MASTER
YAEC-104

YANKEE ATOMIC ELECTRIC COMPANY
RESEARCH AND DEVELOPMENT PROGRAM

DARED-1

AN IBM-704 PROGRAM FOR REDUCING DATA FROM
FOIL IRRADIATION AND FITTING BY LEAST SQUARES TO
BESSEL J_0 OR COSINE FUNCTION

R&D SUBCONTRACT NO.1 under
USAEC-YAEC CONTRACT AT(30-3)-222

JANUARY, 1959

WESTINGHOUSE ELECTRIC CORPORATION
ATOMIC POWER DEPARTMENT

PITTSBURGH, 30

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Yankee Atomic Electric Company
Research And Development Program

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An IBM-704 Program for Reducing Data From
Foil Irradiation and Fitting by Least Squares to
Bessel J_0 or Cosine Function

—
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For The Yankee Atomic Electric Company
Under Research and Development Subcontract
No. 1 of USAEC-YAEC Contract AT(30-3)-222

January, 1959

APPROVED:

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I. ABSTRACT

A description is given of a code for the IBM-704 computer which reduces and fits by least squares the measurements of radioactivity of a sequence of foils.

Corrections for background, counter deadtime, foil weight and radioactive decay are applied, and readings outside a specified range are rejected. Errors due to statistical fluctuations are computed and off-center ordinates are calculated. Reduced data are then fitted by least squares to the best value of the arguments of Bessel J_0 or cosine functions. Up to 100 foils in a sequence can be handled and decay times up to 999 min. can be accommodated. An IBM-704 computer having 8192 words of core storage is required. No drums or tapes are needed. Running time for a typical 50 point problem involving data reduction alone is 2 min. With least squares fitting, the same problem would require 4 minutes.

II. INTRODUCTION

In the course of experimental measurements of buckling, flux mapping and control rod interactions, a determination of neutron flux at various positions within the core of a nuclear reactor is required. With the exception of power calibrations, a measurement of neutron flux relative to some arbitrary value, usually the peak value, is desired.

Flux measurements are usually made by placing stringers of foils made of materials with high neutron capture cross section in the neutron flux at the desired positions for an appropriate period of time and then measuring their induced radioactivity. Alternately, the radioactivity of the fission products contained in the fuel rods may be measured. In both cases the data obtained have to be reduced to a form suitable for plotting or fitting by least squares by applying proper corrections to the observed data.

The code described on the following pages has been developed with this application in mind. It offers several choices of treatment of data in which any or all of the following corrections are applied to the raw data: corrections for background radioactivity, counter deadtime, variation in foil weight and radioactive decay. If desired, points outside a prespecified range are rejected, relative counter efficiencies are calculated and the statistical error determined. For flux traverses taken along a chord dimension of a cylindrical core, proper space ordinates are calculated. Reduced data may be printed out at this stage or, if least squares fit is requested, the code offers two subroutines for fitting it to obtain the best argument of

the Bessel J_0 or cosine functions. The value of buckling is calculated. Least squares fitting is accomplished by use of two other machine codes used here as subroutines. They are the COFIT 1 program, and the JOFIT 2 program which is a version of COFIT modified by J. Jedruch to fit the Bessel J_0 function.

III. LIST OF SYMBOLS USED IN THE EQUATIONS

A	Maximum amplitude of fitted functions.
a, b, c	Increments on A, B, C.
A _f , B _f , C _f	Final values of quantities A, B, C.
A _o , B _o , C _o	Initial estimates of A, B, C.
B	Square root of buckling.
B	Average background counting rate, counts/min.
C	Displacement of the center.
C _{obs}	Average observed counting rate, counts/min.
C _{true}	Average true counting rate, counts/min.
D	Relative overall counter factor.
d	Deviation of the experimental points from the curve.
F	Point selection factor.
H	Extrapolated core height
m _{foil} = m	Mass of the foil, gm.
M	Atomic weight of foil material
n	Number of counters $1 < n \leq 4$.
N	Number of foils
N _A	Atomic number density of foil material, atoms/cm ³ .
N _B	Atomic number density of radioactive nuclide, atoms/cm ³ .
N _o	Avogadro's number 6.023×10^{23} atoms/mole.
R	Extrapolated core radius
S	Standard deviation.

t_0	Time of start of irradiation, min.
t_1	Time of end of irradiation, min.
t_2	Time of start of counting, min.
t_3	Time of end of counting, min.
T_{obs}	Total observed number of counts.
T_{true}	Total true number of counts.
$\bar{T}_{true}$	Average true total counts.
$\bar{T}_r$	Reduced average total counts.
$\bar{T}_0$	Reduced average total counts for reference foil.
u, v, w	Partial derivatives of the operative function.
V_{foil}	Volume of the foil, cm^3 .
λ	Deadtime correction.
β	Background correction.
γ	Foil weight correction.
δ	Decay correction.
Δt	Counting time interval = $t_3 - t_2$, min.
ϵ	Overall relative counter factor.
η	Reciprocal number of counters.
σ^2	Sum of the squares of the residuals.
λ_B	Decay constant of radioactive nuclide, min^{-1} .
μ	Additive correction factor.
ν	Multiplicative correction factor.
ξ	Absolute overall counter factor.

σ_A^C	Microscopic capture cross section of foil material, 10^{-24} cm^2 .
σ_T	Standard deviation of the observed total counts.
Σ_A^C	Macroscopic capture cross section of foil material, cm^{-1} .
Σ_B^C	Macroscopic capture cross section of radioactive nuclide, cm^{-1} .
τ	Counter deadtime, min/count.
Φ	Neutron flux, neutrons/ cm^2 -sec.
ψ	Operative function, cosine or Bessel J_0 .
ψ'	First derivative of the operative function, sine or J_1 .

IV. MATHEMATICAL ANALYSIS

1. Equations for the Reduction of Data

For the purposes of this description it will be assumed that a sequence of foils arranged at uniform intervals along a stringer has been placed in a reactor core and irradiated for a certain length of time. The foils are then taken out of the reactor core and are counted in the same sequence in one, two, three or four counters to determine their radioactivity.

In cases where the radioactivity of the fission products in the fuel rods is used for the same purpose as the foils, the fuel rods are counted along their length at uniform spacings or, if a sequence of fuel rods is counted in a radial traverse, each of the rods is counted at the same distance from its end.

2. Correction for Background and Counter Deadtime

The radioactivity of the foil is recorded by the detecting apparatus as the total observed number of counts, T_{obs} , in the given time interval. Most of the detecting devices will also record radiation due to cosmic rays and the natural radioactivity of the earth. The effect of all of these extraneous sources of radiation can be measured and expressed as the background counting rate B , counts/minute. This quantity may vary in time due to movement or changes of intensity of radioactive sources in the vicinity and therefore a provision is made in the code to calculate the arithmetic average of two background counting rates, one taken at the start

and the other at the end of the counting of a foil sequence:

$$\bar{B} = \frac{B_{\text{start}} + B_{\text{finish}}}{2} \frac{\text{counts}}{\text{min.}} \quad (1)$$

For a foil counted for Δt minutes, the total correction, $\bar{B} \Delta t$ counts, is subtracted from the observed total counts to correct for background. The background correction varies with the counter and should be recorded for each counter separately. If only one value, that at the start or at the finish, is given, this single value will be used by the machine. If none is provided, background correction will be omitted from the calculation.

In addition to the above correction consideration has to be given to the inherent inability of the detector and the circuit to count all radiation incident on the detector. This is due to the finite response time of the apparatus. An apparatus designed to be nonparalyzable will not respond to any additional impulses until the initial one has been recorded. The correction for this effect is called the deadtime correction.

Denoting by τ (min/count) the time the counter is unable to count after each registered event and by $C_{\text{obs}} \approx \frac{T_{\text{obs}}}{\Delta t}$ (counts/min) the average observed counting rate, we see that the counter is dead for a fraction $C_{\text{obs}} \tau$ of each unit counting time. It is active for $1 - C_{\text{obs}} \tau$ fraction of time. This is also the fraction of the true number of events which can be recorded.

$$\frac{C_{\text{obs}}}{C_{\text{true}}} = 1 - C_{\text{obs}} \tau$$

or

$$C_{\text{true}} = \frac{C_{\text{obs}}}{1 - C_{\text{obs}} \tau} \quad (2)$$

For $C_{\text{obs}} \tau \ll 1$ this may be expressed as:

$$C_{\text{true}} = C_{\text{obs}} \left[1 + C_{\text{obs}} \tau + (C_{\text{obs}} \tau)^2 + (C_{\text{obs}} \tau)^3 + \dots \right]$$

The terms of orders higher than the first are usually very small and can be neglected. Thus a simple correction results

$$C_{\text{true}} = C_{\text{obs}} + (C_{\text{obs}})^2 \tau \quad (3)$$

Substituting the total observed counts in the place of the counting rates, and applying the background correction the following equation is obtained:

$$T_{\text{true}} = T_{\text{obs}} + \frac{(T_{\text{obs}})^2 \tau}{\Delta t} - \bar{B} \Delta t \quad (4)$$

The deadtime of the counter, τ , is a characteristic of the individual counter and has to be determined experimentally.

3. Correction for Radioactive Decay

The foil counting apparatus is an integrating device and the total counts it produces, T_{true} , is related to the time integral of the decay rate of the foil. This is the number from which one calculates the original neutron flux, Φ , to which the foil has been exposed.

Let the atomic density of the foil material be denoted by N_A , its macroscopic capture cross section by Σ_A^C ; the atomic density of this

resulting radioactive nuclide formed by neutron capture by N_B , its macroscopic capture cross section by Σ_B^C , and its radioactive decay constant by λ_B . Then the equation for the rate of change of N_B with time may be expressed as

$$\frac{dN_B}{dt} = \Sigma_A^C \Phi - \lambda_B N_B - \Sigma_B^C \Phi \quad (5)$$

If the irradiation is of fairly short duration and the neutron flux, Φ , is constant with time, the atomic density of the foil material will not be appreciably changed and the product $\Sigma_A^C \Phi$ may be considered a constant. Similarly, if the number of radioactive nuclei formed is small but their decay constant λ_B is large, the rate of destruction of nuclei N_B by neutron capture $\Sigma_B^C \Phi$ will be much smaller than the rate of radioactive disintegration $\lambda_B N_B$ and may be neglected. A simplified equation results:

$$dN_B + \lambda_B N_B dt = \Sigma_A^C \Phi dt \quad (6)$$

which can be solved through the use of integrating factor $e^{\lambda_B t}$ and the boundary condition $t = 0, N_B = 0$ to obtain:

$$N_B = \frac{\Sigma_A^C \Phi}{\lambda_B} (1 - e^{-\lambda_B t}) \quad (7)$$

If the foil is removed from the neutron flux at time t_1 , there will have been formed

$$N_B(t_1) = \frac{\Sigma_A^C \Phi}{\lambda_B} (1 - e^{-\lambda_B t_1}) \quad (8)$$

radioactive nuclei which will decay according to

$$\frac{dN_B}{dt} = -\lambda_B N_B \quad (9)$$

This situation is presented graphically in the Figure 1.

Figure 1. Irradiation and Decay Curve

As mentioned before, the detecting apparatus records a number directly proportional to the total number of nuclei which have decayed in the time interval $\Delta t = t_3 - t_2$. This number is the time integral of the differential equation (9), or ΔN_B . With proper substitution from equation (7) and on integration between t_2 and t_3 , ΔN_B is expressed as:

$$\Delta N_B = \frac{\Sigma_A^0 \Phi}{\lambda_B} \left[e^{\lambda_B t_1} - 1 \right] \times \left[e^{-\lambda_B t_2} - e^{-\lambda_B t_3} \right] \quad (10)$$

The proportionality between the total number of nuclei decayed in the time interval $\Delta t = t_3 - t_2$; i.e., during the time of counting, and the true total counts recorded by the counting apparatus, T_{true} , may be expressed as

$$T_{\text{true}} = \xi \Delta N_B V_{\text{foil}} \quad (11)$$

Here ξ is the absolute overall counter factor accounting for counter efficiency, changes in geometry, etc. and V_{foil} is the volume of the foil.

A relative proportionality factor can be obtained directly from the data analyzed if more than one counter is used to count the same foil in succession. The method of calculating it will be shown later.

With substitution of equation (10) into equation (11) the neutron flux producing the observed effect is

$$\Phi = \frac{T_{\text{true}}}{\xi V_{\text{foil}}} \times \frac{\lambda_B}{\Sigma_A^C} \times \frac{1}{\left[e^{\lambda_B t_1} - 1 \right]} \times \frac{1}{\left[e^{-\lambda_B t_2} - e^{-\lambda_B t_3} \right]} \quad (12)$$

4. Correction for Foil Weight

In the equations derived so far the physical size of the foil appears through the foil volume, V_{foil} . This volume is as a rule small, difficult to measure and varies from foil to foil. A quantity easier to measure is the foil weight. The product appearing in the denominator of equation (12) may be expressed as:

$$V_{\text{foil}} \Sigma_A^C = V_{\text{foil}} \frac{m_{\text{foil}}}{V_{\text{foil}}} \times \frac{N_0}{M} \sigma_A^C \quad (13)$$

In this equation m_{foil} is the weight of the foil, N_0 is the Avogadro's number, M is the atomic weight of the foil material and σ_A^C is the microscopic capture cross section of the foil material.

Substitution of equation (13) into (12) provides the weight correction:

$$\Phi = \frac{T_{\text{true}} \lambda_B M}{\xi m_{\text{foil}} N_o \sigma_A^C} \times \frac{1}{\begin{bmatrix} \lambda_B & t_1 \\ e & -1 \end{bmatrix}} \times \frac{1}{\begin{bmatrix} -\lambda_B & t_2 & -\lambda_B & t_3 \\ e & -e & & \end{bmatrix}}. \quad (14)$$

5. Rejection of Obviously Bad Counts

It may happen that in recording the number of counts an erroneous number will be recorded due to a mis-setting of the timer, counting of two foils together or simple over-sight on the part of the operator. To prevent such errors from being carried through, a simple procedure has been devised for rejecting these grossly wrong points.

A system of acceptance or rejection of a count has been devised based on the arithmetic average of the corrected counts of some of its neighbors in the sequence selected in the manner described below. A fraction of this average is taken, as prespecified on the input sheet, and by adding and subtracting it from the average, a range of permissible variation is constructed. If the corrected number of counts for the foil in question is outside this range the count is rejected.

The complete system for acceptance of a count provides three ways in which a foil may be accepted.

- a. The point has one neighbor on each side in the sequence and lies within a specified range of the average of those points.
- b. (a) above does not hold, but the point has both second neighbors and it does lie within a specified range of the average of these second neighbors.

- c. One or both of its first neighbors is missing at the same time, one or both of its second neighbors is missing.

Exception to the above:

- a. The first and last points are always accepted.
- b. The second and next to last points are tested only on the basis of nearest neighbors. Equations expressing the acceptance criterion are as follows:

$$\frac{(T_{N-1} + T_{N+1})}{2} (1-F) < T_N < \frac{(T_{N-1} + T_{N+1})}{2} (1+F)$$

$$\text{or } \frac{(T_{N-2} + T_{N+2})}{2} (1-F) < T_N < \frac{(T_{N-2} + T_{N+2})}{2} (1+F). \quad (15)$$

Where N is the foil number, F the selection factor, and T the corrected true total counts for this foil. The rejection procedure is illustrated in Figure 2.

Fig. 2. Scheme for the Rejection of Bad Counts

The selection factor may be varied at will and if it is desired that no points be rejected a large selection factor should be specified.

It should be noted that the selection factor is the required fraction of total counts and thus, for the part of the traverse with the low total counts and highest statistical error, the rejection criterion is strictest.

6. Correction for Counter Efficiency

In order to improve the certainty that a correct reading has been taken of the radioactivity of a foil, each foil will often be counted more than once. For foils containing isotopes with large decay constants such recounting should be done as soon as possible to avoid counting at low absolute activities. As a result, to conserve time the foil will be counted in one, two, three or four different counters in succession, the next foil following close behind.

In most cases different counters will respond differently to the same foil. Systematic changes of geometry will also contribute in such a way that the same foil will appear to have different activity as detected by different counters, (see Figure 3).

In data reduction it is desired to obtain an average total counts for each foil properly weighted by the appropriate overall counter factor.

Fig. 3. Foil Activity and Counter Response

In the method of calculation which follows it is necessary that each foil considered should be counted in succession in each of the counters. If a count in one of the counters has been missed for any of the foils, the machine is instructed to neglect this foil for the purposes of calculating the overall counter factors.

When the same foil is counted in two counters (a) and (b) the neutron flux is of course the same and the equation (14) can be written as a ratio:

$$\frac{\Phi}{\Phi} = 1 = \frac{\frac{(T_{\text{true}})_a}{\xi_a^m} \times \frac{1}{\left[e^{-\lambda_B t_{2a}} e^{-\lambda_B t_{3a}} \right]}}{\frac{(T_{\text{true}})_b}{\xi_b^m} \times \frac{1}{\left[e^{-\lambda_B t_{2b}} e^{-\lambda_B t_{3b}} \right]}} \quad (16)$$

where the exposure factor and other constants have been cancelled

$$\frac{\xi_b}{\xi_a} = D_{b/a} = \frac{(T_{\text{true}})_a/m \left[e^{-\lambda_B t_{2a}} e^{-\lambda_B t_{3a}} \right]}{(T_{\text{true}})_b/m \left[e^{-\lambda_B t_{2b}} e^{-\lambda_B t_{3b}} \right]} \quad (17)$$

This equation defines the overall counter factor of counter (a) relative to counter (b) as obtained from the counting of one foil in two counters at different times for two different lengths of time. Similar counter factors $D_{c/a}$ and $D_{d/a}$ may be obtained for the other counters. Due to the random nature of radioactive decay a repeated measurement of this quantity would show a variation. This variation may be minimized by summing the corrected counts for the whole sequence of foils for each counter and taking their ratio:

$$\frac{\sum_{i=1}^N \Phi_i}{\sum_{i=1}^N \Phi_i} = 1 = \frac{\frac{1}{\xi_a} \sum_{i=1}^N (T_{\text{true}})_{ai}/m_i \left[e^{-\lambda_B t_{2ai}} e^{-\lambda_B t_{3ai}} \right]}{\frac{1}{\xi_b} \sum_{i=1}^N (T_{\text{true}})_{bi}/m_i \left[e^{-\lambda_B t_{2bi}} e^{-\lambda_B t_{3bi}} \right]} \quad (18)$$

The relative overall counter factor becomes

$$\frac{\xi_b}{\xi_a} = D_{a/b} = \frac{\sum_{i=1}^N (T_{\text{true}})_{ai}/m_i \left[e^{-\lambda_B t_{2ai}} e^{-\lambda_B t_{3ai}} \right]}{\sum_{i=1}^N (T_{\text{true}})_{bi}/m_i \left[e^{-\lambda_B t_{2bi}} e^{-\lambda_B t_{3bi}} \right]} \quad (19)$$

where (i) ranges over only those foils which have acceptable counts in all of the counters which were used.

The accuracy of the determination of this factor is directly related to the number of foils in the sequence (N).

The counter factors determined from equation (19) will be used to obtain the weighted overage of counts

$$\bar{T}_{\text{true}} = \frac{(T_{\text{true}})_a D_{a/a} + (T_{\text{true}})_b D_{b/a} + (T_{\text{true}})_c D_{c/a} + (T_{\text{true}})_d D_{d/a}}{n} \quad (20)$$

where n is the number of counters for which counts were accepted for a particular foil and may be equal to 1, 2, 3 or 4.

Direct proportionality between the flux Φ and the true reduced total counts $\bar{T}_{\text{true}}$, leads to

$$\frac{\Phi_i}{\Phi_o} = \frac{(\bar{T}_{\text{true}})_i}{(\bar{T}_{\text{true}})_o} \quad (21)$$

where the subscript (i) denotes any foil in the sequence and the (o) the reference foil.

7. Calculation of Statistical Error

It is desirable in the reduction of data to take into account the random nature of radioactive decay. A good measure of the error introduced into the recorded total counts due to statistical fluctuations is the standard deviation of the final reduced quantity. In the derivation that follows it will be assumed that all of the error is due to the variation in the observed total counts, T_{obs} , and that no error is due to the inaccuracies in the determination of the foil weight, measurement of time or background. Although the correction for the deadtime of the counter is dependent on the recorded total counts, for the purposes of this discussion it will be assumed to be known with absolute accuracy.

A Poisson frequency distribution should be used to describe the radioactive decay. The expectation value of the standard deviation of the total number of observed counts, T_{obs} , will be used as a fundamental variable. Thus we have

$$\sigma_T = \sqrt{T_{\text{obs}}} \quad (22)$$

It is now possible to write an equation for reduced average total counts, $\bar{T}_r$, from equation (14) with the following intermediate step.

$$\bar{T}_r = \frac{\Phi N_o \sigma_A^C}{\lambda_B^M} (e^{\lambda_B t_{i-1}}) = \frac{1}{n} \sum_{i=1}^n \frac{\left[T_{\text{obs},i} + \frac{(T_{\text{obs},i})^2 \tau}{\Delta t} - \bar{B} \Delta t \right] D}{m \left[e^{-\lambda_B t_{i,2}} - e^{-\lambda_B t_{i,3}} \right]} \quad (23)$$

This equation can be simplified and expressed in terms of the observed total counts, T_{obs} , by writing

deadtime correction	$\alpha = (T_{\text{obs}})^2 \tau / (t_3 - t_2)$
background correction	$\beta = -\bar{B} (t_3 - t_2)$
weight correction	$\gamma = 1/m$
decay correction	$\delta = 1 / (e^{-\lambda_B t_2} - e^{-\lambda_B t_3})$
overall counter factor	$\epsilon = D$
averaging factor	$\eta = 1/n$

Thus equation (23) for a particular foil with error of T_{obs} included becomes:

$$\bar{T}_r = \sum_{i=1}^n \left[\left(T_{\text{obs},i} \pm \sqrt{T_{\text{obs},i}} \right) + \alpha_i + \beta_i \right] \gamma_i \delta_i \epsilon_i \eta \quad (24)$$

where $n = 1, 2, 3, 4$ is the number of counters. The factors modifying the observed total counts, T_{obs} , to obtain the reduced average total counts, $\bar{T}_r$, may be grouped into multiplicative and additive:

$$\bar{T}_r = \sum_{i=1}^n \left[\left(T_{\text{obs},i} \pm \sqrt{T_{\text{obs},i}} \right) \gamma_i \delta_i \epsilon_i \eta \right] + \left[(\alpha_i + \beta_i) \gamma_i \delta_i \epsilon_i \eta \right] \quad (25)$$

To simplify this expression still further let

$$\nu_i = \gamma_i \delta_i \epsilon_i \eta \quad \text{and} \quad \mu_i = (\alpha_i + \beta_i) \gamma_i \delta_i \epsilon_i \eta \quad (26)$$

so that

$$\bar{T}_r = \sum_{i=1}^n \nu_i \left(T_{\text{obs},i} \pm \sqrt{T_{\text{obs},i}} \right) + \mu_i. \quad (27)$$

The first terms of this expression from each counter may be added according to the scheme

$$U = \left(x \pm \sqrt{x} \right) + \left(y \pm \sqrt{y} \right) = (x + y) \pm \sqrt{\left(\sqrt{x} \right)^2 + \left(\sqrt{y} \right)^2}$$

So that the final expression results:

$$\bar{T}_r = \sum_{i=1}^n (\nu_i T_{\text{obs},i} + \mu_i) \pm \sqrt{\sum_{i=1}^n \nu_i^2 T_{\text{obs},i}} \quad (28)$$

The normalized quantity $\bar{T}_n$, required in the calculation of the final answer will be obtained by dividing the above result for each of the foils by an arbitrary constant. In this code the constant chosen is the quantity

$$\bar{T}_o = \sum_{i=1}^n \nu_i T_{\text{obs},i} + \mu_i \quad (29)$$

which is the reduced total counts, without its error; for a designated foil, usually one in the position of expected maximum flux.

The result of these calculations, the relative neutron flux of equation (21) becomes thus in terms of equations (23), (28) and (29)

$$\frac{\Phi_i}{\Phi_o} = \frac{\sum_{i=1}^n (v_i T_{obs,i} + \mu_i) \pm \sqrt{\sum_{i=1}^n v_i^2 T_{obs,i}}}{T_o} \quad (30)$$

The error of the relative flux

$$\frac{\Delta\Phi_i}{\Phi_o} = \pm \frac{\sqrt{\sum_{i=1}^n v_i^2 T_{obs,i}}}{T_o} \quad (31)$$

will be printed out as a part of the answer alongside the relative flux Φ_i/Φ_o and may be used, if desired, in the least squares fitting part of the code.

8. Calculation of Offset Abscissae

In some flux measurements in a horizontal plane of a vertical right circular core the geometrical arrangement of the constituent parts of the core does not allow a flux traverse to be taken along the diameter of the core. The traverse is taken along a chord and a correction is required for the displacement from the diameter. If an assumption is made that the flux at any position in the horizontal plane is dependent on the radial distance from the vertical axis of symmetry of the core the correction may be simply calculated by the theorem of Pythagoras as is shown in Figure 4.

$$x_i' = \sqrt{z^2 + x_i^2} \quad (32)$$

Figure 4. Offset Traverse and Equivalent Abscissae

9. An Outline of Equations for Least Squares Fitting

When only the reduction of data is needed in cases such as flux mapping, the code will print out the answers and stop. For traverses taken in the axial or radial direction it may be often required to fit the reduced results by least squares to obtain the best argument of some desired function. The DARED code offers a choice of two such functions, cosine for axial traverses and Bessel J_0 for radial, through the incorporation of two other codes, COFIT and JOFIT in it. These codes fit the parameters A, B, C of the function:

$$\phi_i = A \cos [B (x_i - C)] \quad (33)$$

or

$$\phi_i = A J_0 [B (x_i - C)] \quad (34)$$

Both of these functions can be expressed in the form

$$\begin{aligned} f_i &= A \psi [B (x_i - C)] \\ &= (A_o + a) \psi \left\{ (B_o + b) [x_i - (C_o + c)] \right\} \end{aligned} \quad (35)$$

where a, b, c are small increments on A_o, B_o, C_o the initial estimates of the parameters, and ψ is the operative function.

The function f_i may be expanded in a Taylor series about the point (A_o, B_o, C_o)

$$f_i(A, B, C) = f_i(A_o, B_o, C_o) + \left. \frac{\partial f_i}{\partial A} \right|_o a + \left. \frac{\partial f_i}{\partial B} \right|_o b + \left. \frac{\partial f_i}{\partial C} \right|_o c + \quad (36)$$

Define

$$\left. \frac{\partial f_i}{\partial A} \right|_o = u_i; \quad \left. \frac{\partial f_i}{\partial B} \right|_o = v_i; \quad \left. \frac{\partial f_i}{\partial C} \right|_o = w_i \quad (37)$$

then

$$\begin{aligned} u_i &= \psi B_o (x_i - C_o) \\ v_i &= -(x_i - C_o) A_o \psi' B_o (x_i - C_o) \\ w_i &= A_o B_o \psi' B_o (x_i - C_o) \end{aligned} \quad (38)$$

The deviations, d_i , of the experimental points Φ_i from the curve f_i are given by

$$d_i = \Phi_i - [f_i(A_o, B_o, C_o) + u_i a + v_i b + w_i c]$$

The least squares principle now asserts that the quantity

$$\theta^2 = \sum_{i=1}^N \left(\frac{d_i}{\Delta \Phi_i} \right)^2, \quad (39)$$

where N is the number of foils, is to be minimized with respect to the constants, i.e.

$$\frac{\partial \theta^2}{\partial A} = 0; \quad \frac{\partial \theta^2}{\partial B} = 0; \quad \frac{\partial \theta^2}{\partial C} = 0 \quad (40)$$

The solution of the resulting equations leads to a 3×3 determinant which is solved by iteration combined with adjusting each time the increments a , b , c . The mathematical analysis of this part of the code is described in detail in the description of the COFIT and the JOFIT codes 1 and 2.

The results of the fitting are the best values of the parameters A , B and C and their standard deviations S_A , S_B and S_C . In addition, the square of B and its standard deviation are calculated.

$$S_{B^2} = 2S_B B \quad (41)$$

A half period of the cosine function

$$H = \frac{\pi}{B} \quad (42)$$

or the first intercept of the Bessel J_0 function

$$R = \frac{2.4048}{B} \quad (43)$$

with their standard deviations S_H and S_R are also calculated.

It is also possible, by making an appropriate choice of printout, to perform an error search about the final values of A , B , C . The value of θ^2 is calculated at the points $A \pm S_A$, $B \pm S_B$, $C \pm S_C$. Choices of printout will be described in the next section.

V. PREPARATION OF INPUT

All input quantities have to be entered on special DARED input forms. These are of two kinds: the Instruction Form and the Data Form. Examples of both forms will be found in Appendix A.

1. The Instruction Form

This form consists of a typed page with spaces provided for entries. Some of the entries are for the benefit and reference of the user. Only entries on lines marked with an asterisk will be punched on cards and used by the computer. All entries on a line marked with an asterisk should have a decimal point followed, where appropriate, by a zero. This restriction does not apply to the title lines. Thus zero will be entered as 0.0 and one as 1.0. Entries such as 0.005 are proper.

The individual lines of input should be filled as follows:

Title - Any combination of printed letters, numbers and spacing can be used providing that the total number of symbols and blank spaces does not exceed 60.

Run and Traverse - Any identifying combination consisting of printed letters, numbers, symbols and blank spaces, but not exceeding 60 in number, may be used.

Both of the above lines will be printed out as the title of the output.

The following lines are self-evident. The line called Counter Designation provides space for numerals or other identification of counters. This identification and the data in the column below should

match the counter designation and data entered on the second form. Its purpose is to assure that the characteristics of the counter entered in the leftmost column on the Instruction Form correspond to counting data entered in the leftmost column of counts on the Data form, etc.

On the lines that follow, the pertinent data should be entered. If an entry is missing 0.0 should be entered.

Counter Background may be entered for both start and finish of counting.

The machine will compute an arithmetic average and use it. If only start, finish or zero background is entered, this will be the value used by the machine. For this correction to be applied start and finish times of counting must be entered for each foil on the Data form.

Counter Deadtime should be entered in min. per count $\times 10^6$. Thus, 500 μ sec/count will be entered as 8.333. Start and finish times of counting are needed for the correction. If no correction is required enter zero for counter deadtime.

Number of Counters used should describe the number of counters in which each foil has been counted. An occasional missed count in one of the counters for one of the foils is allowed but a greater number will diminish the accuracy with which the overall counter factors are calculated. It is not allowed to count part of the foil sequence in, say, counters I and II and the remainder in counters III and IV. Each of these two sub-sequences should be run as a separate problem.

Program - The choice of program should be entered as 1.0 in the proper space with 0.0 in the others. If DARED is specified the data will be reduced and printed out. A choice of DARED + COFIT or DARED + JOFIT will

cause the machine to fit the reduced data by least squares to the cosine or Bessel J_0 shape. The fitted curve and constants associated with it will be printed out in addition to the reduced data.

DARED: Point Selection Factor - The entry in this space determines the allowable percent difference from the average of its neighbors, outside of which a count is rejected for each foil. For most runs 0.15 will be sufficient. If it is desired to retain all points enter 1.0.

Reference Foil Number - The number of the foil should be entered to which it is desired to have the results normalized. Normally, the foil in the estimated peak flux should be chosen. The reduced data will be printed out with the relative flux for this particular foil as 1.0000.

If the least squares fit has been requested the machine will itself find the position of the peak flux and renormalize all the points to it. For traverses taken along a chord the reference foil number should be the number of the foil on the axis of symmetry of the core or closest to it (see Figure 4). The distance of this foil in centimeters from the center of the core should be entered on the last line under "traverse offset." First foil in sequence may not be used as reference.

Error of y - This quantity is used in calculating the statistical weight of each foil in the least squares fitting. If it is desired to have the machine calculate the error of the relative flux, enter 1.0 in the space "Calculate." If the same error is assigned to all points, i.e. no weighting is required, enter 1.0 in the space "Use."

COFIT or JOFIT - Convergence factors which are the limiting percent differences between each successive iteration should be entered in the appropriate spaces. If the original data form a mirror image about an

axis of symmetry, a very loose convergence on C should be used such as 0.5; in all other cases convergence factors of 0.0005 may be used for all three quantities.

Print Routine - The number of the print routine should be entered here, such as 0.0, 1.0, 2.0 or 3.0. The choice of print routine determines the form of output. For all print routines the reduced data will be printed out. In addition, when least squares fitting is requested the following will be printed out:

Print Routine	Data Type Printed Out
0.0	0
1.0	0, 1
2.0	0, 1, 2
3.0	0, 2

The 0, 1, 2 types of data are described in Section VI "Form of Output." When only DARED has been requested 0.0 should be entered in the space for the print routine.

Guess of A, B, C - Enter here first estimates of the parameters A, B, C. Estimate of A will usually be 1.0, estimate of $B = \frac{\pi}{H}$ or $\frac{2.4048}{R}$ depending on the traverse (H and R to first approximation may be taken as core height radius) and should be in cm^{-1} . Estimate of C is the distance in centimeters of the peak of the fitted curve from the origin of the coordinate axis. For ordinary traverses of both COFIT and JOFIT it may be taken as the product of the reference foil number and the foil spacing in centimeters. For offset traverses run on JOFIT where the machine constructs a system of ordinates about the axis of symmetry, the guess of C should be a small positive number, say 0.05.

Foil Spacing - Uniform foil spacing only is allowed, although a foil in the sequence may be missed, providing the corresponding foil number is retained in the data on the second page. The machine will construct a grid of abscissae for the foil sequence by multiplying foil number by the foil spacing. These abscissae, or their corrected equivalents in the case of a chord traverse, will be used in least squares fitting.

Decay Constant - The decay constant of the foil material should be entered here. If automatic decay correction has been used either in the case of foils or fuel rod scanning, enter here 0.0 and in the spaces for background and counter deadtime above enter 0.0. The machine will then not apply these corrections.

Number of Foils - The actual number of foils appearing on Data Form and including missed foils should be entered here and not the number of the last foil in the sequence. In case the first foil is numbered 0, the two numbers differ. The maximum foil number allowed is 99.

Traverse Offset - is the distance in centimeters of the foil closest to the center of the core in case of traverses taken along a chord (see Figure 4). The last line of the form is for user's reference and will not be punched on cards.

2. The Data Form

This form consists of a typed page with spaces provided for entries. The problem and page designation are provided for the convenience of card punch operator to assure that matching sets of first and second pages are punched.

Counter - This space should bear the counter designation. Care should be taken that counters are entered in the same order as that used on the first page so that counter background and deadtime matches the counts from the given counter.

On this page, the only entries used by the machine are those below the double line. None of these entries should include a decimal point.

Foil Number - The allowable foil numbers are from 0 to 99. If a foil has been skipped in the geometrical sequence, the corresponding foil number should be retained and zeros entered in the spaces for foil weight, time and the number of counts.

Foil Weight - Only the significant figures of the foil weight should be entered taking care that the relationship between different foils be retained. Thus foil weights 0.00935 gm and 0.0102 gm shall be entered as 935 and 1020. A maximum of 6 digits is allowed. If foils have been calibrated first by irradiation in standard flux their total counts may be entered in place of foil weight. If the data from fuel rod counting is to be reduced enter 1 in the space for foil weight.

Time - The time of start of counting and end of counting for each foil should be entered in minutes as one 6 digit number with zeros in proper places. The first 3 digits are for the start time and the last 3 digits are for the end of count time. For instance, start 3 min., end 11 min. should be entered as 003011. For convenience the dotted line divides the first three digits from the last. The machine will divide this 6 digit number by 1000 and use the quotient as the start and the remainder as the finish time. Maximum time entry allowed is 999 minutes. All times entered

in one column for one counter should refer to the same zero time but for a different counter the zero time may be different. The difference will be taken care of by the machine in the overall counter factor. If automatic correction for decay has been used in foil counting and no deadtime or background correction is required enter zero in the time column. Background and deadtime corrections require the difference between the start and finish time. It may be entered as finish time for each foil, e.g. for a 3 minute counting interval, enter 000 003.

Total Counts - The number of counts recorded in the counting interval should be entered here. If a count is missed enter 0 in this space. The maximum allowable number of counts is 99 999.

If the above restriction on counts is followed, no difficulties will ever arise. However, the actual restriction on the number of digits used under "Total Counts" is that the sum of the number of digits under "Foil Number", "Foil Weight", "Time", and "Total Counts" does not exceed 52. Thus, if only three counters are used, counts may consist of as many as 8 digits. The foil weight may also consist of more than 6 digits provided the limit of 52 is not exceeded. The limit of 2 digits on the foil number, however, is fixed by the program and cannot be altered without a change in the program.

The results of counting of the same sequence of foils in other counters should be entered in an analogous manner in the following columns.

If only one counter has been used, the first column on the left should be used; for more counters, fill the columns from left to right. Blank columns should be marked with zero in top and bottom line with a dashed line drawn vertically between them.

When more than one page of counting data is recorded the entries for each counter are continued from page to page in the same order.

The complete sequence of foils should be counted on the same shelf in any given counter, i.e. no changes of geometry are allowed for one counter, but different geometries in different counters are allowed.

VI. FORM OF OUTPUT

DARED output consists first of two lines of the input form which are printed out as a title followed by the words "Reduced Data". Following this are 4 blocks of numbers headed respectively by the following titles:

Foil Number	Abscissae	Ordinates	Error of y
-------------	-----------	-----------	------------

Meaning x_i y_i Δy_i

If a least squares fit has been requested this part of the printout will be followed by the words "Fitted Data". Below it there will be 5 blocks of numbers headed respectively by the following titles:

Foil Number	Abscissae	Initial-y	Computed-y	Wtd. Res.
-------------	-----------	-----------	------------	-----------

Meaning x_i y_i/A_f $\cos B_f (x_i - C_f)$ $d_i/\Delta y_i$

or x_i y_i/A_f $J_o B_f (x_i - C_f)$ $d_i/\Delta y_i$

as the case may be. This is data Type 1.

In addition the following quantities will be printed out in case COFIT has been requested.

H_f	S_H	B^2	S_{B^2}		Res. Sq.
A_f	S_A	B_f	S_B	C_f	S_C

For JOFIT the corresponding output will be

R_f	S_R	B^2	S_{B^2}		Res. Sq.
A_f	S_A	B_f	S_B	C_f	S_C

This is Data Type 0.

Data Type 2 has 27 lines of print expressing θ^2 as a function of all combinations of $A \pm S_A$, $B \pm S_B$, $C \pm S_C$. The format and method of combining these is as follows:

2	A	B	C	θ^2
2	A	B	$C + S_C$	θ^2
2	A	B	$C - S_C$	θ^2
2	A	$B + S_B$	C	θ^2
2	A	$B + S_B$	$C + S_C$	θ^2
2	A	$B + S_B$	$C - S_C$	θ^2
2	A	$B + S_B$	C	θ^2
2	$A + S_A$	B	C	θ^2
2	$A + S_A$	$B - S_B$	$C - S_C$	θ^2

All output with the exception of foil numbers is in floating decimal point form printed six words to a line. Each word consists of the exponent (none, one or two digits) and an eight digit fraction. Both the exponent and

the fraction are signed. The number is read as a fraction times 10 raised to the power of the exponent. Plus signs and zero exponents are not printed. An example of printout using Printing Routine 2.0 appears in the Appendix B. The following common mistakes in coding will cause the results to be meaningless:

1. Point selection factor entered by mistake as 0.0. The printout of the reduced data has only the first and the last point retained and zeros in the remaining spaces. Change point selection factor to the desired value.
2. For offset traverses run with JOFIT the guess of C entered by mistake as equal to the product of reference foil number and foil spacing, values of "Initial-y" and "Computed-y" appear negative, and other results are improper. Change guess of C to 0.05. A misjudgement of the value of C by an order of magnitude with either COFIT or JOFIT will cause similar trouble.

VII. INSTRUCTIONS FOR PUNCHING CARDS

- a. In the first two cards, punch BCD in columns 8, 9, and 10. Then beginning in column 13, punch the information opposite Title into the first card and the information opposite Run and Traverse on the second data card.
- b. In all other cards, punch DEC in columns 8, 9, 10. Then, beginning in column 12, punch the numbers as they appear on the data sheet with commas separating the numbers. Each line is punched on a separate card. On the first data sheet, only those lines which have asterisks are to be punched.

Detailed instructions are as follows:

- (1) In the third card, punch the numbers opposite Counter Background, Start. Punch zeros for all blank spaces.
- (2) In the fourth card, punch the numbers opposite Counter Background, Finish. Punch zeros for all blank spaces.
- (3) In the fifth card, punch the numbers opposite Counter Deadtime. Punch zeros for all blank spaces.
- (4) In the sixth card, punch the one number opposite Number of Counters Used. Do not punch zero for the long space which is left blank.
- (5) In the seventh card, punch the numbers which are entered on the line which begins with Program. Punch zeros for all blank spaces.
- (6) In the eighth card, punch the numbers which are entered on the line which begins with DARED. Punch zeros for blank spaces.

- (7) In the ninth card, punch the two numbers which are opposite Calculate and Use. Punch zeros for blank spaces. However, do not punch a zero for the last long blank space.
 - (8) In the tenth card, punch the numbers which are entered on the line which begins with COFIT or JOFIT. Punch zeros for blank spaces.
 - (9) In the eleventh card, punch the numbers which are entered on the line beginning Print Routine. Punch zeros for blank spaces.
 - (10) In the twelfth card, punch the numbers which are entered on the line beginning with Foil Spacing. Punch zeros for blank spaces.
 - (11) In the thirteenth card, punch the one number opposite Transverse Offset. Punch a zero if the space is blank. However, do not punch a zero for the last long blank space.
- c. All remaining cards are to be punched from data sheets which are headed by Foil No., Foil Wt., Time Min., Total Counts, etc. They must be punched according to the following rules:
- (1) Punch DEC in columns 8, 9, and 10.
 - (2) Beginning in column 12 of the card, punch the data entered on one line. Solid block lines are to be punched as commas. Dotted lines must be ignored and are never punched as commas. All blank spaces, i.e. all spaces between two solid block lines, must be punched as zeros.

VIII. OPERATING INSTRUCTIONS

1. Any number of cases may be stacked behind the transfer card of the binary deck.
2. Sense switch 1 is down for card input and up for tape input. To begin problem, clear and load cards.
3. If on-line output is desired, push sense switch 6 down. This may be done at any time during the operation of the problem to find out how the problem is progressing. Sense switch 6 may also be returned to the "up" position at any time.
4. Regardless of the position of sense switch 6, the results are written on tape 2. Tape 2 should be printed on the off-line printer under program control. There will be one file for each problem.

Program Stops in DARED

- 251₈ $B + 1 - A$ negative ($B \neq 0$). No data will be read in.
- 320₈ Illegal pseudo-operation. Check data to see if it is in correct form.
- 636₈ Out of range decimal data.
- 1117₈ No end of record. Check for proper number of cards or machine error.
- 7732₈)
7740₈) Range error in exponential routine.
- 10424₈)
10471₈) Range error in SQRT routine.

NO SOLUTION will be printed out after the reduced data is a division by zero or the extraction of the square root of a negative number is tried.

For all stops TRA to 7454 and read in next set of data.

Final stop is at 7454 selecting the card reader.

IX. ACKNOWLEDGEMENT

Special thanks are due Ronald D. Cummings of the Westinghouse Atomic Power Department who was responsible for extensive parts of programming in connection with the DARED program.

The authors also wish to thank Betty L. Anderson and Thomas J. Lawton of the Central Physics and Mathematics Department, Westinghouse Bettis Plant, for permission to incorporate in DARED, their code "COFIT - A Least Squares Cosine Fitting Program for the IBM-704" - WAPD-TM-26. The JOFIT program used in DARED is also a modification of the COFIT program.

X. REFERENCES

1. COFIT - A Least Squares Cosine Fitting Program for the IBM-704 -
WAPD-TM-26 - Betty L. Anderson and Thomas J. Lawton.
2. JOFIT - A least Squares Bessel J_0 Fitting Program for the IBM-704 -
YAEC-86 - J. Jedruch .

APPENDIX A

Example of Input Forms

DARED Input Form

Problem	Title: <u>DARED Sample Problem</u> *
	Run and Traverse <u>Feb. 17, 1959 J. J.</u> *
	Job No. <u>00000</u> L. S. No. _____
	Analyst <u>Jacek Jedruch</u> Date <u>Feb. 17, 1959</u>
	Fuel Rods in Core _____ Control Rods _____
Counter	Counter Type _____
	Counter Designation <u>I</u> <u>II</u> <u>III</u>
	Counter Background, Start, cpm, . . . <u>0.0</u> <u>0.0</u> <u>0.0</u> <u>0.0</u> *
	Counter Background, Finish, cpm, . . . <u>27.3</u> <u>42.1</u> <u>36.4</u> <u>0.0</u> *
	Counter Deadtime, $\frac{\text{min.}}{\text{count}} \times 10^6$, . . . <u>8.33</u> <u>8.33</u> <u>8.33</u> <u>0.0</u> *
	Number of Counters Used <u>3.0</u> *
Program	Program: <u>DARED</u> <u>0.0</u> , <u>DARED + COFIT</u> <u>0.0</u> , <u>DARED + JOFIT</u> <u>1.0</u> *
	DARED: Point Selection Factor <u>0.10</u> Reference Foil No. <u>2.0</u> *
	Error of y: Calculate <u>1.0</u> Use <u>0.0</u> *
	COFIT or JOFIT: Conv. A <u>0.0005</u> Conv. B <u>0.0005</u> Conv. C <u>0.0005</u> *
	Print Routine <u>2.0</u> Guess A <u>1.0</u> Guess B <u>0.07</u> Guess C <u>2.190</u> *
Foil	Foil Spacing, cm <u>1.095</u> Decay Const., min. ⁻¹ <u>0.012803</u> No. of Foils <u>24</u> *
	Traverse offset, cm <u>0.0</u> *
	Foil Size _____ Foil Material _____

All numbers on this page should have a decimal point followed by zero.

Lines marked with an asterisk will be punched on cards.

Problem DARED Sample ProblemDate 2-17-59

Counter									
Foil No.	Foil Wt.	Time, Min.	Tot. Counts	Time, Min.	Tot. Counts	Time, Min.	Tot. Counts	Time, Min.	Tot. Counts
1	147	068 069	19264	070 071	15568	072 073	14669	0	0
2	138	066 067	18561	068 069	15283	070 071	14137	0	0
3	138	064 065	18022	066 067	14964	068 069	13638	0	0
4	147	062 063	19057	064 065	15942	066 067	14396	0	0
5	150	060 061	19567	062 063	17131	064 065	14771	0	0
6	142	058 059	19143	060 061	15733	062 063	14416	0	0
7	138	056 057	19571	058 059	16399	060 061	14939	0	0
8	143	054 055	19154	056 057	16097	058 059	14633	0	0
9	150	052 053	19479	054 056	16172	056 057	15721	0	0
10	140	050 051	18808	052 053	15866	054 055	14165	0	0
11	144	048 049	19210	050 051	16121	052 053	14595	0	0
12	146	046 047	18250	048 049	15169	050 051	13743	0	0
13	140	044 045	17210	046 047	14293	048 049	12973	0	0
14	143	084 085	11138	044 045	14993	046 047	14238	0	0
15	137	082 083	11184	084 085	9123	044 045	13500	0	0
16	138	080 081	10449	082 083	8618	084 085	7817	0	0
17	141	036 032	16723	080 081	8492	082 083	8011	0	0
18	148	034 035	17125	036 037	13994	080 081	8158	0	0
19	148	032 033	15392	034 035	12836	036 037	11656	0	0
20	146	030 031	14752	032 033	12148	034 035	11273	0	0
21	141	028 029	14484	030 031	10395	032 033	9671	0	0
22	145	026 027	13518	028 029	11212	030 031	10684	0	0
23	149	024 023	13341	026 027	10788	028 029	10365	0	0
24	140	022 021	13072	024 025	10788	026 027	10059	0	0

APPENDIX B

An example of output with Print Routine 2.

DARED

TITLE DARED SAMPLE PROBLEM

RUN AND TRAVERSE FEB. 17, 1959 J.J.

REDUCED DATA

FOIL NO.	ABSCISSAE	ORDINATES	ERROR-Y
1	1 10950000	99715084	-2 39802640
2	1 21900000	1 10000000	-2 40697096
3	1 32850000	94381113	-2 39096263
4	1 43800000	92133468	-2 36823114
5	1 54750000	92240623	-2 35925364
6	1 65700000	90370138	-2 36165698
7	1 76650000	94063243	-2 36894274
8	1 87600000	86484978	-2 34355567
9	1 98549999	83242065	-2 32470900
10	2 10950000	81916672	-2 32970030
11	2 12045000	79590577	-2 31599522
12	2 13140000	71748922	-2 29510649
13	2 14235000	68317915	-2 29131574
14	2 15330000	69985093	-2 31689871
15	2 16425000	69795217	-2 35387553
16	2 17520000	63412236	-2 36415432
17	2 18615000	60317323	-2 32577774
18	2 19710000	56989223	-2 27762256
19	2 20805000	49134338	-2 22384904
20	2 21900000	46270134	-2 21643392
21	2 22995000	41703717	-2 20654589
22	2 24090000	40832797	-2 19973982
23	2 25185000	37595579	-2 18678649
24	2 26280000	38287714	-2 19211328

FITTED DATA

JOFIT

FOIL NO.	ABSCISSAE	INITIAL-Y	COMPUTED-Y	WTD. RES.
1 1000000	1 1095000	9165417	9232156	1-1824088
1 2000000	1 2190000	9191606	9075343	1 3108392
1 3000000	1 3285000	8675140	8905140	1-6399664

1 4000000		1 4380000	8468545	8721940	1-7485646
1 5000000		1 5475000	8478395	8526168	1-1445453
1 6000000		1 6570000	8306467	8318275	-3536562
1 7000000		1 7665000	8645922	8098742	2 1613721
1 8000000		1 8760000	7949358	7868076	1 2576216
1 9000000		1 9855000	7651283	7626806	8227126
2 1000000		2 1095000	7529458	7375489	1 5083558
2 1100000		2 1204500	7315652	7114699	1 6921958
2 1200000		2 1314000	6594878	6845034	1-9218539
2 1300000		2 1423500	6279513	6567111	2-1073650
2 1400000		2 1533000	6432754	6281563	1 5194617
2 1500000		2 1642500	6415301	5989039	2 1310879
2 1600000		2 1752000	5828603	5690203	1 4138772
2 1700000		2 1861500	5544131	5385730	1 5294436
2 1800000		2 1971000	5238225	5076309	1 6350781
2 1900000		2 2080500	4516235	4762634	2-1196826
2 2000000		2 2190000	4252968	4445409	1-9665714
2 2100000		2 2299500	3833241	4125342	2-1537765
2 2200000		2 2409000	3753190	3803146	1-2712180
2 2300000		2 2518500	3455637	3479534	1-1382186
2 2400000		2 2628000	3519256	3155220	2 2062515
R	SR	BSQ	S BSQ		RES. SQ

2 4722842	1 5864509	-2 2592748	-3 6439001		4 1846046
A	SA	B	SB	C	SC

1 1087949	-1 7970319	-1 5091903	-2 6322785	1-9896120	1 5065892
		VAR. A	VAR. B	VAR. C	RES. SQ

1 2000000	1 1087949	-1 5091903	1-9896120	4 1846046
1 2000000	1 1087949	-1 5091903	1-4830228	5 6054463
1 2000000	1 1087949	-1 5091903	2-1496201	5 7012126
1 2000000	1 1087949	-1 5724182	1-9896120	5 3741479
1 2000000	1 1087949	-1 5724182	1-4830228	5 1273814
1 2000000	1 1087949	-1 5724182	2-1496201	6 2341649
1 2000000	1 1087949	-1 4459625	1-9896120	5 3532757
1 2000000	1 1087949	-1 4459625	1-4830228	6 1465603
1 2000000	1 1087949	-1 4459625	2-1496201	4 5186799
1 2000000	1 1167652	-1 5091903	1-9896120	4 8578167
1 2000000	1 1167652	-1 5091903	1-4830228	6 1129049
1 2000000	1 1167652	-1 5091903	2-1496201	5 4583423
1 2000000	1 1167652	-1 5724182	1-9896120	5 2382750

1 20000000	1 1167652	-1 5724182	1-4830228	5 3909844
1 20000000	1 1167652	-1 5724182	2-1496201	6 2024070
1 20000000	1 1167652	-1 4459625	1-9896120	5 7165742
1 20000000	1 1167652	-1 4459625	1-4830228	6 2294624
1 20000000	1 1167652	-1 4459625	2-1496201	4 2765182
1 20000000	1 1008246	-1 5091903	1-9896120	4 8584406
1 20000000	1 1008246	-1 5091903	1-4830228	5 2729685
1 20000000	1 1008246	-1 5091903	2-1496201	6 1029613
1 20000000	1 1008246	-1 5724182	1-9896120	5 6134289
1 20000000	1 1008246	-1 5724182	1-4830228	4 2418972
1 20000000	1 1008246	-1 5724182	2-1496201	6 2718153
1 20000000	1 1008246	-1 4459625	1-9896120	5 1617395
1 20000000	1 1008246	-1 4459625	1-4830228	5 8608002
1 20000000	1 1008246	-1 4459625	2-1496201	5 1979584

APPENDIX C

Flow Chart

DARED FLOW CHART

APPENDIX D

Listing of DARED Program

			00144	ORG 100
			00144	K HED
			00144	COMMON BSS 60
00240	0	50000	4 00001	LOAD CLA 1,4
00241	0	62100	0 00700	STA LOC
00242	0	60100	0 00155	STO BADR
00243	0	77100	0 00022	ARS 18
00244	0	10000	0 00252	TZE LOAD3
00245	0	62200	0 00155	STD BADR
00246	0	40000	0 00717	ADD Q1
00247	0	40200	0 00155	SUB BADR
00250	0	12000	0 00252	TPL LOAD3
00251	0	00000	4 00002	HTR 2,4
00252	0	60200	0 00155	LOAD3 SLW BADR
00253	-0	63400	1 00321	SXD PX1,1
00254	-0	63400	2 00322	SXD PX2,2
00255	-0	63400	4 00323	SXD PX4,4
00256	-0	53400	1 00321	RTD LXD PX1,1
00257	-0	53400	2 00322	LXD PX2,2
00260	0	50000	0 01030	CLA RTX+4
00261	0	62200	0 00262	STD RTD1
00262	0	76000	0 00161	RTD1 SWT 1
00263	0	76200	0 00203	RTD 3
00264	0	07400	4 01024	TSX RTX,4
00265	0	77777	0 00156	RTD2 BCD,,-1
00266	1	00000	0 00715	TXI EOF
00267	0	50000	0 00722	FIL CLA MASK
00270	0	60100	0 00172	STO BCD+12
00271	0	40200	0 00156	SUB BCD
00272	0	10000	0 00300	TZE CTRL1
00273	0	56000	0 00156	LDQ BCD
00274	-0	75400	0 00000	PXD
00275	0	60200	0 00147	SLW SYMB
00276	0	07400	2 00355	TSX LOCB-1,2
00277	0	62100	0 00700	STA LOC
00300	-0	53400	2 00265	CTRL1 LXD RTD2,2
00301	0	53400	1 00372	LXA TWO,1
00302	0	56000	2 00156	LDQ BCD,2
00303	-0	76300	0 00036	LGL 30
00304	-0	60000	0 00150	STQ MQ
00305	-0	50000	0 00150	CAL MQ
00306	0	77100	0 00036	ARS 30
00307	0	60200	0 00145	SLW CH
00310	-0	50000	0 00157	CAL BCD+1

B-A+1 NEGATIVE
WORD COUNT

RESTORE INDEX REGISTERS
1 AND 2 IN CASE OF EOF
SET RTD1 TO SWT 1 FOR UA CSH 2 OR
TO NOP FOR UA TSH 1
TEST FOR TAPE OR CARD READER IF UA CSH 2
SELECT TAPE 3 FOR OFF-LINE INPUT
GO TO READ AND CHECK TAPE

EOF OR TWO FAILURES
NORMAL RETURN - SET END OF VARIABLE FIELD

SET BEGINNING OF
VARIABLE FIELD

00311	0	76700	0	00007	ALS 7	
00312	0	77100	0	00023	ARS 19	
00313	-0	53400	4	00315	LXD TX4,4	
00314	0	34000	4	00727	TEST CAS BCD0+1,4	
00315	-3	00004	0	00320	TX4 TXL INSTR,,4	
00316	0	02000	4	00325	TRA BCDOP+1,4	
00317	2	00001	4	00314	TIX TEST,4,1	
00320	0	00000	0	00256	INSTR HTR RTD	
00321	-3	00000	0	00335	PX1 TXL TRAOP,0	
00322	-3	00000	0	00404	PX2 TXL OCTOP,0	
00323	-3	00000	0	00447	PX4 TXL DECOP,0	
00324	0	50000	0	00145	BCDOP CLA CH	DETERMINE NUMBER
00325	0	34000	0	00720	CAS Q10	OF BCD WORDS
00326	0	50000	0	00720	CLA Q10	
00327	3	00000	0	00000	TXH	
00330	0	73400	1	00000	PAX ,1	
00331	0	50000	2	00157	3CD2 CLA BCD+1,2	
00332	0	07400	4	00700	TSX LOC,4	
00333	-2	00001	1	00256	TNX RTD,1,1	
00334	1	77777	2	00331	TXI BCD2,2,-1	
00335	-0	50000	0	00145	TRAOP CAL CH	PREPARE TO COMPUTE
00336	0	60100	0	00147	STO SYMB	
00337	0	56000	0	00160	LDQ BCD+2	EXIT ADDRESS
00340	-0	75400	0	00000	PXD	
00341	0	07400	2	00355	TSX LOCB-1,2	
00342	0	60100	0	00346	STO EXIT2	
00343	-0	53400	1	00321	LXD PX1,1	RESTORE PROGRAM
00344	-0	53400	2	00322	LXD PX2,2	INDEX REGISTERS
00345	-0	53400	4	00323	LXD PX4,4	
00346	0	02000	0	00000	EXIT2 TRA	EXIT2 TRANSFER
00347	-0	76300	0	00003	TAG LGL 3	
00350	-0	75400	0	00000	PXD	
00351	-0	76300	0	00003	LGL 3	
00352	0	76700	0	00017	ALS 15	
00353	-0	50100	0	00147	ORA SYMB	
00354	-3	00000	0	00402	TXL LOCC	
00355	0	53400	4	00356	LXA LOCB,4	SET CHARACTER COUNT
00356	-0	76300	0	00006	LOCB LGL 6	COMPUTE ABSOLUTE
00357	0	34000	0	00732	CAS COMMA	
00360	0	02000	2	00002	TRA 2,2	
00361	-3	00000	0	00347	TXL TAG	
00362	0	34000	0	00731	CAS BLANK	LOCATION
00363	0	02000	2	00002	TRA 2,2	
00364	-3	00000	0	00377	TXL LOCA	

00365	0	34000	0	00720	CAS	TEN
00366	0	02000	2	00002	TRA	2,2
00367	0	02000	2	00002	TRA	2,2
00370	0	60100	0	00146	STO	CHD
00371	0	50000	0	00147	CLA	SYMB
00372	0	76700	0	00002	TWO	ALS 2
00373	0	40000	0	00147		ADD SYMB
00374	0	76700	0	00001		ALS 1
00375	0	40000	0	00146		ADD CHD
00376	0	60100	0	00147		STO SYMB
00377	-0	75400	0	00000	LOCA	PXD
00400	2	00001	4	00356		TIX LOCB,4,1
00401	0	50000	0	00147		CLA SYMB
00402	-0	50100	0	00727	LOCC	ORA TAGC
00403	0	02000	2	00001		TRA 1,2
00404	0	56000	0	00150	OCTOP	LDQ MQ
00405	0	50000	0	00443		CLA OCT10
00406	0	63000	0	00443		STP OCT10
00407	-0	75400	0	00000		PXD
00410	-3	00000	0	00416		TXL OCT9
00411	-0	75400	0	00000	OCT1	PXD
00412	-0	76300	0	00003		LGL 3
00413	-0	10000	0	00424		TNZ OCT8
00414	0	50000	0	00152		CLA DATUM
00415	-0	76300	0	00003		LGL 3
00416	0	60100	0	00152	OCT9	STO DATUM
00417	-0	60200	0	00152		ORS DATUM
00420	2	00001	1	00411	OCT6	TIX OCT1,1,1
00421	1	77777	2	00422		TXI OCT2,2,-1
00422	0	56000	2	00156	OCT2	LDQ BCD,2
00423	1	00005	1	00411		TXI OCT1,1,5
00424	-0	76300	0	00003	OCT8	LGL 3
00425	-0	60000	0	00150		STQ MQ
00426	0	34000	0	00732		CAS COMMA
00427	-3	00000	0	00437		TXL OCT3
00430	-3	00000	0	00441		TXL OCT4
00431	0	34000	0	00733		CAS MINUS
00432	-3	00000	0	00437		TXL OCT3
00433	-3	00000	0	00445		TXL OCT5
00434	0	34000	0	00737		CAS PLUS
00435	-3	00000	0	00437		TXL OCT3
00436	-3	00000	0	00420		TXL OCT6
00437	0	50200	0	00443	OCT3	CLS OCT10
00440	0	60100	0	00443		STO OCT10

RESET SWITCH FOR EXIT FROM
OCTOP
CLEAR WORD

INVERT SWITCH TO EXIT FROM OCTOP
AFTER LAST WORD ON THIS CARD IS STORED

30441	0	50000	0	00152	OCT4	CLA DATUM	
30442	0	07400	4	00700		TSX LOC,4	
30443	3	00000	0	00256	OCT10	TXH RTD	SWITCH - INVERTED TO TXL RTD TO EXIT
30444	-3	00000	0	00404		TXL OCTOP	
30445	0	50000	0	00730	OCT5	CLA PBIT	SET NEGATIVE SIGN
30446	-3	00000	0	00416		TXL OCT9	
30447	-0	75400	0	00000	DECOP	PXD	CLEAR CONVERSION
00450	0	60200	0	00154	BN2	SLW BN	REGISTERS
00451	0	60200	0	00144	EX2	SLW EXPN	
00452	0	60200	0	00151	INTN	SLW N	
00453	-0	53400	4	00717		LXD Q1,4	SET DECIMAL COUNT TO ZERO
00454	-0	50000	0	00463		CAL SW1	RESET SWITCHES FOR
00455	0	63000	0	00577		STP CM2	FIXED POINT
00456	0	63000	0	00654		STP CM6	X
00457	0	63000	0	00570		STP EXS	EXP
00460	0	63000	0	00601		STP CM3	POINT
00461	0	63000	0	00676		STP NX4	EXIT FROM DECOP
00462	-0	50000	0	00452		CAL INTN	INITIALIZE CONVERSION
00463	-3	00000	0	00476	SW1	TXL BN3	
00464	0	50200	0	00601	PT1	CLS CM3	INVERT SWITCH TO SIGNAL DECIMAL POINT
00465	0	60100	0	00601		STO CM3	
00466	-0	50000	0	00517		CAL CV3	
00467	0	62100	0	00534		STA CV5	ROUTINE TO COUNT
00470	0	62100	0	00537		STA CV6	DECIMAL PLACES
00471	1	00001	4	00534		TXI CV5,4,1	
00472	1	77777	4	00517	PT3	TXI CV3,4,-1	COUNT DECIMAL PLACES
00473	0	50200	0	00570	EX1	CLS EXS	INVERT SWITCH TO SIGNAL EXPONENT
00474	0	60100	0	00570		STO EXS	
00475	-0	50000	0	00451		CAL EX2	SET UP EXPONENT CONVERSION
00476	0	62100	0	00525	BN3	STA CV7	STORE CONVERSION
00477	0	62100	0	00527		STA CV8	ADDRESS
00500	0	62100	0	00533		STA CV9	
00501	-0	50000	0	00472		CAL PT3	INITIAL CONVERSION
00502	0	62100	0	00534		STA CV5	WITHOUT DECIMAL COUNT
00503	0	62100	0	00537		STA CV6	
00504	-0	50000	0	00527	PL1	CAL CV8	
00505	0	62200	0	00531	MN3	STD CV10	
00506	0	14000	0	00534		TOV CV5	
00507	-3	00000	0	00534		TXL CV5	
00510	0	50000	0	00577	BN1	CLA CM2	INVERT SWITCHES TO SIGNAL FIXED POINT
00511	0	63000	0	00577		STP CM2	
00512	0	63000	0	00654		STP CM6	
00513	-0	50000	0	00450		CAL BN2	SET UP B CONVERSION
00514	-3	00000	0	00476		TXL BN3	

00515	-0	50000	0	00516	MN1	CAL MN2
00516	-3	40200	0	00505	MN2	TXL MN3,0,258*64
00517	-0	75400	0	00472	CV3	PXD PT3
00520	-0	76300	0	00006		LGL 6
00521	0	34000	0	00720		CAS TEN
00522	-3	00000	0	00541		TXL CM
00523	-3	00000	0	00563		TXL CV2
00524	0	60200	0	00145		SLW CH
00525	0	50000	0	00151	CV7	CLA N
00526	0	76700	0	00002		ALS 2
00527	0	40000	0	00151	CV8	ADD N
00530	0	76700	0	00001		ALS 1
00531	0	40000	0	00145	CV10	ADD CH
00532	0	14000	0	00540		TOV OV
00533	0	60100	0	00151	CV9	STO N
00534	2	00001	1	00517	CV5	TIX CV3,1,1
00535	1	77777	2	00536		TXI CV4,2,-1
00536	0	56000	2	00156	CV4	LDQ BCD,2
00537	1	00005	1	00517	CV6	TXI CV3,1,5
00540	1	00001	4	00534	OVF	TXI CV5,4,1
00541	0	34000	0	00732	CM	CAS COMMA
00542	-3	00000	0	00563		TXL CV2
00543	-3	00000	0	00565		TXL CM1
00544	0	34000	0	00733		CAS MINUS
00545	-3	00000	0	00563		TXL CV2
00546	-3	00000	0	00515		TXL MN1
00547	0	34000	0	00734		CAS POINT
00550	-3	00000	0	00563		TXL CV2
00551	-3	00000	0	00464		TXL PT1
00552	0	34000	0	00735		CAS E
00553	-3	00000	0	00563		TXL CV2
00554	-3	00000	0	00473		TXL EX1
00555	0	34000	0	00736		CAS B
00556	-3	00000	0	00563		TXL CV2
00557	-3	00000	0	00510		TXL BN1
00560	0	34000	0	00737		CAS PLUS
00561	-3	00000	0	00563		TXL CV2
00562	-3	00000	0	00504		TXL PL1
00563	0	50200	0	00676	CV2	CLS NX4
00564	0	60100	0	00676		STO NX4
00565	-0	60000	0	00150	CM1	STQ MQ
00566	0	50000	0	00151		CLA N
00567	0	10000	0	00674		TZE STOR
00570	-3	00000	0	00577	EXS	TXL CM2

TEST FOR DIGIT

PERFORM CODED
MULTIPLICATION
BY TEN AND ADD
CURRENT DIGIT

TEST FOR OVERFLOW

COUNT CHARACTERS
OBTAIN NEXT BCD
WORD AND RESTORE
CHARACTER COUNT
COUNT DECIMAL OVERFLOWS

INVERT SWITCH TO SIGNAL END OF
VARIABLE FIELD

SWITCH - INVERTED TO TXH INDICATES EXPONENT

00571	-0	50000	0	00730	CAL PBIT	PREPARE TRUE
00572	0	40000	0	00144	ADD EXPN	DECIMAL EXPONENT
00573	0	76700	0	00022	ALS 18	
00574	0	62200	0	00576	STD CM4	
00575	0	50000	0	00151	CLA N	
00576	1	00000	4	00602	CM4 TXI CM5,4	FLOAT CONVERTED
00577	-3	00000	0	00601	CM2 TXL CM3	SWITCH - INVERTED TO TXH INDICATES FIXED POI
00600	-3	00000	0	00602	TXL CM5	
00601	-3	00000	0	00674	CM3 TXL STOR	SWITCH - INVERTED TO TXH INDICATES POINT
00602	0	62100	0	00742	CM5 STA FL1	35 BIT INTEGER
00603	0	77100	0	00017	ARS 15	
00604	-0	50100	0	00743	ORA FL2	
00605	0	30000	0	00743	FAD FL2	
00606	0	12000	0	00611	TPL CMF1	
00607	0	30200	0	00742	FSB FL1	
00610	-3	00000	0	00612	TXL CMF2	
00611	0	30000	0	00742	CMF1 FAD FL1	
00612	-0	60000	0	00153	CMF2 STQ RESID	
00613	-3	00000	4	00654	TXL CM6,4	
00614	3	00046	4	00637	TXH CM7,4,38	TEST FOR NEGATIVE EXP
00615	1	77777	4	00616	CM11 TXI CM9,4,-1	COMPUTE ABSOLUTE
00616	-0	63400	4	00620	CM9 SXD CM10,4	VALUE OF EXPONENT
00617	-0	53400	4	00615	LXD CM11,4	
00620	-2	00000	4	00635	CM10 TNX CM8,4	
00621	0	60100	0	00152	STO DATUM	
00622	0	56000	4	00743	LDQ ONE,4	COMPUTE FLOATING
00623	0	26000	0	00152	FMP DATUM	BINARY REPRESENTATION
00624	0	60100	0	00146	STO T	OF INTEGER TIMES THE
00625	-0	60000	0	00147	STQ T+1	POWER OF TEN GIVEN
00626	0	56000	4	00743	LDQ ONE,4	BY THE TRUE EXPONENT
00627	0	26000	0	00153	FMP RESID	
00630	0	30000	0	00147	FAD T+1	
00631	0	30000	0	00146	FAD T	
00632	0	36100	0	00740	ACL EXC1	
00633	-0	76000	0	00001	PBT	
00634	-3	00000	0	00654	TXL CM6	
00635	-0	75400	0	00000	CM8 PXD	
00636	0	00000	0	00674	HTR STOR	
00637	-3	77717	4	00635	CM7 TXL CM8,4,-49	TEST FOR ILLEGAL EXP
00640	0	16100	0	00641	CM13 TQO CM13+1	
00641	0	24100	4	00743	FDP ONE,4	COMPUTE FLOATING
00642	-0	60000	0	00146	STQ T	BINARY EQUIVALENT
00643	0	30000	0	00153	FAD RESID	OF INTEGER TIMES
00644	0	24100	4	00743	FDP ONE,4	POWER OF TEN GIVEN

00645	0	16100	0	00635	TQO	CM8	
00646	-0	60000	0	00147	STQ	T+1	BY TRUE EXPONENT
00647	0	50000	0	00147	CLA	T+1	
00650	0	30000	0	00146	FAD	T	
00651	0	36100	0	00741	ACL	EXC2	
00652	-0	76000	0	00001	PBT		
00653	-3	00000	0	00635	TXL	CM8	
00654	-3	00000	0	00674	CM6	TXL	STOR SWITCH - INVERTED TO TXH INDICATES FIXED POINT
00655	0	60100	0	00146		STO	T
00656	0	76700	0	00002		ALS	2
00657	-0	76000	0	00003		SSM	DETERMINE SHIFT
00660	0	77100	0	00035		ARS	29 NECESSARY TO POSITION
00661	0	40000	0	00721		ADD	Q128 NUMBER AS INDICATED
00662	0	40000	0	00154		ADD	BN BY B
00663	0	12000	0	00665		TPL	SHIFT
00664	-0	10000	0	00635		TNZ	CM8
00665	0	62100	0	00673	SHIFT	STA	CM12
00666	0	50000	0	00146		CLA	T REMOVE CHARACTERISTICS
00667	0	76300	0	00010		LLS	8 FROM FLOATING NUMBER
00670	0	76700	0	00002		ALS	2
00671	0	77100	0	00012		ARS	10
00672	0	76300	0	00010		LLS	8
00673	0	76500	0	00000	CM12	LRS	POSITION FIXED NUMBER
00674	0	07400	4	00700	STOR	TSX	LOC,4
00675	0	56000	0	00150		LDQ	MQ
00676	-3	00000	0	00447	NX4	TXL	DECOP,,** SWITCH - INVERTED TO TXH INDICATES END OF CARD
00677	-3	00000	0	00256	LX4	TXL	RTD,0,
00700	0	60100	0	00000	LOC	STO	
00701	0	50000	0	00700		CLA	LOC
00702	0	40000	0	00717		ADD	Q1
00703	0	62100	0	00700		STA	LOC
00704	0	50000	0	00155		CLA	BADR
00705	0	10000	4	00001		TZE	1,4
00706	0	40200	0	00717		SUB	Q1
00707	0	60100	0	00155		STO	BADR
00710	-0	10000	4	00001		TNZ	1,4
00711	-0	53400	4	00323	EXIT1	LXD	PX4,4
00712	-0	53400	2	00322		LXD	PX2,2
00713	-0	53400	1	00321		LXD	PX1,1
00714	0	02000	4	00002		TRA	2,4
00715	0	12000	0		EOF	TPL	FINISH
00716	0	00000	0	00267		HTR	FIL
00717	0	00000	0	00001	Q1		1
00720	0	00000	0	00012	Q10		10

00721 +000000000200
 00722 606060606060
 00723 000000635121
 00724 000000462363
 00725 000000242523
 00726 000000222324
 00727 0 02000 0 00000
 00730 -0 00000 0 00000
 00731 000000000060
 00732 000000000073
 00733 000000000040
 00734 000000000033
 00735 000000000025
 00736 000000000022
 00737 000000000020
 00740 +043000000000
 00741 +335000000000
 00742 +233000000000
 00743 +252000000000
 00744 +141500000000
 00745 +144620000000
 00746 +147764000000
 00747 +153470400000
 00750 +156606500000
 00751 +161750220000
 00752 +165461132000
 00753 +170575360400
 00754 +173734654500
 00755 +177452013710
 00756 +202564416672
 00757 +205721522451
 00760 +211443023471
 00761 +214553630410
 00762 +217706576512
 00763 +223434157116
 00764 +226543212741
 00765 +231674055532
 00766 +235425434430
 00767 +240532743536
 00770 +243661534466
 00771 +247417031702
 00772 +252522640262
 00773 +255647410336
 00774 +261410545213

Q128 DEC 128
 MASK BCD 1
 TRA BCD 1000TRA
 OCT BCD 1000OCT
 DEC BCD 1000DEC
 BCDO BCD 1000BCD
 TAGC TRA
 PBIT MZE
 BLANK BCD 100000
 COMMA BCD 100000,
 MINUS BCD 100000-
 POINT BCD 100000.
 E BCD 100000E
 B BCD 100000B
 PLUS BCD 100000+
 EXC1 DEC 35B8
 EXC2 DEC 221B8
 FL1 DEC 155B8
 FL2 DEC 170B8

CHARACTERISTIC=35
 CHAR.=COMPL. 35

OCT 141500000000,144620000000,147764000000,153470400000

 OCT 156606500000,161750220000,165461132000,170575360400

 OCT 173734654500,177452013710,202564416672,205721522451

 OCT 211443023471,214553630410,217706576512,223434157116

 OCT 226543212741,231674055532,235425434430,240532743536

 OCT 243661534466,247417031702,252522640262,255647410336

 OCT 261410545213,264512676456,267635456171,273402374714

00775 +264512676456
 00776 +267635456171
 00777 +273402374714
 01000 +276503074077
 01001 +301623713116
 01002 +304770675742
 01003 +310473426555
 01004 +313612334311
 01005 +316755023373
 01006 +322464114135
 01007 +325601137164
 01010 +330741367021
 01011 +334454732313
 01012 +337570120775
 01013 +342726145174
 01014 +346445677216
 01015 +351557257061
 01016 +354713132676
 01017 +360436770626
 01020 +363546566774
 01021 +366700324573
 01022 +372430204755
 01023 +375536246150

OCT 276503074077,301623713116,304770675742,310473426555

OCT 313612334311,316755023373,322464114135,325601137164

OCT 330741367021,334454732313,337570120775,342726145174

OCT 346445677216,351557257061,354713132676,360436770626

OCT 363546566774,366700324573,372430204755,375536246150

00720 TEN SYN Q10
 00743 ONE SYN FL2
 00144 ORG COMMON
 00144 EXPN BSS 1
 00145 CH BSS 1
 00146 CHD BSS 1
 00146 T SYN CHD
 00147 SYMB BSS 1
 00150 MQ BSS 1
 00151 N BSS 1
 00152 DATUM BSS 1
 00153 RESID BSS 1
 00154 BN BSS 1
 00155 BADR BSS 1
 00156 BCD BSS 14
 01024 ORG ONE+49

01024 0 50000 4 77777 RTX CLA -1,4
 01025 0 62100 0 01054 STA RTX+24
 01026 0 62100 0 01055 STA RTX+25
 01027 0 50000 4 00001 CLA 1,4
 01030 0 76000 0 00161 SWT 1

PICK UP TAPE IDENTIFICATION
 SET TAPE INSTRUCTIONS - BST
 X - RDS
 PICK UP BLOCK ORIGIN AND DECREMENT
 TEST FOR OFF- OR ON-LINE

01031	1	00000	0	01034	TXI RTX+8	OFF-LINE, GO TO TAPE READ
01032	0	76200	0	00321	RCD	ON-LINE, SELECT CARD READER AND
01033	1	00000	0	01063	TXI RDBCD	GO TO READ CARD READER
01034	0	62100	0	01043	STA RTX+15	SET ORIGIN
01035	0	62200	0	01044	STD RTX+16	SET DECREMENT
01036	-0	63400	2	01057	SXD RTX+27,2	SAVE PROGRAM INDEX
01037	0	50000	0	01053	CLA RTX+23	SET SWITCH FOR TWO ATTEMPTS
01040	0	60100	0	01053	STO RTX+23	SET SWITCH
01041	0	76000	0	00000	CLM	CLEAR ACC FOR ACL CHECKSUM
01042	-0	73400	2	00000	PDX ,2	CLEAR INDEX FOR COUNT
01043	-0	70000	2	00000	CAD **,2	COPY AND CHECKSUM LOOP
01044	1	00000	2	01043	TXI RTX+15,2,**	X
01045	1	00001	4	01050	TXI RTX+20,4,1	END OF FILE - SET UP ALTERNATE EXIT
01046	-0	76000	0	00012	RTT	TEST FOR REDUNDANCY FAILURE
01047	1	00000	0	01053	TXI RTX+23,**	FAILURE, SKIP RETURN CODING
01050	-0	63400	2	01047	SXD RTX+19,2	SAVE COUNT
01051	-0	53400	2	01057	LXD RTX+27,2	RESTORE PROGRAM INDEX
01052	0	02000	4	00003	TRA 3,4	RETURN
01053	3	00000	0	01045	TXH RTX+17	SWITCH, TXH - 1 FAILURE, TXL 2 FAILURES
01054	0	76400	0	00200	BST **	BACKSPACE TAPE
01055	0	76200	0	00000	RDS **	READ SELECT TAPE AGAIN
01056	0	50200	0	01053	CLS RTX+23	INVERT SWITCH FOR SECOND FAILURE EXIT
01057	1	00000	0	01040	TXI RTX+12,**	REPEAT
01060	0	76200	0	00321	RCD RCD	RESTART AFTER ERROR
01061	-0	53400	1	01075	LXD B2,1	X
01062	-0	53400	2	01077	LXD B3,2	X
01063	0	70000	0	00153	RDBCD CPY L	COPY 9 LEFT ROW
01064	-3	00000	0	01066	TXL B1	X
01065	0	02000	4	00002	TRA 2,4	END OF FILE EXIT
01066	-0	60000	0	00145	B1 STQ LS	SET LEFT SUM
01067	-0	63400	1	01075	SXD B2,1	SAVE INDEX REGISTERS
01070	-0	63400	2	01077	SXD B3,2	X
01071	-0	53400	1	01105	LXD B4,1	SET DIGIT ROW COUNT
01072	0	70000	0	00154	CPY R	COPY 9 RIGHT ROW AND
01073	-0	60000	0	00146	STQ RS	SET RIGHT SUM
01074	0	07400	2	01227	TSX C1,2	ENTER CONVERSION LOOP
01075	-3	00000	0	01100	B2 TXL B5	LEAVE CONVERSION LOOP
01076	0	76700	0	00001	ALS 1	
01077	-3	00000	0	01264	B3 TXL C2	INITIALIZE BCD RECORD
01100	0	70000	0	00147	B5 CPY 8L	COPY 8 ROW AND
01101	-0	60000	0	00145	STQ LS	USE AS SUM
01102	0	70000	0	00150	CPY 8R	X
01103	-0	60000	0	00146	STQ RS	X
01104	0	07400	2	01227	TSX C1,2	ENTER CONVERSION LOOP

01105	-3	00010	0	01110	B4	TXL B6,0,8	LEAVE CONVERSION LOOP
01106	0	76700	0	00003		ALS 3	ADD 8 TIMES 8 ROW
01107	-3	00000	0	01263		TXL C3	X
01110	-0	50000	0	00153	B6	CAL L	USE 9 ROW AS SUM
01111	0	60200	0	00145		SLW LS	X
01112	-0	50000	0	00154		CAL R	X
01113	0	60200	0	00146		SLW RS	X
01114	-3	00001	1	01140	B13	TXL B7,1,1	TEST FOR ZERO ROW
01115	0	70000	0	00153	B14	CPY L	COPY LEFT ROW AND
01116	-3	00000	0	01121		TXL B8	TEST FOR END OF RECORD
01117	0	00000	0	01060	B17	HTR RCD	ERROR
01120	-3	00000	0	01160		TXL B9	END OF RECORD
01121	-0	50000	0	00153	B8	CAL L	TEST LEFT ROW FOR
01122	-0	32000	0	00145		ANA LS	ILLEGAL DOUBLE PUNCH
01123	-0	10000	0	01117		TNZ B17	X
01124	-0	50000	0	00153	B10	CAL L	FORM LOGICAL SUM
01125	-0	60200	0	00145		ORS LS	OF LEFT ROWS
01126	0	70000	0	00154		CPY R	COPY RIGHT ROW AND
01127	-0	50000	0	00154		CAL R	TEST FOR ILLEGAL
01130	-0	32000	0	00146		ANA RS	DOUBLE PUNCH
01131	-0	10000	0	01117		TNZ B17	X
01132	-0	50000	0	00154	B11	CAL R	FORM LOGICAL SUM OF
01133	-0	60200	0	00146		ORS RS	RIGHT ROWS
01134	-2	00001	1	01154		TNX B12,1,1	TEST FOR ZONE ROWS
01135	0	07400	2	01227		TSX C1,2	ENTER CONVERSION LOOP
01136	-3	00000	0	01114		TXL B13	LEAVE CONVERSION LOOP
01137	-3	00000	0	01263		TXL C3	ADD TO BCD RECORD
01140	-0	50000	0	00147	B7	CAL 8L	ADD 8 LEFT ROW TO
01141	-0	50100	0	00145		ORA LS	LEFT LOGICAL SUM
01142	0	60200	0	00147		SLW LDS	X
01143	0	70000	0	00151		CPY LZ	COPY ZERO LEFT AND
01144	-0	32000	0	00151		ANA LZ	FORM INDICATOR FOR
01145	0	60200	0	00145		SLW LS	BOTH DIGIT AND ZERO
01146	-0	50000	0	00150		CAL 8R	ADD 8 RIGHT ROW TO
01147	-0	50100	0	00146		ORA RS	RIGHT LOGICAL SUM
01150	0	60200	0	00150		SLW RDS	X
01151	0	70000	0	00152		CPY RZ	COPY ZERO RIGHT AND
01152	-0	32000	0	00152		ANA RZ	FORM INDICATOR FOR
01153	0	60200	0	00146		SLW RS	BOTH DIGIT AND ZERO
01154	0	07400	2	01227	B12	TSX C1,2	ENTER CONVERSION LOOP
01155	-3	00000	0	01115		TXL B14	LEAVE CONVERSION LOOP
01156	0	76700	0	00004		ALS 4	SHIFT TO ZONE POSITION
01157	-3	00000	0	01263		TXL C3	X
01160	-0	50000	0	00145	B9	CAL LS	SAVE LEFT ZONE SUM

01161	0	60200	0	00153	SLW L	X
01162	-0	50000	0	00147	CAL LDS	FORM INDICATOR FOR
01163	0	76000	0	00006	COM	ZERO AND X AND / OR Y
01164	-0	32000	0	00151	ANA LZ	IN LEFT ROWS
01165	0	32000	0	00145	ANS LS	X
01166	-0	50000	0	00146	CAL RS	SAVE RIGHT ZONE SUM
01167	0	60200	0	00154	SLW R	X
01170	-0	50000	0	00150	CAL RDS	FORM INDICATOR FOR
01171	0	76000	0	00006	COM	ZERO AND X AND/OR Y
01172	-0	32000	0	00152	ANA RZ	IN RIGHT ROWS
01173	0	32000	0	00146	ANS RS	X
01174	0	07400	2	01227	TSX C1,2	ENTER CONVERSION LOOP
01175	-3	00000	0	01203	TXL B15	LEAVE CONVERSION LOOP
01176	0	60200	0	00144	SLW TP	MULTIPLY INDICATOR
01177	0	76700	0	00002	ALS 2	BITS BY TEN
01200	0	36100	0	00144	ACL TP	X
01201	0	76700	0	00001	ALS 1	X
01202	-3	00000	0	01263	TXL C3	X
01203	-0	50000	0	00147	B15 CAL LDS	FORM INDICATOR FOR
01204	-0	50100	0	00151	ORA LZ	BLANK COLUMNS IN
01205	-0	50100	0	00153	ORA L	LEFT HALF OF CARD
01206	0	76000	0	00006	COM	X
01207	0	60200	0	00145	SLW LS	X
01210	-0	50000	0	00150	CAL RDS	FORM INDICATOR FOR
01211	-0	50100	0	00152	ORA RZ	BLANK COLUMNS IN
01212	-0	50100	0	00154	ORA R	RIGHT HALF OF CARD
01213	0	76000	0	00006	COM	X
01214	0	60200	0	00146	SLW RS	X
01215	0	07400	2	01227	TSX C1,2	ENTER CONVERSION LOOP
01216	-3	00000	0	01224	TXL B16	LEAVE CONVERSION LOOP
01217	0	60200	0	00144	SLW TP	MULTIPLY INDICATOR
01220	0	76700	0	00001	ALS 1	BITS BY 3 AND
01221	0	36100	0	00144	ACL TP	SHIFT TO ZONE POSITION
01222	0	76700	0	00004	ALS 4	X
01223	-3	00000	0	01263	TXL C3	X
01224	-0	53400	1	01075	B16 LXD B2,1	RESTORE INDEX REGISTERS
01225	-0	53400	2	01077	LXD B3,2	AND RETURN TO MAIN
01226	0	02000	4	00003	TRA 3,4	PROGRAM
01227	-0	63400	1	01232	C1 SXD C4,1	SAVE ROW COUNT
01230	-0	50000	4	00001	C9 CAL 1,4	INITIALIZE ADDRESSES
01231	0	40100	0	01246	ADM C7	X ADD 6
01232	-3	00000	0	01236	C4 TXL C6,,**	TRANSFER TO LEFT ROW
01233	0	40100	0	01246	ADM C7	RIGHT ROW, ADD 6 MORE
01234	0	56000	0	00146	LDQ RS	OBTAIN RIGHT SUM AND

01235	1	00000	0	01237	TXI	C8	SKIP OVER LEFT SUM
01236	0	56000	0	00145	LDQ	LS	OBTAIN LEFT SUM
01237	0	62100	0	01264	STA	C2	SET BCD RECORD ADDRESS
01240	0	62100	0	01263	STA	C3	X
01241	3	00001	1	01245	TXH	C5,1,1	SKIP TEST IF DIGIT ROW
01242	-0	60000	0	00144	STQ	TP	TEST FOR NO SUM
01243	-0	50000	0	00144	CAL	TP	X
01244	0	10000	0	01267	TZE	C11	X
01245	0	53400	1	01246	LXA	C7,1	SET WORD COUNT
01246	-0	75400	0	00006	PXD	6	CONVERT ROW
01247	-0	76300	0	00001	LGL	1	X
01250	0	76700	0	00005	ALS	5	X
01251	-0	76300	0	00001	LGL	1	X
01252	0	76700	0	00005	ALS	5	X
01253	-0	76300	0	00001	LGL	1	X
01254	0	76700	0	00005	ALS	5	X
01255	-0	76300	0	00001	LGL	1	X
01256	0	76700	0	00005	ALS	5	X
01257	-0	76300	0	00001	LGL	1	X
01260	0	76700	0	00005	ALS	5	X
01261	-0	76300	0	00001	LGL	1	X
01262	0	02000	2	00002	TRA	2,2	EXIT FOR ROW PROCEDURE
01263	0	36100	1	00000	ACL	0,1	ADD TO BCD RECORD
01264	0	60200	1	00000	SLW	0,1	STORE IN BCD RECORD
01265	2	00001	1	01246	TIX	C7,1,1	COUNT WORDS
01266	-0	53400	1	01232	LXD	C4,1	RESTORE ROW COUNT
01267	0	50200	0	01232	CLS	C4	INVERT ROW SWITCH AND
01270	0	60100	0	01232	STO	C4	TEST FOR RIGHT ROW DONE
01271	-0	12000	2	00001	TMI	1,2	TRANSFER IF RIGHT ROW DONE
01272	1	00000	0	01230	TXI	C9	GO CONVERT RIGHT ROW
				00144	ORG	COMMON	
				00144	TP	BSS	1
				00145	LS	BSS	1
				00146	RS	BSS	1
				00147	LDS	BSS	1
				00150	RDS	BSS	1
				00151	LZ	BSS	1
				00152	RZ	BSS	1
				00153	L	BSS	1
				00154	R	BSS	1
				00147	8L	SYN	LDS
				00150	8R	SYN	RDS
				01273	ORG	C10+1	
				01273	HED		

TEMPORARY
 LEFT SUM
 RIGHT SUM
 LEFT DIGIT SUM
 RIGHT DIGIT SUM
 LEFT ZERO ROW
 RIGHT ZERO ROW
 LEFT ROW
 RIGHT ROW
 8 LEFT ROW
 8 RIGHT ROW

01273	FONO	BSS	100
01437	FOWT	BSS	100
01603	FLT11	BSS	100
01747	FLT21	BSS	100
02113	FLT31	BSS	100
02257	FLT41	BSS	100
02423	FLT12	BSS	100
02567	FLT22	BSS	100
02733	FLT32	BSS	100
03077	FLT42	BSS	100
03243	ICNT1	BSS	100
03407	ICNT2	BSS	100
03553	ICNT3	BSS	100
03717	ICNT4	BSS	100
04063	FIXT1	BSS	100
04227	FIXT2	BSS	100
04373	FIXT3	BSS	100
04537	FIXT4	BSS	100
04703	CCNT1	BSS	100
05047	CCNT2	BSS	100
05213	CCNT3	BSS	100
05357	CCNT4	BSS	100
05523	ABSC	BSS	100
05667	STWT	BSS	100
06033	BKS	BSS	4
06037	BKE	BSS	4
06043	TAU	BSS	4
06047	TEMP	BSS	10
06061 +0000000000000	BLNK1	DEC	0,0
06062 +0000000000000			
06063	CCNT	BSS	100
06227 +0000000000000	BLNK2	DEC	0,0
06230 +0000000000000			
06231	NUE	BSS	400
07051	PERC	BSS	1
07052	REFO	BSS	1
07053	REFAV	BSS	1
07054	OFST	BSS	1
07055	CNTM	BSS	1
07056	CNTN	BSS	1
07057	COWT	BSS	1
07060	LINE1	BSS	10
07072	LINE2	BSS	10
07104	CONT	BSS	3

07107	CALC	BSS	1
07110	STAWT	BSS	1
07111	EPS	BSS	3
07114	PR	BSS	1
07115	AO	BSS	1
07116	BO	BSS	1
07117	CO	BSS	1
07120	FOSP	BSS	1
07121	LAMB	BSS	1
07122	N	BSS	1
07123	M	BSS	1
07124	SVNDX	BSS	1
07125	BK	BSS	1
07126	INDX	BSS	1
07127	INT	BSS	2
07131	INTS	BSS	100
07275	TITL1	BCD	1TITLE
07276	TITL2	BCD	3RUN AND TRAVERSE

07275	633163432560
07276	516445602145
07277	246063512165
07300	255162256060
07301	264631436045
07302	463360606060
07303	602122622331
07304	626221256060
07305	606060606060
07306	465124314521
07307	632562606060
07310	606060606060
07311	255151465140
07312	706060606060
07313	606060606021
07314	606060606060
07315	606060606062
07316	216060606060
07317	606060606022
07320	606060606060
07321	606060606062
07322	226060606060
07323	606060606023
07324	606060606060
07325	606060606062
07326	236060606060
07327	606060606051
07330	606060606060

TITL3	BCD	FOIL NO.	ABSCISSAE	ORDINATES	ERROR-Y
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TITL4	BCD	A	SA	B	SB	C
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	BCD	2	SC			
TITL5	BCD	R	SR	BSQ	S	BSQ

07331 606060606062
 07332 516060606060
 07333 606060606022
 07334 625060606060
 07335 606060606062
 07336 602262506060
 07337 606060606060
 07340 606060606060
 07341 606060606051
 07342 256233606250
 07343 314523465151
 07344 252363602421
 07345 632160606060
 07346 454660624643
 07347 646331464560
 07350 602646314360
 07351 454633606060
 07352 606060606060
 07353 606060606060
 07354 606060212262
 07355 233162622125
 07356 606031453163
 07357 312143407060
 07360 606023464447
 07361 646325244070
 07362 606060666324
 07363 336051256233
 07364 606060606060
 07365 606060606060
 07366 606060606060
 07367 606060606060
 07370 606060606065
 07371 215133602160
 07372 606060606065
 07373 215133602260
 07374 606060606065
 07375 215133602360
 07376 606060606051
 07377 256233625060
 07400 606060606060
 07401 606060606060
 07402 606060606060
 07403 512524642325
 07404 246024216321

BCD 2 RES. SQ.

TITL6 BCD 3 INCORRECT DATA

TITL7 BCD 2 NO SOLUTION

TITL8 BCD FOIL NO.

ABSCISSAE INITIAL-Y COMPUTED-Y

BCD 2 WTD. RES.

TITL9 BCD

VAR. A

VAR. B

VAR. C

BCD 2 RES. SQ

TITL10 BCD 5

REDUCED DATA

07405 606060606060
07406 606060606060
07407 606060606060
07410 263163632524
07411 602421632160
07412 606060606023
07413 462631636060
07414 606060606041
07415 462631636060
07416 606060606030
07417 606060606060
07420 606060606062
07421 306060606060
07422 606060606022
07423 625060606060
07424 606060606062
07425 602262506060
07426 606060606060
07427 606060606060
07430 606060606051
07431 256233606250
07432 606060606060
07433 606060606060
07434 606060606060
07435 606060242151
07436 252460606060
07437 +000000000000
07440 +000000000001
07441 +000000000002
07442 +000000001750
07443 +233000000000
07444 +000000002570
07445 +202400000000
07446 +201400000000
07447 +000000000144
07450 +000000000004
07451 +000000000003
07452 +000000000144
07453 +224750220000
07454 0 07400 4 00240
07455 0 07071 0 07060
07456 0 07400 4 00240
07457 0 07103 0 07072
07460 0 07400 4 00240

TITL11 BCD 5

FITTED DATA

TITL12 BCD 2 COFIT

TITL13 BCD 2 JOFIT

TITL14 BCD H SH BSQ S BSQ

BCD 2 RES. SQ.

TITL15 BCD 5 DARED

CONST DEC 0,1,2,1000

OCT 233000000000

DEC 1400,2,1,100,4,3,100,1000000,0

DAR TSX K\$LOAD,4
PZE LINE1,0,LINE1+9 READ IN TITLE CARDS
TSX K\$LOAD,4
PZE LINE2,0,LINE2+9
TSX K\$LOAD,4

07461	0	06036	0	06033	PZE BKS,0,BKS+3	READ IN BACKGROUNDS
07462	0	07400	4	00240	TSX K\$LOAD,4	
07463	0	06042	0	06037	PZE BKE,0,BKE+3	
07464	0	07400	4	00240	TSX K\$LOAD,4	
07465	0	06046	0	06043	PZE TAU,0,TAU+3	READ IN DEAD TIME CORRECTION FACTOR
07466	0	07400	4	00240	TSX K\$LOAD,4	
07467	0	07123	0	07123	PZE M,0,M	NO. OF COUNTERS
07470	0	07400	4	00240	TSX K\$LOAD,4	
07471	0	07106	0	07104	PZE CONT,0,CONT+2	
07472	0	07400	4	00240	TSX K\$LOAD,4	
07473	0	07052	0	07051	PZE PERC,0,REFO	
07474	0	07400	4	00240	TSX K\$LOAD,4	
07475	0	07110	0	07107	PZE CALC,0,STAWT	STA. WEIGHT
07476	0	07400	4	00240	TSX K\$LOAD,4	
07477	0	07113	0	07111	PZE EPS,0,EPS+2	CONVERGENCES OF A B C
07500	0	07400	4	00240	TSX K\$LOAD,4	
07501	0	07117	0	07114	PZE PR,0,CO	GUESSES FOR A B C
07502	0	07400	4	00240	TSX K\$LOAD,4	
07503	0	07122	0	07120	PZE FOSP,0,N	FOIL SPACING AND NO. OF FOILS
07504	0	07400	4	00240	TSX K\$LOAD,4	
07505	0	07054	0	07054	PZE OFST,0,OFST	DISTANCE OF OFF SET
07506	0	50000	0	07123	CLA M	
07507	0	60000	0	07123	STZ M	
07510	-0	30000	0	07443	UFA CONST+4	
07511	0	62100	0	07123	STA M	
07512	0	50000	0	07122	CLA N	FIX NUMBER OF COUNTERS
07513	0	60000	0	07122	STZ N	
07514	-0	30000	0	07443	UFA CONST+4	
07515	0	62100	0	07122	STA N	FIX FOIL NUMBERS
07516	0	50000	0	07114	CLA PR	
07517	0	60000	0	07114	STZ PR	
07520	-0	30000	0	07443	UFA CONST+4	
07521	0	62100	0	07114	STA PR	FIX PRINT ROUTINE
07522	0	53400	1	07122	LXA N,1	
07523	0	53400	2	07437	LXA CONST,2	
07524	0	07400	4	00240	TSX K\$LOAD,4	READ IN DATA CARDS
07525	0	06060	0	06047	PZE TEMP,0,TEMP+9	
07526	0	50000	0	06047	CLA TEMP	
07527	0	60100	2	01273	STO FONO,2	
07530	0	50000	0	06050	CLA TEMP+1	
07531	0	60100	2	01437	STO FOWT,2	
07532	0	50000	0	06051	CLA TEMP+2	
07533	0	60100	2	04063	STO FIXT1,2	
07534	0	50000	0	06052	CLA TEMP+3	

DAR1

07535	0	60100	2	03243		STO ICNT1,2
07536	0	50000	0	06053		CLA TEMP+4
07537	0	60100	2	04227		STO FIXT2,2
07540	0	50000	0	06054		CLA TEMP+5
07541	0	60100	2	03407		STO ICNT2,2
07542	0	50000	0	06055		CLA TEMP+6
07543	0	60100	2	04373		STO FIXT3,2
07544	0	50000	0	06056		CLA TEMP+7
07545	0	60100	2	03553		STO ICNT3,2
07546	0	50000	0	06057		CLA TEMP+8
07547	0	60100	2	04537		STO FIXT4,2
07550	0	50000	0	06060		CLA TEMP+9
07551	0	60100	2	03717		STO ICNT4,2
07552	1	77777	2	07553		TXI DAR2,2,-1
07553	2	00001	1	07524	DAR2	TIX DAR1,1,1
07554	0	07400	4	12777		TSX Y\$OUT,4
07555	3	11642	0	07432		PTH TITL15,0,5026
07556	1	00060	0	00002		PON 2,,48
07557	-1	00000	0	00000		FVE 0,,0
07560	0	07400	4	12777		TSX Y\$OUT,4
07561	1	00060	0	00002		PON 2,,48
07562	-1	00000	0	00000		FVE 0,,0
07563	0	07400	4	12777		TSX Y\$OUT,4
07564	3	01757	0	07275		PTH TITL1,0,1007
07565	3	23526	0	07060		PTH LINE1,0,10070
07566	1	00060	0	00002		PON 2,0,48
07567	-1	00000	0	00000		FVE 0,,0
07570	0	07400	4	12777		TSX Y\$OUT,4
07571	1	00060	0	00002		PON 2,,48
07572	-1	00000	0	00000		FVE 0,,0
07573	0	07400	4	12777		TSX Y\$OUT,4
07574	3	05713	0	07276		PTH TITL2,0,3019
07575	3	23540	0	07072		PTH LINE2,0,10080
07576	1	00060	0	00002		PON 2,,48
07577	-1	00000	0	00000		FVE 0,,0
07600	0	07400	4	12777		TSX Y\$OUT,4
07601	1	00060	0	00002		PON 2,,48
07602	-1	00000	0	00000		FVE 0,,0
07603	0	53400	1	07450		LXA CONST+9,1
07604	0	50000	1	06047	DAR3	CLA TAU+4,1
07605	0	24000	0	07453		FDH CONST+12
07606	-0	60000	1	06047		STQ TAU+4,1
07607	2	00001	1	07604		TIX DAR3,1,1
07610	0	53400	4	07123		LXA M,4

PRINT TITLES

SET M=1

07611	0	60000	0	07124	STZ	SVNDX	
07612	0	53400	1	07122	DAR20	LXA N,1	SET N=1
07613	-0	53400	2	07124		LXD SVNDX,2	
07614	0	50000	2	04063	DAR21	CLA FIXT1,2	
07615	0	76500	0	00043		LRS 35	
07616	0	22000	0	07442		DVH CONST+3	
07617	-0	60000	2	01603		STQ FLT11,2	
07620	0	60100	2	02423		STO FLT12,2	BREAK TIME INTO START AND FINISH
07621	1	77777	2	07622		TXI DAR22,2,-1	
07622	2	00001	1	07614	DAR22	TIX DAR21,1,1	
07623	-0	53400	1	07124		LXD SVNDX,1	
07624	1	77634	1	07625		TXI DAR23,1,-100	
07625	-0	63400	1	07124	DAR23	SXD SVNDX,1	
07626	2	00001	4	07612		TIX DAR20,4,1	
07627	0	53400	1	07444		LXA CONST+5,1	
07630	0	53400	2	07437		LXA CONST,2	
07631	0	50000	2	01273	DAR24	CLA FONO,2	
07632	0	10000	0	07636		TZE DAR25	
07633	-0	50100	0	07443		ORA CONST+4	
07634	0	30000	0	07437		FAD CONST	
07635	0	60100	2	01273		STO FONO,2	FLOAT ALL THE INPUT DATA
07636	1	77777	2	07637	DAR25	TXI DAR26,2,-1	
07637	2	00001	1	07631	DAR26	TIX DAR24,1,1	
07640	0	50000	0	07440		CLA CONST+1	SET M=1
07641	0	60100	0	07055		STO CNTM	
07642	0	53400	4	07437		LXA CONST,4	
07643	0	60000	0	07124		STZ SVNDX	
07644	0	53400	1	07122	DAR27	LXA N,1	SET N=1
07645	-0	53400	2	07124		LXD SVNDX,2	
07646	0	50000	4	06033		CLA BKS,4	
07647	0	10000	0	07657		TZE DAR28	
07650	0	50000	4	06037		CLA BKE,4	
07651	0	10000	0	07666		TZE DAR30	
07652	0	50000	4	06033		CLA BKS,4	BKS,BKE UNEQUAL ZERO
07653	0	30000	4	06037		FAD BKE,4	
07654	0	24000	0	07445		FDH CONST+6	
07655	-0	60000	0	07125		STQ BK	
07656	0	02000	0	07670		TRA DAR31	
07657	0	50000	4	06037	DAR28	CLA BKE,4	
07660	0	10000	0	07664		TZE DAR29	
07661	0	50000	4	06037		CLA BKE,4	BKE UNEQUAL ZERO
07662	0	60100	0	07125		STO BK	
07663	0	02000	0	07670		TRA DAR31	
07664	0	60000	0	07125	DAR29	STZ BK	BKS,BKE = 0

07665	0	02000	0	07670	TRA DAR31	
07666	0	50000	4	06033	DAR30 CLA BKS,4	BKS UNEQUAL ZERO
07667	0	60100	0	07125	STO BK	
07670	0	56000	2	03243	DAR31 LDQ ICNT1,2	
07671	0	26000	2	03243	FMP ICNT1,2	
07672	0	60100	0	00144	STO COMMON	
07673	0	56000	0	00144	LDQ COMMON	
07674	0	26000	4	06043	FMP TAU,4	
07675	0	60100	0	00144	STO COMMON	
07676	0	50000	2	02423	CLA FLT12,2	
07677	0	30200	2	01603	FSB FLT11,2	
07700	0	60100	0	00145	STO COMMON+1	
07701	-0	10000	0	07704	TNZ ARE32	
07702	0	60000	0	00144	STZ COMMON	
07703	0	02000	0	07707	TRA ARE33	
07704	0	50000	0	00144	ARE32 CLA COMMON	
07705	0	24000	0	00145	FDH COMMON+1	
07706	-0	60000	0	00144	STQ COMMON	
07707	0	50000	0	00144	ARE33 CLA COMMON	
07710	0	30000	2	03243	FAD ICNT1,2	
07711	0	60100	0	00144	STO COMMON	
07712	0	56000	0	00145	LDQ COMMON+1	
07713	0	26000	0	07125	FMP BK	BACK GROUND CORRECTION
07714	0	76000	0	00002	CHS	
07715	0	30000	0	00144	FAD COMMON	
07716	0	60100	2	04703	STO CCNT1,2	CORRECTED FOR DEAD TIME AND BACKGROUND
07717	1	77777	2	07720	TXI DAR32,2,-1	
07720	2	00001	1	07670	DAR32 TIX DAR31,1,1	
07721	0	50000	0	07123	CLA M	
07722	0	40200	0	07055	SUB CNTM	
07723	0	10000	0	07733	TZE DAR34	TEST FOR NO OF CONTERS
07724	0	50000	0	07055	CLA CNTM	
07725	0	40000	0	07440	ADD CONST+1	
07726	0	60100	0	07055	STO CNTM	M+1 REPLACES M
07727	-0	53400	2	07124	LXD SVNDX,2	
07730	1	77634	2	07731	TXI DAR33,2,-100	
07731	-0	63400	2	07124	DAR33 SXD SVNDX,2	
07732	1	77777	4	07644	TXI DAR27,4,-1	
07733	0	50000	0	07440	DAR34 CLA CONST+1	
07734	0	60100	0	07055	STO CNTM	
07735	0	60000	0	07124	STZ SVNDX	
07736	0	53400	4	07437	DAR35 LXA CONST,4	
07737	-0	53400	2	07124	LXD SVNDX,2	
07740	0	53400	1	07122	LXA N,1	SET N=1

07741	0	50000	0	07121	DR35	CLA LAMB	
07742	-0	10000	0	07747		TNZ DAR36	
07743	0	50000	4	01437		CLA FOWT,4	
07744	0	60100	0	00144		STO COMMON	
07745	0	60100	2	06231		STO NUE,2	
07746	0	02000	0	07774		TRA AR36	
07747	-0	63400	4	07126	DAR36	SXD INDX,4	
07750	0	56000	0	07121		LDQ LAMB	
07751	0	26000	2	01603		FMP FLT11,2	
07752	0	76000	0	00002		CHS	
07753	0	07400	4	13561		TSX X\$EXP,4	E-LAMB*T FOR START TIME
07754	0	00000	0	00000		HTR	
07755	0	60100	0	06047		STO TEMP	
07756	0	56000	0	07121		LDQ LAMB	
07757	0	26000	2	02423		FMP FLT12,2	
07760	0	76000	0	00002		CHS	
07761	0	07400	4	13561		TSX X\$EXP,4	E-LAMB*T FOR END TIME
07762	0	00000	0	00000		HTR	
07763	0	60100	0	06050		STO TEMP+1	
07764	-0	53400	4	07126		LXD INDX,4	
07765	0	50000	0	06047		CLA TEMP	
07766	0	30200	0	06050		FSB TEMP+1	
07767	0	60100	0	00144		STO COMMON	
07770	0	56000	0	00144		LDQ COMMON	TIME CORRECTION
07771	0	26000	4	01437		FMP FOWT,4	
07772	0	60100	0	00144		STO COMMON	
07773	0	60100	2	06231		STO NUE,2	
07774	0	50000	0	00144	AR36	CLA COMMON	
07775	0	10000	0	10002		TZE AR37	
07776	0	50000	2	04703		CLA CCNT1,2	
07777	0	24000	0	00144		FDH COMMON	
10000	-0	60000	2	04703		STQ CCNT1,2	
10001	0	02000	0	10003		TRA AR38	
10002	0	60000	2	04703	AR37	STZ CCNT1,2	
10003	1	77777	2	10004	AR38	TXI DAR37,2,-1	
10004	1	77777	4	10005	DAR37	TXI ARE38,4,-1	
10005	2	00001	1	07741	ARE38	TIX DR35,1,1	
10006	0	50000	0	07123		CLA M	
10007	0	40200	0	07055		SUB CNTM	
10010	0	10000	0	10020		TZE DAR39	TEST FOR NUMBER OF COUNTERS
10011	0	50000	0	07055		CLA CNTM	
10012	0	40000	0	07440		ADD CONST+1	
10013	0	60100	0	07055		STO CNTM	M+1 REPLACES M
10014	-0	53400	1	07124		LXD SVNDX,1	

10015	1	77634	1	10016			
10016	-0	63400	1	07124	DAR38	SXD	SVNDX,1
10017	0	02000	0	07736		TRA	DAR35
10020	0	60000	0	07124	DAR39	STZ	SVNDX
10021	0	50000	0	07440		CLA	CONST+1
10022	0	60100	0	07055		STO	CNTM
10023	-0	53400	2	07124	DAR40	LXD	SVNDX,2
10024	0	53400	4	07437		LXA	CONST,4
10025	0	53400	1	07447		LXA	CONST+8,1
10026	0	60000	1	06227	ARE39	STZ	CCNT+100,1
10027	2	00001	1	10026		TIX	ARE39,1,1
10030	0	53400	1	07122		LXA	N,1
10031	0	50000	2	04703	DAR41	CLA	CCNT1,2
10032	0	60100	4	06063		STO	CCNT,4
10033	1	77777	4	10034		TXI	AR41,4,-1
10034	1	77777	2	10035	AR41	TXI	DAR42,2,-1
10035	2	00001	1	10031	DAR42	TIX	DAR41,1,1
10036	-0	53400	2	07124		LXD	SVNDX,2
10037	0	53400	1	07122		LXA	N,1
10040	0	53400	4	07437		LXA	CONST,4
10041	0	50000	4	06062	DAR43	CLA	CCNT-1,4
10042	0	10000	0	10066		TZE	DAR44
10043	0	50000	4	06064		CLA	CCNT+1,4
10044	0	10000	0	10066		TZE	DAR44
10045	0	30000	4	06062		FAD	CCNT-1,4
10046	0	24000	0	07445		FDH	CONST+6
10047	-0	60000	0	00144		STQ	COMMON
10050	0	26000	0	07051		FMP	PERC
10051	0	60100	0	00145		STO	COMMON+1
10052	0	30000	0	00144		FAD	COMMON
10053	0	60100	0	00146		STO	COMMON+2
10054	0	30200	0	00145		FSB	COMMON+1
10055	0	30200	0	00145		FSB	COMMON+1
10056	0	60100	0	00147		STO	COMMON+3
10057	0	50000	0	00146		CLA	COMMON+2
10060	0	30200	4	06063		FSB	CCNT,4
10061	-0	12000	0	10114		TMI	DAR46
10062	0	50000	4	06063		CLA	CCNT,4
10063	0	30200	0	00147		FSB	COMMON+3
10064	-0	12000	0	10114		TMI	DAR46
10065	0	02000	0	10123		TRA	DAR48
10066	0	50000	4	06061	DAR44	CLA	CCNT-2,4
10067	0	10000	0	10123		TZE	DAR48
10070	0	50000	4	06065		CLA	CCNT+2,4

CLEAR CCNT

CHECK FOR LOWER NEIGHBOR

CHECK FOR UPPER NIEGHBOR

AVERAGE THE TWO IMED.NEIGHBORS

UPPER LIMIT

LOWER LIMIT

BAD POINT

BAD POINT
GO TO 10

10071	0	10000	0	10123	TZE	DAR48	GO TO 10
10072	0	50000	4	06065	DAR45	CLA CCNT+2,4	BEGIN 8
10073	0	30000	4	06061		FAD CCNT-2,4	HAS BOTH 2ND NEIGHBORS
10074	0	24000	0	07445		FDH CONST+6	
10075	-0	60000	0	00144		STQ COMMON	
10076	0	26000	0	07051		FMP PERC	
10077	0	60100	0	00145		STO COMMON+1	
10100	0	30000	0	00144		FAD COMMON	
10101	0	60100	0	00146		STO COMMON+2	
10102	0	30200	0	00145		FSB COMMON+1	
10103	0	30200	0	00145		FSB COMMON+1	
10104	0	60100	0	00147		STO COMMON+3	
10105	0	50000	0	00146		CLA COMMON+2	
10106	0	30200	4	06063		FSB CCNT,4	
10107	-0	12000	0	10121		TMI DAR47	GO TO 9
10110	0	50000	4	06063		CLA CCNT,4	
10111	0	30200	0	00147		FSB COMMON+3	
10112	-0	12000	0	10121		TMI DAR47	GO TO 9
10113	0	02000	0	10123		TRA DAR48	GO TO 10
10114	0	50000	4	06061	DAR46	CLA CCNT-2,4	
10115	0	10000	0	10121		TZE DAR47	GO TO 9
10116	0	50000	4	06065		CLA CCNT+2,4	
10117	0	10000	0	10121		TZE DAR47	GO TO 9
10120	0	02000	0	10072		TRA DAR45	
10121	0	60000	2	04703	DAR47	STZ CCNT1,2	
10122	0	60000	2	03243		STZ ICNT1,2	
10123	0	76100	0	00000	DAR48	NOP	
10124	1	77777	4	10125		TXI AR48,4,-1	
10125	1	77777	2	10126	AR48	TXI DAR49,2,-1	
10126	2	00001	1	10041	DAR49	TIK DAR43,1,1	
10127	-0	53400	1	07124		LXD SVNDX,1	
10130	1	77634	1	10131		TXI DAR50,1,-100	
10131	-0	63400	1	07124	DAR50	SXD SVNDX,1	
10132	0	50000	0	07055		CLA CNTM	
10133	0	40200	0	07123		SUB M	
10134	0	10000	0	10141		TZE AR50	
10135	0	50000	0	07055		CLA CNTM	
10136	0	40000	0	07440		ADD CONST+1	
10137	0	60100	0	07055		STO CNTM	
10140	0	02000	0	10023		TRA DAR40	
10141	0	60000	0	12547	AR50	STZ SUM	
10142	0	60000	0	12550		STZ SUM+1	
10143	0	60000	0	12551		STZ SUM+2	
10144	0	60000	0	12552		STZ SUM+3	

10145	0	60000	0	07124	STZ SVNDX	SETN=1
10146	0	53400	1	07122	LXA N,1	
10147	-0	53400	2	07124	DAR51 LXD SVNDX,2	SETM=1
10150	0	53400	4	07123	LXA M,4	
10151	0	50000	2	04703	DAR52 CLA CCNT1,2	
10152	0	10000	0	10166	TZE DAR56	
10153	0	50000	2	04703	CLA CCNT1,2	
10154	0	60100	4	06053	STO TEMP+4,4	
10155	1	77634	2	10156	TXI DAR53,2,-100	
10156	2	00001	4	10151	DAR53 TIX DAR52,4,1	
10157	0	53400	2	07437	LXA CONST,2	
10160	0	53400	4	07123	LXA M,4	
10161	0	50000	4	06053	DAR54 CLA TEMP+4,4	
10162	0	30000	2	12547	FAD SUM,2	
10163	0	60100	2	12547	STO SUM,2	FIND SUM FOR EACH COUNTER
10164	1	77777	2	10165	TXI DAR55,2,-1	
10165	2	00001	4	10161	DAR55 TIX DAR54,4,1	
10166	-0	53400	2	07124	DAR56 LXD SVNDX,2	
10167	1	77777	2	10170	TXI DAR57,2,-1	N+1=N
10170	-0	63400	2	07124	DAR57 SXD SVNDX,2	
10171	2	00001	1	10147	TIX DAR51,1,1	M+1=M
10172	0	53400	1	07450	LXA CONST+9,1	
10173	0	50000	1	12553	DAR58 CLA SUM+4,1	
10174	0	60100	1	06053	STO TEMP+4,1	PUT SUMS IN TEMP
10175	2	00001	1	10173	TIX DAR58,1,1	
10176	0	53400	1	07451	LXA CONST+10,1	
10177	0	50000	1	06053	DAR59 CLA TEMP+4,1	
10200	0	30200	0	06047	FSB TEMP	
10201	-0	12000	0	10204	TMI DAR60	
10202	0	50000	1	06053	CLA TEMP+4,1	
10203	0	60100	0	06047	STO TEMP	FIND LARGEST SUM
10204	2	00001	1	10177	DAR60 TIX DAR59,1,1	
10205	0	53400	2	07437	LXA CONST,2	
10206	0	53400	1	07123	LXA M,1	
10207	0	50000	0	06047	DAR61 CLA TEMP	
10210	0	24000	2	12547	FDH SUM,2	
10211	-0	60000	2	12547	STQ SUM,2	
10212	1	77777	2	10213	TXI ARE61,2,-1	
10213	2	00001	1	10207	ARE61 TIX DAR61,1,1	
10214	0	53400	4	07437	LXA CONST,4	SET M=1
10215	0	50000	0	07440	CLA CONST+1	
10216	0	60100	0	07055	STO CNTM	
10217	0	60000	0	07124	STZ SVNDX	
10220	0	53400	1	07122	DAR62 LXA N,1	SET N=1

10221	-0	53400	2	07124		LXD SVNDX,2	
10222	0	56000	2	04703	DAR63	LDQ CCNT1,2	
10223	0	26000	4	12547		FMP SUM,4	
10224	0	60100	2	04703		STO CCNT1,2	COUNTS CORRECTED FOR COUNTER EFFICIENCY
10225	1	77777	2	10226		TXI AR63,2,-1	
10226	2	00001	1	10222	AR63	TIX DAR63,1,1	
10227	0	50000	0	07123		CLA M	
10230	0	40200	0	07055		SUB CNTM	TEST OF M
10231	0	10000	0	10241		TZE ARE65	
10232	0	50000	0	07055		CLA CNTM	M+1 REPLACES M
10233	0	40000	0	07440		ADD CONST+1	
10234	0	60100	0	07055		STO CNTM	
10235	-0	53400	2	07124		LXD SVNDX,2	
10236	1	77634	2	10237		TXI DAR64,2,-100	
10237	-0	63400	2	07124	DAR64	SXD SVNDX,2	
10240	1	77777	4	10220		TXI DAR62,4,-1	
10241	0	53400	1	07447	ARE65	LXA CONST+8,1	
10242	0	60000	1	06227	DAR65	STZ CCNT+100,1	
10243	2	00001	1	10242		TIX DAR65,1,1	
10244	0	60000	0	07124		STZ SVNDX	
10245	0	53400	1	07122		LXA N,1	
10246	0	53400	4	07437		LXA CONST,4	
10247	0	50000	0	07440	DAR66	CLA CONST+1	
10250	0	60100	0	07055		STO CNTM	
10251	0	50000	0	07123		CLA M	
10252	-0	50100	0	07443		ORA CONST+4	FLOAT M
10253	0	30000	0	07437		FAD CONST	
10254	0	60100	0	07127		STO INT	STORE M IN INTERIES
10255	0	60100	0	07130		STO INT+1	
10256	-0	53400	2	07124		LXD SVNDX,2	
10257	0	50000	2	04703	DAR67	CLA CCNT1,2	
10260	0	10000	0	10273		TZE DAR70	TEST FOR ZEROS IN COUNTS
10261	0	30000	4	06063		FAD CCNT,4	
10262	0	60100	4	06063		STO CCNT,4	
10263	1	77634	2	10264	DAR68	TXI DAR69,2,-100	
10264	0	50000	0	07123	DAR69	CLA M	
10265	0	40200	0	07055		SUB CNTM	
10266	0	10000	0	10300		TZE DAR71	
10267	0	50000	0	07055	AR69	CLA CNTM	
10270	0	40000	0	07440		ADD CONST+1	
10271	0	60100	0	07055		STO CNTM	
10272	0	02000	0	10257		TRA DAR67	
10273	0	50000	0	07127	DAR70	CLA INT	
10274	0	30200	0	07446		FSB CONST+7	

10275 0 10000 0 10303
 10276 0 60100 0 07127
 10277 0 02000 0 10263
 10300 0 50000 4 06063
 10301 0 24000 0 07127
 10302 -0 60000 4 06063
 10303 1 77777 4 10304
 10304 -0 53400 2 07124
 10305 1 77777 2 10306
 10306 -0 63400 2 07124
 10307 2 00001 1 10247
 10310 0 50000 0 07440
 10311 0 60100 0 07056
 10312 0 53400 1 07437
 10313 0 50000 0 07052
 10314 0 34000 1 01273
 10315 1 77777 1 10320
 10316 0 02000 0 10324
 10317 1 77777 1 10320
 10320 0 50000 0 07056
 10321 0 40000 0 07440
 10322 0 60100 0 07056
 10323 0 02000 0 10313
 10324 0 50000 0 07056
 10325 0 40200 0 07441
 10326 0 76000 0 00006
 10327 0 73400 1 00000
 10330 0 73400 2 00000
 10331 0 50000 1 06063
 10332 0 10000 0 10335
 10333 0 60100 0 07053
 10334 0 02000 0 10346
 10335 1 77777 1 10336
 10336 0 50000 1 06063
 10337 0 10000 0 10342
 10340 0 60100 0 07053
 10341 0 02000 0 10346
 10342 1 00001 2 10343
 10343 0 50000 2 06063
 10344 0 10000 0 10335
 10345 0 60100 0 07053
 10346 0 53400 1 07122
 10347 0 53400 2 07437
 10350 0 50000 2 06063

DAR71 CLA CCNT,4
 FDH INT
 STQ CCNT,4
 DAR72 TXI DAR73,4,-1
 DAR73 LXD SVNDX,2
 TXI ARE73,2,-1
 ARE73 SXD SVNDX,2
 TIX DAR66,1,1
 CLA CONST+1
 STO CNTN
 LXA CONST,1
 CORR2 CLA REFO
 CAS FONO,1
 TXI CORR1,1,-1
 TRA CORR3
 TXI CORR1,1,-1
 CORR1 CLA CNTN
 ADD CONST+1
 STO CNTN
 TRA CORR2
 CORR3 CLA CNTN
 SUB CONST+2
 COM
 PAX 0,1
 PAX 0,2
 CLA CCNT,1
 TZE DAR74
 STO REFAV
 TRA DAR78
 DAR74 TXI DAR75,1,-1
 DAR75 CLA CCNT,1
 TZE DAR76
 STO REFAV
 TRA DAR78
 DAR76 TXI DAR77,2,1
 DAR77 CLA CCNT,2
 TZE DAR74
 STO REFAV
 DAR78 LXA N,1
 LXA CONST,2
 DAR79 CLA CCNT,2

FINDING NUMBER OF ENTRIES

AVERAGE OF ALL COUNTS FOREACH FOIL

TEST TO SEE IF REF.FOIL IS GOOD

TEST FOR UPPER FOIL IF REF.FOIL IS REJECTED

TEST FOR LOWER FOIL IF REF.FOIL IS REJECTED

10351	0	24000	0	07053	FDH REFAV	
10352	-0	60000	2	06063	STQ CCNT,2	NORMALIZED COUNTS
10353	1	77777	2	10354	TXI DAR80,2,-1	
10354	2	00001	1	10350	DAR80 TIX DAR79,1,1	
10355	0	50000	0	07107	CLA CALC	
10356	-0	10000	0	10370	TNZ ARE79	CALCULATE STAT. WT.
10357	0	50000	0	07440	CLA CONST+1	
10360	0	60100	0	07056	STO CNTN	
10361	0	53400	1	07122	LXA N,1	
10362	0	53400	2	07437	LXA CONST,2	
10363	0	50000	0	07110	ARE77 CLA STAWT	
10364	0	60100	2	05667	STO STWT,2	USE GIVEN STAT. WT.
10365	1	77777	2	10366	TXI ARE78,2,-1	
10366	2	00001	1	10363	ARE78 TIX ARE77,1,1	
10367	0	02000	0	10516	TRA AR86	
10370	0	50000	0	07440	ARE79 CLA CONST+1	
10371	0	60100	0	07056	STO CNTN	
10372	0	60000	0	07124	STZ SVNDX	
10373	0	53400	1	07437	LXA CONST,1	
10374	-0	53400	2	07124	ARE94 LXD SVNDX,2	
10375	0	53400	4	07123	LXA M,4	
10376	0	50000	0	07130	CLA INT+1	
10377	0	60100	0	06054	STO TEMP+5	
10400	0	50000	2	03243	DAR95 CLA ICNT1,2	
10401	0	10000	0	10421	TZE DAR99	
10402	1	77634	2	10403	ARE95 TXI DAR96,2,-100	
10403	2	00001	4	10400	DAR96 TIX DAR95,4,1	
10404	0	50000	0	06054	CLA TEMP+5	
10405	0	60100	1	07131	STO INTS,1	
10406	-0	53400	2	07124	LXD SVNDX,2	
10407	1	77777	2	10410	TXI DAR97,2,-1	
10410	-0	63400	2	07124	DAR97 SXD SVNDX,2	
10411	1	77777	1	10412	TXI DAR98,1,-1	
10412	0	50000	0	07122	DAR98 CLA N	
10413	0	40200	0	07056	SUB CNTN	
10414	0	10000	0	10425	TZE DAR100	
10415	0	50000	0	07056	CLA CNTN	
10416	0	40000	0	07440	ADD CONST+1	
10417	0	60100	0	07056	STO CNTN	
10420	0	02000	0	10374	TRA ARE94	
10421	0	50000	0	06054	DAR99 CLA TEMP+5	
10422	0	30200	0	07446	FSB CONST+7	
10423	0	60100	0	06054	STO TEMP+5	
10424	0	02000	0	10402	TRA ARE95	

10425	0	60000	0	07057	DAR100	STZ	COWT	
10426	0	60000	0	07124		STZ	SVNDX	
10427	0	60000	0	07126		STZ	INDX	
10430	0	50000	0	07440		CLA	CONST+1	
10431	0	60100	0	07056		STO	CNTN	
10432	0	50000	0	07440	ARE80	CLA	CONST+1	
10433	0	60100	0	07055		STO	CNTM	
10434	-0	53400	2	07124		LXD	SVNDX,2	
10435	0	53400	4	07437		LXA	CONST,4	
10436	-0	53400	1	07126		LXD	INDX,1	
10437	0	56000	2	06231	DAR81	LDQ	NUE,2	
10440	0	26000	1	07131		FMP	INTS,1	
10441	0	60100	0	00144		STO	COMMON	
10442	0	10000	0	10451		TZE	ARE82	
10443	0	50000	4	12547		CLA	SUM,4	D
10444	0	24000	0	00144		FDH	COMMON	
10445	-0	60000	2	06231		STQ	NUE,2	
10446	0	56000	2	06231		LDQ	NUE,2	
10447	0	26000	2	06231		FMP	NUE,2	
10450	0	60100	0	00144		STO	COMMON	NU SQRD
10451	0	56000	0	00144	ARE82	LDQ	COMMON	
10452	0	26000	2	03243		FMP	ICNT1,2	
10453	0	60100	4	06047		STO	TEMP,4	
10454	1	77634	2	10455		TXI	DAR82,2,-100	
10455	1	77777	4	10456	DAR82	TXI	DAR83,4,-1	
10456	0	50000	0	07123	DAR83	CLA	M	
10457	0	40200	0	07055		SUB	CNTM	
10460	0	10000	0	10465		TZE	ARE84	
10461	0	50000	0	07055		CLA	CNTM	
10462	0	40000	0	07440		ADD	CONST+1	
10463	0	60100	0	07055		STO	CNTM	
10464	0	02000	0	10437		TRA	DAR81	
10465	-0	53400	1	07126	ARE84	LXD	INDX,1	
10466	1	77777	1	10467		TXI	AR94,1,-1	
10467	-0	63400	1	07126	AR94	SXD	INDX,1	
10470	0	53400	1	07123		LXA	M,1	
10471	0	53400	2	07437		LXA	CONST,2	
10472	0	76000	0	00000		CLM		
10473	0	30000	2	06047	DAR84	FAD	TEMP,2	
10474	1	77777	2	10475		TXI	DAR85,2,-1	
10475	2	00001	1	10473	DAR85	TXI	DAR84,1,1	
10476	0	07400	4	13653		TSX	W\$SQRT,4	
10477	0	00000	0	00000		HTR		
10500	0	24000	0	07053		FDH	REFAV	

10501	-0	53400	4	07057	LXD COWT,4	
10502	-0	60000	4	05667	STQ STWT,4	
10503	-0	53400	1	07124	LXD SVNDX,1	
10504	1	77777	1	10505	TXI DAR86,1,-1	
10505	-0	63400	1	07124	DAR86 SXD SVNDX,1	
10506	-0	63400	1	07057	SXD COWT,1	
10507	0	50000	0	07122	CLA N	
10510	0	40200	0	07056	SUB CNTN	
10511	0	10000	0	10516	TZE AR86	
10512	0	50000	0	07056	CLA CNTN	
10513	0	40000	0	07440	ADD CONST+1	
10514	0	60100	0	07056	STO CNTN	
10515	0	02000	0	10432	TRA ARE80	
10516	0	50000	0	07054	AR86 CLA OFST	
10517	0	10000	0	10563	TZE DAR89	NO OFF SET CAL.
10520	0	60100	0	07117	STO CO	
10521	0	56000	0	07054	LDQ OFST	CALCULATE OFF SET
10522	0	26000	0	07054	FMP OFST	
10523	0	60100	0	07054	STO OFST	B SQRD
10524	0	53400	2	07437	LXA CONST,2	
10525	0	53400	1	07122	LXA N,1	
10526	0	50000	0	07052	DAR87 CLA REFO	
10527	0	30200	2	01273	FSB FONO,2	
10530	0	60100	2	04703	STO CCNT1,2	
10531	1	77777	2	10532	TXI ARE86,2,-1	
10532	2	00001	1	10526	ARE86 TIX DAR87,1,1	
10533	0	53400	2	07437	LXA CONST,2	
10534	0	53400	1	07122	LXA N,1	
10535	0	56000	2	04703	DAR88 LDQ CCNT1,2	
10536	0	26000	0	07120	FMP FOSP	
10537	0	60100	2	04703	STO CCNT1,2	
10540	0	56000	2	04703	LDQ CCNT1,2	
10541	0	26000	2	04703	FMP CCNT1,2	A SQRD
10542	0	30000	0	07054	FAD OFST	A SQRD +B SQRD
10543	0	07400	4	13653	TSX WSSQRT,4	
10544	0	00000	0	00000	HTR	
10545	0	60100	2	05523	STO ABSC,2	ABSISSAE OF OFF SET DATA
10546	1	77777	2	10547	ARE87 TXI ARE88,2,-1	
10547	2	00001	1	10535	ARE88 TIX DAR88,1,1	
10550	0	50000	0	07440	CLA CONST+1	
10551	0	76700	0	00043	ALS 35	
10552	0	60200	0	07056	SLW CNTN	
10553	0	53400	1	07122	LXA N,1	
10554	0	53400	2	07437	LXA CONST,2	

10555 -0 50000 0 07056
 10556 -0 32000 2 04703
 10557 -0 60200 2 05523
 10560 1 77777 2 10561
 10561 2 00001 1 10555
 10562 0 02000 0 10572
 10563 0 53400 2 07437
 10564 0 53400 1 07122
 10565 0 56000 0 07120
 10566 0 26000 2 01273
 10567 0 60100 2 05523
 10570 1 77777 2 10571
 10571 2 00001 1 10565
 10572 0 07400 4 12777
 10573 3 11662 0 07400
 10574 1 00060 0 00002
 10575 -1 00000 0 00000
 10576 0 07400 4 12777
 10577 1 00060 0 00002
 10600 -1 00000 0 00000
 10601 0 07400 4 12777
 10602 3 23515 0 07301
 10603 1 00060 0 00002
 10604 -1 00000 0 00000
 10605 0 07400 4 12777
 10606 1 00060 0 00002
 10607 -1 00000 0 00000
 10610 0 53400 1 07122
 10611 0 53400 2 07437
 10612 0 07400 4 12777
 10613 -3 00005 2 01273
 10614 -2 17530 2 05523
 10615 -2 17550 2 06063
 10616 -2 17570 2 05667
 10617 1 00060 0 00002
 10620 -1 00000 0 00000
 10621 1 77777 2 10622
 10622 2 00001 1 10612
 10623 0 07400 4 12777
 10624 1 00060 0 00002
 10625 -1 00000 0 00000
 10626 0 50000 0 07104
 10627 0 10000 0 10632
 10630 0 77000 0 00202

ARE89 CAL CNTN
 ANA CCNT1,2
 ORS ABSC,2
 TXI ARE90,2,-1
 ARE90 TIX ARE89,1,1
 TRA AR91
 DAR89 LXA CONST,2
 LXA N,1
 AR90 LDQ FOSP
 FMP FONO,2
 STO ABSC,2
 TXI DAR90,2,-1
 DAR90 TIX AR90,1,1
 AR91 TSX Y\$OUT,4
 PTH TITL10,,5042
 PON 2,,48
 FVE 0,,0
 TSX Y\$OUT,4
 PON 2,,48
 FVE 0,,0
 TSX Y\$OUT,4
 PTH TITL3,,10061
 PON 2,0,48
 FVE 0,,0
 TSX Y\$OUT,4
 PON 2,0,48
 FVE 0,,0
 LXA N,1
 LXA CONST,2
 DAR91 TSX Y\$OUT,4
 SVN FONO,2,5
 SIX ABSC,2,8024
 SIX CCNT,2,8040
 SIX STWT,2,8056
 PON 2,,48
 FVE 0,,0
 TXI DAR92,2,-1
 DAR92 TIX DAR91,1,1
 TSX Y\$OUT,4
 PON 2,,48
 FVE 0,,0
 CLA CONT
 TZE ARE92
 WEF 2

RETAIN PROPER SIGN

ABSCISSAS

PRINT OUT REDUCED DATA

10631	0	02000	0	07454	TRA DAR	DARED ONLY
10632	0	07400	4	12777	ARE92 TSX Y\$OUT,4	
10633	3	11662	0	07405	PTH TITL11,,5042	
10634	1	00060	0	00002	PON 2,,48	
10635	-1	00000	0	00000	FVE 0,,0	
10636	0	07400	4	12777	TSX Y\$OUT,4	
10637	1	00060	0	00002	PON 2,,48	
10640	-1	00000	0	00000	FVE 0,,0	
10641	0	50000	0	07105	CLA CONT+1	
10642	0	10000	0	10653	TZE DAR93	
10643	0	07400	4	12777	TSX Y\$OUT,4	
10644	3	03732	0	07412	PTH TITL12,,2010 COFIT	
10645	1	00060	0	00002	PON 2,,48	
10646	-1	00000	0	00000	FVE 0,,0	
10647	0	07400	4	12777	TSX Y\$OUT,4	
10650	1	00060	0	00002	PON 2,,48	
10651	-1	00000	0	00000	FVE 0,,0	
10652	0	02000	0	10662	TRA DAR94	
10653	0	07400	4	12777	DAR93 TSX Y\$OUT,4	
10654	3	03732	0	07414	PTH TITL13,,2010 JOFIT	
10655	1	00060	0	00002	PON 2,,48	
10656	-1	00000	0	00000	FVE 0,,0	
10657	0	07400	4	12777	TSX Y\$OUT,4	
10660	1	00060	0	00002	PON 2,,48	
10661	-1	00000	0	00000	FVE 0,,0	
10662	0	50000	0	07122	DAR94 CLA N	
10663	0	60100	0	07123	STO M	
10664	0	60000	0	12711	STZ TEST	
10665	0	60000	0	12712	STZ TEST+1	
10666	0	53400	1	07122	LXA N,1	
10667	0	53400	2	07437	LXA CONST,2	
10670	0	50000	2	06063	COF CLA CCNT,2	
10671	-0	10000	0	10675	TNZ COF1	
10672	0	50000	0	07122	CLA N	
10673	0	40200	0	07440	SUB CONST+1	
10674	0	60100	0	07122	STO N	
10675	1	77777	2	10676	COF1 TXI COF2,2,-1	
10676	2	00001	1	10670	COF2 TIX COF,1,1	
10677	0	53400	1	07122	LXA N,1	
10700	0	53400	2	07437	LXA CONST,2	
10701	0	53400	4	07123	LXA M,4	
10702	0	50000	2	06063	COF3 CLA CCNT,2	
10703	0	10000	0	10714	TZE COF4	ELIMINATE ZERO POINTS
10704	0	60100	1	12234	STO Y,1	

10705	0	50000	2	05523		CLA	ABSC,2
10706	0	60100	1	12070		STO	X,1
10707	0	50000	2	05667		CLA	STWT,2
10710	0	60100	1	12400		STO	DELY,1
10711	0	50000	2	01273		CLA	FONO,2
10712	0	60100	1	12544		STO	FOIL,1
10713	2	00001	1	10714		TIX	COF4,1,1
10714	1	77777	2	10715	COF4	TXI	COF5,2,-1
10715	2	00001	4	10702	COF5	TIX	COF3,4,1
10716	0	50000	0	07115	GUESS	CLA	AO
10717	0	10000	0	10723		TZE	GUESS+5
10720	0	50000	0	07116		CLA	BO
10721	0	10000	0	10760		TZE	COMP1
10722	0	02000	0	11020		TRA	INIT
10723	0	53400	1	07122		LXA	N,1
10724	0	50000	1	12234		CLA	Y,1
10725	0	60100	0	12762		STO	MIN+1
10726	0	60100	0	12764		STO	MAX+1
10727	0	50000	1	12070		CLA	X,1
10730	0	60100	0	12761		STO	MIN
10731	0	60100	0	12763		STO	MAX
10732	2	00001	1	10740	SETX	TIX	COMP,1,1
10733	0	50000	0	12764		CLA	MAX+1
10734	0	60100	0	07115		STO	AO
10735	0	50000	0	12763		CLA	MAX
10736	0	60100	0	07117		STO	CO
10737	0	02000	0	10765		TRA	COMP1+5
10740	0	50000	1	12234	COMP	CLA	Y,1
10741	0	34000	0	12762		CAS	MIN+1
10742	0	02000	0	10747		TRA	LITLY
10743	0	02000	0	10732		TRA	SETX
10744	0	60100	0	12762		STO	MIN+1
10745	0	50000	1	12070		CLA	X,1
10746	0	60100	0	12761		STO	MIN
10747	0	50000	1	12234	LITLY	CLA	Y,1
10750	0	34000	0	12764		CAS	MAX+1
10751	0	02000	0	10754		TRA	LRGY
10752	0	76100	0	00000		NOP	
10753	0	02000	0	10732		TRA	SETX
10754	0	60100	0	12764	LRGY	STO	MAX+1
10755	0	50000	1	12070		CLA	X,1
10756	0	60100	0	12763		STO	MAX
10757	0	02000	0	10732		TRA	SETX
10760	0	53400	1	07122	COMP1	LXA	N,1

TRANSFER OF DATA FROM DARED TO COFIT OR JOFIT

```

10761 0 50000 1 12234
10762 0 60100 0 12762
10763 0 50000 1 12070
10764 0 60100 0 12761
10765 0 50000 0 12762
10766 0 24000 0 07115
10767 -0 60000 0 00144
10770 0 26000 0 00144
10771 0 60100 0 00145
10772 0 56000 0 00145
10773 0 26000 0 12766
10774 0 30000 0 12767
10775 0 60100 0 00146
10776 0 56000 0 00146
10777 0 26000 0 00145
11000 0 30000 0 12770
11001 0 60100 0 00145
11002 0 56000 0 00144
11003 0 26000 0 00145
11004 0 76000 0 00002
11005 0 30000 0 12771
11006 0 60100 0 00144
11007 0 50000 0 12761
11010 0 30200 0 07117
11011 0 60100 0 00145
11012 0 50000 0 00144
11013 0 24000 0 00145
11014 -0 60000 0 00144
11015 0 50000 0 00144
11016 0 76000 0 00003
11017 0 60100 0 07116
11020 0 50000 0 12717
11021 0 62100 0 11160
11022 0 50000 0 12720
11023 0 62100 0 11162
11024 0 50000 0 12714
11025 0 60100 0 12544
11026 0 60100 0 12545
11027 0 50000 0 12731
11030 0 60100 0 12546
11031 0 50000 0 12730
11032 0 62100 0 11604
11033 0 76000 0 00012
11034 0 76100 0 00000

```

INIT

```

CLA Y,1
STO MIN+1
CLA X,1
STO MIN
CLA MIN+1
FDH AO
STQ COMMON
FMP COMMON
STO COMMON+1
LDQ COMMON+1
FMP CON
FAD CON+1
STO COMMON+2
LDQ COMMON+2
FMP COMMON+1
FAD CON+2
STO COMMON+1
LDQ COMMON
FMP COMMON+1
CHS
FAD CON+3
STO COMMON
CLA MIN
FSB CO
STO COMMON+1
CLA COMMON
FDH COMMON+1
STQ COMMON
CLA COMMON
SSP
STO BO
CLA LEOL
STA SW1
CLA LMIN
STA SW3
CLA L9
STO STOR
STO STOR+1
CLA LD2
STO STOR+2
CLA LANEW
STA SW5
DCT
NOP

```

3INTO STORAGE
OF INDEX REGISTERS

11035	0	14000	0	11036	TOV	INIT+14
11036	0	16100	0	11037	TQO	UN
11037	0	53400	1	07122	LXA	N,1
11040	0	53400	2	12714	LXA	L9,2
11041	-0	75400	0	00000	PXD	0,0
11042	0	60100	2	12560	STO	SUM+9,2
11043	2	00001	2	11042	TIX	UN+3,2,1
11044	0	60100	0	12737	STO	RESSQ
11045	0	50000	1	12400	DEUX	CLA DELY,1
11046	0	10000	0	11712	TZE	ERR2
11047	0	50000	1	12070	CLA	X,1
11050	0	30200	0	07117	FSB	CO
11051	0	60100	0	12740	STO	DIF
11052	0	56000	0	12740	LDQ	DIF
11053	0	26000	0	07116	FMP	BO
11054	0	60100	0	12741	STO	ARG
11055	0	50000	0	07105	TROIS	CLA CONT+1
11056	0	10000	0	11063	TZE	JOFT0
11057	0	50000	0	12741	CLA	ARG
11060	0	07400	4	13704	TSX	ASCOS,4
11061	0	00000	0	11703	HTR	ERR4
11062	0	02000	0	11066	TRA	COF6
11063	0	50000	0	12741	JOFT0	CLA ARG
11064	0	76000	0	00003	SSP	
11065	0	07400	4	14064	TSX	B\$JO,4
11066	0	60100	0	12742	COF6	STO CSN
11067	0	56000	0	12742	LDQ	CSN
11070	0	26000	0	07115	FMP	AO
11071	0	60100	0	00144	STO	COMMON
11072	0	50000	1	12234	CLA	Y,1
11073	0	30200	0	00144	FSB	COMMON
11074	0	24000	1	12400	FDH	DELY,1
11075	-0	60000	0	12744	STQ	RHO
11076	0	50000	0	12742	CLA	CSN
11077	0	24000	1	12400	FDH	DELY,1
11100	-0	60000	0	12745	STQ	MU
11101	0	50000	0	07105	QUATR	CLA CONT+1
11102	0	10000	0	11107	TZE	JOFT1
11103	0	50000	0	12741	CLA	ARG
11104	0	07400	4	13706	TSX	ASCOS+2,4
11105	0	00000	0	00000	HTR	
11106	0	02000	0	11116	TRA	COF7
11107	0	50000	0	12741	JOFT1	CLA ARG
11110	-0	12000	0	11113	TMI	COFT

11111	0	07400	4	14011		TSX	B\$J1,4	
11112	0	02000	0	11116		TRA	COF7	
11113	0	76000	0	00003	COFT	SSP		
11114	0	07400	4	14011		TSX	B\$J1,4	
11115	0	76000	0	00002		CHS		
11116	0	60100	0	12743	COF7	STO	SN	
11117	0	56000	0	12743		LDQ	SN	
11120	0	26000	0	07115		FMP	AO	
11121	0	60100	0	12743		STO	SN	SN-ASINB*X-C
11122	0	56000	0	12743		LDQ	SN	
11123	0	26000	0	07116		FMP	BO	
11124	0	24000	1	12400		FDH	DELY,1	
11125	-0	60000	0	12747		STQ	OMEGA	
11126	0	50200	0	12743		CLS	SN	
11127	0	24000	1	12400		FDH	DELY,1	
11130	0	26000	0	12740		FMP	DIF	
11131	0	60100	0	12746		STO	NU	
11132	-0	53400	2	12714		LXD	L9,2	
11133	0	56000	0	12744	PROD1	LDQ	RHO	CALCULATE
11134	0	26000	2	12750		FMP	OMEGA+1,2	SUMS
11135	0	30000	2	12552		FAD	SUM+3,2	RHOMU
11136	0	60100	2	12552		STO	SUM+3,2	RHONU
11137	2	00001	2	11133		TIX	PROD1,2,1	RHOOMEGA
11140	-0	53400	2	12714		LXD	L9,2	
11141	0	56000	0	12745	PROD2	LDQ	MU	
11142	0	26000	2	12750		FMP	OMEGA+1,2	
11143	0	30000	2	12555		FAD	SUM+6,2	
11144	0	60100	2	12555		STO	SUM+6,2	
11145	2	00001	2	11141		TIX	PROD2,2,1	
11146	0	53400	2	12715		LXA	L2,2	
11147	0	56000	0	12746	PROD3	LDQ	NU	
11150	0	26000	2	12750		FMP	OMEGA+1,2	
11151	0	30000	2	12557		FAD	SUM+8,2	
11152	0	60100	2	12557		STO	SUM+8,2	
11153	2	00001	2	11147		TIX	PROD3,2,1	
11154	0	56000	0	12747		LDQ	OMEGA	
11155	0	26000	0	12747		FMP	OMEGA	
11156	0	30000	0	12557		FAD	SUM+8	
11157	0	60100	0	12557		STO	SUM+8	
11160	0	02000	0	11161	SW1	TRA	EOL	
11161	2	00001	1	11045	EOL	TIX	DEUX,1,1	
11162	0	02000	0	11163	SW3	TRA	MINOR	
11163	0	56000	0	12556	MINOR	LDQ	SUM+7	
11164	0	26000	0	12556		FMP	SUM+7	

11165	0	60100	0	00144	STO COMMON
11166	0	56000	0	12555	LDQ SUM+6
11167	0	26000	0	12557	FMP SUM+8
11170	0	30200	0	00144	FSB COMMON
11171	0	60100	0	12560	STO D
11172	0	56000	0	12554	LDQ SUM+5
11173	0	26000	0	12554	FMP SUM+5
11174	0	60100	0	00144	STO COMMON
11175	0	56000	0	12552	LDQ SUM+3
11176	0	26000	0	12557	FMP SUM+8
11177	0	30200	0	00144	FSB COMMON
11200	0	60100	0	12563	STO D+3
11201	0	56000	0	12553	LDQ SUM+4
11202	0	26000	0	12553	FMP SUM+4
11203	0	60100	0	00144	STO COMMON
11204	0	56000	0	12552	LDQ SUM+3
11205	0	26000	0	12555	FMP SUM+6
11206	0	30200	0	00144	FSB COMMON
11207	0	60100	0	12565	STO D+5
11210	0	56000	0	12553	LDQ SUM+4
11211	0	26000	0	12557	FMP SUM+8
11212	0	60100	0	00144	STO COMMON
11213	0	56000	0	12556	LDQ SUM+7
11214	0	26000	0	12554	FMP SUM+5
11215	0	30200	0	00144	FSB COMMON
11216	0	60100	0	12561	STO D+1
11217	0	56000	0	12554	LDQ SUM+5
11220	0	26000	0	12555	FMP SUM+6
11221	0	60100	0	00144	STO COMMON
11222	0	56000	0	12553	LDQ SUM+4
11223	0	26000	0	12556	FMP SUM+7
11224	0	30200	0	00144	FSB COMMON
11225	0	60100	0	12562	STO D+2
11226	0	56000	0	12552	LDQ SUM+3
11227	0	26000	0	12556	FMP SUM+7
11230	0	60100	0	00144	STO COMMON
11231	0	56000	0	12553	LDQ SUM+4
11232	0	26000	0	12554	FMP SUM+5
11233	0	30200	0	00144	FSB COMMON
11234	0	60100	0	12564	STO D+4
11235	-0	75400	0	00000	PXD 0,0
11236	0	60100	0	12566	STO D+6
11237	-0	53400	2	12714	LXD L9,2
11240	0	56000	2	12563	LDQ D+3,2

DEN

11241	0	26000	2	12555	FMP SUM+6,2	
11242	0	30000	0	12566	FAD D+6	
11243	0	60100	0	12566	STO D+6	
11244	2	00001	2	11240	TIX DEN,2,1	
11245	0	10000	0	11717	TZE ERR3	
11246	0	02000	0	11247	TRA CING	
11247	-0	53400	2	12714	LXD L9,2	CING
11250	-0	75400	0	00000	PXD 0,0	
11251	0	60100	0	12750	STO INCA	
11252	0	56000	2	12563	LDQ D+3,2	NUM1
11253	0	26000	2	12552	FMP SUM+3,2	NUMERATOR
11254	0	30000	0	12750	FAD INCA	INCCA
11255	0	60100	0	12750	STO INCA	
11256	2	00001	2	11252	TIX NUM1,2,1	
11257	0	24000	0	12566	FDH D+6	STORE
11260	-0	60000	0	12750	STQ INCA	
11261	0	56000	0	12547	LDQ SUM	
11262	0	26000	0	12561	FMP D+1	
11263	0	60100	0	12751	STO INCB	
11264	0	56000	0	12550	LDQ SUM+1	
11265	0	26000	0	12563	FMP D+3	NUMERATOR
11266	0	30000	0	12751	FAD INCB	INCB
11267	0	60100	0	12751	STO INCB	
11270	0	56000	0	12551	LDQ SUM+2	
11271	0	26000	0	12564	FMP D+4	
11272	0	30000	0	12751	FAD INCB	
11273	0	24000	0	12566	FDH D+6	STORE
11274	-0	60000	0	12751	STQ INCB	
11275	0	56000	0	12547	LDQ SUM	
11276	0	26000	0	12562	FMP D+2	
11277	0	60100	0	12752	STO INCC	
11300	0	56000	0	12550	LDQ SUM+1	
11301	0	26000	0	12564	FMP D+4	NUMERATOR
11302	0	30000	0	12752	FAD INCC	INCC
11303	0	60100	0	12752	STO INCC	
11304	0	56000	0	12551	LDQ SUM+2	
11305	0	26000	0	12565	FMP D+5	
11306	0	30000	0	12752	FAD INCC	
11307	0	24000	0	12566	FDH D+6	STORE
11310	-0	60000	0	12752	STQ INCC	INCC
11311	-0	53400	4	12714	LXD L9,4	
11312	0	50000	4	12753	CLA INCC+1,4	SIX
11313	0	24000	4	07120	FDH CO+1,4	CONVERGENCE
11314	-0	60000	0	00144	STQ COMMON	TESTS

11315	0	50000	0	00144	CLA	COMMON
11316	0	76000	0	00003	SSP	
11317	0	34000	4	07114	CAS	EPS+3,4
11320	0	02000	0	11355	TRA	SEPT
11321	0	76100	0	00000	NOP	
11322	2	00001	4	11312	TIX	SIX,4,1
11323	0	50000	0	12721	CLA	LVAR0
11324	0	62100	0	11162	STA	SW3
11325	0	50000	0	12724	CLA	LCONV
11326	0	62100	0	11160	STA	SW1
11327	0	50000	0	07114	CLA	PR
11330	0	34000	0	12715	CAS	L2
11331	0	02000	0	11347	TRA	INIT3
11332	0	02000	0	11335	TRA	INIT2
11333	0	10000	0	11342	TZE	INIT0
11334	0	02000	0	11351	TRA	INIT1
11335	0	50000	0	12722	CLA	LVAR1
11336	0	62100	0	11702	STA	SW2
11337	0	50000	0	12726	CLA	LPLUS
11340	0	62100	0	11556	STA	SW4
11341	0	02000	0	11355	TRA	SEPT
11342	0	50000	0	12725	CLA	LFIN
11343	0	62100	0	11556	STA	SW4
11344	0	50000	0	12717	CLA	LEOL
11345	0	62100	0	11702	STA	SW2
11346	0	02000	0	11355	TRA	SEPT
11347	0	50000	0	12717	CLA	LEOL
11350	0	02000	0	11336	TRA	INIT2+1
11351	0	50000	0	12722	CLA	LVAR1
11352	0	62100	0	11702	STA	SW2
11353	0	50000	0	12725	CLA	LFIN
11354	0	62100	0	11556	STA	SW4
11355	-0	53400	1	12714	LXD	L9,1
11356	0	50000	1	07120	CLA	CO+1,1
11357	0	30000	1	12753	FAD	INCC+1,1
11360	0	60100	1	07120	STO	CO+1,1
11361	2	00001	1	11356	TIX	SEPT+1,1,1
11362	0	02000	0	11037	TRA	UN
11363	0	56000	0	07115	LDQ	AO
11364	-0	60000	0	12567	STQ	ALPHA
11365	0	56000	0	07116	LDQ	BO
11366	-0	60000	0	12572	STQ	BETA
11367	0	56000	0	07117	LDQ	CO
11370	-0	60000	0	12575	STQ	GAMMA

11371	0	53400	1	12714	LXA L9,1	9INTO IR1
11372	-0	53400	4	12714	LXD L9,4	3INTO IR4
11373	0	50000	1	12600	CLA GAMMA+3,1	CALCULATE
11374	0	30000	4	12756	FAD DEVC+1,4	A PLUS OR MINUS DELTA
11375	0	60100	1	12601	STO GAMMA+4,1	ETC.
11376	0	50000	1	12600	CLA GAMMA+3,1	
11377	0	30200	4	12756	FSB DEVC+1,4	
11400	0	60100	1	12602	STO GAMMA+5,1	
11401	2	00003	1	11402	TIX NEWB,1,3	
11402	2	00001	4	11373	TIX NEWA,4,1	
11403	0	50000	0	12723	CLA LVAR2	
11404	0	62100	0	11162	STA SW3	
11405	0	50000	0	12717	CLA LEOL	
11406	0	62100	0	11702	STA SW2	
11407	0	02000	0	11037	TRA UN	
11410	0	50000	0	12732	CLA CHAR	
11411	0	40000	0	07122	ADD N	
11412	0	60100	0	00144	STO COMMON	
11413	0	76000	0	00000	CLM	
11414	0	30000	0	00144	FAD COMMON	
11415	0	30200	0	12774	FSB CON+6	
11416	0	60100	0	00144	STO COMMON	
11417	0	50000	0	12737	CLA RESSQ	
11420	0	24000	0	00144	FDH COMMON	
11421	-0	60000	0	12765	STQ FACT	
11422	0	50000	0	12560	CLA D	
11423	0	24000	0	12566	FDH D+6	
11424	0	26000	0	12765	FMP FACT	
11425	0	60100	0	00144	STO COMMON	
11426	0	50000	0	00144	CLA COMMON	
11427	0	07400	4	13653	TSX W\$SQRT,4	
11430	0	02000	0	11717	TRA ERR3	
11431	0	60100	0	12753	STO DEVA	
11432	0	50000	0	12563	CLA D+3	
11433	0	24000	0	12566	FDH D+6	
11434	0	26000	0	12765	FMP FACT	
11435	0	60100	0	00144	STO COMMON	
11436	0	50000	0	00144	CLA COMMON	
11437	0	07400	4	13653	TSX W\$SQRT,4	
11440	0	02000	0	11717	TRA ERR3	
11441	0	60100	0	12754	STO DEVB	
11442	0	50000	0	12565	CLA D+5	
11443	0	24000	0	12566	FDH D+6	
11444	0	26000	0	12765	FMP FACT	

11445	0	60100	0	00144	STO COMMON	
11446	0	50000	0	00144	CLA COMMON	
11447	0	07400	4	13653	TSX W\$SQRT,4	
11450	0	02000	0	11717	TRA ERR3	
11451	0	60100	0	12755	STO DEVC	
11452	0	50000	0	07105	CLA CONT+1	
11453	0	10000	0	11457	TZE COF8	
11454	0	50000	0	12771	CLA CON+3	USE1/2 PI
11455	0	30000	0	12771	FAD CON+3	
11456	0	02000	0	11461	TRA COF9	
11457	0	50000	0	12776	COF8 CLA CON+8	USE 1/2JO OF 0
11460	0	30000	0	12776	FAD CON+8	
11461	0	24000	0	07116	COF9 FDH BO	
11462	-0	60000	0	12756	STQ H	
11463	0	26000	0	12754	FMP DEVB	
11464	0	24000	0	07116	FDH BO	
11465	-0	60000	0	12757	STQ DEVH	
11466	0	50000	0	07106	CLA CONT+2	
11467	-0	10000	0	11500	TNZ COF10	
11470	0	07400	4	12777	TSX Y\$OUT,4	
11471	1	00060	0	00002	PON 2,,48	
11472	-1	00000	0	00000	FVE 0,,0	
11473	0	07400	4	12777	TSX Y\$OUT,4	
11474	3	27450	0	07416	PTH TITL14,,12072	
11475	1	00060	0	00002	PON 2,,48	
11476	-1	00000	0	00000	FVE 0,,0	
11477	0	02000	0	11504	TRA COF11	
11500	0	07400	4	12777	COF10 TSX Y\$OUT,4	
11501	3	27450	0	07327	PTH TITL5,,12072	
11502	1	00060	0	00002	PON 2,0,48	
11503	-1	00000	0	00000	FVE 0,0,0	
11504	0	56000	0	07116	COF11 LDQ BO	
11505	0	26000	0	07116	FMP BO	
11506	0	60100	0	12735	STO BS	
11507	0	56000	0	07116	LDQ BO	
11510	0	26000	0	12773	FMP CON+5	
11511	0	60100	0	00144	STO COMMON	
11512	0	56000	0	00144	LDQ COMMON	
11513	0	26000	0	12754	FMP DEVB	
11514	0	60100	0	12736	STO DEVBS	
11515	0	07400	4	12777	TSX Y\$OUT,4	
11516	1	00060	0	00002	PON 2,0,48	
11517	-1	00000	0	00000	FVE 0,,0	
11520	0	07400	4	12777	TSX Y\$OUT,4	

11521 -2 15544 0 12756
 11522 -2 15560 0 12757
 11523 -2 15574 0 12735
 11524 -2 15610 0 12736
 11525 -2 15640 0 12737
 11526 1 00060 0 00002
 11527 -1 00000 0 00000
 11530 0 07400 4 12777
 11531 1 00060 0 00002
 11532 -1 00000 0 00000
 11533 0 07400 4 12777
 11534 3 27450 0 07313
 11535 1 00060 0 00002
 11536 -1 00000 0 00000
 11537 0 07400 4 12777
 11540 1 00060 0 00002
 11541 -1 00000 0 00000
 11542 0 07400 4 12777
 11543 -2 15544 0 07115
 11544 -2 15560 0 12753
 11545 -2 15574 0 07116
 11546 -2 15610 0 12754
 11547 -2 15624 0 07117
 11550 -2 15640 0 12755
 11551 1 00060 0 00002
 11552 -1 00000 0 00000
 11553 0 07400 4 12777
 11554 1 00060 0 00002
 11555 -1 00000 0 00000
 11556 0 02000 0 11557
 11557 0 77000 0 00202
 11560 0 02000 0 07454
 11561 0 50000 0 12711
 11562 -0 10000 0 11574
 11563 0 07400 4 12777
 11564 3 27450 0 07364
 11565 1 00060 0 00002
 11566 -1 00000 0 00000
 11567 0 07400 4 12777
 11570 1 00060 0 00002
 11571 -1 00000 0 00000
 11572 0 50000 0 12775
 11573 0 60100 0 12711
 11574 0 07400 4 12777

SW4
 FIN
 VAR2

OUT1

SIX H,0,7012
 SIX DEVB,0,7024
 SIX BS,0,7036
 SIX DEVBS,0,7048
 SIX RESSQ,0,7072
 PON 2,0,48
 FVE 0,,0
 TSX Y\$OUT,4
 PON 2,0,48
 FVE 0,,0
 TSX Y\$OUT,4
 PTH TITL4,,12072
 PON 2,0,48
 FVE 0,,0
 TSX Y\$OUT,4
 PON 2,0,48
 FVE 0,,0
 TSX Y\$OUT,4
 SIX AO,0,7012
 SIX DEVA,0,7024
 SIX BO,0,7036
 SIX DEVB,0,7048
 SIX CO,0,7060
 SIX DEVC,0,7072
 PON 2,0,48
 FVE 0,,0
 TSX Y\$OUT,4
 PON 2,0,48
 FVE 0,,0
 TRA FIN
 WEF 2
 TRA DAR
 CLA TEST
 TNZ OUT1
 TSX Y\$OUT,4
 PTH TITL9,,12072
 PON 2,0,48
 FVE 0,,0
 TSX Y\$OUT,4
 PON 2,0,48
 FVE 0,,0
 CLA CON+7
 STO TEST
 TSX Y\$OUT,4

11575 +2 15544 0 12773
 11576 -2 15574 0 07115
 11577 -2 15610 0 07116
 11600 -2 15624 0 07117
 11601 -2 15640 0 12737
 11602 1 00060 0 00002
 11603 -1 00000 0 00000
 11604 0 02000 0 11605
 11605 -0 53400 1 12544
 11606 -0 53400 2 12545
 11607 -0 53400 4 12546
 11610 0 50000 1 12572
 11611 0 60100 0 07115
 11612 0 50000 2 12575
 11613 0 60100 0 07116
 11614 0 50000 4 12600
 11615 0 60100 0 07117
 11616 2 00001 4 11626
 11617 -0 53400 4 12714
 11620 2 00001 2 11626
 11621 -0 53400 2 12714
 11622 2 00001 1 11626
 11623 0 50000 0 12727
 11624 0 62100 0 11604
 11625 0 02000 0 11037
 11626 -0 63400 1 12544
 11627 -0 63400 2 12545
 11630 -0 63400 4 12546
 11631 0 02000 0 11037
 11632 0 50000 0 12712
 11633 -0 10000 0 11645
 11634 0 07400 4 12777
 11635 3 27450 0 07350
 11636 1 00060 0 00002
 11637 -1 00000 0 00000
 11640 0 07400 4 12777
 11641 1 00060 0 00002
 11642 -1 00000 0 00000
 11643 0 50000 0 12775
 11644 0 60100 0 12712
 11645 0 07400 4 12777
 11646 -2 15544 1 12544
 11647 -2 15574 1 12070
 11650 -2 15610 0 12760

SIX CON+5,0,7012
 SIX AO,0,7036
 SIX BO,0,7048
 SIX CO,0,7060
 SIX RESSQ,0,7072
 PON 2,0,48
 FVE 0,,0
 TRA ANEW
 LXD STOR,1
 LXD STOR+1,2
 LXD STOR+2,4
 CLA ALPHA+3,1
 STO AO
 CLA BETA+3,2
 STO BO
 CLA GAMMA+3,4
 STO CO
 TIX SAVE,4,1
 LXD L9,4
 TIX SAVE,2,1
 LXD L9,2
 TIX SAVE,1,1
 CLA LEND
 STA SW5
 TRA UN
 SXD STOR,1
 SXD STOR+1,2
 SXD STOR+2,4
 TRA UN
 CLA TEST+1
 TNZ OUT2
 TSX Y\$OUT,4
 PTH TITL8,,12072
 PON 2,0,48
 FVE 0,0,0
 TSX Y\$OUT,4
 PON 2,0,48
 FVE 0,,0
 CLA CON+7
 STO TEST1
 TSX Y\$OUT,4
 SIX FOIL,1,7012
 SIX X,1,7036
 SIX NORMY,0,7048

SW5
ANEW

PICK UP
APPROPRIATE
A,B,C

SAVE

SAVE CONTENTS
OF IR1,2,4

VAR1

OUT2

11651	-2	15624	0	12742		SIX	CSN,0,7060
11652	-2	15640	0	12733		SIX	RES,0,7072
11653	1	00060	0	00002		PON	2,0,48
11654	-1	00000	0	00000		FVE	0,,0
11655	0	02000	0	11161		TRA	EOL
11656	0	56000	0	12745	CONV	LDQ	MU
11657	0	26000	0	12750		FMP	INCA
11660	0	30200	0	12744		FSB	RHO
11661	0	60100	0	00144		STO	COMMON
11662	0	56000	0	12745		LDQ	MU
11663	0	26000	0	12751		FMP	INCB
11664	0	30000	0	00144		FAD	COMMON
11665	0	60100	0	00144		STO	COMMON
11666	0	56000	0	12747		LDQ	OMEGA
11667	0	26000	0	12752		FMP	INCC
11670	0	30000	0	00144		FAD	COMMON
11671	0	76000	0	00002		CHS	
11672	0	60100	0	12733		STO	RES
11673	0	56000	0	12733		LDQ	RES
11674	0	26000	0	12733		FMP	RES
11675	0	30000	0	12737		FAD	RESSQ
11676	0	60100	0	12737		STO	RESSQ
11677	0	50000	1	12234		CLA	Y,1
11700	0	24000	0	07115		FDH	AO
11701	-0	60000	0	12760		STQ	NORMY
11702	0	02000	0	11161	SW2	TRA	EOL
11703	-0	12000	0	11707	ERR4	TMI	ERR4+4
11704	0	30200	0	12772		FSB	CON+4
11705	0	60100	0	12741		STO	ARG
11706	0	02000	0	11055		TRA	TROIS
11707	0	30000	0	12772		FAD	CON+4
11710	0	60100	0	12741		STO	ARG
11711	0	02000	0	11055		TRA	TROIS
11712	0	07400	4	12777	ERR2	TSX	Y\$OUT,4
11713	3	05712	0	07343		PTH	TITL6,,3018
11714	1	00001	0	00002		PON	2,0,1
11715	-1	00001	0	00000		FVE	0,,1
11716	0	02000	0	11557		TRA	FIN
11717	0	07400	4	12777	ERR3	TSX	Y\$OUT,4
11720	3	03734	0	07346		PTH	TITL7,,2012
11721	1	00060	0	00002		PON	2,0,48
11722	-1	00000	0	00000		FVE	0,,0
11723	0	02000	0	11557	END	TRA	FIN
				12070	X	BES	100

			12234	Y	BES	100
			12400	DELY	BES	100
			12544	FOIL	BES	100
			12544	STOR	BSS	3
			12547	SUM	BSS	9
			12560	D	BSS	7
			12567	ALPHA	BSS	3
			12572	BETA	BSS	3
			12575	GAMMA	BSS	3
			12600	CD	BSS	72
			12711	TEST	BES	1
			12712	TEST1	BES	1
12712	0	00000	0	00000	L0	PZE
12713	0	00000	0	00001	L1	PZE 1,0,0
12714	0	00003	0	00011	L9	PZE 9,0,3
12715	0	00000	0	00002	L2	PZE 2,0,0
12716	0	00110	0	00030	L24	PZE 24,0,72
12717	0	00000	0	11161	LEOL	PZE EOL
12720	0	00000	0	11163	LMIN	PZE MINOR
12721	0	00000	0	11410	LVAR0	PZE VAR0
12722	0	00000	0	11632	LVAR1	PZE VAR1
12723	0	00000	0	11561	LVAR2	PZE VAR2
12724	0	00000	0	11656	LCONV	PZE CONV
12725	0	00000	0	11557	LFIN	PZE FIN
12726	0	00000	0	11363	LPLUS	PZE PLUSA
12727	0	00000	0	11723	LEND	PZE END
12730	0	00000	0	11605	LANEW	PZE ANEW
12731	0	00002	0	00000	LD2	PZE 0,0,2
12732	+233	0000000000			CHAR	OCT 2330000000000
12733	0	00000	0	00000	RES	
			12734	SVA	BSS	1
			12735	BS	BSS	1
			12736	DEVBS	BSS	1
12737	0	00000	0	00000	RESSQ	
12740	0	00000	0	00000	DIF	
12741	0	00000	0	00000	ARG	
12742	0	00000	0	00000	CSN	
12743	0	00000	0	00000	SN	
12744	0	00000	0	00000	RHO	
12745	0	00000	0	00000	MU	
12746	0	00000	0	00000	KU	
12747	0	00000	0	00000	GMEGA	
12750	0	00000	0	00000	INCA	
12751	0	00000	0	00000	INCB	

12752	0	00000	0	00000	INCC	
12753	0	00000	0	00000	DEVA	
12754	0	00000	0	00000	DEVB	
12755	0	00000	0	00000	DEVC	
12756	0	00000	0	00000	H	
12757	0	00000	0	00000	DEVH	
12760	0	00000	0	00000	NORMY	
				12761	MIN	BSS 2
				12763	MAX	BSS 2
12765	0	00000	0	00000	FAC	
12766	+175463146314				CON	DEC .75E-1,.16666667,1.0,1.5707963,.3294199E7,2.0,3.0,1,1.2024128
12767	+176525252527					
12770	+201400000000					
12771	+201622077323					
12772	+226622077340					
12773	+202400000000					
12774	+202600000000					
12775	+000000000001					
12776	+201463642515					
		12777	Y		HED	
						GL OUT 2 GENERAL PURPOSE OUTPUT PROGRAM
12777	-0	63400	1	13047	OUT	SXD SAVEX,1
13000	-0	63400	2	13046		SXD SAVEX-1,2
13001	-0	63400	4	13051		SXD SAVEX+2,4
13002	-0	50000	0	13524	OUT1	CAL BLANK
13003	-0	53400	2	13107	OUT2	LXD PRT10,2
13004	-0	63400	2	13055		SXD BIN,2
13005	-0	63400	2	13140		SXD ZD,2
13006	-0	53400	1	13176		LXD 20D,1
13007	0	60200	1	00227	OUT3	SLW COMMON+51,1
13010	2	00001	1	13007		TIX OUT3,1,1
13011	-0	50000	4	00001	OUT4	CAL 1,4
13012	-0	63400	4	13120		SXD S4,4
13013	0	62100	0	13062		STA PRT2
13014	0	76500	0	00022		LRS 18
13015	0	62100	0	13220		STA PP
13016	0	62100	0	13063		STA PRT3
13017	0	76700	0	00003		ALS 3
13020	-0	73400	2	00000		PDX ,2
13021	0	76000	0	00000		CLM
13022	0	76300	0	00003		LLS 3
13023	0	73400	1	00000		PAX ,1
13024	0	50000	1	13050		CLA SAVEX+1,1
13025	0	77100	0	00022		ARS 18

SET FOR ONE CYCLE PRINT

L+20

NEXT CALLING SEQUENCE WORD

STORE PRINT INSTRUCTION 1

STORE 1000N + PP

STORE PRINT INSTRUCTION 2

PSUEDO-OP INTO I.R.2

TAG INTO I.R.1

CONTENTS OF SPECIFIED I.R.

13026	0	40000	0	13062	ADD PRT2	MODIFIED ADDRESS
13027	0	62100	0	13037	STA LOC	
13030	0	40200	0	13542	SUB CON1	
13031	0	62100	0	13432	STA HTH4	
13032	0	56000	0	13220	LDQ PP	1000N+PP
13033	-0	75400	0	C0000	PXD	
13034	0	22100	0	13537	DVP TEN-2	DIVIDE BY 1000
13035	-0	60000	0	00145	STQ COMMON+1	
13036	0	60200	0	13220	SLW PP	
13037	0	50000	0	00000	LOC CLA	
13040	-0	10000	0	13042	TNZ LOC+3	
13041	0	76000	0	00003	SSP	
13042	-0	53400	1	13107	LXD PRT10,1	
13043	0	60100	0	00151	STO COMMON+5	SIGNR
13044	0	76000	0	00003	SSP	
13045	0	02000	2	13055	TRA BIN,2	
13046	-3	00000	0	13260	TXL FTX	
13047	-3	00000	0	13344	SAVEX TXL FTF	
13050	-3	00000	0	13056	TXL PRT	
13051	-3	00000	0	13277	TXL FTX4	
13052	-3	00016	0	13425	14D TXL HTH,,14	
13053	-3	00020	0	13450	16D TXL XTX,,16	
13054	-3	00023	0	13464	19D TXL TPW,,19	
13055	-3	00000	0	13203	BIN TXL ERROR	U.T.
13056	0	76000	0	00166	PRT SWT 6	
13057	0	02000	0	13142	TRA PRT15+5	
13060	-0	53400	4	13176	LXD 20D,4	
13061	0	76600	0	00361	PRT1 WPR	
13062	0	76000	0	00360	PRT2 SPR	INSTRUCTION 1
13063	0	76000	0	00360	PRT3 SPR	INSTRUCTION 2
13064	-0	53400	2	13055	LXD BIN,2	
13065	-2	00001	2	13070	TNX PRT4,2,1	
13066	-3	00001	2	13070	TXL PRT4,2,1	
13067	0	76000	0	00371	SPR 9	
13070	-0	63400	2	13055	PRT4 SXD BIN,2	
13071	-0	63400	2	13112	SXD GATE,2	SET GATE TO MOVE
13072	-0	53400	2	13053	PRT5 LXD 16D,2	
13073	-0	75400	0	00000	PXD	CLEAR ACCUMULATOR
13074	0	60200	2	00203	PRT6 SLW COMMON+31,2	CLEAR RT. HALF CARD IMAGE
13075	2	00001	2	13074	TIX PRT6,2,1	
13076	-0	50000	0	13531	CAL MZE	BIT
13077	0	56000	4	00227	PRT7 LDQ COMMON+51,4	LOAD MQ WITH NEXT WORD
13100	1	00144	4	13101	TXI PRT8,4,100	
13101	-0	10000	0	13157	PRT8 TNZ GO	

13102	-0	53400	1	13107	HALFC	LXD	PRT10,1	ZERO INTO I.R. 1
13103	-0	50000	1	00164	PRT9	CAL	COMMON+16,1	CIR-2
13104	-0	60200	0	00167		ORS	COMMON+19	CIR+1 TAKE CARE OF
13105	-0	60200	1	00174		ORS	COMMON+24,1	CIR+6 8-3 AND 8-4
13106	0	60200	1	00165		SLW	COMMON+17,1	CIR-1 COMBINATIONS
13107	3	00000	1	13111	PRT10	TXH	PRT11,1	
13110	1	00001	1	13103		TXI	PRT9,1,1	
13111	2	00144	4	13112	PRT11	TIX	GATE,4,100	
13112	-3	00000	4	13121	GATE	TXL	PRIN,4	
13113	-0	53400	1	13052		LXD	14D,1	
13114	0	56000	1	00202	MOVE	LDQ	COMMON+30,1	CIR+12 MOVE R IMAGE
13115	-0	60000	1	00162		STQ	COMMON+14,1	CIL+12 TO L IMAGE
13116	2	00001	1	13114		TIX	MOVE,1,1	
13117	-0	63400	4	13112		SXD	GATE,4	SET GATE TO PRINT
13120	-3	00000	0	13072	S4	TXL	PRT5	U.T.
13121	-0	53400	2	13054	PRIN	LXD	19D,2	
13122	-3	00007	2	13125	PRT12	TXL	PRT13,2,7	
13123	0	70000	2	00171		CPY	COMMON+21,2	CIL+19
13124	0	70000	2	00211		CPY	COMMON+37,2	CIR+19
13125	3	00000	2	13135	PRT13	TXH	PRT15,2	
13126	3	00013	2	13146		TXH	FIX,2,11	
13127	1	00020	2	13130		TXI	PRT14,2,16	
13130	0	70000	0	00202	PRT14	CPY	COMMON+30	READ ECHO IMPULSES
13131	0	50000	0	00202		CLA	COMMON+30	
13132	0	40200	2	00177		SUB	COMMON+27,2	CIR+9
13133	-0	10000	0	13221		TNZ	ECERR	ECHO CHECK ERROR
13134	2	00020	2	13130		TIX	PRT14,2,16	
13135	2	00001	2	13122	PRT15	TIX	PRT12,2,1	
13136	-0	53400	2	13055		LXD	BIN,2	
13137	3	00001	2	13061		TXH	PRT1,2,1	TRANSFER IF 2 CYCLES ARE NEEDED
13140	3	00000	1	13142	ZD	TXH	ZD+2,1	
13141	0	42000	0	00000		HPR		
13142	-0	53400	4	13120		LXD	S4,4	
13143	-0	53400	1	13047		LXD	SAVEX,1	
13144	-0	53400	2	13046		LXD	SAVEX-1,2	
13145	0	02000	4	00002		TRA	2,4	RETURN TO MAIN PROGRAM
13146	-0	53400	1	13156	FIX	LXD	2D,1	
13147	1	00020	2	13150	FIX1	TXI	FIX2,2,16	
13150	-0	50000	3	00202	FIX2	CAL	COMMON+30,3	
13151	0	76000	0	00006		COM		
13152	0	32000	2	00203		ANS	COMMON+31,2	
13153	0	32000	3	00211		ANS	COMMON+37,3	
13154	2	00020	2	13150		TIX	FIX2,2,16	
13155	2	00001	1	13147		TIX	FIX1,1,1	

13156	-3	00002	0	13135	2D	TXL PRT15,,2	
13157	0	60200	0	00162	GO	SLW COMMON+14	BIT
13160	-0	75400	0	00000		PXD	
13161	-0	76300	0	00002		LGL 2	
13162	0	73400	2	00000		PAX ,2	
13163	-0	75400	0	00000		PXD	
13164	-0	76300	0	00004		LGL 4	
13165	0	73400	1	00000		PAX ,1	
13166	-0	50000	0	00162		CAL COMMON+14	BIT
13167	3	00014	1	13201		TXH NHERR,1,12	NON-HOLLERITH CHARACTER
13170	3	00000	1	13173		TXH ORSD,1	
13171	3	00002	2	13175		TXH BITRS,2,2	
13172	3	00000	2	13174		TXH ORSZ,2	
13173	-0	60200	1	00177	ORSZ	ORS COMMON+27,1	
13174	-0	60200	2	00202	ORSZ	ORS COMMON+30,2	
13175	0	77100	0	00001	BITRS	ARS 1	
13176	2	00024	4	13101	20D	TIX PRT8,4,20	
13177	-2	00001	4	13077		TIX PRT7,4,1	
13200	-3	00000	0	13102		TXL HALFC	U.T.
13201	-0	53400	1	13140	NHERR	SXD ZD,1	
13202	-3	00000	0	13175		TXL BITRS	
13203	-0	50000	0	13120	ERROR	CAL S4	
13204	0	76000	0	00006		COM	ADDRESS OF WORD IN ERROR
13205	0	36100	0	13135		ACL PRT15	TWOS COMPLEMENT
13206	0	76500	0	00036		LRS 30	
13207	-0	53400	4	13265		LXD 4D,4	
13210	-0	50000	0	13524		CAL BLANK	
13211	0	76700	0	00003	ERR2	ALS 3	
13212	0	76300	0	00003		LLS 3	
13213	2	00001	4	13211		TIX ERR2,4,1	
13214	0	60200	0	13560		SLW ERIND+2	ADDRESS IN BCD
13215	0	07400	4	12777		TSX OUT,4	
13216	3	05712	0	13556		PTH ERIND,,3018	HTH CODE
13217	-1	00000	0	00364		FVE 244	PRT CODE
13220	0	00000	0	00000	PP	HTR	
13221	-0	50000	0	13530	ECERR	CAL XXXXX	
13222	0	07400	4	13003		TSX OUT2,4	
13223	-1	00000	0	00365		FVE 245	PRT CODE
13224	-0	53400	4	13051		LXD SAVEX+2,4	
13225	-3	00003	0	13002	3D	TXL OUT1,,3	U.T.
13226	-0	53400	1	13054	SETPP	LXD 19D,1	
13227	0	53400	2	13220		LXA PP,2	
13230	3	00170	2	13203		TXH ERROR,2,120	PP GREATER THAN 120
13231	-2	00110	2	13235		TNX SET2,2,72	

13232	-0	50000	0	13225	CAL	3D	
13233	0	62200	0	13055	STD	BIN	ALLOWS 2 PRINT CYCLES
13234	1	77764	1	13235	TXI	SET2,1,-12	
13235	-2	00006	2	13237	SET2	TNX SET3,2,6	
13236	1	77777	1	13235	TXI	SET2,1,-1	
13237	-0	75400	0	00000	SET3	PXD	
13240	0	40000	0	13543	SET4	ADD CON6	REMAINDER TIMES
13241	2	00001	2	13240		TIX SET4,2,1	SIX
13242	0	73400	2	00000		PAX ,2	
13243	0	02000	4	00001		TRA 1,4	
13244	0	60100	0	00144	ENTNO	STO COMMON	
13245	-0	50000	1	00226		CAL COMMON+50,1	L+19
13246	0	76500	2	00044		LRS 36,2	
13247	0	77100	0	00006		ARS 6	
13250	0	76700	0	00006		ALS 6	
13251	0	36100	0	00144		ACL COMMON	
13252	0	76300	2	00044	ENT2	LLS 36,2	
13253	0	60200	1	00226		SLW COMMON+50,1	L+19
13254	2	00006	2	13257		TIX ENT4,2,6	
13255	1	00001	1	13256		TXI ENT3,1,1	
13256	0	53400	2	13252	ENT3	LXA ENT2,2	
13257	0	02000	4	00001	ENT4	TRA 1,4	
13260	0	76500	0	00043	FTX	LRS 35	
13261	0	76300	0	00010		LLS 8	
13262	0	40200	0	13465		SUB C0128	
13263	0	12000	0	13266		TPL FTX1	
13264	-0	50100	0	13352		ORA FTF2	SET UP A RIGHT SHIFT
13265	-3	00004	0	13267	4D	TXL FTX2,,4	U.T.
13266	-0	50100	0	13303	FTX1	ORA FTX6	SET UP A LEFT SHIFT
13267	0	60200	0	13275	FTX2	SLW FTX3	
13270	-0	50000	0	13527		CAL DECPT	
13271	0	60200	0	00152		SLW COMMON+6	BLANK, MINUS OR DEC. POINT
13272	-0	75400	0	00000		PXD	
13273	0	60100	0	00157		STO COMMON+11	
13274	0	14000	0	13275		TOV FTX3	
13275	0	00000	0	00000	FTX3	PZE	PROPER SHIFT
13276	0	14000	0	13344		TOV FTF	NUMBER TOO LARGE
13277	0	53400	4	00145	FTX4	LXA COMMON+1,4	DEC. PLACES INTO I.R. 4
13300	0	60200	0	00153	FTX5	SLW COMMON+7	STORE INTEGRAL PART
13301	-0	20000	4	13542		MPR TBTEN+8,4	ROUND TO N DEC. PLACES
13302	0	34000	4	13542		CAS TBTEN+8,4	
13303	0	76300	0	00000	FTX6	LLS 0	
13304	-3	00000	0	13336	FTX7	TXL RC	ROUNDING CAUSED CARRY
13305	0	60100	0	00154	FTX8	STO COMMON+8	FRACTIONAL PART

13306	-0	63400	4	13343	FTX8A	SXD SA4,4	
13307	0	07400	4	13226		TSX SETPP,4	
13310	-0	53400	4	13343		LXD SA4,4	
13311	-3	00000	4	13326		TXL FTX13,4	NO FRACTIONAL PART
13312	0	50000	0	00154	FTX9	CLA COMMON+8	
13313	-3	00010	4	13315	FTX10	TXL FTX11,4,8	
13314	0	10000	0	13330		TZE FTX14	
13315	0	76500	0	00043	FTX11	LRS 35	
13316	0	22100	0	13541		DVP TEN	
13317	-0	60000	0	00154		STQ COMMON+8	FRAFT
13320	-0	63400	4	13343		SXD SA4,4	
13321	0	07400	4	13244		TSX ENTNO,4	ENTER DIGIT
13322	-0	53400	4	13343		LXD SA4,4	
13323	2	00001	4	13312		TIX FTX9,4,1	
13324	0	50000	0	00152		CLA COMMON+6	BMORP
13325	0	07400	4	13244	FTX12	TSX ENTNO,4	ENTER BLANK, MINUS OR POINT
13326	0	50000	0	00153	FTX13	CLA COMMON+7	INTEGRAL PART
13327	1	13351	4	13313		TXI FTX10,4,FTX12+20	
13330	0	50000	0	00151	FTX14	CLA COMMON+5	SIGNR
13331	0	12000	0	13334		TPL FTX15	
13332	0	50000	0	13526		CLA MINUS	
13333	0	07400	4	13244		TSX ENTNO,4	ENTER MINUS SIGN
13334	-0	53400	4	13120	FTX15	LXD S4,4	
13335	1	77777	4	13011		TXI OUT4,4,-1	EXIT
13336	0	50000	0	13542	RC	CLA CON1	
13337	0	40000	1	00153		ADD COMMON+7,1	
13340	0	60100	1	00153		STO COMMON+7,1	
13341	0	60200	0	00153		SLW COMMON+7	
13342	0	50000	1	00157		CLA COMMON+11,1	
13343	-3	00000	0	13305	SA4	TXL FTX8	U.T.
13344	0	56000	0	00151	FTF	LDQ COMMON+5	SIGNR
13345	-0	50000	0	13525		CAL LORBL	
13346	0	16200	0	13350		TQP FTF1	
13347	0	77100	0	00002		ARS 2	
13350	0	60200	0	00152	FTF1	SLW COMMON+6	BLANK, MINUS OR POINT
13351	-0	75400	0	00000		PXD	
13352	0	76500	0	00000	FTF2	LRS 0	
13353	0	76300	0	00010		LLS 8	
13354	0	40200	0	13465		SUB C0128	
13355	-0	60000	0	00144		STQ COMMON	
13356	0	76500	0	00043		LRS 35	
13357	0	20000	0	13544		MPY LOG2	
13360	0	60100	0	00151		STO COMMON+5	SIGNR
13361	0	12000	0	13370		TPL FTF3	

13362	0	40200	0	13542
13363	0	60100	0	00151
13364	0	76300	0	00043
13365	0	76000	0	00006
13366	0	76000	0	00003
13367	0	76500	0	00043
13370	0	20000	0	13545
13371	0	76500	0	00041
13372	0	73400	4	00000
13373	-0	60000	0	00154
13374	-0	53400	2	13122
13375	0	56000	0	13546
13376	0	20000	0	00154
13377	0	40000	2	13556
13400	0	76500	0	00043
13401	2	00001	2	13376
13402	0	20000	0	00144
13403	0	76500	4	00042
13404	0	10000	0	13411
13405	0	22100	0	13541
13406	0	50000	0	00151
13407	0	40000	0	13542
13410	0	60100	0	00151
13411	0	53400	4	00145
13412	3	00000	4	13414
13413	1	00010	4	13414
13414	0	50000	4	13543
13415	0	60100	0	00155
13416	0	76300	0	00045
13417	0	10000	0	13423
13420	0	76500	0	00045
13421	0	50000	0	00151
13422	-0	10000	0	13424
13423	0	60200	0	00151
13424	1	00002	1	13300
13425	0	07400	4	13226
13426	-0	50200	0	00145
13427	0	40000	0	13555
13430	0	73400	4	00000
13431	-3	00000	4	13334
13432	0	56000	4	00000
13433	-0	63400	4	00146
13434	0	53400	4	13440
13435	-0	77300	0	00036

	SUB	CON1
	STO	COMMON+5
	LLS	35
	COM	
	SSP	
	LRS	35
FTF3	MPY	LOG10
	LRS	33
	PAX	,4
	STQ	COMMON+8
FTF4	LXD	PRT12,2
	LDQ	2TOXC
FTF5	MPY	COMMON+8
	ADD	2TOXC+8,2
	LRS	35
	TIX	FTF5,2,1
	MPY	COMMON
	LRS	34,4
	TZE	FTF6
	DVP	TEN
	CLA	COMMON+5
	ADD	CON1
	STO	COMMON+5
FTF6	LXA	COMMON+1,4
	TXH	FTF7,4
	TXI	FTF7,4,8
FTF7	CLA	TBTEN+9,4
	STO	COMMON+9
	LLS	37
	TZE	FTF8
	LRS	37
	CLA	COMMON+5
	TNZ	FTF8+1
FTF8	SLW	COMMON+5
	TXI	FTX5,1,2
HTH	TSX	SETPP,4
	CLS	COMMON+1
	ADD	2TOXC+7
	PAX	,4
HTH3	TXL	FTX15,4
HTH4	LDQ	,4
	SXD	COMMON+2,4
	LXA	HTH6,4
HTH5	RQL	30

SIGNR

OMIT CHARACTERISTIC
FOR
ZERO

OMIT SIGN OF ZERO
CHARACTERISTIC

ALL WORDS FINISHED

SET FOR 6 CHARACTERS

13436	-0	60000	0	00147	STQ	COMMON+3	
13437	0	76000	0	00000	CLM		
13440	-0	76300	0	00006	HTH6	LGL 6	
13441	-0	63400	4	13343	SXD	SA4,4	
13442	0	07400	4	13244	TSX	ENTNO,4	ENTER BCD CHARACTER
13443	-0	53400	4	13343	LXD	SA4,4	
13444	0	56000	0	00147	LDQ	COMMON+3	
13445	2	00001	4	13435	TIX	HTH5,4,1	NEXT CHARACTER
13446	-0	53400	4	00146	LXD	COMMON+2,4	
13447	1	00001	4	13431	TXI	HTH3,4,1	NEXT WORD
13450	0	76500	0	00043	XTX	LRS 35	
13451	1	77777	4	13452	TXI	XTX1,4,-1	BUMP I.R. TO SKIP BIN
13452	-0	53400	4	13120	XTX1	SXD S4,4	
13453	-0	50000	4	00001	CAL	1,4	CLEAR ADD BINARY PLACES
13454	0	62100	0	13463	STA	XTX2	
13455	0	40200	0	13507	SUB	CON36	
13456	0	12000	0	13203	TPL	ERROR	B OUTSIDE RANGE 0-35
13457	0	77100	0	00041	ARS	33	
13460	-0	10000	0	13203	TNZ	ERROR	BIN DOES NOT FOLLOW XTX
13461	-0	50000	0	13463	CAL	XTX2	
13462	-3	00000	0	13267	TXL	FTX2	U.T.
13463	0	76300	0	00000	XTX2	LLS	
13464	0	02000	0	13466	TPW	TRA TPW+2	
13465	0	00000	0	00200	CO128	HTR 128	ERROR IF NOT ALREADY OFF
13466	0	50000	0	13555	CLA	2TOXC+7	25 COMPLEMENT OF
13467	0	40200	0	13037	SUB	LOC	TAPE NUMBER
13470	0	73400	2	00000	PAX	,2	
13471	0	76600	2	00200	TPW1	WTD ,2	
13472	0	56000	0	00203	LDQ	COMMON+31	SET UP
13473	-0	60000	0	00147	STQ	COMMON+3	SAVE 1ST WORD OF RECORD
13474	-0	76300	0	00006	LGL	6	PRINT
13475	0	50000	0	13220	CLA	PP	CONTROL CHARACTER
13476	-0	76300	0	00036	LGL	30	IN
13477	0	60200	0	00203	SLW	COMMON+31	COLUMN 1
13500	-0	53400	4	13176	LXD	20D,4	
13501	0	70000	4	00227	TPW2	CPY COMMON+51,4	TAPE COPY
13502	2	00001	4	13501	TIX	TPW2,4,1	LOOP
13503	0	02000	0	13511	TRA	TPW3+4	
13504	0	76200	2	00200	RTD	,2	READ RECORD
13505	0	70000	0	00144	TPW3	CPY COMMON	
13506	0	02000	0	13505	TRA	TPW3	
13507	+0000000000044				CON36	DEC 36	
13510	-0	76000	0	00012	RTT		
13511	0	76600	0	00333	IOD		

13512	0 56000 0 00147	LDQ COMMON+3	RESTORE 1ST WORD
13513	-0 60000 0 00203	STQ COMMON+31	OF RECORD
13514	-0 53400 4 13120	LXD S4,4	
13515	-0 50000 4 00002	CAL 2,4	
13516	0 77100 0 00040	ARS 32	
13517	0 40200 0 13541	SUB TEN	
13520	0 10000 0 13335	TZE FTX15+1	
13521	-3 00000 0 13142	TXL PRT15+5	U.T
13522	0 76400 2 00200	TPW4 BST ,2	
13523	-3 00000 0 13471	TXL TPW1	U.T
13524	-206060606060	BLANK OCT -206060606060	
13525	+0000000000060	LORBL OCT 60	
13526	+0000000000014	MINUS OCT 14	
13527	+0000000000033	DECPT OCT 33	
13530	676767676767	XXXXX BCD 1XXXXXX	
13531	-0 00000 0 00000	MZE MZE	
13532	+000575360400	TBTEN DEC 100000000	
13533	+000046113200	DEC 10000000	
13534	+000003641100	DEC 1000000	
13535	+000000303240	DEC 100000	
13536	+000000023420	DEC 10000	
13537	+000000001750	DEC 1000	
13540	+000000000144	DEC 100	
13541	+000000000012	TEN DEC 10	
13542	+000000000001	CON1 DEC 1	
13543	+000000000006	CON6 DEC 6	
13544	+115040465025	LOG2 OCT 115040465025	LOG BASE 10 OF 2
13545	+324464741127	LOG10 OCT 324464741127	LOG BASE 2 OF 10/4
13546	+000001601225	2TOXC OCT 1601225	C7
13547	+000007762664	OCT 7762664	C6
13550	+000132240566	OCT 132240566	C5
13551	+001164125106	OCT 1164125106	C4
13552	+007066267024	OCT 7066267024	C3
13553	+036577252307	OCT 36577252307	C2
13554	+130562064437	OCT 130562064437	C1
13555	+200000000000	OCT 200000000000	C0
13556	255151465160	ERIND BCD 3ERROR IN LOC	
13557	314560434623		
13560	606060606060		
	00000	S-ACE1 EQU 0	
	00367	SKIP1 EQU 247	
	00362	SKIP2 EQU 242	
	00363	EXTRA EQU 243	
	00364	SPACE2 EQU 244	

				00365	SPACE0 EQU 245	
				00366	SKIP3 EQU 246	
				00370	SUPSK EQU 248	
				00020	0SPACE EQU 16	
				00060	1SPACE EQU 48	
				00000	2SPACE EQU 0	
				00001	1SKIP EQU 1	
				00002	2SKIP EQU 2	
				00003	3SKIP EQU 3	
				00004	4SKIP EQU 4	
				00005	5SKIP EQU 5	
				00006	6SKIP EQU 6	
				00007	7SKIP EQU 7	
				00010	8SKIP EQU 8	
				00011	9SKIP EQU 9	
				00041	1SHSK EQU 33	
				00042	2SHSK EQU 34	
				00043	3SHSK EQU 35	
				00044	4SHSK EQU 36	
				00045	5SHSK EQU 37	
				00046	6SHSK EQU 38	
				00047	7SHSK EQU 39	
				00050	8SHSK EQU 40	
				00051	9SHSK EQU 41	
				13561	X HED	
13561	0	60100	0	00144	EXP STO COMMON	STORE X
13562	-0	76000	0	00003	SSM	
13563	0	40000	0	13644	ADD EXP+51	TEST FOR SIZE
13564	0	12000	0	13567	TPL EXP+6	
13565	0	50000	0	00144	CLA COMMON	/X/ TOO BIG---ERROR RETURN
13566	0	02000	4	00001	TRA 1,4	
13567	-0	63400	2	00145	SXD COMMON+1,2	SAVE REGISTER 2
13570	0	53400	2	13566	LXA EXP+5,2	1 INTO 2
13571	0	40200	0	13644	SUB EXP+51	RESTORE -/X/
13572	0	76500	0	00033	LRS 27	
13573	0	34000	0	13645	CAS EXP+52	SEPARATE AND TEST EXPONENT
13574	0	02000	0	13602	TRA EXP+17	
13575	0	02000	0	13602	TRA EXP+17	
13576	0	40200	0	13645	SUB EXP+52	E GR. THAN -3
13577	-0	40000	0	13566	SBM EXP+5	SET UP REG. 2 FOR SQUARING
13600	0	73400	2	00000	PAX 0,2	
13601	0	50000	0	13645	CLA EXP+52	SET EXPONENT TO -3
13602	0	76500	0	00010	LRS 8	
13603	-0	60000	0	00146	STQ COMMON+2	NEW X

13604	0	26000	0	00146	FMP COMMON+2	
13605	0	60100	0	00147	STO COMMON+3	NEW X SQUARED
13606	0	30000	0	13651	FAD EXP+56	COMPUTE F
13607	0	60100	0	00150	STO COMMON+4	
13610	0	30000	0	13652	FAD EXP+57	
13611	0	24000	0	00150	FDH COMMON+4	
13612	0	26000	0	00147	FMP COMMON+3	
13613	0	24000	0	13650	FDH EXP+55	
13614	-0	60000	0	00147	STQ COMMON+3	F
13615	0	50200	0	00146	CLS COMMON+2	
13616	0	40200	0	13646	SUB EXP+53	-X/2
13617	0	30000	0	00147	FAD COMMON+3	
13620	0	30000	0	13647	FAD EXP+54	
13621	0	60100	0	00147	STO COMMON+3	STORE DENOMINATOR
13622	0	30000	0	00146	FAD COMMON+2	
13623	0	24000	0	00147	FDH COMMON+3	
13624	-0	60000	0	00146	STQ COMMON+2	
13625	0	50000	0	00146	CLA COMMON+2	EXPONENTIAL BEFORE SQUARING
13626	-2	00001	2	13633	TNX EXP+42,2,1	CHECK FOR SQUARING
13627	0	26000	0	00146	FMP COMMON+2	SQUARE PROPER NUMBER OF TIMES
13630	0	60100	0	00146	STO COMMON+2	
13631	0	56000	0	00146	LDQ COMMON+2	
13632	2	00001	2	13627	TIX EXP+38,2,1	
13633	-0	53400	2	00145	LXD COMMON+1,2	RESTORE REGISTER 2
13634	0	56000	0	00144	LDQ COMMON	
13635	0	16200	0	13637	TQP EXP+46	
13636	0	02000	4	00002	TRA 2,4	OUT IF X IS NEGATIVE
13637	0	50000	0	13647	CLA EXP+54	
13640	0	24000	0	00146	FDH COMMON+2	INVERT IF X IS POSITIVE
13641	-0	60000	0	00144	STQ COMMON	
13642	0	50000	0	00144	CLA COMMON	
13643	0	02000	4	00002	TRA 2,4	
13644	+207540000000				OCT 207540000000	FLO. 88
13645	-000000000175				OCT -175	
13646	+001000000000				OCT 1000000000	
13647	+201400000000				OCT 201400000000	FLO. 1
13650	+206500000000				OCT 206500000000	FLO. 40
13651	+206520000000				OCT 206520000000	FLO. 42
13652	+207610000000				OCT 207610000000	FLO. 98
		13653	W		HED	
13653	0	60100	0	00144	STO COMMON	SAVE ARGUMENT SIGN
13654	0	76000	0	00003	SSP	N
13655	0	10000	0	13677	TZE SQRT+20	GO TO EXIT IF ZERO
13656	0	60100	0	00145	STO COMMON+1	SAVE N

13657	-0	32000	0	13702	ANA	SQRT+23	COMPUTE TRIAL VALUE, X
13660	0	76500	0	00001	LRS	1	X
13661	0	40000	0	00145	ADD	COMMON+1	X
13662	0	76500	0	00001	LRS	1	X
13663	0	40000	0	13703	ADD	SQRT+24	X
13664	-0	63400	4	00144	SXD	COMMON,4	SAVE RETURN ADDRESS
13665	0	53400	4	13654	LXA	SQRT+1,4	SET INDEX FOR 3 ITERATIONS
13666	0	60100	0	00146	STO	COMMON+2	SAVE X
13667	0	50000	0	00145	CLA	COMMON+1	COMPUTE SQUARE ROOT
13670	0	24000	0	00146	FDH	COMMON+2	X N/X
13671	-0	60000	0	00147	STQ	COMMON+3	X
13672	0	50000	0	00147	CLA	COMMON+3	X N/X
13673	0	30000	0	00146	FAD	COMMON+2	X + X
13674	0	40200	0	13702	SUB	SQRT+23	X DIVIDE BY 2
13675	2	00001	4	13666	TIX	SQRT+11,4,1	REPEAT LOOP
13676	-0	53400	4	00144	LXD	COMMON,4	RESTORE EXIT ADDRESS
13677	0	56000	0	00144	LDQ	COMMON	TEST SIGN OF ARGUMENT
13700	0	16200	4	00002	TQP	2,4	IF + , SKIP ONE
13701	0	02000	4	00001	TRA	1,4	IF - , DO NOT SKIP ONE
13702	+001000000000				DEC	134217728,8657043456	0*2 EXP -127, 1/2 * EXP -64
13703	+100400000000						
				13704	HED		
				13704	HED		
13704	0	30200	0	14001	FSB	COS+61	COS ENTRY ,PI/2-X FOR X
13705	0	76000	0	00002	CHS		
13706	0	60100	0	00147	STO	COMMON+3	SINE ENTRY
13707	0	76000	0	00003	SSP		STORE SIGN INDICATOR, MAKE X +
13710	0	56000	0	14010	LDQ	COS+68	
13711	0	04000	0	13771	TLQ	COS+53	OUT IF X IS TOO LARGE
13712	0	14000	0	13713	TOV	COS+7	
13713	0	24000	0	13777	FDH	COS+59	DIVIDE X BY 2PI
13714	-0	60000	0	00145	STQ	COMMON+1	
13715	0	50000	0	00145	CLA	COMMON+1	SEPARATE FRACTIONAL PART
13716	-0	30000	0	13774	UFA	COS+56	
13717	-0	77300	0	00010	RQL	8	
13720	0	76500	0	00010	LRS	8	
13721	-0	60000	0	00145	STQ	COMMON+1	
13722	-0	63400	1	13773	SXD	COS+55,1	SAVE REGISTER 1
13723	0	50000	0	00145	CLA	COMMON+1	
13724	0	76000	0	00003	SSP		
13725	0	34000	0	14002	CAS	COS+62	
13726	0	02000	0	13731	TRA	COS+21	
13727	0	02000	0	13767	TRA	COS+51	SIN X IS 1
13730	0	02000	0	13737	TRA	COS+27	TO COMPUTE Y

13731	0	40200	0	13775	SUB COS+57	
13732	-0	12000	0	13724	TMI COS+16	TEST X-PI
13733	0	60100	0	00145	STO COMMON+1	
13734	0	50200	0	00147	CLS COMMON+3	CHANGE SIGN OF INDICATOR
13735	0	60100	0	00147	STO COMMON+3	
13736	0	02000	0	13723	TRA COS+15	
13737	0	76700	0	00002	ALS 2	COMPUTE AND STORE
13740	0	60100	0	00145	STO COMMON+1	Y AND Y SQUARED
13741	0	56000	0	00145	LDQ COMMON+1	
13742	0	20000	0	00145	MPY COMMON+1	
13743	0	60100	0	00146	STO COMMON+2	
13744	0	76000	0	00000	CLM	CLEAR ERASABLE WORD
13745	0	60200	0	00144	SLW COMMON	
13746	0	53400	1	13773	LXA COS+55,1	LOAD 1 WITH 5
13747	0	56000	0	00146	LDQ COMMON+2	
13750	0	20000	0	00144	MPY COMMON	CALCULATE IN EVEN POWERS
13751	0	40000	1	14010	ADD COS+68,1	
13752	0	60100	0	00144	STO COMMON	
13753	2	00001	1	13747	TIX COS+35,1,1	
13754	0	56000	0	00144	LDQ COMMON	MAKE FINAL MPY BY Y,
13755	0	20000	0	00145	MPY COMMON+1	YEILDING FIXED-POINT RESULT
13756	0	40000	0	00145	ADD COMMON+1	
13757	0	14000	0	13767	TOV COS+51	TEST FOR OVERFLOW
13760	0	77100	0	00010	ARS 8	
13761	-0	50100	0	13775	ORA COS+57	AFFIX EXPONENT AND NORMALIZE
13762	0	30000	0	13775	FAD COS+57	
13763	0	56000	0	00147	LDQ COMMON+3	SET PROPER SIGN,RESTORE
13764	0	76300	0	00000	LLS 0	REGISTER 1, AND EXIT
13765	-0	53400	1	13773	LXD COS+55,1	
13766	0	02000	4	00002	TRA 2,4	
13767	0	50000	0	14000	CLA COS+60	SIN X IS 1
13770	0	02000	0	13763	TRA COS+47	
13771	0	50000	0	00147	CLA COMMON+3	--ERROR RETURN
13772	0	02000	4	00001	TRA 1,4	
13773	0	00000	0	00005	PZE 5	
13774	+2230000000000				OCT 2230000000000	CONSTANT FOR INTEGER
13775	+2000000000000				OCT 2000000000000	BASE EXPONENT
13776	+202622077325				OCT 202622077325	FLO. PI
13777	+203622077325				OCT 203622077325	FLO. 2PI
14000	+2014000000000				OCT 2014000000000	FLO.1.0
14001	+201622077325				OCT 201622077325	FLO PI/2
14002	+1000000000000				OCT 1000000000000	1/4
14003	+000023665735				OCT 000023665735	C9 .00015,148419
14004	-001144463060				OCT -001144463060	C7-.00467,376557

14005	+024315053663	OCT	024315053663	C5	.07968,967928	
14006	-245273602653	OCT	-245273602653	C3-	.64596,371106	
14007	+222077324404	OCT	222077324404	C1	.57079,631847	
14010	+226622077324	OCT	226622077324	FLO.	X LIMIT	
	14011	B	HED			
14011	0 60100 0 14055	J1	STO J1+36	S	X	00000
14012	0 56000 0 14055		LDQ J1+36	X		00001
14013	0 26000 0 14053		FMP J1+34	O	ALF	00002
14014	0 60100 0 14063		STO J1+42	S	QUALS ONE HALF X	00003
14015	0 60100 0 14056		STO J1+37	A	PREVIOUS TERM	00004
14016	0 56000 0 14056		LDQ J1+37			00005
14017	0 26000 0 14056		FMP J1+37			00006
14020	0 60100 0 14057		STO J1+38	S	X/2SQUARED	00007
14021	0 50000 0 14052		CLA J1+33	O		00008
14022	0 60100 0 14060		STO J1+39	S	EQUAL TO ONE	00009
14023	0 50000 0 14060		CLA J1+39	S	OF LOOP	00010
14024	0 30000 0 14052		FAD J1+33			00011
14025	0 60100 0 14061		STO J1+40	S	N PLUS ONE	00012
14026	0 56000 0 14061		LDQ J1+40			00013
14027	0 26000 0 14060		FMP J1+39			00014
14030	0 60100 0 14062		STO J1+41	N	ES N PLUS ONE	00015
14031	0 56000 0 14056		LDQ J1+37	F	NEXT TERM	00016
14032	0 26000 0 14057		FMP J1+38			00017
14033	0 24100 0 14062		FDP J1+41			00018
14034	-0 60000 0 14056		STQ J1+37	N	TERM	00019
14035	0 50000 0 14054		CLA J1+35			00020
14036	-0 40000 0 14056		SBM J1+37			00021
14037	0 12000 0 14050		TPL J1+31	C	RGENCE	00022
14040	0 50000 0 14061		CLA J1+40	N	S ONE	00023
14041	0 60100 0 14060		STO J1+39	N		00024
14042	0 50000 0 14056		CLA J1+37			00025
14043	0 76000 0 00002		CHS			00026
14044	0 60100 0 14056		STO J1+37	C	E PREVIOUS TERM SIGN	00027
14045	0 30000 0 14063		FAD J1+42			00028
14046	0 60100 0 14063		STO J1+42	S	S INCREASED	00029
14047	0 02000 0 14023		TRA J1+10	T	FER TO REPEAT LOOP	00030
14050	0 50000 0 14063		CLA J1+42	A	R TO AC	00031
14051	0 02000 4 00001		TRA 1,4	E		00032
14052	+201400000000		DEC 1.0			00033
14053	+200400000000		DEC 0.5			00034
14054	+146527461670		DEC .00000001			00035
14055	0 00000 0 00000		HTR 0	X		00036
14056	0 00000 0 00000		HTR 0	P	OUS TERM	00037
14057	0 00000 0 00000		HTR 0	O	ALF X AQUARED	00038

14060	0	00000	0	00000	HTR	0	N		00039
14061	0	00000	0	00000	HTR	0	N	S ONE	00040
14062	0	00000	0	00000	HTR	0	N	ES N PLUS ONE	00041
14063	0	00000	0	00000	HTR	0	S		00042
14064	0	60100	0	14130	J0 STO	J0+36	S	X	00000
14065	0	50000	0	14125	CLA	J0+33			00001
14066	0	60100	0	14135	STO	J0+41	S	UM EQUAL TO ONE	00002
14067	0	60100	0	14131	STO	J0+37	P	OUS TERM EQUALS ONE	00003
14070	0	56000	0	14130	LDQ	J0+36			00004
14071	0	26000	0	14126	FMP	J0+34			00005
14072	0	60100	0	14132	STO	J0+38			00006
14073	0	56000	0	14132	LDQ	J0+38			00007
14074	0	26000	0	14132	FMP	J0+38			00008
14075	0	60100	0	14132	STO	J0+38	S	X/2 SQUARED	00009
14076	0	76000	0	00000	CLM				00010
14077	0	60100	0	14133	STO	J0+39	S	EQUAL TO ZERO	00011
14100	0	50000	0	14133	CLA	J0+39	S	OF LOOP	00012
14101	0	30000	0	14125	FAD	J0+33			00013
14102	0	60100	0	14133	STO	J0+39	N	INCREASED BY ONE	00014
14103	0	56000	0	14133	LDQ	J0+39	N		00015
14104	0	26000	0	14133	FMP	J0+39	N		00016
14105	0	60100	0	14134	STO	J0+40	N	ARED	00017
14106	0	56000	0	14131	LDQ	J0+37	F	NEXT TERM	00018
14107	0	26000	0	14132	FMP	J0+38			00019
14110	0	24100	0	14134	FDP	J0+40			00020
14111	-0	60000	0	14131	STQ	J0+37	N	TERM	00021
14112	0	50000	0	14127	CLA	J0+35	C	RGENCE TEST	00022
14113	-0	40000	0	14131	SBM	J0+37			00023
14114	0	12000	0	14123	TPL	J0+31	C	RGENCE	00024
14115	0	50000	0	14131	CLA	J0+37			00025
14116	0	76000	0	00002	CHS				00026
14117	0	60100	0	14131	STO	J0+37	S	CHANGE FOR ALTERNATE	00027
14120	0	30000	0	14135	FAD	J0+41			00028
14121	0	60100	0	14135	STO	J0+41	S	S INCREASED	00029
14122	0	02000	0	14100	TRA	J0+12	T	FER TO REPEAT LOOP	00030
14123	0	50000	0	14135	CLA	J0+41	A	R IN AC	00031
14124	0	02000	4	00001	TRA	1,4	E		00032
14125	+2014000000000				DEC	1.0			00033
14126	+2004000000000				DEC	0.5			00034
14127	+146527461670				DEC	0.000000001			00035
14130	0	00000	0	00000	HTR	0	X		00036
14131	0	00000	0	00000	HTR	0	N	TERM	00037
14132	0	00000	0	00000	HTR	0	X	QUARED	00038
14133	0	00000	0	00000	HTR	0	N		00039

14134 0 00000 0 00000
14135 0 00000 0 00000
14136
07454
00000

FINISH

HTR 0
HTR 0
HED
END DAR

N ARED
S F SERIES

00040
00041