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Automation of a Guarded Hot Plate Thermal Conductivity Instrument

By L. L. Holland

Published June 1980

Topical Report
D. S. Genser, Project Leader

Prepared for the United States Department of Energy
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**Kansas City
Division**

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THERMAL CONDUCTIVITY INSTRUMENT

By L. L. Holland

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AUTOMATION OF A GUARDED HOT PLATE THERMAL CONDUCTIVITY INSTRUMENT

BDX-613-2430, Topical Report, June 1980

Prepared by L. L. Holland

The Thermo-Physics Corporation's GP-1800 guarded hot plate thermal conductivity instrument has been automated using a Digital Equipment Corporation PDP 11/35 minicomputer with an Industrial Control Subsystem Remote. Automation included constructing a hardware link between the instrument and the minicomputer system and designing, writing, and documenting software to perform equipment control, data acquisition, data reduction, and report generation. The software was designed and written so that non-programmers can run the thermal conductivity experiment.

NN:jap

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SUMMARY

A materials property measurement routinely required at Bendix is the thermal conductivity of a material at a specified temperature. The Materials Evaluation Laboratory, in determining this property, uses a guarded hot plate and makes absolute measurements. Specimens are subjected to one-dimensional heat flow with a temperature gradient of greater than 10C/mm. The thermal conductivity is then calculated from temperatures, voltages, and dissipated power.

The Thermo-Physics Corporation's GP-1800 guarded hot plate thermal conductivity instrument has been automated using a Digital Equipment Corporation PDP 11/35 minicomputer with an Industrial Control Subsystem Remote (ICR).

The hardware link between the minicomputer and the instrument consists of cables from the GP-1800 to carry analog voltage signals to the ICR analog-to-digital (A/D) converters, and cables from the ICR flip-flop relays to relays on the GP-1800. The software uses the flip-flop relay system to output signals to relays on the instrument. The relays then energize the stepper motors and solenoids for equipment control.

The software reads the ICR A/D converters, transforms the A/D words to the proper quantities (temperature, voltage, or current), and stores the quantities needed for data acquisition. Also, the software reduces data, generates reports, and prepares data for archiving on microfiche.

DISCUSSION

SCOPE AND PURPOSE

One objective of the Computerized Laboratory and Diagnostic Services (CLADS) project is to automate the Thermo-Physics Corporation's GP-1800 thermal conductivity instrument by using a Digital Equipment Corporation PDP 11/35 minicomputer system and an Industrial Control Subsystem Remote (ICR). This automation will reduce turnaround time and labor costs. The automated functions are: equipment control (stepper motors to control the main heater and guard heater voltages and a relay to control a solenoid on the guard heater thermopile output), data acquisition, data reduction, report generation, and preparation of the data for archiving on microfiche.

The thermal conductivity test in the manual mode is labor intensive, which means a technologist will spend about 30 hours per set of two specimens. Running this test in the manual mode requires an operator to constantly monitor the instrument, record data, and control the temperature of the specimens. In addition, when the test is complete, the operator is required to reduce the data, generate the report, and archive the data in a laboratory notebook. Turnaround time and labor costs have been reduced; now this test is economically feasible and timely for more materials development projects.

ACTIVITY

Experimental Equipment and Operating Procedure

The equipment used to determine the thermal conductivity of a material includes a Thermo-Physics Corporation GP-1800 thermal conductivity instrument (Figure 1) and a Digital Equipment Corporation PDP 11/35 minicomputer system with an ICR peripheral (Figure 2). The guarded hot plate can be used to test specimens below, at, or above room temperature. This automation covers tests both at and below room temperature.

The Guarded Hot Plate test, as defined in ASTM C-177, is the primary method of thermal conductivity measurement practiced at the National Bureau of Standards and is the referee technique used in industry. To aid the reader in understanding the test method, some pieces of the guarded hot plate are described. The main heater assembly, several types of which are shown in Figure 3, contains two separate heaters--the main heater and the guard heater. The main heater assembly currently used is circular (200 mm in diameter). The guard heater is in the shape of a ring surrounding the circular (100 mm in diameter) main heater.

Figure 1. Thermal Conductivity Instrument

Figure 2. PDP 11/35 Minicomputer System and Industrial Control Subsystem Remote

Figure 3. Main Heater Assemblies

The main and guard heaters are controlled separately to ensure that there is no heat flow from the main heater to the guard heater or vice versa--a necessity for all one-dimensional heat flow problems.

Two and three dimensional problems are much more complicated to solve; therefore, this simplification saves considerable time and effort. Radial heat flow is monitored using a differential thermopile imbedded in the main and guard heaters. Besides these heaters, two heat sinks are required. They are cooled with water for room temperature tests and liquid nitrogen for tests below room temperature. The specimens used are cylindrical, 200 mm in diameter, and at least 13-mm thick.

Prior to running the test, the stack (a combination of heaters, specimens, and heat sinks) must be assembled (Figure 4). To assemble the stack, the lower specimen, instrumented with four thermocouples, is placed on the lower heat sink. A layer of heat sink compound is used between the specimens and all other surfaces to ensure good thermal contact. The main heater assembly is then placed on top of the lower sample, and the instrumented upper sample is placed on top of it.

Figure 4. Assembled Heater Stack

Finally, the upper heat sink is placed on top of the upper specimen and all circuits are checked for continuity. Four of the chromel-alumel thermocouples are between the heat sinks and the specimens, and the other four are between the heater and the specimens. Half are located at the center of the stack; the other half are at the edge of the stack. With the stack assembled and all circuits working properly, the test is ready to begin.

The voltage to the main heater is raised in increments of not more than 0.5 V every 15 minutes until the mean temperature of the specimen reaches the desired level (for room temperature tests, approximately 23°C). When the desired temperature has been reached, the guard heater voltage is adjusted until the output from the differential thermopile is less than ± 0.05 of a Celsius degree. At this point, the system is balanced and checked for stability. The stability requirement from ASTM C-177 is that the value of the thermal conductivity not change more than 1 percent during a period of not less than 2 hours. At that point the data is recorded and the test is complete.

Data Acquisition

With the stack assembled and all circuits checked for continuity, the operator begins the initialization software. This interactive software records information concerning test parameters which include specimen thicknesses and the desired specimen temperature. The software writes the data to a disk file and calls the data acquisition/equipment control software. This software brings the specimens to the desired temperature, balances the guard heater to prevent radial heat flow, and checks the readings for stability. When enough readings have been taken to show that the thermal conductivity has not varied by more than 1 percent in 2 hours, this data is recorded on the disk, the main heater voltage is returned to zero, and the test is complete. At this time, the software halts and data reduction/report generation can begin.

Because the data acquisition/equipment control software runs unattended, several safety features have been designed into it. For example, the software runs several checks during the test in addition to the over-temperature check performed by the GP-1800 hardware. These checks include limiting the number of times the guard heater and main heater voltages can be changed during a given period, putting an upper limit on the main heater voltage, and fixing the range of allowable steps for each stepper motor. If any of these limits are violated, the main heater voltage is turned back to zero and the test is aborted.

The data recorded by the data acquisition software include temperature from the eight thermocouples around the specimens, voltage outputs from the main and guard heaters, and the output from the differential thermopile.

A listing of the software that performs initialization of parameters, data acquisition, and equipment control is found in Appendix A. This software is written partially in FORTRAN IV and partially in MACRO-11, a PDP 11 assembly language.

Data Reduction and Report Generation

The data reduction and report generation software allows the operator several options in examining and outputting data. The operator can print a list of all the test parameters input with the initialization software. The operator also can examine all the data recorded by the data acquisition program and can print other quantities of interest, such as the heat loss through the sides of the stack. In this way the operator can check the data for any abnormalities during the test. The operator also has the opportunity to prepare the data for archiving on microfiche. Finally, the operator can print the test laboratory report, which includes data, test parameters, date of test, name of person running the test, test results, and any necessary comments.

Listings of the data reduction and report generation software written in FORTRAN IV are in Appendix B, and sample outputs are in Appendix C. Also included in Appendix C are samples of the interactive I/O from the initialization software.

ACCOMPLISHMENTS

The guarded hot plate thermal conductivity instrument is now fully automated for tests at and below room temperature. The software has been written and the necessary hardware changes made so that non-programmers can run this test in the automated mode. The PDP 11/35 minicomputer system now uses operator input to perform initialization of parameters, equipment control, data acquisition, data reduction, report generation, and preparation of data for archiving on microfiche. Labor costs have been reduced from 30 labor hours per set of specimens to approximately 6 labor hours per test. Turnaround time for this test also has been greatly reduced. Clerical help is no longer needed to prepare the test laboratory reports.

FUTURE WORK

Labor costs for running the automated version of the thermal conductivity test are not likely to be reduced by further

automation work. The 6 labor hours needed to run this test are used primarily in assembling the stack and preparing the specimens. Therefore, no future automation work is expected on this test.

Appendix A

INITIALIZATION SOFTWARE

```
0009 DATA TASK/6RGHPDAC/,SPCNM1/10*1H /,SPCNM2/10*1H /
```

```

C
C+
C
C   RELAY NUMBERS ARE HARDWIRED ON THE COMPUTER CARD.  TO
C   CHANGE RELAY BIT ASSIGNMENTS, THE WIRING AND THE NUMBERS
C   IN THE SOFTWARE MUST BOTH BE CHANGED.
C-
0010      IPSRN=4          !POWER SUPPLY RELAY NUMBER
0011      ISOLRN=5        !SOLENOID RELAY NUMBER
0012      IMHRN1=6        !MAIN HEATER RELAY #1

C
C   SECOND MAIN HEATER RELAY IS 7
C   FIRST GUARD HEATER RELAY IS 8
C   SECOND GUARD HEATER RELAY IS 9
C+
C   A/D CHANNEL ASSIGNMENTS
C
C   16 = MAIN HEATER CURRENT
C   19 = MAIN HEATER VOLTAGE
C   20 = GUARD HEATER VOLTAGE
C   62 = THERMOCOUPLE 1 - COLD, CENTER, LOWER
C   63 = THERMOCOUPLE 2 - HOT, CENTER, LOWER
C   64 = THERMOCOUPLE 3 - HOT, CENTER, UPPER
C   65 = THERMOCOUPLE 4 - COLD, CENTER, UPPER
C   66 = THERMOCOUPLE 5 - COLD, SIDE, LOWER
C   67 = THERMOCOUPLE 6 - HOT, SIDE, LOWER
C   68 = THERMOCOUPLE 7 - HOT, SIDE, UPPER
C   69 = THERMOCOUPLE 8 - COLD, SIDE, UPPER
C   70 = SHROUD HEATER TEMPERATURE
C   71 = BUCKING HEATER TEMPERATURE
C
C   NOT CURRENTLY USED
C   NOT CURRENTLY USED
C-
0013      IMHCC=16
0014      IMHVC=19
0015      IGHC=20
0016      ITCC=62
0017      IBHC=71

C
C   SET VOLTAGE FLAG TO 0
C   IVF=0      INITIAL MAIN VOLTAGE = 3.0 VOLTS
C   IVF=1      INITIAL MAIN VOLTAGE = 0.5 VOLTS
C
C

```

```

0018      IVF=0
      C
      C      BEGIN INTERACTIVE PORTION
      C
      C      ASK FOR LTR NUMBER (6 OR 7 ASCII CHARACTERS)
      C
0019      WRITE(5,100)
0020      READ(5,101) NLTR,LTR
      C
      C      ASK FOR THE TWO CHARACTER SPECIMEN ID
      C
0021      WRITE(5,102)
0022      READ(5,103) (SPECID(I),I=1,2)
      C
      C      ASK FOR EMPLOYEE NUMBER
      C
0023      WRITE(5,104)
0024      READ(5,103) (EMPNO(I),I=1,6)
      C
      C      ASK FOR NUMBER OF SAMPLES ( 1 OR 2)
0025      WRITE(5,143)
0026      READ(5,116) NSAM
0027      IF(NSAM.NE.2) GO TO 2
      C
      C      ASK FOR 2 SAMPLE NAMES
      C
0029      WRITE(5,205)
0030      READ(5,112) IS1,SPCNM1
0031      WRITE(5,210)
0032      READ(5,112) IS2,SPCNM2
      C
      C      ASK FOR 2 SAMPLE THICKNESSES
      C
0033      WRITE(5,105)
0034      READ(5,106) THCKUP, THCKLO
0035      GO TO 4
      C
      C      ASK FOR ONE SAMPLE NAME AND THICKNESS
      C
0036      2  WRITE(5,205)
0037      READ(5,112) IS1,SPCNM1
0038      WRITE(5,144)
0039      READ(5,106) THCKUP
      C
      C      ASK FOR SET POINT TEMPERATURE

```

```

      C
0040  4      WRITE(5,107)
0041      READ(5,108)STTEMP
      C
      C      ASK FOR MATERIAL NAME
      C
0042      WRITE(5,109)
0043      READ(5,101) NMATRL,MATRL
      C
      C      ASK FOR CHARGE NUMBER
      C
0044      WRITE(5,110)
0045      READ(5,101)NCHARG, CHARG
      C
      C      ASK FOR NAME OF PERSON REQUESTING TEST
      C
0046      WRITE(5,111)
0047      READ(5,112) NREQ,REQDBY
      C
      C      ASK FOR DEPT # OF PERSON REQUESTING TEST
      C
0048      WRITE(5,113)
0049      READ(5,101) NDEPT,DEPT
      C
      C      ASK FOR TEST SPECIFICATION
      C
0050      WRITE(5,114)
0051      READ(5,112)NTSTSP,TSTSPC
      C
      C      CHECK INITIAL SETTINGS
      C
      C      IS GUARD HEATER OPEN 5 TURNS?
      C
0052  5      WRITE(5,117)
0053      READ(5,148) IANS
0054      IF (IANS.NE.IY) GO TO 5
      C
      C      CHECK FOR MAIN HEATER VOLTAGE SETTING.
      C      IS VOLTAGE SET TO 3 OR 1/2 VOLTS?
      C
0056  6      WRITE(5,115)
0057      READ(5,148) IANS
0058      IF (IANS.EQ.IY) GO TO 10
      C
0060      WRITE(5,136)

```

FORTRAN IV V01C-03C
CORE=08K, UIC=[300,111]

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PAGE 005
LP=THMCON

```
0061      READ(5,148) IANS
0062      IF(IANS.EQ.IY) GO TO 8
0064      WRITE(5,137)
0065      GO TO 6
0066      8      IVF=1
          C
0067      10     WRITE(5,135)
0068      READ(5,119) DUM
          C
          C      CHECK CIRCUITS
          C
          C      ICS LUN = 3
          C
          C      READ HEATER VOLTAGES AND CURRENT A/D WORDS
          C      NOTE: MAIN HEATER READING IS IN VOLTS
          C
0069      CALL ADREAD(IMHCC,1,IHEAT,IERR,3)
0070      IF (IERR.NE.0) STOP 'A/D ERROR'
0072      CALL SPLIT (IHEAT,IADV,GAIN)
0073      11     RMV(1)=4.8828*FLOAT(IADV)/GAIN
0074      CALL ADREAD (IMHVC,1,IHEAT,IERR,3)
0075      CALL SPLIT(IHEAT,IADV,GAIN)
0076      RMV(2)=4.8828*FLOAT(IADV)/GAIN
0077      IF(IVF.EQ.0) GO TO 15
0079      IF(RMV(2).GT.750..OR.RMV(2).LT.250.) GO TO 21
          C
          C
          C      IF(RMV(1).GT.1.1.OR.RMV(1).LT..3) GO TO 22
          C
0081      GO TO 18
0082      15     IF (RMV(2).GT.3250..OR.RMV(2).LT.2750.) GO TO 21
0084      IF (RMV(1).GT.4.2.OR.RMV(1).LT.3.7) GO TO 22
          C
          C
          C      #AMPS=MV READING/10.
          C      SO      .37 < I < .42 AMPS
          C
          C      READ TEMPERATURES
          C
0086      18     CALL ADREAD(ITCC,10,ITEMP,IERR,3)
0087      IF(IERR.NE.0) STOP 'A/D ERROR'
          C
```

```

0089      DO 19 I=1,8
0090          CALL SPLIT(ITEMP(I),IADV,GAIN)
0091          RMVT=4.8828*FLOAT(IADV)/GAIN
0092          CALL TEMPF(RMVT,T)
0093          IF(IVF.EQ.1.AND.T.GT.95.) GO TO 20
0095          IF(IVF.EQ.0.AND.T.LT.45..OR.T.GT.95.) GO TO 20
0097      19      CONTINUE
0098          GO TO 40
0099      20      WRITE(5,147) I,T
0100          GO TO 99
0101      21      WRITE(5,140)RMV(2)
0102          GO TO 99
0103      22      WRITE(5,141)RMV(1)
0104          GO TO 99
0105      40      CONTINUE
           C
0106          CALL TIME(TIM)
0107          CALL DATE(DAT)
           C
           C      CREATE DATA FILE NAME FROM LTR# AND SPECIMEN ID
           C
           C      THE NUMBER OF CHARACTERS IN THE FILE NAME DEPENDS ON
           C      WHETHER THERE ARE 6 OR 7 CHARACTERS IN THE LTR#
           C
0108          DO 45 I=1,NLTR
0109      45      FILE(13+I)=LTR(I)
0110          FILE(NLTR+14)=SPECID(1)
0111          FILE(NLTR+15)=SPECID(2)
           C
0112          DO 50 I=1,4
0113      50      FILE(NLTR+15+I)=EXT(I)
           C
0114          CALL ASSIGN(1,FILE,NLTR+19)
           C
           C      WRITE HEADER INFORMATION TO THE DATA FILE
           C
0115          WRITE(1,128) (LTR(I),I=1,NLTR)
0116          WRITE(1,129) (SPECID(I),I=1,2)
0117          WRITE(1,130) (EMPNO(I),I=1,6)
0118          WRITE(1,146) NSAM
0119          IF(NSAM.NE.2) GO TO 70
0121          WRITE(1,131) THCKUP,THCKLO
0122          GO TO 75
0123      70      WRITE(1,145)THCKUP
0124      75      WRITE(1,132) STTEMP

```

```

0125      WRITE(1,133) (MATRL(I),I=1,NMATRL)
0126      WRITE(1,139) (SPCNM1(I),I=1,IS1)
0127      IF(NSAM.NE.2) GO TO 77
0129      WRITE(1,139) (SPCNM2(I),I=1,IS2)
0130      GO TO 79
0131  77    WRITE(1,211)
0132  79    WRITE(1,134) (CHARG(I),I=1,NCHARG)
0133      WRITE(1,134) (REQDBY(I),I=1,NREQ)
0134      WRITE(1,134) (DEPT(I),I=1,NDEPT)
0135      WRITE(1,134) (TSTSPC(I),I=1,NTSTSP)
0136      WRITE(1,119) (DAT(I),I=1,9), (TIM(I),I=1,2)
0137      WRITE(1,120) IPSRN
0138      WRITE(1,121) ISOLRN
0139      WRITE(1,122) IMHRN1
0140      WRITE(1,123) IMHCC
0141      WRITE(1,124) IMHVC
0142      WRITE(1,125) IGHC
0143      WRITE(1,126) ITCC
0144      WRITE(1,127) IBHC
0145      WRITE(1,149) IVF
0146      CALL CLOSE(1)

      C
      C      REQUEST DATA ACQUISITION TO BEGIN AND SEND THE TASK THE NAME
      C      OF THE DATA FILE FOR THIS TEST.
      C

0147      CALL REQUES(TASK)
0148      CALL SEND(TASK,FILE)
0149  99    STOP
      C      FORMAT STATEMENTS
      C

0150  100   FORMAT('SENDER LTR # [7A1]: ')
0151  101   FORMAT(Q,8A1)
0152  102   FORMAT('SENDER SPECIMEN ID# [2A1]: ')
0153  103   FORMAT(6A1)
0154  104   FORMAT('SENDER EMPLOYEE NUMBER [6A1]: ')
0155  105   FORMAT('SENDER THICKNESS OF UPPER AND LOWER SAMPLES [2F8.5]: ')
0156  106   FORMAT(2F8.5)
0157  107   FORMAT('SENDER SET POINT TEMPERATURE [F6.2]: ')
0158  108   FORMAT(F6.2)
0159  109   FORMAT('SENDER MATERIAL TO BE TESTED [8A1]: ')
0160  110   FORMAT('SENDER CHARGE NUMBER [8A1]: ')
0161  111   FORMAT('SENDER NAME OF PERSON REQUESTING TEST [14A1]: ')
0162  112   FORMAT(Q,14A1)
0163  113   FORMAT('SENDER DEPARTMENT OF PERSON REQUESTING TEST [3A1]: ')
0164  114   FORMAT('SENDER TEST SPECIFICATION [12A1]: ')

```



```

0165 115  FORMAT('SIS MAIN HEATER SET AT 3 VOLTS? [Y/N]: ')
0166 116  FORMAT(12)
0167 117  FORMAT('SIS GUARD HEATER POT OPEN 5 TURNS? [Y/N]: ')
0168 119  FORMAT(9A1,5X,2A4)
0169 120  FORMAT(12,5X,'POWER SUPPLY RELAY NUMBER')
0170 121  FORMAT(12,5X,'SOLENOID RELAY NUMBER')
0171 122  FORMAT(12,5X,'FIRST MAIN HEATER RELAY NUMBER')
0172 123  FORMAT(12,5X,'MAIN HEATER CURRENT A/D CHANNEL')
0173 124  FORMAT(12,5X,'MAIN HEATER VOLTAGE A/D CHANNEL')
0174 125  FORMAT(12,5X,'GUARD HEATER A/D CHANNEL')
0175 126  FORMAT(12,5X,'FIRST THERMOCOUPLE A/D CHANNEL')
0176 127  FORMAT(12,5X,'BUCKING HEATER A/D CHANNEL')
0177 128  FORMAT('  HEADER INFORMATION:  LTR #',/,7A1)
0178 129  FORMAT(2A1,5X,'SPECIMEN ID #')
0179 130  FORMAT(6A1,5X,'EMPLOYEE NUMBER')
0180 131  FORMAT(2(F8.5,5X),'THICKNESS OF UPPER AND LOWER SAMPLES')
0181 132  FORMAT(F6.2,5X,'SET POINT TEMPERATURE')
0182 133  FORMAT('MATERIAL, CHARGE NUMBER, PERSON REQUESTING TEST, ',
1      'DEPARTMENT REQUESTING TEST, TEST SPECIFICATION',/,14A1)
0183 134  FORMAT(14A1)
0184 135  FORMAT('SPRESS CARRIAGE RETURN WHEN READY:')
0185 136  FORMAT('SIS MAIN HEATER SET TO 0.5 VOLTS? [Y/N]: ')
0186 137  FORMAT(' MAIN HEATER MUST INITIALLY BE SET TO 3. OR 0.5 VOLTS')
0187 139  FORMAT(14A1)
0188 140  FORMAT(' HEATER VOLTAGE OUT OF RANGE= ',F12.6)
0189 141  FORMAT(' HEATER CURRENT OUT OF RANGE= ',F6.3)
0190 143  FORMAT('SENER NUMBER OF SAMPLES (1 OR 2) [12]: ')
0191 144  FORMAT('SENER THICKNESS OF SAMPLE [F8.5]: ')
0192 145  FORMAT(F8.5,5X,' THICKNESS OF SAMPLE')
0193 146  FORMAT(12,5X,' NUMBER OF SAMPLES')
0194 147  FORMAT(' TEMP OUT OF RANGE.  TC # ',12,' = ',F8.3)
0195 148  FORMAT(A1)
0196 149  FORMAT(12,5X,'VOLTAGE FLAG')
0197 150  FORMAT('  GUARD READING = ',F7.4)
0198 200  FORMAT('ARE THERE MORE THAN 2 SPECIMEN ON THIS LTR? [Y/N]: ')
0199 205  FORMAT('SENER SPECIMEN NAME [10]: ')
0200 210  FORMAT('SENER SPECIMEN 2'S NAME [10]: ')
0201 211  FORMAT(2X)
0202      END

```

0001

PROGRAM GHPDAC
.IDENT /052579/

C
C+

C JUL 1978 L. L. HOLLAND
C APR 1979 LATEST REVISION L. L. HOLLAND

C
C DATA ACQUISITION PROGRAM FOR GUARDED HOT PLATE
C GP 1800

C
C THIS PROGRAM PERFORMS EQUIPMENT CONTROL AND DATA ACQUISITION
C FOR THE GP1800 GUARDED HOT PLATE. IT CONTROLS THE VOLTAGE
C TO THE MAIN HEATER AND GUARD HEATER, AS WELL AS A SOLENOID
C WHICH ENABLES THE 11/35 TO READ THE GUARD HEATER. THIS
C PROGRAM ALSO ACQUIRES AND REDUCES THE DATA, AND THEN STORES
C IT IN THE FILE WITH THE HEADER INFORMATION, CREATED BY THMCON.

C
C THIS PROGRAM RUNS AS AN INSTALLED TASK AND IS CALLED BY THMCON.
C THE INITIALIZATION PORTION OF THIS SOFTWARE PACKAGE.

C
C THE PROGRAM BEGINS WITH THE GUARD HEATER SET TO MID-RANGE,
C THE MAIN HEATER SET TO EITHER 0.5 OR 3 VOLTS, AND THE
C TEMPERATURES NEAR ROOM TEMPERATURE. THE MAIN HEATER VOLTAGE
C IS RAISED UNTIL THE MEAN TEMPERATURE OF THE SPECIMENS EQUALS THE
C SET POINT TEMPERATURE ENTERED IN THMCON AND STORED IN THE DATA
C FILE, PLUS OR MINUS 5 DEGREES FAHRENHEIT. WHEN THE SET POINT
C TEMPERATURE IS REACHED, THE GUARD HEATER IS ADJUSTED UNTIL
C THE OUTPUT FROM THE THERMOPILE READS 0 MV, PLUS OR MINUS .02
C MILLIVOLTS.

C WHEN THE GUARD HEATER IS BALANCED AND THE SET POINT
C TEMPERATURE HAS BEEN REACHED, THE SYSTEM MUST REMAIN STABLE
C FOR 2 HOURS BEFORE THE END OF THE TEST. STABILITY REQUIREMENTS
C ARE THAT THE THERMAL CONDUCTIVITY VALUES CALCULATED MUST NOT
C DIFFER BY MORE THAN 1% OVER A TWO HOUR PERIOD. THIS IS
C ACCOMPLISHED WITH THE SOFTWARE BY TAKING READINGS EVERY 15
C MINUTES FOR 2 HOURS, A TOTAL OF 9 READINGS. IF THE T.C.
C VALUES DO NOT FALL IN THE DESIRED RANGE, THE FIRST READING
C IS DROPPED AND ANOTHER IS TAKEN. IF THE VALUES STILL DO NOT
C FALL IN THE DESIRED RANGE, THIS PROCESS IS REPEATED UNTIL
C THEY DO. AT THE END OF THE TEST, ALL NINE VALUES OF THE
C THERMAL CONDUCTIVITY AND THE READINGS TAKEN TO DETERMINE THEM
C ARE RECORDED IN THE ORIGINAL DATA FILE CREATED BY THMCON,
C ALONG WITH THE ORIGINAL INFORMATION.

C
C
C

C THIS PROGRAM CREATES A TEMPORARY FILE, LTR#ID#.TMP, THAT

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C      STORES ALL THE READINGS TAKEN AFTER THE SYSTEM HAS BALANCED.
C      THIS FILE IS ERASED WHEN THE PROGRAM EXITS NORMALLY.  IF THE
C      PROGRAM DOES NOT EXIT NORMALLY, THE TEMPORARY FILE
C      CAN BE USED TO EXAMINE THE DATA TAKEN UP TO THAT POINT.
C      THIS WOULD HAPPEN IF THE SYSTEM NEVER STABILIZED, DUE FOR
C      EXAMPLE TO FLUCTUATIONS IN THE HEAT SINK TEMPERATURES.
C
C      TO TASKBUILD:
C
C      TKB>
C      TKB>DK1:[1,54]GHPDAC/CP=GHPDAC,DK0:[1,1]D016LBR/LB
C      TKB>/
C      ENTER OPTIONS:
C      TKB>ASG=IC:3,TI:5
C      TKB>///
C
C-
0002      DIMENSION IBUF(15),ITEMP(4),KTEMP(9),TMP(9,8),VLTAGE(9)
0003      DIMENSION CURENT(9),GRDT(9),THMCON(9),DELT(9)
C
C      THESE ARE THE VARIABLES USED TO STORE THE STABLIZED VALUES
C      OF THE DATA.
C
C
0004      LOGICAL*1 TIM(8),TM(9,8),FILE(26),IDOT,IT,IM
0005      LOGICAL*1 FIL2(26),IP
C
C      THE FIRST TWO BYTES OF THE 15 BYTE MESSAGE SENT FROM THMCON ARE
C      NOT NEEDED.  THEY ARE SKIPPED, AND THE REST OF THE BYTES CONTAIN
C      THE DATA FILE NAME.  THE FILE NAME IS EQUIVALENCED TO FILE IN
C      THE FOLLOWING STATEMENT.
C
0006      EQUIVALENCE (FILE(1),IBUF(3))
C
0007      DATA IDOT/1H./, TASK/6RWAIT15/
0008      DATA IT/1HT/, IP/1HP/,IM/1HM/
C
C      RECIEVE THE LTR * AND ID * OR EXIT
C
0009      CALL RECOEX(,IBUF)
C
C      RECREATE THE FILE NAME FROM LTR* AND ID*.
C

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C      NFLE IS THE NUMBER OF CHARACTERS IN THE FILENAME, WHICH
C      IS EITHER 25 OR 26, DEPENDING ON THE NUMBER OF CHARACTERS
C      IN THE LTR# (5 OR 6)
C
0010      NFLE=25
0011      IF(FILE(23).EQ.IDOT) NFLE=26
0013      CALL ASSIGN(1,FILE,NFLE)
0014      CALL FDBSET(1,'OLD')
C
0015      DO 2 I=1,NFLE-3
0016  2      FIL2(I)=FILE(I)
0017      FIL2(NFLE-2)=IT
0018      FIL2(NFLE-1)=IM
0019      FIL2(NFLE)=IP
C
C
C      READ THE NECESSARY HEADER INFORMATION FROM THE DISK FILE
C
0020      READ(1,155) NSAM
0021      IF(NSAM.EQ.2) GO TO 5
0023      READ(1,150) THCKUP
0024      GO TO 7
0025  5      READ(1,150) THCKUP,THCKLO
0026      THCKAV=(THCKUP+THCKLO)*.5
0027  7      READ(1,151) STTEMP
0028      READ(1,154) IPSRN,ISOLRN,IMHRN,IMHCC,IMHVC,IGHC,ITCC
0029      READ(1,169) IVF
0030      CALL CLOSE(1)
0031      IGHRN=IMHRN+2
C
C
C      INITIALIZE THE GUARD HEATER COUNTER AND THE MAIN HEATER COUNTER
C
C      MAIN HEATER COUNTER IS SET TO 10 WHEN ROOM TEMPERATURE TEST
C      IS RUNNING --- MAIN HEATER VOLTAGE = 3.0 VOLTS
C
C      MAIN HEATER COUNTER IS SET TO 4 WHEN LOW TEMPERATURE TEST
C      IS RUNNING --- MAIN HEATER VOLTAGE = 0.5 VOLTS
C
C      LOOPTM IS THE FLAG USED TO DETERMINE IF THE TEMPORARY FILE HAS
C      BEEN CREATED. LOOPTM=0 --- FILE NOT CREATED.
C      LOOPTM=1 --- FILE IS CREATED.
C
C
C

```

```

0032      IMAIN=10
0033      IF(IVF.EQ.1) IMAIN=4
0035      ICNTR=160
0036      LOOPTM=0

      C
      C      READ THE MAIN HEATER VOLTAGE AND CHECK FOR ACCEPTABLE LIMITS
      C
      C
      C
0037      CALL ADREAD(IMHVC,1,IRESLT,IERR,3)
0038      IF(IERR.EQ.0) GO TO 9
0040      WRITE(5,190)IERR
0041      STOP
0042  9      CALL SPLIT(IRESLT,IADV,GAIN)
0043      VLTMH=.0048852*FLOAT(IADV)/GAIN
0044      IF(VLTMH.GE.12.)GO TO 29
0045      IF(IMAIN.GE.52) GO TO 29
0046      IF(IMAIN.LE.1) GO TO 41

      C
      C      IF MEAN TEMP = SET POINT TEMP, THE MAIN HEATER VOLTAGE HAS
      C      REACHED THE DESIRED LEVEL, AND THE GUARD HEATER IS THEN
      C      BALANCED. IF NOT, THE MAIN HEATER IS ADJUSTED AGAIN.
      C
      C      MEAN TEMP = SET POINT TEMP?
      C
0050  10     CALL ADREAD(ITCC,4,ITEMP,IERR,3)
0051      TMPMN=0.
0052      DO 20 I=1,4
0053      CALL SPLIT(ITEMP(I),IMAG,GAIN)
0054      V=4.8928*FLOAT(IMAG)/GAIN
0055      CALL TEMPF(V,TMPF)
0056  20     TMPMN=TMPMN+.25*TMPF
0057      ST1=STTEMP-5.
0058      ST2=STTEMP+5.
0059      IF (TMPMN.LT.ST1) GO TO 22
0061      IF (TMPMN.GT.ST2) GO TO 30
0063      GO TO 61

      C
0064  22     VHI=VLTMH+.6
0065      VLO=VLTMH+.4

      C
      C      IFG = NUMBER OF TIMES TO LOOP
      C      STEP THE MAIN HEATER VOLTAGE NO MORE THAN THREE TIMES
      C
0066      IFG=1
0067  23     CALL STEP(3,IPSRN,IMHRN,1,IERR)

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0068      IMAIN=IMAIN+1
0069      IF (IMAIN.GE.52) GO TO 28
0071      CALL ADREAD(IMHVC,1,IRESLT,IERR,3)
0072      CALL SPLIT(IRESLT,IADV,GAIN)
      C
      C      MAIN HEATER VOLTAGE IS READ IN VOLTS AND CONVERTED HERE TO
      C      MILLIVOLTS BY DIVIDING BY 1000
      C
0073      VOLT=.0048852*FLOAT(IADV)/GAIN
0074      IF (VOLT.GE.12.) GO TO 29
0076      IF (VOLT.GT.VHI) GO TO 24
0078      IF (VOLT.GT.VLO) GO TO 51
0080      IF (IFG.GE.3) GO TO 51
0082      IFG=IFG+1
0083      GO TO 23
      C
      C      EXECUTE THIS CODE IF THE MAIN HEATER HAS BEEN TURNED UP TOO FAR
      C
0084  24      CALL STEP(3,IPSRN,IMHRN,-1,IERR)
0085          IMAIN=IMAIN-1
0086          GO TO 51
0087  28      WRITE(5,165)IMAIN
0088          STOP
0089  29      WRITE(5,166) VOLT,IMAIN
      C
      C      SHUT VOLTAGE BELOW 12V AND EXIT
      C
0090      CALL STEP(3,IPSRN,IMHRN,-2,IERR)
0091      IMAIN=IMAIN-2
0092      CALL ADREAD(IMHVC,1,IRESLT,IERR,3)
0093      CALL SPLIT(IRESLT,IADV,GAIN)
0094      VOLT=4.8828*FLOAT(IADV)/GAIN
0095      WRITE(5,175)VOLT
0096      STOP
      C
      C      EXECUTE THIS CODE IF THE MEAN TEMP > SET POINT TEMP.
      C      THIS WILL LOWER MAIN HEATER VOLTAGE, THEREBY DECREASING
      C      THE MEAN TEMP.
      C
0097  30      VHI=VLTMH-.2
0098          VLO=VLTMH-.4
0099  37      CALL STEP(3,IPSRN,IMHRN,-1,IERR)
0100          IMAIN=IMAIN-1
0101          IF (IMAIN.LE.1) GO TO 41
0103          CALL ADREAD(IMHVC,1,IRESLT,IERR,3)

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0104      CALL SPLIT(IRESLT,IADV,GAIN)
0105      VOLT=.0049852*FLOAT(IADV)/GAIN
0106      IF(VOLT.GE.12.) GO TO 29
0108      IF(VOLT.LT.VHI) GO TO 51
0110      GO TO 37
0111  41    WRITE(5,167) IMAIN
0112      STOP
0113  51    VLTMM=VOLT
0114      CALL REQUES(TASK)
0115      CALL SUSPND
0116      GO TO 10

      C
      C      SET POINT TEMPERATURE REACHED.  NOW ADJUST GUARD HEATER.
      C
      C      THE SOLENOID MUST BE OPEN TO READ THE GUARD HEATER VOLTAGE
      C
      C
0117  61    CALL OPNSOL(ISOLRN,3)
      C
      C      WAIT 2 SECONDS BEFORE READING GUARD VOLTAGE TO GIVE THE
      C      SOLENOID A CHANCE TO WARM UP.
      C
0118      CALL WAIT(2,2,IDS)
0119      CALL ADREAD(IGHC,1,IRESLT,IERR,3)
      C
      C      CLOSE THE SOLENOID
      C
0120      CALL CLSSOL(ISOLRN,3)
0121      CALL SPLIT(IRESLT,IADV,GAIN)
0122      GDELT=4.8828*FLOAT(IADV)/GAIN
      C
      C      BASED ON THE GUARD HEATER VOLTAGE, SKIP OUT OF
      C      THIS LOOP, OR TURN THE GUARD POT ONE WAY OR THE OTHER
      C      TO BALANCE THE GUARD HEATER.
      C
0123      IF(GDELT.GE.-.02.AND.GDELT.LE..02) GO TO 70
0125      IF(ICNTR.EQ.1.AND.GDELT.LE.0) GO TO 69
0127      IF(ICNTR.EQ.319.AND.GDELT.GE.0) GO TO 69
      C      OK TO STEP MOTOR
0129      IF(GDELT.LT.-.05.OR.GDELT.GT..05) GO TO 62
0131      NURNS=1
0132      IF(GDELT.GT.0) NURNS=-1
0134      GO TO 63
0135  62    NURNS=-8.*GDELT/.15
      C

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C      GEAR RATIO FOR GUARD HEATER IS 0/3
C      NURNS IS # OF 11.25 DEGREE TURNS ON GUARD HEATER CONTROL
C
0136      IF(NURNS.GT.16) NURNS=16
0138      IF(NURNS.LT.-16) NURNS=-16
0140 63    ICNTR=ICNTR+NURNS
0141      IF(ICNTR.GT.1.AND.ICNTR.LT.319) GO TO 68
0143      ICNTR=ICNTR-NURNS
0144      IF(NURNS.LT.0) GO TO 65
0146      NURNS=319-ICNTR
0147      GO TO 67
0148 65    NURNS=1-ICNTR
0149 67    ICNTR=ICNTR+NURNS
0150 68    CALL STEP(3,IPSRN,IGHRN,NURNS,IERR)
0151      CALL REQUES(TASK)
0152      CALL SUSPND
0153      GO TO 61
0154 69    STOP 'GH UNBALANCED'
C
C      CONTINUE WITH GUARD BALANCED
C
C
C
C      NOW AT THE RIGHT TEMPERATURE
C
C      IS SYSTEM STABLE?
C
C+
C
C      SYSTEM IS STABLE IF 9 READINGS, TAKEN 15 MINUTES APART
C      YEILD VALUES OF THE THERMAL CONDUCTIVITY THAT ARE LESS THAN
C      1% DIFFERENT.
C
C
C-
0155 70    IK=1
0156 71    CALL TIME(TIM)
0157      DO 72 JJ=1,8
0158 72      TM(IK,JJ)=TIM(JJ)
0159      CALL ADREAD(IMHVC,1,IRESLT,IERR,3)
0160      CALL SPLIT(IRESLT,IADV,GAIN)
C
C      READS IN VOLTS, CONVERT TO MILLIVOLTS
0161      VLTRGE(IK)=.0048852*FLOAT(IADV)/GAIN
0162      CALL ADREAD(IMHCC,1,IRESLT,IERR,3)

```



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0163      CALL SPLIT (IRESLT,IADV,GAIN)
0164      CURENT(IK)=.48852*FLOAT(IADV)/GAIN
      C
      C      THIS RESULT IS DIVIDED BY 10 BECAUSE THE GP 1800 READS
      C      50 MV TO CORRESPOND TO 5.0 AMPS
      C
0165      CALL OPNSOL (ISOLRN,3)
0166      CALL WAIT(2,2,IDS)
0167      CALL ADREAD(IGHC,1,IRESLT,IERR,3)
0168      CALL CLSSOL (ISOLRN,3)
0169      CALL SPLIT (IRESLT,IADV,GAIN)
0170      GRDT(IK)=4.8828*FLOAT(IADV)/GAIN
0171      CALL ADREAD(ITCC,8,KTEMP,IERR,3)
0172      DO 75 I=1,8
0173          CALL SPLIT(KTEMP(I),IADV,GAIN)
0174          V=4.8828*FLOAT(IADV)/GAIN
0175          CALL TEMPF(V,TMP(IK,I))
0176 75      CONTINUE
      C
      C      CALCULATE MEAN TEMPERATURE
      C
0177      DELT(IK)=.5*(TMP(IK,2)+TMP(IK,3)-TMP(IK,1)-TMP(IK,4))
      C
      C      CALCULATE THE THERMAL CONDUCTIVITY VALUE FOR THIS READING
      C
0178      THMCON(IK)=3.412*VLTAGE(IK)*CURENT(IK)*THCKAV/(.174*DELT(IK))
      C
      C
0179      CALL TIME(TIM)
0180      IF (IK.GE.9) GO TO 80
0182      IK=IK+1
      C
      C      REQUEST THE WAIT15 TASK TO BEGIN EXECUTION AND SUSPEND THIS
      C      ONE. THIS WILL ALLOW GHPDAC TO BE CHECKPOINTED AS NEEDED.
      C      WAIT15 IS A MACRO PROGRAM THAT IS IN A WAIT LOOP FOR 15
      C      MINUTES, THEN SENDS A COMMAND TO RESUME GHPDAC AND WAIT15 EXITS.
      C
0183      CALL REQUES(TASK)
0184      CALL SUSPND
0185      GO TO 71
      C
      C      2 HOURS OF READINGS HAVE BEEN RECORDED. ARE THEY STABLE?
      C      CHECK FOR THERMAL CONDUCTIVITY VALUES DIFFERING BY NOT MORE
      C      THAN 1%.
      C

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```

0186 80    SMALL=THMCON(1)
0187      BIG=THMCON(1)
0188      DO 82 I=2,9
0189          IF(THMCON(I).GT.BIG) BIG=THMCON(I)
0191          IF(THMCON(I).LT.SMALL) SMALL=THMCON(I)
0193 82      CONTINUE
0194      DIFF=(BIG-SMALL)*100./SMALL
      C
      C      IF DIFF < 1, READINGS ARE STABLE
      C
0195      IF(DIFF.LE.1.) GO TO 90
      C
      C      IF NOT, DROP FIRST READING, WAIT 15 MINUTES, AND RECORD ANOTHER.
      C
      C
0197      CALL ASSIGN(2,FIL2,NFILE)
0198      IF(LOOPM.NE.0) GO TO 84
0200      DO 83 LH = 1, 9
0201          WRITE(2,170) VLTAGE(LH)
0202          WRITE(2,171) CURENT(LH)
0203          WRITE(2,172) GRDT(LH)
0204          WRITE(2,173) (TMP(LH,I), I=1,8)
0205          WRITE(2,174) THMCON(LH)
0206 83      WRITE(2,152) (TM(LH,JK), JK=1,8)
0207      LOOPM=1
0208      GO TO 87
0209 84      CALL FDBSET(2,'OLD')
0210      DO 85 IC = 1, 2000
0211 85      READ(2,168,END=86,ERR=86) DUM
0212      STOP 'FILE ERROR'
0213 86      WRITE(2,170) VLTAGE(9)
0214          WRITE(2,171) CURENT(9)
0215          WRITE(2,172) GRDT(9)
0216          WRITE(2,173) (TMP(9,I), I=1,8)
0217          WRITE(2,174) THMCON(9)
0218          WRITE(2,152) (TM(9,JK), JK=1,8)
0219 87      CALL CLOSE(2)
0220      DO 89 I=1,8
0221          VLTAGE(I)=VLTAGE(I+1)
0222          THMCON(I)=THMCON(I+1)
0223          DELT(I)=DELT(I+1)
0224          CURENT(I)=CURENT(I+1)
0225          GRDT(I)=GRDT(I+1)
0226      DO 83 L=1,8

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0227             TMP(I,L)=TMP(I+1,L)
0228             TM(I,L)=TM(I+1,L)
0229 88          CONTINUE
0230 89          CONTINUE
0231             IK=9
0232             CALL REQUES(TASK)
0233             CALL SUSPND
0234             GO TO 71
C
C             SYSTEM IS STABLE.  OUTPUT DATA TO DISK FILE, TURN DOWN MAIN
C             HEATER VOLTAGE AND EXIT.  THE DISK FILE IS THE SAME ONE CREATED
C             BY THMCON AND CONTAINS ALL THE HEADER INFORMATION.
C
C
C             SINCE THE SYSTEM IS STABLE AND BALANCED, THE TEMPORARY
C             FILE IS NO LONGER NEEDED.  DELETE IT.
C
C
0235 90          CALL ASSIGN(2,FIL2,NFILE)
0236             READ(2,168) DUM
0237             CALL DELFILE(2,IRRER)
0238             CALL CLOSE(2)
C
0239             CALL ASSIGN(1,FILE,NFILE)
0240             CALL FDBSET(1,'OLD')
0241             WRITE(5,185)
C
C
C             SKIP TO END OF FILE BEFORE WRITING DATA
C
C
0242             DO 91 I=1,25
0243 91          READ(1,168)DUM
C
C             WRITE THE DATA TO THE DISK FILE
C
0244             DO 95 M=1,9
0245                 WRITE(1,170) VLTAGE(M)
0246                 WRITE(1,171) CURENT(M)
0247                 WRITE(1,172) GRDT(M)
0248                 WRITE(1,173) (TMP(M,I),I=1,8)
0249                 WRITE(1,174) THMCON(M)
0250                 WRITE(1,152) (TM(M,JK),JK=1,8)
0251 95          CONTINUE

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```

0252      CALL TIME(TIM)
      C
      C      TURN MAIN HEATER VOLTAGE DOWN, DO NOT ADJUST GUARD
      C      HEATER, AND EXIT
      C
0253      IMAIN=IMAIN-2
0254      CALL STEP(3,IPSRN,IMHRN,-IMAIN,IERR)
0255      STOP
      C
      C
      C
      C      FORMAT STATEMENTS
      C
0256 150  FORMAT(F8.5,5X,F8.5)
0257 151  FORMAT(F6.2)
0258 152  FORMAT(8A1)
0259 154  FORMAT(/////////7(I2/))
0260 155  FORMAT(/////I2)
0261 165  FORMAT(' IMAIN = ',I4,' TOO BIG')
0262 166  FORMAT(' MAIN HEATER VOLTAGE = ',F7.2,' IMAIN = ',I4)
0263 167  FORMAT(' IMAIN = ',I4,' TOO SMALL')
0264 168  FORMAT(A1)
0265 169  FORMAT(I2)
0266 170  FORMAT(F8.4,' MAIN HEATER VOLTAGE - VOLTS')
0267 171  FORMAT(F8.4,' MAIN HEATER CURRENT - AMPS')
0268 172  FORMAT(F8.4,' GUARD DELTA T')
0269 173  FORMAT(8F8.4,' 8 TC''S')
0270 174  FORMAT(F8.4,' = K, THERMAL CONDUCTIVITY')
0271 175  FORMAT(' MAIN HEATER VOLTAGE REDUCED TO',F8.4,' PROGRAM HALTED')
0272 185  FORMAT(///' GHPDAC COMPLETE')
0273 190  FORMAT(' STOP.  A/D READ ERROR # ',I4)
0274      END

```

```

1      .TITLE WAIT15
2      ; .IDENT /031479/
3      ;+
4      ; FEB. 1979                      S. L. CAHILL
5      ; MARCH 1979          LATEST REVISION      D. E. LACEY
6      ;
7      ; THIS IS A MACRO PROGRAM TO WAIT FOR 15 MINUTES AND THEN
8      ; RESUME THE RUNNING OF GHPDAC WHICH WAS SUSPENDED.
9      ;
10     ; ASSEMBLY INSTRUCTIONS:
11     ;
12     ; MAC WAIT15=WAIT15
13     ;
14     ; TASKBUILDER INSTRUCTIONS:
15     ;
16     ; TKB> WAIT15/PR:0=WAIT15
17     ; TKB> /
18     ; TKB> //
19     ;
20     ; -
21     ;
22     ; .MCALL MRKT$C,RSUM$C,EXIT$S,WTSE$S
23     ;
24 000000 WAIT15::MRKT$C 6,15,,3
25 000006 WTSE$S #6
26 000020 RSUM$C GHPDAC
27 000026 EXIT$S
28 000000 .END WAIT15

```

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28 000000
29 000000 017502 000002
30 000004 013703 000000G
31 000010 004767 000000G
32 000014 010001
33 000016 062700 000014
34 000022
35 000026 103410
36 000030 012700 000066
37 000034 005021
38 000036 005309
39 000040 001375
40 000042 010075 000004
41 000046 000207
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43 000050 116000 000000G
44 000054 000772
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.TITLE DELFLF
.IDENT/060579/

INSERTED IN D816LBR - JUNE 1979 ...D. E. LACEY

THIS IS A DEC SUPPLIED SUBROUTINE

FORTRAN CALL:
CALL DELFLF(LUN,ERR)

WHERE LUN = LOGICAL UNIT NUMBER

RETURN:
ERR = FCS ERROR CODE FROM FDB.

NOTE:
FILE MUST EITHER BE OPEN, OR FDBSET MUST BE USED
(ALONG WITH CALL ASSIGN) TO FILL IN THE REQUIRED
INFO IN THE FDB.

INVALID LUN'S WILL RESULT IN A FORTRAN ERROR
TRAPPED BY THE FCHNL ROUTINE.

.MCALL DELET$,Q10W$$
.GLOBL $FCHNL,$OTS$,ATTDEV,DETDEV,DELFLF
.ENABL LSB

DELFLF:
MOV Q2(R5), R2 ;GET LUN
MOV QOTS$,R3 ;GET WORK AREA ADDRESS
JSR PC,$FCHNL ;FIND FDB ADDRESS
MOV R0, R1 ;SAVE ADDRESS OF FORTRAN FDB
ADD Q14, R0 ;GET TO RSX FDB
DELET$ R0 ;DELETE FILE
BCS ERR ;ERROR?
MOV Q66, R0 ;THIS MANY WORDS TO ZERO
15: CLR (R1)+ ;MAKE THIS LUN RE-USABLE
DEC R0
BNE 15
25: MOV R0,Q4(R5) ;STORE ERROR CODE (OR 0)
RTS PC ;AND RETURN TO CALLER.

ERR: MOVB F.ERR(R0),R0 ;GET FCS ERROR CODE FROM FDB.
BR 25 ;AND USE COMMON RETURN.
.DSABL LSB

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.TITLE ATTDEV
.IDENT/060579/

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52
53
54
55
56
57

MAY 1978
JUNE 1979

LATEST REVISION

D. E. LACEY
D. E. LACEY

THIS FORTRAN CALLABLE SUBROUTINE ATTACHES A DEVICE
TO A TASK.

```

58      ;      FORTRAN CALL:
59      ;
60      ;      CALL ATTDEV(LUN)
61      ;
62      ;      WHERE LUN = LOGICAL UNIT NUMBER
63      ;
64      ;      :-
65      ;
66      000056      ATTDEV:
67      000056      017500      000002      MOV      02(R5),R0      ;GET LUN
68      000062      QIOWSS      *IO.ATT,R0,*6      ;ATTACH DEVICE
69      000124      000207      RTS      PC      ;RETURN
70      ;
71      ;
72      ;      .TITLE DETDEV
73      ;      .IDENT/060579/
74      ;      +
75      ;      MAY 1978      D. E. LACEY
76      ;      JUNE 1979      LATEST REVISION      D. E. LACEY
77      ;
78      ;      THIS FORTRAN CALLABLE SUBROUTINE DETACHES A DEVICE
79      ;      FROM A TASK.
80      ;
81      ;      FORTRAN CALL:
82      ;
83      ;      CALL DETDEV(LUN)
84      ;
85      ;      WHERE LUN = LOGICAL UNIT NUMBER
86      ;
87      ;      :-
88      ;
89      000126      DETDEV:
90      000126      017500      000002      MOV      02(R5),R0      ;GET LUN
91      000132      QIOWSS      *IO.DET,R0,*6      ;DETACH DEVICE
92      000174      000207      RTS      PC      ;RETURN
93      000001      .END

```



```

1      .TITLE OPCLSL ;OPENS AND CLOSES SOLENOIDS
2      .IDENT /022478/
3
4      ;+
5      ; FEB 1978 J. S. BESHONER
6      ; JUL 1978 LATEST REVISION L. L. HOLLAND
7
8      ; THIS SUBROUTINE OPENS AND CLOSES A RELAY CONTROLLING A
9      ; SOLENOID. THIS SUBROUTINE WORKS FOR THOSE SOLENOIDS
10     ; HARDWIRED IN THE SAME MANNER AS THE GUARDED HOT PLATE,
11     ; BUT NOT AS THE TE2000 THERMAL EXPANSION INSTRUMENT.
12     ; THE LABELS OF OPEN AND CLOSE ARE REVERSED FOR THE THERMAL
13     ; EXPANSION SOLENOID ROUTINE, DUE TO THE WAY IT WAS WIRED.
14
15     ;PIP DK0:[*,*]MCDRV.*;*/LI
16
17     ;+
18     ; .GLCBL OPNSOL,CLSSOL ;PROGRAM ENTRY
19
20     ; OPNSOL OPENS THE SOLENOID
21
22     ; CLSSOL CLOSES THE SOLENOID
23
24     ; CALL OPNSOL(IREL,ILUN)
25
26     ; WHERE IREL IS THE RELAY NUMBER OF THE SOLENOID
27     ; AND ILUN IS THE LOGICAL UNIT NUMBER OF THE ICS.
28
29     ;+
30     ; .MCALL QIOW$,DIR$
31
32     ;+
33     ; USER DEFINED PARAMETERS
34
35     ; NUMRLY = 2
36
37     ; ST.20 SUBROUTINE TO DETERMINE BIT SETTING FOR RELAY CHANNELS
38
39     ; ENTRY R0 - CONTAINS THE LOGICAL RELAY NUMBER 0,1,2 ...ETC.
40     ; R5 - CONTAINS ADDR OF 3-WORD STORAGE AREA
41
42     ; RETURN
43     ; STORAGE AREA - STARTING RELAY NUMBER FOR THE PARTICULAR
44     ; CARD ... 0,16,ETC
45     ; +2 - BIT TO VIRTUAL RELAY, 0-15
46     ; +4 - BIT TO VIRTUAL RELAY + 1
47
48     ;+
49     ; ST.20:
50     ; CLR R5 ;ASSUME RELAY IS ON 1ST CARD
51     ; MOV #NUMRLY,R4 ;NUMBER OF CARDS IN ICS FILE
52     ; CLR R3 ;1ST CARD HAS 0 RELAY TO START
53
54     ; 105:
55     ; DEC R4 ;ANY MORE CARDS TO TRY ?
56
57     ; 000000 005015
58     ; 000002 012704 000002
59     ; 000006 005003
60     ; 000010 005004

```

52 000012 003406
53 000014 062703 000020
54 000020 020003
55 000022 002402
56 000024 010315
57 000026 000770

BLE 20\$
ADD #16.,R3
CMP R0,R3
BLT 20\$
MOV R3,R5
BR 10\$

;MUST HAVE BEEN LAST CARD
;BUMP TO 1ST ON NEXT CARD
;THIS RELAY ON LAST CARD ?
;BR IF YES
;SAVE STARTING RELAY NUMBER
;LOOK AT NEXT CARD

```

58 000030
59 000030 012701 000001
60 000034 012702 000002
61 000040 161500
62 000042 001403
63 000044
64 000044 006301
65 000046 006302
66 000050 077003
67 000052
68 000052 010105 000002
69 000056 010205 000004
70 000062 000207
71
72 000064
73 000064 005067 000134
74 000070 000403
75
76 000072
77 000072 012767 000001 000124
78
79 000100
80 000100 005725
81 000102 013557 000120
82 000106 013557 000060
83 000112 116757 000054 000054
84 000120 013750 000102
85 000124 012705 000230
86 000130 004767 177644
87 000134 012724 000202
88 000140 012524
89 000142 011524
90 000144 005014
91 000146 005767 000052
92 000152 001001
93 000154 011514
94 000156
95 000156
96 000164 000207
97
98
99
100 000166
101
102 000216
103
104 000222
105
106 000224
107 000226 000000
108
20$:
MOV *1,R1 ;INITIALIZE VIRTUAL AND
MOV *2,R2 ;... VIRTUAL + 1 BIT POSITIONS
SUB @R5,R0 ;GET LOGICAL BIT POSITIONS
BEQ 60$ ;DONE IF ZERO
30$:
ASL R1 ;ROTATE TO
ASL R2 ;... PROPER POSITIONS
SOB R0,30$
50$:
MOV R1,2(R5) ;PASS BACK
MOV R2,4(R5) ;... TO CALLER
RETURN
;ROUTINES TO OPEN OR CLOSE THE SOLENOID
OPNSOL:
CLR OPNFLG ;SHOW US OPENING SOLENOID
BR OPN.00 ;DO COMMON LOGIC
CLSSOL:
MOV *1,OPNFLG ;SHOW US CLOSING THE SOLENOID
OPN.00:
TST (R5)+ ;PAST FORTRAN GARBAGE
MOV @R5+,ST.PWR ;SOLENOID RELAY NUMBER
MOV @R5+,ST.Q10+Q.IOLU ;ICS LUN
MOVB ST.Q10+Q.IOLU,ST.Q10+Q.IOEF ;SET EFN
MOV ST.PWR,R0 ;DETERMINE THE RELAY BIT
MOV @ST.PWR+2,R5
CALL ST.23
MOV @ST.Q10+Q.IOPL,R4 ;Q10 PARAMETER LIST POINTER
MOV (R5)+,(R4)+ ;SET THE RELAY CARD NUMBER
MOV @R5,(R4)+ ;SET THE RELAY MASK BIT
CLR @R4 ;SET TO CLOSE RELAY
TST OPNFLG ;ARE WE CLOSING ?
BNE 10$ ;BR IF YES
MOV @R5,@R4 ;IF OPENING, SET THE BIT
10$:
DIRS @ST.Q10 ;SERVICE THE SOLENOID
RETURN
;+
;STORAGE AREA
;-
ST.Q10: Q10WS 10.MLO,...,Q10STA
;
Q10STA: .BLKW 2
;
ST.ERR: .BLKW 1
;
OPNFLG: .BLKW 1 ;OPEN/CLOSE SOLENOID FLAG
ST.PWR: .WORD 0 ;RELAY NUMBER FOR POWER SUPPLY

```

109 000230 000000
110
111 000232 000000
112 000234 000000
113 000001

.WORD 0
;.
.WORD 0
.WORD 0
.END

;1ST RELAY ON POWER SUPPLY CARD
;POWER SUPPLY RELAY BIT POSITION
;DUMMY REQUIRED BY ST.20

```

1      .TITLE STEP30 ;STEPS RELAYS FOR STEPPER MOTORS
2      .IDENT /000270/
3      ;+
4      ; FEB 1978 J. S. BESHONER
5      ; AUG 1978 LATEST REVISION L. L. HOLLAND
6      ;
7      ; MODIFIED TO MAKE STEPS OF 30 DEGREES INSTEAD OF 90
8      ; DEGREES. -- L. L. HOLLAND
9      ;
10     ;STEP CALLED TO STEP RELAYS FOR STEPPER MOTORS.
11     ; A STEP ROTATES THE SHAFT 30 DEGREES.
12     ;
13     ; CALLING SEQUENCE FOLLOWS:
14     ;
15     ; CALL STEP(ILUN,IPOWER,IMOTOR,ISTEP,IERR)
16     ;
17     ; WHERE:
18     ; ILUN = LUN ASSIGNED TO ICS
19     ; IPOWER = RELAY NUMBER CORRESPONDING TO POWER SUPPLY (0-31)
20     ; IMOTOR = RELAY NUMBER OF LEAST SIGNIFICANT STEPPER RELAY (0-31)
21     ;           (2ND RELAY ASSUMED SEQUENTIALLY NEXT TO THIS RELAY)
22     ; *NOTE NOTE THAT CERTAIN VALUES ARE DECLARED ILLEGAL IN
23     ; THE INITIATOR SOFTWARE
24     ; ISTEP = THE NUMBER OF STEPS DESIRED. A POSITIVE ISTEP
25     ; CAUSES THE MOTOR TO MOVE IN A CLOCKWISE DIRECTION AS
26     ; SEEN FROM AN OBSERVER SITTING ON THE MOTOR LOOKING DOWN
27     ; THE SHAFT. (CW CLOSES THE VALVE ON TE2000 LN2)
28     ; IERR = 0 IF NO ERRORS OCCUR OTHERWISE CONTAINS THE Q10
29     ; DIRECTIVE STATUS.
30     ;
31     ;-
32     .GLOBL STEP ;PROGRAM ENTRY
33     .GLOBL SDSW
34     ;+
35     ;
36     ;-
37     ;
38     .MCALL MKTSS,WTSESS,Q10WS,DIRS
39     ;
40     ;+
41     ;USER DEFINED PARAMETERS
42     ;
43     000007 .TIMER = 7. ;CLOCK TICKS TO WAIT BETWEEN STEPS
44     000002 .NUMRLY = 2 ;NUMBER OF RELAY CARDS IN THE SYSTEM
45     ;
46     000020 .TIMEFN = 20 ;EVENT FLAG FOR MARK-TIME DIRECTIVE
47     000021 .Q10EFN = 21 ;EVENT FLAG FOR Q10 TO ICS DIRECTIVE
48     ;-
49

```

```

50 000000                                STEP:
51 000000 005725                                TST      (R5)+          ;MOVE PAST FORTRAN COUNTER
52 000002 013567 000440                        MOV      @R5)+,ST.Q10+Q.IOLU ;SET ICS LUN
53 000006 116767 000434 000434                MOV8     ST.Q10+Q.IOLU,ST.Q10+Q.IOEF ;SET EFN
54 000014 013567 000462                        MOV      @R5)+,ST.PWR          ;POWER SUPPLY RELAY *
55 000020 013567 000466                        MOV      @R5)+,ST.MOT          ;LEAST SIG. MOTOR RELAY NUMBER
56 000024 013567 000450                        MOV      @R5)+,ST.STP          ;NUMBER OF STEPS REQUESTED
57 000030 011567 000442                        MOV      (R5),ST.ERR          ;ADDR OF ERROR WORD
58 000034 016700 000442                        MOV      ST.PWR,R0          ;RETRIEVE POWER RELAY
59 000040 012705 000504                        MOV      *ST.PWR+2,R5        ;WHERE TO SAVE DATA
60 000044 004767 000246                        CALL     ST.20             ;DETERMINE POWER RELAY BIT POSITION
61 000050 012704 000456                        MOV      *ST.Q10+Q.IOPL,R4 ;ADDR OF Q10 PARAMETER BLK
62 000054 012524                                MOV      (R5)+,(R4)+        ;PUT STARTING CARD RELAY IN BLK
63 000056 011524                                MOV      @R5,(R4)+         ;BIT LOCATION OF POWER RELAY
64 000060 011514                                MOV      @R5,@R4           ;USE SAME BIT FOR ICS MASK
65 000062                                DIR$     *ST.Q10,ST.90        ;TURN ON THE POWER SUPPLY
66 000076 016700 000410                        MOV      ST.MOT,R0         ;RELAY * FOR LS MOTOR RELAY
67 000102 012705 000514                        MOV      *ST.MOT+2,R5        ;WHERE TO SAVE DATA
68 000106 004767 000204                        CALL     ST.20             ;DETERMINE MOTOR RELAY BITS
69 000112 012704 000522                        MOV      *ST.BFR,R4         ;STEP SEQUENCE BUFFER
70 000116 016702 000356                        MOV      ST.STP,R2          ;GET STEP COUNT. POSITIVE ?
71 000122 003012                                BGT      10$               ;BR IF POSITIVE
72 000124 002402                                BLT      5$                ;IF NEGATIVE THEN CCW
73 000126 000167 000260                        JMP      ST.99              ;DO NOTHING IF ZERO
74
75 ;TURN MOTOR COUNTER CLOCKWISE
76
77 000132                                5$:
78 000132 016764 000360 000004                MOV      ST.MOT+4,4(R4)     ;3RD AND 1ST STEPS
79 000140 016714 000354                        MOV      ST.MOT+6,(R4)     ;... FOR CCW DIRECTION
80 000144 005402                                NEG      R2                 ;MAKE STEP COUNT POSITIVE
81 000146 000405                                BR       20$                ;DO COMMON LOGIC
82
83 ;TURN MOTOR COUNTER CLOCKWISE
84
85 000150                                10$:
86 000150 016714 000342                        MOV      ST.MOT+4,(R4)     ;1ST AND 3RD STEPS
87 000154 016764 000340 000004                MOV      ST.MOT+6,4(R4)    ;... FOR CW DIRECTION
88 000162                                20$:
89 000162 011464 000002                        MOV      (R4),2(R4)        ;DETERMINE 2ND STEP
90 000166 056464 000004 000002                BIS      4(R4),2(R4)       ;... FOR EITHER DIRECTION.
91 000174 005064 000006                        CLR      6(R4)             ;4TH STEP ALWAYS THE SAME
92 000200 016767 000310 000250                MOV      ST.MOT+2,ST.Q10+Q.IOPL ;1ST RELAY ON MOTOR CARD
93 000206 016467 000002 000244                MOV      2(R4),ST.Q10+Q.IOPL+2 ;ICS DRIVER MASK FOR 2 RELAYS
94 000214                                30$:
95 000214 012703 000004                        MOV      *4,R3             ;NUMBER OF OUTPUTS PER STEP
96 000220                                40$:
97 000220 012467 000236                        MOV      (R4)+,ST.Q10+Q.IOPL+4 ;GET NEXT STEPPER BITS
98 000224                                DIR$     *ST.Q10,ST.90        ;OUTPUT THOSE BITS
99 000240                                MRKT$    *TIMEFN,*TIMER,*1    ;GIVE MOTOR TIME TO STEP
100 000264                                WTSE$    *TIMEFN              ;WAIT FOR TIMER

```

101 000276 077330
102 000300 162704 000010
103 000304 077235
104 000306 005077 000164
105 000312 000167 000074

S08 R3,40\$
SUB *10,R4
S08 R2,30\$
CLR @ST.ERR
JMP ST.99

;LOOP IF MORE IN SEQUENCE
;RESET SEQUENCE POINTER
;LOOP IF MORE STEPS
;ZERO THE ERROR CODE
;GO TERMINATE

```

107
108 ;+
109 ;ST.20 SUBROUTINE TO DETERMINE BIT SETTING FOR RELAY CHANNELS
110 ;
111 ;ENTRY R0 - CONTAINS THE LOGICAL RELAY NUMBER 0,1,2 ...ETC.
112 ; R5 - CONTAINS ADDR OF 3-WORD STORAGE AREA
113 ;
114 ;RETURN
115 ; STORAGE AREA - STARTING RELAY NUMBER FOR THE PARTICULAR
116 ; CARD ... 0,16,ETC
117 ; +2 - BIT TO VIRTUAL RELAY, 0-15
118 ; +4 - BIT TO VIRTUAL RELAY + 1
119
119 000316 ST.20:
120 000316 005015 CLR Q05 ;ASSUME RELAY IS ON 1ST CARD
121 000320 012704 000002 MOV #NUMRLY,R4 ;NUMBER OF CARDS IN ICS FILE
122 000324 005003 CLR R3 ;1ST CARD HAS 0 RELAY TO START
123 000326
124 000326 005304 10$: DEC R4 ;ANY MORE CARDS TO TRY ?
125 000330 003406 BLE 20$ ;MUST HAVE BEEN LAST CARD
126 000332 062703 000020 ADD #16,,R3 ;BUMP TO 1ST ON NEXT CARD
127 000336 020003 CMP R0,R3 ;THIS RELAY ON LAST CARD ?
128 000340 002402 BLT 20$ ;OR IF YES
129 000342 010315 MOV R3,Q05 ;SAVE STARTING RELAY NUMBER
130 000344 000770 BR 10$ ;LOOK AT NEXT CARD
131 000346
132 000346 012701 000001 20$: MOV #1,R1 ;INITIALIZE VIRTUAL AND
133 000352 012702 000002 MOV #2,R2 ;... VIRTUAL + 1 BIT POSITIONS
134 000356 161500 SUB Q05,R0 ;GET LOGICAL BIT POSITIONS
135 000360 001403 BR 30$ ;DONE IF ZERO
136 000362
137 000362 006301 30$: ASL R1 ;ROTATE TO
138 000364 006302 ASL R2 ;... PROPER POSITIONS
139 000366 077003 SOB R0,30$
140 000370
141 000370 010165 000002 60$: MOV R1,2(R5) ;PASS BACK
142 000374 010265 000004 MOV R2,4(R5) ;... TO CALLER
143 000400 000207 RETURN

```



```

145                                     ;+
146                                     ;HERE IF ERROR OCCURS DURING Q10
147                                     ;+
148 000402                               ST.90:
149 000402 005726                       TST    (SP)+          ;DROP ERROR CALL RETURN
150 000404 013777 0000005 000064      MOV     @*SDSW,0ST.ERR ;PASS ERROR TO CALLER
151                                     ;
152                                     ; FALL THROUGH
153                                     ;
154                                     ;+
155                                     ;ST.99 - EVERYBODY TERMINATES THROUGH HERE
156                                     ;
157                                     ; TURNS OFF POWER SUPPLY AND RETURNS TO ORIGINAL CALLER
158                                     ;+
159 000412                               ST.99:
160 000412 016767 000066 000036      MOV     ST.PWR+2,Q.IOPL+ST.Q10 ;PROPER CARD
161 000420 016767 000062 000032      MOV     ST.PWR+4,Q.IOPL+2+ST.Q10 ;ICS BIT MASK
162 000426 005067 000030              CLR     Q.IOPL+4+ST.Q10      ;TURN OFF POWER
163 000432                                DIR$    *ST.Q10
164 000440 000207                      RETURN                       ;BACK TO CALLER

```

166		;+		
167		;STORAGE AREA		
168		;-		
169	000442	ST.Q10: Q10WS	10.MLO,,,Q10STA	
170		;		
171	000472	Q10STA: .BLKW	2	
172		;		
173	000476	ST.ERR: .BLKW	1	;ERROR LOCATION
174		;		
175	000500	ST.STP: .BLKW	1	;NUMBER OF STEPS
176		;		
177		;		
178	000502 000000	ST.PWR: .WORD	0	;RELAY NUMBER FOR POWER SUPPLY
179		;		
180	000504 000000		.WORD 0	;1ST RELAY ON POWER SUPPLY CARD
181		;		
182	000506 000000		.WORD 0	;POWER SUPPLY RELAY BIT POSITION
183		;		
184	000510 000000		.WORD 0	;DUMMY REQUIRED BY ST.20
185		;		
186	000512 000000	ST.MOT: .WORD	0	;RELAY NUMBER FOR 1ST STEPPER RELAY
187		;		
188	000514 000000		.WORD 0	;1ST RELAY ON STEPPER RELAY CARD
189		;		
190	000516 000000		.WORD 0	;1ST STEPPER RELAY BIT POSITION
191		;		
192	000520 000000		.WORD 0	;2ND STEPPER RELAY BIT POSITION
193		;		
194	000522	ST.BFR: .BLKW	4	;BUFFER FOR 4 SEQUENTIAL STEPS
195		;		
196	000001		.END	

```

1
2
3
4
5
6
7
8
9
10
11 000000
12 000000 005725
13 000002 013501
14 000004 010100
15 000006 042700 170000
16 000012 032700 004000
17 000016 001402
18 000020 052700 170000
19 000024
20 000024 010035
21 000026 011505
22
23 000030 010100
24 000032 000300
25 000034 006000
26 000036 006000
27 000040 006000
28 000042 006000
29 000044 042700 177760
30 000050 000241
31 000052 006000
32 000054 103001
33 000056 005200
34 000060
35 000060 006300
36 000062 006300
37 000064 062700 000076
38 000070 012025
39 000072 011015
40 000074 000207
41
42 000076
43 000076 040200 000000
44 000102 040400 000000
45 000106 041040 000000
46 000112 041240 000000
47 000116 041510 000000
48 000122 041710 000000
49 000126 042110 000000
50 000132 042572 000000
51 000001

.TITLE SPLIT
.IDENT/031078/

;+
; MARCH 1978
;
; EDITED MACRH 13,1978 BY J BESHONER
;
; CHANGE SOFTWARE TO WORK CORRECTLY
; SUBROUTINE SPLIT (INPUT,IADV,GAIN)
;-
SPLIT::
    TST (R5)+
    MOV @ (R5)+,R1
    MOV R1,R0 ;INPUT A/D READING
    BIC *170000,R0 ;CLEAR GAIN
    BIT *4000,R0 ;NEGITIVE MAGNITUDE ...JSB
    BEQ 5$ ;SKIP IF NOT ...JSB
    BIS *170000,R0 ;OTHERWISE MAKE NEGATIVE...JSB
    5$:
    MOV R0,@ (R5)+ ;SAVE A/D MAGNITUDE VALUE
    MOV (R5),R5 ;GET GAIN'S ADDRESS ...JSB
    ;
    MOV R1,R0 ;INPUT
    SWAB R0
    ROR R0
    ROR R0
    ROR R0
    ROR R0
    BIC *177760,R0 ;MASK TO GAIN ...JSB
    CLC ; ...JSB
    ROR R0 ; ...JSB
    BCC 10$ ; ...JSB
    INC R0 ;CONVERT TO UNIT VALUE ...JSB
    10$:
    ASL R0 ;MULTIPLY BY 4 ...JSB
    ASL R0 ; ...JSB
    ADD *G.TBL,R0 ;GAIN TABLE POINTER ...JSB
    MOV (R0)+,(R5)+ ;PASS GAIN TO CALLER ...JSB
    MOV (R0),(R5) ; ...JSB
    RETURN ;
    ;
    G.TBL:
    .FLT2 1.0 ;A/D GAIN TABLE ...JSB
    .FLT2 2.0
    .FLT2 10.0
    .FLT2 20.0
    .FLT2 50.0
    .FLT2 100.0
    .FLT2 200.0
    .FLT2 1000.0
    .END

```

```

0001      SUBROUTINE TEMPF(V,T)
      C
      C      THIS SUBROUTINE CONVERTS EMF (V) VOLTAGES FROM CHROMEL-ALUMEL
      C      THERMOCOUPLES TO TEMPERATURE IN DEGREES 'F' (T)
      C
0002      IF(V .GE. 0.0) GO TO 70      !SKIP IF POSITIVE EMF
0004      IF(V .GT. -.692) GO TO 30
0006      IF(V .GT. -1.445) GO TO 40
0008      IF(V .EQ. -1.445) GO TO 50
0010      T = 35.8618 + 49.7259*V      !EMF .LT. -1.445
0011      GO TO 160
0012 30    T = 32.0339 + 46.1652*V      ! 0.0 .GT. EMF .GE. -.692
0013      GO TO 160
0014 40    T = 32.9694 + 47.6031*V      ! -.692 .GT. EMF .GT. -1.445
0015      GO TO 160
0016 50    T = -36.0      ! EMF .EQ. -1.445
0017      GO TO 160
0018 70    C1 = -1.353306E01
0019      C2 = 3.891834E01
0020      C3 = 1.654515E-02
0021      C4 = -7.370237E-05
0022      C5 = 2.283579E-07
0023      C6 = -3.570023E-10
0024      C7 = 2.993291E-13
0025      C8 = -1.284985E-16
0026      C9 = 2.2240E-20
0027      N = 8
0028      T = 512.
0029 100    E = C1 + C2*T + C3*T**2 + C4*T**3 + C5*T**4 + C6*T**5 + C7*T**6
0030      E = E + C8*T**7 + C9*T**8
0031      E = .001 * ( E + 125.*EXP( - ( ( (T-127.)/65. )**2 )/2. ) )
0032      IF(V .EQ. E) GO TO 150
0034      IF(V .GT. E) GO TO 130
0036      T = T - 2.*N      !HERE IF V .LT. E
0037      GO TO 140
0038 130    T = T + 2.*N      !HERE IF V .GT. E
0039 140    N = N - 1
0040      IF(N .NE. -5) GO TO 100
0042 150    T = 1.8*T + 32.      !'C' TO 'F' CONVERSION
0043 160    RETURN
0044      END

```

```

1          .LIST TTM
2
3          .TITLE ADREAD
4          .IDENT/031079/
5          ;+
6          ;      MARCH 1978
7          ;      APRIL 1979      LATEST REVISION
8          ;      .MCALL QIOS$,DIR$,WTSE$$,MRKTS$
9          ;
10         ;
11         ; CALL ADREAD (ISTART,NUM,IRESLT,IERR,IUNIT)
12         ;
13         ;      ISTART - FIRST A/D CHANNEL NUM (0-71)
14         ;      NUM    - NUMBER OF CONSECUTIVE CHANNELS
15         ;      IRESLT - BUFFER , LENGTH = TO NUM OF CHAN
16         ;                  ON INPUT WILL HAVE GAIN IN BITS 12-15
17         ;                  ON OUTPUT WILL HAVE GAIN AND AD VALUE IN BITS 0-11
18         ;      IERR   - 0 = NO ERROR
19         ;                  ELSE, RETURNS ICS ERROR CODE
20         ;      IUNIT  - LUN 1 TO 16
21         ;
22         ;
23         ; LOCAL DATA
24         ;
25 000000 UNDFLG: .BLKW 1
26 000002 NCHAN: .BLKW 1
27 000004 LUN: .BLKW 1 ;QIO LUN
28 000006 CNTRL: .BLKW 72. ;QIO CHANNEL CONTROL BUFFER
29 000226 DATA: .BLKW 72. ;QIO DATA BUFFER A/D VALUES
30 000446 IOSB: .BLKW 2 ;STATUS BLOCK
31 ;
32 000452 ADDQIO: QIOS$ IO.R0C,0,1,,IOSB,,<DATA,0,CNTRL>
33 ;
34 ;
35 000000 G.1=0
36 000001 G.2=1
37 000004 G.10=4
38 000005 G.20=5
39 000010 G.50=10
40 000011 G.100=11
41 000014 G.200=14
42 000015 G.1000=15
43 ;EVENT FLAG = 1
44 ;
45 ;

```

```

47 000502      ADREAD::
48 000502      005725      TST      (R5)+
49 000504      017500      MOV      @ (R5),R0      ;FIRST CHANNEL NUM
               000000
50 000510      017567      MOV      @2(R5),NCHAN    ;NUM OF CHANNELS
               000002
               177264
51 000516      016503      MOV      4(R5),R3      ;@ OF IRESLT BUFFER
               000004
52
53      ; FROM ISTART CHANNEL, LOOP THRU
54      ; IRESLT AND EXTRACT GAIN SETTINGS
55      ;
56 000522      012704      MOV      #CNTRL,R4      ;@ CNTRL BUFFER
               000006
57 000526      012302      1$:      MOV      (R3)+,R2      ;GET GAIN
58 000530      042702      BIC      #7777,R2      ;CLEAR GARGABE
               007777
59 000534      050002      BIS      R0,R2      ;OR WITH CHANNEL #
60 000536      010224      MOV      R2,(R4)+      ;STORE IN CNTRL BUFFER
61 000540      005200      INC      R0      ;NEXT CHANNEL
62 000542      005367      DEC      NCHAN      ;ANY MORE LEFT
               177234
63 000546      001367      BNE      1$      ;BIF YES
64
65      ; CALL A/D DRIVER
66
67 000550      012703      MOV      #ADQIO,R3      ;GET @DPB
               000452
68 000554      017501      MOV      @2(R5),R1      ;NUM OF CHANNELS
               000002
69 000560      006301      ASL      R1      ;BYTE LENGTH CNTRL BUFFER
70 000562      010163      MOV      R1,Q.IOPL+2(R3) ;STORE IN DPB
               000016
71 000566      017563      MOV      @0.(R5),Q.IOLU(R3) ;GET LUN
               000010
               000004
72 000574      017567      MOV      @0.(R5),LUN      ;AND SAVE FOR LATER
               000010
               177202
73 000602      DIR$      R3      ;@DPB
74 000606      103411      BCS      2$      ;BIF ERROR
75 000610      WTSESS      *1      ;EVENT FLAG 1
76 000622      126727      CMPB      IOSB,#IS.SUC      ;OR
               177620
               000000G
77 000630      001405      BEQ      3$      ;BIF NO ERROR
78 000632      116701      2$+:      MOVB      IOSB,R1      ;GET ERROR NUMBER
               177610
79 000636      010175      MOV      R1,@6(R5)      ;RETURN ERROR CODE
               000006

```

80 000642 000207

RTS

PC

;AND EXIT

```

82          ;CHECK RESULTS FOR CORRECT GAIN
83          ;SETTINGS, IF WRONG, ADJUST GAIN AND REMEASURE.
84          ;
85 000644 012703 3$: MOV    #DATA,R3          ;@A/D VALUES BUFFER
           000226
86 000650 017567      MOV    @2(R5),NCHAN      ;NUM OF CHANNELS
           000002
           177124
87 000656 012704      MOV    #CNTRL,R4         ;@GAIN VALUES BUFFER
           000006
88          ;
89 000662 011401 4$: MOV    (R4),R1           ;GET CHANNEL AND GAIN
90 000664 011300      MOV    (R3),R0           ;GET DATA READING
91 000666 005067      CLR    UNDFLG           ;EXTERNAL FLAG FOR CHKGAN
           177106
92          ;
93 000672 004767      JSR    PC,CHKGAN         ;ADJUST FOR NEW GAIN
           000112
94          ;
95          ;INPUT R0= A/D DATA
96          ;INPUT R1= CURRENT GAIN/CHANNEL
97          ;RETURN R0= A/D DATA RIGHT JUST
98 000676 126727      CMPB   IOSB,#IS.SUC      ;RETURN R1= NEW GAIN/CHANNEL
           177544          ;ERROR
           000000G
99 000704 001405      BEQ    5$                ;BIF NO
100 000706 116701      MOVB   IOSB,R1          ;GET ERROR NUM
           177534
101 000712 010175      MOV    R1,@6(R5)        ;RET WITH ERROR CODE
           000006
102 000716 000207      RTS    PC
103          ;
104          ;
105 000720 010023 5$: MOV    R0,(R3)+          ;SAVE A/D IN DATA
106 000722 010124      MOV    R1,(R4)+          ;SAVE GAIN IN CNTRL
107 000724 005367      DEC    NCHAN            ;ANY MORE
           177052
108 000730 001354      BNE    4$                ;BIF YES

```



```

110      ; RETURN GAIN AND A/D VALUE IN IRESLT
111      ;
112 000732 017567      MOV      @2(R5),NCHAN      ;NUMBER OF CHANNELS
          000002
          177042
113 000740 012703      MOV      #DATA,R3          ;DATA BUFFER
          000226
114 000744 012704      MOV      #CNTRL,R4          ;CNTRL BUFFER
          000006
115 000750 016502      MOV      4(R5),R2          ; IRESLT ADDRESS
          000004
116      ;
117 000754 012301 6$:  MOV      (R3)+,R1          ;GET A/D VALUE
118 000756 042701      BIC      #170000,R1        ;CLR GARBAGE
          170000
119 000762 012400      MOV      (R4)+,R0          ;GET GAIN
120 000764 042700      BIC      #7777,R0          ;CLR GARBAGE
          007777
121 000770 050001      BIS      R0,R1              ;COMBINE GAIN AND DATA
122 000772 010122      MOV      R1,(R2)+          ;STORE IN IRESLT
123 000774 005367      DEC      NCHAN
          177002
124 001000 001365      BNE      6$
125 001002 005075      CLR      @6(R5)            ;BIF MORE
          000006      ;NO ERRORS
126 001006 000207      RTS      PC

```

```

128      ;SUBROUTINE CHKGAN
129
130      ; UPON ENTRY    R1 = CURRENT GAIN/CHANNEL
131      ;                R0 = A/D VALUE
132
133      ; UPON EXIT     R1 = NEW GAIN AND CHANNEL
134      ;                R0 = A/D VALUE
135
136      ; NOTE *** THIS IS A RECURSIVE SUBROUTINE
137
138 001010 010346 CHKGAN: MOV    R3,-(SP)      ;SAVE
139 001012 010446      MOV    R4,-(SP)
140 001014 072027      ASH     #-4,R0        ;RIGHT JUSTIFY FROM A/D
141      177774
142 001020 010102      MOV    R1,R2        ;EXTRACT GAIN
143 001022 072227      ASH     #-12,R2      ;SHIFT RIGHT
144      177764
145 001026 042702      BIC     #177760,R2
146      177760
147
148 001032 020027      CMP     R0,#3777     ;POS SATURATION
149      003777
150
151 001036 001452      BEQ     OVFL          ;BIF YES
152 001040 020027      CMP     R0,#-4000    ;NEG SATURATION
153      174000
154
155 001044 001447      BEQ     OVFL          ;BIF YES
156
157      ;
158      ;CHECK FOR UNDER FLOW SATURATION
159      ;AND INCREASE GAIN
160
161 001046 020227      CMP     R2,#G.1000   ;MAX GAIN
162      000015
163
164 001052 001526      BEQ     C.EXIT        ;BIF YES
165 001054 010003      MOV     R0,R3        ;POSITIVE READING
166 001056 100001      BPL     1$          ;BIF YES
167 001060 005403      NEG     R3          ;ABSOLUTE VALUE
168 001062 020227 1$: CMP     R2,#G.200    ;GAIN OF 200
169      000014
170
171 001066 001412      BEQ     5$          ;BIF YES
172 001070 020227 2$: CMP     R2,#G.20     ;GAIN OF 20
173      000005
174
175 001074 001004      BNE     3$          ;BIF NO
176 001076 020327      CMP     R3,#319.    ;LESS THAN 2/5 MAX
177      001463
178
179 001102 003112      BGT     C.EXIT        ;BIF NO
180 001104 000412      BR      INCGAN
181 001106 020227 3$: CMP     R2,#G.2      ;GAIN OF 2
182      000001
183
184 001112 001004      BNE     4$          ;BIF NO
185 001114 020327 5$: CMP     R3,#3777/5   ;LESS THAN 1/5 MAX
186      000631

```

168 001120	003103		BGT	C.EXIT	;BIF NO
169 001122	000403		BR	INCGAN	
170					;ALL OTHER GAINS ARE
171					; INCREMENTED BY 2 FOLD
172 001124	020327	4\$:	CMP	R3,*3777/2	;LESS THAN 1/2 MAX
	001777				

```

173 001130 003077      BGT      C.EXIT      ;BIF NO
174
175      ;FIND NEXT HIGHEST GAIN SETTING
176
177 001132 010027  INCGAN: MOV      R0,(PC)+      ;SAVE OLD RESULTS
178
179 001134 000000  OLDRSL: .WORD      0
180 001136 010127      MOV      R1,(PC)+      ;SAVE OLD ICNTL
181 001140 000000  OLD CNT: .WORD      0
182 001142 010227      MOV      R2,(PC)+      ;SAVE OLD GAIN
183 001144 000000  OLDGAN: .WORD      0
184 001146 004767      JSR      PC,GETGAN      ;@ OF GAIN TABLE IN R4
185      000220
185 001152 022424      CMP      (R4)+,(R4)+      ;POSITION TO NEXT HIGHEST GAIN
186 001154 012402      MOV      (R4)+,R2      ;GET GAIN CODE
187 001156 005267      INC      UNDFLG      ;SHOW UNDER SATURATION
188      176616
188 001162 000421      BR       C.ATOD      ;CONVERT
189
190      ;CHECK FOR MIN GAIN ON OVERFLOW
191      ;AND IF DUE TOO MUCH INCREASE IN
192      ;GAIN FROM LAST OPERATION
193
194 001164 005767  OVFL:  TST      UNDFLG      ;WAS LAST AN UNDER SATURATION
195      176610
195 001170 001407      BEQ      4$      ;BIF NO
196 001172 016701      MOV      OLD CNT,R1      ;RESTORE OLD ICNTL
197      177742
197 001176 016700      MOV      OLDRSL,R0      ;RESTORE OLD VALUE
198      177732
198 001202 016702      MOV      OLDGAN,R2      ;RESTORE OLD GAIN
199      177736
199 001206 000450      BR       C.EXIT
200 001210 120227  4$:  CMPB     R2,#G.1      ;MINIMUM GAIN
201      000000
201 001214 001445      BEQ      C.EXIT      ;BIF YES
202 001216 004767      JSR      PC,GETGAN
203      000150
203 001222 005744      TST      -(R4)      ;SKIP GAIN VALUE
204 001224 014402      MOV      -(R4),R2      ;GET NEXT LOWEST GAIN CODE
205
206      ;CALL A/D DRIVER
207
208 001226 072227  C.ATOD: ASH      #12,,R2      ;SET NEW GAIN
209      000014
209 001232 042701      BIC      #170000,R1      ;SAVE CHANNEL NUMBER
210      170000
210 001236 050291      BIS      R2,R1
211 001240 010167      MOV      R1,CNTRL2      ;SET UP CONTROL INFO
212      000122
212 001244 012703      MOV      @ADQ102,R3      ;@ OF DPB

```

	001336*		
213 001250	016763	MOV	LUN,Q.IOLU(R3) ; INSERT LUN
	176530		
	000004		
214	;		
215	;		

```

216      ;      THIS WAIT IS USED TO WAIT FOR THE A/D CONVERTER TO
217      ;      FINISH THE CONVERSION PROCESS (50 MILLISECONDS) BEFORE
218      ;      CHANGING THE GAIN AND READING THE CHANNEL AGAIN.
219      ;
220      ;
221 001256      MRKT$      .3,0
222      ;
223      ;
224      ;
225 001270      DIR$      R3      ;CALL A/D DRIVER
226 001274      103415      BCS      C.EXIT      ;BIF ERROR
227 001276      WTSE$      #1      ;WAIT
228 001310      126727      CMPB      IOSB, #IS.SUC      ;OK
                177132
                000000G
229 001316      001004      BNE      C.EXIT      ;BIF NO
230 001320      016700      MOV      DATA2, R0      ;NEW A/D VALUE
                000044
231      ;
232 001324      004767      JSR      PC, CHKGAN      ;R1 = GAIN AND CHANNEL
                177460      ;ENTER RECURSIVELY
233 001330      012604      C.EXIT: MOV      (SP)+, R4      ;POP REG
234 001332      012603      MOV      (SP)+, R3
235 001334      000207      RTS      PC
236      ;
237      ;
238 001336      ADQIO2: QIO$      IO.RBC, 0, 1, IOSB, <DATA2, 2, CNTRL2>
239 001366      CNTRL2: .BLKW      1
240 001370      DATA2: .BLKW      1
241

```

```

243                ;SUBROUTINE GETGAN
244                ;
245                ;R2 = CURRENT GAIN CODE
246                ;RETURNS Q OF TABLE IN R4 FOR GAIN
247                ;
248
249 001372          GETGAN::
250 001372 012704      MOV      @G.TBL,R4          ;START @
                001410
251 001376 120214 1$:  CMPB    R2,(R4)            ;GAIN CODE MATCH
252 001400 001402      BEQ     2$                  ;GIF YES
253 001402 022424      CMP     (R4)+,(R4)+        ;POSITION TO NEXT ENTRY
254 001404 000774      BR      1$
255 001406 000207 2$:  RTS     PC                  ;EXIT
256
257 001410 000000  G.TBL: .WORD  0,      1,      ;GAIN CODE AND GAIN VALUE
                001412 000001
258 001414 000001      .WORD  1,      2,
                001416 000002
259 001420 000004      .WORD  4,      10,
                001422 000012
260 001424 000005      .WORD  5,      20,
                001426 000024
261 001430 000010      .WORD  10,     50,
                001432 000062
262 001434 000011      .WORD  11,     100,
                001436 000144
263 001440 000014      .WORD  14,     200,
                001442 000310
264 001444 000015      .WORD  15,     1000,
                001446 001750
265
266                000001      .END

```

Appendix B

DATA REDUCTION AND REPORT GENERATION SOFTWARE

0001 PROGRAM GHRPT
C .IDENT /101279/

C+

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0002

0003

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AUG 1978 DATE WRITTEN 08/??/79 S. L. CAHILL - D/744
APRIL 1979 REVISED 04/12/79 G. I. HUEY
SEP 1979 REVISED 09/11/79 S. L. CAHILL - D/744
OCT 1979 REVISED 10/11-12/79 S. L. CAHILL - D/744
MAINTAINENCE RESPONSIBILITY L. L. HOLLAND

THIS PROGRAM IS DESIGNED TO READ INFORMATION FROM A DATA
FILE CREATED BY THE GP1800 SOFTWARE ON DM0:[300,011], THEN
PRINT OUT A REPORT OF THE INITIALIZATION DATA, OUTPUT A COVER
SHEET, AND/OR CREATE A DISK FILE FOR ARCHIVAL PURPOSES.
THE RESULTS ARE PRINTED ONLY IF THE EXPERIMENT IS COMPLETE.

THE OUTPUT FROM THIS PROGRAM CAN BE DIRECTED TO THE USER
TERMINAL, THE LINE PRINTER, OR TO THE DISK IN THE FORM
OF A FILE READY TO BE ARCHIVED.

OUTPUT DATA IS FLAGGED IF IT DOES NOT MEET ASTM C177
REQUIREMENTS FOR HEAT LOSS.

TASKBUILDER INSTRUCTIONS

TKB>GHRPT/CP=GHRPT,LB:[1,1]D816LBR/LB
TKB>/
TKB>ENTER OPTIONS:
TKB>ASG=LP:4,TI:5
TKB>///

VARIABLE INITIALIZATION

DIMENSION THMCON(9), CURENT(9), VLTAGE(9)
DIMENSION GRDT(9), TMP(9,8), TEMPM(9)

62

```

0024      30  WRITE (5, 540)
0025      READ (5, 550,ERR= 30,END= 30) COMPLT
      C
0026      IF (COMPLT .EQ. Y .OR. COMPLT .EQ. N) GO TO 40
0028      WRITE (5, 560)
0029      GO TO 30
      C
      C
      C      WRITE REPORT TO THE LINE PRINTER OR TO THE TERMINAL?
      C
      C
0030      40  WRITE (5, 570)
0031      READ (5, 580,ERR= 40,END= 40) IDEV
      C
0032      IF (IDEV .EQ. 3 .OR. IDEV .EQ. 4 .OR. IDEV .EQ. 5) GO TO 50
0034      WRITE (5, 590)
0035      GO TO 40
      C
      C
      C      MAKE SURE THE USER DOES NOT ARCHIVE DATA THAT IS NOT COMPLETE.
      C
      C
0036      50  IF (IDEV .EQ. 3 .AND. COMPLT .EQ. N) GO TO 30
      C
      C
      C      OPEN THE DATA FILE
      C
      C
0038      CALL ASSIGN (1,FILE,NFILE)
0039      CALL NOLOCK (1)
      C
      C
      C      NOW READ THE HEADER DATA
      C
0040      READ (1, 600) LTR
0041      READ (1, 610) SPECID
0042      READ (1, 610) EMPNO
0043      READ (1, 620) NSAM
0044      IF (NSAM .NE. 2) GO TO 60
0046      READ (1, 630) THCKUP, THCKLO
0047      GO TO 70
0048      60  READ (1, 630) THCKUP
0049      70  READ (1, 640) STTEMP
0050      READ (1, 600) MATERL

```

```

0051      READ  (1, 610) SPCNM1
0052      READ  (1, 610) SPCNM2
0053      READ  (1, 610) CHARGE
0054      READ  (1, 610) REQDBY
0055      READ  (1, 610) DEPT
0056      READ  (1, 610) TSTSPC
0057      READ  (1, 650) (DAT(I), I = 1, 9), (TIM(I), I = 1, 8)
0058      READ  (1, 620) ISPRN
0059      READ  (1, 620) ISOLRN
0060      READ  (1, 620) IMHRN1
0061      READ  (1, 620) IMHCC
0062      READ  (1, 620) IMHVC
0063      READ  (1, 620) IGHC
0064      READ  (1, 620) ITCC
0065      READ  (1, 620) IBHC
0066      READ  (1, 620) IVF

```

C
C
C
C
C
C

IF THE EXPERIMENT IS COMPLETE, READ THE DATA.
OTHERWISE, JUMP TO WHERE THE FILE IS CLOSED.

```

0067      IF (COMPLT .EQ. N) GO TO 90

```

C
C
C

```

0069      DO 80 M = 1, 9
0070          READ  (1, 660,ERR= 90,END= 90) VLTAGE(M)
0071          READ  (1, 660,ERR= 90,END= 90) CURENT(M)
0072          READ  (1, 660,ERR= 90,END= 90) GRDT(M)
0073          READ  (1, 670,ERR= 90,END= 90) (TMP(M,I), I = 1, 8)
0074          READ  (1, 660,ERR= 90,END= 90) THMCON(M)
0075      80      CONTINUE

```

C
C
C
C
C

CLOSE THE DATA FILE.

```

0076      90  CALL CLOSE (1)

```

C
C
C
C
C
C

FIND NAME TO MATCH EMPLOYEE NUMBER IN THE EMPLOYEE NUMBER FILE,
DM0:[300,011]EMPLNO.DAT (IF SUCH A MATCH EXISTS).

```

0077      CALL ASSIGN (2,'DM0:[300,011]EMPLNO.DAT')
0078      CALL NOLOCK (2)
C
C
C      SKIP THE FIRST 5 LINES.  THEY DO NOT CONTAIN DATA.
C
C
0079      DO 100 M = 1, 5
0080          READ (2,600) DUM
0081      100  CONTINUE
C
C
C      NOW START CHECKING FOR A MATCH FOR THE EMPLOYEE NUMBER.
C
C
0082      DO 120 M = 1, 15
0083          READ (2, 690,END= 130,ERR= 130) (ENUMB(I), I = 1, 6),
1              (NAME(I), I = 1, 14)
0084          DO 110 L = 1, 5
0085              IF (EMPNO(L) .NE. ENUMB(L)) GO TO 120
0087      110  CONTINUE
C
C
C      THE NAME WAS FOUND, SO SET THE FLAG TO 1 TO OUTPUT THE NAME.
C
C
0088          NAMFLG = 1
0089          GO TO 140
0090      120  CONTINUE
C
C
C      THE NAME WAS NOT FOUND, SO SET THE FLAG TO 0 TO OUTPUT THE
C      EMPLOYEE NUMBER.
C
C
0091      130  NAMFLG = 0
C
C
C      CLOSE THE DM0:[300,011]EMPLNO.DAT FILE.
C
C
0092      140  CALL CLOSE (2)
C
C
C      IF THE USER WANTS TO ARCHIVE THE DATA, WE MUST DO A COVER

```

```

      C      SHEET, SO SKIP THE QUESTION AND GO ON TO ASK FOR THE COMMENT.
      C
      C
0093      IF (IDEV .EQ. 3) GO TO 160
      C
      C
      C      IF THE DATA IS NOT COMPLETE, WE CANNOT DO A COVER SHEET, SO
      C      SKIP AROUND THE COVER SHEET QUESTIONS.
      C
      C
0095      IF (COMPLT .EQ. N) GO TO 190
      C
      C
      C      FIND OUT IF THE USER WANTS TO OUTPUT A COVER SHEET.
      C
      C
0097      150 WRITE (5, 700)
0098      READ (5, 550, ERR= 150, END= 150) COVER
      C
0099      IF (COVER .EQ. Y) GO TO 160
0101      IF (COVER .EQ. N) GO TO 190
0103      WRITE (5, 560)
0104      GO TO 150
      C
      C
      C      IF A COVER SHEET IS TO BE OUTPUT, ASK IF A COMMENT IS DESIRED.
      C
      C
0105      160 WRITE (5, 710)
0106      READ (5, 550, ERR= 160, END= 160) COVCOM
      C
0107      IF (COVCOM .EQ. Y) GO TO 170
0109      IF (COVCOM .EQ. N) GO TO 180
0111      WRITE (5, 560)
0112      GO TO 160
      C
      C
      C      IF A COMMENT IS DESIRED, FIND OUT WHAT IT IS.
      C
      C
0113      170 WRITE (5, 720)
0114      READ (5, 730, ERR= 170, END= 180) KCOM, (CCMMNT(I), I = 1, KCOM)
      C
0115      180 FILE(17+NCH) = G
0116      FILE(18+NCH) = P

```

```
0117      FILE(19+NCH) = D
      C
      C
      C      IF THE USER WANTS THE DATA ARCHIVED, THEN IT WILL BE LISTED,
      C      SO SKIP THIS QUESTION.
      C
      C
0118      IF (IDEV .EQ. 3) GO TO 200
      C
      C
      C      FIND OUT IF THE USER WANTS THE DATA LISTED.
      C
      C
0120      190  WRITE (5, 740)
0121      READ (5, 550,ERR= 190,END= 190) IDATA
      C
0122      IF (IDATA .EQ. Y .OR. IDATA .EQ. N) GO TO 210
0124      WRITE (5, 560)
0125      GO TO 170
      C
      C
      C      IF THE DATA IS TO BE ARCHIVED, SET THE FLAG PARAMETERS,
      C      OPEN THE FILE, AND THEN RESET THE FILE EXTENSION SO THAT
      C      IT CORRECTLY REFLECTS THE DATA FILE NAME WHEN OUTPUT LATER.
      C
      C
0126      200  IDATA = Y
0127      COVER = Y
      C
0128      CALL ASSIGN (3,FILE,NFILE)
      C
0129      FILE(17+NCH) = G
0130      FILE(18+NCH) = H
0131      FILE(19+NCH) = P
      C
      C
      C      IF THE USER DID NOT REQUEST A COVER SHEET OR DATA LISTINGS,
      C      ASSUME THEY DID NOT REALLY WANT TO RUN THE PROGRAM FOR THIS
      C      DATA FILE AND GO TO THE END AND ASK IF THEY WANT TO RUN THE
      C      PROGRAM AGAIN WITH A DIFFERENT DATA FILE.
      C
      C
0132      210  IF (COVER .EQ. N .AND. IDATA .EQ. N) GO TO 400
      C
      C
```

```
      C      IF THE LINE PRINTER IS TO BE USED, ATTACH IT.
      C
      C
0134      IF (IDEV .EQ. 4) CALL ATTDEV (4)
      C
      C
      C      IF THE USER DOES NOT WANT DATA LISTINGS, SKIP THE NEXT
      C      SET OF WRITE STATEMENTS.
      C
      C
0136      IF (IDATA .EQ. N) GO TO 300
      C
      C
      C      OUTPUT THE DATA LISTINGS.
      C
      C
0138      WRITE (IDEV, 750)
0139      WRITE (IDEV, 760) LTR
0140      WRITE (IDEV, 770) SPECID
0141      WRITE (IDEV, 780) REQDBY, DEPT
0142      WRITE (IDEV, 790) CHARGE
      C
      C
      C
      C      OUTPUT THE EMPLOYEE'S NAME OR THE EMPLOYEE NUMBER DEPENDENT
      C      UPON WHETHER OR NOT IT WAS MATCHED IN THE EMPLOYEE NUMBER
      C      DATA FILE.
      C
      C
0143      IF (NAMFLG .EQ. 0) WRITE (IDEV, 800) EMPNO
0145      IF (NAMFLG .EQ. 1) WRITE (IDEV, 800) NAME
      C
      C
      C      CONTINUE OUTPUTTING THE DATA LISTINGS.
      C
      C
0147      WRITE (IDEV, 810) NSAM
0148      IF (NSAM .EQ. 2) GO TO 220
0150      WRITE (IDEV, 820) THCKUP
0151      GO TO 230
0152      220 WRITE (IDEV, 830) THCKUP
0153      WRITE (IDEV, 840) THCKLO
0154      230 WRITE (IDEV, 850) SPCNM1
0155      WRITE (IDEV, 850) SPCNM2
0156      WRITE (IDEV, 860) STTEMP
```



```

0157      WRITE (IDEV, 870) MATERL
0158      WRITE (IDEV, 880) TSTSPC
0159      WRITE (IDEV, 890) (DAT(I), I = 1, 9), (TIM(I), I = 1, 8)
0160      WRITE (IDEV, 900) ISPRN
0161      WRITE (IDEV, 910) ISOLRN
0162      WRITE (IDEV, 920) IMHRN1
0163      WRITE (IDEV, 930) IMHCC
0164      WRITE (IDEV, 940) IMHVC
0165      WRITE (IDEV, 950) IGHC
0166      WRITE (IDEV, 960) ITCC
0167      WRITE (IDEV, 970) IBHC

```

C
C
C
C
C
C

IF THE TEST IS FINISHED, CONTINUE.
OTHERWISE, SKIP THE DATA OUTPUT.

```

0168      IF (COMPLT .EQ. N) GO TO 390

```

C

```

0170      DO 290 I = 1, 9
0171          WRITE (IDEV, 980) I
0172          WRITE (IDEV, 990) VLTAGE(I)
0173          WRITE (IDEV, 1000) CURENT(I)
0174          WRITE (IDEV, 1010) GRDT(I)
0175          DO 240 M = 1, 8
0176              WRITE (IDEV, 1020) M, TMP(I,M)
0177      240      CONTINUE
0178          TEMPM(I) = TMP(I,1) + TMP(I,2) + TMP(I,3) + TMP(I,4)
0179          TMEAN = TEMPM(I) * .25
0180          WRITE (IDEV, 1030) TMEAN
0181          WRITE (IDEV, 1040) THMCON(I)
0182          WRITE (IDEV, 1050)
0183          DELTLO = TMP(I,2) - TMP(I,1)
0184          DELTUP = TMP(I,3) - TMP(I,4)
0185          AVG = (DELTLO + DELTUP) / 2.
0186          X = (ABS((DELTLO - DELTUP) / AVG) * 100.)
0187          IF (X .GT. 1.) GO TO 250
0189          WRITE (IDEV, 1070) X
0190          GO TO 260
0191      250      WRITE (IDEV, 1080) X

```

C
C
C
C
C

CALCULATE MEAN TEMPERATURE, HEAT LOSS, AND HEAT LOSS
THROUGH THE SIDES TO DETERMINE IF REQUIREMENTS FOR ASTM
C177 HAVE BEEN FULFILLED.

```

0192 250 TEMPE = TMP(I,5) + TMP(I,6) + TMP(I,7) + TMP(I,8)
0193      TEMPD = (DELTLO + DELTUP) * 2.
0194      HTLOSS = (TEMPE - TEMPM(I)) / TEMPD
0195      IF (HTLOSS .GT. 0) GO TO 270
0197      HTLOSS = HTLOSS * -1.
0198 270 IF (HTLOSS .GT. 0.1) GO TO 290
0200      WRITE (IDEV,1090) HTLOSS
0201      GO TO 290
0202 290 WRITE (IDEV,1100) HTLOSS
0203 290 CONTINUE

C
C
C CALCULATE AVERAGES FOR THERMAL CONDUCTIVITY AND MEAN
C TEMPERATURE. WRITE THESE TO ARCHIVAL FILE
C
C
0204 300 TCAV = 0.
0205      TMPA = 0.
0206      DO 310 I = 1, 9
0207          TMPA = TMPA + TMP(I,1) + TMP(I,2) + TMP(I,3) + TMP(I,4)
0208          TCAV = TCAV + THMCON(I)
0209 310 CONTINUE
0210      TMPA = TMPA / 36.
0211      TMC = (TMPA - 32.) * 5. / 9.
0212      TCAV = TCAV / 9.
0213      TCMET = TCAV * .1442279

C
0214      WRITE (IDEV,1110) TCAV, TMPA

C
C
C IF THE USER DID NOT CHOOSE TO OUTPUT A COVER SHEET, SKIP
C THIS NEXT SECTION.
C
C
0215      IF (COVER .EQ. N) GO TO 390

C
0217      WRITE (IDEV,1120)
0218      WRITE (IDEV,1130) REQDBY
0219      WRITE (IDEV,1140) DEPT, DAT
0220      WRITE (IDEV,1150) LTR
0221      WRITE (IDEV,1160) CHARGE
0222      WRITE (IDEV,1170) MATERL
0223      WRITE (IDEV,1180) TSTSPC
0224      WRITE (IDEV,1190)
0225      WRITE (IDEV,1200)

```

```
0226      WRITE (IDEV,1210)
0227      WRITE (IDEV,1220) SPCNM1, SPCNM2, TCMET, TCAV, TMC, TMPA
      C
      C
      C      IF THERE IS A COMMENT TO BE INCLUDED ON THE COVER SHEET,
      C      PRINT IT.
      C
0228      IF (COVCOM .EQ. Y) WRITE (IDEV,1230) (CCMMNT(I), I = 1, KCOM)
      C
      C      OUTPUT EITHER THE EMPLOYEE'S NAME OR THE EMPLOYEE NUMBER,
      C      DEPENDENT ON WHETHER A MATCH WAS FOUND IN THE EMPLOYEE NUMBER
      C      FILE.
      C
0230      IF (NAMFLG .EQ. 0) WRITE (IDEV,1240) EMPNO
0232      IF (NAMFLG .EQ. 1) WRITE (IDEV,1240) NAME
      C
      C      FINISH PRINTING THE COVER SHEET.
      C
0234      WRITE (IDEV,1250) (FILE(I), I = 1, NFLE)
0235      WRITE (IDEV,1260)
      C
      C      IF THE USER CHOSE TO CREATE AN ARCHIVAL FILE, ASK FOR THE
      C      EQUIPMENT INFORMATION.
      C
      C      IF THIS IS NOT FOR AN ARCHIVAL FILE, SKIP THE EQUIPMENT
      C      INFORMATION QUESTIONS.
      C
0236      IF (IDEV .NE. 3) GO TO 380
      C
0238      320 WRITE (5,1270)
0239      READ (5,1280,ERR= 320,END= 380) EQUIP
0240      WRITE (IDEV,1290) EQUIP
      C
0241      330 WRITE (5,1300)
0242      READ (5,1310,ERR= 330,END= 330) BKC
0243      WRITE (IDEV,1320) BKC
      C
0244      340 WRITE (5,1330)
```

```

0245      READ (5,1340,ERR= 340,END= 340) CALDAT
0246      WRITE (IDEV,1350) CALDAT
      C
0247  350  WRITE (5,1360)
0248      READ (5,1340,ERR= 350,END= 350) EXPDAT
0249      WRITE (IDEV,1365) EXPDAT
      C
0250  360  WRITE (5,1370)
0251      LINCOM = 0
0252  370  READ (5,1372,ERR= 360,END= 320) LCOM, ACMNT
0253      LINCOM = LINCOM + 1
0254      IF (LCOM .LT. 1) GO TO 320
0255      IF (LCOM .GT. 80) LCOM = 80
0256      IF (LINCOM .EQ. 1) WRITE (IDEV,1375)
0257      WRITE (IDEV,1380) (ACMNT(I), I = 1, LCOM)
0258      LCOM = 0
0259      GO TO 370
      C
      C
      C      OUTPUT A BLANK LINE TO KEEP FROM LOSING ANY DATA TO
      C      A SYSTEM BUG.
      C
      C
0263  380  WRITE (IDEV,1400)
      C
      C
      C      CLOSE THE FILE IF WE ARE OUTPUTTING TO AN ARCHIVAL FILE,
      C      DETACH THE DEVICE IF WE ARE OUTPUTTING TO THE LINE PRINTER,
      C      AND JUST CONTINUE IF OUTPUT IS TO THE USER TERMINAL.
      C
      C
0264      IF (IDEV .EQ. 3) CALL CLOSE (3)
0265      IF (IDEV .EQ. 4) CALL DETDEV (4)
      C
      C
      C      NOW ASK IF THE USER WANTS TO RUN THE PROGRAM AGAIN.
      C      (A SECOND RUN WILL ASK ALL QUESTIONS AGAIN AND READ
      C      THE DATA FILE AGAIN, SO THE SAME OR A DIFFERENT DATA
      C      SET MAY BE DONE.)
      C
      C
0268  390  WRITE (5,1390)
0269      READ (5, 550,ERR= 390,END= 390) AGAIN
      C
0270      IF (AGAIN .EQ. Y) GO TO 10

```

```

0272      IF (AGAIN .EQ. N) GO TO 400
0274      WRITE (5, 560)
0275      GO TO 390

C
C
C      THE USER IS DONE, SO WE EXIT (GRACEFULLY).
C
C
0276 400 CALL EXIT

C
C
C      FORMAT STATEMENTS FOR ASKING THE OPERATOR THE QUESTIONS
C      NECESSARY FOR OPERATION OF THE PROGRAM.
C
C
0277 500 FORMAT ('$WHAT IS THE LTR #? [7A1]: ')
0278 510 FORMAT (0,7A1)
0279 520 FORMAT ('$WHAT IS THE SAMPLE IDENTIFICATION NUMBER?',
1 ' (ID#) [2A1]: ')
0280 530 FORMAT (2A1)
0281 540 FORMAT ('$IS THE EXPERIMENT COMPLETE? [Y/N]: ')
0282 550 FORMAT (A1)
0283 560 FORMAT (' PLEASE ANSWER Y OR N.')
0284 570 FORMAT (' YOU MAY OUTPUT TO: '/'
1          '      3  AN ARCHIVAL FILE'/'
2          '      4  THE LINE PRINTER'/'
3          '      5  YOUR TERMINAL'/'
4          '$WHICH DO YOU CHOOSE? [I1]: ')
0285 580 FORMAT (I1)
0286 590 FORMAT (' PLEASE ANSWER 3, 4 OR 5.')

C
C
C      FORMAT STATEMENTS FOR READING THE INFORMATION FROM THE
C      DATA FILE.
C
C
0287 600 FORMAT (/16A1)
0288 610 FORMAT (16A1)
0289 620 FORMAT (I2)
0290 630 FORMAT (F8.5,5X,F8.5)
0291 640 FORMAT (F6.2)
0292 650 FORMAT (9A1,5X,8A1)
0293 660 FORMAT (F8.4)
0294 670 FORMAT (8F8.4)
0295 680 FORMAT (2A1)

```

0296 690 FORMAT (6A1,2X,14A1)

C

C

C

MORE FORMATS FOR DIALOG (700-740)

C

C

0297 700 FORMAT ('\$CREATE A COVER SHEET? [Y/N]: ')

0298 710 FORMAT ('\$INCLUDE COMMENT ON COVER SHEET? [Y/N]: ')

0299 720 FORMAT (' ENTER THE COMMENT. [80A1]:')

0300 730 FORMAT (0,80A1)

0301 740 FORMAT ('\$LIST INITIALIZATION DATA AND RESULTS? [Y/N]: ')

C

C

C

FORMATS FOR OUTPUT OF INITIALIZATION DATA (750-970)

C

AND FOR THE RESULTS (980-1110)

C

C

0302 750 FORMAT ('1',3X,'GUARDED HOT PLATE RESULTS'/)

0303 760 FORMAT (' LTR NO.: ',7A1)

0304 770 FORMAT (' SPEC. ID. NO.: ',2A1)

0305 780 FORMAT (' REQUESTED BY: ',14A1,' DEPT ',3A1)

0306 790 FORMAT (' CHARGE NUMBER: ',8A1)

0307 800 FORMAT (' TESTED BY: ',14A1)

0308 810 FORMAT (' NUMBER OF SAMPLES TESTED: ',12)

0309 820 FORMAT (' THICKNESS OF THE SAMPLE: ',F8.5)

0310 830 FORMAT (' THICKNESS OF UPPER SAMPLE: ',F8.5)

0311 840 FORMAT (' THICKNESS OF LOWER SAMPLE: ',F8.5)

0312 850 FORMAT (' SAMPLE NAME: ',14A1)

0313 860 FORMAT (' SET POINT TEMPERATURE: ',F6.2)

0314 870 FORMAT (' MATERIAL TESTED: ',12A1)

0315 880 FORMAT (' TEST SPECIFICATION: ',12A1)

0316 890 FORMAT ('0DATA RECORDED ON: ',9A1,2X,'AT: ',8A1)

0317 900 FORMAT (' POWER SUPPLY RELAY NO.: ',12)

0318 910 FORMAT (' SOLENOID RELAY NO.: ',12)

0319 920 FORMAT (' FIRST MAIN HEATER RELAY NO.: ',12)

0320 930 FORMAT (' MAIN HEATER CURRENT A/D CHANNEL: ',12)

0321 940 FORMAT (' MAIN HEATER VOLTAGE A/D CHANNEL: ',12)

0322 950 FORMAT (' GUARD HEATER A/D CHANNEL: ',12)

0323 960 FORMAT (' FIRST THERMOCOUPLE A/D CHANNEL: ',12)

0324 970 FORMAT (' BUCKING HEATER A/D CHANNEL: ',12)

C

C

FORMAT STATEMENTS FOR PRINTING THE EXPERIMENT RESULTS,

C

USED ONLY WHEN THE EXPERIMENT IS COMPLETE. (980-1110)

C

0325 980 FORMAT ('0',/' DATA SET ',11)

```

0326 990 FORMAT ('MAIN HEATER VOLTAGE - VOLTS: ',F8.4)
0327 1000 FORMAT (' MAIN HEATER CURRENT - AMPS: ',F8.4)
0328 1010 FORMAT (' GUARD DELTA T - MILLIVOLTS: ',F8.4)
0329 1020 FORMAT (' T.C. ',I1,' - DEGREES F:',12X,F8.4)
0330 1030 FORMAT (' MEAN TEMPERATURE - DEGREES F: ',F8.4)
0331 1040 FORMAT (' THERMAL CONDUCTIVITY:',10X,F8.4)
0332 1050 FORMAT (' [ BTU*IN/H*FT*FT*DEGREE(F) ]')
0333 1060 FORMAT (' THIS DATA RECORDED AT " ',8A1,' " ')
0334 1070 FORMAT (' TEMP. DROP DIFF. 2 SPECIMENS: ',F7.3)
0335 1080 FORMAT (/// '*****')
1      ' * * * * * '
2      ' * TEMP. DROP DIFFERS BY ',F5.1,'% * '
3      ' * * * * * '
4      ' * DOES NOT MEET ASTM C177 * '
5      ' * * * * * '
6      ' *****')
0336 1090 FORMAT (' HEAT LOSS THROUGH SIDES: ',5X,F8.4)
0337 1100 FORMAT (/// '*****')
1      ' * * * * * '
2      ' * HEAT LOSS THROUGH SIDES:',F5.1,' * '
3      ' * * * * * '
4      ' * DOES NOT MEET ASTM C177 * '
5      ' * * * * * '
6      ' *****')
0338 1110 FORMAT (' THERMAL CONDUCTIVITY = ',8X,F8.4/
1      ' AVERAGE OF MEAN TEMPERATURES = ',F8.4)
C
C
C FORMATS FOR OUTPUT OF COVER SHEET. (1120-1260)
C
0339 1120 FORMAT ('1',///43X,'TEST LABORATORY RE',
1      ' P O R T'///)
0340 1130 FORMAT ('S',3X,'TO: ',14A1)
0341 1140 FORMAT ('+',2X,'D',3A1.65X,'DATE: ',9A1/)
0342 1150 FORMAT (/4X,'LTR NO.: ',7A1)
0343 1160 FORMAT (/4X,'E. P. NO.: ',14A1///)
0344 1170 FORMAT (/4X,'MATERIAL: ',14A1)
0345 1180 FORMAT (/4X,'TEST SPECIFICATIONS: ',14A1)
0346 1190 FORMAT (/11X,'SPECIMEN NAME',29X,'THERMAL CONDUCTIVITY',23X
1      ', MEAN TEMPERATURE')
0347 1200 FORMAT (47X,'W/(M*K) BTU*IN/H*FT*FT*DEGREE(F)',12X
1      ', DEGREES C DEGREES F')
0348 1210 FORMAT (11X,'-----',15X,'-----',
1      '-----',12X,'-----')

```

0349 1220 FORMAT (11X,14A1,' AND ',14A1,2X,F6.2,12X,F6.2,23X,F6.1,7X,F6.1)
0350 1230 FORMAT (////19X,80A1)
0351 1240 FORMAT (///\$',3X,'TESTED BY: ',14A1)
0352 1250 FORMAT ('+ /GP1000-VERS1 //',26A1)
0353 1260 FORMAT (/// APPROVED BY:')

C

C

C

C

C

C

FORMATS TO INCLUDE EQUIPMENT INFORMATION FOR ARCHIVAL PURPOSES.
(1270-1400)

0354 1270 FORMAT (' ENTER NAME AND/OR DESCRIPTION OF EQUIPMENT',
1 ' INVOLVED. [80A1]: ')
0355 1280 FORMAT (80A1)
0356 1290 FORMAT (' EQUIPMENT: ',80A1)
0357 1300 FORMAT ('\$ENTER BKC NUMBER. [8A1]: ')
0358 1310 FORMAT (8A1)
0359 1320 FORMAT (' BKC NUMBER: ',8A1)
0360 1330 FORMAT ('\$ENTER CALIBRATION DATE. [18A1]: ')
0361 1340 FORMAT (18A1)
0362 1350 FORMAT (' CALIBRATION DATE: ',18A1)
0363 1360 FORMAT ('\$ENTER CALIBRATION EXPIRATION DATE. [18A1]: ')
0364 1365 FORMAT (' EXPIRATION DATE: ',18A1)
0365 1370 FORMAT (' ENTER ARCHIVE COMMENT. [80A1 * NLINES]: ')
0366 1372 FORMAT (0,80A1)
0367 1375 FORMAT (' COMMENT: ')
0368 1380 FORMAT (' ',80A1)
0369 1390 FORMAT ('\$DO YOU WANT TO RUN THE PROGRAM AGAIN? [Y/N]: ')
0370 1400 FORMAT (' ')
0371 END


```

1      .TITLE NOLOCK
2      .IDENT/062579/
3
4      ;+
5      ; JUNE 1979
6      ; D. E. LACEY
7      ;
8      ; THIS FORTRAN CALLABLE SUBROUTINE, IF CALLED IMMEDIATELY BEFORE AN
9      ; EXISTING FILE IS OPENED, WILL PREVENT THAT FILE FROM BEING LOCKED. NO
10     ; MATTER HOW THE TASK EXITS, THE BIT BEING SET IN THE FDB IS DOCUMENTED
11     ; IN APPENDIX "A" OF THE IAS/RSX-11 I/O OPERATIONS MANUAL.
12     ;
13     ; CALLING SEQUENCE: CALL NOLOCK(LUN)
14     ;
15     ;-
16     .GLOBL NOLOCK
17
18     ;
19     ; D.FDB=14
20     ; F.ACTL=76
21     ; LENGTH OF FORTRAN FDB HEADER
22     ; OFFSET TO CONTROL WORD
23
24     NOLOCK:
25     MOV     02(R5),R2
26     JSR     PC,$FCHNL
27     BCS     10$
28     BIS     *101000,D.FDB+F.ACTL(R0)
29
30     10$:
31     RETURN
32
33     .END

```

Appendix C
SAMPLE OUTPUTS

RUN THMCON
ENTER LTR # [7A1]: 062179
ENTER SPECIMEN ID# [2A1]: GR
ENTER EMPLOYEE NUMBER [6A1]: 51545
ENTER NUMBER OF SAMPLES (1 OR 2) [I2]: 2
ENTER SPECIMEN NAME [10]: #001
ENTER SPECIMEN 2'S NAME [10]: #002
ENTER THICKNESS OF UPPER AND LOWER SAMPLES [2F8.5]: .492,2\2\,492
ENTER SET POINT TEMPERATURE [F6.2]: 77.
ENTER MATERIAL TO BE TESTED [8A1]: RUBBER
ENTER CHARGE NUMBER [8A1]: 000
ENTER NAME OF PERSON REQUESTING TEST [14A1]: D. GENSER
ENTER DEPARTMENT OF PERSON REQUESTING TEST [3A1]: 816
ENTER TEST SPECIFICATION [12A1]: NONE
IS GUARD HEATER POT OPEN 5 TURNS? [Y/N]: Y
IS MAIN HEATER SET AT 3 VOLTS? [Y/N]: Y
PRESS CARRIAGE RETURN WHEN READY:
TTO -- STOP
>ACT
...MCR
...SYS
GHPDAC
WAIT15
>

```

RUN GHPRPT
WHAT IS THE LTR #? [7A1]: 022679
WHAT IS THE SAMPLE IDENTIFICATION NUMBER? (ID#) [2A1]: SC
IS THE EXPERIMENT COMPLETE? [Y/N]: Y
YOU MAY OUTPUT TO:
  3  AN ARCHIVAL FILE
  4  THE LINE PRINTER
  5  YOUR TERMINAL
WHICH DO YOU CHOOSE? [11]: 4
CREATE A COVER SHEET? [Y/N]: Y
INCLUDE COMMENT ON COVER SHEET? [Y/N]: Y
ENTER THE COMMENT. [80A1]:
THIS IS THE COMMENT T\T\FOR THE TOPIV\ICAL REPORT.
LIST INITIALIZATION DATA AND RESULTS? [Y/N]: Y
DO YOU WANT TO RUN THE PROGRAM AGAIN? [Y/N]: Y
WHAT IS THE LTR #? [7A1]: 022679
WHAT IS THE SAMPLE IDENTIFICATION NUMBER? (ID#) [2A1]: SC
IS THE EXPERIMENT COMPLETE? [Y/N]: Y
YOU MAY OUTPUT TO:
  3  AN ARCHIVAL FILE
  4  THE LINE PRINTER
  5  YOUR TERMINAL
WHICH DO YOU CHOOSE? [11]: 3
INCLUDE COMMENT ON COVER SHEET? [Y/N]: Y
ENTER THE COMMENT. [80A1]:
THIS IS THE COMMENT FOR THE TOPICAL REPORT.
ENTER NAME AND/OR DESCRIPTION OF EQUIPMENT INVOLVED. [80A1]:
12" CALIPER
ENTER BKC NUMBER. [8A1]: 123456
ENTER CALIBRATION DATE. [18A1]: 10/15/79
ENTER CALIBRATION EXPIRATION DATE. [18A1]: 10/15/99
ENTER ARCHIVE COMMENT. [80A1 * NLINES]:
THIS IS THE ARCHIVAL COMMENT.
THIS IS THE SECOND LINE OF COMMENT.
ETC.

ENTER NAME AND/OR DESCRIPTION OF EQUIPMENT INVOLVED. [80A1]:
^Z

DO YOU WANT TO RUN THE PROGRAM AGAIN? [Y/N]: N
>

```

GUARDED HOT PLATE RESULTS

LTR NO.: 022679
 SPEC. ID. NO.: GH
 REQUESTED BY: SAM DEPT 816
 CHARGE NUMBER: 12345678
 TESTED BY: G. HUEY
 NUMBER OF SAMPLES TESTED: 2
 THICKNESS OF UPPER SAMPLE: 0.49200
 THICKNESS OF LOWER SAMPLE: 0.49200
 SAMPLE NAME: FIRST ONE
 SAMPLE NAME: SECOND ONE
 SET POINT TEMPERATURE: 77.00
 MATERIAL TESTED: RUBBER
 TEST SPECIFICATION: NONE

DATA RECORDED ON: 26-FEB-79 AT: 08:55:44
 POWER SUPPLY RELAY NO.: 4
 SOLENOID RELAY NO.: 5
 FIRST MAIN HEATER RELAY NO.: 6
 MAIN HEATER CURRENT A/D CHANNEL: 16
 MAIN HEATER VOLTAGE A/D CHANNEL: 19
 GUARD HEATER A/D CHANNEL: 20
 FIRST THERMOCOUPLE A/D CHANNEL: 62
 BUCKING HEATER A/D CHANNEL: 71

DATA SET 1

MAIN HEATER VOLTAGE - VOLTS: 6.3361
 MAIN HEATER CURRENT - AMPS: 0.8530
 GUARD DELTA T - MILLIVOLTS: 0.0098
 T.C. 1 - DEGREES F: 52.5875
 T.C. 2 - DEGREES F: 103.2125
 T.C. 3 - DEGREES F: 101.1875
 T.C. 4 - DEGREES F: 52.1375
 T.C. 5 - DEGREES F: 51.6875
 T.C. 6 - DEGREES F: 103.6625
 T.C. 7 - DEGREES F: 101.4125
 T.C. 8 - DEGREES F: 55.2875
 MEAN TEMPERATURE - DEGREES F: 77.2813
 THERMAL CONDUCTIVITY: 1.0462
 [BTU*IN/H*FT*FT*DEGREE(F)]

 *
 * TEMP. DROP DIFFERS BY 3.2% *
 *
 * DOES NOT MEET ASTM C177 *
 *

HEAT LOSS THROUGH SIDES: 0.0147

DATA SET 2

MAIN HEATER VOLTAGE - VOLTS: 6.3410
 MAIN HEATER CURRENT - AMPS: 0.8544
 GUARD DELTA T - MILLIVOLTS: -0.0098
 T.C. 1 - DEGREES F: 52.1375
 T.C. 2 - DEGREES F: 103.2125
 T.C. 3 - DEGREES F: 101.1875
 T.C. 4 - DEGREES F: 51.9125
 T.C. 5 - DEGREES F: 51.4625
 T.C. 6 - DEGREES F: 103.4375
 T.C. 7 - DEGREES F: 101.4125
 T.C. 8 - DEGREES F: 54.8375
 MEAN TEMPERATURE - DEGREES F: 77.1125
 THERMAL CONDUCTIVITY: 1.0418
 [BTU*IN/H*FT*FT*DEGREE(F)]

 *
 * TEMP. DROP DIFFERS BY 3.6%
 *
 * DOES NOT MEET ASTM C177
 *

HEAT LOSS THROUGH SIDES: 0.0135

DATA SET 3

MAIN HEATER VOLTAGE - VOLTS: 6.3361
 MAIN HEATER CURRENT - AMPS: 0.8530
 GUARD DELTA T - MILLIVOLTS: 0.0000
 T.C. 1 - DEGREES F: 52.3625
 T.C. 2 - DEGREES F: 103.2125
 T.C. 3 - DEGREES F: 101.1875
 T.C. 4 - DEGREES F: 51.9125
 T.C. 5 - DEGREES F: 51.4625
 T.C. 6 - DEGREES F: 103.4375
 T.C. 7 - DEGREES F: 101.4125
 T.C. 8 - DEGREES F: 54.8375
 MEAN TEMPERATURE - DEGREES F: 77.1608
 THERMAL CONDUCTIVITY: 1.0415
 [BTU*IN/H*FT*FT*DEGREE(F)]

 *
 * TEMP. DROP DIFFERS BY 3.1%
 *
 * DOES NOT MEET ASTM C177
 *

*

HEAT LOSS THROUGH SIDES: 0.0124

DATA SET 4

MAIN HEATER VOLTAGE - VOLTS: 6.3361
 MAIN HEATER CURRENT - AMPS: 0.8530
 GUARD DELTA T - MILLIVOLTS: 0.0098
 T.C. 1 - DEGREES F: 52.5875
 T.C. 2 - DEGREES F: 103.2125
 T.C. 3 - DEGREES F: 101.1875
 T.C. 4 - DEGREES F: 52.1375
 T.C. 5 - DEGREES F: 51.6875
 T.C. 6 - DEGREES F: 103.4375
 T.C. 7 - DEGREES F: 101.4125
 T.C. 8 - DEGREES F: 54.8375
 MEAN TEMPERATURE - DEGREES F: 77.2813
 THERMAL CONDUCTIVITY: 1.0462
 [BTU*IN/H*FT*FT*DEGREE(F)]

 *
 * TEMP. DROP DIFFERS BY 3.2% *
 *
 * DOES NOT MEET ASTM C177 *
 *

HEAT LOSS THROUGH SIDES: 0.0113

DATA SET 5

MAIN HEATER VOLTAGE - VOLTS: 6.3361
 MAIN HEATER CURRENT - AMPS: 0.8530
 GUARD DELTA T - MILLIVOLTS: 0.0147
 T.C. 1 - DEGREES F: 52.3625
 T.C. 2 - DEGREES F: 103.2125
 T.C. 3 - DEGREES F: 101.4125
 T.C. 4 - DEGREES F: 51.9125
 T.C. 5 - DEGREES F: 51.4625
 T.C. 6 - DEGREES F: 103.6625
 T.C. 7 - DEGREES F: 101.6375
 T.C. 8 - DEGREES F: 54.6125
 MEAN TEMPERATURE - DEGREES F: 77.2250
 THERMAL CONDUCTIVITY: 1.0392
 [BTU*IN/H*FT*FT*DEGREE(F)]

```

*
* TEMP. DROP DIFFERS BY 2.7%
*
* DOES NOT MEET ASTM C177
*
*
* * * * *

```

HEAT LOSS THROUGH SIDES: 0.0123

DATA SET 6

```

MAIN HEATER VOLTAGE - VOLTS: 6.3410
MAIN HEATER CURRENT - AMPS: 0.8534
GUARD DELTA T - MILLIVOLTS: 0.0099
T.C. 1 - DEGREES F: 52.5875
T.C. 2 - DEGREES F: 103.4375
T.C. 3 - DEGREES F: 101.4125
T.C. 4 - DEGREES F: 52.3625
T.C. 5 - DEGREES F: 51.9125
T.C. 6 - DEGREES F: 103.6625
T.C. 7 - DEGREES F: 101.6375
T.C. 8 - DEGREES F: 55.0625
MEAN TEMPERATURE - DEGREES F: 77.4500
THERMAL CONDUCTIVITY: 1.0453
[ BTU*IN/H*FT*FT*DEGREE(F) ]

```

```

* * * * *
*
* TEMP. DROP DIFFERS BY 3.6%
*
* DOES NOT MEET ASTM C177
*
*
* * * * *

```

HEAT LOSS THROUGH SIDES: 0.0124

DATA SET 7

```

MAIN HEATER VOLTAGE - VOLTS: 6.3361
MAIN HEATER CURRENT - AMPS: 0.8534
GUARD DELTA T - MILLIVOLTS: 0.0000
T.C. 1 - DEGREES F: 52.5875
T.C. 2 - DEGREES F: 103.4375
T.C. 3 - DEGREES F: 101.4125
T.C. 4 - DEGREES F: 52.1375
T.C. 5 - DEGREES F: 51.9125
T.C. 6 - DEGREES F: 103.6625
T.C. 7 - DEGREES F: 101.6375
T.C. 8 - DEGREES F: 54.8375
MEAN TEMPERATURE - DEGREES F: 77.3938
THERMAL CONDUCTIVITY: 1.0421

```


[BTU*IN/H*FT*FT*DEGREE(F)]

*
* TEMP. DROP DIFFERS BY 3.1% *
*
* DOES NOT MEET ASTM C177 *
*

HEAT LOSS THROUGH SIDES: 0.0124

DATA SET 8

MAIN HEATER VOLTAGE - VOLTS: 6.3361
MAIN HEATER CURRENT - AMPS: 0.8530
GUARD DELTA T - MILLIVOLTS: 0.0195
T.C. 1 - DEGREES F: 52.8125
T.C. 2 - DEGREES F: 103.4375
T.C. 3 - DEGREES F: 101.6375
T.C. 4 - DEGREES F: 52.3625
T.C. 5 - DEGREES F: 51.9125
T.C. 6 - DEGREES F: 103.0875
T.C. 7 - DEGREES F: 101.6375
T.C. 8 - DEGREES F: 55.0625
MEAN TEMPERATURE - DEGREES F: 77.5625
THERMAL CONDUCTIVITY: 1.0439
[BTU*IN/H*FT*FT*DEGREE(F)]

*
* TEMP. DROP DIFFERS BY 2.7% *
*
* DOES NOT MEET ASTM C177 *
*

HEAT LOSS THROUGH SIDES: 0.0113

DATA SET 9

MAIN HEATER VOLTAGE - VOLTS: 6.3361
MAIN HEATER CURRENT - AMPS: 0.8530
GUARD DELTA T - MILLIVOLTS: 0.0244
T.C. 1 - DEGREES F: 52.5875
T.C. 2 - DEGREES F: 103.6625
T.C. 3 - DEGREES F: 101.6375
T.C. 4 - DEGREES F: 52.1375
T.C. 5 - DEGREES F: 51.6875
T.C. 6 - DEGREES F: 104.1125

T.C. 7 - DEGREES F: 101.8625
T.C. 8 - DEGREES F: 54.8375
MEAN TEMPERATURE - DEGREES F: 77.5063
THERMAL CONDUCTIVITY: 1.0368
[BTU*IN/H*FT*FT*DEGREE(F)]

*
* TEMP. DROP DIFFERS BY 3.1% *
*
* DOES NOT MEET ASTM C177 *
*

HEAT LOSS THROUGH SIDES: 0.0123
THERMAL CONDUCTIVITY = 1.0426
AVERAGE OF MEAN TEMPERATURES = 77.3313

TEST LABORATORY REPORT

TO: SAM

D/016

DATE: 26-FEB-79

LTR NO.: 022679

E. P. NO.: 12345678

MATERIAL: RUBBER

TEST SPECIFICATIONS: NONE

SPECIMEN NAME		THERMAL CONDUCTIVITY		MEAN TEMPERATURE	
		W/(M*K)	BTU*IN/H*FT*FT*DEGREE(F)	DEGREES C	DEGREES F
FIRST ONE	AND SECOND ONE	0.15	1.04	25.2	77.3

THIS IS THE COMMENT FOR THE TOPICAL REPORT.

TESTED BY: G. HUEY

/GP1800-VERS1 /DM0:[300,011]022679SC.GPD

APPROVED BY:

1 GUARDED HOT PLATE RESULTS

LTR NO.: 022679
 SPEC. ID. NO.: GH
 REQUESTED BY: SAM DEPT 816
 CHARGE NUMBER: 12345678
 TESTED BY: G. HUEY
 NUMBER OF SAMPLES TESTED: 2
 THICKNESS OF UPPER SAMPLE: 0.49200
 THICKNESS OF LOWER SAMPLE: 0.49200
 SAMPLE NAME: FIRST ONE
 SAMPLE NAME: SECOND ONE
 SET POINT TEMPERATURE: 77.00
 MATERIAL TESTED: RUBBER
 TEST SPECIFICATION: NONE
 DATA RECORDED ON: 26-FEB-79 AT: 08:55:44
 POWER SUPPLY RELAY NO.: 4
 SOLENOID RELAY NO.: 5
 FIRST MAIN HEATER RELAY NO.: 6
 MAIN HEATER CURRENT A/D CHANNEL: 16
 MAIN HEATER VOLTAGE A/D CHANNEL: 19
 GUARD HEATER A/D CHANNEL: 20
 FIRST THERMOCOUPLE A/D CHANNEL: 62
 BUCKING HEATER A/D CHANNEL: 71

0

DATA SET 1
 MAIN HEATER VOLTAGE - VOLTS: 6.3361
 MAIN HEATER CURRENT - AMPS: 0.8530
 GUARD DELTA T - MILLIVOLTS: 0.0098
 T.C. 1 - DEGREES F: 52.5875
 T.C. 2 - DEGREES F: 103.2125
 T.C. 3 - DEGREES F: 101.1875
 T.C. 4 - DEGREES F: 52.1375
 T.C. 5 - DEGREES F: 51.6875
 T.C. 6 - DEGREES F: 103.6625
 T.C. 7 - DEGREES F: 101.4125
 T.C. 8 - DEGREES F: 55.2875
 MEAN TEMPERATURE - DEGREES F: 77.2813
 THERMAL CONDUCTIVITY: 1.0462
 [BTU*IN/H*FT*FT*DEGREE(F)]

 *
 * TEMP. DROP DIFFERS BY 3.2% *
 *
 * DOES NOT MEET ASTM C177 *
 *

HEAT LOSS THROUGH SIDES: 0.0147

0

DATA SET 2

MAIN HEATER VOLTAGE - VOLTS: 6.3410
 MAIN HEATER CURRENT - AMPS: 0.8544
 GUARD DELTA T - MILLIVOLTS: -0.0098
 T.C. 1 - DEGREES F: 52.1375
 T.C. 2 - DEGREES F: 103.2125
 T.C. 3 - DEGREES F: 101.1875
 T.C. 4 - DEGREES F: 51.9125
 T.C. 5 - DEGREES F: 51.4625
 T.C. 6 - DEGREES F: 103.4375
 T.C. 7 - DEGREES F: 101.4125
 T.C. 8 - DEGREES F: 54.8375
 MEAN TEMPERATURE - DEGREES F: 77.1125
 THERMAL CONDUCTIVITY: 1.0418
 [BTU*IN/H*FT*FT*DEGREE(F)]

 * *
 * TEMP. DROP DIFFERS BY 3.6% *
 * *
 * DOES NOT MEET ASTM C177 *
 * *

HEAT LOSS THROUGH SIDES: 0.0135

0

DATA SET 3

MAIN HEATER VOLTAGE - VOLTS: 6.3361
 MAIN HEATER CURRENT - AMPS: 0.8530
 GUARD DELTA T - MILLIVOLTS: 0.0000
 T.C. 1 - DEGREES F: 52.3625
 T.C. 2 - DEGREES F: 103.2125
 T.C. 3 - DEGREES F: 101.1875
 T.C. 4 - DEGREES F: 51.9125
 T.C. 5 - DEGREES F: 51.4625
 T.C. 6 - DEGREES F: 103.4375
 T.C. 7 - DEGREES F: 101.4125
 T.C. 8 - DEGREES F: 54.8375
 MEAN TEMPERATURE - DEGREES F: 77.1688
 THERMAL CONDUCTIVITY: 1.0415
 [BTU*IN/H*FT*FT*DEGREE(F)]

 * *
 * TEMP. DROP DIFFERS BY 3.1% *
 * *
 * DOES NOT MEET ASTM C177 *
 * *

HEAT LOSS THROUGH SIDES: 0.0124

0

DATA SET 4

MAIN HEATER VOLTAGE - VOLTS: 6.3361
 MAIN HEATER CURRENT - AMPS: 0.8530
 GUARD DELTA T - MILLIVOLTS: 0.0098
 T.C. 1 - DEGREES F: 52.5875
 T.C. 2 - DEGREES F: 103.2125
 T.C. 3 - DEGREES F: 101.1875
 T.C. 4 - DEGREES F: 52.1375
 T.C. 5 - DEGREES F: 51.6875
 T.C. 6 - DEGREES F: 103.4375
 T.C. 7 - DEGREES F: 101.4125
 T.C. 8 - DEGREES F: 54.8375
 MEAN TEMPERATURE - DEGREES F: 77.2813
 THERMAL CONDUCTIVITY: 1.0462
 [BTU*IN/H*FT*FT*DEGREE(F)]

 *
 * TEMP. DROP DIFFERS BY 3.2% *
 *
 * DOES NOT MEET ASTM C177 *
 *

HEAT LOSS THROUGH SIDES: 0.0115
 0

DATA SET 5

MAIN HEATER VOLTAGE - VOLTS: 5.3361
 MAIN HEATER CURRENT - AMPS: 0.8530
 GUARD DELTA T - MILLIVOLTS: 0.0147
 T.C. 1 - DEGREES F: 52.3625
 T.C. 2 - DEGREES F: 103.2125
 T.C. 3 - DEGREES F: 101.4125
 T.C. 4 - DEGREES F: 51.9125
 T.C. 5 - DEGREES F: 51.4625
 T.C. 6 - DEGREES F: 103.6625
 T.C. 7 - DEGREES F: 101.6375
 T.C. 8 - DEGREES F: 54.6125
 MEAN TEMPERATURE - DEGREES F: 77.2250
 THERMAL CONDUCTIVITY: 1.0392
 [BTU*IN/H*FT*FT*DEGREE(F)]

 *
 * TEMP. DROP DIFFERS BY 2.7% *
 *
 * DOES NOT MEET ASTM C177 *
 *

HEAT LOSS THROUGH SIDES: 0.0123
 0

DATA SET 6

MAIN HEATER VOLTAGE - VOLTS: 6.3410
 MAIN HEATER CURRENT - AMPS: 0.8534
 GUARD DELTA T - MILLIVOLTS: 0.0090
 T.C. 1 - DEGREES F: 52.5875
 T.C. 2 - DEGREES F: 103.4375
 T.C. 3 - DEGREES F: 101.4125
 T.C. 4 - DEGREES F: 52.3625
 T.C. 5 - DEGREES F: 51.9125
 T.C. 6 - DEGREES F: 103.6625
 T.C. 7 - DEGREES F: 101.6375
 T.C. 8 - DEGREES F: 55.0625
 MEAN TEMPERATURE - DEGREES F: 77.4500
 THERMAL CONDUCTIVITY: 1.0453
 [BTU*IN/H*FT*FT*DEGREE(F)]

 *
 * TEMP. DROP DIFFERS BY 3.6% *
 *
 * DOES NOT MEET ASTM C177 *
 *

HEAT LOSS THROUGH SIDES: 0.0124

0

DATA SET 7

MAIN HEATER VOLTAGE - VOLTS: 6.3361
 MAIN HEATER CURRENT - AMPS: 0.8534
 GUARD DELTA T - MILLIVOLTS: 0.0000
 T.C. 1 - DEGREES F: 52.5875
 T.C. 2 - DEGREES F: 103.4375
 T.C. 3 - DEGREES F: 101.4125
 T.C. 4 - DEGREES F: 52.1375
 T.C. 5 - DEGREES F: 51.9125
 T.C. 6 - DEGREES F: 103.6625
 T.C. 7 - DEGREES F: 101.6375
 T.C. 8 - DEGREES F: 54.8375
 MEAN TEMPERATURE - DEGREES F: 77.3938
 THERMAL CONDUCTIVITY: 1.0421
 [BTU*IN/H*FT*FT*DEGREE(F)]

 *
 * TEMP. DROP DIFFERS BY 3.1% *
 *
 * DOES NOT MEET ASTM C177 *
 *

HEAT LOSS THROUGH SIDES: 0.0124

0

DATA SET 8

MAIN HEATER VOLTAGE - VOLTS: 6.3361
 MAIN HEATER CURRENT - AMPS: 0.8530
 GUARD DELTA T - MILLIVOLTS: 0.0195
 T.C. 1 - DEGREES F: 52.6125
 T.C. 2 - DEGREES F: 103.4375
 T.C. 3 - DEGREES F: 101.6375
 T.C. 4 - DEGREES F: 52.3625
 T.C. 5 - DEGREES F: 51.9125
 T.C. 6 - DEGREES F: 103.8875
 T.C. 7 - DEGREES F: 101.6375
 T.C. 8 - DEGREES F: 55.0625
 MEAN TEMPERATURE - DEGREES F: 77.5625
 THERMAL CONDUCTIVITY: 1.0439
 [BTU*IN/H*FT*FT*DEGREE(F)]

 * *
 * TEMP. DROP DIFFERS BY 2.7% *
 * *
 * DOES NOT MEET ASTM C177 *
 * *

HEAT LOSS THROUGH SIDES: 0.0113

0.

DATA SET 9

MAIN HEATER VOLTAGE - VOLTS: 6.3361
 MAIN HEATER CURRENT - AMPS: 0.8530
 GUARD DELTA T - MILLIVOLTS: 0.0244
 T.C. 1 - DEGREES F: 52.5875
 T.C. 2 - DEGREES F: 103.6625
 T.C. 3 - DEGREES F: 101.6375
 T.C. 4 - DEGREES F: 52.1375
 T.C. 5 - DEGREES F: 51.6875
 T.C. 6 - DEGREES F: 104.1125
 T.C. 7 - DEGREES F: 101.0625
 T.C. 8 - DEGREES F: 54.8375
 MEAN TEMPERATURE - DEGREES F: 77.5063
 THERMAL CONDUCTIVITY: 1.0368
 [BTU*IN/H*FT*FT*DEGREE(F)]

 * *
 * TEMP. DROP DIFFERS BY 3.1% *
 * *
 * DOES NOT MEET ASTM C177 *
 * *

HEAT LOSS THROUGH SIDES: 0.0123
 THERMAL CONDUCTIVITY = 1.0425

AVERAGE OF MEAN TEMPERATURES = 77.3313

1

TEST LABORATORY REPORT

S TO: SAM
+ D/816

DATE: 26-FEB-79

LTR NO.: 022679

E. P. NO.: 12345678

MATERIAL: RUBBER

TEST SPECIFICATIONS: NONE

SPECIMEN NAME		THERMAL CONDUCTIVITY		MEAN TEMPERATURE	
		W/(MMK)	BTU*IN/IN*FT*FT*DEGREE(F)	DEGREES C	DEGREES F
FIRST ONE	AND SECOND ONE	0.15	1.04	25.2	77.3

THIS IS THE COMMENT FOR THE TOPICAL REPORT.

S TESTED BY: G. HUEY
+ /GP1888-VER51 /DM0:0398,011022679SC.GHP

APPROVED BY:

EQUIPMENT: 12" CALIPER
BKC NUMBER: 232999
CALIBRATION DATE: 3/21/78
EXPIRATION DATE: 8/21/79
COMMENT:
THIS IS A LINE OF ARCHIVAL COMMENT.
THIS IS ANOTHER LINE OF ARCHIVAL COMMENT.

BDX-613-2430

AUTOMATION OF A GUARDED HOT PLATE THERMAL CONDUCTIVITY INSTRUMENT, L. L. Holland, Topical, June 1980.

The Thermo-Physics Corporation's GP-1800 guarded hot plate thermal conductivity instrument has been automated using a Digital Equipment Corporation PDP 11/35 minicomputer with an Industrial Control Subsystem Remote (ICR). Automation included constructing a hardware link between the instrument and the minicomputer system and designing, writing, and documenting software to perform equipment

SPECIAL PROJECTS: Thermal Testing

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The Thermo-Physics Corporation's GP-1800 guarded hot plate thermal conductivity instrument has been automated using a Digital Equipment Corporation PDP 11/35 minicomputer with an Industrial Control Subsystem Remote (ICR). Automation included constructing a hardware link between the instrument and the minicomputer system and designing, writing, and documenting software to perform equipment

control, data acquisition, data reduction,
and report generation. The software was
designed and written so that non-programmers
can run the thermal conductivity experiment.

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