JSC-12891
Revision A

"AS-BUILT" DESIGN SPECIFICATION
FOR
HISTORICAL DAILY DATA BASES FOR TESTING ADVANCED MODELS

Job Order 74-963

AD 63-1347-4963-08

Prepared By
Lockheed Electronics Company, Inc.
Systems and Services Division
Houston, Texas
Contract NAS 9-15200

For

EARTH OBSERVATIONS DIVISION

SPACE AND LIFE SCIENCES DIRECTORATE

National Aeronautics and Space Administration

LYNDON B. JOHNSON SPACE CENTER

Houston, Texas

January 1978

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CONTENTS

1. SCOPE

This document describes the acquisition of daily weather data from North Dakota and Kansas, the reduction of U.S.S.R. synoptic observations (4-8 observations daily) to daily data and conversion of all three data sets to the formats utilized by advanced wheat yield models. Data from the three areas are available on tape, those of each area having a unique format. Tapes were built by converting these data to one of two possible formats, depending on the amount of data available.

North Dakota and Kansas data contain daily temperature maximums and minimums, as well as total daily precipitation. North Dakota precipitation information is less detailed than that of Kansas. No significant manipulation is required to convert these data to the needed formats.

Synoptic data are available for the U.S.S.R., with a maximum of eight 3-hourly observations per day containing detailed weather information recorded at the time of observation. An algorithm is applied to the U.S.S.R. data to estimate daily maximum and minimum temperatures and sum the daily precipitation.

Nineteen tapes have been obtained to date from NOAA's National Climatic Center (NCC) at Asheville, North Carolina including synoptic weather data from WMO blocks 33, 28, and 35. In general Block 33 covers the western three-fourths of the Ukraine, Block 28 covers the area on both sides of the Ural Mountains and Block 35 includes the area between the Ural Mountains and the Aral Sea. Within the wheat areas in these blocks daily precipitation and max-min temperature records have been derived for forty-seven stations for most years during the period 1965 through 1975. Additional tapes are available from NCC from which similar records could be derived for the roughly 80 percent of the U.S.S.R. not included in Blocks 33, 28, and 35.

2. APPLICABLE DOCUMENTS

- Job Order 63-1347-4963
- Action Documentation 63-1347-4963-08 (Task II, AD #1)

3. SYSTEM DESCRIPTION

3.1 HARDWARE DESCRIPTION

These data conversion programs will operate on an IBM 360/370 system with Fortran and PL/I compilers and magnetic tape drive. In the event that a PL/I compiler is not available, one short program can be rewritten in Fortran. These programs can also operate on a PDP 11/45 batch environment with a Fortran compiler and magnetic tape drive.

3.2 NORTH DAKOTA DATA BASE FORMAT AND CONVERSION PROGRAM

The tape obtained from North Dakota State University contains daily data for 59 North Dakota weather stations, each station on a separate file. NDSU personnel had assembled these data in 26-character records, with each record containing weather data for one day/station.

The North Dakota 26-character format is different from the standard 26-character format used for the advanced wheat yield models (Format I, referred to by Kansas State University personnel as "modified Kansas format"). A short PL/I program was written to convert the data of 12 stations to Format I. This program can be rewritten in Fortran if a PL/I compiler is not available. Documentation is given in Appendix A.

3.3 KANSAS DATA BASE FORMAT

The tape obtained from Kansas State University contains daily data for 39 Kansas weather stations, with each station on a separate file. KSU, in turn, had obtained their data from the National Climatic Center in Asheville, North Carolina, and had filled in missing data from local sources.

The tape format is referred to by KSU personnel as "Format II." It consists of 960-character records, with each record containing the necessary input weather data for one month/station. Documentation is given in Appendix B.

3.4 U.S.S.R. DATA BASE FORMAT AND CONVERSION PROGRAM

Nineteen tapes were obtained from the National Climatic Center in Asheville, North Carolina, covering World Meteorological Organization (WMO) blocks 28, 33, and 35 for the years 1965-1975. These tapes contain synoptic data for all reporting weather stations within these three areas, recorded in WMO tape deck format 9685.

The program to perform this conversion (max-min algorithm) and its subroutines are described subsequently.

3.4.1 MAX-MIN ALGORITHM

The Statistics Department of Kansas State University has developed a non-linear regression model to estimate maximum and minimum temperatures from synoptic data. This algorithm was programmed in Fortran by LEC personnel, using a main program supported by seventeen different subroutines and functional subprograms. The program is unique, with no other major library subroutines or linkage needed. Each of the subroutines will be described below under separate paragraph headings; flowcharts and sample listings of the main program and all subroutines will be found in Appendix C. The results are stored on a tape in Format I.

Program MINIMAX is designed to estimate the daily maximum and minimum temperatures for weather stations in the U.S.S.R. with greater than 90% accuracy when compared with Soviet-published daily weather data.

The algorithm is based on temperature readings recorded every three hours over a 24-hour interval. Two possible situations are associated with the given observations:

1. Fewer than eight readings in a 24-hour interval.
   The estimation for minimum and maximum temperatures will be based on specified readings. Suitable correction factors derived from the algorithm are applied to the selected temperature readings to determine the day's minimum and maximum temperatures.

   a. The daily minimum will utilize the following temperature readings:

Time Zone	Hours 1st Choice	2nd Choice	3rd Choice
00	03	06	00
01	03	00	06
02	03	00	06

   b. The daily maximum will use the following temperature readings:

Time Zone	Hours 1st Choice	2nd Choice	3rd Choice
00	15	12	09
01	12	15	09
02	12	09	15

2. Eight readings in a 24-hour interval.
   The highest and lowest readings among the eight, with proper correction factors, will be the daily maximum and minimum temperatures, respectively.

3.4.2 SUBROUTINE CONV

The subroutine CONV is used to convert special characters (missing data) from the temperature and precipitation variables to numeric values. Input and output arguments are TEMP and PRECIP.

3.4.3 SUBROUTINE CMDTOJ

This subroutine converts the input arguments YR, MONTH and DAY into the Julian date and output argument, JILIAN.

3.4.4 SUBROUTINE EST1

If fewer than eight observations for a particular day have been recorded, this subroutine chooses the best possible hour and temperature reading to use in calculation of the sun time (ST) for the day's minimum temperature. If all eight observations have been recorded, this subroutine is not utilized. The input arguments are the station's time zone HO, an array of the day's temperature observations KHRTEM, the sun time correction factor SUNCOR, and the hour of observation HOUR. Output arguments are the sun time ST, and the position of the chosen temperature reading within the array of a day's observations HT.

3.4.5 SUBROUTINE EST2

If fewer than eight observations for a day have been recorded, this subroutine chooses the best possible hour and temperature reading to use in calculation of the sun time (ST) for the day's maximum temperature. If all eight observations have been recorded, this subroutine is not used. Input and output arguments are identical to those used in EST1.

3.4.6 SUBROUTINE ESTDTN

If fewer than eight observations have been recorded, this subroutine estimates the value for DTN, the correction factor for the daily minimum temperature. Regression coefficients were provided by the KSU Statistics Department. Input arguments are an array of regression coefficients B, an array of variable combinations X, the sun time ST, daylength DL and the average monthly temperature range for the station TR; the output argument is DTN.

3.4.7 SUBROUTINE ESTDTX

If fewer than eight observations have been recorded, this subroutine estimates the value for DTX, the correction factor for the daily maximum temperature. Regression coefficients were provided by the KSU Statistics Department. Input arguments are the same as those used in ESTDTN; the output argument is DTX.

3.4.8 SUBROUTINE MAXMIN

If fewer than eight observations are recorded, this subroutine estimates the daily maximum and daily minimum temperatures from the specified hour temperature readings. Input arguments are the correction factor for the daily maximum temperature DTX, the correction factor for the minimum temperature DTN, the recorded temperature at the hour chosen to calculate the maximum HTDX, and the hour chosen to calculate the minimum HTDN. Output arguments are the day's estimated maximum and minimum temperatures, DMAX and DMIN, respectively.

3.4.9 SUBROUTINE MAX

When all eight temperature observations have been recorded, this subroutine is used to find the highest temperature of the eight. The input arguments are an array of the day's observations KHRTEM, an array of subscripts to KHRTEM called K, and the sun correction factor SUNCOR. Output arguments are the maximum observed temperature OBSMAX and the hour at which this max occurred STMX.

3.4.10 SUBROUTINE MIN

When all eight temperature observations have been recorded, this subroutine is used to find the lowest temperature of the eight. The input arguments are the same as those for subroutine MAX; the output arguments are the minimum observed temperature OBSMIN and the hour at which this minimum occurred STMN.

3.4.11 FUNCTION DLNGTH

This functional subprogram estimates the daylength of each Julian day. The input arguments are the latitude of the station being considered XLAT and the Julian date DATE. The output is transferred back to the main program by the name of the funcitonal subprogram DLNGTH.

3.4.12 SUBROUTINE PSUD01

When all eight temperature observations have been recorded, this subroutine estimates the correction factor for the daily minimum temperature DTN for stations located in time zone 00. Input arguments are an array of regression coefficients B, an array of variable combinations X, the hour at which the minimum temperature occurred STMN, daylength DL, average monthly temperature range TR and the sun time correction factor SC; the output argument is DTN.

3.4.13 SUBROUTINE PSUD02

When all eight temperature observations have been recorded, this subroutine estimates the correction factor for the daily maximum temperature DTX for stations located in time zone 00. Input arguments are an array of regression coefficients B, an array of variable combinations X, the hour at which the maximum temperature occurred STMX, daylength DL, average monthly temperature range TR and the sun time correction factor SC; the output argument is DTX.

3.4.14 SUBROUTINE PSUD03

When all eight temperature observations have been recorded, this subroutine estimates the correction factor for the daily minimum temperature DTN for stations located in time zone 01. Input and output arguments are identical to those of PSUD01.

3.4.15 SUBROUTINE PSUD04

When all eight temperature observations have been recorded, this subroutine estimates the DTX for stations in time zone 01. Input and output arguments are identical to those of PSUD02.

3.4.16 SUBROUTINE PSUD05

When all eight temperature observations have been recorded, this subroutine estimates the DTN for stations in time zone 02. Input and output arguments are the same as those of PSUD01.

3.4.17 SUBROUTINE PSUD06

When all eight temperature observations have been recorded, this subroutine estimates the DTX for stations in time zone 02. Input and output arguments are the same as those of PSUD02.

3.4.18 SUBROUTINE OUT

This subroutine is used to put the output information into Format I (see Appendix A). The input arguments are the station number STATN, year SAVYR, month SAVMON, day SAVDAY, estimated maximum temperature DMAX, estimated minimum temperature DMIN, the day's precipitation total SUMPRE. Output arguments are STATN, SAVYR, SAVMON, SAVDAY, maximum temperature MAX, minimum temperature MIN and the day's precipitation PRE.

4. OPERATION

To operate program MINIMAX the number of stations to be used, NUMSTA, must be declared. The following card input is necessary, using one card/station:

Columns	Variable name, description
1 - 5	STNARR, station number
6	blank
7 - 10	SUNARR, sun correction factor in thousandths of degrees longitude, no decimal point
11 - 70	TRARR, monthly temperature ranges, in hundredths ^{o}F, no decimal points
11-15	January temperature range
16-20	February temperature range
.	.
.	.
66-70	December temperature range
71	blank
72 - 75	LATARR, station latitude in hundredths of degrees, no decimal point
76 - 77	TZARR, station time zone location
78 - 80	blank

If more than 30 stations will be used, space for the above arrays must be increased. Output data from MINIMAX will be in Format I.

After conversion to either Format I or Format II, the North Dakota, Kansas and U.S.S.R. data bases may be directly accessed by the advanced wheat yield models.

APPENDIX A

FORMAT I

FORMAT I

Character String (per record)	
1 - 6	Station number
7 - 8	Year
9 - 10	Month
11 - 12	Day
13	Blank
14 - 16	Max Temperature *
17 - 19	Min Temperature *
20 - 22	Blank
23 - 26	Precipitation **

* Temperatures are in whole degrees Fahrenheit with a leading minus sign if negative; missing temperatures are indicated by blanks or 999.

** Precipitation is in hundredths of inches with no decimal point; missing precipitation is indicated by 9999.

```
REFORM: PROC OPTIONS(MAIN);
        DCL 1 DAILY BASED(P),
                2 STA#    CHAR(6),
                2 FILL1   CHAR(1),
                2 YR      CHAR(2),
                2 MON     CHAR(2),
                2 DAY     CHAR(2),
                2 FILL2   CHAR(1),
                2 CMAX    CHAR(3),
                2 FILL3   CHAR(1),
                2 CMIN    CHAR(3),
                2 FILL4   CHAR(1),
                2 CPPT    CHAR(4);
      DCL 1 NEWREC BASED(P),
                2 STA#    CHAR(6),
                2 YR      CHAR(2),
                2 MON     CHAR(2),
                2 DAY     CHAR(2),
                2 FILL1   CHAR(1),
                2 CMAX    CHAR(3),
                2 CMIN    CHAR(3),
                2 FILL2   CHAR(3),
                2 CPPT    CHAR(4);
    DCL DATAFIL FILE RECORD INPUT;
    DCL OUTFIL FILE RECORD OUTPUT;
    ALLOCATE DAILY;
    ON ENDFILE(DATAFIL) GO TO EOF;
RD: ;
    READ FILE(DATAFIL) INTO (DAILY);
         IF DAILY.YR < '31' | DAILY.YR > '74' THEN GO TO RD;
         NEWREC = DAILY, BY NAME;
    WRITE FILE(OUTFIL) FROM (NEWREC);
    GO TO RD;
EOF:FREE DAILY;
    END REFORM;
```

Original North Dakota format

format I

APPENDIX B

FORMAT II

FORMAT II

Character String
(per record)

1 - 2	State Index #
3 - 6	Station Indes
7 - 8	Year
9 - 10	Month
11 - 134	Precipitation (31 values)
135 - 227	Max Temperature (31 values)
228 - 320	Min Temperature (31 values)
321 - 382	Max water temperature - Pan (31 values)
383 - 413	Estimated precipitation (31 values)
414 - 475	Snowfall (31 values)
476 - 568	Snow Depth on ground (31 values)
569 - 661	Water equivalent of snow on ground (31 values)
662 - 785	Wind movement (31 values)
786 - 878	Evaporation (31 values)
879 - 940	Min water temperature - Pan (31 values)
941 - 960	All 1's

Precipitation (fields of 4)
Characters 11 - 134, 31 values, field of 4. For months with less than 31 days fill remaining fields with 9999.

Contents of each field

0001 - 9997	00.01 - 99.97 inches to hundredths
0000	for trace
0000	for no precipitation
9998	amount included in subsequent measurement
9999	missing or not reported

Maximum Temperature (fields of 3)
Characters 135 - 227, 31 values, field of 3. For months with less than 31 days fill remaining fields with 999.

Contents of each field

001 - 299	-99. to 199. ^{o}F. Bias each value by +100^{o}F thus character string will contain values from 1 to 299
999	not reported or missing

Minimum Temperature (fields of 3)
Characters 228 - 320

Contents of each field (Same as for Maximum Temperatures)

Maximum Water Temperature - Pan (fields of 2)
Characters 321 - 382, 31 values, field of 2. For months with less than 31 days, remaining fields are 99.

Contents of each field

00 - 98	30 to 128°F	Each temperature value is biased by -30°F; if temperature is greater than 128°F it is set to 128°F, if temperature is less than 30°F it is set to 30°F.
99		Missing or not reported

Estimated Precipitation (fields of 1)
Characters 383 - 413, 31 values, field of 1. For months with less than 31 days, remaining fields are 9.

Contents of each field

9	When daily precipitation was not estimated or when it is missing or nor reported.
1	When daily precipitation was estimated.

Snowfall (fields of 2)
Characters 414 - 475, 31 values, field of 2. For months with less than 31 days, fill remaining fields with 99.

Contents of each field

01 - 97	1 to 97 inches rounded to nearest whole inch (if over 97 inches change to 97)
00	No snowfall
98	Amount included in subsequent measurement
00	Trace
99	Missing or not reported

Snow Depth on Ground (fields of 3)
Characters 476 - 568, 31 values, field of 3. For months with less than 31 days, fill remaining fields with 999.

Contents of each field

001 - 998	1-998 inches (whole inches)
000	None
000	Trace
999	Missing or not reported

Water Equivalent of Snow on Ground (fields of 3)
Characters 569 - 661, 31 values, field of 3. For months with less than 31 days, fill remaining fields with 999.

Contents of each field

000 - 998	00.0 to 99.8 inches of water
999	Missing or not reported

*NOTE....water equivalent data available only at first-order stations beginning October, 1963.

Wind Movement (fields of 4)
Characters 662 - 785, 31 values, field of 4. For months with less than 31 days, fill remaining fields with 9999.

Contents of each field

0000 - 9997	Whole miles (if over 9997 miles, change to 9997).
9998	Amount included in subsequent measurement
9999	Missing or not reported

Evaporation (fields of 3)
Characters 786 - 878, 31 values, field of 3. For months with less than 31 days, fill remaining fields with 999.

Contents of each field

001 - 997	0.01 - 9.97 (to hundredths)
998	Amount included in subsequent measurement
999	Missing or not reported

Minimum Water Temperature - Pan (fields of 2)
Characters 879 - 940

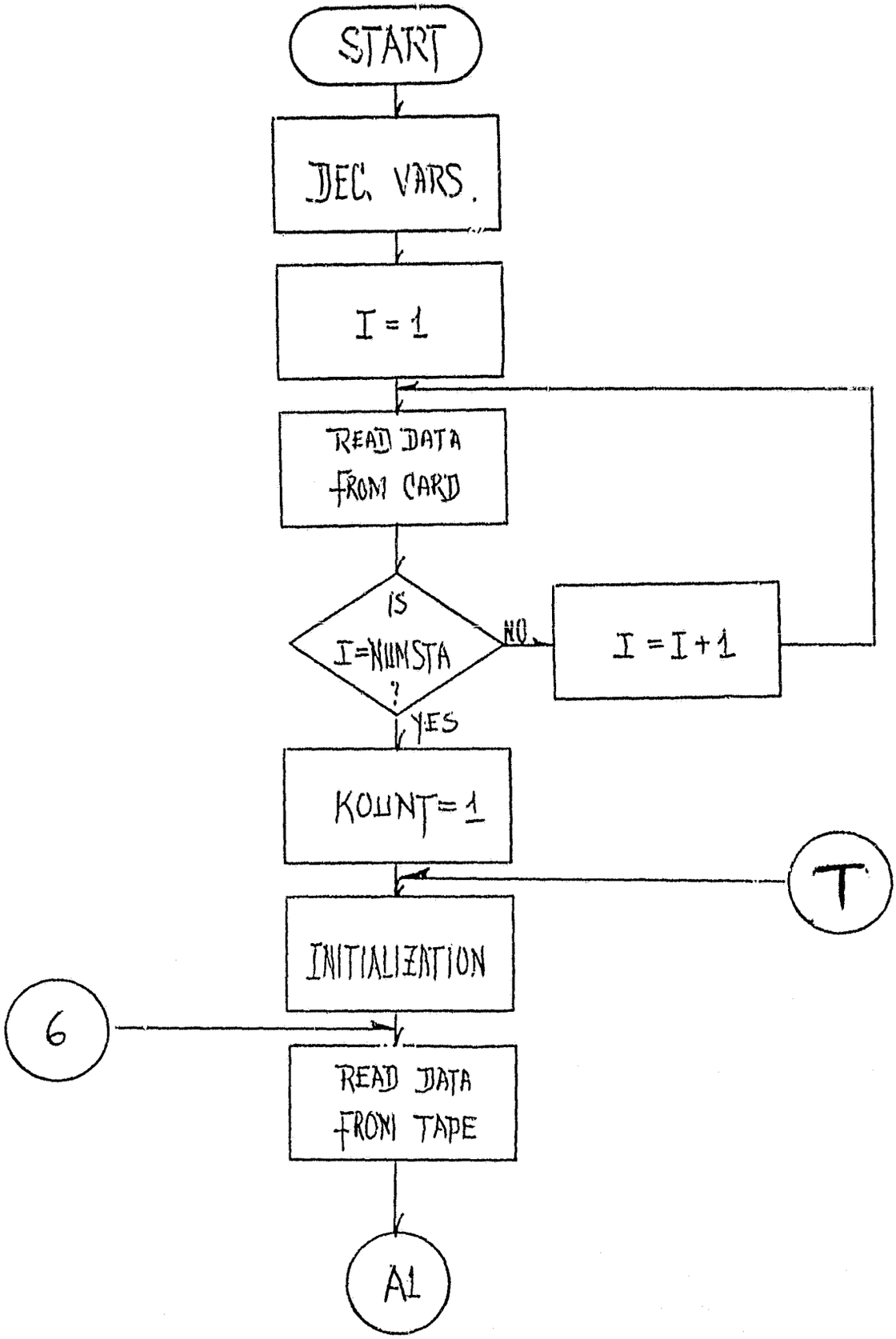
Contents of each field (same as for Maximum Water Temperature - Pan).

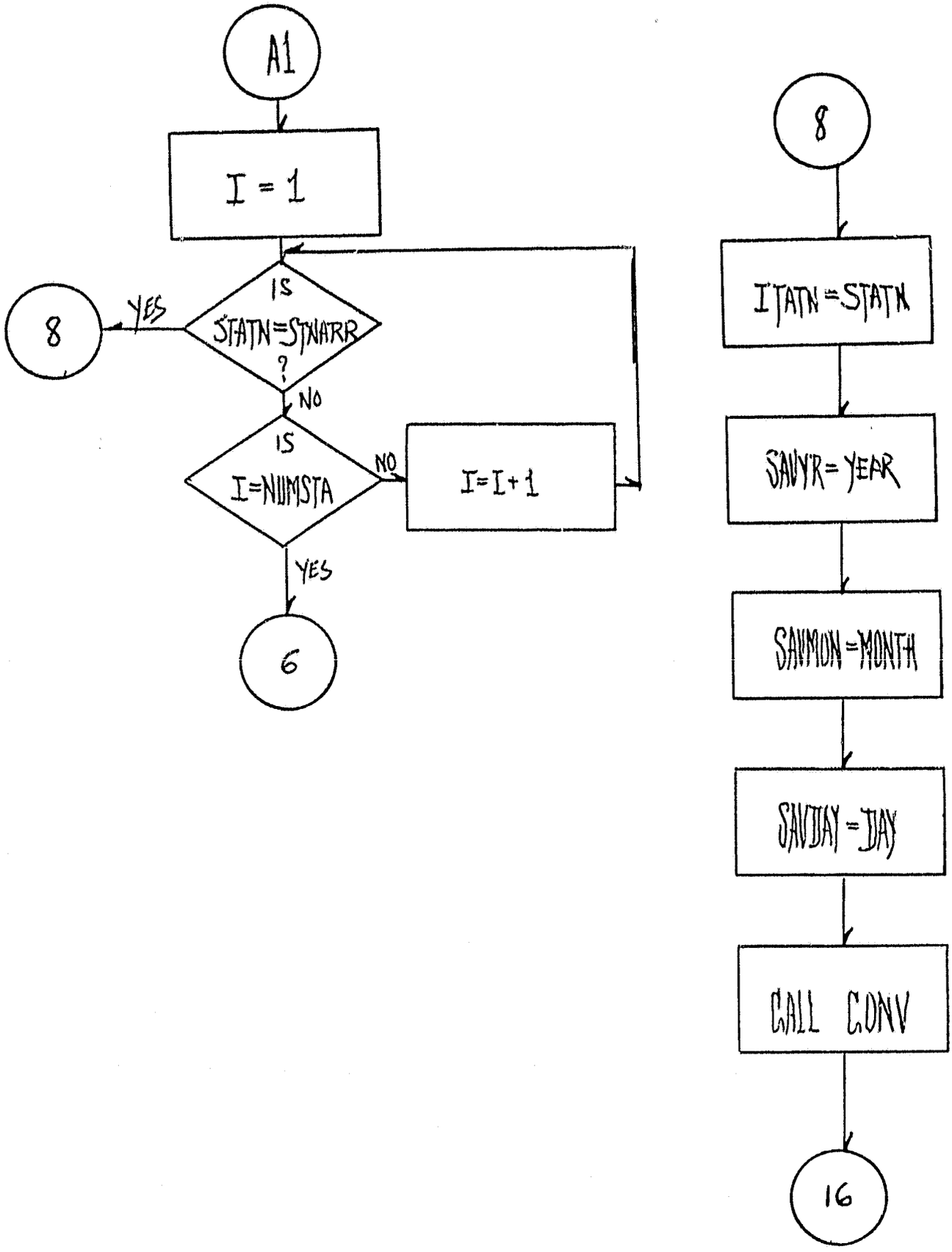
APPENDIX C

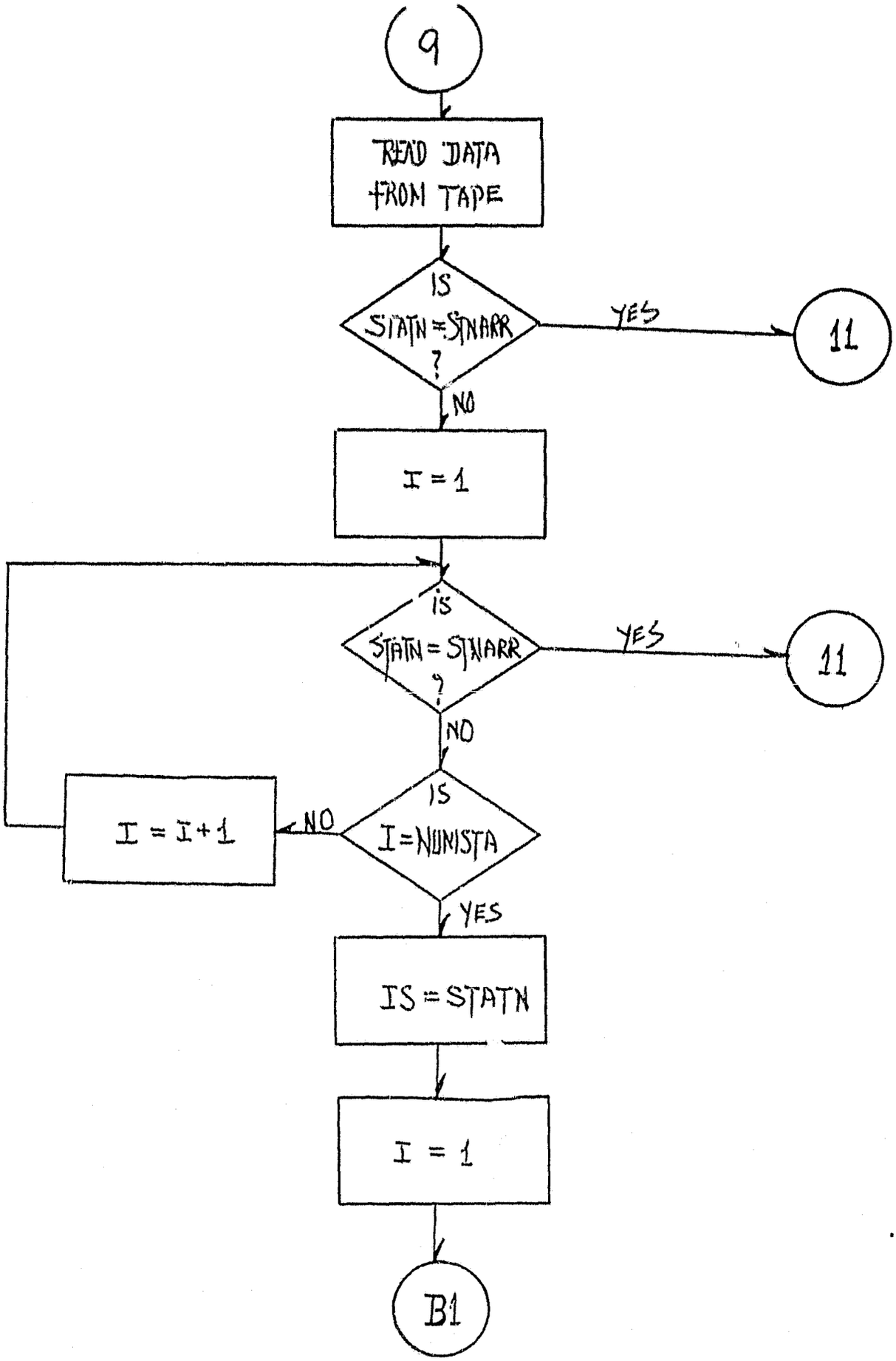
MAX-MIN ALGORITHM

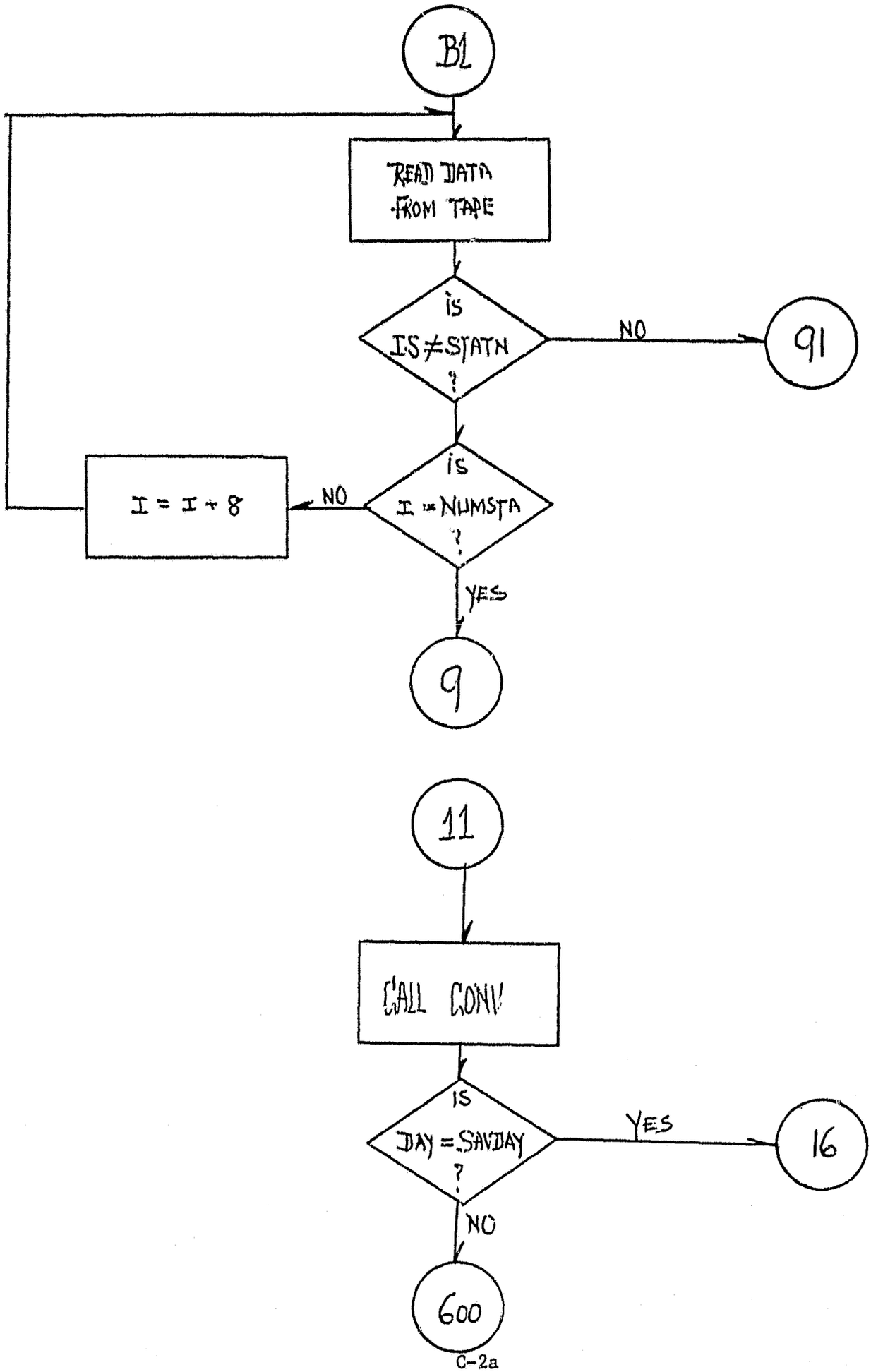
APPENDIX C

TABLE OF CONTENTS

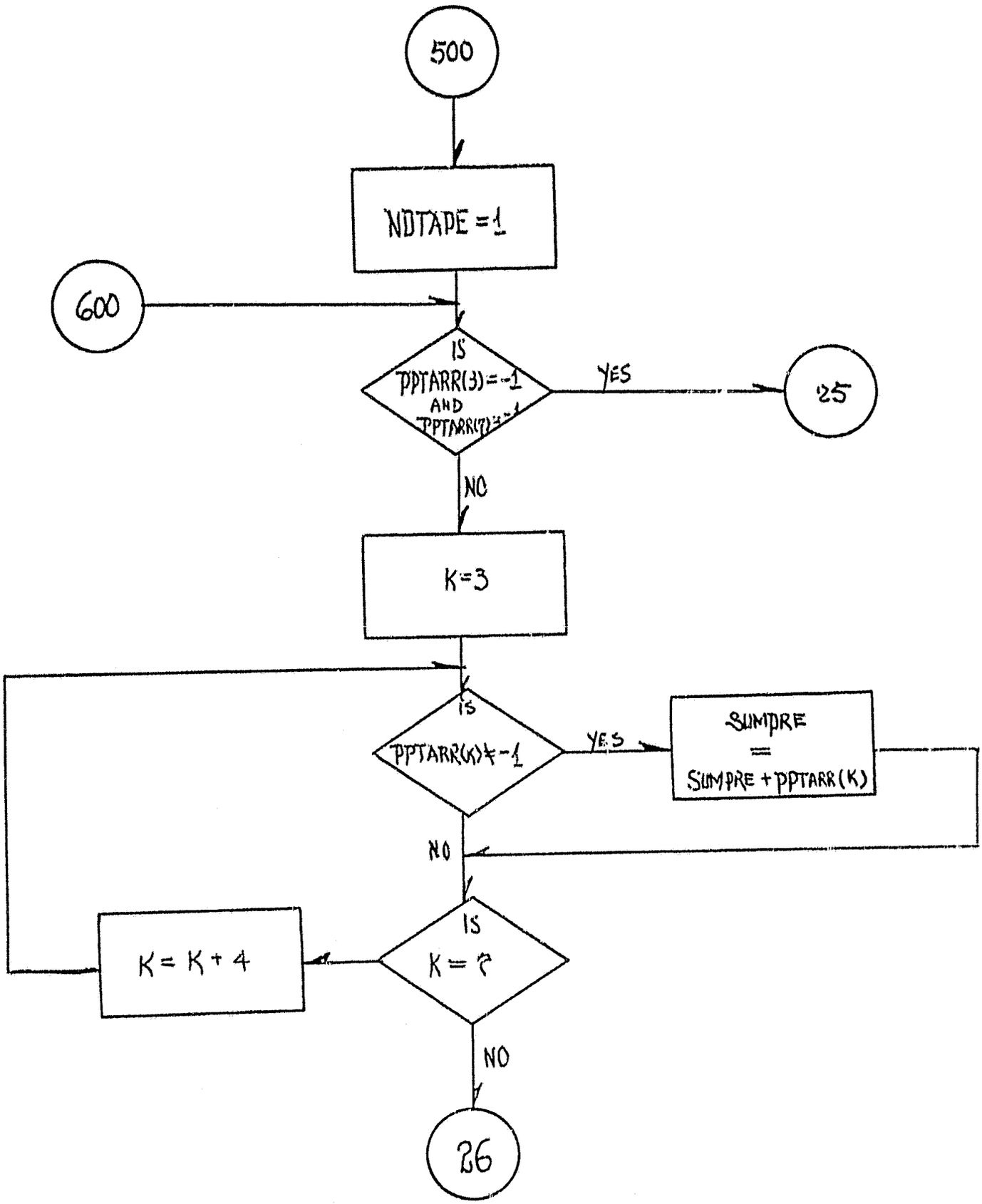

START
DEC. VARS.
I = 1
READ DATA FROM CARD
IS I=NUMSTA ?
NO
I = I + 1
YES
KOUNT = 1
T
INITIALIZATION
6
READ DATA FROM TAPE
A1

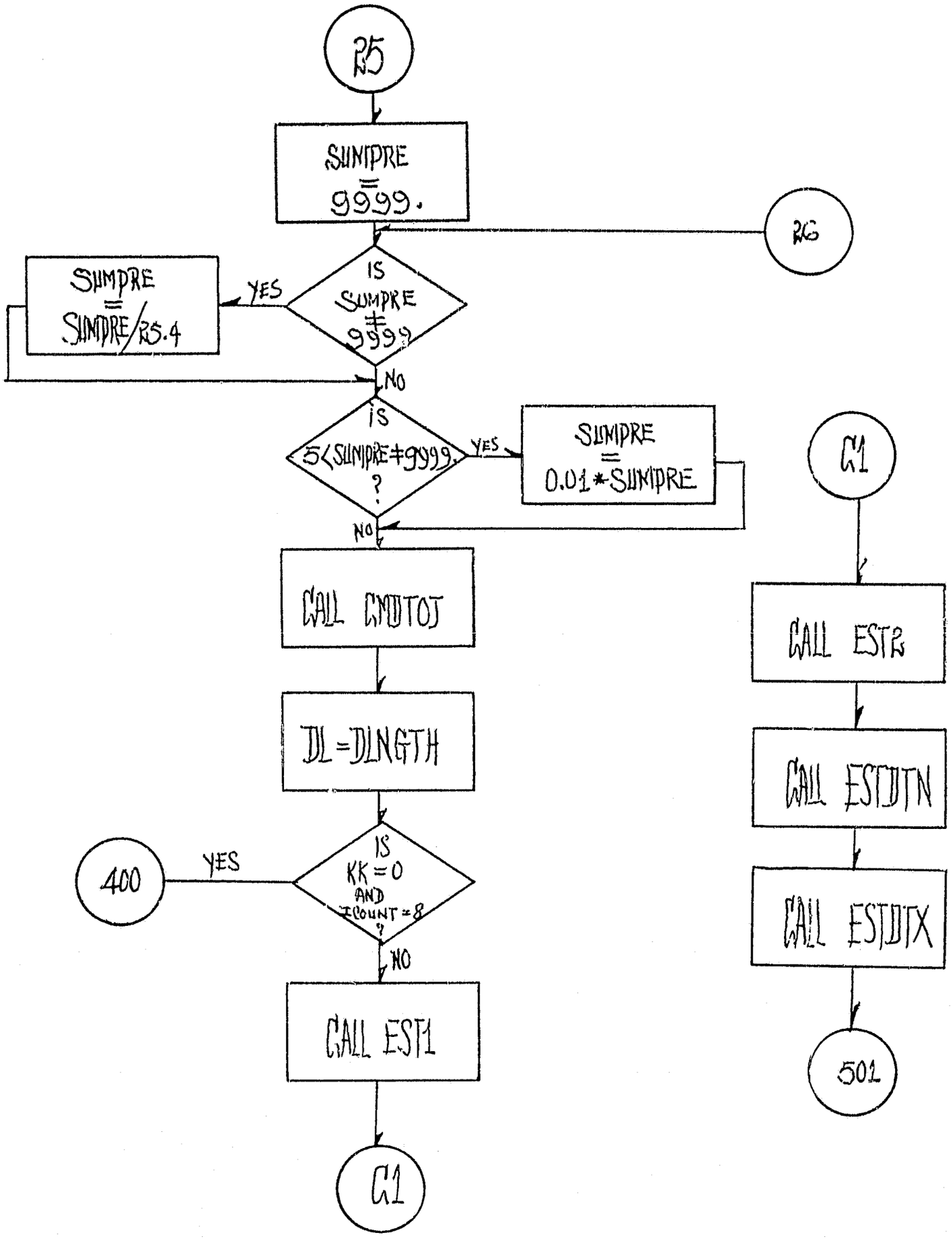

A1
I = 1
IS
STATN=STNARR
?
YES
8
NO
IS
I=NUMSTA
NO
I=I+1
YES
6
8
ITATN=STATN
SAVYR=YEAR
SAVMON=MONTH
SAVDAY=DAY
CALL CONV
16

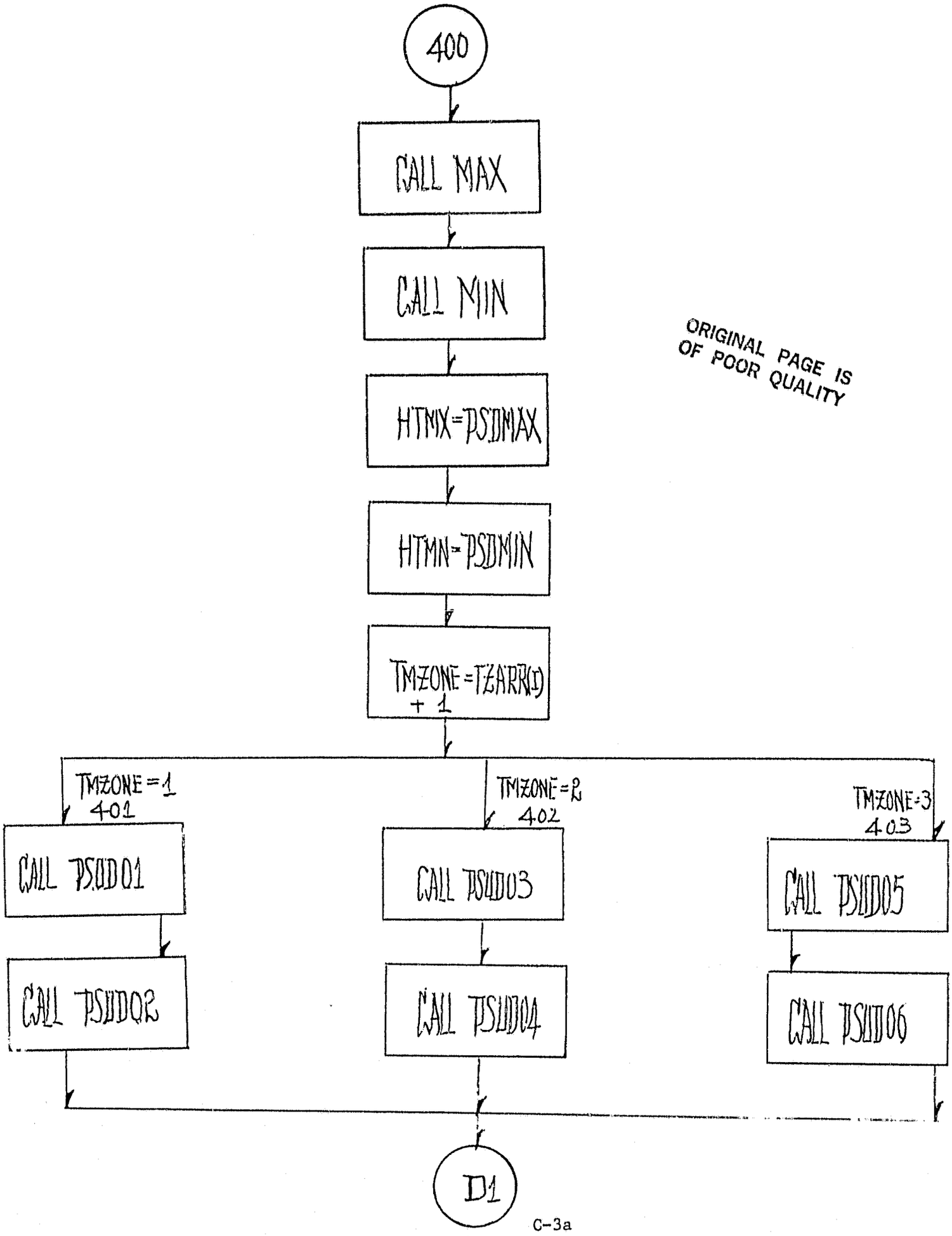

9
READ DATA FROM TAPE
IS STATN = STNARR ?
YES
11
NO
I = 1
IS STATN = STNARR ?
YES
11
NO
IS I = NUMSTA
NO
I = I + 1
YES
IS = STATN
I = 1
B1

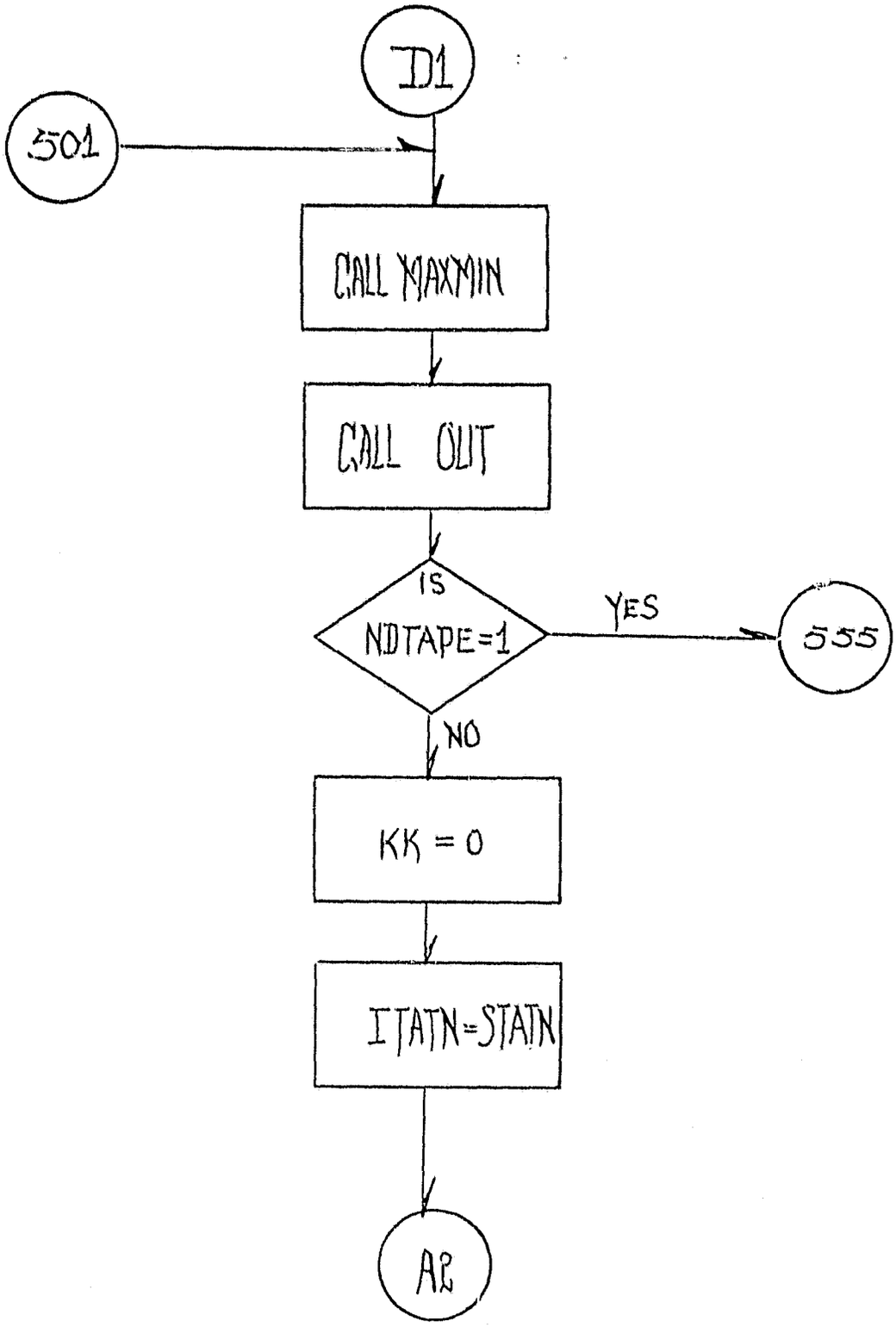

B1
READ DATA FROM TAPE
IS IS≠STATN ?
NO
91
IS I = NUMSTA ?
NO
I = I + 8
YES
9
11
CALL CONV
IS DAY = SAVDAY ?
YES
16
NO
600

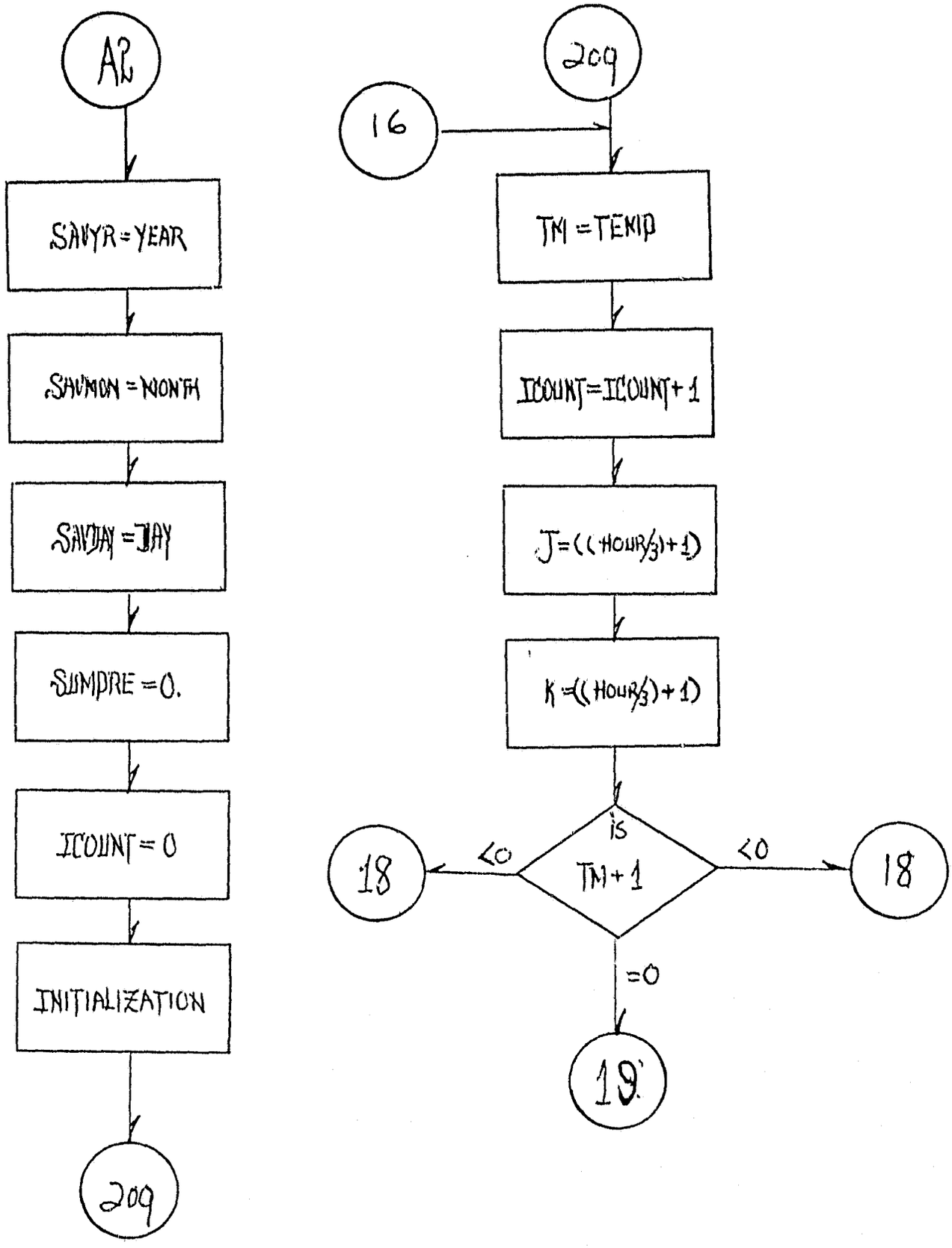
C-2a

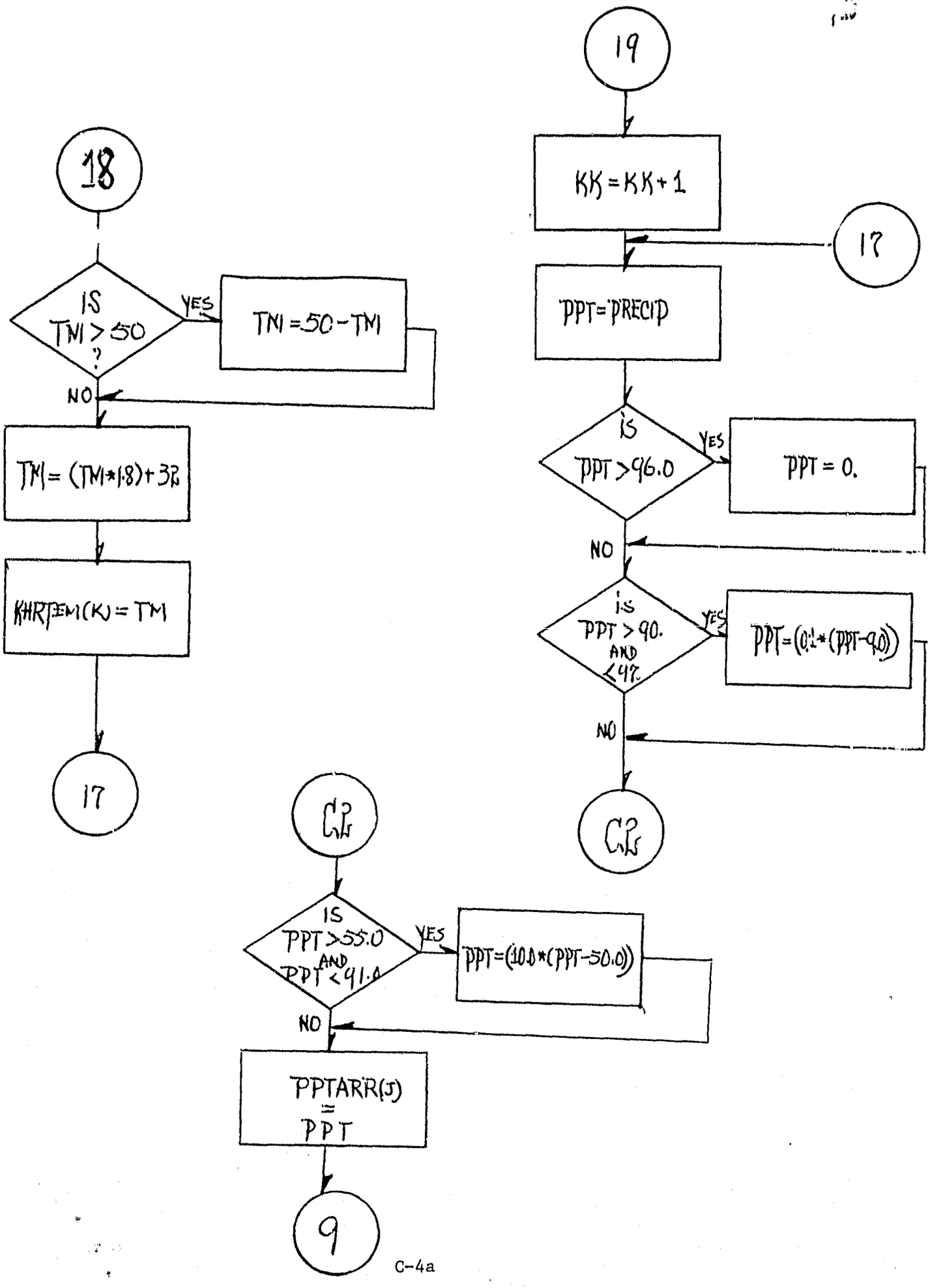

500
NDTAPE = 1
600
IS PPTARR(3) = -1 AND PPTARR(7) = -1
YES
25
NO
K = 3
IS PPTARR(K) ≠ -1
YES
SUMPRE = SUMPRE + PPTARR(K)
NO
IS K = 7
K = K + 4
NO
26

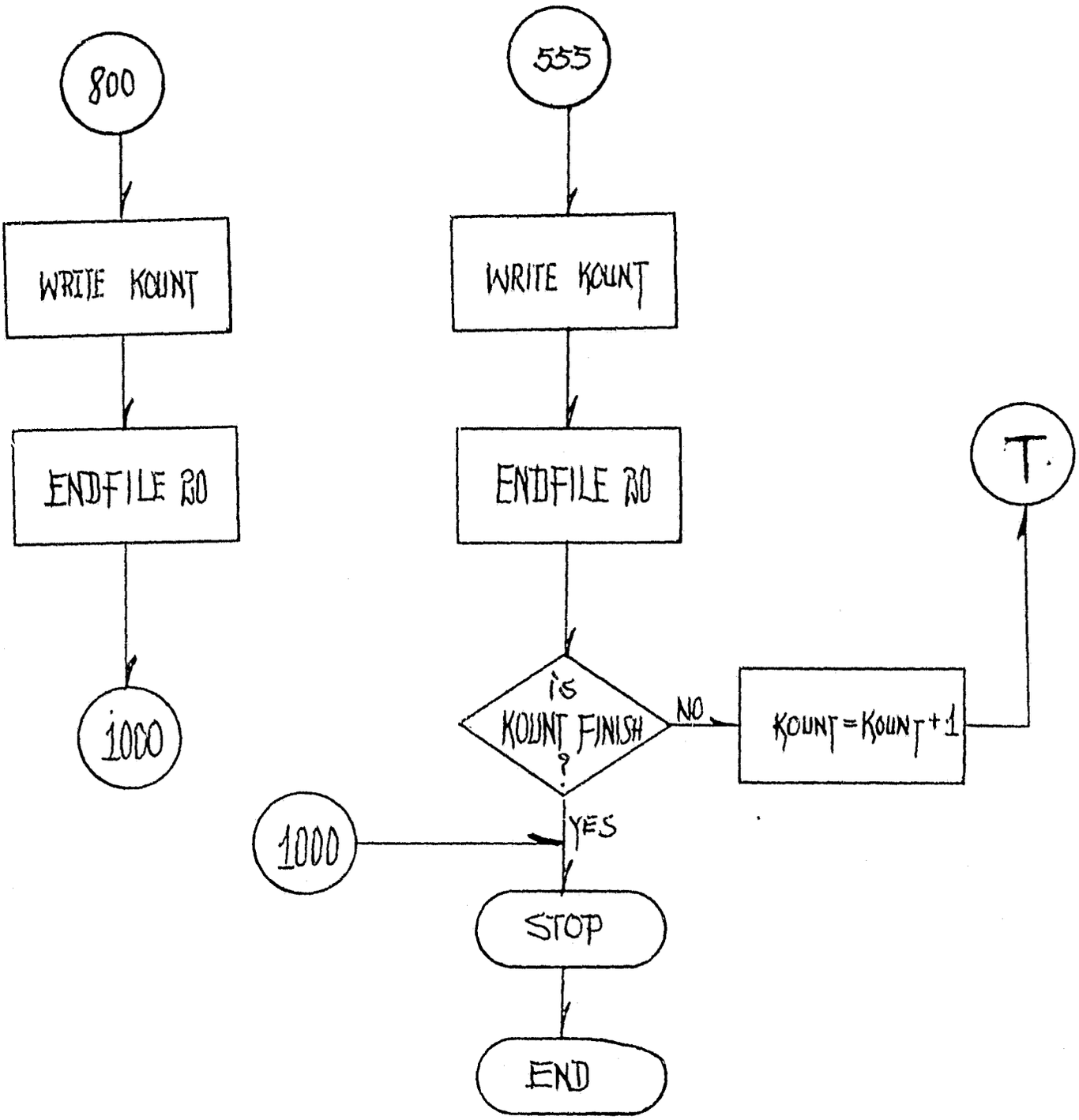

25
SUMPRE = 9999.
26
IS SUMPRE ≠ 9999
YES
SUMPRE = SUMPRE/25.4
NO
IS 5<SUMPRE≠9999. ?
YES
SUMPRE = 0.01*SUMPRE
NO
CALL CMDTOJ
JL=JLNGTH
IS KK=0 AND ICOUNT=8 ?
YES
400
NO
CALL EST1
C1
C1
CALL EST2
CALL ESTJTN
CALL ESTJTX
501




D1
501
CALL MAXMIN
CALL OUT
IS
NDTAPE=1
YES
555
NO
KK = 0
ITATN=STATN
A2


A2
SAVYR = YEAR
SAVMON = MONTH
SAVDAY = JAY
SUMPRE = 0.
ICOUNT = 0
INITIALIZATION
209
209
16
TM = TEMP
ICOUNT = ICOUNT + 1
J = ((HOUR/3) + 1)
K = ((HOUR/3) + 1)
IS
TM + 1
<0
18
<0
18
=0
19

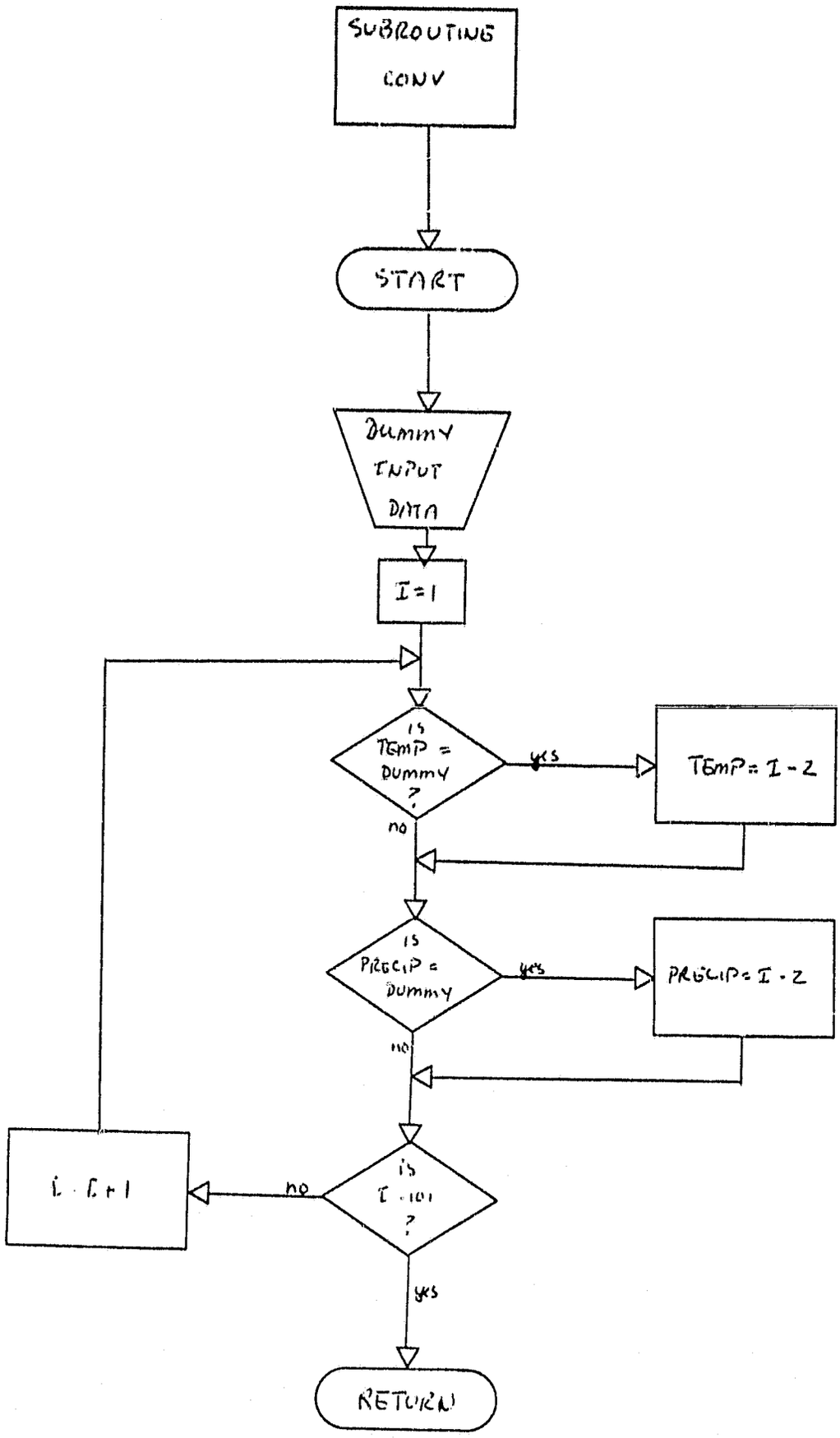

19
KK = KK + 1
17
PPT = PRECIP
IS PPT > 96.0
YES
PPT = 0.
NO
IS PPT > 90. AND < 97.
YES
PPT = (0.1 * (PPT - 90.0))
NO
C2
18
IS TMI > 50 ?
YES
TMI = 50 - TMI
NO
TMI = (TMI * 1.8) + 32
KHRTEMI(K) = TMI
17
C2
IS PPT > 55.0 AND PPT < 91.0
YES
PPT = (10.0 * (PPT - 50.0))
NO
PPTARR(J) = PPT
9


800
WRITE KOUNT
ENDFILE 20
1000
555
WRITE KOUNT
ENDFILE 20
IS KOUNT FINISH ?
NO
KOUNT = KOUNT + 1
T.
1000
YES
STOP
END

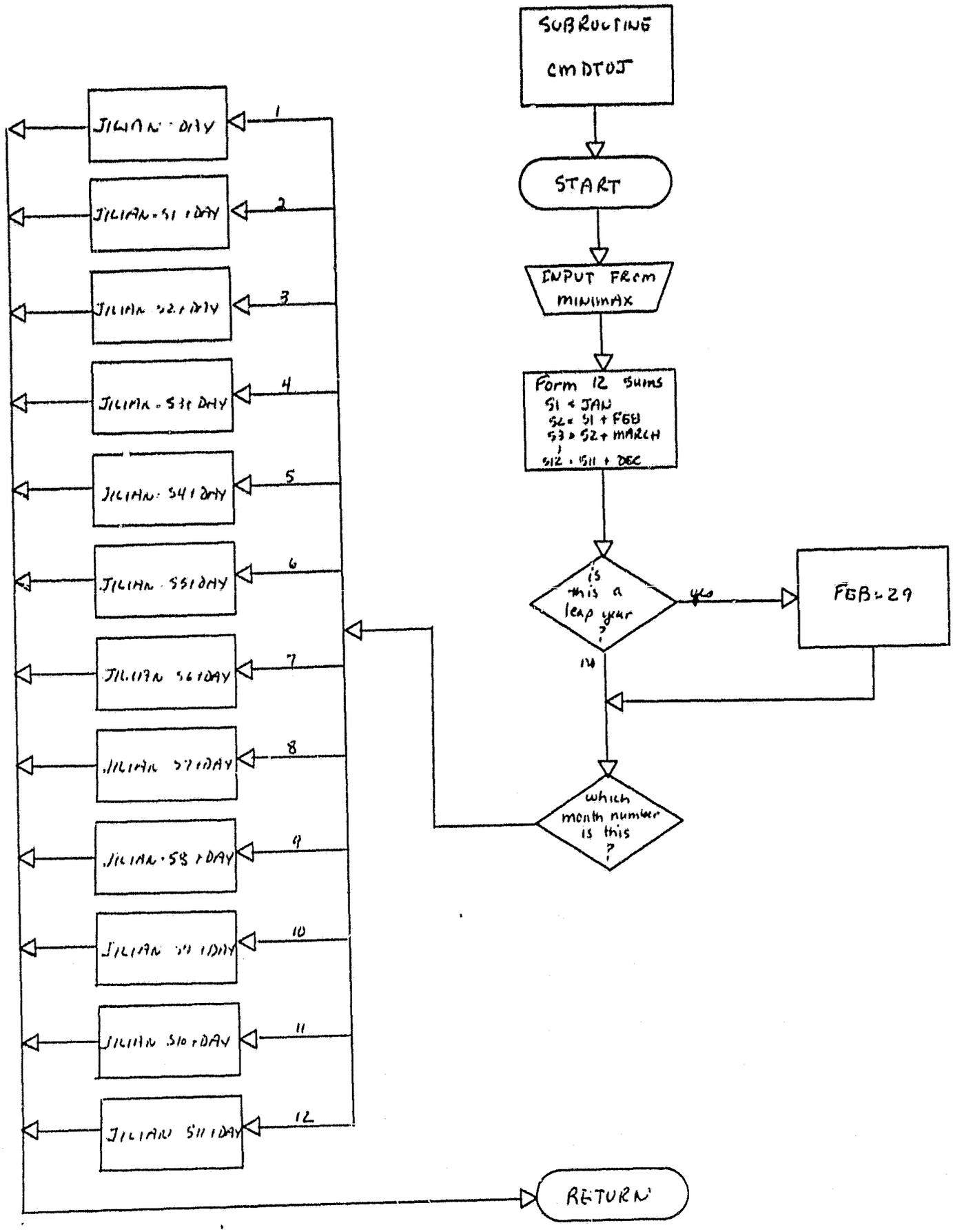
```
C     ****************************************
C     ******                                ******
C     ******     THE PSUEDO MINIMAX         ******
C     ******     ESTIMATION OF USSR         ******
C     ******     DAILY TEMPERATURE          ******
C     ******                                ******
C     ****************************************
C
C
      INTEGER*2 TEMP,PRECIP
      REAL SUNARR(30),TRARR(30,12),PPTARR(8),B(50),X(50),LATARR(30),
     +KHRTEM(8),DMAX,DMIN,SUMPRE
      INTEGER SAVYR,SAVMON,SAVDAY,STATN,YEAR,MONTH,DAY,HOUR,
     +STNARR(30),TZARR(30),TMZONE,BMAX,BMIN,PRE,ITATN
C     'NUMSTA' IS THE NUMBER OF STATIONS TO BE USED
      NUMSTA=28
C     READ CARD INPUT -- INFO ON STATION#, SUN CORRECTION FACTOR,
C     MONTHLY TEMPERATURE RANGES,LATITUDE AND TIME ZONES
      DO 5 I=1,NUMSTA
      READ(5,4) STNARR(I),SUNARR(I),(TRARR(I,J),J=1,12),LATARR(I),
     *TZARR(I)
    5 CONTINUE
    4 FORMAT (I5,1X,F4.3,12(1X,F4.2),1X,F4.2,I2)
      DO 1000 KOUNT=1,3
      KK=0
      SUMPRE=0.0
      ICOUNT = 0
C     INITIALIZE PRECIP ARRAY TO ZERO
      DO 1 K=1,8
    1 PPTARR(K)=0.0
C     INITIALIZE TEMP ARRAY TO '9999' TO CALL ATTENTION TO MISSING VALUES
      DO 2 K=1,8
      KHRTEM(K)=9999.
    2 CONTINUE
    3 FORMAT (I5,1X,4I2,14X,A2,11X,A2)
      WRITE(20,55)
   55 FORMAT(' STATN','YR','MO','DAY','MAX','MIN',3X,'PRE')
C     READ TAPE TO FIND FIRST 'WANTED' STATION TO INITIALIZE DUMMY
C        VARIABLE 'SAVDAY'
    6 READ(18,3,END=800)STATN,YEAR,MONTH,DAY,HOUR,TEMP,PRECIP
      DO 7 I=1,NUMSTA
      IF(STATN.EQ.STNARR(I)) GO TO 8
    7 CONTINUE
      GO TO 6
    8 ITATN=STATN
      SAVYR=YEAR
      SAVMON=MONTH
      SAVDAY=DAY
      CALL CONV(TEMP,PRECIP)
      GO TO 16
C     READ STATEMENT FOR THE REST OF THE TAPE INPUT
    9 READ(18,3,END=500) STATN, YEAR, MONTH, DAY, HOUR, TEMP, PRECIP
      IF(STATN.EQ.STNARR(I)) GO TO 11
   91 DO 10 I=1,NUMSTA
      IF(STATN.EQ.STNARR(I)) GO TO 11
   10 CONTINUE
      IS=STATN
      DO 92 I=1,2920,8
      READ(18,3,END=500) STATN,YEAR,MONTH,DAY,HOUR,TEMP,PRECIP
```

```
0040/                    IF(IS.NE.STATN) GO TO 91
0041                  92 CONTINUE
0042                     GO TO 9
                  C      WHEN A DIFFERENT DAY IS REACHED, THE DAY'S PRECIP VLUES ARE SUMMED
                  C         AND SUBROUTINES TO DERIVE MAX & MIN ARE CALLED; ELSE, THE PRECIP
                  C         AND TEMP ARRAYS CONTINUE TO BE FILLED WITH VALUES
0043                  11 CALL CONV(TEMP,PRECIP)
0044                     IF (DAY.EQ.SAVDAY) GO TO 16
                  C      WE ONLY USED THE VALUE OF PRECIP RECORDS AT THE HOURS OF 6 AND 18,
                  C      ALL OTHER PRECIPS ARE DISCARDED BECAUSE OF THE ERRORS OF
                  C      REPEATING PRECIP REPORTS BY OUR USSR COUNTERPART
0045                     GO TO 600
0046                 500 NDTAPE=1
                  C      WHEN NDTAPE=1 THAT IS END OF DATA
0047                 600 IF (PPTARR(3).EQ.-1.AND.PPTARR(7).EQ.-1) GO TO 25
0048                     DO 12 K=3,7,4
0049                     IF (PPTARR(K).NE.-1) SUMPRE = SUMPRE + PPTARR(K)
0050                  12 CONTINUE
0051                     GO TO 26
0052                  25 SUMPRE=9999.0
0053                  26 IF(SUMPRE.NE.9999.0)SUMPRE=(SUMPRE/25.4)
                  C      WHEN THE DAILY TOTAL PRECIP IS GREATER THAN 5 INCHES
                  C      WE CONSIDER IT AS A POSSIBLE ERROR AND ONLY TAKE 1% OF IT
0054                     IF(SUMPRE.NE.9999.AND.SUMPRE.GT.5.0) SUMPRE=0.01*SUMPRE
0055                     CALL CMDTOJ(SAVYR,SAVMON,SAVDAY,JILIAN)
0056                     DL=DLNGTH(LATARR(I),JILIAN)
0057                     IF((KK.EQ.0).AND.(ICOUNT.EQ.8)) GO TO 400
                  C      WHEN THE 8 OBSERVATIONS ARE NOT COMPLETE, ESTIMATE PTX AND
                  C      PTN BY THE SPECIFIED HOURS PROCEDURE
0058                     CALL EST1(TZARR(I),KHRTEM,SUNARR(I),HRMN,HTMN,STMN)
0059                     CALL EST2(TZARR(I),KHRTEM,SUNARR(I),HRMX,HTMX,STMX)
0060                     CALL ESTDTN(DTN,B,X,STMN,DL,TRARR(I,SAVMON))
0061                     CALL ESTDTX(DTX,B,X,STMX,DL,TRARR(I,SAVMON))
0062                     GO TO 501
                  C      WHEN ALL 8 OBSERVATIONS APPEAR, USE A SET OF PROGRAMS
                  C      CORRESPONDING TO THE STATION'S TIME ZONE TO ESTIMATE PTX AND PTN
0063                 400 CALL MAX(KHRTEM,8,PSDMAX,SUNARR(I),STMX)
0064                     CALL MIN(KHRTEM,8,PSDMIN,SUNARR(I),STMN)
0065                     HTMX=PSDMAX
0066                     HTMN=PSDMIN
0067                     TMZONE=TZARR(I)+1
0068                     GO TO  (401,402,403),TMZONE
0069                 401 CALL PSUDO1 (DTN,B,X,STMN,DL,TRARR(I,SAVMON),SUNARR(I))
0070                     CALL PSUDO2 (DTX,B,X,STMX,DL,TRARR(I,SAVMON),SUNARR(I))
0071                     GO TO 501
0072                 402 CALL PSUDO3 (DTN,B,X,STMN,DL,TRARR(I,SAVMON),SUNARR(I))
0073                     CALL PSUDO4 (DTX,B,X,STMX,DL,TRARR(I,SAVMON),SUNARR(I))
0074                     GO TO 501
0075                 403 CALL PSUDO5 (DTN,B,X,STMN,DL,TRARR(I,SAVMON),SUNARR(I))
0076                     CALL PSUDO6 (DTX,B,X,STMX,DL,TRARR(I,SAVMON),SUNARR(I))
0077                 501 CALL MAXMIN(DMAX,DMIN,DTX,DTN,HTMX,HTMN)
                  C      PRINT THE DAY'S MAX, MIN AND PRECIP VALUES
0078                     CALL OUT(ITATN,SAVYR,SAVMON,SAVDAY,DMAX,DMIN,SUMPRE,BMAX,BMIN,
                        #PRE)
0079                     IF (NDTAPE.EQ.1) GO TO 555
                  C      KK IS THE COUNTER FOR THE # OF MISSING TEMP OBSERVATIONS
0080                     KK=0
0081                     ITATN=STATN
0082                     SAVYR=YEAR
```

```
0083                    SAVMON=MONTH
0084                    SAVDAY=DAY
0085                    SUMPRE=0.0
0086                    ICOUNT = 0
                  C     RE-INITIALIZING PRECIP ARRAY TO ZERO
0087                    DO 14 J=1,8
0088                 14 PPTARR(J)=0.0
                  C     RE-INITIALIZING TEMP ARRAY TO '9999'
0089                    DO 15 K=1,8
0090                    KHRTEM(K)=9999.
0091                 15 CONTINUE
                  C     'TM' IS DUMMY VARIABLE FOR TEMP
0092                 16 TM=TEMP
0093                    ICOUNT = ICOUNT + 1
                  C     FOR BELOW ZERO TEMPS, 50 IS ADDED TO THE TEMP'S ABSOLUTE VALUE;
                  C        THEREFORE, THE TEMP CODE MUST BE CONVERTED TO AN ACTUAL VALUE
0094                    J=((HOUR/3)+1)
0095                    K=((HOUR/3)+1)
0096                    IF(TM+1.0)18,19,18
0097                 18 IF(TM.GT.50.0)TM=50.0-TM
                  C     TEMPS ARE IN CENTIGRADE AND MUST BE CONVERTED TO FAHRENHEIT
                  C        FOR USE IN SUBROUTINES
0098                    TM=(TM*1.8)+32.0
0099                    KHRTEM(K)=TM
0100                    GO TO 17
0101                 19 KK=KK+1
                  C     'PPT' IS A DUMMY VARIABLE FOR PRECIP
0102                 17 PPT=PRECIP
                  C      TRANSLATING PRECIP CODES TO MEANINGFUL VALUES
0103                    IF(PPT.GT.96.0)PPT=0.0
0104                    IF((PPT.GT.90.0).AND.(PPT.LT.97.0))PPT=(0.1*(PPT-90.0))
0105                    IF((PPT.GT.50.0).AND.(PPT.LT.91.0))PPT=(10.0*(PPT-50.0))
0106                    PPTARR(J)=PPT
0107                    GO TO 9
0108                800 WRITE(6,900)KOUNT
0109                900 FORMAT(' NO WANTED STATN IN TAPE # ',I3)
0110                    ENDFILE 20
0111                    GO TO 1000
0112                555 WRITE(6,700)KOUNT
0113                700 FORMAT('0','DATA TRANSMISSION TO TAPE NO.',I3,'  IS COMPLETED')
0114                    ENDFILE 20
0115               1000 CONTINUE
0116                    STOP
0117                    END
```

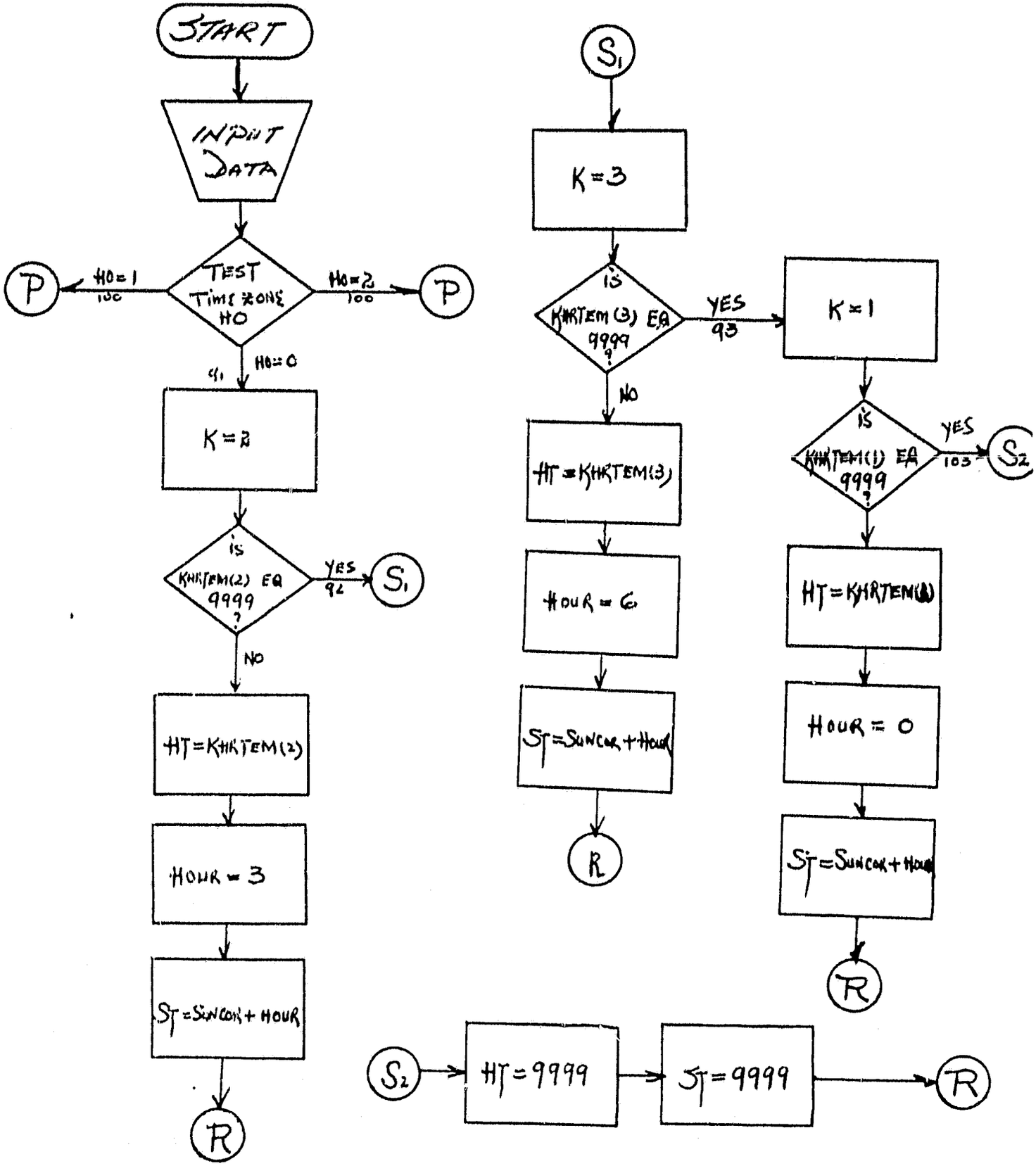

SUBROUTINE CONV
START
DUMMY INPUT DATA
I = 1
IS TEMP = DUMMY ?
yes
TEMP = I - 2
no
IS PRECIP = DUMMY
yes
PRECIP = I - 2
no
I = I + 1
no
IS I = 101 ?
yes
RETURN

```
FORTRAN IV G1  RELEASE 2.0                CONV                    DATE = 77067      18/47/25

0001                  SUBROUTINE CONV(TEMP,PRECIP)
                      C     THIS SUBROUTINE WILL CONVERT SPECIAL CHARACTERS (MISSING DATA)
                      C     TO NUMERIC VALUES
0002                  INTEGER*2 TEMP,PRECIP,DUMMY(101)
0003                  DATA DUMMY/'///','00','01','02','03','04','05','06','07','08','09',
                     +'10','11','12','13','14','15','16','17','18','19','20','21','22',
                     +'23','24','25','26','27','28','29','30','31','32','33','34','35',
                     +'36','37','38','39','40','41','42','43','44','45','46','47','48',
                     +'49','50','51','52','53','54','55','56','57','58','59','60','61',
                     +'62','63','64','65','66','67','68','69','70','71','72','73','74',
                     +'75','76','77','78','79','80','81','82','83','84','85','86','87',
                     +'88','89','90','91','92','93','94','95','96','97','98','99'/
0004                  DO 100 I=1,101
0005                  IF(TEMP.EQ.DUMMY(I)) TEMP=I-2
0006                  IF(PRECIP.EQ.DUMMY(I)) PRECIP=I-2
0007            100   CONTINUE
0008                  RETURN
0009                  END
```

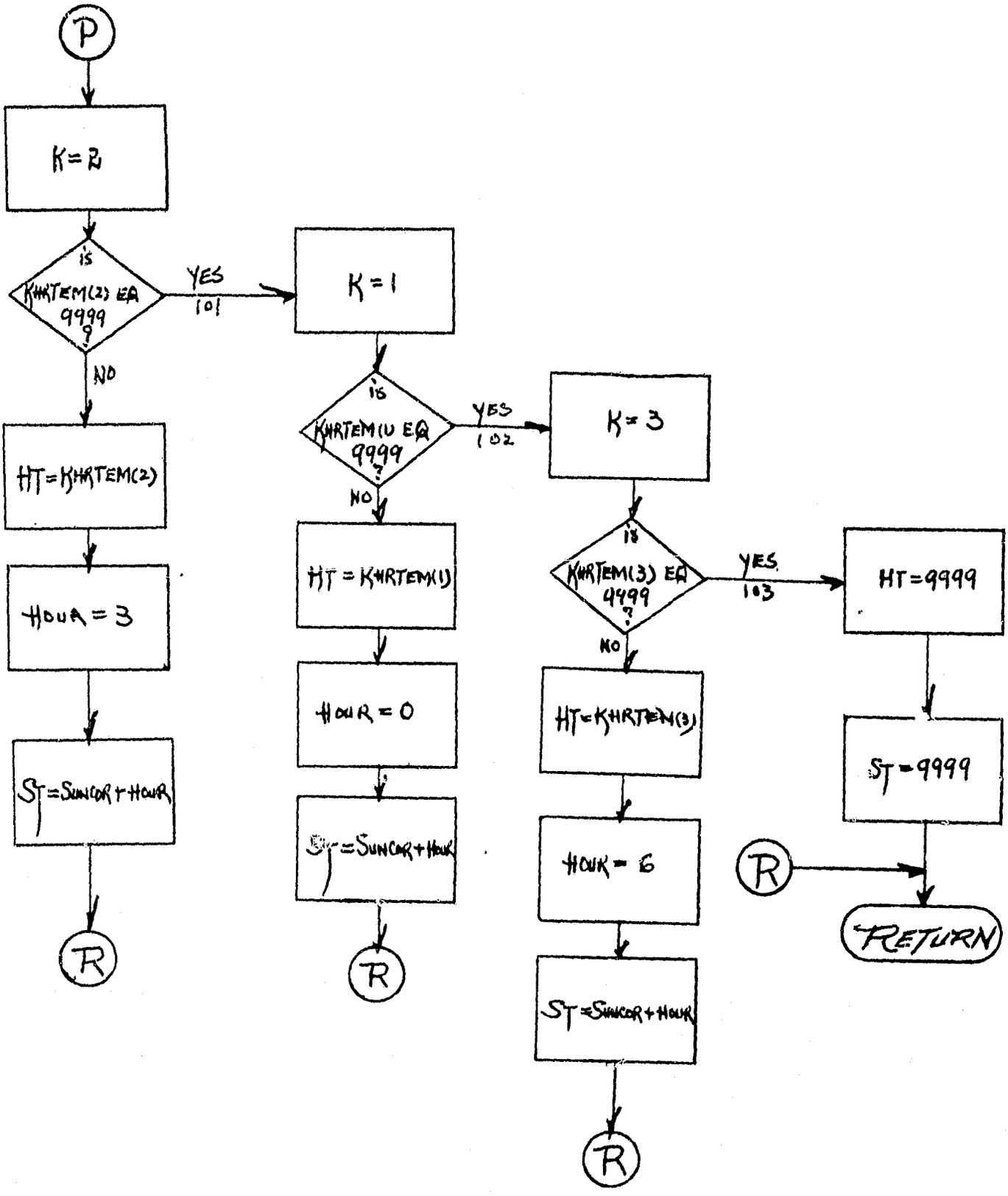

SUBROUTINE
CMDTOJ
START
INPUT FROM
MINIMAX
Form 12 sums
S1 = JAN
S2 = S1 + FEB
S3 = S2 + MARCH
S12 = S11 + DEC
is this a leap year ?
yes
FEB=29
no
which month number is this ?
JULIAN DAY
JULIAN S1 DAY
JULIAN S2 DAY
JULIAN S3 DAY
JULIAN S4 DAY
JULIAN S5 DAY
JULIAN S6 DAY
JULIAN S7 DAY
JULIAN S8 DAY
JULIAN S9 DAY
JULIAN S10 DAY
JULIAN S11 DAY
1
2
3
4
5
6
7
8
9
10
11
12
RETURN

```
FORTRAN IV G1  RELEASE 2.0          CMDTOJ          DATE = 77067          13/47/25

0001                    SUBROUTINE CMDTOJ(YR,MONTH,DAY,JILIAN)
                    C   THIS PROGRAM IS DESIGNED TO CONVERT A CALENDAR MONTH AND DAY
                    C   TO JULIAN DAY
0002                    INTEGER YR,MONTH,DAY,JILIAN
0003                    JAN=31
0004                    FEB=28
0005                    MAR=31
0006                    APRIL=30
0007                    MAY=31
0008                    JUNE=30
0009                    JULY=31
0010                    AUG=31
0011                    SEPT=30
0012                    OCT=31
0013                    NOV=30
0014                    DEC=31
0015                    S1=JAN
0016                    S2=31+FEB
0017                    S3=S2+MAR
0018                    S4=S3+ APRIL
0019                    S5=S4 + MAY
0020                    S6=S5+JUNE
0021                    S7=S6+JULY
0022                    S8=S7+AUG
0023                    S9=S8+SEPT
0024                    S10=S9+OCT
0025                    S11=S10+NOV
0026                    S12=S11+DEC
0027                    IF (MOD(YR,4).EQ.0)FEB=29
0028                    GO TO (1,2,3,4,5,6,7,8,9,10,11,12),MONTH
0029                1   JILIAN=DAY
0030                    GO TO 900
0031                2   JILIAN=S1+DAY
0032                    GO TO 900
0033                3   JILIAN=S2+DAY
0034                    GO TO 900
0035                4   JILIAN=S3+DAY
0036                    GO TO 900
0037                5   JILIAN=S4+DAY
0038                    GO TO 900
0039                6   JILIAN=S5+DAY
0040                    GO TO 900
0041                7   JILIAN=S6+DAY
0042                    GO TO 900
0043                8   JILIAN=S7+DAY
0044                    GO TO 900
0045                9   JILIAN=S8+DAY
0046                    GO TO 900
0047               10   JILIAN=S9+DAY
0048                    GO TO 900
0049               11   JILIAN=S10+DAY
0050                    GO TO 900
0051               12   JILIAN=S11+DAY
0052              900   RETURN
0053                    END
```

FLOWCHART FOR THE SUBROUTINE EST2



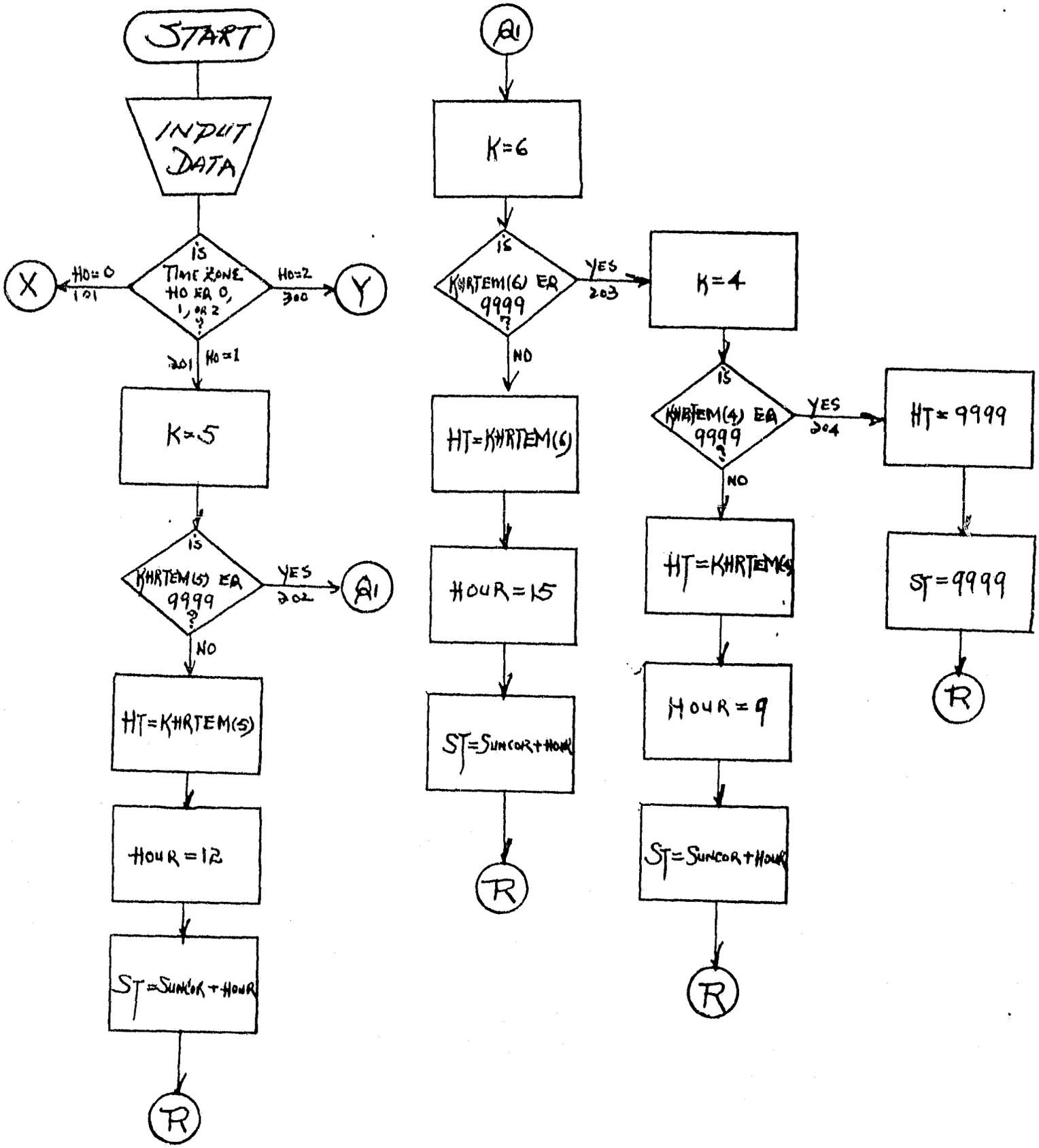
ESI (CONTINUE)



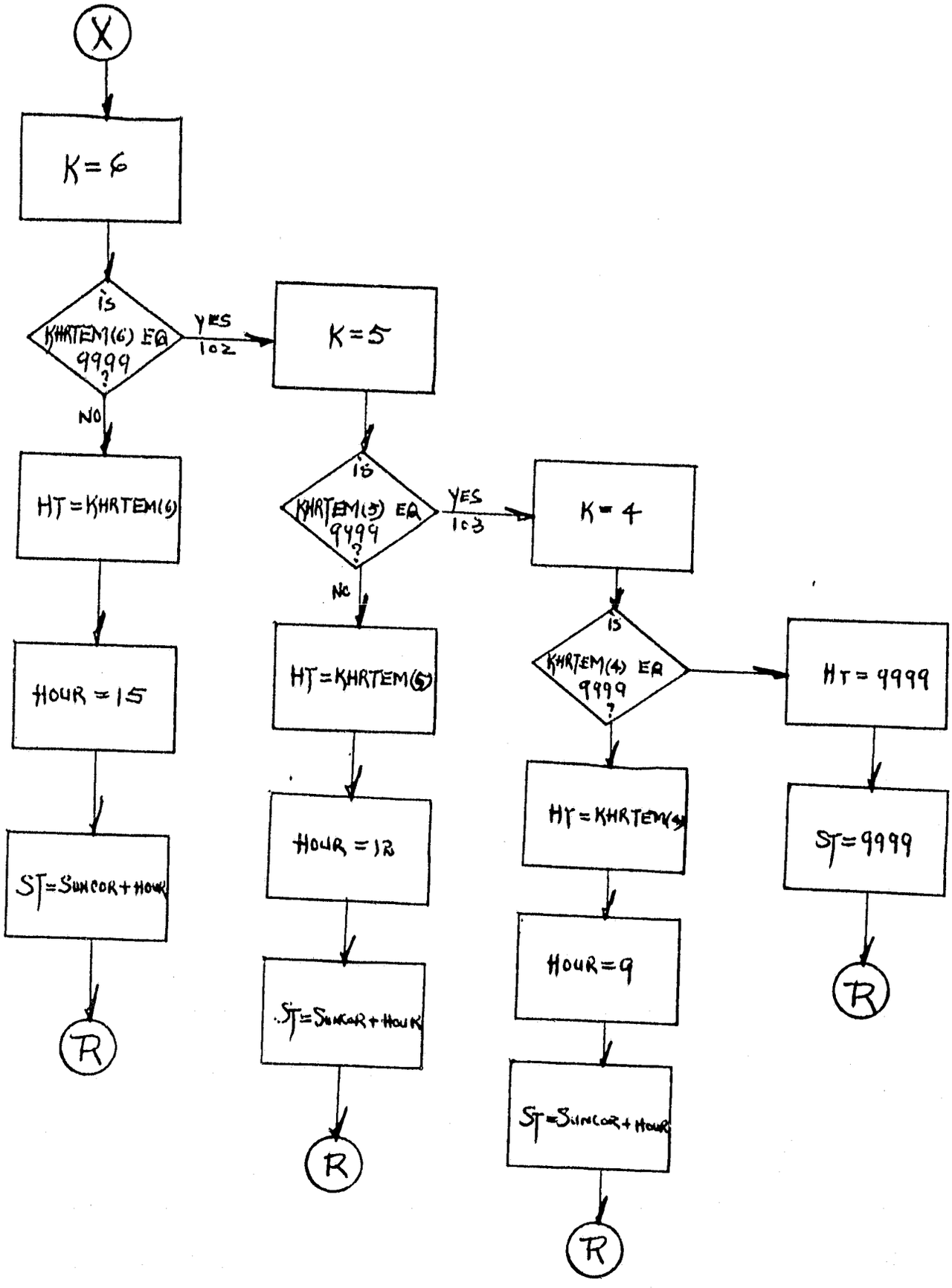
```
FORTRAN IV G1  RELEASE 2.0                EST1                    DATE = 77087          18/47/25

0001                  SUBROUTINE EST1(HC,KHRTEM,SUNCOR,HOUR,HT,ST)
                C     THIS SUBROUTINE IS USED TO FIND THE BEST POSSIBLE VALUE
                C     OF HOUR AND TEMP FOR THE SUN TIME CORRECTION VARIABLE-ST,
                C     THE ST IS NEEDED FOR THE OTN ESTIMATION
0002                  INTEGER HC
0003                  REAL KHRTEM(8)
0004                  IF(HC-1)91,100,100
0005               91 K=2
                C     TAKE K=2 AS THE 1ST CHOICE FOR HC=00
                C     K=2 IMPLIES THAT THE HOUR IS 03 (3 AM)
0006                  IF(KHRTEM(K).EQ.9999.) GO TO 92
0007                  HT=KHRTEM(K)
0008                  HOUR=03.0
0009                  ST = SUNCOR + HOUR
0010                  RETURN
0011               92 K=3
                C     TAKE K=3 AS THE 2ND CHOICE FOR HC=00
                C     K=3 IMPLIES THAT THE HOUR IS 06 (6 AM)
0012                  IF(KHRTEM(K).EQ.9999.) GO TO 93
0013                  HT=KHRTEM(K)
0014                  HOUR=06.0
0015                  ST = SUNCOR + HOUR
0016                  RETURN
0017               93 K=1
                C     TAKE K=1 AS THE 3RD CHOICE FOR HC=00
                C     K=1 IMPLIES THAT THE HOUR IS 00 (MIDNIGHT)
0018                  IF(KHRTEM(K).EQ.9999.) GO TO 103
0019                  HT=KHRTEM(K)
0020                  HOUR=00.0
0021                  ST=SUNCOR + HOUR
0022                  RETURN
0023              100 K=2
                C     TAKE K=2 AS THE 1ST CHOICE FOR HC=01 OR HC=02
                C     K=2 IMPLIES THAT THE HOUR IS 03 (3AM)
0024                  IF(KHRTEM(K).EQ.9999.) GO TO 101
0025                  HT=KHRTEM(K)
0026                  HOUR=03.0
0027                  ST=SUNCOR+HOUR
0028                  RETURN
0029              101 K=1
                C     TAKE K=1 AS THE 2ND CHOICE FOR HC=01 OR HC=02
                C     K=1 IMPLIES THAT THE HOUR IS 00 (MIDNIGHT)
0030                  IF (KHRTEM(K).EQ.9999.) GO TO 102
0031                  HT=KHRTEM(K)
0032                  HOUR=00.0
0033                  ST=SUNCOR+HOUR
0034                  RETURN
0035              102 K=3
                C     K=3 IS THE 3RD CHOICE FOR HC=01 OR HC=02
                C     K=3 IMPLIES THAT THE HOUR IS 06 (6AM)
0036                  IF(KHRTEM(K).EQ.9999.) GO TO 103
0037                  HT=KHRTEM(K)
0038                  HOUR=06.0
0039                  ST=SUNCOR+HOUR
0040                  RETURN
0041              103 HT=9999.
```

```
FORTRAN IV G1  RELEASE 2.0          EST1          DATE = 77087          18/47/25

0042                    ST=9999.
0043                    RETURN
0044                    END
```

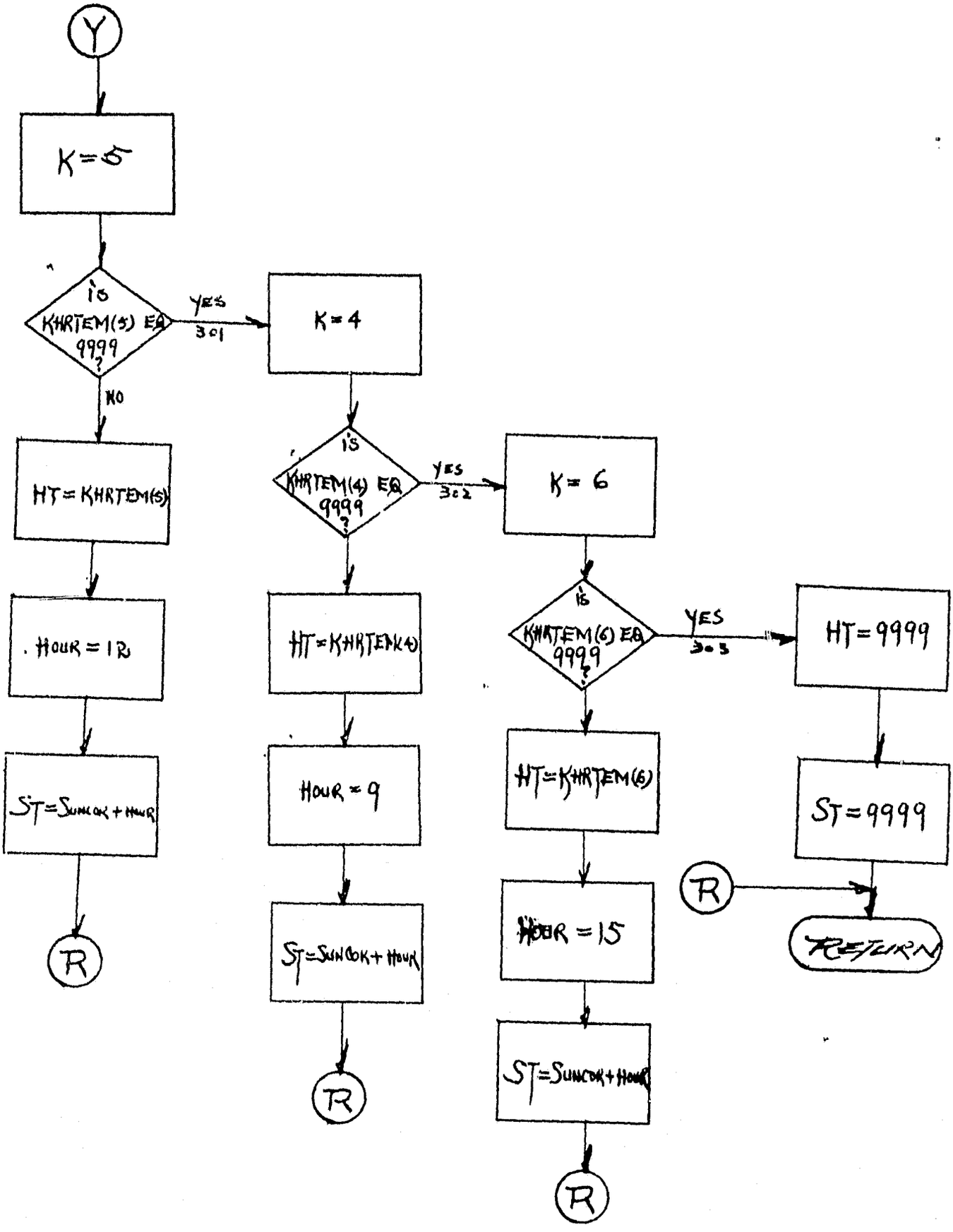
FLOWCHART FOR THE SUBROUTINE EST2



ESTR (CONTINUE)

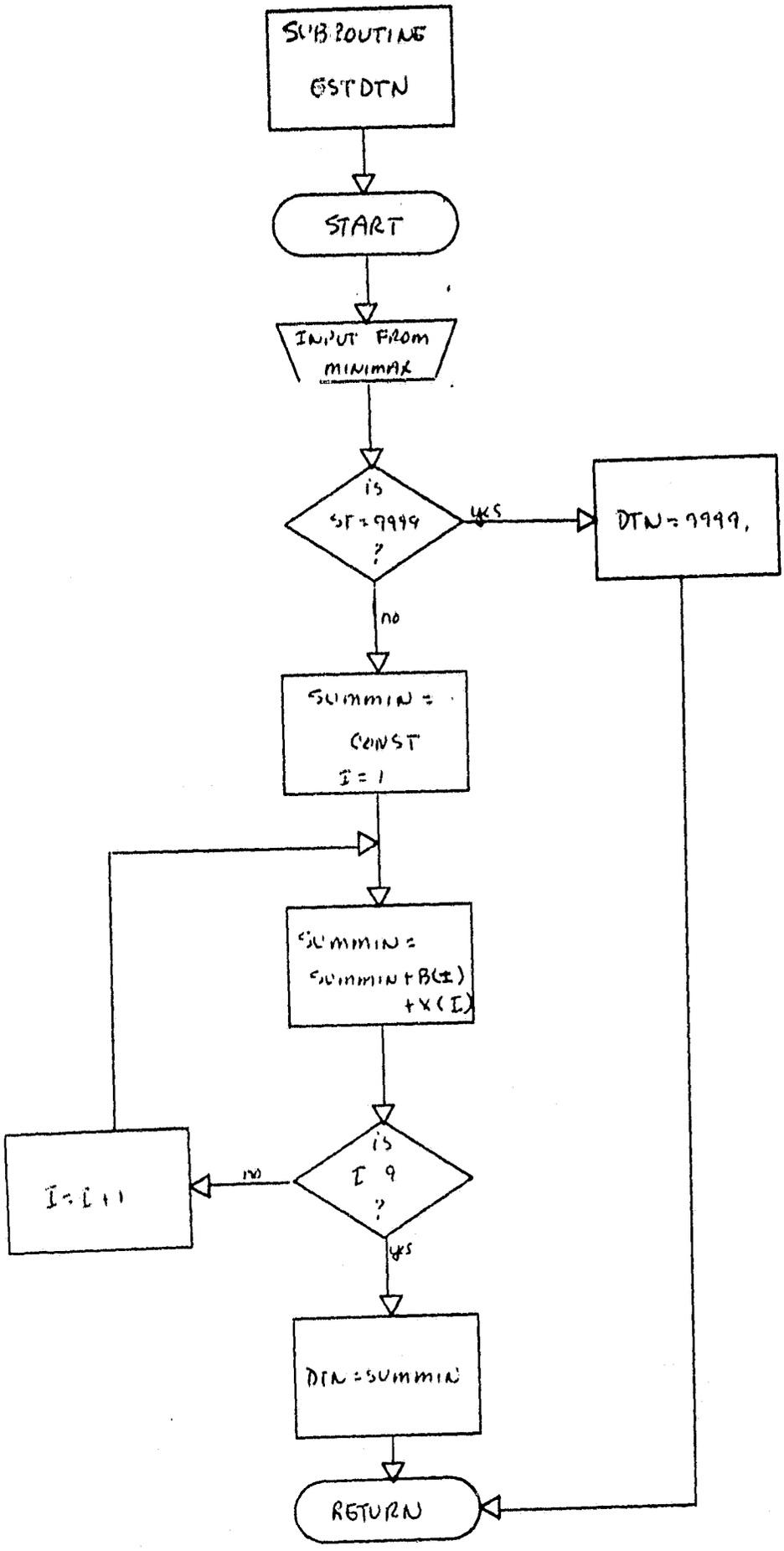


ESTR (CONTINUE)

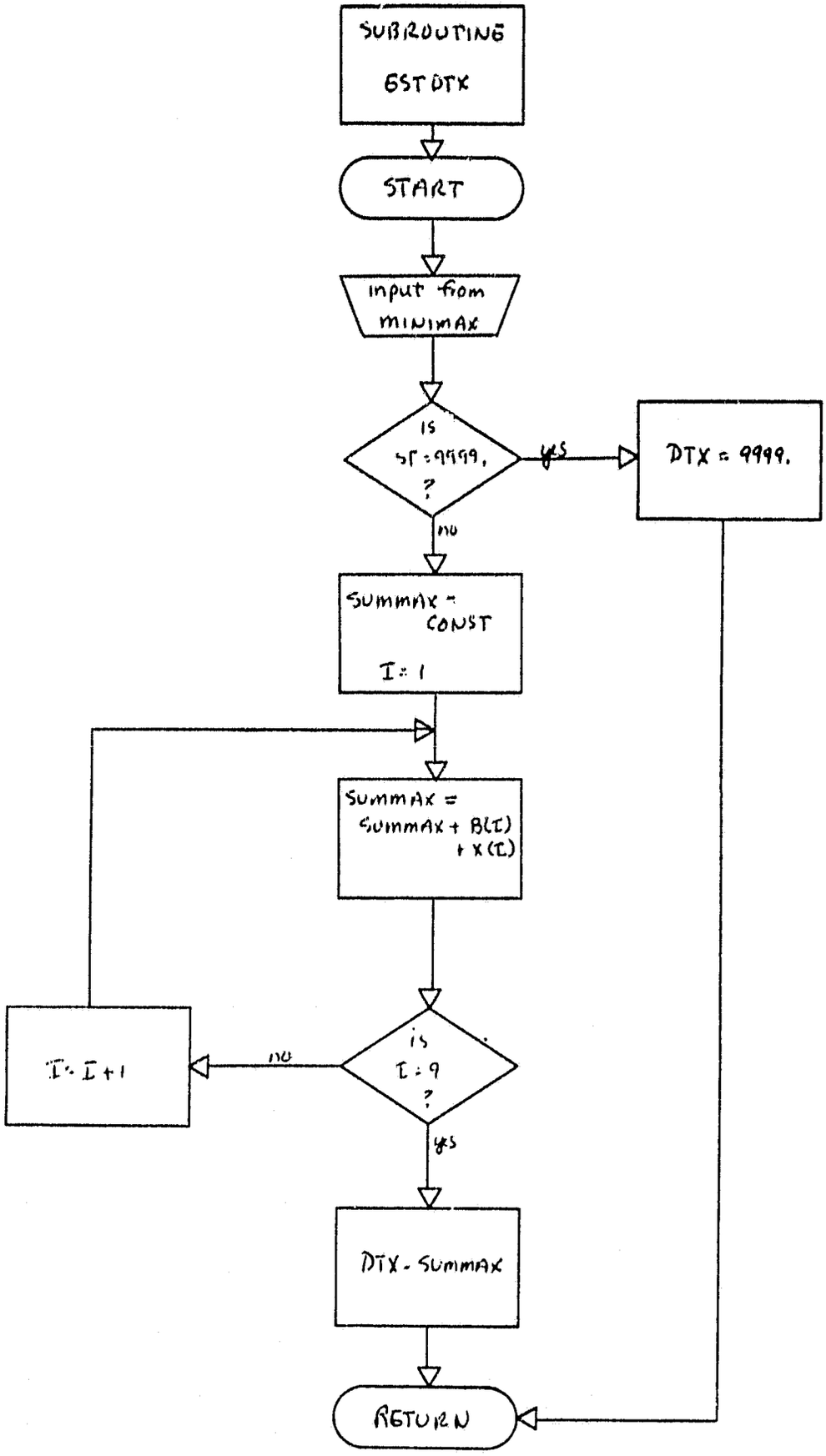


```
0001                  SUBROUTINE EST2(HC,KHRTEM,SUNCOR,HOUR,HT,ST)
                    C     THIS SUBROUTINE IS USED TO FIND THE BEST POSSIBLE VALUE OF HOUR
                    C     AND TEMP FOR THE SUN TIME CORRECTION VARIABLE,ST,WHICH IS
                    C     NEEDED FOR THE DTX ESTIMATION
0002                  INTEGER HC
0003                  REAL KHRTEM(8)
0004                  IF(HC-1)101,201,301
0005                101 K=5
                    C     TAKE K=5 AS THE 1ST CHOICE FOR HC=00
                    C     K=5 IMPLIES THAT THE HOUR IS 15 (3PM)
0006                  IF(KHRTEM(K).EQ.9999.) GO TO 102
0007                  HT = KHRTEM(K)
0008                  HOUR=15.0
0009                  ST = SUNCOR + HOUR
0010                  RETURN
0011                102 K=6
                    C     TAKE K=6 AS THE 2ND CHOICE FOR HC = 00
                    C     K=6 IMPLIES THAT THE HOUR IS 12 (NOON)
0012                  IF(KHRTEM(K).EQ.9999.) GO TO 103
0013                  HT=KHRTEM(K)
0014                  HOUR=12.0
0015                  ST = SUNCOR + HOUR
0016                  RETURN
0017                103 K=4
                    C     TAKE K=4 AS THE 3RD CHOICE FOR HC = 00
                    C     K=4 IMPLIES THAT THE HOUR IS 09 (9AM)
0018                  IF(KHRTEM(K).EQ.9999.) GO TO 104
0019                  HT=KHRTEM(K)
0020                  HOUR=09.0
0021                  ST = SUNCOR + HOUR
0022                  RETURN
0023                104 HT = 9999.
0024                  ST = 9999.
0025                  GO TO 400
0026                201 K=5
                    C     TAKE K=5 AS THE 1ST CHOICE FOR HC=01
                    C     K=5 IMPLIES THAT THE HOUR IS 12 (NOON)
0027                  IF(KHRTEM(K).EQ.9999.) GO TO 202
0028                  HT=KHRTEM(K)
0029                  HOUR=12.0
0030                  ST=SUNCOR+HOUR
0031                  RETURN
0032                202 K=6
                    C     TAKE K=6 AS THE 2ND CHOICE FOR HC=01
                    C     K=6 IMPLIES THAT THE HOUR IS 15 (3 PM)
0033                  IF (KHRTEM(K).EQ.9999) GO TO 203
0034                  HT=KHRTEM(K)
0035                  HOUR=15.0
0036                  ST=SUNCOR+HOUR
0037                  RETURN
0038                203 K=4
                    C     TAKE K=4 AS THE 3RD CHOICE FOR HC=01
                    C     K=4 IMPLIES THAT THE HOUR IS 09 (9 AM)
0039                  IF(KHRTEM(K).EQ.9999.) GO TO 204
0040                  HT=KHRTEM(K)
0041                  HOUR=09.0
```

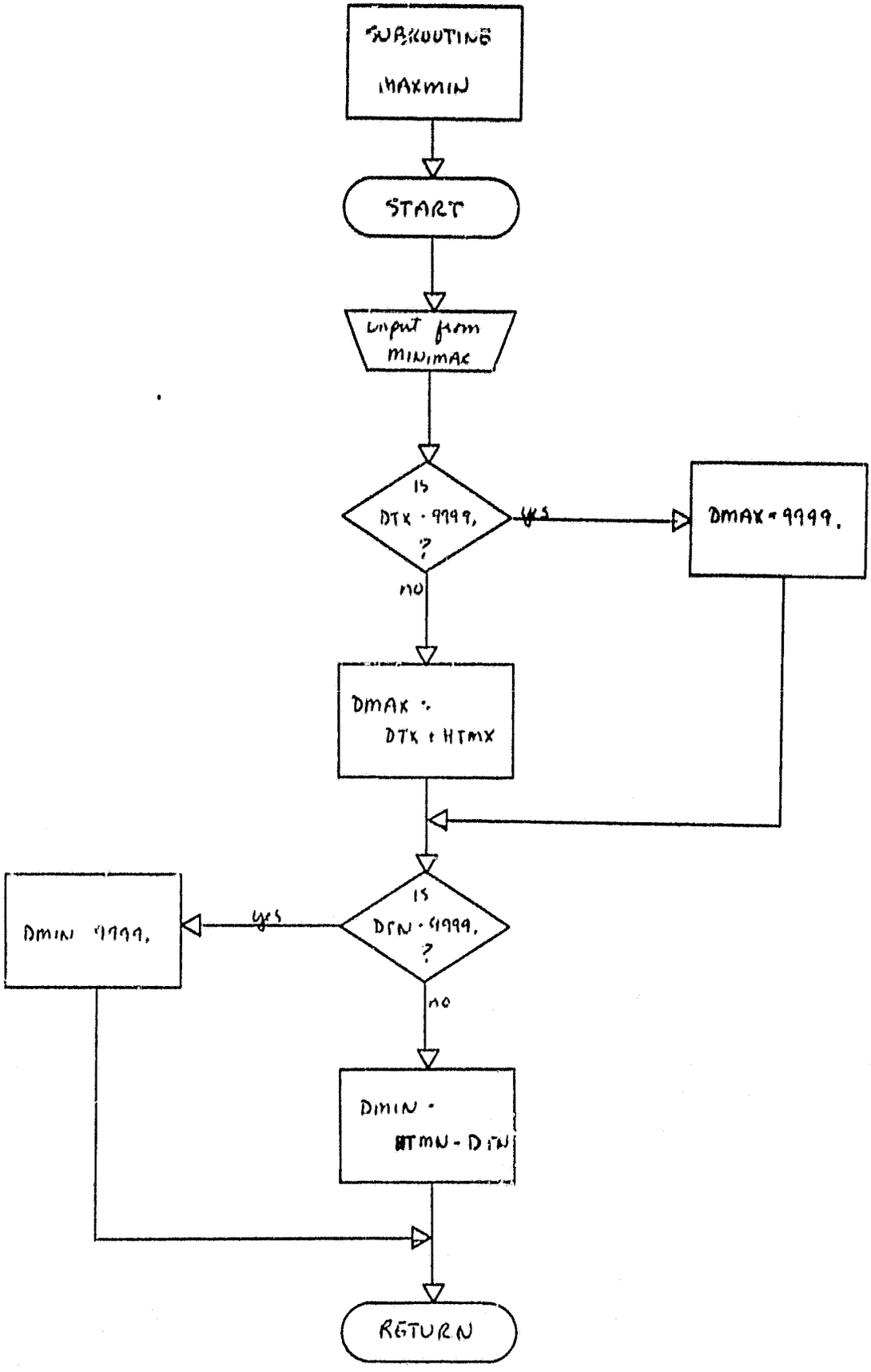
```
FORTRAN IV G1  RELEASE 2.0                TST2                 DATE = 77087          18/47/25

0042                        ST=SUNCOR +HOUR
0043                        RETURN
0044                   200  HT=9999.
0045                        ST=9999.
0046                        GO TO 400
0047                   300  K=5
                    C       TAKE K=5 AS THE 1ST CHOICE FOR HC=02
                    C       K=5 IMPLIES THAT THE HOUR IS 12 (NOON)
0048                        IF(KHRTEM(K).EQ.9999.) GO TO 301
0049                        HT=KHRTEM(K)
0050                        HOUR=12.0
0051                        ST=SUNCOR+HOUR
0052                        RETURN
0053                   301  K=4
                    C       TAKE K=4 AS THE 2ND CHOICE FOR HC=02
                    C       K=4 IMPLIES THAT THE HOUR IS 09 (9 AM)
0054                        IF(KHRTEM(K).EQ.9999.) GO TO 302
0055                        HT=KHRTEM(K)
0056                        HOUR=09.0
0057                        ST=SUNCOR+HOUR
0058                        RETURN
0059                   302  K=3
                    C       TAKE K=3 AS THE 3RD CHOICE FOR HC=02
                    C       K=3 IMPLIES THAT THE HOUR IS 15 (3 PM)
0060                        IF(KHRTEM(3).EQ.9999.) GO TO 303
0061                        HT=KHRTEM(K)
0062                        HOUR=15.0
0063                        ST=SUNCOR+HOUR
0064                        RETURN
0065                   303  HT=9999.
0066                        ST=9999.
0067                   400  RETURN
0068                        END
```


SUBROUTINE
GSTDTN
START
INPUT FROM
MINIMAX
is
ST = 9999
?
yes
DTN = 9999.
no
SUMMIN =
CONST
I = 1
SUMMIN =
SUMMIN + B(I)
+X(I)
is
I 9
?
no
I = I + 1
yes
DTN = SUMMIN
RETURN

```
FORTRAN IV G1  RELEASE 2.0                ESTDTN                DATE = 77097          18/47/25

0001                  SUBROUTINE ESTDTN(LTN,B,X,ST,DL,TR)
                    C IF FEWER THAN EIGHT OBSERVATIONS ARE RECORDED, THIS SUBROUTINE
                    C ESTIMATES THE CORRECTION FACTOR FOR THE DAILY MIN TEMP
0002                  REAL B(50),X(50)
0003                  IF(ST.LT.0.99999.) GO TO 300
0004                  CONST=7.712
0005                  B(1)=-.448138
0006                  B(2)=-3.425059
0007                  B(3)=-9.013818
0008                  B(4)=-6.791654
0009                  B(5)=-6.167218
0010                  B(6)=0.008466
0011                  B(7)=0.055675
0012                  B(8)=0.020133
0013                  B(9)=0.004224
0014                  X(1)=ST
0015                  X(2)=ST*ST
0016                  X(3)=DL*DL
0017                  X(4)=ST*DL
0018                  X(5)=ST*TR
0019                  X(6)=DL*TR
0020                  X(7)=DL*ST*ST
0021                  X(8)=ST*DL*DL
0022                  X(9)=ST*TR*TR
0023                  SUMTN=CONST
0024                  DO 100 I=1,9
0025                  SUMTN=SUMTN+B(I)*X(I)
0026            100   CONTINUE
0027                  DTN=SUMTN
0028                  GO TO 400
0029            300   DTN=9999.
0030            400   RETURN
0031                  END
```

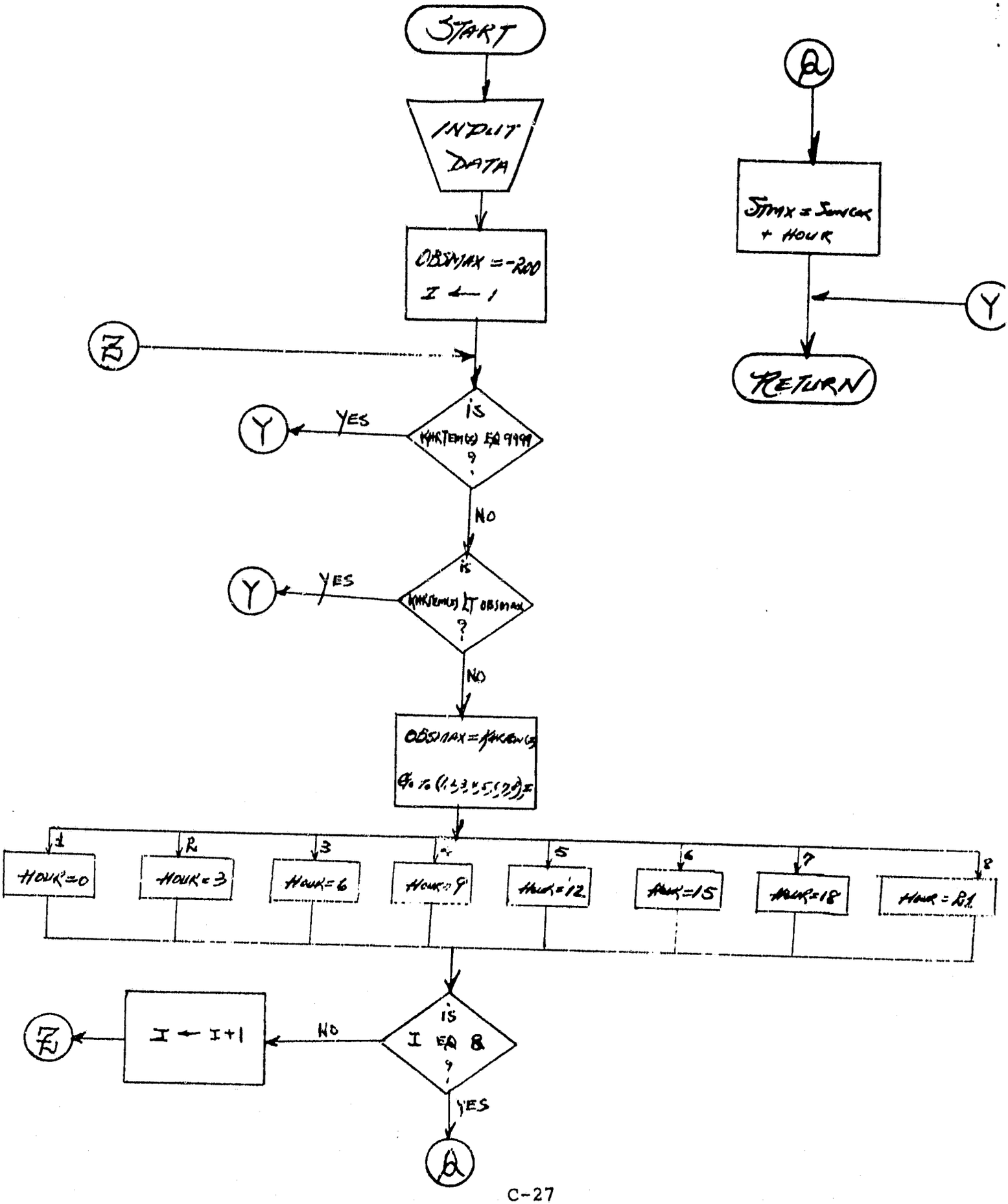

SUBROUTINE
GSTDTX
START
input from
MINIMAX
IS
ST=9999.
?
yes
DTX = 9999.
no
SUMMAX =
CONST
I = 1
SUMMAX =
SUMMAX + B(I)
* X(I)
IS
I = 9
?
no
I = I + 1
yes
DTX - SUMMAX
RETURN

```
FORTRAN IV G1  RELEASE 2.0              STDTX                   DATE = 77087          18/47/25

0001                    SUBROUTINE ESTDTX(DTX,B,X,ST,DL,TF)
                C       IF FEWER THAN EIGHT OBSERVATIONS ARE RECORDED, THIS SUBROUTINE
                C       ESTIMATES THE CORRECTION FACTOR FOR THE DAILY MAX TEMP
0002                    REAL B(6),X(6)
0003                    IF(ST.EQ.9999.) GO TO 300
0004                    CONST=77.252
0005                    B(1)=-7.754
0006                    B(2)=-1.5232E5
0007                    B(3)=0.4282E7
0008                    B(4)=0.3626E9
0009                    B(5)=9.053422
0010                    B(6)=-3.021126
0011                    X(1)=ST
0012                    X(2)=DL
0013                    X(3)=TF
0014                    X(4)=ST*ST
0015                    X(5)=DL*DL
0016                    X(6)=ST*TF
0017                    SUMMAX=CONST
0018                    DO 200 I=1,6
0019                    SUMMAX=SUMMAX+B(I)*X(I)
0020                200 CONTINUE
0021                    DTX=SUMMAX
0022                    GO TO 400
0023                300 DTX=9999.
0024                400 RETURN
0025                    END
```


SUBROUTINE
MAXMIN
START
input from
MINIMAX
IS
DTX = 9999.
?
yes
DMAX = 9999.
no
DMAX =
DTX + HTMX
IS
DTN = 9999.
?
yes
DMIN = 9999.
no
DMIN =
HTMN - DTN
RETURN

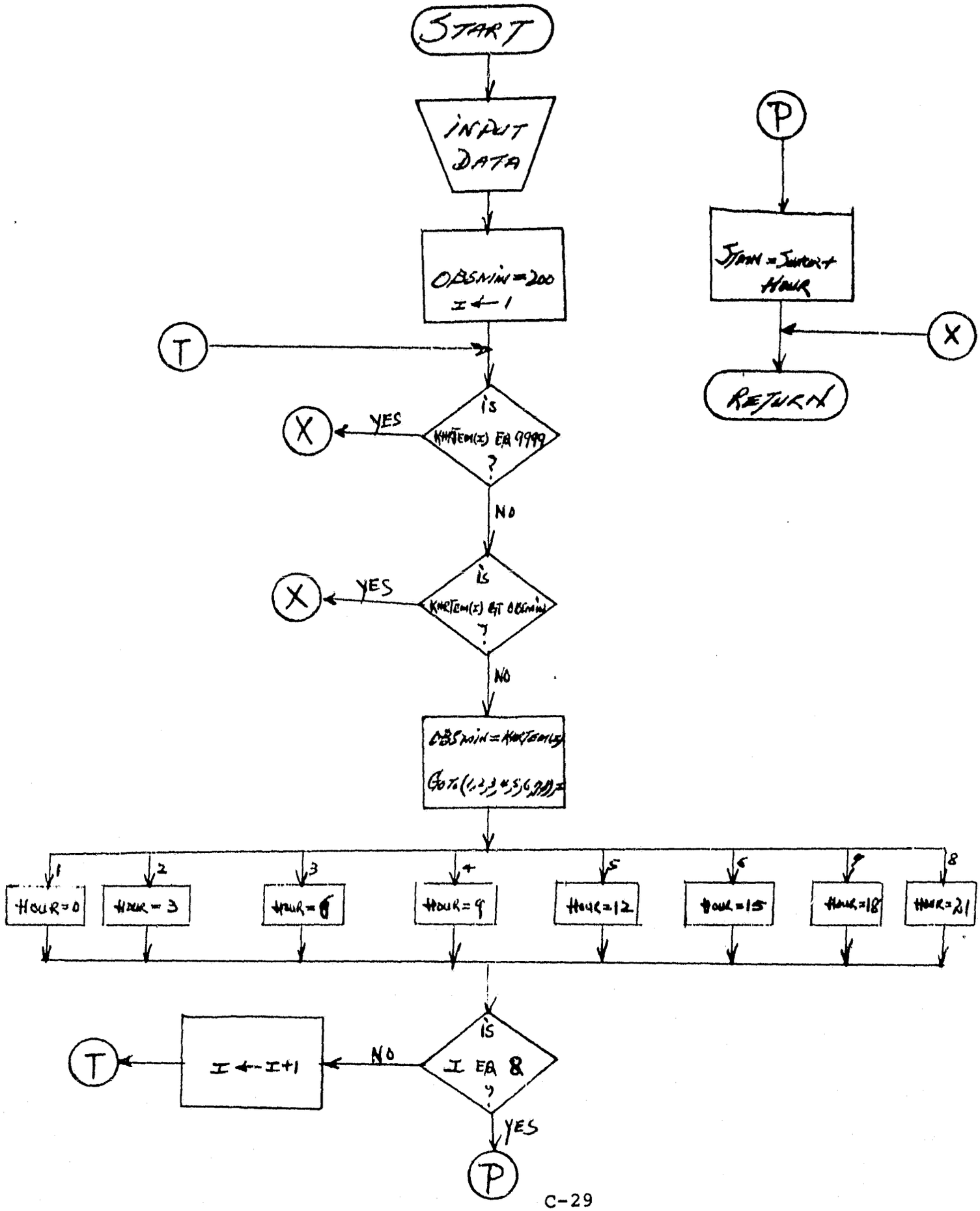
```
FORTRAN IV G1  RELEASE 2.0          MAXMIN          DATE = 77087          19/47/25

0001                  SUBROUTINE MAXMIN(DMAX,DMIN,DTX,DTN,HTVX,HTMN)
                    C THIS SUBROUTINE IS USED TO CALCULATE THE ESTIMATED DAILY
                    C MAXIMUM AND MINIMUM TEMPERATURES
0002                  IF(DTX.EQ.9999.) GO TO 100
0003                  DMAX=DTX+HTMX
0004                  GO TO 200
0005              100 DMAX=9999.
0006              200 IF(DTN.EQ.9999.) GO TO 300
0007                  DMIN=HTMN-DTN
0008                  GO TO 400
0009              300 DMIN=9999.
0010              400 RETURN
0011                  END
```

FLOWCHART FOR THE SUBROUTINE MAX

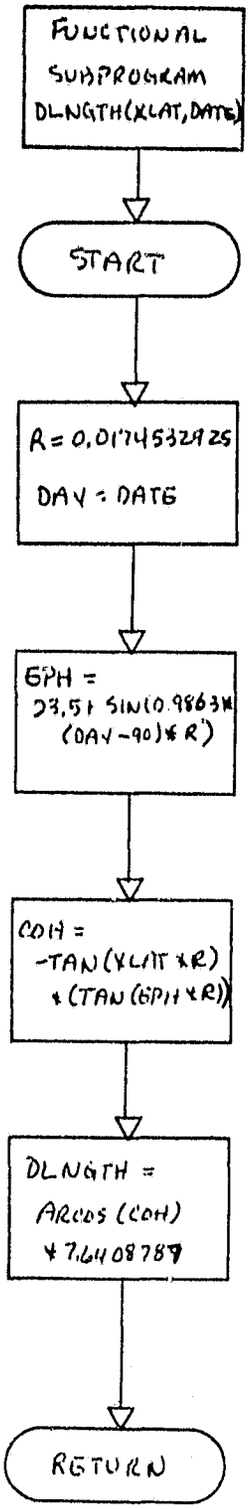


```
      SUBROUTINE MAX(KHFTEM,K,OBSMAX,SUNCOR,STMX)
C     THIS SUBROUTINE CHOOSES THE HIGHEST OF THE EIGHT OBSERVATIONS
      REAL KHFTEM(K)
      OBSMAX=-200
      DO 200 I=1,K
      IF(KHFTEM(I).EQ.9999.) GO TO 200
      IF(KHFTEM(I).LT.OBSMAX) GO TO 200
      OBSMAX=KHFTEM(I)
      GO TO (1,2,3,4,5,6,7,8),I
    1 HOUR=0
      GO TO 200
    2 HOUR=3
      GO TO 200
    3 HOUR=6
      GO TO 200
    4 HOUR=9
      GO TO 200
    5 HOUR=12
      GO TO 200
    6 HOUR=15
      GO TO 200
    7 HOUR=18
      GO TO 200
    8 HOUR=21
  200 CONTINUE
      STMX=SUNCOR+HOUR
      RETURN
      END
```

FLOWCHART FOR THE SUBROUTINE MIN

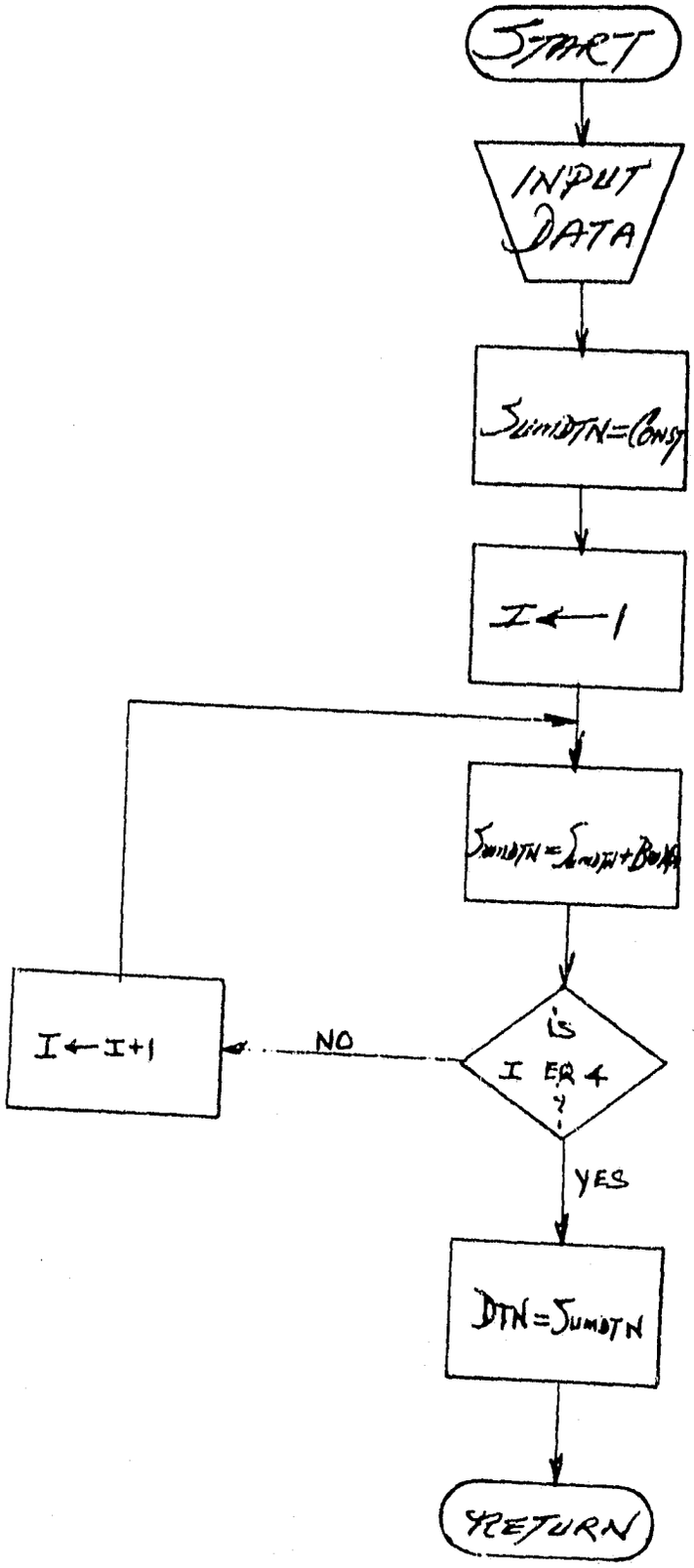


```
FORTRAN IV G1 RELEASE 2.0                    MIT          DATE = 77087          18/47/25

0001                  SUBROUTINE MIN(KHRTSM,K,CRSMIN,SUNCOR,STMN)
0002                C THIS SUBROUTINE CHOOSES THE LOWEST OF THE EIGHT OBSERVATIONS
0003                  REAL KHRTSM(K)
0004                  CRSMIN=230
0005                  DO 200 I=1,K
0006                  IF(KHRTSM(I).EQ.0000.) GO TO 200
0007                  IF(KHRTSM(I).GT.CRSMIN) GO TO 200
0008                  CRSMIN=KHRTSM(I)
0009                  GO TO (1,2,3,4,5,6,7,8),I
0010                1 HOUR=0
0011                  GO TO 200
0012                2 HOUR=3
0013                  GO TO 200
0014                3 HOUR=6
0015                  GO TO 200
0016                4 HOUR=9
0017                  GO TO 200
0018                5 HOUR=12
0019                  GO TO 200
0020                6 HOUR=15
0021                  GO TO 200
0022                7 HOUR=18
0023                  GO TO 200
0024                8 HOUR=21
0025              200 CONTINUE
0026                  STMN=SUNCOR+HOUR
0027                  RETURN
                      END
```


FUNCTIONAL
SUBPROGRAM
DLNGTH(XLAT,DATE)
START
R = 0.0174532925
DAY = DATE
GPH =
23.5 * SIN(0.9863 *
(DAY-90) * R)
COH =
-TAN(XLAT * R)
* (TAN(GPH * R))
DLNGTH =
ARCOS(COH)
* 7.6408789
RETURN

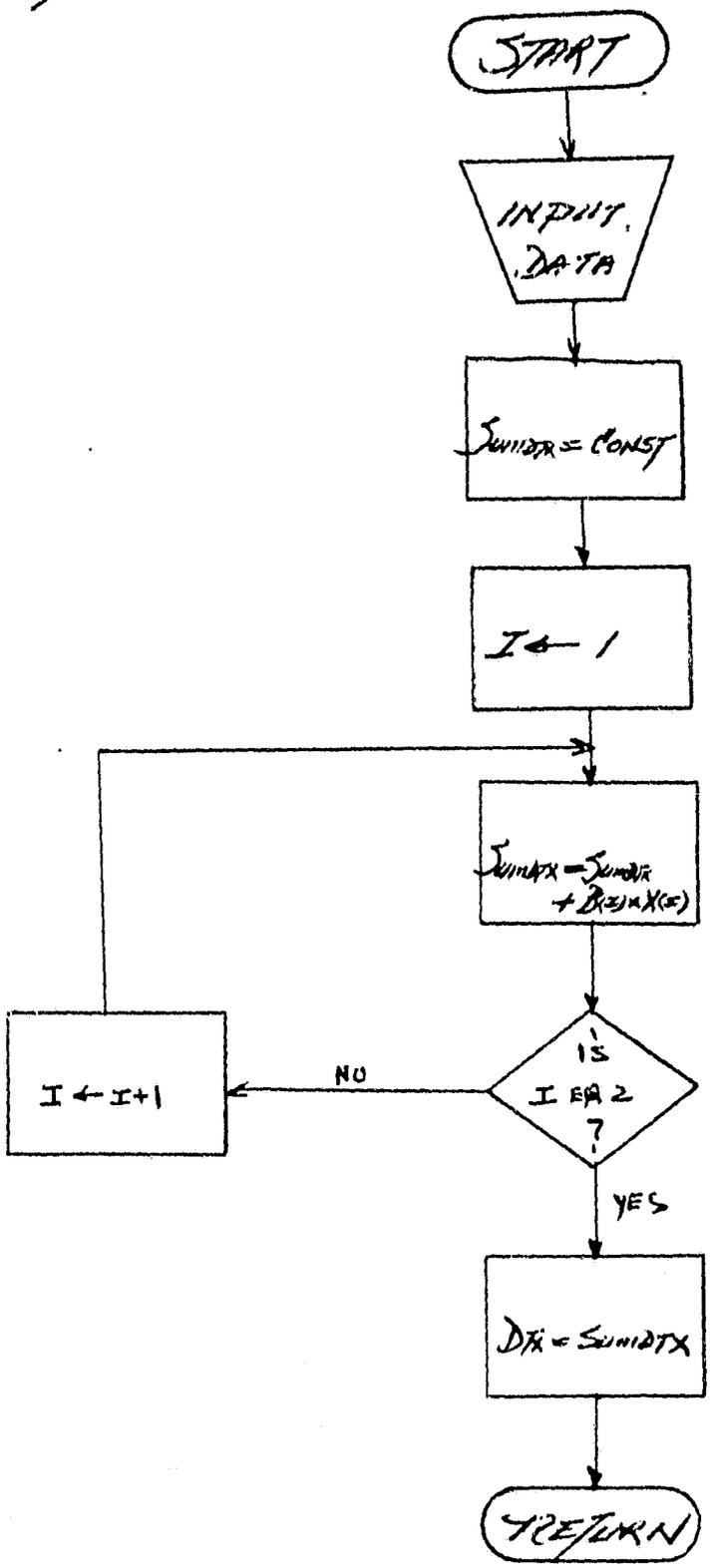
```
FORTRAN IV G1  RELEASE 2.0          DLNGTH          DATE = 77087        18/47/25

0001                  REAL FUNCTION DLNGTH(XLAT,DAY)
                    C THIS FUNCTIONAL SUBROUTINE IS DESIGNED TO CALCULATE THE
                    C DAYLENGTH OF EACH DAY
0002                  REAL XLAT, DAY, EPH,CCH
0003                  INTEGER DAY
0004                  R=.0174532925
0005                  DAY=DAY
0006                  EPH=23.5*SIN(6.5PE3*(DAY-80.0)*R)
0007                  CCH=-TAN(XLAT*R)*TAN(EPH*R)
0008                  DLNGTH=ACOS(CCH)*7.6394787
0009                  RETURN
0010                  END
```

Flowchart for the Subroutine DSUD01



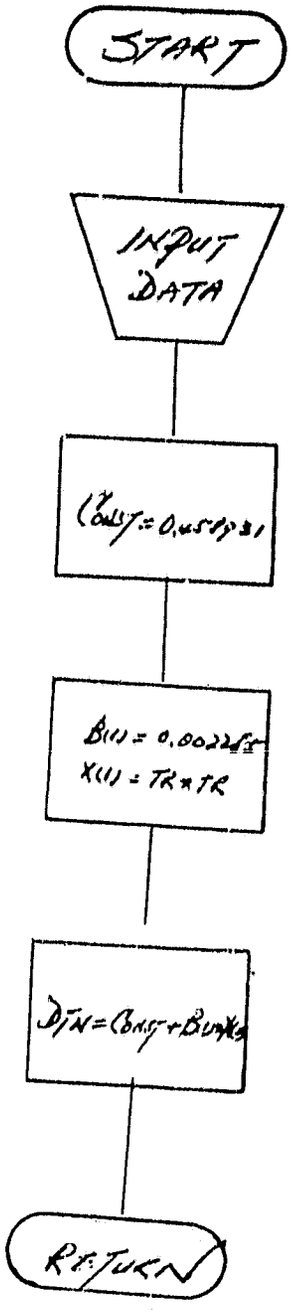
```
FORTRAN IV G1  REL-A5-  2.0              PSUDC1          DATE = 77087        13/47/25

0001                    SUBROUTINE PSUDC1(DTN,B,X,STMN,DL,TR,SC)
                      C THIS SUBROUTINE PSUDC1 IS USED TO ESTIMATE THE DTN FOR THE
                      C STATIONS LOCATED AT THE TIME ZONE HO=00
0002                    REAL B(5),X(5)
0003                    CONST=11.552863
0004                    B(1)=0.503615
0005                    B(2)=-1.472865
0006                    B(3)=0.045956
0007                    B(4)=-0.006668
0008                    X(1)=SC
0009                    X(2)=DL
0010                    X(3)=DL*DL
0011                    X(4)=DL*TR
0012                    SUMDTN=CONST
0013                    DO 200 I=1,4
0014                    SUMDTN=SUMDTN+B(I)*X(I)
0015                200 CONTINUE
0016                    DTN=SUMDTN
0017                    RETURN
0018                    END
```

FLOWCHART FOR THE SUBROUTINE DSUDO2



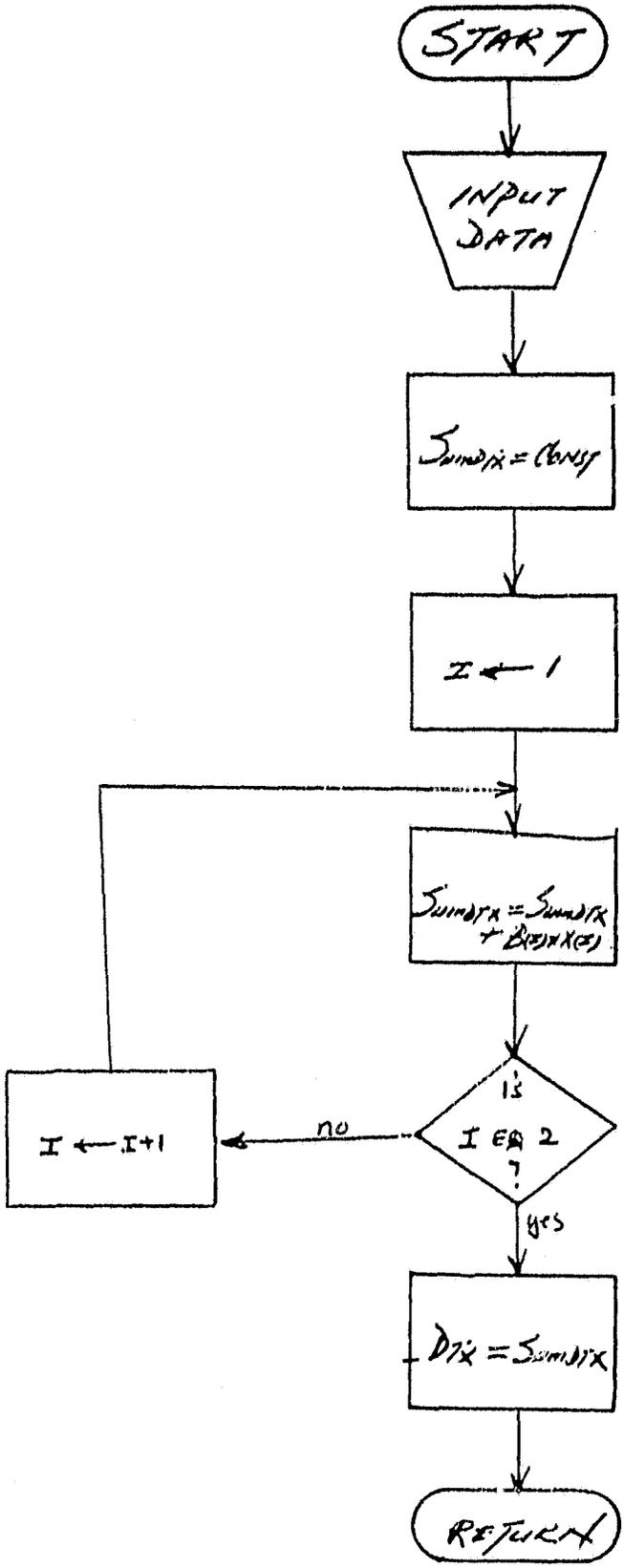
```
FORTRAN IV G1  RELEASE 2.0                PSUDO2                DATE = 77087          18/47/25

0001                  SUBROUTINE PSUDO2(DTX,P,X,STMX,DL,TR,SC)
                C     THIS SUBROUTINE PSUDO2 IS USED TO ESTIMATE THE DTX FOR THE
                C     STATIONS LOCATED AT THE TIME ZONE P)=00
0002                  REAL P(50),X(50)
0003                  CONST=0.,G1821
0004                  P(1)=0.400910
0005                  P(2)=0.003199
0006                  X(1)=SC
0007                  X(2)=DL*TR
0008                  SUMDTX=CONST
0009                  DO 200 I=1,2
0010                  SUMDTX=SUMDTX+P(I)*X(I)
0011              200 CONTINUE
0012                  DTX=SUMDTX
0013                  RETURN
0014                  END
```

FLOWCHART FOR THE SUBROUTINE DSUB03



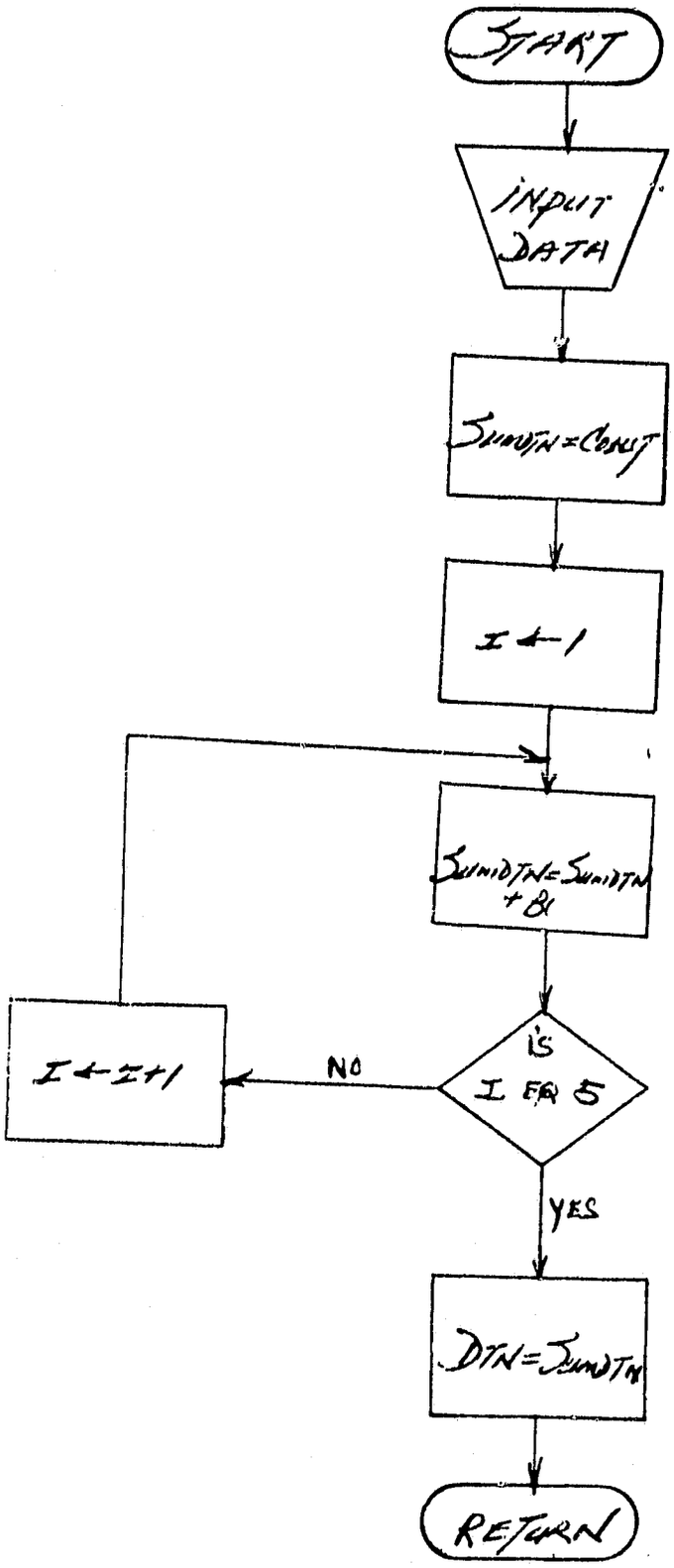
```
0001          SUBROUTINE PSUD03(DTN,B,X,STMN,DL,TR,SC)
      C       THIS SUBROUTINE PSUD03 IS USED TO ESTIMATE THE DTN FOR THE
      C       STATIONS LOCATED AT THE TIME ZONE H0=01
0002          REAL B(50),X(50)
0003          CONST=0.456731
0004          B(1)=0.002285
0005          X(1)=TR*TR
0006          DTN=CONST+B(1)*X(1)
0007          RETURN
0008          END
```

Flowchart for the subroutine DSUB04



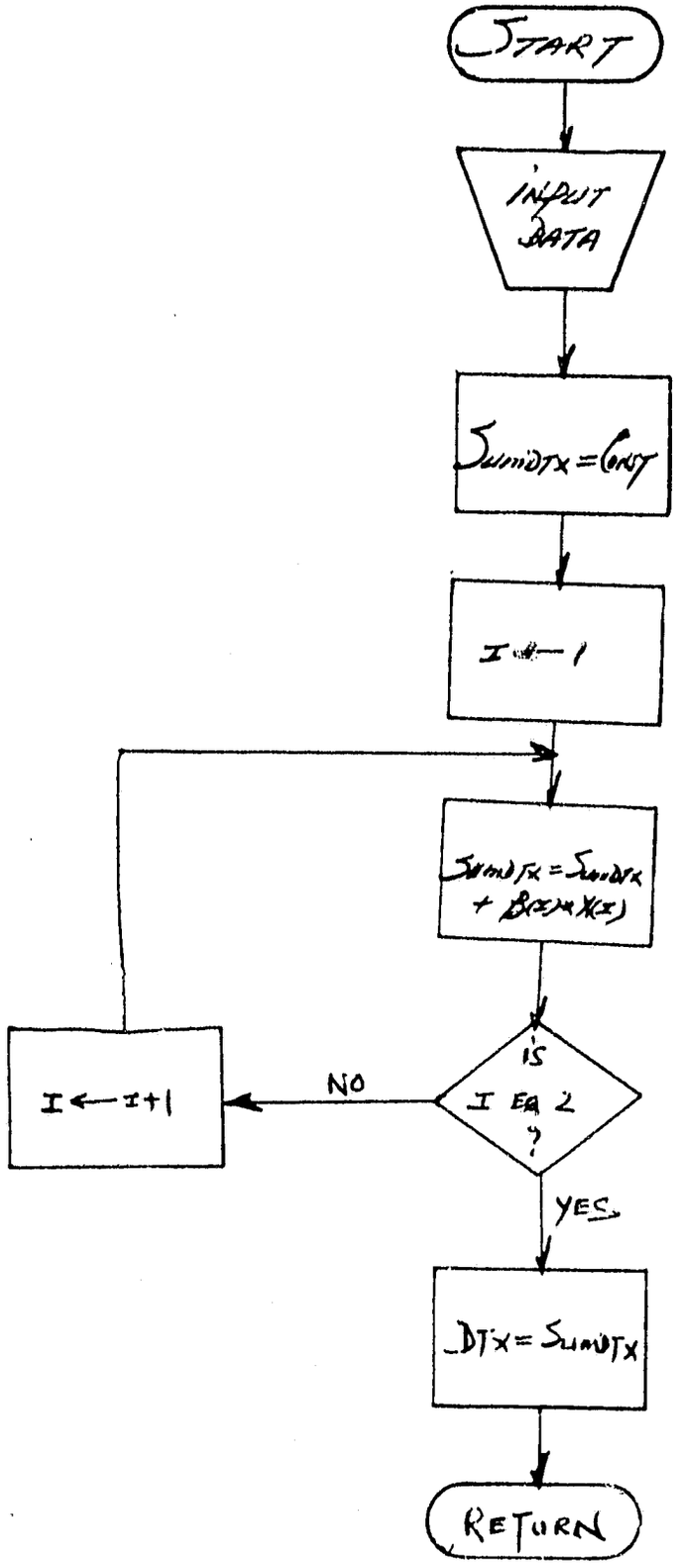
```
FORTRAN IV G1   RELEASE 2.0                PSUDO4              DATE = 77097          18/47/25

 0001                    SUBROUTINE PSUDO4(DTX,B,X,STNX,DL,TR,SC)
                    C    THIS SUBROUTINE PSUDO4 IS USED TO ESTIMATE THE DTX FOR THE
                    C    STATIONS LOCATED AT THE TIME ZONE PJ=1
 0002                    REAL B(50),X(50)
 0003                    CONST=1.181802
 0004                    B(1)=0.031554
 0005                    B(2)=0.001536
 0006                    X(1)=SC
 0007                    X(2)=DL*TR
 0008                    SUMDTX=CONST
 0009                    DO 200 I=1,2
 0010                    SUMDTX=SUMDTX+B(I)*X(I)
 0011               200  CONTINUE
 0012                    DTX=SUMDTX
 0013                    RETURN
 0014                    END
```

FLOWCHART FOR THE SUBROUTINE DSUB05



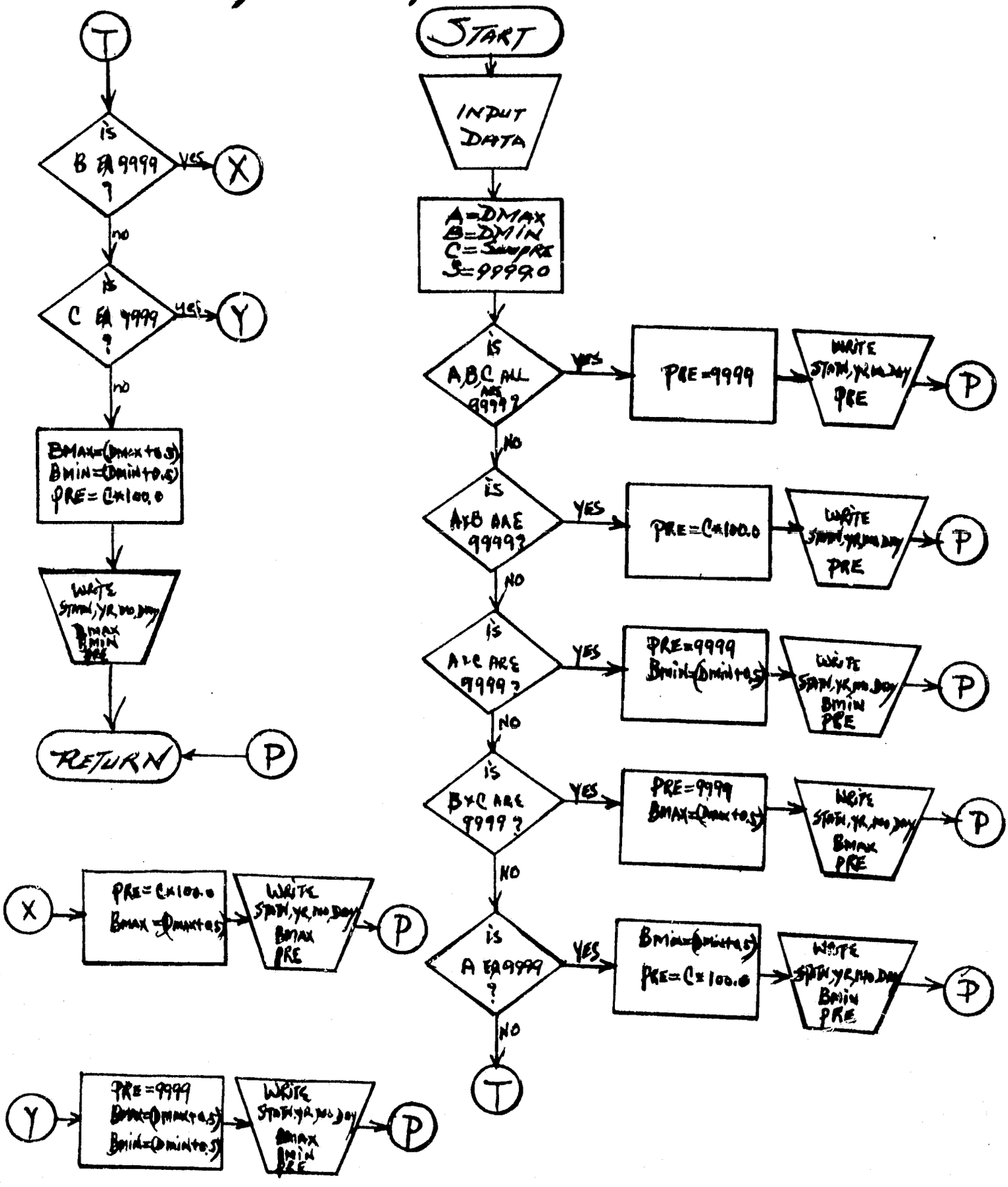
```
FORTRAN IV G1  RELEASE 2.0          PSUDOS          DATE = 77087          12/47/25

0001                    SUBROUTINE PSUDOS(DTN,P,X,STM,TF,SC)
                      C THIS SUBROUTINE PSUDOS IS USED TO ESTIMATE THE DTN FOR THE
                      C STATIONS LOCATED AT THE TIME ZONE NO=02
0002                    REAL B(5),X(5)
0003                    CONST=-2.693513
0004                    B(1)=0.388277
0005                    B(2)=-0.457537
0006                    B(3)=0.503343
0007                    B(4)=0.014372
0008                    B(5)=-0.007771
0009                    X(1)=SC
0010                    X(2)=DL
0011                    X(3)=TF
0012                    X(4)=DL*DL
0013                    X(5)=TF*TF
0014                    SUMDTN=CONST
0015                    DO 200 I=1,5
0016                    SUMDTN=SUMDTN+B(I)*X(I)
0017                200 CONTINUE
0018                    DTN=SUMDTN
0019                    RETURN
0020                    END
```

FLOWCHART FOR THE SUBROUTINE PSUDO6



```
FORTRAN IV G1  REL.7.0          PSUDO          DATE = 77087          18/47/25

0001                  SUBROUTINE PSUDO(DTX,H,X,STMX,DL,T2,SC)
                C     THIS SUBROUTINE PSUDO IS USED TO ESTIMATE THE DTX FOR THE
                C     STATIONS LOCATED AT THE TIME ZONE HD=02
0002                  REAL X(50),X(50)
0003                  CONST=1.177465
0004                  S(1)=0.3[illegible]28
0005                  P(2)=[illegible]
0006                  X(1)=SC
0007                  X(2)=DL*T2
0008                  SUMDTX=CONST
0009                  DO 200 I=1,2.
0010                  SUMDTX=SUMDTX+S(I)*X(I)
0011              200 CONTINUE
0012                  DTX=SUMDTX
0013                  RETURN
0014                  END
```

FLOWCHART FOR THE SUBROUTINE OUT



```
FORTRAN IV G1  RELEASE 2.0                    CUT                    DATE = 77087          19/47/25

0001                  SUBROUTINE OUT(STATN,YEAR,MONTH,DAY,DMAX,DMIN,SUMPRE,BMAX,BMIN,
                     *PRE)
                C     THIS SUBROUTINE PUTS THE DATA INTO THE CORRECT OUTPUT FORMAT
0002                  INTEGER STATN,YEAR,MONTH,DAY,BMAX,BMIN,PRE
0003                  REAL DMAX,DMIN,SUMPRE
0004                  A=DMAX
0005                  B=DMIN
0006                  C=SUMPRE
0007                  S=0.0
0008                  IF((A.EQ.S).AND.(B.EQ.S).AND.(C.EQ.S)) GO TO 100
0009                  IF((A.EQ.S).AND.(B.EQ.S)) GO TO 200
0010                  IF((A.EQ.S).AND.(C.EQ.S)) GO TO 300
0011                  IF((B.EQ.S).AND.(C.EQ.S)) GO TO 400
0012                  IF(A.EQ.S) GO TO 500
0013                  IF(B.EQ.S) GO TO 600
0014                  IF(C.EQ.S) GO TO 700
                C     CHANGE THE DMAX AND THE DMIN TO A WHOLE DEGREE
0015                  BMAX=(DMAX+0.5)
0016                  BMIN=(DMIN+0.5)
                C     CHANGE SUMPRE TO CMS TO 100 AN INCH
0017                  PRE=C*100.0
0018                  WRITE(6,900)STATN,YEAR,MONTH,DAY,BMAX,BMIN,PRE
0019              900 FORMAT(I6,3I2,1X,2I3,3X,I4)
0020                  GO TO 999
                C     SINCE BMAX,BMIN,AND SUMPRE ARE 9999,SO SET THEM TO BLANK
0021              100 PRE=9999
0022                  WRITE(6,10) STATN,YEAR,MONTH,DAY,PRE
0023               10 FORMAT(I6,3I2,10X,I4)
0024                  GO TO 999
0025              200 PRE=C*100.0
0026                  WRITE(6,20)STATN,YEAR,MONTH,DAY,PRE
0027               20 FORMAT(I6,3I2,10X,I4)
0028                  GO TO 999
0029              300 BMIN=(BMIN+0.5)
0030                  PRE=9999
0031                  WRITE(6,30)STATN,YEAR,MONTH,DAY,BMIN,PRE
0032               30 FORMAT(I6,3I2,4X,I3,3X,I4)
0033                  GO TO 999
0034              400 BMAX=(BMAX+0.5)
0035                  PRE=9999
0036                  WRITE(6,40)STATN,YEAR,MONTH,DAY,BMAX,PRE
0037               40 FORMAT(I6,3I2,1X,I3,6X,I4)
0038                  GO TO 999
0039              500 BMIN=(BMIN+0.5)
0040                  PRE=C*100.0
0041                  WRITE(6,50)STATN,YEAR,MONTH,DAY,BMIN,PRE
0042               50 FORMAT(I6,3I2,4X,I3,3X,I4)
0043                  GO TO 999
0044              600 BMAX=(BMAX+0.5)
0045                  PRE=C*100.0
0046                  WRITE(6,60)STATN,YEAR,MONTH,DAY,BMAX,PRE
0047               60 FORMAT(I6,3I2,1X,I3,6X,I4)
0048                  GO TO 999
0049              700 BMAX=(BMAX+0.5)
0050                  BMIN=(BMIN+0.5)
0051                  PRE=9999
```

```
FORTRAN IV G1  RELEASE 2.0          OUT                    DATE = 77087          18/47/25

0052                    WRITE(6,70)STATN,YEAR,MONTH,DAY,BMAX,BMIN,PRE
0053                 70 FORMAT(I6,3I2,1X,2I3,2X,I4)
0054                900 RETURN
0055                    END
```