANATION	ACTION
		1. For no change, press Run. 2. To alter B servos, key new numbers into corresponding LSD of rA. Undigit H must be keyed in as necessary to provide 3 LSD total.

RERUN STOPS - ABNORMAL

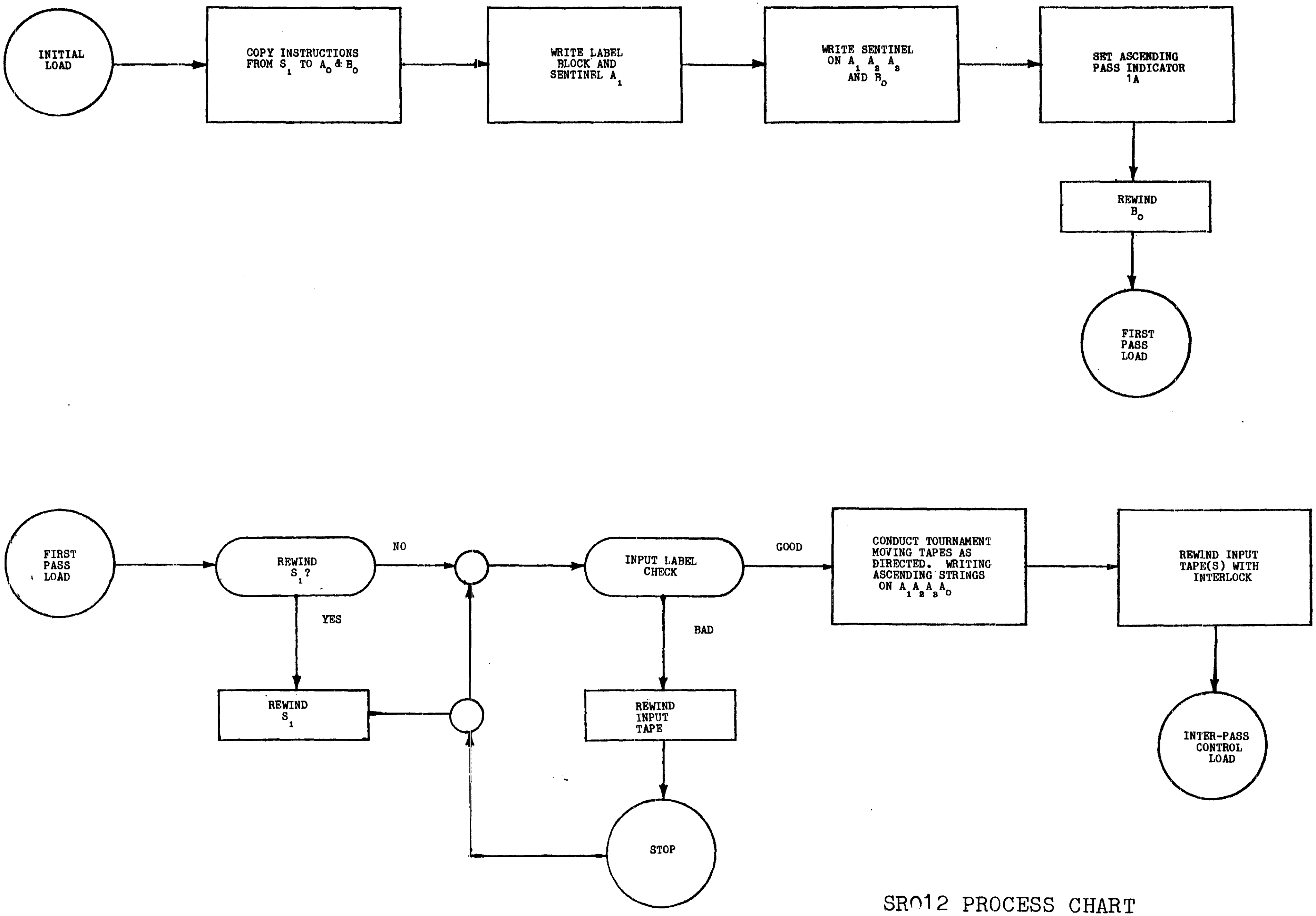
STOP	EXPLANATION	ACTION
67 4222 4423 67 4253 4223 67 4255 4254	A label discrepancy has been discovered. 4422 bad label Servo A_1. 4253 bad label Servo A_2. 4255 bad lavel Servo A_3.	The expected label is in rA, the tape label is in rL. Both are in the form psRRR0b00 where p = Rerun point number. s = Servo number. RRR = Run number. b = Servo B_0. Rewind the tape containing the invalid label. Mount the correct tape. Press n.
67 4177 4178 67 4586 4587 67 4536 4537 67 4436 4437	A block count error has been discovered. 4177 bad count Servo A_0. 4586 bad count Servo A_1. 4536 bad count Servo A_2. 4436 bad count Servo A_3.	The computer count is in rA, the tape count is in rL. Both are in the form bbbb000000. 1. Initiate Rerun again. 2. Return to a previous Rerun point. 3. Restart. 4. To continue despite discrepancy, press m.

7. In addition to the above, Running Stops, both normal and abnormal, can also appear.

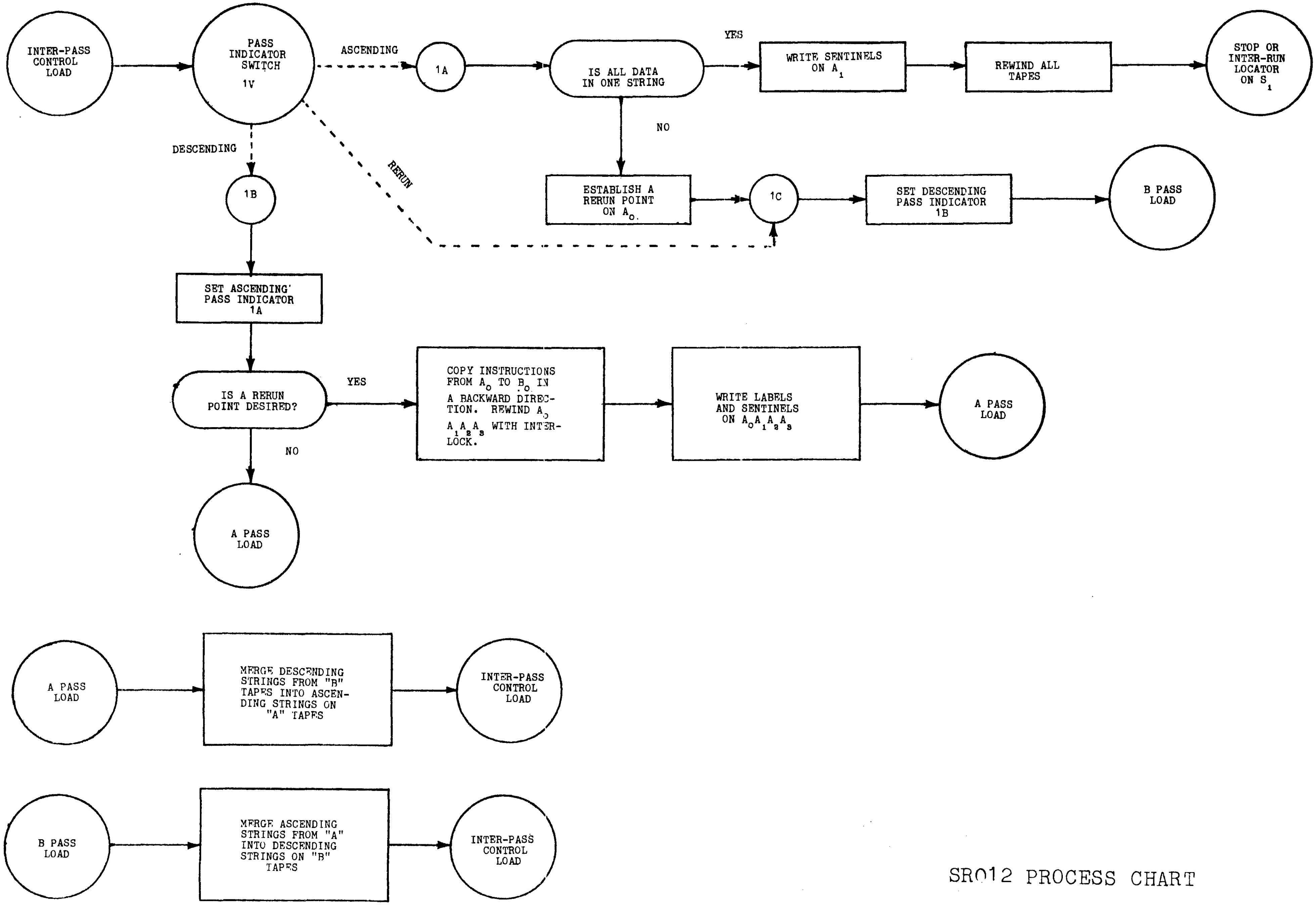
[8] These Tape Error stops may actually occur due to a normal condition of a sort where the allocation of a single servo to more than one tape is indicated in the parameters. Specifically, among other error indications, both are concerned with read or write instructions for tapes currently rewound with interlock.

STOP	EXPLANATION	ACTION
67 8003 1807	If the Input tape is to replace the instruction Tape on Servo 1, SR012 will attempt to read a block from Servo 1, at the beginning of the First Pass, but the Servo is rewound with interlock. Note the TEFF indication on the SYNCHRONIZER.	If this error stop is a manifestation of SR012 parameters, proceed as follows: Mount the input tape on Servo 1. Key G2 0100 1807 into rC. Execute on one instruction. Examine SYNC. for errors, if none, run on continuous. If error, rewind tape and try above again.
67 8006 000A	If a B collation tape is assigned to a servo used first for instructions or input, SR012 will attempt to write a block on a Servo rewound with interlock during the first B Pass. Note the TEFF indication on the SYNCHRONIZER.	If this error stop is a manifestation of SR012 parameters, proceed as follows: Mount a blank tape on the Servo indicated in the unexecuted write order (rA). Depress Run button.

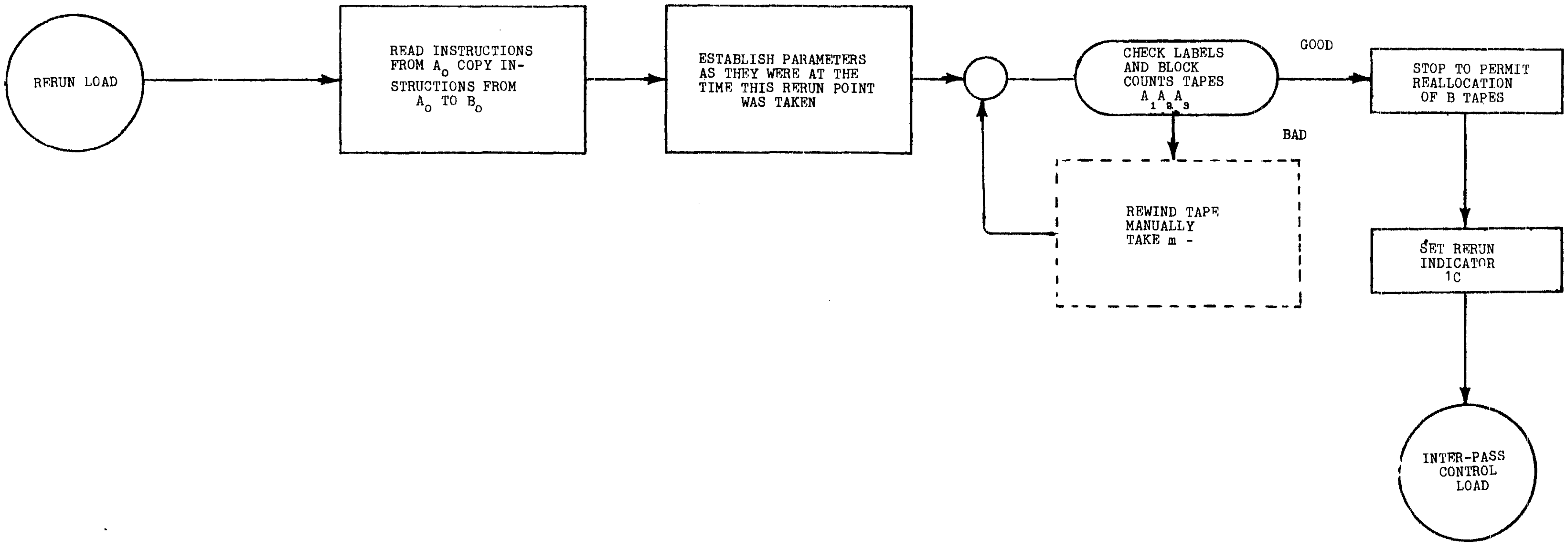
U 1775.35



SR012 PROCESS CHART



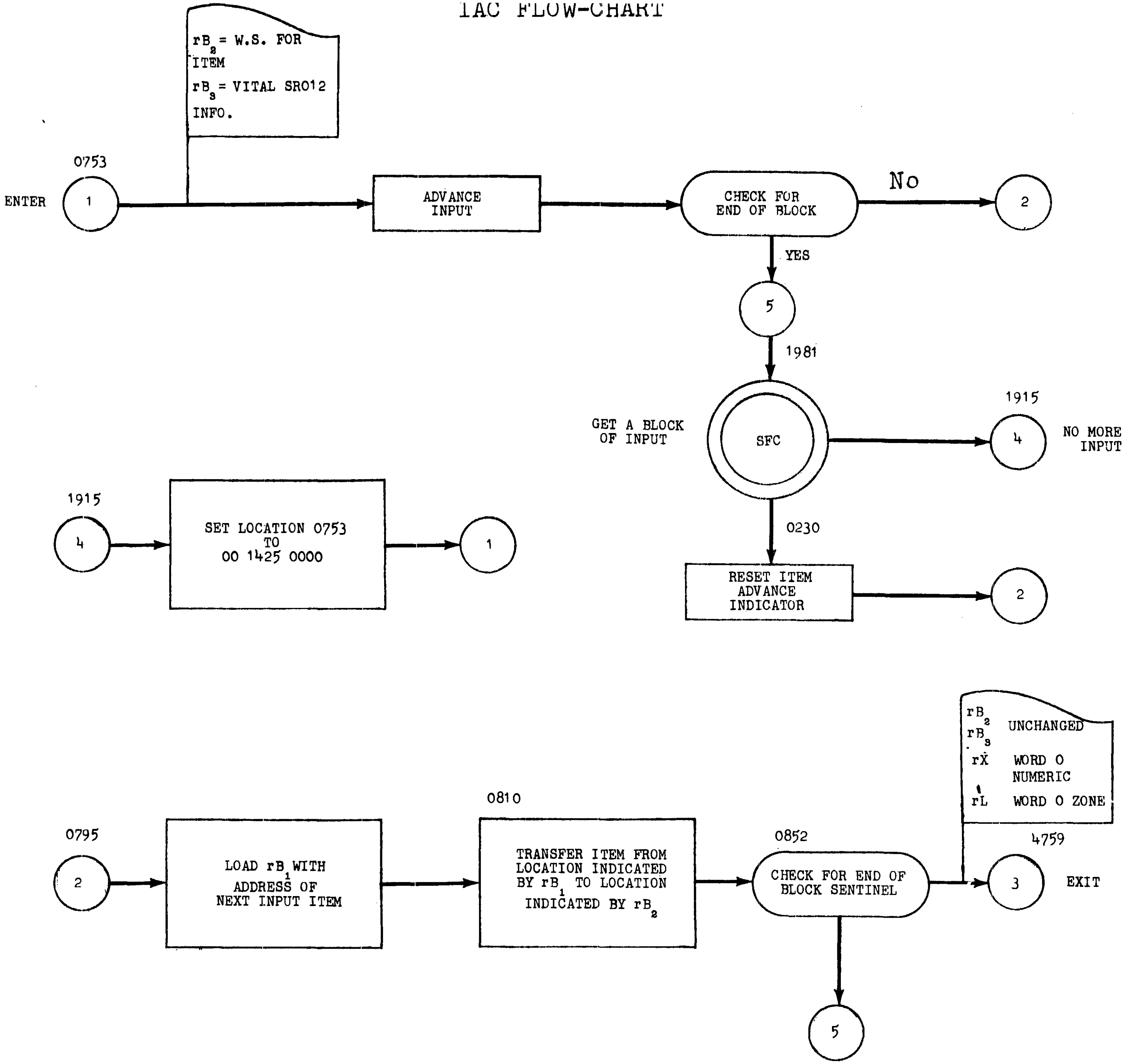
SR012 PROCESS CHART



SR012 PROCESS CHART

U 1775.35

IAC FLOW-CHART



CODING:

Page	Line	a	Op	m	c	Key	
001	01	0753	25	4558	0964		
001	02	0964	70	0966	0769		Advance input item indicator. Test for End-of-Block limit.
001	03	0966	00	0002	0000		
001	04	0769	77	0000	0774		
001	05	0774	25	0776	0778		
001	06	0778	82	1981	0795		
001	07	0230	30	0792	0795		Load rL with band of current input block supplied by SFC (bb00).
001	08	0792	00	0000	0000		
001	09	0795	25	0997	0799		Store address minus one of the numeric portion of the first word of current input item in rB_1 and in 4558.
001	10	0997	02	0000	0606	1	
001	11	0799	20	000B	000A		
001	12	0606	50	4558	0810		
001	13	0776	00	0016	0000		ITEM LIMIT PARAMETER
001	14	0852	25	0854	0657		
001	15	0657	37	0100	0661		
001	16	0661	82	1981	0664		Test for End-of-Block sentinel.
001	17	0664	25	000C	0869		
001	18	0869	05	000B	0877		
001	19	0877	77	0000	4759		
001	20	0854	FF	FFFF	FFF1		

CODING:

Page	Line	a	Op	m	c	Key	
002	01	4558	00	0014	0000		Setting for Current item.
002	02	0994	25	0996	0998		
002	03	0996	05	0006	0823	1	
002	04	0998	30	0001	000A	1	TRANSFER WORD 0
002	05	0823	25	0825	0827		
002	06	0825	65	0036	0852	2	
002	07	0827	50	0031	000A	2	
002	08	0810	25	0812	0814		
002	09	0812	30	0022	0839	1	
002	10	0814	05	0017	000A	1	
002	11	0839	25	0841	0843		TRANSFER WORD 1
002	12	0841	50	0052	0874	2	
002	13	0843	65	0047	000A	2	
002	14	0824	25	0826	0829		
002	15	0826	30	0038	0855	1	
002	16	0829	05	0033	000A	1	
002	17	0855	25	0857	0859		TRANSFER WORD 2
002	18	0857	50	0068	0890	2	
002	19	0859	65	0063	000A	2	
002	20	0842	25	0844	0846		

CODING:

Page	Line	a	Op	m	c	Key	
003	01	0844	30	0054	0871	1	
003	02	0846	05	0049	000A	1	
003	03	0871	25	0873	0875		TRANSFER WORD 3
003	04	0873	50	0084	0906	2	
003	05	0875	65	0079	000A	2	
003	06	0858	25	0860	0862		
003	07	0860	30	0070	0887	1	
003	08	0862	05	0065	000A	1	TRANSFER WORD 4
003	09	0887	25	0889	0891		
003	10	0889	50	0100	0922	2	
003	11	0891	65	0095	000A	2	
003	12	0874	25	0876	0878		
003	13	0876	30	0086	0903	1	
003	14	0878	05	0081	000A	1	TRANSFER WORD 5
003	15	0903	25	0905	0907		
003	16	0905	50	0116	0938	2	
003	17	0907	65	0111	000A	2	
003	18	0890	25	0892	0894		
003	19	0892	30	0102	0919	1	TRANSFER WORD 6
003	20	0894	05	0097	000A	1	

CODING:

Page	Line	a	Op	m	c	Key	
004	01	0919	25	0921	0923		
004	02	0921	50	0132	0954	2	
004	03	0923	65	0127	000A	2	
004	04	0906	25	0908	0910		
004	05	0908	30	0118	0935	1	
004	06	0910	05	0113	000A	1	
004	07	0935	25	0937	0939		TRANSFER WORD 7
004	08	0937	50	0148	0970	2	
004	09	0939	65	0143	000A	2	
004	10	0922	25	0924	0926		
004	11	0924	30	0134	0951	1	
004	12	0926	05	0129	000A	1	
004	13	0951	25	0953	0955		TRANSFER WORD 8
004	14	0953	50	0164	0994	2	
004	15	0955	65	0159	000A	2	
004	16	0938	25	0940	0942		
004	17	0940	30	0150	0967	1	
004	18	0942	05	0145	000A	1	TRANSFER WORD 9
004	19	0967	25	0969	0971		
004	20	0969	50	0180	0824	2	

CODING:

Page	Line	a	Op	m	c	Key	
005	01	0971	65	0175	000A	2	
005	02	0954	25	0956	0958		
005	03	0956	30	0166	0983	1	
005	04	0958	05	0161	000A	1	
005	05	0983	25	0985	0987		TRANSFER WORD 10
005	06	0985	50	0196	0842	2	
005	07	0987	65	0191	000A	2	
005	08	0970	25	0972	0974		
005	09	0972	30	0182	0999	1	
005	10	0974	05	0177	000A	1	
005	11	0999	25	0801	0803		TRANSFER WORD 11
005	12	0801	50	0012	0858	2	
005	13	0803	65	0007	000A	2	
005	14	1915	25	3028	3032		Set (0753) to 00 1425 0000. SFC has indicated no more blocks of input are available.
005	15	3028	00	1425	0000		
005	16	3032	60	0753	0753		

UNIVAC® SOLID-STATE COMPUTER - MEMORY CHART

PROGRAM: FPOC Locations Available[9]

BAND: 0400

04 00 TO 04 99		05 00 TO 05 99	
00	50	00	50
01	51	01	51
02	52	02	52
03	53	03	53
04	54	04	54
05	55	05	55
06	56	06	56
07	57	07	57
08	58	08	58
09	59	09	59
10	60	10	60
11	61	11	61
12	62	12	62
13	63	13	63
14	64	14	64
15	65	15	65
16	66	16	66
17	67	17	67
18	68	18	68
19	69	19	69
20	70	20	70
21	71	21	71
22	72	22	72
23	73	23	73
24	74	24	74
25	75	25	75
26	76	26	76
27	77	27	77
28	78	28	78
29	79	29	79
30	80	30	80
31	81	31	81
32	82	32	82
33	83	33	83
34	84	34	84
35	85	35	85
36	86	36	86
37	87	37	87
38	88	38	88
39	89	39	89
40	90	40	90
41	91	41	91
42	92	42	92
43	93	43	93
44	94	44	94
45	95	45	95
46	96	46	96
47	97	47	97
48	98	48	98
49	99	49	99

BAND: 0600

06 00 TO 06 99				07 00 TO 07 99			
00	x	50	x	00	x	50	x
01		51		01	x	51	
02	x	52	x	02	x	52	x
03	x	53	x	03		53	IAC
04	x	54	x	04	x	54	x
05		55		05		55	x
06	IAC	56	x	06	x	56	x
07	x	57	IAC	07	x	57	
08		58	x	08	x	58	
09	x	59	x	09		59	x
10		60	x	10		60	
11		61	IAC	11	x	61	x
12	x	62		12		62	
13	x	63	x	13	x	63	
14	x	64	IAC	14		64	x
15		65	x	15		65	x
16	x	66		16	x	66	x
17		67		17	x	67	
18		68	x	18	x	68	x
19		69	x	19		69	IAC
20		70	x	20	x	70	x
21		71	x	21		71	x
22		72	x	22	x	72	x
23	x	73	x	23	x	73	
24	x	74	x	24	x	74	IAC
25		75	x	25		75	x
26	x	76	x	26		76	IAC
27	x	77	x	27	x	77	x
28	x	78	x	28		78	IAC
29	x	79	x	29	x	79	
30	x	80		30		80	x
31	IAC	81	x	31		81	x
32	x	82		32	x	82	x
33	x	83	x	33	x	83	
34		84	x	34	x	84	x
35		85	x	35		85	
36		86	x	36	x	86	x
37		87		37		87	x
38		88	x	38	x	88	x
39		89		39	x	89	
40	x	90	x	40	x	90	
41		91	x	41		91	x
42	x	92	x	42		92	IAC
43	x	93		43	x	93	x
44	x	94	x	44		94	
45		95	x	45	x	95	IAC
46		96	x	46		96	x
47	x	97	x	47		97	x
48	x	98		48	x	98	x
49		99	x	49	x	99	IAC

[9]Blank and "IAC" locations are available; "x" locations are use by other sections of SR012.

UNIVAC® SOLID-STATE COMPUTER - MEMORY CHART

PROGRAM: FPOC Locations Available

BAND: 0800

08 00 TO 08 99				09 00 TO 0999			
00	x	50		00	x	50	IAC
01	IAC	51		01		51	IAC
02		52	IAC	02		52	IAC
03	IAC	53		03	IAC	53	IAC
04		54	IAC	04	x	54	IAC
05		55	IAC	05	IAC	55	IAC
06	x	56		06	IAC	56	IAC
07		57	IAC	07	IAC	57	
08		58	IAC	08	IAC	58	IAC
09		59	x	09		59	
10	IAC	60	IAC	10	IAC	60	
11		61		11		61	
12	IAC	62	IAC	12		62	
13		63	x	13		63	
14	IAC	64		14		64	IAC
15		65	x	15		65	
16		66		16		66	IAC
17		67		17		67	IAC
18		68	x	18		68	x
19		69	IAC	19	IAC	69	IAC
20		70		20	x	70	IAC
21		71	IAC	21	IAC	71	IAC
22		72	IAC	22	IAC	72	IAC
23	IAC	73	IAC	23	IAC	73	
24	IAC	74	IAC	24	IAC	74	IAC
25	IAC	75	IAC	25		75	
26	IAC	76	IAC	26	IAC	76	
27	IAC	77	IAC	27		77	
28	x	78	IAC	28		78	
29	IAC	79		29		79	
30		80		30		80	
31		81	x	31		81	
32		82		32		82	
33		83		33		83	IAC
34		84		34		84	x
35		85	x	35	IAC	85	IAC
36		86		36	x	86	
37		87	IAC	37	IAC	87	IAC
38		88	x	38	IAC	88	
39	IAC	89	IAC	39	IAC	89	
40		90	IAC	40	IAC	90	
41	IAC	91	IAC	41		91	
42	IAC	92	IAC	42	IAC	92	
43	IAC	93		43		93	
44	IAC	94	IAC	44		94	IAC
45		95		45		95	
46	IAC	96		46		96	IAC
47		97		47		97	IAC
48		98		48		98	IAC
49		99		49		99	IAC

BAND: 4400

4500 TO 99				__00 TO __99			
00	x	50	x	00		50	
01	x	51	x	01		51	
02	x	52	x	02		52	
03	x	53		03		53	
04	x	54		04		54	
05	x	55		05		55	
06	x	56		06		56	
07	x	57		07		57	
08	x	58	IAC	08		58	
09	x	59		09		59	
10	x	60	x	10		60	
11	x	61	x	11		61	
12	x	62		12		62	
13	x	63		13		63	
14	x	64		14		64	
15	x	65		15		65	
16	x	66		16		66	
17	x	67		17		67	
18	x	68		18		68	
19	x	69		19		69	
20	x	70	x	20		70	
21	x	71		21		71	
22	x	72		22		72	
23	x	73	x	23		73	
24	x	74		24		74	
25	x	75		25		75	
26	x	76		26		76	
27	x	77		27		77	
28	x	78	x	28		78	
29	x	79		29		79	
30	x	80	x	30		80	
31	x	81		31		81	
32	x	82		32		82	
33	x	83		33		83	
34	x	84		34		84	
35	x	85		35		85	
36	x	86		36		86	
37	x	87		37		87	
38	x	88		38		88	
39	x	89		39		89	
40	x	90	x	40		90	
41	x	91	x	41		91	
42	x	92	x	42		92	
43	x	93		43		93	
44	x	94		44		94	
45	x	95		45		95	
46	x	96		46		96	
47	x	97		47		97	
48	x	98		48		98	
49	x	99	x	49		99	

UNIVAC® SOLID-STATE COMPUTER - MEMORY CHART

PROGRAM: SR012

BAND: WORKING STORAGE AREAS			
00 TO 99		__00 TO __99	
00	50	00	50
01 WS6-10	51 WS3-1	01 WS4-4	51 WS5-7
02	52	02	52
03 WS7-10	53 WS4-1	03 WS5-4	53 WS6-7
04	54	04	54
05 WS8-10	55 WS5-1	05 WS6-4	55 WS7-7
06	56	06	56
07 WS1-11	57 WS6-1	07 WS7-4	57 WS8-7
08	58	08	58
09 WS2-11	59 WS7-1	09 WS8-4	59 WS1-8
10	60	10	60
11 WS3-11	61 WS8-1	11 WS1-5	61 WS2-8
12	62	12	62
13 WS4-11	63 WS1-2	13 WS2-5	63 WS3-8
14	64	14	64
15 WS5-11	65 WS2-2	15 WS3-5	65 WS4-8
16	66	16	66
17 WS6-11	67 WS3-2	17 WS4-5	67 WS5-8
18	68	18	68
19 WS7-11	69 WS4-2	19 WS5-5	69 WS6-8
20	70	20	70
21 WS8-11	71 WS5-2	21 WS6-5	71 WS7-8
22	72	22	72
23	73 WS6-2	23 WS7-5	73 WS8-8
24	74	24	74
25	75 WS7-2	25 WS8-5	75 WS1-9
26	76	26	76
27	77 WS8-2	27 WS1-6	77 WS2-9
28	78	28	78
29	79 WS1-3	29 WS2-6	79 WS3-9
30	80	30	80
31 WS1-0	81 WS2-3	31 WS3-6	81 WS4-9
32	82	32	82
33 WS2-0	83 WS3-3	33 WS4-6	83 WS5-9
34	84	34	84
35 WS3-0	85 WS4-3	35 WS5-6	85 WS6-9
36	86	36	86
37 WS4-0	87 WS5-3	37 WS6-6	87 WS7-9
38	88	38	88
39 WS5-0	89 WS6-3	39 WS7-6	89 WS8-9
40	90	40	90
41 WS6-0	91 WS7-3	41 WS8-6	91 WS1-10
42	92	42	92
43 WS7-0	93 WS8-3	43 WS1-7	93 WS2-10
44	94	44	94
45 WS8-0	95 WS1-4	45 WS2-7	95 WS3-10
46	96	46	96
47 WS1-1	97 WS2-4	47 WS3-7	97 WS4-10
48	98	48	98
49 WS2-1	99 WS3-4	49 WS4-7	99 WS5-10

BAND: WORKING STORAGE AREAS			
00 TO 99		00 TO 99	
00	50	00	50
01	51	01	51
02	52	02	52
03	53	03	53
04	54	04	54
05	55	05	55
06	56	06	56
07	57	07	57
08	58	08	58
09	59	09	59
10	60	10	60
11	61	11	61
12	62	12	62
13	63	13	63
14	64	14	64
15	65	15	65
16	66	16	66
17	67	17	67
18	68	18	68
19	69	19	69
20	70	20	70
21	71	21	71
22	72	22	72
23	73	23	73
24	74	24	74
25	75	25	75
26	76	26	76
27	77	27	77
28	78	28	78
29	79	29	79
30	80	30	80
31	81	31	81
32	82	32	82
33	83	33	83
34	84	34	84
35	85	35	85
36	86	36	86
37	87	37	87
38	88	38	88
39	89	39	89
40	90	40	90
41	91	41	91
42	92	42	92
43	93	43	93
44	94	44	94
45	95	45	95
46	96	46	96
47	97	47	97
48	98	48	98
49	99	49	99

WS_f-n Working Storage Numeric Words, f=1,2,...,8; n=Word of Storage 0,1,...,1
Corresponding zone words are five levels after the respective numberic.

CTY. 2
SCH 3
ED# 7
pd 1

205
60
1

1991

CTY SCH ED#
pd