On-line Measurement of Yarn Faults through Interfacing with Computer

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Yarn is passed through the desired slot of the capacitance probe/sensor. The variation in mass is converted to analogue signal and displayed in the meter of the machine. The output signal (mv dc) is fed to an instrumentation amplifier, which amplifies the input signal to the desired level as required by the AD conversion card. This is achieved by varying the sensitivity and span control of the amplifier unit. The amplified output is measured with multimeter and adjusted according to the requirement. This signal is fed to the computer in 'on-line manner' through the AD card and on-line mass and diameter variation are represented through graph. The variation in the mass and diameter values is also stored and can be displayed on the monitor of the computer. Thus, the imperfections present in a yarn can be calculated and are displayed on the monitor of the computer.

Keywords: On-line measurement; Sensor; Measurement of yarn faults; AD card; Q-Basic language

INTRODUCTION

On-line Measurement of Yarn Faults during Spinning[1,2]

Application of computer, microprocessors and on-line measurement and monitoring of different parameters in the preparatory and spinning process have become the common feature of modern spinning machines. Autolevelling at carding and draw frame, automatic material correction can be introduced that will ensure an improvement both in productivity and quality for all subsequent processes with continuous on-line data collection in different type of spinning systems. The introduction of these systems, will however, result in a reduction in the number of 'off-line' quality control processes, results in improving productivity and quality control in yarn production.

Due to more and more emphasis on diversification and manufacturing of yarns for export, the question of improving upon the existing method of measurement of evenness is loosing importance and on-line measurement of evenness and yarn faults are now essential but the process could not be adopted due to very high cost of the instrument and software. In this project, an attempt has been made to develop the instrument and software at negligible cost, so that the same can be used by most of the spinning mill.

The nature of irregularity observed in a yarn has two distinct features:

- A general and gradual variation of the diameter or mass[3] of yarn throughout its length; and
- A localized conglomeration of fibres producing thick and thin places and neps at certain intervals along the length of the yarn.

In the previous paper, the measurement of mass variation has been discussed. In this research work, measurement of yarn faults with and software-controlled digital data processing technique having a distinct advantage of yielding more accurate results and higher reliability.

Faults—Classification and Measurement[4]

Yarn faults may be defined as yarn irregularities that can lead to difficulties in subsequent production stages, or to defects in fabric. Faults can be broadly classified into two categories as in Figure 1. The seldom-occurring faults have a cross-section of +100% and more and their frequency is very small compared to that of frequently occurring faults.

Frequently Occurring Faults

These faults can be divided into three main classes. They are:

1. Thick places
2. Thin places
3. Neps

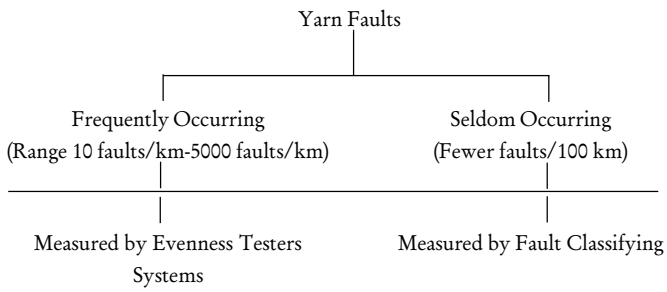

Figure 1 Yarn faults classification

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These faults, generally referred to as imperfections, can be further subdivided into four levels depending upon the size of fault with reference to mean yarn cross-section.

Thin (%)	–30	–40	–50	–60
Thick (%)	+100	+70	+50	+35
Neps (%)	+400	+280	+200	+140

Nep is a thick place having length shorter than 4 mm with a reference length of 1 mm. Thick places are longer than 4 mm and shorter than 8 cm and thin places are shorter than 8 cm. Generally for comparing the results, thin places (–50%), thick places (+50%) and neps (+200%) are chosen.

Seldom Occurring Faults

The faults which occur less frequently like slubs, fly, piecing etc are referred to as seldom occurring faults. These faults are generally measured on either uster classimat system or classi-fault system.

Classimat System UCM II

The classimat UCM II system provides a detailed break up of yarn faults based on the length and dimension of the faults. The different classes of faults are shown in Figure 2.

There are totally 23 types of faults: each fault is identified by an alphabet; the alphabet represents the length range of the fault. 'A' faults have a length range of 0.1 cm-1 cm, 'B' faults 1 cm-2 cm, 'C' faults 2 cm-4 cm and so on. The alphabets A to G indicate the thick yarn faults while the letters represent the thin faults.

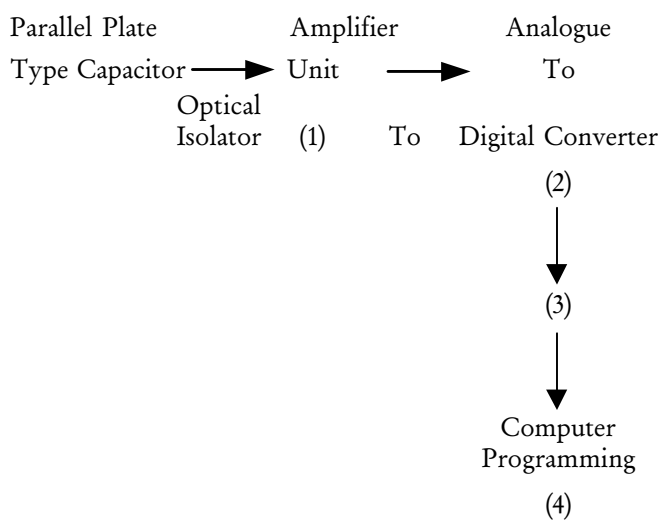


Figure 2 Block schematic diagram of the measurement process[7]

Numerical values indicate the percentage increase in cross-sectional size. The number 1 represents the fault of size +100% up to +150% over the nominal cross-section in case of thick places and –30% up to –45% in case of thin places. The number 2 means +150% up to +250% for thick places and –45% up to –65% for thin places and so on.

Specification of the Major Components used for Development of Amplifier Unit[8]

1. Operational amplifier: CA 3140 having input impedance 1.5 × 106.
2. Operational amplifier: LF 356 having input impedance 1 × 106.
3. Power supply (0-18 V dc, 500 amp) : LM 317T adjustable voltage regulator.
4. Power supply (0-12 V dc, 500 amp) : LM 7812 +ve voltage regulator.

Precaution taken in the Measuring System

1. Proper ear thing.
2. Proper shielding to avoid stray noises.
3. Selection of good quality components required for the development of the amplifier and dc power supply unit.
4. Input voltage in the computer should never increase more than 10 V.

Software Development

1. Mass variation in the yarn is measured by capacitive type measuring head/sensor/probe.
2. The variation in mass in + and – range is observed on the galvanometer.
3. Output voltage from the capacitor varies according to the mass variation measured by the sensor.
4. Output voltage from the capacitor (600 mv dc-1600 mv dc) is fed to the instrumentation amplifier in dc mode for amplifying the dc voltage in the desired range of the AD card (0 V-10 V).
5. The output voltage for maximum and minimum mass variation is measured by means of multimeter.
6. The voltage variation is fed analogically to the analogue to digital card.
7. The maximum and minimum voltage is for maximum and minimum diameter variation can be represented by the software programming and the yarn faults can be measured by the software programming by using suitable formula.

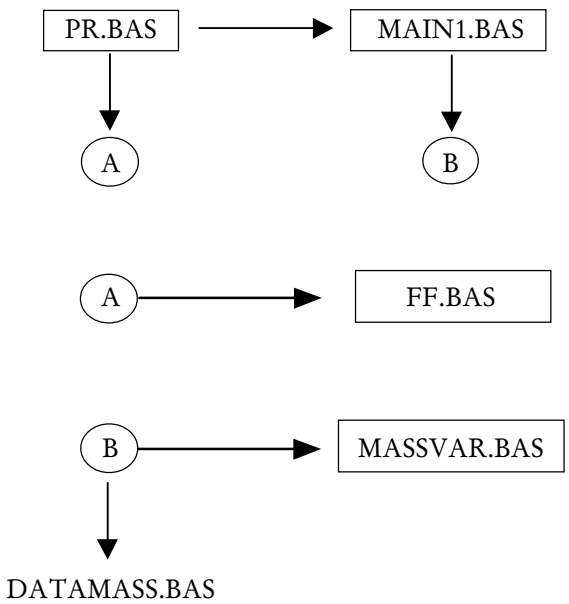


Figure 3 Flowchart of the programming

8. Those digital data are displayed on the monitor graphically in on-line manner by means of software programming.
9. Those on-line graphical data are stored in a memory by means of software programming.

Software Programming

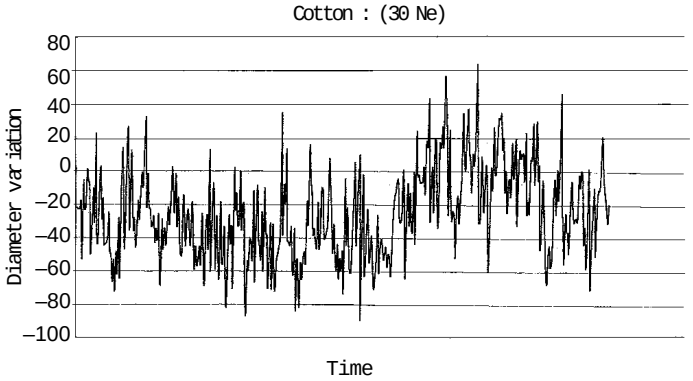
The entire logic of data capturing and subsequent on-line data display using menu driven interactive format has been implemented using the Q-BASIC[1] programming language. The flowchart of programming control flow has been shown in Figure 3.

EXPERIMENTAL RESULTS AND DISCUSSION

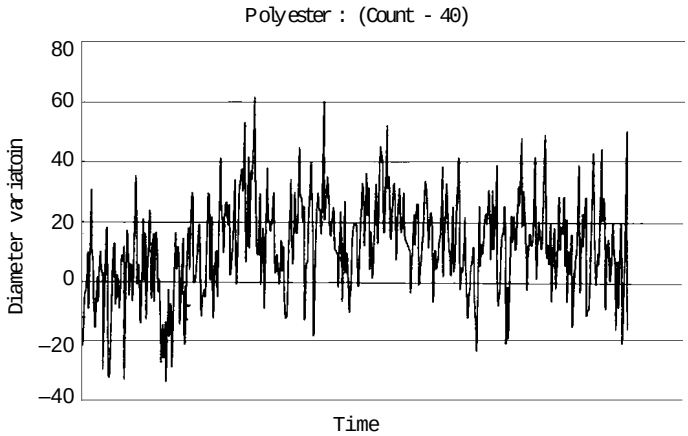
Parallel type capacitors actually sense the mass by means of capacity variation of the system. But in this project work, the mass variation has been converted to diameter variation by developing software and instrument. The output signal corresponding to different count gives a polynomial equation,

Table 1 Observed yarn faults (per km of yarn) on the computer screen

Cotton		
Count = 30		
Number of thick places	=	884
Number of thin places	=	156
Number neps	=	35
Polyester		
Count = 40		
Number of thick places	=	13
Number of thin places	=	765
Number of neps	=	2



On-line measurement of cotton yarn imperfections as shown on the computer screen



On-line measurement of polyester yarn imperfections as shown on the computer screen

which is given in the programming part. Two different such equations have been obtained one for cotton and another for polyester. The signal from the parallel type capacitor has been fed to the computer through the AD card. Due to the variation of yarn diameter, the output signal also varies. The yarn diameter and its variation have been calculated from the polynomial equation and thus, the imperfections can also be calculated. Though today's UT-3 machines are available from which U%, thick place, thin place and neps can be calculated but the UT-3 is very costly and it is not possible to achieve by all the means. The software, which has been developed in Q-Basic, by interfacing with computer, the m/c with capacitor (parallel plate type) becomes fully automatic and economic. Now, it is very easier to measure the diameter, its variation, CV%, mass variation and PMD.

CONCLUSION

1. It is a real time information measurement and if there is any defect it can be rectified immediately.
2. The process is cost effective, informative and time saving.
3. The diameter of the yarn, which is near about original diameter, can be calculated.
4. The CV and diameter can be measured.

5. By the application of this software in Q-Basic and interfacing with computer the conventional uster can be modified and it is comparable to present generation UT-3 and it is economically too cheaper.

AS ON COMPUTER SCREEN AFTER RUNNING THE PROGRAMME

Step-1

◀ MAIN MENU ▶ ◀ SUB MENU ▶

THICK, THIN, NEPS ▶ ON-LINE GRAPHICAL REPRESENTATION ▶

DIA ▶ ON-LINE AVERAGE YARN DIA ▶

PRESS SPACE BAR TO GO TO NEXT MENU....

PRESS ENTER TO GO TO NEXT SUB MENU....

PRESS ESC TO CLEAR THE OPEN MENU BAR....

Step-2 (for Yarn Faults)

Enter the machine speed (meter per minute)

?

Enter the yarn count (10 to 60)

?

Enter the thick percentage (general val 50%)

?

Enter the thin percentage (general val 50%)

?

Enter the neps percentage (general val 200%)

?

Enter the type of yarn 1-Cotton, 2-Polyester

?

Enter 1 to see the original dia/time

Enter 2 to see the dia variation with respect to time

?

Step-3

DIAMETER VARIATION =

DIAMETER VARIATION =

DIAMETER VARIATION =

DIAMETER VARIATION =

DIAMETER VARIATION =

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DIAMETER VARIATION =

DIAMETER VARIATION =

AVERAGE DIAMETER VARIATION (PERCENTAGE) =

CO-EFFICIENT OF VARIATION (%) =

Press Pg Up to go to previous page

Step-4

PER KILOMETER OF YARN

NUMBER OF THICK PLACES =

NUMBER OF THIN PLACES =

NUMBER OF NEPS =

REFERENCES

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APPENDIX

Pr.Bas

```
CLS
10 SCREEN 12
V$ = INKEY$
PAINT (100, 100), 0, 15
LINE (30, 10) – (637, 470), 15, B
LINE (110, 50) – (515, 130), 15, B
FOR K = 516 TO 520 STEP 1
LINE (K, 55) – (K, 135), 8
NEXT K
FOR P = 115 TO 520 STEP 1
LINE (P, 131) – (P, 135) 8
NEXT P
COLOR 2
LOCATE 5, 23
PRINT "ON-LINE MEASUREMENT OF YARN FAULTS"
COLOR 2
LOCATE 6, 27
'PRINT "AND ITS ON-LINE CONTROL"
COLOR 2
LOCATE 6, 33
PRINT "THROUGH"
COLOR 2
LOCATE 7, 25
PRINT "INERFACING WITH COMPUTER"
LINE (175, 200) – (435, 305), 15, B
LINE (185, 205) – (425, 255), 15, B
COLOR 2
LOCATE 14, 35
PRINT "UNDER"
COLOR 11
LOCATE 15, 26
PRINT "DR SATYAKI BHATTACHARYYA"
COLOR 2
LOCATE 18, 25
PRINT "COLLEGE OF TEXTILE TECHNOLOGY"
COLOR 2
LOCATE 19, 35
PRINT "SERAMPORE"
IF V$ = CHR$(27) THEN SYSTEM
LOCATE 28, 30
COLOR 10
PRINT "PRESS C TO CONTINUE"
IF V$ = CHR$ (67) OR V$ = CHR$ (99) THEN GO TO 30
GO TO 10
'***************************** 30 '*****************************
30 CHAIN "C:\QBASIC\MAIN1.BAS"
```

MAIN1.BAS

```
CLS
10 SCREEN 12
PAINT (100, 100), 8
LINE (55, 50) – (255, 200), 7, BF
LOCATE 5, 14
COLOR 14
PRINT CHR$ (17); "MAIN MENU"; CHR$ (16)
COLOR 10
LOCATE 7, 8
PRINT "THICK, THIN, NEPS          "; CHR$ (16)
LOCATE 9,8
COLOR 10
PRINT "                MASS                "; CHR$ (16)
LOCATE 17, 8
PRINT "PRESS SPACEBAR TO GO NEXT MENU...."
LOCATE 20, 8
PRINT "PRESS ENTER TO GO NEXT SUB MENU...."
LOCATE 23, 8
PRINT "PRESS ESC TO CLEAR THE OPEN MENU BAR...."
X = 7: Y = 8
DO
        V$ = INKEY$
        IF V$ = CHR$ (32) THEN GOSUB 100
        IF X = 7 AND Y = 8 THEN
                LOCATE X, Y
```

```
                PRINT "                    "
                GOSUB 150
                GOSUB 150
                LOCATE X, Y
                PRINT "THICK, THIN, NEPS"; CHR$ (16)
                GOSUB 150
                GOSUB 150
        END IF
        IF X = 9 AND Y = 8 THEN
                LOCATE X, Y
                PRINT "                    "
                GOSUB 150
                GOSUB 150
                LOCATE X, Y
                PRINT "          MASS    ";      CHR$ (16)
                GOSUB 150
                GOSUB 150
        END IF
        IF X = 7 AND Y = 8 AND V$ = CHR$ (13) THEN
                LOCATE 7, 8
                LOCATE X, Y
                PRINT " THICK, THIN, NEPS "; CHR$ (16)
                CHAIN "C:\Q-BASIC\FF.BAS"
        END IF
        IF X = 9 AND Y = 8 AND V$ = CHR$ (13) THEN
                LOCATE 9, 8
                LOCATE X, Y
    '********************************************** SUB 100
*********************************************************
100
X = X + 2: Y = 8
IF X > 9 AND Y = 8 THEN
    X = 7 : Y = 8
END IF
RETURN
    '********************************************** SUB 150
*********************************************************
150
FOR P = 0 TO 4000 : NEXT P
RETURN
    '********************************************** SUB 400
*********************************************************
400
DO
        V$ = INKEY$
        LINE (255, 50) - (570, 200), 3, BF
        GOSUB 500
LOOP
    '********************************************** SUB 500
*********************************************************
500
LOCATE 5, 42
COLOR 12
PRINT CHR$ (17); "SUB MENU"; CHR$ (16)
COLOR 15
LOCATE 7, 37
PRINT "ON-LINE GRAPHICAL REPRESENTATION"; CHR$ (16)
LOCATE 9, 37
PRINT "ON-LINE AVERAGE YARN MASS          "; CHR$ (16)
X = 7 : Y = 37
DO
        V$ = INKEY$
        IF V$ = CHR$ (32) THEN
            X = X + 2 : Y = 37
        END IF
        IF X > 9 AND Y = 37 THEN
            X = 7 : Y = 37
        END IF
        IF V$ = CHR$ (27) THEN
            LINE (255, 50) - (570, 200), 8, BF
            GOTO 10
        END IF
        IF X = 7 AND Y = 37 THEN
            LOCATE X, Y
            PRINT "                    "
            GOSUB 150
            LOCATE X, Y
            PRINT "ON-LINE GRAPHICAL
            REPRESENTATION";
CHR$ (16)
            GOSUB 150
        END IF
        IF X = 9 AND Y = 37 THEN
```

```
                LOCATE X, Y
                PRINT "                    "
                GOSUB 150
                LOCATE X, Y
                PRINT "ON-LINE AVERAGE YARN MASS   ";
CHR$ (16)
                GOSUB 150
        END IF
        IF X = 7 AND Y = 37 AND V$ = CHR$ (13) THEN
                CHAIN "C:\Q-BASIC\MASSVAR.BAS"
        END IF
        IF X = 9 AND Y = 37 AND V$ = CHR$ (13) THEN
                CHAIN "C:\Q-BASIC\DATAMASS.BAS"
        END IF
        LOOP
```

Ff. Bas

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CLS
SCREEN 12
COLOR 10
LOCATE 4, 10
PRINT "ENTER THE MACHINE SPEED (METER PER MINUTE)"
LOCATE 5, 10
INPUT MCSPEED
LOCATE 6, 10
PRINT "ENTER THE YARN COUNT (10 TO 60)"
LOCATE 7, 10
INPUT C
LOCATE 8, 10
PRINT "ENTER THE THICK PERCENTAGE (GENERAL VAL 50%)"
LOCATE 9, 10
INPUT THICKPER
LOCATE 10, 10
PRINT "ENTER THE THIN PERCENTAGE (GENERAL VAL 50 %)"
LOCATE 11, 10
INPUT THINPER
LOCATE 12, 10
PRINT "ENTER THE NEPS PERCENTAGE (GENERAL VAL 200 %)"
LOCATE 13, 10
INPUT NEPSPER
LOCATE 14, 10
PRINT "ENTER THE TYPE OF YARN 1-COTTON, 2-POLYESTER"
LOCATE 15, 10
INPUT CHOICE
    IF CHOICE < > 1 AND CHOICE < > 2 THEN
    LOCATE 18, 10
    PRINT "TYPE CORRECT CHOICE"
    PRINT "ENTER THE TYPE OF YARN 1-COTTON, 2-POLYESTER"
    LOCATE 22, 10
    INPUT CHOICE
    END IF
    SPE = 1.4
    IF (CHOICE = 1) THEN
    SPE = 1.8
    END IF
    IF (CHOICE = 2) THEN
    SPE = 1.05
    END IF
RDIA = 0.86729 * SQR (SPE)/(SQR (C))
CLOSE #1
CLOSE #2
CLOSE #3
BA = 768
OUT (BA + 20), 192
OUT (BA + 20), 64
OUT (BA + 20), 192
X = INP (BA + 16)
Y = INP (BA + 18)
W = 256 * Y + X
V = W/65536
V1 = 10 * V * 3
LOCATE 24, 10
PRINT "ENTER 1 TO SEE THE ORIGINAL DIA/TIME"
LOCATE 25, 10
PRINT "ENTER 2 TO SEE THE DIA VARIATION WITH RESPECT TO
TIME"
LOCATE 28, 10
INPUT Z
XX = 0
YY = 0
NEPS = 0
G = 0
G4 = 0
```

```
N = 0
S = 0
TIMER ON
STARTTIME = TIMER
IF (Z = 1) THEN
OPEN "O", #1 "C:\Q-BASIC\DATA.REC"
OPEN "O", #3, "C:\Q-BASIC\CV.REC"
10 CLS
SCREEN 12
COLOR 10
DRAW "BM10, 10 CL R600 D450 1600 U450"
PAINT (100, 100), 8
LOCATE 3, 14
PRINT "ON-LINE GRAPHICAL REPRESENTATION OF DIAMETER"
LOCATE 7, 6
PRINT "0.30 MM"
LOCATE 10, 6
PRINT "0.25 MM"
LOCATE 13, 6
PRINT "0.20 MM"
LOCATE 16, 6
PRINT "0.15 MM"
LOCATE 19, 6
PRINT "0.10 MM"
LOCATE 22, 6
PRINT "0.05 MM"
LOCATE 25, 6
PRINT "0.00 MM"
LINE (100, 400) - (600, 401), 0, BF
LINE (100, 60) - (101, 400), 0, BF
A = 100 : B = 230
J = 100
DO
  BA = 768
      N = N + 1
  OUT (BA + 20), 192
  OUT (BA + 20), 64
  OUT (BA + 20), 192
  X = INP (BA + 16)
  Y = INP (BA + 18)
  W = 256 * Y + X
  V = W/65536
  V1 = 10 * V * 2.5
  IF CHOICE = 2 THEN
  V1 = 30 * V
  END IF
  IF CHOICE = 2 THEN
      DIA = (- 0.3707) * V1 * V1 - 15.768 + 4.8805 * V1
  ELSEIF CHOICE = 1 THEN
      DIA = 0.4126 * V1 - 0.0193 * V1 * V1 - 1.6278
  END IF
      LOCATE 22, 50
          PRINT "DIA ="
  LOCATE 22, 55
  PRINT USING; "#.###"; DIA
      IF (DIA < (1 - (THINPER/100)) * RDIA) THEN
      XX = XX + 1
      END IF
      IF (DIA > (1 + (THICKPER/100)) * RDIA AND DIA < (1 +
      (NEPSPER/100)) * RDIA) THEN
      YY = YY + 1
      END IF
      IF (DIA > (1 + (NEPSPER/100)) * RDIA) THEN
      NEPS = NEPS + 1
      END IF
  S = S + DIA
  AVG = S/N
IF V1 > 15 THEN
V1 = 15
END IF
IF V1 < 3 THEN
V1 = 3
END IF
LOCATE 28, 50
TIMEPAST = TIMER - STARTTIME
  RUNLENGTH = TIMEPAST * (MCSPEED/60)
  LOCATE 28, 8
  PRINT "TIME PAST= "; TIMEPAST
  LOCATE 28, 25
  PRINT "SECONDS"
  LOCATE 24, 50
```

```
  PRINT "V1 =";
PRINT USING; "##.###"; V1;
WRITE #1, DIA
IF (C > 5 AND C < 15) THEN
VR = 745
ELSEIF C > 15 AND C < 20 THEN
VR = 805
ELSEIF C > 20 AND C < 25 THEN
VR = 815
ELSEIF C > 25 AND C < 35 THEN
VR = 825
ELSEIF C > 35 AND C < 45 THEN
VR = 850
ELSEIF C > 45 AND C < 55 THEN
VR = 865
ELSE
VR = 880
END IF
LINE (A, B) - (J, VR - (V1 * 95)), 3
A = J
B = (VR - (V1 * 95))
J = J + 2
IF J = 600 THEN
J = 100
GOTO 10
END IF
DELAY1 = 7000
DO
DELAY1 = DELAY1 - 1
LOOP UNTIL DELAY1 = 0
LOOP UNTIL INKEY$ = CHR$ (27)
  END IF
      'GRAPH OF DIA VARIATION
      IF (Z = 2) THEN
OPEN "O", #1, "C:\Q-BASIC\DATA.REC"
OPEN "O", #2, "C:\Q-BASIC\DIAVAR.REC"
OPEN "O", #3, "C:\Q-BASIC\CV.REC"
IF CHOICE = 2 THEN
DIA = (- 0.3707) * V1 * V1 - 15.768 + 4.8805 * V1
ELSELF CHOICE = 1 THEN
DIA = 0.4126 * V1 - .0193 * V1 * V1 - 1.6278
END IF
DIAVAR = RDIA - DIA
P = (545 - 250 * (14.726 * RDIA * RDIA - 2.7746 * RDIA + 6.0215) - 230)
15 CLS
  SCREEN 12
      COLOR 10
    LOCATE 28, 10
    PRINT "PLEASE PRESS L TO SEE DATA"
    DRAW "BM10, 10 CL R600 D450 1600 U450"
    PAINT (100, 100), 8
    LOCATE 3, 14
    PRINT "MEASUREMENT OF IMPERFECTIONS IN A YARN"
LOCATE 5, 6
PRINT "+100%"
LOCATE 25, 6
PRINT "-100%"
LOCATE 15, 6
PRINT "0%"
LINE (80, 230) - (600, 230, 5), 0, BF
LINE (100, 60) - (101, 400), 0, BF
SD = 0
C = 0
C12 = 0
A = 100: B = 230
J = 100
DO
BA = 768
N= N + 1
OUT (BA + 20), 192
OUT (BA + 20), 64
OUT (BA + 20), 192
  X = INP (BA + 16)
  Y = INP (BA + 18)
  W = 256 * Y + X
  V = W/65536
V1 = 10 * V * 2.5
IF CHOICE = 2 THEN
V1 = V * 30
END IF
```

```
IF CHOICE = 2 THEN
DIA = (- 0.3707) * V1 * V1 - 15.768 + 4.8805 * V1
ELSEIF CHOICE = 1 THEN
DIA = (0.4126 * V1) - (0.0193 * V1 * V1) - 1.6278
END IF
LOCATE 25, 50
PRINT "DIA="
LOCATE 25, 56
PRINT USING; "0.###"; DIA
    IF (DIA < (1 - (THINPER/100)) * RDIA) THEN
    XX = XX + 1
    END IF
    IF (DIA > (1 + (THICKPER/100)) * RDIA AND DIA < (1 +
    NEPSPER/100)) * RDIA) THEN
    YY = YY + 1
    END IF
    IF (DIA > (1 + (NEPSPER/100)) * RDIA) THEN
    NEPS = NEPS + 1
    END IF
    WRITE #1, DIA
    LET D = (DIA - RDIA) * (DIA - RDIA)
    C = C + D
D12 = (DIA - RDIA)
IF D12 < 0 THEN
D12 = - D12
END IF
C12 = (C12 + D12)
IF C12 < 0 THEN
C12 = - C12
END IF
  SD = SQR (C/N)
CV = SD * 100/RDIA
PMD = CV/1.25
IF V1 > 15 THEN
V1 = 5
END IF
IF V1 < 3 THEN
V1 = 1
END IF
LET DIAVAR (PERCENT) = (DIA - RDIA) * 100/RDIA
LET D = (DIA - RDIA) * (DIA - RDIA)
C = C + D
  SD = SQR (C/N)
CV = SD * 100/RDIA
WRITE #2, DIAVAR (PERCENT)
LOCATE 28, 50
TIMEPAST = TIMER - STARTTIME
  RUNLENGTH = TIMEPAST * (MCSPEED/60)
  LOCATE 28, 10
  PRINT "TIMEPAST ="; TIMEPAST
  LOCATE 28, 25
  PRINT "SECONDS"
LINE (A, B) - (J, (780 - V1 * 90)), 3
A = J
B = 780 - V1 * 90
J = J + 2
IF J = 600 THEN
J = 100
GOTO 15
END IF
DELAY1 = 6000
DO
DELAY1 = DELAY1 - 1
LOOP UNTIL DELAY1 = 0
LOOP UNTIL INKEY$ = CHR$ (27)
END IF
SCREEN 8
COLOR 10, 8
TKIND = 0
TNIND = 0
NIND = - 1
THICKTEST = YY * 1000/RUNLENGTH
THINTEST = XX * 1000/RUNLENGTH
NEPSTEST = NEPS * 1000/RUNLENGTH
DO
TKIND = TKIND + 1
LOOP UNTIL (THICKTEST < TKIND)
DO
TNIND = TNIND + 1
LOOP UNTIL (THINTEST < TNIND)
```

```
DO
NIND = NIND + 1
LOOP UNTIL (NEPSTEST < NIND)
NIND = NIND – 1
IF (NIND < 0) THEN
NIND = 0
END IF
LOCATE 5, 20
PRINT "PER KILOMETER OF YARN"
LOCATE 8, 20
PRINT "NO OF THICK PLACES=  "; TKIND
  LOCATE 10, 20
  PRINT "NO OF THIN PLACES= "; TNIND
  LOCATE 12, 20
  PRINT "NO OF NEPS= "; NIND
  A$ = INPUT$ (1)
  CLOSE #1
  CLOSE #2
  CLOSE #3
  CHAIN "C:\Q-BASIC\MAIN1.BAS"
302 END
```

DATAMASS.BAS

```
CLS
KEY OFF
SCREEN 12
CLOSE
OPEN "I", #1, "C:\Q-BASIC\DAT1.REC"
X = 2: Y = 5
CTR = 0
C = 0
V2 = 0
S = 0
A = 0
B = 0
DO
        INPUT #1, MASS
        CTR = CTR + 1
        C = C + 1
        S = S + MASS
        LOCATE X, Y
        COLOR 12
        PRINT "MASS VARIATION = "; USING  "##########.##";
MASS
        X = X + 1
        V2 = V1 + V2
        AVGMASSVARIATION (PERCENTAGE) = S/C
          A = MASS * MASS + A
        IF X > 27 THEN
              X = 2: Y = Y + 35
        END IF
        IF CTR > 50 THEN
              CTR = 0
              COLOR 14
              LOCATE 29, 50
              PRINT "PRESS ANY KEY TO CONTINUE..."
              ANS$ = INPUT$ (1)
              CLS
              X = 2: Y = 5
              LOCATE X, Y
        END IF
LOOP UNTIL (EOF(1))
V2 = V2/C
B = A/(C – 1)
CV = SQR (B)
LOCATE 29, 15
COLOR 9
PRINT "AVERAGE MASS VARIATION (PERCENTAGE) = "; USING
"##########.##"; AVGMASSVARIATION (PERCENTAGE)
PRINT "                CO-EFFICIENT OF VARIATION = "; USING
"####.####"; CV
ANS$ = INPUT$ (1)
ANS$ = INPUT$ (1)
CHAIN "C:\Q-BASIC\MAIN1.BAS"
```