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CONICAL SHELL DEFLECTION AND ACCELERATION RESPONSE PROGRAM (DARC)

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SUBMITTED UNDER NASA Contract NAS 1-3179

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SUMMARY

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Detailed information is presented for using an IBM 7094 computer program which will calculate the response of truncated conical shells to random pressure excitation such as encountered by spacecraft adapters during a launch trajectory. This program was developed in connection with NASA (Langley Research Center) Contract NAS 1-3179.

A normal mode approach is used in the program formulation, with each mode represented by a second order linear oscillator. Options are provided for using either theoretical or experimental vibration modal data. The pressure excitation is handled by dividing the shell surface into many small areas and either (1) assuming a different homogeneous pressure over each resulting sub-area, or (2) using empirically determined pressure co-spectra to integrate the equations for each sub-area pair.

Author

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1. INTRODUCTION

This report is a program manual to be used in conjunction with an IBM 7094 computer program developed by McDonnell Aircraft Corporation for NASA (Langley Research Center) Contract NAS 1-3179.

The computer program will calculate the response of truncated conical shells to random pressure excitation induced by aerodynamic turbulence; a typical application would be the determination of spacecraft adapter response to buffeting pressures. The computed response functions are the normal coordinate deflection and acceleration power spectra, and the shell radial deflection and acceleration power spectra. The integrals of these functions with respect to frequency are also obtained which gives the associated mean-square responses.

The detailed response analysis upon which the program is based is given in References 1 and 2. In brief, this analysis consists of a normal mode approach with each mode represented by a second order linear oscillator. The exciting pressures are handled by divinding the shell surface into many small areas and either:

(1) assuming a different homogeneous pressure over each resulting sub-area (constant correlation assumption).

(2) using empirically determined pressure co-spectra and integrating the equations over each sub-area pair.

Either theoretical or experimental vibration modal data may be used in the computer program. The modes designated in this report as theoretical are derived in an analysis given in Reference 3 and briefly discussed in Reference 1. These are basically sine-cosine modes. A more general representation of the mode shapes is available in the form of a Fourier series. This later representation may be used for either theoretical or experimental modes.

The size of problem that can be solved (i.e., the number of normal modes and the number of areas into which the shell can be divided) is limited only by the core storage of the IBM 7094. At present the program can handle up to 25 normal modes and 112 areas.

Sections 3 and 4 give all necessary information for using the computer program. Section 3 is arranged such that the basic equations are covered first, with subsequent discussion of the variables appearing in the equations. Derivations associated with details of the program computations are also given in this section. Section 4 is slanted more toward actual program useage, i.e., input of data, program operations, deck set-up, etc.

A detailed table of contents is used herein for the purpose of separating the information of sections 3 and 4 into semi-outline form. This will enable the user to more readily obtain desired information.

2. MAIN SYMBOLS

A	Sub-area or special matrix defined in text
A_m^n	Mode shape coefficient for displacement w
C	Power spectrum or co-spectrum depending upon alike or unlike superscripts
f	Frequency in cycles per second
L	Length of shell frustum
M	Generalized mass
m	Number of longitudinal half-waves of a given mode
n	Number of circumferential waves of a given mode
p	Pressure
q	Normal coordinate
R	Auto-correlation function
r	Radius of shell
x	Coordinate defining distance along cone generator from apex to a point on shell
t	Time
U_c	Convection velocity
w	Radial displacement
α	Streamwise decay rate
$\bar{\alpha}$	Complement of conical shell half-angle
β	Circumferential decay rate
ζ	Ratio of damping to critical damping
θ	Coordinate defining angular position on shell
λ_m	L/m
τ	Time shift for auto-correlation or cross-correlation functions

Φ	Radial mode shape
Ω	Reduced frequency
ω	Frequency in radians per second

Subscripts and Superscripts

A	Indicates relationship to area
a	Indicates response point a
i	Indicates mode i
k, ℓ	Indicate sub-areas k and ℓ, respectively
N	Indicates normalized function
p,q,w	Indicate relationship to pressure, normal coordinate, and deflection, respectively

Matrix Notation

[ ]	Square or Rectangular
⌈ ⌋	Diagonal matrix
⌊ ⌋	Row matrix
$[\ ]^T$	Transpose of matrix

NOTE: Double subscripts or superscripts appearing on symbols within a matrix imply all possible combinations of themselves as they vary from unity to their maximums. As the subscripts or superscripts vary, they give the row and column designation within the matrix; the first subscript or superscript gives the row, and the second gives the column. Thus, the variability of the subscripts or superscripts is limited by the number of rows and columns in the matrix.

Miscellaneous Notation

( )	Parenthesis following a symbol indicates that the symbol is a funtion of those variables appearing within the parenthesis
< >	Indicates a time average

Differentiation of a variable with respect to time is indicated by dots over the variable.

3. ENGINEERING EXPLANATION OF PROGRAM OPERATIONS AND CAPABILITIES

3.1 Basic Equations. - As previously discussed, equations have been derived in Reference 1 for the response of a truncated conical shell to random pressure excitation. These equations result in the radial deflection and acceleration power spectrum of any point "a" on the shell surface. They are programmed on the IBM 7094 as follows:

Normal Coordinate Deflection Spectra

$$C_q^{ii}(f) = \frac{(1/M_i^2\ \omega_i^4)[\Phi_{ik}^A][C_p^{k\ell}(f)][\Phi_{i\ell}^A]^T}{(1-(f/f_i)^2)^2 + (2\zeta_i(f/f_i))^2} \qquad (1)$$

Normal Coordinate Acceleration Spectra

$$C_{\ddot{q}}^{ii}(f) = (\text{ACCEL.})(2\pi)^4\ f^4\ C_q^{ii}(f) \qquad (2)$$

NOTE: "ACCEL." is a constant which is input to the computer program in order that the units of $C_{\ddot{q}}^{ii}$ be g^2/cps.

Radial Shell Deflection Spectra

$$C_w^{aa}(f) = \sum_i \Phi_{ai}^2\ C_q^{ii}(f) \qquad (3)$$

Radial Shell Acceleration Spectra

$$C_{\ddot{w}}^{aa}(f) = \sum_i \Phi_{ai}^2 C_{\ddot{q}}^{ii}(f) \qquad (4)$$

Mean-Square Normal Coordinate Deflection

$$\langle q_i^2(t)\rangle = \int C_q^{ii}(f)\ df \qquad (5)$$

Mean-Square Normal Coordinate Acceleration

$$\langle \ddot{q}_i^2(t)\rangle = \int C_{\ddot{q}}^{ii}(f)\ df = (\text{ACCEL.})(2\pi)^4 \int f^4\ C_q^{ii}(f)\ df \qquad (6)$$

Mean-Square Radial Deflection

$$\langle w_a^2(t)\rangle = \int C_w^{aa}(f)\, df = \sum_i \Phi_{ai}^2 \langle q_i^2(t)\rangle \quad (7)$$

Mean-Square Radial Acceleration

$$\langle \ddot{w}_a^2(t)\rangle = \int C_{\ddot{w}}^{aa}(f)\, df = \sum_i \Phi_{ai}^2 \langle \ddot{q}_i^2(t)\rangle \quad (8)$$

The variables in Equations (1) through (8) are defined as follows:

f	Variable frequency in cycles/sec.
f_i	Ith modal frequency in cycles/sec.
ω_i	Ith modal frequency in radians/sec.
M_i	Generalized mass of ith mode
ζ_i	Ratio of damping to critical damping for mode i
$\Phi_{ik}^A = \int_{A_k} \Phi(x,\theta)\, dA_k$	Integral over the kth area of the ith mode shape
$\lfloor \Phi_{ik}^A \rfloor$	Row matrix formed as k varies from unity to the total number of areas
$[C_p^{k\ell}(f)]$	Matrix of co-spectra of pressures formed as k and ℓ take on all values from unity to the total number of areas. When $k = \ell$, $C_p^{k\ell}(f)$ is a power spectrum.
Φ_{ai}	Value of radial mode shape at point "a" in the ith mode

The determination of the variables needed to solve Equations (1) through (4) is discussed in subsequent sections; once these variables have been determined, the calculation of the deflection and acceleration spectra is relatively straightforward. Equations (5) and (6) are numerically evaluated by use of trapezoidal integration. Equations (7) and (8) are obtained from the results of Equations (5) and (6).

3.2 Co-Spectrum Matrix. - Information pertaining to the co-spectrum matrix is divided into the following five sub-sections.

3.2.1 Constant Correlation Assumption. - When utilizing the constant correlation assumption discussed in Reference 1, the pressure co-spectrum matrix, $[C_p^{k\ell}(f)]$, is computed from

$$\left[C_p^{k\ell}(f)\right] = \left[\sqrt{C_p^{kk}(f)}\right] \left[C_{pN}^{k\ell}(f)\right] \left[\sqrt{C_p^{kk}(f)}\right] \quad (9)$$

where $[C_{pN}^{k\ell}(f)]$ is a matrix of normalized co-spectra with its $k\ell$th element given by

$$C_{pN}^{k\ell}(f) = C_p^{k\ell}(f) \Big/ \sqrt{C_p^{kk}(f)}\,\sqrt{C_p^{\ell\ell}(f)} \quad (10)$$

The input of the pressure power spectra, $C_p^{kk}(f)$, is relatively simple and is discussed in sections 3.2.3 and 4.3.10.3.

The normalized pressure co-spectrum information is input to the computer program in tabular form. Use of a straightforward approach would require the input of one table for each element of $[C_{pN}^{k\ell}(f)]$. With 112 the maximum order of the normalized co-spectrum matrix, this approach is impossible both from a human capability standpoint and from core storage limitations. To circumvent this problem, assumptions have been made which allow the computer program to form the normalized co-spectrum matrix from a limited amount of input data; i.e., the normalized co-spectrum matrix is expanded from a relatively small input matrix. Depending on the assumptions one wishes to make, the normalized co-spectrum matrix can be formed by either of two methods denoted Form One Expansion and Form Two Expansion, respectively.

The basic assumption involved with the Form One Expansion is that the normalized pressure co-spectra are independent of the shell coordinates (x and Θ), but depend only on the increments Δx and $\Delta\Theta$. The Form Two Expansion assumes that the normalized pressure co-spectra are independent of Θ, but in contrast to Form One, they do depend upon longitudinal position x; thus, the co-spectra depend upon x and $\Delta\Theta$. The intricacies of these methods are covered in the explanations which follow. In these explanations, the subscript "p" in $[C_{pN}^{k\ell}(f)]$ can be dropped without loss of clarity if it is remembered that the discussions are concerned with pressure co-spectra only.

3.2.1.1 Form One Expansion - The Form One Expansion assumes that there exists circumferential correlation between three adjacent strips. Since the circumferential correlation is symmetric, right or left, only two strips (columns) are required for input, i.e., the correlation between areas laand 5 is identical to the correlation between areas 1 and 57. The number of sub-areas over which there is appreciable correlation longitudinally is indicated by the crosshatched section shown as an example case in Figure 3.2.1.1-1. Extension to the general case is straightforward. It should be noted that the size of crosshatched section is assumed to be independent of position on the frustum. In other words, the crosshatched section could have been shown anywhere on the frustum as long as it covers three areas longitudinally and two areas circumferentially. Since the normalized co-spectra are input only for the sub-areas in the crosshatched section, the input information will be explained as if areas 1, 2, 3, 5, 6 and 7 are included in the crosshatched section, as shown. It is required that the nor-

Truncated Conical Shell with Form One Expansion

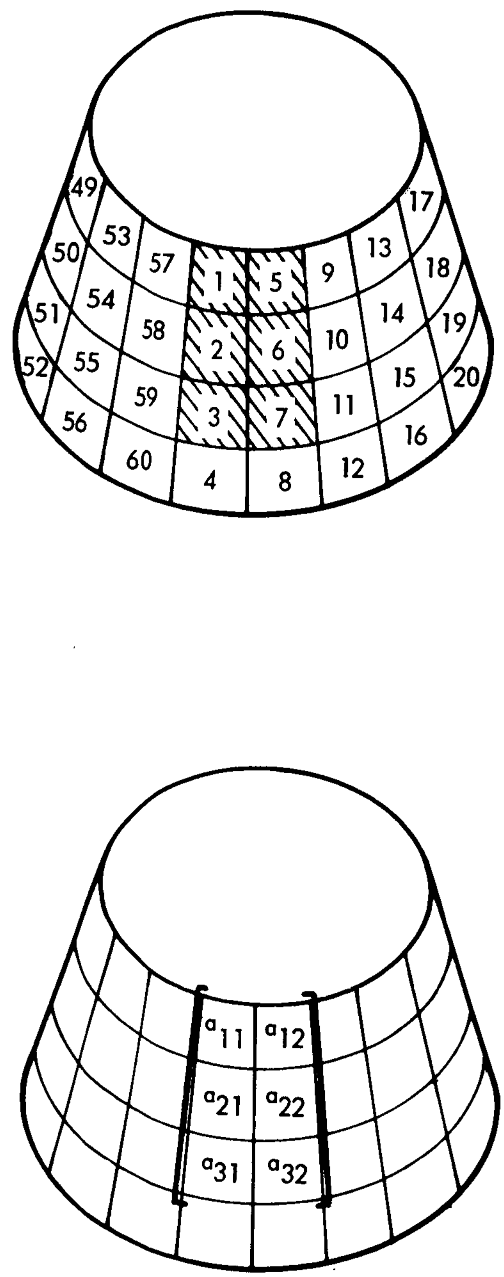


Figure 3.2.1.1-1

malized co-spectrum between each area in the crosshatched section and the number 1 area be input as a co-spectra matrix defined as

$$[A] = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \\ a_{31} & a_{32} \end{bmatrix}$$

There is a specific relationship between the location of any element "a" with respect to the 1,1 element in [A] and the physical location of the corresponding area on the shell with respect to the number 1 area. For instance, a_{32} is two rows down and one column over from a_{11}. Therefore, it is the normalized co-spectrum between area 1 and the area two rows down and one column over, in this case area 7. The element a_{11} would be the normalized co-spectrum of area 1 with itself, which is equal to unity. In terms of the areas in the crosshatched section, the complete set of elements is as follows:

$$a_{11} = C_N^{1,1} = 1.0 \qquad a_{12} = C_N^{1,5}$$

$$a_{21} = C_N^{1,2} \qquad a_{22} = C_N^{1,6}$$

$$a_{31} = C_N^{1,3} \qquad a_{32} = C_N^{1,7}$$

The elements of [A] are read into the program by column.

To form the normalized co-spectra matrix for all areas, $[C_N^{k\ell}]$, the programming logic assumes that the normalized co-spectra depend only on relative position between two areas. Thus, $C_N^{k\ell}$ is formed under the following assumptions:

$$C_N^{1,2} = C_N^{2,3} = C_N^{3,4} = C_N^{5,6} = C_N^{6,7} = \ldots C_N^{57,58} = C_N^{58,59} = C_N^{59,60}$$

$$C_N^{1,3} = C_N^{5,7} = \ldots C_N^{57,59}$$

$C_N^{1,4} = C_N^{5,8} = \ldots C_N^{57,60}$, where $C_N^{1,4} = 0$ since, in this example, there is appreciable correlation over only three areas longitudinally.

$C_N^{1,5} = C_N^{5,9} = \ldots C_N^{53,57}, \; C_N^{1,57}$

$C_N^{1,5} = C_N^{2,6} = C_N^{6,10} = \ldots C_N^{54,58}, \; C_N^{2,58}$

$\vdots$

$C_N^{1,5} = C_N^{4,8} = C_N^{8,12} = \ldots C_N^{56,60}, \; C_N^{4,60}$

$C_N^{1,6} = C_N^{3,8} = C_N^{7,12} = C_N^{11,16}$, etc.

$C_N^{1,6} = C_N^{1,58} = C_N^{57,54} = C_N^{53,50}$, etc.

$C_N^{1,6} = C_N^{2,59} = C_N^{58,55} = C_N^{54,51}$, etc.

$C_N^{1,6} = C_N^{3,60} = C_N^{59,56} = C_N^{55,52}$, etc.

$C_N^{1,7} = C_N^{5,11} = C_N^{9,15} = C_N^{13,19}$, etc.

$C_N^{1,7} = C_N^{2,8} = C_N^{6,12} = C_N^{10,16}$, etc.

$C_N^{1,7} = C_N^{1,59} = C_N^{57,55} = C_N^{53,51}$, etc.

$C_N^{1,7} = C_N^{2,60} = C_N^{58,56} = C_N^{54,62}$, etc.

Since, in this example, there is appreciable correlation over only three areas longitudinally and only two areas circumferentially, the program would use a zero co-spectrum between any areas separated either longitudinally by two areas or circumferentially by one area. For instance, $C_N^{5,8} = 0$ and $C_N^{2,10} = 0$. In forming $[C_N^{k\ell}]$ advantage is taken of the fact that $C_N^{\ell k} = C_N^{k\ell}$.

The size of the crosshatched section and the number of longitudinal areas are identified by the following input parameters:

KL - number of longitudinal areas
KC - number of longitudinal areas over which there is appreciable correlation
KK - number of circumferential areas over which there is appreciable correlation

3.2.1.2 Form Two Expansion. - Figure 3.2.1.2-1 shows a truncated conical shell divided for illustrative purposes into four sections along x and fifteen sections circumferentially. The Form Two Expansion assumes that the correlation between areas in a longitudinal strip is the same for all strips, and correlation between any two areas not in the same strip is zero. Thus, if the co-spectra for the first four areas are input, the program can use this information for the other fourteen strips. The following matrix of co-spectra contains all necessary information for the first strip:

$$\begin{bmatrix} 1 & C_N^{1,2} & C_N^{1,3} & C_N^{1,4} \\ C_N^{1,2} & 1 & C_N^{2,3} & C_N^{2,4} \\ C_N^{1,3} & C_N^{2,3} & 1 & C_N^{3,4} \\ C_N^{1,4} & C_N^{2,4} & C_N^{3,4} & 1 \end{bmatrix} = [\Gamma] \qquad (11)$$

The matrix of normalized co-spectra has been defined as $[\Gamma]$ for convenience. The superscripts correspond to the areas in the first strip. Since $[\Gamma]$ is symmetric and all diagonal terms equal unity, only the elements to the right of the diagonal are input. The order of input is by row, i.e.,

$$C_N^{1,2},\ C_N^{1,3},\ C_N^{1,4},\ C_N^{2,3},\ C_N^{2,4},\ C_N^{3,4}\ .$$

Based on the assumptions of the Form Two Expansion, the total $[C_N^{k\ell}]$ is formed in terms of $[\Gamma]$ as follows:

$$[C_N^{k\ell}] = \begin{bmatrix} \overset{\textcircled{1}}{[\Gamma]} & & & & \\ & \overset{\textcircled{2}}{[\Gamma]} & & & \\ & & \cdot & & \\ & & & \cdot & \\ & & & & \cdot\ \overset{\textcircled{15}}{[\Gamma]} \end{bmatrix} \qquad (12)$$

where the circled numbers indicate the longitudinal strips.

The number of longitudinal areas is given by KL. KC and KK have no meaning in Form Two.

3.2.2 Empirically Determined Correlation. - Empirically determined correlation is incorporated in the response equations by analytically describing the pressure co-spectra over the shell surface and subsequently performing the required integrations for each area and pair of areas into which the shell is subdivided. This approach is given detailed treatment in the appendix of Reference 1.

Truncated Conical Shell with Form Two Expansion

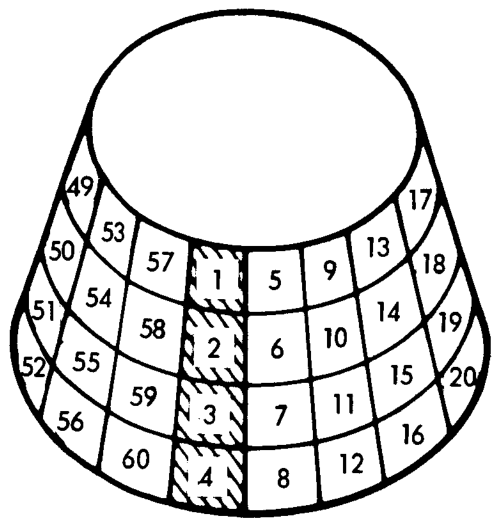


Figure 3.2.1.2-1

The effect of this approach on the computation scheme is to require the calculation of $[C_N^{k\ell}(f)]$ for substitution into Equation (9) rather than inputting tables as is done with the constant correlation assumption method. As is the case with this latter method, however, the normalized co-spectra are not required for every pair of areas; i.e., all possible combinations of $C_N^{k\ell}(f)$ need not be calculated. Instead, it is necessary to calculate only the elements of [A] or [Γ] which are required input when using the constant correlation assumption method. It is also possible to calculate specified elements of [A] and [Γ] and to use input tables for the unspecified elements.

The analytical expression used for the normalized co-spectra is based on the assumption of a convected decaying pressure field. This results in the following equation:

$$C_N(\xi,\eta,f) = e^{-\alpha\xi}\, e^{-\beta\eta} \cos\Omega \tag{13}$$

where:

$\xi = \Delta x$, streamwise separation distance

$\eta = r\,\Delta\Theta$, circumferential separation

α = streamwise decay rate

β = circumferential decay rate

$\Omega = \dfrac{2\pi f \xi}{U_c}$, reduced frequency

U_c = streamwise convection velocity

The integration of Equation (13) for a particular pair of sub-areas results in

$$C_N^{k\ell}(f) = \frac{1}{[(\alpha\xi)^2 + \Omega^2](\beta\eta)^2}\Big\{[(\alpha\xi)^2 - \Omega^2]\cdot$$

$$[e^{-k\alpha\xi}\cos k\Omega + e^{-(k-2)\alpha\xi}\cos(k-2)\Omega - 2e^{-(k-1)\alpha\xi}\cos(k-1)\Omega]$$

$$+\ \delta_{k_1}\alpha\xi\Omega(e^{\alpha\xi} - e^{-\alpha\xi})\sin\Omega\Big\}\Big\{e^{-\ell\beta\eta} + e^{-(\ell-2)\beta\eta} - 2e^{-(\ell-1)\beta\eta}\Big\} \tag{14}$$

where

$\delta_{k_1} = 1$ if $k = 1$

$\delta_{k_1} = 0$ if $k \neq 1$

As used in Equation (14), the superscripts k and ℓ refer to area position longitudinally (streamwise) and circumferentially, respectively. Thus, they have the same meaning as the row and column designation identifying the elements of [A]. The relationship between the calculated normalized co-spectra and the elements of [Γ] is not so straightforward, but this need not concern the reader since the relationship is handled by special programming.

3.2.2.1 Examples. - In order to clarify the above discussion, the examples covered in sections 3.2.1.1 and 3.2.1.2 will again be covered with specified normalized co-spectra to be calculated.

3.2.2.1.1 Form One Expansion. - The method for indicating that a particular normalized co-spectrum (particular element of [A]) is to be calculated consists of putting 21 on the input card which gives the number of points to be expected in the table following the aforementioned card. Actual tabular input must be accomplished with the number of points in the table less than or equal to 20 as indicated in sections 3.2.4 and 4.3.10.4.

Now for illustrative purposes, assume that the following elements of [A] are to be calculated: a_{11}, a_{21}, a_{12}, a_{22}, a_{32}. Assume that it is desired to input element a_{31} as a table. The order and manner of input would be:

co-table ele. (1,1) - 21 points
co-table ele. (2,1) - 21 points
co-table ele. (3,1) - some specified no. of points less than 21
co-table ele. (1,2) - 21 points
co-table ele. (2,2) - 21 points
co-table ele. (3,2) - 21 points

3.2.2.1.2 Form Two Expansion. - Assume that the following required elements of [Γ] are to be calculated: $C_N^{1,3}$, $C_N^{1,4}$, $C_N^{3,4}$. This leaves the elements $C_N^{1,2}$, $C_N^{2,3}$ and $C_N^{2,4}$ to be input by tables. The order and manner of input would be:

co-table ele. (1,2) - less than 21 points
co-table ele. (1,3) - 21 points
co-table ele. (1,4) - 21 points
co-table ele. (2,3) - less than 21 points
co-table ele. (2,4) - less than 21 points
co-table ele. (3,4) - 21 points

As previously mentioned, the computer program will automatically pick the correct k and ℓ to be used in Equation (14); however, the input order must be as given above.

3.2.2.2 Required Input.- When using either of the methods discussed in sections 3.2.2.1.1 and 3.2.2.1.2, the following information with the appropriate units is required:

Input	Units
α, streamwise decay rate	in.$^{-1}$
β, circumferential decay rate	in.$^{-1}$
Average size (length) of sub-area in longitudinal direction	in.
Average size (width of sub-area in circumferential direction	in.
U_c, convection velocity	ft.sec.$^{-1}$

In addition to the above, KL, KC, and KK are required and have the same meanings as when used with the constant correlation assumption methods.

3.2.3 Power Spectra Input. - Regardless of which form of normalized co-spectra input is utilized, there are three possible options concerning power spectra input. These options are the following:

(1) Input only one power spectrum table, which is used for the complete shell.

(2) Input a power spectrum table for each area in one strip into which the shell has been divided.

(3) Input a power spectrum table for each area into which the shell has been divided.

The first option assumes a homogeneous distribution over the complete shell. The second option assumes circular symmetry for the pressure distribution; i.e., the input for a single strip is used for all strips. The third option allows for the power spectrum to vary from area-to-area circumferentially as well as longitudinally. This latter condition is representative of the situation encountered by spacecraft adapters for non-zero angle of attack. When it is used, one is, in effect, assuming that only the magnitude of the exciting pressure is changed by angle of attack, with the correlation (normalized co-spectra) remaining unaffected. This assumption is shown to be fairly reasonable by the data presented in References 4 and 5.

3.2.4 Spectra Tables. - The spectra tables are restricted to twenty points each. The first frequency in the table must be equal to or less than the smallest calculating frequency. The largest calculating frequency must be exceeded of equalled by the largest frequency in the table. The frequencies in each table are independent of the frequencies in any other table. Thus, different sets of frequencies may be used for each table if desired.

When scaled model wind tunnel tests provide the spectral data, as is usually the case, it is necessary to multiply the model frequencies and power spectrum levels by appropriate constants in order to convert the data to full scale. As a convenience, provisions have been made in the computer program to multiply the frequencies of all tables (both power spectra and normalized co-spectra) and the power spectrum levels by input constants. This is not an option, i.e., constants must always be input. Thus, if it is not desired to scale the frequencies and power spectrum levels, the constants must be input as unity.

3.2.5 Mathematical Definition of Power Spectra. - The power spectrum levels are defined such that the area under a power spectrum curve gives the mean-square value. Mathematically,

$$C_p^{kk}(f) = 4 \int_0^\infty \cos(2\pi f \tau) \, R_p^{kk}(\tau) \, d\tau$$

where $R_p^{kk}(\tau)$ is an auto-correlation function.

3.3 Calculation of $[\Phi^A]^T$. - The row matrices $\lfloor \Phi_{ik}^A \rfloor$ and $\lfloor \Phi_{i\ell}^A \rfloor$ appearing in Equation (1) make up the rows of a matrix defined as $[\Phi^A]^T$. That is,

$$[\Phi^A]^T = \begin{bmatrix} \lfloor \Phi_{1k}^A \rfloor \\ \lfloor \Phi_{2k}^A \rfloor \\ \cdot \\ \cdot \\ \lfloor \Phi_{ik}^A \rfloor \end{bmatrix}$$

Note that k and ℓ can be used interchangeably since, when used inside a matrix, each varies from one to the total number of areas into which the shell has been subdivided. The kth element of $\lfloor \Phi_{ik}^A \rfloor$ is the integral over the kth area of the ith mode shape and can be written as

$$\Phi_{ik}^A = \int_{A_k} \Phi_i(x,\theta) \, dA_k \qquad (15)$$

where $\Phi_i(x,\theta)$ is the ith mode radial deflection of a truncated conical shell.

3.3.1 Theoretical Modes. - The mode shape $\Phi_i(x,\theta)$ is given in Reference 1 for a theoretical set of modes and has the form

$$\Phi_i(x,\theta) = A_{m_i}^n \, x \cos(\overline{\alpha}) \sin \frac{x - x_1}{\lambda m_i} \cos(n_i \theta) \qquad (16)$$

The variables in Equation (16) are defined as follows:

$A^n_{m_i}$ - Amplitude factor of ith mode

x - As shown in Figure 3.3.1-1

$\overline{\alpha}$ - As shown in Figure 3.3.1-1

x_1 - As shown in Figure 3.3.1-1

λ_{m_i} - $L/m_i\pi$

L - Length of frustum, $x_E - x_1$

m_i - Number of longitudinal half-waves

n_i - Number of circumferential waves

In order to determine Φ^A_{ik}, Equation (16) is used to substitute for $\Phi_i(x,\theta)$ in Equation (15) and A_k is put in a more definitive form. This results in

$$\Phi^A_{ik} = A^n_{m_i} \cos(\overline{\alpha}) \int_{x_u}^{x_{u+1}} \int_{\theta_v}^{\theta_{v+1}} x \sin\left(\frac{x-x_1}{\lambda_{m_i}}\right)\cos(n_i\theta) r(x)\, d\theta\, dx \tag{17}$$

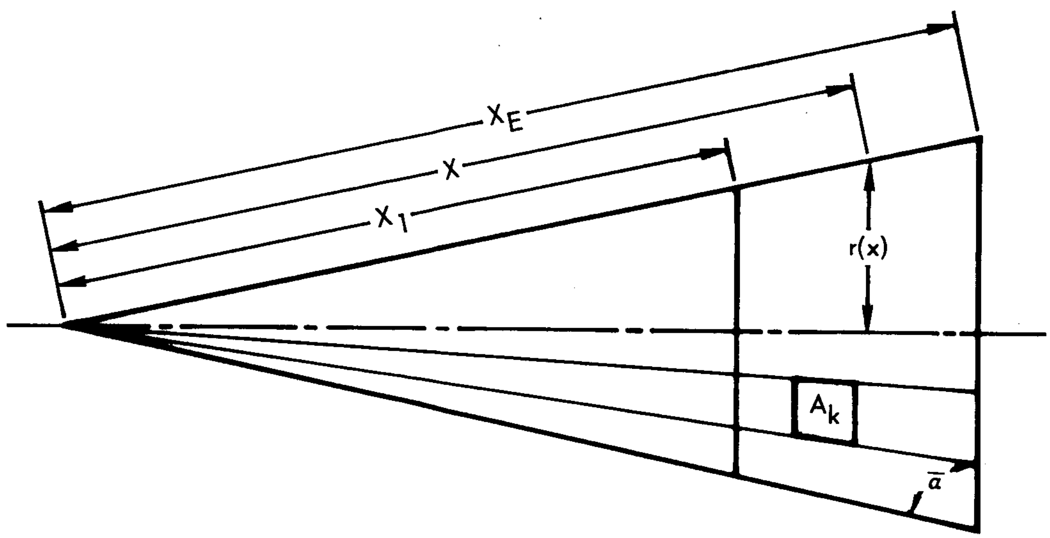
The variables x_u, x_{u+1}, θ_v, θ_{v+1} define the limits associated with A_k (see Figure 3.3.1-1). Substitution of $r(x) = x \cos(\overline{\alpha})$ in Equation (17) gives

$$\Phi^A_{ik} = A^n_{m_i} \cos^2(\overline{\alpha}) \int_{x_u}^{x_{u+1}} \int_{\theta_v}^{\theta_{v+1}} x^2 \sin\left(\frac{x-x_1}{\lambda_{m_i}}\right) \cos(n_i\theta)\, d\theta\, dx \tag{18}$$

The integral of Equation (18) is given by

$$\begin{aligned}
\Phi^A_{ik} = {} & \overline{\beta}\, \lambda^3_{m_i} \cos\left(\frac{x_1}{\lambda_{m_i}}\right) \Bigg\{ -\left(\frac{x^2_{u+1}}{\lambda^2_{m_i}} \cos\left(\frac{x_{u+1}}{\lambda_{m_i}}\right) - \frac{x^2_u}{\lambda^2_{m_i}} \cos\left(\frac{x_u}{\lambda_{m_i}}\right)\right) \\
& + 2\left(\frac{x_{u+1}}{\lambda_{m_i}} \sin\left(\frac{x_{u+1}}{\lambda_{m_i}}\right) - \frac{x_u}{\lambda_{m_i}} \sin\left(\frac{x_u}{\lambda_{m_i}}\right)\right) + 2\left(\cos\left(\frac{x_{u+1}}{\lambda_{m_i}}\right) - \cos\left(\frac{x_u}{\lambda_{m_i}}\right)\right)\Bigg\} \\
& - \overline{\beta}\, \lambda^3_{m_i} \sin\left(\frac{x_1}{\lambda_{m_i}}\right) \Bigg\{\left(\frac{x^2_{u+1}}{\lambda^2_{m_i}} \sin\left(\frac{x_{u+1}}{\lambda_{m_i}}\right) - \frac{x^2_u}{\lambda^2_{m_i}} \sin\left(\frac{x_u}{\lambda_{m_i}}\right)\right) \\
& + 2\left(\frac{x_{u+1}}{\lambda_{m_i}} \cos\left(\frac{x_{u+1}}{\lambda_{m_i}}\right) - \frac{x_u}{\lambda_{m_i}} \cos\left(\frac{x_u}{\lambda_{m_i}}\right)\right) - 2\left(\sin\left(\frac{x_{u+1}}{\lambda_{m_i}}\right) - \sin\left(\frac{x_u}{\lambda_{m_i}}\right)\right)\Bigg\}
\end{aligned} \tag{19}$$

Truncated Conical Shell Theoretical Modal Representation



Section of Frustum

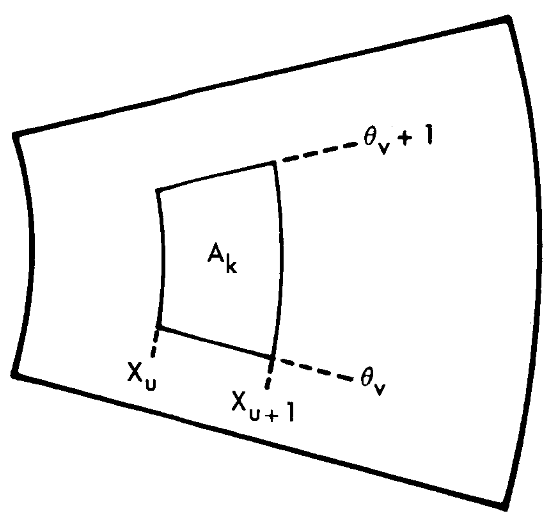


Figure 3.3.1-1

where:

$$\overline{\beta} = \frac{1}{n_i}\left(A^{n}_{m_i} \cos^2 (\overline{\alpha})\right)\left(\sin(n_i \, \theta_{v+1}) - \sin(n_i\theta_v)\right), \; n_i \neq 0$$

$$\overline{\beta} = \left(A^{n}_{m_i} \cos^2 (\overline{\alpha})\right)\left(\theta_{v+1} - \theta_v\right), \; n_i = 0 \qquad (20)$$

Equations (19) and (20) are solved for each area into which the shell is subdivided. The order in which the areas are covered follows a specific sequence. The areas are numbered as shown in Figures 3.2.1.1-1 and 3.2.1.2-1. The area numbers correspond to k in $[\Phi^A_{ik}]$ which is the ith row of $[\Phi^A]^T$. The example configuration shown in Figures 3.2.1.1-1 and 3.2.1.2-1 is for four equal divisions along x and fifteen equal divisions circumferentially; however, the user would specify the number of divisions for an actual problem, subject to the limitations given in section 4.3.6.1.

3.3.2 Fourier Series Modes. - When using a Fourier series modal representation, $[\Phi^A]^T$ is formed in a manner similar to that used with theoretical modes, except a double Fourier series instead of Equation (16) is used for $\Phi_i(x,\theta)$. Referring to Figure 3.3.2-1, the double Fourier series in terms of $\overline{x}$ and θ is

$$\Phi_i(\overline{x},\theta) = \left\{\frac{a_{o_i}}{2} + \sum_m \left(a_{m_i} \cos(\frac{m_i\pi}{\overline{L}}\overline{x}) + b_{m_i} \sin(\frac{m_i\pi}{\overline{L}}\overline{x})\right)\right\}\left\{\frac{c_{o_i}}{2}\right.$$

$$\left. + \sum_n \left(c_{n_i} \cos(n_i\theta) + d_{n_i} \sin(n_i\theta)\right)\right\} \qquad (21)$$

where,

x - Coordinate defining longitudinal distance along part of shell to be analyzed

L - Length of shell frustum to be analyzed

$\overline{x}$ - Coordinate to which Fourier series is referenced

$\overline{L}$ - Length over which Fourier series is defined

γ - Distance between $\overline{x}$ and x($\overline{x}$-x = γ), positive as shown in Figure 3.3.2-1

m_i - Number of longitudinal half-waves

n_i - Number of circumferential waves

a_{m_i} - Coefficient for cosine terms of longitudinal series

Truncated Conical Shell Fourier Series Modal Representation

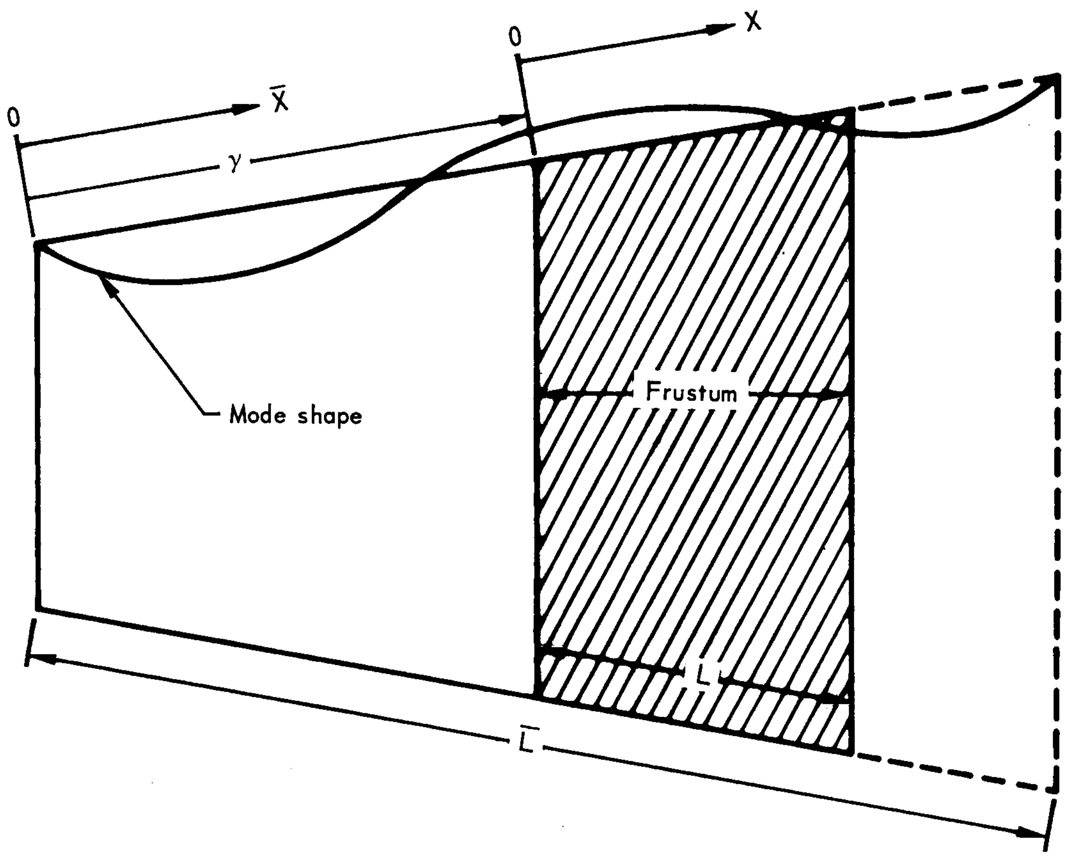


Figure 3.3.2-1

b_{m_i} - Coefficient for sine terms of longitudinal series

c_{n_i} - Coefficient for cosine terms of circumferential series

d_{n_i} - Coefficient for sine terms of circumferential series

Substituting $\bar{x} = x + \gamma$ into Equation (21) and simplifying gives

$$\Phi_i(s,\theta) = \left\{\frac{a_{o_i}}{2} + \sum_m \left[a_{m_i} \left(\cos(\frac{m_i\pi}{\bar{L}} x) \cos(\frac{m_i\pi}{\bar{L}} \gamma) - \sin(\frac{m_i\pi}{\bar{L}} x)\sin(\frac{m_i\pi}{\bar{L}} \gamma)\right) + b_{m_i}\left(\sin(\frac{m_i\pi}{\bar{L}} x)\cos(\frac{m_i\pi}{\bar{L}} \gamma) + \cos(\frac{m_i\pi}{\bar{L}} x)\sin(\frac{m_i\pi}{\bar{L}} \gamma)\right)\right]\right\} \bullet \left\{\frac{c_{o_i}}{2} + \sum_n \left[c_{n_i} \cos(n_i\theta) + d_{n_i} \sin(n_i\theta)\right]\right\} \quad (22)$$

Writing Equation (22) in a simpler manner and substituting into Equation (15) results in

$$\Phi^A_{ik} = \int_{x_u}^{x_{u+1}} \int_{\theta_v}^{\theta_{v+1}} \left\{\left[\frac{a_{o_i}}{2} + \sum_m \left(\bar{a}_{m_i} \cos(\frac{m_i\pi}{\bar{L}} x) + \bar{b}_{m_i} \sin(\frac{m_i\pi}{\bar{L}} x)\right)\right]\left[\frac{c_{o_i}}{2} + \sum_n \left(c_{n_i} \cos(n_i\theta) + d_{n_i} \sin(n_i\theta)\right)\right] r(x)\,d\theta\,dx\right\} \quad (23)$$

where

$$\bar{a}_{m_i} = a_{m_i} \cos(\frac{m_i\pi}{\bar{L}} \gamma) + b_{m_i} \sin(\frac{m_i\pi}{\bar{L}} \gamma) \quad (24)$$

$$\bar{b}_{m_i} = -a_{m_i} \sin(\frac{m_i\pi}{\bar{L}} \gamma) + b_{m_i} \cos(\frac{m_i\pi}{\bar{L}} \gamma) \quad (25)$$

Assuming that $r(x)$ can be approximated satisfactorily by the average radius of the crosshatched section, r_{av}, the integration indicated in Equation (23) gives the following result:

$$\Phi^A_{ik} = \frac{r_{av}\,\bar{L}}{\pi}\left\{\frac{a_{o_i}\pi}{2\bar{L}} (x_{u+1} - x_u) + \sum_m \frac{1}{m_i}\left[\bar{a}_{m_i}\left(\sin(\frac{m_i\pi}{\bar{L}} x_{u+1}) - \sin(\frac{m_i\pi}{\bar{L}} x_u)\right) - \bar{b}_{m_i}\left(\cos(\frac{m_i\pi}{\bar{L}} x_{u+1}) - \cos(\frac{m_i\pi}{\bar{L}} x_u)\right)\right]\right\} \left\{\frac{c_{o_i}}{2} (\theta_{v+1} - \theta_v) + \sum_n \frac{1}{n_i}\left[c_{n_i}\left(\sin(n_i\theta_{v+1}) - \sin(n_i\theta_v)\right) - d_{n_i}\left(\cos(n_i\theta_{v+1}) - \cos(n_i\theta_v)\right)\right]\right\} \quad (26)$$

Assuming that the section of frustum to be analyzed is divided into equal segments longitudinally and circumferentially, i.e., $x_{u+1} - x_u = \Delta x$ and $\theta_{v+1} - \theta_v = \Delta\theta$, Equation (26) can be written as

$$\Phi^A_{ik} = \frac{r_{av}\,\bar{L}}{\pi}\left\{\frac{a_{o_i}\,\pi}{\bar{L}}\,\Delta x + \sum_m \frac{1}{m_i}\left[\bar{a}_{m_i}\left(\mu_{m_i}\sin\left(\frac{m_i\pi}{\bar{L}}\,x_u\right) + \nu_{m_i}\cos\left(\frac{m_i\pi}{\bar{L}}\,x_u\right)\right)\right.\right.$$

$$\left.\left. - \bar{b}_{m_i}\left(\mu_{m_i}\cos\left(\frac{m_i\pi}{\bar{L}}\,x_u\right) - \nu_{m_i}\sin\left(\frac{m_i\pi}{\bar{L}}\,x_u\right)\right)\right]\right\}\left\{\frac{c_{o_i}}{2}\,\Delta\theta + \right.$$

$$\sum_n \frac{1}{n_i}\left[c_{n_i}\left(\mu_{n_i}\sin(n_i\theta_v) + \nu_{n_i}\cos(n_i\theta_v)\right)\right.$$

$$\left.\left. - d_{n_i}\left(\mu_{n_i}\cos(n_i\theta_v) - \nu_{n_i}\sin(n_i\theta_v)\right)\right]\right\} \qquad (27)$$

where

$$\mu_{m_i} = \left[\cos\left(\frac{m_i\pi}{\bar{L}}\,\Delta x\right)\right] - 1 \qquad (28)$$

$$\nu_{m_i} = \sin\left(\frac{m_i\pi}{\bar{L}}\,\Delta x\right) \qquad (29)$$

$$\mu_{n_i} = \left[\cos(n_i\Delta\theta)\right] - 1 \qquad (30)$$

$$\nu_{n_i} = \sin(n_i\Delta\theta) \qquad (31)$$

Equations (24), (25), and (27) through (31) are solved for each area into which the shell has been divided. The order in which the areas are covered follows the same sequence as given for the theoretical modes.

3.4 <u>Deflection and Acceleration Calculations</u> - From Equation (3) of section 3.1, it can be seen that the response deflection calculation requires Φ^2_{ai} for all combinations of a and i.

3.4.1 Theoretical Modes. - It will be shown in this section how Φ_{ai}^2 is related to the theoretical modes given in Reference 1. The equation for the ith radial mode, as written in Reference 1, is

$$\Phi_i(x,\theta)_c = A_{m_i}^n \; x \cos(\bar{\alpha}) \sin\left(\frac{x-x_1}{\lambda_{m_i}}\right) \cos(n_i\theta) \tag{32}$$

The subscript "c" indicates cosine mode. To obtain a completely general solution, a sine mode in θ must also be included in the analysis. The equation for this mode is

$$\Phi_i(x,\theta)_s = A_{m_i}^n \; x \cos(\bar{\alpha}) \sin\left(\frac{x-x_1}{\lambda_{m_i}}\right) \sin(n_i\theta) \tag{33}$$

With both these modes included in the analysis, the deflection response is given as

$$C_w^{aa}(f) = \sum_i \Phi_i^2(x_a,\theta_a)_c \, C_{q_c}^{ii}(f) + \Phi_i^2(x_a,\theta_a)_s \, C_{q_s}^{ii}(f) \tag{34}$$

where $C_{q_c}^{ii}(f)$ and $C_{q_s}^{ii}(f)$ are the normal coordinate power spectra for the ith cosine mode and ith sine mode, respectively.

In order to write Equation (34), it is necessary to neglect all cross terms between the normal coordinate responses (normal coordinate co-spectra) in the same manner as is done in Reference 1. Computer studies have indicated this to be a valid assumption, even for the co-spectrum between a sine and cosine pair of modes having the same modal frequencies. These co-spectra have been found to be several orders of magnitude less than the associated normal coordinate power spectra, $C_{q_c}^{ii}$ and $C_{q_s}^{ii}$. A further result of the above computer studies is that, for all practical purposes, $C_{q_c}^{ii}$ and $C_{q_s}^{ii}$ are equal. These findings are for a symmetric pressure excitation, however, and are not valid for non-symmetric excitation.

Equation (34) is simplified and the amount of computation substantially reduced if it is assumed that $C_{q_c}^{ii} = C_{q_s}^{ii}$. Thus, Equation (34) is written

$$C_w^{aa}(f) = \sum_i \left(\Phi_i^2(x_a,\theta_a)_c + \Phi_i^2(x_a,\theta_a)_s\right) C_{q_c}^{ii}(f) \tag{35}$$

By setting

$$\left(\Phi_i^2(x_a,\theta_a)_c + \Phi_i^2(x_a,\theta_a)_s\right) = \Phi_{ai}^2$$

Equation (35) becomes Equation (3). Substituting Equations (32) and (33) into the above expression for Φ_{ai}^2 results in

$$\Phi_{ai}^2 = \left(A_{m_i}^n \, x_a \cos (\overline{\alpha}) \right)^2 \sin^2 \left(\frac{x_a - x_1}{\lambda_{m_i}} \right) \tag{36}$$

The above equation is used to determine the required Φ_{ai}^2. The values of x at which the responses are desired are input to the computer program. The calculated deflection and acceleration response spectra are printed out in the same order as the x's are read in.

It should be noted that the assumption used to write Equation (35), i.e., $C_{q_s}^{ii} = C_{q_c}^{ii}$, cannot be used with the third power spectrum input option covered in section 3.2.3.

3.4.2 Fourier Series Modes. - When using a Fourier series modal representation, the values of Φ_{ai}^2 are read directly into the computer program. They are stored in a matrix designated $[\Phi^2]^T$ and are arranged in this matrix as follows:

$$[\Phi^2]^T = \begin{bmatrix} \Phi_{11}^2 & \Phi_{21}^2 & \cdots & \Phi_{a1}^2 \\ \Phi_{12}^2 & \Phi_{22}^2 & \cdots & \Phi_{a2}^2 \\ \vdots & \vdots & & \vdots \\ \Phi_{1i}^2 & \Phi_{2i}^2 & \cdots & \Phi_{ai}^2 \end{bmatrix}$$

Thus, each row of the above matrix gives the modal deflections squared of a particular mode.

As is the case with theoretical modes, the response spectra are printed out in the same order as the Φ_{ai}^2 are input.

3.5 Input of Generalized Masses, Modal Damping, and Modal Frequencies. - The generalized masses, modal damping ratios, and modal frequencies are input in the same order as the rows of $[\Phi^A]^T$. In other words, the ith input generalized mass, damping ratio, and frequency are related to the ith row of $[\Phi^A]^T$.

3.6 Calculation Frequencies. - The calculating frequencies are best explained by an example. Let a set of calculating frequencies be given by the following:

Calculation Frequency	Calculation Interval	No. of Calculations ÷ No. of Printouts
50.	2.	1.
60.	3.	1.
70.	1.	2.
81.		

Between 50 and 60 cps, the program will calculate every 2 cps and printout each time it calculates. Between 60 and 70 cps, the program will calculate and printout 63, 66, 69 and 70 cps. Between 70 and 81 cps, the program will calculate every 1 cps and printout at 72, 74, 76, 68, 80 and 81 cps.

In addition to the above frequencies, the program also calculates and prints out at each of the modal frequencies.

3.7 Units. - In addition to the specific units required in section 3.2.2, the modal frequencies f_i must be input with units of cycles/sec. Also when using theoretical modes, α is always input in degrees.

Any consistent set of units may be used for the other input variables; a possible set is as follows:

Input	Units
$C^{kk}(f)$	$(\text{lb./in.}^2)^2/\text{cps}$
$[\phi^A]^T$	in.^2
$[\phi^2]^T$	Dimensionless
M_i	$\text{lb.sec.}^2/\text{in.}$

Output	Units
Normal Coordinate Deflection Spectra	$\text{in.}^2/\text{cps}$
Normal Coordinate Acceleration Spectra	$(\text{in/sec.}^2)^2/\text{cps}$ with ACCEL. = 1.0 g^2/cps with ACCEL. = 1/386
Radial Shell Deflection Spectra	$\text{in.}^2/\text{cps}$
Radial Shell Acceleration	$(\text{in/sec.}^2)^2/\text{cps}$ with ACCEL. = 1.0 g^2/cps with ACCEL. = 1/386

There may be some confusion about the elements of $[\Phi^2]^T$ having no units. This is because of the x in Equations (32) and (33), which apparently gives Φ_{ai}^2 units of $inches^2$. It should be recognized, however, that the x, as used in these equations, is a mode shape modifying factor only. Another possible modifying factor, which would not cause confusion, would be e^{hx}. This latter factor is obviously dimensionless, although it does depend on x.

4. COMPUTATIONAL PROCEDURES AND DETAILED PROGRAM INFORMATION

4.1 General Program Discussion. - The Deflection and Acceleration Response Calculation Digital Computer Program (DARC) will calculate the random response of the frustum of a moderately tapered conical shell, or section of a cylinder, subjected to random pressure excitation.

4.1.1 Language. - This program was originally written in FORTRAN II and later converted to FORTRAN IV. This write-up pertains only to the FORTRAN IV version.

4.1.2 Operations. - The program requires only standard input-output tapes with no special setup. The operating system is IBSYS. See section 4.4

4.1.3 Size. - The program is too large for an in-core program so the overlay feature of IBSYS is used to overcome this difficulty. The program is divided into three links, with each link being called once per data case.

4.1.4 Options. - The program allows the user the option of calculating the basic data or inputing the data directly. Also, optional input features are available. Following is a brief list of these options.

4.1.4.1 Optional $[\Phi A]^T$. - Three methods are allowed and they are as follows:

(a) Input,
(b) Calculated using theoretical modes,
(c) Calculated using Fourier Series modes.

4.1.4.2 Optional $[\Phi^2]^T$. - Two methods are allowed and they are as follows:

(a) Input,
(b) Calculated using theoretical modes.

4.1.4.3 Optional Power Spectrum Input. - Three methods are allowed and they are as follows:

(a) One PSD for each area in strip of shell,
(b) One PSD for complete shell (homogenous pressure),
(c) One PSD for each area of shell (angle-of-attack).

4.1.4.4 Optional Co-Spectrum Input. - Two methods are allowed and they are as follows:

(a) Form one. See section 4.3.10.4
(b) Form two. See section 4.3.10.4

4.1.5 Subroutines. - A brief description of the various subroutines and links used by DARC are given in the following paragraphs.

4.1.5.1 TLU2, Linear Interpolation. - This routine calculates an f(x) for x by a linear interpolation. No extrapolation will be made. If x is out of the range of the x values in the table an error indicator will be set. See section 4.6.3

4.1.5.2 DPRT, Prints Diagonal Matrix. - This routine prints a diagonal matrix as a row with proper identification. See section 4.6.4

4.1.5.3 DTRM, Calculates Results of Row Matrix Product. - This routine performs only those matrix operations necessary to determine the resulting elements of a row matrix times a rectangular matrix. See section 4.6.5.

4.1.5.4 EXPANC, Co-Spectra Expansion. - This routine expands the basic C matrix to be used in the form two expansion. See section 4.6.2

4.1.5.5 Main Program Link. - This link is used to call the necessary overlay links. See section 4.6.1

4.1.5.6 PART 1, Overlay Link 1. - This link is the first link called by the main program. The $[\Phi A]^T$, the $[\Phi^2]^T$, the integral of the θ function, and the integral of the χ function are calculated in this routine. See section 4.6.6

4.1.5.7 FHALF, Overlay Link 2. - This link is the second link called by the main program. It prints the matrices that are to be used (input or calculated) and reads in more tables for PSD and Co-Spectrum values. See section 4.6.7

4.1.5.8 SHALF, Overlay Link 3. - This link is the third link called by the main program. The program cycles and calculates: Normal Coordinate Deflection Power Spectra, Normal Coordinate Acceleration Power Spectra, Shell Radial Deflection Power Spectra, Shell Radial Acceleration Power Spectra, Mean-Square Normal Coordinate Deflection, Mean-Square Normal Coordinate Acceleration, Mean-Square Radial Deflection, and Mean-Square Radial Acceleration. This routine calls: TLU2, DPRT, DTRM, and EXPANC subroutines. See section 4.6.8

4.2 General Program Flowcharts. - A condensed description of the entire flow of the program has been charted and is identified as Figure 4.2-1. It consists of 9 pages and contains many word descriptions rather than detailed equations.

GENERAL FLOW CHART

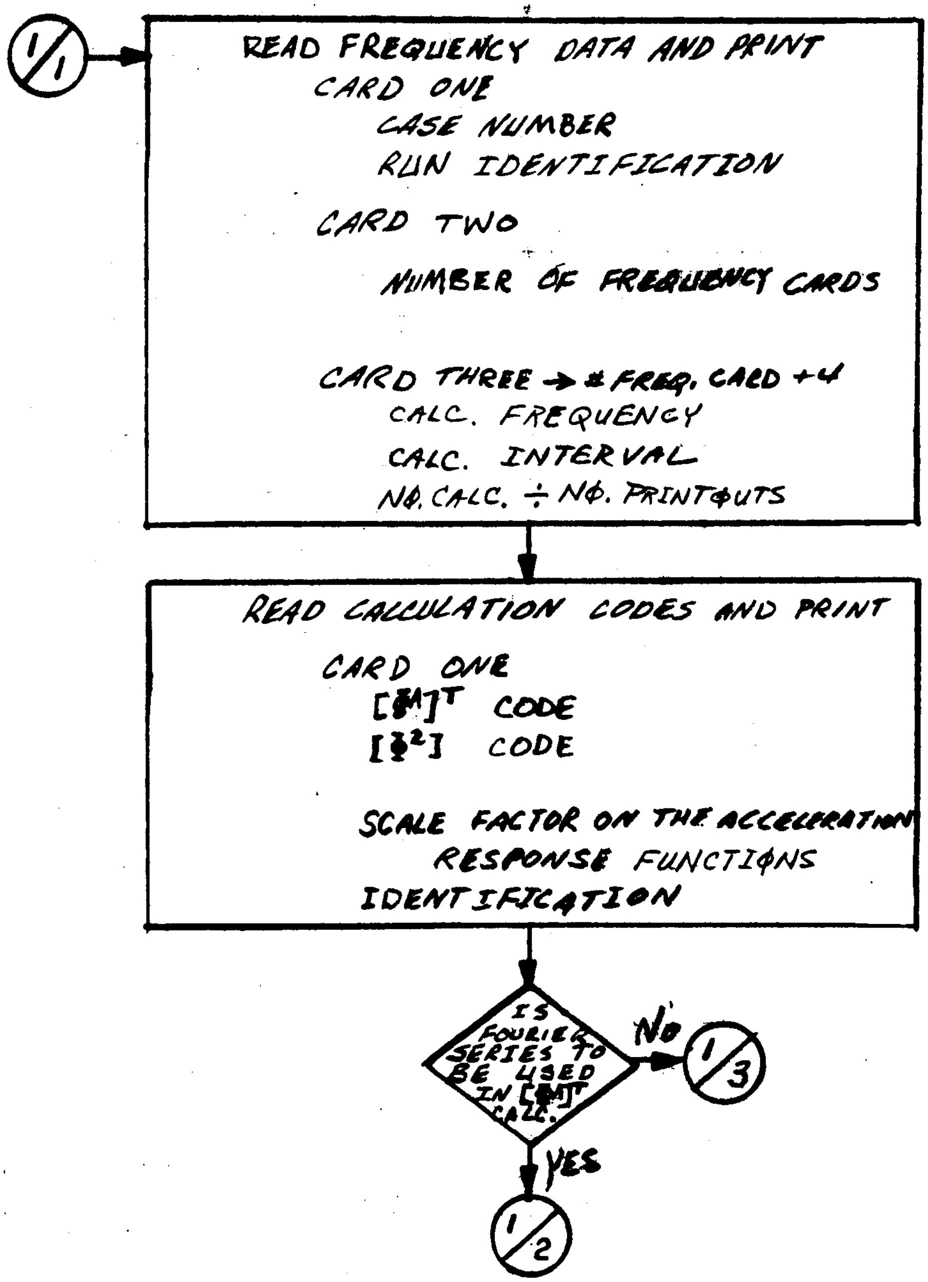


Figure 4.2-1

GENERAL FLOW CHART (CONTINUED)

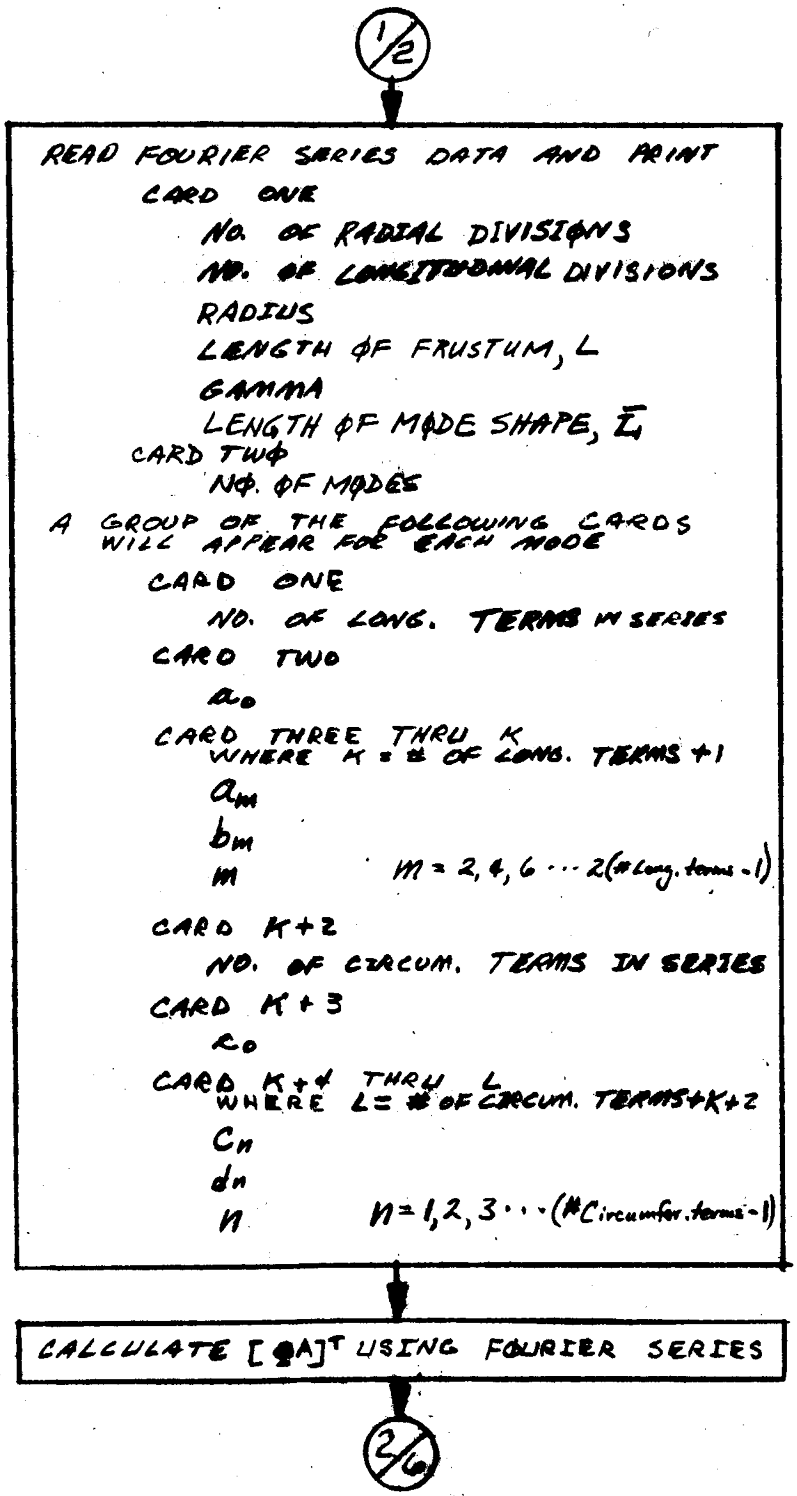


Figure 4.2-1 (Continued)

GENERAL FLOW CHART (CONTINUED)

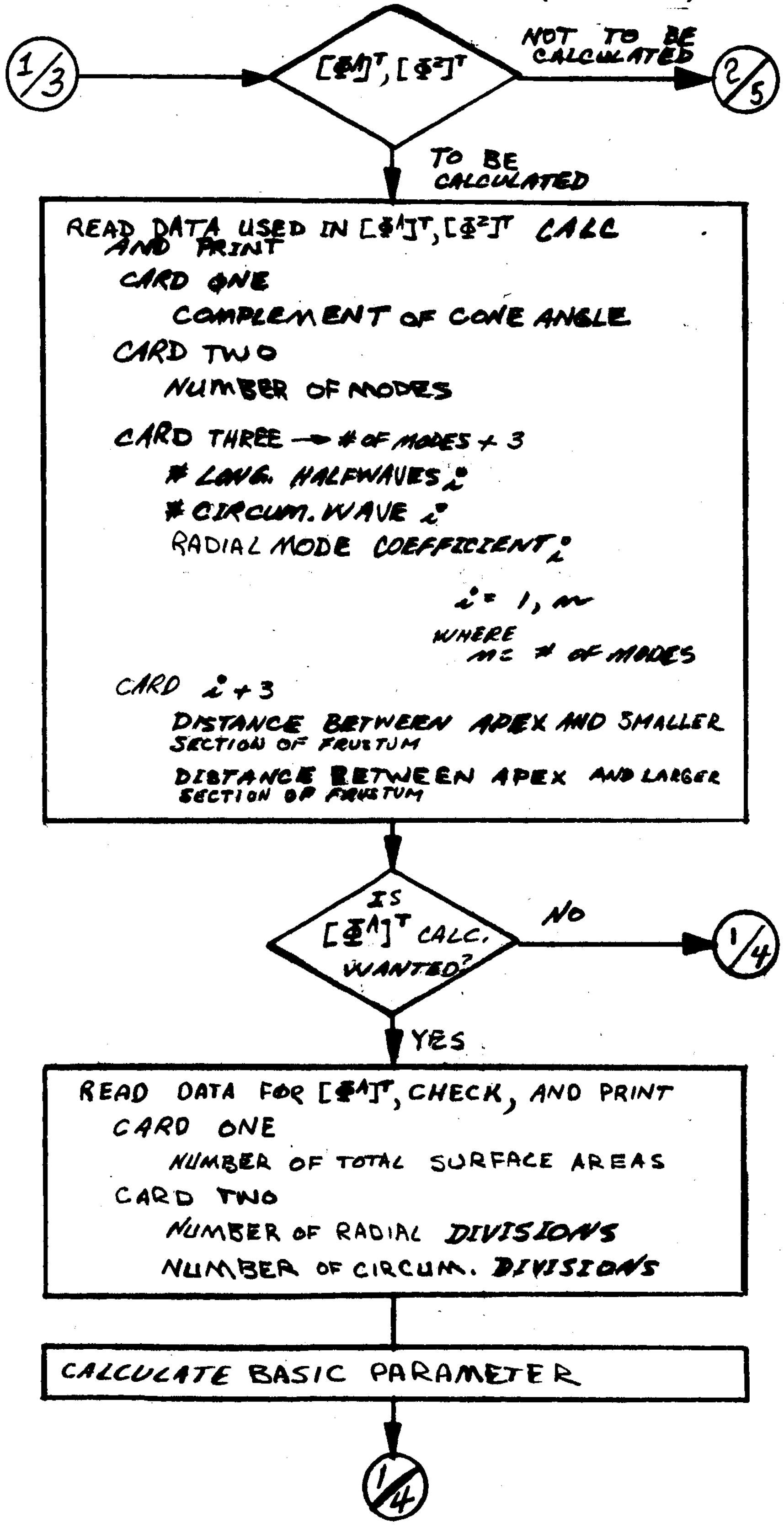


Figure 4.2-1 (Continued)

GENERAL FLOW CHART (CONTINUED)

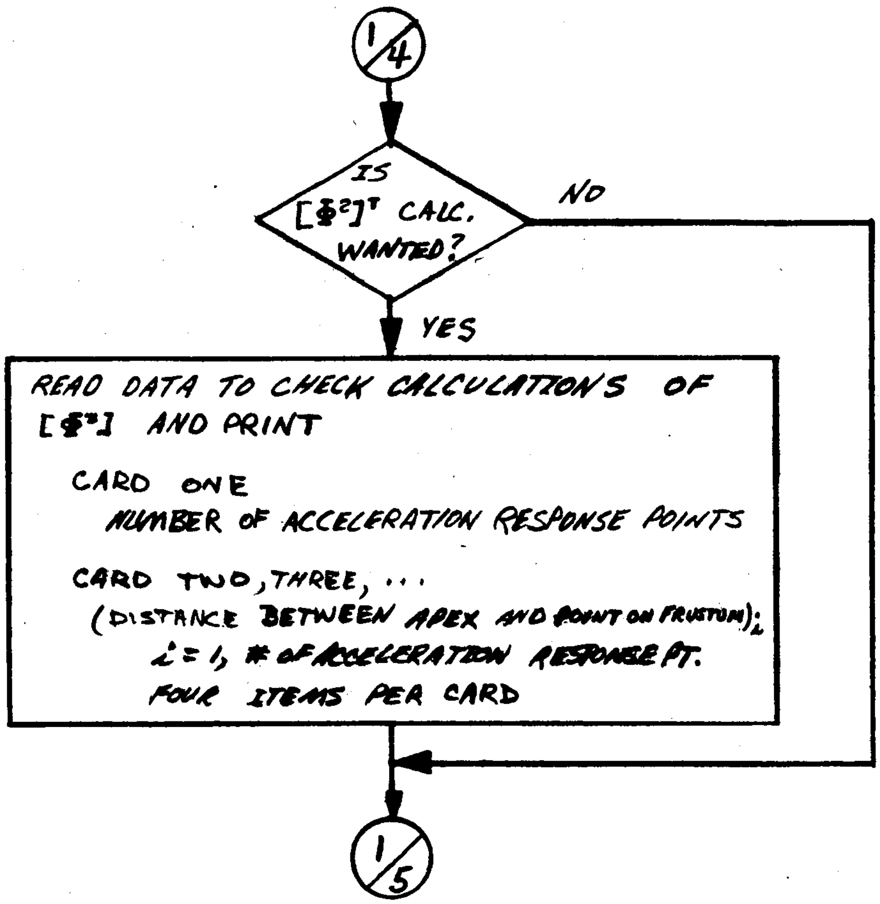


Figure 4.2-1 (Continued)

GENERAL FLOW CHART (CONTINUED)

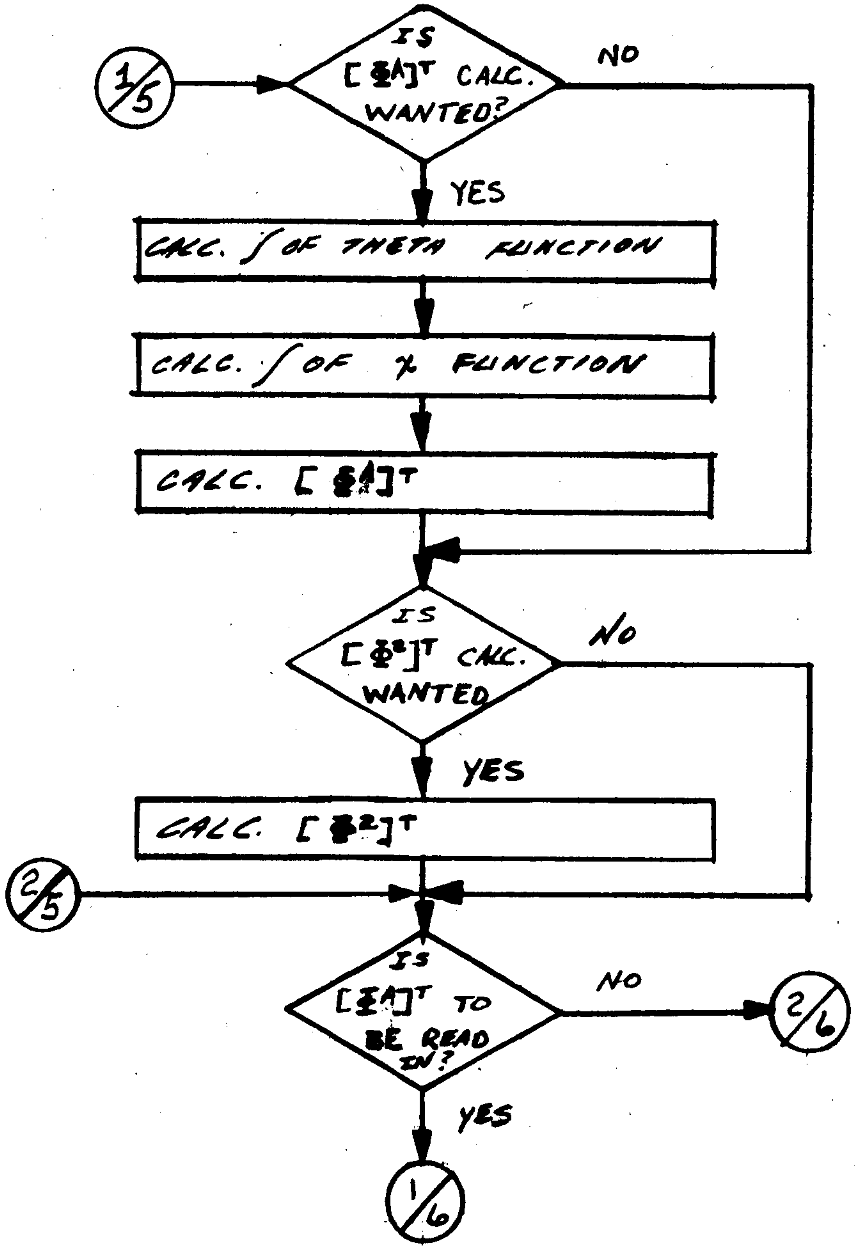


Figure 4.2-1 (Continued)

GENERAL FLOW CHART (CONTINUED)

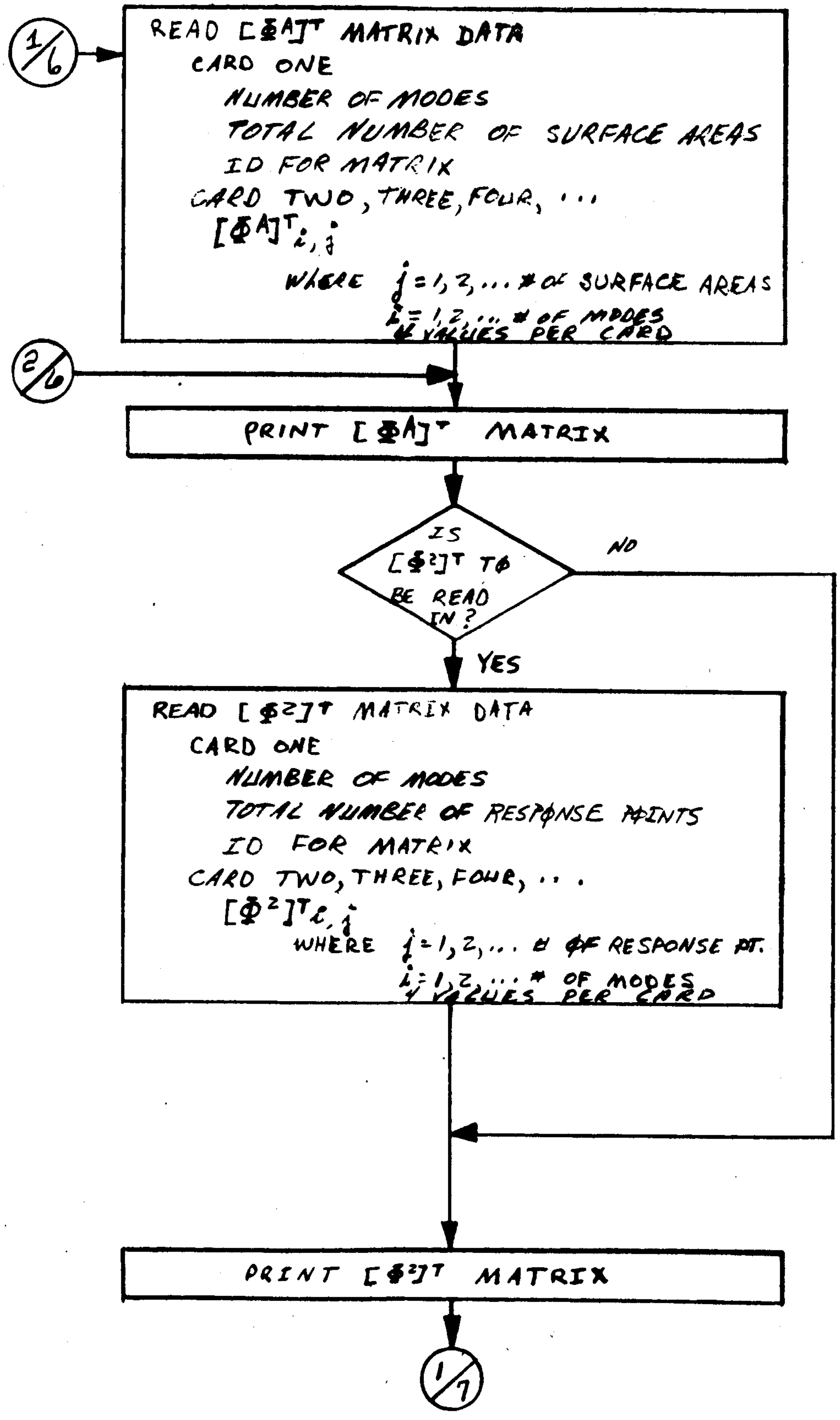


Figure 4.2-1 (Continued)

GENERAL FLOW CHART (CONTINUED)

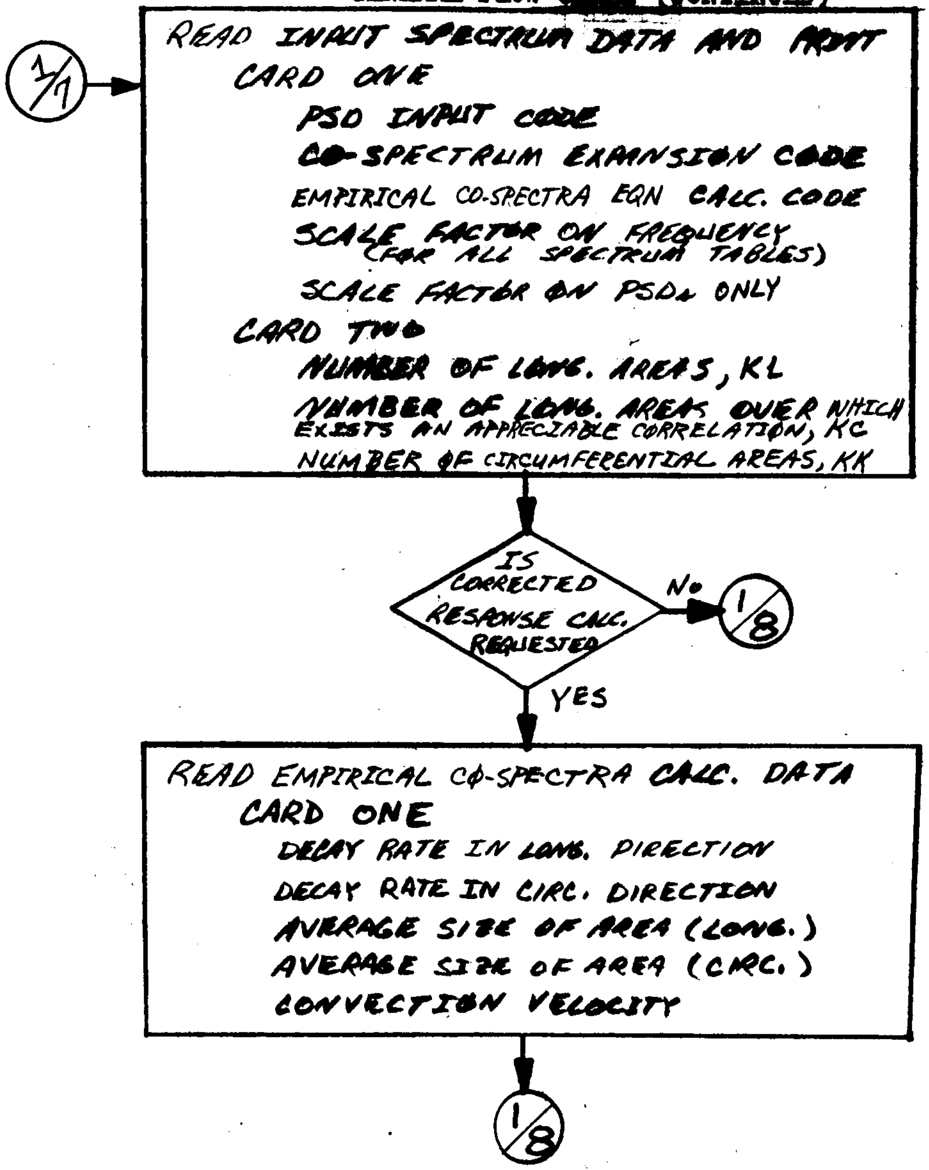


Figure 4.2-1(Continued)

GENERAL FLOW CHART (CONTINUED)

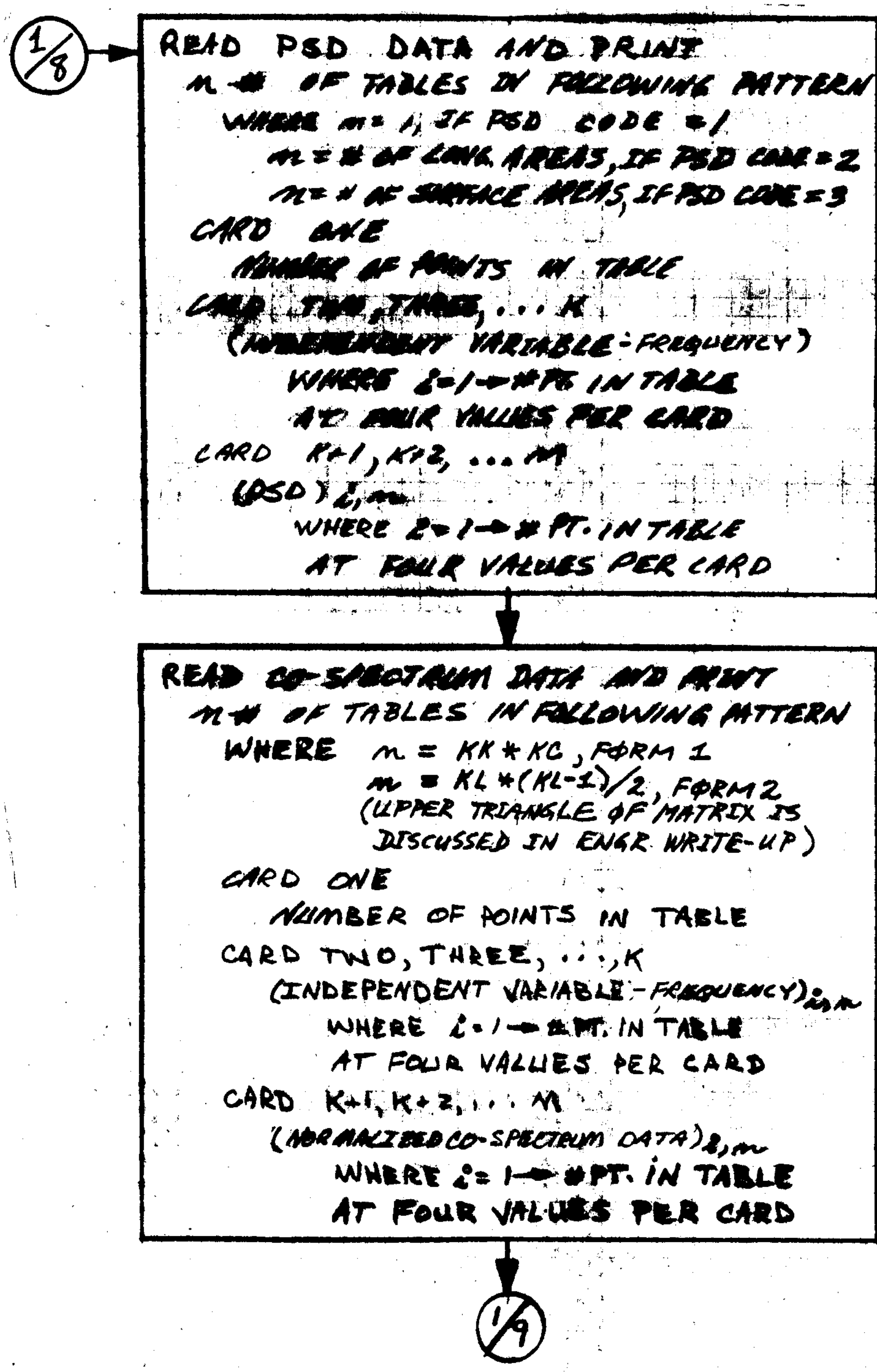


Figure 4.2-1 (Continued)

GENERAL FLOW CHART (CONCLUDED)

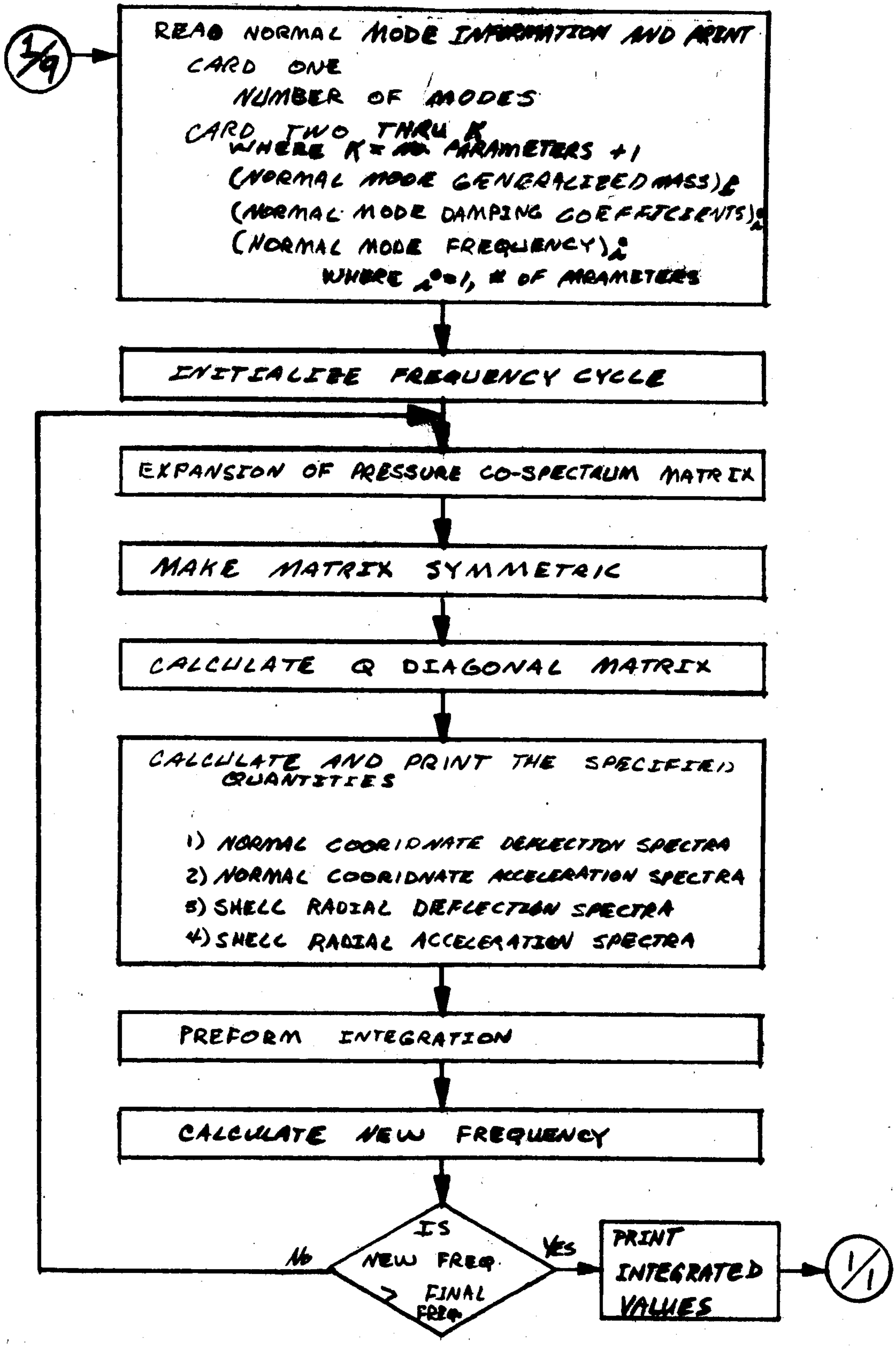


Figure 4.2-1 (Concluded)

4.3 Input Data Description. - Even though the DARC program deals with symmetrical pressures, it still requires a great deal of input data to adequately describe the problem. Herein is a detailed account of the formats required, the order of the data, and the numerical forms necessary.

4.3.1 Case Header Card. - Figure 4.3.1-1 shows the header card for each case. The case number is a fixed point integer and the case identification may be any alpha-numeric character desired.

4.3.2 Frequency Data. - Figure 4.3.1-1 also shows the format for inputing the calculation frequency data. First is a card specifying the number of cards to follow (input number must be fixed point). Second, then, is the set of frequency data cards. The maximum number of frequency data cards if 50. The values must be in floating point notation.

4.3.3 Matrix Control Card. - Figure 4.3.1-1 also shows the control card for determining $[\Phi^A]^T$ and $[\Phi^z]^T$. A value of one indicates direct input. Two indicates that the respective matrix is to be calculated using theoretical modes. Three indicates that $[\Phi^A]^T$ is to be calculated using Fourier Series modes. Three is not valid for $[\Phi^z]^T$. In addition a scale factor for multiplying the acceleration response function is included. This number must be floating point. An ID, or matrix comment, may also be input.

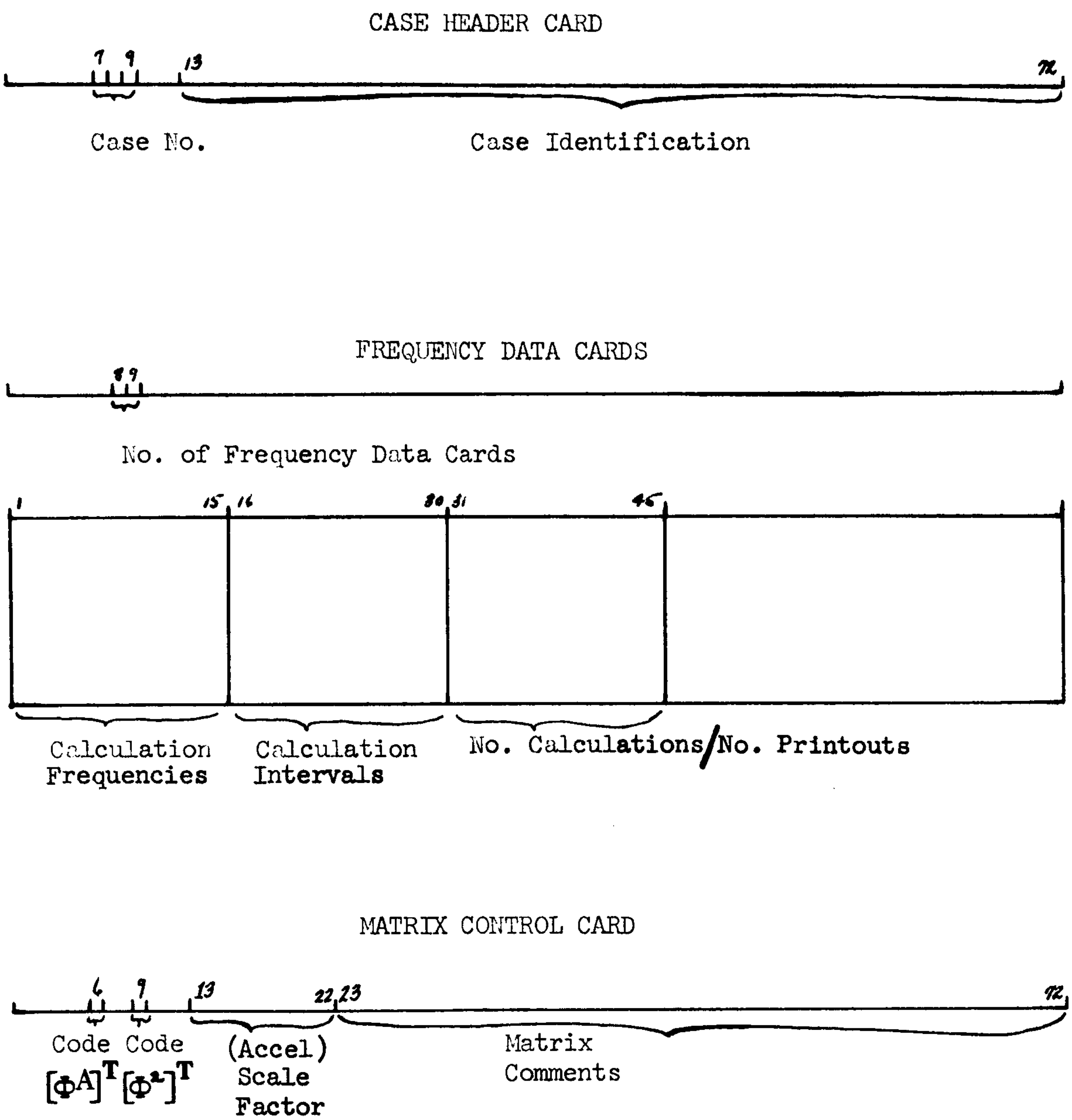

CASE HEADER CARD
7 9
13
72
Case No.
Case Identification
FREQUENCY DATA CARDS
No. of Frequency Data Cards
1
15 16
30 31
45
Calculation Frequencies
Calculation Intervals
No. Calculations/No. Printouts
MATRIX CONTROL CARD
6
13
22 23
72
Code Code
$[\Phi A]^T [\Phi^2]^T$
(Accel) Scale Factor
Matrix Comments

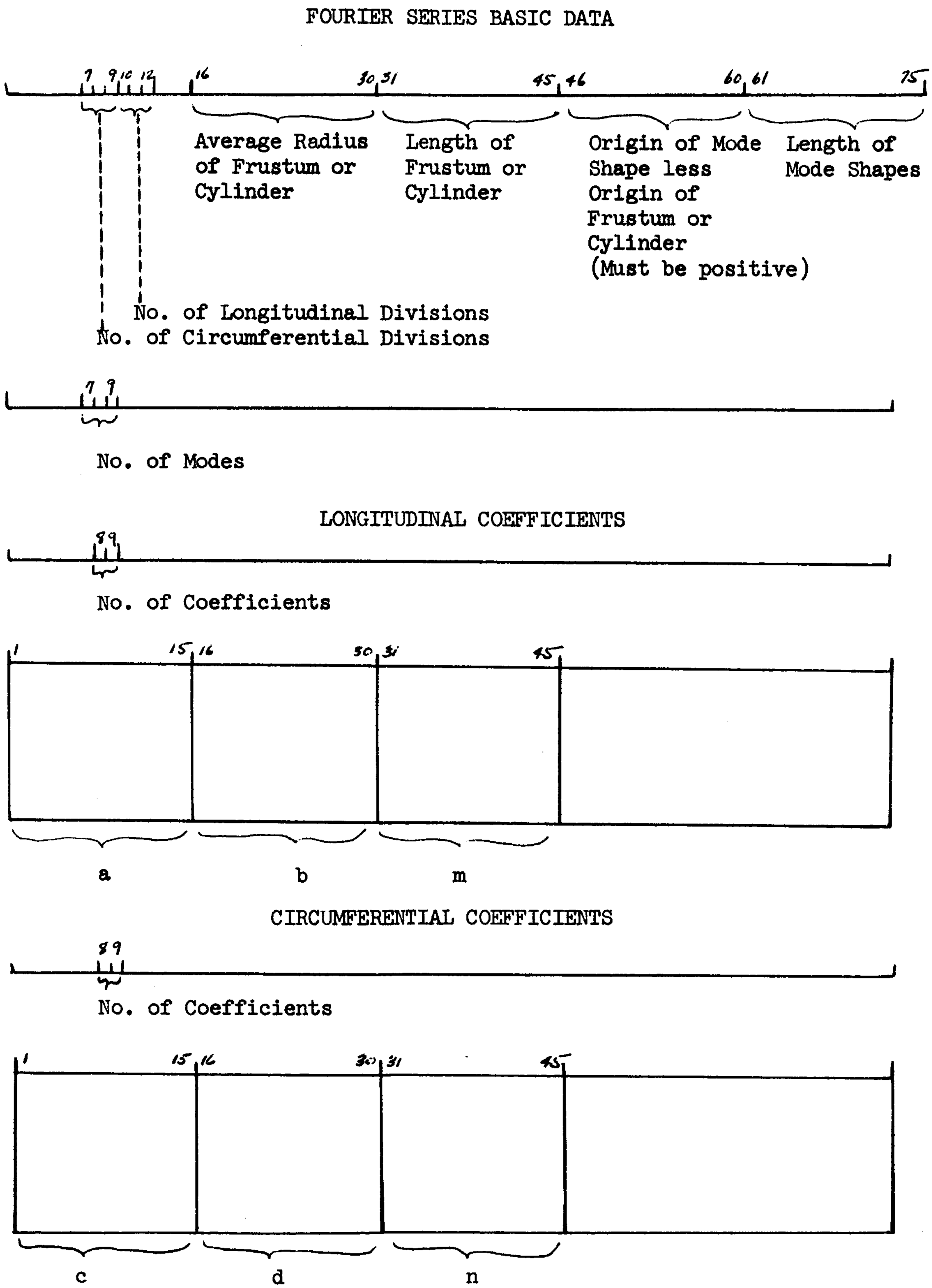
Figure 4.3.1-1

4.3.4 Calculation of $[\Phi^A]^T$ By Fourier Series. - If the code specified is a three, then the set of data described in Figure 4.3.4-1 must be included. Otherwise this portion must be omitted.

4.3.4.1 Fourier Series Basic Data. - In Figure 4.3.4-1 the first card contains two fixed point integers denoting divisions of the frustum or cylinder and four floating point parameters. Card two contains the number of modes (maximum of 25). Following this, then, is a dual set of coefficients for each mode. They are described in the following paragraphs. The longitudinal coefficients are always first.

4.3.4.2 Longitudinal Coefficients. - In Figure 4.3.4-1, under Longitudinal Coefficients, the first card contains a fixed point integer denoting the number of coefficients for the longitudinal series. The maximum number of coefficients is 31. Following this is a set of cards containing the coefficients with the first card containing R_o. The coefficients relating to the Fourier Series are defined in Equation 21, Section 3.3.2.

4.3.4.3 Circumferential Coefficients. - In Figure 4.3.4-1, under Circumferential Coefficients, the first card contains a fixed point integer denoting the number of coefficients for the circumferential series. The maximum here, too, is 31. Following this is a set of cards containing the coefficients with the first card containing R_o. The coefficients relating to the Fourier Series are defined in Equation 21, Section 3.3.2.



(Repeat both Longitudinal and Circumferential Coefficients for each mode).

Figure 4.3.4-1

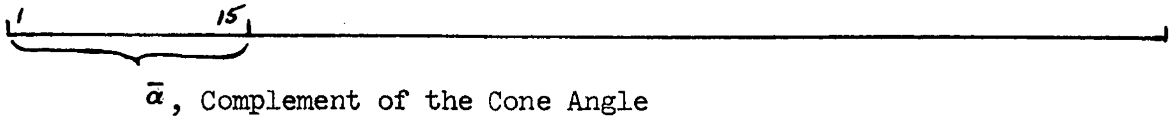
4.3.5 Calculation of Either $[\Phi^{A}]^{T}$ Or $[\Phi^{2}]^{T}$ By The Theoretical Modes. - If the code specified for either $[\Phi^{A}]^{T}$ or $[\Phi^{2}]^{T}$ is a two, then the set of data described in Figure 4.3.5-1 must be included. Otherwise this portion should be omitted.

4.3.5.1 Theoretical Modes Basic Parameter Card. - In Figure 4.3.5-1, under Theoretical Modes Basic Parameter Card, a single card is described which denotes an angular constant.

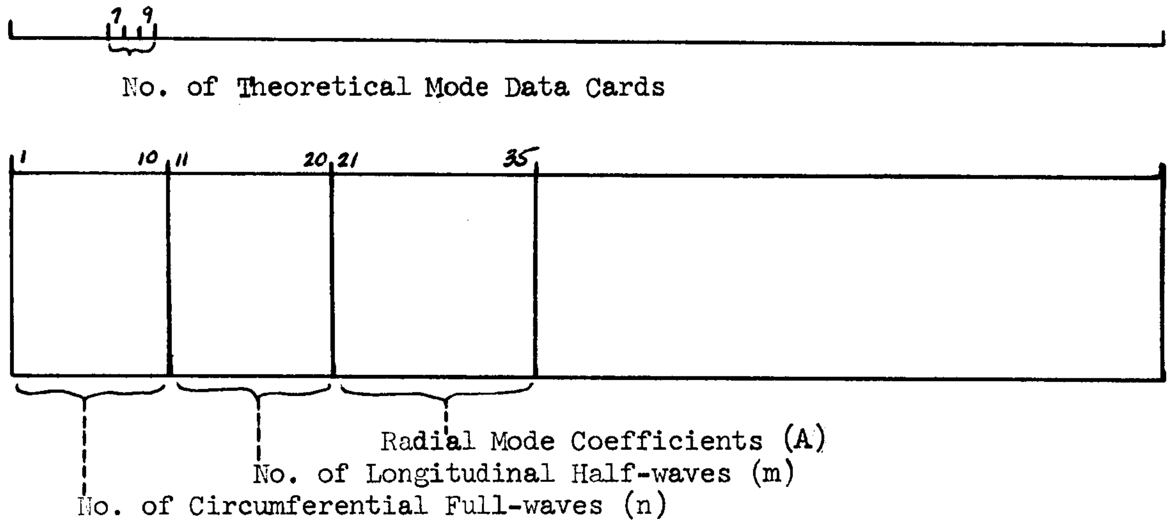
4.3.5.2 Theoretical Modes Data. - In Figure 4.3.5-1, under Theoretical Modes Data, the first card contains a fixed point number denoting the number of data cards to follow. Following it, then, is a set of data cards in floating point notation. The maximum number of theoretical modes is 25.

4.3.5.3 Distance Parameter Card. - In Figure 4.3.5-1, under Distance Parameter Card, a single card is described which denotes two floating point constants. These are used by the Theoretical Modes Option.

THEORETICAL MODES BASIC PARAMETER CARD



THEORETICAL MODES DATA



DISTANCE PARAMETER CARD

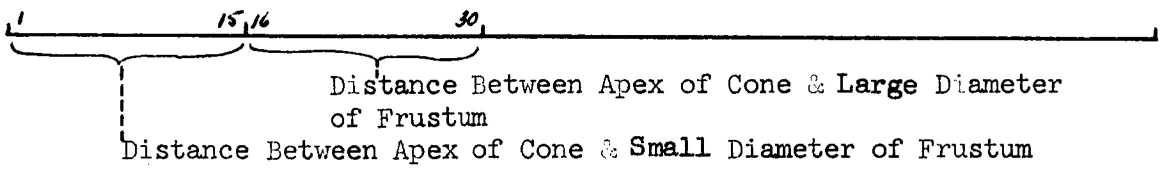


Figure 4.3.5-1

4.3.6 Calculation of $[\Phi^A]^T$ Using Theoretical Modes. - When the code specified is a two, then the two data cards described in Figure 4.3.6-1 must be included. Otherwise this portion should be omitted.

4.3.6.1 Area Parameter Cards. - In Figure 4.3.6-1, under Area Parameter Cards, the first card contains a fixed point parameter. The maximum value is 112. The second card contains two parameters in fixed point notation. The product of the two numbers must equal the number of the first card. In addition to that, the parameter which defines the number of longitudinal areas is limited to a maximum of seven.

AREA PARAMETER CARDS

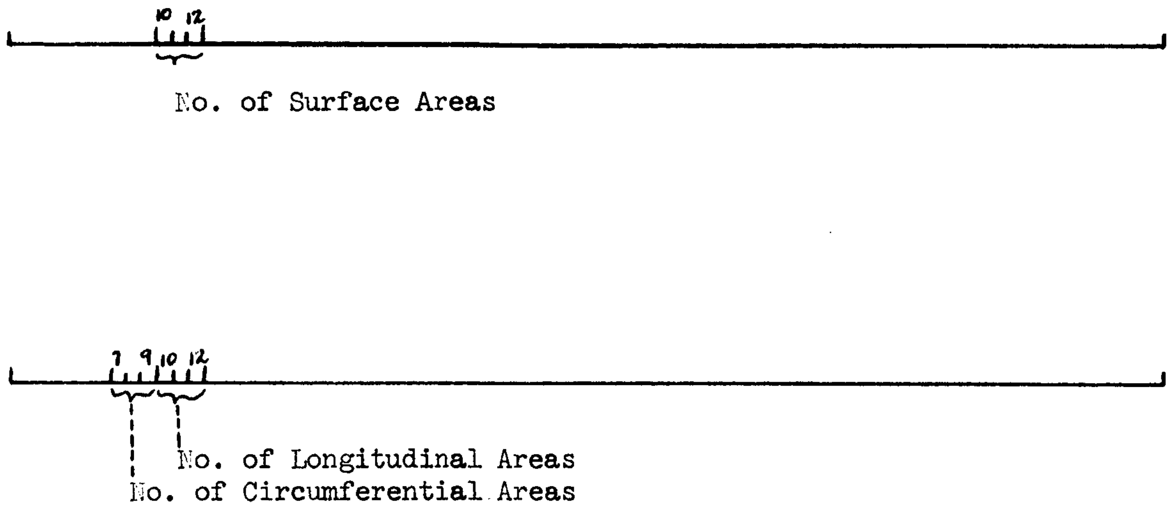
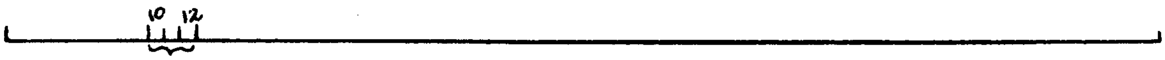


Figure 4.3.6-1

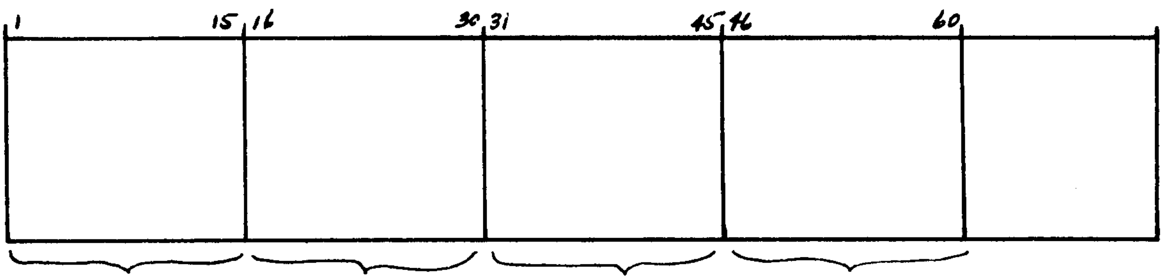
4.3.7 Calculation of $[\Phi^{\ell}]^T$ Using Theoretical Modes. - When the code specified is a two, then the set of data cards described in Figure 4.3.7-1 must be included. Otherwise this portion should be omitted.

4.3.7.1 Acceleration Response Points Desired. - In Figure 4.3.7-1, under Acceleration Response Points Desired, the first card contains a fixed point parameter denoting the number of points specified. Following it, then, is a set of cards containing four floating point values per card. This data represents the distances measured from the apex. The maximum number of response points is 20.

ACCELERATION RESPONSE POINTS DESIRED



No. of Acceleration Response Points



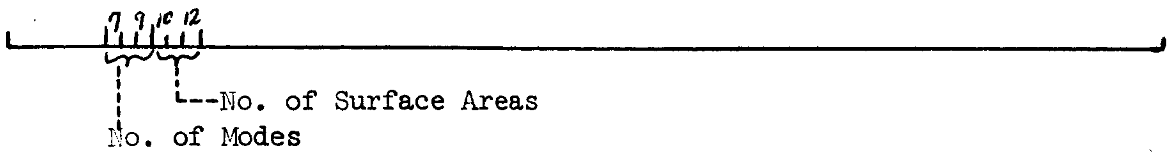
Each value is distance measured from the apex.

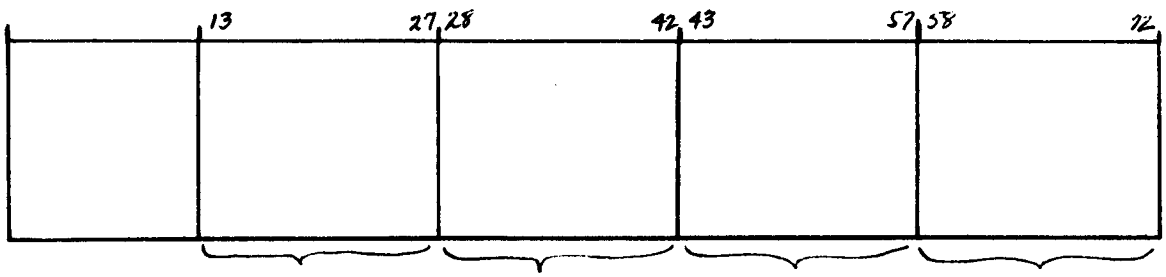
Figure 4.3.7-1

4.3.8 <u>Input $[\Phi A]^T$</u>. - When the code specified is a one, then the set of data cards described in Figure 4.3.8-1 must be included. Otherwise this portion should be omitted.

4.3.8.1 <u>$[\Phi A]^T$ Data Cards</u>. - In Figure 4.3.8-1, under $[\Phi A]^T$ Data Cards, the first card contains a pair of fixed point numbers denoting the order of the matrix to be input. Following it, then, is a set of cards containing four floating point values per card. The matrix is input rowwise with each row beginning on a new card. The maximum order is (25,112). The elements of each row equal the number of surface areas. Each row pertains to a different mode.

$[\Phi A]^T$ DATA CARDS





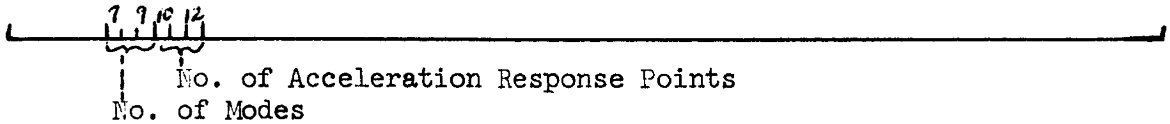
Matrix values with four elements per card, input rowwise, and each row begins on a new card.

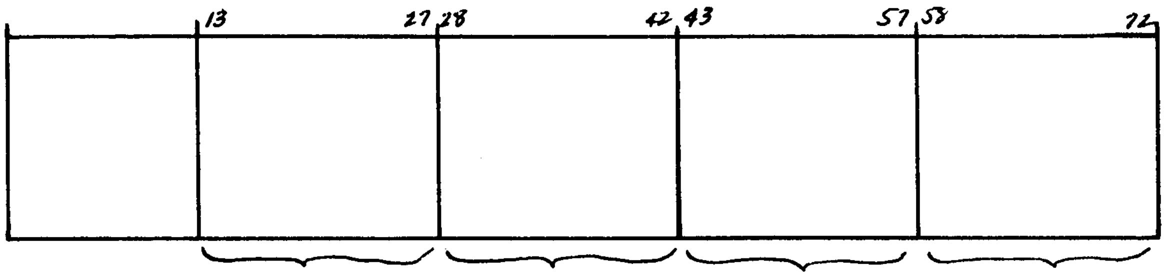
Figure 4.3.8-1

4.3.9 Input $[\Phi^2]^T$. - When the code specified is a one, then the set of data cards described in Figure 4.3.9-1 must be included. Otherwise this portion should be omitted.

4.3.9.1 $[\Phi^2]^T$ Data Cards. - In Figure 4.3.9-1, under $[\Phi^2]^T$ Data Cards, the first card contains a pair of fixed point numbers denoting the order of the matrix to be input. Following it, then, is a set of cards containing four floating point values per card. The matrix is input rowwise with each row beginning on a new card. The maximum order is (25,20). The number of elements of each row equals the number of response points desired. Each row pertains to a different mode.

$[\Phi^2]^T$ DATA CARDS





Matrix values with four elements per card, input rowwise, and each row begins on a new card.

Figure 4.3.9-1

4.3.10 Spectra Input Data. - The power spectral densities (PSDs) and the normalized co-spectra are represented in the DARC program in the form of tables. Linear interpolation is used to obtain the spectrum at a desired frequency. There exists several options of input. This, and other necessary information, will be described in the following paragraphs.

4.3.10.1 Table Control Cards. - Figure 4.3.10.1-1 shows the two control cards required to define the option of input and scalars used.

4.3.10.1.1 PSD Input Code. - In Figure 4.3.10.1-1 the first card contains the PSD Input Code. The code definitions are:

(a) A code of one specifies that a PSD is required for each area in one longitudinal strip. This information is then used for all other strips.

(b) A code of two specifies that one PSD is sufficient for the complete shell (Homogeneous Pressure Distribution).

(c) A code of three specifies that a PSD is required for each area of the shell (Angle of Attack).

4.3.10.1.2 Normalized Co-Spectra Expansion Code. - In Figure 4.3.10.1-1 the first card contains the Normalized Co-Spectra Expansion Code. The code definitions are:

(a) A code of zero specifies that form one is used. See section 4.3.10.4

(b) A code of one specifies that form two is used. See section 4.3.10.4

4.3.10.1.3 Empirical Co-Spectra Calculate Code. - In Figure 4.3.10.1-1 the first card also contains a code specifying the use of empirical co-spectrum rather than using a direct table-lookup. If the code specifies zero, this means no calculation. A non-zero value activates the option.

4.3.10.1.4 Table Scale Factors. - In Figure 4.3.10.1-1 the remaining two floating point parameters of the first card are scale factors. The first applies to all frequency values in all the tables. The latter applies to the PSD magnitudes only.

4.3.10.1.5 Table Input Control Card. - In Figure 4.3.10.1-1 the second card contains three fixed point numbers which specify the number of tables to be input. The parameters, as previously described, are KL, KC, and KK in that order.

TABLE CONTROL CARDS

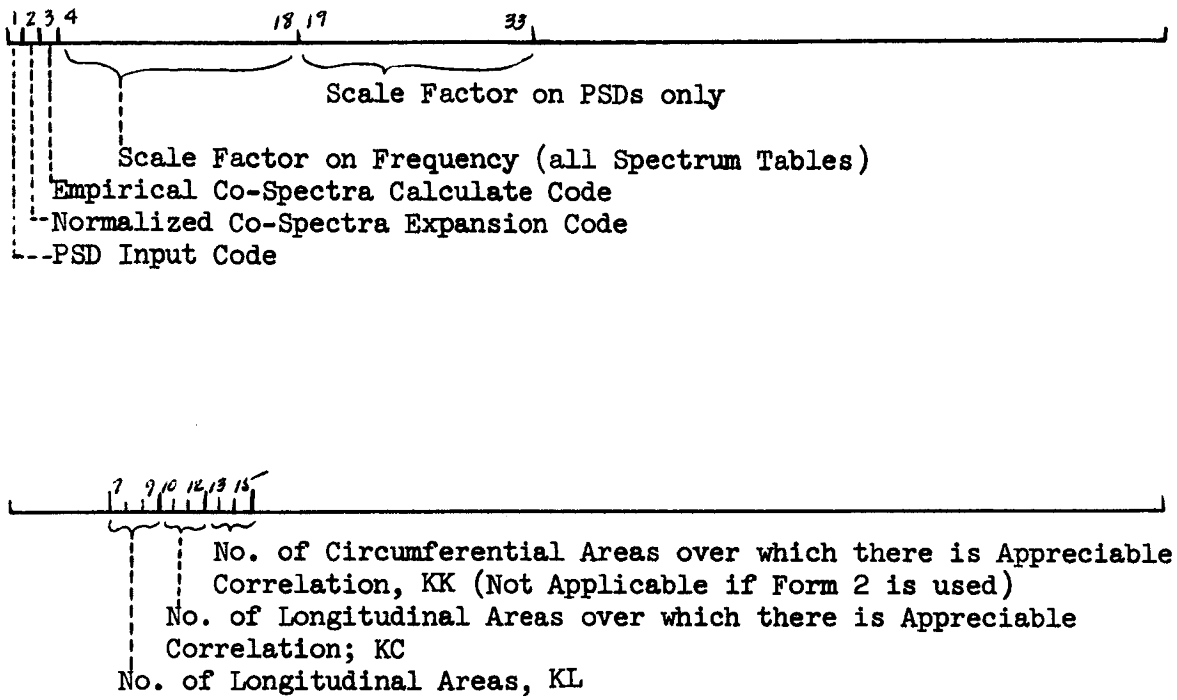


Figure 4.3.10.1-1

4.3.10.2 Empirical Co-Spectra Calculation Parameters. - If the code specified is non-zero, then the data card described in Figure 4.3.10.2-1 must be included. Otherwise this card should be omitted.

EMPIRICAL CO-SPECTRA CALCULATION PARAMETERS

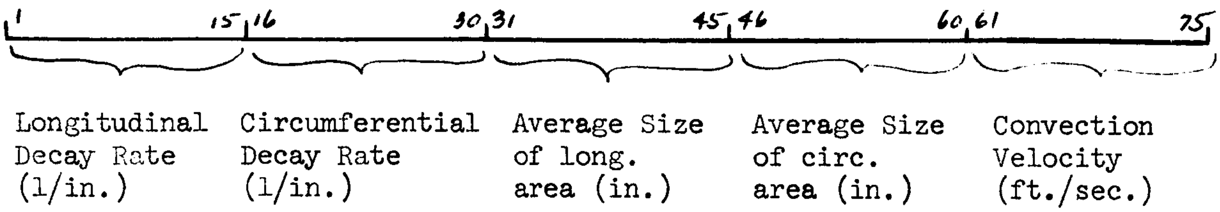


Figure 4.3.10.2-1

4.3.10.3 PSD Tables. - In Figure 4.3.10.3-1 the first card contains a fixed point number denoting the number of points for that table. Following it, then, are two sets of data cards in floating point notation. The first set, with four values per card, contains the independent variable, frequency. The second set, also with four values per card, contains the dependent variable, PSD. The maximum number of tables is 112. The number of PSD tables to be input is based on the PSD Input Code. The following rules apply:

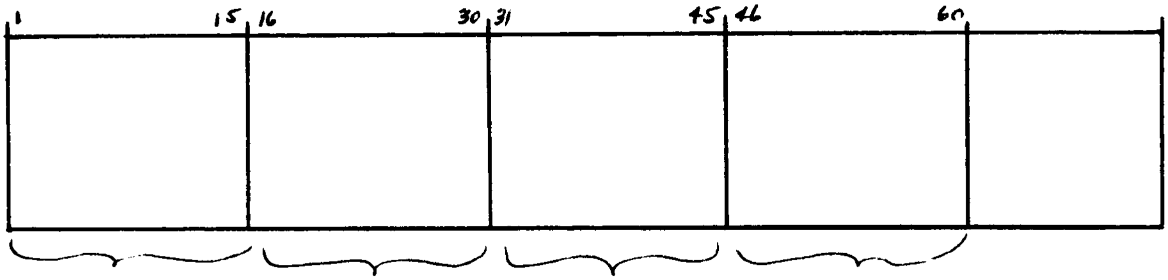
(a) If the code is one, then the number of tables input equals the number of longitudinal areas.

(b) If the code is two, then only one table is input.

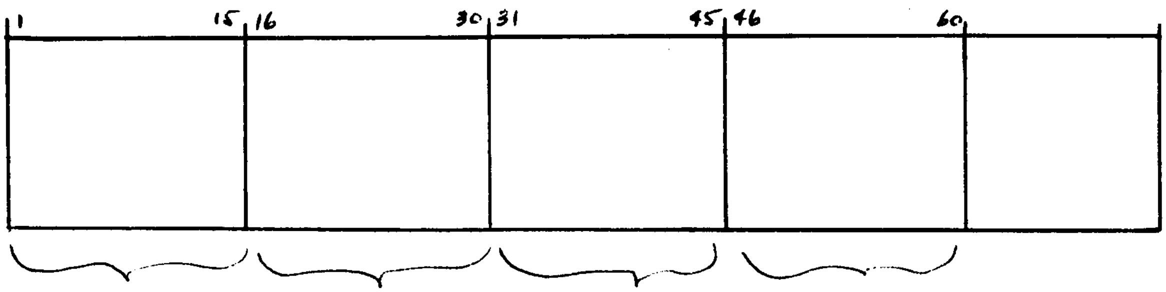
(c) If the code is three, then the number of tables input equals the number of surface areas.

PSD TABLES

No. of Points in Table



Frequency Values (four per card)



PSDs (four per card)

(Repeat process for each PSD table input)

Figure 4.3.10.3-1

4.3.10.4 Normalized Co-Spectra Tables. - In Figure 4.3.10.4-1 the first card contains a fixed point number. If this number is less than or equal to 20, then the number represents the number of points for that table. Following it, then, are two sets of data cards in floating point notation. The first set, with four values per card, contain the independent variable, frequency. The second set, also with four values per card, contain the dependent variable, Co-Spectrum. The maximum number of points is 20. The maximum number of tables is 21. The number of Co-Spectra tables to be input is based on the Co-Spectra Expansion Code. The following rules apply:

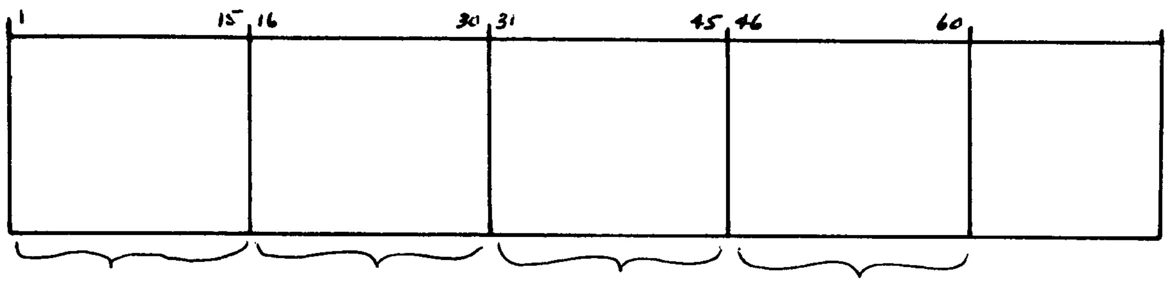
(a) If the code is zero, then input the tables for the longitudinal areas by column, including the (1,1) element, up to KC, which is the number of longitudinal areas over which there is appreciable correlation. Repeat for KK columns where KK is the number of circumferential areas over which there is appreciable correlation. Thus, there are KKxKC tables. See section 3.2.1.1 for physical explanation.

(b) If the code is one, then input the tables for the upper right triangle of the matrix by row (excluding the diagonal). Thus, the number of tables equals $\frac{KL(KL-1)}{2}$, where KL is the number of longitudinal areas. See section 3.2.1.2 for physical explanation.

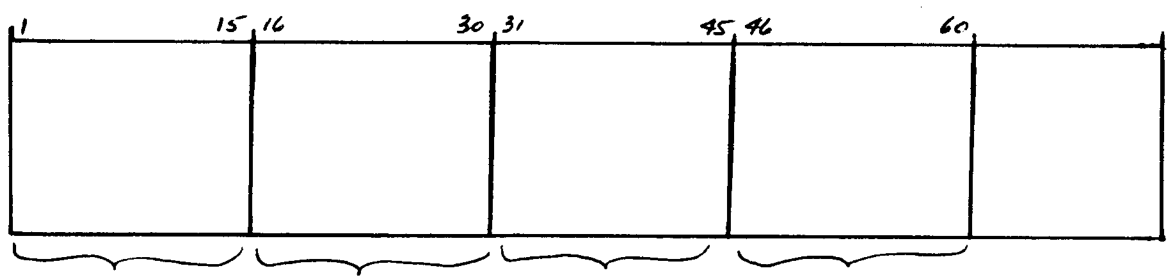
4.3.10.4.1 Element-By-Element Calculation Code. - In paragraph 4.3.10.4 a description was given for the input of a co-spectrum table. If the number of points specified exceeds 20, then no table should be input. This feature along with the Empirical Co-Spectra Calculate Code activated, results in calculating the normalized co-spectrum for this element. If the Empirical Co-Spectra Calculate Code is activated, then the (1,1) element is always calculated. See section 3.2.2.1 and subsections for physical explanation.

CO-SPECTRA TABLES

No. of Points in Table



Frequency Values (four per card)



Normalized Co-Spectrum (four per card)

(Repeat process for each Normalized Co-Spectrum table input)

Figure 4.3.10.4-1

4.3.11 Normal Mode Parameters. - In Figure 4.3.11-1 the first card contains a fixed point number denoting the number of data cards to follow. Following it, then, is the set of floating point data. The maximum number of data cards is 25.

NORMAL MODE PARAMETERS

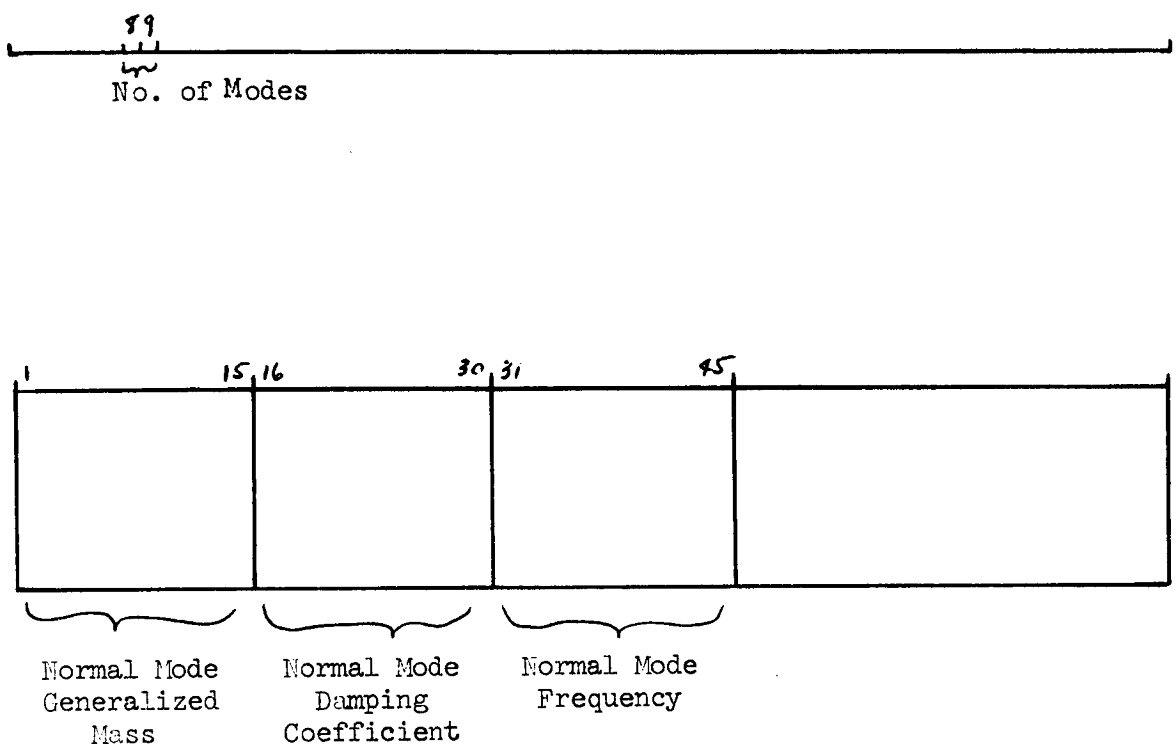


Figure 4.3.11-1

4.4 Operational Procedures. - This section contains two basic operational requirements. They are operating instructions and deck configuration.

4.4.1 Operating Instructions. - The basic computer setup is described on the following page. It should be noted that time estimates are also included.

OPERATING INSTRUCTIONS

DECK NO.	TITLE
T650	Conical Shell Deflection and Acceleration Response Program

PROGRAMMER	ASSIGNED TO
A. Brunkow/ S. Linn, Dept. 73, MAC	S. Linn

REQUESTED BY	DEPT.	C.R. NO.
Dept. 236, MAC (Contract NAS 1-3179)		

REPLACES DECK	NEW DECK	MODIFICATION OF DECK	SOS	FORTRAN II	IB-SYS	OTHER
	☒		☐	☐	☒	☐

RESERVED TAPES USED

None

UTILITY TAPES USED

None

OUTPUT

TAPES Standard Fortran Printout Tape

CARDS	PLOTTING	INPUT TO OTHER DECK	OTHER
☐	☐	☐	☐

DEFINE CARD FORMAT BELOW

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73

EST. NO. OF INPUT CARDS PER CASE

50/1500 (Depends on options requested)

EST. RUNNING TIME PER CASE

.02/.15 hr (7094)

EST. PRINTING TIME PER CASE

.05/.40 hr (1401)

CAN THIS JOB BE INTERRUPTED

☒ YES ☐ NO

CAN MORE THAN ONE CASE BE RUN AT A TIME

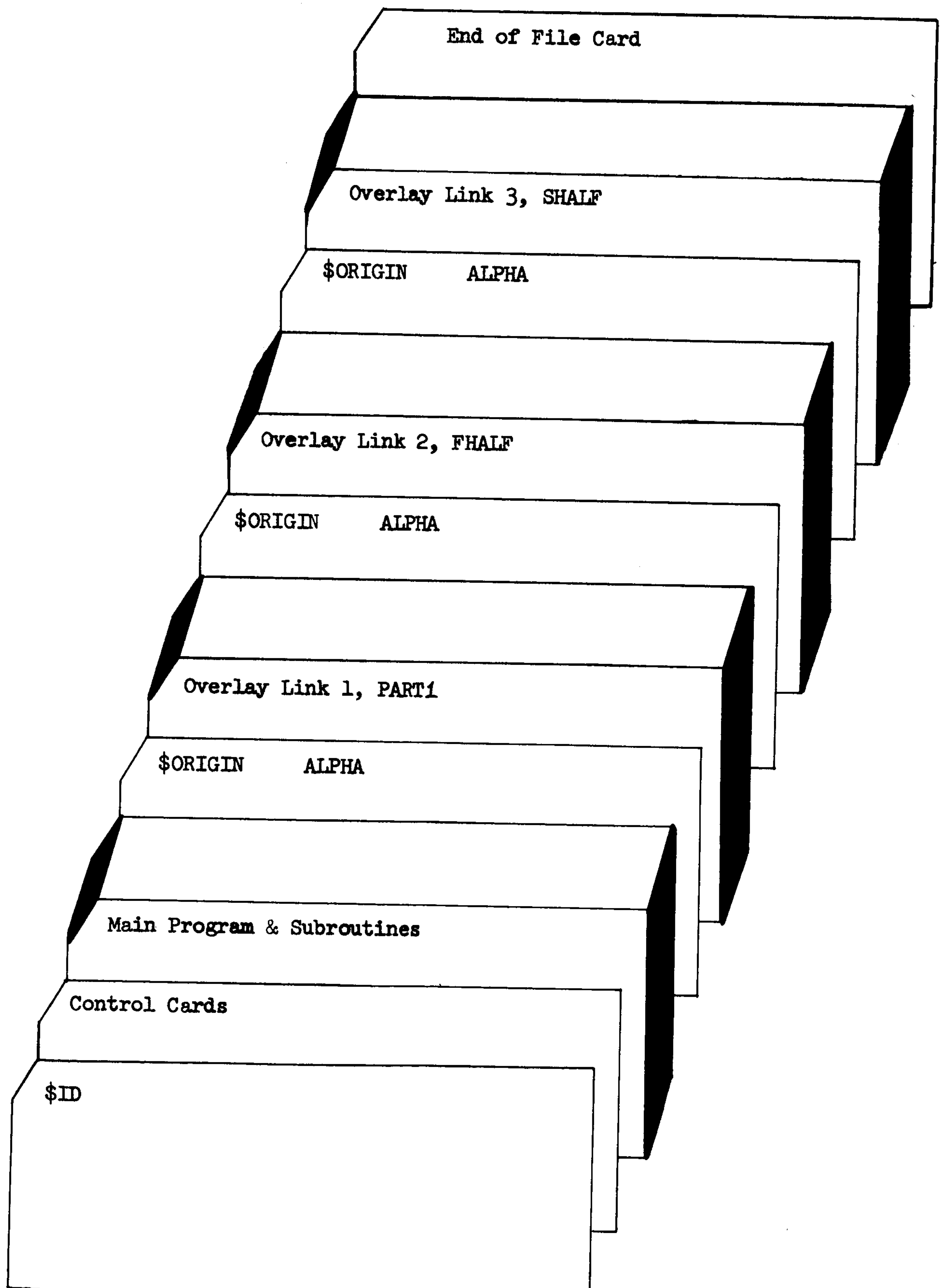
☒ YES ☐ NO

SPECIAL INSTRUCTION:

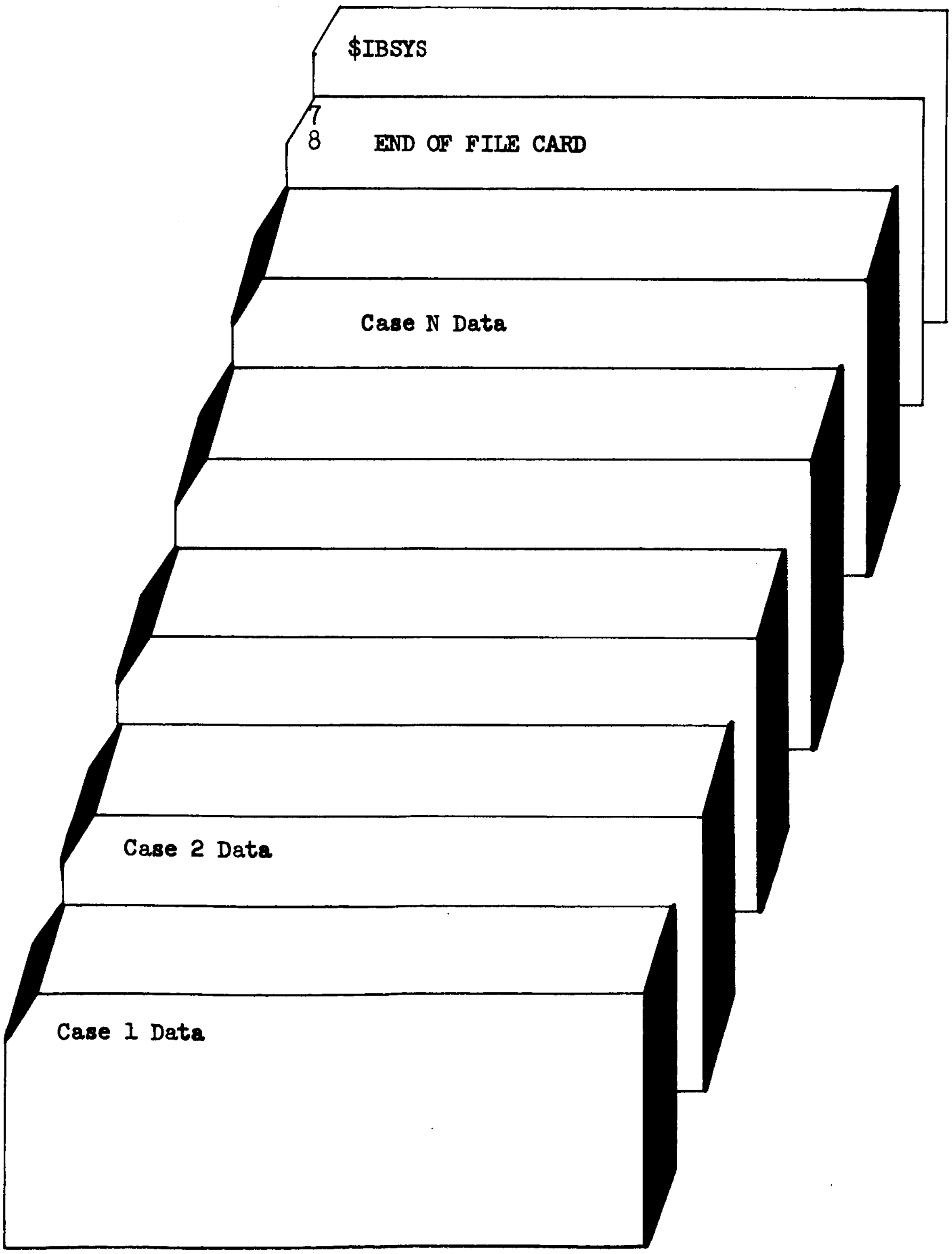
None

4.4.2 Deck Configuration. - The basic deck setup is shown on the following pages. The control cards for IBSYS at the M.A.C. installation consists of two cards. They are shown as the first two cards of the program listing in section 4.8

DECK ORGANIZATION



DECK ORGANIZATION (Concluded)



4.5 Error Analysis and Messages - There exists in the program various error checks before calculations actually begin. When an error is detected by the program a comment is written on the output tape and appropriate action is taken. Following is a list of error comments and their meanings.

4.5.1 Program Cannot Continue, Gamma = X.XXXXEXX - This is the result of a negative gamma to be used in the Fourier Series Calculation. The program terminates.

4.5.2 Response Calculation Involving PHI2T & PHIAT Depends Upon Assumption of Symmetric Pressure Power Spectra Distribution. LCOD = Indicates Unsymmetric Distribution - This is self-explanatory. The comment is merely a warning.

4.5.3 Error, PHI2T & PHIAT Incompatible, XXX YYY - The number of rows in PHIAT (XXX) must be equal to the number of rows in PHI2T(YYY). The error, XXX not equal to YYY, terminates the program.

4.5.4 Error, PHIAT & Normal Modes Unequal, XXX YYY - The number of normal modes specified must be the same as the number of rows of PHI2T. The error terminates the program.

4.5.5. Error, TLU ERR In XXX Tables - In generating the spectrum matrices at a particular frequency, a total of XXX errors occurred in the linear interpolation routine (TLU2). This includes the PSDs and the co-correlation tables. The error terminates the program.

4.5.6 General Errors. - The system may output error comments. These usually result from data setup errors. These errors cause the system to terminate the program.

4.6 Detailed Flowcharts. - Extensive program flow charts are given in this section. The blocks contain mostly Fortran terminology to closely identify the flowcharts with the program. Also included for this purpose were: statement numbers, DO loops, and sub-titles.

4.6.1 Main Program. - Figure 4.6.1-1 shows the linkage of the various subprograms as they are executed by the main program.

MAIN PROGRAM

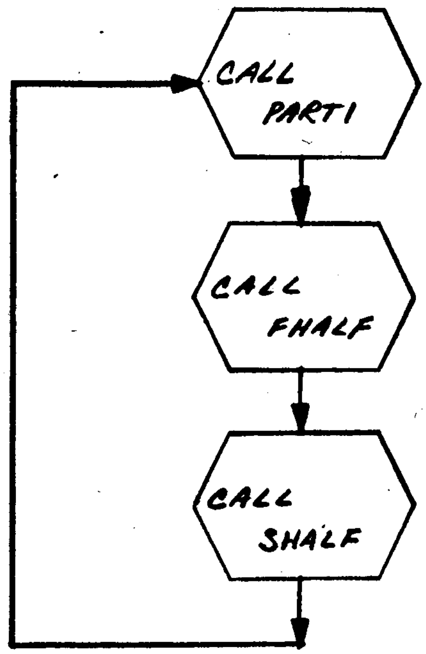


Figure 4.6.1-1

4.6.2 Subroutine EXPANC. - Figure 4.6.2-1 shows the calling sequence and flow of the EXPANC subroutine. Note that this is for expansion form two.

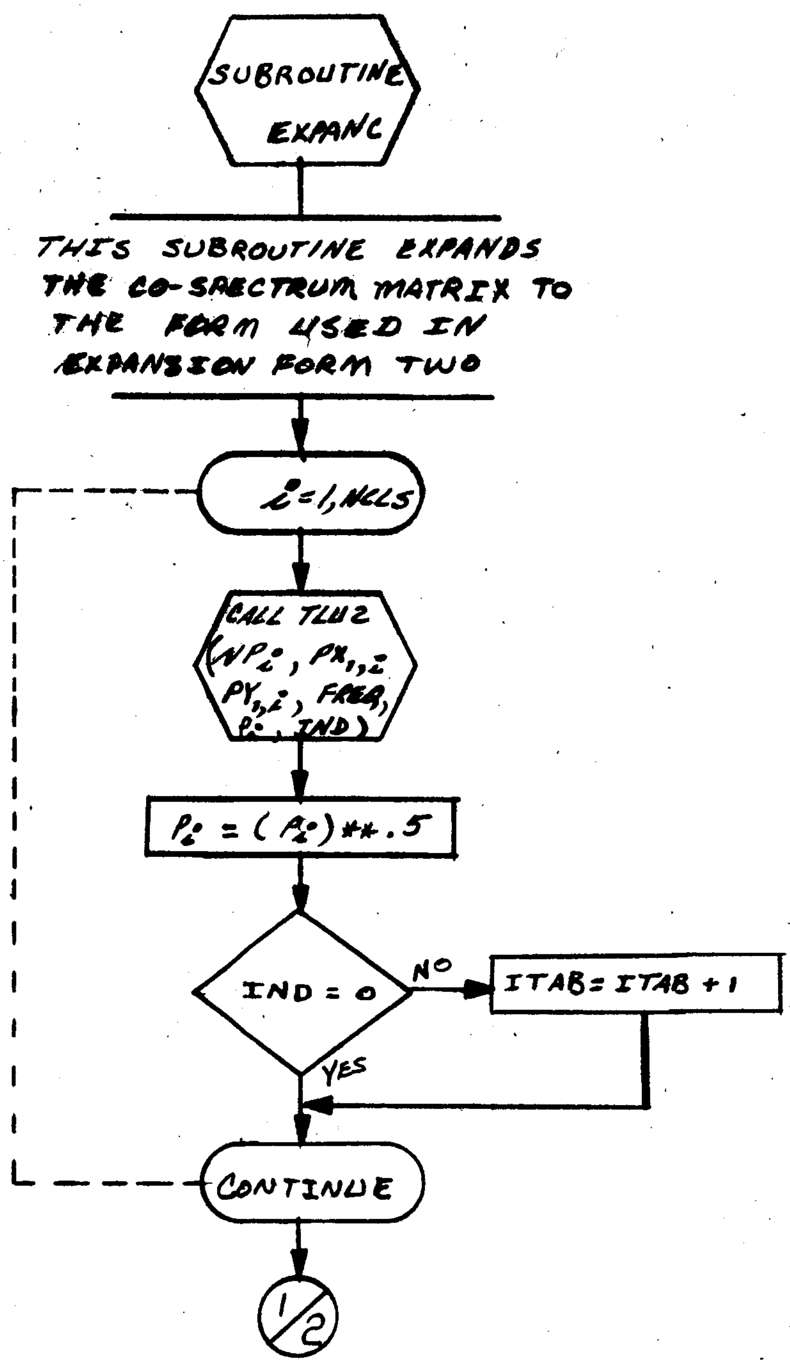

SUBROUTINE EXPANC
THIS SUBROUTINE EXPANDS THE CO-SPECTRUM MATRIX TO THE FORM USED IN EXPANSION FORM TWO
i=1,NCLS
CALL TLU2 (NPi, PX1,i PY1,i, FREQ, Pi, IND)
Pi = (Pi)**.5
IND = 0
NO
ITAB=ITAB+1
YES
CONTINUE
1/2

Figure 4.6.2-1

Subroutine EXPANC (Concluded)

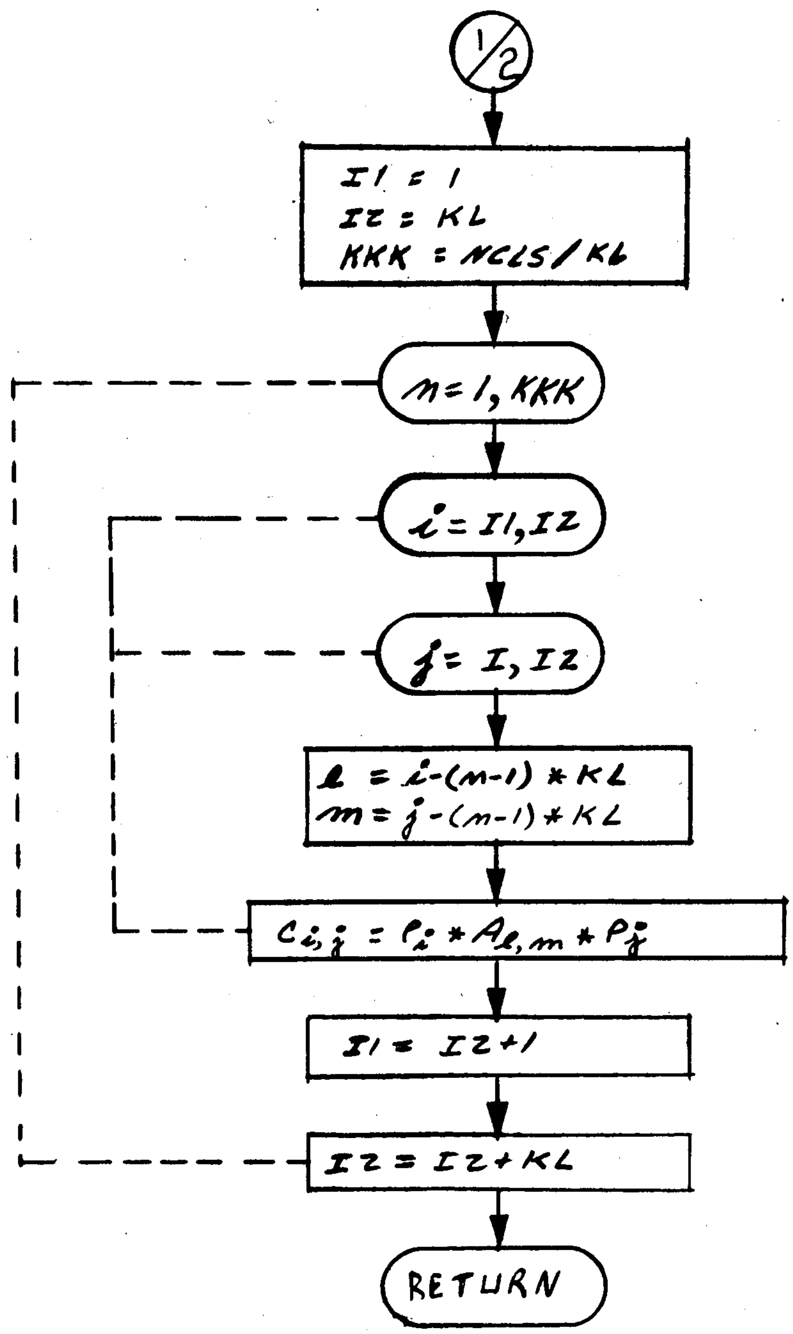


Figure 4.6.2-1 (Concluded)

4.6.3 Subroutine TLU2. - Figure 4.6.3-1 shows the calling sequence and flow of the table lookup routine, TLU2.

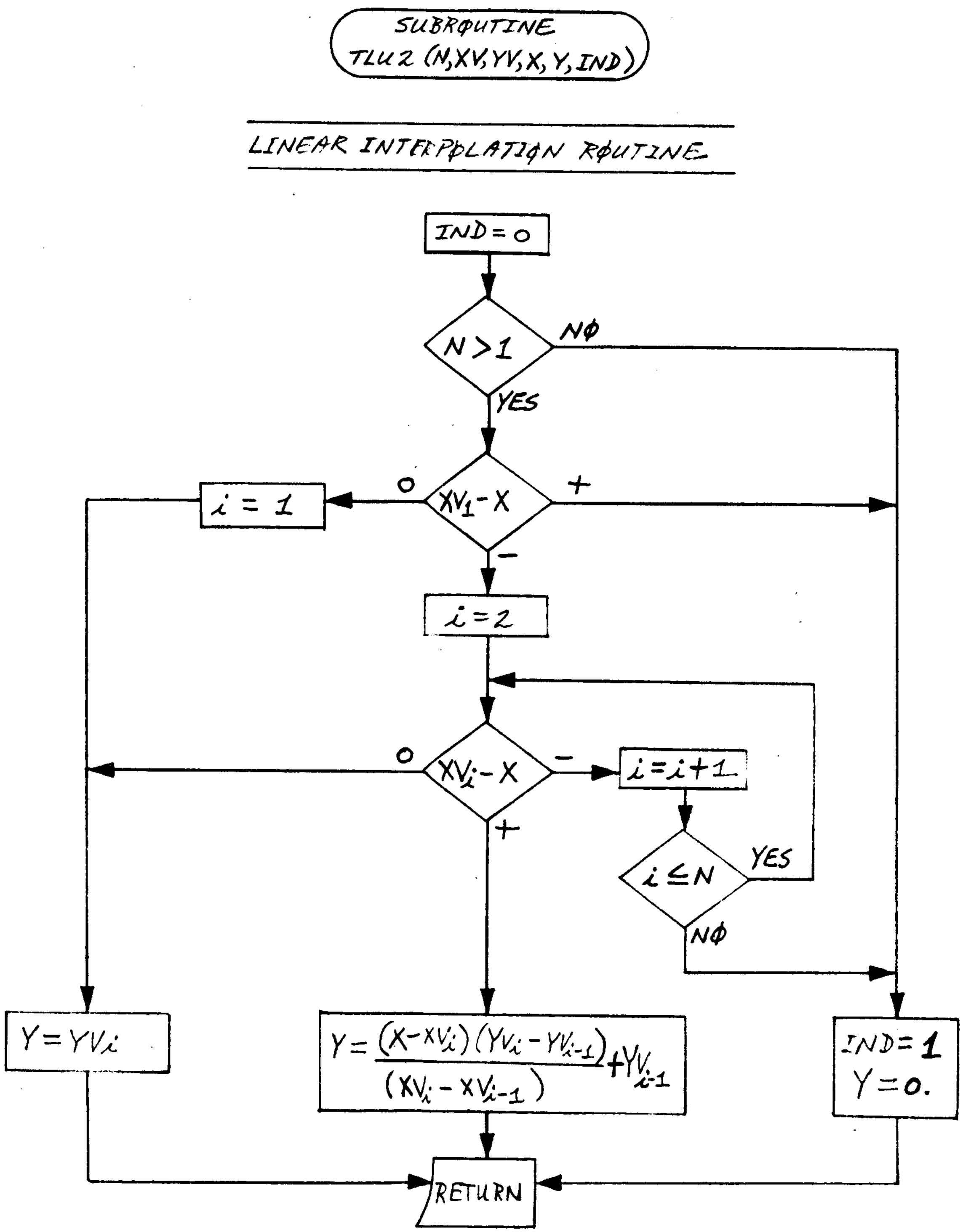

SUBROUTINE
TLU2 (N,XV,YV,X,Y,IND)
LINEAR INTERPOLATION ROUTINE
IND = 0
N > 1
NO
YES
$XV_1 - X$
0
+
−
i = 1
i = 2
$XV_i - X$
0
−
+
i = i + 1
i ≤ N
YES
NO
$Y = YV_i$
$Y = \frac{(X - XV_i)(YV_i - YV_{i-1})}{(XV_i - XV_{i-1})} + YV_{i-1}$
IND = 1
Y = 0.
RETURN

Figure 4.6.3-1

4.6.4 Subroutine DPRT. - Figure 4.6.4-1 shows the calling sequence and flow of the diagonal matrix print subroutine, DPRT.

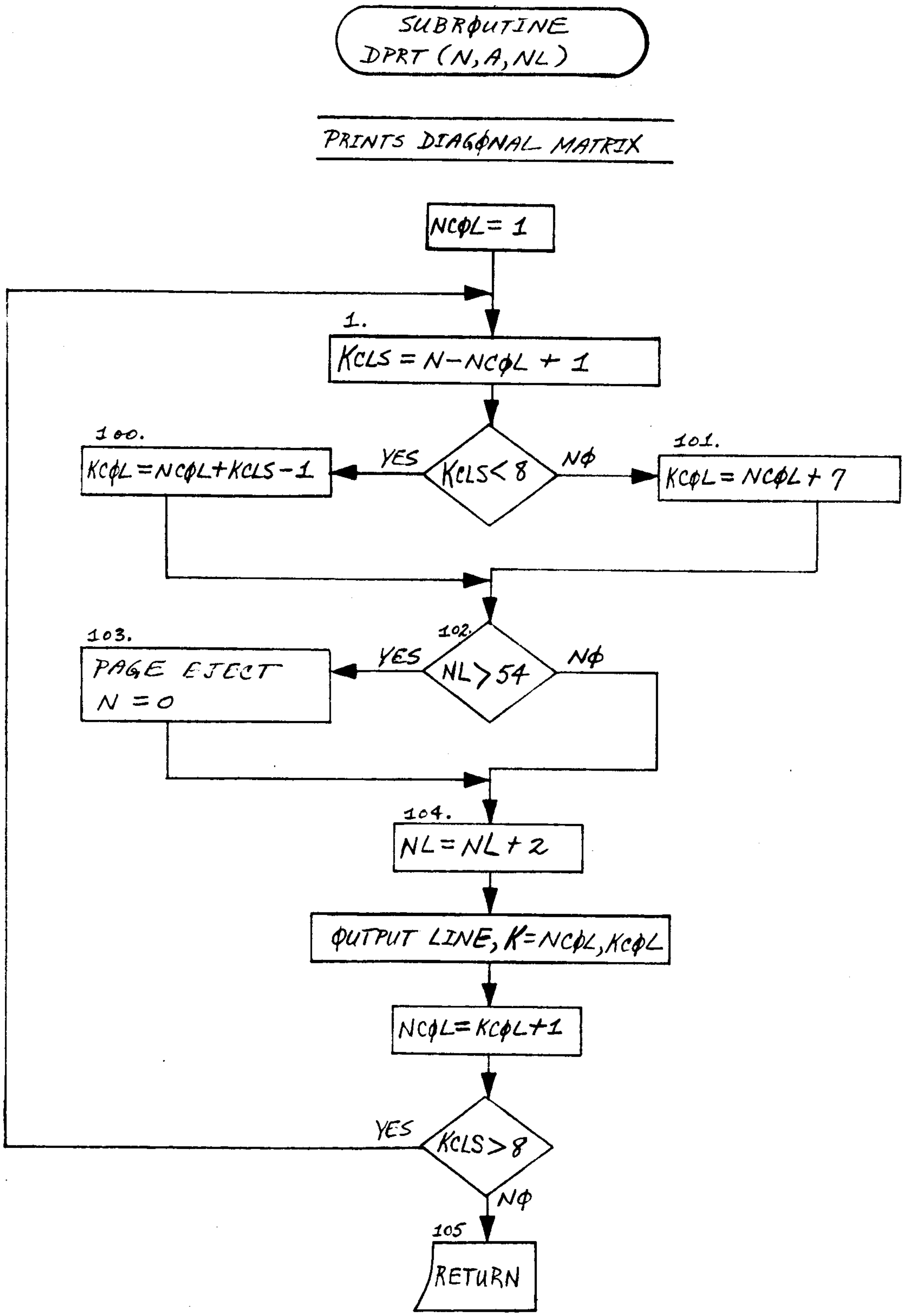

SUBRØUTINE
DPRT (N,A,NL)
PRINTS DIAGØNAL MATRIX
NCØL = 1
1.
KCLS = N-NCØL + 1
KCLS < 8
YES
NØ
100.
KCØL = NCØL+KCLS-1
101.
KCØL = NCØL + 7
102.
NL > 54
YES
NØ
103.
PAGE EJECT
N = 0
104.
NL = NL + 2
ØUTPUT LINE, K=NCØL,KCØL
NCØL = KCØL+1
KCLS > 8
YES
NØ
105
RETURN

Figure 4.6.4-1

4.6.5 Subroutine DTRM. - Figure 4.6.5-1 shows the calling sequence and flow of the diagonal matrix product subroutine, DTRM. It calculates product row A * [P].

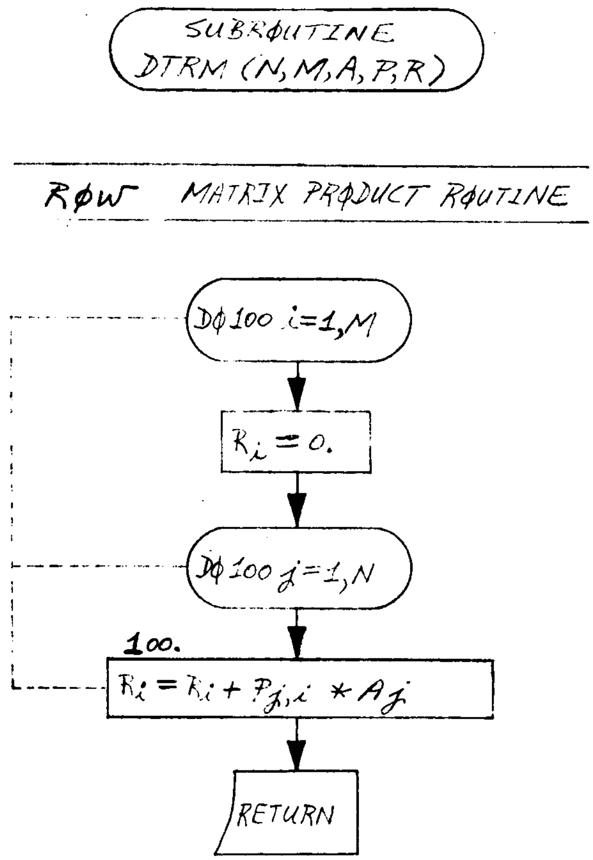

SUBROUTINE
DTRM (N,M,A,P,R)
ROW MATRIX PRODUCT ROUTINE
DO 100 i=1,M
R_i = 0.
DO 100 j=1,N
100.
R_i = R_i + P_j,i * A_j
RETURN

Figure 4.6.5-1

4.6.6 Link One, PART1. - Figure 4.6.6-1 shows the initial input portion for each case. It consists of 14 pages. After this link is executed and completed the program returns control to the MAIN program.

Subroutine PART1

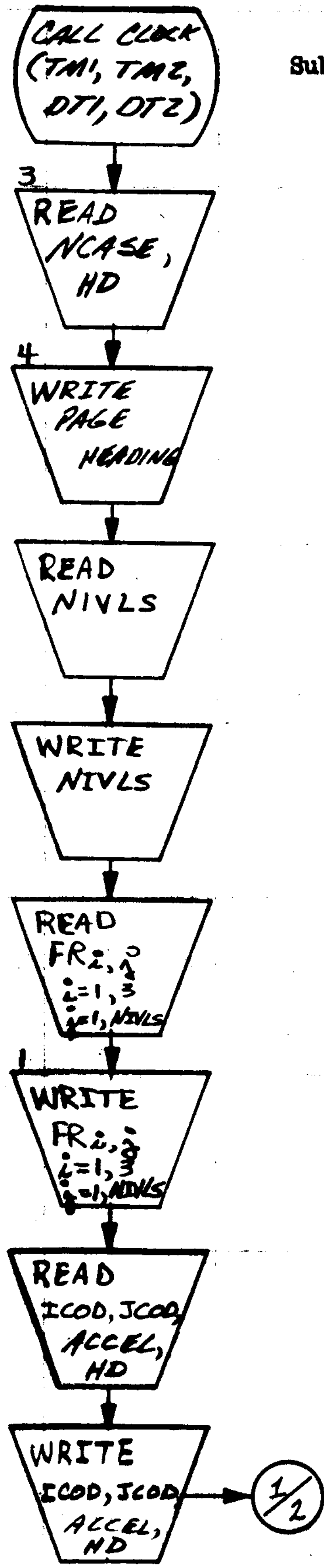


Figure 4.6.6-1

Subroutine PART1
(Continued)

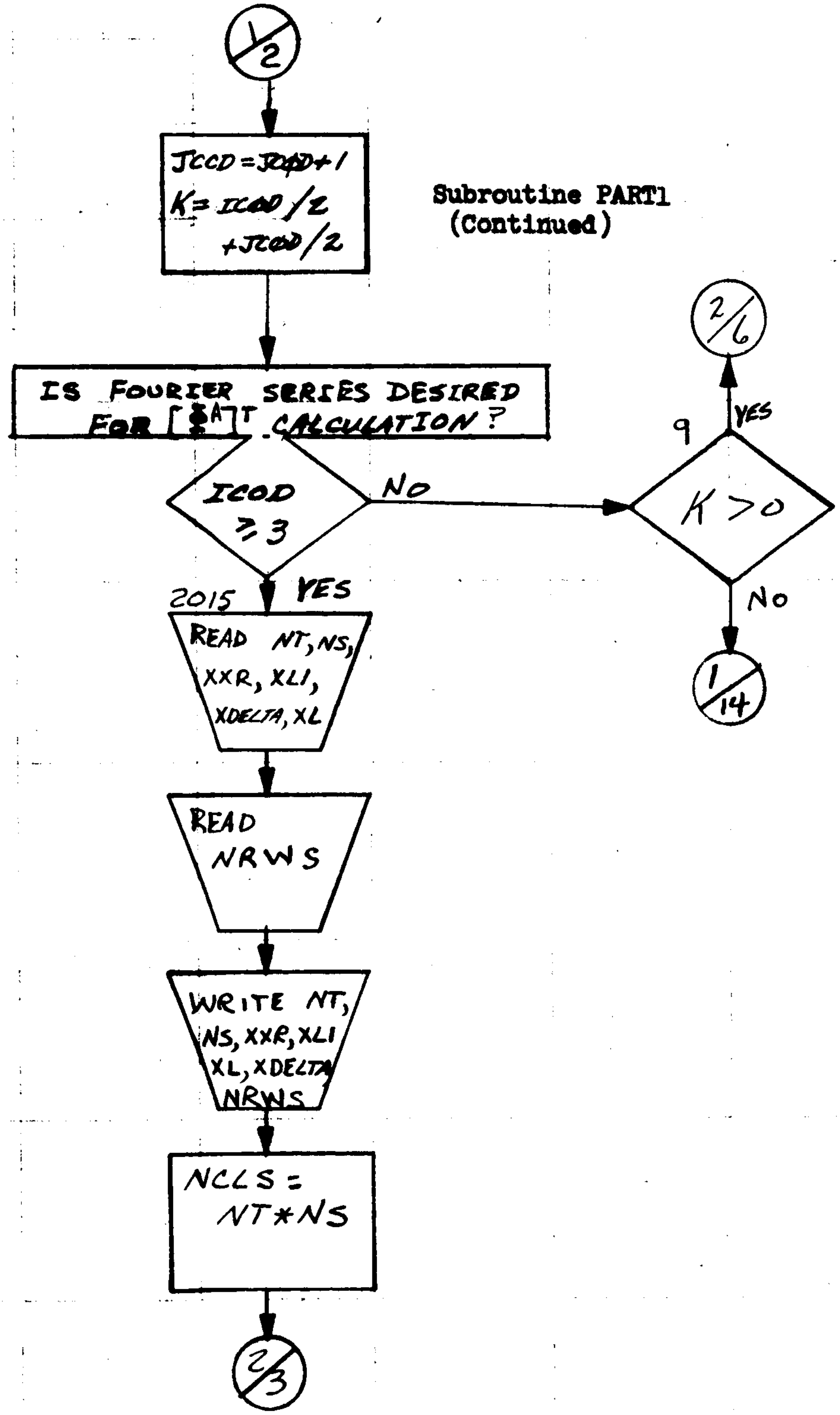


Figure 4.6.6-1 (Continued)

Subroutine PART1
(Continued)

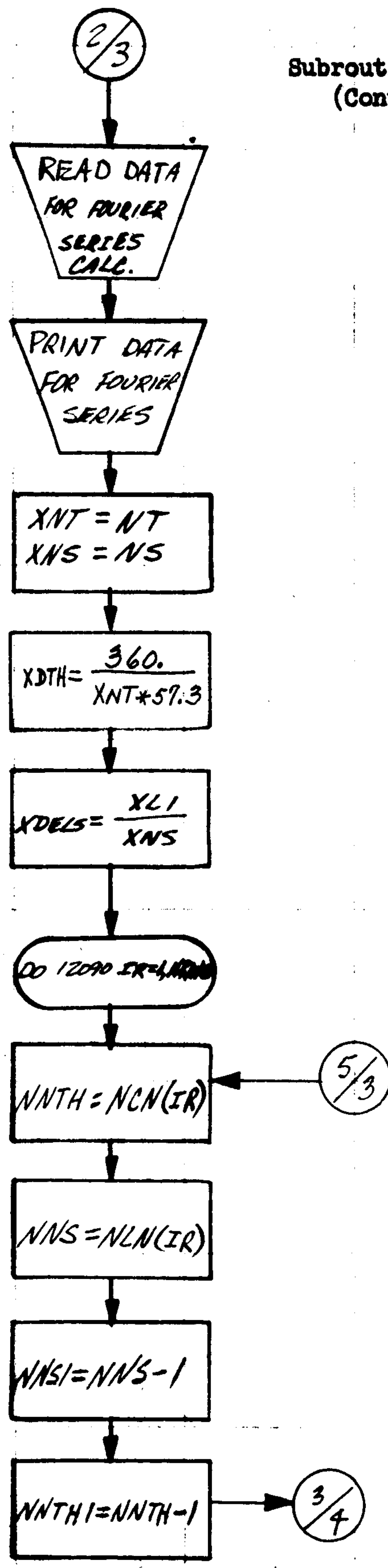


Figure 4.6.6-1 (Continued)

Subroutine PART1 (Continued)

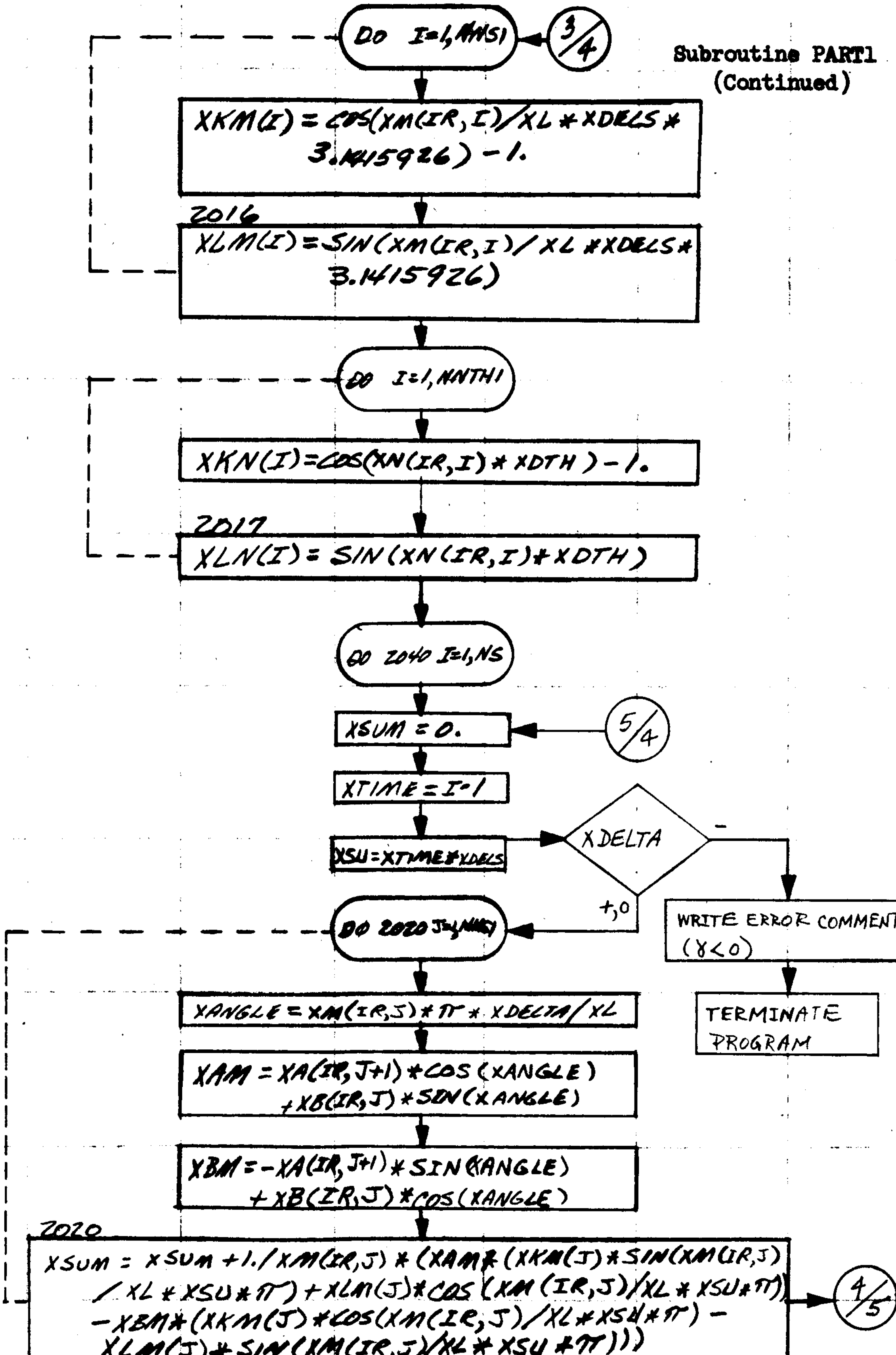


Figure 4.6.6-1 (Continued)

Subroutine PART1 (Continued)

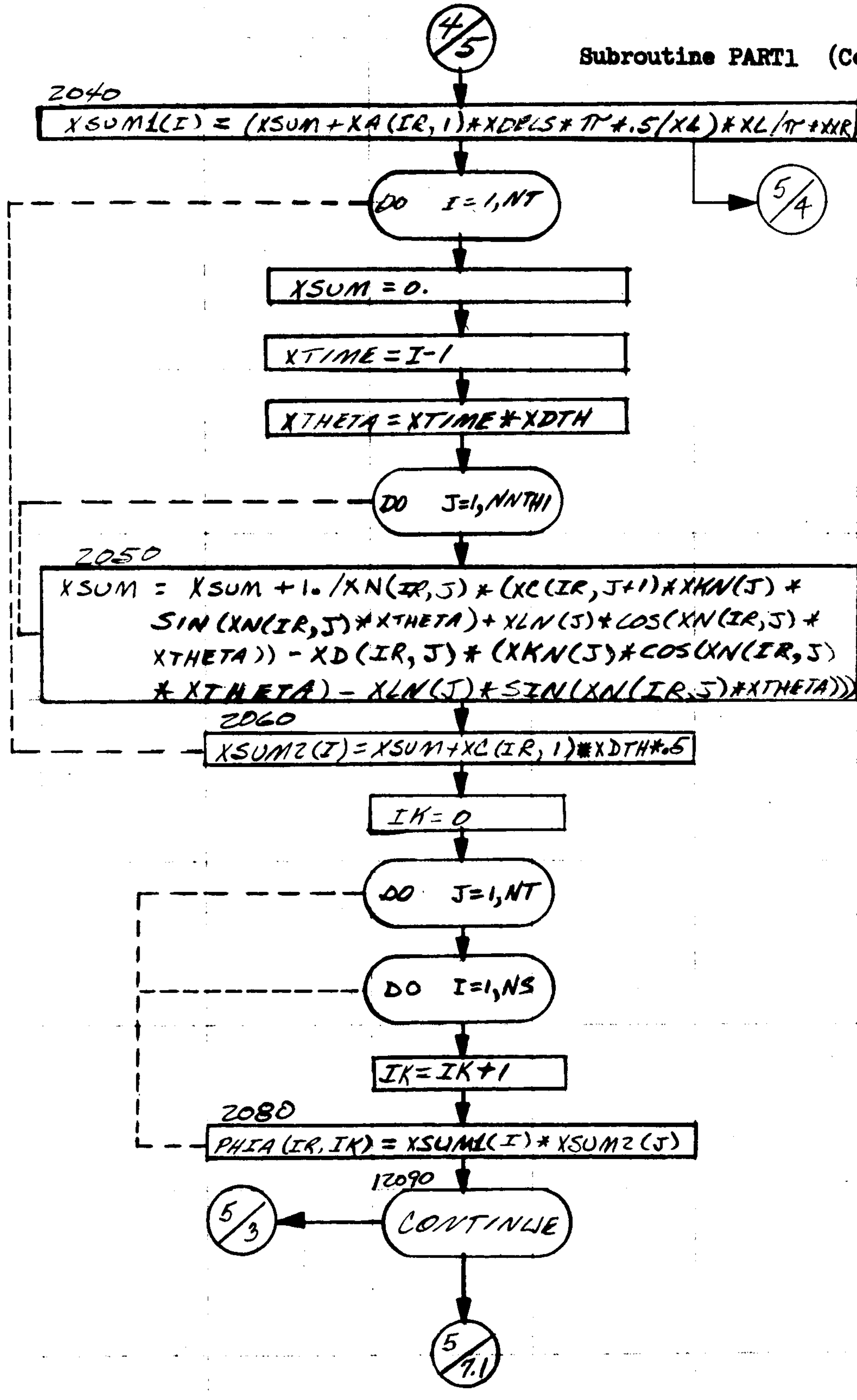


Figure 4.6.6-1 (Continued)

Subroutine PART1 (Continued)

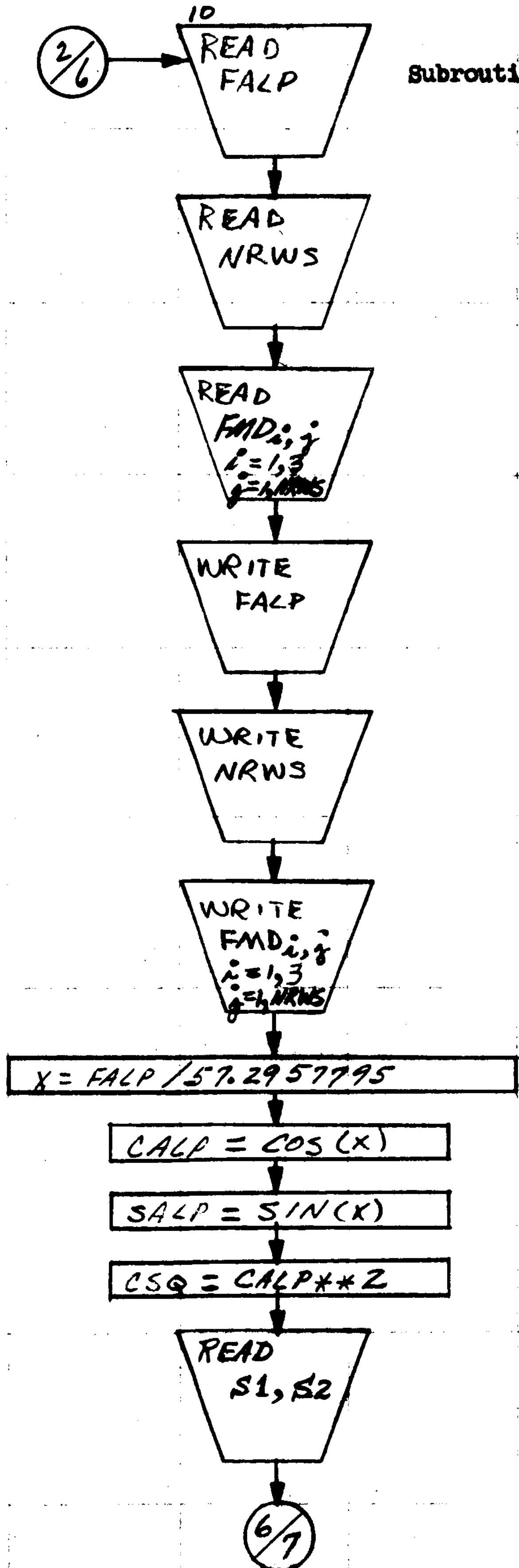


Figure 4.6.6-1 (Continued)

Subroutine PART1 (Continued)

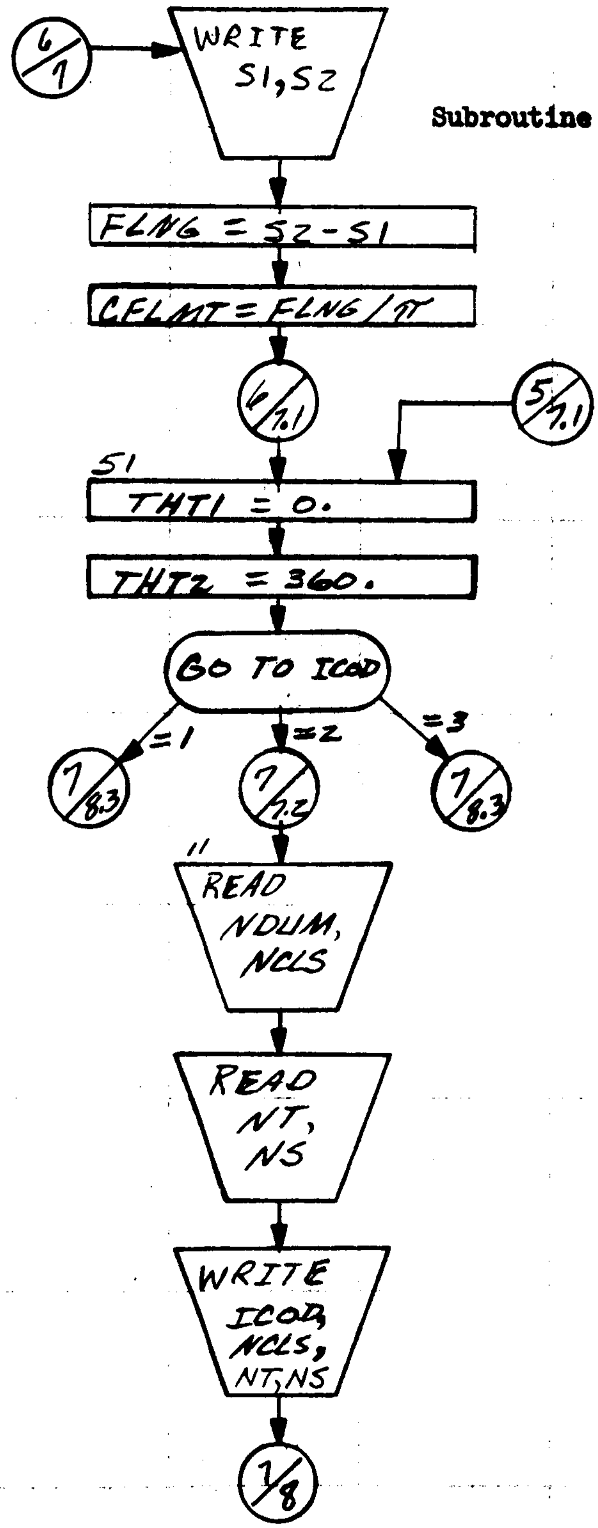


Figure 4.6.6-1 (Continued)

Subroutine PART1
(Continued)

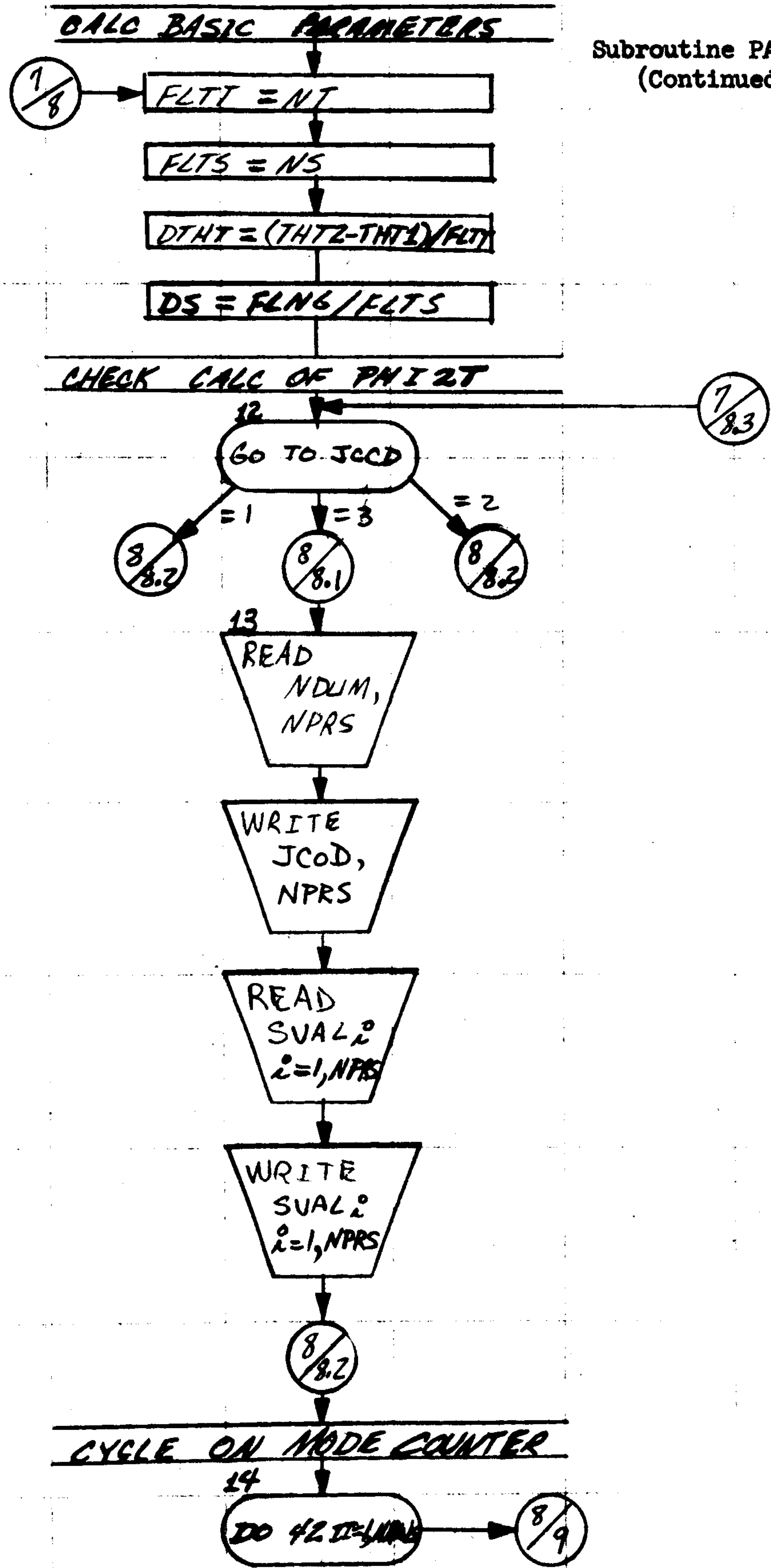


Figure 4.6.6-1 (Continued)

Subroutine PART1 (Continued)

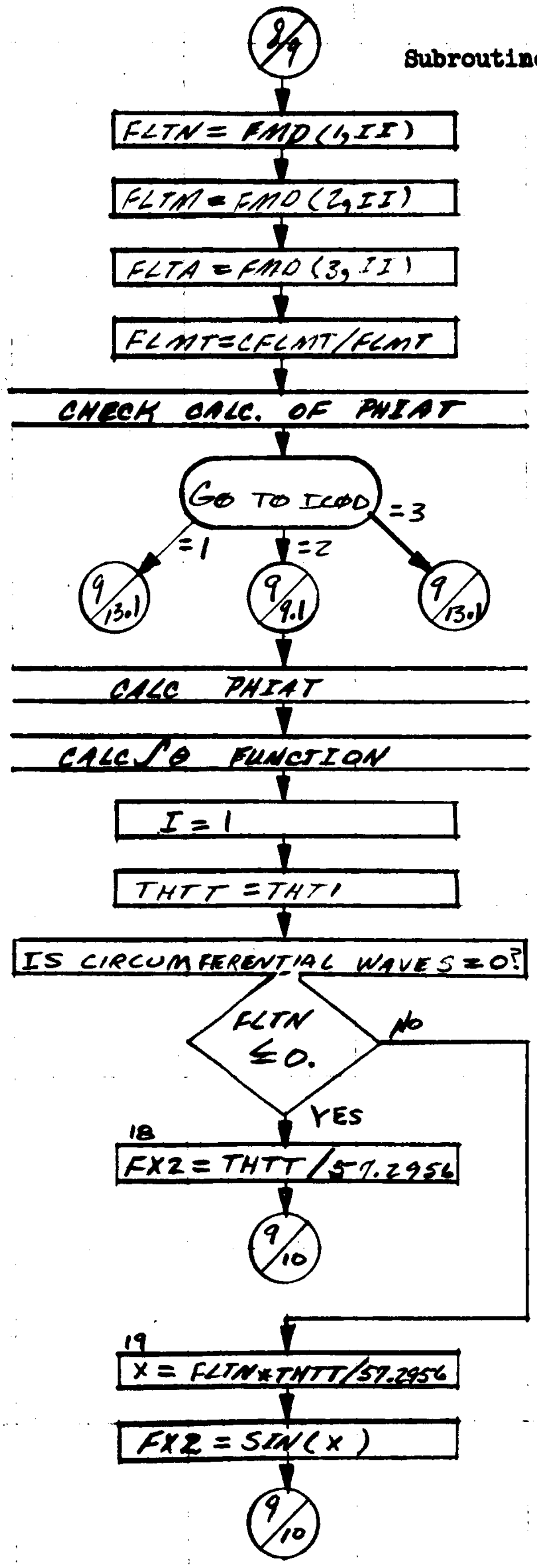


Figure 4.6.6-1 (Continued)

Subroutine PART1 (Continued)

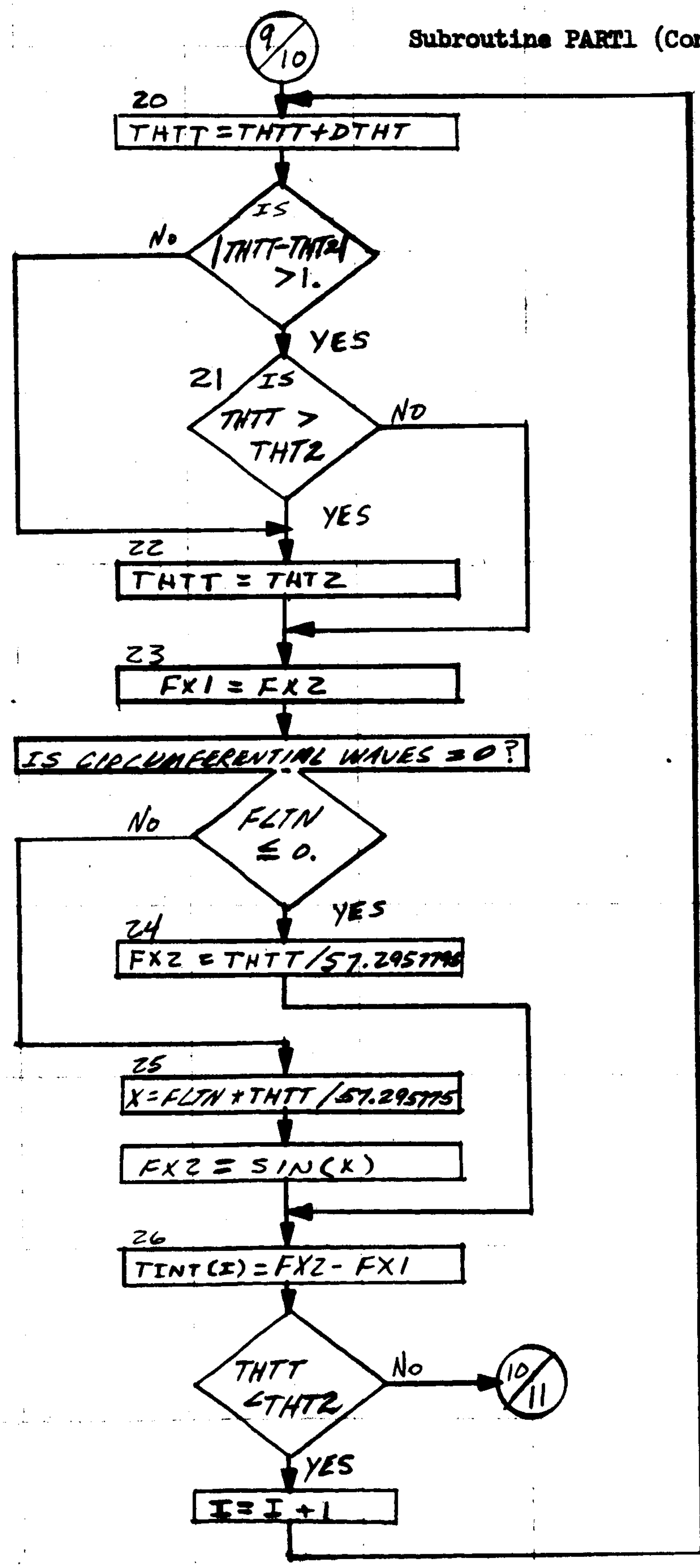


Figure 4.6.6-1 (Continued)

Subroutine PART1
(Continued)

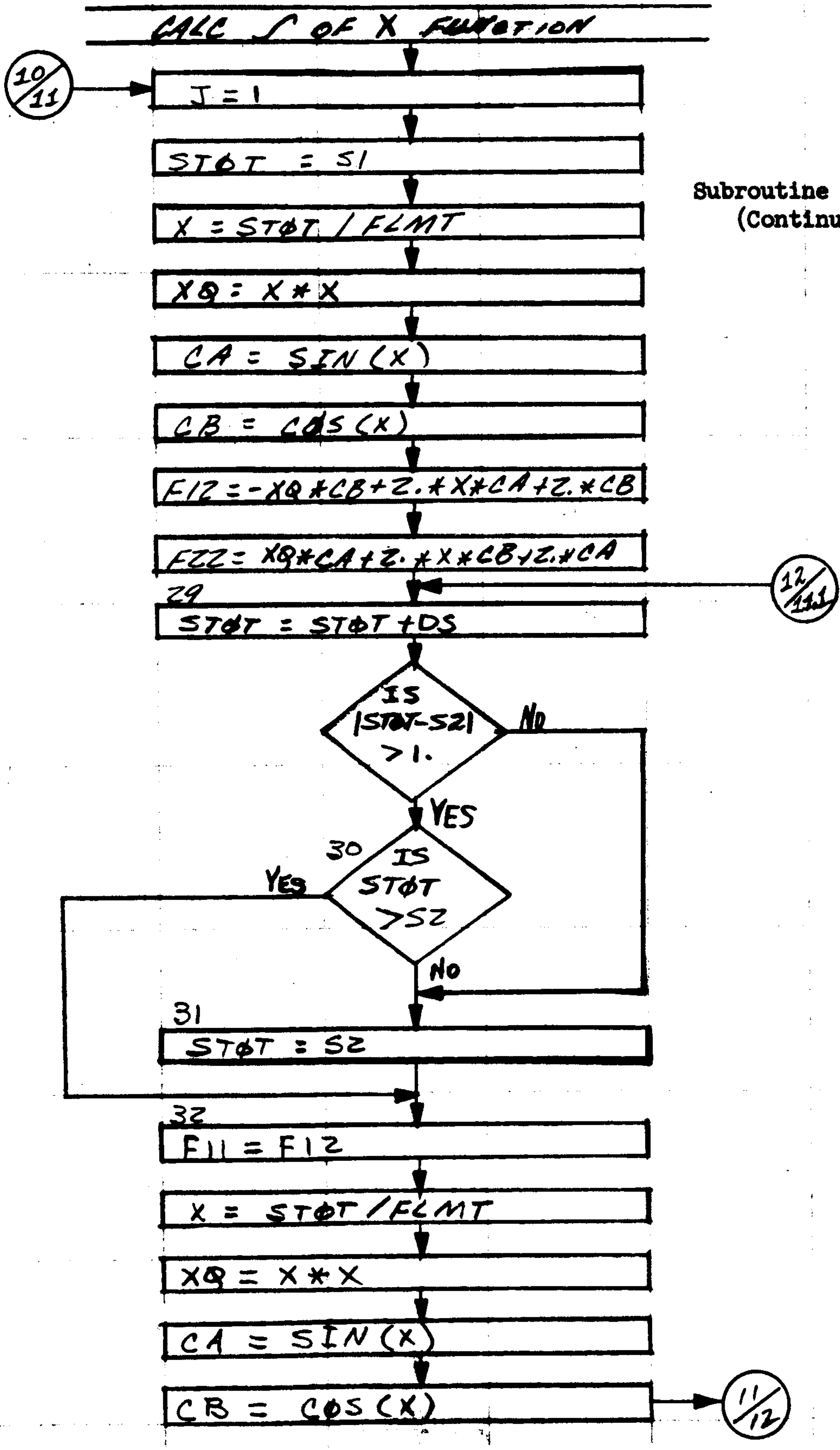


Figure 4.6.6-1 (Continued)

Subroutine PART1 (Continued)

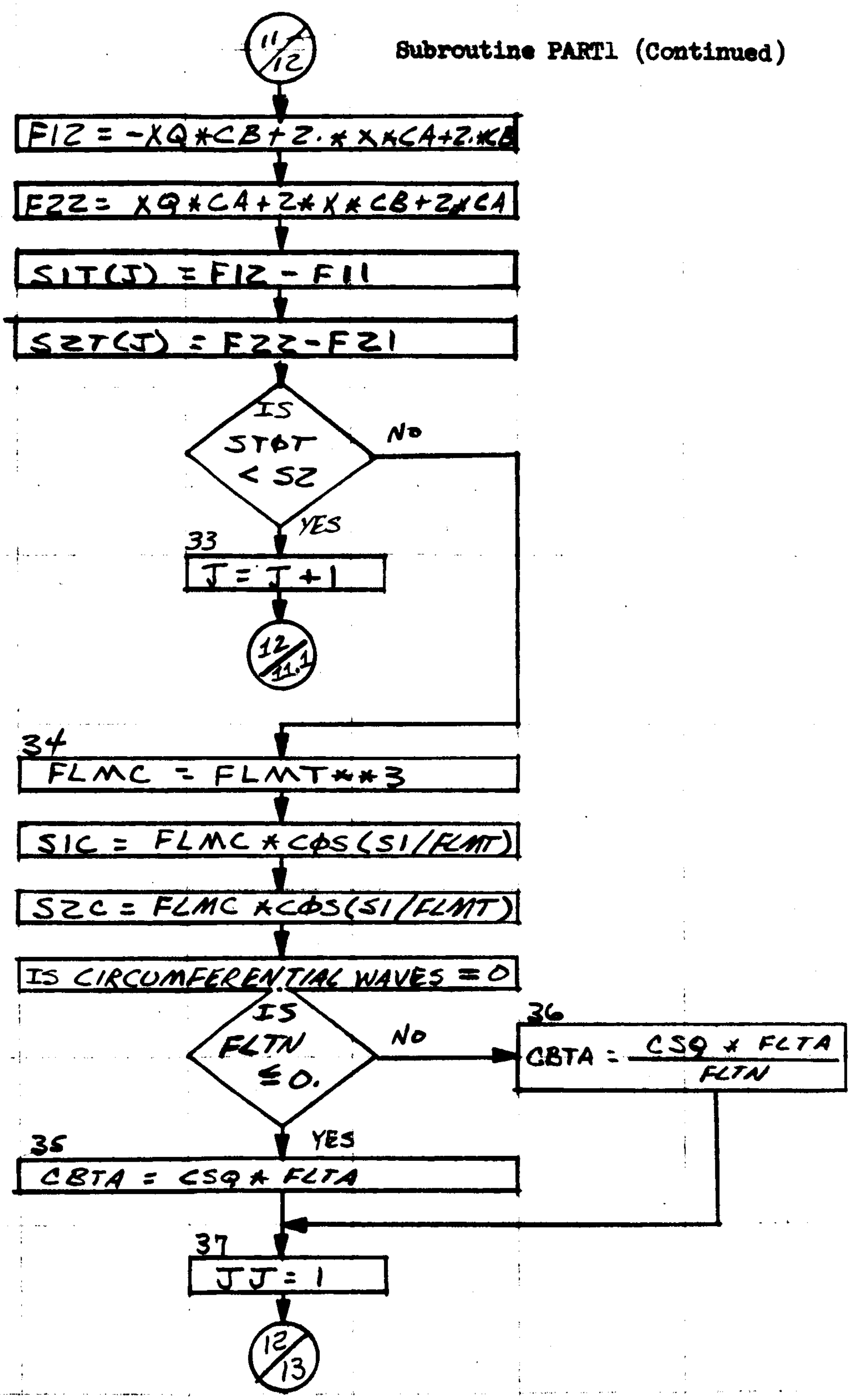


Figure 4.6.6-1 (Continued)

Subroutine PART1 (Continued)

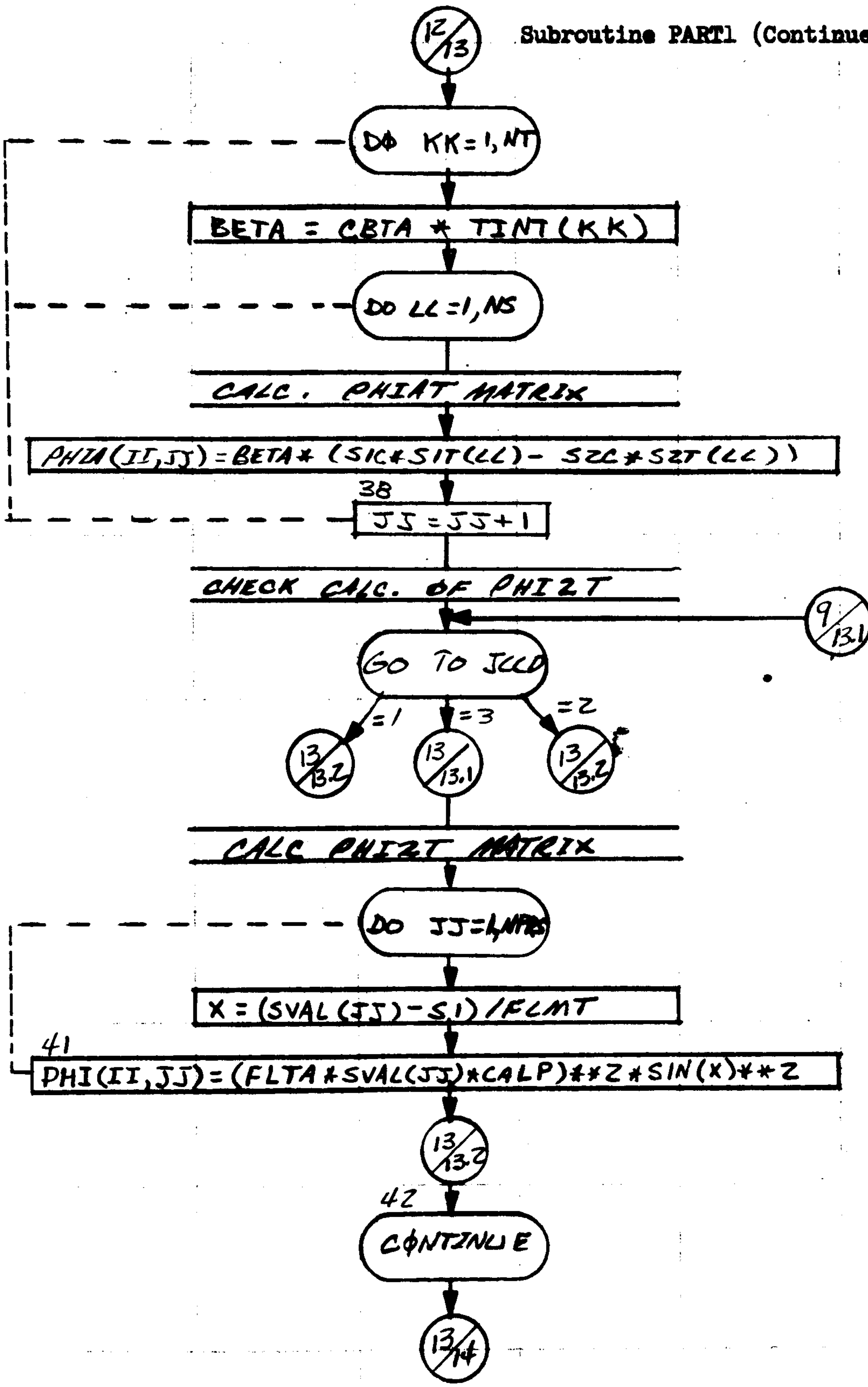


Figure 4.6.6-1 (Continued)

Subroutine PART1 (Concluded)

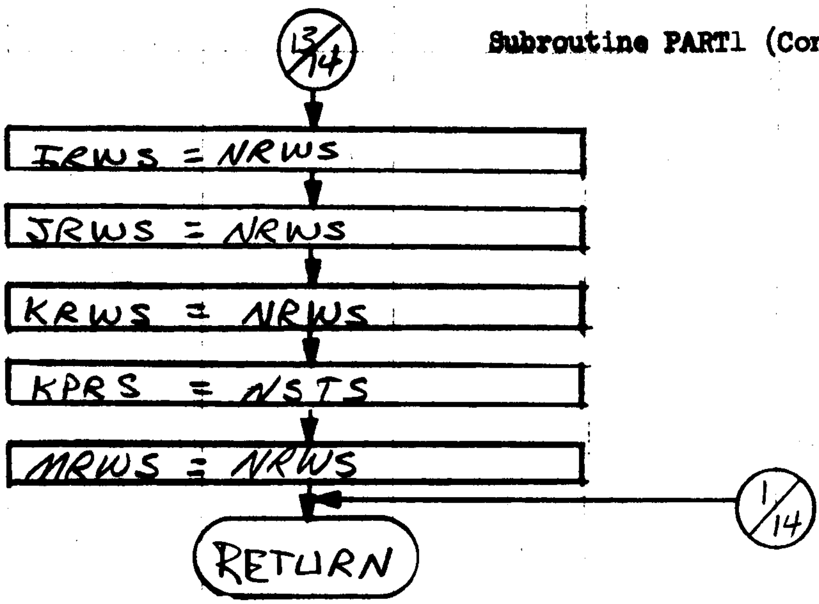


Figure 4.6.6-1 (Concluded)

4.6.7 Link Two, FHALF. - Figure 4.6.7-1 shows the remaining input portion for each case. It consists of 14 pages. Control returns to the MAIN program after this link is completed.

Subroutine FHALF

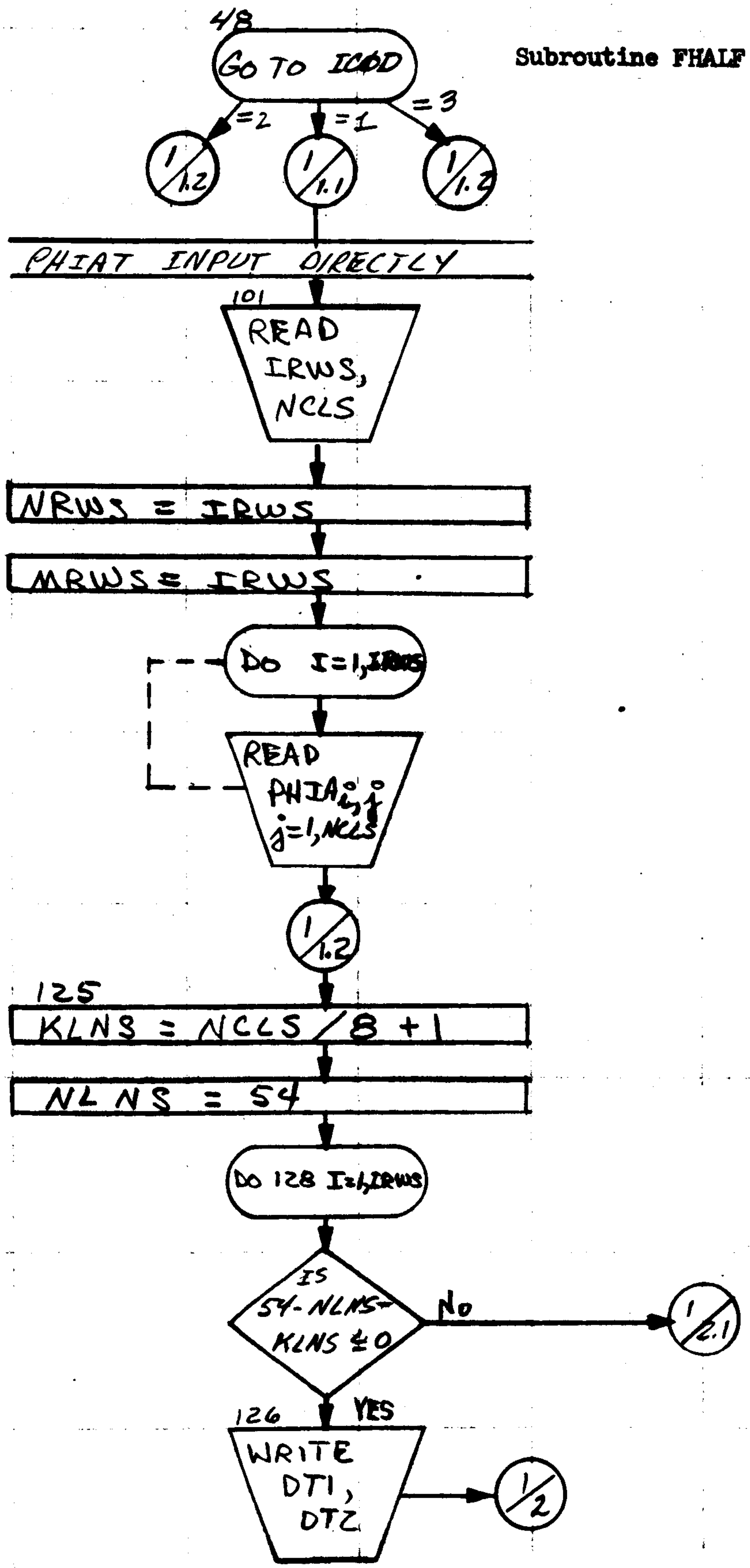


Figure 4.6.7-1

Subroutine FHALF (Continued)

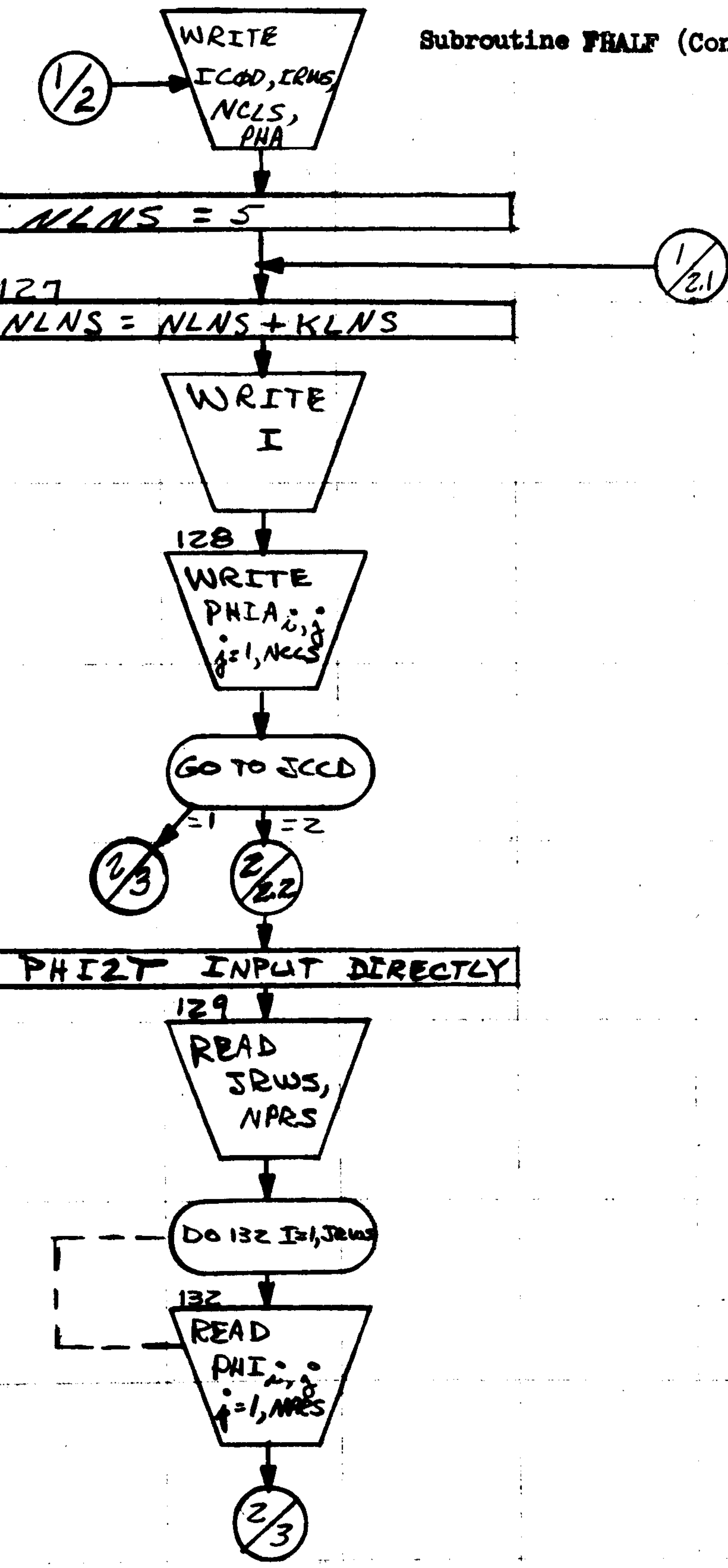


Figure 4.6.7-1 (Continued)

Subroutine PHALF
(Continued)

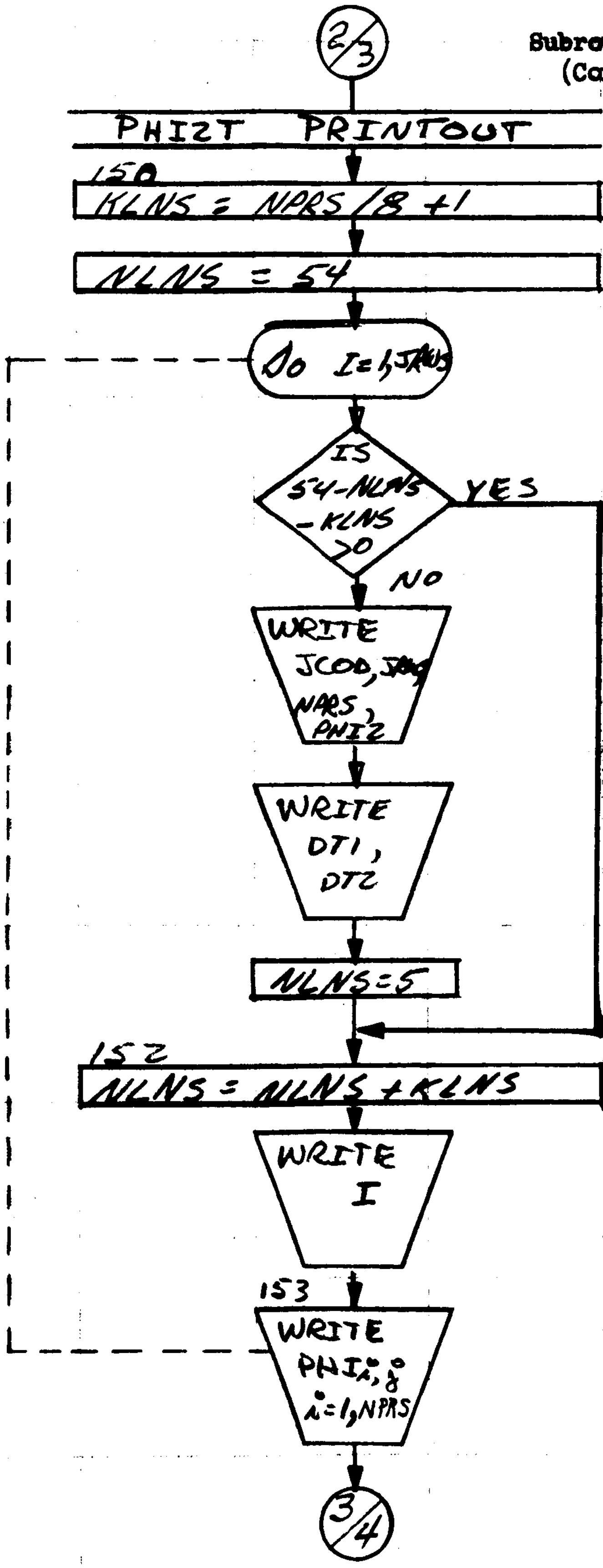


Figure 4.6.7-1 (Continued)

Subroutine FHALF (Continued)

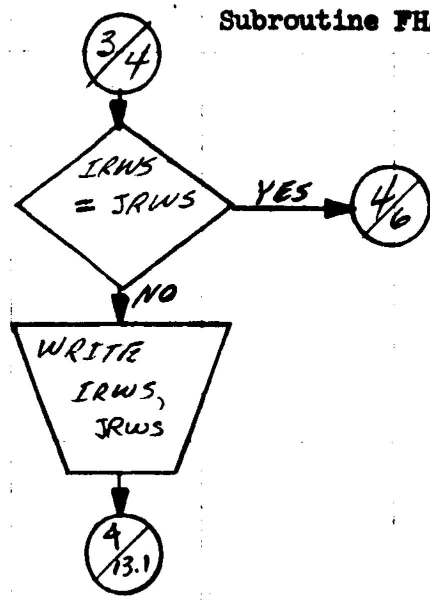


Figure 4.6.7-1 (Continued)

Subroutine FHALF (Continued)

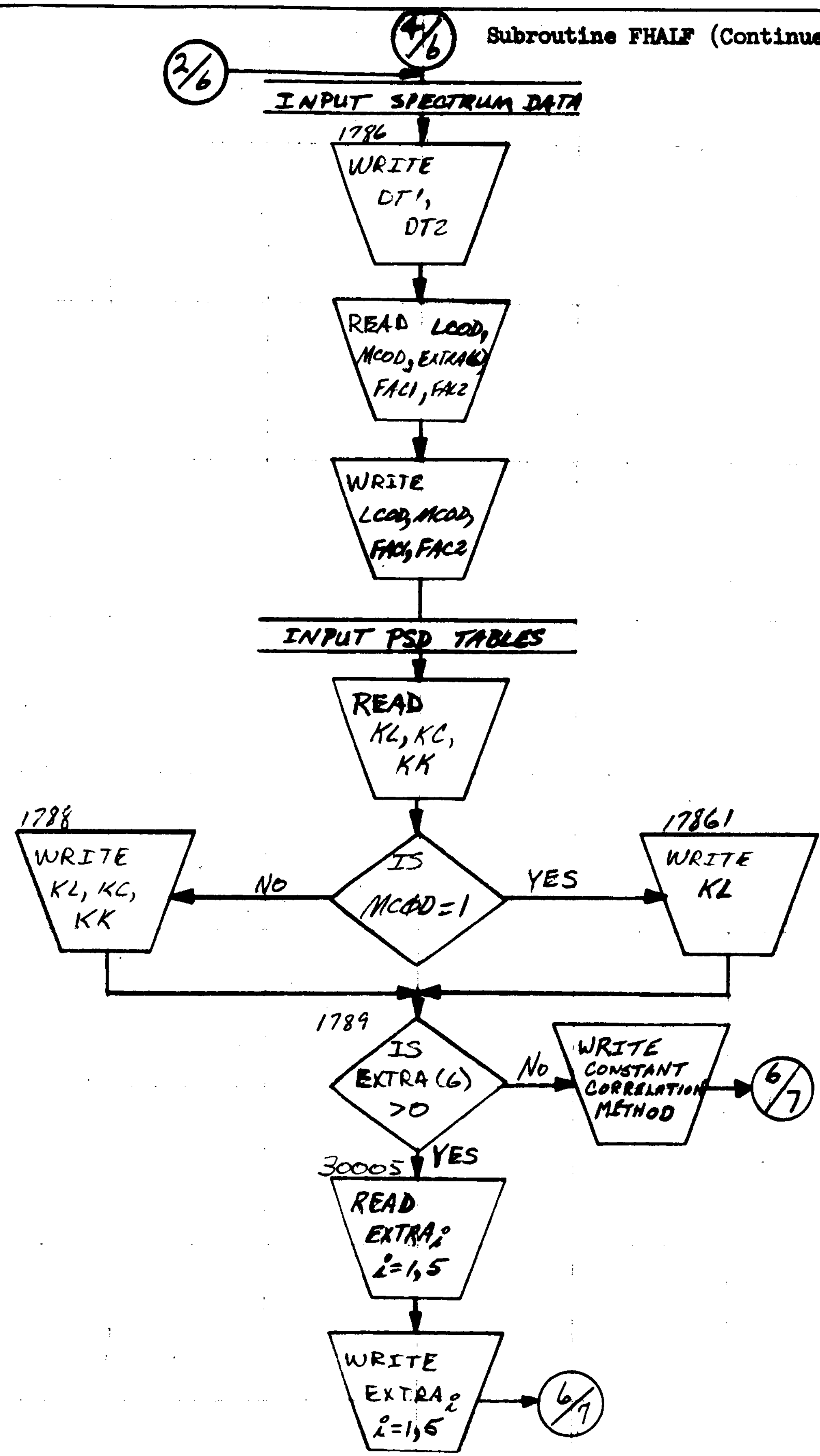


Figure 4.6.7-1 (Continued)

Subroutine FHALF (Continued)

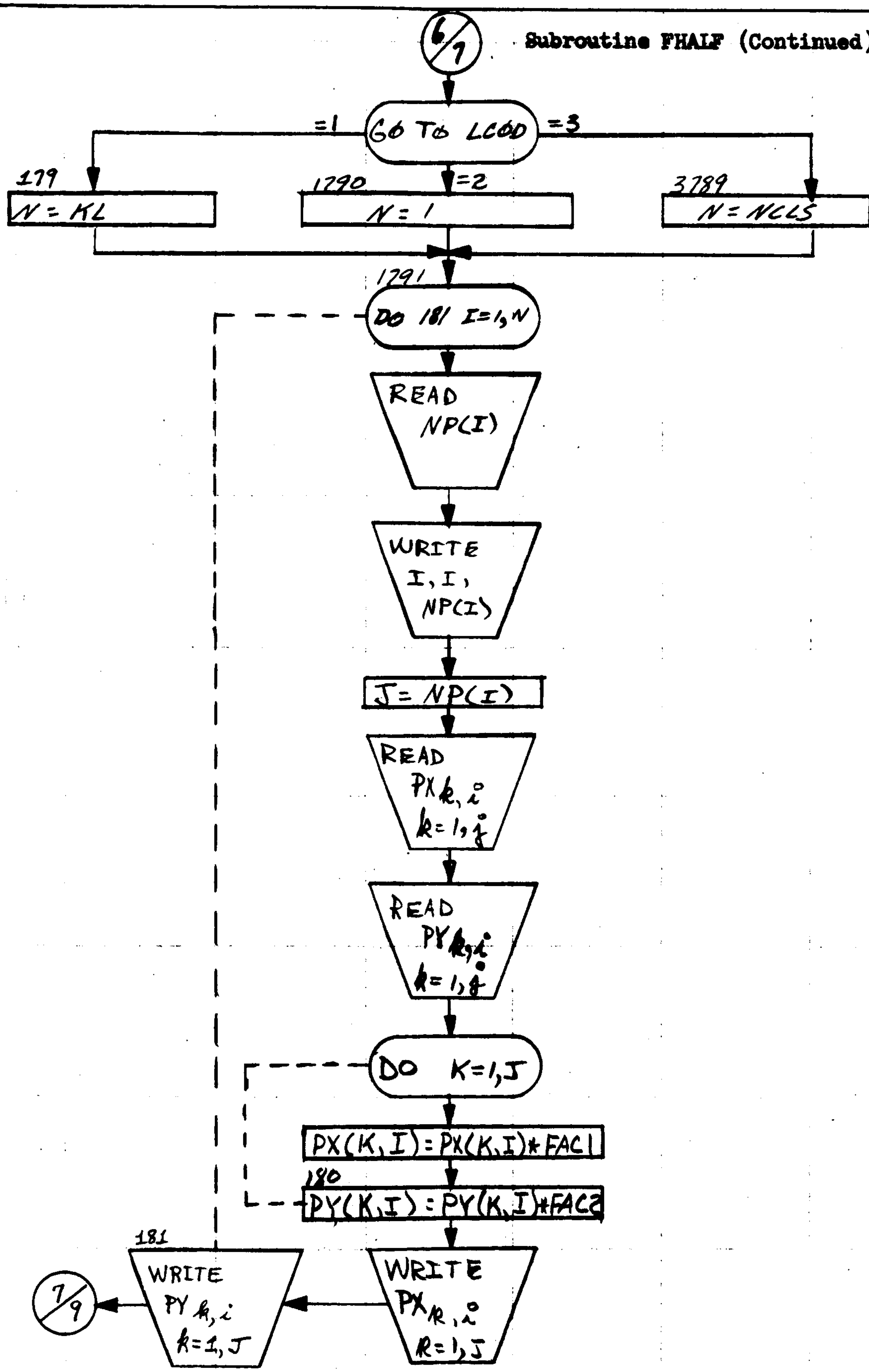


Figure 4.6.7-1 (Continued)

Subroutine FHALF (Continued)

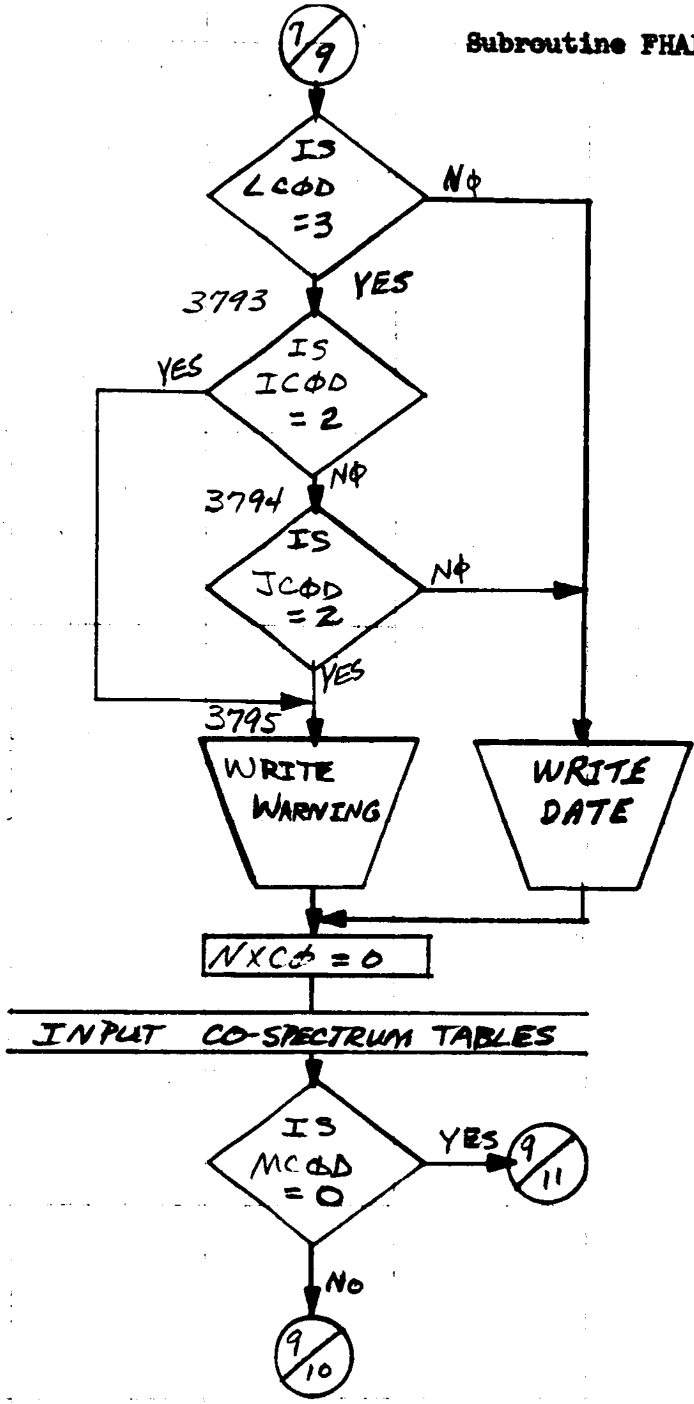


Figure 4.6.7-1 (Continued)

Subroutine FHALF (Continued)

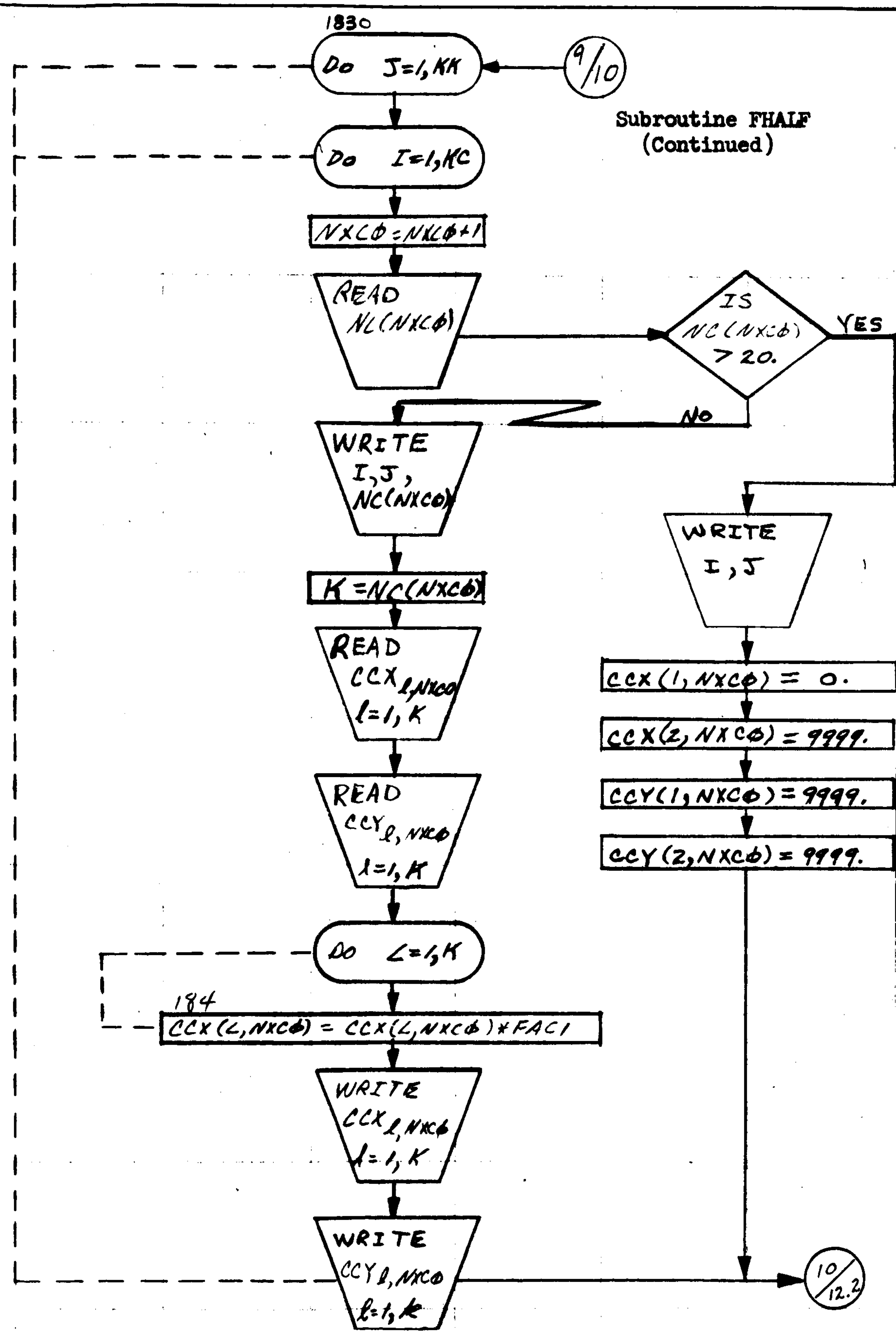


Figure 4.6.7-1 (Continued)

Subroutine FHALF (Continued)

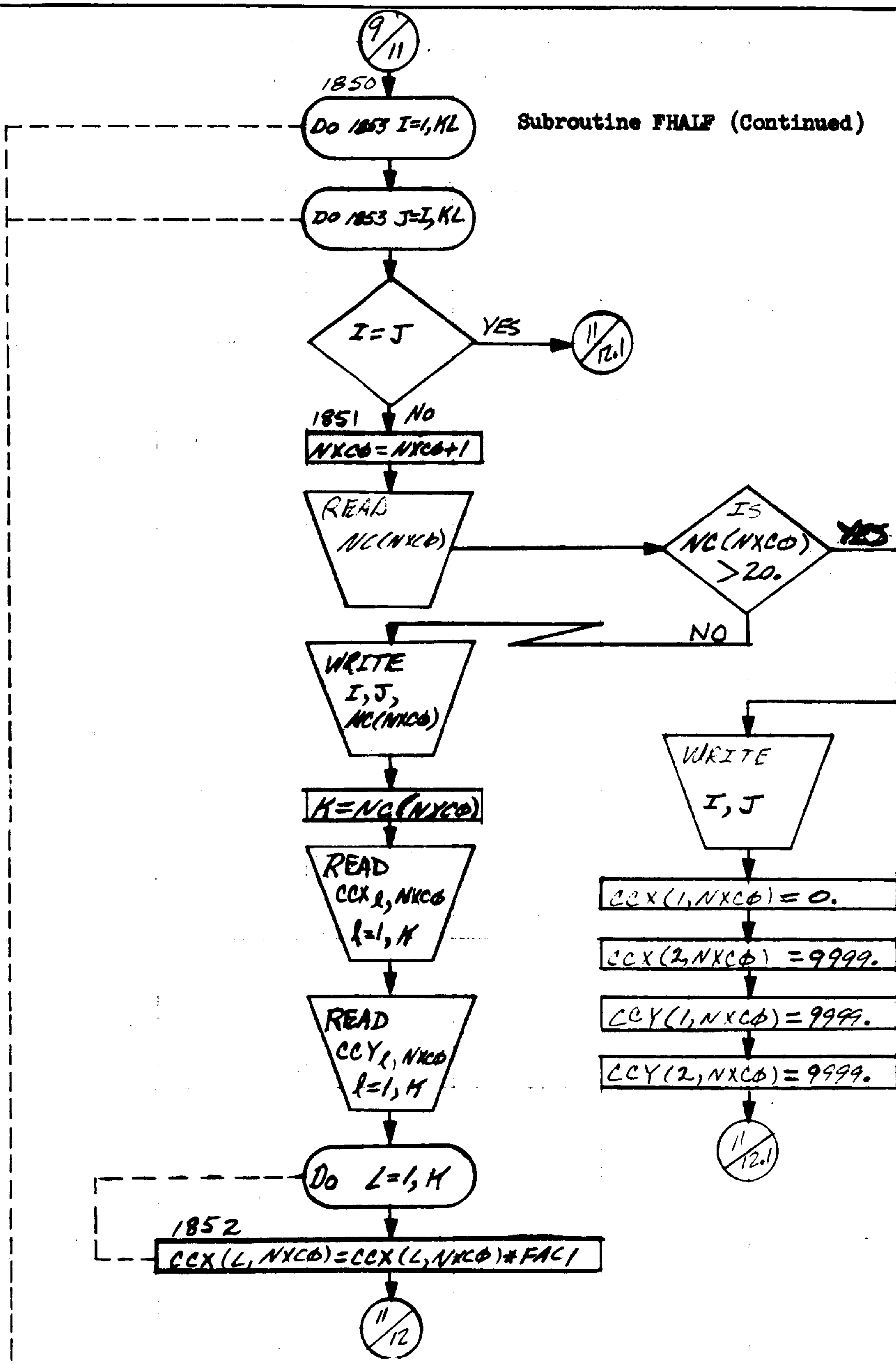


Figure 4.6.7-1 (Continued)

Subroutine FHALF (Continued)

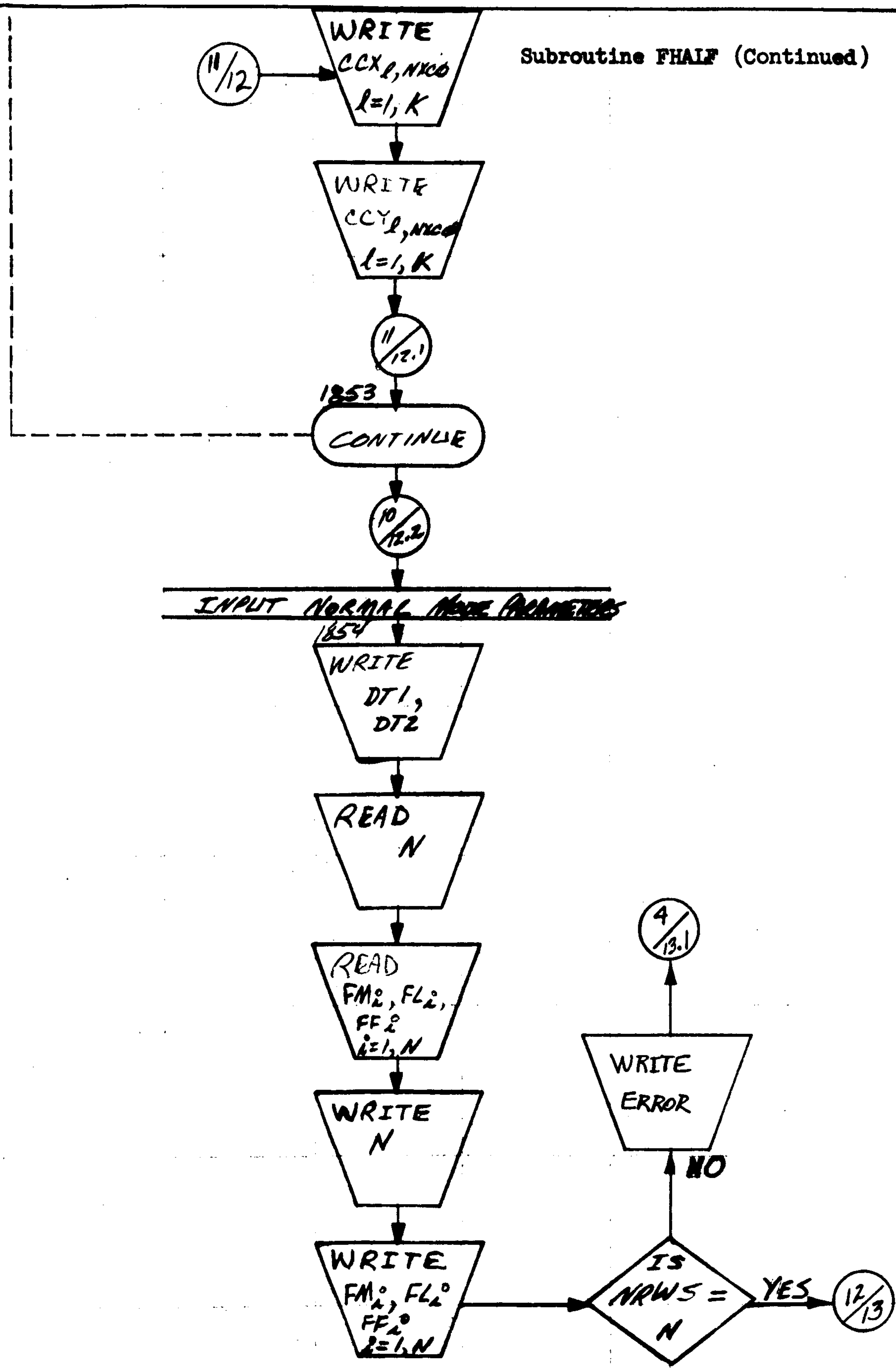


Figure 4.6.7-1 (Continued)

Subroutine FHALF (Continued)

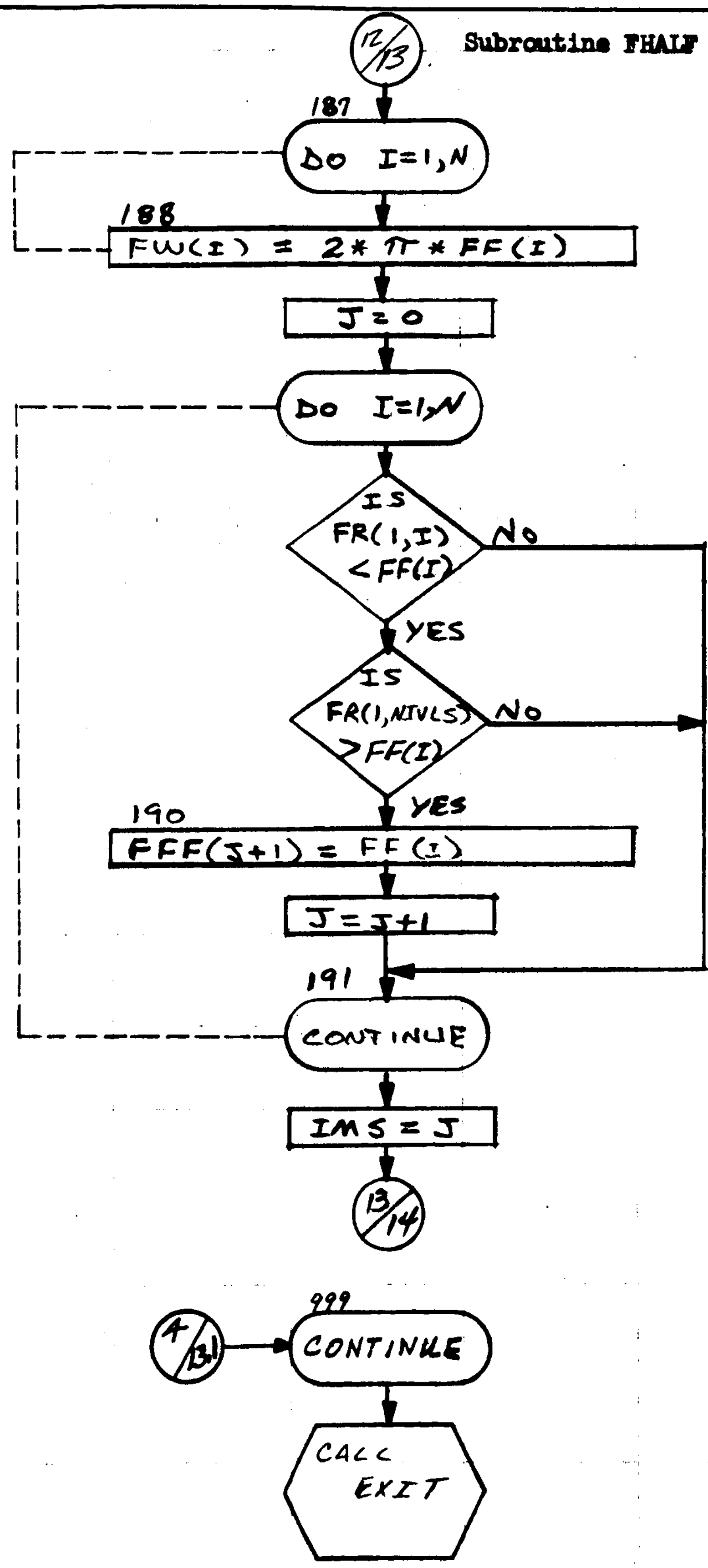


Figure 4.6.7-1 (Continued)

Subroutine FHALF (Concluded)

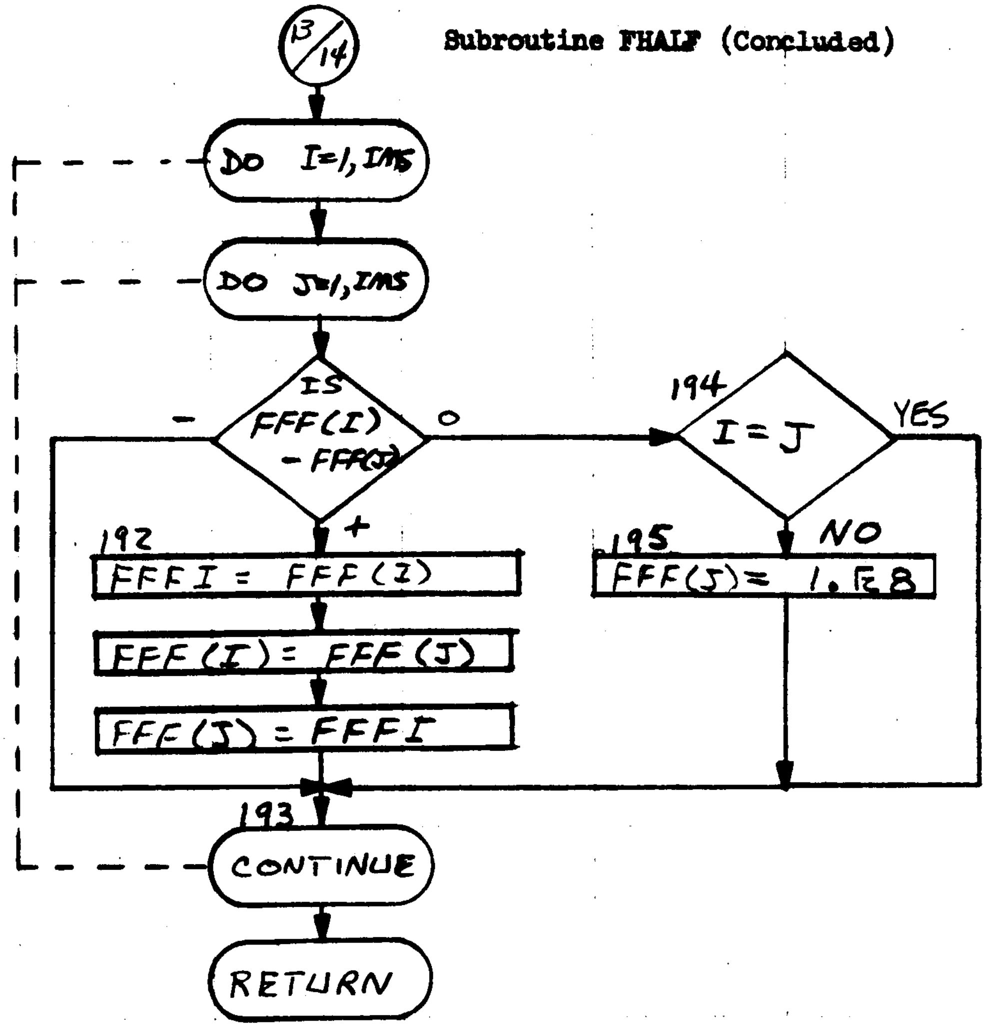


Figure 4.6.7-1 (Concluded)

4.6.8 Link Three, SHALF. - Figure 4.6.8-1 shows the main cycle of the program and how the desired responses are calculated. This portion consists of 20 pages. Control returns to the MAIN program after this link is completed to begin on the next case, if any.

Subroutine SHALF

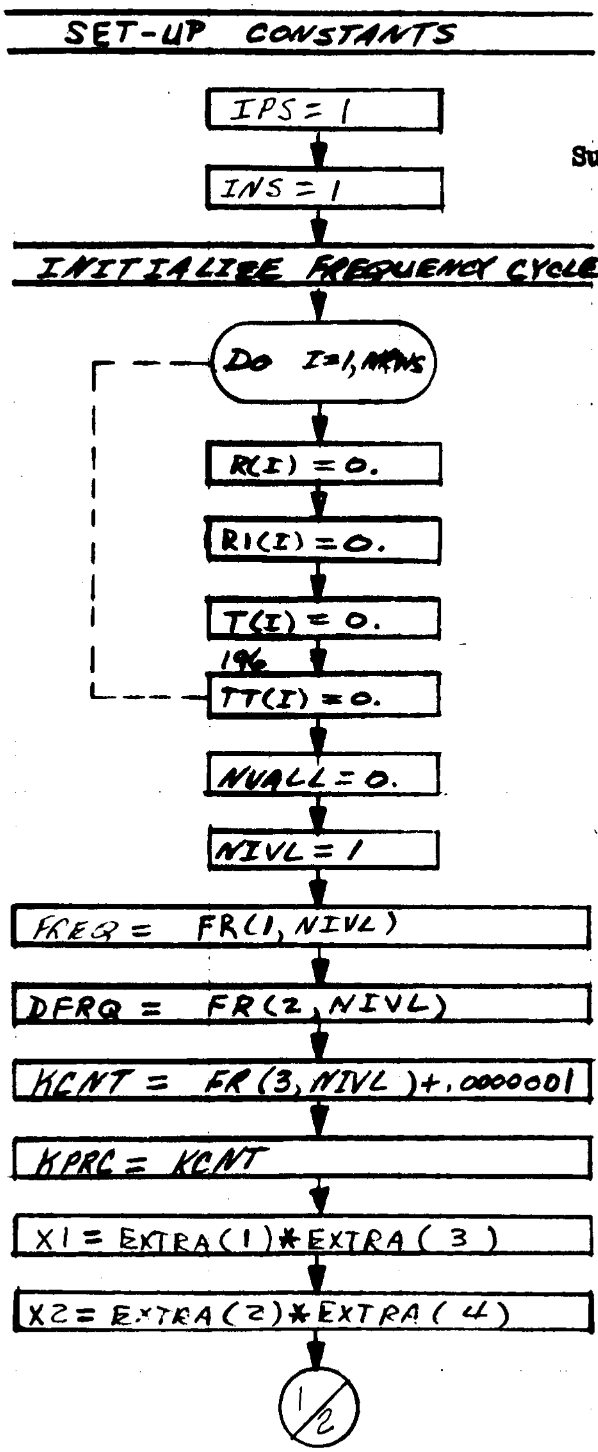


Figure 4.6.8-1

Subroutine SHALF (Continued)

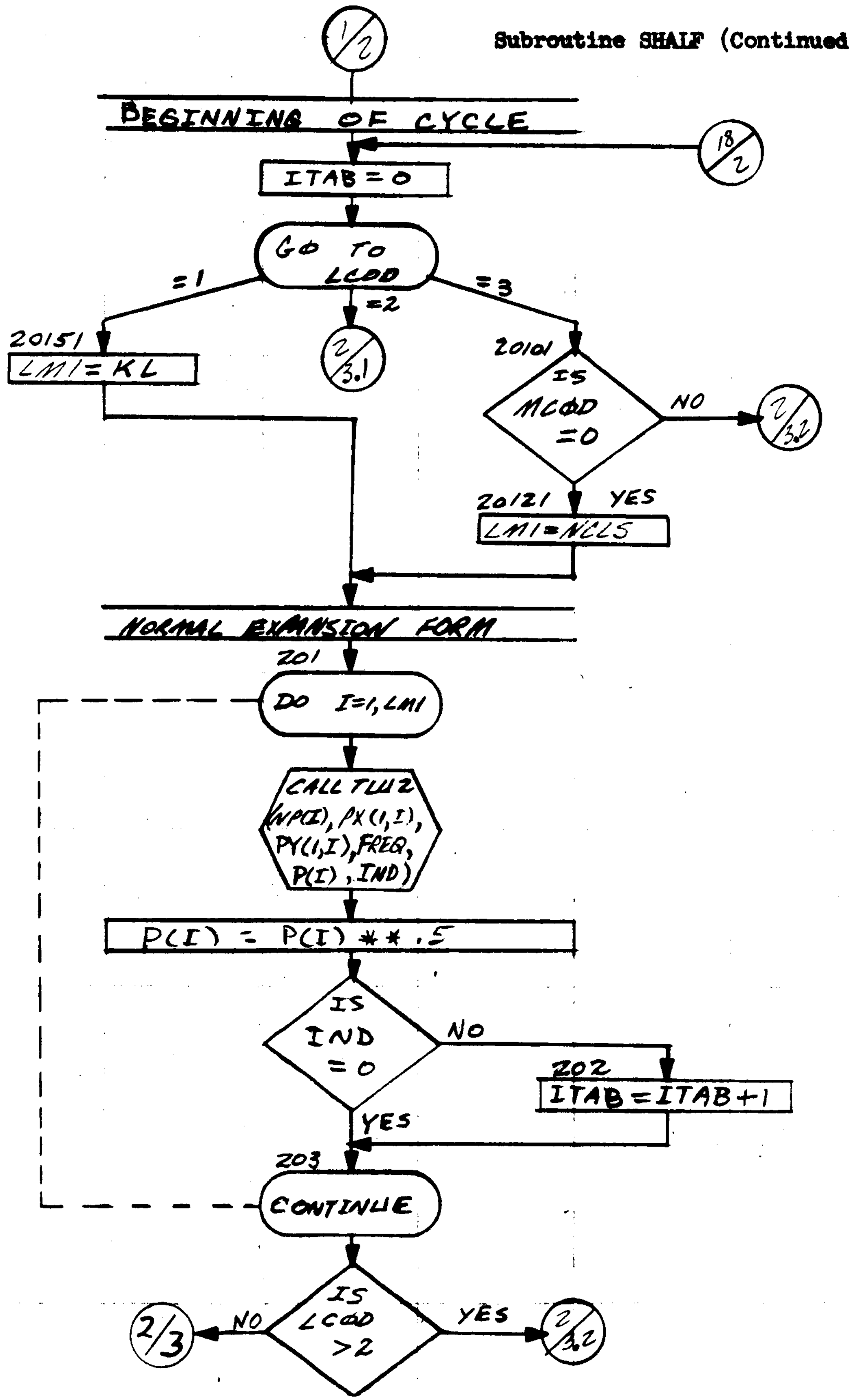


Figure 4.6.8-1 (Continued)

Subroutine SHALF
(Continued)

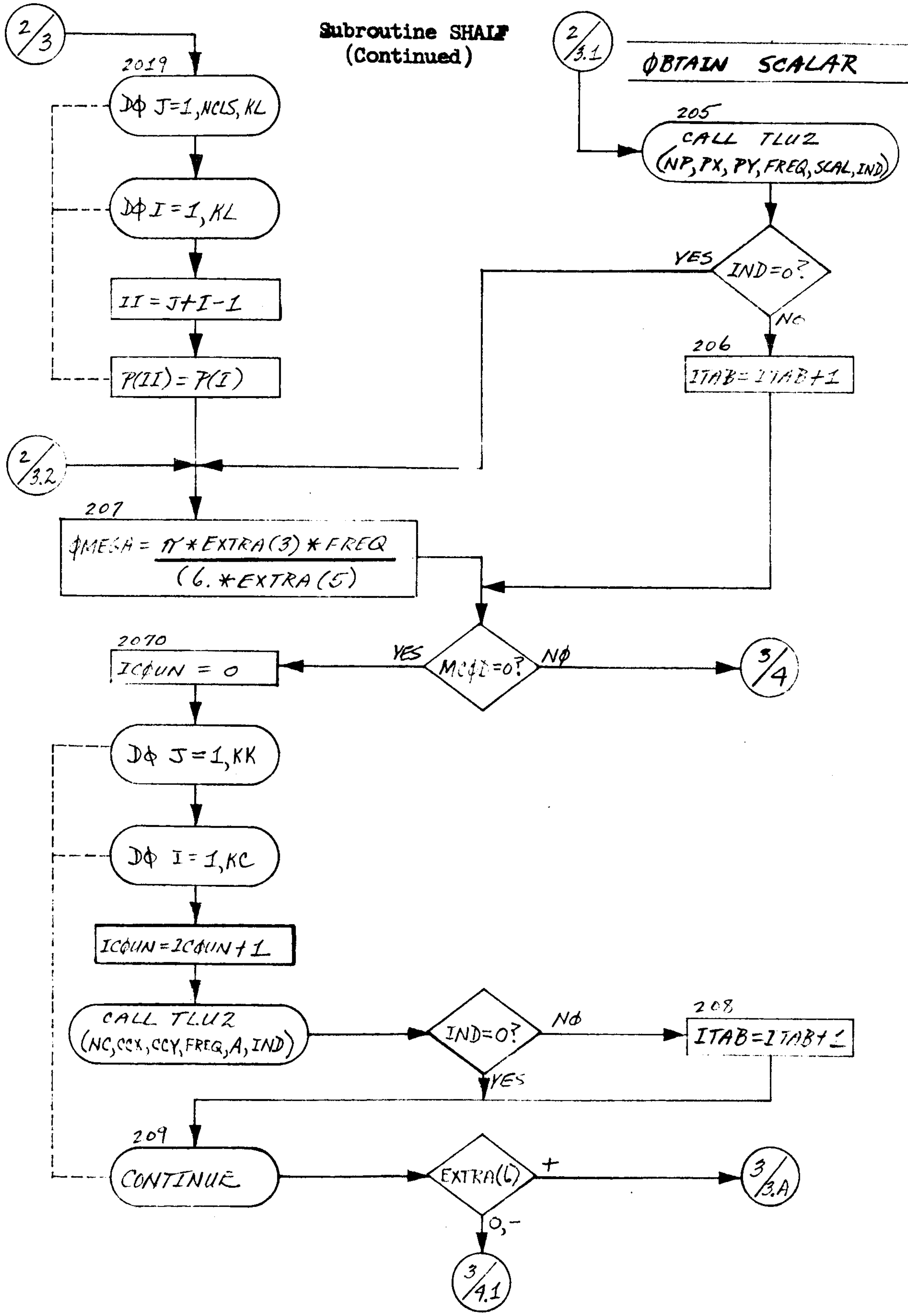
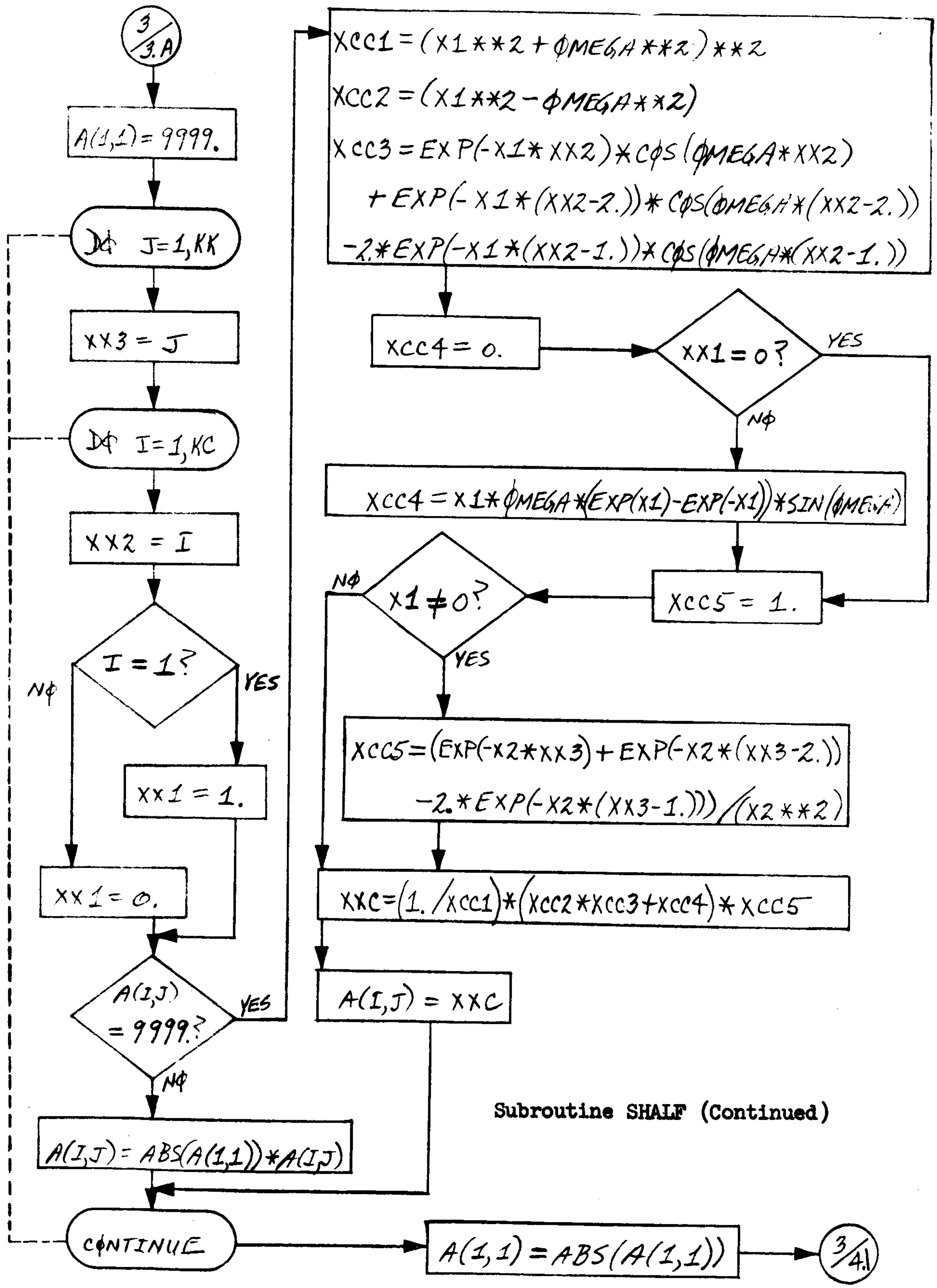


Figure 4.6.8-1 (Continued)



Subroutine SHALF (Continued)

Figure 4.6.8-1 (Continued)

Subroutine SHALF (Continued)

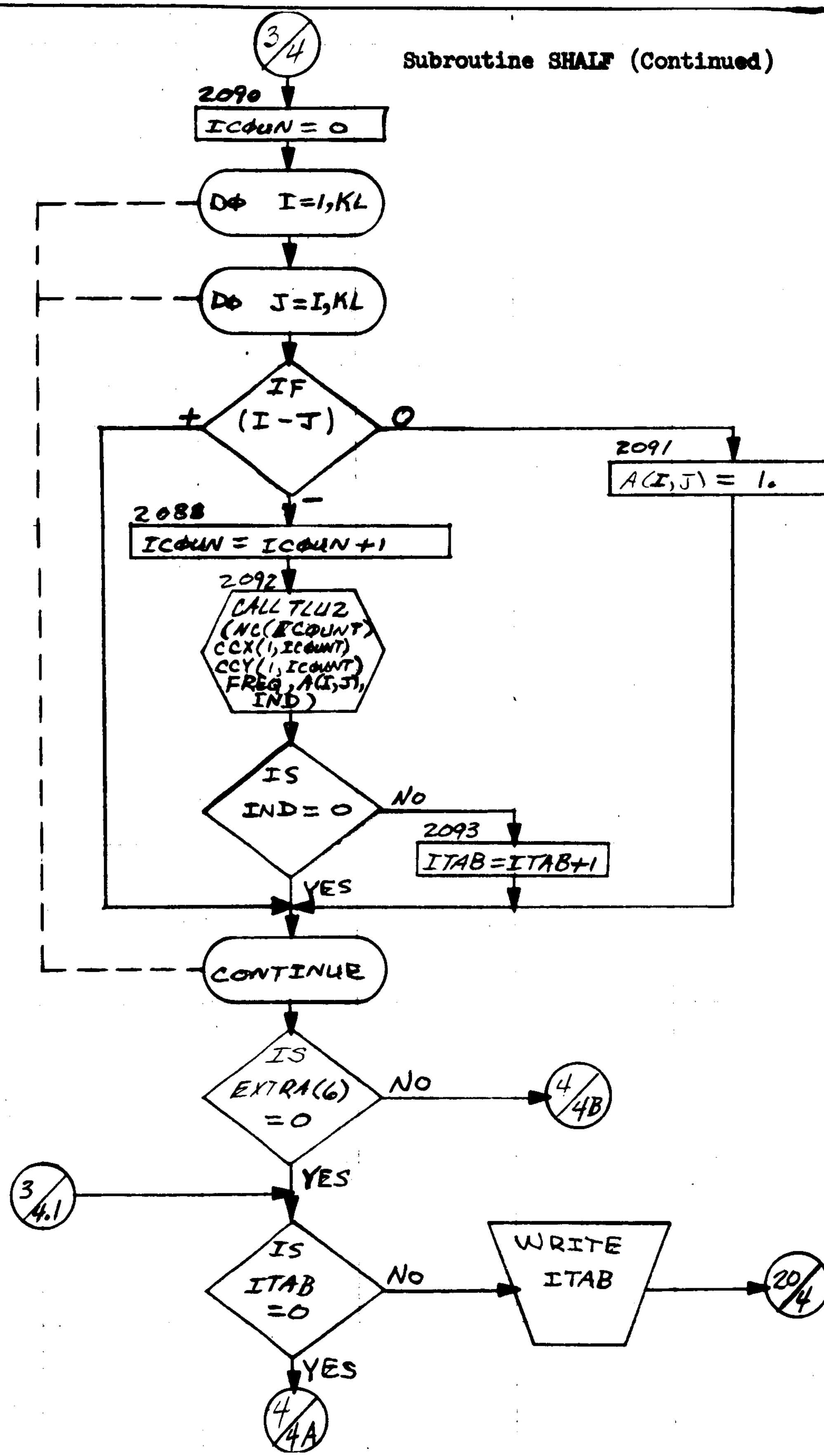


Figure 4.6.8-1 (Continued)

Subroutine SHALF (Continued)

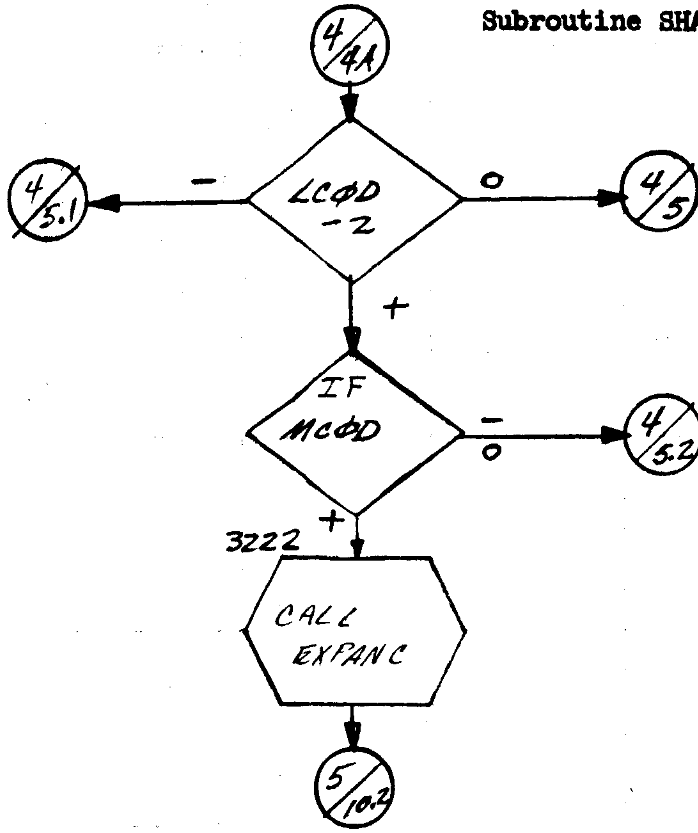
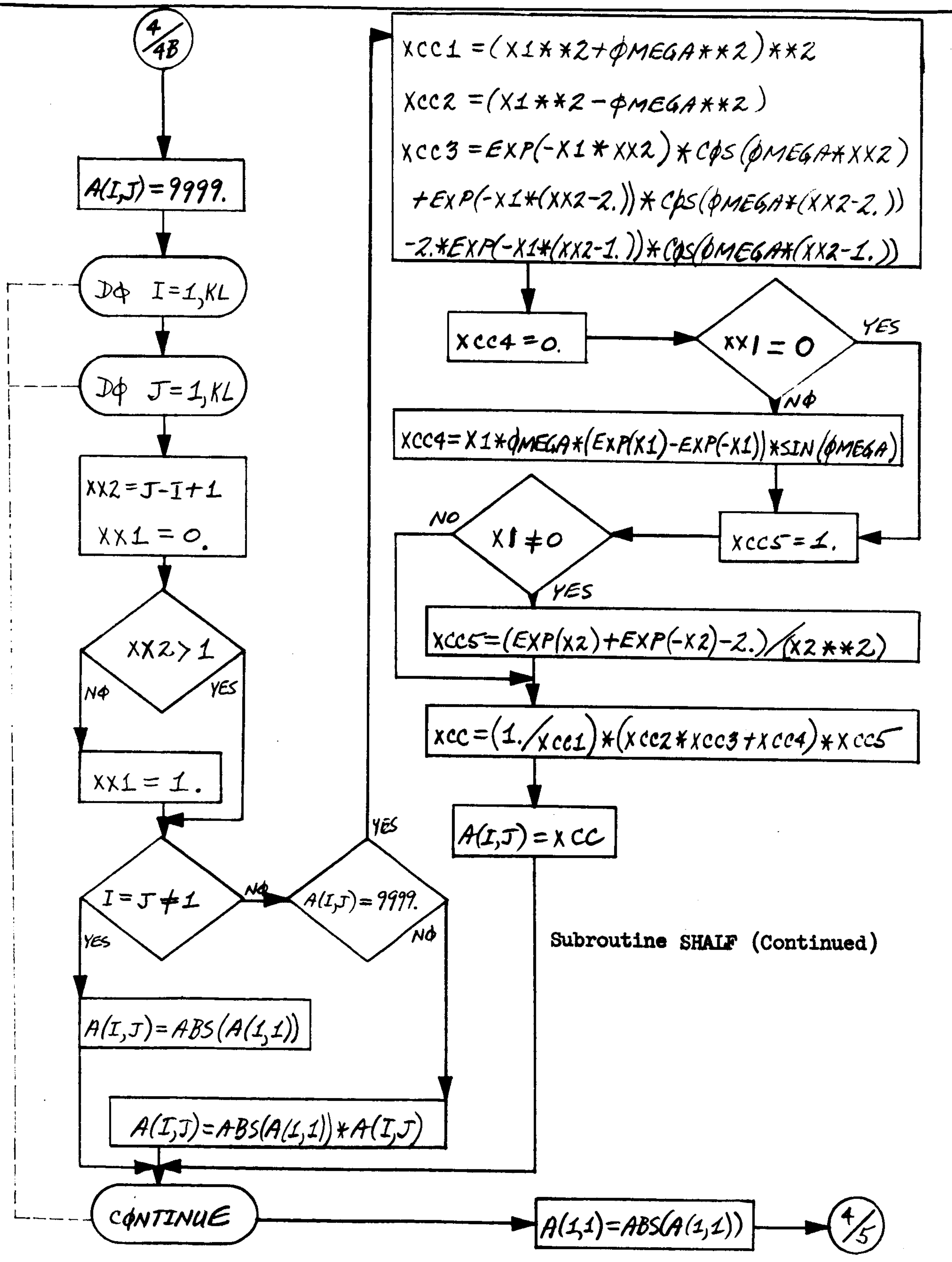


Figure 4.6.8-1 (Continued)



Subroutine SHALF (Continued)

Figure 4.6.8-1 (Continued)

Subroutine SHALF (Continued)

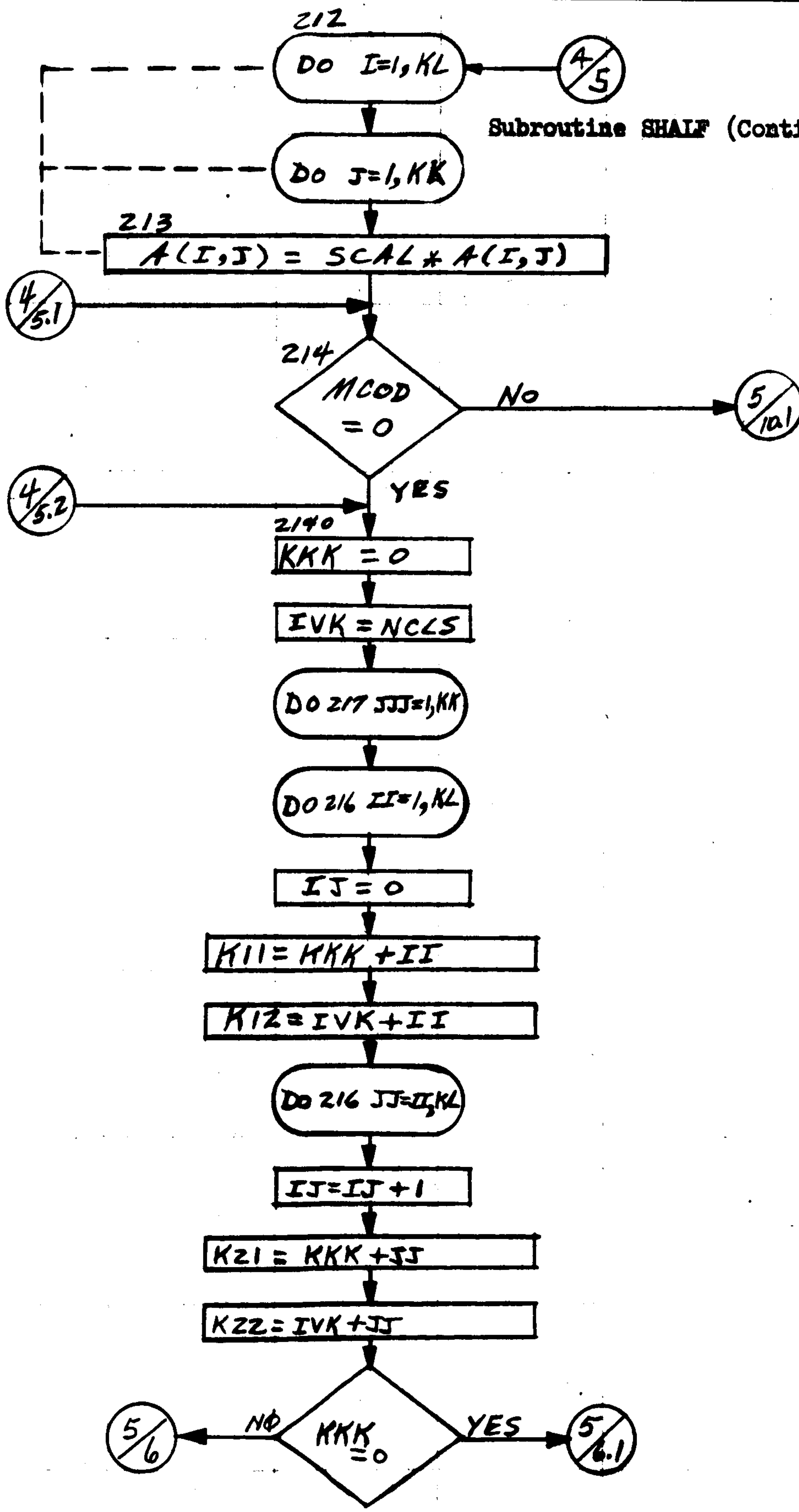


Figure 4.6.8-1 (Continued)

Subroutine SHALF (Continued)

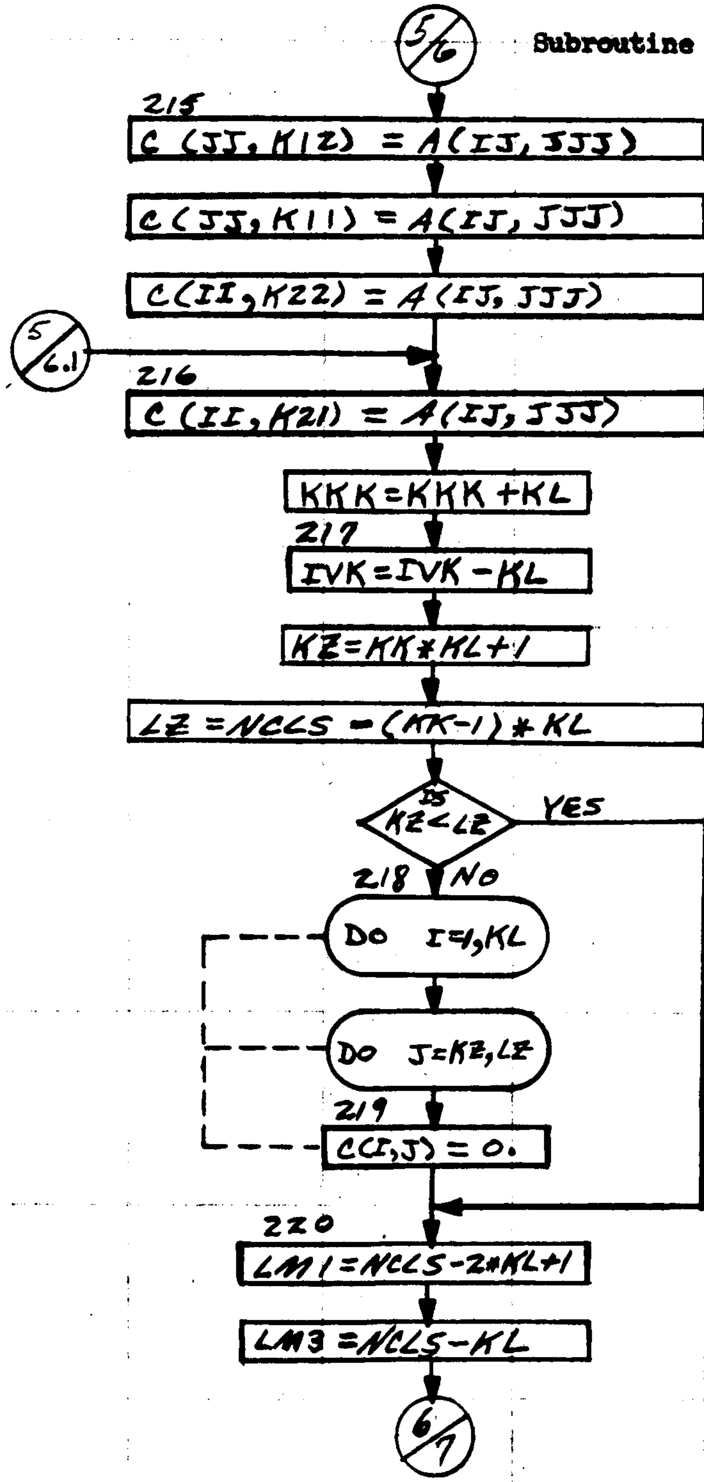


Figure 4.6.8-1 (Continued)

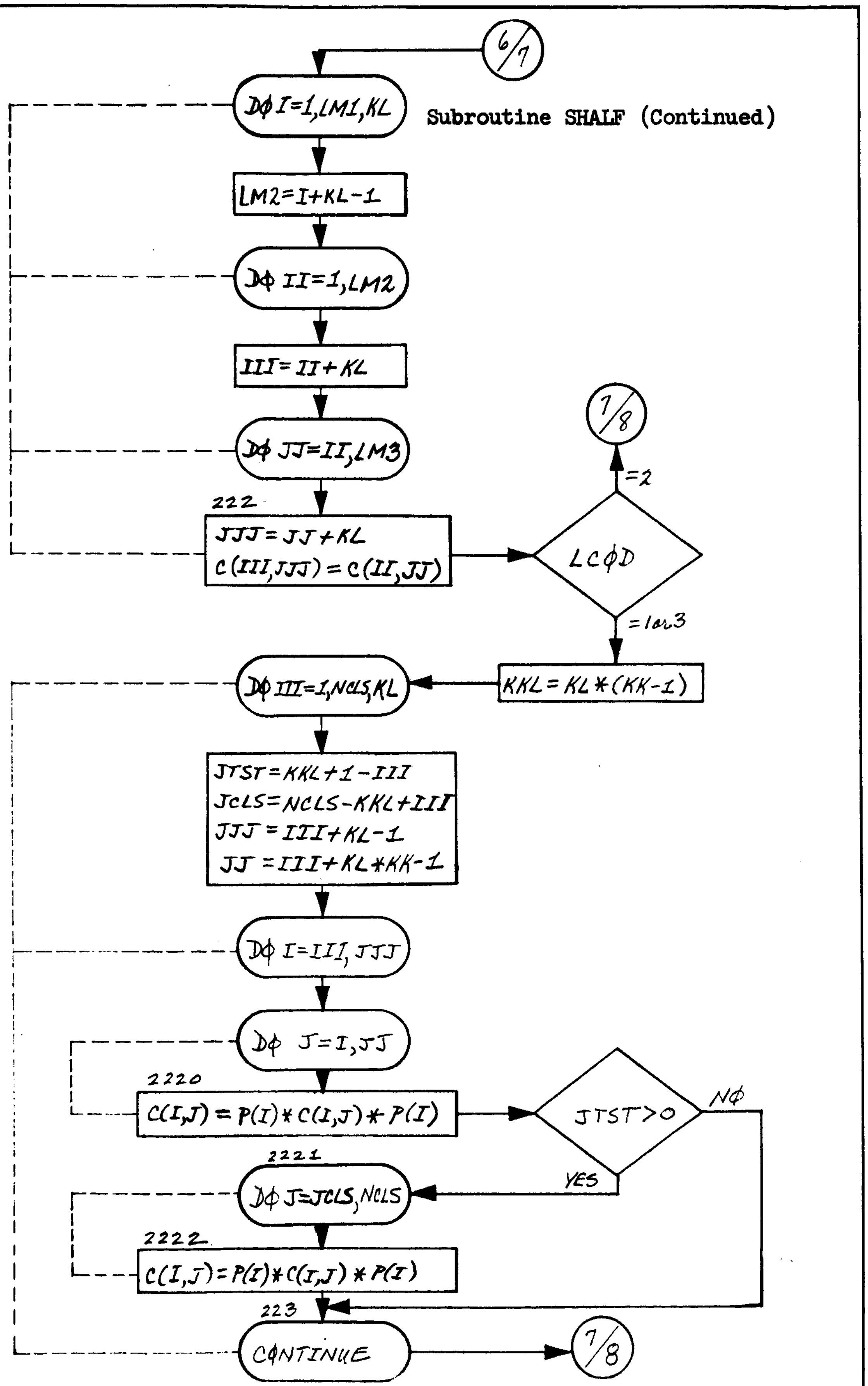
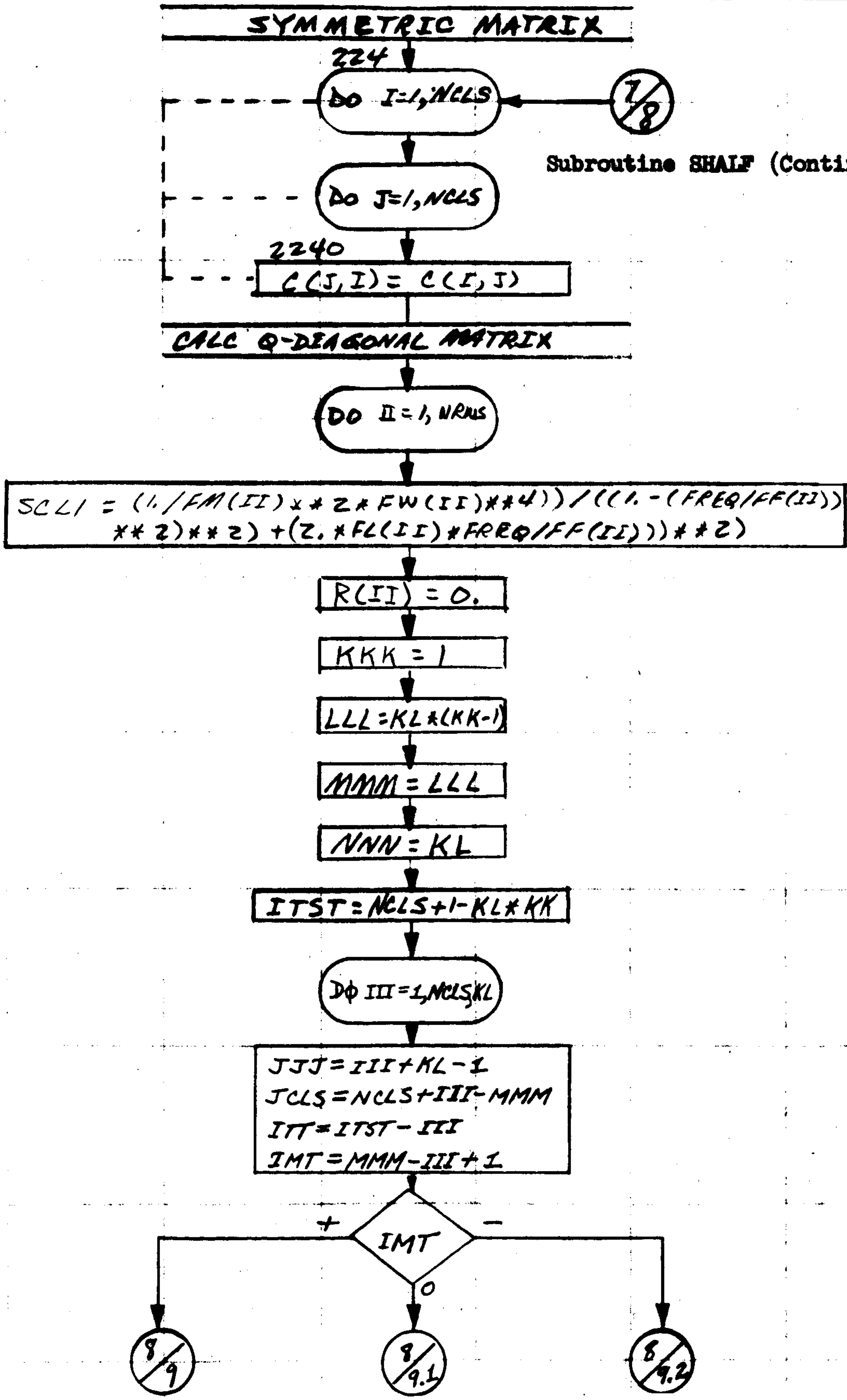


Figure 4.6.8-1 (Continued)



Subroutine SHALF (Continued)

Figure 4.6.8-1 (Continued)

Subroutine SHALF (Continued)

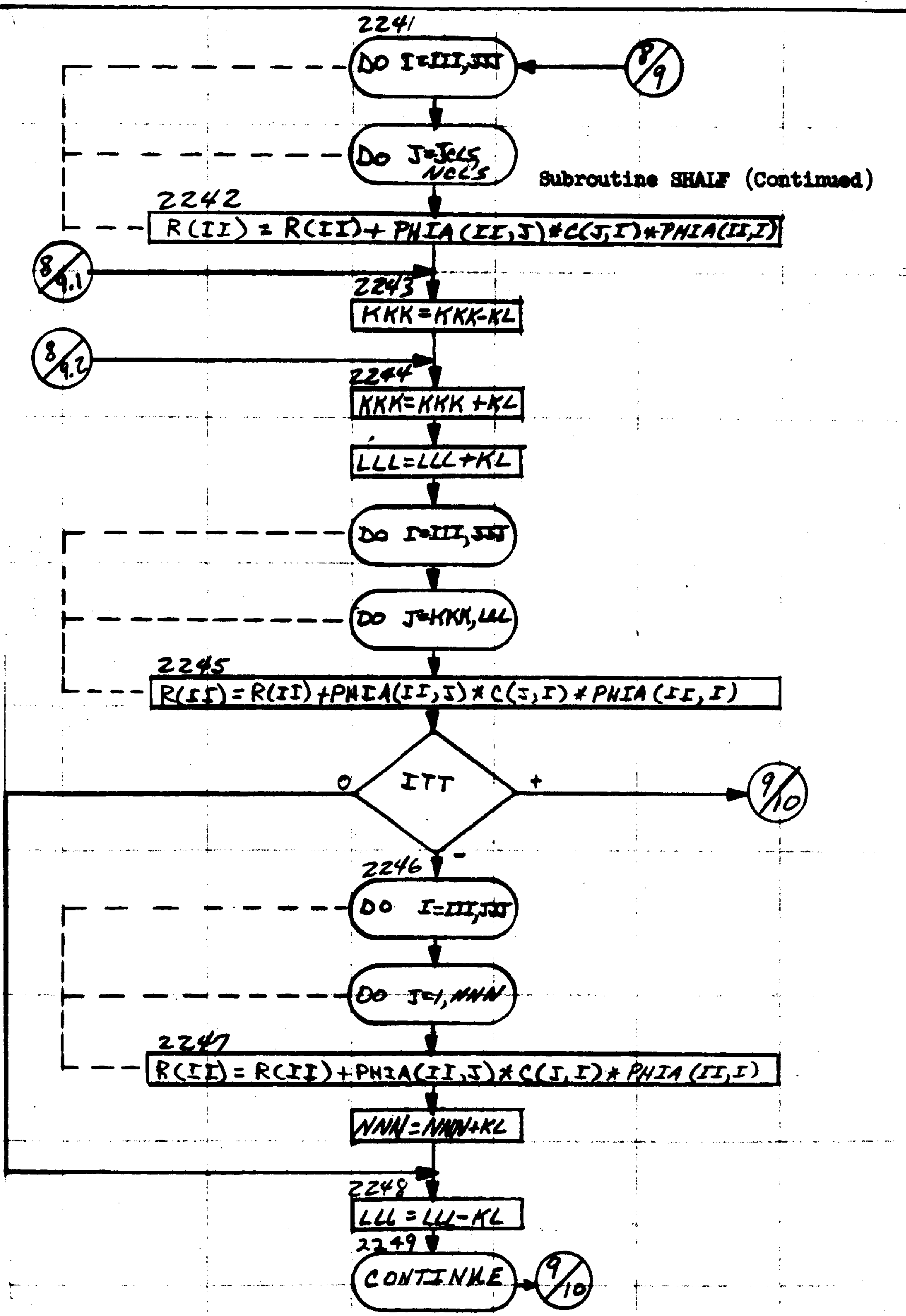


Figure 4.6.8-1 (Continued)

Subroutine SHALF (Continued)

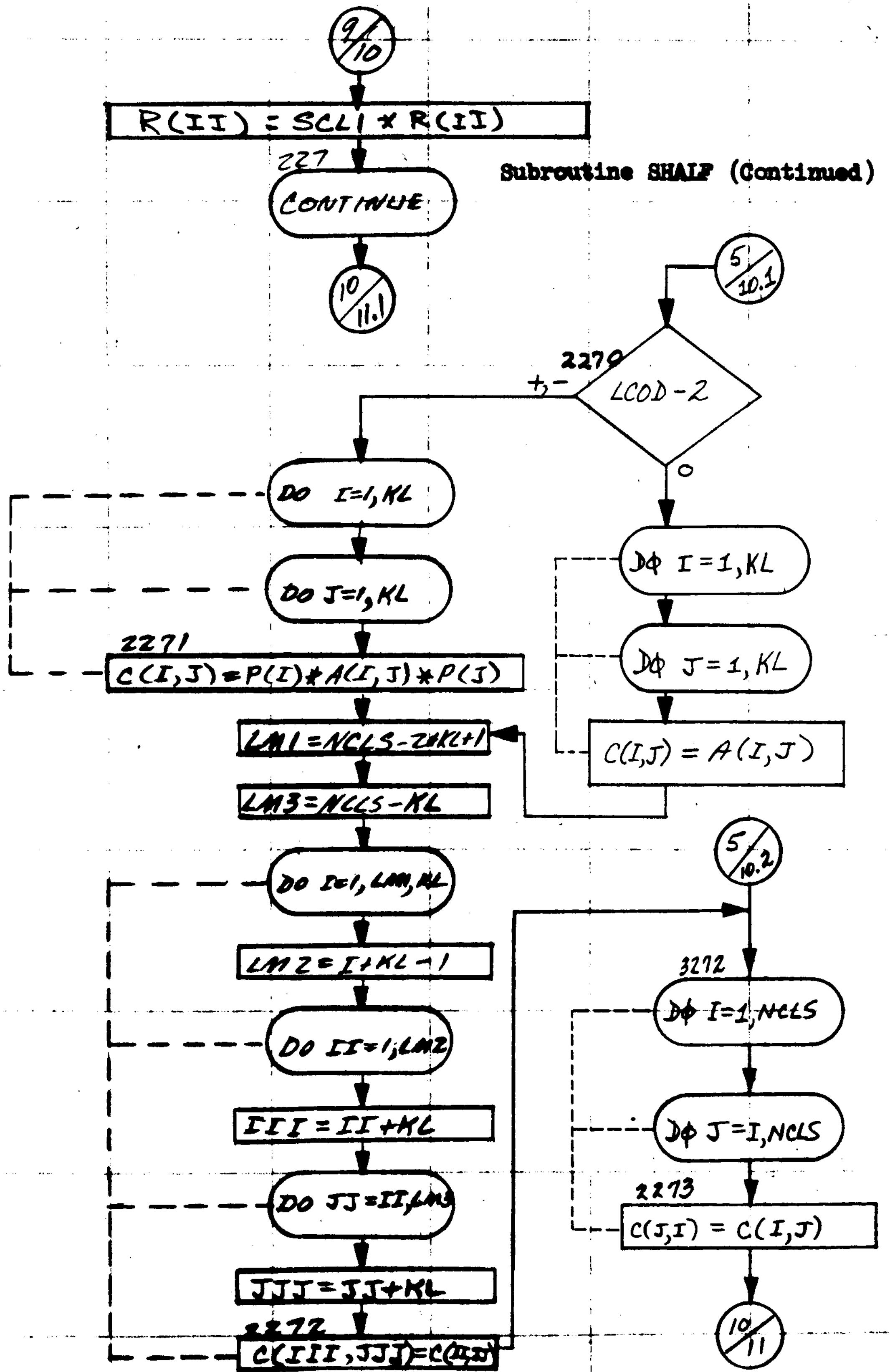


Figure 4.6.8-1 (Continued)

Subroutine SHALF (Continued)

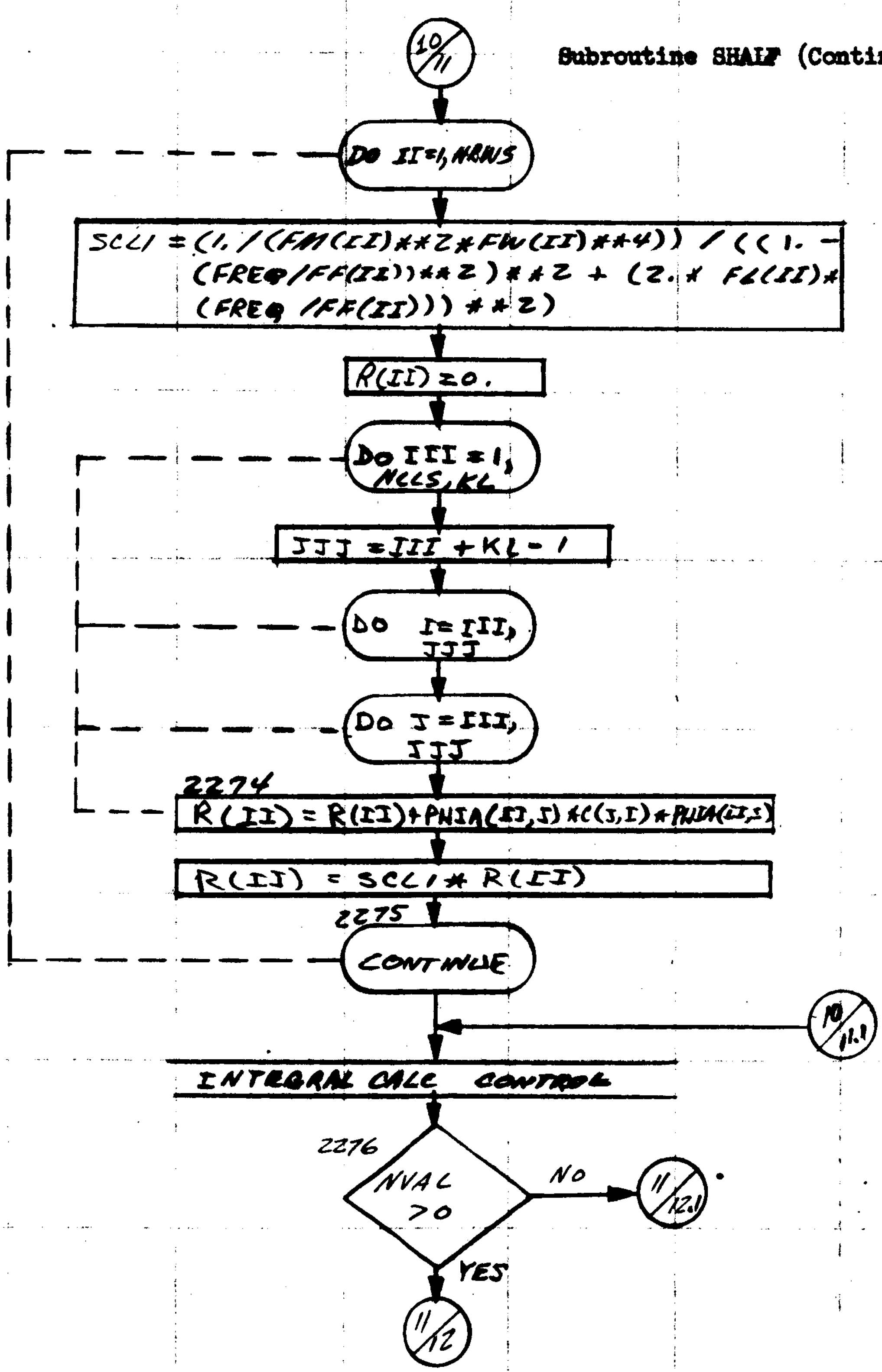


Figure 4.6.8-1 (Continued)

Subroutine SHALF (Continued)

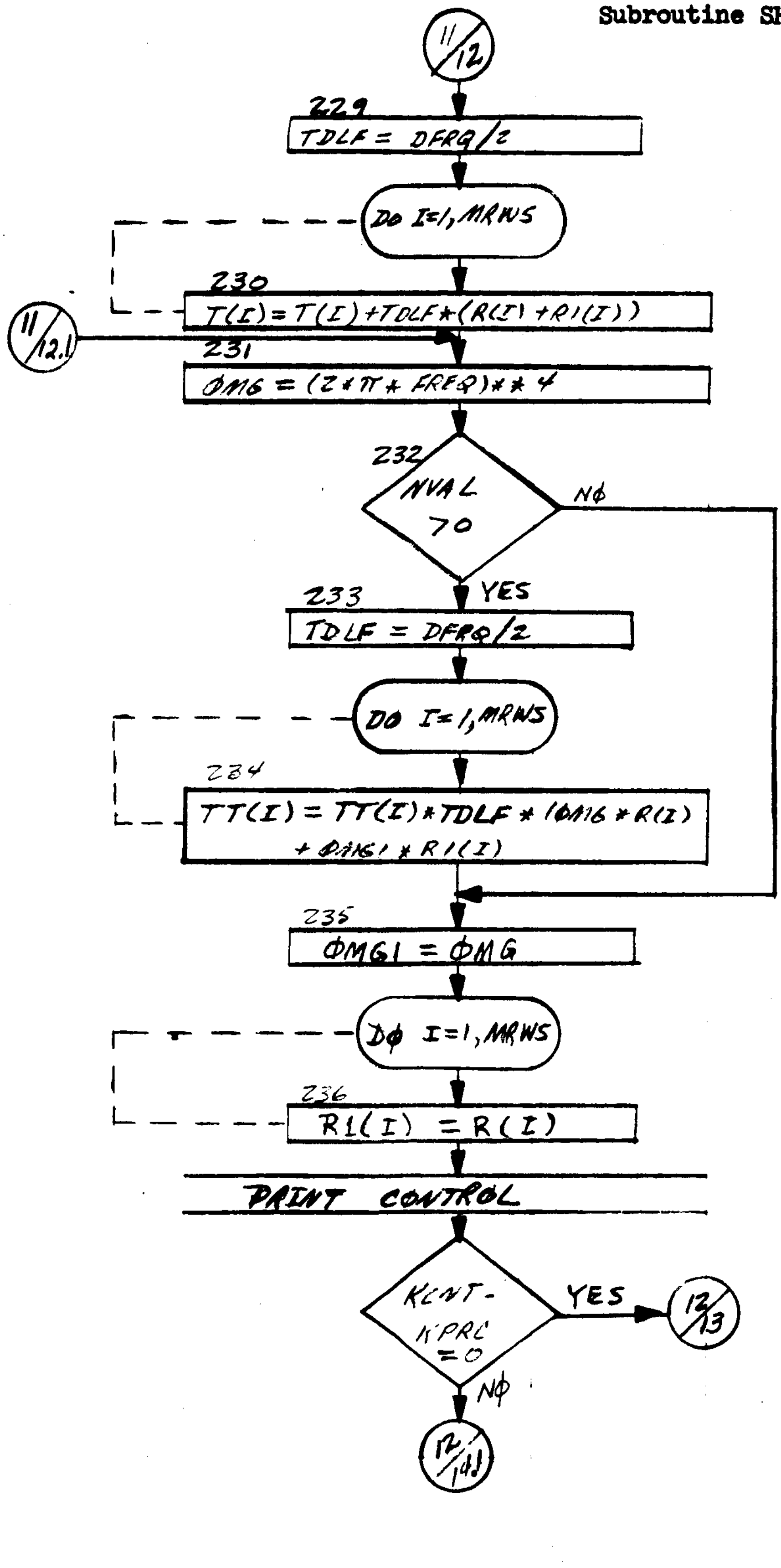


Figure 4.6.8-1 (Continued)

Subroutine SHALF (Continued)

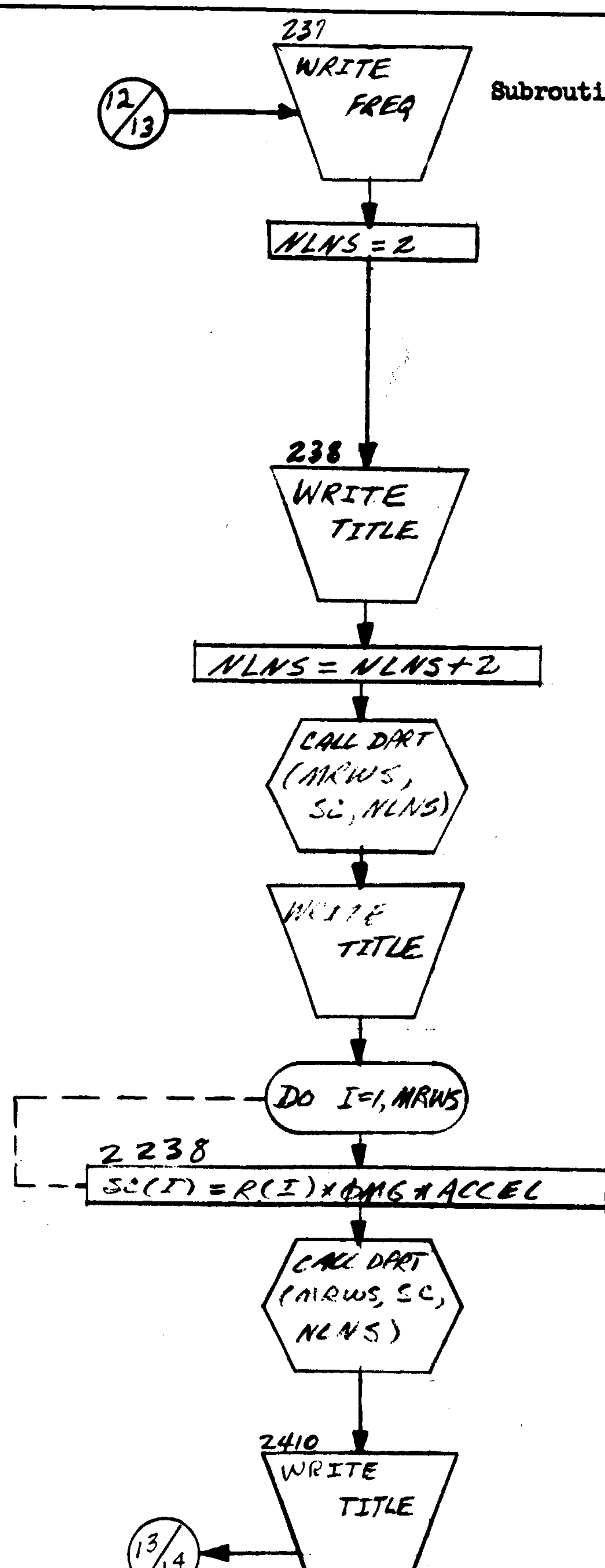


Figure 4.6.8-1 (Continued)

Subroutine SHALF (Continued)

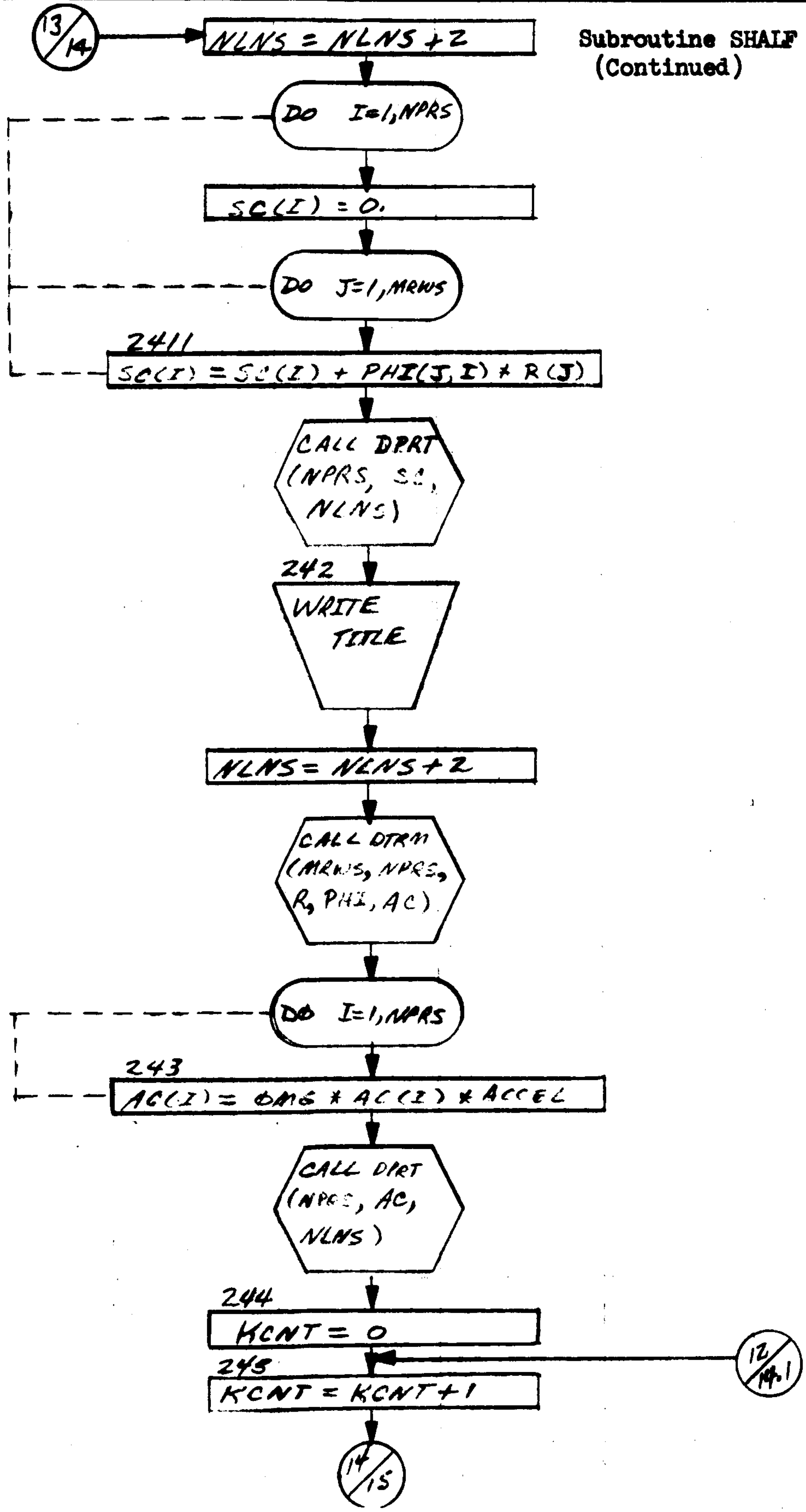


Figure 4.6.8-1 (Continued)

Subroutine SHALF (Continued)

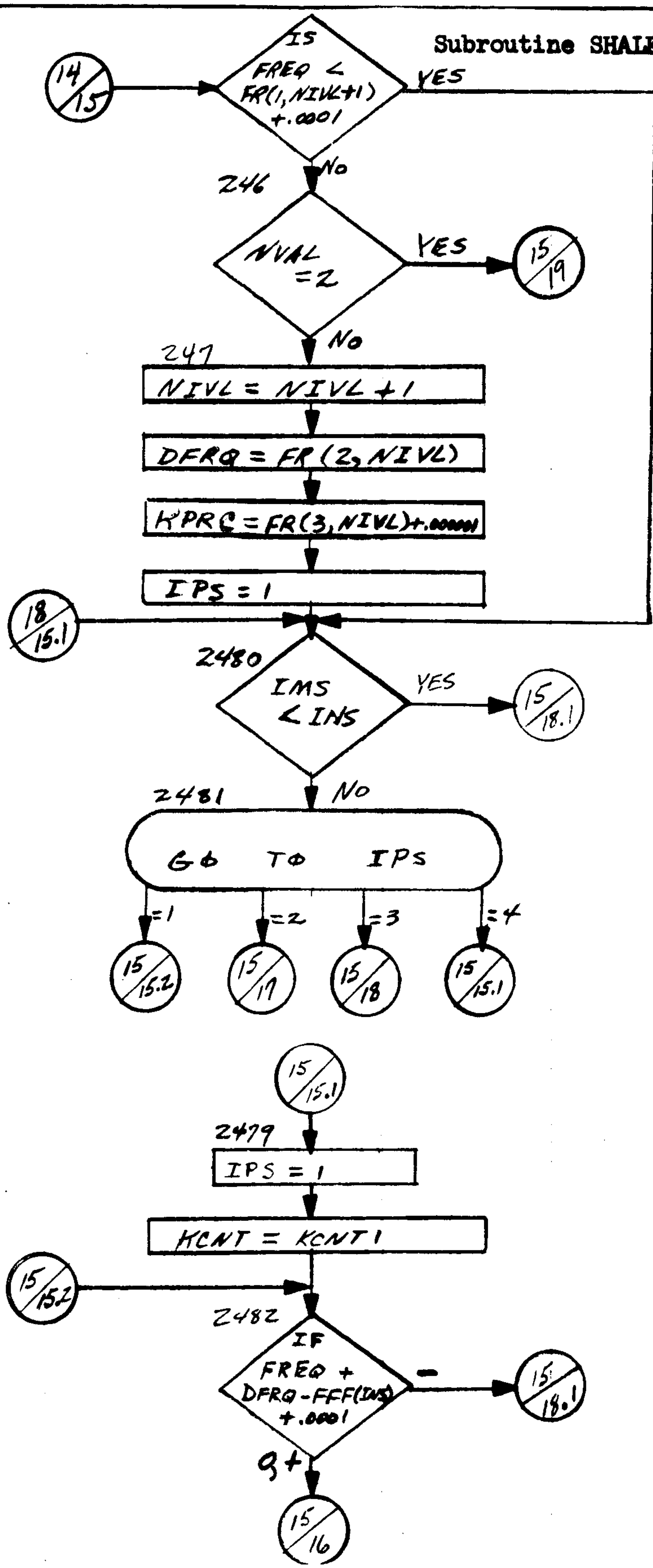


Figure 4.6.8-1 (Continued)

Subroutine SHALF (Continued)

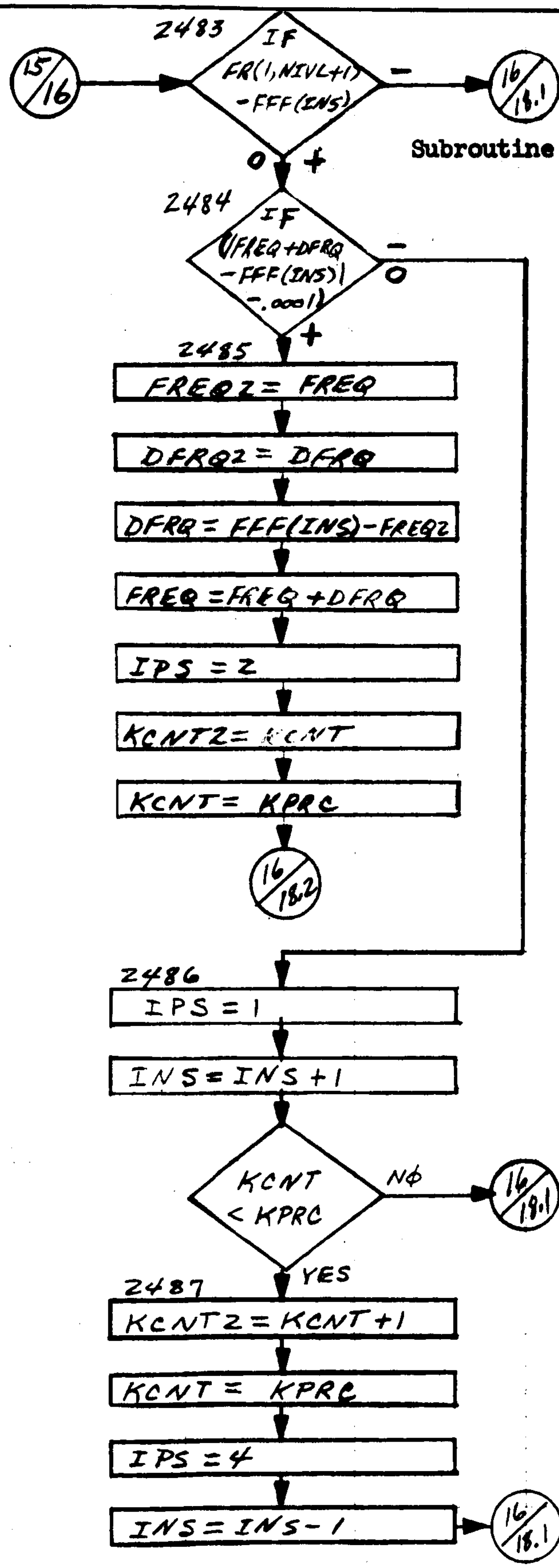


Figure 4.6.8-1 (Continued)

Subroutine SHALF (Continued)

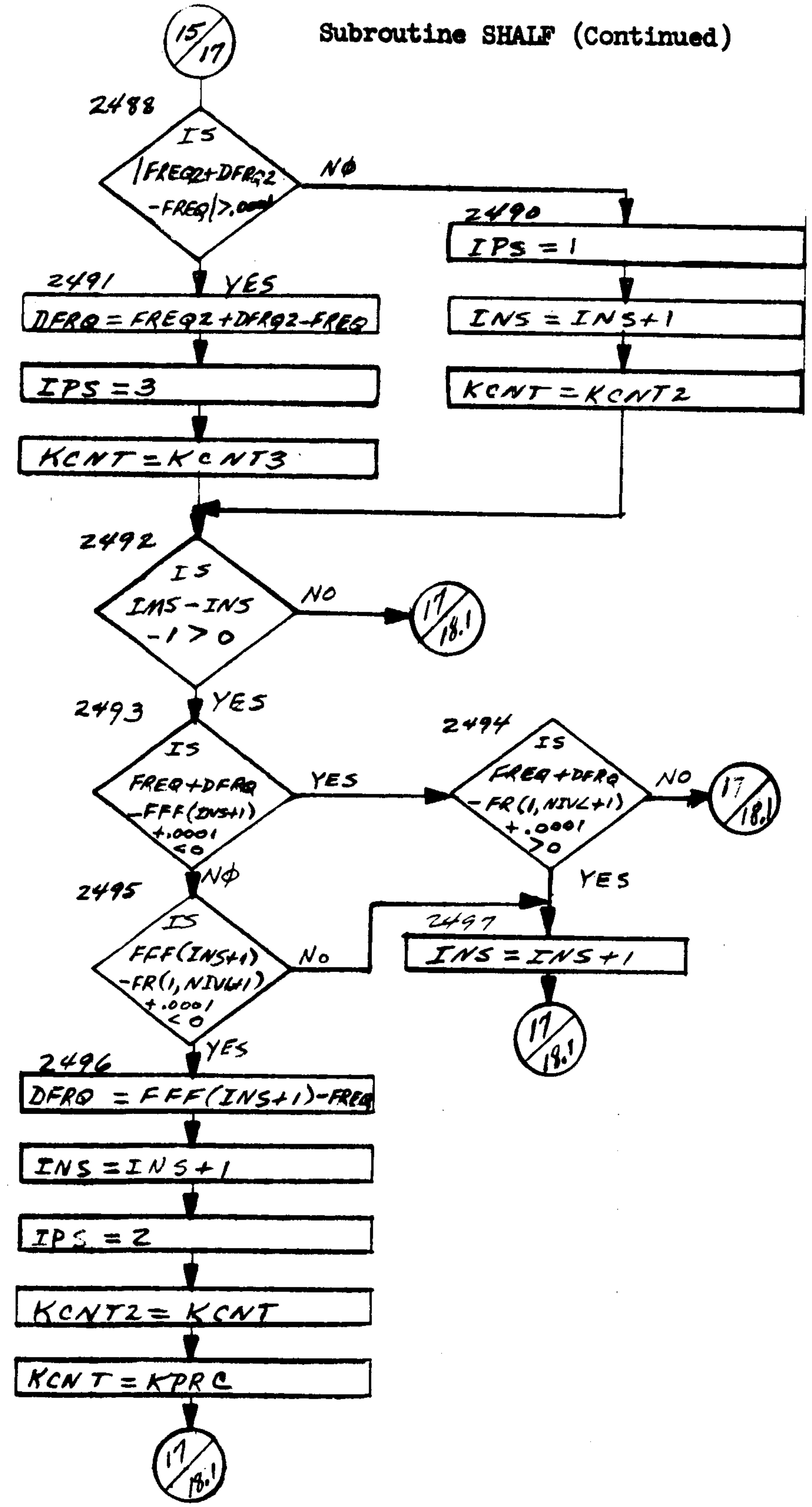


Figure 4.6.8-1 (Continued)

Subroutine SHALF (Continued)

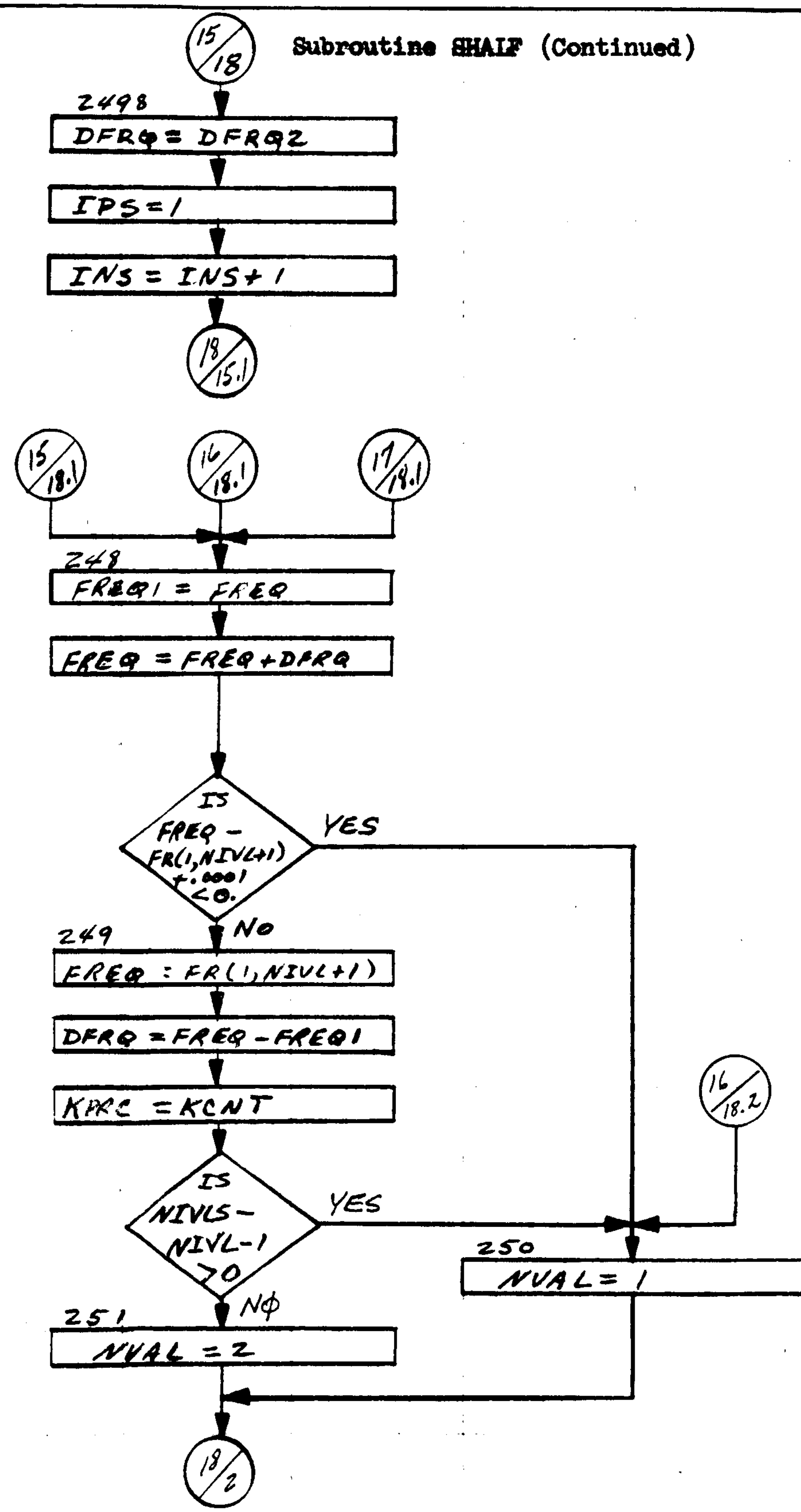


Figure 4.6.8-1 (Continued)

Subroutine SHALF (Continued)

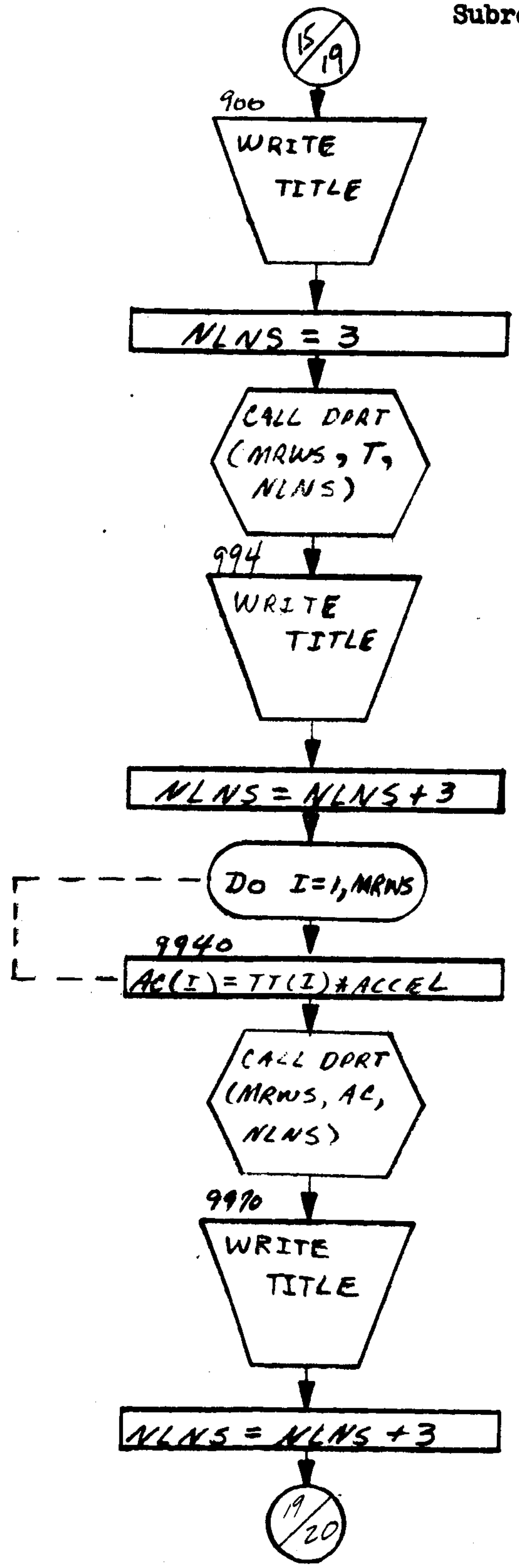


Figure 4.6.8-1 (Continued)

Subroutine SHALF (Concluded)

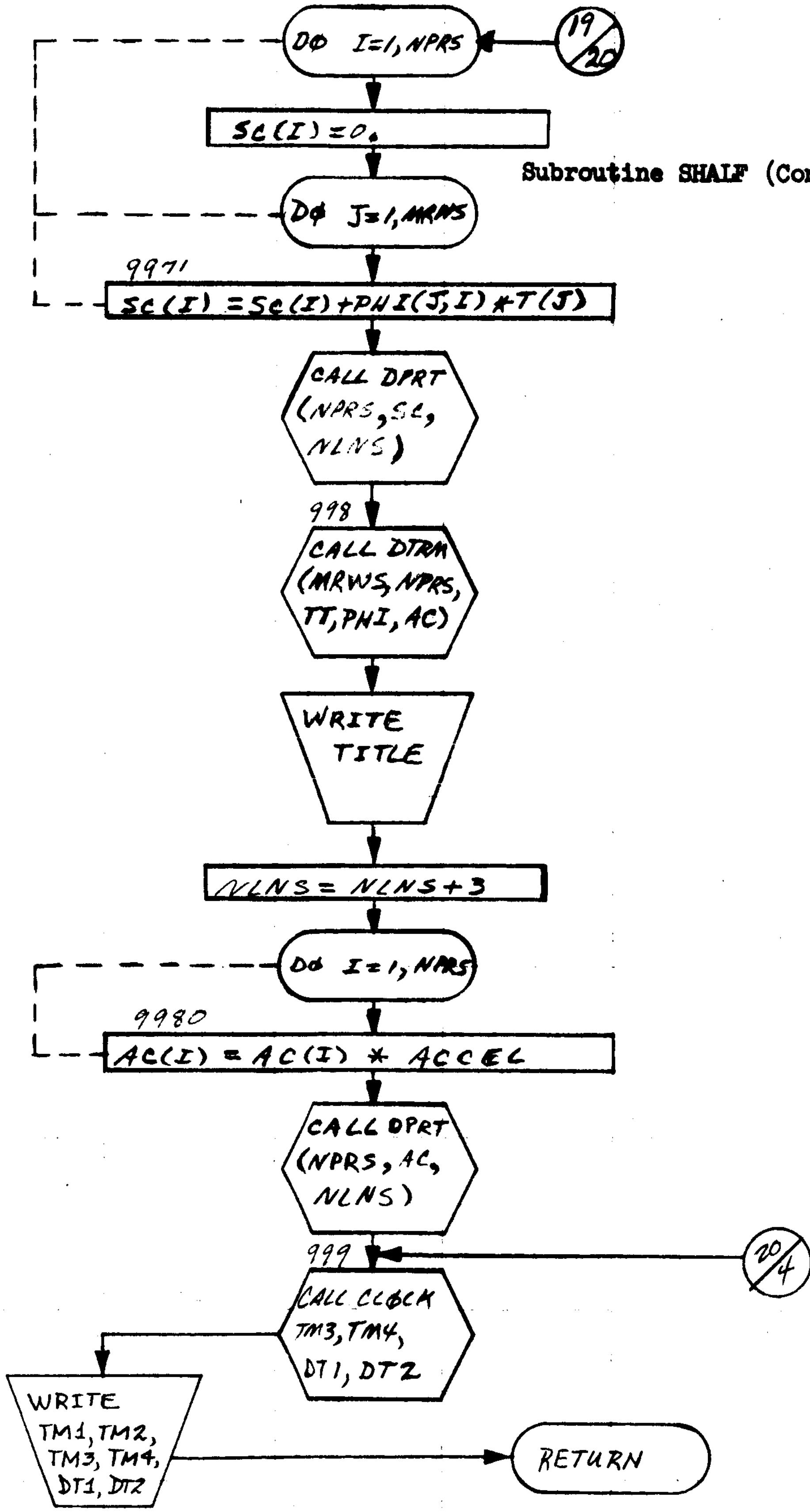


Figure 4.6.8-1 (Concluded)

4.7 Nomenclature Table. - To adequately examine the DARC program in detail it is necessary to first be able to correlate the various parameters (inputs, outputs, and internal) with the designated symbols used in the program. This section is an attempt to show that correlation.

4.7.1 Table Description. - Table 4.7.1-1 shows a list of symbols used in the DARC program. Along with each symbol is the dimension given the parameter in the program and a comment stating its usage or its description.

NOMENCLATURE TABLE

A	7,7	INPUT MATRIX OF NORMALIZED CO-SPECTRA	0010
AC	25	ACCELERATION SPECTRA	0020
ACCEL		SCALE FACTOR ON THE ACCELERATION RESPONSE MATRIX	0030
BETA		INTERMEDIATE STORAGE	0040
C	112,112	MATRIX OF CO-SPECTRA OF PRESSURES	0050
CA		INTERMEDIATE STORAGE	0060
CALP		COS OF COMPLEMENT OF CONE ANGLE	0070
CB		INTERMEDIATE STORAGE	0080
CBTA		INTERMEDIATE STORAGE	0090
CCX	20,21	INDEPENDENT VARIABLE,FREQUENCY (CO-SPECTRUM TABLE)	0100
CCY	20,21	DEPENDENT VARIABLE (CO-SPECTRUM TABLE)	0110
CFLMT		LENGTH OF FRUSTUM / PI	0120
CSQ		COS OF COMPLEMENT OF CONE ANGLE SQUARED	0130
DFRQ		DELTA FREQUENCY	0140
DFRQ2		DELTA FREQUENCY TEMPORARY STORAGE	0150
DS		LENGTH OF FRUSTUM SEGMENT	0160
DTHT		NUMBER OF DEGREES IN EACH SEGMENT	0170
DT1		DATE TAKEN FROM CLOCK	0180
DT2		DATE TAKEN FROM CLOCK	0190
EXTRA	10	CO-SPECTRA EQUATION PARAMETERS	0200
		1-DECAY RATE IN LONGITUDINAL DIRECTION	0210
		2-DECAY RATE IN CIRCUMFERENTIAL DIRECTION	0220
		3-AVERAGE SIZE OF AREA (LONG.)	0230
		4-AVERAGE SIZE OF AREA (CIRC.)	0240
		5-CONVECTION VELOCITY	0250
		6-SWITCH TO DETERMINE METHOD TO CALC. CO-SPECTRA	0260
		7-10 NOT USED	0270
FAC1		SCALE FACTOR ON INDEPENDENT VARIABLE(ALL TABLES)	0280
FAC2		SCALE FACTOR ON PSD VALUES ONLY	0290
FALP		COMPLEMENT OF CONE ANGLE DEGREES	0300
FF	25	NORMAL MODE FREQUENCY	0310
FFF	25	NORMAL MODE FREQUENCY TEMPORARY STORAGE	0320
FFFI		INTERMEDIATE STORAGE	0330
FL	25	NORMAL MODE DAMPING COEFFICIENT	0340
FLMC		INTERMEDIATE STORAGE	0350
FLMT		LENGTH OF FRUSTUM / (LONG. HALFWAVE*PI)**3	0360
FLNG		LENGTH OF FRUSTUM	0370
FLTA		RADIAL MODE COEFFICIENT FOR (N,M)	0380

Table 4.7.1-1

NOMENCLATURE TABLE (Continued)

FLTM		NUMBER OF LONGITUDINAL HALFWAVES	0410
FLTN		NUMBER OF CIRCUMFERENTIAL WAVES	0420
FLTS		NS FLOATED	0430
FLTT		NT FLOATED	0440
FM	25	NORMAL MODE GENERALIZED MASS	0450
FMD	3,25	NUMBER OF LONGITUDINAL HALFWAVES	0460
FR	3,50	FREQUENCY DATA	0470
FREQ		FREQUENCY	0480
FREQ1		FREQUENCY TEMPORARY STORAGE	0490
FREQ2		FREQUENCY TEMPORARY STORAGE	0500
FW	25	NORMAL MODE FREQUENCY * 6.28318531	0510
FX1		INTERMEDIATE STORAGE	0520
FX2		INTERMEDIATE STORAGE	0530
F11		INTERMEDIATE STORAGE	0540
F12		INTERMEDIATE STORAGE	0550
F21		INTERMEDIATE STORAGE	0560
F22		INTERMEDIATE STORAGE	0570
HD	10	CASE ID	0580
I		INDEX REGISTER	0590
ICOD		PHIA TRANSPOSE CODE	0600
ICOUN		COUNTER	0610
II		COUNTER	0620
III		COUNTER	0630
IJ		COUNTER	0640
IK		COUNTER	0650
IMS		COUNTER	0660
IMT		COUNTER	0670
IND		ERROR INDICATOR	0680
INS		COUNTER	0690
IPS		COUNTER	0700
IR		COUNTER	0710
IRWS		NUMBER OF MODES	0720
ITAB		TOTAL NO. ERRORS	0730
ITST		COUNTER	0740
ITT		COUNTER	0750
IVK		COUNTER	0760
J		INDEX REGISTER	0770
JCCD		JCOD+1	0780
JCLS		COUNTER	0790
JCOD		PHI**2 TRANSPOSE CODE	0800

Table 4.7.1-1 (Continued)

NOMENCLATURE TABLE (Continued)

JJ		COUNTER	0810
JJJ		COUNTER	0820
JRWS		NUMBER OF MODES	0830
JTST		COUNTER	0840
K		INDEX REGISTER	0850
KC		NUMBER OF NON-ZERO LONGITUDINAL AREAS	0860
KCNT		COUNTER	0870
KCNT1		COUNTER	0880
KCNT2		COUNTER	0890
KK		NUMBER OF RADIAL AREAS	0900
KKK		COUNTER	0910
KKL		COUNTER	0920
KL		NUMBER OF LONGITUDINAL AREAS	0930
KLNS		COUNTER	0940
KPRC		COUNTER	0950
KPRS		NUMBER OF MODES	0960
KRWS		NUMBER OF MODES	0970
KZ		COUNTER	0980
K11		COUNTER	0990
K12		COUNTER	1000
K21		COUNTER	1010
K22		COUNTER	1020
L		COUNTER	1030
LL		COUNTER	1040
LCOD		PSD INPUT CODE	1050
LLL		COUNTER	1060
LM1		COUNTER	1070
LM2		COUNTER	1080
LM3		COUNTER	1090
LZ		COUNTER	1100
MCOD		CO-CORRELATION EXPANSION CODE	1110
MMM		COUNTER	1120
MRWS		NUMBER OF MODES	1130
N		NUMBER OF MODES	1140
NC	21	NUMBER OF POINTS IN CO-SPECTRUM TABLE	1150
NCASE		CASE NUMBER	1160
NCLS		NUMBER OF SURFACE AREAS	1170
NCN	25	NUMBER OF COEFFICIENTS USED XC(1,I)	1180
NDUM		DUMMY VARIABLE	1190
NIVL		COUNTER	1200

Table 4.7.1-1 (Continued)

NOMENCLATURE TABLE (Continued)

NIVLS		NUMBER OF FREQUENCY VALUES	1210
NLN	25	NUMBER OF COEFFICIENTS USED XA(1,I)	1220
NLNS		COUNTER	1230
NNN		INTERMEDIATE STORAGE	1240
NNS		INTERMEDIATE STORAGE	1250
NNS1		INTERMEDIATE STORAGE	1260
NNTH		INTERMEDIATE STORAGE	1270
NNTH1		INTERMEDIATE STORAGE	1280
NP	112	NUMBER OF POINTS IN PSD TABLE	1290
NPRQ		INTERMEDIATE PRINTOUT CODE	1300
NPRS		NUMBER OF ACCELERATION RESPONSE POINTS	1310
NRWS		NUMBER OF MODES	1320
NS		NUMBER OF LONGITUDINAL VALUES	1330
NSTS		NUMBER OF LONGITUDINAL VALUES	1340
NT		NUMBER OF RADIAL VALUES	1350
NVAL		COUNTER	1360
NXCO		COUNTER	1370
N1		COUNTER	1380
OMG		INTERMEDIATE STORAGE	1390
OMG1		INTERMEDIATE STORAGE	1400
OMEGA		INTERMEDIATE STORAGE	1410
P	112	DIAGONAL MATRIX OF SQRTF(PSD) AT FREQ IN QUESTION	1420
PHA		HOLLERITH REPRESENTATION OF PHIAT	1430
PHI	25,20	MODAL DEFLECTION SQUARED MATRIX	1440
PHIA	25,112	TRANSFORMATION MATRIX TO CONVERT THE PRESSURE	1450
		SPECTRUMS TO GENERALIZED FORCE SPECTRUMS	1460
PHI2		HOLLERITH REPRESENTATION OF PHI2T	1470
PX	20,112	INDEPENDENT VARIABLE,FREQUENCY (PSD TABLE)	1480
PY	20,112	DEPENDENT VARIABLE (PSD TABLE)	1490
R	25	NORMAL COORDINATE SPECTRA	1500
R1	25	NORMAL COORDINATE SPECTRA PREVIOUS FREQUENCY	1510
SALP		SIN OF COMPLEMENT OF CONE ANGLE	1520
SC	25	DEFLECTION SPECTRA	1530
SCAL		SCALAR USED TO MULT. CO-SPECTRUM SUB MATRIX	1540
SC11		INTERMEDIATE STORAGE	1550
STOT		DISTANCE FROM APEX AT THE POINT IN QUESTION	1560
SVAL	20	DISTANCE BETWEEN APEX AND GIVEN VALUE	1570
S1		DISTANCE BETWEEN THE APEX AND INITIAL VALUE (X1)	1580
S1C		INTERMEDIATE STORAGE	1590
S1T	112	INTERMEDIATE STORAGE	1600

Table 4.7.1-1 (Continued)

NOMENCLATURE TABLE (Continued)

S2		DISTANCE BETWEEN THE APEX AND FINAL VALUE (XF)	1610
S2C		INTERMEDIATE STORAGE	1620
S2T	112	INTERMEDIATE STORAGE	1630
T	25	INTERMEDIATE STORAGE	1640
TDLF		DELTA FREQUENCY DIVIDED BY TWO	1650
THTT		THETA IN DEGREES	1660
THT1		CONSTANT = 0.	1670
THT2		CONSTANT = 360.	1680
TINT	112	INTEGRAL OF THETA FUNCTION	1690
TM1		TIME TAKEN FROM CLOCK	1700
TM2		TIME TAKEN FROM CLOCK	1710
TM3		TIME TAKEN FROM CLOCK	1720
TM4		TIME TAKEN FROM CLOCK	1730
TT	25	INTERMEDIATE STORAGE	1740
X		COMPLEMENT OF CONE ANGLE RADIANS	1750
X1		EXTRA(1)*EXTRA(3)	1760
X2		EXTRA(2)*EXTRA(4)	1770
XA	25,31	COEFFICIENTS USED IN FOURIER SERIES CALCULATION OF PHIA	1780
XAM		INTERMEDIATE STORAGE	1790
XANGLE		INTERMEDIATE STORAGE	1800
XB	25,30	COEFFICIENTS USED IN FOURIER SERIES CALCULATION OF PHIA	1810
XBM		INTERMEDIATE STORAGE	1820
XC	25,31	COEFFICIENTS USED IN FOURIER SERIES CALCULATION OF PHIA	1830
XCC1		SEGMENT OF EMPIRICAL CO-SPECTRA EQN	1840
XCC2		SEGMENT OF EMPIRICAL CO-SPECTRA EQN	1850
XCC3		SEGMENT OF EMPIRICAL CO-SPECTRA EQN	1860
XCC4		SEGMENT OF EMPIRICAL CO-SPECTRA EQN	1870
XCC5		SEGMENT OF EMPIRICAL CO-SPECTRA EQN	1880
XD	25,30	COEFFICIENTS USED IN FOURIER SERIES CALCULATION OF PHIA	1890
XDELS		LENGTH EACH AREA ALONG THE ADAPTER	1900
XDELTA		COORDINATE TO WHICH FOURIER SERIES IS REFERENCED	1910
XDTH		DELTA THETA (THETA = ANGLE OF ADAPTER)	1920
XKM	25	INTERMEDIATE STORAGE USED IN FOURIER SERIES	1930
XKN	112	INTERMEDIATE STORAGE USED IN FOURIER SERIES	1940
XL		LENGTH OF ADAPTER	1950
XL1		CO-SPECTRA EQN LONGITUDINAL DIRECTION	1960
XLM	25	INTERMEDIATE STORAGE USED IN FOURIER SERIES	1970
XLN	112	INTERMEDIATE STORAGE USED IN FOURIER SERIES	1980
XM	25,30	COEFFICIENTS USED IN FOURIER SERIES CALCULATION OF PHIA	1990
XN	25,30	COEFFICIENTS USED IN FOURIER SERIES CALCULATION OF PHIA	2000

Table 4.7.1-1 (Continued)

NOMENCLATURE TABLE (Concluded)

XNS		FLOATED NS	2010
XNT		FLOATED NT	2020
XQ		INTERMEDIATE STORAGE	2030
XSU		USED FOR INTERMEDIATE STORAGE	2040
XSUM		USED FOR INTERMEDIATE STORAGE	2050
XSUM1	25	INTERMEDIATE STORAGE USED IN FOURIER SERIES	2060
XSUM2	112	INTERMEDIATE STORAGE USED IN FOURIER SERIES	2070
XT1		CO-SPECTRA EQN CIRCUMFERENTIAL DIRECTION	2080
XTHETA		ANGLE OF ADAPTER	2090
XTIME		COUNTER	2100
XX1		CO-SPECTRA EQN, DELTA K	2110
XX2		CO-SPECTRA EQN, KL (OR KC)	2120
XX3		CO-SPECTRA EQN, KK	2130
XXC		CO-SPECTRA EQN VALUE	2140
XXR		RADIUS OF ADAPTER	2150

Table 4.7.1-1 (Concluded)

4.8 Program Listing. - The DARC program listing as it exists in its symbolic form is contained in this section. It should be noted that the library routines (i.e. mathematical routines) are not contained in the listing or the actual program cards. It is assumed that these basic routines will be contained in the system wherever this program is compiled. The listing shows the make-up of the deck as it would be for compilation and execution, with the exception of an $ID card to precede the deck and data following the deck. The data setup is described in section 4.4.2.

```
$EXECUTE        IBJOB                                                          T6500000
$IBJOB          MAP                                                            T6500010
$IBFTC T650     REF                                                            T6500020
CT650                DEFLECTION ACCELERATION RESPONSE CALCULATION              T6500030
1     CALL PART1                                                               T6500040
      CALL FHALF                                                               T6500050
      CALL SHALF                                                               T6500060
      GO TO 1                                                                  T6500070
      END                                                                      T6500080
$IBFTC EXPANC  REF                                                             T6500090
CEXPANSION SUBROUTINE FOR STRAIN RESPONSE CALCULATION                          T6500100
C                                                                              T6500110
C                                                                              T6500120
C                                                                              T6500130
C                                                                              T6500140
      SUBROUTINE EXPANC                                                        T6500150
      DIMENSION A( 7,7 ),AC(25),C(112,112),CCX(20,21),CCY(20,21),              T6500160
     1FF(25),FFF(25),FL(25),FM(25),FR(3,50),FW(25),NP(112),NC(21),             T6500170
     3P(112),PHI(25,20),PHIA(25,112),           PX(20,112),PY(20,112)          T6500180
      COMMON    A      ,AC      ,ACCEL   ,                        BETA    ,T6500190
     1C        ,CCX    ,CCY     ,DT1     ,DT2     ,FFF     ,                   T6500200
     2FF       ,FL     ,FLNG    ,FM      ,FR      ,FREQ    ,                   T6500210
     3FW       ,                                                               T6500220
     7ICOD     ,IND    ,IRWS    ,ITAB    ,                 IMS,                T6500230
     8JCCD     ,JCOD   ,JRWS    ,                 KC       ,KLNS    ,T6500240
     9KL,KK    ,KPRS   ,KRWS    ,LCOD    ,MCOD    ,MRWS                        T6500250
      COMMON    NC     ,NCLS    ,NIVLS   ,NP      ,NPRQ    ,NPRS    ,T6500260
     1NRWS     ,PHIA   ,PHI     ,         PX      ,PY      ,                   T6500270
     2P        ,TM1    ,TM2                                                    T6500280
      COMMON EXTRA(10)                                                         T6500290
      DO 75 I=1,NCLS                                                           T6500300
      CALL TLU2(NP(I),PX(1,I),PY(1,I),FREQ,P(I),IND)                           T6500310
      P(I) = P(I)**.5                                                          T6500320
      IF(IND)70,75,70                                                          T6500330
70    ITAB = ITAB+1                                                            T6500340
75    CONTINUE                                                                 T6500350
      I1 = 1                                                                   T6500360
      I2 = KL                                                                  T6500370
      KKK = NCLS/KL                                                            T6500380
      DO 200 N=1,KKK                                                           T6500390
```

```
         DO 100 I=I1,I2                                         T6500400
         DO 100 J=I ,I2                                         T6500410
         L = I-(N-1)*KL                                         T6500420
         M = J-(N-1)*KL                                         T6500430
 100     C(I,J) = P(I)*A(L,M)*P(J)                              T6500440
         I1 = I2+1                                              T6500450
 200     I2 = I2+KL                                             T6500460
         RETURN                                                 T6500470
         END                                                    T6500480
$IBFTC DPRT     REF                                             T6500490
CDPRT                    PRINT DIAGONAL MATRIX (DPRT)           T6500500
         SUBROUTINE DPRT (N,A,NL)                               T6500510
         DIMENSION A(25)                                        T6500520
C        DIMENSION A(25)                                        T6500530
         NCOL=1                                                 T6500540
 1       KCLS=N-NCOL+1                                          T6500550
         IF (KCLS-8) 100,101,101                                T6500560
 100     KCOL=NCOL+KCLS-1                                       T6500570
         GO TO 102                                              T6500580
 101     KCOL=NCOL+7                                            T6500590
 102     IF (54-NL) 103,103,104                                 T6500600
 103     WRITE (6,200)                                          T6500610
         NL=0                                                   T6500620
 104     NL=NL+2                                                T6500630
         WRITE (6,201)((K,K),K=NCOL,KCOL)                       T6500640
         WRITE (6,202)(A(K),K=NCOL,KCOL)                        T6500650
         NCOL=KCOL+1                                            T6500660
         IF (KCLS-8) 105,105,1                                  T6500670
 105     CONTINUE                                               T6500680
         RETURN                                                 T6500690
 200     FORMAT (1H1)                                           T6500700
 201     FORMAT (6X,8(2X,I3,2X,I3,4X))                          T6500710
 202     FORMAT (6X,1P8E14.7)                                   T6500720
         END                                                    T6500730
$IBFTC DTRM     REF                                             T6500740
CDTRM              DIAGONAL MATRIX PRODUCT ROUTINE (DTRM)       T6500750
         SUBROUTINE DTRM (N,M,A,P,R)                            T6500760
         DIMENSION A(25),P(25,20),R(20)                         T6500770
C        DIMENSION A(25),P(25,20),R(20)                         T6500780
         DO 100 I=1,M                                           T6500790
```

```
       R(I)=0.0                                                          T6500800
       DO 100 J=1,N                                                      T6500810
  100  R(I)=R(I)+P(J,I)*A(J)                                             T6500820
       RETURN                                                            T6500830
       END                                                               T6500840
$IBFTC TLU2     REF                                                      T6500850
CTLU2           LINEAR INTERPOLATION ROUTINE (TLU2)                      T6500860
       SUBROUTINE TLU2 (N,XV,YV,X,Y,IND)                                 T6500870
       DIMENSION XV(20),YV(20)                                           T6500880
C      DIMENSION XV(20),YV(20)                                           T6500890
       IND = 0                                                           T6500900
       IF (N-1) 40,40,10                                                 T6500910
   10  IF (XV(1)-X) 20,60,40                                             T6500920
   20  DO 30 I=2,N                                                       T6500930
       IF (XV(I)-X) 30,70,50                                             T6500940
   30  CONTINUE                                                          T6500950
   40  IND = 1                                                           T6500960
       GO TO 80                                                          T6500970
   50  Y = (X-XV(I-1))*(YV(I)-YV(I-1))/(XV(I)-XV(I-1))+YV(I-1)           T6500980
       GO TO 90                                                          T6500990
   60  I = 1                                                             T6501000
   70  Y = YV(I)                                                         T6501010
       GO TO 90                                                          T6501020
   80  Y = 0.0                                                           T6501030
   90  RETURN                                                            T6501040
       END                                                               T6501050
$ORIGIN         ALPHA                                                    T6501060
$IBFTC PART1    FULIST,REF                                               T6501070
       SUBROUTINE PART1                                                  T6501080
CPART1                                                                   T6501090
      DIMENSION A( 7,7 ),AC(25),C(112,112),CCX(20,21),CCY(20,21),        T6501100
     1FF(25),FFF(25),FL(25),FM(25),FMD(3,25),         FR(3,50),FW(25),   T6501110
     2HD(10),NP(112),NC(21),                                             T6501120
     3P(112),PHI(25,20),PHIA(25,112),           PX(20,112),PY(20,112),T6501130
     4S1T(112),S2T(112),SVAL(20),TINT(112)                               T6501140
      DIMENSION     XA(25,31),     XB(25,30),      XC(25,31),            T6501150
     1XD(25,30),    XKM(25),         XKN(112),     XLM(25),              T6501160
     2XLN(112),     XM(25,30),      XN(25,30),     XSUM1(25),            T6501170
     3XSUM2(112)                                                         T6501180
      DIMENSION NLN(25),NCN(25)                                          T6501190
```

```
      COMMON    A         ,AC        ,ACCEL     ,                    BETA    ,T6501200
     1C        ,CCX       ,CCY       ,DT1       ,DT2      ,FFF      ,         T6501210
     2FF       ,FL        ,FLNG      ,FM        ,FR       ,FREQ     ,         T6501220
     3FW       ,                                                              T6501230
     7ICOD     ,IND       ,IRWS      ,ITAB      ,                 IMS,        T6501240
     8JCCD     ,JCOD      ,JRWS      ,                   KC       ,KLNS      ,T6501250
     9KL,KK    ,KPRS      ,KRWS      ,LCOD      ,MCOD     ,MRWS               T6501260
      COMMON    NC        ,NCLS      ,NIVLS     ,NP       ,NPRQ     ,NPRS    ,T6501270
     1NRWS     ,PHIA      ,PHI       ,           PX       ,PY       ,         T6501280
     2P        ,TM1       ,TM2                                                T6501290
      COMMON EXTRA(10)                                                        T6501300
      EQUIVALENCE (C(1),XA(1)),(C(776),XB(1)),(C(1526),XC(1)),                T6501310
     1(C(2301),XD(1)),(C(3051),XKM(1)),(C(3076),XKN(1)),                      T6501320
     2(C(3188),XLM(1)),(C(3213),XLN(1)),(C(3325),XM(1)),                      T6501330
     3(C(4075),XN(1)),(C(4825),XSUM1(1)),(C(4850),XSUM2(1))                   T6501340
      EQUIVALENCE (C(5962),NLN(1)),(C(5990),NCN(1))                           T6501350
      NPRQ = 1                                                                T6501360
C                              FREQUENCY DATA INPUT                           T6501370
      CALL CLOCK (TM1,TM2,DT1,DT2)                                            T6501380
    3 READ (5,2012)NCASE,HD                                                   T6501390
    4 WRITE (6,1000)DT1,DT2                                                   T6501400
      WRITE (6,2013)NCASE,HD                                                  T6501410
      READ (5,2006)NIVLS                                                      T6501420
      WRITE (6,1001)NIVLS                                                     T6501430
      DO 1 J=1,NIVLS                                                          T6501440
      READ (5,2001)(FR(I,J),I=1,3)                                            T6501450
    1 WRITE (6,1002)(FR(I,J),I=1,3)                                           T6501460
C                              PRGM C PRIME                                   T6501470
      READ(5,4000)ICOD,JCOD,ACCEL,HD                                          T6501480
      WRITE(6,4001)ICOD,JCOD,ACCEL,HD                                         T6501490
      JCCD = JCOD+1                                                           T6501500
      K=ICOD/2+JCOD/2                                                         T6501510
      IF(ICOD-3)9,2015,2015                                                   T6501520
    9 IF(K)48,48,10                                                           T6501530
C                                                                             T6501540
C                                                                             T6501550
C             ALL FLOATING POINT VARIABLES START WITH X                       T6501560
C             REVISION IS AN OPTION TO USE A MORE COMPLICATED                 T6501570
C             FUNCTION TO CALCULATE THE PHIA MATRIX                           T6501580
 2015 READ (5,2085)NT,NS,XXR,XL1,XDELTA,XL                                    T6501590
```

```
2085  FORMAT(6X,2I3,3X,4E15.6)                                        T6501600
2086  FORMAT(4E15.6)                                                   T6501610
10001 FORMAT(1H0,10X,27HINPUT DATA FOR FOURIER CALC///                 T6501620
     111X, 5HNT = ,I3/                                                 T6501630
     211X, 5HNX = ,I3/                                                 T6501640
     311X, 4HR  = ,1PE15.6/                                            T6501650
     411X, 4HL  = ,1PE15.6/                                            T6501660
     511X,7HLBAR  =1PE15.6/                                            T6501670
     611X,7HGAMMA =1PE15.6/                                            T6501680
     711X, 6HNRWS = ,I3)                                               T6501690
10002 FORMAT(1H1,10X, 5HNL = I3,10X, 7HMODE = I3/                      T6501700
     119X,1HI,16X,1HA,24X,1HB,24X,1HM)                                 T6501710
10003 FORMAT(18X,I2,9X,3(1PE15.6,10X))                                 T6501720
10004 FORMAT(1H1,10X, 5HNC = I3,10X,7HMODE = I3/                       T6501730
     119X,1HI,16X,1HC,24X,1HD,24X,1HN)                                 T6501740
      READ (5,2085)NRWS                                                T6501750
      WRITE (6,10001)NT,NS,XXR,XL1,XL,XDELTA,NRWS                      T6501760
      NCLS = NT*NS                                                     T6501770
      DO 12015 N=1,NRWS                                                T6501780
      READ (5,2085)NNS                                                 T6501790
      WRITE (6,10002)NNS,N                                             T6501800
      READ (5,2086)XA(N,1)                                             T6501810
      N1 = 0                                                           T6501820
      WRITE (6,10003)N1,XA(N,1)                                        T6501830
      IF(NNS-1)12012,12012,12010                                       T6501840
12010 DO 12011 I=2,NNS                                                 T6501850
      READ (5,2086)XA(N,I),XB(N,I-1),XM(N,I-1)                         T6501860
      N1 = N1+1                                                        T6501870
12011 WRITE (6,10003)N1,XA(N,I),XB(N,I-1),XM(N,I-1)                    T6501880
12012 NLN(N)=NNS                                                       T6501890
      READ (5,2085)NNTH                                                T6501900
      WRITE (6,10004)NNTH,N                                            T6501910
      READ (5,2086)XC(N,1)                                             T6501920
      N1 = 0                                                           T6501930
      WRITE (6,10003)N1,XC(N,1)                                        T6501940
      IF(NNTH-1)12015,12015,12013                                      T6501950
12013 DO 12014 I=2,NNTH                                                T6501960
      READ (5,2086)XC(N,I),XD(N,I-1),XN(N,I-1)                         T6501970
      N1 = N1+1                                                        T6501980
12014 WRITE (6,10003)N1,XC(N,I),XD(N,I-1),XN(N,I-1)                    T6501990
```

```
12015 NCN(N) = NNTH                                                    T6502000
      XNT = NT                                                         T6502010
      XNS = NS                                                         T6502020
      XDTH = 360.0/(XNT*57.2957795)                                    T6502030
      XDELS = XL1/XNS                                                  T6502040
      DO12090 IR=1,NRWS                                                T6502050
      NNS = NLN(IR)                                                    T6502060
      NNTH = NCN(IR)                                                   T6502070
      NNS1 = NNS-1                                                     T6502080
      NNTH1 = NNTH-1                                                   T6502090
      DO 2016 I=1,NNS1                                                 T6502100
      XKM(I) = COS(XM(IR,I)/XL*XDELS*3.1415926)-1.0                    T6502110
 2016 XLM(I) = SIN(XM(IR,I)/XL*XDELS*3.1415926)                        T6502120
      DO 2017 I=1,NNTH1                                                T6502130
      XKN(I) = COS(XN(IR,I)*XDTH)-1.0                                  T6502140
 2017 XLN(I) = SIN(XN(IR,I)*XDTH)                                      T6502150
      DO 2040 I=1,NS                                                   T6502160
      XSUM = 0.0                                                       T6502170
      XTIME = I-1                                                      T6502180
      XSU = XTIME*XDELS                                                T6502190
      IF(XDELTA)12017,12019,12019                                      T6502200
12017 WRITE (6,12018)                                                  T6502210
12018 FORMAT(33H1PROGRAM CANNOT CONTINUF GAMMA = F12.4)                T6502220
      CALL EXIT                                                        T6502230
12019 DO 2020 J=1,NNS1                                                 T6502240
      XANGLE = XM(IR,J)*3.1415926*XDELTA/XL                            T6502250
      XAM = XA(IR,J+1)*COS(XANGLE)+XB(IR,J)*SIN(XANGLE)                T6502260
      XBM =-XA(IR,J+1)*SIN(XANGLE)+XB(IR,J)*COS(XANGLE)                T6502270
 2020 XSUM = XSUM+1.0/XM(IR,J)*(XAM*(XKM(J)*SIN(XM(IR,J)/XL*XSU* 3.14159T6502280
     126)+XLM(J)*COS(XM(IR,J)/XL*XSU*3.1415926) ) -XBM*(XKM(J)*COS(XM(IRT6502290
     2,J)/XL*XSU*3.1415926) -XLM(J)*SIN(XM(IR,J)/XL*XSU*3.1415926)))   T6502300
 2040 XSUM1(I) = (XSUM+XA(IR,1)*XDELS*3.1415926*.5/XL)*XL/3.1415926*XXR T6502310
      DO 2060 I=1,NT                                                   T6502320
      XSUM = 0.0                                                       T6502330
      XTIME = I-1                                                      T6502340
      XTHETA = XTIME*XDTH                                              T6502350
      DO 2050 J=1,NNTH1                                                T6502360
 2050 XSUM = XSUM+1.0/XN(IR,J)*(XC(IR,J+1)*(XKN(J)*SIN(XN(IR,J)*XTHETA) T6502370
     1+XLN(J)*COS(XN(IR,J)*XTHETA)) -XD(IR,J)*(XKN(J)*COS(XN(IR,J)*XTHETT6502380
     2A)- XLN(J)*SIN(XN(IR,J)*XTHETA)))                                T6502390
```

```
2060   XSUM2(I) = XSUM+XC(IR,1)*XDTH*.5                           T6502400
       IK = 0                                                      T6502410
       DO 2080 J=1,NT                                              T6502420
       DO 2080 I=1,NS                                              T6502430
       IK = IK+1                                                   T6502440
2080   PHIA(IR,IK) = XSUM1(I)*XSUM2(J)                             T6502450
12090   CONTINUE                                                   T6502460
       GO TO 51                                                    T6502470
C                            READ BASIC INPUT DATA                 T6502480
 10    READ (5,3001)FALP                                           T6502490
       READ (5,3000)NRWS                                           T6502500
       READ(5,3003)((FMD(I,J),I=1,3),J=1,NRWS)                     T6502510
       WRITE (6,4002)FALP                                          T6502520
       WRITE (6,4003)NRWS                                          T6502530
       WRITE(6,4004)((FMD(I,J),I=1,3),J=1,NRWS)                    T6502540
       X=FALP/57.2957795                                           T6502550
       CALP=COS(X)                                                 T6502560
       SALP=SIN(X)                                                 T6502570
       CSQ=CALP**2                                                 T6502580
       READ (5,3001)S1,S2                                          T6502590
       WRITE (6,4005)S1,S2                                         T6502600
       FLNG=S2-S1                                                  T6502610
       CFLMT=FLNG/3.14159265                                       T6502620
 51    THT1=0.0                                                    T6502630
       THT2=360.0                                                  T6502640
C                            CHECK CALC OF PHIAT                   T6502650
       GO TO(12,11,12),ICOD                                        T6502660
 11    READ (5,3000)NDUM,NCLS                                      T6502670
       READ (5,3000)NT,NS                                          T6502680
       WRITE(6,4006)ICOD,NCLS,NT,NS                                T6502690
C                            CALC BASIC PARAMETERS                 T6502700
       FLTT=NT                                                     T6502710
       FLTS=NS                                                     T6502720
       DTHT=(THT2-THT1)/FLTT                                       T6502730
       DS=FLNG/FLTS                                                T6502740
C                            CHECK CALC OF PHI2T                   T6502750
 12    GO TO (14,14,13) , JCCD                                     T6502760
 13    READ (5,3000)NDUM,NPRS                                      T6502770
       WRITE(6,4007)JCOD,NPRS                                      T6502780
       READ (5,3001)(SVAL(I),I=1,NPRS)                             T6502790
```

```
      WRITE (6,3002)(SVAL(I),I=1,NPRS)                                  T6502800
C                             CYCLE ON MODE COUNTER                     T6502810
 14   DO 42 II=1,NRWS                                                   T6502820
      FLTN=FMD(1,II)                                                    T6502830
      FLTM=FMD(2,II)                                                    T6502840
      FLTA=FMD(3,II)                                                    T6502850
      FLMT=CFLMT/FLTM                                                   T6502860
C                             CHECK CALC OF PHIAT                       T6502870
      GO TO(39,17,39),ICOD                                              T6502880
C                             CALC PHIAT                                T6502890
C                             CALC INTEGRALS OF THETA FUNCTION          T6502900
 17   I=1                                                               T6502910
      THTT=THT1                                                         T6502920
      IF (FLTN) 18,18,19                                                T6502930
 18   FX2=THTT/57.2957795                                               T6502940
      GO TO 20                                                          T6502950
 19   X=FLTN*THTT/57.2957795                                            T6502960
      FX2=SIN(X)                                                        T6502970
 20   THTT=THTT+DTHT                                                    T6502980
      IF (ABS(THTT-THT2)-1.0) 22,22,21                                  T6502990
 21   IF (THTT-THT2) 23,23,22                                           T6503000
 22   THTT=THT2                                                         T6503010
 23   FX1=FX2                                                           T6503020
      IF (FLTN) 24,24,25                                                T6503030
 24   FX2=THTT/57.2957795                                               T6503040
      GO TO 26                                                          T6503050
 25   X=FLTN*THTT/57.2957795                                            T6503060
      FX2=SIN(X)                                                        T6503070
 26   TINT(I)=FX2-FX1                                                   T6503080
      IF (THTT-THT2) 27,28,28                                           T6503090
 27   I=I+1                                                             T6503100
      GO TO 20                                                          T6503110
C                             CALC INTEGRALS OF X FUNCTION              T6503120
 28   J=1                                                               T6503130
      STOT=S1                                                           T6503140
      X=STOT/FLMT                                                       T6503150
      XQ=X**2                                                           T6503160
      CA=SIN(X)                                                         T6503170
      CB=COS(X)                                                         T6503180
      F12=-XQ*CB+2.0*X*CA+2.0*CB                                        T6503190
```

```
      F22= XQ*CA+2.0*X*CB-2.0*CA                                T6503200
29    STOT=STOT+DS                                              T6503210
      IF (ABS(STOT-S2)-1.0) 31,31,30                            T6503220
30    IF (STOT-S2) 32,32,31                                     T6503230
31    STOT=S2                                                   T6503240
32    F11=F12                                                   T6503250
      F21=F22                                                   T6503260
      X=STOT/FLMT                                               T6503270
      XQ=X**2                                                   T6503280
      CA=SIN(X)                                                 T6503290
      CB=COS(X)                                                 T6503300
      F12=-XQ*CB+2.0*X*CA+2.0*CB                                T6503310
      F22= XQ*CA+2.0*X*CB-2.0*CA                                T6503320
      S1T(J)=F12-F11                                            T6503330
      S2T(J)=F22-F21                                            T6503340
      IF (STOT-S2) 33,34,34                                     T6503350
33    J=J+1                                                     T6503360
      GO TO 29                                                  T6503370
34    FLMC=FLMT**3                                              T6503380
      S1C=FLMC*COS(S1/FLMT)                                     T6503390
      S2C=FLMC*SIN(S1/FLMT)                                     T6503400
      IF (FLTN) 35,35,36                                        T6503410
35    CBTA=CSQ*FLTA                                             T6503420
      GO TO 37                                                  T6503430
36    CBTA=(CSQ*FLTA)/FLTN                                      T6503440
37    JJ=1                                                      T6503450
      DO 38 KK=1,NT                                             T6503460
      BETA=CBTA*TINT(KK)                                        T6503470
      DO 38 LL=1,NS                                             T6503480
      PHIA(II,JJ)=BETA*(S1C*S1T(LL)-S2C*S2T(LL))                T6503490
38    JJ=JJ+1                                                   T6503500
C                             CHECK CALC OF PHI2T               T6503510
39    GO TO (42,42,40),JCCD                                     T6503520
C                             CALC PHI2T                        T6503530
40    DO 41 JJ=1,NPRS                                           T6503540
      X=(SVAL(JJ)-S1)/FLMT                                      T6503550
41    PHI(II,JJ)=(FLTA*SVAL(JJ)*CALP)**2*(SIN(X))**2            T6503560
42    CONTINUE                                                  T6503570
C                                                               T6503580
C                             MATRIX COMPUTATION IS DONE        T6503590
```

```
      IRWS = NRWS                                                       T6503600
      JRWS=NRWS                                                         T6503610
      KRWS=NRWS                                                         T6503620
      KPRS=NSTS                                                         T6503630
      MRWS=NRWS                                                         T6503640
48    RETURN                                                            T6503650
1000  FORMAT(1H110X44HSHELL RESPONSE TO RANDOM PRESSURE EXCITATION     /T6503660
     111X,10HNAS 1-3179,3X,A6,A2/)                                      T6503670
1001  FORMAT (1H0,10X,20HNO. OF CALC. FREQ. =,I4/1H0,19X,               T6503680
     19HCALC FREQ,12X,13HCALC INTERVAL,8X,23HNO. CALC / NO. PRINTOUT)   T6503690
1002  FORMAT(11X3(1PE21.6))                                             T6503700
 2001 FORMAT (1P8E15.7)                                                 T6503710
 2006 FORMAT (6X,3I3)                                                   T6503720
 2012 FORMAT (6X,I3,3X,10A6)                                            T6503730
 2013 FORMAT (9X,I3,3X,10A6/)                                           T6503740
 3000 FORMAT (6X,4I3)                                                   T6503750
 3001 FORMAT (1P4E15.7)                                                 T6503760
 3002 FORMAT (1H0,1P8E15.5)                                             T6503770
3003  FORMAT(2E10.4,E15.7)                                              T6503780
4000  FORMAT(3X,2I3,3X,1PE10.4,10A5)                                    T6503790
4001  FORMAT(1H110X,                                                    T6503800
     118HPHIAT CALC CODE = ,I2,6X,18HPHI2T CALC CODE = ,I2/             T6503810
     2                             11X,16HACCEL. SCALAR = ,             T6503820
     31PE10.4/11X,10A5/)                                                T6503830
 4002 FORMAT (1H0,10X,8HALPHA = ,1PE15.6)                               T6503840
 4003 FORMAT (1H0,10X,8HMODES = ,I3//1H0,17X,                           T6503850
     11HN,13X,1HM,11X,3HAMN)                                            T6503860
4004  FORMAT(9X,1P2E14.4,1PE14.6)                                       T6503870
 4005 FORMAT (1H0,10X,5HX1 = ,1PE14.6,3X,5HXE = ,1PE14.6)               T6503880
4006  FORMAT(1H010X12HPHIAT CODE =I2,12H    N COLS =I3,                 T6503890
     18X,4HNT =,I3,8X,4HNX =,I3)                                        T6503900
4007  FORMAT(1H010X12HPHI2T CODE =I2,12H    N COLS =I3//                T6503910
     *10X21HPHI2T RESPONSE POINTS)                                      T6503920
      END                                                               T6503930
$ORIGIN       ALPHA                                                     T6503940
$IBFTC FHALF  FULIST,REF                                                T6503950
      SUBROUTINE FHALF                                                  T6503960
CFHALF                                                                  T6503970
      DIMENSION A( 7,7 ),AC(25),C(112,112),CCX(20,21),CCY(20,21),       T6503980
     1FF(25),FFF(25),FL(25),FM(25),FR(3,50),FW(25),NP(112),NC(21),      T6503990
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```
      3P(112),PHI(25,20),PHIA(25,112),               PX(20,112),PY(20,112) T6504000
       COMMON    A         ,AC        ,ACCEL     ,                   BETA   ,T6504010
      1C        ,CCX       ,CCY       ,DT1       ,DT2      ,FFF      ,       T6504020
      2FF       ,FL        ,FLNG      ,FM        ,FR       ,FREQ     ,       T6504030
      3FW       ,                                                          T6504040
      7ICOD     ,IND       ,IRWS      ,ITAB      ,                IMS,     T6504050
      8JCCD     ,JCOD      ,JRWS      ,                  KC       ,KLNS     ,T6504060
      9KL,KK    ,KPRS      ,KRWS      ,LCOD      ,MCOD     ,MRWS           T6504070
       COMMON    NC        ,NCLS      ,NIVLS     ,NP       ,NPRQ     ,NPRS   ,T6504080
      1NRWS     ,PHIA      ,PHI       ,           PX       ,PY       ,       T6504090
      2P        ,TM1       ,TM2                                            T6504100
       COMMON EXTRA(10)                                                    T6504110
       DATA Q000CT/0473031216360/                                          T6504120
       PHA =Q000CT                                                         T6504130
       DATA Q001CT/0473031026360/                                          T6504140
       PHI2=Q001CT                                                         T6504150
       DATA Q002CT/0473062026360/                                          T6504160
       PHS2=Q002CT                                                         T6504170
48     GO TO(101,125,125),ICOD                                             T6504180
C                             PHIAT INPUT DIRECTLY                         T6504190
101    READ(5,2006)IRWS,NCLS                                               T6504200
       NRWS=IRWS                                                           T6504210
       MRWS = IRWS                                                         T6504220
       DO 102 I=1,IRWS                                                     T6504230
 102   READ (5,2005)(PHIA(I,J),J=1,NCLS)                                   T6504240
C                             PHIAT PRINTOUT                               T6504250
 125   KLNS=NCLS/8+1                                                       T6504260
       NLNS=54                                                             T6504270
       DO 128 I=1,IRWS                                                     T6504280
       IF (54-NLNS-KLNS) 126,126,127                                       T6504290
 126   WRITE (6,1000)DT1,DT2                                               T6504300
       WRITE(6,1013)ICOD,IRWS,NCLS,PHA                                     T6504310
       NLNS=5                                                              T6504320
 127   NLNS=NLNS+KLNS                                                      T6504330
       WRITE (6,2006)I                                                     T6504340
 128   WRITE (6,2001)(PHIA(I,J),J=1,NCLS)                                  T6504350
       GO TO (      129,150),JCOD                                          T6504360
C                             PHI2T INPUT DIRECTLY                         T6504370
129    READ(5,2006)JRWS,NPRS                                               T6504380
       DO 132 I=1,JRWS                                                     T6504390
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  132 READ (5,2005)(PHI(I,J),J=1,NPRS)                         T6504400
C                              PHI2T PRINTOUT                  T6504410
  150 KLNS=NPRS/8+1                                            T6504420
      NLNS=54                                                  T6504430
      DO 153 I=1,JRWS                                          T6504440
      IF (54-NLNS-KLNS) 151,151,152                            T6504450
  151 WRITE (6,1000)DT1,DT2                                    T6504460
      WRITE(6,1013)JCOD,JRWS,NPRS,PHI2                         T6504470
      NLNS=5                                                   T6504480
  152 NLNS=NLNS+KLNS                                           T6504490
      WRITE (6,2006)I                                          T6504500
  153 WRITE (6,2001)(PHI(I,J),J=1,NPRS)                        T6504510
      IF (IRWS-JRWS) 1530,1786,1530                            T6504520
 1530 WRITE (6,1042)IRWS,JRWS                                  T6504530
      GO TO 999                                                T6504540
C                              INPUT SPECTRUM DATA             T6504550
 1786 WRITE (6,1000)DT1,DT2                                    T6504560
      READ(5,2010)LCOD,MCOD,EXTRA(6),FAC1,FAC2                 T6504570
 2010 FORMAT(2I1,F1.0,2F15.0)                                  T6504580
      WRITE (6,1020)LCOD,MCOD,FAC1,FAC2                        T6504590
C                              INPUT PSD TABLES                T6504600
      READ (5,2006)KL,KC,KK                                    T6504610
      IF(MCOD-1)1788,17861,1788                                T6504620
17861 WRITE (6,10211)KL                                        T6504630
      GO TO 1789                                               T6504640
 1788 WRITE (6,1021)KL,KC,KK                                   T6504650
 1789 IF (EXTRA(6))30000,30000,30005                           T6504660
30000 WRITE(6,30001)                                           T6504670
30001 FORMAT (1H0,10X,27HCONSTANT CORRELATION METHOD)          T6504680
      GO TO 31789                                              T6504690
30005 READ(5,30006)(EXTRA(I),I=1,5)                            T6504700
30006 FORMAT(5F15.0)                                           T6504710
      WRITE(6,30002)(EXTRA(I),I=1,5)                           T6504720
30002 FORMAT (1H0,10X,27HEMPIRICAL CO-SPECTRA METHOD/11X,      T6504730
     127HLONGITUDINAL DECAY RATE    E15.8/11X                  T6504740
     127HCIRCUMFERENTIAL DECAY RATE E15.8/11X                  T6504750
     127HAVERAGE SIZE OF AREA(LONG.)E15.8/11X                  T6504760
     127HAVERAGE SIZE OF AREA(CIR.) E15.8/11X                  T6504770
     119HCONVECTION VELOCITY8XE15.8)                           T6504780
31789 GO TO(179,1790,3789),LCOD                                T6504790
```

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C                             NORMAL EXPANSION FORM                                     T6504800
 179   N=KL                                                                             T6504810
       GO TO 1791                                                                       T6504820
C                             INPUT ONLY ONE PSD TABLE                                  T6504830
 1790  N=1                                                                              T6504840
       WRITE (6,1045)                                                                   T6504850
       GO TO 1791                                                                       T6504860
C                    ANGLE OF ATTACK                                                    T6504870
3789   N = NCLS                                                                         T6504880
 1791  DO 181 I=1,N                                                                     T6504890
       READ (5,2006)NP(I)                                                               T6504900
       WRITE (6,1022)I,I,NP(I)                                                          T6504910
       J=NP(I)                                                                          T6504920
       READ (5,2004)(PX(K,I),K=1,J)                                                     T6504930
       READ (5,2004)(PY(K,I),K=1,J)                                                     T6504940
       DO 180 K=1,J                                                                     T6504950
       PX(K,I)=FAC1*PX(K,I)                                                             T6504960
 180   PY(K,I)=FAC2*PY(K,I)                                                             T6504970
       WRITE (6,1025)(PX(K,I),K=1,J)                                                    T6504980
181    WRITE(6,1027)(PY(K,I),K=1,J)                                                     T6504990
       IF(LCOD-3)182,3793,182                                                           T6505000
3793   IF(ICOD-2)3794,3795,3794                                                         T6505010
3794   IF(JCOD-2)182,3795,182                                                           T6505020
3795   WRITE (6,3796)                                                                   T6505030
3796   FORMAT(55H1 RESPONSE CALCULATION INVOLVING PHI2T AND PHIAT MATRIX/T6505040
     1        50H  DEPENDING UPON ASSUMPTION OF SYMMETRIC PRESSURE      /T6505050
     2        30H  POWER SPECTRA DISTRIBUTION.                         /T6505060
     3        47H  LCOD = 3  INDICATES UNSYMMETRIC DISTRIBUTION        )T6505070
C                             INPUT CO-SPECTRUM TABLES                                  T6505080
182    WRITE (6,1000)DT1,DT2                                                            T6505090
       NXCO = 0                                                                         T6505100
       IF (MCOD) 1850,1830,1850                                                         T6505110
 1830  DO 185 J=1,KK                                                                    T6505120
       DO 185 I=1,KC                                                                    T6505130
       NXCO = NXCO+1                                                                    T6505140
       READ (5,2006)NC(NXCO)                                                            T6505150
       IF(NC(NXCO)-20)1831,1831,1832                                                    T6505160
1832   WRITE(6,1024)I,J                                                                 T6505170
       CCX(1,NXCO) = 0.                                                                 T6505180
       CCX(2,NXCO) = 9999.                                                              T6505190
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      CCY(1,NXCO) = 9999.                                               T6505200
      CCY(2,NXCO) = 9999.                                               T6505210
      GO TO 185                                                         T6505220
 1831 WRITE(6,1023)I,J,NC(NXCO)                                         T6505230
      K = NC(NXCO)                                                      T6505240
      READ (5,2004)(CCX(L,NXCO),L=1,K)                                  T6505250
      READ (5,2004)(CCY(L,NXCO),L=1,K)                                  T6505260
      DO 184 L=1,K                                                      T6505270
 184  CCX(L,NXCO) = CCX(L,NXCO)*FAC1                                    T6505280
      WRITE (6,1025)(CCX(L,NXCO),L=1,K)                                 T6505290
      WRITE(6,1026)(CCY(L,NXCO),L=1,K)                                  T6505300
 185  CONTINUE                                                          T6505310
      GO TO 1854                                                        T6505320
 1850 DO 1853 I=1,KL                                                    T6505330
      DO 1853 J=I,KL                                                    T6505340
      IF (I-J) 1851,1853,1851                                           T6505350
 1851 NXCO = NXCO+1                                                     T6505360
      READ (5,2006)NC(NXCO)                                             T6505370
      IF(NC(NXCO)-20)2851,2851,2852                                     T6505380
 2852 WRITE(6,1024)I,J                                                  T6505390
      CCX(1,NXCO) = 0.                                                  T6505400
      CCX(2,NXCO) = 9999.                                               T6505410
      CCY(1,NXCO) = 9999.                                               T6505420
      CCY(2,NXCO) = 9999.                                               T6505430
      GO TO 1853                                                        T6505440
 2851 WRITE(6,1023)I,J,NC(NXCO)                                         T6505450
      K = NC(NXCO)                                                      T6505460
      READ (5,2004)(CCX(L,NXCO),L=1,K)                                  T6505470
      READ (5,2004)(CCY(L,NXCO),L=1,K)                                  T6505480
      DO 1852 L=1,K                                                     T6505490
 1852 CCX(L,NXCO) = CCX(L,NXCO)*FAC1                                    T6505500
      WRITE (6,1025)(CCX(L,NXCO),L=1,K)                                 T6505510
      WRITE (6,1026)(CCY(L,NXCO),L=1,K)                                 T6505520
 1853 CONTINUE                                                          T6505530
C                          INPUT NORMAL MODE PARAMETERS                 T6505540
 1854 WRITE (6,1000)DT1,DT2                                             T6505550
      READ (5,2006)N                                                    T6505560
      READ (5,2002)(FM(I),FL(I),FF(I),I=1,N)                            T6505570
      WRITE (6,1031)N                                                   T6505580
      WRITE (6,2009)(FM(I),FL(I),FF(I),I=1,N)                           T6505590
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      IF (NRWS-N) 186,187,186                                          T6505600
  186 WRITE (6,1046)NRWS,N                                             T6505610
      GO TO 999                                                        T6505620
  187 DO 188 I=1,N                                                     T6505630
  188 FW(I)=6.28318531*FF(I)                                           T6505640
      J=0                                                              T6505650
      DO 191 I=1,N                                                     T6505660
      IF (FR(1,1)-FF(I)) 189,191,191                                   T6505670
  189 IF (FR(1,NIVLS)-FF(I)) 191,191,190                               T6505680
  190 FFF(J+1)=FF(I)                                                   T6505690
      J=J+1                                                            T6505700
  191 CONTINUE                                                         T6505710
      IMS=J                                                            T6505720
      DO 193  I=1,IMS                                                  T6505730
      DO 193 J=I,IMS                                                   T6505740
      IF (FFF(I)-FFF(J)) 193,194,192                                   T6505750
  192 FFFI=FFF(I)                                                      T6505760
      FFF(I)=FFF(J)                                                    T6505770
      FFF(J)=FFFI                                                      T6505780
      GO TO 193                                                        T6505790
  194 IF (I-J) 195,193,195                                             T6505800
  195 FFF(J)=1.E8                                                      T6505810
  193 CONTINUE                                                         T6505820
      RETURN                                                           T6505830
  999 CONTINUE                                                         T6505840
 9990 CALL EXIT                                                        T6505850
      RETURN                                                           T6505860
 1000 FORMAT(1H110X44HSHELL RESPONSE TO RANDOM PRESSURE EXCITATION    /T6505870
     111X,10HNAS 1-3179,3X,A6,A2/)                                     T6505880
 1013 FORMAT(1H010X6HCODE =I4,3X3HN =I4,3X3HM =I4,3XA6)                T6505890
 1020 FORMAT(1H010X10HPSD CODE =I4,3X15HCO-SPEC. CODE =I4,3X           T6505900
     113HFREQ. MULT. =1PE15.6,3X11HPSD MULT. =1PE15.6)                 T6505910
 1021 FORMAT (1H0,10X,5HKL = ,I3,3X,5HKC = ,I3,3X,5HKK = ,I3/)          T6505920
10211 FORMAT (1H0,10X,5HKL = ,I3)                                      T6505930
 1022 FORMAT(1H0,10X15HPSD TBLE, ELE (I3,1H,I3,6H) WITHI3,5H PTS.)     T6505940
 1023 FORMAT (1H0,10X,15HCO- TBLE, ELE (,I1,1H,,I1,6H) WITH,I3,5H PTS.) T6505950
 1024 FORMAT(1H010X15HCO- TBLE, ELE (I1,1H,I1,18H) TO BE CALCULATED)    T6505960
 1025 FORMAT(4X,5HFREQ./10(2X1PE10.3))                                 T6505970
 1026 FORMAT(4X,8HCO-SPEC./10(2X1PE10.3))                              T6505980
 1027 FORMAT(4X,3HPSD/10(2X1PE10.3))                                   T6505990
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 1031 FORMAT (1H0,10X,11HNO MODES = ,I3/                               T6506000
     112X,12H GEN. MASSES,3X,12H DMP. COEFFS,3X,12H MODAL FREQS/)      T6506010
 1042 FORMAT (1H0,10X,34HERROR, PHIT AND PHIAT,INCOMPATIBLE,2I4)        T6506020
 1045 FORMAT (1H0,10X,32HPSD IS SCALAR FROM 1 TABLE INPUT)              T6506030
 1046 FORMAT (1H0,10X,36HERROR,PHIAT AND NORMAL MODES UNEQUAL,2I3)      T6506040
 2001 FORMAT (1P8E15.7)                                                 T6506050
 2002 FORMAT (1P3E15.7)                                                 T6506060
 2004 FORMAT (1P4E15.7)                                                 T6506070
 2005 FORMAT (12X,1P4E15.7)                                             T6506080
 2006 FORMAT (6X,3I3)                                                   T6506090
 2008 FORMAT (6X,2I3,1P2E15.7)                                          T6506100
 2009 FORMAT (10X,1P3E15.6)                                             T6506110
      END                                                               T6506120
$ORIGIN      ALPHA                                                      T6506130
$IBFTC SHALF   FULIST,REF                                               T6506140
      SUBROUTINE SHALF                                                  T6506150
CSHALF                                                                  T6506160
      DIMENSION A( 7,7 ),AC(25),C(112,112),CCX(20,21),CCY(20,21),       T6506170
     1FF(25),FFF(25),FL(25),FM(25),FR(3,50),FW(25),NP(112),NC(21),      T6506180
     3P(112),PHI(25,20),PHIA(25,112),           PX(20,112),PY(20,112),T6506190
     4R(25),R1(25),T(25),TT(25),SC(25)                                  T6506200
      COMMON   A        ,AC       ,ACCEL    ,                  BETA   ,T6506210
     1C       ,CCX      ,CCY      ,DT1      ,DT2      ,FFF      ,       T6506220
     2FF      ,FL       ,FLNG     ,FM       ,FR       ,FREQ     ,       T6506230
     3FW      ,                                                         T6506240
     7ICOD    ,IND      ,IRWS     ,ITAB     ,              IMS,         T6506250
     8JCCD    ,JCOD     ,JRWS     ,                   KC       ,KLNS   ,T6506260
     9KL,KK   ,KPRS     ,KRWS     ,LCOD     ,MCOD     ,MRWS             T6506270
      COMMON   NC       ,NCLS     ,NIVLS    ,NP       ,NPRQ     ,NPRS  ,T6506280
     1NRWS    ,PHIA     ,PHI      ,          PX       ,PY       ,       T6506290
     2P       ,TM1      ,TM2                                            T6506300
      COMMON EXTRA(10)                                                  T6506310
C                               INITIALIZE FREQUENCY CYCLE              T6506320
      IPS=1                                                             T6506330
      INS=1                                                             T6506340
      DO 196 I=1,NRWS                                                   T6506350
      R(I) = 0.0                                                        T6506360
      R1(I) = 0.0                                                       T6506370
      T(I) = 0.0                                                        T6506380
  196 TT(I) = 0.0                                                       T6506390
```

```
      NVAL=0                                                            T6506400
      NIVL=1                                                            T6506410
      FREQ=FR(1,NIVL)                                                   T6506420
      DFRQ=FR(2,NIVL)                                                   T6506430
      KCNT=FR(3,NIVL)+0.0000001                                         T6506440
      KPRC=KCNT                                                         T6506450
      X1 = EXTRA(1)*EXTRA(3)                                            T6506460
      X2 = EXTRA(2)*EXTRA(4)                                            T6506470
C                             BEGINNING OF CYCLE                        T6506480
  200 ITAB=0                                                            T6506490
      GO TO(20151,205,20101),LCOD                                       T6506500
20101 IF(MCOD)20121,20121,207                                           T6506510
20121 LM1 = NCLS                                                        T6506520
      GO TO 201                                                         T6506530
20151 LM1 = KL                                                          T6506540
C                             NORMAL EXPANSION FORM                     T6506550
201   DO 203 I=1,LM1                                                    T6506560
      CALL TLU2 (NP(I),PX(1,I),PY(1,I),FREQ,P(I),IND)                   T6506570
      P(I) = P(I)**.5                                                   T6506580
      IF (IND) 202,203,202                                              T6506590
  202 ITAB=ITAB+1                                                       T6506600
  203 CONTINUE                                                          T6506610
      IF(LCOD-2)2019,2019,207                                           T6506620
2019  DO 204 J=1,NCLS,KL                                                T6506630
      DO 204 I=1,KL                                                     T6506640
      II=J+I-1                                                          T6506650
  204 P(II)=P(I)                                                        T6506660
      GO TO 207                                                         T6506670
C                             OBTAIN SCALAR                             T6506680
  205 CALL TLU2 (NP,PX,PY,FREQ,SCAL,IND)                                T6506690
      IF (IND) 206,207,206                                              T6506700
  206 ITAB=ITAB+1                                                       T6506710
C                             CO-SPECTRUM SUB-MATRIX                    T6506720
207   OMEGA = 3.1416*EXTRA(3)*FREQ/(6.*EXTRA(5))                        T6506730
      IF(MCOD)2090,2070,2090                                            T6506740
2070  ICOUN = 0                                                         T6506750
      DO 209 J=1,KK                                                     T6506760
      DO 209 I=1,KC                                                     T6506770
      ICOUN = ICOUN+1                                                   T6506780
      CALL TLU2(NC(ICOUN),CCX(1,ICOUN),CCY(1,ICOUN),FREQ,A(I,J),IND)    T6506790
```

```
      IF (IND) 208,209,208                                              T6506800
  208 ITAB=ITAB+1                                                       T6506810
  209 CONTINUE                                                          T6506820
      IF(EXTRA(6))2095,2095,30025                                       T6506830
30025 A(1,1) = 9999.                                                    T6506840
      DO 30075 J=1,KK                                                   T6506850
      XX3 = J                                                           T6506860
      DO 30075 I=1,KC                                                   T6506870
      XX2 = I                                                           T6506880
      IF (I-1) 30030,30030,30035                                        T6506890
30030 XX1= 1.                                                           T6506900
      GO TO 30040                                                       T6506910
30035 XX1= 0.                                                           T6506920
30040 IF (A(I,J).NE.9999.) GO TO 30044                                  T6506930
      XCC1 = (X1**2+OMEGA**2)**2                                        T6506940
      XCC2 = (X1**2-OMEGA**2)                                           T6506950
      XCC3 = EXP(-X1*XX2)*COS(OMEGA*XX2)+EXP(-X1*(XX2-2.))*             T6506960
     1 COS(OMEGA*(XX2-2.))-2.*EXP(-X1*(XX2-1.))*COS(OMEGA*(XX2-1.))     T6506970
      XCC4 =0.                                                          T6506980
      IF (XX1.EQ.0.) GO TO 30042                                        T6506990
      XCC4 = X1*OMEGA*(EXP(X1)-EXP(-X1))*SIN(OMEGA)                     T6507000
30042 XCC5 = 1.                                                         T6507010
      IF (X1.EQ.0.) GO TO 30043                                         T6507020
      XCC5=(EXP(-X2*XX3)+EXP(-X2*(XX3-2.))-2.*EXP(-X2*(XX3-1.)))/(X2**2)T6507030
30043 XXC = (1./XCC1)*(XCC2*XCC3+XCC4)*XCC5                             T6507040
      A(I,J) = XXC                                                      T6507050
      GO TO 30075                                                       T6507060
30044 A(I,J) = A(I,J)*ABS(A(1,1))                                       T6507070
30075 CONTINUE                                                          T6507080
      A(1,1) = ABS(A(1,1))                                              T6507090
      GO TO 2095                                                        T6507100
 2090 ICOUN = 0                                                         T6507110
      DO 2094 I=1,KL                                                    T6507120
      DO 2094 J=I,KL                                                    T6507130
      IF(I-J)2088,2091,2094                                             T6507140
 2091 A(I,J)=1.0                                                        T6507150
      GO TO 2094                                                        T6507160
 2088 ICOUN = ICOUN+1                                                   T6507170
 2092 CALL TLU2(NC(ICOUN),CCX(1,ICOUN),CCY(1,ICOUN),FREQ,A(I,J),IND)    T6507180
      IF (IND) 2093,2094,2093                                           T6507190
```

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 2093 ITAB=ITAB+1                                                  T6507200
 2094 CONTINUE                                                     T6507210
      IF(EXTRA(6))2095,2095,30080                                  T6507220
30080 A(1,1) = 9999.                                               T6507230
      DO 30150 I=1,KL                                              T6507240
      DO 30150 J=I,KL                                              T6507250
      XX2 = J-I+1                                                  T6507260
      XX1 = 0.                                                     T6507270
      IF (XX2.GT.1.) GO TO 30081                                   T6507280
      XX1 = 1.                                                     T6507290
30081 IF (I.NE.J.OR.I.EQ.1) GO TO 30100                            T6507300
30090 A(I,J) = ABS(A(1,1))                                         T6507310
      GO TO 30150                                                  T6507320
30100 IF (A(I,J).NE.9999.) GO TO 30120                             T6507330
      XCC1 = (X1**2+OMEGA**2)**2                                   T6507340
      XCC2 = (X1**2-OMEGA**2)                                      T6507350
      XCC3 = EXP(-X1*XX2)*COS(OMEGA*XX2)+EXP(-X1*(XX2-2.))*        T6507360
     1 COS(OMEGA*(XX2-2.))-2.*EXP(-X1*(XX2-1.))*COS(OMEGA*(XX2-1.))T6507370
      XCC4 = 0.                                                    T6507380
      IF (XX1.EQ.0.) GO TO 30101                                   T6507390
      XCC4 = X1*OMEGA*(EXP(X1)-EXP(-X1))*SIN(OMEGA)                T6507400
30101 XCC5 = 1.                                                    T6507410
      IF (X1.EQ.0.) GO TO 30102                                    T6507420
      XCC5 = (EXP(-X2)+EXP(X2)-2.)/(X2**2)                         T6507430
30102 XXC = (1./XCC1)*(XCC2*XCC3+XCC4)*XCC5                        T6507440
      A(I,J) = XXC                                                 T6507450
      GO TO 30150                                                  T6507460
30120 A(I,J) = ABS(A(1,1))*A(I,J)                                  T6507470
30150 CONTINUE                                                     T6507480
      A(1,1) = ABS(A(1,1))                                         T6507490
 2095 IF (ITAB) 210,211,210                                        T6507500
 210  WRITE (6,1032)ITAB                                           T6507510
      GO TO 999                                                    T6507520
211   GO TO(214,212,3221),LCOD                                     T6507530
3221  IF(MCOD)2140,2140,3222                                       T6507540
3222  CALL EXPANC                                                  T6507550
      GO TO 3272                                                   T6507560
212   IF(MCOD)5212,5212,5300                                       T6507570
5300  DO 5305 I=1,KL                                               T6507580
      DO 5305 J=I,KL                                               T6507590
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5305  A(I,J) = A(I,J)*SCAL                                          T6507600
      GO TO 12270                                                   T6507610
5212  DO 213 I=1,KL                                                 T6507620
      DO 213 J=1,KK                                                 T6507630
 213  A(I,J)=SCAL*A(I,J)                                            T6507640
 214  IF (MCOD) 2270,2140,2270                                      T6507650
 2140 KKK=0                                                         T6507660
      IVK=NCLS                                                      T6507670
      DO 217 JJJ=1,KK                                               T6507680
      DO 216 II=1,KL                                                T6507690
      IJ=0                                                          T6507700
      K11=KKK+II                                                    T6507710
      K12=IVK+II                                                    T6507720
      DO 216 JJ=II,KL                                               T6507730
      IJ=IJ+1                                                       T6507740
      K21=KKK+JJ                                                    T6507750
      K22=IVK+JJ                                                    T6507760
      IF (KKK) 215,216,215                                          T6507770
 215  C(JJ,K12)=A(IJ,JJJ)                                           T6507780
      C(JJ,K11)=A(IJ,JJJ)                                           T6507790
      C(II,K22)=A(IJ,JJJ)                                           T6507800
 216  C(II,K21)=A(IJ,JJJ)                                           T6507810
      KKK=KKK+KL                                                    T6507820
 217  IVK=IVK-KL                                                    T6507830
      KZ=KK*KL+1                                                    T6507840
      LZ=NCLS-(KK-1)*KL                                             T6507850
      IF (KZ-LZ) 220,218,218                                        T6507860
 218  DO 219 I=1,KL                                                 T6507870
      DO 219 J=KZ,LZ                                                T6507880
 219  C(I,J)=0.0                                                    T6507890
 220  LM1=NCLS-2*KL+1                                               T6507900
      LM3=NCLS-KL                                                   T6507910
      DO 221 I=1,LM1,KL                                             T6507920
      LM2=I+KL-1                                                    T6507930
      DO 221 II=I,LM2                                               T6507940
      III=II+KL                                                     T6507950
      DO 221 JJ=II,LM3                                              T6507960
      JJJ=JJ+KL                                                     T6507970
 221  C(III,JJJ)=C(II,JJ)                                           T6507980
      GO TO (222,224,222),LCOD                                      T6507990
```

```
 222  KKL=KL*(KK-1)                                                        T6508000
      DO 223 III=1,NCLS,KL                                                 T6508010
      JTST=KKL+1-III                                                       T6508020
      JCLS=NCLS-KKL+III                                                    T6508030
      JJJ=III+KL-1                                                         T6508040
      JJ=III+KL*KK-1                                                       T6508050
      DO 223 I=III,JJJ                                                     T6508060
      DO 2220 J=I,JJ                                                       T6508070
 2220 C(I,J)=P(I)*C(I,J)*P(J)                                              T6508080
      IF (JTST)223,223,2221                                                T6508090
 2221 DO 2222 J=JCLS,NCLS                                                  T6508100
 2222 C(I,J)=P(I)*C(I,J)*P(J)                                              T6508110
 223  CONTINUE                                                             T6508120
C                                 SYMMETRIC MATRIX                         T6508130
 224  DO 2240 I=1,NCLS                                                     T6508140
      DO 2240 J=I,NCLS                                                     T6508150
 2240 C(J,I)=C(I,J)                                                        T6508160
C                                 CALC ●-DIAGONAL MATRIX                   T6508170
      DO 227 II=1,NRWS                                                     T6508180
      SCL1=(1.0/(FM(II)**2*FW(II)**4))/((1.0-(FREQ/FF(II))**2)**2 +(2.0*T6508190
     1FL(II)*(FREQ/FF(II)))**2)                                            T6508200
      R(II)=0.0                                                            T6508210
      KKK=1                                                                T6508220
      LLL=KL*(KK-1)                                                        T6508230
      MMM=LLL                                                              T6508240
      NNN=KL                                                               T6508250
      ITST=NCLS+1-KL*KK                                                    T6508260
      DO 2249 III=1,NCLS,KL                                                T6508270
      JJJ=III+KL-1                                                         T6508280
      JCLS=NCLS+III-MMM                                                    T6508290
      ITT=ITST-III                                                         T6508300
      IMT=MMM-III+1                                                        T6508310
      IF (IMT) 2244,2243,2241                                              T6508320
 2241 DO 2242 I=III,JJJ                                                    T6508330
      DO 2242 J=JCLS,NCLS                                                  T6508340
 2242 R(II)=R(II)+PHIA(II,J)*C(J,I)*PHIA(II,I)                             T6508350
 2243 KKK=KKK-KL                                                           T6508360
 2244 KKK=KKK+KL                                                           T6508370
      LLL=LLL+KL                                                           T6508380
      DO 2245 I=III,JJJ                                                    T6508390
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      DO 2245  J=KKK,LLL                                                T6508400
 2245 R(II)=R(II)+PHIA(II,J)*C(J,I)*PHIA(II,I)                          T6508410
      IF (ITT) 2246,2248,2249                                           T6508420
 2246 DO 2247  I=III,JJJ                                                T6508430
      DO 2247  J=1,NNN                                                  T6508440
 2247 R(II)=R(II)+PHIA(II,J)*C(J,I)*PHIA(II,I)                          T6508450
      NNN=NNN+KL                                                        T6508460
 2248 LLL=LLL-KL                                                        T6508470
 2249 CONTINUE                                                          T6508480
      R(II)=SCL1*R(II)                                                  T6508490
 227  CONTINUE                                                          T6508500
      GO TO 2276                                                        T6508510
2270  IF(LCOD-2)12280,12270,12280                                       T6508520
12270 DO 12271  I=1,KL                                                  T6508530
      DO 12271  J=1,KL                                                  T6508540
12271 C(I,J) = A(I,J)                                                   T6508550
      GO TO 12285                                                       T6508560
12280 DO 2271  I=1,KL                                                   T6508570
      DO 2271  J=I,KL                                                   T6508580
 2271 C(I,J)=P(I)*A(I,J)*P(J)                                           T6508590
12285 LM1 = NCLS-2*KL+1                                                 T6508600
      LM3=NCLS-KL                                                       T6508610
      DO 2272  I=1,LM1,KL                                               T6508620
      LM2=I+KL-1                                                        T6508630
      DO 2272  II=I,LM2                                                 T6508640
      III=II+KL                                                         T6508650
      DO 2272  JJ=II,LM3                                                T6508660
      JJJ=JJ+KL                                                         T6508670
 2272 C(III,JJJ)=C(II,JJ)                                               T6508680
3272  DO 2273  I=1,NCLS                                                 T6508690
      DO 2273  J=I,NCLS                                                 T6508700
 2273 C(J,I)=C(I,J)                                                     T6508710
      DO 2275  II=1,NRWS                                                T6508720
      SCL1=(1.0/(FM(II)**2*FW(II)**4))/((1.0-(FREQ/FF(II))**2)**2 +(2.0*T6508730
     1FL(II)*(FREQ/FF(II)))**2)                                         T6508740
      R(II)=0.0                                                         T6508750
      DO 2274  III=1,NCLS,KL                                            T6508760
      JJJ=III+KL-1                                                      T6508770
      DO 2274  I=III,JJJ                                                T6508780
      DO 2274  J=III,JJJ                                                T6508790
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 2274 R(II)=R(II)+PHIA(II,J)*C(J,I)*PHIA(II,I)                  T6508800
      R(II)=SCL1*R(II)                                          T6508810
 2275 CONTINUE                                                  T6508820
C                          INTEGRAL CALC CONTROL                T6508830
2276  IF(NVAL)231,231,229                                       T6508840
 229  TDLF=DFRQ/2.0                                             T6508850
      DO 230 I=1,MRWS                                           T6508860
 230  T(I)=T(I)+TDLF*(R(I)+R1(I))                               T6508870
 231  OMG=(6.28318531*FREQ)**4                                  T6508880
 232  IF (NVAL) 235,235,233                                     T6508890
 233  TDLF=DFRQ/2.0                                             T6508900
      DO 234 I=1,MRWS                                           T6508910
 234  TT(I)=TT(I)+TDLF*(OMG*R(I)+OMG1*R1(I))                    T6508920
C                          MOVE RESULTS(I) TO (I-1)             T6508930
 235  OMG1=OMG                                                  T6508940
      DO 236 I=1,MRWS                                           T6508950
 236  R1(I)=R(I)                                                T6508960
C                          PRINT CONTROL                        T6508970
      IF(KCNT-KPRC)245,237,245                                  T6508980
 237  WRITE (6,1033)FREQ                                        T6508990
      NLNS=2                                                    T6509000
 238  WRITE (6,1034)                                            T6509010
      NLNS=NLNS+2                                               T6509020
      CALL DPRT (MRWS,R,NLNS)                                   T6509030
      WRITE (6,1050)                                            T6509040
      DO 2238 I=1,MRWS                                          T6509050
2238  SC(I) = R(I)*OMG*ACCEL                                    T6509060
      CALL DPRT(MRWS,SC,NLNS)                                   T6509070
 2410 WRITE (6,1047)                                            T6509080
      NLNS=NLNS+2                                               T6509090
      DO 2411 I=1,NPRS                                          T6509100
      SC(I)=0.0                                                 T6509110
      DO 2411 J=1,MRWS                                          T6509120
2411  SC(I) = SC(I) + PHI(J,I)*R(J)                             T6509130
      CALL DPRT (NPRS,SC,NLNS)                                  T6509140
 242  WRITE (6,1036)                                            T6509150
      NLNS=NLNS+2                                               T6509160
      CALL DTRM  (MRWS,NPRS,R,PHI,AC)                           T6509170
      DO 243 I=1,NPRS                                           T6509180
 243  AC(I)=OMG*AC(I)*ACCEL                                     T6509190
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      CALL DPRT (NPRS,AC,NLNS)                                          T6509200
  244 KCNT=0                                                            T6509210
  245 KCNT=KCNT+1                                                       T6509220
      IF (FREQ-FR(1,NIVL+1)+.0001) 2480,246,246                         T6509230
  246 IF (NVAL-2) 247,990,247                                           T6509240
  247 NIVL=NIVL+1                                                       T6509250
      DFRQ=FR(2,NIVL)                                                   T6509260
      KPRC=FR(3,NIVL)+.0000001                                          T6509270
      IPS=1                                                             T6509280
 2480 IF (IMS-INS) 248,2481,2481                                        T6509290
 2481 GO TO(2482,2488,2498,2479),IPS                                    T6509300
 2479 IPS = 1                                                           T6509310
      KCNT = KCNT1                                                      T6509320
      GO TO 2482                                                        T6509330
 2482 IF (FREQ+DFRQ-FFF(INS)+.0001) 248,2483,2483                       T6509340
 2483 IF (FR(1,NIVL+1)-FFF(INS)+.0001) 248,2484,2484                    T6509350
 2484 IF (ABS(FREQ+DFRQ-FFF(INS))-.0001) 2486,2486,2485                 T6509360
 2485 FREQ2=FREQ                                                        T6509370
      DFRQ2=DFRQ                                                        T6509380
      DFRQ=FFF(INS)-FREQ2                                               T6509390
      FREQ=FREQ+DFRQ                                                    T6509400
      IPS=2                                                             T6509410
      KCNT2=KCNT                                                        T6509420
      KCNT=KPRC                                                         T6509430
      GO TO 250                                                         T6509440
 2486 IPS=1                                                             T6509450
      INS=INS+1                                                         T6509460
      IF (KCNT-KPRC) 2487,248,248                                       T6509470
 2487 KCNT2=KCNT+1                                                      T6509480
      KCNT=KPRC                                                         T6509490
      IPS=4                                                             T6509500
      INS=INS-1                                                         T6509510
      GO TO 248                                                         T6509520
 2488 IF (ABS(FREQ2+DFRQ2-FREQ)-.0001) 2490,2490,2491                   T6509530
 2490 IPS=1                                                             T6509540
      INS=INS+1                                                         T6509550
      KCNT=KCNT2                                                        T6509560
      GO TO 2492                                                        T6509570
 2491 DFRQ=FREQ2+DFRQ2-FREQ                                             T6509580
      IPS=3                                                             T6509590
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      KCNT=KCNT2                                                        T6509600
 2492 IF(IMS-INS-1) 248,2493,2493                                       T6509610
 2493 IF (FREQ+DFRQ-FFF(INS+1)+.0001) 2494,2495,2495                    T6509620
 2494 IF(FREQ+DFRQ-FR( 1,NIVL+1)+.0001) 248,248,2497                    T6509630
 2495 IF (FFF(INS+1)-FR(1,NIVL+1)+.0001) 2496,2497,2497                 T6509640
 2496 DFRQ = FFF(INS+1)-FREQ                                            T6509650
      INS=INS+1                                                         T6509660
      IPS=2                                                             T6509670
      KCNT2=KCNT                                                        T6509680
      KCNT=KPRC                                                         T6509690
      GO TO 248                                                         T6509700
 2497 INS = INS+1                                                       T6509710
      GO TO 248                                                         T6509720
 2498 DFRQ = DFRQ2                                                      T6509730
      IPS=1                                                             T6509740
      INS=INS+1                                                         T6509750
      GO TO 2480                                                        T6509760
  248 FREQ1=FREQ                                                        T6509770
      FREQ=FREQ+DFRQ                                                    T6509780
      IF (FREQ-FR(1,NIVL+1)+.0001) 250,249,249                          T6509790
  249 FREQ=FR(1,NIVL+1)                                                 T6509800
      DFRQ=FREQ-FREQ1                                                   T6509810
      KPRC=KCNT                                                         T6509820
      IF (NIVLS-NIVL-1) 251,251,250                                     T6509830
  250 NVAL=1                                                            T6509840
      GO TO 200                                                         T6509850
  251 NVAL=2                                                            T6509860
      GO TO 200                                                         T6509870
  990 WRITE(6,1037)                                                     T6509880
      NLNS=3                                                            T6509890
      CALL DPRT (MRWS,T,NLNS)                                           T6509900
  994 WRITE (6,1038)                                                    T6509910
      NLNS=NLNS+3                                                       T6509920
      DO 9940 I=1,MRWS                                                  T6509930
 9940 AC(I) =TT(I)*ACCEL                                                T6509940
      CALL DPRT (MRWS,AC,NLNS)                                          T6509950
 9970 WRITE (6,1048)                                                    T6509960
      NLNS=NLNS+3                                                       T6509970
      DO 9971 I=1,NPRS                                                  T6509980
      SC(I)=0.0                                                         T6509990
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      DO 9971 J=1,MRWS                                                  T6510000
 9971 SC(I) = SC(I)+PHI(J,I)*T(J)                                       T6510010
      CALL DPRT (NPRS,SC,NLNS)                                          T6510020
  998 CALL DTRM  (MRWS,NPRS,TT,PHI,AC)                                  T6510030
      WRITE (6,1040)                                                    T6510040
      NLNS=NLNS+3                                                       T6510050
      DO 9980 I=1,NPRS                                                  T6510060
 9980 AC(I)=AC(I)*ACCEL                                                 T6510070
      CALL DPRT (NPRS,AC,NLNS)                                          T6510080
 999  CALL CLOCK(TM3,TM4,DT1,DT2)                                       T6510090
      WRITE (6,1041)TM1,TM2,TM3,TM4,DT1,DT2                             T6510100
      RETURN                                                            T6510110
 1032 FORMAT (1H0,10X,17HERROR, TLU ERR IN,I3,7H TABLES)                T6510120
 1033 FORMAT (1H1,10X,12HFREQUENCY = ,1PE13.6/1H0,10X,9HDARC PRGM)      T6510130
 1034 FORMAT(1H0,10X36HNORMAL COORDINATE DEFLECTION SPECTRA)            T6510140
 1036 FORMAT(1H010X33HRADIAL SHELL ACCELERATION SPECTRA)                T6510150
 1037 FORMAT(1H010X40HMEAN-SQUARE NORMAL COORDINATE DEFLECTION)         T6510160
 1038 FORMAT(1H010X42HMEAN-SQUARE NORMAL COORDINATE ACCELERATION)       T6510170
 1040 FORMAT(1H010X31HMEAN-SQUARE RADIAL ACCELERATION)                  T6510180
 1041 FORMAT (1H1,10X,13HINIT. TIME = ,A6,A2,4X,13HFINAL TIME = ,       T6510190
     1A6,A2,4X,7HDATE = ,A6,A2)                                         T6510200
 1047 FORMAT(1H010X31HRADIAL SHELL DEFLECTION SPECTRA)                  T6510210
 1048 FORMAT(1H010X29HMEAN-SQUARE RADIAL DEFLECTION)                    T6510220
 1050 FORMAT(1H0,10X38HNORMAL COORDINATE ACCELERATION SPECTRA)          T6510230
      END                                                               T6510240
-               END OF FILE CARD                                        T6510250
```

4.9 Sample Case. - This section contains a sample case composed of a card input listing and the corresponding computer results. Only a portion of the output is given here as the entire listing is rather lengthy. A test case using all the options is impossible, but it is assumed that one case would aid immeasurably in understanding the program and its requirements.

4.9.1 Sample Input Listing. - The sample input listing, shown on the following pages, is an off-line listing of the cards as they would be setup for a computer run. To understand this section reference should be made to section 4.3

```
   1111   DUP. RESPONSE NO. 10 CHECK CASE FOR CORRECTED RESPONSE CAL.   0001
    27  1                                                              0002
  0.             100.          1.                                      0003
  150.           5.            1.                                      0004
  170.           2.            1.                                      0005
  174.           5.            1.                                      0006
  179.           5.            1.                                      0007
  209.           2.            1.                                      0008
  219.           5.            1.                                      0009
  239.           5.            1.                                      0010
  244.           2.            1.                                      0011
  252.           5.            1.                                      0012
  272.           2.            1.                                      0013
  290.           5.            1.                                      0014
  310.           3.            1.                                      0015
  316.           5.            1.                                      0016
  331.           2.            1.                                      0017
  341.           3.            1.                                      0018
  350.           5.            1.                                      0019
  404.           2.            1.                                      0020
  418.           5.            1.                                      0021
  435.           3.            1.                                      0022
  441.           5.            1.                                      0023
  461.           3.            1.                                      0024
  473.           5.            1.                                      0025
  503.           2.            1.                                      0026
  511.           5.            1.                                      0027
546.           3.            1.                                        0028
565.                                                                   0029
   2  2  1 6.7   -06                                                   0030
  88.2                                                                 0031
     19                                                                0032
   2.         1.         1.                                            0033
   3.         1.         1.                                            0034
   3.         2.         1.                                            0035
   2.         2.         1.                                            0036
   3.         3.         1.                                            0037
   1.         1.         1.                                            0038
   4.         3.         1.                                            0039
   4.         1.         1.                                            0040
```

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MODEL

```
   4.         2.          1.                                                     0041
   2.         3.          1.                                                     0042
   5.         3.          1.                                                     0043
   1.         2.          1.                                                     0044
   1.         3.          1.                                                     0045
   5.         2.          1.                                                     0046
   5.         1.          1.                                                     0047
   6.         3.          1.                                                     0048
   0.         3.          1.                                                     0049
   0.         1.          1.                                                     0050
   0.         2.          1.                                                     0051
  1110.086         1160.86                                                       0052
         80                                                                      0053
      20  4                                                                      0054
       2  8                                                                      0055
  1116.4327      1122.7795      1129.1262      1135.473                          0056
  1141.8197      1148.1665      1154.5132      1123.396                          0057
1011.               1.                                                           0058
       4  4  2                                                                   0059
 .053           .126           12.7           11.            410.                0060
       6                                                                         0061
 0.             18.            32.            160.                               0062
 320.           700.                                                             0063
 .0002          .00035         .000195        .000095                            0064
 .00005         .00005                                                           0065
       6                                                                         0066
 0.             18.            32.            160.                               0067
 320.           700.                                                             0068
 .0002          .00035         .000195        .000095                            0069
 .00005         .00005                                                           0070
       6                                                                         0071
 0.             18.            32.            160.                               0072
 320.           700.                                                             0073
 .0002          .00035         .000195        .000095                            0074
 .00005         .00005                                                           0075
       6                                                                         0076
 0.             19.5           52.            160.                               0077
 325.           700.                                                             0078
 .000275        .000525        .00009         .000045                            0079
 .00001         .00001                                                           0080
```

	21		C(1,1)			0081
	19		C(2,1)			0082
0.		20.		72.	97.5	0083
135.		150.		185.	210.	0084
240.		270.		287.	325.	0085
350.		390.		410.	430.	0086
460.		500.		700.		0087
.67		.65		0.	-.25	0088
-.52		-.52		-.25	0.	0089
.22		.36		.36	.22	0090
0.		-.2		-.26	-.26	0091
-.2		0.		0.		0092
	19		C(3,1)			0093
0.		20.		55.	70.	0094
77.5		112.		135.	140.	0095
163.		190.		205.	215.	0096
250.		275.		285.	335.	0097
360.		380.		700.		0098
.54		.3		-.3	-.42	0099
-.42		.12		.32	.32	0100
.12		-.12		-.21	-.21	0101
.04		.16		.16	-.12	0102
-.12		0.		0.		0103
	21		C(4,1)			0104
	13		C(1,2)			0105
0.		19.02		28.53	57.06	0106
76.08		95.1		152.2	171.2	0107
199.7		256.8		332.	450.	0108
700.						0109
.58		.38		.34	.37	0110
.41		.25		.32	.19	0111
.2		.1		.1	0.	0112
0.						0113
	21		C(2,2)			0114
	21		C(3,2)			0115
	21		C(4,2)			0116
	19					0117
90.34		.02		172.		0118
83.08		.020		215.		0119
78.6		.020		248.		0120

0121	277.	.020	79.74
0122	280.	.020	66.61
0123	288.	.020	109.24
0124	313.	.020	66.85
0125	336.	.020	80.57
0126	337.	.020	77.69
0127	348.	.020	66.02
0128	406.	.020	67.07
0129	415.	.020	78.29
0130	438.	.020	64.96
0131	464.	.020	77.67
0132	469.	.020	80.29
0133	507.	.020	67.56
0134	508.	.020	64.31
0135	529.	.020	77.95
0136	532.	.020	73.77

4.9.2 Sample Output Listing. - The sample output listing, shown on the following pages, is a direct result from the sample input and the DARC program. It contains various printouts. Initially it contains the input and computed matrices. Intermediate printout consists of the normal coordinate response at the desired frequencies. The final portion consists of printouts of the various mean-square responses.

SHELL RESPONSE TO RANDOM PRESSURE EXCITATION
NAS 1-3179 06/12/65
111 DUP. RESPONSE NO. 10 CHECK CASE FOR CORRECTED RESPONSE CAL.

NO. OF CALC. FREQ. = 27

CALC FREQ	CALC INTERVAL	NO. CALC / NO. PRINTOUT
0.	1.000000E 02	1.000000E 00
1.500000E 02	5.000000E 00	1.000000E 00
1.700000E 02	2.000000E 00	1.000000E 00
1.740000E 02	5.000000E 00	1.000000E 00
1.790000E 02	5.000000E 00	1.000000E 00
2.090000E 02	2.000000E 00	1.000000E 00
2.190000E 02	5.000000E 00	1.000000E 00
2.380000E 02	5.000000E 00	1.000000E 00
2.440000E 02	2.000000E 00	1.000000E 00
2.520000E 02	5.000000E 00	1.000000E 00
2.720000E 02	2.000000E 00	1.000000E 00
2.900000E 02	5.000000E 00	1.000000E 00
3.100000E 02	3.000000E 00	1.000000E 00
3.160000E 02	5.000000E 00	1.000000E 00
3.310000E 02	2.000000E 00	1.000000E 00
3.410000E 02	3.000000E 00	1.000000E 00
3.500000E 02	5.000000E 00	1.000000E 00
4.040000E 02	2.000000E 00	1.000000E 00
4.180000E 02	5.000000E 00	1.000000E 00
4.350000E 02	3.000000E 00	1.000000E 00
4.410000E 02	5.000000E 00	1.000000E 00
4.610000E 02	3.000000E 00	1.000000E 00
4.730000E 02	5.000000E 00	1.000000E 00
5.030000E 02	2.000000E 00	1.000000E 00
5.110000E 02	5.000000E 00	1.000000E 00
5.460000E 02	3.000000E 00	1.000000E 00
5.650000E 02	-0.	-0.

PHIAT CALC CODE = 2 PHI2T CALC CODE = 2
ACCEL. SCALAR = 6.7000E-06

ALPHA = 8.820000E 01

MODES = 19

N	M	AMN
2.0000E 00	1.0000E 00	1.000000E 00
3.0000E 00	1.0000E 00	1.000000E 00
3.0000E 00	2.0000E 00	1.000000E 00
2.0000E 00	2.0000E 00	1.000000E 00
3.0000E 00	3.0000E 00	1.000000E 00
1.0000E 00	1.0000E 00	1.000000E 00
4.0000E 00	2.0000E 00	1.000000E 00
4.0000E 00	1.0000E 00	1.000000E 00
4.0000E 00	2.0000E 00	1.000000E 00
2.0000E 00	3.0000E 00	1.000000E 00
5.0000E 00	3.0000E 00	1.000000E 00
1.0000E 00	2.0000E 00	1.000000E 00
1.0000E 00	3.0000E 00	1.000000E 00
5.0000E 00	2.0000E 00	1.000000E 00
5.0000E 00	1.0000E 00	1.000000E 00
6.0000E 00	3.0000E 00	1.000000E 00
0.	3.0000E 00	1.000000E 00
0.	1.0000E 00	1.000000E 00
0.	2.0000E 00	1.000000E 00

X1 = 1.110086E 03 XF = 1.160860E 03

PHIAT CODE = 2 N COLS = 80 NT = 20 NX = 4

PHI2T CODE = 2 N COLS = 8

PHI2T RESPONSE POINTS

1.11643E 03	1.12278E 03	1.12913E 03	1.13547E 03
1.14182E 03	1.14817E 03	1.15451E 03	1.12340E 03

SHELL RESPONSE TO RANDOM PRESSURE EXCITATION
NAS 1-3179 06/12/65

CODE = 2 N = 19 M = 80 PHIAT

1

1.7170790E 03	4.2274529E 03	4.3177448E 03	1.8231504E 03	1.0612132E 03	2.6127096E 03	2.6685131E 03	1.1267689E 03
0.	0.	0.	0.	-1.0612132E 03	-2.6127096E 03	-2.6685130E 03	-1.1267689E 03
-1.7170790E 03	-4.2274528E 03	-4.3177447E 03	-1.8231504E 03	-1.7170790E 03	-4.2274531E 03	-4.3177449E 03	-1.8231504E 03
-1.0612132E 03	-2.6127096E 03	-2.6685131E 03	-1.1267689E 03	-8.7060610E-05	-2.1434345E-04	-2.1892149E-04	-9.2438719E-05
1.0612132E 03	2.6127096E 03	2.6685131E 03	1.1267689E 03	1.7170789E 03	4.2274526E 03	4.3177444E 03	1.8231502E 03
1.7170791E 03	4.2274531E 03	4.3177449E 03	1.8231505E 03	1.0612133E 03	2.6127099E 03	2.6685133E 03	1.1267690E 03
1.3059091E-04	3.2151517E-04	3.2838224E-04	1.3865808E-04	-1.0612131E 03	-2.6127093E 03	-2.6685127E 03	-1.1267688E 03
-1.7170790E 03	-4.2274529E 03	-4.3177447E 03	-1.8231504E 03	-1.7170791E 03	-4.2274531E 03	-4.3177450E 03	-1.8231505E 03
-1.0612133E 03	-2.6127099E 03	-2.6685134E 03	-1.1267690E 03	-1.0882576E-04	-2.6792931E-04	-2.7365187E-04	-1.1554840E-04
1.0612129E 03	2.6127089E 03	2.6685123E 03	1.1267686E 03	1.7170790E 03	4.2274529E 03	4.3177447E 03	1.8231504E 03

2

1.5755710E 03	3.8790599E 03	3.9619106E 03	1.6729008E 03	2.7662380E 02	6.8104851E 02	6.9559465E 02	2.9371204E 02
-1.2503802E 03	-3.0784393E 03	-3.1441900E 03	-1.3276216E 03	-1.7465339E 03	-4.2999709E 03	-4.3918117E 03	-1.8544248E 03
-8.0279354E 02	-1.9764798E 03	-2.0186943E 03	-8.5238556E 02	8.0279348E 02	1.9764796E 03	2.0186942E 03	8.5238550E 02
1.7465339E 03	4.2999708E 03	4.3918115E 03	1.8544248E 03	1.2503803E 03	3.0784396E 03	3.1441903E 03	1.3276217E 03
-2.7662363E 02	-6.8104811E 02	-6.9559425E 02	-2.9371187E 02	-1.5755710E 03	-3.8790598E 03	-3.9619105E 03	-1.6729008E 03
-1.5755711E 03	-3.8790601E 03	-3.9619108E 03	-1.6729009E 03	-2.7662390E 02	-6.8104875E 02	-6.9559490E 02	-2.9371215E 02
1.2503800E 03	3.0784388E 03	3.1441895E 03	1.3276214E 03	1.7465340E 03	4.2999712E 03	4.3918120E 03	1.8544249E 03
8.0279367E 02	1.9764801E 03	2.0186947E 03	8.5238571E 02	-8.0279343E 02	-1.9764795E 03	-2.0186941E 03	-8.5238545E 02
-1.7465337E 03	-4.2999705E 03	-4.3918112E 03	-1.8544246E 03	-1.2503804E 03	-3.0784397E 03	-3.1441904E 03	-1.3276217E 03
2.7662354E 02	6.8104786E 02	6.9559399E 02	2.9371177E 02	1.5755707E 03	3.8790592E 03	3.9619099E 03	1.6729005E 03

3

2.6882607E 03	2.7327963E 03	-2.8117076E 03	-2.8572644E 03	4.7197930E 02	4.7979844E 02	-4.9365293E 02	-5.0165137E 02
-2.1334158E 03	-2.1687594E 03	2.2313837E 03	2.2675379E 03	-2.9799600E 03	-3.0293280E 03	3.1168019E 03	3.1673020E 03
-1.3697373E 03	-1.3924293E 03	1.4326366E 03	1.4558490E 03	1.3697372E 03	1.3924292E 03	-1.4326365E 03	-1.4558489E 03
2.9799599E 03	3.0293280E 03	-3.1168018E 03	-3.1673019E 03	2.1334159E 03	2.1687596E 03	-2.2313840E 03	-2.2675380E 03
-4.7197903E 02	-4.7979816E 02	4.9365264E 02	5.0165107E 02	-2.6882607E 03	-2.7327963E 03	2.8117076E 03	2.8572644E 03
-2.6882609E 03	-2.7327965E 03	2.8117078E 03	2.8572646E 03	-4.7197947E 02	-4.7979861E 02	4.9365311E 02	5.0165155E 02
2.1334154E 03	2.1687590E 03	-2.2313834E 03	-2.2675375E 03	2.9799601E 03	3.0293282E 03	-3.1168021E 03	-3.1673022E 03
1.3697376E 03	1.3924296E 03	-1.4326369E 03	-1.4558493E 03	-1.3697371E 03	-1.3924291E 03	1.4326364E 03	1.4558488E 03
-2.9799597E 03	-3.0293277E 03	3.1168016E 03	3.1673017E 03	-2.1334160E 03	-2.1687597E 03	2.2313840E 03	2.2675381E 03
4.7197886E 02	4.7979799E 02	-4.9365247E 02	-5.0165089E 02	2.6882603E 03	2.7327959E 03	-2.8117071E 03	-2.8572640E 03

4

2.9297037E 03	2.9782391E 03	-3.0642377E 03	-3.1138862E 03	1.8106565E 03	1.8406531E 03	-1.8938031E 03	-1.9244876E 03
0.	0.	-0.	-0.	-1.8106564E 03	-1.8406530E 03	1.8938030E 03	1.9244875E 03
-2.9297036E 03	-2.9782391E 03	3.0642377E 03	3.1138861E 03	-2.9297037E 03	-2.9782392E 03	3.0642378E 03	3.1138863E 03
-1.8106564E 03	-1.8406530E 03	1.8938031E 03	1.9244875E 03	-1.4854400E-04	-1.5100489E-04	1.5536525E-04	1.5788256E-04
1.8106564E 03	1.8406530E 03	-1.8938031E 03	-1.9244875E 03	2.9297034E 03	2.9782389E 03	-3.0642375E 03	-3.1138859E 03
2.9297038E 03	2.9782393E 03	-3.0642379E 03	-3.1138863E 03	1.8106566E 03	1.8406532E 03	-1.8938033E 03	-1.9244877E 03
2.2281600E-04	2.2650733E-04	-2.3304788E-04	-2.3682384E-04	-1.8106562E 03	-1.8406528E 03	1.8938029E 03	1.9244873E 03
-2.9297036E 03	-2.9782391E 03	3.0642377E 03	3.1138862E 03	-2.9297038E 03	-2.9782393E 03	3.0642379E 03	3.1138864E 03
-1.8106567E 03	-1.8406532E 03	1.8938033E 03	1.9244877E 03	-1.8568000E-04	-1.8875611E-04	1.9420656E-04	1.9735321E-04
1.8106560E 03	1.8406525E 03	-1.8938026E 03	-1.9244870E 03	2.9297036E 03	2.9782391E 03	-3.0642377E 03	-3.1138862E 03

SHELL RESPONSE TO RANDOM PRESSURE EXCITATION
NAS 1-3179 06/12/65

CODE = 2 N = 19 M = 80 PHIAT

5							
3.0561973E 03	-1.3074689E 03	-1.3060232E 03	3.2551051E 03	5.3657811E 02	-2.2955298E 02	-2.2929915E 02	5.7150046E 02
-2.4254119E 03	1.0376132E 03	1.0364659E 03	-2.5832660E 03	-3.3878208E 03	1.4493404E 03	1.4477379E 03	-3.6083119E 03
-1.5572104E 03	6.6618869E 02	6.6545207E 02	-1.6585590E 03	1.5572102E 03	-6.6618864E 02	-6.6545202E 02	1.6585988E 03
3.3878207E 03	-1.4493404E 03	-1.4477378E 03	3.6083117E 03	2.4254121E 03	-1.0376133E 03	-1.0364659E 03	2.5832663E 03
-5.3657780E 02	2.2955284E 02	2.2929902E 02	-5.7150013E 02	-3.0561972E 03	1.3074689E 03	1.3060232E 03	-3.2551051E 03
-3.0561975E 03	1.3074690E 03	1.3060233E 03	-3.2551054E 03	-5.3657830E 02	2.2955306E 02	2.2929924E 02	-5.7150066E 02
2.4254115E 03	-1.0376130E 03	-1.0364657E 03	2.5832656E 03	3.3878210E 03	-1.4493405E 03	-1.4477379E 03	3.6083120E 03
1.5572106E 03	-6.6618882E 02	-6.6545218E 02	1.6585592E 03	-1.5572101E 03	6.6618861E 02	6.6545198E 02	-1.6585587E 03
-3.3878204E 03	1.4493403E 03	1.4477377E 03	-3.6083115E 03	-2.4254122E 03	1.0376133E 03	1.0364660E 03	-2.5832663E 03
5.3657761E 02	-2.2955276E 02	-2.2929893E 02	5.7149992E 02	3.0561968E 03	-1.3074687E 03	-1.3060230E 03	3.2551046E 03
6							
1.8054437E 03	4.4450071E 03	4.5399456E 03	1.9169738E 03	1.6287143E 03	4.0098988E 03	4.0955440E 03	1.7293270E 03
1.2925550E 03	3.1822738E 03	3.2502422E 03	1.3724017E 03	8.2987139E 02	2.0431455E 03	2.0867839E 03	8.8113613E 02
2.8595418E 02	7.0401995E 02	7.1905673E 02	3.0361881E 02	-2.8595418E 02	-7.0401995E 02	-7.1905673E 02	-3.0361881E 02
-8.2987131E 02	-2.0431453E 03	-2.0867837E 03	-8.8113605E 02	-1.2925550E 03	-3.1822738E 03	-3.2502422E 03	-1.3724017E 03
-1.6287143E 03	-4.0098988E 03	-4.0955441E 03	-1.7293270E 03	-1.8054436E 03	-4.4450068E 03	-4.5399453E 03	-1.9169737E 03
-1.8054437E 03	-4.4450071E 03	-4.5399457E 03	-1.9169738E 03	-1.6287144E 03	-4.0098990E 03	-4.0955443E 03	-1.7293271E 03
-1.2925548E 03	-3.1822734E 03	-3.2502418E 03	-1.3724015E 03	-8.2987152E 02	-2.0431459E 03	-2.0867843E 03	-8.8113627E 02
-2.8595427E 02	-7.0402016E 02	-7.1905695E 02	-3.0361890E 02	2.8595410E 02	7.0401973E 02	7.1905650E 02	3.0361872E 02
8.2987134E 02	2.0431454E 03	2.0867838E 03	8.8113608E 02	1.2925550E 03	3.1822738E 03	3.2502422E 03	1.3724017E 03
1.6287140E 03	4.0098982E 03	4.0955434E 03	1.7293267E 03	1.8054437E 03	4.4450071E 03	4.5399457E 03	1.9169738E 03
7							
2.6945816E 03	-1.1527664E 03	-1.1514918E 03	2.8699542E 03	-1.0292385E 03	4.4031758E 02	4.3983070E 02	-1.0962249E 03
-3.3306860E 03	1.4248976E 03	1.4233221E 03	-3.5474585E 03	-1.0292386E 03	4.4031762E 02	4.3983074E 02	-1.0962251E 03
2.6945914E 03	-1.1527664E 03	-1.1514917E 03	2.8699541E 03	2.6945817E 03	-1.1527665E 03	-1.1514918E 03	2.8699544E 03
-1.0292383E 03	4.4031748E 02	4.3983060E 02	-1.0962247E 03	-3.3306861E 03	1.4248577E 03	1.4233221E 03	-3.5474586E 03
-1.0292398E 03	4.4031768E 02	4.3983081E 02	-1.0962252E 03	2.6945813E 03	-1.1527663E 03	-1.1514916E 03	2.8699539E 03
2.6945818E 03	-1.1527665E 03	-1.1514919E 03	2.8699545E 03	-1.0292384E 03	4.4031751E 02	4.3983063E 02	-1.0962248E 03
-3.3306855E 03	1.4248974E 03	1.4233219E 03	-3.5474580E 03	-1.0292394E 03	4.4031793E 02	4.3983105E 02	-1.0962258E 03
2.6945812E 03	-1.1527663E 03	-1.1514916E 03	2.8699538E 03	2.6945820E 03	-1.1527666E 03	-1.1514919E 03	2.8699546E 03
-1.0292382E 03	4.4031743E 02	4.3983055E 02	-1.0962246E 03	-3.3306861E 03	1.4248977E 03	1.4233221E 03	-3.5474586E 03
-1.0292390E 03	4.4031778E 02	4.3983091E 02	-1.0962254E 03	2.6945811E 03	-1.1527662E 03	-1.1514916E 03	2.8699537E 03
9							
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-1.7170790E 03	-4.2274529E 03	-4.3177448E 03	-1.8231504E 03	-5.3060663E 02	-1.3063549E 03	-1.3342566E 03	-5.6338450E 02
1.3891460E 03	3.4200811E 03	3.4931288E 03	1.4749596E 03	1.3891462E 03	3.4200815E 03	3.4931291E 03	1.4749597E 03
-5.3060646E 02	-1.3063545E 03	-1.3342562E 03	-5.6338431E 02	-1.7170790E 03	-4.2274531E 03	-4.3177449E 03	-1.8231504E 03
-5.3060671E 02	-1.3063551E 03	-1.3342568E 03	-5.6338457E 02	1.3891459E 03	3.4200809E 03	3.4931286E 03	1.4749595E 03
1.3891462E 03	3.4200816E 03	3.4931293E 03	1.4749598E 03	-5.3060649E 02	-1.3063546E 03	-1.3342563E 03	-5.6338435E 02
-1.7170788E 03	-4.2274523E 03	-4.3177442E 03	-1.8231501E 03	-5.3060700E 02	-1.3063558E 03	-1.3342576E 03	-5.6338489E 02
1.3891459E 03	3.4200809E 03	3.4931285E 03	1.4749595E 03	1.3891463E 03	3.4200818E 03	3.4931295E 03	1.4749599E 03
-5.3060640E 02	-1.3063543E 03	-1.3342560E 03	-5.6338425E 02	-1.7170790E 03	-4.2274531E 03	-4.3177449E 03	-1.8231504E 03
-5.3060692E 02	-1.3063554E 03	-1.3342571E 03	-5.6338470E 02	1.3891459E 03	3.4200807E 03	3.4931284E 03	1.4749594E 03

SHELL RESPONSE TO RANDOM PRESSURE EXCITATION
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CODE = 2 N = 19 M = 80 PHIAT

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-2.9297037E 03	-2.9782391E 03	3.0642377E 03	3.1138862E 03	-9.0532829E 02	-9.2032658E 02	9.4690162E 02	9.6224383E 02
2.3701799E 03	2.4094460E 03	-2.4790203E 03	-2.5191867E 03	2.3701802E 03	2.4094462E 03	-2.4790206E 03	-2.5191870E 03
-9.0532799E 02	-9.2032628E 02	9.4690131E 02	9.6224352E 02	-2.9297037E 03	-2.9782392E 03	3.0642378E 03	3.1138863E 03
-9.0532842E 02	-9.2032671E 02	9.4690175E 02	9.6224396E 02	2.3701798E 03	2.4094458E 03	-2.4790201E 03	-2.5191866E 03
2.3701803E 03	2.4094463E 03	-2.4790207E 03	-2.5191871E 03	-9.0532805E 02	-9.2032634E 02	9.4690136E 02	9.6224358E 02
-2.9297032E 03	-2.9782387E 03	3.0642373E 03	3.1138858E 03	-9.0532892E 02	-9.2032722E 02	9.4690228E 02	9.6224451E 02
2.3701797E 03	2.4094458E 03	-2.4790201E 03	-2.5191866E 03	2.3701804E 03	2.4094465E 03	-2.4790208E 03	-2.5191872E 03
-9.0532788E 02	-9.2032616E 02	9.4690119E 02	9.6224340E 02	-2.9297037E 03	-2.9782392E 03	3.0642378E 03	3.1138863E 03
-9.0532862E 02	-9.2032691E 02	9.4690195E 02	9.6224418E 02	2.3701797E 03	2.4094457E 03	-2.4790200E 03	-2.5191865E 03
10							
3.3306860E 03	-1.4248976E 03	-1.4233221E 03	3.5474585E 03	2.0584772E 03	-8.8063519E 02	-8.7966144E 02	2.1924500E 03
0.	-0.	-0.	0.	-2.0584771E 03	8.8063515E 02	8.7966141E 02	-2.1924499E 03
-3.3306859E 03	1.4248976E 03	1.4233221E 03	-3.5474584E 03	-3.3306861E 03	1.4248977E 03	1.4233221E 03	-3.5474586E 03
-2.0584771E 03	8.8063518E 02	8.7966142E 02	-2.1924499E 03	-1.6887490E-04	7.2246215E-05	7.2166330E-05	-1.7986587E-04
2.0584771E 03	-8.8063518E 02	-8.7966142E 02	2.1924499E 03	3.3306857E 03	-1.4248975E 03	-1.4233220E 03	3.5474582E 03
3.3306861E 03	-1.4248977E 03	-1.4233221E 03	3.5474586E 03	2.0584773E 03	-8.8063526E 02	-8.7966151E 02	2.1924501E 03
2.5331236E-04	-1.0836932E-04	-1.0824949E-04	2.6979880E-04	-2.0584769E 03	8.8063507E 02	8.7966131E 02	-2.1924496E 03
-3.3306859E 03	1.4248976E 03	1.4233221E 03	-3.5474584E 03	-3.3306861E 03	1.4248977E 03	1.4233222E 03	-3.5474587E 03
-2.0584774E 03	8.8063527E 02	8.7966152E 02	-2.1924502E 03	-2.1109363E-04	9.0307769E-05	9.0207912E-05	-2.2483233E-04
2.0584766E 03	-8.8063494E 02	-8.7966119E 02	2.1924493E 03	3.3306859E 03	-1.4248976E 03	-1.4233221E 03	3.5474584E 03
11							
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-2.2666006E 03	9.6967229E 02	9.6860008E 02	-2.4141188E 03	2.2666004E 03	-9.6967220E 02	-9.6860000E 02	2.4141186E 03
2.2666007E 03	-9.6967231E 02	-9.6860011E 02	2.4141189E 03	-2.2666003E 03	9.6967217E 02	9.6859996E 02	-2.4141185E 03
-2.2666008E 03	9.6967235E 02	9.6860014E 02	-2.4141189E 03	2.2666003E 03	-9.6967214E 02	-9.6859994E 02	2.4141184E 03
2.2666008E 03	-9.6967237E 02	-9.6860017E 02	2.4141190E 03	-2.2666002E 03	9.6967212E 02	9.6859990E 02	-2.4141184E 03
-2.2666009E 03	9.6967241E 02	9.6860020E 02	-2.4141191E 03	2.2666001E 03	-9.6967207E 02	-9.6859988E 02	2.4141183E 03
2.2666010E 03	-9.6967244E 02	-9.6860025E 02	2.4141192E 03	-2.2666003E 03	9.6967216E 02	9.6859995E 02	-2.4141185E 03
-2.2666008E 03	9.6967236E 02	9.6860015E 02	-2.4141190E 03	2.2666000E 03	-9.6967201E 02	-9.6859982E 02	2.4141181E 03
2.2666011E 03	-9.6967250E 02	-9.6860030E 02	2.4141193E 03	-2.2666002E 03	9.6967211E 02	9.6859990E 02	-2.4141183E 03
-2.2666009E 03	9.6967242E 02	9.6860021E 02	-2.4141191E 03	2.2665998E 03	-9.6967195E 02	-9.6859975E 02	2.4141180E 03
12							
3.0804727E 03	3.1315060E 03	-3.2219303E 03	-3.2741337E 03	2.7789346E 03	2.8249723E 03	-2.9065453E 03	-2.9536387E 03
2.2053750E 03	2.2419108E 03	-2.3066474E 03	-2.3440210E 03	1.4159379E 03	1.4393953E 03	-1.4809588E 03	-1.5049541E 03
4.8789894E 02	4.9598181E 02	-5.1030361E 02	-5.1857183E 02	-4.8789894E 02	-4.9598181E 02	5.1030361E 02	5.1857183E 02
-1.4159378E 03	-1.4393952E 03	1.4809586E 03	1.5049540E 03	-2.2053750E 03	-2.2419108E 03	2.3066474E 03	2.3440210E 03
-2.7789346E 03	-2.8249724E 03	2.9065453E 03	2.9536387E 03	-3.0804726E 03	-3.1315058E 03	3.2219301E 03	3.2741335E 03
-3.0804728E 03	-3.1315060E 03	3.2219303E 03	3.2741338E 03	-2.7789347E 03	-2.8249725E 03	2.9065454E 03	2.9536389E 03
-2.2053747E 03	-2.2419105E 03	2.3066471E 03	2.3440207E 03	-1.4159381E 03	-1.4393955E 03	1.4809590E 03	1.5049543E 03
-4.8789909E 02	-4.9598196E 02	5.1030377E 02	5.1857198E 02	4.8789879E 02	4.9598166E 02	-5.1030346E 02	-5.1857167E 02
1.4159379E 03	1.4393952E 03	-1.4809587E 03	-1.5049540E 03	2.2053750E 03	2.2419108E 03	-2.3066474E 03	-2.3440210E 03
2.7789342E 03	2.8249719E 03	-2.9065448E 03	-2.9536382E 03	3.0804728E 03	3.1315060E 03	-3.2219303E 03	-3.2741338E 03

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2.5072200E 03	-1.0726115E 03	-1.0714254E 03	2.6703985E 03	1.6097343E 03	-6.8865893E 02	-6.8789746E 02	1.7145014E 03
5.5467663E 02	-2.3729569E 02	-2.3703330E 02	5.9077690E 02	-5.5467663E 02	2.3729569E 02	2.3703330E 02	-5.9077690E 02
-1.6097342E 03	6.8865886E 02	6.8789739E 02	-1.7145012E 03	-2.5072200E 03	1.0726115E 03	1.0714254E 03	-2.6703985E 03
-3.1592815E 03	1.3515693E 03	1.3500748E 03	-3.3648984E 03	-3.5020903E 03	1.4982260E 03	1.4965693E 03	-3.7300184E 03
-3.5020906E 03	1.4982261E 03	1.4965694E 03	-3.7300187E 03	-3.1592816E 03	1.3515693E 03	1.3500748E 03	-3.3648986E 03
-2.5072197E 03	1.0726113E 03	1.0714253E 03	-2.6703982E 03	-1.6097346E 03	6.8865904E 02	6.8789756E 02	-1.7145017E 03
-5.5467680E 02	2.3729576E 02	2.3703338E 02	-5.9077708E 02	5.5467646E 02	-2.3729562E 02	-2.3703323E 02	5.9077672E 02
1.6097343E 03	-6.8865891E 02	-6.8789743E 02	1.7145013E 03	2.5072200E 03	-1.0726115E 03	-1.0714254E 03	2.6703985E 03
3.1592810E 03	-1.3515690E 03	-1.3500745E 03	3.3648978E 03	3.5020906E 03	-1.4982261E 03	-1.4965694E 03	3.7300187E 03
14							
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-1.9937239E 03	-2.0267533E 03	2.0852771E 03	2.1190639E 03	1.9937237E 03	2.0267531E 03	-2.0852769E 03	-2.1190637E 03
1.9937239E 03	2.0267533E 03	-2.0852771E 03	-2.1190639E 03	-1.9937236E 03	-2.0267530E 03	2.0852768E 03	2.1190636E 03
-1.9937240E 03	-2.0267534E 03	2.0852772E 03	2.1190640E 03	1.9937236E 03	2.0267530E 03	-2.0852768E 03	-2.1190636E 03
1.9937240E 03	2.0267535E 03	-2.0852773E 03	-2.1190641E 03	-1.9937235E 03	-2.0267529E 03	2.0852767E 03	2.1190635E 03
-1.9937241E 03	-2.0267535E 03	2.0852773E 03	2.1190642E 03	1.9937235E 03	2.0267529E 03	-2.0852766E 03	-2.1190634E 03
1.9937242E 03	2.0267536E 03	-2.0852774E 03	-2.1190642E 03	-1.9937236E 03	-2.0267530E 03	2.0852768E 03	2.1190636E 03
-1.9937240E 03	-2.0267534E 03	2.0852773E 03	2.1190641E 03	1.9937233E 03	2.0267527E 03	-2.0852765E 03	-2.1190633E 03
1.9937243E 03	2.0267537E 03	-2.0852776E 03	-2.1190644E 03	-1.9937235E 03	-2.0267529E 03	2.0852767E 03	2.1190635E 03
-1.9937241E 03	-2.0267535E 03	2.0852774E 03	2.1190642E 03	1.9937232E 03	2.0267526E 03	-2.0852764E 03	-2.1190632E 03
15							
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1.1685078E 03	2.8768692E 03	2.9383146E 03	1.2406915E 03	-1.1685076E 03	-2.8768688E 03	-2.9383142E 03	-1.2406914E 03
-1.1685078E 03	-2.8768693E 03	-2.9383148E 03	-1.2406916E 03	1.1685076E 03	2.8768686E 03	2.9383141E 03	1.2406913E 03
1.1685078E 03	2.8768694E 03	2.9383148E 03	1.2406916E 03	-1.1685075E 03	-2.8768685E 03	-2.9383141E 03	-1.2406913E 03
-1.1685079E 03	-2.8768694E 03	-2.9383149E 03	-1.2406916E 03	1.1685075E 03	2.8768685E 03	2.9383139E 03	1.2406912E 03
1.1685079E 03	2.8768696E 03	2.9383150E 03	1.2406917E 03	-1.1685076E 03	-2.8768687E 03	-2.9383142E 03	-1.2406913E 03
-1.1685078E 03	-2.8768693E 03	-2.9383148E 03	-1.2406916E 03	1.1685074E 03	2.8768683E 03	2.9383138E 03	1.2406912E 03
1.1685080E 03	2.8768697E 03	2.9383152E 03	1.2406918E 03	-1.1685075E 03	-2.8768685E 03	-2.9383140E 03	-1.2406913E 03
-1.1685079E 03	-2.8768695E 03	-2.9383150E 03	-1.2406917E 03	1.1685073E 03	2.8768681E 03	2.9383136E 03	1.2406911E 03
16							
1.7963877E 03	-7.6851094E 02	-7.6766117E 02	1.9133028E 03	-2.9066163E 03	1.2434768E 03	1.2421018E 03	-3.0957889E 03
-5.6291635E-05	2.4082071E-05	2.4055443E-05	-5.9955288E-05	2.9066164E 03	-1.2434768E 03	-1.2421019E 03	3.0957890E 03
-1.7963875E 03	7.6851085E 02	7.6766108E 02	-1.9133026E 03	-1.7963879E 03	7.6851103E 02	7.6766125E 02	-1.9133030E 03
2.9066162E 03	-1.2434768E 03	-1.2421018E 03	3.0957888E 03	2.3923945E-04	-1.0234880E-04	-1.0223563E-04	2.5480997E-04
-2.9066163E 03	1.2434768E 03	1.2421018E 03	-3.0957889E 03	1.7963872E 03	-7.6851072E 02	-7.6766096E 02	1.9133023E 03
1.7963881E 03	-7.6851113E 02	-7.6766135E 02	1.9133033E 03	-2.9066163E 03	1.2434768E 03	1.2421018E 03	-3.0957889E 03
-5.4884344E-04	2.3480020E-04	2.3454057E-04	-5.8456405E-04	2.9066166E 03	-1.2434769E 03	-1.2421020E 03	3.0957893E 03
-1.7963873E 03	7.6851075E 02	7.6766098E 02	-1.9133023E 03	-1.7963881E 03	7.6851110E 02	7.6766133E 02	-1.9133032E 03
2.9066160E 03	-1.2434766E 03	-1.2421017E 03	3.0957885E 03	1.1961972E-03	-5.1174402E-04	-5.1117816E-04	1.2740499E-03
-2.9066170E 03	1.2434771E 03	1.2421021E 03	-3.0957896E 03	1.7963869E 03	-7.6851058E 02	-7.6766081E 02	1.9133019E 03

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3.5603678E 03	-1.5231576E 03	-1.5214734E 03	3.7920888E 03	3.5603680E 03	-1.5231577E 03	-1.5214735E 03	3.7920890E 03
3.5603677E 03	-1.5231576E 03	-1.5214733E 03	3.7920887E 03	3.5603680E 03	-1.5231577E 03	-1.5214735E 03	3.7920890E 03
3.5603680E 03	-1.5231577E 03	-1.5214735E 03	3.7920890E 03	3.5603677E 03	-1.5231576E 03	-1.5214733E 03	3.7920887E 03
3.5603680E 03	-1.5231577E 03	-1.5214735E 03	3.7920890E 03	3.5603680E 03	-1.5231577E 03	-1.5214735E 03	3.7920890E 03
3.5603673E 03	-1.5231574E 03	-1.5214732E 03	3.7920883E 03	3.5603680E 03	-1.5231577E 03	-1.5214735E 03	3.7920890E 03
3.5603680E 03	-1.5231577E 03	-1.5214735E 03	3.7920890E 03	3.5603680E 03	-1.5231577E 03	-1.5214735E 03	3.7920890E 03
3.5603680E 03	-1.5231577E 03	-1.5214735E 03	3.7920890E 03	3.5603680E 03	-1.5231577E 03	-1.5214735E 03	3.7920890E 03
3.5603673E 03	-1.5231574E 03	-1.5214732E 03	3.7920883E 03	3.5603680E 03	-1.5231577E 03	-1.5214735E 03	3.7920890E 03
18							
1.8354876E 03	4.5189753E 03	4.6154937E 03	1.9488736E 03	1.8354876E 03	4.5189753E 03	4.6154937E 03	1.9488736E 03
1.8354876E 03	4.5189753E 03	4.6154937E 03	1.9488737E 03	1.8354876E 03	4.5189752E 03	4.6154936E 03	1.9488736E 03
1.8354876E 03	4.5189752E 03	4.6154936E 03	1.9488736E 03	1.8354877E 03	4.5189754E 03	4.6154938E 03	1.9488737E 03
1.8354875E 03	4.5189750E 03	4.6154934E 03	1.9488735E 03	1.8354877E 03	4.5189754E 03	4.6154938E 03	1.9488737E 03
1.8354877E 03	4.5189754E 03	4.6154938E 03	1.9488737E 03	1.8354875E 03	4.5189750E 03	4.6154934E 03	1.9488735E 03
1.8354877E 03	4.5189754E 03	4.6154938E 03	1.9488737E 03	1.8354877E 03	4.5189754E 03	4.6154938E 03	1.9488737E 03
1.8354874E 03	4.5189746E 03	4.6154929E 03	1.9488733E 03	1.8354877E 03	4.5189754E 03	4.6154938E 03	1.9488737E 03
1.8354877E 03	4.5189754E 03	4.6154938E 03	1.9488737E 03	1.8354877E 03	4.5189754E 03	4.6154938E 03	1.9488737E 03
1.8354877E 03	4.5189754E 03	4.6154938E 03	1.9488737E 03	1.8354877E 03	4.5189754E 03	4.6154938E 03	1.9488737E 03
1.8354874E 03	4.5189746E 03	4.6154929E 03	1.9488733E 03	1.8354877E 03	4.5189754E 03	4.6154938E 03	1.9488737E 03
19							
3.1317341E 03	3.1836165E 03	-3.2755456E 03	-3.3286177E 03	3.1317341E 03	3.1836165E 03	-3.2755456E 03	-3.3286177E 03
3.1317341E 03	3.1836166E 03	-3.2755456E 03	-3.3286178E 03	3.1317340E 03	3.1836165E 03	-3.2755455E 03	-3.3286177E 03
3.1317340E 03	3.1836165E 03	-3.2755455E 03	-3.3286177E 03	3.1317342E 03	3.1836167E 03	-3.2755457E 03	-3.3286179E 03
3.1317339E 03	3.1836164E 03	-3.2755454E 03	-3.3286175E 03	3.1317342E 03	3.1836167E 03	-3.2755457E 03	-3.3286179E 03
3.1317342E 03	3.1836167E 03	-3.2755457E 03	-3.3286179E 03	3.1317339E 03	3.1836164E 03	-3.2755454E 03	-3.3286175E 03
3.1317342E 03	3.1836167E 03	-3.2755457E 03	-3.3286179E 03	3.1317342E 03	3.1836167E 03	-3.2755457E 03	-3.3286179E 03
3.1317336E 03	3.1836160E 03	-3.2755450E 03	-3.3286172E 03	3.1317342E 03	3.1836167E 03	-3.2755457E 03	-3.3286179E 03
3.1317342E 03	3.1836167E 03	-3.2755457E 03	-3.3286179E 03	3.1317342E 03	3.1836167E 03	-3.2755457E 03	-3.3286179E 03
3.1317342E 03	3.1836167E 03	-3.2755457E 03	-3.3286179E 03	3.1317342E 03	3.1836167E 03	-3.2755457E 03	-3.3286179E 03
3.1317336E 03	3.1836160E 03	-3.2755450E 03	-3.3286172E 03	3.1317342E 03	3.1836167E 03	-3.2755457E 03	-3.3286179E 03

SHELL RESPONSE TO RANDOM PRESSURE EXCITATION
NAS 1-3179 06/12/65

CODE = 2 N = 19 M = 8 PHI2T

1	1.8009200E 02	6.2189218E 02	1.0736717E 03	1.2720694E 03	1.0979545E 03	6.5033562E 02	1.9259321E 02	6.7002733E 02
2	1.8009200E 02	6.2189218E 02	1.0736717E 03	1.2720694E 03	1.0979545E 03	6.5033562E 02	1.9259321E 02	6.7002733E 02
3	6.1487430E 02	1.2437873E 03	6.2895342E 02	1.0857614E-09	6.4315478E 02	1.3006694E 03	6.5755261E 02	1.2379206E 03
4	6.1487430E 02	1.2437873E 03	6.2895342E 02	1.0857614E-09	6.4315478E 02	1.3006694E 03	6.5755261E 02	1.2379206E 03
5	1.0496615E 03	6.2189801E 02	1.8420379E 02	1.2720694E 03	1.8838916E 02	6.5033202E 02	1.1225071E 03	4.8132775E 02
6	1.8009200E 02	6.2189218E 02	1.0736717E 03	1.2720694E 03	1.0979545E 03	6.5033562E 02	1.9259321E 02	6.7002733E 02
7	1.0496615E 03	6.2189801E 02	1.8420379E 02	1.2720694E 03	1.8838916E 02	6.5033202E 02	1.1225071E 03	4.8132775E 02
8	1.8009200E 02	6.2189218E 02	1.0736717E 03	1.2720694E 03	1.0979545E 03	6.5033562E 02	1.9259321E 02	6.7002733E 02
9	6.1487430E 02	1.2437873E 03	6.2895342E 02	1.0857614E-09	6.4315478E 02	1.3006694E 03	6.5755261E 02	1.2379206E 03
10	1.0496615E 03	6.2189801E 02	1.8420379E 02	1.2720694E 03	1.8838916E 02	6.5033202E 02	1.1225071E 03	4.8132775E 02
11	1.0496615E 03	6.2189801E 02	1.8420379E 02	1.2720694E 03	1.8838916E 02	6.5033202E 02	1.1225071E 03	4.8132775E 02
12	6.1487430E 02	1.2437873E 03	6.2895342E 02	1.0857614E-09	6.4315478E 02	1.3006694E 03	6.5755261E 02	1.2379206E 03
13	1.0496615E 03	6.2189801E 02	1.8420379E 02	1.2720694E 03	1.8838916E 02	6.5033202E 02	1.1225071E 03	4.8132775E 02
14	6.1487430E 02	1.2437873E 03	6.2895342E 02	1.0857614E-09	6.4315478E 02	1.3006694E 03	6.5755261E 02	1.2379206E 03
15	1.8009200E 02	6.2189218E 02	1.0736717E 03	1.2720694E 03	1.0979545E 03	6.5033562E 02	1.9259321E 02	6.7002733E 02
16	1.0496615E 03	6.2189801E 02	1.8420379E 02	1.2720694E 03	1.8838916E 02	6.5033202E 02	1.1225071E 03	4.8132775E 02
17	1.0496615E 03	6.2189801E 02	1.8420379E 02	1.2720694E 03	1.8838916E 02	6.5033202E 02	1.1225071E 03	4.8132775E 02
18	1.8009200E 02	6.2189218E 02	1.0736717E 03	1.2720694E 03	1.0979545E 03	6.5033562E 02	1.9259321E 02	6.7002733E 02
19	6.1487430E 02	1.2437873E 03	6.2895342E 02	1.0857614E-09	6.4315478E 02	1.3006694E 03	6.5755261E 02	1.2379206E 03

SHELL RESPONSE TO RANDOM PRESSURE EXCITATION
NAS 1-3179 06/12/65

PSD CODE = 1 CO-SPEC. CODE = 0 FREQ. MULT. = 1.000000E 00 PSD MULT. = 1.000000E 00

KL = 4 KC = 4 KK = 2

EMPIRICAL CO-SPECTRA METHOD

LONGITUDINAL DECAY RATE	0.52999999E-01
CIRCUMFERENTIAL DECAY RATE	0.12599999E-00
AVERAGE SIZE OF AREA(LONG.)	0.12700000E 02
AVERAGE SIZE OF AREA(CIR.)	0.11000000E 02
CONVECTION VELOCITY	0.41000000E 03

PSD TBLE. ELE (1. 1) WITH 6 PTS.

FREQ.					
0.	1.800E 01	3.200E 01	1.600E 02	3.200E 02	7.000E 02
PSD					
2.000E-04	3.500E-04	1.950E-04	9.500E-05	5.000E-05	5.000E-05

PSD TBLE. ELE (2. 2) WITH 6 PTS.

FREQ.					
0.	1.800E 01	3.200E 01	1.600E 02	3.200E 02	7.000E 02
PSD					
2.000E-04	3.500E-04	1.950E-04	9.500E-05	5.000E-05	5.000E-05

PSD TBLE. ELE (3. 3) WITH 6 PTS.

FREQ.					
0.	1.800E 01	3.200E 01	1.600E 02	3.200E 02	7.000E 02
PSD					
2.000E-04	3.500E-04	1.950E-04	9.500E-05	5.000E-05	5.000E-05

PSD TBLE. ELE (4. 4) WITH 6 PTS.

FREQ.					
0.	1.950E 01	5.200E 01	1.600E 02	3.250E 02	7.000E 02
PSD					
2.750E-04	5.250E-04	9.000E-05	4.500E-05	1.000E-05	10.000E-06

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SHELL RESPONSE TO RANDOM PRESSURE EXCITATION
NAS 1-3179   06/12/65

CO- TBLE, ELE (1,1) TO BE CALCULATED

CO- TBLE, ELE (2,1) WITH 19 PTS.
 FREQ.
0.          2.000E 01   7.200E 01   9.750E 01   1.350E 02   1.500E 02   1.850E 02   2.100E 02   2.400E 02   2.700E 02
2.870E 02   3.250E 02   3.500E 02   3.900E 02   4.100E 02   4.300E 02   4.600E 02   5.000E 02   7.000E 02
 CO-SPEC.
6.700E-01   6.500E-01   0.         -2.500E-01  -5.200E-01  -5.200E-01  -2.500E-01   0.          2.200E-01   3.600E-01
3.600E-01   2.200E-01   0.         -2.000E-01  -2.600E-01  -2.600E-01  -2.000E-01   0.          0.

CO- TBLE, ELE (3,1) WITH 19 PTS.
 FREQ.
0.          2.000E 01   5.500E 01   7.000E 01   7.750E 01   1.120E 02   1.350E 02   1.400E 02   1.630E 02   1.900E 02
2.050E 02   2.150E 02   2.500E 02   2.750E 02   2.850E 02   3.350E 02   3.600E 02   3.800E 02   7.000E 02
 CO-SPEC.
5.400E-01   3.000E-01  -3.000E-01  -4.200E-01  -4.200E-01   1.200E-01   3.200E-01   3.200E-01   1.200E-01  -1.200E-01
-2.100E-01 -2.100E-01   4.000E-02   1.600E-01   1.600E-01  -1.200E-01  -1.200E-01   0.          0.

CO- TBLE, ELE (4,1) TO BE CALCULATED

CO- TBLE, ELE (1,2) WITH 13 PTS.
 FREQ.
0.          1.902E 01   2.853E 01   5.706E 01   7.608E 01   9.510E 01   1.522E 02   1.712E 02   1.997E 02   2.568E 02
3.320E 02   4.500E 02   7.000E 02
 CO-SPEC.
5.800E-01   3.800E-01   3.400E-01   3.700E-01   4.100E-01   2.500E-01   3.200E-01   1.900E-01   2.000E-01   1.000E-01
1.000E-01   0.          0.

CO- TBLE, ELE (2,2) TO BE CALCULATED

CO- TBLE, ELE (3,2) TO BE CALCULATED

CO- TBLE, ELE (4,2) TO BE CALCULATED
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SHELL RESPONSE TO RANDOM PRESSURE EXCITATION
NAS 1-3179 06/12/65

NO MODES = 19

GEN. MASSES	DMP. COEFFS	MODAL FREQS
9.034000E 01	2.000000E-02	1.720000E 02
8.308000E 01	2.000000E-02	2.150000E 02
7.860000E 01	2.000000E-02	2.480000E 02
7.974000E 01	2.000000E-02	2.770000E 02
6.661000E 01	2.000000E-02	2.800000E 02
1.092400E 02	2.000000E-02	2.880000E 02
6.685000E 01	2.000000E-02	3.130000E 02
8.057000E 01	2.000000E-02	3.360000E 02
7.769000E 01	2.000000E-02	3.370000E 02
6.602000E 01	2.000000E-02	3.480000E 02
6.707000E 01	2.000000E-02	4.060000E 02
7.829000E 01	2.000000E-02	4.150000E 02
6.496000E 01	2.000000E-02	4.380000E 02
7.767000E 01	2.000000E-02	4.640000E 02
8.029000E 01	2.000000E-02	4.690000E 02
6.756000E 01	2.000000E-02	5.070000E 02
6.431000E 01	2.000000E-02	5.080000E 02
7.795000E 01	2.000000E-02	5.290000E 02
7.377000E 01	2.000000E-02	5.320000E 02

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FREQUENCY =   0.

DARC PRGM

NORMAL COORDINATE DEFLECTION SPECTRA
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
4.0767530E-11 1.7114507E-11 4.0425515E-12 3.0947398E-12 1.9424110E-12 3.8609621E-12 8.3703386E-13 2.4898702E-12
   9    9         10   10         11   11         12   12         13   13         14   14         15   15         16   16
8.8999585E-13 1.0566310E-12 1.5407961E-13 7.1607644E-13 4.9804732E-13 1.5681598E-13 5.0643803E-13 1.3296963E-14
  17   17         18   18         19   19
5.8676862E-13 1.3702965E-12 6.2045041E-13

NORMAL COORDINATE ACCELERATION SPECTRA
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
0.            0.            0.            0.            0.            0.            0.            0.
   9    9         10   10         11   11         12   12         13   13         14   14         15   15         16   16
0.            0.            0.            0.            0.            0.            0.            0.
  17   17         18   18         19   19
0.            0.            0.

RADIAL SHELL DEFLECTION SPECTRA
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
2.3100758E-08 5.6119063E-08 7.7905315E-08 9.0568628E-08 7.9667138E-08 5.8685681E-08 2.4704191E-08 5.8530145E-08

RADIAL SHELL ACCELERATION SPECTRA
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
0.            0.            0.            0.            0.            0.            0.            0.
```

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FREQUENCY =  1.000000E 02

DARC PRGM

NORMAL COORDINATE DEFLECTION SPECTRA
   1     1          2     2          3     3          4     4          5     5          6     6          7     7          8     8
7.7117968E-12 2.3728923E-12 1.7614863E-12 1.1633486E-12 1.2772203E-12 4.0823691E-13 6.3963705E-13 2.6593522E-13
   9     9         10    10         11    11         12    12         13    13         14    14         15    15         16    16
3.7046657E-13 5.6C71584E-13 1.6257511E-13 2.2095028E-13 2.3356171E-13 7.4298844E-14 5.2365173E-14 4.7564278E-14
  17    17         18    18         19    19
2.6278124E-13 1.1997624E-13 1.8038091E-13

NORMAL COORDINATE ACCELERATION SPECTRA
   1     1          2     2          3     3          4     4          5     5          6     6          7     7          8     8
8.0528539E-06 2.4778344E-06 1.8393887E-06 1.2147981E-06 1.3337058E-06 4.2629136E-07 6.6792525E-07 2.7769631E-07
   9     9         10    10         11    11         12    12         13    13         14    14         15    15         16    16
3.8685060E-07 5.8551372E-07 1.6976506E-07 2.3072189E-07 2.4389107E-07 7.7584739E-08 5.4681043E-08 4.9667826E-08
  17    17         18    18         19    19
2.7440285E-C7 1.2528224E-07 1.8835832E-07

RADIAL SHELL DEFLECTION SPECTRA
   1     1          2     2          3     3          4     4          5     5          6     6          7     7          8     8
7.6294509E-09 1.3468423E-08 1.4694778E-08 1.7955587E-08 1.5027096E-08 1.4084378E-08 8.1589856E-09 1.3524891E-08

RADIAL SHELL ACCELERATION SPECTRA
   1     1          2     2          3     3          4     4          5     5          6     6          7     7          8     8
7.9668663E-03 1.4064069E-02 1.5344660E-02 1.8749680E-02 1.5691675E-02 1.4707265E-02 8.5198200E-03 1.4123035E-02
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FREQUFNCY = 1.500000E 02

DARC PRGM

NORMAL COORDINATE DEFLECTION SPECTRA

1 1	2 2	3 3	4 4	5 5	6 6	7 7	8 8
2.9905711F-11	2.7189114F-12	1.2910120E-12	7.6466256E-13	1.1118700E-12	3.1593123E-13	4.9702096E-13	1.5679198E-13
9 9	10 10	11 11	12 12	13 13	14 14	15 15	16 16
1.9134656F-13	4.1848382F-13	1.0732771F-13	1.1461640E-13	1.5927377E-13	3.0994551E-14	2.3842809E-14	2.8391750E-14
17 17	18 18	19 19					
1.7267416E-13	7.0735962F-14	8.8026892E-14					

NORMAL COORDINATE ACCELERATION SPECTRA

1 1	2 2	3 3	4 4	5 5	6 6	7 7	8 8
1.5809329E-04	1.4373229F-05	6.8247944E-06	4.0423054E-06	5.8777796E-06	1.6701361E-06	2.6274472E-06	8.2886370E-07
9 9	10 10	11 11	12 12	13 13	14 14	15 15	16 16
1.0115328F-06	2.2122691F-06	5.6737626E-07	6.0590711E-07	8.4198345E-07	1.6384932E-07	1.2604242E-07	1.5008989E-07
17 17	18 18	19 19					
9.1282313F-07	3.7393796E-07	4.6534458E-07					

RADIAL SHELL DEFLECTION SPECTRA

1 1	2 2	3 3	4 4	5 5	6 6	7 7	8 8
1.0121842E-08	2.5278870E-08	3.7657042E-08	4.5396295E-08	3.8508703E-08	2.6435012E-08	1.0824405E-08	2.6511286E-08

RADIAL SHELL ACCELERATION SPECTRA

1 1	2 2	3 3	4 4	5 5	6 6	7 7	8 8
5.3508016E-02	1.3363400E-01	1.9906985E-01	2.3998257E-01	2.0357206E-01	1.3974581E-01	5.7222036E-02	1.4014903E-01

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FREQUENCY =  1.55000CE 02

DARC PRGM

NORMAL COORDINATE DEFLECTION SPECTRA
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
4.4658449E-11 2.9368074E-12 1.3690879E-12 7.8054793E-13 1.0676674E-12 3.0815109E-13 4.7360930E-13 1.5705481E-13
   9    9         10   10         11   11         12   12         13   13         14   14         15   15         16   16
1.9891999E-13 3.9062125E-13 1.0135554E-13 1.1187158E-13 1.4639704E-13 3.3021192E-14 2.435C967E-14 2.6990141E-14
  17   17         18   18         19   19
1.5778920E-13 6.6195583E-14 8.4949576E-14

NORMAL COORDINATE ACCELERATION SPECTRA
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
2.6916878E-04 1.7700947E-05 8.2518698E-06 4.7045774E-06 6.4351253E-06 1.8573115E-06 2.8545737E-06 9.4661261E-07
   9    9         10   10         11   11         12   12         13   13         14   14         15   15         16   16
1.1989456E-06 2.3543819E-06 6.1089776E-07 6.7428082E-07 8.8237530E-07 1.9902782E-07 1.4676999E-07 1.6267701E-07
  17   17         18   18         19   19
9.5103899E-07 3.9897901E-07 5.1201449E-07

RADIAL SHELL DEFLECTION SPECTRA
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
1.2738852E-08 3.4622146E-08 5.3755603E-08 6.4259140E-08 5.4971354E-08 3.6205620E-08 1.3623078E-08 3.6592406E-08

RADIAL SHELL ACCELERATION SPECTRA
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
7.6780571E-02 2.0867721E-01 3.2399983E-01 3.8730753E-01 3.3132749E-01 2.1822125E-01 8.2110044E-02 2.2055251E-01
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  FREQUENCY =  1.600000E 02

  DARC PRGM

  NORMAL COORDINATE DEFLECTION SPECTRA
    1     1          2     2          3     3          4     4          5     5          6     6          7     7          8     8
7.4381772E-11 3.0883953E-12 1.4204202E-12 7.7411148E-13 1.0093665E-12 2.8531309E-13 4.4639291E-13 1.5333672E-13
    9     9         10    10         11    11         12    12         13    13         14    14         15    15         16    16
2.0263955E-13 3.5691949E-13 9.5355766E-14 1.0551428E-13 1.3133743E-13 3.4645078E-14 2.4653280E-14 2.5845731E-14
   17    17         18    18         19    19
1.4059990E-13 5.8552229E-14 7.9112923E-14

  NORMAL COORDINATE ACCELERATION SPECTRA
    1     1          2     2          3     3          4     4          5     5          6     6          7     7          8     8
5.0902687E-04 2.1135235E-05 9.7205544E-06 5.2975822E-06 6.9075345E-06 1.9525218E-06 3.0548612E-06 1.0493500E-06
    9     9         10    10         11    11         12    12         13    13         14    14         15    15         16    16
1.3867507E-06 2.4425556E-06 6.5256105E-07 7.2208018E-07 8.9879925E-07 2.3709137E-07 1.6871313E-07 1.7687360E-07
   17    17         18    18         19    19
9.6718636E-07 4.0069841E-07 5.4140419E-07

  RADIAL SHELL DEFLECTION SPECTRA
    1     1          2     2          3     3          4     4          5     5          6     6          7     7          8     8
1.7969883E-08 5.3128718E-08 8.5789763E-08 1.0201721E-07 8.7730011E-08 5.5558628E-08 1.9217228E-08 5.6557453E-08

  RADIAL SHELL ACCELERATION SPECTRA
    1     1          2     2          3     3          4     4          5     5          6     6          7     7          8     8
1.2297574E-01 3.6358297E-01 5.8709673E-01 6.9814823E-01 6.0037468E-01 3.8021190E-01 1.3151186E-01 3.8704729E-01
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FREQUENCY =  1.650000E 02

DARC PRGM

NORMAL COORDINATE DEFLECTION SPECTRA
  1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
1.6811026E-10 3.3768046E-12 1.5182802E-12 7.8939855E-13 9.7810689E-13 2.7021351E-13 4.3102520E-13 1.5339757E-13
  9    9         10   10         11   11         12   12         13   13         14   14         15   15         16   16
2.1103647E-13 3.3333764E-13 9.1831709E-14 1.0203647E-13 1.2027880E-13 3.6842025E-14 2.5431818E-14 2.5313579E-14
 17   17         18   18         19   19
1.2783673E-13 5.2800898E-14 7.5506732E-14

NORMAL COORDINATE ACCELERATION SPECTRA
  1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
1.3011407E-03 2.6135810E-05 1.1751193E-05 6.1097911E-06 7.5703569E-06 2.0914000E-06 3.3360511E-06 1.1872673E-06
  9    9         10   10         11   11         12   12         13   13         14   14         15   15         16   16
1.6333812E-06 2.5799684E-06 7.1075954E-07 7.8974243E-07 9.3093445E-07 2.8515009E-07 1.9683732E-07 1.9592217E-07
 17   17         18   18         19   19
9.8943141E-07 4.0866867E-07 5.8440741E-07

RADIAL SHELL DEFLECTION SPECTRA
  1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
3.4866740E-08 1.1166874E-07 1.8676686E-07 2.2146300E-07 1.9099085E-07 1.1677609E-07 3.7286993E-08 1.1963513E-07

RADIAL SHELL ACCELERATION SPECTRA
  1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
2.6986178E-01 8.6429430E-01 1.4455391E 00 1.7140805E 00 1.4782320E 00 9.0382419E-01 2.8859406E-01 9.2595261E-01
```

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FREQUENCY =  1.700000E 02

DARC PRGM

NORMAL COORDINATE DEFLECTION SPECTRA
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
5.6610497E-10 3.7542095E-12 1.6305616E-12 8.0686338E-13 9.4927363E-13 2.5508691E-13 4.1654094E-13 1.5328633E-13
   9    9         10   10         11   11         12   12         13   13         14   14         15   15         16   16
2.1901693E-13 3.1082822E-13 8.8428489E-14 9.8598453E-14 1.0982780E-13 3.8761191E-14 2.6073402E-14 2.4765931E-14
  17   17         18   18         19   19
1.1583868E-13 4.7286761E-14 7.1976967E-14

NORMAL COORDINATE ACCELERATION SPECTRA
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
4.9372703E-03 3.2742244E-05 1.4220903E-05 7.0370389E-06 8.2790662E-06 2.2247341E-06 3.6328514E-06 1.3368829E-06
   9    9         10   10         11   11         12   12         13   13         14   14         15   15         16   16
1.9101507E-06 2.7108805E-06 7.7122685E-07 8.5992392E-07 9.5786039E-07 3.3805475E-07 2.2739852E-07 2.1599545E-07
  17   17         18   18         19   19
1.0102841E-06 4.1241030E-07 6.2774531E-07

RADIAL SHELL DEFLECTION SPECTRA
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
1.0659152E-07 3.5950839E-07 6.1453258E-07 7.2807704E-07 6.2843111E-07 3.7595116E-07 1.1399060E-07 3.8666170E-07

RADIAL SHELL ACCELERATION SPECTRA
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
9.2963526E-01 3.1354434E 00 5.3596305E 00 6.3499057E 00 5.4808462E 00 3.2788486E 00 9.9416614E-01 3.3722603E 00
```

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FREQUENCY =  1.720000E 02

DARC PRGM

NORMAL COORDINATE DEFLECTION SPECTRA
  1    1           2    2           3    3           4    4           5    5           6    6           7    7           8    8
7.2346991E-10 3.9902278E-12 1.6916337E-12 8.2186900E-13 9.4329169E-13 2.5403251E-13 4.1222804E-13 1.5430519E-13
  9    9          10   10          11   11          12   12          13   13          14   14          15   15          16   16
2.2289382E-13 3.0412934E-13 8.7107933E-14 9.8241210E-14 1.0660954E-13 3.9438998E-14 2.6299098E-14 2.4455535E-14
 17   17          18   18          19   19
1.1211673E-13 4.6098267E-14 7.1349424E-14

NORMAL COORDINATE ACCELERATION SPECTRA
  1    1           2    2           3    3           4    4           5    5           6    6           7    7           8    8
6.6119342E-03 3.6467478E-05 1.5460174E-05 7.5112229E-06 8.6209288E-06 2.3216532E-06 3.7674334E-06 1.4102256E-06
  9    9          10   10          11   11          12   12          13   13          14   14          15   15          16   16
2.0370706E-06 2.7794980E-06 7.9609657E-07 8.9784579E-07 9.7432556E-07 3.6044078E-07 2.4035264E-07 2.2350396E-07
 17   17          18   18          19   19
1.0246569E-06 4.2130115E-07 6.5207645E-07

RADIAL SHELL DEFLECTION SPECTRA
  1    1           2    2           3    3           4    4           5    5           6    6           7    7           8    8
1.3499614E-07 4.5760173E-07 7.8378856E-07 9.2852260E-07 8.0151509E-07 4.7853097E-07 1.4436694E-07 4.9234420E-07

RADIAL SHELL ACCELERATION SPECTRA
  1    1           2    2           3    3           4    4           5    5           6    6           7    7           8    8
1.2337563E 00 4.1821124E 00 7.1631982E 00 8.4859512E 00 7.3252046E 00 4.3733889E 00 1.3193980E 00 4.4996308E 00
```

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FREQUENCY =  1.740000E 02

DARC PRGM

NORMAL COORDINATE DEFLECTION SPECTRA
   1      1          2      2          3      3          4      4          5      5          6      6          7      7          8      8
5.2949566E-10 4.3384491E-12 1.7740617E-12 8.4863423E-13 9.4503936E-13 2.6049194E-13 4.0988171E-13 1.5690733E-13
   9      9         10     10         11     11         12     12         13     13         14     14         15     15         16     16
2.2793729E-13 3.0053558E-13 8.5816922E-14 9.9372641E-14 1.0462971E-13 4.0064208E-14 2.6507674E-14 2.4018110E-14
  17     17         18     18         19     19
1.0975371E-13 4.6307845E-14 7.1845396E-14

NORMAL COORDINATE ACCELERATION SPECTRA
   1      1          2      2          3      3          4      4          5      5          6      6          7      7          8      8
5.0681987E-03 4.1526539E-05 1.6980870E-05 8.1229125E-06 9.0456781E-06 2.4933631E-06 3.9232843E-06 1.5018774E-06
   9      9         10     10         11     11         12     12         13     13         14     14         15     15         16     16
2.1817582E-06 2.8766507E-06 8.2141792E-07 9.5116981E-07 1.0014891E-06 3.8348448E-07 2.5372476E-07 2.2989528E-07
  17     17         18     18         19     19
1.0505348E-06 4.4324700E-07 6.8768598E-07

RADIAL SHELL DEFLECTION SPECTRA
   1      1          2      2          3      3          4      4          5      5          6      6          7      7          8      8
1.0018821E-07 3.3733162E-07 5.7597933E-07 6.8221586E-07 5.8900594E-07 3.5276009E-07 1.0714280E-07 3.6275516E-07

RADIAL SHELL ACCELERATION SPECTRA
   1      1          2      2          3      3          4      4          5      5          6      6          7      7          8      8
9.5897623E-01 3.2288531E 00 5.5131287E 00 6.5299979E 00 5.6378161E 00 3.3765305E 00 1.0255438E 00 3.4722008E 00
```

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FREQUENCY =  1.790000E 02

DARC PRGM

NORMAL COORDINATE DEFLECTION SPECTRA
  1      1            2      2            3      3            4      4            5      5            6      6            7      7            8      8
1.3334315E-10 5.4457036E-12 2.0004959E-12 9.1805257E-13 9.5306261E-13 2.7725522E-13 4.0500240E-13 1.6329350E-13
  9      9           10     10           11     11           12     12           13     13           14     14           15     15           16     16
2.3990360E-13 2.9229755E-13 8.2740401E-14 1.0185006E-13 9.9969187E-14 4.1393766E-14 2.6956426E-14 2.2961437E-14
 17     17           18     18           19     19
1.0417774E-13 4.6698394E-14 7.2788986E-14

NORMAL COORDINATE ACCELERATION SPECTRA
  1      1            2      2            3      3            4      4            5      5            6      6            7      7            8      8
1.4294767E-03 5.8379499E-05 2.1445888E-05 9.8417859E-06 1.0217104E-05 2.9722552E-06 4.3417414E-06 1.7505530E-06
  9      9           10     10           11     11           12     12           13     13           14     14           15     15           16     16
2.5718352E-06 3.1335133E-06 8.8700075E-07 1.0918618E-06 1.0716982E-06 4.4375300E-07 2.8898059E-07 2.4615317E-07
 17     17           18     18           19     19
1.1168151E-06 5.0062012E-07 7.8031873E-07

RADIAL SHELL DEFLECTION SPECTRA
  1      1            2      2            3      3            4      4            5      5            6      6            7      7            8      8
2.9219806E-08 9.2047666E-08 1.5204921E-07 1.7969667E-07 1.5548799E-07 9.6257606E-08 3.1248072E-08 9.8457694E-08

RADIAL SHELL ACCELERATION SPECTRA
  1      1            2      2            3      3            4      4            5      5            6      6            7      7            8      8
3.1324467E-01 9.8677728E-01 1.6300110E 00 1.9263996E 00 1.6668757E 00 1.0319090E 00 3.3498827E-01 1.0554946E 00
```

FREQUENCY = 1.840000E 02

DARC PRGM

NORMAL COORDINATE DEFLECTION SPECTRA

1	2	3	4	5	6	7	8
5.0247141E-11	7.0658571E-12	2.2626926E-12	9.9157754E-13	9.6734629E-13	2.9506712E-13	4.0177754E-13	1.6953223E-13

9	10	11	12	13	14	15	16
2.5090616E-13	2.8526852E-13	7.9909318E-14	1.0380782E-13	9.5757954E-14	4.2387904E-14	2.7304621E-14	2.1964658E-14

17	18	19
9.9108641E-14	4.6904244E-14	7.3303778E-14

NORMAL COORDINATE ACCELERATION SPECTRA

1	2	3	4	5	6	7	8
6.0141869E-04	8.4572741E-05	2.7082647E-05	1.1868402E-05	1.1578373E-05	3.5317209E-06	4.8089605E-06	2.0291672E-06

9	10	11	12	13	14	15	16
3.0031490E-06	3.4144394E-06	9.5645154E-07	1.2424978E-06	1.1461472E-06	5.0734980E-07	3.2681480E-07	2.6289965E-07

17	18	19
1.1862523E-06	5.6140683E-07	8.7738844E-07

RADIAL SHELL DEFLECTION SPECTRA

1	2	3	4	5	6	7	8
1.4756883E-08	4.1823692E-08	6.4815896E-08	7.6073482E-08	6.6281755E-08	4.3736542E-08	1.5781195E-08	4.4312274E-08

RADIAL SHELL ACCELERATION SPECTRA

1	2	3	4	5	6	7	8
1.7662826E-01	5.0059663E-01	7.7579519E-01	9.1053963E-01	7.9334037E-01	5.2349194E-01	1.8888846E-01	5.3038300E-01

FREQUENCY = 1.890000E 02

DARC PRGM

NORMAL COORDINATE DEFLECTION SPECTRA

1 1	2 2	3 3	4 4	5 5	6 6	7 7	8 8
2.5518405E-11	9.8038853E-12	2.5797024E-12	1.0731815E-12	9.8527850E-13	3.2062784E-13	3.9871927E-13	1.7957260E-13
9 9	10 10	11 11	12 12	13 13	14 14	15 15	16 16
2.6172110E-13	2.7851740E-13	7.6971654E-14	1.0552846E-13	9.1682628E-14	4.3191183E-14	2.8197978E-14	2.0918756E-14
17 17	18 18	19 19					
9.4221982E-14	4.7889879E-14	7.3595175E-14					

NORMAL COORDINATE ACCELERATION SPECTRA

1 1	2 2	3 3	4 4	5 5	6 6	7 7	8 8
3.4001260E-04	1.3062903E-04	3.4372497E-05	1.4299295E-05	1.3128058E-05	4.2721128E-06	5.3126193E-06	2.3926631E-06
9 9	10 10	11 11	12 12	13 13	14 14	15 15	16 16
3.4872269E-06	3.7110243E-06	1.0255865E-06	1.4060833E-06	1.2215986E-06	5.7548839E-07	3.7571578E-07	2.7872590E-07
17 17	18 18	19 19					
1.2554335E-06	6.3809481E-07	9.8059756E-07					

RADIAL SHELL DEFLECTION SPECTRA

1 1	2 2	3 3	4 4	5 5	6 6	7 7	8 8
1.1051698E-08	2.8680898E-08	4.1503733E-08	4.8141322E-08	4.2442344E-08	2.9992635E-08	1.1818811E-08	3.0111017E-08

RADIAL SHELL ACCELERATION SPECTRA

1 1	2 2	3 3	4 4	5 5	6 6	7 7	8 8
1.4725515E-01	3.8215031E-01	5.5300446E-01	6.4144509E-01	5.6551071E-01	3.9962817E-01	1.5747632E-01	4.0120552E-01

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FREQUENCY =  1.940000E 02

DARC PRGM

NORMAL COORDINATE DEFLECTION SPECTRA
   1      1             2     2             3     3             4     4             5     5             6     6             7     7             8     8
1.5298209E-11 1.4706353E-11 2.9376990E-12 1.1520335E-12 1.0042076E-12 3.5299810E-13 3.9442310E-13 1.9233422E-13
   9      9            10    10            11    11            12    12            13    13            14    14            15    15            16    16
2.6916844E-13 2.7120025E-13 7.3635075E-14 1.0586565E-13 8.7477674E-14 4.3263616E-14 2.9407706E-14 1.9739160E-14
  17     17            18    18            19    19
8.9249254E-14 4.9303315E-14 7.2883031E-14

NORMAL COORDINATE ACCELERATION SPECTRA
   1      1             2     2             3     3             4     4             5     5             6     6             7     7             8     8
2.2627771E-04 2.1752349E-04 4.3451869E-05 1.7039870E-05 1.4853360E-05 5.2212387E-06 5.8339610E-06 2.8448392E-06
   9      9            10    10            11    11            12    12            13    13            14    14            15    15            16    16
3.9813038E-06 4.0113566E-06 1.0891455E-06 1.5658719E-06 1.2938931E-06 6.3991750E-07 4.3497301E-07 2.9196436E-07
  17     17            18    18            19    19
1.3200568E-06 7.2925143E-07 1.0780219E-06

RADIAL SHELL DEFLECTION SPECTRA
   1      1             2     2             3     3             4     4             5     5             6     6             7     7             8     8
1.0368924E-08 2.5951810E-08 3.6123589E-08 4.1429437E-08 3.6940509E-08 2.7138725E-08 1.1088640E-08 2.7126551E-08

RADIAL SHELL ACCELERATION SPECTRA
   1      1             2     2             3     3             4     4             5     5             6     6             7     7             8     8
1.5336804E-01 3.8385644E-01 5.3430848E-01 6.1278794E-01 5.4639165E-01 4.0141224E-01 1.6401344E-01 4.0123217E-01
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FREQUENCY =  1.990000E 02

DARC PRGM

NORMAL COORDINATE DEFLECTION SPECTRA
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
1.0057829E-11 2.4300962E-11 3.3748009E-12 1.2360959E-12 1.0312102E-12 3.8861598E-13 3.9163469E-13 2.0526081E-13
   9    9         10   10         11   11         12   12         13   13         14   14         15   15         16   16
2.7508895E-13 2.6492989E-13 7.0481279E-14 1.0551979E-13 8.3644599E-14 4.2954588E-14 3.0494963E-14 1.8606968E-14
  17   17         18   18         19   19
8.4696178E-14 5.0489569E-14 7.1674380E-14

NORMAL COORDINATE ACCELERATION SPECTRA
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
1.6470652E-04 3.9795139E-04 5.5265577E-05 2.0242247E-05 1.6887048E-05 6.3639566E-06 6.4133909E-06 3.3613411E-06
   9    9         10   10         11   11         12   12         13   13         14   14         15   15         16   16
4.5048434E-06 4.3384792E-06 1.1541980E-06 1.7279871E-06 1.3697599E-06 7.0342226E-07 4.9938405E-07 3.0470681E-07
  17   17         18   18         19   19
1.3869805E-06 8.2681476E-07 1.1737362E-06

RADIAL SHELL DEFLECTION SPECTRA
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
1.1490716E-08 2.9347816E-08 4.1184472E-08 4.7039669E-08 4.2115841E-08 3.0690050E-08 1.2288300E-08 3.0730771E-08

RADIAL SHELL ACCELERATION SPECTRA
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
1.8817141E-01 4.8059842E-01 6.7443494E-01 7.7031935E-01 6.8968699E-01 5.0257878E-01 2.0123261E-01 5.0324563E-01
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FREQUENCY =  5.520000E 02

DARC PRGM

NORMAL COORDINATE DEFLECTION SPECTRA
   1     1             2     2             3     3             4     4             5     5             6     6             7     7             8     8
1.0576287E-15 1.4798450E-15 1.5161350E-15 1.6875438E-15 1.6232337E-15 1.0753047E-15 1.7941055E-15 2.9684083E-15
   9     9            10    10            11    11            12    12            13    13            14    14            15    15            16    16
2.4684510E-15 2.6441061E-15 3.5378852E-15 5.1725320E-15 7.4211518E-15 1.0806884E-14 1.5444730E-14 2.5556476E-14
  17    17            18    18            19    19
8.6350157E-14 2.7196107E-13 3.3801177E-13

NORMAL COORDINATE ACCELERATION SPECTRA
   1     1             2     2             3     3             4     4             5     5             6     6             7     7             8     8
1.0253775E-06 1.4347188E-06 1.4699022E-06 1.6360841E-06 1.5737351E-06 1.0425145E-06 1.7393963E-06 2.8778900E-06
   9     9            10    10            11    11            12    12            13    13            14    14            15    15            16    16
2.3931784E-06 2.5634770E-06 3.4300013E-06 5.0148014E-06 7.1948522E-06 1.0477340E-05 1.4973761E-05 2.4777161E-05
  17    17            18    18            19    19
8.2747501E-05 2.6366793E-04 3.2770448E-04

RADIAL SHELL DEFLECTION SPECTRA
   1     1             2     2             3     3             4     4             5     5             6     6             7     7             8     8
4.0837260E-10 7.0973048E-10 5.6542163E-10 5.3670401E-10 5.7820357E-10 7.4218837E-10 4.3671654E-10 7.0378881E-10

RADIAL SHELL ACCELERATION SPECTRA
   1     1             2     2             3     3             4     4             5     5             6     6             7     7             8     8
3.9591974E-01 6.8808806E-01 5.4817975E-01 5.2033783E-01 5.6057191E-01 7.1955618E-01 4.2339937E-01 6.8232756E-01
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FREQUENCY =  5.550000E 02

DARC PRGM

NORMAL COORDINATE DEFLECTION SPECTRA
   1      1          2      2          3      3          4      4          5      5          6      6          7      7          8      8
1.0315341E-15 1.4412214E-15 1.4788125E-15 1.6412399E-15 1.5538239E-15 1.0427409E-15 1.7168013E-15 2.8658977E-15
   9      9         10     10         11     11         12     12         13     13         14     14         15     15         16     16
2.3932538E-15 2.5095327E-15 3.3443300E-15 4.9251912E-15 6.8831377E-15 1.0102745E-14 1.4304091E-14 2.2322511E-14
  17     17         18     18         19     19
7.3532814E-14 2.1990196E-13 2.6882591E-13

NORMAL COORDINATE ACCELERATION SPECTRA
   1      1          2      2          3      3          4      4          5      5          6      6          7      7          8      8
1.0219973E-06 1.4278970E-06 1.4651406E-06 1.6260663E-06 1.5394585E-06 1.0331005E-06 1.7009292E-06 2.8394019E-06
   9      9         10     10         11     11         12     12         13     13         14     14         15     15         16     16
2.3711277E-06 2.4863316E-06 3.3134110E-06 4.8796567E-06 6.8195018E-06 1.0009343E-05 1.4171847E-05 2.2116135E-05
  17     17         18     18         19     19
7.2852988E-05 2.1786892E-04 2.6634056E-04

RADIAL SHELL DEFLECTION SPECTRA
   1      1          2      2          3      3          4      4          5      5          6      6          7      7          8      8
3.3867053E-10 5.7909798E-10 4.6091598E-10 4.4834135E-10 4.7133567E-10 6.0558164E-10 3.6217659E-10 5.7325646E-10

RADIAL SHELL ACCELERATION SPECTRA
   1      1          2      2          3      3          4      4          5      5          6      6          7      7          8      8
3.3553945E-01 5.7374411E-01 4.5665472E-01 4.4419634E-01 4.6697809E-01 5.9998292E-01 3.5882820E-01 5.6795658E-01
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FREQUENCY =  5.580000E 02

DARC PRGM

NORMAL COORDINATE DEFLECTION SPECTRA
   1     1          2     2          3     3          4     4          5     5          6     6          7     7          8     8
1.0049742E-15 1.4021091E-15 1.4408631E-15 1.5947531E-15 1.4869606E-15 1.0101645E-15 1.6422811E-15 2.7645799E-15
   9     9         10    10         11    11         12    12         13    13         14    14         15    15         16    16
2.3179453E-15 2.3817544E-15 3.1614022E-15 4.6889271E-15 6.3898506E-15 9.4495405E-15 1.3262583E-14 1.9612444E-14
  17    17         18    18         19    19
6.3776977E-14 1.8050199E-13 2.1746931E-13

NORMAL COORDINATE ACCELERATION SPECTRA
   1     1          2     2          3     3          4     4          5     5          6     6          7     7          8     8
1.0173865E-06 1.4194264E-06 1.4586589E-06 1.6144497E-06 1.5053258E-06 1.0226409E-06 1.6625647E-06 2.7987249E-06
   9     9         10    10         11    11         12    12         13    13         14    14         15    15         16    16
2.3465739E-06 2.4111711E-06 3.2004482E-06 4.7468393E-06 6.4687707E-06 9.5662504E-06 1.3426387E-05 1.9854674E-05
  17    17         18    18         19    19
6.4564677E-05 1.8273134E-04 2.2015525E-04

RADIAL SHELL DEFLECTION SPECTRA
   1     1          2     2          3     3          4     4          5     5          6     6          7     7          8     8
2.8505111E-10 4.8030150E-10 3.8184961E-10 3.7958305E-10 3.9048208E-10 5.0226689E-10 3.0483556E-10 4.7469639E-10

RADIAL SHELL ACCELERATION SPECTRA
   1     1          2     2          3     3          4     4          5     5          6     6          7     7          8     8
2.8857173E-01 4.8623363E-01 3.8556578E-01 3.8427122E-01 3.9530486E-01 5.0847031E-01 3.0860054E-01 4.8055930E-01
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FREQUENCY =  5.610000E 02

DARC PRGM

NORMAL COORDINATE DEFLECTION SPECTRA
   1   1          2   2          3   3          4   4          5   5          6   6          7   7          8   8
9.7304849E-16 1.3626444E-15 1.4022991E-15 1.5480766E-15 1.4229397E-15 9.7766680E-16 1.5708135E-15 2.6646407E-15
   9   9         10  10         11  11         12  12         13  13         14  14         15  15         16  16
2.2425398E-15 2.2610729E-15 2.9889702E-15 4.4628512E-15 5.9387387E-15 8.8417321E-15 1.2309277E-14 1.7323320E-14
  17  17         18  18         19  19
5.5664752E-14 1.5012738E-13 1.7859970E-13

NORMAL COORDINATE ACCELERATION SPECTRA
   1   1          2   2          3   3          4   4          5   5          6   6          7   7          8   8
1.0115936E-06 1.4093804E-06 1.4503952E-06 1.6011726E-06 1.4717438E-06 1.0111988E-06 1.6246894E-06 2.7560326E-06
   9   9         10  10         11  11         12  12         13  13         14  14         15  15         16  16
2.3194545E-06 2.3386232E-06 3.0914860E-06 4.6159182E-06 6.1424257E-06 9.1449862E-06 1.2731461E-05 1.7917476E-05
  17  17         18  18         19  19
5.7573944E-05 1.5527646E-04 1.8472532E-04

RADIAL SHELL DEFLECTION SPECTRA
   1   1          2   2          3   3          4   4          5   5          6   6          7   7          8   8
2.4302067E-10 4.0409709E-10 3.2084954E-10 3.2512855E-10 3.2810312E-10 4.2257743E-10 2.5988789E-10 3.9879409E-10

RADIAL SHELL ACCELERATION SPECTRA
   1   1          2   2          3   3          4   4          5   5          6   6          7   7          8   8
2.5135580E-01 4.1795683E-01 3.3185405E-01 3.3627982E-01 3.3935641E-01 4.3707101E-01 2.6880153E-01 4.1247194E-01
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FREQUENCY =  5.640000E 02

DARC PRGM

NORMAL COORDINATE DEFLECTION SPECTRA
   1     1           2     2           3     3           4     4           5     5           6     6           7     7           8     8
9.5085025E-16 1.3229524E-15 1.3631448E-15 1.5012138E-15 1.3619833E-15 9.4532920E-16 1.5025950E-15 2.5662426E-15
   9     9          10    10          11    11          12    12          13    13          14    14          15    15          16    16
2.1670732E-15 2.1476588E-15 2.8268160E-15 4.2462050E-15 5.5272059E-15 8.2746346E-15 1.1434755E-14 1.5375965E-14
  17    17          18    18          19    19
4.8876114E-14 1.2630808E-13 1.4862346E-13

NORMAL COORDINATE ACCELERATION SPECTRA
   1     1           2     2           3     3           4     4           5     5           6     6           7     7           8     8
1.0046685E-06 1.3978317E-06 1.4402990E-06 1.5861827E-06 1.4390717E-06 9.9883497E-07 1.5876421E-06 2.7114923E-06
   9     9          10    10          11    11          12    12          13    13          14    14          15    15          16    16
2.2897299E-06 2.2692165E-06 2.9868142E-06 4.4865407E-06 5.8400465E-06 8.7429801E-06 1.2081964E-05 1.6246247E-05
  17    17          18    18          19    19
5.1642510E-05 1.3345714E-04 1.5703557E-04

RADIAL SHELL DEFLECTION SPECTRA
   1     1           2     2           3     3           4     4           5     5           6     6           7     7           8     8
2.0949845E-10 3.4421703E-10 2.7291657E-10 2.8131376E-10 2.7908660E-10 3.5995889E-10 2.2403898E-10 3.3924004E-10

RADIAL SHELL ACCELERATION SPECTRA
   1     1           2     2           3     3           4     4           5     5           6     6           7     7           8     8
2.2135609E-01 3.6369976E-01 2.8836369E-01 2.9723615E-01 2.9488294E-01 3.8033261E-01 2.3671962E-01 3.5844108E-01
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FREQUENCY =  5.650000E 02

DARC PRGM

NORMAL COORDINATE DEFLECTION SPECTRA
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
9.4173890E-16 1.3096914E-15 1.3499690E-15 1.4855544E-15 1.3423722E-15 9.3459816E-16 1.4806013E-15 2.5338103E-15
   9    9         10   10         11   11         12   12         13   13         14   14         15   15         16   16
2.1419148E-15 2.1114811E-15 2.7745989E-15 4.1759670E-15 5.3983684E-15 8.0939416E-15 1.1159309E-14 1.4791719E-14
  17   17         18   18         19   19
4.6862783E-14 1.1951344E-13 1.4016114E-13

NORMAL COORDINATE ACCELERATION SPECTRA
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
1.0021173E-06 1.3936606E-06 1.4365206E-06 1.5807988E-06 1.4284367E-06 9.9451873E-07 1.5755281E-06 2.6962623E-06
   9    9         10   10         11   11         12   12         13   13         14   14         15   15         16   16
2.2792410E-06 2.2468560E-06 2.9529144E-06 4.4437038E-06 5.7444779E-06 8.6128743E-06 1.1874774E-05 1.5740071E-05
  17   17         18   18         19   19
4.9867331E-05 1.2717589E-04 1.4914739E-04

RADIAL SHELL DEFLECTION SPECTRA
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
1.9982478E-10 3.2709869E-10 2.5921497E-10 2.6860370E-10 2.6507527E-10 3.4205768E-10 2.1369388E-10 3.2223114E-10

RADIAL SHELL ACCELERATION SPECTRA
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
2.1263629E-01 3.4807021E-01 2.7583421E-01 2.8582488E-01 2.8207024E-01 3.6398828E-01 2.2739460E-01 3.4289058E-01

MEAN-SQUARE NORMAL COORDINATE DEFLECTION
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
1.1472392E-08 5.3457134E-09 1.9972329E-09 8.7386532E-10 7.0383907E-10 5.9579210E-10 2.2000951E-10 2.1105466E-10
   9    9         10   10         11   11         12   12         13   13         14   14         15   15         16   16
1.3341757E-10 1.5348502E-10 3.6813468E-11 7.5285412E-11 6.7398306E-11 3.2059650E-11 5.0348374E-11 2.1317996E-11
  17   17         18   18         19   19
1.1643144E-10 1.2943188E-10 9.8746667E-11

MEAN-SQUARE NORMAL COORDINATE ACCELERATION
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
8.1264791E-02 9.4929081E-02 5.9106933E-02 3.2354175E-02 2.5670937E-02 2.2794099E-02 7.9737490E-03 4.4869198E-03
   9    9         10   10         11   11         12   12         13   13         14   14         15   15         16   16
4.2107676E-03 3.3523036E-03 2.1712457E-03 3.3303818E-03 5.1402037E-03 7.2223434E-03 9.0577172E-03 1.0103133E-02
  17   17         18   18         19   19
3.7456935E-02 3.5698780E-02 3.6761987E-02

MEAN-SQUARE RADIAL DEFLECTION
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
6.5654225E-06 1.5886402E-05 2.1378777E-05 2.4327089E-05 2.1862242E-05 1.6612969E-05 7.0211314E-06 1.6539146E-05

MEAN-SQUARE RADIAL ACCELERATION
   1    1          2    2          3    3          4    4          5    5          6    6          7    7          8    8
2.2905408E 02 3.8935088E 02 3.7337343E 02 4.3263065E 02 3.8181627E 02 4.0715699E 02 2.4495192E 02 3.8754669E 02
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5. REFERENCES

1. Schweiker, J. W. and Davis, R. E., "Response of Complex Shell Structures to Buffeting Flows", Proposed NASA-CR.

2. Davis, R. E., "Random Pressure Excitation of Shells and Statistical Dependence Effect of Normal Mode Response", Proposed NASA-CR.

3. McMunn, J. C. and Dick, J. W., "Vibration Analysis of the Ring-Stiffened Conical Shell Gemini Adapter and the Out-of-Plane Ring Vibration Mode", McDonnell Aircraft Corporation, SDPN 236-52-7A, February 1965.

4. Weissenburger, J. T. and Davis, R. E., "Interim Report on Buffeting Flows Analysis, Fluctuating Pressure Data", McDonnell Aircraft Corporation Report A932, Vol. III, July 1964.

5. Davis, R. E., "Fluctuating Pressure Data, 32% Mercury-Atlas Configuration", McDonnell Aircraft Corporation Report B661, April 1965.