COMPUTER PROGRAMS FOR COMPUTING PARTICLE-SIZE STATISTICS OF FLUVIAL SEDIMENTS

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EXPLANATORY SYMBOLS

		see page
C_ϕ	Mean phi value of a normal-probability distribution	5
D	Grain diameter, in millimeters	3
D_i	Geometric mean grain size, in millimeters, of the i^{th} size fraction	13
D_p	Grain diameter, in millimeters, corresponding to a given percentage	6
M	Mean of a normal-probability distribution	4
M_ϕ	Inman's phi mean diameter	7
Md	Median diameter, in millimeters, at which 50 percent is finer	6
Md_ϕ	Phi median diameter	7
M_z	Folk's graphic mean diameter, in phi units	8
n	Number of defined size fractions in the distribution	13
P_i	Percentage of material in the i^{th} size fraction	13
Sk	Trask's skewness coefficient	6
Sk_I	Folk's inclusive graphic skewness	8
So	Trask's sorting coefficient	6
X	Dimensionless deviation from the mean, expressed as a multiple of the standard deviation, in the standardized normal-probability distribution function	4
X′	Observed value from a normal-probability distribution	4
α_1	Inman's phi skewness measure	7
α_2	Inman's second phi skewness measure	7
β_ϕ	Inman's phi kurtosis measure	7
ϕ	Grain diameter, in phi units	3
ϕ_p	Grain diameter, in phi units, corresponding to a given percentage	7
σ	Standard deviation, in phi units, of a normal-probability distribution	5
σ'	Standard deviation of a normal-probability distribution	4
σ_I	Folk's inclusive graphic standard deviation	8
σ_ϕ	Inman's sorting or phi deviation measure	7

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H. H. Stevens, Jr. and D. W. Hubbell

ABSTRACT

Two versions of computer programs for inputing data and computing particle-size statistics of fluvial sediments are presented. The FORTRAN 77 language versions are for use on the Prime computer, and the BASIC language versions are for use on microcomputers. The size-statistics programs compute Inman, Trask, and Folk statistical parameters from phi values and sizes determined for 10 specified percent-finer values from inputed size and percent-finer data. The program also determines the percentages of gravel, sand, silt, and clay, and the Meyer-Peter effective diameter. Documentation and listings for both versions of the programs are included in the report.

INTRODUCTION

The size distribution of particles in a sediment sample can be characterized by plotting either a histogram, which shows the percentages of particles whose sizes are within specified size classes, or a cumulative-frequency curve, which shows the percentage of particles whose size is either finer or coarser than a specified size. These curves provide visual images of the distribution and facilitate the division of the sample into various size grades, such as clay, silt, and sand, and the determination of the sizes for which preselected proportions of the sample are finer or coarser. However, for comparisons between samples, and for other analytical purposes, characterizing size distributions numerically is considerably more convenient. For this reason, various investigators have developed sets of statistical measures to quantitatively describe certain features of a size distribution. The statistical measures invariably involve expressions of central tendency and dispersion; however, in addition to being somewhat different from one another, they also use different notation. Statistical measures devised by Trask (1932) describe the grain-size distribution in dimensional (millimeter) notation; whereas, the measures used by Inman (1952) and Folk (1968) describe distributions in the dimensionless phi notation developed by Krumbein (1936).

The statistical measures in each of these sets are based on the sizes of particles for which certain percentages of the sample are either finer or coarser. Ordinarily, these sizes are obtained from cumulative-frequency curves. However, to eliminate the necessity of manually plotting and reading the curves, and then computing the various measures, a computer program has been prepared that determines the required size values by interpolation (or extrapolation) between points defined by a particle-size analysis. The program then uses the size values to calculate the Trask, Inman, and Folk statistical measures. The "effective diameter," which is a bed-material parameter used in the Meyer-Peter and Müller (1948) equation for determining bedload discharge, also is computed for all size distributions, whether they are suspended-sediment or bed-material distributions.

This report describes two computer programs. Program SIZEDATA allows for keyboard entry of particle-size analysis data and storage into a data file, and program SEDSIZE reads the data from the data file and computes the size statistics. Both programs are written in FORTRAN and MS-BASIC[1/] for use on a variety of computers. A general explanation of the computational procedures and statistical measures used in the programs is expressed using common symbols (see Explanatory Symbols). The computer programs are explained using assigned variable names (see Supplemental Data Sections A and B at the back of this report.) Program listings, examples of output from SIZEDATA and SEDSIZE, and a flowchart for program SEDSIZE are included at the back of this report in Supplemental Data Sections C through J.

FUNDAMENTALS OF THE PARTICLE-SIZE STATISTICS PROGRAM

Particle-Size Notation

In most particle-size analyses, regardless of the method, particles are separated into classes according to the Wentworth grade scale (Wentworth, 1922) for sieving. With this classification, the area of the screen-mesh opening changes by a factor of 2; therefore, particle sizes, which are expressed in terms of the length of a side of a square mesh, change by $\sqrt{2}$. When these kinds of particle-size data are plotted as histograms, using an arithmetic scale for the size axis, the distributions invariably appear highly skewed toward the fine sizes. However, when the data are plotted using the logarithms of the sizes, the histograms usually are reasonably symmetrical and generally correspond to normal (Gaussian) distributions. As a result, cumulative-frequency curves (percent-finer values versus size values) tend to plot as straight lines whenever the frequency (percent-finer) axis is a normal-probability scale and the size axis is a logarithmic scale. The degree to which such size distributions correspond or deviate from a logarithmic normal distribution can be used to characterize the size distribution.

1/ Microsoft BASIC language developed by the Microsoft Corporation. The use of trade names in this report is for identification only and does not constitute endorsement by the U.S. Geological Survey.

With the above factors in mind, Krumbein (1936) introduced the use of phi, the negative logarithm (base 2) of grain diameter, for statistical computation. Because values of standard size divisions vary with $\sqrt{2}$, Krumbein chose the logarithmic base 2 so that phi would change by 1 unit whenever the size doubled or halved. He also used negative logarithms to avoid negative phi values for sizes finer than 1.0 mm, which are dominant in most fluvial sediments. Krumbein's phi equation is

$$\phi = -\log_2 D = -3.322 \log_{10} D,$$

where D is grain diameter, in millimeters.

McManus (1963) pointed out that logarithms can be obtained only from dimensionless numbers. Therefore, phi should be redefined as a logarithmic transformation of the ratio of the grain diameter, in millimeters, to a standard grain diameter of 1.0 mm. The revised equation is

$$\phi = -\log_2 \frac{D}{1.0 \text{ mm}}.$$

Size numbers and corresponding particle diameters, and phi values used in program SIZEDATA are shown in table 1.

Table 1.--Corresponding size numbers, particle diameters, in millimeters, and phi values used in program SIZEDATA.

Size number	Particle diameter	Phi	Size number	Particle Diameter	Phi	Size Number	Particle Diameter	Phi
1	0.002	9.0	12	0.088	3.5	23	4.00	-2.0
2	.003	8.5	13	.125	3.0	24	5.66	-2.5
3	.004	8.0	14	.177	2.5	25	8.00	-3.0
4	.006	7.5	15	.250	2.0	26	11.3	-3.5
5	.008	7.0	16	.354	1.5	27	16.0	-4.0
6	.011	6.5	17	.500	1.0	28	22.6	-4.5
7	.016	6.0	18	.707	.5	29	32.0	-5.0
8	.022	5.5	19	1.00	0.0	30	45.2	-5.5
9	.031	5.0	20	1.41	- .5	31	64.0	-6.0
10	.044	4.5	21	2.00	-1.0	32	90.5	-6.5
11	.062	4.0	22	2.83	-1.5	33	128.0	-7.0

Linear Interpolation

Because particle-size distributions expressed as log-normal cumulative-frequency curves tend to be linear, the curves usually can be approximated by a series of straight-line segments between the defined points of the distribution. Therefore, if the linear function for any line segment is

derived, all points in the distribution that lie on the segment can be determined. This is the principle applied in the SEDSIZE program to obtain the various size values that are required to compute the size statistics.

The normal-distribution function with mean equal to zero and standard deviation equal to 1.0 (standardized normal-probability distribution function) is used to determine the parameters of the linear functions. This distribution function gives the probability that an observed value of X will be less than or equal to any specified X value, where

$$X = \frac{X' - M}{\sigma'};$$

where X' is a value from a normal distribution, and

M and σ' are the distribution mean and standard deviation.

A graph of the function is shown in figure 1. In figure 1, probabilities have been multiplied by 100 to represent percentage values, and L is the counter (matrix-element number) for obtaining the probability for a specific X from a standardized table of values, generated by the SEDSIZE program for internal use, in which the X increment is 0.02. Throughout the text and within the program, probabilities are expressed as percentages.

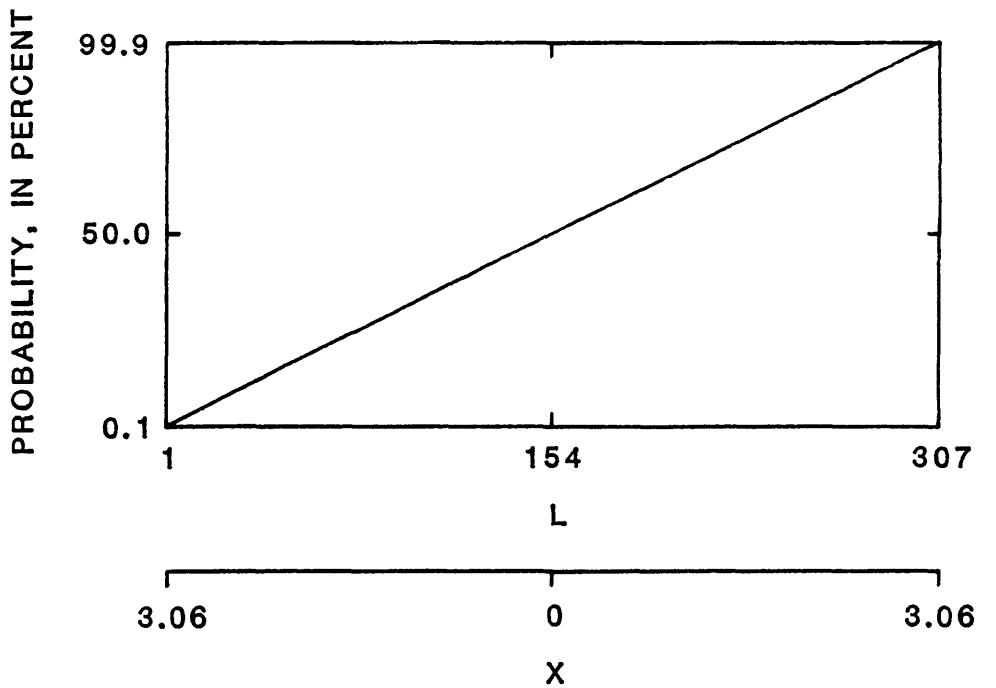

Figure 1.--Standardized normal-probability distribution function as used in the SEDSIZE program. L is the matrix-element number of corresponding probability and X values in the standardized normal-probability table generated for internal use by the SEDSIZE program.

To determine the phi value for a given percent-finer value from any linear function defined by two points with known size and percent-finer values, the known sizes are converted to phi values, Φ_1 and Φ_2. Then, using the known percent-finer values (probabilities), corresponding X values, X_1 and X_2, are determined from the standardized probability table. By definition, the deviations, in phi units, of the known points from the mean phi value, C_Φ, of the linear function are:

$$\Phi_1 - C_\Phi = X_1\sigma \quad \text{and} \quad \Phi_2 - C_\Phi = X_2\sigma .$$

Thus,

$$\Phi_1 - \Phi_2 = X_1 \sigma - X_2 \sigma = \sigma (X_1 - X_2) ,$$

and

$$\sigma = \frac{\Phi_1 - \Phi_2}{X_1 - X_2} ,$$

where σ is the standard deviation, in phi units, of the defined function.

Also,

$$C_\Phi = \Phi_1 - X_1 \sigma \quad \text{or} \quad C_\Phi = \Phi_2 - X_2 \sigma .$$

After computing the X value for the given percent-finer (probability) value, the unknown corresponding phi value is determined from

$$\Phi = C_\Phi + X \sigma .$$

In the SEDSIZE program, C_Φ is CENTER, σ is SIGMA, Φ_1 is DEV1, and Φ_2 is DEV2. Percent-finer values and corresponding probability and X values, for which phi values are determined in program SEDSIZE, are shown in table 2. CP values given in table 2 are identical to X values, except for probabilities greater than 50 percent, in which case, they are equal to X times -1.0. CP values are used in the SEDSIZE program to facilitate computation of phi values, because of the way in which X values for probabilities greater than 50 percent are determined from data statements in the program.

Table 2.--Percent-finer values and corresponding probability, X, and CP values for which phi values are determined in program SEDSIZE.

Percent finer	Probability (percent)	X value	CP value
5	5.0	1.645	1.645
16	15.87	1.0	1.0
25	25.0	.6745	.6745
35	35.0	.3854	.3854
50	50.0	0.0	0.0
65	65.0	.3854	-.3854
75	75.0	.6745	-.6745
84	84.13	1.0	-1.0
90	90.0	1.282	-1.282
95	95.0	1.645	-1.645

Particle-Size Statistics

Statistical measures commonly used to characterize size distributions include the median, mean, sorting or uniformity, skewness or asymmetry, and kurtosis or peakedness. Each of these measures can be computed in a variety of ways. Relations derived by Trask (1932), Inman (1952), and Folk (1968) are computed in program SEDSIZE. The original equations developed by each of these authors were expressed in terms of percent-coarser size values; however, in this report and computer program, all terms are based on percent-finer values.

Trask Statistics

Trask's (1932) quartile measures are computed from size values expressed in millimeters. The measures are:

Coefficient of sorting, So,

$$So = \frac{D_{75}}{D_{25}};$$

Coefficient of skewness, Sk,

$$Sk = \frac{D_{25}D_{75}}{Md^2};$$

where D_{25} is the particle diameter, in millimeters, at which 25 percent of the material, by weight, is finer;
D_{75} is the particle diameter, in millimeters, at which 75 percent of the material, by weight is finer; and
Md is the median particle diameter, in millimeters, at which 50 percent of the material, by weight, is finer.

Inman Statistics

The statistics computed with Inman's (1952) formulas are based on particle diameters converted to phi units and are derived from analogies to central-moment measures. The statistics are:

Phi mean diameter, M_Φ ,

$$M_\Phi = \frac{\Phi_{16} + \Phi_{84}}{2} ;$$

Sorting or phi deviation, σ_Φ ,

$$\sigma_I = \frac{\Phi_{16} - \Phi_{84}}{2} ;$$

Phi-skewness measure, α_1 ,

$$\alpha_1 = \frac{M_\Phi - Md_\Phi}{\sigma_I} ;$$

Second phi-skewness measure, α_2 ,

$$\alpha_2 = \frac{0.5\ (\Phi_{95} + \Phi_5) - Md_\Phi}{\sigma_\Phi} ;$$

Phi-kurtosis measure, β_Φ ,

$$\beta_\Phi = \frac{0.5\ (\Phi_5 - \Phi_{95}) - \sigma}{\sigma_\Phi} ;$$

where Φ_{16} is the particle diameter, in phi units, at which 16 percent of the material, by weight, is finer;
Φ_{84} is the particle diameter, in phi units, at which 84 percent of the material, by weight, is finer;
Md_Φ is the particle diameter, in phi units, at which 50 percent of the material, by weight, is finer;
Φ_{95} is the particle diameter, in phi units, at which 95 percent of the material, by weight, is finer; and
Φ_5 is the particle diameter, in phi units, at which 5 percent of the material, by weight, is finer.

Folk Statistics

The formulas used to compute Folk's (1968) statistics are modifications of the Inman (1952) equations. They also are based on particle diameters converted to phi units, and are derived from analogies to central-moment measures. The statistics are:

Graphic mean diameter, M_z,

$$M_z = \frac{\Phi_{16} + \Phi_{50} + \Phi_{84}}{3};$$

Inclusive graphic standard deviation, σ_I,

$$\sigma_\Phi = \frac{\Phi_{16} - \Phi_{84}}{4} + \frac{\Phi_5 - \Phi_{95}}{6.6};$$

Inclusive graphic skewness, Sk_I,

$$Sk_I = \frac{\Phi_{84} + \Phi_{16} - 2\,\Phi_{50}}{2\,(\Phi_{16} - \Phi_{84})} + \frac{\Phi_{95} + \Phi_5 - 2\,\Phi_{50}}{2\,(\Phi_5 - \Phi_{95})};$$

where Φ_{50} is the particle diameter, in phi units, at which 50 percent of the material, by weight, is finer.

COMPUTER PROGRAMS

Program SIZEDATA

The FORTRAN program for entering size-distribution data is organized in the form of a main program called SIZEDATA, six executable subroutines, and one BLOCK DATA subprogram (see Supplemental Data Section C). The counterpart BASIC program (see Supplemental Data Section E) contains minor variations from the FORTRAN program because of differences between the two languages. FORTRAN- and BASIC-program variable definitions are presented in Supplemental Data Section A. The main difference between the two versions is that the FORTRAN data file is random access, so that data sets are read and stored individually and the maximum number of data sets in the file is not fixed; whereas, the BASIC data file is sequential access, so that all data sets are read or stored in a single disk operation. To prevent loss of data, the BASIC program automatically stores data on the disk whenever ten data sets are entered into memory. The maximum number of data sets allowable in a single sequential file is 30.

Data Input

Size-distribution data are entered by keyboard and stored in a file called SIZE.DATA or a user-specified file. The following variables form a data set:

LOC	- Location/description of sample;
DATE	- Date of sample (MM/DD/YY);
TIME	- Time of sample (2400);
NO	- Number of entered sizes;
SIZDIA(33)	- Size-analysis separation sizes, in millimeters; and
PCTFN(33)	- Percent-finer value for each size.

A percent-finer value of 0 is entered for sizes for which no value was defined. Also, a value of 99.9 may be entered whenever the percent-finer value is 100 percent; the program converts all entered 100 percent values to 99.9. A data file containing eight data sets is shown in Section H of the supplemental data at the back of this report.

Program Description

The program is initiated by opening a data file called SIZE.DATA or a user-named file. A program option code, NC, is entered to perform one of the following functions:

1 is to start a new data file;
2 is to add to an existing data file;
3 is to correct one or more data sets;
4 is to list data on screen; and
5 is to list data on printer.

If NC >1, the number of data sets, NSAMP, is read from the data file; otherwise, NSAMP is set to 0.

When NC = 1 or 2, data sets are added by the following procedure.

A. A diameter input-option code, INOPT, is entered to select the method for determination of SIZDIA values.

1 is to input the number of sizes to be entered, NO, and the corresponding size numbers (see table 1). First, the value of NO is entered, and subroutine TABLE is called to display table 1 on the screen. Then, appropriate size numbers are entered and corresponding SIZDIA values are stored in memory.

2 is to input minimum and maximum diameter numbers and a diameter-number increment (see table 1). First, subroutine TABLE is called to display Table 1 on the screen. Then, values of NMIN, NMAX, and NINC from the table are entered. Subsequently, SIZDIA values corresponding to the size numbers from NMIN to NMAX, at an increment of NINC, are stored in memory. Also, NO is set equal to the number of SIZDIA values.

3 is to input the number of sizes to be entered, NO, and to enter user-selected diameter values.

4 is to input minimum and maximum phi values and the phi-value increment. First, subroutine TABLE is called to display table 1 on the screen. Next, the selected values of PMIN, PMAX, and PINC are entered. Then, SIZDIA values corresponding to phi values from PMIN to PMAX, at an increment of PINC, are computed from

$$SIZDIA = 0.5^{(phi\ value)},$$

and NO is set equal to the number of SIZDIA values.

B. After SIZDIA values are listed, they are indicated to be correct or incorrect (Y/N). If diameters are not correct, step A is repeated.

C. The sample location/description, LOC, is entered.

D. A value of JOPTN, the data-input option, is entered to retain or alter the input sequence.

1 is for no change in the input sequence. Program goes to step E.

2 permits data from a new location/description to be entered. Program goes back to step C.

3 allows a new diameter-input option to be selected. Program goes back to step A.

4 ends the run. The value of NSAMP is written on record one of the data file and the run is terminated.

E. NSAMP is increased by one.

F. Values of DATE and TIME are entered.

G. Defined percent-finer values for each corresponding SIZDIA value are entered.

H. After subroutine DALIST is called to list the data set on the screen, an option code is entered.

1 is to accept the data as correct.

2 is to re-enter the entire data set.

3 is to correct part of the data set.

If the data set is correct, subroutine DAWRITE is called to write the data set on the data file, and the program goes back to step D for another data set. If the entire data set is to be re-entered, the program goes back to step F. With option 3, subroutine DACORR is called. In subroutine DACORR, one of the following options is selected by entering the corresponding data-correction number.

0 is to continue by entering the next data set.

1 is to change LOC.

2 is to change DATE.

3 is to change TIME.

4 is to change one or more SIZDIA values.

5 is to change one or more PCTFN values.

For number 0, the program goes back to step H. For numbers 1-3, after the current value is displayed, a new value is entered; then the above menu is redisplayed so a new data-correction number can be selected. For numbers 4 and 5, first, all current SIZDIA and PCTFN values are displayed by size number. Then, the size number for which SIZDIA or PCTFN is to be changed is selected, and the new value is entered. This process is repeated, until a zero is entered; at that time the above menu is redisplayed to permit selection of a new data-correction number.

Data sets are corrected (NC = 3) by the following procedure.

A. The number of the data set to be corrected is entered; a value of zero ends the corrections, and the run is terminated. In sequence, subroutine DAREAD is called to input the data set from the data file, subroutine DALIST is called to list the data set on the screen, and subroutine DACORR is called to permit values in the data set to be corrected. Correction procedures are identical to those previously described in step H.

B. Lastly, subroutine DALIST is called to list the corrected data set. If the data set still is not correct, the appropriate "change" option is selected. Otherwise, zero is entered, and subroutine DAWRITE is called to write the data set on the data file. The program then goes back to step A.

Data sets are listed on the screen (NC = 4) in the following manner.

A. The starting and ending numbers of the data sets to be listed are entered.

B. For each data set, subroutine DAREAD is called to input the data set from the data file, and subroutine DALIST is called to list the data set on the screen. The display is held on the screen until any number key is pressed.

Data sets are listed by the printer (NC = 5) by the following sequence.

A. The starting and ending numbers of the data sets to be printed are entered.

B. For each data set, subroutine DAREAD is called to input the data set from the data file. The data set then is directed to an output file called SIZEDATA.LIST in the FORTRAN version of the program, or to a line printer in the BASIC version. The file SIZEDATA.LIST is printed using the line printer. Output from a SIZEDATA.LIST file containing eight data sets is shown in Supplemental Data Section H.

Program SEDSIZE

The SEDSIZE program is divided into two parts. Part 1 computes both the Meyer-Peter effective diameter and phi and diameter values for 10 specified percent-finer values (see table 2) from entered size and associated percent-finer values. Part 2 computes Inman, Trask, and Folk statistical parameters, and percent gravel, sand, silt, and clay from the computed phi values and diameters. Input to the program is obtained from data files created by the SIZEDATA program.

Definitions of all FORTRAN and BASIC variable names used in the SEDSIZE program are presented in Supplemental Data Section B. The FORTRAN program is organized in the form of a main program called SEDSIZE and a subroutine called INTERP (see Supplemental Data Section D). Supplemental Data Section G presents a flow chart which illustrates the computation procedure. The BASIC program (see Supplemental Data Section F) contains minor variations from the FORTRAN program because of differences between the two languages; however, the FORTRAN program description can be used along with the BASIC variable definitions (Supplemental Data Section B) to understand the BASIC program.

Program Output

Output from the FORTRAN version of program SEDSIZE is stored on a file named SIZE.OUT or a user-specified file, and later is printed using the line printer at a page width of 128 columns. The BASIC version causes the output to be printed directly, without intermediate storage, on an 80-column line printer.

FORTRAN-version outputs from eight data sets are shown in Supplemental Data Section I. The upper left section of the output lists entered data for sizes with percent-finer values greater than zero. Computed phi values and diameters for the 10 critical percent-finer values used in the SEDSIZE program to determine the various statistical measures are given in the upper right. The note "EXTRAPOLATED FROM POINTS AND " is printed to indicate sizes that are obtained by extrapolation from either larger or smaller entered data values (see Supplemental Data Section I, p. I2-I5). Whenever an extrapolated size is unrealistically small (phi value >14), the computed phi value and diameter are listed as "UNDEFINED" (see Supplemental Data Section I, p. I4).

The lower section of the output lists the computed Inman, Trask, and Folk statistical measures; the percent gravel, sand, silt and clay; and the Meyer-Peter effective diameter. A "*" symbol is printed after computed statistics that are based on extrapolated phi or diameter values. Statistical measures involving sizes having undefined phi or diameter values are not computed, and a "+" symbol is printed to indicate no value. Whenever an "*" has been printed, the explanatory footnote "* BASED ON EXTRAPOLATED VALUES - ERROR MAY BE EXCESSIVE" also is printed; if a "+" has been printed, the footnote "+ UNDEFINED" is added. Whenever the percentage of material in the finest or coarsest size fraction is not defined, the Meyer-Peter effective diameter is not computed, and an explanatory note is printed.

Program Description

Main program SEDSIZE

The main program opens the data file created by program SIZEDATA --either SIZE.DATA or the counterpart user-specified file; reads the number of data sets, NSAMP; and starts a computation loop (NS=1,NSAMP) for each data set.

First, the Meyer-Peter effective diameter, DMP, is computed from

$$DMP = \frac{\sum_{i=1}^{n} D_i P_i}{100} ;$$

where n is the number of size fractions;

D_i is the geometric mean size of the i^{th} size fraction, in millimeters; and

P_i is the percentage of material in the i^{th} size fraction.

The Meyer-Peter effective diameter is not computed for data sets for which 0 and 100 (99.9) percent-finer values have not been defined.

Next, entered SIZDIA values are converted to SIZPHI values with

$$SIZPHI = -3.322 \log_{10} SIZDIA .$$

Then, arrays of DIA, PCT, and PHI, each M values long, are formed by eliminating values of SIZDIA, PCTFN, and SIZPHI for sizes for which PCTFN equals zero.

The PCT-value counter, N, is set equal to 1, and a loop (I=1 to 10) is entered to compute phi, H, and diameter values for 10 preselected probability values, TP. The 10 probability values and corresponding CP values are shown in table 2. For each value of TP(I), N is increased until TP(I) is less or equal to PCT(N). If N equals 1, the footnote code number (ICD(I)) is set equal to 1 for extrapolation below PCT values 1 and 2. If N is greater than M, 1 is subtracted from N, and ICD(I) is set equal to 2 for extrapolation above the last 2 PCT values. Otherwise, 1 is subtracted

from N, and ICD(I) is set equal to 0 for interpolation between points. Subroutine INTERP is called to compute DEV, SIGMA, and CENTER. If DEV is less than or equal to 0, erroneous data has been entered, and the error message "DEV = 0 input data in error" is printed. Immediately, computation is terminated, and the program goes back for the next set of data. Otherwise, the phi value is computed from

$$H(I) = CENTER + CP(I)\ SIGMA\ ,$$

and diameter is computed from

$$D(I) = 0.5^{H(I)}\ .$$

Whenever extrapolation produces an H value greater than 14, the H and D values are declared undefined by setting the ICD(I) value equal to -20.

The DIA, PHI, and PCT arrays, together with the 10 specified TP values and computed H and D values, are printed with appropriate footnotes.

Part 2 computes and prints the Inman, Trask, and Folk statistical measures as follows:

Inman mean diameter, M_Φ ,

$$AB(1) = 0.5\ (H(2)+H(8))\ ;$$

Inman sorting, σ_Φ ,

$$AB(2) = 0.5\ (H(2)-H(8))\ ;$$

Inman skewness, α_1 ,

$$AB(3) = (AB(1)-H(5))/AB(2)\ ;$$

Inman second skewness, α_2 ,

$$AB(4) = (0.5\ (H(10)=H(1))-H(5))/AB(2)\ ;$$

Inman kurtosis, β_Φ ,

$$AB(5) = (0.5\ (H(1)-H(10))-AB(2))/AB(2)\ ;$$

Trask sorting, So ,

$$AB(6) = (D(7)/D(3))\ ;$$

Trask skewness, Sk ,

$$AB(7) = (D(7)\ D(3))/D(5)\ ;$$

Folk graphic mean diameter, M_z ,

$$AB(8) = (H(8)+H(5)+H(2))/3\ ;$$

Folk inclusive graphic standard deviation, σ_Φ ,

$$AB(9) = (H(2)-H(8))/4 + (H(1)-H(10))/6.6; \text{ and}$$

Folk inclusive graphic skewness, Sk_I ,

$$X1 = (H(8)+H(2)-2\ H(5))\ /\ 2\ (H(2)-H(8))$$

$$X2 = (H(10)+H(1)-2\ H(5))\ /\ 2\ (H(1)-H(10))$$

$$AB(10) = X1+X2\ .$$

The last section of the program computes and prints the percent clay (PCTCL), percent silt (PCTSL), percent sand (PCTSD), and percent gravel (PCTGR) by entering a loop, NN = 1 to 3. When NN is equal to 1, and PHI(M) is greater than -1, PROBD is set equal to 100, and the loop is restarted for NN equal to 2. Otherwise, D9 is set equal to -1, the value of phi for the division between gravel and sand. Next, N is set equal to 1 and incremented by 1, until PHI(N) is equal to or less than D9. Then, if PHI(N) is equal to D9, PROBD is set equal to PCT(N); otherwise, PROBD is computed by first calling subroutine INTERP to compute DEV, SIGMA, and CENTER. If DEV is less than or equal to 0, erroneous data has been entered, and the error message "DEV=0 input data in error" is printed. Subsequently, computation is terminated, and the program goes back to the start of the next data set; otherwise, computation continues. If D9 is equal to CENTER, PROBD is set equal to 50. If D9 is less than CENTER, DEVD is computed from

$$DEVD=(CENTER-D9)/SIGMA\ .$$

Then, if DEVD is greater than 3.06, PROBD is set equal to 100; otherwise, N is set equal to 154 and incremented by 1, until DEVD is greater than or equal to X(N). If DEVD is equal to X(N), PROBD is set equal to PROB(N); otherwise, PROBD is computed by interpolation. If D9 is greater than CENTER, DEVD is computed from

$$DEVD=(D9-CENTER)/SIGMA\ .$$

Then, if DEVD is greater than 3.06, PROBD is set equal to 0; otherwise, N is set equal to 1 and incremented by 1, until DEVD is greater than or equal to X(N). If DEVD is equal to X(N), PROBD is set equal to PROB(N); otherwise, PROBD is computed by interpolation.

When NN is equal to 2, PROB1 is set equal to the rounded value of PROBD, and D9 is set equal to 4, the value of phi for the division between sand and silt. Then, a new value for PROBD is computed using the previous procedure.

When NN is equal to 3, PROB4 is set equal to the rounded value of PROBD, and D9 is set equal to 8, the value of phi for the division between silt and clay. Next, a new value for PROBD is computed, and PROB8 is set equal to PROBD.

Then, the percent values for clay, silt, sand, and gravel are computed from:

$$PCTCL = PROB8 ;$$

$$PCTST = PROB4 - PROB8 ;$$

$$PCTSD = PROB1 - PROB4 ;$$

and

$$PCTGR = 100 - PROB1 .$$

The values of PCTGR, PCTSD, PCTST, PCTCL, and DMP subsequently are printed. If the Meyer-Peter effective diameter has not been computed, a explanation note is printed (see Supplemental Data Section I). The program then goes back for the next set of data.

Subroutine INTERP

Subroutine INTERP computes values of DEV, SIGMA, and CENTER from values of PCT, PROB, and X, using an entered value of N. First, DEV1 is computed. If PCT(N) is greater than or equal to 50, L is set equal to 1; otherwise, L is set equal to 154. Then L is incremented by 1, until PROB(L) is greater than or equal to PCT(N). If PCT(N) is less than 0.1, DEV1 is set equal to X(1); otherwise, DEV1 is computed by interpolation. Then L1 is set equal to the value of L. Next, DEV2 is computed by the same procedure using N+1, and L2 is set equal to the new value of L. If L1 is greater than 154, L3 is set equal to 1; otherwise, L3 is set equal to -1. Likewise, if L2 is greater than 154, L4 is set equal to 1; otherwise, L4 is set equal to -1. L5 is then set equal to the sum of L3 and L4. An L5 value of less than 3 indicates that the CENTER is above both points and DEV is computed from

$$DEV = DEV1 - DEV2 .$$

An L5 value of 3 indicates that the center is between the two points and DEV is computed from

$$DEV = DEV1 + DEV2 .$$

If DEV is less than or equal to 0, control is returned to the main program; otherwise, SIGMA and CENTER are obtained from

$$SIGMA = (PHI(N)-PHI(N+1))/DEV \text{ and}$$

$$CENTER = PHI(N)-DEV1*SIGMA .$$

Control then is returned to the main program.

An L5 value greater than 3 indicates that CENTER is below both points and DEV is computed from

$$DEV = DEV2 - DEV1 .$$

If DEV is less than or equal to 0, control is returned to the main program; otherwise, SIGMA and CENTER are determined from

SIGMA = (PHI(N)-PHI(N+1))/DEV and

CENTER = PHI(N)+DEV1*SIGMA .

Control then is returned to the main program.

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SUPPLEMENTAL DATA

SUPPLEMENTAL DATA--SECTION A.

DEFINITION OF PROGRAM SIZEDATA VARIABLES

PROGRAM		DEFINITION
FORTRAN	BASIC	
		VARIABLES IN COMMON BLOCK /AA/
DATE	DATE$	Date of sample (MM/DD/YY)
DIAM	DIAM	Diameters listed in size table, in millimeters
LOC	LO$	Location of sample
NO	NS	Number of sizes in data set
NREC	--	Random file record number
PCTFN	PCTFN	Entered percent finer values to be stored
SIZDIA	SIZDIA	Diameters selected from size table or entered values
SIZE	SIZE	Stored diameters - same as SIZDIA
TIME	TIME	Time of sample (2400)
		VARIABLES IN MAIN PROGRAM NOT IN COMMON BLOCK /AA/
DFILE	DFILE$	Data file name
I	I	Loop counter
INOPT	INOPT	Diameter input option
J	J	Loop counter
JOPTN	JOPTN	Data input option
N	I	Temporary computation value
NC	NC	Program option flag
NINC	NINC	Table diameter number increment to be used
NMAX	NMAX	Maximum table diameter number to be used
NMIN	NMIN	Minimum table diameter number to be used
NS	--	Data set number
NS1	--	Start data set number to list or print
NS2	--	End data set number to list or print
NSAMP	NU	Number of data sets - maximum is 30 in BASIC program
P1	P1	Used in the conversion from phi units to diameters, in millimeters
P2	P2	Used in the conversion from phi units to diameters, in millimeters
PINC	PINC	Phi value increment to be used - usually 1.0 or 0.5
PMAX	PMAX	Maximum phi value to be used
PMIN	PMIN	Minimum phi value to be used
STA	L$	Temporary value of location of sample

NOTE: Variables in all subroutines not in common block /AA/ are loop counters.

SUPPLEMENTAL DATA--SECTION B.

DEFINITION OF PROGRAM SEDSIZE VARIABLES

PROGRAM		DEFINITION
FORTRAN	BASIC	
		VARIABLES IN COMMON BLOCK
L	L	Counter for entering the PROB versus X table
N	N	Counter for PCT values
PCT	PCT	Percent-finer values after elimination of zero values
PHI	PHI	Phi values for corresponding PCT values
PROB	PROB	Cummulative probability times 100 for a given X value
x	X	Dimensionless deviation from the mean, expressed as a multiple of the standard deviation, in the standardized normal probability distribution function
TOL	--	Tolerance factor used to compare equal or nonequal values
		VARIABLES IN MAIN PROGRAM NOT IN COMMON BLOCK
AB	AB	Array containing Inman, Trask and Folk size statistic values
ASK	--	Footnote symbol "*"
BLK	--	Footnote symbol "blank"
CENTER	CENTER	Mean value
CP	CP	X values for corresponding TP values
D	D	Diameters optained from computed phi values (H)
D9	D9	Temporary phi values used in the computation of percent of clay, silt, sand and gravel
DATE	DATE$	Date of sample (MM/DD/YY)
DEV	DEV	Deviation value in phi units
DEVD	DEVD	Deviation value in phi units computed from D9 values
DFILE	DFILE$	Data file name
DIA	DIA	Diameter for corresponding PCT values
DMP	DMP	Meyer-Peter effective diameter
FMAT	--	Variable format used to print Inman, Trask and Folk size statistic values
FNT	--	Footnote print format
H	H	Computed phi values from the 10 TP values
I	I	Loop counter
I1	--	Temporary value used to determine NPL
ICD	ICD	Footnote code number for the 10 computed diameters DIA
ITIME	--	Integer value of TIME for printing
KMAT	--	Components of variable format FMAT
LOC	LO$	Location of sample

DEFINITION OF PROGRAM SEDSIZE VARIABLES--Continued

PROGRAM		DEFINITION
FORTRAN	BASIC	
	VARIABLES IN MAIN PROGRAM NOT IN COMMON BLOCK--Continued	
M	M	Number of sizes after elimination of zero percent-finer values
MP	MP	Meyer-Peter effective diameter computation flag
N9	N9	Footnote print flag
NCD	NCD	Footnote code numbers for Inman, Trask and Folk size statistic values
NF	--	Variable format FMAT counter
NN	NN	Loop counter
NO	NO	Number of sizes in data set
NP	--	Variable VA counter
NPL	--	Page line counter
NS	NS	Data set counter
NSAMP	NSAMP	Number of data sets - maximun equals 30 in BASIC program
NTOT	NTOT	Sum of NCD values
OFILE	--	Output file name
P1	P1	Temporary value for computation of DMP
PCTCL	PCTCL	Percent clay in sample
PCTFN	PCTFN	Entered percent-finer values
PCTGR	PCTGR	Percent gravel in sample
PCTSD	PCTSD	Percent sand in sample
PCTST	PCTST	Percent silt in samnple
PF	PF	Rounded TP values
PLS	--	Footnote symbol "+"
PROB1	PROB1	Computed percent finer value for upper limit of sand fraction
PROB4	PROB4	Computed percent finer value for upper limit of silt fraction
PROB8	PROB8	Computed percent finer value for upper limit of clay fraction
PROBD	PROBD	Computed percent finer value from D9 values
S1	S1	Temporary value of SIZDIA for computation of DMP
SIGMA	SIGMA	Standard deviation
SIZDIA	SIZDIA	Entered diameter values
SIZPHI	SIZPHI	Computed phi values from entered diameter values
TIME	TIME	Time of sample (2400)
TP	TP	Percent finer values for which phi values (H) are computed
VA	--	Inman, Trask and Folk size statistics values that are printed using variable format FMAT

DEFINITION OF PROGRAM SEDSIZE VARIABLES--Continued

PROGRAM		DEFINITION
FORTRAN	BASIC	
	VARIABLES IN MAIN PROGRAM NOT IN COMMON BLOCK--Continued	
X1	X1	Temporary computation value
X2	X2	Temporary computation value
	VARIABLES IN SUBROUTINE INTERP NOT IN COMMON BLOCK	
CENTER	CENTER	Mean value
DEV	DEV	Deviation value in phi units
DEV1	DEV1	Deviation value in phi units
DEV2	DEV2	Deviation value in phi units
L1	L1	Temporary computation value
L2	L2	Temporary computation value
L3	L3	Temporary computation value
L4	L4	Temporary computation value
L5	L5	Temporary computation value
SIGMA	SIGMA	Standard deviation

SUPPLEMENTAL DATA--SECTION C.

FORTRAN PROGRAM SIZEDATA LISTING

```
      PROGRAM SIZEDATA                                                  SZDA  10
C                                                                       SZDA  20
C     ENTER DATA FOR SEDSIZE PROGRAM TO INPUT FILE SIZE.DATA OR         SZDA  30
C          USER SPECIFIED FILE                                          SZDA  40
C                                                                       SZDA  50
      COMMON /AA/ LOC,DATE,TIME,DIAM(33),SIZDIA(33),PCTFN(33),          SZDA  60
     1 SIZE(33),NREC,NO                                                 SZDA  70
      CHARACTER*80 LOC,STA                                              SZDA  80
      CHARACTER*10 DATE                                                 SZDA  90
      CHARACTER*20 DFILE                                                SZDA 100
      CHARACTER*1 RESP                                                  SZDA 110
    1 FORMAT ('ENTER PCT FINER VALUE FOR ',F8.3)                        SZDA 120
    2 FORMAT (A80)                                                      SZDA 130
    3 FORMAT ('NUMBER DATA SETS = ',I4)                                 SZDA 140
    4 FORMAT (A20)                                                      SZDA 150
    5 FORMAT (1H1,'DATA STORED IN FILE  ',A20 )                         SZDA 160
    6 FORMAT (1H ,'DATA SET NUMBER',I4 / 1H )                           SZDA 170
    7 FORMAT (1H0,'DATA SET NUMBER',I4 / 1H ,A80)                       SZDA 180
    8 FORMAT (1H ,'DATE  ',A10,5X,'TIME  ',F5.0,5X,'NO. SIZES = ',I4)   SZDA 190
    9 FORMAT (1H ,15F8.3)                                               SZDA 200
   10 FORMAT ('ENTER TABLE NUMBER FOR DIAM NO. ',I3)                    SZDA 210
   11 FORMAT ('ENTER DIAM. IN MM (INCLUDE DECIMAL) SIZE NO. ',I3)       SZDA 220
   12 FORMAT (1H ,15F8.1)                                               SZDA 230
   13 FORMAT ('ENTER START SET NUMBER TO BE LISTED   0 TO END RUN')     SZDA 240
   14 FORMAT ('ENTER END SET NUMBER TO BE LISTED     MAX =',I4)        SZDA 250
   15 FORMAT ('ENTER START SET NUMBER TO BE PRINTED   0 TO END RUN')    SZDA 260
   16 FORMAT ('ENTER END SET NUMBER TO BE PRINTED     MAX =I4)         SZDA 270
   17 FORMAT (1H ,5X,'1. START DATA ENTRY INTO ',A20 / 1H ,5X,'2. ADD DASZDA 280
     1TA TO 'A20 / 1H ,5X,'3. CORRECT DATA IN ',A20 / 1H ,5X,'4. DISPLAYSZDA 290
     2 DATA IN ',A20 / 1H ,5X,'5. PRINT DATA IN ',A20)                  SZDA 300
   18 FORMAT (10I8)                                                     SZDA 310
   19 FORMAT (10F8.3)                                                   SZDA 320
   20 FORMAT (1H ,'DATA STORED IN FILE  ',A20)                          SZDA 330
   21 FORMAT (A10)                                                      SZDA 340
   22 FORMAT (A1)                                                       SZDA 350
   23 FORMAT (1H0,15I8)                                                 SZDA 360
      DFILE='SIZE.DATA'                                                 SZDA 370
      CALL CLSCR(25)                                                    SZDA 380
      WRITE (1,*) 'ESTABLISH FILE NAME:'                                SZDA 390
      WRITE (1,*) '          '                                          SZDA 400
      WRITE (1,*) '     1. USE PROGRAMMED FILE NAME (SIZE.DATA)'       SZDA 410
      WRITE (1,*) '     2. PROVIDE FILE NAME'                          SZDA 420
      CALL CLSCR(3)                                                     SZDA 430
      WRITE (1,*) 'ENTER NUMBER OF SELECTION'                           SZDA 440
      CALL CLSCR(10)                                                    SZDA 450
      READ (1,*) I                                                      SZDA 460
      IF (I.LT.2) GO TO 50                                              SZDA 470
```

```
      CALL CLSCR(25)                                                    SZDA 480
      WRITE (1,*) 'ENTER DESIRED FILE NAME'                             SZDA 490
      CALL CLSCR(10)                                                    SZDA 500
      READ (1,4) DFILE                                                  SZDA 510
   50 CALL CLSCR(25)                                                    SZDA 520
      WRITE (1,17) DFILE,DFILE,DFILE,DFILE,DFILE                        SZDA 530
      CALL CLSCR(3)                                                     SZDA 540
      WRITE (1,*) 'ENTER NUMBER OF SELECTION'                           SZDA 550
      CALL CLSCR(10)                                                    SZDA 560
      READ (1,*) NC                                                     SZDA 570
      IF (NC.EQ.1) GO TO 80                                             SZDA 580
      OPEN (10,FILE=DFILE,STATUS='OLD',ACCESS='DIRECT',RECL=40)         SZDA 590
      READ (10,REC=1) NSAMP                                             SZDA 600
      GO TO (80,70,600,700,800),NC                                      SZDA 610
C     ADD DATA TO EXISTING FILE                                         SZDA 620
   70 NREC=NSAMP*6+1                                                    SZDA 630
      GO TO 90                                                          SZDA 640
C     START NEW SET OF DATA                                             SZDA 650
   80 OPEN (10,FILE=DFILE,STATUS='NEW',ACCESS='DIRECT',RECL=40)         SZDA 660
      NSAMP=0                                                           SZDA 670
      NREC=1                                                            SZDA 680
   90 IST=0                                                             SZDA 690
      CALL CLSCR(25)                                                    SZDA 700
      WRITE (1,*) 'METHOD OF ENTERING PARTICLE DIAMETERS:'              SZDA 710
      WRITE (1,*) '                                                     SZDA 720
      WRITE (1,*) '     1. INDIVIDUAL DIAMETER NUMBERS FROM SIZE TABLE' SZDA 730
      WRITE (1,*) '     2. SEQUENTIAL DIAMETERS BETWEEN MIN-MAX TABLE NUSZDA 740
     1MBERS'                                                            SZDA 750
      WRITE (1,*) '     3. INDIVIDUALLY ENTERED DIAMETERS (IN MILLIMETERSZDA 760
     1S)'                                                               SZDA 770
      WRITE (1,*) '     4. SEQUENTIAL PHI VALUES BETWEEN MIN-MAX VALUES'SZDA 780
      CALL CLSCR(3)                                                     SZDA 790
      WRITE (1,*) 'ENTER NUMBER OF SELECTION'                           SZDA 800
      CALL CLSCR(10)                                                    SZDA 810
      READ (1,*) INOPT                                                  SZDA 820
      IF (INOPT.GT.4) GOTO 90                                           SZDA 830
      GO TO (100,120,140,180),INOPT                                     SZDA 840
  100 CALL CLSCR(25)                                                    SZDA 850
      WRITE (1,*) 'ENTER NUMBER DIAMETERS TO BE USED  (MAX 33)'         SZDA 860
      CALL CLSCR(10)                                                    SZDA 870
      READ (1,*) NO                                                     SZDA 880
      IF (NO.GT.33) GO TO 100                                           SZDA 890
      DO 110 I=1,NO                                                     SZDA 900
  104 CALL TABLE                                                        SZDA 910
      CALL CLSCR(3)                                                     SZDA 920
      WRITE (1,10) I                                                    SZDA 930
      CALL CLSCR(3)                                                     SZDA 940
      READ (1,*) J                                                      SZDA 950
      IF (J.GT.33) GO TO 104                                            SZDA 960
```

```
      SIZDIA(I)=DIAM(J)                                                  SZDA 970
  110 CONTINUE                                                           SZDA 980
      GO TO 300                                                          SZDA 990
  120 CALL TABLE                                                         SZDA1000
      WRITE (1,*) 'ENTER MIN TABLE DIAMETER NO.'                         SZDA1010
      READ (1,*) NMIN                                                    SZDA1020
      IF (NMIN.LT.1) GO TO 120                                           SZDA1030
  130 WRITE (1,*) 'ENTER MAX TABLE DIAMETER NO.'                         SZDA1040
      READ (1,*) NMAX                                                    SZDA1050
      IF (NMAX.GT.33) GO TO 130                                          SZDA1060
      WRITE (1,*) 'ENTER DIAMETER NUMBER INCREMENT'                      SZDA1070
      READ (1,*) NINC                                                    SZDA1080
      NO=0                                                               SZDA1090
      DO 132 J=NMIN,NMAX,NINC                                            SZDA1100
      NO=NO+1                                                            SZDA1110
      IF (NO.GT.33) GO TO 135                                            SZDA1120
      SIZDIA(NO)=DIAM(J)                                                 SZDA1130
  132 CONTINUE                                                           SZDA1140
      GO TO 300                                                          SZDA1150
  135 WRITE (1,*) '**** NUMBER DIAMETERS > 33 ****'                      SZDA1160
      GO TO 120                                                          SZDA1170
  140 CALL CLSCR(25)                                                     SZDA1180
      WRITE (1,*) 'ENTER NUMBER OF SIZES TO BE ENTERED  (MAX 33)'        SZDA1190
      CALL CLSCR(10)                                                     SZDA1200
      READ (1,*) NO                                                      SZDA1210
      IF (NO.GT.33) GO TO 140                                            SZDA1220
      DO 160 I=1,NO                                                      SZDA1230
      CALL CLSCR(3)                                                      SZDA1240
      WRITE (1,11) I                                                     SZDA1250
      CALL CLSCR(3)                                                      SZDA1260
      READ (1,*) SIZDIA(I)                                               SZDA1270
  160 CONTINUE                                                           SZDA1280
      GO TO 300                                                          SZDA1290
  180 CALL TABLE                                                         SZDA1300
      WRITE (1,*) 'ENTER MAX PHI VALUE'                                  SZDA1310
      READ (1,*) PMAX                                                    SZDA1320
      WRITE (1,*) 'ENTER MIN PHI VALUE'                                  SZDA1330
      READ (1,*) PMIN                                                    SZDA1340
      WRITE (1,*) 'ENTER PHI INCREMENT (1.0 OR 0.5)'                     SZDA1350
      READ (1,*) PINC                                                    SZDA1360
      NO=INT((PMAX-PMIN)/PINC+1.0)                                       SZDA1370
      IF (NO.LE.33) GO TO 200                                            SZDA1380
      WRITE (1,*) '**** NUMBER DIAMETERS > 33 ****'                      SZDA1390
      GO TO 180                                                          SZDA1400
  200 P1=PMAX                                                            SZDA1410
      SIZDIA(1)=0.5**(P1)                                                SZDA1420
      DO 220 I=2,NO                                                      SZDA1430
      P2=P1-PINC                                                         SZDA1440
      SIZDIA(I)=0.5**(P2)                                                SZDA1450
```

```
    P1=P2                                                                SZDA1460
220 CONTINUE                                                             SZDA1470
300 CALL CLSCR(25)                                                       SZDA1480
    N1=-9                                                                SZDA1490
310 N1=N1+10                                                             SZDA1500
    N2=N1+9                                                              SZDA1510
    IF (N2.GT.NO) N2=NO                                                  SZDA1520
    WRITE (1,18) (N,N=N1,N2)                                             SZDA1530
    WRITE (1,19) (SIZDIA(N),N=N1,N2)                                     SZDA1540
    WRITE (1,*) '                '                                       SZDA1550
    IF (N2.LT.NO) GO TO 310                                              SZDA1560
    CALL CLSCR(3)                                                        SZDA1570
    WRITE (1,*) 'DIAMETERS OK (Y/N)'                                     SZDA1580
    CALL CLSCR(10)                                                       SZDA1590
    READ (1,22) RESP                                                     SZDA1600
    IF (.NOT.(RESP.EQ.'Y'.OR.RESP.EQ.'y')) GO TO 90                      SZDA1610
320 CALL CLSCR(25)                                                       SZDA1620
    WRITE (1,*) 'ENTER LOCATION/DESCRIPTION (MAX 80 CHARACTERS)'         SZDA1630
    CALL CLSCR(10)                                                       SZDA1640
    READ (1,2) STA                                                       SZDA1650
    IF (IST.EQ.0) GO TO 400                                              SZDA1660
    IST=IST+1                                                            SZDA1670
350 CALL CLSCR(25)                                                       SZDA1680
    WRITE (1,*) 'REQUIREMENT FOR NEXT DATA-SET ENTRY:'                   SZDA1690
    WRITE (1,*) '              '                                         SZDA1700
    WRITE (1,*) '     1. NO CHANGE IN INPUT SEQUENCE'                    SZDA1710
    WRITE (1,*) '     2. CHANGE LOCATION/DESCRIPTION'                    SZDA1720
    WRITE (1,*) '     3. CHANGE PARTICLE DIAMETERS'                      SZDA1730
    WRITE (1,*) '     4. END RUN'                                        SZDA1740
    CALL CLSCR(3)                                                        SZDA1750
    WRITE (1,*) 'ENTER NUMBER OF SELECTION'                              SZDA1760
    CALL CLSCR(10)                                                       SZDA1770
    READ (1,*) JOPTN                                                     SZDA1780
    IF (JOPTN.GT.4) GO TO 350                                            SZDA1790
    GO TO (400,320,90,560),JOPTN                                         SZDA1800
400 NSAMP=NSAMP+1                                                        SZDA1810
420 CALL CLSCR(25)                                                       SZDA1820
    WRITE (1,6) NSAMP                                                    SZDA1830
    LOC=STA                                                              SZDA1840
    WRITE (1,2) LOC                                                      SZDA1850
    WRITE (1,*) '                '                                       SZDA1860
    WRITE (1,*) 'ENTER DATE  (MM/DD/YY)'                                 SZDA1870
    WRITE (1,*) '                '                                       SZDA1880
    READ (1,21) DATE                                                     SZDA1890
    WRITE (1,*) '                '                                       SZDA1900
    WRITE (1,*) 'ENTER TIME (2400 HR)'                                   SZDA1910
    WRITE (1,*) '                '                                       SZDA1920
    READ (1,*) TIME                                                      SZDA1930
    DO 430 I=1,33                                                        SZDA1940
```

```
      SIZE(I)=0                                                          SZDA1950
      PCTFN(I)=0                                                         SZDA1960
  430 CONTINUE                                                           SZDA1970
      DO 450 I=1,NO                                                      SZDA1980
      SIZE(I)=SIZDIA(I)                                                  SZDA1990
      WRITE (1,*) '                                                      SZDA2000
      WRITE (1,1) SIZDIA(I)                                              SZDA2010
      WRITE (1,*) '                                                      SZDA2020
      READ (1,*) PCTFN(I)                                                SZDA2030
      IF (PCTFN(I).LT.99.9) GO TO 450                                    SZDA2040
      PCTFN(I)=99.9                                                      SZDA2050
      GO TO 500                                                          SZDA2060
  450 CONTINUE                                                           SZDA2070
  500 CALL DALIST (NSAMP)                                                SZDA2080
      WRITE (1,*) '                                                      SZDA2090
      WRITE (1,*) '     1. DATA SET OK'                                  SZDA2100
      WRITE (1,*) '     2. RE-ENTER COMPLETE DATA SET'                   SZDA2110
      WRITE (1,*) '     3. CORRECT PART OF DATA SET'                     SZDA2120
      WRITE (1,*) '          '                                           SZDA2130
      WRITE (1,*) 'ENTER NUMBER OF SELECTION'                            SZDA2140
      CALL CLSCR(3)                                                      SZDA2150
      READ (1,*) I                                                       SZDA2160
      GO TO (520,420,510),I                                              SZDA2170
  510 CALL DACORR (NSAMP)                                                SZDA2180
  520 CALL DAWRITE                                                       SZDA2190
      GO TO 350                                                          SZDA2200
  560 CALL CLSCR(25)                                                     SZDA2210
      WRITE (1,3) NSAMP                                                  SZDA2220
      WRITE (10,REC=1)NSAMP                                              SZDA2230
  570 CLOSE (10)                                                         SZDA2240
      WRITE (1,20) DFILE                                                 SZDA2250
      WRITE (1,*)                                                        SZDA2260
      WRITE (1,*) 'END OF RUN'                                           SZDA2270
      CALL CLSCR(10)                                                     SZDA2280
      CALL EXIT                                                          SZDA2290
C     CORRECT DATA                                                       SZDA2300
  600 CALL CLSCR(25)                                                     SZDA2310
      WRITE (1,*) 'ENTER DATA NUMBER TO BE CORRECTED   0 TO END RUN'     SZDA2320
      CALL CLSCR(10)                                                     SZDA2330
      READ (1,*) NS                                                      SZDA2340
      IF (NS.EQ.0) GO TO 560                                             SZDA2350
      IF (NS.GT.NSAMP) GO TO 600                                         SZDA2360
      NREC=(NS-1)*6+1                                                    SZDA2370
      CALL DAREAD                                                        SZDA2380
      CALL DACORR (NS)                                                   SZDA2390
      NREC=(NS-1)*6+1                                                    SZDA2400
      CALL DAWRITE                                                       SZDA2410
      GO TO 600                                                          SZDA2420
C     LIST ON SCREEN                                                     SZDA2430
```

```
  700 CALL CLSCR(25)                                                    SZDA2440
      WRITE (1,13)                                                      SZDA2450
      CALL CLSCR(3)                                                     SZDA2460
      READ (1,*) NS1                                                    SZDA2470
      IF (NS1.EQ.0) GO TO 850                                           SZDA2480
      IF (NS1.GT.NSAMP) GO TO 700                                       SZDA2490
      NREC=(NS1-1)*6+1                                                  SZDA2500
  710 CALL CLSCR(3)                                                     SZDA2510
      WRITE (1,14) NSAMP                                                SZDA2520
      CALL CLSCR(3)                                                     SZDA2530
      READ (1,*) NS2                                                    SZDA2540
      IF (NS2.GT.NSAMP) GO TO 710                                       SZDA2550
      DO 720 NS=NS1,NS2                                                 SZDA2560
      CALL DAREAD                                                       SZDA2570
      CALL DALIST (NS)                                                  SZDA2580
      WRITE (1,*) 'PRESS RETURN TO CONTINUE'                            SZDA2590
      READ (1,22) RESP                                                  SZDA2600
  720 CONTINUE                                                          SZDA2610
      GO TO 700                                                         SZDA2620
C     LIST DATA ON PRINT FILE SIZEDATA.LIST                             SZDA2630
  800 OPEN (11,FILE='SIZEDATA.LIST',STATUS='NEW')                       SZDA2640
      WRITE (11,5) DFILE                                                SZDA2650
  810 CALL CLSCR(25)                                                    SZDA2660
      WRITE (1,15)                                                      SZDA2670
      CALL CLSCR(3)                                                     SZDA2680
      READ (1,*) NS1                                                    SZDA2690
      IF (NS1.EQ.0) GO TO 840                                           SZDA2700
      IF (NS1.GT.NSAMP) GO TO 810                                       SZDA2710
      NREC=(NS1-1)*6+1                                                  SZDA2720
  820 CALL CLSCR(3)                                                     SZDA2730
      WRITE (1,16) NSAMP                                                SZDA2740
      CALL CLSCR(3)                                                     SZDA2750
      READ (1,*) NS2                                                    SZDA2760
      IF (NS2.GT.NSAMP) GO TO 820                                       SZDA2770
      DO 830 NS=NS1,NS2                                                 SZDA2780
      CALL DAREAD                                                       SZDA2790
      WRITE (11,7) NS,LOC                                               SZDA2800
      WRITE (11,8) DATE,TIME,NO                                         SZDA2810
      N1=-14                                                            SZDA2820
  825 N1=N1+15                                                          SZDA2830
      N2=N1+14                                                          SZDA2840
      IF (N2.GT.NO) N2=NO                                               SZDA2850
      WRITE (11,23) (N,N=N1,N2)                                         SZDA2860
      WRITE (11,9) (SIZE(N),N=N1,N2)                                    SZDA2870
      WRITE (11,12) (PCTFN(N),N=N1,N2)                                  SZDA2880
      IF (N2.LT.NO) GO TO 825                                           SZDA2890
  830 CONTINUE                                                          SZDA2900
      GO TO 810                                                         SZDA2910
  840 ENDFILE (11)                                                      SZDA2920
```

```
      CLOSE (11)                                                        SZDA2930
  850 CLOSE (10)                                                        SZDA2940
      CALL CLSCR(25)                                                    SZDA2950
      WRITE (1,*) 'END OF RUN'                                          SZDA2960
      CALL CLSCR(15)                                                    SZDA2970
      CALL EXIT                                                         SZDA2980
      END                                                               SZDA2990

      BLOCK DATA                                                        BKDA  10
      COMMON /AA/ LOC,DATE,TIME,DIAM(33),SIZDIA(33),PCTFN(33),          BKDA  20
     1 SIZE(33),NREC,NO                                                 BKDA  30
      CHARACTER*80 LOC                                                  BKDA  40
      CHARACTER*10 DATE                                                 BKDA  50
      DATA DIAM/0.002,0.003,0.004,0.006,0.008,0.011,0.016,0.022,0.031,  BKDA  60
     1 0.044,0.062,0.088,0.125,0.177,0.250,0.354,0.500,0.707,1.0,1.4,   BKDA  70
     2 2.0,2.8,4.0,5.6,8.0,11.3,16.0,22.6,32.0,45.2,64.0,90.5,128.0/    BKDA  80
      END                                                               BKDA  90

      SUBROUTINE DAWRITE                                                WRIT  10
C     WRITE ONE SET OF DATA TO FILE                                     WRIT  20
      COMMON /AA/ LOC,DATE,TIME,DIAM(33),SIZDIA(33),PCTFN(33),          WRIT  30
     1 SIZE(33),NREC,NO                                                 WRIT  40
      CHARACTER*80 LOC                                                  WRIT  50
      CHARACTER*10 DATE                                                 WRIT  60
      NREC=NREC+1                                                       WRIT  70
      WRITE (10,REC=NREC) LOC                                           WRIT  80
      NREC=NREC+1                                                       WRIT  90
      WRITE (10,REC=NREC) DATE,TIME,NO                                  WRIT 100
      NREC=NREC+1                                                       WRIT 110
      WRITE (10,REC=NREC) (SIZE(I),I=1,17)                              WRIT 120
      NREC=NREC+1                                                       WRIT 130
      WRITE (10,REC=NREC) (SIZE(I),I=18,33)                             WRIT 140
      NREC=NREC+1                                                       WRIT 150
      WRITE (10,REC=NREC) (PCTFN(I),I=1,17)                             WRIT 160
      NREC=NREC+1                                                       WRIT 170
      WRITE (10,REC=NREC) (PCTFN(I),I=18,33)                            WRIT 180
      RETURN                                                            WRIT 190
      END                                                               WRIT 200

      SUBROUTINE DAREAD                                                 READ  10
C     READ ONE SET OF DATA FROM FILE                                    READ  20
      COMMON /AA/ LOC,DATE,TIME,DIAM(33),SIZDIA(33),PCTFN(33),          READ  30
     1 SIZE(33),NREC,NO                                                 READ  40
      CHARACTER*80 LOC                                                  READ  50
      CHARACTER*10 DATE                                                 READ  60
      NREC=NREC+1                                                       READ  70
      READ (10,REC=NREC,ERR=100,END=200) LOC                            READ  80
      NREC=NREC+1                                                       READ  90
      READ (10,REC=NREC,ERR=100,END=200) DATE,TIME,NO                   READ 100
```

```
      NREC=NREC+1                                                        READ 110
      READ (10,REC=NREC,ERR=100,END=200) (SIZE(I),I=1,17)                READ 120
      NREC=NREC+1                                                        READ 130
      READ (10,REC=NREC,ERR=100,END=200) (SIZE(I),I=18,33)               READ 140
      NREC=NREC+1                                                        READ 150
      READ (10,REC=NREC,ERR=100,END=200) (PCTFN(I),I=1,17)               READ 160
      NREC=NREC+1                                                        READ 170
      READ (10,REC=NREC,ERR=100,END=200) (PCTFN(I),I=18,33)              READ 180
      RETURN                                                             READ 190
  100 WRITE (1,*) 'ENDING WITH READ ERROR'                               READ 200
      CLOSE (10)                                                         READ 210
      CALL EXIT                                                          READ 220
  200 WRITE (1,*) 'STOPPED AT END-OF-FILE'                               READ 230
      CLOSE (10)                                                         READ 240
      CALL EXIT                                                          READ 250
      END                                                                READ 260

      SUBROUTINE DACORR (NSAMP)                                          CORR  10
C     CORRECT ONE SET OF DATA                                            CORR  20
      COMMON /AA/ LOC,DATE,TIME,DIAM(33),SIZDIA(33),PCTFN(33),           CORR  30
     1 SIZE(33),NREC,NO                                                  CORR  40
      CHARACTER*80 LOC                                                   CORR  50
      CHARACTER*10 DATE                                                  CORR  60
    1 FORMAT (A80)                                                       CORR  70
    2 FORMAT ('ENTER NEW DATE TO REPLACE ',A10)                          CORR  80
    3 FORMAT (A10)                                                       CORR  90
    4 FORMAT ('ENTER NEW TIME TO REPLACE ',F5.0)                         CORR 100
    5 FORMAT ('ENTER SIZE NUMBER  MAX= 'I3,'   0 TO END')                CORR 110
    6 FORMAT ('ENTER NEW DIAM  VALUE TO REPLACE ',F8.3)                  CORR 120
    7 FORMAT ('ENTER NEW PCT FINER VALUE TO REPLACE ',F6.1)              CORR 130
  100 CALL DALIST (NSAMP)                                                CORR 140
      WRITE (1,*) '                                                      CORR 150
      WRITE (1,*) '0. ALL CORRECTIONS COMPLETED        3. CHANGE TIME'   CORR 160
      WRITE (1,*) '1. CHANGE LOCATION/DESCRIPTION      4. CHANGE DIAMETECORR 170
     1R VALUES'                                                          CORR 180
      WRITE (1,*) '2. CHANGE DATE                      5. CHANGE PCT FINCORR 190
     1ER VALUES'                                                         CORR 200
      WRITE (1,*) '                                                      CORR 210
      WRITE (1,*) 'ENTER NUMBER OF SELECTION'                            CORR 220
      READ (1,*) I                                                       CORR 230
      IF (I.GT.5) GO TO 100                                              CORR 240
      IF (I.EQ.0) RETURN                                                 CORR 250
      GO TO (110,120,130,140,150),I                                      CORR 260
  110 WRITE (1,*) 'ENTER NEW LOCATION/DESCRIPTION TO REPLACE'            CORR 270
      WRITE (1,1) LOC                                                    CORR 280
      READ (1,1) LOC                                                     CORR 290
      GO TO 100                                                          CORR 300
  120 WRITE (1,2) DATE                                                   CORR 310
      READ (1,3) DATE                                                    CORR 320
```

```
      GO TO 100                                                          CORR 330
  130 WRITE (1,4) TIME                                                   CORR 340
      READ (1,*) TIME                                                    CORR 350
      GO TO 100                                                          CORR 360
  140 WRITE (1,5) NO                                                     CORR 370
      READ(1,*) N                                                        CORR 380
      IF (N.EQ.0) GO TO 100                                              CORR 390
      IF (N.GT.NO) GO TO 140                                             CORR 400
      WRITE (1,6) SIZE(N)                                                CORR 410
      READ (1,*) SIZE(N)                                                 CORR 420
      GO TO 140                                                          CORR 430
  150 WRITE (1,5) NO                                                     CORR 440
      READ (1,*) N                                                       CORR 450
      IF (N.EQ.0) GO TO 100                                              CORR 460
      IF (N.GT.NO) GO TO 150                                             CORR 470
      WRITE (1,7) PCTFN(N)                                               CORR 480
      READ (1,*) PCTFN(N)                                                CORR 490
      GO TO 150                                                          CORR 500
      END                                                                CORR 510

      SUBROUTINE DALIST (NSAMP)                                          LIST  10
C     LIST ONE SET OF DATA ON SCREEN                                     LIST  20
      COMMON /AA/ LOC,DATE,TIME,DIAM(33),SIZDIA(33),PCTFN(33),           LIST  30
     1 SIZE(33),NREC,NO                                                  LIST  40
      CHARACTER*80 LOC                                                   LIST  50
      CHARACTER*10 DATE                                                  LIST  60
    1 FORMAT ('DATA SET NUMBER',I4)                                      LIST  70
    2 FORMAT (A80)                                                       LIST  80
    3 FORMAT ('DATE  ',A10,5X,'TIME  ',F5.0,5X,'NO. SIZES = ',I4)        LIST  90
    4 FORMAT (10I8)                                                      LIST 100
    5 FORMAT (10F8.3)                                                    LIST 110
    6 FORMAT (10F8.1)                                                    LIST 120
      CALL CLSCR(25)                                                     LIST 130
      WRITE (1,1) NSAMP                                                  LIST 140
      WRITE (1,*) '          '                                           LIST 150
      WRITE (1,2) LOC                                                    LIST 160
      WRITE (1,*) '          '                                           LIST 170
      WRITE (1,3) DATE,TIME,NO                                           LIST 180
      WRITE (1,*) '          '                                           LIST 190
      N1=-9                                                              LIST 200
   50 N1=N1+10                                                           LIST 210
      N2=N1+9                                                            LIST 220
      IF (N2.GT.NO) N2=NO                                                LIST 230
      WRITE (1,4) (N,N=N1,N2)                                            LIST 240
      WRITE (1,5) (SIZE(N),N=N1,N2)                                      LIST 250
      WRITE (1,6) (PCTFN(N),N=N1,N2)                                     LIST 260
      WRITE (1,*) '          '                                           LIST 270
      IF (N2.LT.NO) GO TO 50                                             LIST 280
      RETURN                                                             LIST 290
      END                                                                LIST 300
```

```
      SUBROUTINE TABLE                                                    TABL  10
C     LIST SIZE TABLE ON SCREEN                                           TABL  20
      COMMON /AA/ LOC,DATE,TIME,DIAM(33),SIZDIA(33),PCTFN(33),            TABL  30
     1 SIZE(33),NREC,NO                                                   TABL  40
      CHARACTER*80 LOC                                                    TABL  50
      CHARACTER*10 DATE                                                   TABL  60
      CALL CLSCR(25)                                                      TABL  70
      WRITE (1,*) 'SIZE NO. AND CORRESPONDING DIAM. IN MM AND PHI UNITS'TABL  80
      WRITE (1,*) '                                                    ' TABL  90
      WRITE (1,*) ' NO    MM    PHI    NO    MM    PHI    NO    MM     TABL 100
     1PHI'                                                                TABL 110
      WRITE (1,*) '  1 0.002   9.0    12 0.088   3.5    23    4.00    -TABL 120
     12.0'                                                                TABL 130
      WRITE (1,*) '  2 0.003   8.5    13 0.125   3.0    24    5.66    -TABL 140
     12.5'                                                                TABL 150
      WRITE (1,*) '  3 0.004   8.0    14 0.177   2.5    25    8.00    -TABL 160
     13.0'                                                                TABL 170
      WRITE (1,*) '  4 0.006   7.5    15 0.250   2.0    26   11.3     -TABL 180
     13.5'                                                                TABL 190
      WRITE (1,*) '  5 0.008   7.0    16 0.354   1.5    27   16.0     -TABL 200
     14.0'                                                                TABL 210
      WRITE (1,*) '  6 0.011   6.5    17 0.500   1.0    28   22.6     -TABL 220
     14.5'                                                                TABL 230
      WRITE (1,*) '  7 0.016   6.0    18 0.707   0.5    29   32.0     -TABL 240
     15.0'                                                                TABL 250
      WRITE (1,*) '  8 0.022   5.5    19 1.00    0.0    30   45.2     -TABL 260
     15.5'                                                                TABL 270
      WRITE (1,*) '  9 0.031   5.0    20 1.41   -0.5    31   64.0     -TABL 280
     16.0'                                                                TABL 290
      WRITE (1,*) ' 10 0.044   4.5    21 2.00   -1.0    32   90.5     -TABL 300
     16.5'                                                                TABL 310
      WRITE (1,*) ' 11 0.062   4.0    22 2.83   -1.5    33  128.0     -TABL 320
     17.0'                                                                TABL 330
      WRITE (1,*) '                                                    ' TABL 340
      RETURN                                                              TABL 350
      END                                                                 TABL 360

      SUBROUTINE CLSCR(N)                                                 CLSC  10
C                                                                         CLSC  20
C     MOVE CURSOR DOWN N LINES                                            CLSC  30
C                                                                         CLSC  40
      DO 10 I=1,N                                                         CLSC  50
      WRITE (1,*) '                                                    ' CLSC  60
   10 CONTINUE                                                            CLSC  70
      RETURN                                                              CLSC  80
      END                                                                 CLSC  90
```

SUPPLEMENTAL DATA--SECTION D.

FORTRAN PROGRAM SEDSIZE LISTING

```
      PROGRAM SEDSIZE                                                    SIZE  10
C                                                                        SIZE  20
C     COMPUTE SIZE STATISTICS FROM PERCENT FINER VALUES                  SIZE  30
C                                                                        SIZE  40
      COMMON PROB(307),X(307),PCT(33),PHI(33),N,L,TOL                    SIZE  50
      INTEGER PF,PCTCL,PCTST,PCTSD,PCTGR,PROB1,PROB4,PROB8               SIZE  60
      CHARACTER*80 LOC                                                   SIZE  70
      CHARACTER*1 BLK,ASK,PLS,FNT(14)                                    SIZE  80
      CHARACTER*8 FMAT(15),KMAT(2)                                       SIZE  90
      CHARACTER*10 DATE,CLS                                              SIZE 100
      CHARACTER*20 DFILE,OFILE                                           SIZE 110
      DIMENSION PCTFN(33),DIA(33),TP(10),CP(10),SIZPHI(33),VA(10),       SIZE 120
     1 H(10),D(10),SIZDIA(33),ICD(10),AB(10),NCD(10)                     SIZE 130
C                                                                        SIZE 140
    1 FORMAT (' COMPUTING SIZE STATISTICS FOR DATA ON FILE ',A20)        SIZE 150
    5 FORMAT (A20)                                                       SIZE 160
   39 FORMAT (1H+,61X,'-- UNDEFINED')                                    SIZE 170
   40 FORMAT (1H+,61X,'-- EXTRAPOLATED FROM POINTS  1 AND  2')           SIZE 180
   41 FORMAT (1H+,61X,'-- EXTRAPOLATED FROM POINTS',I3,' AND',I3)        SIZE 190
   42 FORMAT (1H0,'PCT GRAVEL   PCT SAND     PCT SILT     PCT CLAY',10X,SIZE 200
     1 'MEYER-PETER EFFECTIVE DIAMETER IS 'F8. 3,' MM' )                 SIZE 210
   43 FORMAT (1H0,'PCT GRAVEL   PCT SAND     PCT SILT     PCT CLAY',10X,SIZE 220
     1 'MEYER-PETER EFF. DIAM. NOT COMPUTED - 0% FINER SIZE NOT DEFINED  SIZE 230
     2 ')                                                                SIZE 240
   44 FORMAT (1H0,'PCT GRAVEL   PCT SAND     PCT SILT     PCT CLAY',10X,SIZE 250
     1 'MEYER-PETER EFF.DIAM. NOT COMPUTED - 100% FINER SIZE NOT DEFINEDSIZE 260
     2 ')                                                                SIZE 270
   45 FORMAT (1H ,I5,A1,9X,I3,A1,9X,I3,A1,9X,I3,A1)                      SIZE 280
   46 FORMAT (1H0,10X,'* BASED ON EXTRAPOLATED VALUES - ERROR MAY BE EXCSIZE 290
     1ESSIVE')                                                           SIZE 300
   47 FORMAT (1H+,76X,'+ UNDEFINED')                                     SIZE 310
   51 FORMAT (1H1)                                                       SIZE 320
   52 FORMAT (21H0SIZE STATISTICS FOR  , A80,5X,A10,I6  /                SIZE 330
     1 1H0,'  INPUT SIZE DISTRIBUTION',12X,'SPECIFIED COMPUTED SIZES' / SIZE 340
     2 1H ,'  PARTICLE SIZE     PERCENT',9X,'PERCENT     PARTICLE SIZE'/SIZE 350
     3 1H ,'MILLIMETER    PHI    FINER',11X,'FINER    PHI   MILLIMETER'/SIZE 360
     4 1H )                                                              SIZE 370
   53 FORMAT (1H0,13('----------'))                                      SIZE 380
   54 FORMAT (1H ,F8.3,F9.2,F9.1,10X,I5,F9.3,F10.3)                      SIZE 390
   55 FORMAT (1H ,36X,I5,F9.3,F10.3)                                     SIZE 400
   56 FORMAT (1H0,18X,'INMAN VALUES',24X,'TRASK VALUES',14X,'FOLK VALUESSIZE 410
     1' / 1H ,'    MEAN     SORT    ALPH1    ALPH2     BETA',9X,'SORT   SIZE 420
     2  SKEW',9X,'MEAN     SORT     SKEW' / 1H ,5(8X,A1),4X,2(8X,A1),   SIZE 430
     3 4X,3(8X,A1))                                                      SIZE 440
   57 FORMAT (38H0*** DEV = 0   INPUT DATA IN ERROR ***  / 1H0)          SIZE 450
   58 FORMAT (1H ,'OUTPUT ON FILE ',A20 / )                              SIZE 460
   59 FORMAT (1H0,'*** READ ERROR ON FILE ',A20,' ***'  )                SIZE 470
```

```
   60 FORMAT (1H0,'*** END-OF-FILE ON FILE ',A20,' ***' )                    SIZE 480
C                                                                            SIZE 490
      DATA (PROB(I),I=1,154)/0.10,0.11,0.12,0.13,0.14,0.15,0.16,0.18,        SIZE 500
     1 0.19,0.20,0.21,0.23,0.24,0.26,0.27,0.29,0.31,0.33,0.35,0.37,          SIZE 510
     2 0.39,0.41,0.44,0.47,0.49,0.52,0.55,0.59,0.62,0.66,0.69,0.73,          SIZE 520
     3 0.78,0.82,0.87,0.91,0.96,1.02,1.07,1.13,1.19,1.25,1.32,1.39,          SIZE 530
     4 1.46,1.54,1.62,1.70,1.79,1.88,1.97,2.07,2.17,2.28,2.39,2.50,          SIZE 540
     5 2.62,2.74,2.87,3.01,3.14,3.29,3.44,3.59,3.75,3.92,4.09,4.27,          SIZE 550
     6 4.46,4.65,4.85,5.05,5.26,5.48,5.71,5.94,6.18,6.43,6.68,6.94,          SIZE 560
     7 7.21,7.49,7.78,8.08,8.38,8.69,9.01,9.34,9.68,10.03,10.38,10.75,       SIZE 570
     8 11.12,11.51,11.90,12.30,12.71,13.14,13.57,14.01,14.46,14.92,          SIZE 580
     9 15.39,15.87,16.35,16.85,17.36,17.88,18.41,18.94,19.49,20.05,          SIZE 590
     A 20.61,21.19,21.77,22.36,22.97,23.58,24.20,24.83,25.46,26.11,          SIZE 600
     B 26.76,27.43,28.10,28.77,29.46,30.15,30.85,31.56,32.28,33.00,          SIZE 610
     C 33.72,34.46,35.20,35.94,36.69,37.45,38.21,38.97,39.74,40.52,          SIZE 620
     D 41.29,42.07,42.86,43.64,44.43,45.22,46.02,46.81,47.61,48.40,          SIZE 630
     E 49.20,50.00/                                                          SIZE 640
      DATA CP/1.645,1.0,0.6745,0.3854,0.0,-0.3854,-0.6745,-1.0,-1.282,       SIZE 650
     1 -1.645/                                                               SIZE 660
      DATA TP/5.0,15.87,25.0,35.0,50.0,65.0,75.0,84.13,90.0,95.0/            SIZE 670
      DATA BLK,ASK,PLS/' ','*','+'/                                          SIZE 680
      DATA FMAT(1),FMAT(7),FMAT(10),FMAT(14)/'(1H+ ',' ,4X',' ,4X',' )'/SIZE 690
      DATA KMAT/',F8.3,1X',' ,9X    '/                                       SIZE 700
C                                                                            SIZE 710
      DO 70 I=155,307                                                        SIZE 720
      J=308-I                                                                SIZE 730
      PROB(I)=100.0-PROB(J)                                                  SIZE 740
   70 CONTINUE                                                               SIZE 750
      DO 80 I=1,153                                                          SIZE 760
      X1 = 3.06 -FLOAT(I-1)*0.02                                             SIZE 770
      X(I) = X1                                                              SIZE 780
      X(308-I) = X1                                                          SIZE 790
   80 CONTINUE                                                               SIZE 800
      X(154) = 0.0                                                           SIZE 810
      TOL=0.001                                                              SIZE 820
C                                                                            SIZE 830
C     INPUT DATA                                                             SIZE 840
C                                                                            SIZE 850
      DFILE='SIZE.DATA'                                                      SIZE 860
      CALL CLSCR(25)                                                         SIZE 870
      WRITE (1,*) 'ESTABLISH DATA FILE NAME:'                                SIZE 880
      WRITE (1,*) '                '                                       SIZE 890
      WRITE (1,*) '     1. USE PROGRAMMED FILE NAME  (SIZE.DATA)'            SIZE 900
      WRITE (1,*) '     2. PROVIDE FILE NAME'                                SIZE 910
      CALL CLSCR(3)                                                          SIZE 920
      WRITE (1,*) 'ENTER NUMBER OF SELECTION'                                SIZE 930
      CALL CLSCR(10)                                                         SIZE 940
      READ (1,*) I                                                           SIZE 950
      IF (I.LT.2) GO TO 160                                                  SIZE 960
```

```
      CALL CLSCR(25)                                                    SIZE 970
      WRITE (1,*) 'ENTER DESIRED FILE NAME'                             SIZE 980
      CALL CLSCR(10)                                                    SIZE 990
      READ (1,5) DFILE                                                  SIZE1000
  160 OPEN (5,FILE=DFILE,STATUS='OLD',FORM='UNFORMATTED')               SIZE1010
      OFILE='SIZE.OUT'                                                  SIZE1020
      CALL CLSCR(25)                                                    SIZE1030
      WRITE (1,*) 'ESTABLISH OUTPUT FILE NAME'                          SIZE1040
      WRITE (1,*) '          '                                          SIZE1050
      WRITE (1,*) '     1. USE PROGRAMMED FILE NAME  (SIZE.OUT)'       SIZE1060
      WRITE (1,*) '     2. PROVIDE FILE NAME'                          SIZE1070
      CALL CLSCR(3)                                                     SIZE1080
      WRITE (1,*) 'ENTER NUMBER OF SELECTION'                           SIZE1090
      CALL CLSCR(10)                                                    SIZE1100
      READ (1,*) I                                                      SIZE1110
      IF (I.LT.2) GO TO 170                                             SIZE1120
      CALL CLSCR(25)                                                    SIZE1130
      WRITE (1,*) 'ENTER DESIRED FILE NAME'                             SIZE1140
      CALL CLSCR(10)                                                    SIZE1150
      READ (1,5) OFILE                                                  SIZE1160
  170 OPEN (6,FILE=OFILE,STATUS='NEW')                                  SIZE1170
      NPL=100                                                           SIZE1180
      READ (5) NSAMP                                                    SIZE1190
      CALL CLSCR(25)                                                    SIZE1200
      WRITE (1,1) DFILE                                                 SIZE1210
      CALL CLSCR(10)                                                    SIZE1220
      DO 980 NS=1,NSAMP                                                 SIZE1230
      READ (5,ERR=1000,END=1010) LOC                                    SIZE1240
      READ (5,ERR=1000,END=1010) DATE,TIME,NO                           SIZE1250
      READ (5,ERR=1000,END=1010) (SIZDIA(I),I=1,17)                     SIZE1260
      READ (5,ERR=1000,END=1010) (SIZDIA(I),I=18,33)                    SIZE1270
      READ (5,ERR=1000,END=1010) (PCTFN(I),I=1,17)                      SIZE1280
      READ (5,ERR=1000,END=1010) (PCTFN(I),I=18,33)                     SIZE1290
      ITIME=TIME                                                        SIZE1300
C                                                                       SIZE1310
C     COMPUTE MEYER-PETER EFFECTIVE DIAMETER                            SIZE1320
C                                                                       SIZE1330
      P1=0.0                                                            SIZE1340
      DMP=0.0                                                           SIZE1350
      IF (PCTFN(1).GT.0.0) GO TO 220                                    SIZE1360
      DO 180 I=1,NO                                                     SIZE1370
      IF (PCTFN(I+1).GT.0.0) GO TO 190                                  SIZE1380
  180 CONTINUE                                                          SIZE1390
  190 S1=SIZDIA(I)                                                      SIZE1400
      I1=I+1                                                            SIZE1410
      DO 200 I=I1,NO                                                    SIZE1420
      IF (PCTFN(I).LT.TOL) GO TO 200                                    SIZE1430
      DMP=DMP+SQRT(S1*SIZDIA(I))*(PCTFN(I)-P1)                          SIZE1440
      S1=SIZDIA(I)                                                      SIZE1450
```

```
      P1=PCTFN(I)                                                       SIZE1460
      IF (P1.GE.99.9) GO TO 250                                         SIZE1470
  200 CONTINUE                                                          SIZE1480
      MP=3                                                              SIZE1490
      GO TO 400                                                         SIZE1500
  220 MP=2                                                              SIZE1510
      GO TO 400                                                         SIZE1520
  250 MP=1                                                              SIZE1530
      DMP=DMP/100.0                                                     SIZE1540
  400 DO 450 I=1,NO                                                     SIZE1550
      P1=-3.322*(ALOG10(SIZDIA(I)))                                     SIZE1560
      SIZPHI(I)=INT(P1*10.0+SIGN(0.5,P1))/10.0                          SIZE1570
  450 CONTINUE                                                          SIZE1580
C                                                                       SIZE1590
C     ELIMINATION OF ZERO PCTFN VALUES                                  SIZE1600
C                                                                       SIZE1610
  550 M = 0                                                             SIZE1620
      DO 570 I=1,NO                                                     SIZE1630
      IF (PCTFN(I).LT.TOL) GO TO 570                                    SIZE1640
      M = M+1                                                           SIZE1650
      DIA(M) = SIZDIA(I)                                                SIZE1660
      PCT(M) = PCTFN(I)                                                 SIZE1670
      PHI(M) = SIZPHI(I)                                                SIZE1680
  570 CONTINUE                                                          SIZE1690
      I1=M+16                                                           SIZE1700
      IF (M.LT.10) I1=26                                                SIZE1710
      NPL=NPL+I1                                                        SIZE1720
      IF (NPL.GT.57) GO TO 580                                          SIZE1730
      WRITE (6,53)                                                      SIZE1740
      GO TO 600                                                         SIZE1750
  580 NPL = I1                                                          SIZE1760
      WRITE (6,51)                                                      SIZE1770
  600 WRITE (6,52) LOC,DATE,ITIME                                       SIZE1780
C                                                                       SIZE1790
C     COMPUTE STATISTICS                                                SIZE1800
C                                                                       SIZE1810
      N = 1                                                             SIZE1820
      DO 670 I=1,10                                                     SIZE1830
      ICD(I)=0                                                          SIZE1840
  625 IF (TP(I).LE.PCT(N)) GO TO 645                                    SIZE1850
      IF (N.LT.M) GO TO 640                                             SIZE1860
C                                                                       SIZE1870
C     IF ABOVE STAT. WAS FALSE, EXTRAPOLATION ABOVE GIVEN POINTS        SIZE1880
C                                                                       SIZE1890
      ICD(I)=2                                                          SIZE1900
      GO TO 650                                                         SIZE1910
  640 N = N+1                                                           SIZE1920
      GO TO 625                                                         SIZE1930
  645 IF (N.GT.1) GO TO 650                                             SIZE1940
```

```
C                                                                       SIZE1950
C     IF STAT. 645 WAS TRUE, INTERPOLATION BETWEEN POINTS. IF FALSE     SIZE1960
C     EXTRAPOLATION BELOW GIVEN POINTS                                  SIZE1970
C                                                                       SIZE1980
      IF (ABS(TP(I)-PCT(N)).GT.TOL) ICD(I)=1                            SIZE1990
      GO TO 652                                                         SIZE2000
  650 N = N-1                                                           SIZE2010
  652 CALL INTERP (DEV,SIGMA,CENTER)                                    SIZE2020
      IF (DEV.LE.0.0) GO TO 950                                         SIZE2030
      PF = INT(TP(I)+0.3)                                               SIZE2040
      H(I) = CENTER+CP(I)*SIGMA                                         SIZE2050
      IF (H(I).LE.14) GO TO 658                                         SIZE2060
      ICD(I)=-20                                                        SIZE2070
      IF (M.LT.I) GO TO 654                                             SIZE2080
      WRITE (6,54) DIA(I),PHI(I),PCT(I),PF                              SIZE2090
      GO TO 656                                                         SIZE2100
  654 WRITE (6,55) PF                                                   SIZE2110
  656 WRITE (6,39)                                                      SIZE2120
      GO TO 670                                                         SIZE2130
  658 D(I)=0.5**H(I)                                                    SIZE2140
      IF (M.LT.I) GO TO 660                                             SIZE2150
      WRITE (6,54) DIA(I),PHI(I),PCT(I),PF,H(I),D(I)                    SIZE2160
      GO TO 662                                                         SIZE2170
  660 WRITE (6,55) PF,H(I),D(I)                                         SIZE2180
  662 N9=ICD(I)+1                                                       SIZE2190
      GO TO (670,664,666),N9                                            SIZE2200
  664 WRITE (6,40)                                                      SIZE2210
      GO TO 670                                                         SIZE2220
  666 WRITE (6,41) M-1,M                                                SIZE2230
  670 CONTINUE                                                          SIZE2240
      IF (M.LE.10) GO TO 690                                            SIZE2250
      DO 680 I=11,M                                                     SIZE2260
  680 WRITE (6,54) DIA(I),PHI(I),PCT(I)                                 SIZE2270
C                                                                       SIZE2280
C     COMPUTE INMAN, TRASK AND FOLK VALUES                              SIZE2290
C                                                                       SIZE2300
  690 AB(1) = 0.5*(H(2)+H(8))                                           SIZE2310
      AB(2) = 0.5*(H(2)-H(8))                                           SIZE2320
      AB(3) = (AB(1)-H(5))/AB(2)                                        SIZE2330
      AB(3) = AINT(AB(3)*100.0)/100.0                                   SIZE2340
      AB(4) = (0.5*(H(10)+H(1))-H(5))/AB(2)                             SIZE2350
      AB(4) = AINT(AB(4)*100.0)/100.0                                   SIZE2360
      AB(5) = (0.5*(H(1)-H(10))-AB(2))/AB(2)                            SIZE2370
      AB(6) = (D(7)/D(3))**0.5                                          SIZE2380
      AB(7) = (D(7)*D(3))/(D(5)**2)                                     SIZE2390
      AB(8) = (H(8)+H(5)+H(2))/3.0                                      SIZE2400
      AB(9) = (H(2)-H(8))/4.0+(H(1)-H(10))/6.6                          SIZE2410
      X1 = (H(8)+H(2)-2.0*H(5))/(2.0*(H(2)-H(8)))                       SIZE2420
      X2 = (H(10)+H(1)-2.0*H(5))/(2.0*(H(1)-H(10)))                     SIZE2430
```

```
      AB(10) = X1+X2                                                    SIZE2440
      NCD(1)=ICD(2)+ICD(8)                                              SIZE2450
      NCD(2)=NCD(1)                                                     SIZE2460
      NCD(3)=NCD(1)+ICD(5)                                              SIZE2470
      NCD(8)=NCD(3)                                                     SIZE2480
      NCD(5)=NCD(1)+ICD(1)+ICD(10)                                      SIZE2490
      NCD(9)=NCD(5)                                                     SIZE2500
      NCD(4)=NCD(5)+ICD(5)                                              SIZE2510
      NCD(10)=NCD(4)                                                    SIZE2520
      NCD(6)=ICD(3)+ICD(7)                                              SIZE2530
      NCD(7)=NCD(6)+ICD(5)                                              SIZE2540
      NTOT=0                                                            SIZE2550
      NF=1                                                              SIZE2560
      NP=0                                                              SIZE2570
      DO 698 I=1,10                                                     SIZE2580
      NTOT=NTOT+ICD(I)                                                  SIZE2590
      NF=NF+1                                                           SIZE2600
      IF (NCD(I).GE.0) GO TO 692                                        SIZE2610
      FMAT(NF)=KMAT(2)                                                  SIZE2620
      FNT(I)=PLS                                                        SIZE2630
      GO TO 694                                                         SIZE2640
  692 FNT(I)=BLK                                                        SIZE2650
      IF (NCD(I).GT.0) FNT(I)=ASK                                       SIZE2660
      FMAT(NF)=KMAT(1)                                                  SIZE2670
      NP=NP+1                                                           SIZE2680
      VA(NP)=AB(I)                                                      SIZE2690
  694 IF (I.NE.5.AND.I.NE.7) GO TO 698                                  SIZE2700
      NF=NF+1                                                           SIZE2710
  698 CONTINUE                                                          SIZE2720
      WRITE (6,56) (FNT(I),I=1,10)                                      SIZE2730
      WRITE (6,FMAT) (VA(I),I=1,NP)                                     SIZE2740
C                                                                       SIZE2750
C     COMPUTATION OF PERCENT CLAY, SILT, SAND, AND GRAVEL               SIZE2760
C                                                                       SIZE2770
      DO 820 NN=1,3                                                     SIZE2780
      IF (NN-2) 700,710,715                                             SIZE2790
  700 IF (PHI(M).GT.-1.0) GO TO 705                                     SIZE2800
      D9=-1.0                                                           SIZE2810
      GO TO 720                                                         SIZE2820
  705 PROBD=100.0                                                       SIZE2830
      GO TO 820                                                         SIZE2840
  710 PROB1=PROBD+0.5                                                   SIZE2850
      D9=4.0                                                            SIZE2860
      GO TO 720                                                         SIZE2870
  715 PROB4=PROBD+0.5                                                   SIZE2880
      IF (M.EQ.1) GO TO 830                                             SIZE2890
      D9=8.0                                                            SIZE2900
  720 N=1                                                               SIZE2910
  725 IF (D9-PHI(N)) 730,735,740                                        SIZE2920
```

```
730 IF (N.GE.M) GO TO 745                                                    SIZE2930
    N=N+1                                                                    SIZE2940
    GO TO 725                                                                SIZE2950
735 PROBD=PCT(N)                                                             SIZE2960
    GO TO 820                                                                SIZE2970
740 IF (N.EQ.1) GO TO 750                                                    SIZE2980
745 N=N-1                                                                    SIZE2990
750 CALL INTERP (DEV,SIGMA,CENTER)                                           SIZE3000
    IF (DEV.LE.0.0) GO TO 950                                                SIZE3010
    IF (D9-CENTER) 755,785,790                                               SIZE3020
755 DEVD=(CENTER-D9)/SIGMA                                                   SIZE3030
    IF (DEVD.GT.3.06) GO TO 780                                              SIZE3040
    N=154                                                                    SIZE3050
760 IF (DEVD-X(N)) 775,770,765                                               SIZE3060
765 N=N+1                                                                    SIZE3070
    GO TO 760                                                                SIZE3080
770 PROBD=PROB(N)                                                            SIZE3090
    GO TO 820                                                                SIZE3100
775 PROBD=PROB(N-1)+(DEVD-X(N-1))*(PROB(N)-PROB(N-1))/0.02                   SIZE3110
    GO TO 820                                                                SIZE3120
780 PROBD=100.0                                                              SIZE3130
    GO TO 820                                                                SIZE3140
785 PROBD=50.0                                                               SIZE3150
    GO TO 820                                                                SIZE3160
790 DEVD=(D9-CENTER)/SIGMA                                                   SIZE3170
    IF (DEVD.GT.3.06) GO TO 810                                              SIZE3180
    N=1                                                                      SIZE3190
795 IF (DEVD-X(N)) 800,805,775                                               SIZE3200
800 N=N+1                                                                    SIZE3210
    GO TO 795                                                                SIZE3220
805 PROBD=PROB(N)                                                            SIZE3230
    GO TO 820                                                                SIZE3240
810 PROBD=0.0                                                                SIZE3250
820 CONTINUE                                                                 SIZE3260
    PROB8=PROBD+0.5                                                          SIZE3270
    PCTCL=PROB8                                                              SIZE3280
    PCTST= PROB4-PROB8                                                       SIZE3290
    PCTSD=PROB1-PROB4                                                        SIZE3300
    PCTGR=100-PROB1                                                          SIZE3310
    GO TO 850                                                                SIZE3320
830 PCTCL=0                                                                  SIZE3330
    PCTST= PROB4                                                             SIZE3340
    PCTSD=PROB1-PROB4                                                        SIZE3350
    PCTGR=100-PROB1                                                          SIZE3360
850 FNT(11)=BLK                                                              SIZE3370
    IF (PCTGR.EQ.0) GO TO 860                                                SIZE3380
    IF (PHI(M).LE.-1.0.OR.ABS(PCT(M)-99.9).LT.TOL) GO TO 860                 SIZE3390
    FNT(11)=ASK                                                              SIZE3400
    NTOT=NTOT+1                                                              SIZE3410
```

```
  860 FNT(12)=BLK                                                        SIZE3420
      IF (PCTSD.EQ.0) GO TO 870                                          SIZE3430
      IF (PHI(M).LE.-1.0.OR.ABS(PCT(M)-99.9).LT.TOL.AND.PHI(1).GT.4.0.ORSIZE3440
     1.ABS(PCT(1)-0.1).LT.TOL) GO TO 870                                 SIZE3450
      FNT(12)=ASK                                                        SIZE3460
      NTOT=NTOT+1                                                        SIZE3470
  870 FNT(13)=BLK                                                        SIZE3480
      IF (PCTST.EQ.0) GO TO 880                                          SIZE3490
      IF (PHI(M).GT.4.0.OR.ABS(PCT(M)-99.9).LT.TOL.AND.PHI(1).GT.8.0.OR.SIZE3500
     1ABS(PCT(1)-0.1).LT.TOL) GO TO 880                                  SIZE3510
      FNT(13)=ASK                                                        SIZE3520
      NTOT=NTOT+1                                                        SIZE3530
  880 FNT(14)=BLK                                                        SIZE3540
      IF (PCTCL.EQ.0) GO TO 900                                          SIZE3550
      IF (PHI(1).GT.8.0.OR.ABS(PCT(1)-0.1).LT.TOL) GO TO 900             SIZE3560
      FNT(14)=ASK                                                        SIZE3570
      NTOT=NTOT+1                                                        SIZE3580
  900 GO TO (910,920,930),MP                                             SIZE3590
  910 WRITE (6,42) DMP                                                   SIZE3600
      GO TO 970                                                          SIZE3610
  920 WRITE (6,43)                                                       SIZE3620
      GO TO 970                                                          SIZE3630
  930 WRITE (6,44)                                                       SIZE3640
  970 WRITE (6,45) PCTGR,FNT(11),PCTSD,FNT(12),PCTST,FNT(13),PCTCL,      SIZE3650
     1 FNT(14)                                                           SIZE3660
      IF (NTOT.EQ.0) GO TO 980                                           SIZE3670
      WRITE (6,46)                                                       SIZE3680
      IF (NTOT.LT.0) WRITE (6,47)                                        SIZE3690
      GO TO 980                                                          SIZE3700
  950 WRITE (6,57)                                                       SIZE3710
      WRITE (6,46)                                                       SIZE3720
  980 CONTINUE                                                           SIZE3730
      GO TO 1020                                                         SIZE3740
 1000 WRITE (6,59)DFILE                                                  SIZE3750
      GO TO 1020                                                         SIZE3760
 1010 WRITE (6,60)DFILE                                                  SIZE3770
 1020 ENDFILE (6)                                                        SIZE3780
      CLOSE (5)                                                          SIZE3790
      CLOSE (6)                                                          SIZE3800
      WRITE (1,58) OFILE                                                 SIZE3810
      WRITE (1,*) 'END OF RUN'                                           SIZE3820
      CALL CLSCR(5)                                                      SIZE3830
      CALL EXIT                                                          SIZE3840
      END                                                                SIZE3850


      SUBROUTINE INTERP (DEV,SIGMA,CENTER)                               INTR  10
      COMMON PROB(307),X(307),PCT(33),PHI(33),N,L,TOL                    INTR  20
```

```
      IF (PCT(N).GE.50.0) GO TO 40                                        INTR  30
      L=1                                                                 INTR  40
   10 IF (PROB(L).GE.PCT(N)) GO TO 20                                     INTR  50
      L = L+1                                                             INTR  60
      GO TO 10                                                            INTR  70
   20 IF (PCT(N).GT.0.1) GO TO 30                                         INTR  80
      DEV1 = X(1)                                                         INTR  90
      GO TO 60                                                            INTR 100
   30 DEV1=X(L-1)-((PCT(N)-PROB(L-1))*0.02/(PROB(L)-PROB(L-1)))           INTR 110
      GO TO 60                                                            INTR 120
   40 L=154                                                               INTR 130
   45 IF (PROB(L).GE.PCT(N)) GO TO 50                                     INTR 140
      L = L+1                                                             INTR 150
      GO TO 45                                                            INTR 160
   50 DEV1=X(L-1)+((PCT(N)-PROB(L-1))*0.02/(PROB(L)-PROB(L-1)))           INTR 170
   60 L1 = L                                                              INTR 180
      IF (PCT(N+1).GE.50.0) GO TO 90                                      INTR 190
      L=1                                                                 INTR 200
   70 IF (PROB(L).GE.PCT(N+1)) GO TO 80                                   INTR 210
      L = L+1                                                             INTR 220
      GO TO 70                                                            INTR 230
   80 DEV2=X(L-1)-((PCT(N+1)-PROB(L-1))*0.02/(PROB(L)-PROB(L-1)))         INTR 240
      GO TO 110                                                           INTR 250
   90 L=154                                                               INTR 260
   95 IF (PROB(L).GE.PCT(N+1)) GO TO 100                                  INTR 270
      L = L+1                                                             INTR 280
      GO TO 95                                                            INTR 290
  100 DEV2=X(L-1)+((PCT(N+1)-PROB(L-1))*0.02/(PROB(L)-PROB(L-1)))         INTR 300
  110 L2 = L                                                              INTR 310
      L3 = 1                                                              INTR 320
      L4 = 1                                                              INTR 330
      IF (L1.GT.154) GO TO 120                                            INTR 340
      L3 = -1                                                             INTR 350
  120 IF(L2.GT.154) GO TO 130                                             INTR 360
      L4 = -1                                                             INTR 370
  130 L5 = L3+L4+3                                                        INTR 380
      IF (L5-3) 150,160,140                                               INTR 390
C                                                                         INTR 400
C     CENTER IS ABOVE BOTH POINTS                                         INTR 410
C                                                                         INTR 420
  140 DEV = DEV2-DEV1                                                     INTR 430
      IF (DEV.LT.TOL) RETURN                                              INTR 440
      SIGMA = (PHI(N)-PHI(N+1))/DEV                                       INTR 450
      CENTER = PHI(N)+DEV1*SIGMA                                          INTR 460
      RETURN                                                              INTR 470
C                                                                         INTR 480
C     CENTER IS BELOW BOTH POINTS                                         INTR 490
C                                                                         INTR 500
  150 DEV = DEV1-DEV2                                                     INTR 510
```

```
      GO TO 170                                                    INTR 520
C                                                                  INTR 530
C     CENTER IS BETWEEN POINTS                                     INTR 540
C                                                                  INTR 550
  160 DEV = DEV1+DEV2                                              INTR 560
  170 IF (DEV.LT.TOL) RETURN                                       INTR 570
      SIGMA = (PHI(N)-PHI(N+1))/DEV                                INTR 580
      CENTER = PHI(N)-DEV1*SIGMA                                   INTR 590
      RETURN                                                       INTR 600
      END                                                          INTR 610


      SUBROUTINE CLSCR(N)                                          CLSC  10
C                                                                  CLSC  20
C     MOVE CURSOR DOWN N LINES                                     CLSC  30
C                                                                  CLSC  40
      DO 10 I=1,N                                                  CLSC  50
      WRITE (1,*)                                                  CLSC  60
   10 CONTINUE                                                     CLSC  70
      RETURN                                                       CLSC  80
      END                                                          CLSC  90
```

SUPPLEMENTAL DATA--SECTION E.

BASIC PROGRAM SIZEDATA LISTING

```
10 REM PROGRAM SIZEDATA
20 REM ENTER DATA FOR SIZE STATISTIC PROGRAM TO INPUT FILE
30 REM STORES DATA ON SEQUENTIAL FILE DFILE$ AFTER EACH 10 ENTERED DATA SETS
40 DIM LO$(30),DIAM(33),SIZDIA(33),PCTFN(30,33),SIZE(30,33),DATE$(30),TIME(30),
NS(30)
50 DATA 0.002,0.003,0.004,0.006,0.008,0.011,0.016,0.022,0.031,0.044,0.062,0.088,
0.125,0.177,0.25,0.354,0.5,0.707,1,1.4,2,2.8,4,5.6,8,11.3,16,22.6,32,45.2,64,90.
5,128
60 FOR I=1 TO 33 : READ DIAM(I) : NEXT I
70 DFILE$="SIZE.DAT"
80 NN=25 : GOSUB 2980
90 PRINT "TURN ON PRINTER´ : PRINT : PRINT "ESTABLISH FILE NAME:" : PRINT
100 PRINT "     1. USE PROGRAMMED FILE NAME (SIZE.DAT)"
110 PRINT "     2. PROVIDE FILE NAME"
120 NN=3 : GOSUB 2980
130 PRINT "ENTER NUMBER OF SELECTION"
140 NN=10 : GOSUB 2980 : INPUT " ",I
150 IF I=1 THEN 190
160 NN=25 : GOSUB 2980
170 PRINT "ENTER DESIRED FILE NAME"
180 NN=10 : GOSUB 2980 : INPUT " ",DFILE$
190 NN=25 : GOSUB 2980
200 PRINT "     1. START DATA ENTRY INTO ";DFILE$
210 PRINT "     2. ADD DATA TO ";DFILE$
220 PRINT "     3. CORRECT DATA IN ";DFILE$
230 PRINT "     4. DISPLAY DATA IN ";DFILE$
240 PRINT "     5. PRINT DATA IN ";DFILE$
250 NN=3 : GOSUB 2980
260 PRINT "ENTER NUMBER OF SELECTION"
270 NN=10 : GOSUB 2980 : INPUT " ",NC
280 NU=0 : ND=0 : IST=0
290 IF NC=1 GOTO 420
300 REM LOAD DATA FROM DISK  * * * * * * * * * * * * * * * * * * * * * * * * * * *
310 OPEN "I",#1,DFILE$
320 INPUT #1,NU
330 FOR I=1 TO NU
340 INPUT #1,LO$(I),DATE$(I),TIME(I),NS(I)
350 NO=NS(I)
360 FOR N=1 TO NO : INPUT #1,SIZE(I,N) : NEXT N
370 FOR N=1 TO NO : INPUT #1,PCTFN(I,N) : NEXT N
380 NEXT I
390 CLOSE
400 ON NC GOTO 420,420,1820,2220,2380
410 REM ENTER DATA * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
420 NN=25 : GOSUB 2980
430 PRINT "METHOD OF ENTERING PARTICLE DIAMETERS:"
440 PRINT
```

```
450 PRINT "     1. INDIVIDUAL DIAMETER NUMBERS FROM SIZE TABLE
460 PRINT "     2. SEQUENTIAL DIAMETERS BETWEEN MIN-MAX TABLE NUMBERS
470 PRINT "     3. INDIVIDUALLY ENTERED DIAMETERS (IN MILLIMETERS)
480 PRINT "     4. SEQUENTIAL PHI VALUES BETWEEN MIN-MAX VALUES
490 NN=3 : GOSUB 2980
500 PRINT "ENTER NUMBER OF SELECTION"
510 NN=10 : GOSUB 2980 : INPUT " ",INOPT
520 IF INOPT>4 THEN 420
530 ON INOPT GOTO 540,670,830,930
540 NN=25 : GOSUB 2980
550 PRINT "ENTER NUMBER DIAMETERS TO BE USED  (MAX 33)"
560 NN=10 : GOSUB 2980 : INPUT " ",NO
570 IF NO>33 THEN 540
580 FOR I=1 TO NO
590 GOSUB 2820
600 NN=3 : GOSUB 2980
610 PRINT USING "ENTER TABLE NUMBER FOR DIAM NO.  ##";I
620 NN=3 : GOSUB 2980 : INPUT " ",J
630 IF J>33 THEN 590
640 SIZDIA(I)=DIAM(J)
650 NEXT I
660 GOTO 1090
670 GOSUB 2820
680 INPUT "ENTER MIN TABLE DIAMETER NUMBER ";NMIN
690 IF NMIN<1 THEN 670
700 INPUT "ENTER MAX TABLE DIAMETER NUMBER ";NMAX
710 IF NMAX>=33 THEN 700
720 INPUT "ENTER DIAMETER NUMBER INCREMENT ";NINC
730 NO=0
740 FOR J=NMIN TO NMAX STEP NINC
750 NO=NO+1
760 IF NO>33 THEN 800
770 SIZDIA(NO)=DIAM(J)
780 NEXT J
790 GOTO 1090
800 PRINT : PRINT "**** NUMBER DIAMETERS > 33 ****"
810 PRINT : PRINT "PRESS ANY KEY TO CONTINUE" : S$=INPUT$(1)
820 GOTO 670
830 NN=25 : GOSUB 2980
840 PRINT "ENTER NUMBER SIZES TO BE ENTERED  (MAX 33)"
850 NN=10 : GOSUB 2980 : INPUT " ",NO
860 IF NO>33 THEN 830
870 FOR I=1 TO NO
880 NN=3 : GOSUB 2980
890 PRINT USING "ENTER DIAM. IN MM SIZE NUMBER ##";I
900 NN=3 : GOSUB 2980 : INPUT " ",SIZDIA(I)
910 NEXT I
920 GOTO 1090
930 GOSUB 2820
```

```
940 INPUT "ENTER MAX PHI VALUE ",PMAX
950 INPUT "ENTER MIN PHI VALUE ",PMIN
960 INPUT "ENTER PHI INCREMENT  (1.0 OR 0.5) ",PINC
970 NO=INT((PMAX-PMIN)/PINC+1)
980 IF NO<34 THEN 1020
990 PRINT : PRINT "**** NUMBER DIAMETERS > 33 ****"
1000 PRINT : PRINT "PRESS ANY KEY TO CONTINUE" : S$=INPUT$(1)
1010 GOTO 930
1020 P1=PMAX
1030 SIZDIA(1)=.5^(P1)
1040 FOR I=2 TO NO
1050 P2=P1-PINC
1060 SIZDIA(I)=.5^(P2)
1070 P1=P2
1080 NEXT I
1090 NN=25 : GOSUB 2980
1100 PRINT "NUMBER DIAMETERS = ";NO : PRINT
1110 N1=-9
1120 N1=N1+10 : N2=N1+9
1130 IF N2>NO THEN N2=NO
1140 FOR I=N1 TO N2 : PRINT USING "########";I; : NEXT I : PRINT
1150 FOR I=N1 TO N2 : PRINT USING "####.###";SIZDIA(I); : NEXT I : PRINT
1160 PRINT
1170 IF N2<NO THEN 1120
1180 NN=3 : GOSUB 2980
1190 PRINT "DIAMETERS OK  (Y/N)"
1200 NN=10 : GOSUB 2980 : INPUT " ",S$
1210 IF NOT (S$="Y" OR S$="y") THEN 420
1220 NOD=NO
1230 NN=25 : GOSUB 2980
1240 PRINT "ENTER LOCATION/DESCRIPTION  (MAX 80 CHARACTERS)"
1250 NN=10 : GOSUB 2980 : LINE INPUT L$
1260 IF IST=0 THEN 1400
1270 IST=IST+1
1280 IF NU=30 THEN 1880
1290 N=25 : GOSUB 2980
1300 PRINT "REQUIREMENT FOR NEXT DATA-SET ENTRY:" : PRINT
1310 PRINT "     1. NO CHANGE IN INPUT SEQUENCE
1320 PRINT "     2. CHANGE LOCATION/DESCRIPTION
1330 PRINT "     3. CHANGE PARTICLE DIAMETERS
1340 PRINT "     4. STOP DATA ENTRY (END RUN)"
1350 NN=3 : GOSUB 2980
1360 PRINT "ENTER NUMBER OF SELECTION"
1370 NN=3 : GOSUB 2980 : INPUT " ",JOPTN
1380 IF JOPTN>4 THEN 1290
1390 ON JOPTN GOTO 1400,1230,420,1880
1400 NU=NU+1 : ND=ND+1
1410 IF ND<11 THEN 1440
1420 GOSUB 1690
```

```
1430 ND=0
1440 NN=25 : GOSUB 2980
1450 PRINT "DATA SET NO. ";NU; : PRINT "    MAX = 30" : PRINT
1460 PRINT L$ : PRINT
1470 LO$(NU)=L$
1480 PRINT : INPUT "ENTER DATE  (MM/DD/YY) ",DATE$(NU)
1490 PRINT : INPUT "ENTER TIME  (2400 HR) ",TIME(NU)
1500 NS(NU)=NOD : NO=NOD
1510 FOR I=1 TO NO
1520 SIZE(NU,I)=SIZDIA(I)
1530 PCTFN(NU,I)=0
1540 NEXT I
1550 FOR I=1 TO NO
1560 PRINT : PRINT USING "ENTER PCT FINER VALUE FOR  ###.### ";SIZDIA(I); : INPU
T PCTFN(NU,I)
1570 IF PCTFN(NU,I)<99.9 THEN 1600
1580 PCTFN(NU,I)=99.9
1590 GOTO 1610
1600 NEXT I
1610 N=NU : GOSUB 2670
1620 PRINT
1630 PRINT "     1. DATA SET OK
1640 PRINT "     2. RE-ENTER COMPLETE DATA SET
1650 PRINT "     3. CORRECT PART OF DATA SET
1660 PRINT : INPUT "ENTER NUMBER OF SELECTION ",I
1670 IF I>3 THEN 1610
1680 ON I GOTO 1280,1450,1950
1690 REM STORE DATA ON DISK  * * * * * * * * * * * * * * * * * * * * * * * * * *
1700 OPEN "O",#1,DFILE$
1710 WRITE #1,NU
1720 FOR I=1 TO NU
1730 WRITE #1,LO$(I),DATE$(I),TIME(I),NS(I)
1740 NO=NS(I)
1750 FOR N=1 TO NO : WRITE #1,SIZE(I,N) : NEXT N
1760 FOR N=1 TO NO : WRITE #1,PCTFN(I,N) : NEXT N
1770 NN=25 : GOSUB 2980
1780 NEXT I
1790 CLOSE
1800 RETURN
1810 END
1820 REM CORRECT DATA  * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
1830 NN=25 : GOSUB 2980
1840 PRINT "ENTER DATA SET NUMBER TO BE CORRECTED   0 TO END RUN"
1850 NN=10 : GOSUB 2980 : INPUT " ",N
1860 IF N>NU THEN 1830
1870 IF N>0 THEN 1940
1880 GOSUB 1690
1890 NN=25 : GOSUB 2980
1900 PRINT "NUMBER DATA SETS = ";NU
```

```
1910 PRINT : PRINT "DATA STORED IN FILE  ";DFILE$
1920 PRINT : PRINT "END OF RUN"
1930 NN=10 : GOSUB 2980 : END
1940 NO=NS(N)
1950 GOSUB 2670
1960 PRINT
1970 PRINT "0. ALL CORRECTIONS COMPLETED        3. CHANGE TIME"
1980 PRINT "1. CHANGE LOCATION/DESCRIPTION       4. CHANGE DIAMETERS"
1990 PRINT "2. CHANGE DATE                      5. CHANGE PCT FINER VALUES"
2000 PRINT : INPUT "ENTER NUMBER OF SELECTION ",I
2010 IF I>5 THEN 1950
2020 IF I>0 THEN 2050
2030 IF NC=3 THEN 1830
2040 GOTO 1280
2050 ON I GOTO 2060,2080,2100,2120,2170
2060 PRINT : PRINT "OLD LOCATION/DESCRIPTION IS " : PRINT LO$(N) : PRINT "ENTER N
EW STATION DESCRIPTION   (MAX 80 CHARACTERS)"
2070 LINE INPUT LO$(N) : GOTO 1950
2080 PRINT : PRINT "OLD DATE IS ";DATE$(N) : INPUT "ENTER NEW DATE ",DATE$(N)
2090 GOTO 1950
2100 PRINT : PRINT "OLD TIME IS ";TIME(N) : INPUT "ENTER NEW TIME ",TIME(N)
2110 GOTO 1950
2120 PRINT : PRINT USING "ENTER SIZE NUMBER  MAX = ##";NO; : PRINT "   0 TO END
"; : INPUT I
2130 IF I=0 THEN 1950
2140 IF I>NO THEN 2120
2150 GOSUB 2670
2160 PRINT : PRINT "OLD DIAMETER IS ";SIZE(N,I) : INPUT "ENTER NEW DIAMETER ",SI
ZE(N,I) : GOTO 2120
2170 PRINT : PRINT USING "ENTER SIZE NUMBER.  MAX = ##";NO; : PRINT "   0 TO END
 "; : INPUT I
2180 IF I=0 THEN 1950
2190 IF I>NO THEN 2170
2200 GOSUB 2670
2210 PRINT : PRINT "OLD PCT FINER VALUE IS ";PCTFN(N,I) : INPUT "ENTER NEW PCT F
INER VALUE ",PCTFN(N,I) : GOTO 2170
2220 REM LIST DATA ON SCREEN * * * * * * * * * * * * * * * * * * * * * * * * *
2230 NN=25 : GOSUB 2980
2240 PRINT "ENTER START SET NUMBER TO BE LISTED   0 TO END RUN "
2250 NN=3 : GOSUB 2980 : INPUT " ",NS1
2260 IF NS1=0 THEN 2640
2270 IF NS1>NU THEN 2230
2280 NN=3 : GOSUB 2980
2290 PRINT USING "ENTER END SET NUMBER TO BE LISTED     MAX = ## ";NU
2300 NN=3 : GOSUB 2980 : INPUT " ",NS2
2310 IF NS2>NU THEN 2280
2320 FOR N=NS1 TO NS2
2330 NO=NS(N)
2340 GOSUB 2670
```

```
2350 PRINT : PRINT "PRESS ANY KEY TO CONTINUE" : S$=INPUT$(1)
2360 NEXT N
2370 GOTO 2230
2380 REM LIST DATA ON PRINTER  * * * * * * * * * * * * * * * * * * * * * * * * *
2390 LPRINT "DATA STORED ON FILE ";DFILE$ : LPRINT
2400 NN=25 : GOSUB 2980
2410 PRINT "ENTER START SET NUMBER TO BE PRINTED    0 TO END RUN "
2420 NN=3 : GOSUB 2980 : INPUT " ",NS1
2430 IF NS1=0 THEN 2640
2440 IF NS1>NU THEN 2400
2450 NN=3 : GOSUB 2980
2460 PRINT USING "ENTER END SET NUMBER TO BE PRINTED     MAX = ## ";NU
2470 NN=3 : GOSUB 2980 : INPUT " ",NS2
2480 IF NS2>NU THEN 2450
2490 FOR N=NS1 TO NS2
2500 NO=NS(N)
2510 LPRINT : LPRINT : LPRINT "SET NUMBER  "N
2520 LPRINT : LPRINT LO$(N) : LPRINT
2530 LPRINT "DATE  ";DATE$(N); : LPRINT USING "    TIME  ####";TIME(N); : LPRINT
 USING "    NO. SIZES  ##";NO
2540 LPRINT : N1=-9
2550 N1=N1+10 : N2=N1+9
2560 IF N2>NO THEN N2=NO
2570 FOR I=N1 TO N2 : LPRINT USING "########";I; : NEXT I : LPRINT
2580 FOR I=N1 TO N2 : LPRINT USING "####.###";SIZE(N,I); : NEXT I : LPRINT
2590 FOR I=N1 TO N2 : LPRINT USING "######.#";PCTFN(N,I); : NEXT I
2600 LPRINT : LPRINT
2610 IF N2<NO THEN 2550
2620 NEXT N
2630 GOTO 2410
2640 NN=25 : GOSUB 2980 : PRINT "END OF RUN"
2650 NN=10 : GOSUB 2980 : END
2660 REM LIST ONE SET OF DATA ON SCREEN * * * * * * * * * * * * * * * * * * *
2670 NN=25 : GOSUB 2980
2680 PRINT USING "SET NUMBER  ##";N
2690 PRINT : PRINT LO$(N) : PRINT
2700 PRINT "DATE  ";DATE$(N); : PRINT USING "    TIME  ####";TIME(N); : PRINT US
ING "    NO. SIZES  ##";NO : PRINT
2710 N1=-9
2720 N1=N1+10 : N2=N1+9
2730 IF N2>NO THEN N2=NO
2740 FOR K=N1 TO N2 : PRINT USING "########";K; : NEXT K : PRINT
2750 FOR K=N1 TO N2 : PRINT USING "####.###";SIZE(N,K); : NEXT K : PRINT
2760 FOR K=N1 TO N2 : PRINT USING "######.#";PCTFN(N,K); : NEXT K
2770 PRINT : PRINT
2780 IF N2<NO THEN 2720
2790 RETURN
2800 END
2810 REM SUBROUTINE TO PRINT SIZE TABLE  * * * * * * * * * * * * * * * * * * *
```

BASIC PROGRAM SIZEDATA LISTING--Continued

```
2820 NN=25 : GOSUB 2980
2830 PRINT "   SIZE NO. AND CORRESPONDING DIAM. IN MM AND PHI UNITS" : PRINT
2840 PRINT "NO    MM     PHI     NO     MM     PHI     NO     MM      PHI" : PRINT
2850 PRINT " 1  0.002   9.0     12   0.088   3.5     23     4.00    -2.0"
2860 PRINT " 2  0.003   8.5     13   0.125   3.0     24     5.66    -2.5"
2870 PRINT " 3  0.004   8.0     14   0.177   2.5     25     8.00    -3.0"
2880 PRINT " 4  0.006   7.5     15   0.250   2.0     26    11.3     -3.5"
2890 PRINT " 5  0.008   7.0     16   0.354   1.5     27    16.0     -4.0"
2900 PRINT " 6  0.011   6.5     17   0.500   1.0     28    22.6     -4.5"
2910 PRINT " 7  0.016   6.0     18   0.707   0.5     29    32.0     -5.0"
2920 PRINT " 8  0.022   5.5     19   1.00    0.0     30    45.2     -5.5"
2930 PRINT " 9  0.031   5.0     20   1.41   -0.5     31    64.0     -6.0"
2940 PRINT "10  0.044   4.5     21   2.00   -1.0     32    90.5     -6.5"
2950 PRINT "11  0.062   4.0     22   2.83   -1.5     33   128.0     -7.0" : PRINT
2960 RETURN
2970 END
2980 REM SUBROUTINE TO MOVE CURSOR DOWN NN LINES * * * * * * * * * * * * * * * *
2990 FOR LL=1 TO NN : PRINT : NEXT LL
3000 RETURN
3010 END
```

SUPPLEMENTAL DATA--SECTION F.

BASIC PROGRAM SEDSIZE LISTING

```
10 REM PROGRAM SEDSIZE
20 REM COMPUTE SIZE STATISTICS FROM PERCENT FINER VALUES
30 DIM PROB(307),X(307),PCT(33),PHI(33),FMT$(10),FM$(3),PCTFN(33),DIA(33),AB(10)
40 DIM TP(10),CP(10),SIZPHI(33),H(10),D(10),SIZDIA(33),ICD(10),NCD(10)
50 DATA 0.10,0.11,0.12,0.13,0.14,0.15,0.16,0.18,0.19,0.20
60 DATA 0.21,0.23,0.24,0.26,0.27,0.29,0.31,0.33,0.35,0.37
70 DATA 0.39,0.41,0.44,0.47,0.49,0.52,0.55,0.59,0.62,0.66
80 DATA 0.69,0.73,0.78,0.82,0.87,0.91,0.96,1.02,1.07,1.13
90 DATA 1.19,1.25,1.32,1.39,1.46,1.54,1.62,1.70,1.79,1.88
100 DATA 1.97,2.07,2.17,2.28,2.39,2.50,2.62,2.74,2.87,3.01
110 DATA 3.14,3.29,3.44,3.59,3.75,3.92,4.09,4.27,4.46,4.65
120 DATA 4.85,5.05,5.26,5.48,5.71,5.94,6.18,6.43,6.68,6.94
130 DATA 7.21,7.49,7.78,8.08,8.38,8.69,9.01,9.34,9.68,10.03
140 DATA 10.38,10.75,11.12,11.51,11.90,12.30,12.71,13.14,13.57,14.01
150 DATA 14.46,14.92,15.39,15.87,16.35,16.85,17.36,17.88,18.41,18.94
160 DATA 19.49,20.05,20.61,21.19,21.77,22.36,22.97,23.58,24.20,24.83
170 DATA 25.46,26.11,26.76,27.43,28.10,28.77,29.46,30.15,30.85,31.56
180 DATA 32.28,33.00,33.72,34.46,35.20,35.94,36.69,37.45,38.21,38.97
190 DATA 39.74,40.52,41.29,42.07,42.86,43.64,44.43,45.22,46.02,46.81
200 DATA 47.61,48.40,49.20,50.00
210 FOR I=1 TO 154 : READ PROB(I) : NEXT I
220 DATA 1.645,1.0,0.6745,0.3854,0.0,-0.3854,-0.6745,-1.0,-1.282,-1.645
230 FOR I=1 TO 10 : READ CP(I) : NEXT I
240 DATA 5.0,15.87,25.0,35.0,50.0,65.0,75.0,84.13,90.0,95.0
250 FOR I=1 TO 10 : READ TP(I) : NEXT I
260 FOR I=1 TO 153
270 X1=3.06-(I-1)*.02
280 X(I)=X1 : X(308-I)=X1
290 NEXT I
300 X(154)=0!
310 FOR I=155 TO 307
320 J=308-I
330 PROB(I)=100!-PROB(J)
340 NEXT I
350 FM$(1)=" " : FM$(2)="*" : FM$(3)="+"
360 DEF FNL(X)=LOG(X)/2.30259
370 REM INPUT DATA * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
380 DFILE$="SIZE.DAT"
390 NN=25 : GOSUB 3510
400 PRINT "TURN ON PRINTER" : PRINT : PRINT "ESTABLISH FILE NAME:" : PRINT
410 PRINT "     1. USE PROGRAMMED FILE NAME (SIZE.DAT)"
420 PRINT "     2. PROVIDE FILE NAME"
430 NN=3 : GOSUB 3510
440 PRINT "ENTER NUMBER OF SELECTION"
450 NN=10 : GOSUB 3510 : INPUT " ",I
460 IF I=1 THEN 500
470 NN=25 : GOSUB 3510
```

```
480 PRINT "ENTER DESIRED FILE NAME"
490 NN=10 : GOSUB 3510 : INPUT " ",DFILE$
500 OPEN "I",#1,DFILE$
510 INPUT #1,NSAMP
520 FOR NS=1 TO NSAMP
530 INPUT #1,LO$,DATE$,TIME,NO
540 FOR N=1 TO NO : INPUT #1,SIZDIA(N) : NEXT N
550 FOR N=1 TO NO : INPUT #1,PCTFN(N) : NEXT N
560 NN=25 : GOSUB 3510
570 PRINT "DATA SET NUMBER ";NS : PRINT LO$
580 PRINT DATE$; : PRINT SPC(10);TIME
590 NN=10 : GOSUB 3510
600 REM COMPUTE MEYER-PETER EFFECTIVE DIAMETER * * * * * * * * * * * * * * * * * *
610 P1=0
620 DMP=0
630 IF PCTFN(1)>0 THEN 780
640 FOR I=1 TO NO
650 IF PCTFN(I+1)>0 THEN 670
660 NEXT I
670 S1=SIZDIA(I)
680 I1=I+1
690 FOR I=I1 TO NO
700 IF PCTFN(I)=0 THEN 750
710 DMP=DMP+SQR(S1*SIZDIA(I))*(PCTFN(I)-P1)
720 S1=SIZDIA(I)
730 P1=PCTFN(I)
740 IF P1>=99.9 THEN 800
750 NEXT I
760 MP=3
770 GOTO 820
780 MP=2
790 GOTO 820
800 MP=1
810 DMP=DMP/100
820 FOR I=1 TO NO
830 P1=-3.322*(FNL(SIZDIA(I)))
840 SIZPHI(I)=FIX(P1*10+.5*SGN(P1))/10
850 NEXT I
860 REM ELIMINATION OF ZERO PCTFN VALUES * * * * * * * * * * * * * * * * * * * *
870 M = 0
880 FOR I=1 TO NO
890 IF PCTFN(I)=0 THEN 940
900 M = M+1
910 DIA(M) = SIZDIA(I)
920 PCT(M) = PCTFN(I)
930 PHI(M) = SIZPHI(I)
940 NEXT I
950 LPRINT "SIZE STATISTICS FOR:" : LPRINT LO$
960 LPRINT DATE$; : LPRINT SPC(10);TIME : LPRINT
```

```
970 LPRINT "INPUT SIZE DISTRIBUTION   SPECIFIED COMPUTED SIZES"
980 LPRINT " PARTICLE SIZE  PERCENT   PERCENT   PARTICLE SIZE"
990 LPRINT "MILLIMETER  PHI  FINER     FINER   PHI  MILLIMETER" : LPRINT
1000 REM COMPUTE STATISTICS * * * * * * * * * * * * * * * * * * * * * * * * * * *
1010 N = 1
1020 FOR I=1 TO 10
1030 ICD(I)=0
1040 IF TP(I)<=PCT(N) THEN 1100
1050 IF N<M THEN 1080
1060 ICD(I)=2
1070 GOTO 1130
1080 N = N+1
1090 GOTO 1040
1100 IF N>1 THEN 1130
1110 IF TP(I)<>PCT(N) THEN ICD(I)=1
1120 GOTO 1140
1130 N = N-1
1140 GOSUB 2970
1150 IF DEV<=0 THEN 2900
1160 PF = INT(TP(I)+.3)
1170 H(I) = CENTER+CP(I)*SIGMA
1180 IF H(I)<=14 THEN 1270
1190 ICD(I)=-20
1200 IF M<I THEN 1240
1210 LPRINT USING "####.###";DIA(I);
1220 LPRINT USING "#####.#";PHI(I),PCT(I); : LPRINT USING "#########";PF;
1230 GOTO 1250
1240 LPRINT SPC(27); : LPRINT USING "####";PF;
1250 LPRINT SPC(17);"-- UNDEFINED"
1260 GOTO 1420
1270 D(I)=.5^H(I)
1280 IF M<I THEN 1320
1290 LPRINT USING "####.###";DIA(I);
1300 LPRINT USING "#####.#";PHI(I),PCT(I); : LPRINT USING "#########";PF;
1310 GOTO 1330
1320 LPRINT SPC(27); : LPRINT USING "####";PF;
1330 LPRINT USING "####.###"; H(I),D(I);
1340 N9=ICD(I)+1
1350 ON N9 GOTO 1410,1360,1380
1360 LPRINT " -- EXTRAPOLATED FROM PTS  1 &  2"
1370 GOTO 1420
1380 LPRINT USING " -- EXTRAPOLATED FROM PTS ##";M-1; : LPRINT " & ";
1390 LPRINT USING "##";M
1400 GOTO 1420
1410 LPRINT
1420 NEXT I
1430 IF M<=10 THEN 1490
1440 FOR I=11 TO M
1450 LPRINT USING "####.###";DIA(I);
```

```
1460 LPRINT USING "#####.#";PHI(I),PCT(I)
1470 NEXT I
1480 REM COMPUTE INMAN, TRASK AND FOLK VALUES  * * * * * * * * * * * * * * * * * *
1490 AB(1)=.5*(H(2)+H(8))
1500 AB(2)=.5*(H(2)-H(8))
1510 AB(3)=(AB(1)-H(5))/AB(2)
1520 AB(3)=FIX(AB(3)*100)/100
1530 AB(4)=(.5*(H(10)+H(1))-H(5))/AB(2)
1540 AB(4)=FIX(AB(4)*100)/100
1550 AB(5)=(.5*(H(1)-H(10))-AB(2))/AB(2)
1560 AB(6)=(D(7)/D(3))^.5
1570 AB(7)=(D(7)*D(3))/(D(5)^2)
1580 AB(8)=(H(8)+H(5)+H(2))/3!
1590 AB(9)=(H(2)-H(8))/4!+(H(1)-H(10))/6.6
1600 X1=(H(8)+H(2)-2*H(5))/(2*(H(2)-H(8)))
1610 X2=(H(10)+H(1)-2*H(5))/(2*(H(1)-H(10)))
1620 AB(10)=X1+X2
1630 NCD(1)=ICD(2)+ICD(8)
1640 NCD(2)=NCD(1)
1650 NCD(3)=NCD(1)+ICD(5)
1660 NCD(8)=NCD(3)
1670 NCD(5)=NCD(1)+ICD(1)+ICD(10)
1680 NCD(9)=NCD(5)
1690 NCD(4)=NCD(5)+ICD(5)
1700 NCD(10)=NCD(4)
1710 NCD(6)=ICD(3)+ICD(7)
1720 NCD(7)=NCD(6)+ICD(5)
1730 NTOT=0
1740 FOR I=1 TO 10
1750 NTOT=NTOT+ICD(I)
1760 IF NCD(I)>=0 THEN 1790
1770 FMT$(I)=FM$(3)
1780 GOTO 1840
1790 X=FIX(AB(I)*1000+.5*SGN(AB(I)))/1000+.0001*SGN(AB(I))
1800 X$=STR$(X)
1810 IF ABS(X)<1 THEN X$=LEFT$(X$,1)+"0"+MID$(X$,2,5)
1820 FMT$(I)=LEFT$(X$,LEN(X$)-1)+FM$(1)
1830 IF NCD(I)>0 THEN FMT$(I)=LEFT$(X$,LEN(X$)-1)+FM$(2)
1840 NEXT I
1850 LPRINT : LPRINT SPC(18);"INMAN VALUES"
1860 LPRINT "    MEAN      SORT     ALPH1     ALPH2      BETA"
1870 FOR I=1 TO 5 : LPRINT SPC(9-LEN(FMT$(I)));FMT$(I); : NEXT I
1880 LPRINT:LPRINT : LPRINT "      TRASK VALUES"; : LPRINT SPC(14);"FOLK VALUES"
1890 LPRINT "    SORT      SKEW          MEAN      SORT      SKEW"
1900 LPRINT SPC(9-LEN(FMT$(6)));FMT$(6);SPC(9-LEN(FMT$(7)));FMT$(7);SPC(4);
1910 FOR I=8 TO 10 : LPRINT SPC(9-LEN(FMT$(I)));FMT$(I); : NEXT I
1920 LPRINT : LPRINT
1930 LPRINT "PCT GRAVEL   PCT SAND      PCT SILT      PCT CLAY"
1940 REM COMPUTATION OF PERCENT CLAY, SILT, SAND, AND GRAVEL * * * * * * * * *
```

```
1950 FOR NN=1 TO 3
1960 ON SGN(NN-2)+2 GOTO 1970,2020,2050
1970 IF PHI(M)>-1 THEN 2000
1980 D9=-1
1990 GOTO 2080
2000 PROBD=100
2010 GOTO 2430
2020 PROB1=FIX(PROBD+.5)
2030 D9=4
2040 GOTO 2080
2050 PROB4=FIX(PROBD+.5)
2060 IF M=1 THEN 2500
2070 D9=8
2080 N=1
2090 ON SGN(D9-PHI(N))+2 GOTO 2100,2130,2150
2100 IF N>=M THEN 2160
2110 N=N+1
2120 GOTO 2090
2130 PROBD=PCT(N)
2140 GOTO 2430
2150 IF N=1 THEN 2170
2160 N=N-1
2170 GOSUB 2970
2180 IF DEV<=0 THEN 2900
2190 ON SGN(D9-CENTER)+2 GOTO 2200,2320,2340
2200 DEVD=(CENTER-D9)/SIGMA
2210 IF DEVD>3.06 THEN 2300
2220 N=154
2230 ON SGN(DEVD-X(N))+2 GOTO 2280,2260,2240
2240 N=N+1
2250 GOTO 2230
2260 PROBD=PROB(N)
2270 GOTO 2430
2280 PROBD=PROB(N-1)+(DEVD-X(N-1))*(PROB(N)-PROB(N-1))/.02
2290 GOTO 2430
2300 PROBD=100
2310 GOTO 2430
2320 PROBD=50
2330 GOTO 2430
2340 DEVD=(D9-CENTER)/SIGMA
2350 IF DEVD>3.06 THEN 2420
2360 N=1
2370 ON SGN(DEVD-X(N))+2 GOTO 2380,2400,2280
2380 N=N+1
2390 GOTO 2370
2400 PROBD=PROB(N)
2410 GOTO 2430
2420 PROBD=0
2430 NEXT NN
```

```
2440 PROB8=FIX(PROBD+.5)
2450 PCTCL=PROB8
2460 PCTST= PROB4-PROB8
2470 PCTSD=PROB1-PROB4
2480 PCTGR=100-PROB1
2490 GOTO 2540
2500 PCTCL=0
2510 PCTST= PROB4
2520 PCTSD=PROB1-PROB4
2530 PCTGR=100-PROB1
2540 P$=STR$(PCTGR) : X$=P$+FM$(1)
2550 IF PCTGR=0 THEN 2590
2560 IF PHI(M)<=-1 OR PCT(M)=99.9 THEN 2590
2570 X$=P$+FM$(2)
2580 NTOT=NTOT+1
2590 LPRINT SPC(6-LEN(X$));X$;
2600 P$=STR$(PCTSD) : X$=P$+FM$(1)
2610 IF PCTSD=0 THEN 2650
2620 IF PHI(M)<=-1 OR PCT(M)=99.9 AND PHI(1)>4 OR PCT(1)=.1 THEN 2650
2630 X$=P$+FM$(2)
2640 NTOT=NTOT+1
2650 LPRINT SPC(13-LEN(X$));X$;
2660 P$=STR$(PCTST) : X$=P$+FM$(1)
2670 IF PCTST=0 THEN 2710
2680 IF PHI(M)>4 OR PCT(M)=99.9 AND PHI(1)>8 OR PCT(1)=.1 THEN 2710
2690 X$=P$+FM$(2)
2700 NTOT=NTOT+1
2710 LPRINT SPC(13-LEN(X$));X$;
2720 P$=STR$(PCTCL) : X$=P$+FM$(1)
2730 IF PCTCL=0 THEN 2770
2740 IF PHI(1)>8 OR PCT(1)=.1 THEN 2770
2750 X$=P$+FM$(2)
2760 NTOT=NTOT+1
2770 LPRINT SPC(13-LEN(X$));X$ : LPRINT
2780 ON MP GOTO 2790,2810,2830
2790 LPRINT USING "MEYER-PETER EFFECTIVE DIAMETER IS ####.### MM";DMP
2800 GOTO 2840
2810 LPRINT "MEYER-PETER EFF. DIAM. NOT COMPUTED - 0% FINER SIZE NOT DEFINED"
2820 GOTO 2840
2830 LPRINT "MEYER-PETER EFF. DIAM. NOT COMPUTED - 100% FINER SIZE NOT DEFINED"
2840 LPRINT
2850 ON SGN(NTOT)+2 GOTO 2860,2910,2880
2860 LPRINT "* BASED ON EXTRAPOLATED VALUES - ERROR MAY BE EXCESSIVE       + UND
EFINED"
2870 GOTO 2910
2880 LPRINT "* BASED ON EXTRAPOLATED VALUES - ERROR MAY BE EXCESSIVE"
2890 GOTO 2910
2900 LPRINT : LPRINT "*** DEV = 0   INPUT DATA IN ERROR ***"
2910 LPRINT CHR$(12)
```

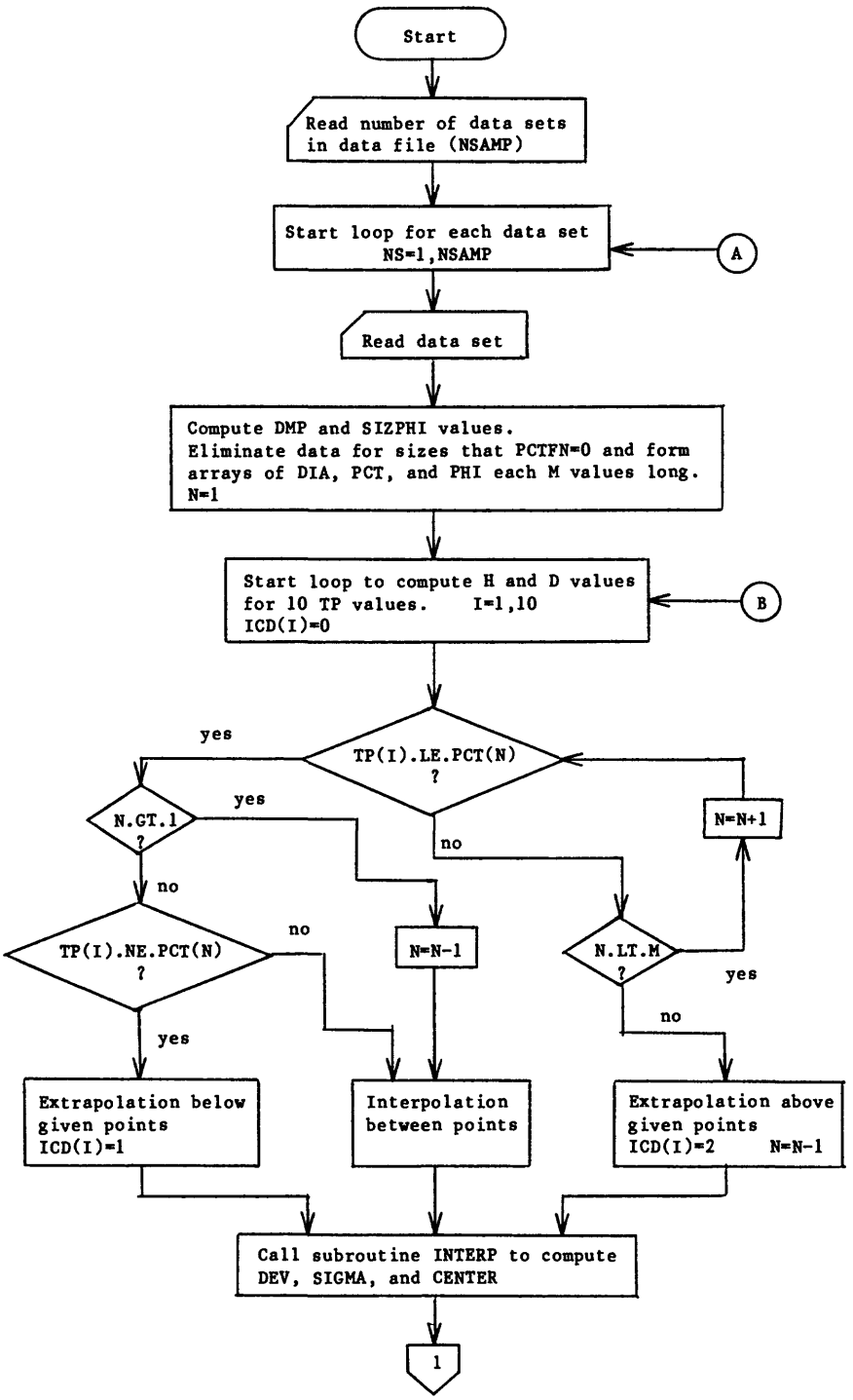
```
2920 NEXT NS
2930 NN=25 : GOSUB 3510
2940 PRINT "END OF RUN"
2950 NN=10 : GOSUB 3510
2960 END
2970 REM SUBROUTINE INTERP * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
2980 IF PCT(N)>=50! THEN 3080
2990 L=1
3000 IF PROB(L)>=PCT(N) THEN 3030
3010 L = L+1
3020 GOTO 3000
3030 IF PCT(N)>.1 THEN 3060
3040 DEV1 = X(1)
3050 GOTO 3130
3060 DEV1=X(L-1)-((PCT(N)-PROB(L-1))*.02/(PROB(L)-PROB(L-1)))
3070 GOTO 3130
3080 L=154
3090 IF PROB(L)>=PCT(N) THEN 3120
3100 L = L+1
3110 GOTO 3090
3120 DEV1=X(L-1)+((PCT(N)-PROB(L-1))*.02/(PROB(L)-PROB(L-1)))
3130 L1 = L
3140 IF PCT(N+1)>=50! THEN 3210
3150 L=1
3160 IF PROB(L)>=PCT(N+1) THEN 3190
3170 L = L+1
3180 GOTO 3160
3190 DEV2=X(L-1)-((PCT(N+1)-PROB(L-1))*.02/(PROB(L)-PROB(L-1)))
3200 GOTO 3260
3210 L=154
3220 IF PROB(L)>=PCT(N+1) THEN 3250
3230 L = L+1
3240 GOTO 3220
3250 DEV2=X(L-1)+((PCT(N+1)-PROB(L-1))*.02/(PROB(L)-PROB(L-1)))
3260 L2 = L
3270 L3 = 1
3280 L4 = 1
3290 IF L1>154 THEN 3310
3300 L3 = -1
3310 IF L2>154 THEN 3330
3320 L4 = -1
3330 L5 = L3+L4+3
3340 ON SGN(L5-3)+2 GOTO 3420,3450,3360
3350 REM CENTER IS BELOW BOTH POINTS * * * * * * * * * * * * * * * * * * * * * *
3360 DEV = DEV2-DEV1
3370 IF DEV<=0 THEN RETURN
3380 SIGMA = (PHI(N)-PHI(N+1))/DEV
3390 CENTER = PHI(N)+DEV1*SIGMA
3400 RETURN
```

```
3410 REM CENTER IS ABOVE BOTH POINTS * * * * * * * * * * * * * * * * * * * * *
3420 DEV = DEV1-DEV2
3430 GOTO 3460
3440 REM CENTER IS BETWEEN POINTS  * * * * * * * * * * * * * * * * * * * * * *
3450 DEV = DEV1+DEV2
3460 IF DEV<=0 THEN RETURN
3470 SIGMA = (PHI(N)-PHI(N+1))/DEV
3480 CENTER = PHI(N)-DEV1*SIGMA
3490 RETURN
3500 END
3510 REM SUBROUTINE TO MOVE CURSOR DOWN NN LINES * * * * * * * * * * * * * * *
3520 FOR LL=1 TO NN : PRINT : NEXT LL
3530 RETURN
3540 END
```

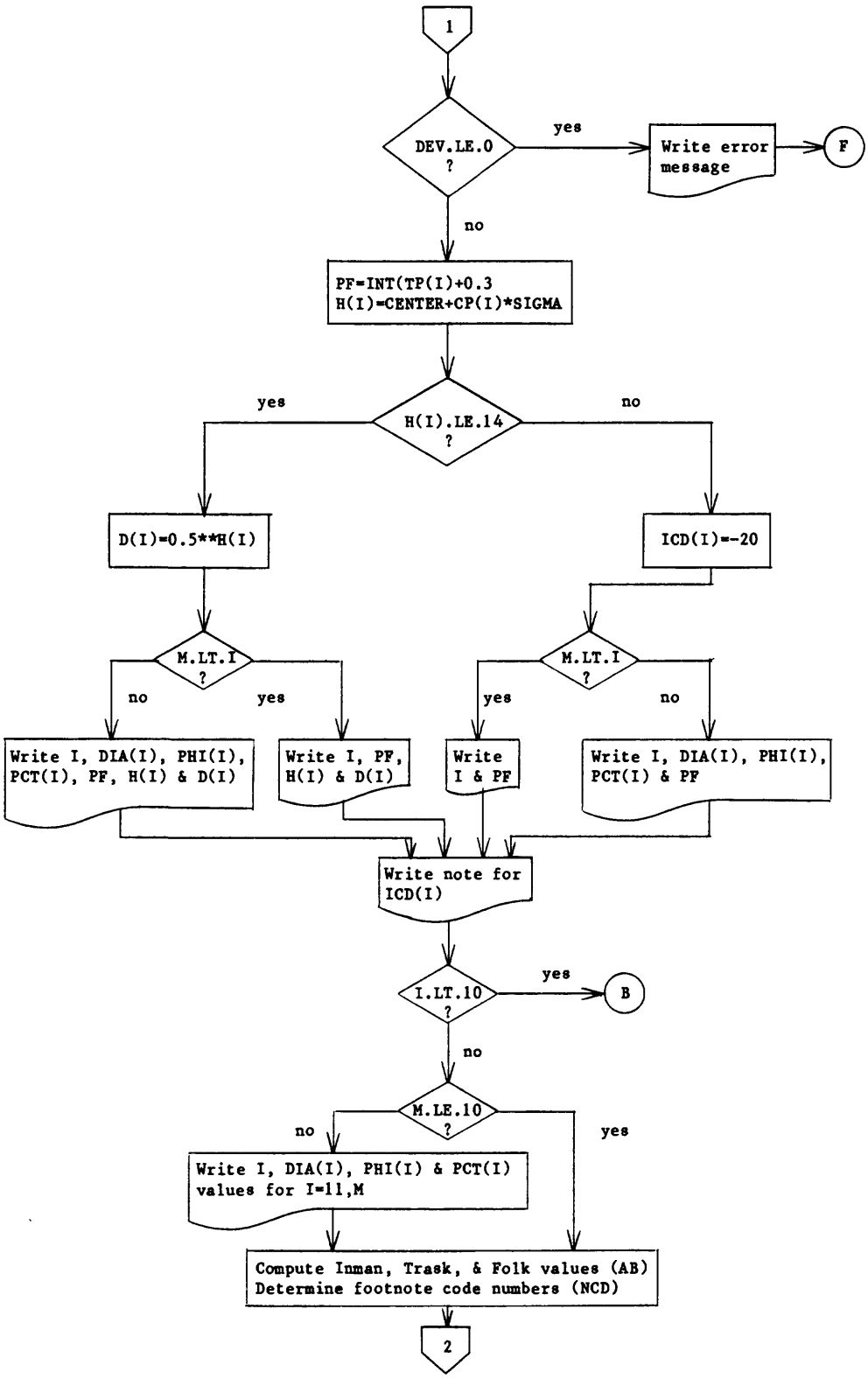
SUPPLEMENTAL DATA--SECTION G.

FLOW CHART OF PROGRAM SEDSIZE

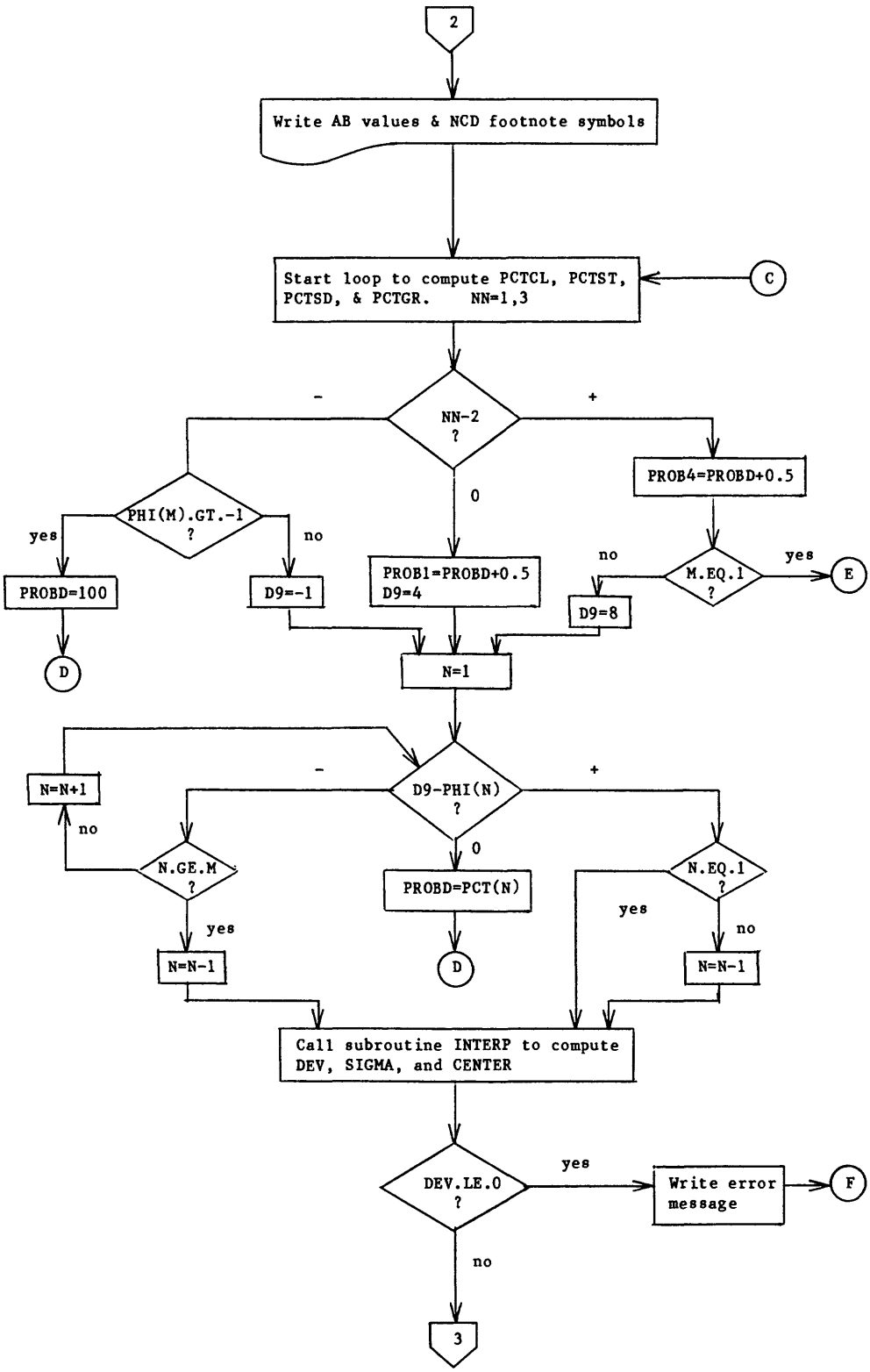
MAIN PROGRAM



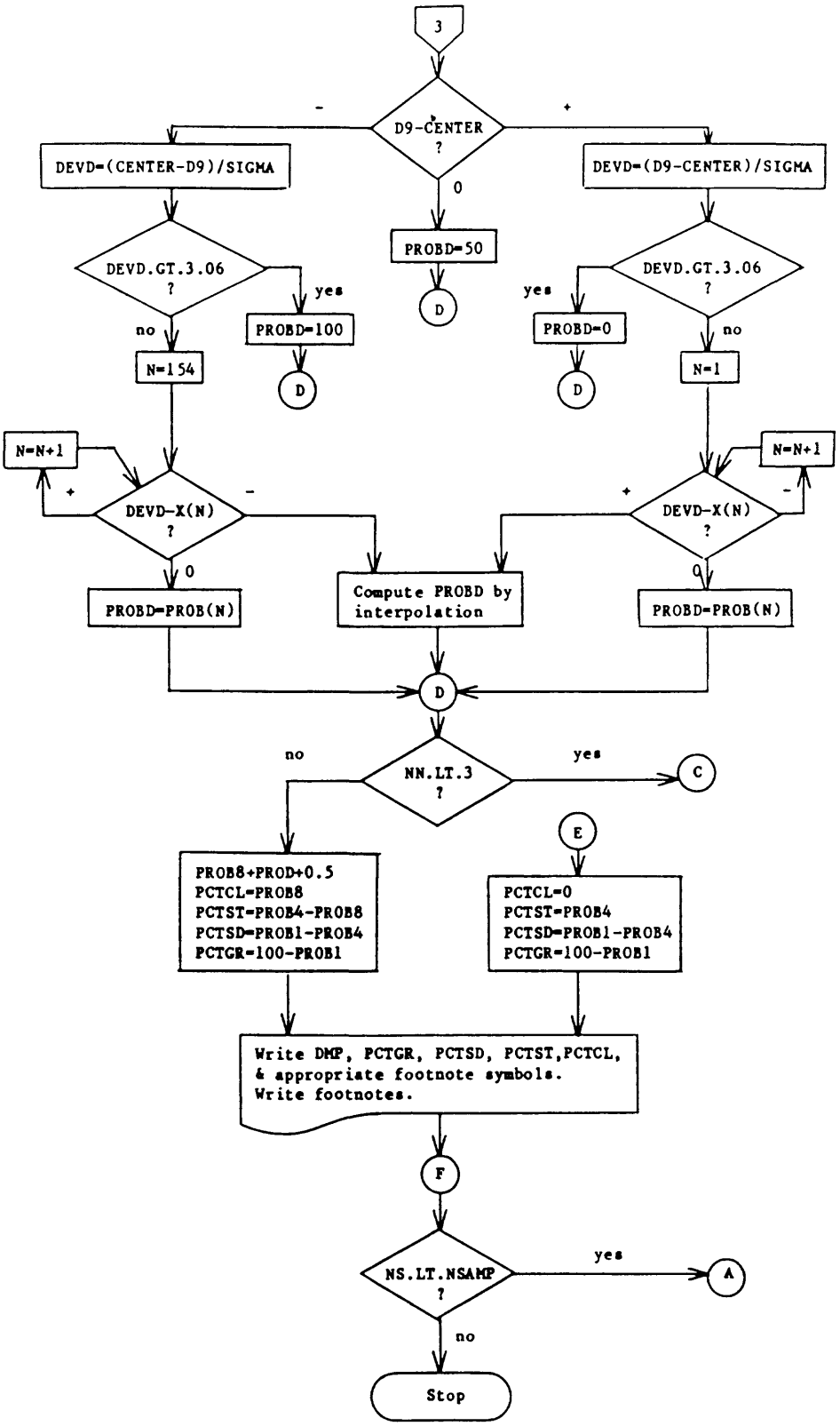
FLOW CHART OF PROGRAM SEDSIZE--Continued



FLOW CHART OF PROGRAM SEDSIZE--Continued

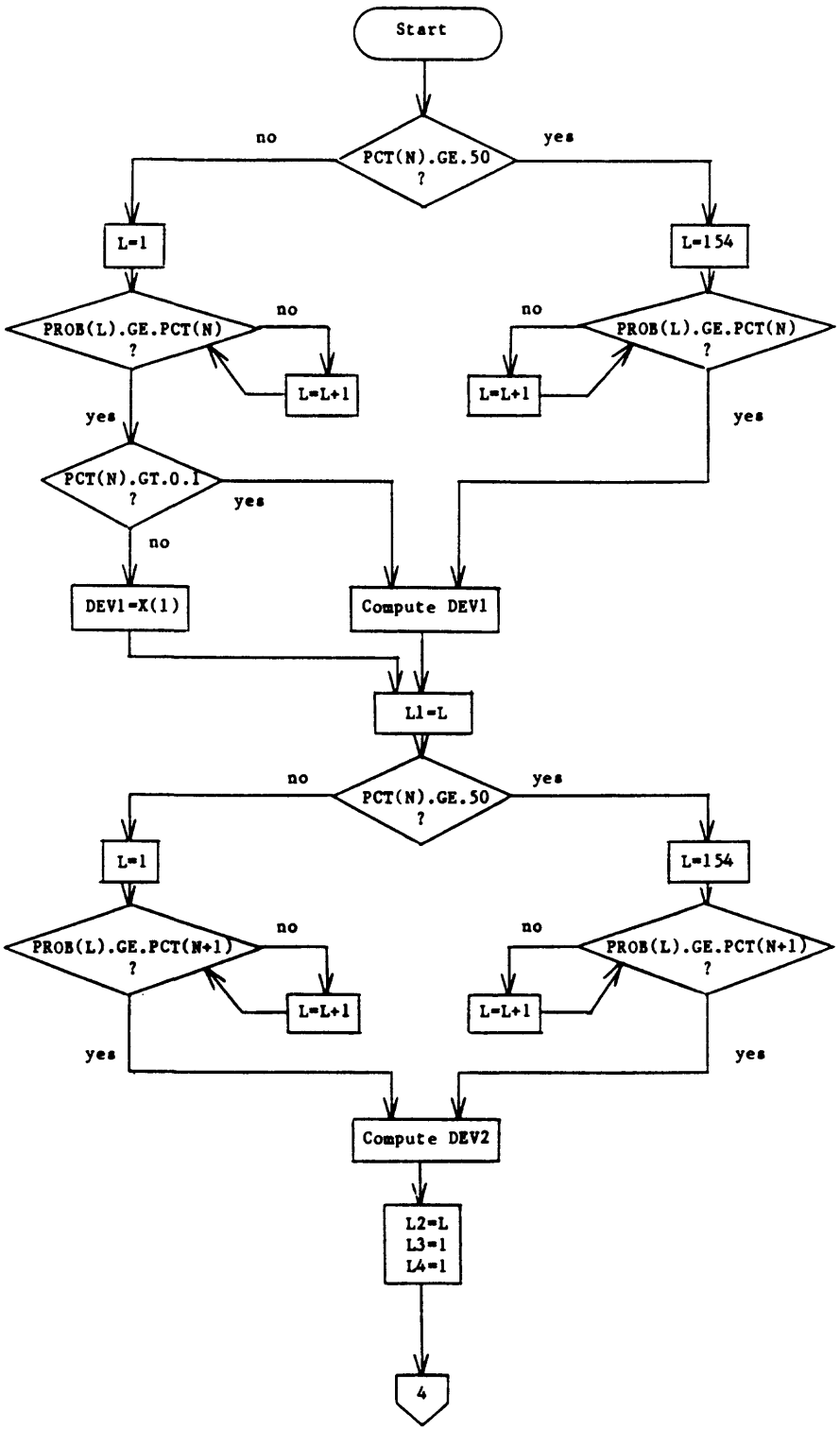


FLOW CHART OF PROGRAM SEDSIZE--Continued

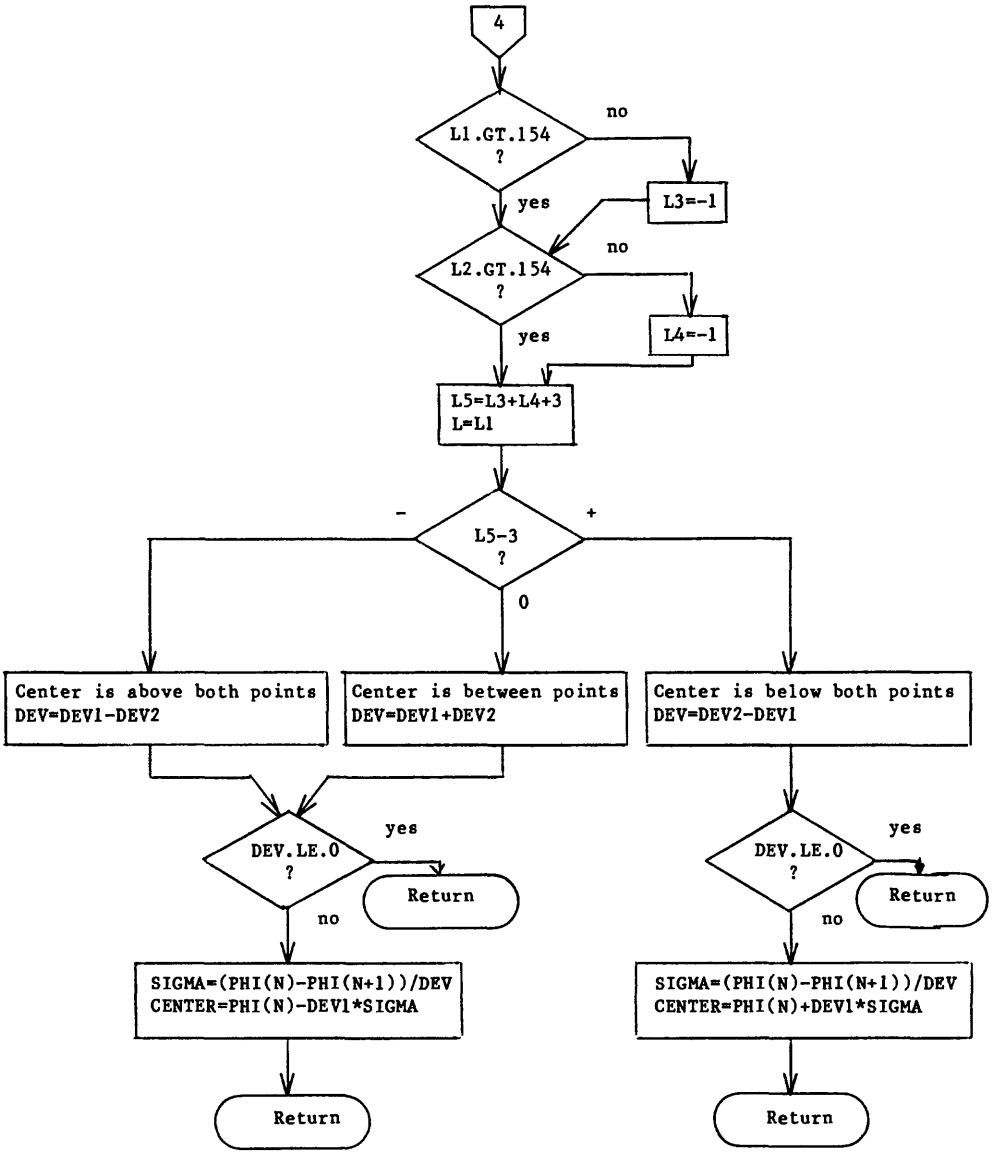


FLOW CHART OF PROGRAM SEDSIZE--Continued

SUBROUTINE INTERP



FLOW CHART OF PROGRAM SEDSIZE--Continued



SUPPLEMENTAL DATA--SECTION H.

EXAMPLES OF PROGRAM SIZEDATA OUTPUT

DATA STORED IN FILE SIZE.DATA

DATA SET NUMBER 1
BED MATERIAL SAMPLES FROM COLUMBIA RIVER AT VANCOUVER, WA
DATE 12/14/76 TIME 1630. NO. SIZES = 18

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0.031	0.044	0.062	0.088	0.125	0.177	0.250	0.354	0.500	0.707	1.000	1.400	2.000	2.800	4.000
1.1	0.0	1.6	3.9	11.9	34.9	67.7	85.6	90.3	92.0	93.1	93.8	94.5	95.1	95.7

16	17	18
5.600	8.000	11.300
96.3	97.9	99.9

DATA SET NUMBER 2
BED MATERIAL SAMPLES FROM COLUMBIA RIVER AT VANCOUVER, WA
DATE 1/4/77 TIME 1230. NO. SIZES = 18

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0.031	0.044	0.062	0.088	0.125	0.177	0.250	0.354	0.500	0.707	1.000	1.400	2.000	2.800	4.000
0.0	0.0	0.3	0.6	0.9	3.0	11.9	28.6	45.3	55.7	70.0	0.0	86.7	98.1	99.3

16	17	18
5.600	8.000	11.300
99.6	99.9	0.0

DATA SET NUMBER 3
DEPTH INTEGRATED SAMPLES FOR COLUMBIA RIVER AT BEAVER ARMY TERMINAL, OR
DATE 6/23/67 TIME 1800. NO. SIZES = 10

1	2	3	4	5	6	7	8	9	10
0.002	0.004	0.008	0.016	0.031	0.062	0.088	0.125	0.177	0.250
13.0	21.0	26.0	31.0	43.0	58.0	62.0	66.0	74.0	92.0

DATA SET NUMBER 4
BED MATERIAL SAMPLES FROM COLUMBIA RIVER ESTUARY
DATE 12/22/68 TIME 1200. NO. SIZES = 21

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0.002	0.003	0.004	0.006	0.008	0.011	0.016	0.022	0.031	0.044	0.062	0.088	0.125	0.177	0.250
33.0	0.0	45.0	0.0	57.0	0.0	80.0	0.0	95.0	0.0	96.0	96.1	96.2	97.0	97.1

16	17	18	19	20	21
0.354	0.500	0.707	1.000	1.400	2.000
97.2	97.3	0.0	97.4	0.0	99.9

DATA SET NUMBER 5
BED MATERIAL SAMPLES FROM COLUMBIA RIVER ESTUARY
DATE 9/3/68 TIME 1200. NO. SIZES = 21

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0.002	0.003	0.004	0.006	0.008	0.011	0.016	0.022	0.031	0.044	0.062	0.088	0.125	0.177	0.250
0.0	0.0	0.0	0.0	1.0	0.0	1.1	0.0	2.0	0.0	2.1	2.2	2.3	6.0	33.0

16	17	18	19	20	21
0.354	0.500	0.707	1.000	1.400	2.000
53.0	86.0	0.0	98.0	0.0	0.0

DATA SET NUMBER 6
BED MATERIAL SAMPLES FROM COLUMBIA RIVER ESTUARY
DATE 12/12/68 TIME 1200. NO. SIZES = 21

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0.002	0.003	0.004	0.006	0.008	0.011	0.016	0.022	0.031	0.044	0.062	0.088	0.125	0.177	0.250
29.0	0.0	30.0	0.0	43.0	0.0	65.0	0.0	86.0	0.0	96.0	96.1	96.2	96.3	97.0

16	17	18	19	20	21
0.354	0.500	0.707	1.000	1.400	2.000
99.0	0.0	0.0	0.0	0.0	0.0

DATA SET NUMBER 7
BED MATERIAL SAMPLES FROM COLUMBIA RIVER ESTUARY
DATE 12/13/68 TIME 1200. NO. SIZES = 21

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0.002	0.003	0.004	0.006	0.008	0.011	0.016	0.022	0.031	0.044	0.062	0.088	0.125	0.177	0.250
19.0	0.0	20.0	0.0	34.0	0.0	60.0	0.0	85.0	0.0	96.0	96.1	96.2	96.3	97.0

16	17	18	19	20	21
0.354	0.500	0.707	1.000	1.400	2.000
99.0	0.0	0.0	0.0	0.0	0.0

DATA SET NUMBER 8
BED SAMPLE FROM FLUME DURING MIXTURE RUN
DATE 8/19/81 TIME 1200. NO. SIZES = 13

1	2	3	4	5	6	7	8	9	10	11	12	13
0.500	0.707	1.000	1.400	2.000	2.800	4.000	5.600	8.000	11.300	16.000	22.600	32.000
12.0	0.0	36.0	47.0	62.0	68.0	77.0	81.0	88.0	92.0	93.0	96.0	99.9

SUPPLEMENTAL DATA--SECTION I.

EXAMPLES OF PROGRAM SEDSIZE OUTPUT

SIZE STATISTICS FOR BED MATERIAL SAMPLES FROM COLUMBIA RIVER AT VANCOUVER, WA 12/14/76 1630

INPUT SIZE DISTRIBUTION			SPECIFIED COMPUTED SIZES		
PARTICLE SIZE		PERCENT	PERCENT	PARTICLE SIZE	
MILLIMETER	PHI	FINER	FINER	PHI	MILLIMETER
0.031	5.00	1.1	5	3.399	0.095
0.062	4.00	1.6	16	2.886	0.135
0.088	3.50	3.9	25	2.681	0.156
0.125	3.00	11.9	35	2.498	0.177
0.177	2.50	34.9	50	2.271	0.207
0.250	2.00	67.7	65	2.044	0.243
0.354	1.50	85.6	75	1.822	0.283
0.500	1.00	90.3	84	1.552	0.341
0.707	0.50	92.0	90	1.036	0.488
1.000	0.00	93.1	95	-1.412	2.661
1.400	-0.50	93.8			
2.000	-1.00	94.5			
2.800	-1.50	95.1			
4.000	-2.00	95.7			
5.600	-2.50	96.3			
8.000	-3.00	97.9			
11.300	-3.50	99.9			

INMAN VALUES					TRASK VALUES		FOLK VALUES		
MEAN	SORT	ALPH1	ALPH2	BETA	SORT	SKEW	MEAN	SORT	SKEW
2.219	0.667	-0.070	-1.910	2.605	1.347	1.028	2.236	1.063	-0.304

PCT GRAVEL	PCT SAND	PCT SILT	PCT CLAY	MEYER-PETER EFF. DIAM. NOT COMPUTED - 0% FINER SIZE NOT DEFINED
5	93	2*	0	

* BASED ON EXTRAPOLATED VALUES - ERROR MAY BE EXCESSIVE

SIZE STATISTICS FOR BED MATERIAL SAMPLES FROM COLUMBIA RIVER AT VANCOUVER, WA 1/4/77 1230

INPUT SIZE DISTRIBUTION PARTICLE SIZE MILLIMETER	PHI	PERCENT FINER	SPECIFIED COMPUTED SIZES PERCENT FINER	PARTICLE SIZE PHI	MILLIMETER
0.062	4.00	0.3	5	2.331	0.199
0.088	3.50	0.6	16	1.854	0.277
0.125	3.00	0.9	25	1.589	0.332
0.177	2.50	3.0	35	1.299	0.406
0.250	2.00	11.9	50	0.774	0.585
0.354	1.50	28.6	65	0.182	0.881
0.500	1.00	45.3	75	-0.255	1.194
0.707	0.50	55.7	84	-0.809	1.752
1.000	0.00	70.0	90	-1.088	2.126
2.000	-1.00	86.7	95	-1.276	2.422
2.800	-1.50	98.1			
4.000	-2.00	99.3			
5.600	-2.50	99.6			
8.000	-3.00	99.9			

INMAN VALUES MEAN	SORT	ALPH1	ALPH2	BETA	TRASK VALUES SORT	SKEW	FOLK VALUES MEAN	SORT	SKEW
0.522	1.331	-0.180	-0.180	0.355	1.895	1.160	0.606	1.212	-0.163

PCT GRAVEL	PCT SAND	PCT SILT	PCT CLAY	MEYER-PETER EFFECTIVE DIAMETER IS
13	87	0	0	0.905 MM

SIZE STATISTICS FOR DEPTH INTEGRATED SAMPLES FOR COLUMBIA RIVER AT BEAVER ARMY TERMINAL, OR 6/23/67 1800

INPUT SIZE DISTRIBUTION PARTICLE SIZE MILLIMETER	PHI	PERCENT FINER	SPECIFIED COMPUTED SIZES PERCENT FINER	PARTICLE SIZE PHI	MILLIMETER	
0.002	9.00	13.0	5	10.620	0.001	-- EXTRAPOLATED FROM POINTS 1 AND 2
0.004	8.00	21.0	16	8.605	0.003	
0.008	7.00	26.0	25	7.191	0.007	
0.016	6.00	31.0	35	5.654	0.020	
0.031	5.00	43.0	50	4.534	0.043	
0.062	4.00	58.0	65	3.126	0.115	
0.088	3.50	62.0	75	2.480	0.179	
0.125	3.00	66.0	84	2.266	0.208	
0.177	2.50	74.0	90	2.081	0.236	
0.250	2.00	92.0	95	1.843	0.279	-- EXTRAPOLATED FROM POINTS 9 AND 10

INMAN VALUES MEAN	SORT	ALPH1	ALPH2	BETA	TRASK VALUES SORT	SKEW	FOLK VALUES MEAN	SORT	SKEW
5.435	3.169	0.280	0.530*	0.385*	5.118	0.658	5.135	2.915*	0.336*

PCT GRAVEL	PCT SAND	PCT SILT	PCT CLAY	MEYER-PETER EFF. DIAM. NOT COMPUTED - 0% FINER SIZE NOT DEFINED
0	42*	37*	21	

* BASED ON EXTRAPOLATED VALUES - ERROR MAY BE EXCESSIVE

SIZE STATISTICS FOR BED MATERIAL SAMPLES FROM COLUMBIA RIVER ESTUARY 12/22/68 1200

INPUT SIZE DISTRIBUTION PARTICLE SIZE MILLIMETER	PHI	PERCENT FINER
0.002	9.00	33.0
0.004	8.00	45.0
0.008	7.00	57.0
0.016	6.00	80.0
0.031	5.00	95.0
0.062	4.00	96.0
0.088	3.50	96.1
0.125	3.00	96.2
0.177	2.50	97.0
0.250	2.00	97.1
0.354	1.50	97.2
0.500	1.00	97.3
1.000	0.00	97.4
2.000	-1.00	99.9

SPECIFIED COMPUTED SIZES PERCENT FINER	PARTICLE SIZE PHI	MILLIMETER
5	12.832	0.000 -- EXTRAPOLATED FROM POINTS 1 AND 2
16	10.781	0.001 -- EXTRAPOLATED FROM POINTS 1 AND 2
25	9.746	0.001 -- EXTRAPOLATED FROM POINTS 1 AND 2
35	8.826	0.002
50	7.584	0.005
65	6.686	0.010
75	6.251	0.013
84	5.803	0.018
90	5.452	0.023
95	5.000	0.031

INMAN VALUES MEAN	SORT	ALPH1	ALPH2	BETA	TRASK VALUES SORT	SKEW	FOLK VALUES MEAN	SORT	SKEW
8.292*	2.489*	0.280*	0.530*	0.573*	3.357*	0.563*	8.056*	2.431*	0.312*

PCT GRAVEL	PCT SAND	PCT SILT	PCT CLAY
0	4	51	45

MEYER-PETER EFF. DIAM. NOT COMPUTED - 0% FINER SIZE NOT DEFINED

* BASED ON EXTRAPOLATED VALUES - ERROR MAY BE EXCESSIVE

SIZE STATISTICS FOR BED MATERIAL SAMPLES FROM COLUMBIA RIVER ESTUARY 9/3/68 1200

INPUT SIZE DISTRIBUTION PARTICLE SIZE MILLIMETER	PHI	PERCENT FINER
0.008	7.00	1.0
0.016	6.00	1.1
0.031	5.00	2.0
0.062	4.00	2.1
0.088	3.50	2.2
0.125	3.00	2.3
0.177	2.50	6.0
0.250	2.00	33.0
0.354	1.50	53.0
0.500	1.00	86.0
1.000	0.00	98.0

SPECIFIED COMPUTED SIZES PERCENT FINER	PARTICLE SIZE PHI	MILLIMETER
5	2.602	0.165
16	2.251	0.210
25	2.105	0.232
35	1.947	0.259
50	1.573	0.336
65	1.346	0.393
75	1.202	0.435
84	1.040	0.486
90	0.793	0.577
95	0.420	0.747

INMAN VALUES MEAN	SORT	ALPH1	ALPH2	BETA	TRASK VALUES SORT	SKEW	FOLK VALUES MEAN	SORT	SKEW
1.646	0.606	0.110	-0.100	0.802	1.368	0.894	1.621	0.633	0.031

PCT GRAVEL	PCT SAND	PCT SILT	PCT CLAY
0	98*	1*	1*

MEYER-PETER EFF.DIAM. NOT COMPUTED - 100% FINER SIZE NOT DEFINED

* BASED ON EXTRAPOLATED VALUES - ERROR MAY BE EXCESSIVE

SIZE STATISTICS FOR BED MATERIAL SAMPLES FROM COLUMBIA RIVER ESTUARY 12/12/68 1200

INPUT SIZE DISTRIBUTION PARTICLE SIZE MILLIMETER	PHI	PERCENT FINER	SPECIFIED COMPUTED SIZES PERCENT FINER	PHI	PARTICLE SIZE MILLIMETER	
0.002	9.00	29.0	5			-- UNDEFINED
0.004	8.00	30.0	16			-- UNDEFINED
0.008	7.00	43.0	25	13.180	0.000	-- EXTRAPOLATED FROM POINTS 1 AND 2
0.016	6.00	65.0	35	7.601	0.005	
0.031	5.00	86.0	50	6.686	0.010	
0.062	4.00	96.0	65	6.000	0.016	
0.088	3.50	96.1	75	5.584	0.021	
0.125	3.00	96.2	84	5.116	0.029	
0.177	2.50	96.3	90	4.699	0.038	
0.250	2.00	97.0	95	4.158	0.056	
0.354	1.50	99.0				

INMAN VALUES MEAN	SORT	ALPH1	ALPH2	BETA	TRASK VALUES SORT	SKEW	FOLK VALUES MEAN	SORT	SKEW
+	+	+	+	+	13.911*	0.024*	+	+	+

PCT GRAVEL	PCT SAND	PCT SILT	PCT CLAY	
0	4*	66*	30	MEYER-PETER EFF. DIAM. NOT COMPUTED - 0% FINER SIZE NOT DEFINED

* BASED ON EXTRAPOLATED VALUES - ERROR MAY BE EXCESSIVE + UNDEFINED

SIZE STATISTICS FOR BED MATERIAL SAMPLES FROM COLUMBIA RIVER ESTUARY 12/13/68 1200

INPUT SIZE DISTRIBUTION PARTICLE SIZE MILLIMETER	PHI	PERCENT FINER	SPECIFIED COMPUTED SIZES PERCENT FINER	PHI	PARTICLE SIZE MILLIMETER	
0.002	9.00	19.0	5			-- UNDEFINED
0.004	8.00	20.0	16	12.391	0.000	-- EXTRAPOLATED FROM POINTS 1 AND 2
0.008	7.00	34.0	25	7.610	0.005	
0.016	6.00	60.0	35	6.959	0.008	
0.031	5.00	85.0	50	6.381	0.012	
0.062	4.00	96.0	65	5.831	0.018	
0.088	3.50	96.1	75	5.462	0.023	
0.125	3.00	96.2	84	5.047	0.030	
0.177	2.50	96.3	90	4.656	0.040	
0.250	2.00	97.0	95	4.148	0.056	
0.354	1.50	99.0				

INMAN VALUES MEAN	SORT	ALPH1	ALPH2	BETA	TRASK VALUES SORT	SKEW	FOLK VALUES MEAN	SORT	SKEW
8.719*	3.672*	0.630*	+	+	2.105	0.806	7.939*	+	+

PCT GRAVEL	PCT SAND	PCT SILT	PCT CLAY	
0	4*	76*	20	MEYER-PETER EFF. DIAM. NOT COMPUTED - 0% FINER SIZE NOT DEFINED

* BASED ON EXTRAPOLATED VALUES - ERROR MAY BE EXCESSIVE + UNDEFINED

SIZE STATISTICS FOR BED SAMPLE FROM FLUME DURING MIXTURE RUN 8/19/81 1200

INPUT SIZE DISTRIBUTION PARTICLE SIZE MILLIMETER	PHI	PERCENT FINER	SPECIFIED COMPUTED SIZES PERCENT FINER	PARTICLE SIZE PHI	MILLIMETER	
0.500	1.00	12.0	5	1.576	0.336	-- EXTRAPOLATED FROM POINTS 1 AND 2
1.000	0.00	36.0	16	0.786	0.580	
1.400	-0.50	47.0	25	0.387	0.765	
2.000	-1.00	62.0	35	0.033	0.977	
2.800	-1.50	68.0	50	-0.599	1.514	
4.000	-2.00	77.0	65	-1.246	2.372	
5.600	-2.50	81.0	75	-1.881	3.683	
8.000	-3.00	88.0	84	-2.706	6.523	
11.300	-3.50	92.0	90	-3.232	9.397	
16.000	-4.00	93.0	95	-4.308	19.808	
22.600	-4.50	96.0				
32.000	-5.00	99.9				

INMAN VALUES					TRASK VALUES		FOLK VALUES		
MEAN	SORT	ALPH1	ALPH2	BETA	SORT	SKEW	MEAN	SORT	SKEW
-0.960	1.746	-0.200	-0.430*	0.685*	2.195	1.228	-0.840	1.764*	-0.234*

PCT GRAVEL	PCT SAND	PCT SILT	PCT CLAY	
38	62	0	0	MEYER-PETER EFF. DIAM. NOT COMPUTED - 0% FINER SIZE NOT DEFINED

* BASED ON EXTRAPOLATED VALUES - ERROR MAY BE EXCESSIVE

SUPPLEMENTAL DATA--SECTION J.

LOADING AND RUNNING THE PROGRAM ON THE PRIME COMPUTER

After the FORTRAN source code for the two programs (SIZEDATA.F77 and SEDSIZE.F77) have been entered into the Prime computer, they need to be compiled and loaded before they can be run.

Compiled programs SIZEDATA.BIN and SEDSIZE.BIN are created by entering and executing in sequence, the commands F77 SIZEDATA and F77 SEDSIZE.

The compiled programs are loaded by entering and executing the following command sequences:

```
SEG -LOAD                and        SEG -LOAD
$ LO SIZEDATA                       $ LO SEDSIZE
$ LI                                $ LI
LOAD COMPLETE                       LOAD COMPLETE
$ Q                                 $ Q
```

Files SIZEDATA.SEG and SEDSIZE.SEG are created.

The command SEG SIZEDATA or SEG SEDSIZE is entered and executed to run the desired program.

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