IBM - POUGHKEEPSIE
DEPT 255 BLDG 990
FEBRUARY 1, 1963

7090/7094 DIAGNOSTIC ENGINEERING RELEASE

DIAGNOSTIC PROGRAM - 9M71B
9M76B

TITLE- 7094 MAINFRAME INSTRUCTION CHECKOUT AND RELIABILITY PROGRAM

9M71B OBSOLETES 9M71A, DATED 8-01-62

C O M M E N T

SEE PAGE 3 OF WRITE-UP FOR PURPOSE OF UPDATED RELEASE.

9M71B WAS RELEASED AT MACHINE EC 252597.

TWO FAILURES IN DFDP CAN BE EXPECTED UNTIL A LATER YET UNKNOWN EC NUMBER HAS BEEN INSTALLED. DIRECTIONS FOR BYPASSING THESE TEST ROUTINES CAN BE FOUND ON PAGE 911 OF LISTING.

OTHER PROGRAM FAILURES MAY OCCUR UNTIL THE MACHINE HAS BEEN BROUGHT UP TO EC 252597.

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ENCLOSURES - 1040 PROGRAM PAGES
9M71B 1489 BINARY CARDS NUMBERED 0000-1488 (22 INST/CARD)
9M76B 488 BINARY CARDS NUMBERED 001-488 (24 INST/CARD)

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9M71B

9M76B

7094 MAINFRAME

INSTRUCTION CHECKOUT AND

RELIABILITY PROGRAM

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PURPOSE OF CHANGE

1. To include test routines to cover the EC's released after the release of 9M71A.

2. To incorporate more reliability and/or data-dependent routines.

3. The section looping routine was revised for this release. See E 7 for particulars.

EC LEVEL

1. 9M71B was released at machine EC 252597.

2. Two failures in DFDP can be expected until a later yet unknown EC has been installed. Directions for bypassing these test routines can be found on page 911 of listing.

3. 9M71B was run on a 7094 at EC 252222. Except for the two DFDP printouts, no other printouts occurred. This cannot be guaranteed on all 7094's at EC 252222. Other failures may occur until the machine is brought up to EC 252597.

9M71B

7094 MAINFRAME PROGRAM

UNITS TESTED - 7109 and 7110 CPU

A. PURPOSE OF PROGRAM

9M71 was written to provide in ONE program the instruction checkout of all the 7094 mainframe instructions.

B. METHOD OF TEST

1. The mainframe instructions are tested in such a manner that no instruction is used by the program until it has been tested by the program. The test routines are then ordered, beginning with the simple basic instructions and continuing to the more complex and/or multi-cycle instructions.

2. A test routine linkage to the error print subroutine is not provided until the instructions and registers required in the error print subroutine have been tested by the program. Error halts are incorporated in the test routines for those not linked to the error print subroutine.

3. 9M71 is divided into seven major sections. A list of instructions covered in each section is provided under program arrangement of this write-up.

SECTION ONE

Checkout of the basic mainframe instructions and registers.

PART 1

Checkout of the XAD and XR4 using the AXT, TXL and TXH instructions.
The error halt is incorporated in the test routines.

PART 2

Checkout of those instructions required in the checkout of the XR1, XR2, SC, ACC and MQ registers.
Checkout of those instructions required in the error print subroutine.
The error halt is incorporated in the test routines in conjunction with Sense Switch 1 and 2 control.

B. 3. PART 3

Checkout of the main adder and its look-ahead carries.
Checkout of the remaining basic mainframe instructions covered in this section.
All test routines are linked to the error print subroutine.

SECTION TWO

Checkout of the more complex and/or multi-cycle basic mainframe instructions.
All test routines are linked to the error print subroutine.

SECTION THREE

Checkout of the Sense Indicator register and the associated SI instructions. A reliability test of these SI instructions is also included in this section.
All test routines are linked to the error print subroutine.

SECTION FOUR

A reliability and extended reliability check of the instructions and registers tested in the previous three sections. The extended reliability part is under Sense Switch 4 control. This extended reliability part requires approximately 16 minutes to run.

SECTION FIVE

Checkout of all the single and double precision floating-point instructions.
Single precision instructions are checked first followed by single precision reliability test routines. The reliability part following the checkout of the double precision instructions cover both single and double precision instructions.
A partial simulation of the FAD, DFAD, DFMP and DFDP instructions is included in this section. On an error, SPLAT is used to print out the partial results.
All the test routines, except the simulation test routines, are linked to the error print subroutine.

B. 3. SECTION SIX

Checkout of the manual operations and halt instructions. This section is under control of Sense Switch 5. Sense Switch 5 has to be down before this section can be executed. Some of the test routines are linked to the error print subroutine.

SECTION SEVEN

Checkout of the overlap feature.
The error halt is incorporated in the test routine.

4. After the whole program has been read into memory, the computer should halt (HPR instruction) at location (IC) 00002. On pushing Start, the program will proceed to Section One and continue in sequence under program control. On the first pass the program identification will be printed after execution of part 2 of Section One. The extended reliability part of Section Four will be bypassed if SSW 4 is UP. Section Six will be bypassed if SSW 5 is UP.

5. The following diagnostic troubleshooting aids and/or program features have been incorporated in 9M71.

   a. Looping in a test routine.

   b. Indicating or bypassing error conditions.

   c. Printing or halting on error condition.

   d. Continuously repeating the complete program or stopping the program and calling in the next program.

   e. Looping in a section of the program.

   f. Monitoring the program sequence.

   g. Restart control on location 00000.

   See program control section of this write-up.

C. MACHINE UNITS AND STORAGE AREA REQUIREMENTS

1. Units Required

CPU, CF, Chan A, PR, CR

2. Storage Requirements

A 32K memory is required for the operation of this program.

D. LOADING PROCEDURES

1. Cards

9M71 is loaded in from card reader using the standard high end loader (9LD02A). Approximately six minutes are required for reading in the program deck.

2. Tape

The loading procedure is depended on utility program used by installation. See 9U61.

E. PROGRAM CONTROL

1. Card Deck

M71A	0000	9LD02A High End Loader
	0001 - 1485	Program
	1486	Transfer card (TRA 00000)
	1487 - 1488	Two blank cards

2. Sense Switch Control

Sense Switch 1

UP Proceed to next test routine in sequence.
DN Repeat test routine or a loop within test routine.

Sense Switch 2

UP Indicate all errors, test Sense Switch 3 or Halt.
DN Bypass all errors, check Sense Switch 1.

Sense Switch 3

UP Print all program control and error requests.
DN Bypass all printing requests and Halt on errors.

E. 2. Sense Switch 4

UP Bypass extended reliability part of Section Four.
DN Perform extended reliability part of Section Four. Adds approximately 16 minutes to running time for each program pass.

Sense Switch 5

UP Bypass Section Six (manual operation and halt instructions).
DN Perform Section Six each program pass that switch is down.

Sense Switch 6

UP End 9M71 on completion of all test routines and simulate Load Cards or Tape (S position of keys) to read in next diagnostic program.
DN Repeat 9M71 upon completion of the last test routine.

3. Keys

a. The Sign position is used in conjunction with Sense Switch 6. With S -

UP Next program deck is in from tape A1.
DN Next program deck is in card reader.

b. Keys 11-17 are used to indicate to program which program section(s) operator wants to loop in. See E 7 on Section looping.

With Key DOWN

11	Loop in Section 1
12	Loop in Section 2
13	Loop in Section 3
14	Loop in Section 4
15	Loop in Section 5
16	Loop in Section 6
17	Loop in Section 7

With keys 11-17 UP, 9M71B will loop in the whole program.

E. 4. Sense Light Control and Indications

a. Sense lights 1, 2 and 3 are used in Section Five (EP).

Sense Light 1 ON	Indicates a trap to location 00010.
Sense Light 2 ON	Indicates a trap to location 00001.
Sense Light 3 ON	Indicates execution of floating point instruction in the 704 mode.

b. Sense Light 4 is set ON by program for manual restart control. See Manual Restart section.

5. Manual Transfers

Manual transfers can be made anywhere within the program. However, to avoid excessive error printouts or halts, transfers should only be made to the beginning instruction of each test routine. The transfer instruction (the decrement of the keys must contain octal 02000) should be left in the keys only until after the START key has been depressed. Failure to clear this transfer in the keys will suppress all program out-of-sequence printouts.

6. Manual Restarts

Location zero is controlled by program.

On entry to Part 3 of Section One, a STR instruction is set into location zero, and a TTR instruction to the manual restart subroutine is set into location 00002. Sense light 4 is set ON by the program in the error print subroutine through TSX OK, 4.

With this in mind, a manual restart will function as follows:

a. If the operator resets and starts 9M71 before it has reached Section One Part 3 on the first pass, the program will halt at location 00002 in the IC. On pushing the Start button, the program will begin running sequentially from Section One Part 1.

b. If the instruction counter (IC) is set to zero after Section One Part 3 of the first pass has been reached, and all sense lights are out, it is assumed that a manual reset and start has occurred. The program will start running from the last test routine that was completed.

E. 6. c. There are two exceptions to 6 b.

1) Some trap test routines set at HTR instruction in location 00000. In this case the operator may manually transfer to location 00100 to restart program.

2) The only way to break away (excluding manual transfers) from the extended reliability part of Section Four is by setting Sense Switch 4 UP, resetting and starting the machine. The program will start running sequentially from Section One Part 1.

7. Section Looping

The looping feature in 9M71B is different from that in 9M71A.

Keys 11-17 are used to allow the operator to select which section(s) of 9M71B he would like to run. With keys 11-17 UP, the program will loop in the entire program. By setting any of these keys down, the program will loop only in those sections in which the keys (11-17) are DOWN. All these keys DOWN will cause the program to run all seven sections.

The program pass counter is not stepped with any of these keys (11-17) DOWN. Therefore, all pass complete printouts will be suppressed.

8. Sequence Checking

a. All test routines linked to the error print subroutine are sequence checked. Only the three following conditions are considered as being proper sequences.

1) The address portion of the transfer instruction following the TSX OK, 4 instruction is compared with the location of the previous TSX OK, 4. If their difference is 3, the program is in sequence and continues.

2) If the difference is not 3, the location of this TSX OK, 4 is compared with the location of the previous TSX OK, 4 location. If they are equal, the program is assumed to be under Sense Switch 1 control and continues.

E. 8. a. 3) Otherwise, the decrement of the console keys is examined. If it contains 02000, it is assumed that a manual transfer has been executed and the program continues.

An out-of-sequence error will be indicated if none of the previous checks are found to exist.

NOTE: Care should be taken in making manual transfers. Once the machine is running in automatic, the transfer instruction should be removed from the keys. This is necessary because any true out-of-sequences will not be indicated as long as the transfer instruction remains in the keys.

b. Section One parts 1 and 2 are not linked to the error print subroutine. For these test routines, the following monitoring system is used.

1) Section One Part 1 - XR1 is used as a reference point by use of an AXT instruction.

2) Section One Part 2 - XR1 is used as the reference point.

F. NORMAL STOPS

1.	00002	Due to HPR at location 00001. Press START to continue program. This is a normal stop on the first pass only.

Following STOPS with SSW 5 DN.

2.	70014	DVH TEST - Press START to continue.
3.	70024	DVH TEST - Press START to continue.
4.	70036	DVH TEST - Press START to continue.
5.	70047	DVH TEST - Press START to continue.
6.	70064	VDH TEST - Press START to continue.
7.	70113	VDH TEST - Press START to continue.
8.	70130	FDH TEST - Press START to continue.
9.	70151	FDH TEST - Press START to continue.
10.	70171	FDH TEST - Press START to continue.
11.	70204	DFDH TEST - Press START to continue.
12.	70224	HPR - Press START to continue.
13.	70233	HTR - Press START to continue.
14.	70242	DFDH TEST - Press START to continue.
15.	70263	HPR - DISPLAY SENSE INDICATORS TEST. Observe that all ones are displayed in SR. Press START to continue.
16.	70274	HTR - DISPLAY SENSE INDICATORS TEST. Observe that ones are displayed in SR COLS 21-35. Press START to continue.

F.	17.	70310	HPR - DISPLAY STORAGE TEST. Place machine in MANUAL. Place 70630 in address of Keys. Press MANUAL DISPLAY STORAGE. All ones should be observed in SR COLS 21-35. Place machine in AUTOMATIC and press START to continue.
	18.	70323	HTR - DISPLAY STORAGE TEST. Place machine in MANUAL. Place 70630 in address of Keys. Press MANUAL DISPLAY STORAGE. All ones should be observed in SR COLS 21-35. Place machine in AUTOMATIC and press START TWICE to continue.
	19.	70337	HPR - DISPLAY EFFECTIVE ADDRESS TEST. Place machine in MANUAL. Press MANUAL DISPLAY EFFECTIVE ADDRESS. Observe that SR COLS 21-35 contain 00077. Place machine in AUTOMATIC and press START to continue.
	20.	70355	HTR - DISPLAY EFFECTIVE ADDRESS TEST. Place machine in MANUAL. Press MANUAL DISPLAY EFFECTIVE ADDRESS. Observe that SR COLS 12-35 contain 25252. Place machine in AUTOMATIC and press START to continue.
	21.	70406	HTR - RESET BUTTON TEST. Observe all console lights. All registers except SR should contain ones. This includes IBR and SI. Press RESET and all lights except SI should go out. Press START to continue.
	22.	70420	HTR - SENSE LIGHT TEST. Observe that all SENSE LIGHTS are lit. Place SENSE SWITCHES 1, 3, 5 down only and press START to continue.
	23.	70442	HPR - SENSE SWITCH TEST. Place Sense Switches 2, 4 and 6 down only and press START to continue.

F.

24.	70464	HTR - ENTER KEY TEST. Reset Sense Switches for program control. Place all ones in Keys and press START to continue.
25.	70474	HTR - ENTER KEY TEST. Place all zeros in Keys and press START to continue.
26.	70513	HPR - MACHINE CYCLE MPY TEST. Press MACHINE CYCLE KEY thrice. Observe AC, MQ and SC for correct contents. See listing for specifics.
27.	70534	HPR - MACHINE CYCLE DVP TEST. Press MACHINE CYCLE KEY thrice. Observe AC, MQ and SC for correct contents. See listing for specifics.
28.	70554	HPR - MACHINE CYCLE FAD TEST. Press MACHINE CYCLE KEY twice. Observe AC and MQ for correct contents. See listing for specifics.

G. ERROR STOPS

	Program Ctr.	Inst.	Comments
1.	00127	HPR	In Error print with SSW 3 DN. True error location is in XR4.
2.	00145	HPR	In Error - 1 print with SSW 3 DN. True error location is in XR4.
3.	01215	HTR	Sequence Error with SSW 3 DN. MQ DECR contains recovery address. ADDR contains last test routine to TSX OK.
4.	01513	HPR	PC inadvertently reset. Location 00101 contains 2's complement address of last TSX OK.

G.	Program Ctr.	Inst.	Comments
			SECTION ONE
5.	01600 to 03605	HPR	Part 1 - See listing for specific stop. No sense switch controls provided.
6.	03606 to 11610	HPR	Part 2 - See listing for specific stop. SSW 1 and 2 options available in this part.
			SECTION TWO
7.	34403	DVH	Divide check in error.
8.	35071	VDH	Divide check in error.
9.	35120	VDH	Divide check in error.
10.	35174	HPR	LTM does not reset Trap Mode.
11.	36256	HTR	IA trigger stays on.
			SECTION THREE
12.	40307	HPR	Hot ones from SI register.
13.	45235	HTR	Trap to location 00001 in error (SSW 3 DN).
			SECTION FOUR
	Fixed-Point Simulators		
14.	46027		Simulated multiply error halt.
15.	46033		Error detected during the simulation routine. See listing.
16.	46067		Multiply simulator error halt with SSW 3 DOWN. See listing.
17.	46660		Simulated divide error halt.
18.	46662		Error detected during the simulation routine. See listing.

G.	Program Ctr.	Inst.	Comments
			SECTION FOUR (continued)
19.	46726		Divide simulator error halt with SSW 3 DOWN. See listing.
20.	52757 to 56222	HPR	Extended reliability checking of index register and instruction. See listing for specific stop.
			SECTION FIVE
21.	64053	HTR	Error in DFMP simulator (SSW 3 DN).
22.	64375	HTR	Error in DFDP simulator (SSW 3 DN).
			SECTION SIX (SSW 5 DN)
23.	70275	HTR	Display Indicator button error.
24.	70276	HTR	Display Indicator button error.
25.	70311	HTR	Display Storage button error.
26.	70312	HTR	Display Storage button error
27.	70324	HTR	Display Storage button error.
28.	70325	HTR	Display Storage button error.
29.	70356	HTR	Display Effective Addr. button error.
30.	70357	HTR	Display Effective Addr. button error.
31.	70440	HPR	Error testing sense switches 1, 3 and 5.
32.	70461	HPR	Error testing sense switches 2, 4 and 6.
			SECTION SEVEN
33.	71000 to 73662	HPR	See listing for specific stop. SSW 1 and 2 options available in this section.

H. SAMPLE PRINTOUTS

1. ERROR PRINTOUTS

A. SECTIONS ONE AND TWO

```
 TEST LOC  12051  XR1  00000  XR4  65722  ACC QP00 +300000000000
ERROR LOC  12056  XR2  00000  XR5  77777  MQ       +000000000000
OPERATION ADD     XR3  24074  XR6  77777  LOC ZERO -100000036151
SENSE SWS 000001 LITES  0001  XR7  77777  KEYS     +002000012056
 ACC OVFL  OFF  DIV CK OFF
```

B. SECTIONS THREE, FOUR, AND SIX

```
 TEST LOC  44775  XR1  00025  XR4  32766  ACC QP00 +377777737777
ERROR LOC  45012  XR2  00000  XR5  32767  MQ       +000000000000
OPERATION OFT     XR3  00025  XR6  32767  LOC ZERO -100000000000
SENSE SWS 000001 LITES  0001  XR7  32767  KEYS     +000003000000
 ACC OVFL  OFF  DIV CK OFF                SENSE IND 111111111111
```

C. SECTION FIVE

```
 TEST LOC  65703  XR1  00000  XR4  20545  ACC QP01 -200666666666
ERROR LOC  65714  XR2  20353  XR5  20557  MQ       +000000000000
OPERATION DFDP    XR3  20553  XR6  20557  LOC ZERO +002000000101
SENSE SWS 000001 LITES  0101  XR7  20557  KEYS     +002000000101
 ACC OVFL  ON   DIV CK OFF                SENSE IND 666506375501
FLT PT ERROR INDICATORS 00001000000000000000000
```

D. SECTION FOUR SIMULATORS

```
ROUTINE LOCATION   45304
MPY VALUES SR -157727006413  MQ +376560150273
SIMULATE ANS   ACC - 00 157270235133  MQ -144205473411
THE 7094 ANS   ACC - 00 157270235133  MQ +144205473411
```

E. SECTION FIVE SIMULATORS

```
ROUTINE LOCATION  064063
DFDPS  VALUES AC  144115122547  SR  651460147211
              MQ  111143423631  IBR 616100030733
SIMULATE ANS AC       473201675370  MQ  440724171176 TRAP FLAGS 000000
MACHINE  ANS AC       473201675370  MQ  040724171176 TRAP FLAGS 000000
```

F. PROGRAM SEQUENCE ERROR

```
PROGRAM SEQUENCE OUT OF CONTROL.  OUT AT  46143      REGAINED AT  45256
```

2. PROGRAM CONTROL PRINTOUTS

A. PROGRAM IDENTIFICATION

9M71B MAINFRAME INSTRUCTION CHECKOUT AND RELIABILITY PROGRAM.

B. EXTENDED RELIABILITY PRINTOUT

1 PASSES COMPLETE 9M71B EXTENDED RELIABILITY MODE. TOTAL PASSES 6

C. PASS COUNT PRINTOUT

9M71B MF 50 PASSES. TOTAL OF 9,900 PASSES COMPLETED

D. PROGRAM END PRINTOUT

9M71B MF TEST ENDS. TOTAL OF 10,004 PASSES COMPLETED.

J. PROGRAM ERROR PRINT SUBROUTINE

The error print subroutine is an integral part of 9M71 and cannot be replaced by DEPRX.
The test routine linkages to this subroutine is the same as that of DEPRX.
The sense switch control of this subroutine is compatible to DEPRX.

K. SECTION FOUR (Fixed-Point Reliability)

1. The Simulators

Multiply, divide, variable length multiply and divide instructions are executed with random values for multiplicands, multipliers, dividends, divisors and variable length fields. The results are compared with data obtained from adding and shifting routines that simulate the instructions under test. If the values are unequal, a special printout occurs which gives the error information and also the intermediate information which should be in the arithmetic registers after each depression of the machine cycle key.

2. The Reliability Tests

These tests were written not to exercise any particular instructions so much as to provide rigourous tests for the arithmetic registers, the adders, and the shifting controls before getting into the floating-point section of the program.

3. The extended Reliability Tests

The machine enters this portion of the program only when sense switch four is down. It takes about 16 minutes, providing a test of the machine's ability to handle data that is as thorough as it can practically be. For example, the test for the TIX instruction tests it with every possible decrement by loading an index register with all ones and stepping it down as far as it will go. The test is then repeated on each of the remaining index registers in turn.

L. SECTION FIVE - FLOATING POINT

The first part consists of routines to check single precision floating-point instructions. Each routine first goes to a Clear routine to initialize conditions. The instructions are then executed. To check the results, the program goes to a Check routine where the registers are compared to the five numbers following the TSX to Check. The first word contains the expected sign, Q and P of the ACC, and various bits to indicate expected conditions of other latches that can be set during the floating-point instruction. The next words contain the correct contents of the ACC 1-35, the MQ S-35, the SI 0-35, and location

L. SECTION FIVE - FLOATING POINT (continued)

zero 3-35. If a register or control latch is found to be in error, a bit in the floating-point error indicator is set; and after the checking is completed, the error word is tested for zero. If not zero, an error print will occur (SSW 3 UP) and the error word will be printed as part of the regular printout. The chart following this write-up (page 30) gives a breakdown of the meaning of each bit in the floating-point error indicators.

After the basic single precision controls are checked, four reliability routines are used to further check these instructions.

1. FAD Simulator

   The FAD instruction is simulated using fixed-point instructions. The data used in this routine is obtained from a random number table. An error printout (SSW 3 UP) occurs on all unequal compares of hardware and simulated results. The floating-point simulator printout is used for these printouts.

2. Problem: $N + N - N \times N \div N$.

   The loss of precision is compensated for by an UFA instruction. The results are checked using the CHECK subroutine.

3. Single precision floating-point square root routine, using the Newton Iteration method.

   $$X = 1/2 \left(X_0 + \frac{N}{X_0}\right)$$

   N = radicand
   X_0 = first trial root

   The roots of eight numbers are determined from a fixed table.

4. Evaluation of primitive roots of eight numbers using the method of Greunberger.

   This method is as follows -

   a. The prime is checked to make sure it is greater than 2, but less than 7777.

   b. The value 2 is subtracted and the prime is made a fixed point number.

L. 4. c. This number is preserved at SALON + 1 and is called the tally count. The original floating-point prime is stored at SALON.

d. The tally count is placed in XRB, and 12 is placed in XRA.

e. The first trial root is selected and stored at TEMP.

f. The trial root is squared and placed at TEMP + 1, then divided by the prime.

g. The decimal places are removed from the quotient and the whole number part, the integral part only, is used. This is multiplied by the original prime.

h. Then the value at TEMP + 1, the dividend, is subtracted from the previous product. If the result is minus one and if the tally count is one, then the root has been found. If the result is less than minus one and,
if the tally count is greater than one, the tally count is stepped down one, the result just calculated is stored at TEMP, with this now as the trial root the iteration is repeated.
or the tally count is one, the tally count is reset to its initial value, a new trial root is selected, and the iteration is repeated.

The program then goes on to start checking double precision floating-point instruction controls. The method and procedure used in these routines is the same as was used in checking the single precision instructions.

Finally, there are a number of routines to check the reliability of the double precision instructions and to check for possible data dependent failures.

1. DFAD, DFMP and DFDP simulator routines using random numbers.

DFAD is simulated using fixed-point instructions. The DFMP and DFDP instructions are simulated using single precision floating-point instructions. The random number table (50 sets of DP number) generated each program pass weights the exponents on alternate passes. This is done to insure a more realistic distribution of exponents for the FAD and DFAD

L. 1. instructions. The exponents are weighted with 50% having an exponent difference of 7 or less, 25% having an exponent difference of 15 or less, etc.

The nomenclature used in the listing is as follows:

C (AC) = A	C (MQ) = B
C (Y) = C	C (Y + 1) = D
$AB/C = Q_1 + R_1$	$(R_1 - Q_1D)/C = Q_2$

2. Problem: $N + N \times .5 \times N \div N - N$.

After correction for lost precision, a zero result is tested for. On each program pass, 50 numbers from the random number table are used.

3. DP square root routine (Newton Iteration method - same as used in SP). On each program pass, 50 numbers from the random number table are used. The random number is first squared before the square root is obtained. The root is compared against the original number.

4. Solution of three quadratic equations using the quadratic equation. Both single and double precision instructions are used in this routine. The DP Square root routine is also used by this routine. All partial results are checked and the solution always proceeds with the proper partial result from a table.

M. PROGRAM ARRANGEMENT

Instruction Tested	Starting Memory Location
SECTION ONE	
PART I	
NOP	00000
HPR	00001
TRA	00027
AXT	01600
TXL	01607
TXH	01613
SECTION ONE	
PART II	
TIX	05076
TXI	05136
AXC	05165
LXA	06766
LXD	07042
SXA	07062
SXD	07430
NZT	07732
ZET	07742
LDQ	10006
STQ	10006
LGL	10173
LGR	10421
TQP	10455
CAL	10702
CLA	10715
TNZ	11036
TZE	11072
STZ	11141
STO	11152
SLW	11174
ORS	11232
ALS	11301
ARS	11421
TSX	11536

M.

Instruction Tested	Starting Memory Location

SECTION ONE

PART III

LBT	11621
PBT	11637
TOV	11654
TNO	11716
TPL	11736
TMI	11753
CLS	11770
ADD	12004
SUB	12171
ACL	12264
COM	21636
ADM	21750
SBM	21760
ORA	22000
STP	22054
STD	22134
STT	22175
STA	22255
STL	22345
PAX	23507
PAC	23571
PDX	23611
PDC	23650
PXA	23660
PXD	23751
PCA	24014
PCD	24023
LMTM-EMTM	24166
TNX	24516
SCA	24555
SCD	24575
LAC	24613
LDC	24623
LRS	24640
LLS	24707
RQL	24770
SSP	25045

M. Instruction Tested — Starting Memory Location

SECTION ONE

PART III (continued)

SSM	25106
CHS	25133
CLM	25205
RND	25273
SLN	25344
SLF	25426
SLT	25353
XCA	25765
XCL	26036

SECTION TWO

CAS	27004
LAS	27335
ANA	27654
ANS	30302
ERA	30757
TLQ	31413
SLQ	31725
RND	32052
MPY	32123
VLM	32773
MPR	33513
DCT	33550
DVP	33570
DVH	34375
VDP	34426
VDH	35063
TTR	35144
LTM	35161
ETM	35200
STR	35524
XEC	35260
CRQ	36520
CVR	36546
CAQ	36650

M.

Instruction Tested	Starting Memory Location
SECTION THREE	
PIA	40401
STI	40436
LDI	41002
PAI	41071
OSI	41137
OAI	41174
RIS	41334
ONT	43076
RIA	41422
IIS	41621
IIA	41707
RIL	41761
SIL	42013
IIL	42063
SIR	42142
RIR	42300
IIR	42371
TIO	42405
TIF	42431
OFT	43126
RFT, LFT	44630
RNT, LNT	44664
SECTION FIVE	
FRN	57006
UFM	57237
FMP	57504
FDP	57643
UAM	60052
USM	60154
UFA	60223
UFS	60307
FAD	60341
FAM	60356
FSM	60410
FSB	60474
EFTM	60762
TQO, LFTM	61167

M.

Instruction Tested	Starting Memory Location
SECTION FIVE (continued)	
DLD	61720
DST	62002
DUFA	62022
DFAD	62172
DUFS	62414
DFSB	62431
DFAM	62446
DFSM	62463
DUAM	62500
DUSM	62515
DUFM	62532
DFMP	62717
DFDP	62766
SECTION SIX	
DVH	70011
VDH	70056
FDH	70122
DFDH	70200
HTR	70231
SWT	70421
ENK	70464

N. 9M76

1. Purpose of Program

The 9M76 program deck provides a means for loading Section One into memory WITHOUT the use of the Standard Diagnostic Loaders (9LD01A or 9LD02A).

This program deck can be loaded into memory by use of the LOAD CARDS button or manually through the data channel.

2. Method of Test

The 9M76 program is the same program as 9M71 Section One. Therefore, the listing for 9M71 Section One also pertains to 9M76. This is also true for the write-up.

3. Loading Procedures

a. Normal Load

Ready the 9M76 program deck in the card reader and press the LOAD CARDS button. The first word on the first card is a NOP 3. This is decoded as a IOCD command with a starting address of 00003 and a word count of 76100 (cotal). The second word is the HPR instruction, which halts the mainframe while the cards are being read in. After the program has been loaded, press Reset and Start.

b. Manual Load

Ready the 9M76 program deck in the card reader. Place the Data Channel Console in manual. Enter the IOCD command,

0 77777 0 00000

into the channel keys. Press the Load Command button and then the Read Cards button. After the program has been loaded, return the Channel Console to automatic. On the mainframe console push Reset and Start.

N. 4. Program Deck

9M76A	001 - 486	Program deck
	487 - 488	Two blank cards

5. Printouts

All references to 9M71 in any of printouts have been changed to 9M76.

6. Card Deck Format

The 9M76 binary deck consists of 24 words per card instead of the normal 22 words per card as provided in the 9M71 binary deck.

```
                        00000   ORG   00000
00000   0761 00 0 00003         NOP   3
00001   0420 00 0 00000         HPR                 PROGRAM HALT FIRST PASS.
00002   0761 00 0 00000         NOP
00003   0761 00 0 00000         NOP
00004   0774 00 4 00001         AXT   00001,4
00005   0774 00 4 00002         AXT   00002,4
00006   0774 00 4 00004         AXT   00004,4
00007   0774 00 4 00010         AXT   8,4
00010   0774 00 4 00020         AXT   16,4
00011   0774 00 4 00040         AXT   32,4
00012   0774 00 4 00100         AXT   64,4
00013   0774 00 4 00200         AXT   128,4
00014   0774 00 4 00400         AXT   256,4
00015   0774 00 4 01000         AXT   512,4
00016   0774 00 4 02000         AXT   1024,4
00017   0774 00 4 04000         AXT   2048,4
00020   0774 00 4 10000         AXT   4096,4
00021   0774 00 4 20000         AXT   8192,4
00022   0774 00 4 40000         AXT   16384,4
00023   0774 00 4 11111         AXT   4681,4
00024   0774 00 4 22222         AXT   9362,4
00025   0774 00 4 44444         AXT   18724,4
00026   0774 00 4 77777         AXT   32767,4
00027   0020 00 0 00032         TRA   *+3
00030   0420 00 0 00000         HPR                 ERROR HALT.
00031   0420 00 0 00000         HPR                 ERROR HALT.
00032   0020 00 0 00062         TRA   00050
00033   0420 00 0 00000         HPR                 ERROR HALT.
00034  +000000000000            OCT   0
00035  +000000000000            OCT   0
00036  +000000000000            OCT   0
00037  +000000000000            OCT   0
00040  +000000000000            OCT   0
00041  +000000000000            OCT   0
00042  +000000000000            OCT   0
00043  +000000000000            OCT   0
00044  +000000000000            OCT   0
00045  +000000000000            OCT   0
00046  +000000000000            OCT   0
00047  +000000000000            OCT   0
00050  +000000000000            OCT   0
00051  +000000000000            OCT   0
00052  +000000000000            OCT   0
00053  +000000000000            OCT   0
00054  +000000000000            OCT   0
00055  +000000000000            OCT   0
00056  +000000000000            OCT   0
00057  +000000000000            OCT   0
00060  +000000000000            OCT   0
00061  +000000000000            OCT   0
00062   0774 00 1 00062         AXT   *,1           WASTE INSTRUCTION
00063   0774 00 1 00063         AXT   *,1
00064   0761 00 0 00000         NOP
00065   0761 00 0 00000         NOP
00066   0761 00 0 00000         NOP
```

```
00067   0761 00 0 00000          NOP
00070   0761 00 0 00000          NOP
00071   0761 00 0 00000          NOP
00072   0761 00 0 00000          NOP
00073   0761 00 0 00000          NOP
00074   0761 00 0 00000          NOP
00075   0761 00 0 00000          NOP
00076   0761 00 0 00000          NOP
00077   0761 00 0 00000          NOP
```

```
                    00100          ORG   64
00100   0020 00 0 01600            TRA   SECT1
00101  +000000000000       SVXR4  OCT   +0          LAST OK,4 ENTRY LOCATION.
00102  +000000000000       INDCW  OCT   +0          FLOATING POINT SI CNTL WD.
00103   0020 00 0 01202            TRA   SEQER
00104   0020 00 0 00114            TRA   ERROR-1
00105   0020 00 0 00115            TRA   ERROR
00106   0020 00 0 00150            TRA   OK
00107   0020 00 0 01245            TRA   PGMST
00110   0020 00 0 00717            TRA   BDIMG
00111   0020 00 0 01522            TRA   LOOP
00112  +000000000000       RELBTY OCT   0
00113   0021 00 0 01503            TTR   RESTR       RESTART


00114   0020 00 0 00131            TRA   ERRMI
00115   0760 00 0 00162    ERROR   SWT   2           SENSE SWITCH 2 -
00116   0020 00 0 00120            TRA   SSW3              UP - INDICATE ERROR.
00117   2 00001 4 00150            TIX   OK,4,1            DN - BYPASS ERROR.


00120   0600 00 0 00677    SSW3    STZ   ENTRY         INDICATE ERROR ENTRY.
00121   0760 00 0 00163            SWT   3           SENSE SWITCH 3 -
00122   0020 00 0 00210            TRA   PRINT             UP - PRINT ERROR.
00123   0634 00 4 00125            SXA   *+2,4             DN - HALT ON ERROR.
00124   0634 00 4 00127            SXA   *+3,4
00125   0774 00 4 00000            AXC   **,4          TRUE ERROR LOCATION IS
00126   0420 00 0 00000            HPR                   IN XR4.

00127   0774 00 4 00000            AXT   **,4          RESTORE 2S COMPL TO XR4.
00130   0020 00 0 00147            TRA   OK-1


00131   0760 00 0 00162    ERRMI   SWT   2           SENSE SWITCH 2 -
00132   0020 00 0 00136            TRA   SSW3A             UP - INDICATE ERROR.
                                                           DN - BYPASS ERROR.

00133   0760 00 0 00161    OK1     SWT   1           SENSE SWITCH 1 -
00134   0020 00 4 00002            TRA   2,4               UP - GO TO NEXT PART
                                                                 OF TEST ROUTINE.
00135   0020 00 4 00001            TRA   1,4               DN - RETURN TO THE
                                                                 BEGINNING OF
                                                                 TEST ROUTINE.
00136   0634 00 4 00677    SSW3A   SXA   ENTRY,4       MAKE LOCATION NON-ZERO.
00137   0760 00 0 00163            SWT   3           SENSE SWITCH 3 -
00140   0020 00 0 00210            TRA   PRINT             UP - PRINT ERROR.
00141   0634 00 4 00143            SXA   *+2,4             DN - HALT ON ERROR.
00142   0634 00 4 00145            SXA   *+3,4
00143   0774 00 4 00000            AXC   **,4          TRUE ERROR LOCATION IS
00144   0420 00 0 00000            HPR                   IN XR4.

00145   0774 00 4 00000            AXT   **,4          RESTORE 2S COMPL TO XR4.
00146   0020 00 0 00133            TRA   OK1           CHECK SSW1.
```

```
    PROGRAM SEQUENCE CHECK INCORPORATED IN OK.

00147   2 00001 4 00150          TIX  OK,4,1     ADJUST FOR ERROR ENTRY.
00150   0560 00 4 00001   OK     LDQ  1,4        BRING IN TEST ROUTINE
00151  -0600 00 0 00654          STQ  BNTMP        RETURN ADDRESS AND SET
00152   0534 00 2 00654          LXA  BNTMP,2         IN INDEX REG 2.
00153  -0634 00 2 00156          SXD  *+3,2

00154   0534 00 1 00101          LXA  SVXR4,1    LOC OF LAST TSX OK TO XR 1
00155   2 00003 1 00156          TIX  *+1,1,3      ADD 3 TO LAST LOCATION.
00156   1 00000 1 00157          TXI  *+1,1,**   ADD LOC OF TEST ROUT RTRN
                                                   TO ITS OWN 2S COMPLEMENT
00157  -3 00000 1 00175          TXL  OKAY,1,0   XFER IF PROPER SEQUENCE

        CHECK IF PROGRAM IS LOOPING CONTINUOUSLY IN ONE ROUTINE

00160  -0634 00 4 00165          SXD  *+5,4
00161   0534 00 2 00101          LXA  SVXR4,2    OBTAIN TRUE ADDRESS
00162   0634 00 2 00163          SXA  *+1,2      OF THE LAST TSX OK LOC
00163  -0774 00 1 00000          AXC  **,1       AND SET IN XR1
00164  -0634 00 1 00673          SXD  SEQWD,1    SAVE IN CASE OF ERROR.
00165   1 00000 1 00166          TXI  *+1,1,**   ADD TRUE ADDR OF LAST TSX
                                                   OK TO THE 2S COMP THIS OK


00166  -3 00000 1 00175          TXL  OKAY,1,0   TRANSFER IF IN SEQUENCE.
                                                   ON TRANSFER, PROGRAM IS
                                                   LOOPING UNDER SW 1 CNTRL

    CHECK FOR MANUAL ENTRY TO TEST ROUTINE FROM KEYS
    ONLY THE DECREMENT OF KEYS IS CHECKED FOR TRA INST.
00167   0760 00 0 00004   CKENK ENK              FROM KEYS TO MQ
00170  -0600 00 0 00654          STQ  BNTMP          TO STORAGE AND
00171  -0534 00 2 00654          LXD  BNTMP,2              DECREMENT TO XR2.

00172   3 02000 2 00174          TXH  *+2,2,1024  TESTING XR2 FOR TRA
00173   3 01777 2 00175          TXH  *+2,2,1023  INSTRUCTION

00174   0020 00 0 01202          TRA  SEQER       TRA INST NOT IN KEYS

00175   0634 00 4 00101   OKAY   SXA  SVXR4,4  SAVE XR4 FOR NEXT ENTRY.
00176   0600 00 0 00102          STZ  INDCW
00177   0560 00 0 00704          LDQ  ZERO      CLEAR
00200   0754 00 0 00000          PXA                 OUT
00201   0774 00 1 00000          AXT  0,1               SOME
00202   0774 00 2 00000          AXT  0,2                   REGISTERS.
00203   0535 00 3 00101          LAC  SVXR4,3           FOR MONITOR
00204   0760 00 0 00144          SLN  4          SET FOR POSSIBLE RESET
00205   0760 00 0 00161          SWT  1         SENSE SWITCH 1 -
00206   0020 00 4 00003          TRA  3,4             UP - GO TO NEXT TEST
                                                           ROUTINE.
00207   0020 00 4 00001          TRA  1,4             DN - REPEAT LAST TEST
                                                           ROUTINE.
```

FORM PRINT IMAGE

```
00210  0601 00 0 00660   PRINT STO  ACC          SAVE ACC 1-35.
00211 -0600 00 0 00662         STQ  MQ           SAVE MQ S-35
00212  0771 00 0 00043         ARS  35           SAVE SIGN,
00213  0601 00 0 00661         STO  PQ                    P AND Q.
00214  0634 00 1 00663         SXA  XR1,1        SAVE
00215  0634 00 2 00664         SXA  XR2,2
00216  0634 00 3 00665         SXA  XR3,3
00217  0634 00 4 00666         SXA  XR4,4                 INDEX REGISTERS.
00220  0634 00 5 00667         SXA  XR5,5
00221  0634 00 6 00670         SXA  XR6,6
00222  0634 00 7 00671         SXA  XR7,7
00223  0534 00 4 00666         LXA  XR4,4        TO INSURE CORRECT LOC.
00224  0634 00 4 00315         SXA  LNE2A,4
00225  0766 00 0 01361         WPRA               SPACE A LINE

      SET ACC OVFL INTO PRINT IMAGE
00226  0560 00 0 00716         LDQ  OFBCD
00227 -0140 00 0 00232         TNO  *+3
00230  0560 00 0 00715         LDQ  ONBCD
00231 -0600 00 0 00702         STQ  OFLON
00232 -0600 00 0 00545         STQ  LINE5+2

      READY LINE 1 FOR PRINTING

       INSERT TEST LOCATION
00233 -0520 00 0 00677         NZT  ENTRY
00234  0020 00 0 00237         TRA  *+3          ZERO - ERROR ENTRY
00235  0560 00 4 00001         LDQ  1,4          NZERO- ERROR-1 ENTRY
00236  0020 00 0 00240         TRA  *+2
00237  0560 00 4 00002         LDQ  2,4
00240 -0600 00 0 00675         STQ  TSTLC
00241  0074 00 4 00637         TSX  BNOCT-1,4    BINARY TO OCTAL.
00242 -0600 00 0 00304         STQ  LINE1+2

       INSERT XR1
00243  0560 00 0 00663         LDQ  XR1
00244  0074 00 4 00637         TSX  BNOCT-1,4    BINARY TO OCTAL
00245 -0600 00 0 00306         STQ  LINE1+4

       INSERT XR4
00246  0560 00 0 00666         LDQ  XR4
00247  0074 00 4 00637         TSX  BNOCT-1,4    BINARY TO OCTAL
00250 -0600 00 0 00310         STQ  LINE1+6

00251  0560 00 0 00707         LDQ  BLNK6
00252 -0763 00 0 00044         LGL  36
00253 -0602 00 0 00304         ORS  LINE1+2
00254 -0602 00 0 00306         ORS  LINE1+4
00255 -0602 00 0 00310         ORS  LINE1+6
```

```
        INSERT ACCUMULATOR

00256   0560 00 0 00660         LDQ   ACC
00257   0074 00 4 00640         TSX   BNOCT,4
00260  -0600 00 0 00313         STQ   LINE1+9
00261   0602 00 0 00314         SLW   LINE1+10

00262   0560 00 0 00711         LDQ   LNE18       INSERT
00263  -0600 00 0 00312         STQ   LINE1+8           P
00264   0560 00 0 00661         LDQ   PQ                 AND
00265  -0763 00 0 00043         LGL   35                   Q
00266   0767 00 0 00005         ALS   5                      .
00267  -0763 00 0 00001         LGL   1
00270   0767 00 0 00014         ALS   12
00271  -0602 00 0 00312         ORS   LINE1+8

00272   0560 00 0 00703         LDQ   OCT20       INSERT
00273  -0763 00 0 00044         LGL   36                ACC
00274   0560 00 0 00660         LDQ   ACC                  SIGN.
00275   0162 00 0 00277         TQP   *+2
00276   0767 00 0 00001         ALS   1
00277  -0602 00 0 00312         ORS   LINE1+8

   LINE 1 READY FOR PRINTING.
00300   0074 00 4 00717         TSX   BDIMG,4


00301   606060606060            BCD 1
00302   606060632562      LINE1 BCD 6   TEST LOC          XR1          XR4
00303   636043462360
00304   606060606060
00305   606067510160
00306   606060606060
00307   606067510460
00310   606060606060            BCD 5         ACC QP00 0
00311   606021232360
00312   504700006000
00313   606060606060
00314   606060606060
```

```
      READY LINE 2 FOR PRINTING

       INSERT ERROR LOCATION.  EQUAL TO TSX LOC
00315 -0774 00 2 00000   LNE2A AXC  **,2
00316  0634 00 2 00676         SXA  TRXR4,2
00317  0560 00 0 00676         LDQ  TRXR4
00320  0074 00 4 00637         TSX  BNOCT-1,4  BINARY TO OCTAL
00321 -0600 00 0 00353         STQ  LINE2+2

       INSERT XR2
00322  0560 00 0 00664         LDQ  XR2
00323  0074 00 4 00637         TSX  BNOCT-1,4  BINARY TO OCTAL
00324 -0600 00 0 00355         STQ  LINE2+4

       INSERT XR5
00325  0560 00 0 00667         LDQ  XR5
00326  0074 00 4 00637         TSX  BNOCT-1,4 BINARY TO OCTAL
00327 -0600 00 0 00357         STQ  LINE2+6

00330  0560 00 0 00707         LDQ  BLNK6
00331 -0763 00 0 00044         LGL  36
00332 -0602 00 0 00353         ORS  LINE2+2
00333 -0602 00 0 00355         ORS  LINE2+4
00334 -0602 00 0 00357         ORS  LINE2+6

       INSERT MQ
00335  0560 00 0 00662         LDQ  MQ
00336  0074 00 4 00640         TSX  BNOCT,4
00337 -0600 00 0 00362         STQ  LINE2+9
00340  0602 00 0 00363         SLW  LINE2+10

00341  0560 00 0 00703         LDQ  OCT20
00342 -0763 00 0 00044         LGL  36                 MQ
00343  0560 00 0 00662         LDQ  MQ                   SIGN.
00344  0162 00 0 00346         TQP  *+2
00345  0767 00 0 00001         ALS  1
00346 -0602 00 0 00361         ORS  LINE2+8

   LINE 2 READY FOR PRINTING
00347  0074 00 4 00717         TSX  BDIMG,4


00350  606060606060            BCD 1
00351  606025515146      LINE2 BCD 6  ERROR LOC         XR2          XR5
00352  516043462360
00353  606060606060
00354  606067510260
00355  606060606060
00356  606067510560
00357  606060606060            BCD 5        MQ       0
00360  606044506060
00361  606060606000
00362  606060606060
00363  606060606060
```

```
   READY LINE 3 FOR PRINTING

         INSERT OPN CODE
00364   0534 00 1 00675          LXA  TSTLC,1
00365   2 00001 1 00366          TIX  *+1,1,1
00366   0634 00 1 00367          SXA  *+1,1
00367   0560 00 0 00000          LDQ  **
00370  -0600 00 0 00423          STQ  LINE3+2

         INSERT XR3
00371   0560 00 0 00665          LDQ  XR3
00372   0074 00 4 00637          TSX  BNOCT-1,4  BINARY TO OCTAL
00373  -0600 00 0 00425          STQ  LINE3+4
         INSERT XR6
00374   0560 00 0 00670          LDQ  XR6
00375   0074 00 4 00637          TSX  BNOCT-1,4  BINARY TO OCTAL
00376  -0600 00 0 00427          STQ  LINE3+6

00377   0560 00 0 00707          LDQ  BLNK6
00400  -0763 00 0 00044          LGL  36
00401  -0602 00 0 00425          ORS  LINE3+4
00402  -0602 00 0 00427          ORS  LINE3+6

         INSERT LOCATION ZERO
00403   0560 00 0 00000          LDQ  0
00404   0074 00 4 00640          TSX  BNOCT,4
00405  -0600 00 0 00432          STQ  LINE3+9
00406   0602 00 0 00433          SLW  LINE3+10
00407   0560 00 0 00712          LDQ  LNE38      INSERT
00410  -0600 00 0 00431          STQ  LINE3+8          SIGN.
00411   0560 00 0 00703          LDQ  OCT20
00412  -0763 00 0 00044          LGL  36
00413   0560 00 0 00000          LDQ  0
00414   0162 00 0 00416          TQP  *+2
00415   0767 00 0 00001          ALS  1
00416  -0602 00 0 00431          ORS  LINE3+8

   LINE 3 READY FOR PRINTING
00417   0074 00 4 00717          TSX  BDIMG,4

00420   606060606060             BCD 1
00421   606046472551      LINE3  BCD 6  OPERATION        XR3          XR6
00422   216331464560
00423   606060606060
00424   606067510360
00425   606060606060
00426   606067510660
00427   606060606060             BCD 5        LOC ZERO 0
00430   606043462360
00431   712551466000
00432   606060606060
00433   606060606060
```

```
   READY LINE 4 FOR PRINTING
        INSERT SENSE SWITCHES
00434   0774 00 1 00006          AXT  6,1
00435   0560 00 0 00700          LDQ  SWTWD
00436   0760 00 1 00167          SWT  7,1          SENSE SWITCH-
00437   0020 00 0 00442          TRA  *+3            UP - SET TO A ZERO.
00440  -0763 00 0 00006          LGL  6              DN - SET TO A ONE.
00441   0020 00 0 00443          TRA  *+2
00442   0767 00 0 00006          ALS  6
00443   2 00001 1 00436          TIX  *-5,1,1
00444   0602 00 0 00505          SLW  LINE4+2
        INSERT SENSE LITES
00445   0774 00 1 00004          AXT  4,1
00446   0560 00 0 00701          LDQ  SLTWD
00447  -0763 00 0 00014          LGL  12
00450  -0760 00 1 00145          SLT  5,1          SENSE LITE -
00451   0020 00 0 00455          TRA  *+4            OFF
00452  -0763 00 0 00006          LGL  6              ON
00453   0760 00 1 00145          SLN  5,1          SET BACK ON.
00454   0020 00 0 00456          TRA  *+2
00455   0767 00 0 00006          ALS  6
00456   2 00001 1 00450          TIX  *-6,1,1
00457   0602 00 0 00507          SLW  LINE4+4
        INSERT XR7
00460   0560 00 0 00671          LDQ  XR7
00461   0074 00 4 00637          TSX  BNOCT-1,4    BINARY TO OCTAL
00462  -0600 00 0 00511          STQ  LINE4+6
00463   0560 00 0 00707          LDQ  BLNK6
00464  -0763 00 0 00044          LGL  36
00465  -0602 00 0 00511          ORS  LINE4+6
        INSERT KEYS
00466   0760 00 0 00004          ENK
00467  -0600 00 0 00674          STQ  ENKTP
00470   0074 00 4 00640          TSX  BNOCT,4
00471  -0600 00 0 00514          STQ  LINE4+9
00472   0602 00 0 00515          SLW  LINE4+10
00473   0560 00 0 00703          LDQ  OCT20
00474  -0763 00 0 00044          LGL  36
00475   0560 00 0 00674          LDQ  ENKTP
00476   0162 00 0 00500          TQP  *+2
00477   0767 00 0 00001          ALS  1
00500  -0602 00 0 00513          ORS  LINE4+8
   LINE 4 READY FOR PRINTING
00501   0074 00 4 00717          TSX  BDIMG,4
00502   606060606060             BCD  1
00503   606062254562      LINE4  BCD  6  SENSE SWS        LITES        XR7
00504   256062666260
00505   606060606060
00506   604331632562
00507   606060606060
00510   606067510760
00511   606060606060             BCD  5        KEYS     0
00512   606042257062
00513   606060606000
00514   606060606060
00515   606060606060
```

```
   READY LINE 5 FOR PRINTING

        INSERT DIV CK STATUS
00516   0560 00 0 00716          LDQ  OFBCD
00517   0760 00 0 00012          DCT                DIV CK TGR-
00520   0020 00 0 00523          TRA  *+3             ON
00521  -0600 00 0 00547          STQ  LINE5+4         OFF
00522   0020 00 0 00526          TRA  *+4
00523   0560 00 0 00715          LDQ  ONBCD
00524  -0600 00 0 00547          STQ  LINE5+4
00525   0221 00 0 00704          DVP  ZERO          TURN BACK ON.

      INSERT SENSE INDICATORS FOR SECT 3, 4, AND 5.
00526   0534 00 1 00676          LXA  TRXR4,1
00527  -3 40100 1 00541          TXL  *+10,1,SECT3
00530   0604 00 0 00672          STI  SIND
00531   0560 00 0 00672          LDQ  SIND
00532   0074 00 4 00643          TSX  BNOCT+3,4
00533  -0600 00 0 00554          STQ  LINE5+9
00534   0602 00 0 00555          SLW  LINE5+10
00535   0560 00 0 00713          LDQ  LNE57
00536  -0600 00 0 00552          STQ  LINE5+7
00537   0560 00 0 00714          LDQ  LNE58
00540  -0600 00 0 00553          STQ  LINE5+8

   LINE 5 READY FOR PRINTING
00541   0074 00 4 00717          TSX  BDIMG,4

00542   606060606060             BCD 1
00543   606060212323      LINE5  BCD 6   ACC OVFL       DIV CK
00544   604665264360
00545   606060606060
00546   243165602342
00547   606060606060
00550   606060606060
00551   606060606060             BCD 5
00552   606060606060
00553   606060606060
00554   606060606060
00555   606060606060
```

SENSE SWITCH AND ERROR PRINT ROUTINE

READY LINE 6 FOR FLOATING POINT ONLY

```
00556   0520 00 0 00102          ZET   INDCW
00557   0020 00 0 00561          TRA   *+2
00560   0020 00 0 00606          TRA   RESTO
00561   0560 00 0 00102          LDQ   INDCW
00562   0774 00 1 00004          AXT   4,1
00563   0774 00 2 00006          AXT   6,2
00564   0767 00 0 00005          ALS   5
00565  -0763 00 0 00001          LGL   1
00566   2 00001 2 00564          TIX   *-2,2,1
00567   0602 00 1 00603          SLW   LINE6+8,1
00570   2 00001 1 00563          TIX   *-5,1,1
00571   0074 00 4 00717          TSX   BDIMG,4
00572   606060606060             BCD 1
00573   264363604763       LINE6 BCD 6FLT PT ERROR INDICATORS
00574   602551514651
00575   603145243123
00576   216346516260
00577   606060606060
00600   606060606060
00601   606060606060             BCD 5
00602   606060606060
00603   606060606060
00604   606060606060
00605   606060606060

00606   0560 00 0 00706    RESTO LDQ   BLANK
00607   0600 00 0 00102          STZ   INDCW
00610  -0600 00 0 00552          STQ   LINE5+7
00611  -0600 00 0 00553          STQ   LINE5+8
00612  -0600 00 0 00554          STQ   LINE5+9
00613  -0600 00 0 00555          STQ   LINE5+10
00614   0560 00 0 00710          LDQ   BLNKS
00615  -0600 00 0 00361          STQ   LINE2+8
00616  -0600 00 0 00513          STQ   LINE4+8
00617   0140 00 0 00620          TOV   *+1        TURN OFF.
00620   0520 00 0 00702          ZET   OFLON
00621   0020 00 0 00623          TRA   *+2          NZ
00622   0767 00 0 00006          ALS   6            ZERO
00623   0560 00 0 00661          LDQ   PQ
00624  -0763 00 0 00044          LGL   36
00625   0560 00 0 00660          LDQ   ACC
00626   0763 00 0 00043          LLS   35
00627   0560 00 0 00662          LDQ   MQ
00630   0534 00 4 00666          LXA   XR4,4
00631   0534 00 2 00664          LXA   XR2,2
00632   0534 00 1 00663          LXA   XR1,1
00633   0766 00 0 01361          WPRA             SPACE PRINTER
00634  -0520 00 0 00677          NZT   ENTRY      WITH ENTRY
00635   0020 00 0 00147          TRA   OK-1       ZERO--ERROR ENTRY.
00636   0020 00 0 00133          TRA   OK1        NZ----ERROR-1 ENTRY.
```

```
        BINARY TO OCTAL BCD
00637 -0763 00 0 00022          LGL   18
00640 -0763 00 0 00001   BNOCT  LGL   1           DROP
00641  0767 00 0 00001          ALS   1
00642 -0765 00 0 00001          LGR   1                SIGN.
00643  0774 00 2 00002          AXT   2,2
00644  0774 00 1 00006   BNLOP  AXT   6,1
00645  0767 00 0 00003          ALS   3
00646 -0763 00 0 00003          LGL   3
00647  2 00001 1 00645          TIX   *-2,1,1
00650  0602 00 2 00660          SLW   BNTMP+4,2  SAVE HIGH ORDER
00651  2 00001 2 00644          TIX   BNLOP,2,1
00652  0560 00 0 00656          LDQ   BNTMP+2
00653  0020 00 4 00001          TRA   1,4
00654 +000000000000      BNTMP  OCT   0           FOUR TEMPORARY LOCATIONS
00655 +000000000000             OCT   0
00656 +000000000000             OCT   0
00657 +000000000000             OCT   0

        STORAGE CELLS
00660 +000000000000      ACC    OCT   +0
00661 +000000000000      PQ     OCT   +0
00662 +000000000000      MQ     OCT   +0
00663 +000000000000      XR1    OCT   +0
00664 +000000000000      XR2    OCT   +0
00665 +000000000000      XR3    OCT   +0
00666 +000000000000      XR4    OCT   +0
00667 +000000000000      XR5    OCT   +0
00670 +000000000000      XR6    OCT   +0
00671 +000000000000      XR7    OCT   +0
00672 +000000000000      SIND   OCT   +0
00673 +000000000000      SEQWD  OCT   +0
00674 +000000000000      ENKTP  OCT   +0
00675 +000000000000      TSTLC  OCT   +0
00676 +000000000000      TRXR4  OCT   +0
00677 +000000000000      ENTRY  OCT   +0           ENTRY STAT
00700 +010101010101      SWTWD  OCT   +010101010101
00701 -206001010101      SLTWD  OCT   +606001010101
00702 +000000000000      OFLON  OCT   +0
00703 +000000000020      OCT20  OCT   +000000000020
00704 +000000000000      ZERO   OCT   +0
00705 +000000000001      BIT35  OCT   +1
00706 -206060606060      BLANK  OCT   +606060606060
00707 -200000000000      BLNK6  OCT   +600000000000
00710  606060606000      BLNKS  BCD 1      0
00711  504700006000      LNE18  BCD 1QP00 0
00712  712551466000      LNE38  BCD 1ZERO 0
00713  606062254562      LNE57  BCD 1  SENS
00714  256031452460      LNE58  BCD 1E IND
00715  604645606060      ONBCD  BCD 1 ON
00716  604626266060      OFBCD  BCD 1 OFF
```

SENSE SWITCH AND ERROR PRINT ROUTINE

BCD TO CARD IMAGE FOR PRINTING

```
00717  0766 00 0 01361   BDIMG WPRA              SELECT PRINTER.
00720  0774 00 1 00030         AXT  24,1
00721  0560 00 0 00704         LDQ  ZERO                PRINT
00722 -0600 00 1 01062         STQ  PI+24,1
00723  2 00001 1 00722         TIX  *-1,1,1

       INITIALIZE
00724  0560 00 0 01022         LDQ  BDTMP       SET
00725 -0600 00 0 00772         STQ  EIGHT          FOR
00726  0560 00 0 01024         LDQ  BDTMP+2           LEFT
00727 -0600 00 0 00766         STQ  ZONE                   ROWS.
00730  0560 00 0 01026         LDQ  BDTMP+4
00731 -0600 00 0 00764         STQ  DIGIT

00732  0560 00 0 01020         LDQ  BDTMP-2
00733 -0600 00 0 01017         STQ  BDTMP-3     SET BIT INDEX
00734  0560 00 0 01030         LDQ  BDTMP+6
00735 -0600 00 0 00775         STQ  EIGHT+3     TRA ADDRESS.
     FORMING CARD IMAGE
00736  2 00001 4 00737         TIX  *+1,4,1
00737  0774 00 1 00006         AXT  6,1
00740  0560 00 4 00000         LDQ  0,4         BRING IN THE BCD WORDS..
00741  0634 00 1 00777   BDLP1 SXA  CHTMP,1
00742  0767 00 0 00022         ALS  18
       ZONE
00743 -0763 00 0 00002         LGL  2           ZONE
00744  0767 00 0 00001         ALS  1               TIMES 2.
00745  0602 00 0 00654         SLW  BNTMP
00746  0534 00 1 00654         LXA  BNTMP,1     SET IN XR1.
       DIGIT
00747  0767 00 0 00022         ALS  18
00750 -0763 00 0 00004         LGL  4           DIGIT
00751  0767 00 0 00001         ALS  1               TIMES 2.
00752  0602 00 0 00654         SLW  BNTMP
00753  0534 00 2 00654         LXA  BNTMP,2
00754 -0600 00 0 00654         STQ  BNTMP
00755  0560 00 0 01017         LDQ  BDTMP-3     BRING IN BIT INDEX
00756 -0763 00 0 00044         LGL  36
00757  0560 00 0 00654         LDQ  BNTMP

00760  3 00000 2 00762         TXH  *+2,2,0     BR IF DIGIT NON-ZERO
00761  3 00000 1 00770         TXH  *+7,1,0     BR IF ZONE ZERO.
00762  3 00030 2 00767         TXH  *+5,2,24    BLANK COL IF ILLEGAL CHAR.
00763  3 00024 2 00772         TXH  EIGHT,2,20  SPECIAL CHARACTERS

00764 -0602 00 2 01055   DIGIT ORS  PI+19,2
00765 -3 00000 1 00767         TXL  *+2,1,0     BYPASS FOR ZERO ZONE
00766 -0602 00 1 01063   ZONE  ORS  PI+25,1
00767  0020 00 0 00774         TRA  *+5
00770 -3 00004 1 00766         TXL  ZONE,1,4    CHECKING FOR BLANK CHAR.
00771  0020 00 0 00774         TRA  *+3         BRANCH IF BLANK CHAR.
```

```
00772 -0602 00 0 01034   EIGHT ORS  PI+2
00773  2 00020 2 00764         TIX  DIGIT,2,16 REDUCE DIGIT COUNT BY 16.
00774  0771 00 0 00001         ARS  1
00775  0100 00 0 01002         TZE  BDFIX     IF ZERO,SET RIGHT IF LEFT--
00776  0602 00 0 01017         SLW  BDTMP-3   SAVE BIT INDEX COUNTER.
00777  0774 00 1 00000   CHTMP AXT  **,1      BCD WORD CHARACTER COUNTER

01000  2 00001 1 00741         TIX  BDLP1,1,1
01001  0020 00 0 00736         TRA  BDLP1-3   BRING IN NEXT BCD WORD.


01002  0560 00 0 01023   BDFIX LDQ  BDTMP+1     SET
01003 -0600 00 0 00772         STQ  EIGHT           FOR
01004  0560 00 0 01025         LDQ  BDTMP+3             RIGHT
01005 -0600 00 0 00766         STQ  ZONE                    ROWS.
01006  0560 00 0 01027         LDQ  BDTMP+5
01007 -0600 00 0 00764         STQ  DIGIT
01010  0560 00 0 01020         LDQ  BDTMP-2     BIT
01011 -0600 00 0 01017         STQ  BDTMP-3       INDEX.
01012  0560 00 0 01031         LDQ  BDTMP+7
01013 -0600 00 0 00775         STQ  EIGHT+3
01014  0020 00 0 00736         TRA  BDLP1-3


01015  0540 00 0 01021   BDONE RCHA BDTMP-1
01016  0020 00 4 00001         TRA  1,4


       STORAGE CELLS
01017 +000000000000            OCT  +0          TMP FOR BIT INDEX CTR
01020 -0 00000 0 00000         MZE              INITIAL BIT INDEX  PSN 1
01021  0000 30 0 01032         IOCD PI,,24    I/O COMMAND
01022 -0602 00 0 01034   BDTMP ORS  PI+2       8 ROW LEFT
01023 -0602 00 0 01035         ORS  PI+3       8 ROW RIGHT
01024 -0602 00 1 01062         ORS  PI+24,1    ZONE ROW LEFT
01025 -0602 00 1 01063         ORS  PI+25,1    ZONE ROW RIGHT
01026 -0602 00 2 01054         ORS  PI+18,2    DIGIT ROW LEFT
01027 -0602 00 2 01055         ORS  PI+19,2    DIGIT ROW RIGHT

01030  0100 00 0 01002         TZE  BDFIX     FOR LEFT
01031  0100 00 0 01015         TZE  BDONE       AND RIGHT ROWS LOOPS.


                 01032   PI    BSS  24
```

SENSE SWITCH AND ERROR PRINT ROUTINE

```
01062   0 00000 0 00012          PZE   10
01063  +000000000000             OCT   +0
01064   0601 00 0 01063   BNTEN  STO   *-1
01065   0600 00 0 00654          STZ   BNTMP       CLEAR TEMPORARY STORAGE
01066   0600 00 0 00655          STZ   BNTMP+1
01067   0760 00 0 00016          LMTM
01070   0774 00 3 00012          AXT   10,3        XRD CONTAINS POWER OF TEN
01071   0774 00 6 00014          AXT   12,6        SET XRF FOR NO OF SHIFTS
01072   0774 00 7 00000          AXT   0,7         SET XRG FOR 6 HIGH DIGITS
01073   0774 00 5 00000          AXT   0,5         SET DIGIT TO ZERO

01074   0500 00 0 01063          CLA   BNTEN-1
01075   0402 00 3 01572          SUB   POWTEN+10,3 SUBTRACT POWER OF TEN
01076  -0120 00 0 01100          TMI   *+2
01077   1 00001 5 01075          TXI   *-2,5,1     ADD ONE TO DIGIT
01100   0400 00 3 01572          ADD   POWTEN+10,3 RESTORE BINARY NUMBER
01101   0601 00 0 01063          STO   BNTEN-1     SAVE FOR NEXT GO-AROUND

01102   0754 00 5 00000          PXA   0,5         DIGIT TO ACC ADDRESS
01103   0767 00 6 00044          ALS   36,6        PUT IT IN POSITION
01104  -0602 00 7 00655          ORS   BNTMP+1,7
01105  -3 00041 6 01110          TXL   *+3,6,33    SHOULD WE START NEW WORD
01106   0774 00 6 00000          AXT   0,6         YES
01107   0774 00 7 00001          AXT   1,7
01110   1 00006 6 01111          TXI   *+1,6,6
01111  -3 00000 3 01113          TXL   *+2,3,0     ARE WE FINISHED
01112   1 77777 3 01073          TXI   BNTEN+7,3,-1  NO
```

BINARY TO DECIMAL CONVERSION COMPLETED. NOW BLANK OUT LEADING ZEROS.

```
01113   0774 00 3 00000          AXT   0,3         SET FOR HIGH ORDER DIGITS
01114   0560 00 3 00655          LDQ   BNTMP+1,3
01115   0754 00 0 00000          PXA   0,0         CLEAR ACC
01116   0774 00 5 00044          AXT   36,5        INITIALIZE FOR NO BLANKS
01117  -0763 00 0 00006          LGL   6
01120  -0100 00 0 01131          TNZ   *+9         SEARCH OUT LEFTMOST
01121   2 00006 5 01117          TIX   *-2,5,6     NON-ZERO DIGIT
01122  -0500 00 0 00706          CAL   BLANK       ALL ZERO
01123   0602 00 3 00655          SLW   BNTMP+1,3
01124  -3 00000 3 01130          TXL   *+4,3,0
01125  -0500 00 0 00655          CAL   BNTMP+1
01126   0560 00 0 00654          LDQ   BNTMP
01127   0020 00 4 00001          TRA   1,4         RETURN

01130   1 00001 3 01114          TXI   *-12,3,1    SET FOR LOW ORDER DIGITS
01131  -0501 00 0 00710          ORA   BLNKS
01132  -0765 00 5 00052          LGR   42,5        RESTORE REMAINING DIGITS
01133  -0600 00 3 00655          STQ   BNTMP+1,3
01134   0020 00 0 01125          TRA   *-7
```

INSERTING COMMAS INTO DECIMAL NUMBER EQUIVALENTS.

```
01135 +000000000000              OCT +0
01136  0602 00 0 01063  INSRT    SLW  BNTEN-1
01137  0500 00 0 01063           CLA  BNTEN-1
01140  0402 00 0 00706           SUB  BLANK
01141  0100 00 0 01156           TZE  NSRT1-1    OK-NO HIGH ORDER DIGITS
01142  0400 00 0 00706           ADD  BLANK
01143  0767 00 0 00006           ALS  6

01144 -0501 00 0 01201           ORA  COMMA      ENTER HIGH ORDER COMMA
01145 -0763 00 0 00006           LGL  6
01146  0602 00 0 01135           SLW  INSRT-1
01147 -0500 00 0 00706           CAL  BLANK
01150 -0763 00 0 00014           LGL  12
01151  0767 00 0 00006           ALS  6

01152 -0501 00 0 01201           ORA  COMMA      ENTER LOW ORDER COMMA
01153 -0765 00 0 00022           LGR  18
01154 -0500 00 0 01135           CAL  INSRT-1
01155  0020 00 4 00001           TRA  1,4

01156 -0500 00 0 00706           CAL  BLANK
01157 -0763 00 0 00022   NSRT1   LGL  18
01160  0767 00 0 00006           ALS  6
01161  0602 00 0 01135           SLW  INSRT-1
01162  0500 00 0 01135           CLA  INSRT-1
01163  0402 00 0 00710           SUB  BLNKS
01164  0100 00 0 01174           TZE  *+8        NO COMMA NEEDED
01165  0400 00 0 00710           ADD  BLNKS
01166 -0501 00 0 01201           ORA  COMMA
01167  0601 00 0 01135           STO  INSRT-1
01170 -0500 00 0 01135           CAL  INSRT-1
01171 -0765 00 0 00022           LGR  18
01172 -0501 00 0 00710           ORA  BLNKS
01173  0020 00 4 00001           TRA  1,4

01174  0400 00 0 00710           ADD  BLNKS
01175  0771 00 0 00006           ARS  6
01176 -0765 00 0 00022           LGR  18
01177 -0500 00 0 01063           CAL  BNTEN-1
01200  0020 00 4 00001           TRA  1,4

01201 +000000000073      COMMA   OCT  +73
```

PROGRAM SEQUENCE ERROR SUBROUTINE

```
01202  0634 00 4 00666  SEQER  SXA  XR4,4
01203  0535 00 2 00666         LAC  XR4,2
01204  0634 00 2 00673         SXA  SEQWD,2
01205  0535 00 1 00101         LAC  SVXR4,1
01206 -0634 00 1 00673         SXD  SEQWD,1
01207  0560 00 0 00673         LDQ  SEQWD

01210  0760 00 0 00162         SWT  2       WANT TO INDICATE ERROR---
01211  0020 00 0 01213         TRA  *+2       UP-YES - TEST SSW 3.
01212  0020 00 0 01243         TRA  SEQRT     DN-RETURN TO PROG.

01213  0760 00 0 00163         SWT  3       WANT TO PRINT OR HALT---
01214  0020 00 0 01216         TRA  *+2       UP- PRINT ERROR.
01215  0000 00 0 01243         HTR  SEQRT     DN-STOP ON ERROR.
```

PROGRAM SEQUENCE IS OUT OF PROGRAM CONTROL.
THE MQ CONTAINS--
DECREMENT - ADDRESS FROM WHICH CONTROL WAS RECOVERED.
ADDRESS - LAST TEST ROUTINE TO TSX OK

```
01216  0074 00 4 00643         TSX  BNOCT+3,4
01217  0602 00 0 01236         SLW  SQPRT+7
01220 -0600 00 0 01242         STQ  SQPRT+11
01221  0560 00 0 00707         LDQ  BLNK6
01222 -0763 00 0 00044         LGL  36
01223 -0602 00 0 01236         ORS  SQPRT+7
01224 -0602 00 0 01242         ORS  SQPRT+11

01225  0766 00 0 01361         WPRA                 SPACE PRINTER.
01226  0074 00 4 00717         TSX  BDIMG,4         PRINT ERROR MESSAGE.
```

PROGRAM SEQUENCE OUT OF CONTROL. OUT AT REGAINED AT

```
01227  604751462751    SQPRT BCD 6 PROGRAM SEQUENCE OUT OF CONTROL.  0
01230  214460622550
01231  642545232560
01232  466463604626
01233  602346456351
01234  464333606046
01235  646360216360          BCD 6UT AT              REGAINED AT
01236  606060606060
01237  606060606060
01240  512527213145
01241  252460216360
01242  606060606060

01243  0534 00 4 00101  SEQRT LXA  SVXR4,4  SET LAST GOOD TSX OK
01244  0020 00 0 00175         TRA  OKAY
```

PROGRAM START SUBROUTINE

```
01245  0600 00 0 01420   PGMST STZ  MFCTR
01246  0600 00 0 00112         STZ  RELBTY
01247  0600 00 0 01421         STZ  MFCTR+1
01250  0774 00 1 00100         AXT  64,1      CLEAR LOCATIONS
01251  0600 00 1 00100         STZ  64,1      0-77
01252  2 00001 1 01251         TIX  *-1,1,1

01253  0500 00 0 01573         CLA  KONE      SET UP
01254  0601 00 0 00000         STO            LOCATION ZERO
01255  0500 00 0 01574         CLA  KTWO      AND TWO
01256  0601 00 0 00002         STO  2
01257  0760 00 0 00163         SWT  3         WITH SSW 3 ---
01260  0020 00 0 01262         TRA  *+2         UP- PRINT PROG ID
01261  0020 00 0 11612         TRA  S1P3        DN- BYPASS ID
```

PROGRAM IDENTIFICATION

```
01262  0074 00 4 00717         TSX  BDIMG,4

   9M71  MAIN FRAME INSTRUCTION CHECKOUT AND RELIABILITY PROGRAM.
01263  606011440701            BCD 5  9M71B  MAINFRAME INSTRUCTION
01264  226060442131
01265  452651214425
01266  603145626351
01267  642363314645
01270  602330252342            BCD 7 CHECKOUT AND RELIABILITY PROGRAM.
01271  466463602145
01272  246051254331
01273  212231433163
01274  706047514627
01275  512144336060
01276  606060606060


01277  0766 00 0 01361         WPRA           SPACE PRINTER.
01300  0060 00 0 01300         TCOA *         WAIT...

01301  0020 00 0 11612         TRA  S1P3
```

PROGRAM CONTROL SUBROUTINES

PROGRAM COMPLETION CONTROL SUBROUTINE

```
01302  0760 00 0 00166   PGEND SWT  6         WANT TO REPEAT PROGRAM
01303  0020 00 0 01423         TRA  MFSTP     UP - NO GO TO STOP

01304  0534 00 1 01420         LXA  MFCTR,1   COUNTING
01305  1 00001 1 01306         TXI  *+1,1,1             N
01306  0634 00 1 01420         SXA  MFCTR,1     PASSES

01307  0500 00 0 01421         CLA  MFCTR+1   COUNTING
01310  0400 00 0 00705         ADD  BIT35     TOTAL PASSES
01311  0601 00 0 01421         STO  MFCTR+1

01312 -0520 00 0 00112         NZT  RELBTY    CHECK FOR EXTENDED PRINT
01313  0020 00 0 01360         TRA  RPAS      NO
01314  0534 00 1 01422         LXA  MFCTR+2,1
01315  1 00001 1 01316         TXI  *+1,1,1   COUNTING
01316  0634 00 1 01422         SXA  MFCTR+2,1  EXTENDED
                                              PASSES
01317  0760 00 0 00163         SWT  3         WANT TO PRINT
01320  0020 00 0 01324         TRA  *+4       YES
01321  0760 00 0 00164         SWT  4         NO--CHECK FOR RELIABILITY
01322  0600 00 0 01422         STZ  MFCTR+2   NO-ZERO RELIABILITY COUNTER
01323  0020 00 0 01600         TRA  SECT1     AND RETURN TO PROG.

01324  0754 00 1 00000         PXA  ,1        SET UP FOR RELIABILITY
01325  0074 00 4 01064         TSX  BNTEN,4   PASSES
01326  0131 00 0 00000         XCA
01327  0560 00 0 01340         LDQ  EXPAS     AND
01330 -0773 00 0 00014         RQL  12        INSERT
01331 -0765 00 0 00014         LGR  12        IN IMAGE
01332 -0600 00 0 01340         STQ  EXPAS
01333 -0500 00 0 01421         CAL  MFCTR+1   SET
01334  0074 00 4 01064         TSX  BNTEN,4   TOTAL
01335  0074 00 4 01156         TSX  NSRT1-1,4 PASSES
                                              IN
01336 -0600 00 0 01353         STQ  EXPAS+11  IMAGE
01337  0074 00 4 00717         TSX  BDIMG,4   PRINT
01340  606060472162     EXPAS BCD 6   PASSES COMPLETE 9M71B EXTENDED RE
01341  622562602346
01342  444743256325
01343  601144070122
01344  602567632545
01345  242524605125
01346  433121223143           BCD 6LIABILITY MODE.  TOTAL PASSES
01347  316370604446
01350  242533606063
01351  466321436047
01352  216262256260
01353  606060606060
01354  0060 00 0 01354         TCOA  *
01355  0760 00 0 00164         SWT   4
01356  0600 00 0 01422         STZ   MFCTR+2
01357  0020 00 0 01600         TRA   SECT1
```

```
01360   3 00061 1 01362   RPAS  TXH  *+2,1,49 TIME TO PRINT
01361   0020 00 0 01600         TRA  SECT1    NO - RETURN
01362   0754 00 1 00000         PXA  ,1
01363   0600 00 0 01420         STZ  MFCTR
01364   0760 00 0 00163         SWT  3        WANT TO PRINT
01365   0020 00 0 01367         TRA  *+2      YES
01366   0020 00 0 01600         TRA  SECT1    NO - RETURN

01367   0074 00 4 01064         TSX  BNTEN,4  CONVERT TO BCD
01370   0074 00 4 01156         TSX  NSRT1-1,4 INSERT COMMAS
01371  -0600 00 0 01404         STQ  MFPAS+2

01372   0500 00 0 01421         CLA  MFCTR+1  INSERT TOTAL
01373   0074 00 4 01064         TSX  BNTEN,4  PASSES
01374   0074 00 4 01136         TSX  INSRT,4  INTO
01375   0602 00 0 01410         SLW  MFPAS+6  PRINT
01376  -0600 00 0 01411         STQ  MFPAS+7  IMAGE
01377  -0500 00 0 00707         CAL  BLNK6
01400  -0602 00 0 01410         ORS  MFPAS+6
01401   0074 00 4 00717         TSX  BDIMG,4
01402   606060114407    MFPAS BCD 6   9M71B MF        PASSES.  TOTAL OF
01403   012260442660
01404   606060606060
01405   604721626225
01406   623360606346
01407   632143604626
01410   606060606060          BCD 6              PASSES COMPLETED.
01411   606060606060
01412   604721626225
01413   626023464447
01414   432563252433
01415   606060606060
01416   0060 00 0 01416         TCOA  *
01417   0020 00 0 01600         TRA   SECT1
01420  +000000000000    MFCTR  OCT   +0
01421  +000000000000           OCT   +0
01422  +000000000000           OCT   +0
```

PROGRAM CONTROL SUBROUTINES

PROGRAM STOP CONTROL SUBROUTINE

```
01423  0600 00 0 01420   MFSTP STZ  MFCTR
01424  0500 00 0 01421         CLA  MFCTR+1
01425  0400 00 0 00705         ADD  BIT35
01426  0600 00 0 01421         STZ  MFCTR+1

01427  0760 00 0 00163         SWT  3          WANT TO PRINT
01430  0020 00 0 01432         TRA  *+2        UP - YES
01431  0020 00 0 01457         TRA  FINIS      DN - NO

01432  0766 00 0 01361         WPRA
01433  0074 00 4 01064         TSX  BNTEN,4      CONVERT TO DEC BCD
01434  0074 00 4 01136         TSX  INSRT,4      INSERT COMMAS
01435  0602 00 0 01447         SLW  MFFIN+5
01436 -0600 00 0 01450         STQ  MFFIN+6
01437 -0500 00 0 00707         CAL  BLNK6
01440 -0602 00 0 01447         ORS  MFFIN+5
01441  0074 00 4 00717         TSX  BDIMG,4
01442  601144070122      MFFIN BCD 6 9M71B  MF TEST ENDS. TOTAL OF
01443  606044266063
01444  256263602545
01445  246233606346
01446  632143604626
01447  606060606060
01450  606060606060            BCD 6       PASSES COMPLETED.
01451  604721626225
01452  626023464447
01453  432563252433
01454  606060606060
01455  606060606060

01456  0060 00 0 01456         TCOA *
01457  0760 00 0 00016   FINIS LMTM
01460  0774 00 3 00000         AXT  0,3
01461  0774 00 5 00000         AXT  0,5
01462  0774 00 6 00000         AXT  0,6
01463  0774 00 7 00000         AXT  0,7
01464 -0760 00 0 00016         EMTM
01465  0774 00 7 00000         AXT  0,7
01466  0754 00 0 00000         PXA  ,,
01467  0140 00 0 01470         TOV  *+1
01470  0760 00 0 00140         SLF
```

```
01471   0760 00 0 00004          ENK              CHECK SIGN POSITION
01472   0162 00 0 01475          TQP   *+3
01473   0762 00 0 01321          RCDA             READ CARDS
01474   0020 00 0 01476          TRA   *+2
01475   0762 00 0 01221          RTBA  1          READ TAPE
01476   0560 00 0 00704          LDQ   ZERO         CLEAR MQ
01477   0540 00 0 01502          RCHA  ADIOS           CALL IN
01500   0544 00 0 00000          LCHA                    NEXT
01501   0021 00 0 00001          TTR   1                     PROGRAM..
01502  -1 00003 0 00000   ADIOS  IOCT  ,,3


01503  -0760 00 0 00007   RESTR  LTM
01504   0634 00 2 01575          SXA   TEMP,2     JUST IN CASE
01505   0774 00 2 00000          AXT   ,2         SAVE C XR2
01506   3 00003 2 01513          TXH   *+5,2,3
01507  -0760 00 2 00144          SLT   4,2        OPERATOR RESTARTED PROGRAM
01510   1 00001 2 01506          TXI   *-2,2,1    IF ALL SENSE LIGHTS ARE OUT
01511   0534 00 2 01575          LXA   TEMP,2     RESTORE XR2

01512   0420 00 0 00000          HPR              PC INADVERTENTLY RESET.
                                                  LOC 00101 CONTAINS TWOS
                                                  COMP ADDRESS OF LAST TSX OK
01513   0534 00 4 00101          LXA   SVXR4,4
01514   0760 00 0 00164          SWT   4          RESTART FROM LAST TSX OK
01515  -0520 00 0 00112          NZT   RELBTY     UNLESS OPERATOR IS TRYING
01516   0020 00 0 00175          TRA   OKAY       TO BREAK AWAY FROM THE
01517   0760 00 0 00161          SWT   1          LONG RELIABILITY TESTS
01520   0020 00 0 01600          TRA   SECT1
01521   0020 00 0 00175          TRA   OKAY


01522   0500 00 4 77777   LOOP   CLA   -1,4      SECTION ID TO ACC
01523   0601 00 0 01575          STO   TEMP       SAVE IN TEMP
01524   0774 00 1 77777          AXT   -1,1       FLAG XRA FOR FIRST TIME
01525   0535 00 2 01575          LAC   TEMP,2

01526   0760 00 0 00004          ENK              C KEYS TO MQ
01527  -0773 00 0 00013          RQL   11         C KEY 11 TO MQ SIGN
01530  -0600 00 0 01576          STQ   TEMP+1     SAVE FOR NEXT ITERATION
01531  -0500 00 0 01576          CAL   TEMP+1

01532   0760 00 0 00006          COM              COMPLEMENT ACCUMULATOR
01533   0767 00 2 00000          ALS   ,2         TEST FOR LATER SECTIONS
01534  -3 00000 2 01536          TXL   *+2,2,0    SKIP IF XRB IS ZERO
01535  -3 77771 2 01542          TXL   *+5,2,-7   TRANSFER ON UNDESIRED
                                                  SECTION SEVEN
01536  -0760 00 0 00001          PBT              SKIP IF SECTION UNWANTED
01537   0020 00 2 01550          TRA   TRTBL,2    WANTED SECTION-GO TO IT
01540   0767 00 0 00001          ALS   1          SET NEXT SECTION TEST
01541   1 77777 2 01535          TXI   *-4,2,-1   SET NEXT SECTION TRANSFER

01542  -3 00000 1 01546          TXL   *+4,1,0    XFER IS KEYS 11-17 UP
01543   0774 00 1 00000          AXT   ,1         SET FOR RESTARTING TESTS
01544   0774 00 2 00000          AXT   ,2
01545   0020 00 0 01531          TRA   *-12       ITERATE
```

PROGRAM CONTROL SUBROUTINES

```
01546  0535 00 2 01575          LAC  TEMP,2
01547  0020 00 2 01550          TRA  TRTBL,2  GO TO NEXT SECTION

01550  0020 00 0 01600  TRTBL  TRA  SECT1
01551  0020 00 0 27000         TRA  SECT2
01552  0020 00 0 40100         TRA  SECT3
01553  0020 00 0 45300         TRA  SECT4
01554  0020 00 0 57000         TRA  SECT5
01555  0020 00 0 70000         TRA  SECT6
01556  0020 00 0 71000         TRA  SECT7
01557  0020 00 0 01302         TRA  PGEND

01560 +112402762000  POWTEN DEC  10000000000

01561 +007346545000         DEC  1000000000

01562 +000575360400         DEC  100000000

01563 +000046113200         DEC  10000000

01564 +000003641100         DEC  1000000

01565 +000000303240         DEC  100000

01566 +000000023420         DEC  10000

01567 +000000001750         DEC  1000

01570 +000000000144         DEC  100

01571 +000000000012         DEC  10

01572 +000000000001         DEC  1


01573 -1 00000 0 00000  KONE  STR
01574  0021 00 0 01503  KTWO  TTR  RESTR
01575 +000000000000     TEMP  OCT  +0
01576 +000000000000           OCT  +0
```