SCANNING NASTRAN OUTPUT DATA FOR

MAXIMUM AND MINIMUM VALUES

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SUMMARY

A new computer program called NASCAN (NASTRAN scan) is offered as a service to NASTRAN users by Control Data Corporation CYBERNET Data Centers. NASCAN enables users to scan lengthy NASTRAN output files for maximum and minimum values in easy user-oriented categories. With this information quickly available through user terminals, a user can more confidently decide on what his next steps should be on the project. Areas of high stress or deflections in any of the NASTRAN rigid formats can be quickly detected and listed out for project documentations. The NASTRAN model can then be revised if necessary by updating an input file tape which is again processed through the NASTRAN program.

This relieves a user of the task of visually scanning lengthy output listings for this type of data. The text of the full output file listing can be used for more detailed documentation.

USING NASTRAN TO CREATE DATA FILES FOR SCANNING

Data to be saved for scanning by NASCAN are controlled by the user during his NASTRAN runs. The OUTPUT2 module of NASTRAN is utilized to request selected data blocks to be saved. Stresses, displacements, loads, velocities, accelerations, or eigenvectors can be chosen.

Figure 1 shows a tabulation of DMAP ALTER numbers and the corresponding NASTRAN data block names used in reference 1 that apply to each of the NASTRAN rigid formats. These names must be entered within the OUTPUT 2 DMAP ALTER statements by the user. The basic ALTER package within the NASTRAN executive control consists of the following cards:

```
ALTER yy
OUTPUT2 a, b, c, d, e // C, N, -1/C, N/11/V, N, P3 = zzzz$
SAVE P3$
OUTPUT2, , , , , //C, N, -9/C, N, 11/V, N, P3$
ENDALTER
```

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SYMBOLS

ALTER yy	rigid format sequence number where the OUTPUT2 DMAP instructions should be inserted into the rigid format
a, b, c, d, e	NASTRAN output data block names taken from table 1; one to five data blocks can be output with OUTPUT2 instruction
11	signifies that NASTRAN should write its processing results onto file UT1; see page 5.3-20i of reference 2 for other options
zzzz	name assigned to the output tape for identification purposes; see reference 2 for more details

If the user does not wish the output listing for these data, the data block name can be removed from the OFP module instruction. This module formats tables and places them on the system output file; subsequently, these tables are printe

If the user wants to scan large data blocks, separate tapes should be used to speed up the scanning process.

A sample statics solution (Rigid Format 1) NASTRAN Executive and Case Contr creating two tapes for scanning with NASCAN is shown in figure 1. One tape will contain the stress output (data block OES1) on file UT1. The displacements (Dat block OUGV1) will be saved on file UT2. Both are called for in the NASTRAN Case Control.

USING THE NASCAN PROGRAM

These data tapes can now be scanned by the NASCAN program which can scan several types of data blocks and multireel files in a single execution. NASCAN input is organized into easily defined major and minor scans. A major scan pertains to one type of NASTRAN output such as element stresses or grid point displacements. It includes a definition of subcase loadings, grid point sets, element sets, frequency ranges, eigenvalues, or time steps to be examined.

Within each major scan several minor scans may be specified to define stre components and element types.

Tables 2, 3, and 4 are taken from reference 3 and illustrate entries for major and minor scans, along with an explanation of the scan termination card.

To illustrate the use of NASCAN with dynamic analysis data, figure 2 is an example of program controls to scan a frequency response analysis run. Note th range of frequencies and the element components requested.

Sample NASCAN input for scanning a statics run with an explanation of the entries is shown in figure 3. The corresponding NASTRAN executive control whic ated these data is shown in figure 4. Note that five data blocks were written the same tape in this example. NASTRAN output results illustrating scannable tput are shown in figure 5.

OUTPUT FROM NASCAN

All major scan parameters are clearly defined in a header block preceding e tabulation of results. The minor scan data are likewise identified with all tput results. Maximum, minimum, and average values are given at each minor an level.

The summary for each major scan (for example, stresses or displacements) ves the maximum and minimum values of all minor scans involved.

Sample output listings are shown in figures 6 and 7. It can be seen that ese data have great value when they represent a summary of large files of formation. Now the project engineer can quickly focus his attention on these gions of his model.

CONCLUDING REMARKS

A computer program called NASCAN (NASTRAN scan) has been described. NASCAN ables users to scan lengthy NASTRAN output files for maximum and minimum values easy user-oriented categories.

REFERENCES

NASTRAN Programmer's Manual. NASA SP-223(01).

NASTRAN User's Manual. NASA SP-222(01).

NASCAN User Information Manual. Control Data Corporation Publication No. 76070200.

Table 1. Alter Numbers and Data Block Names for CDC/NASTRAN

Rigid Format	1	2	3	4	4	5	5	6	7**	8**	9**	10**	11**	12**
Subset				1	2	1	2							
Alters: Phy.	119	107	105	100	157	100	142	162	156	166	161	131	159	154
Alters: Sol.	-	-	-	-	-	-	-	-	145	143	143	121	130	127
NASCAN styp Parameter Entries														
DISP	OUGV1	OUGV1		OUGV1	OUBGV1	OUGV1		OUGV1		OUPVC1	OUPV1		OUPVC1	OUPV1
SDISP*										OUDVC1	OUDV1		OUHVC1	OUHV1
EDISP			OPHIG				OPHIG		OCPHIP			OCPHIP		
SEDI*									OPHID			OPHIH		
VELO										OUPVC1	OUPV1		OUPVC1	OUPV1
SVEL*										OUDVC1	OUDV1		OUHVC1	OUHV1
ACCE										OUPVC1	OUPV1		OUPVC1	OUPV1
SACC*										OUDVC1	OUDV1		OUHVC1	OUHV1
SPCF	OQG1	OQG1	OQG1	OQG1	OQBG1	OQG1	OBQG1	OQG1	OQPC1	OQPC1	OQP1	OQPC1	OQPC1	OQP1
OLOA	OPG1	OPG1		OPG1		OPG1		OPG1		OPPC1	OPP1		OPPC1	OPP1
NLLO*											OPNL1			OPNL1
STRE	OES1	OES1	OES1	OES1	OESB1	OES1	OBES1	OES1	OESC1	OESC1	OES1	OESC1	OESC1	OES1
ELFO	OEF1	OEF1	OEF1	OEF1	OEFB1	OEF1	OBEF1	OEF1	OEFC1	OEFC1	OEF1	OEFC1	OEFC1	OEF1

*Output from module VDR (solution set)
**Do not use a subcase structure without special alters

NOTE: COMP = i is also a valid entry for defining how a minor scan should be performed. See Table 3.

COMP(MAGN) = i = a grid data scanning sub-option that can be specified if the user wants NASCAN to determine vector sums of translations or rotations at a grid point. This only applies to real number data. Only the first component number (e.g., 1 for translations or 4 for rotations) can be specified. A valid example of a translation vector sum is:

SET 100 = 1
DISP COMP(MAGN) = 100

A valid example pertaining to a rotation vector sum is:

SET 200 = 4
DISP COMP(MAGN) = 200

NOTE: Only data using the default CDC/NASTRAN SORT1 option can be input to NASCAN.

Table 2. Valid styp Entries for Major Scans

Valid Entry Columns 1-4	Function
STRE	Specifies that a stress scan should be performed. A BOTH entry is allowed when the user wants to select a sub-option for scanning fiber stresses on each side of selected plate elements. Table 4 lists valid elements and components. Table 3 lists valid parameters that are necessary when entering STRE with a minor scan.
ELFO	Specifies that an element force scan should be performed. Table 4 lists valid elements and components. Table 3 lists valid parameters that must accompany an ELFO entry when a minor scan is being defined.
DISP	Specifies a displacement scan (physical set); applies to grid data scans.*
SDIS	Requests a displacement scan (solution set); applies to grid data scans.*
EDIS	Specifies an eigenvector scan (physical set); applies to grid data scans.*
SEDI	Requests an eigenvector scan (solution set); applies to grid data scans.*
VELO	Specifies a velocity scan (physical set); applies to grid data scans.*
SVEL	Requests a velocity scan (solution set); applies to grid data scans.*
ACCE	Specifies an acceleration scan (physical set); applies to grid data scans.*
SACC	Requests an acceleration scan (solution set); applies to grid data scans.*

*Data blocks for the physical set are output from module SDR1, while blocks for the solution set are output from module VDR.

Table 2. Valid styp Entries for Major Scans (Cont'd)

Valid Entry Columns 1-4	Function
SPCF	Specifies an SPC force scan; applies to grid data scans.*
OLOA	Requests a static or dynamic load scan; applies to grid data scans.*
NLLO	Specifies a non-linear load scan (solution set); applies to grid data scans.*

*Data blocks for the physical set are output from module SDR1, while blocks for the solution set are output from module VDR.

Table 3. Entries Accompanying STRE and ELFO (Minor Scans)

Entry	Function
COMP = i	This mandatory entry specifies the set number (i parameter) that identifies which components should be scanned. Table 4 lists the allowable integer values that represent entries that can be scanned for real and complex forces and stresses. NOTE: For complex numbers, the magnitude is always used. Only 10 entries can be specified for each request set.
ELEM = bcd	This mandatory entry specifies the appropriate element type. Valid entries for the bcd parameter are shown in the first column of Table 4. The minor scan option allows the user to determine the minimum and maximum value of all specified element types. Since this output is compared by component number in the final summary, the user should only specify similar element types (by grouping) as shown in Table 4 when he requests a major scan. NOTE: The bcd parameter refers to the same mnemonic that CDC/NASTRAN employs for element types. See Table 4 for a list of allowable element types. A valid example of COMP = i and ELEM = bcd is: ELFO ELEM = ROD COMP = 110
BOTH	This optional entry causes NASCAN to search the plate fiber stresses on each side of the element to locate a maximum absolute value. This value is then listed with an appropriate mathematical sign. Subsequently, the program finds a minimum absolute value for this side only (containing maximum) and lists it with its appropriate sign. If compressive stresses are higher than tension stress, they are listed as minimum. The BOTH option only applies to real element stresses. Table 4 lists allowable components. When selecting the BOTH option, users must enclose this entry within parentheses. This option can not be selected unless ELEM and COMP are also selected. A valid example of its use is: STRE ELEM = QDPLT COMP(BOTH) = 78

Table 4. NASCAN Element Types and Components for Minor Scans

Element Types	Stresses			Forces		
	Component Real	Code Complex	Component	Component Real	Code Complex	Component
AR	2	2	Stress, A1	2	2	Bend-mom, A1
	3	3	Stress, A2	3	3	Bend-mom, A2
	4	4	Stress, A3	4	3	Bend-mom, B1
	5	5	Stress, A4	5	5	Bend-mom, B2
	6	6	Axial stress	6	6	Shear-1
	7	-	Max stress, A	7	7	Shear-2
	8	-	Min stress, A	8	8	Axial force
	9	-	Safety margin-ten	9	9	Torque
	10	12	Stress, B1			
	11	13	Stress, B2			
	12	14	Stress, B3			
	13	15	Stress, B4			
	14	-	Max stress, B			
	15	-	Min stress, B			
	16	-	Safety margin-com			
ETRA	2	2	Normal-X	undefined		
EXA1	3	3	Normal-Y			
EXA2	4	4	Normal-Z			
EDGE	5	5	Shear-YZ			
	6	6	Shear-XZ			
	7	7	Shear-XY			
	8		Octahedral			
	9		Pressure			
RIM6†	3	-	Normal-X	undefined		
	4	-	Normal-Y			
	5	-	Shear-XY			
	6	-	Shear angle			
	7	-	Maj-prin			
	8	-	Min-prin			
	9	-	Max-shear			

Major Scan Termination Card

A scan termination card (also called a FOR card) is required at the end of each major scan definition. Its purpose is to signal the end of the appropriate major scan data. This card should be filled out according to the following format:

$$\text{FOR}\begin{bmatrix}\text{ELEM}\\ \text{GRID}\end{bmatrix} = \underline{i},\ \text{SUBCASE} = \underline{i},\ \text{RANGE} = \underline{r_1},\ \underline{r_2}$$

†All three corners and centers are scanned.

```
ID    A,B
SOL   1,0
TIME  3
APP   DISP
†ALTER 9,11
†ALTER 14,19
ALTER 119
OUTPUT2 OES1,,,,//C,N,-1/C,N,11/V,N,P1=STRESS$
SAVE  P1
OUTPUT2 ,,,,,//C,N,-9/C,N,11/V,N,P1$
OUTPUT2 OUGV1,,,,//C,N,-1/C,N,12/V,N,P2=IDSPL$
SAVE  P2
OUTPUT2 ,,,,,//C,N,-9/C,N,12/V,N,P2$
†ALTER 122,126
ENDALTER
CEND
```

Executive control instructions

```
TITLE=TESTING
     DISP=ALL
     STRESS=ALL
SUBCASE 1
     LOAD=10
SUBCASE 10
     LOAD=12
     SPC=10
```

Displacements requested (DISP=ALL)

Stresses requested (STRESS=ALL)

Case control instructions

```
BEGIN BULK
.
.
.
ENDDATA
```

CDC/NASTRAN bulk data cards

†Required alters for Rigid Format 1 to bypass the plotting modules

Figure 1.- Generating SCAN data for the NASCAN Program with CDC/NASTRAN.

Figure 2 illustrates how to check NASCAN input data without mounting CDC/NASTRAN output tapes. This example also shows that the CDC/NASTRAN tapes should undergo a frequency response analysis (rigid format 8). In this second instance, the user must enter a COMPLEX = 1 option on his overall parameter card.

```
TITLE=DATA CHECK FOR NASTRAN FREQ. RESP. ANALYSIS RUN.
COMPLEX=1 TIME=1 RESTART=0 NLPP=50
SET 10=1
SET 12=1,2
SET 3=632 THRU 695, 704 THRU 711, 961 THRU 1000
SET 4=2,4,6
SET 5=90 THRU 92, 94 THRU 96
END
SCAN TITLE=MEMBRANE ELEMENTS--STRESS
SCAN SUBTITLE=QDMEM QDMEM1 QDMEM2 TRMEM
SCAN LABEL=SKIP TRIA2
STRE COMP=4 ELEM=QDMEM
     COMP=4 ELEM=QDMEM1
     COMP=4 ELEM=QDMEM2
     COMP=4 ELEM=TRMEM
FOR SUBCASE=10 ELEMENTS=3 RANGE=0.0  100.0
SCAN TITLE=DISPLACEMENTS RANGE 1.E-09 0.5
DISP COMP=12
FOR GRID=5 SUBC=12 RANGE=1.-09  0.5
```

Page TITLE card.

Overall parameter card.

SET definition cards.

Major Scan
1. Complex element stresses
2. SUBCASE=1 (SET 10=1)
3. Elements defined by SET 3
4. Range of frequencies=0.0 to 100.0

Minor Scan #1
1. Element type=QDMEM
2. Components=2,4,6 (SET 4)
3. See Table 3-1

Minor Scan #2
1. Element type=QDMEM1
2. Components=2,4,6

Minor Scan #3
1. Element type=QDMEM2
2. Components=2,4,6

Minor Scan #4
1. Element type=TREMEM
2. Components=2,4,6

Major Scan
1. Complex displacement
2. Range 1.0E-09 to 0.5
3. SUBCASES=1 and 2 (SET 12)
4. Grid points=90 thru 92, 94 thru 96

Minor Scan #1
1. Components=1 and 2 (SET 12)

Figure 2.- Sample NASCAN Program controls: checking input.

```
$SEQUENCE,xxx.
$CHARGE,xxxxxx.
JOB,CM20000,CL20000,T50,P4,TP1.
REQUEST,PROG,HI.(KEY=NASCAN,LIB=APPLIB,NORING)
REWIND(PROG)
COPYBF(PROG,NASCAN)
UNLOAD(PROG)
REWIND(NASCAN)
REQUEST,TAPE1,HI.(xxxxx,NORING)
REWIND(TAPE1)
RFL,70000.
NASCAN.
789
TITLE=DATA CHECK FOR CDC/NASTRAN STATIC ANALYSIS
NTAPE=1, TIME=25
SET 1=1
SET 2=3 THRU 5
SET 3=1 THRU 60, 71 THRU 80
SET 4=2,3
SET 5=6
SET 6=61 THRU 70
SET 10=10
SET 11=11
STRE ELEM=TRIA1,COMP=2
     ELEM=TRIA2,COMP=2
     ELEM=QUAD2,COMP=2
     COMP=2,ELEM=QUAD1
FOR SUBCASE=10, ELEMENTS=3
EFLO ELEMENTS=TRMEM,COMP=4
     ELEMENTS=QDMEM,COMP=4
FOR SUBCASE=10,ELEM=3
STRE COMP=5,ELEM=BAR
FOR SUBCASE=11, ELEMENTS=6
END
```

```
Major Scan
1. Real element stresses
2. SUBCASE 10 (SET 10=10)
3. Element numbers defined by SET 3
Minor Scan #1
1. Element type=TRIA1
2. Components=SET 2=3,4,5
3. See Table 3-1
Minor Scan #2
1. Element type=TRIA2
2. Components=3,4,5
Minor Scan #3
1. Element type=QUAD2
2. Components=3,4,5

Major Scan
1. Real element forces
2. SUBCASE 10
3. Element numbers defined by SET 3
Minor Scan #1
1. Components=SET 4=2,3
2. Element type=TRMEM
Minor Scan #2
1. Components=2,3
2. Element type=TRMEM

Major Scan
1. Real element stresses
2. SUBCASE 11 (SET 11=11)
3. Element numbers defined by SET 6
Minor Scan #1
1. Components=SET 5=6
2. Element type=BAR
```

Figure 3.- Sample NASCAN entries: scanning a statics run.

```
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     N A S T R A N   E X E C U T I V E   C O N T R O L   D E C K   E C H O

ID STRESS ELEMENT OMNIBUS
APP DISP
TIME  3
SOL 1,0
ALTER 9,11
ALTER 14,19
ALTER 119
OUTPUT2 OES1,OUGV1,OEF1,OPG1,OQG1 // C,N,-1/C,N,11/V,N,P3=TEST2 $
SAVE    P3 $
OUTPUT2,  ,,,,//C,N,-9/C,N,11/V,N,P3 $
ALTER   122,126
ENDALTER
CEND
```

Figure 4.- NASTRAN input.

45	G	0.0	0.0	-2.534249E-01	-1.202025E-01	4.520842E-01	0.0
49	G	0.0	0.0	-1.179519E-01	1.120555E-02	1.083306E-01	0.0
61	G	-3.303217E+01	-3.300000E+01	0.0	0.0	0.0	0.0
62	G	6.434090E-02	0.0	0.0	0.0	0.0	0.0
63	G	3.296703E+01	0.0	0.0	0.0	0.0	0.0
81	G	-2.040000E+00	-2.040000E+00	0.0	-2.842171E-14	1.904032E-14	-2.040000E+00
91	G	-6.787400E+04	-2.393623E+00	-6.306478E+04	0.0	0.0	0.0
92	G	-3.313255E+04	0.0	3.313255E+04	0.0	0.0	0.0
93	G	-6.787040E+04	2.393623E+00	6.379611E+04	0.0	0.0	0.0
94	G	-3.312297E+04	0.0	-3.312297E+04	0.0	0.0	0.0
95	G	0.0	4.121017E+03	-8.468160E+04	0.0	0.0	0.0
96	G	0.0	-3.948214E+03	1.213166E+05	0.0	0.0	0.0
97	G	0.0	3.961767E+03	8.736433E+04	0.0	0.0	0.0
98	G	0.0	-4.135371E+03	-1.187211E+05	0.0	0.0	0.0
99	G	0.0	6.024040E+03	-1.146640E+05	0.0	0.0	0.0
100	G	0.0	2.409000E+03	1.082209E+05	0.0	0.0	0.0
101	G	0.0	-2.499065E+03	1.115140E+05	0.0	0.0	0.0
102	G	0.0	-6.013104E+03	-1.113790E+05	0.0	0.0	0.0
103	G	0.0	-4.614711E+03	-9.233194E+04	0.0	0.0	0.0
104	G	0.0	-4.068204E+03	8.880405E+04	0.0	0.0	0.0
105	G	0.0	4.069834E+03	8.878159E+04	0.0	0.0	0.0
106	G	0.0	4.613163E+03	-9.230207E+04	0.0	0.0	0.0
107	G	0.0	0.0	8.138120E+03	0.0	0.0	0.0

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SUBTITLE CARD

LOAD SET 1000 SUBCASE 1

S T R E S S E S I N B E N D I N G Q U A D R I L A T E R A L S (C Q D P L T)

ELEMENT ID.	FIBRE DISTANCE	STRESSES IN ELEMENT COORD SYSTEM NORMAL-X	NORMAL-Y	SHEAR-XY	PRINCIPAL STRESSES (ZERO SHEAR) ANGLE	MAJOR	MINOR	MAX SHEAR
45	-5.000000E-02	1.282374E-01	5.577718E-01	1.519010E-01	72.3645	6.060614E-01	7.994780E-02	2.630568E-01
	5.000000E-02	-1.282374E-01	-5.577718E-01	-1.519010E-01	-17.6355	-7.994780E-02	-6.060614E-01	2.630568E-01

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SUBTITLE CARD

LOAD SET 1000 SUBCASE 1

S T R E S S E S I N G E N E R A L Q U A D R I L A T E R A L E L E M E N T S (C Q U A D 1)

ELEMENT ID.	FIBRE DISTANCE	STRESSES IN ELEMENT COORD SYSTEM NORMAL-X	NORMAL-Y	SHEAR-XY	PRINCIPAL STRESSES (ZERO SHEAR) ANGLE	MAJOR	MINOR	MAX SHEAR
47	-5.000000E-02	7.829556E-02	-2.207411E-03	9.931065E-03	6.9298	7.950259E-02	-3.414436E-03	4.145851E-02
	5.000000E-02	-7.829556E-02	2.207411E-03	-9.931065E-03	-83.0702	3.414436E-03	-7.950259E-02	4.145851E-02
49	-5.000000E-02	-1.560166E-02	2.525553E-01	1.642437E-01	64.6130	3.304981E-01	-9.354440E-02	2.120213E-01
	5.000000E-02	1.560166E-02	-2.525553E-01	-1.642437E-01	-25.3870	9.354440E-02	-3.304981E-01	2.120213E-01

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SUBTITLE CARD

LOAD SET 2000 SUBCASE 2

S T R E S S E S I N B E N D I N G Q U A D R I L A T E R A L S (C Q D P L T)

ELEMENT ID.	FIBRE DISTANCE	STRESSES IN ELEMENT COORD SYSTEM NORMAL-X	NORMAL-Y	SHEAR-XY	PRINCIPAL STRESSES (ZERO SHEAR) ANGLE	MAJOR	MINOR	MAX SHEAR
45	-5.000000E-02	2.564748E-01	1.115544E+00	3.038021E-01	72.3645	1.212123E+00	1.598956E-01	5.261136E-01
	5.000000E-02	-2.564748E-01	-1.115544E+00	-3.038021E-01	-17.6355	-1.598956E-01	-1.212123E+00	5.261136E-01

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SUBTITLE CARD

LOAD SET 2000 SUBCASE 2

S T R E S S E S I N G E N E R A L Q U A D R I L A T E R A L E L E M E N T S (C Q U A D 1)

ELEMENT ID.	FIBRE DISTANCE	STRESSES IN ELEMENT COORD SYSTEM NORMAL-X	NORMAL-Y	SHEAR-XY	PRINCIPAL STRESSES (ZERO SHEAR) ANGLE	MAJOR	MINOR	MAX SHEAR
47	-5.000000E-02	1.565911E-01	-4.414021E-03	1.986213E-02	6.9298	1.590052E-01	-6.028872E-03	8.291702E-02
	5.000000E-02	-1.565911E-01	4.414021E-03	-1.986213E-02	-83.0702	6.028872E-03	-1.590052E-01	8.291702E-02
49	-5.000000E-02	-3.120333E-02	5.051106E-01	3.284874E-01	64.6130	6.609962E-01	-1.870890E-01	4.240426E-01
	5.000000E-02	3.120333E-02	-5.051106E-01	-3.284874E-01	-25.3870	1.870890E-01	-6.609962E-01	4.240426E-01

Figure 5.- NASTRAN scannable output.

```
TITLE=CDC/NASTRAN TEST PROBLEM(RIGID FORMAT 1)
STAPE=1,TIME=25
SET 1 = 1
SET 2 = 2
SET 3 = 1 THRU 2
SET 10 = 10 THRU 19
SET 11 = 2 THRU 5
SET 20 = 1 THRU 61, 63 THRU 88
SET 21 = 2 THRU 4
SET  22 = 3,4,5
SET 40 = 41, 42, 43, 44, 45, 46, 48
SET 41 = 7,8,
              15,16
SET 42 = 7,8
SET 43 = 15,16
SET 80 = 80
SET 81 = 7 THRU 9
SET 90 = 91,92,94,95,96
SET 91 = 8,9
SET 110 = 2,3
SET 100=1
SET 200=6
SET 300=21 THRU 26
SET 400=82
SET 500=1 THRU 6
SET 501=61 THRU 110
END                                                                MAJOR SCANS
SCAN TITLE = ROD, TUBE AND CONROD - 10 SERIES ONLY, SUBCASE1  *STRESS*
STRE    ELEMENT = ROD , COMPONENTS = 11                                  1
        ELEMENT=TUBE  , COMPONENTS = 11
        ELEMENT=CONROD, COMPONENTS = 11
FOR SUBCASE = 1  ELEMENTS = 10
SCAN  SUBTITLE = SHEAR - 20 SERIES, BOTH SUBCASES.  *STRESS*
STRE    ELEMENT = SHEAR, COMP = 21                                       2
FOR SUBCASE = 3, ELEMENTS = 20
SCAN  LABEL = TWIST - 30 SERIES, SUBCASE 2     *STRESS*
STRE    ELEMENT = TWIST, COMP = 21                                       3
FOR SUBCASE = 2  ELEM = 20
SCAN  TITLE = PLATE ELEMENTS - 40 SERIES, BOTH SUBCASES  *STRESS*
SCAN  SUBTITLE= QDPLT, QUAD1, QUAD2, TRBSC, TRIA1, TRIA2, TRPLT,
STRE    ELEM=QDPLT  COMP(BOTH)=42
        ELEM=QUAD1  COMP=42
        ELEM = QUAD2  COMP = 43                                          4
        ELEM = TRBSC  COMP = 41
        ELEM=TRIA1  COMP=42
        ELEM = TRIA2  COMP = 43
        ELEM = TRPLT  COMP = 41
FOR SUBCASE = 3, ELEM = 20
SCAN  TITLE = MEMBRANE ELEMENTS - 60 SERIES, SUBCASE 2   *STRESS*
SCAN  SUBTITLE = QDMEM, QDMEM1  QDMEM2, TRIM6, TRMEM,
SCAN  LABEL     = USING BOTH CTRIM6 ELEMENTS, SKIP CTRIA2
STRE    COMP = 21                ELEM = QDMEM
        COMP = 21                ELEM = QDMEM1                           5
        COMP = 21                ELEM = QDMEM2
        COMP = 22                ELEM = TRIM6
        COMP = 21                ELEM = TRMEM
FOR SUBCASE = 2   ELEMENTS = 20
SCAN TITLE=TEST WITH ONE MINOR SCAN ONLY
STRE COMP=21 ELEM=QDMEM1                                                 6
FOR SUBCASE=2,ELEMENTS=20
SCAN TITLE = BAR 80 - SUBCASE 2     *STRESS*
STRE      ELEM = BAR     COMP = 81                                       7
FOR SUBCASE = 2,ELEM = 80
SCAN  TITLE = SOLID ELEMENTS, 90 SERIES, SUBCASE 1 *STRESS*
SCAN  SUBTITLE = CHEXA1, CHEXA2, CTETRA (BOTH), CWEDGE (94 ONLY),
SCAN  LABEL = PRESSURE AND OCTAHEDRAL ENTRIES,
STRE    ELEM = HEXA1      COMP = 91                                      8
        ELEM = HEXA2      COMP = 91
        ELEM = TETRA      COMP = 91
        ELEM = WEDGE      COMP = 91
FOR SUBCASE = 1          ELEMENTS = 90
SCAN  TITLE = ROD ELEMENTS   --- ELEMENT FORCES  ----
ELFO    ELEM = ROD        COMP = 110                                     9
        ELEM = TUBE       COMP = 110
        ELEM = CONROD     COMP = 110
FOR ELEMENTS = 20     SUBCASE = 2
SCAN TITLE = DISPLACEMENTS
DISP COMP = 3                                                            10
FOR   GRIDS = 11 SUBC = 3
SCAN TITLE = DISPLACEMENTS - BOTH OPTION
DISP     COMP(MAGNITUDE) = 1                                             11
FOR GRIDS = 21 SUBC = 2
SCAN TITLE=TEST FOR MAGN OPTION ON DISPLACEMENTS
DISP COMP(MAGN)=130                                                      12
FOR GRIDS=300  SUBC=2
SCAN TITLE=TEST FOR MAGN OPTION ON ROTATIONS
DISP COMP(MAGN)=1                                                        13
FOR GRIDS=400  SUBC=3
SCAN TITLE=TEST FOR ELEMENT OLOADS
OLOA  COMP=503                                                           14
FOR GRIDS=20  SUBC=3
SCAN TITLE=TEST FOR SPC FORCES
SPCF COMP=500                                                            15
FOR GRIDS=501 SUBC=3
END
```

Figure 6.- NASCAN Program control instructions.

```
R = 0.             43=EID        2=SUBC     2000=LOAD    MAX =  6.1898965E-02
R = 0.             43=EID        1=SUBC     1000=LOAD    MIN =  3.0949483E-02
                COMPONENT 15                 2 ENTRIES.  AVE =-4.6424224E-02--
R = 0.             43=EID        1=SUBC     1000=LOAD    MAX = -3.0949483E-02
R = 0.             43=EID        2=SUBC     2000=LOAD    MIN = -6.1898965E-02
                COMPONENT 16                 2 ENTRIES.  AVE =-6.4449174E-01--
R = 0.             43=EID        1=SUBC     1000=LOAD    MAX = -4.2966116E-01
R = 0.             43=EID        2=SUBC     2000=LOAD    MIN = -8.5932232E-01

*** SUMMARY -- COMPONENT  7   --------      12 ENTRIES.  AVE = 3.9931451E-01*
                   45=EID        2=SUBC     OOPLT        MAX = 1.2121227E+00
                   42=EID        1=SUBC     THBSC        MIN = 3.9953112E-02

*** SUMMARY -- COMPONENT  8   --------      12 ENTRIES.  AVE =-1.7706874E-01*
                   43=EID        2=SUBC     TRPLT        MAX = 6.1898965E-02
                   45=EID        2=SUBC     OOPLT        MIN =-1.2121227E+00

*** SUMMARY -- COMPONENT 15   --------       8 ENTRIES.  AVE = 7.3041993E-01*
                   46=EID        2=SUBC     QUAD2        MAX = 4.8469010E+00
                   44=EID        2=SUBC     TRIA2        MIN =-1.0119742E+00

*** SUMMARY -- COMPONENT 16   --------       8 ENTRIES.  AVE =-2.1334047E+00*
                   42=EID        1=SUBC     THBSC        MAX =-3.9953112E-02
                   46=EID        2=SUBC     QUAD2        MIN =-6.2848164E+00

 FOR ALL MINOR SCANS AND COMPONENTS. MAX = 4.8469010E+00. MIN =-6.2848164E+00

****************************************************************
* MAJOR SCAN   5. REAL ELEM-STRESS     RANGE 0.        TO 0.        *
* SUBCASE =        2                                                *
* ELEMENTS=        1     THRU      61       63     THRU     80      *
*  MEMBRANE ELEMENTS - 60 SERIES. SUBCASE 2   *STRESS*              *
*  QDMEM. QDMEM1  QDMEM2. TRIM6. TRMEM.                             *
*  USING BOTH CTRIM6 ELEMENTS. SKIP CTRIA2                          *
****************************************************************

* MINOR SCAN  1 - QDMEM   ELEMENTS - SUBOPTION (     ) ------------------
                COMPONENT  2                 1 ENTRIES.  AVE = 3.4106051E-13--
R = 0.             63=EID        2=SUBC     2000=LOAD    MAX =  3.4106051E-13
R = 0.             63=EID        2=SUBC     2000=LOAD    MIN =  3.4106051E-13
                COMPONENT  3                 1 ENTRIES.  AVE = 5.5786032E+01--
R = 0.             63=EID        2=SUBC     2000=LOAD    MAX =  5.5786032E+01
R = 0.             63=EID        2=SUBC     2000=LOAD    MIN =  5.5786032E+01
                COMPONENT  4                 1 ENTRIES.  AVE = 6.0000000E+01--
R = 0.             63=EID        2=SUBC     2000=LOAD    MAX =  6.0000000E+01
R = 0.             63=EID        2=SUBC     2000=LOAD    MIN =  6.0000000E+01



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****************************************************************
* MAJOR SCAN  12. REAL DISPLACEMENT    RANGE 0.        TO 0.        *
* SUBCASE =        2                                                *
* GRID NO.=       21     THRU      24                               *
* TEST FOR MAGN OPTION ON DISPLACEMENTS                             *
****************************************************************

* MINOR SCAN  1 - SUBOPTION (MAGN) ------------------------------------
                COMPONENT  1                 4 ENTRIES.  AVE = 8.5212859E-01--
R = 0.             24=GID.RT     2=SUBC     2000=LOAD    MAX =  1.6991984E+00
R = 0.             21=GID.RT     2=SUBC     2000=LOAD    MIN =  0.

 FOR ALL MINOR SCANS AND COMPONENTS. MAX = 1.6991984E+00. MIN = 0.

****************************************************************
* MAJOR SCAN  13. REAL DISPLACEMENT    RANGE 0.        TO 0.        *
* SUBCASE =        1     THRU       2                               *
* GRID NO.=       82                                                *
* TEST FOR MAGN OPTION ON ROTATIONS                                 *
****************************************************************

* MINOR SCAN  1 - SUBOPTION (MAGN) ------------------------------------
                COMPONENT  1                 2 ENTRIES.  AVE = 7.8426099E+00--
R = 0.             82=GID.RT     2=SUBC     2000=LOAD    MAX =  1.0456813E+01
R = 0.             82=GID.RT     1=SUBC     1000=LOAD    MIN =  5.2284066E+00

 FOR ALL MINOR SCANS AND COMPONENTS. MAX = 1.0456813E+01. MIN = 5.2284066E+00

****************************************************************
* MAJOR SCAN  14. REAL LOAD VECTOR     RANGE 0.        TO 0.        *
* SUBCASE =        1     THRU       2                               *
* GRID NO.=        1     THRU      61       63     THRU     80      *
* TEST FOR ELEMENT OLOADS                                           *
****************************************************************

* MINOR SCAN  1 - SUBOPTION (     ) -------------------------------------
                COMPONENT  1                80 ENTRIES.  AVE = 7.5000000E-02--
R = 0.              4=GID        2=SUBC     2000=LOAD    MAX =  4.0000000E+00
R = 0.             22=GID        2=SUBC     2000=LOAD    MIN = -2.0000000E+00
                COMPONENT  2                80 ENTRIES.  AVE = 6.1875000E-01--
R = 0.             77=GID        2=SUBC     2000=LOAD    MAX =  3.0000000E+00
R = 0.             74=GID        2=SUBC     2000=LOAD    MIN =  0.
                COMPONENT  3                80 ENTRIES.  AVE = 5.8125000E-02--
R = 0.             52=GID        2=SUBC     2000=LOAD    MAX =  2.1000000E+00
R = 0.             77=GID        2=SUBC     2000=LOAD    MIN =  0.
                COMPONENT  4                80 ENTRIES.  AVE = 1.8750000E-02--
R = 0.              4=GID        2=SUBC     2000=LOAD    MAX =  1.0000000E+00
R = 0.             77=GID        2=SUBC     2000=LOAD    MIN =  0.
                COMPONENT  5                80 ENTRIES.  AVE = 0.          --
```

Figure 7.- Sample NASCAN output.

```
R = 0.              77=GID         2=SUBC     2000=LOAD     MAX =  0.
R = 0.              77=GID         2=SUBC     2000=LOAD     MIN =  0.
                 COMPONENT   6                00 ENTRIES,   AVE = 0.          --
R = 0.              77=GID         2=SUBC     2000=LOAD     MAX =  0.
R = 0.              77=GID         2=SUBC     2000=LOAD     MIN =  0.

 FOR ALL MINOR SCANS AND COMPONENTS, MAX = 4.0000000E+00, MIN =-2.0000000E+00



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****************************************************************
* MAJOR SCAN  15. REAL SPC-FORCES      RANGE 0.          TO 0.   *
* SUBCASE =         1     THRU        2                         *
* GRID NO.=        61     THRU      100                         *
* TEST FOR SPC FORCES                                           *
****************************************************************

* MINOR SCAN  1 - SUBOPTION (     ) ---------------------------------
                 COMPONENT   1                50 ENTRIES,   AVE =-5.2241907E+03--
R = 0.              63=GID         2=SUBC     2000=LOAD     MAX =  3.2967826E+01
R = 0.              91=GID         2=SUBC     2000=LOAD     MIN = -6.7874083E+04
                 COMPONENT   2                50 ENTRIES,   AVE = 2.1925884E+02--
R = 0.              99=GID         2=SUBC     2000=LOAD     MAX =  6.0240480E+03
R = 0.              98=GID         2=SUBC     2000=LOAD     MIN = -4.1353709E+03
                 COMPONENT   3                50 ENTRIES,   AVE =-3.1674778E+01--
R = 0.              96=GID         2=SUBC     2000=LOAD     MAX =  1.2131660E+05
R = 0.              94=GID         2=SUBC     2000=LOAD     MIN = -1.1872105E+05
                 COMPONENT   4                50 ENTRIES,   AVE =-7.3504421E-16--
R = 0.             100=GID         2=SUBC     2000=LOAD     MAX =  0.
R = 0.              81=GID         2=SUBC     2000=LOAD     MIN = -2.8421709E-14
                 COMPONENT   5                50 ENTRIES,   AVE = 4.9242219E-16--
R = 0.              81=GID         2=SUBC     2000=LOAD     MAX =  1.9040325E-14
R = 0.             100=GID         2=SUBC     2000=LOAD     MIN =  0.
                 COMPONENT   6                50 ENTRIES,   AVE =-5.2758621E-02--
R = 0.             100=GID         2=SUBC     2000=LOAD     MAX =  0.
R = 0.              81=GID         2=SUBC     2000=LOAD     MIN = -2.0400000E+00

 FOR ALL MINOR SCANS AND COMPONENTS, MAX = 1.2131660E+05, MIN =-1.1872105E+05
```

Figure 7.- Concluded.