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Abstract for the Elventh CFD Working Group Meeting:

A Fine-Grid Model for the
ASRM Aft Segment with Gimballed Nozzle

Presented By: Dr. Edward J. Reske

Results from computational fluid dynamic analyses for complex three-dimensional internal flows in the Advanced Solid Rocket Motor (ASRM) are presented. In particular, flow visualization and tabulated results from a fine-grid model consisting of 1.5 M grid points for the ASRM Aft Segment at the 19-second burn time with an 8-degree nozzle gimbal angle are shown. The results from this model will enable characterization of various aspects of the ASRM internal environment, and in particular will allow an assessment of the heat transfer and stresses exerted on the submerged nozzle, casing insulation, and nozzle-case joint.

A Fine-Grid Model for the ASRM Aft Segment With Gimballed Nozzle

**Eleventh Workshop for CFD
Applications in Rocket Propulsion**

April 20-22, 1993

Ed Reske

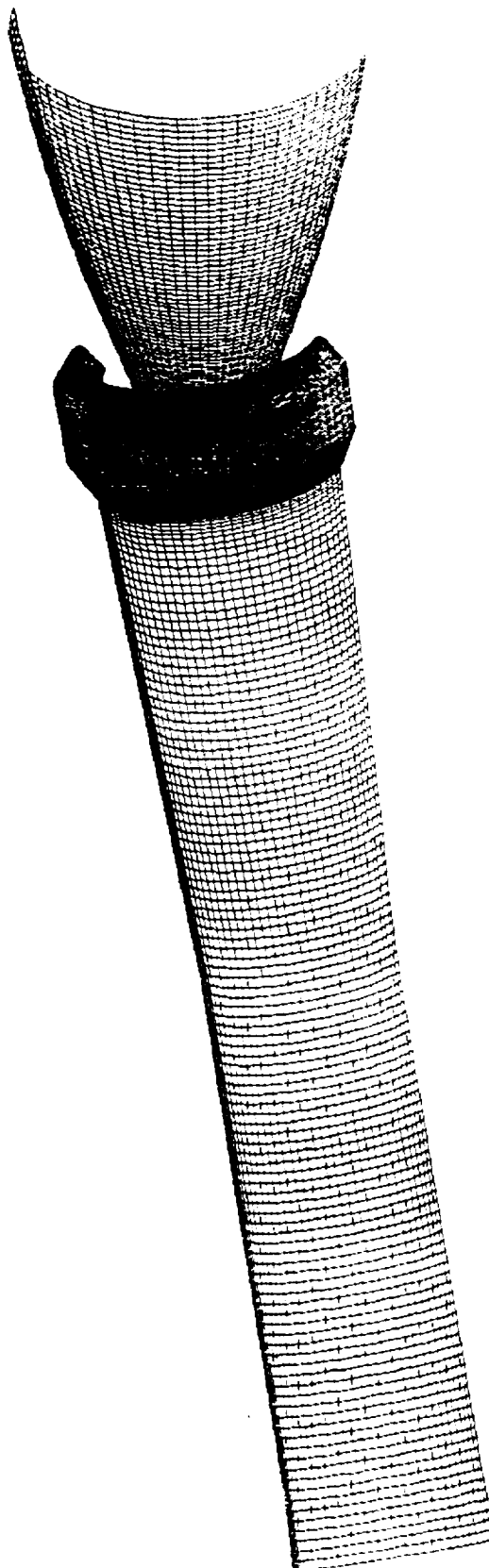
MSFC, CFD Branch

**Animation by Catherine Dumas,
Sverdrup Technology**

GEOMETRY

Fine Grid Model for ASRM at 19 seconds with 8-degree Gimbal Angle
Surface Geometry: Dimensions 127 X 311 X 37 = 1.46 M Grid Points

127x311x37 GRID



019fg.2.img

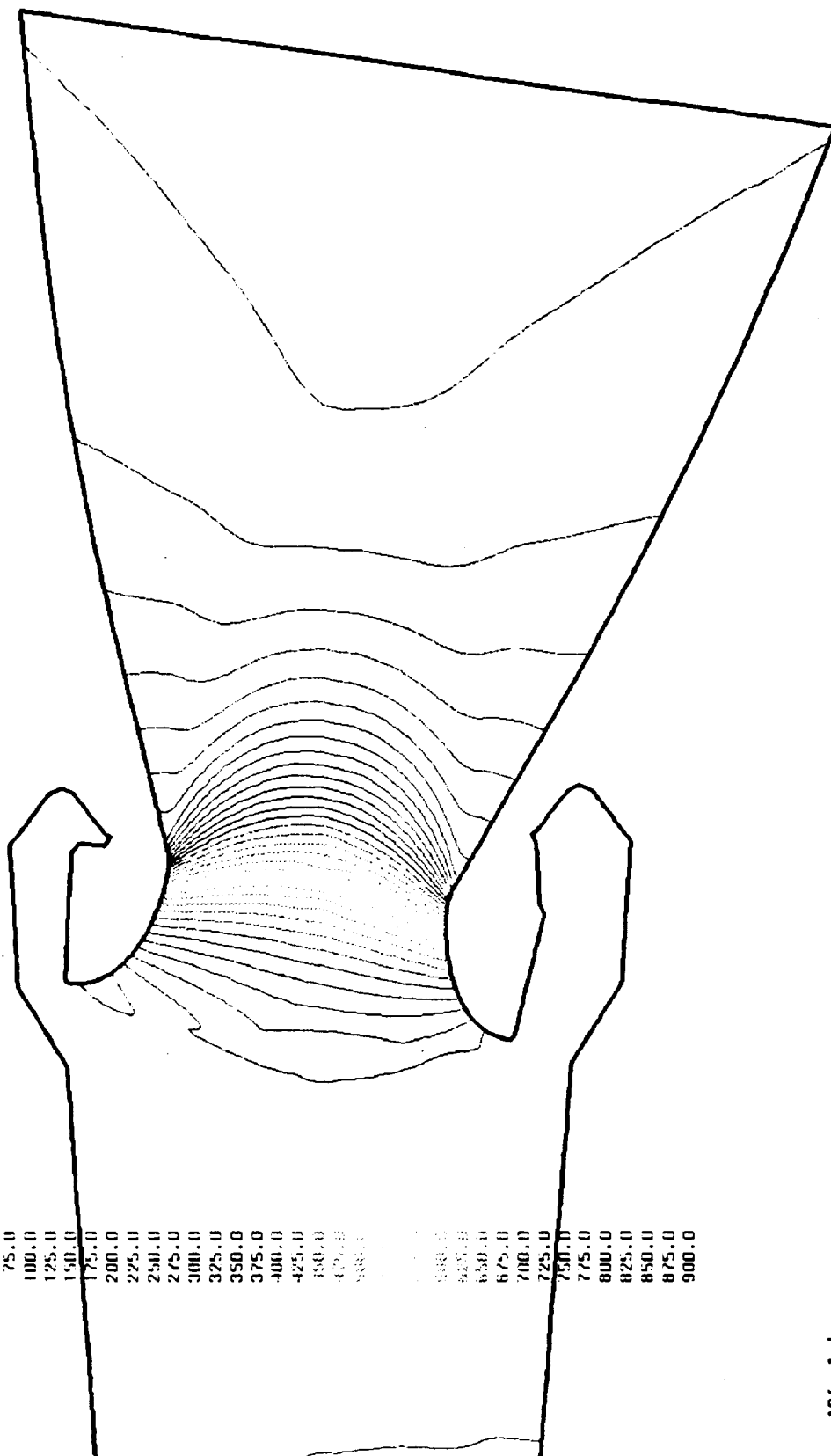
NORMALIZED PRESSURE

Fine Grid Model for ASBH at 19 seconds with 8-degree Gimbale Angle
Pressure in PSIA 4/21/93

CONTOUR LEVELS

0.0
25.0
50.0
75.0
100.0
125.0
150.0
175.0
200.0
225.0
250.0
275.0
300.0
325.0
350.0
375.0
400.0
425.0
450.0
475.0
500.0
525.0
550.0
575.0
600.0
625.0
650.0
675.0
700.0
725.0
750.0
775.0
800.0
825.0
850.0
875.0
900.0

0.224 MACH
0.00 DEG ALPHA
4.56x10⁶ Re
127x311x37 GRID



a19fg.1.1w8

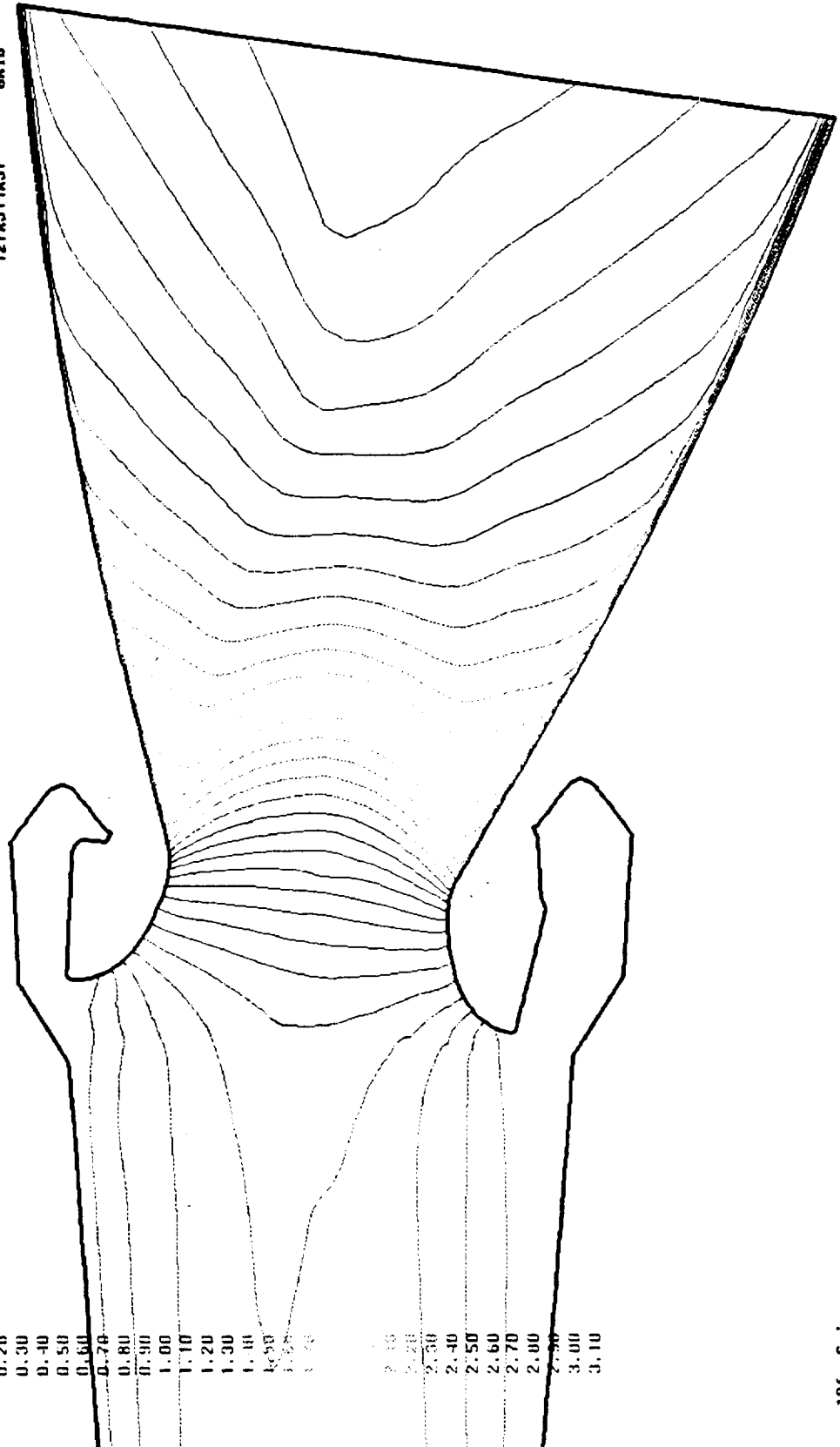
MACH NUMBER
 Fine Grid Model for ASRM at 19 seconds with 8-degree Gimbal Angle

GE POOR QUALITY

0.224 MACH
 0.00 DEG ALPHA
 4.56x10⁰⁶ Re
 127x311x37 GRID

CONTOUR LEVELS

0.00
 0.10
 0.20
 0.30
 0.40
 0.50
 0.60
 0.70
 0.80
 0.90
 1.00
 1.10
 1.20
 1.30
 1.40
 1.50
 1.60
 1.70
 1.80
 1.90
 2.00
 2.10
 2.20
 2.30
 2.40
 2.50
 2.60
 2.70
 2.80
 2.90
 3.00
 3.10



a19fg.6.1mg

VELOCITY MAGNITUDE

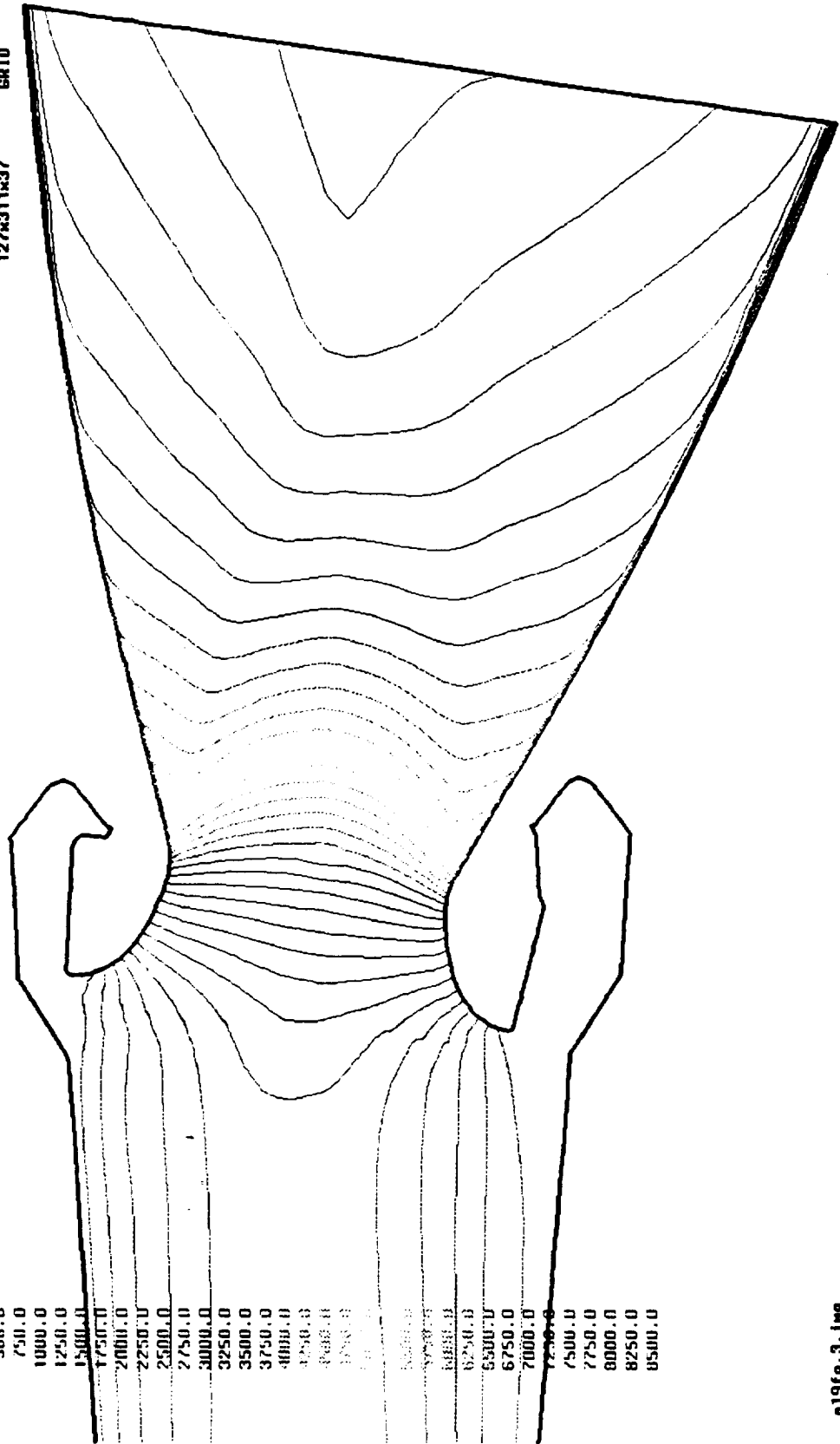
Fine Grid Model for ASRM at 19 seconds with 8-degree Sidelobe Angle

Velocity in ft./sec. 4/21/93

CONTOUR LEVELS

0.0
250.0
500.0
750.0
1000.0
1250.0
1500.0
1750.0
2000.0
2250.0
2500.0
2750.0
3000.0
3250.0
3500.0
3750.0
4000.0
4250.0
4500.0
4750.0
5000.0
5250.0
5500.0
5750.0
6000.0
6250.0
6500.0
6750.0
7000.0
7250.0
7500.0
7750.0
8000.0
8250.0
8500.0

MACH 0.224
ALPHA 0.00 DEG
Re 4.56x10⁰⁶
GRID 127x311x37



a19fg.3.1wg

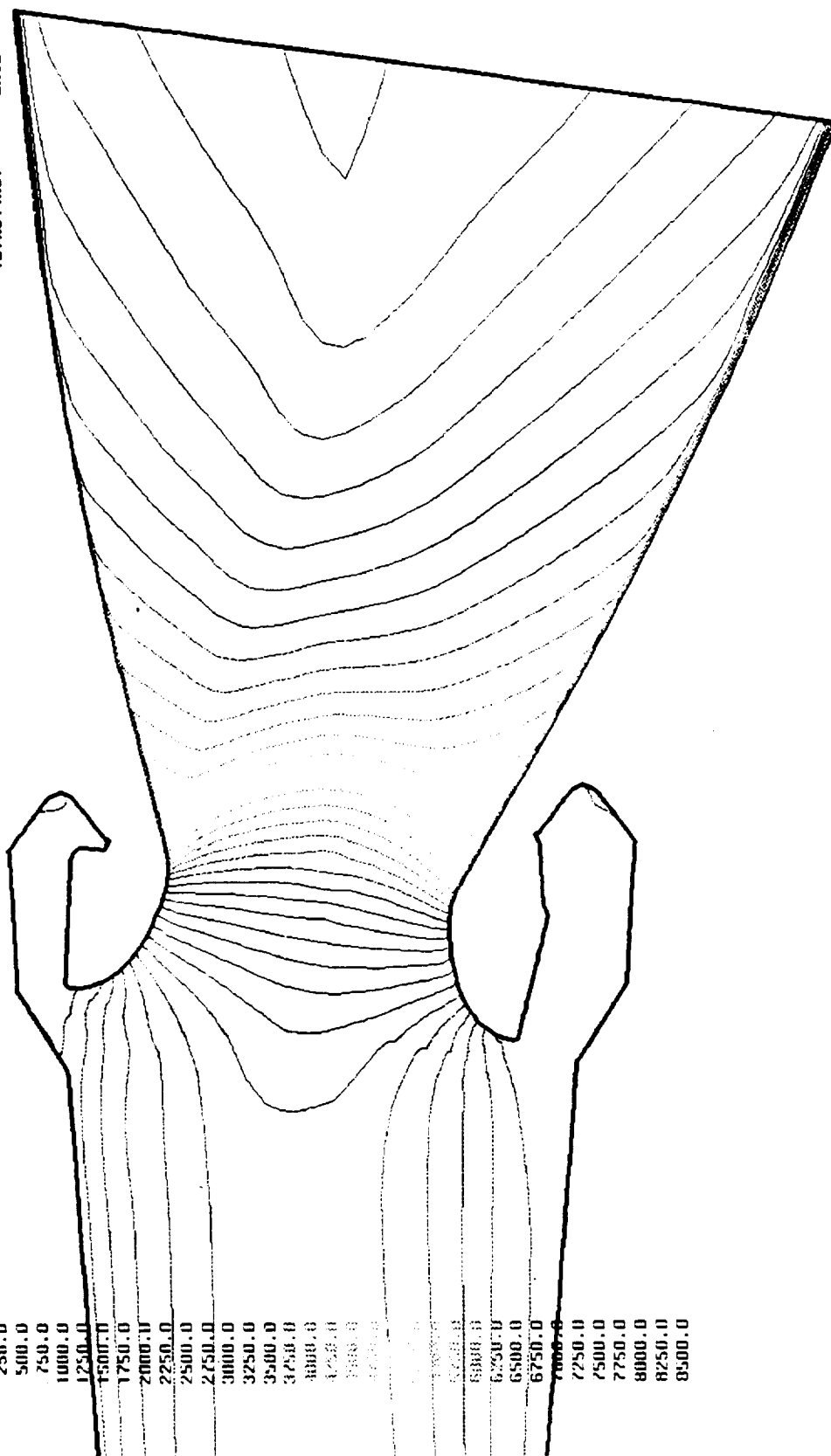
U VELOCITY

Fine Grid Model for ASRM at 19 seconds with 8-degree Gimbal Angle
Velocity in ft./sec. 4/21/93

0.224 MACH
0.00 DEG ALPHA
4.56x10⁰⁶ Re
127x311x37 GRID

CONTOUR LEVELS

-250.0
0.0
250.0
500.0
750.0
1000.0
1250.0
1500.0
1750.0
2000.0
2250.0
2500.0
2750.0
3000.0
3250.0
3500.0
3750.0
4000.0
4250.0
4500.0
4750.0
5000.0
5250.0
5500.0
5750.0
6000.0
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7250.0
7500.0
7750.0
8000.0
8250.0
8500.0



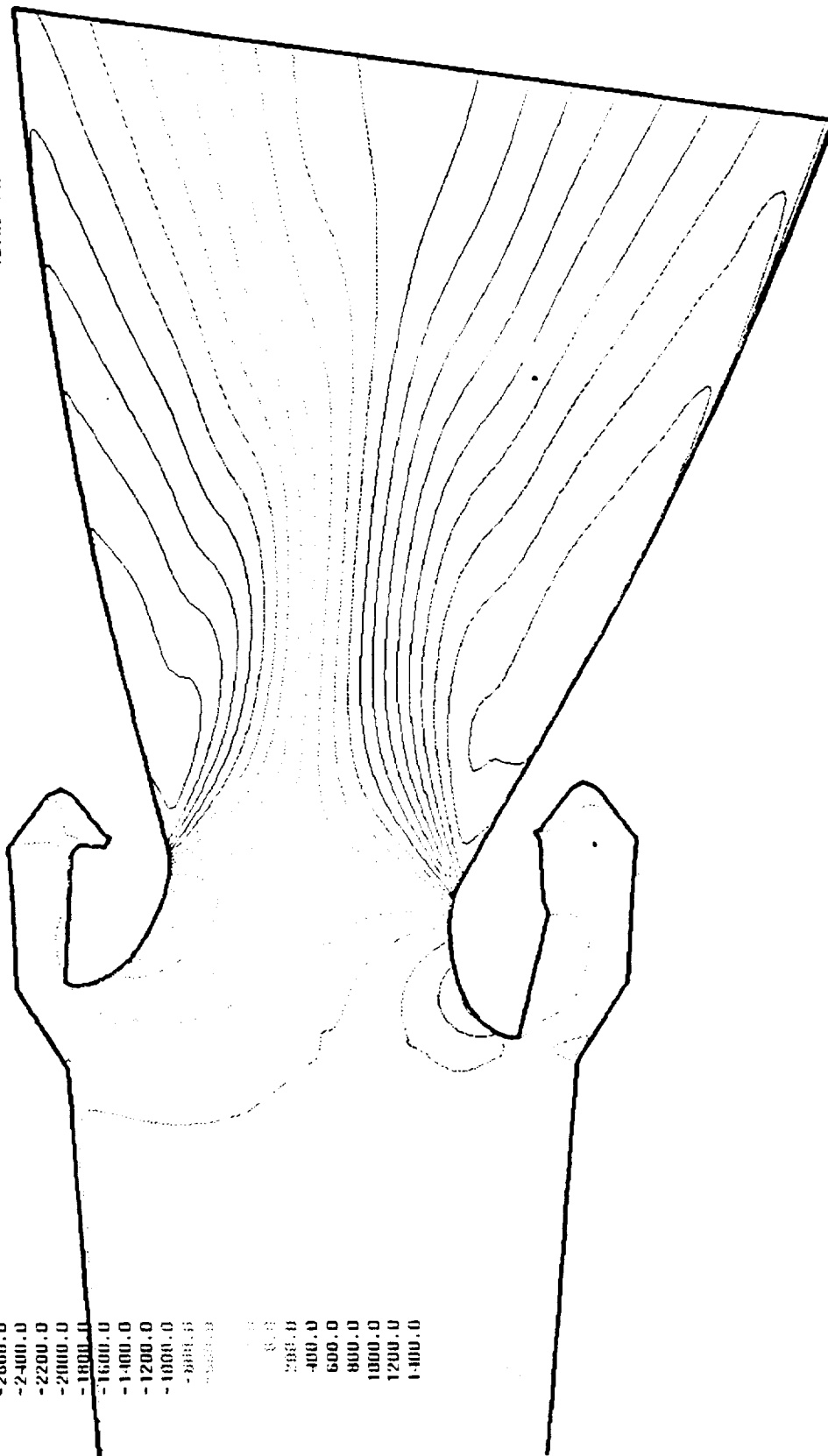
U VELOCITY

Fine Grid Model for RSPM at 19 seconds with 8-degree Gimbai Angle

Velocity in ft./sec. 4/21/93

0.224 MACH
0.00 DEG ALPHA
4.56x10⁰⁶ Re
127x311x37 GRID

CONTOUR LEVELS
-3000.0
-2800.0
-2600.0
-2400.0
-2200.0
-2000.0
-1800.0
-1600.0
-1400.0
-1200.0
-1000.0
-800.0
-600.0
-400.0
-200.0
0.0
200.0
400.0
600.0
800.0
1000.0
1200.0
1400.0



a19fig.5.1mg

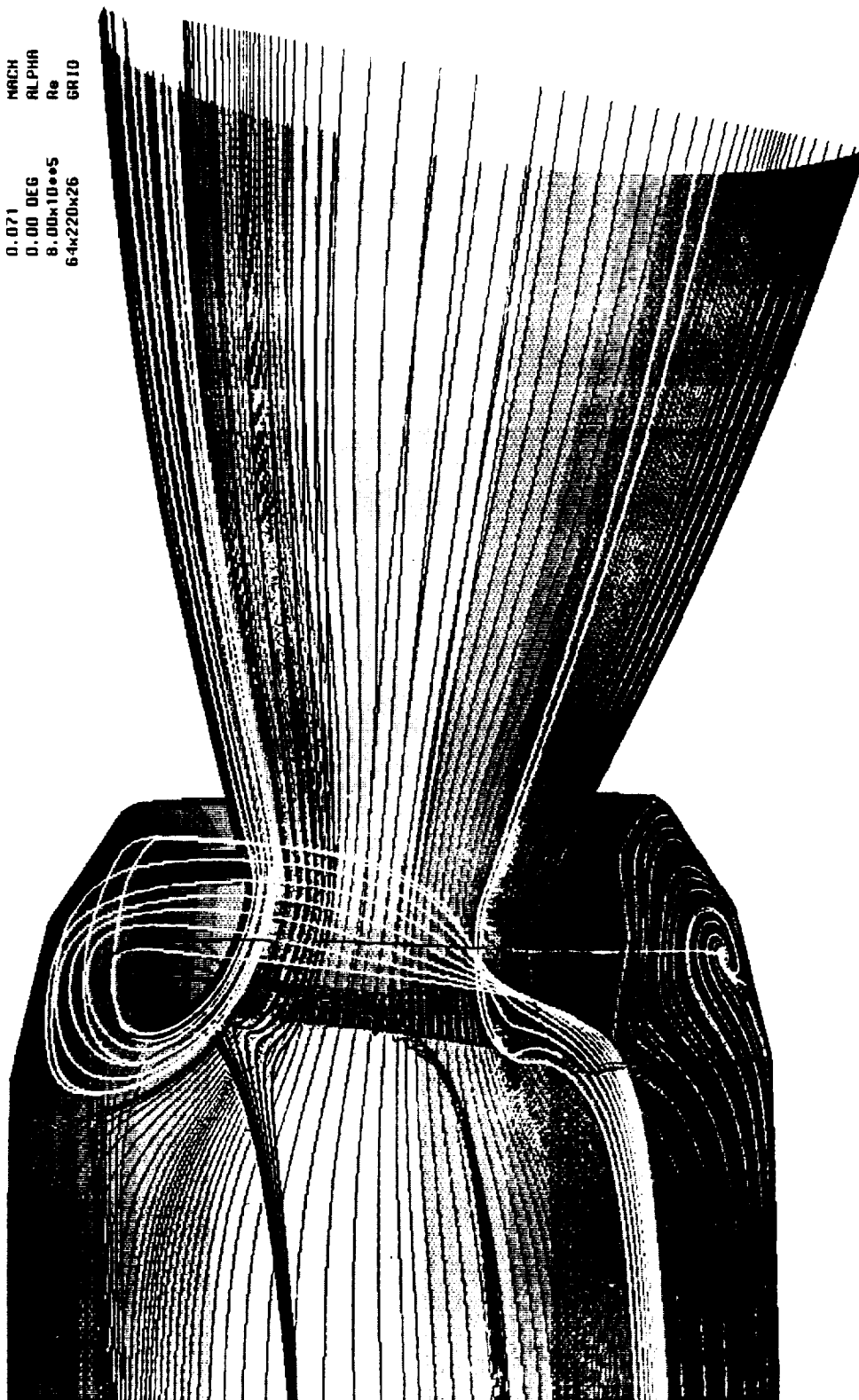
PARTICLE TRACES

ASRH at 115 second burn time with nozzle gimballed at 8 degrees: 3/24/92

Solution "d" (after 3400 iterations)

0.071
0.00 DEG
8.00x10⁰⁵
64x220x26

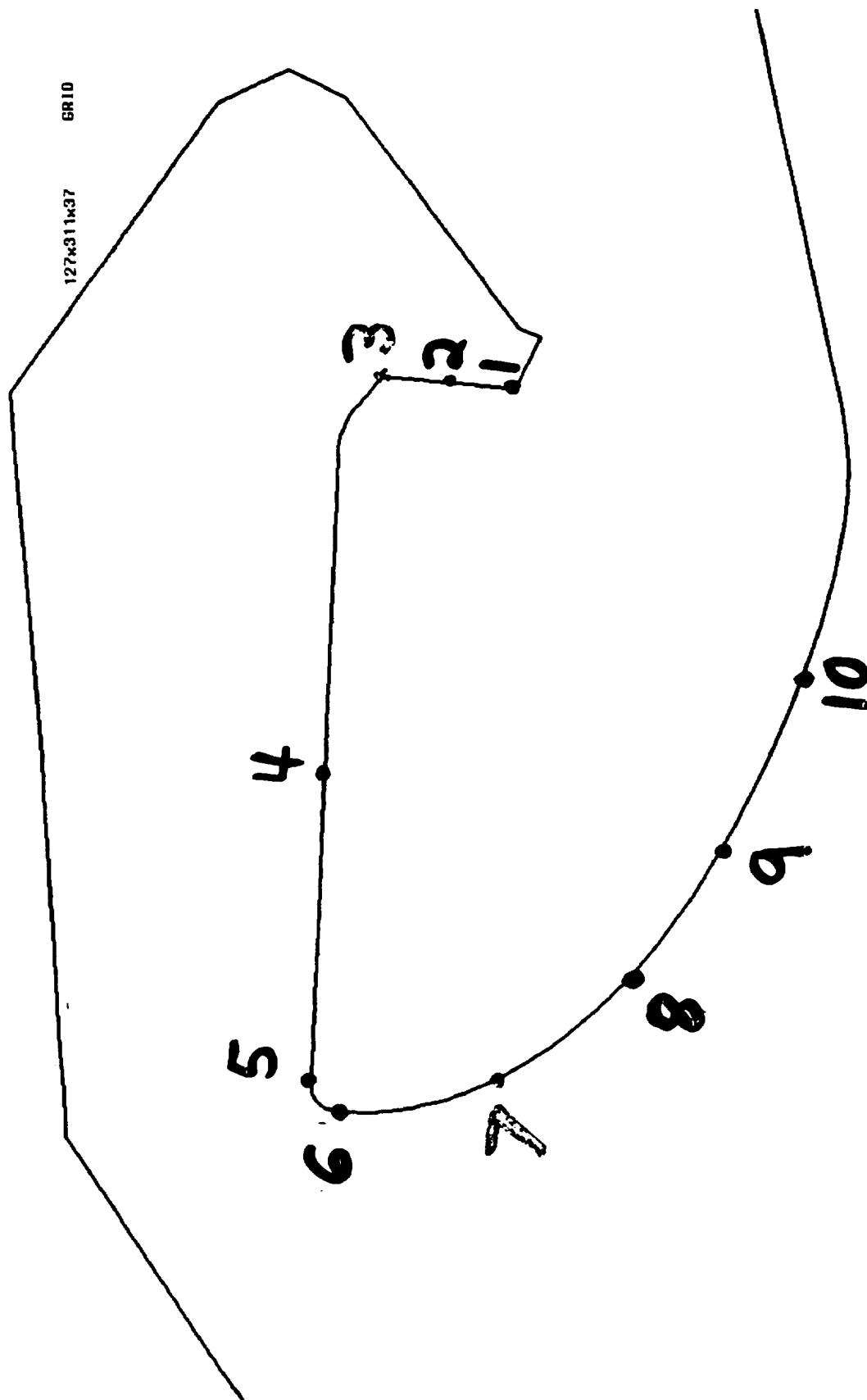
MACH
ALPHA
Re
GR10



f10nd.9.1mg

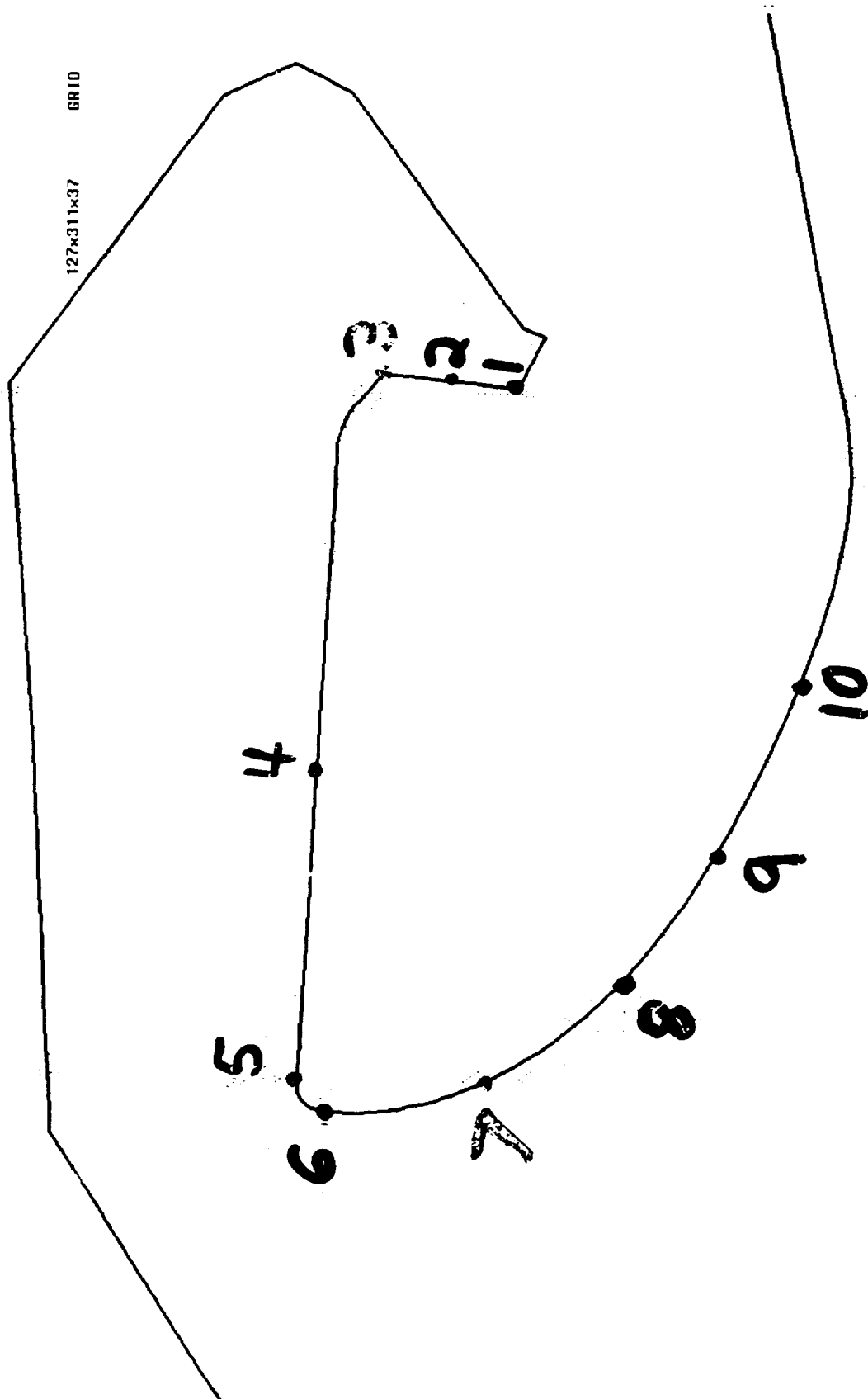
GEOMETRY

ASRM at 19 seconds with 8-degree Gimbal Angle
Station Locations on Nozzle Nose in K = 1 Plane



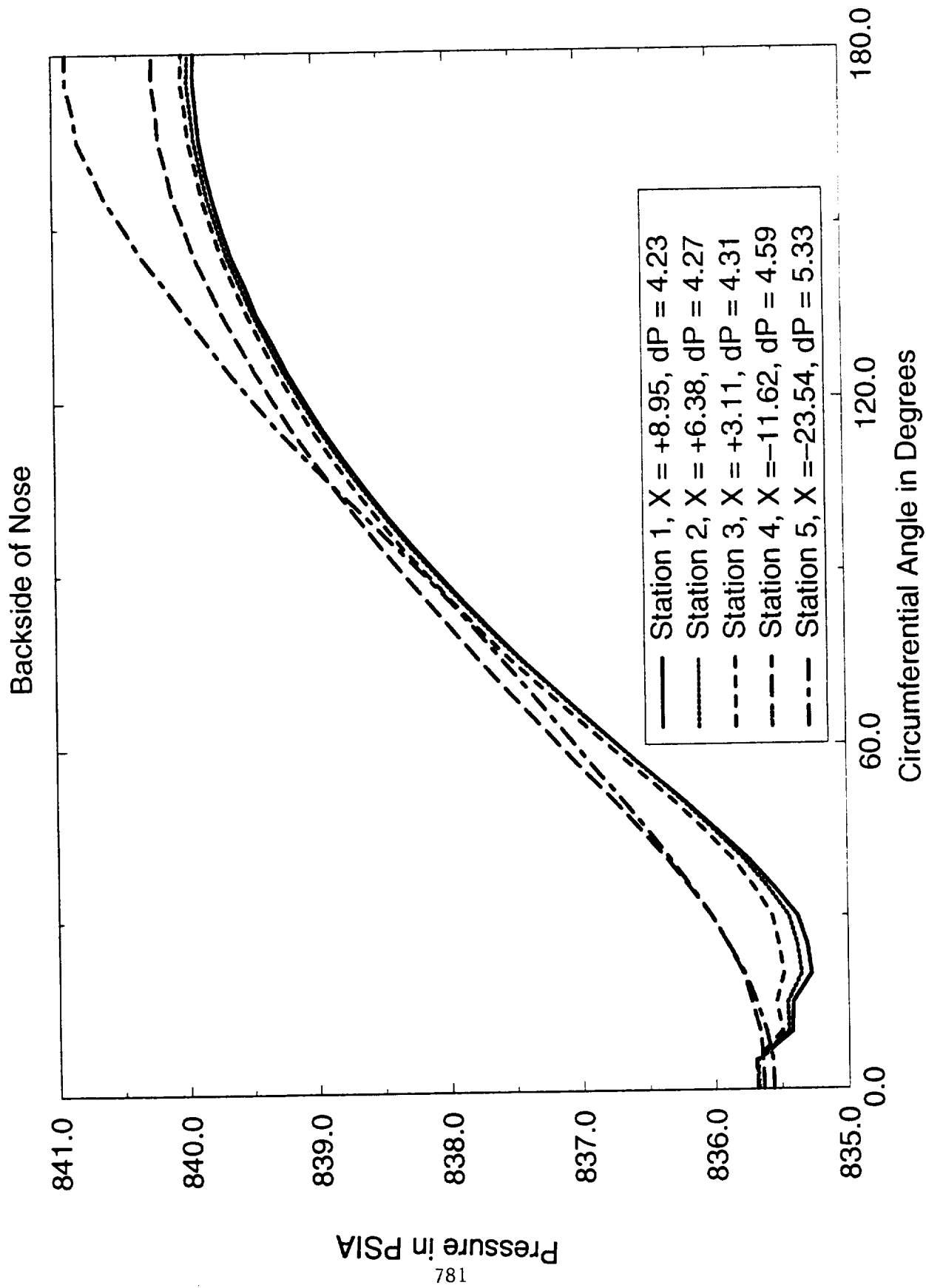
GEOMETRY

ASAM at 19 seconds with 8-degree Gimbal Angle
Station Locations on Nozzle Nose in K = 1 Plane

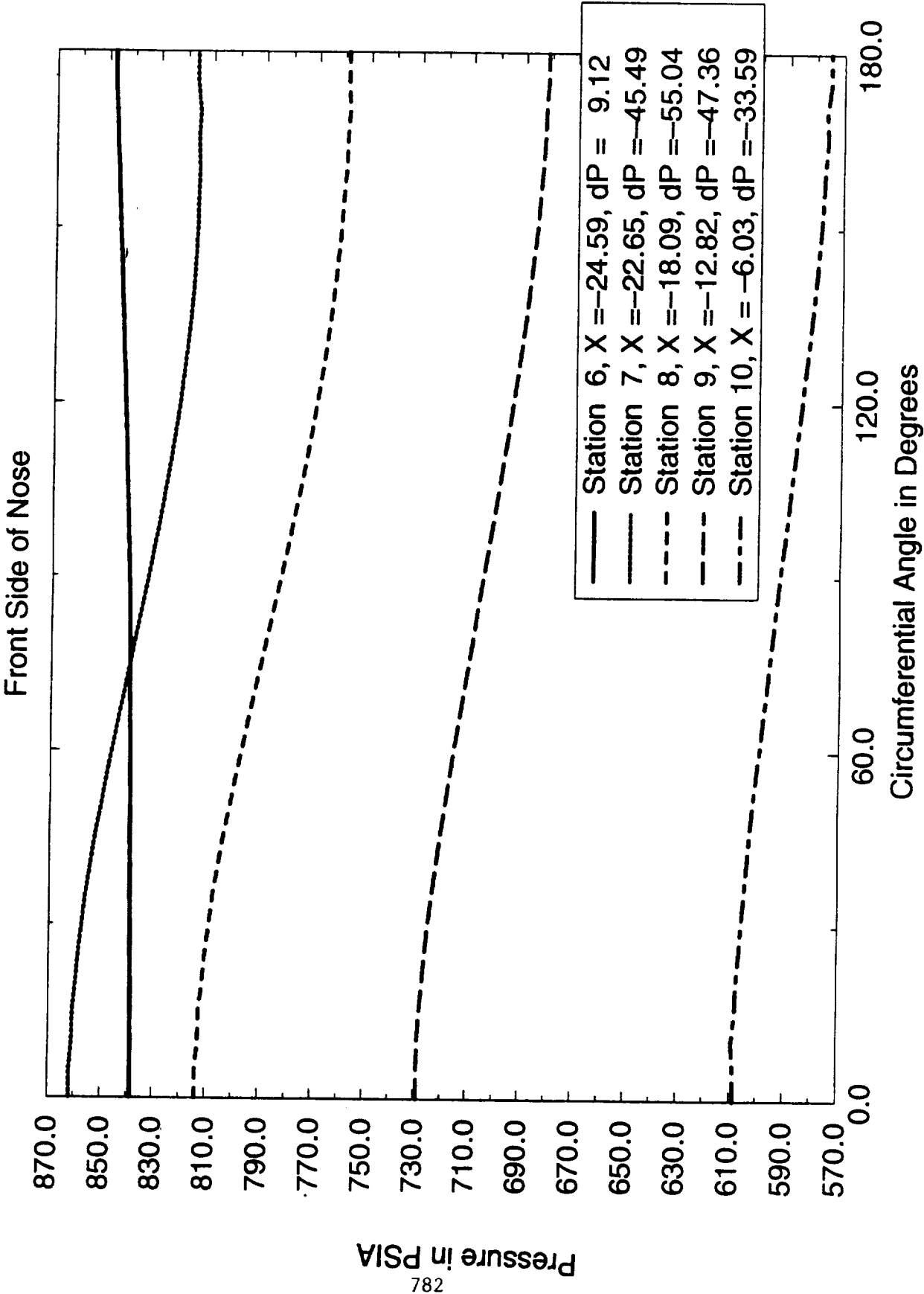


a19fg.1.1mg

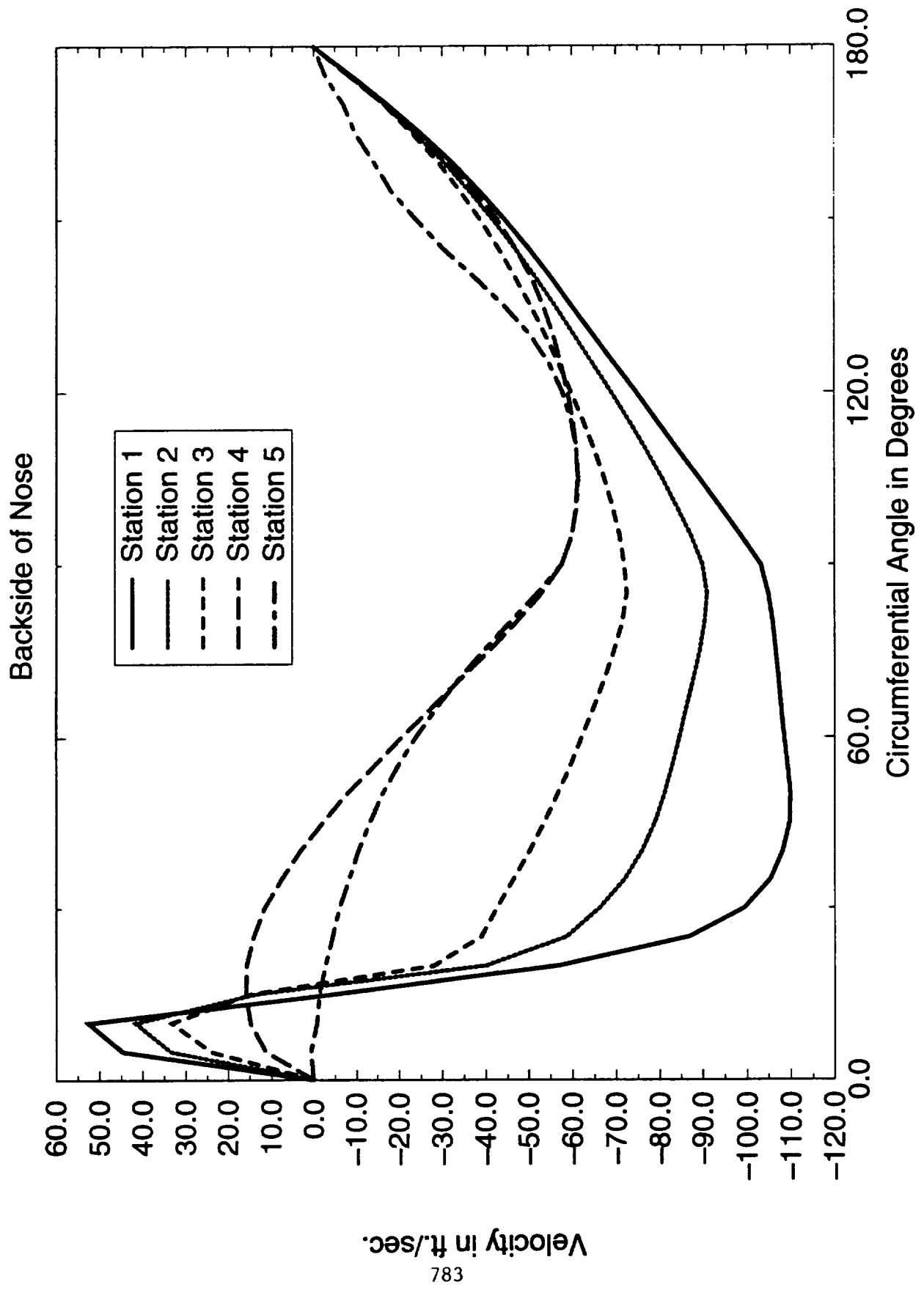
Circumferential Pressure Variation



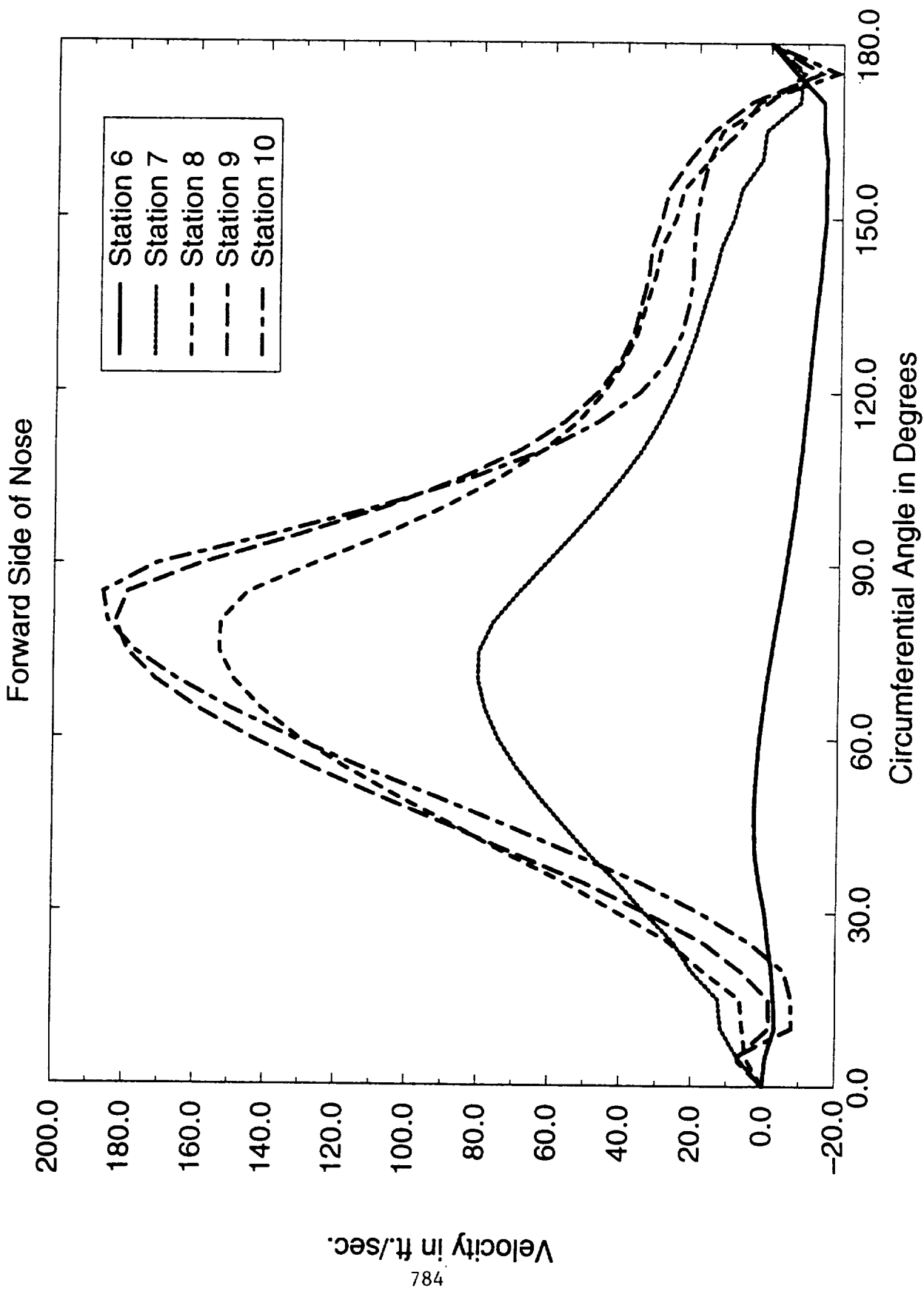
Cumferential Pressure Variation



Variation of Circumferential Velocity

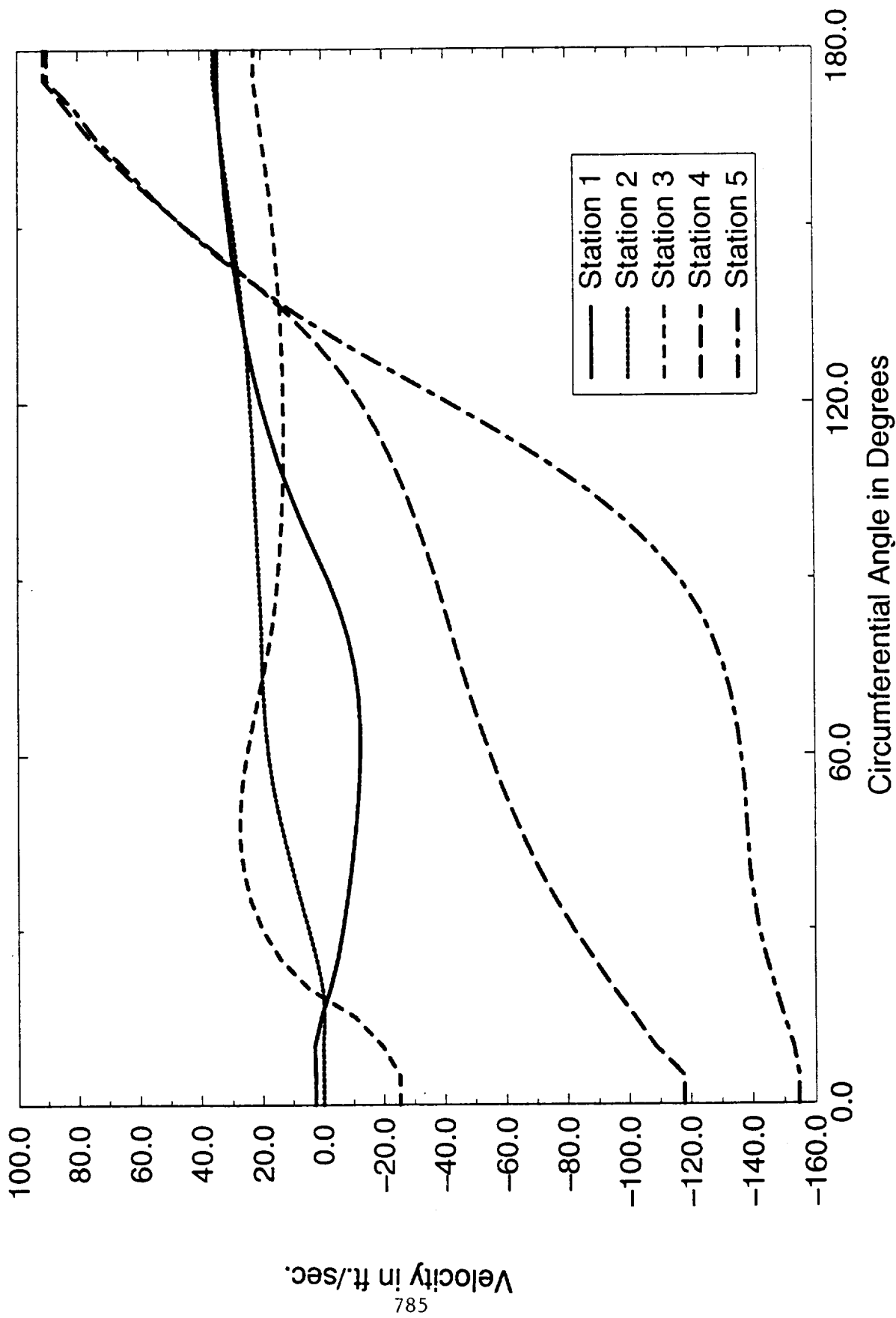


Variation of Circumferential Velocity

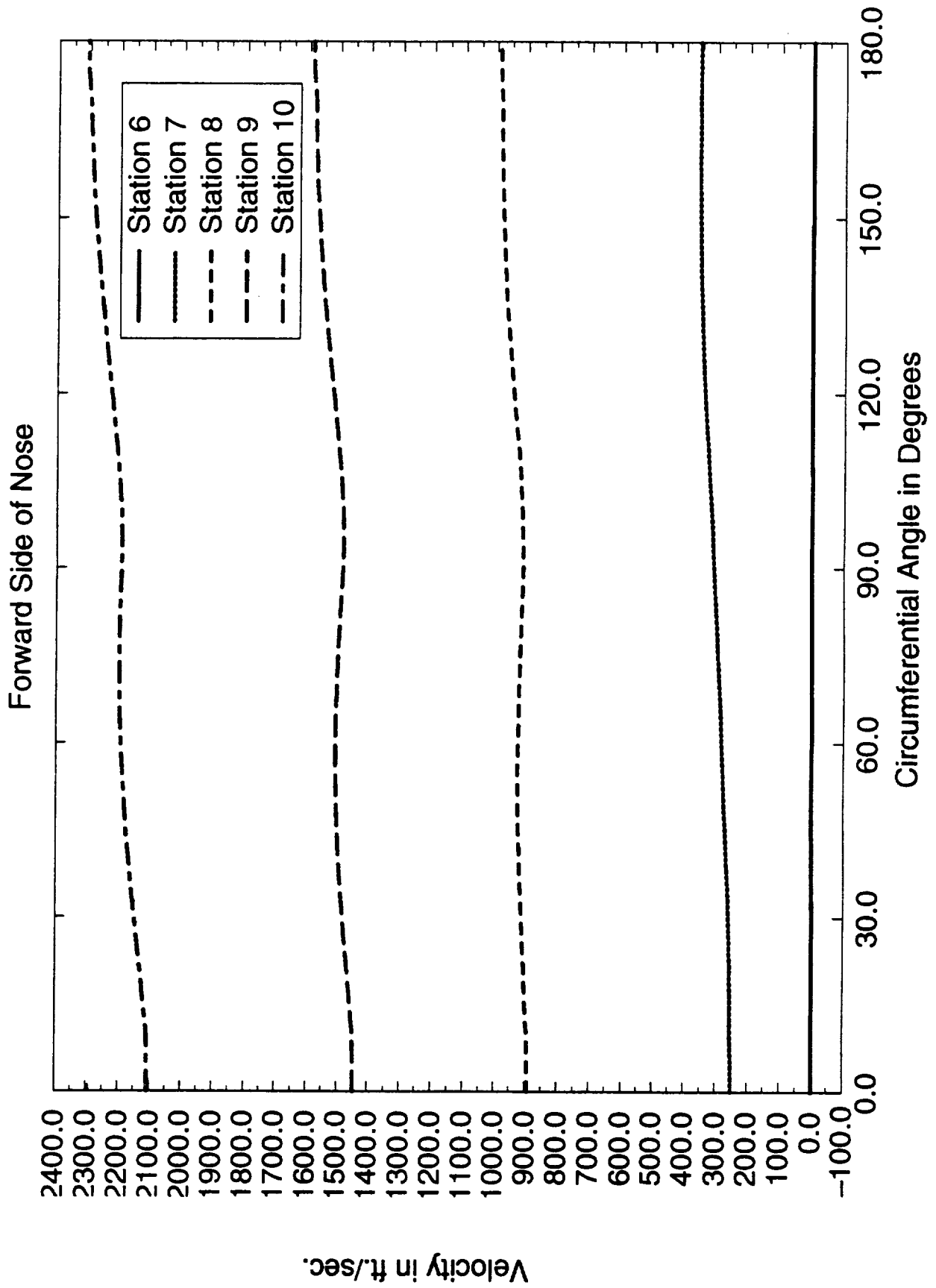


Variation of Axial Velocity

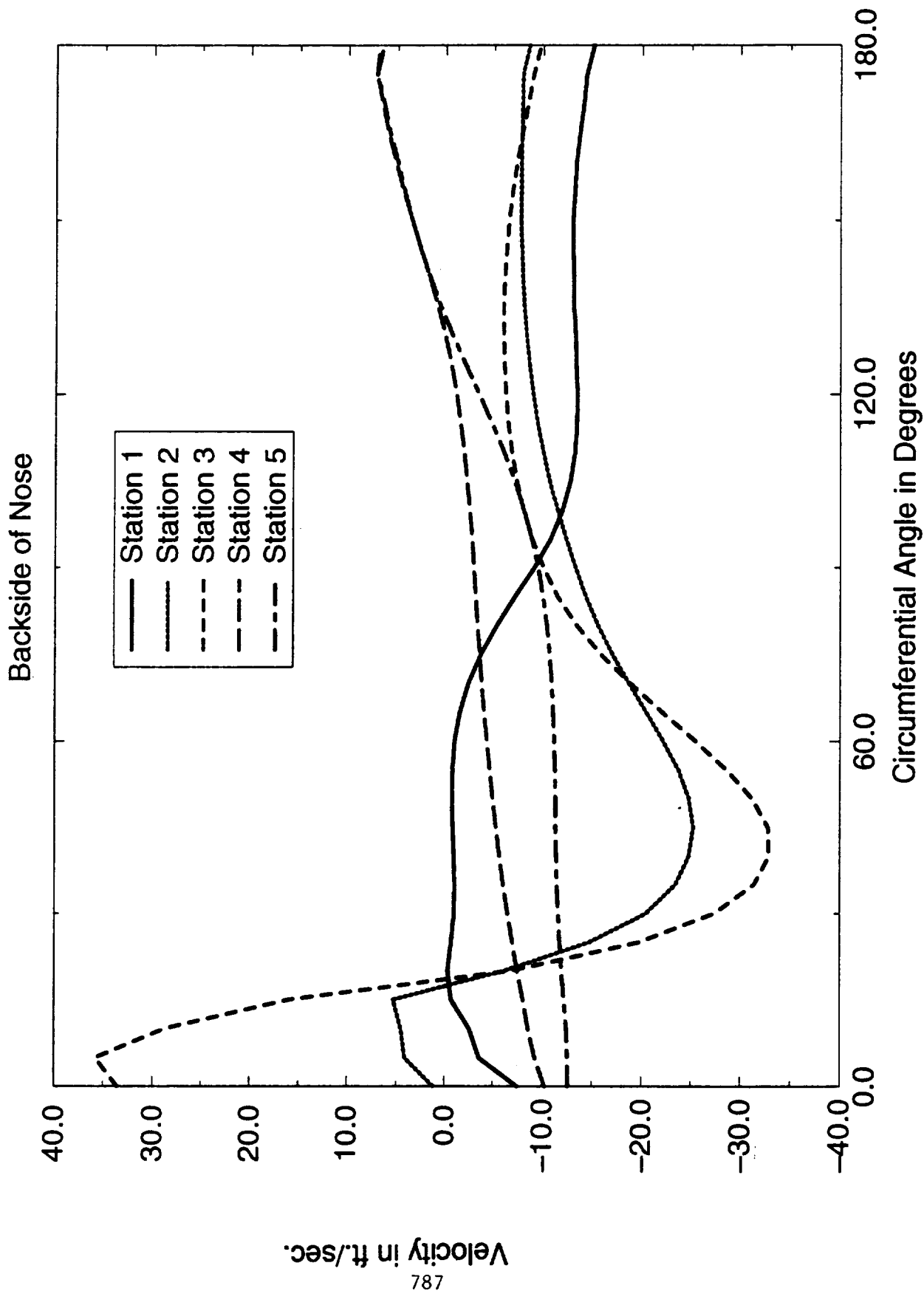
Backside of Nose



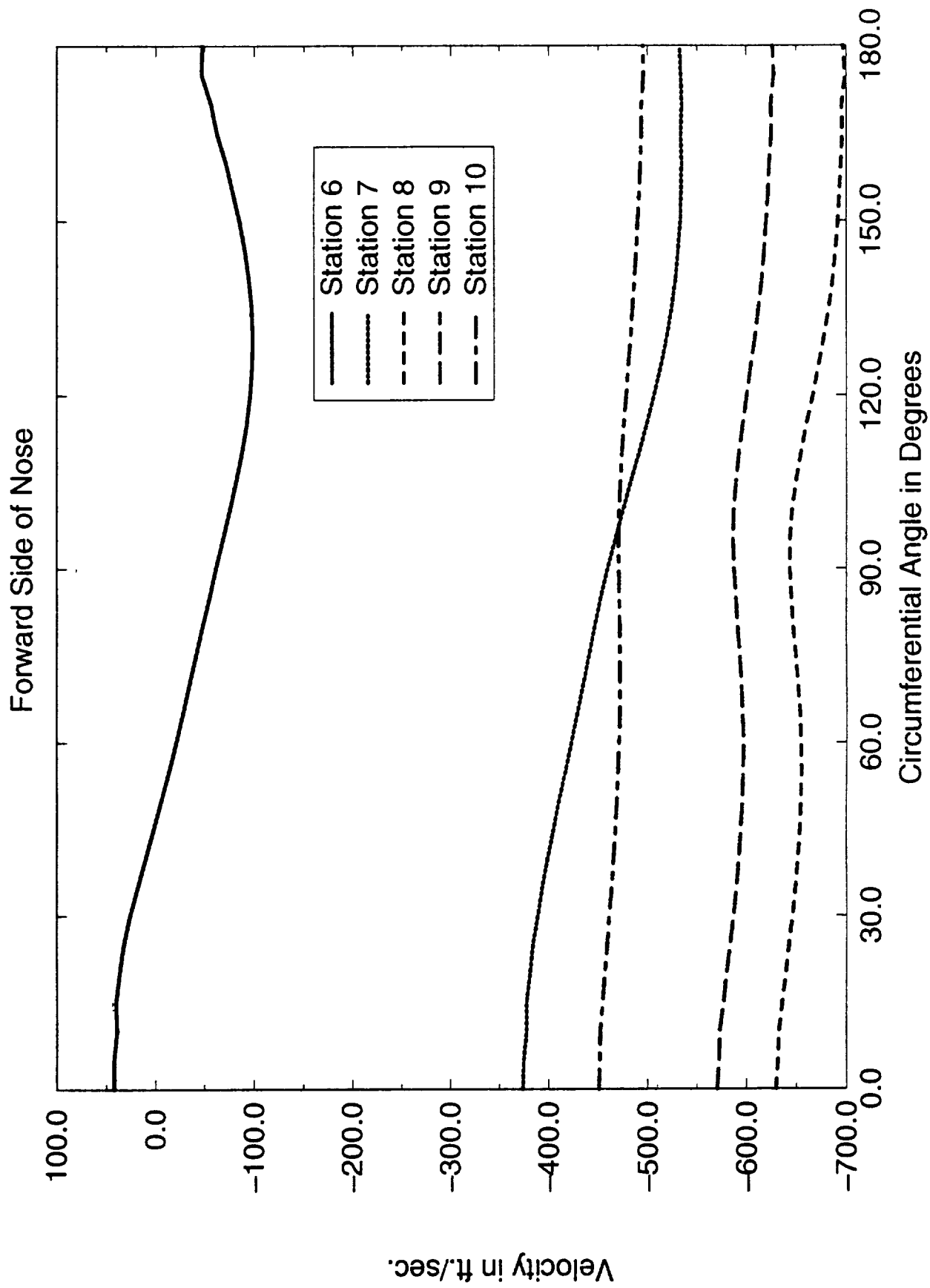
Variation of Axial Velocity



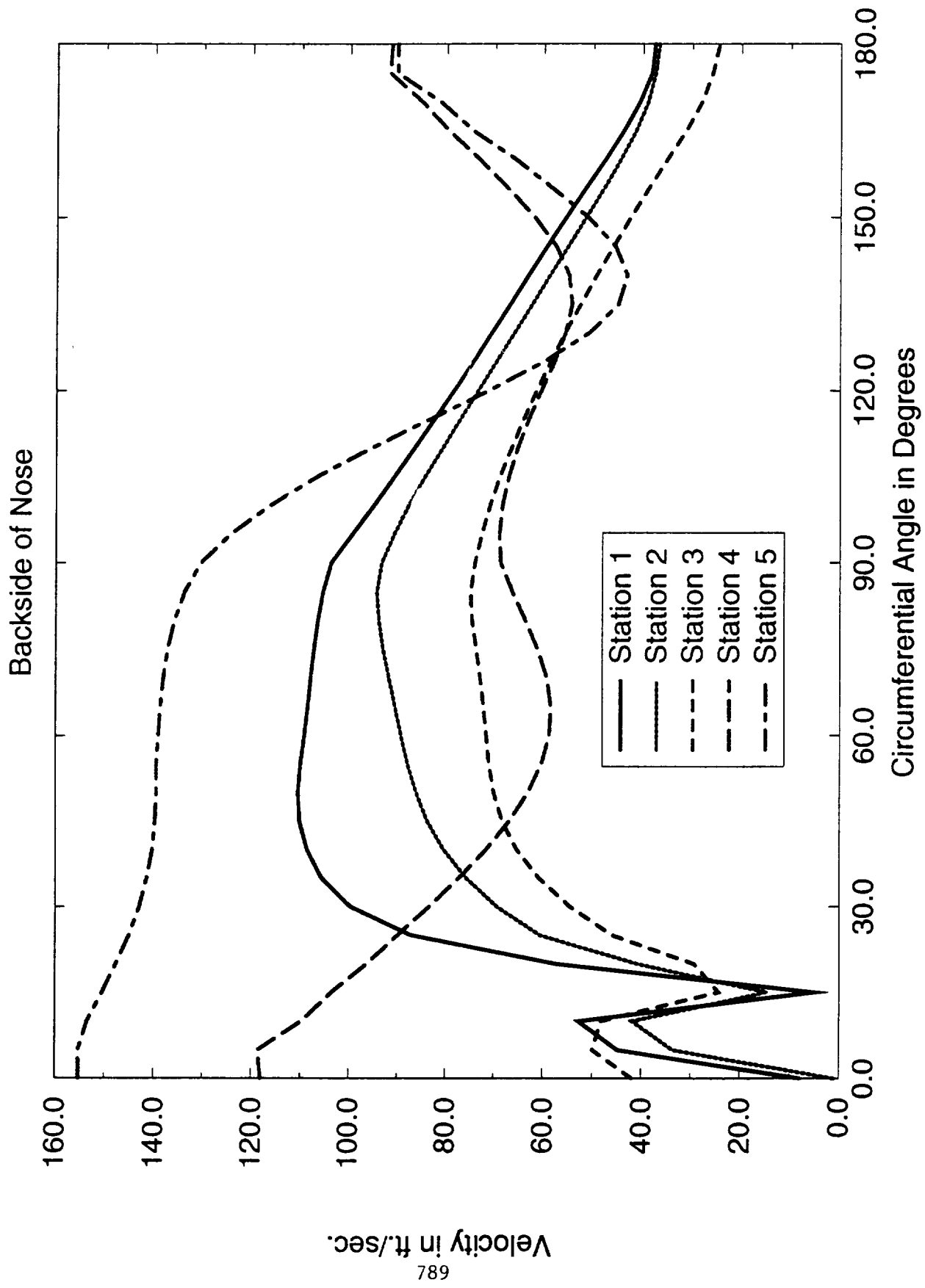
Variation of Radial Velocity



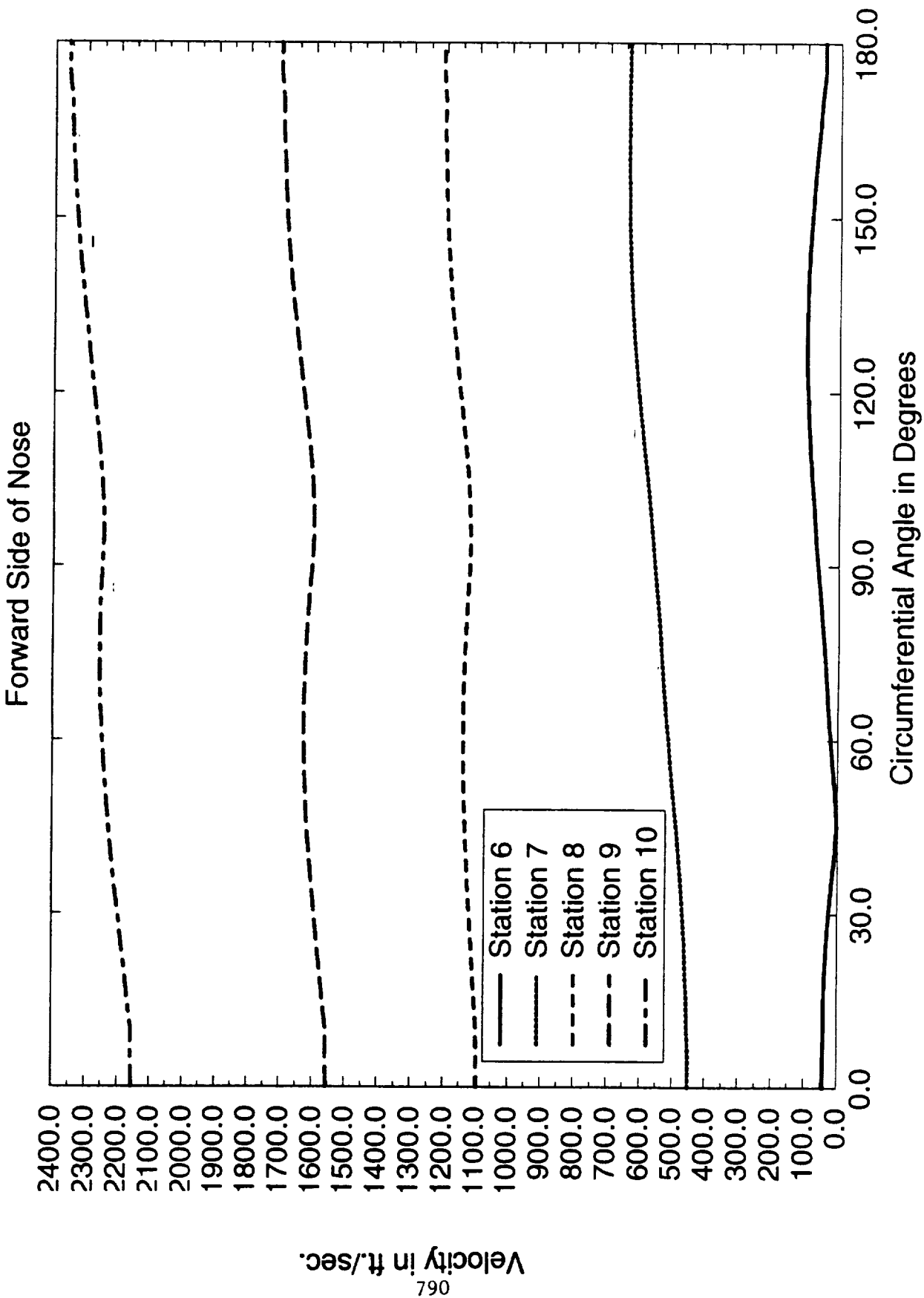
Variation of Radial Velocity



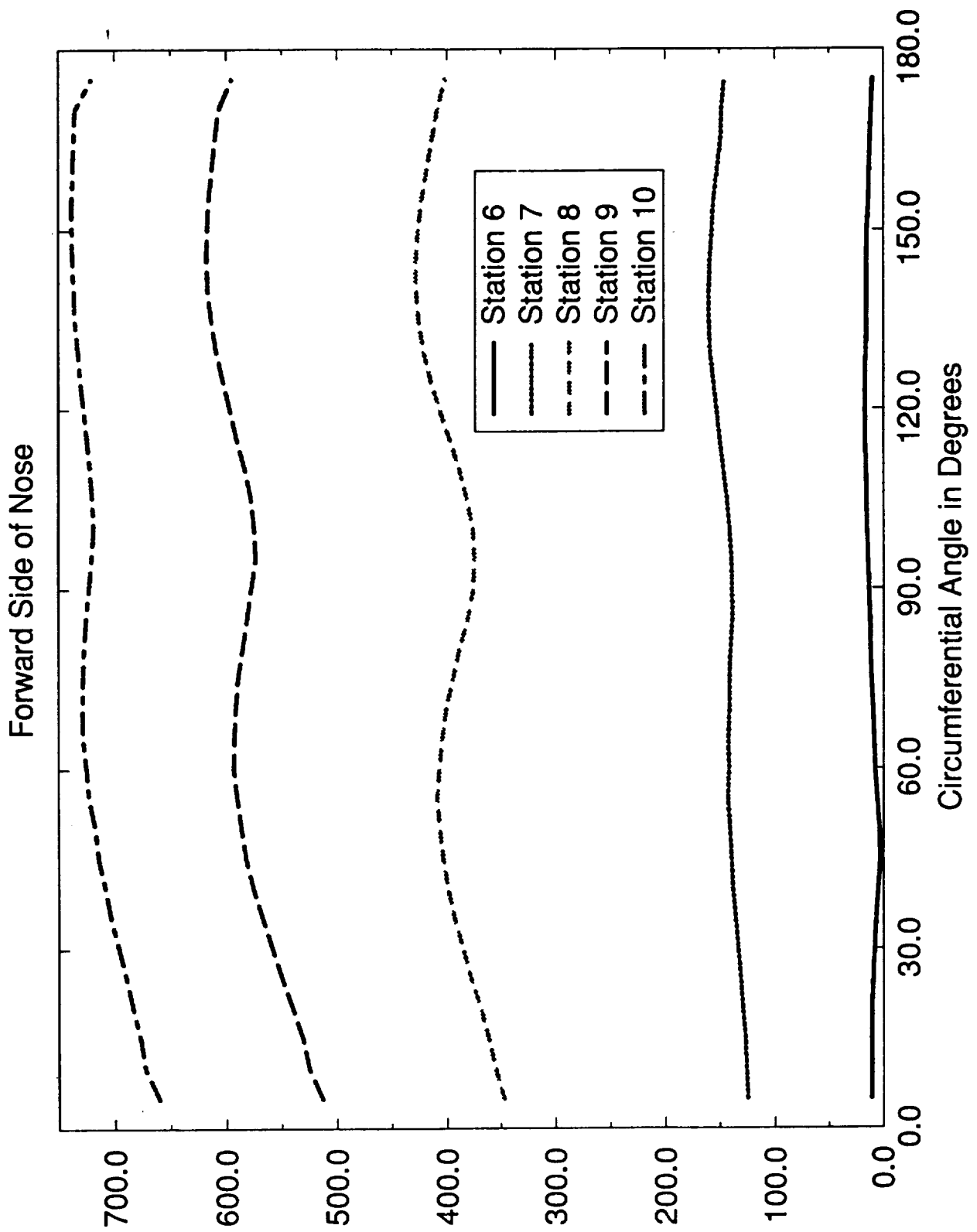
Variation of Velocity Magnitude



Variation of Velocity Magnitude



Variation of Y+ Values



Variation of Y+ Values

