TITLE: Lathe Table APPLESOFT Program

AUTHOR(S): Roger D. Norrod

DATE: March 16, 1983

DISTRIBUTION:

GB Library
GB Library
R. Fisher
R. Lacasse
W. Brundage
R. Weimer
D. Schiebel
C. Moore
C. Brockway
J. Coe
G. Behrens
R. Mauzy
R. Norrod
F. Crews

CV Library
H. Hvatum
M. Balister
S. Weinreb
C. Burgess

TU Library Downtown
Library Mountain
J. Payne

VLA Library
VLA Library
P. Napier
J. Campbell
LATHE TABLE APPLESOFT PROGRAM

Roger D. Norrod

March 15, 1983

The following is a description of an Applesoft BASIC program which is intended to produce a table of data describing a part to be machined on a lathe equipped with a numerical readout. The program is set for the conventions followed by the Green Bank lathe readout; that is, the carriage (Z) readout increases positive toward the tailstock and the crossfeed (X) readout increases positive toward the operator.

This program description consists of two sections. The first is intended for someone who merely wants to use the program to produce a table. The second section is intended for a programmer who wishes to describe a new part or modify the existing program.

1.0 Using the Program

With the APPLE off, insert the proper disk into the disk drive and close the door. Turn the APPLE power on. The video display will soon display a list of programs that are on the disk and then a blinking block cursor. Type RUN LATHE TABLE and Return or the disk may automatically load and run the proper program. A menu is then displayed. To begin the process of producing a table, the user selects "T".

The program then asks the user several questions about how the piece is mounted in the lathe and how the table is to be organized. Most questions have only two acceptable answers and the choices are highlighted on the screen. In addition, most questions have default answers that are displayed between slashes. If the user presses only Return in response to a question, then the default answer is used. An entry of "QQ" will cause the program to return to the menu. The questions asked are:

1. If the machinist will start at reference point 1 or 2. A drawing of the part being machined should indicate two reference points on the Z axis, normally at the endpoints of the described curve. The Z axis will be zeroed at the point selected here, so the user will usually enter the point where the cut begins.

2. If the carriage will move toward the headstock or tailstock during the cut.

3. If the table should have a constant X step size or a constant Z step.

4. The tool radius.

5. The size of the step. The program will only accept inputs here greater than zero.

6. The amount of any oversize, such as would be required for roughing cuts, etc. No checks are made on this input, so the user should be careful to enter the proper sign for this offset. Note that the oversize is a diameter measurement, not a radius.
7. The diameter at which the X axis is zeroed. An entry of zero here implies that the X axis is zeroed at the lathe axis of rotation.

The program then displays the ranges of Z and X (including the effect of the entry in 7 above but not including the oversize or tool radius offsets), and asks the user if he wants the total table or a portion only. If the partial option is selected, the program asks for the starting and ending values. Selecting the starting and ending entries may require some thought since the entries do not include oversize or tool radius offsets, while displayed table values do include the offsets.

The program then asks the user to wait and calculates the data points. This may take several minutes, depending on the number of points requested. Because of memory size restrictions, the computer can only hold 500 points at one time. If the user has requested more than 500, the program will calculate the first 500 and alert the user that the memory is full.

Upon completion of the calculations, the display menu is presented. Options here are:

(P) To print the table. The printout may be terminated at any time by pressing Q. Upon completion of printing, the program returns to the display menu.

(D) To display the table. The data is displayed on the video screen and the I/O paddle buttons may be used to scroll the screen. Upon pressing Q at the keyboard, the program returns to the display menu.

(R) To resume calculations. If memory is full, the program will resume calculations and then return to the display menu. If calculations are complete, the program will return to the main menu, ready to make a new table.

(E) To end the program.

The program saves on disk the entries made by the user so that these become new default values the next time the program is run. Figure 1 shows how the tool radius should be accounted for when zeroing the Z and X axis.

![Figure 1: Zeroing the axes.](image-url)
2.0 Programming Notes

The programmer should first read section 1.0. The program is organized as a group of subroutines. Remarks have been used extensively to make the program self-documenting. A program listing and a variable cross reference index are attached for an example program that has been used to machine a L-band OMT mandrel. For illustration, a drawing of the mandrel is also attached.

The axis along the bed of the lathe is the Z axis; the crossfeed moves along the X axis. Variables Z and X are the positions displayed to the user and agree in magnitude and sign with the digital lathe readout. Program variables RZ and RX are variables in equations that the programmer uses to describe the part. The program converts the variables RZ and RX to Z and X, automatically assigning the correct sign and magnitude.

In order to describe a new part, the programmer need only modify four subroutines:

500-599 This routine calculates RX given a value of RZ, where RX is the radius of the part and RZ is the position along the length of the part.

600-699 This routine calculates the slope at a point RZ, RX and assigns it to the variable SL.

700-899 This routine calculates RZ given a value of RX. This routine is used if the user requests constant steps in the X direction.

900-999 In this routine, the user defines certain variables required by the program. These are:

UNIT% 0 for units of inches
       1 for millimeters

TI$ A string used as a title for the program.

U1$,U2$ Optional strings printed as headers for the data table.

Z1,Z2 Real variables defining the RZ endpoints of the curve. These will usually correspond to the values of RZ at Reference Points 1 and 2, respectively. It is recommended that Z1 < Z2.

X1,X2 Real variables defining the values of RX at Z1 and Z2. These are used if the user requests constant X steps and only make sense if the described curve is monotonic. It is recommended that X1 < X2.

FG +1 for outside cut, -1 for inside cut. This flag is used when calculating offsets due to oversizes or tool radii.
Following is a routine by routine description of the program:

1-29  Loads a "PRINT USING" utility, dimensions the arrays, calls the user routine 900, displays a screen heading, loads default values from disk (routine 1800), and jumps to line 100 to display the main menu.

30-99  Subroutine that displays five lines of the data array on the screen.

100-199  The main menu. Options and destinations are:

   (T) - Make new table  ->  200
   (E) - End program  ->  APPLESOFT.

200-219  Directs flow of the process in calculating and displaying a table. Sets up the table (2000), gets user inputs (1000), saves user inputs to disk (1830), branches to the proper calculation routine (220 or 300), and returns to the main menu (100).

220-299  Subroutine called by 200 to calculate data array with constant RZ steps. Calculates 500 points or the entire array (whichever is less), calls the display menu (400), and then completes the table if required before returning to 200.

300-349  Similar to 220 except for constant RX steps.

350-399  Stores calculated points in the data array. Data stored is Z, X, and the increments of Z and X. Called by 220 or 330.

400-449  The display menu. Options and destinations are:

   (D) - Screen display  ->  Subroutine 30
   (R) - Resume calculations  ->  Returns to calling routine
   (P) - Prints hardcopy  ->  Subroutine 9100
   (E) - Ends program  ->  APPLESOFT

   The display menu is called by 220 or 330.

460-479  Transforms RZ, RX to Z,X. Adds offsets and converts the radius RX to the diameter X. Flips the Z axis if the Z axis is zeroed at Reference Point 2.

490-499  Calculates tool radius offsets needed by 460.

1000-1749  Prompts and accepts user inputs for configuring the table.

1800-1829  Three routines that read and write the user inputs to disk for use as defaults. If an attempt is made to read a non-existent disk file, then "default" default values are written to the disk. The name of the disk default file is TI$+.DEF".
2000-2099 Routines to set up the table. Defines the proper rounding on units chosen, defines column headings, and defines printer header strings.

5300-5340 Printer initialization routine.

9100-9400 Routine to dump the data array to the printer.

Please report any bugs or problems to the author. It is recommended that anyone who modifies this program to describe a new part should generate a dedicated disk containing only his version, clearly identified. The disk must contain a copy of the "PU&F.0" binary program. I have found it helpful to have the greeting (HELLO) program run the proper "LATHE TABLE" program so that the user need not type the program name at each power-up.

RDN/cjd
PROGRAM LENGTH = 11342 BYTES
VARIABLES = 35 BYTES
FREE MEMORY = 20970 BYTES
START = 2049 LOHEN = 13391 FREE = 13426 STRING = 34304 HIMEM = 34304

1 REM LATE TABLE VERSION 15MAR83

2 PRINT CHR$(4)"HAXFILES3"; ADR = PEEK(115) + 256 * PEEK(116) - 533: PRINT CHR$(4)"LOAD PU%F.0,A"; ADR
3 FOR I = 1 TO 11: READ D1, D2: D1 = D1 + ADR: D2 = D2 + ADR: POKE D1 + 1, D2 / 256: POKE D1, D2 - 256 * PEEK(D1 + 1): NEXT: DATA 3, 16, 17, 19, 26, 47, 72, 84, 113, 68, 117, 130, 125, 392, 127, 427, 129, 405, 371, 150
4 CALL ADR: REM INVOKE PRINT USING (REF CALL A.P.P.L.E. IN DEPTH VOL 1)

5 REM BEGIN
6 ND = 501: DIM U(4), ND, U(4)
7 REM DISPLAY HEADING
8 TEXT: HOME
9 GOSUB 300: REM READ PROGRAMMER INPUTS
10 A$ = TI$ + " PROGRAM": B$ = "NRAO-15MAR83"
11 PRINT TAB(20 - LEN(A$) / 2); A$: PRINT TAB(20 - LEN(B$) / 2); B$
12 U = 2: UTAB U + 2: POKE 34, U: REM SCREEN WINDOW

18 REM INITIALIZE CONSTANTS
19 D$ = CHR$(4): REM DI$=CTRL-D
20 REM DEFAULT VALUES
21 GOSUB 1800
22 GOTO 100: REM DISPLAY MENU

30 REM TABLE VIDEO DISPLAY
31 HOME: A$ = "PRESS 0 TO EXIT": HTAB(20 - LEN(A$) / 2): INVERSE
   : PRINT A$: NORMAL
32 U = 4: UTAB U + 1
33 PRINT TAB(4); U$(1); TAB(14); U$(2); TAB(24); U$(3); TAB(34); U$(4)
34 POKE 34, U: REM SCREEN WINDOW
35 UTAB 12: & RPT PRINT > "-", A$40
36 UTAB 14: & RPT PRINT > "-", A$48
44 N1 = 127: N2 = 128: N3 = - 4: N4 = - 6: N5 = 4: N6 = 0: N7 = 7: N8 = 3: N9 = 1
45 A4% = - 16384: REM KEY BUFFER ADDR
46 JK = 1: A1% = - 16287: A2% = - 16286: REM PB0 AND PB1
48 GOSUB 88: REM DISPLAY FIRST PAGE
50 HT% = 256
51 KV = PEEK(A4%): IF KV = 203 OR KV = 31 THEN POKE - 16368, 0: U = 2: POKE 34, U: RETURN: REM RETURN IF 0 PRESSED
52 IF PEEK(A1%) < N2 THEN S1: REM WAIT FOR BUTTON
56 SC% = N3: IF PEEK(A2%) > N1 THEN SC% = N4
59 JK = JK + SC%
60 IF JK < N9 THEN JK = N9
62 IF JK > 12 THEN JK = 12
64  GOSUB 30
66  FOR HT = N5 TO HT%: NEXT HT: REM WAIT
68  IF PEEK (A1%) > N1 THEN HT% = HT% / N5: GOTO 56: REM BUTTON STILL DOWN
70  GOTO 50
72  REM DISPLAY PAGE
74  FOR LN = N6 TO N5
76  UTAB N7 + LN = N5: & CLEAR TO EOL
78  & PRINT USH# > FR##(X1, J%); U(2, J%); U(3, J%); U(4, J%)
80  J% = J% + 1
82  IF J% > 12 THEN LN = 5: & CLEAR TO EOL
84  NEXT LN
86  PRINT CHR$(0): RETURN: REM

100  HOME: UTAB U + 2: REM MENU DISPLAY
105  PRINT "PRESS (T) TO MAKE NEW TABLE"
110  HTAB 7: PRINT "(E) TO END PROGRAM"
115  PRINT "& CLEAR TO EOL: INPUT "SELECTION": };P$
120  IF PS$ = "T" THEN GOTO 200
125  IF PS$ = "E" THEN TEXT: HOME: END
130  & BELL: GOTO 100: REM FAULTY ENTRY

200  REM MAIN PROGRAM
202  CH = 1: REM INITIALIZE HEADING FLAG
205  GOSUB 2000: REM SET UP TABLE
210  GOSUB 1000: REM GET USER INPUTS
215  U3$ = U3$ + STR$(FN R4(TC)) + "+" OVERSIZE DIA = " + STR$(FN R4((TR)) - REM HEADER INFO
220  HOME: UTAB 11: A$ = "PLEASE WAIT": PRINT TAB(20 - LEN(A$) / 2); A$
225  GOSUB 1838: REM SAVE DEFAULT VALUES
230  I = FRE(0): REM GARBAGE COLLECTION
235  ON BR GOSUB 220, 360: REM BRANCH FOR CONSTANT Z STEP OR X STEP
240  GOTO 300: REM DISPLAY MENU

220  REM CONSTANT Z STEP
222  RZ = RZ: REM INITIALIZE RZ
224  GOSUB 500: GOSUB 460: REM CALC INITIAL RX AND Z,X
225  Z0 = Z0: X0 = X: REM INITIALIZE OLD POINTS
230  I = 0: REM BEGIN COUNT
235  IF DD < 0 AND RZ < EZ THEN RZ = EZ
240  IF DD > 0 AND RZ > EZ THEN RZ = EZ
245  GOSUB 500: REM CALC RX(RZ)
250  GOSUB 460: REM CALC Z,X
255  GOSUB 350: REM SAVE DATA
260  RZ = RZ + DD
265  IF I = NO - 1 THEN CP = 0: GOTO 265: REM ARRAY FULL
270  IF DD < 0 AND RZ > EZ + DD + 1E - 5 THEN 232
275  IF DD > 0 AND RZ < EZ + DD - 1E - 5 THEN 232
280  CP = 1: REM END OF TABLE FLAG
285  IZ = I
290  GOSUB 460: REM PROMPT USER FOR TYPE DISPLAY
295  IF NOT CP THEN 230
300  RETURN: REM TABLE COMPLETE
300 REM ROUTINE FOR CONSTANT X STEP
302 RX = SX: REM INITIALIZE RX
303 GOSUB 700: GOSUB 460: REM CALC RZ AND Z,X
304 ZO = 2: X0 = X: REM INITIALIZE OLD DATA
305 I = 0: REM BEGIN COUNT
310 REM BEGIN LOOP
311 IF DD < 0 AND RX < EX THEN RX = EX
312 IF DD > 0 AND RX > EX THEN RX = EX
316 GOSUB 700: GOSUB 460: REM CALC RZ AND Z,X
318 GOSUB 350: REM STORE DATA
320 RX = RX + DD
322 IF I = NO - 1 THEN CP = 0: GOTO 330: REM ARRAY FULL
323 IF DD < 0 AND RX > EX + DD + 1E - 5 THEN 310
325 IF DD > 0 AND RX < EX + DD - 1E - 5 THEN 310
327 CP = 1: REM END OF TABLE
330 IZ = I
332 GOSUB 400: REM PROMPT USER FOR TYPE DISPLAY
336 IF NOT CP THEN 330
340 RETURN: REM TABLE COMPLETE

350 REM STORE DATA IN ARRAY
355 DZ = Z - 20: ZO = Z
356 DX = Y - X0: X0 = X: REM CALC STEPS
358 I = I + 1
360 UK(I,1) = FN R4(Z * ZS): UK(2,I) = FN R4(DZ * ZS)
370 UK(3,I) = FN R4(X - TC): UK(4,I) = FN R4(DX): REM TO IS CENTER OFFSET
380 RETURN: REM

400 REM SECONDARY MENU FOR DISPLAY TYPE
405 HOME
410 UTAB V + 2: PRINT "NUMBER POINTS IS ";IZ
412 IF NOT CP THEN UTAB V + 3: A$ = "MEMORY FULL - CALCULATIONS INCOMPLETE": INVERSE: PRINT A$: NORMAL
413 IF CP THEN UTAB V + 3: A$ = "CALCULATIONS COMPLETE": PRINT A$
415 UTAB V + 5: PRINT "PRESS (P) TO PRINT TABLE"
418 HTAB 7: PRINT "(D) TO DISPLAY TABLE"
420 HTAB 7: PRINT "(R) TO RESUME CALCULATIONS"
422 HTAB 7: PRINT "(E) TO END PROGRAM"
425 PRINT: & CLEAR TO EOL: INPUT "SELECTION? "; P$
428 IF P$ = "D" THEN GOSUB 30: GOTO 405: REM DISPLAY TABLE
430 IF P$ = "R" THEN 445: REM CALC REST OF POINTS OR RETURN TO MENU
435 IF P$ = "P" THEN GOSUB 900: GOTO 405: REM PRINT TABLE
440 & BELL: GOTO 415: REM FAULTY INPUT
445 IF CP THEN RETURN: REM IF TABLE FINISHED, DISPLAY MENU
447 HOME: A$ = "PLEASE WAIT": B$ = "CALCULATING MORE POINTS"
448 UTAB 18: PRINT TAB(20 - LEN(A$) / 2); A$: PRINT: PRINT TAB(20 - LEN(B$) / 2); B$
449 RETURN: REM ELSE CALCULATE REST OF TABLE

450 REM TRANSFORMS RZ,RX TO Z,X
452 GOSUB 600: GOSUB 490: REM CALC SLOPE AND OFFSETS
454 X = 2 * (RX + FX - TR): REM ADD OFFSETS AND CONVERT TO DIA
456 Z = RZ + FZ
470 REM CHANGE Z ZERO TO REF PT 2
472 IF RF = 2 THEN Z = Z2 - Z
479 RETURN: REM
490  REM  CALCULATES FZ AND FX,  TOOL RADIUS OFFSETS
492  AG =  ATN (SL)
494  FZ =  - FG * (TR + OU / 2) * SIN (AG)
496  FX =  FG * (TR + OU / 2) * COS (AG)
498  RETURN ; REM

500  REM  ROUTINE THAT CALCULATES RX GIVEN RZ
520  IF RZ < Z1 THEN RX = X1: RETURN
530  IF RZ > 12.05 THEN RX = X2: RETURN
540  RX = 1.4810 + 0.86725 * (1 + SIN (.260713063 * (RZ - 6.025)))
599  RETURN : REM

600  REM  ROUTINE TO CALCULATE SLOPE AT POINT RZ,RX
610  IF RZ < 0 THEN SL = 0: RETURN
615  IF RZ > 12.05 THEN SL = 0: RETURN
620  SL = 0.22610342 * COS (.260713063 * (RZ - 6.025))
699  RETURN : REM

700  REM  ROUTINE TO CALCULATE RZ GIVEN RX
712  IF RX < X1 THEN RZ = Z1: RETURN
714  IF RX > X2 THEN RZ = Z2: RETURN
720  R1 = 1.15387 * RX - 2.7075967
725  IF R1 > 1.0 THEN C1 = 1.5707963; GOTO 740
728  IF R1 < -1.0 THEN C1 = -1.5707963; GOTO 740
730  C1 = ATN (R1 / SQRT (-R1 * R1 + 1)); REM  ARC SINE
740  RZ = 3.8356341 * C1 + 6.025
899  RETURN ; REM

900  REM  ROUTINE TO SET UP TABLE PARAMETERS
903  UNIT$ = 0; REM  0 FOR INCHES, 1 FOR MILLIMETERS
905  FG = 1; REM -1 FOR OUTSIDE CUT,  -1 FOR INSIDE
910  TI$ = "LOHT HANDREL"
914  UI$ = "L-BAND OHT HANDREL"
920  REM  EXTREMES OF Z AND X
922  Z1 = 0:Z2 = 14.1000
924  X1 = 1.4810; X2 = 3.2155
999  RETURN ; REM

1000 REM  ROUTINE TO GET USER INPUTS
1005 HOME ; UTAB V + 1; A$ = "ENTER IQ TO EXIT"
1007 HTABS 20 - LEP (A$) / 2: INVERSE : PRINT A$; NORMAL
1008 V = 3: POKE 34;U: REM

1010 UTAB V + 2: PRINT "START AT RF POINT "
1020 INVERSE : PRINT "1": NORMAL
1030 PRINT " OR ";
1040 INVERSE : PRINT "2": NORMAL
1050 PRINT " OR ";
1055 PRINT "": OL$ = STR$(RF); GOSUB 1700: REM  DISPLAY OLD VALUE
1052 POKE 45168;O: INPUT UI$: GOSUB 1650: REM  CLR KEYS, ACCEPT INPUT,
1055 UI$ = LEFT$(UI$+,1)
1060 IF UI$ = "1" THEN RF = 1: PRINT "---> "; RF: GOTO 1100
1070 IF UI$ = "2" THEN RF = 2: PRINT "---> "; RF: GOTO 1100
1000 & BELL: GOTO 1010: REM FAULTY INPUT

1100 UTAB U + 5: PRINT "CARRIAGE MOVES TOWARD ";
1110 INVERSE : PRINT "H";: NORMAL
1120 PRINT "EAD OR ";
1130 INVERSE : PRINT "T";: NORMAL
1140 PRINT "AIL STOCK";
1142 IF ZS < 0 THEN OL$ = "H"
1144 IF ZS > 0 THEN OL$ = "T"
1146 GOSUB 1700
1148 INPUT UI$: GOSUB 1650
1150 UI$ = LEFT$ (UI$,1)
1160 IF UI$ = "H" THEN ZS = -1.0: PRINT ""---> ";,UI$: GOTO 1200
1170 IF UI$ = "T" THEN ZS = 1.0: PRINT ""---> ";,UI$: GOTO 1200
1180 & BELL: GOTO 1100: REM FAULTY INPUT

1200 UTAB U + 9: PRINT "CONSTANT ";
1210 INVERSE : PRINT "Z";: NORMAL
1220 PRINT " STEP OR CONSTANT ";
1230 INVERSE : PRINT "X";: NORMAL
1240 PRINT " STEP";
1242 IF BR = 1 THEN OL$ = "Z"
1243 IF BR = 2 THEN OL$ = "X"
1244 GOSUB 1700
1245 INPUT UI$: GOSUB 1650
1247 UI$ = LEFT$ (UI$,1)
1250 IF UI$ = "Z" THEN BR = 1: PRINT ""---> ";,UI$: GOTO 1200
1260 IF UI$ = "X" THEN BR = 2: PRINT ""---> ";,UI$: GOTO 1200
1270 & BELL: GOTO 1200: REM FAULTY INPUT

1280 UTAB U + 11: PRINT "TOOL RADIUS";UNIT$;
1282 OL$ = STR$ (TR): GOSUB 1700
1284 INPUT UI$: GOSUB 1650
1286 TR = VAL (UI$): PRINT ""---> "; FN R4(TR)
1288 REM

1300 UTAB U + 14: PRINT "SIZE OF STEP";UNIT$;
1302 OL$ = STR$ (ABS (DD))
1303 IF BR = 2 THEN OL$ = STR$ ( FN R4(ABS (DD) + 2))
1304 GOSUB 1700
1310 INPUT UI$: GOSUB 1650
1320 DD = VAL (UI$)
1325 IF DD < = 0 THEN & BELL: GOTO 1300: REM FAULTY INPUT
1327 PRINT ""---> "; FN R4(DD): REM

1330 UTAB U + 17: PRINT "X AXIS OVERSIZE QIN";UNIT$;
1332 OL$ = STR$ (OU): GOSUB 1700
1334 INPUT UI$: GOSUB 1650
1336 OU = VAL (UI$): PRINT ""---> "; FN R4(OU)
1338 REM

1340 UTAB U + 19: PRINT "ABSOLUTE X AXIS ZEROED AT ";UNIT$;
1342 OL$ = STR$ (TC): GOSUB 1700
1344 INPUT UI$: GOSUB 1650
1346 TC = VAL (UI$): PRINT ""---> "; FN R4(TC)
REM SET HP TPRIF
IF RF = 1 THEN SX = X1; EX = X2; SZ = Z1; EZ = Z2
IF RF = 2 THEN SX = X2; EX = X1; SZ = Z2; EZ = Z1
IF BR = 2 THEN DD = DD / 2: REM CONVERT DIA TO RADIUS
IF SX > EX AND BR = 2 THEN DD = - DD
IF ZS > EZ AND BR = 1 THEN DD = - DD
HOME: UTAB V + 1: FLASH: PRINT "RANGES. DO NOT INCLUDE TOOLS"
RADII OFFSET": NORMAL
PRINT "RANGE OF Z": PRINT FN R4(Z1); FN R4(Z2)
PRINT "RANGE OF X":
PRINT FN R4(2 * SX - TC); FN R4(2 * EX - TC)
INVERSE: PRINT "P": NORMAL
PRINT "ARTIAL OR ";
INVERSE: PRINT "T": NORMAL
PRINT "ODAL TABLE":
CALL 868: INPUT U1$: GOSUB 1650
U1$ = LEFT$(U1$, 1)
IF U1$ = "T" THEN PRINT "---": U1$: GOTO 1660
IF U1$ = "P" THEN PRINT "---": U1$: GOTO 1400
& BELL: GOTO 1364: REM FAULTY INPUT

REM PARTIAL TABLE
ON BR GOTO 1430, 1500: REM BRANCH ON CONSTANT Z OR X STEPS

UTAB V + 12: PRINT "STARTING Z":UNIT$;
OL$ = STR$(Z1): GOSUB 1700
INPUT U1$: GOSUB 1650
Z3 = VAL(U1$): PRINT "---": FN R4(Z3)
UTAB V + 14: PRINT "ENDING Z":UNIT$;
OL$ = STR$(Z2): GOSUB 1700
INPUT U1$: GOSUB 1650
Z4 = VAL(U1$): PRINT "---": FN R4(Z4)
IF (Z4 < = Z3) THEN & BELL: UTAB V + 10: PRINT "ERROR IN ENDPOINTS"
GOTO 1430
IF RF = 1 THEN Z2 = Z3; EZ = Z4
IF RF = 2 THEN Z2 = Z2 - Z3; EZ = Z2 - Z4
GOTO 1600: REM CONTINUE

UTAB V + 12: PRINT "STARTING X":UNIT$;
OL$ = STR$(2 * SX - TC): GOSUB 1700
INPUT U1$: GOSUB 1650
X3 = VAL(U1$) + TC: PRINT "---": FN R4(X3): REM SUBTRACT TOOL OFFSET
UTAB V + 14: PRINT "ENDING X":UNIT$;
OL$ = STR$(2 * EX - TC): GOSUB 1700
INPUT U1$: GOSUB 1650
X4 = VAL(U1$) + TC: PRINT "---": FN R4(X4)
IF (DD < 0 AND X3 < X4) OR (DD > 0 AND X3 > X4) THEN & BELL:
UTAB V + 10: PRINT "ERROR IN ENDPOINTS": GOTO 1500
SX = X3 / 2: EX = X4 / 2
REM CONTINUE

V = 2: POKE 34, U: HOME: REM SCREEN WINDOW
RETURN: REM END USER INPUT
1650 REM EXIT ROUTINE WHEN "GO" INPUT OR USE OLD VALUE IF NULL STRG
1655 IF LEFT$(UI$,2) = "GO" THEN POP : POP : U = 2 : POKE 34,U : GOTO 100:
100 REM DISPLAY MENU
1657 IF UI$ = "" THEN UI$ = OL$
1658 & CLEAR TO EOL
1660 RETURN : REM

1700 REM DISPLAY OLD INPUT
1710 PRINT "/" + OL$ + "/";
1715 & CLEAR TO EOL
1749 RETURN : REM

1800 REM LOAD DEFAULT VALUES FROM DISK
1801 OHEAD GOTO 1880
1805 PRINT CHR$(0):TD$ = TI$ + ",DEF"
1809 PRINT D$;"OPEN";TD$
1812 PRINT D$;"READ";TD$
1815 INPUT RF,2S,BA,DO,OU,TC,TR
1818 PRINT D$;"CLOSE";TD$
1820 POKE 216,0: REM CLEAR ERR FLG
1823 RETURN : REM

1830 REM WRITE CURRENT DEFAULT VALUES TO DISK
1830 PRINT CHR$(0):TD$ = TI$ + ",DEF";CH$ = "",
1834 PRINT D$;"OPEN";TD$
1836 PRINT D$;"DELETE";TD$
1838 PRINT D$;"OPEN";TD$
1839 PRINT D$;"WRITE";TD$
1840 PRINT RF;CH$;2S;CH$;BA;CH$;DO;CH$;OU;CH$;TC;CH$;TR
1845 PRINT D$;"CLOSE";TD$
1849 RETURN : REM

1880 REM IF NO DEFAULT FILE, MAKE ONE
1882 PRINT CHR$(0): PRINT D$;"CLOSE"
1883 RF = 1:2S = 1.0:BR = 1:DO = 0:OU = 0:TC = 0:TR = 0
1886 GOSUB 1830
1888 GOTO 22
1890 REM

2000 REM ROUTINE TO SET UP TABLE
2010 ON UNIT$: + 1 GOSUB 2080,2090
2020 U$(1) = "Z" + UNIT$: REM COLUMN HEADINGS
2025 U$(2) = "DZ" + UNIT$
2030 U$(3) = "X" + UNIT$
2035 U$(4) = "DX" + UNIT$
2040 NC = 4: REM FOUR COLUMNS
2045 U$ = "CROSSFEED X READOUT ZEROED AT DIA="
2050 U$ = "CARRIAGE Z READOUT ZEROED AT REF POINT "
2079 RETURN : REM

2090 REM INCHES
2092 UNIT$ = "(IN)"
2094 DEF FN R4(X) = INT ((X + 0.00025) * 2000) / 2000: REM ROUNDING
FUNCTION
2035 FR$ = " 0.0000": REM FORMAT STRING
2036 RETURN : REM

2030 REM MILLIMETERS
2032 UNIT$ = "(MM)"
2034 DEF FN R4(X) = INT ((X + 0.005) * 100) / 100: REM Rounding
FUNCTION
2035 FR$ = " 0.00": REM FORMAT STRING
2036 RETURN : REM

5300 PRINT "TURNS ON TRENDCOM PRINTER"
5305 D$ = CHR$(4): REM D$=CTRL D
5307 PRINT CHR$(0)
5310 PRINT D$:"FR$ 1": PRINT CHR$(0)
5320 POKE 1913,0: POKE 1785,73: REM MARGIN
5330 POKE 1657,80: REM LINE LENGTH
5340 RETURN : REM

9100 REM DUMPS TABLE TO PRINTER
9110 HOME : UTA 11:A$ = "PRINTING, PRESS Q TO TERMINATE": PRINT
9115 TAB(20 - LEN(A$)/2): " + FR$: REM ADD 8 SPACES TO FORMAT
9120 FP$ = "
9200 REM PRINTS TABLE OF CALCULATED DATA
9202 GOSUB 5300: REM TURN ON PRINTER
9203 I$ = CHR$(3): REM I$=CTRL I
9205 PRINT I$;"N": REM DISABLE VIDEO
9207 POKE 33,30: REM SET APPLESOFT LINE LENGTH
9208 IF NOT CH THEN 9255
9209 PRINT TABK(48 - LEN(U1$)/2);U1$: PRINT: REM PRINT HEADING
9210 PRINT TABK(48 - LEN(U2$)/2);U2$
9212 PRINT TABK(48 - LEN(U3$)/2);U3$
9214 PRINT TABK(48 - LEN(U4$)/2);U4$: PRINT: REM PRINT HEADING
9216 REM PRINT COLUMNAR HEADINGS
9219 FOR J = 1 TO NC: PRINT TABK(5 + (2 * J - 1) * 9 - LEN(U$(J))/2);U(J);: NEXT J
9225 PRINT CHR$(0): CH = 0
9230 GOSUB 3300
9235 REM PRINT DATA
9236 FOR J = 1 TO IZ
9237 & PRINT USING > FP$:U1(1,1) U2(1,1) U3(1,1) U4(1,1)
9238 KY = PEEK(-16384): IF KY = 200 OR KY = 81 THEN J = IZ + 1:
9239 REM "0" TO TERMINATE PRINT.
9240 POKE -16388,0: PRINT
9245 K = K + 1: IF K > = 5 THEN GOSUB 3300
9247 NEXT J
9250 PRINT : PRINT : PRINT
9255 PRINT D$;"PR$0": REM TURN PRINTER OFF
9252 POKE 33,48: PRINT I$;"I": REM RESTORE VIDEO
9255 RETURN : REM

9300 FOR II = 1 TO 20 * NC
9310 PRINT ";
9320 NEXT II
9330 K = 0: PRINT CHR$(0): RETURN
3. Plating need not wrap around corners. OK to mask surface up to 0.20 inches from corners.


Note: 1. Electroform copper about mandrel to minimum thickness of 0.075. Mask ends.

Note 3

Finish: ±.020 unless noted

TOL:

XXX = ±.030

Dimensions in inches

NRAO GREEN BANK, WV

Drawn by Ron

Revised

2.627-215-002

OMT SHELL PROTOTYPE MANDREL L BAND OMT
PROGRAM: LOHN HANOREL

A$ MISC USE
12 14 31 214 412 413 447 448 1085 1087 9118

A1% ADDR OF PRB
48 52 62

A2% ADDR OF PBA
48 56

A4% ADDR OF KEYBOARD BUFFER
45 51

ADR ADDR OF P&F
3 4 2

AG SLOPE OF CURVE (ANGULAR)
432 434 436

B$ MISC USE
14 447 448 12

BR = 1 for constant B step, =2 for constant X
310 1242 1243 1250 1260 1393 1353 1354 1355
1428 1815 1840 1883

C1 Temp Storage
725 728 730 740

CH =0 if printer header printed, =1 otherwise
202 3203 3225

CM$ "1.00"
1832 1480

CP =0 if memory full, =1 if calculations finished
250 260 280 322 327 336 412 413 445

D$ = CTRL-D
20 1888 1812 1818 1834 1836 1839 1845 1882
5308 5318 9209

D1 Temp Storage
3

D2 Temp Storage
3

DD RZ OR RX STEP
231 232 245 252 255 311 312 320 323 325 1322
1303 1320 1325 1327 1353 1354 1355 1580 1815 1840
1983

DX CHANGE IN X
DZ  \textbf{CHANGE IN Z}
355  370

E
323  325  325  325

EX  \textbf{ENDING X}
311  312  323  325  1351  1352  1354  1362  1535  1585

EZ  \textbf{ENDING Z}
253  232  1351  1352  255  1355  1485  1487  231

FG = +1 \text{ if outside cut}, -1 \text{ if inside cut}
494  496  985

FH R4K  \textbf{ROUNDING Function}
121  211  370  375  1205  1303  1327  1335  1346  1357  1362  1450  1480  1520  1550  2084  2094

FP$  \textbf{PRINTER Format string}
9120  9275

FR$  \textbf{SCREEN Format string}
88  2085  2095  9120

FX  \textbf{X Offset}
484  496

FZ  \textbf{Z Offset}
486  484

I  \textbf{Counter Index}
370  375  385  3  217  322  265  250  230  300  330

I$  \textbf{CTRL-I}
9203  9205  9292

II  \textbf{COUNTER Index}
9300  9320

IZ  \textbf{Number lines in data array}
265  62  34  330  3260  3282  410

J  \textbf{Printer routine counter index}
3220  3265  3275  3282  3287

J$  \textbf{Screen display counter}
58  46  68  88  32  94  62

K  \textbf{Printer lines counter}
3205  9330

KY  \textbf{Keypress Value}
51  3262

LK  \textbf{Screen display index}
34  34  36  82
| N1 | = 12? | 58  68  44 |
| N2 | = 128 | 52  44 |
| N3 | = -4  | 50  44 |
| N4 | = -6  | 50  44 |
| N5 | = 4   | 44  68  32 |
| N6 | = ϕ   | 44  82  68 |
| N7 | = 7   | 44  84 |
| N8 | = 3   | 84  44 |
| N9 | = 1   | 44  68 |

| NC | Number columns printed |
|    | 2040  3220  3300 |

| ND | Dimension of arrays |
|    | 322  256  6 |

| OL5 | Old or default user input string |
|     | 1039  1142  1144  1242  1243  1282  1302  1303  1332 |
|     | 1342  1432  1462  1505  1535  1657  1710 |

| OvU | Oversize diameter value |
|     | 1332  1336  211  494  1815  1846  1883  483 |

| P$ | User menu input |
|    | 185  187  430  435  437  425  180  426 |

| R1 | Temp Storage |
|    | 723  725  728  730 |

| RF | Starting Reference Point |
|    | 1070  212  1351  1352  1468  1435  1437  1815  1840  |
|    | 1883  472  1050 |

| RW | "Real" X |
|    | 720  382  520  323  712  714  530  325  312  320  540 |
|    | 464  311 |

| RZ | "Real" Z |
|    | 245  222  620  253  255  714  748  540  520  231  615 |
|    | 530  610  232  712  468 |

<p>| SCX | Direction of screen scroll |
|     | 58  55 |</p>
<table>
<thead>
<tr>
<th>SL</th>
<th>Slope of curve</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>618 615 492 620</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SH</th>
<th>Starting X</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1351 1352 392 1354 1362 1505 1565</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SZ</th>
<th>Starting Z</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1351 1352 1355 1435 1497 222</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC</th>
<th>Diameter of X axis zero point</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>211 1342 1362 1346 1505 1520 1535 1550 1815</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TD$</th>
<th>Default disk file name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1806 1809 1812 1813 1832 1834 1836 1838 1839</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TI$</th>
<th>User defined program name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>910 1806 1832 12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TR</th>
<th>Tool Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>496 494 1915 1266 1840 212 1883 464 1232</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UK</th>
<th>Column headings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8 34 2020 2025 2030 2035 9220</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UK</th>
<th>Data Array</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>83 370 3275 8 375</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>U1$</th>
<th>Printer Heading strings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>314 3293</td>
</tr>
</tbody>
</table>

| U2$ | 3210 |

| U3$ | 211 2845 3212 |

| U4$ | 212 2050 3214 |

<table>
<thead>
<tr>
<th>UI$</th>
<th>User input string</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1470 1490 1245 1344 1148 1247 1510 1520 1250</td>
</tr>
<tr>
<td></td>
<td>1070 1540 1550 1260 1655 1657 1320 1286 1150 1346</td>
</tr>
<tr>
<td></td>
<td>1336 1655 1378 1334 1060 1458 1160 1372 1374 1284</td>
</tr>
<tr>
<td></td>
<td>1440 1376 1170 1310 1052</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNIT$</th>
<th>&quot;(IN)&quot; or &quot;(MM)&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1360 1500 1480 2020 2025 2030 2035 2032 2032</td>
</tr>
<tr>
<td></td>
<td>1280 1530 1340 1430 1330</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNIT$</th>
<th>= 0 if inch units, 1 if mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2810 903</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>U</th>
<th>Top of screen window</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1300 51 1500 1358 1280 1480 1005 413 1655 1364</td>
</tr>
<tr>
<td></td>
<td>36 1190 1500 1260 16 1340 100 32 419 1530 1460</td>
</tr>
<tr>
<td></td>
<td>1360 1303 415 1430 1810 1680 1330 412</td>
</tr>
</tbody>
</table>

<p>| HT  | Wait counter |</p>
<table>
<thead>
<tr>
<th>X1 = Ref Pt 1 RX coordinate</th>
<th>X2 = Ref Pt 2 RX coordinate</th>
<th>X3 = Temp Storage</th>
<th>X4 = Temp Storage</th>
<th>Previous X value</th>
</tr>
</thead>
<tbody>
<tr>
<td>924 1352 712 520 1351</td>
<td>538 1351 1352 714 924</td>
<td>1500 1565 1520</td>
<td>1500 1550 1565</td>
<td>225 360 304</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Z = Lathe Bed Axis</th>
<th>Z1 = Ref Pt 1 RZ Coordinate</th>
<th>Z2 = Ref Pt 2 RZ Coordinate</th>
<th>Z3 = Temp Storage</th>
<th>Z4 = Temp Storage</th>
<th>Previous Z value</th>
</tr>
</thead>
<tbody>
<tr>
<td>370 355 472 304 468 225</td>
<td>1432 1351 1352 520 822 1358 712</td>
<td>1351 1358 1462 472 1497 714 922 1352</td>
<td>1435 1450 1497 1490</td>
<td>1437 1435 1498 1490</td>
<td>304 355 225</td>
</tr>
</tbody>
</table>

-1 if move toward headstock, +1 if move toward tailstock