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A User's Guide for A344
A Program Using a Finite Difference Method to Analyze Transonic Flow Over Oscillating Airfoils

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16. Abstract

This document describes the design and usage of a pilot program for calculating the pressure distributions over harmonically oscillating airfoils in transonic flow. The procedure used is based on separating the velocity potential into steady and unsteady parts and linearizing the resulting unsteady differential equations for small disturbances. The steady velocity potential, which must be obtained from some other program, is required for input. The unsteady equation, as solved here, is linear with spatially varying coefficients. Since sinusoidal motion is assumed time is not a variable. The numerical solution is obtained through a finite difference formulation and either a line relaxation or an out-of-core direct solution method.

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1.0 SUMMARY

This document describes the design and usage of a pilot program for calculating pressure distributions over harmonically oscillating airfoils in transonic flow. The procedure is based on transonic small perturbation theory, in which the velocity potential is separated into steady and unsteady parts, and the resulting differential equation for the unsteady flow is linearized by assuming small disturbances. The steady velocity potential distribution, which must be obtained from some other program, is required for input. Time is not a variable in the program since harmonic motion is assumed. The differential equation for the unsteady complex velocity potential is linear, with spatially varying coefficients that are dependent on the steady velocity potential distribution. The numerical solution is obtained through a finite difference formulation and either a line relaxation solution or a full direct solution.

2.0 INTRODUCTION

This document describes the design and usage of the FORTRAN IV digital computer program A344. This pilot program was written as part of a continuing research effort to develop a method for analyzing the transonic flow about harmonically oscillating airfoils and wings.

The program uses a procedure based on small perturbation theory in which the velocity potential is separated into steady and unsteady parts. The resulting equation for the unsteady velocity potential is linearized by assuming small perturbations. The solution is obtained using finite difference techniques. Boundary conditions are applied on the outer mesh boundaries, the plane of projection of the airfoil (i.e. on the slit y=0), and over the wake (i.e. the plane vortex sheet downstream of the trailing edge). The derivation of the equations and the application of the finite difference methods are discussed in detail in references 1 through 5. The program computes the unsteady velocity potential and the resulting unsteady pressure distributions. It requires as input the potential distribution from a steady state transonic small perturbation program (e.g. ref. 6). Conservative differencing is used for subsonic points and nonconservative differencing for supersonic points and across shocks. The program uses a rectangular grid.

The solution may be obtained by using either a relaxation procedure or a direct procedure. The procedure and routines for the direct solution, which is out-of-core, is presented by Yip in reference 7.

Features of this program include options to:

- Analyze sections with or without thickness
- Use row or column relaxation, or use a direct solution
- Take advantage of antisymmetry for symmetric airfoils at zero angle-of-attack to perform the solution over half the finite difference space
- Analyze flows with either subsonic or supersonic freestreams
- Obtain the pressure distributions for vertical translation, pitch and control surface motions

A parallel program for three-dimensional flow but using only relaxation procedures is discussed in reference 8.

3.0 SYMBOLS

b	Semichord
I	Column index
IA	Index of first column aft of control surface hingeline
IMAX	Number of columns in mesh grid
I0	Index of first column aft of airfoil leading edge
I1	Index of column at trailing edge or immediately aft of trailing edge
J	Row index
JM	Index of row immediately below airfoil
JMAX	Number of rows in mesh grid
K	Transonic parameter, $(1-M^2)/(M^2\epsilon)$
M	Freestream Mach number
PHI0	Steady-state velocity potential array
PHI1	Unsteady velocity potential array
U	$= K - (\gamma + 1)(d\varphi_0/dx)$
X,Y	Scaled coordinates, $X = X_p$, $Y = \mu Y_p$
X_p, Y_p	Physical coordinates, made dimensionless with semichord, b.
γ	Ratio of specific heats
δ	Thickness ratio or measure of camber and angle of attack
ϵ	$(\delta/M)^{2/3}$
λ_1	$\omega M/(1-M^2)$
μ	Scale factor on Y_p, $\mu = \gamma^{1/3}M^{2/3}$
φ_0	Steady perturbation velocity potential
φ_1	Unsteady perturbation velocity potential
ω	Angular reduced frequency (semichord times frequency in radians per second divided by freestream velocity)

4.0 DISCUSSION

The equations for the relaxation portion of the program of this document are fully derived and presented in the Appendix of reference 1. The notation used in the program is for the most part taken directly from that report. The geometry used for the program is shown in figure 1. The direct solution portion of the program differs mainly in the form of the outer boundry condition where out-going wave boundary conditions are used rather than Klunker-type boundary conditions.

The program includes four solution options:

1 Relaxation, full-space, subsonic freestream
2 Direct solution, half-space, subsonic freestream
3 Direct solution, half-space, supersonic freestream
4 Direct solution, full-space, subsonic freestream

The relaxation procedure is an iterative process in which the solution is obtained as sequence of relatively small problems. In the direct solution, the difference equations are solved *all at once.* Generally, relaxation solutions use significantly less core storage and more central processing time. The direct solutions use more core storage and less central processing time. However, as noted in references 2 and 3, relaxation solutions diverge for values of λ_1 above a certain critical value. This divergence severely limits the useful range of relaxation procedures, particularly in terms of reduced frequency at higher values of Mach number. The estimation of the critical value of λ_1, which is a function of Mach number, reduced frequency, and the dimensions of the solution space, is discussed in section 4.0 of reference 2.

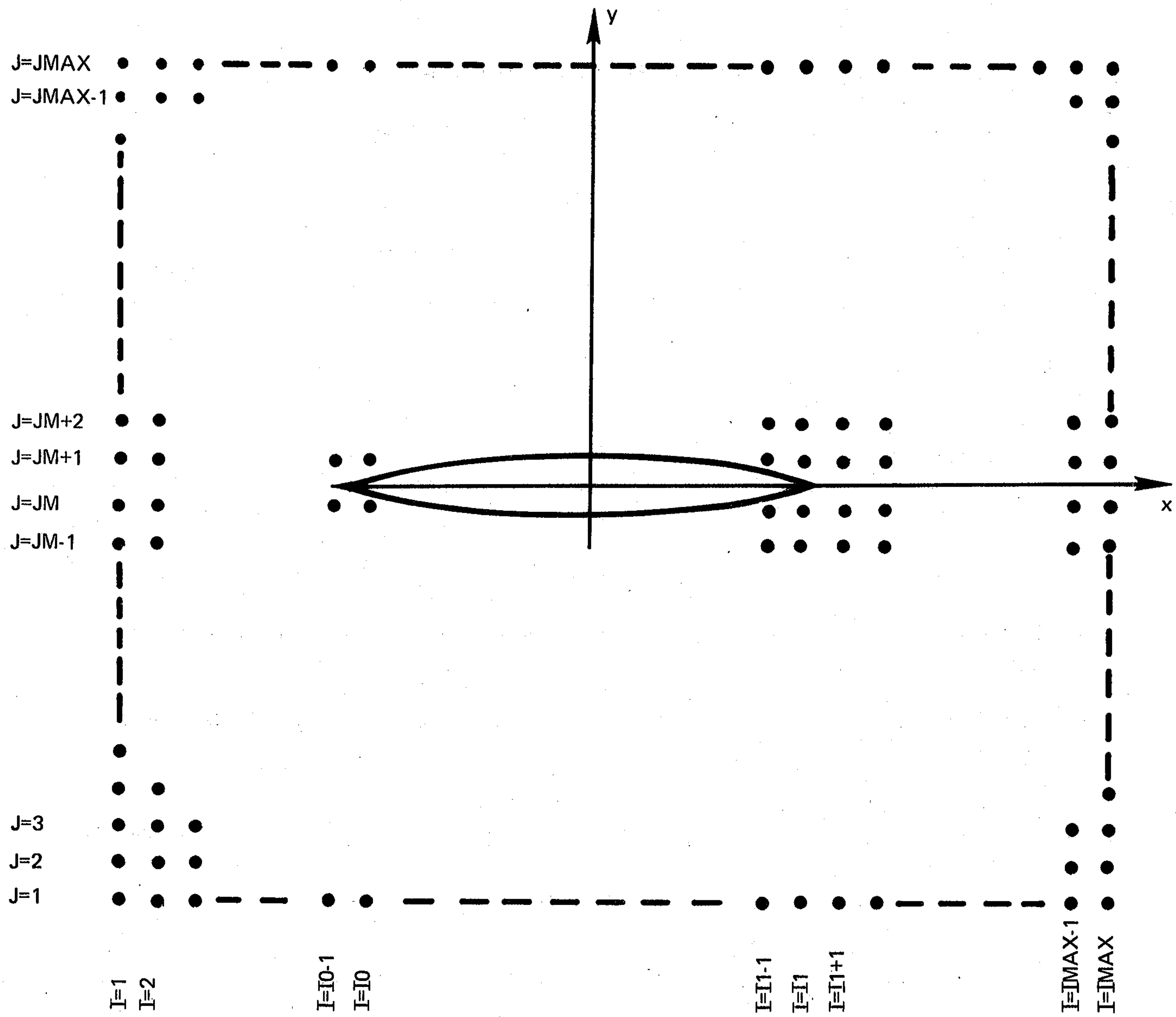
The equations of fluid flow (equations 24 and 26 of ref. 1) are set up for row relaxation as:

$$\text{SUB1(I,J)} * \varphi_1\text{(I-2,J)} + \text{SUB (I,J)} * \varphi_1\text{(I-1,J)} + \text{DIAG(I,J)} * \varphi_1\text{(I,J)}$$
$$+ \text{SUPER(I,J)} * \varphi_1\text{(I+1,J)} = \text{RHS(I,J)}$$

The right-hand side term, RHS(I,J), contains values from both the current and previous iterations. For example, for row relaxation proceding from lower to upper boundary, RHS(I,J) includes values from the current iteration for the row below the Jth row (row J-1) and values from the previous iteration for the row above the Jth row (row J+1). For column relaxation, the unknowns on the left-hand side of the equations are on the left-hand side of the equations are φ_1(I,J-1), φ_1(I,J) and φ_1(I,J+1). For the direct solution all five φ_1's are on the left-hand side.

Solutions for the direct procedure are obtained using an out-of-core solution routine. The procedure and corresponding routines are presented in detail by Yip in reference 7.

The program calculates the modal input data for vertical translation, pitch and control surface motions. A separate run is required for each mode.



(Notation matches that of NASA CR-2257)

Figure 1 — Solution Mesh for Two-Dimensional Problem

5.0 COMPUTER PROGRAM USAGE

5.1 MACHINE REQUIREMENTS

A344 executes on a CDC CYBER 175 or similarly compatible computer.

5.2 OPERATING SYSTEM

A344 was designed for a KRONOS 2.1 or NOS 1.2 operating system.

5.3 STORAGE ALLOCATION

Relaxation option, NVER=1; requires cm=120000 (octal words)

Direct solution options:
- Half-space, subsonic freestream, NVER=2; cm=220000
- Half-space, supersonic freestream, NVER=3; cm=210000
- Full-space, subsonic freestream, NVER=4; cm=310000

5.4 TIMING

Timing is hardware- and operating system- dependent, as well as being a function of the number of mesh points used in the finite difference grid.

The following direct solution examples were run on a CDC Cyber 175 with NOS 1.2 operating system.

1. Full-space solution, 56 x 60 mesh; 70 CPU Sec.
2. Half-space solution, 64 x 46 mesh; 12 CPU Sec. (a 64 x 23 mesh is actually calculated)

5.5 FILE I/O

The program card of A344 is as follows:

```
Program TEA344 (INPUT= 102, OUTPUT=1002, TAPE7, TAPE5=INPUT,
          TAPE6=OUTPUT,TAPE1=1002,TAPE10=1002,TAPE98=512,
          TAPE8)
```

The buffer sizes are given in decimal form, with the default value being 1027 decimal (2003_8).

5.5.1 FILE UTILIZATION

The file named TAPE1 contains one steady state velocity potential distribution (PHI0) from a separate program. This matrix must be present for a wing with thickness (see ref. 3 and input variable MSTST).

The file named TAPE10 is the file where the PHI1 matrix is stored. If the relaxation solution procedure is used, the starting PHI1 (if available) is stored on TAPE10. After a successful execution of the program (using either the relaxation or direct solution procedures), TAPE10 will contain the new PHI1 matrix. If an old PHI1 was stored on TAPE10, it is replaced by the new PHI1. The format for TAPE10 is described in section 5.5.2.

5.5.2 FILE FORMATS

Binary files, TAPE1 and TAPE10.

The files TAPE1 and TAPE10 are binary I/O files. The data on TAPE1 is real and includes the number of rows and columns, the x and y coordinates, and the steady state velocity potential. TAPE1 is read with the following sequence of READ statements:

```
READ (1)     IMAX, JMAX
READ (1)     (X(I), I=1, IMAX), (Y(J), J=1, JMAX)
READ (1)     ((PHI0(I,J), I=1, IMAX), J=1, JMAX)
```

The PHI0 matrix is required only if the airfoil has finite thickness, in which case set MSTST = 0. The parameters IMAX and JMAX, and the coordinate arrays X and Y are required in all cases.

The data on TAPE10 is complex with a real- and imaginary-part for each element of the unsteady velocity potential matrix, PHI1. TAPE10 is read with the statement

```
READ (1)  ((PHI(I,J), I=1, IMAX), J=1, JMAX)
```

If the relaxation solution is being used, a previously calculated PHI1 may be used as a starting point for the new calculations by setting INC$\neq$0.

As mentioned previously the complex binary files will contain a real part and an imaginary part for each element of the PHI1 matrix.

BCD Files

The BCD files INPUT, OUTPUT, and TAPE7 follow the standard FORTRAN and system formats for that type of file.

BCD files are those which deal with character printing or reading. A344 has three of these; INPUT, OUTPUT, and TAPE7.

INPUT, also called TAPE5, is the file which contains cards or card images. Program card (or card image) input is fully described in section 5.7.

OUTPUT, also called TAPE6, is the file on which the program places the primary printed information. (see sec. 3.8 and appendix)

TAPE7 is also a print file. The user may disregard it unless he is executing the program on a terminal where the primary OUTPUT print file is to be printed later. It will print a summary during execution telling the user how convergence is proceeding.

Usage of TAPE7 is LGO, IN, OUT, OUTPUT. (see sec. 5.6)

TAPE7 was primarily used in development of the program. Terminal usage of the program should be limited as terminal execution is usually very expensive.

5.6 CONTROL CARDS

The following control cards can be used to load and execute TEA344 from permanent file:

```
JOBN, T20, CM310000, P00.
USER, ACCTNO, PASWD. URNAME/PN/MS/ORG
GET, XXPROG=TEA344.
GET, TAPE1=URPHI0
GET. XXDATA=URINPT.
XXPROG (XXDATA).
```

If the relaxation solution version is to be used (NVER=1) and an existing PHI1 distribution is to be used as a starting point, a GET, TAPE10=URPHI10 card should be added. if PHI1 is to be saved, a SAVE, TAPE10 = NEWTP10 control card is needed.

5.7 PROGRAM INPUT

5.7.1 GENERAL REMARKS

The input to A344 is of two forms, disk file/tape input (binary input) and card input (BCD input). Disk file/tape input may consist of input point locations and the PHI0 and/or PHI1 distribution. An input PHI1 distribution is indicated if a previously calculated PHI1 matrix is to be used to start the iteration process. If the user is starting an iteration procedure from scratch, there is no PHI1 input and the initial PHI1 distribution is all zeros. The subroutine INCOND generates these zeros if MSTS = 0. There is also no PHI1 input if a direct solution procedure is used. PHIO is the steady-state distribution from another program. If a flat plate solution is sought, PHIO would not be input.

A description of disk file/tape formats is given in section 5.5.2 and a listing of the input for a sample problem is presented in the appendix.

The card input consists of field dependent input and namelist free field input. The field-dependent input is defined in the format column of table 1. as a spceific field (i.e., F10.2, A10, I5). The namelist data will be represented in the same column by the namelist name "PARAM."

It should be noted that the namelist input set is not the same for the four solution options. The input variables ILAX, CONPXT, and CONE6 are read only for the relaxation solution, version 1. The input variables LW and MXRR are read only for the direct solutions, versions 2, 3 and 4. Input variably ICKPRI is read only for version 2.

Some of the features of namelist input are:

1. Card field consists of columns 2 through 80.

2. List consists of a \$ list-name in column 2, in our case, \$ PARAM, followed by a series of specifications continued on as many cards as required and terminated by a \$ END.

3. Specifications are of the form:
   a. Vname = Value
   b. Where Vname is an array, Vname = Value1,...,Valuen. Where Vname is one of the variable names for the list, value is the associated value(s). Value may be an integer, a floating point number in normal or exponential form, or in the case of a logical variable (specifically the options), of the form.
   - .T. or .True. indicating true or on
   - .F. or .False. indicating false or off

4. Specifications must be separated by commas. There is no comma between the last specification and terminating \$.

5. Embedded blanks are allowed except within the \$ PARAM, variable name, or value. At least one blank must separate the \$ list-name and the first specification.

6. The order of appearance of variables on the card(s) is not important; the spelling is.

7. Any or all of the variables may be left out of the list, e.g., \$ list-name, \$ is legitimate. This assumes, of course, that there is a legal default value associated with the variable(s) not included in the list.

5.7.2 LIMITATIONS

The following are size limitations within the program.

- $3 \leq \text{IMAX} \leq 75$ IMAX = Maximum number of x - nodes (in flow direction).
- $3 \leq \text{JMAX} \leq 60$ JMAX = Maximum number of y - nodes (in vertical direction).
- $0 < \text{OMEGA}$
- $\text{FSMACH} < 1$ For subsonic freestream option.

Note: The PHI0 and PHI1 distributions must also correspond to the limitations on the XY mesh.

5.7.3 DATA STACKING

Note: All coordinates and lengths, except for the location of the pitch axis, are entered as scaled quantities,

$$X = X_p / b$$
$$Y = \mu * Y_p / b$$

where b is the semichord and the subscript p means physical coordinate. The pitch axis is entered as $X_p / (2b)$ units aft of leading edge.

The scale factor μ, as well as the parameter ϵ, is undefined for the flat plate for which $\delta = 0$. The program is coded such that it will "blow up" if $\delta = 0$ is used as input. Therefore, a finite value of δ should be used for flat plate configurations. The unsteady velocity potential distribution will be scaled accordingly; however, the pressure coefficient is independent of δ since it is found by multiplying the x - derivative of the potential by the factor ϵ.

Table 1.—User Input Variables

Card number	Variable name	Format	Description
1	VERSION	7X,I2	Denotes version of solution to be used. VERSION=1 uses the full-space relaxation. VERSION=2 uses half-space, direct solution, subsonic freestream. VERSION=3 uses half-space, direct solution, supersonic freestream. VERSION=4 uses full-space, direct solution, subsonic freestream.
2	Title	8A10	80-character title for this problem
3 to N	FSMACH	PARAM	Mach number
	DELTA	PARAM	Thickness ratio
	THETA	PARAM	Amplitude of the oscillatory angle of attack in degrees
	OMEGA	PARAM	Angular reduced frequency
	GAMMA	PARAM	Ratio of specific heats for flow medium
	AL	PARAM	Chord of control surface
	IMAX	PARAM	Maximum X node count in users mesh
	JMAX	PARAM	Maximum Y node count in users mesh
	NVOL	PARAM	No. of far-field updates before the volume integration is included in the far-field calculation. Limited experience indicates that the volume integration does not appear significant to results. The volume integration may also be suppressed by setting IS = 0.
	IS	PARAM	Starting X node limit for volume integral for the wing; currently not used. Intended only for relaxation solutions. if IS=0, the volume integral is not included in the farfield evaluation.
	IE	PARAM	Ending X node limit for volume integral for the wing; currently not used. Intended only for relaxation solutions.
	JS	PARAM	Starting Y node limit for volume integral for the wing; currently not used. Intended only for relaxation solutions.
	JE		Ending Y node limit for volume integral for the wing; currently not used. Required only for relaxation solutions.
	NMAX	PARAM	Maximum number of iterations to be allowed without convergence. Required only for relaxation solutions.
	NA	PARAM	Far-field update cycle control; updates the far-field each NA iteration. Required only for relaxation solutions.
	ERROR	PARAM	Error difference. When the maximum difference between PHI1 distributions of consecutive iterations is less than ERROR, the program stops iterating. Required only for relaxation solutions.

Table 1.–(Continued)

Card number	Variable	Format	Description
	NP	PARAM	Prints pressure distribution every NP iterations. Required only for relaxation solutions.
	INC	PARAM	Restart variable. IF INC≠0,start with the PHI1 distribution on TAPE10; if INC=0, start with a PHI1 distribution of zeros. Required only for relaxation solutions.
	ORF	PARAM	Overrelaxation factor used for subsonic nodes to accelerate convergence,1⩽ORF<2. Required only for relaxation solutions.
	URF	PARAM	Underrelaxation factor used for supersonic nodes to accelerate convergence,0 <URF<1. Required only for relaxation solutions.
	MSTST	PARAM	When MSTST=0, a PHI0 distribution from a steady-state solution is read from TAPE1 and used to calculate U(I,J). When MSTST≠0, U(I,J) is set to K and thickness effects are not included in the analysis. This is the *flat plate* analysis.
	ISWEEP	PARAM	This variable along with ILAX determines the sequence in which line relaxation solutions are obtained. With ILAX = 0 (row relaxation): (1) if ISWEEP = 0, rows will be solved from the upper and lower boundaries, alternating in toward the wing; (2) if ISWEEP = 1, rows will be solved from the airfoil, alternating out to the upper and lower boundaries; (3) if ISWEEP = 2, rows will be solved consecutively from lower boundary to upper boundary. With ILAX = 1 (column relaxation): (1) if ISWEEP = 0, columns will be solved starting at the trailing edge of the airfoil and moving forward to to the upstream boundary, then going back to the trailing edge and moving aft to the downstream boundary; (2) if ISWEEP = 1, columns are solved from upstream boundary to downstream boundary. Required only for relaxation solutions. Default values are ILAX=0 and ISWEEP=0
	ILAX	PARAM	With ILAX = 0, the line relaxation solution procedure uses rows of points, the points forming a line parallel to the airfoil. With ILAX = 1, the line relaxation procedure works with columns of points which are perpendicular to the airfoil. Required and read for the relaxation solution only.
	CONPXT	PARAM	Constants required for convergence of row relaxation (refs. 2 and 3) Read only when NVER = 1.
	IP		Not used.
	MXRR	PARAM	Maximum number block rows. Required for direct solutions only. Default value is 29. MXRR must not be greater than 29. Not read when NVER = 1.

Table 1.—(Concluded)

Card number	Variable	Format	Description
ICKPR1		PARAM	Checkprint option parameter available only for half-space subsonic freestream version (NVER=2). If ICKPR1$\neq$0, a certain limited amount of the intermediate calculations is printed out for check purposes. This includes the NDBLK array, the IN matrix and several of the block coefficient matrices, WW. If ICKPR1 = 0, this data is not printed.
LW		PARAM	This is the LWORK parameter required by the out-of-core direct solution procedure. (see ref. 7). The default value is matched to the maximum permissible values of IMAX and JMAX. (see section 5.7.2)
MODE		PARAM	Selects mode shape. Use MODE = 1 for vertical translation, MODE = 2 for pitch, and MODE = 3 for control surface motion.
PAXIS		PARAM	Location of pitch axis measured aft from leading edge. Note that units are $X_p/(2b)$

5.8 PROGRAM INPUTS

5.8.1 PROGRAM RESULTS

A listing of the output for a sample problem using the direct solution is presented in the Appendix.

The printed output of the program consists of an initial block of information printing back the user's input followed by information identifying some of the program options the user selected.

The X and Y mesh data come next, as read from either cards or binary file (TAPE1). The mesh data are followed by the values of calculated variables, and the FU array which is the downwash on the upper surface of the wing.

The parameter ICKPR1 has been set to 1, resulting in the printing of the NDBLK array (the sizes of the matrix blocks), the IN matrix (the blocks with nonzero elements are identified with integers), values of MXR and MXC, and several coefficient block matrices.

Next is printed a summary of the augmented matrix, and an indication of the quality of the solution as measured by a *"norm"* as defined in reference 6 and the largest residual. For example, *"WW BLOCK I=4"* is the block matrix resulting from putting the block matrices 6,7,8 (see IN matrix) together, i.e. [6|7|8].

Finally, the jump in pressure coefficient across the wing is printed.

A second sample problem using a relaxation solution rather than a direct solution is also included in Appendix A. The initial parameters and mesh data are listed first as for the direct solution. Next the ERROR is printed out after each iteration. The program also prints out intermediate (and unextrapolated) pressure coefficients every NA iterations. The final interpolated pressure coefficients are printed out after the solution converges or after NMAX iterations, whichever occurs first.

5.8.2 PROGRAM DIAGNOSTICS

"SOLUTION FAILED TO CONVERGE IN - - - - ITERATIONS IERR, JERR ERRMAX1 - - - -, - - - -, - - - - - -" indicates the largest error found at the indicated XY node location is still larger than the user-specified standard and that the maximum number of iterations has been attained. This is found in the relaxation solution option.

"SOLUTION CONVERGED. MAXIMUM ERROR IS - - - -" indicates the user error standard has been reached. This is found only in the relaxation solution option.

6.0 COMPUTER PROGRAM DESCRIPTION

6.1 OVERLAY STRUCTURE

The TEA344 program consists of a (0,0) level overlay, two primary overlays and three secondary overlays.

The (0,0) overlay selects whether the solution is to be a relaxation or direct procedure.

The primary level (1,0) overlay is the relaxation solution procedure. The (2,0) overlay selects the particular form of the direct solution.

The secondary overlays (2,1), (2,2), and (2,3) perform direct solutions for subsonic free-stream, half-space; supersonic freestream, half-space; and subsonic freestream, full-space conditions.

6.2 COMMON BLOCK USAGE

Table 2. describes usage of blocks of common variables.

TABLE 2.— Blocks of Common Variables

Block	Usage
B0	Wake integral quantities
CONE6	Row relaxation constant
CONST	Control and calculation constants
EPS	Mach number, angle of attack and amplitude of oscillation
FUL	Modal data for boundary conditions on camber line
FXY	Functions of X and Y of the flow field mesh
GH	Bessel function values
IMESH	X and Y mesh constants
IRLAXF	Array to determine whether column is all subsonic or contains supersonic points
IRELAX	Integers for row relaxation options
IVOL	Volume integral constants for Klunker-type boundary conditions
L	Far-field integral quantities, Klunker-type boundary conditions only
MATRIX	Coefficient arrays required to set up solution matrices
PHI	Unsteady velocity potential array, PHI1
SUBER	Additional coefficient arrays required for solution matrices
SUBSUB	Additional coefficient array for row relaxation solution
SUM	Far-field integral quantities, Klunker-type boundary conditions only
U	Steady flow quantity, $U = K-(\gamma+1)\varphi_{0x}$
V	Terms involved in evaluating the PHI1 on outer boundary; used in relaxation procedure only
WAK	Wake terms for direct solution
WAKE	Wake integral quantities for Klunker-type boundary conditions only
XY	X and Y locations of mesh points

6.3 PROGRAM/SUBROUTINE DESCRIPTION

Short descriptions for the various programs and subroutines of A344 are given in this section. Routines are ordered alphabetically. Maps of the overlay structures and the sequence in which the programs and subroutines are used are shown in figures 2 and 3.

1. SUBROUTINE AIRFOIL

Calculates boundary conditions over airfoil.

2. PROGRAM A344VB1

Performs direct solutions for half-space, subsonic freestream condition.

3. PROGRAM A344VB2

Performs direct solution for half-space supersonic freestream condition.

4. PROGRAM A344VB3

Performs direct solution for full-space subsonic freestream condition.

5. SUBROUTINE BESNIS

Required for calculation of Bessel functions.

6. SUBROUTINE BESNKS

Required for calculation of Bessel functions.

7. SUBROUTINE CPR

Calculates the difference in pressure coefficients across the airfoil.

8. SUBROUTINE DATE

Obtain date; system subroutine.

9. SUBROUTINE DELPHI

Calculates the jump in velocity potential across the airfoil. The velocity potential is found at the wing surface by extrapolation using values at the two points below (or above) the wing before the jump is calculated.

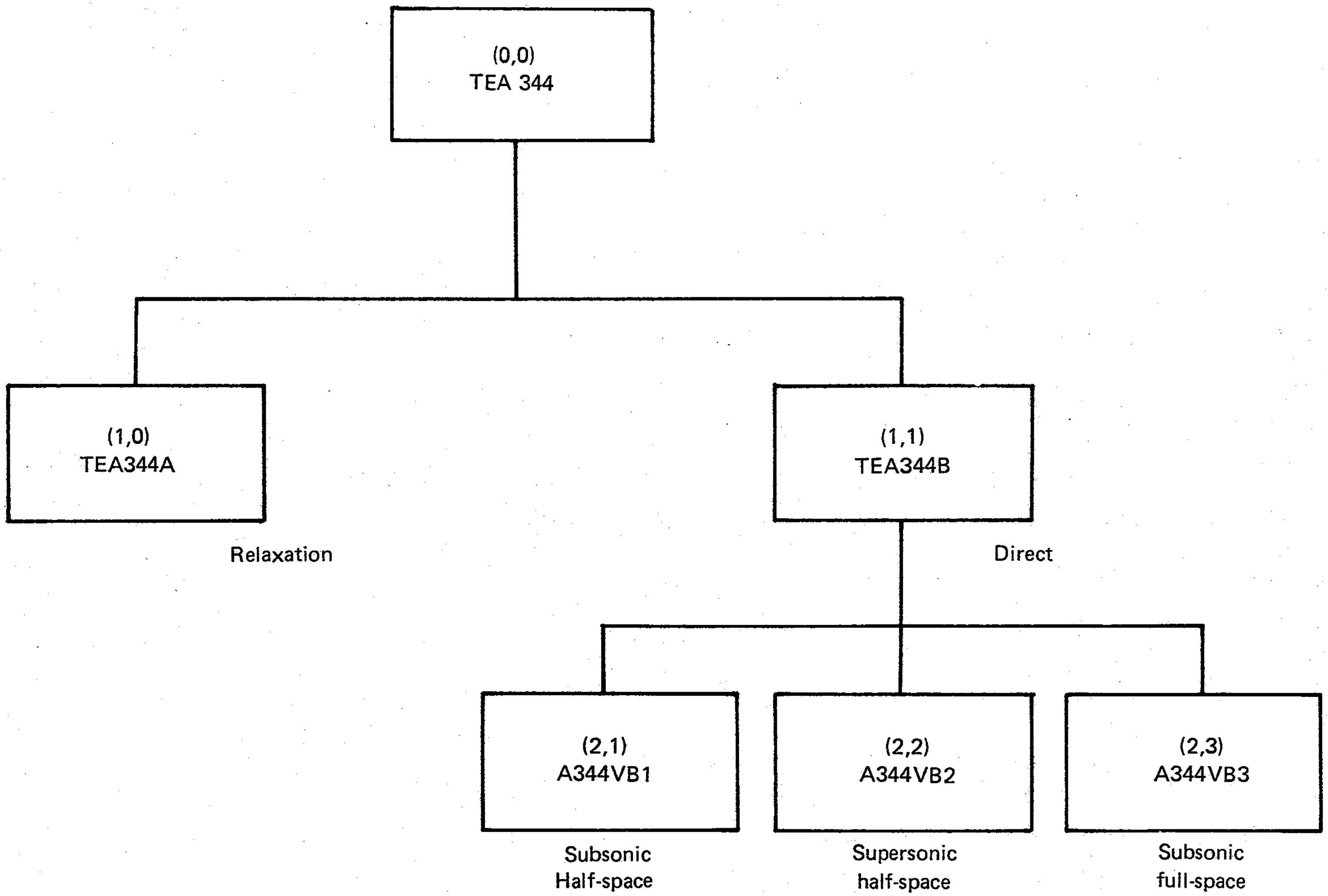


Figure 2.—Overlay and Program Map

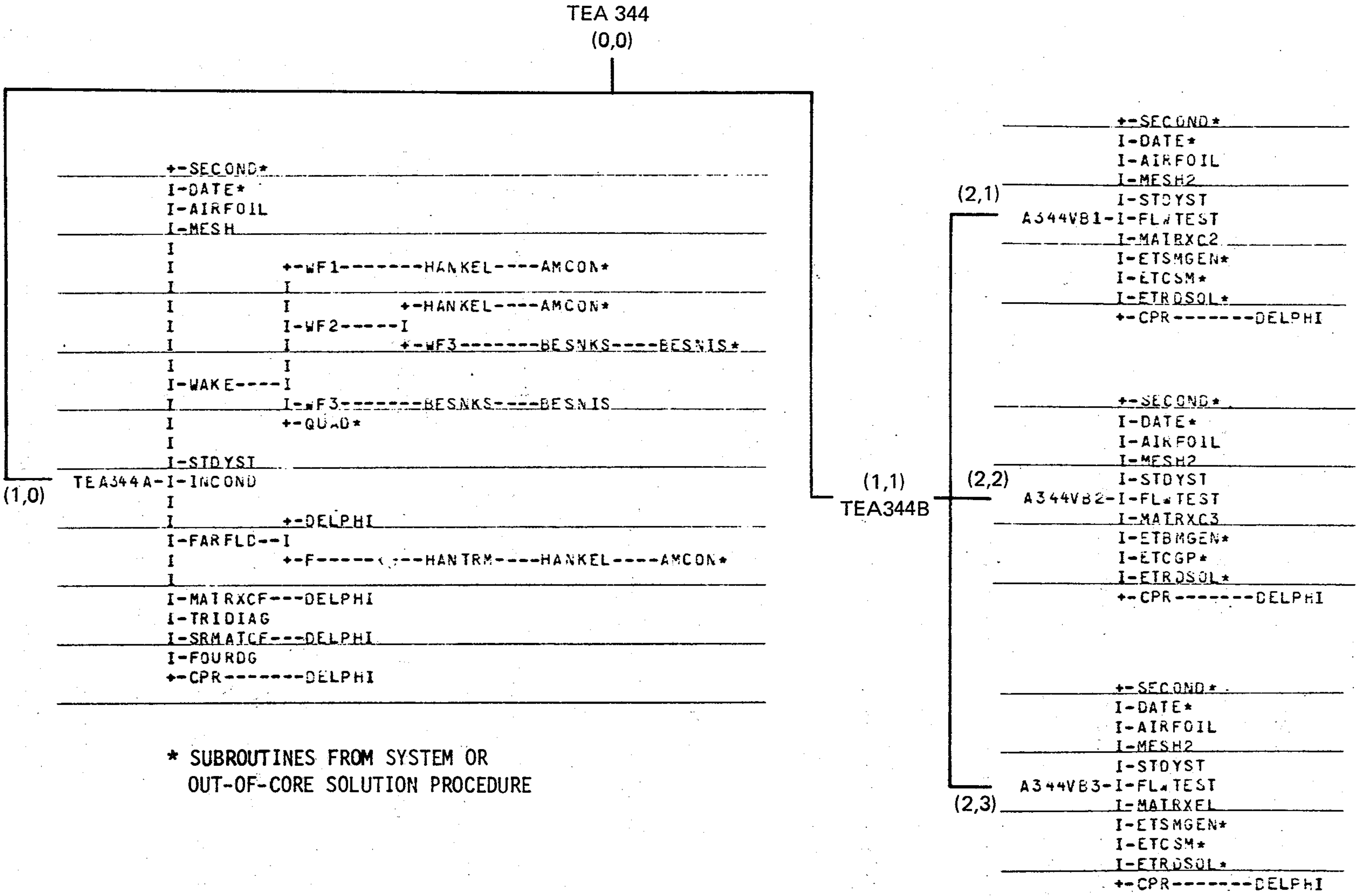


Figure 3.—Overlay, Program and Subroutine Map

10. SUBROUTINE ECTCSM

Subroutines from out-of-core solution systems. See reference 7.

11. SUBROUTINE ETRDSOL

Subroutines from out-of-core solution systems. See reference 7.

12. SUBROUTINE ETSMGEN

Subroutines from out-of-core solution systems. See reference 7.

13. COMPLEX FUNCTION F

Evaluate far field function at specified outer boundary point.

14. SUBROUTINE FARFLD

Calculates Klunker-type boundary conditions on outer mesh boundaries.

15. SUBROUTINE FLWTEST

Checks column of mesh points for supersonic flow.

16. SUBROUTINE HANTRM

Evaluates 3 expressions involving Hankel functions for SUBROUTINE FARFLD.

17. SUBROUTINE HANKEL

Evaluates the complex-valued Hankel function of first or second kind for real arguement x and integer order.

18. SUBROUTINE INCOND (INC)

Provides an initial distribution of unsteady velocity potential.

19. SUBROUTINE MATRXCF

Calculates coefficients for column relaxation solutions.

20. SUBROUTINE MATRXFL

Routine to calculate coefficients for full-space, subsonic freestream solutions.

21. SUBROUTINE MATRXC2

Routine to calculate coefficients for half-space subsonic freestream solutions.

22. SUBROUTINE MATRXC3

Routine to calculate coefficients for half-space supersonic freestream solutions.

23. SUBROUTINE MESH

Routine to calculate mesh functions for relaxation solutions including Klunker-type boundary conditions.

24. SUBROUTINE MESH2

Routine to calculate mesh functions for direct solutions including out-going wave boundary conditions.

25. SUBROUTINE SECOND

Determines central processor time; system subroutine.

26. SUBROUTINE STDYST (MSTST)

Inputs steady velocity potential and evaluates U(I,J).

27. PROGRAM TEA344

Selects either relaxation or direct solution.

28. PROGRAM TEA344A

Performs relaxation procedure.

29. PROGRAM TEA344B

Selects one of three direct solution procedures.

APPENDIX

Input for the first sample problem is for a direct solution of an airfoil in a Freon flow.

```
Card                                    Columns
No.  1           11          21          31          41          51          61
------------------------------------------------------------------------------------

 1   VERSION 2
 2   SAMPLE PROBLEM, HALF SPACE, SUBSONIC FLOW
 3    $PARAM FSMACH=0.9, DELTA=0.06,  THETA=1.5,     OMEGA=0.30,
 4    GAMMA=1.135,
 5    MSTST=0,
 6    MODE=2,
 7    PAXIS=0.0,
 8    ICKPRI=1,
 9    $END
```

Output for the first sample problem starts on the next page.

VERSION 2

OUT-OF-CORE FULL DIRECT SOLUTION

SAMPLE PROBLEM, HALF SPACE, SUBSONIC FLOW 79/11/02.#:

```
$PARAM
FSMACH  = .9E+00,
DELTA   = .6E-01,
THETA   = .15E+01,
OMEGA   = .3E+00,
GAMMA   = .1135E+01,
AL      = .5E+00,
IMAX    = 26,
JMAX    = 24,
IS      = 0,
IE      = 0,
JS      = 0,
JE      = 0,
NMAX    = 50,
NA      = 10,
ERROR   = .1E-05,
NP      = 1000,
INC     = 1,
ORF     = .13E+01,
MSTST   = 0,
ISWEEP  = 0,
NVOL    = 100,
IP      = 0,
LW      = 10000,
MXRR    = 29,
ICKPR1  = 1,
MODE    = 2,
PAXIS   = 0.0,
$END
 MSTST=0 SO THIS AIRFOIL HAS FINITE THICKNESS
```

```
THIS IS HALF-SPACE SOLUTION FOR FLOW          WITH SUBSONIC FREESTREAM

 -2.7500   -2.2089   -1.8224   -1.5463   -1.3492   -1.2983   -1.1077   -1.0359    -.9641    -.8636
  -.7228    -.5258    -.2500     .0258     .2228     .3636     .4641     .5359     .6012     .6927
   .8207    1.0000    1.2322    1.5574    2.0126    2.6500

 -6.2500   -4.4283   -3.1271   -2.1976   -1.5338   -1.0596    -.7208    -.4789    -.3061    -.1826
  -.0945    -.0315     .0315     .0945     .1826     .3061     .4789     .7208    1.0596    1.5338
  2.1976    3.1271    4.4283    6.2500

XK,EPS,XLAM,W1,W2,W7,W9,W11    .143E+01    .164E+00    .142E+01    .128E+01    .170E+01    .190E-01    .547E+00    .141E+01

IMAG,W3,W5,W6,W8,W10   0.0   .100E+01   0.0   .250E+00   0.0   .744E-01   0.0   .128E+01   0.0   .182E+01   0.0   .111E+01

TIME,ELAPSED TIME (SECONDS)            .080      .014
```

IO,IA,I1 9 18 22

FU

```
     0.        0.                  0.        0.                  0.        0.                  0.        0.
          0.        0.                  0.        0.                  0.        0.
          0.        0.             .436E+00  .470E-02           .436E+00  .179E-01
     .436E+00  .363E-01            .436E+00  .621E-01           .436E+00  .982E-01
     .436E+00  .134E+00            .436E+00  .160E+00           .436E+00  .178E+00
     .436E+00  .192E+00            .436E+00  .201E+00           .436E+00  .210E+00
     .436E+00  .222E+00            .436E+00  .238E+00           .436E+00  .262E+00
          0.        0.                  0.        0.                  0.        0.
          0.        0.
```

TIME,ELAPSED TIME (SECONDS) .088 .008

TIME,ELAPSED TIME (SECONDS) .089 .001

TIME,ELAPSED TIME (SECONDS) .089 0.000

TIME,ELAPSED TIME (SECONDS) .092 .003

NOBLK ARRAY

11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 1*********

****

****

IMAX1= 25 IMAX2= 24

IN MATRIX

1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	5
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	7	8	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	10	11	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	13	14	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	16	17	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	19	20	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	21	22	23	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	24	0	0	0	0	0	0	0	25	26	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	29	30	31	0	0	0	0	0	0	0	0	0	0	0	0	0	32	0	0
0	0	0	0	0	0	33	34	35	36	0	0	0	0	0	0	0	0	0	0	0	0	37	0	0	0	0	0
0	0	0	0	38	39	40	41	0	0	0	0	0	0	0	0	0	0	0	42	0	0	0	0	0	0	0	0
0	0	43	44	45	46	0	0	0	0	0	0	0	0	0	0	47	0	0	0	0	0	0	0	0	0	0	0
48	49	50	51	0	0	0	0	0	0	0	0	0	52	0	0	0	0	0	0	0	0	0	0	0	0	0	53
54	55	0	0	0	0	0	0	0	0	56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57	58	59
0	0	0	0	0	0	0	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	61	62	63	0	0
0	0	0	0	64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	65	66	67	0	0	0	0
0	68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	69	70	71	0	0	0	0	72	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73	74	75	0	0	0	76	0	0	0	0

27

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	77	78	79	0	0	80	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	81	82	83	84	0	85	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	86	87	88	89	90	91	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	92	93	0	94	95	96																

MXR= 11 MXC= 22

WW BLOCK MATRIX I= 2

-.51543E+01	-.16068E+01	.24609E+00	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	.39228E+01	-.27539E+01
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.34452E+00	0.	-.55117E+01	-.15112E+01
.48233E+00	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.39006E+01	-.27539E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	.67526E+00	0.	-.64178E+01	-.16505E+01	.94537E+00	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	.39121E+01	-.27539E+01	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.13235E+01	0.	-.82014E+01	-.18472E+01	.18529E+01	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.39974E+01	-.27539E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	.25941E+01	0.
-.11583E+02	-.20634E+01	.36317E+01	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	.41728E+01	-.27539E+01
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.50844E+01	0.	-.17921E+02	-.22485E+01
.71182E+01	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.43991E+01	-.27539E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	.99655E+01	0.	-.29948E+02	-.23776E+01	.13952E+02	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	.46165E+01	-.27539E+01	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.19532E+02	0.	-.53128E+02	-.24532E+01	.27345E+02	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.47803E+01	-.27539E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	.38283E+02	0.
-.98257E+02	-.24912E+01	.53597E+02	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	.48789E+01	-.27539E+01
0.	0.	0.	0.	0.	0.	0.	0.

0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.75035E+02	0.	-.18652E+03	-.25074E+01
.10505E+03	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.49255E+01	-.27539E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	.12606E+03	0.	-.38463E+03	-.25127E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	.49417E+01	-.27539E+01				

MXR= 11 MXC= 33

WW BLOCK MATRIX I= 3

.54917E+01	.19672E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	-.13389E+02	.17273E+01
.24609E+00	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.76768E+01	-.38549E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.54607E+01	.19672E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.34452E+00	0.	-.13621E+02	.18875E+01	.48233E+00	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.76077E+01	-.38549E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.54768E+01	.19672E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.67526E+00	0.	-.14392E+02	.18872E+01
.94537E+00	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.75685E+01	-.38549E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.55962E+01	.19672E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.13235E+01	0.	-.16161E+02	.18868E+01	.18529E+01	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.76618E+01	-.38549E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.58416E+01	.19672E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.25941E+01	0.	-.19781E+02	.18867E+01
.36317E+01	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.79869E+01	-.38549E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.61585E+01	.19672E+01	0.	0.

0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.50844E+01	0.	-.26616E+02	.18872E+01	.71182E+01	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.85283E+01	-.38549E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.64628E+01	.19672E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.99655E+01	0.	-.39282E+02	.18884E+01
.13952E+02	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.91761E+01	-.38549E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.66922E+01	.19672E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.19532E+02	0.	-.63080E+02	.18899E+01	.27345E+02	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.97838E+01	-.38549E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.68302E+01	.19672E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.38283E+02	0.	-.10867E+03	.18912E+01
.53597E+02	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.10230E+02	-.38549E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.68954E+01	.19672E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.75035E+02	0.	-.19718E+03	.18920E+01	.10505E+03	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.10475E+02	-.38549E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.69181E+01	.19672E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.12606E+03	0.	-.39539E+03	.18923E+01
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.10568E+02	-.38549E+01		

MXR= 11 MXC= 33

WW BLOCK MATRIX I= 4

.10749E+02	.27527E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	-.26015E+02	.24885E+01
.24609E+00	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.15045E+02	-.54015E+01	0.	0.

0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.10653E+02	.27527E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.34452E+00	0.	-.26079E+02	.26487E+01	.48233E+00	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.14873E+02	-.54015E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.10598E+02	.27527E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.67526E+00	0.	-.26635E+02	.26483E+01
.94537E+00	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.14690E+02	-.54015E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.10729E+02	.27527E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.13235E+01	0.	-.28340E+02	.26476E+01	.18529E+01	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.14709E+02	-.54015E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.11184E+02	.27527E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.25941E+01	0.	-.32353E+02	.26472E+01
.36317E+01	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.15217E+02	-.54015E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.11942E+02	.27527E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.50844E+01	0.	-.43194E+02	.26473E+01	.71182E+01	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.16323E+02	-.54015E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.12849E+02	.27527E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.99655E+01	0.	-.54405E+02	.26485E+01
.13952E+02	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.17912E+02	-.54015E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.13700E+02	.27527E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.19532E+02	0.	-.80040E+02	.26509E+01	.27345E+02	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.19737E+02	-.54015E+01	0.	0.	0.	0.	0.	0.

0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.14325E+02	.27527E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.38283E+02	0.	-.12735E+03	.26539E+01
.53597E+02	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.21414E+02	-.54015E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.14668E+02	.27527E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.75035E+02	0.	-.21704E+03	.26564E+01	.10505E+03	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.22562E+02	-.54015E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.14797E+02	.27527E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.12606E+03	0.	-.41577E+03	.26576E+01
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.23064E+02	-.54015E+01		

MXR= 11 MXC= 33

MXR= 11 MXC= 33

MXR= 11 MXC= 33

MXR= 11 MXC= 33

WW BLOCK MATRIX I= 8

.13592E+03	.12707E+02	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	-.27202E+03	-.16388E+00
.24609E+00	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.13588E+03	-.12704E+02	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.13383E+03	.12707E+02	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.34452E+00	0.	-.26815E+03	-.35963E-02	.48233E+00	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.13377E+03	-.12704E+02	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.13028E+03	.12707E+02	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.67526E+00	0.	-.26186E+03	-.35695E-02
.94537E+00	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.13023E+03	-.12704E+02	0.	0.

0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.12653E+03	.12707E+02	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.13235E+01	0.	-.25582E+03	-.37150E-02	.18529E+01	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.12639E+03	-.12704E+02	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.12595E+03	.12707E+02	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.25941E+01	0.	-.25713E+03	-.44966E-02
.36317E+01	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.12523E+03	-.12704E+02	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.13169E+03	.12707E+02	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.50844E+01	0.	-.27350E+03	-.59899E-02	.71182E+01	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.12987E+03	-.12704E+02	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.14485E+03	.12707E+02	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.99655E+01	0.	-.30983E+03	-.82873E-02
.13952E+02	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.14134E+03	-.12704E+02	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.16642E+03	.12707E+02	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.19532E+02	0.	-.37335E+03	-.11824E-01	.27345E+02	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.16032E+03	-.12704E+02	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.19896E+03	.12707E+02	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.38283E+02	0.	-.47944E+03	-.17248E-01
.53597E+02	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.18887E+03	-.12704E+02	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.25086E+03	.12707E+02	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.75035E+02	0.	-.66582E+03	-.24894E-01	.10505E+03	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.23515E+03	-.12704E+02	0.	0.	0.	0.	0.	0.

0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.33886E+03	.12707E+02	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.12606E+03	0.	-.10482E+04	-.13572E-01
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.33145E+03	-.12704E+02		

MXR= 11 MXC= 34

WW BLOCK MATRIX I= 9

.11324E+03	.14821E+02	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	-.19434E+03	-.74177E+01
.24609E+00	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.83883E+02	-.75640E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	.11148E+03	.14821E+02
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	.34452E+00	0.	-.19166E+03	-.72574E+01	.48233E+00	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	.79631E+02	-.75640E+01	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.10853E+03	.14821E+02	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.67526E+00	0.	-.18754E+03	-.72571E+01	.94537E+00	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.77667E+02	-.75640E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	.10532E+03	.14821E+02	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	.13235E+01	0.
-.18375E+03	-.72568E+01	.18529E+01	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	.75522E+02	-.75640E+01
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.10436E+03	.14821E+02	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.25941E+01	0.	-.18491E+03	-.72573E+01
.36317E+01	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.74597E+02	-.75640E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	.10823E+03	.14821E+02
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.

0.	0.	.50844E+01	0.	-.19670E+03	-.72588E+01	.71182E+01	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	.76545E+02	-.75640E+01	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.11778E+03	.14821E+02	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.99655E+01	0.	-.22317E+03	-.72619E+01	.13952E+02	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.81740E+02	-.75640E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	.13360E+03	.14821E+02	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	.19532E+02	0.
-.27005E+03	-.72680E+01	.27345E+02	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	.89848E+02	-.75640E+01
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.15739E+03	.14821E+02	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.38283E+02	0.	-.34914E+03	-.72808E+01
.53597E+02	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.10014E+03	-.75640E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	.19596E+03	.14821E+02
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	.75035E+02	0.	-.48563E+03	-.73148E+01	.10505E+03	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	.10986E+03	-.75640E+01	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.27621E+03	.14821E+02	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.12606E+03	0.	-.50461E+03	-.74379E+01	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.10261E+03	-.75640E+01	-.34641E+01	-.37319E-01				

MXR= 11 MXC= 34

MXR= 11 MXC= 34

MXR= 11 MXC= 45

MXR= 11 MXC= 45

MXR= 11 MXC= 45

MXR= 11 MXC= 45

MXR= 11 MXC= 34

MXR= 11 MXC= 34

MXR= 11 MXC= 34

MXR= 11 MXC= 34

MXR= 11 MXC= 34

MXR= 11 MXC= 34

MXR= 11 MXC= 34

WW BLOCK MATRIX I= 22

.19060E+02	.57438E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	-.34013E+02	-.24804E+01
.24609E+00	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.14733E+02	-.34236E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	.18840E+02	.57438E+01
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	.34452E+00	0.	-.33993E+02	-.23199E+01	.48233E+00	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	.14599E+02	-.34236E+01	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.18499E+02	.57438E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.67526E+00	0.	-.34292E+02	-.23194E+01	.94537E+00	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.14446E+02	-.34236E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	.18181E+02	.57438E+01	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	.13235E+01	0.
-.35504E+02	-.23184E+01	.18529E+01	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	.14421E+02	-.34236E+01
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.18294E+02	.57438E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.25941E+01	0.	-.39051E+02	-.23171E+01
.36317E+01	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.14805E+02	-.34236E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.

0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	.19223E+02	.57438E+01
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	.50844E+01	0.	-.46914E+02	-.23161E+01	.71182E+01	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	.15761E+02	-.34236E+01	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.20960E+02	.57438E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.99655E+01	0.	-.61830E+02	-.23155E+01	.13952E+02	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.17226E+02	-.34236E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	.23328E+02	.57438E+01	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	.19532E+02	0.
-.89011E+02	-.23154E+01	.27345E+02	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	.19079E+02	-.34236E+01
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.26173E+02	.57438E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.38283E+02	0.	-.13899E+03	-.23157E+01
.53597E+02	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.21213E+02	-.34236E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	.29420E+02	.57438E+01
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	.75035E+02	0.	-.23281E+03	-.23163E+01	.13505E+03	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	.23574E+02	-.34236E+01	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.32796E+02	.57438E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.12606E+03	0.	-.18467E+03	-.23167E+01	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.26090E+02	-.34236E+01	-.34641E+01	-.20785E+01				

MXR= 11 MXC= 45

MXR= 11 MXC= 56

MXR= 11 MXC= 45

WW BLOCK MATRIX I= 25

0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.28421E+01	.23385E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	-.31785E+01	-.26779E+01	.24609E+00	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.28366E+01	.23385E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.34452E+00	0.	-.35059E+01	-.25180E+01
.48233E+00	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.28542E+01	.23385E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.67526E+00	0.	-.43174E+01	-.25202E+01	.94537E+00	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.29167E+01	.23385E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.13235E+01	0.	-.59359E+01	-.25248E+01
.18529E+01	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.30361E+01	.23385E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.25941E+01	0.	-.91051E+01	-.25314E+01	.36317E+01	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.

0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.31906E+01	.23385E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.50844E+01	0.	-.15237E+02	-.25381E+01
.71182E+01	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.33425E+01	.23385E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.99655E+01	0.	-.27103E+02	-.25435E+01	.13952E+02	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.34616E+01	.23385E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.19532E+02	0.	-.50183E+02	-.25471E+01
.27345E+02	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.35366E+01	.23385E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.38283E+02	0.	-.95261E+02	-.25491E+01	.53597E+02	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.35736E+01	.23385E+01	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.75035E+02	0.	-.18350E+03	-.25500E+01
.10505E+03	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	-.51430E+02	.12266E+02
.46287E+03	-.11039E+03	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.21943E+02	-.53186E-01	-.19749E+03	.47868E+00

0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	.35869E+01	.23385E+01	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
.12606E+03	0.	-.38161E+03	-.25503E+01	-.29805E+01	-.22369E+00		

ENTER ETCGP

```
 SUMMARY ON THE ARGMENTED MATRIX %
ARGMENTED MATRIX IS WRITTEN ON LOGICAL UNIT NO.  8
ORDER OF THE COEFFICIENT MATRIX   264
NO. OF BLOCK ROWS    24
NO. OF NON-ZERO BLOCKS OF THE ARGMENTED MATRIX   96



DECOMPOSE COEFFICIENT MATRIX AND SOLVE LINEAR SYSTEM


RETURN FROM ETCGP
AN INDICATION  ON THE QUALITY OF THE SOLUTION %
B IS THE ROW SUM OF THE COEFFICIENT MATRIX ,A,
X AND Y ARE RESPECTIVELY THE COMPUTED AND ACTUAL SOLUTIONS OF
AX=B.  THE NORM OF (X-Y) IS    .99601E-12

    RESMAX=  .40682E-11     IRESM= 24     JRESM= 12
```

MACH NUMBER = .90 OMEGA = .300 AMPLITUDE= .026

****** MODE 2, PITCH, PAXIS= 0.000 X/C ******

PRESSURE COEFFICIENTS

I	BELOW AIRFOIL		ABOVE AIRFOIL		ABOVE - BELOW		X
9	0.	0.	0.	0.	.981E+01	-.383E+01	-.964E+00
10	0.	0.	0.	0.	.790E+01	-.348E+01	-.864E+00
11	0.	0.	0.	0.	.741E+01	-.153E+01	-.723E+00
12	0.	0.	0.	0.	.597E+01	.787E+00	-.526E+00
13	0.	0.	0.	0.	.476E+01	.145E+01	-.250E+00
14	0.	0.	0.	0.	.394E+01	.186E+01	.258E-01
15	0.	0.	0.	0.	.617E+01	.985E+00	.223E+00
16	0.	0.	0.	0.	.517E+01	.219E+01	.364E+00
17	0.	0.	0.	0.	.250E+01	.326E+01	.464E+00
18	0.	0.	0.	0.	.177E+01	.310E+01	.536E+00
19	0.	0.	0.	0.	.131E+01	.289E+01	.601E+00
20	0.	0.	0.	0.	.843E+00	.250E+01	.693E+00
21	0.	0.	0.	0.	.405E+00	.185E+01	.821E+00
22	0.	0.	0.	0.	0.	0.	.100E+01

TIME,ELAPSED TIME (SECONDS) 1.645 1.553

Input for the second sample problem is for a relaxation solution of an airfoil in a Freon flow.

```
Card                              Columns
 No.  1          11          21          31          41          51          61
--------------------------------------------------------------------------------

  1   VERSION 1
  2   SAMPLE PROBLEM, AIRFOIL AT M=.9 OSCILLATING IN PITCH.
  3    $PARA FSMACH=0.9, DELTA=0.06, THETA=1.5 , OMEGA=.0600,
  4    GAMMA=1.135,
  7    MSTST=0,
  8    NA=5,
  9    NMAX=200,
 10    ORF=1.8,
 11    NVOL=200,
 12    NP=30,
 13    MODE=2,
 14    PAXIS=0.0,
 15    $END
```

Output for the second sample problem starts on the next page.

VERSION 1

VERSION 1
RELAXATION SOLUTION.FULL SPACE
SUBSONIC FREESTREAM ONLY

SAMPLE PROBLEM, AIRFOIL AT M=.) OSCILLATING IN PITCH.   79/11/32.#:

```
$PARAM
FSMACH  = .9E+00,
DELTA   = .6E-01,
THETA   = .15E+01,
OMEGA   = .6E-01,
GAMMA   = .1135E+01,
AL      = .5E+00,
IMAX    = 25,
JMAX    = 20,
IS      = 0,
IE      = 0,
JS      = 0,
JE      = 0,
NMAX    = 200,
NA      = 5,
ERROR   = .1E-05,
NP      = 30,
INC     = 1,
ORF     = .18E+01,
MSTST   = 0,
ISWEEP  = 0,
NVOL    = 200,
IP      = 0,
ILAX    = 0,
URF     = .9E+00,
CONPXT  = .12E+01,
CONES   = .1E+00,
MODE    = 2,
PAXIS   = 0.0,
$END
```

```
MSTST=0 SO THIS AIRFOIL HAS FINITE THICKNESS

THIS IS A ROW RELAX     OUT-IN


  -2.5500    -2.1182    -1.7383    -1.4670    -1.2732    -1.1347    -1.0359    -.9641    -.8636    -.7228
   -.5258     -.2500      .0058      .2228      .3636      .4641      .5359     .6012     .6927     .8207
   1.0000     1.2463     1.5812     2.0740     2.7500


  -6.2500    -4.3924    -3.0655    -2.1177    -1.4407     -.9571     -.6118    -.3659    -.1888    -.0629
    .0629      .1888      .3659      .6118      .9571     1.4407     2.1177    3.0655    4.3924    6.2500

XK,EPS,XLAM,W1,W2,W7,W9,W11    .143E+01    .104E+00    .284E+00    .256E+00    .339E+00    .379E-02    .219E-01    .704E+01

IMAG,W3,W5,W6,W8,W10   0.0   .100E+01   0.0   .250E+00   0.0   .149E-01   0.0   .256E+00   0.0   .365E+00   0.0   .111E+01

TIME,ELAPSED TIME (SECONDS)              .074      .017
```

```
I0,IA,I1          8         17         21


FU
      0.       0.                 0.       0.                0.                0.         0.         0.
           0.        0.                 0.        0.                0.        0.
           .436E+00  .940E-03           .436E+00  .357E-02          .436E+00  .726E-02
           .436E+00  .124E-01           .436E+00  .196E-01          .436E+00  .269E-01
           .436E+00  .320E-01           .436E+00  .357E-01          .436E+00  .383E-01
           .436E+00  .402E-01           .436E+00  .419E-01          .436E+00  .443E-01
           .436E+00  .477E-01           .436E+00  .524E-01          0.        0.
           0.        0.                 0.        0.                0.        0.

TIME,ELAPSED TIME (SECONDS)                  .080       .036


TIME,ELAPSED TIME (SECONDS)                  .081       .001
RELATIVE ERROR-1ST INTEGRAL    .000001
RELATIVE ERROR-2ND INTEGRAL    .000007
RELATIVE ERROR-3RD INTEGRAL    .000005


TIME,ELAPSED TIME (SECONDS)                  .094       .013


TIME,ELAPSED TIME (SECONDS)                  .097       .003


TIME,ELAPSED TIME (SECONDS)                  .099       .002


                 FARFLD ENTRY     NMAX=      1

TIME,ELAPSED TIME (SECONDS)                  .147       .048

N,IERR,JERR,ERRMAX1           1        24          10      .58E-01

N,IERR,JERR,ERRMAX1           2        22          11      .69E-01

N,IERR,JERR,ERRMAX1           3        23          12      .71E-01

N,IERR,JERR,ERRMAX1           4        23          13      .76E-01

TIME,ELAPSED TIME (SECONDS)                  .275       .128


                 FARFLD ENTRY     NMAX=      5

TIME,ELAPSED TIME (SECONDS)                  .322       .047

N,IERR,JERR,ERRMAX1           5         2          18      .94E-01

N,IERR,JERR,ERRMAX1           6        24          15      .72E-01
```

```
N,IERR,JERR,ERRMAX1          7          24          16       .89E-01
N,IERR,JERR,ERRMAX1          8          24          17       .81E-01
N,IERR,JERR,ERRMAX1          9          24          18       .75E-01

TIME,ELAPSED TIME (SECONDS)                    .434        .162

                    FARFLD ENTRY     NMAX=     10

TIME,ELAPSED TIME (SECONDS)                    .532        .146
N,IERR,JERR,ERRMAX1          10         24           2       .71E-01
N,IERR,JERR,ERRMAX1          11          2          17       .41E-01
N,IERR,JERR,ERRMAX1          12         24          17       .35E-01
N,IERR,JERR,ERRMAX1          13         24          14       .34E-01
N,IERR,JERR,ERRMAX1          14         23           7       .31E-01

TIME,ELAPSED TIME (SECONDS)                    .692        .162

                    FARFLD ENTRY     NMAX=     15

TIME,ELAPSED TIME (SECONDS)                    .739        .047
N,IERR,JERR,ERRMAX1          15         24           6       .43E-01
N,IERR,JERR,ERRMAX1          16         24           5       .34E-01
N,IERR,JERR,ERRMAX1          17         24           4       .33E-01
N,IERR,JERR,ERRMAX1          18         24           3       .28E-01
N,IERR,JERR,ERRMAX1          19         24           3       .16E-01

TIME,ELAPSED TIME (SECONDS)                    .909        .170

                    FARFLD ENTRY     NMAX=     20

TIME,ELAPSED TIME (SECONDS)                    .956        .047
N,IERR,JERR,ERRMAX1          20         24           2       .27E-01
N,IERR,JERR,ERRMAX1          21         24          16       .15E-01
```

```
N,IERR,JERR,ERRMAX1         22        24         17     .14E-01

N,IERR,JERR,ERRMAX1         23        24         18     .12E-01

N,IERR,JERR,ERRMAX1         24        24         18     .82E-02

TIME,ELAPSED TIME (SECONDS)                   1.123       .167


                 FARFLD ENTRY     NMAX=   25

TIME,ELAPSED TIME (SECONDS)                   1.169       .046

N,IERR,JERR,ERRMAX1         25        24         19     .13E-01

N,IERR,JERR,ERRMAX1         26         2         18     .72E-02

N,IERR,JERR,ERRMAX1         27        24         18     .68E-02

N,IERR,JERR,ERRMAX1         28        24          7     .44E-02

N,IERR,JERR,ERRMAX1         29        24         19     .54E-02

TIME,ELAPSED TIME (SECONDS)                   1.337       .168


                 FARFLD ENTRY     NMAX=   30

TIME,ELAPSED TIME (SECONDS)                   1.383       .046

N,IERR,JERR,ERRMAX1         30        24          5     .56E-02
```

MACH NUMBER = .90   OMEGA = .060   AMPLITUDE= .026

****** MODE 2, PITCH, PAXIS= 0.000 X/C ******

PRESSURE COEFFICIENTS

I	BELOW AIRFOIL		ABOVE AIRFOIL		ABOVE - BELOW		X
8	-.311E+01	.149E+01	.310E+01	-.149E+01	.621E+01	-.298E+01	-.964E+00
9	-.314E+01	.151E+01	.313E+01	-.151E+01	.627E+01	-.302E+01	-.864E+00
10	-.275E+01	.129E+01	.275E+01	-.128E+01	.550E+01	-.257E+01	-.723E+00
11	-.232E+01	.138E+01	.232E+01	-.135E+01	.464E+01	-.273E+01	-.526E+00
12	-.290E+01	.212E+01	.291E+01	-.211E+01	.581E+01	-.424E+01	-.250E+00
13	-.468E+01	.325E+01	.470E+01	-.321E+01	.938E+01	-.646E+01	.258E-01
14	-.891E+01	.408E+01	.904E+01	-.399E+01	.180E+02	-.807E+01	.223E+00
15	-.665E+01	.199E+01	.672E+01	-.188E+01	.134E+02	-.387E+01	.364E+00
16	-.278E+01	.260E+00	.275E+01	-.176E+00	.553E+01	-.436E+00	.464E+00
17	-.202E+01	.490E-01	.199E+01	.136E-01	.401E+01	-.354E-01	.536E+00
18	-.159E+01	-.438E-01	.156E+01	.868E-01	.316E+01	.131E+00	.601E+00
19	-.118E+01	-.110E+00	.114E+01	.128E+00	.232E+01	.238E+00	.693E+00
20	-.737E+00	-.139E+00	.700E+00	.132E+00	.144E+01	.271E+00	.821E+00
21	-.208E+00	-.692E-01	.151E+00	.417E-01	.350E+00	.111E+00	.100E+01

N,IERR,JERR,ERRMAX1   31   24   4   .44E-02

N,IERR,JERR,ERRMAX1   32   24   3   .49E-02

N,IERR,JERR,ERRMAX1   33   23   2   .29E-02

N,IERR,JERR,ERRMAX1   34   24   2   .28E-02

TIME,ELAPSED TIME (SECONDS)   1.561   .178

FARFLD ENTRY   NMAX=   35

TIME,ELAPSED TIME (SECONDS)   1.609   .048

N,IERR,JERR,ERRMAX1   35   24   19   .32E-02

N,IERR,JERR,ERRMAX1   36   24   7   .17E-02

N,IERR,JERR,ERRMAX1   37   24   6   .18E-02

N,IERR,JERR,ERRMAX1   38   23   5   .15E-02

N,IERR,JERR,ERRMAX1   39   23   4   .13E-02

TIME,ELAPSED TIME (SECONDS)   1.771   .162

FARFLD ENTRY   NMAX=   40

```
TIME,ELAPSED TIME (SECONDS)                1.817      .046

N,IERR,JERR,ERRMAX1         40        24        2      .17E-02

N,IERR,JERR,ERRMAX1         41         2        3      .12E-02

N,IERR,JERR,ERRMAX1         42        24        3      .93E-03

N,IERR,JERR,ERRMAX1         43         2       18      .56E-03

N,IERR,JERR,ERRMAX1         44        24       15      .59E-03

TIME,ELAPSED TIME (SECONDS)                1.979      .162


                 FARFLD ENTRY     NMAX=    45

TIME,ELAPSED TIME (SECONDS)                2.025      .046

N,IERR,JERR,ERRMAX1         45         2       19      .86E-03

N,IERR,JERR,ERRMAX1         46        24       17      .58E-03

N,IERR,JERR,ERRMAX1         47        24       18      .66E-03

N,IERR,JERR,ERRMAX1         48        23       19      .40E-03

N,IERR,JERR,ERRMAX1         49        24       19      .32E-03

TIME,ELAPSED TIME (SECONDS)                2.192      .167


                 FARFLD ENTRY     NMAX=    50

TIME,ELAPSED TIME (SECONDS)                2.237      .045

N,IERR,JERR,ERRMAX1         50        24        2      .46E-03

N,IERR,JERR,ERRMAX1         51         2       18      .25E-03

N,IERR,JERR,ERRMAX1         52        24       15      .26E-03

N,IERR,JERR,ERRMAX1         53        23       16      .21E-03

N,IERR,JERR,ERRMAX1         54        24       17      .19E-03

TIME,ELAPSED TIME (SECONDS)                2.400      .163


                 FARFLD ENTRY     NMAX=    55
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```
TIME,ELAPSED TIME (SECONDS)                    2.446      .046

N,IERR,JERR,ERRMAX1          55         24          19     .21E-03

N,IERR,JERR,ERRMAX1          56          2          18     .17E-03

N,IERR,JERR,ERRMAX1          57         24           5     .13E-03

N,IERR,JERR,ERRMAX1          58          2           3     .88E-04

N,IERR,JERR,ERRMAX1          59         23          18     .83E-04

TIME,ELAPSED TIME (SECONDS)                    2.609      .163

                      FARFLD ENTRY    NMAX=    60

TIME,ELAPSED TIME (SECONDS)                    2.655      .046

N,IERR,JERR,ERRMAX1          60          2           2     .12E-03
```

MACH NUMBER = .90   OMEGA = .060   AMPLITUDE= .026

****** MODE 2, PITCH, PAXIS= 0.000 X/C ******

PRESSURE COEFFICIENTS

I	BELOW AIRFOIL		ABOVE AIRFOIL		ABOVE - BELOW		X
8	-.311E+01	.153E+01	.311E+01	-.153E+01	.621E+01	-.305E+01	-.964E+00
9	-.312E+01	.154E+01	.313E+01	-.154E+01	.625E+01	-.308E+01	-.864E+00
10	-.272E+01	-.129E+01	.272E+01	-.129E+01	.544E+01	-.259E+01	-.723E+00
11	-.229E+01	.136E+01	.229E+01	-.136E+01	.457E+01	-.272E+01	-.526E+00
12	-.289E+01	.214E+01	.289E+01	-.214E+01	.578E+01	-.428E+01	-.250E+00
13	-.465E+01	.328E+01	.465E+01	-.329E+01	.929E+01	-.657E+01	.258E-01
14	-.879E+01	.407E+01	.879E+01	-.407E+01	.176E+02	-.814E+01	.223E+00
15	-.654E+01	.196E+01	.654E+01	-.196E+01	.131E+02	-.392E+01	.364E+00
16	-.271E+01	.251E+00	.272E+01	-.251E+00	.543E+01	-.502E+00	.464E+00
17	-.196E+01	.406E-01	.197E+01	-.402E-01	.393E+01	-.808E-01	.536E+00
18	-.154E+01	-.490E-01	.154E+01	.496E-01	.308E+01	.985E-01	.601E+00
19	-.112E+01	-.105E+00	.112E+01	.106E+00	.224E+01	.211E+00	.693E+00
20	-.689E+00	-.118E+00	.690E+00	.119E+00	.138E+01	.238E+00	.821E+00
21	-.182E+00	-.355E-01	.183E+00	.368E-01	.364E+00	.722E-01	.100E+01

N,IERR,JERR,ERRMAX1   61   24   19   .77E-04

N,IERR,JERR,ERRMAX1   62   24   18   .68E-04

N,IERR,JERR,ERRMAX1   63   24   4   .51E-04

N,IERR,JERR,ERRMAX1   64   24   3   .39E-04

TIME,ELAPSED TIME (SECONDS)   2.833   .178

FARFLD ENTRY   NMAX=   65

TIME,ELAPSED TIME (SECONDS)   2.880   .047

N,IERR,JERR,ERRMAX1   65   24   19   .61E-04

N,IERR,JERR,ERRMAX1   66   2   19   .38E-04

N,IERR,JERR,ERRMAX1   67   24   6   .36E-04

N,IERR,JERR,ERRMAX1   68   23   5   .26E-04

N,IERR,JERR,ERRMAX1   69   2   6   .24E-04

TIME,ELAPSED TIME (SECONDS)   3.041   .161

FARFLD ENTRY   NMAX=   70

```
TIME,ELAPSED TIME (SECONDS)                 3.388        .047

N,IERR,JERR,ERRMAX1          70        24      [illegible]    .25E-04

N,IERR,JERR,ERRMAX1          71         2           3     .23E-04

N,IERR,JERR,ERRMAX1          72         2           3     .18E-04

N,IERR,JERR,ERRMAX1          73         2           2     .19E-04

N,IERR,JERR,ERRMAX1          74         2           2     .15E-04

TIME,ELAPSED TIME (SECONDS)                 3.250        .162


                    FARFLD ENTRY    NMAX=   75

TIME,ELAPSED TIME (SECONDS)                 3.296        .045

N,IERR,JERR,ERRMAX1          75         2          19     .20E-04

N,IERR,JERR,ERRMAX1          76        24           2     .98E-05

N,IERR,JERR,ERRMAX1          77        24           3     .93E-05

N,IERR,JERR,ERRMAX1          78         2           3     .79E-05

N,IERR,JERR,ERRMAX1          79         2           2     .11E-04

TIME,ELAPSED TIME (SECONDS)                 3.443        .167


                    FARFLD ENTRY    NMAX=   80

TIME,ELAPSED TIME (SECONDS)                 3.519        .046

N,IERR,JERR,ERRMAX1          80         2          19     .11E-04

N,IERR,JERR,ERRMAX1          81         2          19     .90E-05

N,IERR,JERR,ERRMAX1          82         2          19     .61E-05

N,IERR,JERR,ERRMAX1          83         2          19     .47E-05

N,IERR,JERR,ERRMAX1          84         2           2     .41E-05

TIME,ELAPSED TIME (SECONDS)                 3.674        .167


                    FARFLD ENTRY    NMAX=   85
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TIME,ELAPSED TIME (SECONDS)                    3.720        .046

N,IERR,JERR,ERRMAX1          85          2          2        .53E-05

N,IERR,JERR,ERRMAX1          86          2         19        .60E-05

N,IERR,JERR,ERRMAX1          87          2         19        .46E-05

N,IERR,JERR,ERRMAX1          88          2         17        .45E-05

N,IERR,JERR,ERRMAX1          89          2          2        .31E-05

TIME,ELAPSED TIME (SECONDS)                    3.885        .165

                  FARFLD ENTRY     NMAX=    90

TIME,ELAPSED TIME (SECONDS)                    3.933        .048

N,IERR,JERR,ERRMAX1          90          2          5        .30E-05
```

MACH NUMBER = .90 OMEGA = .060 AMPLITUDE= .026

****** MODE 2, PITCH, PAXIS= 0.000 X/C ******

PRESSURE COEFFICIENTS

I	BELOW AIRFOIL		ABOVE AIRFOIL		ABOVE - BELOW		X
8	-.311E+01	.153E+01	.311E+01	-.153E+01	.621E+01	-.305E+01	-.964E+00
9	-.312E+01	.154E+01	.312E+01	-.154E+01	.625E+01	-.307E+01	-.864E+00
10	-.272E+01	.129E+01	.272E+01	-.129E+01	.544E+01	-.259E+01	-.723E+00
11	-.229E+01	.136E+01	.229E+01	-.136E+01	.458E+01	-.272E+01	-.526E+00
12	-.289E+01	.214E+01	.289E+01	-.214E+01	.578E+01	-.427E+01	-.250E+00
13	-.465E+01	.328E+01	.465E+01	-.328E+01	.929E+01	-.657E+01	.258E-01
14	-.879E+01	.407E+01	.879E+01	-.407E+01	.176E+02	-.813E+01	.223E+00
15	-.654E+01	.196E+01	.654E+01	-.196E+01	.131E+02	-.392E+01	.364E+00
16	-.272E+01	.251E+00	.272E+01	-.251E+00	.543E+01	-.501E+00	.464E+00
17	-.197E+01	.400E-01	.197E+01	-.400E-01	.393E+01	-.801E-01	.536E+00
18	-.154E+01	-.496E-01	.154E+01	.496E-01	.308E+01	.992E-01	.601E+00
19	-.112E+01	-.106E+00	.112E+01	.106E+00	.224E+01	.211E+00	.693E+00
20	-.690E+00	-.119E+00	.690E+00	.119E+00	.138E+01	.238E+00	.821E+00
21	-.182E+00	-.364E-01	.182E+00	.364E-01	.364E+00	.728E-01	.100E+01

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N,IERR,JERR,ERRMAX1        91         2         4      .29E-05

N,IERR,JERR,ERRMAX1        92         2        19      .36E-05

N,IERR,JERR,ERRMAX1        93         2         2      .33E-05

N,IERR,JERR,ERRMAX1        94         2        19      .32E-05

TIME,ELAPSED TIME (SECONDS)                4.112     .179


              FARFLD ENTRY    NMAX=   95

TIME,ELAPSED TIME (SECONDS)                4.161     .049

N,IERR,JERR,ERRMAX1        95         2         2      .31E-05

N,IERR,JERR,ERRMAX1        96         2        19      .23E-05

N,IERR,JERR,ERRMAX1        97         2         2      .25E-05

N,IERR,JERR,ERRMAX1        98         2        19      .26E-05

N,IERR,JERR,ERRMAX1        99         2         2      .24E-05

TIME,ELAPSED TIME (SECONDS)                4.323     .162


              FARFLD ENTRY    NMAX=  100
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```
TIME,ELAPSED TIME (SECONDS)                4.369      .046
N,IERR,JERR,ERRMAX1        100        2        19      .26E-05
N,IERR,JERR,ERRMAX1        101        2         2      .24E-05
N,IERR,JERR,ERRMAX1        102        2        19      .2[illegible]E-05
N,IERR,JERR,ERRMAX1        103        2         2      .19E-05
N,IERR,JERR,ERRMAX1        104        2        19      .20E-05

TIME,ELAPSED TIME (SECONDS)                4.538      .169

               FARFLD ENTRY     NMAX=  105

TIME,ELAPSED TIME (SECONDS)                4.583      .045
N,IERR,JERR,ERRMAX1        105        2         2      .18E-05
N,IERR,JERR,ERRMAX1        106        2        19      .18E-05
N,IERR,JERR,ERRMAX1        107        2         2      .18E-05
N,IERR,JERR,ERRMAX1        108        2        19      .17E-05
N,IERR,JERR,ERRMAX1        109        2         2      .15E-05

TIME,ELAPSED TIME (SECONDS)                4.748      .165

               FARFLD ENTRY     NMAX=  110

TIME,ELAPSED TIME (SECONDS)                4.794      .046
N,IERR,JERR,ERRMAX1        110        2        19      .15E-05
N,IERR,JERR,ERRMAX1        111        2         2      .15E-05
N,IERR,JERR,ERRMAX1        112        2        19      .14E-05
N,IERR,JERR,ERRMAX1        113        2         2      .14E-05
N,IERR,JERR,ERRMAX1        114        2        19      .14E-05

TIME,ELAPSED TIME (SECONDS)                4.960      .166

               FARFLD ENTRY     NMAX=  115
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TIME,ELAPSED TIME (SECONDS)                  5.005      .045

N,IERR,JERR,ERRMAX1        115          2          2     .13E-05

N,IERR,JERR,ERRMAX1        116          2         19     .12E-05

N,IERR,JERR,ERRMAX1        117          2          2     .12E-05

N,IERR,JERR,ERRMAX1        118          2         19     .12E-05

N,IERR,JERR,ERRMAX1        119          2          2     .12E-05

TIME,ELAPSED TIME (SECONDS)                  5.168      .163


                  FARFLD ENTRY     NMAX=   120

TIME,ELAPSED TIME (SECONDS)                  5.212      .044

N,IERR,JERR,ERRMAX1        120          2         19     .11E-05
```

MACH NUMBER = .90 OMEGA = .060 AMPLITUDE= .026

****** MODE 2, PITCH, PAXIS= 0.000 X/C ******

PRESSURE COEFFICIENTS

I	BELOW AIRFOIL		ABOVE AIRFOIL		ABOVE - BELOW		X
8	-.311E+01	.153E+01	.311E+01	-.153E+01	.621E+01	-.305E+01	-.964E+00
9	-.312E+01	.154E+01	.312E+01	-.154E+01	.625E+01	-.307E+01	-.864E+00
10	-.272E+01	.129E+01	.272E+01	-.129E+01	.544E+01	-.259E+01	-.723E+00
11	-.229E+01	.136E+01	.229E+01	-.136E+01	.458E+01	-.272E+01	-.526E+00
12	-.289E+01	.214E+01	.289E+01	-.214E+01	.578E+01	-.427E+01	-.250E+00
13	-.465E+01	.328E+01	.465E+01	-.328E+01	.929E+01	-.657E+01	.258E-01
14	-.879E+01	.407E+01	.879E+01	-.407E+01	.176E+02	-.813E+01	.223E+00
15	-.654E+01	.196E+01	.654E+01	-.196E+01	.131E+02	-.392E+01	.364E+00
16	-.272E+01	.251E+00	.272E+01	-.251E+00	.543E+01	-.501E+00	.464E+00
17	-.197E+01	.401E-01	.197E+01	-.400E-01	.393E+01	-.801E-01	.536E+00
18	-.154E+01	-.496E-01	.154E+01	.496E-01	.308E+01	.992E-01	.601E+00
19	-.112E+01	-.106E+00	.112E+01	.106E+00	.224E+01	.211E+00	.693E+00
20	-.690E+00	-.119E+00	.690E+00	.119E+00	.138E+01	.238E+00	.821E+00
21	-.182E+00	-.364E-01	.182E+00	.364E-01	.364E+00	.728E-01	.100E+01

N,IERR,JERR,ERRMAX1 121 2 2 .11E-05

N,IERR,JERR,ERRMAX1 122 2 19 .10E-05

N,IERR,JERR,ERRMAX1 123 2 2 .10E-05

N,IERR,JERR,ERRMAX1 124 2 19 .96E-06

TIME,ELAPSED TIME (SECONDS) 5.388 .176

FARFLD ENTRY NMAX= 125

TIME,ELAPSED TIME (SECONDS) 5.433 .045

N,IERR,JERR,ERRMAX1 125 2 2 .94E-06

N,IERR,JERR,ERRMAX1 126 2 19 .91E-06

N,IERR,JERR,ERRMAX1 127 2 2 .87E-06

N,IERR,JERR,ERRMAX1 128 2 19 .84E-06

N,IERR,JERR,ERRMAX1 129 2 2 .81E-06

TIME,ELAPSED TIME (SECONDS) 5.593 .160

FARFLD ENTRY NMAX= 130

```
TIME,ELAPSED TIME (SECONDS)                    5.640        .047

N,IERR,JERR,ERRMAX1        130          2           19        .78E-06

N,IERR,JERR,ERRMAX1        131          2            2        .76E-06

N,IERR,JERR,ERRMAX1        132          2           19        .74E-06

N,IERR,JERR,ERRMAX1        133          2            2        .71E-06

N,IERR,JERR,ERRMAX1        134          2           19        .68E-06

TIME,ELAPSED TIME (SECONDS)                    5.803        .163

                  FARFLO ENTRY    NMAX=  135

TIME,ELAPSED TIME (SECONDS)                    5.850        .047

N,IERR,JERR,ERRMAX1        135          2            2        .66E-06

N,IERR,JERR,ERRMAX1        136          2           19        .64E-06

N,IERR,JERR,ERRMAX1        137          2            2        .62E-06

N,IERR,JERR,ERRMAX1        138          2           19        .60E-06

N,IERR,JERR,ERRMAX1        139          2            2        .57E-06

TIME,ELAPSED TIME (SECONDS)                    6.016        .166

                  FARFLO ENTRY    NMAX=  140

TIME,ELAPSED TIME (SECONDS)                    6.062        .046

N,IERR,JERR,ERRMAX1        140          2           19        .56E-06

N,IERR,JERR,ERRMAX1        141          2            2        .54E-06

SOLUTION CONVERGED. MAXIMUM ERROR IS    .5368E-06
        RESMAX =    .30906E-01     I =     24      J =      2

TIME,ELAPSED TIME (SECONDS)                    6.153        .091
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MACH NUMBER = .90 OMEGA = .060 AMPLITUDE= .026

****** MODE 2, PITCH, PAXIS= 0.000 X/C ******

PRESSURE COEFFICIENTS

I	BELOW AIRFOIL		ABOVE AIRFOIL		ABOVE - BELOW		X
8	-.182E+00	-.364E-01	.182E+00	.364E-01	.108E+02	-.314E+01	-.964E+00
9	-.182E+00	-.364E-01	.182E+00	.364E-01	.655E+01	-.313E+01	-.864E+00
10	-.182E+00	-.364E-01	.182E+00	.364E-01	.561E+01	-.257E+01	-.723E+00
11	-.182E+00	-.364E-01	.182E+00	.364E-01	.462E+01	-.265E+01	-.526E+00
12	-.182E+00	-.364E-01	.182E+00	.364E-01	.582E+01	-.421E+01	-.250E+00
13	-.182E+00	-.364E-01	.182E+00	.364E-01	.936E+01	-.638E+01	.258E-01
14	-.182E+00	-.364E-01	.182E+00	.364E-01	.178E+02	-.820E+01	.223E+00
15	-.182E+00	-.364E-01	.182E+00	.364E-01	.134E+02	-.400E+01	.364E+00
16	-.182E+00	-.364E-01	.182E+00	.364E-01	.545E+01	-.438E+00	.464E+00
17	-.182E+00	-.364E-01	.182E+00	.364E-01	.394E+01	-.143E-01	.536E+00
18	-.182E+00	-.364E-01	.182E+00	.364E-01	.308E+01	.167E+00	.601E+00
19	-.182E+00	-.364E-01	.182E+00	.364E-01	.223E+01	.280E+00	.693E+00
20	-.182E+00	-.364E-01	.182E+00	.364E-01	.135E+01	.306E+00	.821E+00
21	-.182E+00	-.364E-01	.182E+00	.364E-01	0.	0.	.100E+01

TIME,ELAPSED TIME (SECONDS) 6.175 .022

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