NASA Contractor Report 170392

NASTRAN MODEL OF A LARGE FLEXIBLE SWING-WING BOMBER

Volume V: NASTRAN Model Development—Fairing Structure

W. D. Mock and R. A. Latham

September 1982

NASA
National Aeronautics and
Space Administration

All Blank Pages in this Document

are Intentionally Left Blank

NASA Contractor Report 170392

NASTRAN MODEL OF A LARGE FLEXIBLE SWING-WING BOMBER

Volume V: NASTRAN Model Development—Fairing Structure

W. D. Mock and R. A. Latham
Rockwell International
Los Angeles Division
Los Angeles, California

Prepared for Dryden Flight Research Facility
under Contract NAS4-2614

National Aeronautics and
Space Administration

1982

N83-14111#

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

NASTRAN MODEL OF A LARGE FLEXIBLE SWING-WING BOMBER

Volume V: NASTRAN Model Development—Fairing Structure

W. D. Mock and R. A. Latham
Rockwell International Corporation
Los Angeles, California

SUMMARY

This report describes the development and validation of the NASTRAN model of the B-1 aircraft 2 (A/C-2) fairing structure. The development of this model completes the seven substructures defined in the Airloads Research Study NASTRAN Model Plans. Subsequently, these seven NASTRAN substructure models will be joined to form the NASTRAN model representation of the total aircraft structure. The intent is to utilize the assembled NASTRAN model computed stiffness matrix in conjunction with the FLEXSTAB program for aeroelastic analysis. The application of these advanced programs on a large, flexible aircraft that has accumulated significant flight-test data will add to the technology base for future transport aircraft.

During this contract phase, the NASTRAN model plan for the fairing structure was expanded in detail to generate the NASTRAN model of this substructure. The grid point coordinates, element definitions, material properties, and sizing data for each element were specified.

The fairing model was throughly checked out for continuity, connectivity, and constraints. The substructure was processed for structural influence coefficients (SIC) point loadings to determine the deflection characteristics of the fairing model. Finally, a demonstration and validation processing of this substructure was accomplished using the NASTRAN finite-element program installed at the NASA DFRC facility. The bulk data deck, stiffness matrices, and SIC output data were delivered to NASA DFRC.

INTRODUCTION

A/C-2 (figure 1) is employed in the Airloads Survey Flight Test program. This aircraft has undergone extensive ground testing to calibrate the strain

gages utilized in the airloads survey. The aircraft provides a reasonable simulation of a future transport aircraft since it employs the large, flexible structure (figure 2) envisioned in future transport designs.

The airloads data gathered during the flight-test program can be utilized in the evaluation of NASA computer programs recently developed to enhance the analytical techniques of predicting aeroelastic response of large, flexible aircraft. These analytical techniques include computerized structural analysis programs such as NASTRAN and FLEXSTAB.

Since the B-1 development program involves all experimental tests needed to correlate the analytical predictions with actual measured results, detailed plans for constructing a NASTRAN structural model of the B-1 airframe suitable for use on the NASA/DFRC Cyber computer were initiated. This model is of minimum complexity to give satisfactory flexibility characteristics for the FLEXSTAB aeroelastic analysis. Included in this model are the control surfaces, control system stiffness, and secondary leading edge and trailing edge structure. During this contract phase, detailed plans for constructing a NASTRAN model of the fairing substructure were implemented. Grid point coordinates for this substructure were coded for each element, and the material properties and sizing data were specified. The bulk data were throughly checked using interactive graphics techniques. The data were evaluated for continuity, connectivity, and constraints. In addition, the SIC point loadings were applied to compute the deflections at selected locations. A demonstration and validation processing of the NASTRAN model substructure was accomplished using the NASTRAN finite-element program installed on the NASA DFRC Cyber computer.

AIRCRAFT DESCRIPTION

The B-1 aircraft is a prototype long-range supersonic bomber with the capability of high-speed flight at low altitude. Configuration dimensions and general arrangement are presented in figure A-1. The aircraft utilizes a blended wing-body concept with variable-sweep wings, a single vertical stabilizer with a three-section (upper, intermediate, and lower) rudder, and horizontal stabilizers which operate independently to provide both pitch and roll control. The variable-sweep (15 to 67.5 degrees) wing, equipped with slats, spoilers (which also function as speed brakes), and flaps, provides the aircraft with a highly versatile operating envelope. Canted vanes, mounted on each side of the forward fuselage, are part of the structural mode control system which reduces structural bending oscillations in the vertical and lateral axes.

The aircraft is powered by four YF101-GE-100 dual-rotor augmented turbofan engines in the 30,000-pound-thrust class. The engines are mounted in twin nacelles below the wing, approximately at the left and right wing pivot points. For supersonic speeds, an air induction control system varies the internal geometry of the nacelle inlet ducts to maintain the required airflow to the engines for all flight conditions.

FAIRING

The total fairing substructure consists of the overwing fairings shown in figure 3 and the underwing fairings shown in figure 5. The fairing support structure is shown in figure 4.

The overwing fairing is comprised of the upper pivot fairings, the forward intermediate fairing, and the overwing movable fairing. The upper pivot fairings are above the wing pivot fitting and cover the region from fuselage stations 875 to 1036 and butt lines 119 to 188. These fairings are laminated fiberglass panels which are preloaded against the wing surface. The forward intermediate fairing, aft of the pivot fairings, is a sandwich panel with an aluminum core and fiberglass cover. This panel is cantilevered from the fuselage. The overwing movable fairing is a full-depth fiberglass honeycomb panel which extends aft to approximately fuselage station 1140. This movable fairing has a hinge support mounted on the forward intermediate fairing panel. The movable fairing is actuated by a track/trolley arrangement mounted on the movable fairing with support connection to the wing inboard trailing surface structure.

The underwing fairings are comprised of the lower pivot fairing and the intermediate and aft underwing fairing panels. The lower pivot fairing is below the wing pivot fitting and covers the region between fuselage stations 875 and 993 from butt lines 119 to 188. This fairing segment is constructed of laminated fiberglass and is preloaded against the wing structure. The intermediate and aft panels extend over the top of the nacelle structure and are supported by a series of linkages mounted on the nacelle structure. These linkages enable the panels to be actuated up or down during the wingsweep operations. The lower intermediate fairing panel is a machined aluminum plate. The lower aft panel is a sandwich panel with aluminum core and fiberglass face sheets.

Figures 6 through 8 are photographs showing the overwing fairing during the wing sweep operation. The pivot attach region of the support structure is shown in figure 9, viewed from the right-hand side of the aircraft, looking

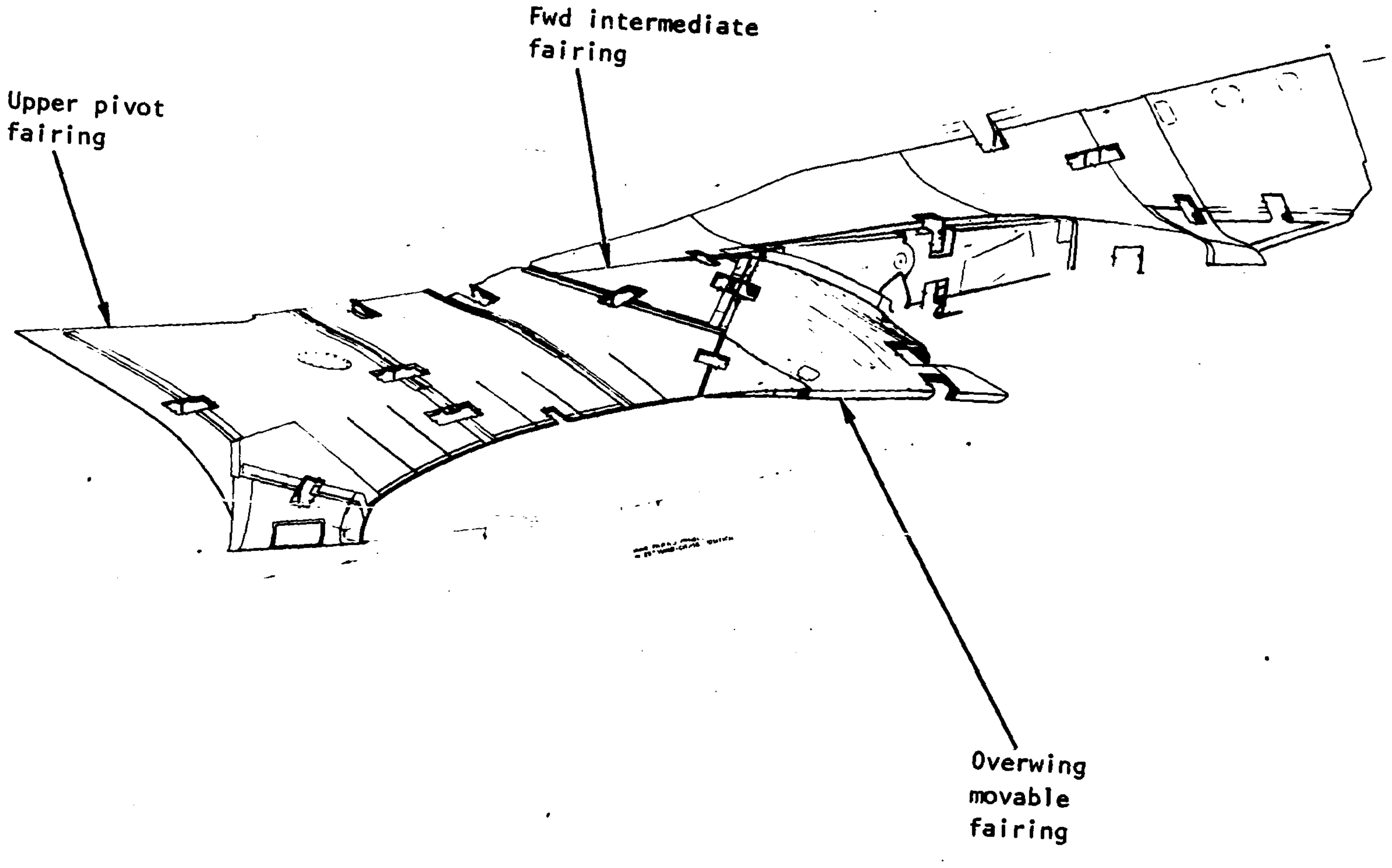


Figure 3. - Overwing fairings.

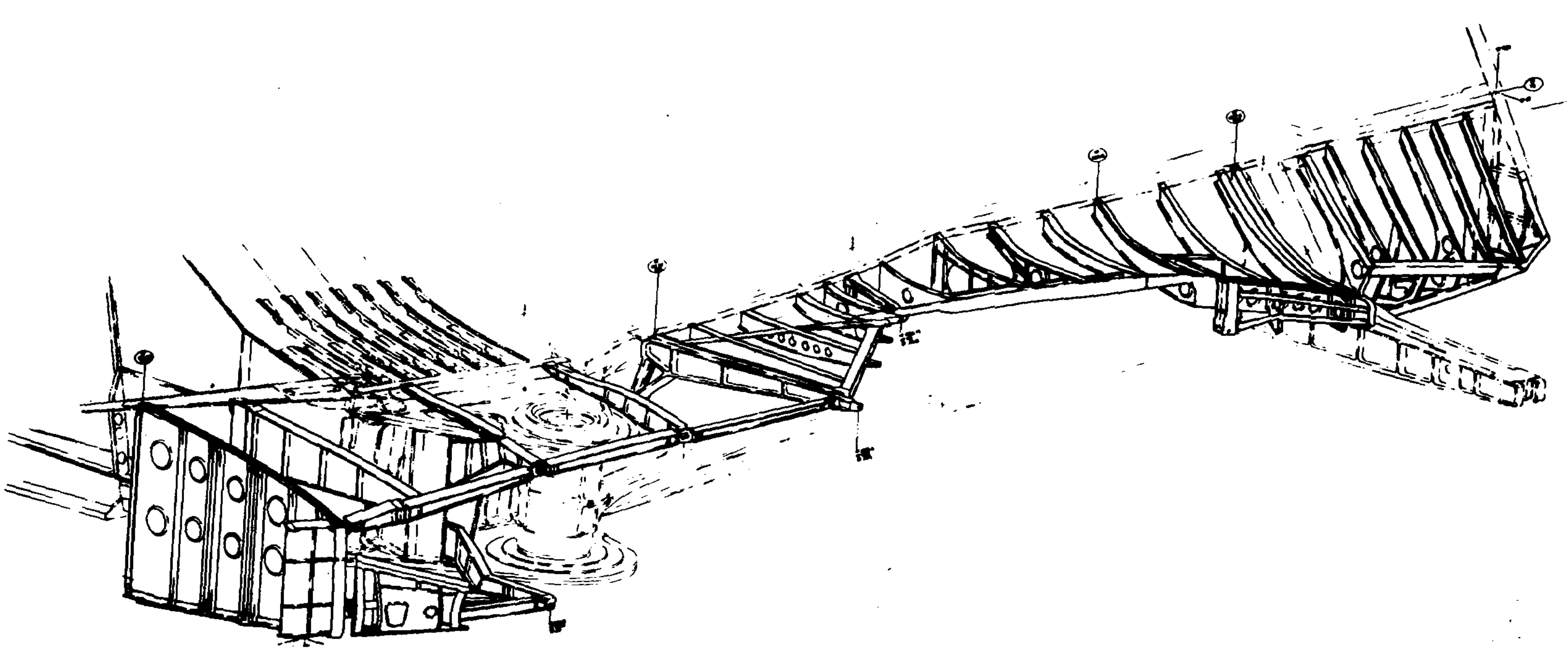


Figure 4. - Fairing support structure.

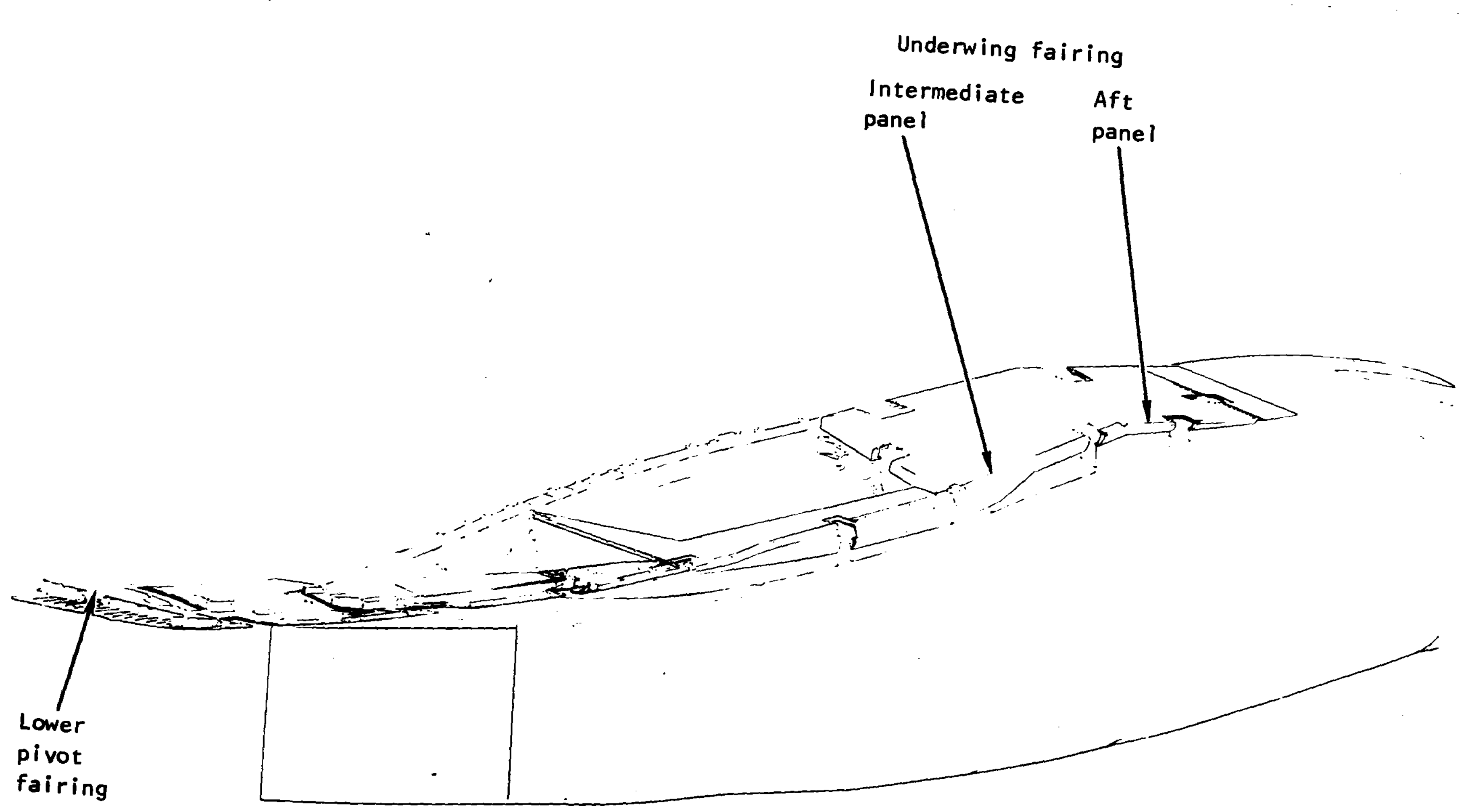


Figure 5. - Underwing fairings.

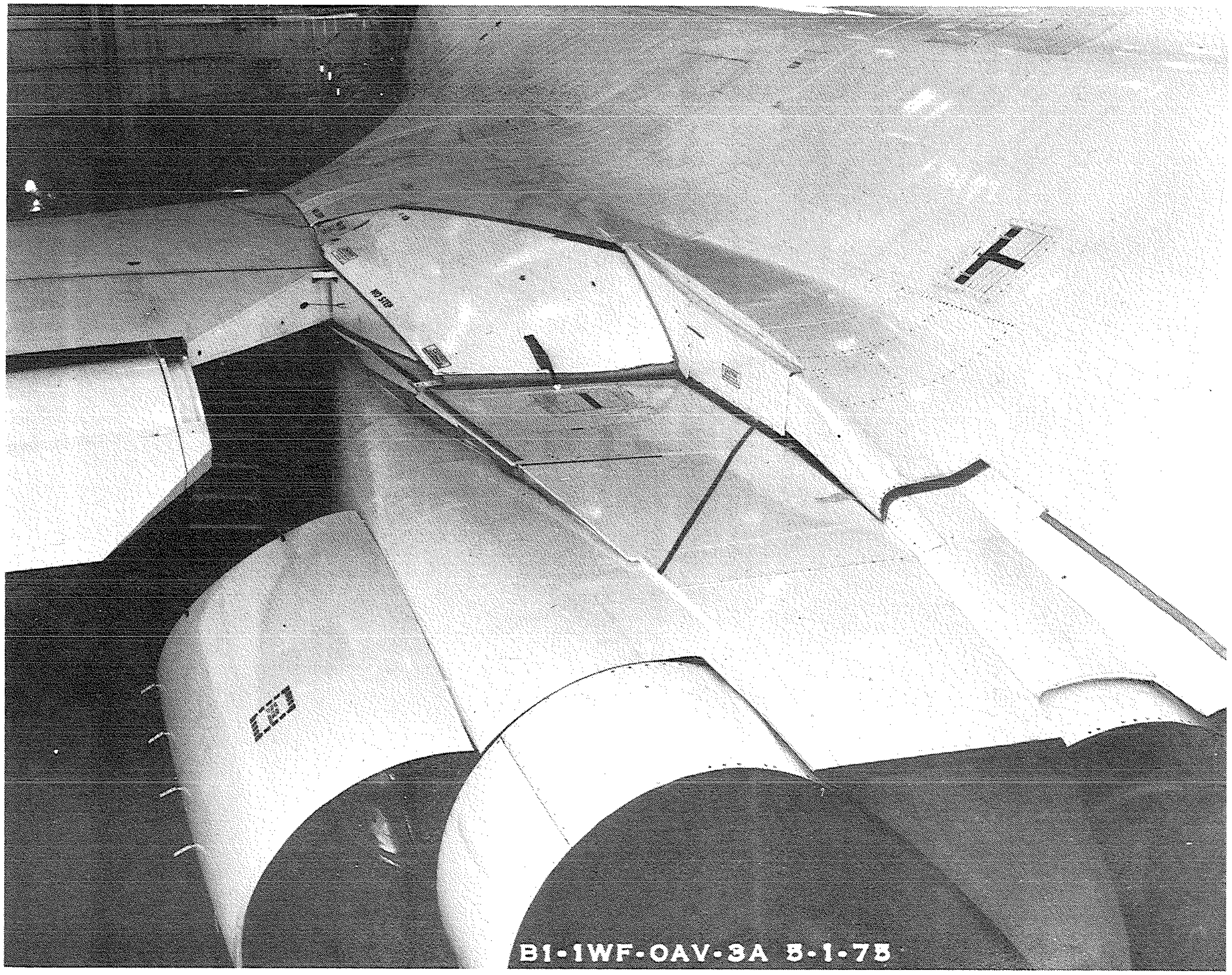


Figure 6. - Fairing position at forward sweep.

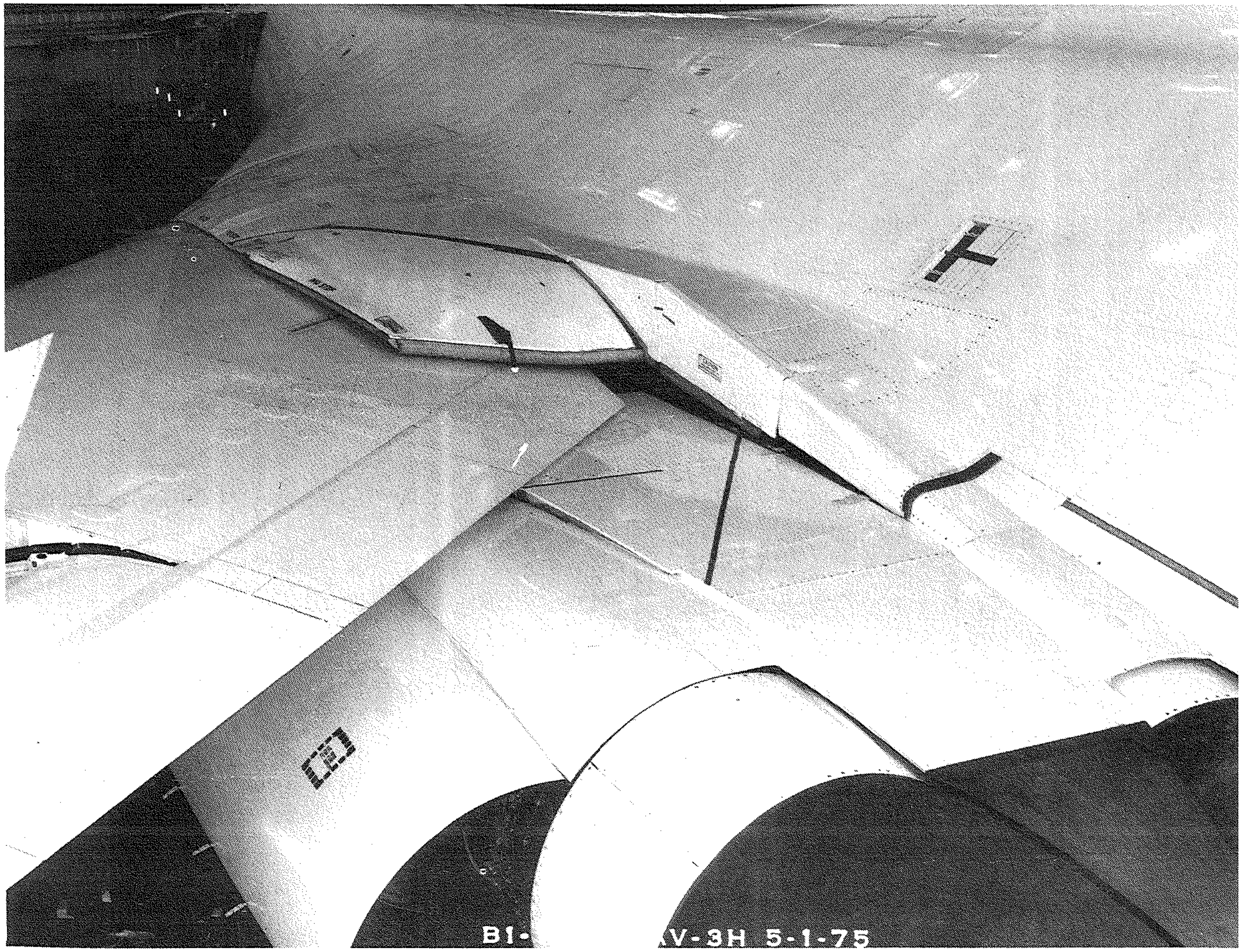


Figure 7. - Fairing position at intermediate sweep.

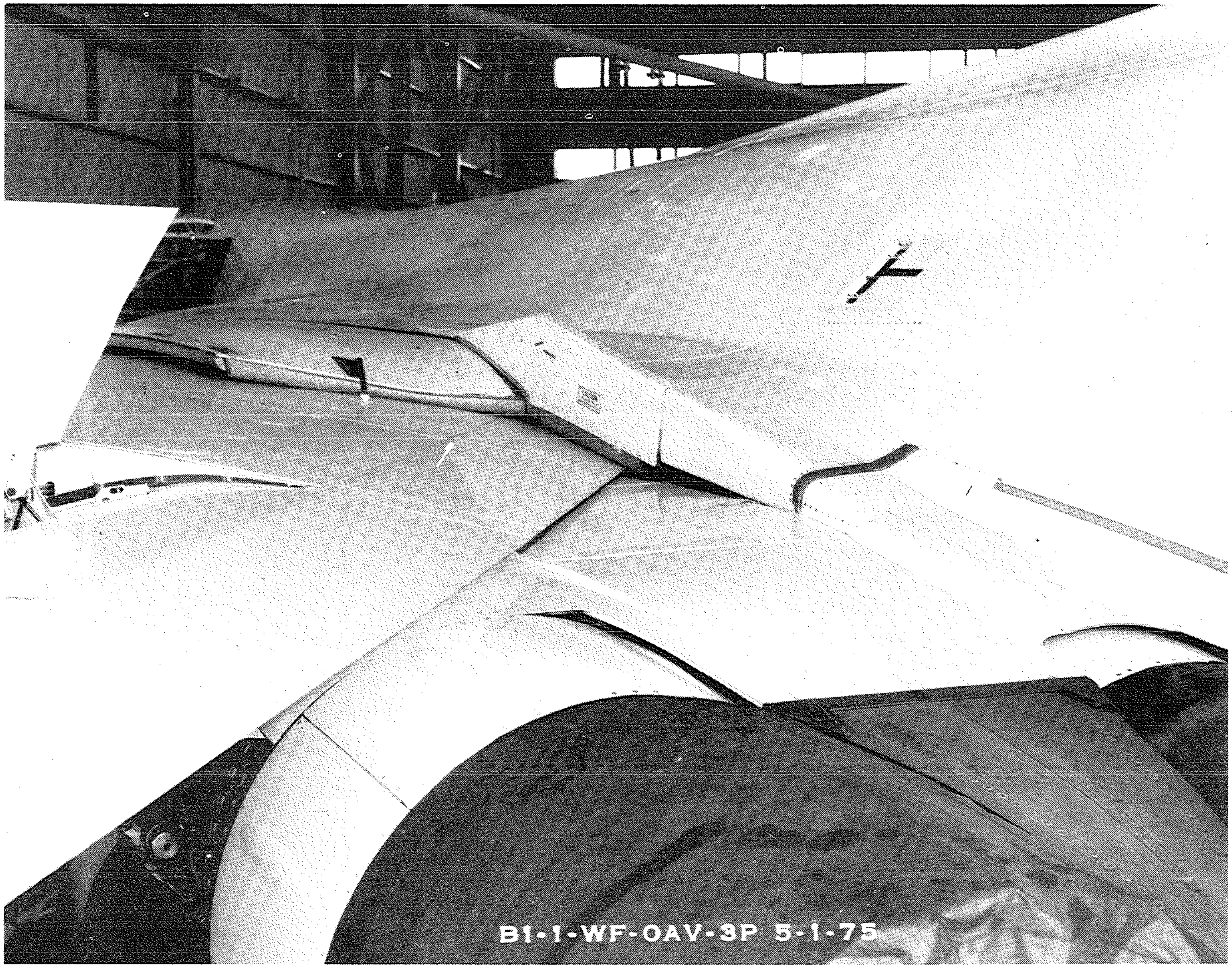


Figure 8. - Fairing position at aft sweep.

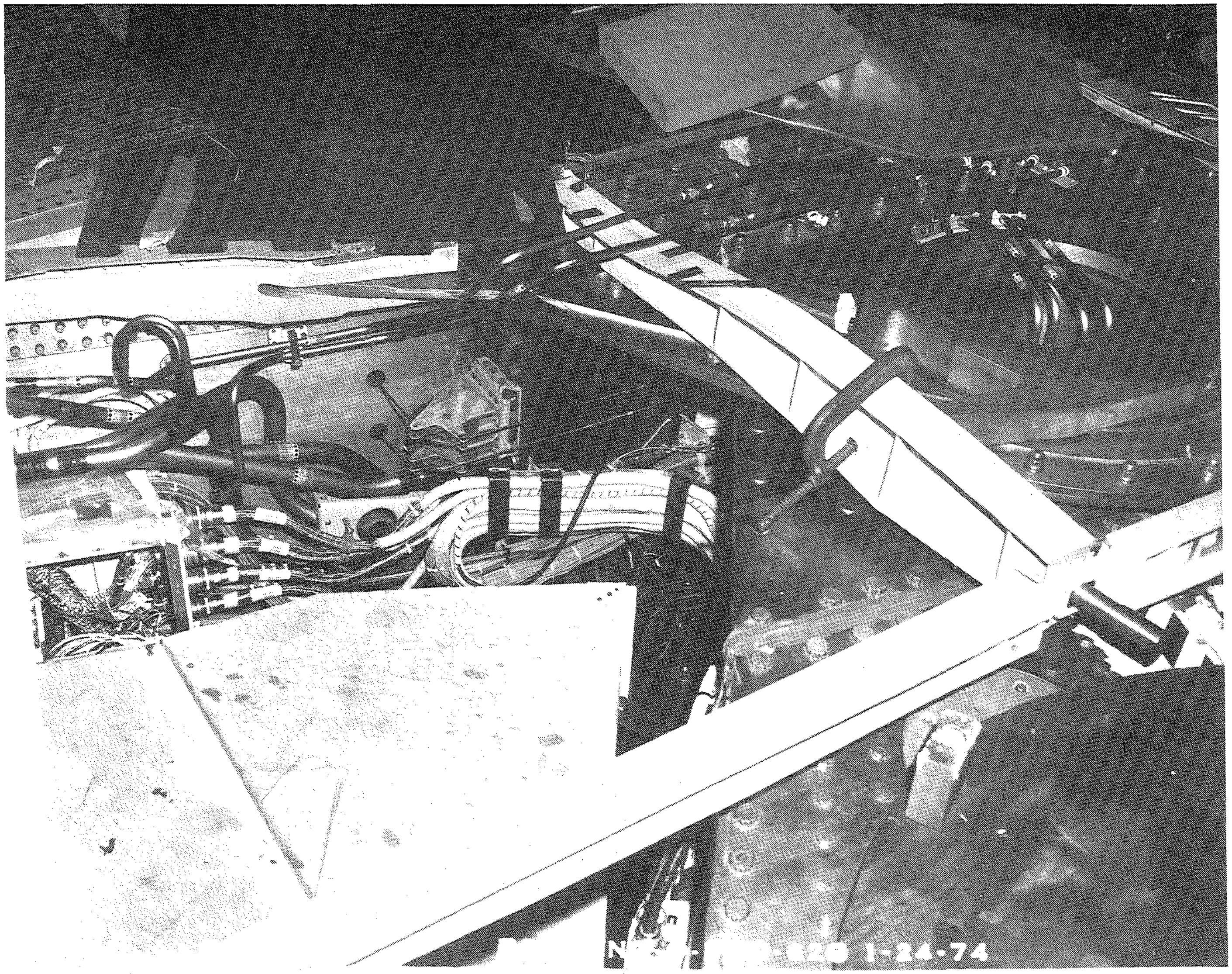


Figure 9. - Fairing support structure to wing attachment.

forward. Figure 10 shows a partial view of the underwing fairing linkage mechanism.

NASTRAN MODELS

The detailed plans for the finite-element modeling of the A/C-2 structure intended for use with the NASA COSMIC release of NASTRAN level 16.0 on the NASA DFRC Cyber computer constrains the model to the minimum complexity to give satisfactory flexibility characteristics for FLEXSTAB aeroelastic analysis.

The NASTRAN model plans specify seven substructures consisting of the following:

(1) Horizontal stabilizer; leading edge, and trailing edge

(2) Vertical stabilizer; leading edge, and rudders

(3) Nacelle structure

(4) Wing outer panel, flaps, slats, and outboard transition ribs

(5) Forward fuselage structure

(6) Aft fuselage structure, wing carry-through structure (WCTS), and inboard transition lugs

(7) Overwing and underwing fairings

In addition to modeling the A/C-2 airframe structure to represent the flexibility characteristics, the model was designed to provide stress data at the airload survey strain gage locations for each component. In these regions, the model complexity was increased to provide the desired accuracy. In some regions, the complexity was dictated by the NASTRAN aspect-ratio constraints. During this contract phase, the NASTRAN model plans for the fairing structure were implemented to generate the NASTRAN model for this substructure. The description of this model, which was demonstrated and validated on the NASA DFRC Cyber computer system, is presented herein.

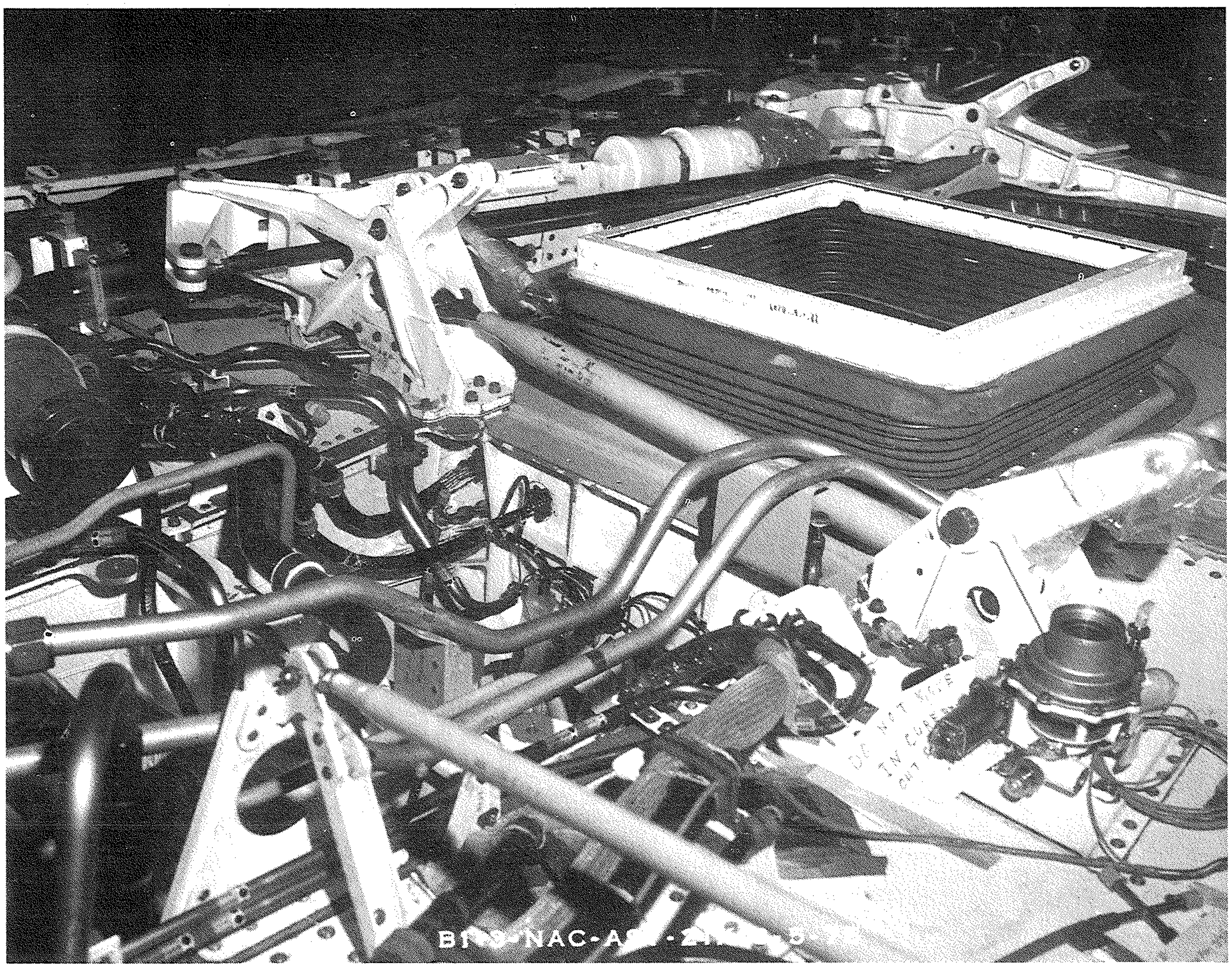


Figure 10. - Underwing fairing linkage mechanism.

Fairing NASTRAN Model

The NASTRAN fairing model is configured to be representative of the A/C-2 structure. The aluminum structure which forms the leading edges of the upper and lower pivot fairings between fuselage stations 863 and 875.5 has been idealized using the NASTRAN plate elements CQUAD2 and CTRIA2. The fuselage station 875.5 aluminum bulkhead has been idealized as a series of conrods and shear panels. The laminate fiberglass sections and aluminum region of the fairing structure have been idealized by the NASTRAN plate elements CQUAD2 and CTRIA2, wich include bending, membrane, and transverse shear effects. The sandwich contruction regions have been modeled utilizing the NASTRAN CQUAD1 and CTRIA1 sandwich elements, which include bending, membrane, and transverse shear effect. The support structures for the pivot fairings are represented by CBAR elements with titanium material properties, except for the upper beam at fuselage station 992 and the lower outboard beam extending from fuselage stations 884 to 944, which are made of steel. The remaining fairing support structure is represented by CBAR elements using aluminum material properties. The connections of the various fairing segments at the slip-slide joints are represented by the NASTRAN CELAS1 elements.

A summary of the number of grid points and element types utilized for the model idealization of the fairing structure is presented in table I.

The model diagrams of the fairing substructure which define the element types, element ID numbers, and grid numbering systems are presented in figures C-1 through C-8.

The fairing is constrained vertically along the leading edge at fuselage station 863 and along the fuselage interface from fuselage stations 863 through 1096. The fairing is also constrained in the inboard-outboard direction along the fuselage interface. The beam at fuselage station 944 is constrained vertically at butt line 148.0. The overwing movable fairing is restrained vertically at fuselage station 1108 and at butt line 134 to represent the fairing-to-wing tie. The underwing forward fairing panel is constrained vertically at the four linkage points at fuselage stations 1142 and 1189. The underwing aft panel is constrained in three directions at fuselage station 1243.5.

The Airloads Research Study NASTRAN model was thoroughly checked out for continuity, connectivity, and constraints using interactive graphics techniques. This model was then processed for the loading applied at each SIC point (table C-1 and figures C-9 and C-10), with fairing structure appropriately supported. The deflections computed for these SIC loadings are shown in figures C-11 through C-15.

TABLE I. - ARS NASTRAN MODEL STATISTICS

Description of substructure	NASTRAN model elements						
	No. of grids	Rods	Bars	Shear panels	Sandwich plates	Plates	Scalar Springs
Fairings	304	10	167	3	64	120	76

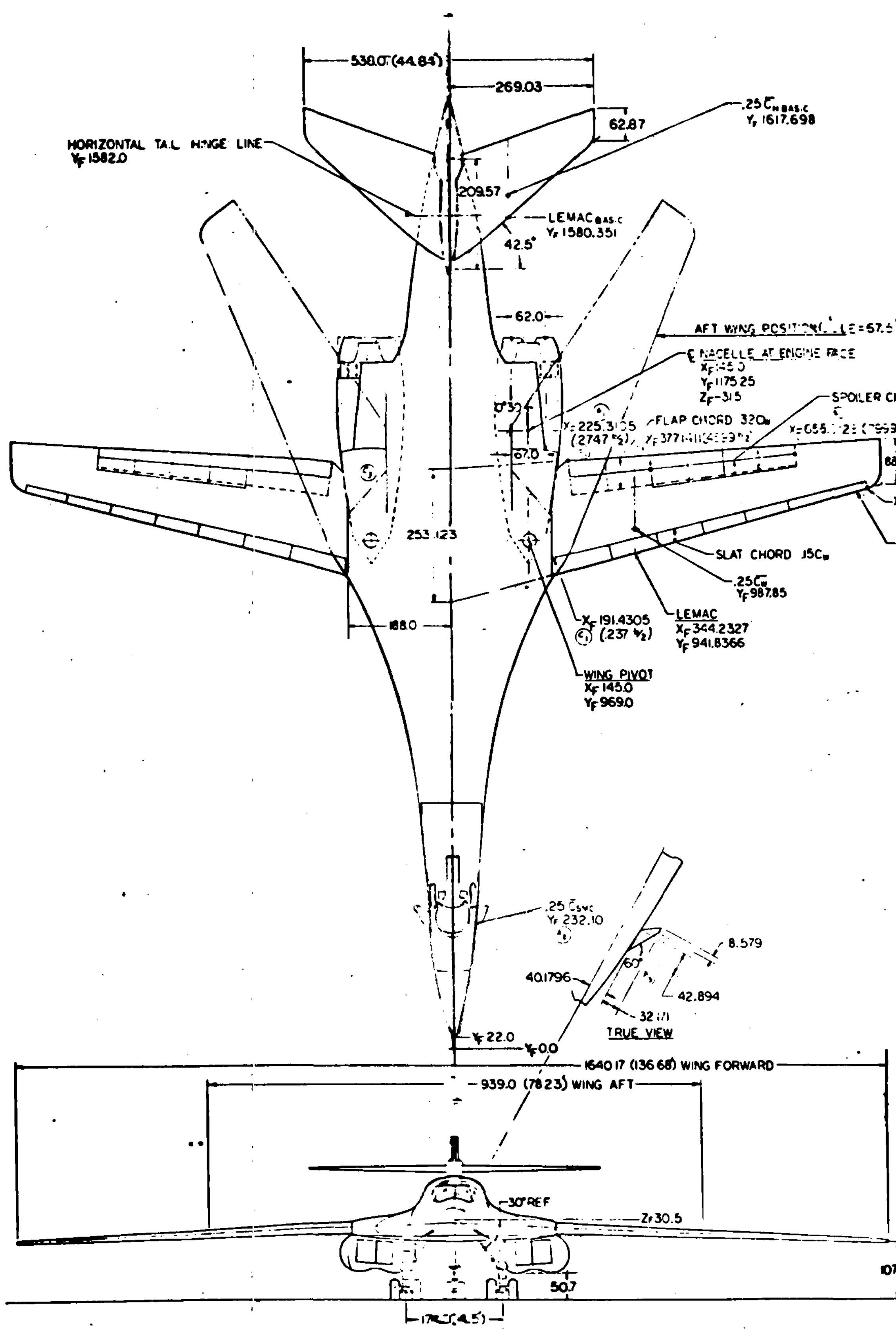
Element		NASTRAN nomenclature
Rod	=	CONROD
Bar	=	CBAR
Shear panel	=	CSHEAR
Sandwich	=	CQUAD1 and CTRIA1
Plate	=	CQUAD2 and CTRIA2
Scalar spring	=	CELAS1

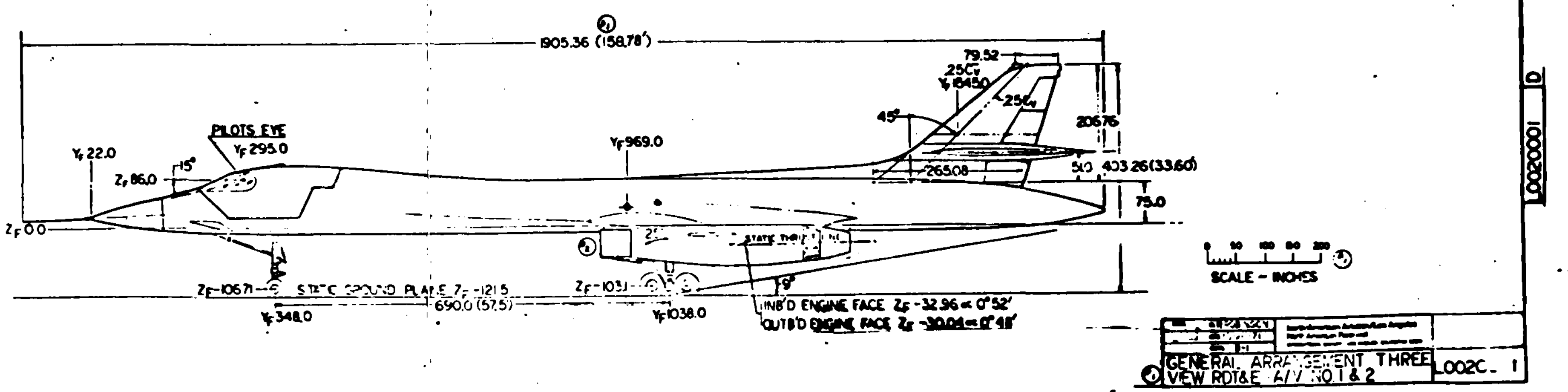
BULK DATA

The NASTRAN model coordinates, sizing, material properties, and loading data are presented in the NASTRAN program input format. Since these data are identified by column numbers, excerpts from the NASTRAN User's Manual which define the contents of the card columns for each card type are included. The format of the sorted bulk data for each element type is presented on pages 25 through 45. This format is applicable to the NASTRAN model bulk data presented on pages 72 through 93.

Appendix A

FIGURES USING ENGINEERING UNITS





GEOMETRIC DATA

ITEM	WING FWD POSITION	WING AFT POSITION	HORIZONTAL TAIL TOTAL	VERTICAL TAIL TOTAL	STRUCTURAL MODE CONTROL
AREA ~ SQ. FT.	1946.0	1946 (REF)	509.0	247.4	11.5
ASPECT RATIO	9.6	3.14	3.95	1.2	2.5
TAPER RATIO	.35	—	.30	.30	.20
THICKNESS RATIO	REF: LINES DRAWING NA69-1902 38-2.11		REF: NA3D 2114	.10 ROOT .09 Z_F 126.0 TO TIP	.05
AIRFOIL SECTION				65A010 ROOT 65A009 Z_F 26.0 TO TIP	65A005
LEADING EDGE SWEEP	15.0°	67.5°	42.5°	45° AT .25C	60°
DIHEDRAL ANGLE	-1.94°	—	0°	—	-30.0°
INCIDENCE ANGLE	2° BXF 55.43 0° TIP	—	0°	—	DEFL ± 20.0°
MAC LENGTH - INCHES	194.053	—	149.385	188.954	29.55
MAC LOCATION - INCHES	344.2327	—	110.373	84.825	12.510 TRUE

CONTROL SURFACE DATA

ITEM	FLAP	SPOILER	SLAT	RUDDER	HORIZ. TAIL
TYPE	SINGLE-SLOTTED	UPPER SURFACE ONLY	POWERED	—	ALL MOVABLE
AREA - SQ FEET	310.38	115.0	187.62	60.6	474.5
DEFLECTION	25°	0° TO 70° UP	20.0°	FLAP DN ±25° FLAP UP ±15°	PITCH +10° -25° ROLL ±20°

LANDING GEAR DATA

ITEM	MAIN	AUXILIARY
TIRE SIZE & TYPE	C44.5×16.0-21 TWIN TANDEM	35×11.5-16 TWIN
PLY RATING	24	24
ROLLING RADIUS - INCHES	18.4	14.79
FLAT RADIUS - INCHES	13.6	11.3
STRUT-TOTAL STROKE-IN	16.5	22.0
STRUT-STATIC TO COMPRESSED	3.5	7.0

PROPULSION DATA

FOUR 100% SIZE GENERAL ELECTRIC YF101 - GE - 100 ENGINES

2-D VARIABLE RAMP INLETS-CAPTURE AREA = 1441 SQ. IN. PER ENGINE

WEIGHT DATA

AIRCRAFT EMPTY WEIGHT	~ LB =	SEE SDM CODE II B-7
DESIGN USEFUL LOAD	~ LB =	SEE SDM CODE II B-7
DESIGN GROSS WEIGHT-TAXI	~ LB =	360,000
MAXIMUM GROSS WEIGHT	~ LB =	391,000

Figure A-1. - General arrangement - RDT&E A/C-1 and-2

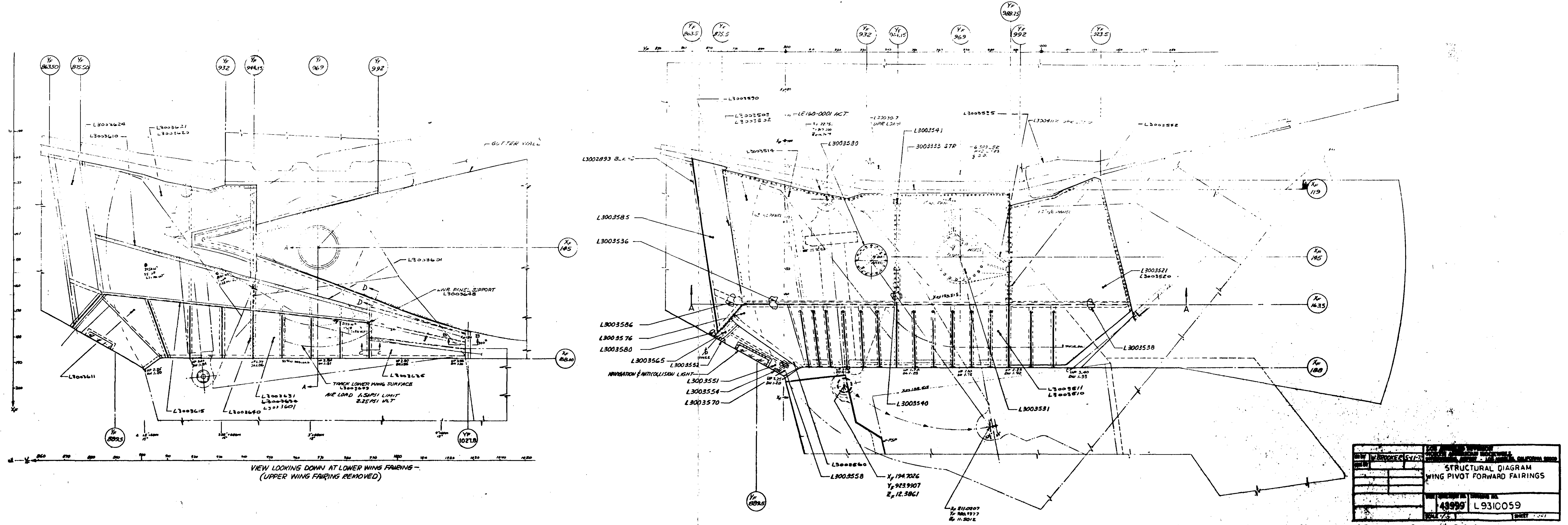


Figure A-2. - Structure diagram - wing pivot forward fairings.

Appendix B

NASTRAN MODEL BULK DATA FORMAT

Input Data Card CBAR Simple Beam Element Connection

Description: Defines a simple beam element (BAR) of the structural model.

Format and Example:

1	2	3	4	5	6	7	8	9	10
CBAR	EID	PID	GA	GB	X1,GO	X2	X3	F	abc
CBAR	2	39	7	3	13			2	123
+bc	PA	PB	Z1A	Z2A	Z3A	Z1B	Z2B	Z3B	
+23		513							

Field	Contents
EID	Unique element identification number (Integer > 0)
PID	Identification number of a PBAR property card (Default is EID unless BARØR card has nonzero entry in field 3) (Integer > 0 or blank*)
GA,GB	Grid point identification numbers of connection points (Integer > 0; GA ≠ GB)
X1,X2,X3	Components of vector $\vec{v}$, at end a, (figure 1(a) on page 1.3-15) measured at end a, parallel to the components of the displacement coordinate system for GA, to determine (with the vector from end a to end b) the orientation of the element coordinate system for the bar element (Real, $X1^2 + X2^2 + X3^2 > 0$ or blank*, see below).
GO	Grid point identification number to optionally supply X1, X2, X3 (integer > 0 or blank*) (see below)
F	Flag to specify the nature of fields 6-8 as follows:

	6	7	8
F = blank*			
F = 1	X1	X2	X3
F = 2	GO	blank/0	blank/0

Field	Contents
PA,PB	Pin flags for bar ends a and b, respectively, that are used to insure that the bar cannot resist a force or moment corresponding to the pin flag at that respective end of the bar. (Up to 5 of the unique digits 1-6 anywhere in the field with no imbedded blanks; integer > 0) (These degree of freedom codes refer to the element forces and not global forces. The bar must have stiffness associated with the pin flag. For example, if pin flag 4 is specified, the bar must have a value for J, the torsional constant.)
Z1A,Z2A,Z3A Z1B,Z2B,Z3B	Components of offset vectors $\vec{w}_a$ and $\vec{w}_b$, respectively, (see figure 1(a), page 1.3-15) in displacement coordinate systems at points GA and GB, respectively. (Real or blank)

Remarks:

1. Element identification numbers must be unique with respect to all other element identification numbers.
2. For an explanation of bar element geometry, see Section 1.3.2.
3. Zero (0) must be used in fields 7 and 8 in order to override entries in these fields associated with F = 1 in field 9 on a BARØR card.
4. If there are no pin flags or offsets, the continuation card may be omitted.

Input Data Card <u>CELAS1</u> Scalar Spring Connection

<u>Description</u>: Defines a scalar spring element of the structural model.

<u>Format and Example</u>:

1	2	3	4	5	6	7	8	9	10
CELAS1	EID	PID	G1	C1	G2	C2			
CELAS1	2	6			8	1			

<u>Field</u>	<u>Contents</u>
EID	Unique element identification number (Integer > 0)
PID	Identification number of a PELAS property card (Default is EID) (Integer > 0)
G1, G2	Geometric grid point identification number (Integer > 0)
C1, C2	Component number (6 ≥ Integer ≥ 0)

<u>Remarks</u>:

1. Scalar points may be used for G1 and/or G2 in which case the corresponding C1 and/or C2 must be zero or blank. Zero or blank may be used to indicate a grounded* terminal G1 or G2 with a corresponding blank or zero C1 or C2. If only scalar points and/or ground are involved, it is more efficient to use the CELAS3 card.

2. Element identification numbers must be unique with respect to <u>all</u> other element identification numbers.

3. The two connection points, (G1, C1) and (G2, C2), must be distinct.

4. For a discussion of the scalar elements, see Section 5.6 of the Theoretical Manual.

* A grounded terminal is a scalar point or coordinate of a geometric grid point whose displacement is constrained to zero.

Input Data Card CØNRØD   Rod Element Property and Connection

Description: Defines a rod element of the structural model without reference to a property card.

Format and Example:

1	2	3	4	5	6	7	8	9	10
CØNRØD	EID	G1	G2	MID	A	J	C	NSM	
CØNRØD	2	16	17	23	2.69				

Field	Contents
EID	Unique element identification number (Integer > 0)
G1, G2	Grid point identification numbers of connection points (Integer > 0; G1 ≠ G2)
MID	Material identification number (Integer > 0)
A	Area of rod (Real)
J	Torsional constant (Real)
C	Coefficient for torsional stress determination (Real)
NSM	Nonstructural mass per unit length (Real)

Remarks:
1. Element identification numbers must be unique with respect to all other element identification numbers.
2. For structural problems, CØNRØD cards may only reference MAT1 material cards.
3. For heat transfer problems, CØNRØD cards may only reference MAT4 or MAT5 material cards.

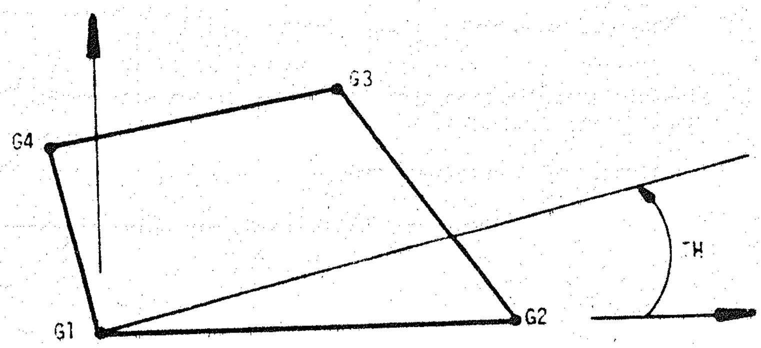
Input Data Card CQUAD1 Quadrilateral Element Connection

Description: Defines a quadrilateral membrane and bending element (QUAD1) of the structural model.

Format and Example:

1	2	3	4	5	6	7	8	9	10
CQUAD1	EID	PID	G1	G2	G3	G4	TH		
CQUAD1	72	13	13	14	15	16	29.2		

Field	Contents
EID	Element identification number (Integer > 0)
PID	Identification number of a PQUAD1 property card (Default is EID) (Integer > 0)
G1,G2,G3,G4	Grid point identification numbers of connection points (Integer > 0; G1 ≠ G2 ≠ G3 ≠ G4)
TH	Material property orientation angle in degrees (Real) The sketch below gives the sign convention for TH.



Remarks: 1. Element identification numbers must be unique with respect to all other element identification numbers.

2. Grid points G1 thru G4 must be ordered consecutively around the perimeter of the element.

3. All interior angles must be less than 180°.

BULK DATA DECK

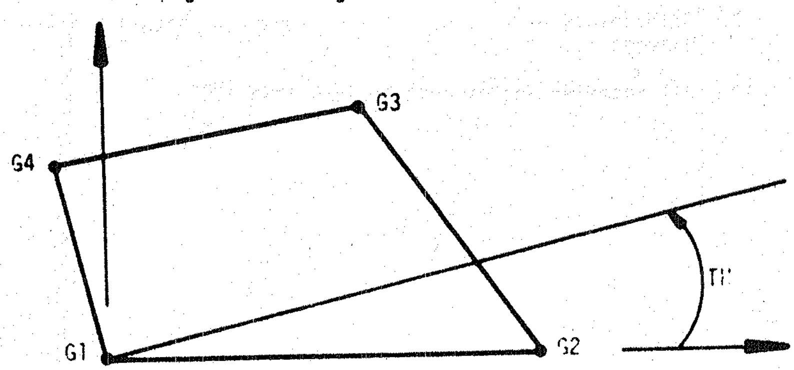
Input Data Card CQUAD2 Quadrilateral Element Connection

Description: Defines a homogeneous quadrilateral membrane and bending element (QUAD2) of the structural model.

Format and Example:

1	2	3	4	5	6	7	8	9	10
CQUAD2	EID	PID	G1	G2	G3	G4	TH		
CQUAD2	72	13	13	14	15	16	29.2		

Field	Contents
EID	Element identification number (Integer > 0)
PID	Identification number of a PQUAD2 property card (Default is EID) (Integer > 0)
G1,G2,G3,G4	Grid point identification numbers of connection points (Integer > 0; G1 ≠ G2 ≠ G3 ≠ G4)
TH	Material property orientation angle in degrees (Real). The sketch below gives the sign convention for TH.



Remarks: 1. Element identification numbers must be unique with respect to all other element identification numbers.

2. Grid points G1 thru G4 must be ordered consecutively around the perimeter of the element.

3. All interior angles must be less than 180°.

Input Data Card <u>CSHEAR</u> Shear Panel Element Connection

Description: Defines a shear panel element (SHEAR) of the structural model.

Format and Example:

1	2	3	4	5	6	7	8	9	10
CSHEAR	EID	PID	G1	G2	G3	G4			
CSHEAR	3	6	1	5	3	7			

Field	Contents
EID	Element identification number (Integer > 0)
PID	Identification number of a PSHEAR property card (Default is EID) (Integer > 0)
G1, G2, G3, G4	Grid point identification numbers of connection points (Integer > 0; G1 ≠ G2 ≠ G3 ≠ G4)

Remarks:

1. Element identification numbers must be unique with respect to all other element identification numbers.
2. Grid points G1 thru G4 must be ordered consecutively around the perimeter of the element.
3. All interior angles must be less than 180°.

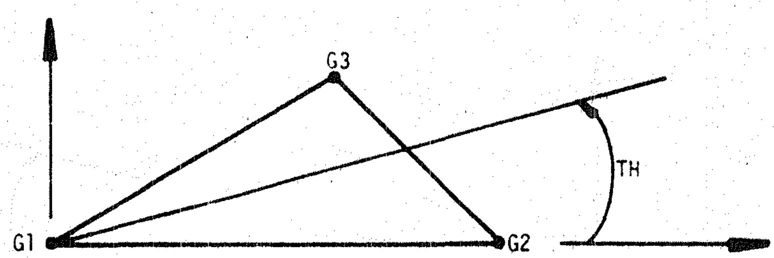
Input Data Card CTRIA1 Triangular Element Connection

Description: Defines a triangular membrane and bending element (TRIA1) of the structural model.

Format and Example:

1	2	3	4	5	6	7	8	9	10
CTRIA1	EID	PID	G1	G2	G3	TH			
CTRIA1	16	2	12	1	3	16.2			

Field	Contents
EID	Element identification number (Integer > 0)
PID	Identification number of a PTRIA1 property card (Default is EID) (Integer > 0)
G1,G2,G3	Grid point identification numbers of connection points (Integer > 0; G1 ≠ G2 ≠ G3)
TH	Material property orientation angle in degrees (Real) - The sketch below gives the sign convention for TH.



Remarks: 1. Element identification numbers must be unique with respect to all other element identification numbers.

2. Interior angles must be less than 180°.

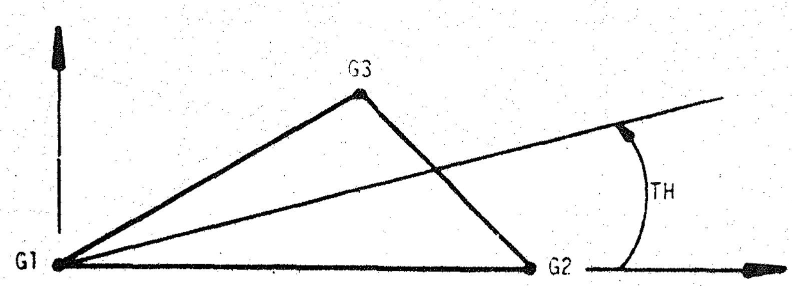
Input Data Card CTRIA2 Triangular Element Connection

Description: Defines a triangular membrane and bending element (TRIA2) of the structural model.

Format and Example:

1	2	3	4	5	6	7	8	9	10
CTRIA2	EID	PID	G1	G2	G3	TH			
CTRIA2	16	2	12	1	3	16.2			

Field	Contents
EID	Element identification number (Integer > 0)
PID	Identification number of a PTRIA2 property card (Default is EID) (Integer > 0)
G1,G2,G3	Grid point identification numbers of connection points (Integer > 0; G1 ≠ G2 ≠ G3)
TH	Material property orientation angle in degrees (Real) - The sketch below gives the sign convention for TH.



Remarks: 1. Element identification numbers must be unique with respect to all other element identification numbers.

2. Interior angles must be less than 180°.

Input Data Card FØRCE Static Load

Description: Defines a static load at a grid point by specifying a vector.

Format and Example:

1	2	3	4	5	6	7	8	9	10
FØRCE	SID	G	CID	F	N1	N2	N3		
FØRCE	2	5	6	2.9	0.0	1.0	0.0		

Field	Contents
SID	Load set identification number (Integer > 0)
G	Grid point identification number (Integer > 0)
CID	Coordinate system identification number (Integer ≥ 0)
F	Scale factor (Real)
N1,N2,N3	Components of Vector measured in coordinate system defined by CID (Real; $N1^2 + N2^2 + N3^2 > 0.0$)

Remarks: 1. The static load applied to grid point G is given by

$$\vec{f} = F\,\vec{N}$$

where $\vec{N}$ is the vector defined in fields 6, 7 and 8.

2. Load sets must be selected in the Case Control Deck (LOAD=SID) to be used by NASTRAN.

3. A CID of zero references the basic coordinate system.

Input Data Card GRAV Gravity Vector

Description: Used to define gravity vectors for use in determining gravity loading for the structural model.

Format and Example:

1	2	3	4	5	6	7	8	9	10
GRAV	SID	CID	G	N1	N2	N3			
GRAV	1	3	32.2	0.0	0.0	-1.0			

Field	Contents
SID	Set identification number (Integer > 0)
CID	Coordinate system identification number (Integer ≥ 0)
G	Gravity vector scale factor (Real)
N1, N2, N3	Gravity vector components (Real; $N1^2 + N2^2 + N3^2 > 0.0$)

Remarks:

1. The gravity vector is defined by

$$\vec{g} = G \cdot (N1, N2, N3).$$

2. A CID of zero references the basic coordinate system.
3. Gravity loads may be combined with "simple loads" (e.g., FØRCE, MØMENT) only by specification on a LØAD card. That is, the SID on a GRAV card may not be the same as that on a simple load card.
4. Load sets must be selected in the Case Control Deck (LØAD=SID) to be used by NASTRAN.

Input Data Card GRID   Grid Point

Description: Defines the location of a geometric grid point of the structural model, the directions of its displacement, and its permanent single-point constraints.

Format and Example:

1	2	3	4	5	6	7	8	9	10
GRID	ID	CP	X1	X2	X3	CD	PS		
GRID	2	3	1.0	2.0	3.0		316		

Field	Contents
ID	Grid point identification number (0<Integer<999999)
CP	Identification number of coordinate system in which the location of the grid point is defined (Integer ≥ 0 or blank*).
X1,X2,X3	Location of the grid point in coordinate system CP (Real)
CD	Identification number of coordinate system in which displacements, degrees of freedom, constraints, and solution vectors are defined at the grid point (Integer ≥ 0 or blank*)
PS	Permanent single-point constraints associated with grid point (any of the digits 1-6 with no imbedded blanks) (Integer ≥ 0 or blank*)

Remarks: 1. All grid point identification numbers must be unique with respect to all other structural, scalar, and fluid points.

2. The meaning of X1, X2 and X3 depend on the type of coordinate system, CP, as follows: (see CØRD__ card descriptions)

Type	X1	X2	X3
Rectangular	X	Y	Z
Cylindrical	R	Θ(degrees)	Z
Spherical	R	Θ(degrees)	Φ(degrees)

3. The collection of all CD coordinate systems defined on all GRID cards is called the Global Coordinate System. All degrees-of-freedom, constraints, and solution vectors are expressed in the Global Coordinate System.

* See the GRDSET card for default options for fields 3, 7 and 8.

Input Data Card MAT1 Material Property Definition

Description: Defines the material properties for linear, temperature-independent, isotropic materials.

Format and Example:

1	2	3	4	5	6	7	8	9	10
MAT1	MID	E	G	NU	RHØ	A	TREF	GE	+abc
MAT1	17	3.+7	1.9+7		4.28	0.19	5.37+2	0.23	ABC
+abc	ST	SC	SS						
+BC	20.+4	15.+4	12.+4						

Field	Contents
MID	Material identification number (Integer > 0)
E	Young's modulus (Real ≥ 0.0 or blank)
G	Shear modulus (Real ≥ 0.0 or blank)
NU	Poisson's ratio (-1.0 < Real ≤ 0.5 or blank)
RHØ	Mass density (Real)
A	Thermal expansion coefficient (Real)
TREF	Thermal expansion reference temperature (Real)
GE	Structural element damping coefficient (Real)
ST, SC, SS	Stress limits for tension, compression and shear (Real) (Required for Property Optimization calculations; otherwise optional if margins of safety are desired.)

Remarks:

1. One of E or G must be positive (i.e., either E > 0.0 or G > 0.0 or both E and G may be > 0.0).
2. If any one of E, G or NU is blank, it will be computed to satisfy the identity E = 2(1+NU)G; otherwise, values supplied by the user will be used.
3. The material identification number must be unique for all MAT1, MAT2 and MAT3 cards.
4. MAT1 materials may be made temperature dependent by use of the MATT1 card.
5. The mass density, RHØ, will be used to automatically compute mass for all structural elements except the two-dimensional bending only elements TRBSC, TRPLT and QDPLT.
6. If E and NU or G and NU are both blank they will be both given the value 0.0.
7. Weight density may be used in field 6 if the value $\frac{1}{g}$ is entered on the PARAM card WTMASS, where g is the acceleration of gravity.
8. Solid elements must not have NU equal to 0.5.

Input Data Card PBAR   Simple Beam Property

Description: Defines the properties of a simple beam (bar) which is used to create bar elements via the CBAR card.

Format and Example:

1	2	3	4	5	6	7	8	9	10
PBAR	PID	MID	A	I1	I2	J	NSM		abc
PBAR	39	6	2.9		5.97				123
+bc	C1	C2	D1	D2	E1	E2	F1	F2	def
+23			2.0	4.0					
+ef	K1	K2	I12						

Field	Contents
PID	Property identification number (Integer > 0)
MID	Material identification number (Integer > 0)
A	Area of bar cross-section (Real)
I1, I2, I12	Area moments of inertia (Real, $I_1 I_2 \geq I_{12}^2$)
J	Torsional constant (Real)
NSM	Nonstructural mass per unit length (Real)
K1, K2	Area factor for shear (Real)
Ci, Di, Ei, Fi	Stress recovery coefficients (Real)

Remarks:

1. For structural problems, PBAR cards may only reference MAT1 material cards.
2. See Section 1.3.2 for a discussion of bar element geometry.
3. For heat transfer problems, PBAR cards may only reference MAT4 or MAT5 material cards.

Input Data Card PELAS   Scalar Elastic Property

Description: Used to define the stiffness, damping coefficient, and stress coefficient of a scalar elastic element (spring) by means of the CELAS1 or CELAS3 card.

Format and Example:

1	2	3	4	5	6	7	8	9	10
PELAS	PID	K	GE	S	PID	K	GE	S	
PELAS	7	4.29	0.06	7.92	27	2.17	0.0032		

Field	Contents
PID	Property identification number (Integer > 0)
K	Elastic property value (Real)
GE	Damping coefficient, g_e (Real)
S	Stress coefficient (Real)

Remarks:
1. The user is cautioned to be careful using negative spring values. (Values are defined directly on some of the CELASi card types.)
2. One or two elastic spring properties may be defined on a single card.
3. For a discussion of scalar elements, see Section 5.6 of the Theoretical Manual.

Input Data Card PQUAD1 General Quadrilateral Element Property

Description: Defines the properties of a general quadrilateral element of the structural model, including bending, membrane, and transverse shear effects. Referenced by the CQUAD1 card.

Format and Example:

1	2	3	4	5	6	7	8	9	10
PQUAD1	PID	MID1	T1	MID2	I	MID3	T3	NSM	abc
PQUAD1	32	16	2.98	9	6.45	16	5.29	6.32	WXYZ1
+bc	Z1	Z2							
+XYZ1	0.09	-0.06							

Field	Contents
PID	Property identification number (Integer 0)
MID1	Material identification number for membrane (Integer $\geq$ 0)
T1	Membrane thickness (Real)
MID2	Material identification number for bending (Integer $\geq$ 0)
I	Area moment of inertia per unit width (Real)
MID3	Material identification number for transverse shear (Integer $\geq$ 0)
T3	Transverse shear thickness (Real)
NSM	Nonstructural mass per unit area (Real)
Z1, Z2	Fiber distances for stress computation, positive according to the right-hand sequence defined on the CQUAD1 card (Real)

Remarks:

1. All PQUAD1 cards must have unique property identification numbers.
2. If T3 is zero, the element is assumed to be rigid in transverse shear.
3. The membrane thickness, T1, is used to compute the structural mass for this element.

Input Data Card PQUAD2 Homogeneous Quadrilateral Property

Decription : Defines the properties of a homogeneous quadrilateral element of the structural model, including bending, membrane and transverse shear effects. Referenced by the CQUAD2 card.

Format and Example:

1	2	3	4	5	6	7	8	9	10
PQUAD2	PID	MID	T	NSM	PID	MID	T	NSM	
PQUAD2	32	16	2.98	9.0	45	16	5.29	6.32	

Field	Contents
PID	Property identification number (Integer > 0)
MID	Material identification number (Integer > 0)
T	Thickness (Real> 0.0)
NSM	Nonstructual mass per unit area (Real)

Remarks:

1. All PQUAD2 cards must have unique identification numbers.
2. The thickness used to compute membrane and transverse shear properties is T.
3. The area moment of inertia per unit width used to compute the bending stiffness is $T^3/12$.
4. Cuter fiber distances of ±T/2 are assumed.
5. One or two homogeneous quadrilateral properties may be defined on a single card.

Input Data Card PSHEAR Shear Panel Property

Description: Defines the elastic properties of a shear panel. Referenced by the CSHEAR card.

Format and Example:

1	2	3	4	5	6	7	8	9	10
PSHEAR	PID	MID	T	NSM	PID	MID	T	NSM	
PSHEAR	13	2	4.9	16.2	14	6	4.9	14.7	

Field	Contents
PID	Property identification number (Integer > 0)
MID	Material identification number (Integer > 0)
T	Thickness of shear panel (Real $\neq$ 0.0)
NSM	Nonstructural mass per unit area (Real)

Remarks:

1. All PSHEAR cards must have unique identification numbers.
2. PSHEAR cards may only reference MAT1 material cards.
3. One or two shear panel properties may be defined on a single card.

Input Data Card PTRIA1 General Triangular Element Property

Description: Defines the properties of a general triangular element of the structural model, including bending, membrane and transverse shear effects. Referenced by the CTRIA1 card.

Format and Example:

1	2	3	4	5	6	7	8	9	10
PTRIA1	PID	MID1	T1	MID2	I	MID3	T3	NSM	abc
PTRIA1	32	16	2.98	9	6.45	16	5.29	6.32	QED
+bc	Z1	Z2							
+ED									

Field	Contents
PID	Property identification number (Integer > 0)
MID1	Material identification number for membrane (Integer ≥ 0)
T1	Membrane thickness (Real)
MID2	Material identification number for bending (Integer ≥ 0)
I	Area of moment of inertia per unit width (Real)
MID3	Bending material identification number for transverse shear (Integer ≥ 0)
T3	Transverse shear thickness (Real)
NSM	Nonstructural mass per unit area (Real)
Z1, Z2	Fiber distances for stress calculations, positive according to the right-hand sequence defined on the CTRIA1 card (Real)

Remarks:
1. All PTRIA1 cards must have unique property identification numbers.
2. If T3 is zero, the element is assumed to be rigid in transverse shear.
3. The membrane thickness, T1, is used to compute the structural mass for this element.

BULK DATA DECK

Input Data Card PTRIA2 Homogeneous Triangular Element Property

Description: Defines the properties of a homogeneous triangular element of the structural model, including membrane, bending and transverse shear effects. Referenced by the CTRIA2 card.

Format and Example:

1	2	3	4	5	6	7	8	9	10
PTRIA2	PID	MID	T	NSM	PID	MID	T	NSM	
PTRIA2	2	16	3.92	14.7	6	16	2.96		

Field	Contents
PID	Property identification number (Integer > 0)
MID	Material identification number (Integer > 0)
T	Thickness (Real > 0.0)
NSM	Nonstructural mass per unit area (Real)

Remarks:

1. All PTRIA2 cards must have unique identification numbers.
2. The thickness used to compute the membrane and transverse shear properties is T.
3. The area moment of inertia per unit width used to compute the bending stiffness is $T^3/12$.
4. Outer fiber distances of ±T/2 are assumed.
5. One or two homogeneous triangular element properties may be defined on a single card.

Input Data Card SPC1   Single-Point Constraint

Description: Defines sets of single-point constraints.

Format and Example:

1	2	3	4	5	6	7	8	9	10
SPC1	SID	C	G1	G2	G3	G4	G5	G6	abc
SPC1	3	2	1	3	10	9	6	5	ABC
+bc	G7	G8	G9	-etc.-					
+BC	2	8							

Alternate Form

1	2	3	4	5	6	7	8	9	10
SPC1	SID	C	GID1	"THRU"	GID2				
SPC1	313	12456	6	THRU	32				

Field	Contents
SID	Identification number of single-point constraint set (Integer > 0)
C	Component number (Any unique combination of the digits 1-6 (with no imbedded blanks) when point identification numbers are grid points; must be null if point identification numbers are scalar points)
Gi, GIDi	Grid or scalar point identification numbers (Integer > 0)

Remarks:

1. Note that enforced displacements are not available via this card. As many continuation cards as desired may appear when "THRU" is not used.

2. A coordinate referenced on this card may not appear as a dependent coordinate in a multipoint constraint relation, nor may it be referenced on a SPC, ØMIT, ØMIT1, SUPØRT card.

3. Single-point constraint sets must be selected in the Case Control Deck (SPC=SID) to be used by NASTRAN.

4. SPC degrees of freedom may be redundantly specified as permanent constraints on the GRID card.

5. All grid points referenced by GID1 thru GID2 must exist.

Input Data Card <u>SPCADD</u> Single-Point Constraint

<u>Description</u>: Defines a single-point constraint set as a union of single-point constraint sets defined via SPC or SPC1 cards.

<u>Format and Example</u>:

1	2	3	4	5	6	7	8	9	10
SPCADD	SID	S1	S2	S3	S4	S5	S6	S7	abc
SPCADD	100	3	2	9	1				

+bc	S8	S9	-etc.-						

-etc.-

<u>Field</u> <u>Contents</u>

SID Identification number for new single-point constraint set (Integer > 0; ≠ 101 or 102 if axisymmetric)

Si Identification numbers of single-point constraint sets defined via SPC or SPC1 cards (Integer > 0; SID ≠ Si)

<u>Remarks</u>:

1. Single-point constraint sets must be selected in the Case Control Deck (SPC=SID) to be used by NASTRAN.
2. No Si may be the identification number of a single-point constraint set defined by another SPCADD card.
3. The Si values must be unique.
4. Set identification numbers of 101 or 102 cannot be used in axisymmetric problems.

Appendix C

FAIRING STRUCTURE

FAIRING NASTRAN MODEL

Five-digit Conrod & bar element numbering scheme

Item	Orientation	Grid No.
In the X-direction	10	XXX
In the Y-direction	20	XXX
In the Z-direction	30	XXX

Four-digit CELAS1 element numbering scheme

Item	Orientation	Grid No.
Scalar spring in X-direction	1	XXX
Scalar spring in Y-direction	2	XXX
Scalar spring in Z-direction	3	XXX

Triangular and quadrilateral element numbering scheme

The smallest of the grid number used to define the element boundary is used as the identification number.

Four-digit triangular & quadrilateral property identification numbering scheme

Item	Matl	Total thickness
CQUAD1, CTRIA1	X	Y.YY
CQUAD2, CTRIA2	X	.YYY

Material numbering scheme

Matl No.	Matl
1	Aluminum
2	Titanium
3	Steel
4	Fiberglass
5	Phenolic resin honeycomb
6	Aluminum honeycomb

Figure C-1. - NASTRAN fairing model - 3-D perspective.

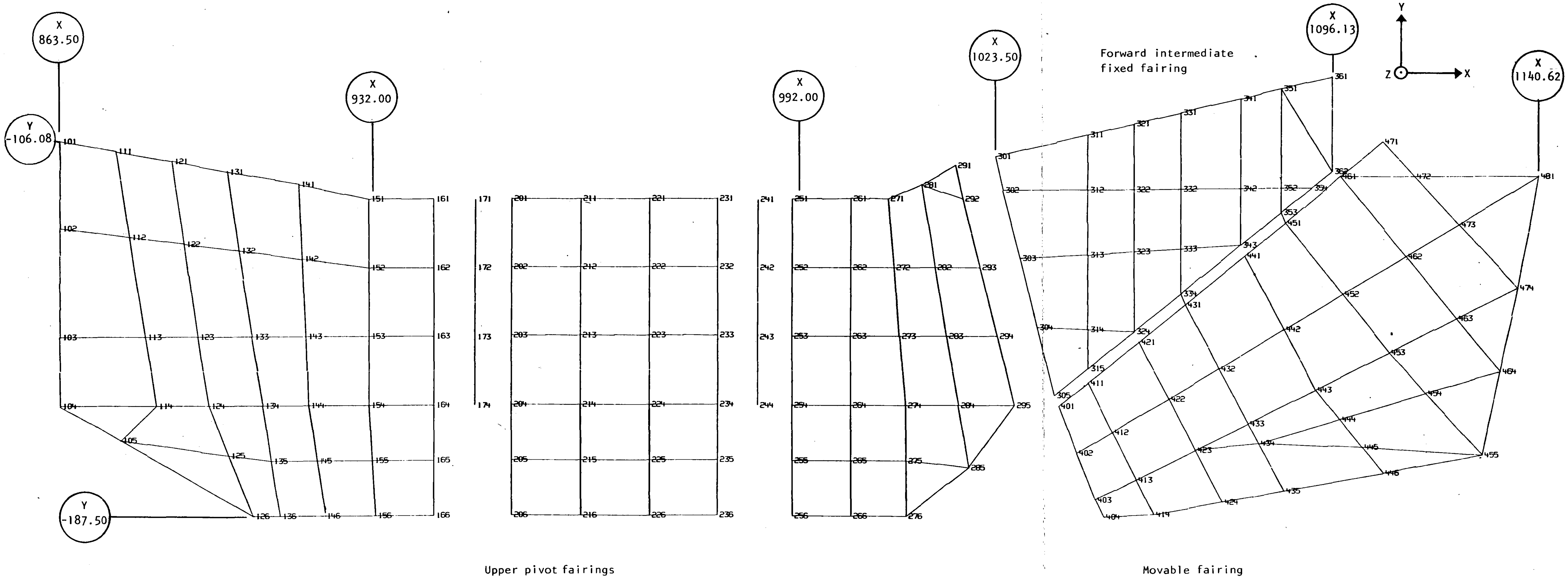


Figure C-2. - NASTRAN overwing fairing model.

Figure C-3. - NASTRAN underwing fairing model.

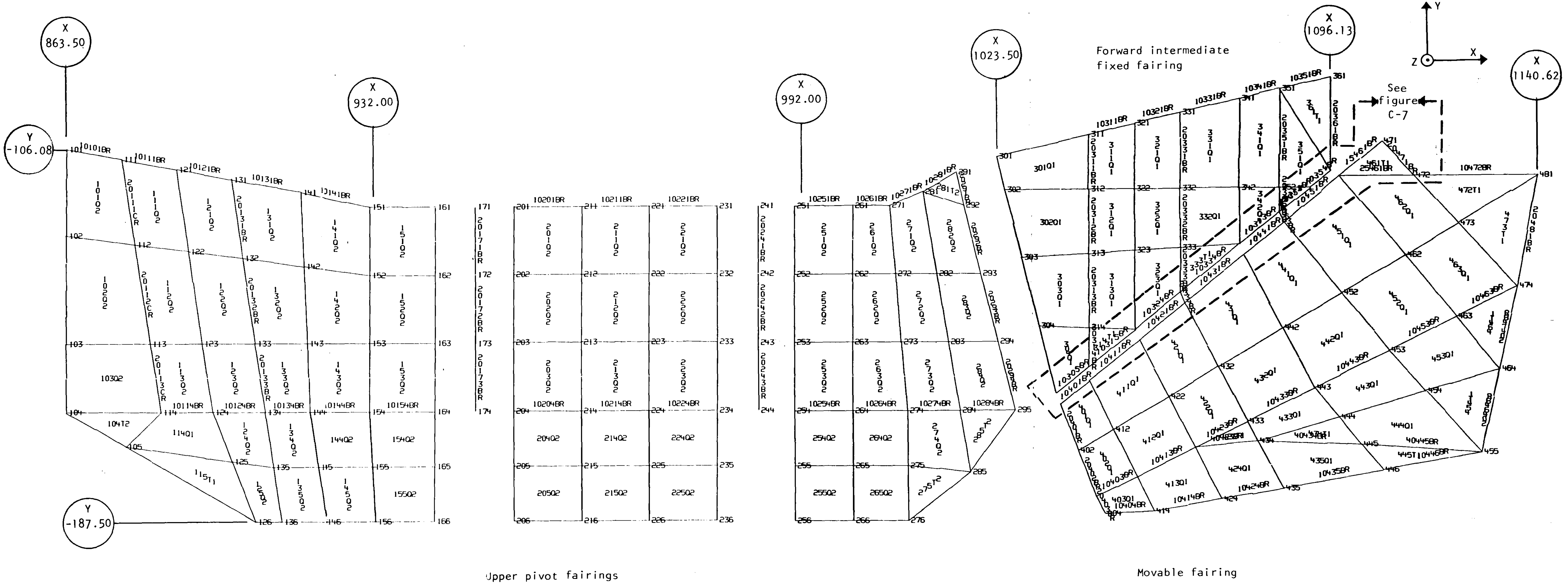


Figure C-4. NASTRAN overwing fairing model - element identifications.

Figure C-5. – NASTRAN underwing fairing model - element identifications.

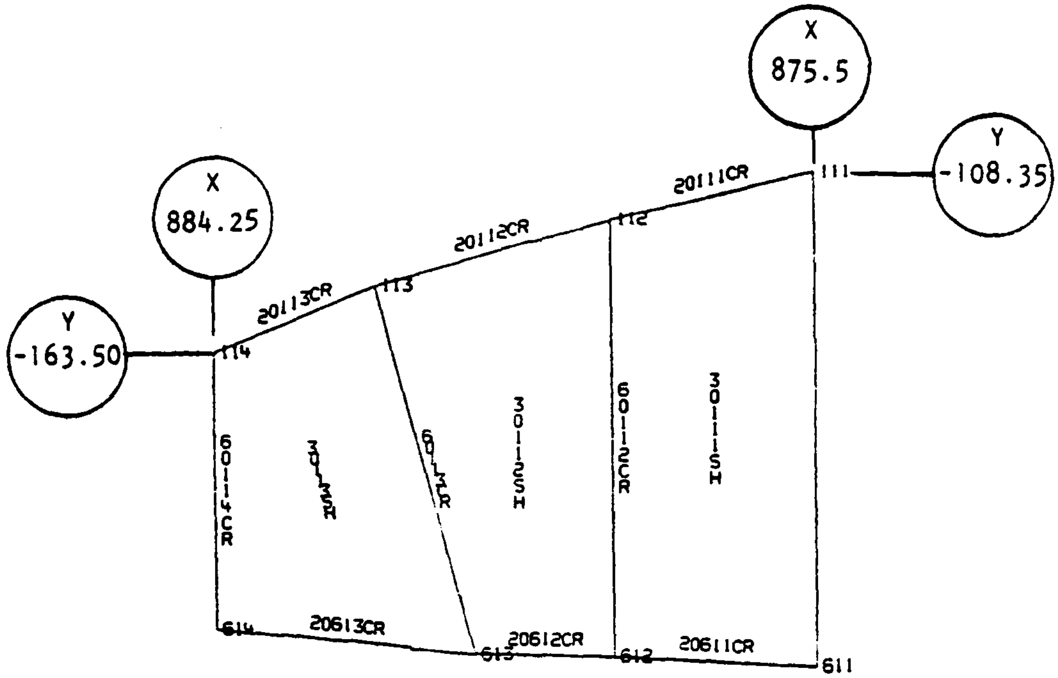


Figure C-6. - Bulkhead station 875.00 - pivot fairing.

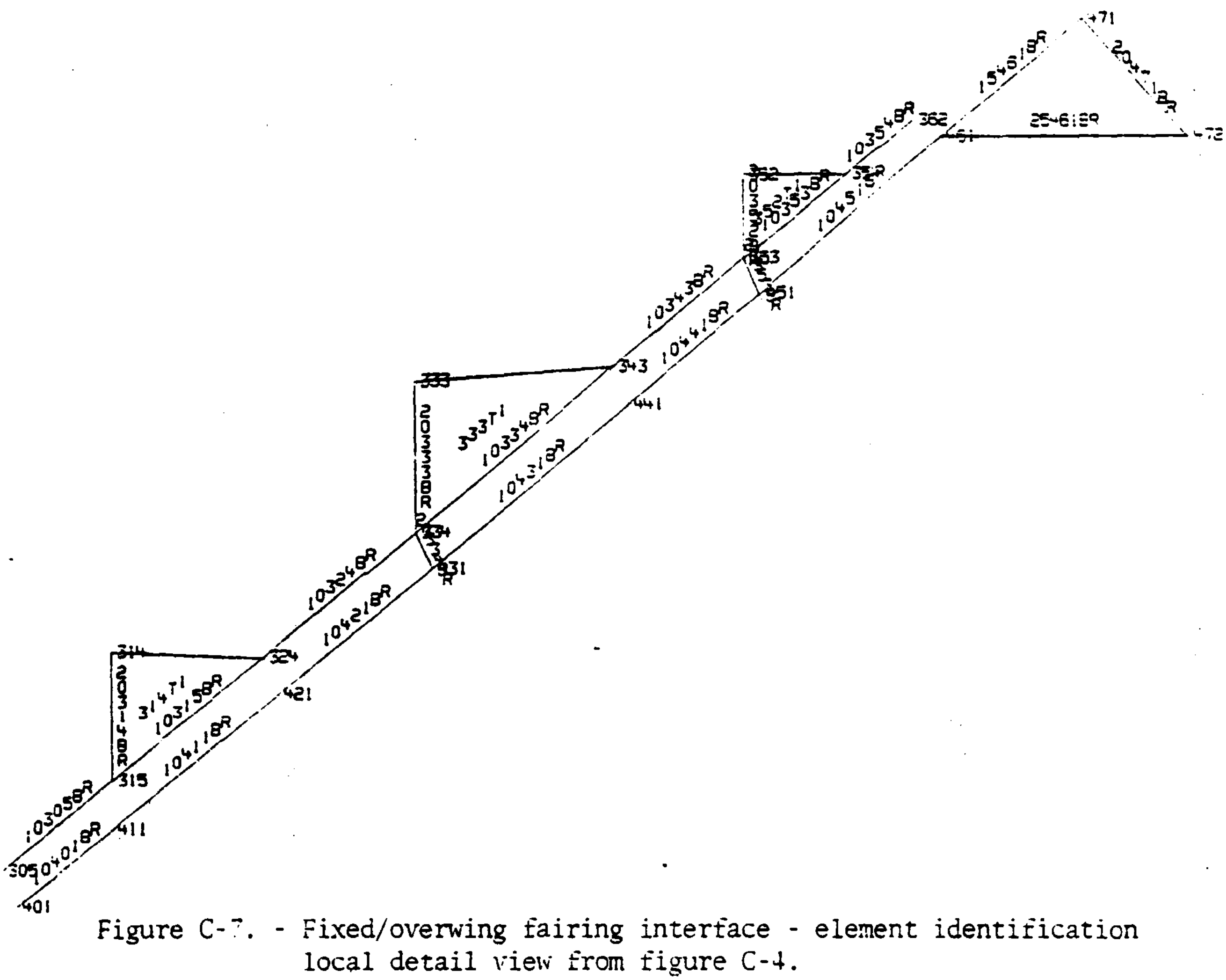


Figure C-7. - Fixed/overwing fairing interface - element identification local detail view from figure C-4.

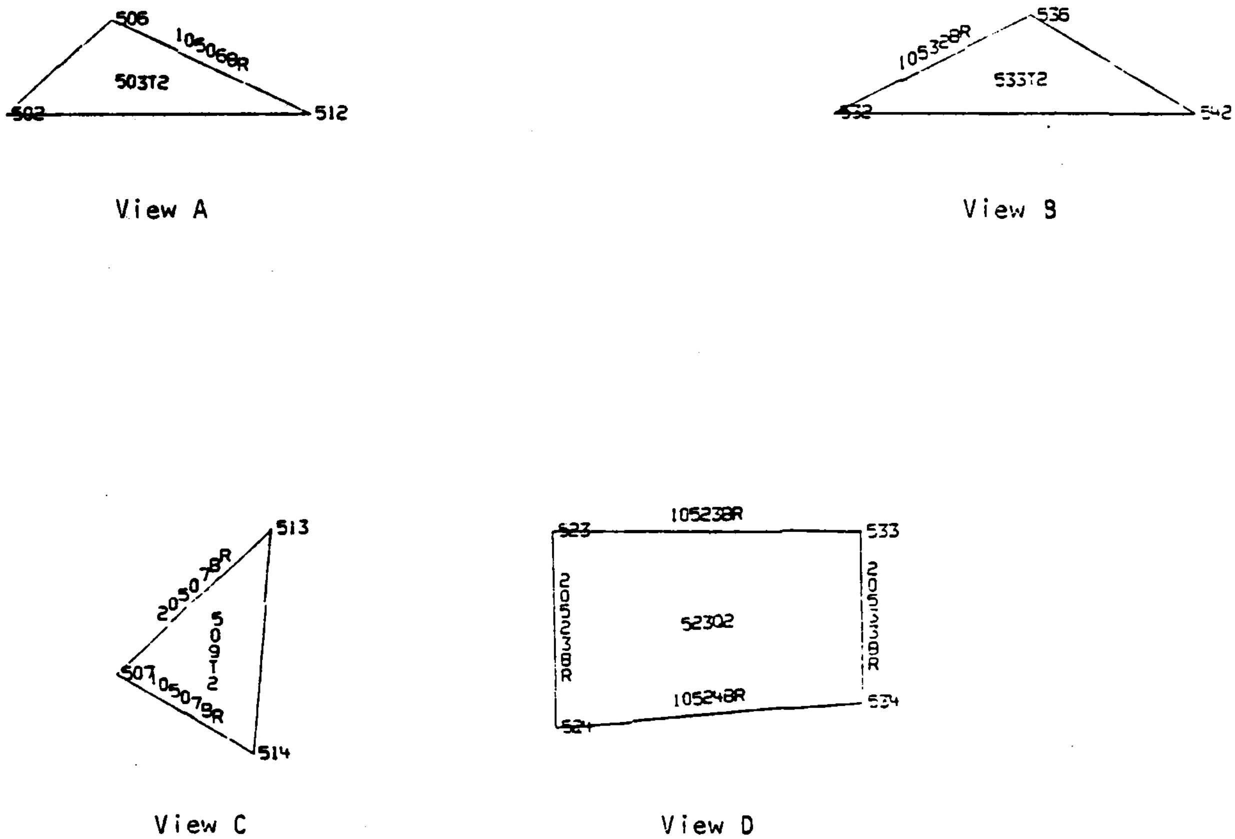


Figure C-8. - Underwing intermediate fairing panel - element identification, local panel views from figure C-5.

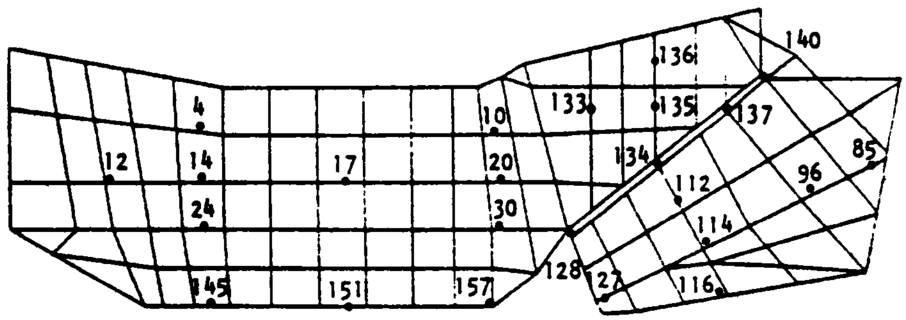


Figure C-9. - Overwing fairing influence coefficient point location.

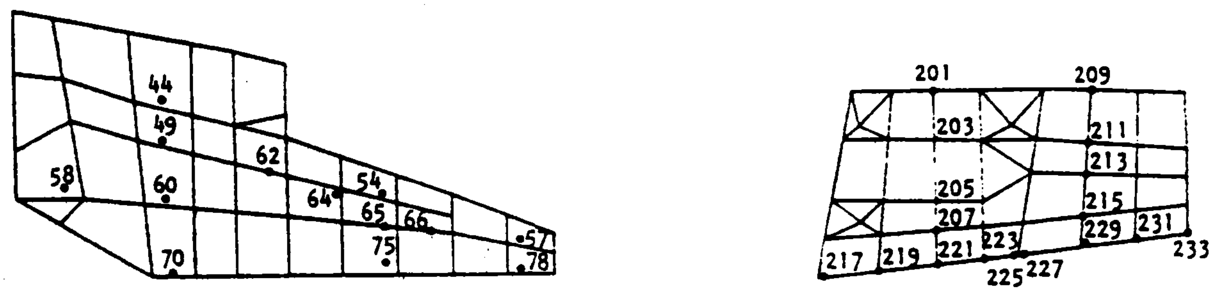


Figure C-10. - Underwing fairing influence coefficient point location.

TABLE C-I. - FAIRING INFLUENCE COEFFICIENT POINTS

SIC point	Description	Coordinate		
		X	Y	Z
4	Upper pivot fairing	924.600	-130.500	36.185
10	Upper pivot fairing	1,013.250	-130.500	33.589
12	Upper pivot fairing	893.200	-146.500	32.059
14	Upper pivot fairing	924.600	-146.500	33.152
17	Upper pivot fairing	969.00	-145.000	35.275
20	Upper pivot fairing	1,013.250	-147.000	33.100
24	Upper pivot fairing	924.600	-163.00	29.117
30	Upper pivot fairing	1,013.250	-163.000	31.487
44	Lower pivot fairing	910.500	-133.500	-5.068
49	Lower pivot fairing	910.500	-147.291	-5.282
54	Lower pivot fairing	970.800	-163.975	-3.189
57	Lower pivot fairing	1,012.100	-174.784	-1.594
58	Lower pivot fairing	883.800	-154.600	-1.412
60	Lower pivot fairing	910.700	-166.237	-1.307
62	Lower pivot fairing	937.500	-169.653	-2.092
64	Lower pivot fairing	959.250	-171.982	-3.650
65	Lower pivot fairing	970.800	-173.116	-3.566
66	Lower pivot fairing	983.250	-174.338	-2.736
70	Lower pivot fairing	912.250	-181.000	1.196
75	Lower pivot fairing	970.800	-182.158	-1.238
78	Lower pivot fairing	1,012.100	-183.769	-0.913
85	Overwing movable fairing	1,133.579	-142.022	16.105
96	Overwing movable fairing	1,111.821	-152.848	23.367
112	Overwing movable fairing	1,069.687	-153.764	30.181

TABLE C-I. - FAIRING INFLUENCE COEFFICIENT POINTS - Continued

SIC point	Description	Coordinate		
		X	Y	Z
114	Overwing Movable Fairing	1,077.683	-169.834	27.968
116	Overwing movable fairing	1,084.236	-183.004	24.879
127	Overwing movable fairing	1,047.467	-184.869	27.621
128	Forward intermediate fixed fairing	1,036.000	-165.480	31.153
133	Forward intermediate fixed fairing	1,043.500	-124.230	32.240
134	Forward intermediate fixed fairing	1,063.500	-142.380	30.527
135	Forward intermediate fixed fairing	1,063.500	-124.230	30.415
136	Forward intermediate fixed fairing	1,063.500	-110.360	30.988
137	Forward intermediate fixed fairing	1,085.100	-124.230	27.691
140	Forward intermediate fixed fairing	1,096.100	-115.000	28.336
145	Upper pivot fairing	924.600	-187.500	19.377
151	Upper pivot fairing	968.300	-187.500	24.006
157	Upper pivot fairing	1,011.000	-187.500	24.580
201	Underwing fairing intermediate panel	1,165.87	-116.50	4.9520
203	Underwing fairing intermediate panel	1,165.87	-132.20	4.5284
205	Underwing fairing intermediate panel	1,165.87	-151.71	3.5536
207	Underwing fairing intermediate panel	1,165.87	-160.86	3.1902
209	Underwing fairing aft panel	1,214.50	-117.10	5.6481
211	Underwing fairing aft panel	1,213.10	-133.91	4.9134
213	Underwing fairing aft panel	1,212.29	-143.76	4.4829
215	Underwing fairing aft panel	1,211.16	-157.36	3.8886
217	Underwing fairing intermediate panel	1,129.20	-175.46	1.8669
219	Underwing fairing intermediate panel	1,147.54	-173.61	2.3121
221	Underwing fairing intermediate panel	1,165.87	-171.76	2.7572

TABLE C-I. - FAIRING INFLUENCE COEFFICIENT POINTS - Concluded

SIC point	Description	Coordinate		
		X	Y	Z
223	Underwing fairing intermediate panel	1,180.35	-170.30	3.1086
225	Underwing fairing intermediate panel	1,190.90	-169.24	3.3646
227	Underwing fairing aft panel	1,191.00	-169.24	3.3646
229	Underwing fairing aft panel	1,210.36	-166.97	3.4685
231	Underwing fairing aft panel	1,227.19	-165.00	3.5546
233	Underwing fairing aft panel	1,243.50	-163.10	3.6362

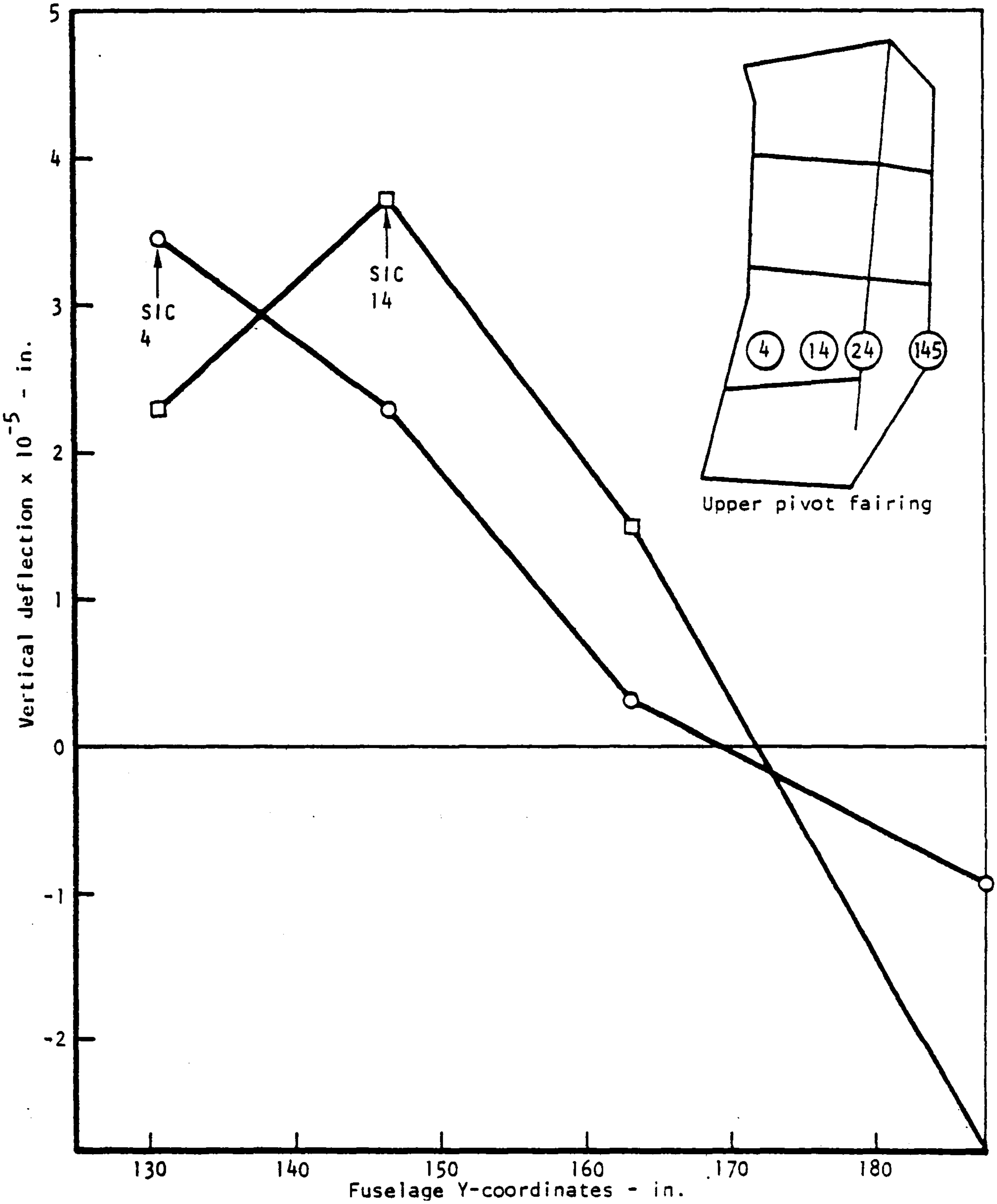


Figure C-11. - Deflections for NASTRAN upper pivot fairing for unit loads applied at SIC 4 and 14.

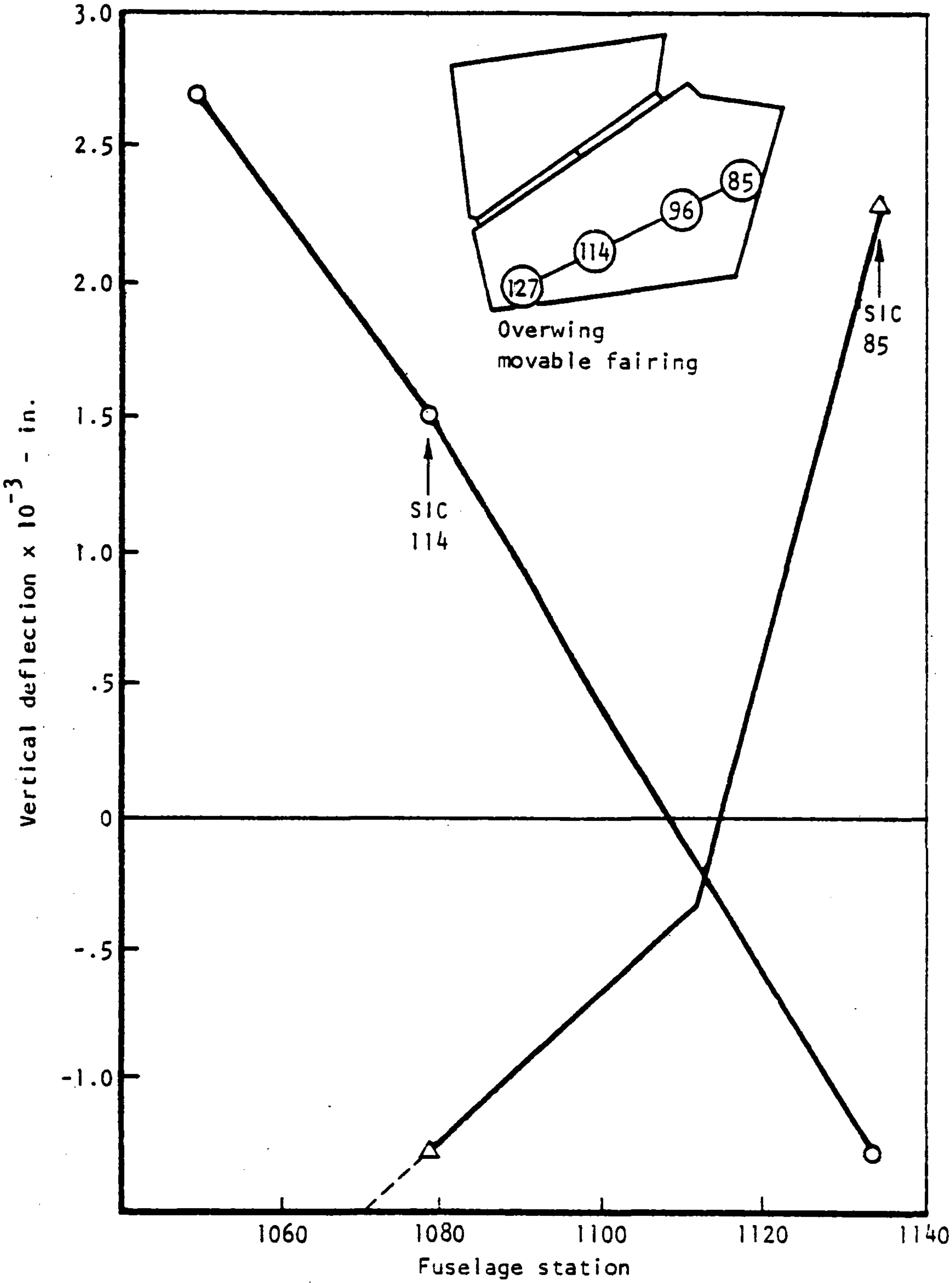


Figure C-12. Deflections for NASTRAN overwing movable fairing for unit loads applied at SIC 85 and 114.

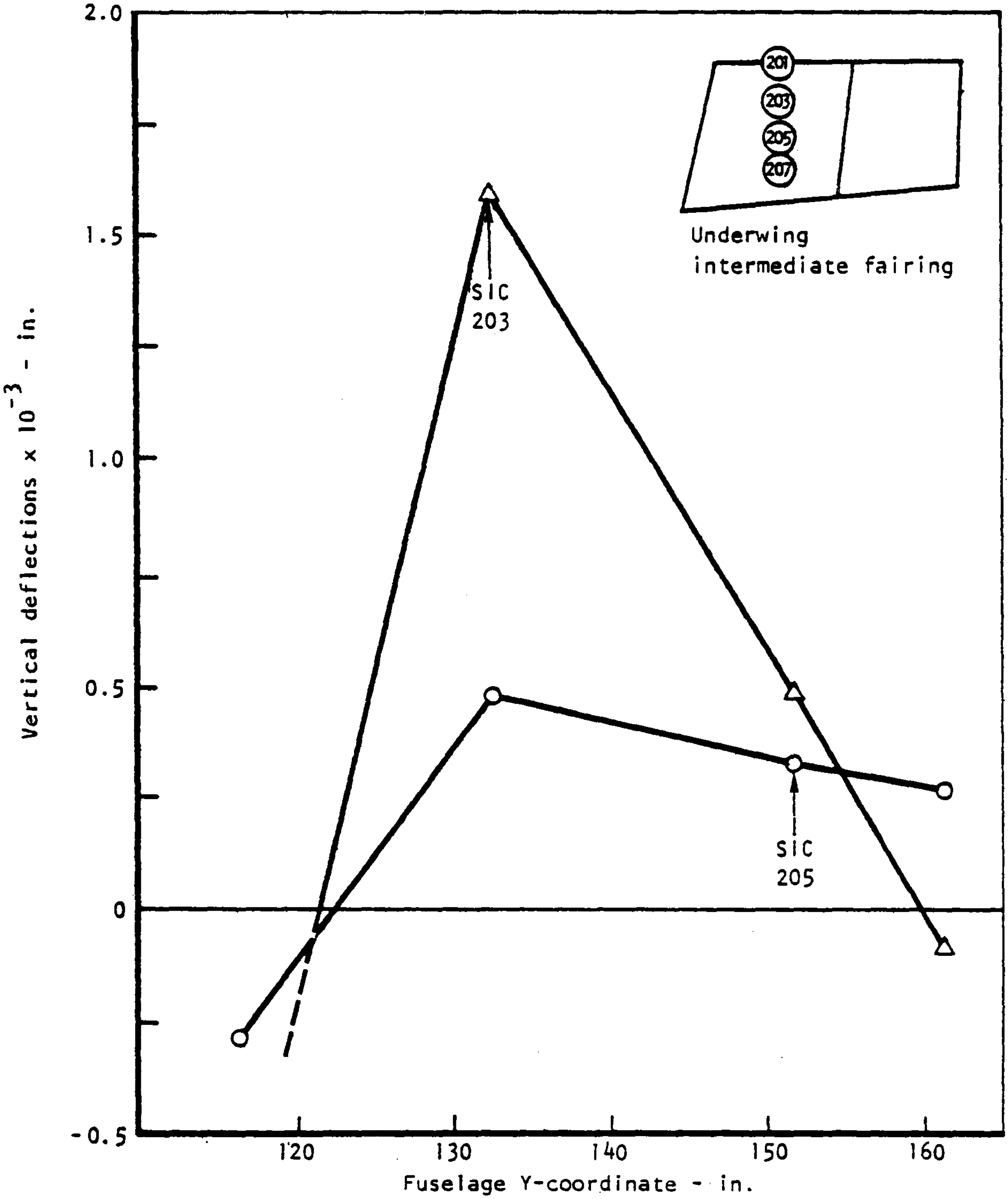


Figure C-13. - Deflections for NASTRAN underwing intermediate fairing for unit loads applied at SIC 203 and 205.

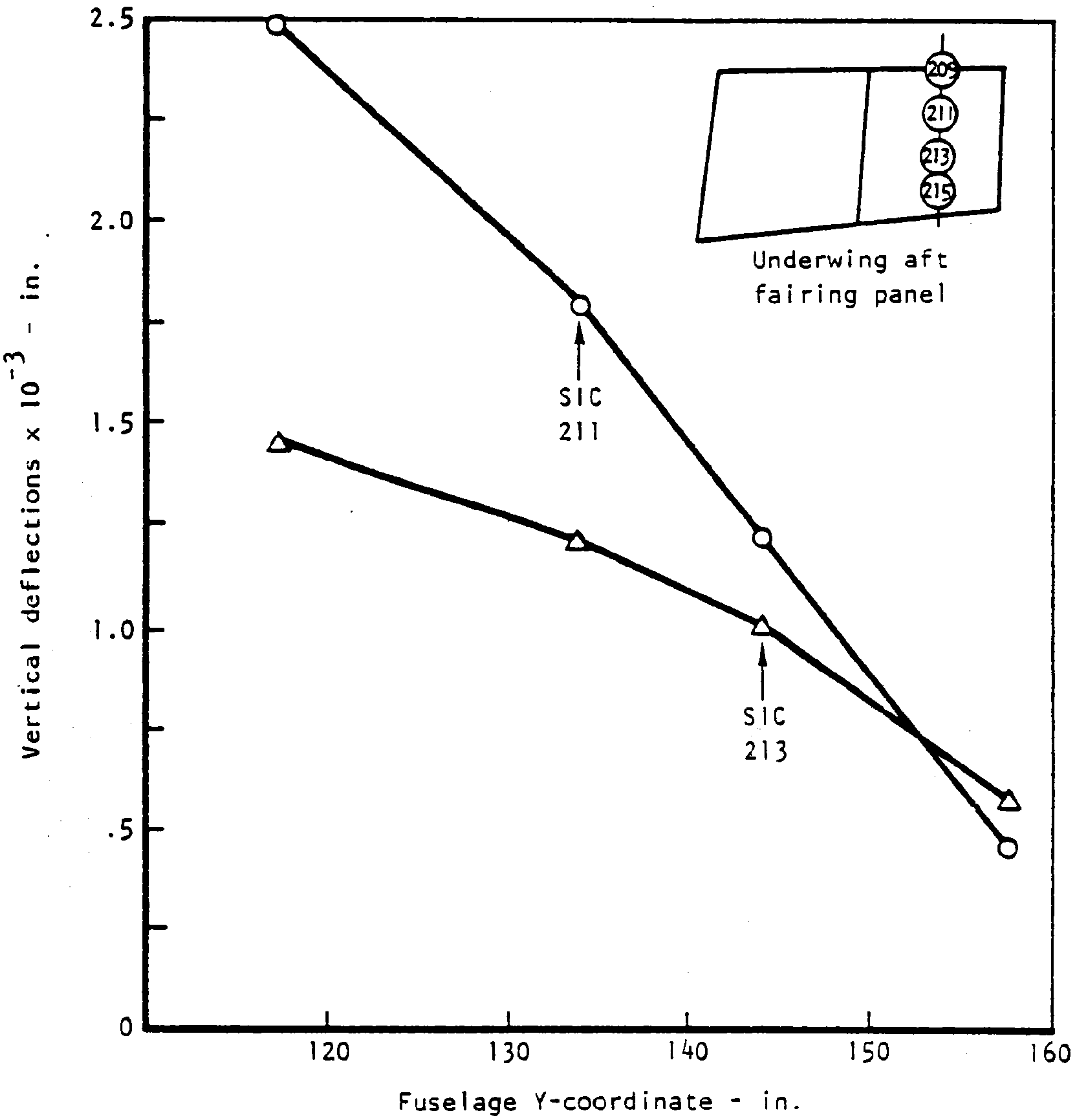


Figure C-14. - Deflections for NASTRAN underwing aft fairing for unit loads applied at SIC 211 and 213.

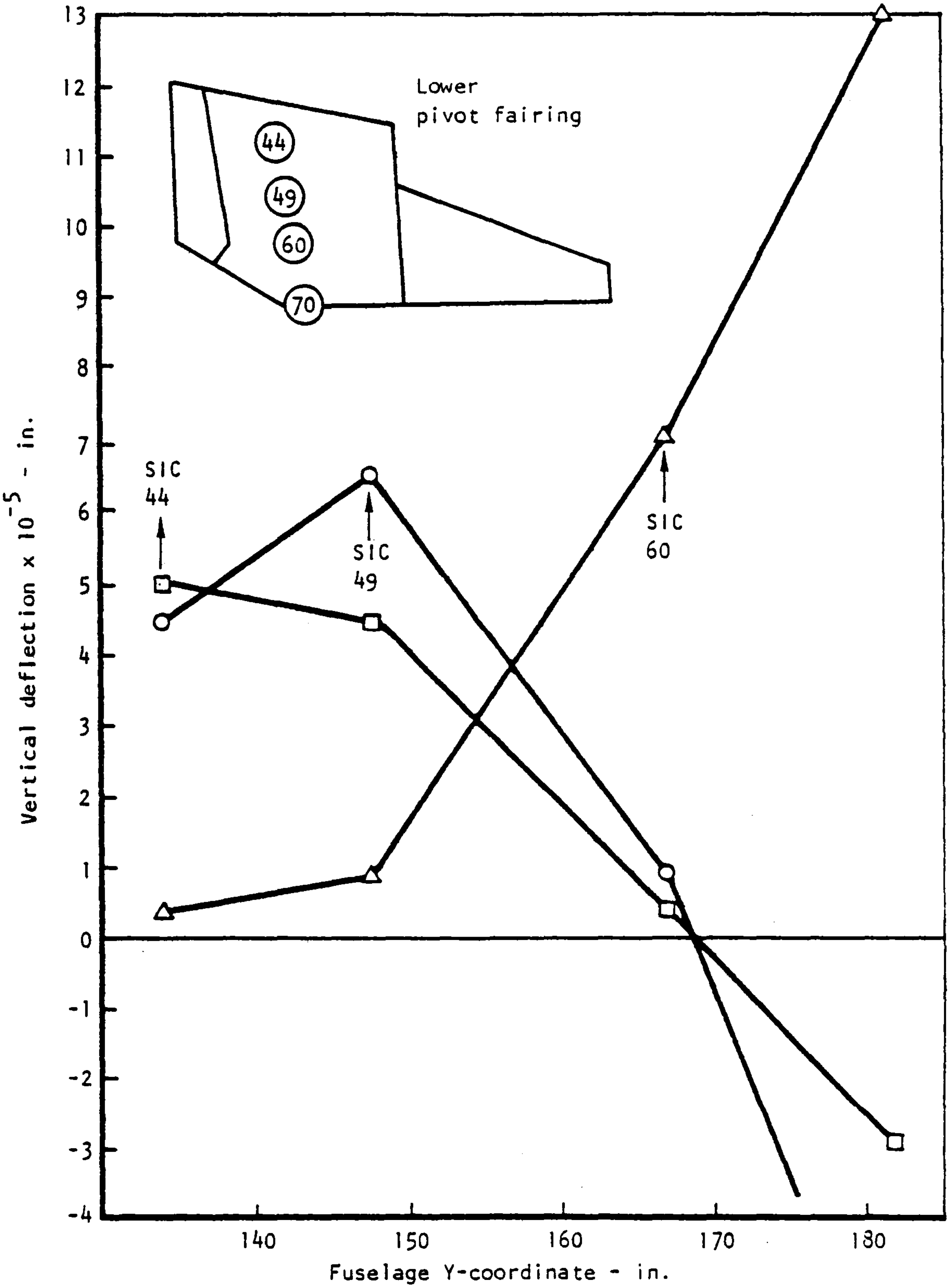


Figure C-15. - Deflections for NASTRAN lower pivot fairing for unit loads applied at SIC 44, 49, and 60.

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
1-										
2-	CBAR	10101	19992	101	111			10.0	1	BAR10101
3-	+AR10101	56	1							
4-	CBAR	10111	19992	111	121			10.0	1	BAR10111
5-	+AR10111		1							
6-	CBAR	10114	11530	114	124			10.0	1	
7-	CBAR	10121	19992	121	131			10.0	1	BAR10121
8-	+AR10121		156							
9-	CBAR	10124	13030	124	134			10.0	1	
10-	CBAR	10131	19992	131	141			10.0	1	BAR10131
11-	+AR10131	56	1							
12-	CBAR	10134	14660	134	144			10.0	1	
13-	CBAR	10141	19992	141	151			10.0	1	BAR10141
14-	+AR10141		156							
15-	CBAR	10144	14930	144	154			10.0	1	
16-	CBAR	10154	16100	154	164			10.0	1	
17-	CBAR	10201	19992	201	211			10.0	1	BAR10201
18-	+AR10201	56	1							
19-	CBAR	10204	16140	204	214			10.0	1	
20-	CBAR	10211	19992	211	221			10.0	1	BAR10211
21-	+AR10211		1							
22-	CBAR	10214	16220	214	224			10.0	1	
23-	CBAR	10221	19992	221	231			10.0	1	BAR10221
24-	+AR10221		156							
25-	CBAR	10224	16220	224	234			10.0	1	
26-	CBAR	10251	19992	251	261			10.0	1	BAR10251
27-	+AR10251	56	1							
28-	CBAR	10254	15440	254	264			10.0	1	
29-	CBAR	10261	19992	261	171			10.0	1	BAR10261
30-	+AR10261		1							
31-	CBAR	10264	13960	264	274			10.0	1	
32-	CBAR	10271	19992	271	281			10.0	1	BAR10271
33-	+AR10271		1							
34-	CBAR	10274	12800	274	284			10.0	1	
35-	CBAR	10281	19992	281	291			10.0	1	BAR10281
36-	+AR10281		156							
37-	CBAR	10284	11780	284	295			10.0	1	
38-	CBAR	10305	10893	305	315			10.0	1	
39-	CBAR	10311	19992	311	321			10.0	1	BAR10311
40-	+AR10311	56	1							
41-	CBAR	10315	10893	315	324			10.0	1	
42-	CBAR	10321	19992	321	331			10.0	1	BAR10321
43-	+AR10321		1							
44-	CBAR	10324	10893	324	334			10.0	1	
45-	CBAR	10331	19992	331	341			10.0	1	BAR10331
46-	+AR10331		1							
47-	CBAR	10334	10893	334	343			10.0	1	
48-	CBAR	10341	19992	341	351			10.0	1	BAR10341
49-	+AR10341		1							
50-	CBAR	10343	10893	343	353			10.0	1	

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
51-	CBAR	10351	19992	351	361			10.0	1	EAR10351
52-	+AR10351		1456							
53-	CBAR	10353	10893	353	354			10.0	1	
54-	CBAR	10354	10893	354	362			10.0	1	
55-	CBAR	10401	10802	401	411			10.0	1	
56-	CBAR	10433	16426	403	413			10.0	1	
57-	CBAR	10404	10198	404	414			10.0	1	
58-	CBAR	10411	10802	411	421			10.0	1	
59-	CBAR	10413	16426	413	423			10.0	1	
60-	CBAR	10414	10199	414	424			10.0	1	
61-	CBAR	10421	10902	421	431			10.0	1	
62-	CBAR	10423	16426	423	433			10.0	1	
63-	CBAR	10424	10198	424	435			10.0	1	
64-	CBAR	10431	10902	431	441			10.0	1	
65-	CBAR	10433	16426	433	443			10.0	1	
66-	CBAR	10435	10199	435	446			10.0	1	
67-	CBAR	10441	10802	441	451			10.0	1	
68-	CBAR	10443	16426	443	453			10.0	1	
69-	CBAR	10446	10199	446	455			10.0	1	
70-	CBAR	10451	10802	451	461			10.0	1	
71-	CBAR	10453	16426	453	463			10.0	1	
72-	CBAR	10453	16426	463	474			10.0	1	
73-	CBAR	10472	11975	472	481			10.0	1	
74-	CBAR	10506	12000	506	512			10.0	1	
75-	CBAR	10507	10256	507	514			10.0	1	
76-	CBAR	10512	14000	512	522			10.0	1	
77-	CBAR	10513	10256	513	523			10.0	1	
78-	CBAR	10514	13500	514	524			10.0	1	
79-	CBAR	10522	18000	522	532			10.0	1	
80-	CBAR	10523	10256	523	533			10.0	1	
81-	CBAR	10524	15500	524	534			10.0	1	
82-	CBAR	10532	14000	532	536			10.0	1	
83-	CBAR	10534	15500	534	544			10.0	1	
84-	CBAR	10601	19992	601	611			10.0	1	EAR10601
85-	+AR10601	56								
86-	CBAR	10611	19992	611	621			10.0	1	EAR10611
87-	CBAR	10613	20684	613	623			10.0	1	
88-	CBAR	10614	31920	614	624			10.0	1	
89-	CBAR	10621	19992	621	631			10.0	1	EAR10621
90-	CBAR	10623	20720	623	633			10.0	1	
91-	CBAR	10624	31640	624	634			10.0	1	
92-	CBAR	10631	19992	631	641			10.0	1	
93-	CBAR	10633	21232	633	643			10.0	1	
94-	CBAR	10634	31640	634	644			10.0	1	
95-	CBAR	10641	19992	641	651			10.0	1	
96-	CBAR	10643	20666	643	654			10.0	1	
97-	CBAR	10644	31640	644	655			10.0	1	
98-	CBAR	10701	10630	701	711			10.0	1	
99-	CBAR	10702	11050	702	712			10.0	1	
100-	CBAR	10703	10591	703	713			10.0	1	

SORTED BULK DATA ECHO

CARD COUNT	1	2	3	4	5	6	7	8	9	10
101-	CBAR	10711	10630	711	721			10.0	1	
102-	CBAR	10712	10850	712	722			10.0	1	
103-	CBAR	10713	10700	713	723			10.0	1	
104-	CBAR	10721	10630	721	731			10.0	1	
105-	CBAR	10722	10638	722	732			10.0	1	
106-	CBAR	10723	10650	723	733			10.0	1	
107-	CBAR	10741	10140	741	751			10.0	1	
108-	CBAR	10742	10140	742	752			10.0	1	
109-	CBAR	10743	10140	743	753			10.0	1	
110-	CBAR	10751	10140	751	761			10.0	1	
111-	CBAR	10752	10140	752	762			10.0	1	
112-	CBAR	10753	10140	753	763			10.0	1	
113-	CBAR	14241	19993	241	246			10.0	1	
114-	CBAR	15103	19993	103	106			10.0	1	EAR15103
115-	+AR15103	56								
116-	CBAR	15104	19993	104	107			10.0	1	EAR15104
117-	+AR15104	1456								
118-	CBAR	15171	19993	171	176			10.0	1	
119-	CBAR	15336	19993	336	355			10.0	1	
120-	CBAR	15355	19993	355	363		10.0		1	
121-	CBAR	15461	10862	461	471			10.0	1	
122-	CBAR	15603	19993	603	606			10.0	1	EAR15603
123-	+AR15603	56								
124-	CBAR	15604	19993	604	607			10.0	1	BAR15604
125-	+AR15604	1456								
126-	CBAR	20131	14288	131	132			10.0	1	
127-	CBAR	20132	13904	132	133			10.0	1	
128-	CBAR	20133	11650	133	134			10.0	1	
129-	CBAR	20171	11840	171	172			10.0	1	
130-	CBAR	20172	11840	172	173			10.0	1	
131-	CBAR	20173	12622	173	174			10.0	1	
132-	CBAR	20241	31616	241	242			10.0	1	
133-	CBAR	20242	33376	242	243			10.0	1	
134-	CBAR	20243	35290	243	244			10.0	1	
135-	CBAR	20291	19999	291	292			10.0	1	
136-	CBAR	20292	16980	292	293			10.0	1	
137-	CBAR	20293	16480	293	294			10.0	1	
138-	CBAR	20294	12135	294	295			10.0	1	
139-	CBAR	20305	35000	305	401			10.0	1	EAR20305
140-	+AR20305		56							
141-	CBAR	20311	10576	311	312			10.0	1	
142-	CBAR	20312	10283	312	313			10.0	1	
143-	CBAR	20313	10552	313	314			10.0	1	
144-	CBAR	20314	10528	314	315			10.0	1	
145-	CBAR	20331	10900	331	332			10.0	1	
146-	CBAR	20332	10950	332	333			10.0	1	
147-	CBAR	20333	10900	333	334			10.0	1	
148-	CBAR	20334	39999	334	431			10.0	1	EAR20334
149-	+AR20334		16							
150-	CBAR	20351	10975	351	352			10.0	1	

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
151-	CBAR	20352	10880	352	353			10.0	1	
152-	CBAR	20353	35000	353	451			10.0	1	EAR20353
153-	+AR20353		56							
154-	CBAR	20361	910893	361	362			10.0	1	
155-	CBAR	20401	10198	401	402			10.0	1	
156-	CBAR	20402	10198	402	403			10.0	1	
157-	CBAR	20403	10198	403	404			10.0	1	
158-	CBAR	20464	10198	464	455			10.0	1	
159-	CBAR	20471	10802	471	472			10.0	1	
160-	CBAR	20474	10198	474	464			10.0	1	
161-	CBAR	20481	10198	481	474			10.0	1	
162-	CBAR	20507	10256	507	513			10.0	1	
163-	CBAR	20522	19998	522	523			10.0	1	
164-	CBAR	20523	19998	523	524			10.0	1	
165-	CBAR	20532	10256	532	533			10.0	1	
166-	CBAR	20533	10256	533	534			10.0	1	
167-	CBAR	20621	19993	621	627			10.0	1	
168-	CBAR	20661	911600	661	662			10.0	1	
169-	CBAR	20662	811600	662	663			10.0	1	
170-	CBAR	20663	11600	663	664			10.0	1	
171-	CBAR	20702	13600	702	703			10.0	1	
172-	CBAR	20712	13600	712	713			10.0	1	
173-	CBAR	20722	13600	722	723			10.0	1	
174-	CBAR	20732	10500	732	733			10.0	1	
175-	CBAR	20751	10140	751	752			10.0	1	
176-	CBAR	25102	19993	102	106			10.0	1	EAR25102
177-	+AR25102	1456								
178-	CBAR	25103	19993	103	107			10.0	1	EAR25103
179-	+AR25103	56								
180-	CBAR	25151	19993	151	159			10.0	1	
181-	CBAR	25241	19993	241	245			10.0	1	
182-	CBAR	25461	11975	461	472			10.0	1	
183-	CBAR	25602	19993	602	606			10.0	1	EAR25602
184-	+AR25602	14								
185-	CBAR	25603	19993	603	607		10.0		1	
186-	CBAR	40131	19993	131	137		10.0		1	
187-	CBAR	40171	19993	171	175			10.0	1	
188-	CBAR	40423	19997	423	434			10.0	1	
189-	CBAR	40434	19997	434	445			10.0	1	
190-	CBAR	40445	19997	445	455			10.0	1	
191-	CBAR	50291	19993	291	306			10.0	1	
192-	CBAR	60137	19993	137	626		10.0		1	
193-	CBAR	60306	19993	306	307		10.0		1	
194-	CBAR	60361	19993	361	363		10.0		1	
195-	CBAR	921311	19993	311	316		10.0		1	
196-	CBAR	921331	19993	331	335		10.0		1	
197-	CELAS1	1171	1	171	1	201	1			
198-	CELAS1	1291	1	291	1	301	1			
199-	CELAS1	1541	1	541	1	551	1			
200-	CELAS1	1542	1	542	1	552	1			

SORTED BULK DATA ECHO

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..
201-	CELAS1	1543	1	543	1	553	1
202-	CELAS1	1544	1	544	1	554	1
203-	CELAS1	1653	1	653	1	662	1
204-	CELAS1	1654	1	654	1	663	1
205-	CELAS1	1655	1	655	1	664	1
206-	CELAS1	1662	1	662	1	701	1
207-	CELAS1	1663	1	663	1	702	1
208-	CELAS1	1664	1	664	1	703	1
209-	CELAS1	1731	1	731	1	741	1
210-	CELAS1	1733	1	733	1	742	1
211-	CELAS1	1734	1	734	1	743	1
212-	CELAS1	2164	1	164	2	174	2
213-	CELAS1	2174	1	174	2	204	2
214-	CELAS1	2234	1	234	2	244	2
215-	CELAS1	2244	1	244	2	254	2
216-	CELAS1	2541	1	541	2	551	2
217-	CELAS1	2542	1	542	2	552	2
218-	CELAS1	2543	1	543	2	553	2
219-	CELAS1	2544	1	544	2	554	2
220-	CELAS1	2653	1	653	2	662	2
221-	CELAS1	2654	1	654	2	663	2
222-	CELAS1	2655	1	655	2	664	2
223-	CELAS1	2662	1	662	2	701	2
224-	CELAS1	2663	1	663	2	702	2
225-	CELAS1	2664	1	664	2	703	2
226-	CELAS1	2731	1	731	2	741	2
227-	CELAS1	2733	1	733	2	742	2
228-	CELAS1	2734	1	734	2	743	2
229-	CELAS1	3161	1	161	3	171	3
230-	CELAS1	3162	1	162	3	172	3
231-	CELAS1	3163	1	163	3	173	3
232-	CELAS1	3164	1	164	3	174	3
233-	CELAS1	3171	1	171	3	201	3
234-	CELAS1	3172	1	172	3	202	3
235-	CELAS1	3173	1	173	3	203	3
236-	CELAS1	3174	1	174	3	204	3
237-	CELAS1	3231	1	231	3	241	3
238-	CELAS1	3232	1	232	3	242	3
239-	CELAS1	3233	1	233	3	243	3
240-	CELAS1	3234	1	234	3	244	3
241-	CELAS1	3241	1	241	3	251	3
242-	CELAS1	3242	1	242	3	252	3
243-	CELAS1	3243	1	243	3	253	3
244-	CELAS1	3244	1	244	3	254	3
245-	CELAS1	3291	1	291	3	301	3
246-	CELAS1	3292	1	292	3	302	3
247-	CELAS1	3293	1	293	3	303	3
248-	CELAS1	3294	1	294	3	304	3
249-	CELAS1	3295	1	295	3	305	3
250-	CELAS1	3541	1	541	3	551	3

. 7 .. 8 .. 9 .. 10 .

SORTED BULK DATA ECHO

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
251-	CELAS1	3542	1	542	3	552	3			
252-	CELAS1	3543	1	543	3	553	3			
253-	CELAS1	3544	1	544	3	554	3			
254-	CELAS1	3653	1	653	3	662	3			
255-	CELAS1	3654	1	654	3	663	3			
256-	CELAS1	3655	1	655	3	664	3			
257-	CELAS1	3662	1	662	3	701	3			
258-	CELAS1	3663	1	663	3	702	3			
259-	CELAS1	3664	1	664	3	703	3			
260-	CELAS1	3731	1	731	3	741	3			
261-	CELAS1	3733	1	733	3	742	3			
262-	CELAS1	3734	1	734	3	743	3			
263-	CELAS1	3762	1	762	3	772	3			
264-	CELAS1	4161	1	161	4	171	4			
265-	CELAS1	4171	1	171	4	201	4			
266-	CELAS1	4231	1	231	4	241	4			
267-	CELAS1	4241	1	241	4	251	4			
268-	CELAS1	920161	1	161	2	171	2			
269-	CELAS1	920171	1	171	2	201	2			
270-	CELAS1	920231	1	231	2	241	2			
271-	CELAS1	920241	1	241	2	251	2			
272-	CELAS1	920291	1	291	2	301	2			
273-	CONROD	20111	111	112	1	1.45				
274-	CONROD	20112	112	113	1	1.38				
275-	CONROD	20113	113	114	1	1.30				
276-	CONROD	20611	611	612	1	1.45				
277-	CONROD	20612	612	613	1	1.38				
278-	CONROD	20613	613	614	1	1.30				
279-	CONROD	60112	112	612	1	.525				
280-	CONROD	60113	113	613	1	.525				
281-	CONROD	60114	114	614	1	.525				
282-	CONROD	60355	355	471	1	5.0				
283-	CQUAD1	114	4512	114	105	125	124			
284-	CQUAD1	301	4804	301	302	312	311			
285-	CQUAD1	302	4739	302	303	313	312			
286-	CQUAD1	303	4739	303	304	314	313			
287-	CQUAD1	304	4739	304	305	315	314			
288-	CQUAD1	311	4804	311	312	322	321			
289-	CQUAD1	312	4739	312	313	323	322			
290-	CQUAD1	313	4739	313	314	324	323			
291-	CQUAD1	321	4804	321	322	332	331			
292-	CQUAD1	322	4739	322	323	333	332			
293-	CQUAD1	323	4739	323	324	334	333			
294-	CQUAD1	331	4804	331	332	342	341			
295-	CQUAD1	332	4739	332	333	343	342			
296-	CQUAD1	341	4804	341	342	352	351			
297-	CQUAD1	342	4739	342	343	353	352			
298-	CQUAD1	351	4804	351	352	354	362			
299-	CQUAD1	401	4166	401	402	412	411			
300-	CQUAD1	402	4166	402	403	413	412			

SORTED BULK DATA ECHO

CARD COUN	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
301-	CQUAD1	403	4166	403	404	414	413			
302-	CQUAD1	411	4303	411	412	422	421			
303-	CQUAD1	412	4413	412	413	423	422			
304-	CQUAD1	413	4313	413	414	424	423			
305-	CQUAD1	421	4300	421	422	432	431			
306-	CQUAD1	422	4410	422	423	433	432			
307-	CQUAD1	424	4160	423	424	435	434			
308-	CQUAD1	431	4295	431	432	442	441			
309-	CQUAD1	432	4405	432	433	443	442			
310-	CQUAD1	433	4405	433	434	444	443			
311-	CQUAD1	435	4155	434	435	446	445			
312-	CQUAD1	441	4292	441	442	452	451			
313-	CQUAD1	442	4402	442	443	453	452			
314-	CQUAD1	443	4401	443	444	454	453			
315-	CQUAD1	444	4200	444	445	455	454			
316-	CQUAD1	451	4290	451	452	462	461			
317-	CQUAD1	452	4234	452	453	463	462			
318-	CQUAD1	453	4239	453	454	464	463			
319-	CQUAD1	462	4290	461	462	473	472			
320-	CQUAD1	463	4152	462	463	474	473			
321-	CQUAD1	551	4750	551	552	562	561			
322-	CQUAD1	552	4795	552	553	563	562			
323-	CQUAD1	553	4820	553	554	564	563			
324-	CQUAD1	554	4820	554	555	565	564			
325-	CQUAD1	561	4750	561	562	572	571			
326-	CQUAD1	562	4795	562	563	573	572			
327-	CQUAD1	563	4820	563	564	574	573			
328-	CQUAD1	564	4820	564	565	575	574			
329-	CQUAD1	571	4759	571	572	582	581			
330-	CQUAD1	572	4795	572	573	583	582			
331-	CQUAD1	573	4820	573	574	584	583			
332-	CQUAD1	574	4820	574	575	585	584			
333-	CQUAD1	614	4380	614	615	625	624			
334-	CQUAD2	101	1070	101	102	112	111			
335-	CQUAD2	102	1070	102	103	113	112			
336-	CQUAD2	103	1070	103	104	114	113			
337-	CQUAD2	111	4437	111	112	122	121			
338-	CQUAD2	112	4602	112	113	123	122			
339-	CQUAD2	113	4468	113	114	124	123			
340-	CQUAD2	121	4495	121	122	132	131			
341-	CQUAD2	122	4657	122	123	133	132			
342-	CQUAD2	123	4711	123	124	134	133			
343-	CQUAD2	124	4891	124	125	135	134			
344-	CQUAD2	125	4549	125	126	136	135			
345-	CQUAD2	131	4644	131	132	142	141			
346-	CQUAD2	132	4729	132	133	143	142			
347-	CQUAD2	133	4936	133	134	144	143			
348-	CQUAD2	134	4891	134	135	145	144			
349-	CQUAD2	135	4549	135	136	146	145			
350-	CQUAD2	141	4644	141	142	152	151			

SORTED BULK DATA ECHO

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
351-	CQUAD2	142	4771	142	143	153	152			
352-	CQUAD2	143	4906	143	144	154	153			
353-	CQUAD2	144	4891	144	147	155	154			
354-	CQUAD2	145	4549	147	148	156	155			
355-	CQUAD2	151	4644	151	152	162	161			
356-	CQUAD2	152	4819	152	153	163	162			
357-	CQUAD2	153	4933	153	154	164	163			
358-	CQUAD2	154	4891	154	157	165	164			
359-	CQUAD2	155	4549	157	158	166	165			
360-	CQUAD2	201	4666	201	202	212	211			
361-	CQUAD2	202	4765	202	203	213	212			
362-	CQUAD2	203	4963	203	204	214	213			
363-	CQUAD2	204	4945	204	205	215	214			
364-	CQUAD2	205	4585	205	206	216	215			
365-	CQUAD2	211	4666	211	212	222	221			
366-	CQUAD2	212	4765	212	213	223	222			
367-	CQUAD2	213	4963	213	214	224	223			
368-	CQUAD2	214	4945	214	217	225	224			
369-	CQUAD2	215	4585	217	218	226	225			
370-	CQUAD2	221	4666	221	222	232	231			
371-	CQUAD2	222	4765	222	223	233	232			
372-	CQUAD2	223	4963	223	224	234	233			
373-	CQUAD2	224	4945	224	227	235	234			
374-	CQUAD2	225	4585	227	228	236	235			
375-	CQUAD2	251	4576	251	252	262	261			
376-	CQUAD2	252	4675	252	253	263	262			
377-	CQUAD2	253	4963	253	254	264	263			
378-	CQUAD2	254	4900	254	255	265	264			
379-	CQUAD2	255	4549	255	256	266	265			
380-	CQUAD2	261	4558	261	262	272	271			
381-	CQUAD2	262	4585	262	263	273	272			
382-	CQUAD2	263	4738	263	264	274	273			
383-	CQUAD2	264	4729	264	267	275	274			
384-	CQUAD2	265	4432	267	268	276	275			
385-	CQUAD2	271	4540	271	272	282	281			
386-	CQUAD2	272	4450	272	273	283	282			
387-	CQUAD2	273	4531	273	274	284	283			
388-	CQUAD2	274	4423	274	275	285	284			
389-	CQUAD2	282	4405	281	282	293	292			
390-	CQUAD2	283	4369	282	283	294	293			
391-	CQUAD2	284	4360	283	284	295	294			
392-	CQUAD2	505	1075	502	503	513	512			
393-	CQUAD2	510	1240	504	505	515	514			
394-	CQUAD2	511	1075	511	512	522	521			
395-	CQUAD2	512	1075	512	513	523	522			
396-	CQUAD2	513	1074	513	514	524	523			
397-	CQUAD2	514	1240	514	515	525	524			
398-	CQUAD2	521	1075	521	522	532	531			
399-	CQUAD2	522	1075	522	523	533	532			
400-	CQUAD2	523	1074	523	524	534	533			

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
401-	CQUAD2	524	1240	524	525	535	534			
402-	CQUAD2	537	1100	533	534	544	543			
403-	CQUAD2	538	1240	534	535	545	544			
404-	CQUAD2	601	1063	601	602	612	611			
405-	CQUAD2	602	1063	602	603	613	612			
406-	CQUAD2	603	1063	603	604	614	613			
407-	CQUAD2	611	4459	611	612	622	621			
408-	CQUAD2	612	4459	612	613	623	622			
409-	CQUAD2	613	4338	613	614	624	623			
410-	CQUAD2	621	4459	621	622	632	631			
411-	CQUAD2	622	4459	622	623	633	632			
412-	CQUAD2	623	4504	623	624	634	633			
413-	CQUAD2	624	4518	624	625	635	634			
414-	CQUAD2	631	4459	631	632	642	641			
415-	CQUAD2	632	4459	632	633	643	642			
416-	CQUAD2	633	4504	633	634	644	643			
417-	CQUAD2	634	4518	634	639	645	644			
418-	CQUAD2	641	4459	641	642	652	651			
419-	CQUAD2	642	4453	642	643	654	653			
420-	CQUAD2	643	4504	643	644	655	654			
421-	CQUAD2	644	4518	644	649	656	655			
422-	CQUAD2	701	4585	701	702	712	711			
423-	CQUAD2	702	4585	702	703	713	712			
424-	CQUAD2	703	4491	703	704	714	713			
425-	CQUAD2	711	4540	711	712	722	721			
426-	CQUAD2	712	4555	712	713	723	722			
427-	CQUAD2	713	4455	713	718	724	723			
428-	CQUAD2	721	4567	721	722	732	731			
429-	CQUAD2	722	4567	722	723	733	732			
430-	CQUAD2	723	4467	723	728	734	733			
431-	CQUAD2	741	1063	741	742	752	751			
432-	CQUAD2	742	1063	742	743	753	752			
433-	CQUAD2	752	1063	751	752	762	761			
434-	CQUAD2	753	1063	752	753	763	762			
435-	CSHEAR	30111	1040	111	112	612	611			
436-	CSHEAR	30112	1040	112	113	613	612			
437-	CSHEAR	30113	1040	113	114	614	613			
438-	CTRIA1	115	4512	105	126	125				
439-	CTRIA1	314	4739	314	315	324				
440-	CTRIA1	333	4739	333	334	343				
441-	CTRIA1	352	4739	352	353	354				
442-	CTRIA1	361	4804	351	362	361				
443-	CTRIA1	423	4409	423	434	433				
444-	CTRIA1	434	4224	434	445	444				
445-	CTRIA1	445	4150	445	446	455				
446-	CTRIA1	454	4200	454	455	464				
447-	CTRIA1	461	4290	461	472	471				
448-	CTRIA1	464	4155	463	464	474				
449-	CTRIA1	472	4290	472	473	481				
450-	CTRIA1	473	4150	473	474	481				

SORTED BULK DATA ECHO

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
451-	CTRIA2	104	1060	104	105	114				
452-	CTRIA2	275	4360	275	276	285				
453-	CTRIA2	281	4405	281	292	291				
454-	CTRIA2	285	4351	284	285	295				
455-	CTRIA2	501	1075	501	506	511				
456-	CTRIA2	502	1075	502	506	501				
457-	CTRIA2	503	1075	502	512	506				
458-	CTRIA2	504	1075	506	512	511				
459-	CTRIA2	506	1075	503	507	513				
460-	CTRIA2	507	1075	504	507	503				
461-	CTRIA2	508	1075	504	514	507				
462-	CTRIA2	509	1075	507	514	513				
463-	CTRIA2	531	1075	531	536	541				
464-	CTRIA2	532	1075	531	532	536				
465-	CTRIA2	533	1075	532	542	536				
466-	CTRIA2	534	1075	536	542	541				
467-	CTRIA2	535	1075	532	543	542				
468-	CTRIA2	536	1075	532	533	543				
469-	CTRIA2	604	1063	604	605	614				
470-	FORCE	4	142		0.001	0.0	0.0	371.382		
471-	FORCE	4	151		0.001	0.0	0.0	176.214		
472-	FORCE	4	152		0.001	0.0	0.0	452.404		
473-	FORCE	10	272		0.001	0.0	0.0	612.251		
474-	FORCE	10	281		0.001	0.0	0.0	186.348		
475-	FORCE	10	282		0.001	0.0	0.0	201.401		
476-	FORCE	12	122		0.001	0.0	0.0	107.961		
477-	FORCE	12	123		0.001	0.0	0.0	879.318		
478-	FORCE	12	133		0.001	0.0	0.0	21.721		
479-	FORCE	14	143		0.001	0.0	0.0	391.294		
480-	FORCE	14	152		0.001	0.0	0.0	146.227		
481-	FORCE	14	153		0.001	0.0	0.0	462.478		
482-	FORCE	17	213		0.001	0.0	0.0	309.537		
483-	FORCE	17	222		0.001	0.0	0.0	247.305		
484-	FORCE	17	223		0.001	0.0	0.0	443.158		
485-	FORCE	20	273		0.001	0.0	0.0	816.401		
486-	FORCE	20	282		0.001	0.0	0.0	112.536		
487-	FORCE	20	283		0.001	0.0	0.0	71.063		
488-	FORCE	24	144		0.001	0.0	0.0	410.942		
489-	FORCE	24	153		0.001	0.0	0.0	33.715		
490-	FORCE	24	154		0.001	0.0	0.0	555.342		
491-	FORCE	30	273		0.001	0.0	0.0	33.714		
492-	FORCE	30	274		0.001	0.0	0.0	940.093		
493-	FORCE	30	284		0.001	0.0	0.0	26.134		
494-	FORCE	44	622		0.001	0.0	0.0	356.392		
495-	FORCE	44	631		0.001	0.0	0.0	153.416		
496-	FORCE	44	632		0.001	0.0	0.0	490.192		
497-	FORCE	49	623		0.001	0.0	0.0	377.451		
498-	FORCE	49	632		0.001	0.0	0.0	108.338		
499-	FORCE	49	633		0.001	0.0	0.0	514.210		
500-	FORCE	54	712		0.001	0.0	0.0	359.244		

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
501-	FORCE	54	721		0.001	0.0	0.0	37.928		
502-	FORCE	54	722		0.001	0.0	0.0	602.827		
503-	FORCE	57	751		0.001	0.0	0.0	464.081		
504-	FORCE	57	752		0.001	0.0	0.0	331.450		
505-	FORCE	57	762		0.001	0.0	0.0	204.470		
506-	FORCE	58	604		0.001	0.0	0.0	-46.462		
507-	FORCE	58	613		0.001	0.0	0.0	374.107		
508-	FORCE	58	614		0.001	0.0	0.0	672.355		
509-	FORCE	60	624		0.001	0.0	0.0	402.594		
510-	FORCE	60	633		0.001	0.0	0.0	0.427		
511-	FORCE	60	634		0.001	0.0	0.0	596.989		
512-	FORCE	62	644		0.001	0.0	0.0	434.840		
513-	FORCE	62	655		0.001	0.0	0.0	529.696		
514-	FORCE	62	656		0.001	0.0	0.0	35.464		
515-	FORCE	64	703		0.001	0.0	0.0	66.299		
516-	FORCE	64	713		0.001	0.0	0.0	891.108		
517-	FORCE	64	714		0.001	0.0	0.0	42.593		
518-	FORCE	65	713		0.001	0.0	0.0	359.244		
519-	FORCE	65	723		0.001	0.0	0.0	598.734		
520-	FORCE	65	724		0.001	0.0	0.0	42.021		
521-	FORCE	66	723		0.001	0.0	0.0	597.059		
522-	FORCE	66	733		0.001	0.0	0.0	362.239		
523-	FORCE	66	734		0.001	0.0	0.0	40.703		
524-	FORCE	70	625		0.001	0.0	0.0	340.321		
525-	FORCE	70	634		0.001	0.0	0.0	314.923		
526-	FORCE	70	635		0.001	0.0	0.0	344.756		
527-	FORCE	75	718		0.001	0.0	0.0	359.244		
528-	FORCE	75	723		0.001	0.0	0.0	371.747		
529-	FORCE	75	724		0.001	0.0	0.0	269.009		
530-	FORCE	78	752		0.001	0.0	0.0	399.475		
531-	FORCE	78	753		0.001	0.0	0.0	396.056		
532-	FORCE	78	763		0.001	0.0	0.0	204.470		
533-	FORCE	85	463		0.001	0.0	0.0	187.818		
534-	FORCE	85	473		0.001	0.0	0.0	0.597		
535-	FORCE	85	474		0.001	0.0	0.0	811.585		
536-	FORCE	96	452		0.001	0.0	0.0	0.776		
537-	FORCE	96	453		0.001	0.0	0.0	759.970		
538-	FORCE	96	463		0.001	0.0	0.0	239.254		
539-	FORCE	112	431		0.001	0.0	0.0	289.576		
540-	FORCE	112	432		0.001	0.0	0.0	704.798		
541-	FORCE	112	442		0.001	0.0	0.0	5.626		
542-	FORCE	114	423		0.001	0.0	0.0	17.701		
543-	FORCE	114	432		0.001	0.0	0.0	0.599		
544-	FORCE	114	433		0.001	0.0	0.0	981.701		
545-	FORCE	116	424		0.001	0.0	0.0	38.213		
546-	FORCE	116	434		0.001	0.0	0.0	140.166		
547-	FORCE	116	435		0.001	0.0	0.0	821.621		
548-	FORCE	127	402		0.001	0.0	0.0	0.259		
549-	FORCE	127	403		0.001	0.0	0.0	712.444		
550-	FORCE	127	413		0.001	0.0	0.0	287.297		

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
551-	FORCE	128	305		0.001	0.0	0.0	1000.00		
552-	FORCE	133	302		0.001	0.0	0.0	-0.011		
553-	FORCE	133	312		0.001	0.0	0.0	627.243		
554-	FORCE	133	313		0.001	0.0	0.0	372.768		
555-	FORCE	134	323		0.001	0.0	0.0	-44.321		
556-	FORCE	134	324		0.001	0.0	0.0	44.306		
557-	FORCE	134	334		0.001	0.0	0.0	1000.015		
558-	FORCE	135	322		0.001	0.0	0.0	-0.015		
559-	FORCE	135	332		0.001	0.0	0.0	596.159		
560-	FORCE	135	333		0.001	0.0	0.0	403.856		
561-	FORCE	136	321		0.001	0.0	0.0	-0.015		
562-	FORCE	136	331		0.001	0.0	0.0	521.124		
563-	FORCE	136	332		0.001	0.0	0.0	478.892		
564-	FORCE	137	343		0.001	0.0	0.0	3.425		
565-	FORCE	137	352		0.001	0.0	0.0	15.857		
566-	FORCE	137	353		0.001	0.0	0.0	980.718		
567-	FORCE	140	362		0.001	0.0	0.0	1000.00		
568-	FORCE	145	147		0.001	0.0	0.0	-0.003		
569-	FORCE	145	148		0.001	0.0	0.0	627.966		
570-	FORCE	145	156		0.001	0.0	0.0	372.038		
571-	FORCE	151	218		0.001	0.0	0.0	357.155		
572-	FORCE	151	226		0.001	0.0	0.0	642.845		
573-	FORCE	157	268		0.001	0.0	0.0	166.654		
574-	FORCE	157	276		0.001	0.0	0.0	833.346		
575-	FORCE	201	521		0.001	0.0	0.0	1000.00		
576-	FORCE	203	522		0.001	0.0	0.0	1000.00		
577-	FORCE	205	523		0.001	0.0	0.0	1000.00		
578-	FORCE	207	524		0.001	0.0	0.0	1000.00		
579-	FORCE	209	561		0.001	0.0	0.0	1000.00		
580-	FORCE	211	562		0.001	0.0	0.0	1000.00		
581-	FORCE	213	563		0.001	0.0	0.0	1000.00		
582-	FORCE	215	564		0.001	0.0	0.0	1000.00		
583-	FORCE	217	505		0.001	0.0	0.0	1000.00		
584-	FORCE	219	515		0.001	0.0	0.0	1000.00		
585-	FORCE	221	525		0.001	0.0	0.0	1000.00		
586-	FORCE	223	535		0.001	0.0	0.0	1000.00		
587-	FORCE	225	545		0.001	0.0	0.0	1000.00		
588-	FORCE	227	555		0.001	0.0	0.0	1000.00		
589-	FORCE	229	565		0.001	0.0	0.0	1000.00		
590-	FORCE	231	575		0.001	0.0	0.0	1000.00		
591-	FORCE	233	585		0.001	0.0	0.0	1000.00		
592-	GRAV	999		3.0	.0	.0	-1.0			
593-	GRAV	1001		1.0	-1.0	-1.0	-1.0			
594-	GRID	101		863.5	-106.08	41.0				
595-	GRID	102		863.5	-125.03	36.5502				
596-	GRID	103		863.5	-148.67	29.0941				
597-	GRID	104		863.5	-163.50	20.4665		6		
598-	GRID	105		876.5	-171.04	18.1558				
599-	GRID	106		863.5	-134.1	34.0				
600-	GRID	107		863.5	-155.2	25.9				

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	1	2	3	4	5	6	7	8	9	10
601-	GRID	111		875.5	-108.35	40.4048				
602-	GRID	112		876.45	-127.01	36.4406				
603-	GRID	113		881.89	-148.67	30.6902				
604-	GRID	114		884.25	-163.50	24.8075				
605-	GRID	121		887.5	-110.63	39.8783				
606-	GRID	122		890.22	-128.57	36.3217				
607-	GRID	123		893.28	-148.67	31.4339				
608-	GRID	124		895.53	-163.50	26.3089				
609-	GRID	125		895.72	-174.25	21.6513				
610-	GRID	126		904.88	-187.50	13.8072		6		
611-	GRID	131		899.50	-112.90	39.3676				
612-	GRID	132		903.05	-130.11	36.1960				
613-	GRID	133		904.80	-148.67	32.0836				
614-	GRID	134		907.00	-163.50	27.6707				
615-	GRID	135		908.77	-175.50	22.7471				
616-	GRID	136		910.55	-187.50	15.7709				
617-	GRID	137		899.5	-112.90	39.37				
618-	GRID	141		914.75	-115.79	38.7204				
619-	GRID	142		915.46	-131.90	35.9838				
620-	GRID	143		916.20	-148.67	32.5292				
621-	GRID	144		916.86	-163.50	28.5225				
622-	GRID	145		918.70	-175.50	24.2179				
623-	GRID	146		920.53	-187.50	18.4838		6		
624-	GRID	147		918.70	-175.50	24.2179				
625-	GRID	148		920.53	-187.50	18.4838		6		
626-	GRID	151		930.00	-119.90	37.9076				
627-	GRID	152		930.00	-133.83	35.5584				
628-	GRID	153		930.00	-148.67	32.8863				
629-	GRID	154		930.00	-163.50	29.2147				
630-	GRID	155		930.74	-175.50	25.4513				
631-	GRID	156		931.47	-187.50	20.5882		6		
632-	GRID	157		930.74	-175.50	25.4513				
633-	GRID	158		931.47	-187.50	20.5863		6		
634-	GRID	159		932.0	-119.0	36.76				
635-	GRID	161		944.04	-119.00	37.4609				
636-	GRID	162		944.04	-133.83	35.6781				
637-	GRID	163		944.04	-148.67	33.6498				
638-	GRID	164		944.04	-163.50	29.9527				
639-	GRID	165		944.04	-175.50	26.4888				
640-	GRID	166		944.04	-187.50	22.2510		6		
641-	GRID	171		944.04	-119.00	37.4609				
642-	GRID	172		944.04	-133.83	35.6781		156		
643-	GRID	173		944.04	-148.67	33.6498		156		
644-	GRID	174		944.04	-163.50	29.9527		156		
645-	GRID	175		947.0	-119.0	35.57				
646-	GRID	176		961.0	-119.0	34.38				
647-	GRID	201		944.04	-119.00	37.4609				
648-	GRID	202		944.04	-133.83	35.6781				
649-	GRID	203		944.04	-148.67	33.6498				
650-	GRID	204		944.04	-163.50	29.9527				

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
651-	GRID	205		944.04	-175.50	26.4688				
652-	GRID	206		944.04	-187.50	22.2510		6		
653-	GRID	211		958.85	-119.00	36.9017				
654-	GRID	212		958.85	-133.83	35.8919				
655-	GRID	213		958.85	-148.67	34.4596				
656-	GRID	214		958.85	-163.50	30.8943				
657-	GRID	215		958.85	-175.50	27.4017				
658-	GRID	216		958.85	-187.50	23.5666		6		
659-	GRID	217		958.85	-175.50	27.4017				
660-	GRID	218		958.85	-187.50	23.5666		6		
661-	GRID	221		973.55	-119.00	36.2189				
662-	GRID	222		973.55	-133.83	35.6347				
663-	GRID	223		973.55	-148.67	34.6931				
664-	GRID	224		973.55	-163.50	31.5175				
665-	GRID	225		973.55	-175.50	28.1337				
666-	GRID	226		973.55	-187.50	24.1004		6		
667-	GRID	227		973.55	-175.50	28.1337				
668-	GRID	228		973.55	-187.50	24.1004		6		
669-	GRID	231		988.25	-119.00	35.6253				
670-	GRID	232		988.25	-133.83	34.7025				
671-	GRID	233		988.25	-148.67	34.2737				
672-	GRID	234		988.25	-163.50	31.6088				
673-	GRID	235		988.25	-175.50	28.5834				
674-	GRID	236		988.25	-187.50	24.3372		6		
675-	GRID	241		988.25	-119.00	35.6253				
676-	GRID	242		988.25	-133.83	34.7025		156		
677-	GRID	243		988.25	-148.67	34.2737		156		
678-	GRID	244		988.25	-163.50	31.6088		156		
679-	GRID	245		977.0	-119.0	33.19				
680-	GRID	246		992.0	-119.0	32.0				
681-	GRID	251		988.25	-119.00	35.6253				
682-	GRID	252		988.25	-133.83	34.7025				
683-	GRID	253		988.25	-148.67	34.2737				
684-	GRID	254		988.25	-163.50	31.6088				
685-	GRID	255		988.25	-175.50	28.5834				
686-	GRID	256		988.25	-187.50	24.3372		6		
687-	GRID	261		1001.00	-119.00	34.9928				
688-	GRID	262		1001.00	-133.83	33.8431				
689-	GRID	263		1001.00	-148.67	33.6393				
690-	GRID	264		1001.00	-163.50	31.4679				
691-	GRID	265		1001.00	-175.50	28.9116				
692-	GRID	266		1001.00	-187.50	24.4656		6		
693-	GRID	267		1001.00	-175.50	28.9116				
694-	GRID	268		1001.00	-187.50	24.4656		6		
695-	GRID	271		1009.01	-119.00	34.5507				
696-	GRID	272		1010.34	-133.83	33.5202				
697-	GRID	273		1011.67	-148.67	33.0674				
698-	GRID	274		1013.00	-163.50	31.421[illegible]				
699-	GRID	275		1013.00	-175.50	29.1378				
700-	GRID	276		1013.00	-187.50	24.598[illegible]		6		

SORTED BULK DATA ECHO

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
701-	GRID	281		1016.25	-115.96	34.347				
702-	GRID	282		1019.32	-133.83	33.2264				
703-	GRID	283		1021.79	-148.67	32.6136				
704-	GRID	284		1024.26	-163.50	31.4419				
705-	GRID	285		1026.50	-177.01	28.8495				
706-	GRID	291		1023.50	-111.70	34.1427				
707-	GRID	292		1025.17	-119.00	33.5835				
708-	GRID	293		1028.85	-133.83	32.8697				
709-	GRID	294		1032.52	-148.67	32.3274				
710-	GRID	295		1036.20	-163.50	31.3786				
711-	GRID	301		1023.50	-111.70	34.1427				
712-	GRID	302		1025.17	-119.00	33.5835				
713-	GRID	303		1028.85	-133.83	32.8697				
714-	GRID	304		1032.52	-148.67	32.3274				
715-	GRID	305		1036.20	-163.50	31.3786				
716-	GRID	306		1023.5	-117.7	32.6				
717-	GRID	307		1023.5	-117.7	25.85				
718-	GRID	311		1043.50	-107.06	32.9479				
719-	GRID	312		1043.50	-119.00	32.3909				
720-	GRID	313		1043.50	-133.03	32.1688				
721-	GRID	314		1043.50	-149.18	31.9222				
722-	GRID	315		1043.50	-157.65	31.6193				
723-	GRID	316		1043.5	-107.06	31.95				
724-	GRID	321		1053.50	-104.74	32.4158				
725-	GRID	322		1053.50	-119.00	31.7478				
726-	GRID	323		1053.50	-132.49	31.6576				
727-	GRID	324		1053.50	-149.64	31.5433				
728-	GRID	331		1063.50	-102.42	31.9713				
729-	GRID	332		1063.50	-119.00	31.0085				
730-	GRID	333		1063.50	-131.95	31.0667				
731-	GRID	334		1063.50	-141.62	31.1101				
732-	GRID	335		1063.5	-102.42	31.82				
733-	GRID	336		1063.5	-102.42	22.15				
734-	GRID	341		1076.46	-99.42	31.5685				
735-	GRID	342		1076.46	-119.00	29.9126				
736-	GRID	343		1076.46	-131.24	30.0623				
737-	GRID	351		1085.13	-97.41	31.4329				
738-	GRID	352		1085.13	-119.00	29.0589				
739-	GRID	353		1085.13	-124.29	29.1339				
740-	GRID	354		1091.73	-119.00	28.3275				
741-	GRID	355		1085.13	-97.41	26.770				
742-	GRID	361		1096.13	-94.86	31.56				
743-	GRID	362		1096.13	-115.48	29.5669				
744-	GRID	363		1096.13	-94.86	19.13				
745-	GRID	401		1037.20	-165.85	31.1194				
746-	GRID	402		1041.04	-176.00	28.6231				
747-	GRID	403		1044.94	-186.13	27.4386				
748-	GRID	404		1046.70	-189.80	26.0633				
749-	GRID	411		1043.50	-160.80	31.4675				
750-	GRID	412		1048.71	-171.46	29.5074				

Airloads Research Study - Fairing Structure

SORTED BULK DATA ECHO

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
751-	GRID	413		1053.74	-181.75	27.9503				
752-	GRID	414		1057.40	-189.25	25.5678				
753-	GRID	421		1054.50	-152.00	31.5017				
754-	GRID	422		1060.75	-164.31	30.1475				
755-	GRID	423		1066.41	-175.45	27.3588				
756-	GRID	424		1072.12	-186.69	24.7550				
757-	GRID	431		1064.50	-144.00	31.0635				
758-	GRID	432		1071.69	-157.81	29.8967				
759-	GRID	433		1077.89	-169.74	28.0378				
760-	GRID	434		1080.13	-174.05	26.7503				
761-	GRID	435		1085.50	-184.36	23.7744				
762-	GRID	441		1077.46	-133.60	30.0032				
763-	GRID	442		1085.72	-149.47	28.4942				
764-	GRID	443		1092.49	-162.47	27.2805				
765-	GRID	444		1097.63	-168.93	25.7593				
766-	GRID	445		1102.47	-175.02	23.8433				
767-	GRID	446		1106.93	-180.63	21.7698				
768-	GRID	451		1086.13	-126.60	29.0812				
769-	GRID	452		1098.34	-141.98	26.2697				
770-	GRID	453		1108.35	-154.59	24.1349				
771-	GRID	454		1116.27	-163.50	22.2233				
772-	GRID	455		1128.35	-176.90	19.2016				
773-	GRID	461		1097.90	-116.50	29.5075				
774-	GRID	462		1111.98	-133.88	23.1573				
775-	GRID	463		1122.89	-147.35	20.0678				
776-	GRID	464		1132.21	-158.85	17.5449				
777-	GRID	471		1107.13	-109.02	26.4528				
778-	GRID	472		1113.94	-116.50	23.8945				
779-	GRID	473		1123.52	-127.03	20.1765				
780-	GRID	474		1136.06	-140.80	15.1568				
781-	GRID	481		1140.62	-116.50	15.1159				
782-	GRID	501		1140.62	-116.50	4.4402		6		
783-	GRID	502		1137.45	-131.75	3.7702		6		
784-	GRID	503		1133.43	-151.06	2.9217		6		
785-	GRID	504		1130.94	-163.02	2.3963		6		
786-	GRID	505		1129.20	-175.46	1.8669		6		
787-	GRID	506		1142.40	-127.46	4.0410				
788-	GRID	507		1142.40	-158.01	2.8276				
789-	GRID	511		1153.25	-116.50	4.6962		6		
790-	GRID	512		1151.70	-131.98	4.0500				
791-	GRID	513		1149.76	-151.38	3.2401				
792-	GRID	514		1148.71	-161.91	2.8095				
793-	GRID	515		1147.54	-173.61	2.3121		6		
794-	GRID	521		1165.87	-116.50	4.9520		6		
795-	GRID	522		1165.87	-132.20	4.3264				
796-	GRID	523		1165.87	-151.71	3.5536				
797-	GRID	524		1165.87	-160.86	3.1902				
798-	GRID	525		1165.87	-171.76	2.7572		6		
799-	GRID	531		1180.35	-116.50	5.2455		6		
800-	GRID	532		1180.35	-132.43	4.6128				

SORTED BULK DATA ECHO

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
801-	GRID	533		1180.35	-152.00	3.8355				
802-	GRID	534		1180.35	-159.96	3.5193				
803-	GRID	535		1180.35	-170.30	3.1086	6			
804-	GRID	536		1189.62	-128.05	4.9747				
805-	GRID	541		1200.00	-116.50	5.6440				
806-	GRID	542		1197.20	-132.70	4.9437				
807-	GRID	543		1195.43	-143.00	4.4987				
808-	GRID	544		1192.63	-159.20	3.7985				
809-	GRID	545		1190.90	-169.24	3.3646	6			
810-	GRID	551		1200.00	-116.50	5.6440	6			
811-	GRID	552		1197.20	-132.70	4.9437	6			
812-	GRID	553		1195.43	-143.00	4.4987	6			
813-	GRID	554		1192.63	-159.20	3.7985	6			
814-	GRID	555		1191.00	-169.24	3.3646	6			
815-	GRID	561		1214.50	-117.10	5.6481	6			
816-	GRID	562		1213.10	-133.91	4.9134	6			
817-	GRID	563		1212.29	-143.76	4.4829	6			
818-	GRID	564		1211.16	-157.36	3.8866	6			
819-	GRID	565		1210.36	-166.97	3.4685	6			
820-	GRID	571		1229.00	-117.71	5.6215	6			
821-	GRID	572		1228.34	-135.07	4.8627	6			
822-	GRID	573		1227.97	-144.48	4.4516	6			
823-	GRID	574		1227.54	-155.73	3.9599	6			
824-	GRID	575		1227.19	-165.00	3.5546	6			
825-	GRID	581		1243.50	-118.31	5.5851	6			
826-	GRID	582		1243.50	-136.23	4.8054	6			
827-	GRID	583		1243.50	-145.18	4.4160	6			
828-	GRID	584		1243.50	-154.14	4.0260	6			
829-	GRID	585		1243.50	-163.10	3.6362	6			
830-	GRID	601		863.5	-106.08	-4.4				
831-	GRID	602		863.50	-125.03	-2.9331				
832-	GRID	603		863.50	-148.67	-0.9111				
833-	GRID	604		863.50	-163.50	1.6339				
834-	GRID	605		876.50	-171.04	2.1027				
835-	GRID	606		863.5	-134.1	-2.2				
836-	GRID	607		863.5	-155.2	-0.2				
837-	GRID	611		875.50	-108.45	-4.4164				
838-	GRID	612		878.45	-127.01	-3.3012				
839-	GRID	613		881.47	-139.71	-2.8559				
840-	GRID	614		884.25	-163.50	-0.3465				
841-	GRID	621		896.00	-112.89	-4.7028				
842-	GRID	622		899.43	-133.97	-3.8651				
843-	GRID	623		900.39	-145.89	-3.7659				
844-	GRID	624		901.90	-165.33	-0.9837				
845-	GRID	625		903.76	-187.50	3.5716				
846-	GRID	626		899.5	-112.9	-4.8				
847-	GRID	627		899.5	-112.9	-4.8				
848-	GRID	631		916.63	-116.56	-4.9347				
849-	GRID	632		916.63	-138.46	-5.9487				
850-	GRID	633		916.63	-150.18	-4.2270				

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
851-	GRID	634		916.63	-166.86	-1.5835				
852-	GRID	635		916.63	-187.50	2.6881		6		
853-	GRID	639		916.63	-187.50	2.6881		6		
854-	GRID	641		929.00	-119.00	-5.0933				
855-	GRID	642		929.00	-141.69	-5.9228				
856-	GRID	643		929.00	-153.41	-4.6116				
857-	GRID	644		929.00	-168.14	-1.8641				
858-	GRID	645		929.00	-187.50	1.9307		6		
859-	GRID	649		929.00	-187.50	1.9307				
860-	GRID	651		944.04	-123.40	-6.0374				
861-	GRID	652		944.04	-138.70	-4.7282				
862-	GRID	653		944.04	-145.60	-4.5415		6		
863-	GRID	654		944.04	-157.32	-5.1065				
864-	GRID	655		944.04	-169.70	-2.4259				
865-	GRID	656		944.04	-187.50	1.1941		6		
866-	GRID	661		944.04	-138.70	-4.7282		156		
867-	GRID	662		944.04	-145.60	-4.5415		56		
868-	GRID	663		944.04	-157.32	-5.1065		56		
869-	GRID	664		944.04	-169.70	-2.4259		56		
870-	GRID	701		944.04	-145.60	-4.5415				
871-	GRID	702		944.04	-157.32	-5.1065				
872-	GRID	703		944.04	-169.70	-2.4259				
873-	GRID	704		944.04	-187.50	1.1941		6		
874-	GRID	711		960.33	-151.51	-3.5327				
875-	GRID	712		960.33	-161.57	-4.6287				
876-	GRID	713		960.33	-171.41	-3.1922				
877-	GRID	714		960.33	-187.50	.7203		6		
878-	GRID	718		960.33	-187.50	.7203				
879-	GRID	721		976.67	-157.43	-2.8570				
880-	GRID	722		976.67	-165.82	-3.1206				
881-	GRID	723		976.67	-173.13	-3.7296				
882-	GRID	724		976.67	-187.50	.3883		6		
883-	GRID	728		976.67	-187.50	.3883				
884-	GRID	731		993.00	-163.35	-2.2996				
885-	GRID	732		993.00	-170.08	-2.1156				
886-	GRID	733		993.00	-174.85	-2.1570				
887-	GRID	734		993.00	-187.50	-0.0404		6		
888-	GRID	741		993.00	-163.35	-2.2996		6		
889-	GRID	742		993.00	-174.85	-2.1570		6		
890-	GRID	743		993.00	-187.50	-0.0404				
891-	GRID	751		1009.17	-169.59	-1.7719		6		
892-	GRID	752		1009.17	-178.16	-1.7055				
893-	GRID	753		1009.17	-187.50	-0.3714				
894-	GRID	761		1023.50	-175.13	-1.3153		6		
895-	GRID	762		1023.50	-181.10	-1.3599				
896-	GRID	763		1023.50	-187.50	-0.9872				
897-	GRID	772		1023.50	-181.10	-1.3599		123456		
898-	MAT1	1	10.5+6	4.0+6	.33	.100				
899-	MAT1	2	16.2+6	6.4+6	.33	.160				
900-	MAT1	3	30.+6	12.+6	.33	.300				

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
901-	MAT1	4	3.6+6	1.4+6	.33	.075				
902-	MAT1	5	51.0+3	20.5+3	.3	.0035				
903-	MAT1	6	86.0+3	46.3+3	.3	.002				
904-	MAT1	10	10.5+6	4.0+6	.33	.0				
905-	PBAR	10140	1	.14	.02					
906-	PBAR	10198	1	.198	.002					
907-	PBAR	10256	1	.26	.65					
908-	PBAR	10283	1	.28	.30					
909-	PBAR	10370	1	.37	.14					
910-	PBAR	10371	1	.37	1.36					
911-	PBAR	10500	1	.50	.40					
912-	PBAR	10528	1	.53	.86					
913-	PBAR	10552	1	.55	1.06					
914-	PBAR	10576	1	.58	1.36					
915-	PBAR	10590	1	.80	1.43					
916-	PBAR	10610	1	.61	.733					
917-	PBAR	10630	1	.63	.84					
918-	PBAR	10638	1	.64	.80					
919-	PBAR	10650	1	.65	1.124					
920-	PBAR	10700	1	.70	1.251					
921-	PBAR	10802	1	.82	.81					
922-	PBAR	10850	1	.85	2.42					
923-	PBAR	10880	1	.88	1.00					
924-	PBAR	10893	1	.89	.89	.45				
925-	PBAR	10900	1	.90	.24					
926-	PBAR	10910	1	.90	2.08					
927-	PBAR	10950	1	.95	2.61					
928-	PBAR	10975	1	.98	1.81					
929-	PBAR	11050	1	1.05	5.06					
930-	PBAR	11530	2	1.14	1.40					
931-	PBAR	11592	1	1.59	247.					
932-	PBAR	11600	2	1.6	2.8					
933-	PBAR	11650	1	1.37	10.1					
934-	PBAR	11738	1	1.74	399.					
935-	PBAR	11760	1	1.76	.02					
936-	PBAR	11780	2	.96	1.23					
937-	PBAR	11840	2	1.64	.21					
938-	PBAR	11851	1	1.85	544.					
939-	PBAR	11975	1	1.98	.002					
940-	PBAR	12000	1	2.00	1.04					
941-	PBAR	12072	1	2.07	5.48					
942-	PBAR	12135	1	2.14	3.95					
943-	PBAR	12622	2	1.84	3.25					
944-	PBAR	12760	1	2.76	5.18					
945-	PBAR	12800	2	1.10	1.60					
946-	PBAR	13030	2	1.31	1.63					
947-	PBAR	13400	1	3.40	.82					
948-	PBAR	13500	1	3.50	1.82					
949-	PBAR	13600	1	3.60	18.4					
950-	PBAR	13900	1	1.54	37.2					

SORTED BULK DATA ECHO

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
951-	PBAR	13960	2	1.20	2.10					
952-	PBAR	14000	1	4.00	2.08					
953-	PBAR	14298	1	1.72	65.3					
954-	PBAR	14660	2	1.38	2.21					
955-	PBAR	14930	2	1.45	2.82					
956-	PBAR	15440	2	1.30	1.90					
957-	PBAR	15500	1	5.50	2.87					
958-	PBAR	16100	2	1.01	1.29					
959-	PBAR	16140	2	1.05	1.49					
960-	PBAR	16220	2	1.01	1.55					
961-	PBAR	16426	1	6.43	3.81					
962-	PBAR	16486	1	6.48	16.5					
963-	PBAR	16980	1	6.98	51.1					
964-	PBAR	18000	1	6.00	4.17					
965-	PBAR	19992	10	10.0	100.0	100.0	100.0			
966-	PBAR	19993	10	1.0+6	1.0+6	1.0+6	1.0+6			
967-	PBAR	19997	1	30.6	126.					
968-	PBAR	19998	1	30.0	5.21					
969-	PBAR	19999	1	30.4	195.					
970-	PBAR	20666	2	.67	.91					
971-	PBAR	20684	2	.68	1.07					
972-	PBAR	20720	2	.72	1.42					
973-	PBAR	21232	2	1.23	2.67					
974-	PBAR	31616	3	1.23	2.49					
975-	PBAR	31640	3	1.64	1.94					
976-	PBAR	31920	3	1.92	1.92					
977-	PBAR	33376	3	1.34	2.50					
978-	PBAR	35000	3	5.00	10.0	10.0				
979-	PBAR	35290	3	1.25	2.51					
980-	PBAR	39999	3	5.0	10.0					
981-	PBAR	811600	2	4.4	10.1					
982-	PBAR	910893	1	.89	7.12	1.78				
983-	PBAR	911610	2	6.1	14.2					
984-	PELAS	1	1.0+7							
985-	PQUAD1	4152	4	.224	4	.112	5	1.30		
986-	PQUAD1	4155	4	.248	4	.129	5	1.30		
987-	PQUAD1	4160	4	.298	4	.156	5	1.30		
988-	PQUAD1	4166	4	.360	4	.197	5	1.30		
989-	PQUAD1	4200	4	.198	4	.179	5	1.80		
990-	PQUAD1	4234	4	.240	4	.296	5	2.10		
991-	PQUAD1	4239	4	.292	4	.368	5	2.10		
992-	PQUAD1	4290	4	.198	4	.388	5	2.70		
993-	PQUAD1	4292	4	.216	4	.426	5	2.70		
994-	PQUAD1	4295	4	.254	4	.507	5	2.70		
995-	PQUAD1	4299	4	.216	4	.426	5	2.70		
996-	PQUAD1	4300	4	.258	4	.605	5	2.70		
997-	PQUAD1	4303	4	.334	4	.686	5	2.70		
998-	PQUAD1	4313	4	.334	4	.735	5	2.80		
999-	PQUAD1	4380	4	.045	4	.001452	6	.335		
1000-	PQUAD1	4401	4	.208	4	.793	5	3.80		

SORTED BULK DATA ECHO

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
1001-	PQUAD1	4402	4	.216	4	.825	5	3.80		
1002-	PQUAD1	4405	4	.254	4	.979	5	3.80		
1003-	PQUAD1	4410	4	.298	4	1.160	5	3.80		
1004-	PQUAD1	4413	4	.334	4	1.314	5	3.80		
1005-	PQUAD1	4512	4	.072	4	.004078	6	.440		
1006-	PQUAD1	4739	4	.054	4	.006644	6	.685		
1007-	PQUAD1	4750	4	.110	4	.01328	6	.640		
1008-	PQUAD1	4795	4	.200	4	.02415	6	.595		
1009-	PQUAD1	4814	4	.054	4	.09815	6	.750		
1010-	PQUAD1	4820	4	.225	4	.02797	6	.595		
1011-	PQUAD2	1063	1	.063						
1012-	PQUAD2	1070	1	.070						
1013-	PQUAD2	1074	1	.074						
1014-	PQUAD2	1075	1	.075						
1015-	PQUAD2	1100	1	.100						
1016-	PQUAD2	1240	1	.240						
1017-	PQUAD2	4338	4	.338						
1018-	PQUAD2	4360	4	.360						
1019-	PQUAD2	4369	4	.369						
1020-	PQUAD2	4405	4	.405						
1021-	PQUAD2	4423	4	.423						
1022-	PQUAD2	4432	4	.432						
1023-	PQUAD2	4437	4	.437						
1024-	PQUAD2	4450	4	.450						
1025-	PQUAD2	4455	4	.455						
1026-	PQUAD2	4459	4	.459						
1027-	PQUAD2	4467	4	.467						
1028-	PQUAD2	4468	4	.468						
1029-	PQUAD2	4491	4	.491						
1030-	PQUAD2	4495	4	.495						
1031-	PQUAD2	4504	4	.504						
1032-	PQUAD2	4518	4	.518						
1033-	PQUAD2	4531	4	.531						
1034-	PQUAD2	4540	4	.540						
1035-	PQUAD2	4549	4	.549						
1036-	PQUAD2	4555	4	.555						
1037-	PQUAD2	4558	4	.558						
1038-	PQUAD2	4567	4	.567						
1039-	PQUAD2	4576	4	.576						
1040-	PQUAD2	4585	4	.585						
1041-	PQUAD2	4602	4	.602						
1042-	PQUAD2	4644	4	.644						
1043-	PQUAD2	4657	4	.657						
1044-	PQUAD2	4666	4	.666						
1045-	PQUAD2	4675	4	.675						
1046-	PQUAD2	4711	4	.711						
1047-	PQUAD2	4720	4	.720						
1048-	PQUAD2	4729	4	.729						
1049-	PQUAD2	4738	4	.738						
1050-	PQUAD2	4765	4	.765						

SORTED BULK DATA ECHO

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
1051-	PQUAD2	4771	4	.771						
1052-	PQUAD2	4819	4	.819						
1053-	PQUAD2	4891	4	.891						
1054-	PQUAD2	4900	4	.900						
1055-	PQUAD2	4906	4	.906						
1056-	PQUAD2	4933	4	.933						
1057-	PQUAD2	4936	4	.936						
1058-	PQUAD2	4945	4	.945						
1059-	PQUAD2	4963	4	.963						
1060-	PSHEAR	1040	1	.040						
1061-	PTRIA1	4150	4	.200	4	.098	5	1.30		
1062-	PTRIA1	4155	4	.252	4	.128	5	1.30		
1063-	PTRIA1	4200	4	.202	4	.179	5	1.80		
1064-	PTRIA1	4224	4	.240	4	.270	5	2.00		
1065-	PTRIA1	4290	4	.198	4	.388	5	2.70		
1066-	PTRIA1	4409	4	.294	4	1.150	5	3.80		
1067-	PTRIA1	4512	4	.072	4	.004078	6	.440		
1068-	PTRIA1	4739	4	.054	4	.006644	6	.685		
1069-	PTRIA1	4804	4	.054	4	.008815	6	.750		
1070-	PTRIA2	1060	1	.060						
1071-	PTRIA2	1063	1	.063						
1072-	PTRIA2	1075	1	.075						
1073-	PTRIA2	4351	4	.351						
1074-	PTRIA2	4360	4	.360						
1075-	PTRIA2	4405	4	.405						
1076-	SPC1	101	2	307						
1077-	SPC1	101	3	101	106	107	453	723		
1078-	SPC1	101	3	507	536	544	176	173		
1079-	SPC1	101	3	606	607	243	601			
1080-	SPC1	101	3	662	661	316	335	363		
1081-	SPC1	101	12	363	626	101	601			
1082-	SPC1	101	23	159	245	336	361			
1083-	SPC1	101	23	246	506					
1084-	SPC1	101	123	306	137	175	627			
1085-	SPC1	101	123	581	582	583	584	585		
1086-	SPC1	102	6	158	218	228	501	502	604	
1087-	SPC1	102	6	503	504	505	511	515	521	
1088-	SPC1	102	6	525	531	535	545	555	575	
1089-	SPC1	102	6	544	734	649	652	718	728	
1090-	SPC1	102	6	605	543	146	541	542	601	
1091-	SPC1	103	1	307	506					
1092-	SPC1	103	2	316	335					
1093-	SPC1	104	4	173						
1094-	SPCADD	101102	101	102	103	104				
	ENDDATA									

1. Report No.
NASA CR-170392

2. Government Accession No.

3. Recipient's Catalog No.

4. Title and Subtitle
NASTRAN Model of a Large Flexible Swing Wing Bomber.
Volume V: NASTRAN Model Development Fairing Structure

5. Report Date
September 1982

6. Performing Organization Code

7. Author(s)
W. D. Mock and R. A. Latham

8. Performing Organization Report No.
NA-76-469

10. Work Unit No.

9. Performing Organization Name and Address
Rockwell International
Los Angeles Division
International Airport
Los Angeles, CA 90009

11. Contract or Grant No.
NAS4-2614

13. Type of Report and Period Covered
Contractor Report—Final

12. Sponsoring Agency Name and Address
National Aeronautics and Space Administration
Washington, D.C. 20546

14. Sponsoring Agency Code
RTOP 505-33-54

15. Supplementary Notes
NASA Technical Monitor: Lawrence S. Schuster, Ames Research Center, Dryden Flight Research Facility

16. Abstract

This report describes the planning, development, and validation of the NASTRAN models of the B-1 aircraft No. 2 structure. Volume I describes the initial planning of the entire modeling effort. Volumes II to V describe, in detail, the development and validation of component structural models. The report includes applicable engineering drawings, NASTRAN structural model plots, and listings of the NASTRAN bulk data deck for each component structure. Validation is documented by comparisons with results from static structural tests.

The subtitles of the volumes included in this report are as follows:

Volume I. NASTRAN Model Plans
Volume II. NASTRAN Model Development—Horizontal Stabilizer, Vertical Stabilizer, and Nacelle Structures
Volume III. NASTRAN Model Development—Wing Structure
Volume IV. NASTRAN Model Development—Fuselage Structure
Volume V. NASTRAN Model Development—Fairing Structure

17. Key Words (Suggested by Author(s))
NASTRAN
Finite elements
Structural modeling

18. Distribution Statement
Unclassified-Unlimited

STAR category 05

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified	97	A05

For sale by the National Technical Information Service, Springfield, Virginia 22161

End of Document