Secondary flows and losses in gas turbines.

Graves, C.P.

SECONDARY FLOWS AND LOSSES IN GAS TURBINES

Volume II of II

CHRISTOPHER PAUL GRAVES

Department of Engineering
University of Durham

A thesis submitted for the degree of Doctor of Philosophy
of the University of Durham

March 1985

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AIII.1 Hot Wire Probe Velocity Components

AIII.2 Hot Wire Probe Cascade Velocity Components

LOW SPEED WIND TUNNEL WORKING SECTION AND CASCADE ARRANGEMENT

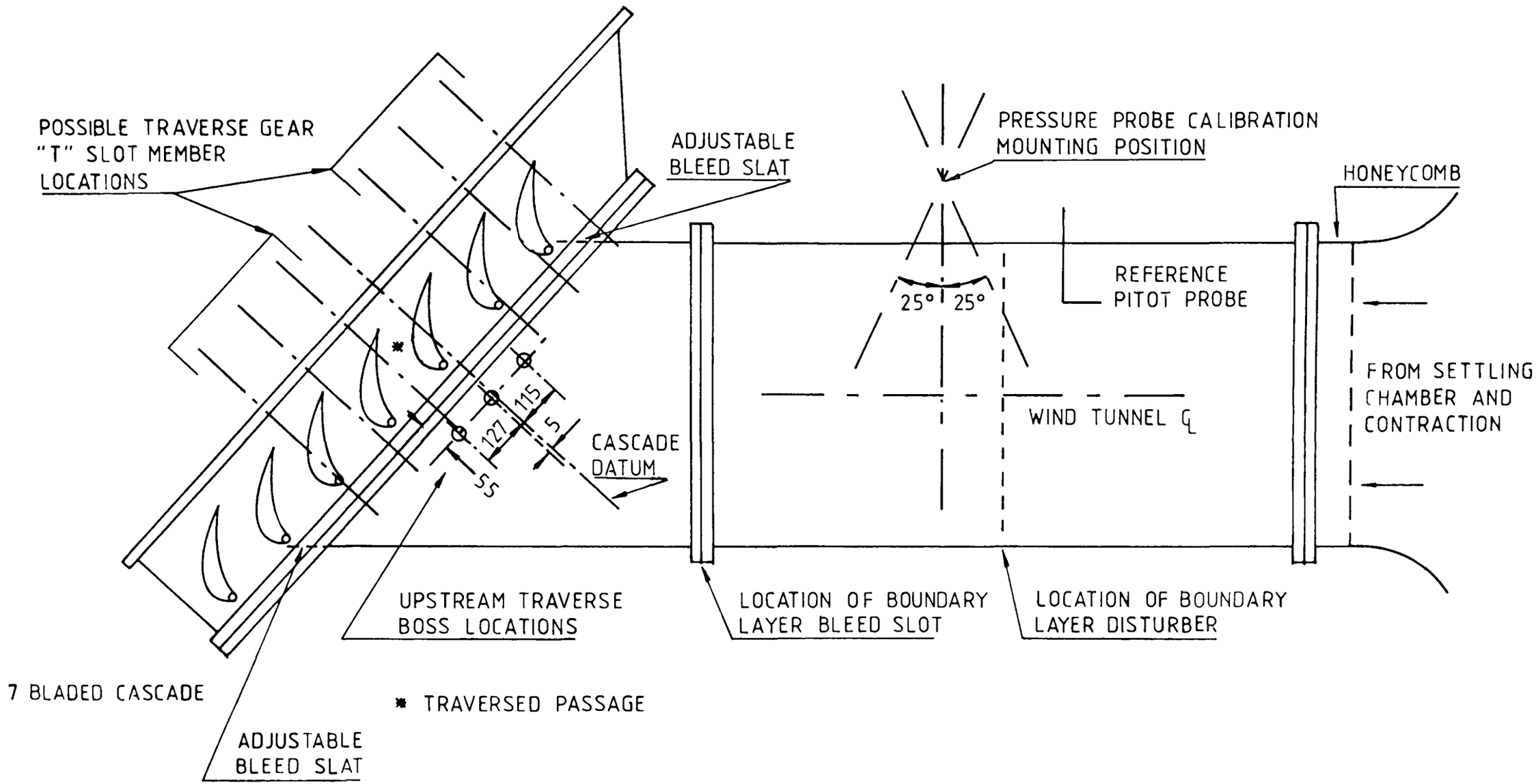


FIGURE 3.1

POSITION OF BLADE SURFACE PRESSURE TAPPINGS AT MIDSPAN

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

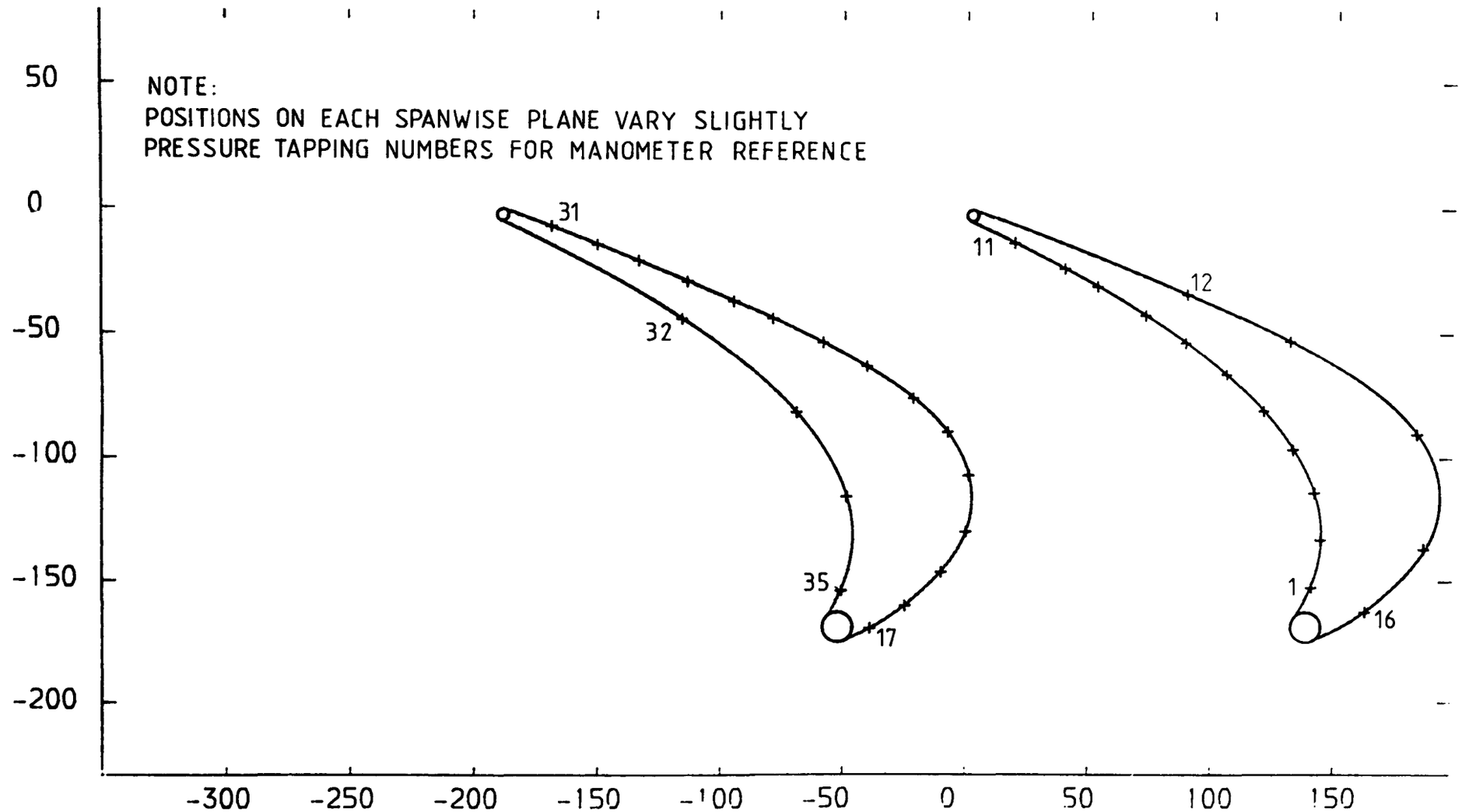


FIGURE 3.2

POSITIONS OF THE EXPERIMENTAL TRAVERSING SLOTS

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

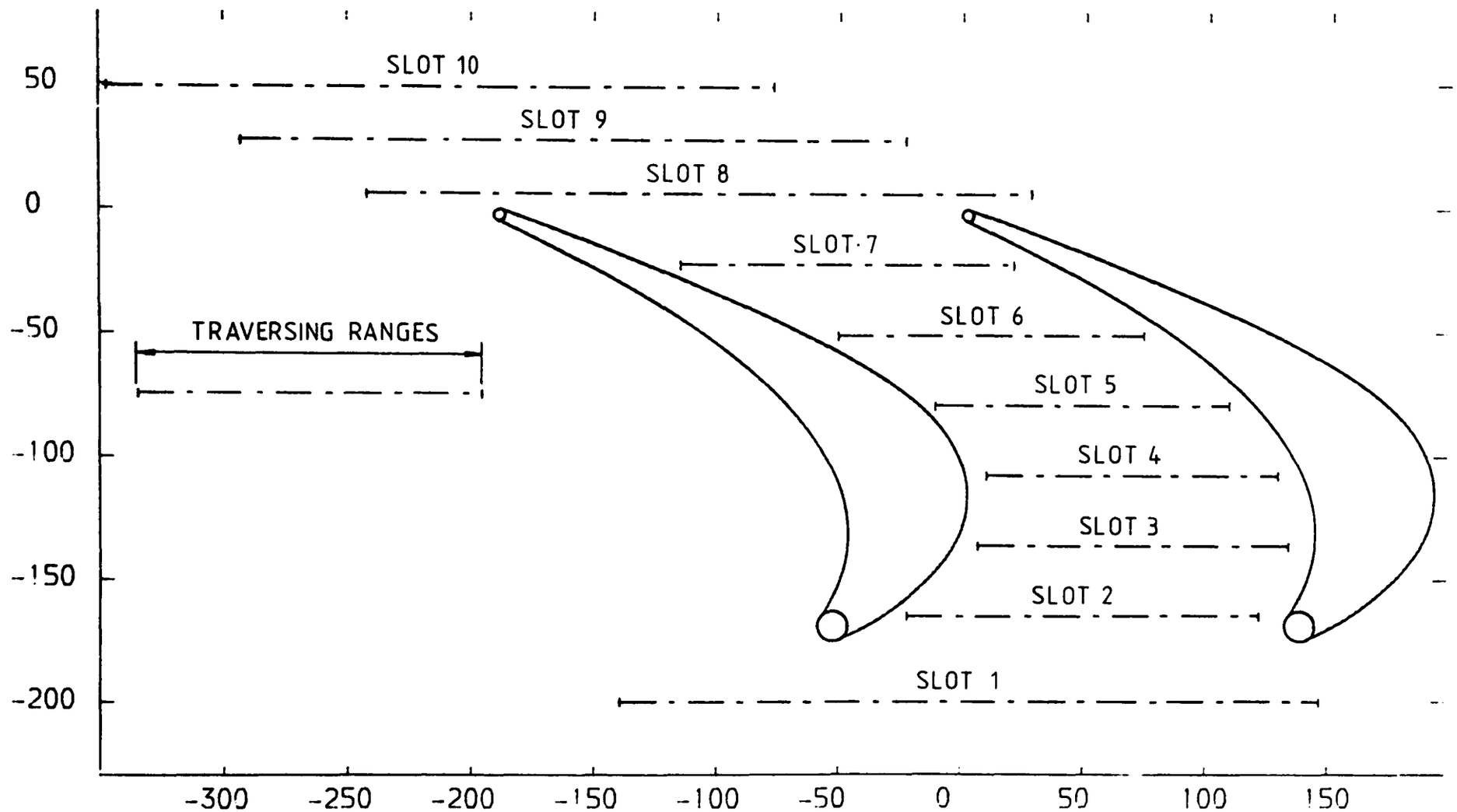


FIGURE 3.3

CASCADE SIGN CONVENTION

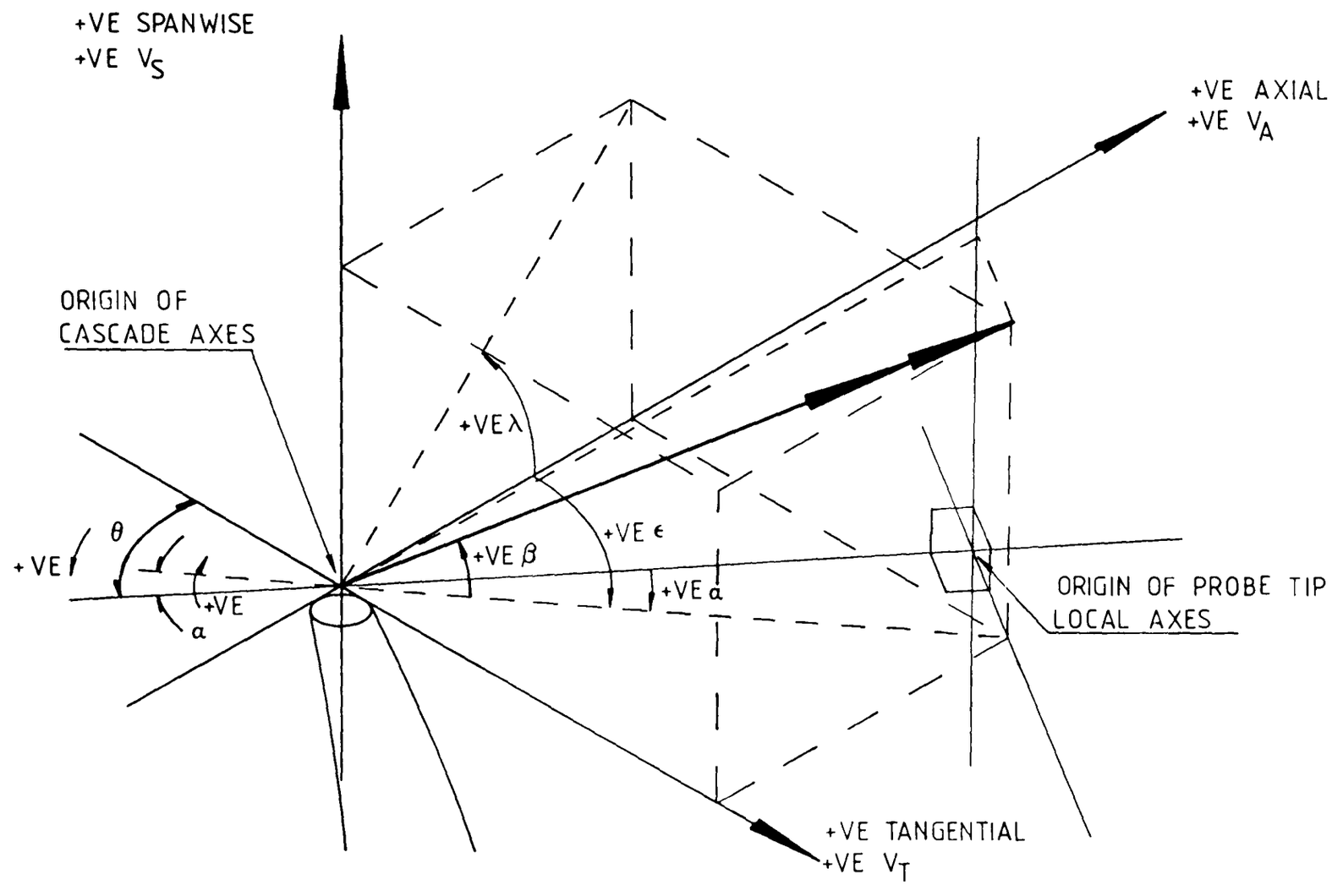


FIG 3.4

CASCADE ENDWALL BOUNDARY LAYER DISTURBER

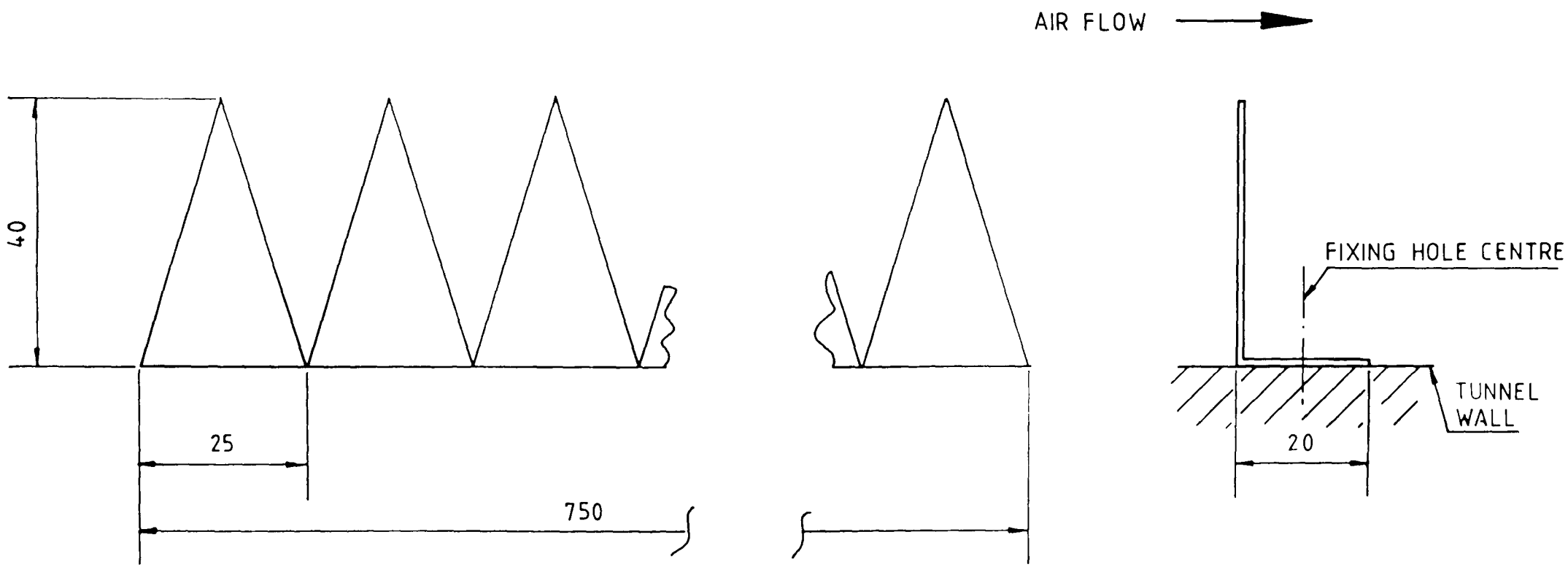


FIGURE 3.5

DATA ACQUISITION UNIT

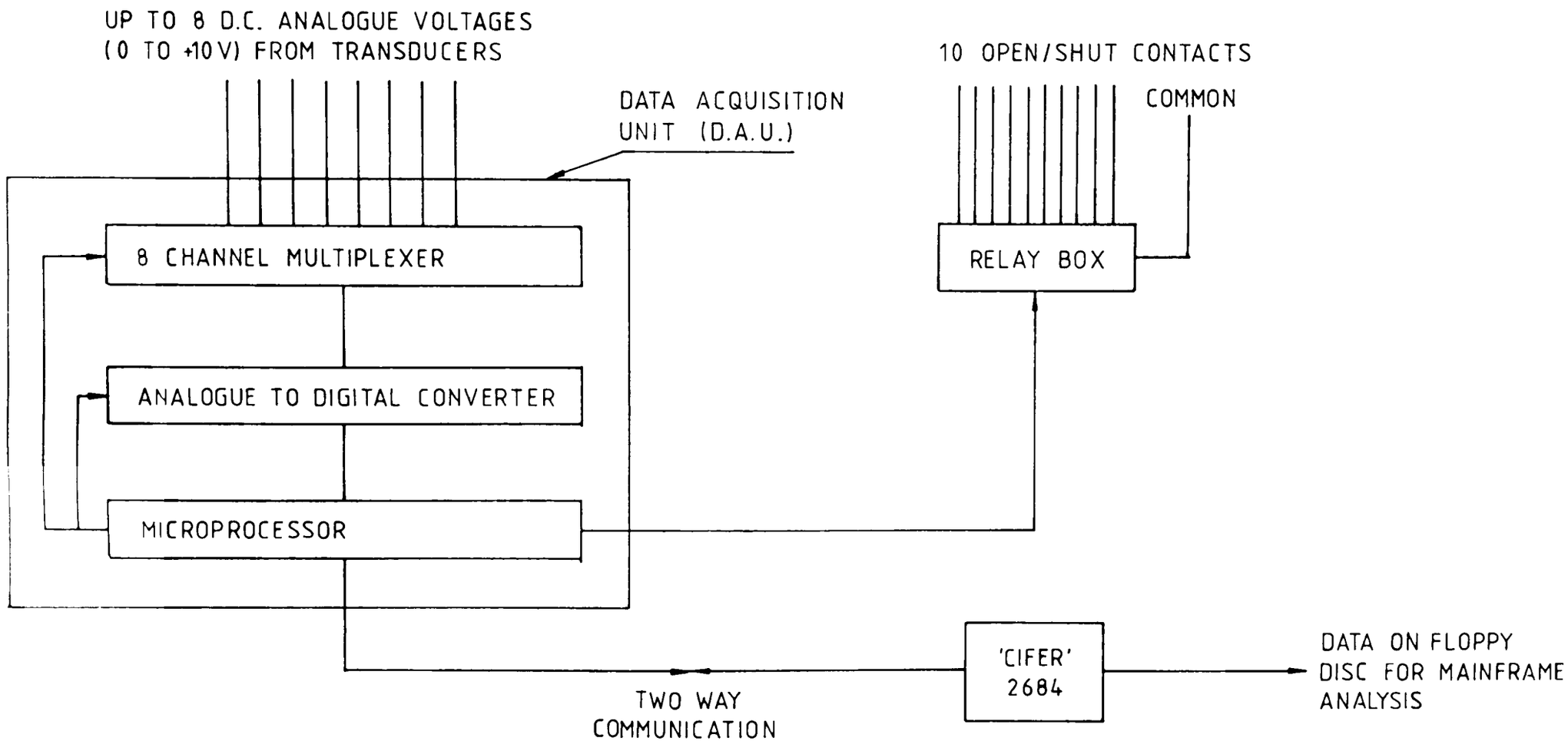


FIGURE 3.6

PRESSURE PROBE ARRANGEMENT

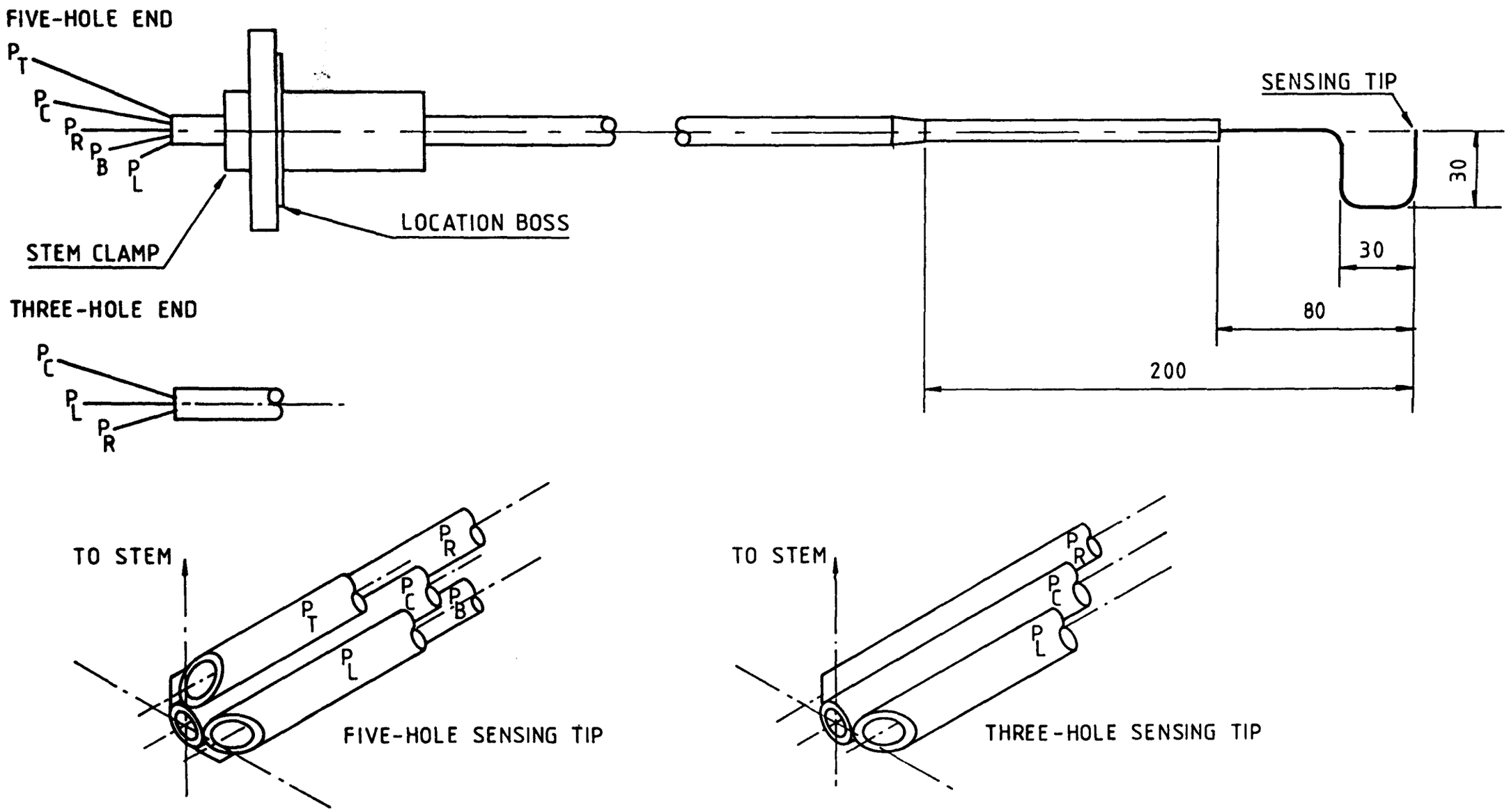


FIGURE 3.

HOT WIRE PROBE STEM ARRANGEMENT

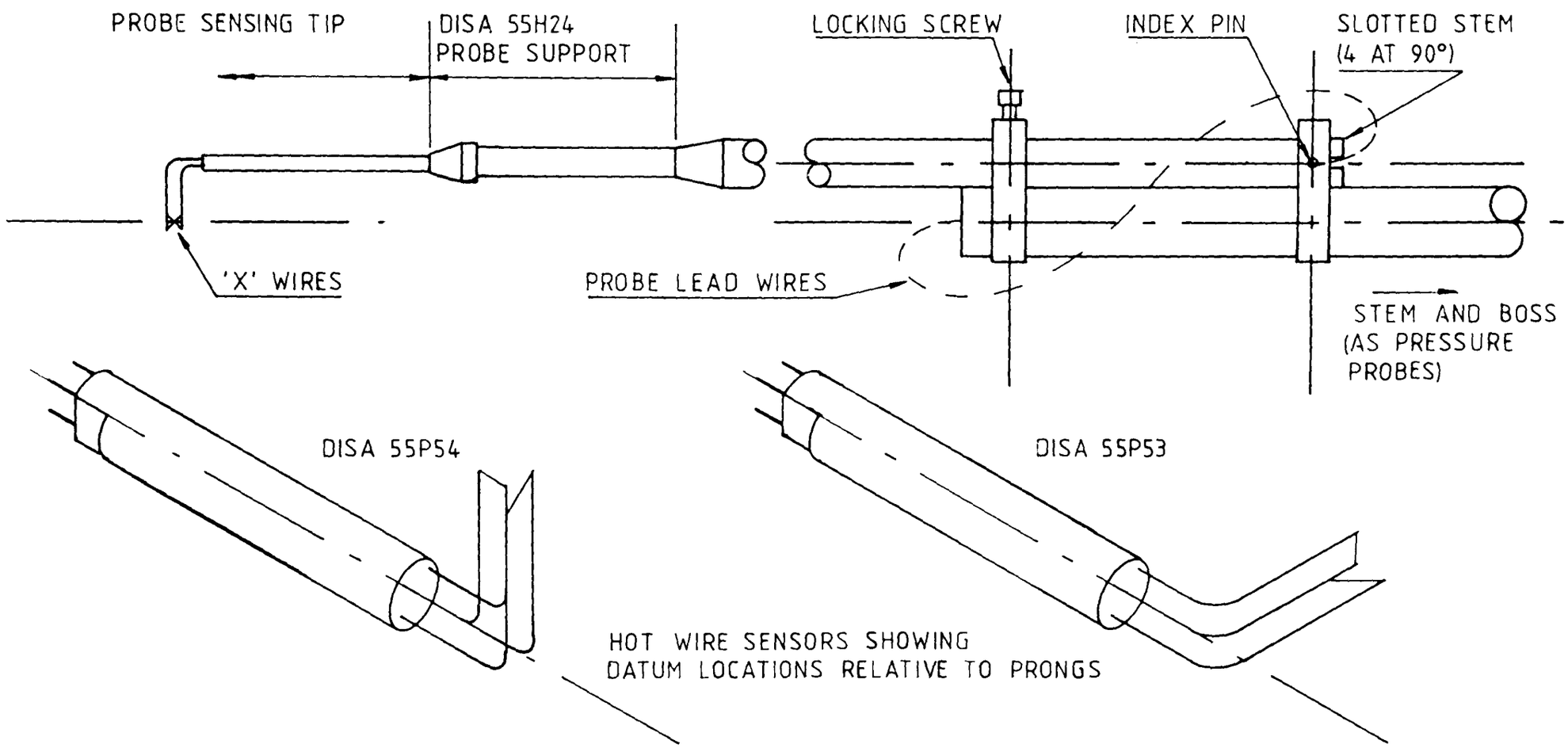
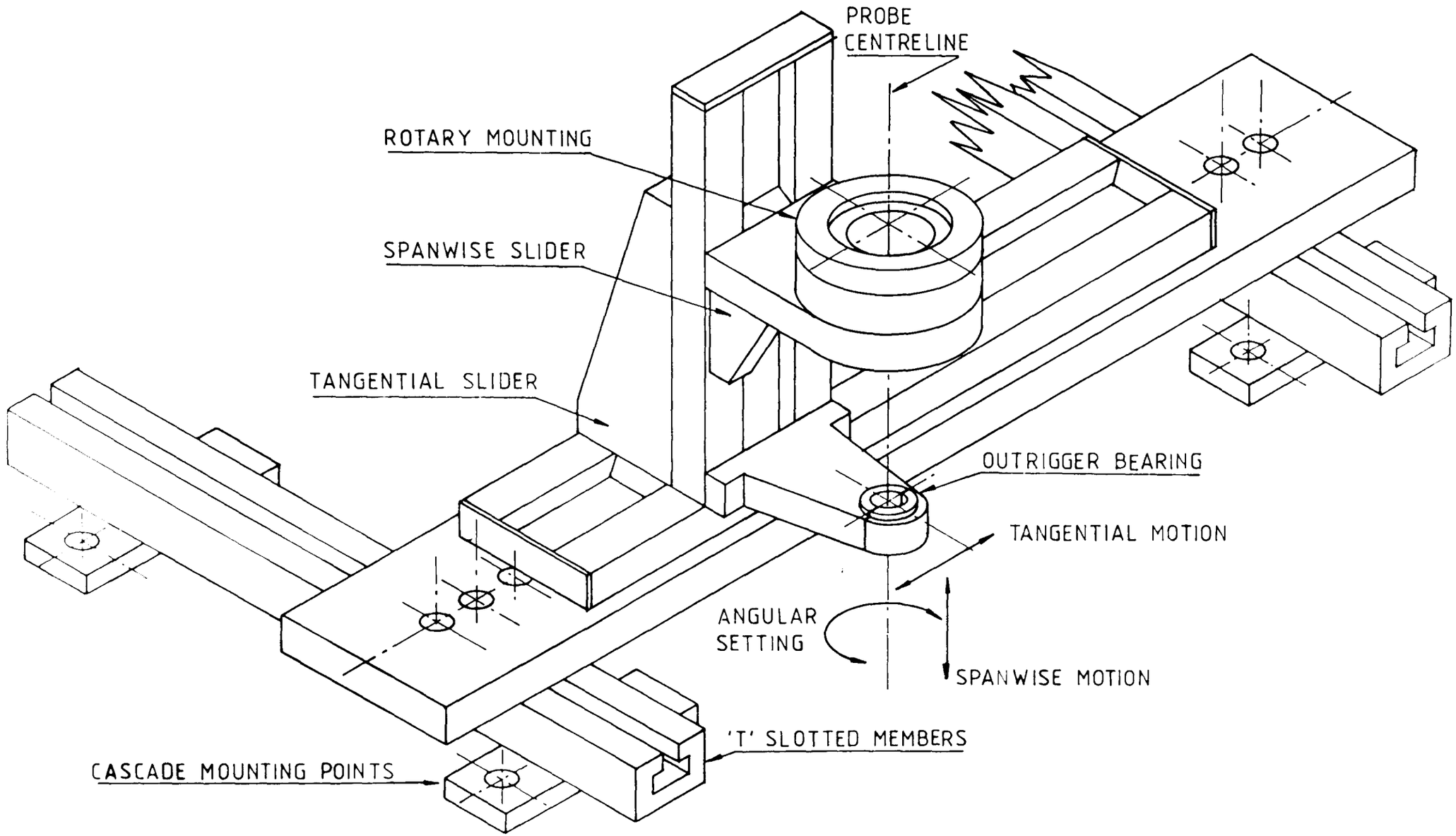


FIGURE 3.8

PROBE TRAVERSING GEAR



DATA ACQUISITION SYSTEM FOR PRESSURE PROBE TRAVERSING

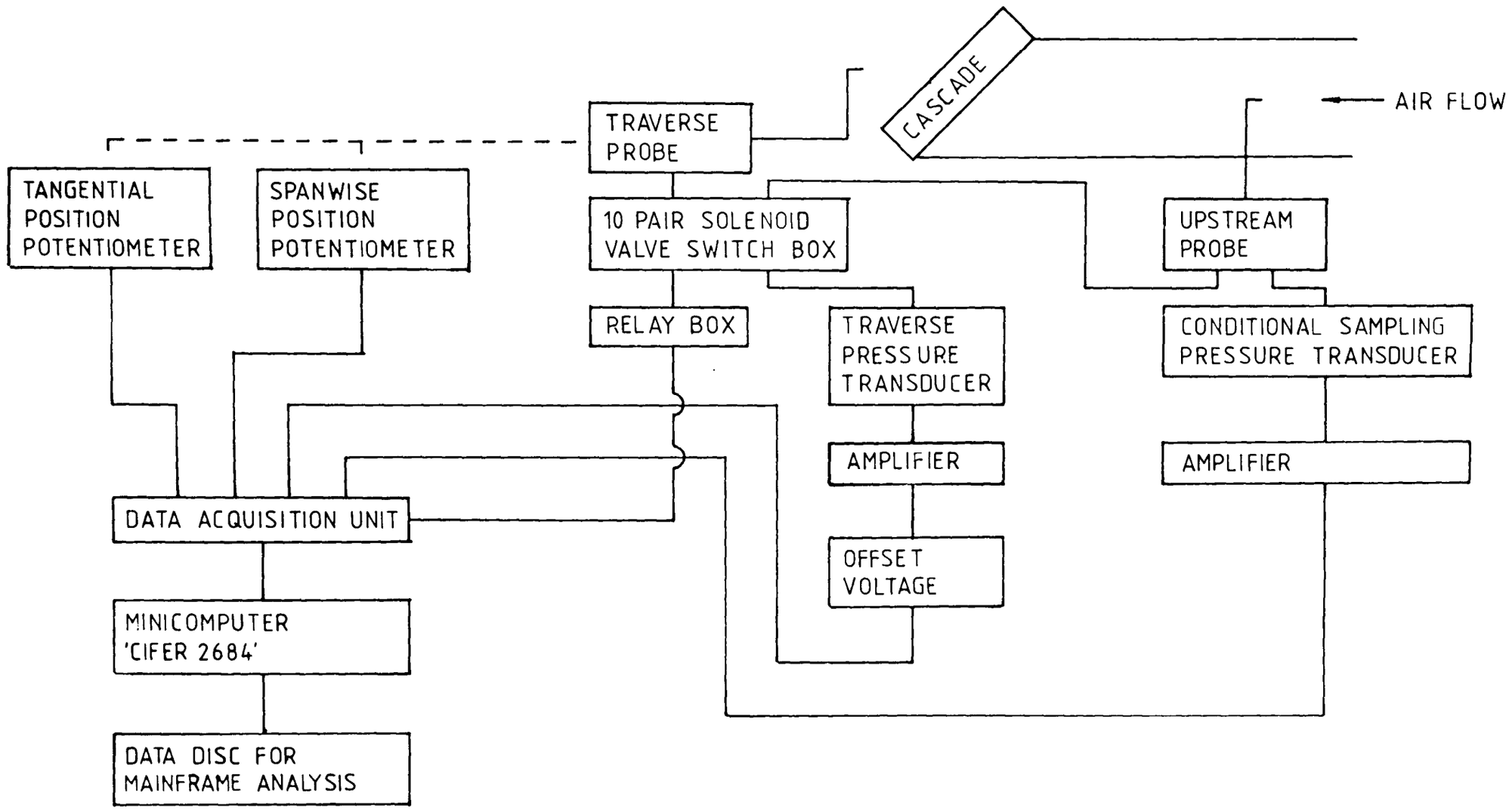
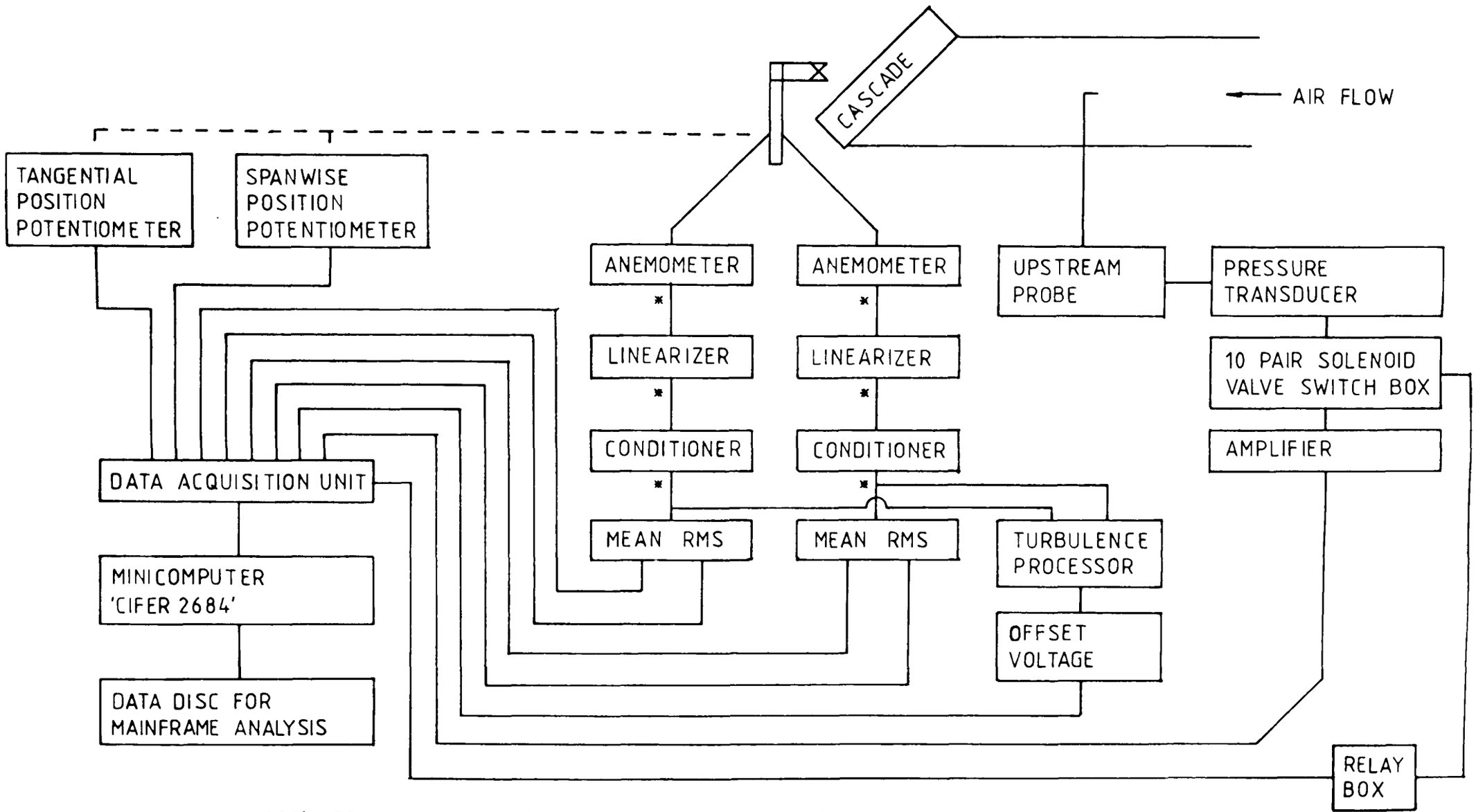


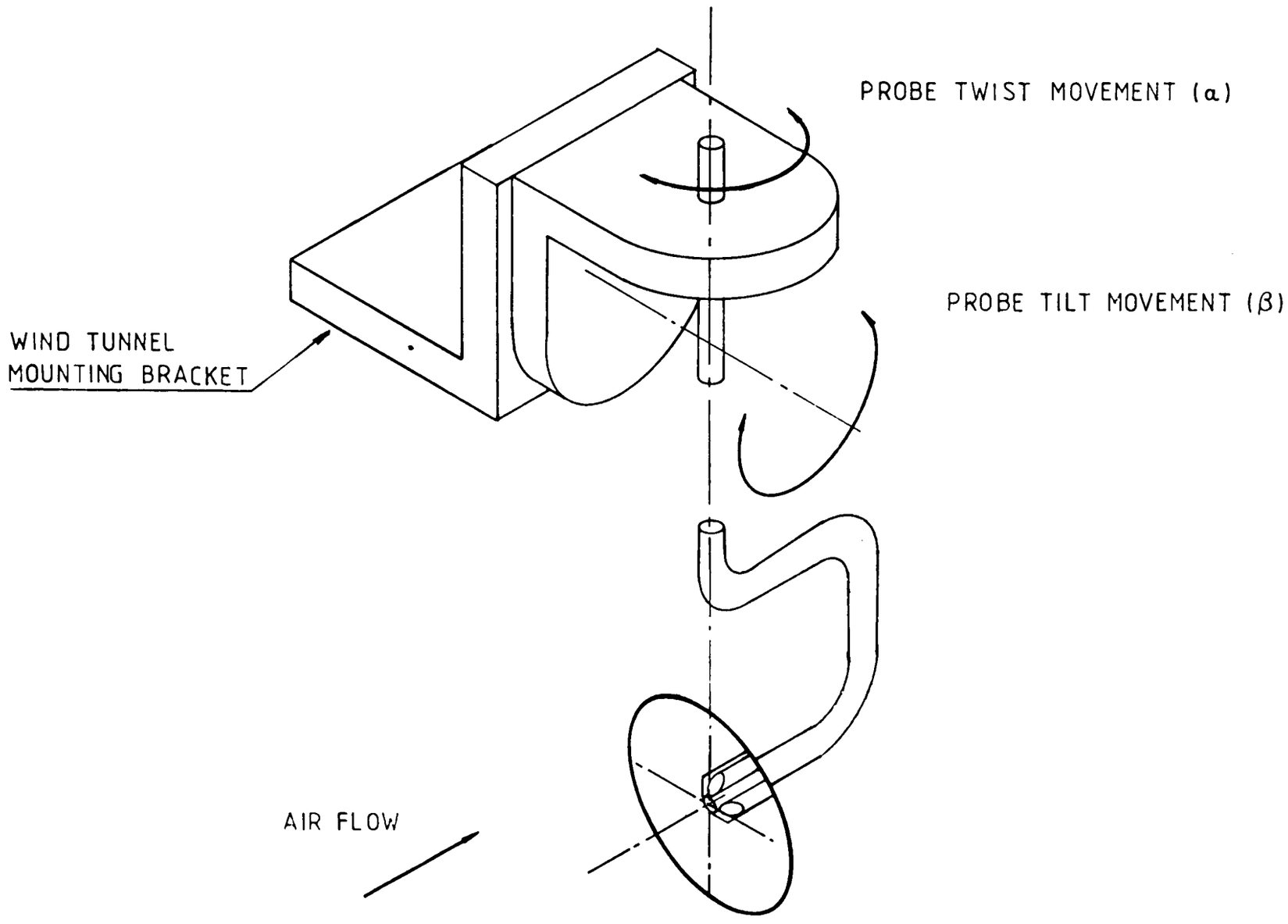
FIGURE 3.10

DATA ACQUISITION SYSTEM FOR HOT WIRE PROBE TRAVERSING



* OSCILLOSCOPE CONNECTION POINT FOR SIGNAL VALIDATION

PRESSURE PROBE CALIBRATION MOUNTING



HOT WIRE PROBE CALIBRATION JET

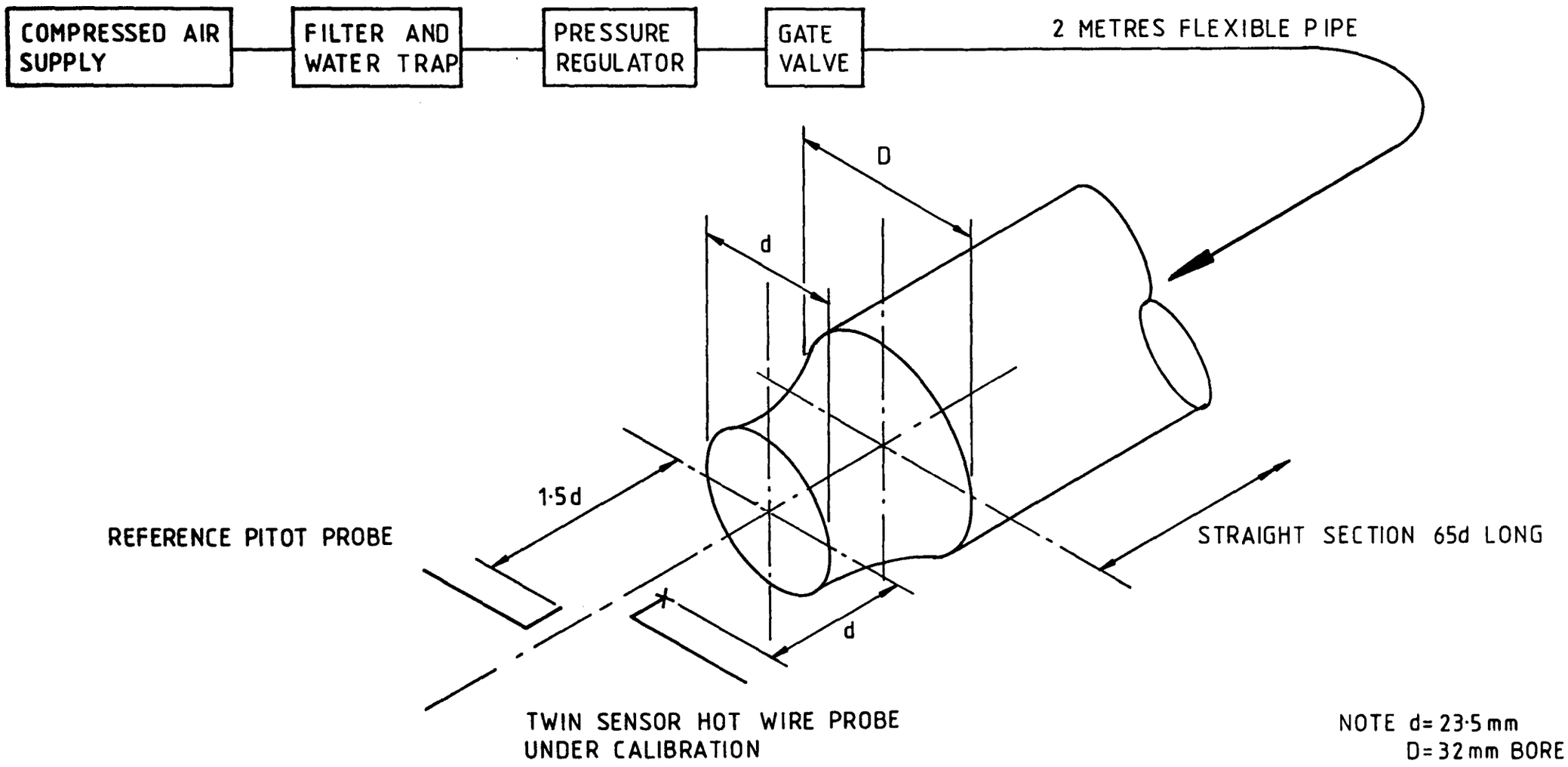


FIGURE 3.13

HOT WIRE PROBE CALIBRATION JET TRAVERSE DATA

X-AXIS RADIAL TRAVERSE POSITION NORMALIZED USING NOZZLE RADIUS
Y-AXIS LOCAL JET VELOCITY NORMALIZED USING CENTRAL VELOCITY

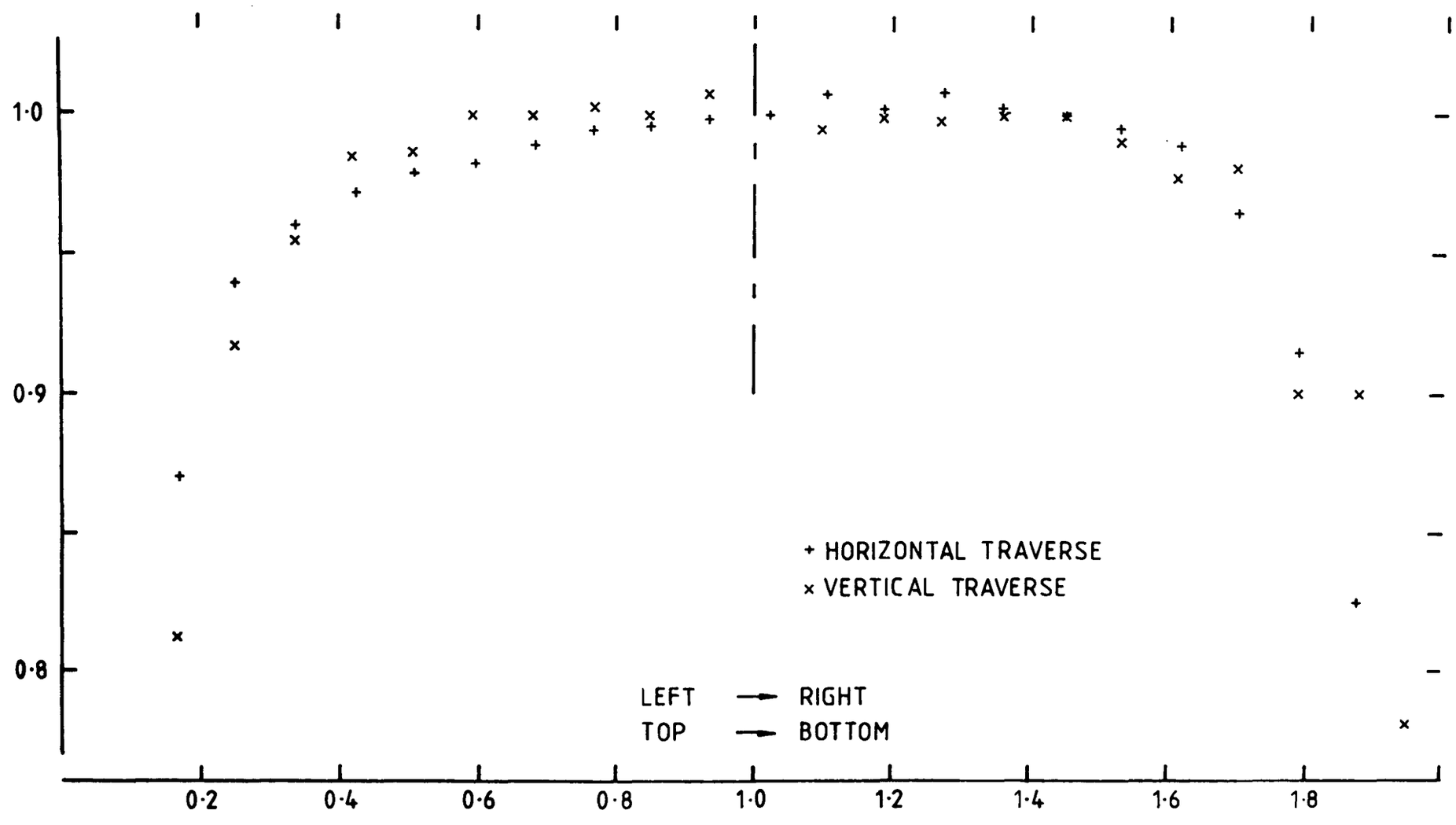


FIGURE 3.14

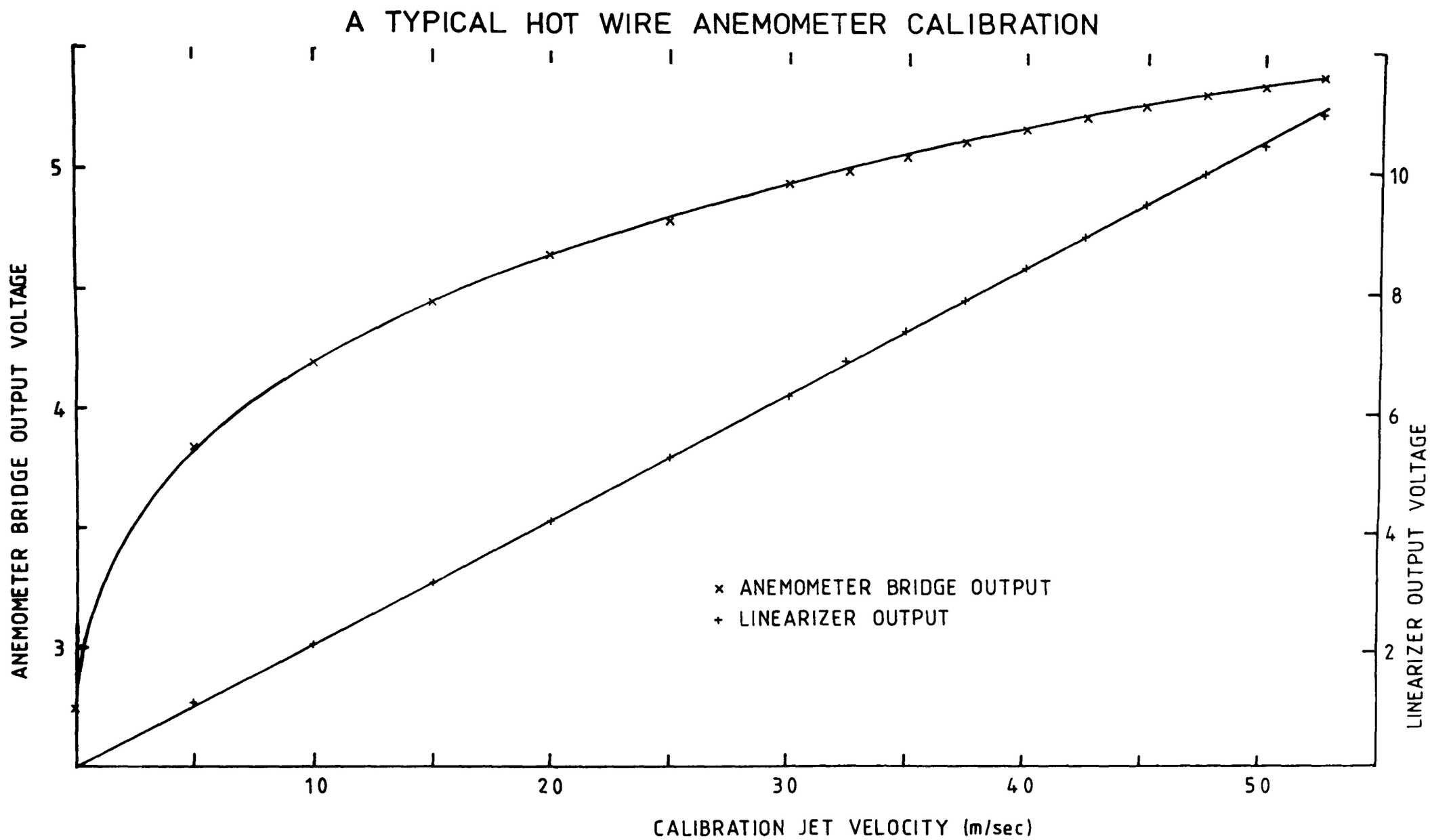

A TYPICAL HOT WIRE ANEMOMETER CALIBRATION
ANEMOMETER BRIDGE OUTPUT VOLTAGE
LINEARIZER OUTPUT VOLTAGE
CALIBRATION JET VELOCITY (m/sec)
× ANEMOMETER BRIDGE OUTPUT
+ LINEARIZER OUTPUT
3
4
5
2
4
6
8
10
10
20
30
40
50

FIGURE 3.15

CONDITIONAL SAMPLING OF PRESSURE PROBE DATA

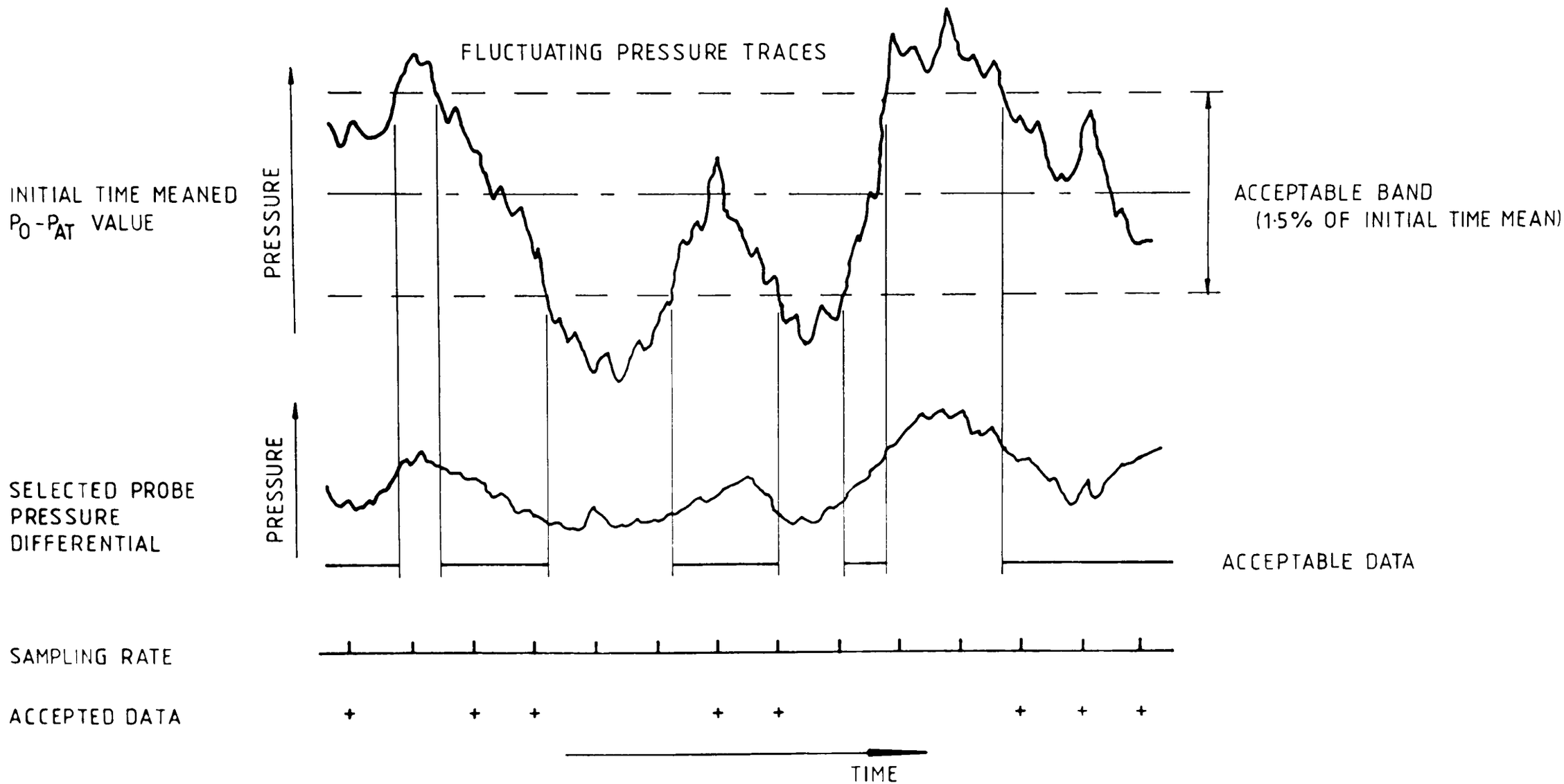
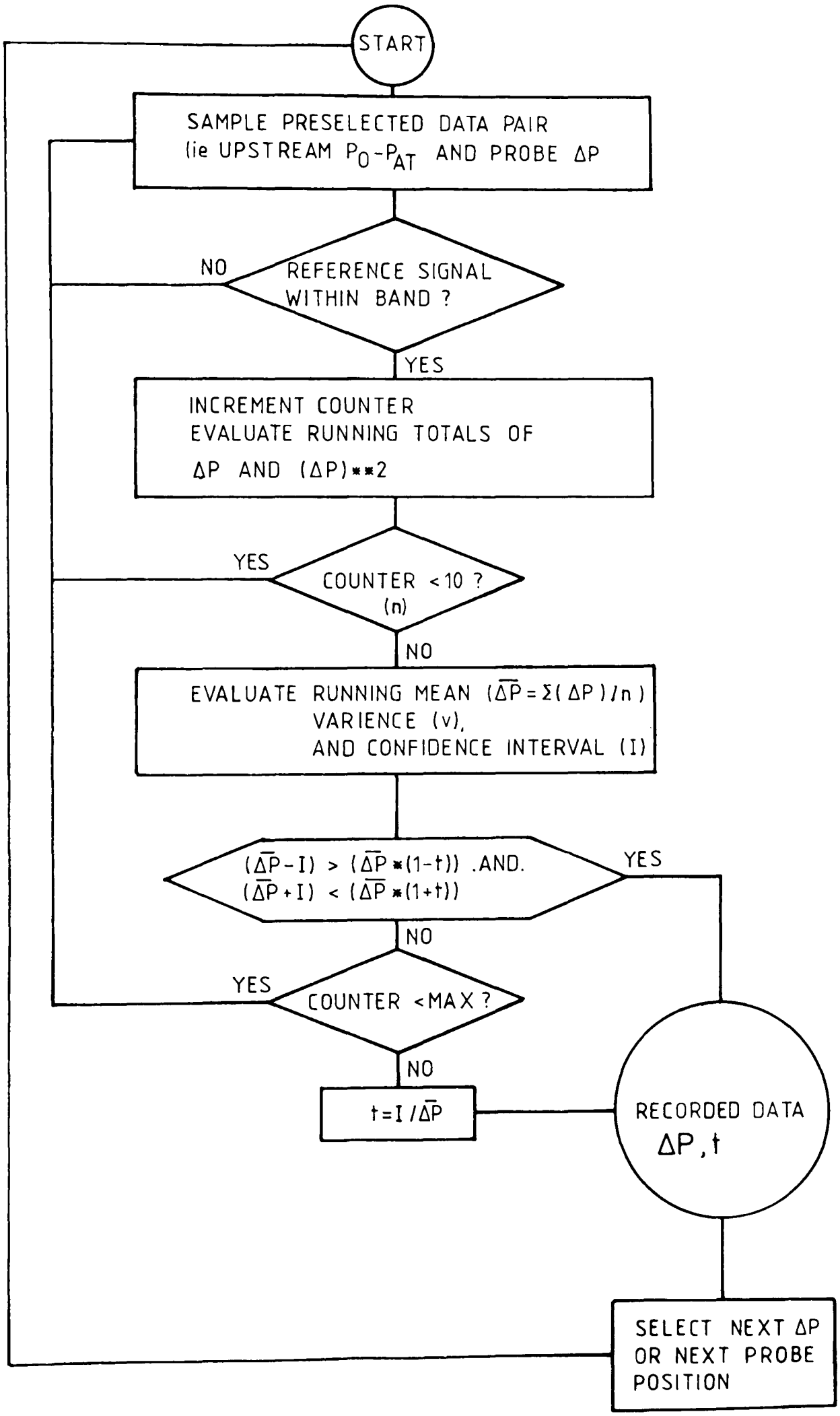


FIGURE 3.16

CONDITIONAL SAMPLING METHOD



NOTE : AT START TOLERANCE (t) = ±1%

FIGURE 3.17

FIVE-HOLE PROBE DATA ANALYSIS

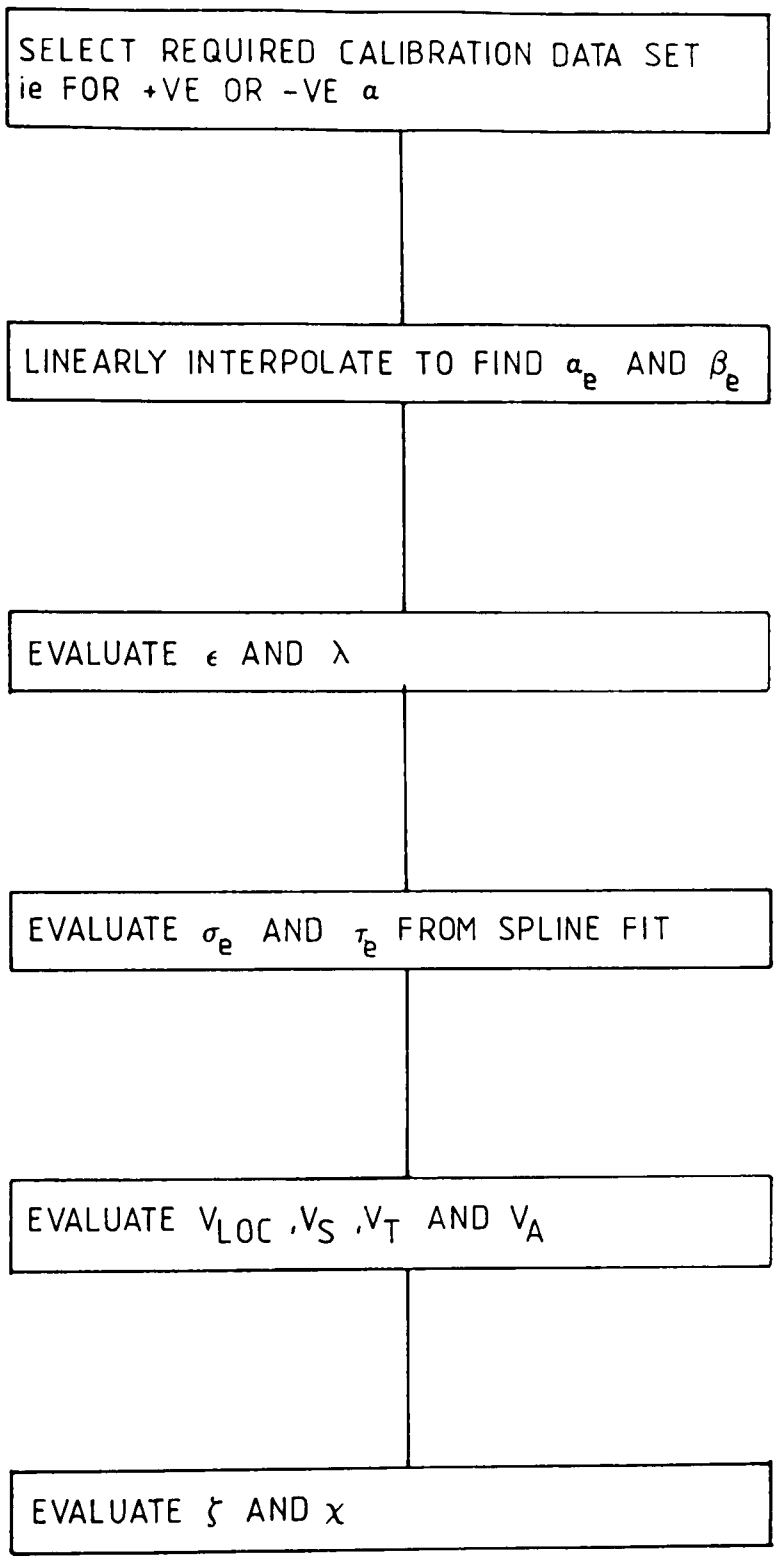


FIGURE 3.18

FIVE-HOLE PROBE ϕ AND ψ AT $\alpha=0^\circ$

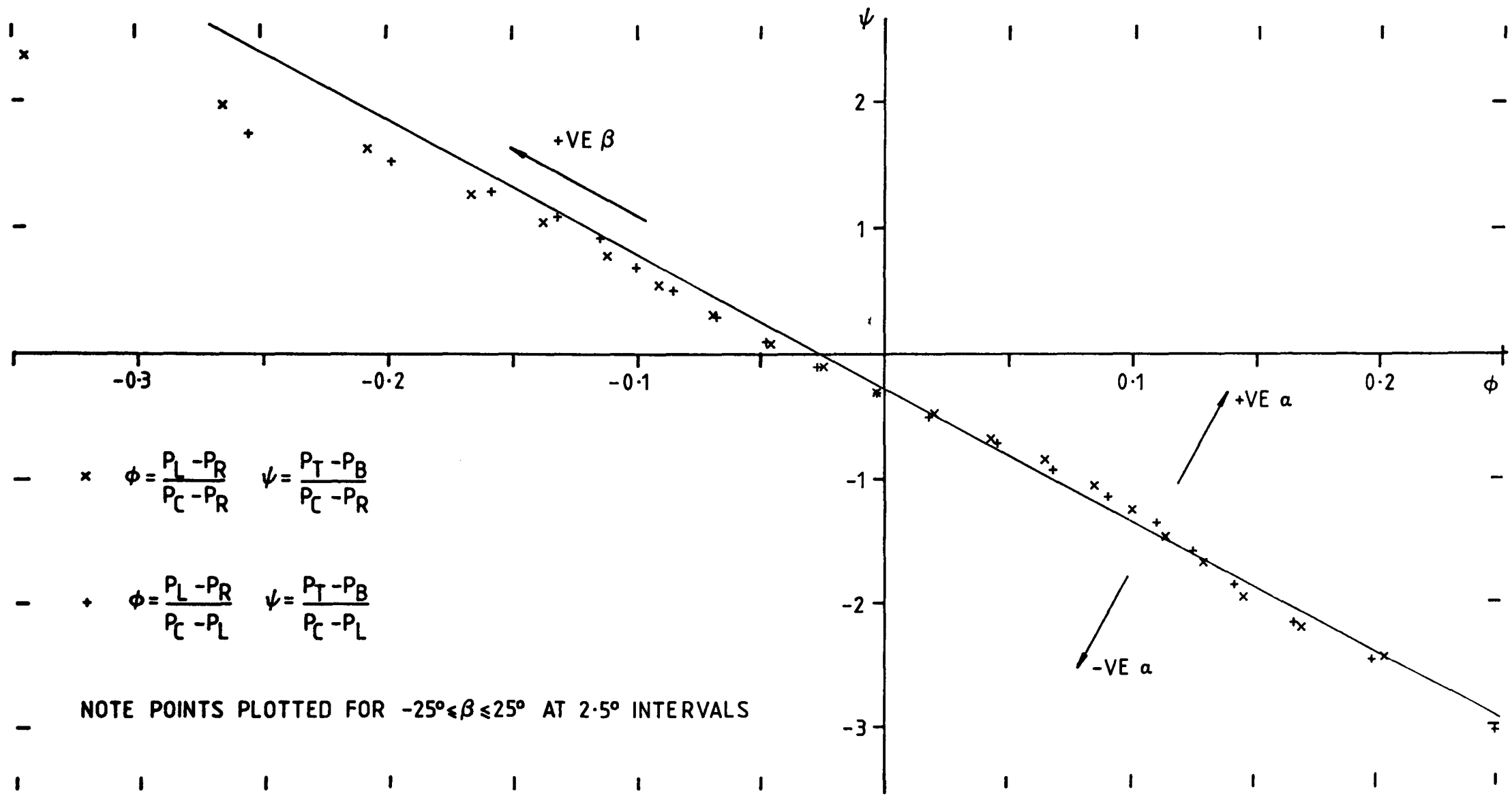
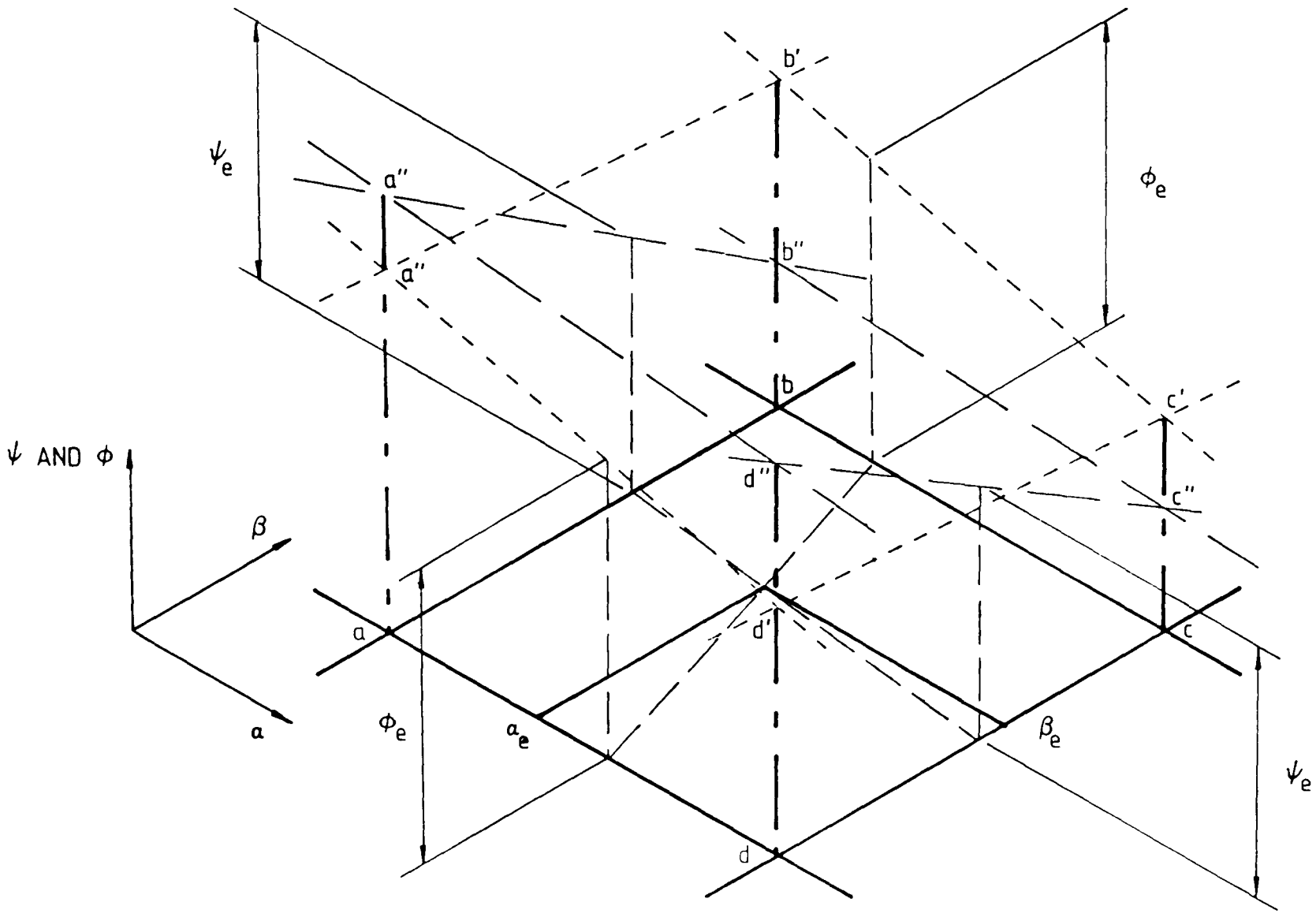


FIGURE 3.19

FIVE-HOLE PROBE DATA ANALYSIS : AN ANALYSIS CELL



CELL CO-ORDINATES

$a(\alpha(I),\beta(J),0)$ $aa' = \phi(I,J)$ $aa'' = \psi(I,J)$

$b(\alpha(I),\beta(J+1),0)$ $bb' = \phi(I,J+1)$ $bb'' = \psi(I,J+1)$

$c(\alpha(I+1),\beta(J+1),0)$ $cc' = \phi(I+1,J+1)$
$cc'' = \psi(I+1,J+1)$

$d(\alpha(I+1),\beta(J),0)$ $dd' = \phi(I+1,J)$
$dd'' = \psi(I+1,J)$

FIGURE 3.20

A CONTOUR PLOTTING CELL

CELL CO-ORDINATES

a(X(I-1),Y(I-1,J),Z(I-1,J))
b(X(I-1),Y(I-1,J+1),Z(I-1,J+1))
c(X(I),Y(I,J+1),Z(I,J+1))
d(X(I),Y(I,J),Z(I,J))
e(0·5*(X(I-1)+X(I)),0·25*(Y(I-1,J)+Y(I-1,J+1)+Y(I,J+1)+Y(I,J)),0·25*(Z(I-1,J)+Z(I-1,J+1)+Z(I,J+1)+Z(I,J)))

NOTE:

POINTS a,b,c,d,e ARE ON 'Z' DATA SURFACE
POINTS a',b',c',d',e',ARE ON PLOT PLANE
(ie Z=0)

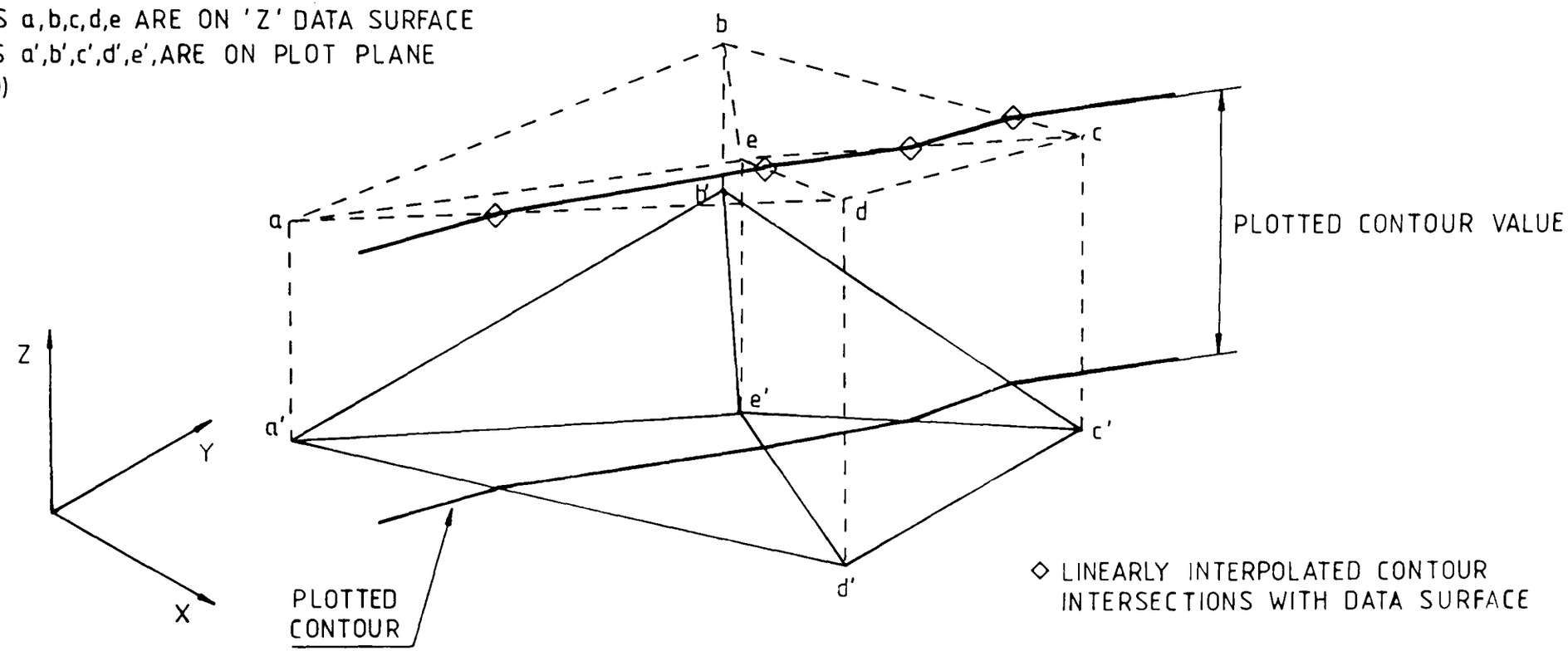


FIGURE 3.21

THICK LINE PLOTTING ALGORITHM

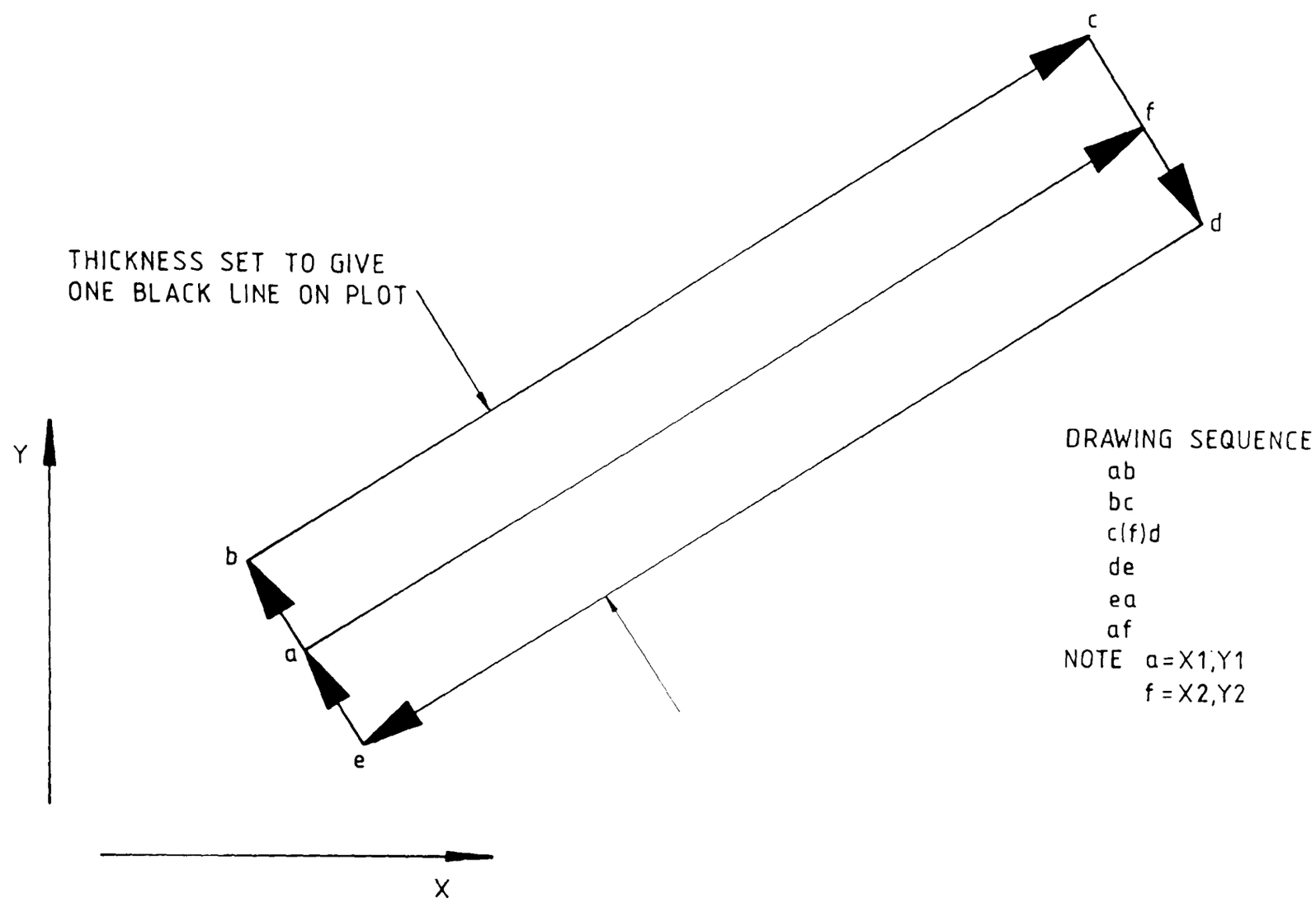


FIGURE 3.22

A VECTOR SCALING CELL

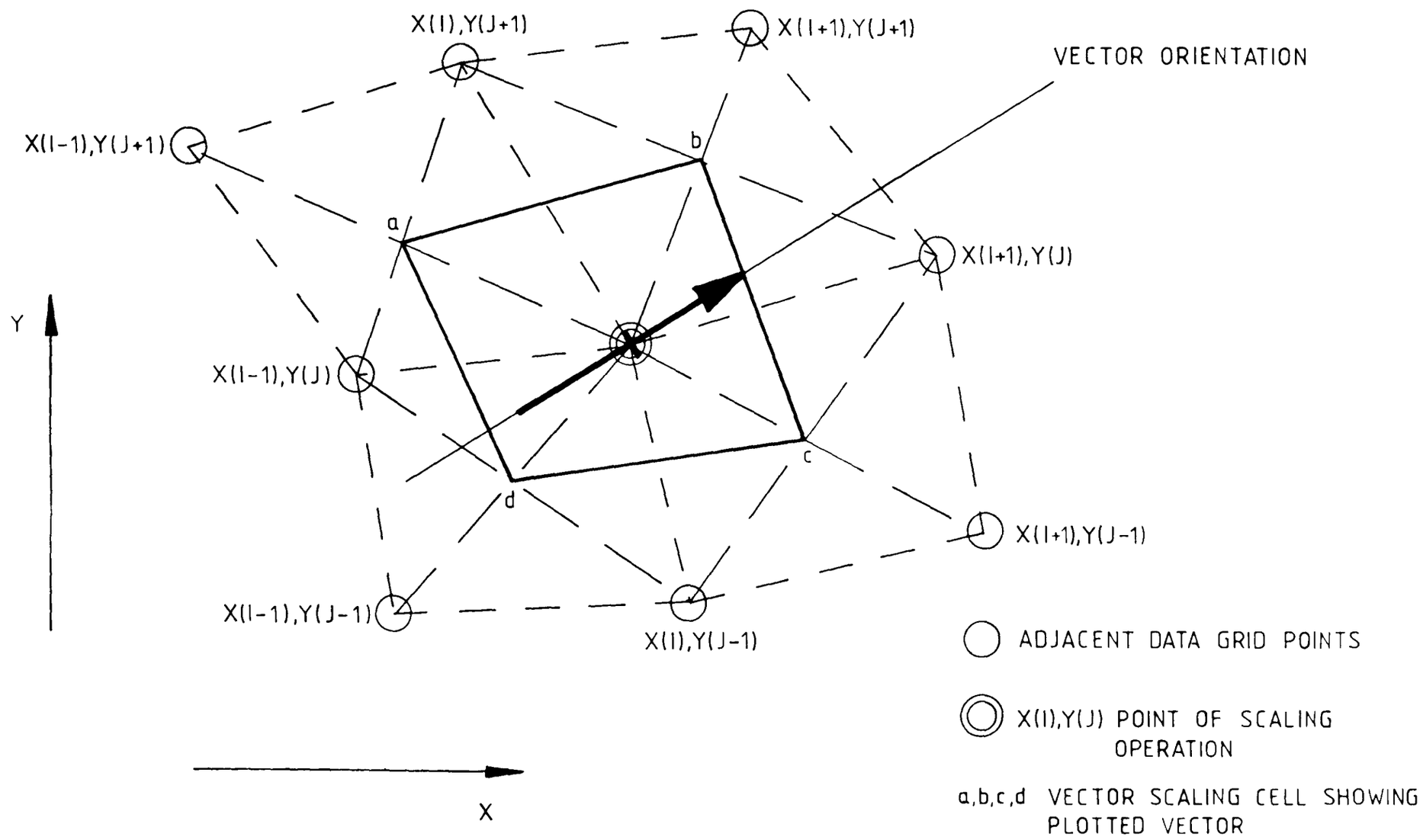


FIGURE 3.

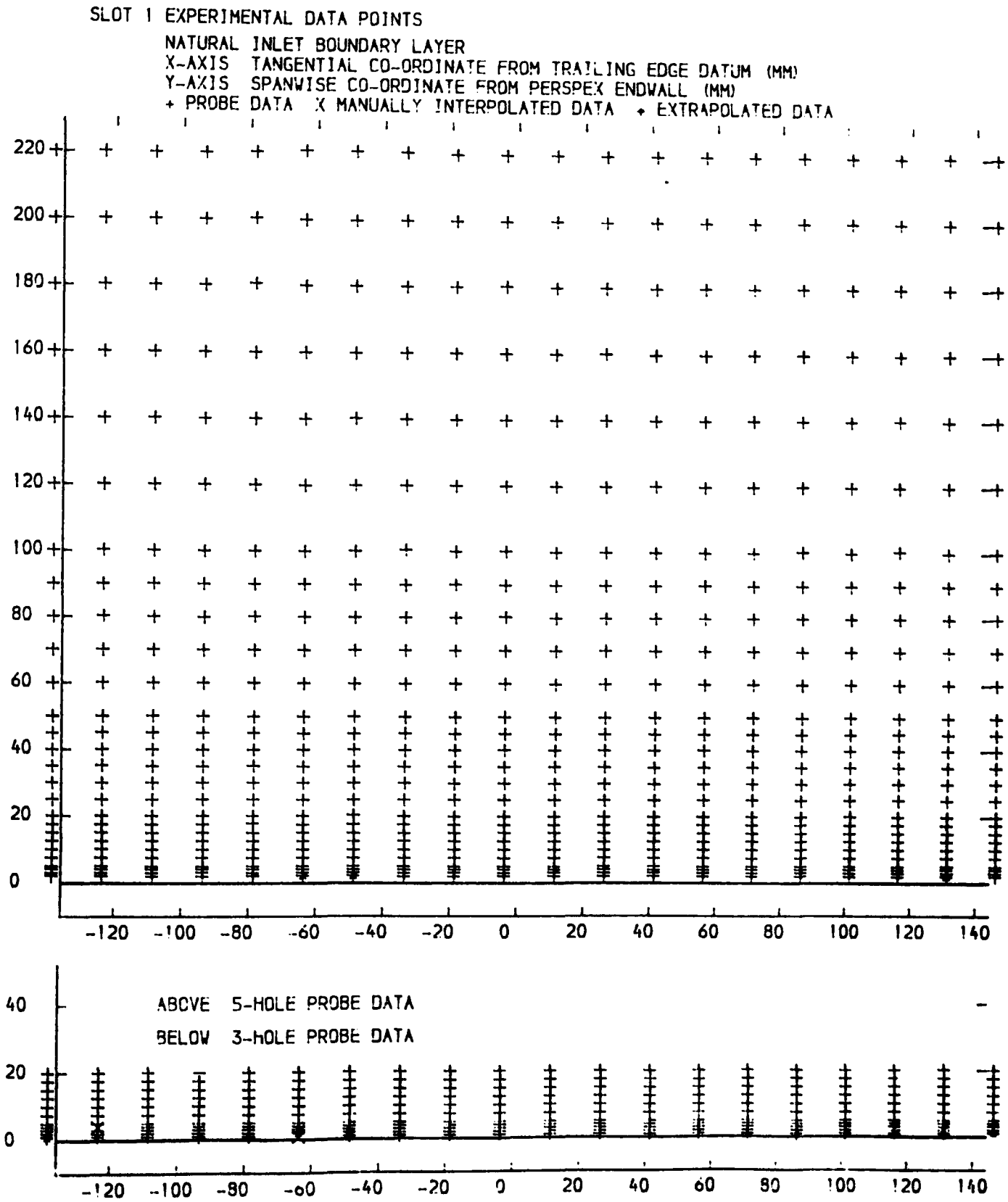

SLOT 1 EXPERIMENTAL DATA POINTS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
+ PROBE DATA X MANUALLY INTERPOLATED DATA + EXTRAPOLATED DATA
220
200
180
160
140
120
100
80
60
40
20
0
-120 -100 -80 -60 -40 -20 0 20 40 60 80 100 120 140
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
40
20
0
-120 -100 -80 -60 -40 -20 0 20 40 60 80 100 120 140

FIGURE 4.1

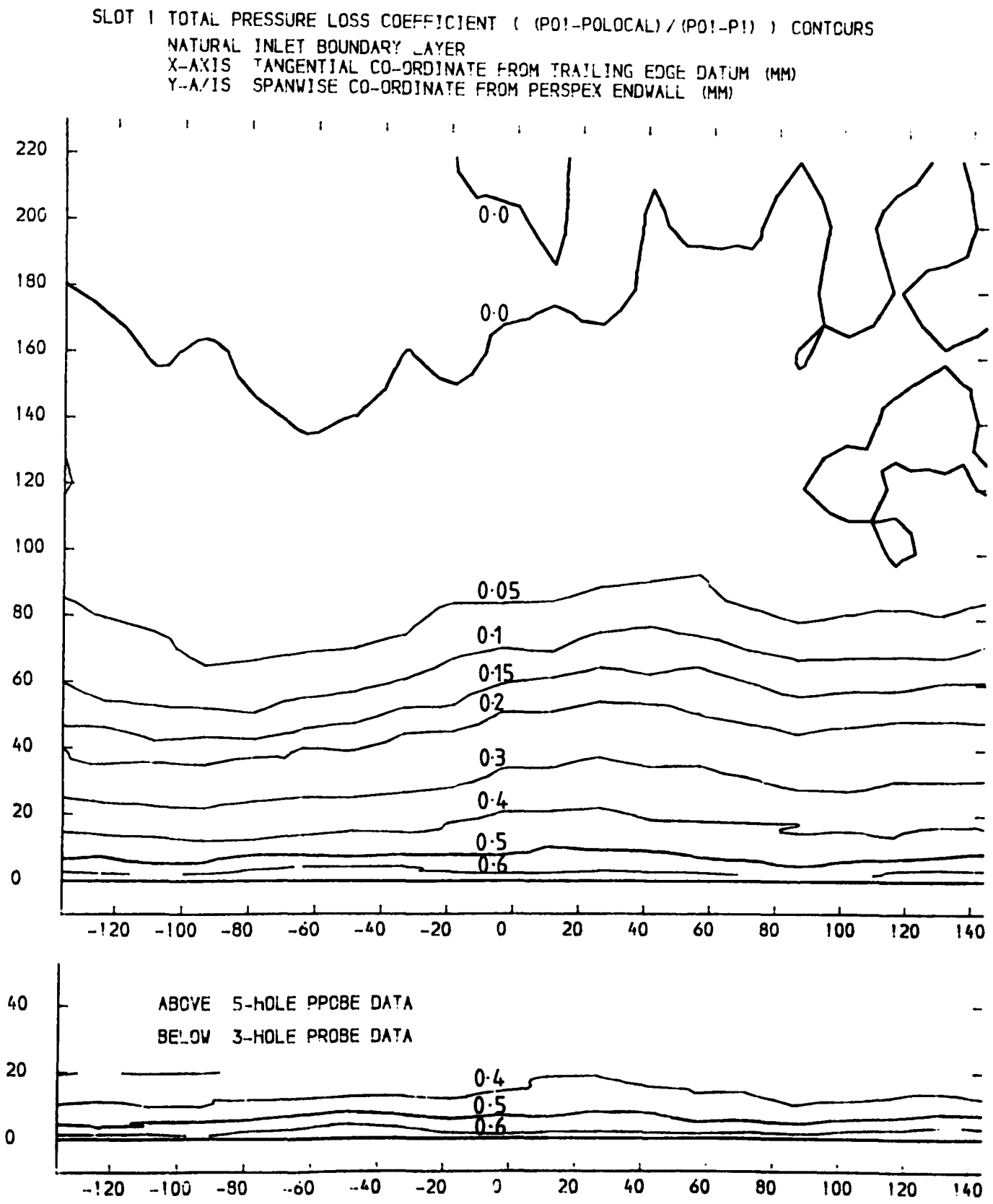
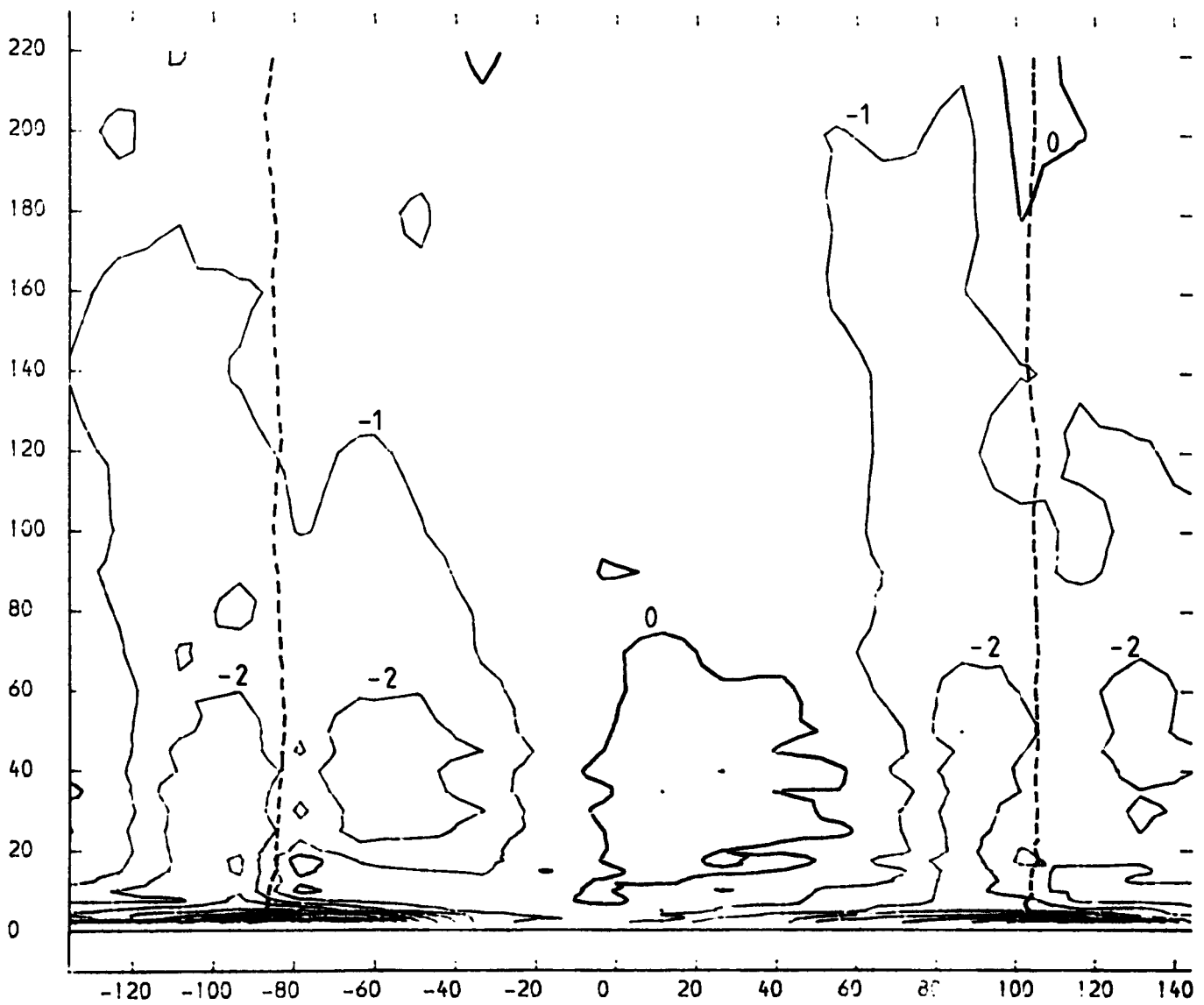

SLOT 1 TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL)/(PO1-P1)) CONTOURS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
0·0
0·0
0·05
0·1
0·15
0·2
0·3
0·4
0·5
0·6
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
0·4
0·5
0·6

FIGURE 4.2

SLOT 1 STREAMWISE SPANWISE ANGLE CONTOURS (CONTOUR UNITS DEGREES)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)



------ 44° YAW ANGLE CONTOUR

FIGURE 4.3

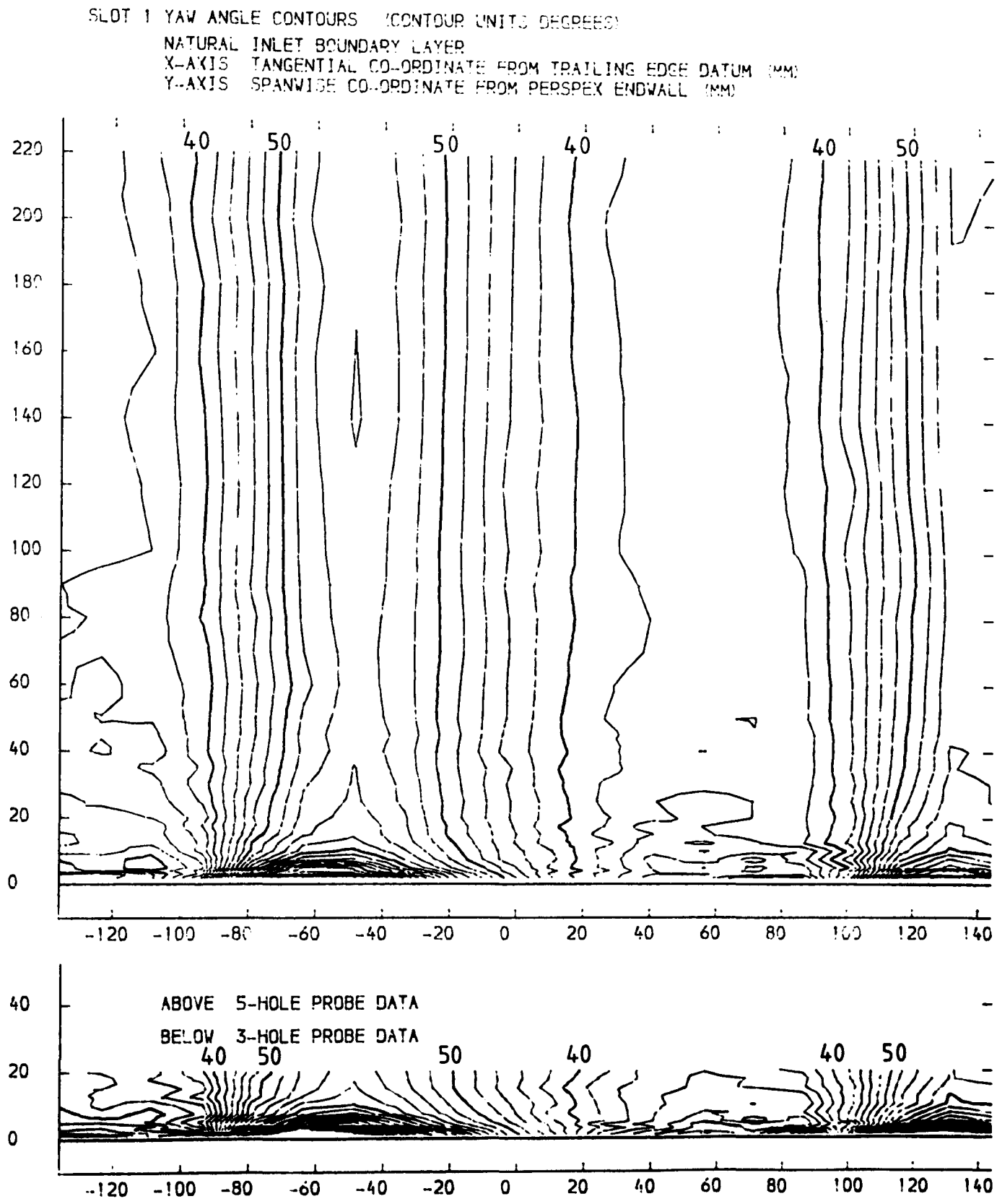

SLOT 1 YAW ANGLE CONTOURS (CONTOUR UNITS DEGREES)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
40
50
50
40
40
50
220
200
180
160
140
120
100
80
60
40
20
0
-120
-100
-80
-60
-40
-20
0
20
40
60
80
100
120
140
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
40
50
50
40
40
50
40
20
0
-120
-100
-80
-60
-40
-20
0
20
40
60
80
100
120
140

FIGURE 4.4

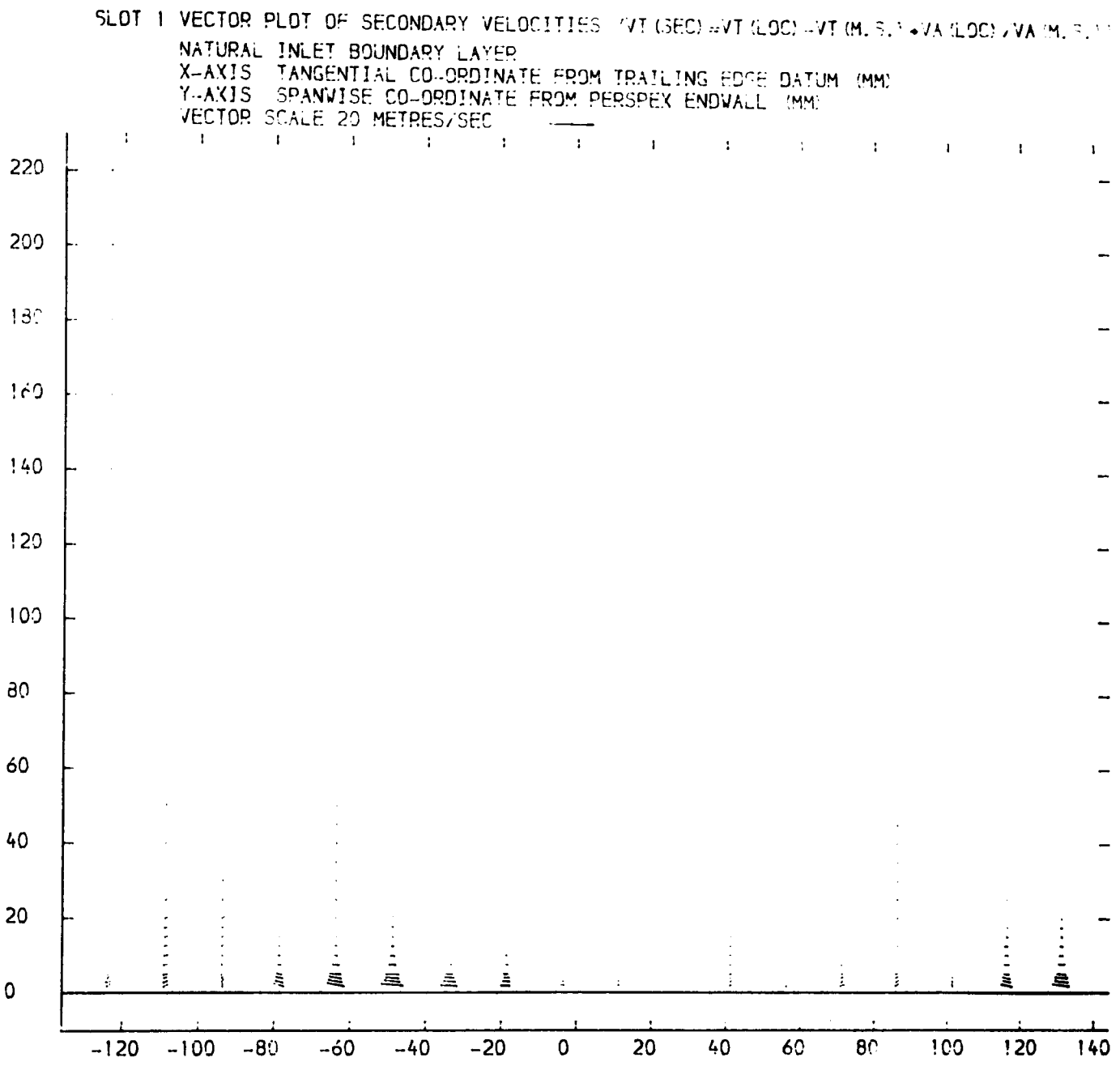

SLOT 1 VECTOR PLOT OF SECONDARY VELOCITIES
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
VECTOR SCALE 20 METRES/SEC
220
200
180
160
140
120
100
80
60
40
20
0
-120
-100
-80
-60
-40
-20
0
20
40
60
80
100
120
140

FIGURE 4.5

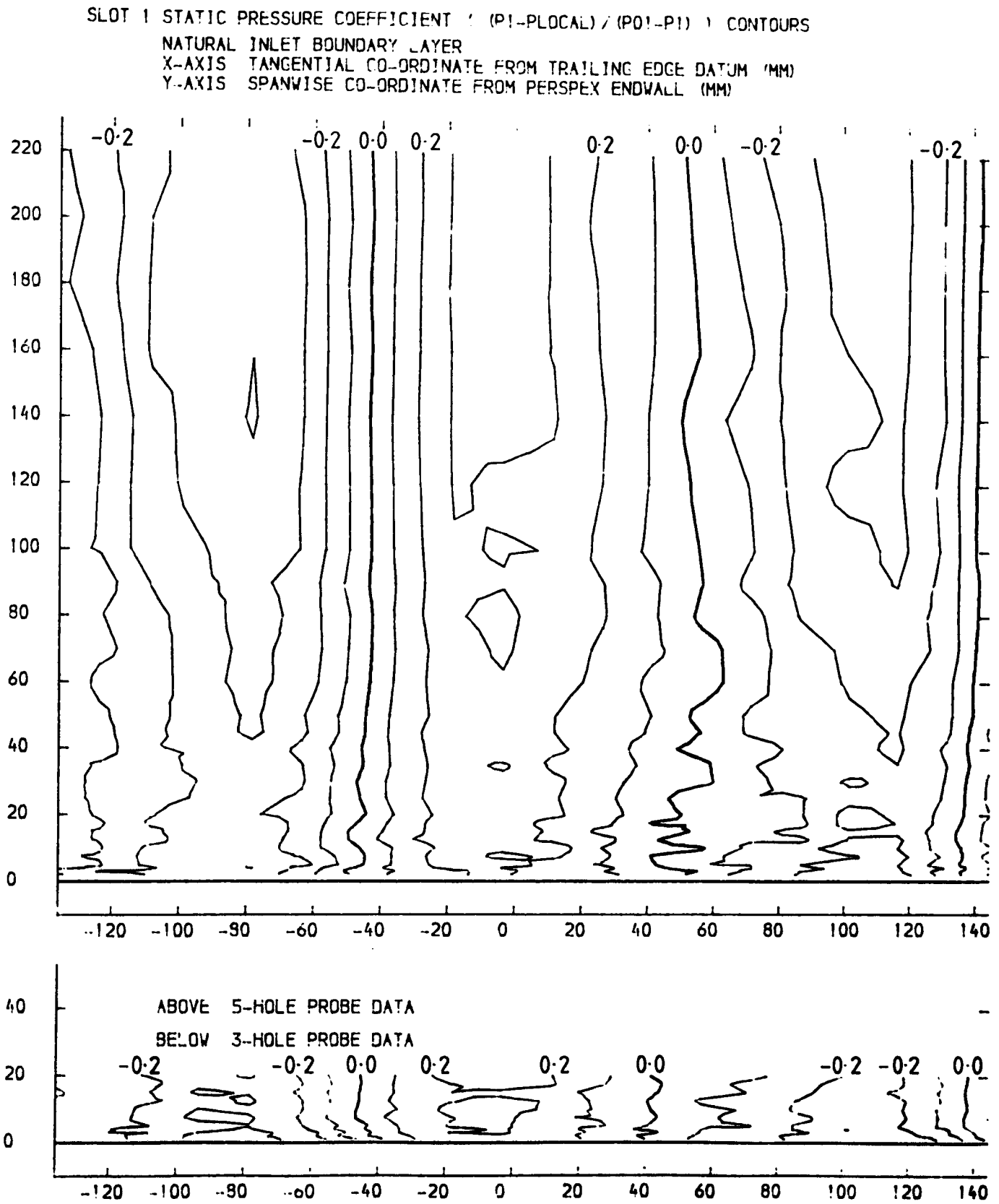

SLOT 1 STATIC PRESSURE COEFFICIENT ((P1-PLOCAL) / (PO1-P1)) CONTOURS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
-0·2
-0·2
0·0
0·2
0·2
0·0
-0·2
-0·2
220
200
180
160
140
120
100
80
60
40
20
0
-120
-100
-80
-60
-40
-20
0
20
40
60
80
100
120
140
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
-0·2
-0·2
0·0
0·2
0·2
0·0
-0·2
-0·2
0·0
40
20
0
-120
-100
-80
-60
-40
-20
0
20
40
60
80
100
120
140

FIGURE 4.6

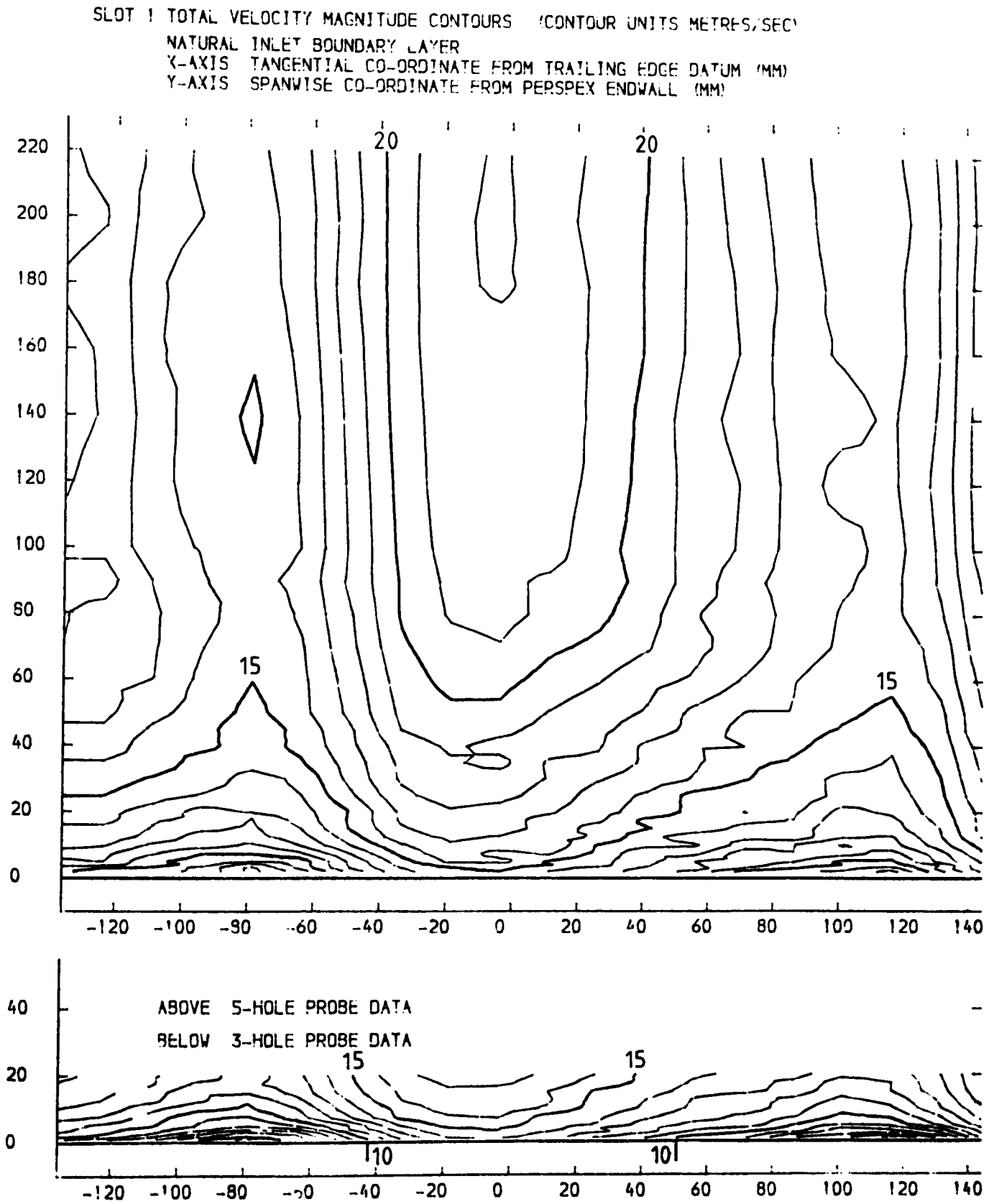
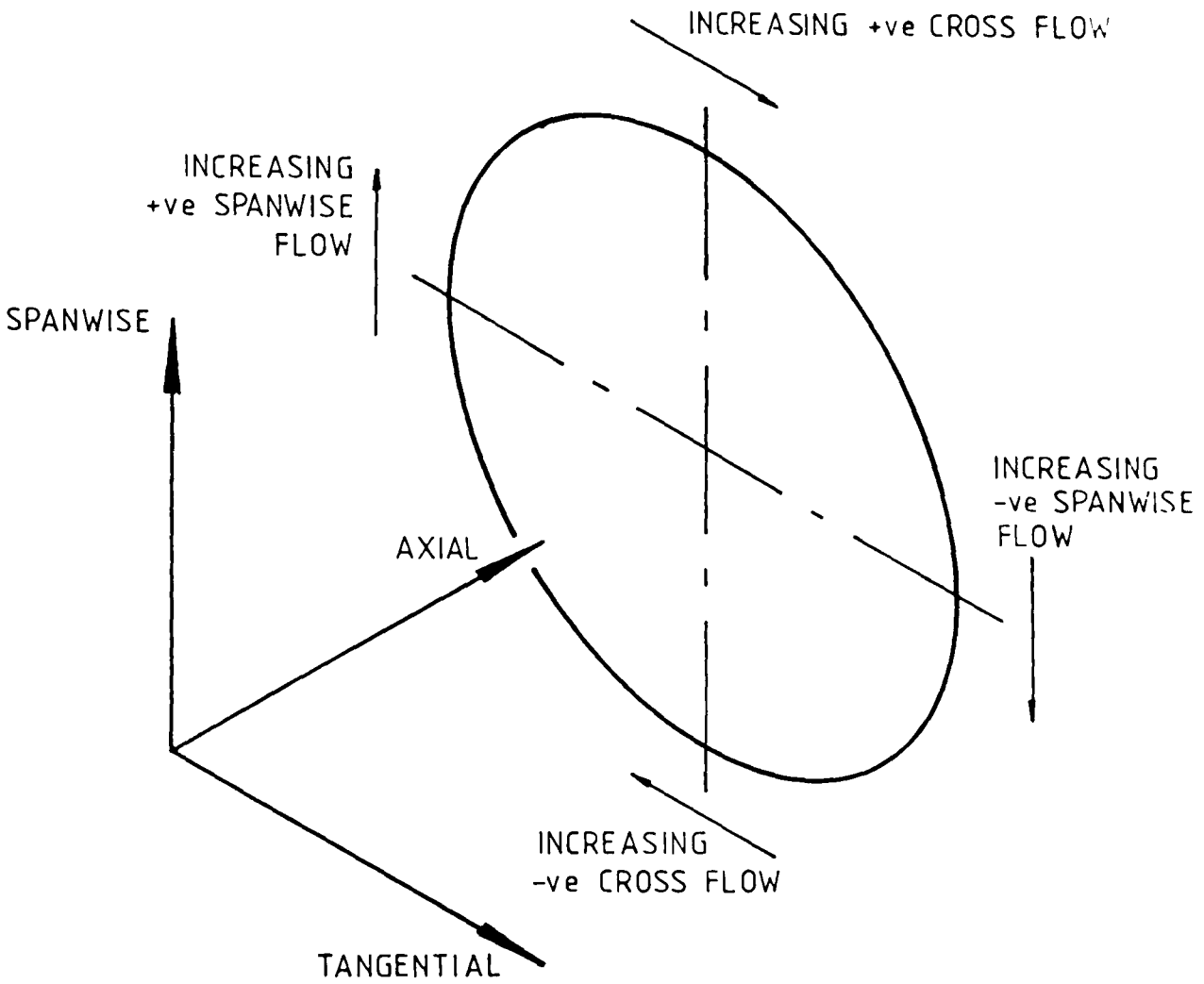

SLOT 1 TOTAL VELOCITY MAGNITUDE CONTOURS (CONTOUR UNITS METRES/SEC)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
20
20
15
15
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
15
15
10
10

FIGURE 4.7

SECTION THROUGH AN IDEALIZED PASSAGE VORTEX



CROSS FLOW ANGLE = ϵ(LOCAL) - ϵ(MIDSPAN)
= -ve OVERTURNING ANGLE

FIGURE 4.8

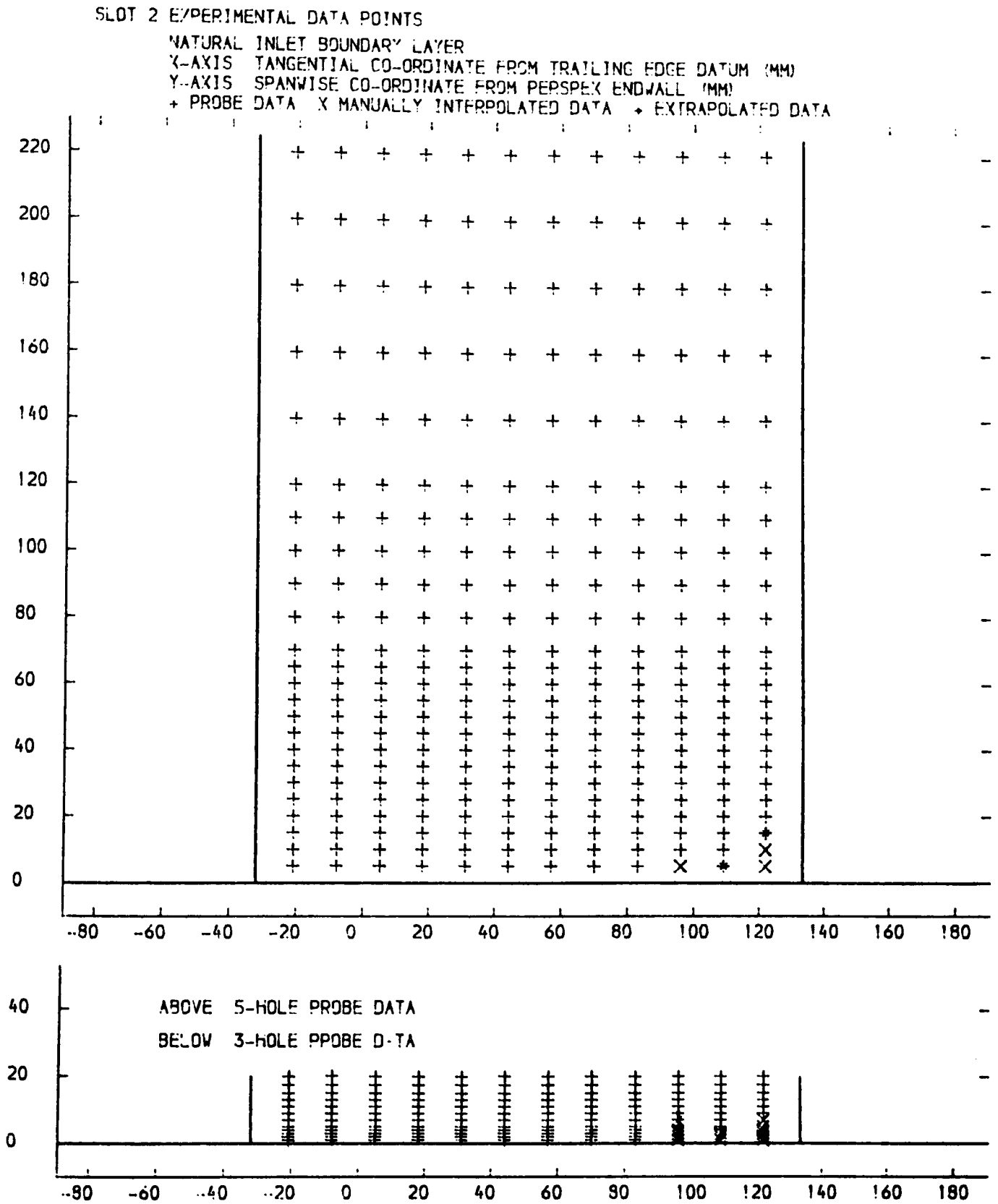

SLOT 2 EXPERIMENTAL DATA POINTS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
+ PROBE DATA X MANUALLY INTERPOLATED DATA + EXTRAPOLATED DATA
220
200
180
160
140
120
100
80
60
40
20
0
-80 -60 -40 -20 0 20 40 60 80 100 120 140 160 180
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
40
20
0
-80 -60 -40 -20 0 20 40 60 80 100 120 140 160 180

FIGURE 4.9

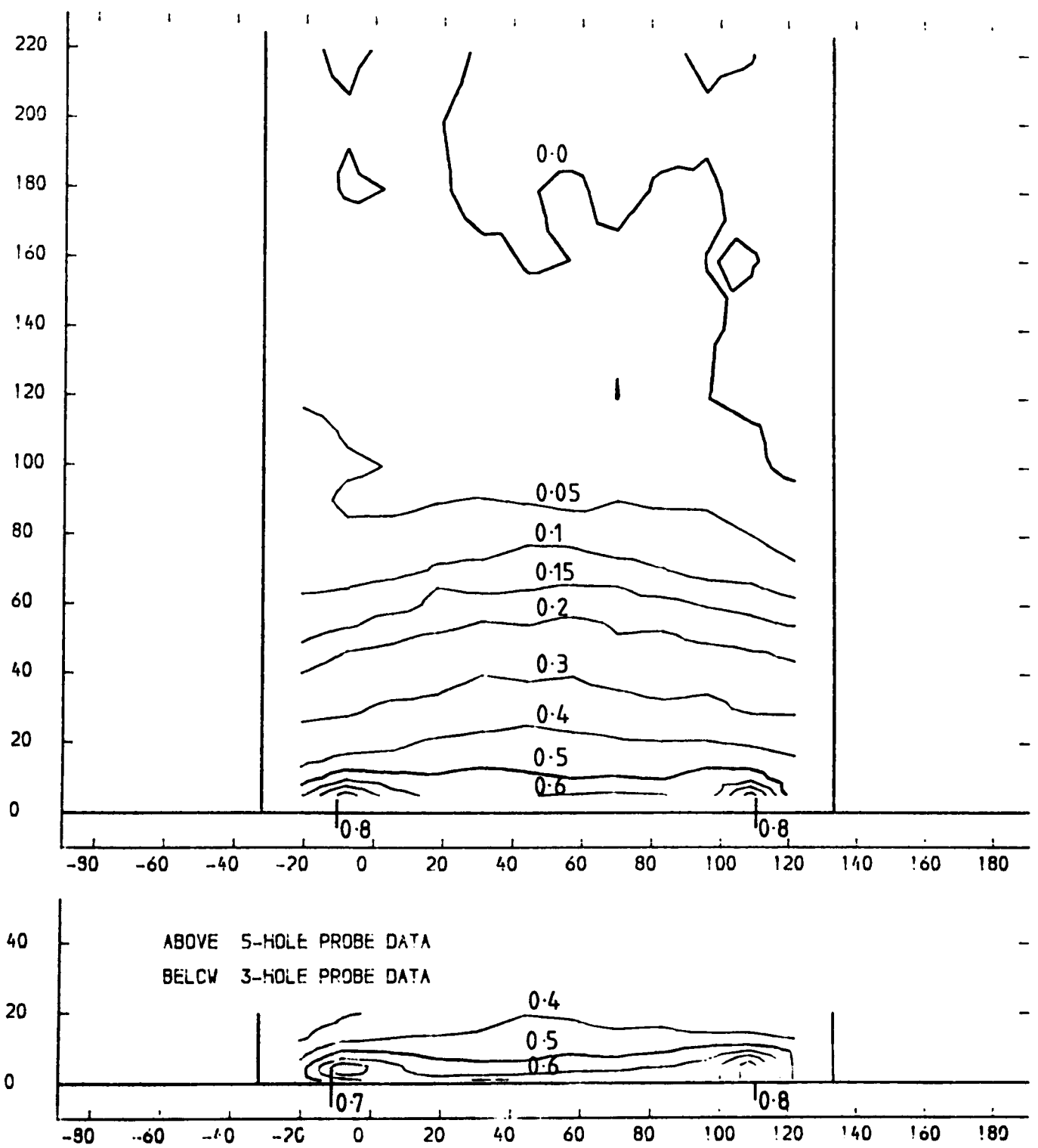

SLOT 2 TOTAL PRESSURE LOSS COEFFICIENT ((P01-P0LOCAL)/(P01-P1)) CONTOURS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
0·0
0·05
0·1
0·15
0·2
0·3
0·4
0·5
0·6
0·8
0·8
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
0·4
0·5
0·6
0·7
0·8

FIGURE 4.10

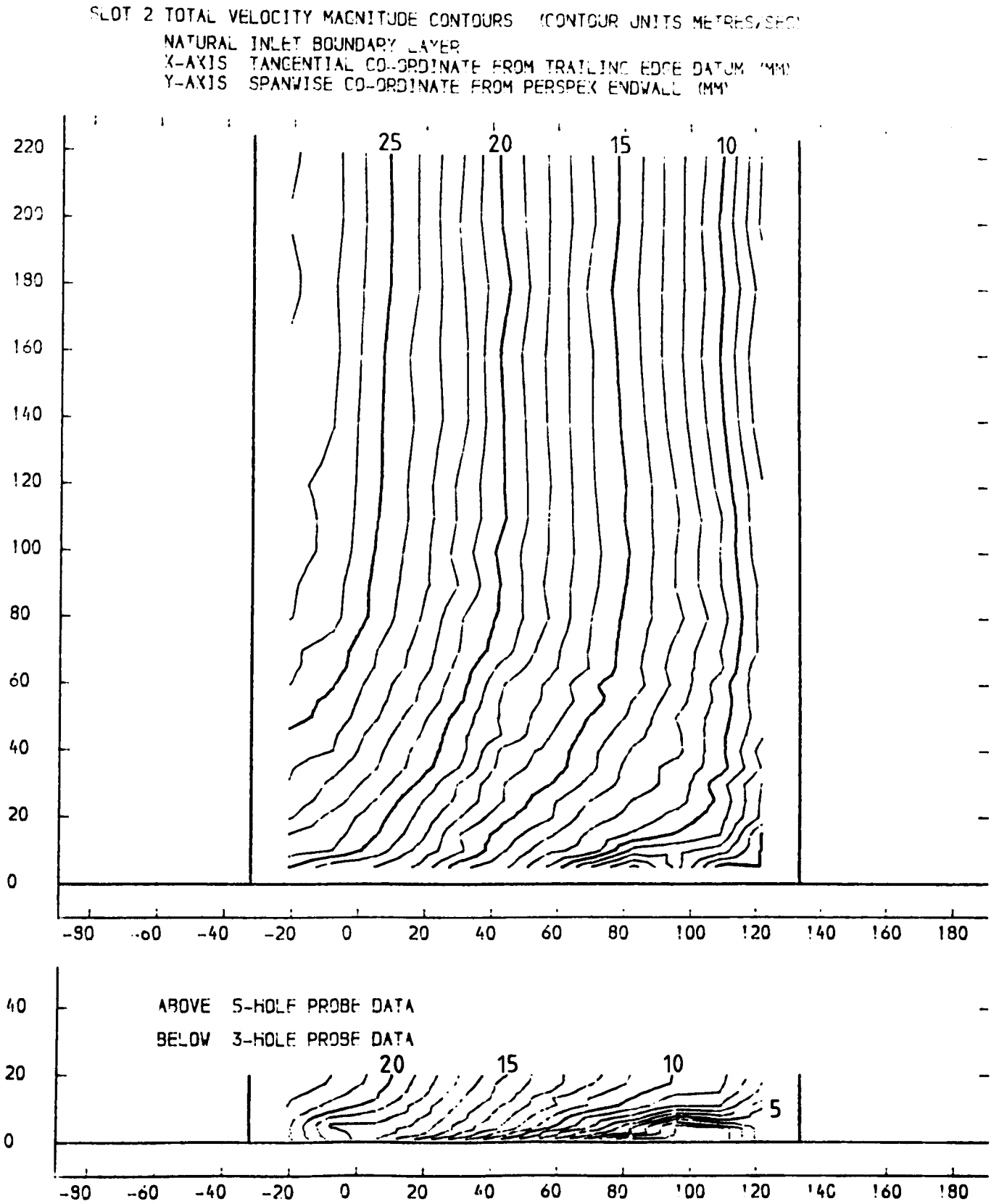

SLOT 2 TOTAL VELOCITY MAGNITUDE CONTOURS (CONTOUR UNITS METRES/SEC)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
25
20
15
10
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
20
15
10
5

FIGURE 4.11

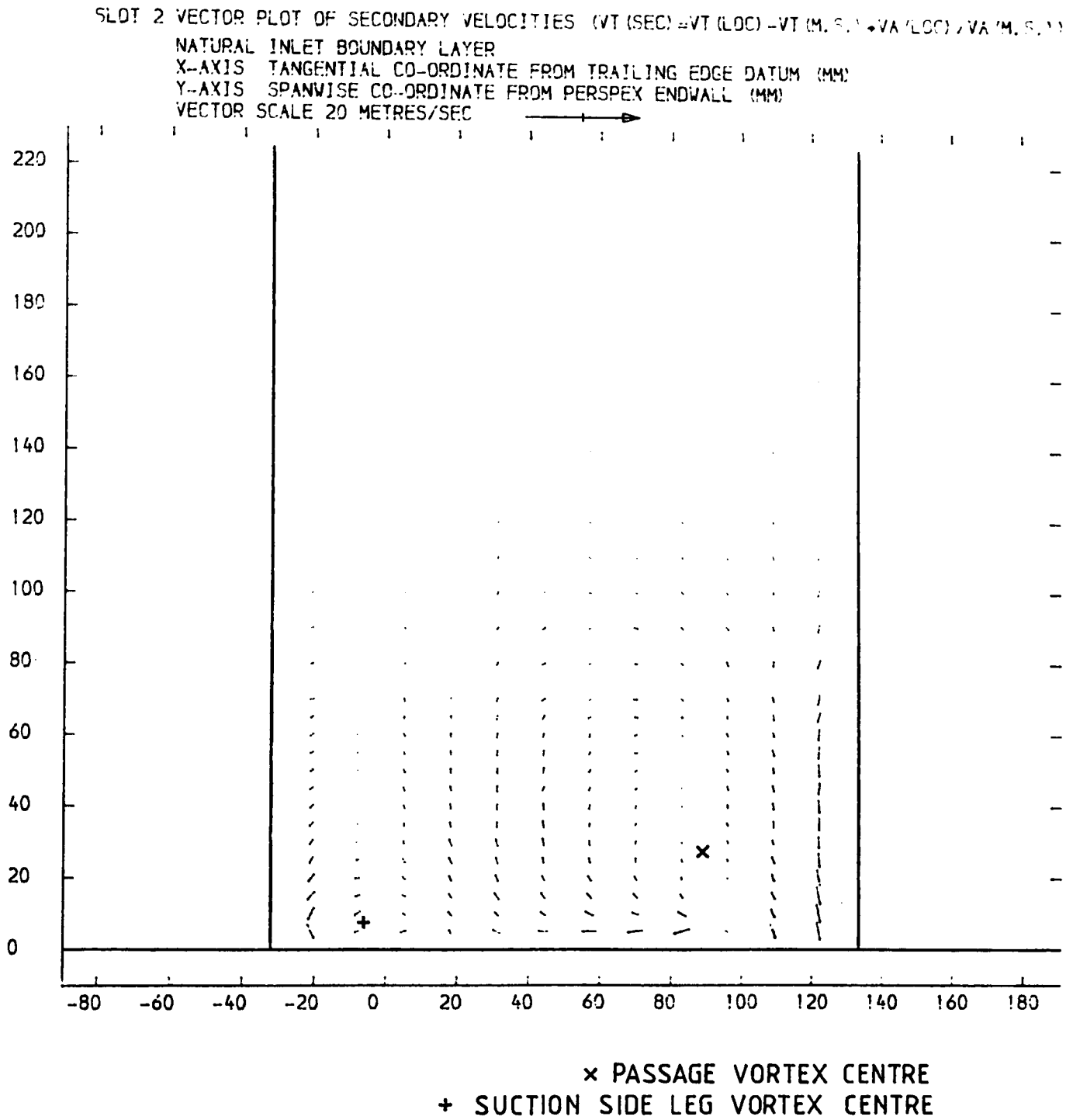

SLOT 2 VECTOR PLOT OF SECONDARY VELOCITIES (VT(SEC)=VT(LOC)-VT(M.S.)+VA(LOC)/VA(M.S.))
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
VECTOR SCALE 20 METRES/SEC
220
200
180
160
140
120
100
80
60
40
20
0
-80
-60
-40
-20
0
20
40
60
80
100
120
140
160
180
× PASSAGE VORTEX CENTRE
+ SUCTION SIDE LEG VORTEX CENTRE

FIGURE 4.12

SLOT 2 SPANWISE ANGLE (PITCH ANGLE) CONTOURS (CONTOUR UNITS DEGREES)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

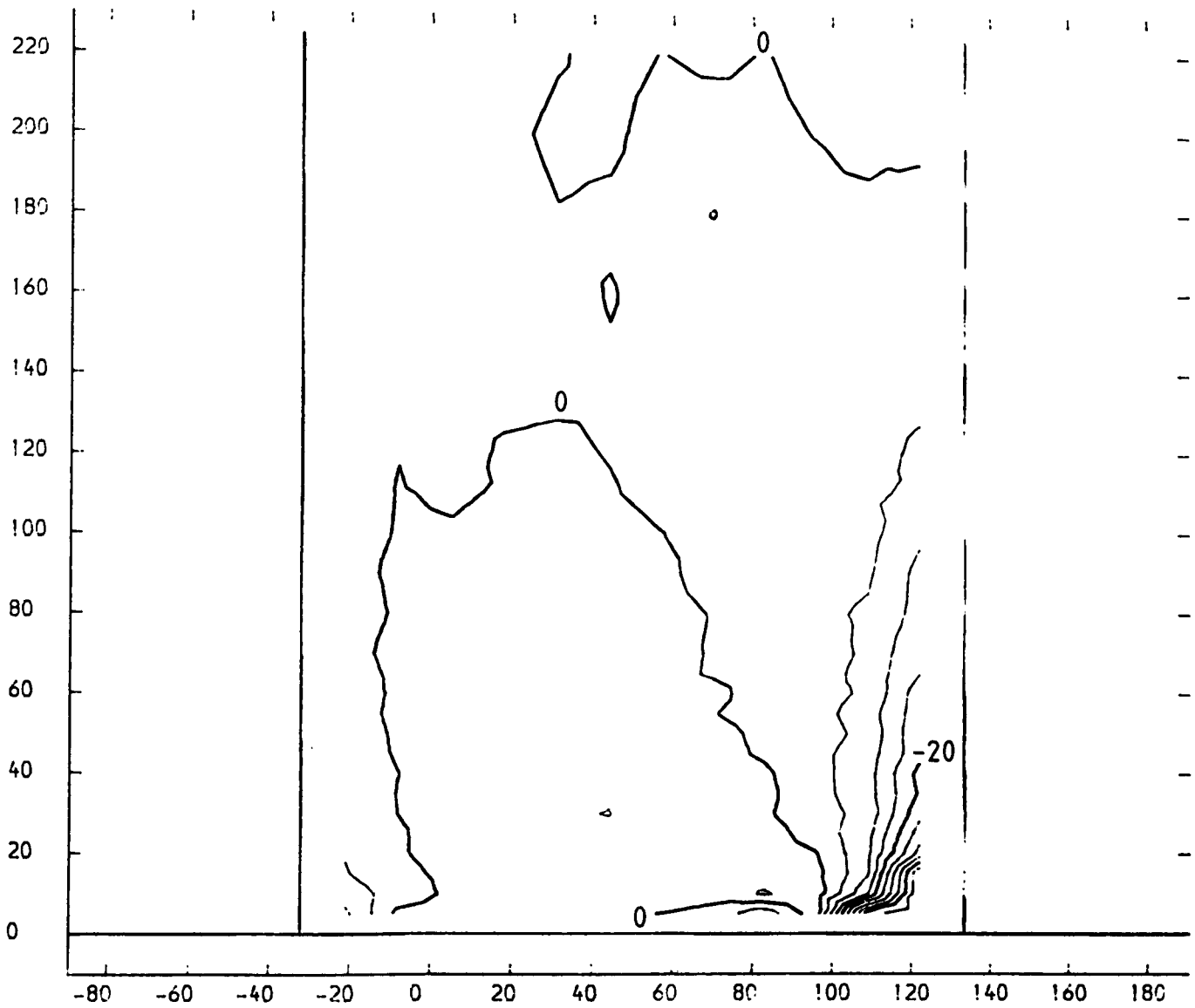


FIGURE 4.13

SLOT 2 YAW ANGLE CONTOURS (CONTOUR UNITS DEGREES)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

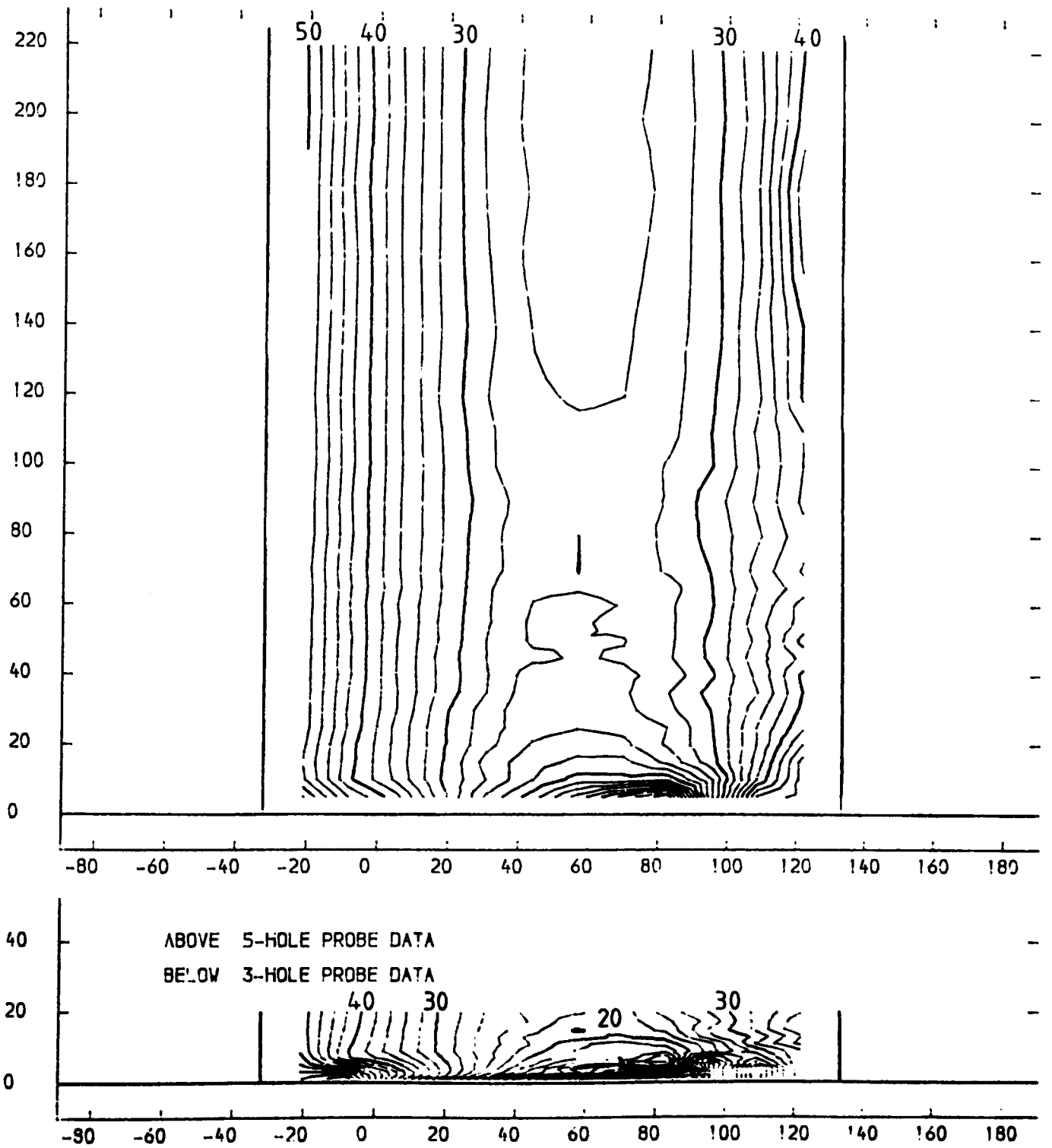


FIGURE 4.14

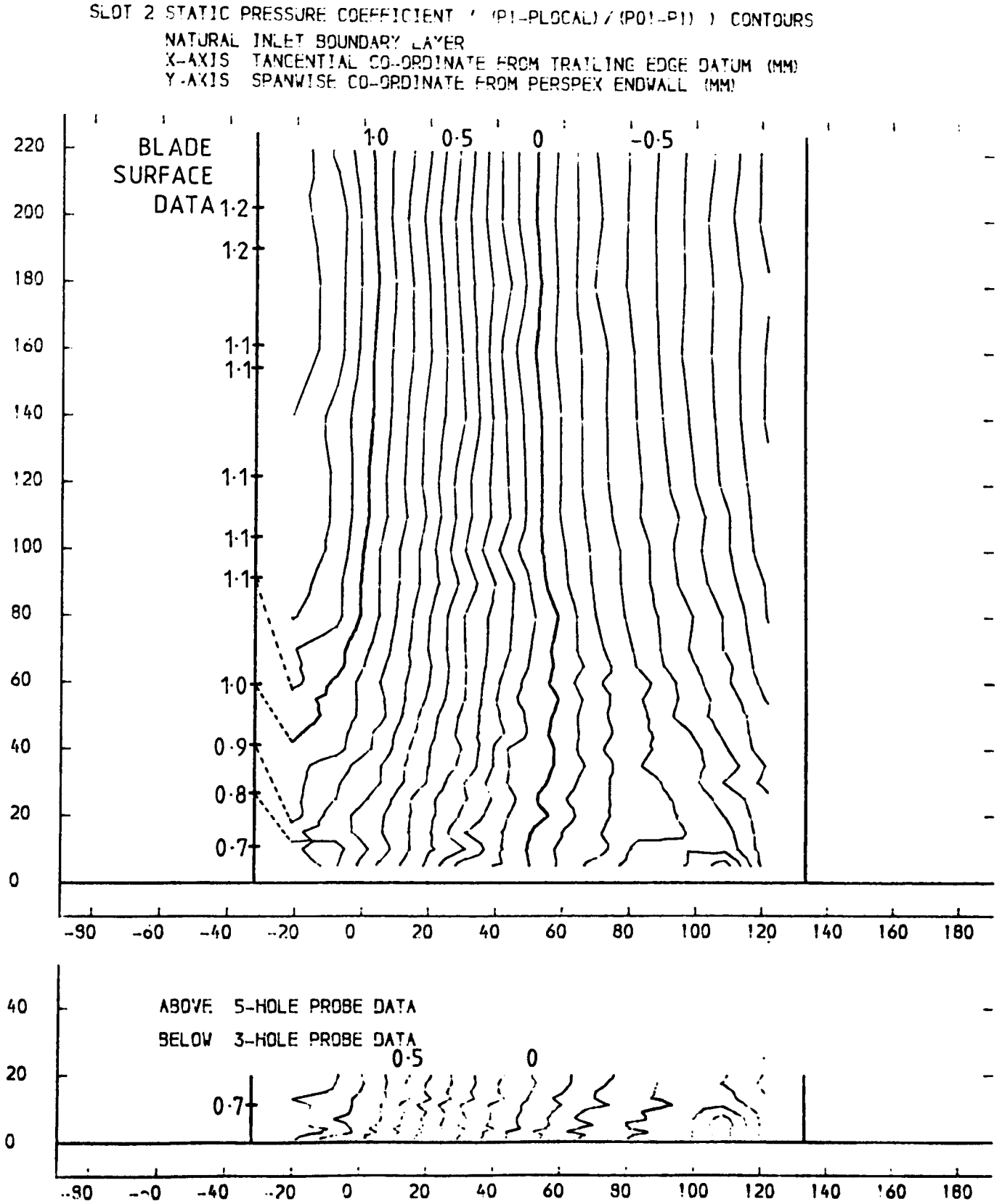

SLOT 2 STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(P01-P1)) CONTOURS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
BLADE SURFACE DATA
1·0
0·5
0
-0·5
1·2
1·1
0·9
0·8
0·7
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA

FIGURE 4.15

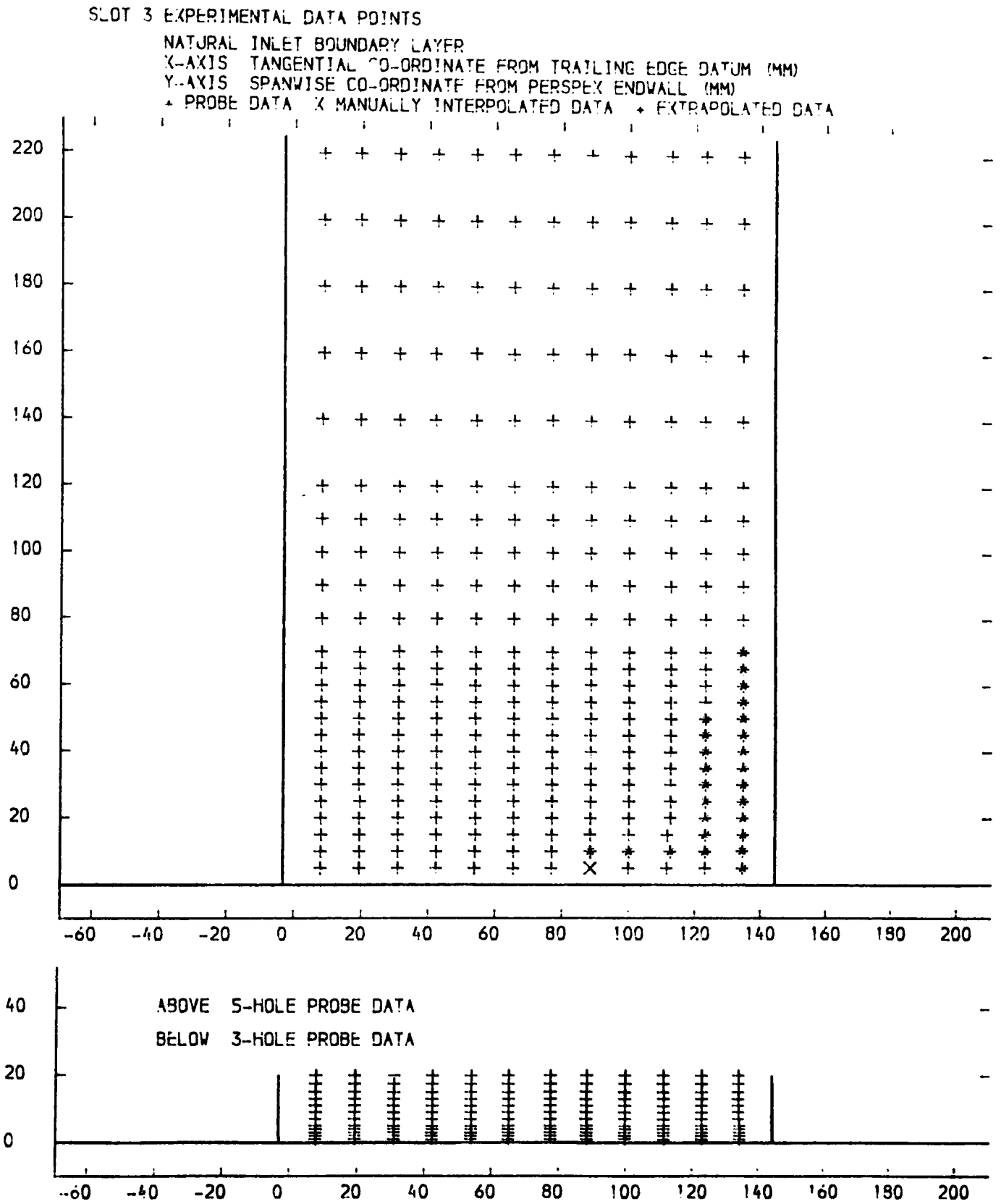

SLOT 3 EXPERIMENTAL DATA POINTS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
+ PROBE DATA X MANUALLY INTERPOLATED DATA * EXTRAPOLATED DATA
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA

FIGURE 4.16

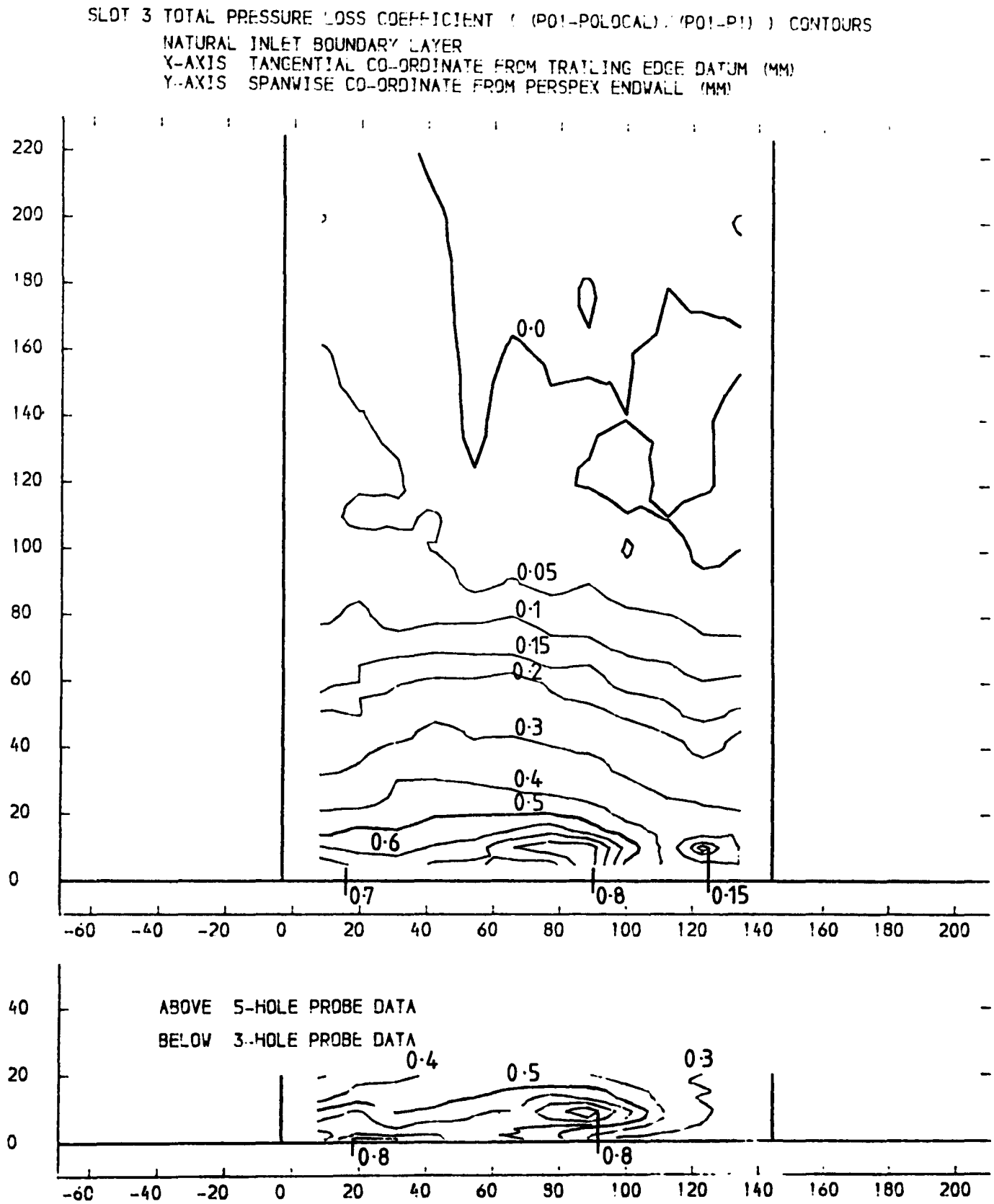

SLOT 3 TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL)/(PO1-P1)) CONTOURS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
0·0
0·05
0·1
0·15
0·2
0·3
0·4
0·5
0·6
0·7
0·8
0·15
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
0·4
0·5
0·3
0·8
0·8

FIGURE 4.17

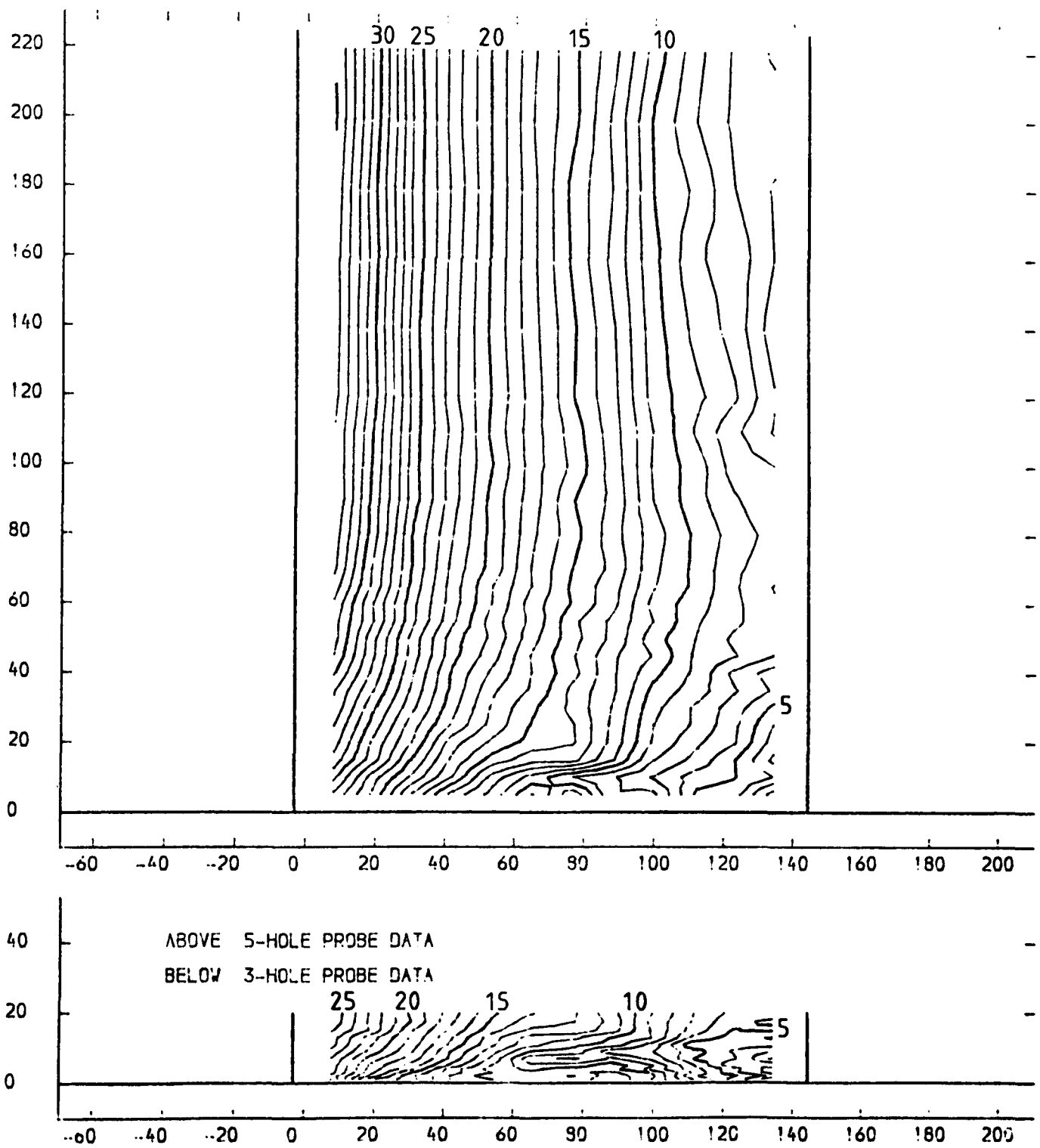

SLOT 3 TOTAL VELOCITY MAGNITUDE CONTOURS (CONTOUR UNITS METRES/SEC)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
30 25 20 15 10
5
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
25 20 15 10
5

FIGURE 4.18

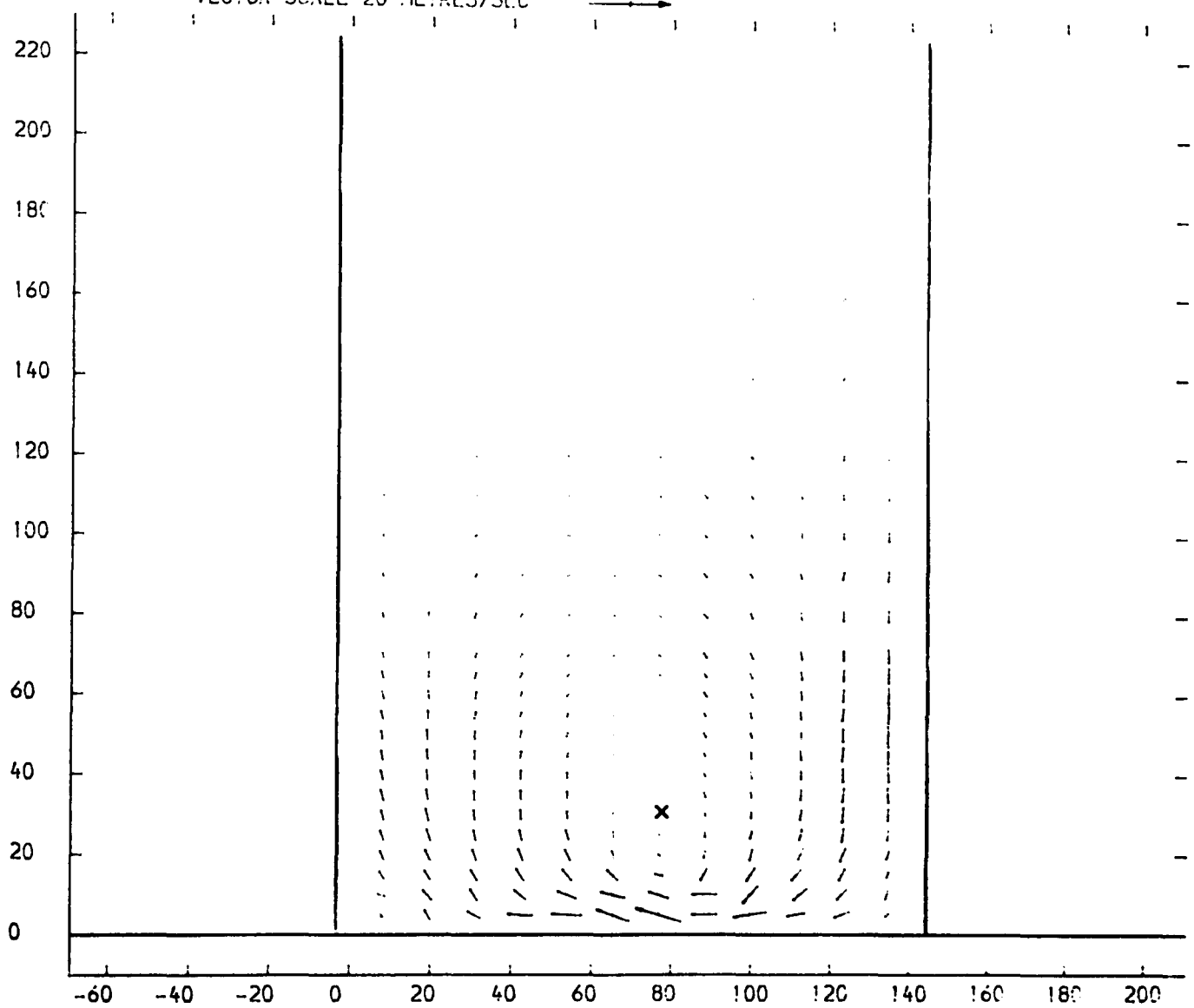
SLOT 3 VECTOR PLOT OF SECONDARY VELOCITIES (VT(SEC)=VT(LOC)-VT(M.S.)+VA(LOC)/VA(M.S.))

NATURAL INLET BOUNDARY LAYER

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

VECTOR SCALE 20 METRES/SEC



× PASSAGE VORTEX CENTRE

FIGURE 4.19

SLOT 3 SPANWISE ANGLE (PITCH ANGLE) CONTOURS (CONTOUR UNITS DEGREES)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

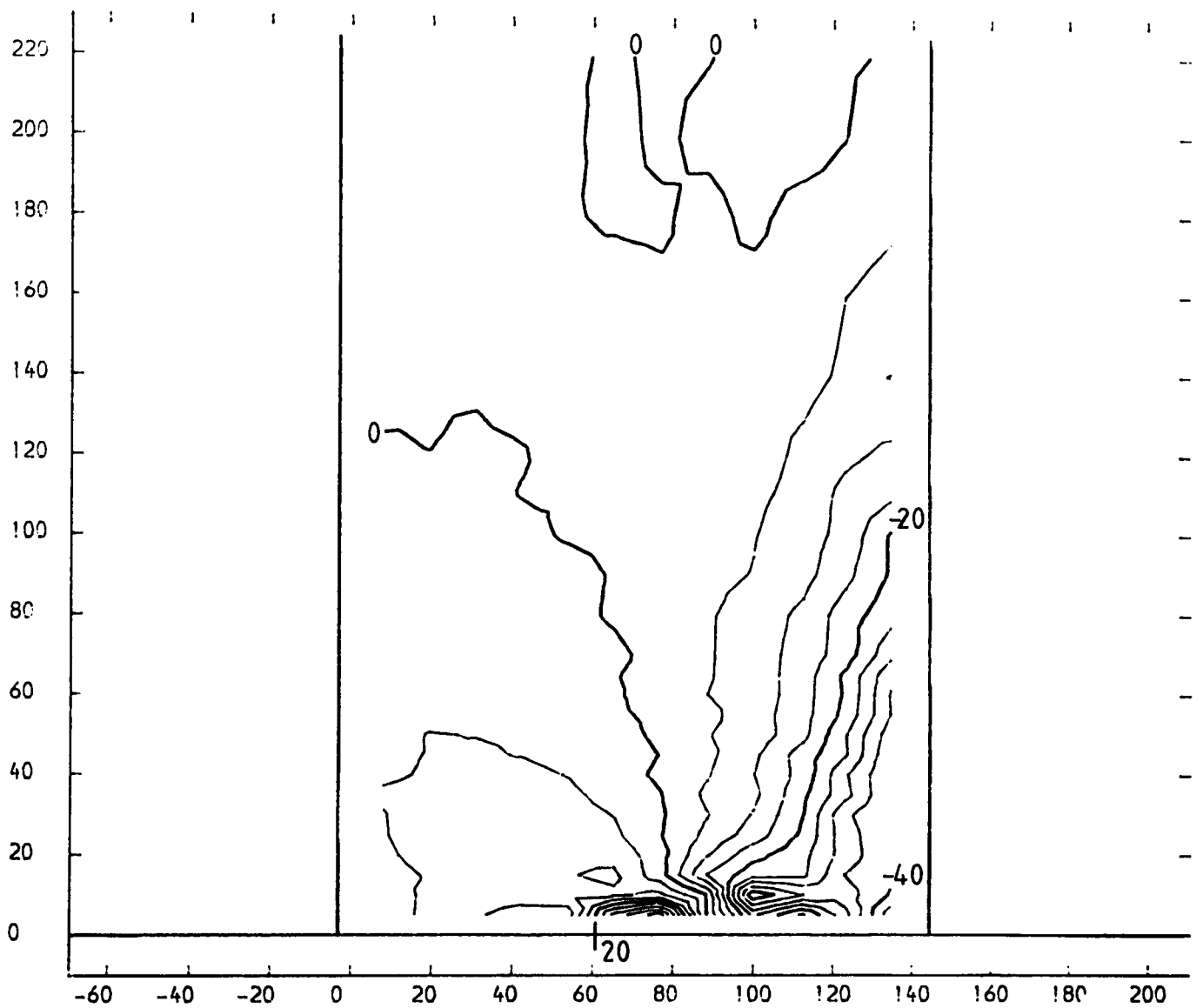


FIGURE 4.20

SLOT 3 YAW ANGLE CONTOURS (CONTOUR UNITS DEGREES)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

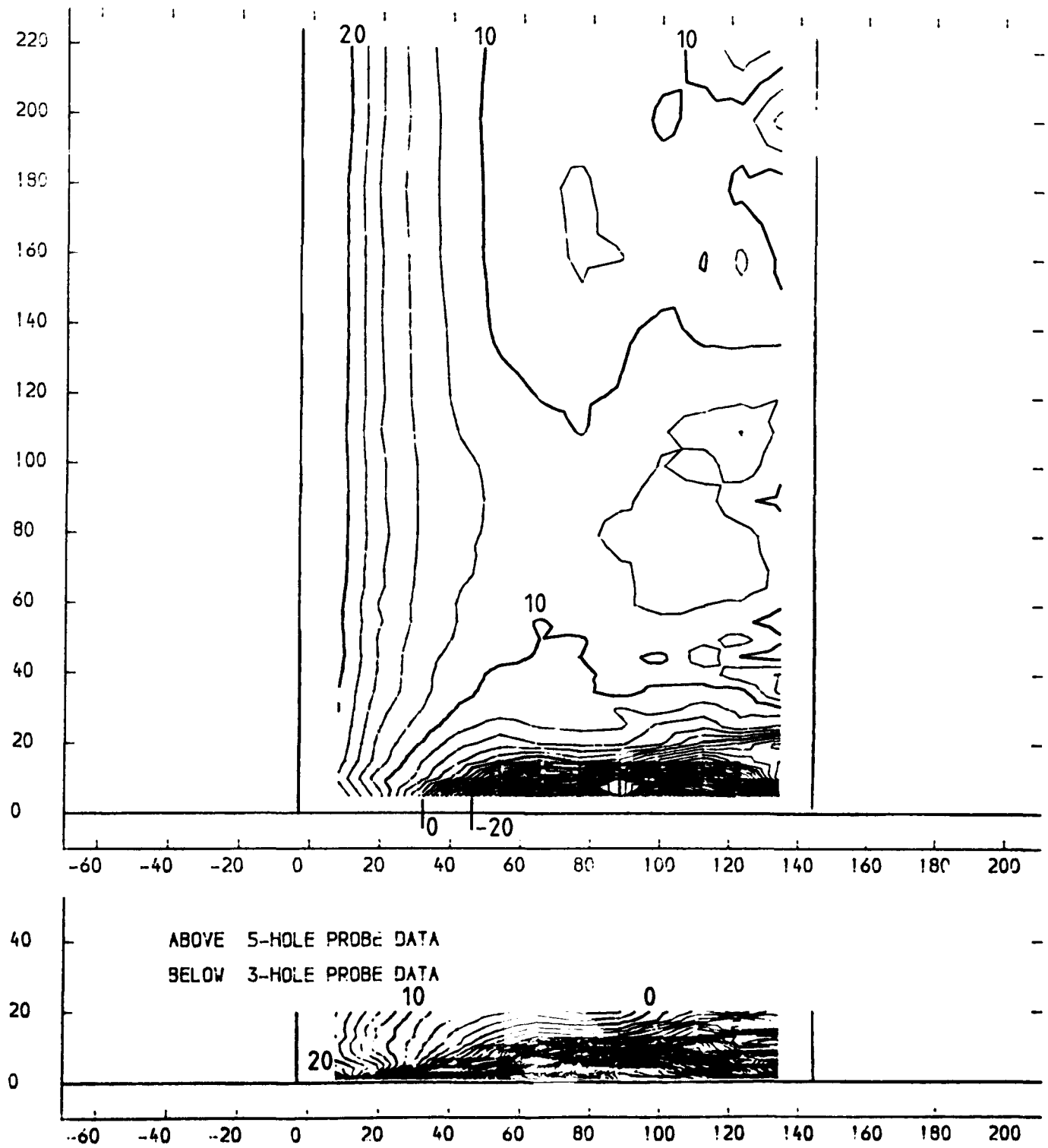


FIGURE 4.21

SLOT 3 STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(P01-P1)) CONTOURS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

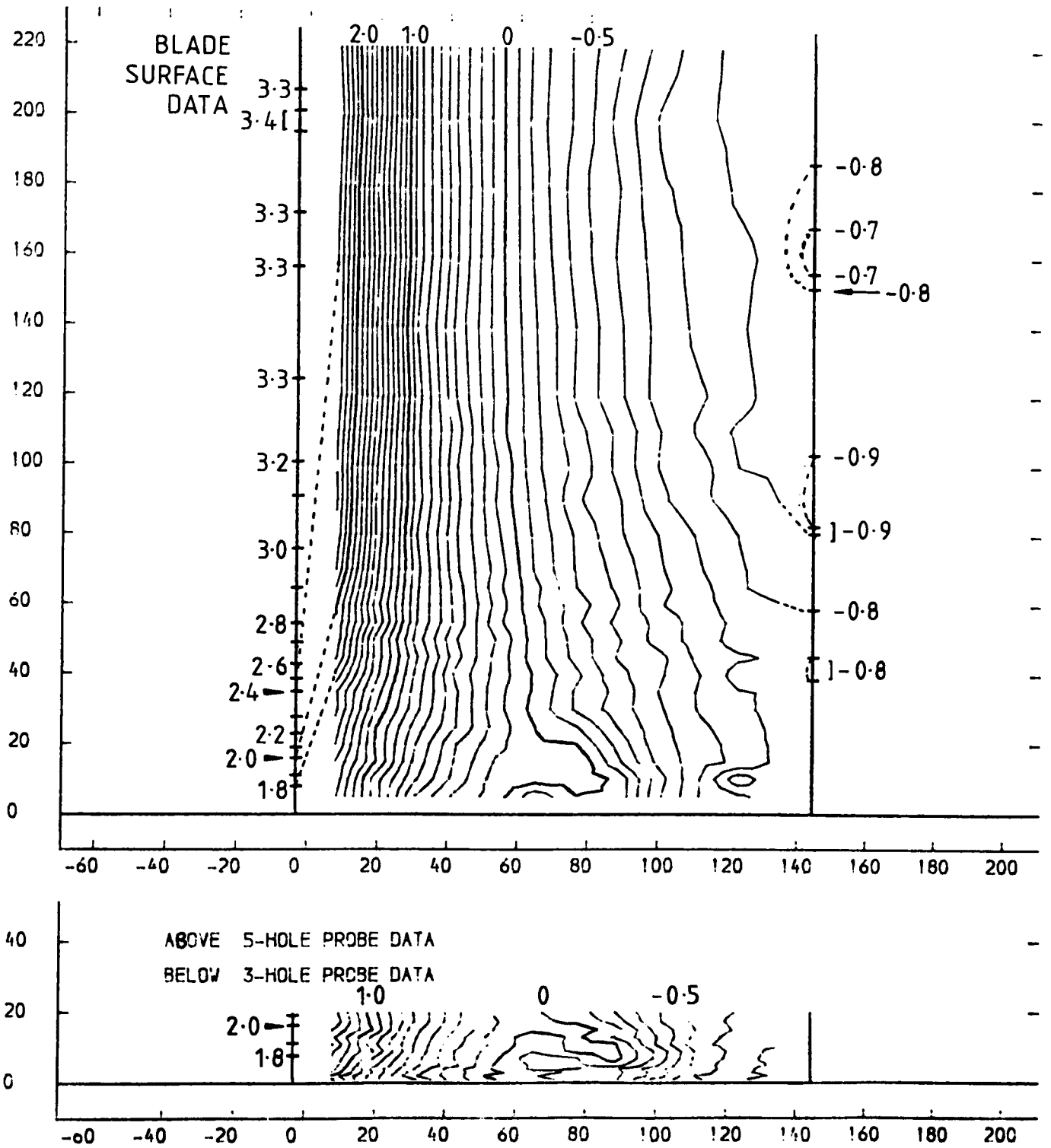


FIGURE 4.22

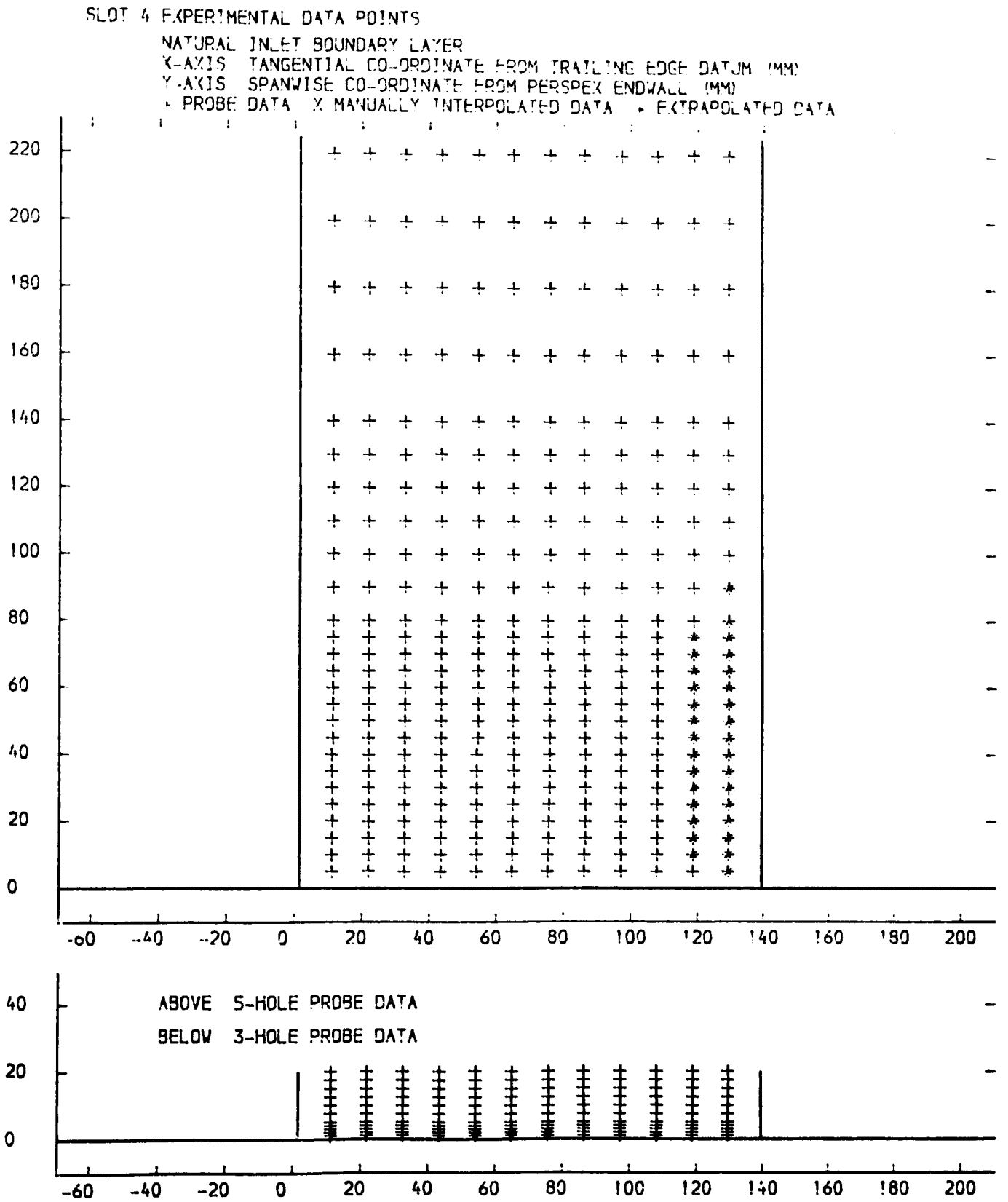

SLOT 4 EXPERIMENTAL DATA POINTS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
+ PROBE DATA X MANUALLY INTERPOLATED DATA * EXTRAPOLATED DATA
220
200
180
160
140
120
100
80
60
40
20
0
-60 -40 -20 0 20 40 60 80 100 120 140 160 180 200
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
40
20
0
-60 -40 -20 0 20 40 60 80 100 120 140 160 180 200

FIGURE 4.23

SLOT 4 TOTAL PRESSURE LOSS COEFFICIENT ((P01-P0LOCAL)/(P01-P1)) CONTOURS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

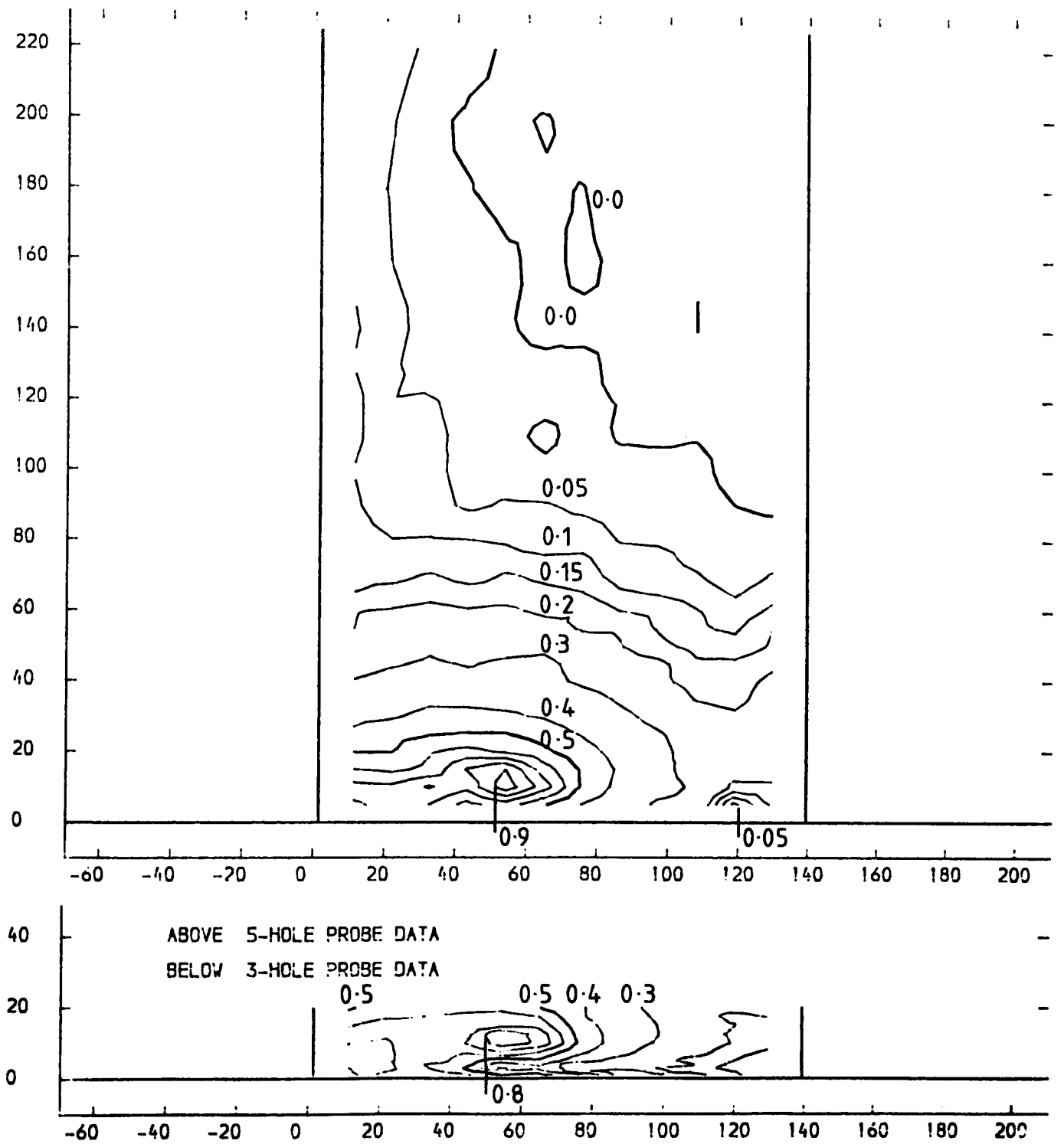


FIGURE 4.24

SLOT 4 TOTAL VELOCITY MAGNITUDE CONTOURS (CONTOUR UNITS METRES/SEC)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

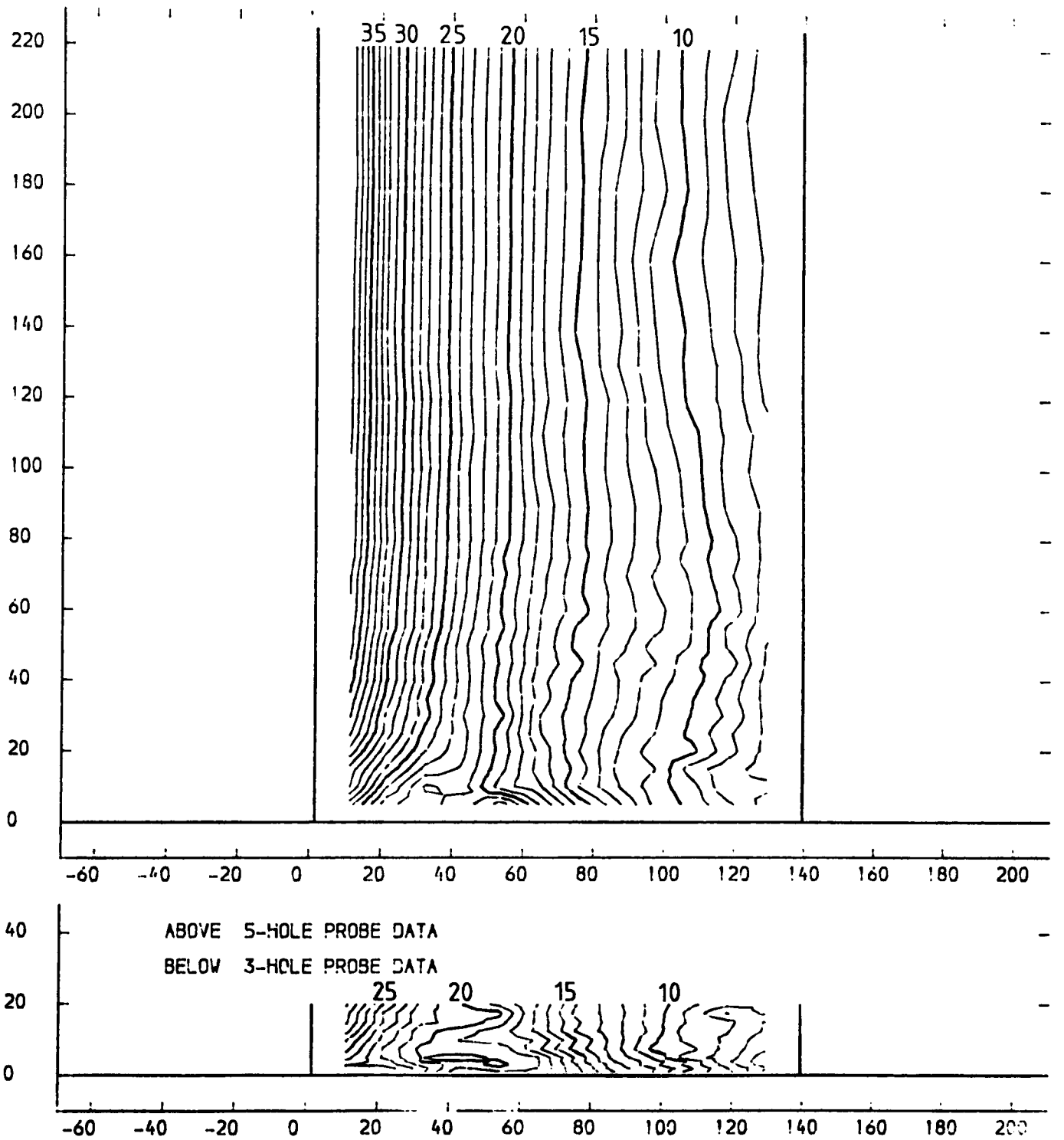


FIGURE 4.25

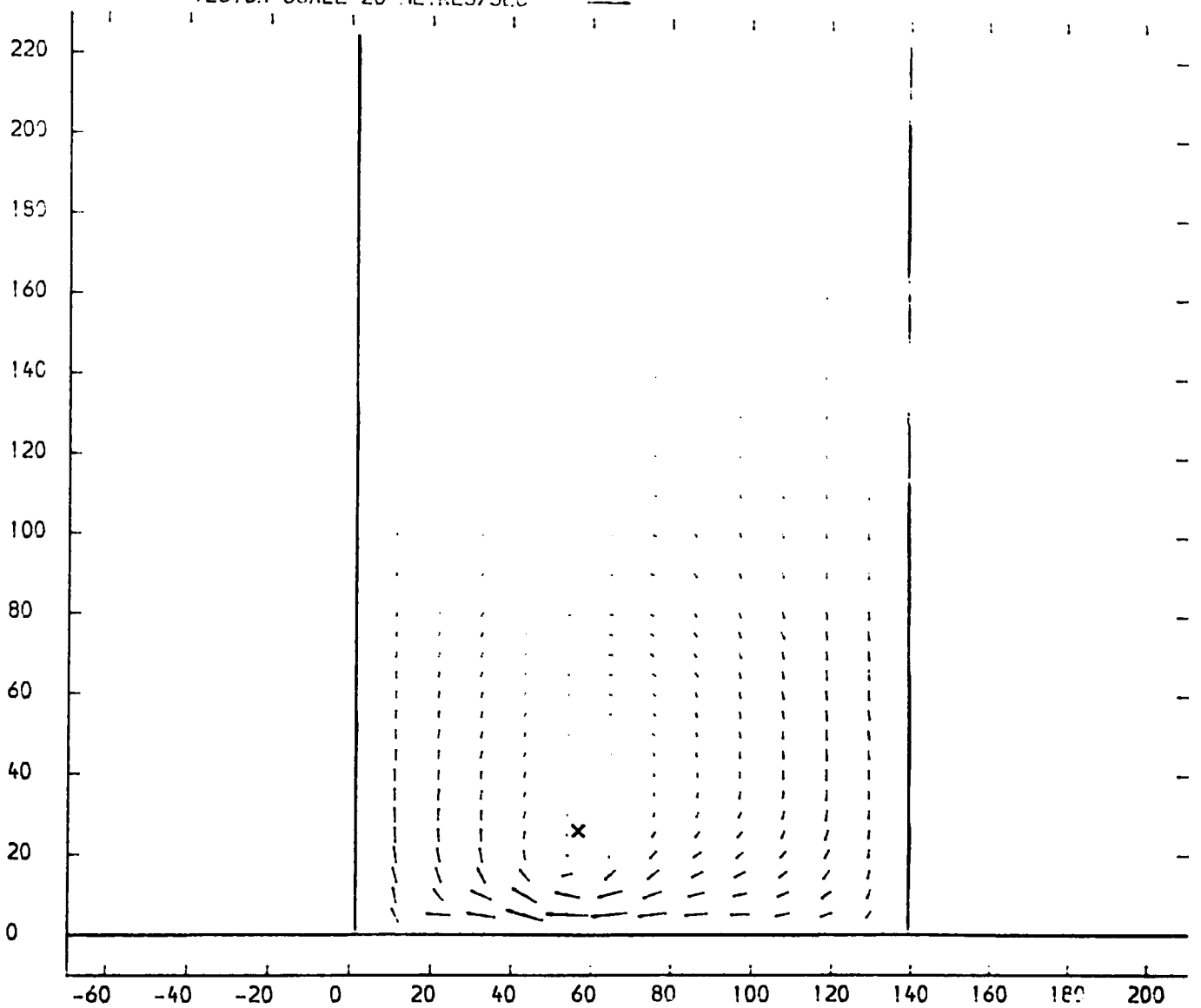
SLOT 4 VECTOR PLOT OF SECONDARY VELOCITIES (VT (SEC) =VT (LOC) -VT (M.S.) +VA (LOC) /VA (M.S.))

NATURAL INLET BOUNDARY LAYER

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

VECTOR SCALE 20 METRES/SEC



× PASSAGE VORTEX CENTRE

FIGURE 4.26

SLOT 4 SPANWISE ANGLE (PITCH ANGLE) CONTOURS (CONTOUR UNITS DEGREES)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

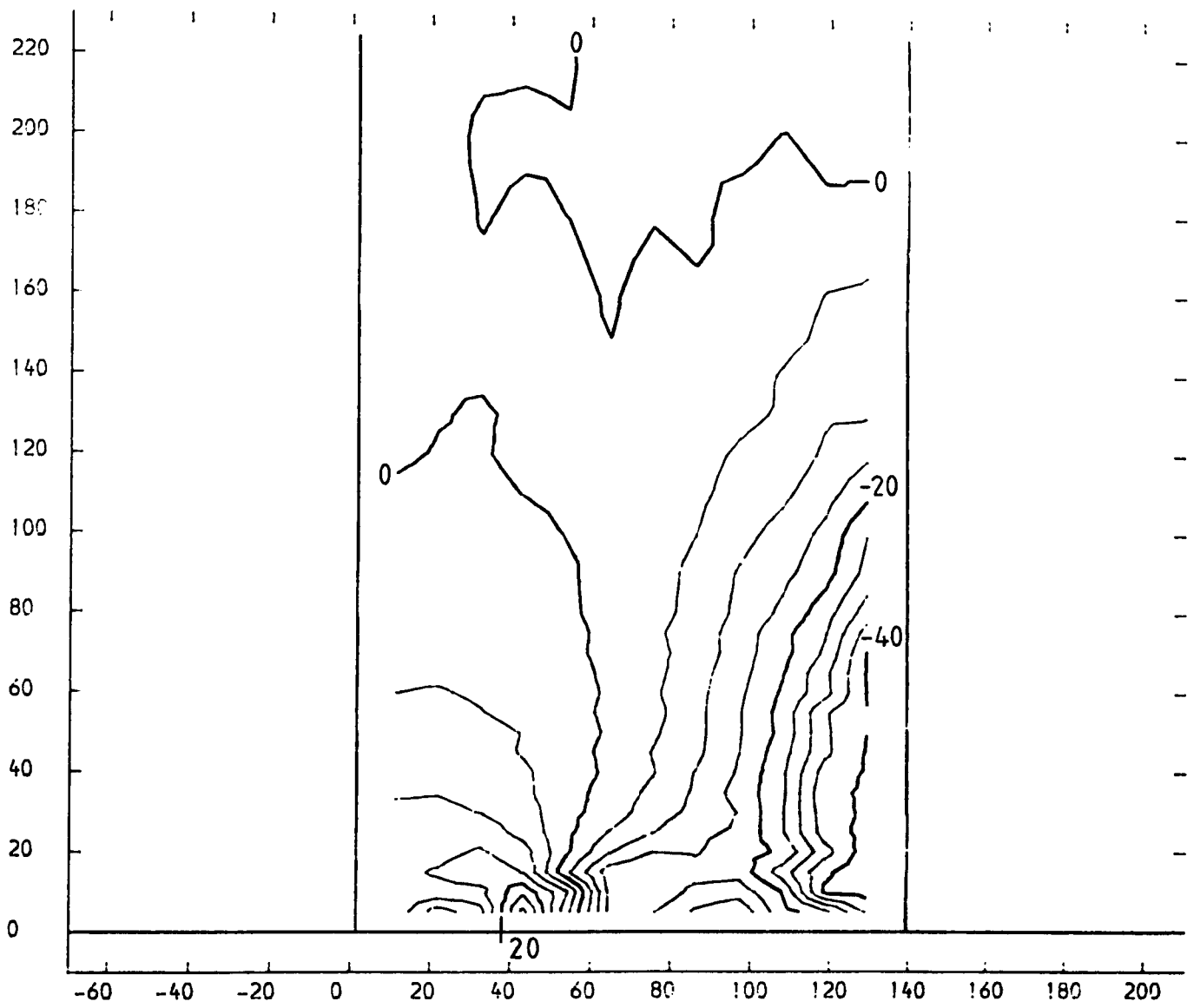


FIGURE 4.27

SLOT 4 YAW ANGLE CONTOURS (CONTOUR UNITS DEGREES)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

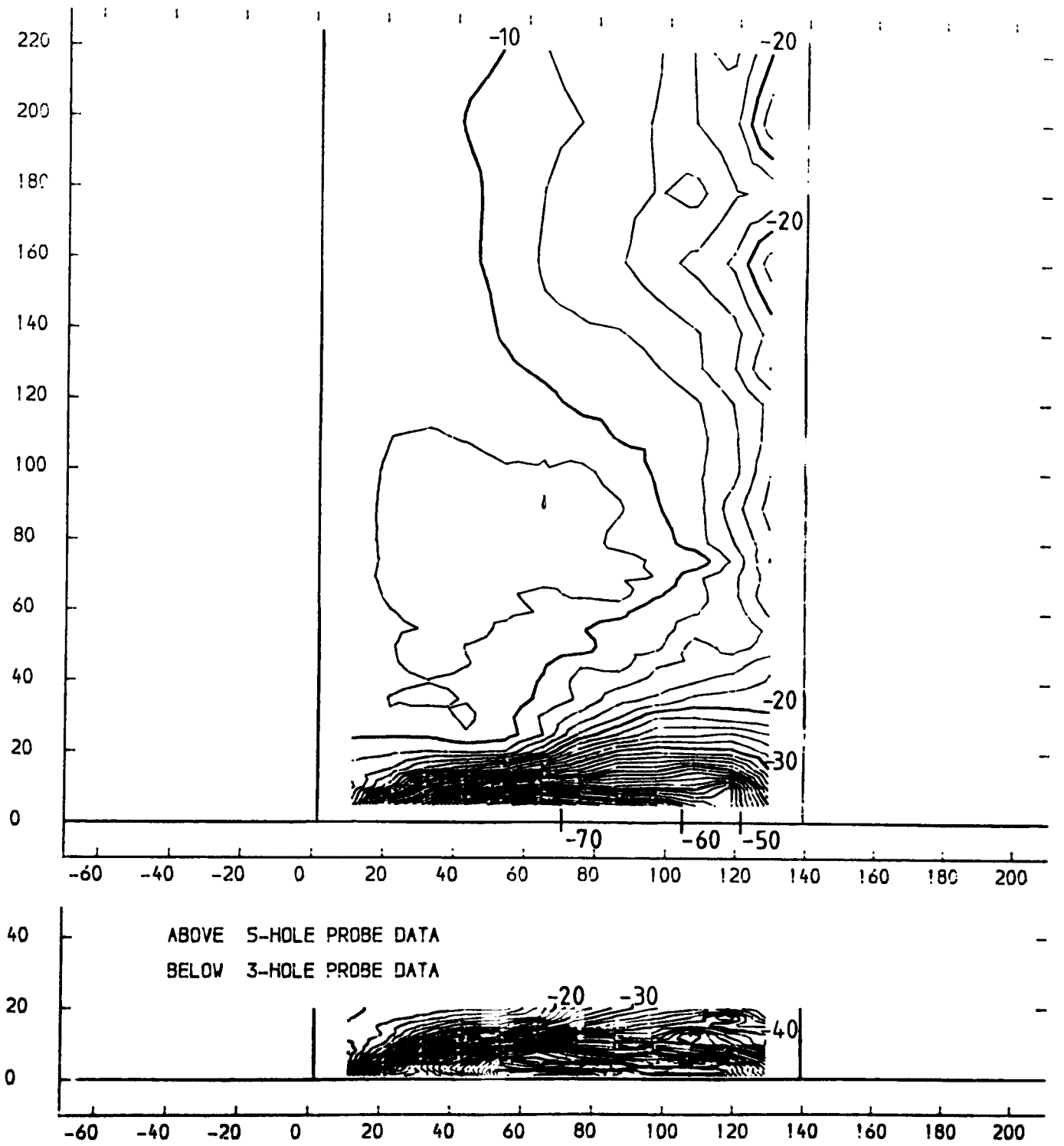


FIGURE 4.28

SLOT 4 STATIC PRESSURE COEFFICIENT ((P1-PLOCAL) / (P01-P1)) CONTOURS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

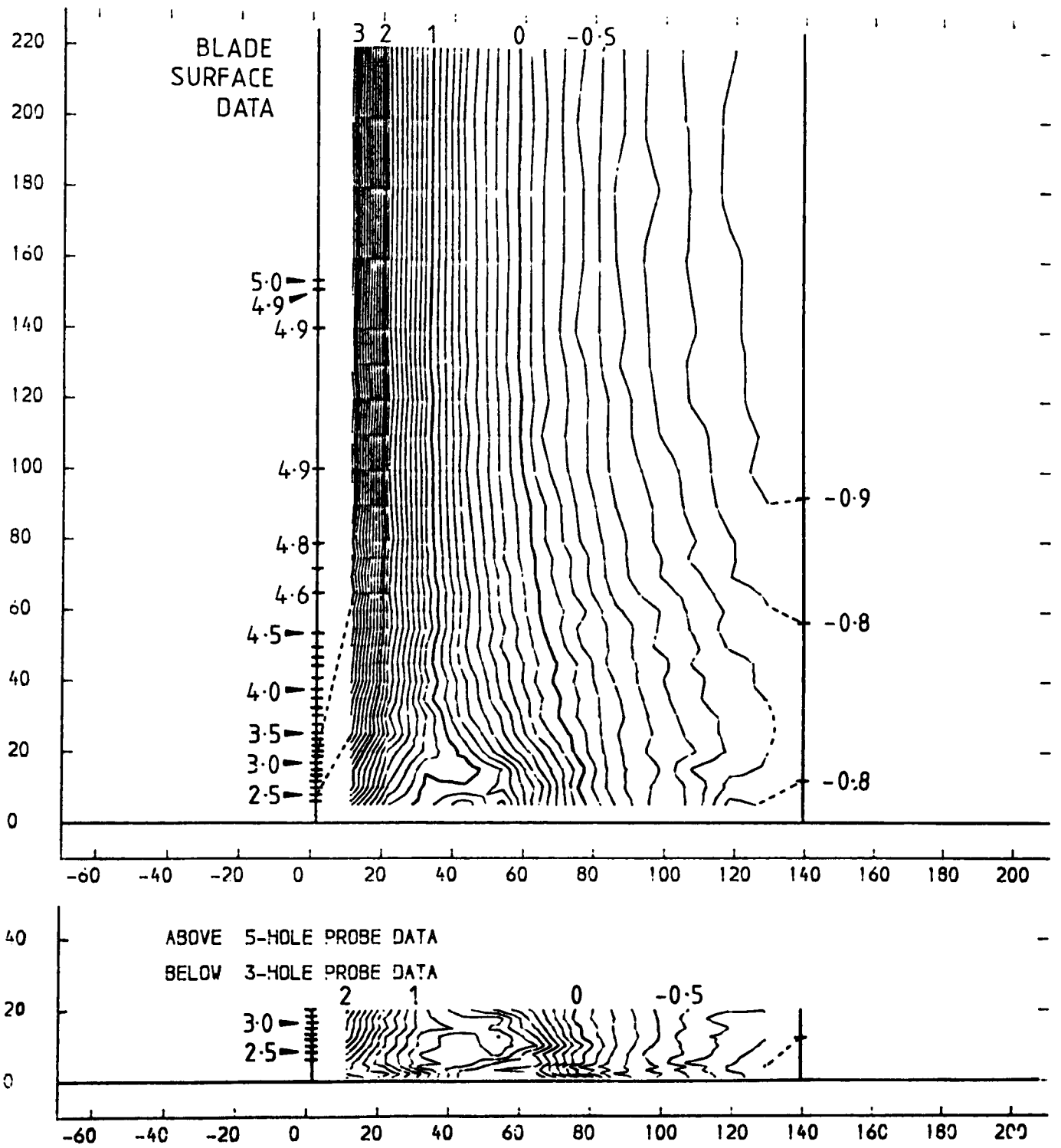


FIGURE 4.29

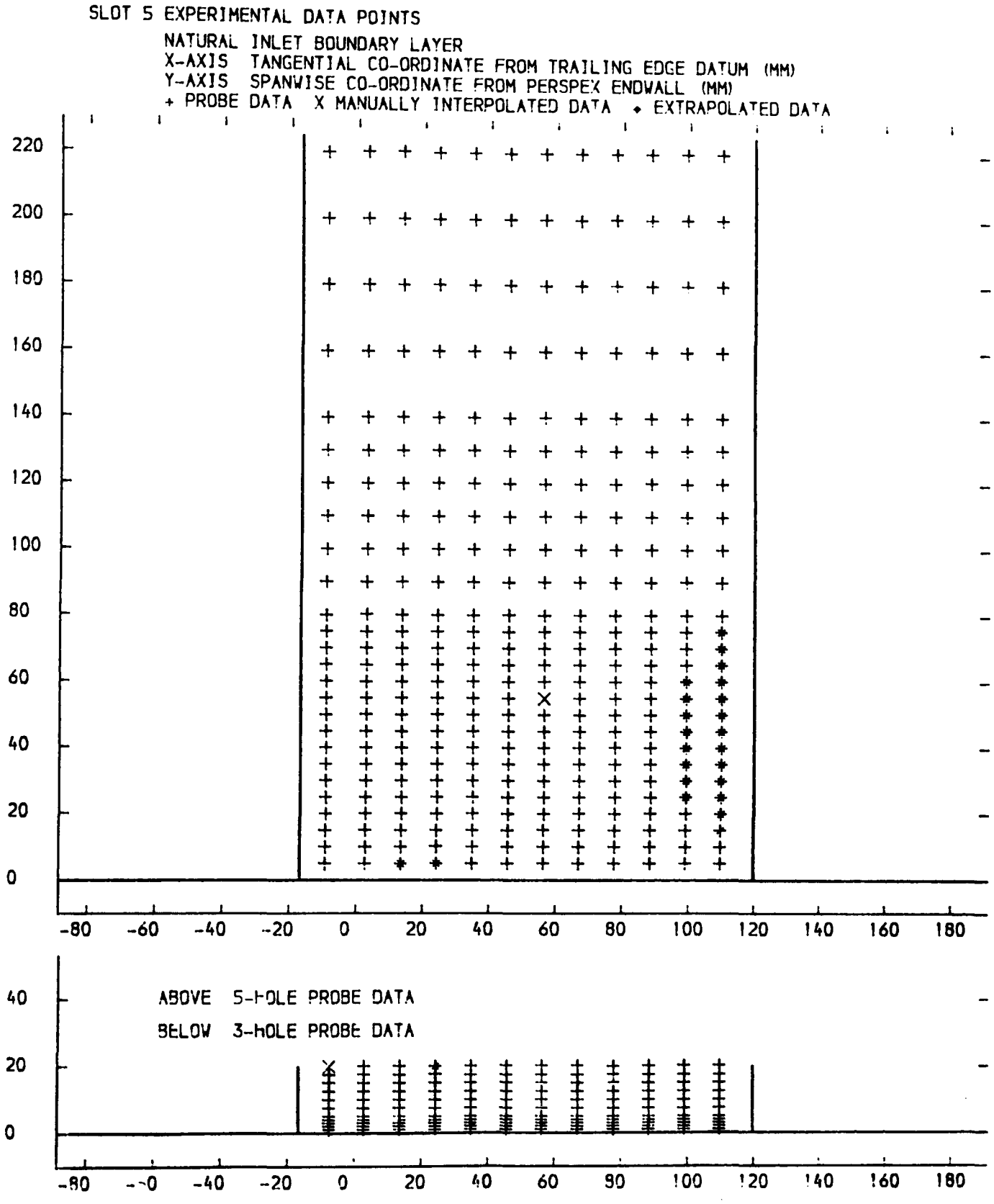

SLOT 5 EXPERIMENTAL DATA POINTS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
+ PROBE DATA X MANUALLY INTERPOLATED DATA ◆ EXTRAPOLATED DATA
220
200
180
160
140
120
100
80
60
40
20
0
-80 -60 -40 -20 0 20 40 60 80 100 120 140 160 180
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
40
20
0
-80 -60 -40 -20 0 20 40 60 80 100 120 140 160 180

FIGURE 4.30

SLOT 5 TOTAL PRESSURE LOSS COEFFICIENT ((P01-POLOCAL) / (P01-P1)) CONTOURS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

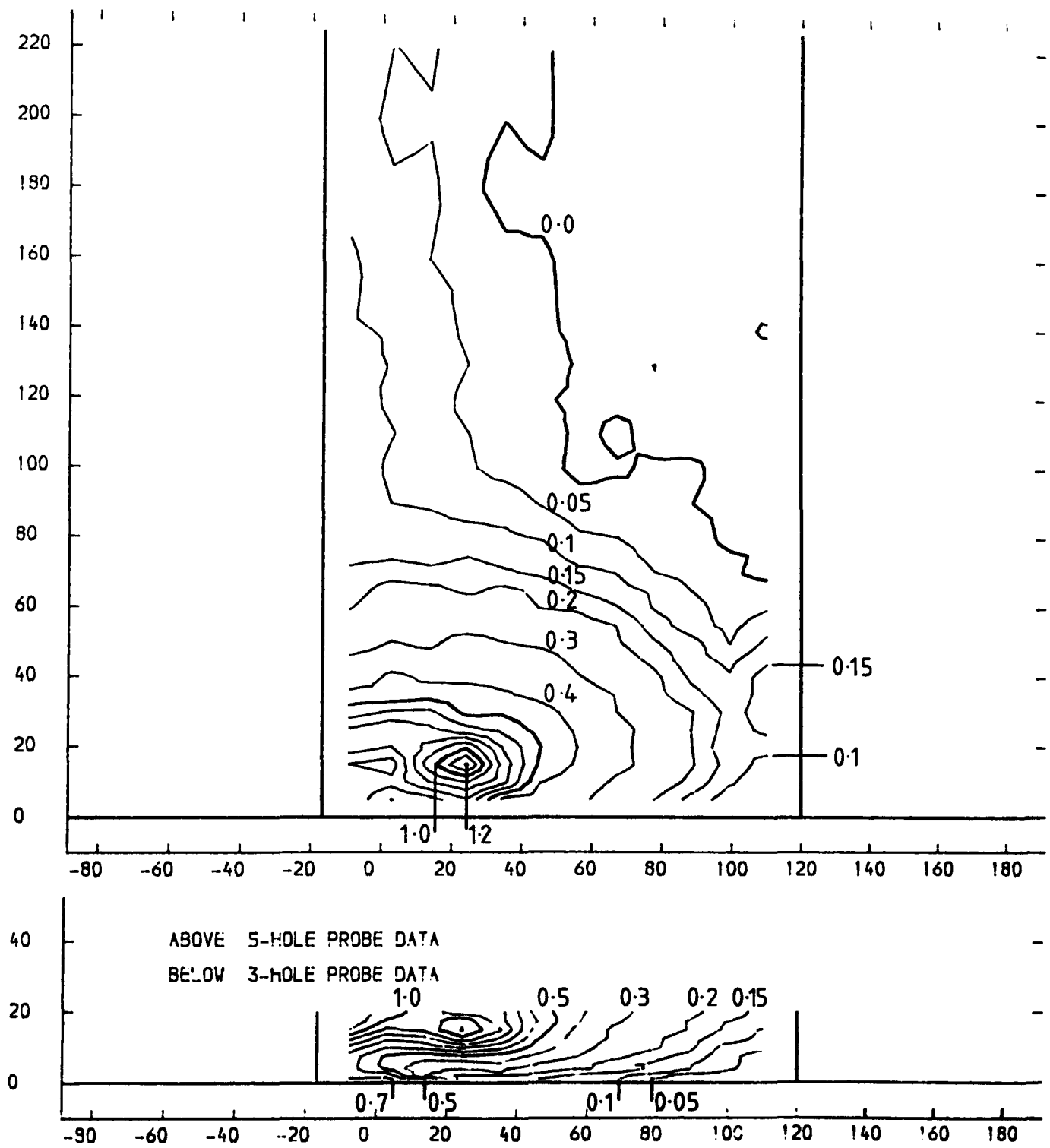


FIGURE 4.31

SLOT 5 TOTAL VELOCITY MAGNITUDE CONTOURS (CONTOUR UNITS METRES/SEC)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

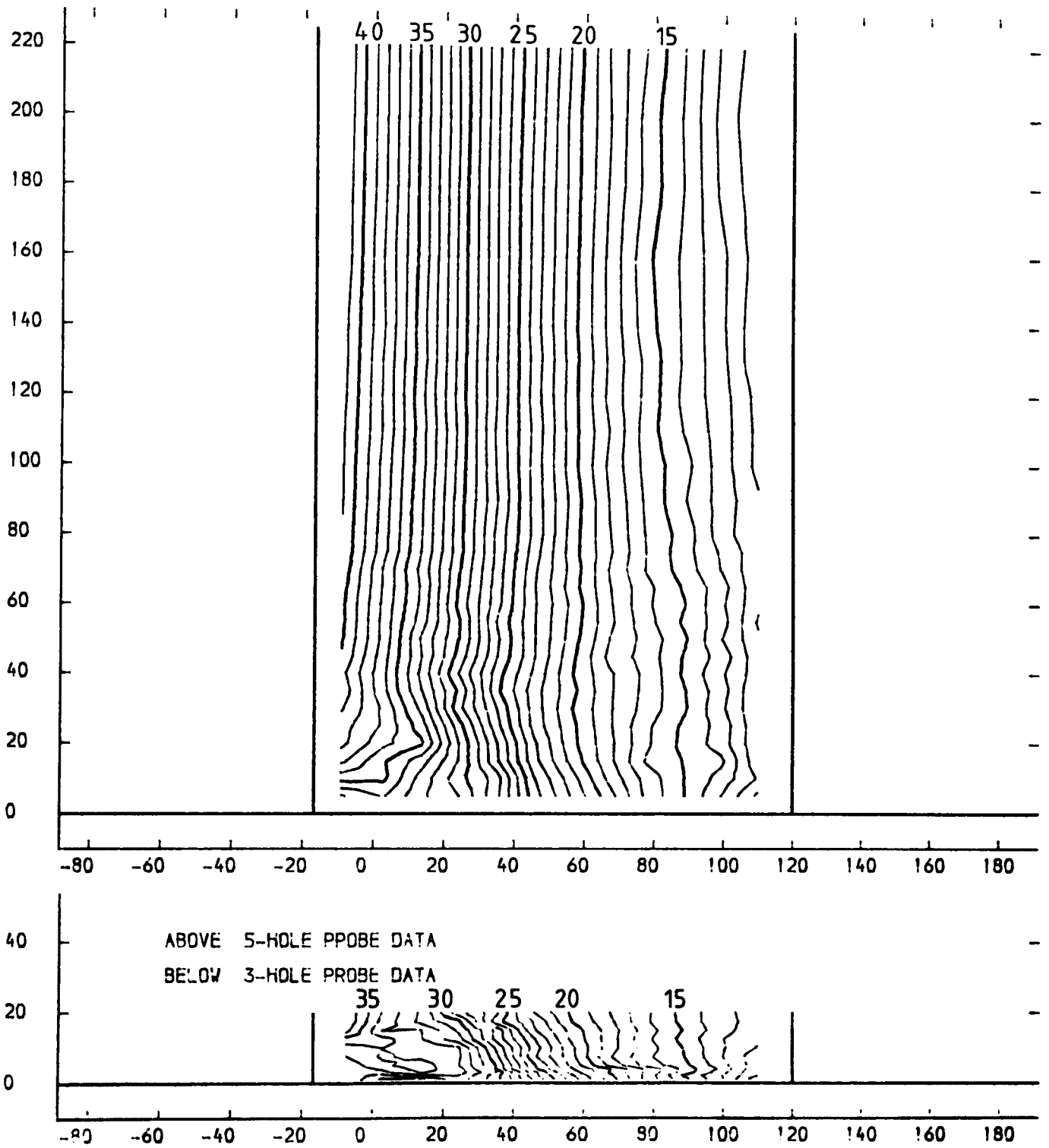


FIGURE 4.32

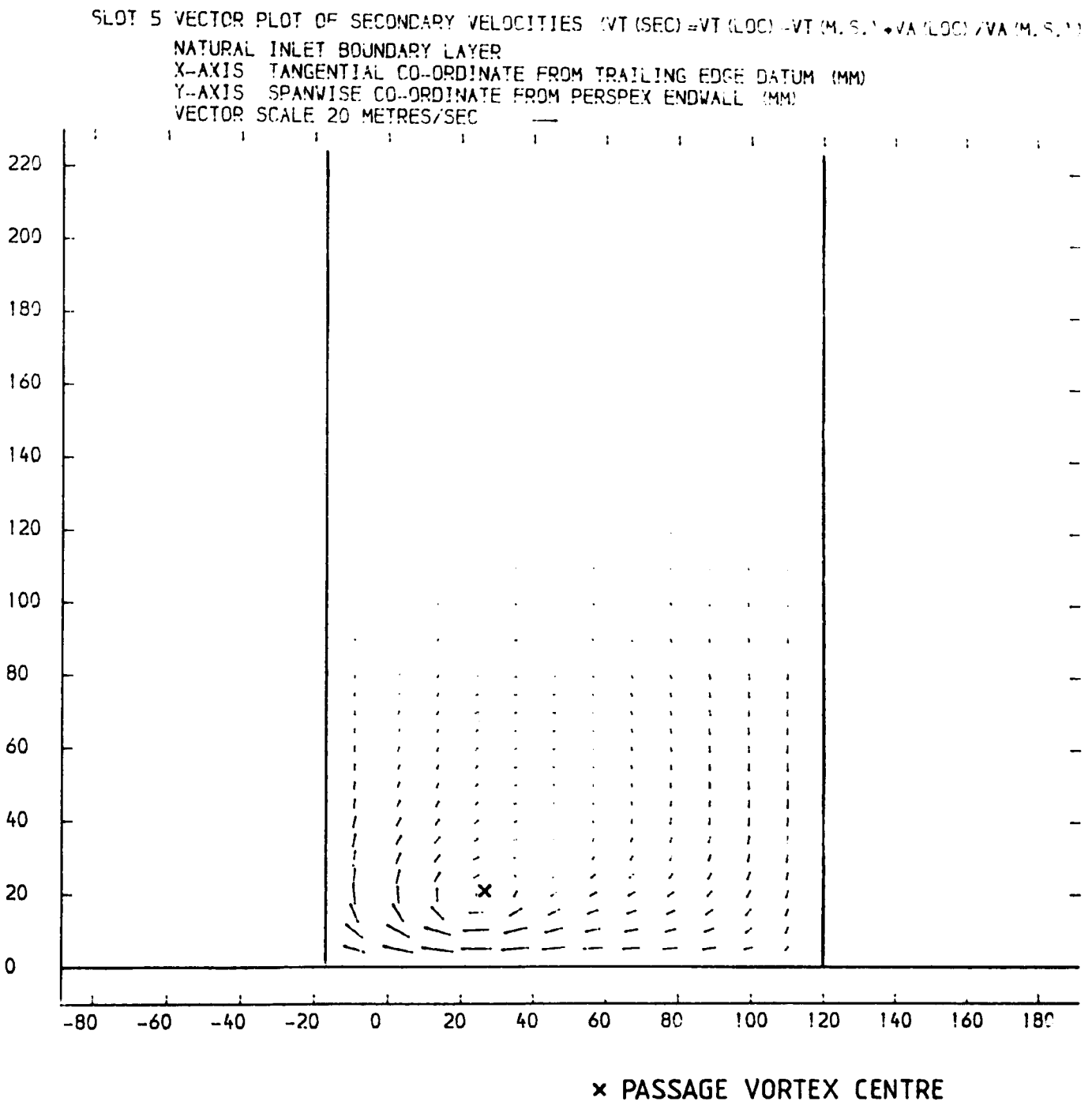

SLOT 5 VECTOR PLOT OF SECONDARY VELOCITIES (VT(SEC)=VT(LOC)-VT(M.S.)+VA(LOC)/VA(M.S.))
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
VECTOR SCALE 20 METRES/SEC
220
200
180
160
140
120
100
80
60
40
20
0
-80
-60
-40
-20
0
20
40
60
80
100
120
140
160
180
× PASSAGE VORTEX CENTRE

FIGURE 4.33

SLOT 5 SPANWISE ANGLE (PITCH ANGLE) CONTOURS (CONTOUR UNITS DEGREES)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

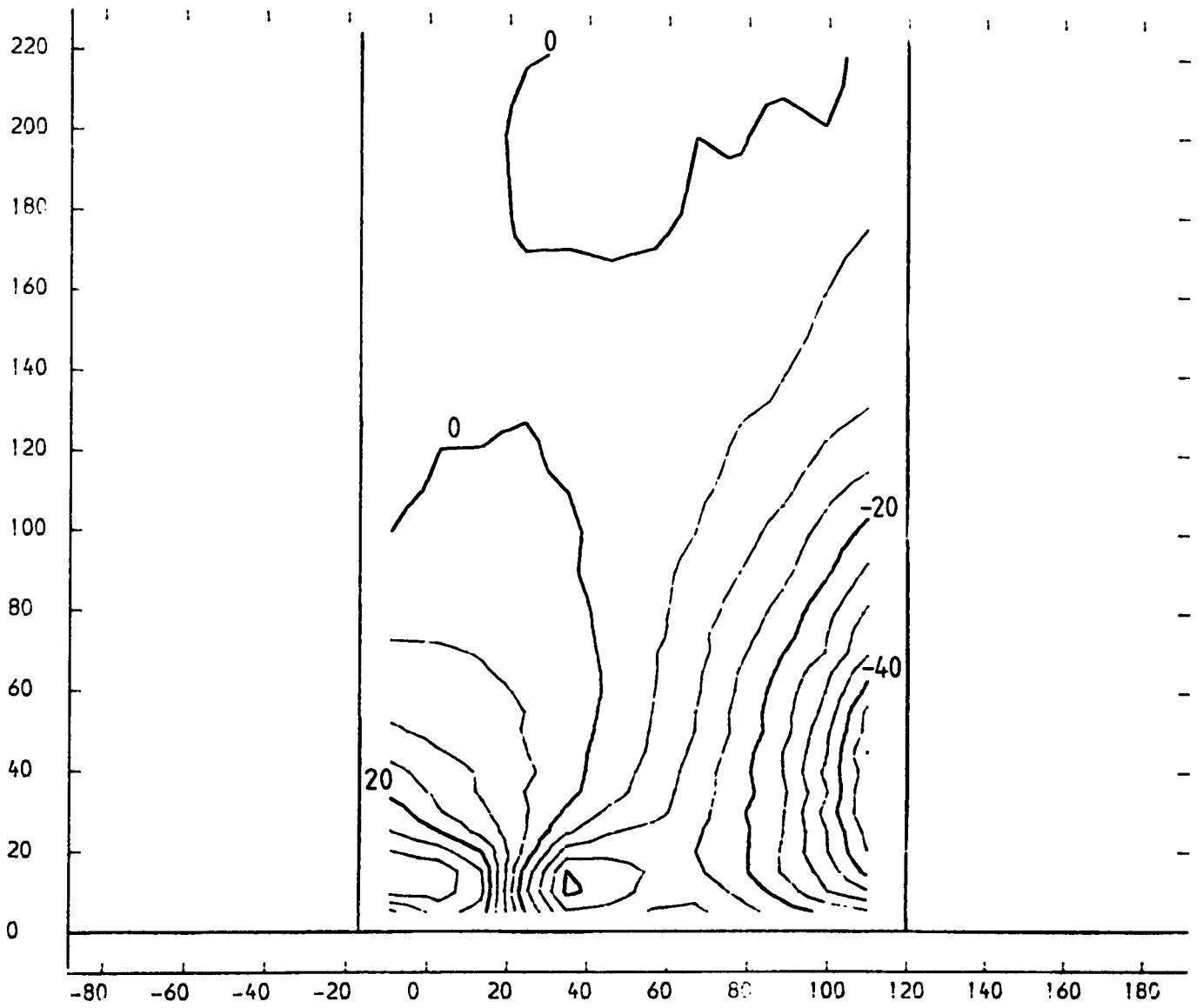


FIGURE 4.34

SLOT 5 YAW ANGLE CONTOURS (CONTOUR UNITS DEGREES)

NATURAL INLET BOUNDARY LAYER

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

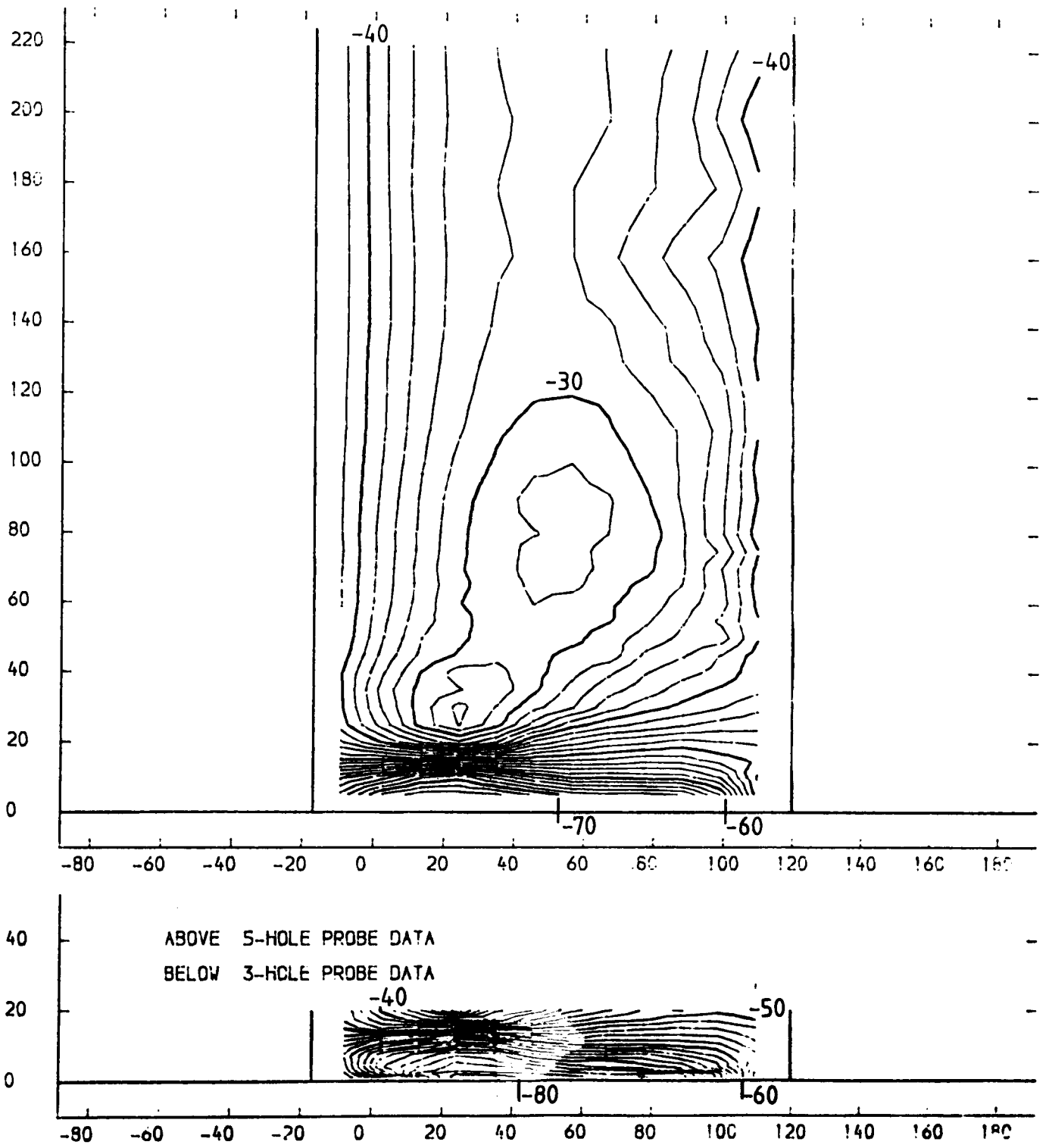


FIGURE 4.35

SLOT 5 STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(P01-P1)) CONTOURS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

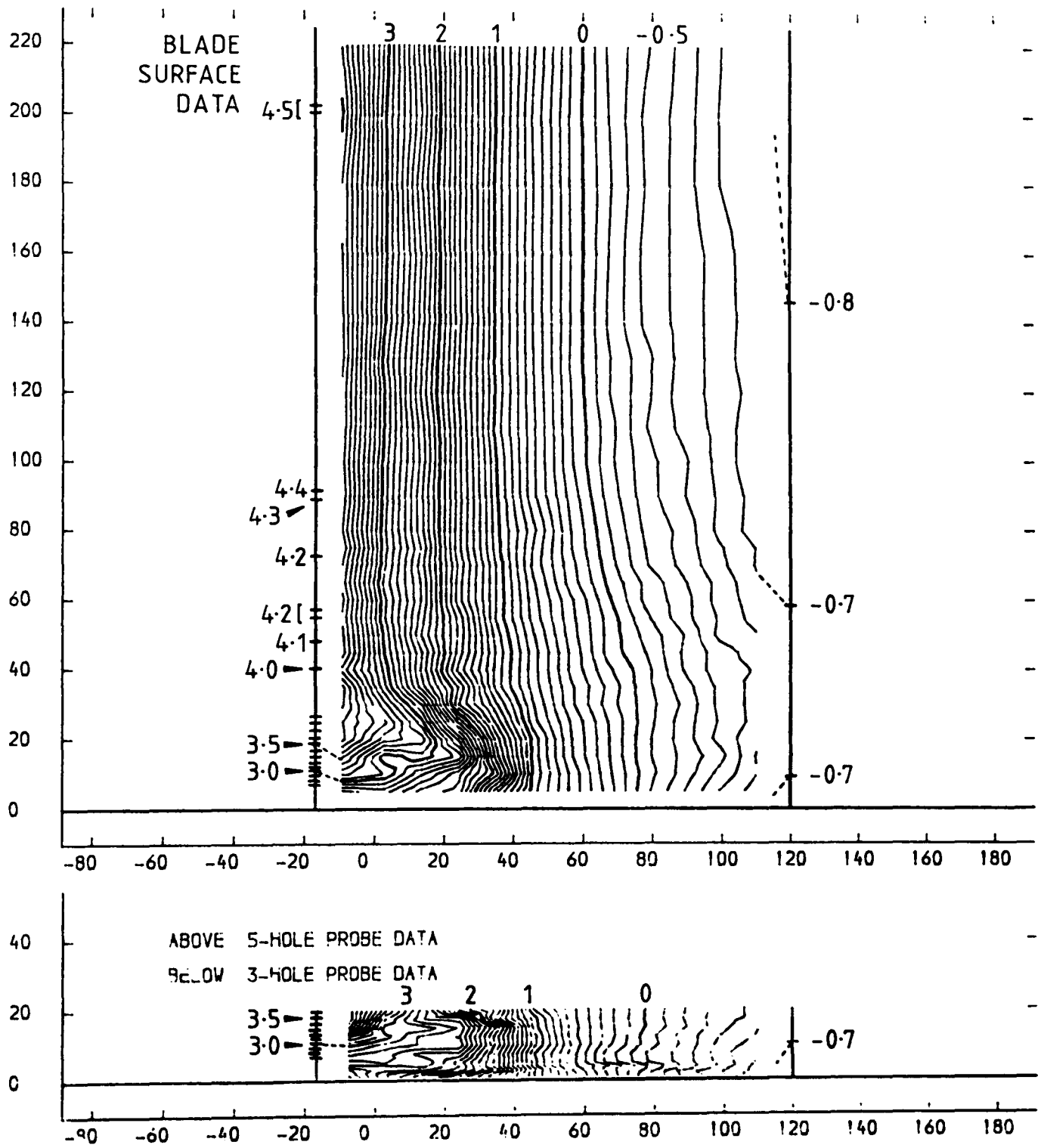


FIGURE 4.36

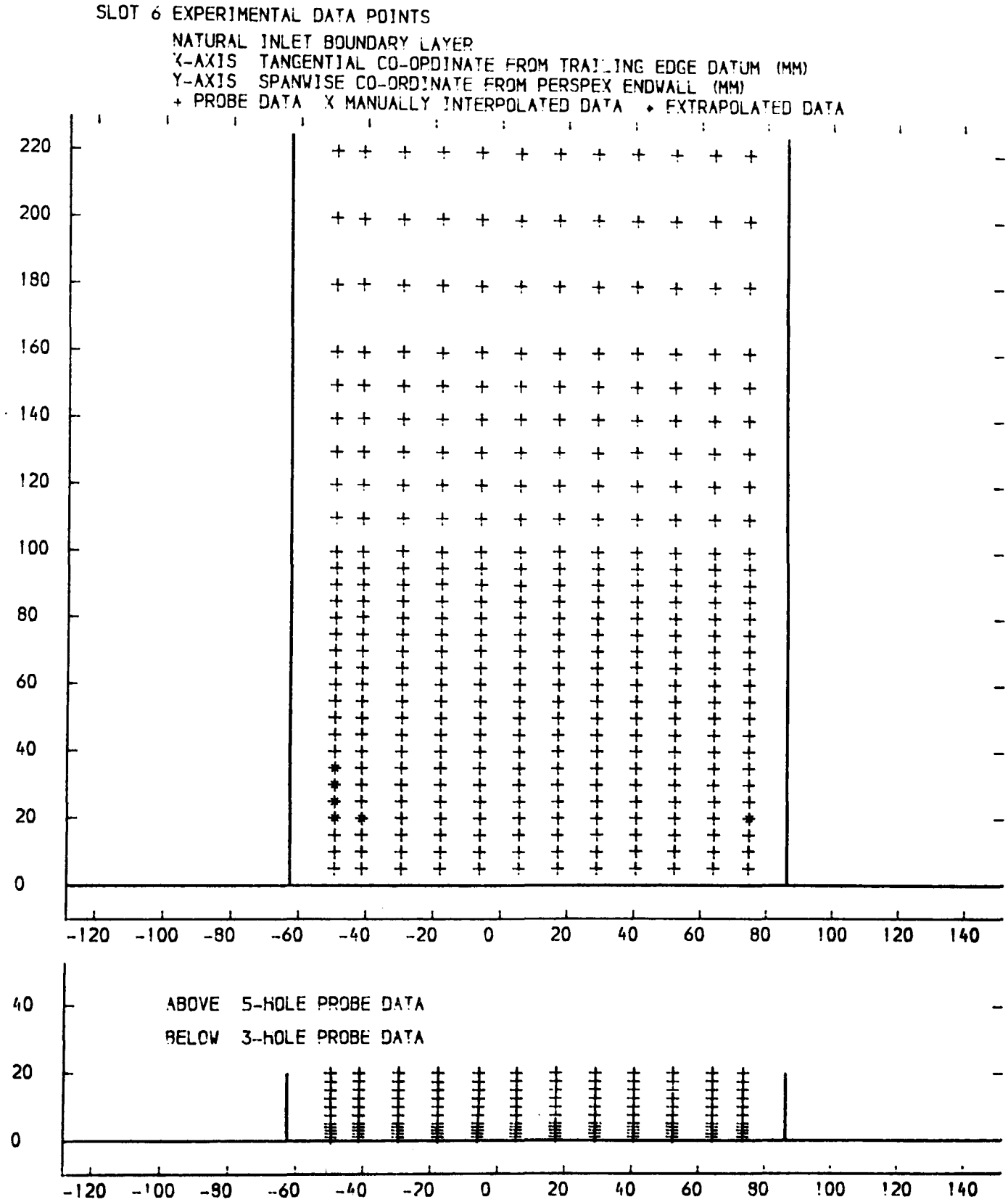

SLOT 6 EXPERIMENTAL DATA POINTS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
+ PROBE DATA X MANUALLY INTERPOLATED DATA • EXTRAPOLATED DATA
220
200
180
160
140
120
100
80
60
40
20
0
-120 -100 -80 -60 -40 -20 0 20 40 60 80 100 120 140
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
40
20
0
-120 -100 -80 -60 -40 -20 0 20 40 60 80 100 120 140

FIGURE 4.37

SLOT 6 TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL)/(PO1-P1)) CONTOURS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL O-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

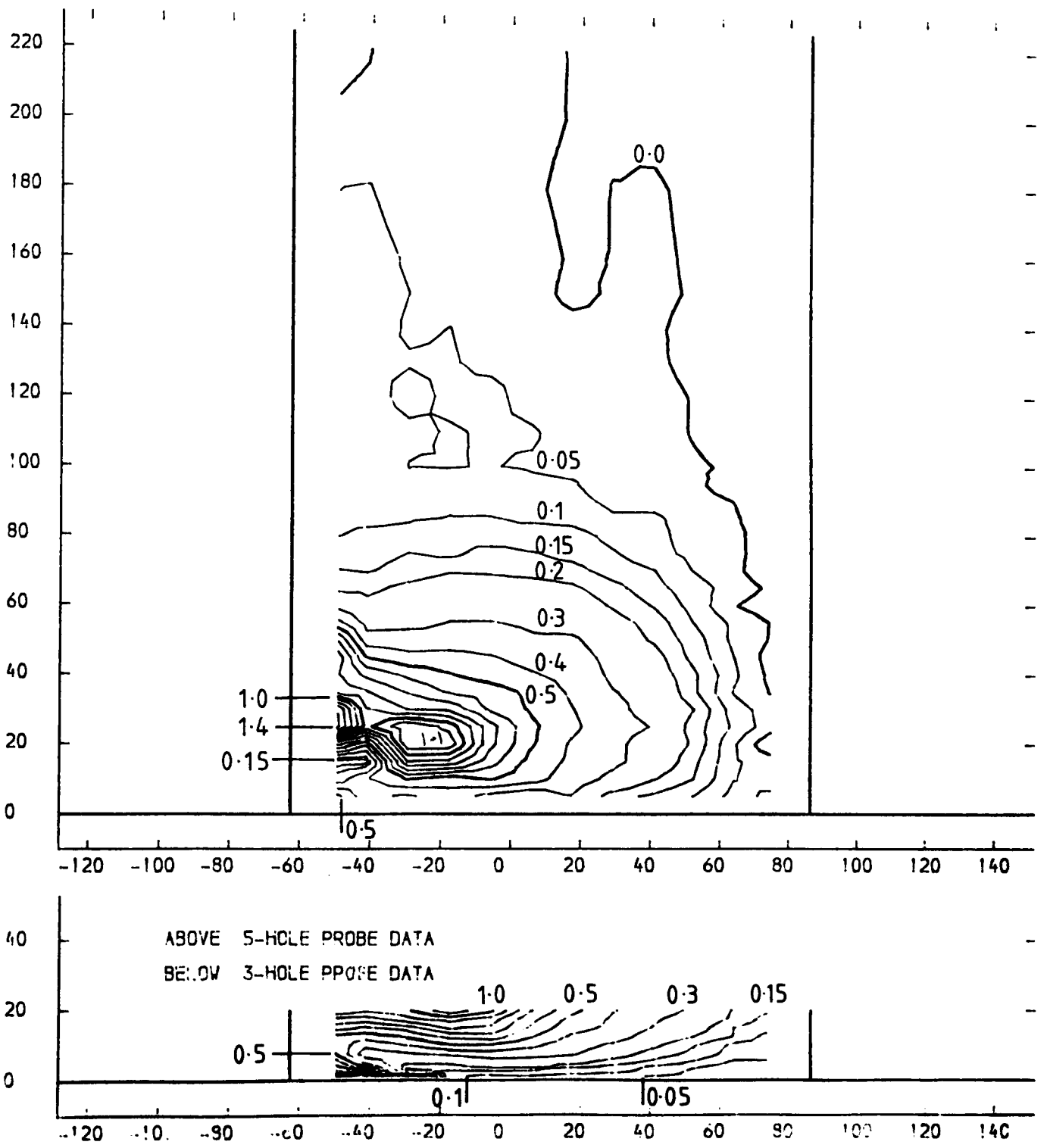


FIGURE 4.38

SLOT 6 TOTAL VELOCITY MAGNITUDE CONTOURS (CONTOUR UNITS METRES/SEC)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

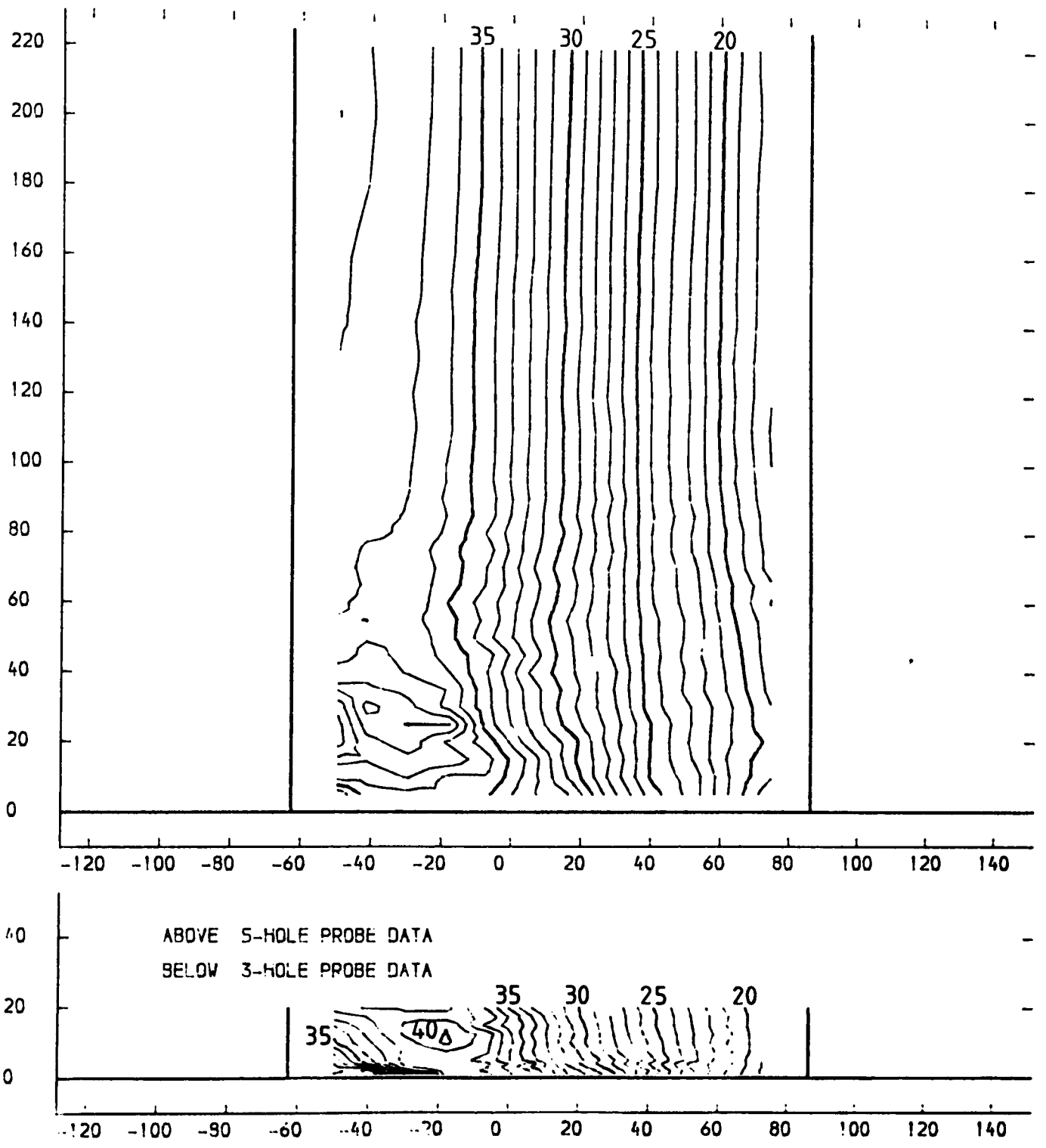


FIGURE 4.39

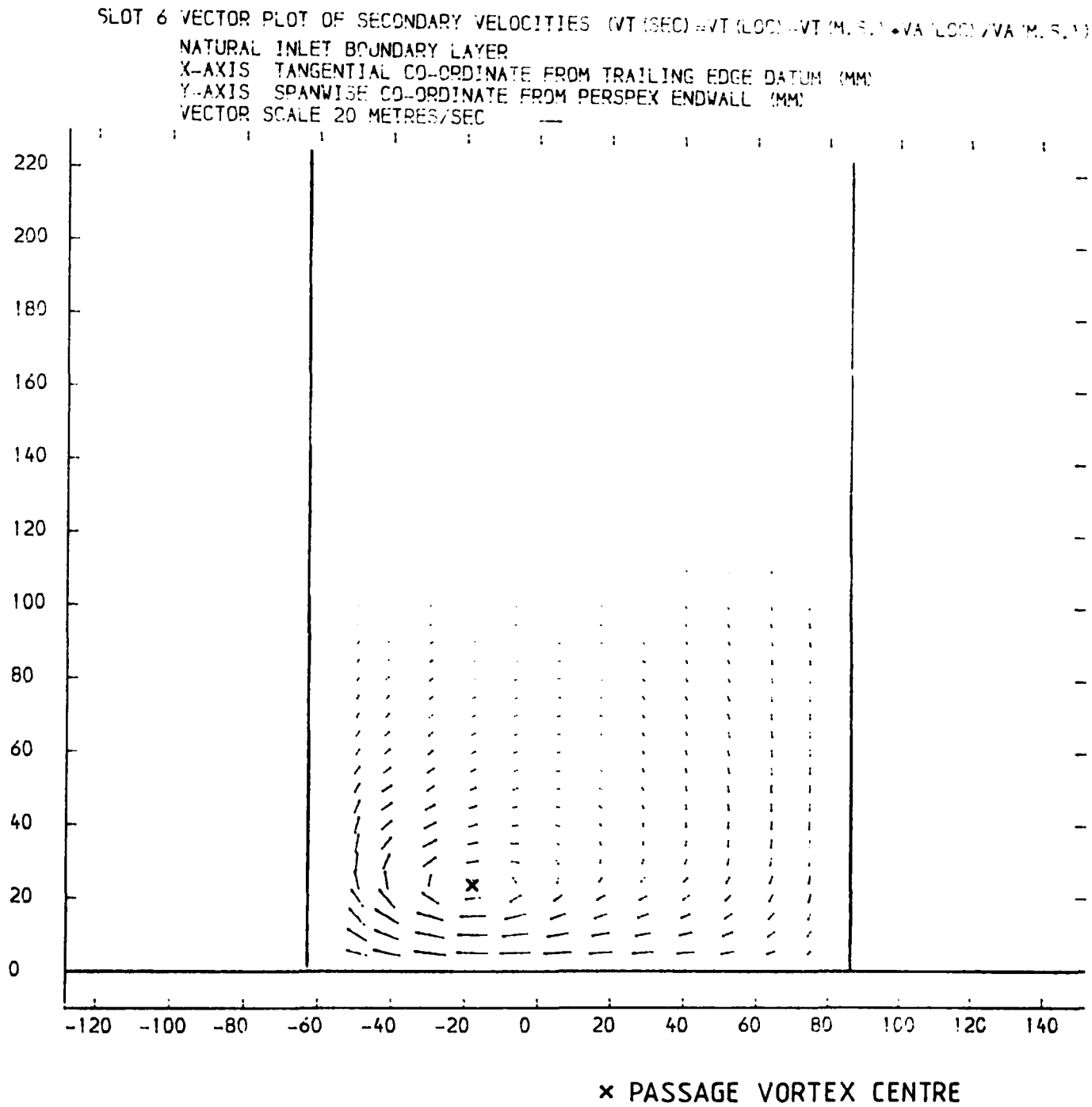

SLOT 6 VECTOR PLOT OF SECONDARY VELOCITIES (VT (SEC)-VT (LOC)-VT (M.S.)+VA (LOC)/VA (M.S.))
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
VECTOR SCALE 20 METRES/SEC
220
200
180
160
140
120
100
80
60
40
20
0
-120
-100
-80
-60
-40
-20
0
20
40
60
80
100
120
140
× PASSAGE VORTEX CENTRE

FIGURE 4.40

SLOT 6 SPANWISE ANGLE (PITCH ANGLE) CONTOURS (CONTOUR UNITS DEGREES)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

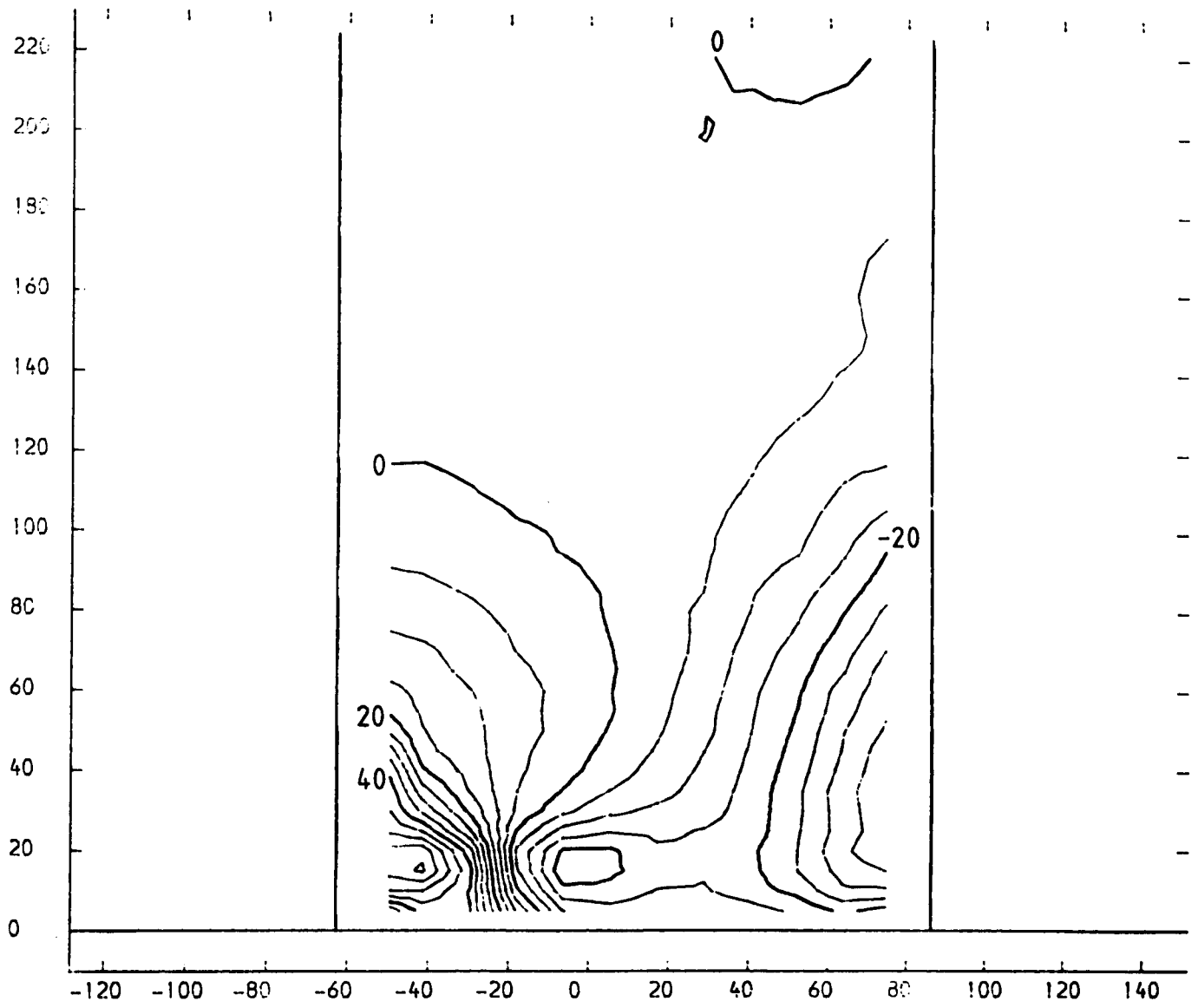


FIGURE 4.41

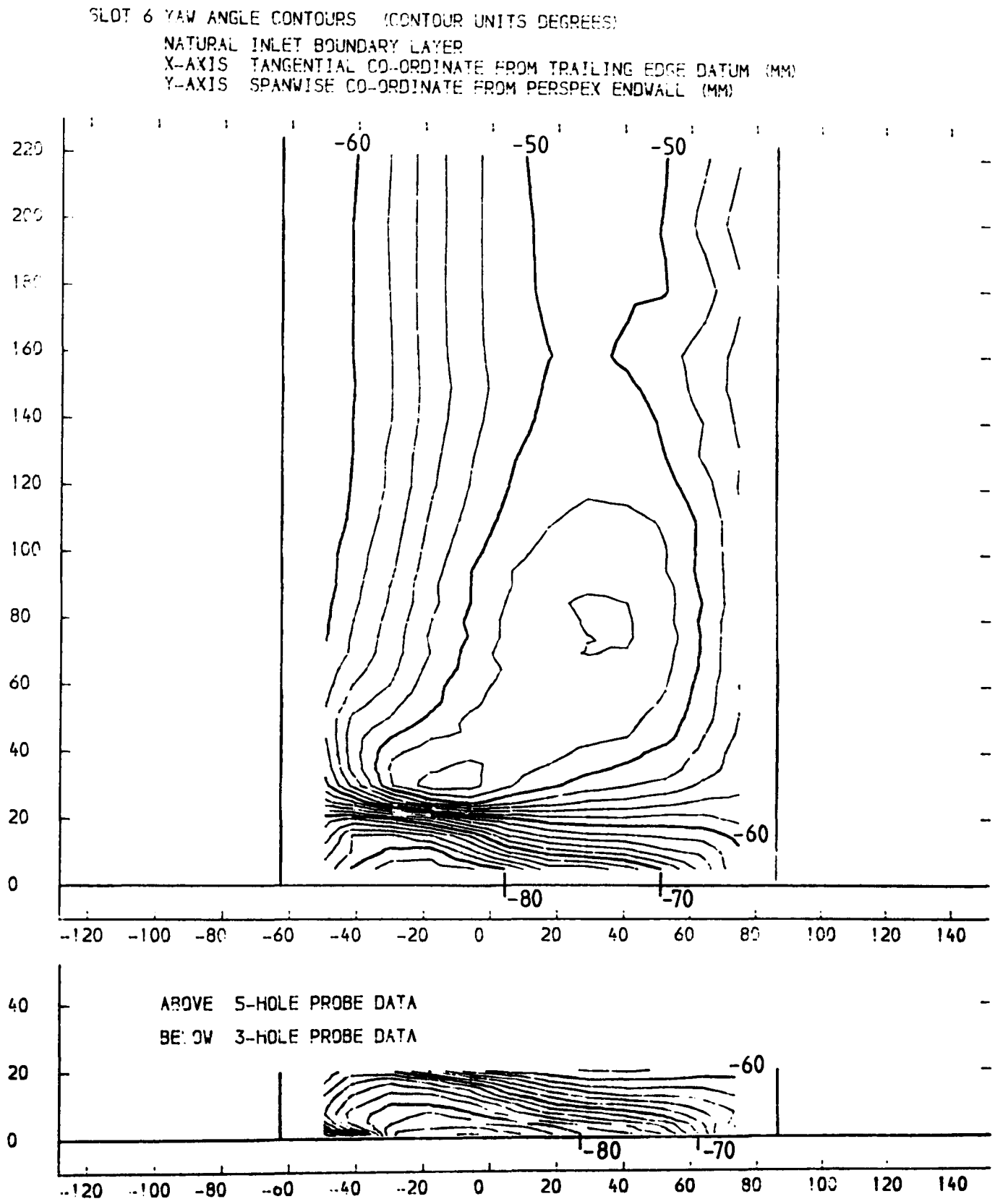

SLOT 6 YAW ANGLE CONTOURS (CONTOUR UNITS DEGREES)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
-60
-50
-50
-60
-80
-70
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
-60
-80
-70

FIGURE 4.42

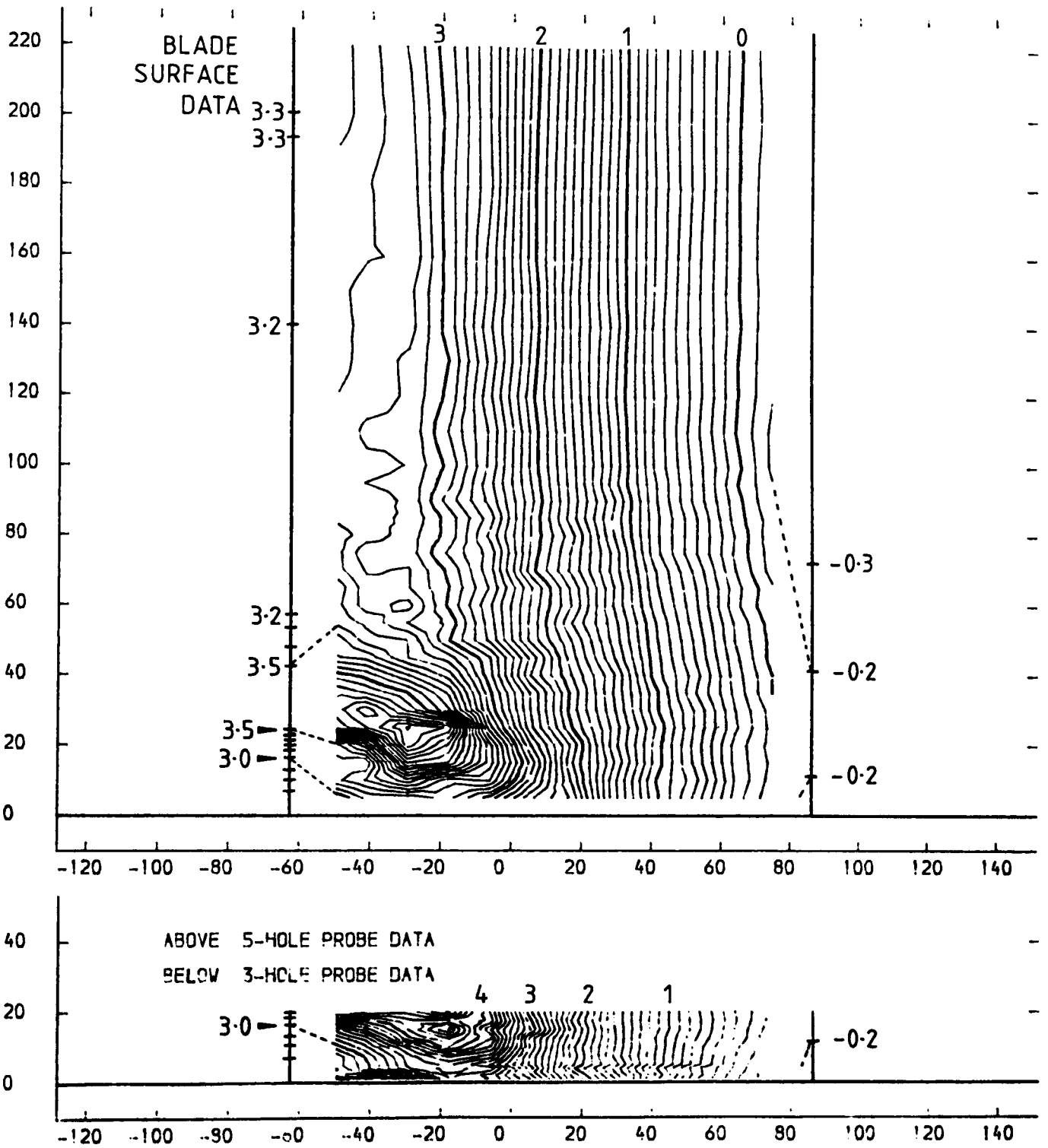

SLOT 6 STATIC PRESSURE COEFFICIENT ((P1-PLOCAL) / (PO1-P1)) CONTOURS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
BLADE SURFACE DATA
3
2
1
0
3·3
3·3
3·2
3·2
3·5
3·5
3·0
-0·3
-0·2
-0·2
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
4
3
2
1
3·0
-0·2

FIGURE 4.43

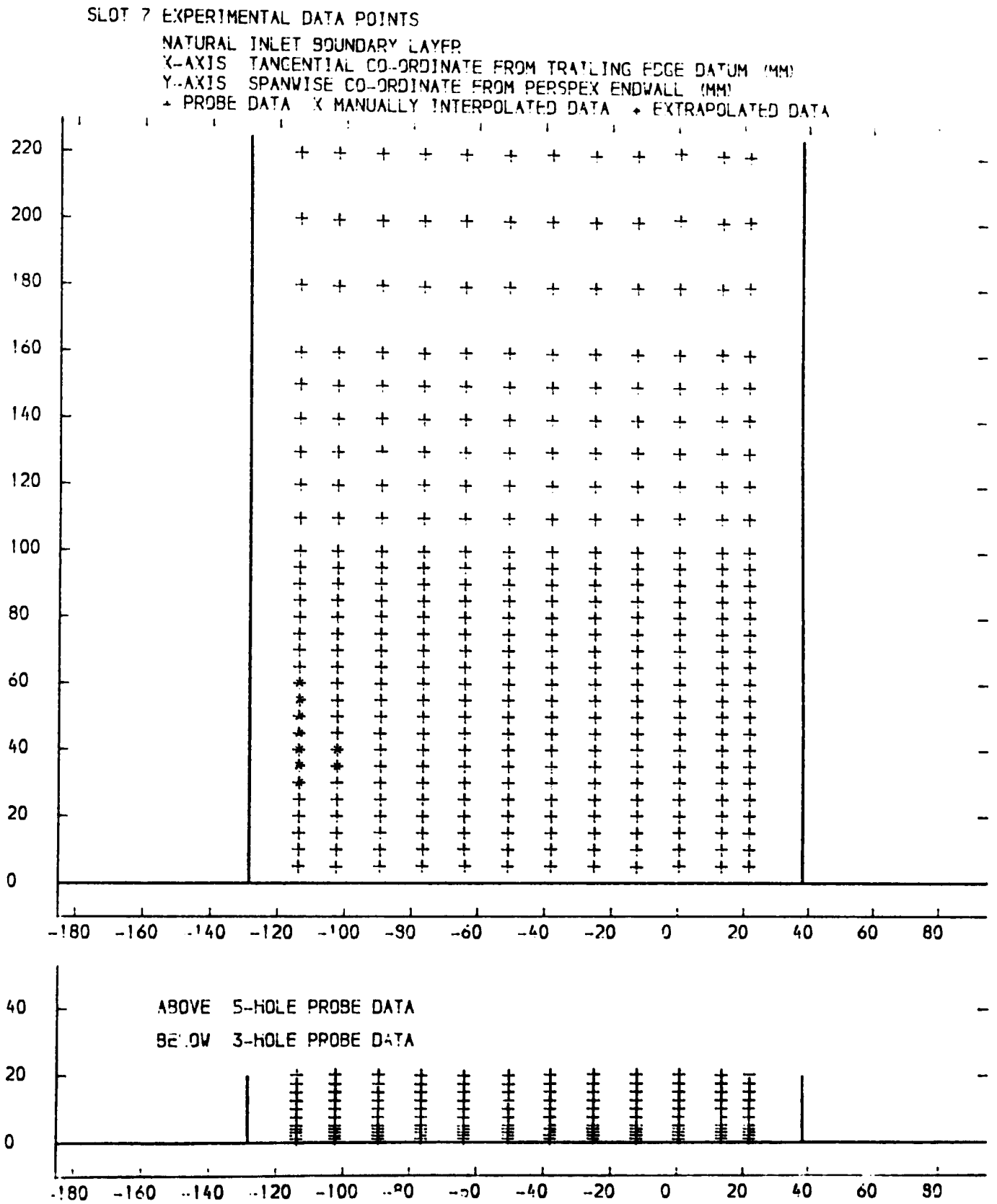

SLOT 7 EXPERIMENTAL DATA POINTS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
+ PROBE DATA X MANUALLY INTERPOLATED DATA * EXTRAPOLATED DATA
220
200
180
160
140
120
100
80
60
40
20
0
-180 -160 -140 -120 -100 -80 -60 -40 -20 0 20 40 60 80
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
40
20
0
-180 -160 -140 -120 -100 -80 -60 -40 -20 0 20 40 60 80

FIGURE 4.44

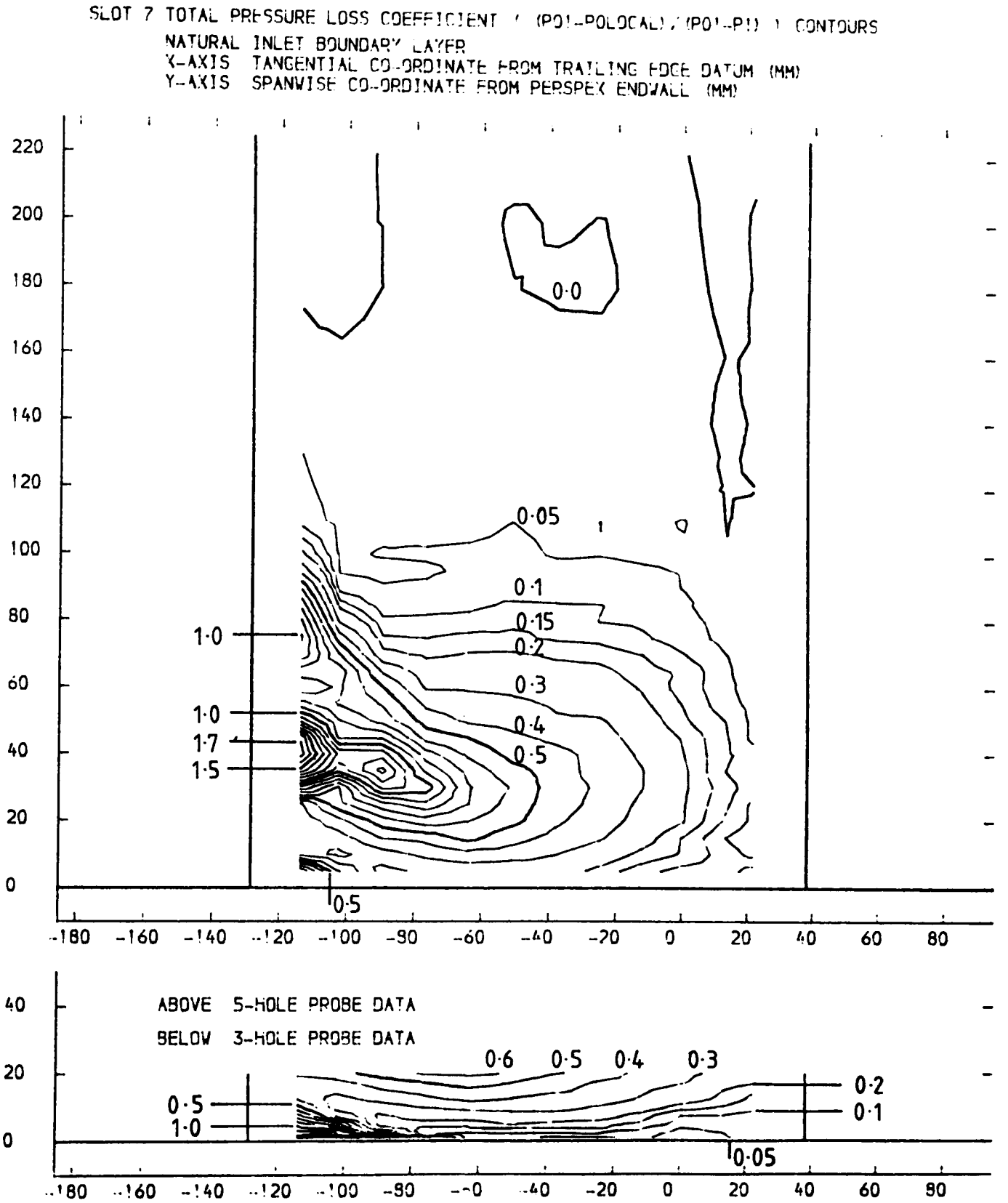

SLOT 7 TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL)/(PO1-P1)) CONTOURS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
0·0
0·05
0·1
0·15
0·2
0·3
0·4
0·5
1·0
1·0
1·7
1·5
0·5
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
0·6
0·5
0·4
0·3
0·2
0·1
0·5
1·0
0·05

FIGURE 4.45

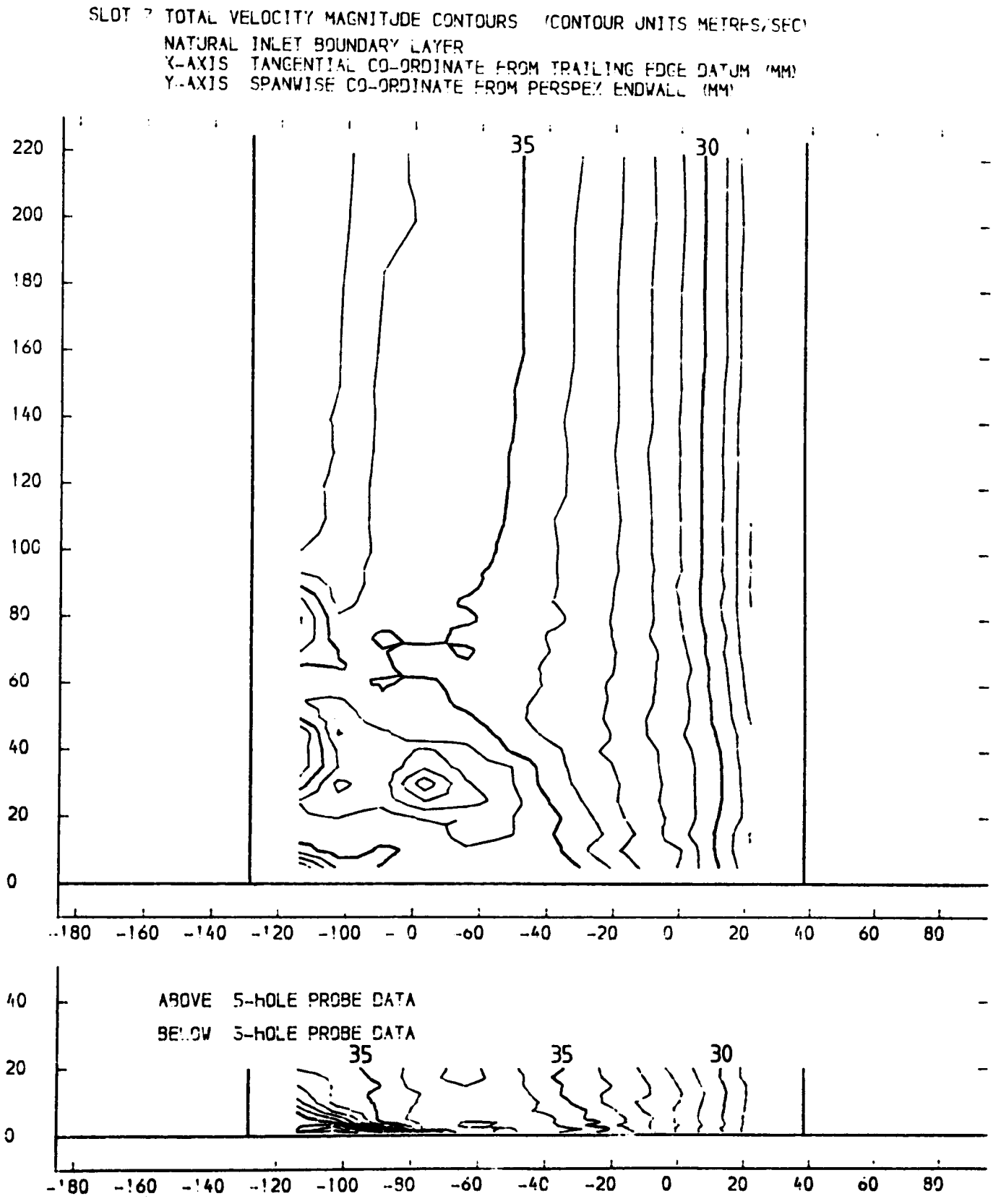

SLOT 7 TOTAL VELOCITY MAGNITUDE CONTOURS (CONTOUR UNITS METRES/SEC)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
35
30
ABOVE 5-HOLE PROBE DATA
BELOW 5-HOLE PROBE DATA
35
35
30

FIGURE 4.46

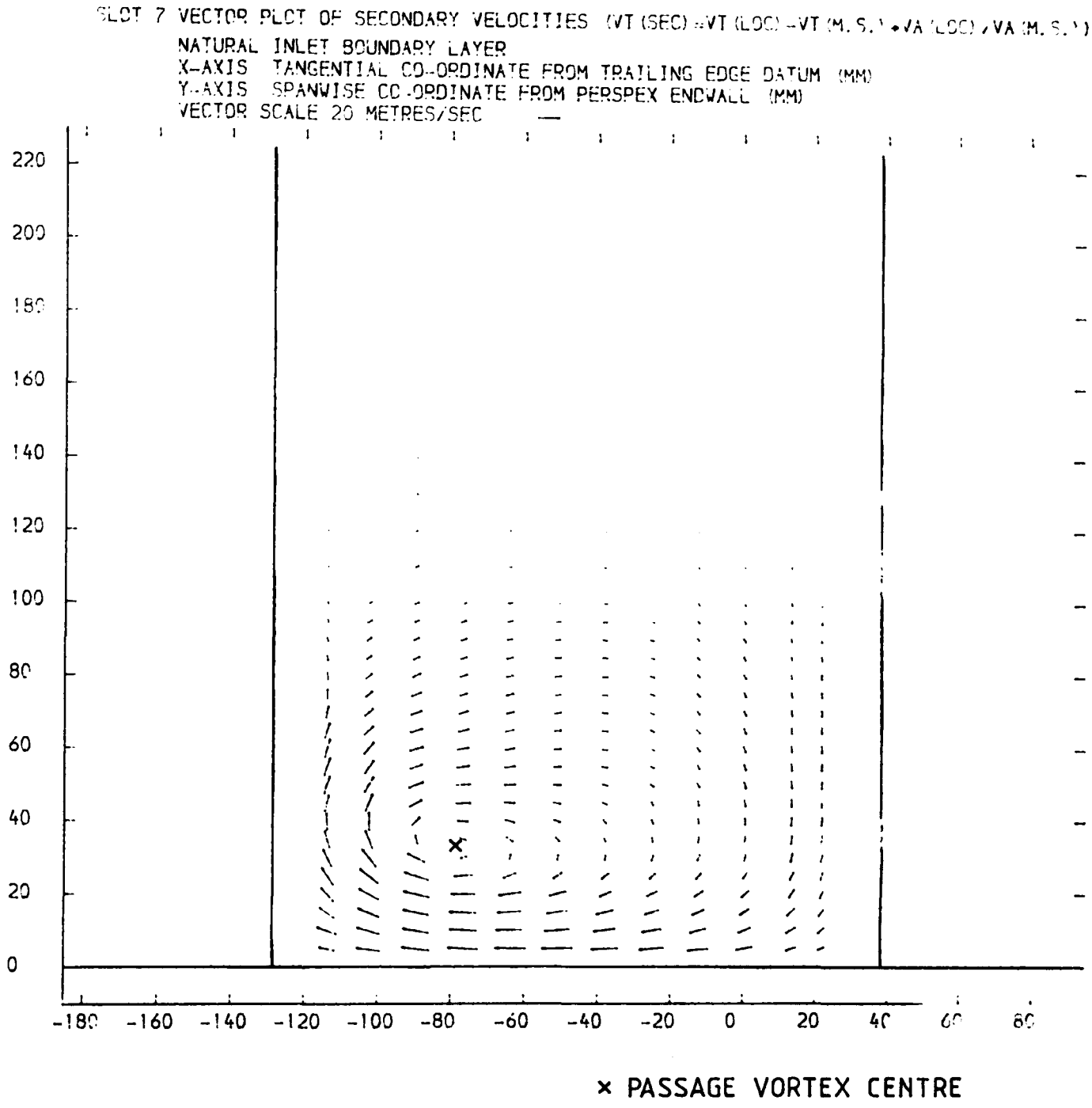

SLOT 7 VECTOR PLOT OF SECONDARY VELOCITIES (VT(SEC)=VT(LOC)-VT(M.S.)+VA(LOC)/VA(M.S.))
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
VECTOR SCALE 20 METRES/SEC
220
200
180
160
140
120
100
80
60
40
20
0
-180
-160
-140
-120
-100
-80
-60
-40
-20
0
20
40
60
80
× PASSAGE VORTEX CENTRE

FIGURE 4.47

SLOT 7 SPANWISE ANGLE (PITCH ANGLE) CONTOURS (CONTOUR UNITS DEGREES)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

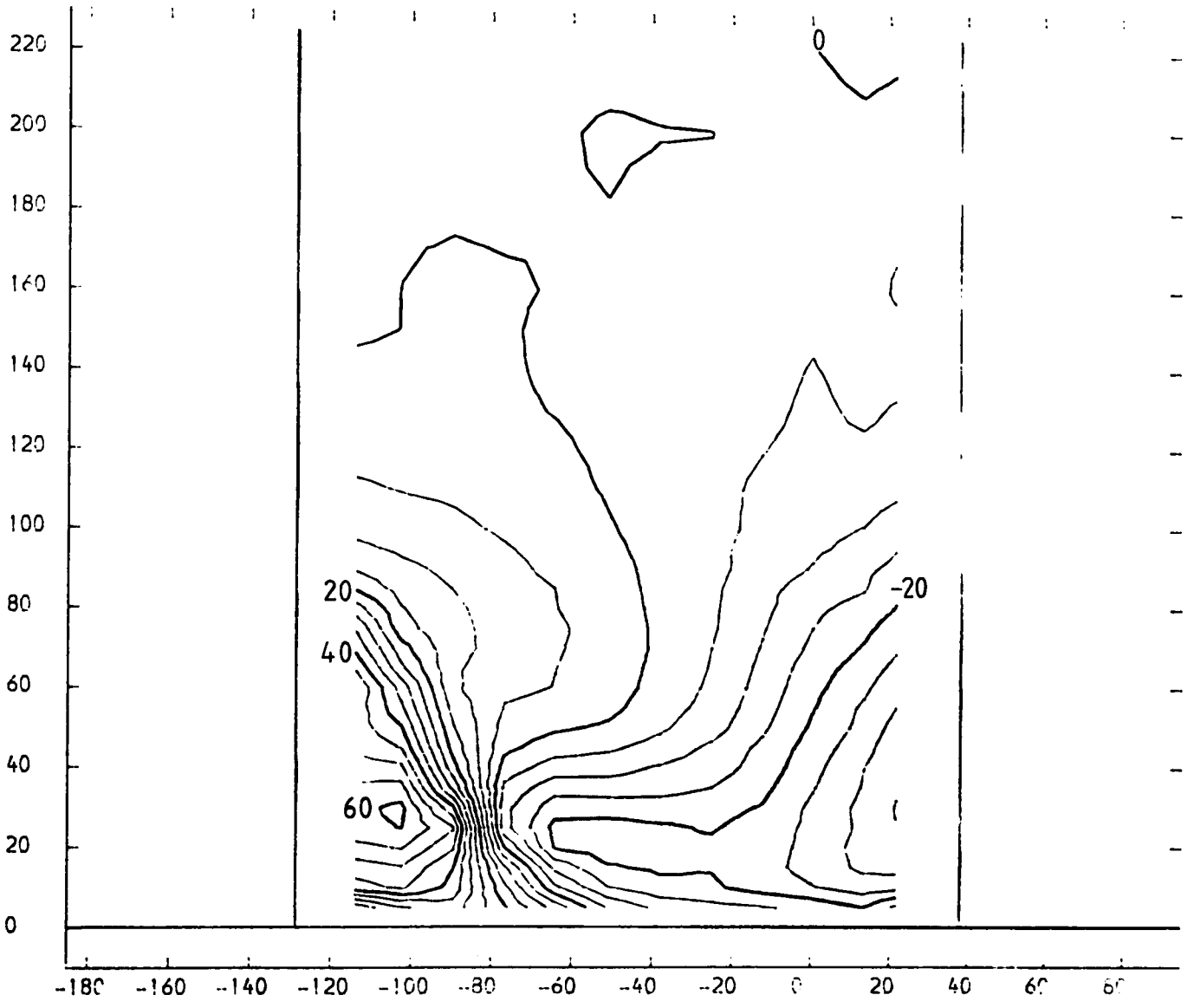


FIGURE 4.48

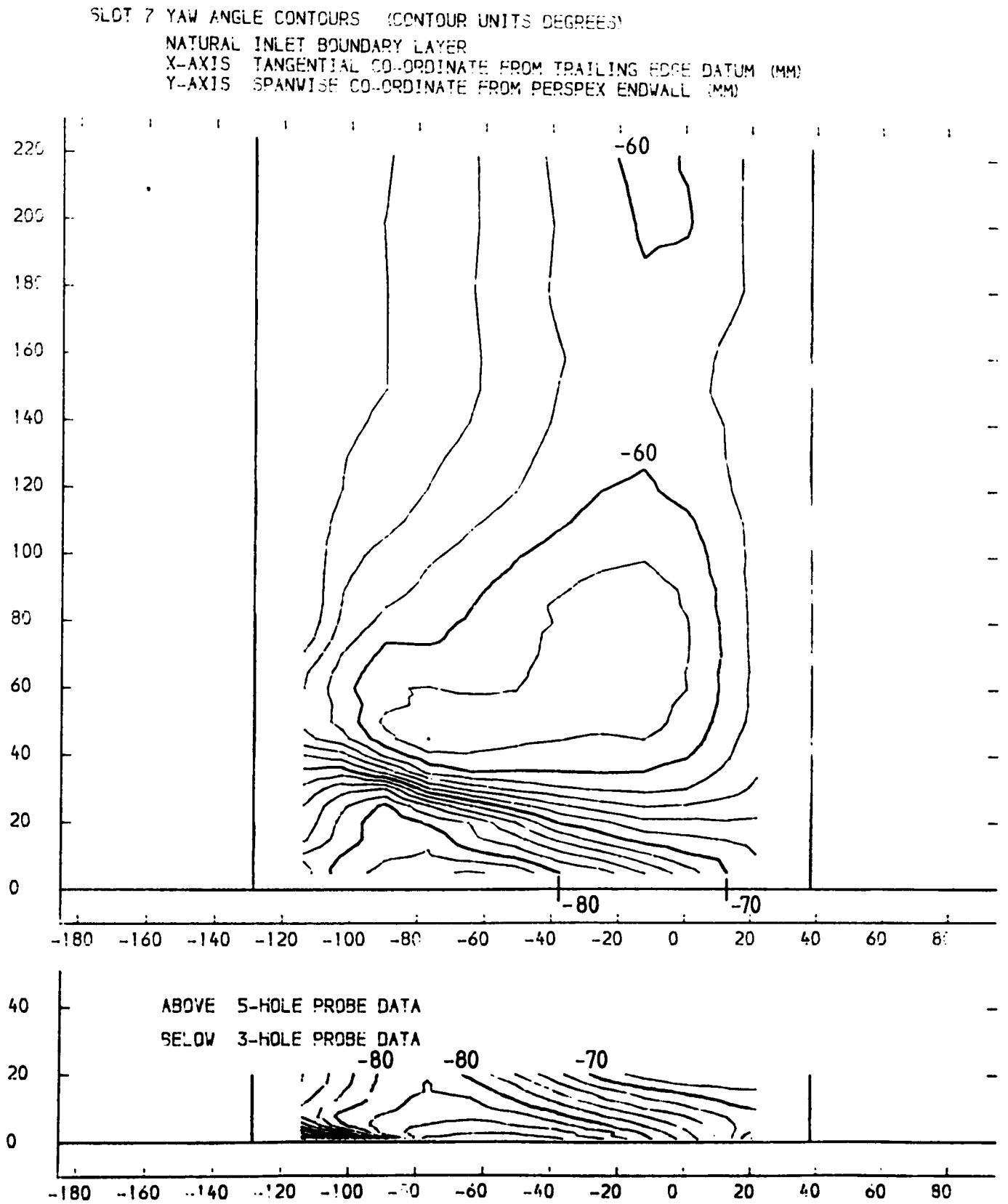

SLOT 7 YAW ANGLE CONTOURS (CONTOUR UNITS DEGREES)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
-60
-60
-80
-70
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
-80
-80
-70

FIGURE 4.49

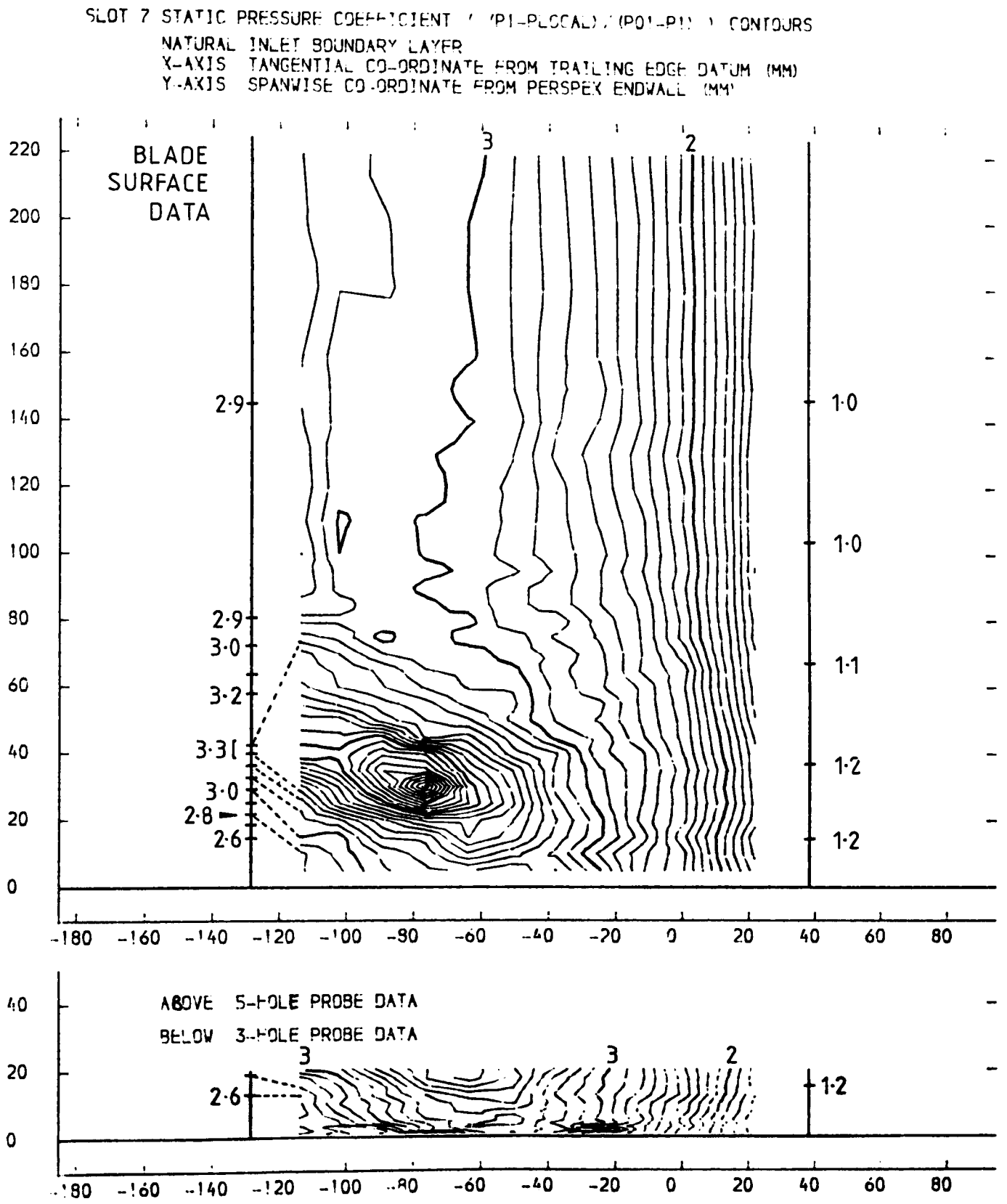
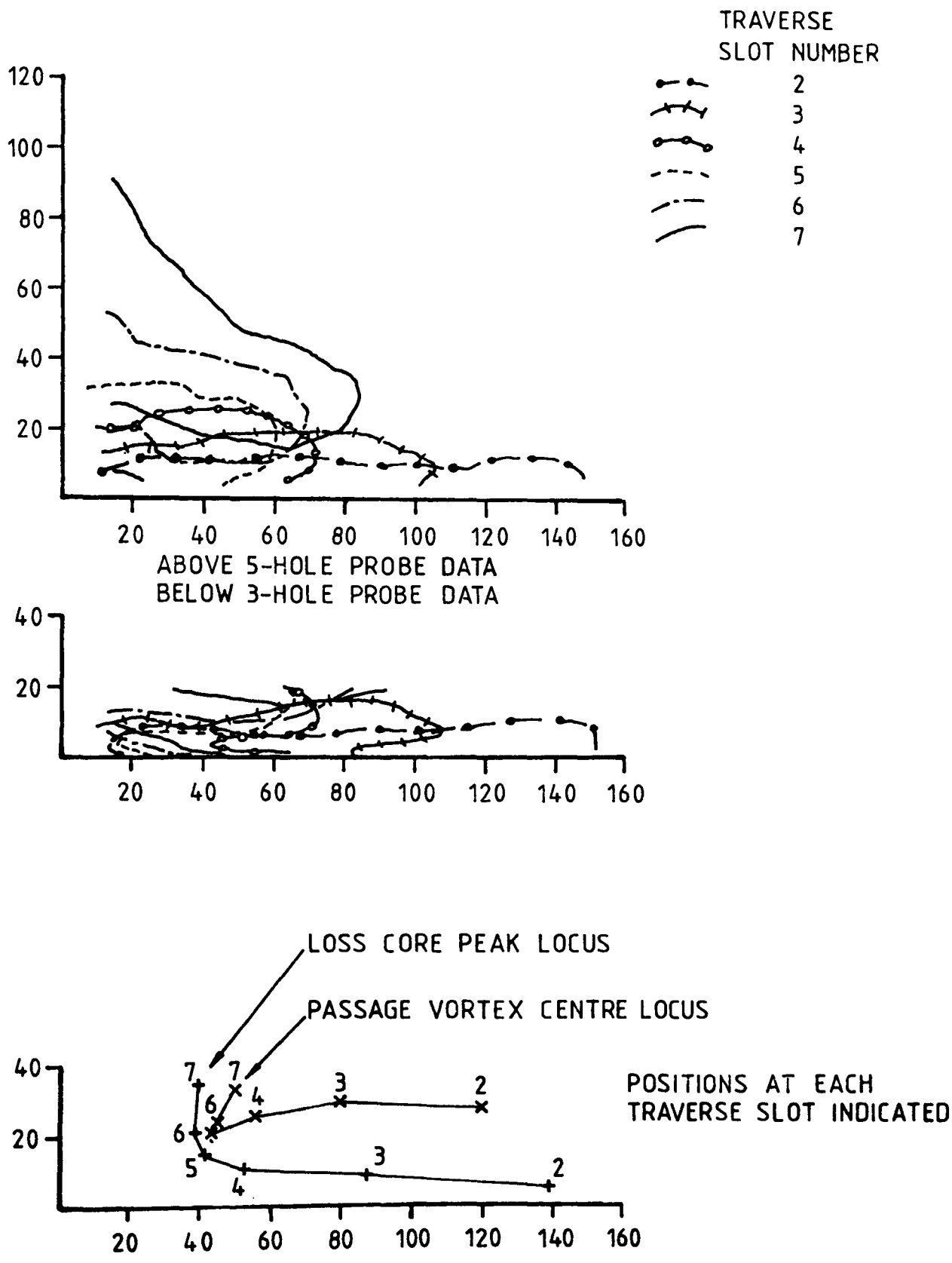

SLOT 7 STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(P01-P1)) CONTOURS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
BLADE SURFACE DATA
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA

FIGURE 4.50

BLADE PASSAGE LOSS CORE DEVELOPMENT AND LOCI OF PASSAGE VORTEX CENTRE AND LOSS CORE PEAK

X-AXIS TANGENTIAL CO-ORDINATE FROM BLADE SUCTION SURFACE (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)



PASSAGE VORTEX CENTRE SITUATED AT INTERSECTION OF ZERO SPANWISE AND ZERO CROSS FLOW ANGLE CONTOURS ON EACH PROBE TRAVERSE PLANE

FIGURE 4.51

SLOT 8 EXPERIMENTAL DATA POINTS

NATURAL INLET BOUNDARY LAYER

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

+ PROBE DATA X MANUALLY INTERPOLATED DATA * EXTRAPOLATED DATA

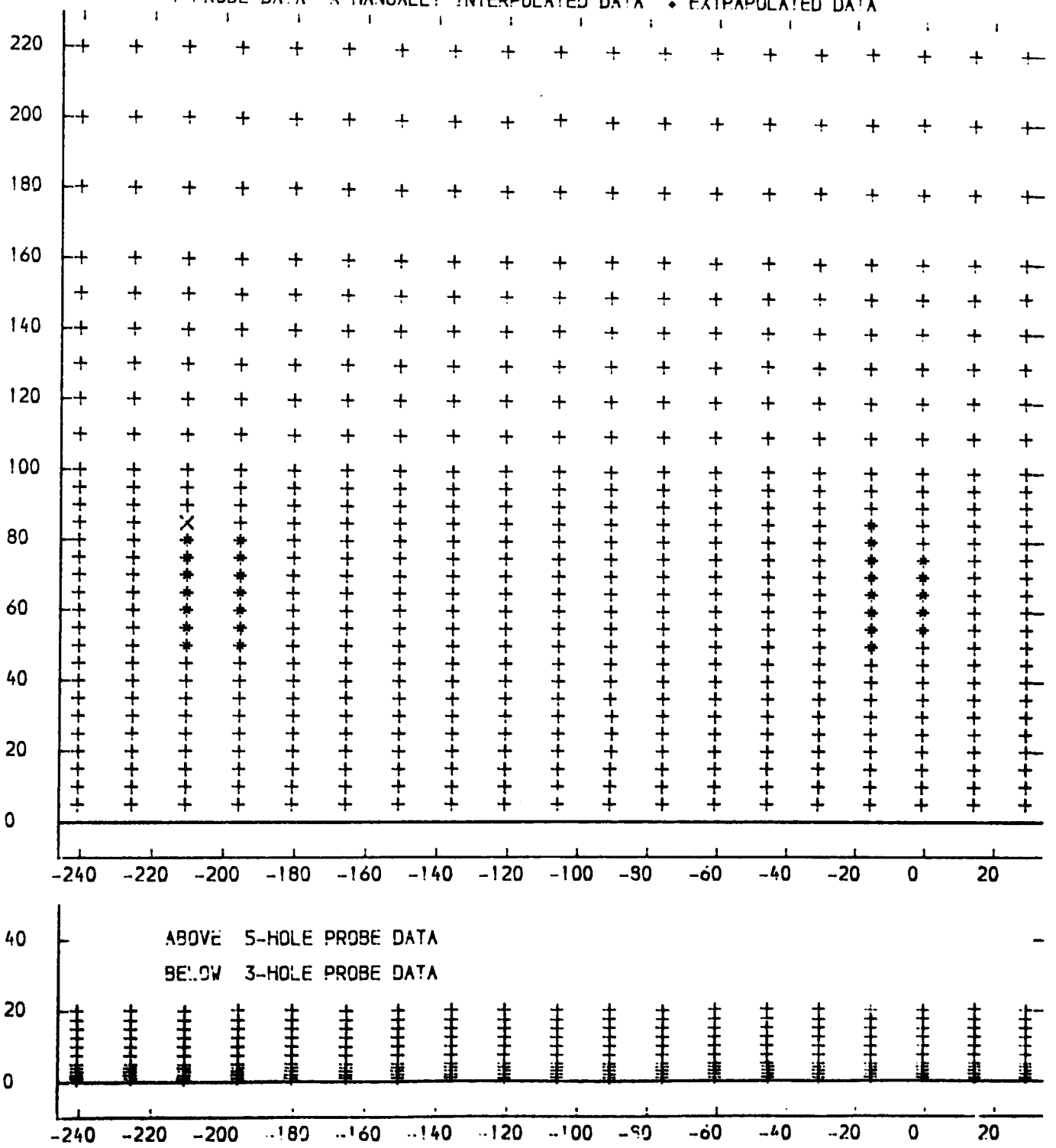


FIGURE 4.52

SLOT 8 TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL) / (PO1-P1)) CONTOURS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

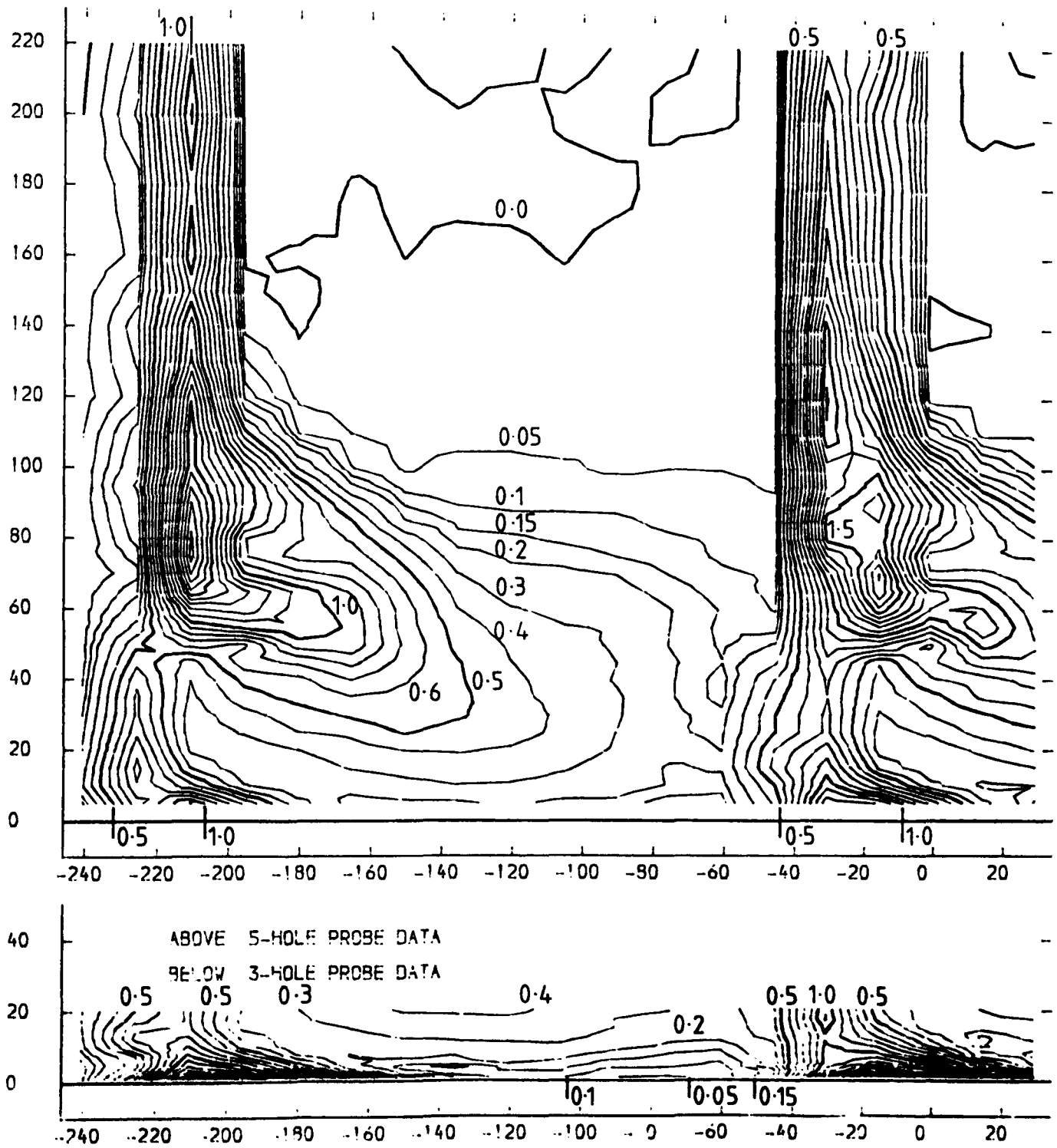


FIGURE 4.53

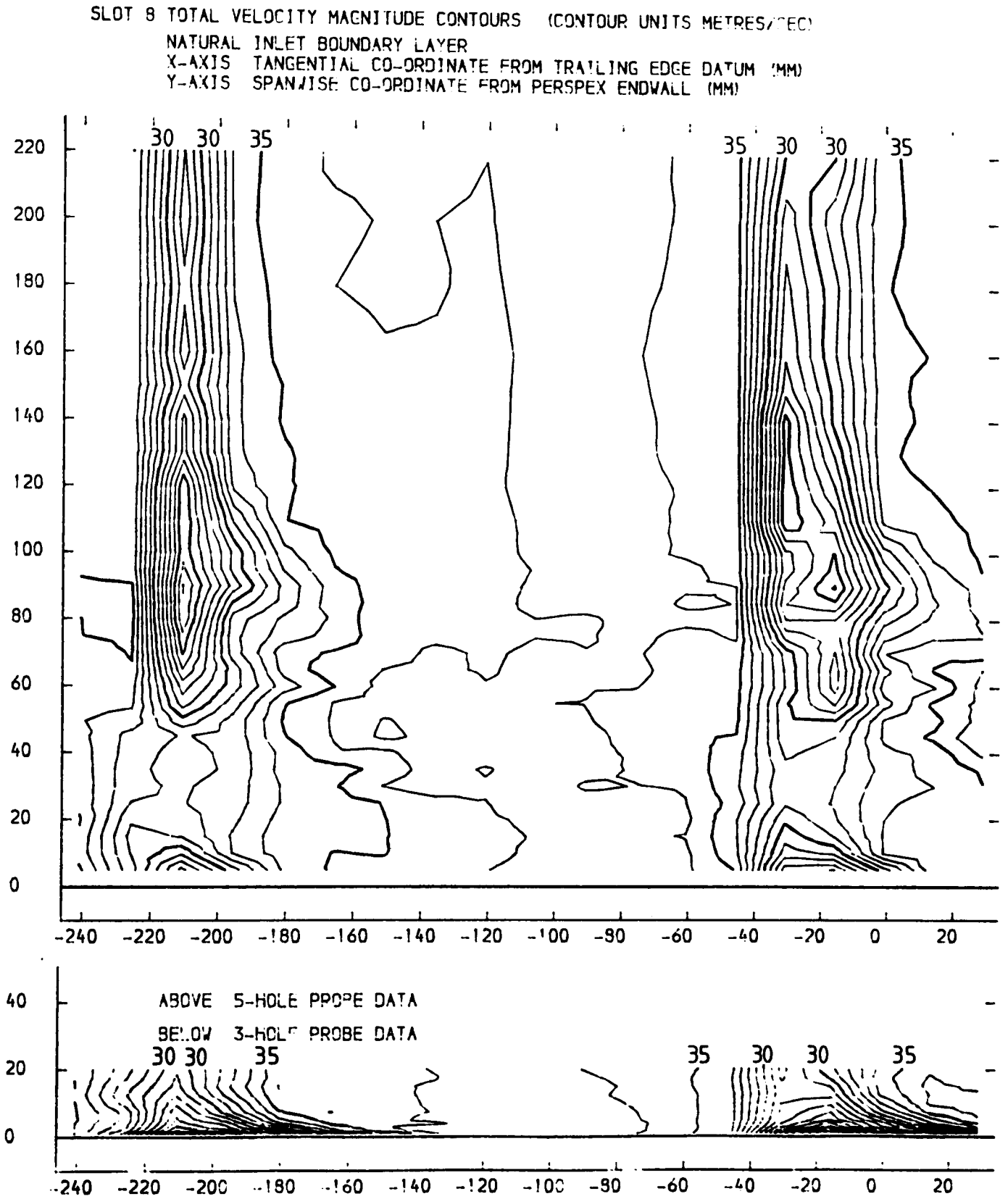
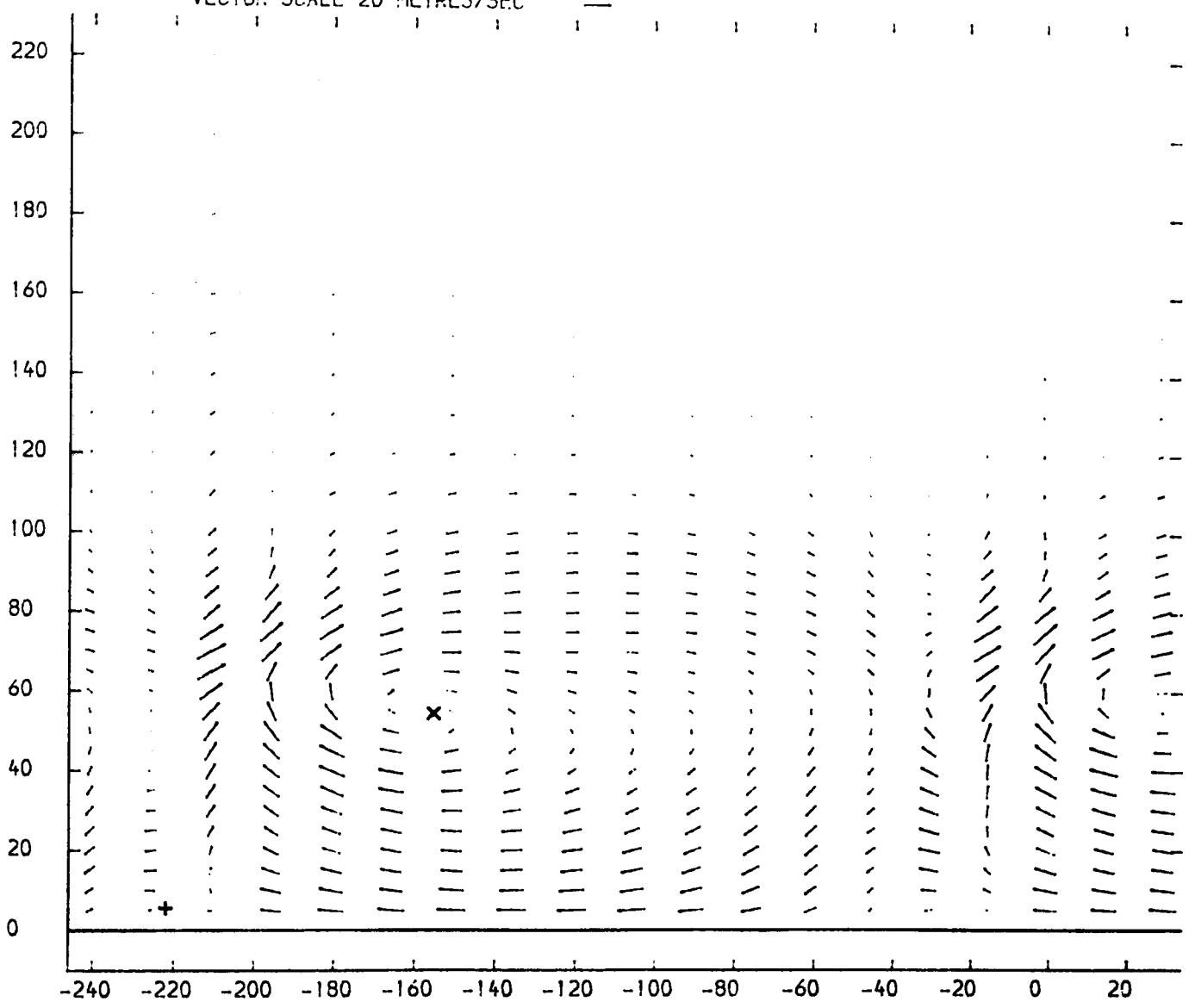

SLOT 8 TOTAL VELOCITY MAGNITUDE CONTOURS (CONTOUR UNITS METRES/SEC)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
30 30 35
35 30 30 35
220
200
180
160
140
120
100
80
60
40
20
0
-240 -220 -200 -180 -160 -140 -120 -100 -80 -60 -40 -20 0 20
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
30 30 35
35 30 30 35
40
20
0
-240 -220 -200 -180 -160 -140 -120 -100 -80 -60 -40 -20 0 20

FIGURE 4.54

SLOT 8 VECTOR PLOT OF SECONDARY VELOCITIES (VT(SEC)=VT(LOC)-VT(M.S.)+VA(LOC)/VA(M.S.))
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
VECTOR SCALE 20 METRES/SEC



× PASSAGE VORTEX CENTRE
+ COUNTER VORTEX CENTRE

FIGURE 4.55

SLOT 8 SPANWISE ANGLE (PITCH ANGLE) CONTOURS (CONTOUR UNITS DEGREES)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

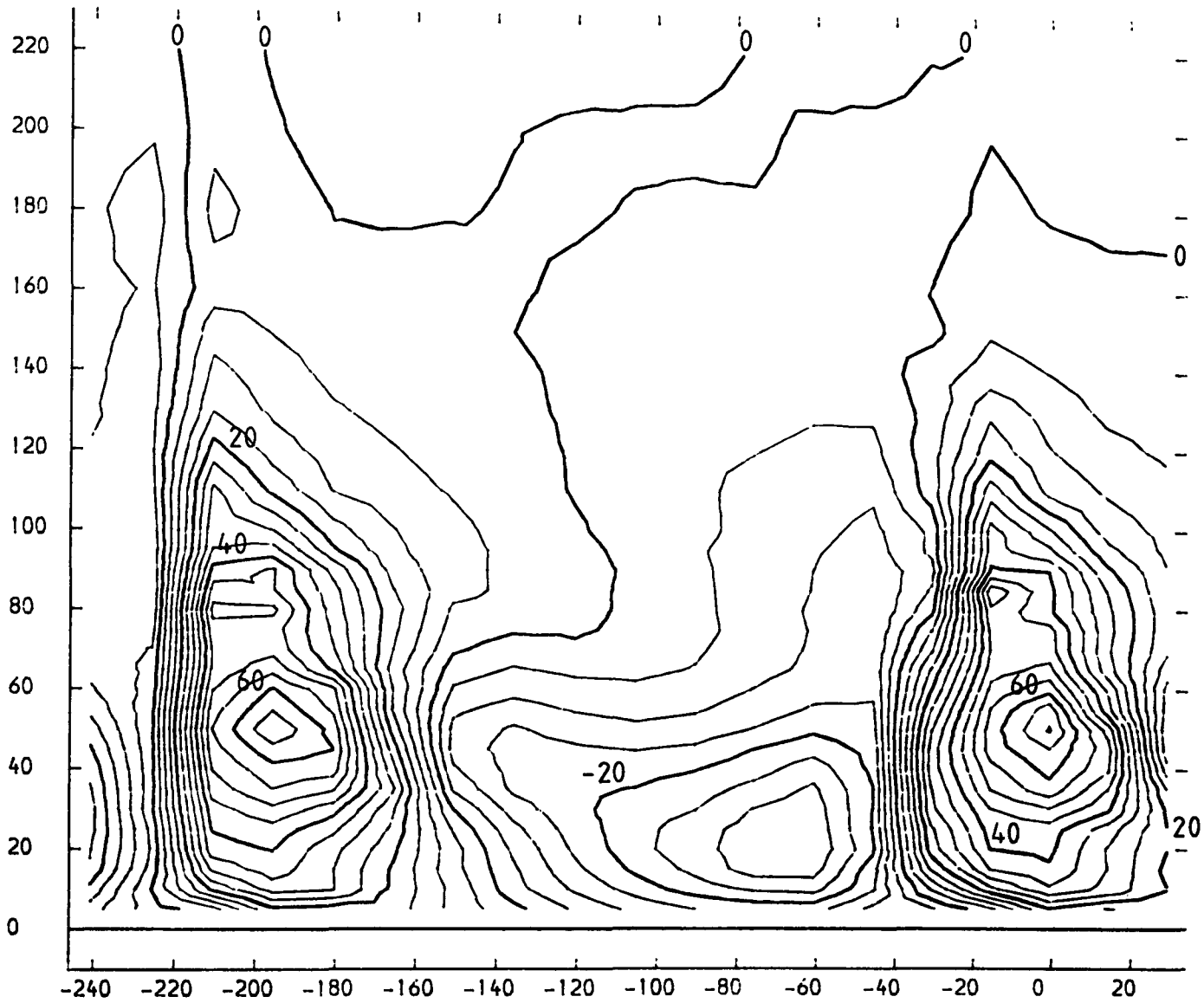


FIGURE 4.56

SLOT 8 YAW ANGLE CONTOURS (CONTOUR UNITS DEGREES)

NATURAL INLET BOUNDARY LAYER

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

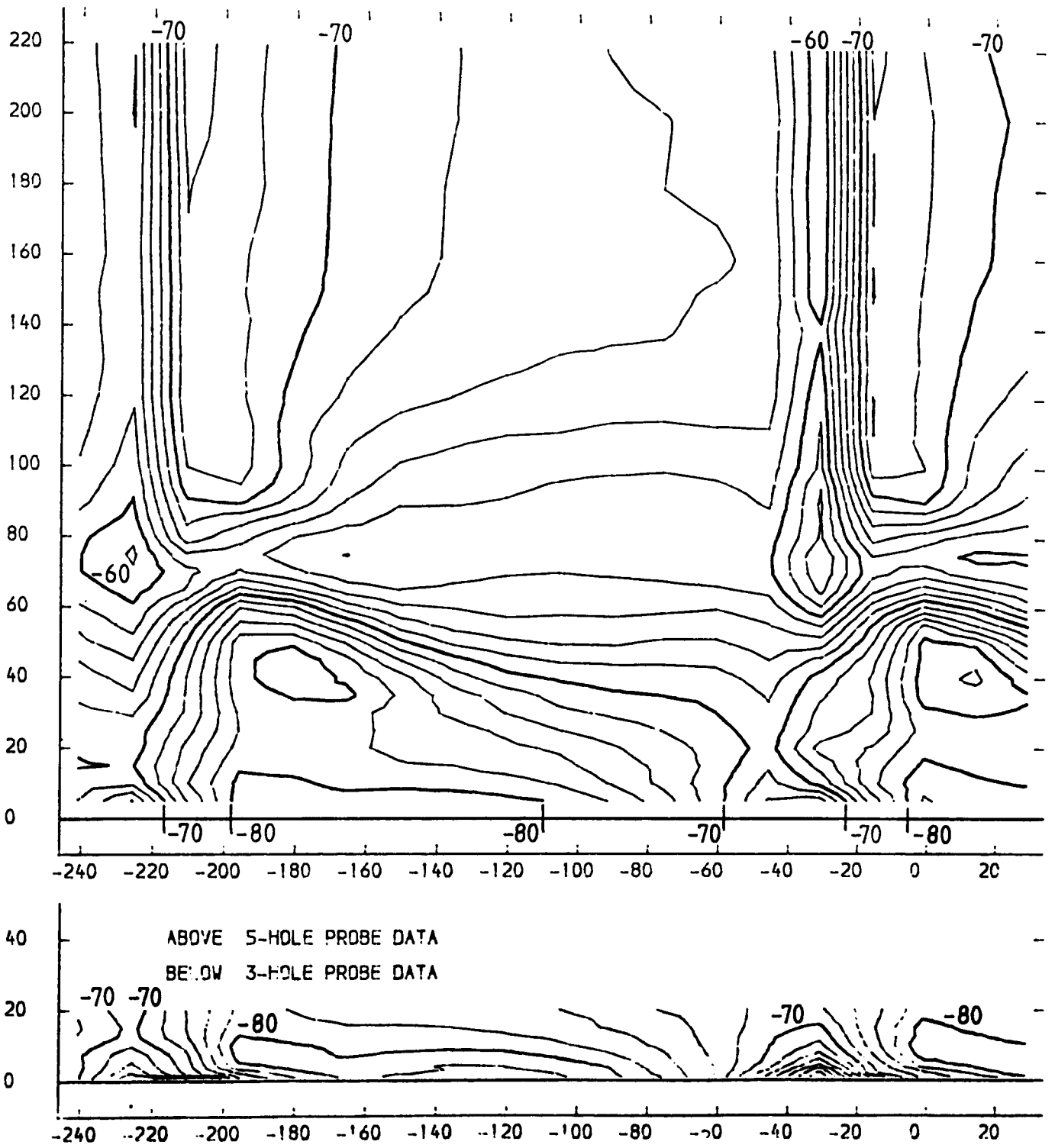


FIGURE 4.57

SLOT 8 STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(P01-P1)) CONTOURS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

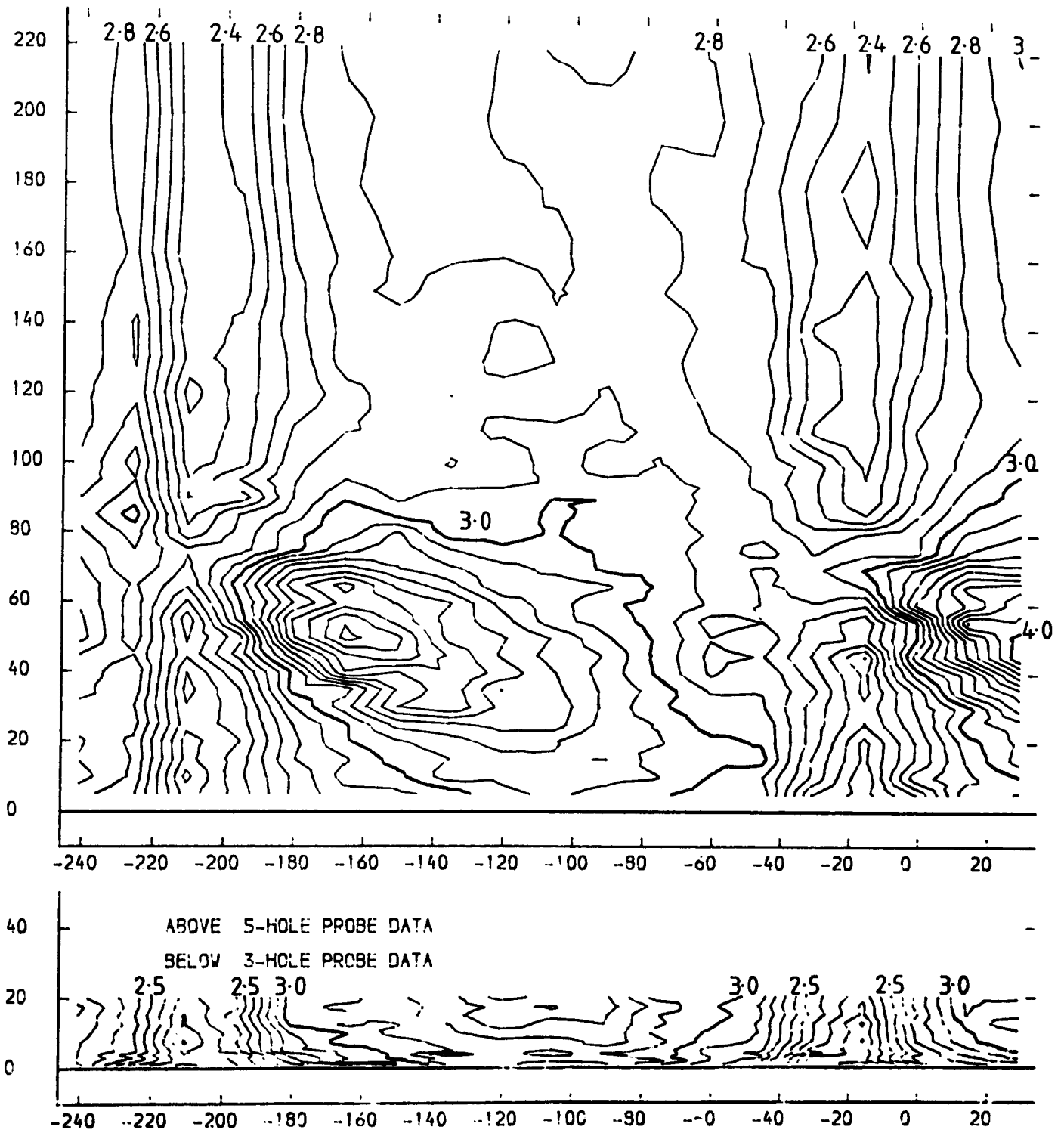


FIGURE 4.58

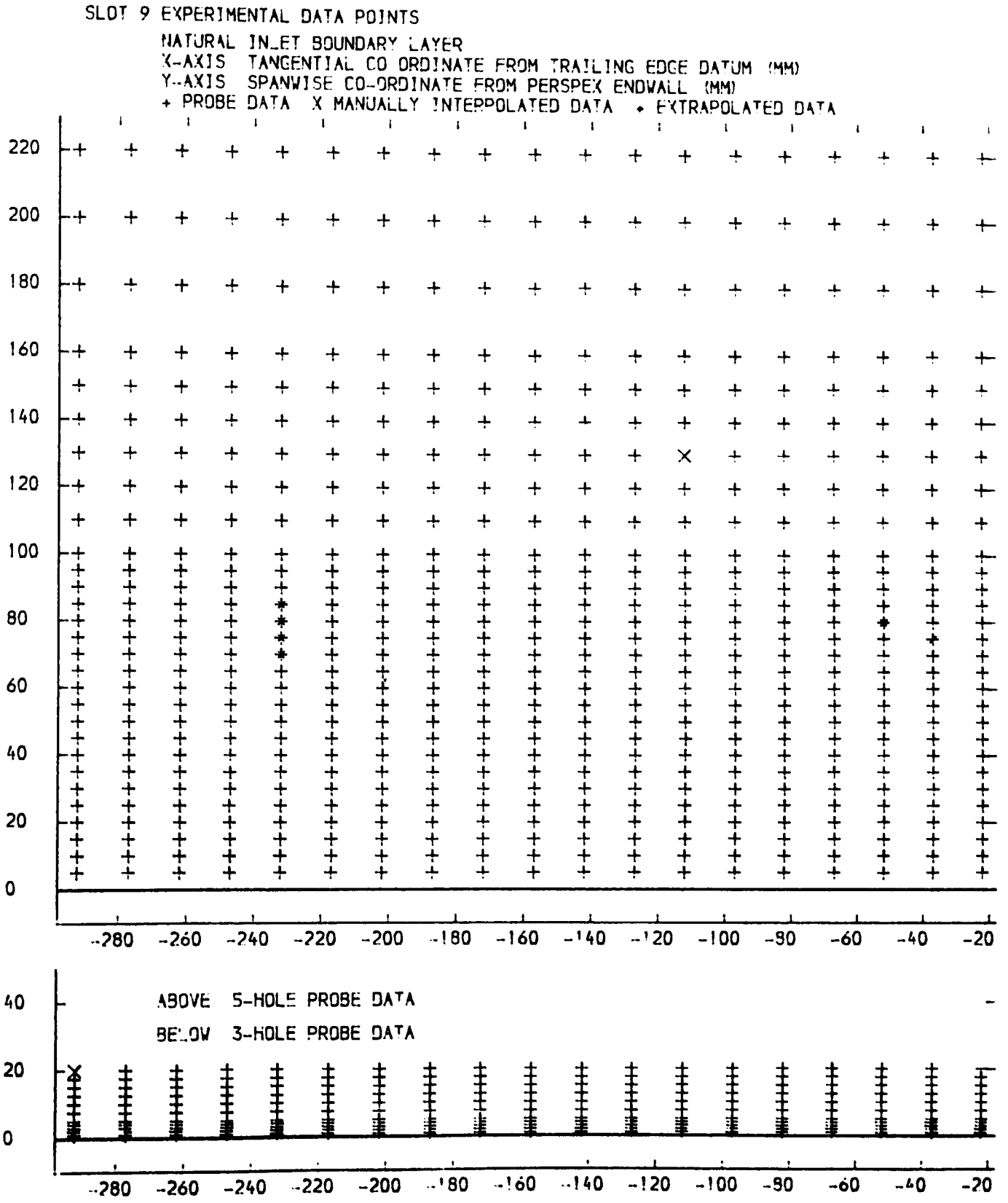

SLOT 9 EXPERIMENTAL DATA POINTS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
+ PROBE DATA X MANUALLY INTERPOLATED DATA * EXTRAPOLATED DATA
220
200
180
160
140
120
100
80
60
40
20
0
-280 -260 -240 -220 -200 -180 -160 -140 -120 -100 -80 -60 -40 -20
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
40
20
0
-280 -260 -240 -220 -200 -180 -160 -140 -120 -100 -80 -60 -40 -20

FIGURE 4.59

SLOT 9 TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL)/(PO1-P1)) CONTOURS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL O-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

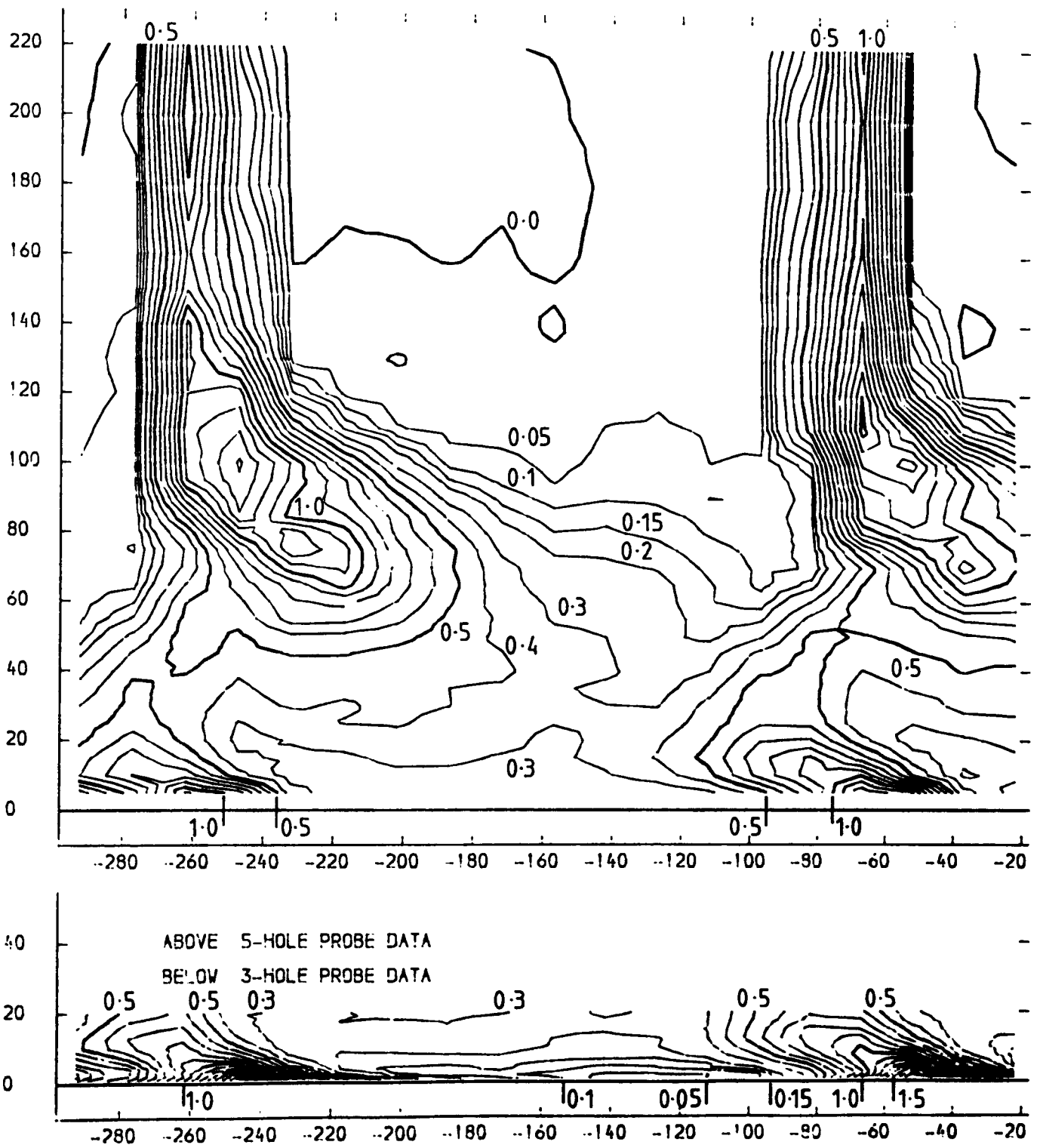


FIGURE 4.60

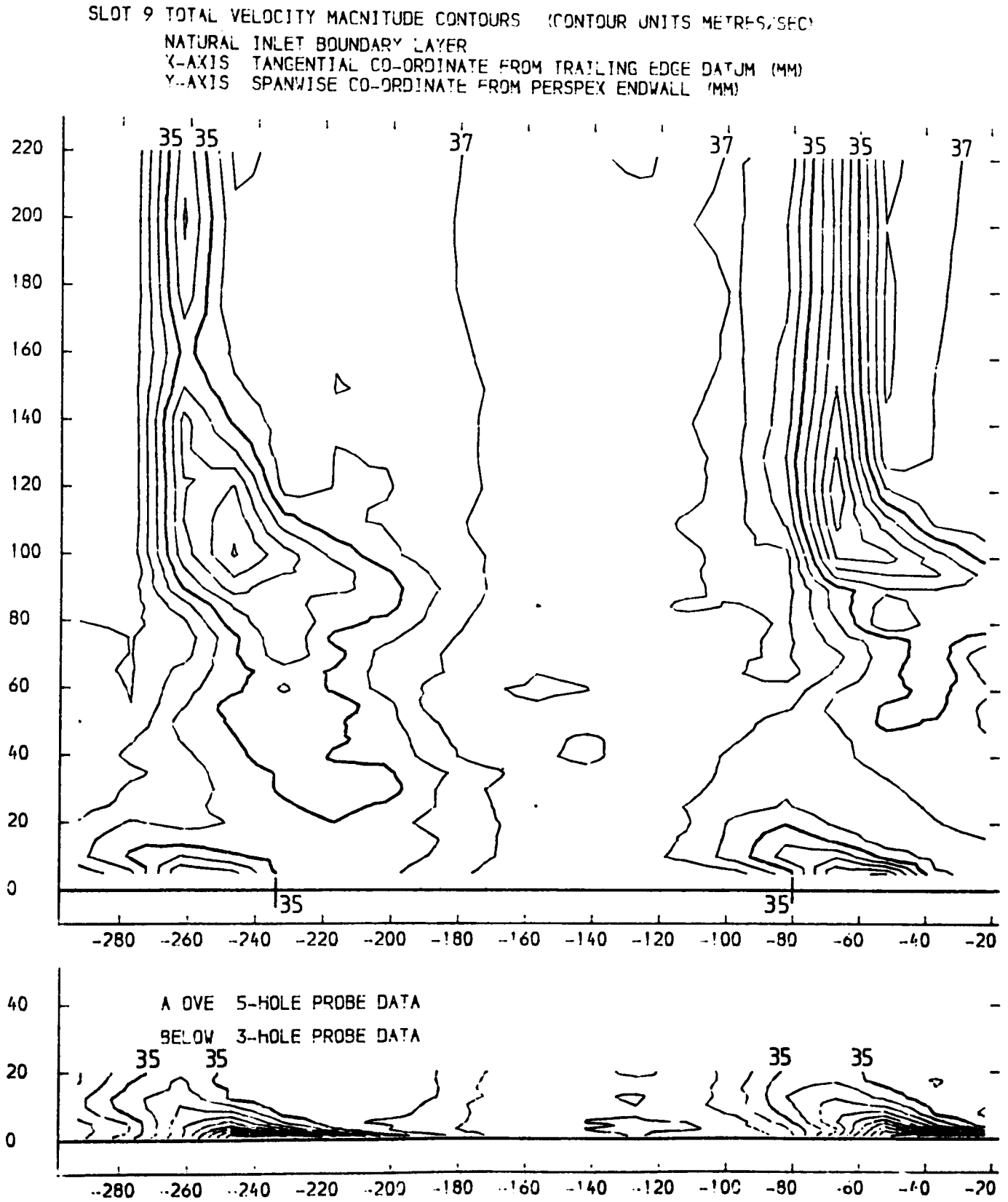

SLOT 9 TOTAL VELOCITY MAGNITUDE CONTOURS (CONTOUR UNITS METRES/SEC)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
35
37
220
200
180
160
140
120
100
80
60
40
20
0
-280
-260
-240
-220
-200
-180
-160
-140
-120
-100
-80
-60
-40
-20
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA

FIGURE 4.61

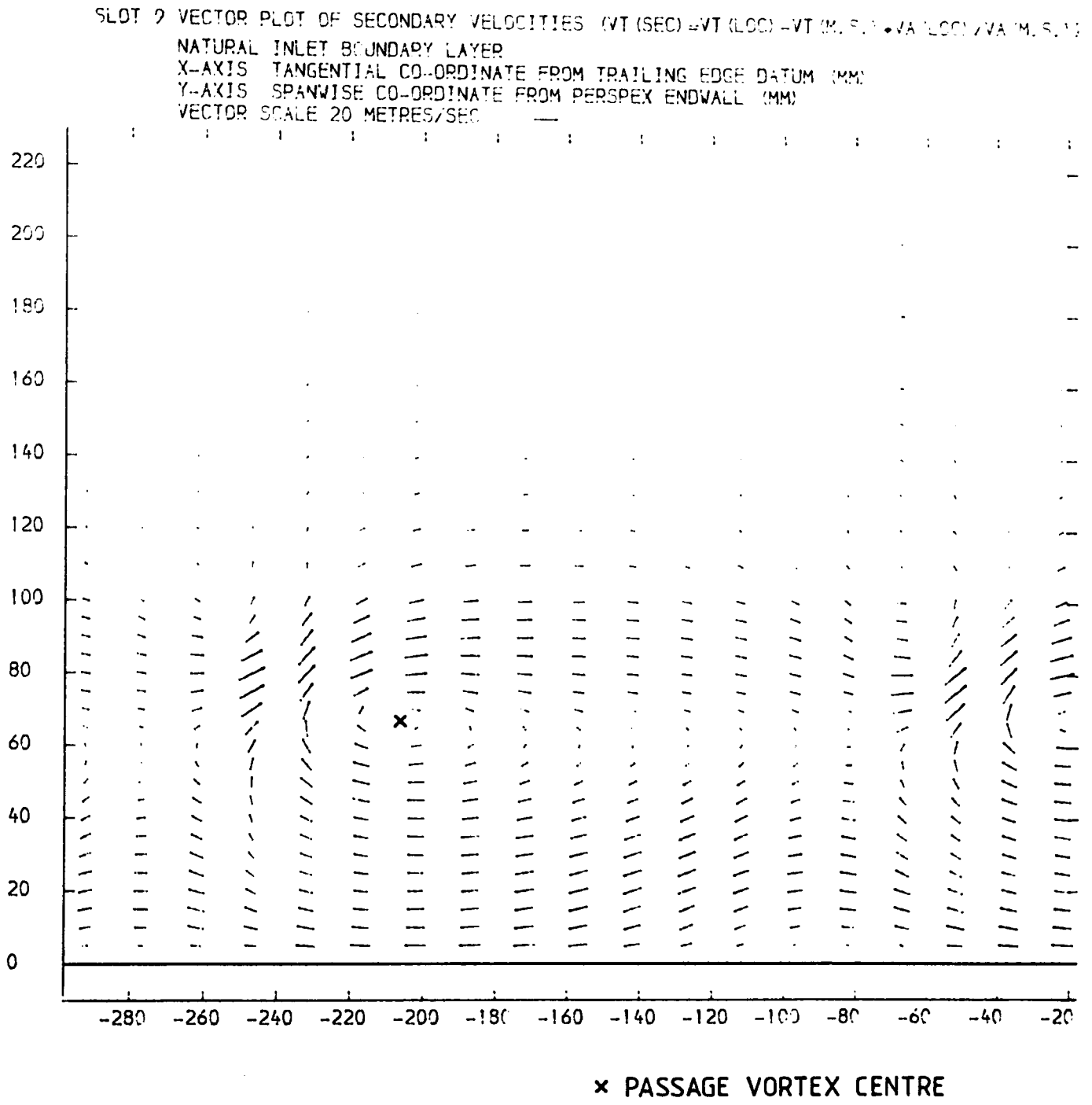

SLOT 2 VECTOR PLOT OF SECONDARY VELOCITIES (VT(SEC)=VT(LOC)-VT(M.S.)+VA(LOC)/VA(M.S.))
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
VECTOR SCALE 20 METRES/SEC
220
200
180
160
140
120
100
80
60
40
20
0
-280
-260
-240
-220
-200
-180
-160
-140
-120
-100
-80
-60
-40
-20
× PASSAGE VORTEX CENTRE

FIGURE 4.62

SLOT 9 SPANWISE ANGLE (PITCH ANGLE) CONTOURS (CONTOUR UNITS DEGREES)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

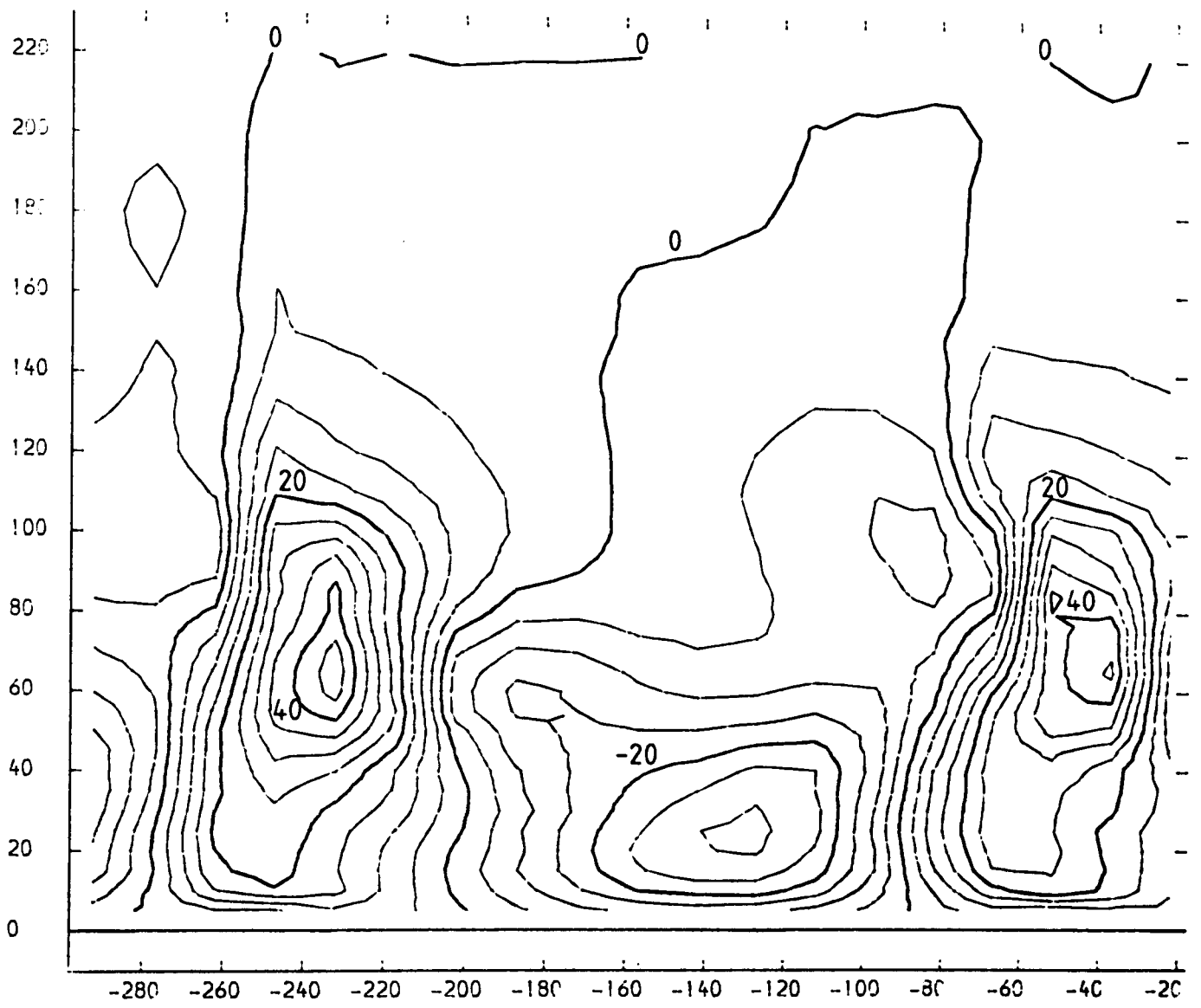


FIGURE 4.63

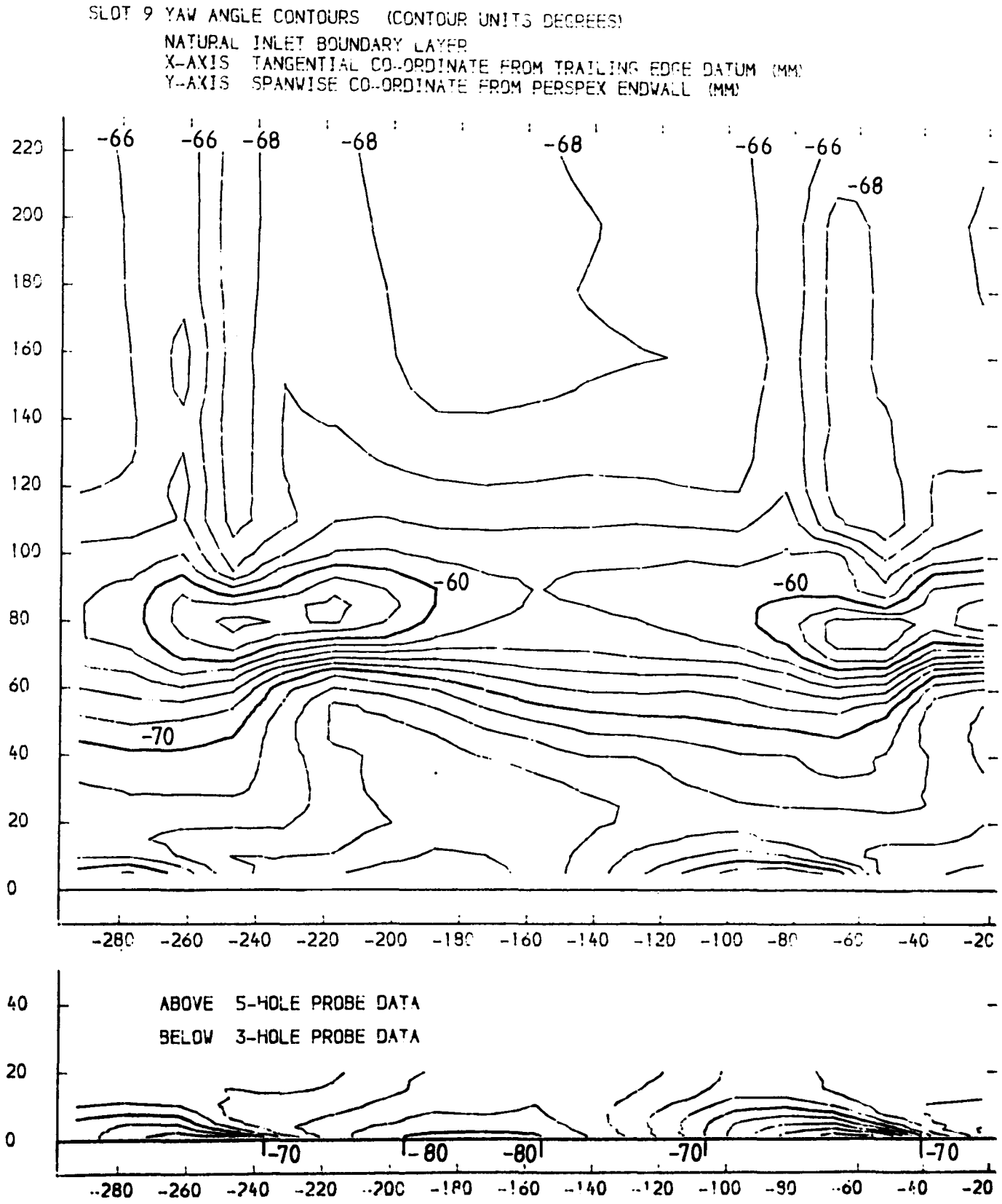

SLOT 9 YAW ANGLE CONTOURS (CONTOUR UNITS DEGREES)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
-66
-66
-68
-68
-68
-66
-66
-68
-60
-60
-70
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
-70
-80
-80
-70
-70

FIGURE 4.64

SLOT 9 STATIC PPESSURE COEFFICIENT ((P1-PLOCAL)/(PO'-P1)) CONTOURS
NATUPAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

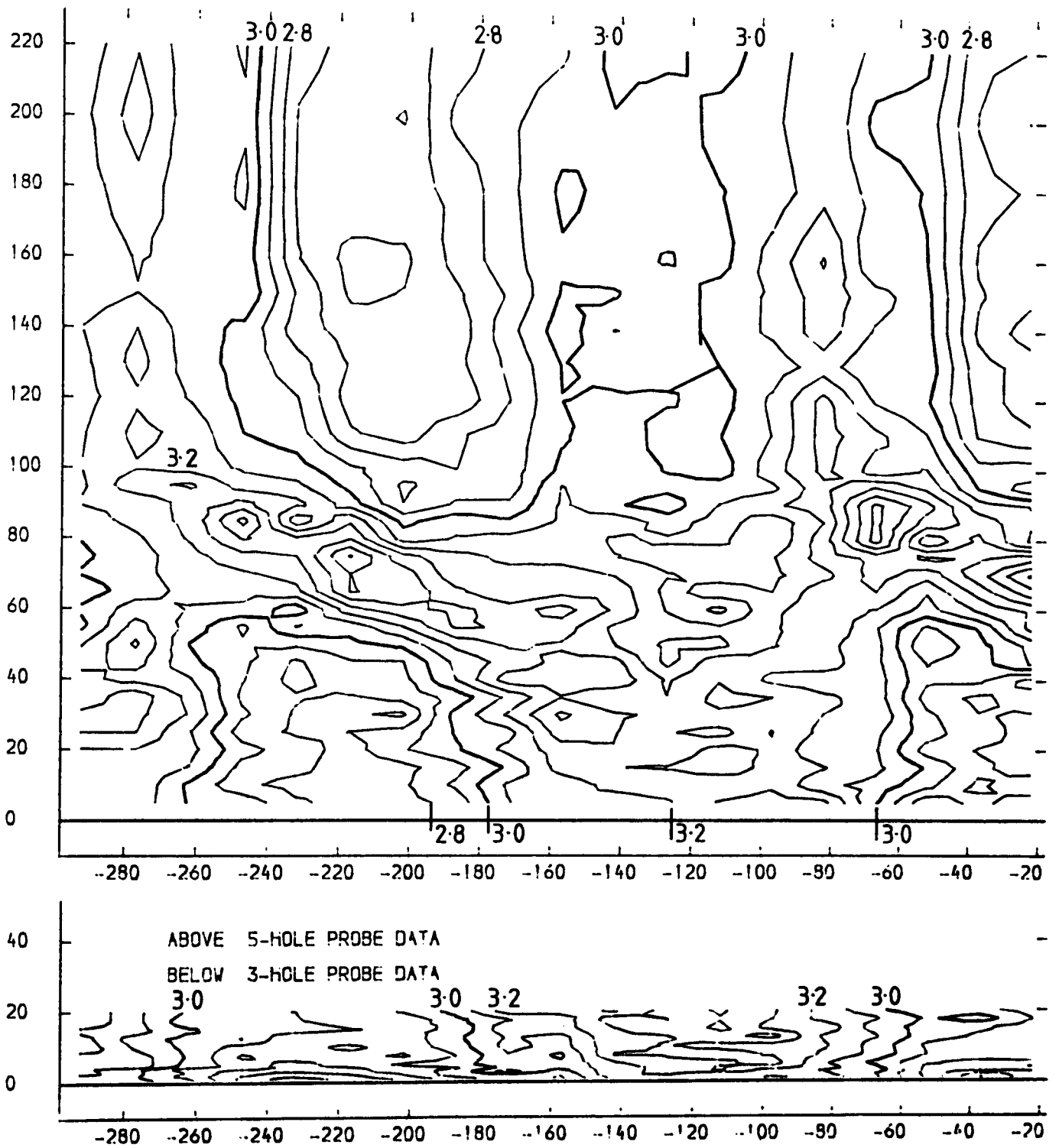


FIGURE 4.65

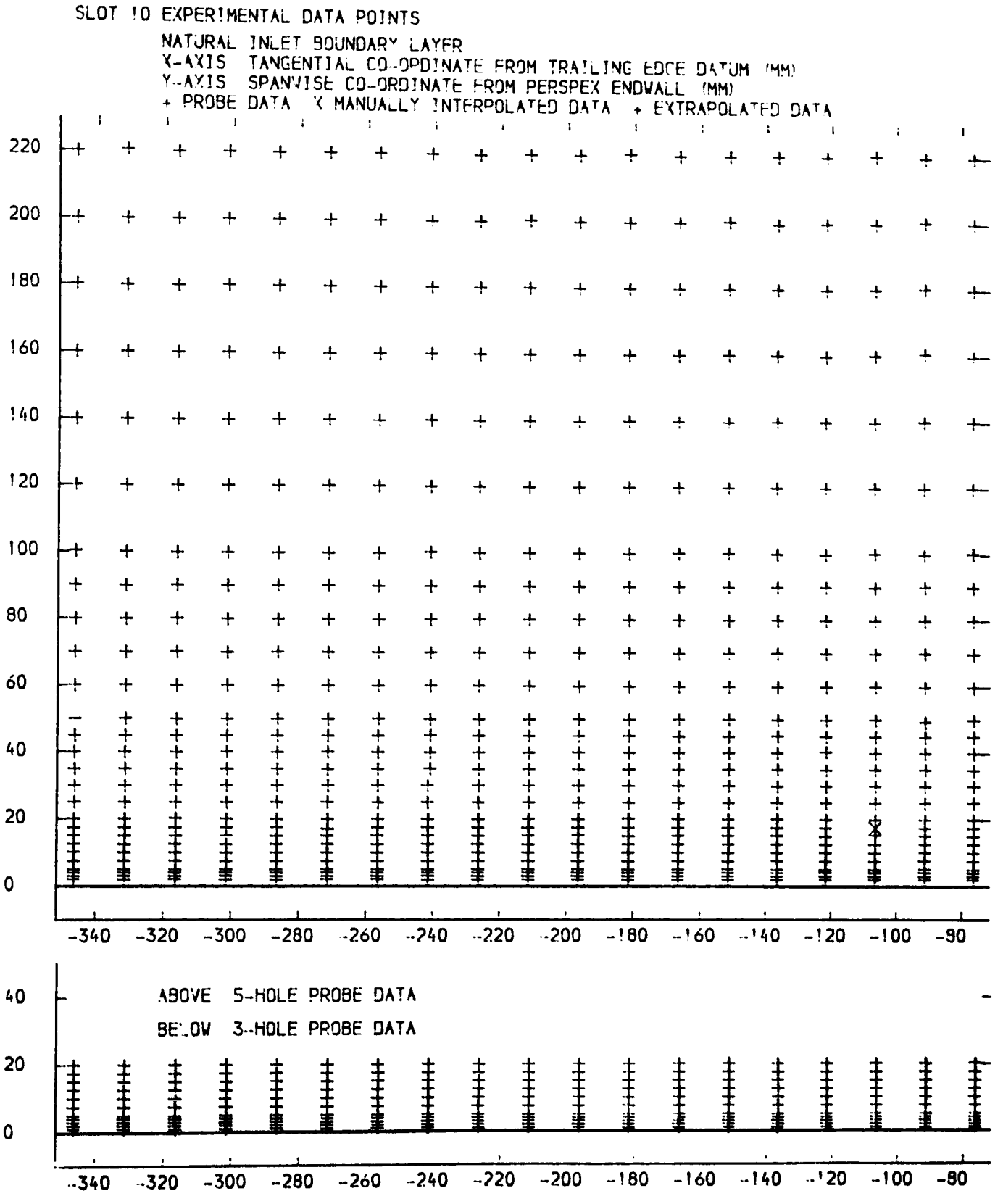

SLOT 10 EXPERIMENTAL DATA POINTS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
+ PROBE DATA X MANUALLY INTERPOLATED DATA + EXTRAPOLATED DATA
220
200
180
160
140
120
100
80
60
40
20
0
-340 -320 -300 -280 -260 -240 -220 -200 -180 -160 -140 -120 -100 -80
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
40
20
0
-340 -320 -300 -280 -260 -240 -220 -200 -180 -160 -140 -120 -100 -80

FIGURE 4.66

SLOT 10 TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL) / (PO1-P1)) CONTOURS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

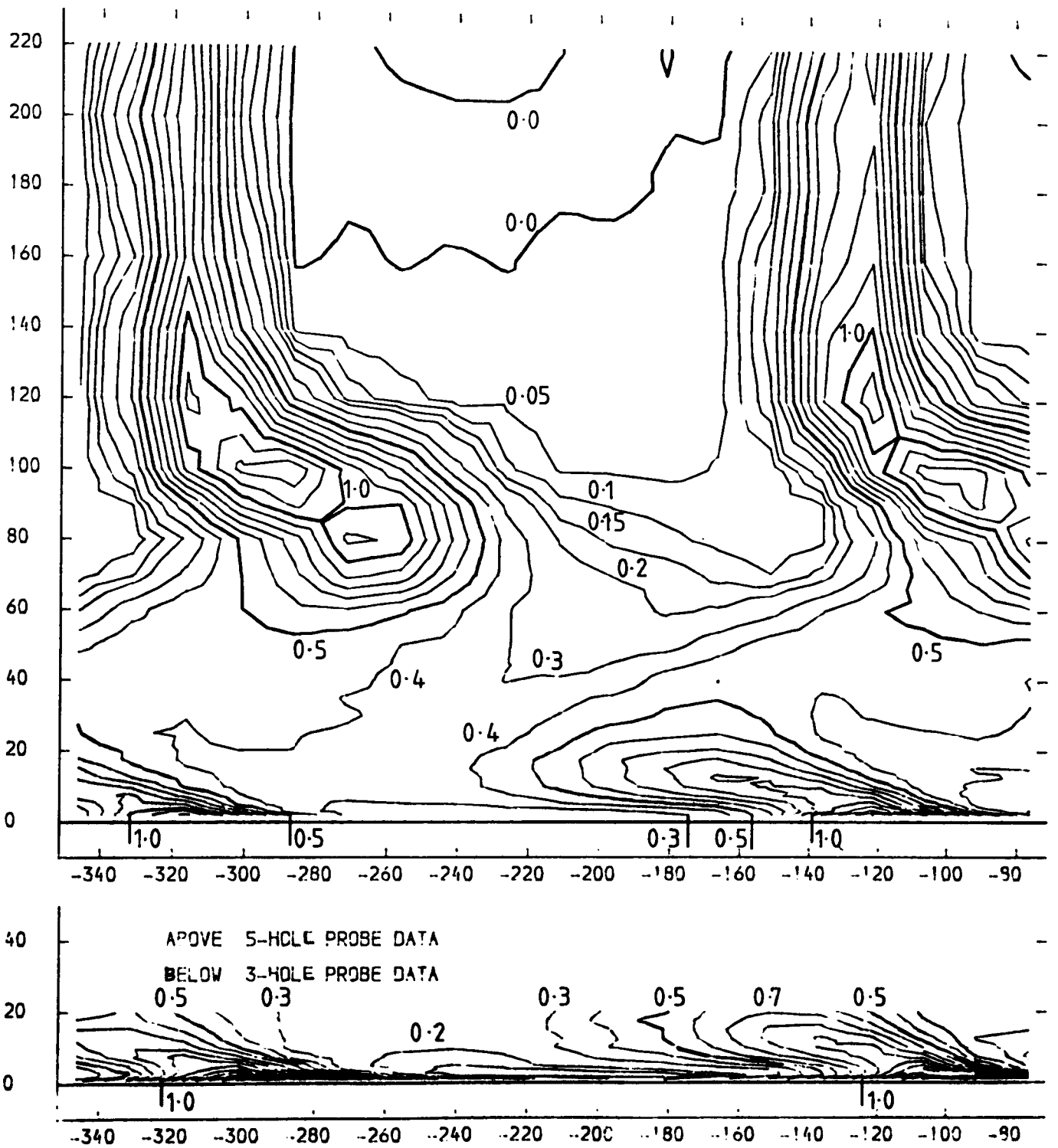


FIGURE 4.67

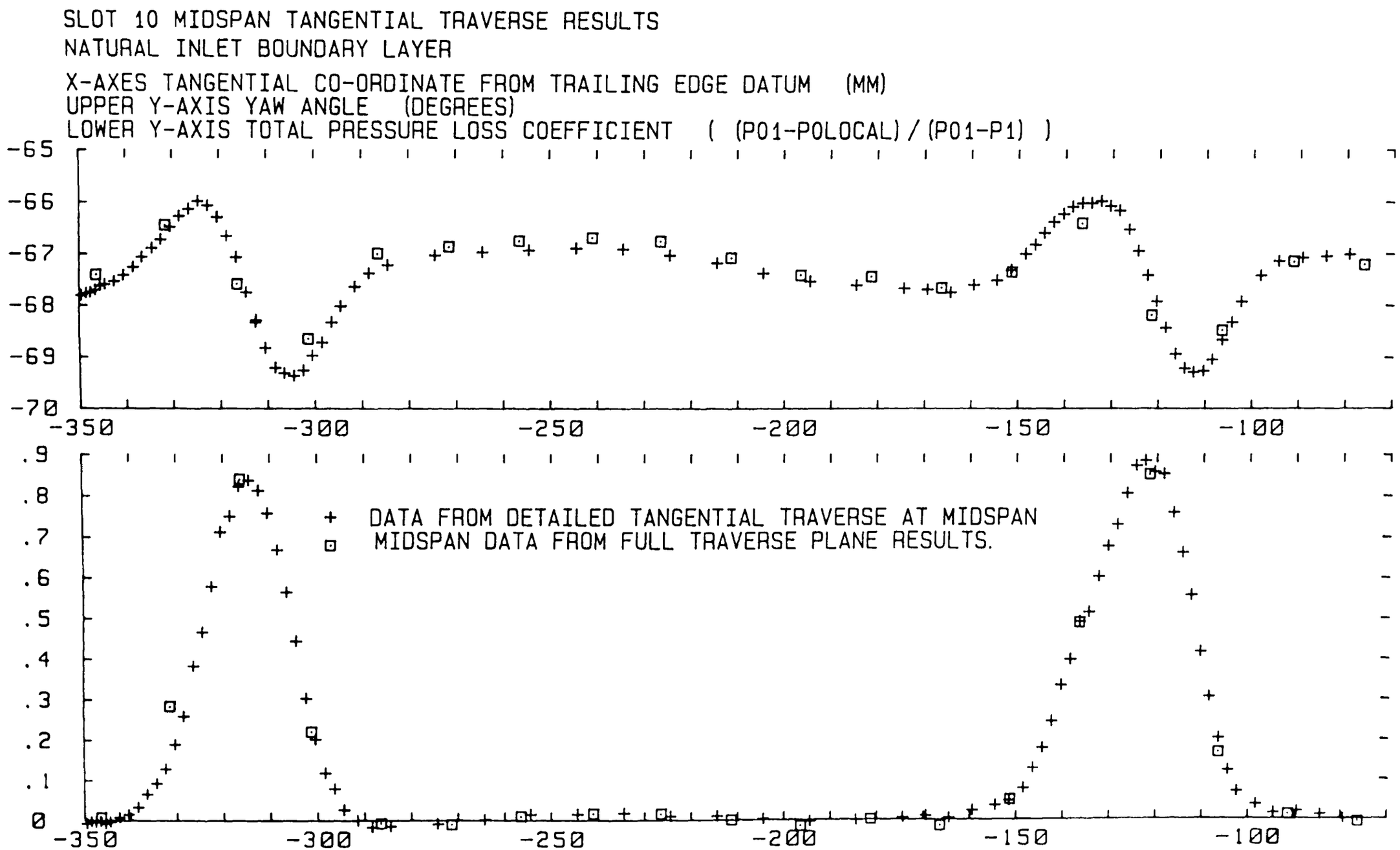

SLOT 10 MIDSPAN TANGENTIAL TRAVERSE RESULTS
NATURAL INLET BOUNDARY LAYER
X-AXES TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
UPPER Y-AXIS YAW ANGLE (DEGREES)
LOWER Y-AXIS TOTAL PRESSURE LOSS COEFFICIENT ((P01-POLOCAL)/(P01-P1))
-65
-66
-67
-68
-69
-70
-350
-300
-250
-200
-150
-100
.9
.8
.7
.6
.5
.4
.3
.2
.1
0
DATA FROM DETAILED TANGENTIAL TRAVERSE AT MIDSPAN
MIDSPAN DATA FROM FULL TRAVERSE PLANE RESULTS.

FIGURE 4.68

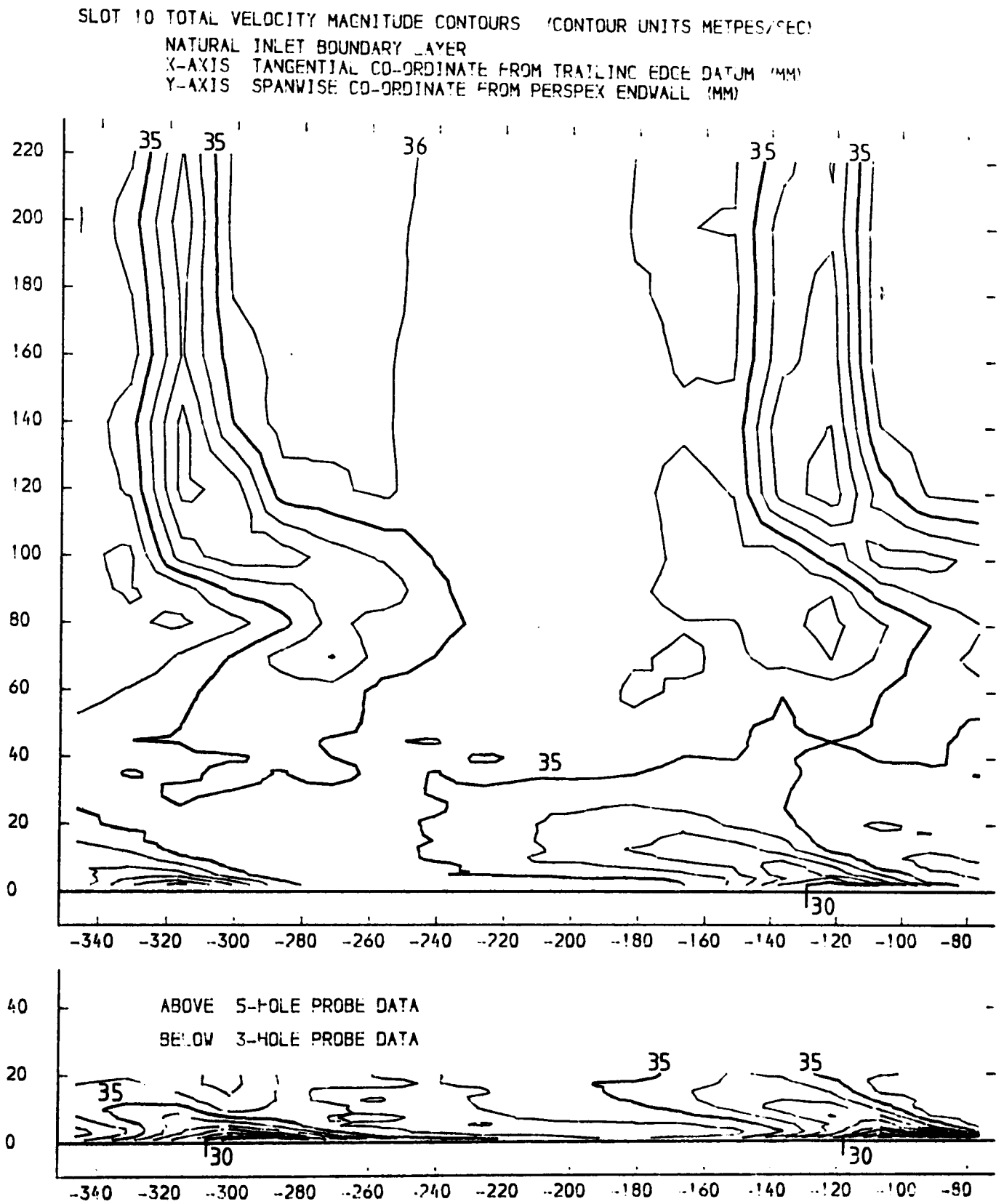
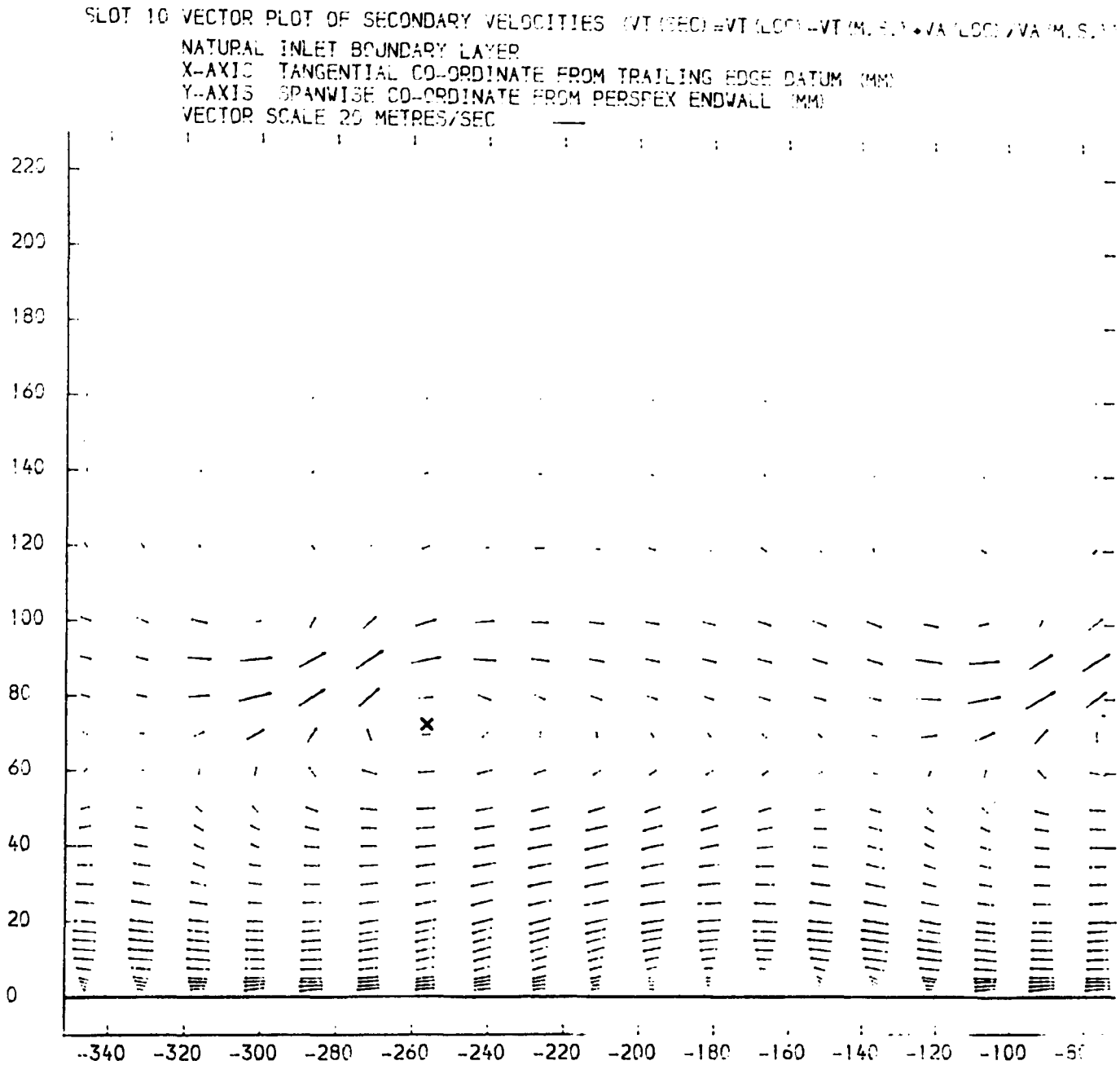

SLOT 10 TOTAL VELOCITY MAGNITUDE CONTOURS (CONTOUR UNITS METRES/SEC)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
35
36
30

FIGURE 4.69



× PASSAGE VORTEX CENTRE

FIGURE 4.70

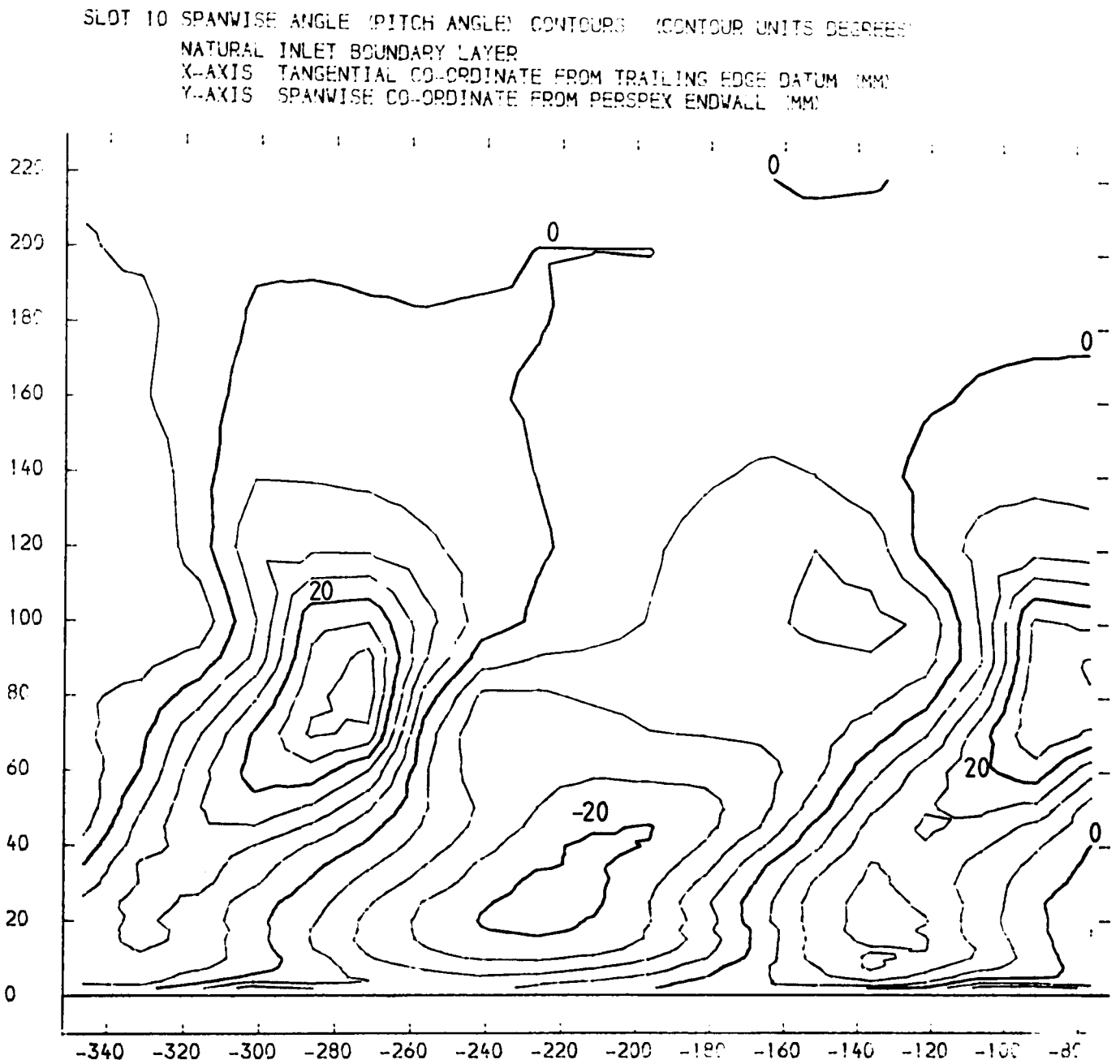

SLOT 10 SPANWISE ANGLE (PITCH ANGLE) CONTOURS (CONTOUR UNITS DEGREES)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
0
0
0
20
-20
20
0
220
200
180
160
140
120
100
80
60
40
20
0
-340
-320
-300
-280
-260
-240
-220
-200
-180
-160
-140
-120
-100
-80

FIGURE 4.71

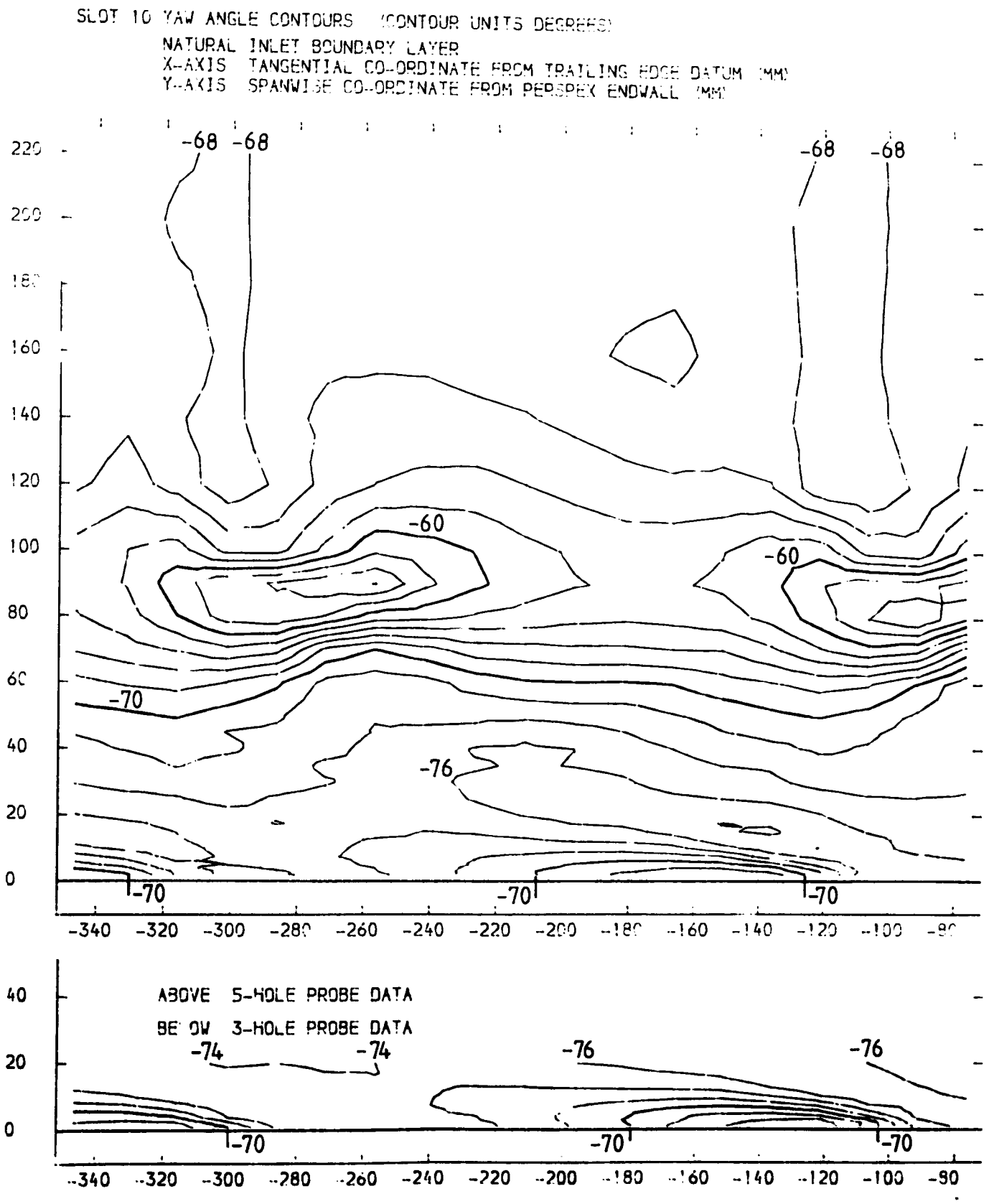

SLOT 10 YAW ANGLE CONTOURS (CONTOUR UNITS DEGREES)
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
-68
-60
-70
-76
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
-74

FIGURE 4.72

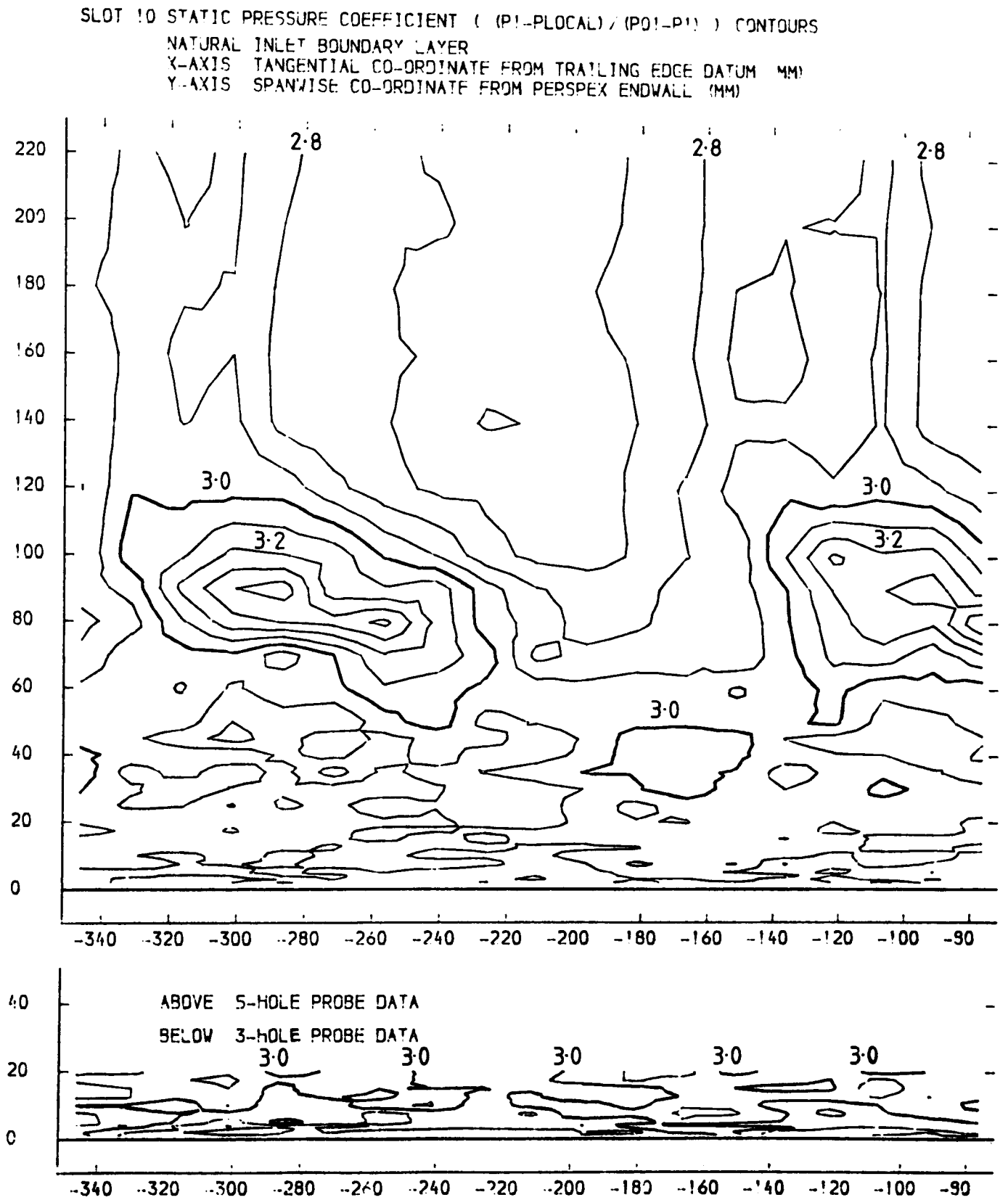
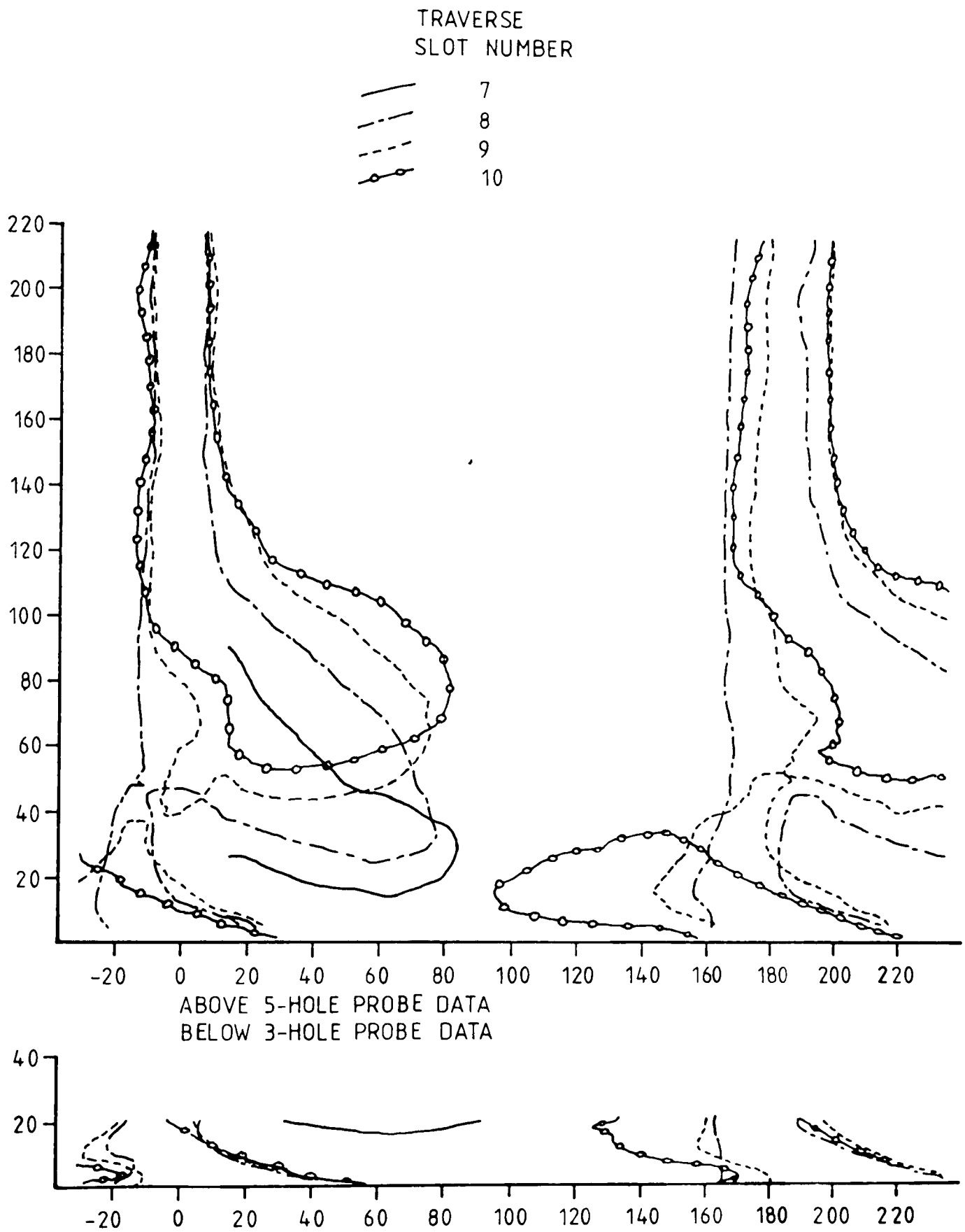

SLOT 10 STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(P01-P1)) CONTOURS
NATURAL INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
2·8
2·8
2·8
3·0
3·0
3·2
3·2
3·0
220
200
180
160
140
120
100
80
60
40
20
0
-340 -320 -300 -280 -260 -240 -220 -200 -180 -160 -140 -120 -100 -90
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
3·0
3·0
3·0
3·0
3·0
40
20
0
-340 -320 -300 -280 -260 -240 -220 -200 -180 -160 -140 -120 -100 -90

FIGURE 4.73

LOSS CORE DEVELOPMENT DOWNSTREAM OF THE BLADE PASSAGE

X-AXIS TANGENTIAL CO-ORDINATE FROM BLADE SUCTION SURFACE OR TANGENTIAL CO-ORDINATE FROM WAKE CENTRE-LINE (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

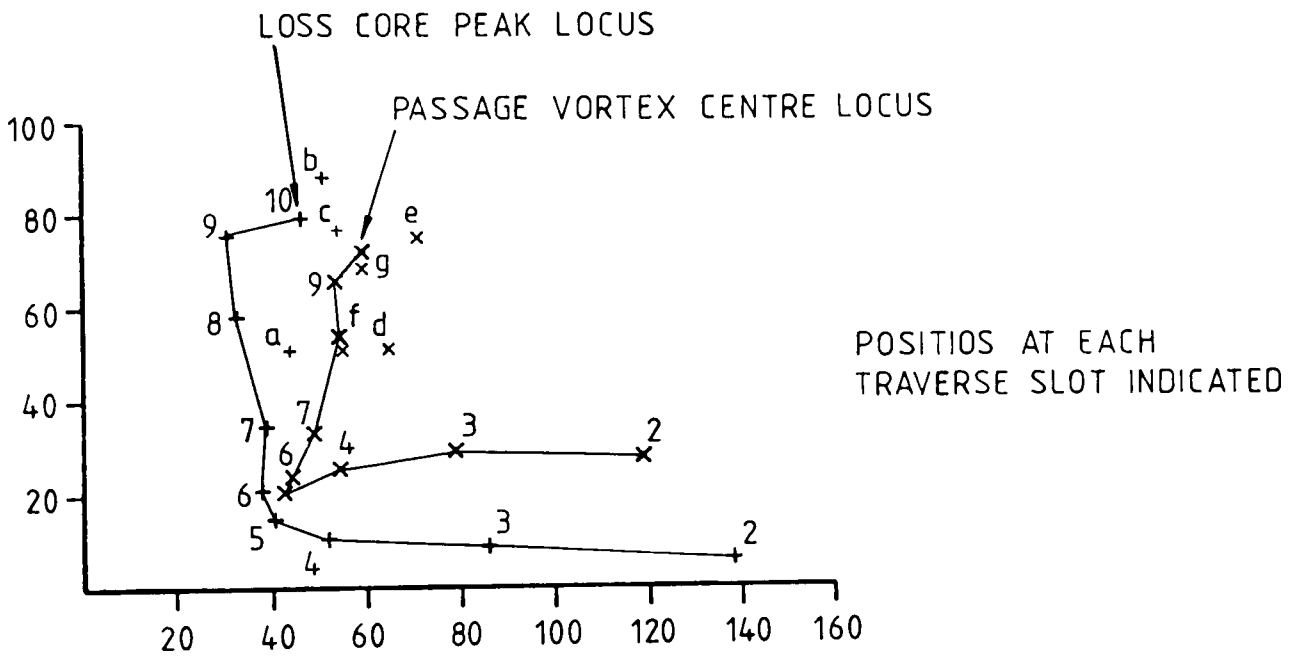


LOCI OF PASSAGE VORTEX CENTRE AND LOSS CORE PEAK

X-AXIS TANGENTIAL CO-ORDINATE FROM BLADE SUCTION SURFACE OR TANGENTIAL CO-ORDINATE FROM WAKE CENTRE-LINE (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

ADDITIONAL POINTS KEY

POINT	SLOT NO.	BOUNDARY LAYER AT CASCADE INLET	
a b	8 10	THICKENED	LOSS CORE POSITION
a c	8 10	THINNED	
d e	8 10	THICKENED	PASSAGE VORTEX CENTRE
f g	8 10	THINNED	



PASSAGE VORTEX CENTRE SITUATED AT INTERSECTION OF ZERO SPANWISE AND ZERO CROSS FLOW ANGLE CONTOURS ON EACH PROBE TRAVERSE PLANE

FIGURE 4.

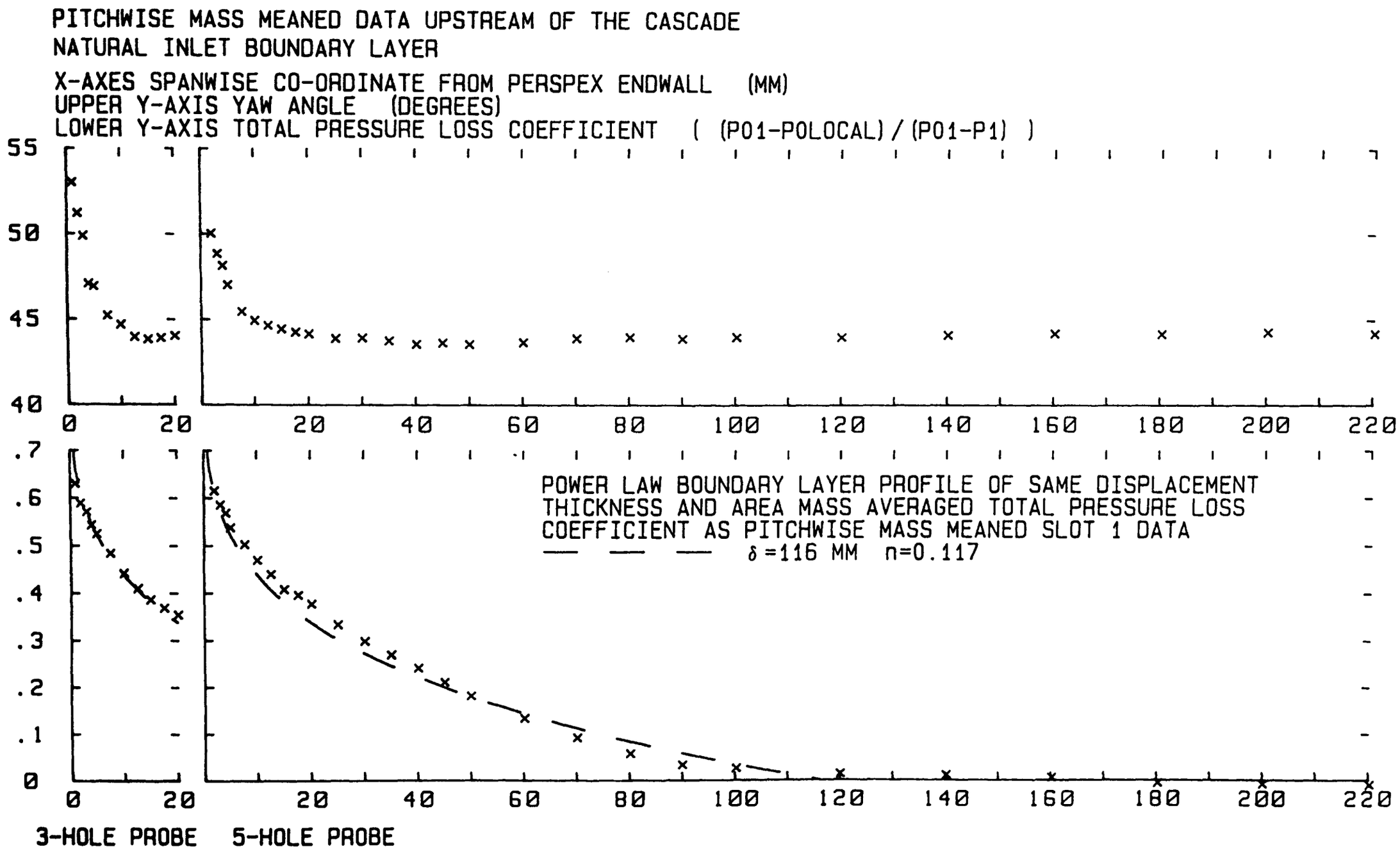

PITCHWISE MASS MEANED DATA UPSTREAM OF THE CASCADE
NATURAL INLET BOUNDARY LAYER
X-AXES SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
UPPER Y-AXIS YAW ANGLE (DEGREES)
LOWER Y-AXIS TOTAL PRESSURE LOSS COEFFICIENT ((P01-POLOCAL)/(P01-P1))
POWER LAW BOUNDARY LAYER PROFILE OF SAME DISPLACEMENT THICKNESS AND AREA MASS AVERAGED TOTAL PRESSURE LOSS COEFFICIENT AS PITCHWISE MASS MEANED SLOT 1 DATA
δ =116 MM n=0.117
3-HOLE PROBE
5-HOLE PROBE

FIGURE 4.76

PITCHWISE MASS MEANED OVERTURNING ANGLE WITHIN THE BLADE PASSAGE
NATURAL INLET BOUNDARY LAYER

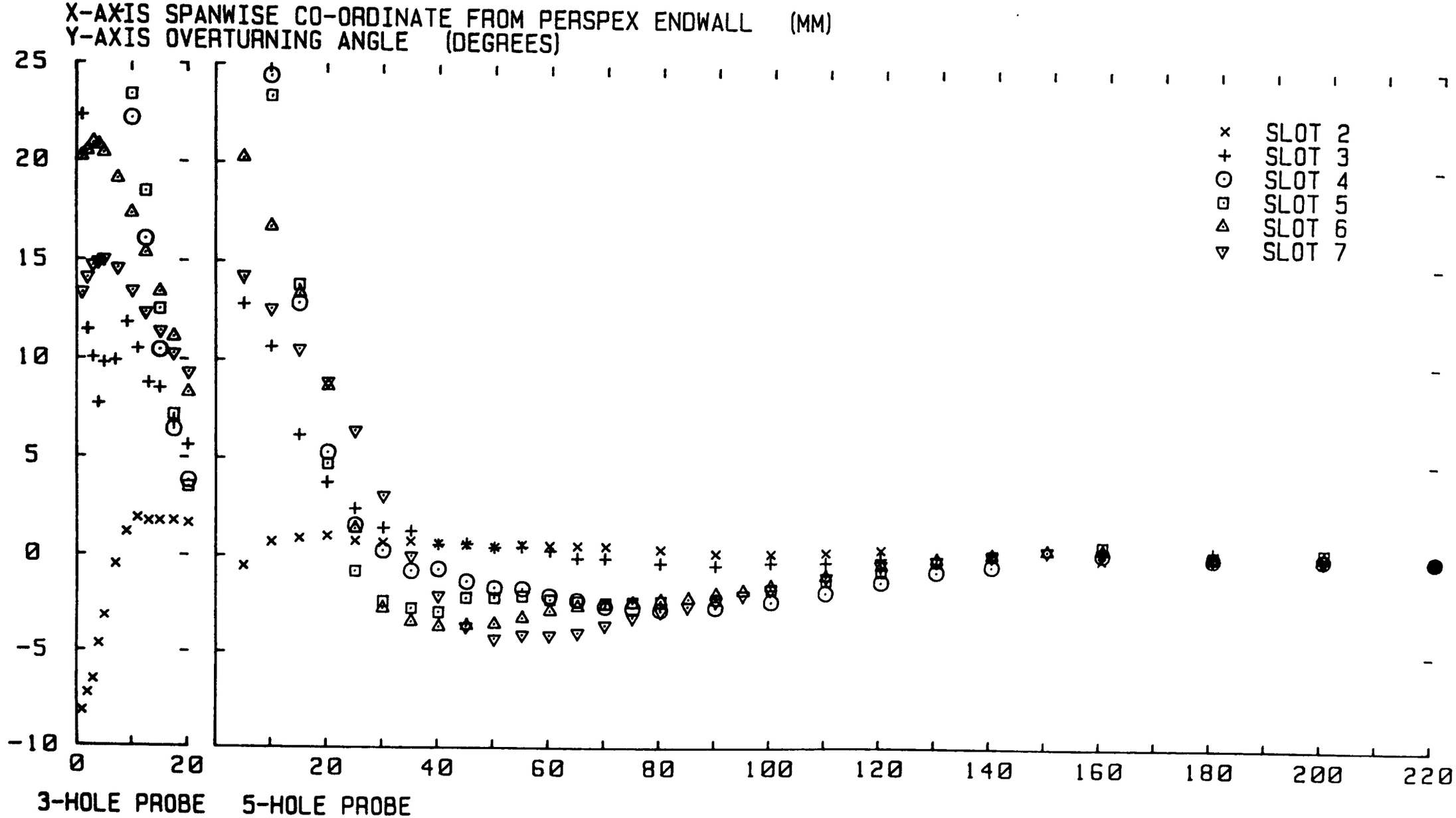


FIGURE 4.77

PITCHWISE MASS MEANED TOTAL PRESSURE LOSS COEFFICIENT WITHIN THE BLADE PASSAGE
NATURAL INLET BOUNDARY LAYER

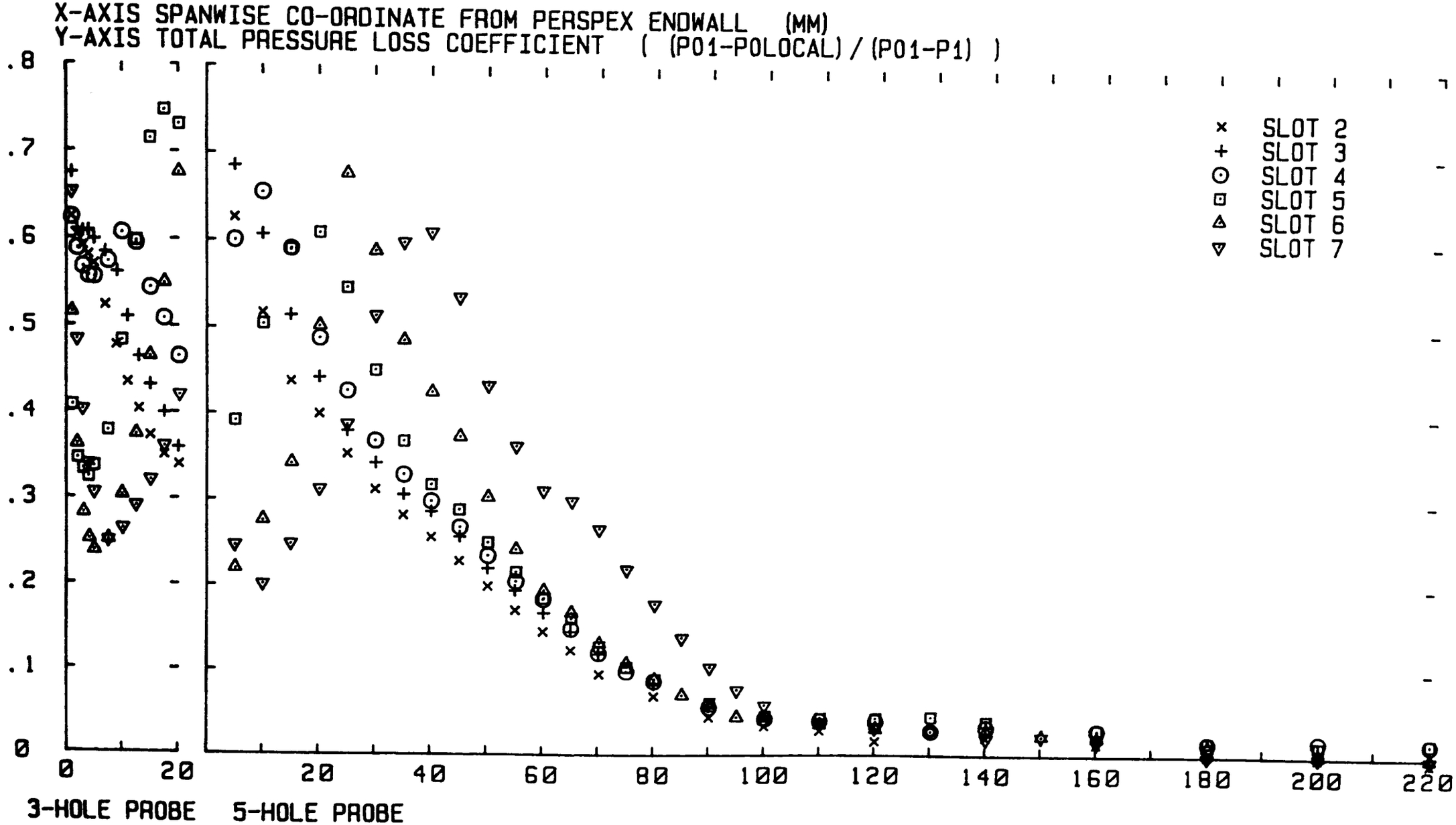


FIGURE 4.78

PITCHWISE MASS MEANED OVERTURNING ANGLE DOWNSTREAM OF THE CASCADE
NATURAL INLET BOUNDARY LAYER

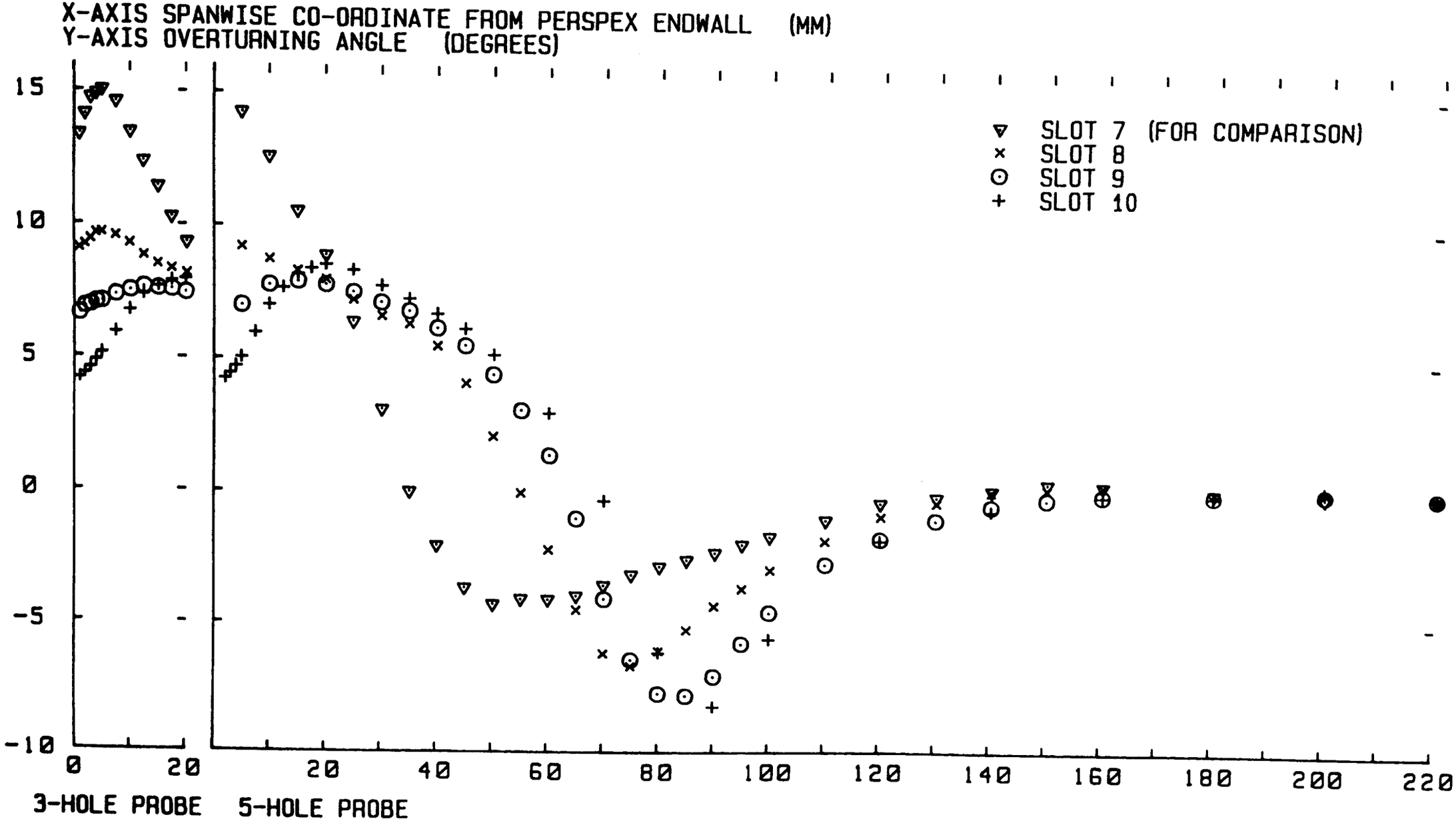


FIGURE 4.79

PITCHWISE MASS MEANED TOTAL PRESSURE LOSS COEFFICIENT DOWNSTREAM OF THE CASCADE
NATURAL INLET BOUNDARY LAYER

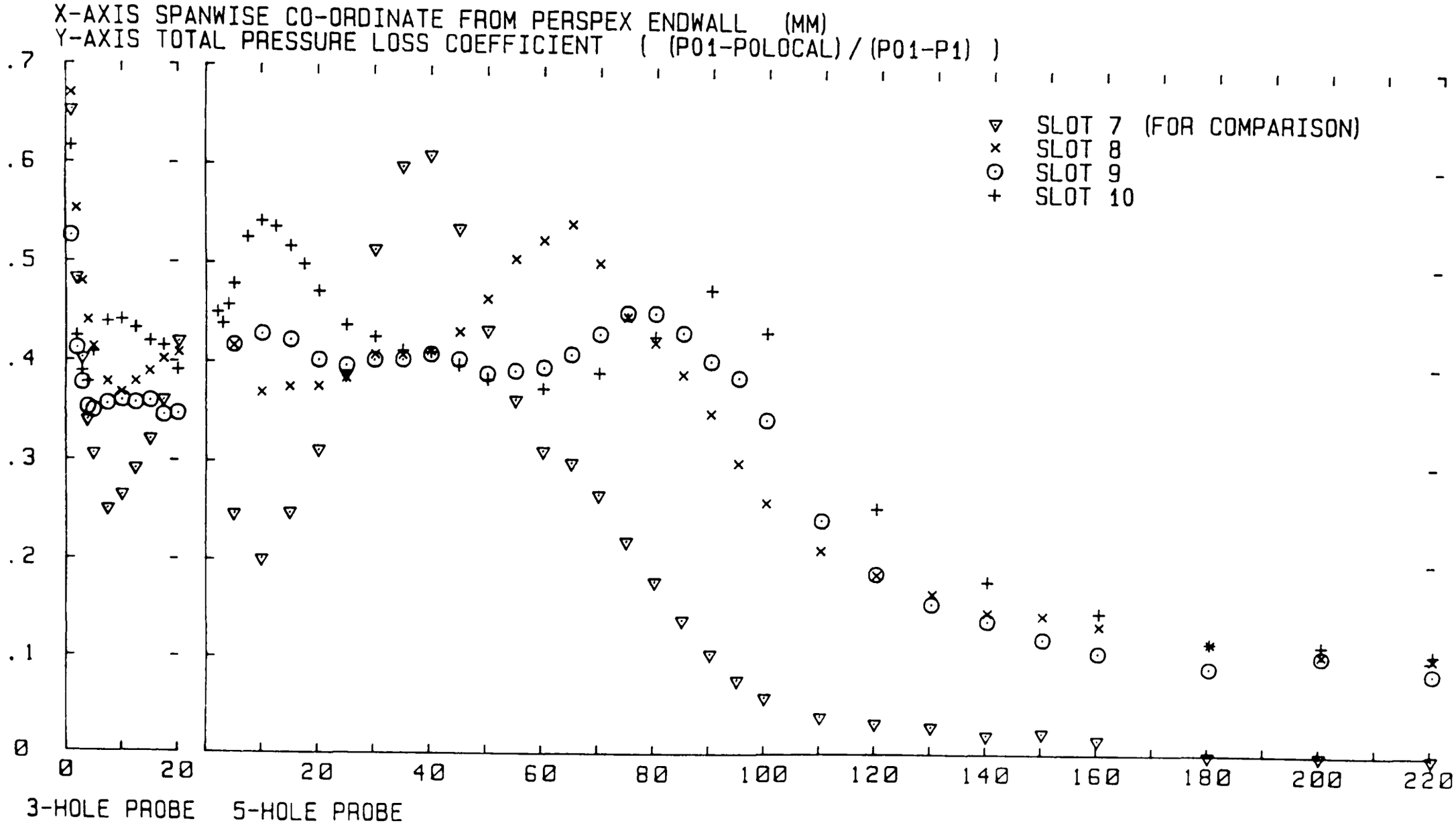


FIGURE 4.80

DEVELOPMENT OF AREA MASS AVERAGED TOTAL PRESSURE LOSS COEFFICIENT

X-AXIS PERCENTAGE OF AXIAL CHORD FROM BLADE TRAILING EDGE
Y-AXIS AREA MASS AVERAGED TOTAL PRESSURE LOSS COEFFICIENT

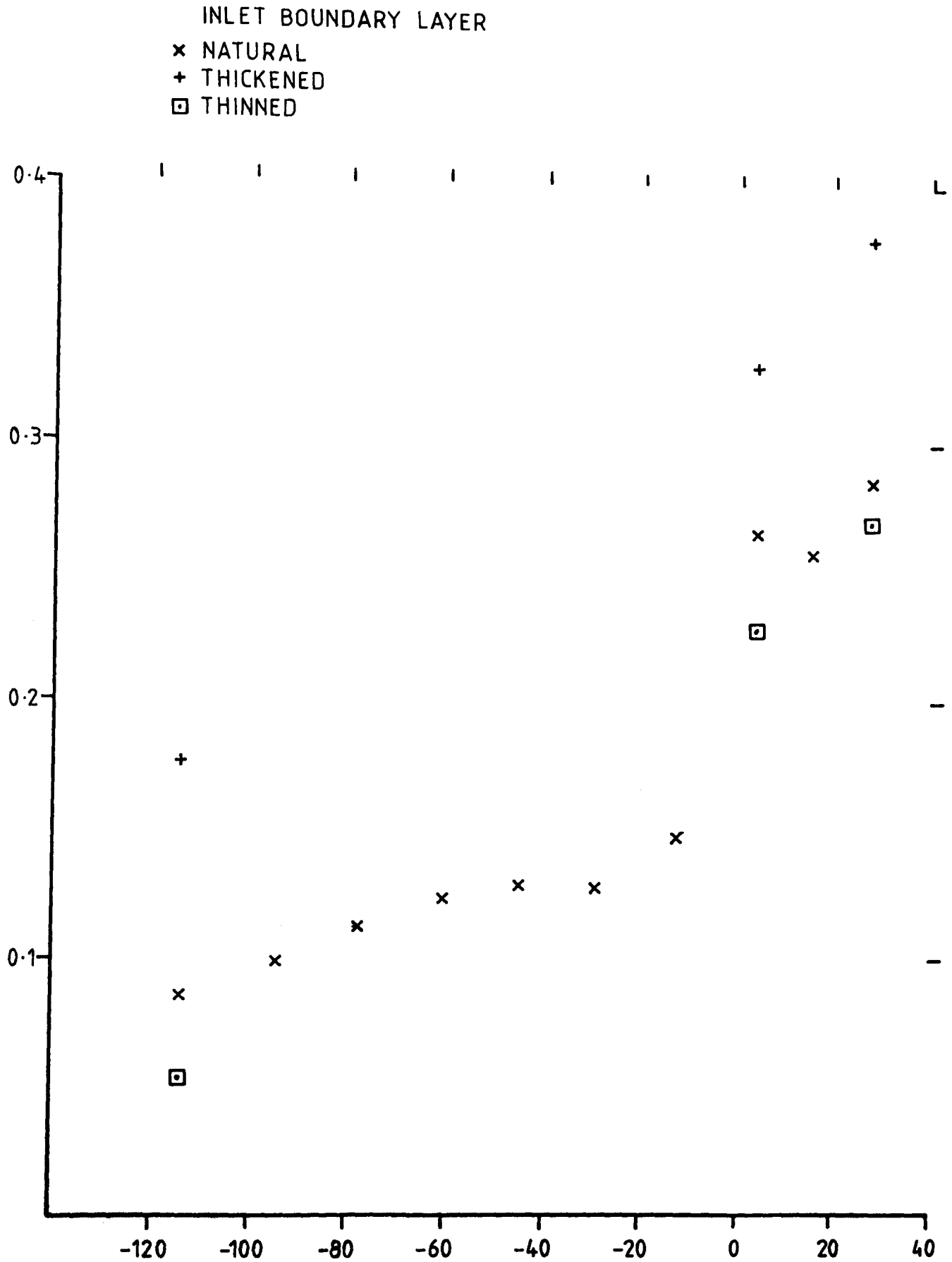


FIGURE 4.81

DEVELOPMENT OF SECONDARY LOSSES

X-AXIS PERCENTAGE OF AXIAL CHORD FROM BLADE TRAILING EDGE
Y-AXIS SECONDARY TOTAL PRESSURE LOSS COEFFICIENT

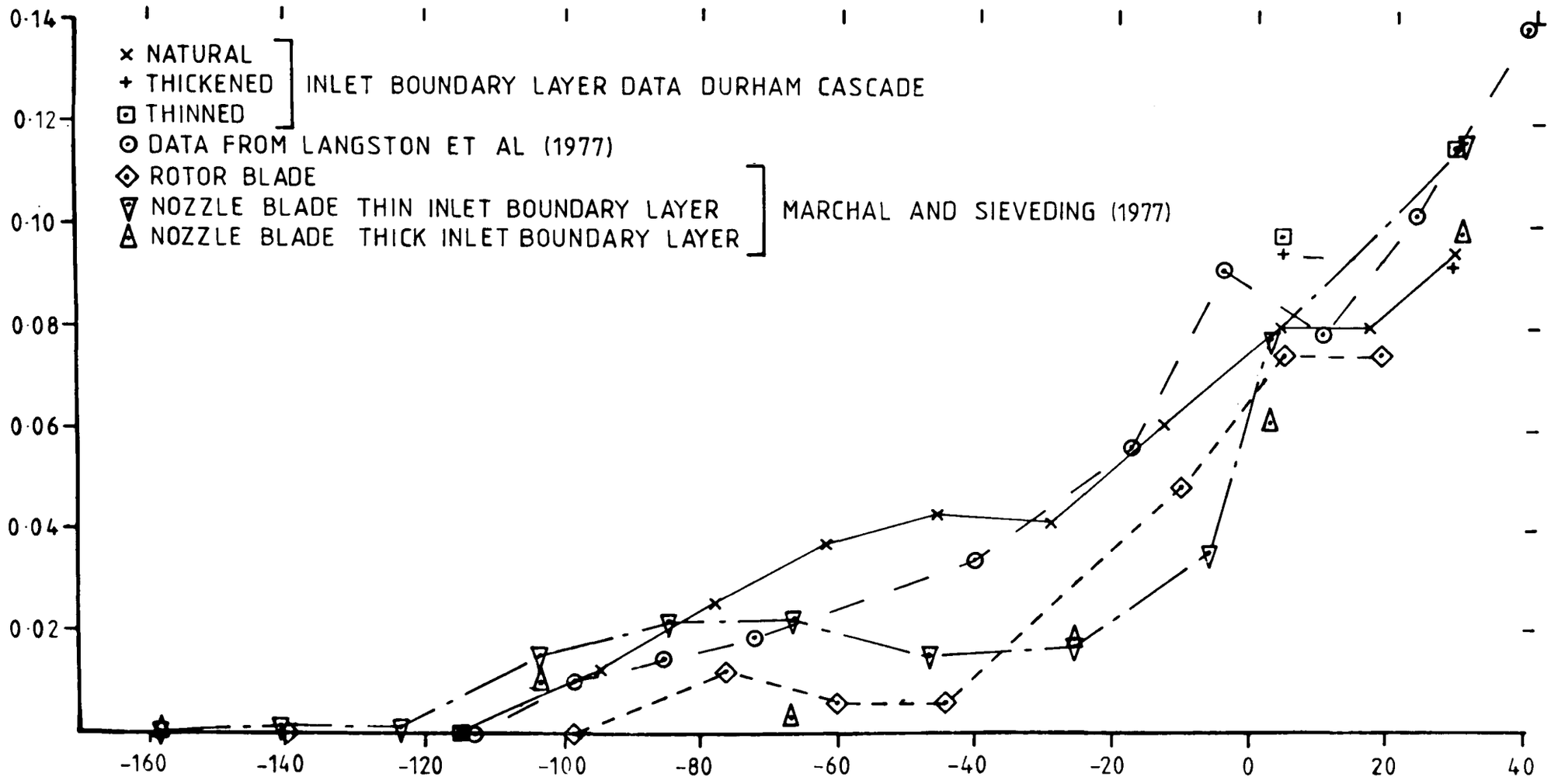


FIGURE 4.12

NORMALIZED CASCADE MASS FLOW RATE

X-AXIS PERCENTAGE OF AXIAL CHORD FROM BLADE TRAILING EDGE
Y-AXIS CASCADE MASS FLOW RATE NORMALIZED USING INLET MASS FLOW
(DURHAM DATA NORMALISED USING NATURAL INLET BOUNDARY LAYER DATA)

DURHAM INLET BOUNDARY LAYER
× NATURAL
+ THICKENED
⊡ THINNED
PRESSURE PROBE DATA
◇ NATURAL HOT WIRE PROBE DATA

⊙ DATA FROM LANGSTON ET AL (1977)

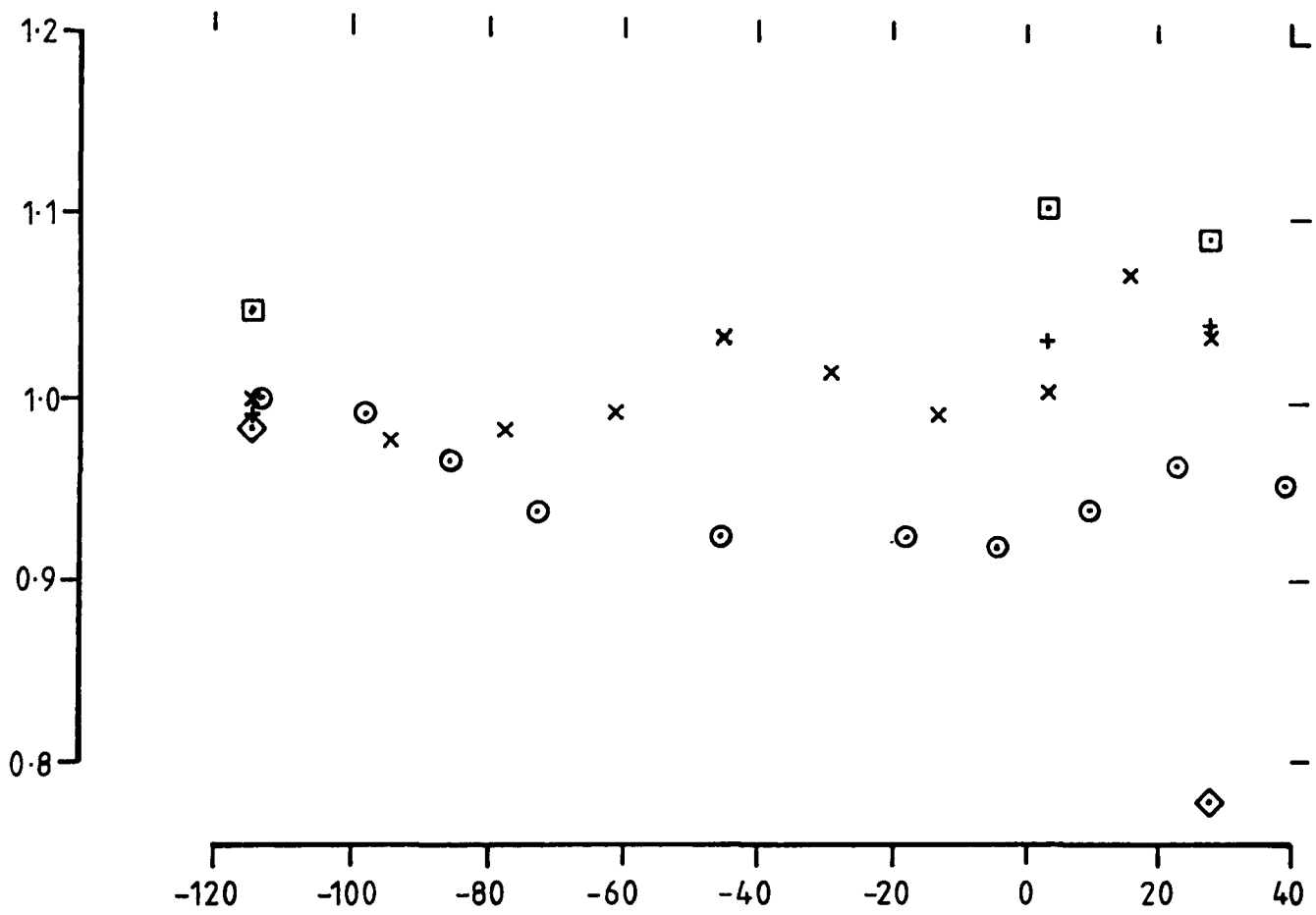


FIGURE 4.83

PLOT ON PLANE 20.1 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)

EXPERIMENTAL DATA POINTS

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
+ PROBE DATA × MANUALLY INTERPOLATED DATA * EXTRAPOLATED DATA

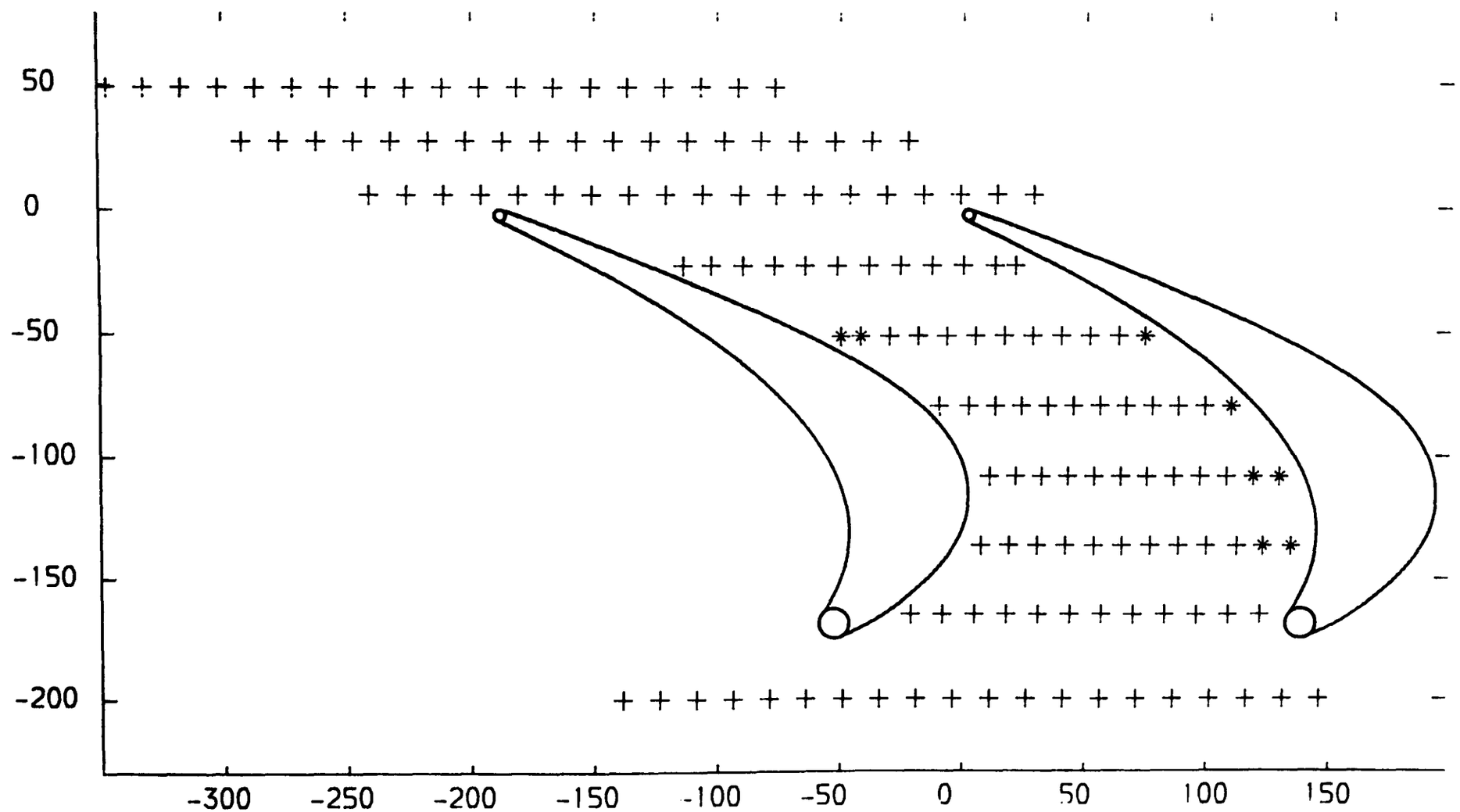


FIGURE 4.84

PLOT ON PLANE 1.0 MM FROM PERSPEX ENDWALL (3-HOLE PROBE DATA)
TOTAL PRESSURE LOSS COEFFICIENT ((PO'-POLOCAL) / (PO1-P1)) CONTOURS
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

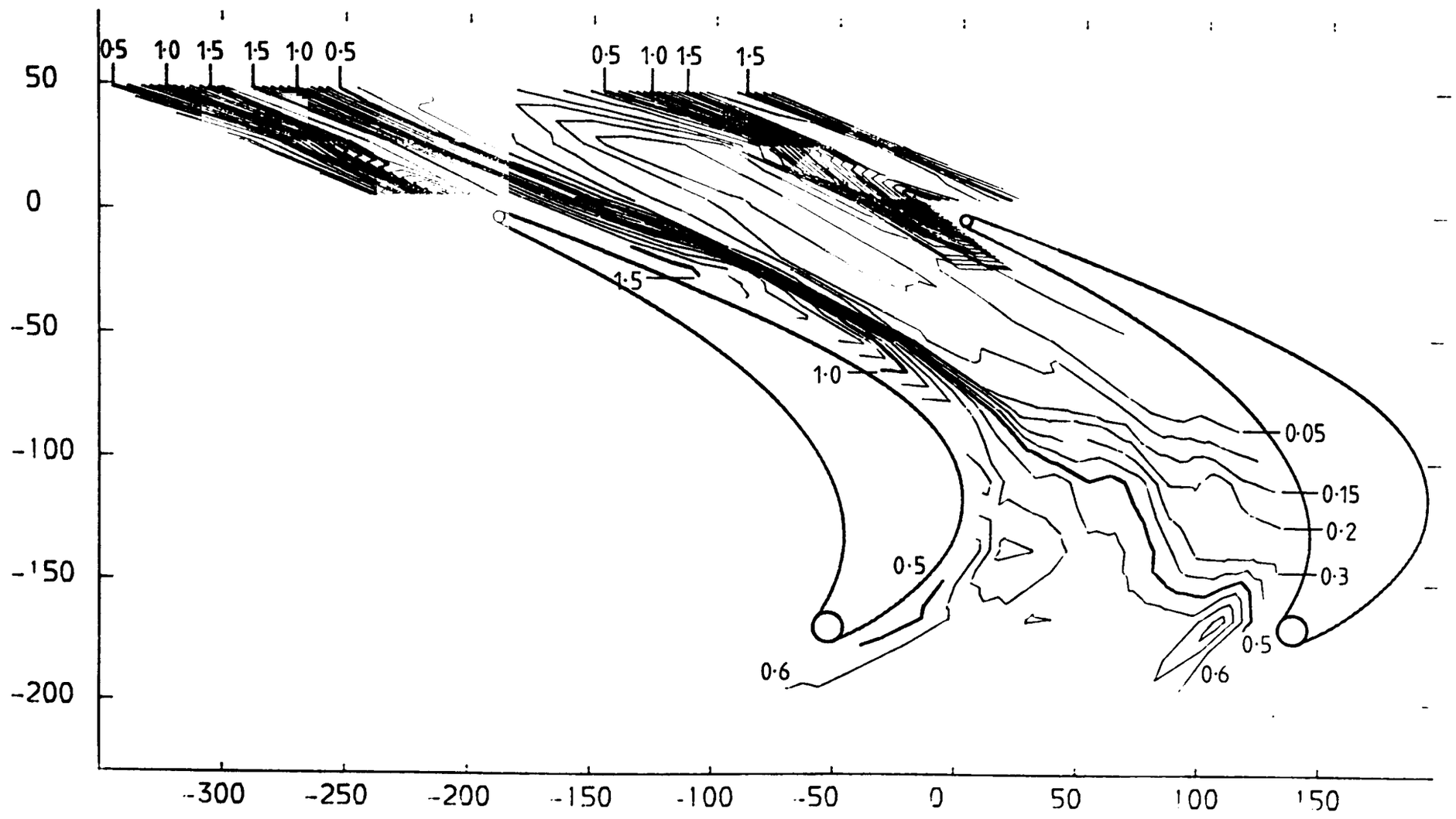


FIGURE 4.85

PLOT ON PLANE 5.0 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)
TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL)/(PO1-P1)) CONTOURS
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

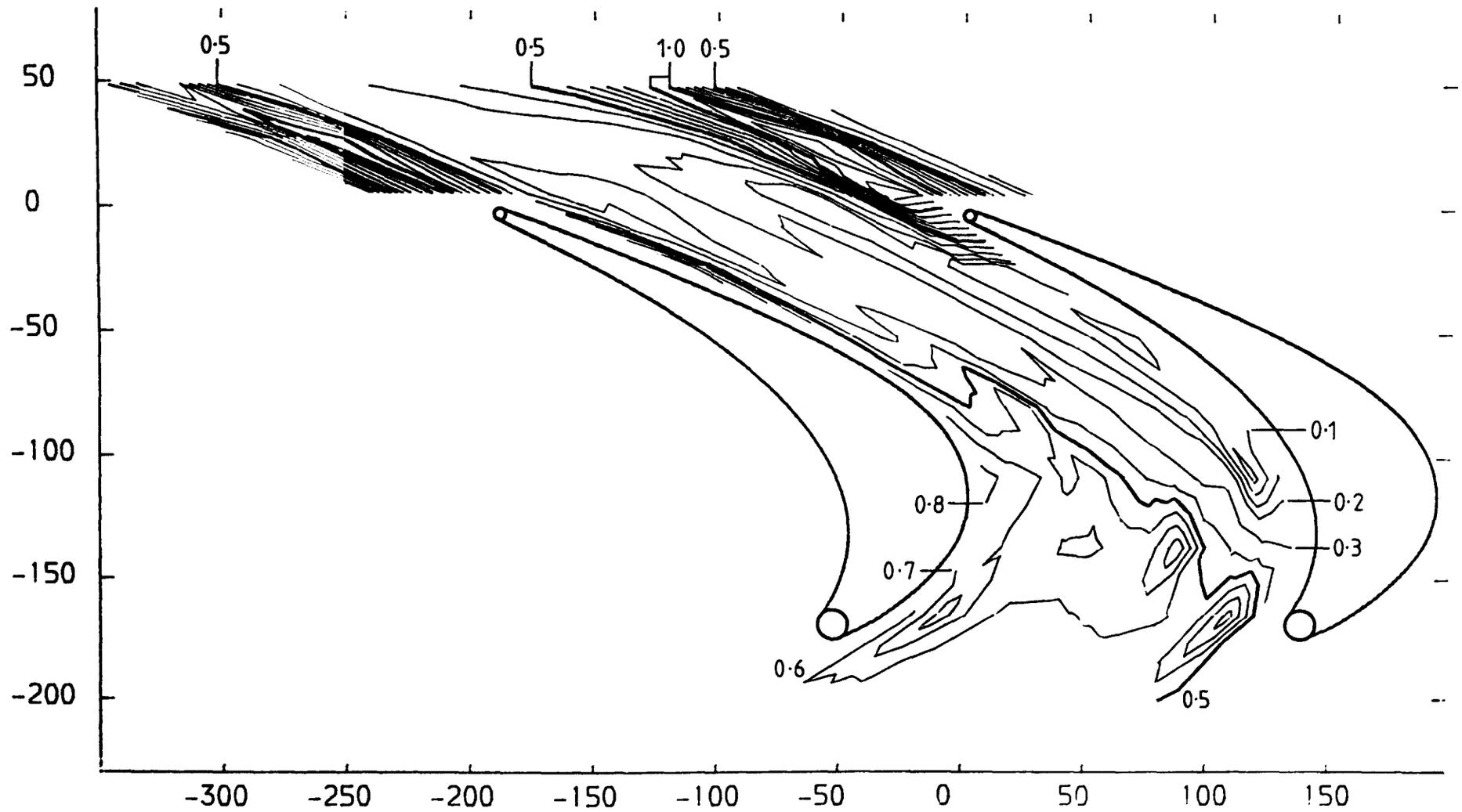


FIGURE 4.86

PLOT ON PLANE 5.0 MM FROM PERSPEX ENDWALL (3-HOLE PROBE DATA)
TOTAL PRESSURE LOSS COEFFICIENT ((PO -POLOCAL) / (PO1-P1)) CONTOURS
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

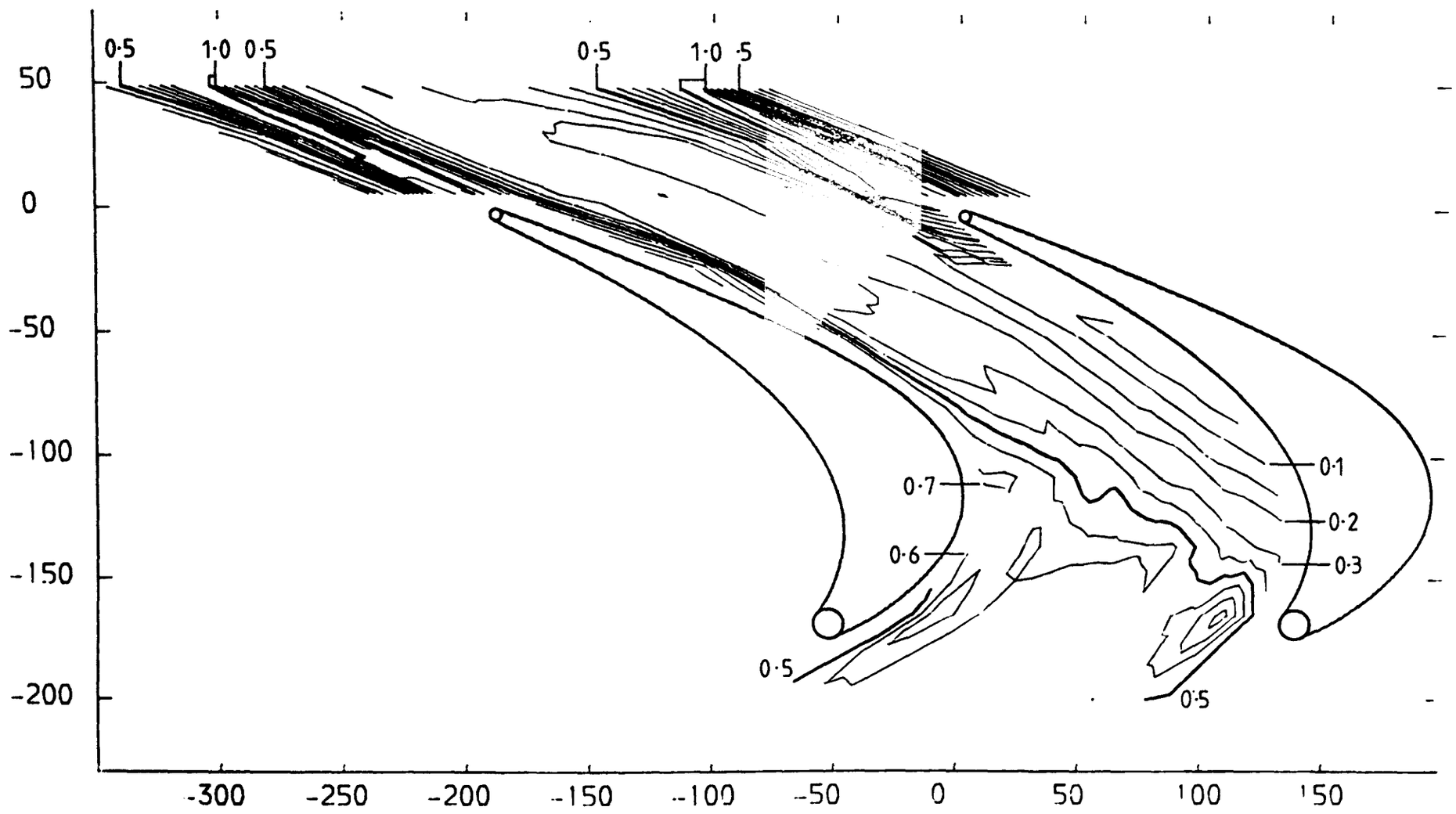


FIGURE 4.87

PLOT ON PLANE 20.1 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)

TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL)/(PO1-P1)) CONTOURS

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

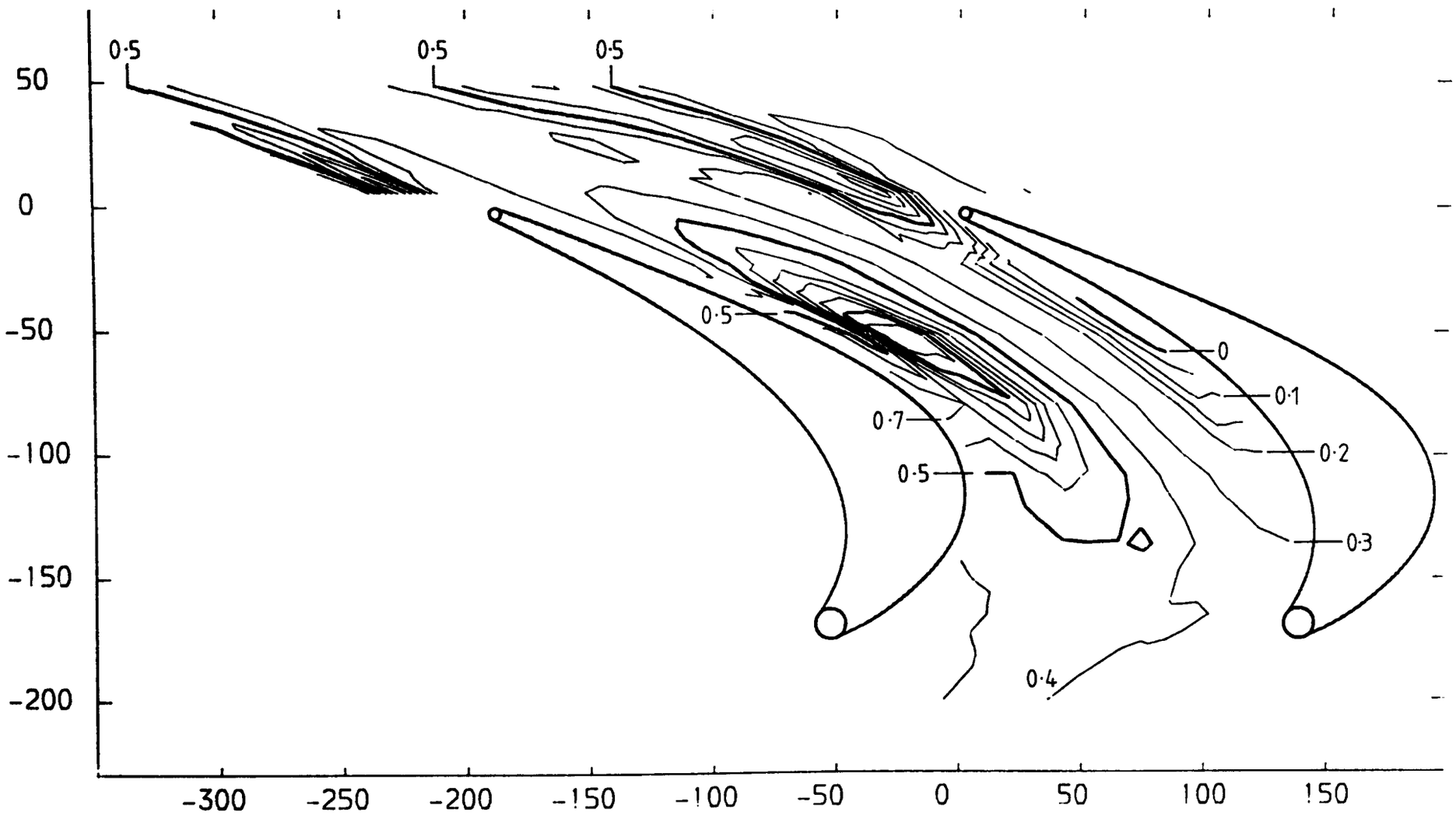


FIGURE 4.88

PLOT ON PLANE 20.1 MM FROM PERSPEX ENDWALL (3-HOLE PROBE DATA)
TOTAL PRESSURE LOSS COEFFICIENT ((PO'-POLOCAL) / (PO'-P1)) CONTOURS
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

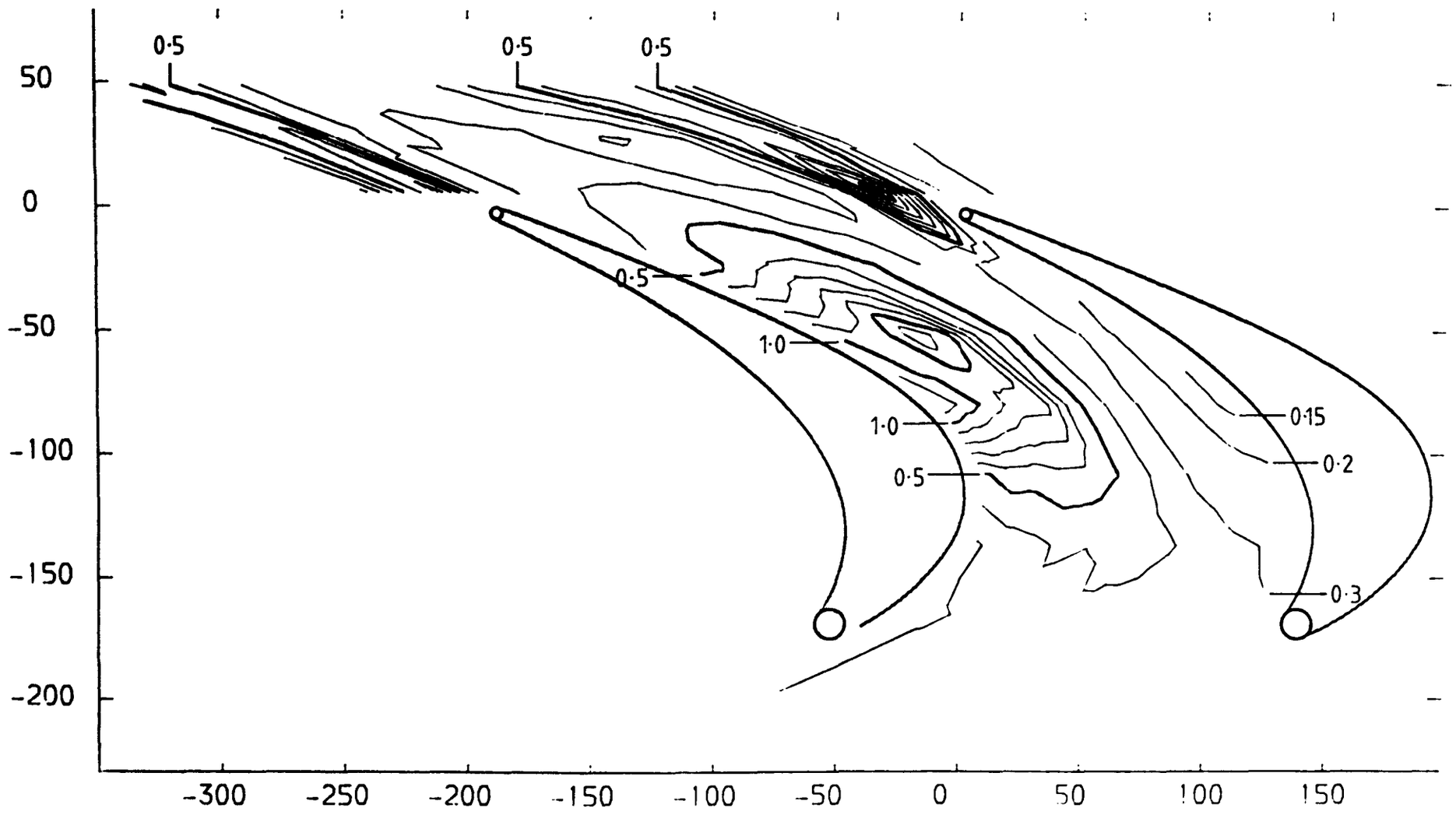


FIGURE 4.89

PLOT ON PLANE 40.0 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)

TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL) / (PO1-P1)) CONTOURS

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

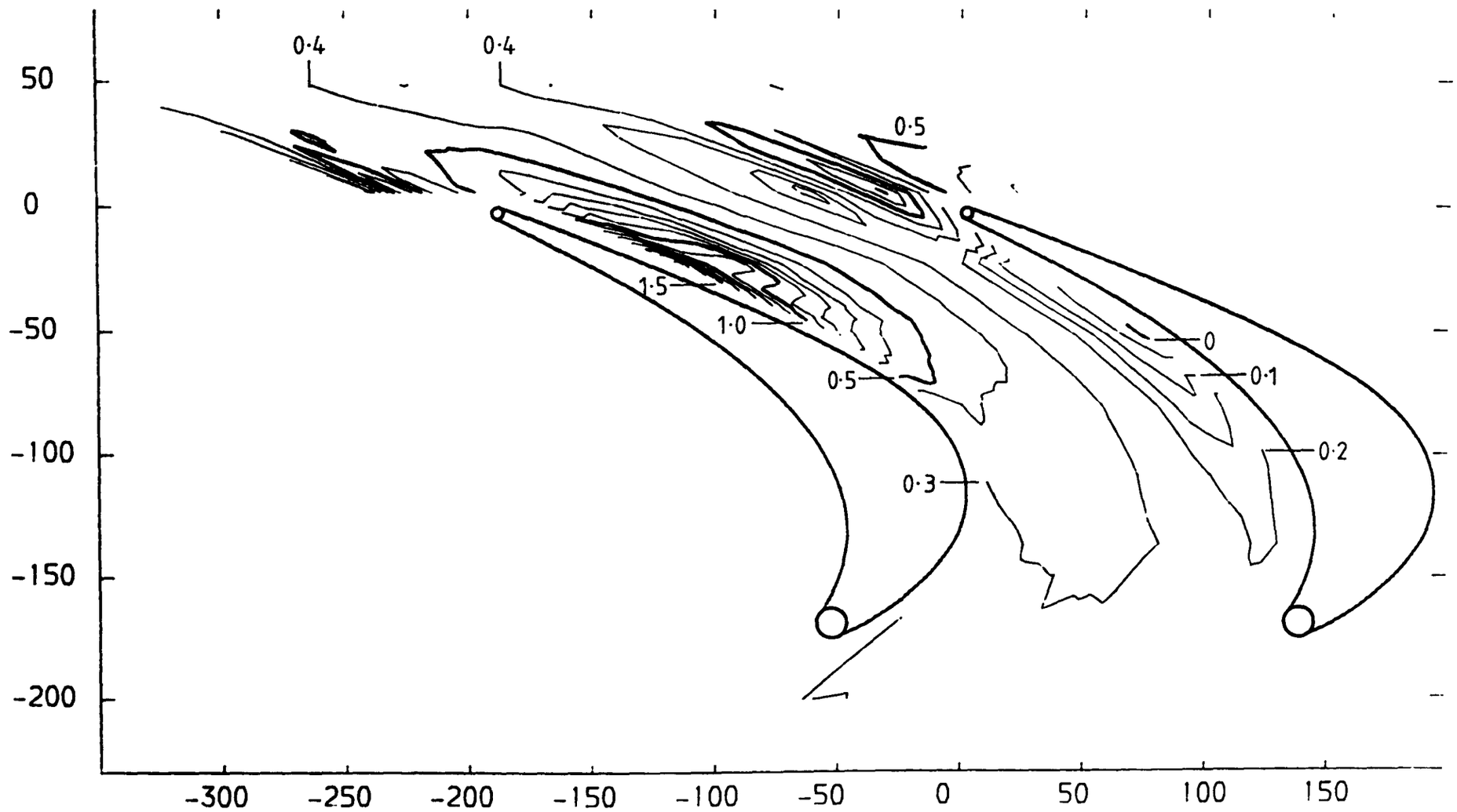


FIGURE 4.90

PLOT ON PLANE 60.0 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)
TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL)/(PO1-P1)) CONTOURS
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

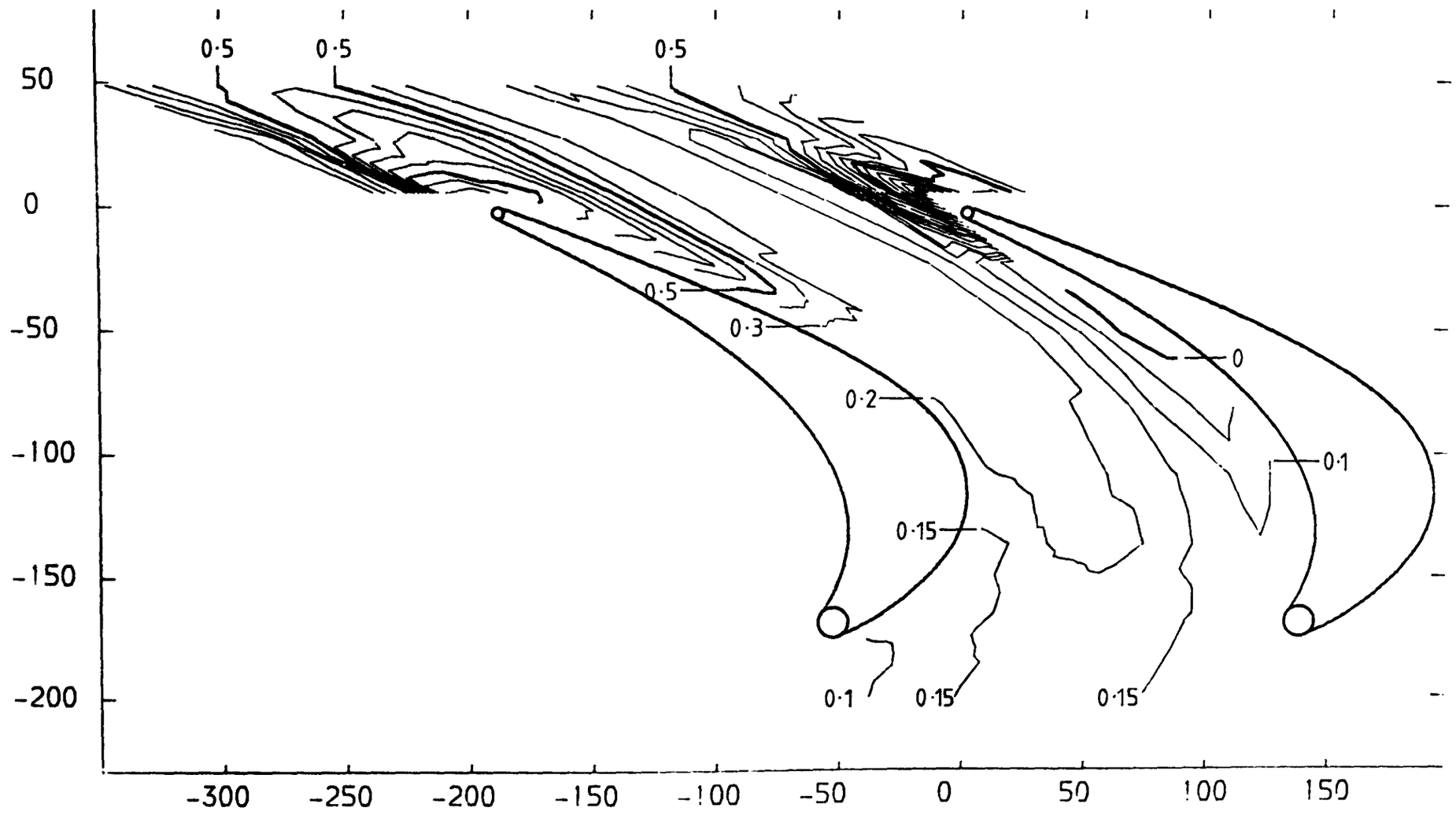


FIGURE 4.91

PLOT ON PLANE 80.0 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)
TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL)/(PO1-P1)) CONTOURS
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

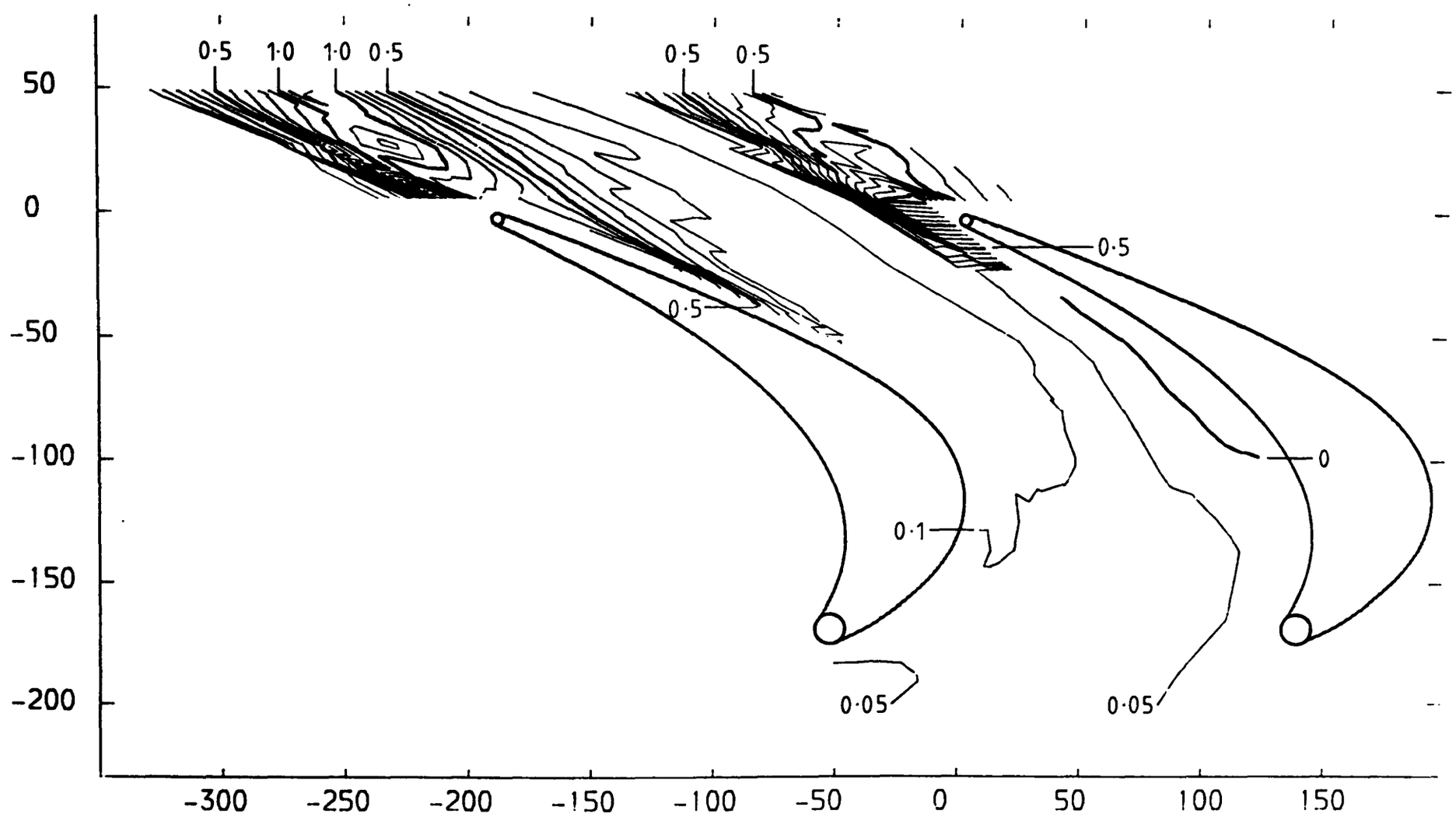


FIGURE 4.92

PLOT ON PLANE 100.1 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)
TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL) / (PO1-P1)) CONTOURS
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

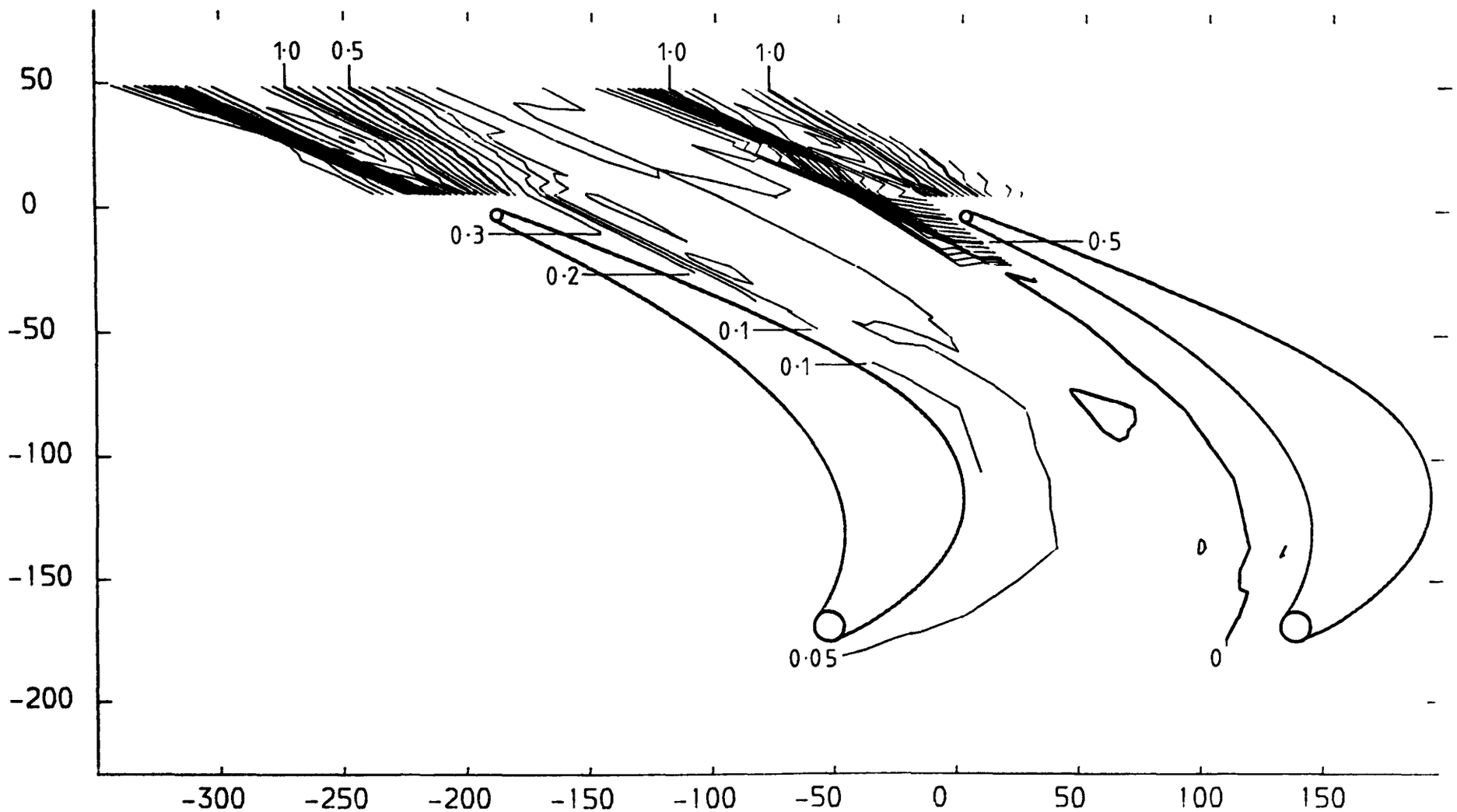


FIGURE 4.93

PLOT ON PLANE 140.1 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)

TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL) / (PO1-P1)) CONTOURS

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

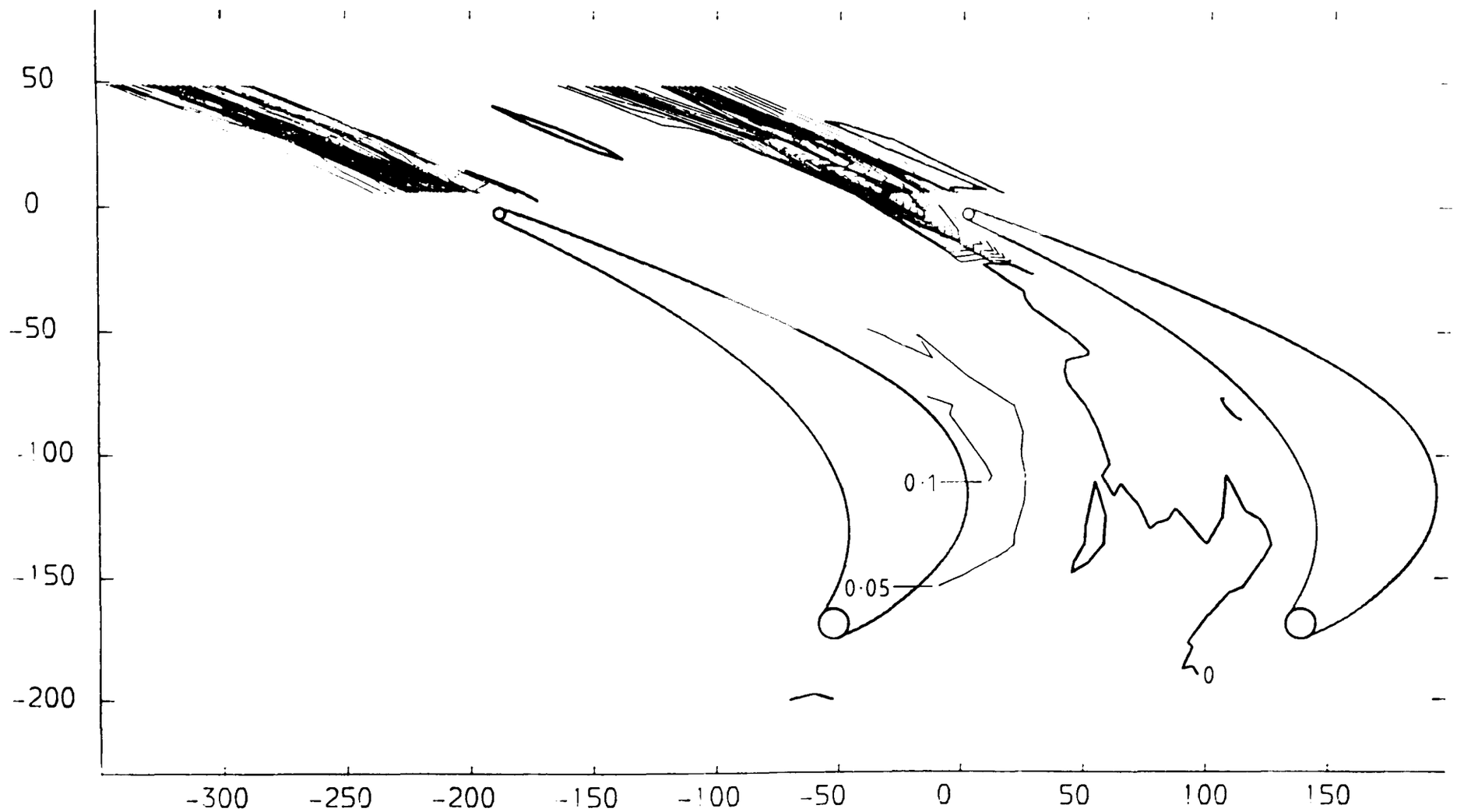


FIGURE 4.94

PLOT ON PLANE 220.1 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)
TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL)/(PO1-P1)) CONTOURS
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

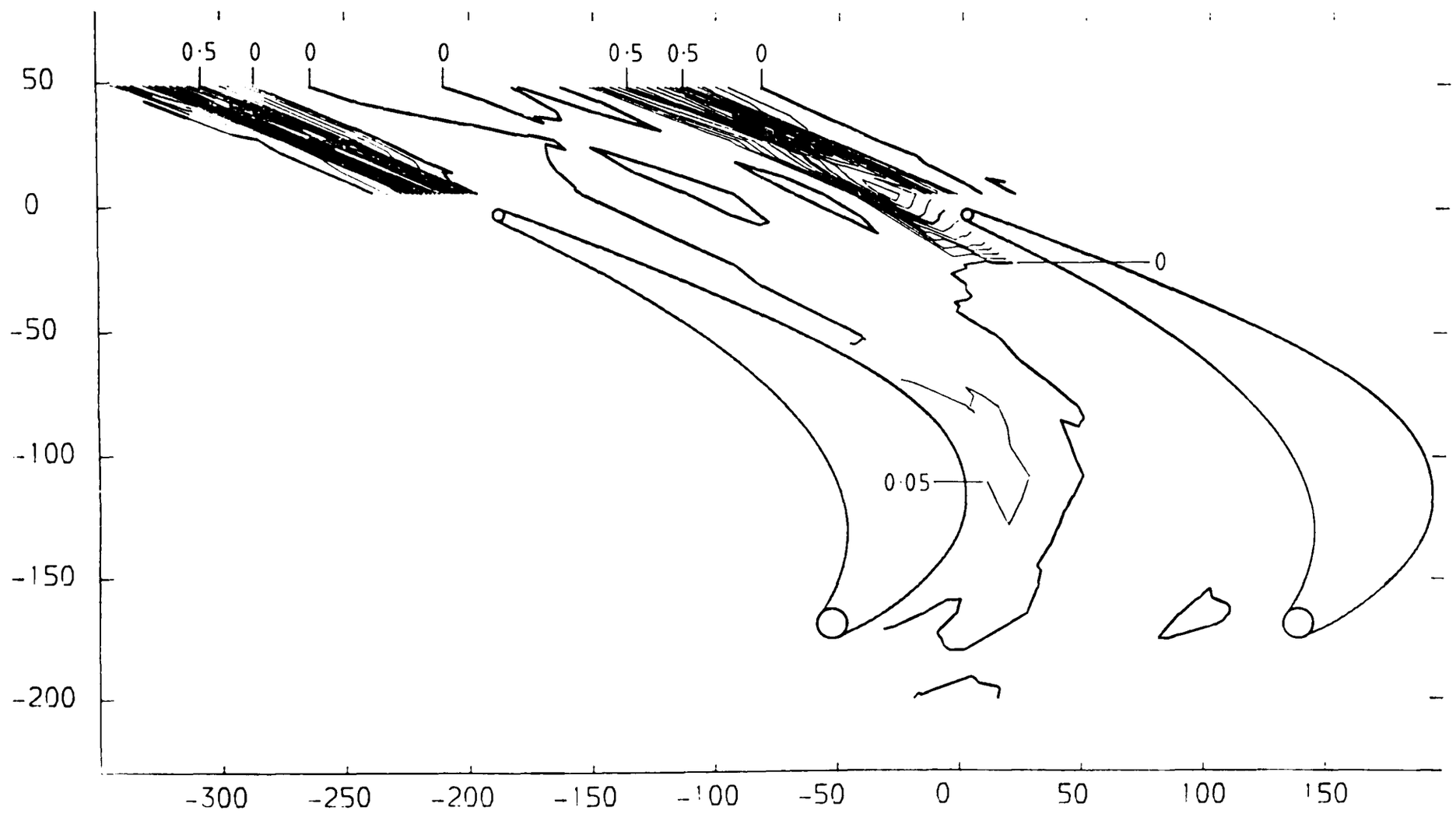


FIGURE 4.95

PLOT ON PLANE 1.0 MM FROM PERSPEX ENDWALL (3-HOLE PROBE DATA)
TOTAL VELOCITY MAGNITUDE CONTOURS (CONTOUR UNITS METRES/SEC)
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

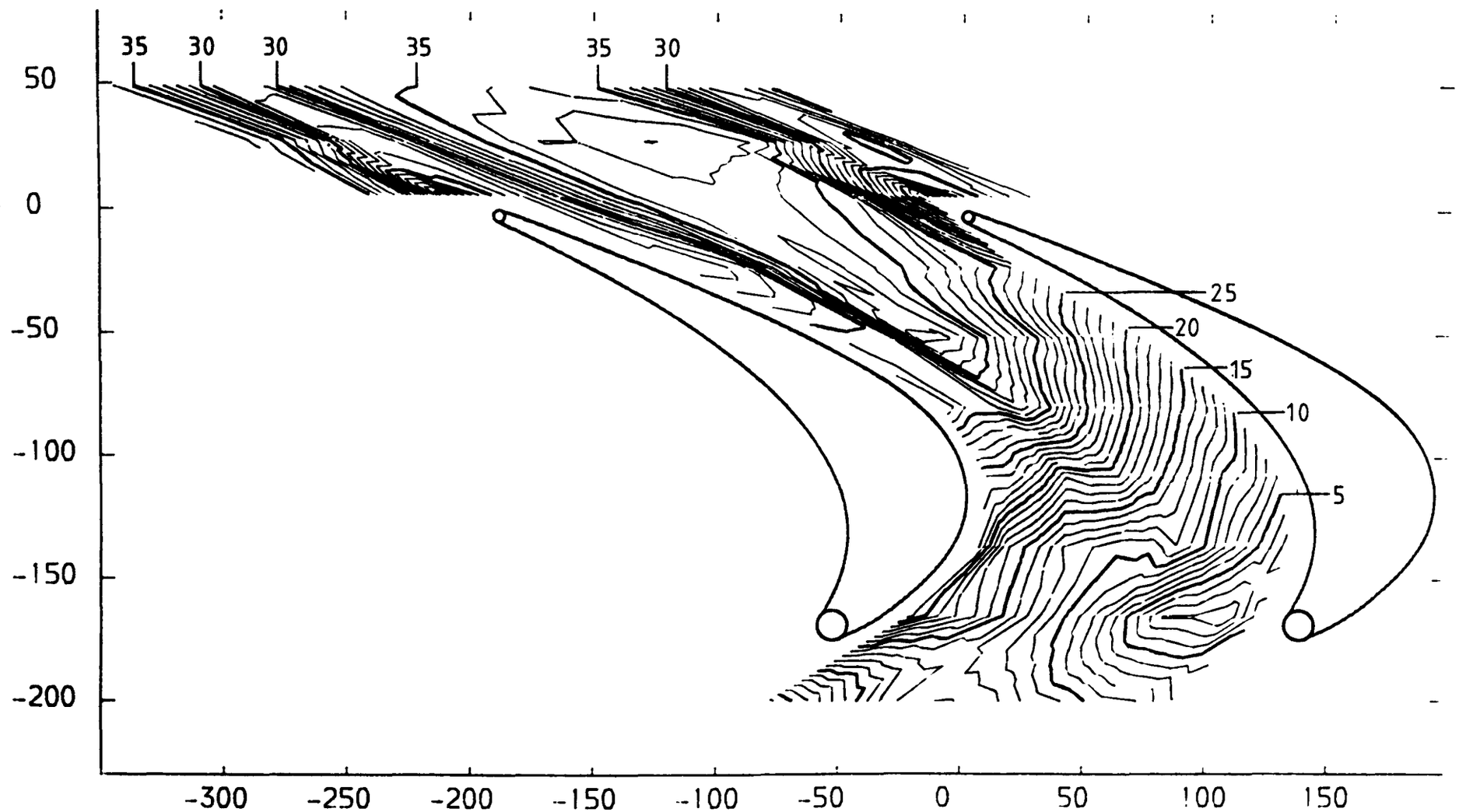


FIGURE 4.96

PLOT ON PLANE 20.1 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)
TOTAL VELOCITY MAGNITUDE CONTOURS (CONTOUR UNITS METRES/SEC)
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

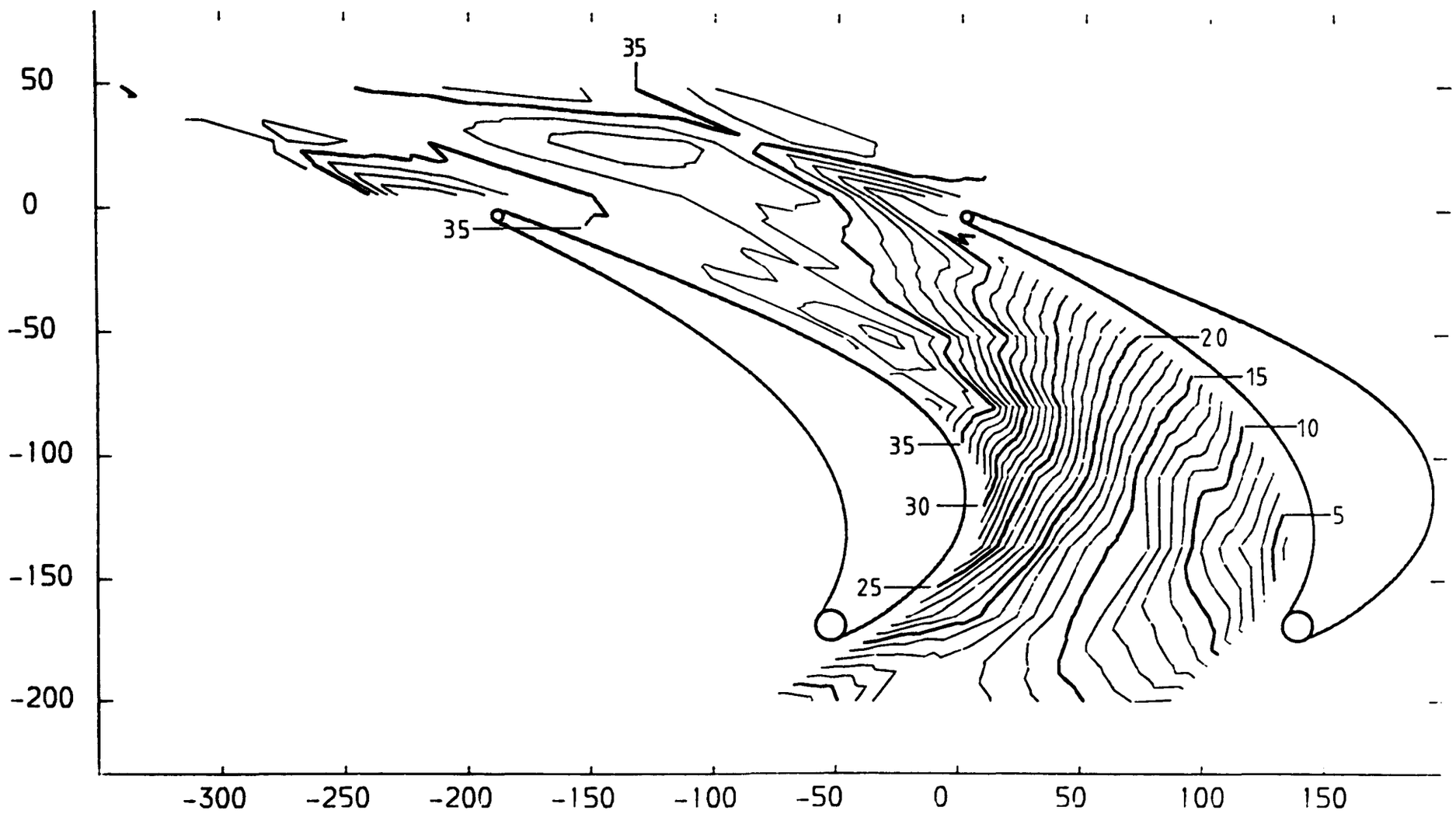


FIGURE 4.97

PLOT ON PLANE 20.1 MM FROM PERSPEX ENDWALL (3-HOLE PROBE DATA)
TOTAL VELOCITY MAGNITUDE CONTOURS (CONTOUR UNITS METRES/SEC)
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

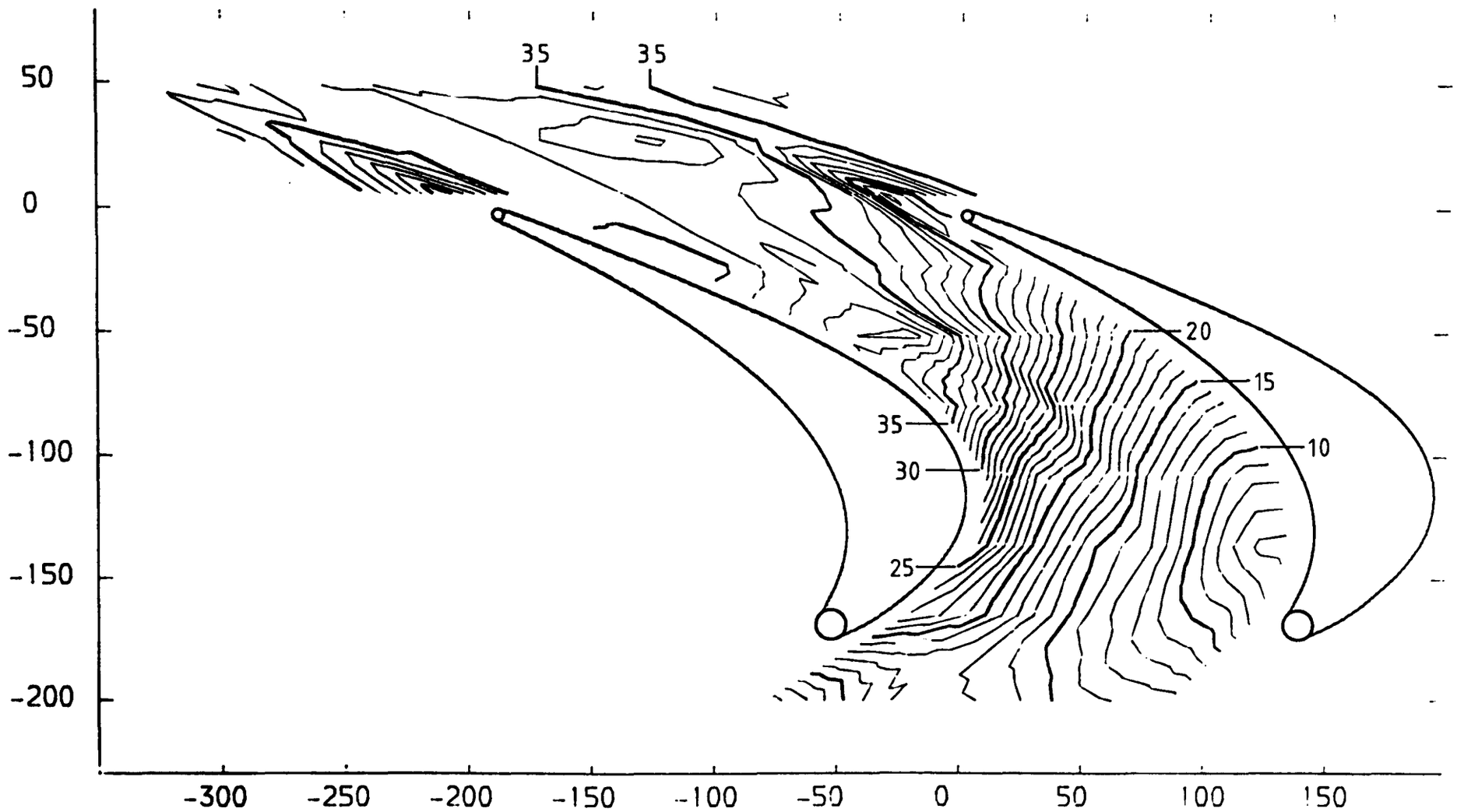


FIGURE 4.98

PLOT ON PLANE 50.1 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)
TOTAL VELOCITY MAGNITUDE CONTOURS (CONTOUR UNITS METRES/SEC)
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

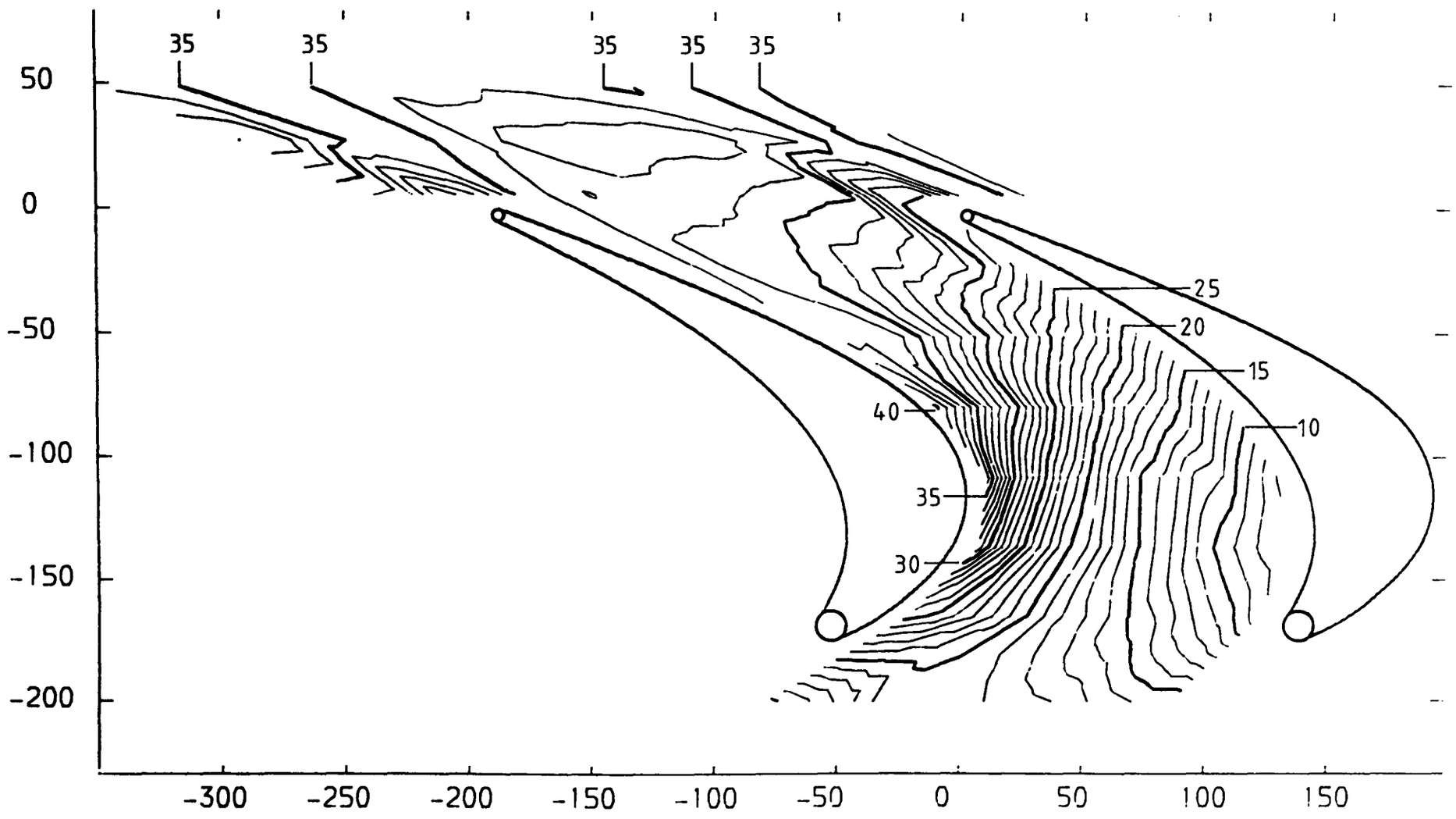


FIGURE 4.99

PLOT ON PLANE 220.1 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)

TOTAL VELOCITY MAGNITUDE CONTOURS (CONTOUR UNITS METRES/SEC)

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

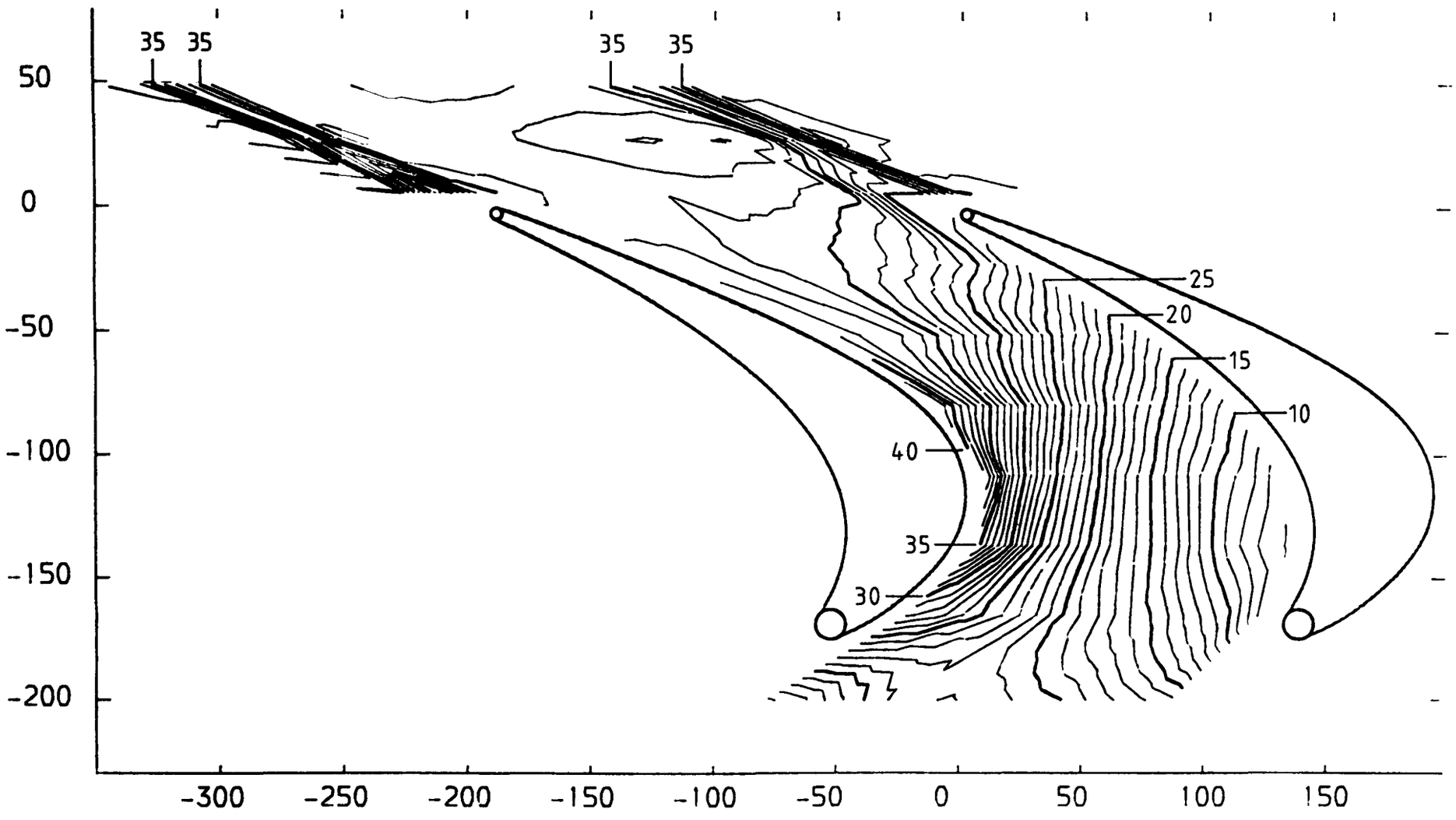


FIGURE 4.100

TWO DIMENSIONAL VELOCITY DISTRIBUITON
PREDICTED VALUES (CONTOUR UNITS METRES/SEC)

X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

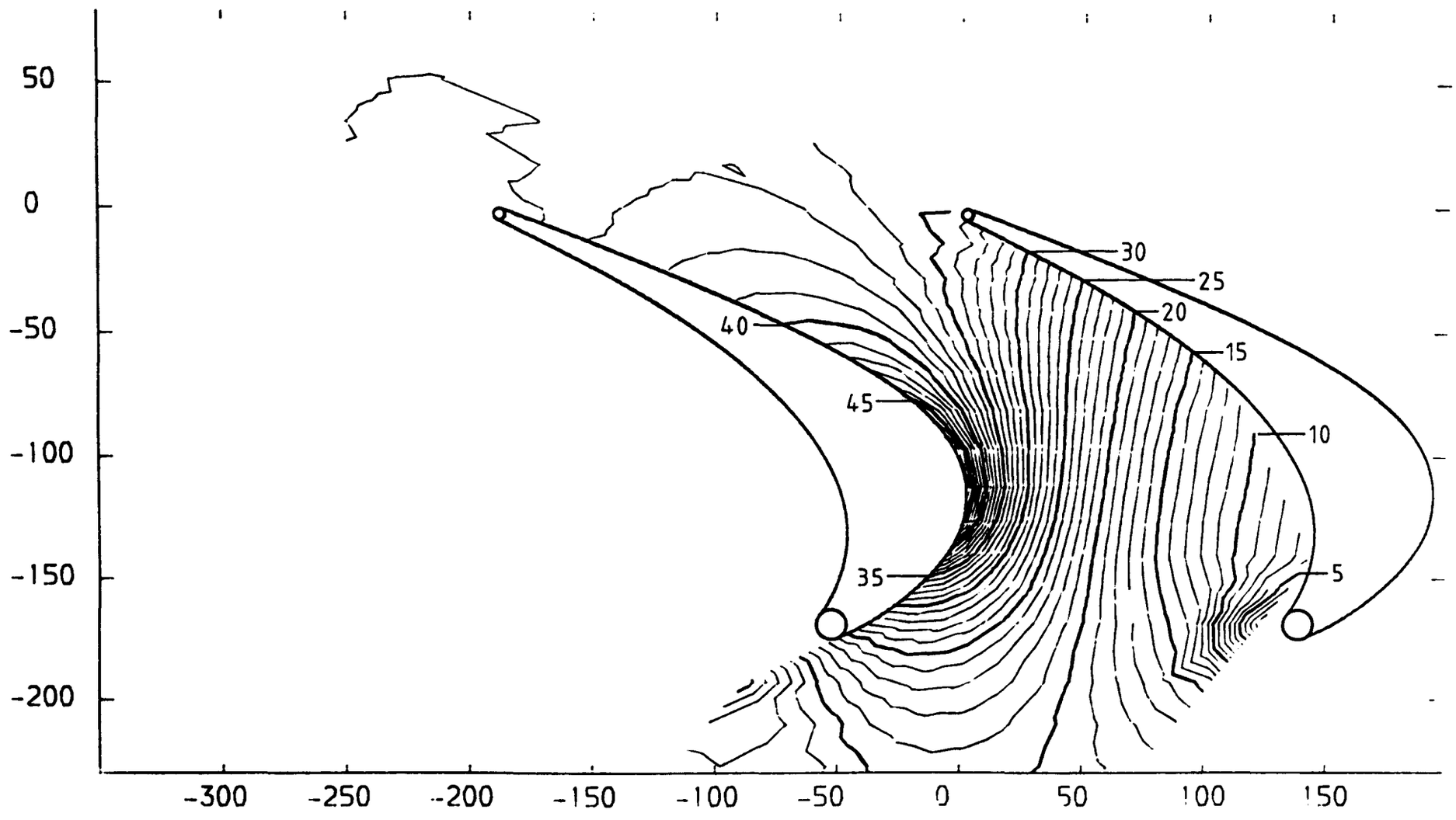


FIGURE 4.101

PLOT ON PLANE 1.0 MM FROM PERSPEX ENDWALL (3-HOLE PROBE DATA)

VECTOR PLOT OF AXIAL AND TANGENTIAL VELOCITIES

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
VECTOR SCALE 40 METRES/SEC ⟶

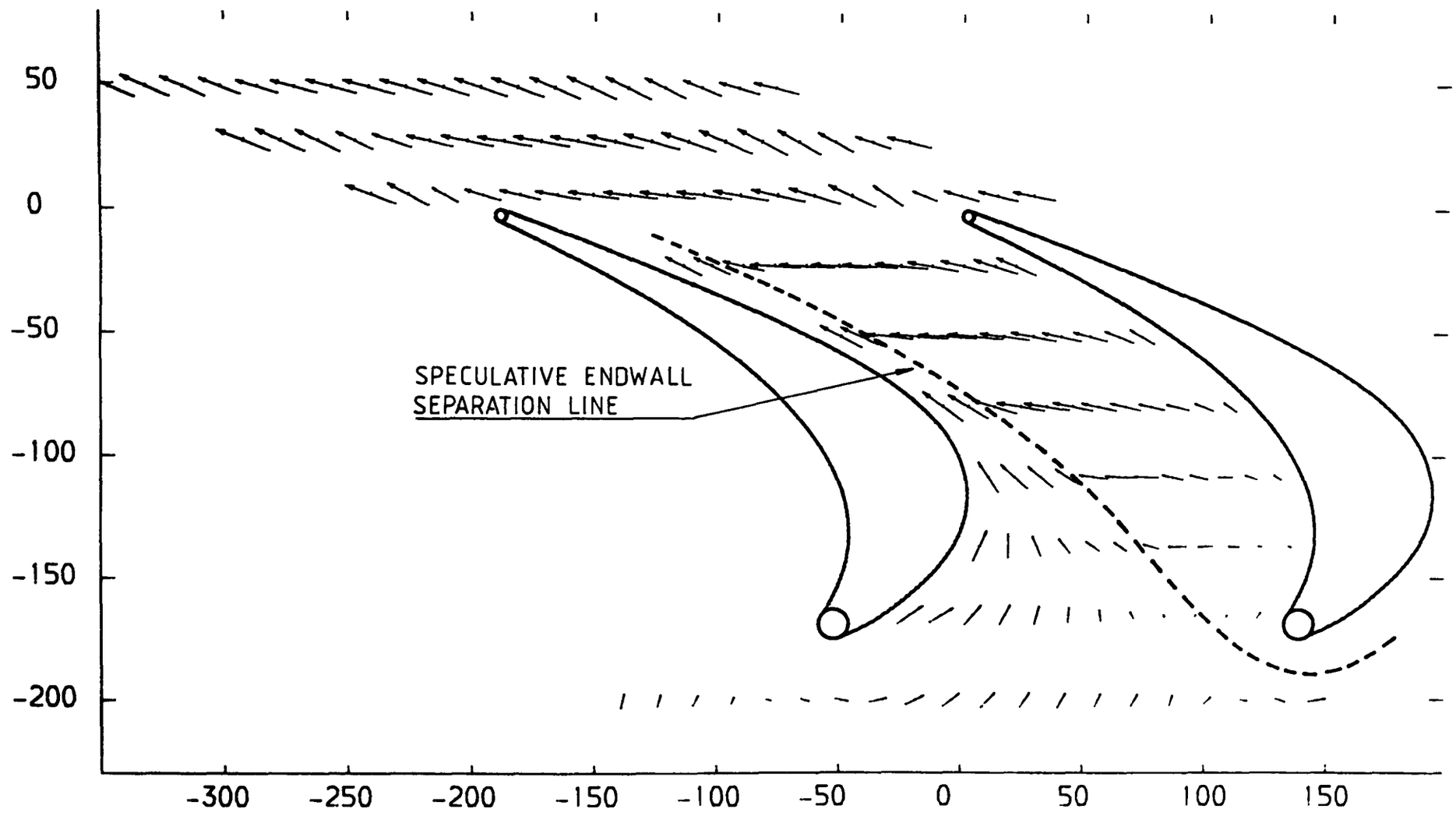


FIGURE 4.102

PLOT ON PLANE 2.0 MM FROM PERSPEX ENDWALL (3-HOLE PROBE DATA)

VECTOR PLOT OF AXIAL AND TANGENTIAL VELOCITIES

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
VECTOR SCALE 40 METRES/SEC ⟶

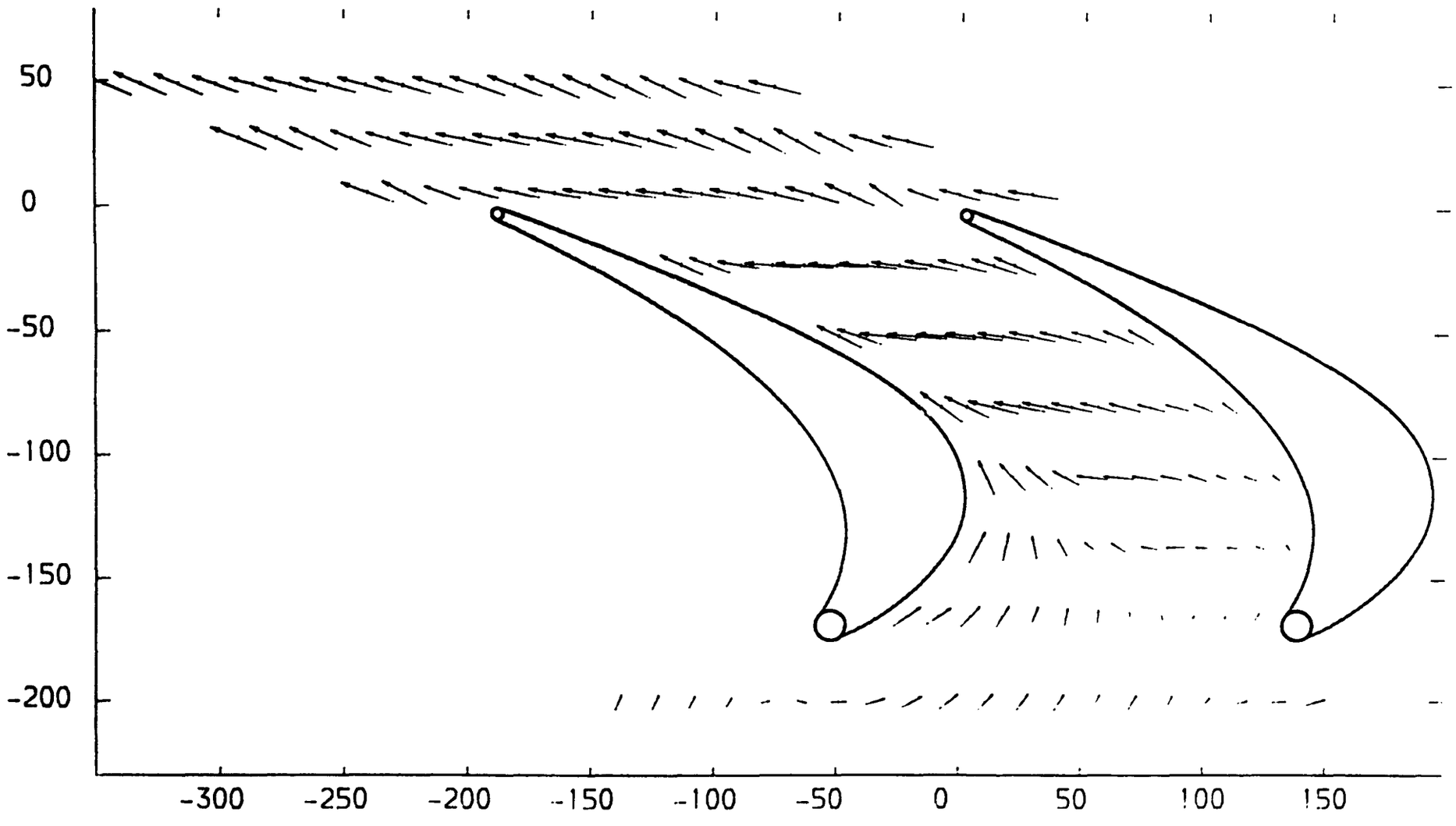


FIGURE 4.103

PLOT ON PLANE 3.0 MM FROM PERSPEX ENDWALL (3-HOLE PROBE DATA)

VECTOR PLOT OF AXIAL AND TANGENTIAL VELOCITIES

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
VECTOR SCALE 40 METRES/SEC ⟶

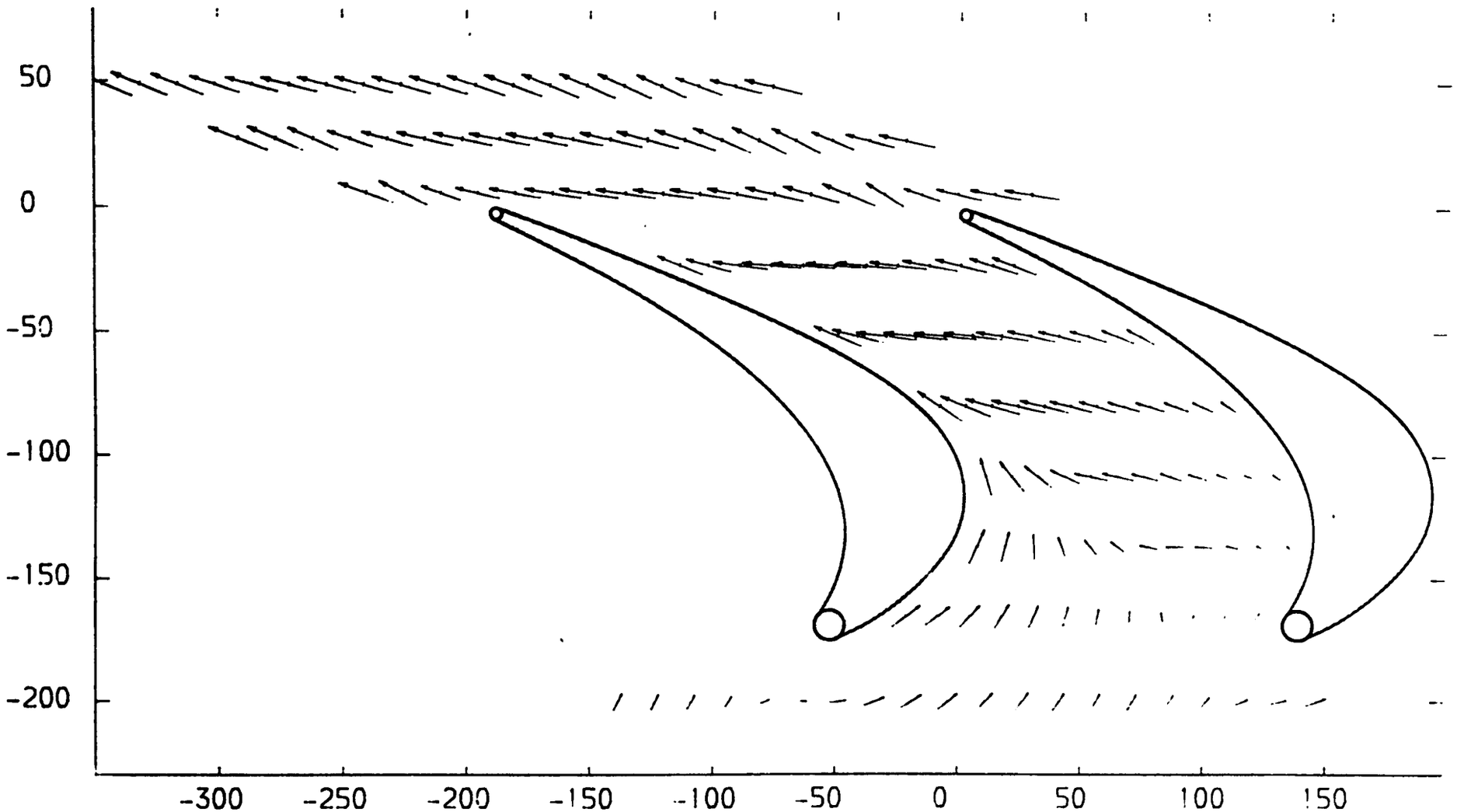


FIGURE 4.104

PLOT ON PLANE 4.0 MM FRO : PERSPEX ENDWALL (3-HOLE PROBE DATA)

VECTOR PLO⁻ OF A/IAL AND TANGENTIAL VELOCITIES

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
VECTOR SCALE 40 METRES/SEC ⟶

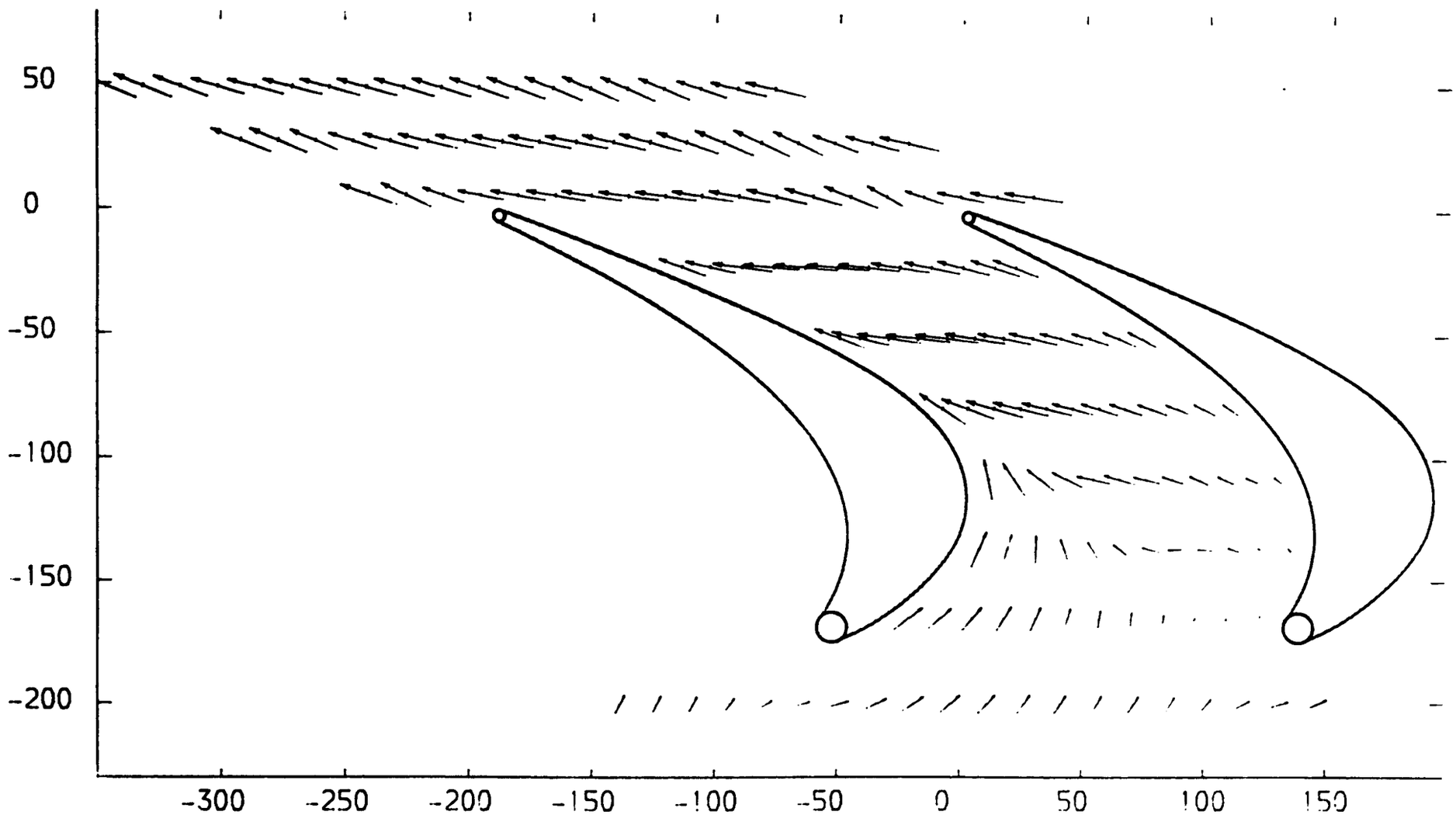


FIGURE 4.105

PLOT ON PLANE 5.0 MM FROM PERSPEX ENDWALL (3-HOLE PROBE DATA)

VECTOR PLOT OF AXIAL AND TANGENTIAL VELOCITIES

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
VECTOR SCALE 40 METRES/SEC

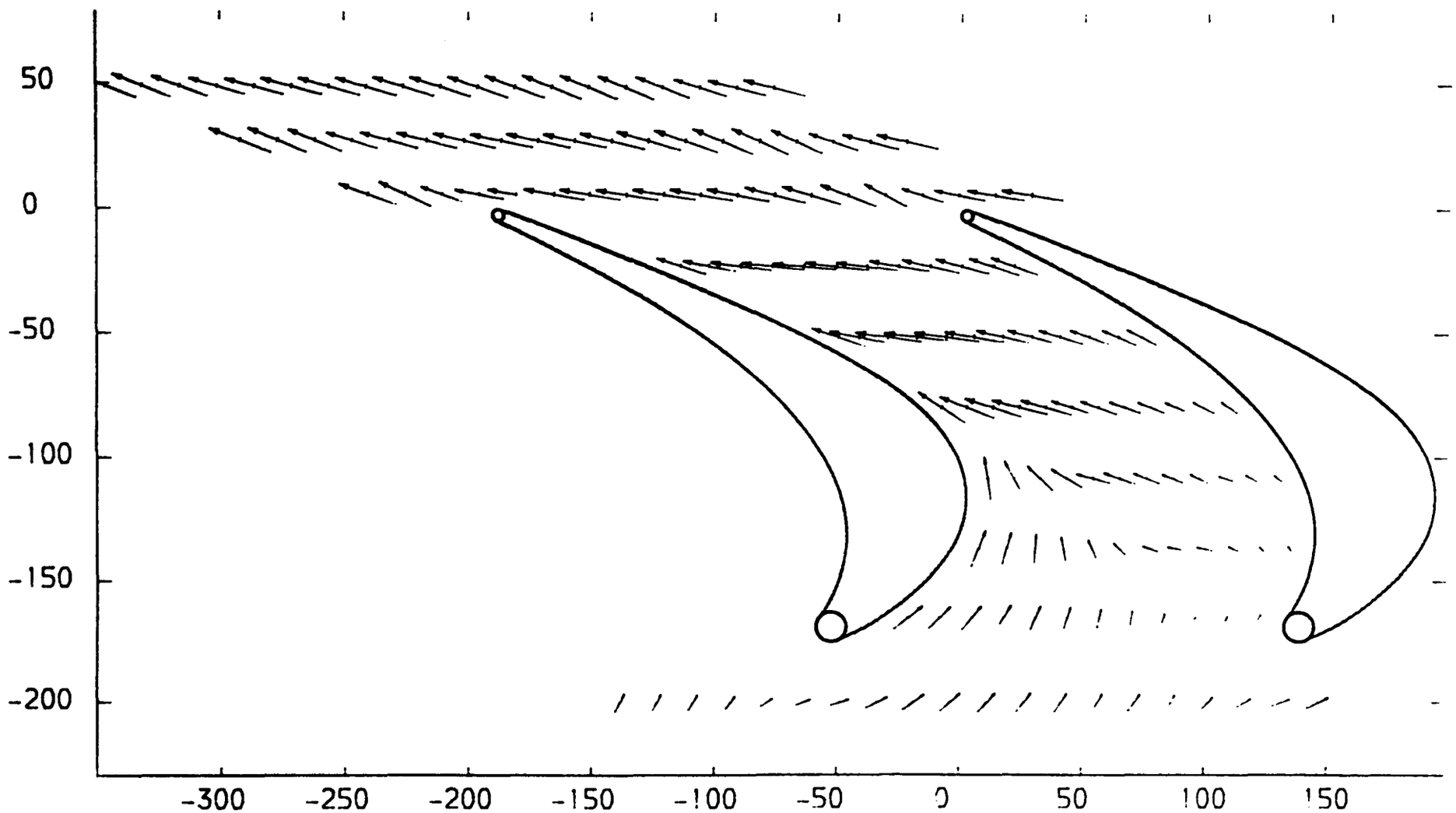


FIGURE 4.106

PLOT ON PLANE 7.4 MM FROM PERSPEX ENDWALL (3-HOLE PROBE DATA)

VECTOR PLOT OF AXIAL AND TANGENTIAL VELOCITIES

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
VECTOR SCALE 40 METRES/SEC

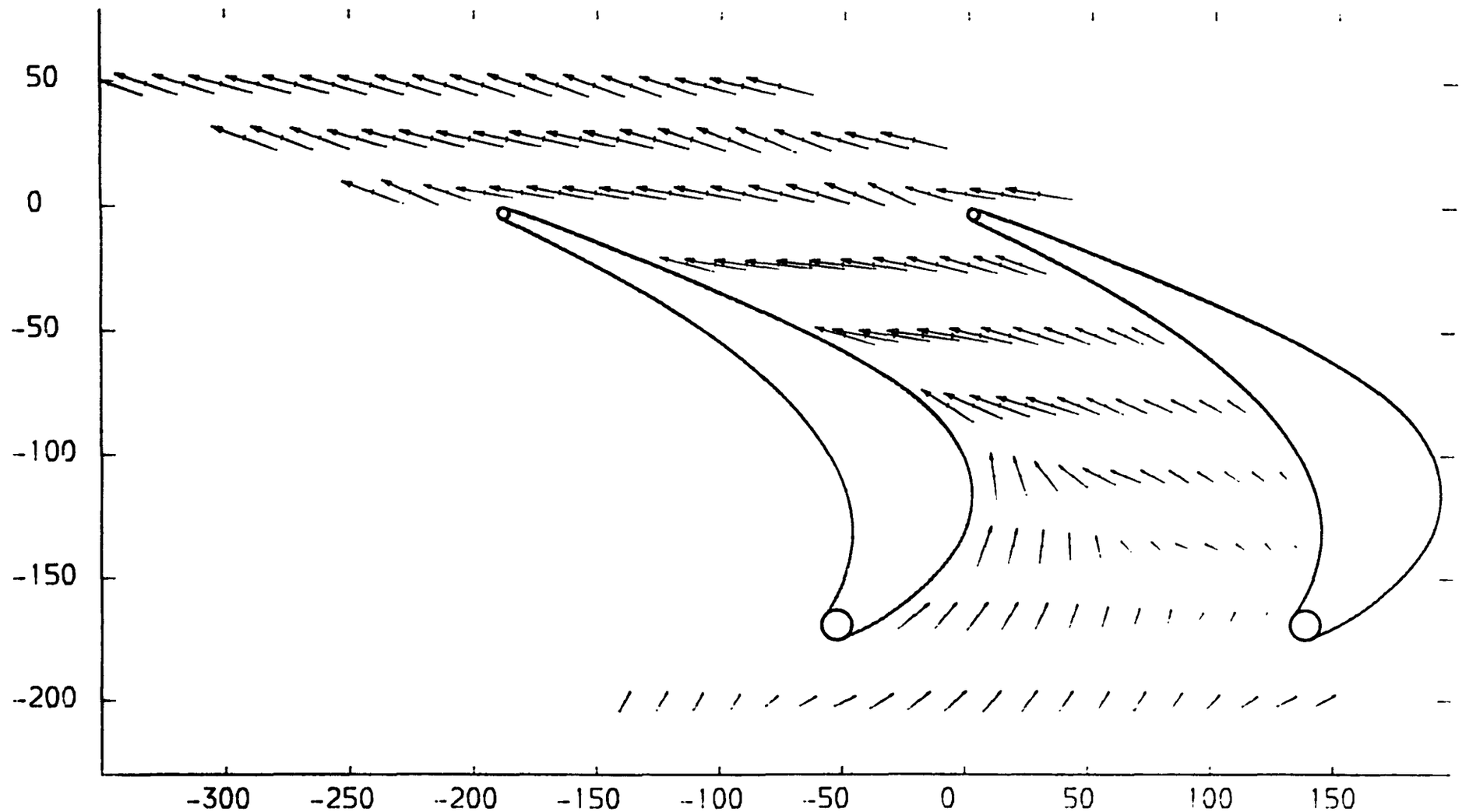


FIGURE 4.107

PLOT ON PLANE 15.0 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)

VECTOR PLOT OF AXIAL AND TANGENTIAL VELOCITIES

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
VECTOR SCALE 40 METRES/SEC

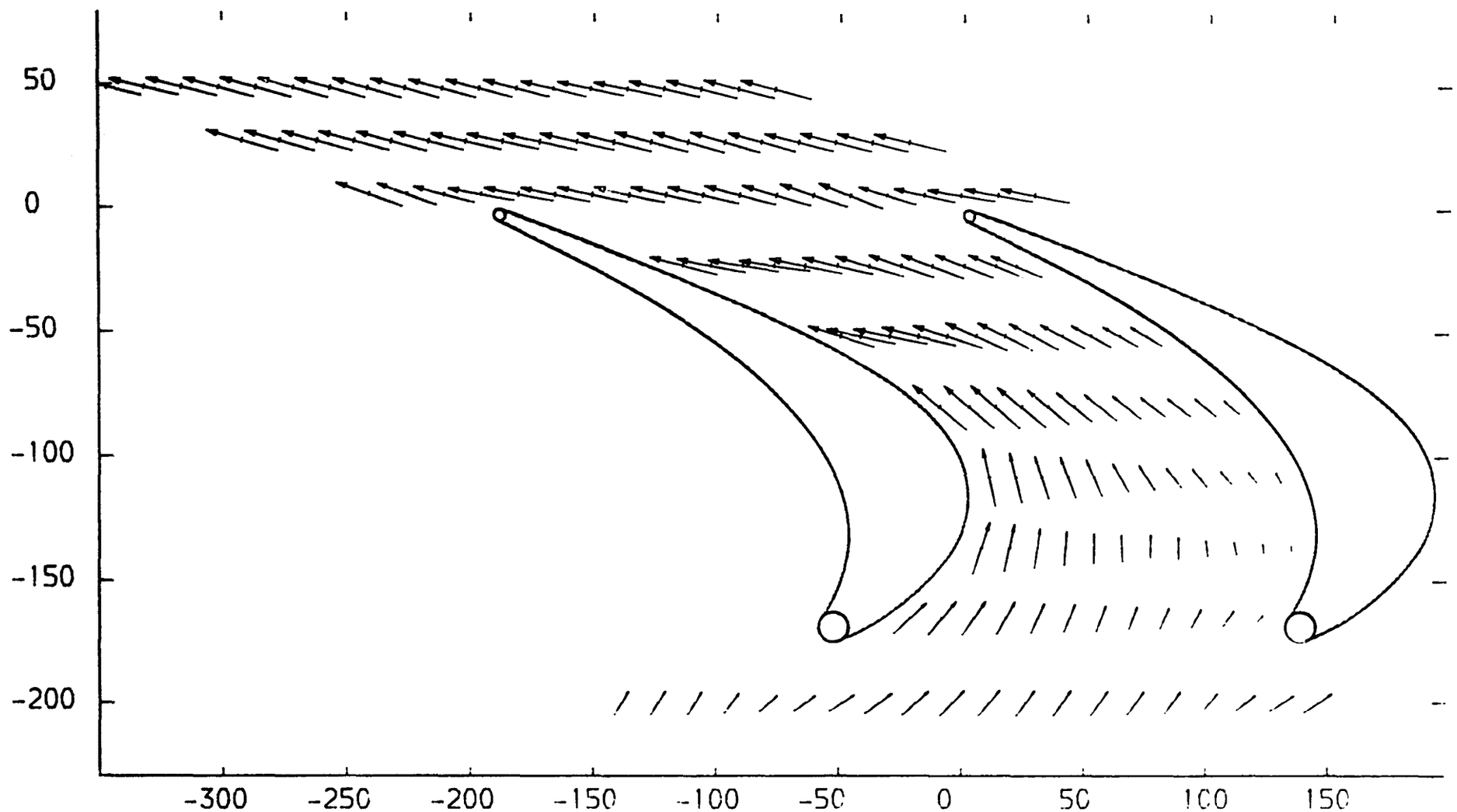


FIGURE 4.108

PLOT ON PLANE 40.0 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)

VECTOR PLOT OF AXIAL AND TANGENTIAL VELOCITIES

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
VECTOR SCALE 40 METRES/SEC ⟶

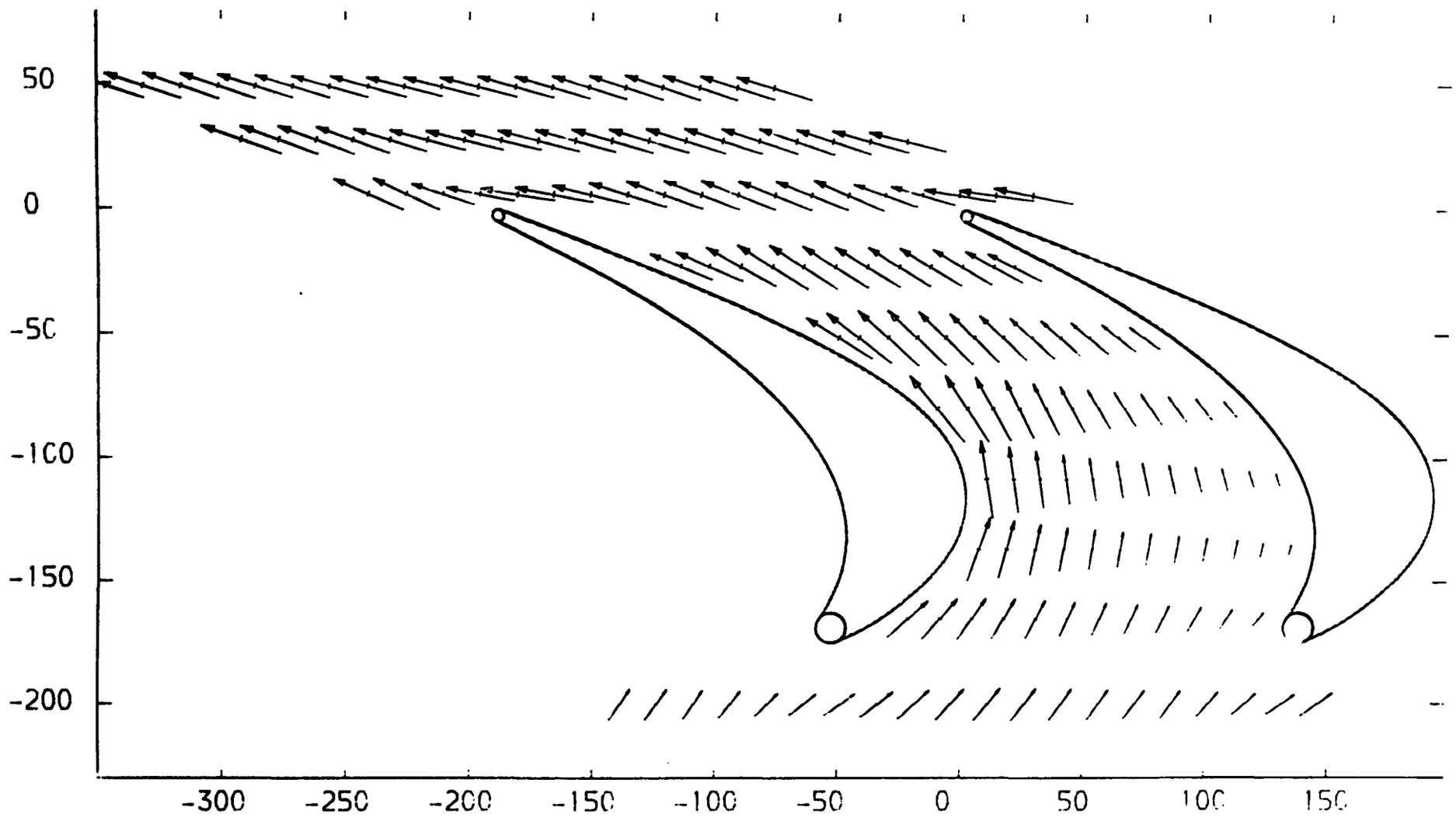


FIGURE 4.109

PLOT ON PLANE 60.0 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)

VECTOR PLOT OF AXIAL AND TANGENTIAL VELOCITIES

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
VECTOR SCALE 40 METRES/SEC

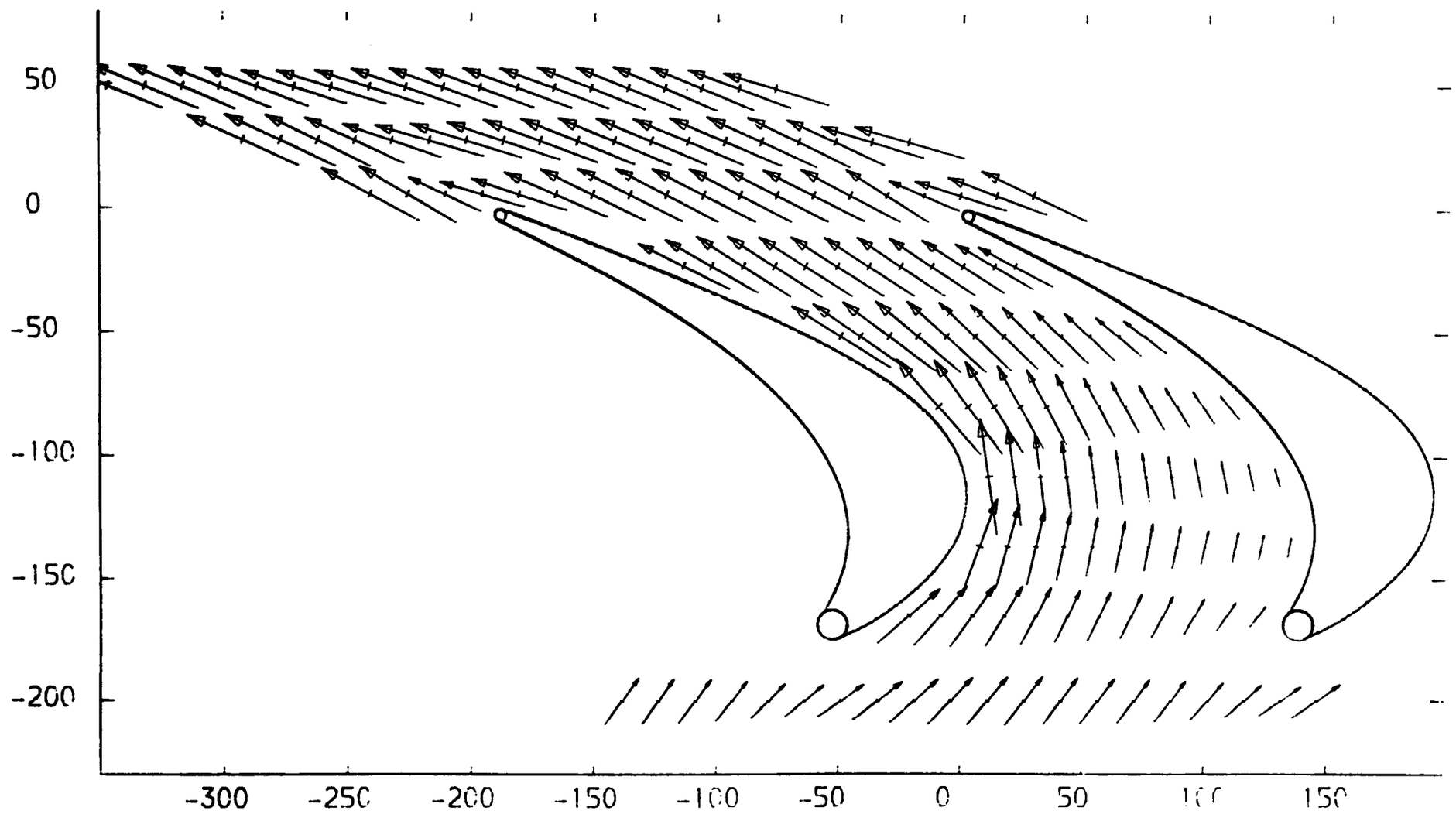


FIGURE 4.110

PLOT ON PLANE 100.1 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)

VECTOR PLOT OF AXIAL AND TANGENTIAL VELOCITIES

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
VECTOR SCALE 40 METRES/SEC ⟶

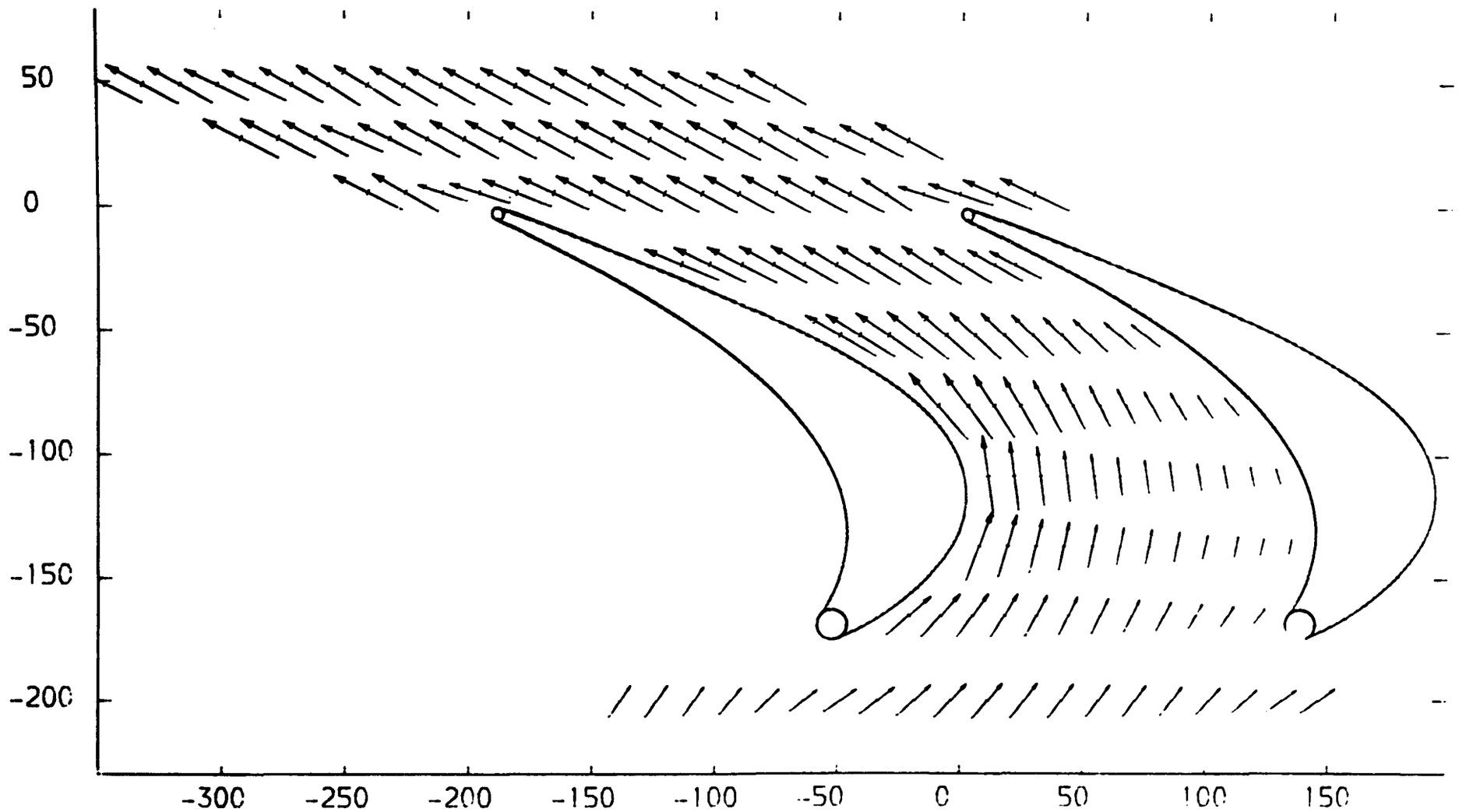


FIGURE 4.111

PLOT ON PLANE 220.1 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)

VECTOR PLOT OF AXIAL AND TANGENTIAL VELOCITIES

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
VECTOR SCALE 40 METRES/SEC

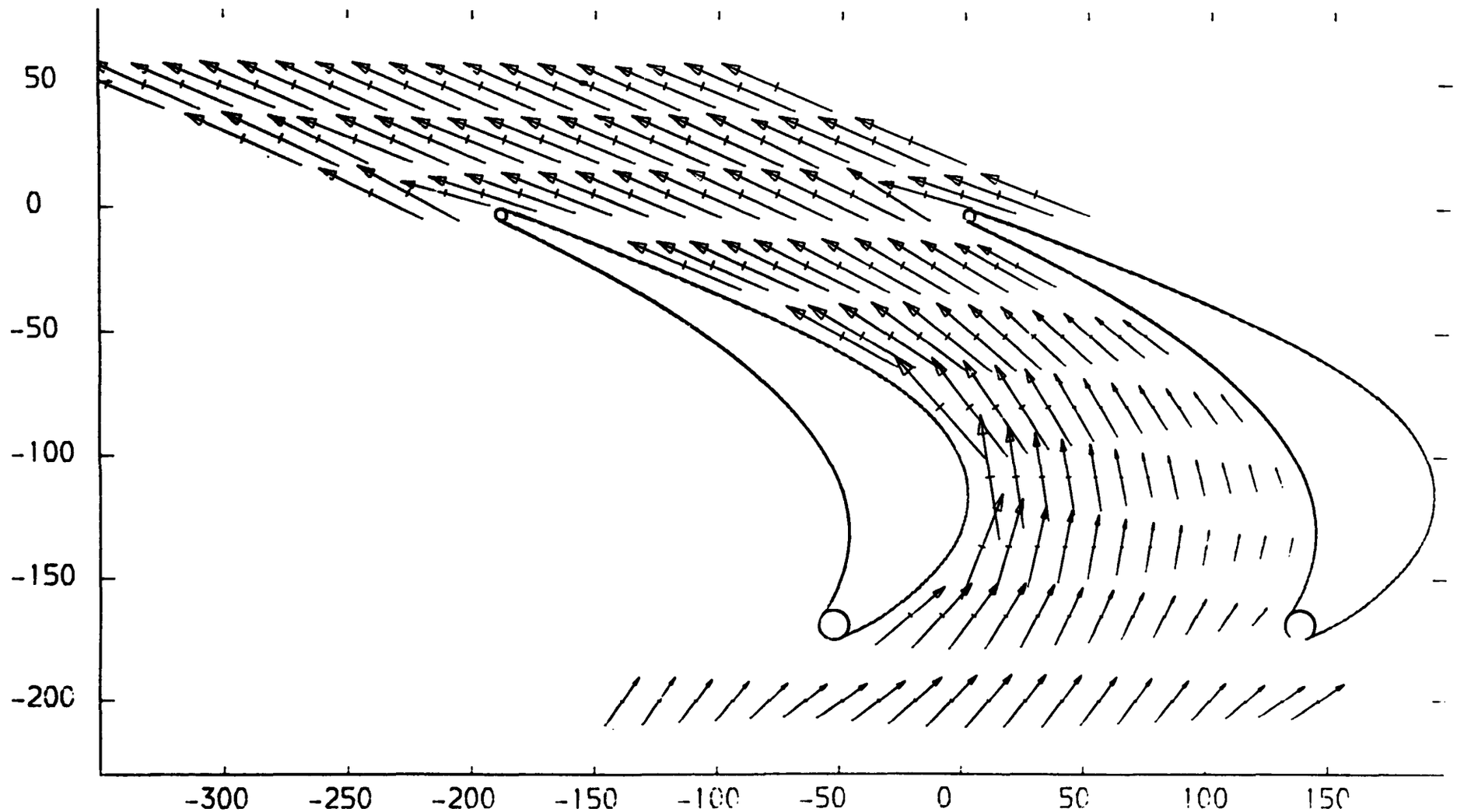


FIGURE 4.112

PLOT ON PLANE 20.1 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)
SPANWISE ANGLE (PITCH ANGLE) CONTOURS (CONTOUR UNITS DEGREES)
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

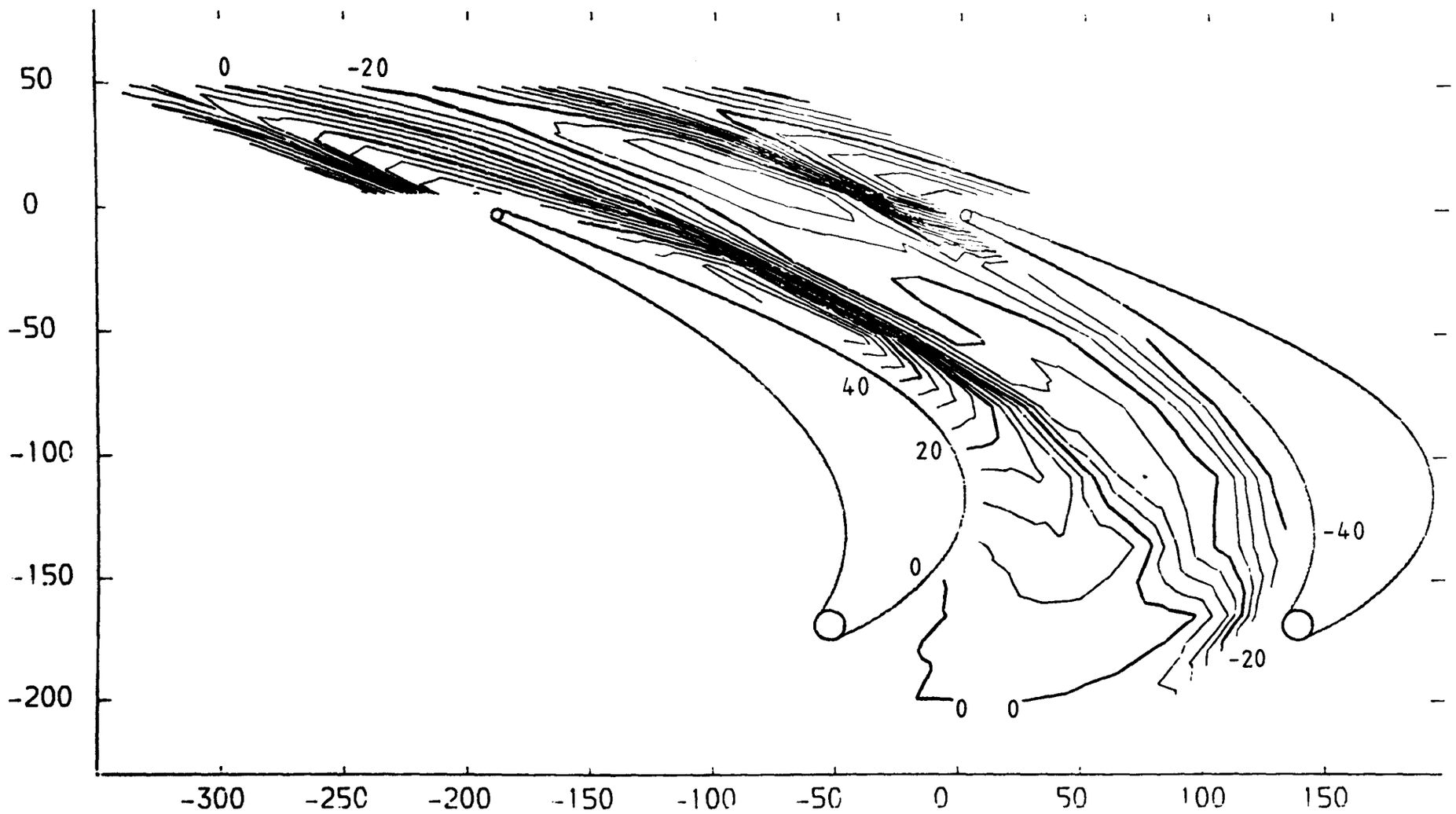


FIGURE 4.113

PLOT ON PLANE 20.1 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)

YAW ANGLE CONTOURS (CONTOUR UNITS DEGREES)

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

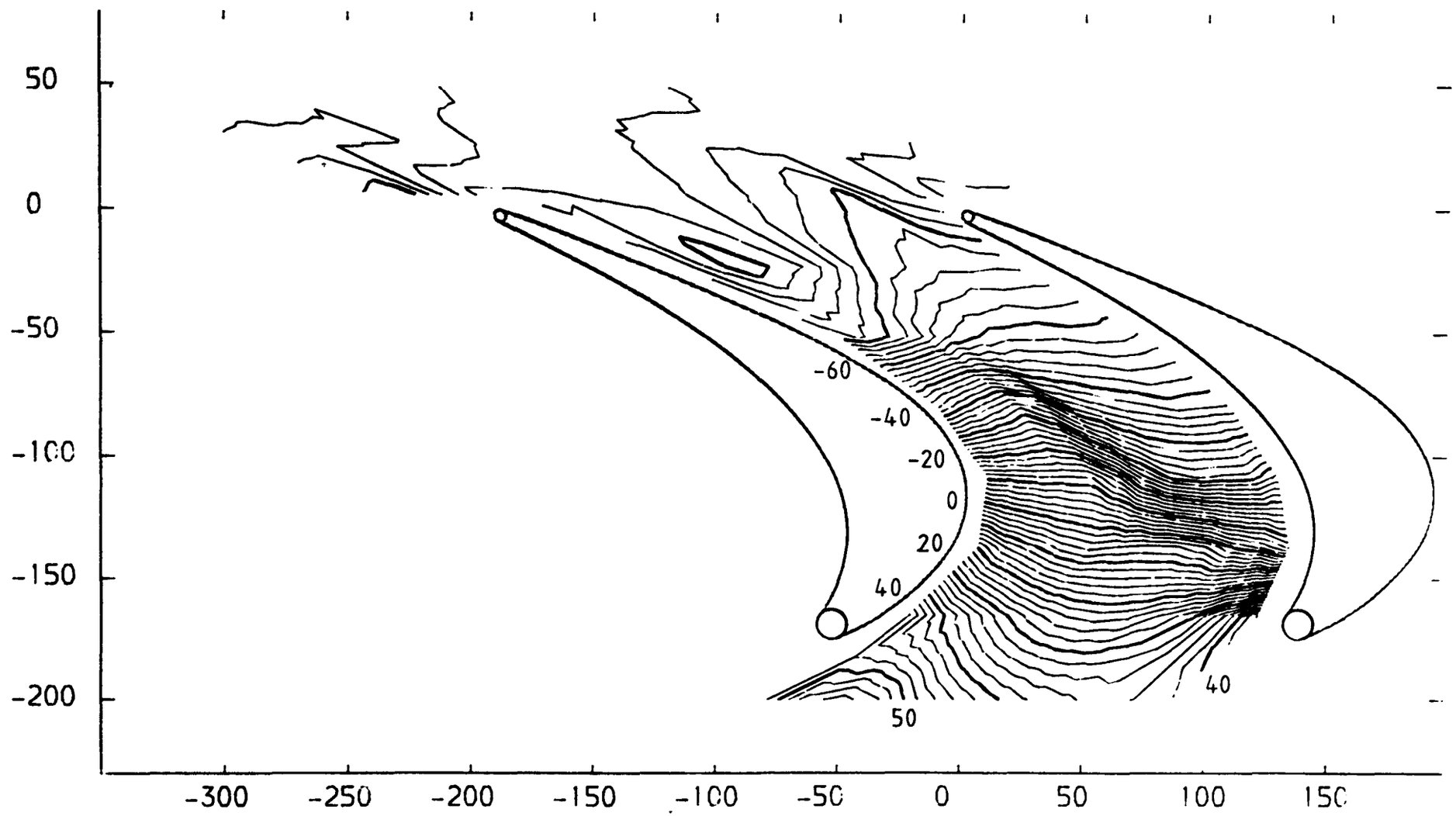


FIGURE 4.114

PLOT ON PLANE 220.1 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)
SPANWISE ANGLE (PITCH ANGLE) CONTOURS (CONTOUR UNITS DEGREES)
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

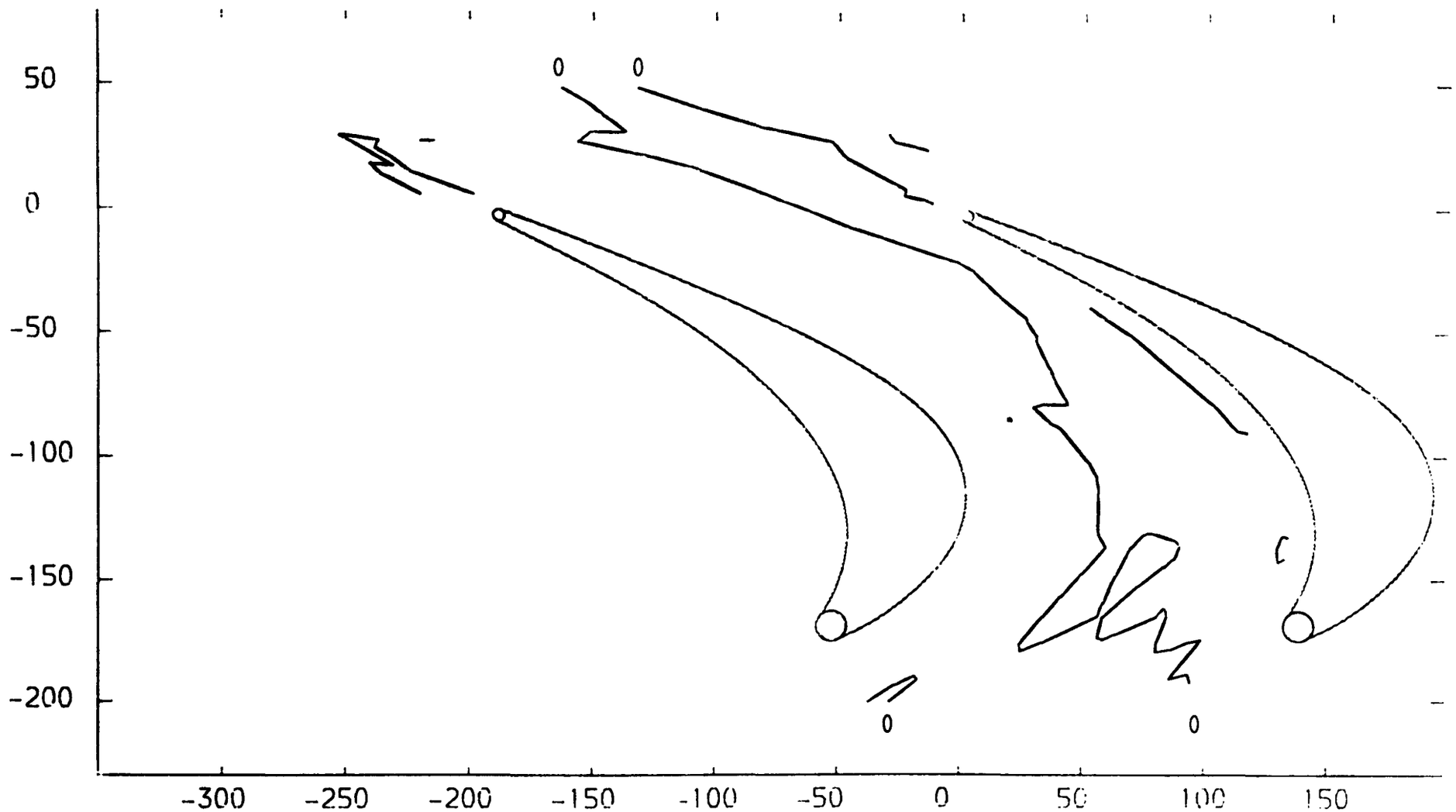


FIGURE 4.115

PLOT ON PLANE 220.1 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)

YAW ANGLE CONTOURS (CONTOUR UNITS DEGREES)

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

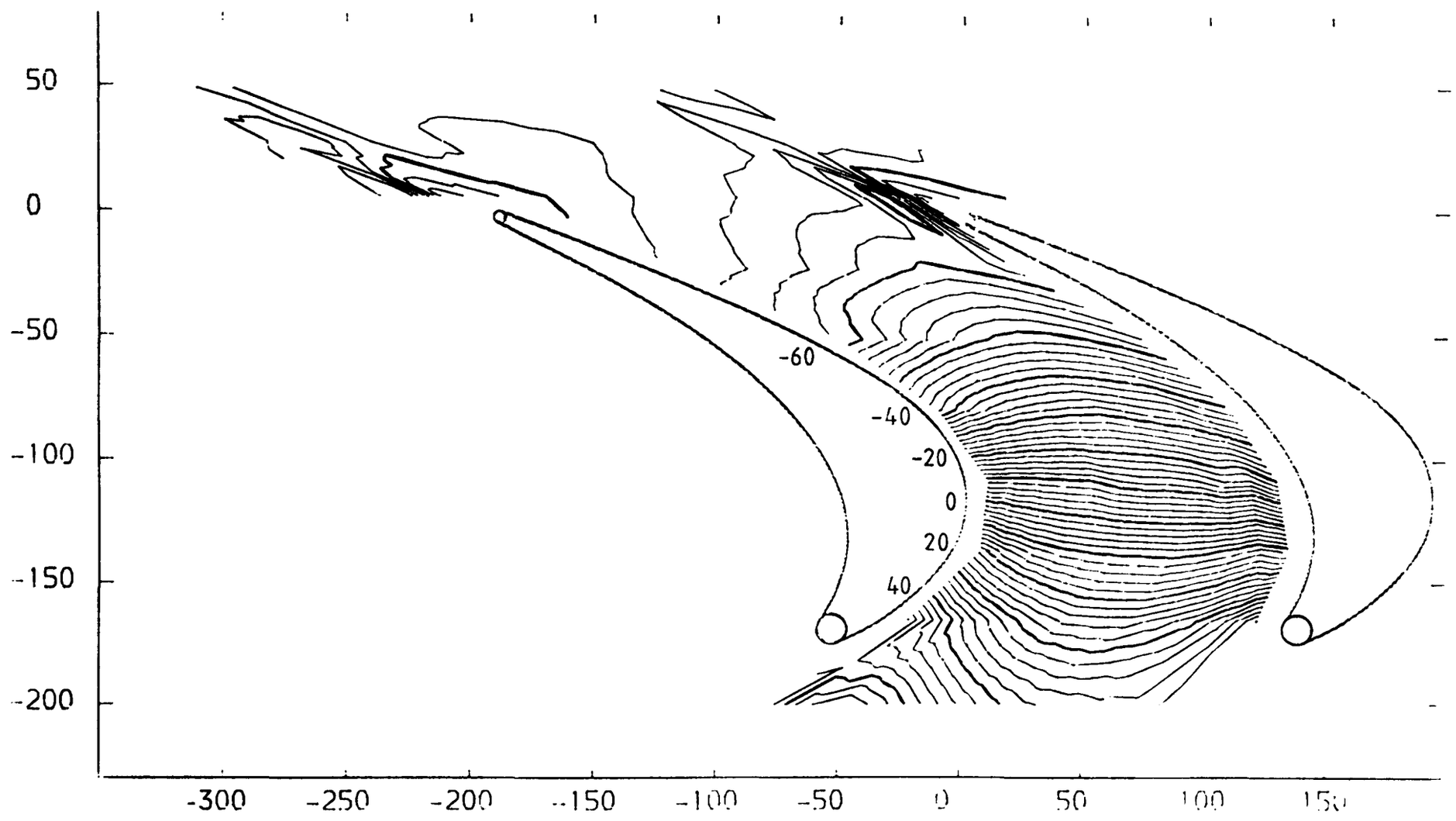


FIGURE 4.116

PLOT ON PLANE 1.0 MM FROM PERSPEX ENDWALL (3-HOLE PROBE DATA)
STATIC PRESSURE COEFFICIENT ((P1-PLOCAL) / (PO1-P1)) CONTOURS
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

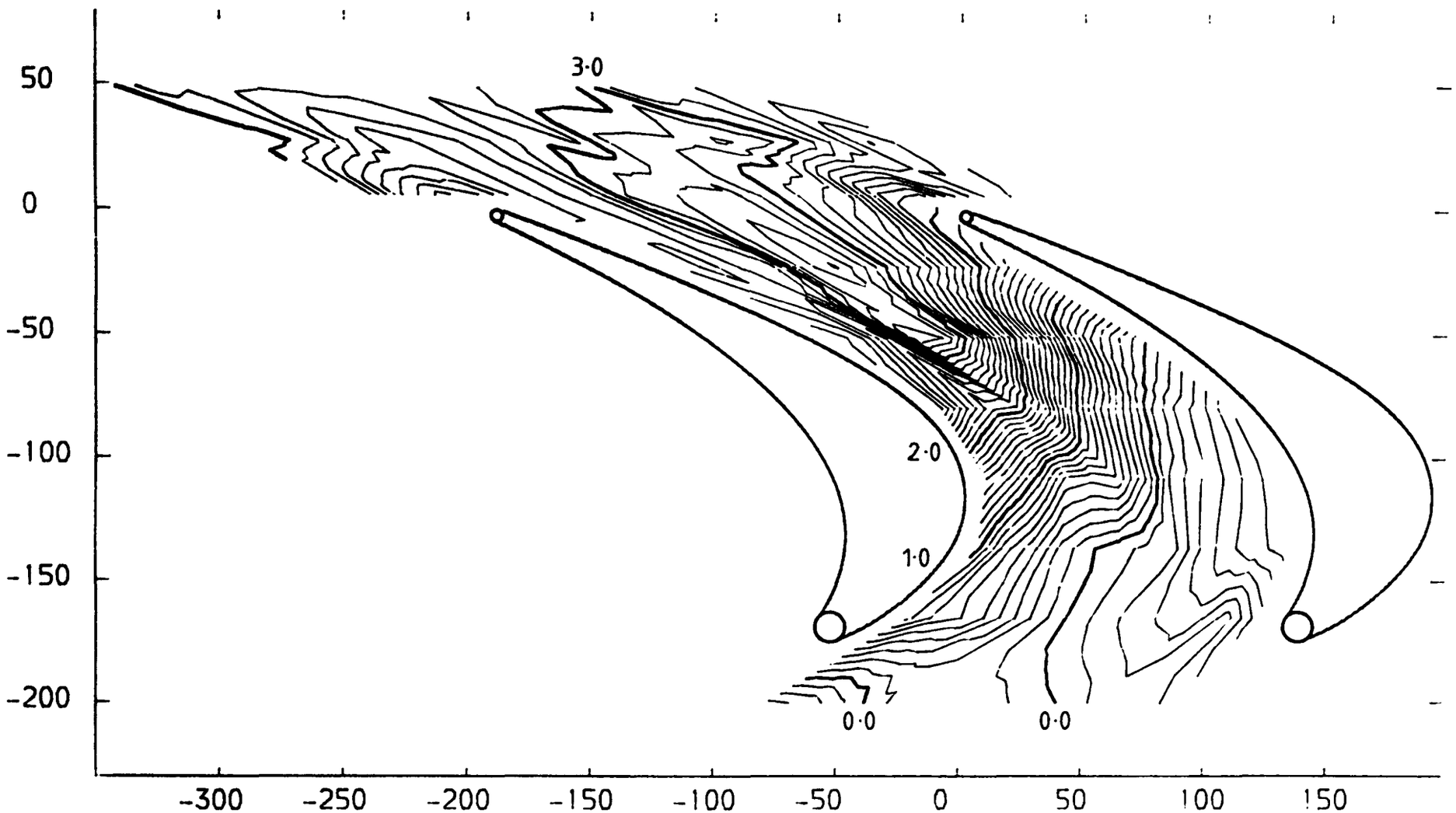


FIGURE 4.117

PLOT ON PLANE 20.1 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)
STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(P01-P1)) CONTOURS
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

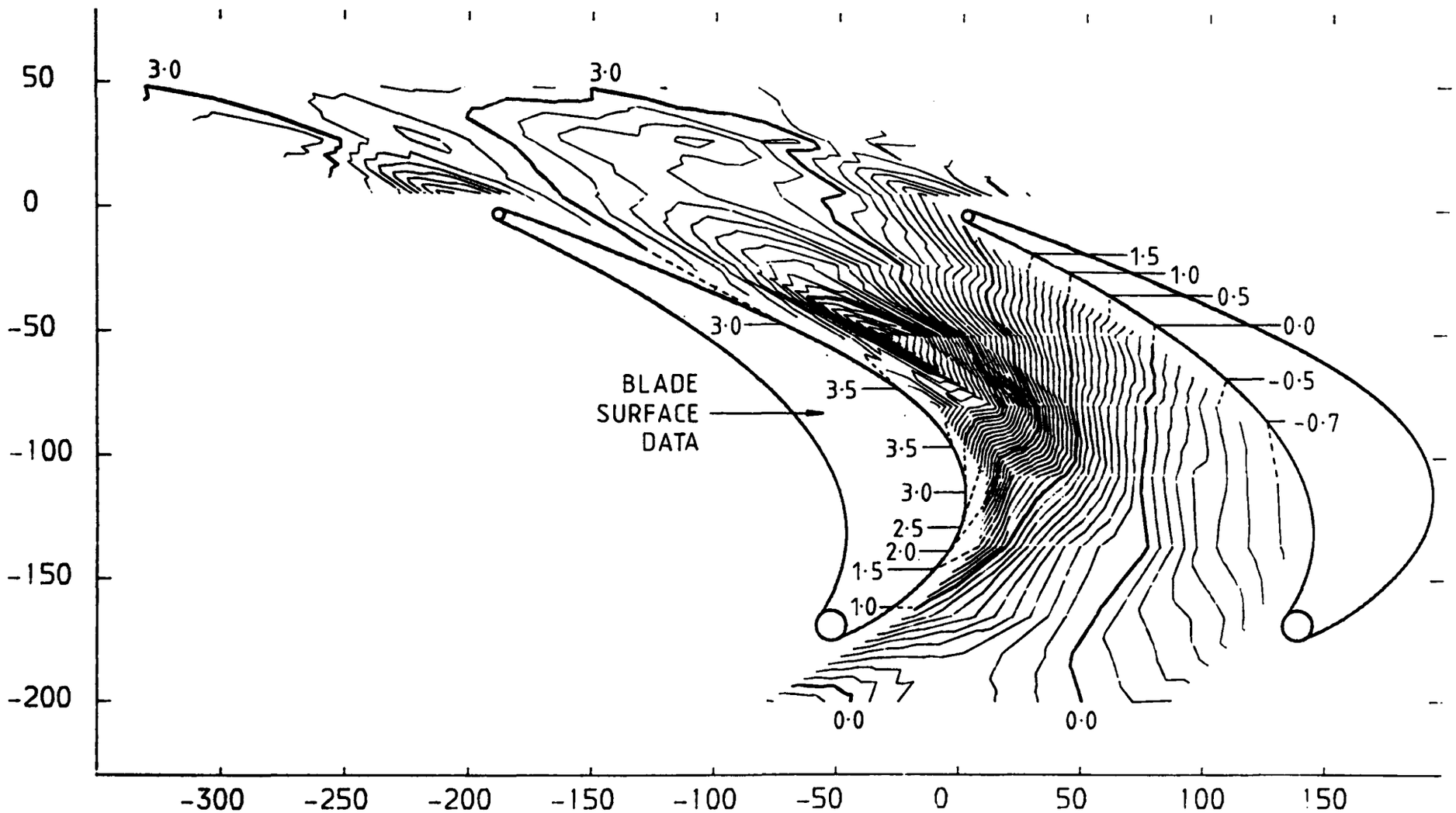


FIGURE 4.118

PLOT ON PLANE 20.1 MM FROM PERSPEX ENDWALL (3-HOLE PROBE DATA)
STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(P01-P1)) CONTOURS
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

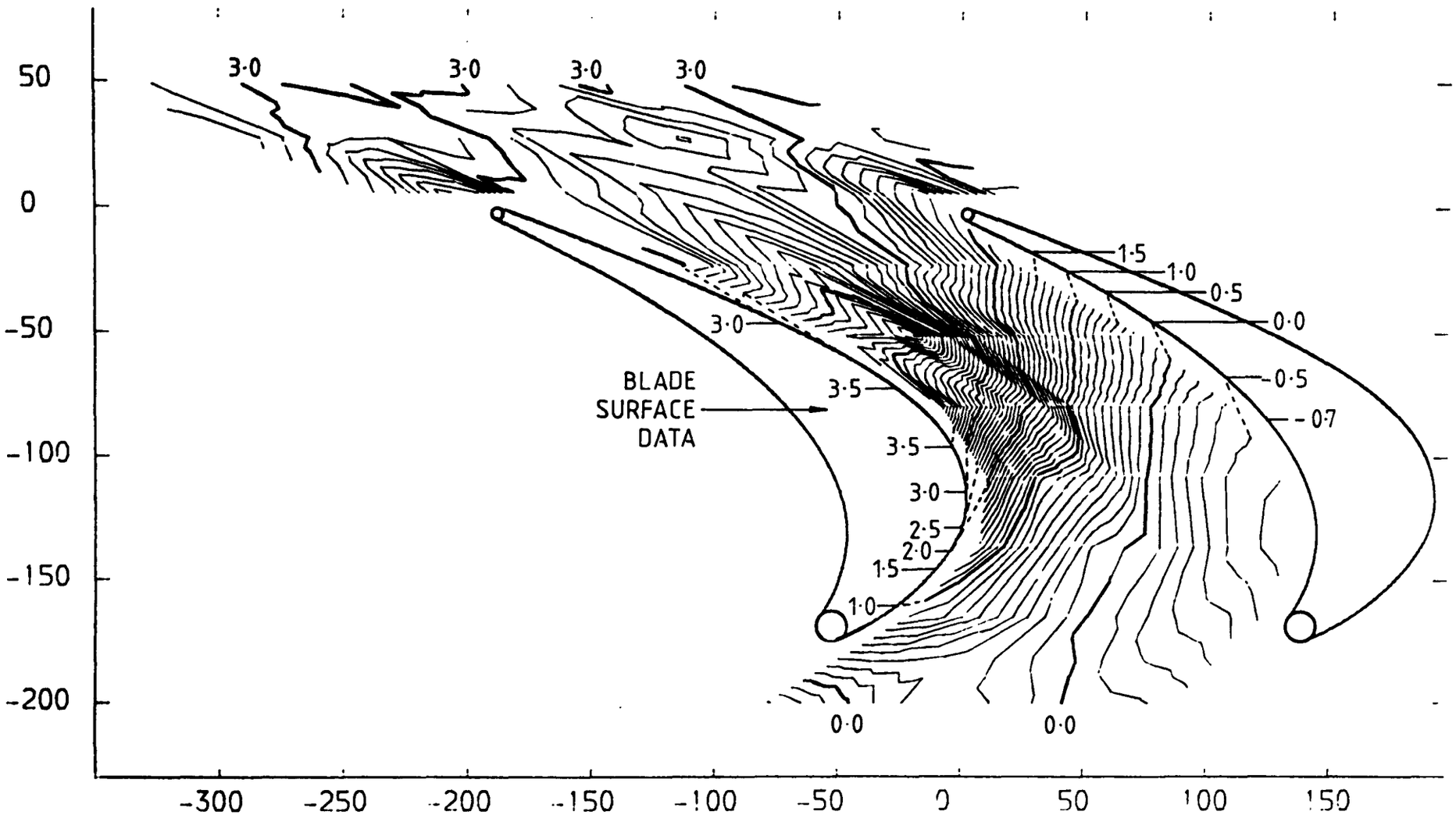


FIGURE 4.119

PLOT ON PLANE 30.0 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)
STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(PO!-P1)) CONTOURS
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

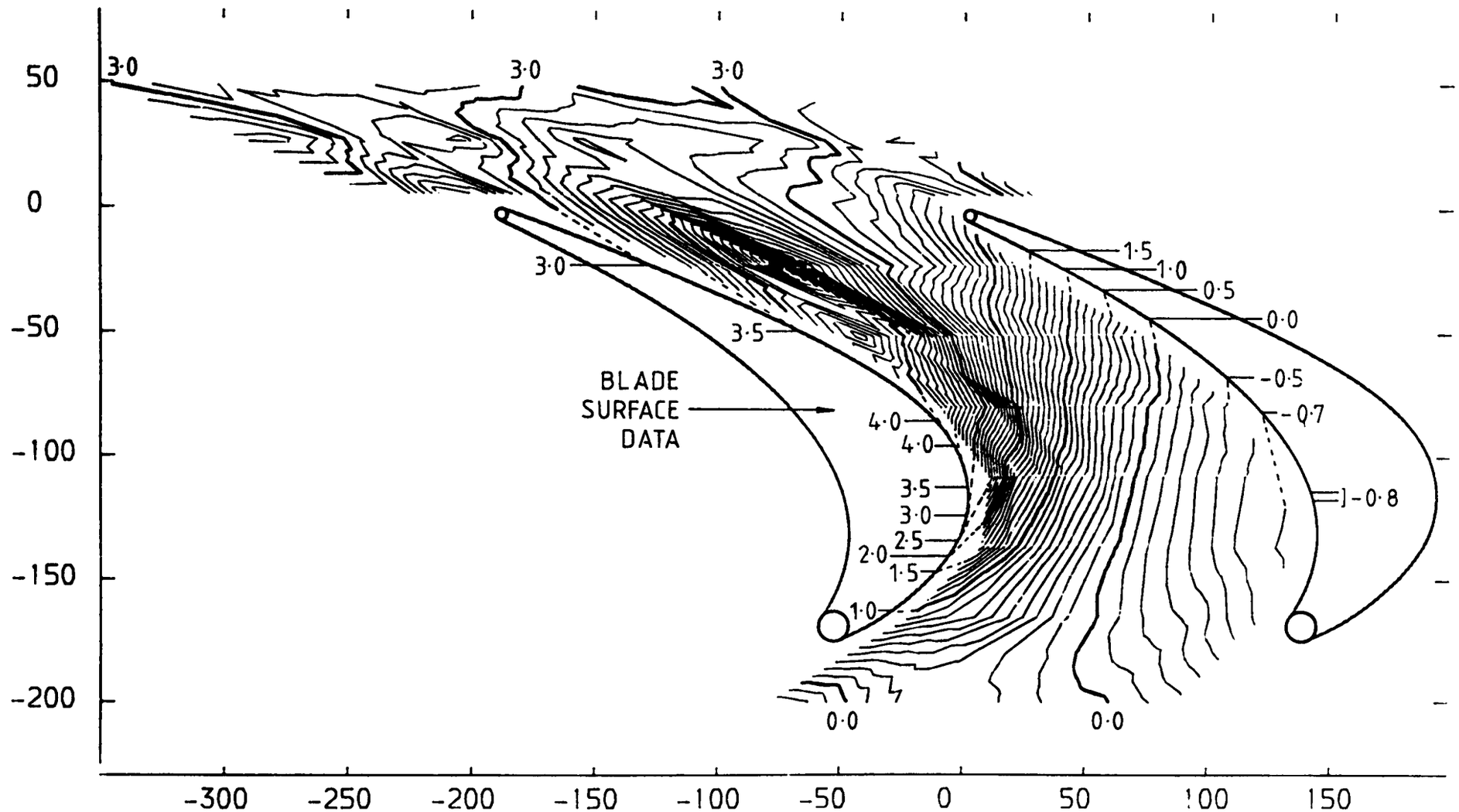


FIGURE 4.120

PLOT ON PLANE 60.0 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)
STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(P01-P1)) CONTOURS
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

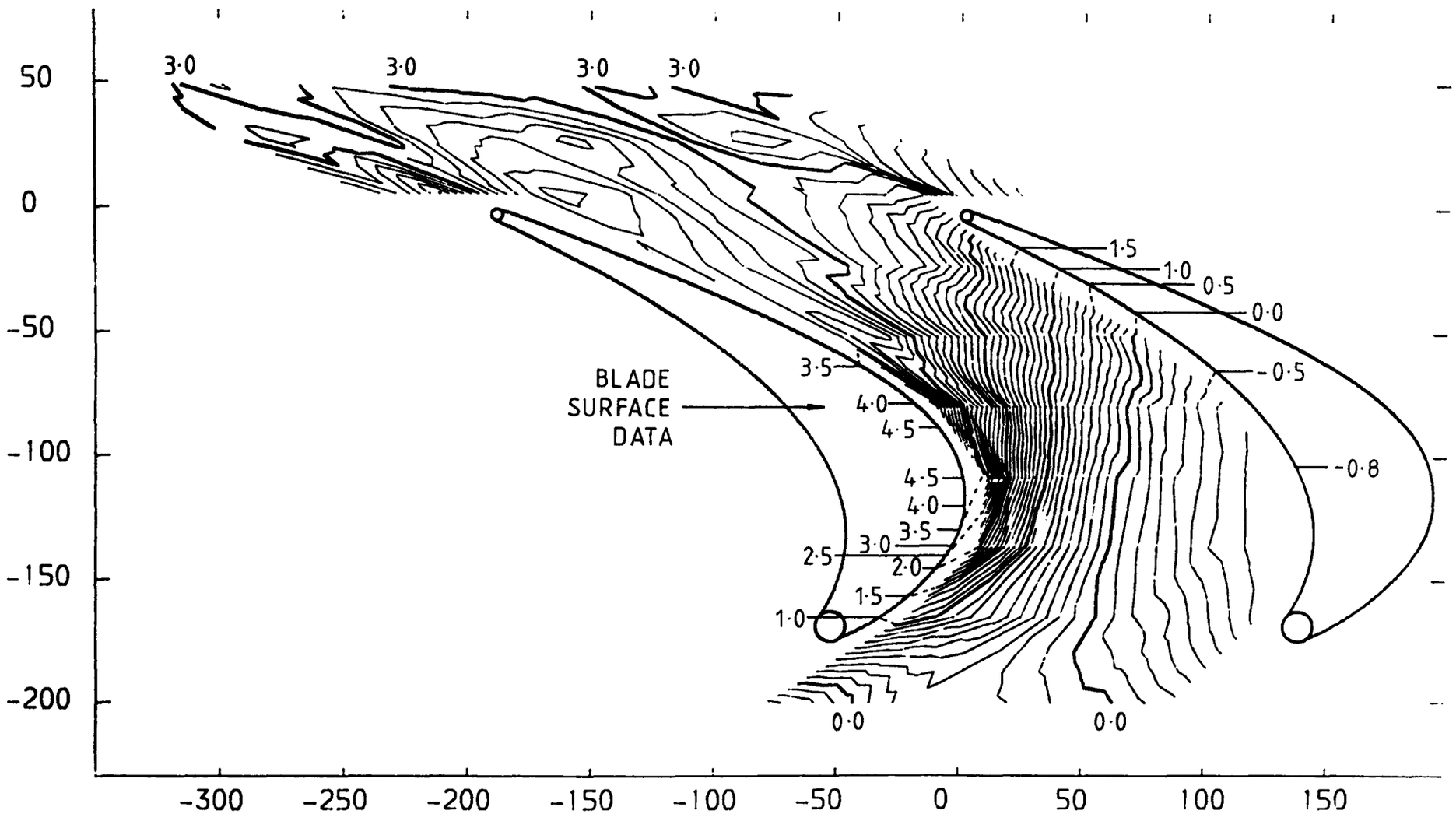


FIGURE 4.121

PLOT ON PLANE 220.1 MM FROM PERSPEX ENDWALL (5-HOLE PROBE DATA)
STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(P01-P1)) CONTOURS
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

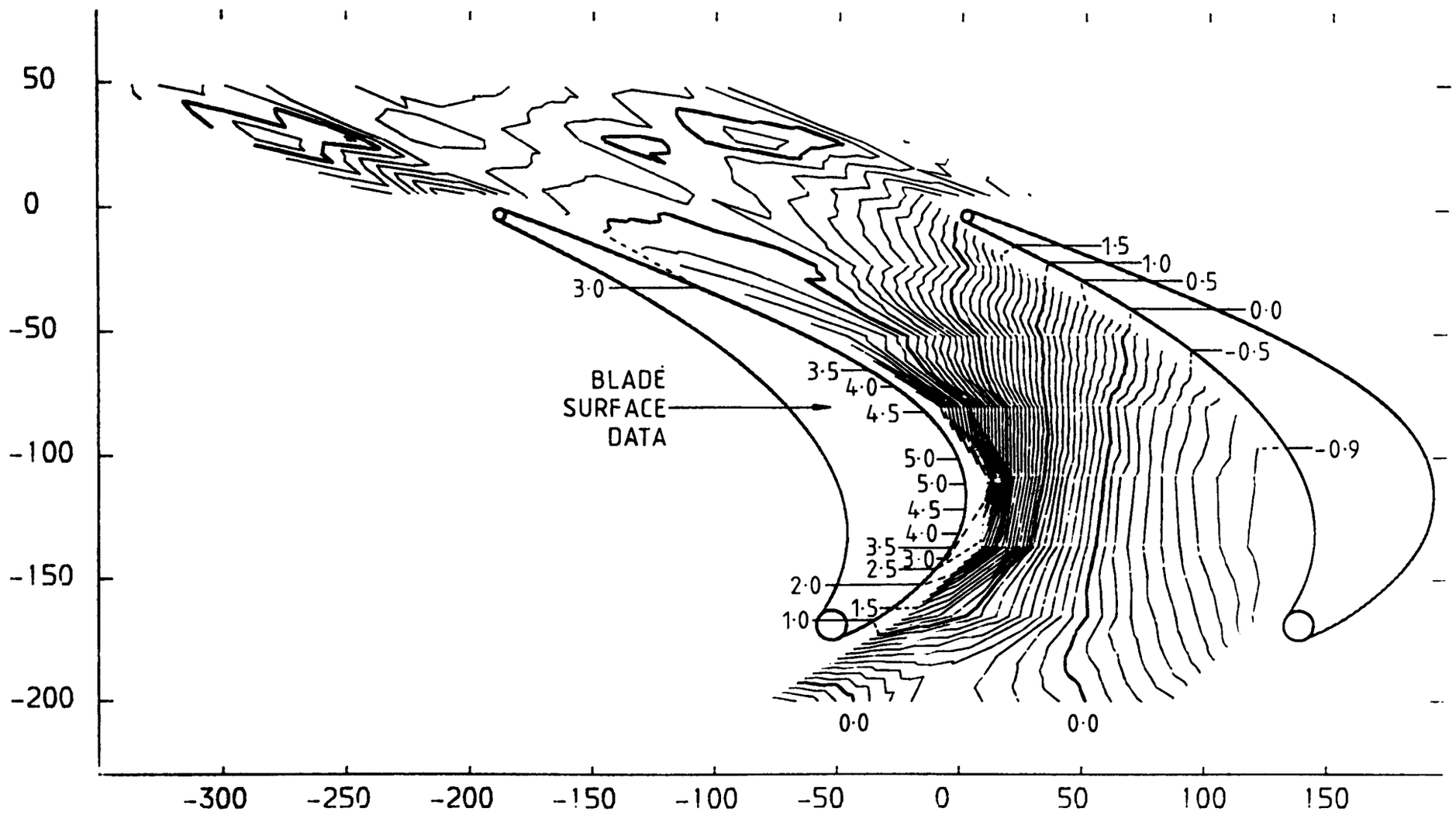


FIGURE 4.122

TWO DIMENSIONAL STATIC PRESSURE COEFFICIENT DISTRIBUITON
PREDICTED VALUES ((P1-PLOCAL)/(P01-P1)) CONTOURS

X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

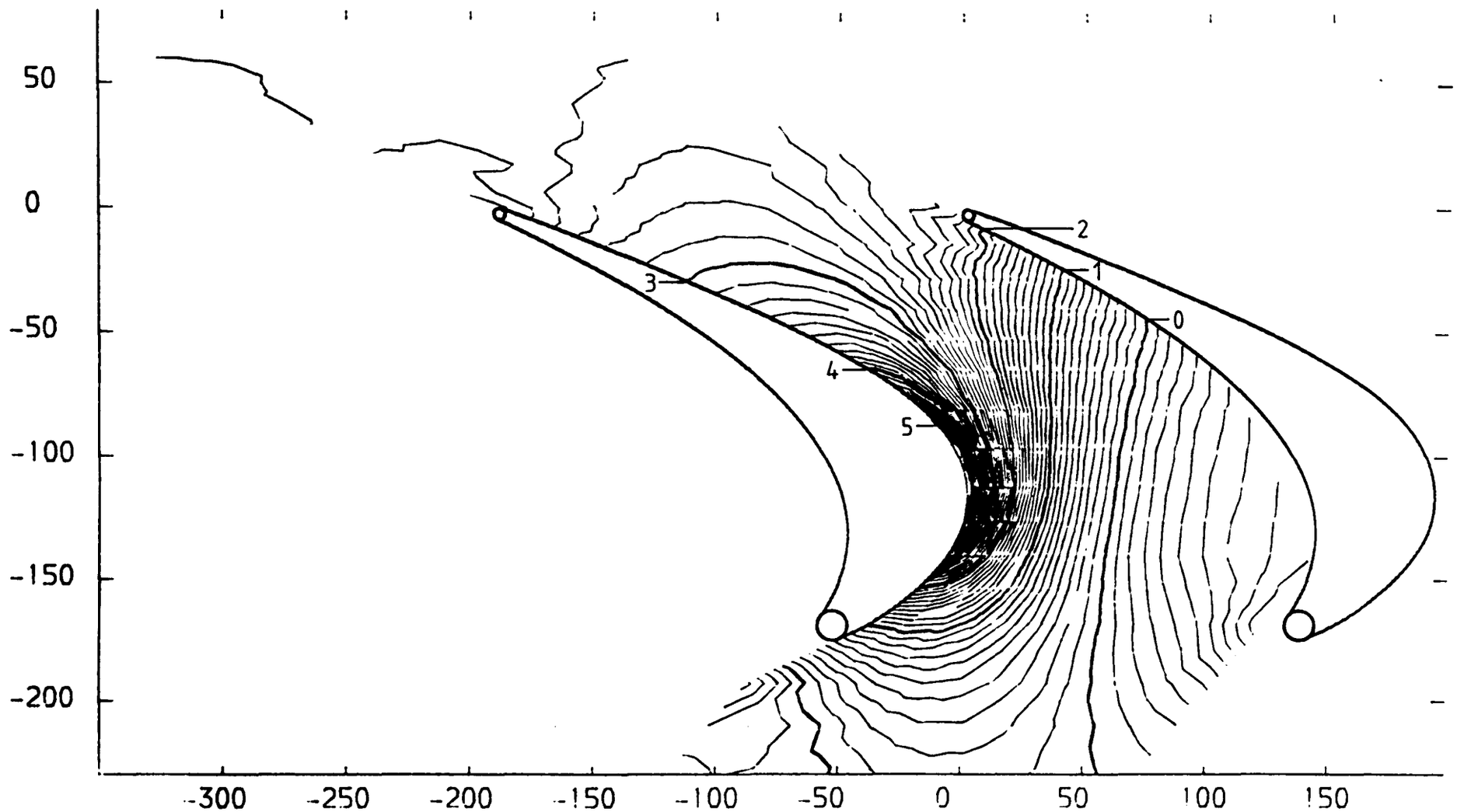


FIGURE 4.123

PLOT APPROXIMATELY 93.3 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE

AVERAGED TANGENTIAL EXPERIMENTAL POINTS

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

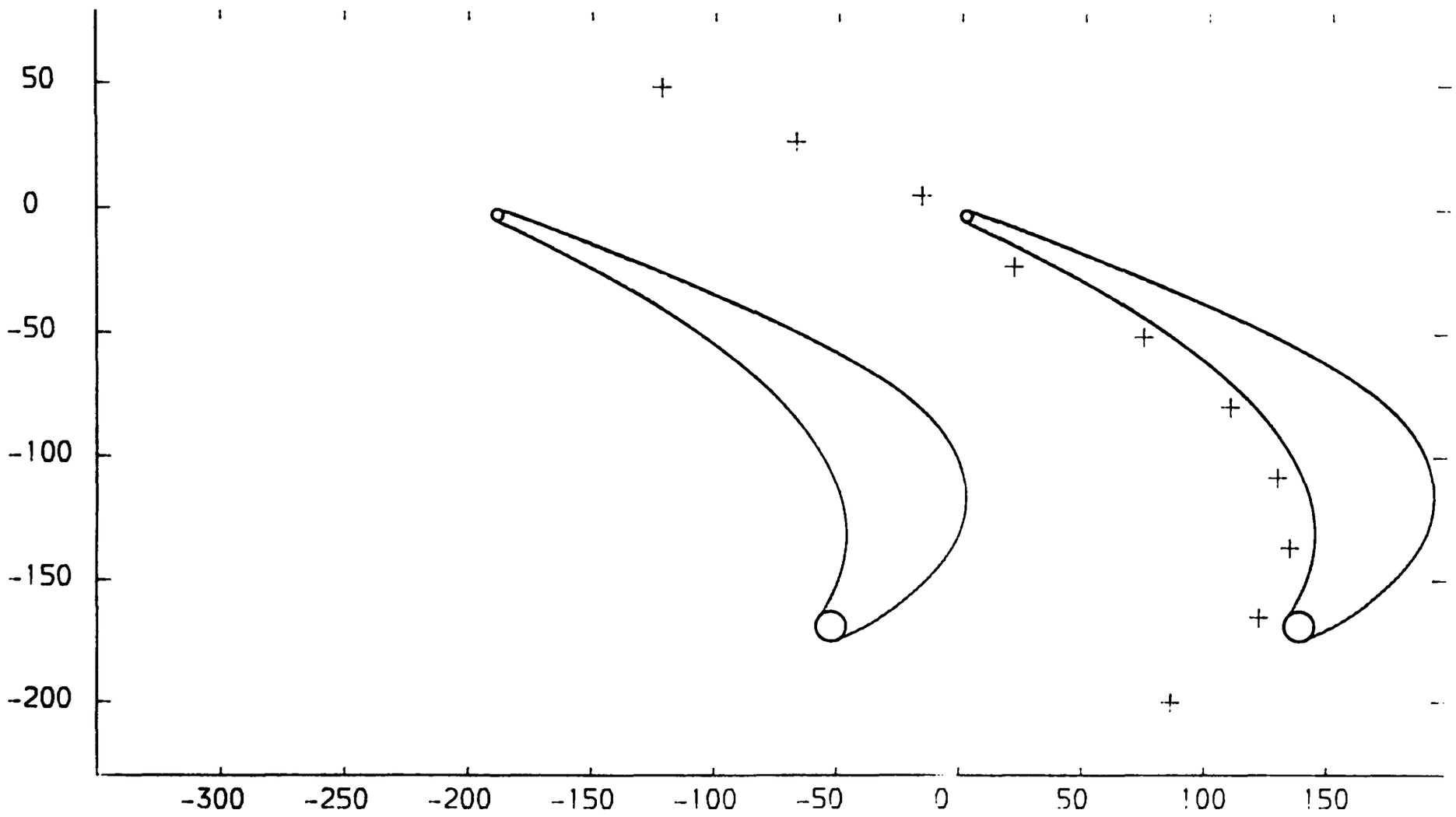


FIGURE 4.124

PLOT APPROXIMATELY 6.7 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE

AVERAGED TANGENTIAL EXPERIMENTAL POINTS

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

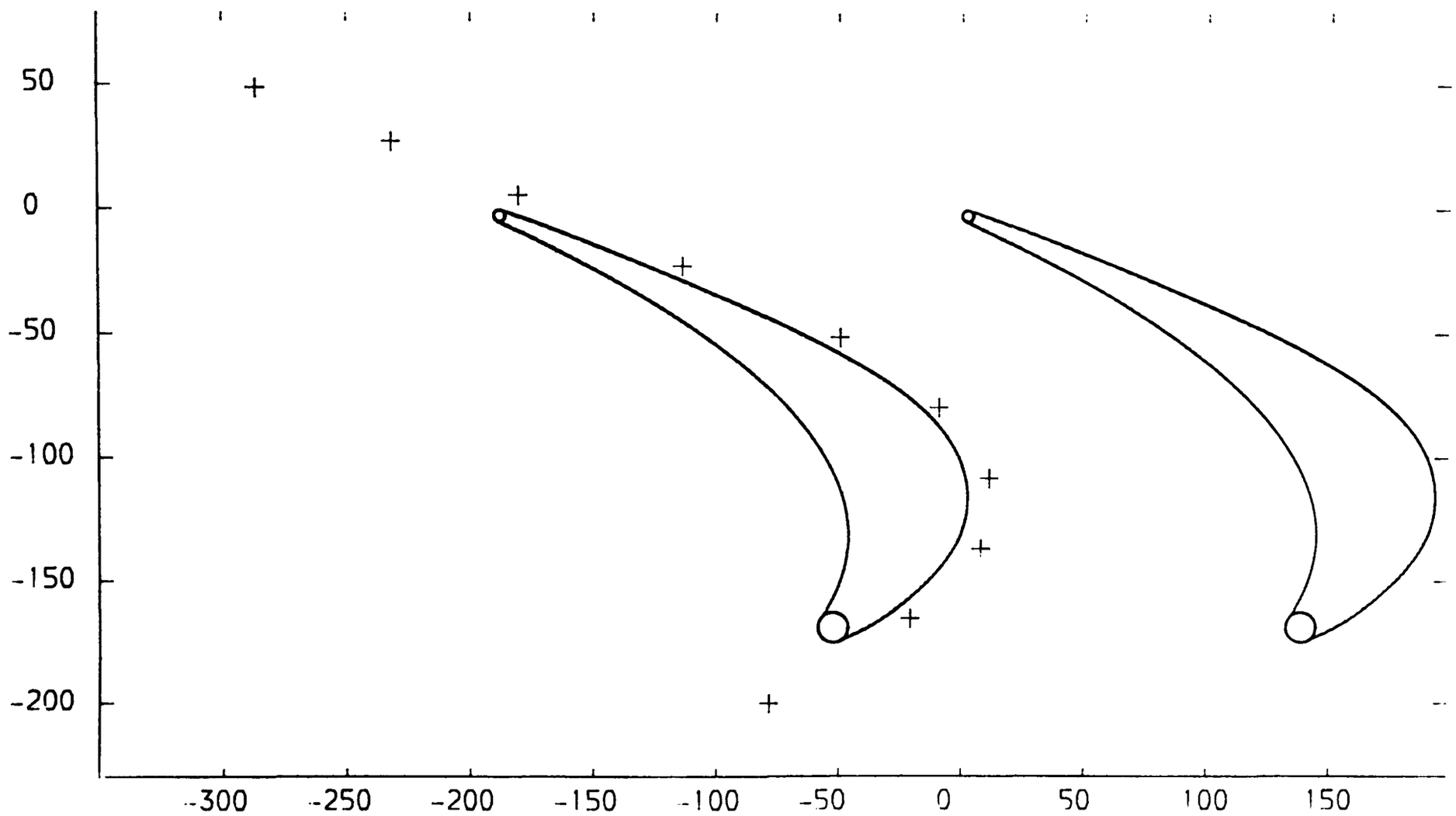


FIGURE 4.125

PLOT APPROXIMATELY 93.3 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
EXPERIMENTAL DATA POINTS

X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
+ PROBE DATA x MANUALLY INTERPOLATED DATA • EXTRAPOLATED DATA

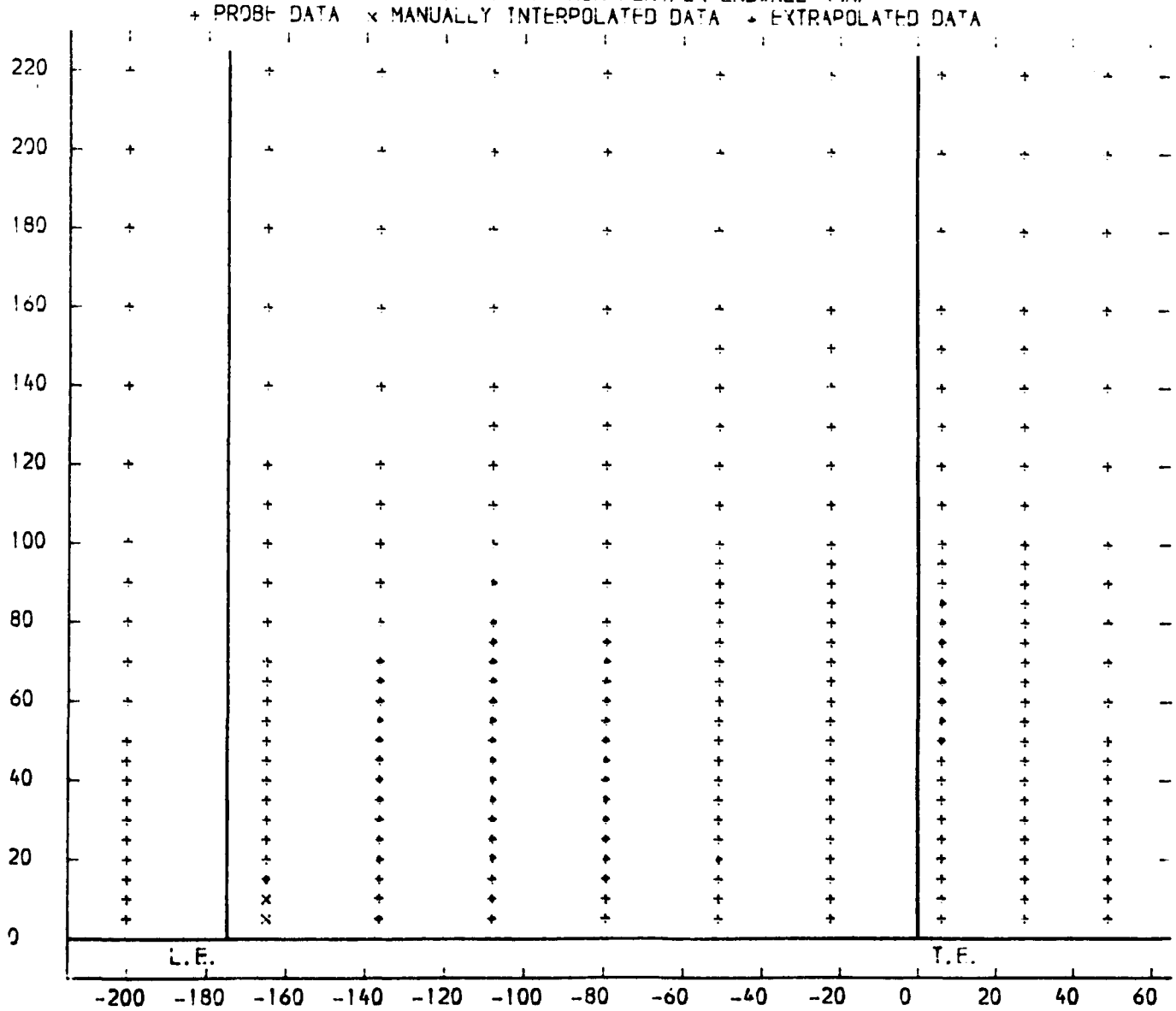


FIGURE 4.126

PLOT APPROXIMATELY 6.7 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
EXPERIMENTAL DATA POINTS

X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
+ PROBE DATA × MANUALLY INTERPOLATED DATA ◆ EXTRAPOLATED DATA

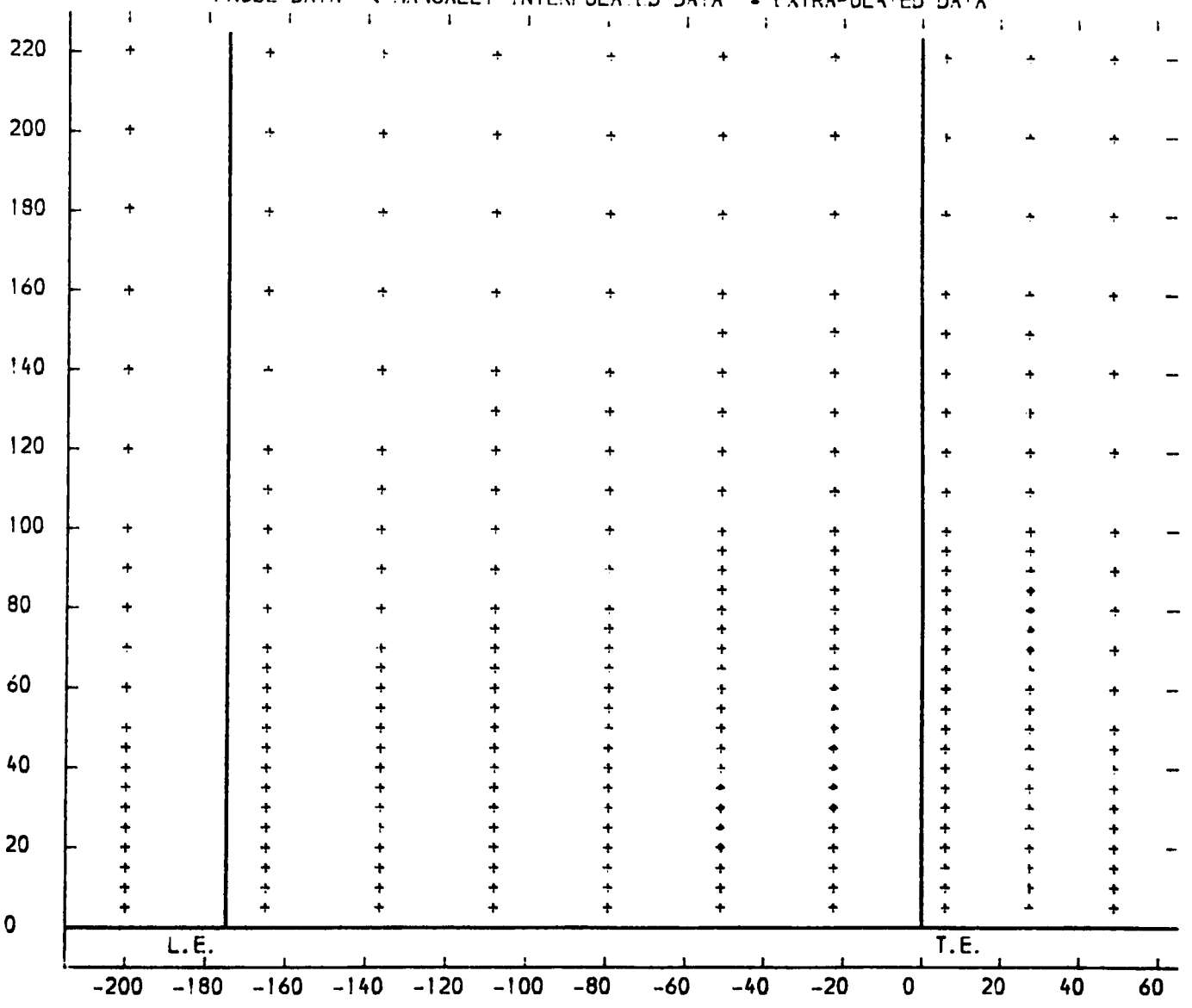


FIGURE 4.127

PLOT APPROXIMATELY 93.3 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL)/(PO1-P1)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

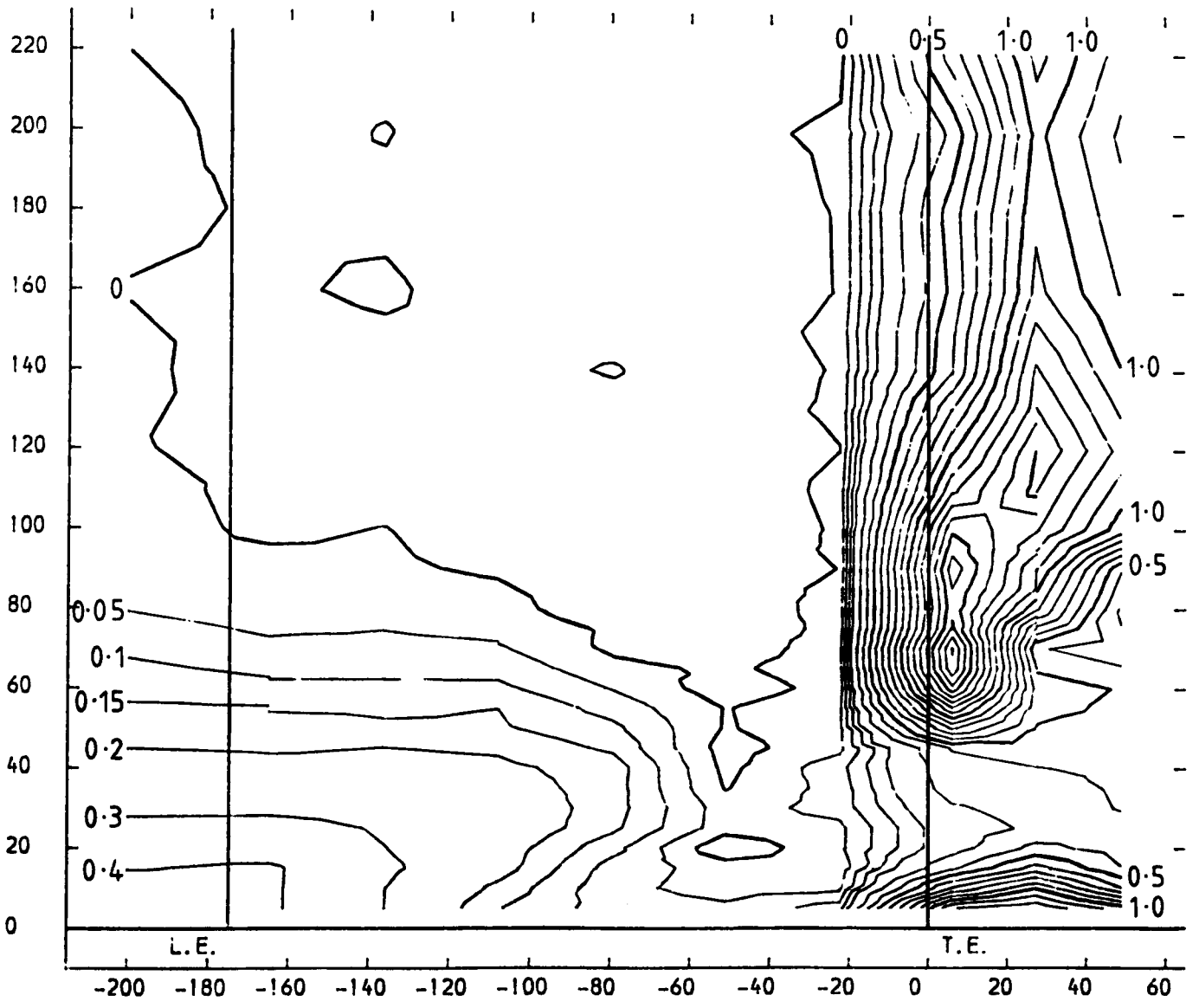


FIGURE 4.128

PLOT APPROXIMATELY 85.4 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL)/(PO1-P1)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

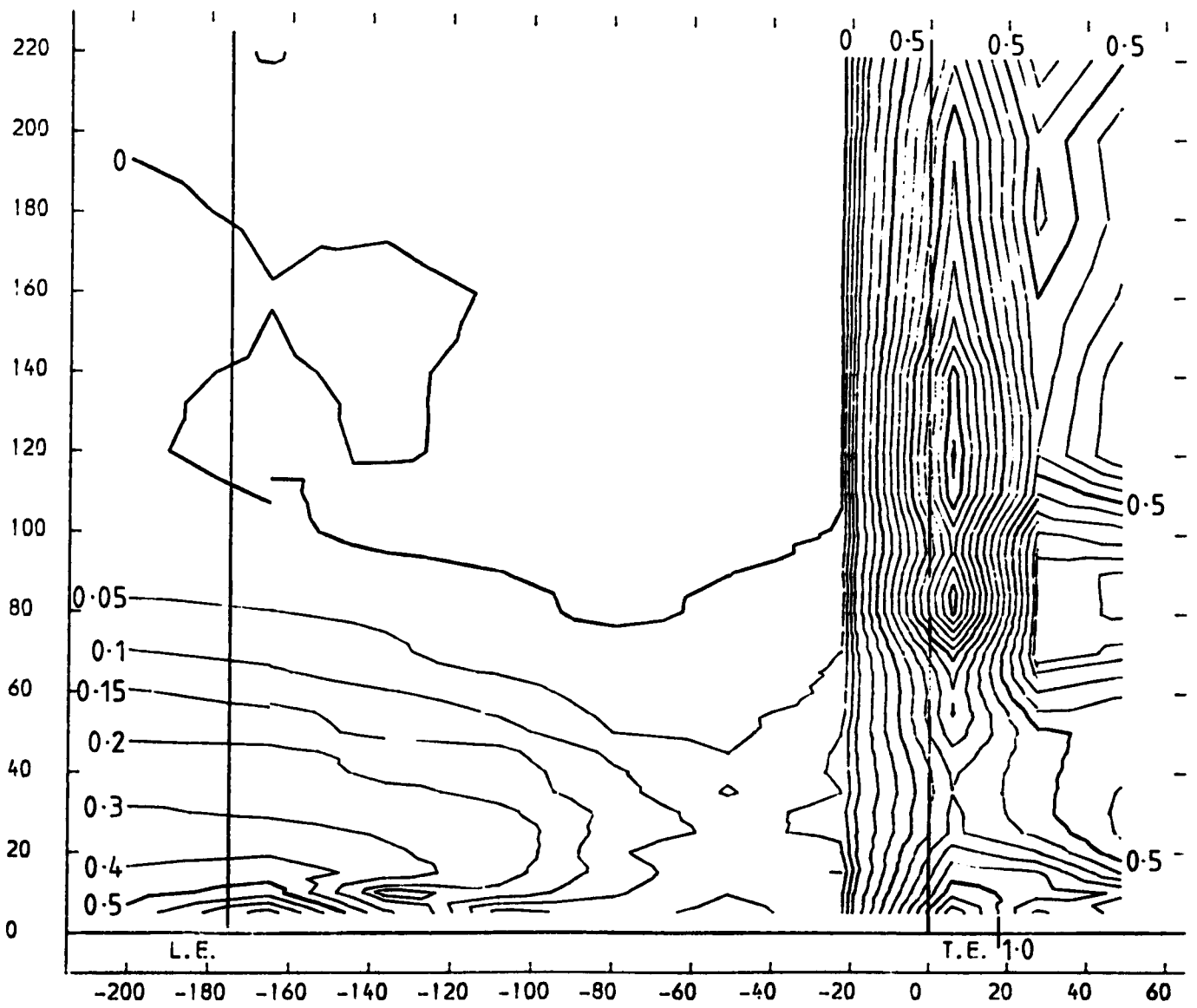


FIGURE 4.129

PLOT APPROXIMATELY 77.5 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL)/(PO1-P1)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

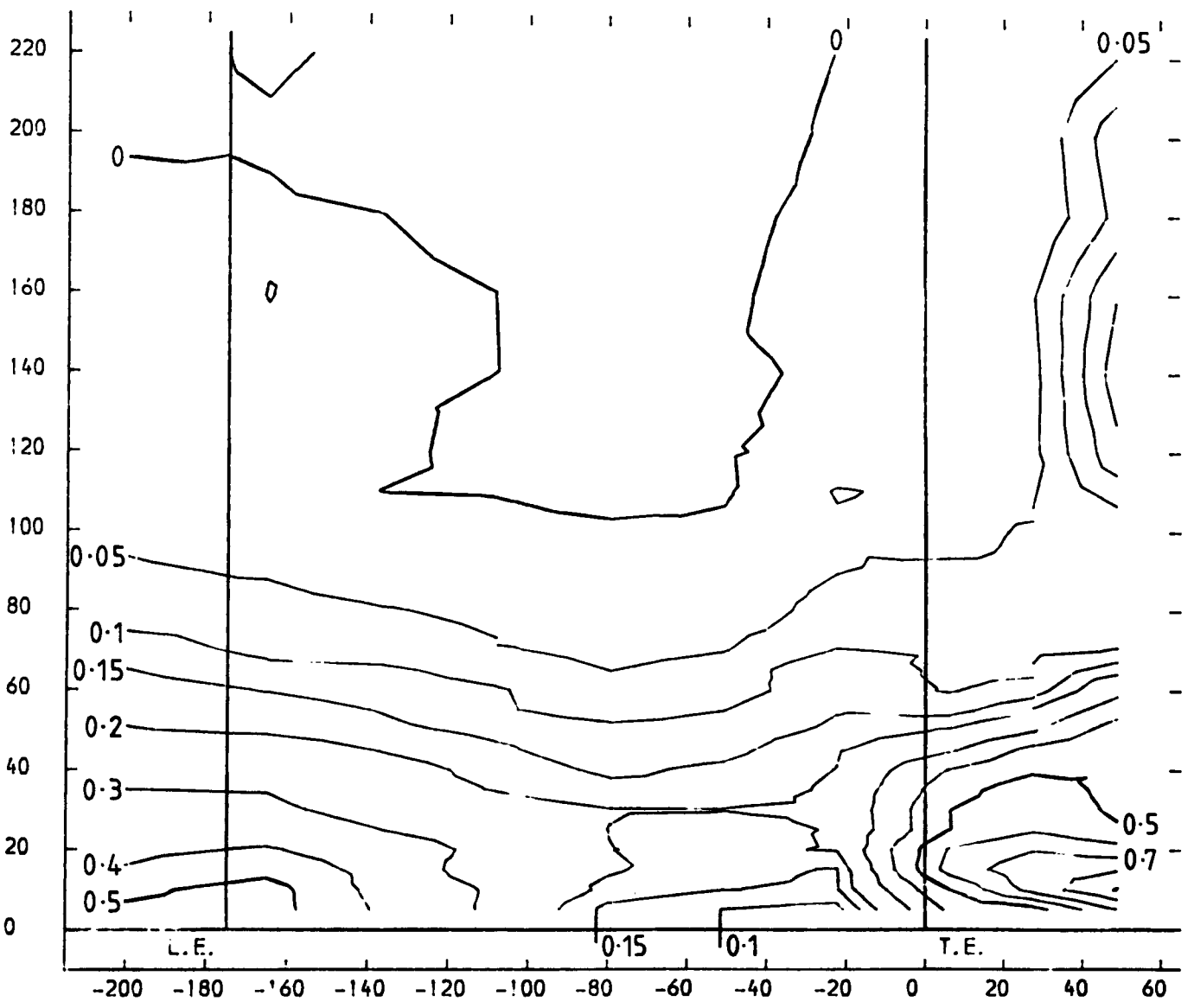


FIGURE 4.130

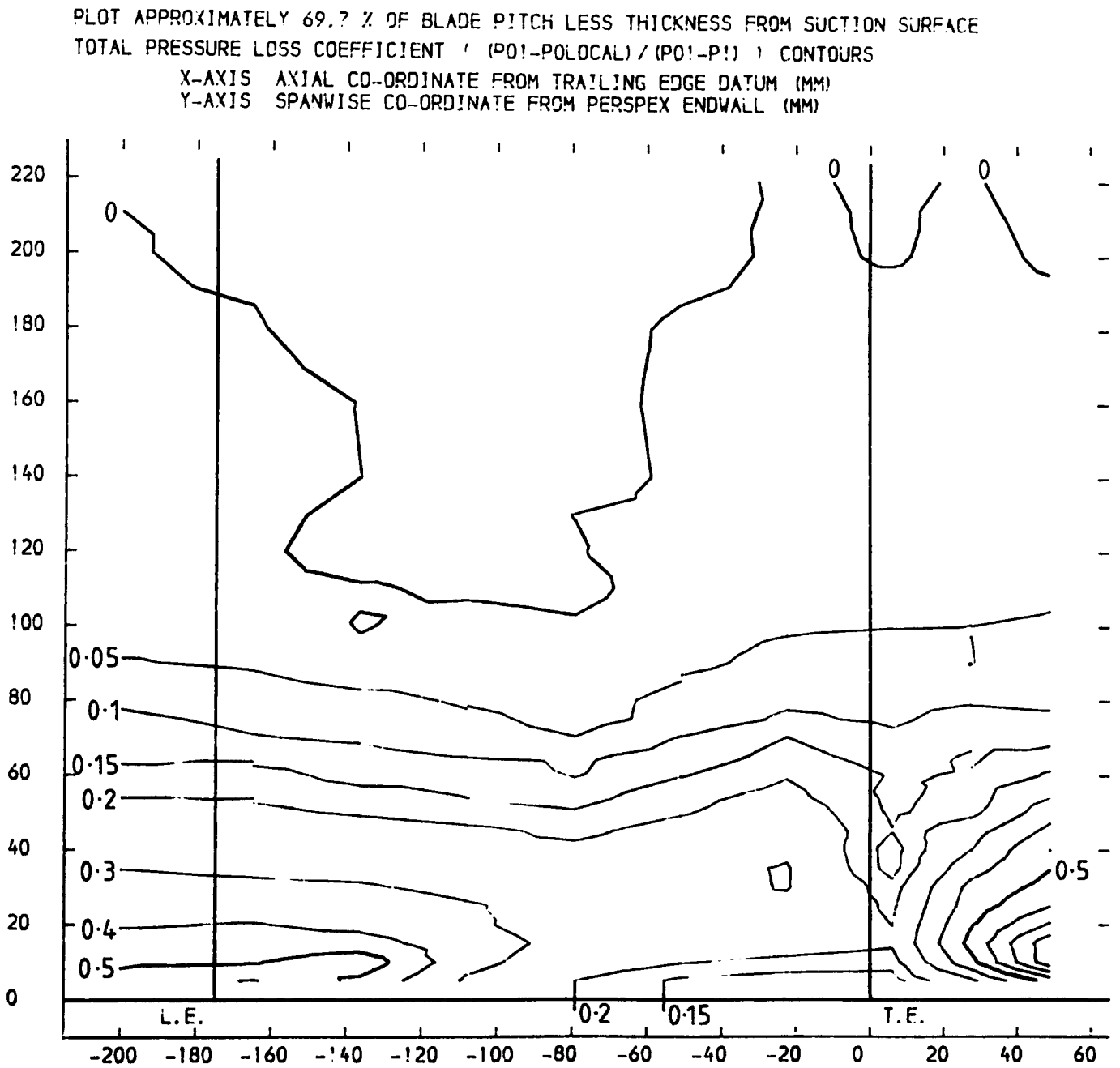

PLOT APPROXIMATELY 69.7 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL) / (PO1-P1)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
220
200
180
160
140
120
100
80
60
40
20
0
0
0
0
0·05
0·1
0·15
0·2
0·3
0·4
0·5
0·5
0·2
0·15
L.E.
T.E.
-200
-180
-160
-140
-120
-100
-80
-60
-40
-20
0
20
40
60

FIGURE 4.131

PLOT APPROXIMATELY 61.8 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL) / (PO1-P1)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

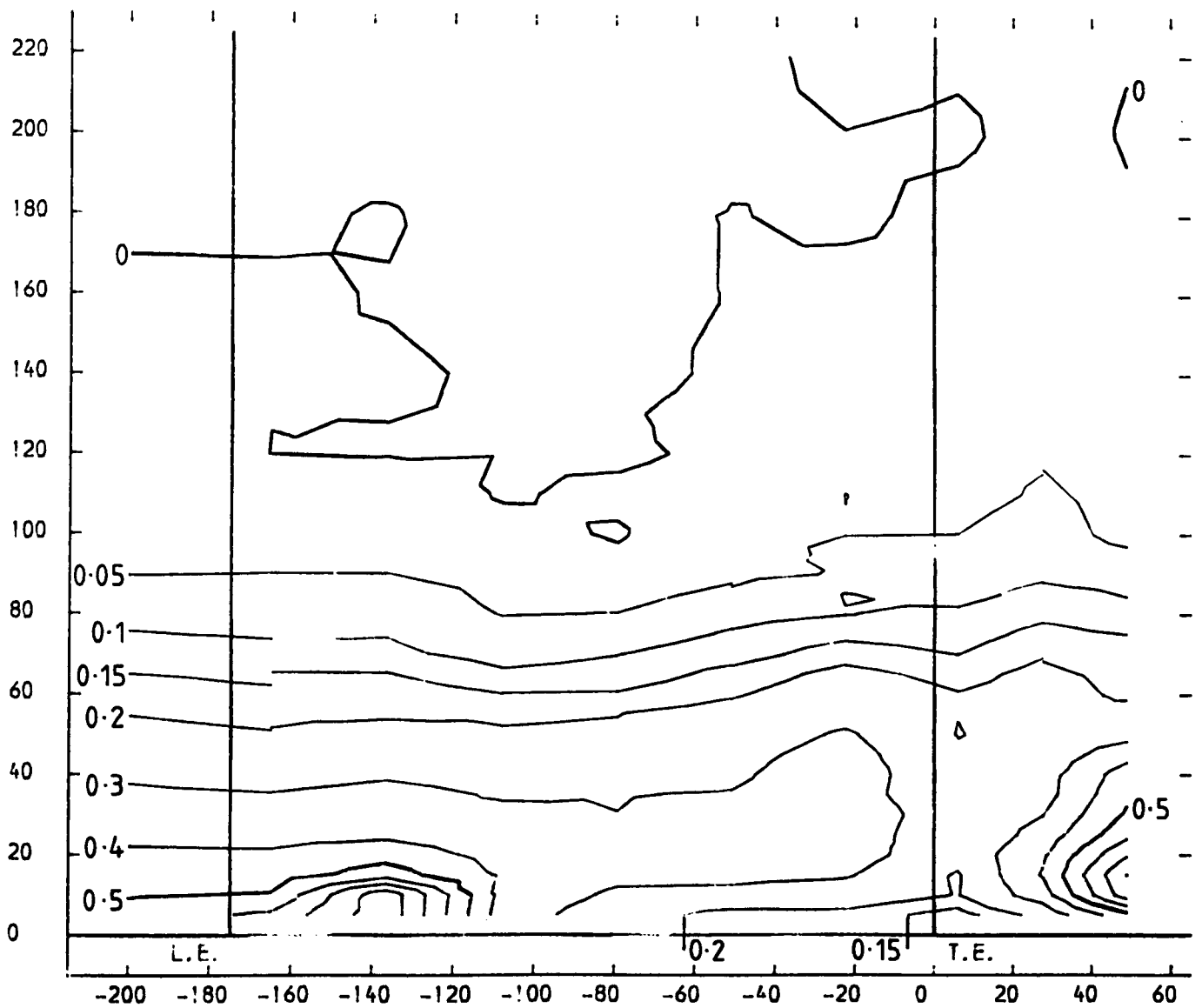


FIGURE 4.132

PLOT APPROXIMATELY 53.9 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
TOTAL PRESSURE LOSS COEFFICIENT ((PO!-POLOCAL)/(PO!-P1)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

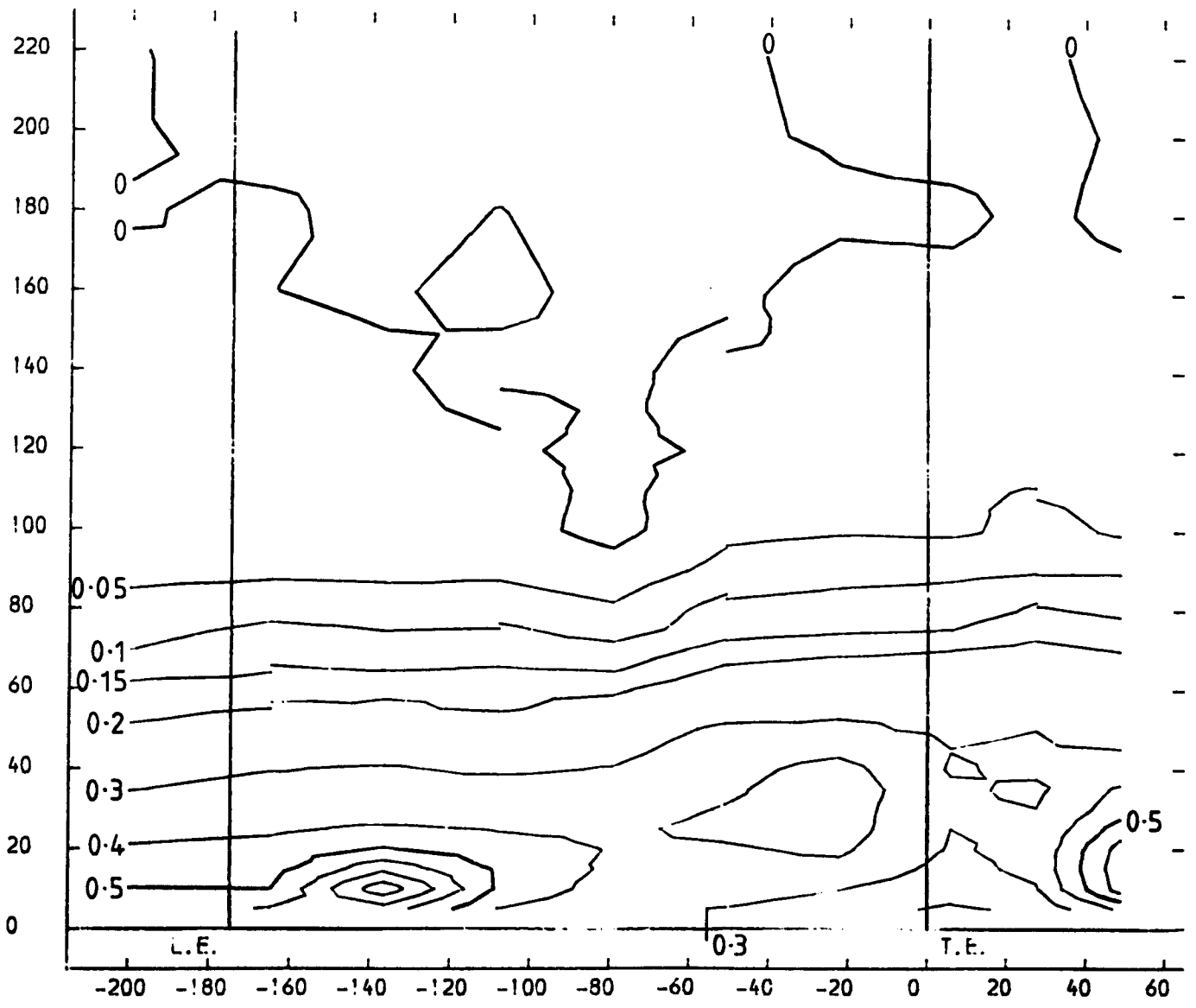


FIGURE 4.133

PLOT APPROXIMATELY 46.1 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL) / (PO1-P1)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

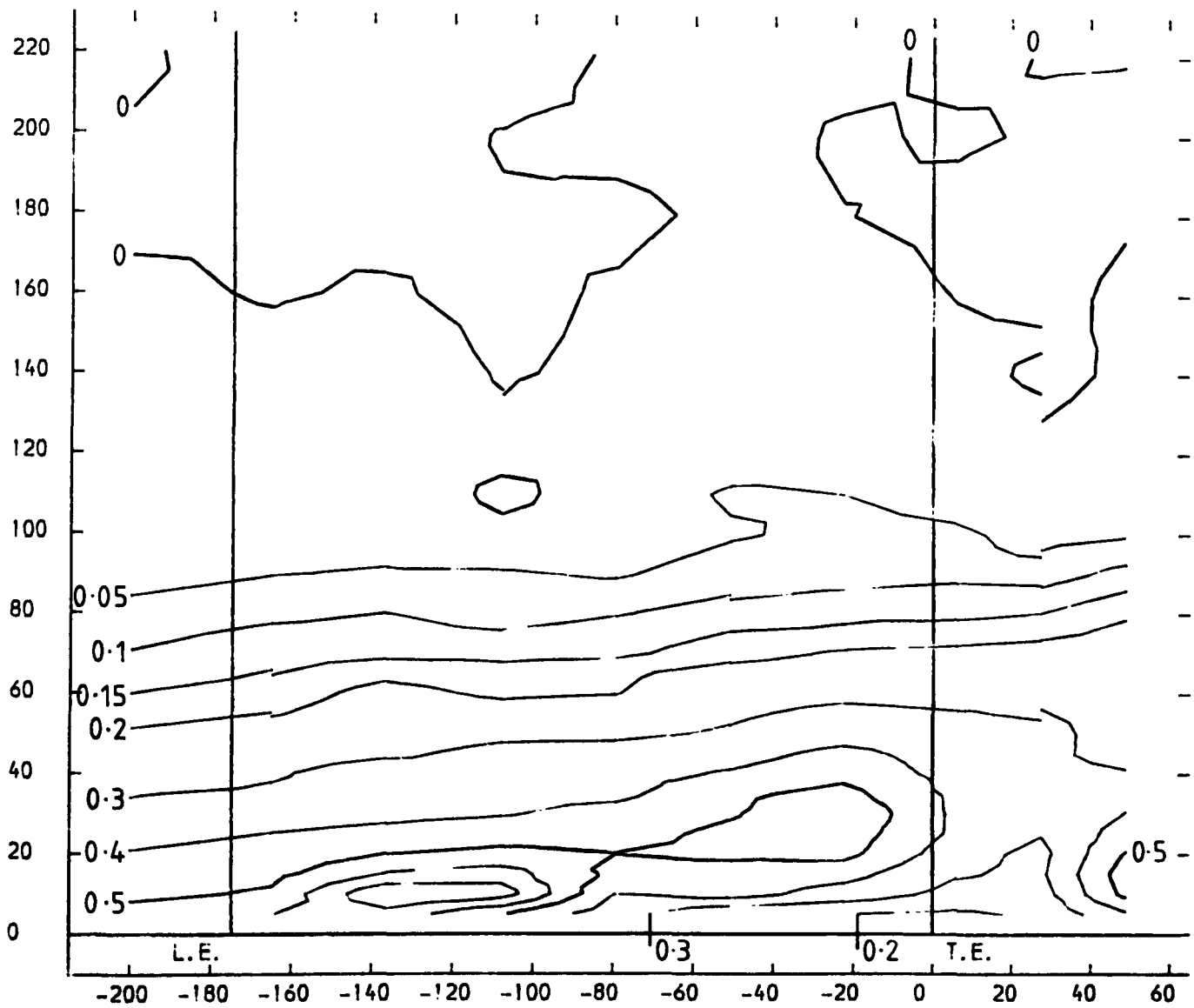


FIGURE 4.134

PLOT APPROXIMATELY 38.2 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
TOTAL PRESSURE LOSS COEFFICIENT ((P01-POLOCAL) / (P01-P1)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

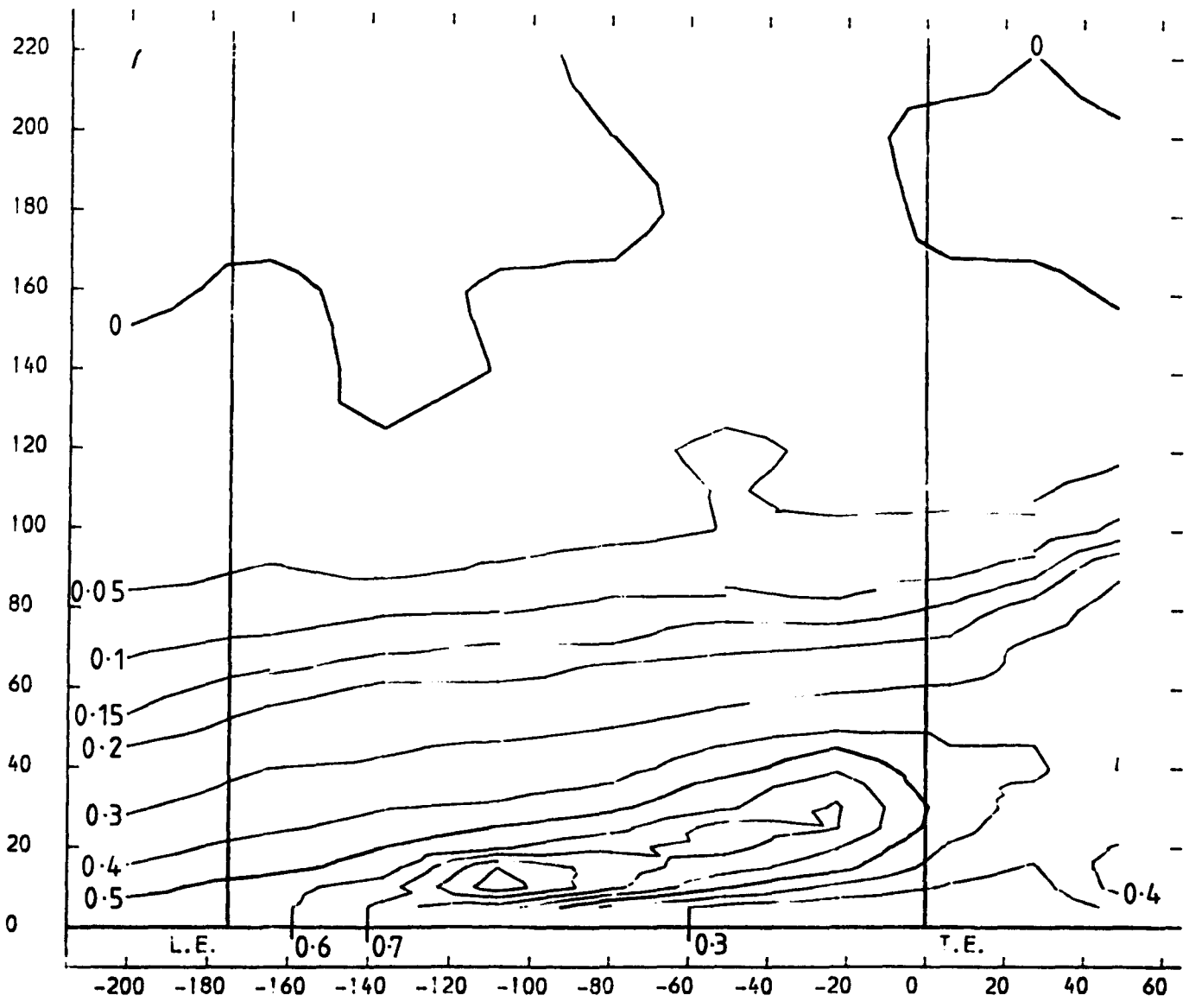


FIGURE 4.135

PLOT APPROXIMATELY 30.3 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL)/(PO1-P1)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

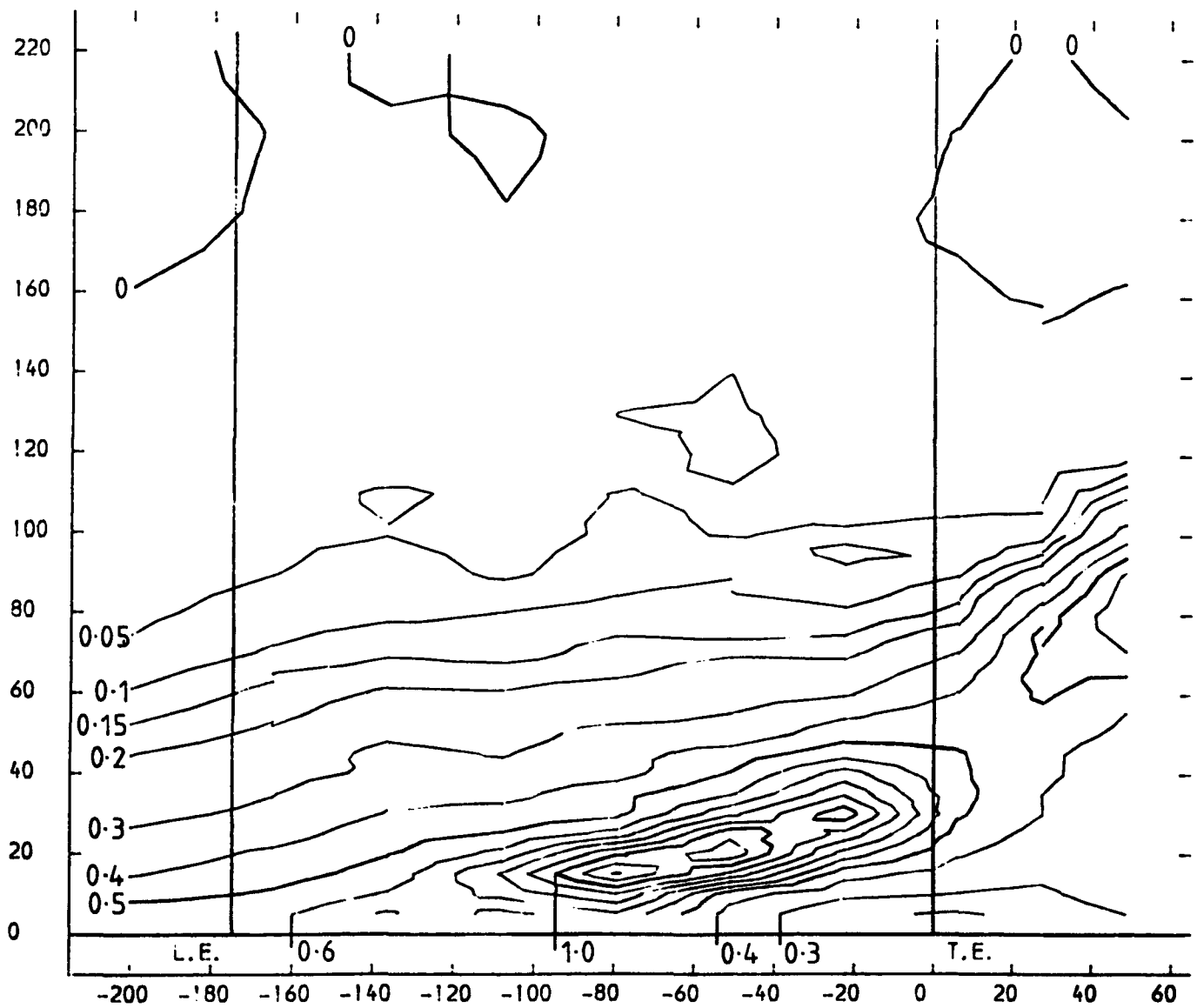


FIGURE 4.136

PLOT APPROXIMATELY 22.5 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
TOTAL PRESSURE LOSS COEFFICIENT ((PO!-POLOCAL) / (PO!-P1)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

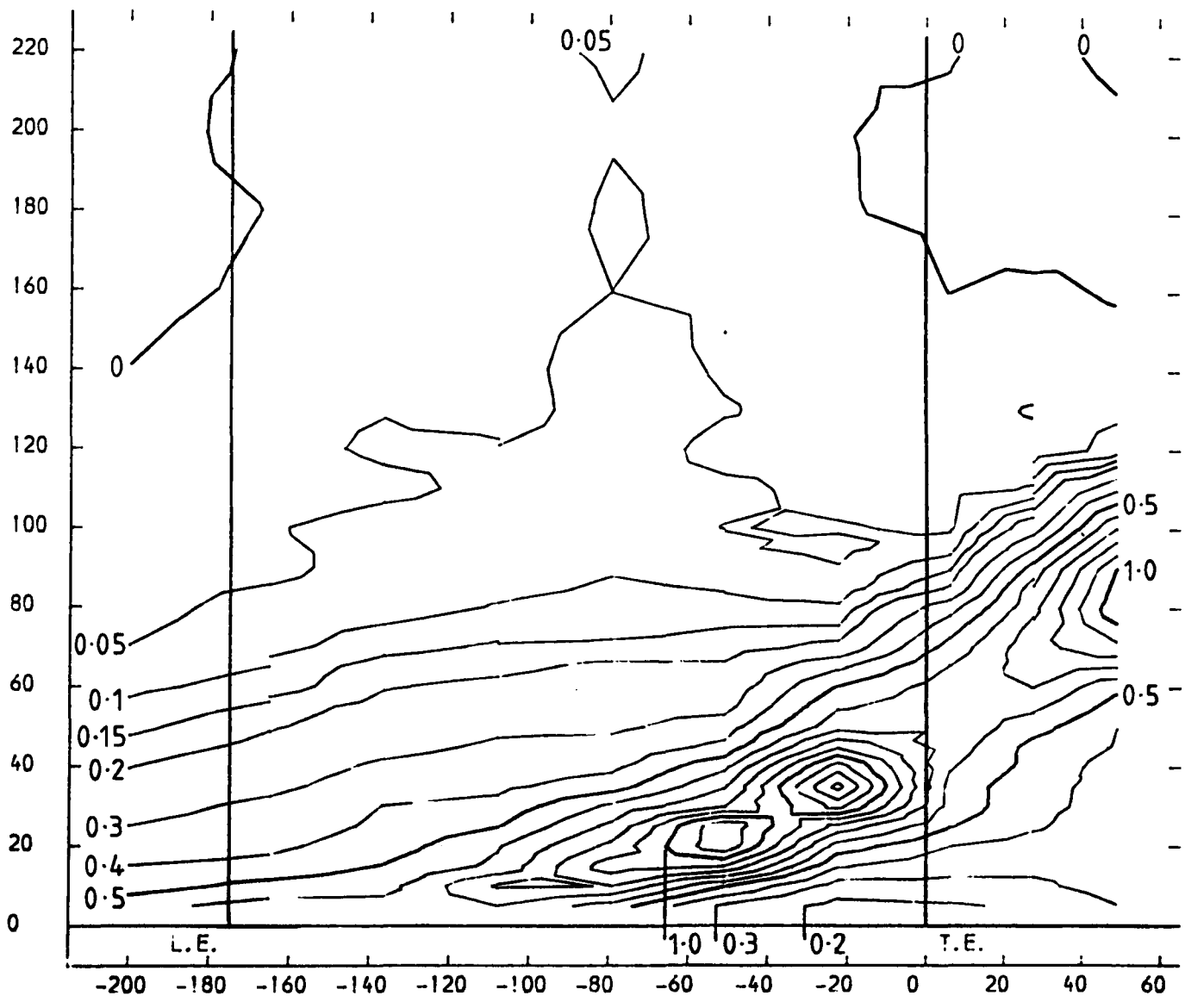


FIGURE 4.137

PLOT APPROXIMATELY 14.6 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
TOTAL PRESSURE LOSS COEFFICIENT ((PO!-POLOCAL) / (PO!-P!)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

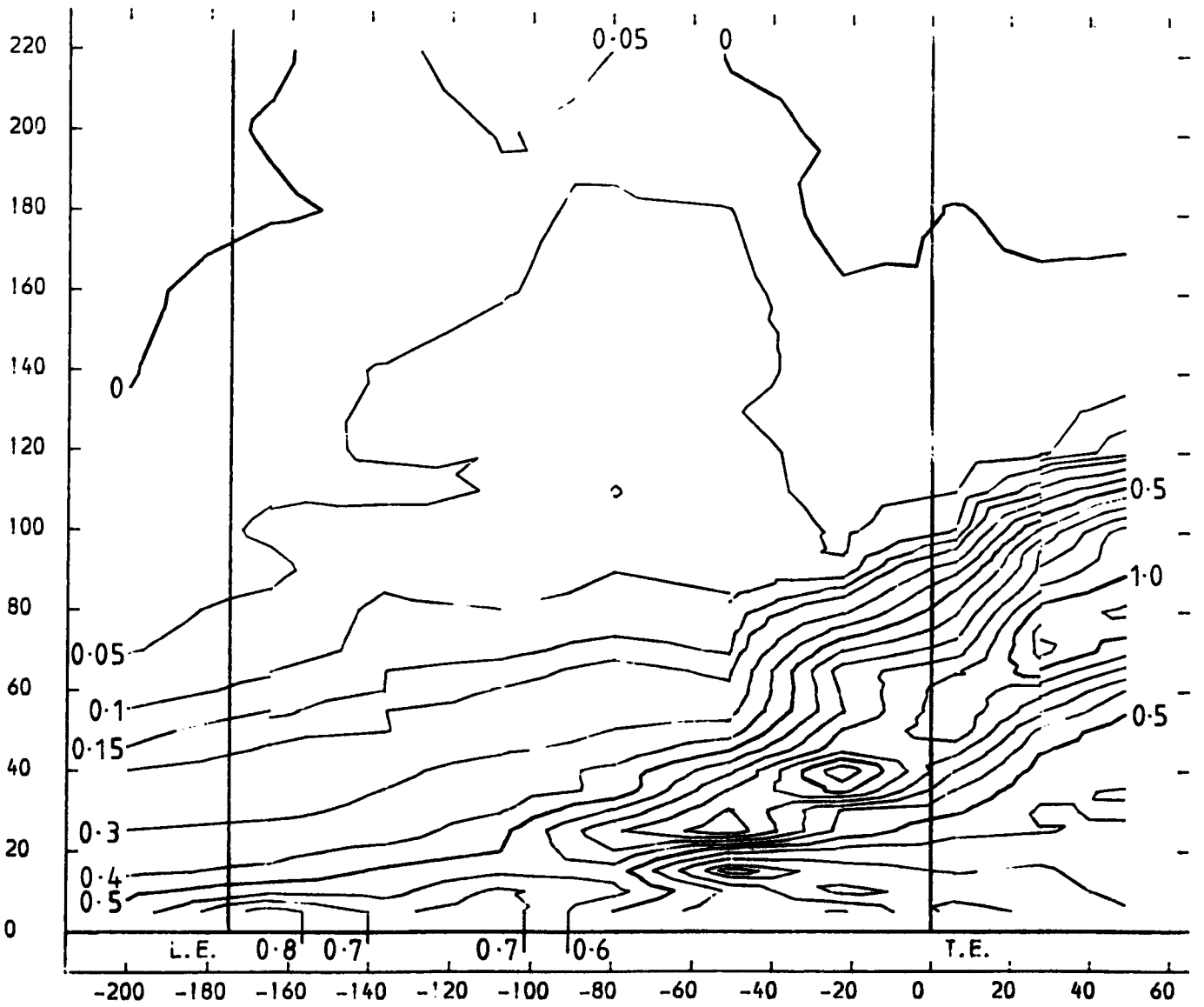


FIGURE 4.138

PLOT APPROXIMATELY 6.7 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL) / (PO1-P1)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

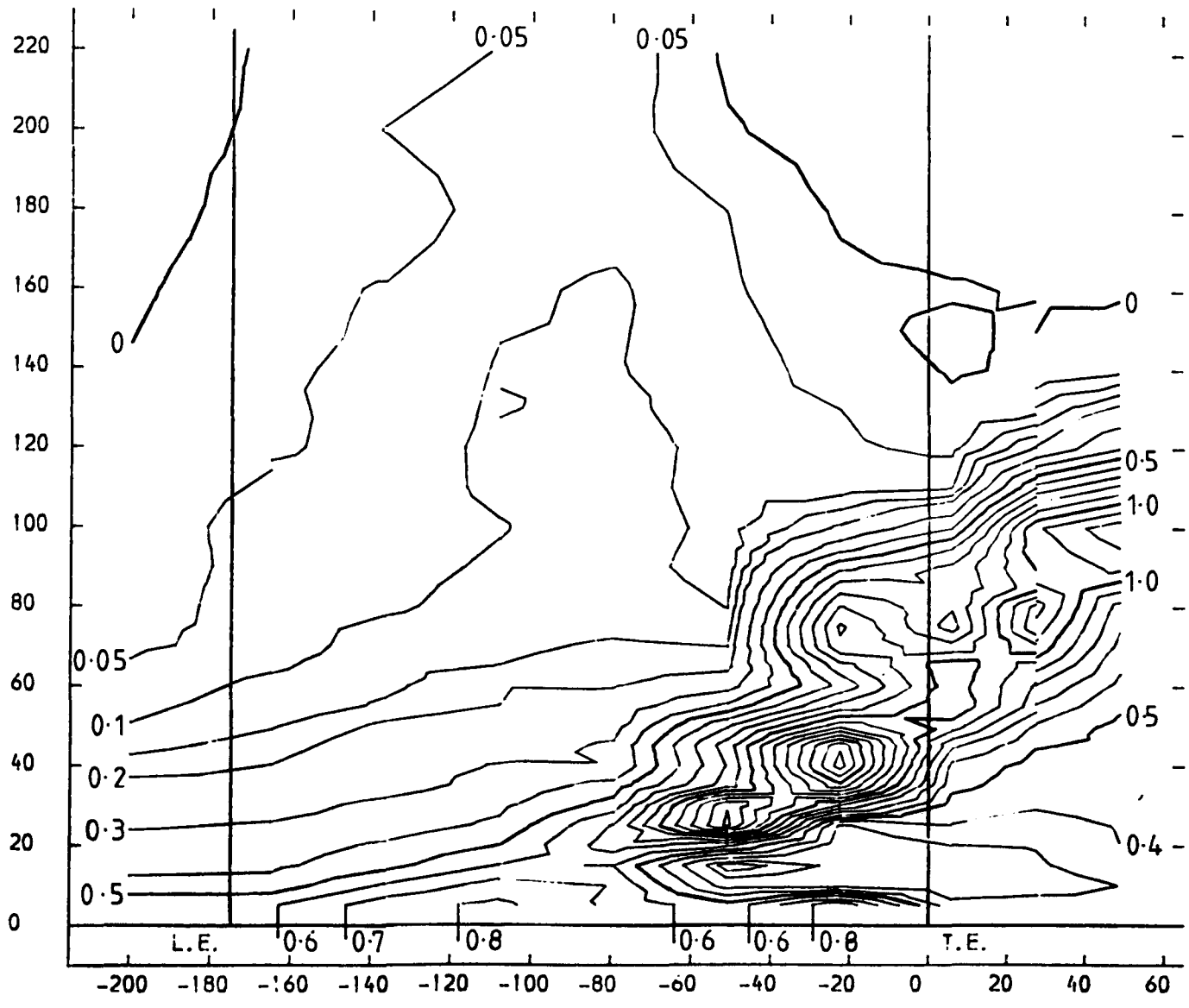


FIGURE 4.139

SPANWISE MIGRATION OF THE LOSS CORE

X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

PERCENTAGE OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE

- 85·4
- 69·7
- 53·9
- 38·2
- 22·5
- 6·7

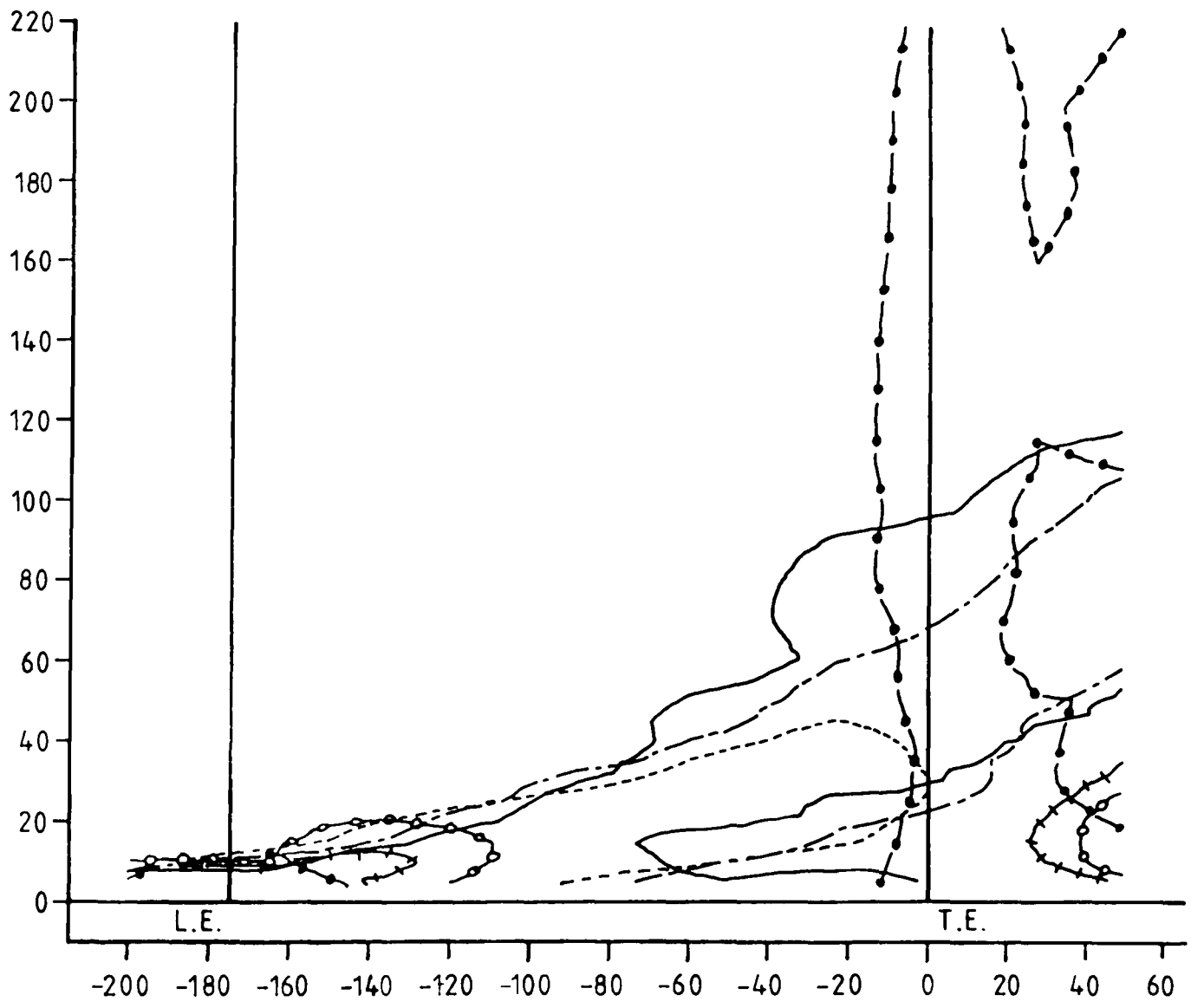


FIG. 4.

PLOT APPROXIMATELY 93.3 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
TOTAL VELOCITY MAGNITUDE CONTOURS (CONTOUR UNITS METRES/SEC)
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

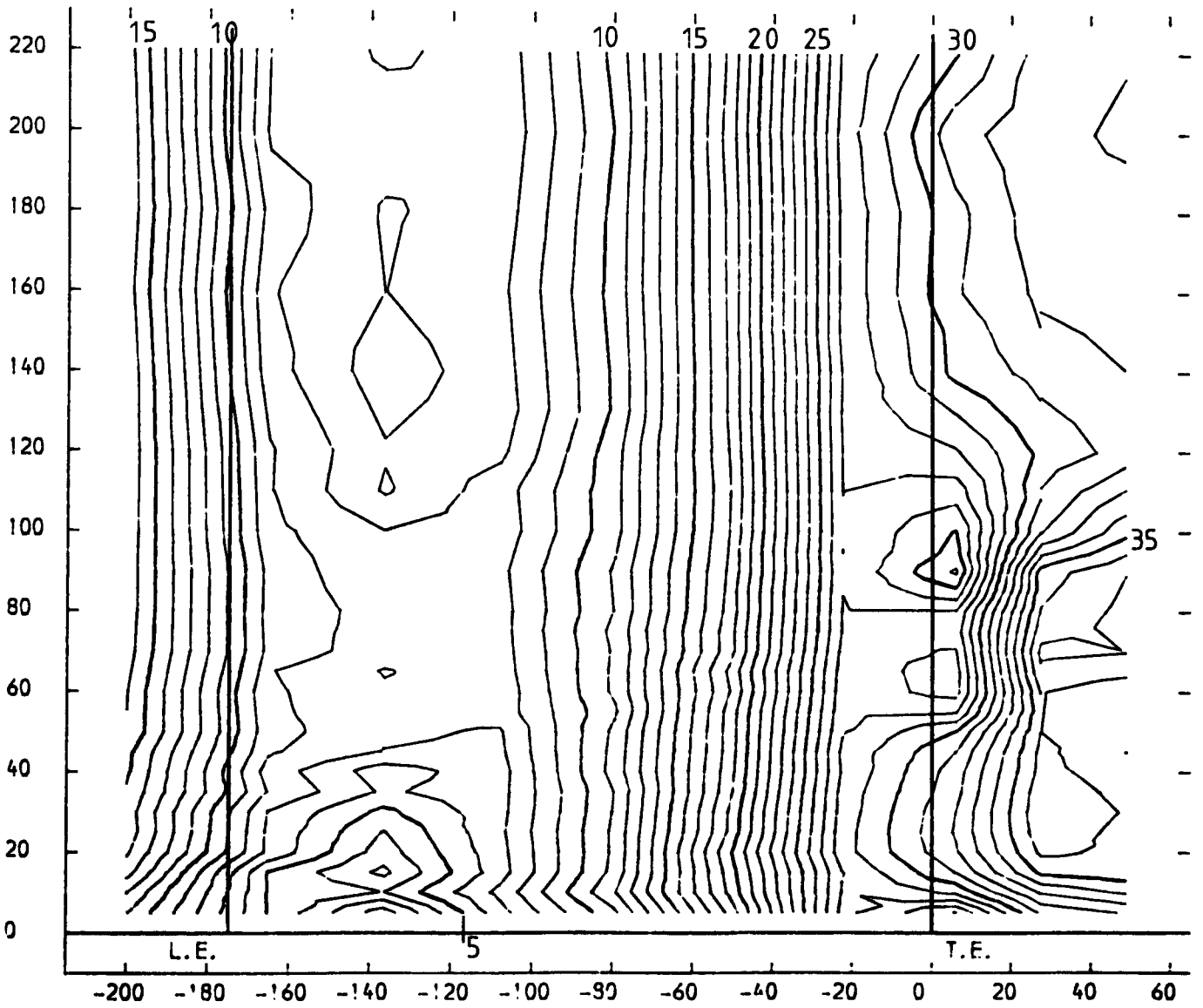


FIGURE 4.141

PLOT APPROXIMATELY 6.7 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
TOTAL VELOCITY MAGNITUDE CONTOURS (CONTOUR UNITS METRES/SEC)
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

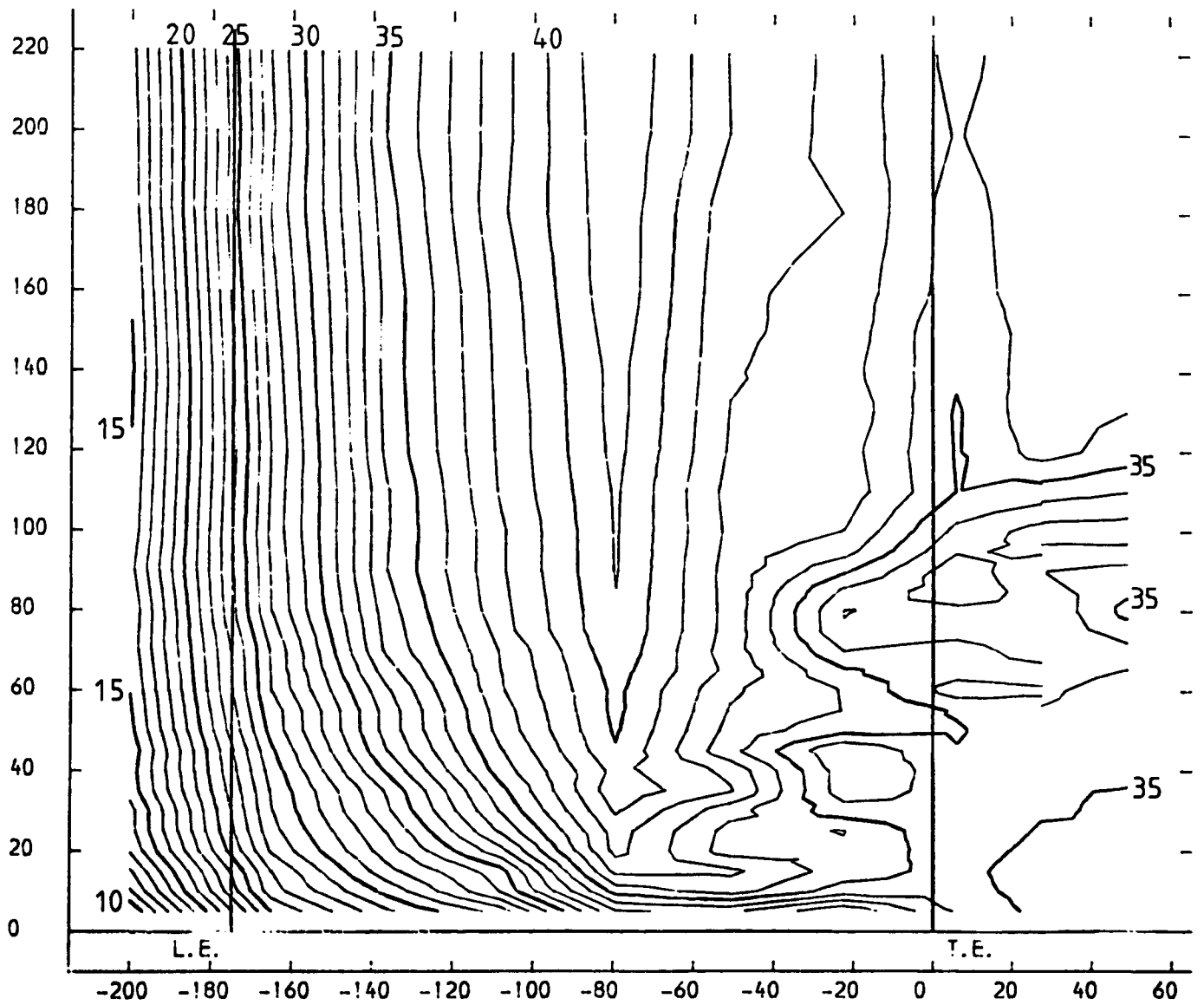


FIGURE 4.142

PLOT APPROXIMATELY 93.3 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
VECTOR PLOT OF AXIAL AND SPANWISE (RADIAL) VELOCITIES

X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
VECTOR SCALE 40 METRES/SEC

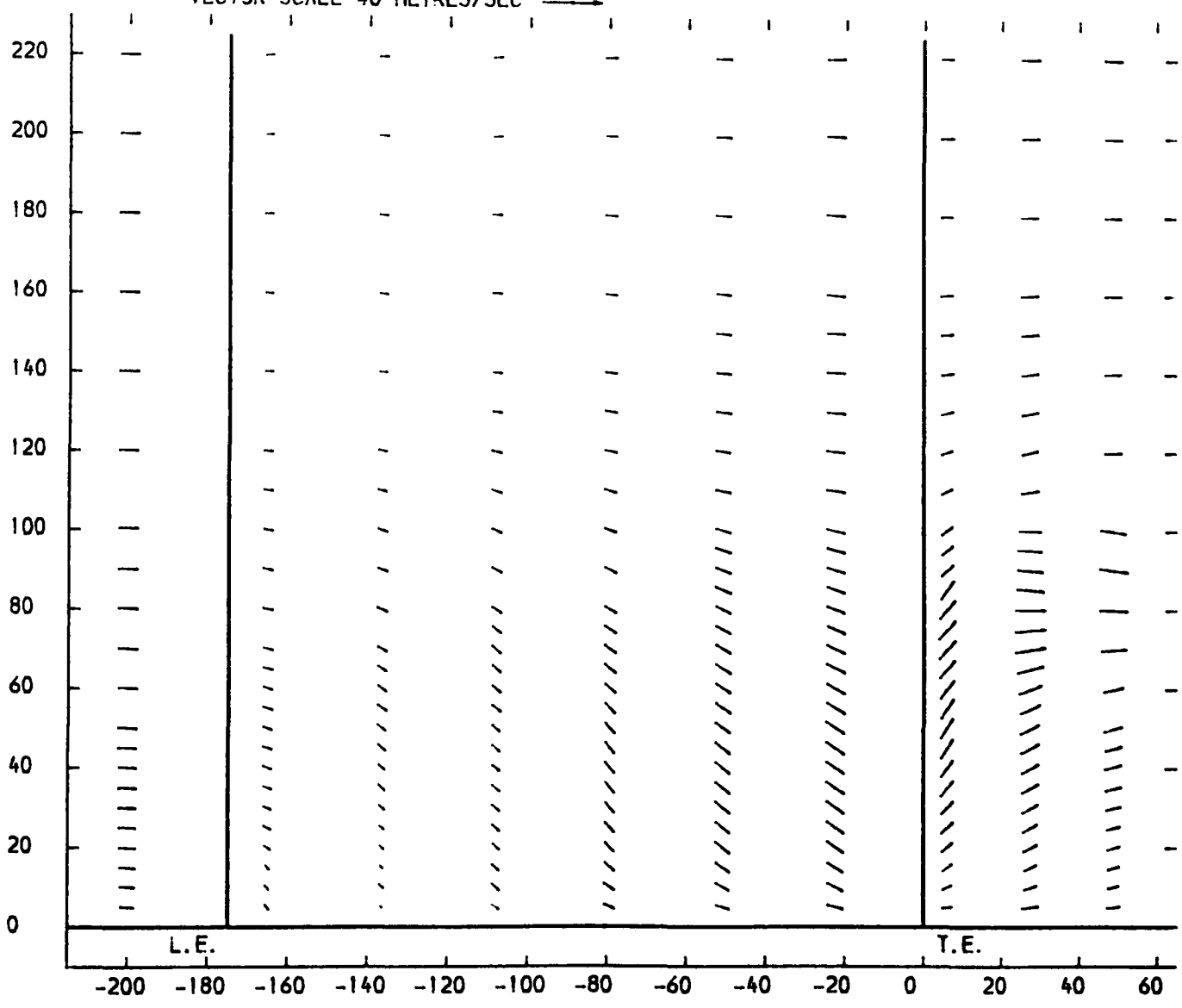


FIGURE 4.143

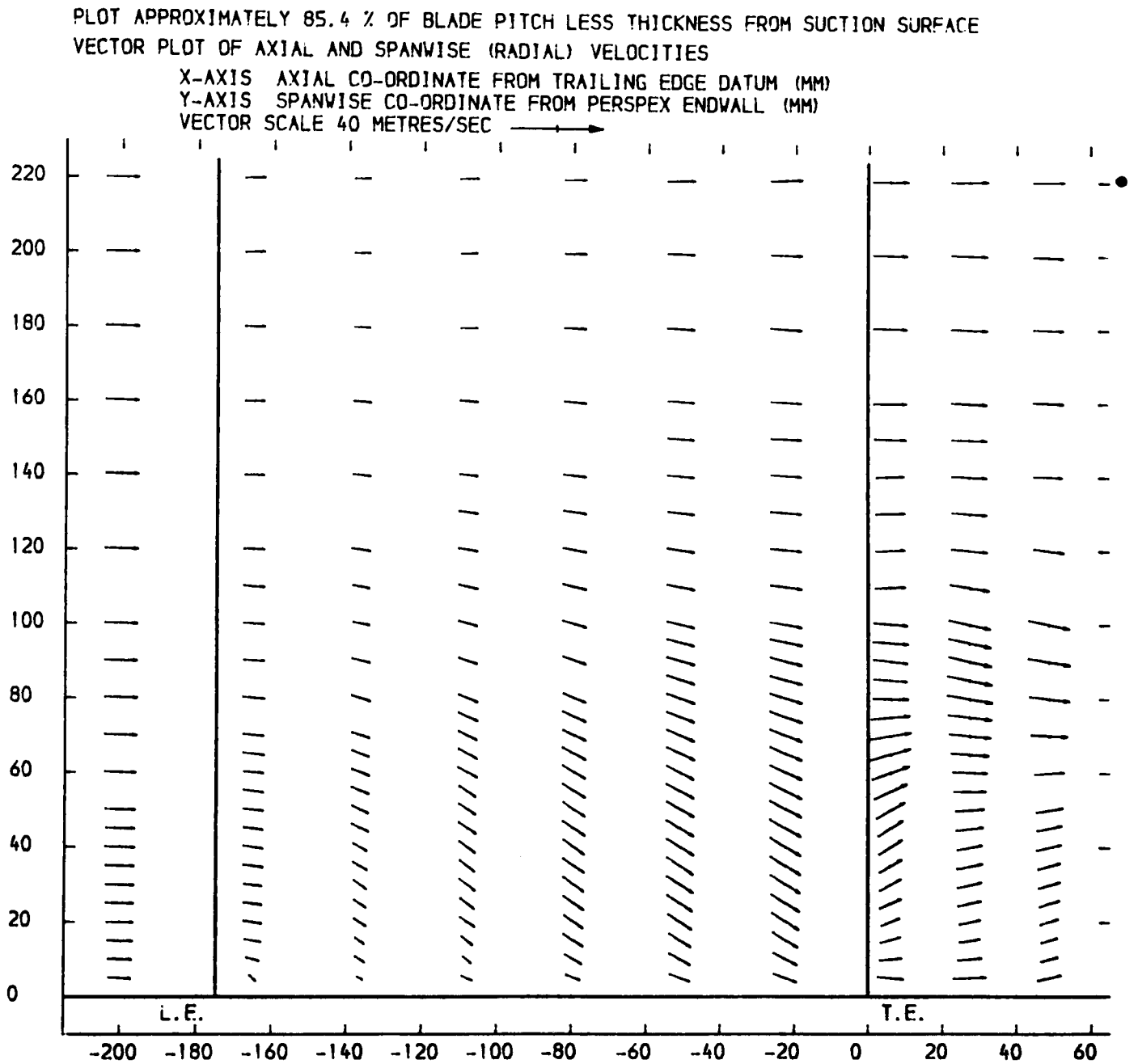

PLOT APPROXIMATELY 85.4 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
VECTOR PLOT OF AXIAL AND SPANWISE (RADIAL) VELOCITIES
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
VECTOR SCALE 40 METRES/SEC
220
200
180
160
140
120
100
80
60
40
20
0
L.E.
T.E.
-200
-180
-160
-140
-120
-100
-80
-60
-40
-20
0
20
40
60

FIGURE 4.144

PLOT APPROXIMATELY 77.5 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
VECTOR PLOT OF AXIAL AND SPANWISE (RADIAL) VELOCITIES

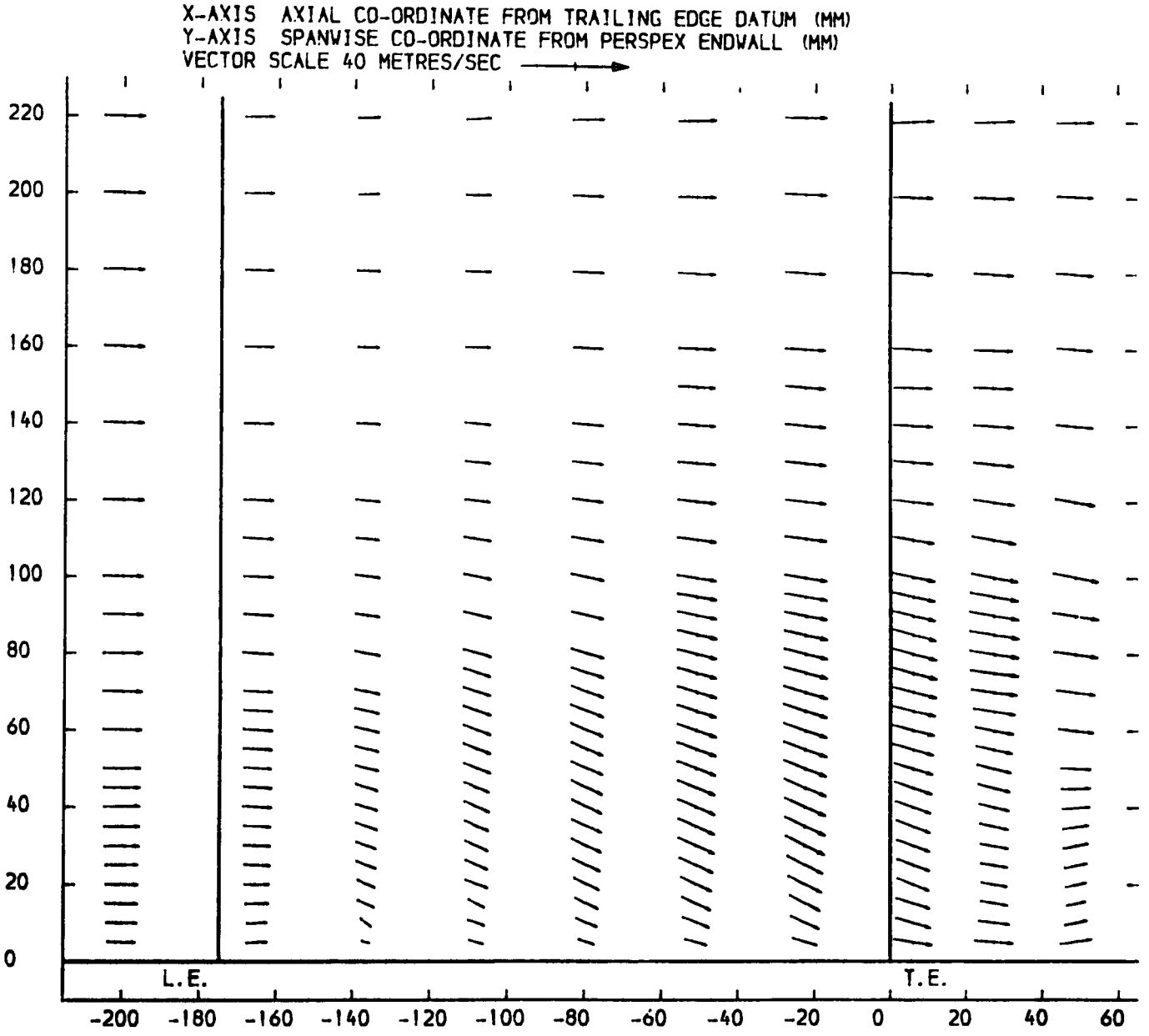


FIGURE 4.145

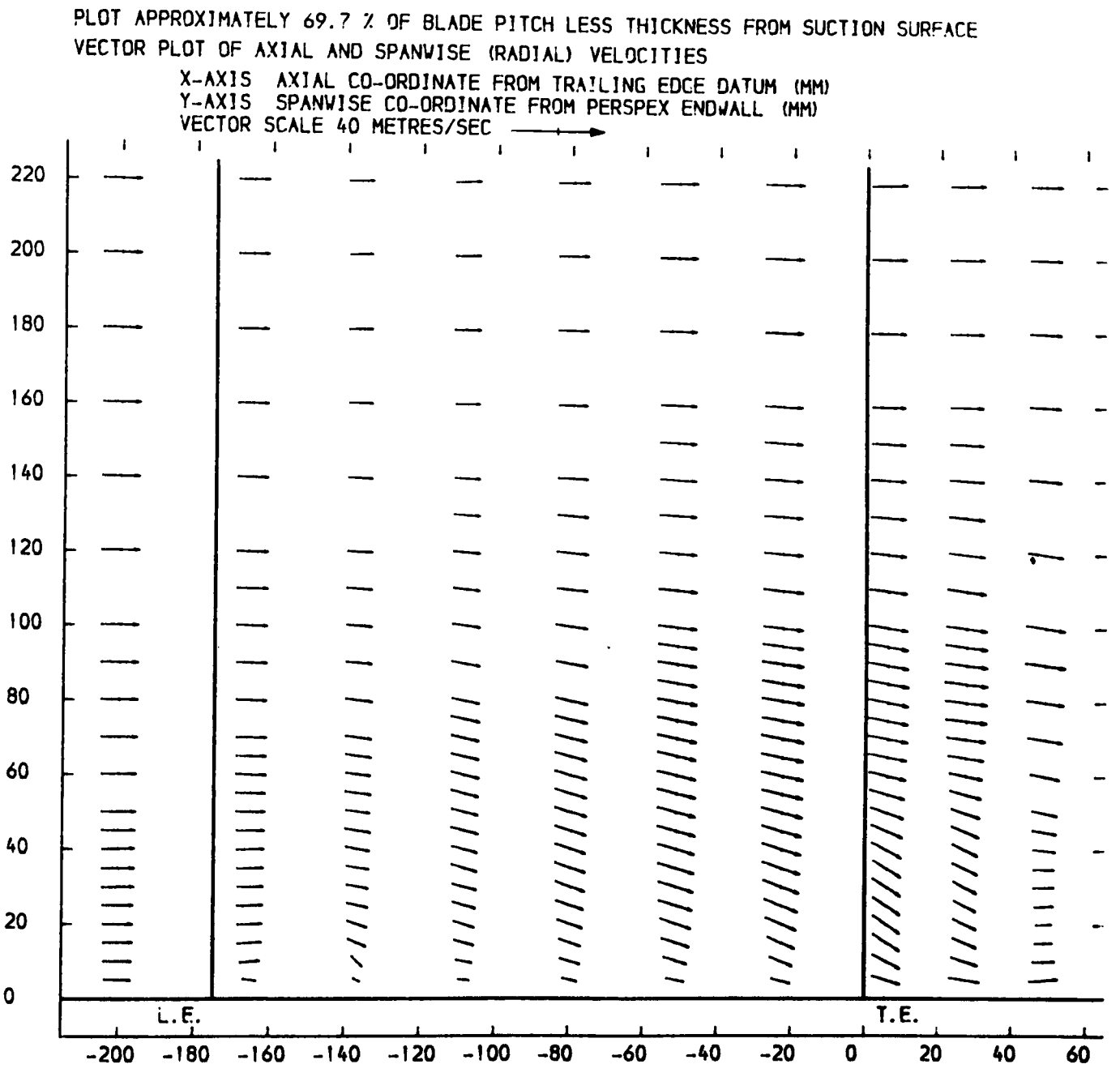

PLOT APPROXIMATELY 69.7 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
VECTOR PLOT OF AXIAL AND SPANWISE (RADIAL) VELOCITIES
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
VECTOR SCALE 40 METRES/SEC
220
200
180
160
140
120
100
80
60
40
20
0
L.E.
T.E.
-200
-180
-160
-140
-120
-100
-80
-60
-40
-20
0
20
40
60

FIGURE 4.146

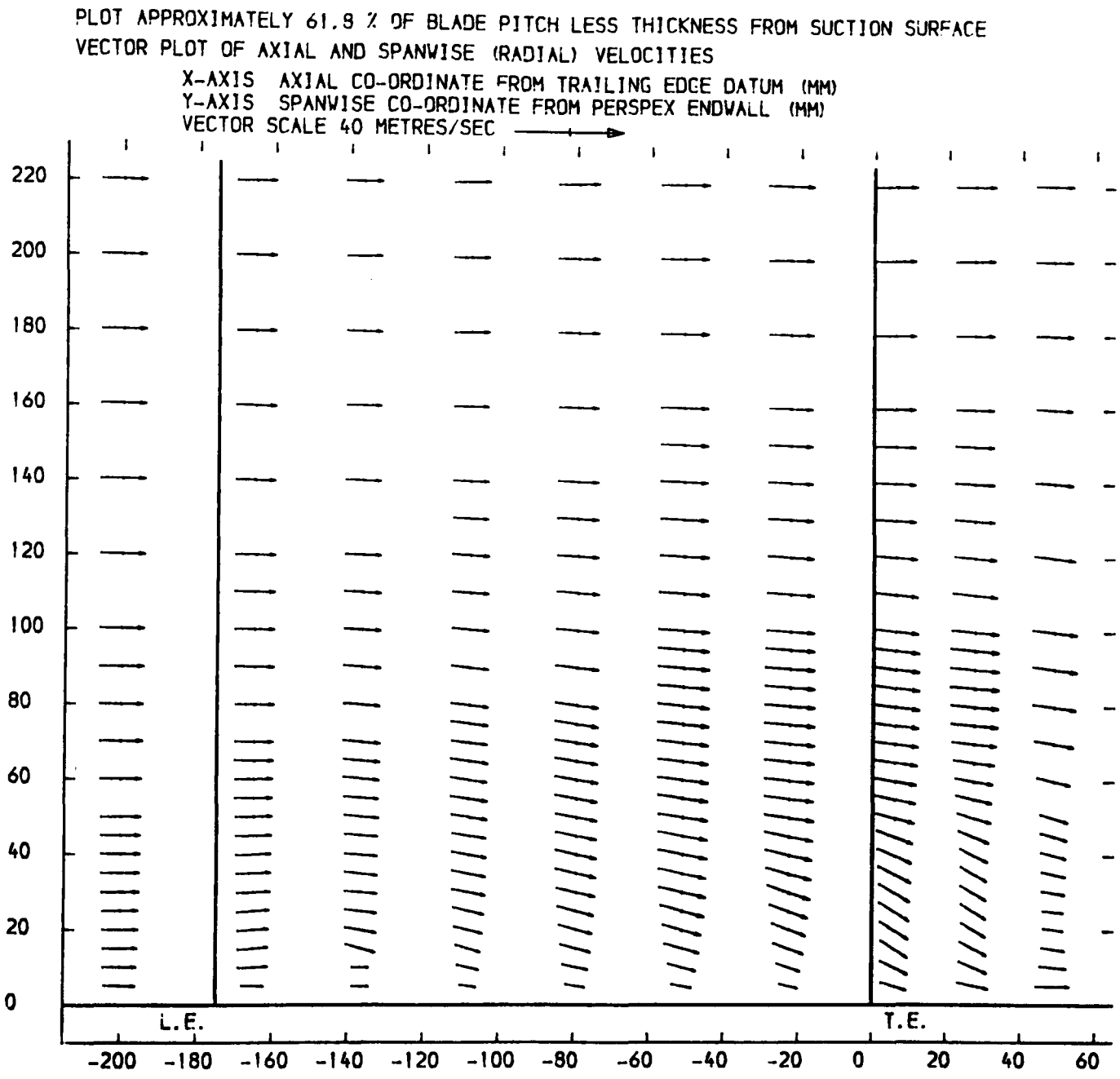

PLOT APPROXIMATELY 61.8 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
VECTOR PLOT OF AXIAL AND SPANWISE (RADIAL) VELOCITIES
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
VECTOR SCALE 40 METRES/SEC
220
200
180
160
140
120
100
80
60
40
20
0
L.E.
T.E.
-200
-180
-160
-140
-120
-100
-80
-60
-40
-20
0
20
40
60

FIGURE 4.147

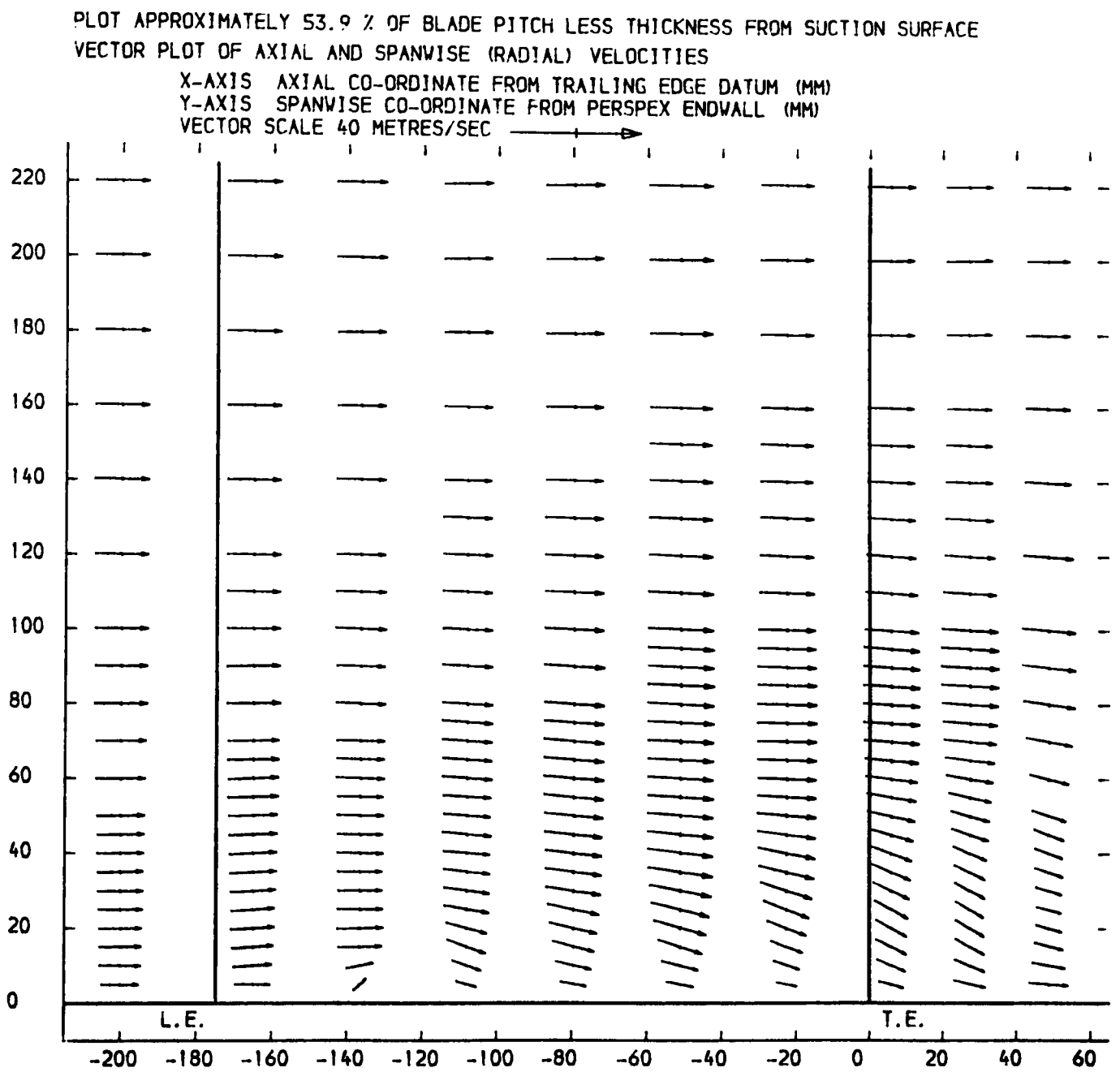

PLOT APPROXIMATELY 53.9 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
VECTOR PLOT OF AXIAL AND SPANWISE (RADIAL) VELOCITIES
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
VECTOR SCALE 40 METRES/SEC
220
200
180
160
140
120
100
80
60
40
20
0
L.E.
T.E.
-200
-180
-160
-140
-120
-100
-80
-60
-40
-20
0
20
40
60

FIGURE 4.148

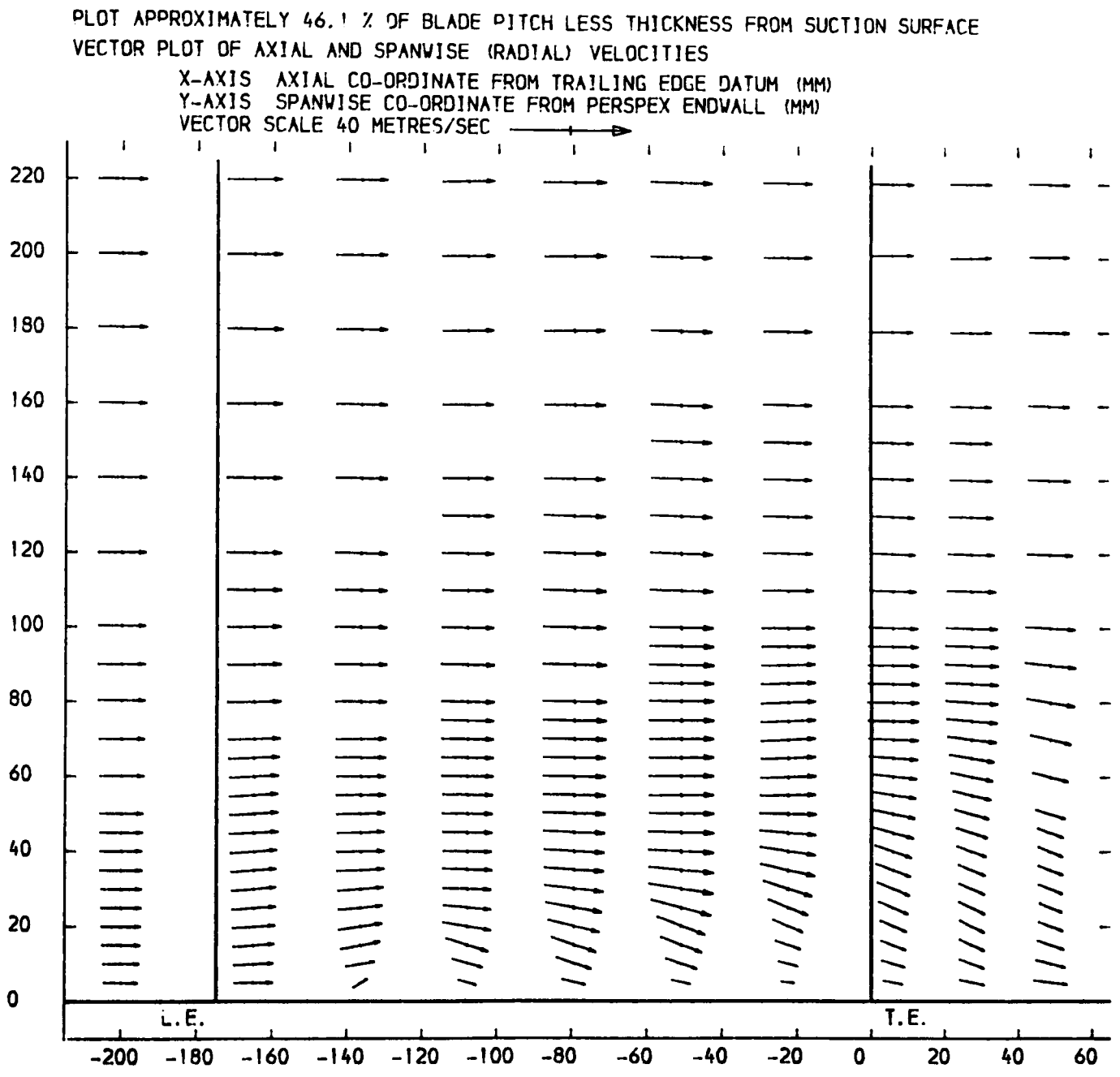

PLOT APPROXIMATELY 46.1 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
VECTOR PLOT OF AXIAL AND SPANWISE (RADIAL) VELOCITIES
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
VECTOR SCALE 40 METRES/SEC
220
200
180
160
140
120
100
80
60
40
20
0
L.E.
T.E.
-200
-180
-160
-140
-120
-100
-80
-60
-40
-20
0
20
40
60

FIGURE 4.149

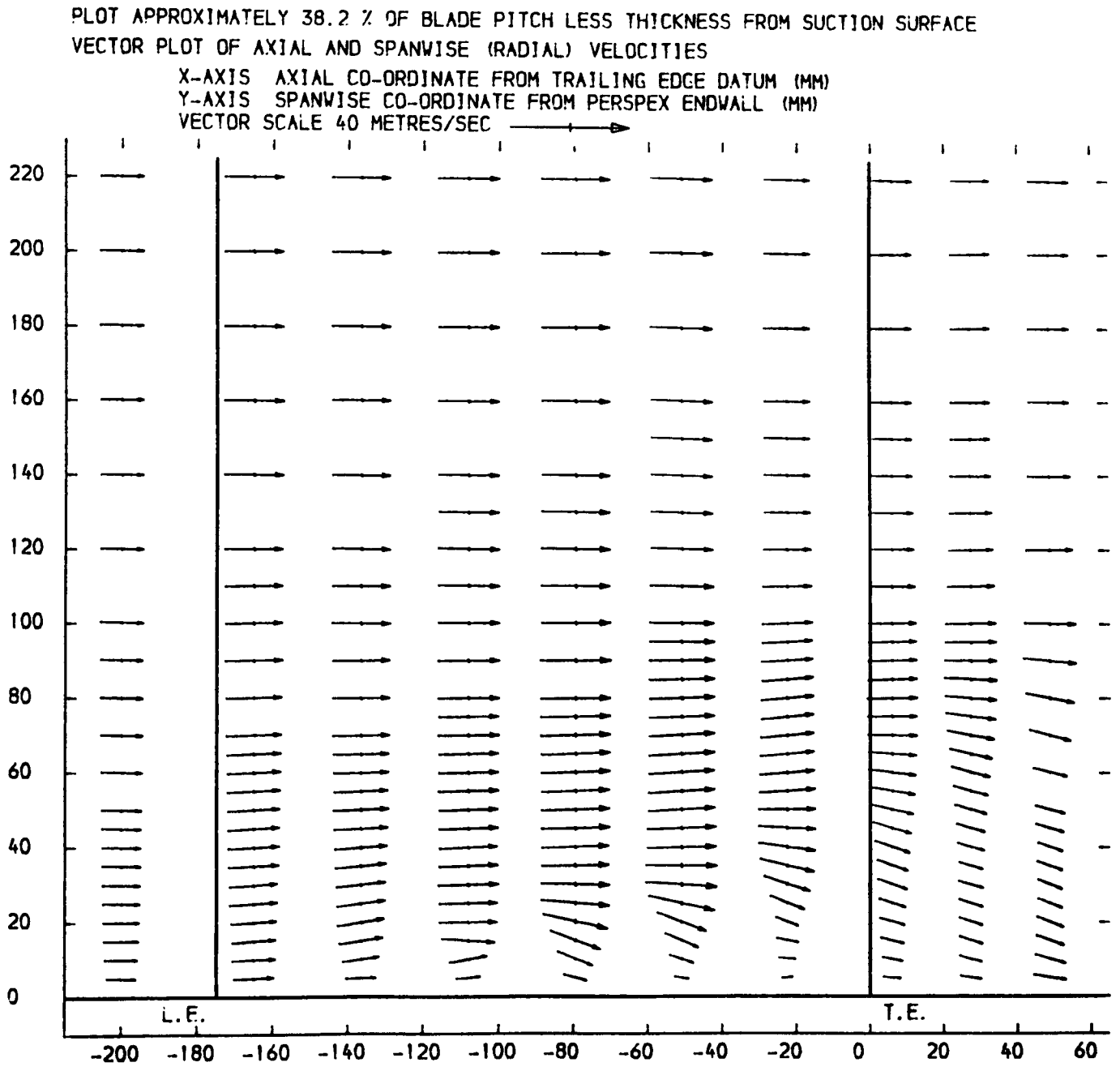

PLOT APPROXIMATELY 38.2 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
VECTOR PLOT OF AXIAL AND SPANWISE (RADIAL) VELOCITIES
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
VECTOR SCALE 40 METRES/SEC
220
200
180
160
140
120
100
80
60
40
20
0
L.E.
T.E.
-200
-180
-160
-140
-120
-100
-80
-60
-40
-20
0
20
40
60

FIGURE 4.150

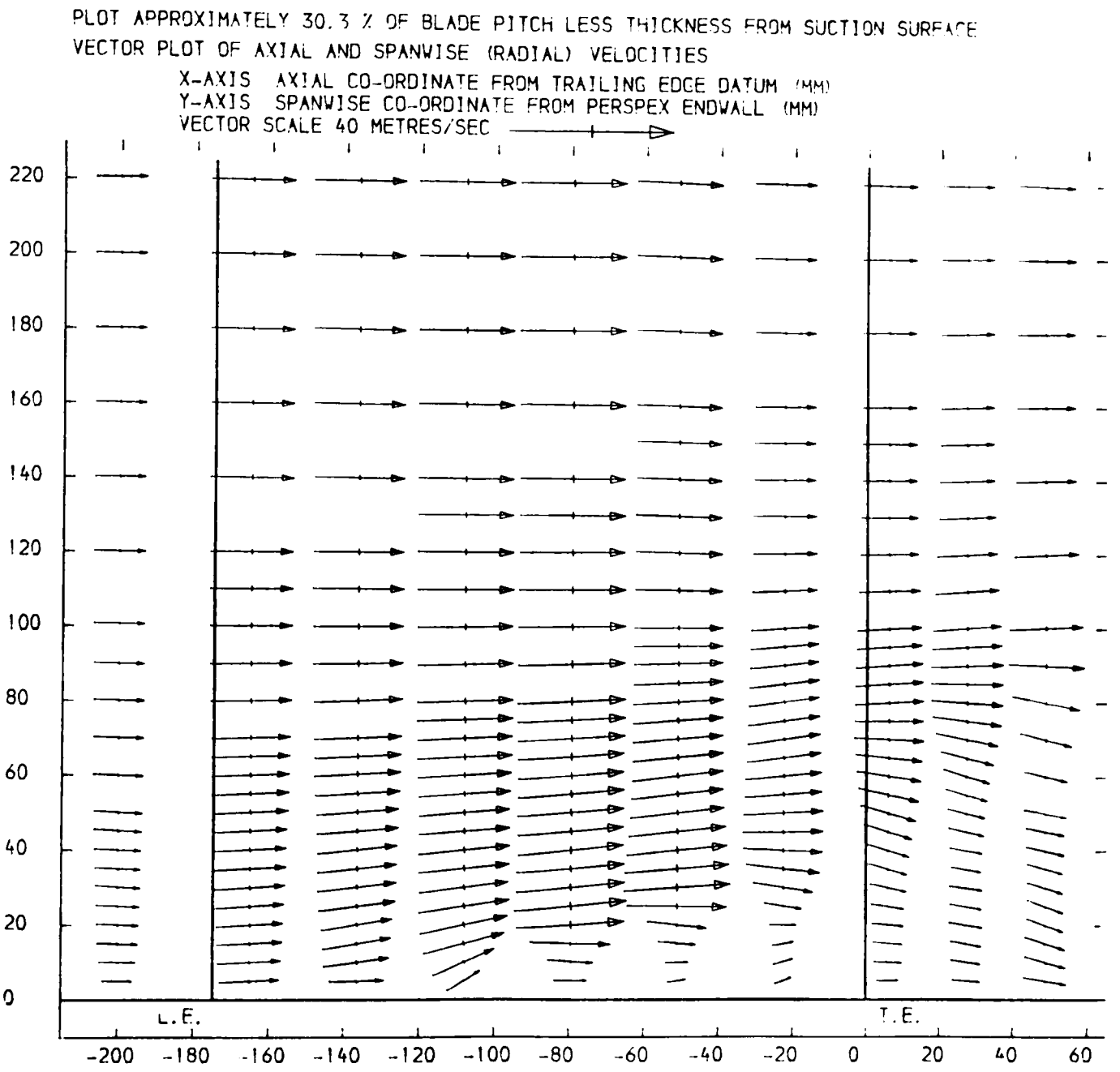

PLOT APPROXIMATELY 30.3 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
VECTOR PLOT OF AXIAL AND SPANWISE (RADIAL) VELOCITIES
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
VECTOR SCALE 40 METRES/SEC
220
200
180
160
140
120
100
80
60
40
20
0
L.E.
T.E.
-200
-180
-160
-140
-120
-100
-80
-60
-40
-20
0
20
40
60

FIGURE 4.151

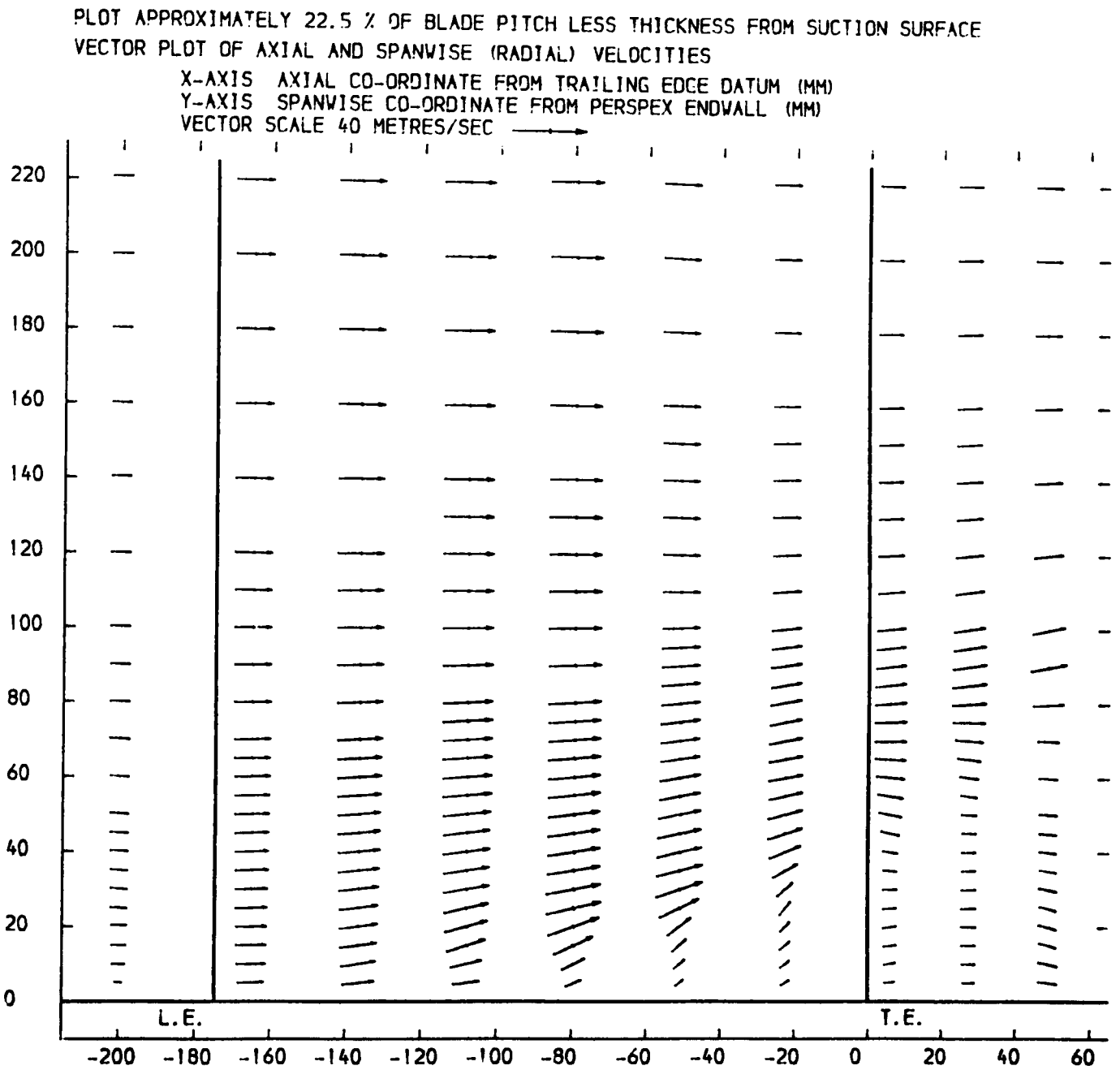

PLOT APPROXIMATELY 22.5 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
VECTOR PLOT OF AXIAL AND SPANWISE (RADIAL) VELOCITIES
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
VECTOR SCALE 40 METRES/SEC
220
200
180
160
140
120
100
80
60
40
20
0
L.E.
T.E.
-200
-180
-160
-140
-120
-100
-80
-60
-40
-20
0
20
40
60

FIGURE 4.152

PLOT APPROXIMATELY 14.6 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
VECTOR PLOT OF AXIAL AND SPANWISE (RADIAL) VELOCITIES

X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
VECTOR SCALE 40 METRES/SEC

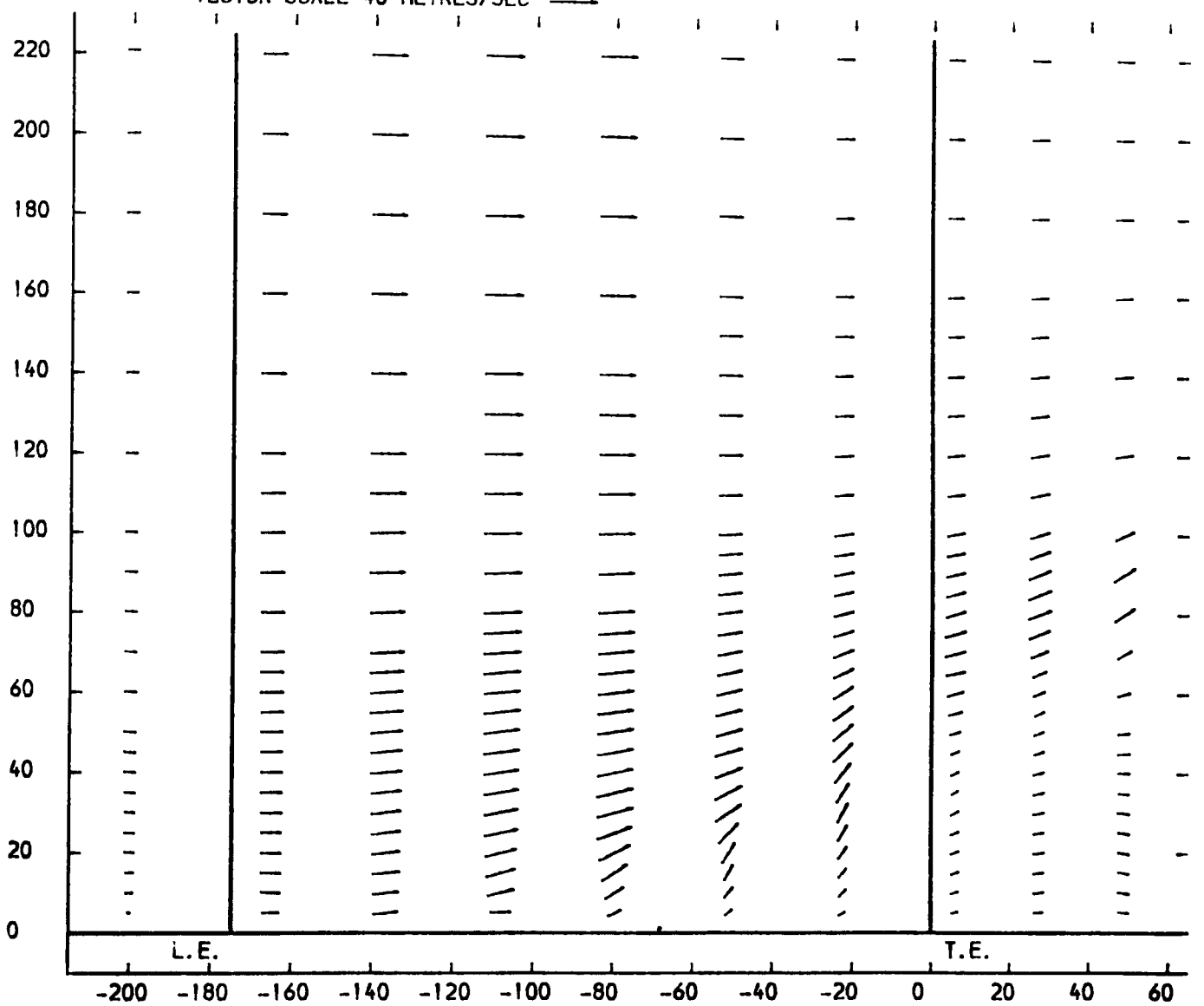


FIGURE 4.153

PLOT APPROXIMATELY 6.7 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
VECTOR PLOT OF AXIAL AND SPANWISE (RADIAL) VELOCITIES

X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
VECTOR SCALE 40 METRES/SEC

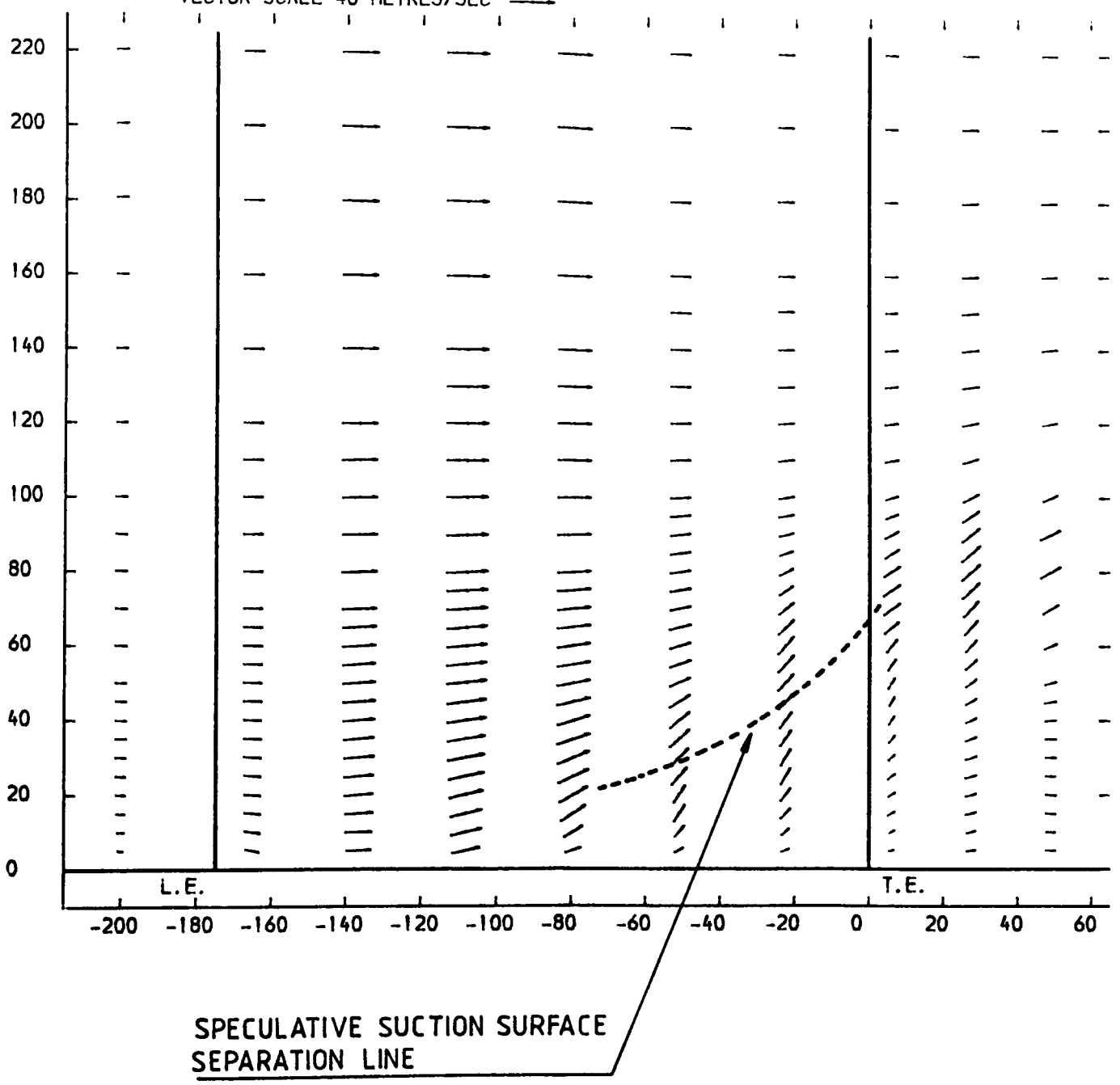
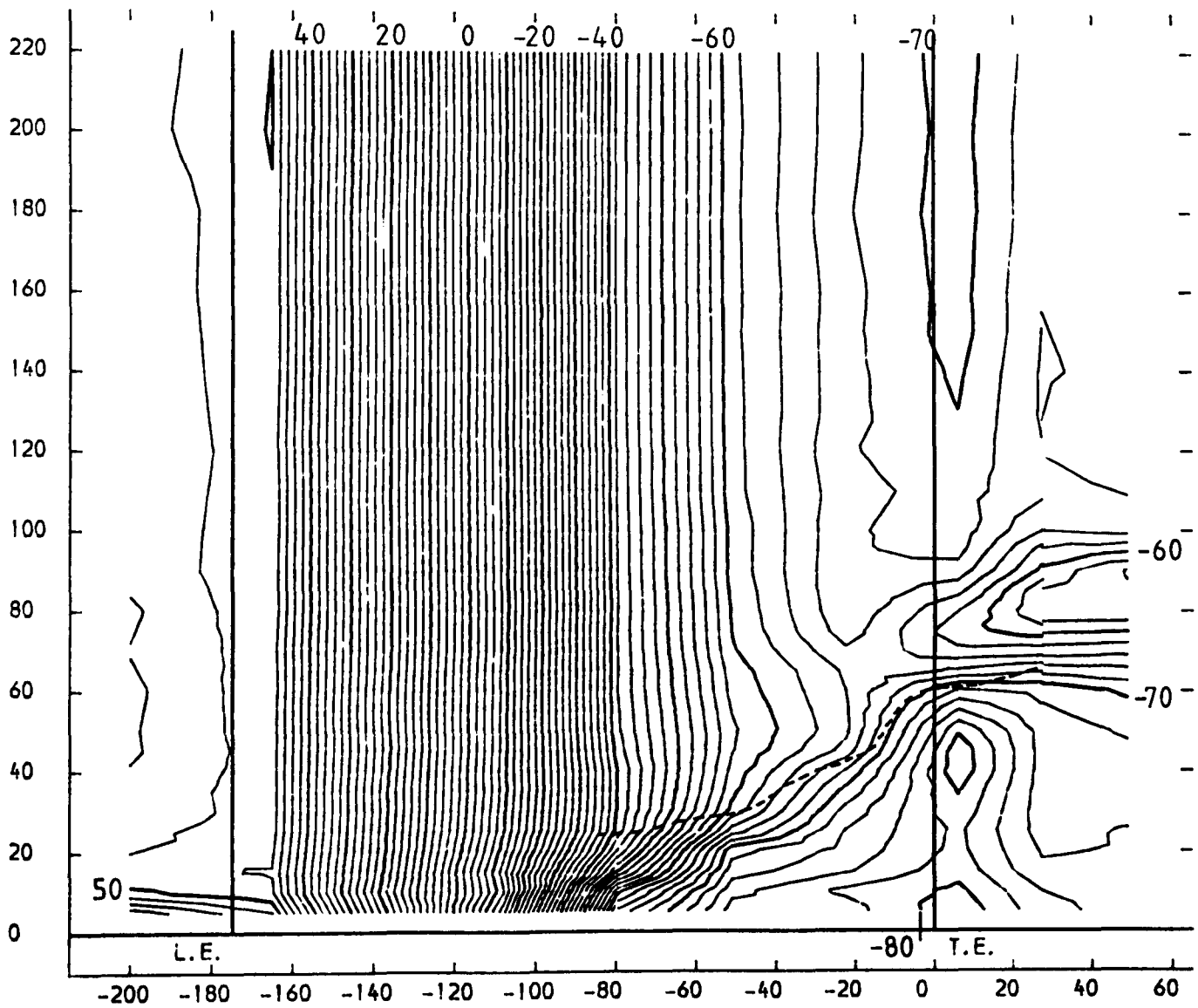


FIGURE 4.154

PLOT APPROXIMATELY 6.7 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
YAW ANGLE CONTOURS (CONTOUR UNITS DEGREES)
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)



------ ZERO CROSS FLOW ANGLE CONTOUR

FIGURE 4.155

ZERO CROSS FLOW ANGLE CONTOURS CLOSE TO THE BLADE SUCTION SURFACE

X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

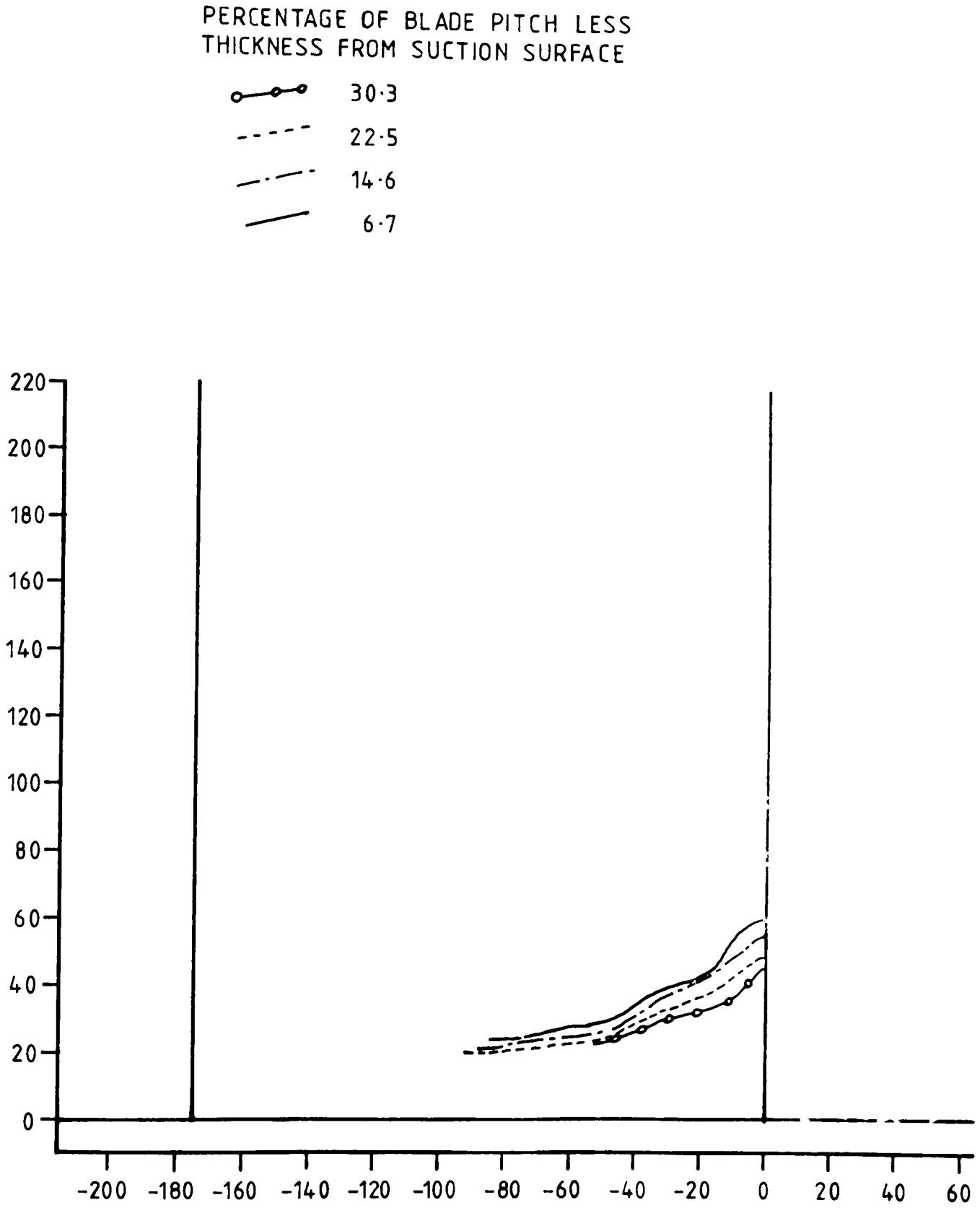


FIGURE 4.156

PLOT APPROXIMATELY 93.3 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(P01-P1)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

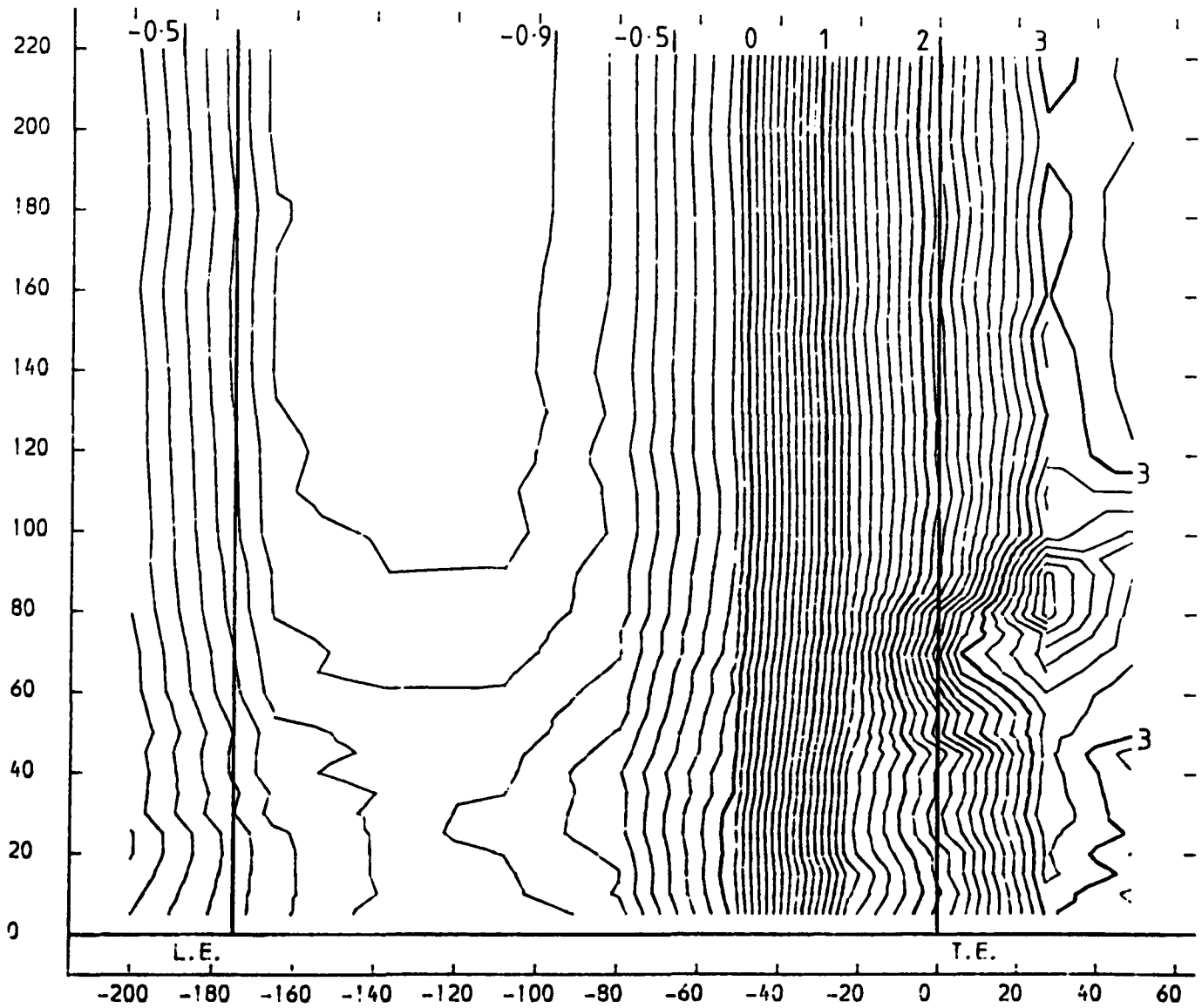


FIGURE 4.157

PLOT APPROXIMATELY 53.9 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(P01-P1)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

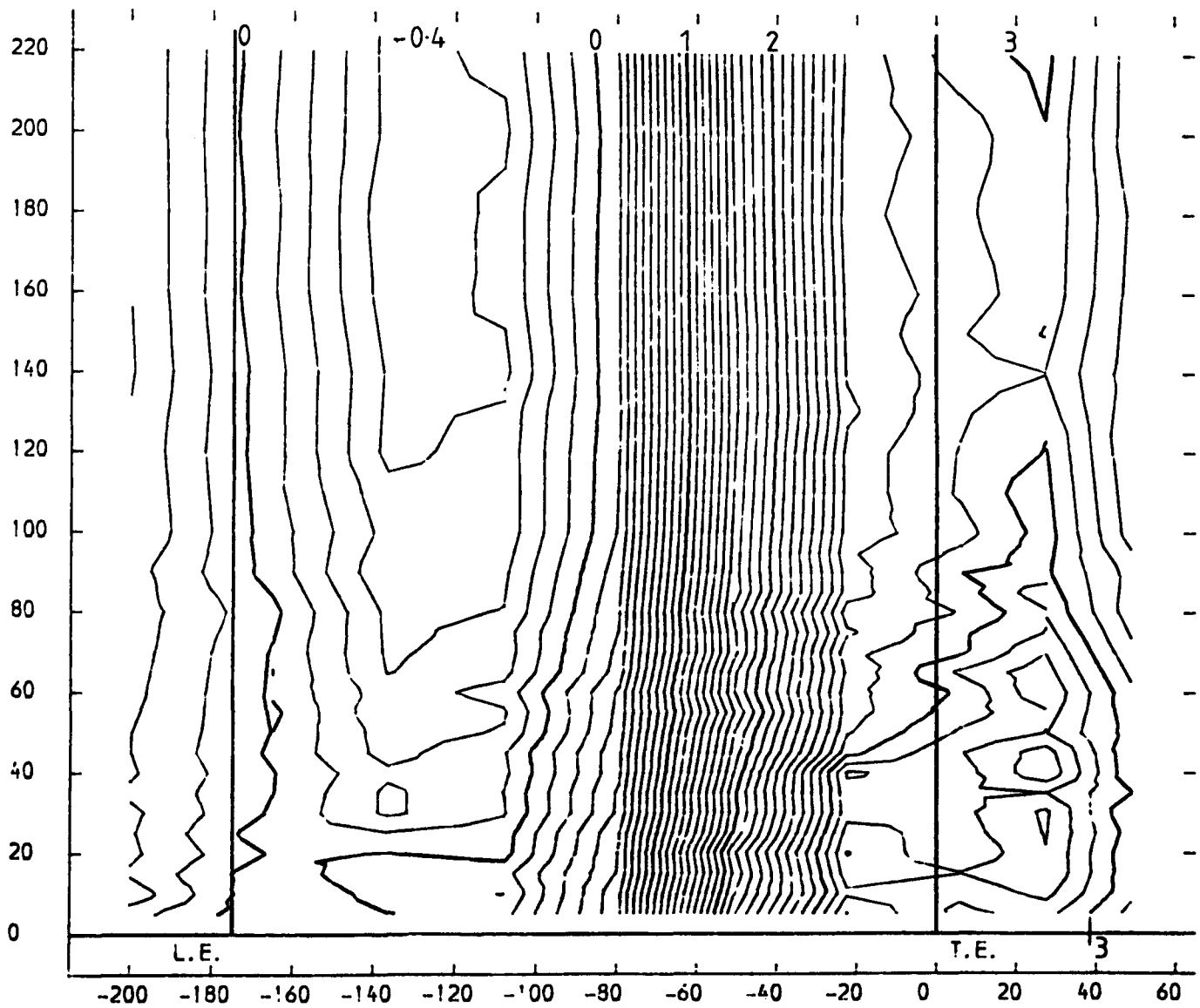


FIGURE 4.158

PLOT APPROXIMATELY 38.2 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(P01-P1)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

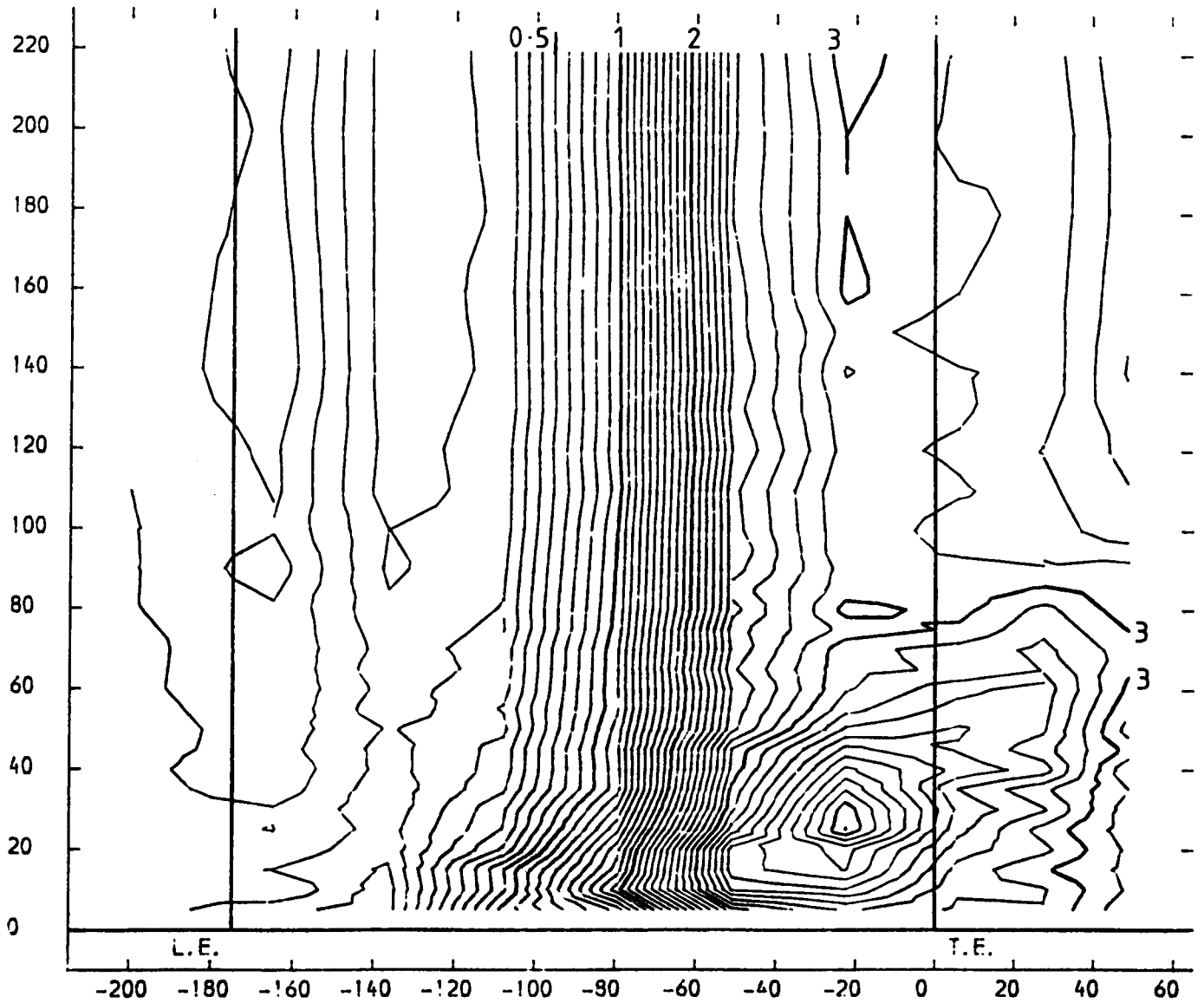


FIGURE 4.159

PLOT APPROXIMATELY 22.5 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(P01-P1)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

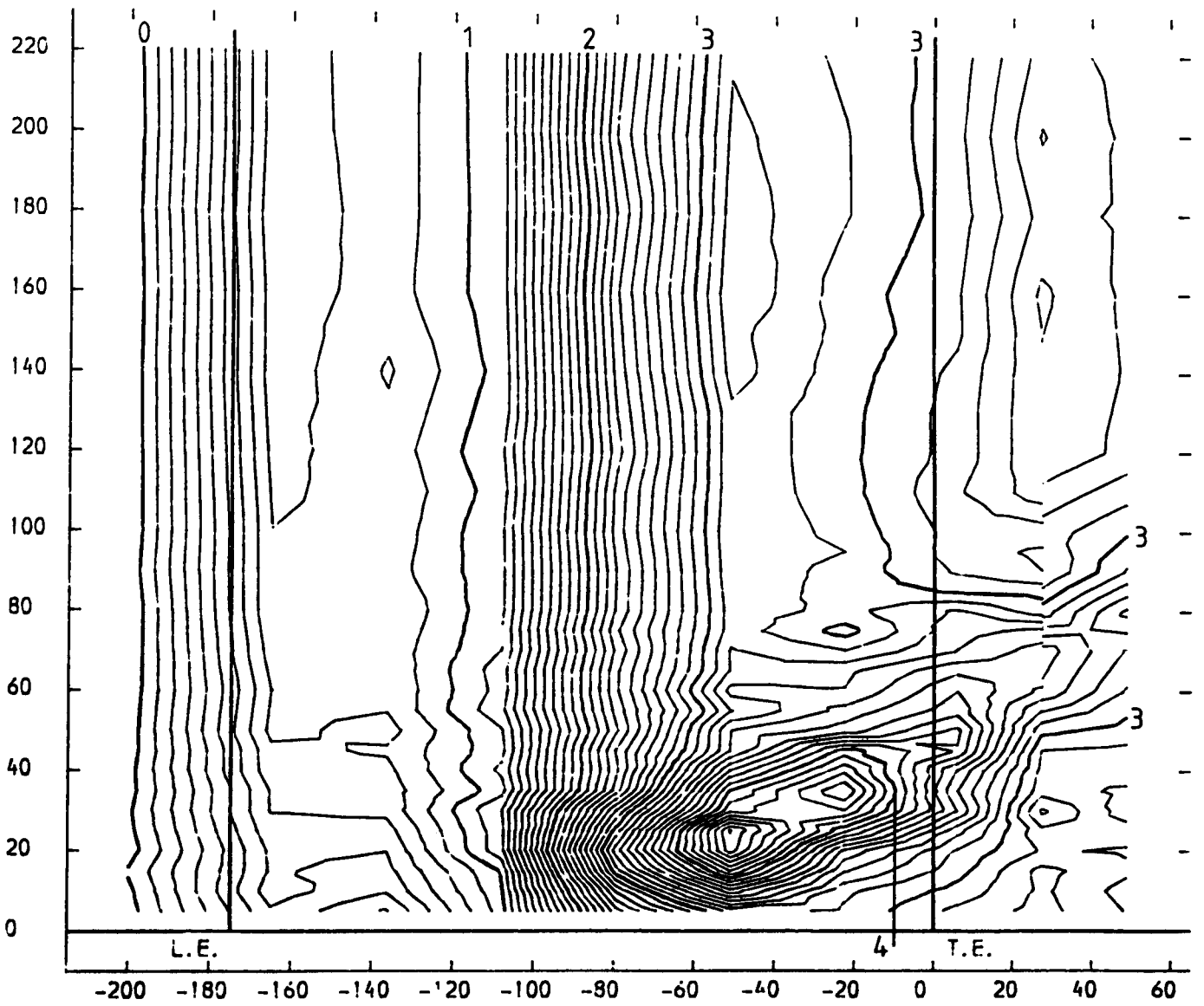


FIGURE 4.160

PLOT APPROXIMATELY 6.7 % OF BLADE PITCH LESS THICKNESS FROM SUCTION SURFACE
STATIC PRESSURE COEFFICIENT ((P1-PLOCAL) / (PO1-P1)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

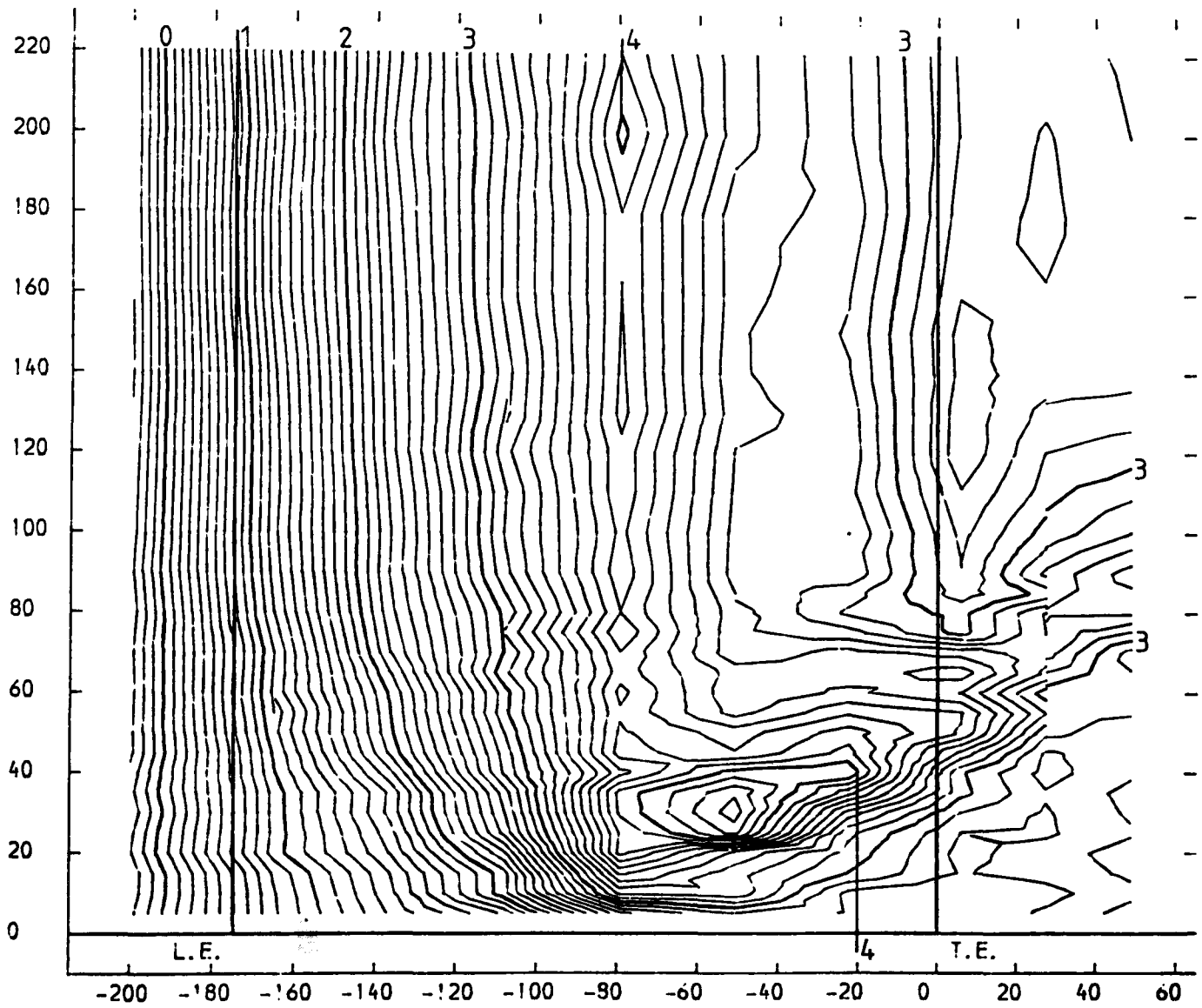


FIGURE 4.161

BLADE SURFACE STATIC PRESSURE COEFFICIENT DISTRIBUTION
(SHOWING DATA FROM ADJACENT PASSAGES)
NATURAL BOUNDARY LAYER DATA

X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

Y-AXIS STATIC PRESSURE COEFFICIENT ((P1-PLOCAL) / (P01-P1))

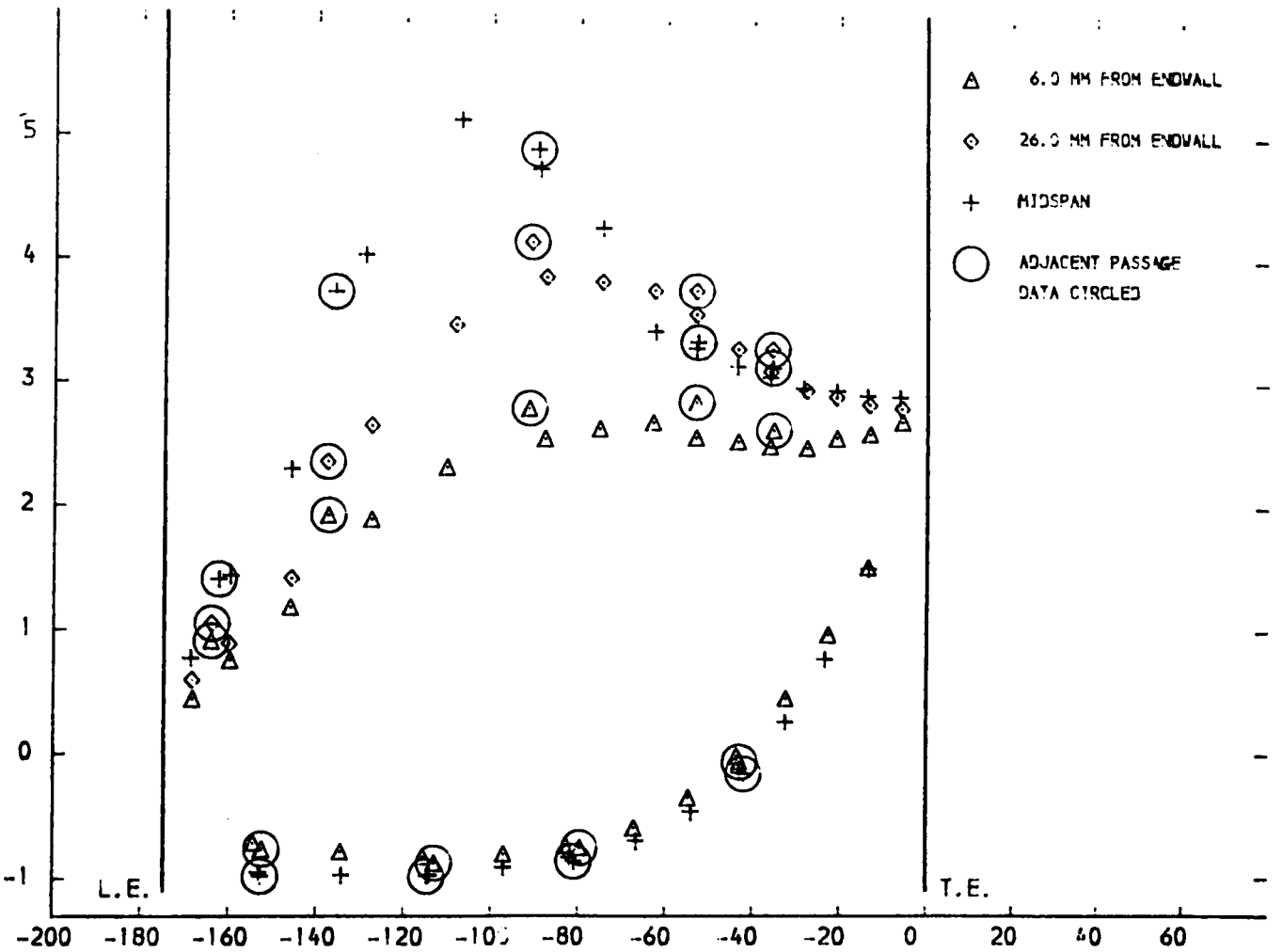


FIGURE 4.162

BLADE SURFACE STATIC PRESSURE COEFFICIENT DISTRIBUTION

NATURAL BOUNDARY LAYER DATA

X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

Y-AXIS STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(P01-P1))

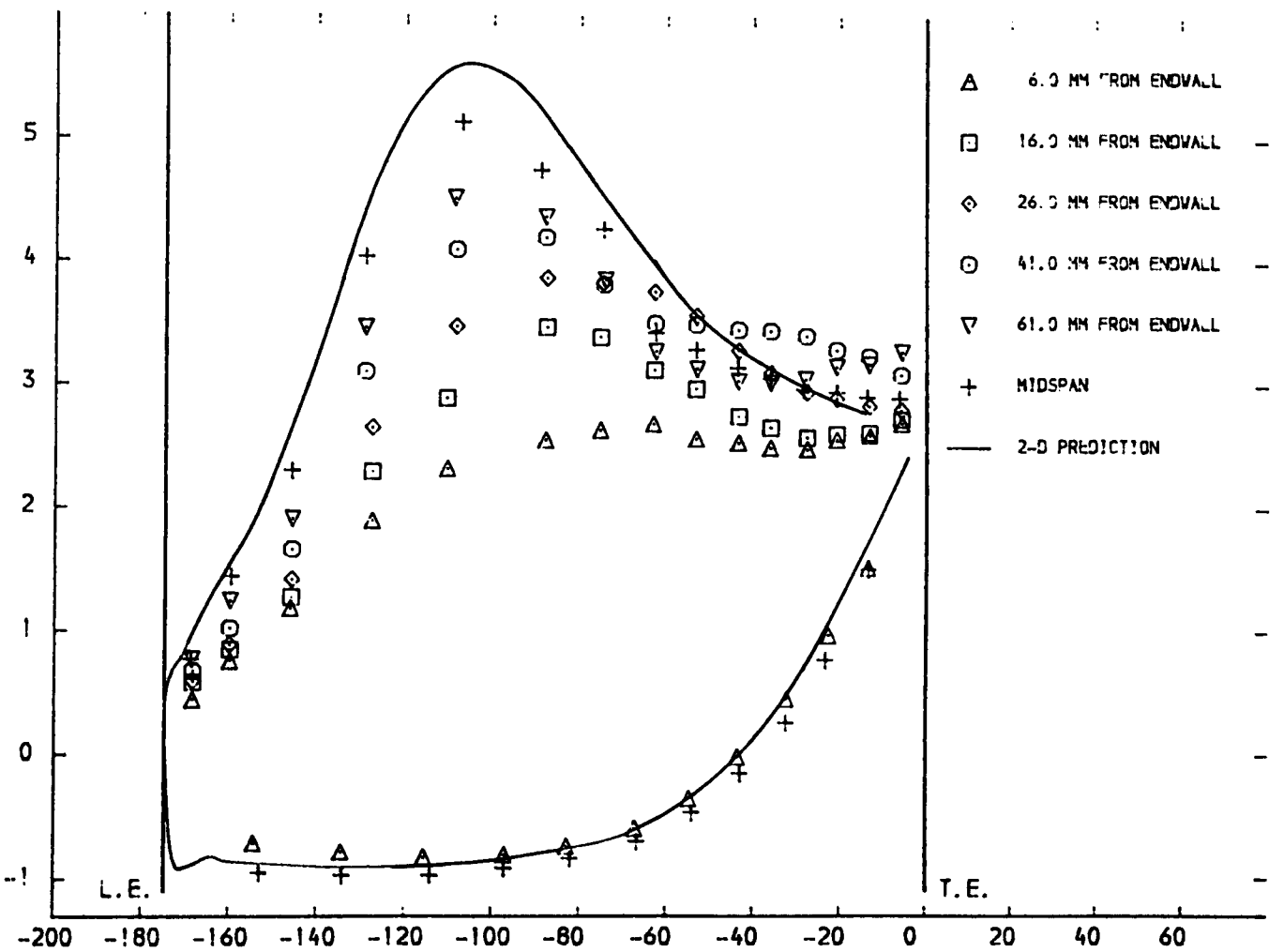


FIGURE 4.163

PLOT ON BLADE PRESSURE SURFACE

LOCATION OF BLADE SURFACE STATIC PRESSURE TAPPINGS

X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

+ SPANWISE DATA FROM PERSPEX WALL × SPANWISE DATA FROM SLOTTED WALL

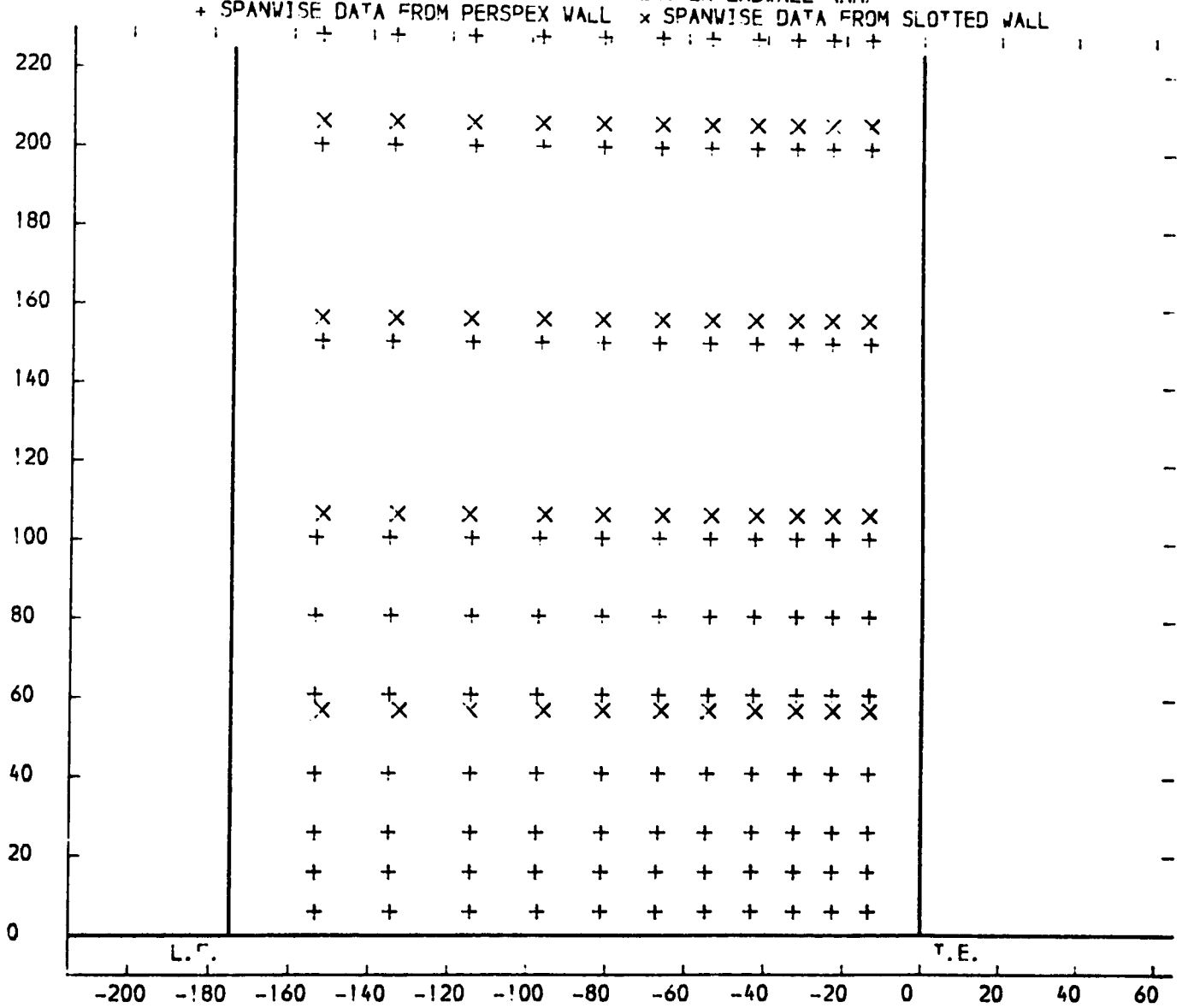


FIGURE 4.164

PLOT ON BLADE SUCTION SURFACE

LOCATION OF BLADE SURFACE STATIC PRESSURE TAPPINGS

X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

+ SPANWISE DATA FROM PERSPEX WALL × SPANWISE DATA FROM SLOTTED WALL

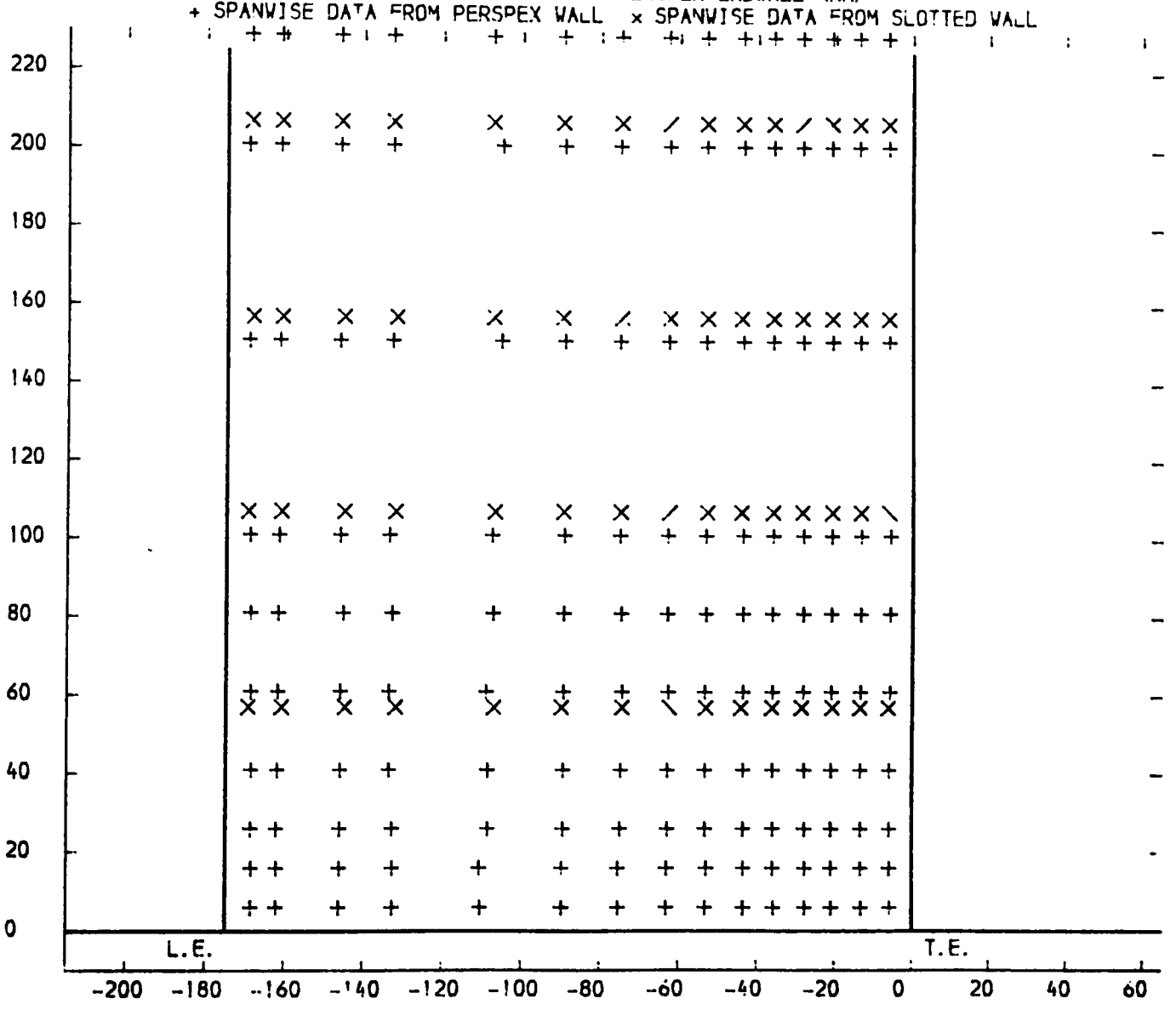


FIGURE 4.165

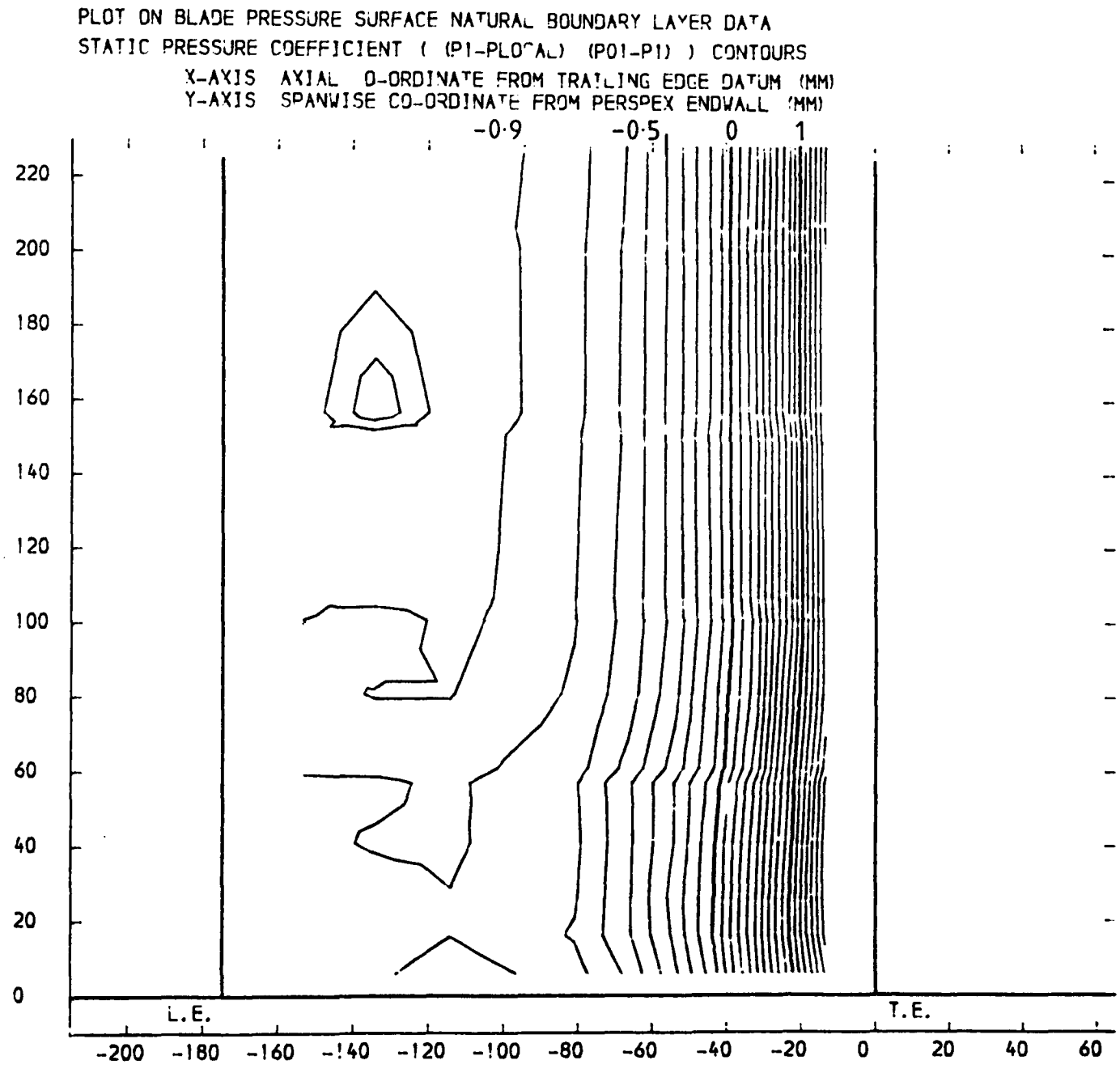

PLOT ON BLADE PRESSURE SURFACE NATURAL BOUNDARY LAYER DATA
STATIC PRESSURE COEFFICIENT ((P1-PLOCAL) (P01-P1)) CONTOURS
X-AXIS AXIAL O-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
-0·9
-0·5
0
1
220
200
180
160
140
120
100
80
60
40
20
0
L.E.
T.E.
-200
-180
-160
-140
-120
-100
-80
-60
-40
-20
0
20
40
60

FIGURE 4.166

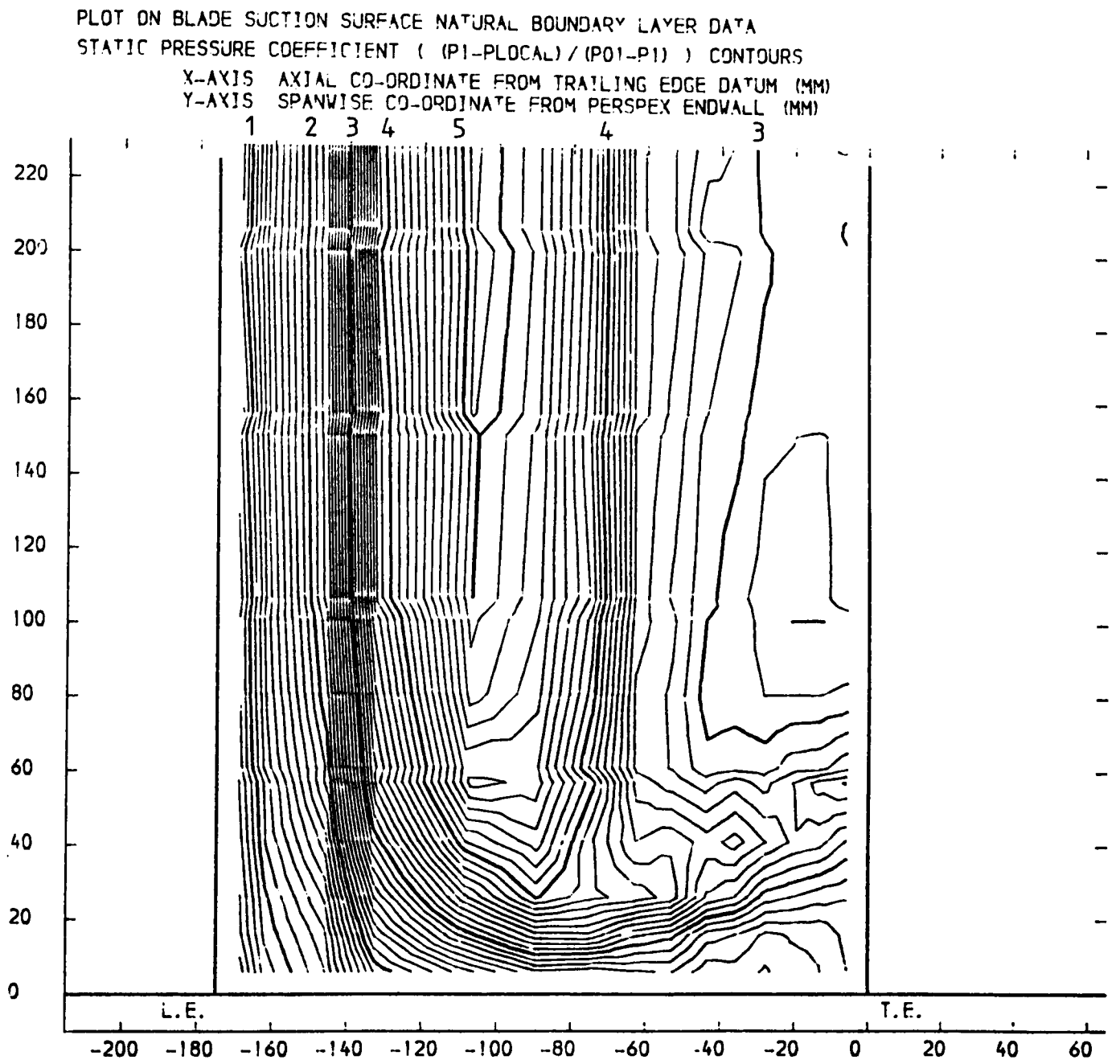

PLOT ON BLADE SUCTION SURFACE NATURAL BOUNDARY LAYER DATA
STATIC PRESSURE COEFFICIENT ((P1-PLOCAL) / (P01-P1)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
1 2 3 4 5 4 3
220
200
180
160
140
120
100
80
60
40
20
0
L.E.
T.E.
-200 -180 -160 -140 -120 -100 -80 -60 -40 -20 0 20 40 60

FIGURE 4.167

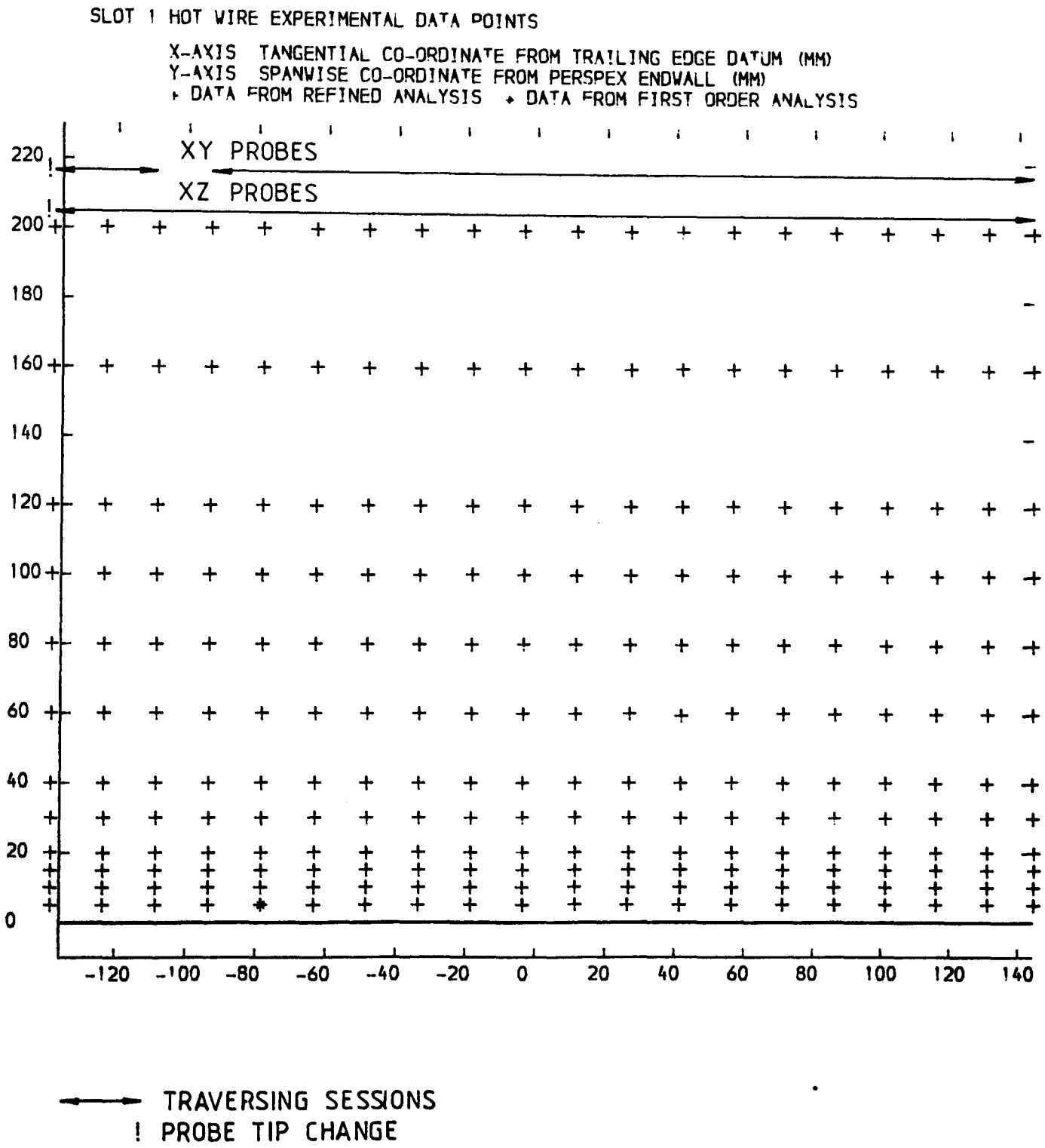

SLOT 1 HOT WIRE EXPERIMENTAL DATA POINTS
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
+ DATA FROM REFINED ANALYSIS + DATA FROM FIRST ORDER ANALYSIS
XY PROBES
XZ PROBES
220
200
180
160
140
120
100
80
60
40
20
0
-120
-100
-80
-60
-40
-20
0
20
40
60
80
100
120
140
TRAVERSING SESSIONS
! PROBE TIP CHANGE

FIGURE 5.1

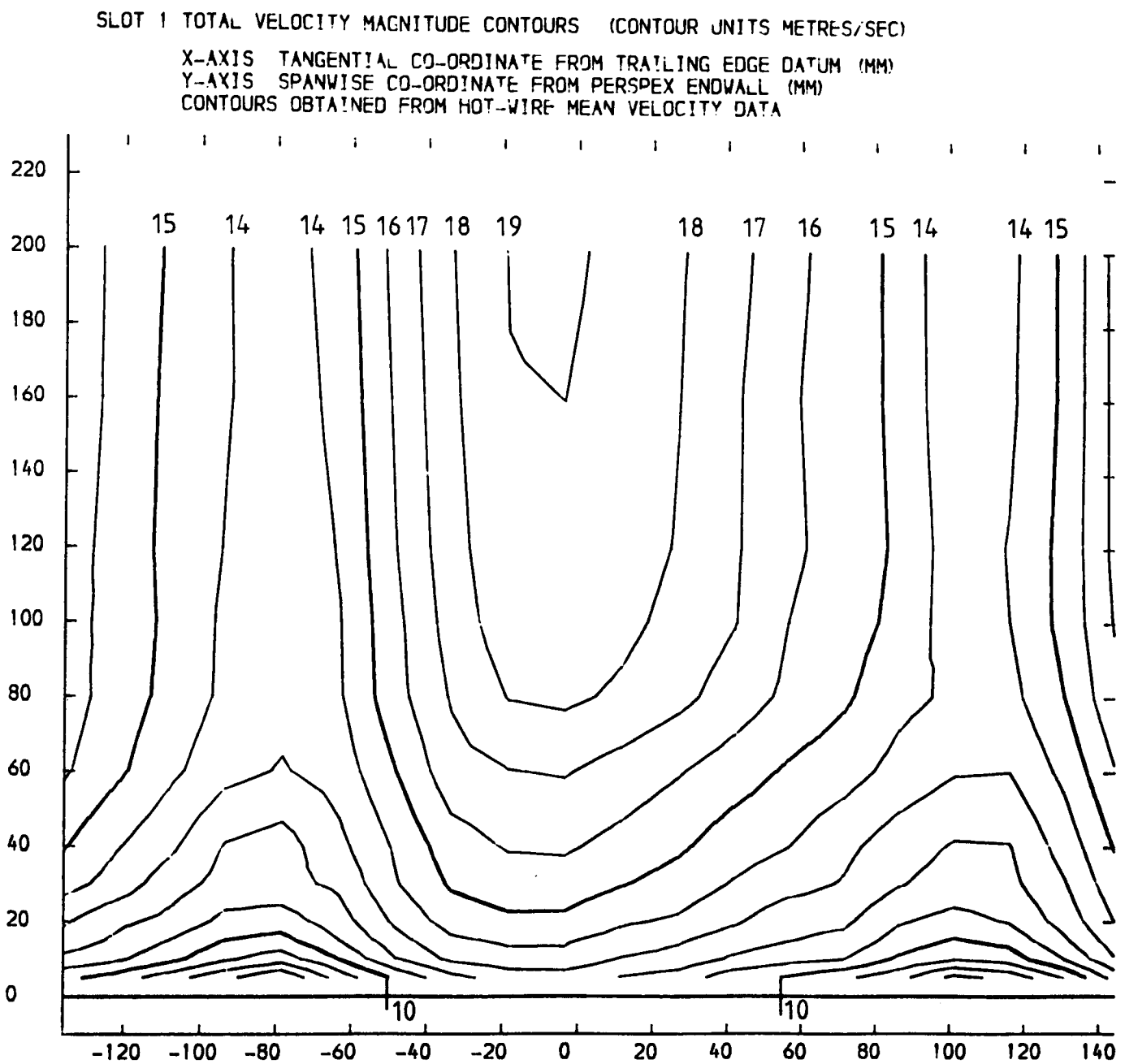

SLOT 1 TOTAL VELOCITY MAGNITUDE CONTOURS (CONTOUR UNITS METRES/SEC)
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
CONTOURS OBTAINED FROM HOT-WIRE MEAN VELOCITY DATA
15
14
14
15
16
17
18
19
18
17
16
15
14
14
15
10
10
220
200
180
160
140
120
100
80
60
40
20
0
-120
-100
-80
-60
-40
-20
0
20
40
60
80
100
120
140

FIGURE 5.2

SLOT 1 YAW ANGLE CONTOURS (CONTOUR UNITS DEGREES)

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
CONTOURS OBTAINED FROM HOT-WIRE MEAN VELOCITY DATA

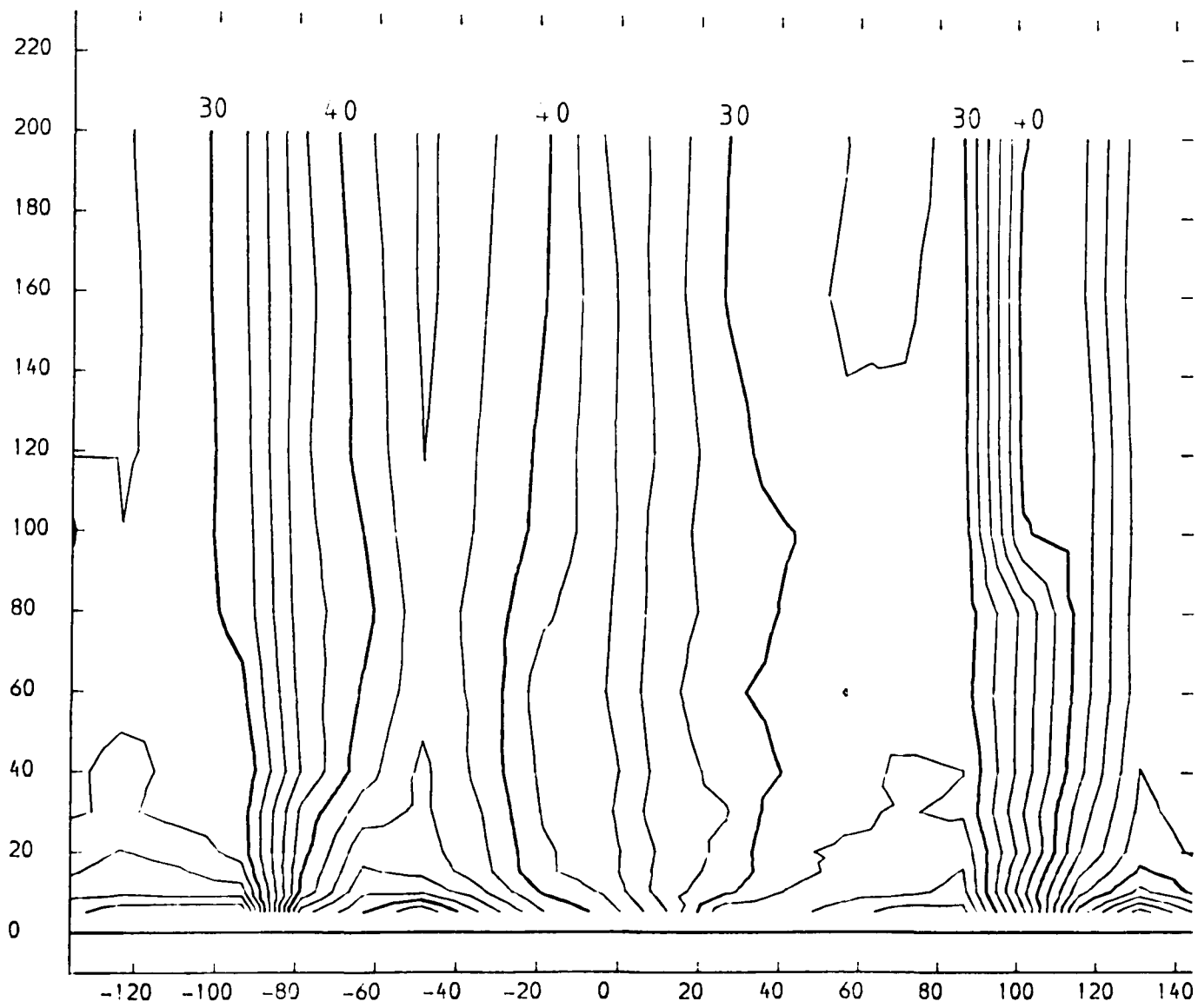


FIGURE 5.3

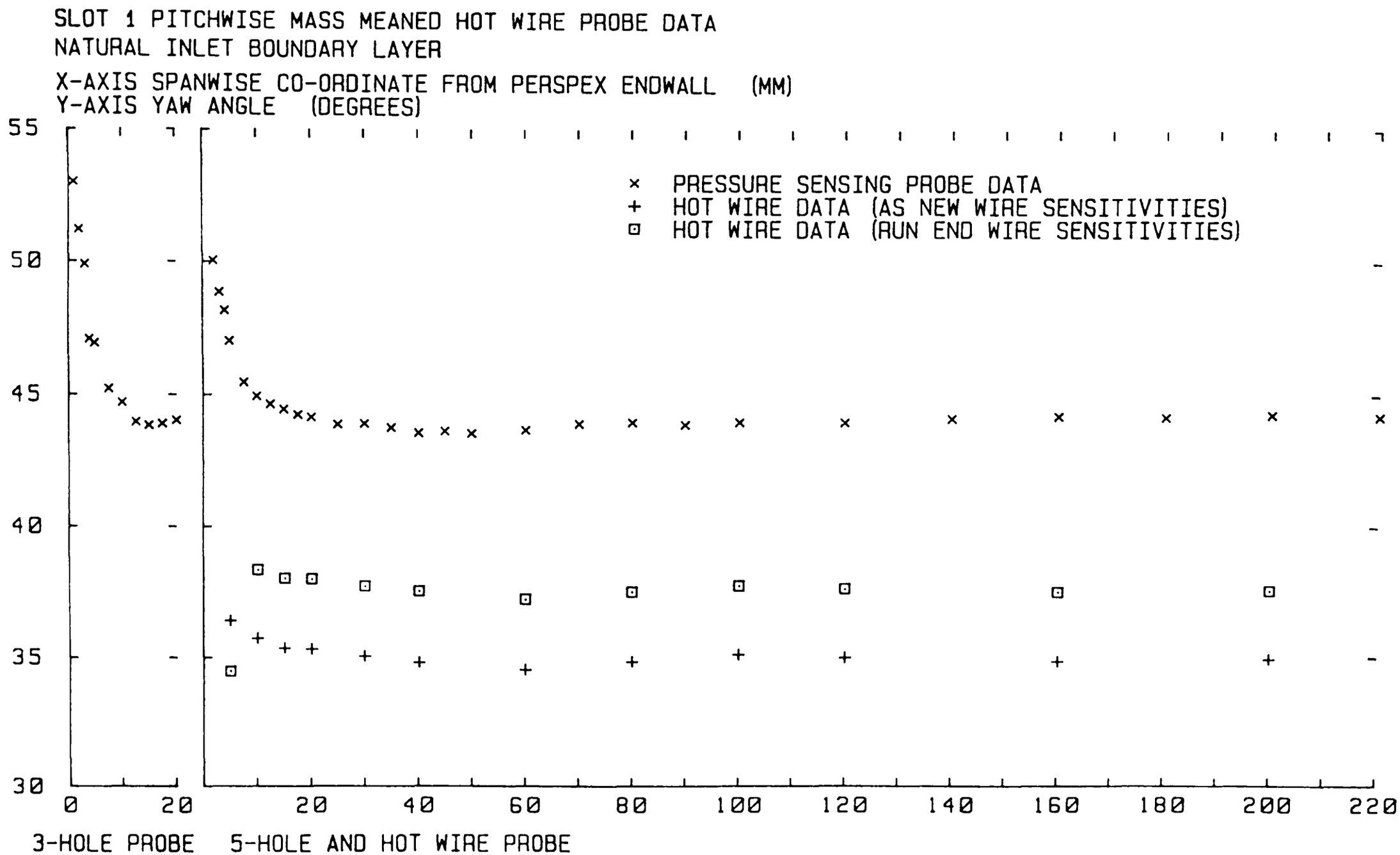

SLOT 1 PITCHWISE MASS MEANED HOT WIRE PROBE DATA
NATURAL INLET BOUNDARY LAYER
X-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
Y-AXIS YAW ANGLE (DEGREES)
× PRESSURE SENSING PROBE DATA
+ HOT WIRE DATA (AS NEW WIRE SENSITIVITIES)
⊡ HOT WIRE DATA (RUN END WIRE SENSITIVITIES)
55
50
45
40
35
30
0
20
20
40
60
80
100
120
140
160
180
200
220
3-HOLE PROBE
5-HOLE AND HOT WIRE PROBE

FIGURE 5.4

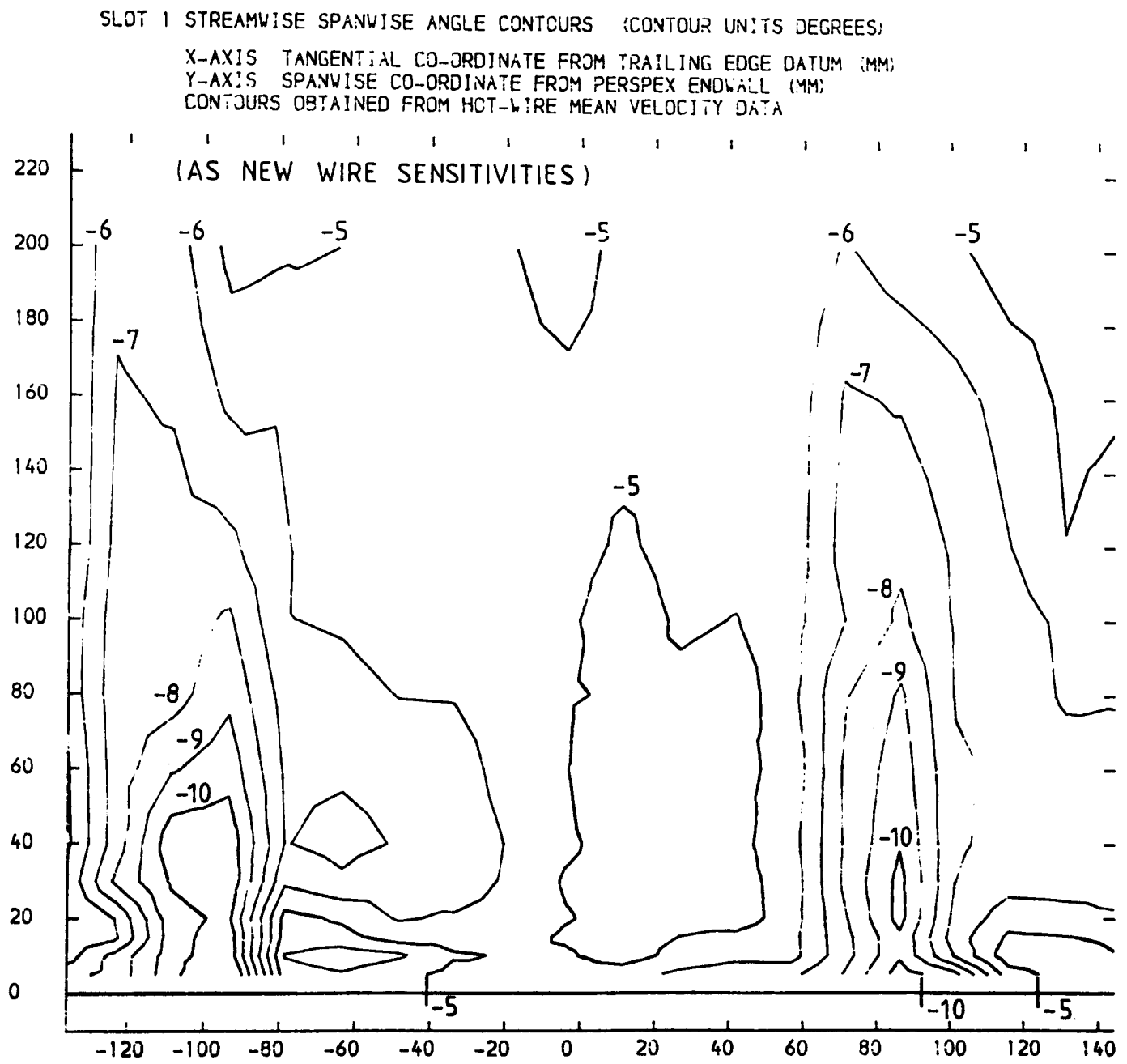

SLOT 1 STREAMWISE SPANWISE ANGLE CONTOURS (CONTOUR UNITS DEGREES)
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
CONTOURS OBTAINED FROM HOT-WIRE MEAN VELOCITY DATA
(AS NEW WIRE SENSITIVITIES)
-6
-6
-5
-5
-6
-5
-7
-7
-5
-8
-9
-8
-9
-10
-10
-5
-10
-5
220
200
180
160
140
120
100
80
60
40
20
0
-120
-100
-80
-60
-40
-20
0
20
40
60
80
100
120
140

FIGURE 5.5

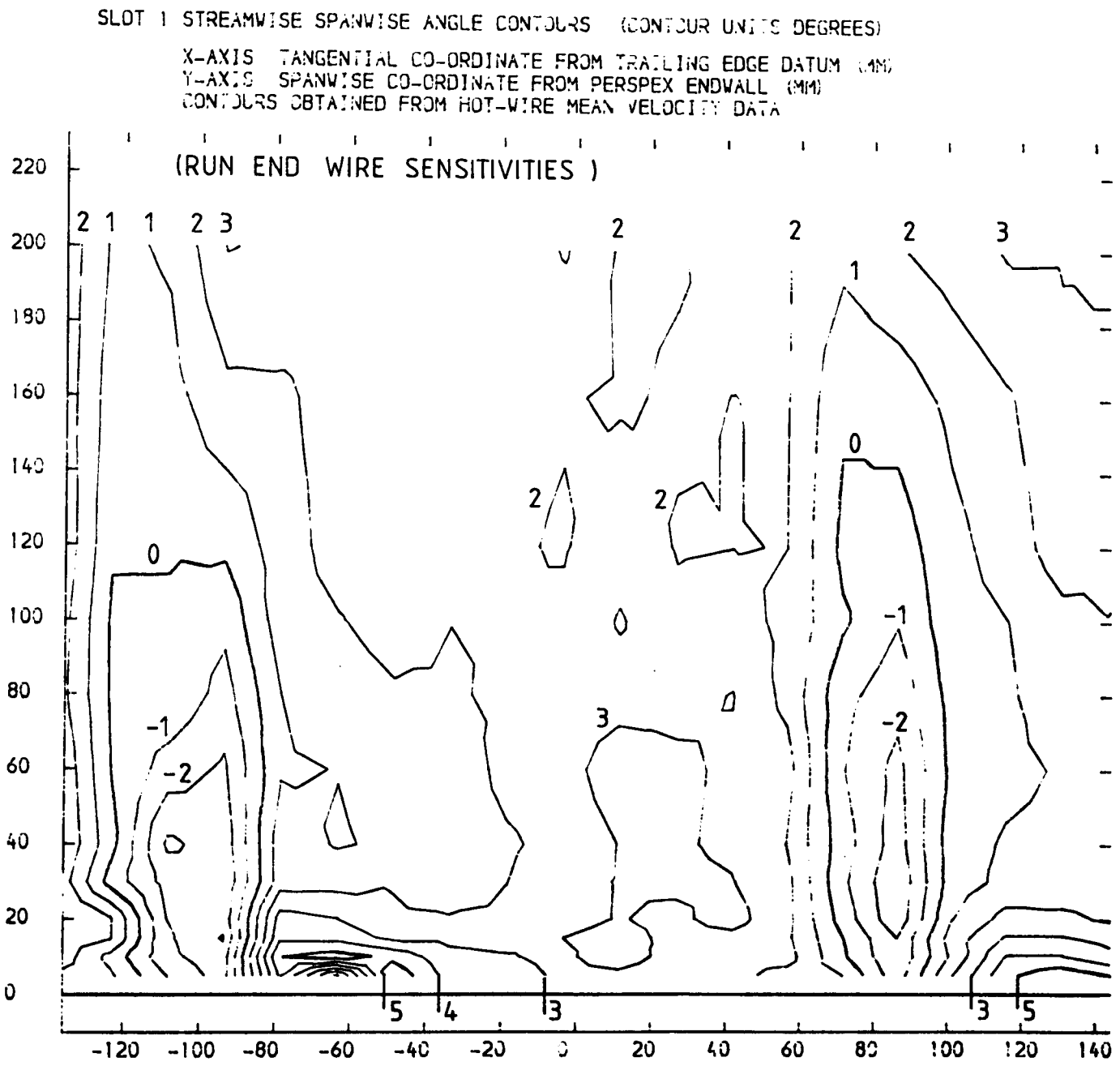

SLOT 1 STREAMWISE SPANWISE ANGLE CONTOURS (CONTOUR UNITS DEGREES)
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
CONTOURS OBTAINED FROM HOT-WIRE MEAN VELOCITY DATA
(RUN END WIRE SENSITIVITIES)
220
200
180
160
140
120
100
80
60
40
20
0
-120
-100
-80
-60
-40
-20
0
20
40
60
80
100
120
140

FIGURE 5.6

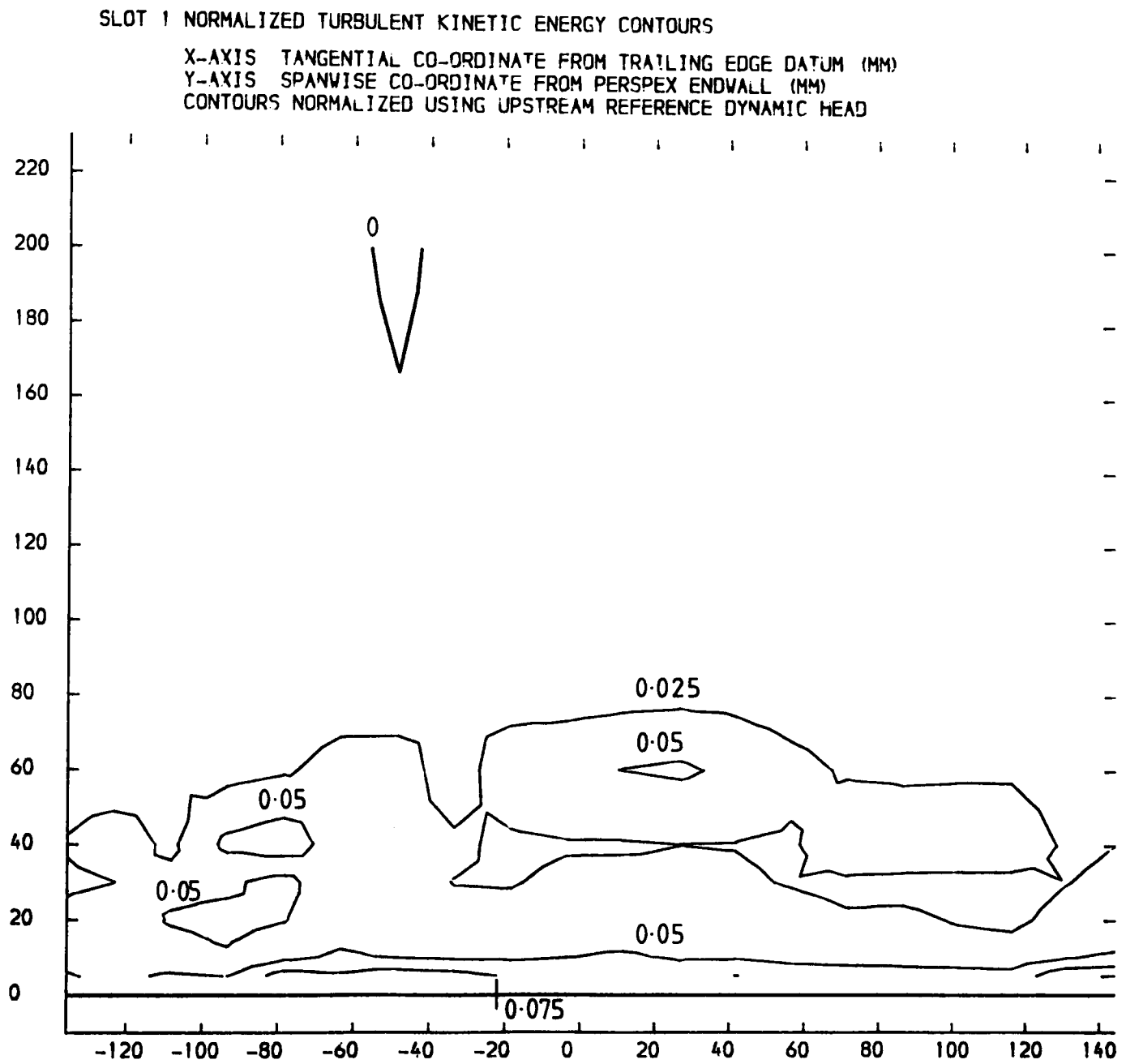

SLOT 1 NORMALIZED TURBULENT KINETIC ENERGY CONTOURS
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
CONTOURS NORMALIZED USING UPSTREAM REFERENCE DYNAMIC HEAD
0
0·025
0·05
0·05
0·05
0·05
0·075
220
200
180
160
140
120
100
80
60
40
20
0
-120
-100
-80
-60
-40
-20
0
20
40
60
80
100
120
140

FIGURE 5.7

SLOT 1 TURBULENCE INTENSITY CONTOURS FOR U DASH

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
CONTOURS NORMALIZED USING UPSTREAM REFERENCE VELOCITY

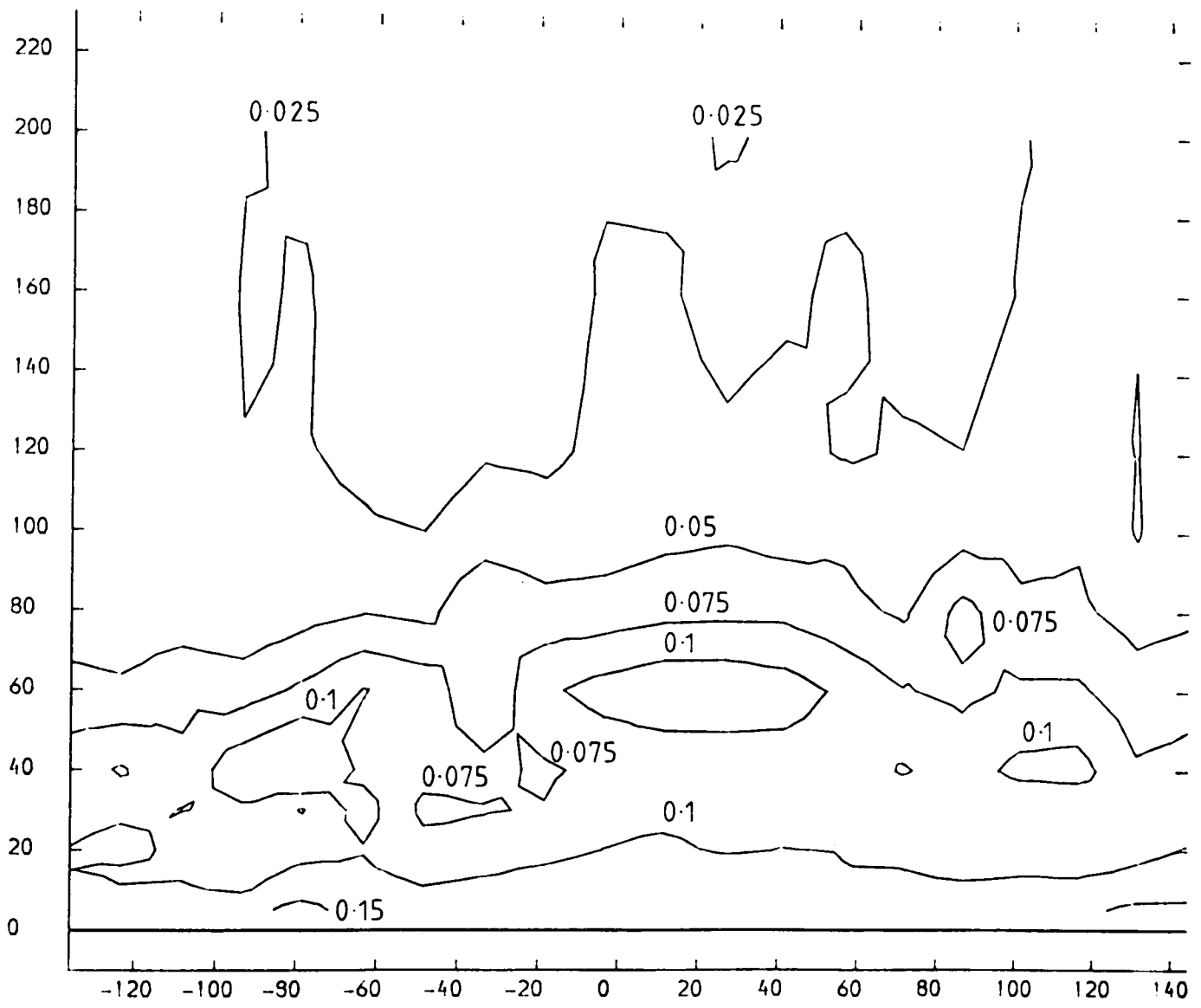


FIGURE 5.8

SLOT 1 TURBULENCE INTENSITY CONTOURS FOR V DASH

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
CONTOURS NORMALIZED USING UPSTREAM REFERENCE VELOCITY

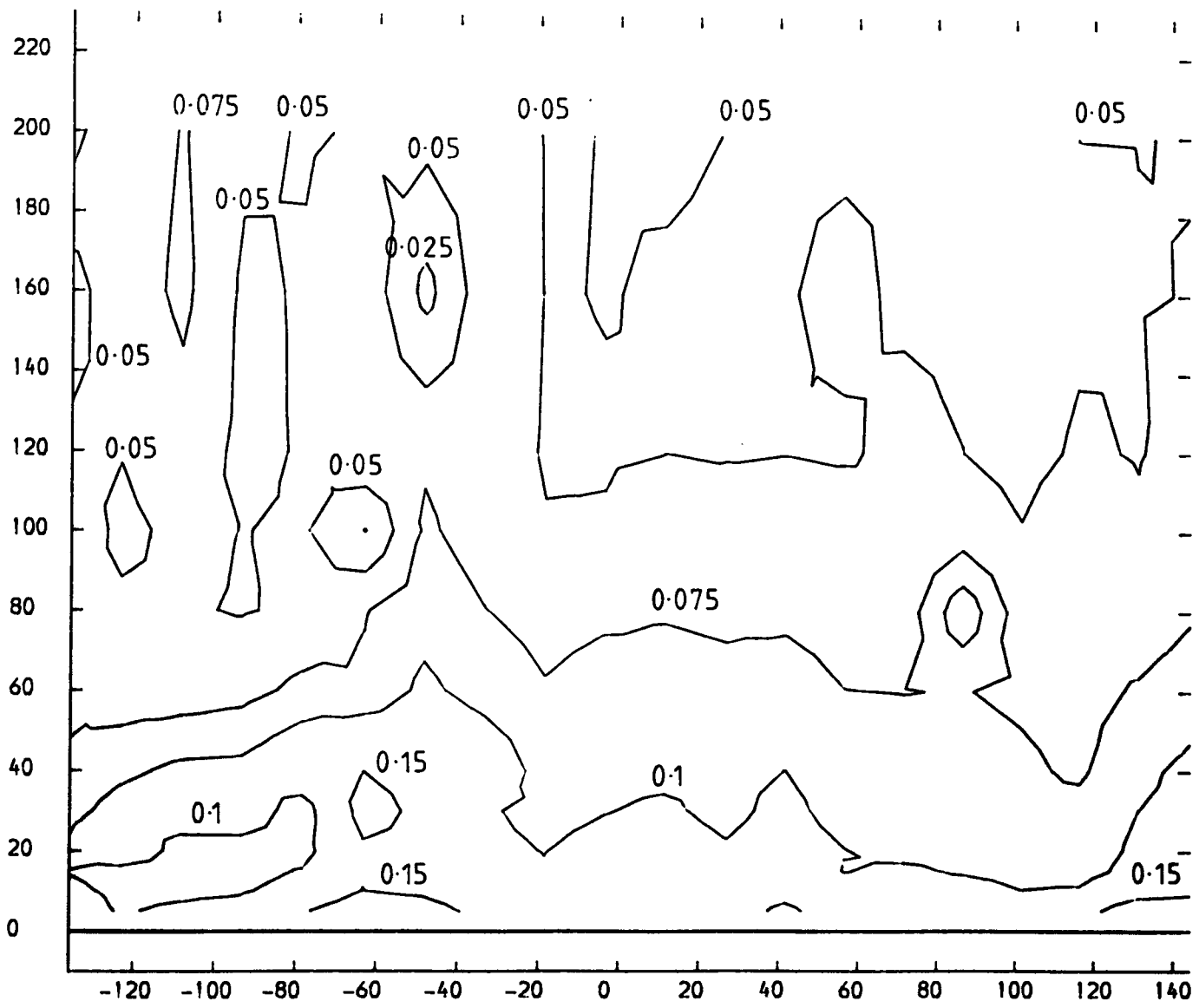


FIGURE 5.9

SLOT 1 TURBULENCE INTENSITY CONTOURS FOR W DASH

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
CONTOURS NORMALIZED USING UPSTREAM REFERENCE VELOCITY

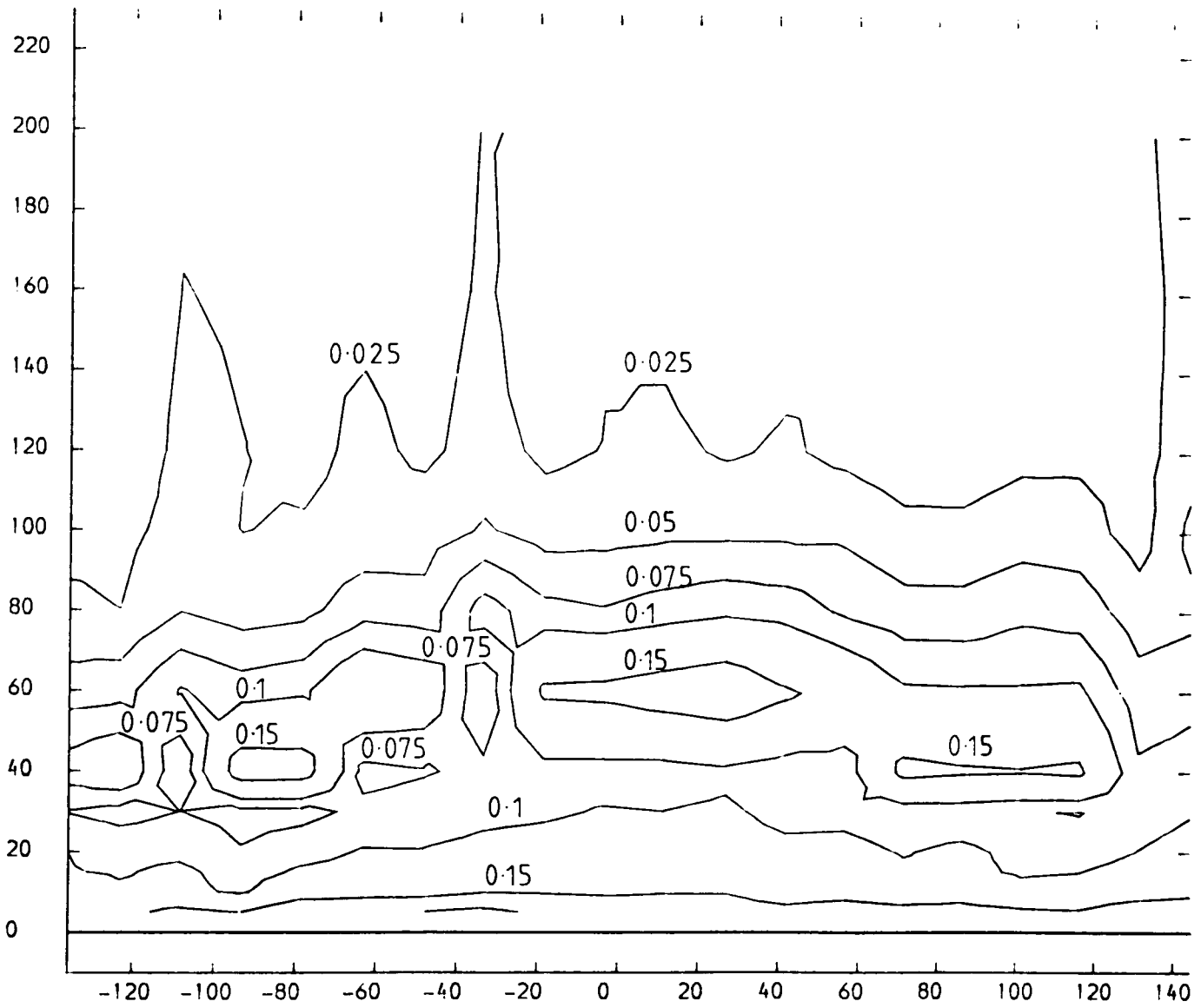


FIGURE 5.10

SLOT 1 PITCHWISE MASS MEANED RELATIVE TURBULENCE INTENSITIES (AS NEW WIRE SENSITIVITIES)
NATURAL INLET BOUNDARY LAYER

X-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
Y-AXIS NORMALIZED TURBULENCE DATA

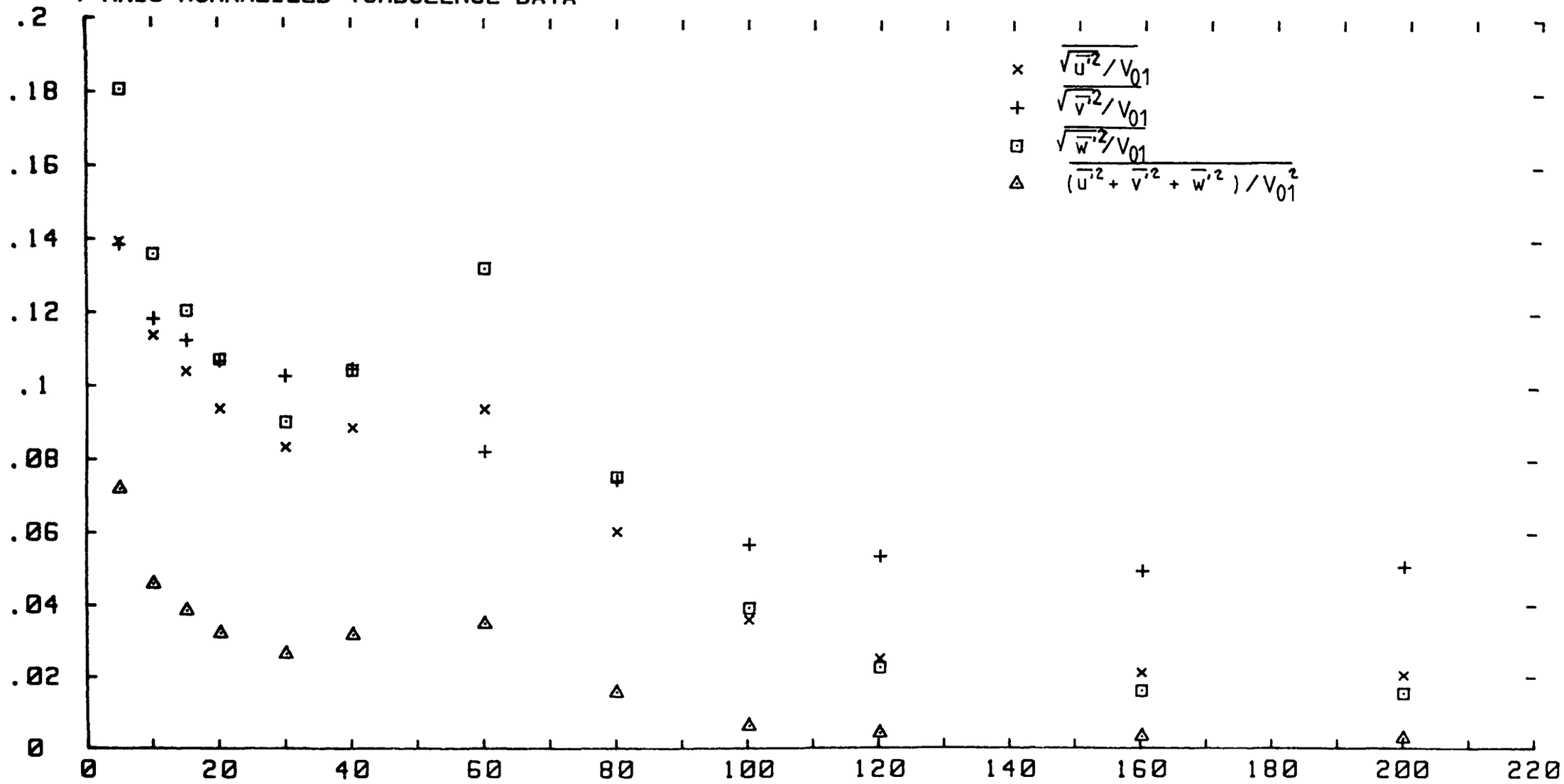


FIGURE 5.11

SLOT 1 PITCHWISE MASS MEANED RELATIVE TURBULENCE INTENSITIES (RUN END WIRE SENSITIVITIES)
NATURAL INLET BOUNDARY LAYER

X-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
Y-AXIS NORMALIZED TURBULENCE DATA

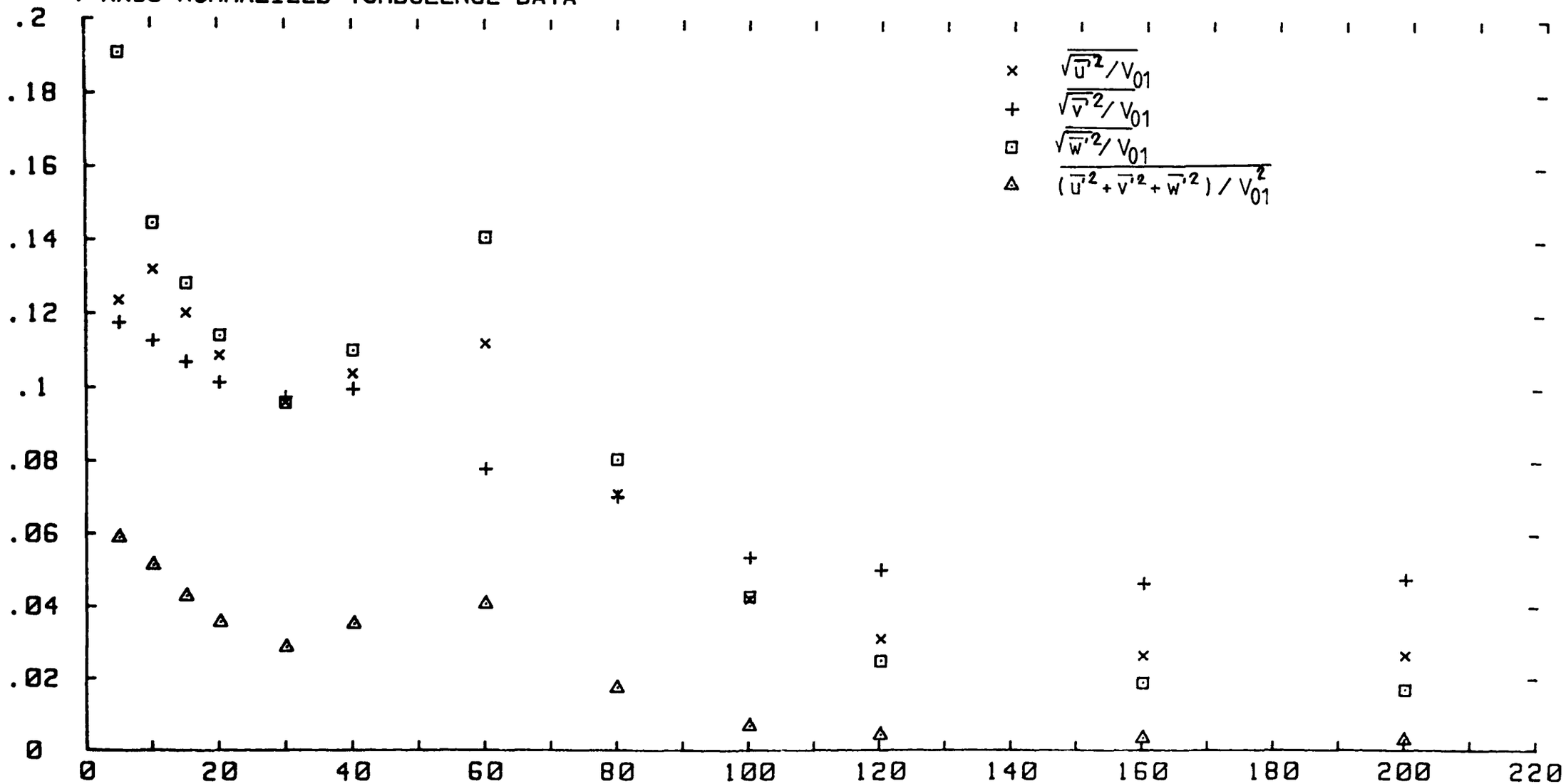


FIGURE 5.12

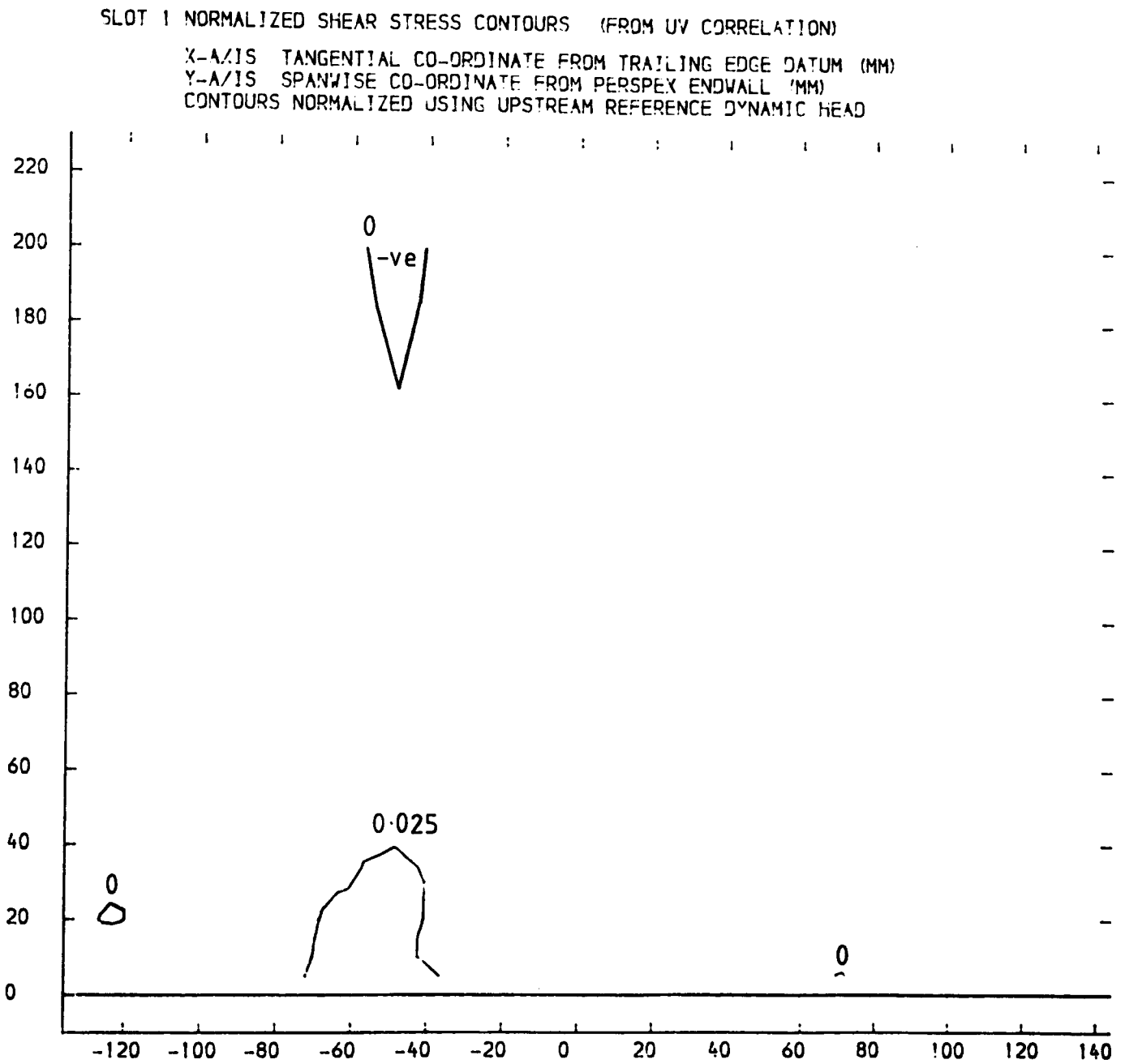

SLOT 1 NORMALIZED SHEAR STRESS CONTOURS (FROM UV CORRELATION)
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
CONTOURS NORMALIZED USING UPSTREAM REFERENCE DYNAMIC HEAD
0
-ve
0·025
0
0
220
200
180
160
140
120
100
80
60
40
20
0
-120
-100
-80
-60
-40
-20
0
20
40
60
80
100
120
140

FIGURE 5.13

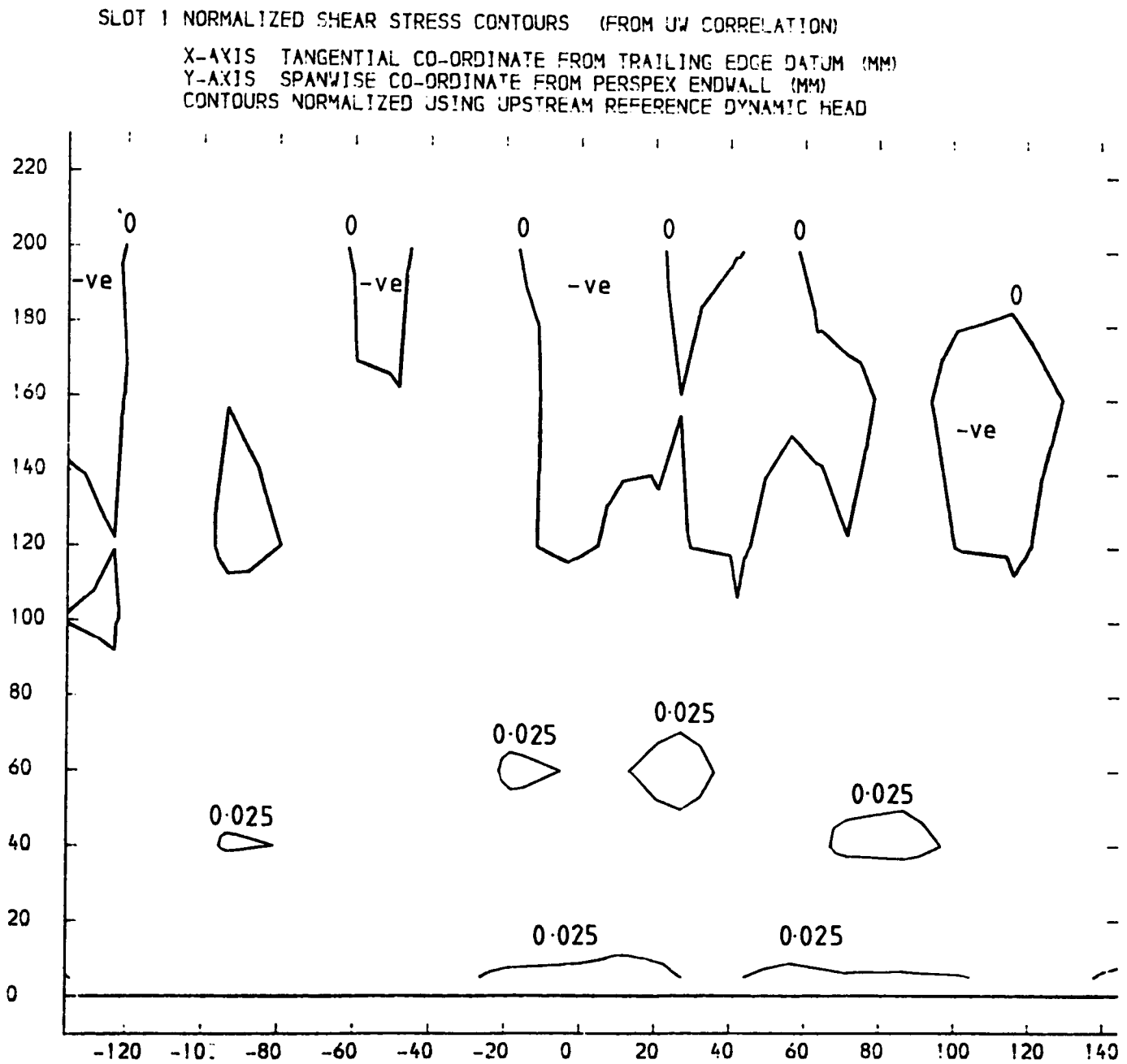
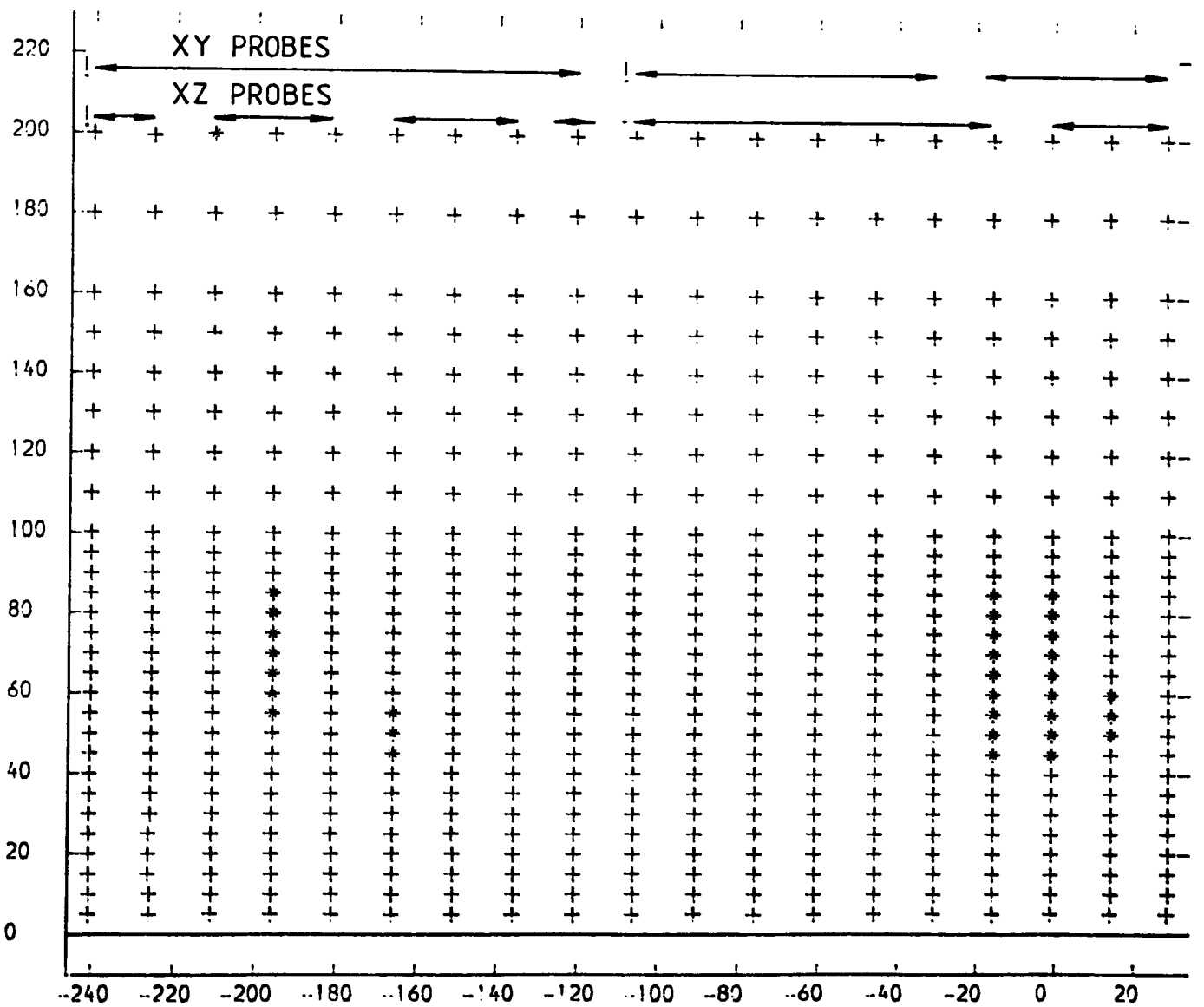

SLOT 1 NORMALIZED SHEAR STRESS CONTOURS (FROM UW CORRELATION)
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
CONTOURS NORMALIZED USING UPSTREAM REFERENCE DYNAMIC HEAD
0
-ve
0.025
220
200
180
160
140
120
100
80
60
40
20
0
-120
-80
-60
-40
-20
0
20
40
60
80
100
120
140

FIGURE 5.14

SLOT 8 HOT WIRE EXPERIMENTAL DATA POINTS

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
+ DATA POINT • IMAGINARY ROOT FOR ONE UBAR OTHER VALUED USED



TRAVERSING SESSIONS
! PROBE TIP CHANGE

FIGURE 5.15

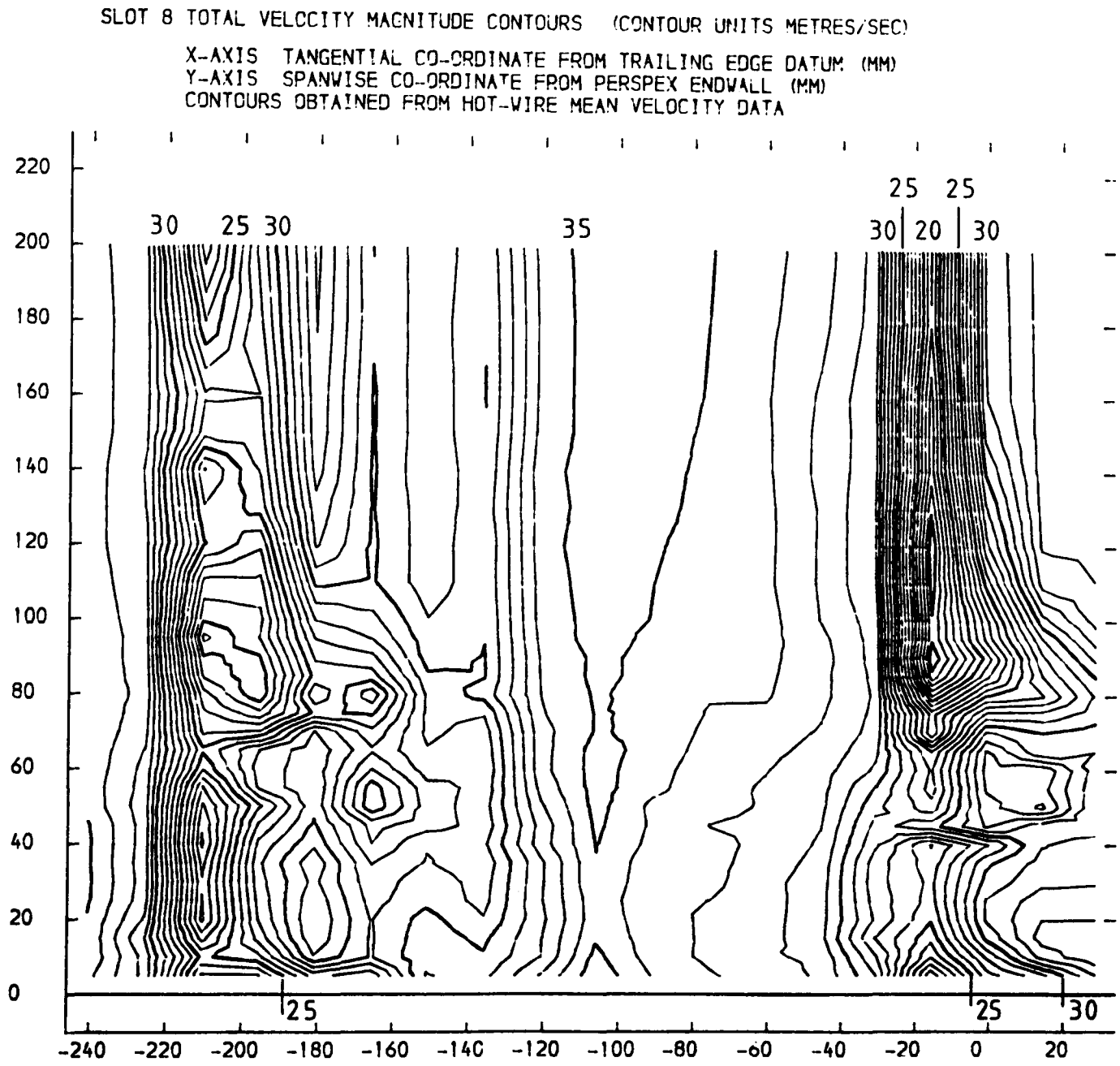

SLOT 8 TOTAL VELOCITY MAGNITUDE CONTOURS (CONTOUR UNITS METRES/SEC)
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
CONTOURS OBTAINED FROM HOT-WIRE MEAN VELOCITY DATA
30
25
30
35
25
25
30
20
30
25
25
30
220
200
180
160
140
120
100
80
60
40
20
0
-240
-220
-200
-180
-160
-140
-120
-100
-80
-60
-40
-20
0
20

FIGURE 5.16

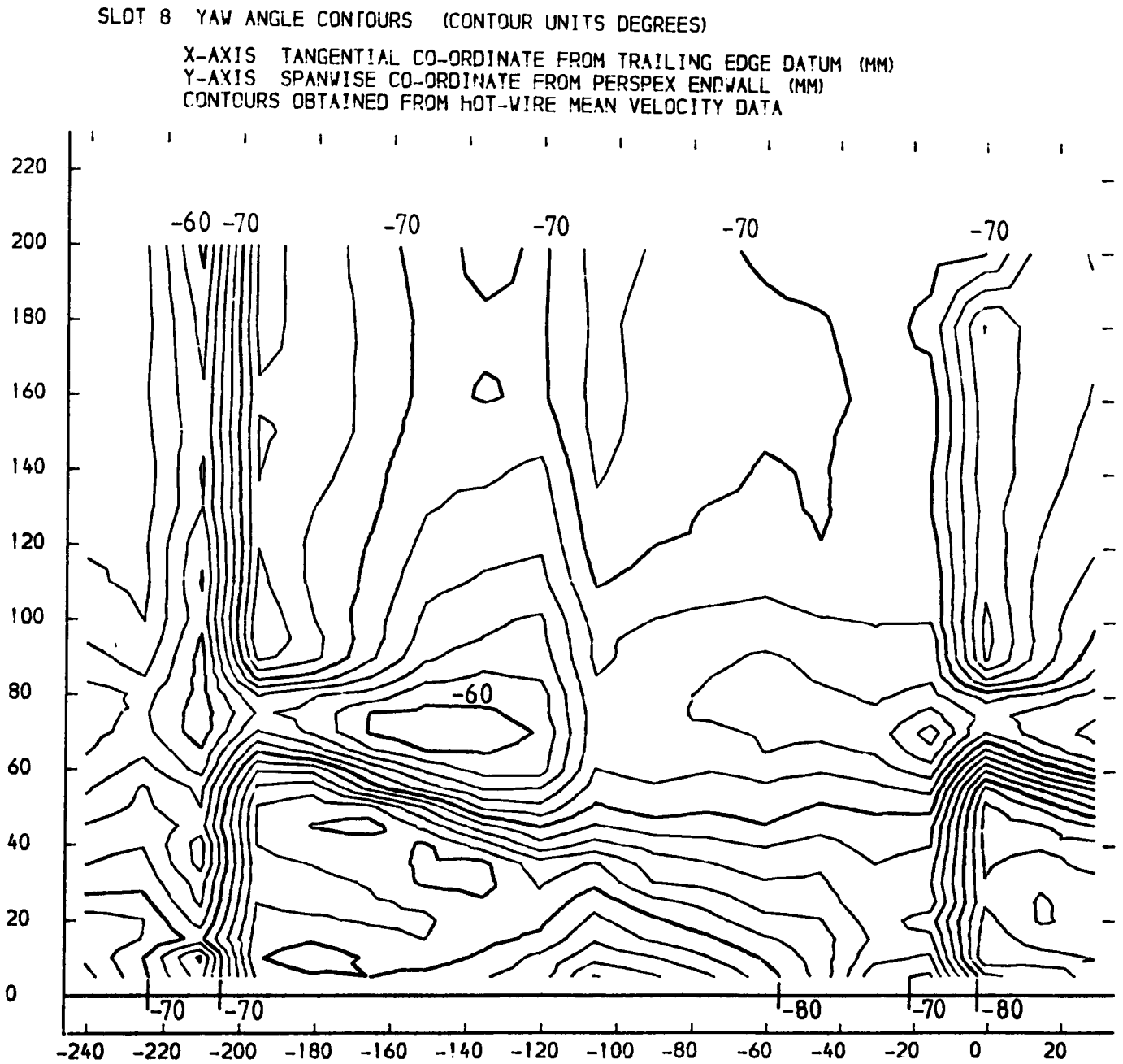

SLOT 8 YAW ANGLE CONTOURS (CONTOUR UNITS DEGREES)
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
CONTOURS OBTAINED FROM HOT-WIRE MEAN VELOCITY DATA
-60 -70
-70
-70
-70
-70
-60
-70 -70
-80
-70 -80
220
200
180
160
140
120
100
80
60
40
20
0
-240 -220 -200 -180 -160 -140 -120 -100 -80 -60 -40 -20 0 20

FIGURE 5.17

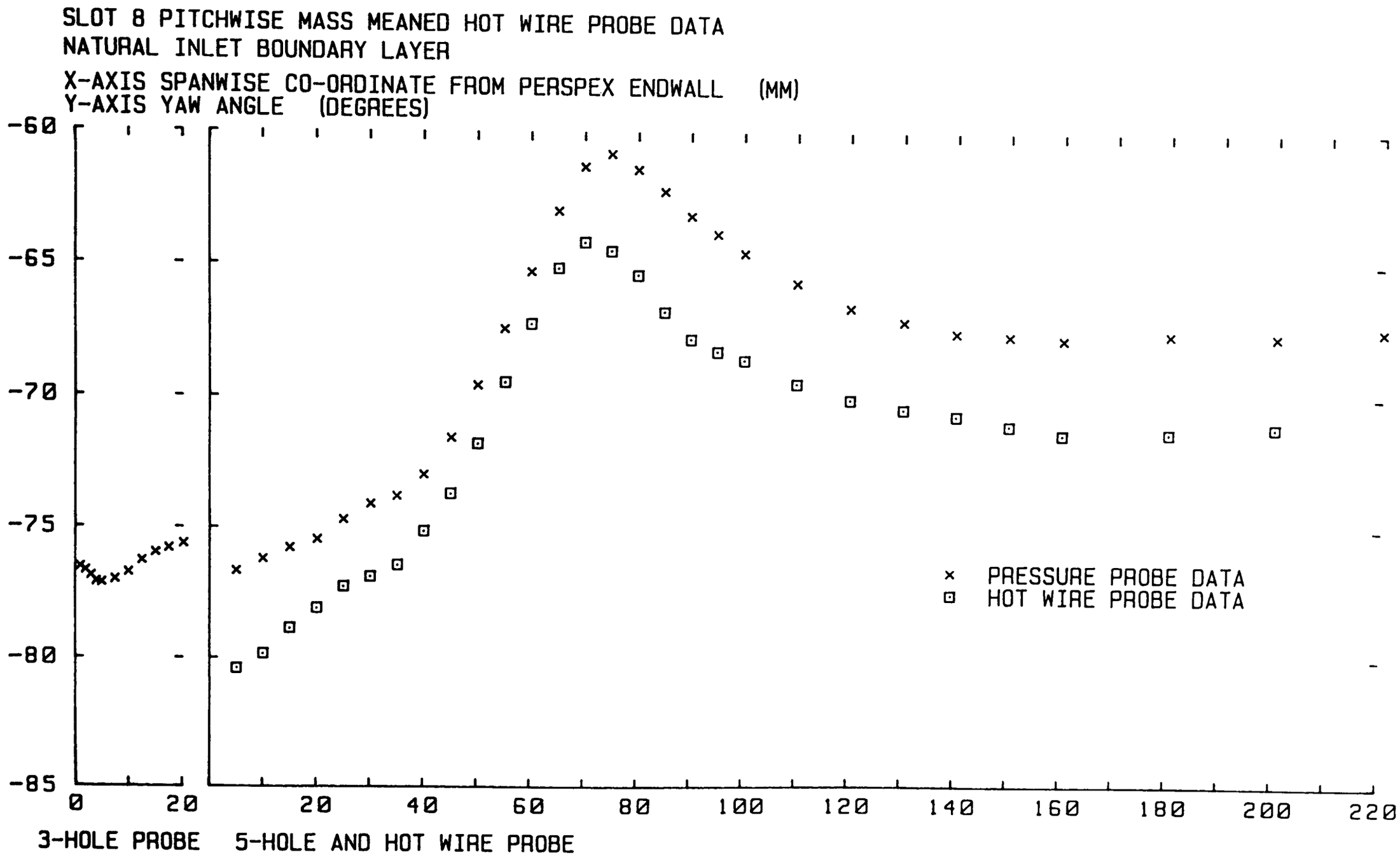

SLOT 8 PITCHWISE MASS MEANED HOT WIRE PROBE DATA
NATURAL INLET BOUNDARY LAYER
X-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
Y-AXIS YAW ANGLE (DEGREES)
-60
-65
-70
-75
-80
-85
0
20
20
40
60
80
100
120
140
160
180
200
220
3-HOLE PROBE
5-HOLE AND HOT WIRE PROBE
PRESSURE PROBE DATA
HOT WIRE PROBE DATA

FIGURE 5.18

SLOT 8 SPANWISE ANGLE (PITCH ANGLE) CONTOURS (CONTOUR UNITS DEGREES)

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
CONTOURS OBTAINED FROM HOT-WIRE MEAN VELOCITY DATA

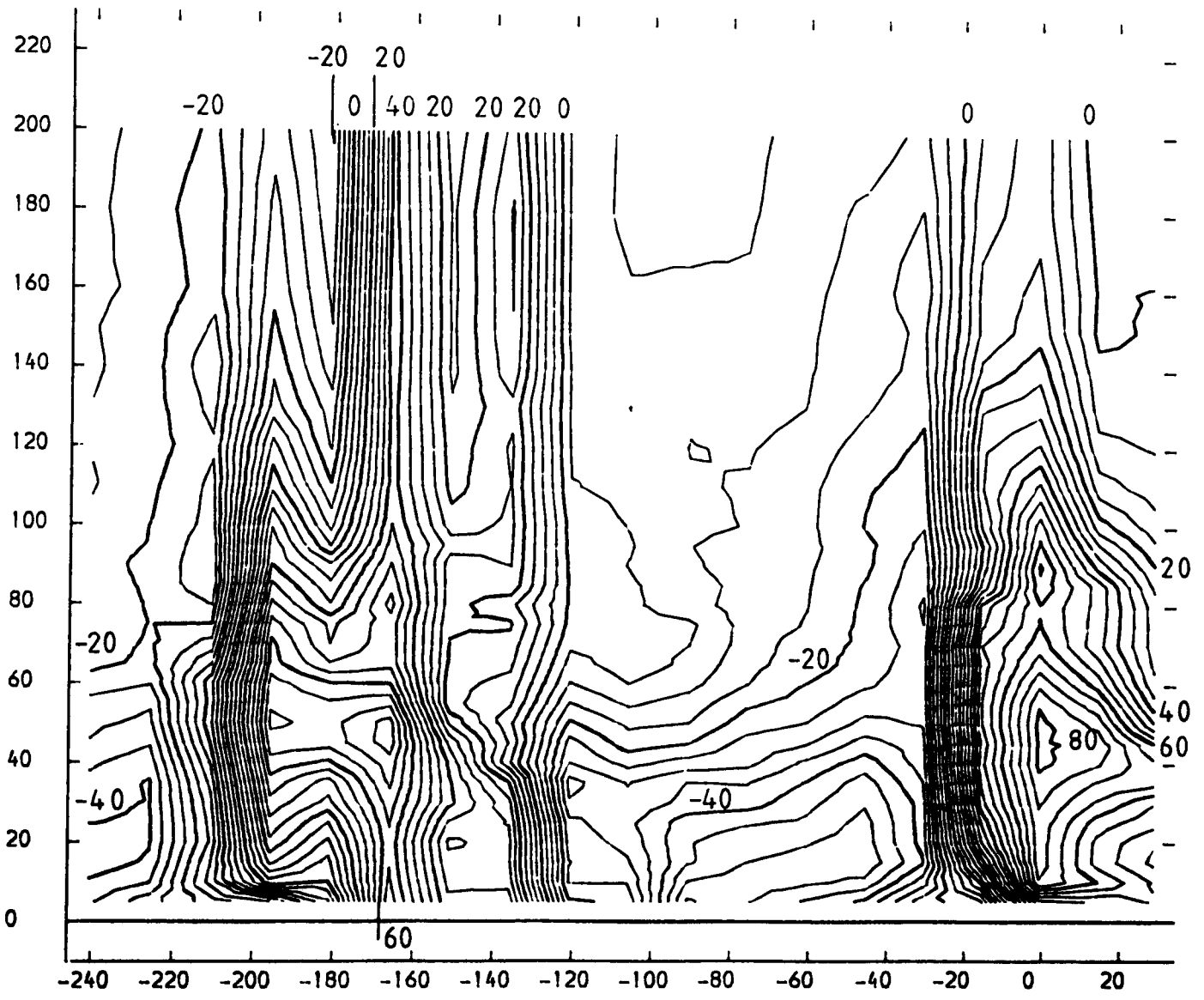


FIGURE 5.19

SLOT 8 NORMALIZED TURBULENT KINETIC ENERGY CONTOURS

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
CONTOURS NORMALIZED USING UPSTREAM REFERENCE DYNAMIC HEAD

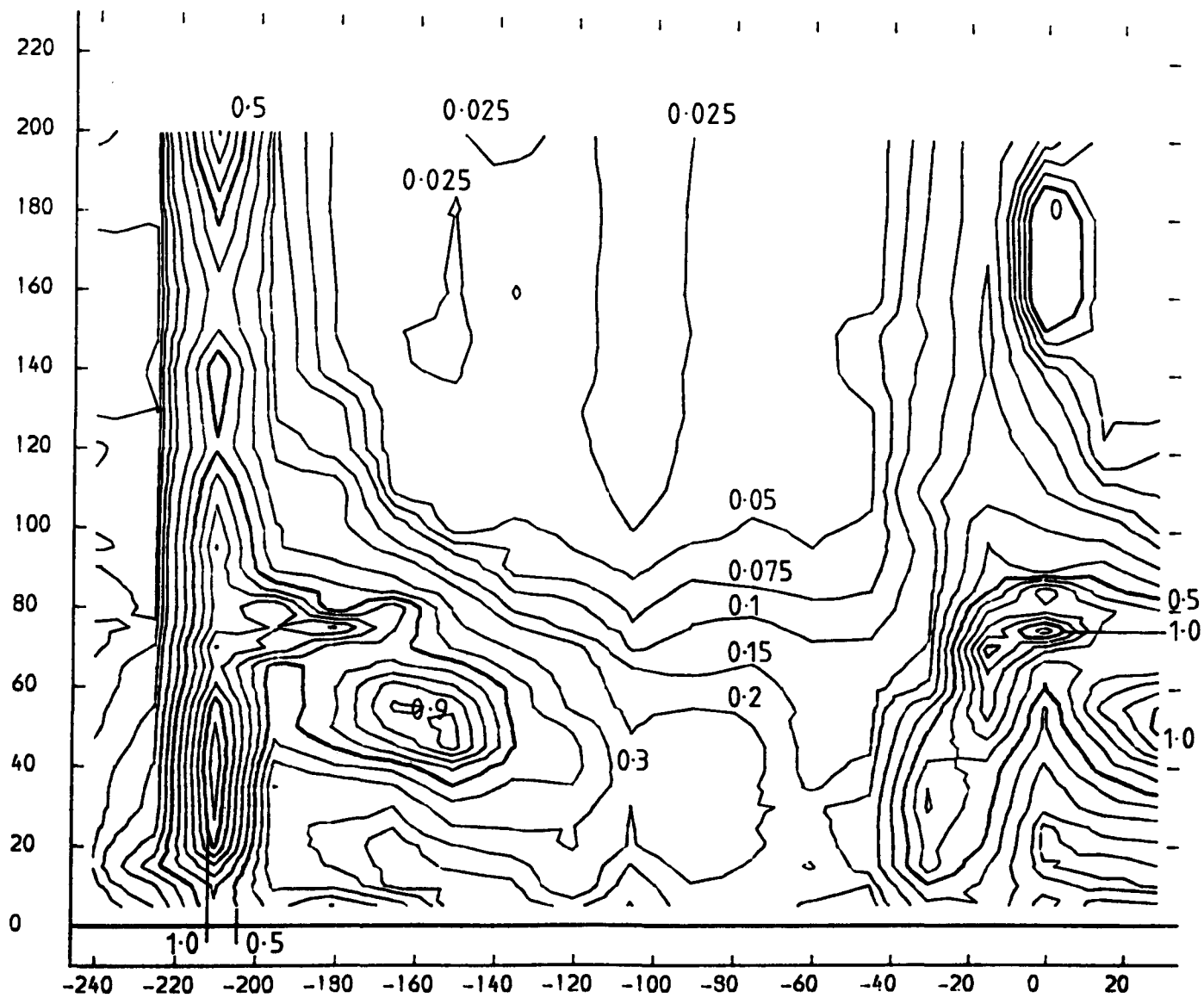


FIGURE 5.20

SLOT 8 TURBULENCE INTENSITY CONTOURS FOR U DASH

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
CONTOURS NORMALIZED USING UPSTREAM REFERENCE VELOCITY

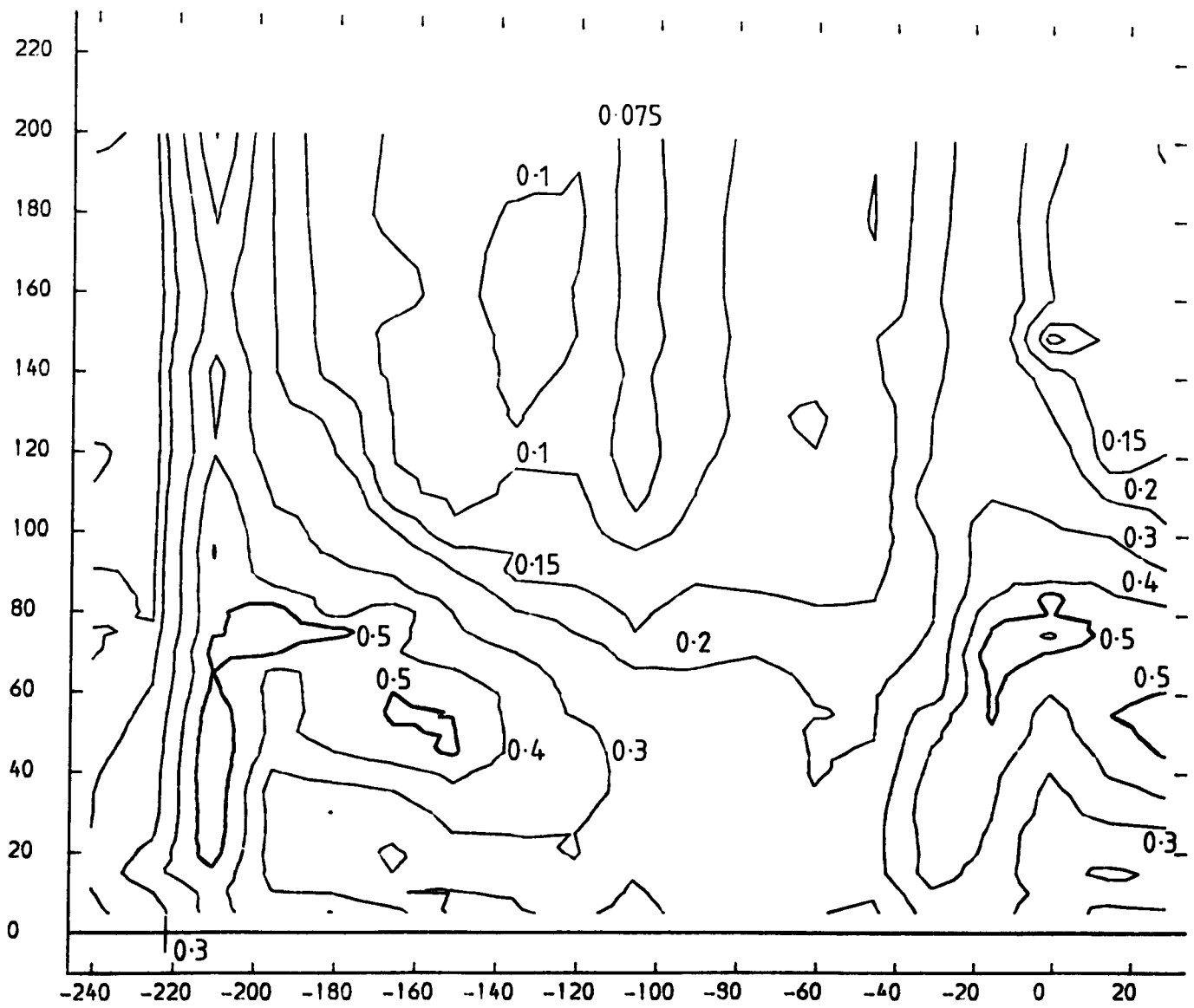


FIGURE 5.21

SLOT 8 TURBULENCE INTENSITY CONTOURS FOR V DASH

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
CONTOURS NORMALIZED USING UPSTREAM REFERENCE VELOCITY

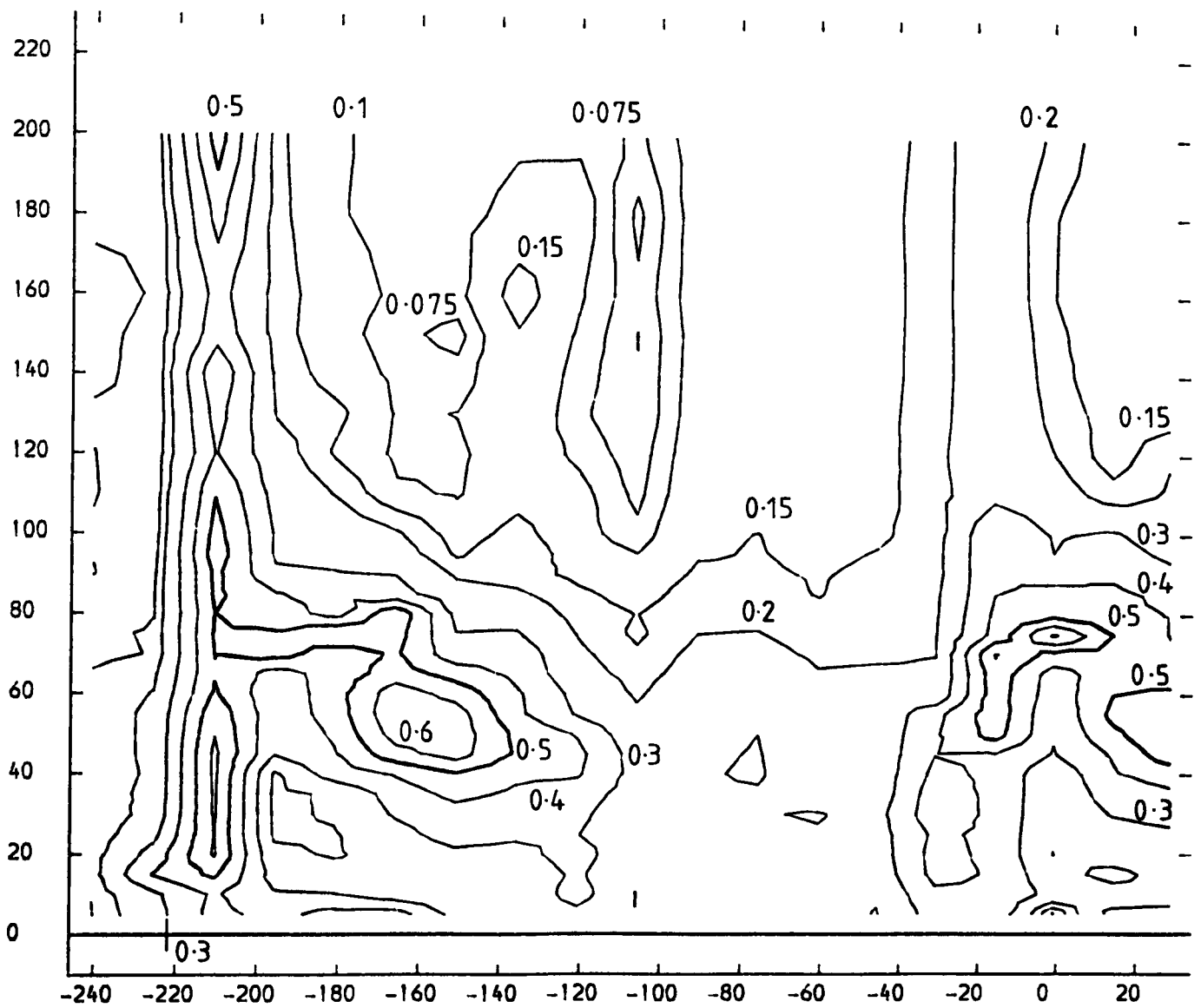


FIGURE 5.22

SLOT 8 TURBULENCE INTENSITY CONTOURS FOR W DASH

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
CONTOURS NORMALIZED USING UPSTREAM REFERENCE VELOCITY

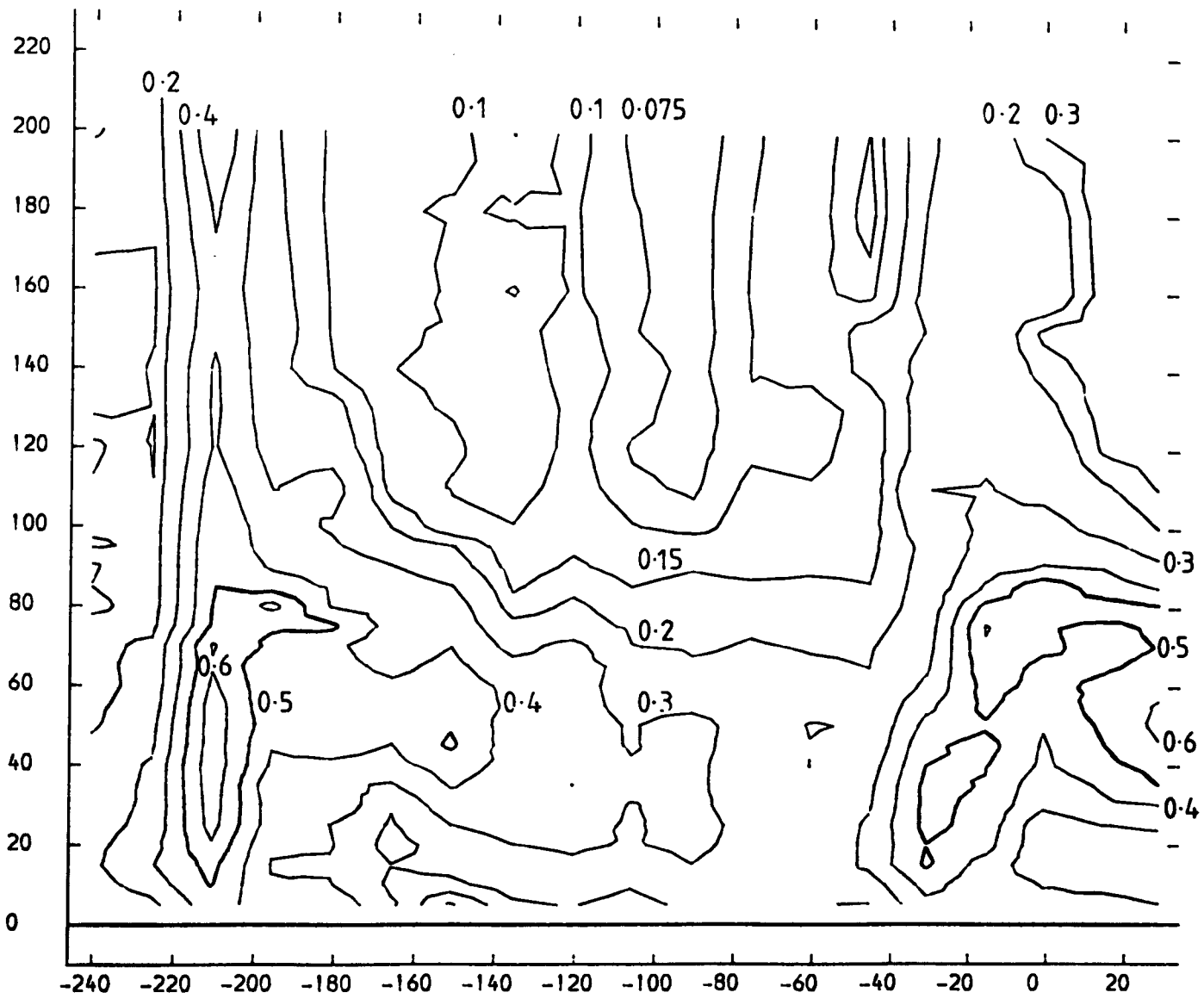


FIGURE 5.23

SLOT 8 PITCHWISE MASS MEANED RELATIVE TURBULENCE INTENSITIES
NATURAL INLET BOUNDARY LAYER

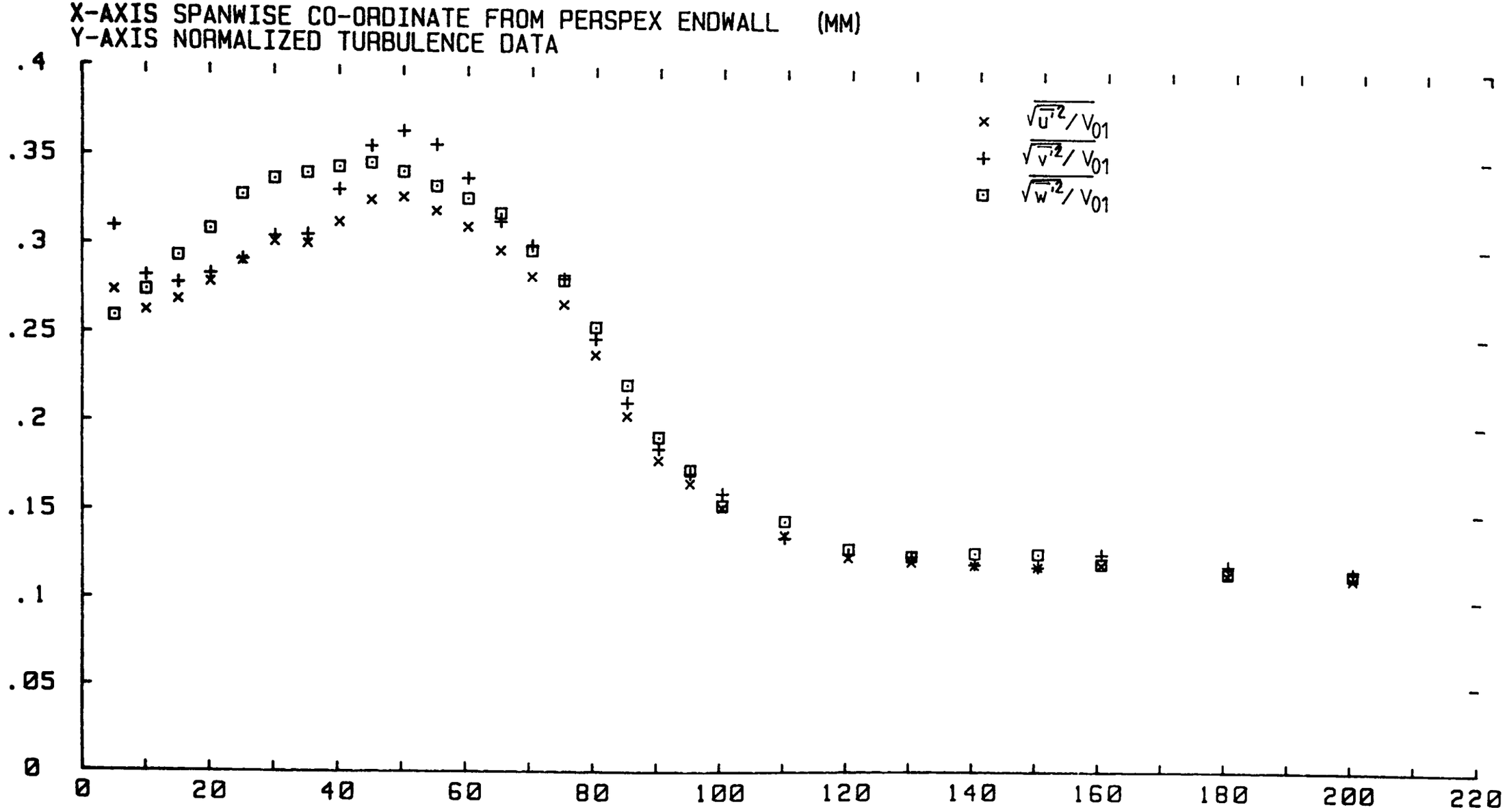


FIGURE 5.24

SLOT 8 PITCHWISE MASS MEANED RELATIVE TURBULENT KINETIC ENERGY AND TOTAL PRESSURE LOSS COEFFICIENT
NATURAL INLET BOUNDARY LAYER

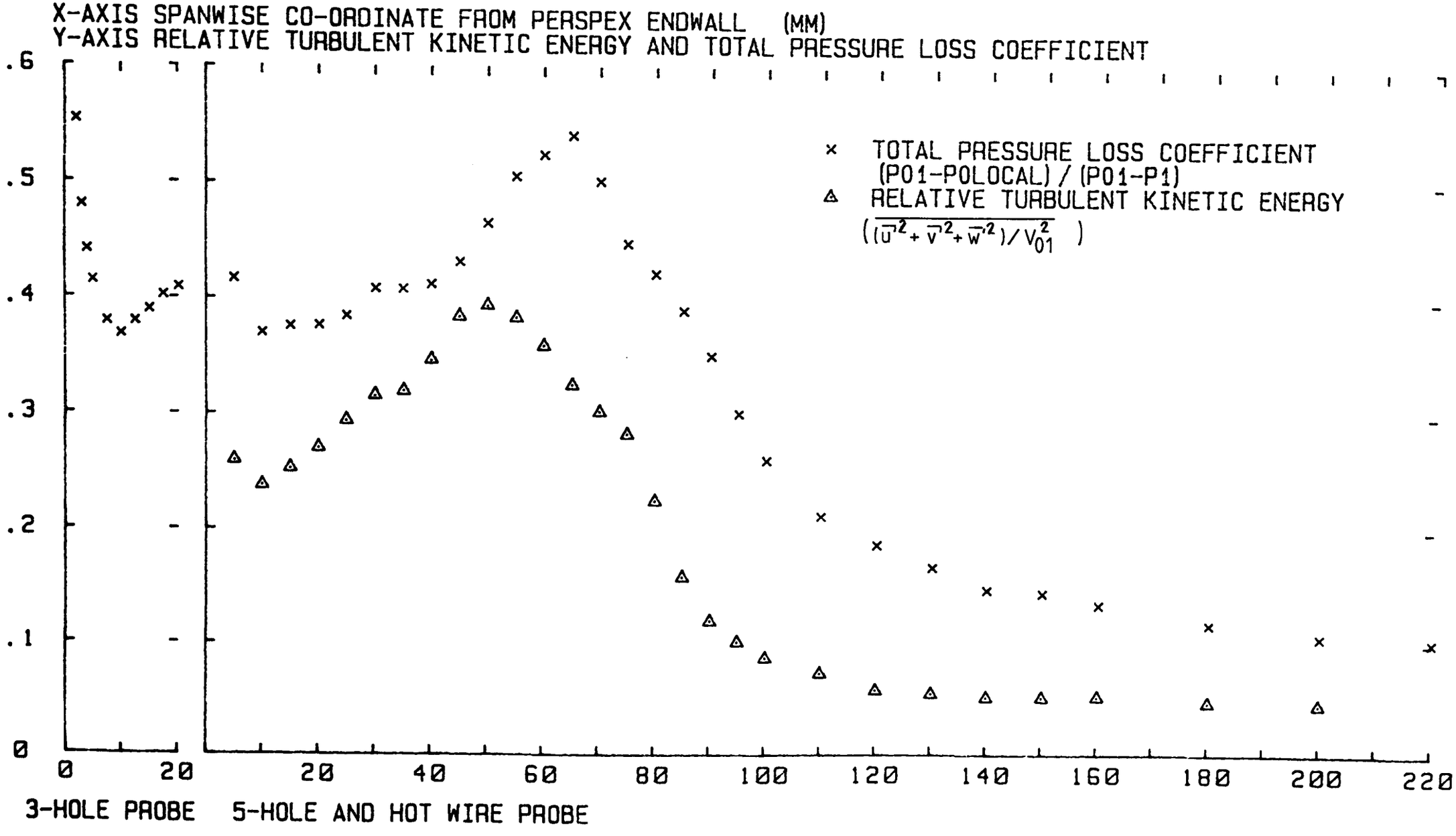


FIGURE 5.25

SLOT 8 NORMALIZED SHEAR STRESS CONTOURS (FROM UV CORRELATION)

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
CONTOURS NORMALIZED USING UPSTREAM REFERENCE DYNAMIC HEAD

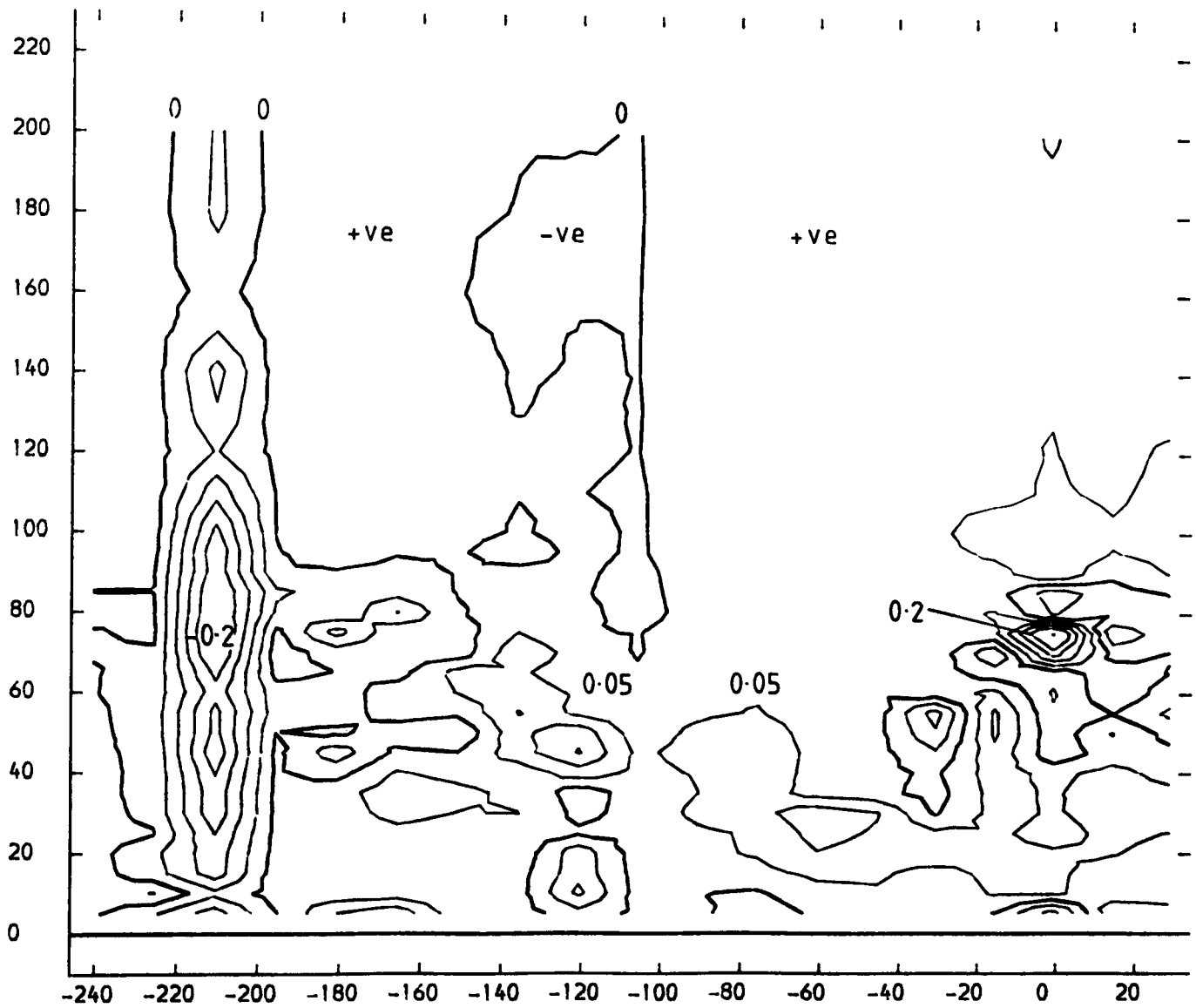


FIGURE 5.26

SLOT 8 NORMALIZED SHEAR STRESS CONTOURS (FROM UW CORRELATION)

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
CONTOURS NORMALIZED USING UPSTREAM REFERENCE DYNAMIC HEAD

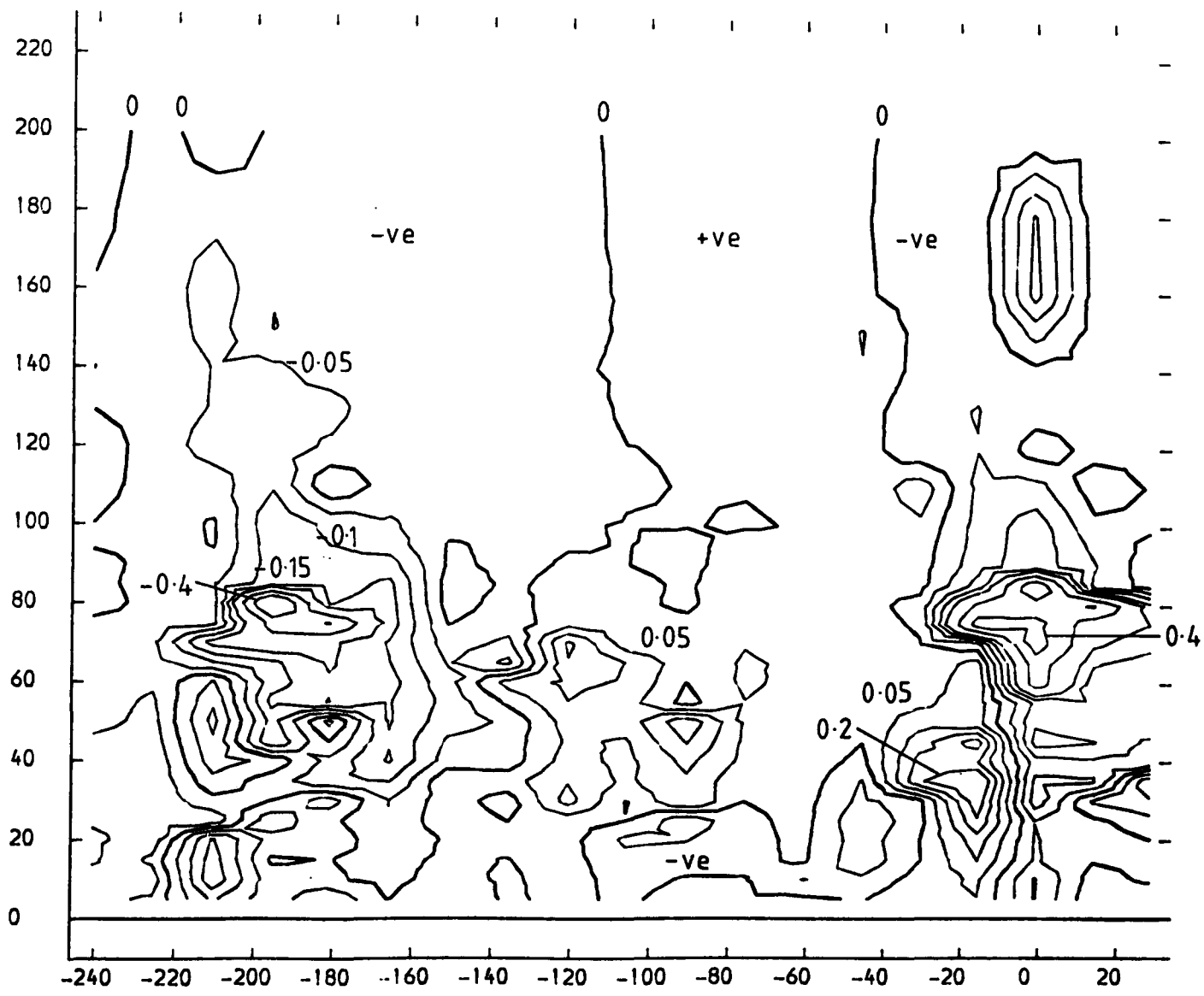


FIGURE 5.27

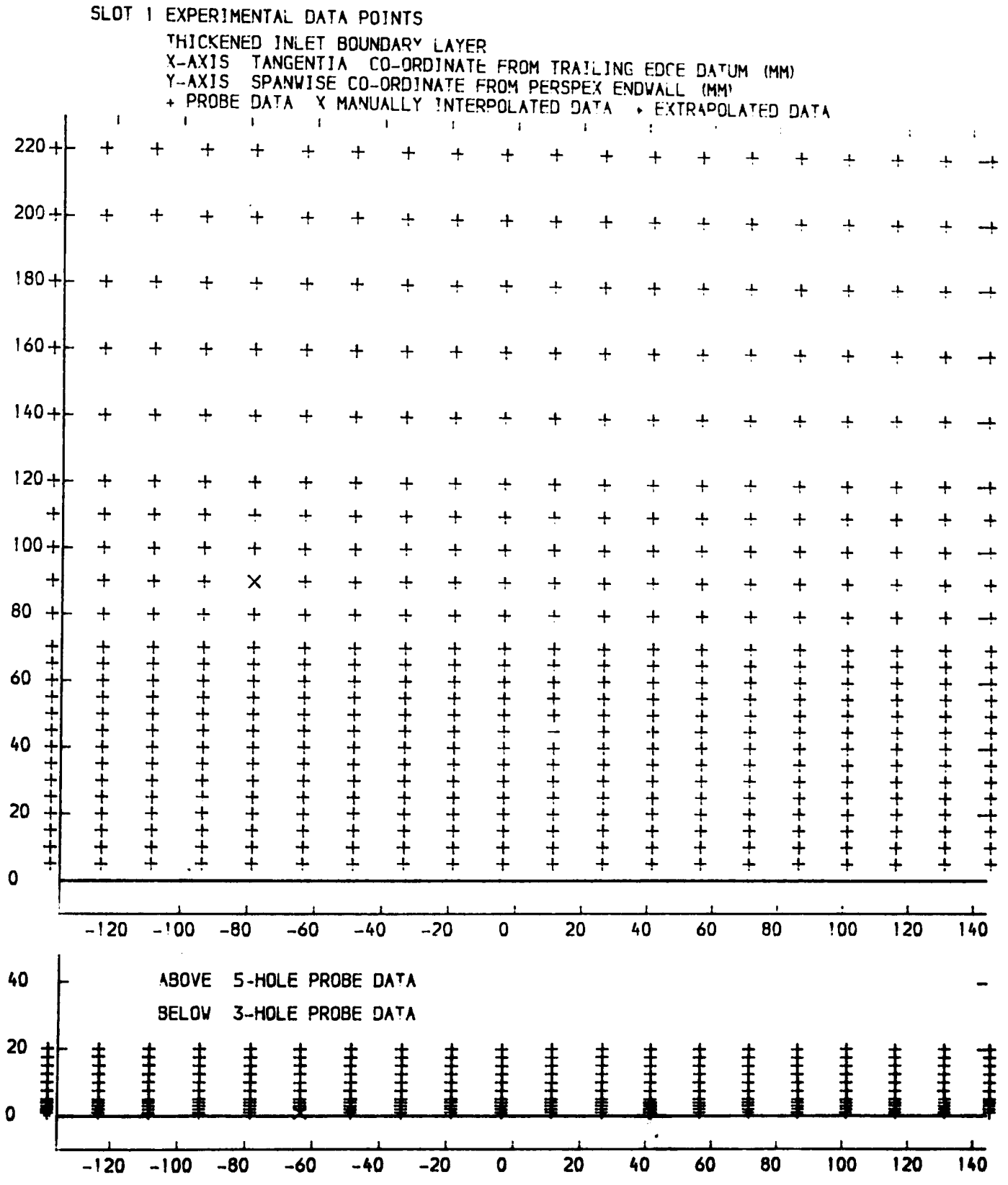

SLOT 1 EXPERIMENTAL DATA POINTS
THICKENED INLET BOUNDARY LAYER
X-AXIS TANGENTIA CO-ORDINATE FROM TRAILING EDCE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
+ PROBE DATA X MANUALLY INTERPOLATED DATA • EXTRAPOLATED DATA
220
200
180
160
140
120
100
80
60
40
20
0
-120 -100 -80 -60 -40 -20 0 20 40 60 80 100 120 140
40
20
0
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
-120 -100 -80 -60 -40 -20 0 20 40 60 80 100 120 140

FIGURE 6.1

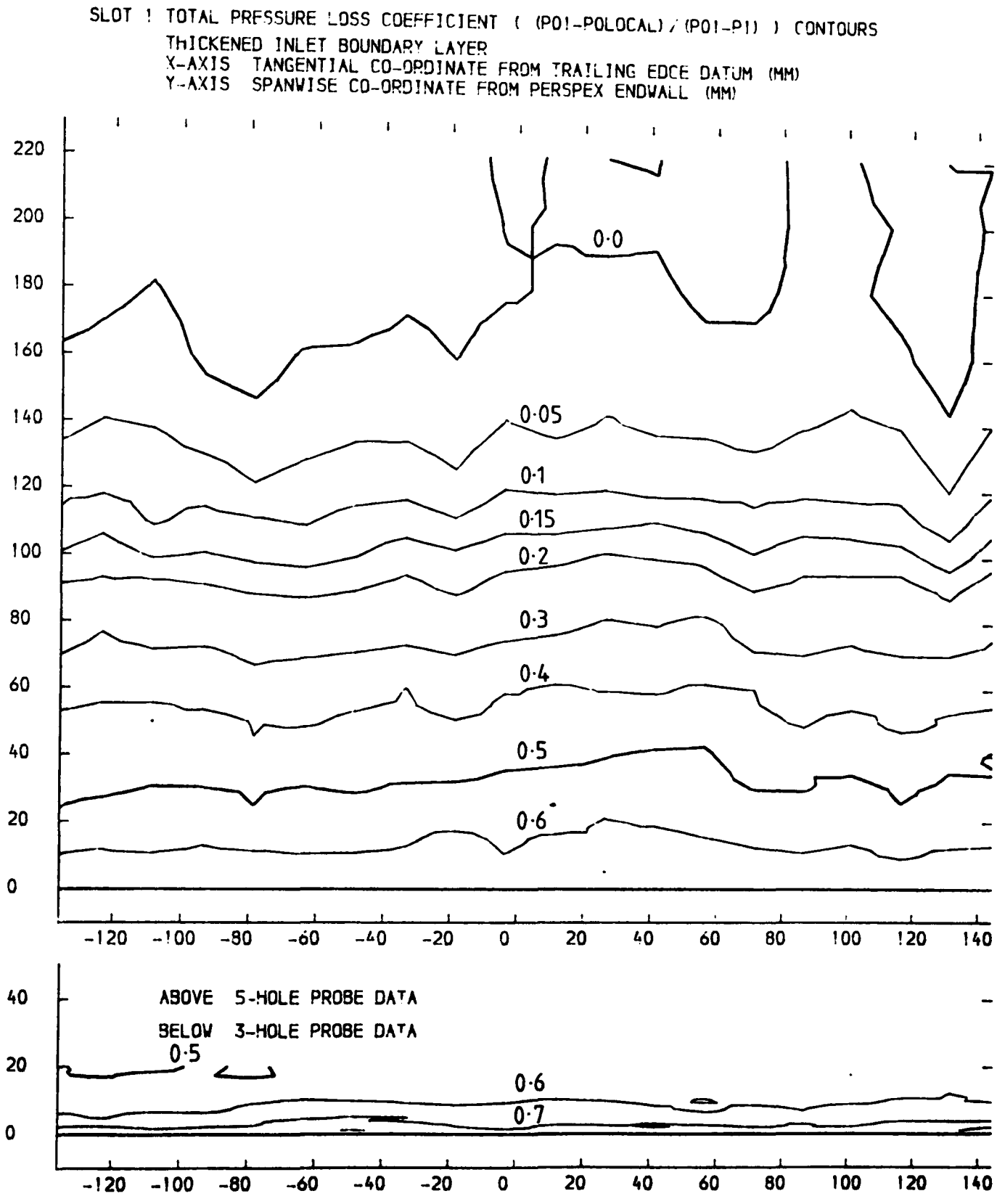

SLOT 1 TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL)/(PO1-P1)) CONTOURS
THICKENED INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
0·0
0·05
0·1
0·15
0·2
0·3
0·4
0·5
0·6
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
0·5
0·6
0·7

FIGURE 6.2

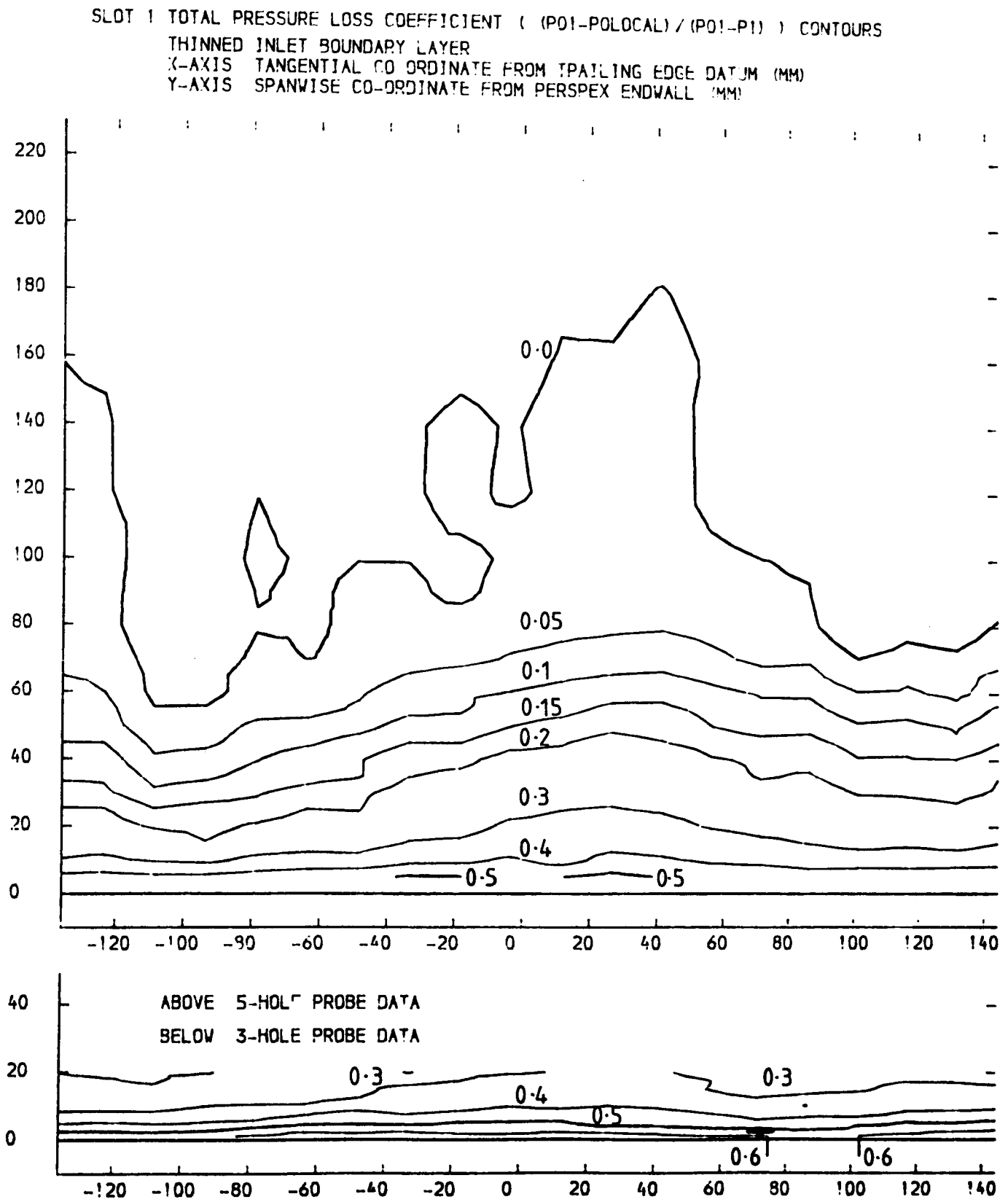
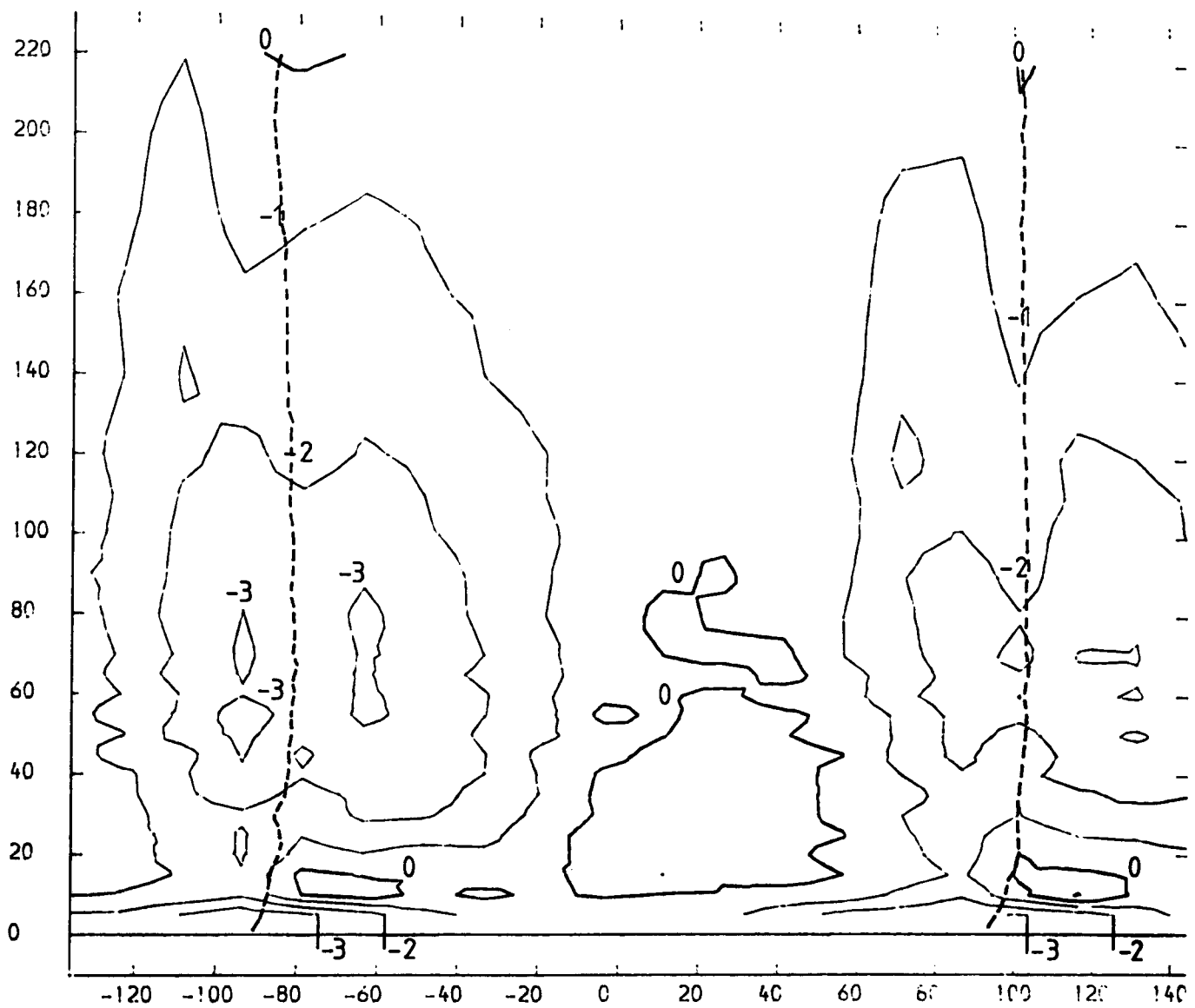

SLOT 1 TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL)/(PO1-P1)) CONTOURS
THINNED INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
0·0
0·05
0·1
0·15
0·2
0·3
0·4
0·5
0·5
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
0·3
0·4
0·5
0·3
0·6
0·6

FIGURE 6.3

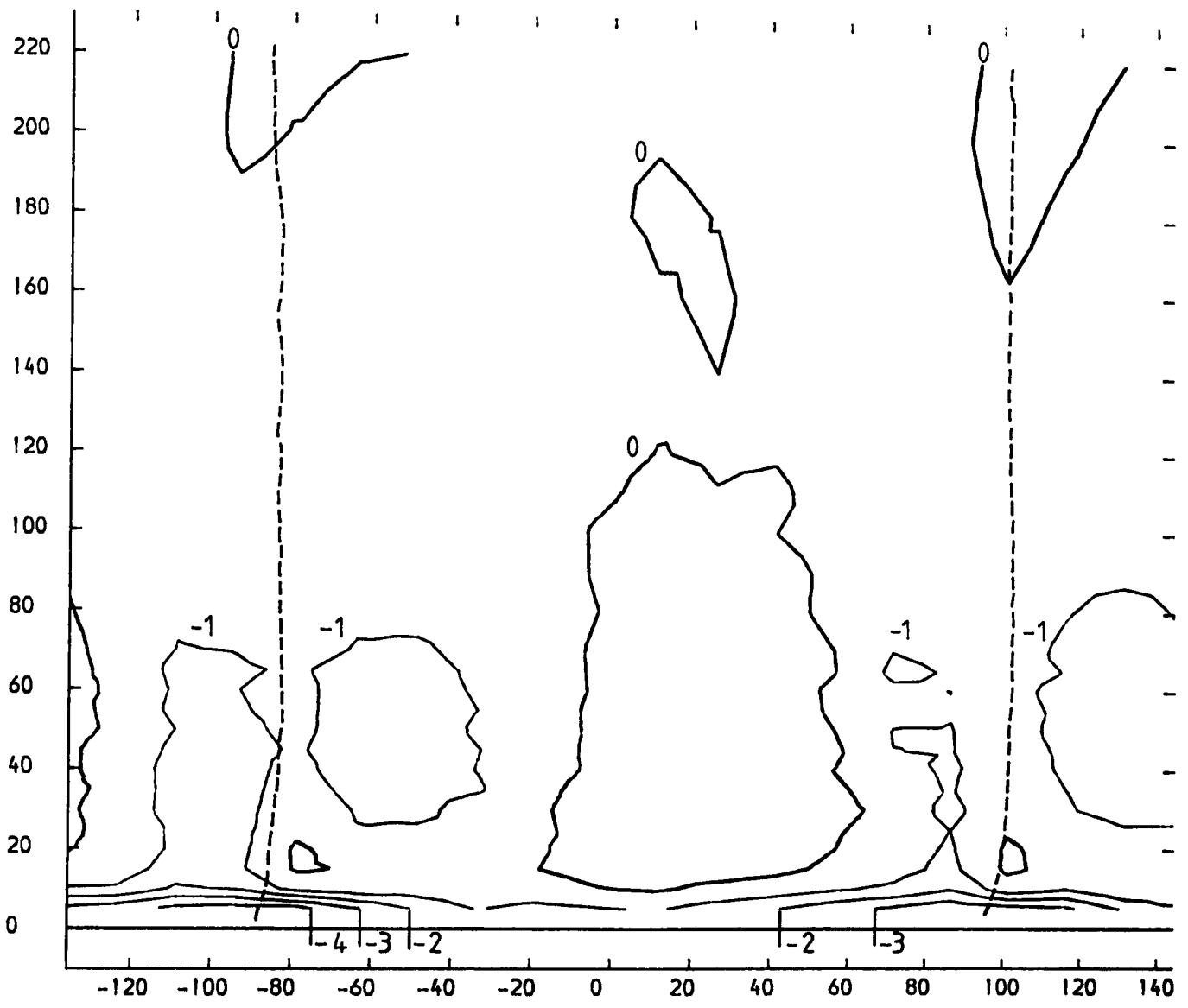
SLOT 1 STREAMWISE SPANWISE ANGLE CONTOURS (CONTOUR UNITS DEGREES)
THICKENED INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)



----- 44° YAW ANGLE CONTOUR

FIGURE 6.4

SLOT 1 STREAMWISE SPANWISE ANGLE CONTOURS (CONTOUR UNITS DEGREES)
THINNED INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)



------ 44° YAW ANGLE CONTOUR

FIGURE 6.5

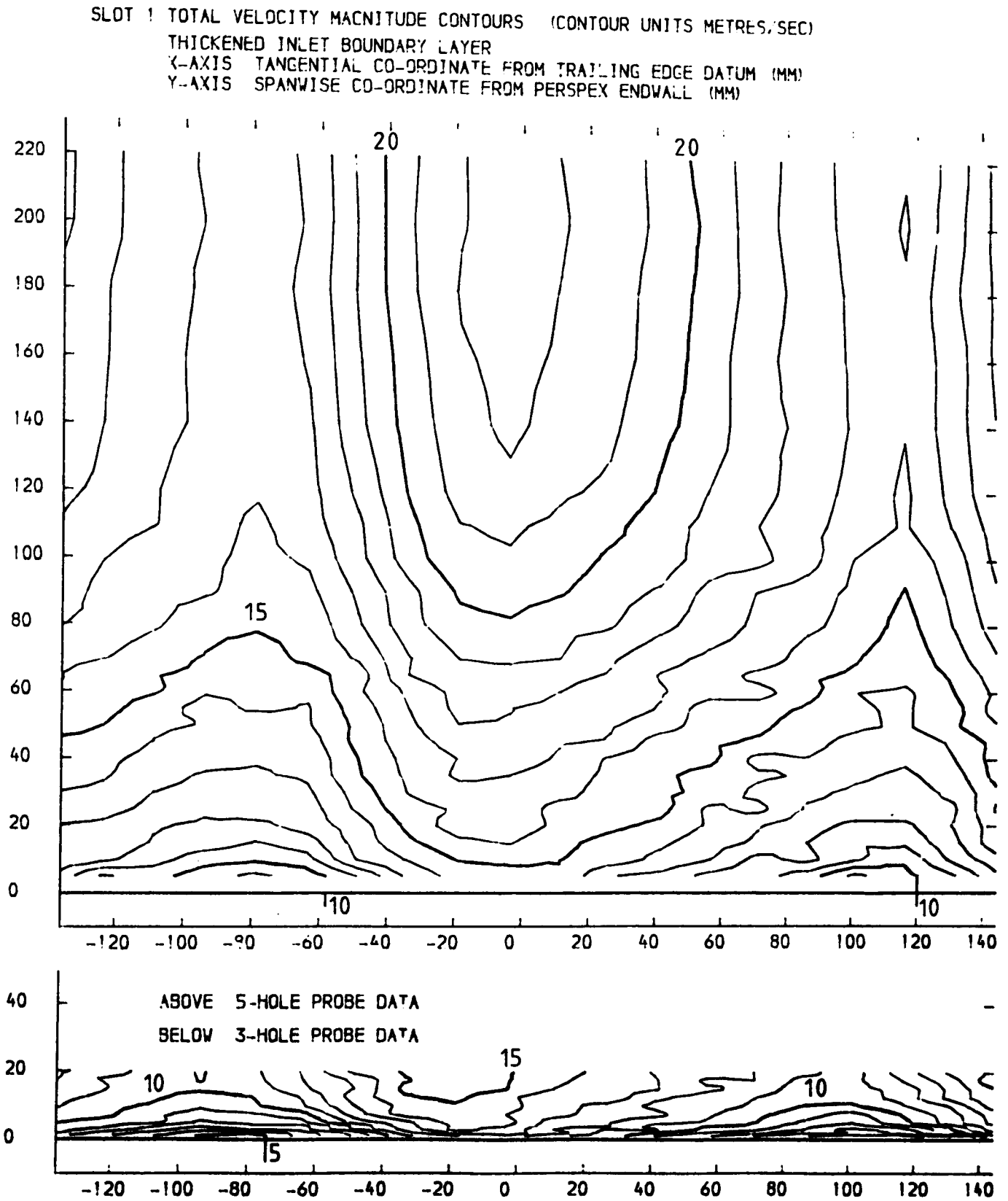

SLOT 1 TOTAL VELOCITY MAGNITUDE CONTOURS (CONTOUR UNITS METRES/SEC)
THICKENED INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
20
20
15
10
10
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
15
10
10
15

FIGURE 6.6

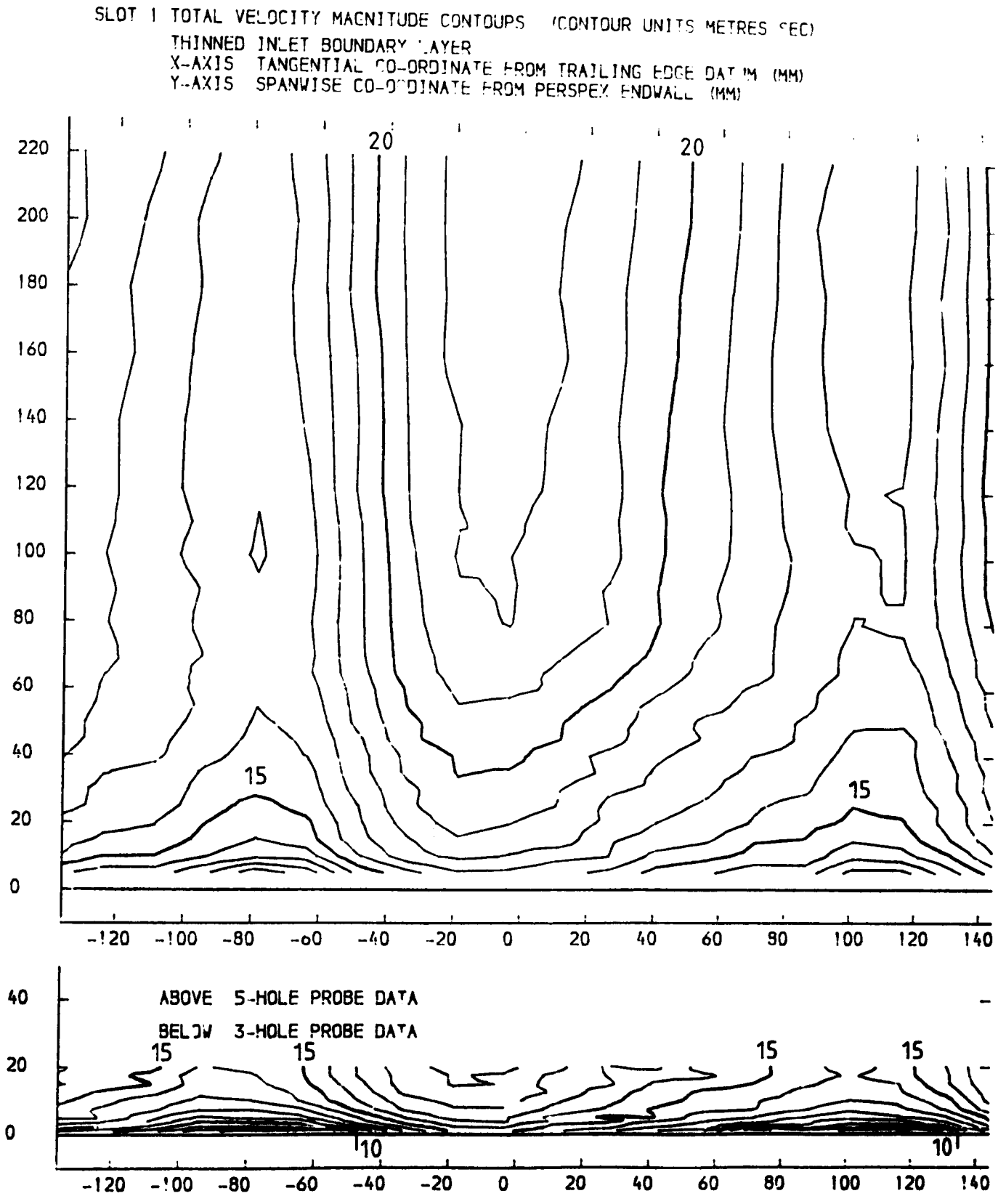

SLOT 1 TOTAL VELOCITY MAGNITUDE CONTOURS (CONTOUR UNITS METRES SEC)
THINNED INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA

FIGURE 6.7

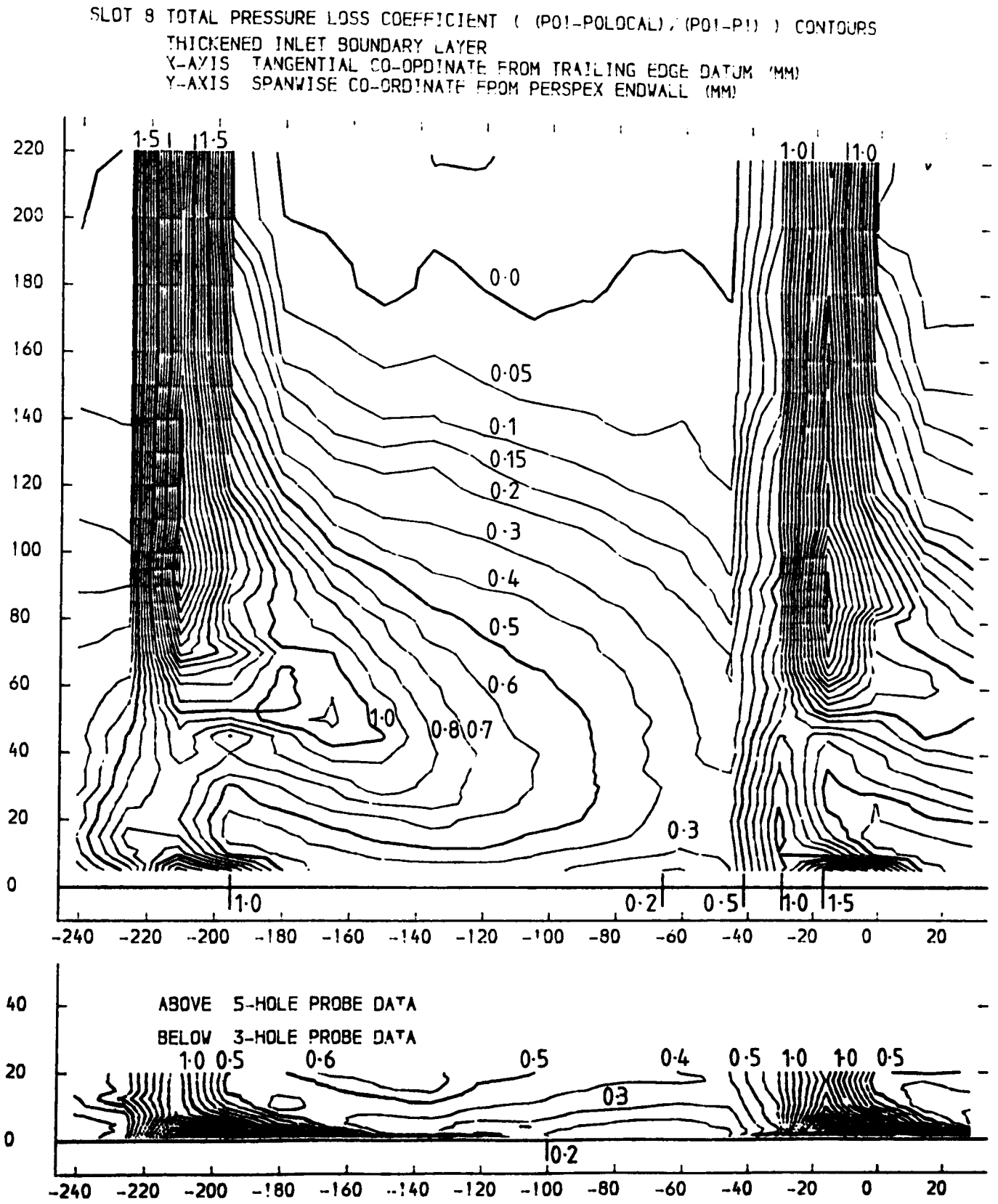

SLOT 8 TOTAL PRESSURE LOSS COEFFICIENT ((P01-POLOCAL)/(P01-P1)) CONTOURS
THICKENED INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA

FIGURE 6.8

SLOT 8 TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL)/(PO1-P1)) CONTOURS
THINNED INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

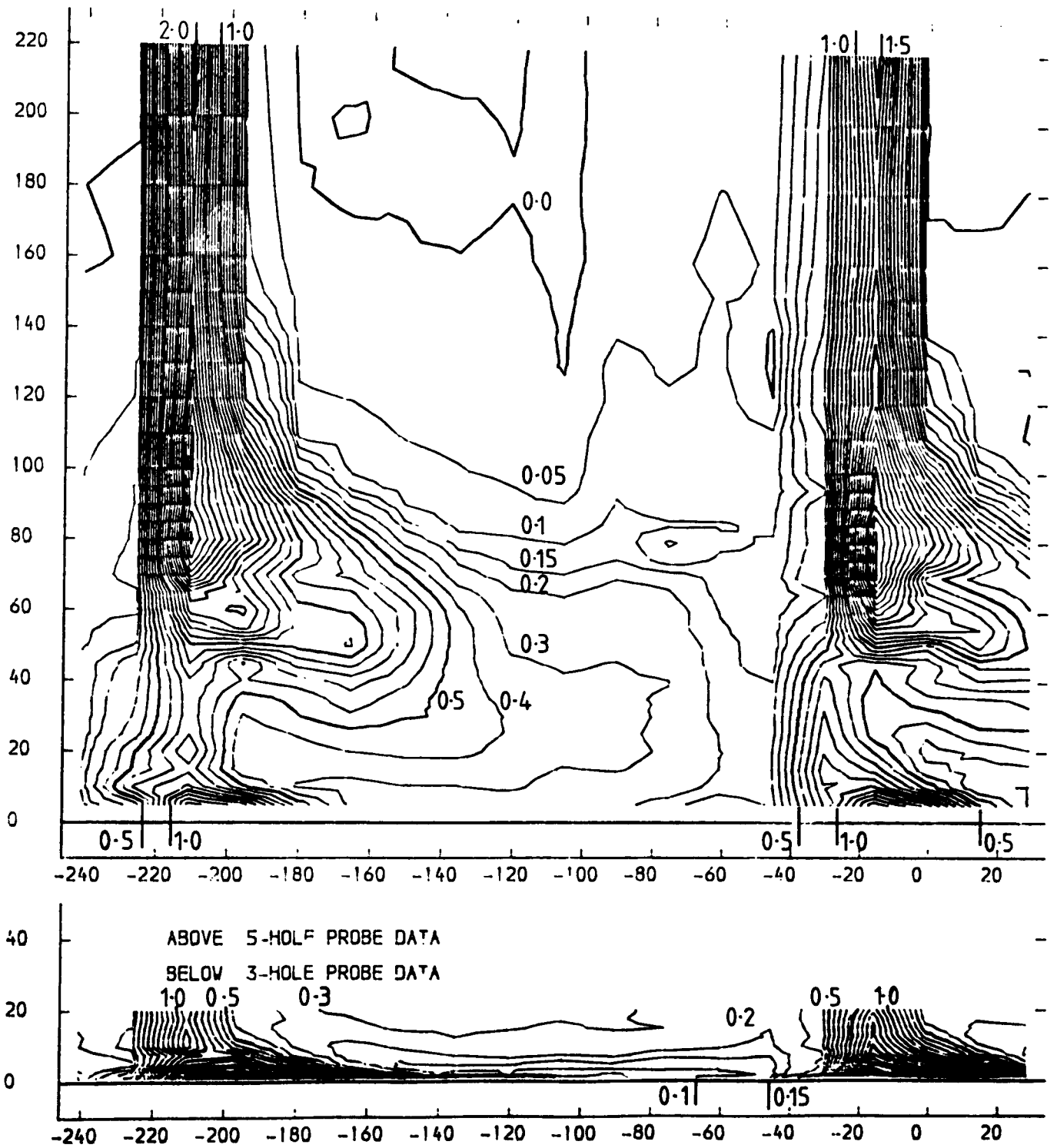
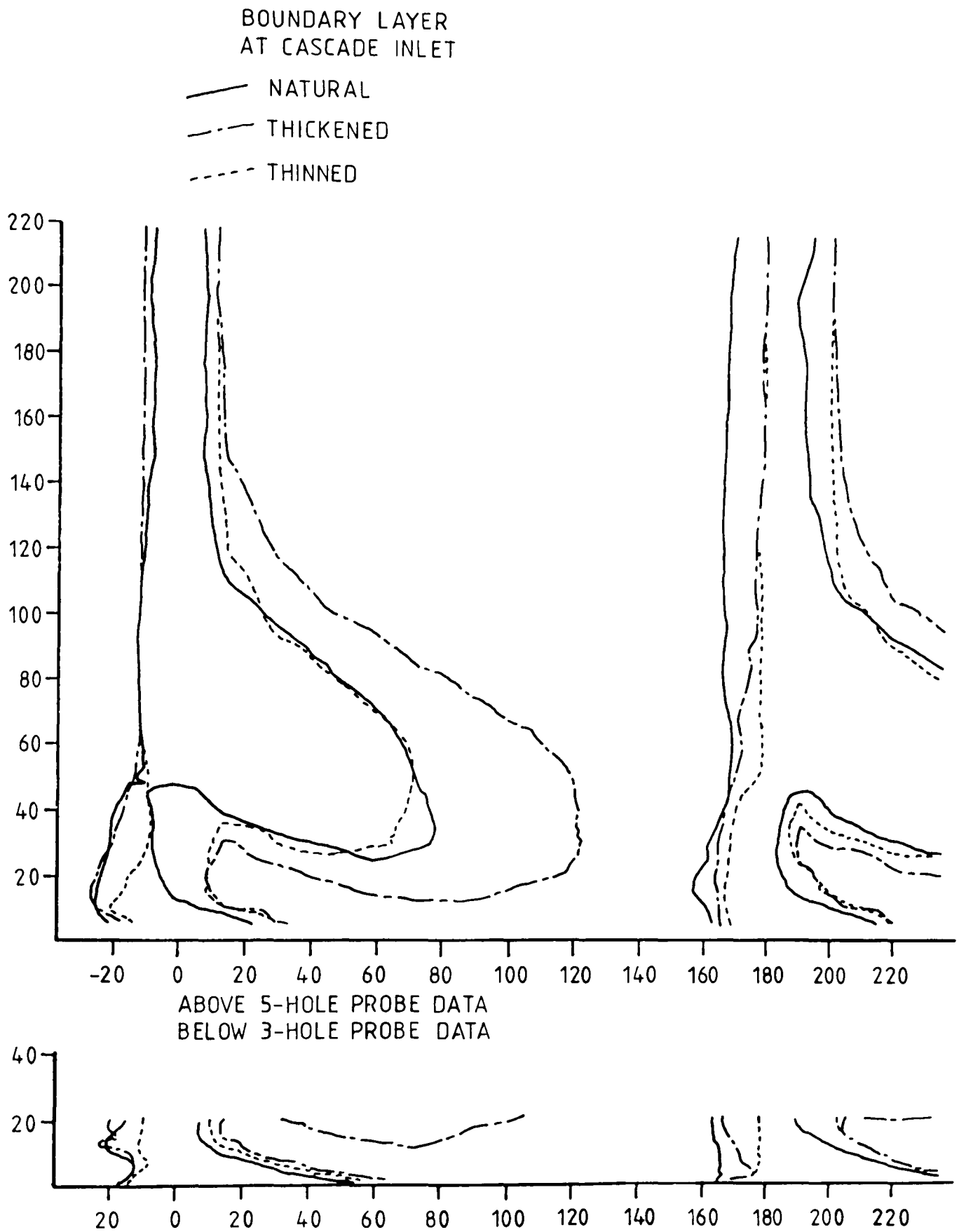


FIGURE 6.9

SLOT 8 COMPARISON OF THE THREE INLET BOUNDARY LAYER LOSS CORES

X-AXIS TANGENTIAL CO-ORDINATE FROM WAKE CENTRE-LINE (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)



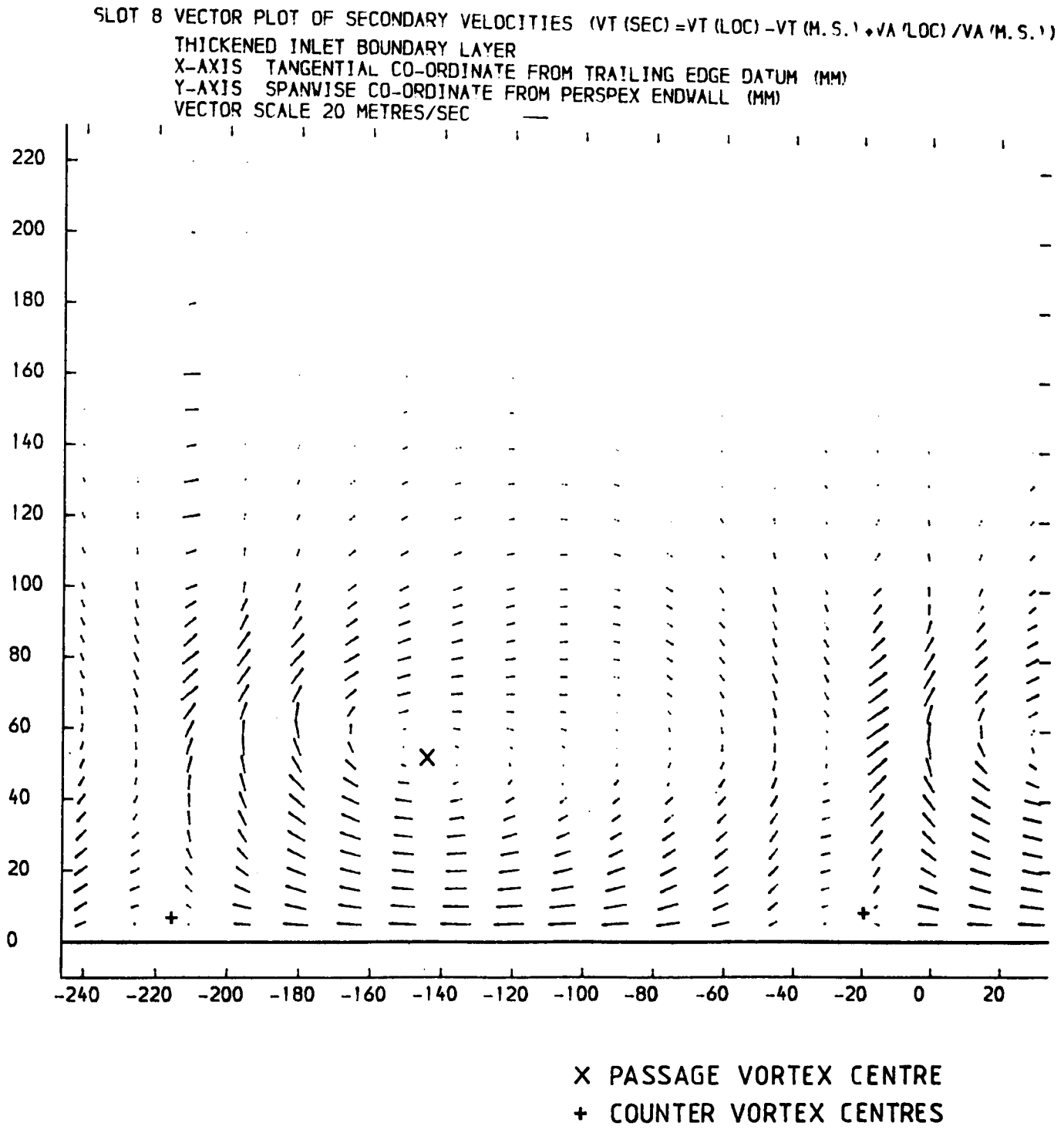
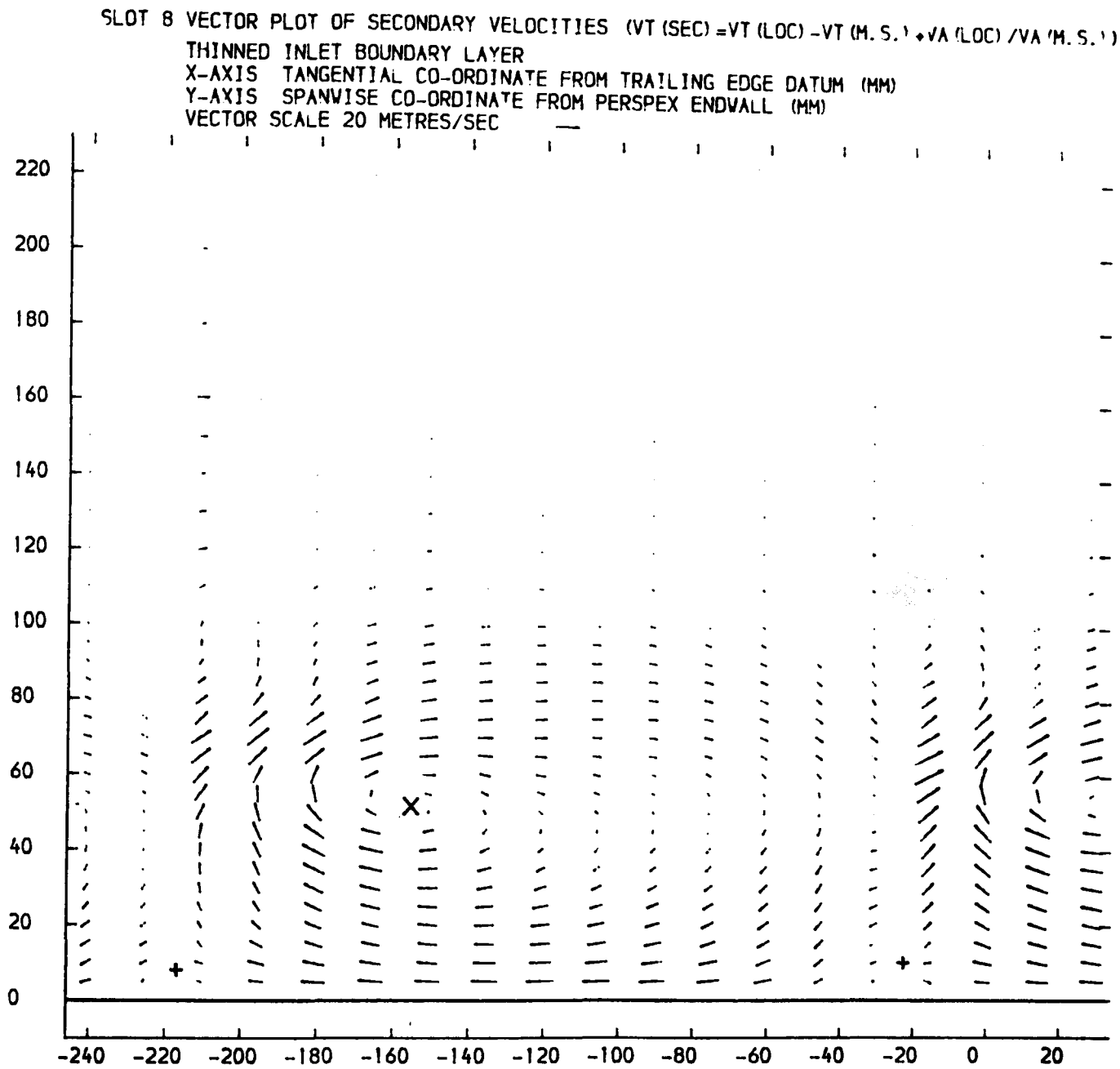

SLOT 8 VECTOR PLOT OF SECONDARY VELOCITIES (VT(SEC)=VT(LOC)-VT(M.S.)+VA(LOC)/VA(M.S.))
THICKENED INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
VECTOR SCALE 20 METRES/SEC
220
200
180
160
140
120
100
80
60
40
20
0
-240
-220
-200
-180
-160
-140
-120
-100
-80
-60
-40
-20
0
20
X PASSAGE VORTEX CENTRE
+ COUNTER VORTEX CENTRES

FIGURE 6.11



X PASSAGE VORTEX CENTRE

+ COUNTER VORTEX CENTRES

FIGURE 6.12

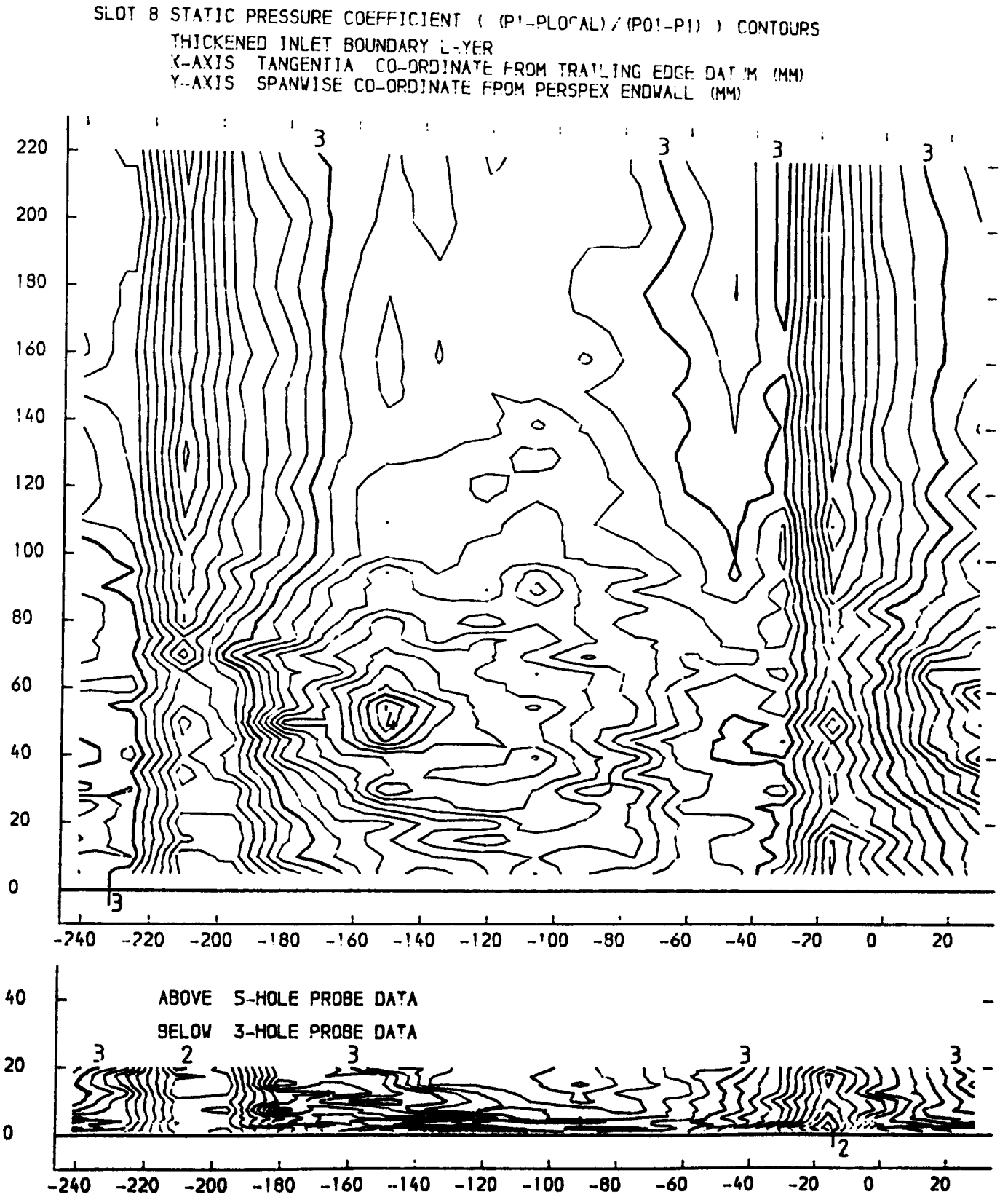

SLOT 8 STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(PO1-P1)) CONTOURS
THICKENED INLET BOUNDARY LAYER
X-AXIS TANGENTIA CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA

FIGURE 6.13

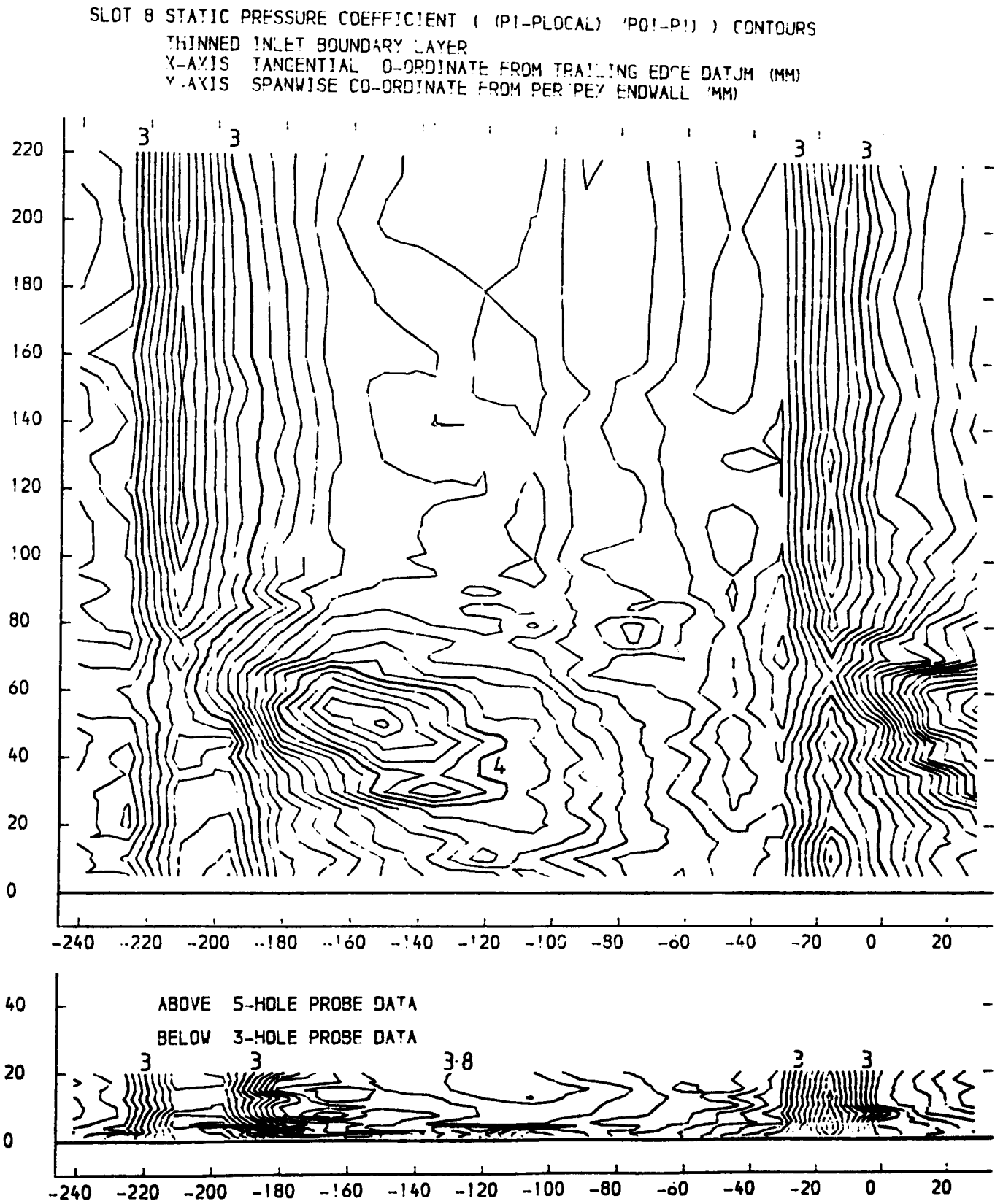

SLOT 8 STATIC PRESSURE COEFFICIENT ((P1-PLOCAL) /(P01-P1)) CONTOURS
THINNED INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA

FIGURE 6.14

SLOT 10 EXPERIMENTAL DATA POINTS

THICKENED INLET BOUNDARY LAYER

X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

+ PROBE DATA X MANUALLY INTERPOLATED DATA + EXTRAPOLATED DATA

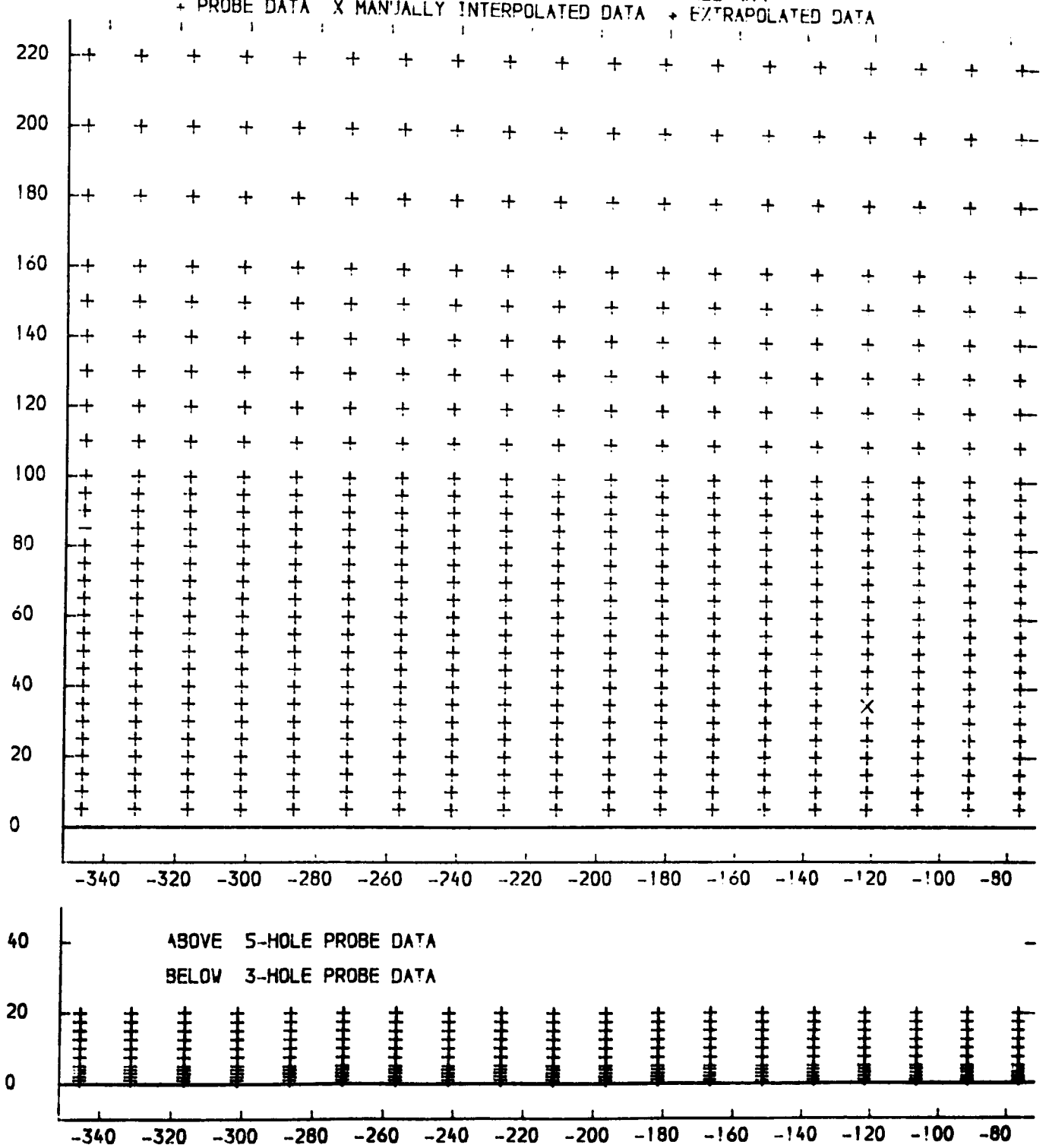


FIGURE 6.15

SLOT 10 TOTAL PRESSURE LOSS COEFFICIENT ((PO1-POLOCAL) / (PO1-P1)) CONTOURS
THICKENED INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

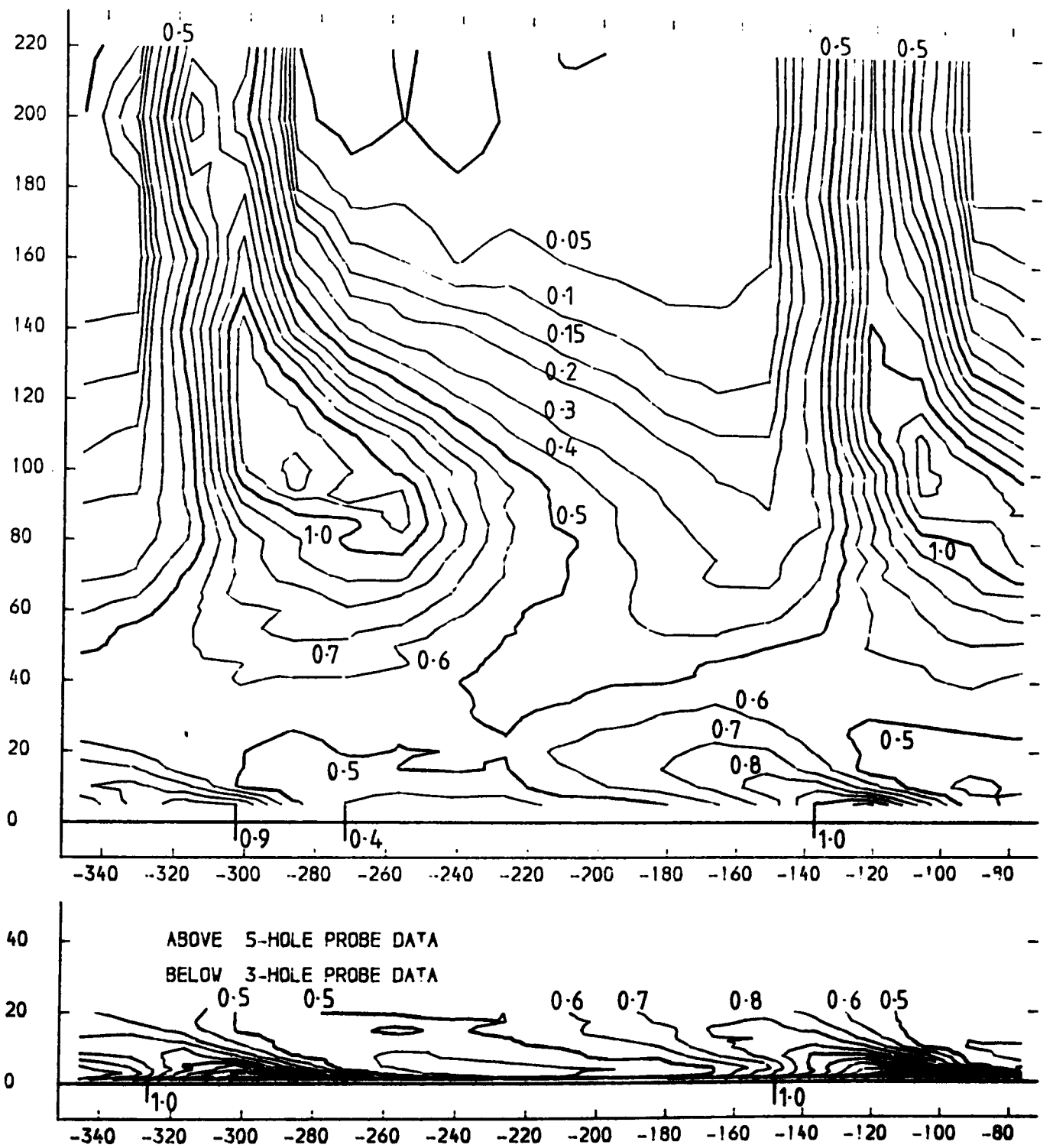


FIGURE 6.16

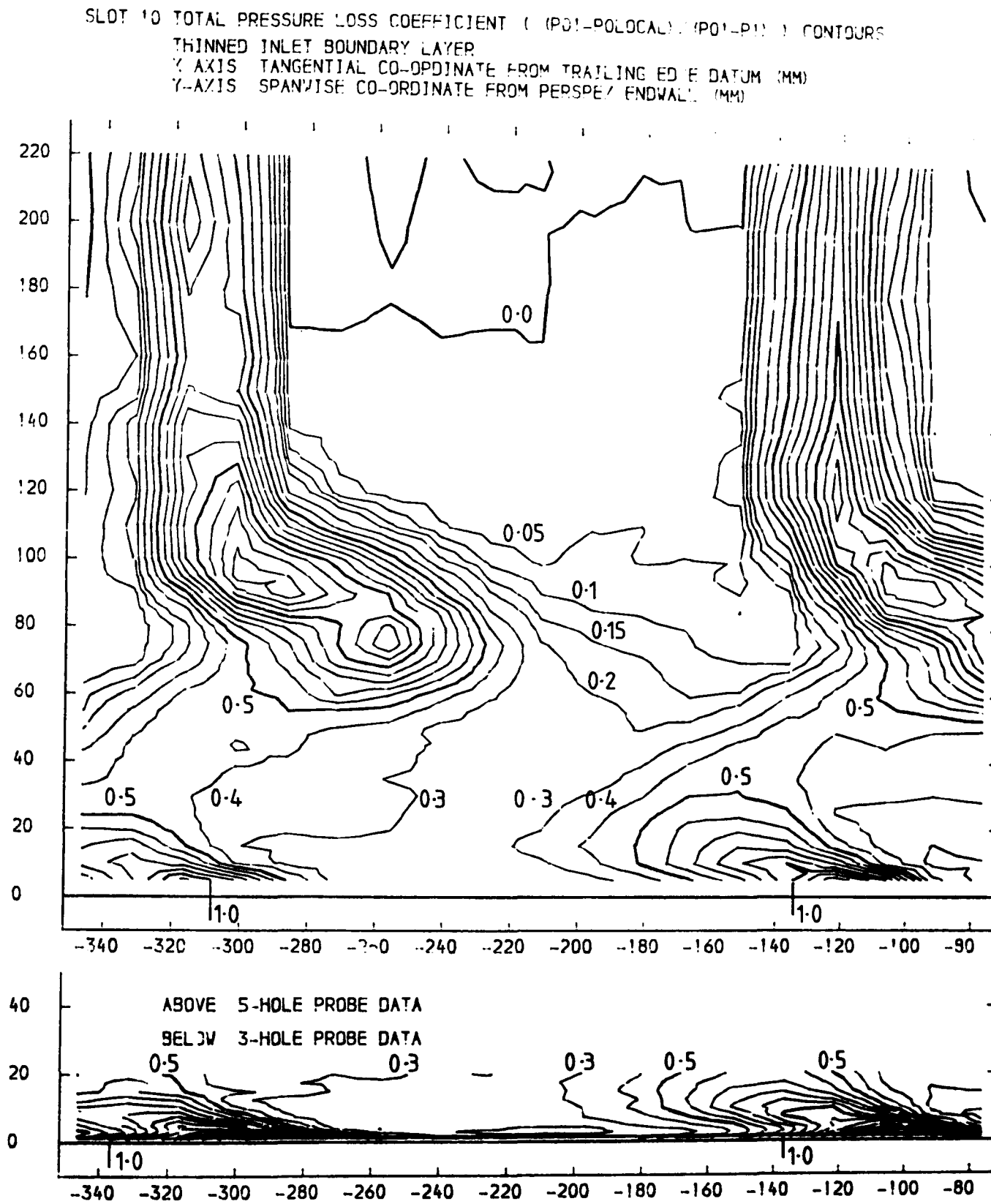

SLOT 10 TOTAL PRESSURE LOSS COEFFICIENT ((P01-P0LOCAL) / (P01-P1)) CONTOURS
THINNED INLET BOUNDARY LAYER
X AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
0·0
0·05
0·1
0·15
0·2
0·3
0·4
0·5
1·0
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA

FIGURE 6.17

SLOT 10 COMPARISON OF THE THREE INLET BOUNDARY LAYER LOSS CORES

X-AXIS TANGENTIAL CO-ORDINATE FROM WAKE CENTRE-LINE (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)

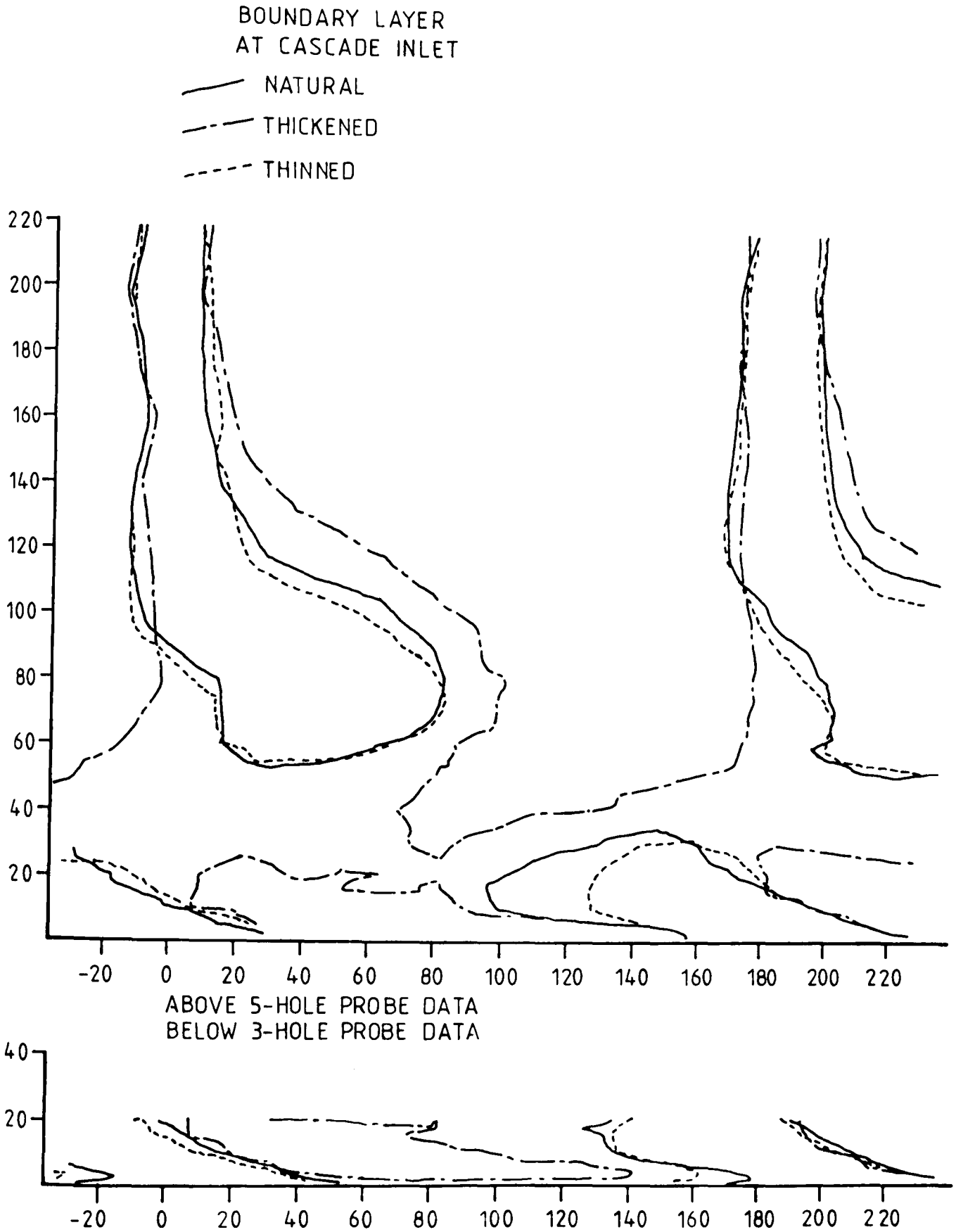
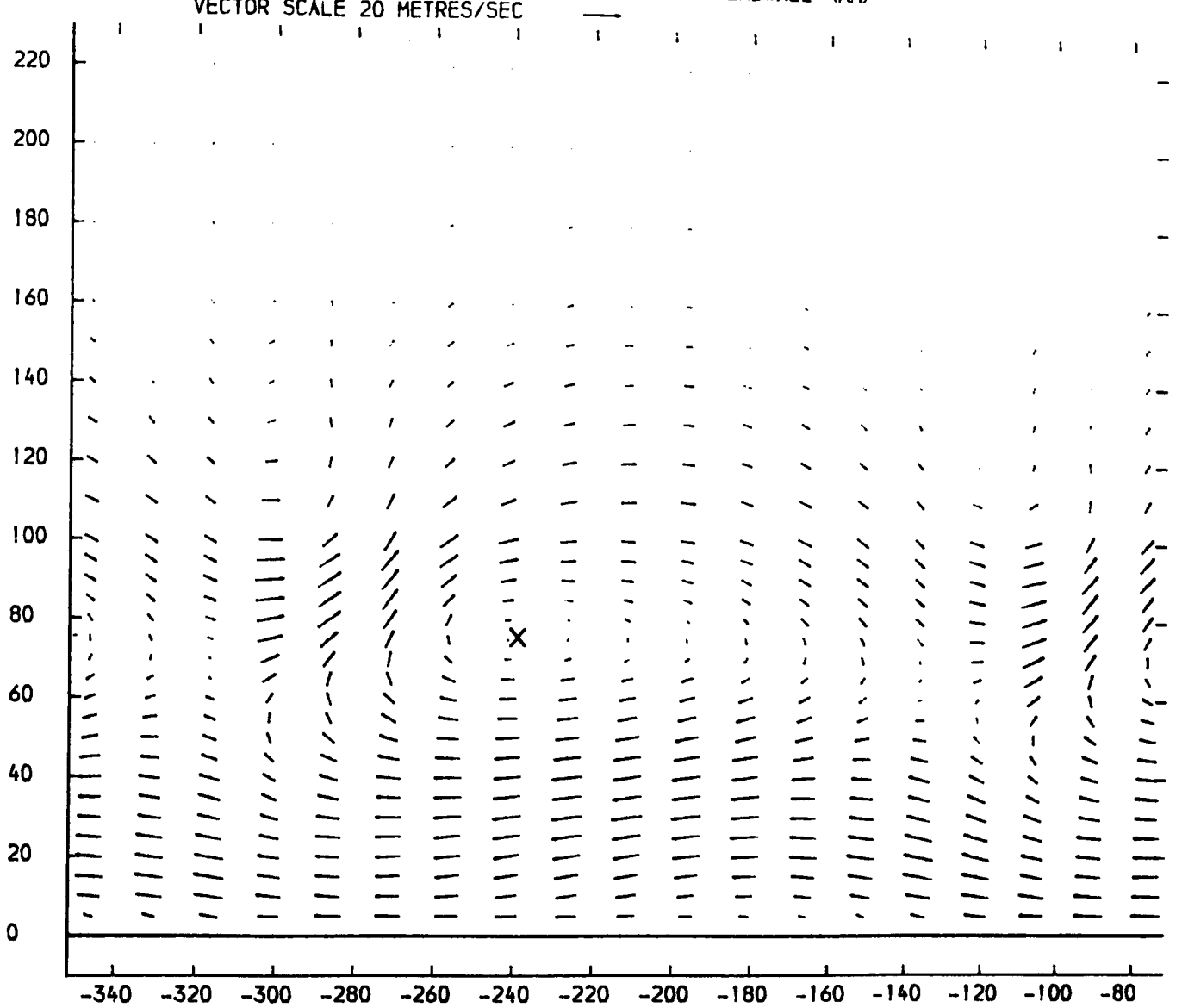


FIGURE 6.18

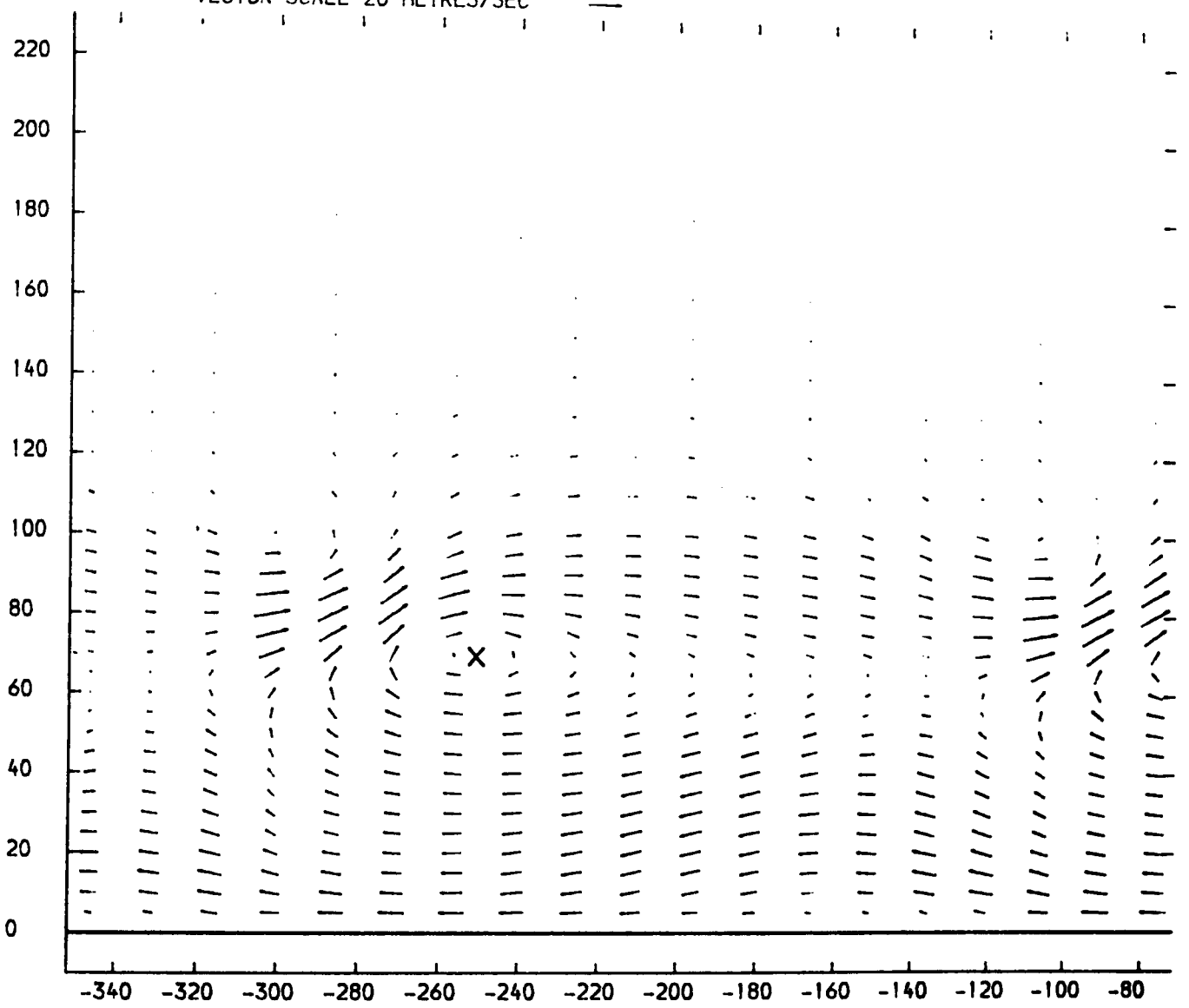
SLOT 10 VECTOR PLOT OF SECONDARY VELOCITIES (VT (SEC) =VT (LOC) -VT (M.S.) +VA (LOC) /VA (M.S.))
THICKENED INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
VECTOR SCALE 20 METRES/SEC



X PASSAGE VORTEX CENTRE

FIGURE 6.19

SLOT 10 VECTOR PLOT OF SECONDARY VELOCITIES (VT(SEC)=VT(LOC)-VT(M.S.)+VA(LOC)/VA(M.S.))
THINNED INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
VECTOR SCALE 20 METRES/SEC



X PASSAGE VORTEX CENTRE

FIGURE 6.20

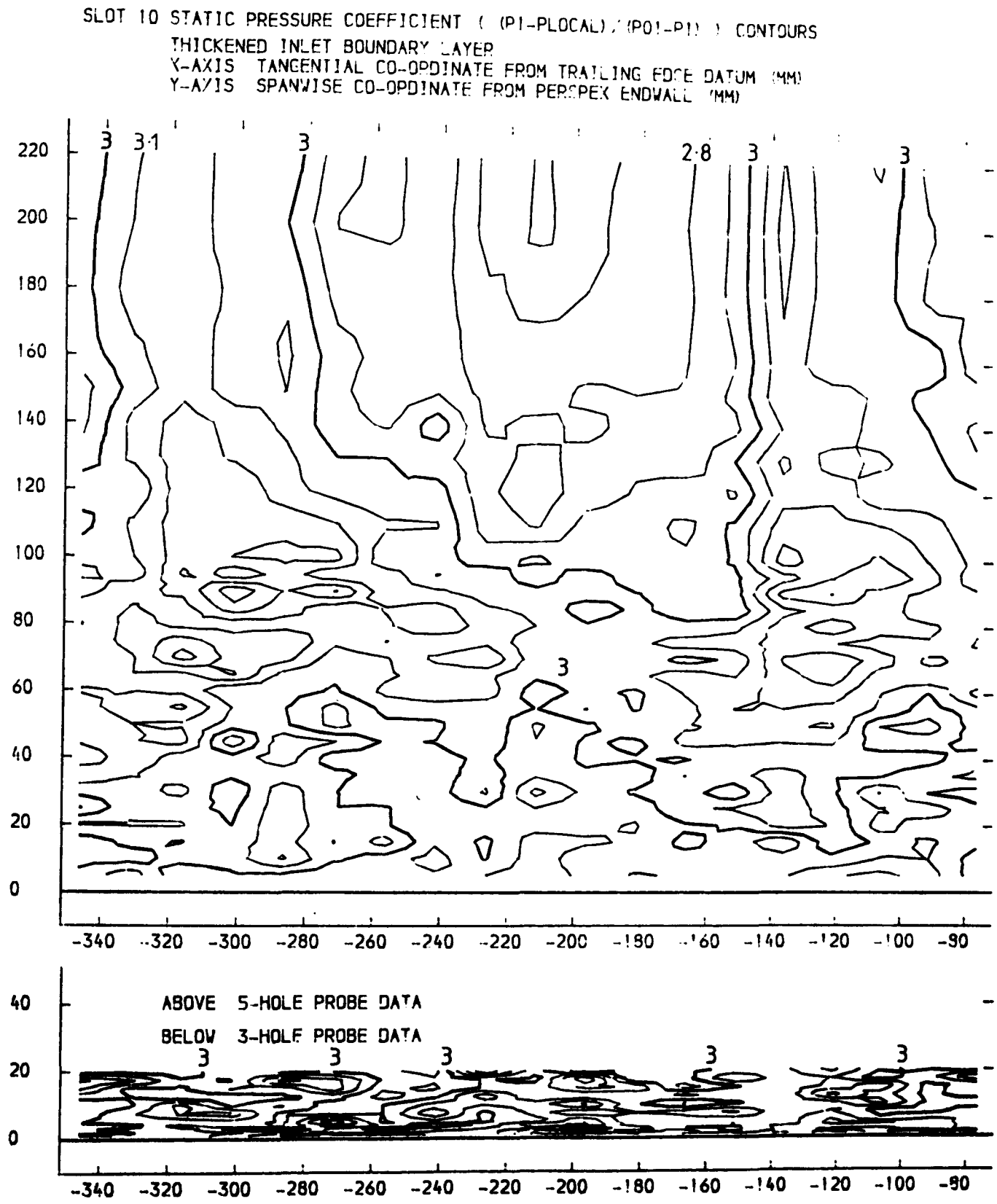

SLOT 10 STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(P01-P1)) CONTOURS
THICKENED INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA

FIGURE 6.21

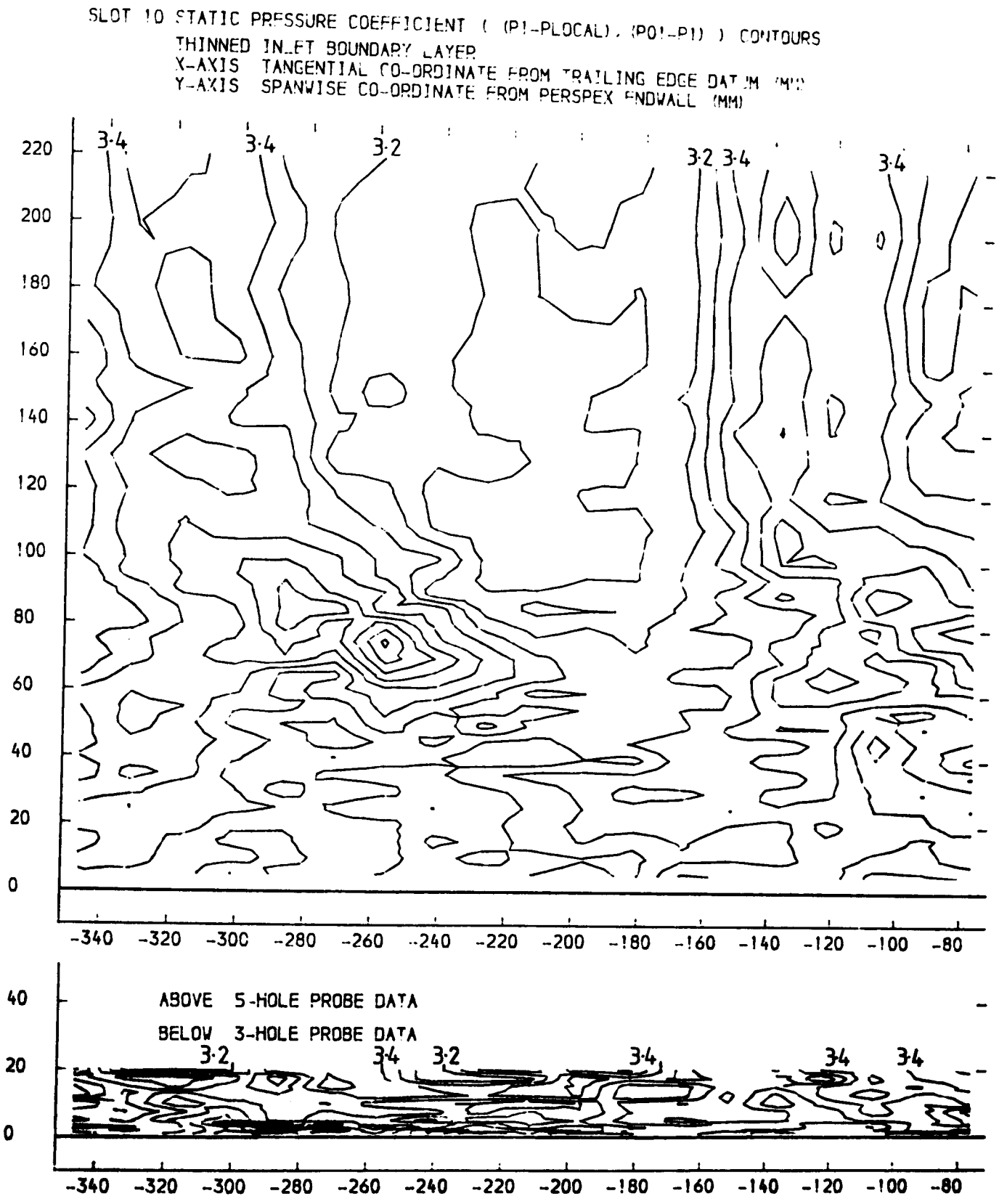

SLOT 10 STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(P01-P1)) CONTOURS
THINNED INLET BOUNDARY LAYER
X-AXIS TANGENTIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
3·4
3·4
3·2
3·2
3·4
3·4
220
200
180
160
140
120
100
80
60
40
20
0
-340
-320
-300
-280
-260
-240
-220
-200
-180
-160
-140
-120
-100
-80
ABOVE 5-HOLE PROBE DATA
BELOW 3-HOLE PROBE DATA
3·2
3·4
3·2
3·4
3·4
3·4
40
20
0
-340
-320
-300
-280
-260
-240
-220
-200
-180
-160
-140
-120
-100
-80

FIGURE 6.22

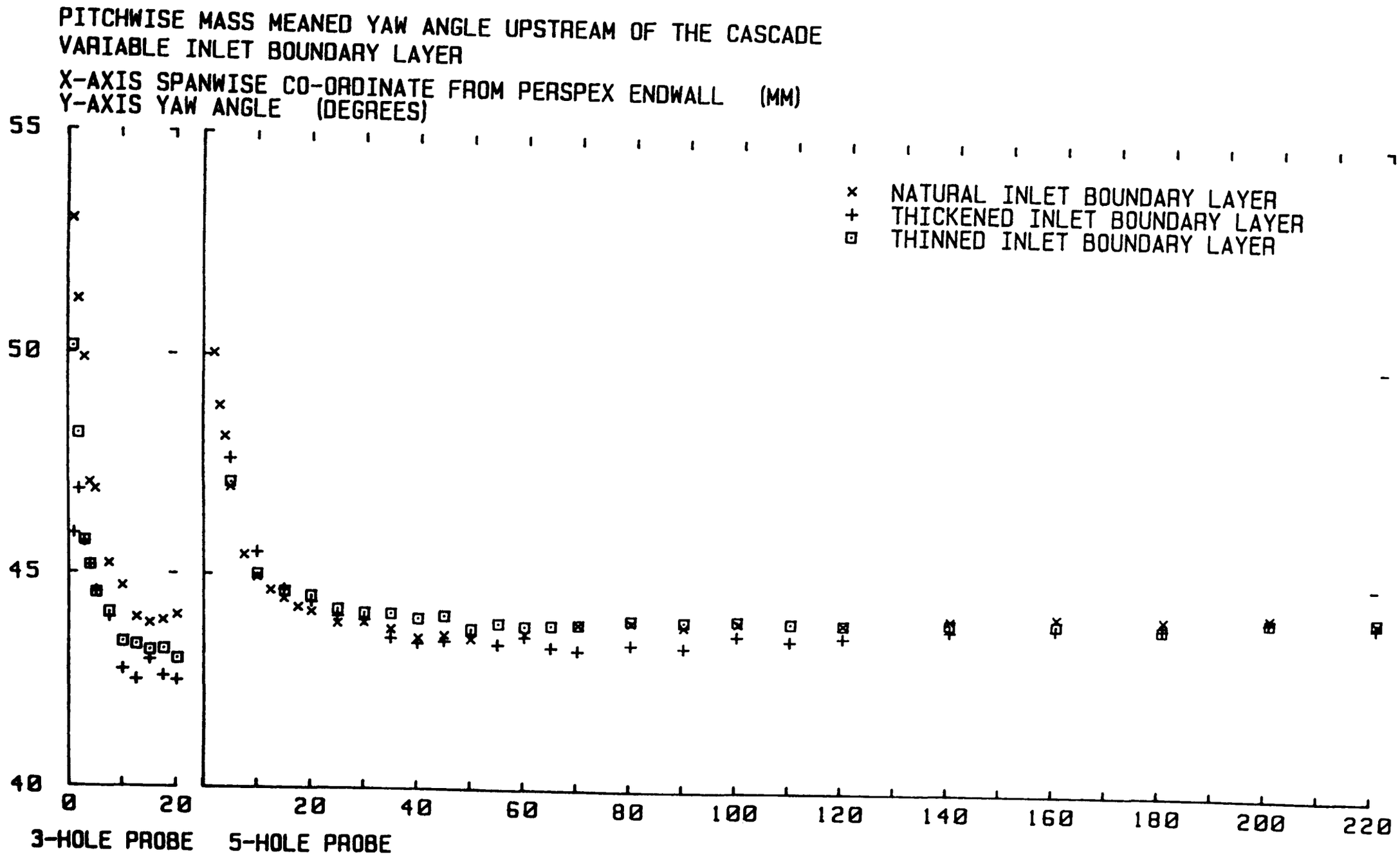

PITCHWISE MASS MEANED YAW ANGLE UPSTREAM OF THE CASCADE
VARIABLE INLET BOUNDARY LAYER
X-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
Y-AXIS YAW ANGLE (DEGREES)
× NATURAL INLET BOUNDARY LAYER
+ THICKENED INLET BOUNDARY LAYER
⊡ THINNED INLET BOUNDARY LAYER
55
50
45
40
0
20
20
40
60
80
100
120
140
160
180
200
220
3-HOLE PROBE
5-HOLE PROBE

FIGURE 6.23

PITCHWISE MASS MEANED TOTAL PRESSURE LOSS COEFFICIENT UPSTREAM OF THE CASCADE
VARIABLE INLET BOUNDARY LAYER

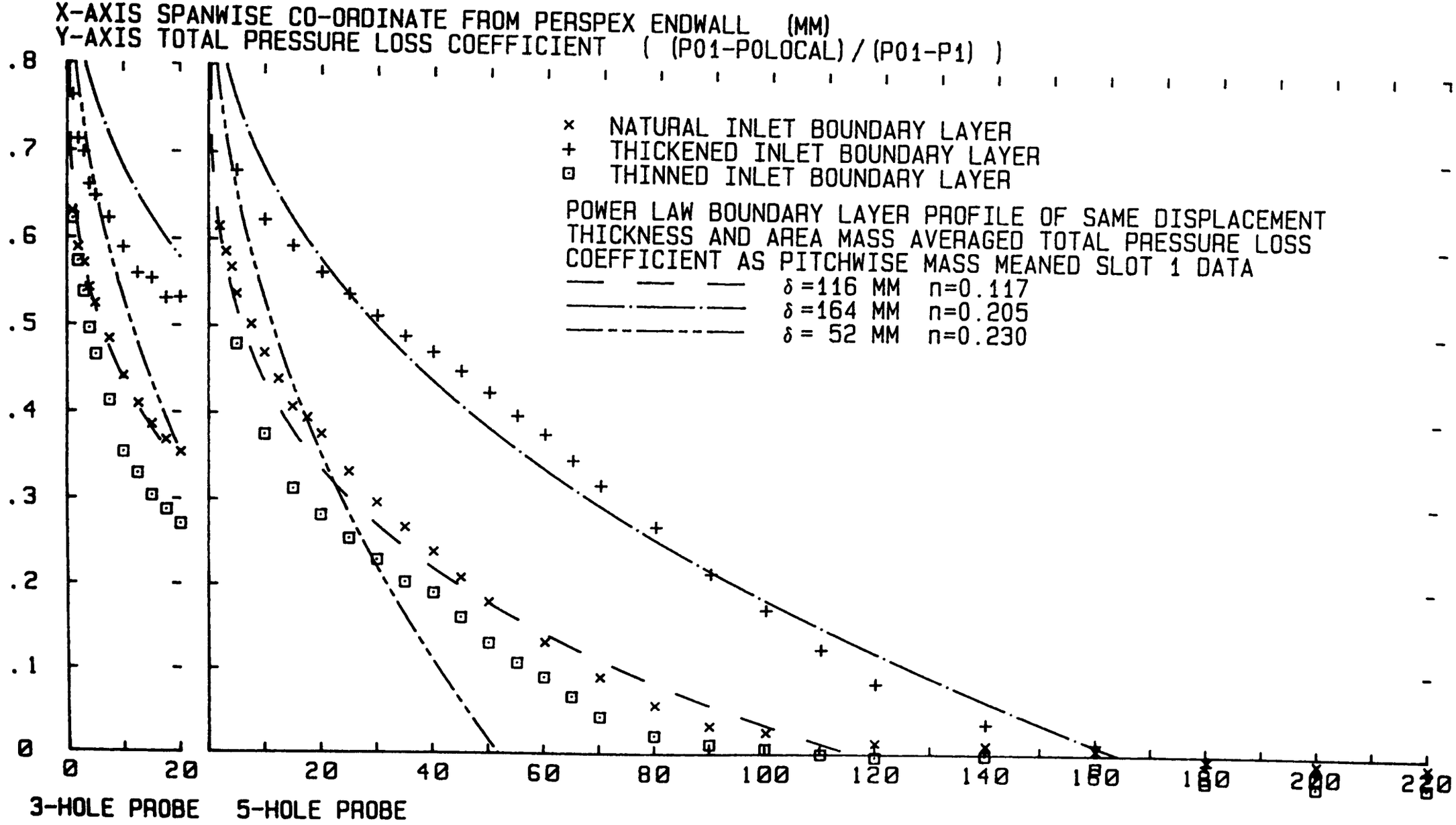


FIGURE 6.24

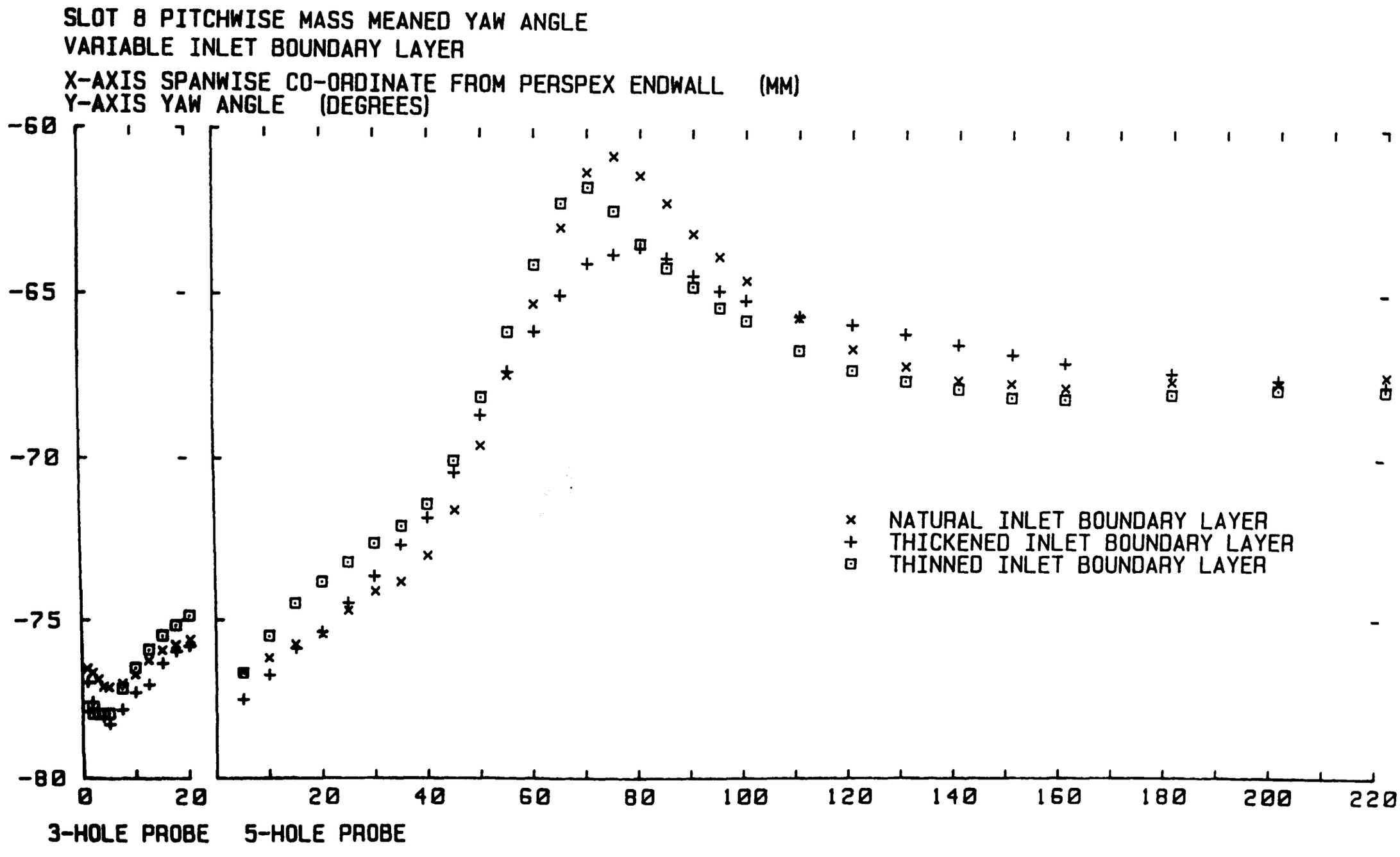

SLOT 8 PITCHWISE MASS MEANED YAW ANGLE
VARIABLE INLET BOUNDARY LAYER
X-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
Y-AXIS YAW ANGLE (DEGREES)
-60
-65
-70
-75
-80
0
20
20
40
60
80
100
120
140
160
180
200
220
3-HOLE PROBE
5-HOLE PROBE
× NATURAL INLET BOUNDARY LAYER
+ THICKENED INLET BOUNDARY LAYER
⊡ THINNED INLET BOUNDARY LAYER

FIGURE 6.25

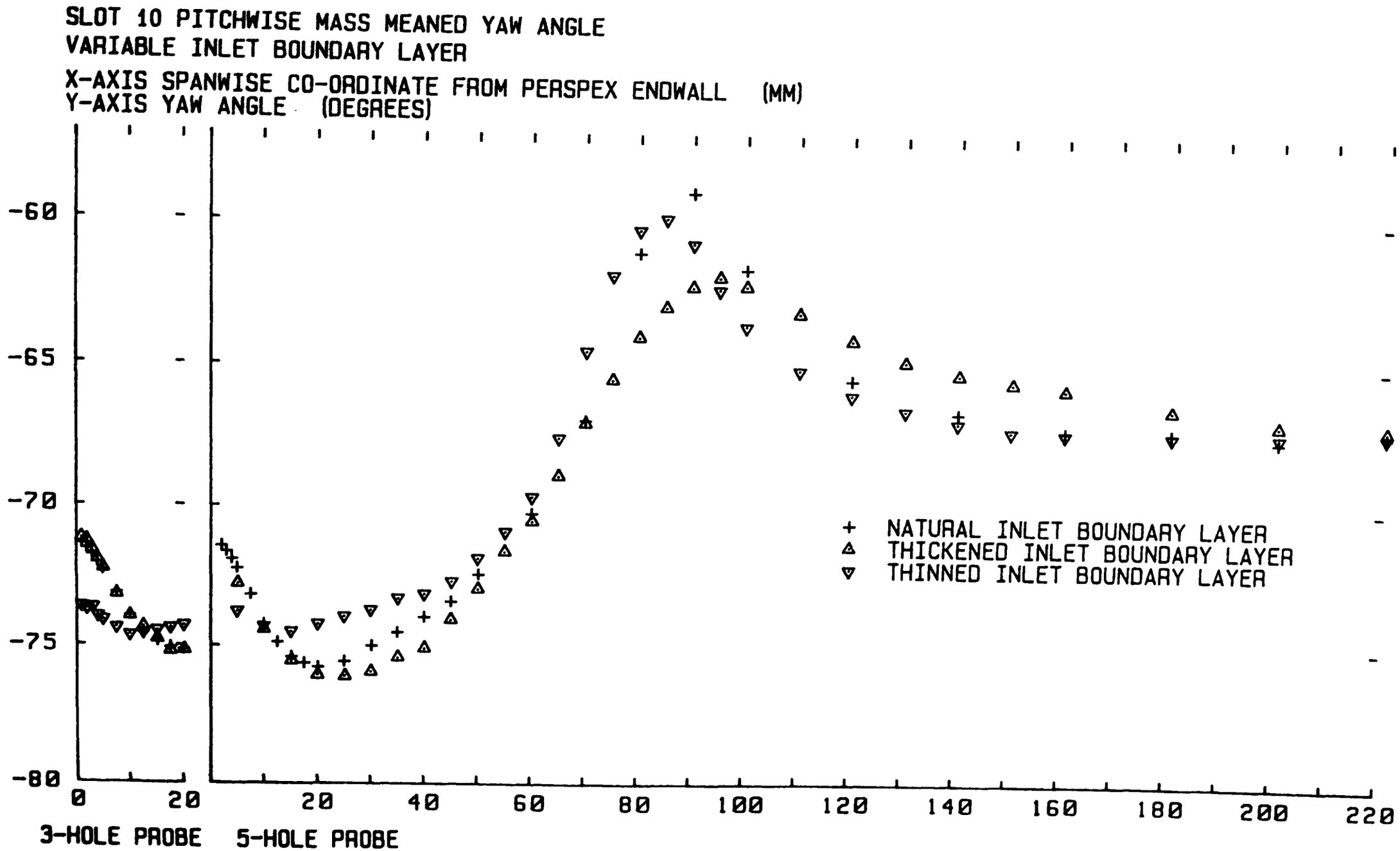

SLOT 10 PITCHWISE MASS MEANED YAW ANGLE
VARIABLE INLET BOUNDARY LAYER
X-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
Y-AXIS YAW ANGLE (DEGREES)
-60
-65
-70
-75
-80
0
20
20
40
60
80
100
120
140
160
180
200
220
3-HOLE PROBE
5-HOLE PROBE
NATURAL INLET BOUNDARY LAYER
THICKENED INLET BOUNDARY LAYER
THINNED INLET BOUNDARY LAYER

FIGURE 6.26

SLOT 8 PITCHWISE MASS MEANED TOTAL PRESSURE LOSS COEFFICIENT
VARIABLE INLET BOUNDARY LAYER

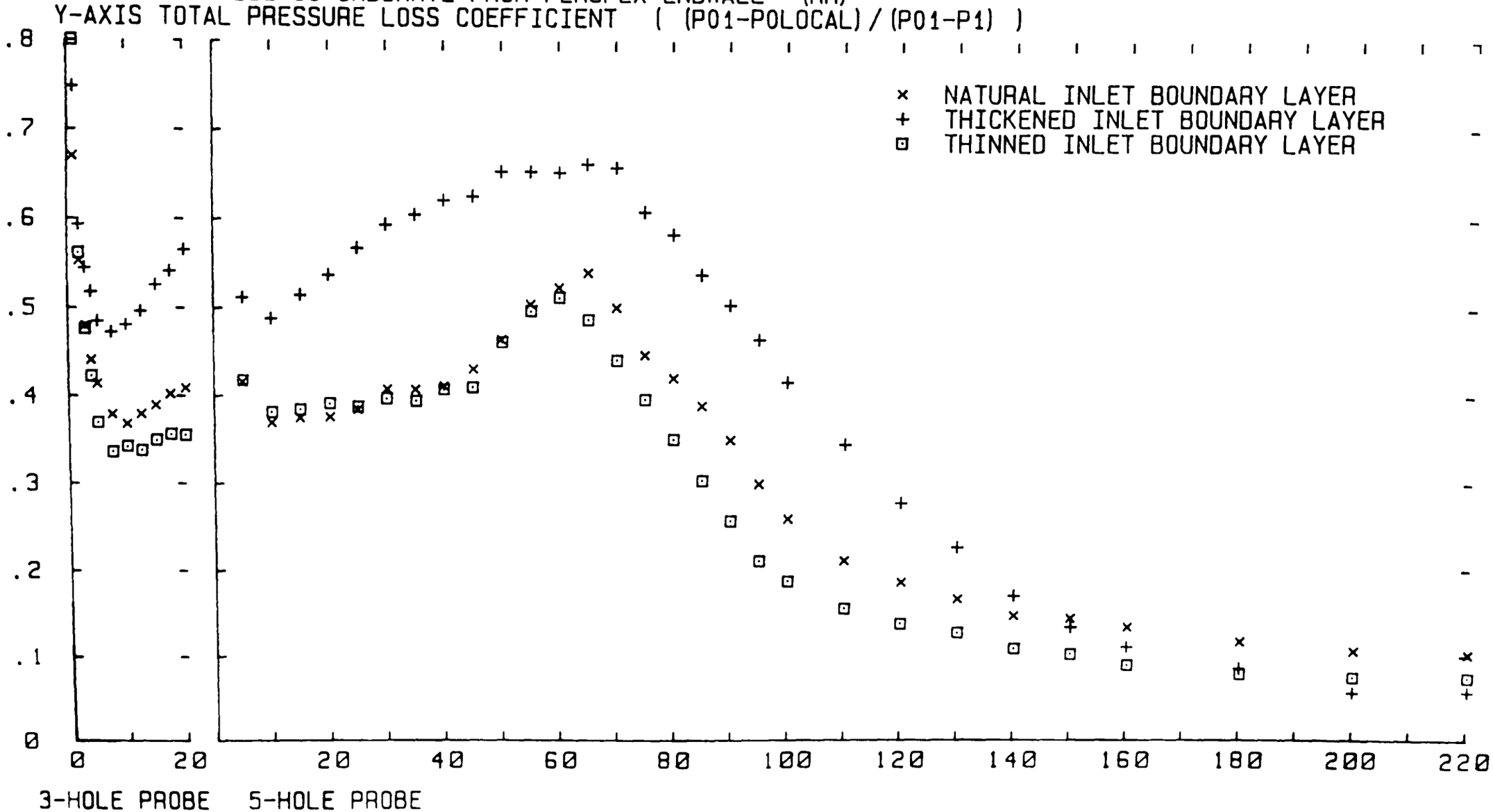


FIGURE 6.27

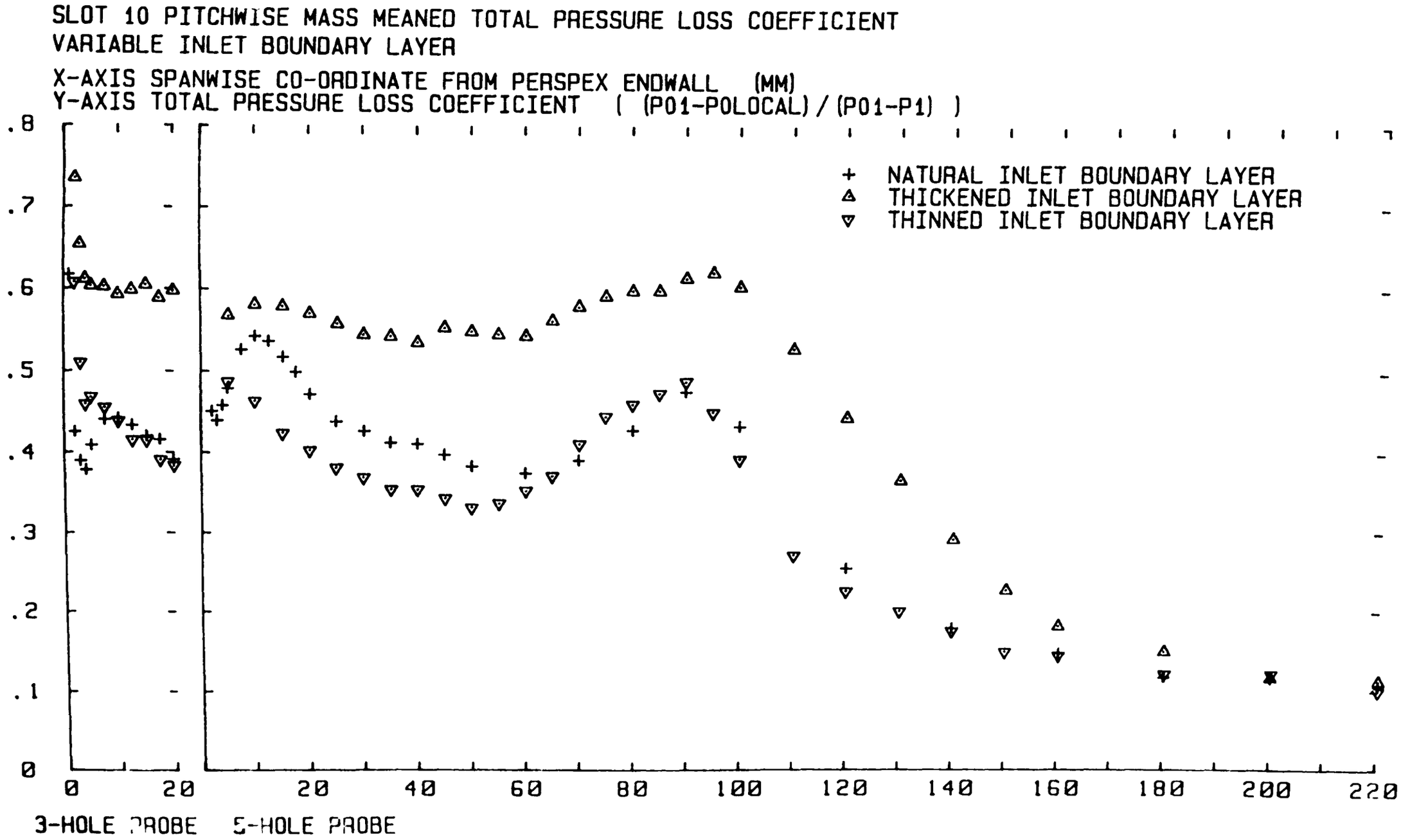

SLOT 10 PITCHWISE MASS MEANED TOTAL PRESSURE LOSS COEFFICIENT
VARIABLE INLET BOUNDARY LAYER
X-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
Y-AXIS TOTAL PRESSURE LOSS COEFFICIENT ((P01-POLOCAL)/(P01-P1))
+ NATURAL INLET BOUNDARY LAYER
△ THICKENED INLET BOUNDARY LAYER
▽ THINNED INLET BOUNDARY LAYER
.8
.7
.6
.5
.4
.3
.2
.1
0
0
20
20
40
60
80
100
120
140
160
180
200
220
3-HOLE PROBE
5-HOLE PROBE

FIGURE 6.28

BLADE SURFACE STATIC PRESSURE COEFFICIENT DISTRIBUTION

THICKENED BOUNDARY LAYER DATA

X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

Y-AXIS STATIC PRESSURE COEFFICIENT ((P1-PLOCAL) / (P01-P1))

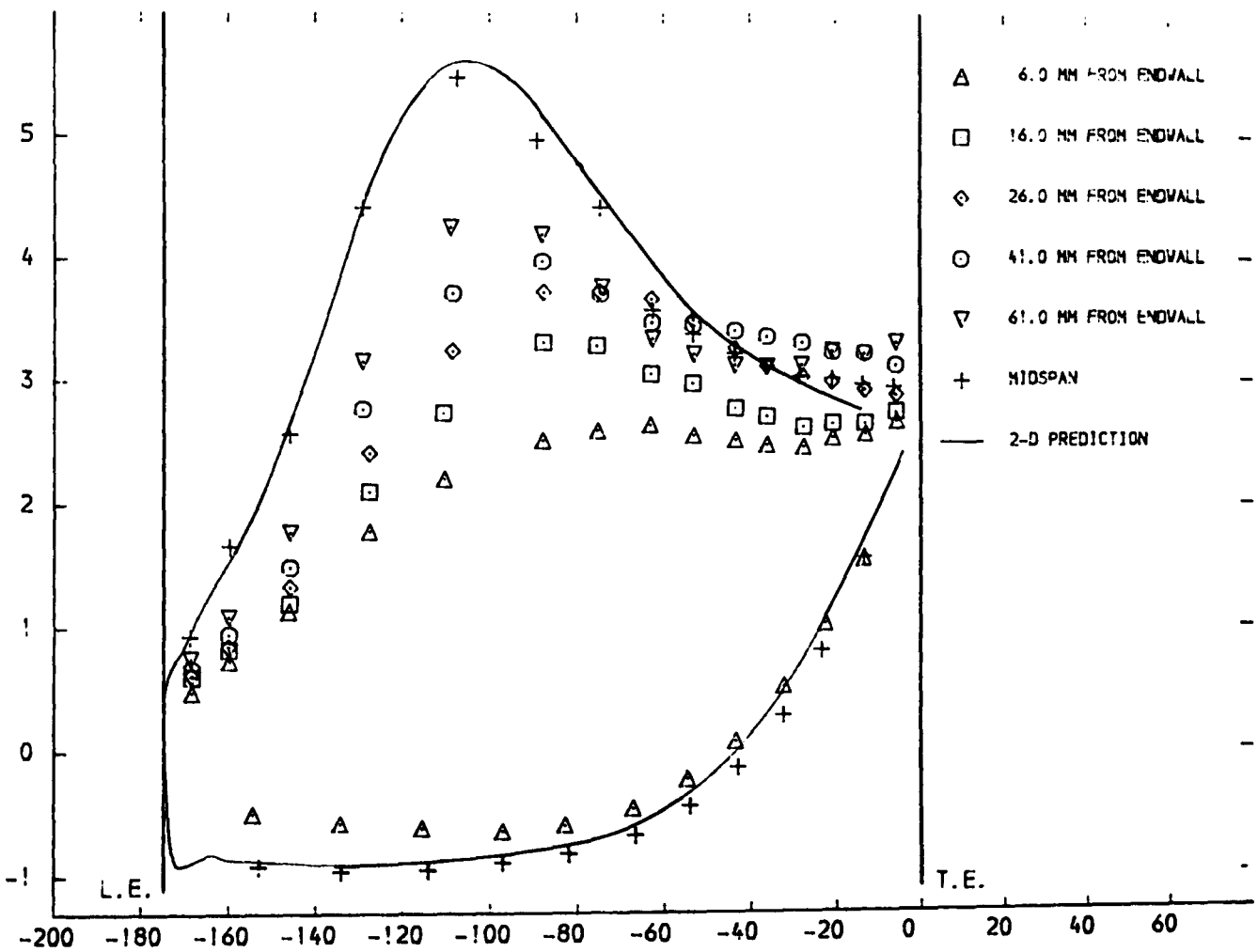


FIGURE 6.29

BLADE SURFACE STATIC PRESSURE COEFFICIENT DISTRIBUTION

THINNED BOUNDARY LAYER DATA

X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)

Y-AXIS STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(P01-P1))

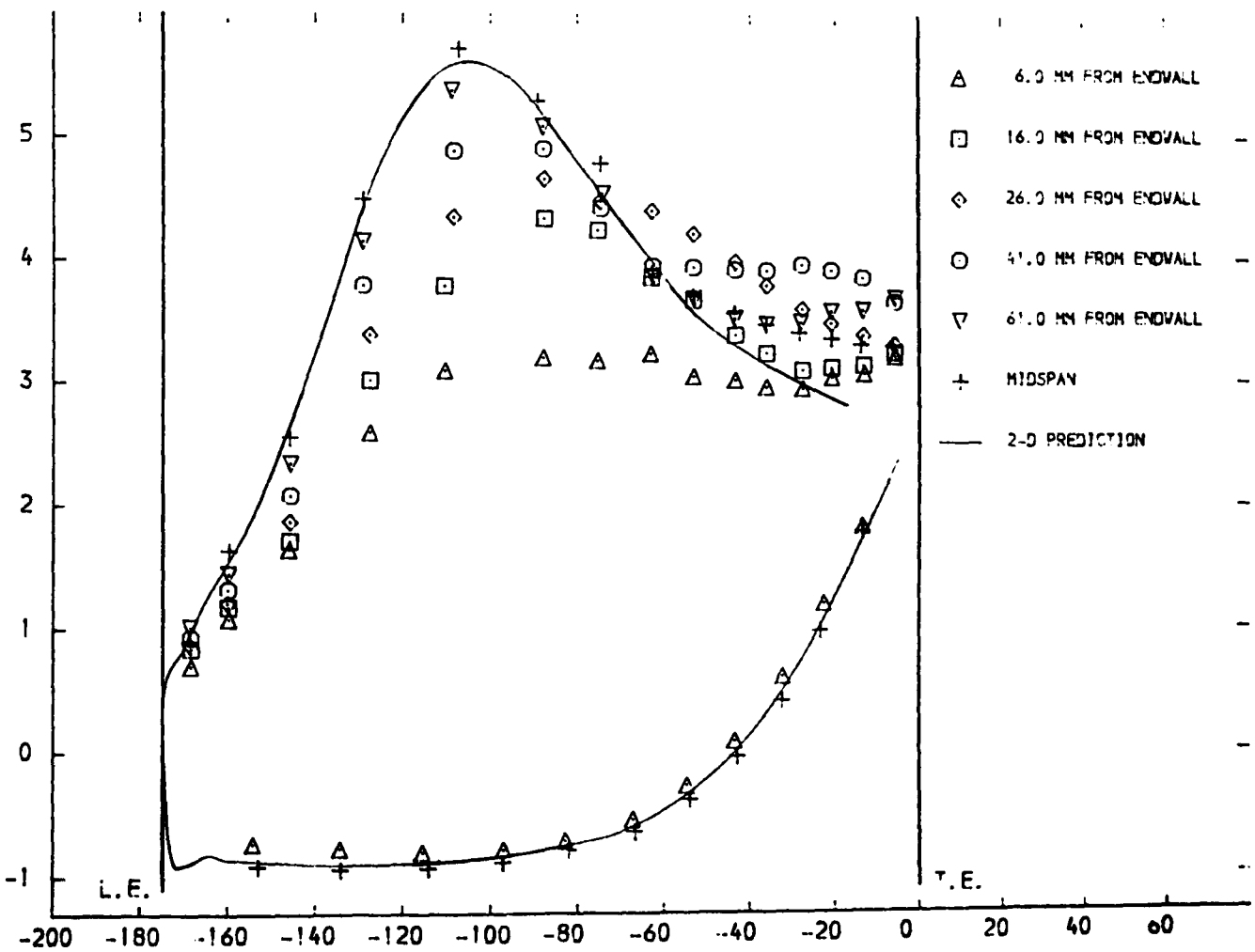


FIGURE 6.30

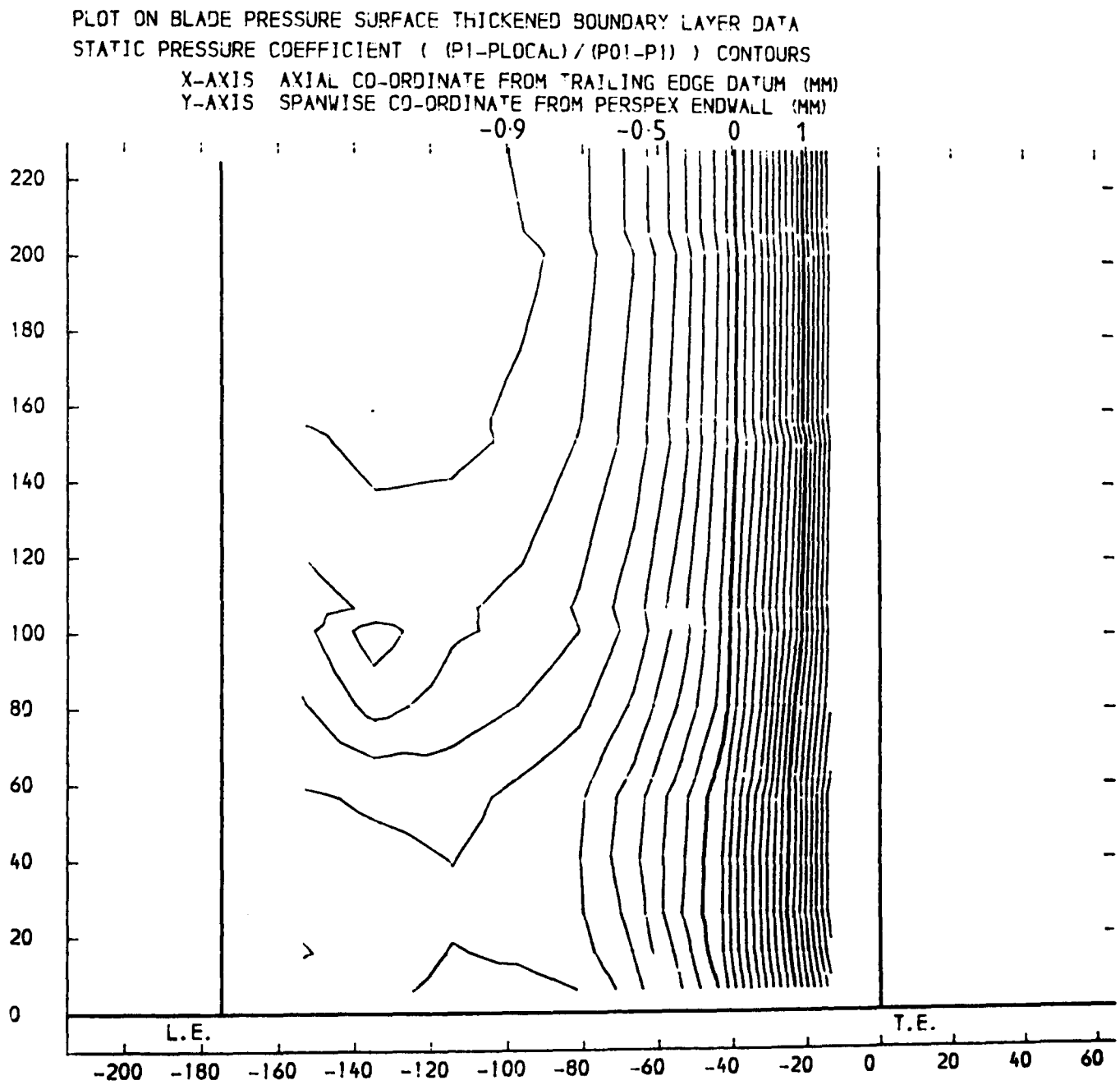

PLOT ON BLADE PRESSURE SURFACE THICKENED BOUNDARY LAYER DATA
STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(P01-P1)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
-0·9
-0·5
0
1
220
200
180
160
140
120
100
80
60
40
20
0
L.E.
T.E.
-200
-180
-160
-140
-120
-100
-80
-60
-40
-20
0
20
40
60

FIGURE 6.31

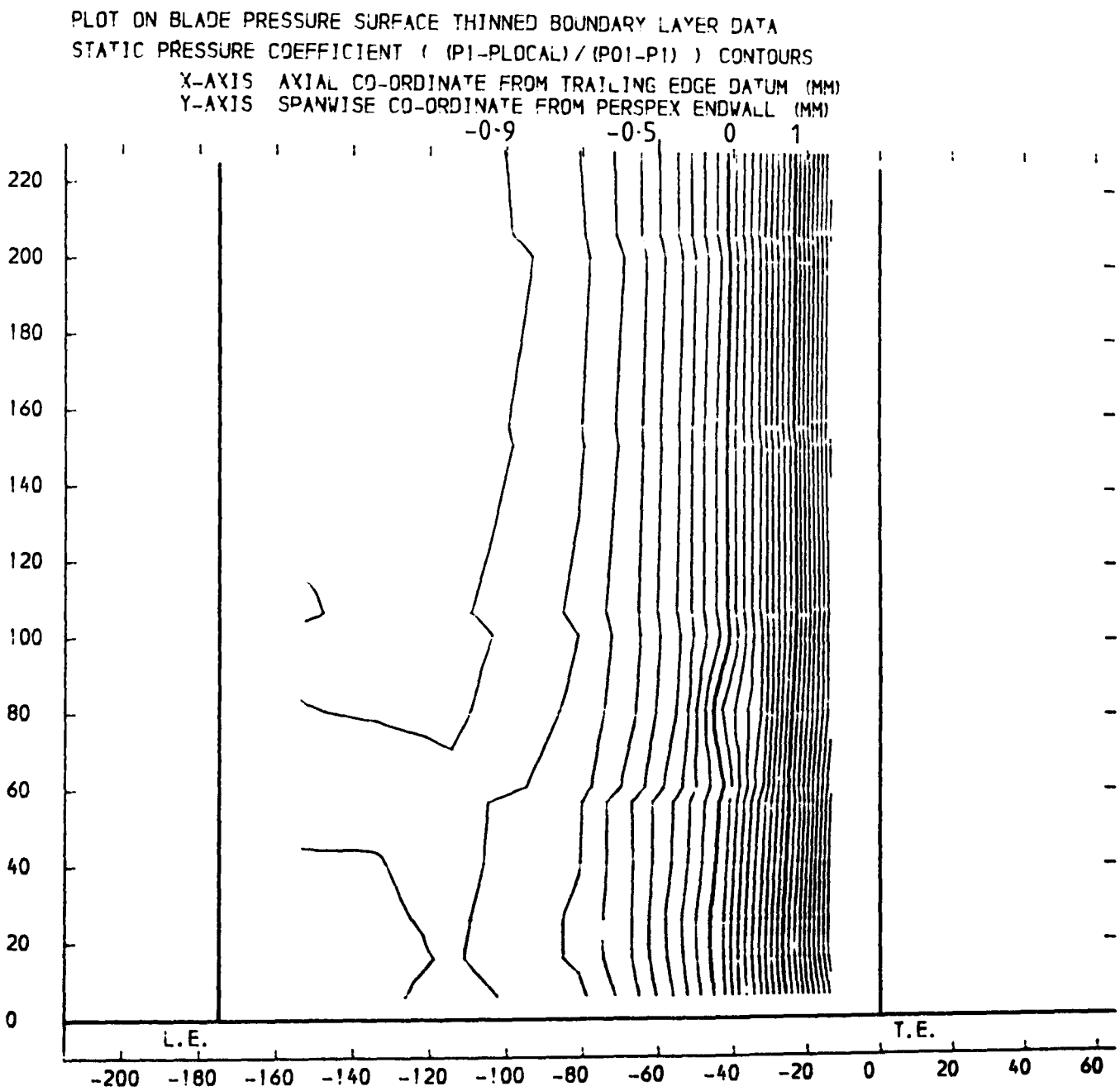

PLOT ON BLADE PRESSURE SURFACE THINNED BOUNDARY LAYER DATA
STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(P01-P1)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
-0·9
-0·5
0
1
220
200
180
160
140
120
100
80
60
40
20
0
L.E.
T.E.
-200
-180
-160
-140
-120
-100
-80
-60
-40
-20
0
20
40
60

FIGURE 6.32

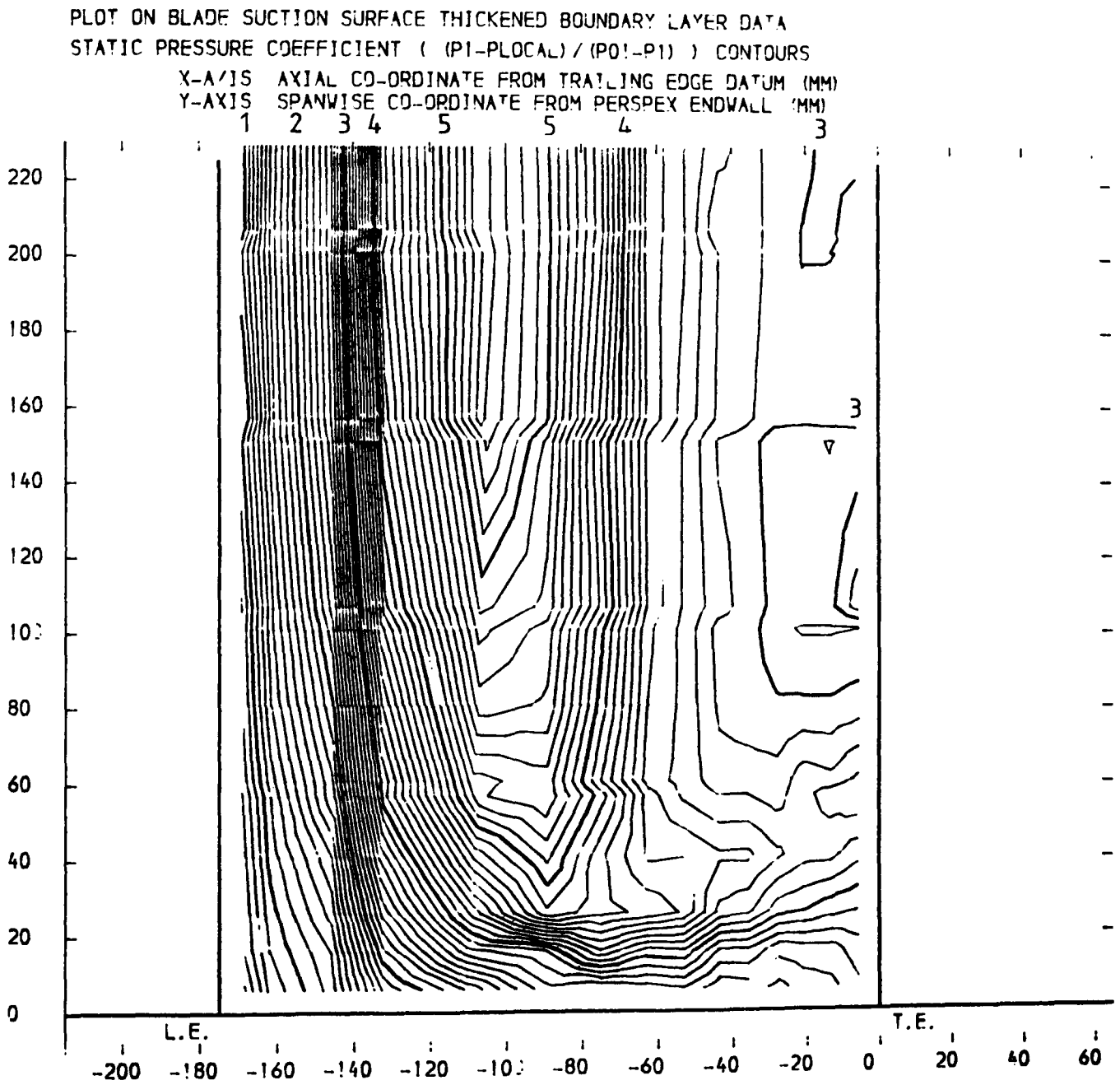

PLOT ON BLADE SUCTION SURFACE THICKENED BOUNDARY LAYER DATA
STATIC PRESSURE COEFFICIENT ((P1-PLOCAL)/(PO1-P1)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
1 2 3 4 5 5 4 3
3
220
200
180
160
140
120
100
80
60
40
20
0
L.E.
T.E.
-200 -180 -160 -140 -120 -100 -80 -60 -40 -20 0 20 40 60

FIGURE 6.33

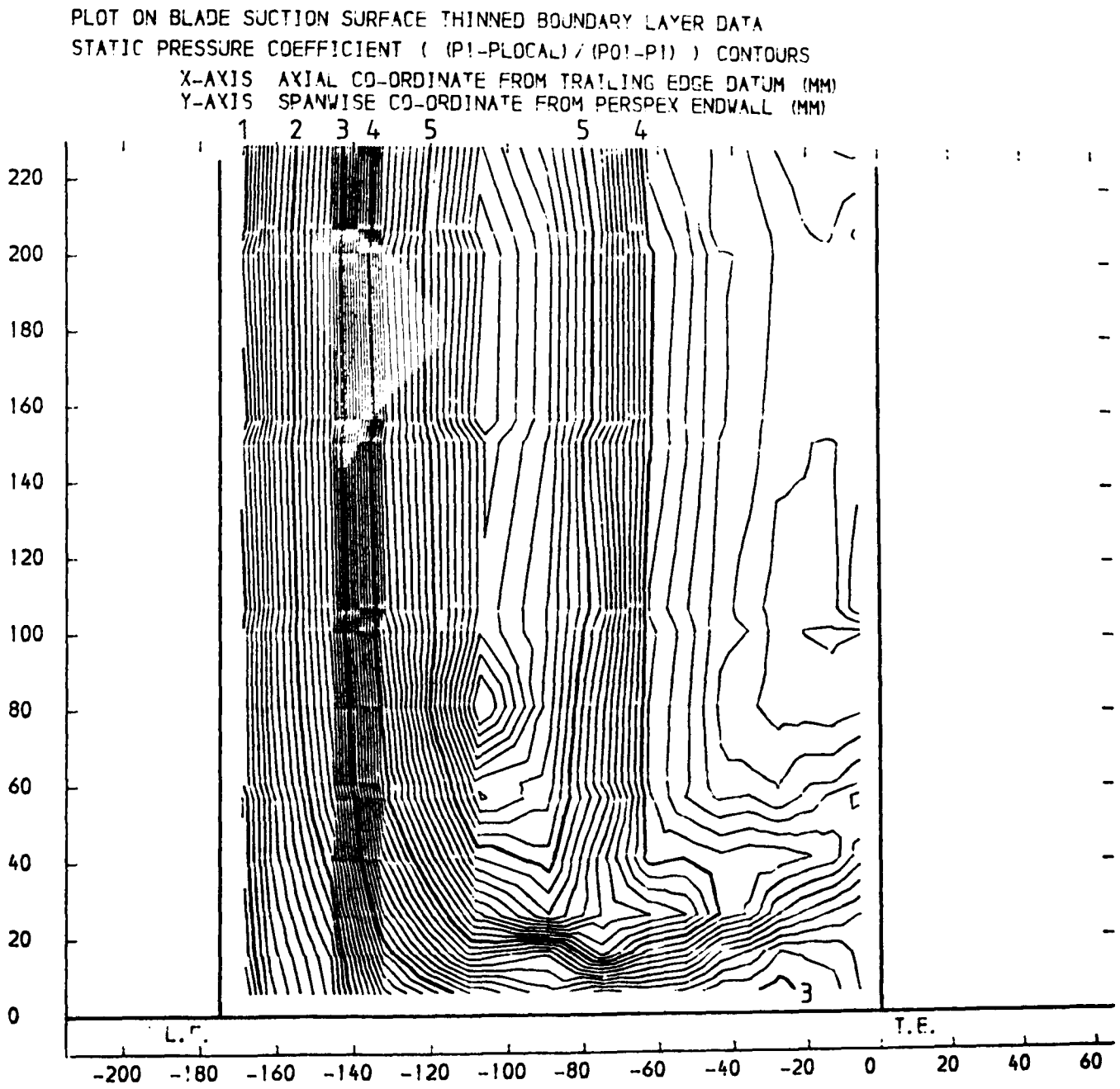
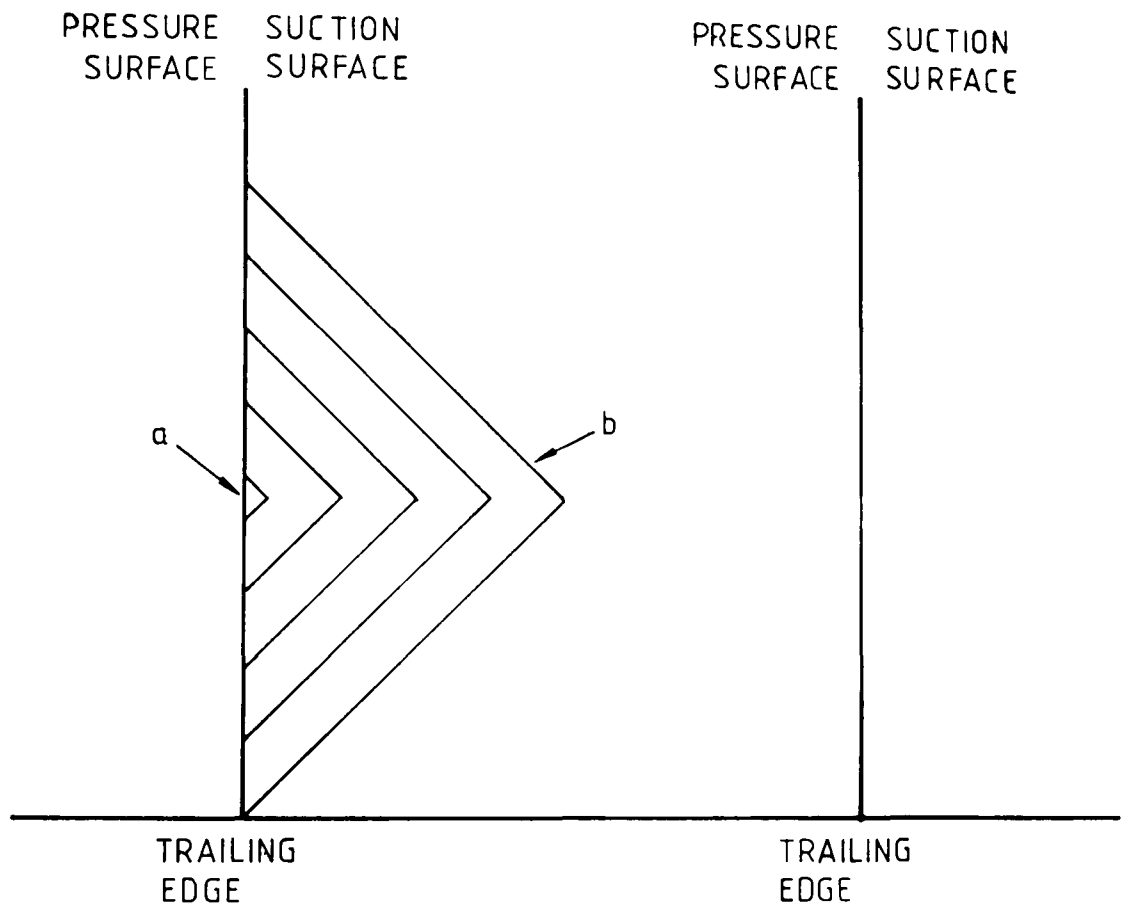

PLOT ON BLADE SUCTION SURFACE THINNED BOUNDARY LAYER DATA
STATIC PRESSURE COEFFICIENT ((P!-PLOCAL) / (PO!-P1)) CONTOURS
X-AXIS AXIAL CO-ORDINATE FROM TRAILING EDGE DATUM (MM)
Y-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
1 2 3 4 5 5 4
220
200
180
160
140
120
100
80
60
40
20
0
L.E.
T.E.
-200 -180 -160 -140 -120 -100 -80 -60 -40 -20 0 20 40 60

FIGURE 6.34

THE TRIANGULAR LOSS CORE



a POINT OF MINIMUM PRESSURE ($P_{0LOC} = P_1$)

b OUTER TOTAL PRESSURE LOSS COEFFICIENT CONTOUR

FIGURE 7.1

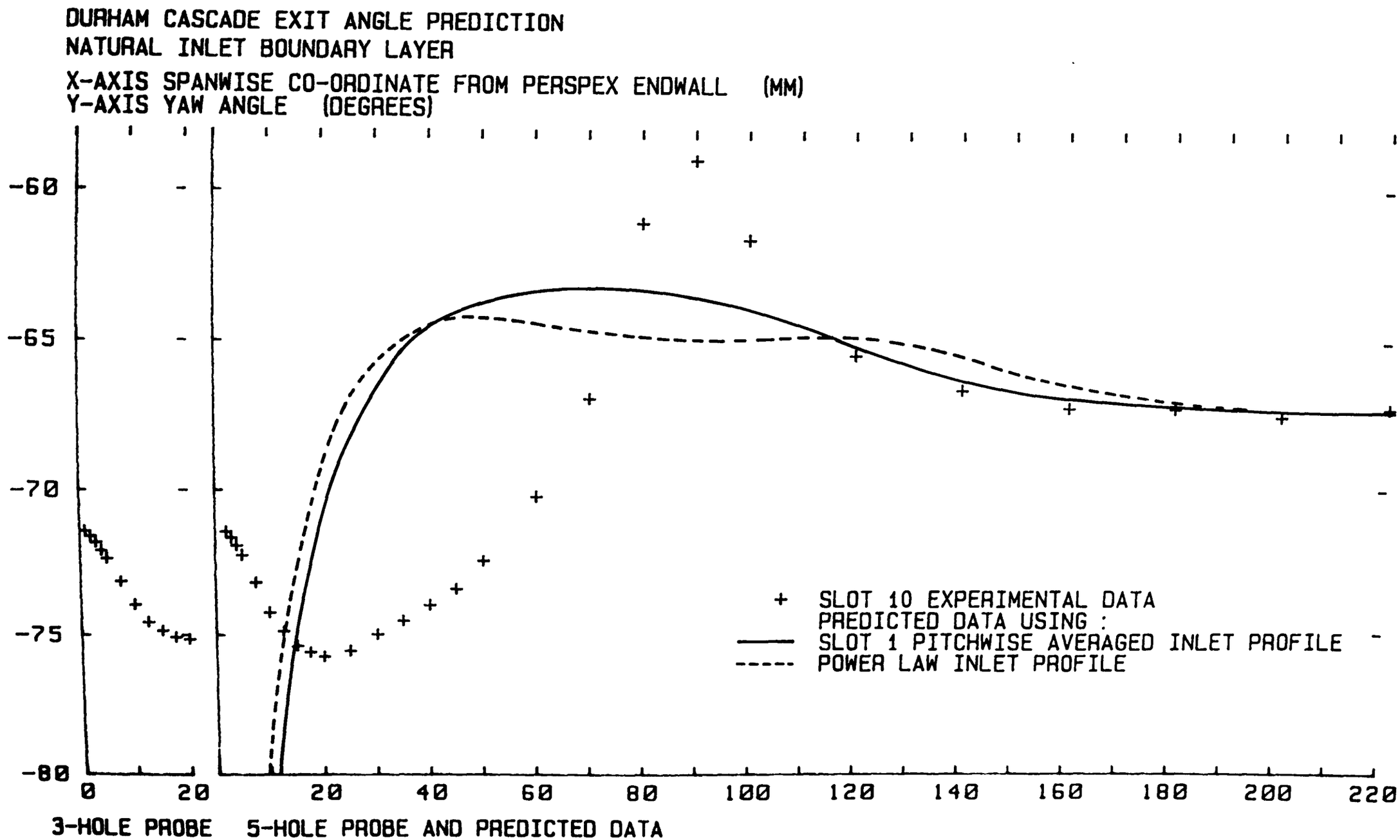

DURHAM CASCADE EXIT ANGLE PREDICTION
NATURAL INLET BOUNDARY LAYER
X-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
Y-AXIS YAW ANGLE (DEGREES)
-60
-65
-70
-75
-80
0
20
20
40
60
80
100
120
140
160
180
200
220
3-HOLE PROBE
5-HOLE PROBE AND PREDICTED DATA
+ SLOT 10 EXPERIMENTAL DATA
PREDICTED DATA USING :
SLOT 1 PITCHWISE AVERAGED INLET PROFILE
POWER LAW INLET PROFILE

FIGURE 7.2

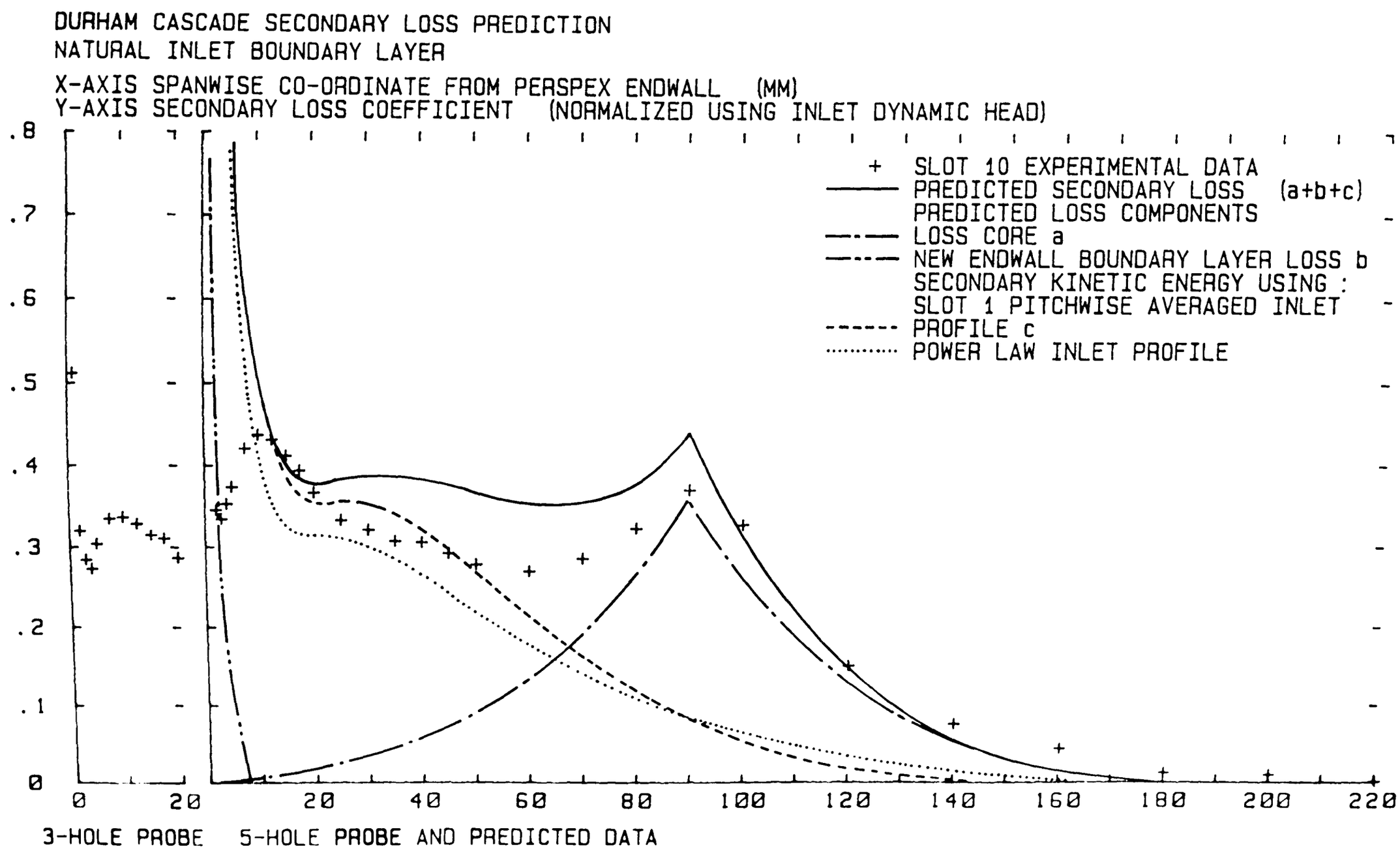

DURHAM CASCADE SECONDARY LOSS PREDICTION
NATURAL INLET BOUNDARY LAYER
X-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
Y-AXIS SECONDARY LOSS COEFFICIENT (NORMALIZED USING INLET DYNAMIC HEAD)
+ SLOT 10 EXPERIMENTAL DATA
PREDICTED SECONDARY LOSS (a+b+c)
PREDICTED LOSS COMPONENTS
LOSS CORE a
NEW ENDWALL BOUNDARY LAYER LOSS b
SECONDARY KINETIC ENERGY USING :
SLOT 1 PITCHWISE AVERAGED INLET
PROFILE c
POWER LAW INLET PROFILE
.8
.7
.6
.5
.4
.3
.2
.1
0
0
20
20
40
60
80
100
120
140
160
180
200
220
3-HOLE PROBE
5-HOLE PROBE AND PREDICTED DATA

FIGURE 7.3

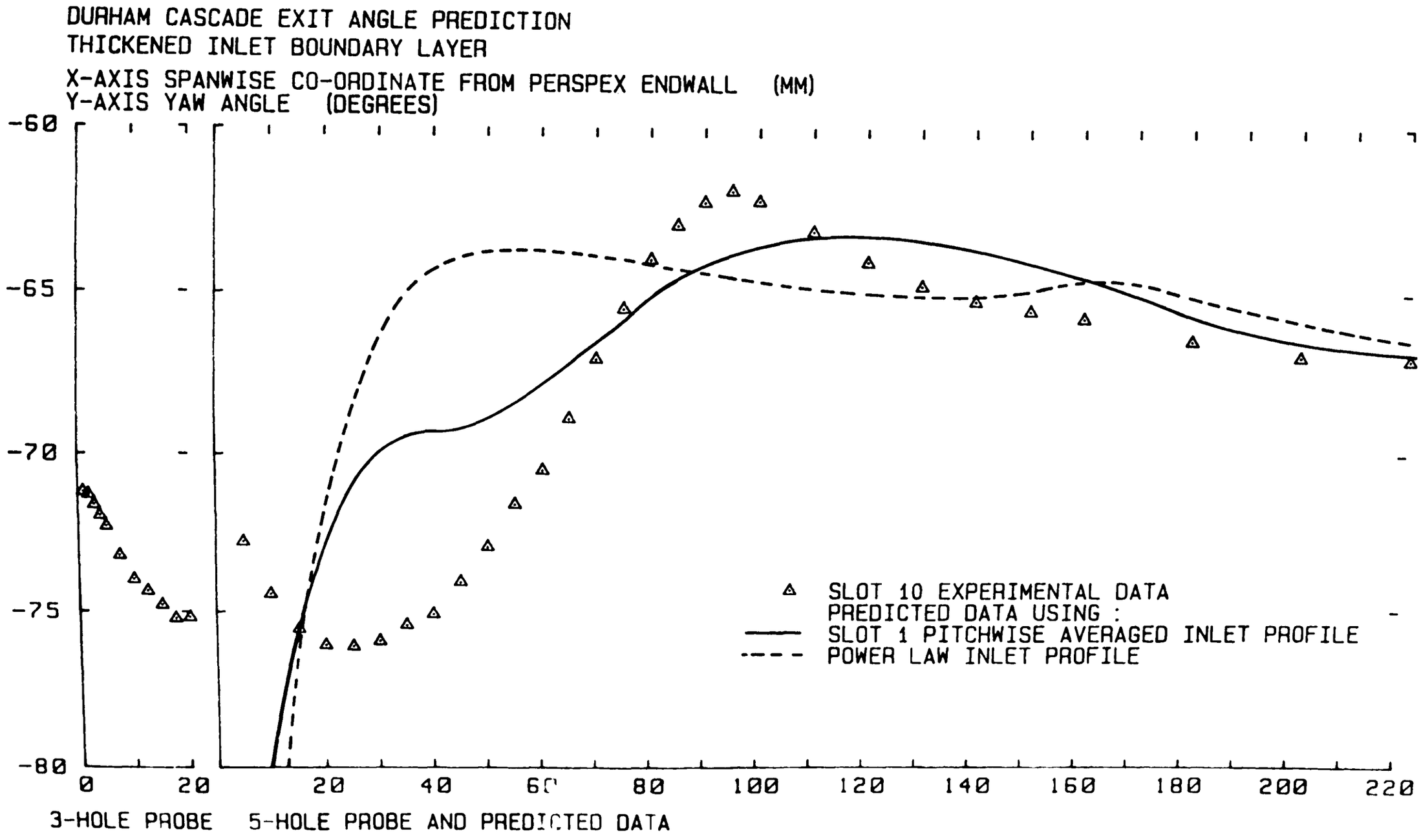

DURHAM CASCADE EXIT ANGLE PREDICTION
THICKENED INLET BOUNDARY LAYER
X-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
Y-AXIS YAW ANGLE (DEGREES)
-60
-65
-70
-75
-80
0
20
20
40
60
80
100
120
140
160
180
200
220
3-HOLE PROBE
5-HOLE PROBE AND PREDICTED DATA
SLOT 10 EXPERIMENTAL DATA
PREDICTED DATA USING :
SLOT 1 PITCHWISE AVERAGED INLET PROFILE
POWER LAW INLET PROFILE

FIGURE 7.4

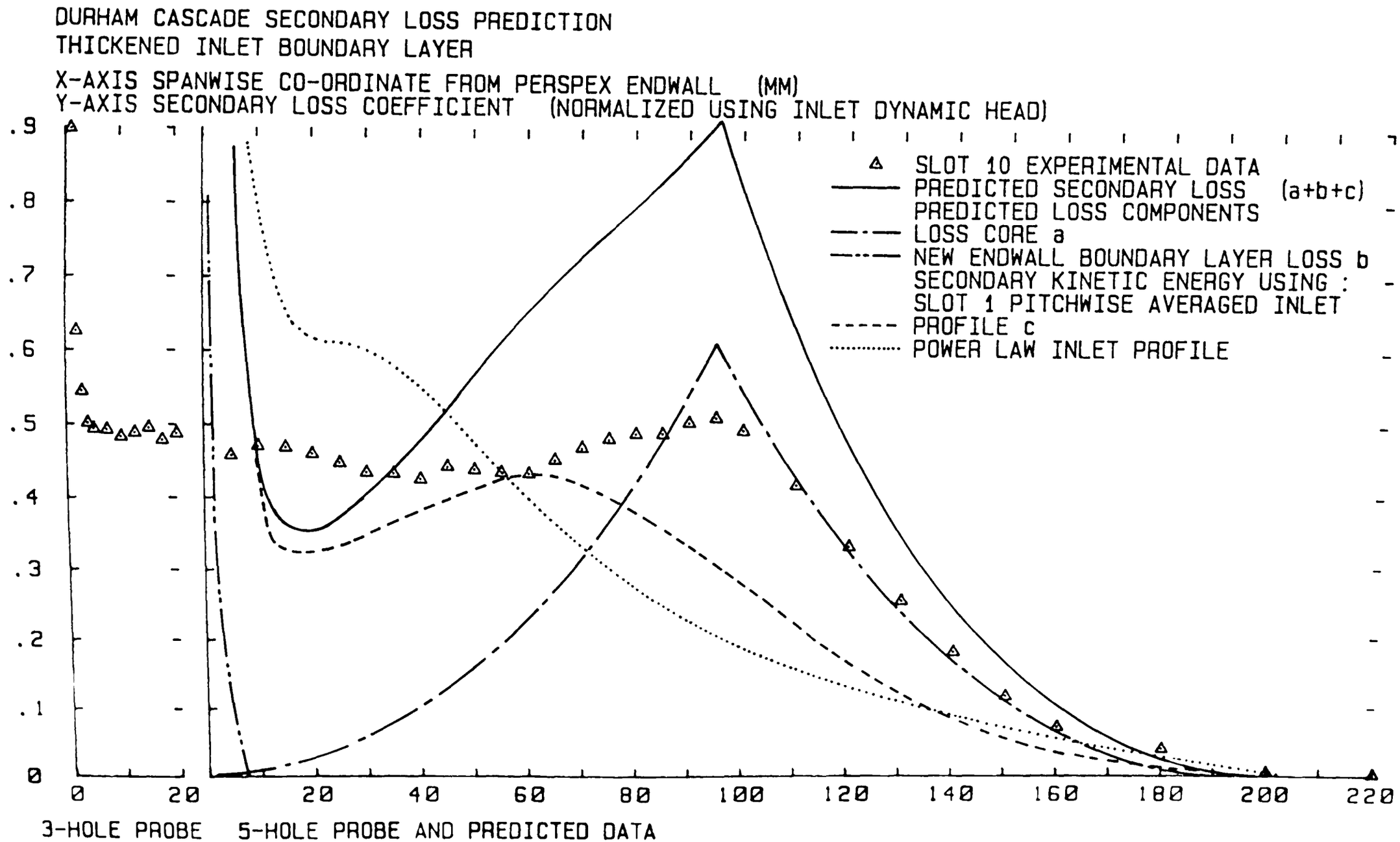

DURHAM CASCADE SECONDARY LOSS PREDICTION
THICKENED INLET BOUNDARY LAYER
X-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
Y-AXIS SECONDARY LOSS COEFFICIENT (NORMALIZED USING INLET DYNAMIC HEAD)
SLOT 10 EXPERIMENTAL DATA
PREDICTED SECONDARY LOSS (a+b+c)
PREDICTED LOSS COMPONENTS
LOSS CORE a
NEW ENDWALL BOUNDARY LAYER LOSS b
SECONDARY KINETIC ENERGY USING :
SLOT 1 PITCHWISE AVERAGED INLET
PROFILE c
POWER LAW INLET PROFILE
.9
.8
.7
.6
.5
.4
.3
.2
.1
0
0
20
20
40
60
80
100
120
140
160
180
200
220
3-HOLE PROBE
5-HOLE PROBE AND PREDICTED DATA

FIGURE 7.5

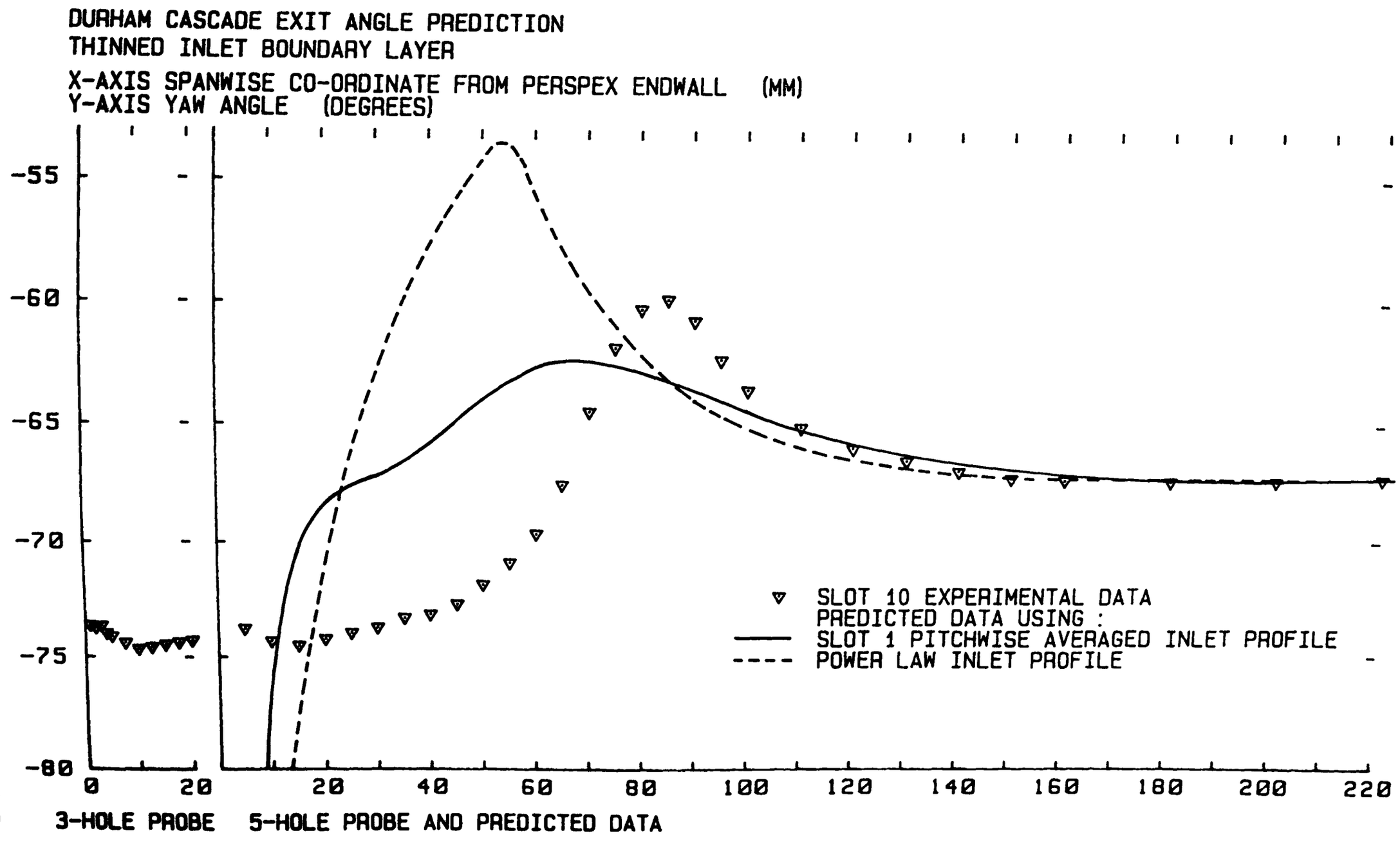

DURHAM CASCADE EXIT ANGLE PREDICTION
THINNED INLET BOUNDARY LAYER
X-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
Y-AXIS YAW ANGLE (DEGREES)
-55
-60
-65
-70
-75
-80
0
20
20
40
60
80
100
120
140
160
180
200
220
SLOT 10 EXPERIMENTAL DATA
PREDICTED DATA USING :
SLOT 1 PITCHWISE AVERAGED INLET PROFILE
POWER LAW INLET PROFILE
3-HOLE PROBE
5-HOLE PROBE AND PREDICTED DATA

FIGURE 7.6

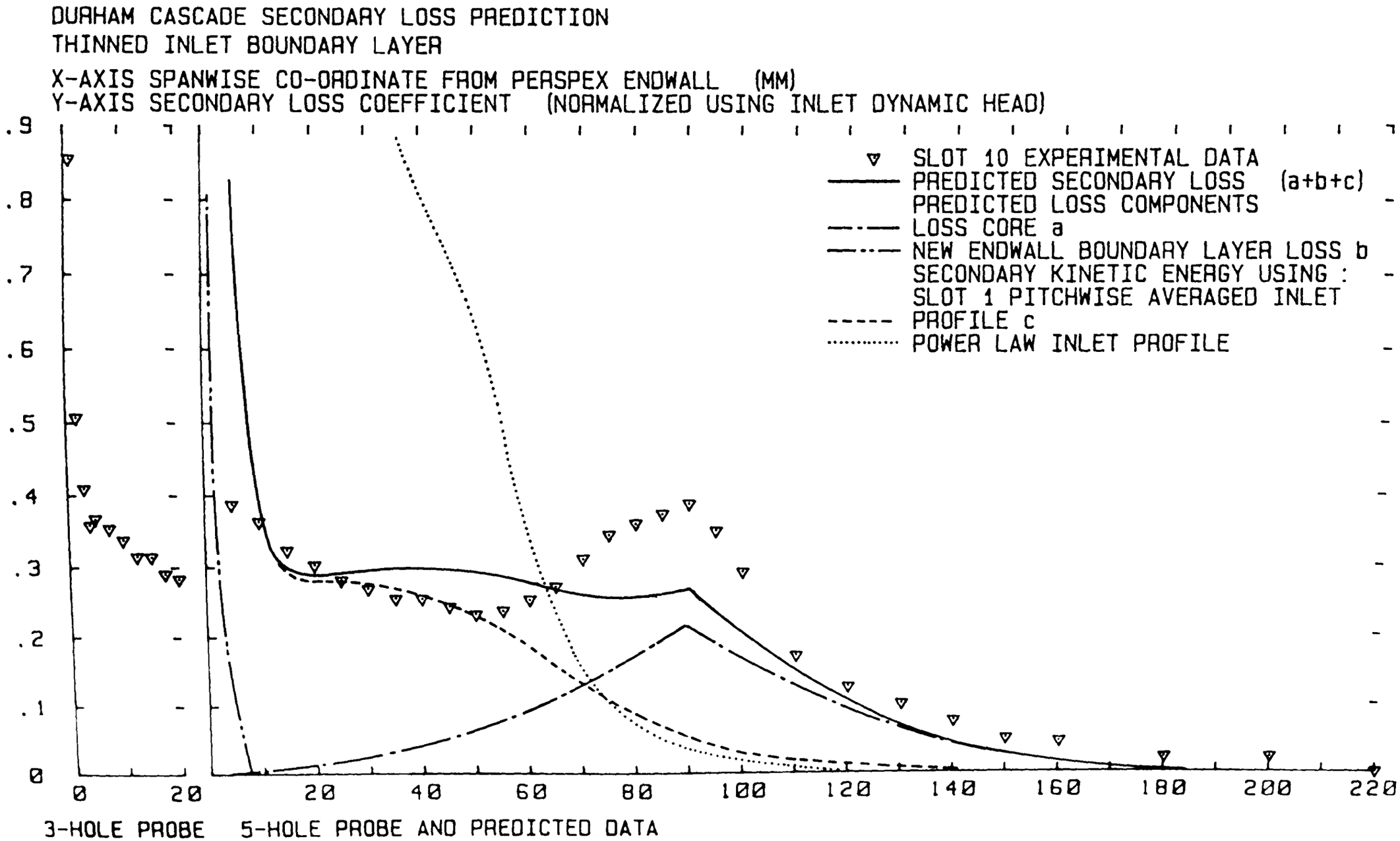

DURHAM CASCADE SECONDARY LOSS PREDICTION
THINNED INLET BOUNDARY LAYER
X-AXIS SPANWISE CO-ORDINATE FROM PERSPEX ENDWALL (MM)
Y-AXIS SECONDARY LOSS COEFFICIENT (NORMALIZED USING INLET DYNAMIC HEAD)
SLOT 10 EXPERIMENTAL DATA
PREDICTED SECONDARY LOSS (a+b+c)
PREDICTED LOSS COMPONENTS
LOSS CORE a
NEW ENDWALL BOUNDARY LAYER LOSS b
SECONDARY KINETIC ENERGY USING :
SLOT 1 PITCHWISE AVERAGED INLET
PROFILE c
POWER LAW INLET PROFILE
.9
.8
.7
.6
.5
.4
.3
.2
.1
0
0
20
20
40
60
80
100
120
140
160
180
200
220
3-HOLE PROBE
5-HOLE PROBE AND PREDICTED DATA

FIGURE 7.7

CARRICK'S CASCADE SECONDARY LOSS PREDICTION ZERO INLET SKEW LOW REYNOLDS No.

X-AXIS PERCENTAGE OF BLADE SPAN FROM ENDWALL
Y-AXIS SECONDARY LOSS COEFFICIENT (NORMALIZED USING INLET DYNAMIC HEAD)

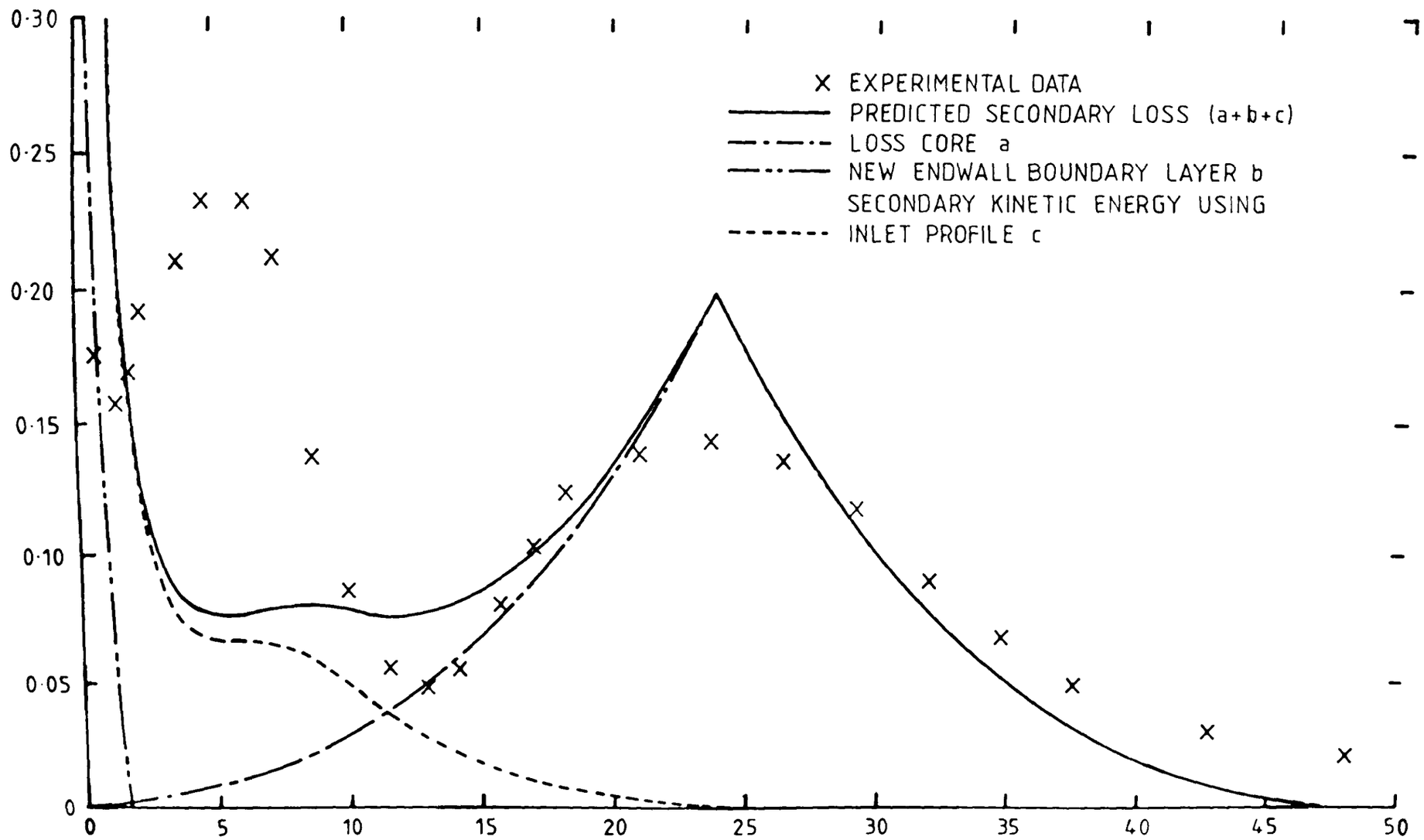


FIGURE 7.8

CARRICK'S CASCADE SECONDARY LOSS PREDICTION HIGH INLET SKEW LOW REYNOLDS No.

X-AXIS PERCENTAGE OF BLADE SPAN FROM ENDWALL
Y-AXIS SECONDARY LOSS COEFFICIENT (NORMALIZED USING INLET DYNAMIC HEAD)

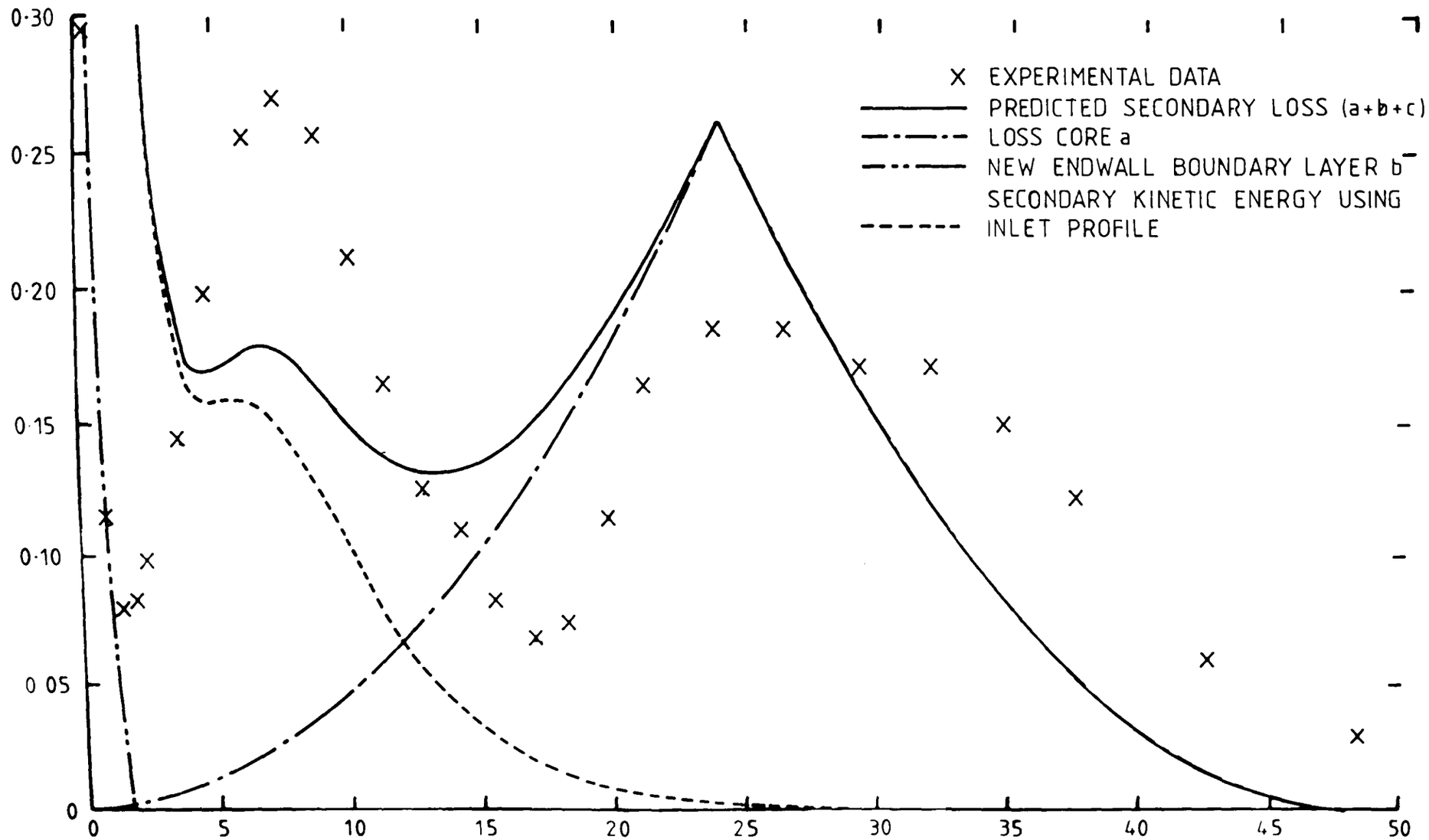


FIGURE 7.8

SJOLANDER'S CASCADE SECONDARY LOSS PREDICTION

X-AXIS PERCENTAGE OF ANNULUS HEIGHT FROM HUB
Y-AXIS SECONDARY LOSS COEFFICIENT (NORMALIZED USING INLET DYNAMIC HEAD)

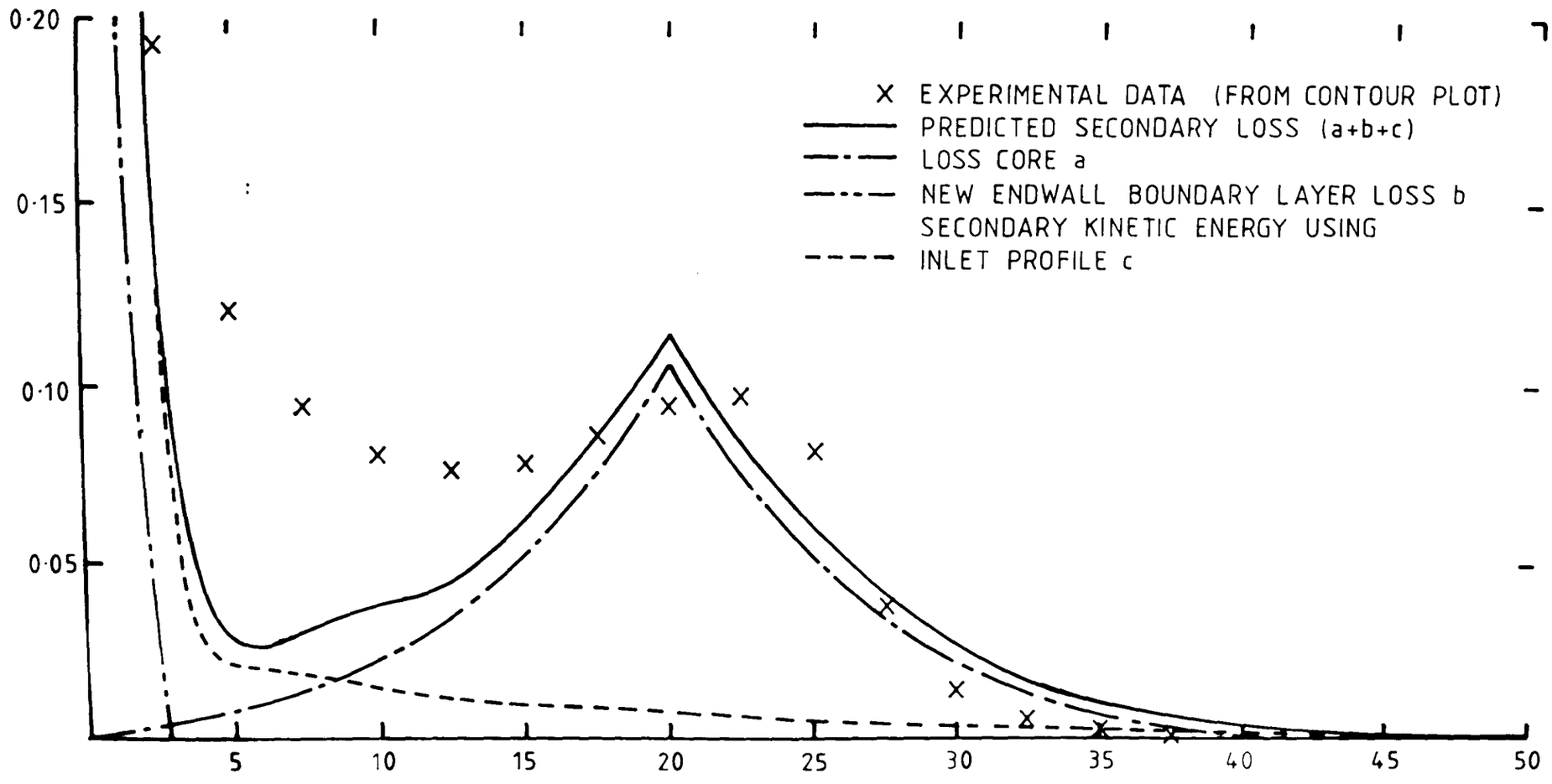


FIGURE 7.10

TEST TURBINE NOZZLE GUIDE VANE EXIT ANGLE PREDICTION

X-AXIS PERCENTAGE OF ANNULUS HEIGHT FROM HUB
Y-AXIS YAW ANGLE (DEGREES)

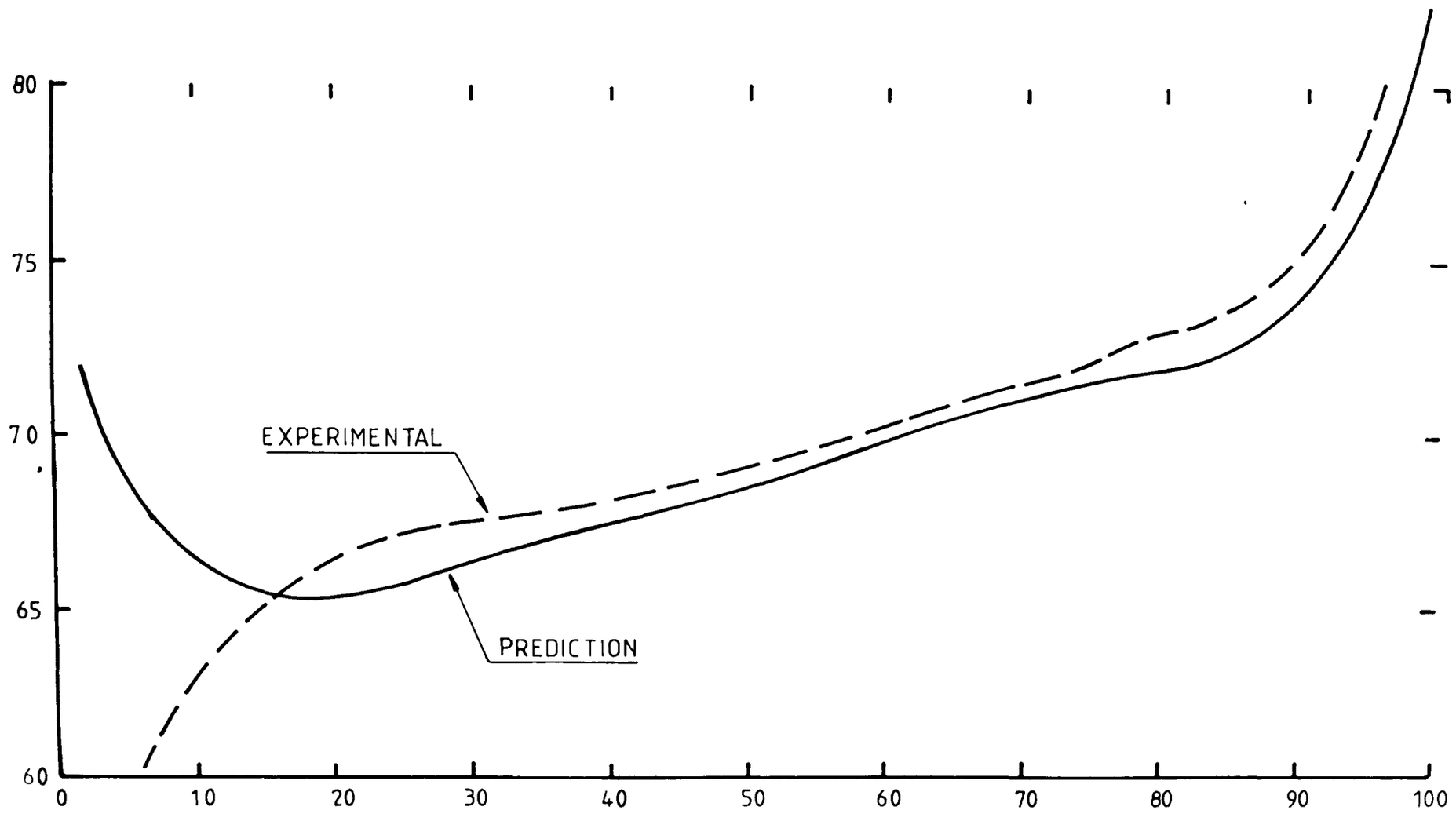


FIG JRI

TEST TURBINE NOZZLE GUIDE VANE SECONDARY LOSS PREDICTION

X-AXIS PERCENTAGE OF ANNULUS HEIGHT FROM HUB
Y-AXIS SECONDARY LOSS COEFFICIENT (NORMALIZED USING EXIT DYNAMIC HEAD)

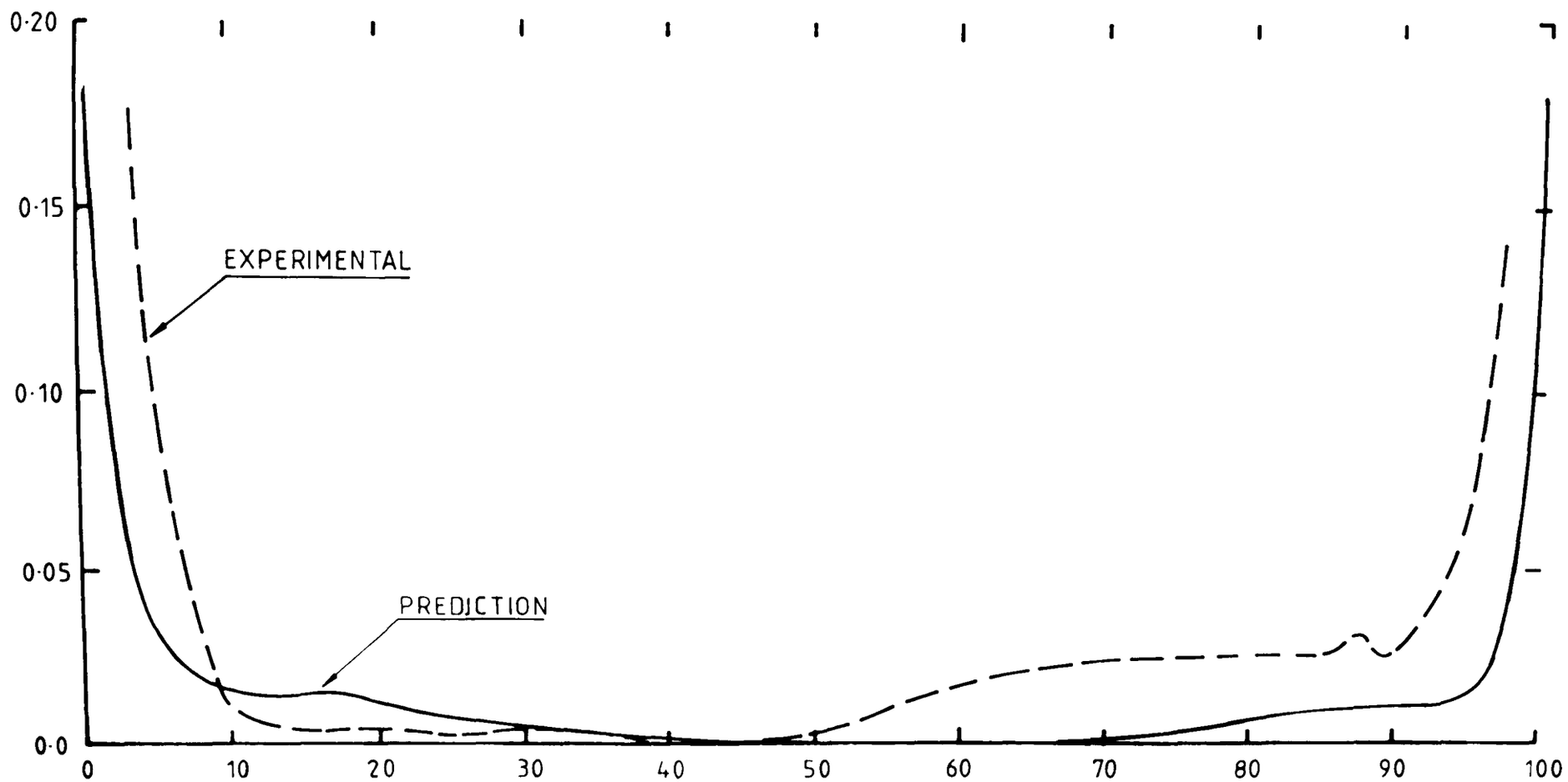
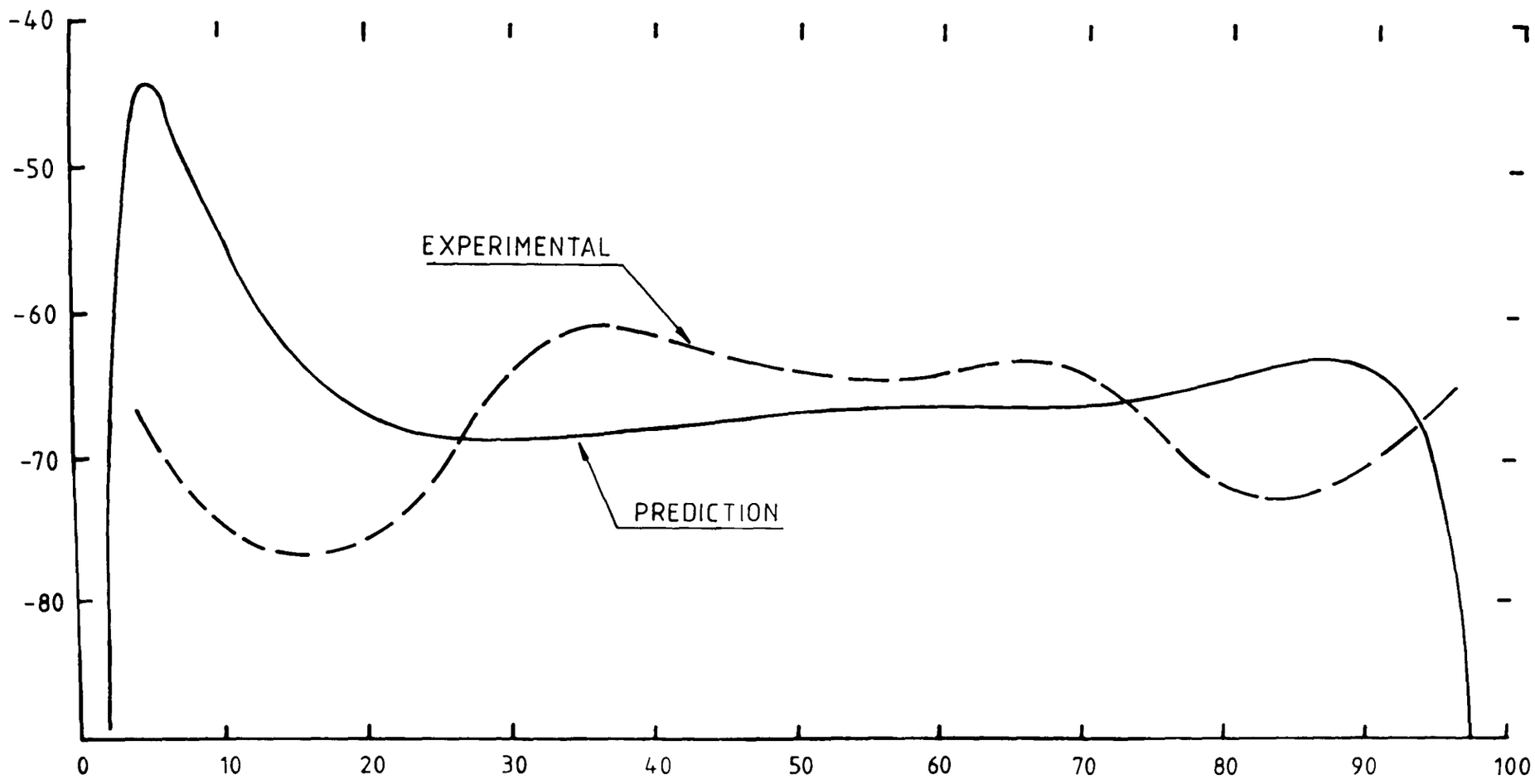


FIGURE 7.12

TEST TURBINE ROTOR EXIT ANGLE PREDICTION

X-AXIS PERCENTAGE OF ANNULUS HEIGHT FROM HUB
Y-AXIS YAW ANGLE (DEGREES ROTOR RELATIVE)



TEST TURBINE ROTOR SECONDARY LOSS PREDICTION

X-AXIS PERCENTAGE OF ANNULUS HEIGHT FROM HUB
Y-AXIS SECONDARY LOSS COEFFICIENT IN STATIC FRAME OF REFERENCE (NORMALIZED USING ROTOR EXIT DYNAMIC HEAD)

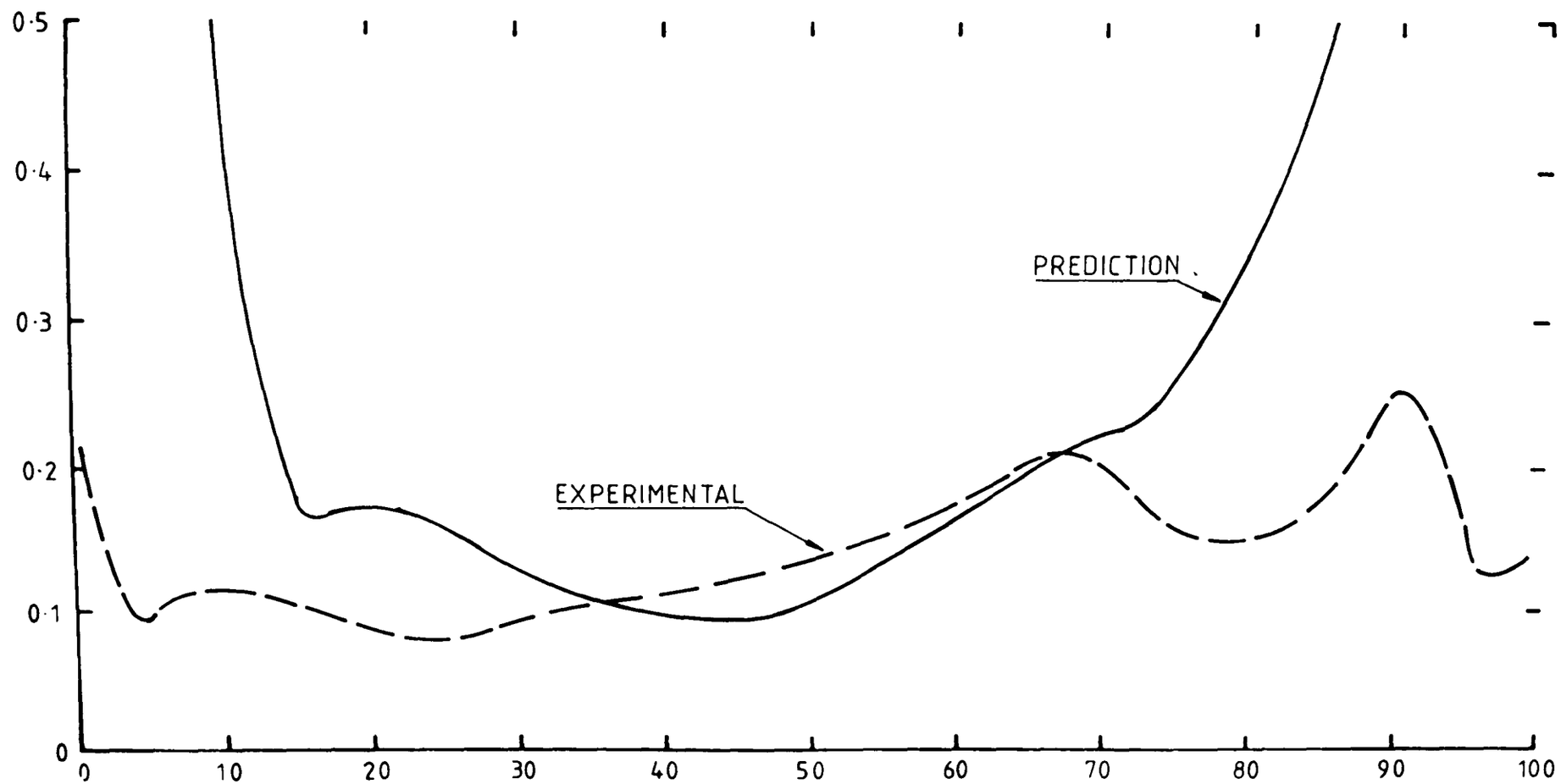
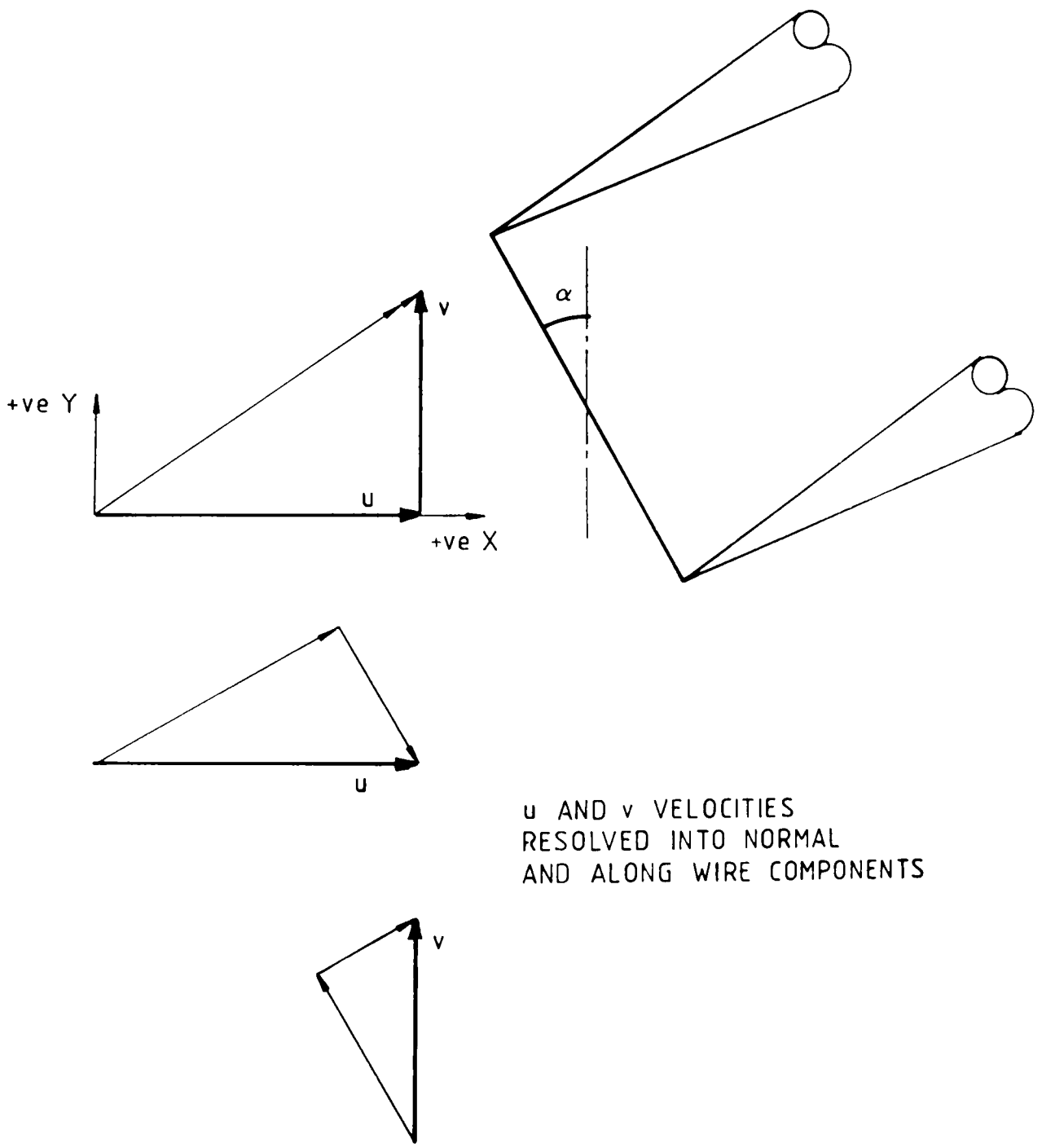


FIGURE 7.14

HOT WIRE PROBE VELOCITY COMPONENTS



u AND v VELOCITIES
RESOLVED INTO NORMAL
AND ALONG WIRE COMPONENTS

FIGURE AIII.1

HOT WIRE PROBE CASCADE VELOCITY COMPONENTS

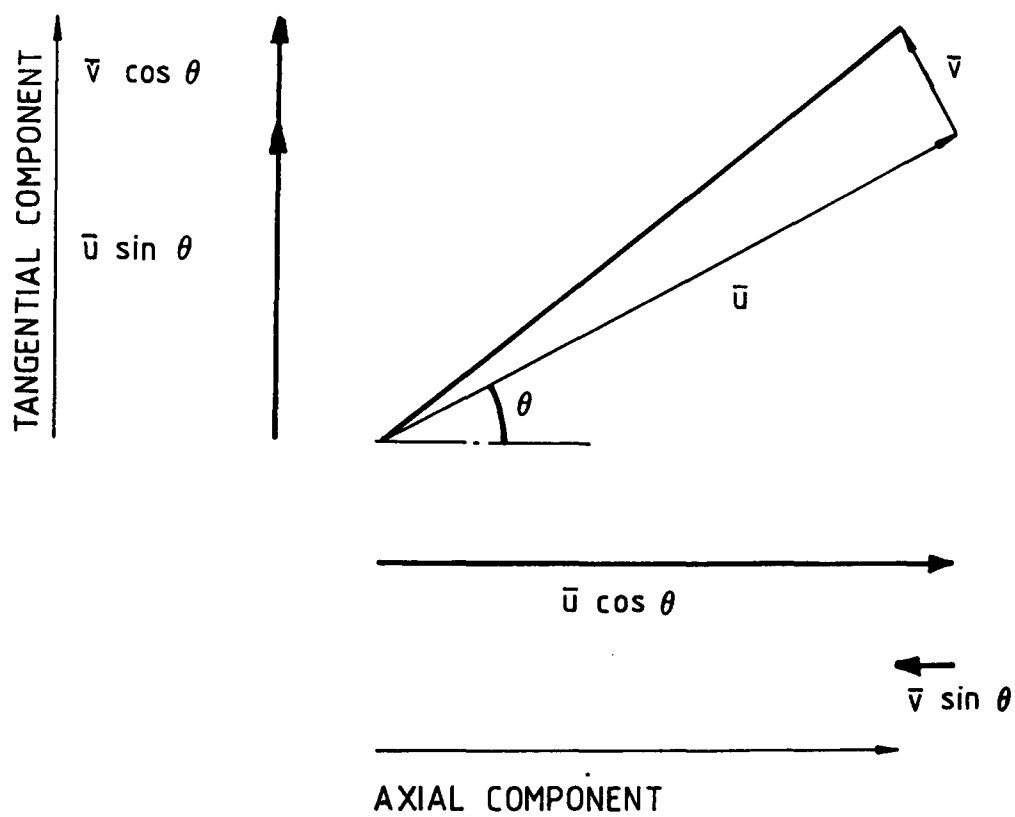


FIGURE AIII.2