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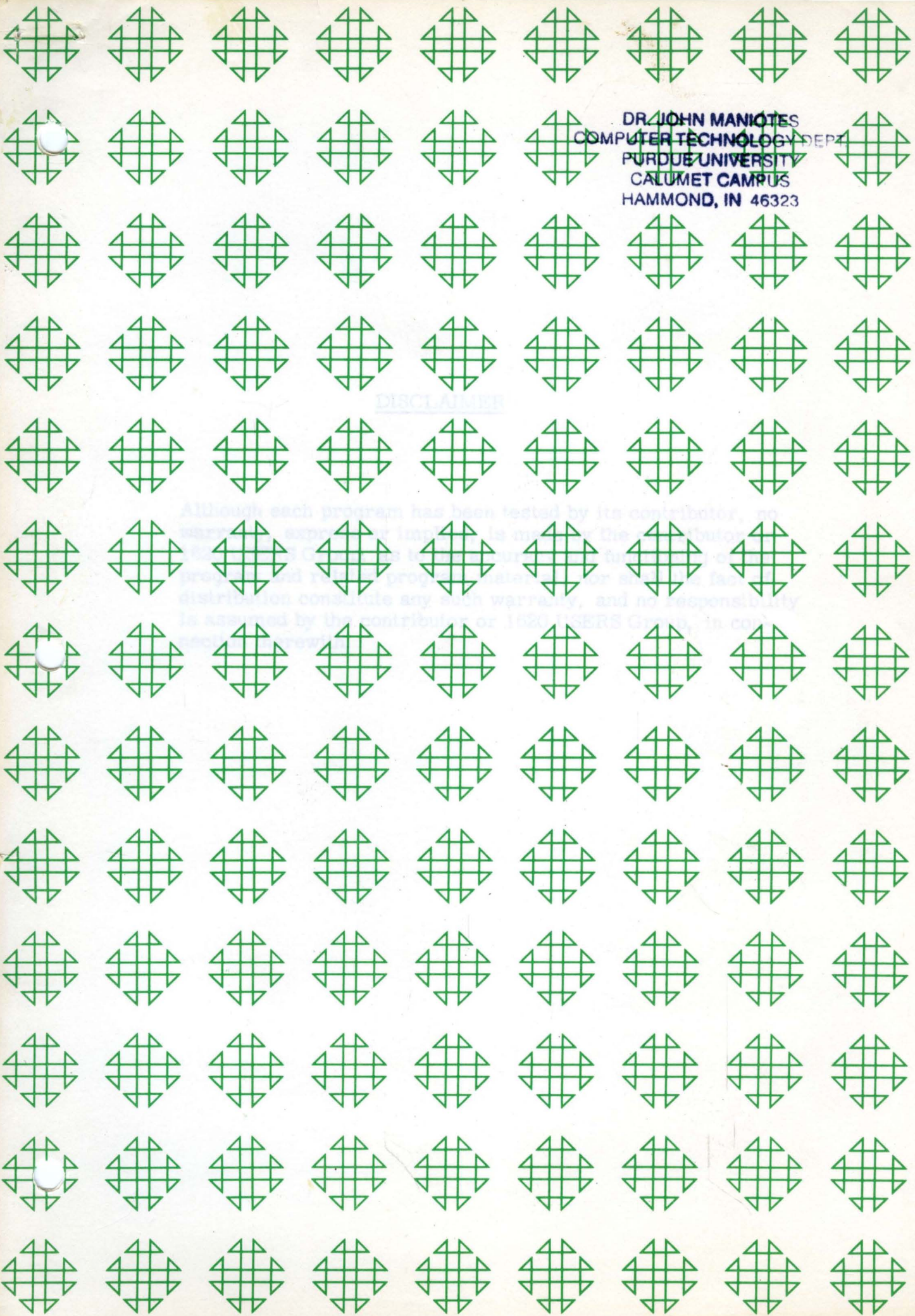
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1620 GENERAL PROGRAM LIBRARY

LP20 Linear Programming System

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1620 USERS GROUP PROGRAM REVIEW AND EVALUATION

Program No. _____

Date _____

Program Name: _____

1. Does the abstract adequately describe what the program is and what it does? Yes ___ No ___
Comment _____

2. Does the program do what the abstract says? Yes ___ No ___
Comment _____

3. Is the Description clear, understandable, and adequate? Yes ___ No ___
Comment _____

4. Are the Operating Instructions understandable and in sufficient detail? Yes ___ No ___
Comment _____
Are the Sense Switch options adequately described (if applicable)? Yes ___ No ___
Are the mnemonic labels identified or sufficiently understandable? Yes ___ No ___
Comment _____

5. Does the source program compile satisfactorily (if applicable)? Yes ___ No ___
Comment _____

6. Does the object program run satisfactorily? Yes ___ No ___
Comment _____

7. Number of test cases run _____
Are any restrictions as to data, size, range, etc. covered adequately in description? Yes ___ No ___
Comment _____

8. Does the Program meet the minimal standards of the 1620 Users Group? Yes ___ No ___
Comment _____

9. Please list any suggestions to improve the usefulness of the program. These will be passed on to the author for his consideration.
Comment _____

Please return to:

Mr. Robert J. Robinson (PREP)
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1515 W. Wisconsin Avenue
Milwaukee 3, Wisconsin

Your Name _____
Company _____
Address _____
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LP20 LINEAR PROGRAMMING SYSTEM

James N. Boles
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Berkeley 4, California



LP20 LINEAR PROGRAMMING SYSTEM

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Deck Key

<u>Deck number</u>	<u>Description</u>	<u>Sequence numbers</u>
1	LP20-1 SPSII source deck	00010-02380
2	LP20-2 SPSII source deck	02390-03530
3	LP20-3 SPSII source deck	03540-05570
4	LP20-4 SPSII source deck	05580-07780
5	LP20-5A SPSII source deck	07790-09600
6	LP20-5B SPSII source deck	09610-11790
7	LP20-6 SPSII source deck	11800-14160
8	LP20-7 SPSII source deck	14170-14570
9	LP20-8 SPSII source deck	14580-15140
10	LP20-9 SPSII source deck	15150-16960
11	LP20-10 SPSII source deck	16970-19010
12	LP20-1 SPSII condensed object deck	0- 83
13	LP20-2 SPSII condensed object deck	0- 92
14	LP20-3 SPSII condensed object deck	0- 142
15	LP20-4 SPSII condensed object deck	0- 150
16	LP20-5A SPSII condensed object deck	0- 82
17	LP20-5B SPSII condensed object deck	0- 92
18	LP20-6 SPSII condensed object deck	0- 93
19	LP20-7 SPSII condensed object deck	0- 13
20	LP20-8 SPSII condensed object deck	0- 69
21	LP20-9 SPSII condensed object deck	0- 124 13D
22	LP20-10 SPSII condensed object deck	0- 142
23	LP20-1 Condensed object deck	
24	LP20-2 Condensed object deck	
25	LP20-3-4 Condensed object deck	
26	LP20-5A Condensed object deck	
27	LP20-5B Condensed object deck	
28	LP20-6 Condensed object deck	
29	LP20-7 Condensed object deck	
30	LP20-8 Condensed object deck	
31	LP20-9 Condensed object deck	
32	LP20-10 Condensed object deck	
33	Data deck, simplex	
34	Data deck, test solution, simplex	
35	Data deck, dual	

All 35 decks are preceded by a hash total card (punched by Hash Total 1.6.031). The hash totals are given on the next page. The hash total cards should be removed from decks 1-11 and 33-35 before using. The hash total cards for decks 12-32 may either be removed or not. They do not interfere with loading object decks.



V

HASH TOTAL DECK NO.

EQUAL 05529176491853283048 1
EQUAL 50035228179102462347 2
EQUAL 53299033376414163272 3
EQUAL 27073835036827641790 4
EQUAL 86239769806850548253 5
EQUAL 27349501494407771476 6
EQUAL 45173343661241833560 7
EQUAL 45646895619146882780 8
EQUAL 77951336605079342038 9
EQUAL 03180169581883637362 10
EQUAL 60736651775034740663 11

EQUAL 33056258994875239348 12
EQUAL 79273596248830181912 13
EQUAL 09557918736864662154 14
EQUAL 96718021170558229963 15
EQUAL 44128824137922456390 16
EQUAL 43055852117610182423 17
EQUAL 48010960771145998000 18
EQUAL 45674305097496970763 19
EQUAL 07154444110657704506 20
EQUAL 11539035524747521076 21
EQUAL 29546305139083657005 22

EQUAL 17207687542338065860 23
EQUAL 94930377756533800108 24
EQUAL 79208084181456621240 25
EQUAL 75866488865834400367 26
EQUAL 87908775057480266997 27
EQUAL 86321940964926867161 28
EQUAL 85769291509321987151 29
EQUAL 40543224641875962857 30
EQUAL 57669993930175826645 31
EQUAL 83924823884165643830 32

EQUAL 53071156726904810504 33
EQUAL 82050716790100892504 34
EQUAL 31732299703759795037 35



1620 Users Group Library, Program Abstract

Title

LP20 Linear Programming System.

Subject Classification

10.1.

Author and Organization

James N. Boles, Associate Professor, Department of Agricultural Economics, University of California, Berkeley.

Direct Inquiries To

Professor James N. Boles, Department of Agricultural Economics, University of California, Berkeley 4, phone--Thornwall 5,6000, extension 3349.

Purpose and Description

This system solves the general linear programming problem. Either or both the dual or simplex algorithm is used. Provision is made for testing the solution by substitution in the restraining equations, for printing or punching the entire matrix with explicit decimal format, and routines are provided for semi-automatic parametric change of the constraints.

Method

The method used is the revised simplex and/or dual algorithm. See Saul I. Gass, Linear Programming Methods and Applications (New York: McGraw-Hill Book Co., Inc. 1958).



Restrictions and Range

Where M is the number of restraining equations and N is the number of real activities, the limitation on problem size is given by

$$(M + 2)(N + 3) \leq \frac{\text{Memory Capacity} - 4800}{10}$$

Except for this limitation, the system is independent of memory size.

Storage Requirements

Program goes to 4775; data starts at 4800 and goes to upper memory.

Equipment Specifications

Card system, any size memory, automatic divide, and no other special features.

Additional Remarks

Eight and 2 floating point arithmetic; SPSII with floating point subroutines, nonrelocatable; SPSII listings and flow charts; listing of actual condensed decks; source decks; SPSII condensed decks; operating decks condensed by routine similar to squeeze; and sequence of 10 semiindependent routines.



Note to Users

After the manual was prepared, it was found that the parametric programming routines may cycle if the current solution is degenerate, i.e. having more than one zero element in the b vector. If it is desired to start the parametric solution with one element of b started at zero and then made larger, other zero elements of b should be perturbed slightly by changing the element to a very small number, for example to 0.00001. Alternately, one may start with the selected element of b so large that the parametric disposal vector is in the optimum solution and then subtract. In this case normal truncation error will usually provide sufficient perturbation so no cycling will occur.

One additional change has been made in LP20-9. If the parametric vector is in the current basis and a multiple of the parametric vector is to be added to b , the program prints ID BASIC and stops. If a multiple of the parametric vector is to be subtracted, the level of the parametric vector in the current solution is reduced to zero and the parametric process continues.



LP20 LINEAR PROGRAMMING SYSTEM

I. Detailed Description of System

A. Introduction

The LP20 Linear Programming System borrows heavily from C. R. Nichols 1620 Linear Programming Code for paper tape input-output and the adaptation of this program by Art Nickel and Lou Davis for card machines. The primary differences are that the current version is written in SPSII with a complete SPSII listing; provision is made for printing or punching in explicit decimal form the entire matrix; provision is made for testing the solution by substitution in the restraining equations; and routines are provided for parametric change of the constraints.

The LP20 Linear Programming System, as compiled, requires a Card 1620 with automatic divide. It is designed so that the sequential programs occupy locations from 00402 to 04764. Data and working areas begin at 04796 and run to upper memory. Since the simplex program occupies the largest space, this program should be recompiled for machines without automatic divide, and the reference address, W (now set at 4809) should be set at least 14 digits beyond the last digit used by the compiled program and subroutines.

As currently compiled, the limitation on problem size is given by:

$$(M + 2)(N + 3) \leq \frac{\text{Memory} - 4800}{10} ;$$

where M = number of restraining equations and N = number of nonbasic variables.

Except for this restriction, the program is independent of memory capacity.

If additional floating point accuracy is desired, the system can be recompiled for more than eight significant digits by making appropriate

changes in address arithmetic. Increasing the word length will, of course, reduce the maximum problem size that can be handled.

For those machines with floating point hardware, the program can be recompiled making appropriate modifications to floating point instructions and their associated instructions that initialize and modify instructions.

The LP20 Linear Programming System is designed to solve a general linear programming problem of the form:

Given coefficients, A_{ij} ; cost coefficients, C_j ; and requirements, b_i ; determine X_j to maximize

$$X_0 = \sum_{j=1}^{M+N} C_j X_j$$

subject to $X_j \geq 0$, $j = 1, 2, \dots, (M+N)$

and to
$$\sum_{j=1}^{M+N} A_{ij} X_j = b_i \quad , \quad i = 1, 2, \dots, M.$$

Either or both the Dual and Simplex Algorithms are used. This requires that a basic solution must be known prior to starting the problem. In order to save space, the unit vectors associated with variables in the basic solution are not stored. As a variable is dropped from the basic solution and a new variable added, the vector representing the deleted activity (in terms of the new basis) replaces the vector corresponding to the variable added to the basic solution.

If any of the b 's are negative in the initial basic solution, the Dual Algorithm is used until a feasible solution is obtained or until it is determined that the problem is inconsistent. Once a feasible basic solution is obtained, the simplex algorithm is used until an optimum basic feasible solution is obtained or until it is determined that the functional is unbounded.

The $Z_j - C_j$ row is computed for the first basic solution based on the floated $C(J)$ values entered for both basic and nonbasic activities. A form of the revised simplex method is used subsequently so that the functional, the b 's, and the $(Z_j - C_j)$'s are transformed in the same way as the A_{ij} elements of the matrix. Therefore, the $(Z_j - C_j)$ elements will also be subject to truncation error, and it may be desirable after a long sequence of iterations to reload the Shadow Price Program to recompute the value of the functional and the $(Z_j - C_j)$ row.

In the process of matrix transformation, each element is tested after transformation to see if its exponent is less than -07 (essential zero). If it is, the element is replaced by zero. In certain problems run on predecessor programs, reasonable solutions were obtained only by increasing essential zero from -08 to -06 . The field address of ESSZER is 00553 for both the Dual and Simplex Algorithms.

To illustrate the relations between various linear programming problems and the way in which they are modified to fit this programming system, several simple problems are now described.

1. Standard Simplex Problem

$$\text{Maximize } X_0 = 83.40 X_1 + 72.35 X_2 + 27.30 X_3 + \\ + 72.05 X_4 + 207.25 X_5 + 455.00 X_6$$

$$\text{subject to } X_j \geq 0 ; j = 1, 2, \dots, 6$$

and to

$$X_1 + X_2 + X_3 + 2 X_4 \leq 60$$

$$X_2 + X_3 + 2 X_4 + X_5 + X_6 \leq 60$$

$$99.4 X_1 + 37.75 X_2 + 19.75 X_3 + 54.4 X_4 + 74.75 X_5 + 53.0 X_6 \leq 2000$$

$$.436 X_3 + 19.1 X_5 + 12.363 X_6 \leq 424$$

$$3 X_2 + .364 X_3 + 9.1 X_5 + 26.737 X_6 \leq 359$$

This problem is modified by adding disposal (slack) activities and corresponding variables X_7, X_8, X_9, X_{10} , and X_{11} .

Modified Problem 1

$$\text{Maximize } X_0 = 83.40 X_1 + 72.35 X_2 + 27.30 X_3 + 72.05 X_4 + 207.25 X_5 + 455.0 X_6 + 0.0 X_7 + 0.0 X_8 + 0.0 X_9 + 0.0 X_{10} + 0.0 X_{11}$$

$$\text{Subject to } X_j \geq 0 ; j = 1, 2, \dots, 11$$

and to

$$\begin{array}{rcccccccccccc} X_1 & + & X_2 & + & X_3 & + & 2 X_4 & + & & + & X_7 & & & = & 60 \\ & & X_2 & + & X_3 & + & 2 X_4 & + & X_5 & + & X_6 & & + & X_8 & = & 60 \\ 99.4 X_1 & + & 37.75 X_2 & + & 19.75 X_3 & + & 54.4 X_4 & + & 74.75 X_5 & + & 53.0 X_6 & & + & X_9 & = & 2000 \\ & & & & .436 X_3 & & & + & 19.1 X_5 & + & 12.363 X_6 & & & + & X_{10} & = & 424 \\ & & 3 X_2 & + & .364 X_3 & & & + & 9.1 X_5 & + & 26.737 X_6 & & & & + & X_{11} & = & 359 \end{array}$$

Finally, the unit vectors corresponding to the disposal (slack) activities are deleted in order to save storage space in the computer.

Problem (1) as stored in computer								
	Column -1	Column 0	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Row -1			0001 83.40	0002 72.35	0003 27.30	0004 72.05	0005 207.25	0006 455.00
Row 0								
Row 1	0007 0.0	60.000	1.000	1.000	1.000	2.000		
Row 2	0008 0.0	60.000		1.000	1.000	2.000	1.000	1.000
Row 3	0009 0.0	2000.000	99.400	37.750	19.750	54.400	74.750	53.000
Row 4	0010 0.0	424.000			0.436		19.100	12.363
Row 5	0011 0.0	359.000		3.000	0.364		9.100	26.737

2. Feed Mix Problem, Using Dual Algorithm

$$\text{Minimize } X_0 = 66 X_1 + 92 X_2 + 156 X_3 + 96 X_4$$

$$\text{subject to } X_1, X_2, X_3, X_4 \geq 0$$

and to

$$17 X_1 + 25 X_2 + 60 X_3 + 45 X_4 \geq 35.0$$

$$2 X_1 + 5 X_2 + 7 X_3 + 0.5 X_4 \geq 1.5$$

$$X_1 + X_2 + X_3 + X_4 \geq 1.0$$

Modification of Problem (2).---Since the programming system assumes a maximizing problem, the objective function is multiplied by minus one so that the problem is now to maximize

$$-X_0 = -66 X_1 - 92 X_2 - 156 X_3 - 96 X_4$$

Disposal activities are added to form equations to replace the inequalities.

$$\text{Maximize } -X_0 = -66 X_1 - 92 X_2 - 156 X_3 - 96 X_4 + 0 X_5 + 0 X_6 + 0 X_7$$

$$\text{subject to } X_j \geq 0_j \quad j = 1, 2, \dots, 7.$$

and

$$17 X_1 + 25 X_2 + 60 X_3 + 45 X_4 - X_5 = 35.0$$

$$2 X_1 + 5 X_2 + 7 X_3 + 0.5 X_4 - X_6 = 1.5$$

$$X_1 + X_2 + X_3 + X_4 - X_7 = 1.0$$

There still is a problem since no basic feasible solution can be obtained by inspection. The solution to this problem is to multiply each equation by minus one and use X_5 , X_6 , and X_7 as the basic variables, allowing the right-hand side to be negative. The Dual Algorithm is then automatically used to derive a basic feasible solution at which time the Simplex Algorithm takes over and obtains the optimum solution. The problem, as entered into the computer, is shown on the next page.

Problem (2) as stored in computer						
	Column -1	Column 0	Column 1	Column 2	Column 3	Column 4
Row -1			0001 -66.0	0002 -92.0	0003 -156.0	0004 -96.0
Row 0						
Row 1	0005 0.0	-35.0	-17.0	-25.0	-60.0	-45.0
Row 2	0006 0.0	- 1.5	- 2.0	- 5.0	- 7.0	- 0.5
Row 3	0007 0.0	- 1.0	- 1.0	- 1.0	- 1.0	- 1.0

3. A problem stated in terms of equalities for which no obvious basic solution is available.

$$\text{Maximize } -X_0 = -66 X_1 - 92 X_2 - 156 X_3 - 96 X_4$$

$$\text{subject to } X_1, X_2, X_3, X_4 \geq 0$$

$$17 X_1 + 25 X_2 + 60 X_3 + 45 X_4 = 35.0$$

$$2 X_1 + 5 X_2 + 7 X_3 + 0.5 X_4 = 1.5$$

$$X_1 + X_2 + X_3 + X_4 = 1.0$$

In this problem artificial slack variables X_7 , X_8 , and X_9 are added. In order to attempt to obtain a solution to the problem as stated, however, a large negative C_j is assigned to these three variables. If a solution exists to the problem as stated, X_7 , X_8 , and X_9 will not be in the optimum basis.

This problem, as entered in the computer, is the same as problem (2) except that for the basic activities, $C_j = 0.0$ is replaced by

$$C_j = -999.999.$$

- B. The LP20 Linear Programming System consists of a number of semi-independent routines. These are briefly described below:

LP20-1, Data Loader

This program can be used to load either of two types of data input, internal floating point format for decks previously punched by LP20-7, Matrix Punch for Restart, or row-column data prepared on a key punch. In the first case, the entire matrix is loaded. In the second case, the matrix area is first cleared and then only nonzero elements are floated and stored in specified cells.

LP20-2, Shadow Price

This program floats the C_j associated with both basic and nonbasic activities, computes the $Z_j - C_j$ row including the value of the functional for the initial basic solution.

LP20-3, Dual

This program tests to see if the basic solution is feasible. If it is not feasible, the Dual Algorithm is used to remove infeasibilities, if this is possible. If it is already feasible, the next program, LP20-4, is loaded.

LP20-4, Simplex

This program uses the simplex method to obtain an optimum solution, if it exists. The dual and simplex programs were compiled in such a way that the matrix transformation subprogram and floating point subroutines are stored in the same locations. Consequently, these are loaded by LP20-3, and the cards pertaining to these routines are deleted from LP20-4. In effect, LP20-3 and LP20-4 are merged into a single deck in the condensed object program decks. Both programs, on sense switch control, can be halted after any iteration. Also, on sense switch control, the iteration number, value of the functional, and the ID/CJ of the entering and leaving variable are printed after each iteration.

LP20-5A, Solution Print

This program prints, for any basic feasible solution, the value of the functional, the basic solution, and shadow prices ($Z_j - C_j$). For both of the latter cases, it prints the identification of the activity and its associated C_j .

LP20-5B, Solution Punch

This program is the same as LP20-5A, except that the information is punched in a format suitable for 80 x 80 listing.

LP20-6, Matrix Punch or Print

This program punches for 80 x 80 listing or prints the entire matrix in explicit decimal format. It can be used to check the initial data input or to print or punch the matrix after any iteration.

LP20-7, Matrix Punch for Restart

This program punches the matrix in floating point format for reloading by LP20-1.

LP20-8, Solution Test

This program is designed to check the accuracy of a solution by substituting the values of the basic variables into the original equations and comparing the results with the original b's. It must be used in conjunction with LP20-1 and the original data deck supplemented with data cards that cause the solution values to be loaded into row zero and column (-2), the working column. If a variable in the solution was originally a basic variable, its level is entered in the corresponding row of column (-2). If a variable was originally a nonbasic variable, its level is entered in the corresponding column of row (0). After loading the augmented data by LP20-1, the entries in column (-2) are subtracted from the corresponding entries in column (0). Then the vectors with positive levels are multiplied by their associated levels and the resulting scalar products subtracted from b, column (0). The result should be that, except for truncation error, b should be null. This can be checked by using LP20-5A or B to print the solution.

LP20-9, Parametric Solution

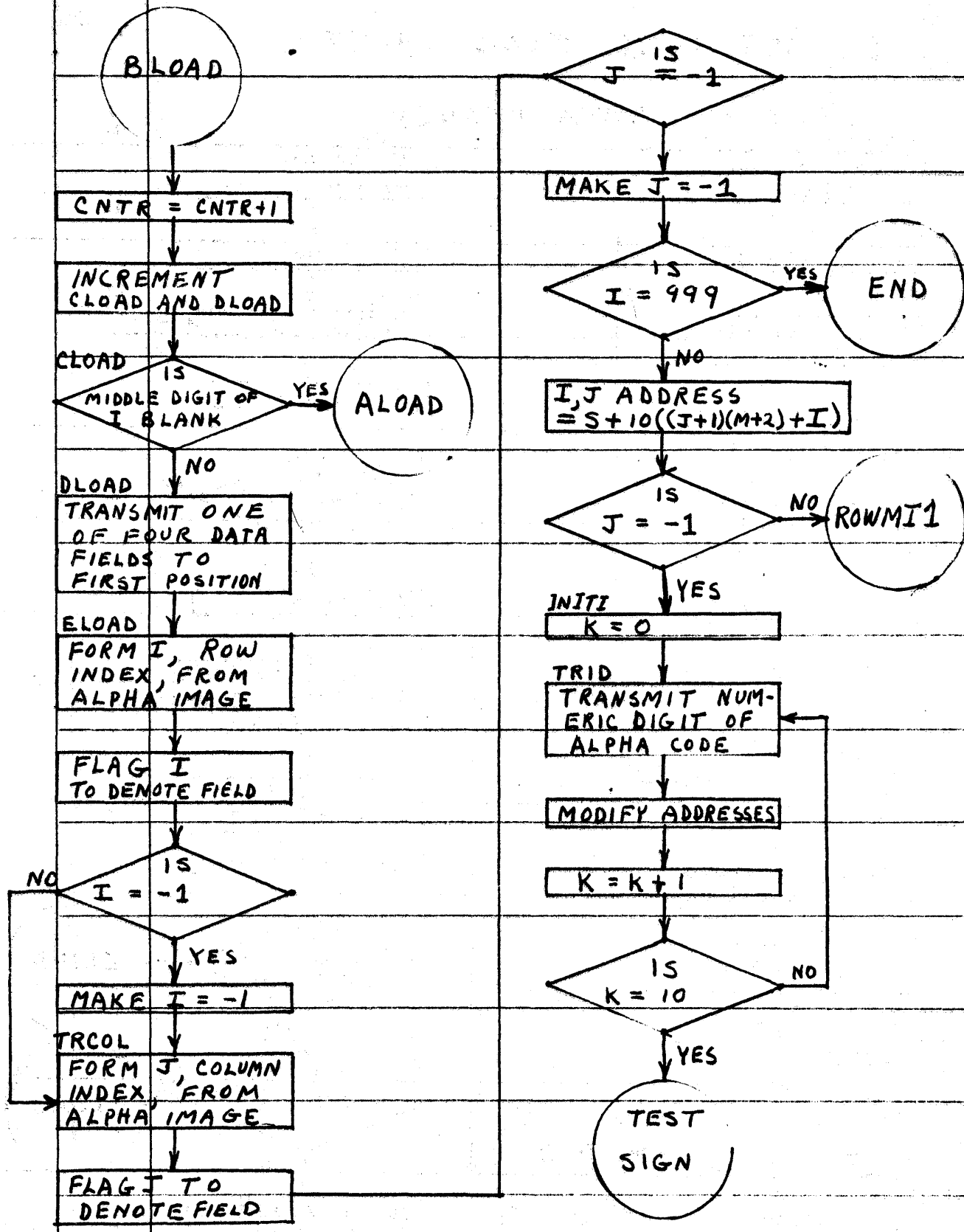
This program is used to add or subtract the largest multiple of a specified nonbasic vector to an optimum basic feasible solution such that one of the elements of the modified b is exactly zero.

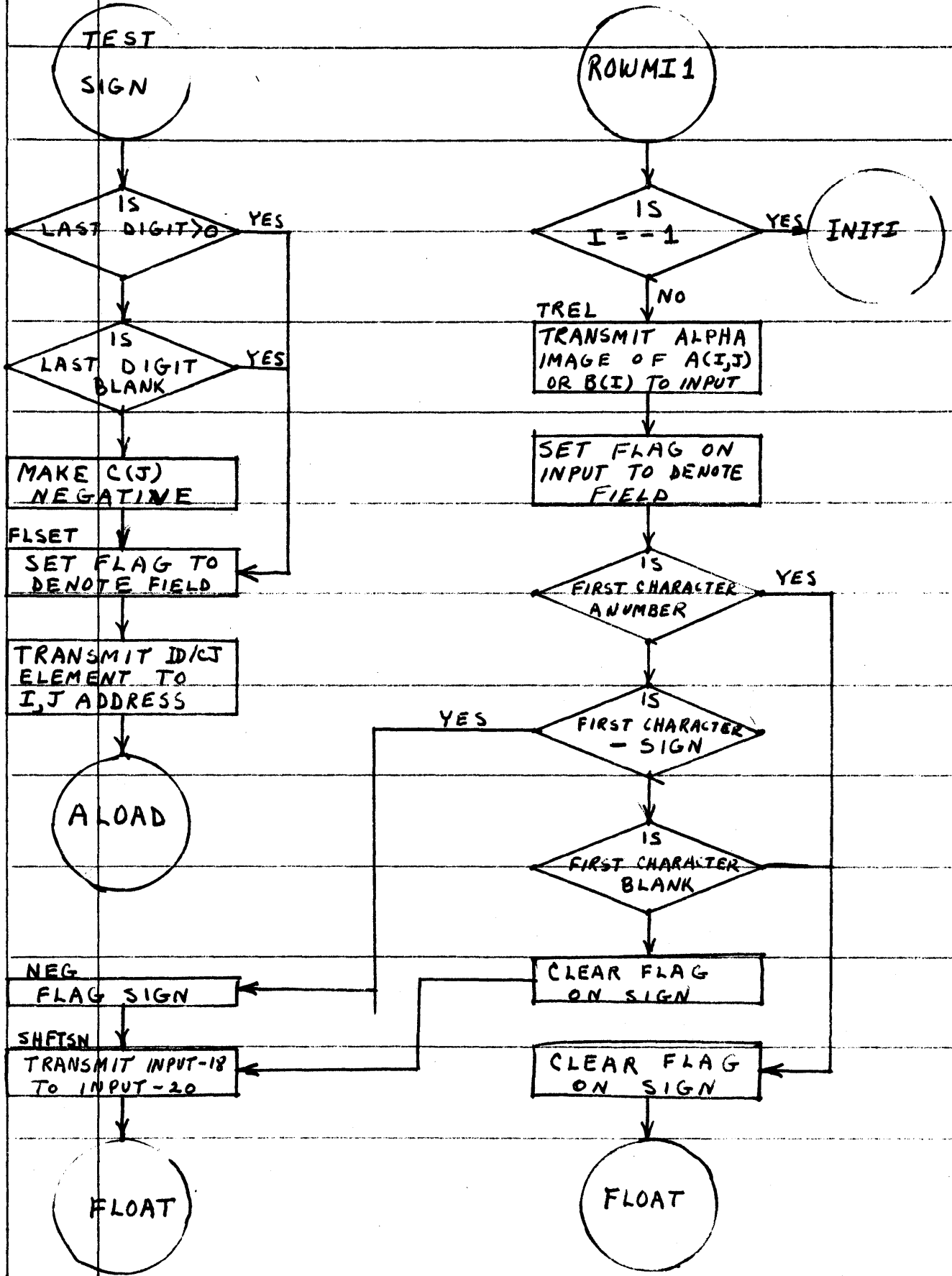
If it is planned to use parametric programming with a vector not occurring naturally in the original problem, the vector should be added to the original problem with an associated C_j such that it will not appear in the optimum solution. The program prints the value of k , the multiplier of the specified vector added to b .

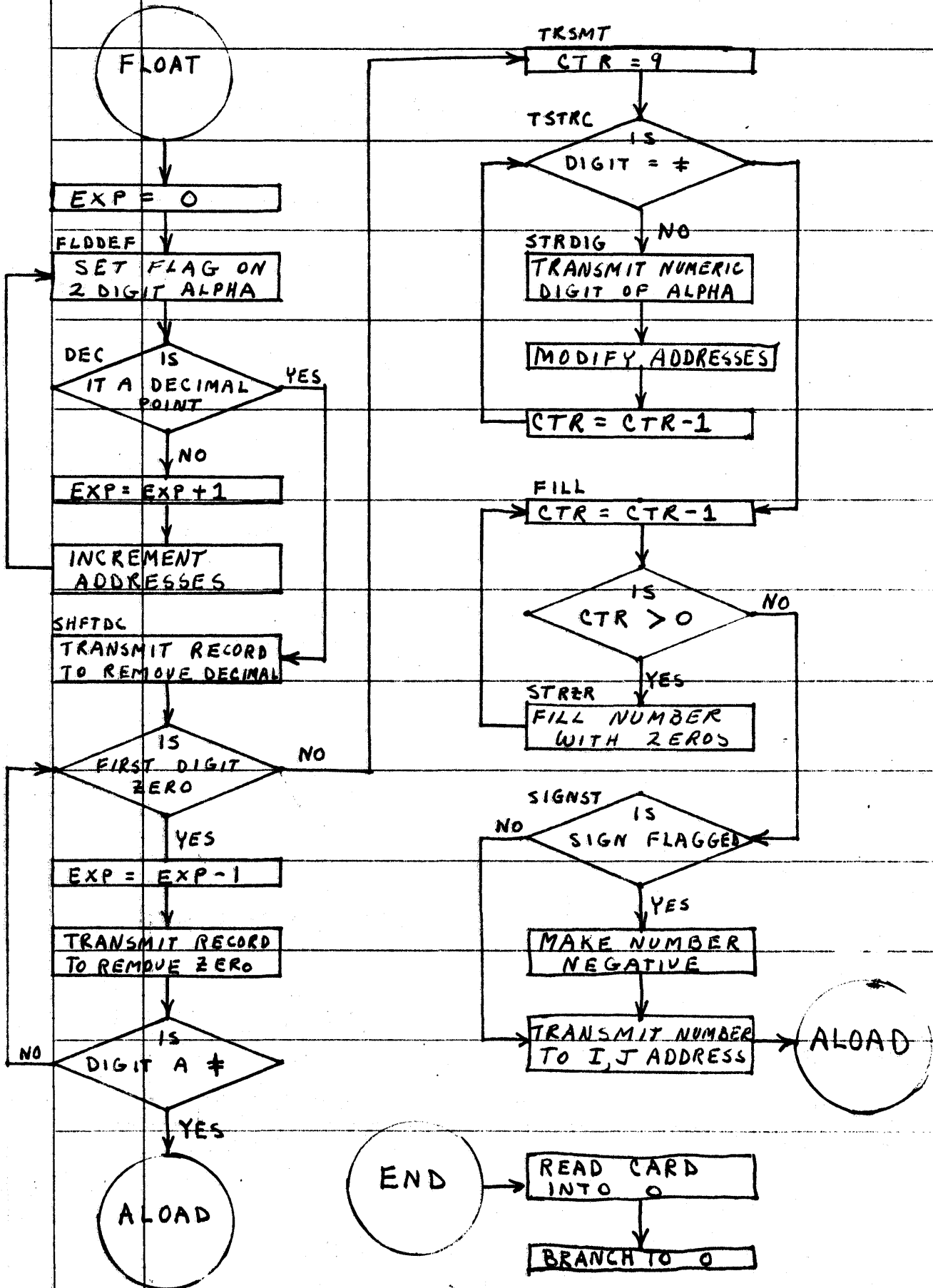
LP20-10, Parametric Dual

This program is essentially similar to LP20-3, except that it has been modified to select an activity at the zero level to delete from the basis rather than one at a negative level. It is also modified to do just one iteration. LP20-9 and 10 are designed to be operated in sequence as many times as desired.

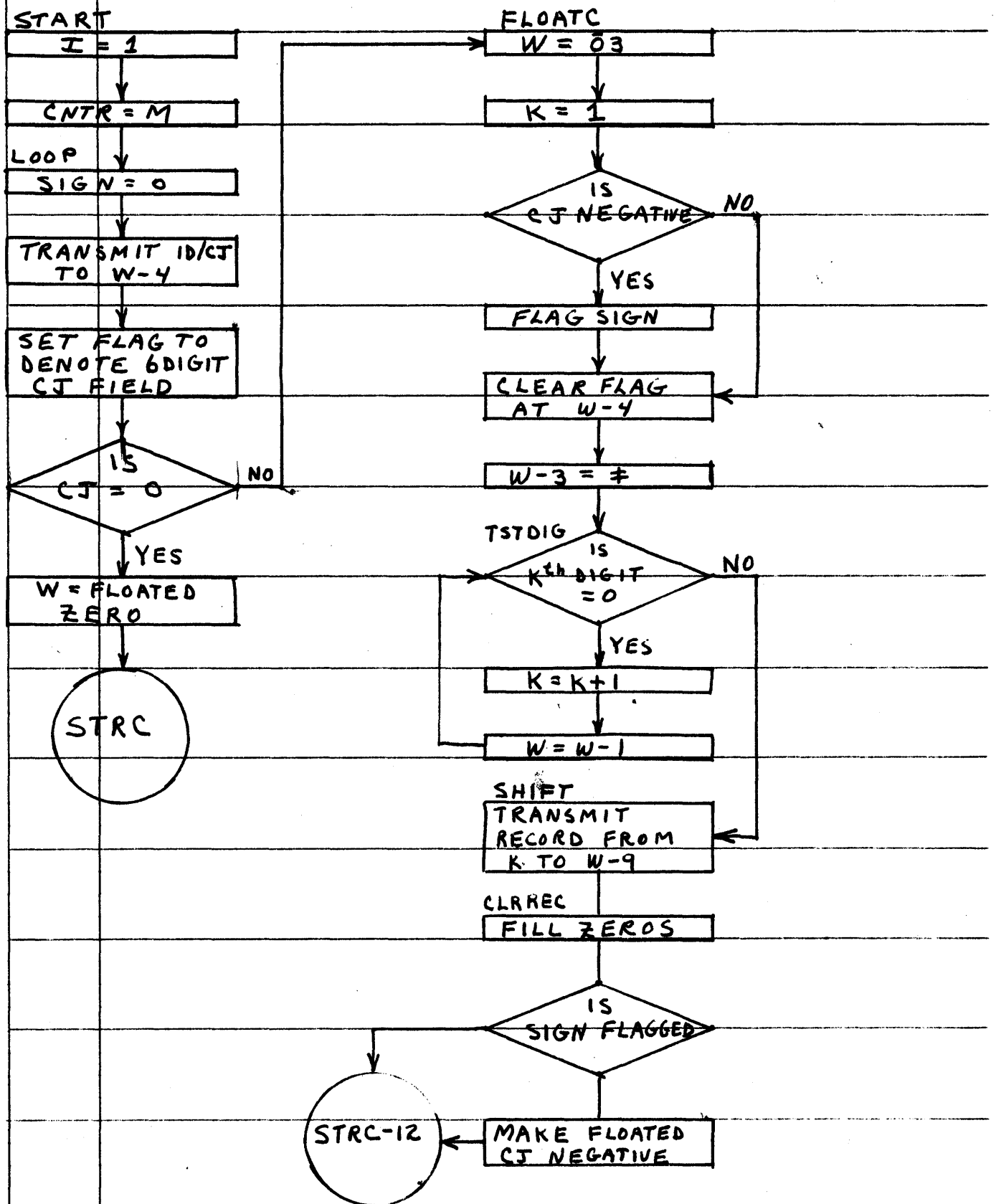








LP20-2, SHADOW PRICE



STRC-12

SET FLAG ON W-9 TO DENOTE FIELD

STRC STORE FLOATED BASIC C(I)

CNTR = CNTR - 1

IS CNTR = 0

NO LOOP

OUT2 REPEAT CNTR=N, FLOAT AND STORE NON-BASIC -C(J)

CALC DJ NCNTR = N

ZRFNCT FUNCTIONAL = 0

J = 0

LOOP2 MCNTR = M

I = 1

DJ LOOP $Z_j - C_j = D_j = D_j + C_i A_{ij}$

BRANCH TO 0

END READ CARD INTO 0

WRITE ITERATION HEADINGS

IS SWITCH 3 ON

IS NCNTR < 0

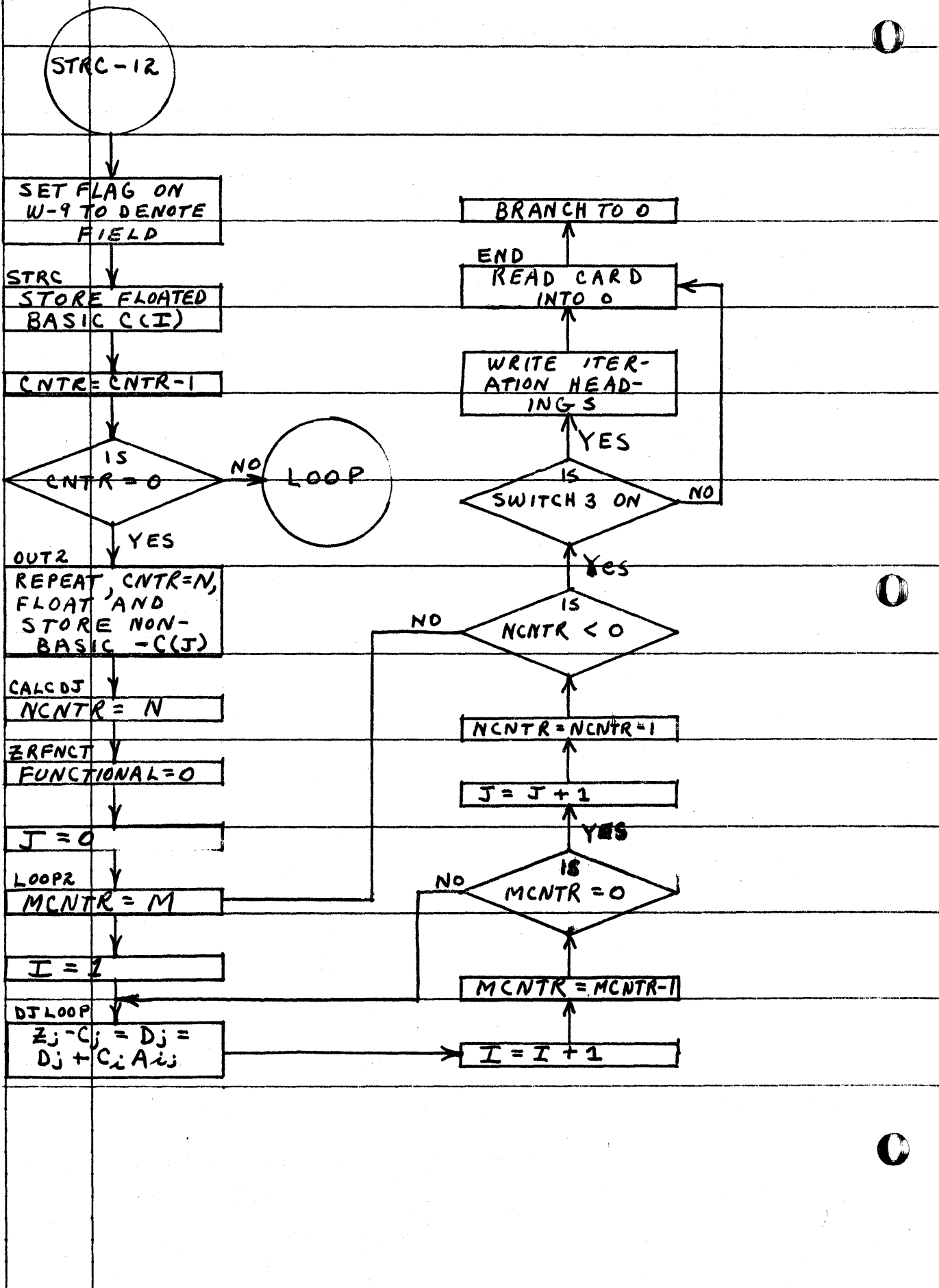
NCNTR = NCNTR - 1

J = J + 1

IS MCNTR = 0

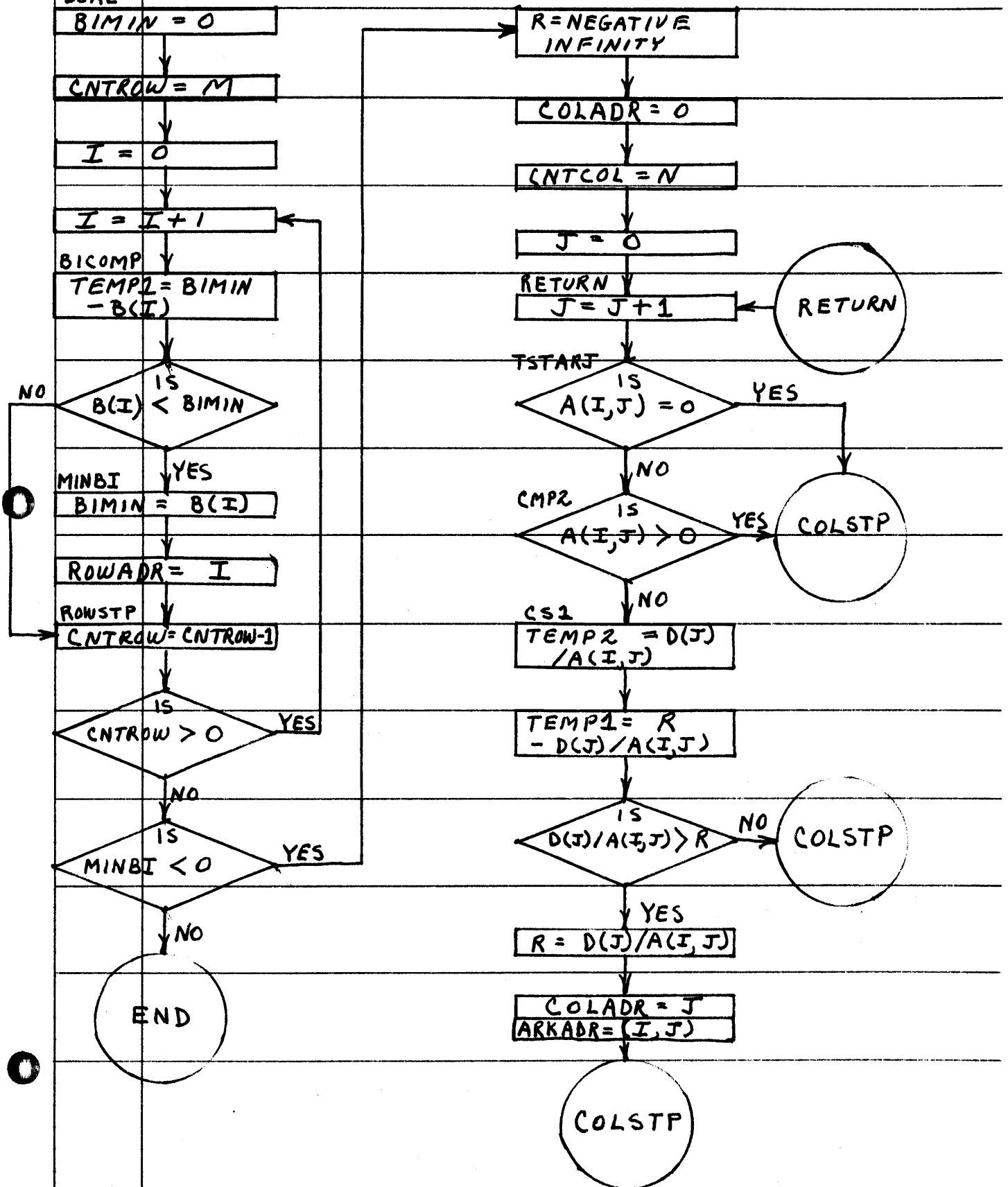
MCNTR = MCNTR - 1

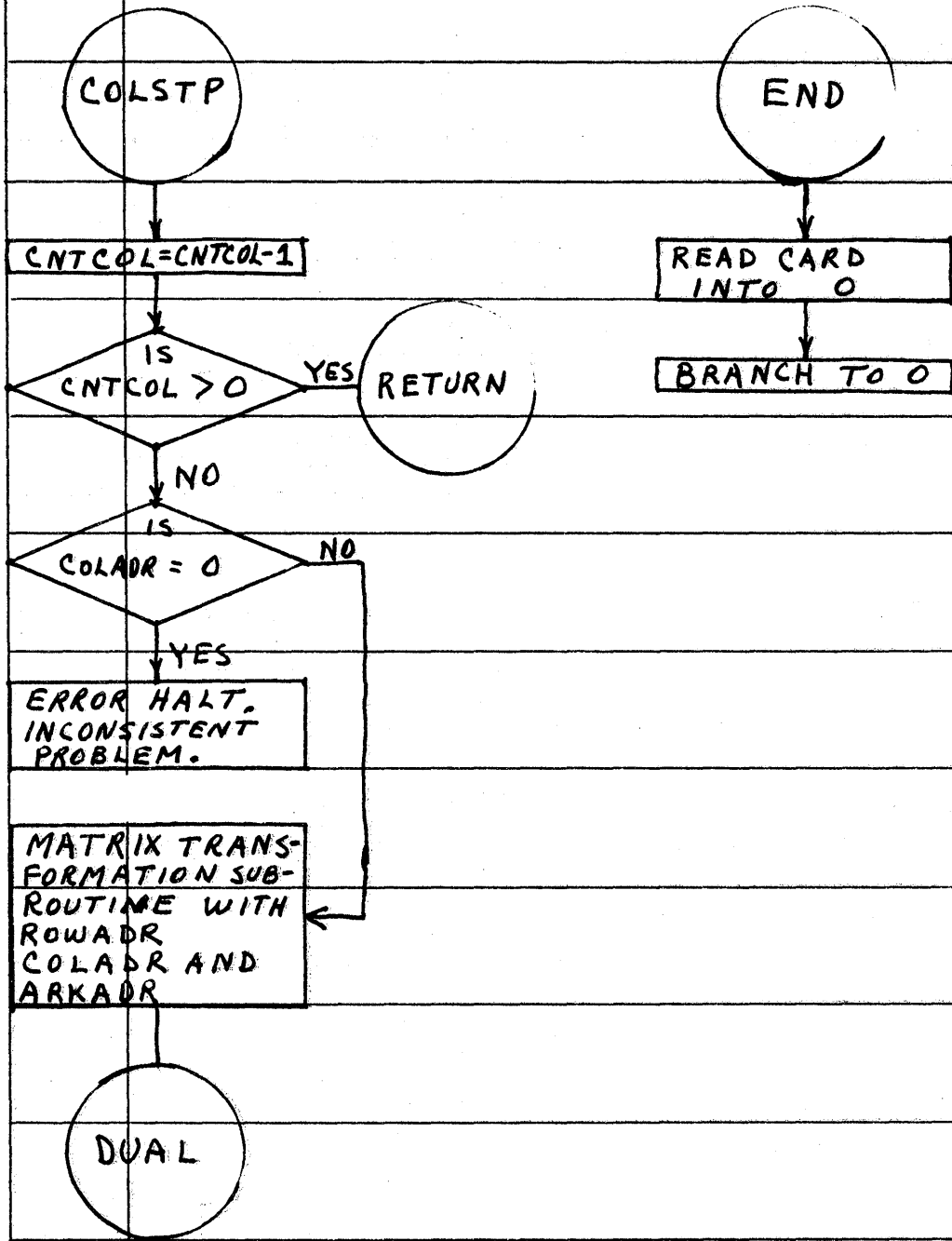
I = I + 1



LP 20-3, DUAL

DUAL

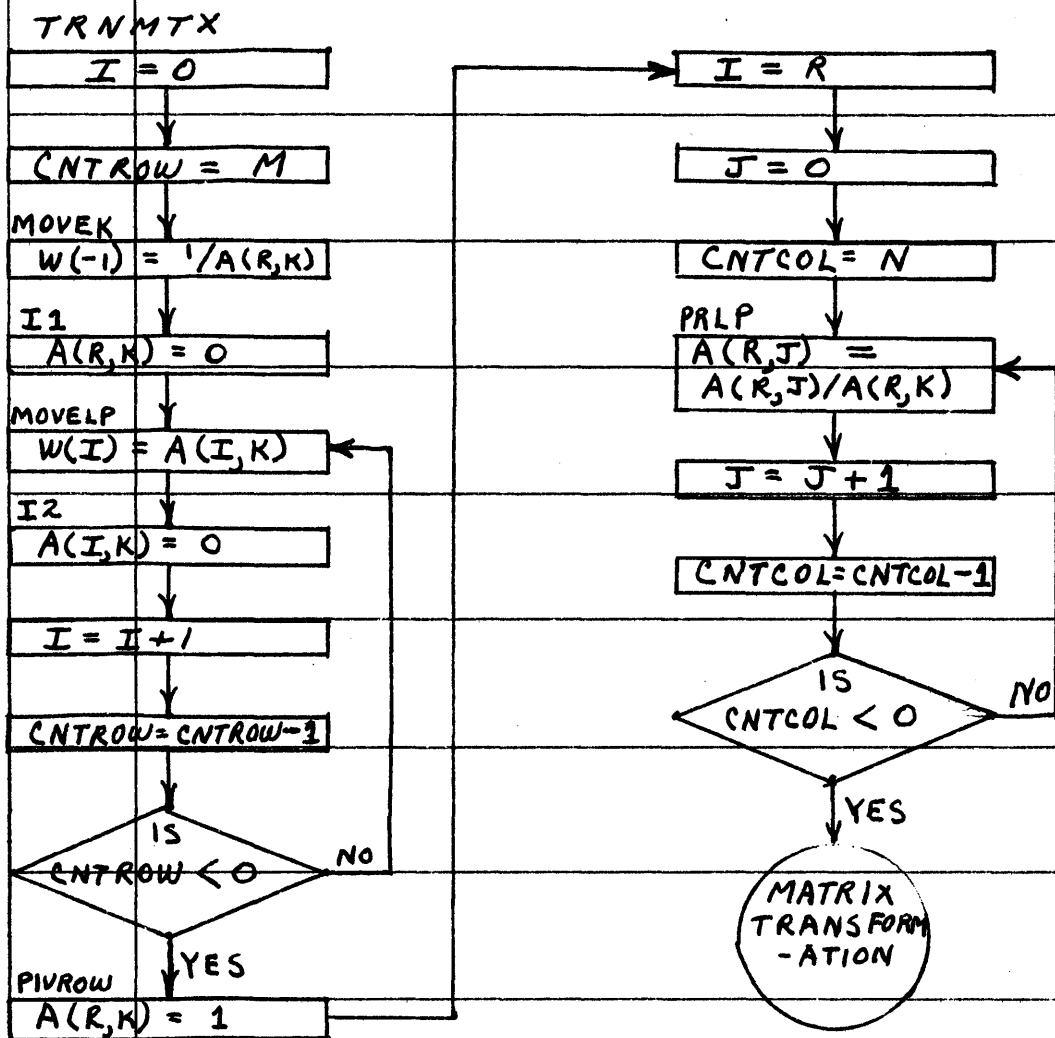


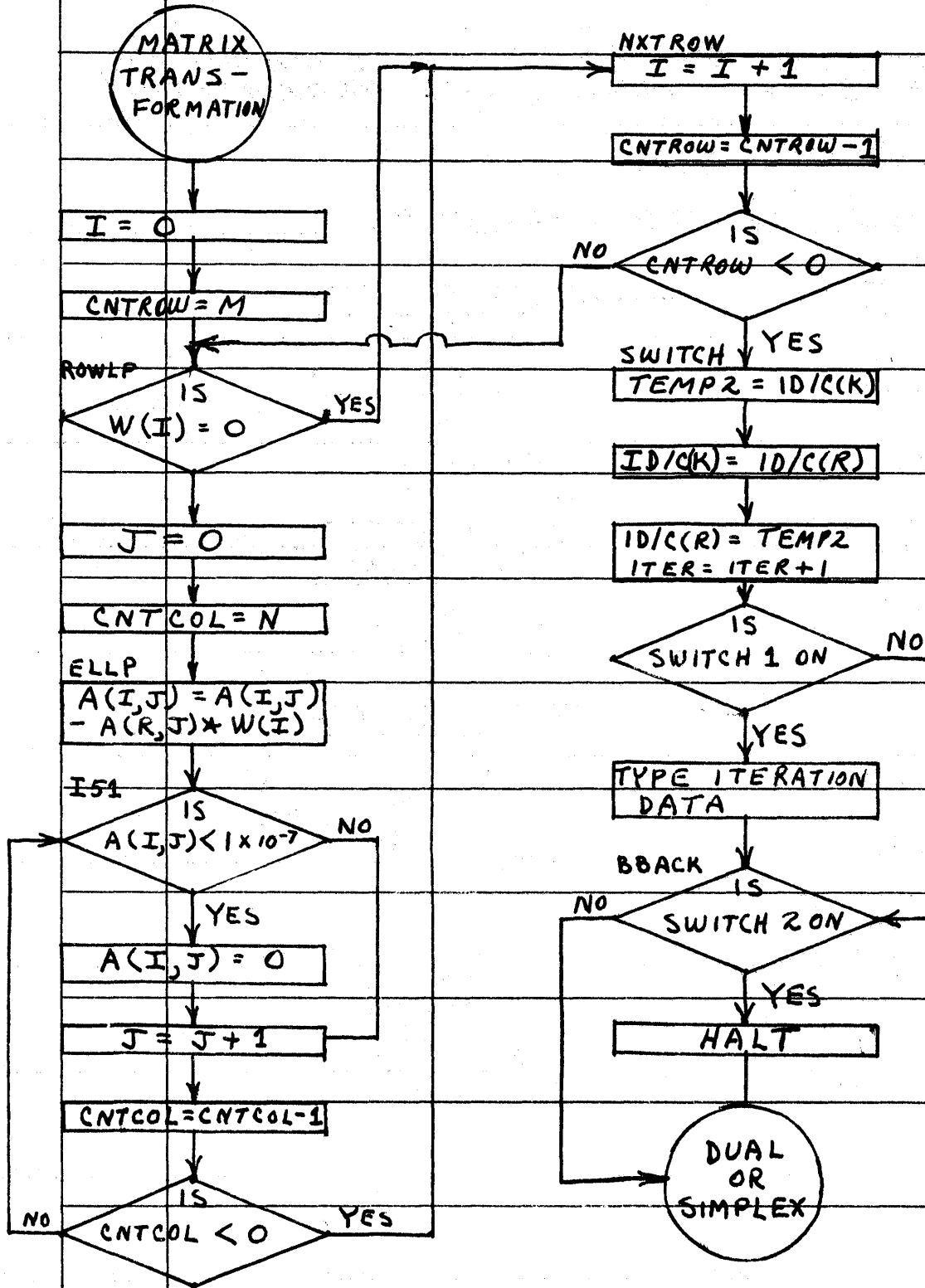


MATRIX TRANSFORMATION SUBROUTINE, USED BY DUAL, SIMPLEX, AND PARAMETRIC, DUAL.

R = INDEX OF PIVOT ROW.

K = INDEX OF PIVOT COLUMN.





LP20-4, SIMPLEX

SIMPLX

DJMIN = 0

CNTCOL = N

J = 1

DJCOMP

TEMP1 = D(J) - DJMIN

IS D(J) < DJMIN

MIN
DJMIN = D(J)

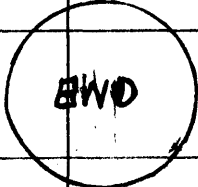
COLADR = J

COLSTP
J = J + 1

CNTCOL = CNTCOL - 1

IS CNTCOL > 0

IS DJMIN < 0



INITRO

R = INFINITY

ROWADR = 0

I = 0

CNTROW = M

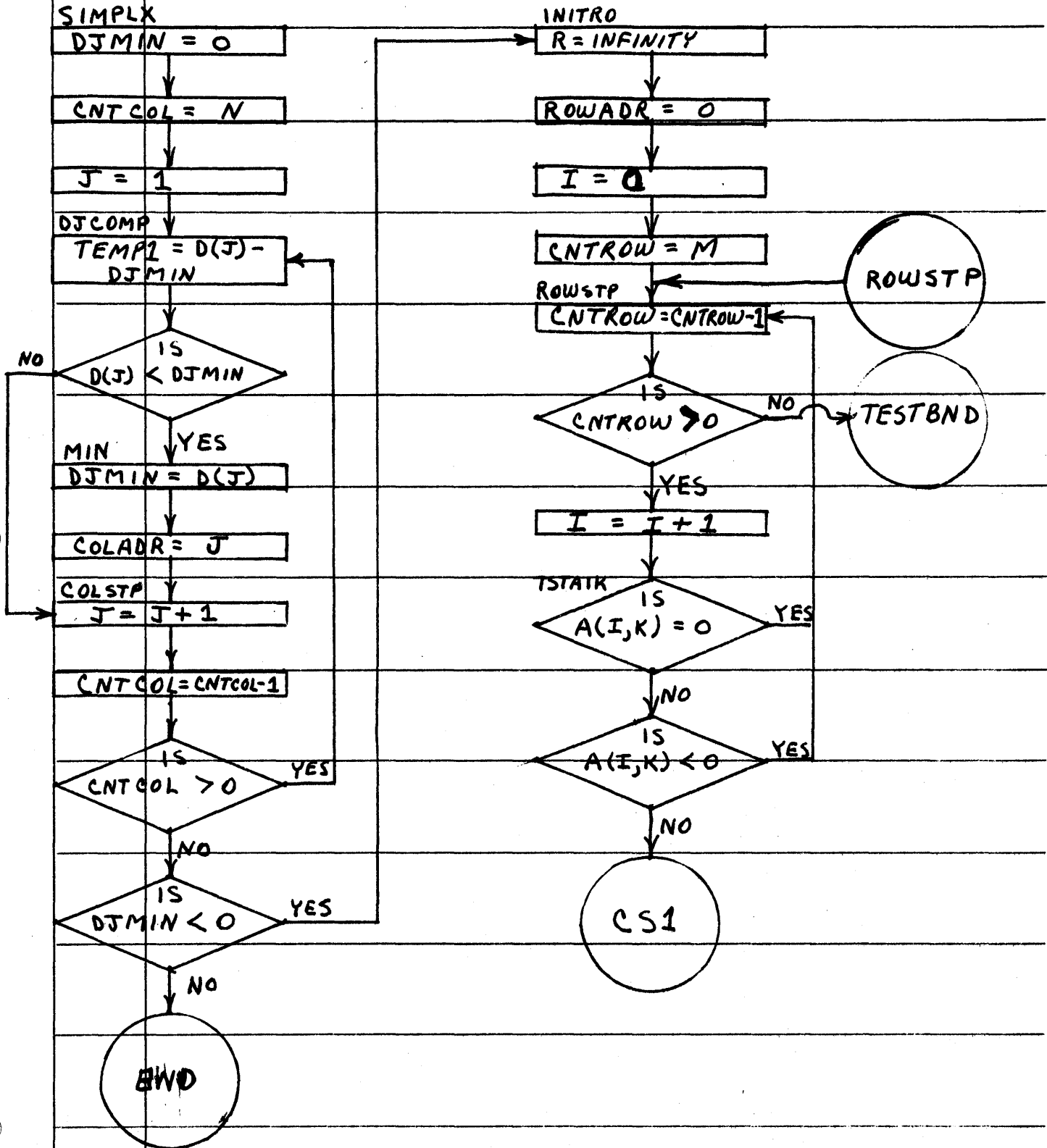
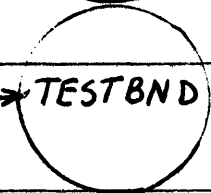
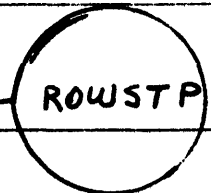
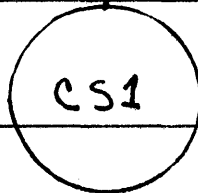
ROWSTP
CNTROW = CNTROW - 1

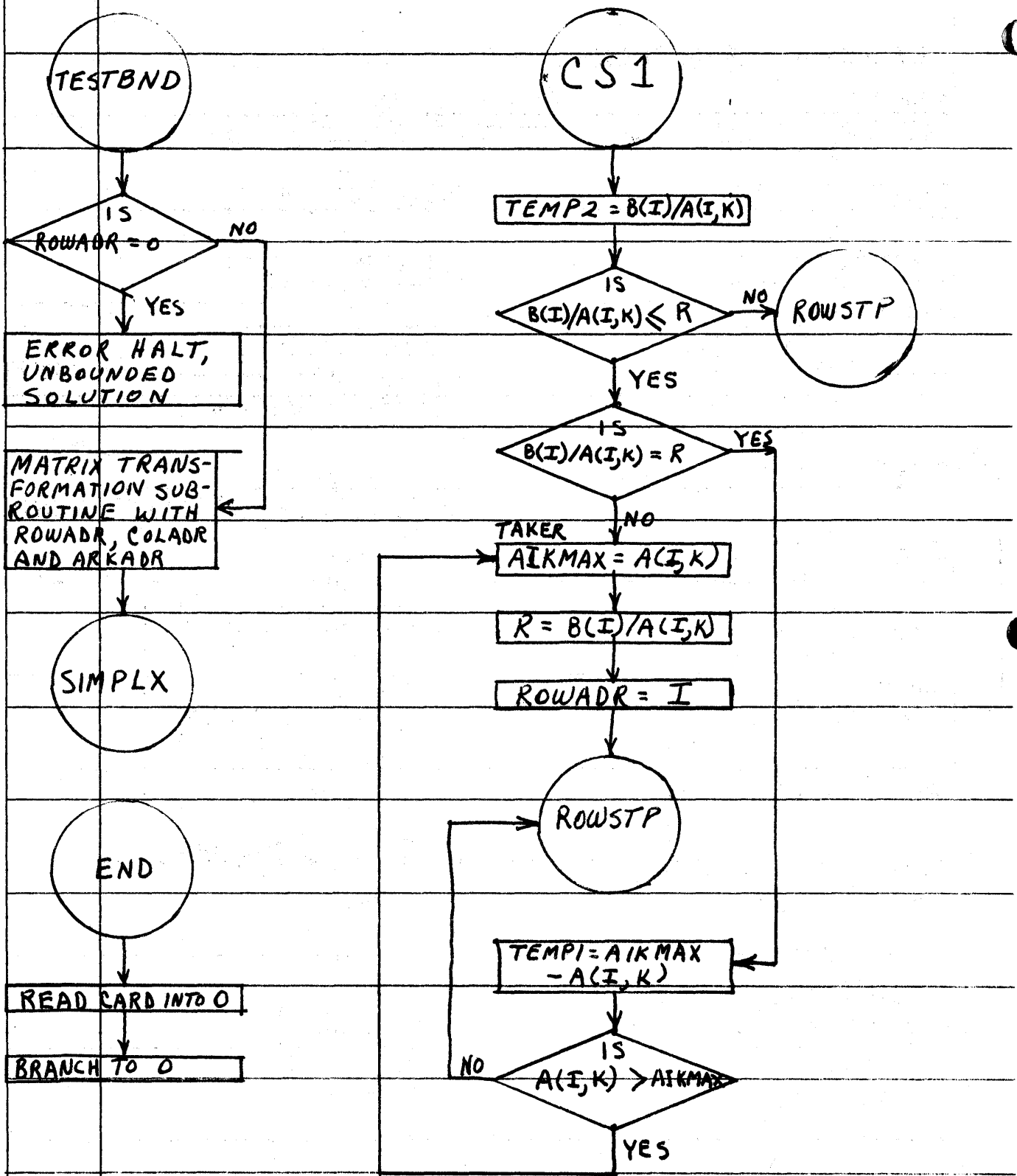
IS CNTROW > 0

I = I + 1

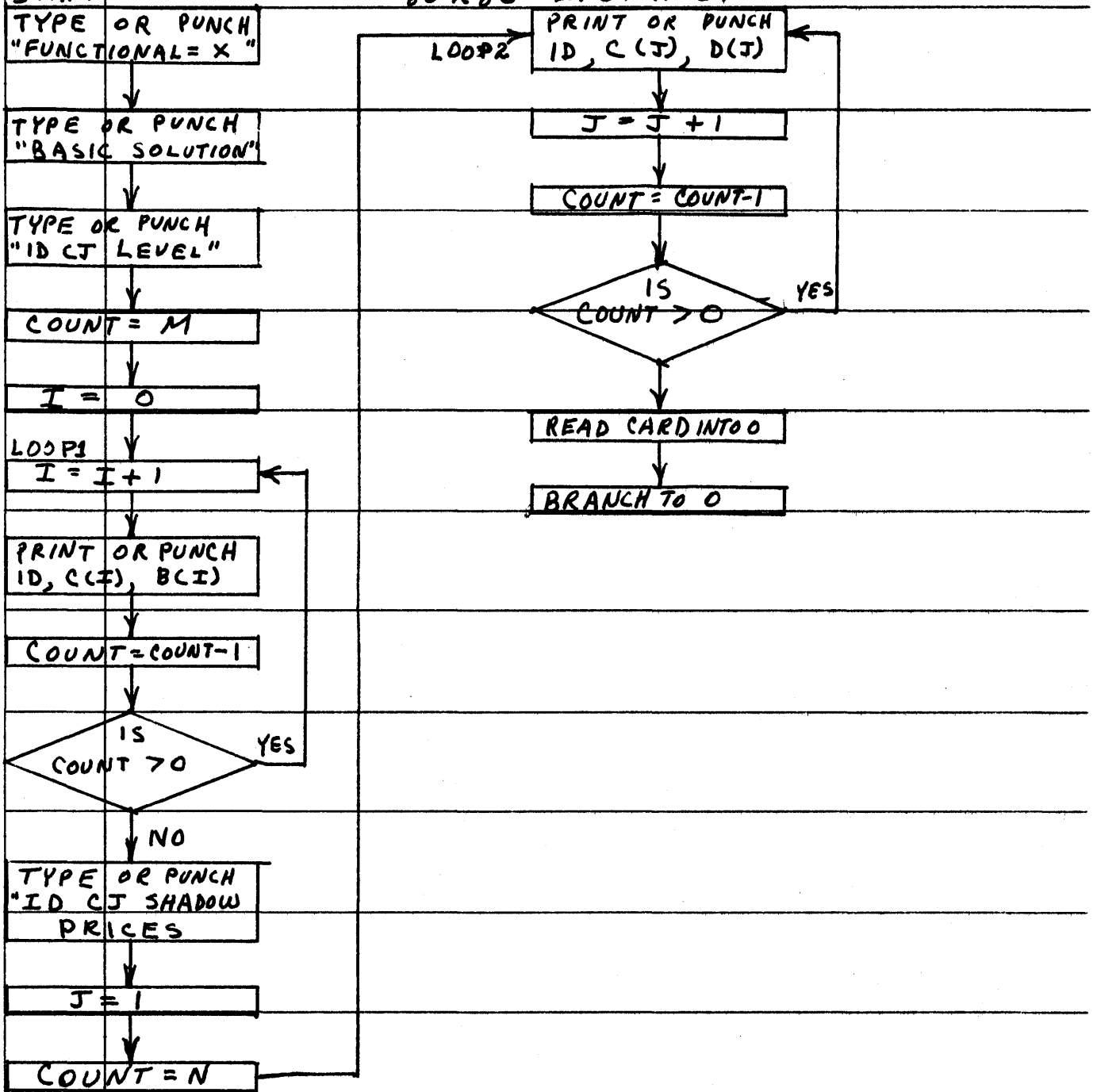
IS A(I,K) = 0

IS A(I,K) < 0



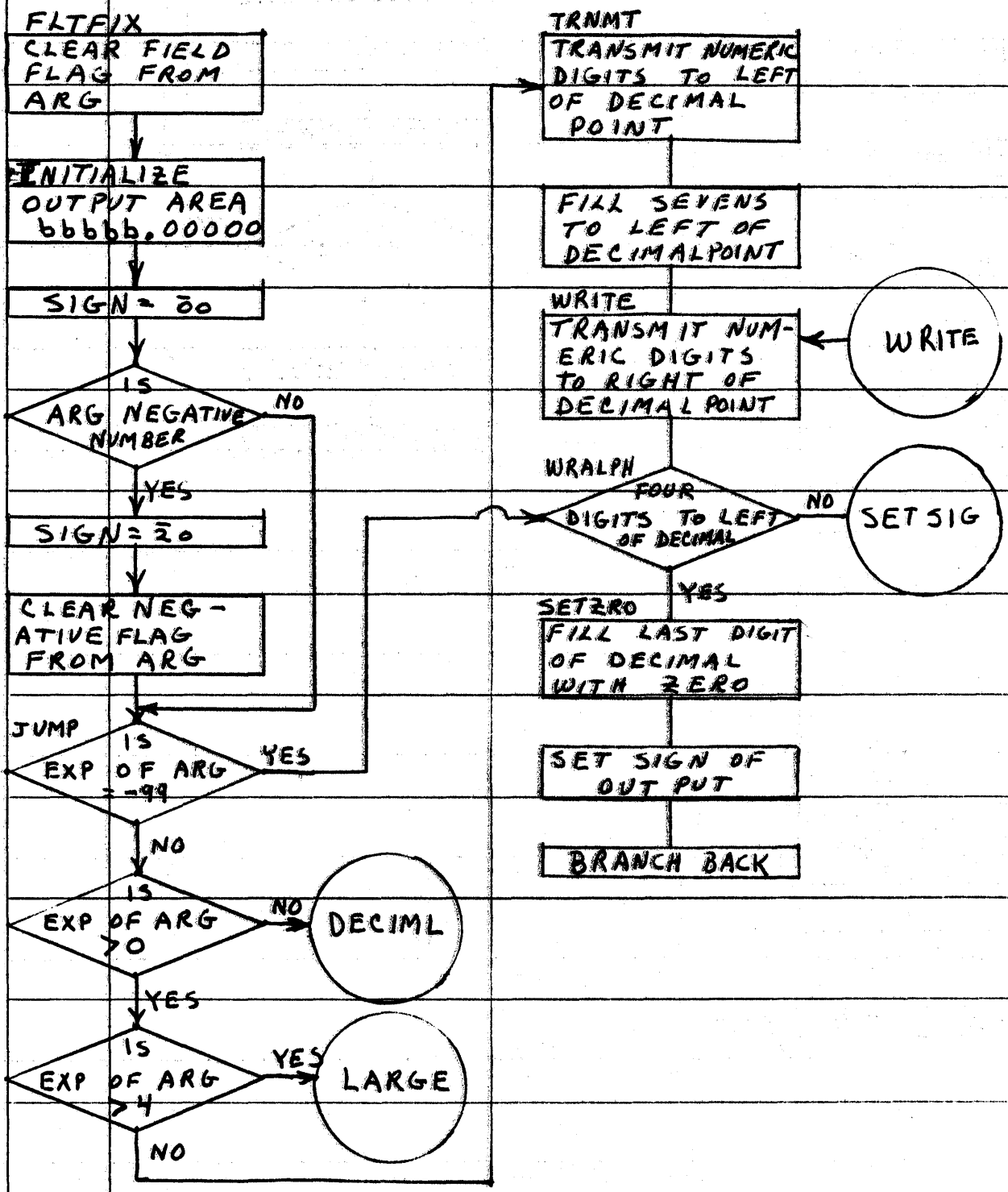


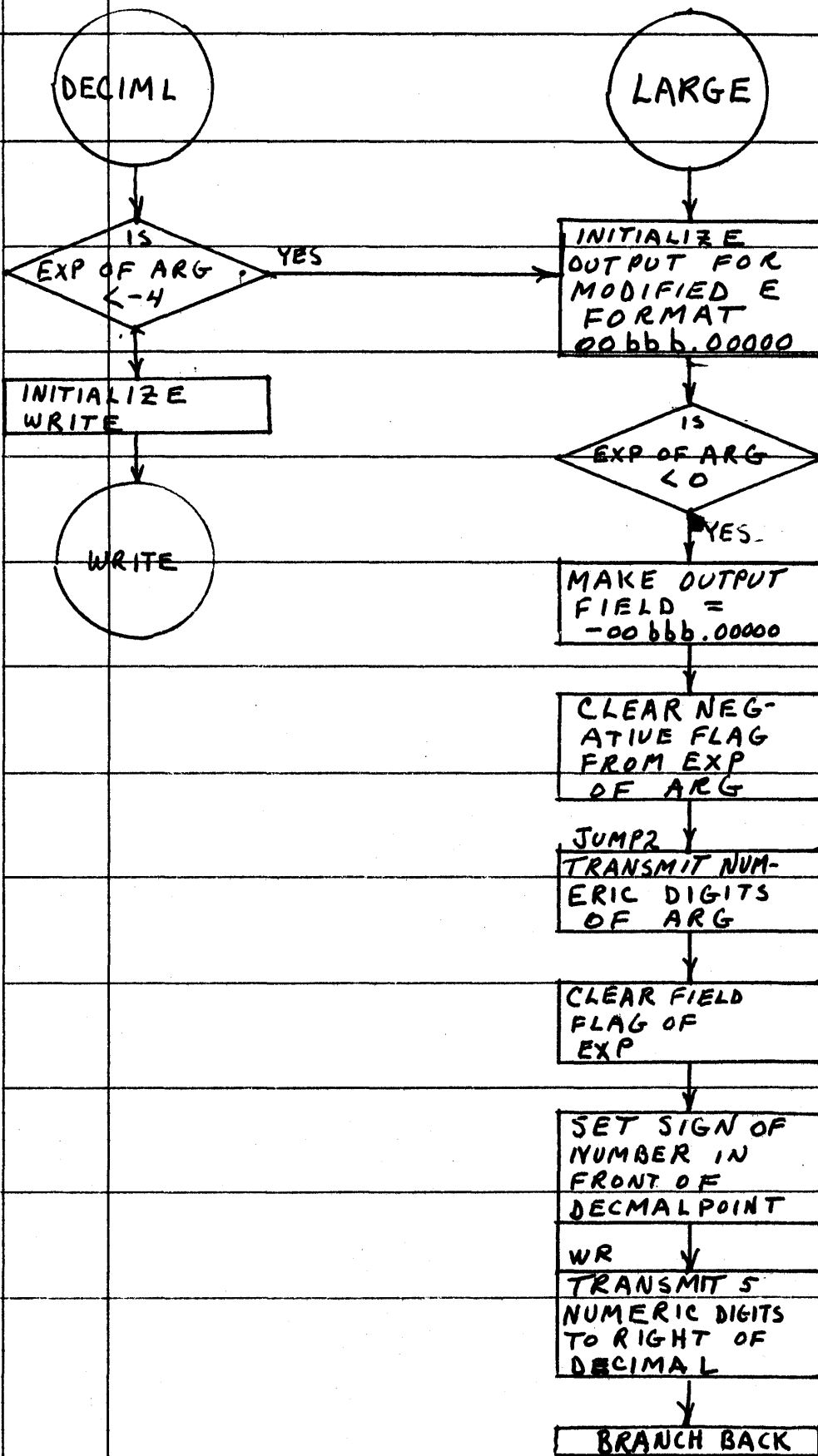
LP20-5A, 5B, 5A TYPES; 5B PUNCHES FOR
START 80 X 80 LISTING.



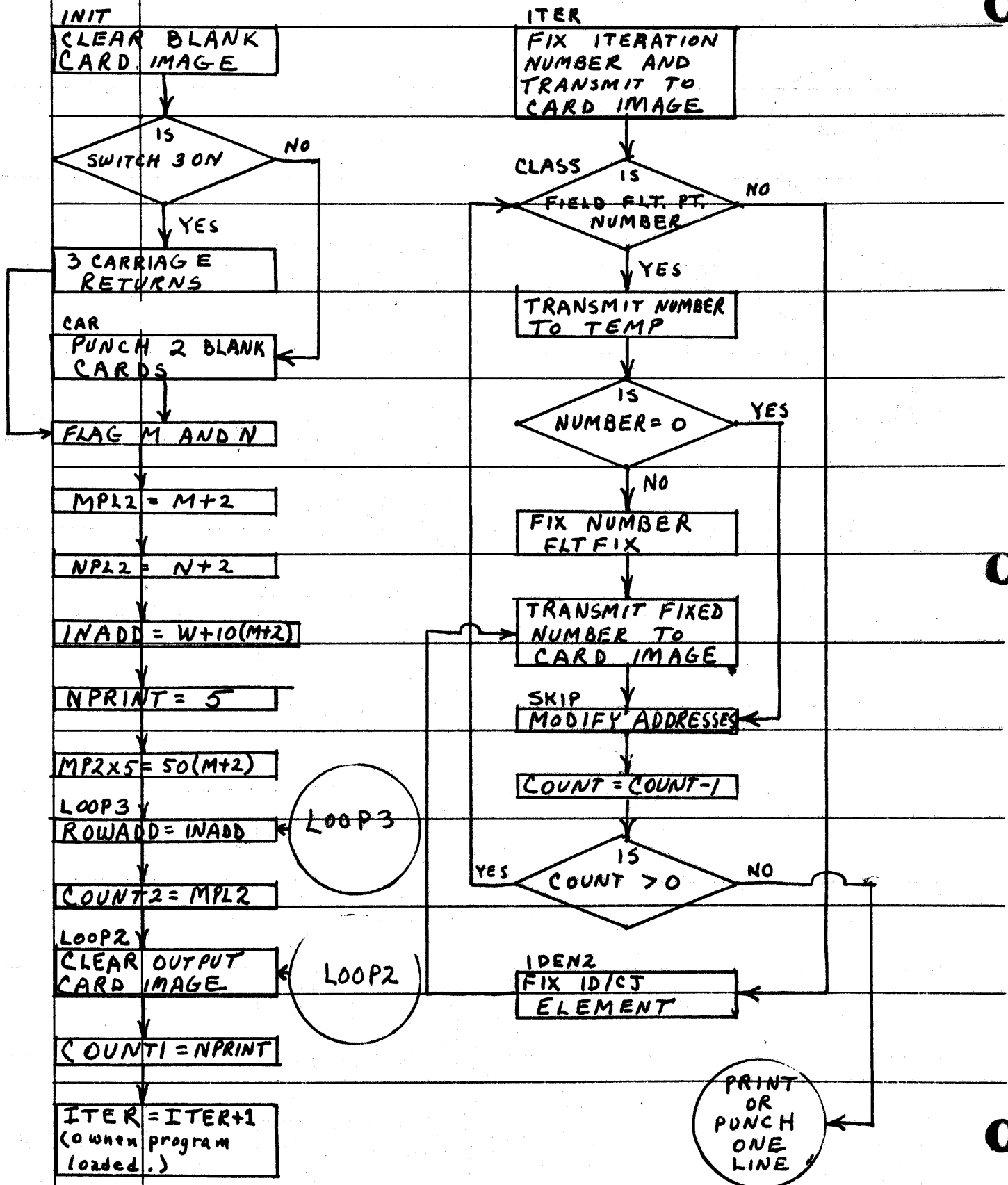
SUBROUTINE FOR FIXING INTERNAL FLOATING POINT NUMBER FOR ALPHAMERICAL PRINTING OR PUNCHING. INTERNAL FORMAT, SPSII. LINKAGE BY BTFS FLTFIX, 99999.

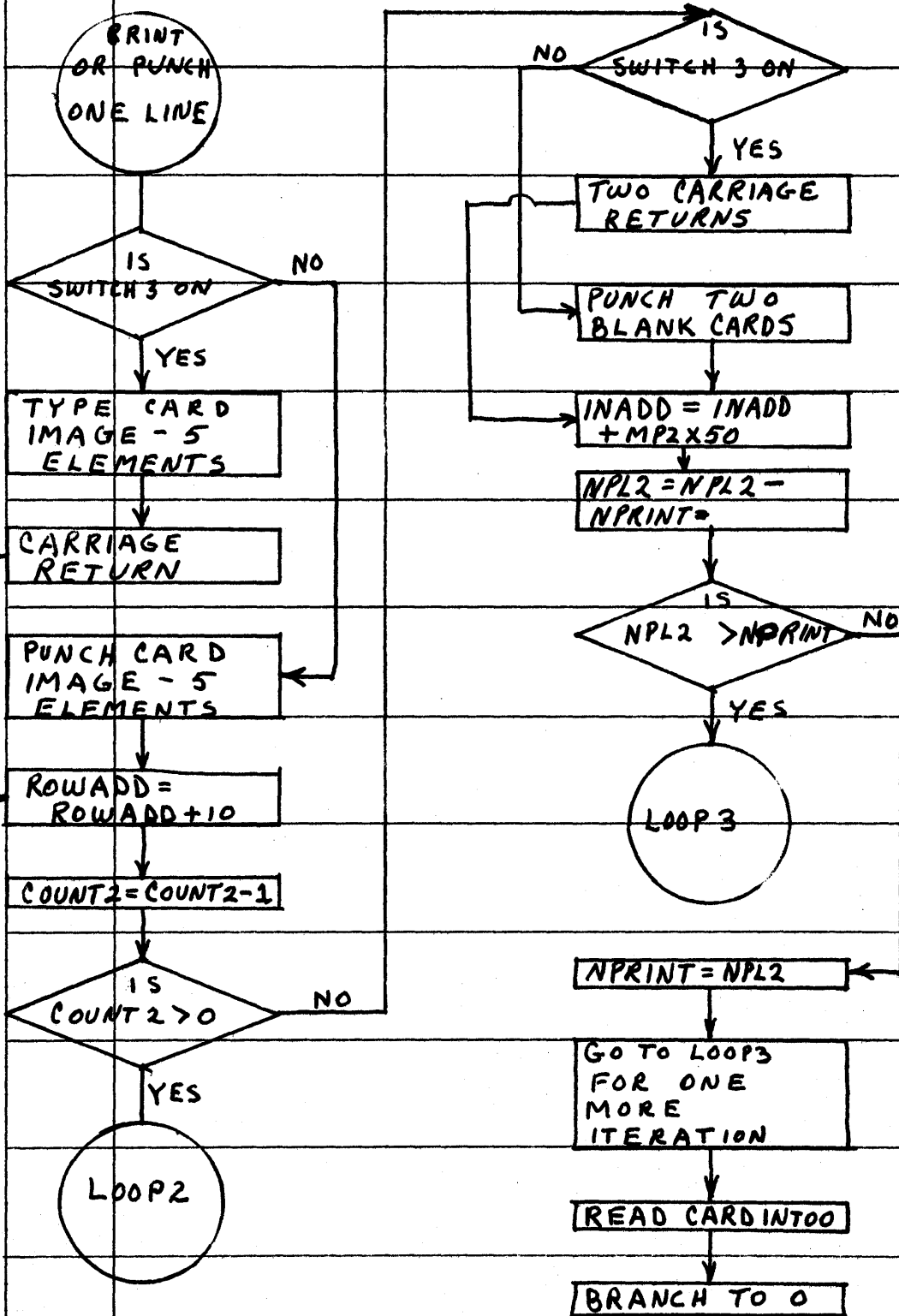
ARG IS FLOATED NUMBER





LP20-6, MATRIX PRINT OR PUNCH





LP20-7, MATRIX PUNCH FOR RESTART

START

FORM = 0
 FLT, PT. FOR-
 MAT

PUNCH PAR-
 AMETER CARD

$(CMP2+11) = S +$
 $10(N+2)(M+2) - 2$

$(CMP+11) = (CMP2+11)$
 $- 70$

ADDRESS =
 $W - 9 + 10(M+2)$

CMP IS
 ADDRESS >
 CMP+11

YES

TRANSMIT ≠
 TO ADDRESS
 $+ 71$

WRITE

PUNCH ONE CARD
 FROM ADDRESS

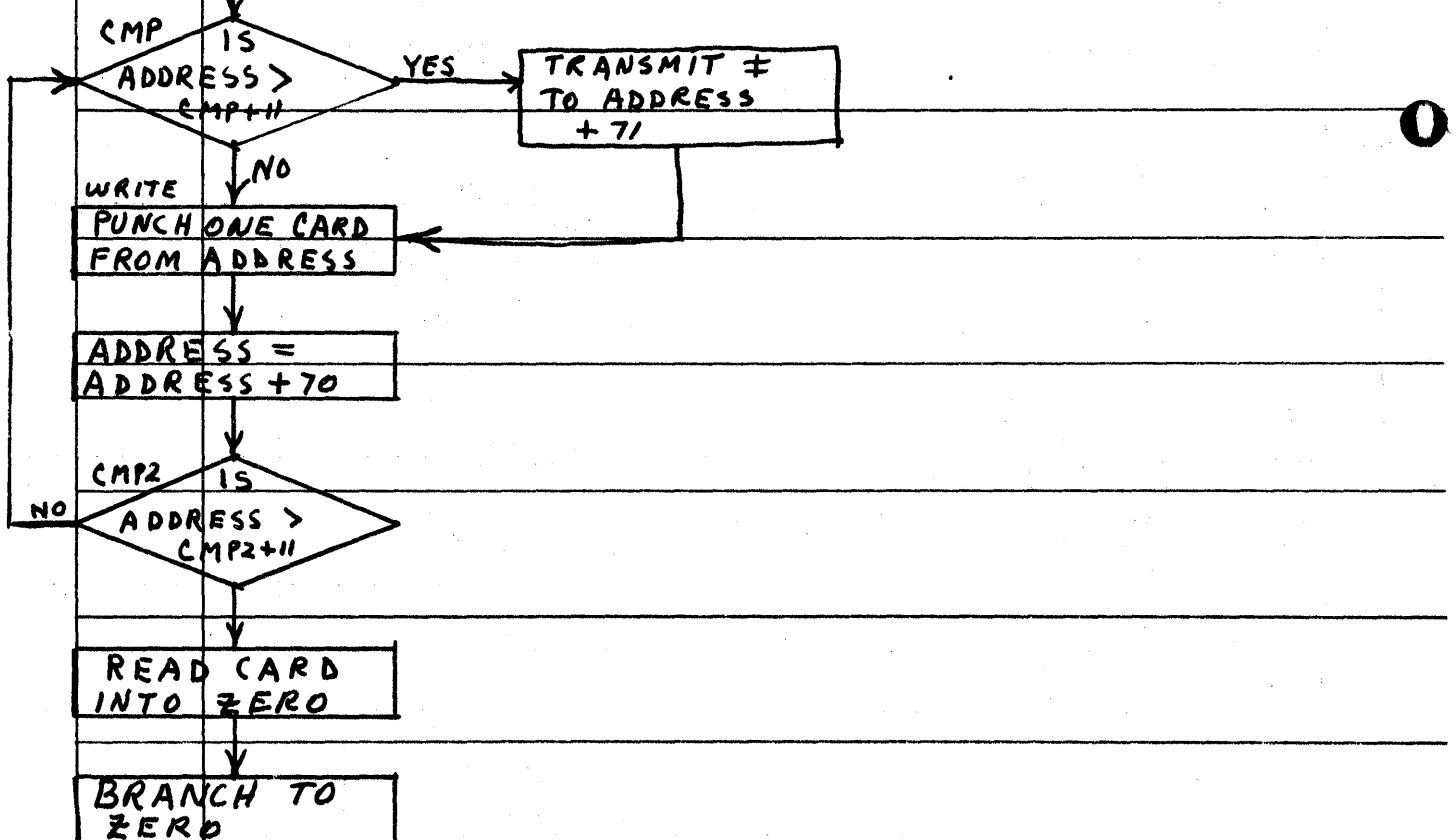
ADDRESS =
 ADDRESS + 70

CMP2 IS
 ADDRESS >
 CMP2+11

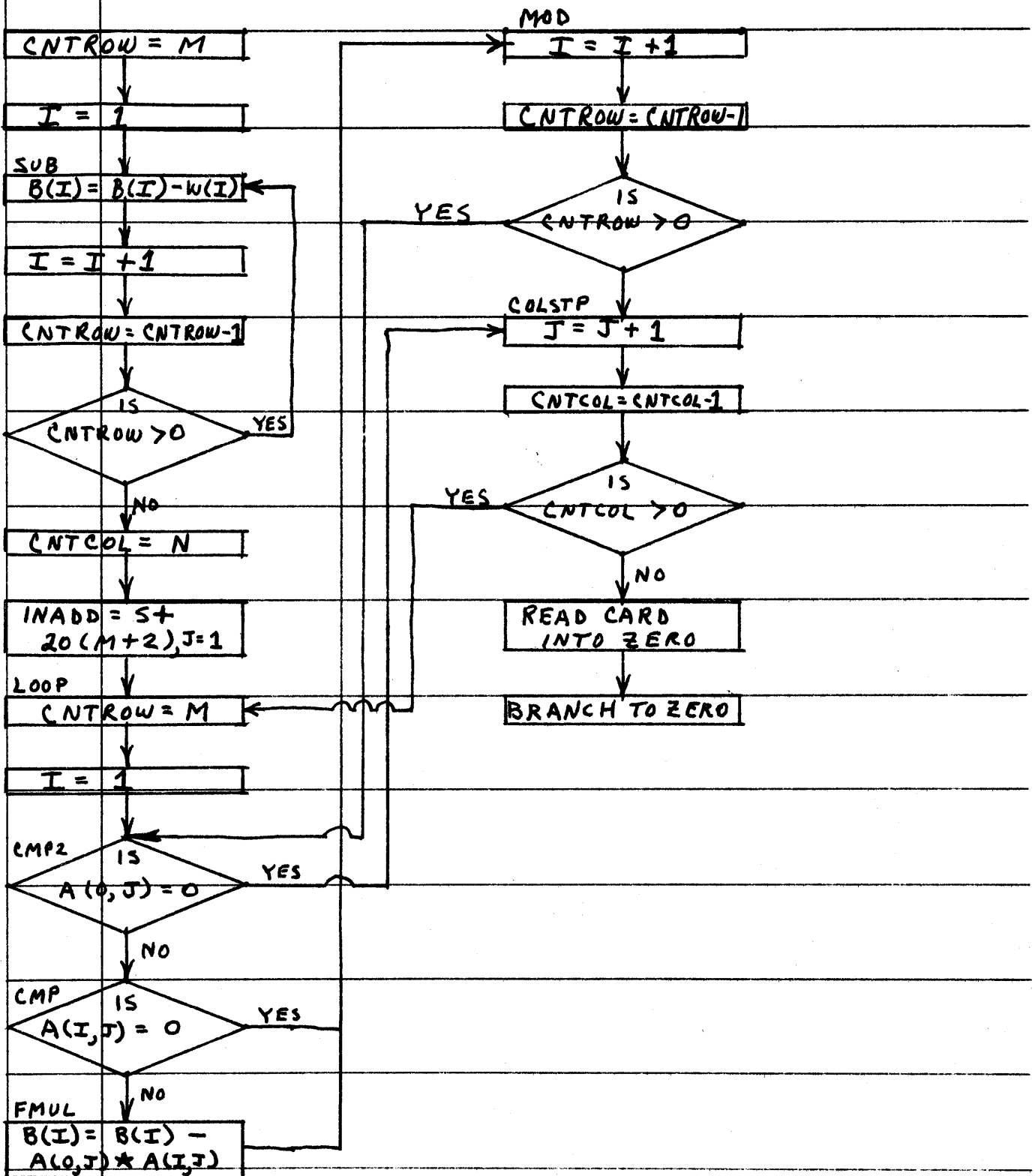
NO

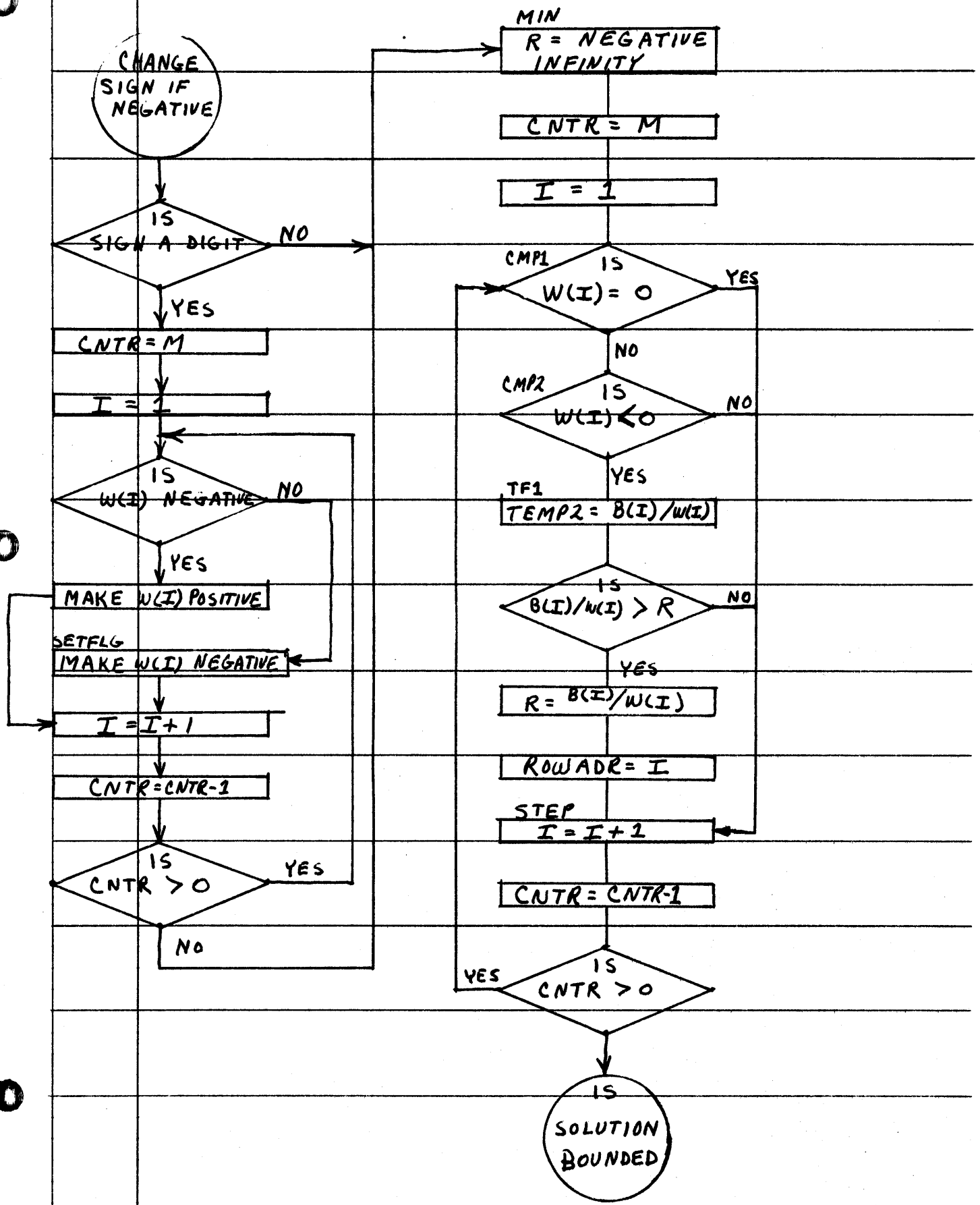
READ CARD
 INTO ZERO

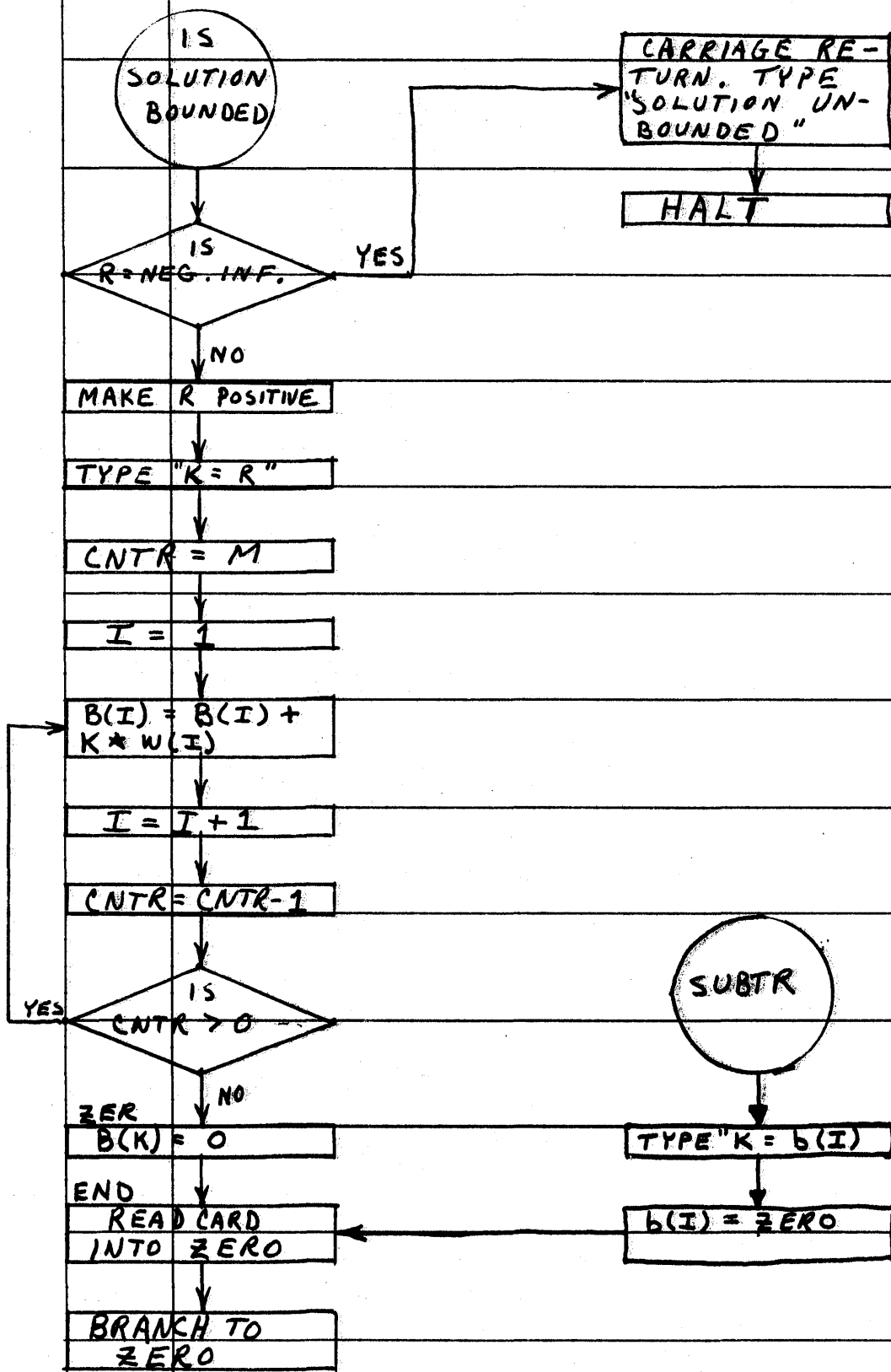
BRANCH TO
 ZERO



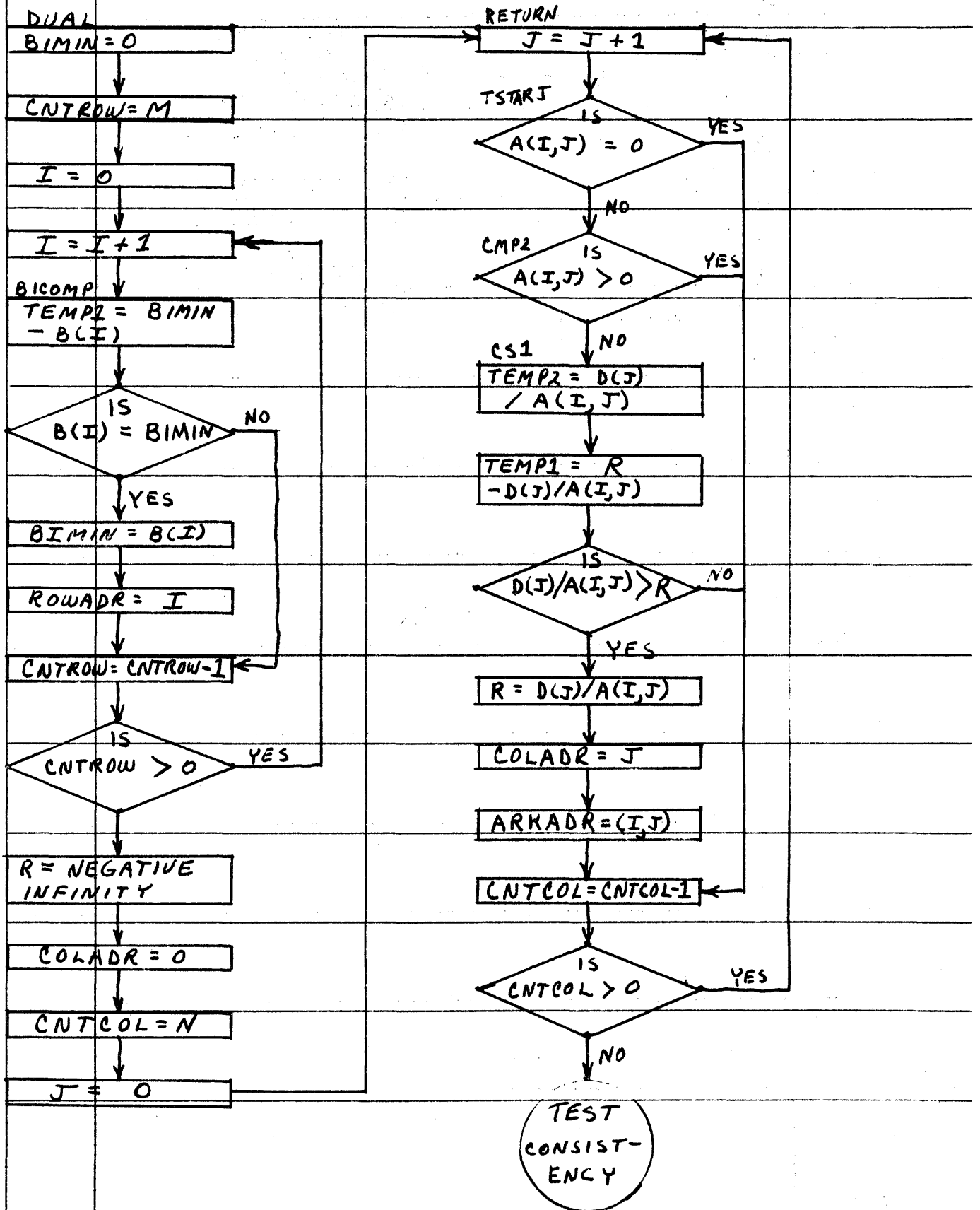
LP20-8, SOLUTION TEST

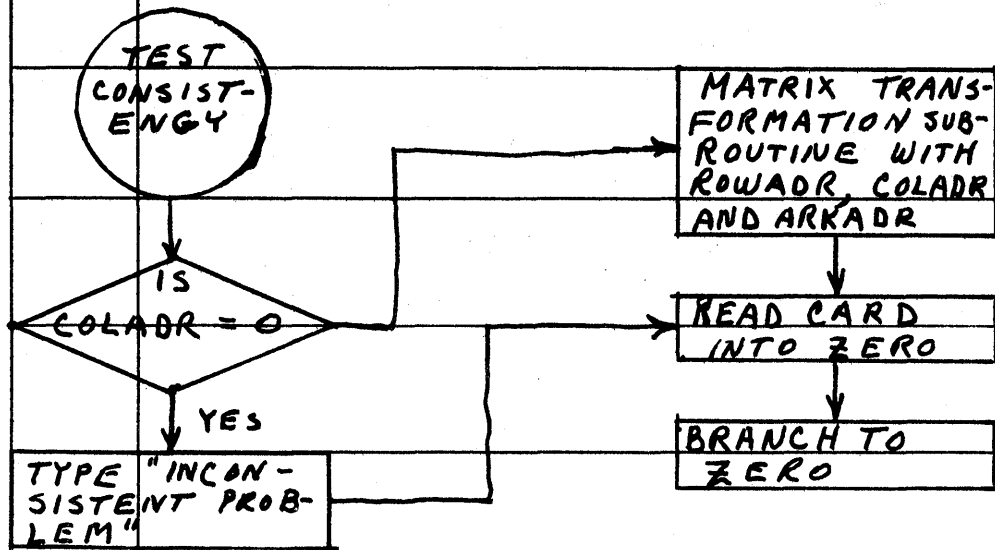






LP20-10, PARAMETRIC DUAL





II. Input-Output Format

A. Input format for data

1. Internal floating point format as punched by LP20-7. See page 41 for detailed description of cards. A single alphameric card must be added to the deck punched by LP20-7.
2. Row-column format
 - a. First data input card. The first card is used for problem identification. Any alphameric information may be punched in columns 1-80. A record mark (0-2-8 multiple punch) may follow the alphameric field but is not necessary. This card is read alphabetically and printed on the typewriter.
 - b. Second data input card. This card is a parameter card and must contain the following information:

<u>Columns</u>	<u>Information</u>	<u>Example</u>
1-3	M, the number of restrictions.	005
4	Blank.	
5-7	N, the number of nonbasic variables.	006
8	Blank.	
9	Input format.	
	1 for row-column, fixed point input.	
	0 for a complete (including zero elements) internal floating point matrix. (Normally only used as punched out by LP20-7, Matrix Punch for Restart.)	

- c. The data, following the cards specified under (a) and (b), are in row-column, fixed point format. Up to four elements with row-

column designations may be entered on each card. A brief tabular description of row-column designations is in order. The matrix is stored by columns with the reference field address, W, corresponding to row (-1) and column (-2).

Rows	Columns						
	-2	-1	0	1	2	3	N
-1	W			Nonbasic ID/CJ			
0	Working column		Function	$(Z_j - C_j)$			
1		Basic ID/CJ	bi	A_{ij}			
2							
M							

ID/CJ stands for a single 10-digit field where the first four digits are an arbitrary identification (ID) of the activity and the next six digits are the associated C_j . Identifications do not need to be sequential. In row (-1) and columns (1) through (N), an ID/CJ element is necessary. In column (-1) and rows (1) through M, an ID/CJ element is necessary. In rows (1) through (M) and columns (0) through (N) only nonzero elements need to be loaded.

Row (0) and column (-2) are used for input only in connection with LP20-8, Solution Test.

In general, the format is as follows:

i j element

~~XXXXXXXXXXXXXXXXXXXX~~ where b stands for a blank column.

There are four fields per card for data:

	<u>Columns for i</u>	<u>Columns for j</u>	<u>Columns for element</u>
Field 1	1- 3	5- 7	9-18
Field 2	21-23	25-27	29-38
Field 3	41-43	45-47	49-58
Field 4	61-63	65-67	69-78

All other columns are not used by the program and may be used for any other purpose. These cards are read alphamerically. Consequently, a blank does not enter as zero (70) but as an alphameric blank (00).

Any field that has the middle digit of the three digit i value left blank will be ignored. Hence, data cards do not have to have a complete set of four elements, nor is it required that a left-hand field be used in order to use succeeding fields on the same card. Matrix elements, b_i , and A_{ij} , may contain up to eight numeric digits with optional leading sign and mandatory decimal point. If the element is negative, an explicit minus sign must be punched in the first column provided, columns 9, 29, 49, or 69. Loading of zero elements is optional.

The signal to the data loader to quit loading is a three digit value of $i = 999$. This must be in the last data card to the right (if other elements are on the card) of the last element. The simplest procedure is to use a trailer card with 999 punched in columns 1-3.

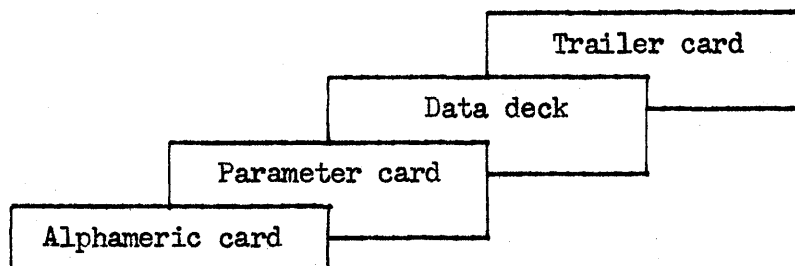
Specific Description of Fields

<u>Item</u>	<u>Description</u>	<u>Row-Column</u>	<u>Remarks-Examples</u>
		i j	
A_{ij}	Matrix element of the i th row and j th column.	XXX XXX	i j element 010 004 36.075 003 004 -4.0 008 017 -0.6 008 017 -.6
		i j	
b_i	Element in the i th row of the requirement vector.	XXX 000	008 000 6.025
		i j	
C_i	Cost per unit of the basic variable for row i . $j = 00\bar{1} = 00J$ where J is a flagged one.	XXX 00J	012 00J 0003001500
		i j	
C_j	Cost per unit of j th nonbasic variable. $i = 00\bar{1} = 00J$ where J is a flagged one.	00J XXX	00J 024 0034123456

For the ID/CJ elements, no explicit decimal points are used. An implicit decimal is assumed in the middle of the six digit CJ field. Negative costs are designated by a flag over the units' position of the CJ field.

<u>Examples</u>	<u>Interpretation</u>
012 00J 0003001500	Row (12) Column (-1) X_3 $C_3 = 1.5$
00J 024 0034123456	Row (-1) Column (24) X_{34} $C_{34} = -123.456$

3. Summary of data load input for row-column, fixed point input.



4. To prepare data for LP20-8, Solution Test, additional data cards are prepared to load the solution into row (0) and column (-2). The levels of originally basic activities are entered in the corresponding rows of column (-2). The levels of originally nonbasic activities are entered in the corresponding columns of row (0). The format is the same as that used for A_{ij} and b_i .

Examples

i	j	
000	034	36.702589
010	002	43.256943

where the nonbasic activity corresponding to the level of 36.702589 was originally stored in column 34, and the basic activity corresponding to the level of 43.256943 was originally stored in row 10.

The original data deck, with the new cards containing the levels of basic and nonbasic variables inserted prior to the trailer card serves as input to LP20-1 followed by LP20-8 to test the solution.

5. Input for LP20-9, Parametric Solution, consists of a single card in which the ID of the parametric vector is punched in columns 1-4 and a 1 is punched in column 6 if the vector is to be subtracted from the b vector. If column 6 is blank, the parametric vector will be added to b.

B. Output format

The only card output that requires detailed description is that of LP20-7, Matrix Punch for Restart.

The first card is punched from location 402 and contains in columns 1-3, M; in columns 5-7, N; a zero in column 9 indicating floating point format; the reference address, S, in columns 10-14; M + 2 in columns 15-17. Other columns of this header card will be punched, but the information contained in them is not essential. The remaining cards contain the entire matrix by columns starting in row (-1) and column (-1) with seven 10-digit fields per card. The fields are either internal floating point or ID/CJ elements. The last card contains a record mark in column 72. Columns 71 to 80 may be punched but do not contain useful information.

The punched output from LP20-5B and 6 is the same as the typed output from LP20-5A and 6. It is suitable for 80 x 80 listing, contains alphabetic headings, and uses explicit decimal format. The float routine prepares most numbers with up to four digits to the left of the decimal and five to the right. If the number is negative, a negative sign precedes the first digit. If the numbers are larger than 9999.99999 or smaller than 0.00010, a modified E format is used with the two digit exponent preceding the mantissa.

For example: $\pm 05 \pm .95342$, which indicates the number, ± 0.000095342 if the leading sign is negative or ± 95342.0 if the leading sign is positive.

C. Object deck format

Two sets of object decks are provided. One set was condensed by the SPSII compiler while the other was further condensed by a routine similar to Squeeze. The first six and the last four cards serve as program loader and contain the add and multiply tables. The remaining cards have a

standard format. The first five columns contain a flagged address to which the digit in column 8 will be transmitted. Columns 6 and 7 contain a flagged number indicating how many digits are to be transmitted.

This condenser has been designed to be used in chained programs where the memory is not cleared prior to loading. The flagged number indicating how many digits are to be transmitted allows one to control the loading in areas where parameters have been stored by previous programs so that they are not destroyed. All program cards with the five digit leading address are read into a fixed location and, starting with column 8, the required number of digits are transmitted to the specified and higher addresses.

LP20-1 has a two card clearing routine independent of memory size prior to the six card loader.

Except for the first six and last four cards, the leading five digit address serves as a sequence number, although sequence is not important.



III. SAMPLE PROBLEMS

NOTE: FOR DATA DECK LISTINGS, SEE PAGES 180-182.

LISTING OF DATA CARDS.
SAMPLE PROBLEM, LP20, SIMPLEX.

005 006 1				
001 001 1.0	001 002 1.0	001 003 1.0	001 004 2.0	
002 002 1.0	002 003 1.0	002 004 2.0	002 005 1.0	
002 006 1.0	003 001 99.4	003 002 37.75	003 003 19.75	
003 004 54.4	003 005 74.75	003 006 53.0	004 003 0.436	
004 005 19.1	004 006 12.363	005 002 3.0	005 003 0.364	
005 005 9.1	005 006 26.737			
001 00J 0007	002 00J 0008	003 00J 0009	004 00J 0010	
005 00J 0011				
00J 001 00010834	00J 002 000207235	00J 003 00030273	00J 004 000407205	
00J 005 000520725	00J 006 0006455			
001 000 60.0	002 000 60.0	003 000 2000.0	004 000 424.0	
005 000 359.0				
999				

SAMPLE PROBLEM, LP20, SIMPLEX, TEST SOLUTION.

005 006 1			
001 001 1.0	001 002 1.0	001 003 1.0	001 004 2.0
002 002 1.0	002 003 1.0	002 004 2.0	002 005 1.0
002 006 1.0	003 001 99.4	003 002 37.75	003 003 19.75
003 004 54.4	003 005 74.75	003 006 53.0	004 003 0.436
004 005 19.1	004 006 12.363	005 002 3.0	005 003 0.364
005 005 9.1	005 006 26.737		
001 00J 0007	002 00J 0008	003 00J 0009	004 00J 0010
005 00J 0011			
00J 001 00010834	00J 002 000207235	00J 003 00030273	00J 004 000407205
00J 005 000520725	00J 006 0006455		
001 000 60.0	002 000 60.0	003 000 2000.0	004 000 424.0
005 000 359.0			
000 001 0.2171115	000 004 23.286457	000 006 13.427085	
001 00K 13.20997	004 00K 258.00095		
999			

LINEAR PROGRAMMING TEST PROBLEM. DUAL. FEED MIX.

003 004 1					
001 001 -17.0	001 002 -25.0	001 003 -60.0	001 004 -45.0		
002 001 -2.0	002 002 -5.0	002 003 -7.0	002 004 -0.5		
003 001 -1.0	003 002 -1.0	003 003 -1.0	003 004 -1.0		
00J 001 000106600-	00J 002 000209200-	00J 003 000315600-	00J 004 000409600-		
001 000 -35.0	002 000 -1.5	003 000 -1.0			
001 00J 0005000000	002 00J 0006000000	003 00J 0007000000			

999

NOTE: TRAILING MINUS SIGN IS A FLAGGED ZERO, 0.

SAMPLE PROBLEM , LP20, SIMPLEX.

ITER	FUNCTIONAL	VAR IN	VAR OUT
0001	6109323604	0006455000	0011000000
0002	7190305404	0001083400	0009000000
0003	7805220104	0004072050	0008000000

FUNCTIONAL = 7805.22010

BASIC SOLUTION

ID	CJ	LEVEL
0007	000.000	13.20997
0004	072.050	23.28645
0001	083.400	.21711
0010	000.000	258.00095
0006	455.000	13.42708

ID	CJ	SHADOW PRICES
0009	000.000	.83903
0002	072.350	17.10861
0003	027.300	7.88345
0008	000.000	13.20327
0005	207.250	3.90254
0011	000.000	14.86060

OPTIMUM SOLUTION MATRIX,
SIMPLEX PROBLEM.

			0009	000.000	0002	072.350	0003	027.300	001
0007	000.000	7805.22010		.83903		17.10861		7.88345	002
0004	072.050	13.20997		-.01006		.03519		.09209	003
0001	083.400	23.28645				.44389		.49319	004
0010	000.000	.21711		.01006		.07701		-.07848	005
0006	455.000	258.00095				-1.38717		.26768	006
		13.42708				.11220		.01361	007
0008	000.000	0005	207.250	0011	000.000				008
	13.20327		3.90254		14.86060				009
	-.72635		-1.04967		.04710				010
	.50000		.32982		-.01870				011
	-.27364		.39002		-.00970				012
			14.89222		-.46239				013
			.34035		.03740				014

SAMPLE PROBLEM, LP20, SIMPLEX, TEST SOLUTION.

FUNCTIONAL = .00000

BASIC SOLUTION

ID	CJ	LEVEL
0007	000.000	-05 .50000
0008	000.000	-05 .10000
0009	000.000	.00050
0010	000.000	.00000
0011	000.000	-04 .30000

} TRUNCATION ERROR.

ID	CJ	SHADOW PRICES
0001	083.400	.21711
0002	072.350	.00000
0003	027.300	.00000
0004	072.050	23.28645
0005	207.250	.00000
0006	455.000	13.42708

} LEVELS OF NONBASIC
ACTIVITIES IN OPT-
IMUM SOLUTION

PARAMETRIC PROGRAMMING, SIMPLEX.

K= T313071004

(WORKING CAPITAL = \$2000 + 1313.07 = \$3313.07) 48.
(ID OF PARAMETRIC VECTOR = 0009)

ITER	FUNCTIONAL	VAR IN	VAR OUT
0001	8906931604	0005207250	0007000000

FUNCTIONAL = 8906.93160

BASIC SOLUTION

ID	CJ	LEVEL
0005	207.250	-.00000
0004	072.050	23.28645
0001	083.400	13.42708
0010	000.000	258.00095
0006	455.000	13.42708

ID	CJ	SHADOW PRICES
0009	000.000	.80163
0002	072.350	17.23944
0003	027.300	8.22585
0008	000.000	10.50278
0007	000.000	3.71784
0011	000.000	15.03574

K= T807605904

(WORKING CAPITAL = \$3313.07 + \$1807.61 = \$5120.68)

ITER	FUNCTIONAL	VAR IN	VAR OUT
0001	T035596505	0008000000	0010000000

FUNCTIONAL = 05 .10355

BASIC SOLUTION

ID	CJ	LEVEL
0005	207.250	17.32454
0004	072.050	17.57241
0001	083.400	24.85517
0008	000.000	-.00000
0006	455.000	7.53063

ID	CJ	SHADOW PRICES
0009	000.000	.65616
0002	072.350	16.33450
0003	027.300	9.83036
0010	000.000	1.01917
0007	000.000	18.17735
0011	000.000	15.24566

K= 2537456304 (WORKING CAPITAL = \$5120.68 + \$2537.46 = \$7658.14)

ITER	FUNCTIONAL	VAR IN	VAR OUT
0001	1202095105	0009000000	0004072050

FUNCTIONAL = 05 .12020

BASIC SOLUTION

ID	CJ	LEVEL
0005	207.250	17.32454
0009	000.000	-.00000
0001	083.400	59.99999
0008	000.000	35.14482
0006	455.000	7.53063

ID	CJ	SHADOW PRICES
0004	072.050	94.75001
0002	072.350	57.22286
0003	027.300	63.23612
0010	000.000	3.51792
0007	000.000	83.40000
0011	000.000	15.39095

ID BASIC. (ACTIVITY 0009 NOW IN BASIS.)

FINAL MATRIX AFTER PARAMETRIC PROGRAMMING

			0004	072.050	0002	072.350	0003	027.300	001
		05	.12020	94.75001		57.22286		63.23612	002
0005	207.250		17.32454			-.09314		.01797	003
0009	000.000			-144.40001		-62.31428		-81.39093	004
0001	083.400		59.99999	2.00000		1.00000		1.00000	005
0008	000.000		35.14482	1.99999		.94924		.97452	006
0006	455.000		7.53063			.14390		.00749	007
0010	000.000	0007	000.000	0011	000.000				008
	3.51792		83.40000		15.39095				009
	.06714		-07 -.10000		-.03104				010
	-3.80811		-99.39999		-.22142				011
			1.00000						012
	-.04429		-06 -.10000		-.01691				013
	-.02285		-07 .10000		.04796				014

LINEAR PROGRAMMING TEST PROBLEM. DUAL. FEED MIX.

ITER	FUNCTIONAL	VAR IN	VAR OUT
0001	7466666502	0004096000	0005000000
0002	7957894702	0003156000	0006000000
0003	8678480902	0002092000	0007000000
0004	8764583302	0001066000	0003156000

FUNCTIONAL = -87.64583

BASIC SOLUTION

ID	CJ	LEVEL
0004	-096.000	.60416
0001	-066.000	.26041
0002	-092.000	.13541

ID	CJ	SHADOW PRICES
0003	-156.000	6.80209
0007	000.000	32.98958
0006	000.000	5.08333
0005	000.000	1.34375

OPTIMUM MATRIX, DUAL FEED MIX PROBLEM.

			0003	-156.000	0007	000.000	0006	000.000	001
		-87.64583		6.80209		32.98958		5.08333	002
0004	-096.000	.60416		.92708		.36458		.08333	003
0001	-066.000	.26041		-2.05729		-2.21354		.20833	004
0002	-092.000	.13541		2.13020		.84895		-.29166	005
0005	000.000								006
	1.34375								007
	-.03124								008
	.04687								009
	-.01562								010

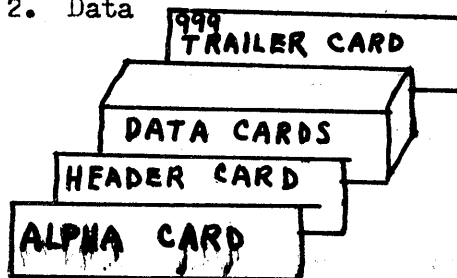
IV. Operating Instructions.

Each of the programs is designed to operate semi-independently. Each has as its last executed instructions a simulate load sequence, read numeric card into location zero, and branch to zero. In the condensed object deck, the programs do not halt at the conclusion of loading the program but branch immediately to the first instruction.

A. Main sequence.

1. LP20-1, Data Loader

2. Data



3. LP20-2, Shadow Price

	<u>On</u>	<u>Off</u>
Sense Switch 1	Print iteration headings	No print

4. LP20-3 and 4, Dual and Simplex

	<u>On</u>	<u>Off</u>
Sense Switch 1	Print iteration number, functional, variable in, and variable out	No print
Sense Switch 2	Halt after complete iteration	No halt

This halt allows the problem to be stopped in midstream to obtain a matrix print or punch (LP20-6), a solution print or punch (LP20-5A or B), or a matrix punch for restart at some later date (LP20-70).

If the dual program is used (an infeasible initial basic solution), an inconsistent problem will lead to an error halt at 02426. If an unbounded solution is found by the simplex program, an error halt occurs at 02608.

The only other error halts are those connected with the floating point subroutines. Here the operator has a choice as to action depending upon the digit stored in 00401. The last digit of card six in the condensed object decks corresponds to 00401 and may be modified to suit the operator's choice of action. In the version distributed, a zero appears at this location which causes a halt when any floating point error is detected.

5. LP20-5A or 5B, Solution Print or Solution Punch

These programs are essentially the same except that 5A types the solution and 5B punches the solution for 80 x 80 listing.

6. LP20-6, Matrix Print or Punch (Optional)

	<u>On</u>	<u>Off</u>
Sense Switch 3	Types matrix	Punches matrix

7. LP20-7, Matrix Punch for Restart (Optional)

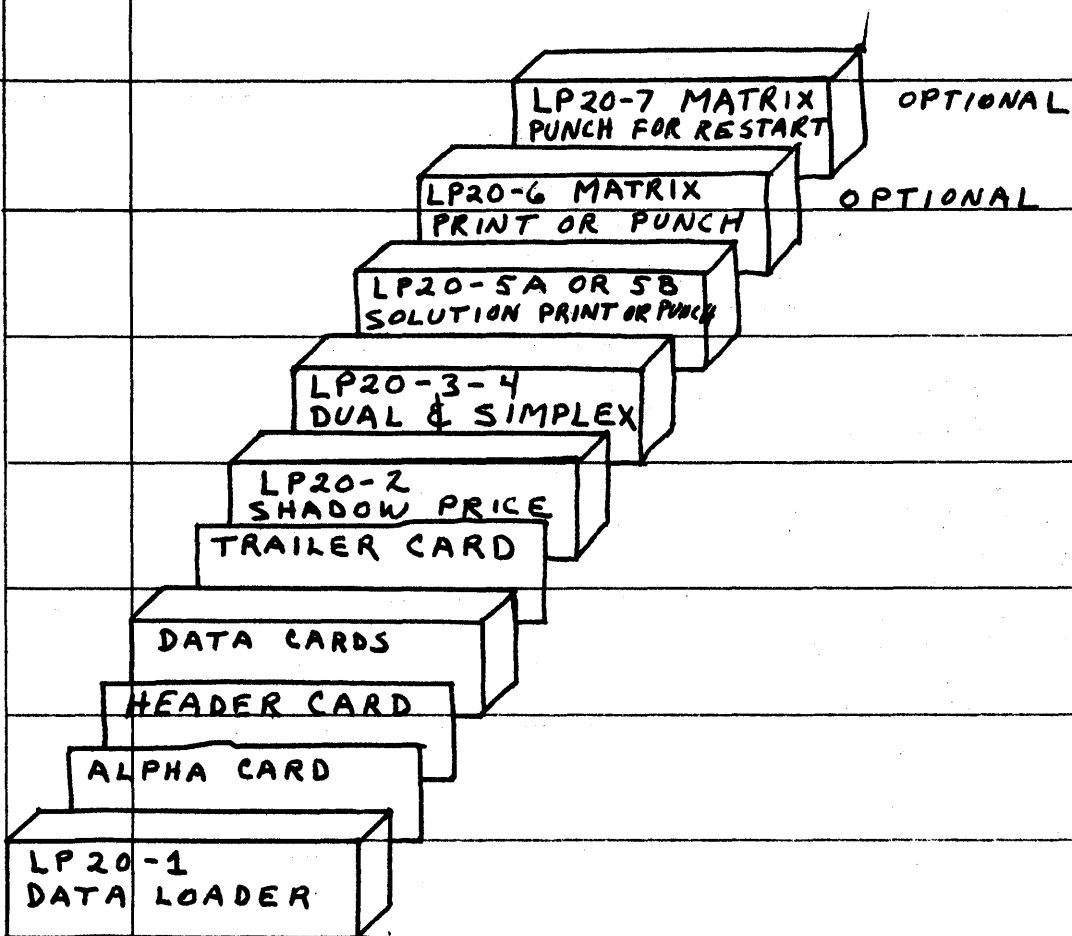
To summarize the operation of the main sequence of programs:

Since the first two cards of LP20-1 are a memory clear routine independent of memory size, it is not necessary to clear memory.

1. Push reset on console.
2. Set left margin and tab stops at left margin +20, left margin +35 and left margin +50.
3. Set sense switches.

	<u>On</u>	<u>Off</u>
Sense Switch 1	Print iteration	No print
Sense Switch 2	Halt after iteration	No halt
Sense Switch 3	Print final matrix	Punch final matrix

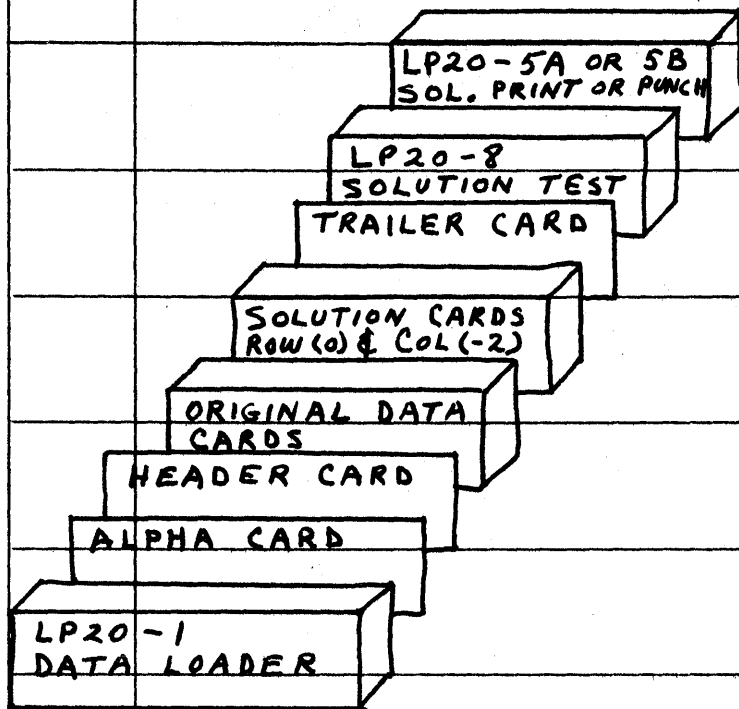
4. Load programs and data in read hopper. Use following sequence:



5. Push load.
6. Push punch start (if needed).
7. Operation will continue automatically until an error halt or until last card of last program stops card reader.
8. Push reader start to read last card.

B. Solution Test.

DECK SEQUENCE.



B. Solution Test

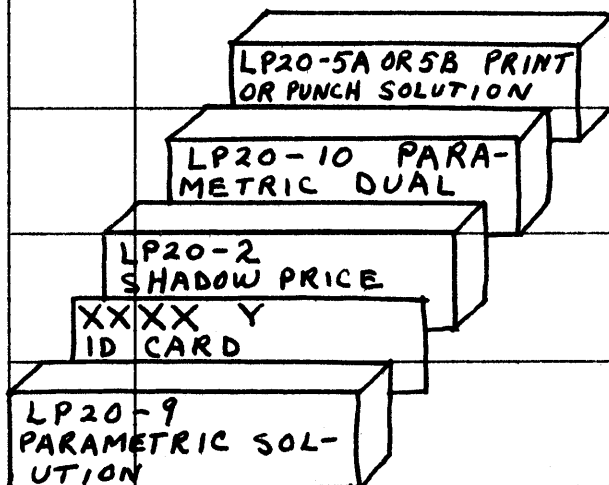
1. Reset on console.
2. Place programs and data in read hopper.
3. Push load.
4. Push punch start (if needed).
5. When only last card is in read hopper, push reader start.

C. Parametric Programming

1. Reset on console.
2. Set sense switch 1 on to print iteration information, off to bypass printing.
3. Place program decks and data in read hopper.

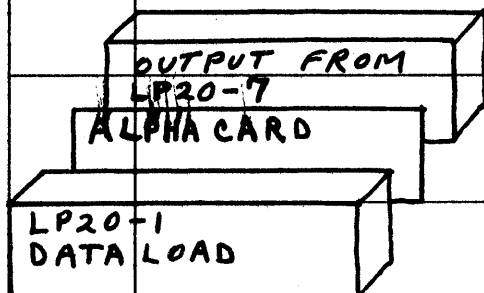
If optimum solution has just been run and is still in memory, use sequence A.

SEQUENCE A



If optimum solution has been punched by LP20-7, Punch for Restart, use this sequence B.

SEQUENCE B





Follow this sequence with sequence A.

4. Push load.
5. Push punch start (if needed).
6. When only last card in read hopper, use reader start.
7. If additional iterations are desired, reload sequence A in read hopper and push reader start.

Note: If parametric vector specified is in current basis, LP20-9 will type "ID basic" and stop at 01014. If parametric vector specified is neither basic nor nonbasic, LP20-9 will type "I can't find it" and stop at 00988. If the parametric vector can be added to b without limit, LP20-9 will type "Solution unbounded" and stop at 01722.

If the problem is inconsistent, LP20-10 will type "Inconsistent problem" and load the following program to print the last solution.

D. Other variations of program sequence are possible. One may want to stop in the middle of a problem for restart later:

1. Turn on sense switch 2 to halt after the completion of one iteration in the dual or simplex program:
2. Remove decks from read hopper.
3. Nonprocess runout.
4. Reset on console.
5. Load LP20-7, Matrix Punch for Restart, in read hopper.
6. Push load and punch start.
7. Push reader start to read last card.
8. Lift blank cards from punch hopper.
9. Nonprocess card punch to obtain last punched card and two blank cards.

One may want to punch the initial table for 80 x 80 listing for a visual record of actual problem solved. Use LP20-1 to load data, follow with

LP20-6 to print or punch the initial matrix, and then follow with LP20-2 and the remaining programs of the main sequence to solve the problem.

If an inconsistent problem is detected by the dual or an unbounded solution by the simplex program, remove program decks from read hopper, nonprocess the last cards out, and load LP20-6 to print or punch the last solution.

V.A. LP20 SPSII LISTINGS.

END OF PASS I

00010* LP20-1, DATA LOADER, LINEAR PROGRAMMING, NOV. 16, 1962.

```

00020*
00030      DORG 402
00040M      DS      3      00402
00050N      DS      4      00404 00003
00060FORM   DS      2      00408 00004
00070S      DS      5      00410 00002
00080MPL2   DS      3      00415 00005
00090       DS      1      00418 00003
00100TEMP   DS     10      00419 00001
00110W      DS     ,4809    00429 00010
00120PROD   DS     20,99    04809 00000
00130CNTR   DS      2      00099 00020
00140CTR    DS      2      00431 00002
00150K      DS      2      00433 00002
00160I      DS      3      00435 00002
00170J      DS      3      00438 00003
00180NUMBR  DS     10      00441 00003
00190SIGN   DS      1      00451 00010
00200CARD   DAS     80      00452 00001
00210       DAC     1,@     00455 00080
00220INPUT  DS     21      00615 00001
00230       DC     1,@     00636 00021
00240MANT   DS      8      00637 00001
00250       DS      2      00645 00008
                   00647 00002

```

```

00260EXP    DS      2
00270       DC     8,0
00280ZERO   DC     2,-99
00290*
00300* READ AND WRITE ALPHA CARD, READ PARAMETER CARD AND INITIALIZE.
00310*
00320START  RCTY
00330       RACD CARD      00660 34 00000 00102
00340       WATY CARD      00672 37 00455 00500
00350       RCTY           00684 39 00455 00100
00360       RCTY           00696 34 00000 00102
00370       RNCD M-2       00708 34 00000 00102
00380       SF     M-2     00720 36 00402 00500
00390       SF     M+2     00732 32 00402 00000
00400*
00410* CALCULATE S=W+10(M+3) AND STORE M+2.
00420*
00430       TFM     S,W      00756 16 00415 04809
00440       TF     TEMP,M    00768 26 00429 00404
00450       AM     TEMP,3,10, TEMP=M+3 00780 11 00429 00003
00460       A     S-1,TEMP
00470       SM     TEMP,1,10 00792 21 00414 00429
00480       TF     MPL2,TEMP 00804 12 00429 00001
00490       TDM   MPL2+1,0   00816 26 00418 00429
00500       BD     CLER,FORM  00828 15 00419 00000
00510*
00520* HERE IF DATA IS IN FLOATING POINT FORM - LOAD ENTIRE MATRIX.
00530*
00540LOAD   TFM   RDMAT+6,W-9 00840 43 00964 00410
00550       A     RDMAT+5,MPL2 00852 16 00906 04800
                   00864 21 00905 00418

```

00560	TF	CHECK+11,RDMAT+6			
00570	AM	CHECK+11,71,10	00876	26	00923 00906
00580RDMAT	RNCD	99999	00888	11	00923 00071
00590CHECK	BNR	MOD,99999	00900	36	99999 00500
00600	B	END	00912	45	00932 99999
00610	DORG	*-3	00924	49	02596 00000
00620MOD	AM	RDMAT+6,70,10	00932		
00630	AM	CHECK+11,70,10	00932	11	00906 00070
00640	B	RDMAT	00944	11	00923 00070
00650	DORG	*-3	00956	49	00900 00000
00660*			00964		
00670*		COMPUTE MATRIX SIZE AND SET MATRIX NULL.			
00680*					
00690CLER	TF	TEMP,N	00964	26	00429 00408
00700	AM	TEMP,3,10	00976	11	00429 00003
00710	M	MPL2,TEMP	00988	23	00418 00429
00720	TFM	CMP1+11,W-10	01000	16	01101 04799
00730	SF	PROD-3	01012	32	00096 00000
00740	A	CMP1+10,PROD	01024	21	01100 00099
00750	TFM	CLEAR+23,W	01036	16	01071 04809
00760CLEAR	TFLS	99999,ZERO	01048	16	02651 01071
			01060	49	02620 00000
			01067	00005	99999
			01072	00005	00659
00770	AM	CLEAR+23,10,10	01078	11	01071 00070
00780CMP1	CM	CLEAR+23,99999	01090	14	01071 99999
00790	BNP	CLEAR	01102	47	01048 01100
00800*					
00810*		LOAD MATRIX WHEN DATA IS IN EXPLICIT DECIMAL FORM.			
00820*					
00830	TFM	CNTR,1,10	01114	16	00431 00001
00840LOADR	RACD	CARD	01126	37	00455 00500
00850	TD	CARD+36,400	01138	25	00491 00400

00860	TD	CARD+76,400			01150 25 00531 00400
00870	TD	CARD+116,400			01162 25 00571 00400
00880	TD	CARD+156,400			01174 25 00611 00400
00890	BD	ELOAD,CARD+1,,MIDDLE DIGIT OF 1 FIELD BLANK.			01186 43 01322 00456
00900ALOAD	CM	CNTR,4,10, IS CARD FINISHED.			01198 14 00431 00004
00910	BNE	BLOAD			01210 47 01254 01200
00920	TFM	CLOAD+11,CARD+1,, REINITIALIZE CLOAD AND DLOAD.			01222 16 01301 00456
00930	TFM	DLOAD+11,CARD-1			01234 16 01321 00454
00940	B	LOADR-12			01246 49 01114 00000
00950	DORG	*-3			01254
00960BLOAD	AM	CNTR,1,10			01254 11 00431 00001
00970	AM	CLOAD+11,40,10			01266 11 01301 00040
00980	AM	DLOAD+11,40,10			01278 11 01321 00040
00990CLOAD	BD	DLOAD,CARD+1,7			01290 43 01310 00456
01000	B	ALOAD			01302 49 01198 00000
01010	DORG	*-3			01310
01020DLOAD	TR	CARD-1,CARD-1,7			01310 31 00454 00454
01030*					
01040*		TRANSMIT DIGITS DESIGNATING ROW.			
01050*					
01060ELOAD	TD	1-2,CARD			01322 25 00436 00455
01070	TD	1-1,CARD+2			01334 25 00437 00457
01080	TD	1,CARD+4			01346 25 00438 00459
01090	SF	1-2			01358 32 00436 00000
01100	SF	CARD+3			01370 32 00458 00000
01110	CM	CARD+4,70,10, IS IT NONBASIC C.			01382 14 00459 00070
01120	BNL	TRCOL			01394 46 01418 01300
01130	SF	1,,SET ROW INDEX = -1.			01406 32 00438 00000
01140*					
01150*		TRANSMIT DIGITS DESIGNATING COLUMN.			

01160*							
01170	TRCOL	TD	J-2, CARD+8				
				01418	25	00439	00463
01180		TD	J-1, CARD+10				
				01430	25	00440	00465
01190		TD	J, CARD+12				
				01442	25	00441	00467
01200		SF	J-2				
				01454	32	00439	00000
01210		SF	CARD+11				
				01466	32	00466	00000
01220		CM	CARD+12, 70, 10, IS IT BASIC C.				
				01478	14	00467	00070
01230		BNL	ACLFL				
				01490	46	01514	01300
01240		SF	J,,, SET COLUMN INDEX = -1.				
				01502	32	00441	00000
01250	ACLFL	CF	CARD+3				
				01514	33	00458	00000
01260		CF	CARD+11				
				01526	33	00466	00000
01270		CM	1, 999, 9, IS ROW = 999, END CARD				
				01538	14	00438	00999
01280		BE	END				
				01550	46	02608	01200
01290*							
01300*	COMPUTE		ADDRESS OF I, J ELEMENT.				
01310*							
01320		TF	STORE+23, S				
				01562	26	02593	00415
01330		TF	TEMP, J,, COLUMN INDEX.				
				01574	26	00429	00441
01340		AM	TEMP, 1, 10				
				01586	11	00429	00001
01350		M	MPL2, TEMP				
				01598	23	00418	00429
01360		A	PROD, 1				
				01610	21	00099	00438
01370		SF	PROD-3				
				01622	32	00096	00000
01380		A	STORE+22, PROD				
				01634	21	02592	00099
01390		TF	FLSET+18, STORE+23				
				01646	26	01892	02593
01400		CM	J, 1, 911				
				01658	14	00441	00001
01405		BNL	ROWM11				
				01670	47	01906	01200
01410*							
01420*	HERE IF		BASIC OR NONBASIC C.				
01430*							
01440	INITI	TFM	K, 0, 10				
				01682	16	00435	00000
01450		TFM	TRID+6, NUMBR-9				
				01694	16	01724	00442

01460	TFM	TRID+11, CARD+16					
01470	TRID	TD	99999, 99999				
				01706	16	01729	00471
01480	AM	TRID+6, 1, 10					
				01718	25	99999	99999
01490	AM	TRID+11, 2, 10					
				01730	11	01724	00001
01500	AM	K, 1, 10					
				01742	11	01729	00002
01510	CM	K, 10, 10					
				01754	11	00435	00001
01520	BNE	TRID					
				01766	14	00435	00070
01530	SF	CARD+33					
				01778	47	01718	01200
01540	CM	CARD+34, 70, 10, IS LAST					
				01790	32	00488	00000
				01802	14	00489	00070
01550	BNL	BCLFL					
				01814	46	01862	01300
01560	CM	CARD+34, 0, 10, IS LAST					
				01826	14	00489	00000
01570	BE	BCLFL					
				01838	46	01862	01200
01580	SF	NUMBR					
				01850	32	00451	00000
01590	BCLFL	CF	CARD+35				
				01862	33	00490	00000
01600	FLSET	SF	NUMBR-9				
				01874	32	00442	00000
01610	TF	99999, NUMBR					
				01886	26	99999	00451
01620	B	ALOAD					
				01898	49	01198	00000
01630	DORG	*-3					
				01906			
01640	OROWM11	BNF	TREL, 1,, IS IT NONBASIC C.				
				01906	44	01926	00438
01650	B	INITI					
				01918	49	01682	00000
01660	DORG	*-3					
				01926			
01670*							
01680*	HERE IF		AN A OR B ELEMENT.				
01690*							
01700	TREL	TD	CARD+36, 400				
				01926	25	00491	00400
01710	TR	INPUT-20, CARD+15					
				01938	31	00616	00470
01720	SF	INPUT-20					
				01950	32	00616	00000
01730	CM	INPUT-19, 70, 10, IS FIRST					
				01962	14	00617	00070
01740	BNL	CLRFLG					
				01974	46	02086	01300

01750	CM	INPUT-19,20,10, IS IT MINUS.	01986	14	00617	00020
01760	BE	NEG	01998	46	02066	01200
01770	BD	CLRFLG, INPUT-19,, IS IT BLANK.	02010	43	02086	00617
01780	CF	SIGN	02022	33	00452	00000
01790	SF	INPUT-18	02034	32	00618	00000
01800	TR	INPUT-20, INPUT-18	02046	31	00616	00618
01810	B	FLOAT	02058	49	02098	00000
01820	DORG	*-3	02066			
01830	NEG	SF SIGN	02066	32	00452	00000
01840	B	SHFTSN	02078	49	02034	00000
01850	DORG	*-3	02086			
01860	CLRFLG	CF SIGN	02086	33	00452	00000
01870	FLOAT	TFM EXP, 0, 10	02098	16	00649	00000
01880	TFM	DEC+6, INPUT-19	02110	16	02152	00617
01890	TFM	FLDDEF+6, INPUT-18	02122	16	02140	00618
01900	FLDDEF	SF 99999	02134	32	99999	00000
01910	DEC	CM 99999, 3, 10, IS IT A DECIMAL	02146	14	99999	00003
01920	BE	SHFTDC	02158	46	02214	01200
01930	AM	DEC+6, 2, 10	02170	11	02152	00002
01940	AM	FLDDEF+6, 2, 10	02182	11	02140	00002
01950	AM	EXP, 1, 10	02194	11	00649	00001
01960	B	FLDDEF	02206	49	02134	00000
01970	DORG	*-3	02214			
01980	SHFTDC	TF *+47, FLDDEF+6	02214	26	02261	02140
01990	TF	*+30, DEC+6	02226	26	02256	02152
02000	SM	*+18, 1, 10	02238	12	02256	00001
02010	TR	99999, 99999	02250	31	99999	99999
02020	ZRTST	BD TRSMT, INPUT-19	02262	43	02318	00617

02030	TR	INPUT-20, INPUT-18	02274	31	00616	00618
02040	SM	EXP, 1, 10	02286	12	00649	00001
02050	BNR	ZRTST, INPUT-19	02298	45	02262	00617
02060	B	ALOAD	02310	49	01198	00000
02070	DORG	*-3	02318			
02080	TRSMT	TFM CTR, 9, 10	02318	16	00433	00009
02090	TFM	TSTRC+11, INPUT-19	02330	16	02377	00617
02100	TFM	STRDIG+6, MANT-7	02342	16	02392	00638
02110	TFM	STRDIG+11, INPUT-19	02354	16	02397	00617
02120	TSTRC	BNR STRDIG, 99999	02366	45	02386	99999
02130	B	FILL	02378	49	02454	00000
02140	DORG	*-3	02386			
02150	STRDIG	TD 99999, 99999	02386	25	99999	99999
02160	AM	TSTRC+11, 2, 10	02398	11	02377	00002
02170	AM	STRDIG+6, 1, 10	02410	11	02392	00001
02180	AM	STRDIG+11, 2, 10	02422	11	02397	00002
02190	SM	CTR, 1, 10	02434	12	00433	00001
02200	B	TSTRC	02446	49	02366	00000
02210	DORG	*-3	02454			
02220	FILL	TF STRZR+6, STRDIG+6	02454	26	02496	02392
02230	SM	CTR, 1, 10	02466	12	00433	00001
02240	BNP	SIGNST	02478	47	02522	01100
02250	STRZR	TDM 99999, 0	02490	15	99999	00000
02260	AM	STRZR+6, 1, 10	02502	11	02496	00001
02270	B	FILL+12	02514	49	02466	00000
02280	DORG	*-3	02522			
02290	SIGNST	BNF *+24, SIGN	02522	44	02546	00452

02300	SF	MANT			
02310	SF	MANT-7			
02320	TF	EXP-2,MANT			
02330	STORE	TFLS 99999,EXP			
02340	B	ALOAD			
02350	DORG	*-3			
02360	END	RNCD 0			
02370	B	0			
02380	DEND	START			
LOAD SUBROUTINES					
END OF PASS11					

02534	32	00645	00000		
02546	32	00638	00000		
02558	26	00647	00645		
02570	16	02663	02593		
02582	49	02632	00000		
02589	00005		99999		
02594	00005		00649		
02600	49	01198	00000		
02608					
02608	36	00000	00500		
02620	49	00000	00000		
00660					
02632	16	03066	03524		
02644	49	02756			

02390*	LP20-2, SHADOW PRICE, LINEAR PROGRAMMING, NOV. 16, 1962.				
02400*					
02410	DORG	402			
				00402	
02420M	DS	3			
				00404	00003
02430N	DS	4			
				00408	00004
02440FORM	DS	2			
				00410	00002
02450S	DS	5			
				00415	00005
02460MPL2	DS	3			
				00418	00003
02470	DS	1			
				00419	00001
02480W	DS	,4809			
				04809	00000
02490PROD	DS	20,99			
				00099	00020
02500CNTR	DS	3			
				00422	00003
02510ZER	DC	8,0			
				00430	00008
02520ZERO	DC	2,-99			
				00432	00002
02530SIGN	DS	1			
				00433	00001
02540MCNTR	DS	3			
				00436	00003
02550NCNTR	DS	3			
				00439	00003
02560TEMP	DS	10			
				00449	00010
02570HDNG	DAC	49,ITER		FUNCTIONAL	VAR IN
				00451	00049
02580HDNG2	DAC	12, VAR OUT@			
				00549	00012
02590*					
02600*	FLOAT AND STORE BASIC C.				
02610*					
02620	START	TFM	STRC+23,W+20,,INITIAL	ADDRESS OF FLOATED BASIC C.	
					00572 16 00989 04829
02630	TF	LOOP+35,S			
				00584	26 00643 00415
02640	TF	CNTR,M			
				00596	26 00422 00404
02650LOOP	TDM	SIGN,0			
				00608	15 00433 00000
02660	AM	LOOP+35,10,10			
				00620	11 00643 00010
02670	TF	W-4,99999,,SECOND	ADDRESS BECOMES S+10.		
				00632	26 04805 99999

02680	SF	W-9			
02690	C	W-4,ZER-2	00644	32	04800 00000
02700	BNE	FLOATC	00656	24	04805 00428
02710	TFLS	W,ZERO	00668	47	00718 01200
			00680	16	01707 00703
			00692	49	01676 00000
			00699	00005	04809
			00704	00005	00432
02720	B	STRC	00710	49	00966 00000
02730	DORG	*-3	00718		
02740	FLOATC	TFM W,03,10	00718	16	04809 00003
02750	TFM	TSTDIG+11,W-9	00730	16	00825 04800
02760	TFM	CLRREC+11,ZER-6	00742	16	00917 00424
02770	TFM	CLRFLG+6,W-3	00754	16	00924 04806
02780	BNF	*+24,W-4	00766	44	00790 04805
02790	SF	SIGN	00778	32	00433 00000
02800	CF	W-4	00790	33	04805 00000
02810	TD	W-3,400	00802	25	04806 00400
02820	TSTDIG	BD OUT1,99999	00814	43	00882 99999
02830	AM	*-1,1,10	00826	11	00825 00001
02840	SM	W,1,10	00838	12	04809 00001
02850	AM	CLRREC+11,1,10	00850	11	00917 00001
02860	SM	CLRFLG+6,1,10	00862	12	00924 00001
02870	B	TSTDIG	00874	49	00814 00000
02880	DORG	*-3	00882		
02890	OUT1	TF SHIFT+11,TSTDIG+11	00882	26	00905 00825
02900	SHIFT	TR W-9,99999	00894	31	04800 99999
02910	CLRREC	TF W-2,ZERO-6	00906	26	04807 00426
02920	CLRFLG	CF 99999	00918	33	99999 00000

02930	BNF	STRC-12,SIGN			
02940	SF	W-2	00930	44	00954 00433
02950	SF	W-9	00942	32	04807 00000
02960	STRC	TFLS 99999,W	00954	32	04800 00000
			00966	16	01707 00989
			00978	49	01676 00000
			00985	00005	99999
			00990	00005	04809
02970	AM	STRC+23,10,10	00996	11	00989 00010
02980	SM	CNTR,1,10	01008	12	00422 00001
02990	BNZ	LOOP	01020	47	00608 01200
03000*					
03010*		FLOAT AND STORE NONBASIC C.			
03020*					
03030	OUT2	TF STRC+23,S			
03040	A	STRC+22,MPL2	01032	26	00989 00415
03050	A	STRC+22,MPL2	01044	21	00988 00418
03060	AM	LOOP+35,10,10	01056	21	00988 00418
03070	TF	LOOP+23,MPL2+1	01068	11	00643 00010
03080	TF	STRC+41,MPL2+1	01080	26	00631 00419
03090	TF	CNTR,N	01092	26	01007 00419
03100	TFM	CLRFLG+18,SETFLG	01104	26	00422 00408
03110	TFM	CLRFLG+25,41,10	01116	16	00936 01172
03120	TFM	OUT2+1,49,10	01128	16	00943 00041
03130	TFM	OUT2+6,CALCDJ	01140	16	01033 00049
03140	B	LOOP	01152	16	01038 01192
03150	DORG	*-3	01164	49	00608 00000
03160	SETFLG	SF W-2	01172		
03170	B	STRC-12	01172	32	04807 00000
03180	DORG	*-3	01184	49	00954 00000
			01192		

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03190*
03200* CALCULATE AND STORE D(J)=Z(J)-C(J) VALUES.
03210*
03220CALCDJ TF NCNTR,N
01192 26 00439 00408
03230 TF ZRFNCT+23,S
01204 26 01251 00415
03240 A ZRFNCT+22,MPL2
01216 21 01250 00418
03250ZRFNCT TFLS 99999,ZERO
01228 16 01707 01251
01240 49 01676 00000
01247 00005 99999
01252 00005 00432
03260 TF DJLOOP+28,S
01258 26 01358 00415
03270 AM DJLOOP+28,10,10
01270 11 01358 000T0
03280 A DJLOOP+27,MPL2
01282 21 01357 00418
03290 TFM FMULT+28,W+20
01294 16 01388 04829
03300 TF FADD+23,ZRFNCT+23
01306 26 01413 01251
03310LOOP2 TF MCNTR,M
01318 26 00436 00404
03320DJLOOP TFLS TEMP ,99999
01330 16 01707 01353
01342 49 01676 00000
01349 00005 00449
01354 00005 99999
03330FMULT FM TEMP ,99999
01360 16 01707 01383
01372 49 01656 00000
01379 00005 00449
01384 00005 99999
03340FADD FA 99999,TEMP
01390 16 01707 01413
01402 49 01636 00000
01409 00005 99999
01414 00005 00449
03350 AM DJLOOP+28,10,10
01420 11 01358 000T0
03360 AM FMULT+28,10,10
01432 11 01388 000T0
03370 SM MCNTR,1,10
01444 12 00436 00001
03380 BNZ DJLOOP
01456 47 01330 01200
03390 AM DJLOOP+28,20,10
01468 11 01358 000Z0
03400 TFM FMULT+28,W+20
01480 16 01388 04829
03410 A FADD+22,MPL2
01492 21 01412 00418
03420 SM NCNTR,1,10
01504 12 00439 00001
03430 BNN LOOP2
01516 46 01318 01300

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03440 BNC1 END
01528 47 01612 00100
03450 RCTY
01540 34 00000 00102
03460 RCTY
01552 34 00000 00102
03470 WATY HDNG
01564 39 00451 00100
03480 WATY HDNG2
01576 39 00549 00100
03490 RCTY
01588 34 00000 00102
03500 RCTY
01600 34 00000 00102
03510END RNCD 0
01612 36 00000 00500
03520 B 0
01624 49 00000 00000
03530 DEND START
00572
LOAD SUBROUTINES
01636 16 02110 02612
01648 49 01696 0
01656 16 02110 03112
01668 49 01696 0
01676 16 02110 03352
01688 49 01800 0
END OF PASS11

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SYMBOL TABLE, LP20-2.

00404	M	00408	N	00410	FORM	00415	S	00418	MPL2
04809	W	00099	PROD	00422	CNTR	00430	ZER	00432	ZERO
00433	SIGN	00436	MCNTR	00439	NCNTR	00449	TEMP	00451	HONG
00549	HONG2	00572	START	00608	LOOP	00718	*FLDATC	00814	*TSDIG
00882	OUT1	00894	SHIFT	00906	*CLRREC	00918	*CLRFLG	00966	STRC
01032	OUT2	01172	*SETFLG	01192	*CALCDJ	01228	*ZRFNCT	01318	LOOP2
01330	*DJLOOP	01360	FNULT	01390	FADD	01612	END		

03540* LP20-3, DUAL, LINEAR PROGRAMMING, NOV. 16, 1962.
 03550*
 03560* REMARKS ON MACROS FOLLOW MACRO INSTRUCTIONS.
 03570*
 03580 DORG 402

03590M	DS	3,,	NUMBER OF RESTRAINING EQUATIONS.	00402
03600N	DS	4,,	NUMBER OF NONBASIC ACTIVITIES.	00404 00003
03610FORM	DS	2,,	FORM OF INPUT - 0 IMPLIES FLT. PT., 1 IMPLIES DECIMAL	00408 00004
03620S	DS	5,,	REFERENCE ADDRESS FOR MATRIX, = W+10(M+3).	00410 00002
03630MPL2	DS	3,,M+2		00415 00005
03640	DS	1		00418 00003
03650W	DS	,4809,	REFERENCE ADDRESS.	00419 00001
03660PROD	DS	20,99,	PRODUCT ADDRESS.	04809 00000
03670OUTPUT	DS	10		00099 00020
03680	DC	1,@		00429 00010
03690R	DS	10,,	MAX OR MIN RATIO FOR DUAL OR SIMPLEX ALGORITHM.	00430 00001
03700COLADR	DS	5,,	ADDRESS OF D(K).	00440 00010
03710ROWADR	DS	5,,	ADDRESS OF B(R).	00445 00005
03720ARKADR	DS	5,,	ADDRESS OF A(R,K).	00450 00005
03730CNTCOL	DS	3,,	COLUMN COUNTER.	00455 00005
03740CNTROW	DS	3,,	ROW COUNTER.	00458 00003
03750TEMP1	DS	10,,	TEMPORARY WORK ADDRESS.	00461 00003
03760TEMP2	DS	10,,	TEMPORARY WORK ADDRESS.	00471 00010
03770BIMIN	DS	10,,	MINIMUM B(I).	00481 00010
03780DJMIN	DS	10,,	MINIMUM D(J).	00491 00010
03790AIKMAX	DS	10,,	DENOMINATOR OF SIMPLEX RATIO, USED TO BREAK TIES.	00501 00010
03800	DC	8,99999999		00511 00010
03810INF	DC	2,99,,	INFINITY.	00519 00008
				00521 00002

03820	DC	8,-99999999		
0383	ONEGINF DC	2,99,, NEGATIVE INFINITY.	00529	00008
03840	DC	8,0	00531	00002
03850	ZERO DC	2,-99,, ZERO	00539	00008
03860	DC	8,10000000	00541	00002
03870	ONE DC	2,1,, ONE.	00549	00008
03880	ESSZER DC	2,-07	00551	00002
03890*			00553	00002
03900*	TRANSFORM ENTIRE MATRIX.			
03910*	(1) COMPUTE RECIPROCAL OF PIVOT ELEMENT.			
03920*	(2) SET PIVOT CELL = ZERO.			
03930*	(3) MOVE PIVOT COLUMN TO WORKING COLUMN.			
03940*	(4) SET PIVOT COLUMN = UNIT VECTOR.			
03950*				
03960	DS	2		
03970	TRNMTX TF	11+23,ARKADR	00555	00002
03980	TF	12+23,COLADR	00556	26 00723 00455
03990	TF	CNTROW,M	00568	26 00783 00445
04000	TF	FDIV1+28,ARKADR	00580	26 00461 00404
04010	TFM	MOVELP+23,W+10	00592	26 00698 00455
04020	TF	MOVELP+28,COLADR	00604	16 00753 04819
04030	TF	PIVROW+23,ARKADR	00616	26 00758 00445
04040	MOVEK TFLS	W,ONE	00628	26 00873 00455
			00640	16 02753 00663
			00652	49 02722 00000
			00659	00005 04809
			00664	00005 00551
04050	FDIV1 FD	W,99999	00670	16 02753 00693
			00682	49 02702 00000
			00689	00005 04809
			00694	00005 99999
04060*	ADDRESS OF A(R,K).			
0407011	TFLS	99999,ZERO	00700	16 02753 00723
			00712	49 02722 00000
			00719	00005 99999
			00724	00005 00541
04080*	ADDRESS OF A(R,K).			
04090	MOVELP TFLS	99999,99999	00730	16 02753 00753
			00742	49 02722 00000
			00749	00005 99999

04100*	W+10, COLADR.		00754	00005 99999
0411012	TFLS	99999,ZERO		
			00760	16 02753 00783
			00772	49 02722 00000
			00779	00005 99999
			00784	00005 00541
04120*	COLADR.			
04130	AM	MOVELP+23,10,10	00790	11 00753 00070
04140	AM	MOVELP+28,10,10	00802	11 00758 00070
04150	AM	12+23,10,10	00814	11 00783 00070
04160	SM	CNTROW,1,10	00826	12 00461 00001
04170	BNN	MOVELP	00838	46 00730 01300
04180	PIVROW TFLS	99999,ONE	00850	16 02753 00873
			00862	49 02722 00000
			00869	00005 99999
			00874	00005 00551
04190*	ADDRESS OF A(R,K).			
04200*				
04210*	(5) MULTIPLY PIVOT ROW BY RECIPROCAL OF PIVOT ELEMENT.			
04220*				
04230	TF	PRLP+23,ROWADR	00880	26 00927 00450
04240	TF	CNTCOL,N	00892	26 00458 00408
04250	PRLP FM	99999,W	00904	16 02753 00927
			00916	49 02682 00000
			00923	00005 99999
			00928	00005 04809
04260	A	PRLP+22,MPL2	00934	21 00926 00418
04270	SM	CNTCOL,1,10	00946	12 00458 00001
04280	BNN	PRLP	00958	46 00904 01300
04290*				
04300*	(6) TRANSFORM ENTIRE MATRIX.			
04310*				
04320	TFM	ROWLP+6,W+10	00970	16 01036 04819
04330	TF	14+11,S	00982	26 01077 00415
04340	A	14+10,MPL2	00994	21 01076 00418
04350	TFM	FMUL+28,W+10	01006	16 01160 04819

04360	TF	CNTROW,M			
04370	ROWLP	CM	99999,99,1011, IS A(I,K), WORKING COLUMN, EQUAL TO ZERO.	01018 26 00461 00404	
04380	BE	NXTROW		01030 14 99999 00099	
04390	TF	ELLP+28,ROWADR		01042 46 01276 01200	
04400	TFM	15+23,99999,,S+10(M+2).		01054 26 01130 00450	
04410	TF	CNTCOL,N		01066 16 01185 99999	
04420	TF	151+6,15+23		01078 26 00458 00408	
04430	ELLP	TFLS TEMP2,99999		01090 26 01198 01185	
				01102 16 02753 01125	
				01114 49 02722 00000	
				01121 00005 00481	
				01126 00005 99999	
04440*	PIVOT ROW ADDRESS. INCREMENT= 10(M+2).				
04450	FMUL	FM	TEMP2,99999		
				01132 16 02753 01155	
				01144 49 02682 00000	
				01151 00005 00481	
				01156 00005 99999	
04460*	W+10, ADDRESS OF A(0,K), WORKING COLUMN. INCREMENT =10.				
04470	FS	99999,TEMP2			
				01162 16 02753 01185	
				01174 49 02662 00000	
				01181 00005 99999	
				01186 00005 00481	
04480*	S+10(M+2), ADDRESS OF FUNCTIONAL. INCREMENT =10(M+2).				
04490	151	C	99999,ESSZER,,SAME ADDRESS AS 15+23. INCREMENT= 10(M+2).		
				01192 24 99999 00553	
04500	BL	LOW		01204 47 01704 01300	
04510	A	ELLP+27,MPL2		01216 21 01129 00418	
04520	A	151+5,MPL2		01228 21 01197 00418	
04530	A	15+22,MPL2		01240 21 01184 00418	
04540	SM	CNTCOL,1,10		01252 12 00458 00001	
04550	BNN	ELLP		01264 46 01102 01300	
04560	NXTROW	AM	ROWLP+6,10,10	01276 11 01036 00010	
04570	AM	FMUL+28,10,10		01288 11 01160 00010	
04580	AM	14+11,10,10		01300 11 01077 00010	

04590	SM	CNTROW,1,10			01312 12 00461 00001
04600	BNN	ROWLP,, IS MATRIX TRANSFORMATION FINISHED.			01324 46 01030 01300
04610*					
04620*	(7)	SWITCH ID/C ELEMENTS.			
04630*					
04640	TF	16+11,ROWADR			01336 26 01431 00450
04650	TF	SWITCH+11,COLADR			01348 26 01419 00445
04660	SM	SWITCH+11,10,10			01360 12 01419 00010
04670	TF	16+6,SWITCH+11			01372 26 01426 01419
04680	S	16+10,MPL2			01384 22 01430 00418
04690	TF	17+6,16+11			01396 26 01438 01431
04700	SWITCH	TF	TEMP2,99999		01408 26 00481 99999
04710	16	TF	99999,99999		01420 26 99999 99999
04720	17	TF	99999,TEMP2		01432 26 99999 00481
04730	AM	ITER+11,1,10			01444 11 01479 00001
04740	BNC1	BBACK			01456 47 01678 00100
04750	ITER	TFM	OUTPUT,0,8		01468 16 00429 00000
04760	WNTY	OUTPUT-3			01480 38 00426 00100
04770	TBTY				01492 34 00000 00108
04780	TF	PR1+28,S			01504 26 01580 00415
04790	A	PR1+27,MPL2,,ADDRESS OF FUNCTIONAL.			01516 21 01579 00418
04800	TF	PR2+11,16+11,,ADDRESS OF VARIABLE IN.			01528 26 01617 01431
04810	TF	PR3+11,16+6,, ADDRESS OF VARIABLE OUT.			01540 26 01653 01426
04820	OPR1	TFLS	OUTPUT,99999		01552 16 02753 01575
					01564 49 02722 00000
					01571 00005 00429
					01576 00005 99999
04830	WNTY	OUTPUT-9			01582 38 00420 00100

04840	TBTY	01594 34 00000 00108
04850PR2	TF OUTPUT,99999	01606 26 00429 99999
04860	WNTY OUTPUT-9	01618 38 00420 00100
04870	TBTY	01630 34 00000 00108
04880PR3	TF OUTPUT,99999	01642 26 00429 99999
04890	WNTY OUTPUT-9	01654 38 00420 00100
04900	RCTY	01666 34 00000 00102
04910BBACK	BNC2 *+24	01678 47 01702 00200
04920	H	01690 48 00000 00000
04930	BB	01702 42 00000 00000
04940	DORG *-9	01704
04950LOW	TF TFL+23,151+6	01704 26 01739 01198
04960TFL	TFLS 99999,ZERO	01716 16 02753 01739
		01728 49 02722 00000
		01735 00005 99999
		01740 00005 00541
04970	B 151+24	01746 49 01216 00000
04980	DORG *-3	01754
04990*		
05000*	DUAL - SELECT SMALLEST B(I).	
05010*		
05020DUAL	TFLS BIMIN,ZERO	01754 16 02753 01777
		01766 49 02722 00000
		01773 00005 00491
		01778 00005 00541
05030	TF CNTROW,M	01784 26 00461 00404
05040	TF CMP1+28,S	01796 26 01890 00415
05050	A CMP1+27,MPL2	01808 21 01889 00418
05060	AM CMP1+28,10,10	01820 11 01890 00000
05070BICOMP	TFLS TEMP1,BIMIN	01832 16 02753 01855
		01844 49 02722 00000
		01851 00005 00471
		01856 00005 00491

05080CMP1	FS TEMP1,99999	01862 16 02753 01885
		01874 49 02662 00000
		01881 00005 00471
		01886 00005 99999
05090*	ADDRESS OF B(J).	
05100	BNP ROWSTP	01892 47 01958 01100
05110NEGA	TF MINBI+28,CMP1+28	01904 26 01944 01890
05120MINBI	TFLS BIMIN,99999	01916 16 02753 01939
		01928 49 02722 00000
		01935 00005 00491
		01940 00005 99999
05130	TF ROWADR,MINBI+28,,SETUP	01946 26 00450 01944
05140ROWSTP	SM CNTROW,1,10	01958 12 00461 00001
05150	BP BICOMP-12	01970 46 01820 01100
05160	BNF END,BIMIN-2,,FINISHED	UNLESS MIN B(I) IS NEGATIVE.
		01982 44 02448 00489
05170*		
05180*	SELECT LARGEST R= D(J)/A(R,J).	
05190*		
05200INITCL	TFLS R,NEGINF	01994 16 02753 02017
		02006 49 02722 00000
		02013 00005 00440
		02018 00005 00531
05210	TFM COLADR,0	02024 16 00445 00000
05220	TF CNTCOL,N	02036 26 00458 00408
05230	TF TSTARJ+6,ROWADR	02048 26 02150 00450
05240	TF CS1+28,S	02060 26 02220 00415
05250	A CS1+27,MPL2	02072 21 02219 00418
05260RETURN	A TSTARJ+5,MPL2	02084 21 02149 00418
05270	TF CMP2+6,TSTARJ+6	02096 26 02174 02150
05280	SM CMP2+6,2,10	02108 12 02174 00002
05290	TF FDI V2+28,TSTARJ+6	02120 26 02250 02150
05300	A CS1+27,MPL2	02132 21 02219 00418
05310TSTARJ	CM 99999,99,1011	02144 14 99999 00099

05320	BE	COLSTP		02156 46 02378 01200
05330CMP2	C	99999,ZERO-2		02168 24 99999 00539
05340	BP	COLSTP		02180 46 02378 01100
05350CS1	TFLS	TEMP2,99999		02192 16 02753 02215
				02204 49 02722 00000
				02211 00005 00481
				02216 00005 99999
05360*	ADDRESS OF D(J).			
05370FDIV2	FD	TEMP2,99999		02222 16 02753 02245
				02234 49 02702 00000
				02241 00005 00481
				02246 00005 99999
05380*	ADDRESS OF A(R,J).			
05390	TFLS	TEMP1,R		02252 16 02753 02275
				02264 49 02722 00000
				02271 00005 00471
				02276 00005 00440
05400	FS	TEMP1,TEMP2		02282 16 02753 02305
				02294 49 02662 00000
				02301 00005 00471
				02306 00005 00481
05410	BP	COLSTP		02312 46 02378 01100
05420	TFLS	R,TEMP2		02324 16 02753 02347
				02336 49 02722 00000
				02343 00005 00440
				02348 00005 00481
05430	TF	ARKADR,FDIV2+28		02354 26 00455 02250
05440	TF	COLADR,CS1+28		02366 26 00445 02220
05450COLSTP	SM	CNTCOL,1,10		02378 12 00458 00001
05460	BP	RETURN		02390 46 02084 01100
05470	CM	COLADR,0		02402 14 00445 00000
05480	BNE	*+14		02414 47 02428 01200
05490	H	,,,ERROR HALT. INCONSISTENT PROBLEM.		02426 48 00000 00000
05500	DORG	*-9		02428
05510	BTM	TRNMTX,0,10		02428 17 00556 00000
05520	B	DUAL		02440 49 01754 00000
05530	DORG	*-3		02448

05540END	RNCD	0	02448 36 00000 00500
05550	B	0	02460 49 00000 00000
05560	DORG	2662	02662
05570	DEND	DUAL	01754
LOAD SUBROUTINES			02662 16 03156 03614
			02674 49 02742
			02682 16 03156 04158
			02694 49 02742
			02702 16 03156 04398
			02714 49 02742
			02722 16 03156 04734
			02734 49 02846
END OF PASS11			

SYMBOL TABLE, LP20-3.

00404	M	00408	N	00410	FORM	00415	S	00418	MPL2
04809	W	00099	PROD	00429	*OUTPUT	00440	R	00445	*COLADR
00450	*ROWADR	00455	*ARKADR	00458	*CNTCOL	00461	*CNTROW	00471	TEMP1
00481	TEMP2	00491	BIMIN	00501	DJMIN	00511	*AIKMAX	00521	INF
00531	*NEGINF	00541	ZERO	00551	ONE	00553	*ESSZER	00556	*TRNMTX
00640	MOVEK	00670	FDIV1	00700	11	00730	*MOVELP	00760	I2
00850	*PIVROW	00904	PRLP	01030	ROWLP	01066	14	01102	ELLP
01132	FUUL	01162	15	01192	151	01276	*NXTROW	01408	*SWITCH
01420	16	01432	17	01468	ITER	01552	PR1	01606	PR2
01642	PR3	01678	BBACK	01704	LOW	01716	TFL	01754	DUAL
01832	*B1COMP	01862	CMPI	01904	NEGA	01916	M1NB1	01958	*ROWSTP
01994	*INITCL	02084	*RETURN	02144	*TSTARJ	02168	CMPI	02192	CS1
02222	FDIV2	02378	*COLSTP	02448	END				

05580* LP20-4, SIMPLEX, LINEAR PROGRAMMING, NOV. 16, 1962.
 05590* REMARKS ON MACROS FOLLOW MACRO INSTRUCTIONS.
 05600*
 05610 DORG 402

05620M	DS	3,,	NUMBER OF RESTRAINING EQUATIONS.	00402
				00404 00003
05630N	DS	4,,	NUMBER OF NONBASIC ACTIVITIES.	00408 00004
05640FORM	DS	2,,	FORM OF INPUT - 0 IMPLIES FLT. PT., 1 IMPLIES DECIMAL	00410 00002
05650S	DS	5,,	REFERENCE ADDRESS FOR MATRIX, = W+10(M+3).	00415 00005
05660MPL2	DS	3,,M+2		00418 00003
05670	DS	1		00419 00001
05680W	DS	,4809,	REFERENCE ADDRESS.	04809 00000
05690PROD	DS	20,99,	PRODUCT ADDRESS.	00099 00020
05700OUTPUT	DS	10		00429 00010
05710	DC	1,@		00430 00001
05720R	DS	10,,	MAX OR MIN RATIO FOR DUAL OR SIMPLEX ALGORITHM.	00440 00010
05730COLADR	DS	5,,	ADDRESS OF D(K).	00445 00005
05740ROWADR	DS	5,,	ADDRESS OF B(R).	00450 00005
05750ARKADR	DS	5,,	ADDRESS OF A(R,K).	00455 00005
05760CNTCOL	DS	3,,	COLUMN COUNTER.	00458 00003
05770CNTROW	DS	3,,	ROW COUNTER.	00461 00003
05780TEMP1	DS	10,,	TEMPORARY WORK ADDRESS.	00471 00010
05790TEMP2	DS	10,,	TEMPORARY WORK ADDRESS.	00481 00010
05800BIMIN	DS	10,,	MINIMUM B(I).	00491 00010
05810DJMIN	DS	10,,	MINIMUM D(J).	00501 00010
05820AIKMAX	DS	10,,	DENOMINATOR OF SIMPLEX RATIO, USED TO BREAK TIES.	00511 00010
05830	DC	8,99999999		00519 00008
05840INF	DC	2,99,,	INFINITY.	00521 00002
05850	DC	8,-99999999		00529 00008

0586	ONEGINF	DC	2,99,,	NEGATIVE INFINITY.	00531	00002
05870		DC	8,0		00539	00008
05880	ZERO	DC	2,-99,,	ZERO	00541	00002
05890		DC	8,10000000		00549	00008
05900	ONE	DC	2,1,,	ONE.	00551	00002
05910	ESSZER	DC	2,-07		00553	00002
05920*						
05930*	TRANSFORM ENTIRE MATRIX.					
05940*	(1) COMPUTE RECIPROCAL OF PIVOT ELEMENT.					
05950*	(2) SET PIVOT CELL = ZERO.					
05960*	(3) MOVE PIVOT COLUMN TO WORKING COLUMN.					
05970*	(4) SET PIVOT COLUMN = UNIT VECTOR.					
05980*						
05990	DS		2		00555	00002
06000	TRNMTX	TF	11+23,	ARKADR	00556	26 00723 00455
06010		TF	12+23,	COLADR	00568	26 00783 00445
06020		TF	CNTROW,	M	00580	26 00461 00404
06030		TF	FDIV1+28,	ARKADR	00592	26 00698 00455
06040		TFM	MOVELP+23,	W+10	00604	16 00753 04819
06050		TF	MOVELP+28,	COLADR	00616	26 00758 00445
06060		TF	PIVROW+23,	ARKADR	00628	26 00873 00455
06070	MOVEK	TFLS	W,ONE		00640	16 02753 00663
					00652	49 02722 00000
					00659	00005 04809
					00664	00005 00551
06080	FDIV1	FD	W,99999		00670	16 02753 00693
					00682	49 02702 00000
					00689	00005 04809
					00694	00005 99999
06090*	ADDRESS OF A(R,K).					
0610011	TFLS 99999,ZERO				00700	16 02753 00723
					00712	49 02722 00000
					00719	00005 99999
					00724	00005 00541

06110*	ADDRESS OF A(R,K).					
06120	MOVELP	TFLS	99999,	99999	00730	16 02753 00753
					00742	49 02722 00000
					00749	00005 99999
					00754	00005 99999
06130*	W+10, COLADR.					
0614012	TFLS 99999,ZERO				00760	16 02753 00783
					00772	49 02722 00000
					00779	00005 99999
					00784	00005 00541
06150*	COLADR.					
06160	AM	MOVELP+23,		10,10	00790	11 00753 00070
06170	AM	MOVELP+28,		10,10	00802	11 00758 00070
06180	AM	12+23,		10,10	00814	11 00783 00070
06190	SM	CNTROW,		1,10	00826	12 00461 00001
06200	BNN	MOVELP			00838	46 00730 01300
06210	PIVROW	TFLS	99999,	ONE	00850	16 02753 00873
					00862	49 02722 00000
					00869	00005 99999
					00874	00005 00551
06220*	ADDRESS OF A(R,K).					
06230*	(5) MULTIPLY PIVOT ROW BY RECIPROCAL OF PIVOT ELEMENT.					
06240*						
06250*						
06260	TF	PRLP+23,		ROWADR	00880	26 00927 00450
06270	TF	CNTCOL,		N	00892	26 00458 00408
06280	PRLP	FM	99999,	W	00904	16 02753 00927
					00916	49 02682 00000
					00923	00005 99999
					00928	00005 04809
06290	A	PRLP+22,		MPL2	00934	21 00926 00418
06300	SM	CNTCOL,		1,10	00946	12 00458 00001
06310	BNN	PRLP			00958	46 00904 01300
06320*	(6) TRANSFORM ENTIRE MATRIX.					
06330*						
06340*						
06350	TFM	ROWLP+6,		W+10	00970	16 01036 04819

06360	TF	14+11,S			
06370	A	14+10,MPL2	00982	26 01077	00415
06380	TFM	FMUL+28,W+10	00994	21 01076	00418
06390	TF	CNTROW,M	01006	16 01160	04819
06400	ROWLP	CM 99999,99,1011, IS A(I,K), WORKING COLUMN, EQUAL TO ZERO.	01018	26 00461	00404
06410	BE	NXTROW	01030	14 99999	00099
06420	TF	ELLP+28,ROWADR	01042	46 01276	01200
06430	TFM	15+23,99999,,S+10(M+2).	01054	26 01130	00450
06440	TF	CNTCOL,N	01066	16 01185	99999
06450	TF	151+6,15+23	01078	26 00458	00408
06460	ELLP	TFLS TEMP2,99999	01090	26 01198	01185
06470*	PIVOT ROW ADDRESS. INCREMENT=	10(M+2).	01102	16 02753	01125
06480	FMUL	FM TEMP2,99999	01114	49 02722	00000
			01121	00005	00481
			01126	00005	99999
			01132	16 02753	01155
			01144	49 02682	00000
			01151	00005	00481
			01156	00005	99999
06490*	W+10, ADDRESS OF A(O,K), WORKING COLUMN. INCREMENT =10.		01162	16 02753	01185
06500	FS	99999,TEMP2	01174	49 02662	00000
			01181	00005	99999
			01186	00005	00481
06510*	S+10(M+2), ADDRESS OF FUNCTIONAL. INCREMENT =10(M+2).		01192	24 99999	00553
06520	C	99999,ESSZER,,SAME ADDRESS AS 15+23. INCREMENT= 10(M+2).	01204	47 01704	01300
06530	BL	LOW	01216	21 01129	00418
06540	A	ELLP+27,MPL2	01228	21 01197	00418
06550	A	151+5,MPL2	01240	21 01184	00418
06560	A	15+22,MPL2	01252	12 00458	00001
06570	SM	CNTCOL,1,10	01264	46 01102	01300
06580	BNN	ELLP			

06590	NXTROW	AM	ROWLP+6,10,10	01276	11 01036	00010
06600	AM	FMUL+28,10,10	01288	11 01160	00010	
06610	AM	14+11,10,10	01300	11 01077	00010	
06620	SM	CNTROW,1,10	01312	12 00461	00001	
06630	BNN	ROWLP,, IS MATRIX TRANSFORMATION FINISHED.	01324	46 01030	01300	
06640*						
06650*	(7)	SWITCH ID/C ELEMENTS.				
06660*	TF	16+11,ROWADR	01336	26 01431	00450	
06670	TF	SWITCH+11,COLADR	01348	26 01419	00445	
06680	SM	SWITCH+11,10,10	01360	12 01419	00010	
06690	TF	16+6,SWITCH+11	01372	26 01426	01419	
06700	S	16+10,MPL2	01384	22 01430	00418	
06710	TF	17+6,16+11	01396	26 01438	01431	
06720	TF	TEMP2,99999	01408	26 00481	99999	
06730	SWITCH	TF	01420	26 99999	99999	
06740	TF	99999,99999	01432	26 99999	00481	
06750	TF	99999,TEMP2	01444	11 01479	00001	
06760	AM	ITER+11,1,10	01456	47 01678	00100	
06770	BNC1	BBACK	01468	16 00429	00000	
06780	ITER	TFM OUTPUT,0,8	01480	38 00426	00100	
06790	WNTY	OUTPUT-3	01492	34 00000	00108	
06800	TBTY		01504	26 01580	00415	
06810	TF	PR1+28,S	01516	21 01579	00418	
06820	A	PR1+27,MPL2,,ADDRESS OF FUNCTIONAL.	01528	26 01617	01431	
06830	TF	PR2+11,16+11,,ADDRESS OF VARIABLE IN.	01540	26 01653	01426	
06840	TF	PR3+11,16+6,, ADDRESS OF VARIABLE OUT.	01552	16 02753	01575	
06850	OPR1	TFLS OUTPUT,99999	01564	49 02722	00000	
			01571	00005	00429	
			01576	00005	99999	

06860	WNTY OUTPUT-9	01582 38 00420 00100
06870	TBTY	01594 34 00000 00108
06880PR2	TF OUTPUT,99999	01606 26 00429 99999
06890	WNTY OUTPUT-9	01618 38 00420 00100
06900	TBTY	01630 34 00000 00108
06910PR3	TF OUTPUT,99999	01642 26 00429 99999
06920	WNTY OUTPUT-9	01654 38 00420 00100
06930	RCTY	01666 34 00000 00102
06940BBACK	BNC2 *+24	01678 47 01702 00200
06950	H	01690 48 00000 00000
06960	BB	01702 42 00000 00000
06970	DORG *-9	01704
06980LOW	TF TFL+23,151+6	01704 26 01739 01198
06990TFL	TFLS 99999,ZERO	01716 16 02753 01739
		01728 49 02722 00000
		01735 00005 99999
		01740 00005 00541
07000	B 151+24	01746 49 01216 00000
07010	DORG *-3	01754
07020*		
07030*	SIMPLEX ALGORITHM - SELECT MINIMUM D(J)=D(K).	
07040*		
07050SIMPLX	TFLS DJMIN,ZERO	01754 16 02753 01777
		01766 49 02722 00000
		01773 00005 00501
		01778 00005 00541
07060	TF CNTCOL,N	01784 26 00458 00408
07070	TF DJCOMP+28,S	01796 26 01860 00415
07080	A DJCOMP+27,MPL2	01808 21 01859 00418
07090	A DJCOMP+27,MPL2	01820 21 01859 00418
07100DJCOMP	TFLS TEMP1,99999	01832 16 02753 01855

		01844 49 02722 00000
		01851 00005 00471
		01856 00005 99999
07110*	ADDRESS OF D(J). INCREMENT = 10(M+2).	
07120	FS TEMP1,DJMIN	01862 16 02753 01885
		01874 49 02662 00000
		01881 00005 00471
		01886 00005 00501
07130	BNN COLSTP	01892 46 01958 01300
07140	TF MIN+28,DJCOMP+28	01904 26 01944 01860
07150MIN	TFLS DJMIN,99999	01916 16 02753 01939
		01928 49 02722 00000
		01935 00005 00501
		01940 00005 99999
07160	TF COLADR,MIN+28	01946 26 00445 01944
07170COLSTP A	DJCOMP+27,MPL2	01958 21 01859 00418
07180	SM CNTCOL,1,10	01970 12 00458 00001
07190	BP DJCOMP	01982 46 01832 01100
07200	BNF END,DJMIN-2	01994 44 02642 00499
07210*		
07220*	SELECT MINIMUM R(I)=B(I)/A(I,K).	
07230*		
07240INITRO	TFLS R,INF	02006 16 02753 02029
		02018 49 02722 00000
		02025 00005 00440
		02030 00005 00521
07250	TFM ROWADR,0	02036 16 00450 00000
07260	TF CNTROW,M	02048 26 00461 00404
07270	TF TSTAIK+6,COLADR	02060 26 02146 00445
07280*	ADDRESS OF MINIMUM D(J).	
07290	TF TSTAIK+35,TSTAIK+6	02072 26 02175 02146
07300	SM TSTAIK+35,2,10	02084 12 02175 00002
07310	TF CS1+28,S	02096 26 02212 00415
07320	A CS1+27,MPL2	02108 21 02211 00418
07330	TF FDIV3+28,COLADR	02120 26 02242 00445

07340	B	ROWSTP+24			
07350	DORG	*-3	02132	49	02436 00000
07360	TSTAIK	CM 99999,99,1011, IS A(I,K) = ZERO.	02140		
07370	BE	ROWSTP	02140	14	99999 00099
07380	BNF	CS1,99999,, IS A(I,K) NEGATIVE.	02152	46	02412 01200
07390	B	ROWSTP	02164	44	02184 99999
07400	DORG	*-3	02176	49	02412 00000
07410	CS1	TFLS TEMP2,99999	02184		
07420*		ADDRESS OF B(I). INCREMENT=10.	02184	16	02753 02207
07430	F DIV3	TEMP2,99999	02196	49	02722 00000
			02203	00005	00481
			02208	00005	99999
07440*		ADDRESS OF A(I,K). INCREMENT = 10.	02214	16	02753 02237
07450	TFLS	TEMP1,TEMP2	02226	49	02702 00000
			02233	00005	00481
			02238	00005	99999
			02244	16	02753 02267
			02256	49	02722 00000
			02263	00005	00471
			02268	00005	00481
07460	FS	TEMP1,R	02274	16	02753 02297
			02286	49	02662 00000
			02293	00005	00471
			02298	00005	00440
07470	BP	ROWSTP	02304	46	02412 01100
07480	BE	EQUAL	02316	46	02492 01200
07490	TAKER	TF MAX+28,TSTAIK+6	02328	26	02368 02146
07500	MAX	TFLS AIKMAX,99999	02340	16	02753 02363
			02352	49	02722 00000
			02359	00005	00511
			02364	00005	99999
07510	TFLS	R,TEMP2	02370	16	02753 02393
			02382	49	02722 00000
			02389	00005	00440
			02394	00005	00481
07520	TF	ROWADR,CS1+28	02400	26	00450 02212
07530	ROWSTP	SM CNTROW,1,10	02412	12	00461 00001
07540	BNP	TSTBND	02424	47	02584 01100
07550	AM	TSTAIK+6,10,10	02436	11	02146 00010

07560	AM	TSTAIK+35,10,10	02448	11	02175 00010
07570	AM	CS1+28,10,10	02460	11	02212 00010
07580	AM	FDIV3+28,10,10	02472	11	02242 00010
07590	B	TSTAIK	02484	49	02140 00000
07600	DORG	*-3	02492		
07610	EQUAL	TFLS TEMP1,AIKMAX	02492	16	02753 02515
			02504	49	02722 00000
			02511	00005	00471
			02516	00005	00511
07620	TF	FSUB2+28,TSTAIK+6	02522	26	02562 02146
07630	FS	TEMP1,99999	02534	16	02753 02557
			02546	49	02662 00000
			02553	00005	00471
			02558	00005	99999
07640	BL	TAKER	02564	47	02328 01300
07650	B	ROWSTP	02576	49	02412 00000
07660	DORG	*-3	02584		
07670	TSTBND	CM ROWADR,0	02584	14	00450 00000
07680	BNE	*+14	02596	47	02610 01200
07690	H	,,,ERROR HALT. UNBOUNDED SOLUTION.	02608	48	00000 00000
07700	DORG	*-9	02610		
07710	TF	ARKADR,MAX+28	02610	26	00455 02368
07720	BTM	TRNMTX,0,10	02622	17	00556 00000
07730	B	SIMPLX	02634	49	01754 00000
07740	DORG	*-3	02642		
07750	END	RNCD 0	02642	36	00000 00500

END OF PASS 1

07760 B 0
07770 DORG *-3
07780 DEND SIMPLX
LOAD SUBROUTINES

02654 49 00000 00000
02662
01754
02662 16 03156 03614
02674 49 02742
02682 16 03156 04158
02694 49 02742
02702 16 03156 04398
02714 49 02742
02722 16 03156 04734
02734 49 02846

94.

SYMBOL TABLE, SIMPLEX

00404	M	00408	N	00410	FORM	00415	S	00418	MPL2
04809	W	00099	PROD	00429	*OUTPUT	00440	R	00445	*COLADR
00450	*ROWADR	00455	*ARKADR	00458	*CNTCOL	00461	*CNTROW	00471	TEMP1
00481	TEMP2	00491	BIMIN	00501	DJMIN	00511	*AIKMAX	00521	INF
00531	*NEGINF	00541	ZERO	00551	ONE	00553	*ESSZER	00556	*TRNMTX
00640	MOVEK	00670	FDIV1	00700	I1	00730	*MOVELP	00760	I2
00850	*PIVROW	00904	PRLP	01030	ROWLP	01066	I4	01102	ELLP
01132	FMUL	01162	I5	01192	I51	01276	*NXTROW	01408	*SWITCH
01420	I6	01432	I7	01468	ITER	01552	PR1	01606	PR2
01642	PR3	01678	BBACK	01704	LOW	01716	TFL	01754	*SIMPLX
01832	*DJCOMP	01916	MIN	01958	*COLSTP	02006	*INITRO	02140	*TSTAIK
02184	CS1	02214	FDIV3	02328	TAKER	02340	MAX	02412	*ROWSTP
02492	EQUAL	02534	FSUB2	02584	*TSTBND	02642	END		

95.

07790* LP20-5A, SOLUTION PRINT, LINEAR PROGRAMMING, NOV. 16, 1962.

07800*				
07810	DORG 402			
		00402		
07820M	DS 3			
		00404	00003	
07830N	DS 4			
		00408	00004	
07840FORM	DS 2			
		00410	00002	
07850S	DS 5			
		00415	00005	
07860MPL2	DS 3			
		00418	00003	
07870	DS 1			
		00419	00001	
07880COUNT	DS 3			
		00422	00003	
07890ALPHA	DAS 80			
		00425	00080	
07900	DAC 1,@			
		00585	00001	
07910FUN	DAC 14,FUNCTIONAL = @			
		00587	00014	
07920HDNG1	DAC 15,BASIC SOLUTION@			
		00615	00015	
07930HDNG2	DAC 33, ID CJ			
		LEVEL @		
		00645	00033	
07940HDNG3	DAC 33, ID CJ			
		SHADOW PRICES @		
		00711	00033	
07950START	RCTY			
		00776	34 00000 00102	
07960	RCTY			
		00788	34 00000 00102	
07970	WATY FUN			
		00800	39 00587 00100	
07980	TF FUNCT+28,S			
		00812	26 00864 00415	
07990	A FUNCT+27,MPL2			
		00824	21 00863 00418	
08000FUNCT	BTFS FLTFIX,99999			
		00836	16 02607 00859	
		00848	49 02576 00000	
		00855	00005 01452	
		00860	00005 99999	
08010	WATY OUTPUT-20			
		00866	39 02319 00100	
08020	RCTY			
		00878	34 00000 00102	
08030	RCTY			
		00890	34 00000 00102	
08040	WATY HDNG1			
		00902	39 00615 00100	
08050	RCTY			
		00914	34 00000 00102	

08060	RCTY			
08070	WATY HDNG2			00926 34 00000 00102
08080	RCTY			00938 39 00645 00100
08090	RCTY			00950 34 00000 00102
08100	TF COUNT,M			00962 34 00000 00102
08110	TF BT1+11,S			00974 26 00422 00404
08120	TF BT2+28,BT1+11			00986 26 01057 00415
08130	A BT2+27,MPL2			00998 26 01110 01057
08140LOOP1	AM BT1+11,10,10			01010 21 01109 00418
08150	AM BT2+28,10,10			01022 11 01057 00010
08160BT1	BT FIXID,99999			01034 11 01110 00010
08170	WATY OUTPUT-26			01046 27 02376 99999
08180	TBTY			01058 39 02313 00100
08190BT2	BTFS FLTFIX,99999			01070 34 00000 00108
				01082 16 02607 01105
				01094 49 02576 00000
				01101 00005 01452
				01106 00005 99999
08200	WATY OUTPUT-20			01112 39 02319 00100
08210	RCTY			01124 34 00000 00102
08220	SM COUNT,1,10			01136 12 00422 00001
08230	BP LOOP1			01148 46 01022 01100
08240	RCTY			01160 34 00000 00102
08250	WATY HDNG3			01172 39 00711 00100
08260	RCTY			01184 34 00000 00102
08270	RCTY			01196 34 00000 00102
08280	TF COUNT,N			01208 26 00422 00408
08290	TF BT3+28,S			01220 26 01344 00415
08300	A BT3+27,MPL2			01232 21 01343 00418

08310	A	BT3+27,MPL2	01244	21	01343	00418
08320	TF	LOOP2+11,BT3+28	01256	26	01291	01344
08330	SM	LOOP2+11,10,10	01268	12	01291	000T0
08340	BT	FIXID,99999	01280	27	02376	99999
08350	WATY	OUTPUT-26	01292	39	02313	00100
08360	TBTY		01304	34	00000	00108
08370	BTFS	FLTFIX,99999	01316	16	02607	01339
			01328	49	02576	00000
			01335	00005	01452	
			01340	00005	99999	
08380	WATY	OUTPUT-20	01346	39	02319	00100
08390	RCTY		01358	34	00000	00102
08400	A	LOOP2+10,MPL2	01370	21	01290	00418
08410	A	BT3+27,MPL2	01382	21	01343	00418
08420	SM	COUNT,1,10	01394	12	00422	00001
08430	BP	LOOP2	01406	46	01280	01100
08440	RNCD	0	01418	36	00000	00500
08450	B	0	01430	49	00000	00000
08460*						
08470*	SUBROUTINE FOR PREPARING DATA FOR ALPHAMERICAL PRINTING OR					
08480*	PUNCHING. INTERNAL FORMAT IS NEW SPS.					
08490*						
08500	ARG	DS 10	01451	00010		
08510	FLTFIX	CF ARG-9	01452	33	01442	00000
08520	TF	OUTPUT,SEVENS	01464	26	02339	02351
08530	CF	OUTPUT-9	01476	33	02330	00000
08540	TF	OUTPUT-10,DCMAL	01488	26	02329	02361
08550	TFM	OUTPUT-19,0,9	01500	16	02320	00000
08560	TFM	SIGN,0,10	01512	16	02363	00000
08570	BNF	JUMP,ARG-2	01524	44	01560	01449

08580	TDM	SIGN-1,2,11	01536	15	02362	00002
08590	CF	ARG-2	01548	33	01449	00000
08600	JUMP	CM ARG,99,1011	01560	14	01451	00099
08610	BE	WRALPH	01572	46	01896	01200
08620	CM	ARG,0,10	01584	14	01451	00000
08630	BNP	DECIML	01596	47	01942	01100
08640	CM	ARG,4,10	01608	14	01451	00004
08650	BH	LARGE	01620	46	02022	01100
08660	TFM	TRNMT+11,ARG-9	01632	16	01691	01442
08670	TFM	*+42,OUTPUT-10	01644	16	01686	02329
08680	S	*+30,ARG	01656	22	01686	01451
08690	S	*+18,ARG	01668	22	01686	01451
08700	TRNMT	TD 99999,99999	01680	25	99999	99999
08710	AM	TRNMT+11,1,10	01692	11	01691	00001
08720	AM	TRNMT+6,2,10	01704	11	01686	00002
08730	CM	TRNMT+6,OUTPUT-12	01716	14	01686	02327
08740	BNH	TRNMT	01728	47	01680	01100
08750	TF	WRITE+23,TRNMT+11	01740	26	01847	01691
08760	TFM	EXPNT2,5,10	01752	16	02365	00005
08770	S	EXPNT2,ARG	01764	22	02365	01451
08780	TFM	*+47,SEVENS	01776	16	01823	02351
08790	S	*+35,EXPNT2	01788	22	01823	02365
08800	S	*+23,EXPNT2	01800	22	01823	02365
08810	A	OUTPUT-12,99999	01812	21	02327	99999
08820	WRITE	TFM *+18,OUTPUT-8	01824	16	01842	02331
08830	TD	OUTPUT-8,0	01836	25	02331	00000
08840	AM	WRITE+23,1,10	01848	11	01847	00001
08850	AM	WRITE+18,2,10	01860	11	01842	00002

08860	CM	WRITE+18,OUTPUT	01872	14	01842	02339
08870	BNH	WRITE+12	01884	47	01836	01100
08880	WRALPH	BD SETZRO,OUTPUT-18	01896	43	01916	02321
08890	B	SETSIG	01908	49	02228	00000
08900	DORG	*-3	01916			
08910	SETZRO	TDM OUTPUT,0	01916	15	02339	00000
08920	TF	OUTPUT-20,SIGN	01928	26	02319	02363
08930	BB		01940	42	00000	00000
08940	DORG	*-9	01942			
08950	DECIML	CM ARG,4,1011	01942	14	01451	00004
08960	BNH	LARGE	01954	47	02022	01100
08970	TFM	WRITE+23,ARG-9	01966	16	01847	01442
08980	TFM	WRITE+18,OUTPUT-8	01978	16	01842	02331
08990	S	WRITE+18,ARG	01990	22	01842	01451
09000	S	WRITE+18,ARG	02002	22	01842	01451
09010	B	WRITE+12	02014	49	01836	00000
09020	DORG	*-3	02022			
09030	LARGE	TF OUTPUT-17,SEVENS-7	02022	26	02322	02344
09040	BNF	JUMP2,ARG	02034	44	02082	01451
09050	TFM	OUTPUT-20,20,10	02046	16	02319	00020
09060	CF	ARG	02058	33	01451	00000
09070	CF	OUTPUT-19	02070	33	02320	00000
09080	JUMP2	TD OUTPUT-16,ARG	02082	25	02323	01451
09090	TD	OUTPUT-18,ARG-1	02094	25	02321	01450
09100	CF	OUTPUT-18	02106	33	02321	00000
09110	TF	OUTPUT-12,SIGN	02118	26	02327	02363
09120	CF	OUTPUT-13	02130	33	02326	00000
09130	TFM	WR+11,ARG-9	02142	16	02177	01442

09140	TFM	WR+6,OUTPUT-8	02154	16	02172	02331
09150	WR	TD 99999,99999	02166	25	99999	99999
09160	AM	WR+11,1,10	02178	11	02177	00001
09170	AM	WR+6,2,10	02190	11	02172	00002
09180	CM	WR+6,OUTPUT	02202	14	02172	02339
09190	BNH	WR	02214	47	02166	01100
09200	BB		02226	42	00000	00000
09210	DORG	*-9	02228			
09220	SETSIG	TFM SETS+11,OUTPUT-16	02228	16	02251	02323
09230	SETS	BD SET,OUTPUT-16	02240	43	02272	02323
09240	AM	SETS+11,2,10	02252	11	02251	00002
09250	B	SETS	02264	49	02240	00000
09260	DORG	*-3	02272			
09270	SET	TF **30,SETS+11	02272	26	02302	02251
09280	SM	**18,2,10	02284	12	02302	00002
09290	TF	99999,SIGN	02296	26	99999	02363
09300	BB		02308	42	00000	00000
09310	DORG	*-9	02310			
09320	DAS	14	02311	00014		
09330	OUTPUT	DS 2	02339	00002		
09340	DAC	1,@	02341	00001		
09350	SEVENS	DC 10,7070707070	02351	00010		
09360	DCMAL	DC 10,0000000003	02361	00010		
09370	SIGN	DS 2	02363	00002		
09380	EXPNT2	DS 2	02365	00002		
09390*						
09400*	SUBROUTINE FOR PREPARING ID/CJ ELEMENTS FOR PRINTING.					
09410*						
09420	DS	10	02375	00010		

09430	FIXID TR	OUTPUT-27, ID-1				
09440	TD	OUTPUT-26, FIXID-10	02376	31	02312	02546
09450	TD	OUTPUT-24, FIXID-9	02388	25	02313	02366
09460	TD	OUTPUT-22, FIXID-8	02400	25	02315	02367
09470	TD	OUTPUT-20, FIXID-7	02412	25	02317	02368
09480	TD	OUTPUT-12, FIXID-6	02424	25	02319	02369
09490	TD	OUTPUT-10, FIXID-5	02436	25	02327	02370
09500	TD	OUTPUT-8, FIXID-4	02448	25	02329	02371
09510	TD	OUTPUT-4, FIXID-3	02460	25	02331	02372
09520	TD	OUTPUT-2, FIXID-2	02472	25	02335	02373
09530	TD	OUTPUT, FIXID-1	02484	25	02337	02374
09540	BNF	*+36, FIXID-1	02496	25	02339	02375
09550	TFM	OUTPUT-14, 20, 10	02508	44	02544	02375
09560	CF	OUTPUT-15	02520	16	02325	00020
09570	BB		02532	33	02324	00000
09580	DORG	*-9	02544	42	00000	00000
09590	DAC	15,0000 000.000@	02546			
09600	DEND	START	02547	00015		
	LOAD	SUBROUTINES	00776			
	END OF	PASS11	02576	16	03010	03468
			02588	49	02700	0

SYMBOL TABLE, LP 20-5A

00404	M	COUNT	00408	FORM	00415	S	00418	MPL2
00422	ALPHA	00425	FUN	FUNCT	00615	HDNG1	00645	HDNG2
00711	START	00776	BT3	BT3	01022	LOOP1	01046	BT1
01082	LOOP2	01280	WRITE	WRITE	01451	ARG	01452	*FLTFIX
01560	JUMP	01680	JUMP2	JUMP2	01896	*WRALPH	01916	*SETZRO
01942	*DECIML	02022	LARGE	LARGE	02166	WR	02228	*SETSIG
02240	SETS	02272	SET	*OUTPUT	02351	*SEVENS	02361	DCNAL
02363	SIGN	02365	*EXPNT2	FIXID	02547	ID		

09610* LP20-5B, SOLUTION PUNCH, LINEAR PROGRAMMING, NOV. 16, 1962.

09620*			
09630	DORG 402		00402
09640M	DS 3		00404 00003
09650N	DS 4		00408 00004
09660FORM	DS 2		00410 00002
09670S	DS 5		00415 00005
09680MPL2	DS 3		00418 00003
09690	DS 1		00419 00001
09700COUNT	DS 3		00422 00003
09710ALPHA	DAS 80		00425 00080
09720	DAC 1,@		00585 00001
09730FUN	DAC 14,FUNCTIONAL = @		00587 00014
09740HDNG1	DAC 15,BASIC SOLUTION@		00615 00015
09750HDNG2	DAC 33,1D CJ		LEVEL @
09760HDNG3	DAC 33,1D CJ	SHADOW PRICES @	00645 00033
09770BLANKS	DAS 80		00711 00033
09780	DAC 1,@		00777 00080
09790ITER	DC 3,001		00937 00001
09800START	RNCD BLANKS-1		00940 00003
09810	RNCD BLANKS+79		00942 36 00776 00500
09820	WACD BLANKS		00954 36 00856 00500
09830	TR ALPHA-1,BLANKS-1		00966 39 00777 00400
09840	TF ALPHA+24,FUN+24		00978 31 00424 00776
09850	TF FUNCT+28,S		00990 26 00449 00611
09860	A FUNCT+27,MPL2		01002 26 01054 00415
09870FUNCT	BTFS FLTFIX,99999		01014 21 01053 00418
			01026 16 03091 01049
			01038 49 03060 00000
			01045 00005 01834

09880	TF ALPHA+46,OUTPUT	01050 00005 99999
09890	BT FIXIT,ITER	01056 26 00471 02721
09900	AM ITER,1,10	01068 27 02974 00940
09910	WACD ALPHA	01080 11 00940 00001
09920	TR ALPHA-1,BLANKS-1	01092 39 00425 00400
09930	WACD BLANKS	01104 31 00424 00776
09940	TF ALPHA+26,HDNG1+26	01116 39 00777 00400
09950	BT FIXIT,ITER	01128 26 00451 00641
09960	AM ITER,1,10	01140 27 02974 00940
09970	WACD ALPHA	01152 11 00940 00001
09980	TR ALPHA-1,BLANKS-1	01164 39 00425 00400
09990	WACD BLANKS	01176 31 00424 00776
10000	TF ALPHA+62,HDNG2+62	01188 39 00777 00400
10010	BT FIXIT,ITER	01200 26 00487 00707
10020	AM ITER,1,10	01212 27 02974 00940
10030	WACD ALPHA	01224 11 00940 00001
10040	TR ALPHA-1,BLANKS-1	01236 39 00425 00400
10050	WACD BLANKS	01248 31 00424 00776
10060	TF COUNT,M	01260 39 00777 00400
10070	TF BT1+11,S	01272 26 00422 00404
10080	TF BT2+28,BT1+11	01284 26 01355 00415
10090	A BT2+27,MPL2	01296 26 01396 01355
10100LOOP1	AM BT1+11,10,10	01308 21 01395 00418
10110	AM BT2+28,10,10	01320 11 01355 00010
10120BT1	BT FIXID,99999	01332 11 01396 00010
10130	TF ALPHA+26,OUTPUT	01344 27 02758 99999
10140BT2	BTFS FLTFIX,99999	01356 26 00451 02721
		01368 16 03091 01391
		01380 49 03060 00000

10150	TF	ALPHA+56,OUTPUT	01387 00005 01834
			01392 00005 99999
10160	BT	FIXIT,ITER	01398 26 00481 02721
10170	AM	ITER,1,10	01410 27 02974 00940
10180	WACD	ALPHA	01422 11 00940 00001
10190	TR	ALPHA-1,BLANKS-1	01434 39 00425 00400
10200	SM	COUNT,1,10	01446 31 00424 00776
10210	BP	LOOP1	01458 12 00422 00001
10220	WACD	BLANKS	01470 46 01320 01100
10230	TF	ALPHA+62,HDNG3+62	01482 39 00777 00400
10240	BT	FIXIT,ITER	01494 26 00487 00773
10250	AM	ITER,1,10	01506 27 02974 00940
10260	WACD	ALPHA	01518 11 00940 00001
10270	TR	ALPHA-1,BLANKS-1	01530 39 00425 00400
10280	WACD	BLANKS	01542 31 00424 00776
10290	TF	COUNT,N	01554 39 00777 00400
10300	TF	BT3+28,S	01566 26 00422 00408
10310	A	BT3+27,MPL2	01578 26 01690 00415
10320	A	BT3+27,MPL2	01590 21 01689 00418
10330	TF	LOOP2+11,BT3+28	01602 21 01689 00418
10340	SM	LOOP2+11,10,10	01614 26 01649 01690
10350	BT	FIXID,99999	01626 12 01649 00070
10360	TF	ALPHA+26,OUTPUT	01638 27 02758 99999
10370	BTFS	FLTFIX,99999	01650 26 00451 02721
			01662 16 03091 01685
			01674 49 03060 00000
			01681 00005 01834
			01686 00005 99999
10380	TF	ALPHA+56,OUTPUT	01692 26 00481 02721
10390	BT	FIXIT,ITER	01704 27 02974 00940

10400	AM	ITER,1,10	01716 11 00940 00001
10410	WACD	ALPHA	01728 39 00425 00400
10420	TR	ALPHA-1,BLANKS-1	01740 31 00424 00776
10430	A	LOOP2+10,MPL2	01752 21 01648 00418
10440	A	BT3+27,MPL2	01764 21 01689 00418
10450	SM	COUNT,1,10	01776 12 00422 00001
10460	BP	LOOP2	01788 46 01638 01100
10470	RNCD	0	01800 36 00000 00500
10480	B	0	01812 49 00000 00000
10490*			
10500*	SUBROUTINE FOR PREPARING DATA FOR ALPHAMERICAL PRINTING OR		
10510*	PUNCHING. INTERNAL FORMAT IS NEW SPS.		
10520*			
10530	ARG	DS 10	01833 00010
10540	FLTFIX	CF ARG-9	01834 33 01824 00000
10550	TF	OUTPUT,SEVENS	01846 26 02721 02733
10560	CF	OUTPUT-9	01858 33 02712 00000
10570	TF	OUTPUT-10,DCMAL	01870 26 02711 02743
10580	TFM	OUTPUT-19,0,9	01882 16 02702 00000
10590	TFM	SIGN,0,10	01894 16 02745 00000
10600	BNF	JUMP,ARG-2	01906 44 01942 01831
10610	TDM	SIGN-1,2,11	01918 15 02744 00002
10620	CF	ARG-2	01930 33 01831 00000
10630	JUMP	CM ARG,99,1011	01942 14 01833 00009
10640	BE	WRALPH	01954 46 02278 01200
10650	CM	ARG,0,10	01966 14 01833 00000
10660	BNP	DECIML	01978 47 02324 01100
10670	CM	ARG,4,10	01990 14 01833 00004
10680	BH	LARGE	02002 46 02404 01100

10690	TFM	TRNMT+11,ARG-9	02014	16	02073	01824
10700	TFM	*+42,OUTPUT-10	02026	16	02068	02711
10710	S	*+30,ARG	02038	22	02068	01833
10720	S	*+18,ARG	02050	22	02068	01833
10730	TRNMT	TD 99999,99999	02062	25	99999	99999
10740	AM	TRNMT+11,1,10	02074	11	02073	00001
10750	AM	TRNMT+6,2,10	02086	11	02068	00002
10760	CM	TRNMT+6,OUTPUT-12	02098	14	02068	02709
10770	BNH	TRNMT	02110	47	02062	01100
10780	TF	WRITE+23,TRNMT+11	02122	26	02229	02073
10790	TFM	EXPNT2,5,10	02134	16	02747	00005
10800	S	EXPNT2,ARG	02146	22	02747	01833
10810	TFM	*+47,SEVENS	02158	16	02205	02733
10820	S	*+35,EXPNT2	02170	22	02205	02747
10830	S	*+23,EXPNT2	02182	22	02205	02747
10840	A	OUTPUT-12,99999	02194	21	02709	99999
10850	WRITE	TFM *+18,OUTPUT-8	02206	16	02224	02713
10860	TD	OUTPUT-8,0	02218	25	02713	00000
10870	AM	WRITE+23,1,10	02230	11	02229	00001
10880	AM	WRITE+18,2,10	02242	11	02224	00002
10890	CM	WRITE+18,OUTPUT	02254	14	02224	02721
10900	BNH	WRITE+12	02266	47	02218	01100
10910	WRALPH	BD SETZRO,OUTPUT-18	02278	43	02298	02703
10920	B	SETSIG	02290	49	02610	00000
10930	DORG	*-3	02298			
10940	SETZRO	TDM OUTPUT,0	02298	15	02721	00000
10950	TF	OUTPUT-20,SIGN	02310	26	02701	02745
10960	BB		02322	42	00000	00000

10970	DORG	*-9	02324			
10980	DECIML	CM ARG,4,1011	02324	14	01833	00004
10990	BNH	LARGE	02336	47	02404	01100
11000	TFM	WRITE+23,ARG-9	02348	16	02229	01824
11010	TFM	WRITE+18,OUTPUT-8	02360	16	02224	02713
11020	S	WRITE+18,ARG	02372	22	02224	01833
11030	S	WRITE+18,ARG	02384	22	02224	01833
11040	B	WRITE+12	02396	49	02218	00000
11050	DORG	*-3	02404			
11060	LARGE	TF OUTPUT-17,SEVENS-7	02404	26	02704	02726
11070	BNF	JUMP2,ARG	02416	44	02464	01833
11080	TFM	OUTPUT-20,20,10	02428	16	02701	00020
11090	CF	ARG	02440	33	01833	00000
11100	CF	OUTPUT-19	02452	33	02702	00000
11110	JUMP2	TD OUTPUT-16,ARG	02464	25	02705	01833
11120	TD	OUTPUT-18,ARG-1	02476	25	02703	01832
11130	CF	OUTPUT-18	02488	33	02703	00000
11140	TF	OUTPUT-12,SIGN	02500	26	02709	02745
11150	CF	OUTPUT-13	02512	33	02708	00000
11160	TFM	WR+11,ARG-9	02524	16	02559	01824
11170	TFM	WR+6,OUTPUT-8	02536	16	02554	02713
11180	WR	TD 99999,99999	02548	25	99999	99999
11190	AM	WR+11,1,10	02560	11	02559	00001
11200	AM	WR+6,2,10	02572	11	02554	00002
11210	CM	WR+6,OUTPUT	02584	14	02554	02721
11220	BNH	WR	02596	47	02548	01100
11230	BB		02608	42	00000	00000

11240	DORG *-9		
11250	SETSIG TFM SETS+11,OUTPUT-16	02610	
11260	SETS BD SET,OUTPUT-16	02610 16 02633	02705
11270	AM SETS+11,2,10	02622 43 02654	02705
11280	B SETS	02634 11 02633	00002
11290	DORG *-3	02646 49 02622	00000
11300	SET TF *+30,SETS+11	02654	
11310	SM *+18,2,10	02654 26 02684	02633
11320	TF 99999,SIGN	02666 12 02684	00002
11330	BB	02678 26 99999	02745
11340	DORG *-9	02690 42 00000	00000
11350	DAS 14	02692	
11360	OUTPUT DS 2	02693	00014
11370	DAC 1,@	02721	00002
11380	SEVENS DC 10,7070707070	02723	00001
11390	DCMAL DC 10,000000003	02733	00010
11400	SIGN DS 2	02743	00010
11410	EXPNT2 DS 2	02745	00002
11420*		02747	00002
11430*	SUBROUTINE FOR PREPARING ID/CJ ELEMENTS FOR PRINTING.		
11440*			
11450	DS 10	02757	00010
11460	FIXID TR OUTPUT-27,1D-1	02758 31 02694	02940
11470	CF FIXID-10	02770 33 02748	00000
11480	TD OUTPUT-26,FIXID-10	02782 25 02695	02748
11490	TD OUTPUT-24,FIXID-9	02794 25 02697	02749
11500	TD OUTPUT-22,FIXID-8	02806 25 02699	02750
11510	TD OUTPUT-20,FIXID-7	02818 25 02701	02751
11520	TD OUTPUT-12,FIXID-6	02830 25 02703	02752

11530	TD OUTPUT-10,FIXID-5	02842 25 02711	02753
11540	TD OUTPUT-8,FIXID-4	02854 25 02713	02754
11550	TD OUTPUT-4,FIXID-3	02866 25 02717	02755
11560	TD OUTPUT-2,FIXID-2	02878 25 02719	02756
11570	TD OUTPUT,FIXID-1	02890 25 02721	02757
11580	BNF *+36,FIXID-1	02902 44 02938	02757
11590	TFM OUTPUT-14,20,10	02914 16 02707	00020
11600	CF OUTPUT-15	02926 33 02706	00000
11610	BB	02938 42 00000	00000
11620	DORG *-9	02940	
11630	DAC 15,0000 000.000@	02941	00015
11640*			
11650*	SUBROUTINE TO FLOAT SEQUENCE NUMBER.		
11660*			
11670	DS 3	02972	00003
11680	FIXIT TF OUT,SEVNS	02974 26 03053	03059
11690	CF FIXIT-3	02986 33 02971	00000
11700	TD OUT,FIXIT-1	02998 25 03053	02973
11710	TD OUT-2,FIXIT-2	03010 25 03051	02972
11720	TD OUT-4,FIXIT-3	03022 25 03049	02971
11730	TF ALPHA+158,OUT	03034 26 00583	03053
11740	BB	03046 42 00000	00000
11750	DORG *-9	03048	
11760	DAS 2	03049	00002
11770	OUT DS 2	03053	00002
11780	SEVNS DC 6,707070	03059	00006
11790	DEND START	00942	
LOAD	SUBROUTINES		
		03060 16 03494	03952
		03072 49 03184	0

12070	RCTY				
12080	RCTY	00818	34	00000	00102
12090	RCTY	00830	34	00000	00102
12100	B GO	00842	34	00000	00102
12110	DORG *-3	00854	49	00886	00000
12120	OCAR WACD BLANKS	00862			
12130	WACD BLANKS	00862	39	00621	00400
12140	GO SF M-2	00874	39	00621	00400
12150	SF M+2	00886	32	00402	00000
12160	TF MPL2,M	00898	32	00406	00000
12170	AM MPL2,2,10	00910	26	00418	00404
12180	TF NPL2,N	00922	11	00418	00002
12190	AM NPL2,2,10	00934	26	00422	00408
12200	TFM INADD,W	00946	11	00422	00002
12210	A INADD-1,MPL2	00958	16	00427	04809
12220	TFM NPRINT,5,9	00970	21	00426	00418
12230	MM MPL2,50,10	00982	16	00435	00005
12240	SF PROD-4	00994	13	00418	00050
12250	TF MP2X5,PROD	01006	32	00095	00000
12260	LOOP3 TF ROWADD,INADD	01018	26	00446	00099
12270	TF COUNT2,MPL2	01030	26	00432	00427
12280*		01042	26	00441	00418
12290*	CLASSIFY ELEMENT, FLOAT, AND TRANSMIT TO CARD IMAGE.				
12300*					
12310	LOOP2 TR CARD-1,BLANKS-1	01054	31	00458	00620
12320	TF COUNT1,NPRINT	01066	26	00438	00435
12330	TFM TRAN+6,CARD+26	01078	16	01284	00485.
12340	TF TFLOAT+28,ROWADD	01090	26	01190	00432
12350	AM ITER+11,1,10	01102	11	01125	00001

12360	ITER BTM FIXIT,0,9				
12370	LOOP1 TF CLASS+11,TFLOAT+28	01114	17	02768	00000
12380	SM CLASS+11,1,10	01126	26	01161	01190
12390	CLASS BNF IDEN1,99999,,FIELD ADDRESS-1. IS FIELD A FLT. PT. NO.	01138	12	01161	00001
12400	TFLOAT TFLS TEMP,99999	01150	44	01254	99999
		01162	16	02905	01185
		01174	49	02854	00000
		01181	00005		00456
		01186	00005		99999
12410	CM TEMP,99,1011, IS FIELD A FLOATING POINT ZERO.	01192	14	00456	00099
12420	BE SKIP	01204	46	01290	01200
12430	BFLOAT BTFS FLT FIX,TEMP	01216	16	02905	01239
		01228	49	02874	00000
		01235	00005		01628
		01240	00005		00456
12440	B TRAN	01246	49	01278	00000
12450	DORG *-3	01254			
12460	IDEN1 TF IDEN2+11,TFLOAT+28	01254	26	01277	01190
12470	IDEN2 BT FIXID,99999	01266	27	02552	99999
12480	TRAN TF 99999,OUTPUT	01278	26	99999	02515
12490	SKIP A TFLOAT+27,MPL2	01290	21	01189	00418
12500	AM TRAN+6,30,10	01302	11	01284	00030
12510	SM COUNT1,1,10	01314	12	00438	00001
12520	BP LOOP1	01326	46	01126	01100
12530*					
12540*	PRINT OR PUNCH ONE LINE OF FIVE ELEMENTS.				
12550*					
12560	BNC3 *-44	01338	47	01382	00300
12570	WATY CARD	01350	39	00459	00100
12580	RCTY	01362	34	00000	00102
12590	B *-20	01374	49	01394	00000
12600	DORG *-3	01382			
12610	WACD CARD	01382	39	00459	00400
12620	AM ROWADD,10,10	01394	11	00432	00010

12630	SM	COUNT2,1,10	01406	12	00441	00001
12640	BP	LOOP2	01418	46	01054	01100
12650	BNC3	*+44	01430	47	01474	00300
12660	RCTY		01442	34	00000	00102
12670	RCTY		01454	34	00000	00102
12680	B	STOP	01466	49	01498	00000
12690	DORG	*-3	01474			
12700	WACD	BLANKS	01474	39	00621	00400
12710	WACD	BLANKS	01486	39	00621	00400
12720STOP	A	INADD,MP2X5	01498	21	00427	00446
12730	S	NPL2,NPRINT	01510	22	00422	00435
12740	C	NPL2,NPRINT	01522	24	00422	00435
12750	BNP	END	01534	47	01554	01100
12760	B	LOOP3	01546	49	01030	00000
12770	DORG	*-3	01554			
12780END	TF	NPRINT,NPL2	01554	26	00435	00422
12790	TFM	STOP+1,49,10	01566	16	01499	00049
12800	TFM	STOP+6,FINISH	01578	16	01504	01598
12810	B	LOOP3	01590	49	01030	00000
12820	DORG	*-3	01598			
12830FINISH	RNCD	0	01598	36	00000	00500
12840	B	0	01610	49	00000	00000
12850	DORG	*-3	01618			
12860*						
12870*	SUBROUTINE FOR PREPARING DATA FOR ALPHAMERICAL PRINTING OR					
12880*	PUNCHING. INTERNAL FORMAT IS NEW SPS.					
12890*						
12900ARG	DS	10	01627			00010
12910FLTFIX	CF	ARG-9	01628	33	01618	00000

12920	TF	OUTPUT,SEVENS	01640	26	02515	02527
12930	CF	OUTPUT-9	01652	33	02506	00000
12940	TF	OUTPUT-10,DCMAL	01664	26	02505	02537
12950	TFM	OUTPUT-19,0,9	01676	16	02496	00000
12960	TFM	SIGN,0,10	01688	16	02539	00000
12970	BNF	JUMP,ARG-2	01700	44	01736	01625
12980	TDM	SIGN-1,2,11	01712	15	02538	00002
12990	CF	ARG-2	01724	33	01625	00000
13000JUMP	CM	ARG,99,1011	01736	14	01627	00099
13010	BE	WRALPH	01748	46	02072	01200
13020	CM	ARG,0,10	01760	14	01627	00000
13030	BNP	DECIML	01772	47	02118	01100
13040	CM	ARG,4,10	01784	14	01627	00004
13050	BH	LARGE	01796	46	02198	01100
13060	TFM	TRNMT+11,ARG-9	01808	16	01867	01618
13070	TFM	*+42,OUTPUT-10	01820	16	01862	02505
13080	S	*+30,ARG	01832	22	01862	01627
13090	S	*+18,ARG	01844	22	01862	01627
13100TRNMT	TD	99999,99999	01856	25	99999	99999
13110	AM	TRNMT+11,1,10	01868	11	01867	00001
13120	AM	TRNMT+6,2,10	01880	11	01862	00002
13130	CM	TRNMT+6,OUTPUT-12	01892	14	01862	02503
13140	BNH	TRNMT	01904	47	01856	01100
13150	TF	WRITE+23,TRNMT+11	01916	26	02023	01867
13160	TFM	EXPNT2,5,10	01928	16	02541	00005
13170	S	EXPNT2,ARG	01940	22	02541	01627
13180	TFM	*+47,SEVENS	01952	16	01999	02527
13190	S	*+35,EXPNT2	01964	22	01999	02541

13200	S	*+23,EXPNT2	01976	22	01999	02541
13210	A	OUTPUT-12,99999	01988	21	02503	99999
13220	WRITE	TFM *+18,OUTPUT-8	02000	16	02018	02507
13230	TD	OUTPUT-8,0	02012	25	02507	00000
13240	AM	WRITE+23,1,10	02024	11	02023	00001
13250	AM	WRITE+18,2,10	02036	11	02018	00002
13260	CM	WRITE+18,OUTPUT	02048	14	02018	02515
13270	BNH	WRITE+12	02060	47	02012	01100
13280	WRALPH	BD SETZRO,OUTPUT-18	02072	43	02092	02497
13290	B	SETSIG	02084	49	02404	00000
13300	DORG	*-3				
13310	SETZRO	TDM OUTPUT,0	02092			
13320	TF	OUTPUT-20,SIGN	02092	15	02515	00000
13330	BB		02104	26	02495	02539
13340	DORG	*-9	02116	42	00000	00000
13350	DECIML	CM ARG,4,1011	02118			
13360	BNH	LARGE	02118	14	01627	00004
13370	TFM	WRITE+23,ARG-9	02130	47	02198	01100
13380	TFM	WRITE+18,OUTPUT-8	02142	16	02023	01618
13390	S	WRITE+18,ARG	02154	16	02018	02507
13400	S	WRITE+18,ARG	02166	22	02018	01627
13410	B	WRITE+12	02178	22	02018	01627
13420	DORG	*-3	02190	49	02012	00000
13430	LARGE	TF OUTPUT-17,SEVENS-7	02198			
13440	BNF	JUMP2,ARG	02198	26	02498	02520
13450	TFM	OUTPUT-20,20,10	02210	44	02258	01627
13460	CF	ARG	02222	16	02495	00020
			02234	33	01627	00000

13470	CF	OUTPUT-19	02246	33	02496	00000
13480	JUMP2	TD OUTPUT-16,ARG	02258	25	02499	01627
13490	TD	OUTPUT-18,ARG-1	02270	25	02497	01626
13500	CF	OUTPUT-18	02282	33	02497	00000
13510	TF	OUTPUT-12,SIGN	02294	26	02503	02539
13520	CF	OUTPUT-13	02306	33	02502	00000
13530	TFM	WR+11,ARG-9	02318	16	02353	01618
13540	TFM	WR+6,OUTPUT-8	02330	16	02348	02507
13550	WR	TD 99999,99999	02342	25	99999	99999
13560	AM	WR+11,1,10	02354	11	02353	00001
13570	AM	WR+6,2,10	02366	11	02348	00002
13580	CM	WR+6,OUTPUT	02378	14	02348	02515
13590	BNH	WR	02390	47	02342	01100
13600	BB		02402	42	00000	00000
13610	DORG	*-9	02404			
13620	SETSIG	TFM SETS+11,OUTPUT-16	02404	16	02427	02499
13630	SETS	BD SET,OUTPUT-16	02416	43	02448	02499
13640	AM	SETS+11,2,10	02428	11	02427	00002
13650	B	SETS	02440	49	02416	00000
13660	DORG	*-3	02448			
13670	SET	TF *+30,SETS+11	02448	26	02478	02427
13680	SM	*+18,2,10	02460	12	02478	00002
13690	TF	99999,SIGN	02472	26	99999	02539
13700	BB		02484	42	00000	00000
13710	DORG	*-9	02486			
13720	DAS	14	02487			
13730	OUTPUT	DS 2	02515			
13740	JAC	1,@	02517			

13750SEVENS DC	10,70707070		
13760DCMAL DC	10,000000003	02527	00010
13770SIGN DS	2	02537	00010
13780EXPNT2 DS	2	02539	00002
		02541	00002
13790*			
13800*	SUBROUTINE FOR PREPARING ID/CJ ELEMENTS FOR PRINTING.		
13810*			
13820	DS 10	02551	00010
13830FIXID TR	OUTPUT-27, ID-1	02552	31 02488 02734
13840	CF FIXID-10	02564	33 02542 00000
13850	TD OUTPUT-26, FIXID-10	02576	25 02489 02542
13860	TD OUTPUT-24, FIXID-9	02588	25 02491 02543
13870	TD OUTPUT-22, FIXID-8	02600	25 02493 02544
13880	TD OUTPUT-20, FIXID-7	02612	25 02495 02545
13890	TD OUTPUT-12, FIXID-6	02624	25 02503 02546
13900	TD OUTPUT-10, FIXID-5	02636	25 02505 02547
13910	TD OUTPUT-8, FIXID-4	02648	25 02507 02548
13920	TD OUTPUT-4, FIXID-3	02660	25 02511 02549
13930	TD OUTPUT-2, FIXID-2	02672	25 02513 02550
13940	TD OUTPUT, FIXID-1	02684	25 02515 02551
13950	BNF *+36, FIXID-1	02696	44 02732 02551
13960	TFM OUTPUT-14, 20, 10	02708	16 02501 00020
13970	CF OUTPUT-15	02720	33 02500 00000
13980	BB	02732	42 00000 00000
13990	DORG *-9	02734	
14000ID	DAC 15,0000 000.000@	02735	00015
14010*			
14020*	SUBROUTINE TO FLOAT SEQUENCE NUMBER.		
14030*			
14040	DS 3	02766	00003
14050FIXIT TF	OUT, SEVNS	02768	26 02847 02853

14060	CF	FIXIT-3	
14070	TD	OUT, FIXIT-1	02780 33 02765 00000
14080	TD	OUT-2, FIXIT-2	02792 25 02847 02767
14090	TD	OUT-4, FIXIT-3	02804 25 02845 02766
14100	TF	CARD+158, OUT	02816 25 02843 02765
14110	BB		02828 26 00617 02847
14120	DORG *-9		02840 42 00000 00000
14130	DAS 2		02842
14140OUT	DS 2		02843 00002
14150SEVNS DC	6,707070		02847 00002
14160	DEND INIT		02853 00006
			00782
	LOAD SUBROUTINES		02854 16 03308 03766
			02866 49 02998 0
			02874 16 03308 03798
			02886 49 02998 0

END OF PASS I I

SYMBOL TABLE, LP20-6.

04809	W	00099	PROD	00404	M	00408	N	00410	FORM
00415	S	00418	MPL2	00422	NPL2	00427	INADD	00432	*ROWADD
00435	*NPRINT	00438	*COUNT1	00441	*COUNT2	00446	MP2X5	00456	TEMP
00459	CARD	00621	*BLANKS	00782	INIT	00862	CAR	00886	GO
01030	LOOP3	01054	LOOP2	01114	ITER	01126	LOOP1	01150	CLASS
01162	*TFLDPT	01216	*BFLOAT	01254	IDEN1	01266	IDEN2	01278	TRAN
01290	SKIP	01498	STOP	01554	END	01598	*FINISH	01627	ARG
01628	*FLTFIX	01736	JUMP	01856	TRNMT	02000	WRITE	02072	*MRALPH
02092	*SETZRO	02118	*DECIMAL	02198	LARGE	02258	JUMP2	02342	WR
02404	*SETSIG	02416	SETS	02448	SET	02515	*OUTPUT	02527	*SEVENS
02537	DCMAL	02539	SIGN	02541	*EXPNT2	02552	FIXID	02735	ID
02768	FIXIT	02847	OUT	02853	SEVNS				

14170*	LP20-7, MATRIX PUNCH FOR RESTART, LINEAR PROGRAMMING,	
14180*	NOV. 16, 1962.	
14190*		
14200	DORG 402	00402
14210M	DS 3	00404 00003
14220N	DS 4	00408 00004
14230FORM	DS 2	00410 00002
14240S	DS 5	00415 00005
14250MPL2	DS 3	00418 00003
14260	DS 64	00482 00064
14270TEMP	DS 10	00492 00010
14280PROD	DS 20, 99	00099 00020
14290W	DS 4809	04809 00000
14300*		
14310*	PUNCH MATRIX IN FLOATING POINT FORMAT FOR RELOADING.	
14320*		
14330START	TDM FORM,0	00494 15 00410 00000
14340	WNCD M-2	00506 38 00402 00400
14350	TF TEMP,N	00518 26 00492 00408
14360	AM TEMP,2,10	00530 11 00492 00002
14370	M TEMP,MPL2	00542 23 00492 00418
14380	SF PROD-4	00554 32 00095 00000
14390	SM PROD,2,10	00566 12 00099 00002
14400	TF CMP+11,S	00578 26 00661 00415
14410	A CMP+10,PROD	00590 21 00660 00099
14420	TF CMP2+11,CMP+11	00602 26 00745 00661
14430	SM CMP+11,70,10	00614 12 00661 00070
14440	TFM WRITE+6,W-9	00626 16 00716 04800
14450	A WRITE+5,MPL2	00638 21 00715 00418
14460CMP	CM WRITE+6,99999	00650 14 00716 99999

14470	BNP	WRITE	00662	47	00710	01100
14480	TF	TDIG+6,WRITE+6	00674	26	00704	00716
14490	AM	TDIG+6,71,10	00686	11	00704	00071
14500	TDIG	TD 99999,400	00698	25	99999	00400
14510	WRITE	WNC D 99999	00710	38	99999	00400
14520	AM	WRITE+6,70,10	00722	11	00716	00070
14530	CMP2	CM WRITE+6,99999	00734	14	00716	99999
14540	BNP	CMP	00746	47	00650	01100
14550	RNCD	0	00758	36	00000	00500
14560	B	0	00770	49	00000	00000
14570	DEND	START	00494			

END OF PASS I I

14580* LP20-8, SOLUTION TEST, LINEAR PROGRAMMING, NOV. 16, 1962.
 14590*
 14600 DORG 402 00402

14610M	DS	3	00404	00003
14620N	DS	4	00408	00004
14630FORM	DS	2	00410	00002
14640S	DS	5	00415	00005
14650MPL2	DS	3	00418	00003
14660	DS	1	00419	00001
14670W	DS	,4809	04809	00000
14680PROD	DS	20,99	00099	00020
14690CNTCOL	DS	3	00422	00003
14700CNTROW	DS	3	00425	00003
14710INADD	DS	5	00430	00005
14720	DS	56	00486	00056
14730START	TF	CNTROW,M	00488	26 00425 00404
14740	TFM	SUB+28,W+20	00500	16 00576 04829
14750	TF	SUB+23,S	00512	26 00571 00415
14760	A	SUB+22,MPL2	00524	21 00570 00418
14770	AM	SUB+23,10,10	00536	11 00571 00070
14780SUB	FS	99999,99999	00548	16 01085 00571
			00560	49 01034 00000
			00567	00005 99999
			00572	00005 99999
14790	AM	SUB+23,10,10	00578	11 00571 00070
14800	AM	SUB+28,10,10	00590	11 00576 00070
14810	SM	CNTROW,1,10	00602	12 00425 00001
14820	BP	SUB	00614	46 00548 01100
14830	TF	CNTCOL,N	00626	26 00422 00408
14840	TF	INADD,S	00638	26 00430 00415
14850	A	INADD-1,MPL2	00650	21 00429 00418

14860	A	INADD-1,MPL2			
14870LOOP	TF	CNTROW,M	00662	21	00429 00418
14880	TF	FMUL+28,INADD	00674	26	00425 00404
14890	TF	CMP+6,FMUL+28	00686	26	00870 00430
14900	AM	CMP+6,10,10	00698	26	00824 00870
14910	TF	FMUL+23,CMP+6	00710	11	00824 000T0
14920	TF	FSUB+28,CMP+6	00722	26	00865 00824
14930	TF	FSUB+23,S	00734	26	00900 00824
14940	A	FSUB+22,MPL2	00746	26	00895 00415
14950	AM	FSUB+23,10,10	00758	21	00894 00418
14960	TF	CMP2+6,FMUL+28	00770	11	00895 000T0
14970CMP2	CM	99999,99,1011, IS A(0,J)=ZERO.	00782	26	00800 00870
14980	BE	COLSTP	00794	14	99999 00099
14990CMP	CM	99999,99,1011, IS A(1,J)=ZERO.	00806	46	00974 01200
15000	BE	MOD	00818	14	99999 00099
15010FMUL	FM	99999,99999	00830	46	00902 01200
			00842	16	01085 00865
			00854	49	01054 00000
			00861	00005	99999
			00866	00005	99999
15020FSUB	FS	99999,99999	00872	16	01085 00895
			00884	49	01034 00000
			00891	00005	99999
			00896	00005	99999
15030MOD	AM	CMP+6,10,10	00902	11	00824 000T0
15040	AM	FMUL+23,10,10	00914	11	00865 000T0
15050	AM	FSUB+23,10,10	00926	11	00895 000T0
15060	AM	FSUB+28,10,10	00938	11	00900 000T0
15070	SM	CNTROW,1,10	00950	12	00425 00001
15080	BP	CMP	00962	46	00818 01100
15090COLSTP	A	INADD-1,MPL2	00974	21	00429 00418

15100	SM	CNTCOL,1,10			
15110	BP	LOOP	00986	12	00422 00001
15120	RNCD	0	00998	46	00674 01100
15130	B	0	01010	36	00000 00500
15140	DEND	START	01022	49	00000 00000
			00488		
			01034	16	01488 01946
			01046	49	01074
			01054	16	01488 02490
			01066	49	01074

END OF PASS I I

15150* LP20-9, PARAMETRIC SOLUTION, LINEAR PROGRAMMING,
 15160* NOV. 16, 1962.
 15170*
 15180 DORG 402

00402
 15190M DS 3,, NUMBER OF RESTRAINING EQUATIONS.
 00404 00003
 15200N DS 4,, NUMBER OF NONBASIC ACTIVITIES.
 00408 00004
 15210FORM DS 2,, FORM OF INPUT - 0 IMPLIES FLT. PT., 1 IMPLIES DECIMAL
 00410 00002
 15220S DS 5,, REFERENCE ADDRESS FOR MATRIX, = W+10(M+3).
 00415 00005
 15230MPL2 DS 3,,M+2
 00418 00003
 15240 DS 1
 00419 00001
 15250W DS ,4809, REFERENCE ADDRESS.
 04809 00000
 15260PROD DS 20,99, PRODUCT ADDRESS.
 00099 00020
 15270OUTPUT DS 10
 00429 00010
 15280 DC 1,@
 00430 00001
 15290R DS 10,, MAX OR MIN RATIO FOR DUAL OR SIMPLEX ALGORITHM.
 00440 00010
 15300COLADR DS 5,, ADDRESS OF D(K).
 00445 00005
 15310ROWADR DS 5,, ADDRESS OF B(R).
 00450 00005
 15320ARKADR DS 5,, ADDRESS OF A(R,K).
 00455 00005
 15330CNTCOL DS 3,, COLUMN COUNTER.
 00458 00003
 15340CNTROW DS 3,, ROW COUNTER.
 00461 00003
 15350TEMP1 DS 10,, TEMPORARY WORK ADDRESS.
 00471 00010
 15360TEMP2 DS 10,, TEMPORARY WORK ADDRESS.
 00481 00010
 15370BIMIN DS 10,, MINIMUM B(I).
 00491 00010
 15380DJMIN DS 10,, MINIMUM D(J).
 00501 00010
 15390AIKMAX DS 10,, DENOMINATOR OF SIMPLEX RATIO, USED TO BREAK TIES.
 00511 00010
 15400 DC 8,99999999
 00519 00008
 15410INF DC 2,99,, INFINITY.
 00521 00002
 15420 DC 8,-99999999
 00529 00008

15430NEGINF DC 2,99,, NEGATIVE INFINITY.
 00531 00002
 15440 DC 8,0
 00539 00008
 15450ZERO DC 2,-99,, ZERO
 00541 00002
 15460 DC 8,10000000
 00549 00008
 15470ONE DC 2,1,, ONE.
 00551 00002
 15480ESSZER DC 2,-07
 00553 00002
 15490MESS1 DAC 16,I CANT FIND IT.@
 00555 00016
 15500MESS2 DAC 10,ID BASIC.@
 00587 00010
 15510MESS3 DAC 20,SOLUTION UNBOUNDED.@
 00607 00020
 15520MESS4 DAC 4,K= @
 00647 00004
 15530CNTR DS 3
 00656 00003
 15540OUT DS 10
 00666 00010
 15550 DC 1,@
 00667 00001
 15560CARD DS 80
 00747 00080
 15570IDEN DS 4,CARD-76
 00671 00004
 15580SIGN DS 1,CARD-74
 00673 00001

15590*
 15600* READ CARD WITH ID OF PARAMETRIC VECTOR AND SIGN.
 15610*
 15620START RNCD IDEN-3
 00748 36 00668 00500
 15630 SF IDEN-3
 00760 32 00668 00000

15640*
 15650* FIND PARAMETRIC VECTOR.
 15660*
 15670* (1). IS IT BASIC.
 15680*
 15690 TF CNTR,M
 00772 26 00656 00404
 15700 TF ILP+6,S
 00784 26 00814 00415
 15710 AM ILP+6,4,10
 00796 11 00814 00004
 15720ILP C 99999,IDEN
 00808 24 99999 00671
 15730 BE FOUNDI
 00820 46 00990 01200
 15740 AM ILP+6,10,10
 00832 11 00814 00010

15750	SM	CNTR,1,10							
15760	BP	ILP	00844	12	00656	00001			
			00856	46	00808	01100			
15770*									
15780*	(2).	IS IT NON-BASIC.							
15790*									
15800	TF	CNTR,N							
15810	TF	JLP+6,ILP+6	00868	26	00656	00408			
15820	A	JLP+5,MPL2	00880	26	00910	00814			
15830JLP	C	99999,IDEN	00892	21	00909	00418			
15840	BE	FOUNDJ	00904	24	99999	00671			
15850	A	JLP+5,MPL2	00916	46	01168	01200			
15860	SM	CNTR,1,10	00928	21	00909	00418			
15870	BP	JLP	00940	12	00656	00001			
15880	RCTY		00952	46	00904	01100			
			00964	34	00000	00102			
15890	WATY	MESS1,,,ERROR HALT, ID NEITHER BASIC NOR NON-BASIC.	00976	39	00555	00100			
15900	H		00988	48	00000	00000			
15910	DORG	*-9	00990						
15920FOUNDI	BD	SUBTR,SIGN	00990	43	01028	00673			
15925	RCTY		01002	34	00000	00102			
15930	WATY	MESS2,,,ERROR HALT, ID BASIC.	01014	39	00587	00100			
15940	H		01026	48	00000	00000			
15950	DORG	*-9	01028						
15951SUBTR	TF	ZE+28,ILP+6	01028	26	01092	00814			
15952	AM	ZE+28,6,10	01040	11	01092	00006			
15953	A	ZE+27,MPL2	01052	21	01091	00418			
15954ZE	TFLS	OUT,99999	01064	16	02323	01087			
			01076	49	02292	00000			
			01083	00005	00666				
			01088	00005	99999				
15955	WATY	MESS4	01094	39	00647	00100			
15956	WNTY	OUT-9	01106	38	00657	00100			
15957	TF	ZE1+23,ZE+28	01118	26	01153	01092			
15958ZE1	TFLS	99999,ZERO	01130	16	02323	01153			

			01142	49	02292	00000			
			01149	00005	99999				
			01154	00005	00541				
15959	B	END	01160	49	02188	00000			
15960	DORG	*-3	01168						
15961*									
15970*									
15980*									
15990FOUNDJ	TF	MOVE+28,JLP+6	01168	26	01244	00910			
16000	AM	MOVE+28,26,10	01180	11	01244	00026			
16010	TFM	MOVE+23,W+20	01192	16	01239	04829			
16020	TF	CNTR,M	01204	26	00656	00404			
16030MOVE	TFLS	99999,99999	01216	16	02323	01239			
			01228	49	02292	00000			
			01235	00005	99999				
			01240	00005	99999				
16040	AM	MOVE+23,10,10	01246	11	01239	00010			
16050	AM	MOVE+28,10,10	01258	11	01244	00010			
16060	SM	CNTR,1,10	01270	12	00656	00001			
16070	BP	MOVE	01282	46	01216	01100			
16080*									
16090*									
16100	BD	CH,SIGN	01294	43	01314	00673			
16110	B	MIN	01306	49	01442	00000			
16120	DORG	*-3	01314						
16130CH	TF	CNTR,M	01314	26	00656	00404			
16140	TFM	CHANGE+11,W+18	01326	16	01349	04827			
16150CHANGE	BNF	SETFLG,99999	01338	44	01382	99999			
16160	TF	*+18,CHANGE+11	01350	26	01368	01349			
16170	CF	99999	01362	33	99999	00000			
16180	B	MOD	01374	49	01406	00000			
16190	DORG	*-3	01382						
16200SETFLG	TF	*+18,CHANGE+11	01382	26	01400	01349			
16210	SF	99999	01394	32	99999	00000			
16220MOD	AM	CHANGE+11,10,10	01406	11	01349	00010			

132.

16230	SM	CNTR,1,10	01418	12	00656	00001
16240	BP	CHANGE	01430	46	01338	01100
16250*						
16260*		SELECT LARGEST RATIO, B(I)/A(I,K), A(I,K) NEGATIVE.				
16270*						
16280MIN	TFLS R,	NEGINF	01442	16	02323	01465
			01454	49	02292	00000
			01461	00005	00440	
			01466	00005	00531	
16290	TF	CNTR,M	01472	26	00656	00404
16300	TFM	CMP1+6,W+20	01484	16	01538	04829
16310	TF	TF1+28,S	01496	26	01632	00415
16320	AM	TF1+28,10,10	01508	11	01632	00010
16330	A	TF1+27,MPL2	01520	21	01631	00418
16340*						
16350*		IS A(I,K) ZERO.				
16360*						
16370CMP1	CM	99999,99,1011	01532	14	99999	00099
16380	BE	STEP	01544	46	01778	01200
16390*						
16400*		IS A(I,K) NEGATIVE.				
16410*						
16420	TF	CMP2+11,CMP1+6	01556	26	01591	01538
16430	SM	CMP2+11,2,10	01568	12	01591	00002
16440CMP2	BNF	STEP,99999	01580	44	01778	99999
16450	TF	FDIV+28,CMP1+6	01592	26	01662	01538
16460TF1	TFLS	TEMP2,99999	01604	16	02323	01627
			01616	49	02292	00000
			01623	00005	00481	
			01628	00005	99999	
16470FDIV	FD	TEMP2,99999	01634	16	02323	01657
			01646	49	02272	00000
			01653	00005	00481	
			01658	00005	99999	
16480TF2	TFLS	TEMP1,TEMP2	01664	16	02323	01687
			01676	49	02292	00000
			01683	00005	00471	
			01688	00005	00481	
16490FSUB	FS	TEMP1,R	01694	16	02323	01717
			01706	49	02212	00000
			01713	00005	00471	
			01718	00005	00440	

133.

16500	BNP	STEP	01724	47	01778	01100
16510	TFLS R,	TEMP2	01736	16	02323	01759
			01748	49	02292	00000
			01755	00005	00440	
			01760	00005	00481	
16520	TF	ROWADR,TF1+28	01766	26	00450	01632
16530STEP	AM	CMP1+6,10,10	01778	11	01538	00010
16540	AM	TF1+28,10,10	01790	11	01632	00010
16550	SM	CNTR,1,10	01802	12	00656	00001
16560	BP	CMP1	01814	46	01532	01100
16570*						
16580*		IS PARAMETRIC SOLUTION BOUNDED.				
16590*						
16600	C	R-2,NEGINF-2	01826	24	00438	00529
16610	BNE	SIGNR	01838	47	01876	01200
16620	RCTY		01850	34	00000	00102
16630	WATY	MESS3,,,SOLUTION UNBOUNDED.	01862	39	00607	00100
16640	H		01874	48	00000	00000
16650	DORG	*-9	01876			
16660*						
16670*		CHANGE SIGN OF R AND PRINT.				
16680*						
16690SIGNR	CF	R-2	01876	33	00438	00000
16700	RCTY		01888	34	00000	00102
16710	TFLS	OUT,R	01900	16	02323	01923
			01912	49	02292	00000
			01919	00005	00666	
			01924	00005	00440	
16720	WATY	MESS4,,,K=	01930	39	00647	00100
16730	WNTY	OUT-9	01942	38	00657	00100
16740*						
16750*		OBTAIN NEW PARAMETRIC SOLUTION.				
16760	TF	CNTR,M	01954	26	00656	00404
16770	TFM	PAR1+23,W+20	01966	16	02049	04829
16780	TFM	PAR2+28,W+20	01978	16	02084	04829
16790	TF	PAR2+23,S	01990	26	02079	00415
16800	A	PAR2+22,MPL2	02002	21	02078	00418

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16810      AM  PAR2+23,10,10
16820PAR1  FM  99999,R
16830PAR2  FA  99999,99999
16840      AM  PAR1+23,10,10
16850      AM  PAR2+23,10,10
16860      AM  PAR2+28,10,10
16870      SM  CNTR,1,10
16880      BP  PAR1
16890*
16900*      SET B(K)=ZERO.
16910*
16920      TF  ZER+23,ROWADR
16930ZER   TFLS 99999,ZERO
16940END   RNCD 0
16950      B   0
16960      DEND START
LOAD SUBROUTINES
02014 11 02079 000T0
02026 16 02323 02049
02038 49 02252 00000
02045 00005 99999
02050 00005 00440
02056 16 02323 02079
02068 49 02232 00000
02075 00005 99999
02080 00005 99999
02086 11 02049 000T0
02098 11 02079 000T0
02110 11 02084 000T0
02122 12 00656 00001
02134 46 02026 01100
02146 26 02181 00450
02158 16 02323 02181
02170 49 02292 00000
02177 00005 99999
02182 00005 00541
02188 36 00000 00500
02200 49 00000 00000
00748
02212 16 02726 03184
02224 49 02312 2
02232 16 02726 03228
02244 49 02312 2
02252 16 02726 03728
02264 49 02312 2
02272 16 02726 03968
02284 49 02312 2
02292 16 02726 04304
02304 49 02416 2

```

END OF PASS11

SYMBOL TABLE, LP20-4.

```

00404 M
04809 W
00450 *ROWADR
00481 *TEMP2
00531 *NEGINF
00587 *MESS2
00747 CARD
00904 JLP
01168 *FOUNDJ
01406 MOD
01634 FDLV
02026 PAR1
00408 N
00099 PROD
00455 *ARKADR
00491 BMIN
00541 ZERO
00607 MESS3
00671 IDEN
00990 *FOUNDI
01216 MOVE
01442 MIN
01664 TF2
02056 PAR2
00410 FORM
00429 *OUTPUT
00458 *CNTCOL
00501 DJMIN
00551 ONE
00647 MESS4
00673 SIGN
01028 SUBTR
01314 CH
01532 CMP1
01694 FSUB
02158 ZER
00415 S
00440 R
00461 *CNTROW
00511 *AIKMAX
00553 *ESSZER
00656 CNTR
00748 START
01064 ZE
01338 *CHANGE
01580 CMP2
01778 STEP
02188 END
00418 MPL2
00445 *COLADR
00471 TEMPI
00521 INF
00555 MESS1
00666 OUT
00808 LLP
01130 ZEI
01382 *SETFLG
01604 TFI
01876 SIGNR

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16970* LP20-10, PARAMETRIC DUAL, LINEAR PROGRAMMING, NOV. 16, 1962.
 16980*
 16990* REMARKS ON MACROS FOLLOW MACRO INSTRUCTIONS.
 17000*
 17010 DORG 402

17020M	DS	3,,	NUMBER OF RESTRAINING EQUATIONS.	00402
17030N	DS	4,,	NUMBER OF NONBASIC ACTIVITIES.	00404 00003
17040FORM	DS	2,,	FORM OF INPUT - 0 IMPLIES FLT. PT., 1 IMPLIES DECIMAL.	00408 00004
17050S	DS	5,,	REFERENCE ADDRESS FOR MATRIX, = W+10(M+3).	00410 00002
17060MPL2	DS	3,,M+2		00415 00005
17070	DS	1		00418 00003
17080W	DS	,4809,	REFERENCE ADDRESS.	00419 00001
17090PROD	DS	20,99,	PRODUCT ADDRESS.	04809 00000
171000OUTPUT	DS	10		00099 00020
17110	DC	1,@		00429 00010
17120R	DS	10,,	MAX OR MIN RATIO FOR DUAL OR SIMPLEX ALGORITHM.	00430 00001
17130COLADR	DS	5,,	ADDRESS OF D(K).	00440 00010
17140ROWADR	DS	5,,	ADDRESS OF B(R).	00445 00005
17150ARKADR	DS	5,,	ADDRESS OF A(R,K).	00450 00005
17160CNTCOL	DS	3,,	COLUMN COUNTER.	00455 00005
17170CNTROW	DS	3,,	ROW COUNTER.	00458 00003
17180TEMP1	DS	10,,	TEMPORARY WORK ADDRESS.	00461 00003
17190TEMP2	DS	10,,	TEMPORARY WORK ADDRESS.	00471 00010
17200BIMIN	DS	10,,	MINIMUM B(I).	00481 00010
17210DJMIN	DS	10,,	MINIMUM D(J).	00491 00010
17220AIXMAX	DS	10,,	DENOMINATOR OF SIMPLEX RATIO, USED TO BREAK TIES.	00501 00010
17230	DC	8,99999999		00511 00010
17240INF	DC	2,99,,	INFINITY.	00519 00008
				00521 00002

17250	DC	8,-99999999		00529 00008
17260NEGINF	DC	2,99,,	NEGATIVE INFINITY.	00531 00002
17270	DC	8,0		00539 00008
17280ZERO	DC	2,-99,,	ZERO	00541 00002
17290	DC	8,10000000		00549 00008
17300ONE	DC	2,1,,	ONE.	00551 00002
17310ESSZER	DC	2,-07		00553 00002
17320*				
17330*			TRANSFORM ENTIRE MATRIX.	
17340*			(1) COMPUTE RECIPROCAL OF PIVOT ELEMENT.	
17350*			(2) SET PIVOT CELL = ZERO.	
17360*			(3) MOVE PIVOT COLUMN TO WORKING COLUMN.	
17370*			(4) SET PIVOT COLUMN = UNIT VECTOR.	
17380*				
17390	DS	2		00555 00002
17400TRNMTX	TF	11+23,ARKADR		00556 26 00723 00455
17410	TF	12+23,COLADR		00568 26 00783 00445
17420	TF	CNTROW,M		00580 26 00461 00404
17430	TF	FDIV1+28,ARKADR		00592 26 00698 00455
17440	TFM	MOVELP+23,W+10		00604 16 00753 04819
17450	TF	MOVELP+28,COLADR		00616 26 00758 00445
17460	TF	PIVROW+23,ARKADR		00628 26 00873 00455
17470MOVEK	TFLS	W,ONE		00640 16 02753 00663
				00652 49 02722 00000
				00659 00005 04809
				00664 00005 00551
17480FDIV1	FD	W,99999		00670 16 02753 00693
				00682 49 02702 00000
				00689 00005 04809
				00694 00005 99999
17490*			ADDRESS OF A(R,K).	
1750011			TFLS 99999,ZERO	
				00700 16 02753 00723
				00712 49 02722 00000
				00719 00005 99999
				00724 00005 00541
17510*			ADDRESS OF A(R,K).	
17520MOVELP	TFLS	99999,99999		00730 16 02753 00753

17530*	W+10, COLADR.	00742 49 02722 00000
1754012	TFLS 99999,ZERO	00749 00005 99999
		00754 00005 99999
17550*	COLADR.	00760 16 02753 00783
17560	AM MOVELP+23, 10, 10	00772 49 02722 00000
17570	AM MOVELP+28, 10, 10	00779 00005 99999
17580	AM 12+23, 10, 10	00784 00005 00541
17590	SM CNTROW, 1, 10	00790 11 00753 00070
17600	BNN MOVELP	00802 11 00758 00070
17610PIVROW	TFLS 99999,ONE	00814 11 00783 00070
		00826 12 00461 00001
		00838 46 00730 01300
17620*	ADDRESS OF A(R,K).	00850 16 02753 00873
17630*		00862 49 02722 00000
17640*	(5) MULTIPLY PIVOT ROW BY RECIPROCAL OF PIVOT ELEMENT.	00869 00005 99999
17650*		00874 00005 00551
17660	TF PRLP+23,ROWADR	00880 26 00927 00450
17670	TF CNTCOL,N	00892 26 00458 00408
17680PRLP	FM 99999,W	00904 16 02753 00927
		00916 49 02682 00000
		00923 00005 99999
		00928 00005 04809
17690	A PRLP+22,MPL2	00934 21 00926 00418
17700	SM CNTCOL, 1, 10	00946 12 00458 00001
17710	BNN PRLP	00958 46 00904 01300
17720*	(6) TRANSFORM ENTIRE MATRIX.	
17730*		
17740*		
17750	TFM ROWLP+6,W+10	00970 16 01036 04819
17760	TF 14+11,S	00982 26 01077 00415
17770	A 14+10,MPL2	00994 21 01076 00418
17780	TFM FMUL+28,W+10	01006 16 01160 04819

17790	TF CNTROW,M	01018 26 00461 00404
17800ROWLP	CM 99999,99,1011, IS A(1,K), WORKING COLUMN, EQUAL TO ZERO.	01030 14 99999 00099
17810	BE NXTROW	01042 46 01276 01200
17820	TF ELLP+28,ROWADR	01054 26 01130 00450
1783014	TFM 15+23,99999,,S+10(M+2).	01066 16 01185 99999
17840	TF CNTCOL,N	01078 26 00458 00408
17850	TF 151+6,15+23	01090 26 01198 01185
17860ELLP	TFLS TEMP2,99999	01102 16 02753 01125
		01114 49 02722 00000
		01121 00005 00481
		01126 00005 99999
17870*	PIVOT ROW ADDRESS. INCREMENT= 10(M+2).	
17880FMUL	FM TEMP2,99999	01132 16 02753 01155
		01144 49 02682 00000
		01151 00005 00481
		01156 00005 99999
17890*	W+10, ADDRESS OF A(0,K), WORKING COLUMN. INCREMENT =10.	
1790015	FS 99999,TEMP2	01162 16 02753 01185
		01174 49 02662 00000
		01181 00005 99999
		01186 00005 00481
17910*	S+10(M+2), ADDRESS OF FUNCTIONAL. INCREMENT =10(M+2).	
17920151	C 99999,ESSZER,,SAME ADDRESS AS 15+23. INCREMENT= 10(M+2).	01192 24 99999 00553
17930	BL LOW	01204 47 01716 01300
17940	A ELLP+27,MPL2	01216 21 01129 00418
17950	A 151+5,MPL2	01228 21 01197 00418
17960	A 15+22,MPL2	01240 21 01184 00418
17970	SM CNTCOL, 1, 10	01252 12 00458 00001
17980	BNN ELLP	01264 46 01102 01300
17990NXTROW	AM ROWLP+6, 10, 10	01276 11 01036 00070
18000	AM FMUL+28, 10, 10	01288 11 01160 00070
18010	AM 14+11, 10, 10	01300 11 01077 00070
18020	SM CNTROW, 1, 10	01312 12 00461 00001
18030	BNN ROWLP,,, IS MATRIX TRANSFORMATION FINISHED.	01324 46 01030 01300

18040*				
18050*	(7)	SWITCH ID/C ELEMENTS.		
18060*				
18070	TF	16+11,ROWADR		
18080	TF	SWITCH+11,COLADR	01336 26 01431 00450	
18090	SM	SWITCH+11, 10, 10	01348 26 01419 00445	
18100	TF	16+6,SWITCH+11	01360 12 01419 00070	
18110	S	16+10,MPL2	01372 26 01426 01419	
18120	TF	17+6,16+11	01384 22 01430 00418	
18130SWITCH	TF	TEMP2,99999	01396 26 01438 01431	
1814016	TF	99999,99999	01408 26 00481 99999	
1815017	TF	99999,TEMP2	01420 26 99999 99999	
18160	AM	ITER+11, 1, 10	01432 26 99999 00481	
18170	BNC1	BBACK	01444 11 01491 00001	
18180	RCTY		01456 47 01690 00100	
18190ITER	TFM	OUTPUT,0,8	01468 34 00000 00102	
18200	WNTY	OUTPUT-3	01480 16 00429 00000	
18210	TBTY		01492 38 00426 00100	
18220	TF	PR1+28,S	01504 34 00000 00108	
18230	A	PR1+27,MPL2,,ADDRESS OF FUNCTIONAL.	01516 26 01592 00415	
18240	TF	PR2+11,16+11,,ADDRESS OF VARIABLE IN.	01528 21 01591 00418	
18250	TF	PR3+11,16+6,, ADDRESS OF VARIABLE OUT.	01540 26 01629 01431	
18260PR1	TFLS	OUTPUT,99999	01552 26 01665 01426	
			01564 16 02753 01587	
			01576 49 02722 00000	
			01583 00005 00429	
			01588 00005 99999	
18270	WNTY	OUTPUT-9	01594 38 00420 00100	
18280	TBTY		01606 34 00000 00108	
18290PR2	TF	OUTPUT,99999	01618 26 00429 99999	
18300	WNTY	OUTPUT-9	01630 38 00420 00100	
18310	TBTY		01642 34 00000 00108	

18320PR3	TF	OUTPUT,99999		01654 26 00429 99999
18330	WNTY	OUTPUT-9		01666 38 00420 00100
18340	RCTY			01678 34 00000 00102
18350BBACK	BNC2	*+24		01690 47 01714 00200
18360	H			01702 48 00000 00000
18370	BB			01714 42 00000 00000
18380	DORG	*-9		01716
18390LOW	TF	TFL+23,151+6		01716 26 01751 01198
18400TFL	TFLS	99999,ZERO		01728 16 02753 01751
				01740 49 02722 00000
				01747 00005 99999
				01752 00005 00541
18410	B	151+24		01758 49 01216 00000
18420	DORG	*-3		01766
18430*				
18440*	DUAL	- SELECT SMALLEST B(1).		
18450*				
18460DUAL	TFLS	BIMIN,ZERO		01766 16 02753 01789
				01778 49 02722 00000
				01785 00005 00491
				01790 00005 00541
18470	TF	CNTROW,M		01796 26 00461 00404
18480	TF	CMP1+28,S		01808 26 01902 00415
18490	A	CMP1+27,MPL2		01820 21 01901 00418
18500	AM	CMP1+28, 10, 10		01832 11 01902 00070
18510BICOMP	TFLS	TEMP1,BIMIN		01844 16 02753 01867
				01856 49 02722 00000
				01863 00005 00471
				01868 00005 00491
18520CMP1	FS	TEMP1,99999		01874 16 02753 01897
				01886 49 02662 00000
				01893 00005 00471
				01898 00005 99999
18530*		ADDRESS OF B(J).		
18540	BNE	ROWSTP		01904 47 01970 01200
18550NEGA	TF	MINBI+28,CMP1+28		01916 26 01956 01902

18560MINBI TFLS BIMIN,99999
 01928 16 02753 01951
 01940 49 02722 00000
 01947 00005 00491
 01952 00005 99999
 18570 TF ROWADR,MINBI+28,,SETUP ROW ADDRESS FOR MATRIX TRANSF.
 01958 26 00450 01956
 18580ROWSTP SM CNTROW,1,10
 01970 12 00461 00001
 18590 BP BICOMP-12
 01982 46 01832 01100
 18600*
 18610* SELECT LARGEST R= D(J)/A(R,J).
 18620*
 18630INITCL TFLS R,NEGINF
 01994 16 02753 02017
 02006 49 02722 00000
 02013 00005 00440
 02018 00005 00531
 18640 TFM COLADR,0
 02024 16 00445 00000
 18650 TF CNTCOL,N
 02036 26 00458 00408
 18660 TF TSTARJ+6,ROWADR
 02048 26 02150 00450
 18670 TF CS1+28,S
 02060 26 02220 00415
 18680 A CS1+27,MPL2
 02072 21 02219 00418
 18690RETURN A TSTARJ+5,MPL2
 02084 21 02149 00418
 18700 TF CMP2+6,TSTARJ+6
 02096 26 02174 02150
 18710 SM CMP2+6,2,10
 02108 12 02174 00002
 18720 TF FDIV2+28,TSTARJ+6
 02120 26 02250 02150
 18730 A CS1+27,MPL2
 02132 21 02219 00418
 18740TSTARJ CM 99999,99,1011
 02144 14 99999 00099
 18750 BE COLSTP
 02156 46 02378 01200
 18760CMP2 C 99999,ZERO-2
 02168 24 99999 00539
 18770 BP COLSTP
 02180 46 02378 01100
 18780CS1 TFLS TEMP2,99999
 02192 16 02753 02215
 02204 49 02722 00000
 02211 00005 00481
 02216 00005 99999
 18790* ADDRESS OF D(J).
 18800FDIV2 FD TEMP2,99999
 02222 16 02753 02245

18810* ADDRESS OF A(R,J).
 18820 TFLS TEMP1,R
 02234 49 02702 00000
 02241 00005 00481
 02246 00005 99999
 18830 FS TEMP1,TEMP2
 02252 16 02753 02275
 02264 49 02722 00000
 02271 00005 00471
 02276 00005 00440
 18840 BP COLSTP
 02282 16 02753 02305
 02294 49 02662 00000
 02301 00005 00471
 02306 00005 00481
 18850 TFLS R,TEMP2
 02312 46 02378 01100
 02324 16 02753 02347
 02336 49 02722 00000
 02343 00005 00440
 02348 00005 00481
 18860 TF ARKADR,FDIV2+28
 02354 26 00455 02250
 18870 TF COLADR,CS1+28
 02366 26 00445 02220
 18880COLSTP SM CNTCOL,1,10
 02378 12 00458 00001
 18890 BP RETURN
 02390 46 02084 01100
 18900 CM COLADR,0
 02402 14 00445 00000
 18910 BNE BTM1
 02414 47 02458 01200
 18920 RCTY
 02426 34 00000 00102
 18930 WATY MESS1
 02438 39 02495 00100
 18940 B END
 02450 49 02470 00000
 18950 DORG *-3
 02458
 18960BTM1 BTM TRNMTX,0,10
 02458 17 00556 00000
 18970END RNCD 0
 02470 36 00000 00500
 18980 B 0
 02482 49 00000 00000
 18990MESS1 DAC 22,INCONSISTENT PROBLEM.@
 02495 00022
 19000 DORG 2662
 02662
 19010 DEND DUAL
 01766
 LOAD SUBROUTINES

D. LISTING OF SAMPLE PROBLEM INPUT DECKS, DUPLICATED ALPHAMERICALLY.

THE FIRST CARD OF EACH DECK IS THE HASH TOTAL CARD AND MUST BE REMOVED
PRIOR TO EXECUTION.

3100080000604900072 5307115672690481050M 05004900000
SAMPLE PROBLEM , LP20, SIMPLEX.
005 006 1
001 001 1.0 001 002 1.0 001 003 1.0 001 004 2.0
002 002 1.0 002 003 1.0 002 004 2.0 002 005 1.0
002 006 1.0 003 001 99.4 003 002 37.75 003 003 19.75
003 004 54.4 003 005 74.75 003 006 53.0 004 003 0.436
004 005 19.1 004 006 12.363 005 002 3.0 005 003 0.364
005 005 9.1 005 006 26.737
001 00J 0007 002 00J 0008 003 00J 0009 004 00J 0010
005 00J 0011
00J 001 00010834 00J 002 000207235 00J 003 00030273 00J 004 000407205
00J 005 000520725 00J 006 0006455
001 000 60.0 002 000 60.0 003 000 2000.0 004 000 424.0
005 000 359.0
999

180.

3100080000604900072 8205071679010089250M 05004900000
SAMPLE PROBLEM, LP20, SIMPLEX, TEST SOLUTION.
005 006 1
001 001 1.0 001 002 1.0 001 003 1.0 001 004 2.0
002 002 1.0 002 003 1.0 002 004 2.0 002 005 1.0
002 006 1.0 003 001 99.4 003 002 37.75 003 003 19.75
003 004 54.4 003 005 74.75 003 006 53.0 004 003 0.436
004 005 19.1 004 006 12.363 005 002 3.0 005 003 0.364
005 005 9.1 005 006 26.737
001 00J 0007 002 00J 0008 003 00J 0009 004 00J 0010
005 00J 0011
00J 001 00010834 00J 002 000207235 00J 003 00030273 00J 004 000407205
00J 005 000520725 00J 006 0006455
001 000 60.0 002 000 60.0 003 000 2000.0 004 000 424.0
005 000 359.0
000 001 0.2171115 000 004 23.286457 000 006 13.427085
001 00K 13.20997 004 00K 258.00095
999

181.

3100080000604900072

3173229970375979503P

05004900000

LINEAR PROGRAMMING TEST PROBLEM. DUAL. FEED MIX.

003 004 1

001 001 -17.0	001 002 -25.0	001 003 -60.0	001 004 -45.0
002 001 -2.0	002 002 -5.0	002 003 -7.0	002 004 -0.5
003 001 -1.0	003 002 -1.0	003 003 -1.0	003 004 -1.0
00J 001 000106600-	00J 002 000209200-	00J 003 000315600-	00J 004 000409600-
001 000 -35.0	002 000 -1.5	003 000 -1.0	
001 00J 0005000000	002 00J 0006000000	003 00J 0007000000	

999

VI. CORE LAYOUT. ALL ADDRESSES ARE FIELD ADDRESSES.

		A. LAYOUT				
ROW NUMBERS		COLUMN NUMBERS				
		-2	-1	0		1-N
-1	WORKING COLUMN					$1D/C(J)$
0				FUNCTIONAL		$Z_j - C_j = \text{SHADOW PRICES}$
1-M			$1D/C(I)$	$b(I)$		$A(I, J)$

		B. ADDRESSES					
ROW NUMBERS		COLUMN NUMBERS					
		-2	-1	0	1	2	N
-1	$W = \overline{04809}$				$S + 10(2M+3)$		$S + 10((N+1)(M+2) - 1)$
0		$S = W + 10(M+3)$	FUNCTIONAL		$S + 10(2M+4)$		$S + 10((N+1)(M+2))$
1					$S + 10(2M+5)$		
2							
M		$4809 + 10(M+1)$	$S + 10M$	$S + 10(2M+2)$	$S + 10(3M+4)$		$S + 10((N+2)(M+2) - 2)$

ADDRESS OF $A(I, J) = S + 10((J+1)(M+2) + I)$

