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Volume II

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FLIGHT TEST INVESTIGATION OF TRANSONIC  
SHOCK-BOUNDARY LAYER PHENOMENA

Jones F. Cahill  
Bill L. Cooper

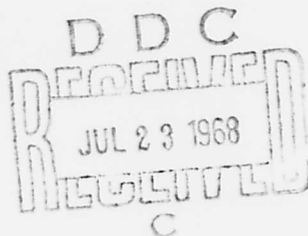
Lockheed-Georgia Company

TECHNICAL REPORT AFFDL-TR-68-84  
VOLUME II

JULY 1968

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FLIGHT TEST INVESTIGATION OF TRANSONIC  
SHOCK-BOUNDARY LAYER PHENOMENA

Jones F. Cahill  
Bill L. Cooper

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## FOREWORD

This report describes a flight investigation of the phenomenon of scaling effects on shock-boundary layer interaction in transonic flow. It was prepared by the Flight Sciences Division of the Lockheed-Georgia Company, Marietta, Georgia, under Air Force Contract F33615-67-C-1777. The work was administered under the direction of the Air Force Flight Dynamics Laboratory, with Mr. A. J. Murn, FDMM, as Project Monitor.

The work reported here was performed during the period from 5 October 1967 to 15 July 1968. This report was submitted by the authors in July 1968.

The authors acknowledge the contributions of the following members of the Lockheed-Georgia Company to the project: Mr. H. J. Coley who supervised the Design, Construction and Installation of the Test Equipment; Mr. A. J. Youngs who directed the Flight Operations; Mr. B. M. Coleman who directed the Data Reduction; and Messrs. W. J. Campbell, P. E. Cole, T. T. Eckert, and Mrs. C. H. Sullins who assisted in the test program and data analysis.

This technical report has been reviewed and is approved.

  
PHILIP P. ANTONATOS  
Chief, Flight Mechanics Division  
Air Force Flight Dynamics Laboratory

## ABSTRACT

A flight test investigation was made using a Lockheed C-141 airplane to obtain data related to scale effects on transonic shock-boundary layer interactions. The primary measurements consisted of wing surface chordwise pressure distributions at three spanwise stations, and boundary layer profiles for three chordwise positions at one spanwise station. Tests were made at nominal altitudes of 20,000 feet and 40,000 feet, resulting in Reynolds number values of approximately  $70 \times 10^6$  and  $40 \times 10^6$ , respectively. At each altitude data were collected at a number of combinations of Mach number (from 0.7 to 0.85) and lift coefficient (from 0 to approximately 0.4). Variations in lift coefficient were obtained by varying load factor.

Volume I contains the data analysis and discussions of the test results. Volume II contains a detailed discussion of the data acquisition and reduction procedures plus a complete presentation of the basic data.

Results obtained, when compared with previously available wind tunnel data, showed that large scale effects on chordwise pressure distribution can occur with turbulent boundary layers on a wing having small Mach number gradients forward of the shock. A shock-induced separation, followed by flow reattachment, was shown to occur when the shock pressure rise reached a value approximately equal to that indicated in NACA Report 1356. Increasing Mach number or angle-of-attack sufficiently beyond the initial separation point caused the separation bubble to spread to the trailing-edge, resulting in an abrupt forward movement of the shock. While the flight shock locations were within the spread of those shown by low Reynolds number wind tunnel results, no single wind tunnel configuration (transition strip, Reynolds number, vortex generator) provided a good indication of the flight result over the whole range of conditions tested. For wing sections of the type used on the C-141, scale effects on buffet phenomena should be anticipated also.

Distribution of this abstract is unlimited.

## TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
I	TEST PROGRAM	1
	General	1
	Instrumentation	1
II	TEST PROCEDURES AND DATA REDUCTION	3
	Test Procedures	3
	Data Reduction	4
III	BASIC DATA PRESENTATION	13
	Scope Of Data	14
	Conditions Table	15
	Boundary Layer Velocity Profiles And Pressure Distributions	18
	REFERENCES	220

## LIST OF ILLUSTRATIONS

<u>Figure</u>	<u>Title</u>	<u>Page</u>
1	Wing Planform and Dimensions	6
2	Boundary Layer Rakes	7
3	Nose Boom Installation	8
4	Ship System Pitot-Static Probe Installation (Right Side)	9
5	Pressure Distribution Comparison - Lag Check                      Mach = .742	10
6	Pressure Distribution Comparison - Lag Check                      Mach = .800	11
7	Scope Of Flight Test Investigation	14
8	Boundary Layer Velocity Profiles And Pressure Distributions                      Mach .700 to .706	18 thru 29
9	Boundary Layer Velocity Profiles And Pressure Distributions                      Mach .742 to .752	30 thru 45
10	Boundary Layer Velocity Profiles And Pressure Distributions                      Mach .762 to .780	46 thru 69
11	Boundary Layer Velocity Profiles And Pressure Distributions                      Mach .794 to .802	70 thru 97
12	Boundary Layer Velocity Profiles And Pressure Distributions                      Mach .817 to .822	98 thru 121
13	Boundary Layer Velocity Profiles And Pressure Distributions                      Mach .840 to .860	122 thru 133

LIST OF ILLUSTRATIONS (CONTINUED)

<u>Figure</u>	<u>Title</u>	<u>Page</u>
14	Boundary Layer Velocity Profiles And Pressure Distributions Mach .690 to .702	134 thru 147
15	Boundary Layer Velocity Profiles And Pressure Distributions Mach .748 to .754	148 thru 161
16	Boundary Layer Velocity Profiles And Pressure Distributions Mach .765 to .780	162 thru 171
17	Boundary Layer Velocity Profiles And Pressure Distributions Mach .790 to .810	172 thru 189
18	Boundary Layer Velocity Profiles And Pressure Distributions Mach .820 to .830	190 thru 205
19	Boundary Layer Velocity Profiles And Pressure Distributions Mach .840 to .850	206 thru 219
TABLE	FLIGHT TEST PRESSURE SURVEY	15 thru 17

## LIST OF ABBREVIATIONS AND SYMBOLS

$C_L$	airplane lift coefficient ( $- N_z W/qS$ )
$N_z$	load factor
$q$	dynamic pressure
$S$	wing area
$W$	airplane weight
$C_p$	pressure coefficient
$M_{BL}$	Mach number in the boundary layer
$M_L$	Mach number outside the boundary layer
$M_\infty$	freestream Mach number
$V_{BL}$	velocity in the boundary layer
$V_L$	velocity outside the boundary layer
$X/C$	streamwise coordinates in terms of airfoil chord
$Y$	vertical coordinate as measured from wing surface
$\Lambda_{L.E.}$	wing leading edge sweep angle
$\Lambda_{T.E.}$	wing trailing edge sweep angle

## SECTION I

### TEST PROGRAM

#### General

The C-141 airplane was used in this program to obtain wing pressure distributions and corresponding boundary layer profiles at transonic speeds. Pressure distributions were obtained at three spanwise stations, and boundary layer profiles at three chordwise locations for one spanwise station. Instrumentation consisted of standard ship's system instrumentation plus a test nose boom, surface static pressure tubing and boundary layer total pressure rakes.

The test objectives were to obtain an accurate measurement of shock locations and boundary layer characteristics over as wide a Reynolds number range as possible. Static pressure pick-ups were installed every two and one-half percent chord, on the wing upper surface, in the region of the shock. The spread in Reynolds number was from values of approximately  $70 \times 10^6$  to  $40 \times 10^6$ .

#### Instrumentation

Surface pressures were measured on the right wing at the three spanwise locations shown in Figure 1. STRIP-A-TUBE of approximately one-eighth inch height and three inch width was bonded to the wing surface. Tubing was attached to the wing fixed structure and flaps separately so as to allow for full flap travel without damage to the tubing. Holes were drilled in the STRIP-A-TUBE at the desired chordwise locations and resulted in twenty-five upper surface orifices, nineteen lower surface orifices plus leading edge and trailing edge orifices at each spanwise station. SCANIVALVES were located in the flap cove area and wiring routed to an oscillograph located in the cargo compartment. Surface pressures were referenced to the test boom static source. A few of the orifices were lost during testing due to leaks in the tubing. Data were also lost on the most inboard station, during one flight, due to a malfunction of the SCANIVALVE. The malfunction was corrected and the lost data recovered on subsequent flights.

Figure 2 shows photographs of the boundary layer rakes used in this investigation. The rakes were located on the left wing at one spanwise station. This location corresponded to the middle station used in wing surface pressure measurements. The three inch high rakes were at 30% and 55% chord positions and the five inch high rake was at 80% chord. The rakes did have a small amount of spanwise variation to assure that one rake would not be in the wake of another. The spanwise variation between rakes was five inches with the 55% chord rake located at wing station 373. All rakes were equipped with two

static pressure probes. Measurement with the boundary layer static probes generally gave good agreement with surface-measured pressures for rakes forward of the shock. In the shock and aft of the shock static pressure data from the probes is subject to question because of possible large flow angles in the boundary layer. For example, in some cases it was noted that the static pressure as measured by the probes was lower than that measured on the surface. Total probes are more insensitive to flow angles and are believed to give good results except in separated flow regions.

The five inch rake has two total probes that face in the aft direction to measure the total pressure of the reversed flow in a separated boundary layer. The results of these measurements were disappointing and again the problem appeared to be large flow angularity with respect to the probes. It is believed that when the flow separates a considerable amount of spanwise flow exists. In some separated cases it was noted that the static probes and both the forward-facing and the aft-facing total probes were recording the same values of pressure. This condition would be expected if the flow were essentially normal to the axis of the probes or if the flow were completely random. No meaningful results were obtained from the aft facing probes and the results were plotted at  $V_{BL}/V_L = 0$  on the boundary layer profile plots in Section III of this report.

Boom total pressure was used as the reference pressure for the rake measurements. Some problems did exist in boom total pressure on the high altitude test. Moisture apparently condensed in the total pressure probe and froze during tests above 28,000 feet. The outer probes on the boundary layer rakes were always recording freestream conditions so they were used as reference pressure for all the high altitude data. Flight 549 was made with a moisture-free boom and proved the validity of using the rake probes, outside the boundary layer, as reference sources.

Information on flight conditions (Mach number, dynamic pressure, ambient pressure and temperature, and airplane load factor) were obtained from the standard airplane instrumentation and a nose boom. Figure 3 shows details of the test boom used in the investigation. Figure 4 shows the pitot-static probe installation used as a part of the standard airplane instrumentation. Two independent pairs of pitot-static probes are located on each side of the fuselage and provide pneumatic information to the pilot's and copilot's central air data computer respectively. The ship's airspeed system was used to determine flight conditions and its accuracy was checked with the boom airspeed system. Exact agreement between the two systems existed at all flight Mach numbers.

## SECTION II

### TEST PROCEDURES AND DATA REDUCTION

#### Test Procedures

Previous wing surface pressure data were available from the original C-141 flight-demonstrated loads investigation, Reference 1. The variations between wind tunnel-measured and flight-measured shock locations were apparent but the exact magnitude of the differences could not be determined due to wide spacing (10% to 15% of the chord) of the measuring orifices. Subsequent to the loads investigation, a wind tunnel test, Reference 2, accurately measured the upper-surface shock locations and boundary layer profiles on a C-141 wing model. Variations in testing techniques were investigated by using different methods of transition location, vortex generators and changing of test Reynolds number. The purpose of the flight program has been to obtain similar information over as wide a Mach number, lift coefficient and Reynolds number range as possible to allow for comparison with the wind tunnel data.

Tests were made at nominal altitudes of 20,000 feet and 40,000 feet to obtain the widest practicable spread in Reynolds number, resulting in values of approximately  $70 \times 10^6$  and  $40 \times 10^6$  respectively. At each altitude, data were collected at a number of combinations of Mach number (from 0.7 to 0.85) and lift coefficient (from 0 to approximately 0.4). Variations in lift coefficient were obtained by varying load factor since the range available from gross weight changes alone was not sufficient for the purposes of this investigation.

The test procedures in some cases were difficult and required considerable skill on the part of the pilots. The airplane was stabilized at a Mach number and altitude and the positive load factors achieved by turning flight. The negative load factors were achieved by a roller coaster maneuver and data recorded while going over the top in a nose over condition. Attempts to hold the steady condition resulted normally in 15 to 20 seconds of data records, and in the most severe case in 5 to 6 seconds of records. The SCANIVALVE sequence time was 3 seconds. Checks for steadiness of the data were made by comparing adjacent records. During each test run the SCANIVALVE was allowed to record continuously.

Since it is not possible to maintain constant values of all primary flight conditions (Mach number, altitude, lift coefficient) during tests of this type, it was considered desirable to demonstrate the absence of extraneous effects in the data measured. In this test series, the most practicable procedure was to hold Mach number and load factor constant and to accept the altitude changes which were necessary to attain the desired test point.

Figures 5 and 6 present the results of tests designed to measure the lag effects on total and static pressures due to altitude changes. Conditions 547/4B1 and 547/4B2 were made in stable flight at an altitude of approximately 20,000 feet. The pressure data were recorded holding the aircraft at constant altitude, Mach number, and load factor. The effects of lag were tested and are shown as conditions 547/4A1 and 547/4A2. The aircraft was placed in a dive at an altitude of approximately 30,000 feet and a constant rate-of-sink established at 8,000 feet per minute. As the aircraft passed through 20,000 feet, the data as shown for conditions 547/4A1 and 547/4A2 were recorded. The Mach numbers and load factors were the same as recorded during the constant altitude test. The results indicate that the measurable lag in the pressure system is zero. Therefore, any altitude changes that might exist in the remainder of the test data should be of no consequence.

Figure 7 presents the scope of the flight test investigation. Lift coefficients and Mach numbers are presented for both the low and high altitude test.

### Data Reduction

Data Reduction involved reducing the surface pressure measurements to pressure coefficients and the boundary layer profiles to velocity ratios. These computations were performed by a UNIVAC 1108 computer and the data plotted by a cathode ray tube plotter.

The surface pressure measurements were reduced to pressure coefficients and corrected for the boom position error. Superimposed on each pressure distribution plot are lines showing constant values of local Mach number normal to the local wing element lines. The following equation was used to calculate pressure coefficients for constant local Mach lines:

$$C_p = \left( \frac{20}{\gamma M_\infty^2} \right) \left[ \frac{(1.0 + [(\gamma - 1)/2] M_\infty^2 \cos^2 \beta)}{(1.0 + [(\gamma - 1)/2] M_{LOCAL}^2)} \right]^{\frac{\gamma}{\gamma - 1}} - 1.0$$

where  $\beta = \tan^{-1} \left[ \tan \Lambda_{LE} - (X/C)(\tan \Lambda_{LE} - \tan \Lambda_{TE}) \right]$

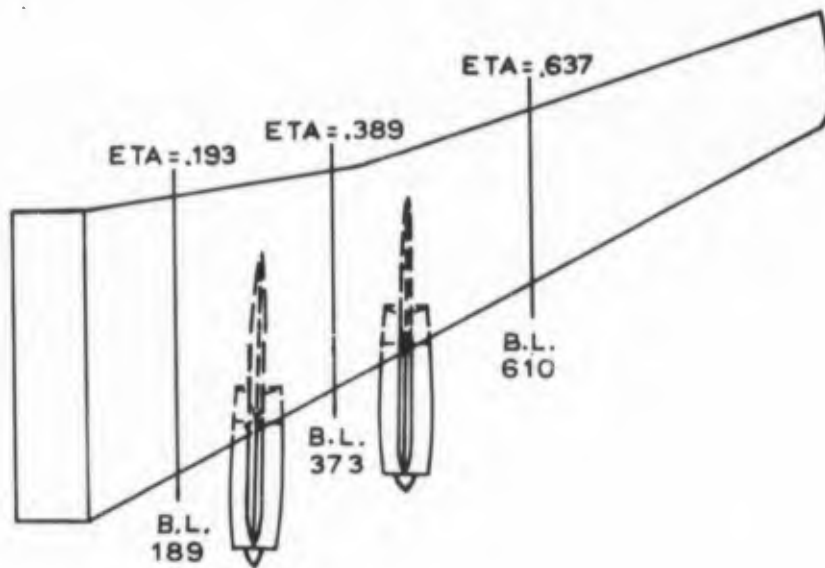
The boundary layer total pressure profiles were reduced to ratios of velocity within the boundary layer ( $v_{BL}$ ) to velocity outside the boundary layer ( $v_L$ ). The following equation was used to calculate velocity profiles:

$$v_{BL}/v_L = (M_{BL}/M_L) \left[ \sqrt{\frac{1.0 + [(\gamma - 1)/2] M_L^2}{1.0 + [(\gamma - 1)/2] M_{BL}^2}} \right]$$

where  $M = \sqrt{5(P_t/P_s)^{2/7} - 5}$

Static pressures in the boundary layer were obtained from the surface pressure measurements obtained by use of the STRIP-A-TUBE on the right wing at the same wing station.

The airplane angle-of-attack was obtained by use of a vane on the test boom. The boom indicated angle-of-attack was corrected for position error to arrive at the correct angle-of-attack. In cases where it was desirable to know the angle-of-attack of an equivalent rigid airplane (for comparisons with wind tunnel model data) it was necessary to account for aerodynamic twist. The twist angle at each spanwise station was calculated for the specific flight condition. The equivalent rigid angle-of-attack was obtained by algebraically adding the aerodynamic twist angle to the corrected angle-of-attack. This calculation allowed airplane and model data to be compared with the corresponding wing sections at the same angles-of-attack. All wind tunnel and flight comparisons in this report are compared at equivalent angles-of-attack.



#### WING DIMENSIONS

Span	159.67 ft
Area total including aileron flaps and 450.0 sq ft of fuselage	3228.1 sq ft
Aspect ratio	7.90
Airfoil Chord:	
At root	398.00 in.
At construction tip	132.62 in.
Mean (MAC)	266.51 in.
Airfoil Section Designation and Thickness (Percent Chord):	
At root NACA 0013.00 (Mod)	13.00
At construction tip NACA 0010.00 (Mod)	10.00
At construction joint (B.L. 415) NACA 0011.00 (Mod)	11.00
Incidence:	
At root	4.89 deg
At construction break	2.25 deg
At construction tip	-0.69 deg
Sweep at 25 Percent Chord:	
Outboard of construction joint	25.02 deg
Inboard of construction joint	23.73 deg
Dihedral at 25 Percent Chord:	
Outboard of construction joint	-1.195 deg
Inboard of construction joint	-0.941 deg

FIGURE 1 WING PLANFORM AND DIMENSIONS

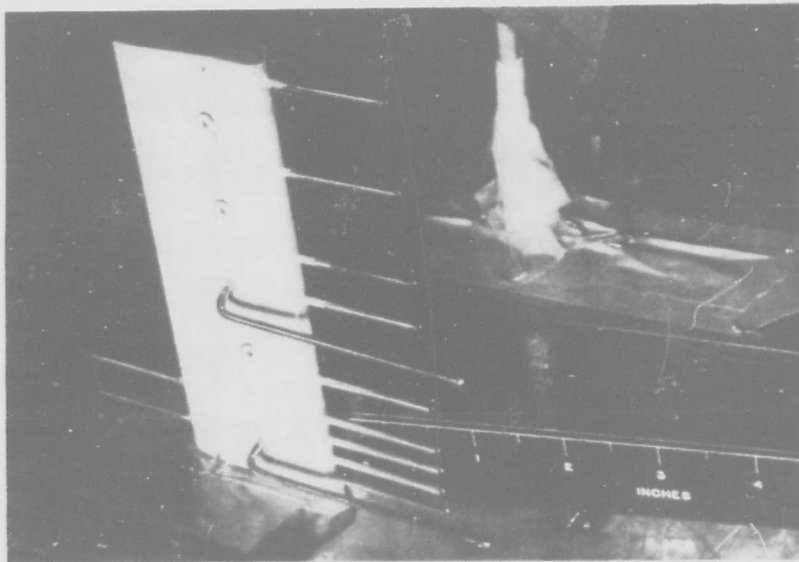
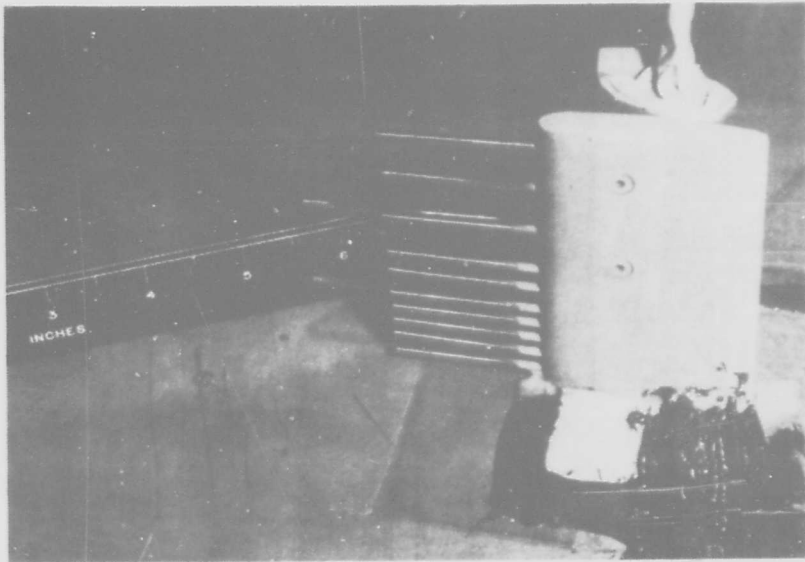


FIGURE 2 BOUNDARY LAYER RAKES

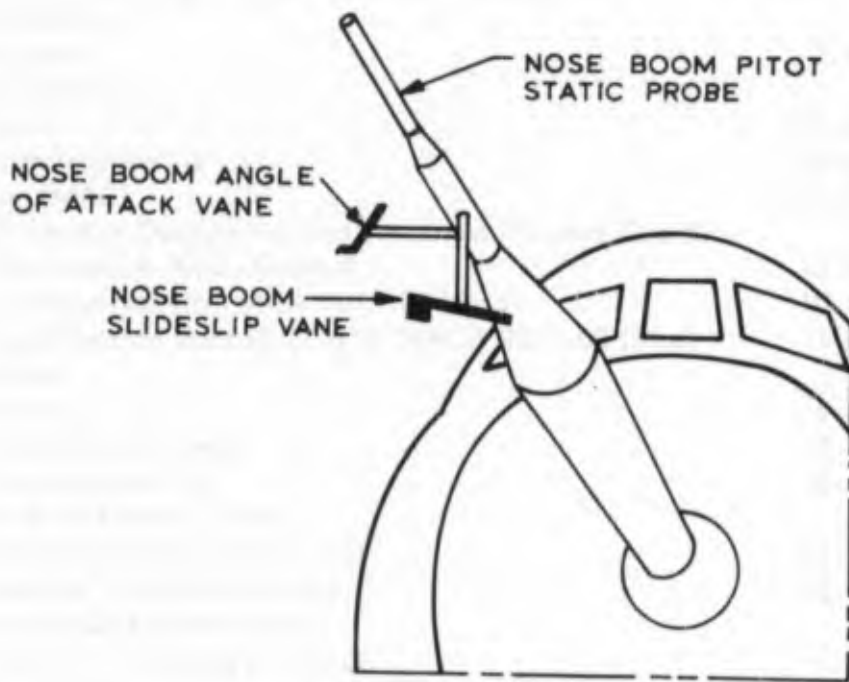
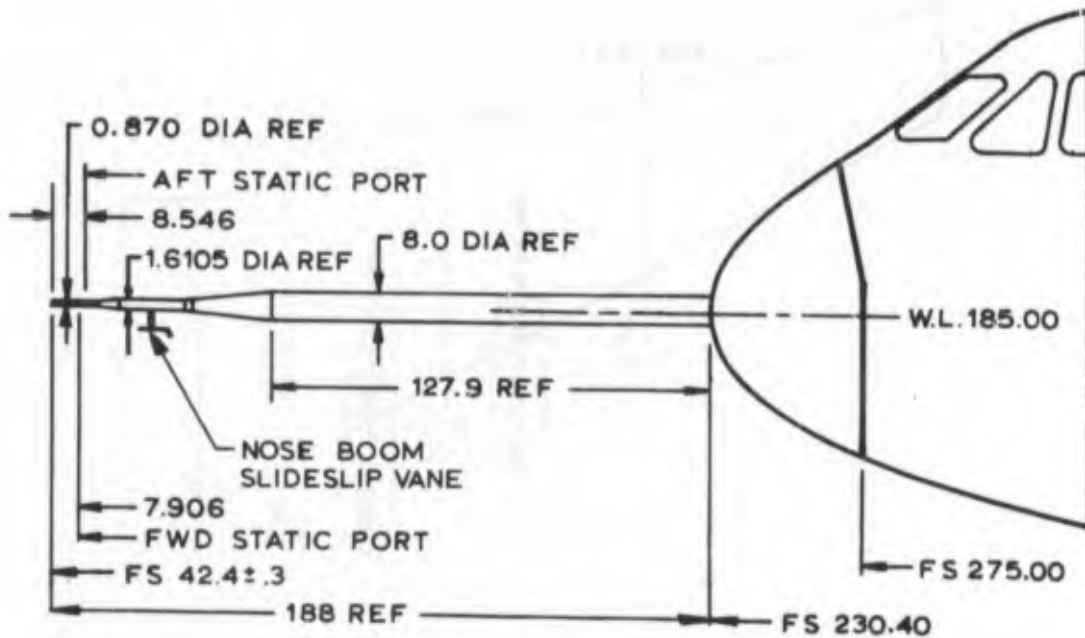


FIGURE 3 NOSE BOOM INSTALLATION



FIGURE 4 SHIP SYSTEM PITOT-STATIC PROBE  
INSTALLATION (RIGHT SIDE)

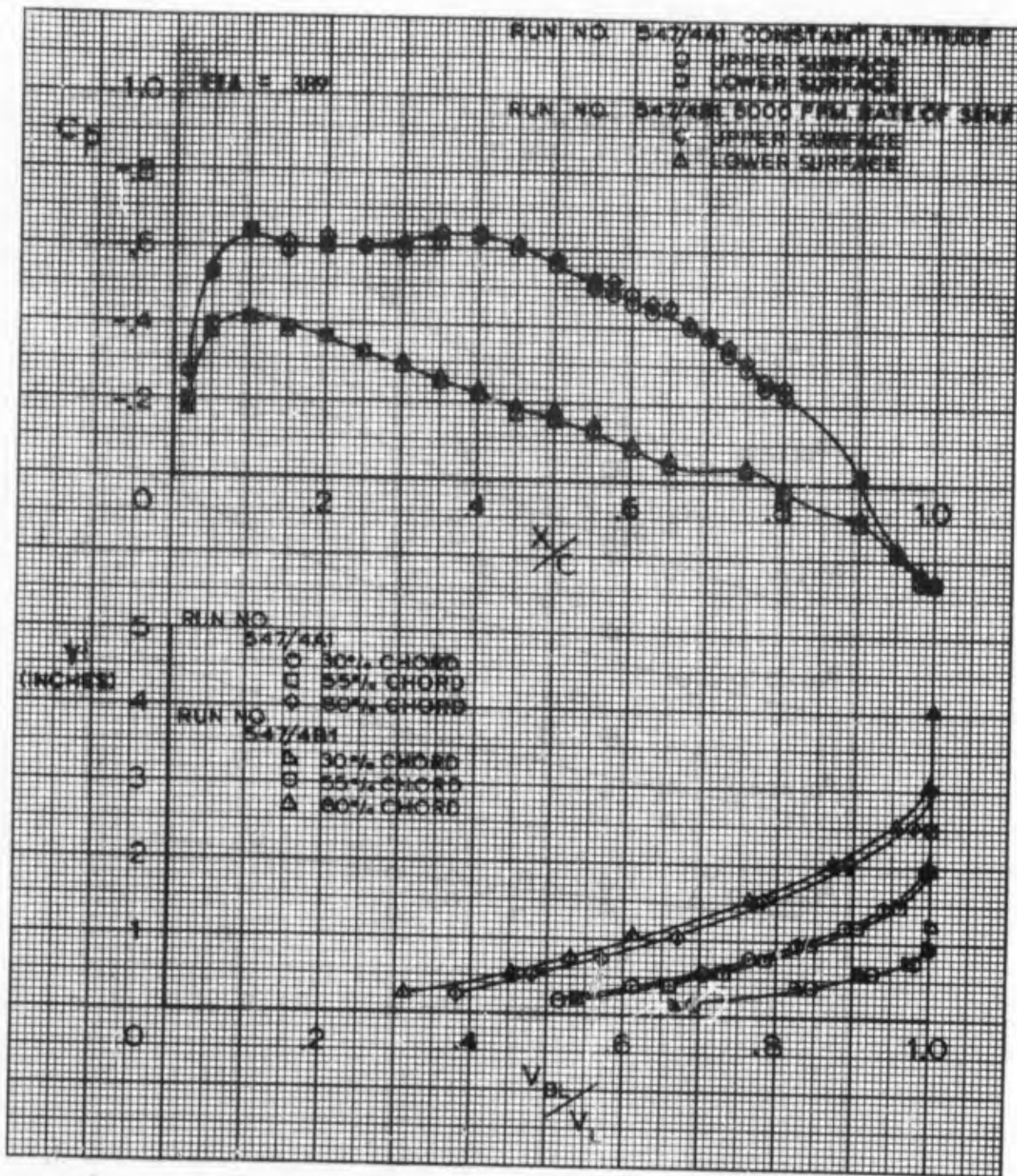


FIGURE 5 PRESSURE DISTRIBUTION COMPARISON  
 LAG CHECK MACH = .742

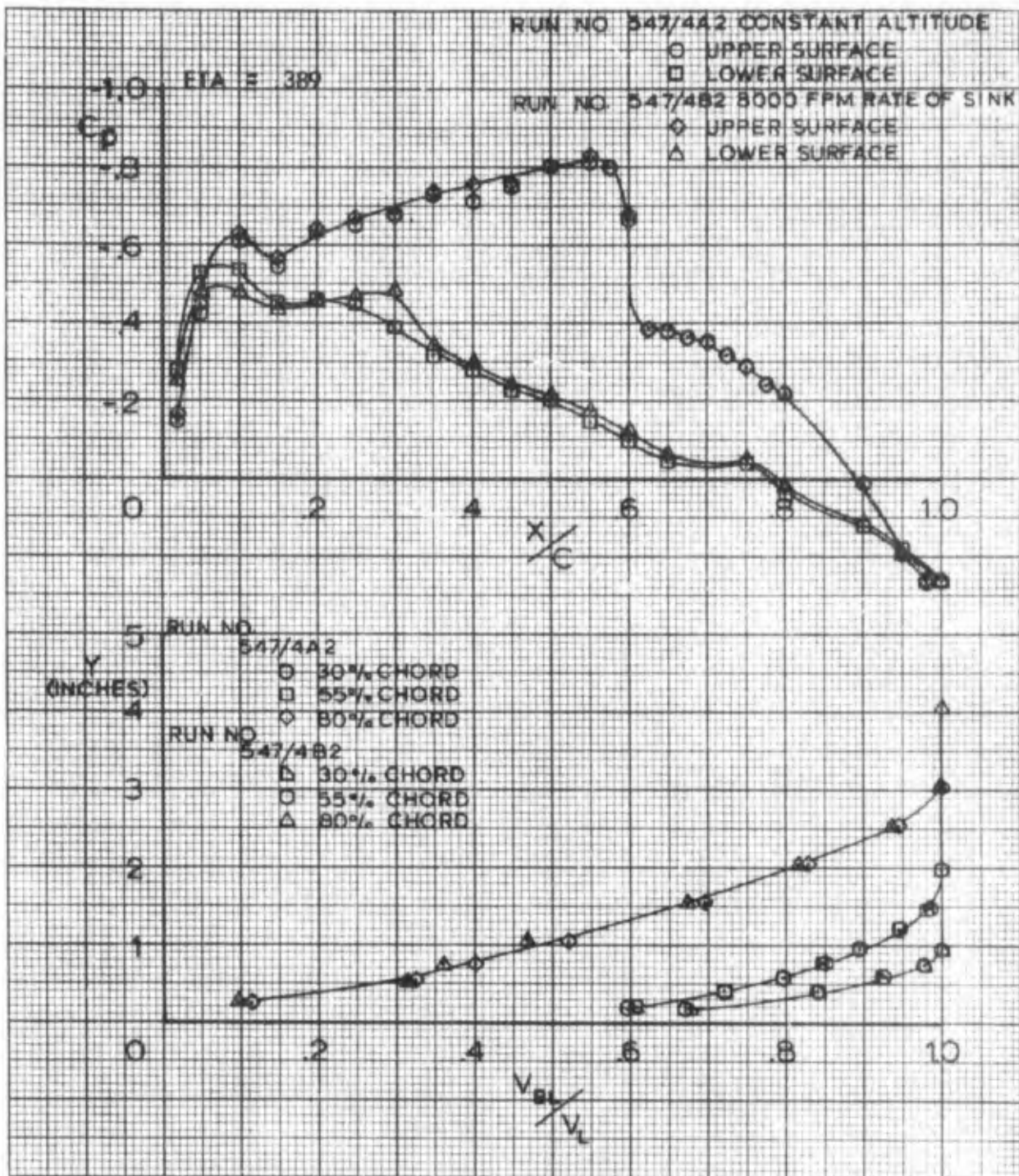


FIGURE 6 PRESSURE DISTRIBUTION COMPARISON  
 LAG CHECK MACH = .800



SECTION III

BASIC DATA PRESENTATION

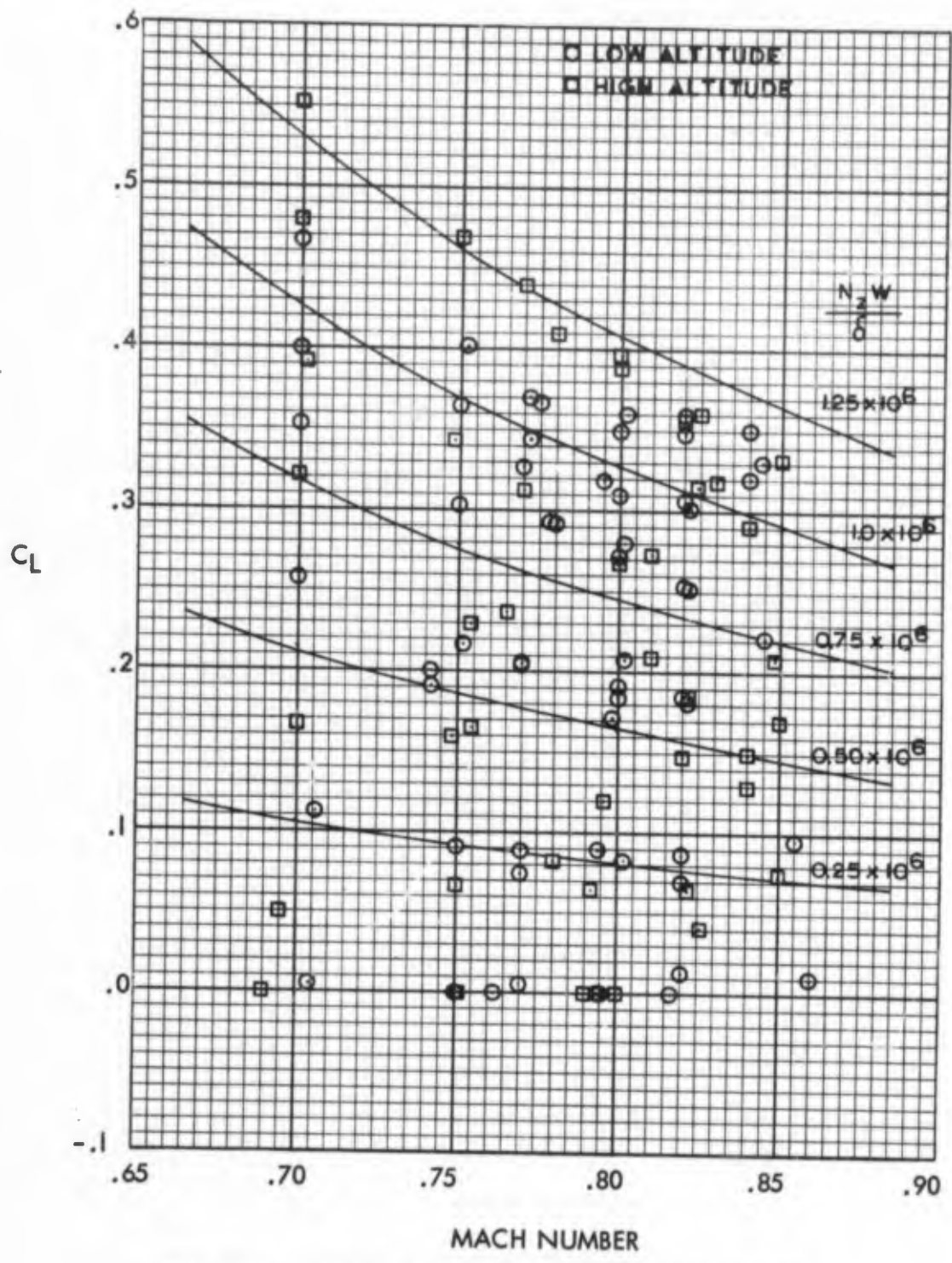


FIGURE 7 SCOPE OF FLIGHT TEST INVESTIGATION

TABLE  
 FLIGHT TEST PRESSURE SURVEY  
 LOW ALTITUDE ( ≈ 20,000 FT)

<u>FIGURE NUMBER</u>	<u>MACH NUMBER</u>	<u>REYNOLD'S NUMBER × 10<sup>-6</sup></u>	<u>CORRECTED ALPHA - deg</u>
8 a)	.704	56.61	-2.87
b)	.706	57.72	-1.86
c)	.700	58.52	-0.54
d)	.700	57.64	0.22
e)	.700	59.72	0.58
f)	.700	58.28	1.07
9 a)	.750	61.50	-2.87
b)	.750	62.19	-2.02
c)	.752	62.48	-0.95
d)	.742	64.89	-0.56
e)	.742	71.21	-0.45
f)	.750	62.41	-0.35
g)	.750	62.35	0.22
h)	.752	63.83	0.31
10 a)	.762	62.72	-2.78
b)	.770	71.63	-2.64
c)	.770	64.92	-2.01
d)	.770	71.13	-1.88
e)	.770	63.47	-1.01
f)	.770	69.73	-0.96
g)	.780	65.45	-0.44
h)	.778	71.21	-0.28
k)	.770	64.34	-0.18
l)	.772	70.97	0.04
m)	.772	64.70	0.15
n)	.775	72.49	0.22
11 a)	.795	63.17	-2.78
b)	.794	73.88	-2.73
c)	.794	62.32	-1.95
d)	.802	77.09	-1.95
e)	.800	71.79	-1.12
f)	.802	62.75	-1.10
g)	.798	72.48	-0.70
h)	.800	72.16	-0.70
k)	.802	63.63	-0.62
l)	.800	72.43	-0.54
m)	.795	62.43	-0.28
n)	.800	72.77	-0.27
o)	.800	72.51	-0.07
p)	.802	64.19	-0.07

TABLE (CONTINUED)

FLIGHT TEST PRESSURE SURVEY

LOW ALTITUDE ( ≈ 20,000 FT)

<u>FIGURE NUMBER</u>	<u>MACH NUMBER</u>	<u>REYNOLD'S NUMBER × 10<sup>-6</sup></u>	<u>CORRECTED ALPHA ~ deg</u>
12 a)	.820	76.21	-2.72
b)	.817	67.24	-2.70
c)	.820	65.04	-2.20
d)	.820	74.93	-2.06
e)	.820	63.71	-1.27
f)	.822	72.50	-1.27
g)	.820	63.77	-0.78
h)	.822	73.13	-0.70
k)	.822	64.76	-0.35
l)	.820	72.82	-0.20
m)	.820	73.07	0.22
n)	.820	64.74	0.22
13 a)	.860	53.38	-2.24
b)	.855	60.93	-1.30
c)	.845	59.05	0.13
d)	.840	58.84	1.00
e)	.844	59.30	1.35
f)	.840	60.95	1.62

HIGH ALTITUDE ( ≈ 40,000 FT)

14 a)	.690	25.47	-2.40
b)	.695	25.37	-1.90
c)	.700	25.43	-0.87
d)	.700	25.40	0.57
e)	.702	25.61	1.17
f)	.700	25.18	1.93
g)	.700	25.27	2.63
15 a)	.751	33.64	-2.40
b)	.750	36.22	-1.64
c)	.748	33.98	-0.97
d)	.754	32.74	-0.97
e)	.754	33.75	-0.37
f)	.748	31.23	0.65
g)	.750	26.64	1.77

TABLE (CONCLUDED)

FLIGHT TEST PRESSURE SURVEY

HIGH ALTITUDE ( =40,000 FT)

<u>FIGURE NUMBER</u>	<u>MACH NUMBER</u>	<u>REYNOLD'S NUMBER x 10<sup>-6</sup></u>	<u>CORRECTED ALPHA - deg</u>
16 a)	.780	36.03	-1.55
b)	.765	32.75	-0.37
c)	.770	32.39	0.13
d)	.770	31.89	1.25
e)	.780	32.85	1.51
17 a)	.790	38.46	-2.31
b)	.800	39.73	-2.14
c)	.796	39.26	-1.30
d)	.810	39.72	-0.70
e)	.810	42.11	-0.60
f)	.800	35.40	-0.18
g)	.792	40.47	0.04
h)	.800	34.05	0.74
k)	.800	33.81	1.25
18 a)	.826	43.76	-2.55
b)	.822	42.14	-2.28
c)	.820	45.43	-1.62
d)	.822	44.27	-1.27
e)	.824	41.35	-0.10
f)	.825	37.52	0.83
g)	.820	35.86	1.10
h)	.830	40.17	1.16
19 a)	.850	45.65	-2.20
b)	.850	44.26	-1.12
c)	.840	44.64	-0.87
d)	.840	42.85	-0.70
e)	.848	46.52	-0.60
f)	.840	44.51	0.31
g)	.850	39.77	1.77

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 546  
 RUN NO 1A1  
 MACH NO .704

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

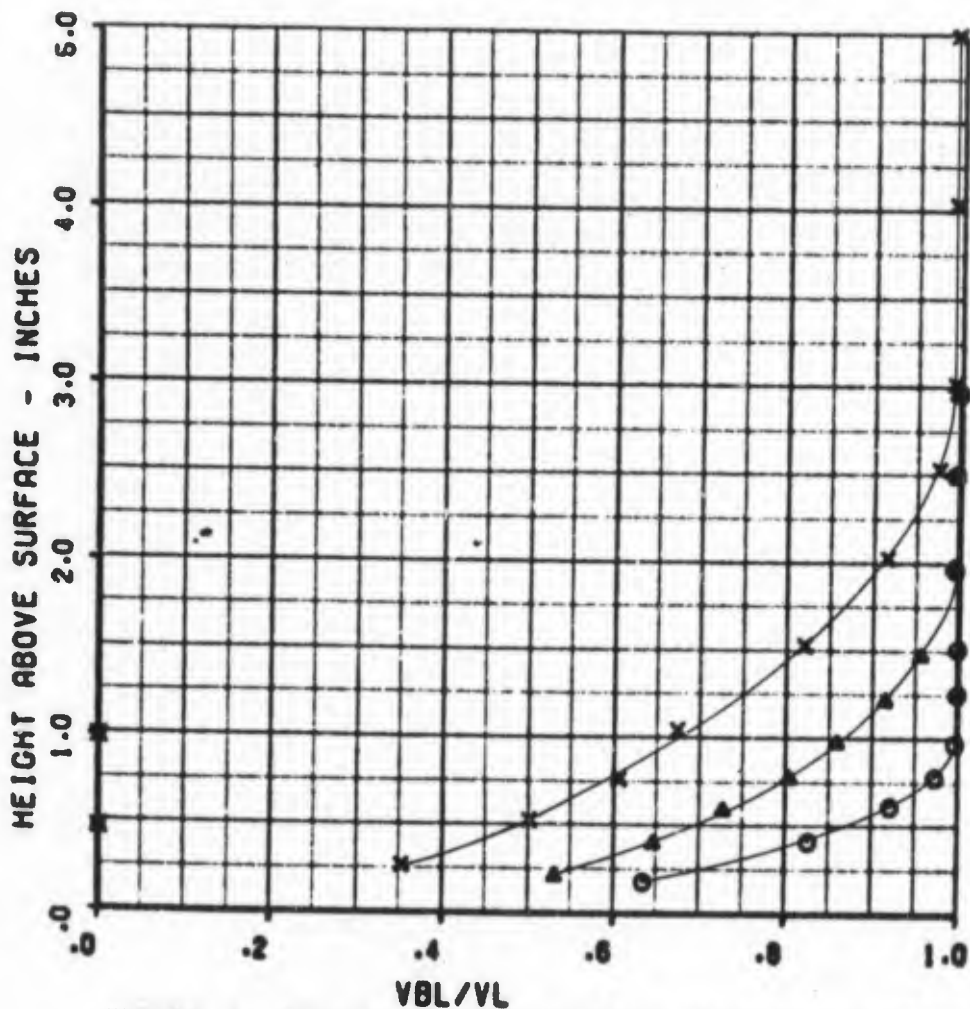


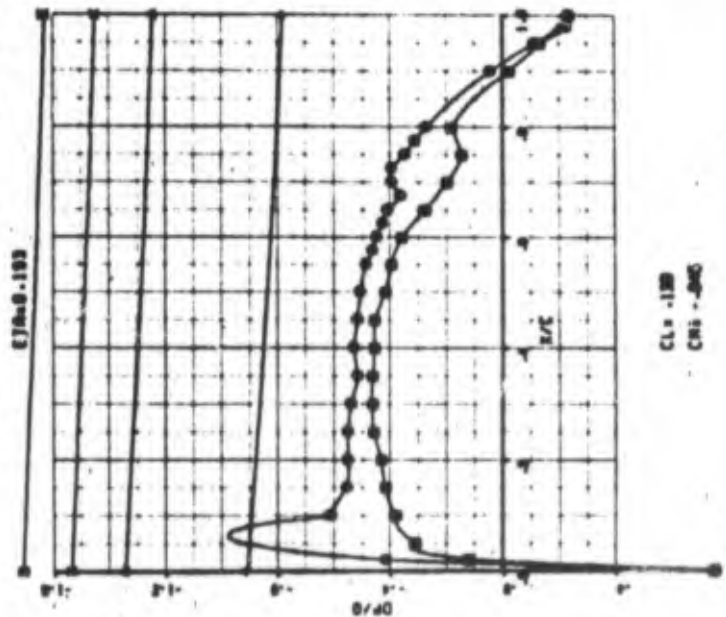
FIGURE 8 BOUNDARY LAYER VELOCITY PROFILES AND PRESSURE DISTRIBUTIONS  
 MACH .700 TO .706  
 (a) CORRECTED ALPHA = -2.87

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 140  
RUM NO 141  
MACH NO .704

Q  
ALPHA  
TRIM

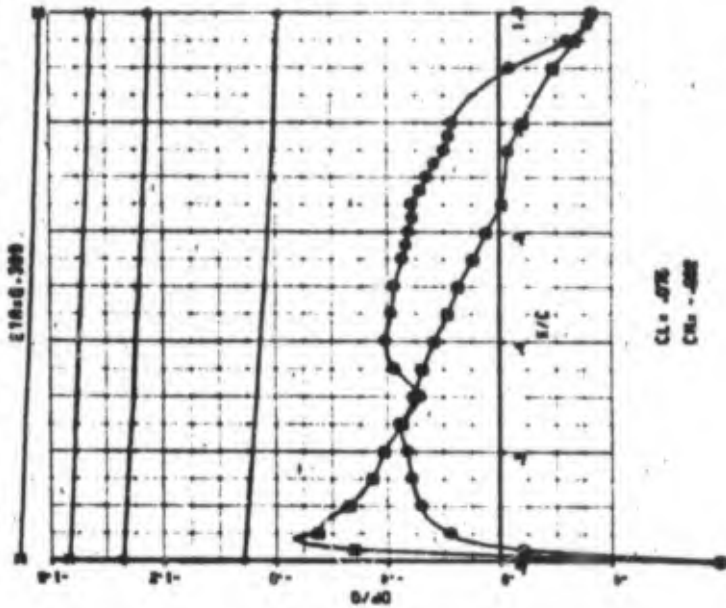
2.19 PSI  
-3.00 DEG  
-20.5 DEG C



ALTITUDE 21800. FT  
WEIGHT 263500. LB  
MZ 402

CO  
RILEYON PBS  
FLMP PBS

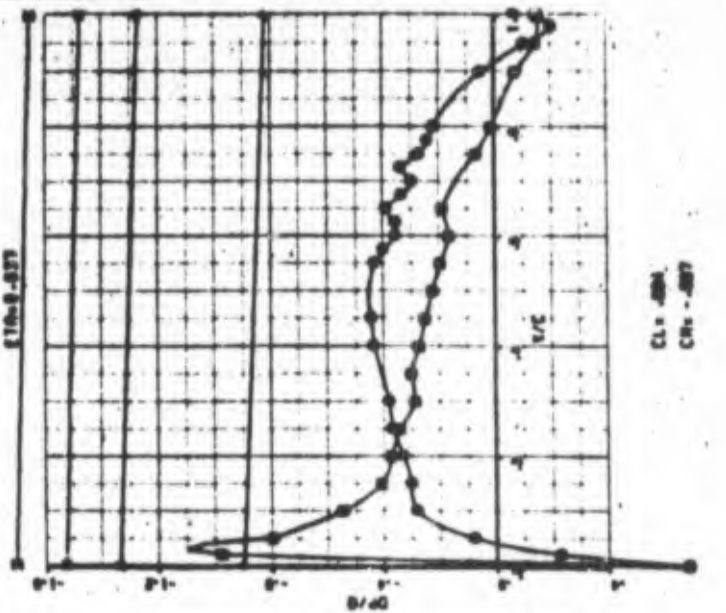
29.00 Z MAC  
-25 DEG  
0.00 DEG



UPPER SURFACE  
LOWER SURFACE  
MACH LOCAL

A  
X  
Z

MACH LOCAL-1-2  
MACH LOCAL-1-3  
MACH LOCAL-1-4



# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 546  
 RUN NO 1A2  
 MACH NO .706

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 60 %  
 ✱ 90 % (AFT)

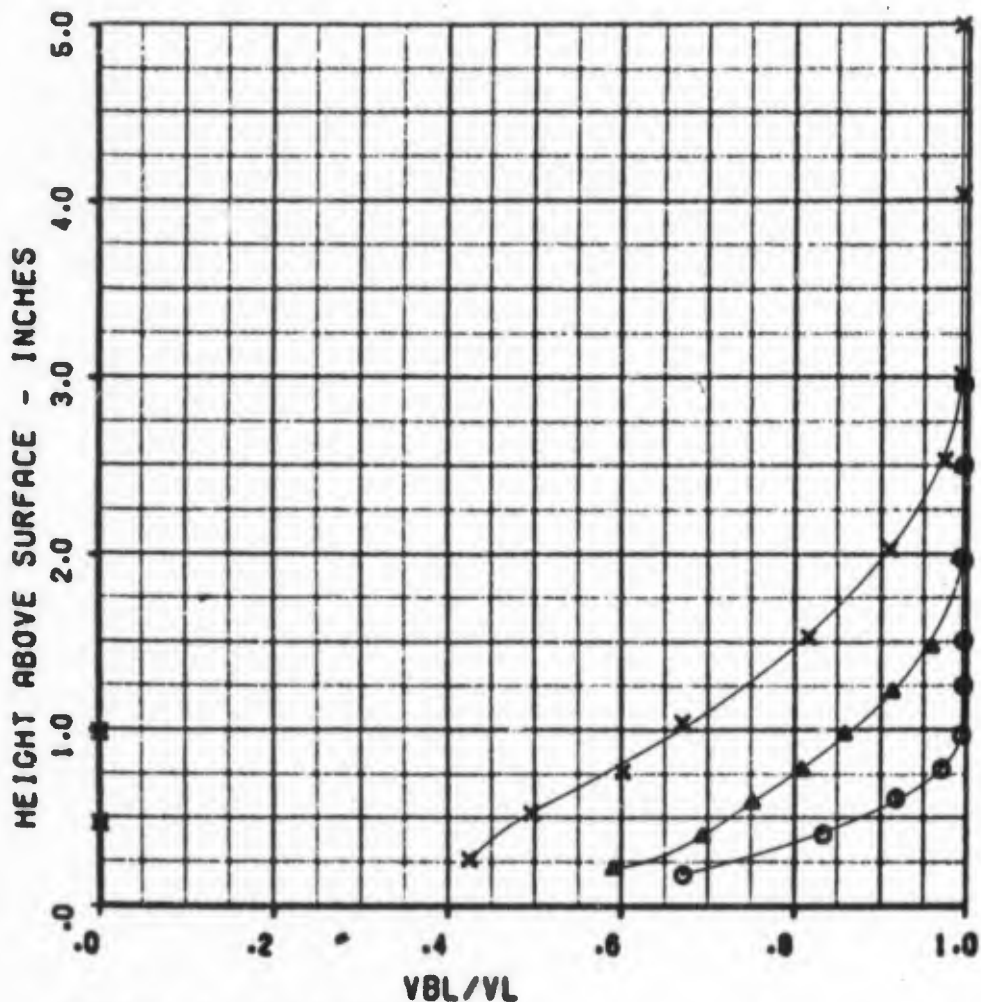


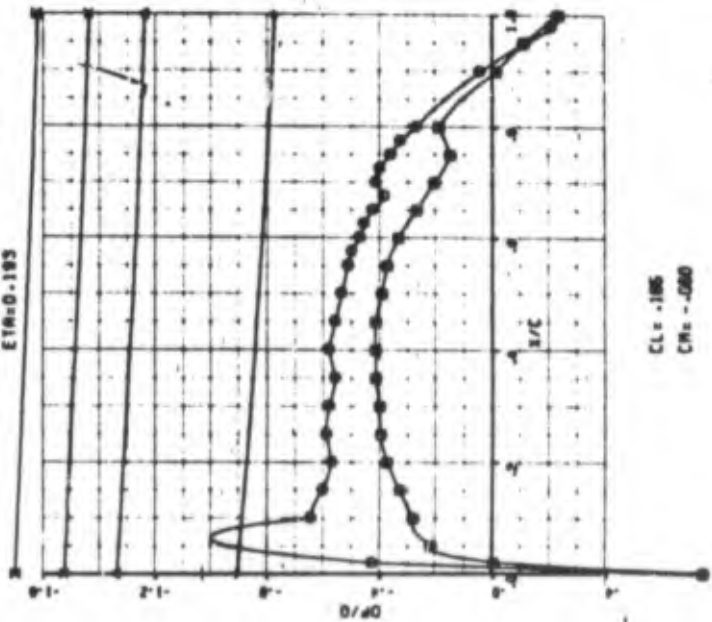
FIGURE 8 (CONTINUED)  
 (b) CORRECTED ALPHA = -1.86

LOCKHEED C-141A  
PRESSURE DISTRIBUTION

FLIGHT NO 545  
RUN NO 182  
MACH NO .705

Q 2.26 PSI  
ALPHA -2.66 DEG  
TRW -19.5 DEG C

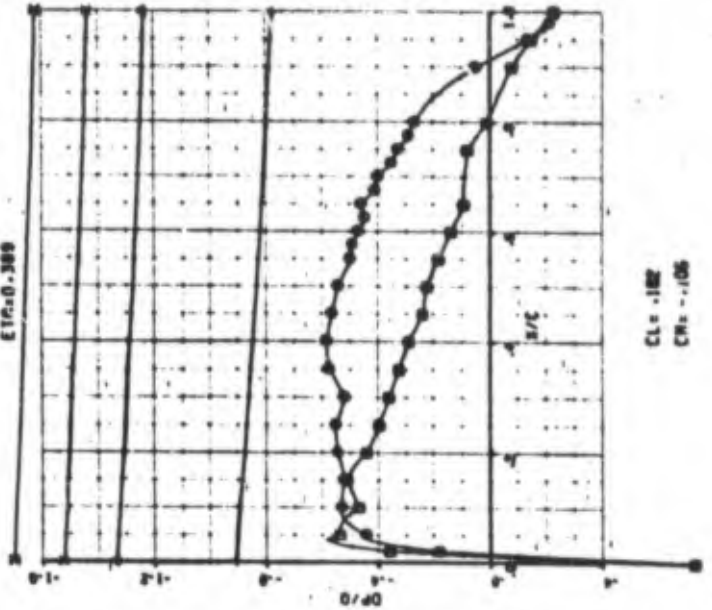
ETA=0.193



ALTITUDE 20000. FT  
HEIGHT 26400. LB  
NZ .46

CO 26.80 X MAC  
AILERON POS -58 DEG  
FLAP POS 0.00 DEG

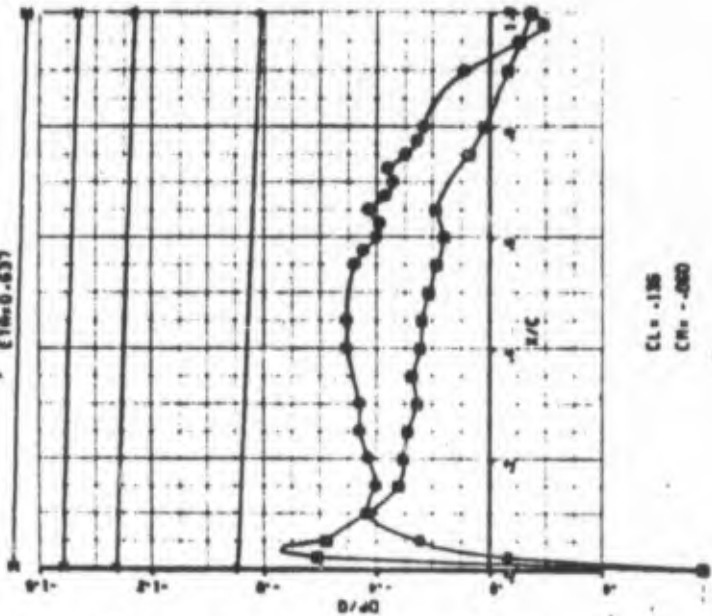
ETA=0.388



UPPER SURFACE  
LOWER SURFACE  
MACH LOCAL -1.0

MACH LOCAL -1.2  
MACH LOCAL -1.3  
MACH LOCAL -1.4

ETA=0.637



# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 546  
 RUN NO 1A  
 MACH NO .700

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

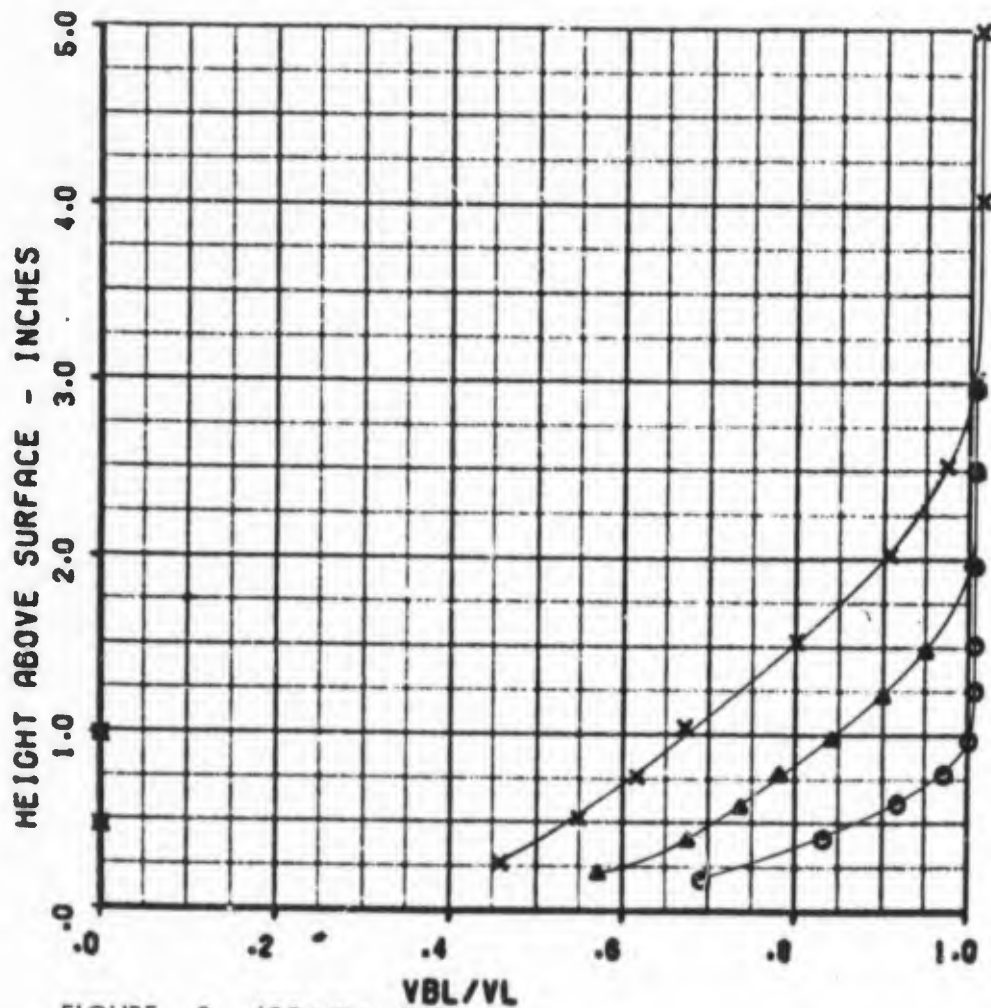
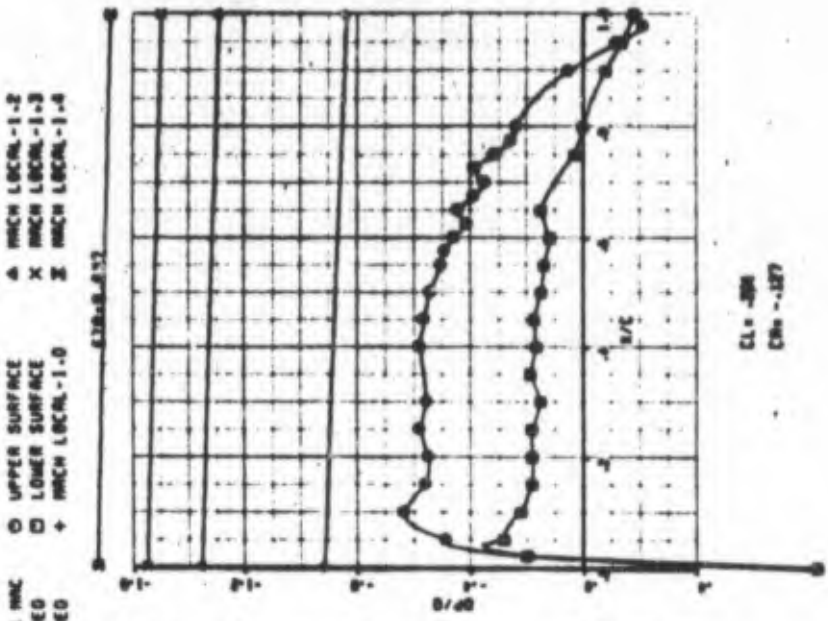
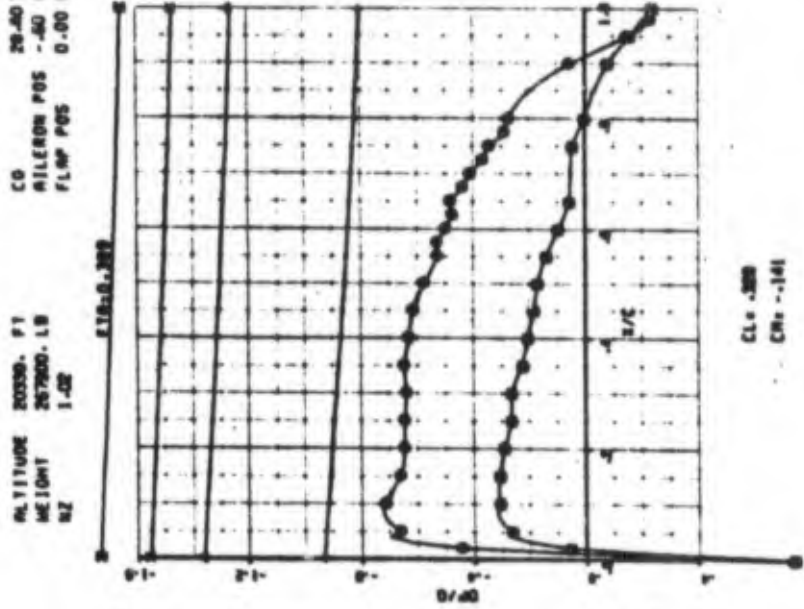
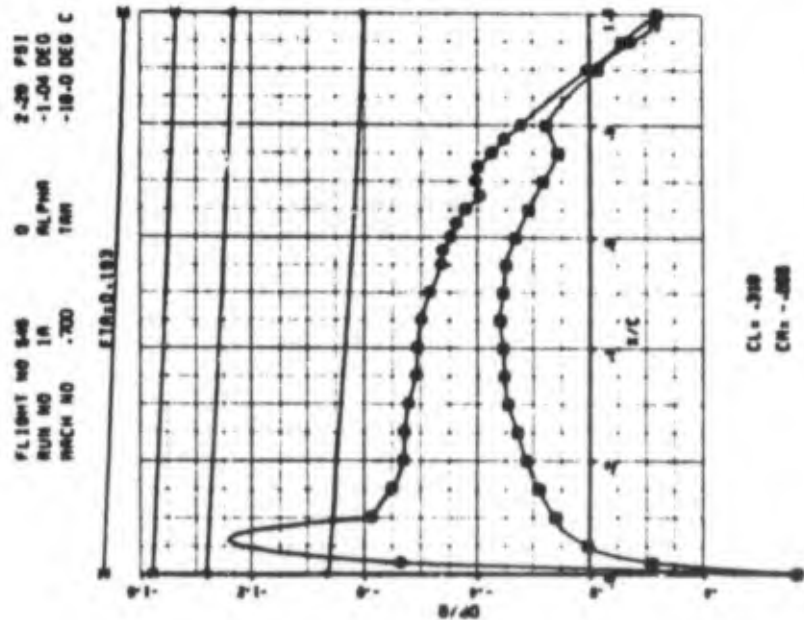


FIGURE 8 (CONTINUED)  
 (c) CORRECTED ALPHA = -0.54

LOCKHEED C-141A  
PRESSURE DISTRIBUTION



# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 546  
 RUN NO 1A3  
 MACH NO .700

### RAKE LOCATIONS

○ 30 %  
 ▲ 65 %  
 × 80 %  
 ✱ 80 % (AFT)

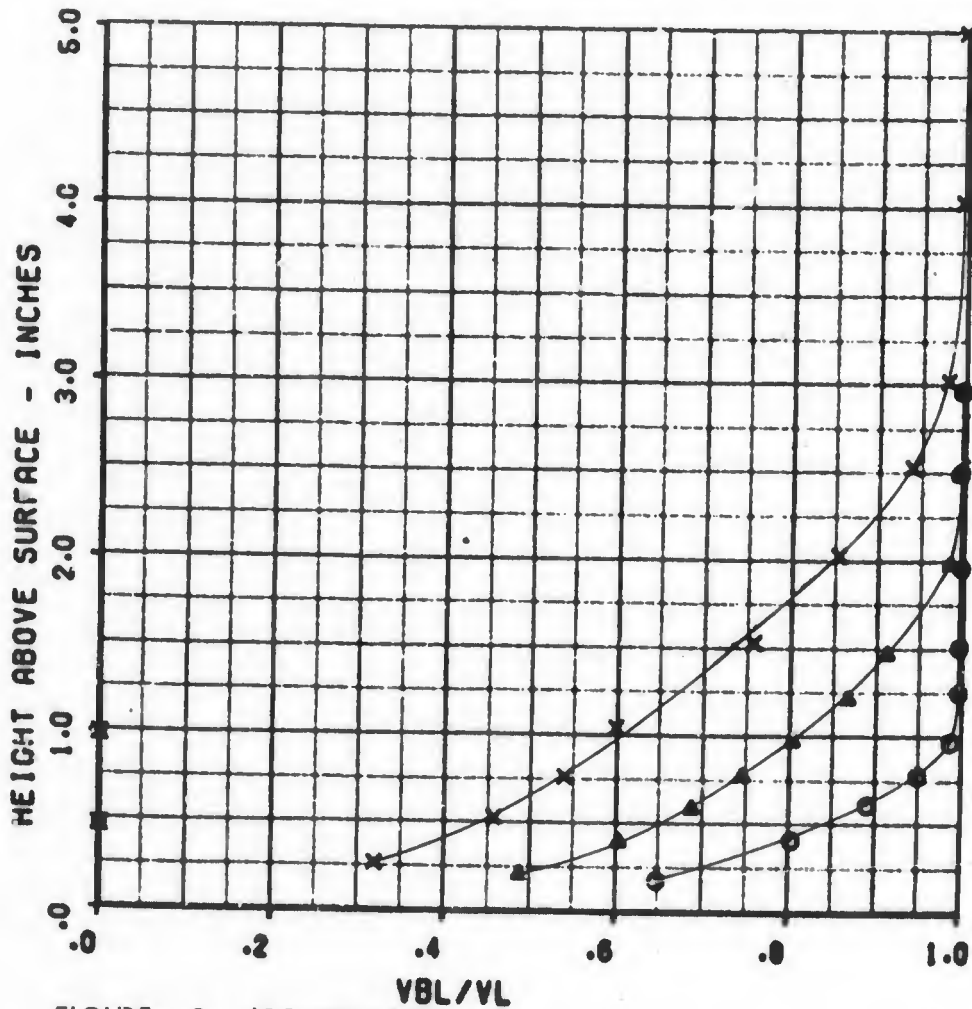


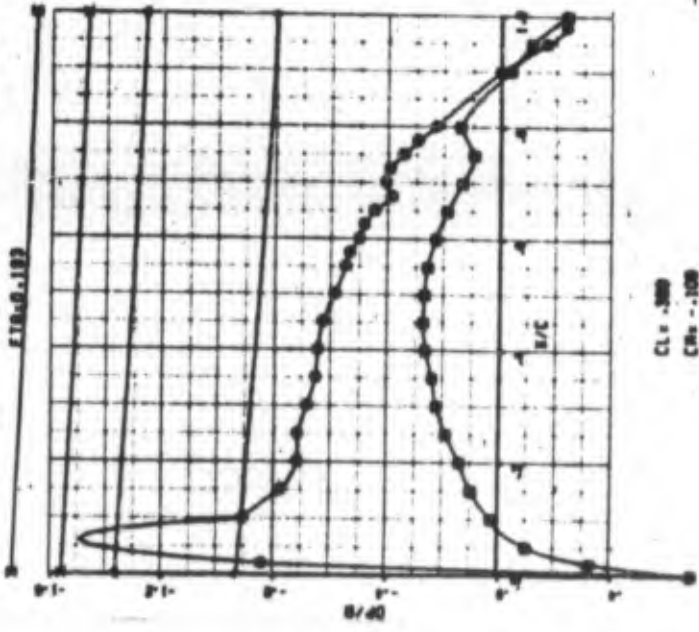
FIGURE 8 (CONTINUED)  
 (d) CORRECTED ALPHA = 0.22

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 648  
RUN NO 183  
MACH NO .703

0  
ALPHA  
TRIM

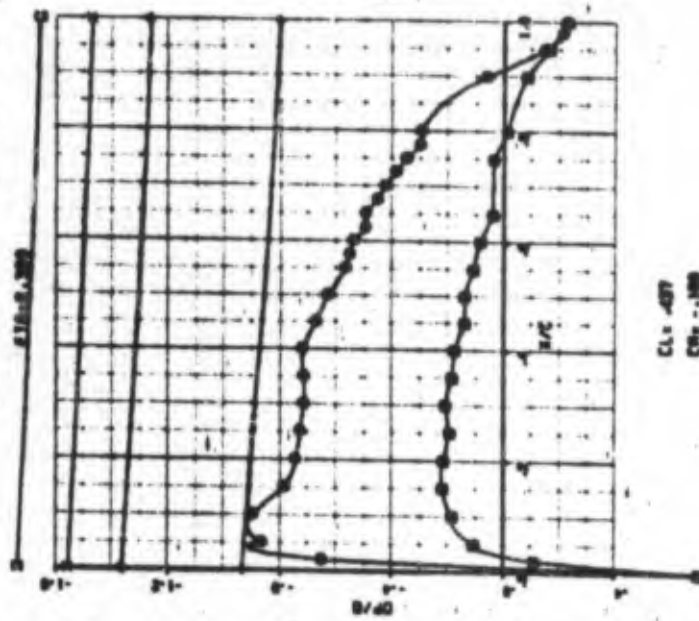
2.25 PSI  
-20 DEG  
-18.5 DEG C



CLx .389  
CRz -.108

ALTITUDE 20700. FT  
WEIGHT 287200. LB  
MZ 1.38

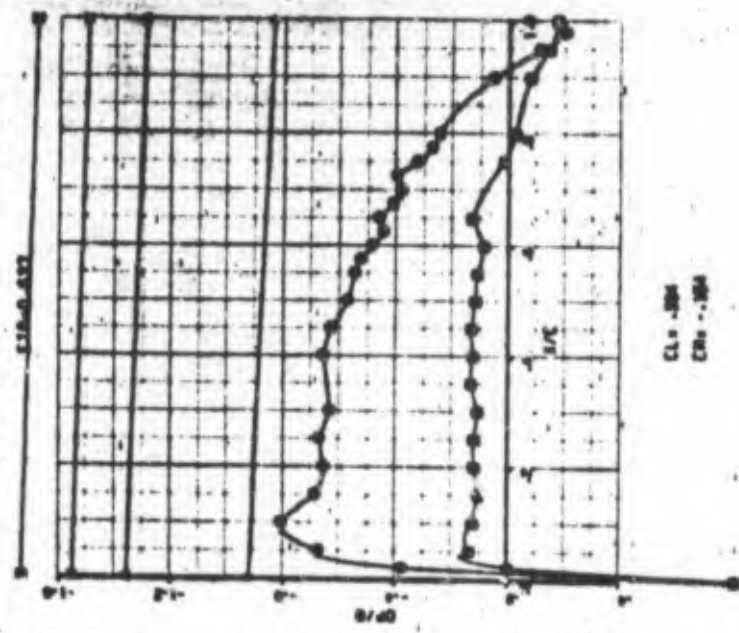
CG 20.60 ± MAC  
MILLERON PPS -.60 DEG  
FLMP PPS 0.00 DEG



CLx .407  
CRz -.109

UPPER SURFACE  
LOWER SURFACE

MACH LOCAL-1.0  
MACH LOCAL-1.4



CLx .394  
CRz -.104

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 546  
 RUN NO 1A4  
 MACH NO .700

## RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AF1)

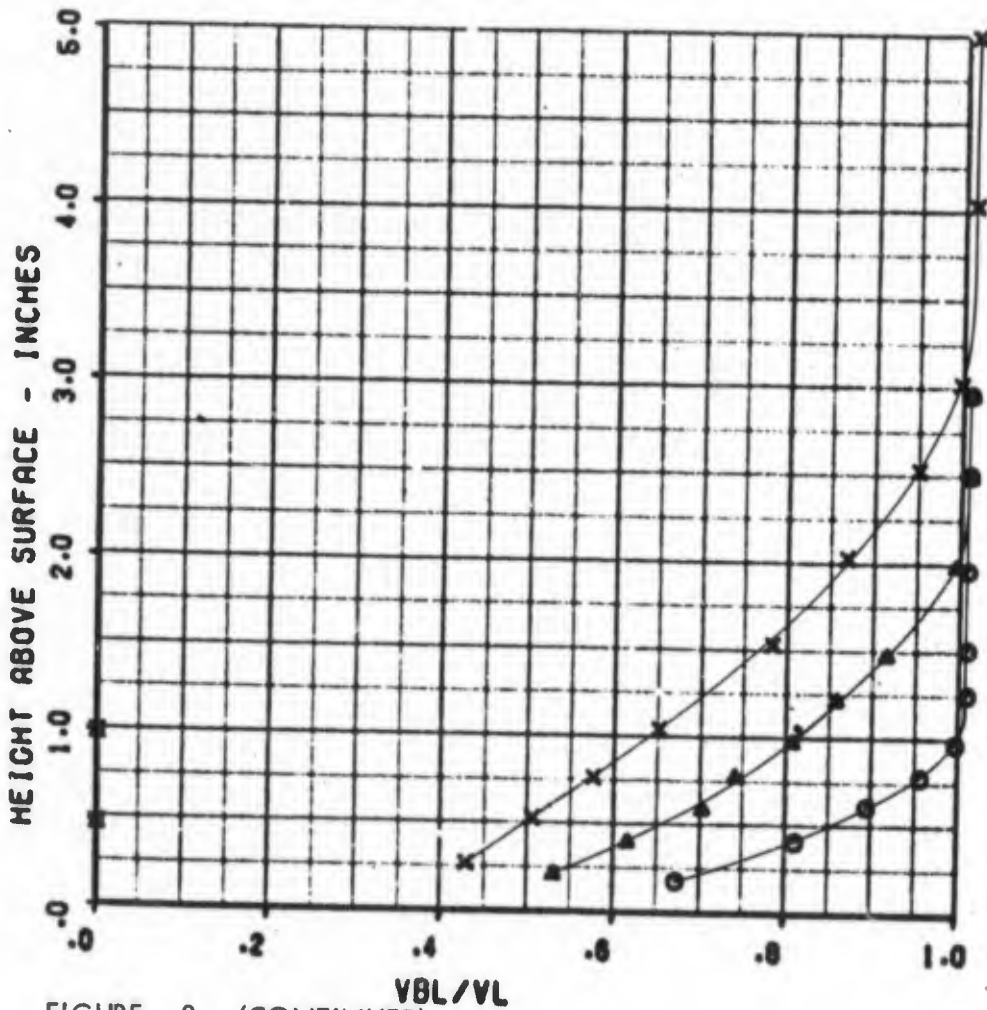


FIGURE 8 (CONTINUED)  
 (e) CORRECTED ALPHA = 0.58

LOCKHEED C-141A

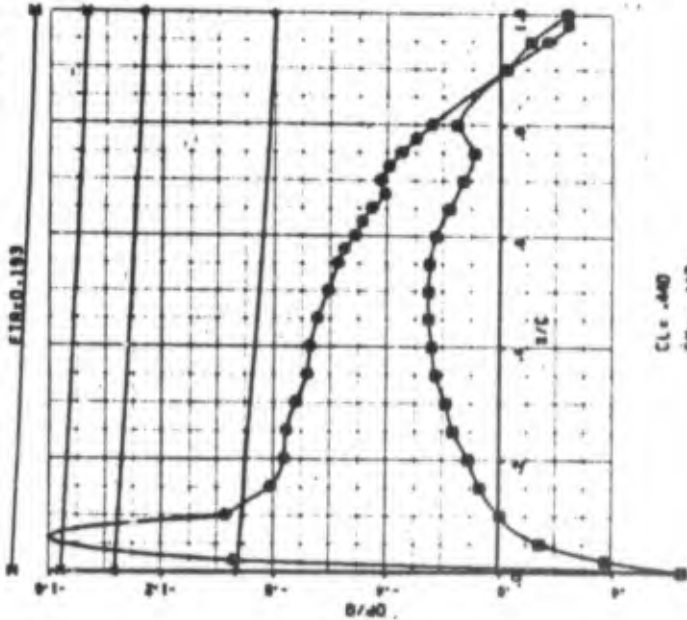
PRESSURE DISTRIBUTION

FLIGHT NO 548  
 RUN NO 184  
 MACH NO .700

0  
 ALPHA  
 TAN

2.34 PSI  
 -10 DEG  
 -16.5 DEG C

F18x0.193



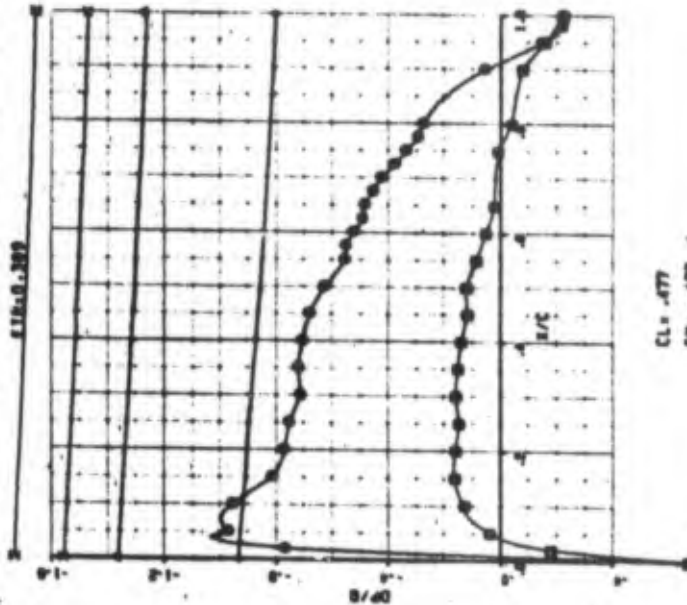
CLc .440  
 CRc -.117

ALTITUDE 19800. FT  
 WEIGHT 266500.-LB  
 NZ 1.64

CD  
 AILERON POS -1.33 DEG  
 FLAP POS 0.00 DEG

20.60 ± MAC

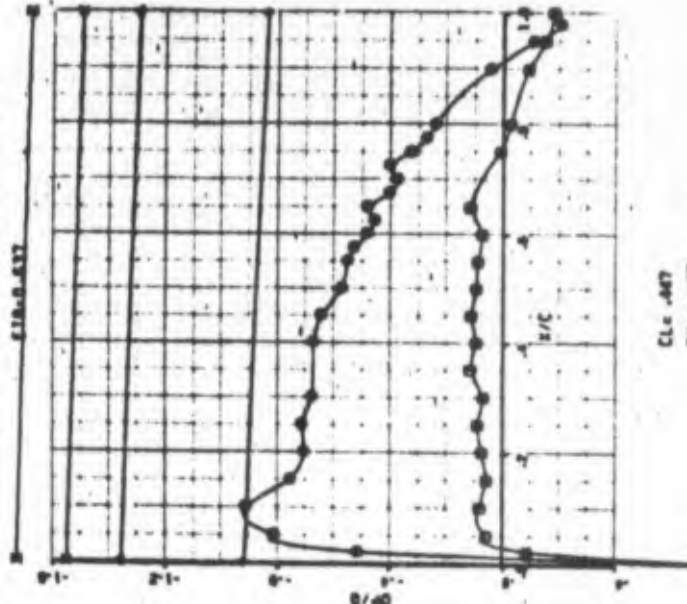
F18x0.309



CLc .477  
 CRc -.177

UPPER SURFACE  
 LOWER SURFACE  
 MACH LOCAL-1.0  
 MACH LOCAL-1.2  
 MACH LOCAL-1.3  
 MACH LOCAL-1.4

F18x0.637



CLc .447  
 CRc -.186

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 546  
 RUN NO 195  
 MACH NO .700

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

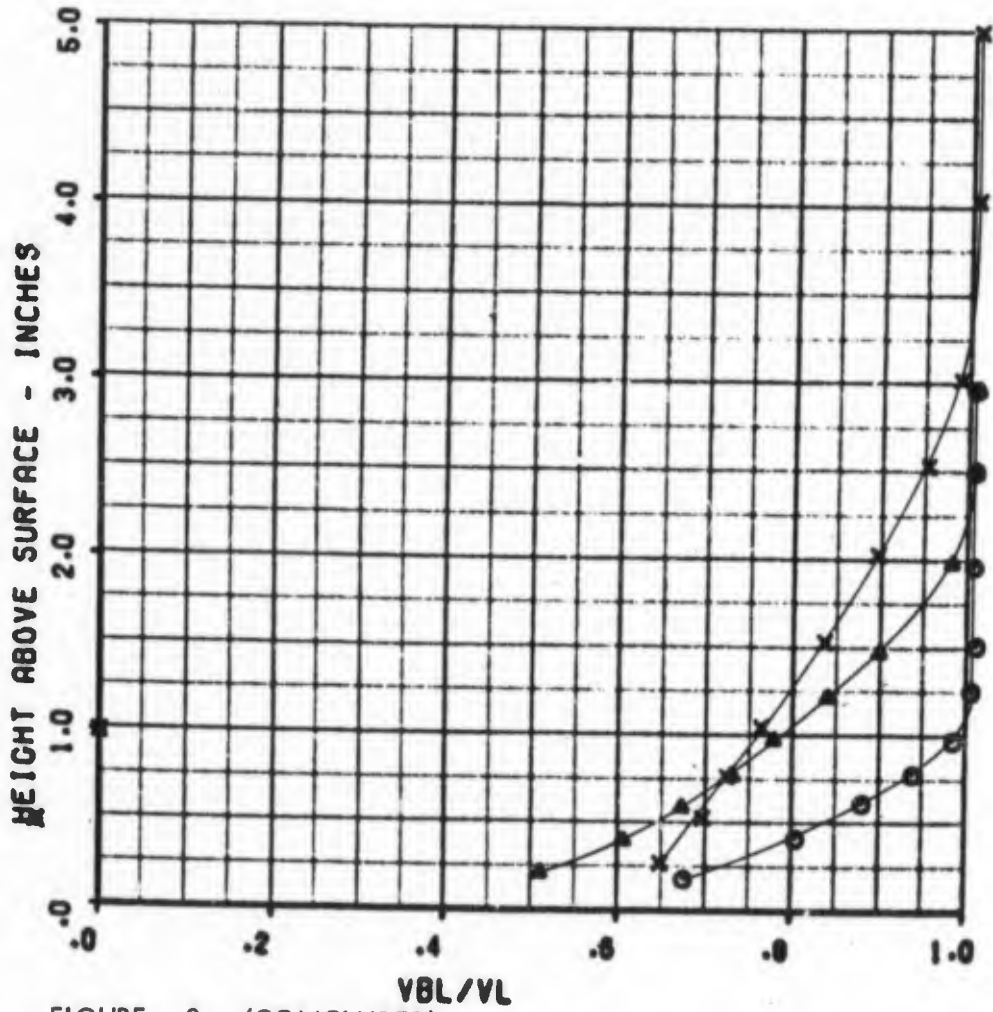


FIGURE 8 (CONCLUDED)  
 (f) CORRECTED ALPHA = 1.07

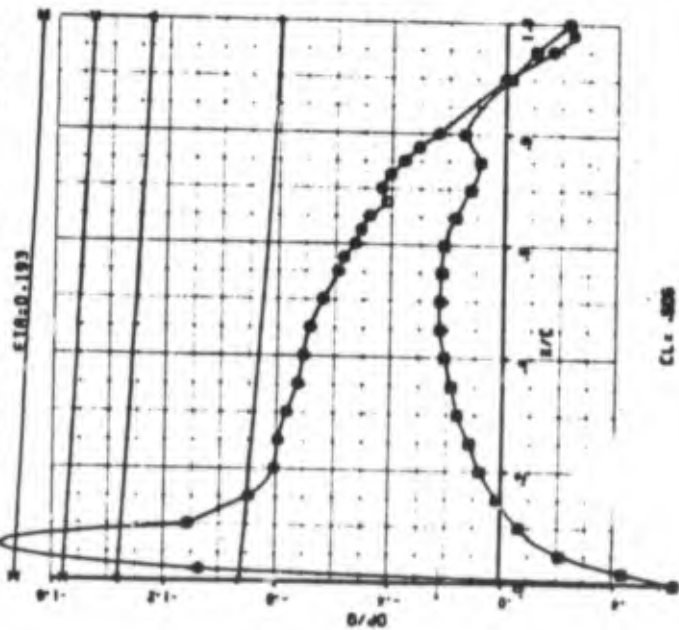
LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 546  
 RUN NO 1A5  
 MACH NO .700

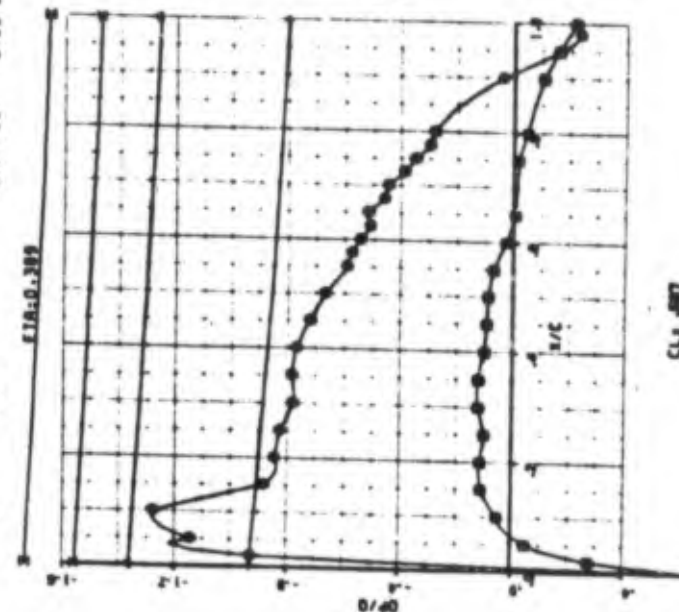
0  
 ALPHA  
 TAN

2.27 P51  
 .85 DEG  
 -18.0 DEG C

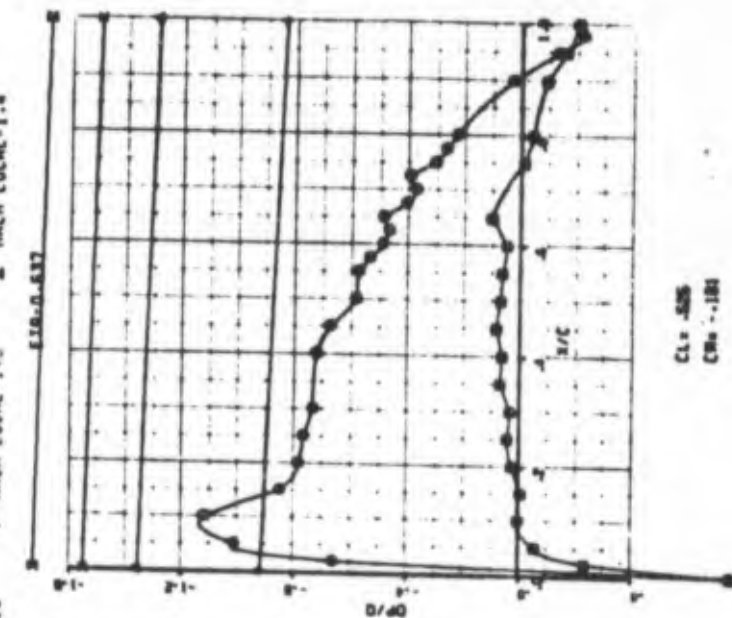


ALTITUDE 20426. FT  
 WEIGHT 265400. LB  
 NZ 1.86

CG  
 AILERON POS -2.19 DEG  
 FLAP POS 0.00 DEG



O UPPER SURFACE  
 X LOWER SURFACE  
 + MACH LOCAL-1.0  
 A MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 X MACH LOCAL-1.4



# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 546  
 RUN NO 181  
 MACH NO .750

## RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

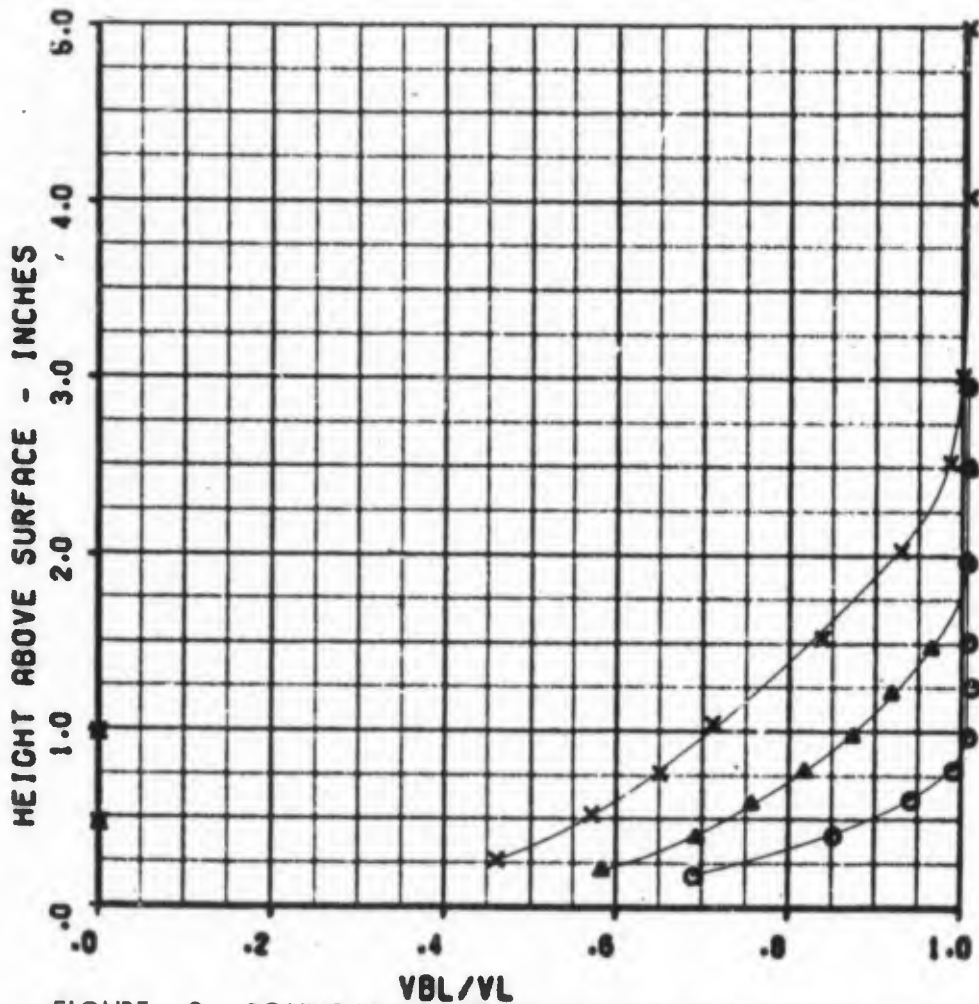


FIGURE 9 BOUNDARY LAYER VELOCITY PROFILES AND PRESSURE DISTRIBUTIONS MACH .742 TO .752  
 (a) CORRECTED ALPHA = -2.87

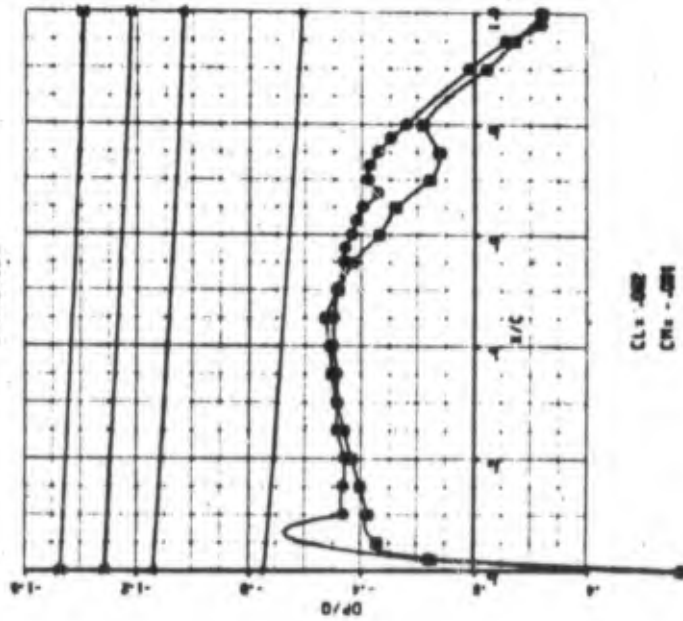
# LOCKHEED C-141R PRESSURE DISTRIBUTION

FLIGHT NO 548  
RUN NO 181  
MACH NO .750

0  
ALPHA  
TRN

2.06 PSI  
-3.80 DEG  
-18.5 DEG C

ETA=0.193

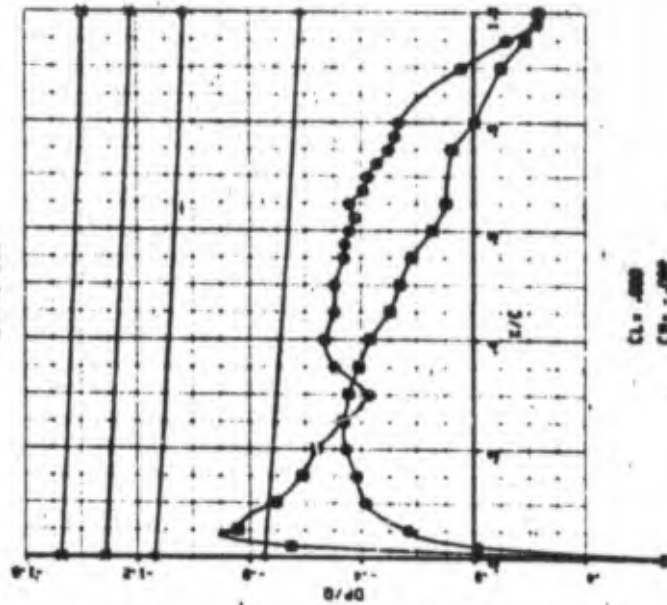


CLs = .002  
CRs = -.001

ALTITUDE 20850. FT  
WEIGHT 258300. LB  
MZ 0.30

29.50 ± MAC  
AILERON POS -7.75 DEG  
FLAP POS 0.00 DEG

ETA=0.309

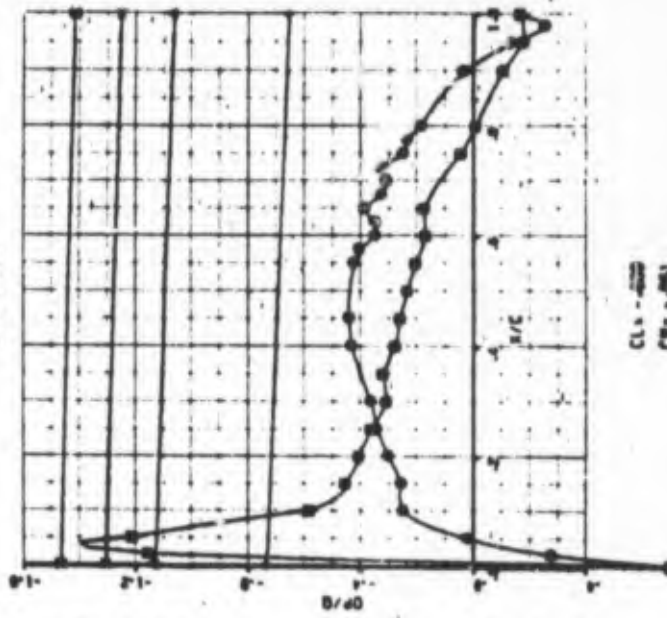


CLs = .008  
CRs = -.002

UPPER SURFACE  
LOWER SURFACE  
MACH LOCAL-1.0

A MACH LOCAL-1.2  
X MACH LOCAL-1.3  
Z MACH LOCAL-1.4

ETA=0.637



CLs = .020  
CRs = .001

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 546  
 RUN NO 182  
 MACH NO .750

## RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

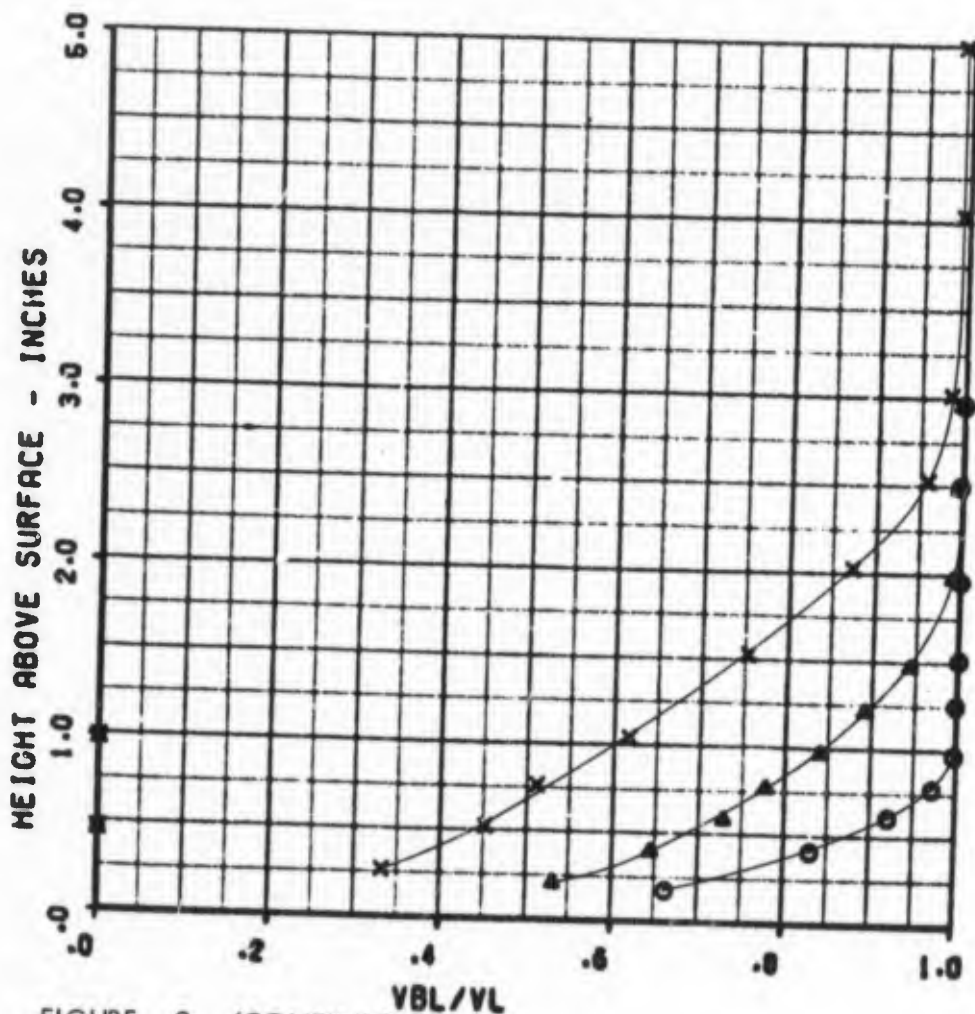


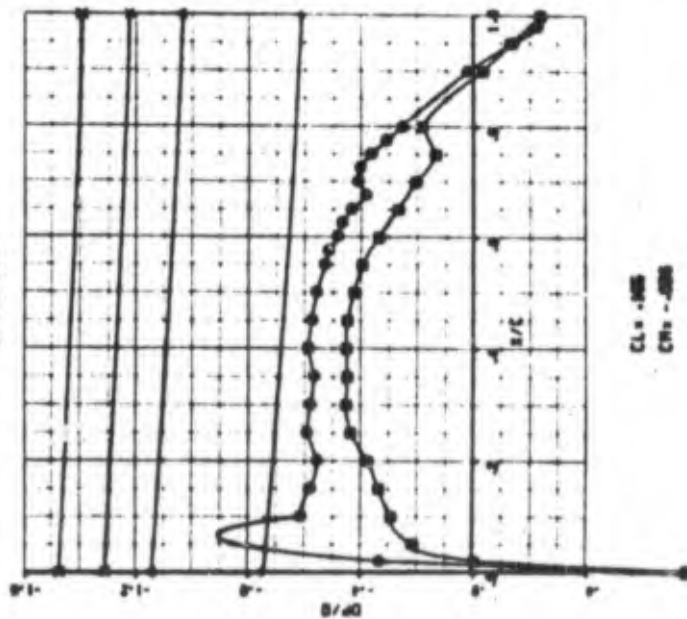
FIGURE 9 (CONTINUED)  
 (b) CORRECTED ALPHA = -2.02

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 545 0 2.41 PSI  
 RUN NO 182 ALPWR -2.85 DEG  
 MACH NO .750 TRW -17.0 DEG C

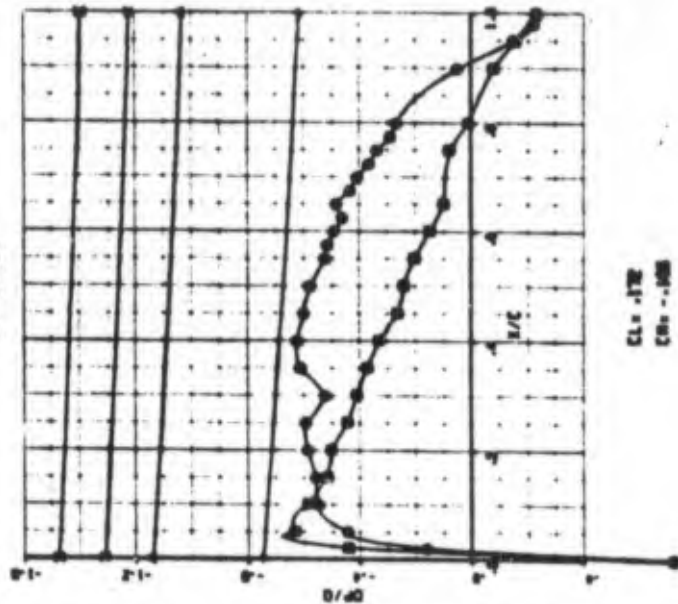
ETA=0.193



CL= .185  
 CR= -.028

ALTITUDE 20000. FT  
 WEIGHT 250000. LB  
 NZ .43

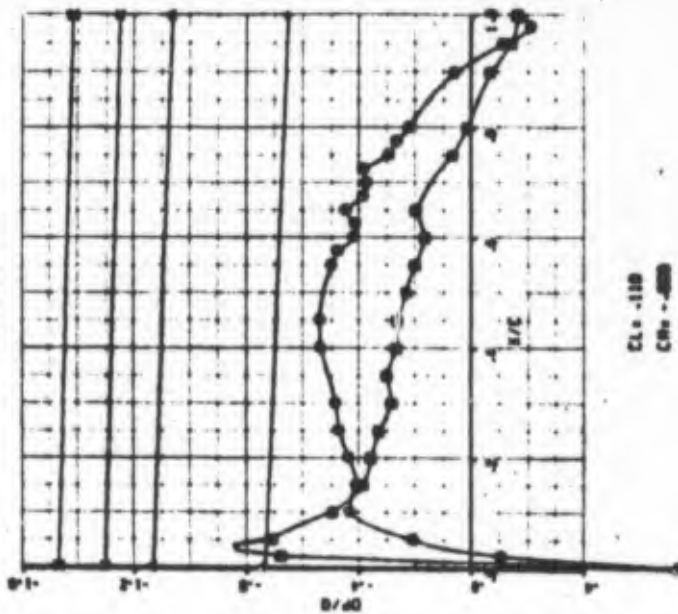
ETA=0.389



CL= .172  
 CR= -.028

CO 29.50 % MAC  
 AIRLON POS 0.00 DEG  
 FLMP POS 0.00 DEG

ETA=0.537



CL= .119  
 CR= -.028

UPPER SURFACE O  
 LOWER SURFACE □  
 MACH LOCAL -1.0 +  
 MACH LOCAL -1.2 Δ  
 MACH LOCAL -1.3 X  
 MACH LOCAL -1.4 ⊞

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

**PJN CONDITIONS**

FLIGHT NO 546  
 RUN NO 18  
 MACH NO .752

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

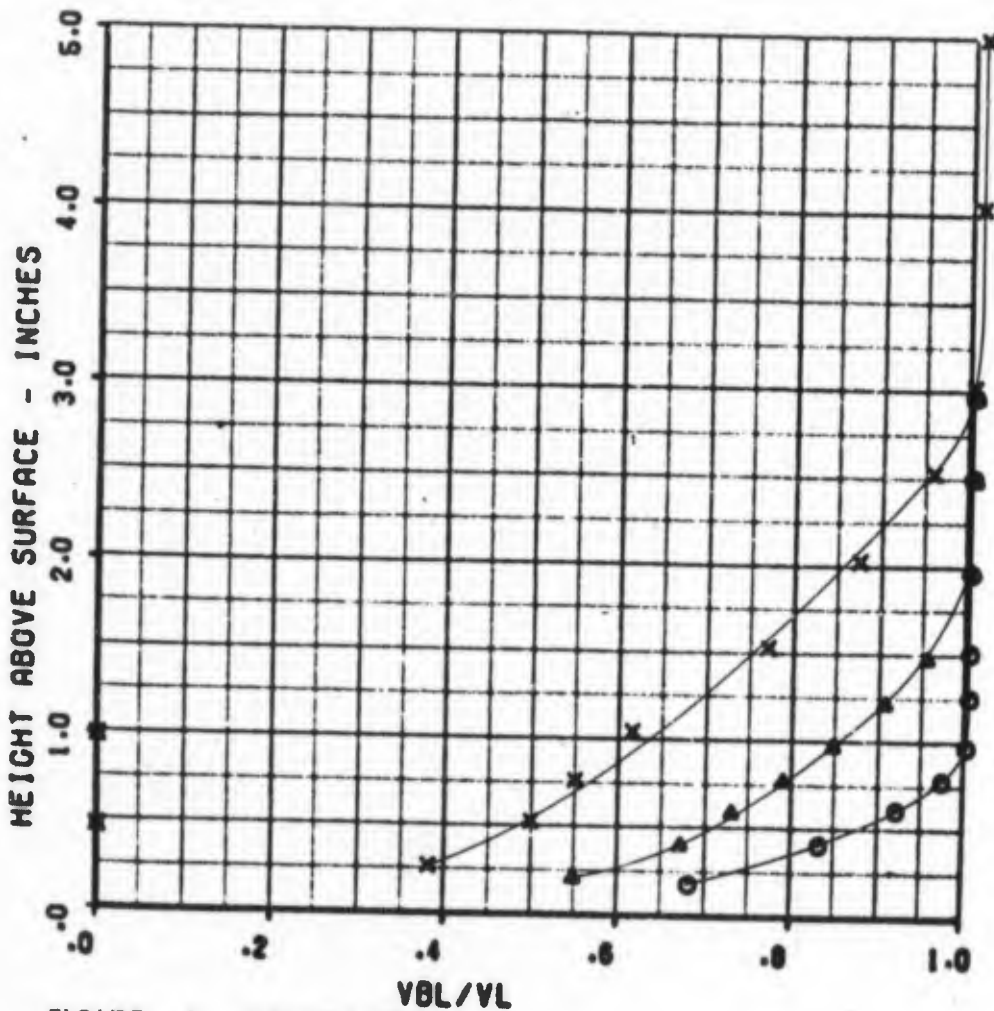


FIGURE 9 (CONTINUED)  
 (c) CORRECTED ALPHA = -0.95

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 548  
 RUN NO 18  
 MACH NO .752

0  
 ALPHA  
 TAN

2.58 DEG  
 -1.52 DEG  
 -19.5 DEG C

ETA=0.193

ALTITUDE 20000. FT  
 WEIGHT 26100. LB  
 NZ 1.00

CO  
 AILERON POS  
 FLAP POS

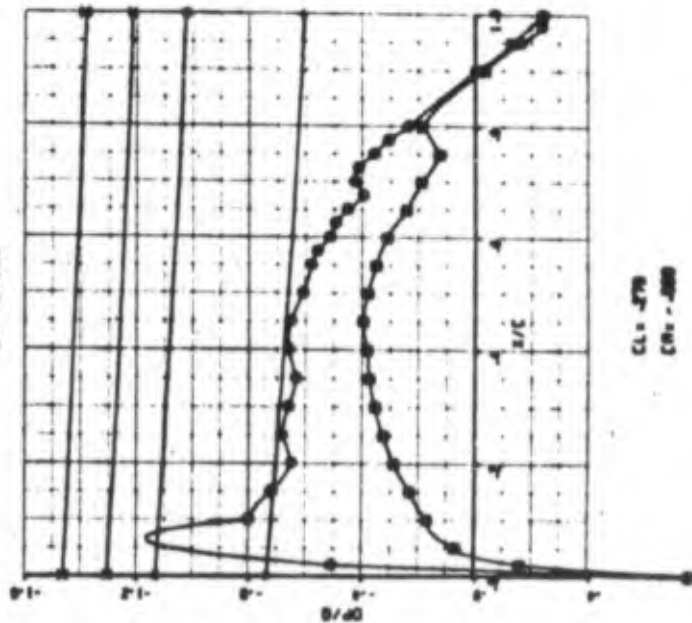
29.85 X MAC  
 -.42 DEG  
 0.00 DEG

ETA=0.209

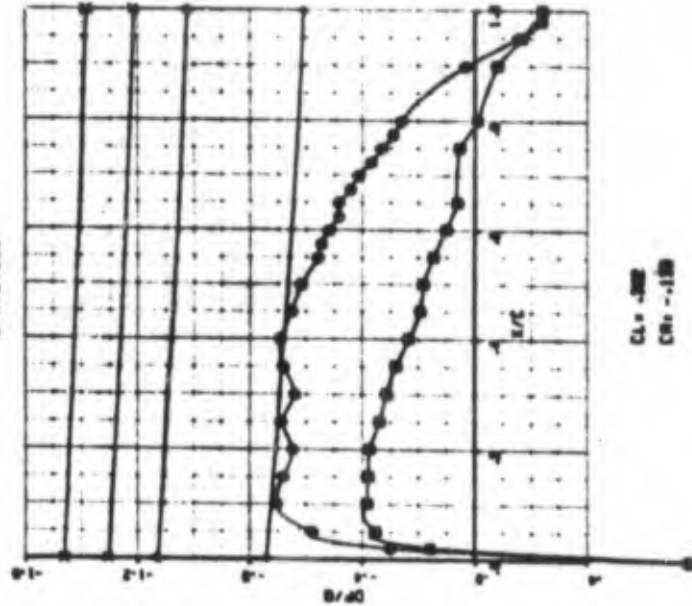
UPPER SURFACE  
 LOWER SURFACE  
 MACH LOCAL-1.0  
 MACH LOCAL-1.2  
 MACH LOCAL-1.3  
 MACH LOCAL-1.4

O  
 X  
 +

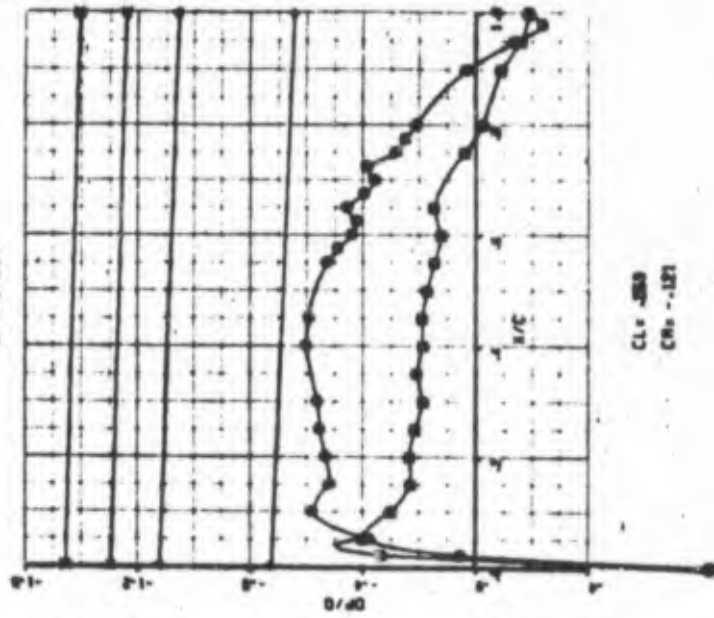
ETA=0.977



CL=0.79  
 CR=-0.08



CL=0.82  
 CR=-0.12



CL=0.85  
 CR=-0.127

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 547  
 RUN NO 4A1  
 MACH NO .742

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 X 80 %  
 ✖ 80 % (AFT)

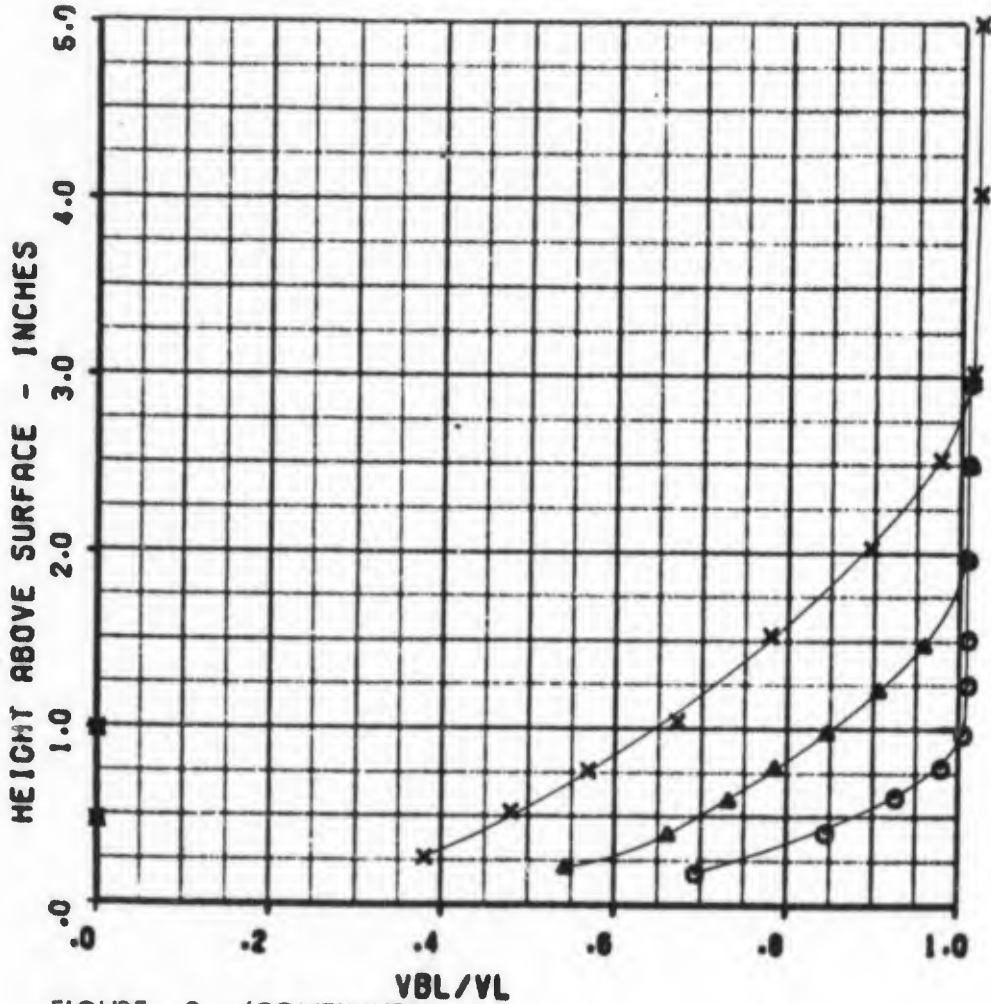


FIGURE 9 (CONTINUED)  
 (d) CORRECTED ALPHA = -0.56

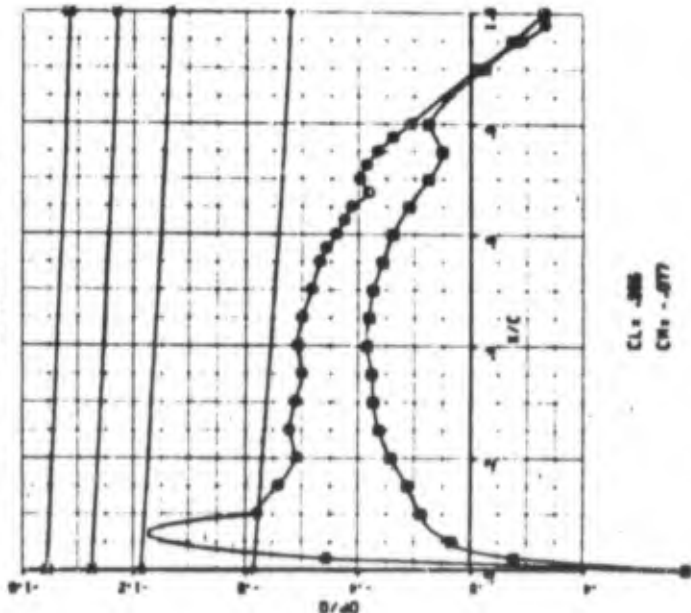
LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN NO 4A1  
 MACH NO .742

Q 2.81 PSI  
 ALPHA -1.16 DEG  
 TAN -22.7 DEG C

ETA=0.193

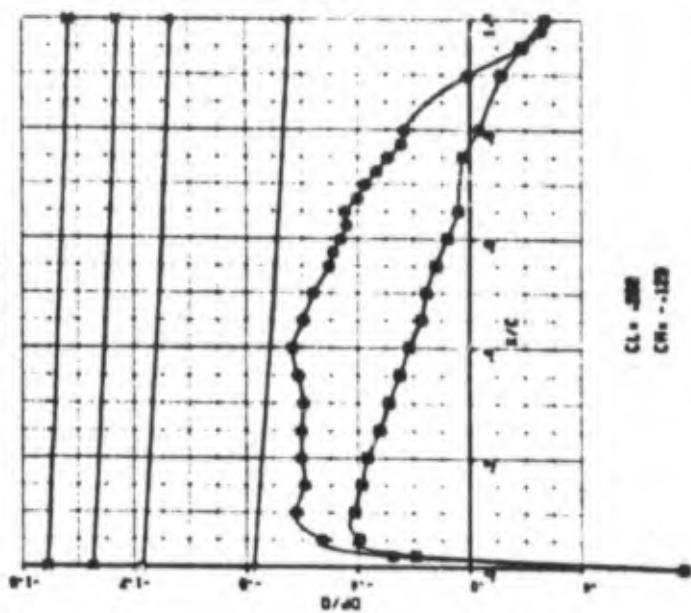


CL = .885  
 CM = -.877

ALTITUDE 19000. FT  
 WEIGHT 255000. LB  
 NZ -.81

CO 20.45 Z MAC  
 AILERON POS -.51 DEG  
 FLAP POS 0.00 DEG

ETA=0.309

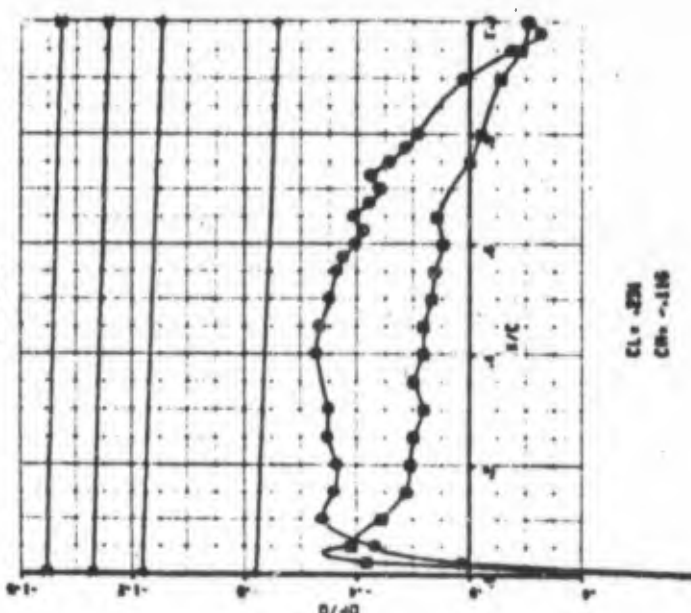


CL = .888  
 CM = -.829

O UPPER SURFACE  
 D LOWER SURFACE  
 + MACH LOCAL -1.0

A MACH LOCAL -1.2  
 X MACH LOCAL -1.3  
 Z MACH LOCAL -1.4

ETA=0.837



CL = .828  
 CM = -.816

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 547  
 RUN NO. 481  
 MACH NO .742

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

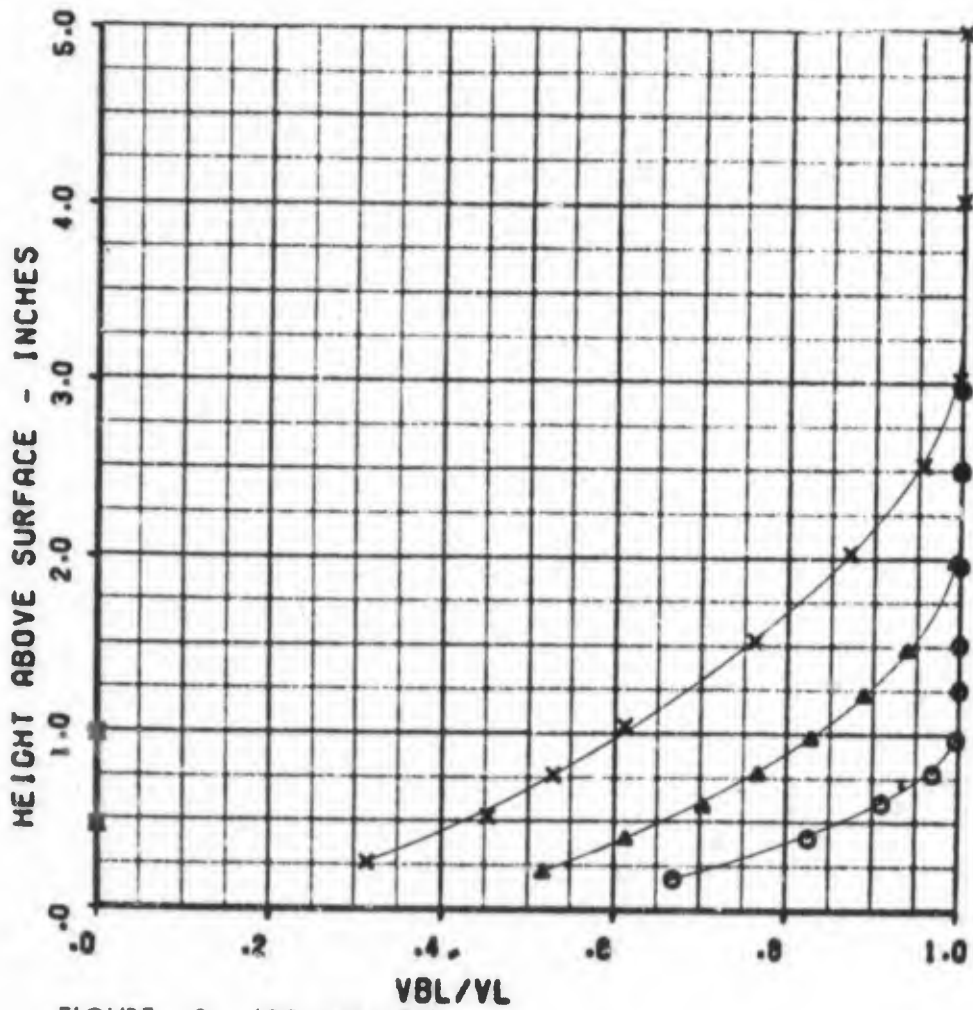


FIGURE 9 (CONTINUED)  
 (e) CORRECTED ALPHA = -0.45

LOCKHEED C-141A

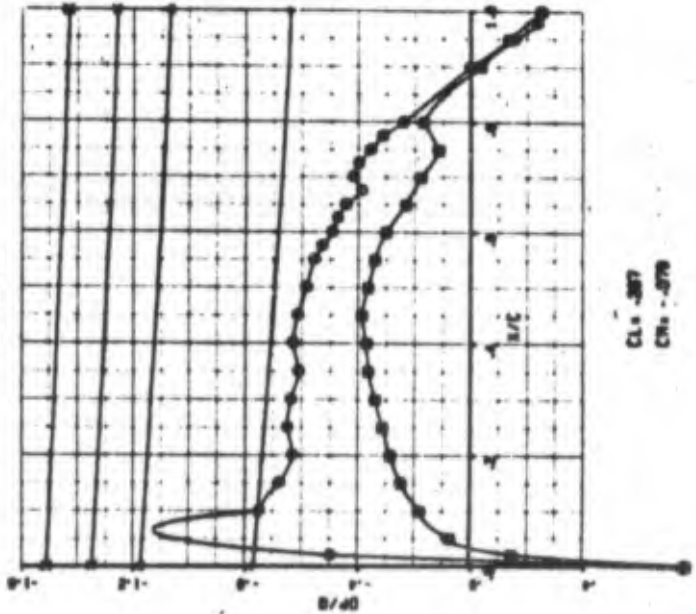
PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN NO 481  
 MACH NO .742

0  
 ALPHA  
 TAN

2.59 PSI  
 -1.05 DEG  
 -29.5 DEG C

ETA=0.193

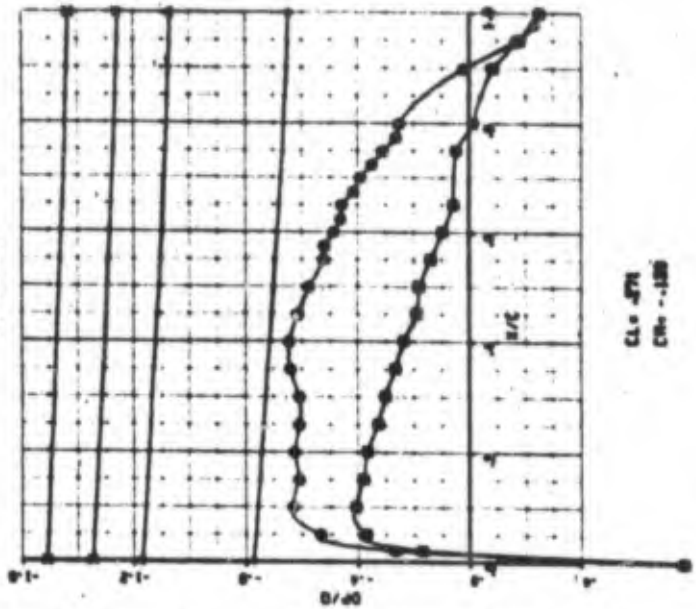


ALTITUDE 20000. FT  
 HEIGHT 253000. LB  
 NZ .95

CD  
 AILERON POS  
 FLAP POS

28.30 X MAC  
 -1.35 DEG  
 0.00 DEG

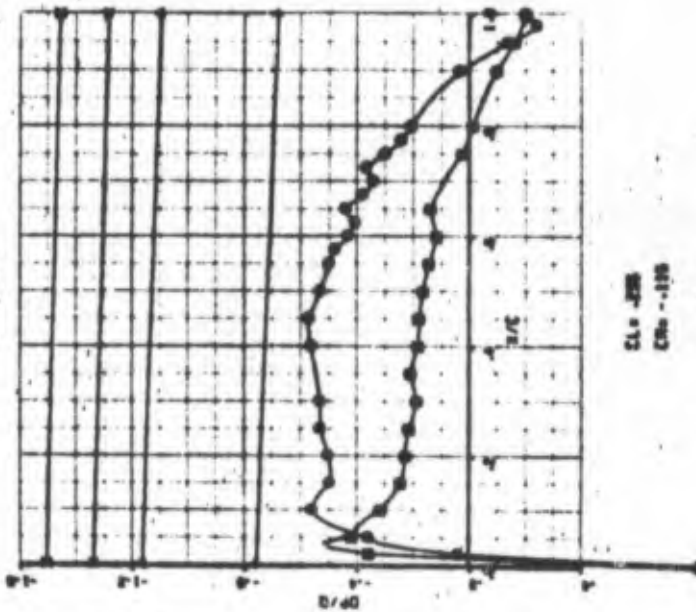
ETA=0.390



UPPER SURFACE  
 LOWER SURFACE

MACH LOCAL-1.0  
 MACH LOCAL-1.2  
 MACH LOCAL-1.3  
 MACH LOCAL-1.4

ETA=0.537



# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 546  
 RUN NO 183  
 MACH NO .750

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

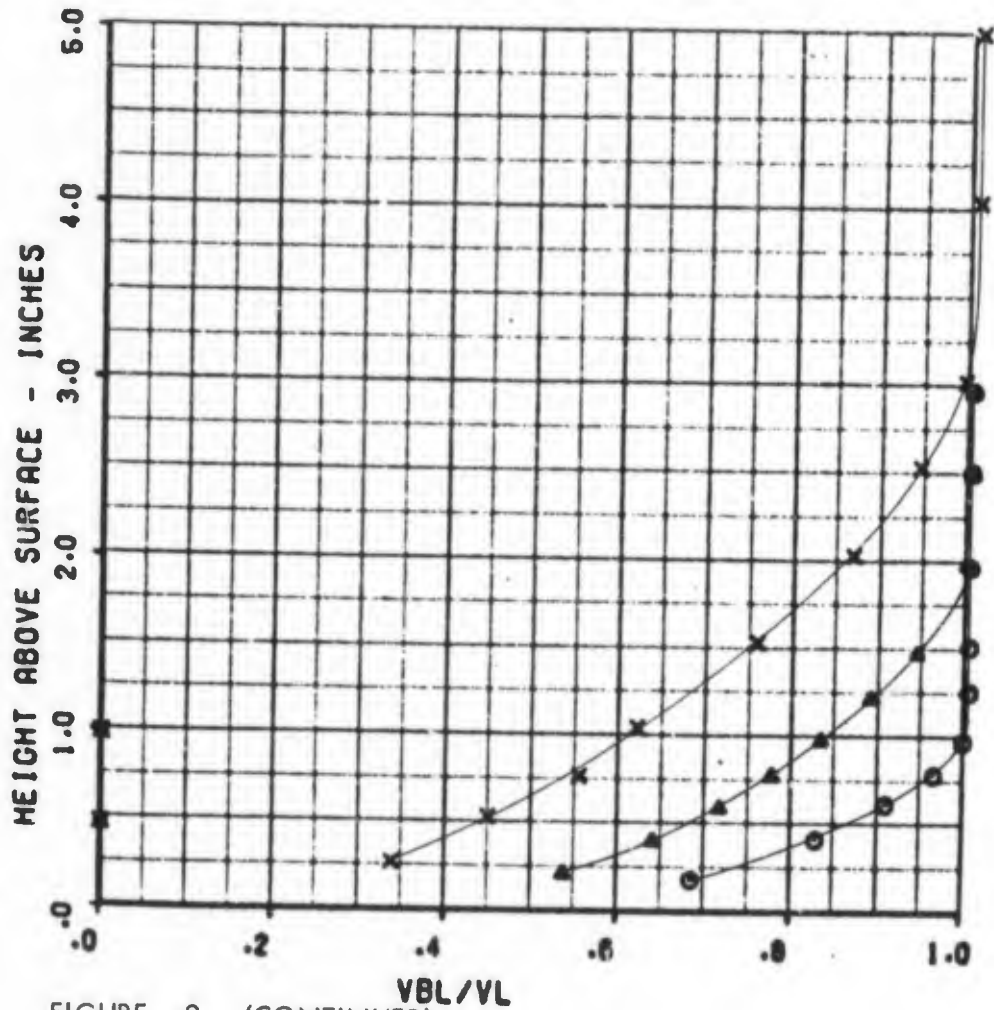


FIGURE 9 (CONTINUED)  
 (f) CORRECTED ALPHA = -0.35

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 548  
RUN NO 183  
MACH NO .750

Q  
ALPHA  
TAN

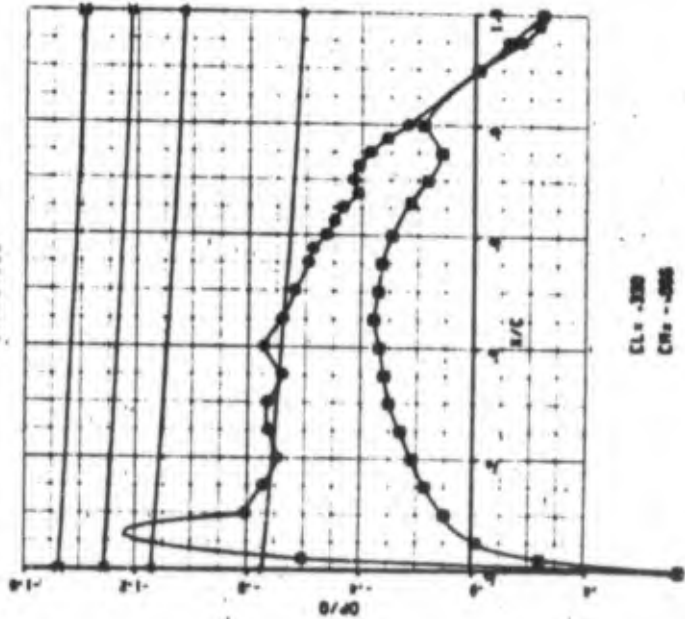
2.56 PSI  
-.95 DEG  
-19.0 DEG C

ALTITUDE 20660. FT  
WEIGHT 261800. LB  
MZ 1.40

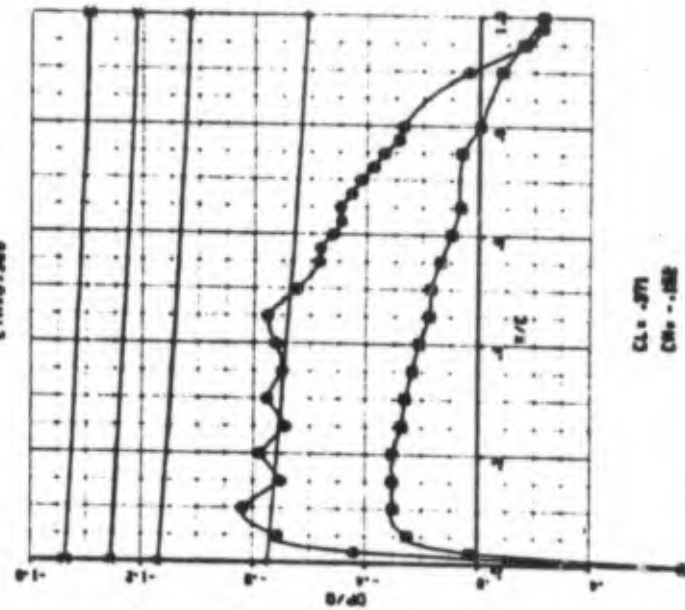
CD 20.54 X MAC  
AILERON POS -.42 DEG  
FLAP POS 0.00 DEG

O UPPER SURFACE  
D LOWER SURFACE  
+ MACH LOCAL-1.0  
A MACH LOCAL-1.2  
X MACH LOCAL-1.3  
Z MACH LOCAL-1.4

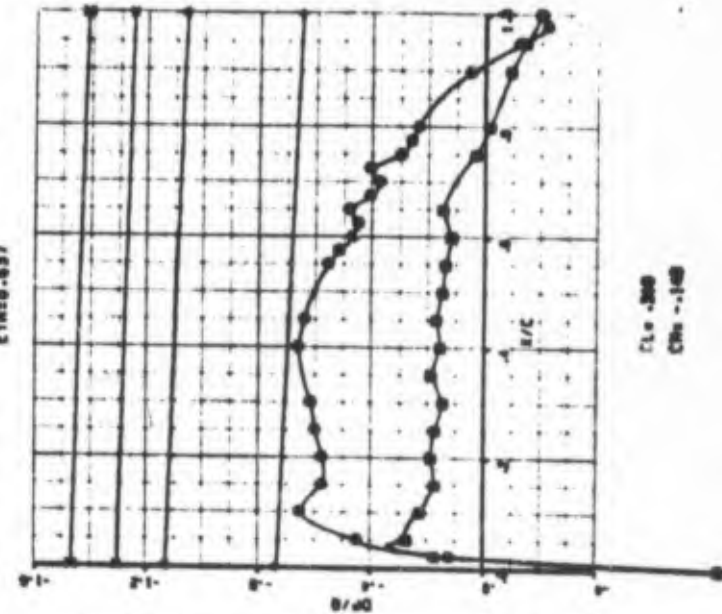
ETA=0.193



ETA=0.309



ETA=0.637



# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 546  
 RUN NO 184  
 MACH NO .750

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

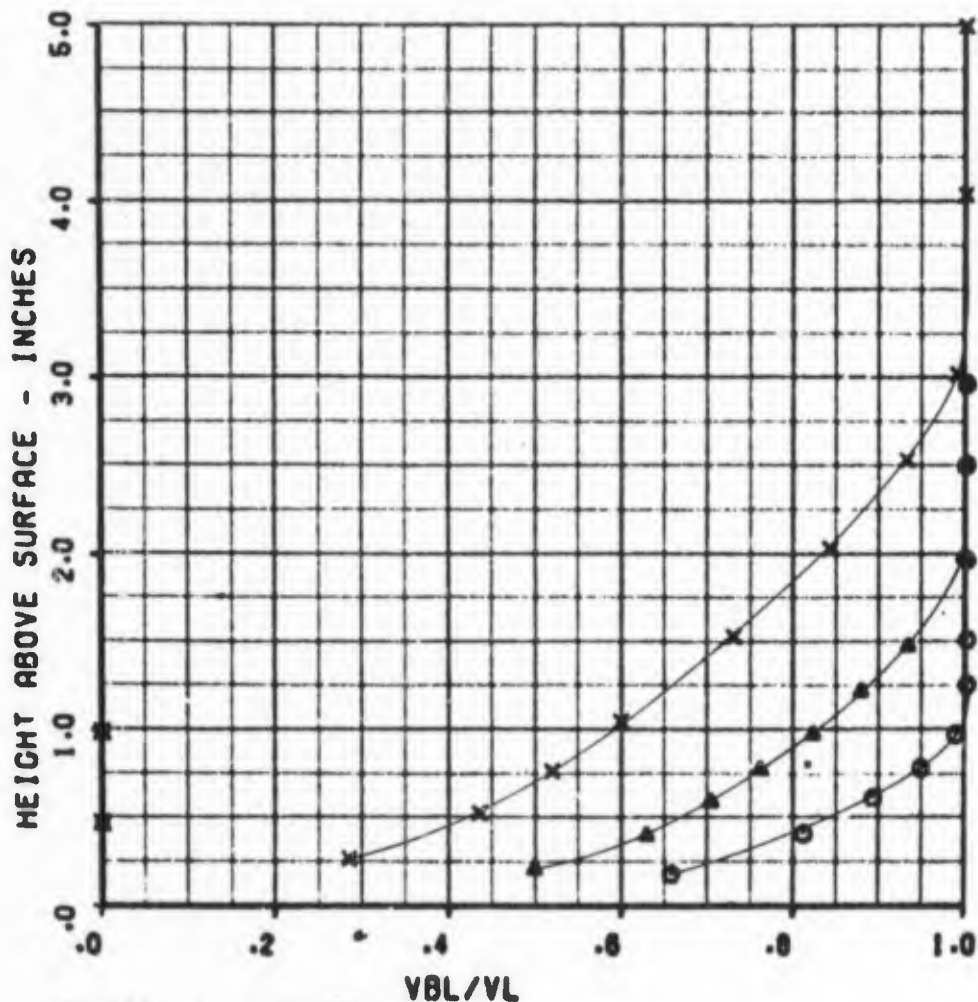
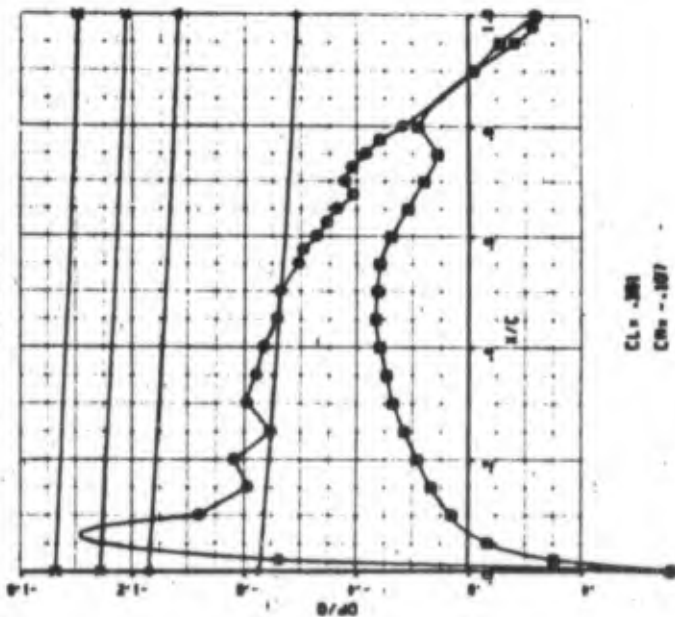


FIGURE 9 (CONTINUED)  
 (g) CORRECTED ALPHA = 0.22

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 546      0      2.81 PSI  
 RUN NO 184      ALPHA      -29 DEG  
 MACH NO .760      TAN      -17.4 DEG C

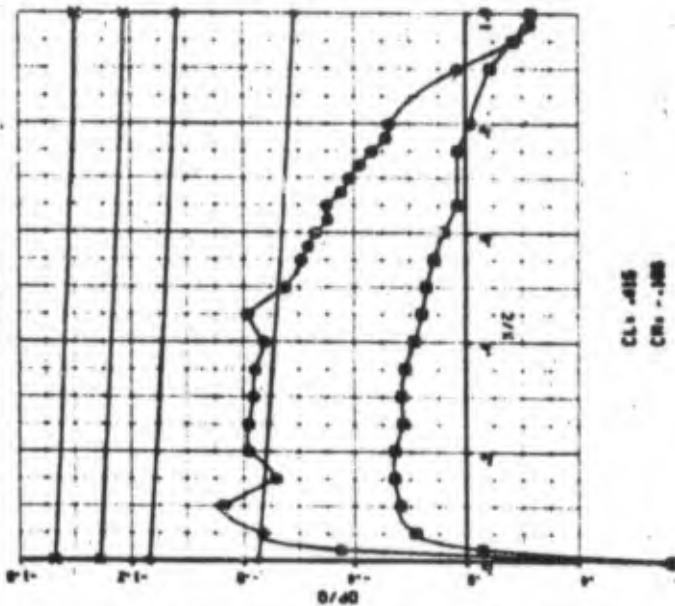
ETA=8.193



CLs .281  
 CMs -.187

ALTITUDE 20760. FT  
 WEIGHT 261300. LB  
 MZ 1.70

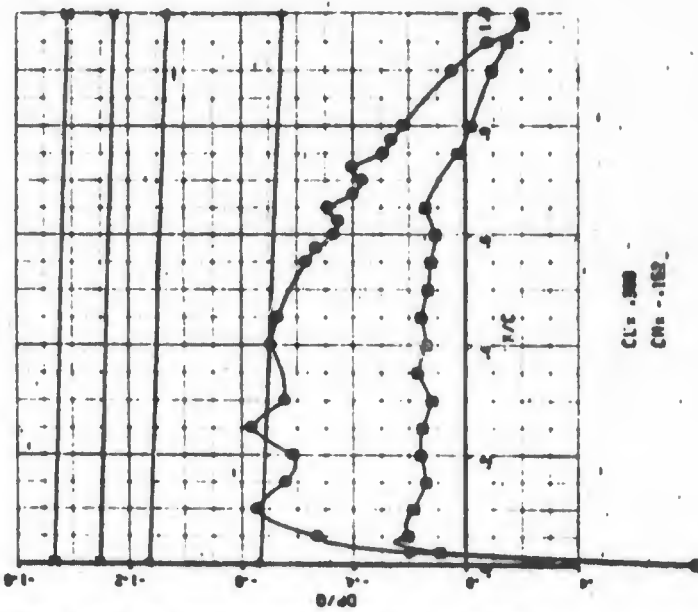
ETA=8.288



CLs .288  
 CMs -.188

CO 26.52 2 MAC  
 RILERON POS .08 DEG  
 FLAP POS 0.00 DEG

ETA=8.637



CLs .289  
 CMs -.189

UPPER SURFACE      O      MACH LOCAL-1.2  
 LOWER SURFACE      X      MACH LOCAL-1.3  
 MACH LOCAL-1.0      +      MACH LOCAL-1.4

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 546  
 RUN NO 185  
 MACH NO .752

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

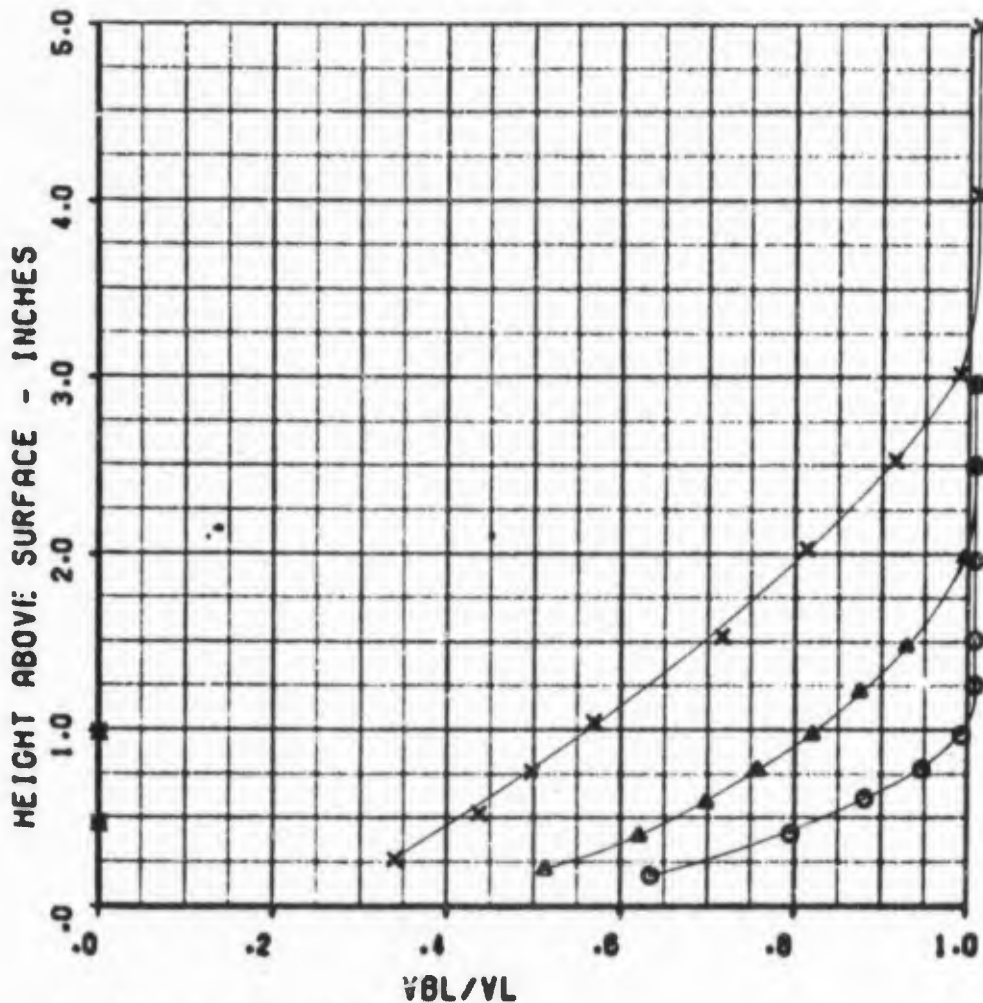


FIGURE 9 (CONCLUDED)  
 (h) CORRECTED ALPHA = 0.31

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 546  
 RUN NO 185  
 MACH NO .752

Q 2.69 PSI  
 ALPHA -19 DEG  
 TAN -16.5 DEG C

C0 28.50 X MAC  
 AILERON POS -58 DEG  
 FLAP POS 0.00 DEG

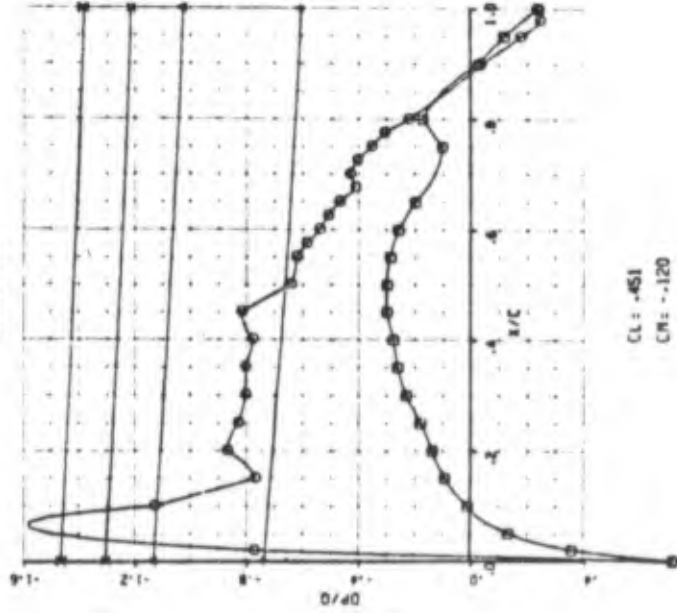
UPPER SURFACE  
 LOWER SURFACE  
 MACH LOCAL-1.0

MACH LOCAL-1.2  
 MACH LOCAL-1.3  
 MACH LOCAL-1.4

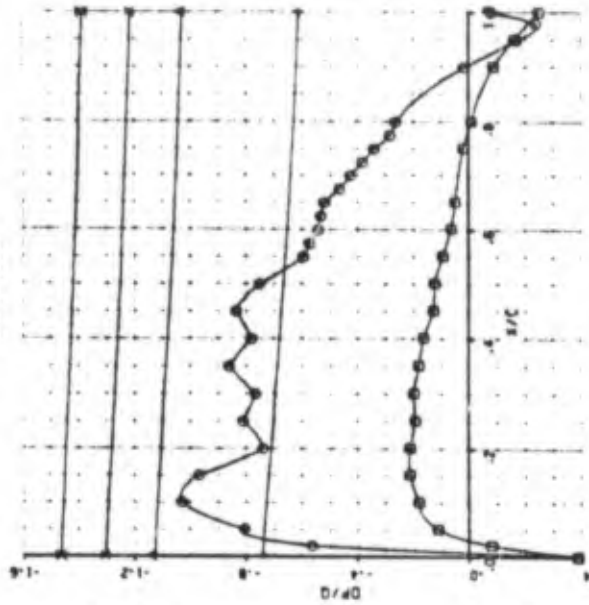
ETA:0.193

ETA:0.389

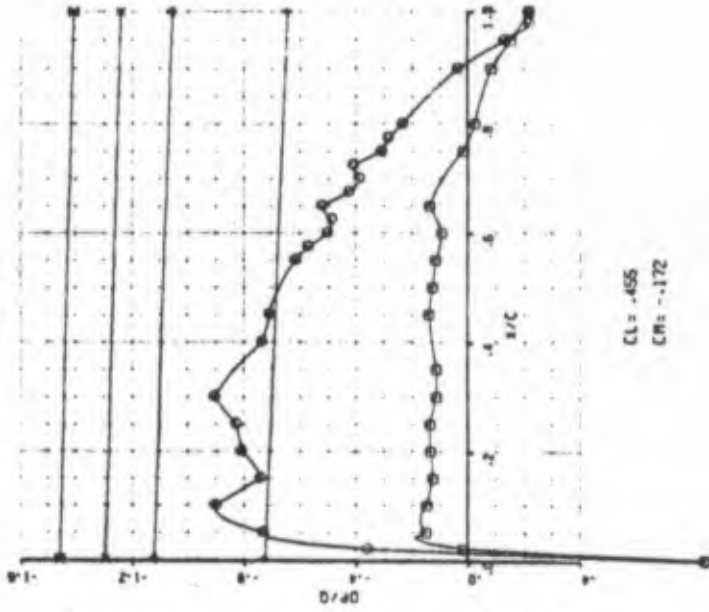
ETA:0.637



CL: .451  
 CR: -.120



CL: .480  
 CR: -.181



CL: .465  
 CR: -.172

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 546  
 RUN NO 1C1  
 MACH NO .762

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 × 60 %  
 ✱ 80 % (AFT)

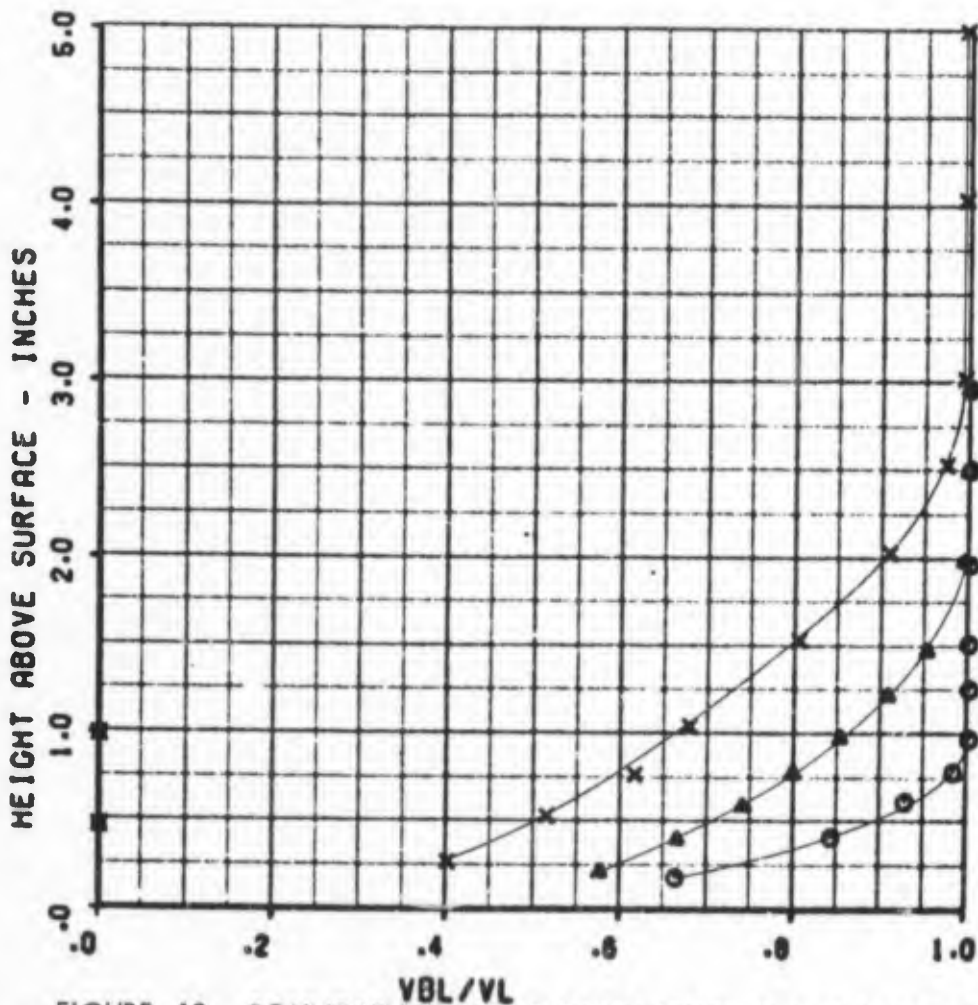


FIGURE 10 BOUNDARY LAYER VELOCITY PROFILES AND PRESSURE DISTRIBUTIONS MACH .762 TO .780  
 (a) CORRECTED ALPHA = -2.78

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 546  
 RUN NO 1C1  
 MACH NO .762

0  
 ALPH  
 1.0

2.65 PSI  
 -3.71 DEG  
 -1.9.5 DEG C

ALTITUDE 20760. FT  
 WEIGHT 253600. LB  
 NZ 0.00

CC  
 AILERON POS  
 FLAP POS

28.35 ± MAC  
 -.42 DEG  
 0.00 DEG

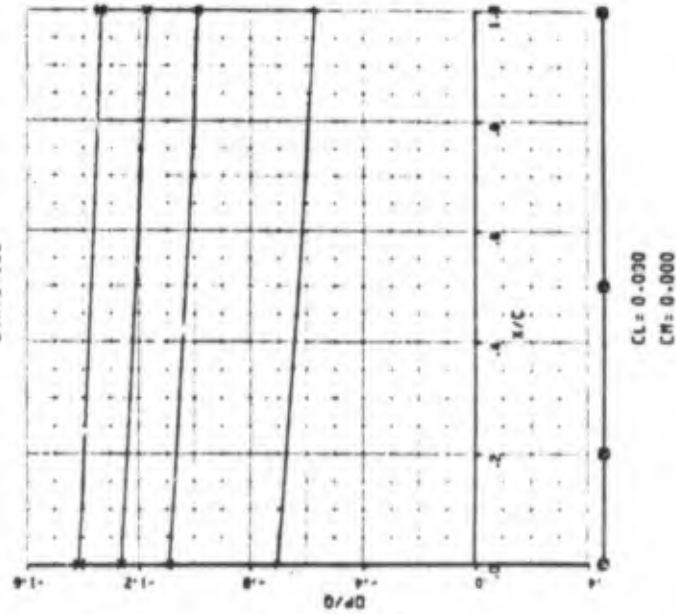
O UPPER SURFACE  
 □ LOWER SURFACE

△ MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 ⊗ MACH LOCAL-1.4

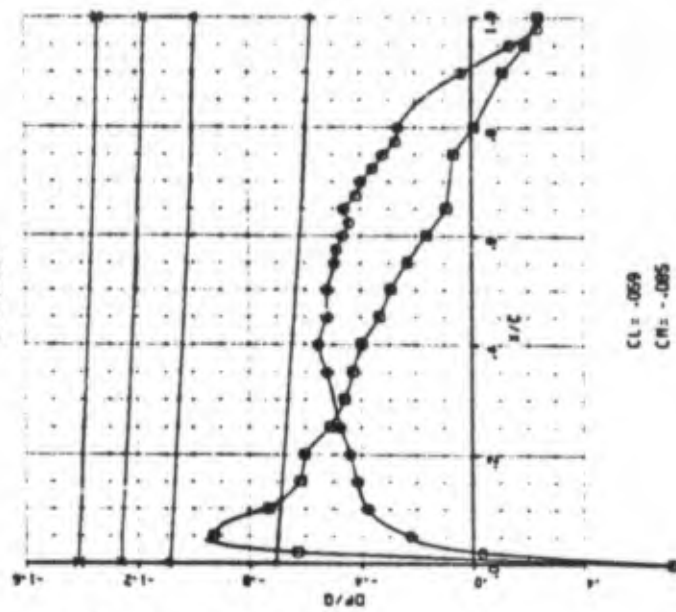
ETA=0.193

ETA=0.389

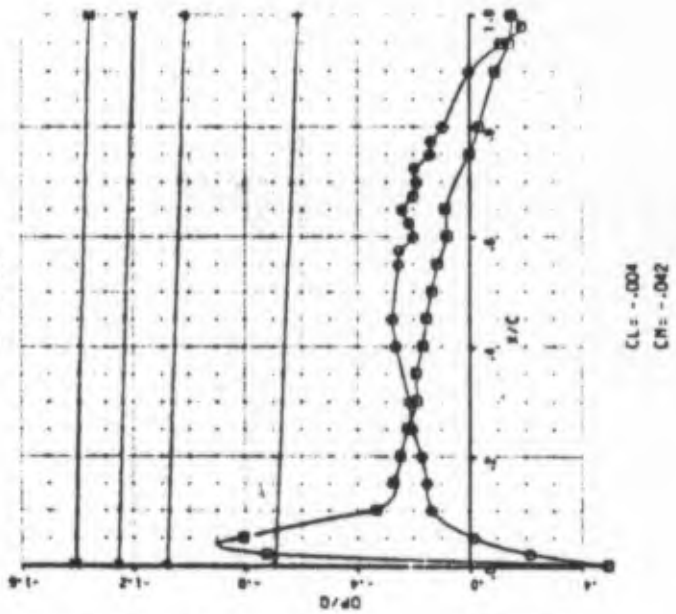
ETA=0.637



CL=0.030  
 CM=0.000



CL=-.059  
 CM=-.085



CL=-.004  
 CM=-.042

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO: 548  
 RUN NO 2A5  
 MACH NO .770

### RAKE LOCATIONS

○ 30 %  
 △ 55 %  
 × 60 %  
 \* 80 % (AFT)

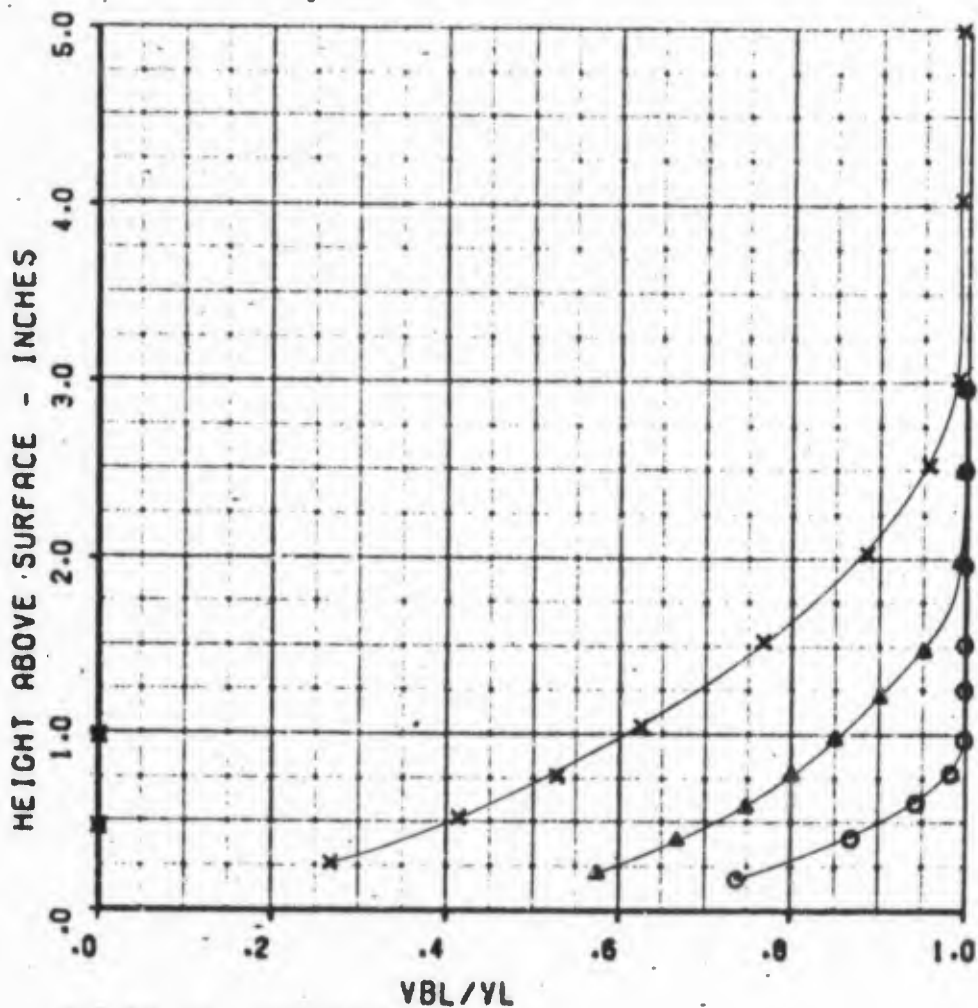


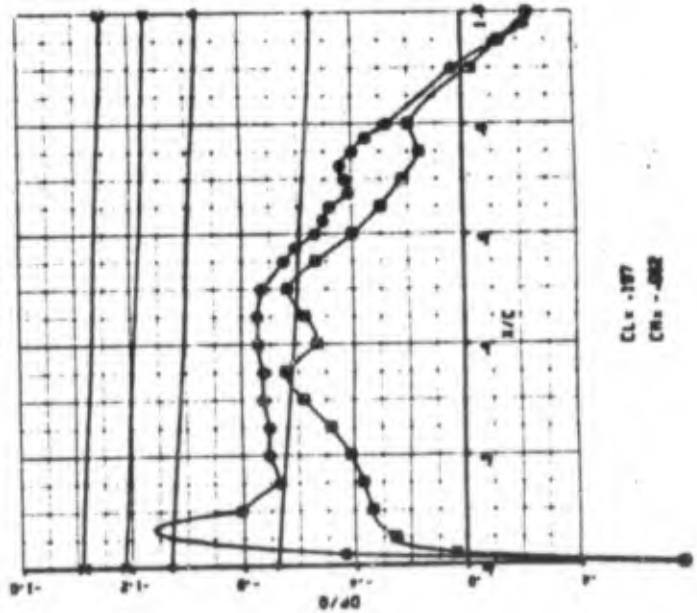
FIGURE 10 (CONTINUED)  
 (b) CORRECTED ALPHA = -2.64

LOCKHEED C-141A  
PRESSURE DISTRIBUTION

FLIGHT NO 548  
RUN NO 2MS  
MACH NO .770

Q 2.80 PSI  
ALPHA 18M  
-3.55 DEG  
-29.0 DEG C

E1R=0.193

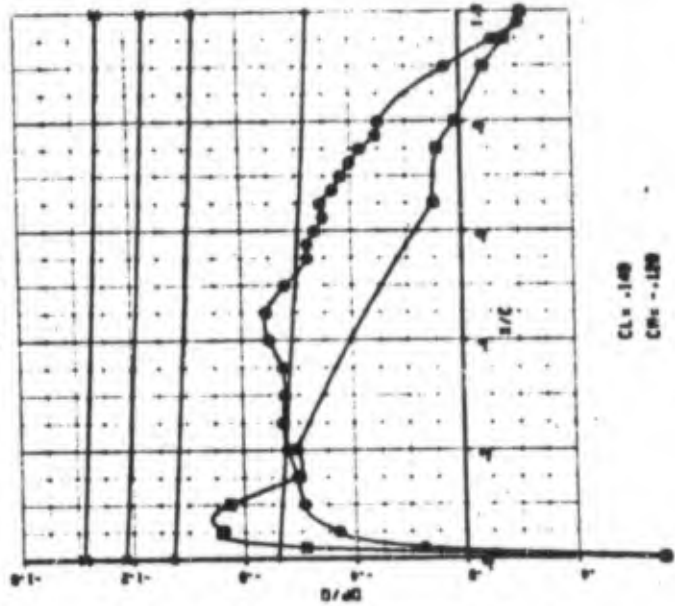


CLx = .187  
CRx = .082

ALTITUDE 18170. FT  
WEIGHT 261500. LB  
MZ -.03

CD 26.52 ± MAC  
AILERON POS -42 DEG  
FLAP POS 0.00 DEG

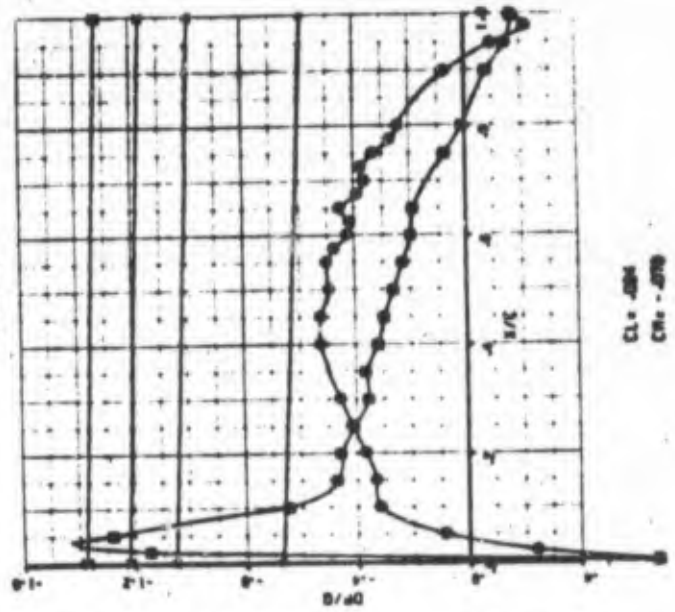
E1R=0.209



CLx = .148  
CRx = .129

O UPPER SURFACE  
X LOWER SURFACE  
MACH LOCAL 1.0

E1R=0.837



CLx = .084  
CRx = .079

A MACH LOCAL 1.2  
X MACH LOCAL 1.3  
MACH LOCAL 1.4

THIS REPORT HAS BEEN DELIMITED  
AND CLEARED FOR PUBLIC RELEASE  
UNDER DOD DIRECTIVE 5200.20 AND  
NO RESTRICTIONS ARE IMPOSED UPON  
ITS USE AND DISCLOSURE.

DISTRIBUTION STATEMENT A

APPROVED FOR PUBLIC RELEASE,  
DISTRIBUTION UNLIMITED.

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 546  
 RUN NO 1C2  
 MACH NO .770

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

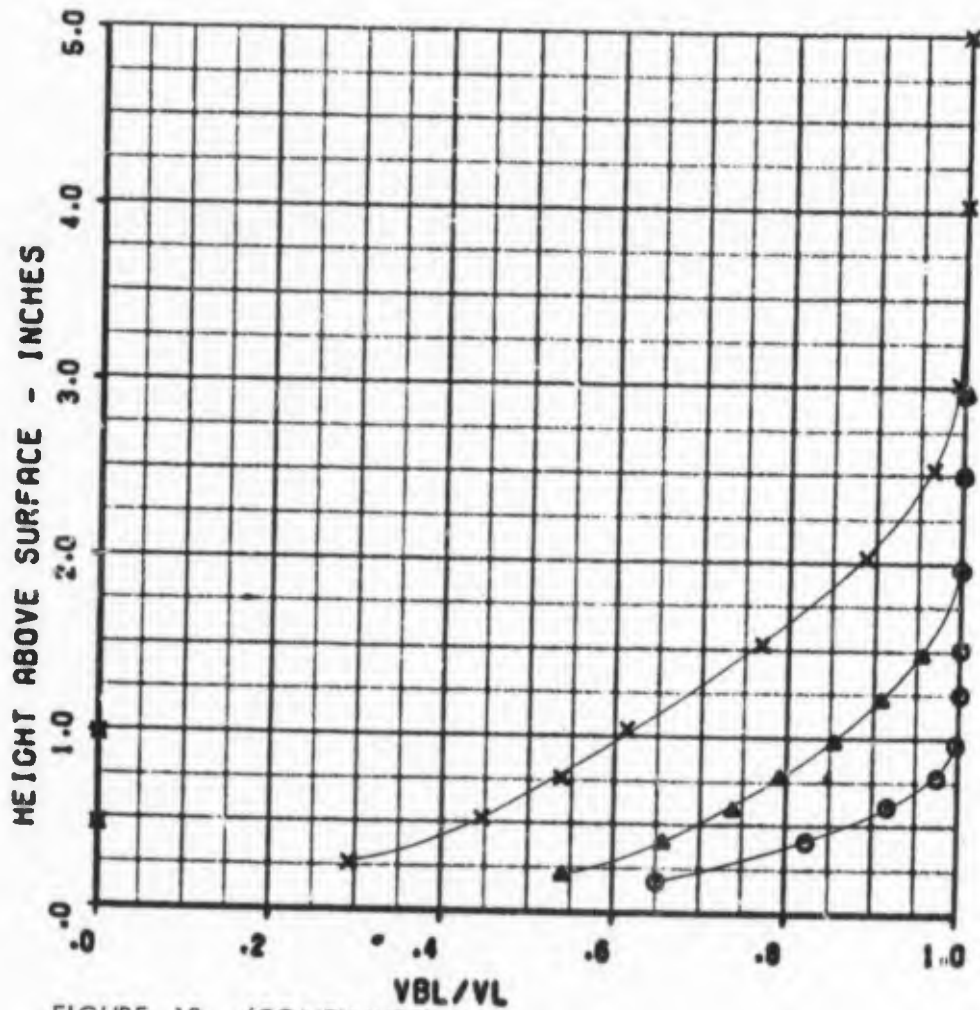


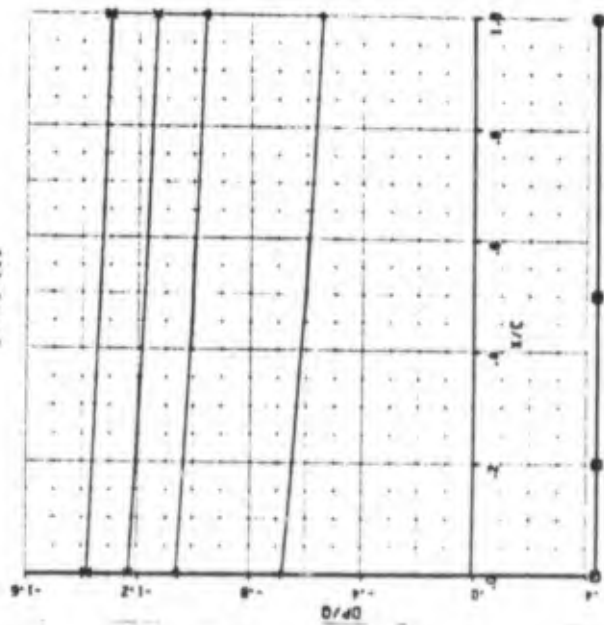
FIGURE 10 (CONTINUED)  
 (c) CORRECTED ALPHA = -2.01

LOCKHEED C-141A  
PRESSURE DISTRIBUTION

FLIGHT NO 546  
RUN NO 1C2  
MACH NO .770

Q 2.79 PSI  
ALPHA -2.95 DEG  
TAN -17.2 DEG C

ETA=0.193

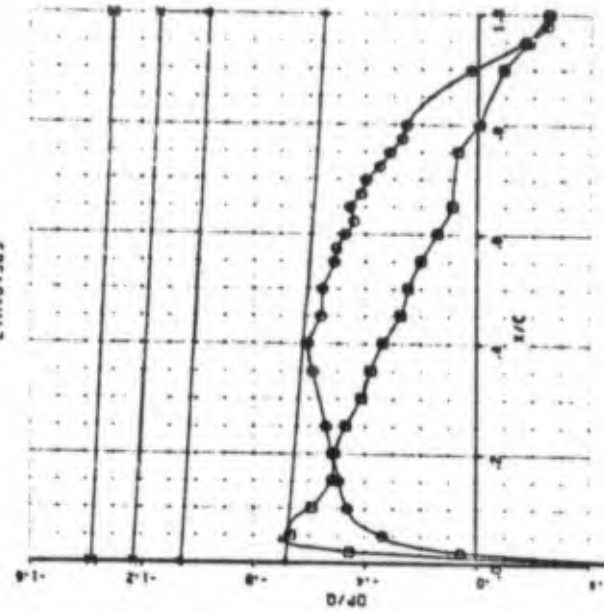


CL=0.000  
CM=0.000

ALTITUDE 20000. FT  
WEIGHT 255000. LB  
NZ -.30

C0 28.35 Z MAC  
AILERON POS -.25 DEG  
FLAP POS 0.00 DEG

ETA=0.389

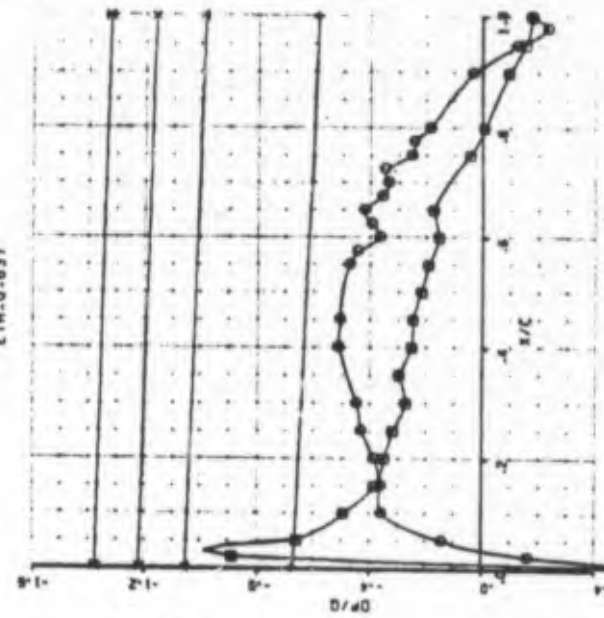


CL=-.140  
CM=-.058

UPPER SURFACE O  
LOWER SURFACE □  
MACH LOCAL-1.0 +

MACH LOCAL-1.2 A  
MACH LOCAL-1.3 X  
MACH LOCAL-1.4 Z

ETA=0.637



CL=-.093  
CM=-.082

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 2A4  
 MACH NO .770

### RAKE LOCATIONS

○ 30 %  
 △ 55 %  
 × 80 %  
 \* 80 % (AFT)

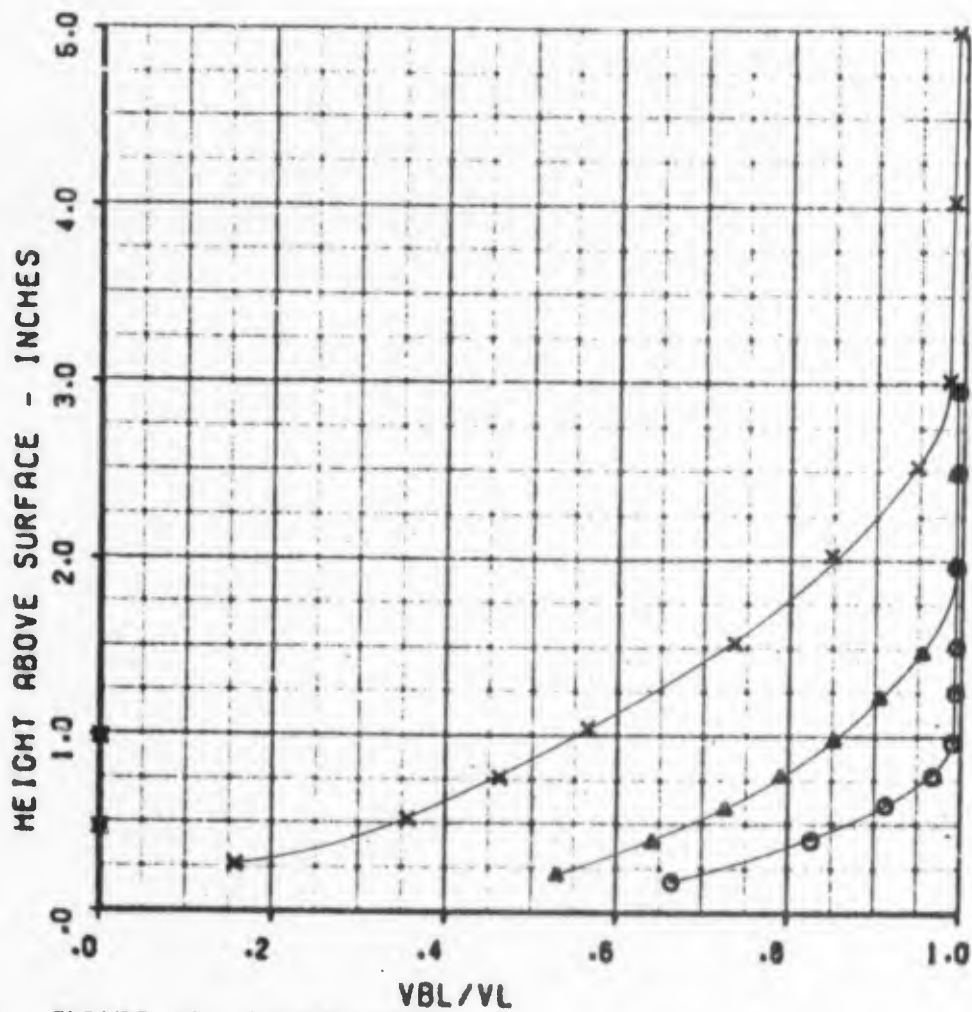
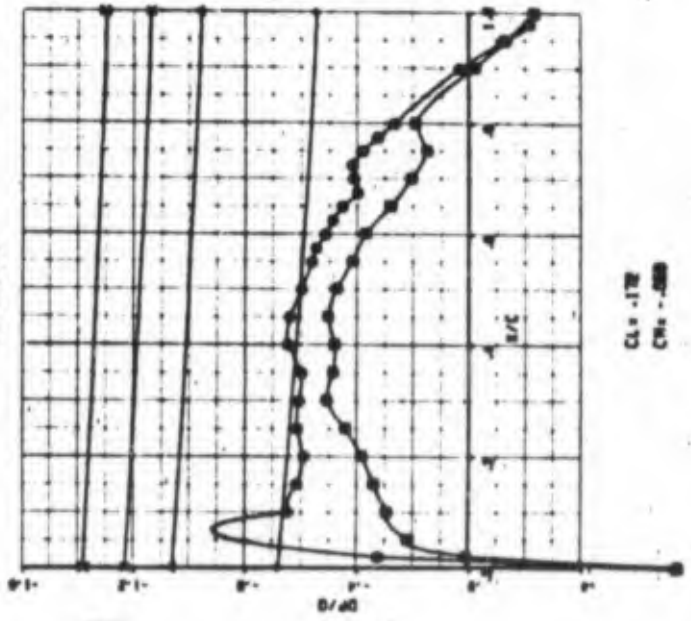


FIGURE 10 (CONTINUED)  
 (d) CORRECTED ALPHA = -1.88

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 540      Q      2.05 PSI  
 RUN NO 284      ALPH      -2.65 DEG  
 MACH NO .770      TAN      -30.2 DEG C

ETA-9-183

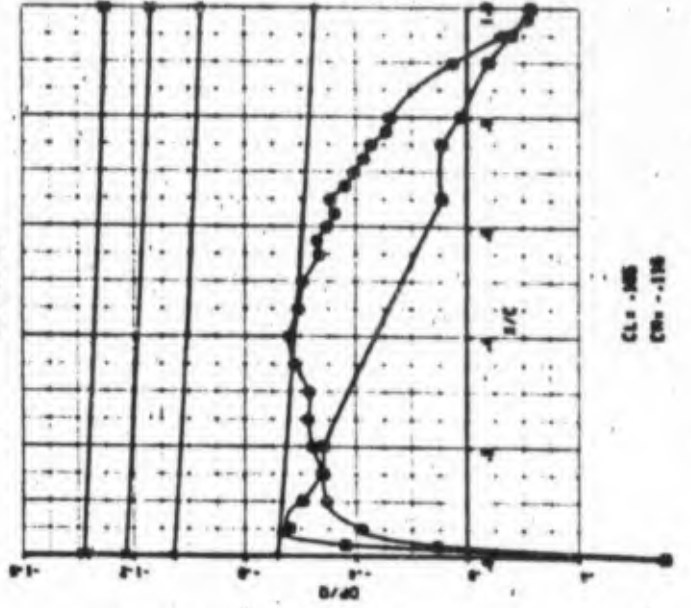


CL: -172  
 CR: -.088

ALTITUDE 15000. FT  
 WEIGHT 262100. LB  
 NZ .46

CG 28.54 I MAC  
 AIRLIFT POS -.61 DEG  
 FLAP POS 0.00 DEG

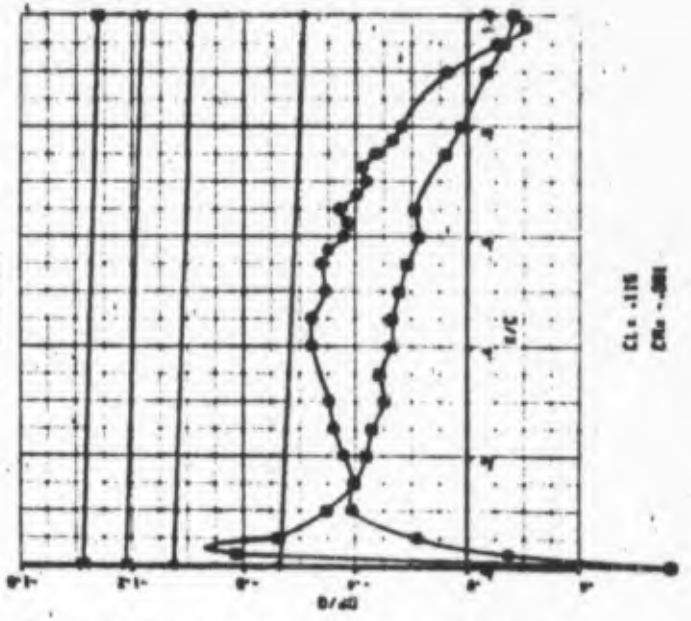
ETA-9-309



CL: -185  
 CR: -.118

C O UPPER SURFACE  
 C O LOWER SURFACE  
 + MACH LOCAL-1.0  
 A MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 X MACH LOCAL-1.4

ETA-9-837



CL: -115  
 CR: -.201

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 546  
 RUN NO 1C  
 MACH NO .770

## RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

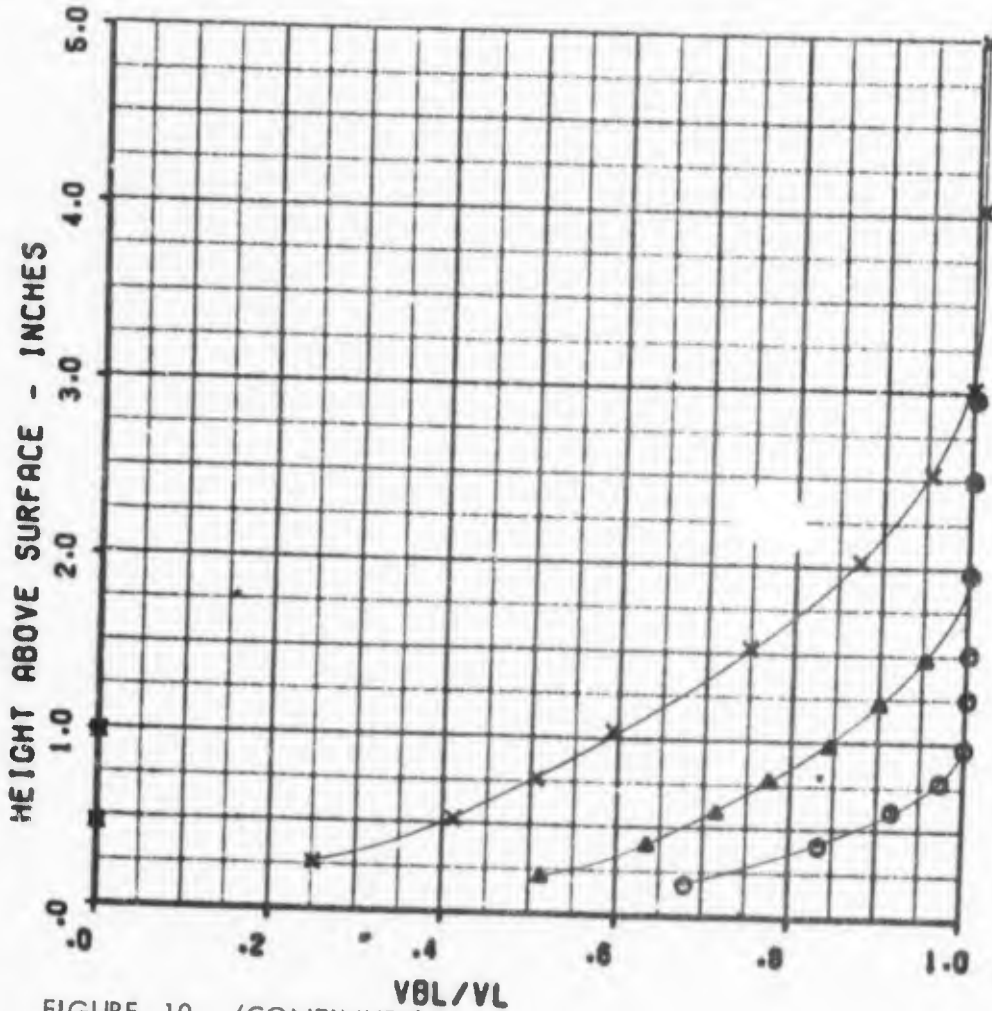


FIGURE 10 (CONTINUED)  
 (e) CORRECTED ALPHA = -1.01

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 548  
 RUN NO 1C  
 MACH NO .770

2.72 PSI  
 -1.71 DEG  
 -17.8 DEG C

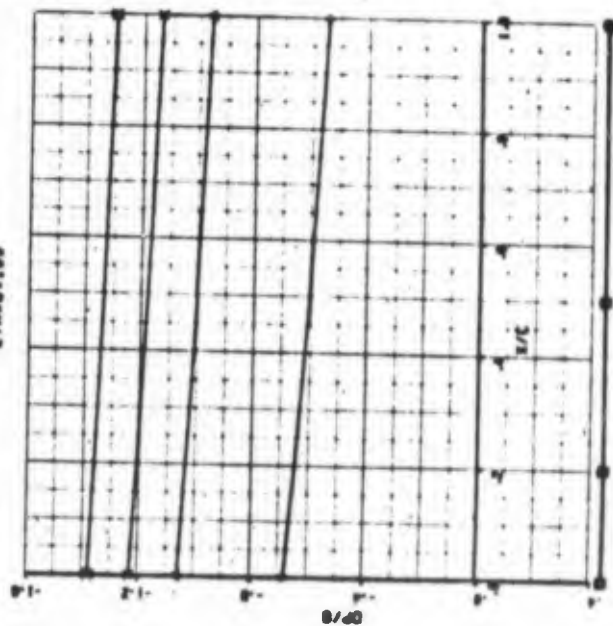
0  
 ALPHA  
 TAN

ALTITUDE 20840. FT  
 HEIGHT 256600. LB  
 NZ 1.01

CO 20.40 X MAC  
 AILERON POS -.76 DEG  
 FLAP POS 0.00 DEG

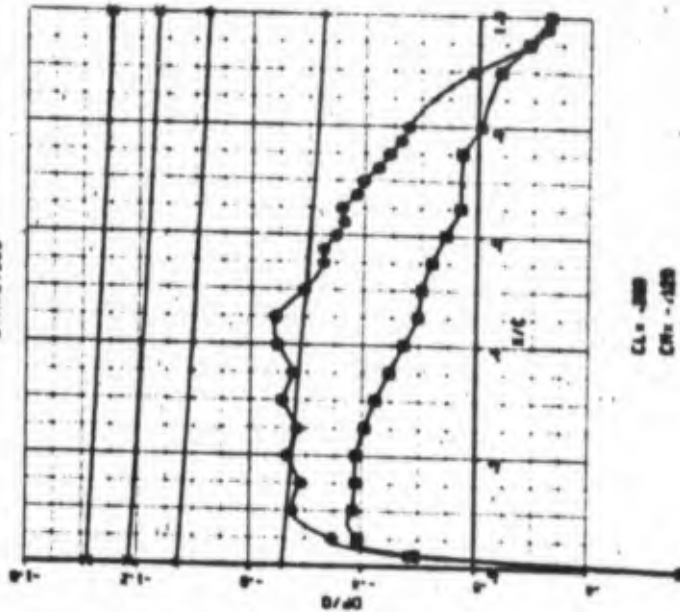
O UPPER SURFACE  
 □ LOWER SURFACE  
 + MACH LOCAL -1.0  
 A MACH LOCAL -1.2  
 X MACH LOCAL -1.3  
 Z MACH LOCAL -1.4

ETA=0.193



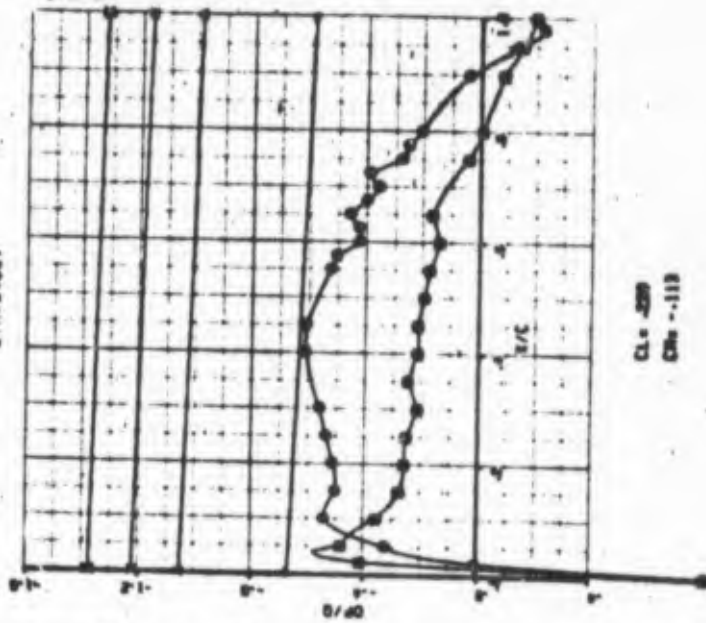
CL = 0.000  
 CR = 0.000

ETA=0.369



CL = .000  
 CR = -.028

ETA=0.637



CL = .000  
 CR = -.113

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 2A  
 MACH NO .770

### RAKE LOCATIONS

○ 30 %  
 △ 55 %  
 × 80 %  
 \* 80 % (AFT)

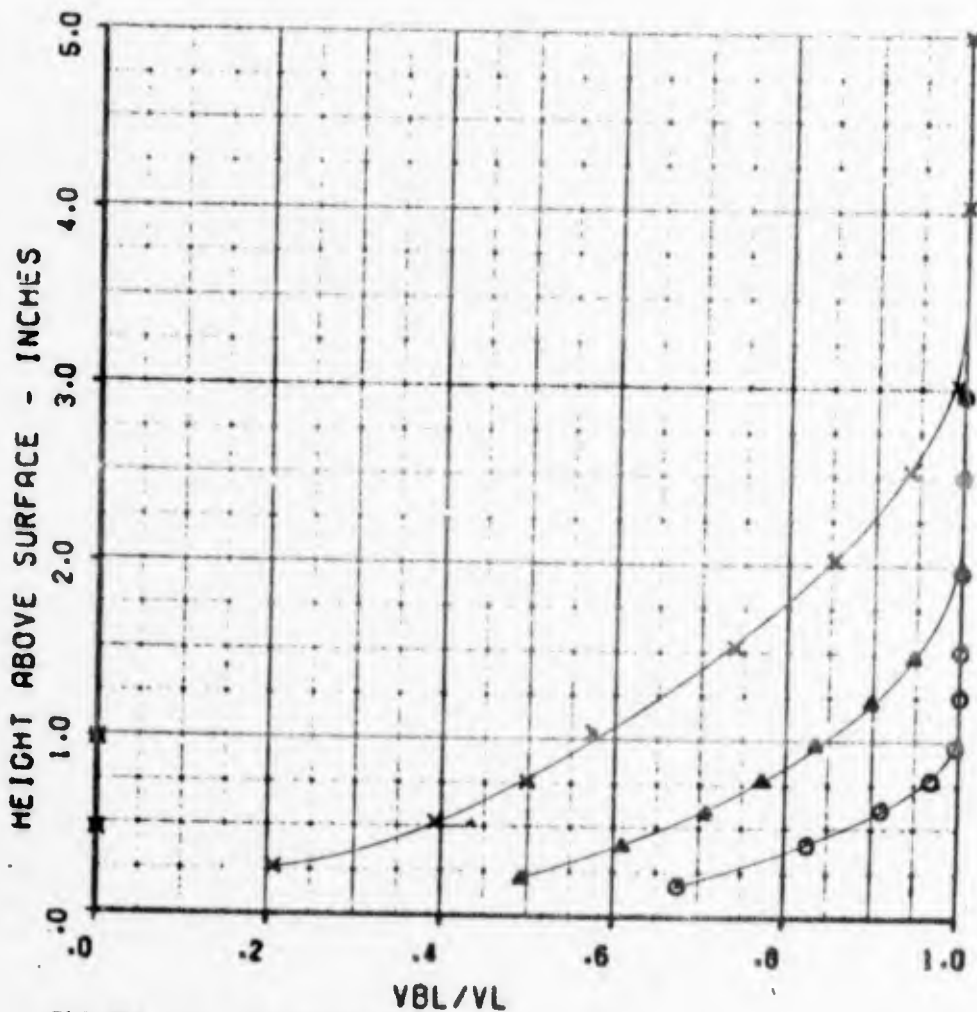


FIGURE 10 (CONTINUED)  
 (f) CORRECTED ALPHA = -0.96

# LOCKHEED C-141R PRESSURE DISTRIBUTION

FLIGHT NO 548  
RUN NO 2A  
MACH NO .770

$\alpha$   
ALPHA  
TMR

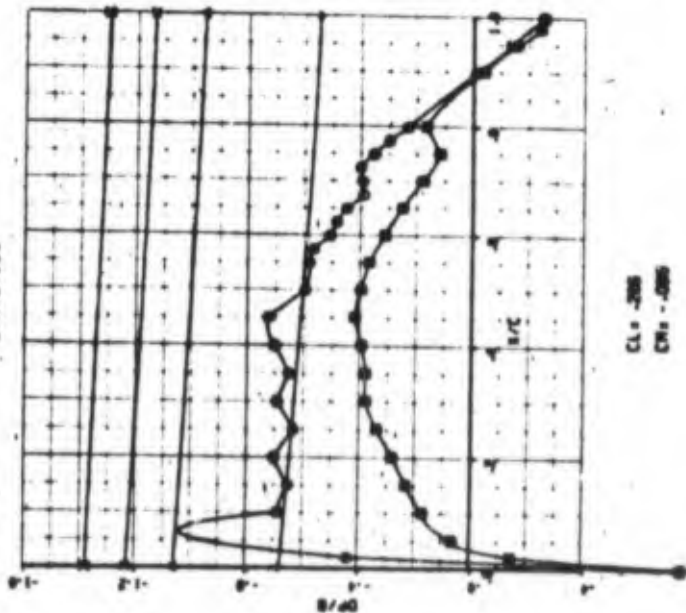
2.77 PSI  
-1.43 DEG  
-32.4 DEG C

ALTITUDE 20000. FT  
WEIGHT 25400. LB  
MZ 1.00

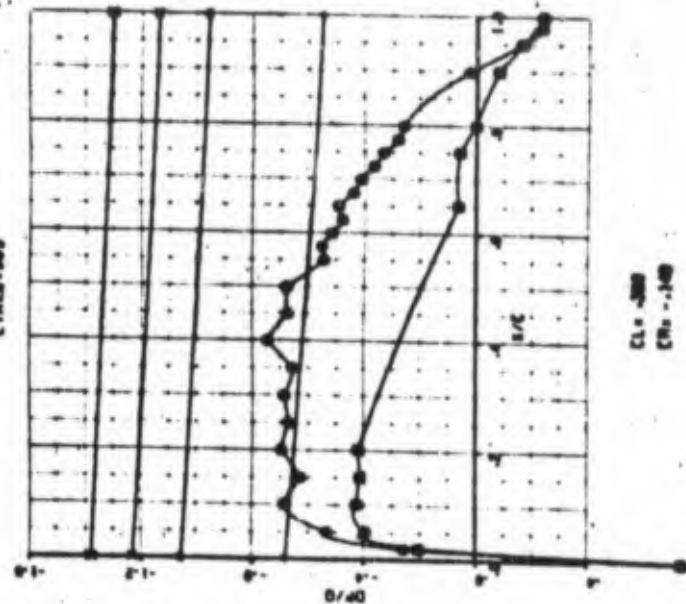
CD 29.69 ± MAC  
AILERON PDS -.76 DEG  
FLAP PDS 0.00 DEG

○ UPPER SURFACE  
□ LOWER SURFACE  
+ MACH LOCAL -1.0  
△ MACH LOCAL -1.2  
× MACH LOCAL -1.3  
Σ MACH LOCAL -1.4

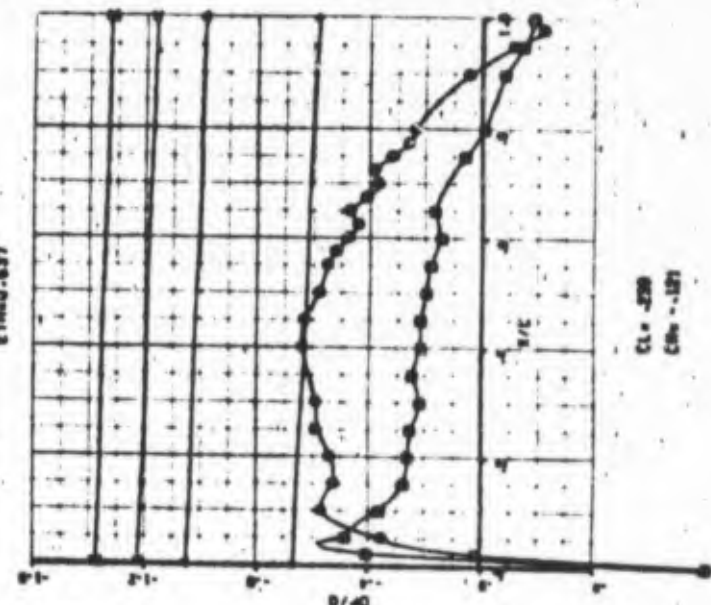
ETA-8.189



ETA-8.209



ETA-8.237



# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 546  
 RUN NO 1C3  
 MACH NO .780

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

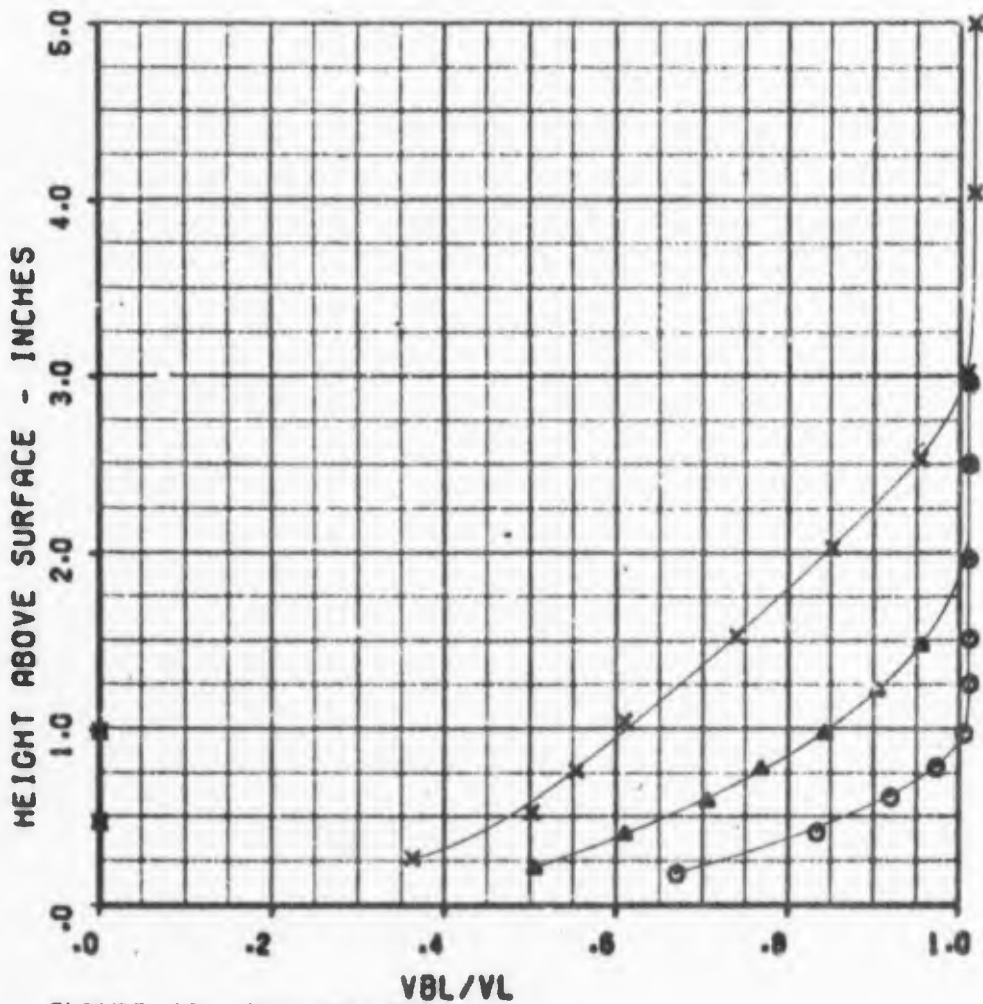


FIGURE 10 (CONTINUED)  
 (g) CORRECTED ALPHA = -0.44

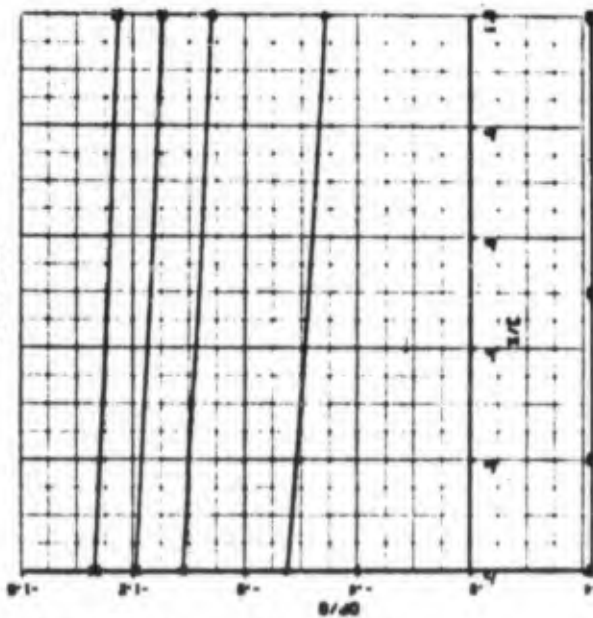
# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 548  
RUN NO 1C3  
MACH NO .780

0  
ALPHA  
TRN

2.84 PSI  
-1.05 DEG  
-18.1 DEG C

ETR=0.183



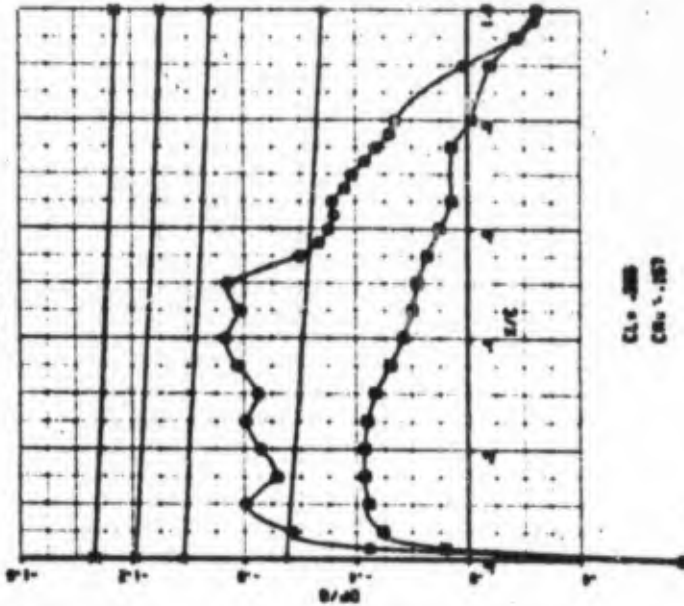
CL = 0.000  
CM = 0.000

ALTITUDE 20000. FT  
WEIGHT 256000. LB  
M2 1.51

CG  
AILERON POS  
FLAP POS

20.40 X MAC  
-2.17 DEG  
0.00 DEG

ETR=0.200

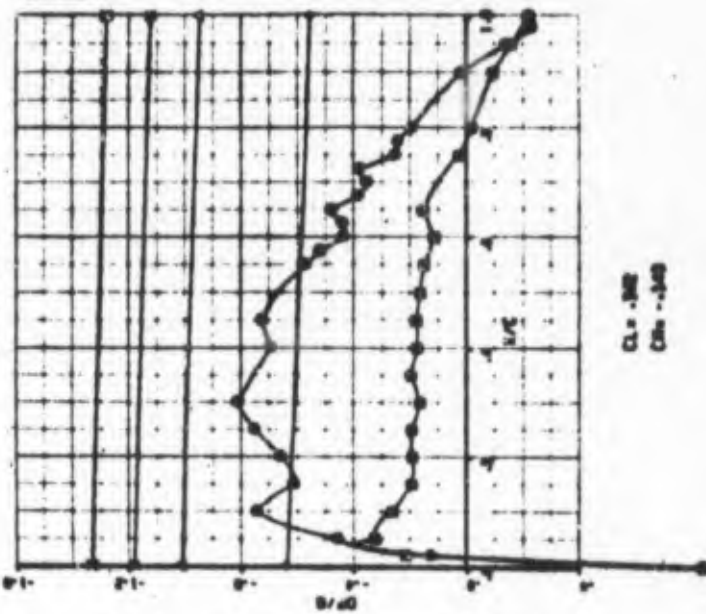


CL = 0.000  
CM = 0.000

UPPER SURFACE  
LOWER SURFACE

MACH LOCAL-1.0  
MACH LOCAL-1.2  
MACH LOCAL-1.3  
MACH LOCAL-1.4

ETR=0.837



CL = 0.000  
CM = 0.000

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 2A1  
 MACH NO .778

### RAKE LOCATIONS

○ 30 %  
 △ 55 %  
 × 80 %  
 \* 60 % (AFT)

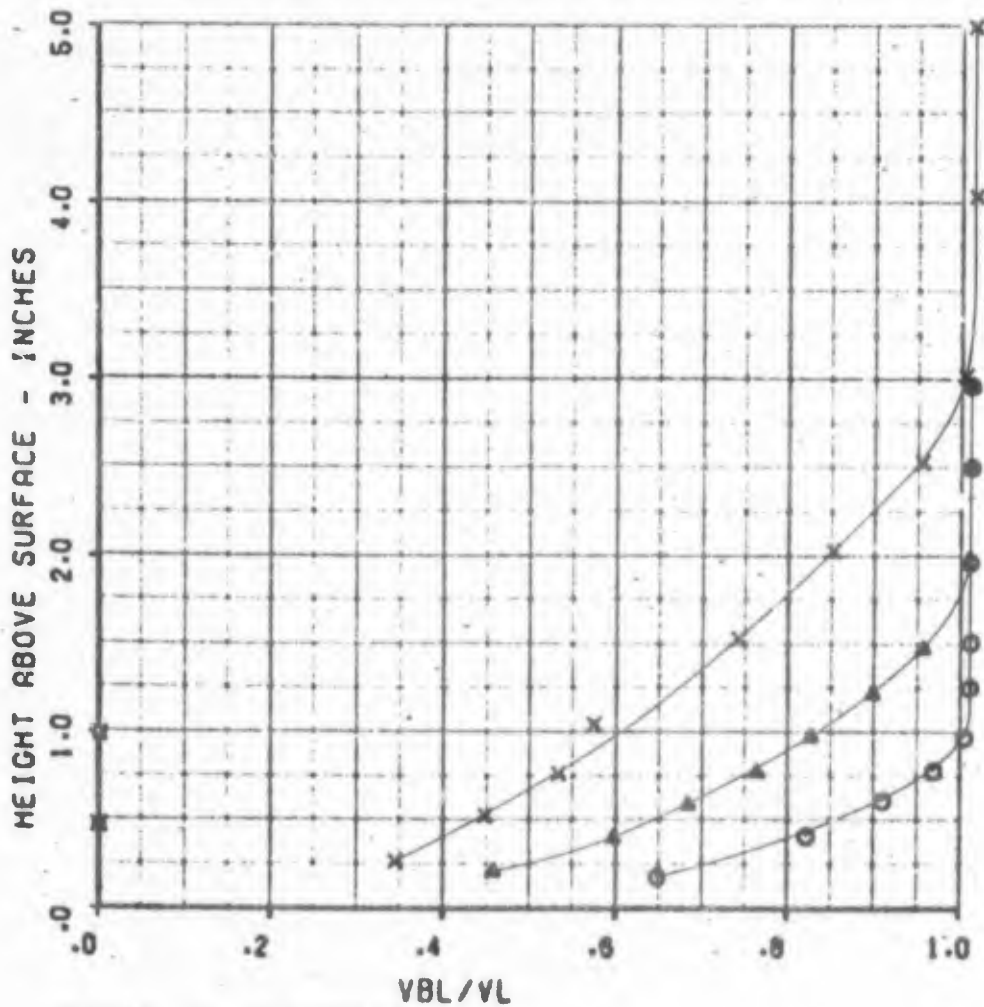


FIGURE 10 (CONTINUED)  
 (h) CORRECTED ALPHA = -0.28

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 548  
 RUN NO 241  
 MACH NO .778

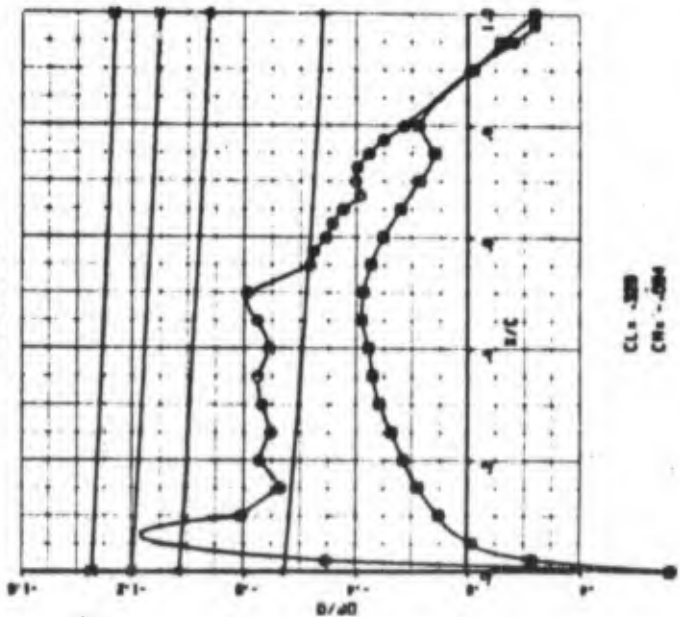
Q 2.06 PSI  
 ALPHA 1.05 DEG  
 THETA -31.8 DEG C

ALTITUDE 19000. FT  
 WEIGHT 26400. LB  
 WZ 1.48

CO 29.88 I MAC  
 AILERON POS -.93 DEG  
 FLAP POS 0.00 DEG

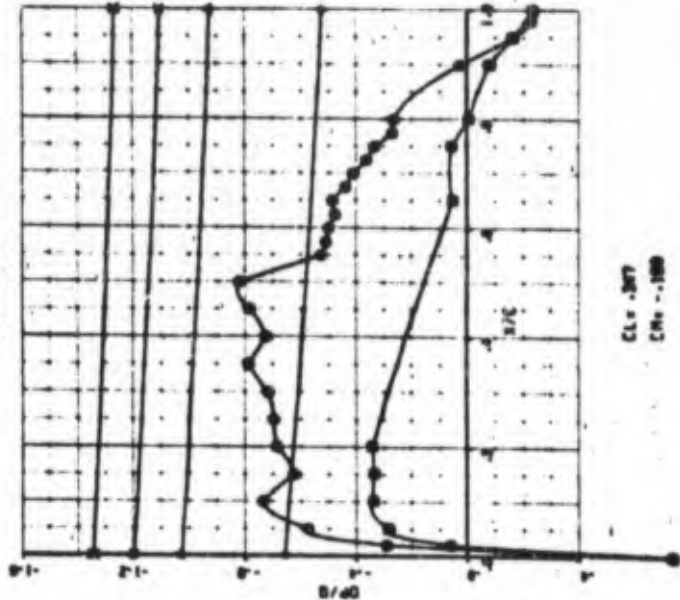
O UPPER SURFACE  
 X LOWER SURFACE  
 MACH LOCAL-1.0  
 MACH LOCAL-1.2  
 MACH LOCAL-1.3  
 MACH LOCAL-1.4

ETA=0.193



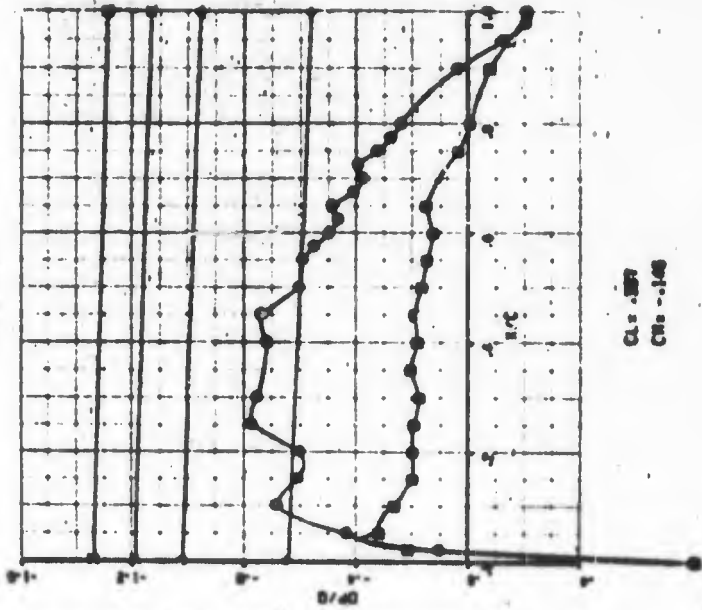
CLx .289  
 CWx -.284

ETA=0.209



CLx .307  
 CWx -.189

ETA=0.837



CLx .387  
 CWx -.146

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 546  
 RUN NO 1C4  
 MACH NO .770

## RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

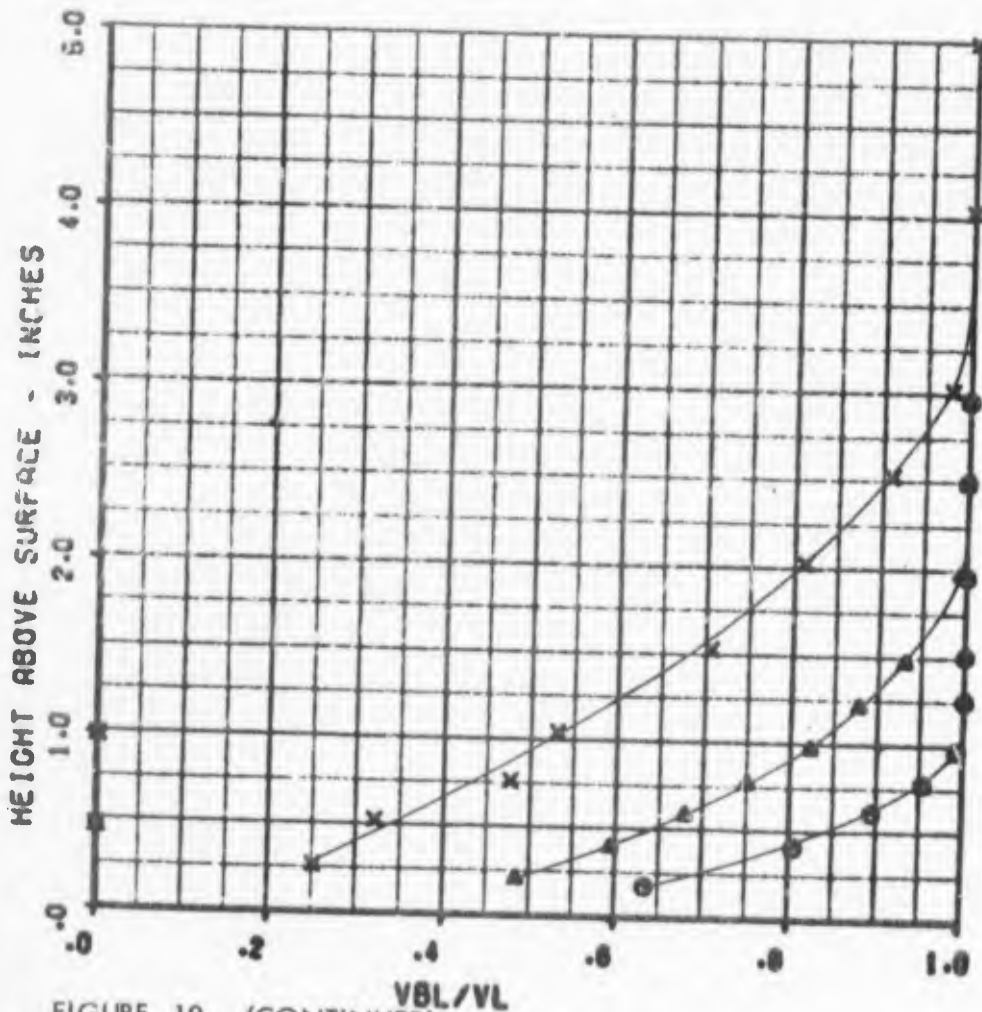


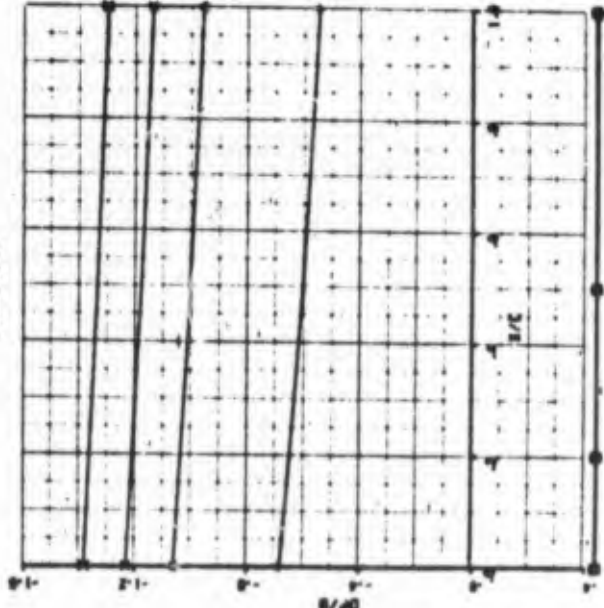
FIGURE 10 (CONTINUED)  
 (k) CORRECTED ALPHA = -0.18

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 548  
 RUN NO 1C4  
 MACH NO .770

$\theta$  2.76 PSI  
 ALPHAR -76 DEG  
 TAN -17.5 DEG C

ETA=0.193

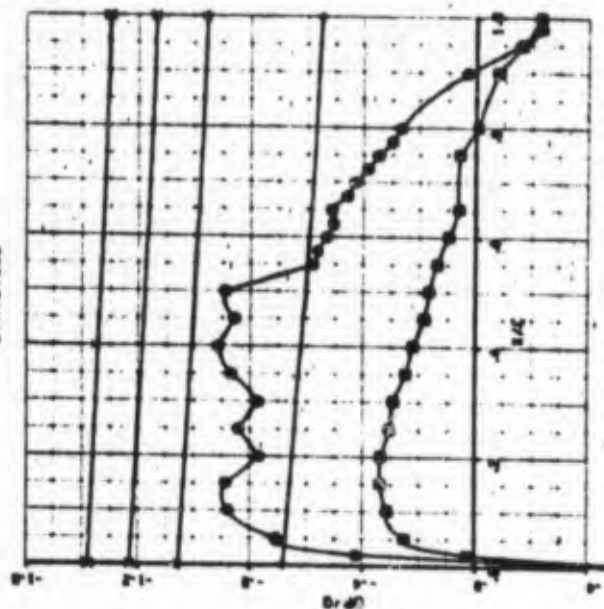


CL=0.000  
 CR=0.000

ALTITUDE 20000. FT  
 WEIGHT 265700. LB  
 NZ 1.06

CO 20.40 ± MACH  
 AILERON POS -2.69 DEG  
 FLAP POS 0.00 DEG

ETA=0.300

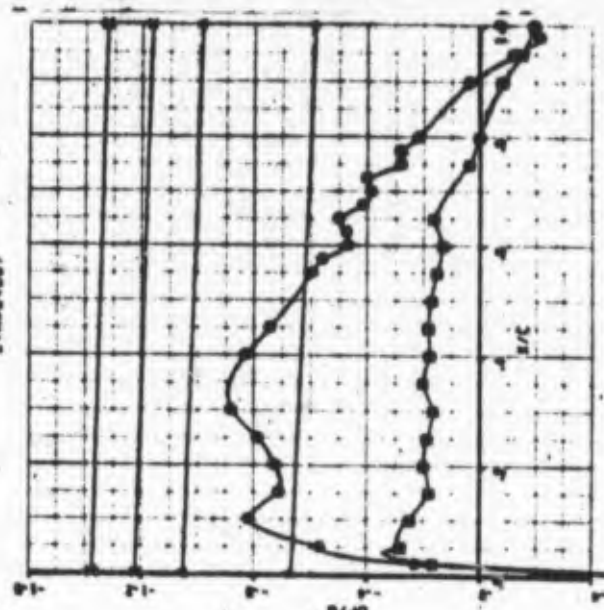


CL=0.001  
 CR=-0.171

UPPER SURFACE-  
 LOWER SURFACE

▲ MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 □ MACH LOCAL-1.4

ETA=0.637



CL=0.000  
 CR=-0.085

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 2A2  
 MACH NO .772

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

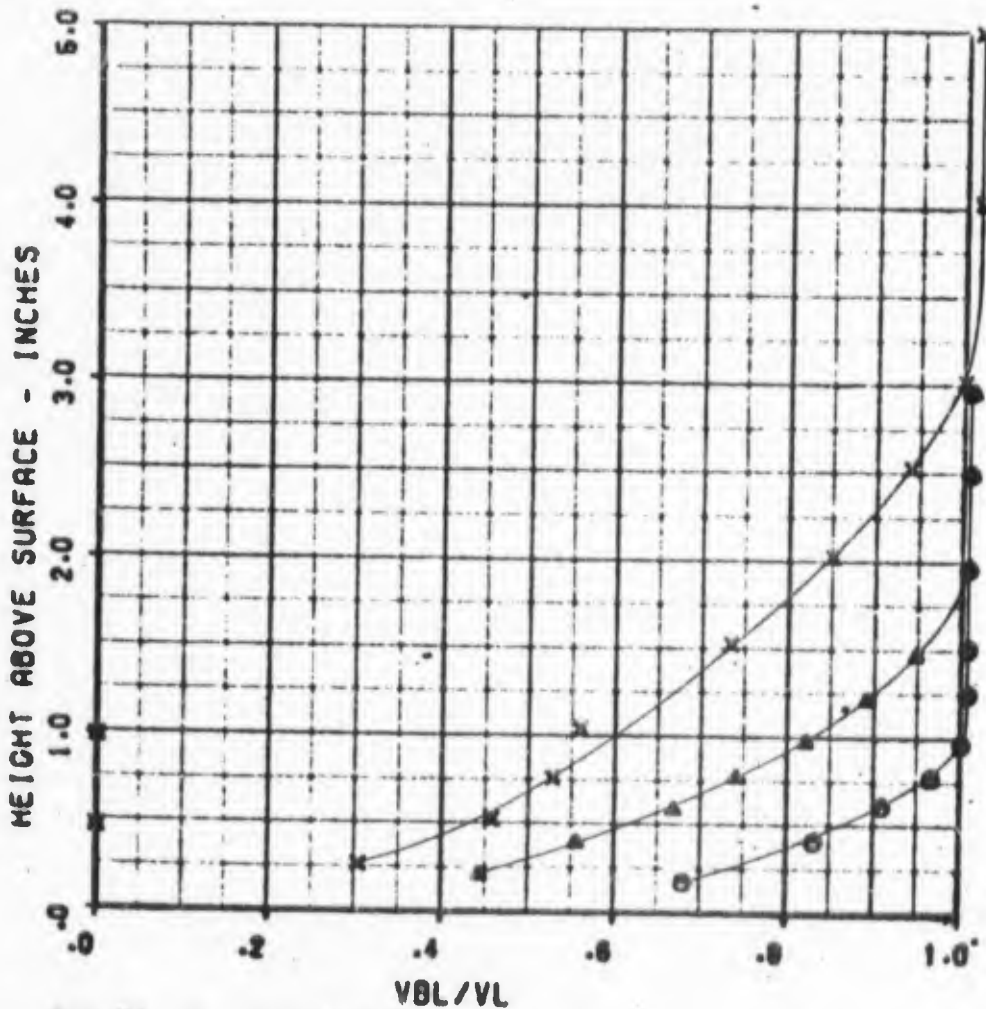


FIGURE 10 (CONTINUED)  
 (I) CORRECTED ALPHA = 0.04

LOCKHEED C-141A  
PRESSURE DISTRIBUTION

FLIGHT NO 549  
RUN NO 242  
MACH NO .772

Q  
ALPMA  
TMM

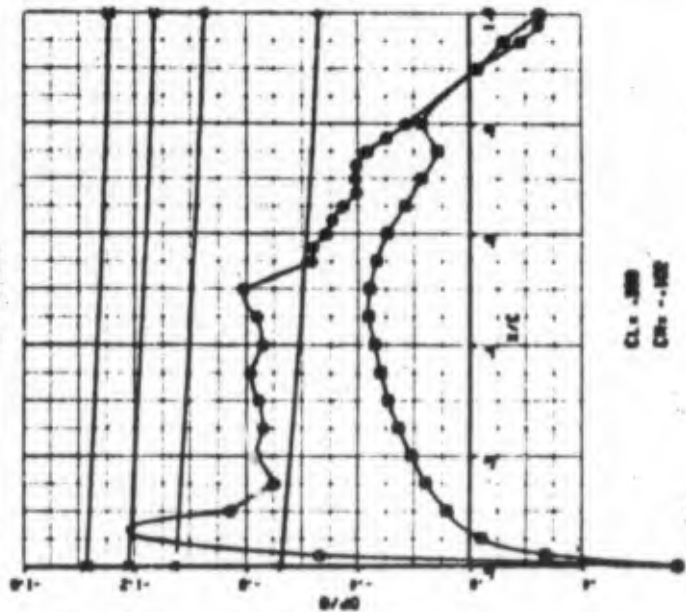
P-45 PSI  
-40 DEG  
-31.0 DEG C

ALTITUDE 19710. FT  
WEIGHT 28400. LB  
MZ 1.79

CO 29.87 X MAC  
RILESON POS -.78 DEG  
FLMP POS 0.00 DEG

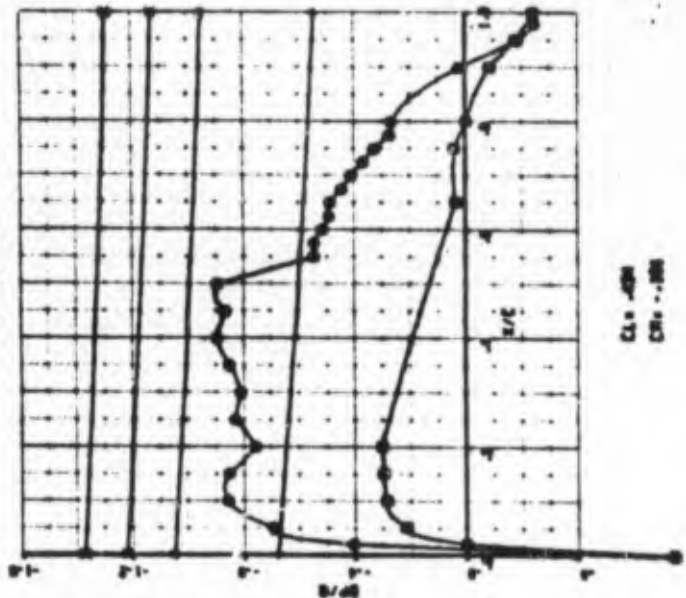
UPPER SURFACE  
LOWER SURFACE  
MACH LOCAL-1.0  
MACH LOCAL-1.2  
MACH LOCAL-1.3  
MACH LOCAL-1.4

ETM-0.193



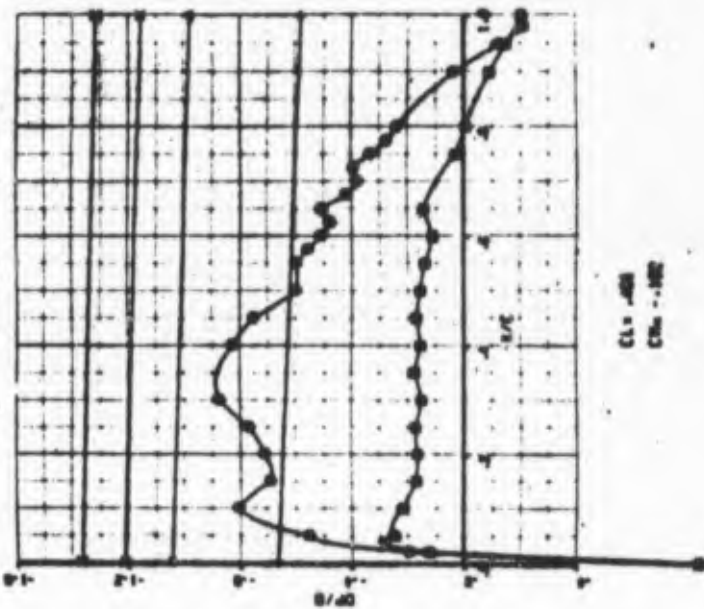
CLs .000  
CRs -.000

ETM-0.300



CLs .000  
CRs -.000

ETM-0.437



CLs .000  
CRs -.000

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RAKE CONDITIONS

FLIGHT NO 546  
 RUN NO 1C5  
 MACH NO .772

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✖ 80 % (AFT)

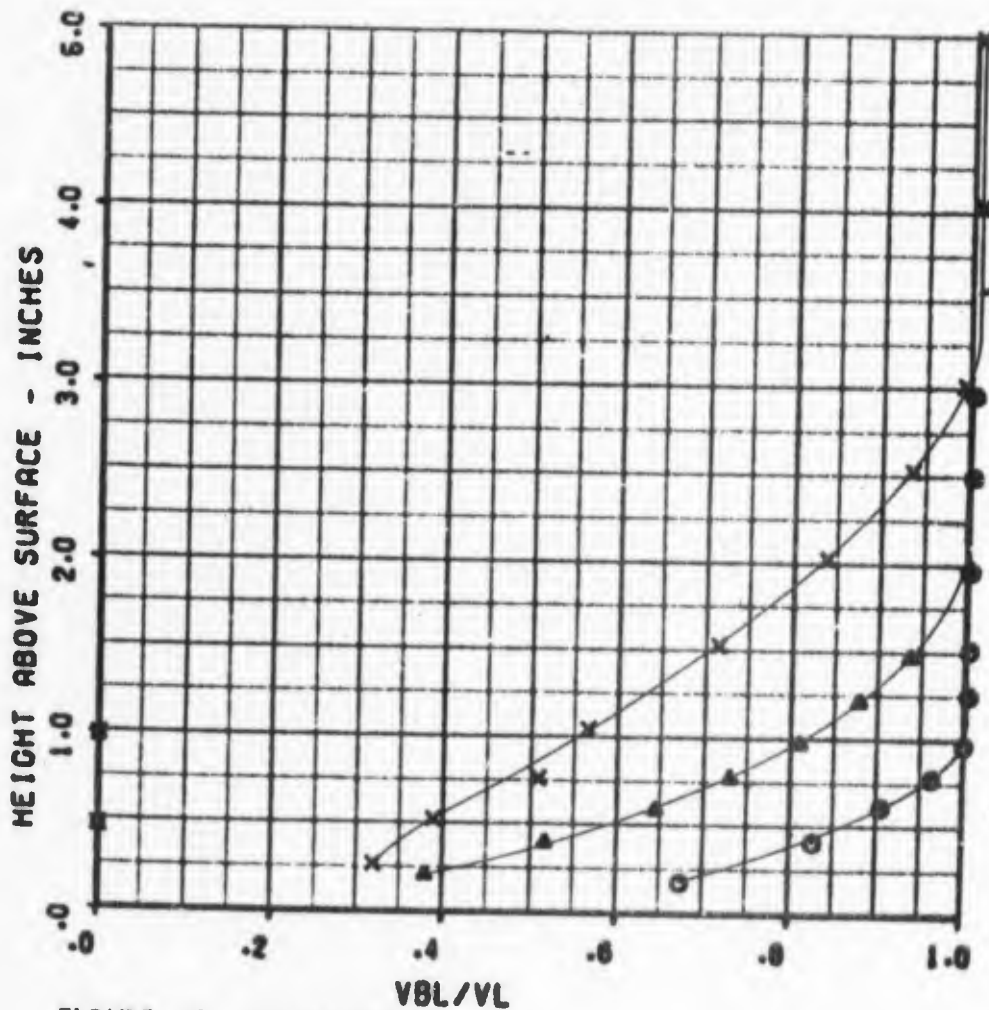


FIGURE 10 (CONTINUED)  
 (m) CORRECTED ALPHA = 0.15

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 548  
 RUN NO 1CS  
 MACH NO .772

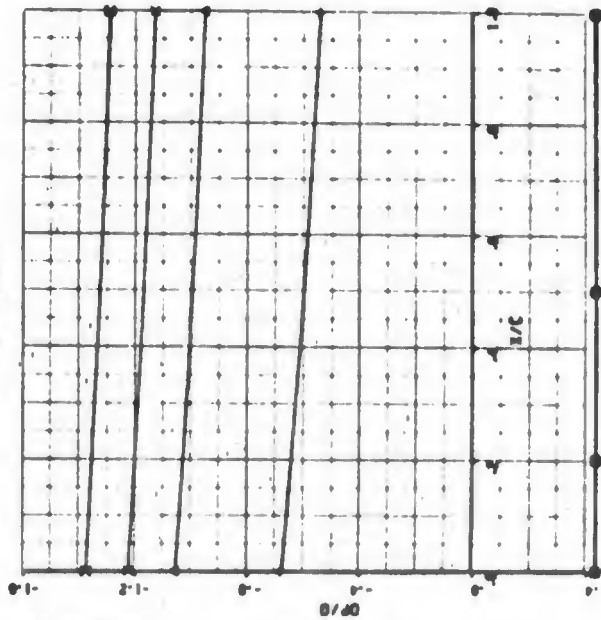
2-80 PSI  
 -38 DEG  
 -16.8 DEG C

ALTITUDE 20120. FT  
 WEIGHT 256400. LB  
 NZ 1.89

CO 20.35 Z MAC  
 AILERON POS -1.33 DEG  
 FLAP POS 0.00 DEG

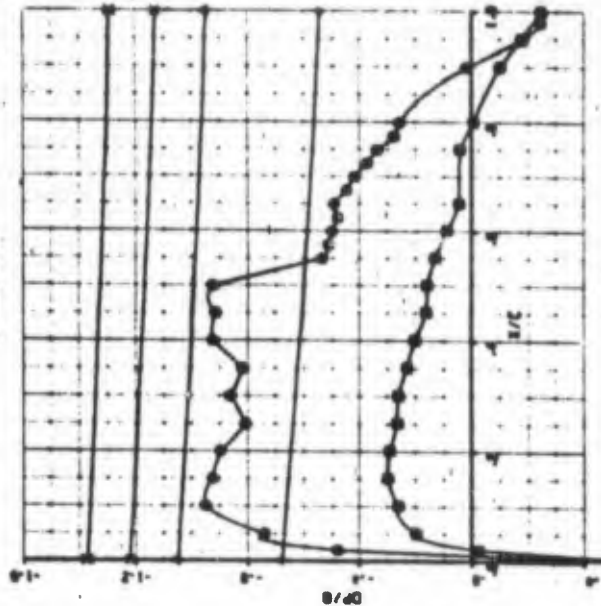
O UPPER SURFACE  
 □ LOWER SURFACE  
 + MACH LOCAL-1.0  
 ▲ MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 Σ MACH LOCAL-1.4

ETA=0.193



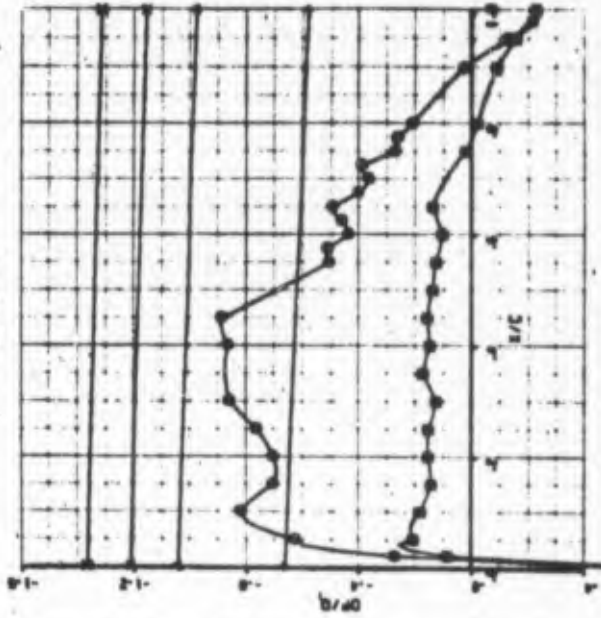
CL= 0.000  
 CM= 0.000

ETA=0.389



CL= -.085  
 CM= -.177

ETA=0.637



CL= -.481  
 CM= -.184

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 2A3  
 MACH NO .775

### RAKE LOCATIONS

⊙ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

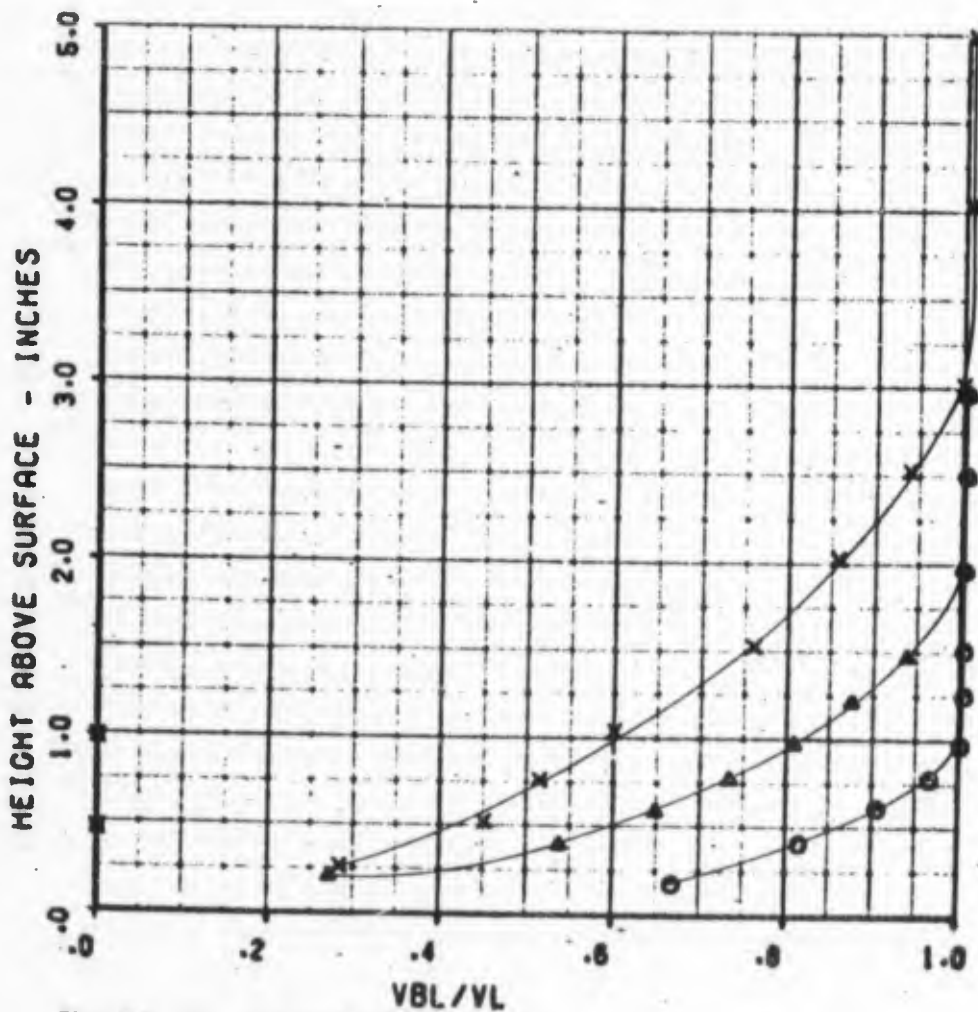
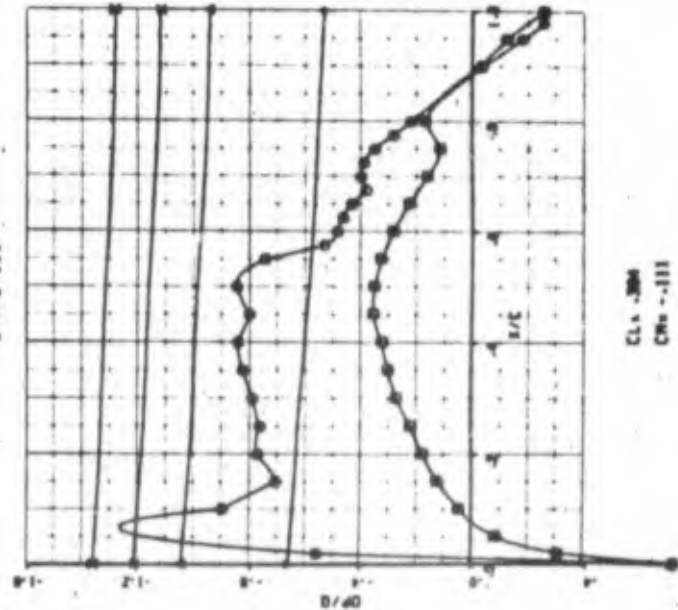


FIGURE 10 (CONCLUDED)  
 (n) CORRECTED ALPHA = 0.22

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 548      0      2.94 PSI  
 RUN NO 293      ALPH      -29 DEG  
 MACH NO .775      TAN      -29.4 DEG C

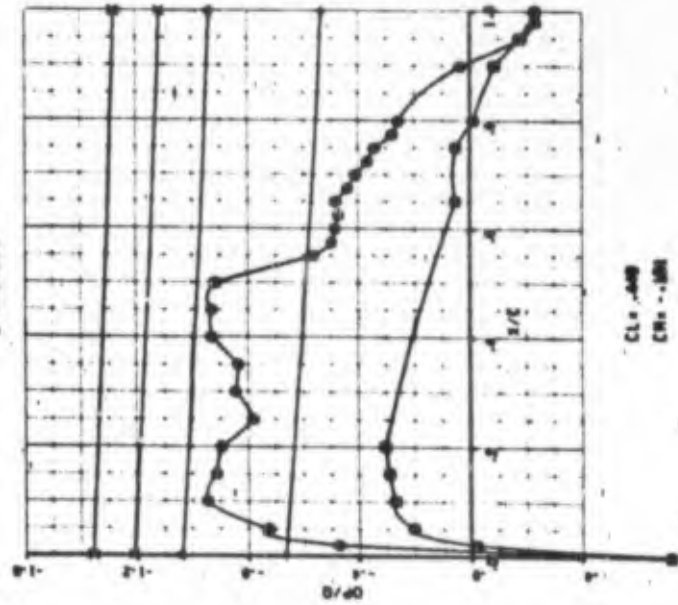
ETA=0.193



CLr = .304  
 CR = -.111

ALTITUDE 10000. FT  
 WEIGHT 263500. LB  
 NZ 1.91

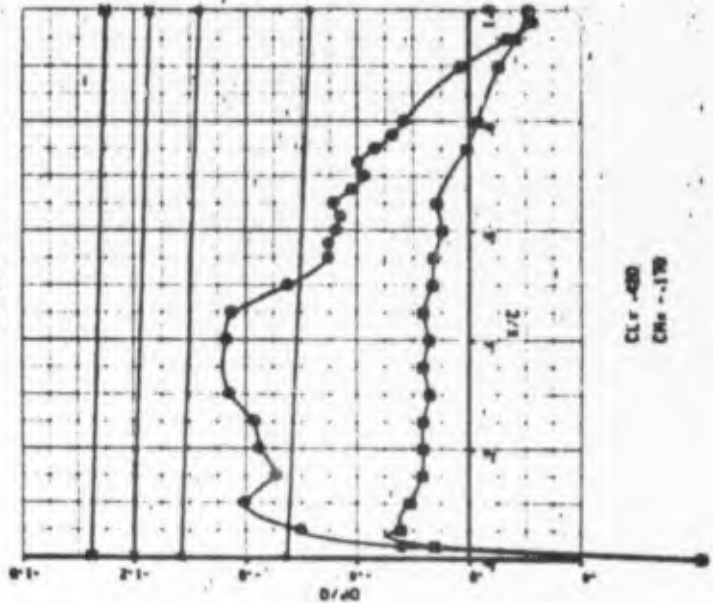
ETA=0.309



CLr = .409  
 CR = -.188

CO 29.56 % MAC  
 AILERON POS -.08 DEG  
 FLAP POS 0.00 DEG

ETA=0.637



CLr = .409  
 CR = -.179

UPPER SURFACE      O      MACH LOCAL-1.2  
 LOWER SURFACE      X      MACH LOCAL-1.3  
 MACH LOCAL-1.0      +      MACH LOCAL-1.4

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 546  
 RUN NO 101  
 MACH NO .795

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

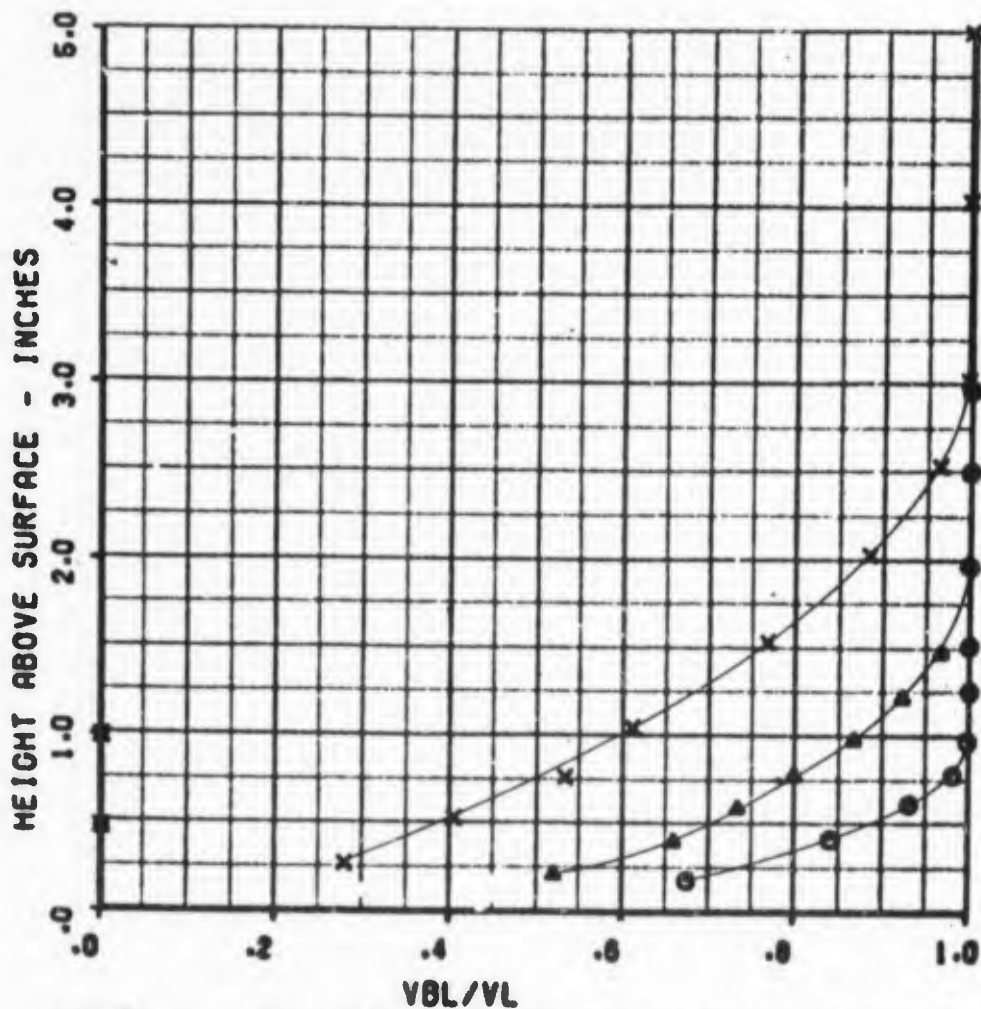


FIGURE 11 BOUNDARY LAYER VELOCITY PROFILES AND PRESSURE DISTRIBUTIONS MACH .794 TO .802

(a) CORRECTED ALPHA = -2.78

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 548  
 RUN NO 101  
 MACH NO .795

2.74 PSI  
 -3.71 DEG  
 -21.9 DEG C

0  
 ALPHA  
 TAN

ALTITUDE 22010. FT  
 WEIGHT 247600. LB  
 NZ 0.00

CO 20.15 X MAC

AILERON POS --.33 DEG  
 FLAP POS 0.00 DEG

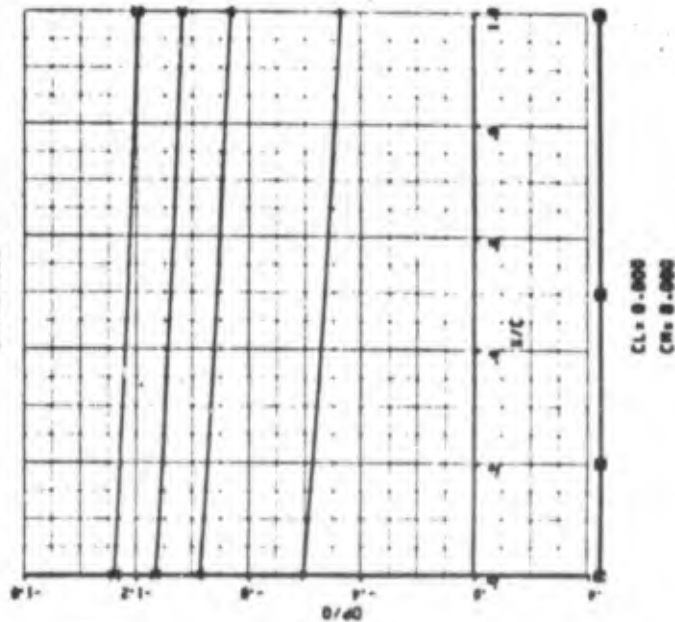
UPPER SURFACE  
 LOWER SURFACE

MACH LOCAL-1.0  
 MACH LOCAL-1.2  
 MACH LOCAL-1.3  
 MACH LOCAL-1.4

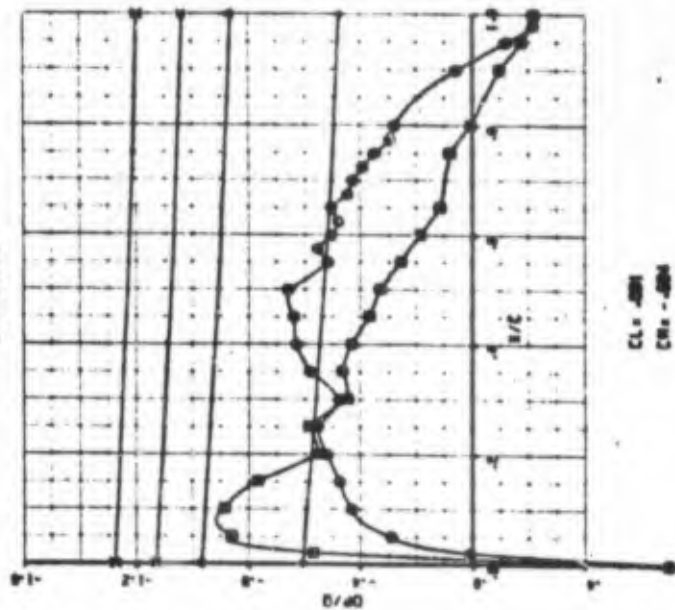
ETA=0.193

ETA=0.209

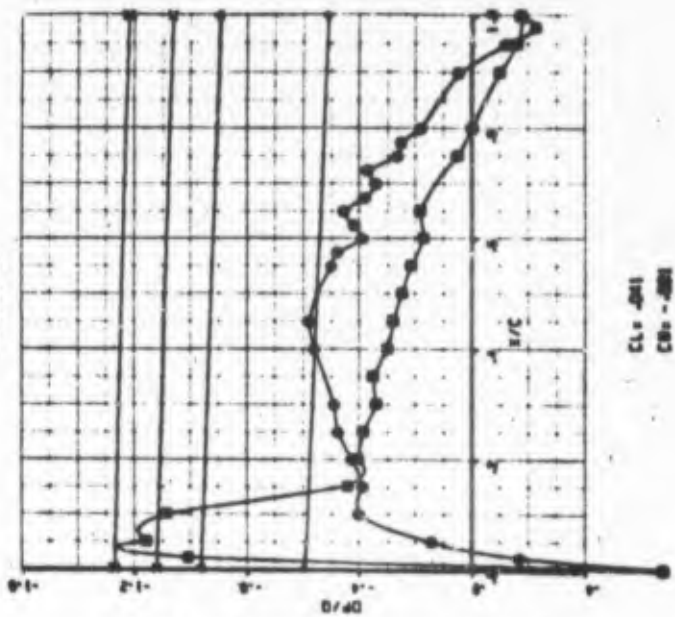
ETA=0.537



CL = 0.000  
 CR = 0.000



CL = .001  
 CR = -.001



CL = .001  
 CR = -.001

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 285  
 MACH NO .794

### RAKE LOCATIONS

○ 30 %  
 △ 55 %  
 × 80 %  
 \* 80 % (AFT)

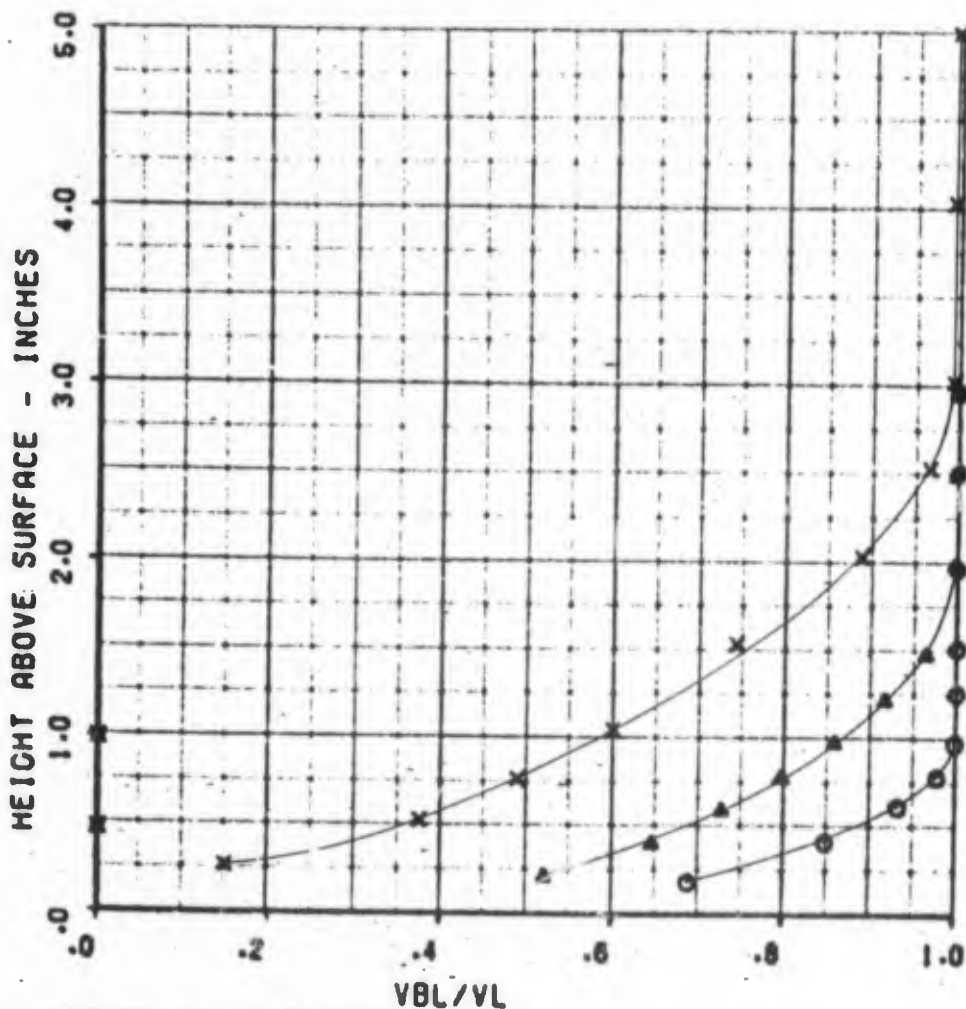


FIGURE 11 (CONTINUED)  
 (b) CORRECTED ALPHA = -2.73

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 548  
 RUN NO 285  
 MACH NO .794

$\theta$  3-12 DEG  
 ALPMA -3-54 DEG  
 TRN -25-9 DEG C

ETA=0.193

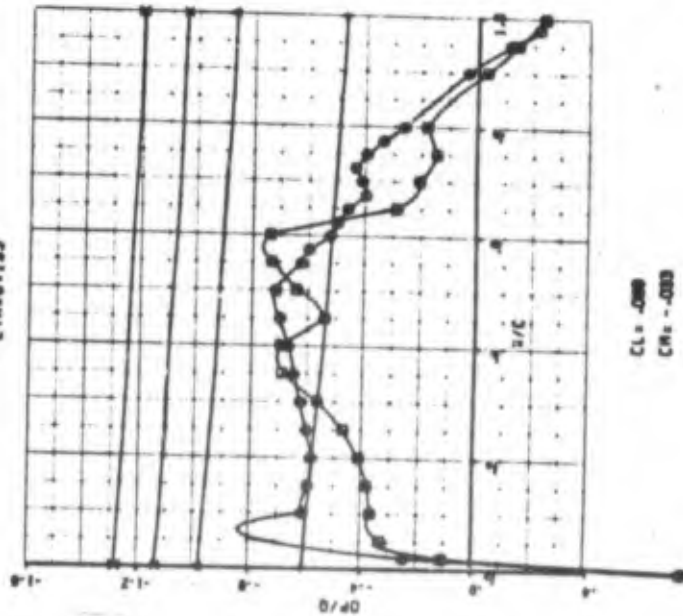
ALTITUDE 10000. FT  
 WEIGHT 257000. LB  
 WZ 0.00

CO 29.38 X MAC  
 AILERON POS -1.78 DEG  
 FLAP POS 0.00 DEG

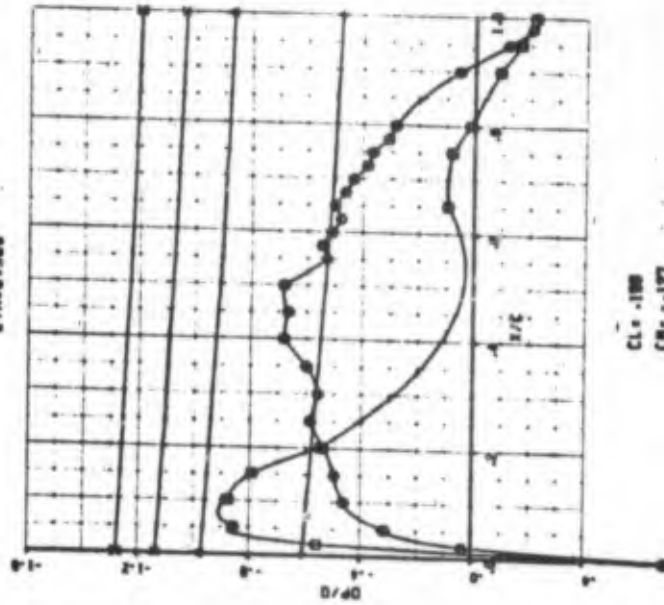
ETA=0.388

UPPER SURFACE  
 LOWER SURFACE  
 MACH LOCAL-1  
 MACH LOCAL-1.2  
 MACH LOCAL-1.3  
 MACH LOCAL-1.4

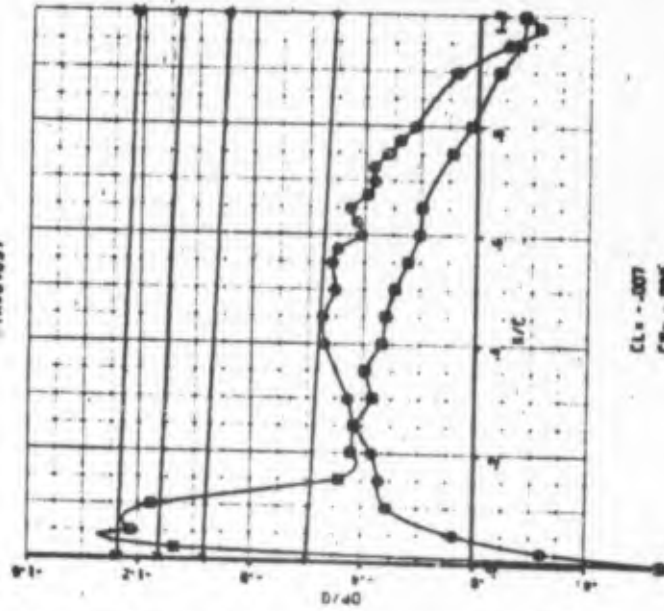
ETA=0.637



CL = .088  
 CM = -.033



CL = .189  
 CM = -.127



CL = -.007  
 CM = -.008

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 546  
 RUN NO 102  
 MACH NO .794

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

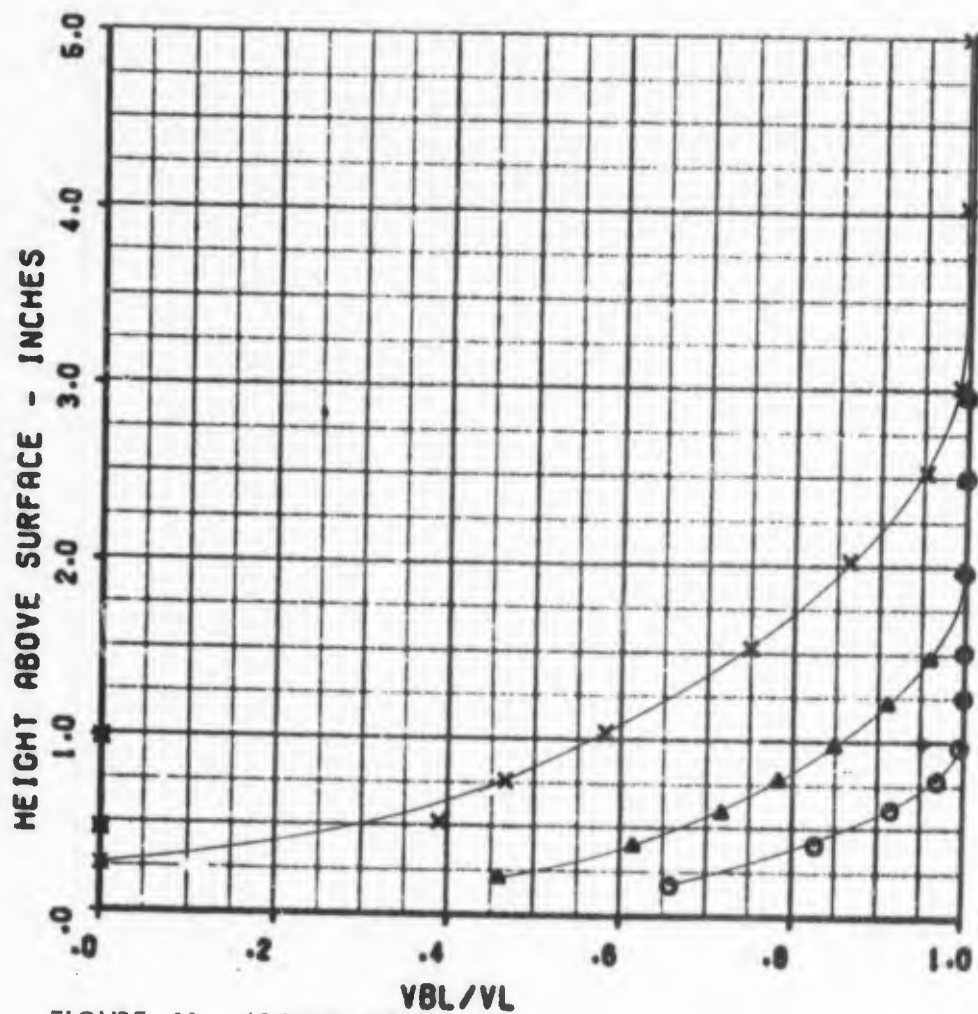


FIGURE 11 (CONTINUED)  
 (c) CORRECTED ALPHA = -1.95

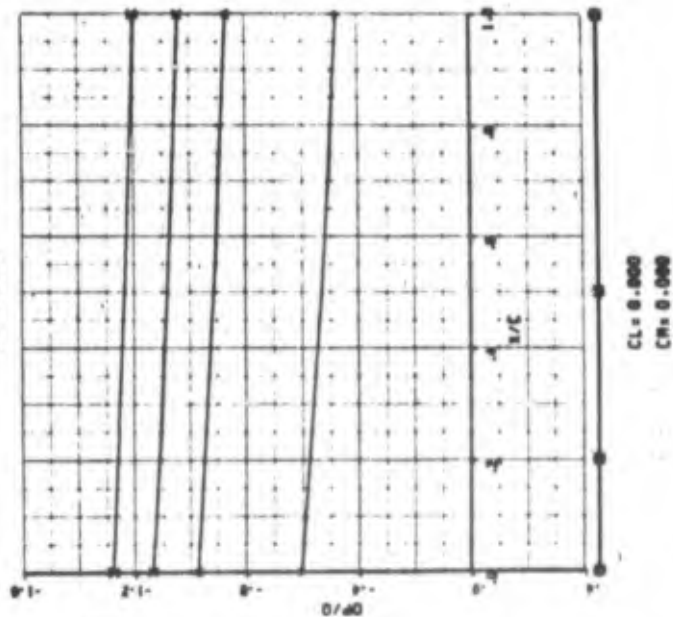
# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 546  
RUN NO 102  
MACH NO .754

Q  
ALPHA  
TRN

2.70 PSI  
-2.76 DEG  
-21.9 DEG C

ETA=0.193

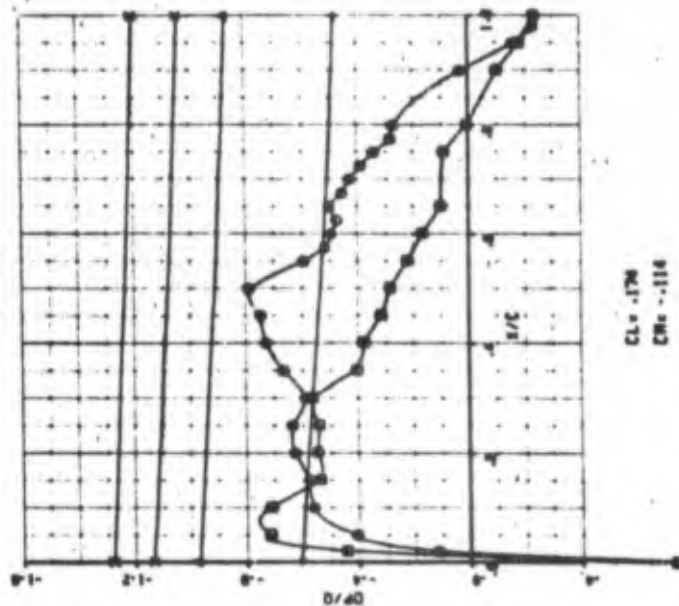


ALTITUDE 22500. FT  
WEIGHT 248500. LB  
MZ .46

CD  
AILERON POS  
FLAP POS

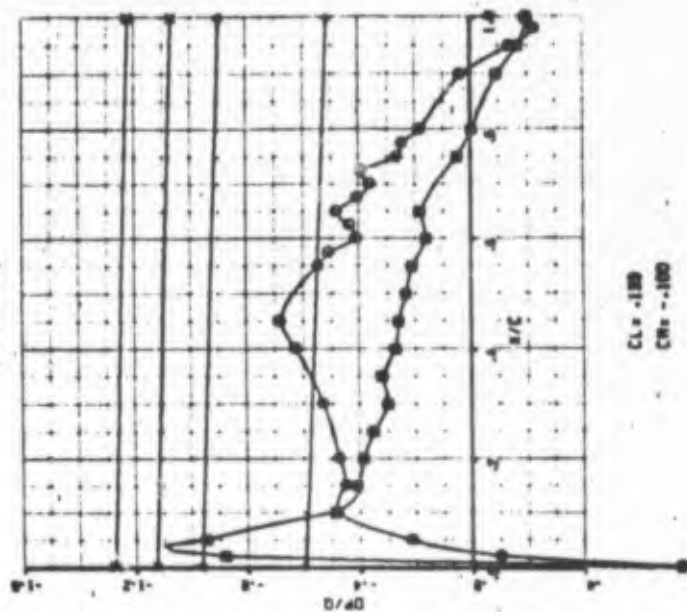
20.15 Z MAC  
-52 DEG  
0.00 DEG

ETA=0.309



O UPPER SURFACE  
□ LOWER SURFACE  
+ MACH LOCAL-1.0  
A MACH LOCAL-1.2  
X MACH LOCAL-1.3  
Σ MACH LOCAL-1.4

ETA=0.837



# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 284  
 MACH NO .802

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✖ 80 % (AFT)

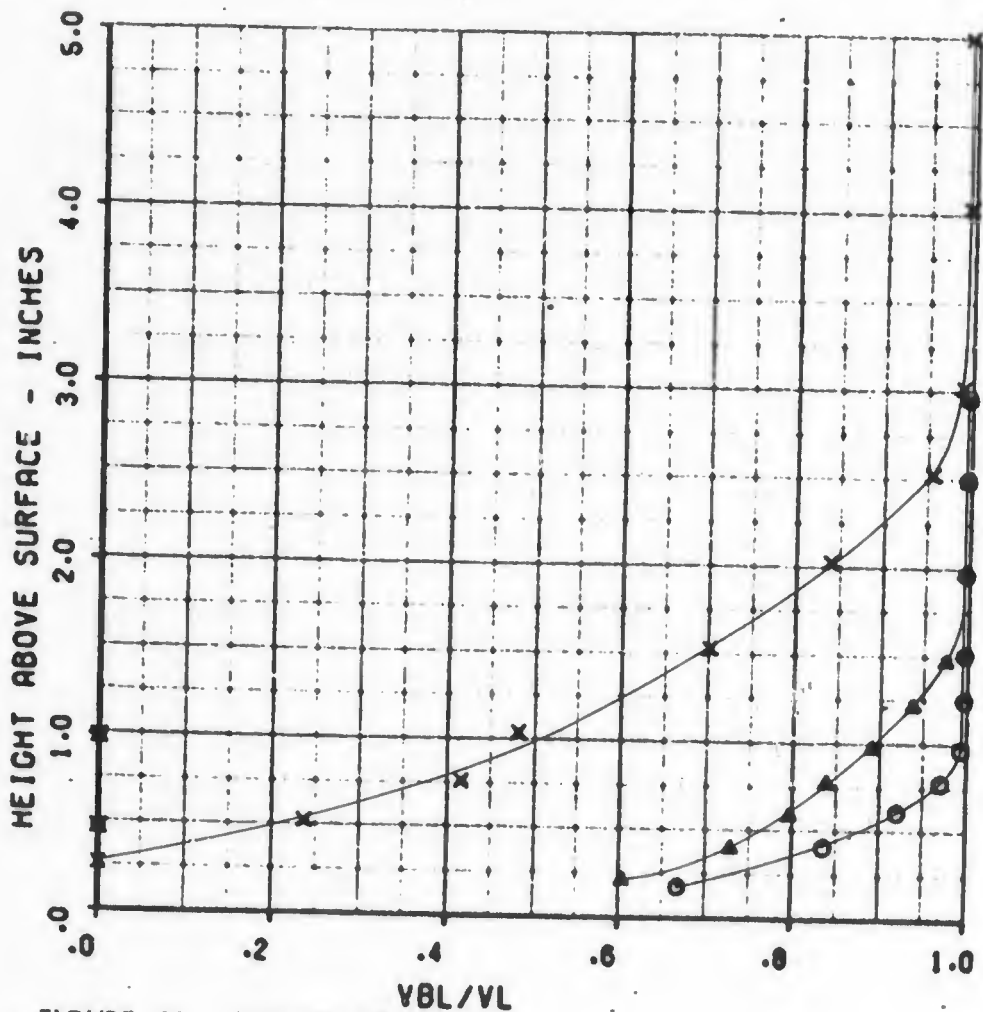


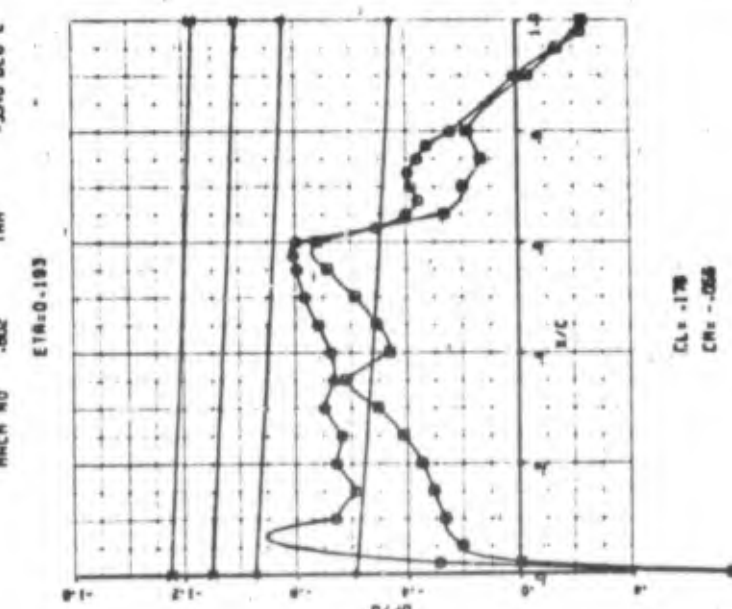
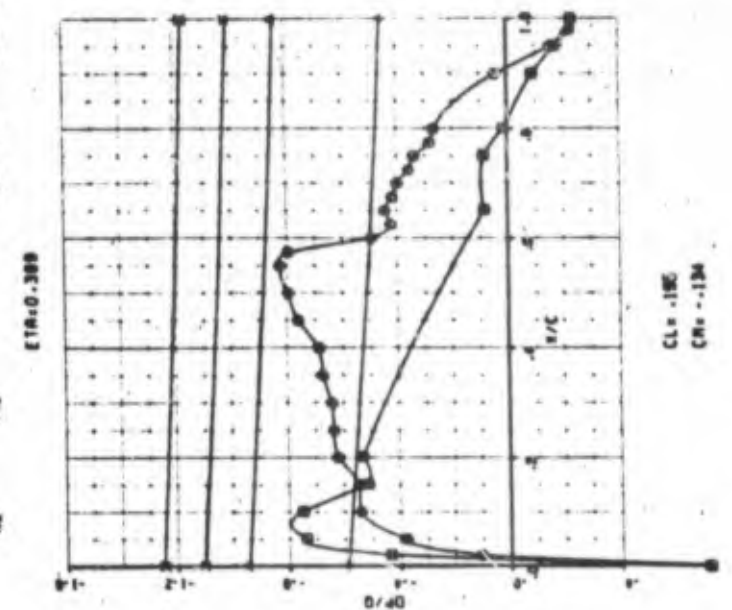
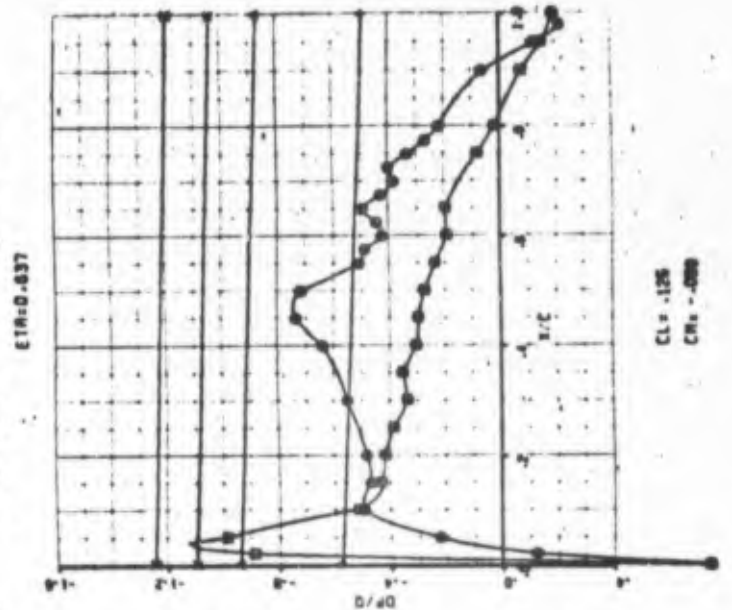
FIGURE 11 (CONTINUED)  
 (d) CORRECTED ALPHA = -1.95

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 548      3.18 PSI  
 RUN NO 284        ALPHA    -2.78 DEG  
 MACH NO .802      TAN       -33.0 DEG C

ALTITUDE 18810. FT      CO 20.40 ± MAC  
 HEIGHT 257600. LB     AIRLON POS -3A DEG  
 NZ -48                    FLAP POS 0.00 DEG

UPPER SURFACE      Δ MACH LOCAL-1.2  
 LOWER SURFACE    X MACH LOCAL-1.3  
 MACH LOCAL-1.0    + MACH LOCAL-1.4



# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 548  
 RUN NO 2B  
 MACH NO .800

**RAKE LOCATIONS**

○ 30 %  
 △ 55 %  
 × 80 %  
 \* 80 % (AFT)

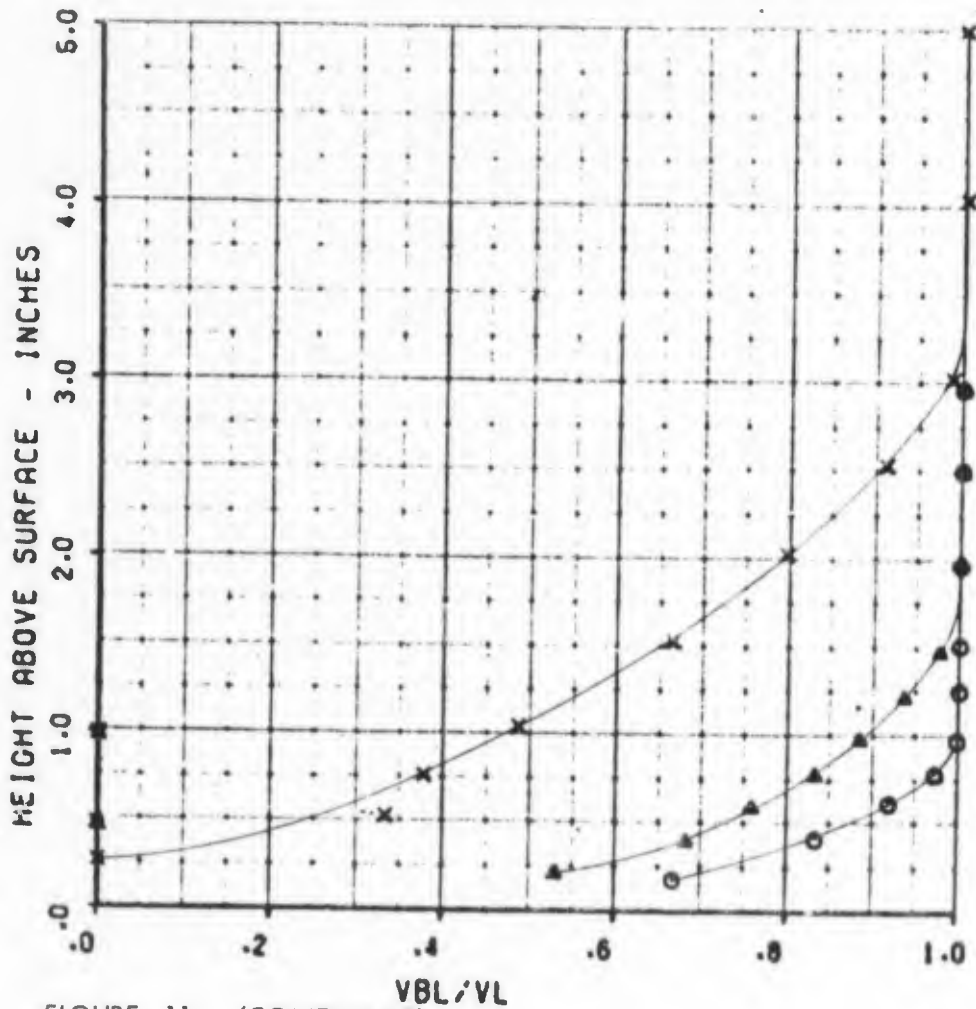


FIGURE 11 (CONTINUED)  
 (e) CORRECTED ALPHA = -1.12

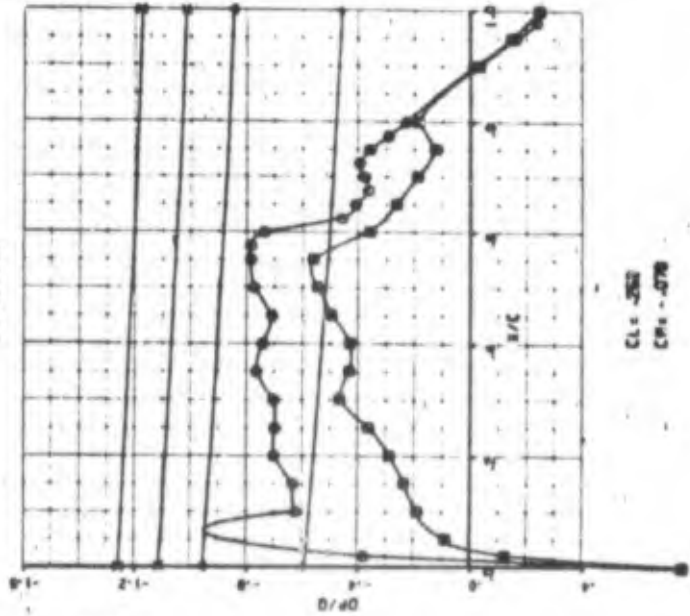
# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 548  
RUN NO 28  
NRCH NO -000

Q  
ALPHA  
TRN

2.94 PSI  
-1.82 DEG  
-33.8 DEG C

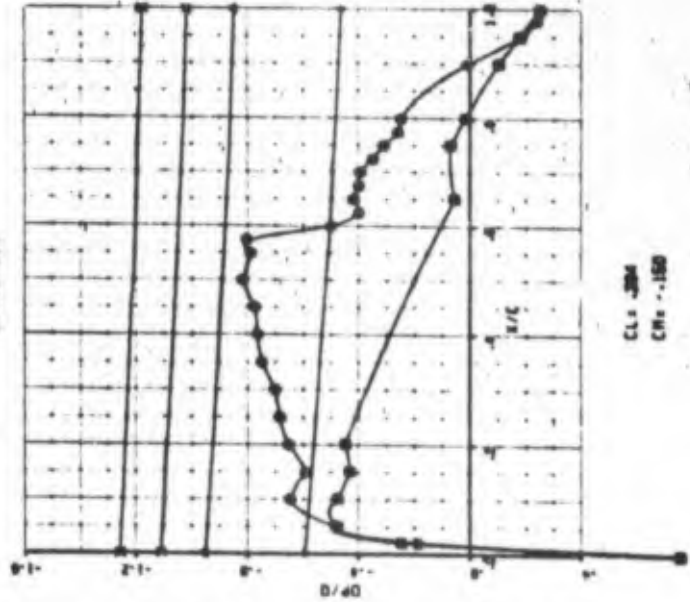
ETA=0.193



ALTITUDE 20000. FT  
WEIGHT 260000. LB  
MZ 1.01

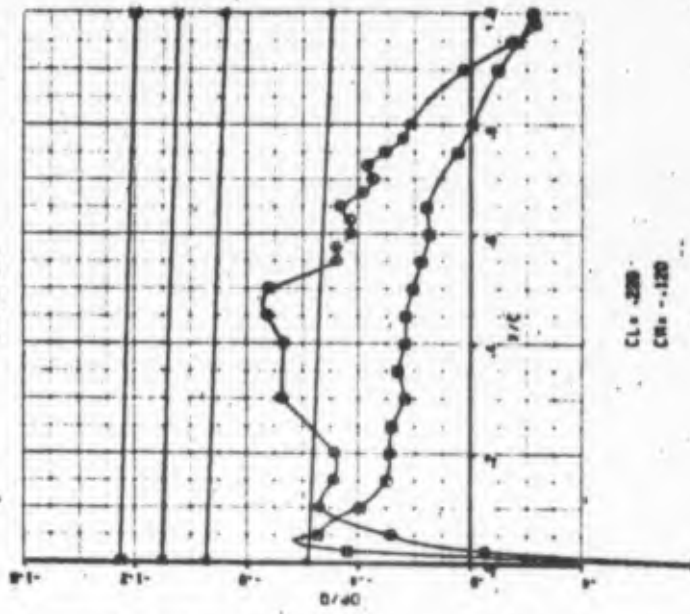
CO 20.50 X MAC  
AILERON POS -1.44 DEG  
FLAP POS 0.00 DEG

ETA=0.289



O UPPER SURFACE  
□ LOWER SURFACE  
+ NRCH LOCAL-1.0  
X NRCH LOCAL-1.3  
Δ NRCH LOCAL-1.2  
⊗ NRCH LOCAL-1.4

ETA=0.937



# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 546  
 RUN NO 10  
 MACH NO .802

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✖ 80 % (AFT)

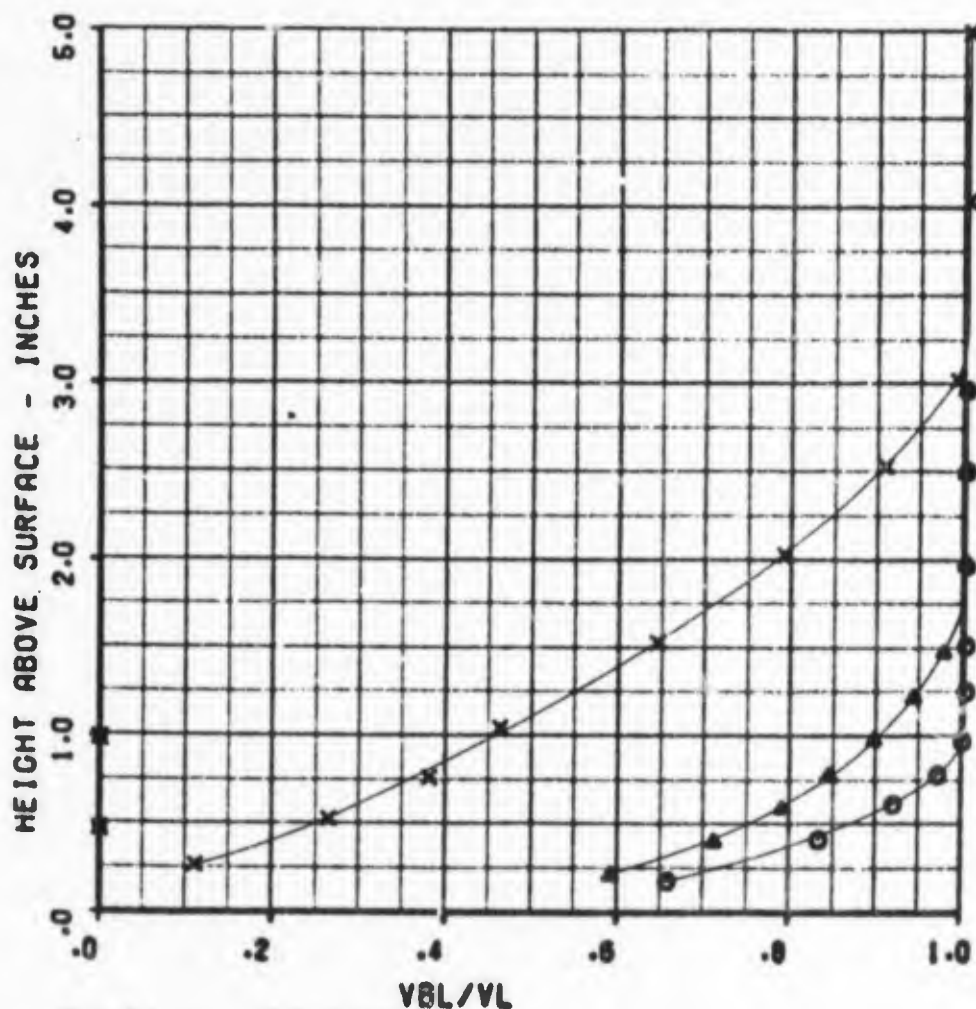
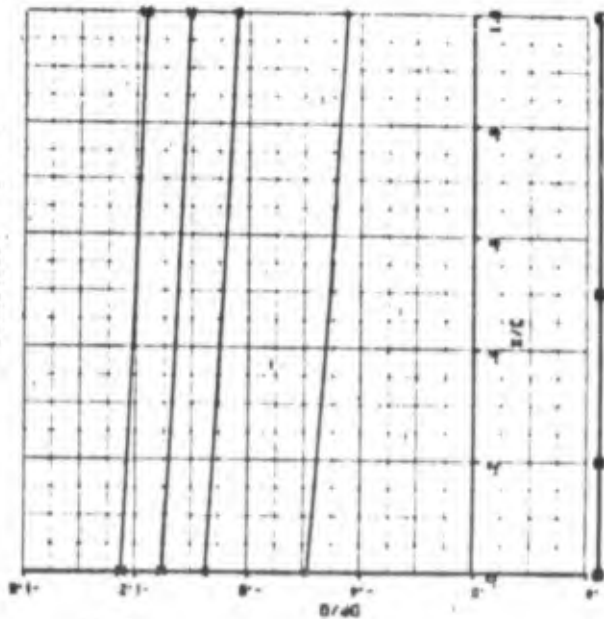


FIGURE 11 (CONTINUED)  
 (F) CORRECTED ALPHA = -1.10

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 546      0      2.73 PSI  
 RUN NO 10      ALPHA      -1.81 DEG  
 MACH NO .832      TAN      -22.5 DEG C

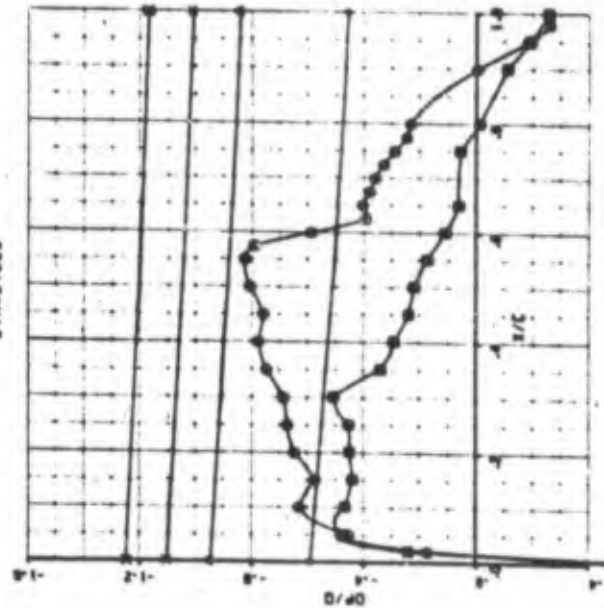
ETA=0.193



CL = 0.000  
 CW = 0.000

ALTITUDE 22460. FT  
 WEIGHT 251900. LB  
 NZ 1.05

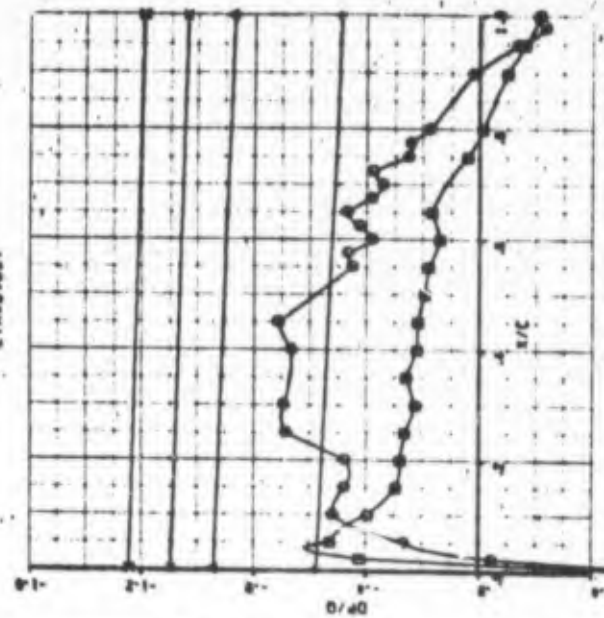
ETA=0.389



CL = .008  
 CW = -.126

CO 20-15 Z MAC  
 AILERON POS -1.08 DEG  
 FLAP POS 0.00 DEG

ETA=0.637



CL = .021  
 CW = -.114

UPPER SURFACE      A MACH LOCAL-1.2  
 LOWER SURFACE      X MACH LOCAL-1.3  
 MACH LOCAL-1.0      + MACH LOCAL-1.4

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 4A2  
 MACH NO .798

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

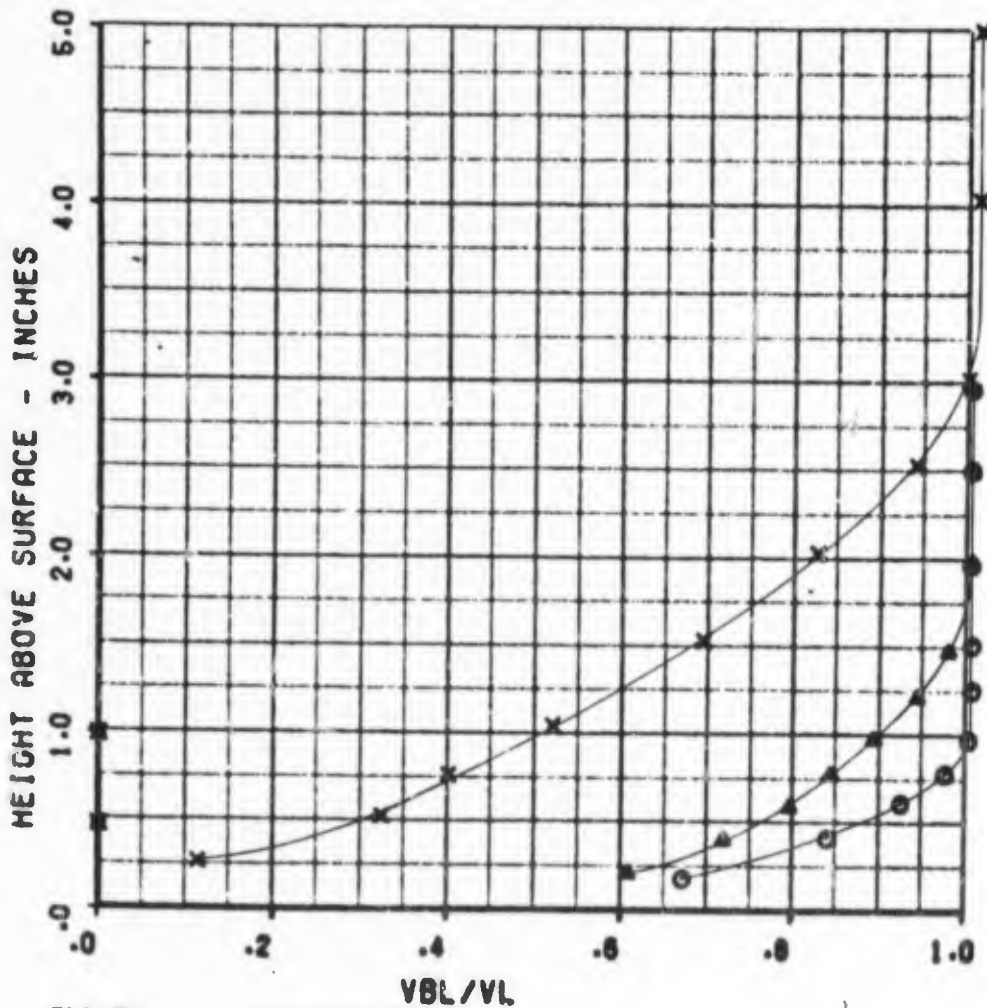


FIGURE 11 (CONTINUED)  
 (g) CORRECTED ALPHA = -0.70

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN NO 4R2  
 MACH NO .758

ALTITUDE 18040. FT  
 WEIGHT 254650. LB  
 MZ .95

CO 28.35 Z RMC  
 ROLLERON POS -.51 DEG  
 FLAP POS 0.00 DEG

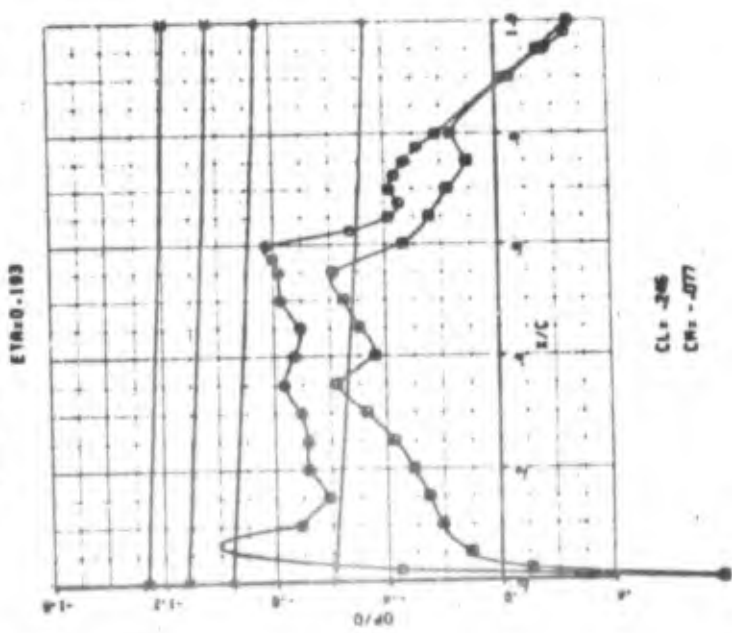
UPPER SURFACE  
 LOWER SURFACE  
 MACH LOCAL-1.0

MACH LOCAL-1.2  
 MACH LOCAL-1.3  
 MACH LOCAL-1.4

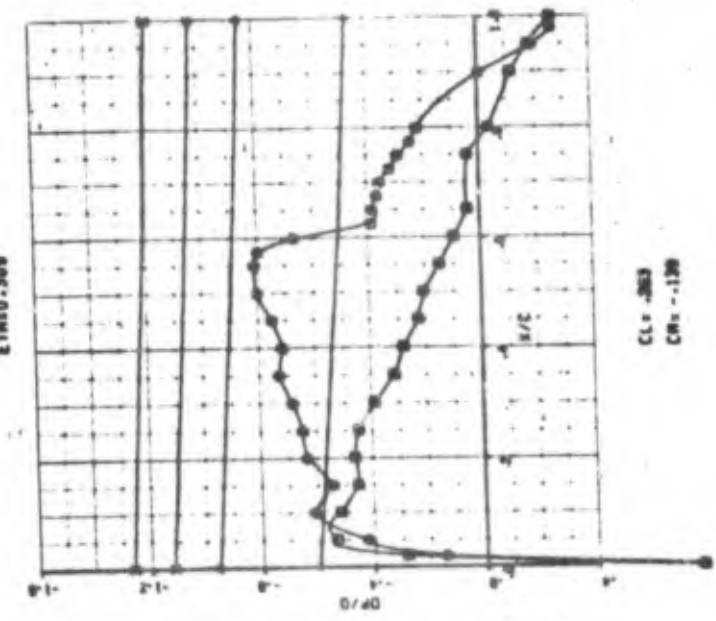
ETA=0.193

ETA=0.309

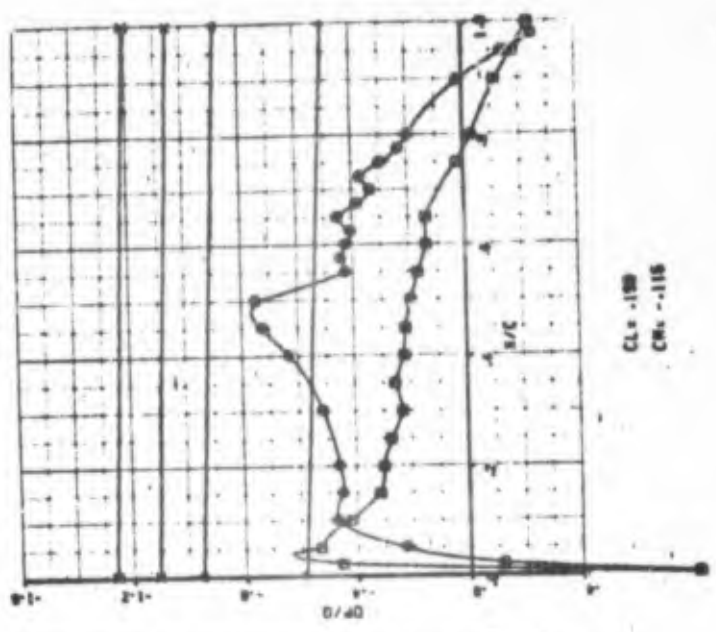
ETA=0.937



CL=J45  
 CR=-J77



CL=J83  
 CR=-J39



CL=J109  
 CR=-J115

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 547  
 RUN NO 482  
 MACH NO .800

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

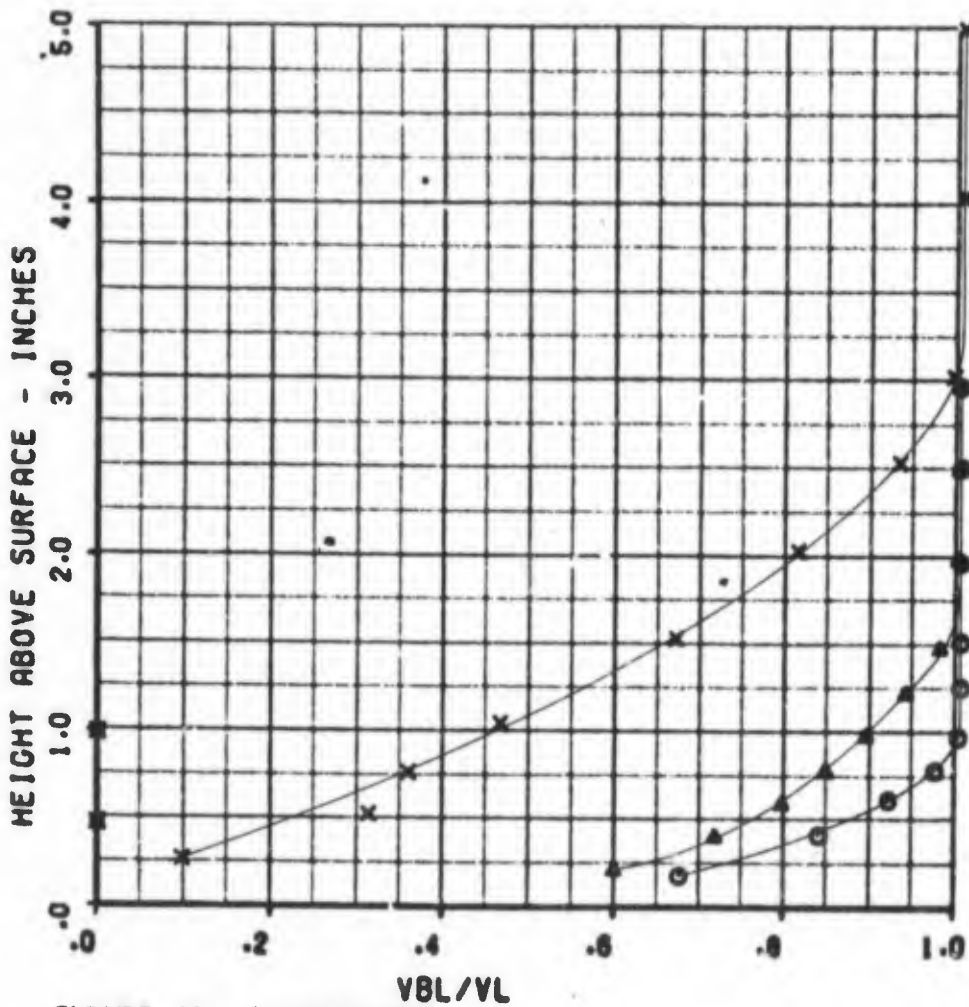


FIGURE 11 (CONTINUED)  
 (h) CORRECTED ALPHA = -0.70

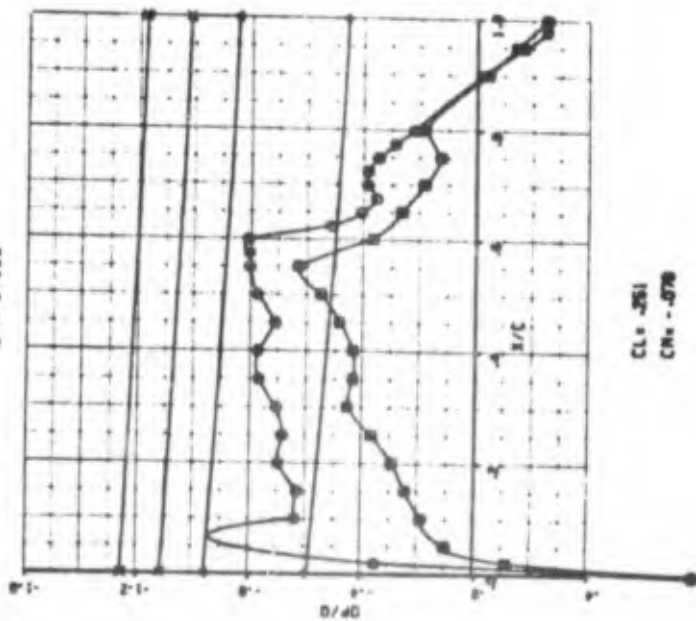
LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN ID 482  
 MACH NO .800

G 3.01 PSI  
 ALPHA -1.35 DEG  
 TRN -30.5 DEG C

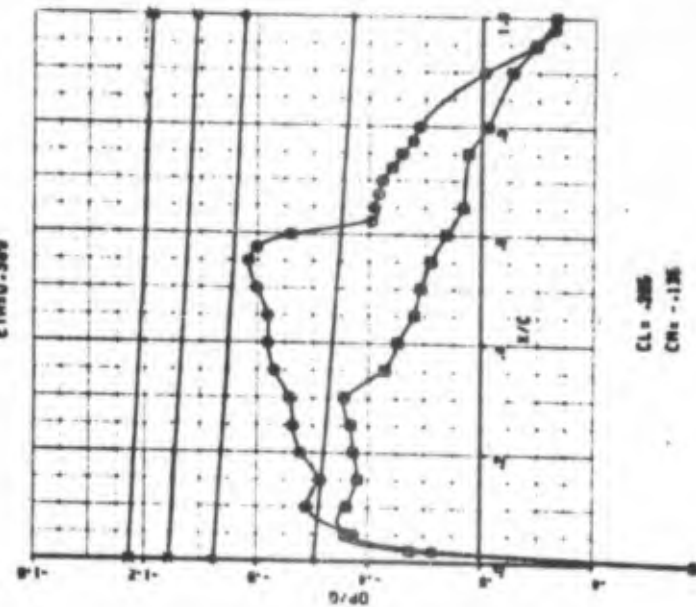
ETA=0.183



ALTITUDE 20100. FT  
 WEIGHT 252000. LB  
 NZ 1.02

CG  
 AILERON POS -1.70 DEG  
 FLAP POS 0.00 DEG

ETA=0.289

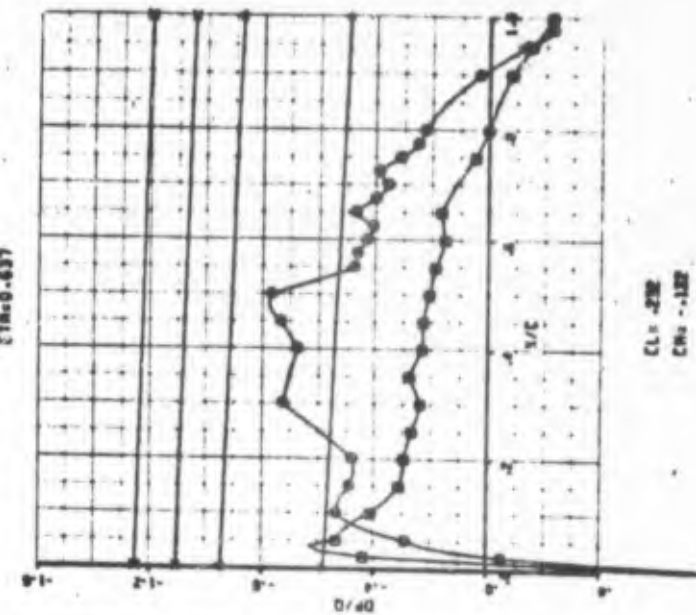


28.25 Z MAC  
 -1.70 DEG  
 0.00 DEG

UPPER SURFACE  
 LOWER SURFACE  
 MACH LOCAL-1.0

MACH LOCAL-1.2  
 MACH LOCAL-1.3  
 MACH LOCAL-1.4

ETA=0.637



# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 546  
 RUN NO 103  
 MACH NO .802

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

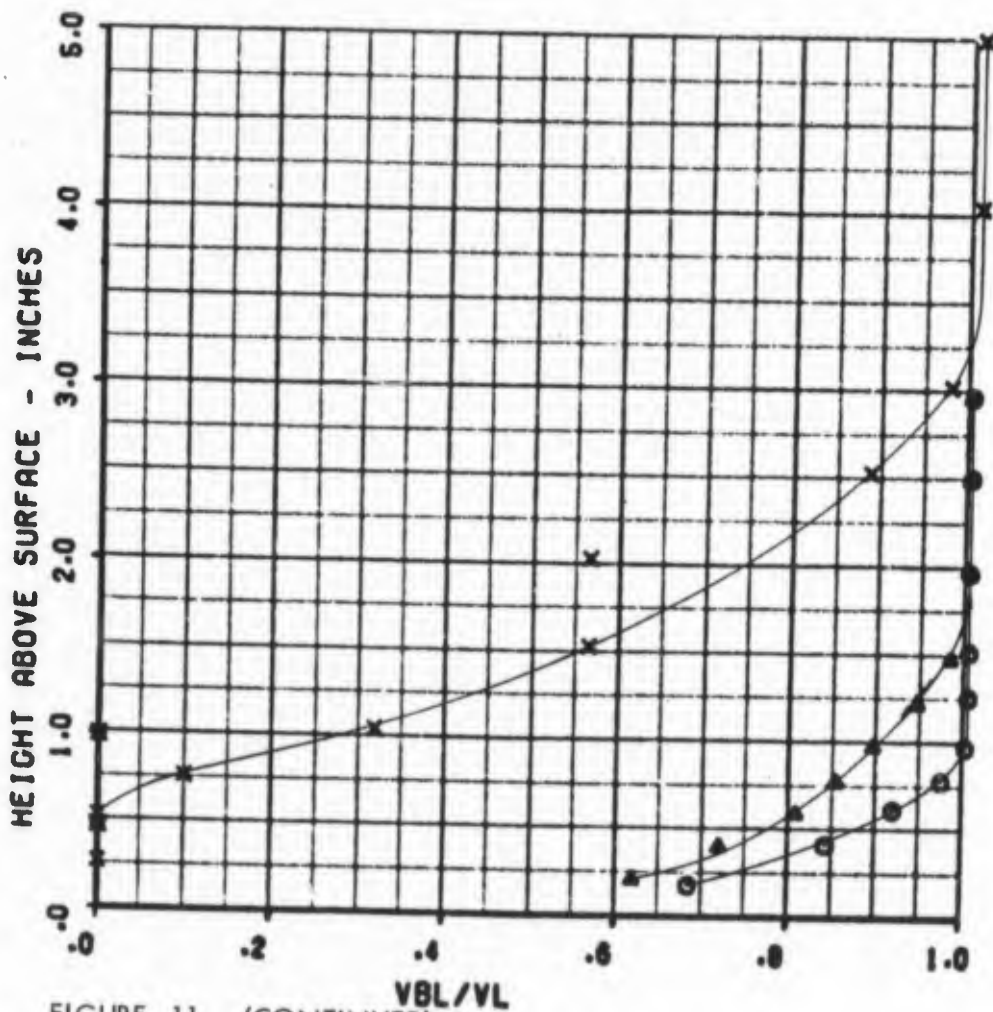


FIGURE 11 (CONTINUED)  
 (k) CORRECTED ALPHA = -0.62

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 5-45  
RUN NO 103  
MACH NO .802

0  
ALPHA  
TRN

2.79 PSI  
-1.24 DEG  
-22.0 DEG C

ALTITUDE 22060. FT  
WEIGHT 251700. LB  
NZ 1.44

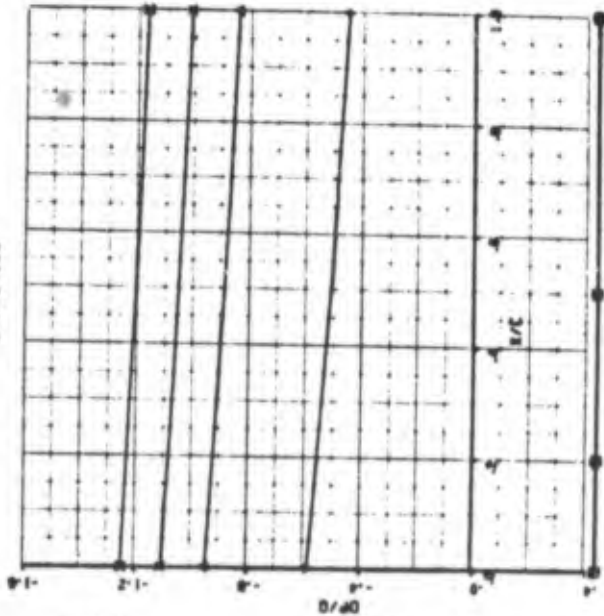
CO  
AILERON POS  
FLAP POS

29.15 X MAC  
-52 DEG  
0.00 DEG

UPPER SURFACE  
LOWER SURFACE  
MACH LOCAL-1.0

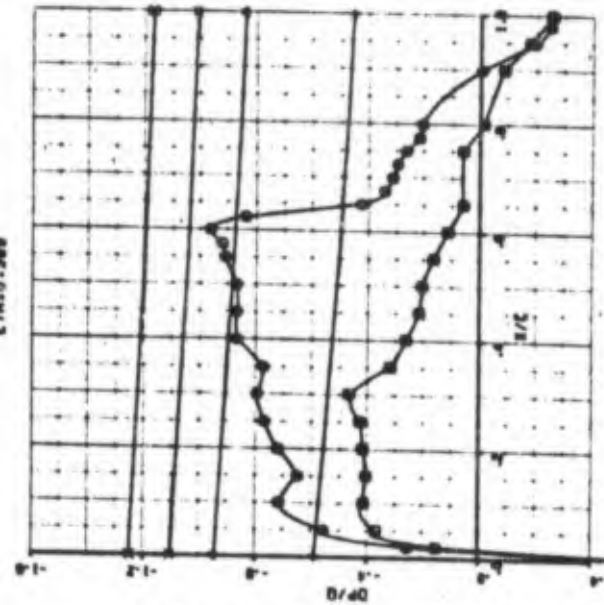
MACH LOCAL-1.2  
MACH LOCAL-1.3  
MACH LOCAL-1.4

ETA=0.183



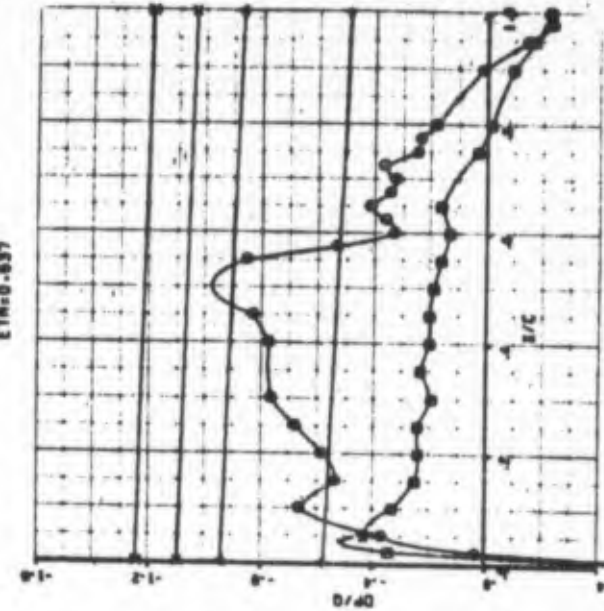
CLx 0.000  
CMx 0.000

ETA=0.388



CLx .281  
CMx -.181

ETA=0.637



CLx .388  
CMx -.140

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 281  
 MACH NO .800

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

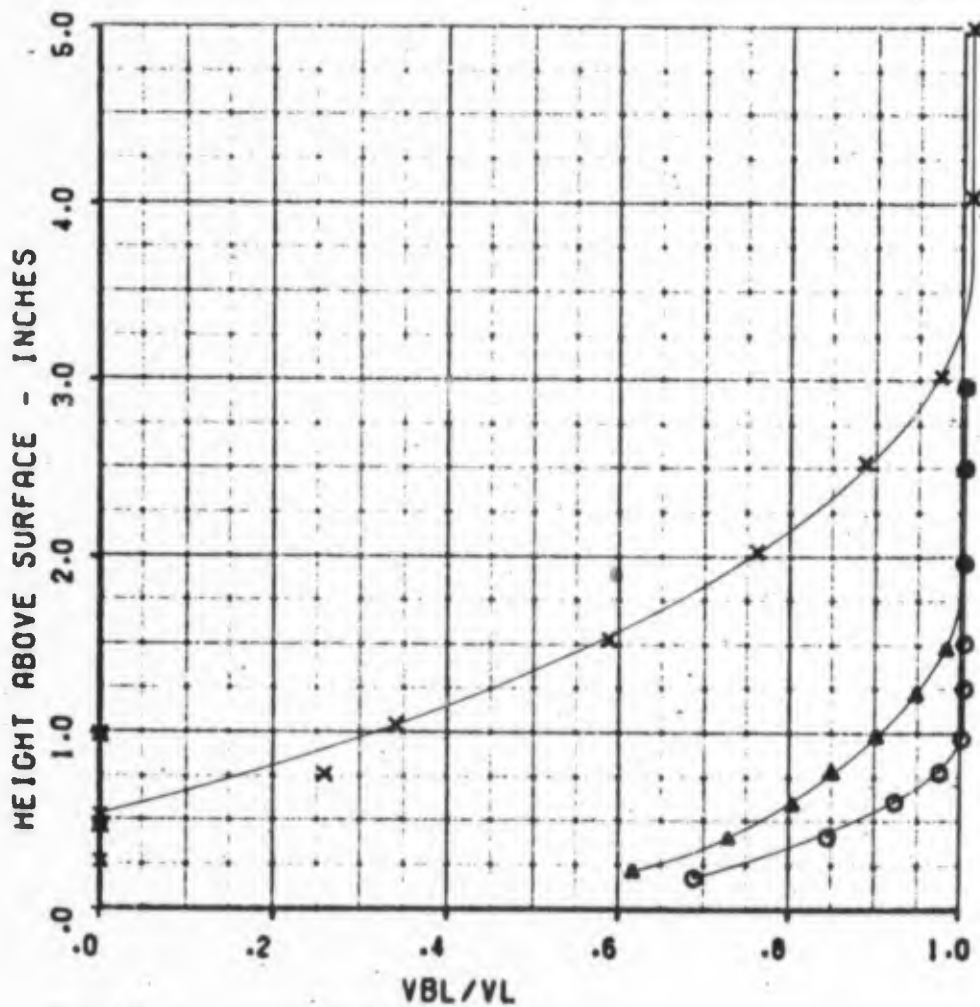


FIGURE 11. (CONTINUED)  
 (I) CORRECTED ALPHA = -0.54

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 549  
 RUN NO 281  
 MACH NO .800

Q 2.99 PSI  
 ALPHA -1.15 DEG  
 TAW -32.4 DEG C

ALTITUDE 20000. FT  
 WEIGHT 257750. LB  
 NZ 1.46

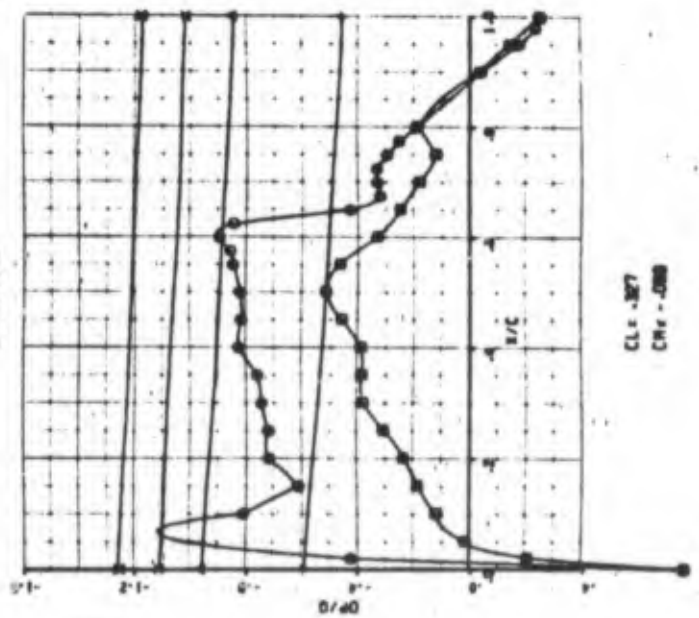
CO 29.50 ± MAC  
 AILERON POS -1.44 DEG  
 FLAP POS 0.00 DEG

O UPPER SURFACE  
 □ LOWER SURFACE  
 + MACH LOCAL-1.0  
 △ MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 ⊗ MACH LOCAL-1.4

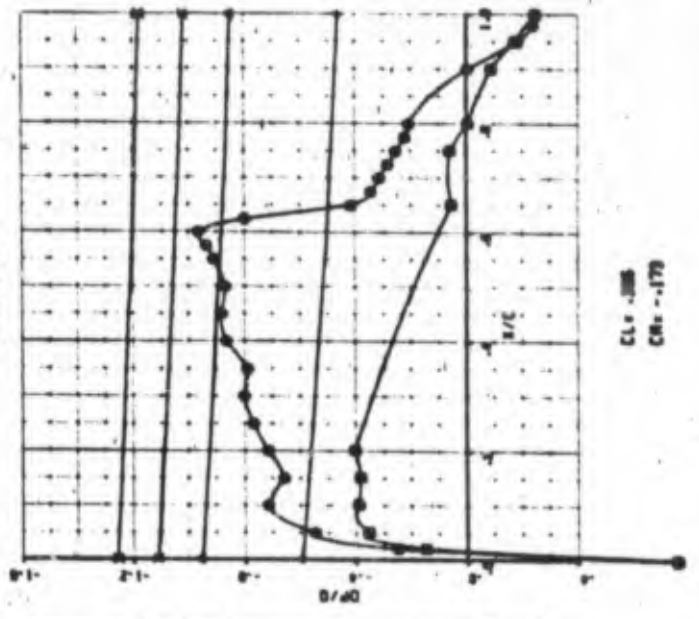
ETA=0.193

ETA=0.398

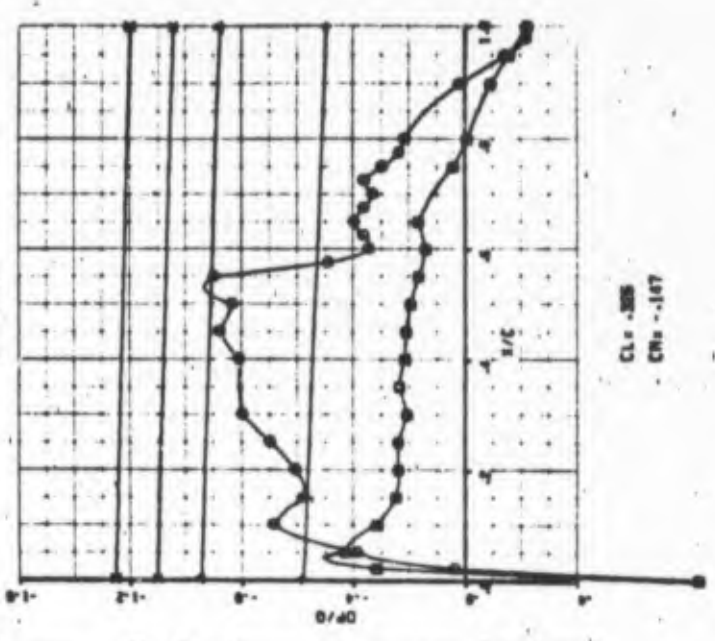
ETA=0.637



CL= .387  
 CR= -.088



CL= .388  
 CR= -.179



CL= .388  
 CR= -.187

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 546  
 RUN NO 104  
 MACH NO .795

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 60 %  
 \* 80 % (AFT)

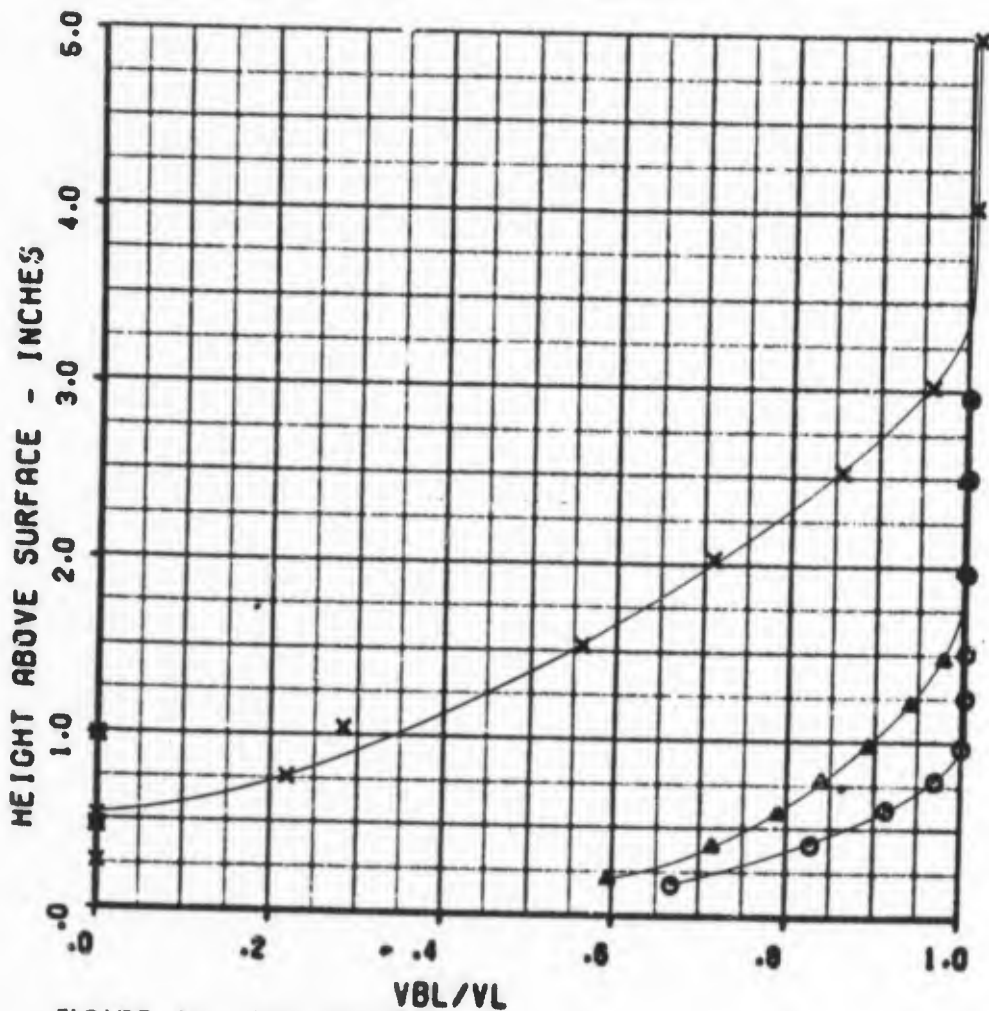


FIGURE 11 (CONTINUED)  
 (m) CORRECTED ALPHA = -0.28

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 546  
RUN NO 104  
MACH NO .795

$\theta$  2.71 DEG  
ALPHA - .85 DEG  
TRN -22.0 DEG C

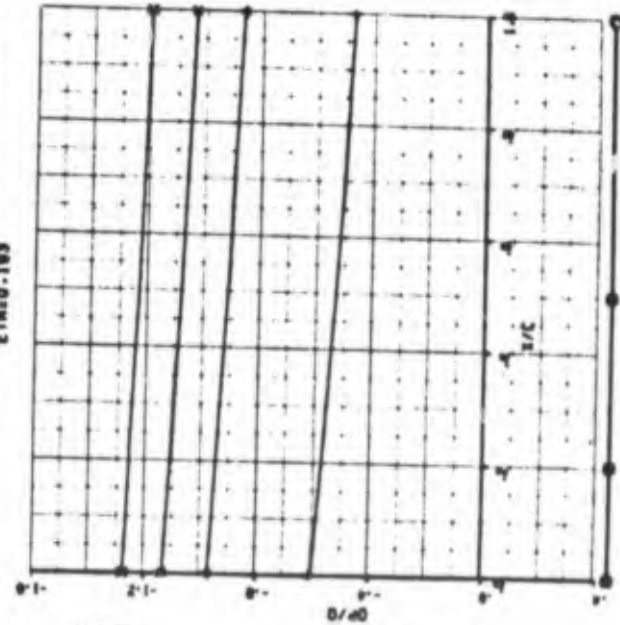
ETA=0.193

ALTITUDE 22300. FT  
WEIGHT 25000. LB  
NZ 1.60

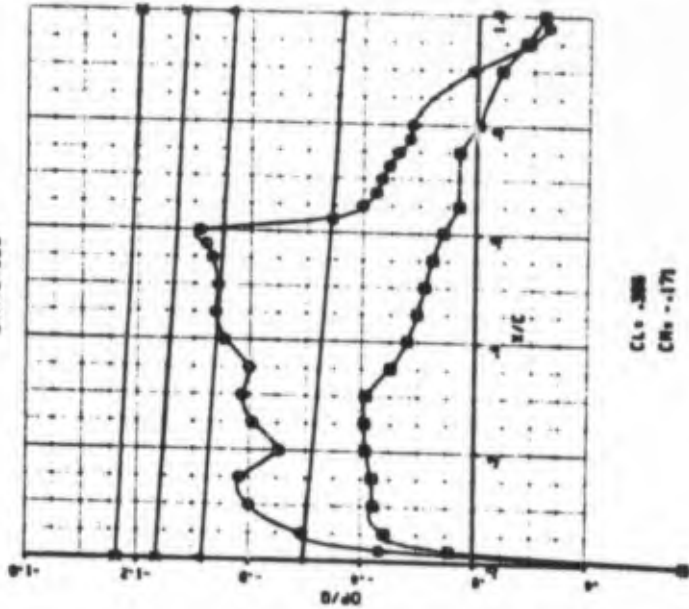
CO 20.15 2 MAC  
AILERON POS -.17 DEG  
FLAP POS 0.00 DEG

ETA=0.309

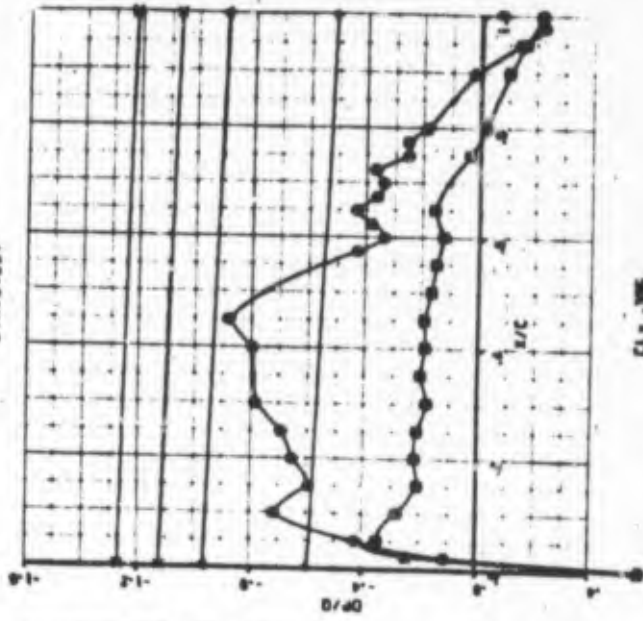
UPPER SURFACE  
LOWER SURFACE  
MACH LOCAL-1.0  
MACH LOCAL-1.2  
MACH LOCAL-1.3  
MACH LOCAL-1.4



CL=0.000  
CR=-0.000



CL=-.308  
CR=-.171



CL=-.305  
CR=-.141

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 282  
 MACH NO .800

## RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

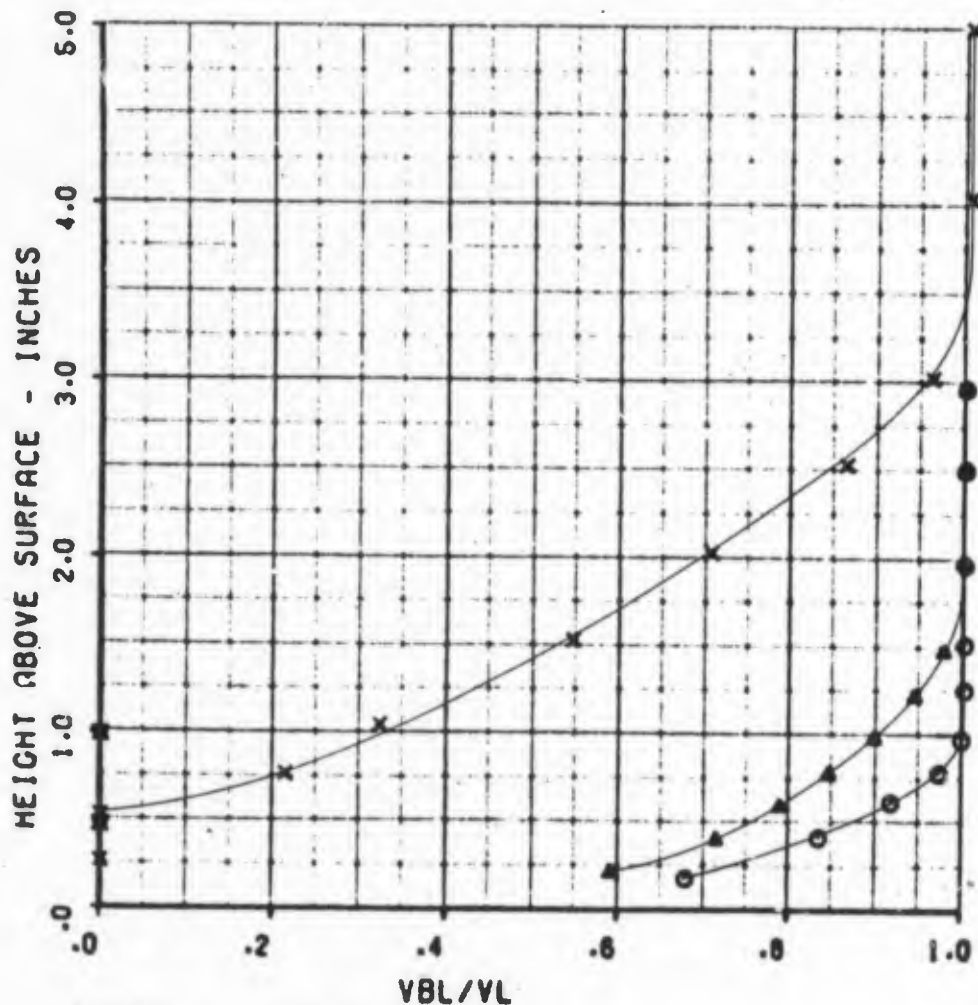


FIGURE 11 (CONTINUED)  
 (n) CORRECTED ALPHA = -0.27

LOCKHEED C-141A  
PRESSURE DISTRIBUTION

FLIGHT NO 548  
RUN NO 292  
MACH NO -000

0  
ALPHA  
TRN

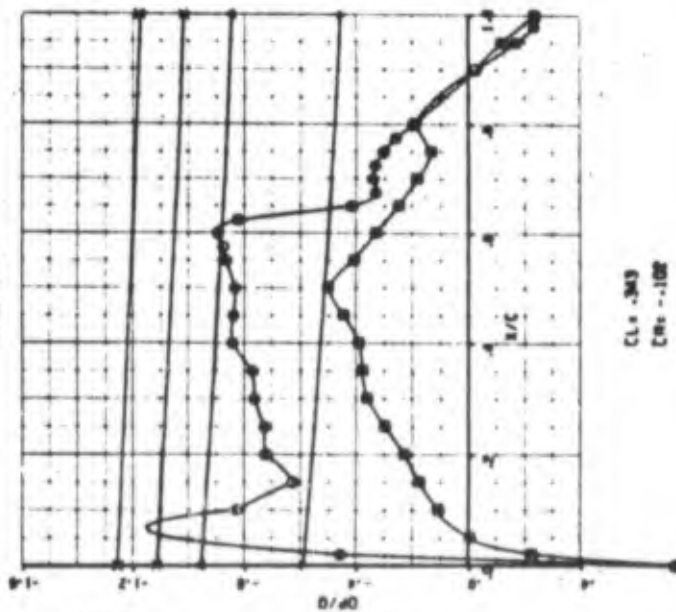
3.02 PSI  
-06 DEG  
-31.5 DEG C

ALTITUDE 20000. FT  
WEIGHT 255000. LB  
NZ 1.00

CO 20.48 X MAC  
AILERON POS -08 DEG  
FLAP POS 0.00 DEG

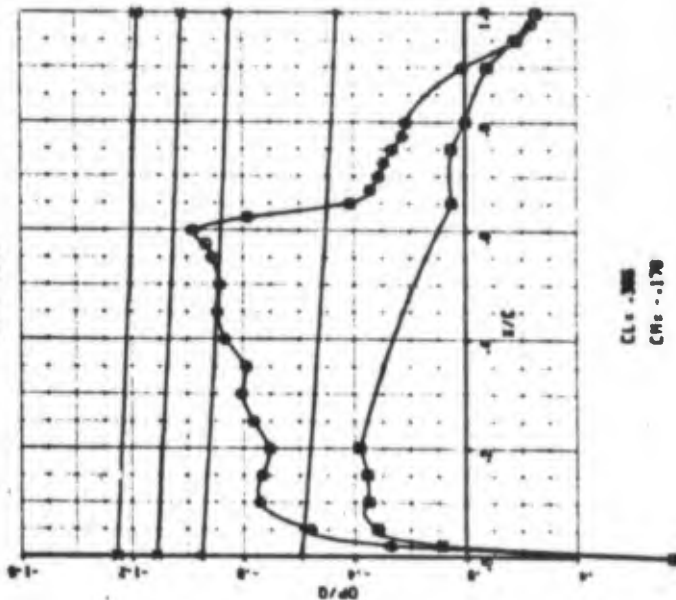
O UPPER SURFACE  
□ LOWER SURFACE  
+ MACH LOCAL-1.0  
△ MACH LOCAL-1.2  
X MACH LOCAL-1.3  
Σ MACH LOCAL-1.4

ETA=0.193



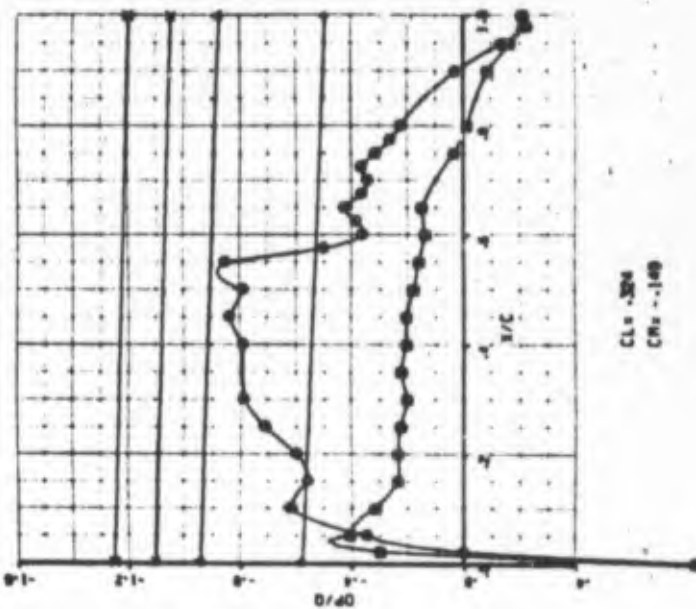
CLs -343  
CWs -102

ETA=0.309



CLs -308  
CWs -170

ETA=0.837



CLs -304  
CWs -149

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 283  
 MACH NO .800

## RAKE LOCATIONS

○ 30 %  
 △ 55 %  
 × 80 %  
 \* 80 % (AFF)

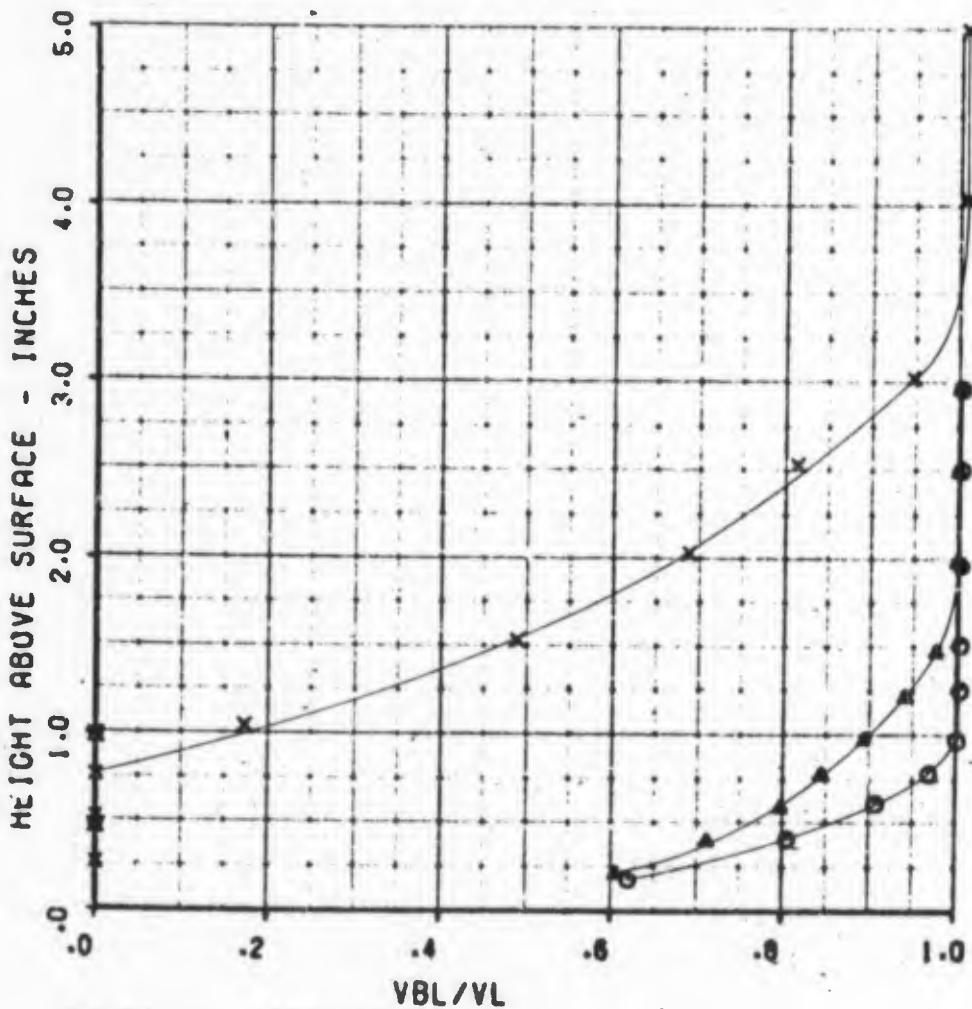


FIGURE 11 (CONTINUED)  
 (o) CORRECTED ALPHA = -0.07

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 548    0    3.01 P81  
 RUN NO 283    ALPHA    -.56 DEG  
 MACH NO .800    TAP    -31.0 DEG C

ETA=0.193

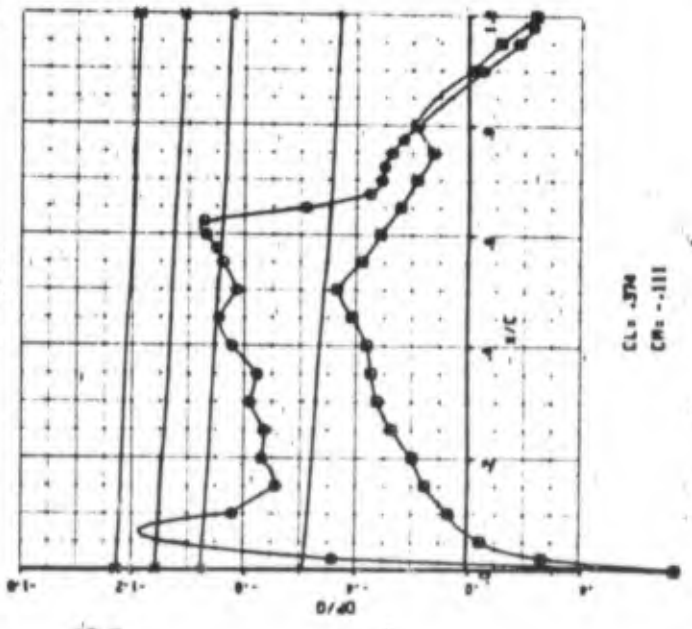
ALTITUDE 20055. FT  
 WEIGHT 268000. LB  
 NZ 1.90

ETA=0.268

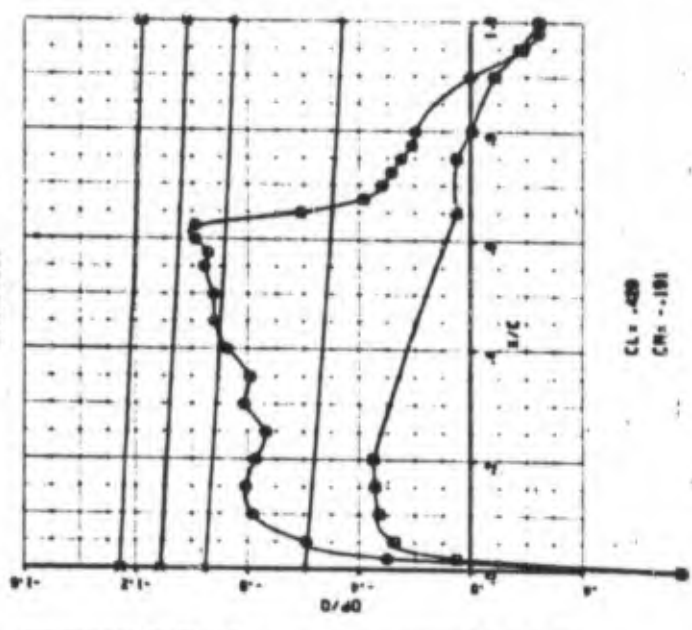
CO 28.42 Z MAC  
 AILERON POS -.93 DEG  
 FLAP POS 0.00 DEG

ETA=0.637

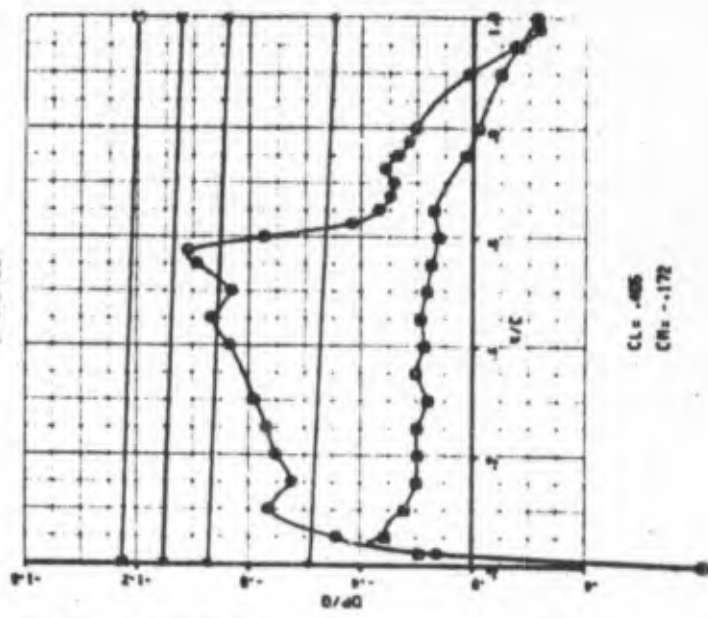
○ UPPER SURFACE    ▲ MACH LOCAL-1-2  
 □ LOWER SURFACE    × MACH LOCAL-1-3  
 + MACH LOCAL-1.0    ⊞ MACH LOCAL-1.4



CLx .374  
 CMx -.111



CLx .428  
 CMx -.181



CLx .485  
 CMx -.172

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 546  
 RUN NO 105  
 MACH NO .802

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

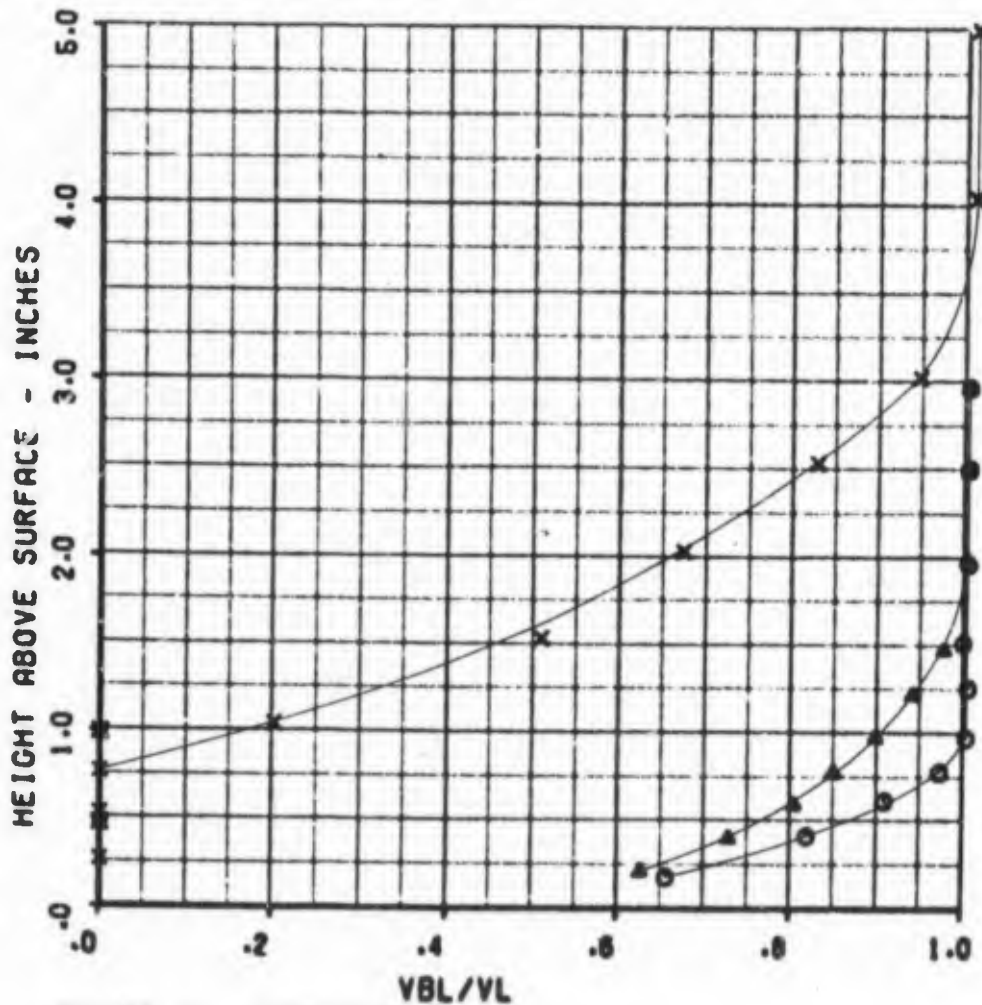


FIGURE 11 (CONCLUDED)  
 (p) CORRECTED ALPHA = -0.07

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 546      2.81 PSI  
 RUN NO 105      -57 DEG  
 MACH NO .802      -21.4 DEG C

ALTITUDE 21700. FT  
 WEIGHT 250100. LB  
 NZ 1.89

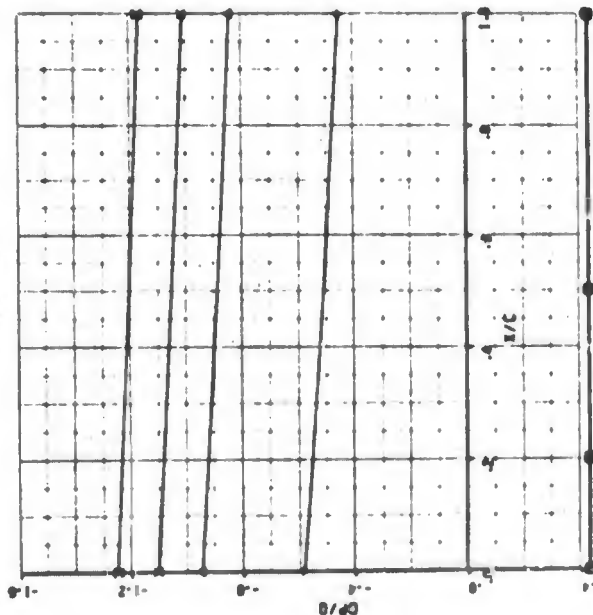
CG 28.15 X MAC  
 AILERON POS -3.92 DEG  
 FLAP POS 0.00 DEG

UPPER SURFACE      O  
 LOWER SURFACE      X  
 MACH LOCAL-1.0      +  
 MACH LOCAL-1.2      A  
 MACH LOCAL-1.3      X  
 MACH LOCAL-1.4      Z

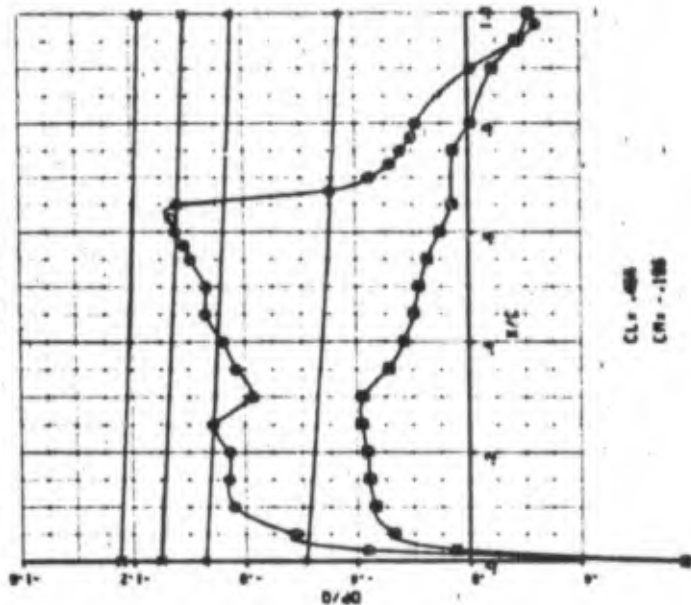
ETA=0.193

ETA=0.388

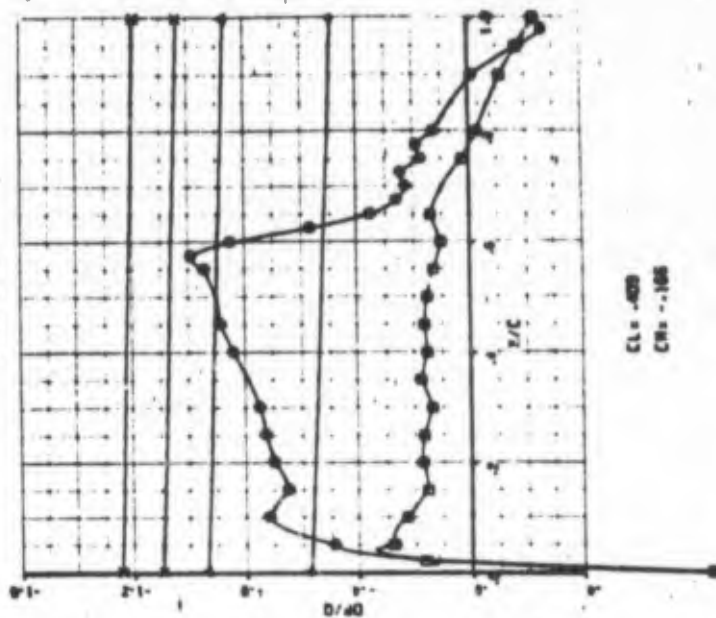
ETA=0.637



CL = 0.000  
 CR = 0.000



CL = .488  
 CR = -.185



CL = .620  
 CR = -.168

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 205  
 MACH NO .820

### RAKE LOCATIONS

○ 30 %  
 △ 55 %  
 × 80 %  
 \* 80 % (AFT)

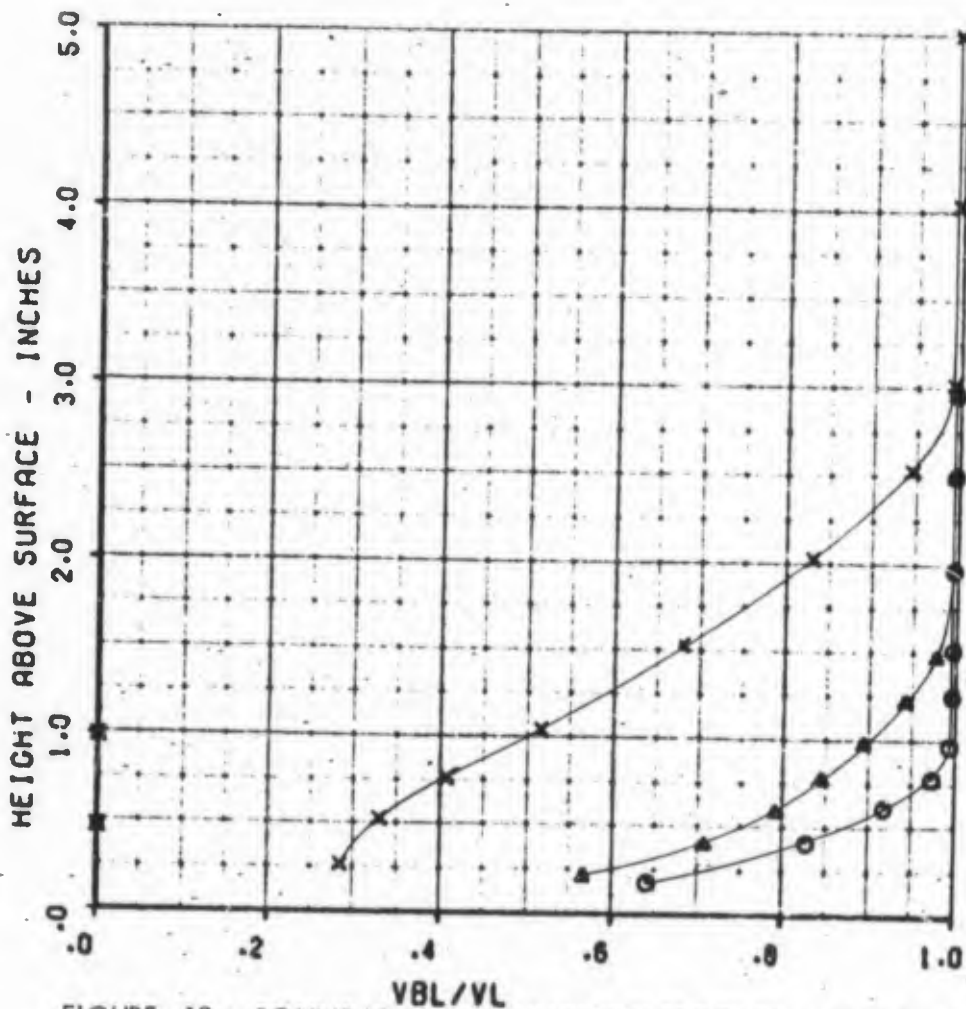


FIGURE 12 BOUNDARY LAYER VELOCITY PROFILES AND PRESSURE DISTRIBUTIONS MACH .817 TO .822

(a) CORRECTED ALPHA = -2.72

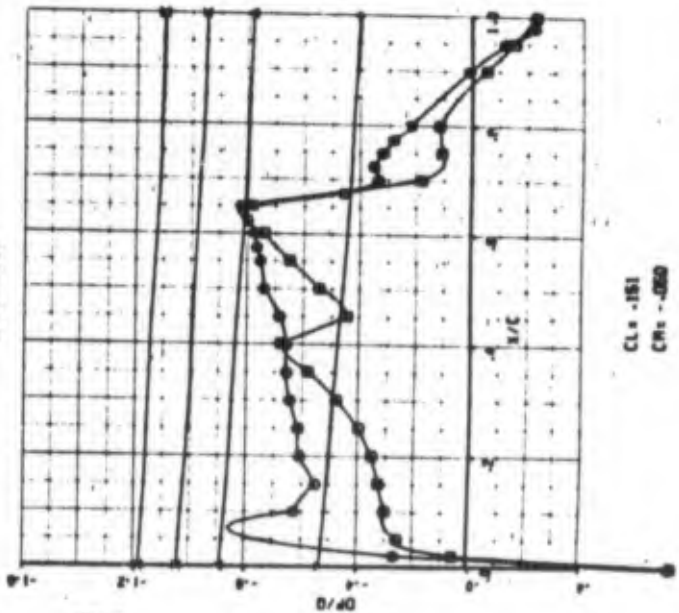
LOCKHEED C-141A  
PRESSURE DISTRIBUTION

FLIGHT NO 549  
RUN NO 2CS  
MACH NO .800

0  
ALPHA  
TRN

3-21 PSI  
-3.64 DEG  
-30.0 DEG C

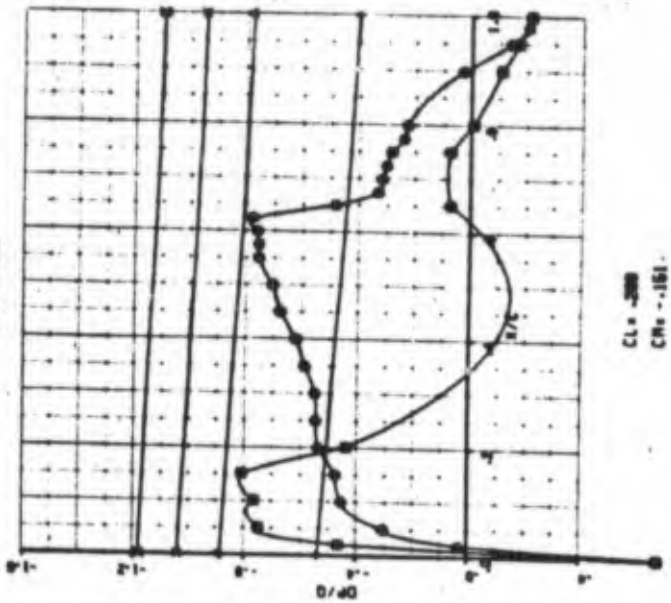
ETA=0.193



ALTITUDE 20720. FT  
WEIGHT 252500. LB  
NZ .08

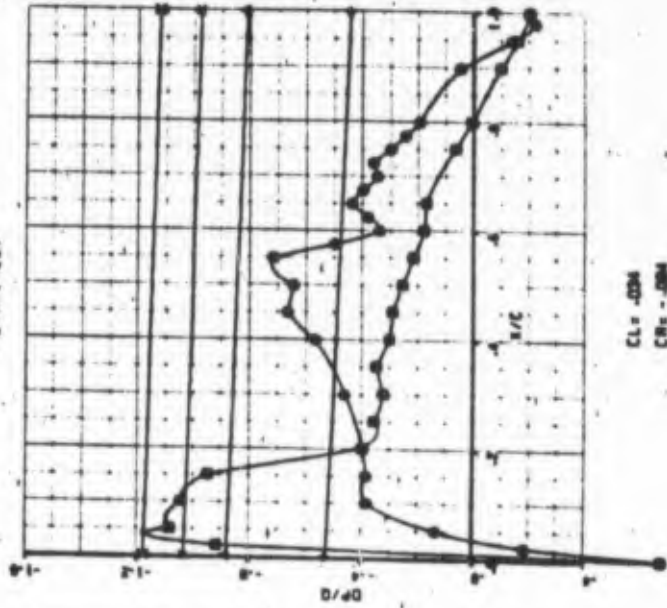
29-25 X MAC  
AILERON POS -2.28 DEG  
FLAP POS 0.00 DEG

ETA=0.209



UPPER SURFACE  
LOWER SURFACE  
MACH LOCAL-1.0  
MACH LOCAL-1.2  
MACH LOCAL-1.3  
MACH LOCAL-1.4

ETA=0.837



# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 546  
 RUN NO 1E1  
 MACH NO .817

### RAKE LOCATIONS

○ 30 %  
 △ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

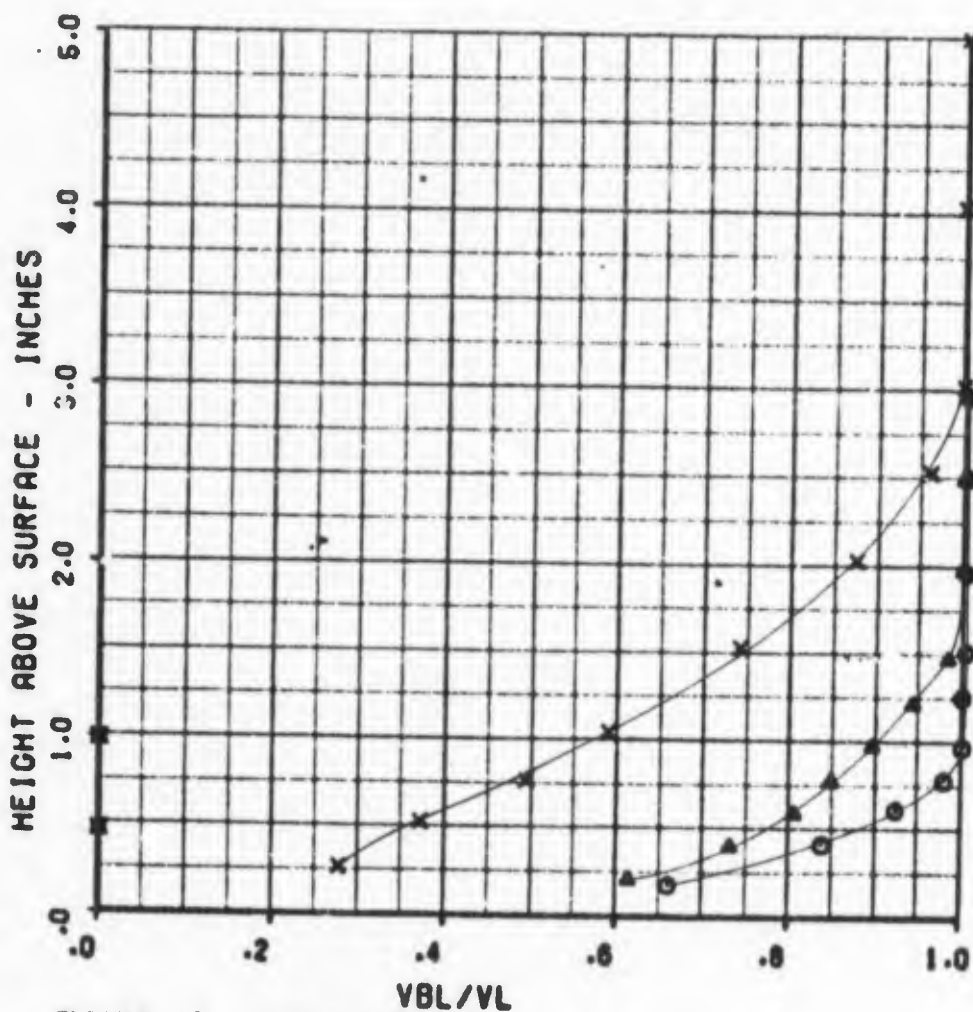


FIGURE 12 (CONTINUED)  
 (b) CORRECTED ALPHA = -2.70

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 548  
 RUN NO 1E1  
 MACH NO .817

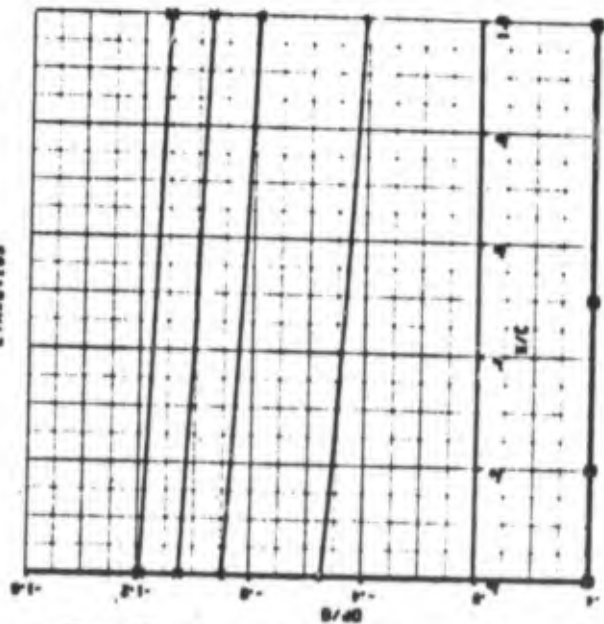
$\alpha$  3.05 PSI  
 ALPHA -3.51 DEG  
 TAN -18.4 DEG C

ALTITUDE 26750. FT  
 WEIGHT 247000. LB  
 NZ 0.00

CO 20-15 Z WAC  
 AILERON POS -1.08 DEG  
 FLAP POS 0.00 DEG

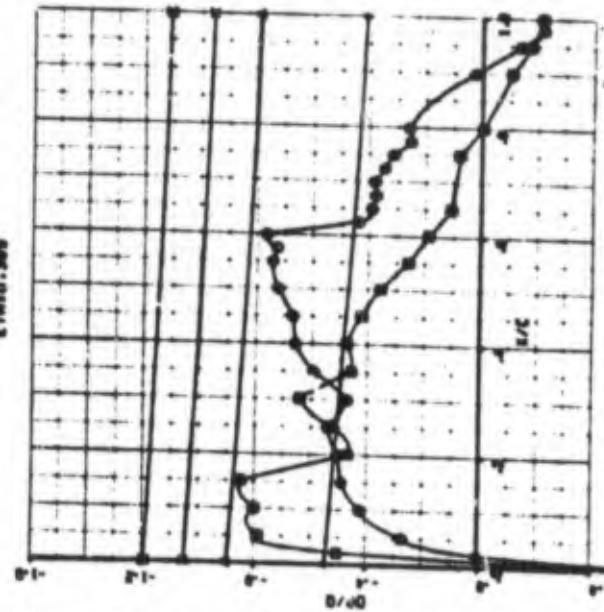
○ UPPER SURFACE  
 □ LOWER SURFACE  
 △ MACH LOCAL-1.2  
 × MACH LOCAL-1.3  
 ⊗ MACH LOCAL-1.4

ETA=0.193



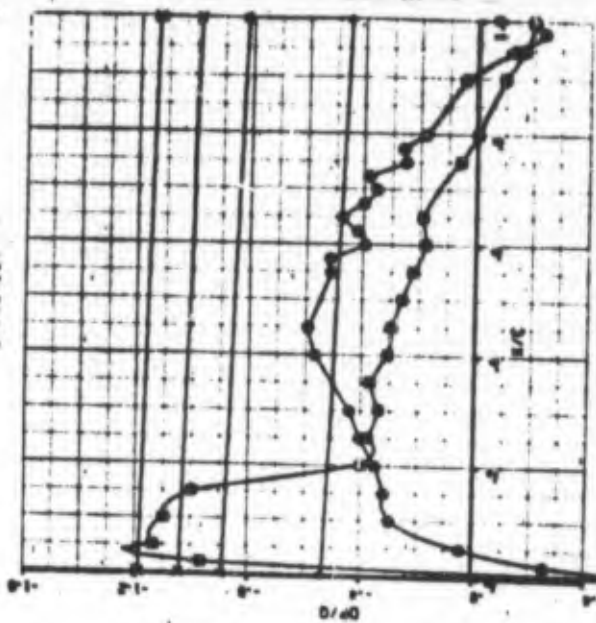
CL = 0.000  
 CR = 0.000

ETA=0.309



CL = .088  
 CR = -.055

ETA=0.837



CL = -.081  
 CR = -.072

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 546  
 RUN NO 1E2  
 MACH NO .820

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

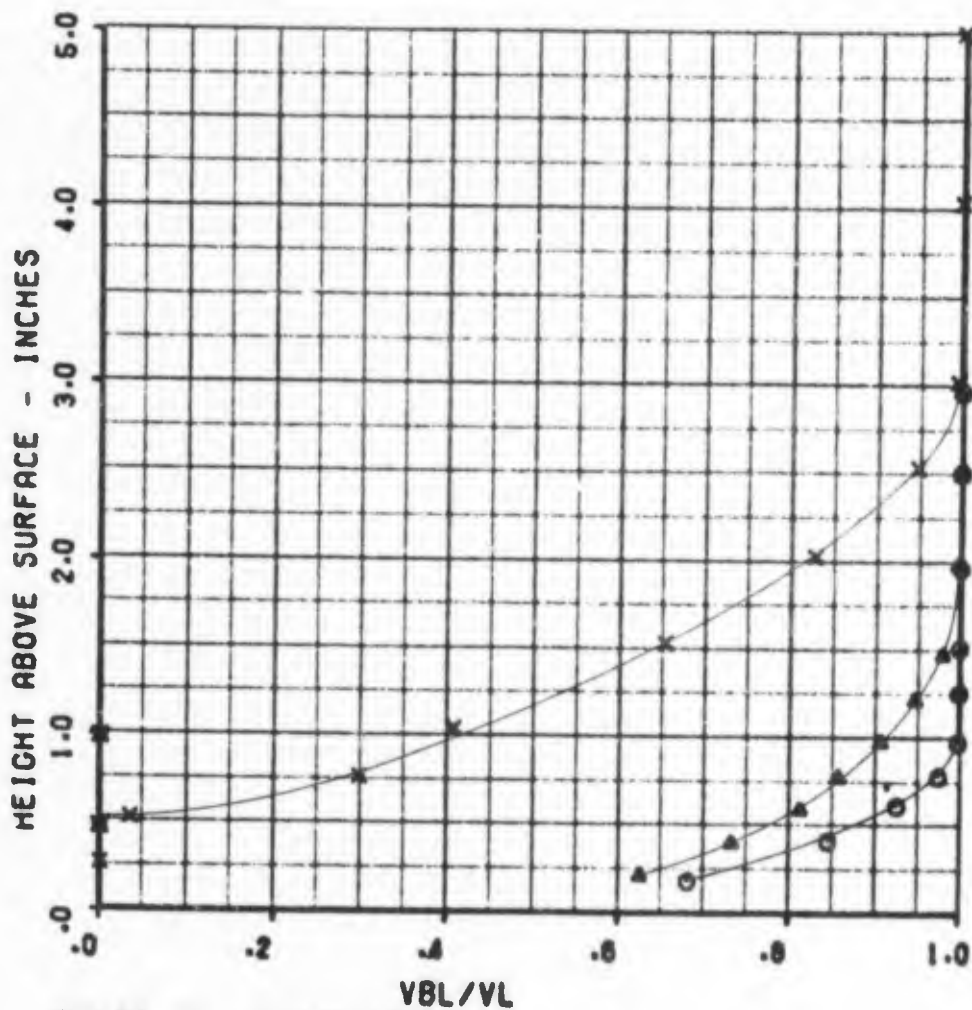


FIGURE 12 (CONTINUED)  
 (c) CORRECTED ALPHA = -2.20

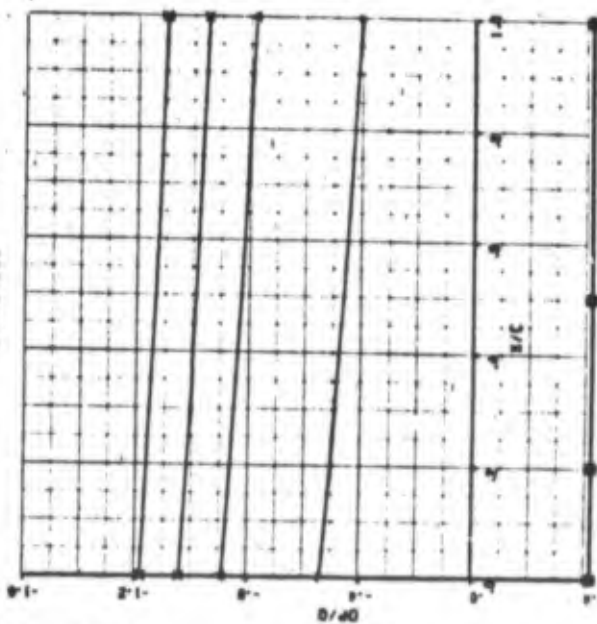
# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 545  
RUN NO 1E2  
MACH N2 .820

0  
ALPHA  
TAN

2.93 PSI  
-3.04 DEG  
-20.5 DEG C

ETA=0.183

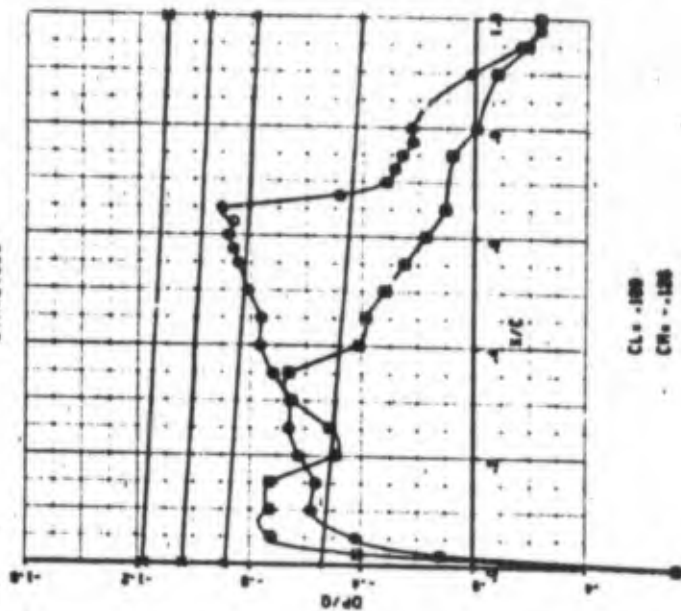


CL = 0.000  
CM = 0.000

ALTITUDE 21000. FT  
WEIGHT 24500. LB  
NZ .39

CO 20.15 X MAC  
AILERON POS -58 DEG  
FLAP POS 0.00 DEG

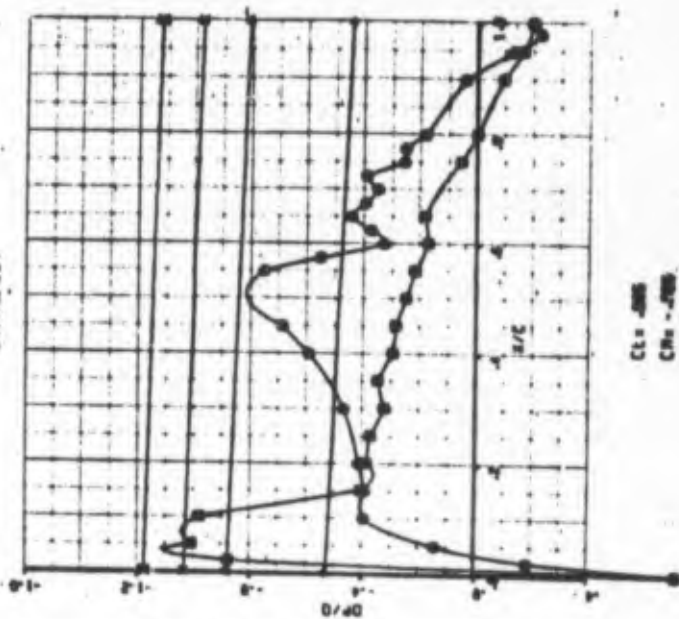
ETA=0.389



CL = .100  
CM = -.125

O UPPER SURFACE  
□ LOWER SURFACE  
+ MACH LOCAL-1.0  
A MACH LOCAL-1.2  
X MACH LOCAL-1.3  
Σ MACH LOCAL-1.4

ETA=0.637



CL = .205  
CM = -.205

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 204  
 MACH NO .820

## RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

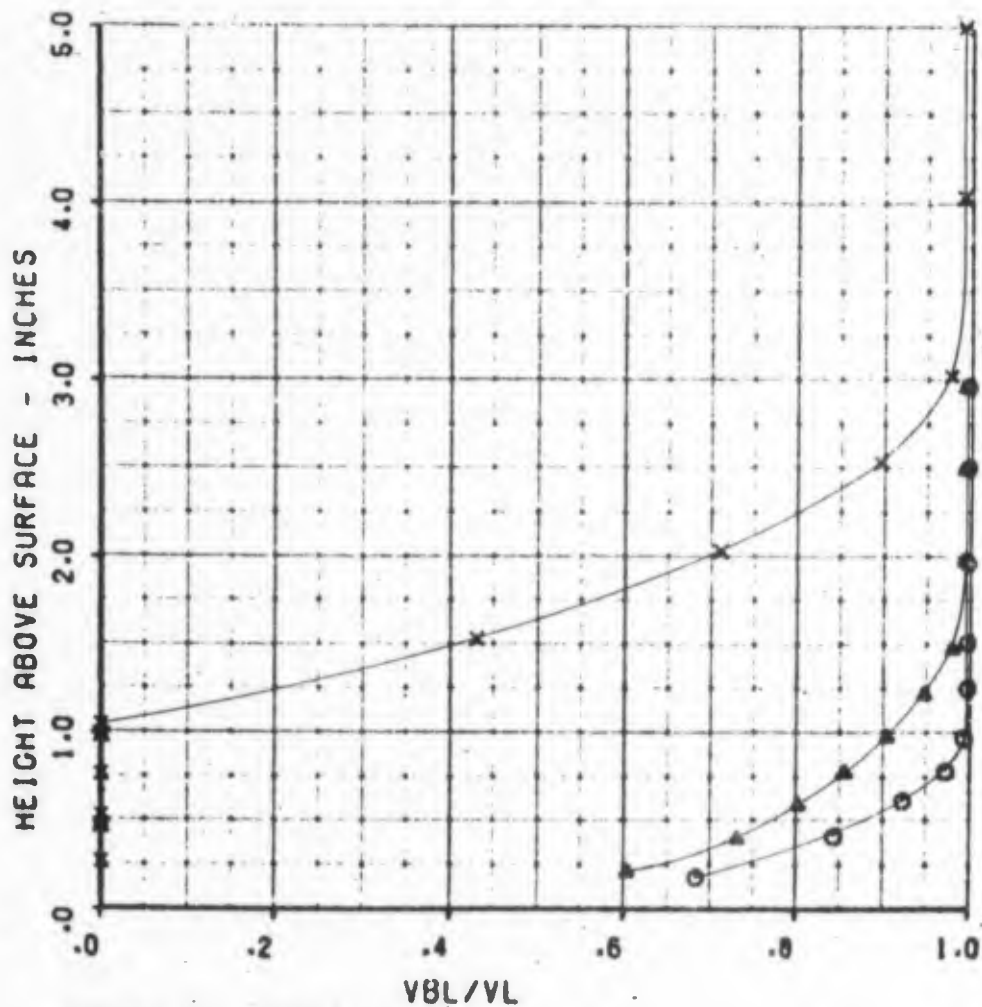


FIGURE 12 (CONTINUED)  
 (d) CORRECTED ALPHA = -2.06

# LOCKHEED C-141A PRESSURE DISTRIBUTION

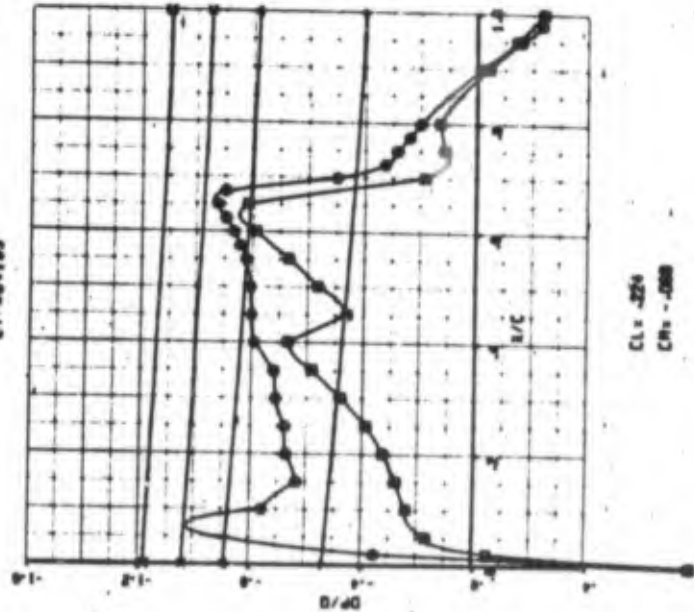
FLIGHT NO 548      3-19 PSI  
 RUN NO 2C4        -2.00 DEG  
 MACH NO .800      -30.8 DEG C

ALTITUDE 19045. FT  
 WEIGHT 253600. LB  
 NZ .51

CO 20-20 X MAC  
 AILERON POS -1.52 DEG  
 FLAP POS 0.00 DEG

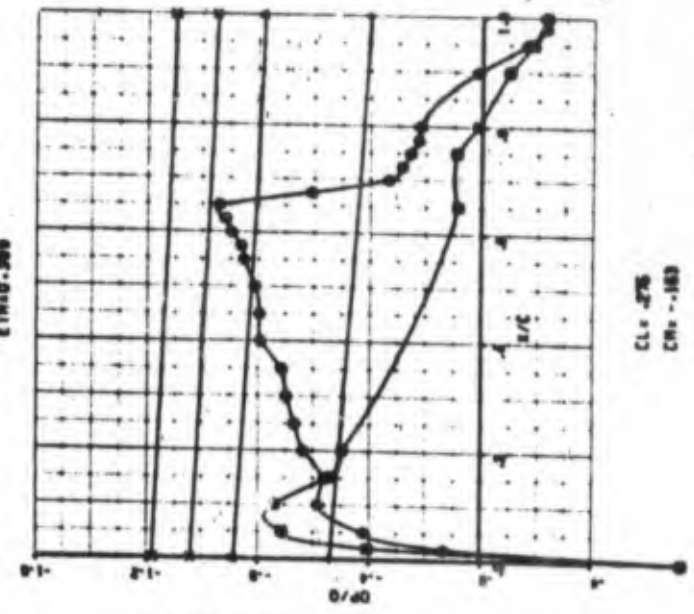
○ UPPER SURFACE      ▲ MACH LOCAL-1-2  
 □ LOWER SURFACE    × MACH LOCAL-1-3  
 + MACH LOCAL-1-0    × MACH LOCAL-1-4

ETP=0.193



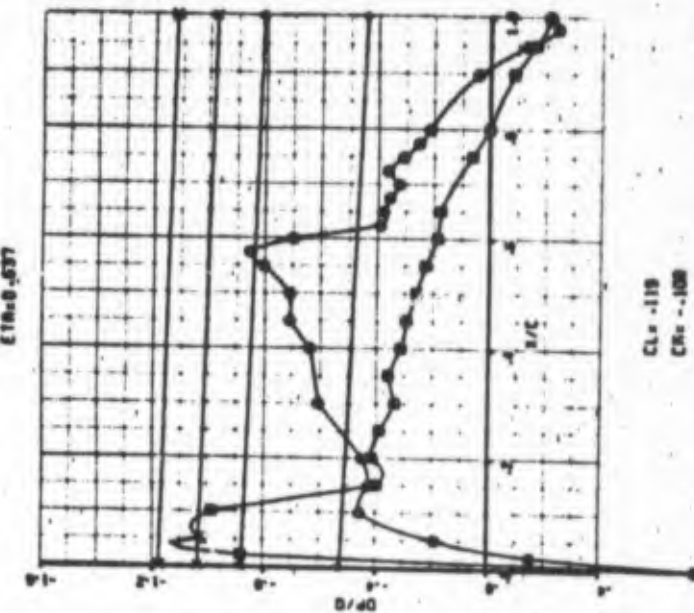
CL = .224  
 CM = -.008

ETP=0.309



CL = .276  
 CM = -.163

ETP=0.637



CL = .119  
 CM = -.108

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 546  
 RUN NO 1E  
 MACH NO .820

## RAKE LOCATIONS

○ 30 %  
 ▲ 65 %  
 × 80 %  
 ✱ 80 % (AFT)

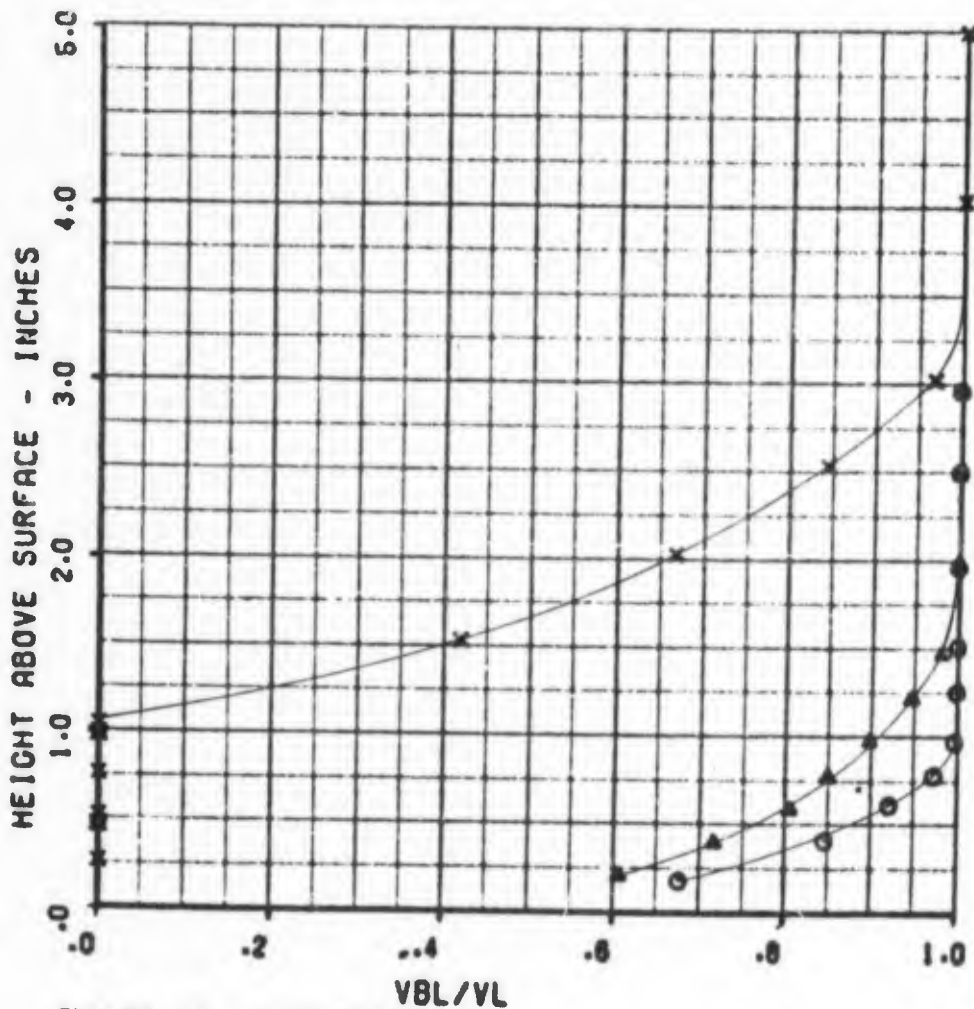


FIGURE 12 (CONTINUED)  
 (e) CORRECTED ALPHA = -1.27

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 848  
 RUN NO 1E  
 MACH NO .820

8  
 ALPHA  
 1.00

2.45 PSI  
 -2.00 DEG  
 -22.1 DEG C

ETW-8-183

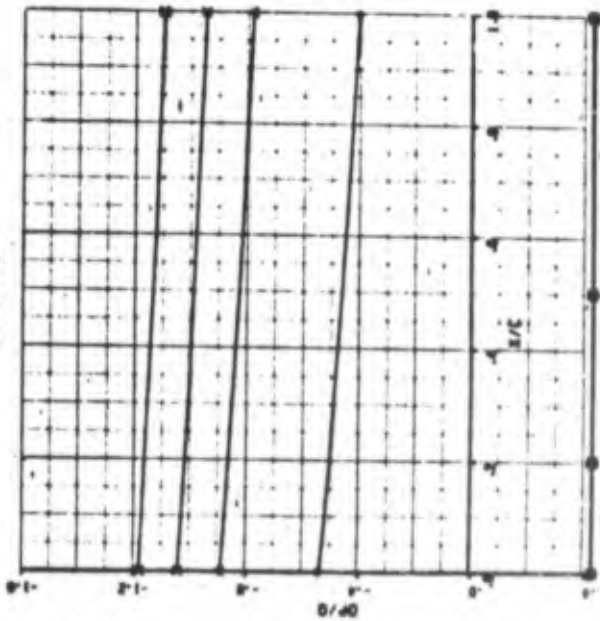
ALTITUDE 22000. FT  
 WEIGHT 240000. LB  
 NZ 1.00

CO 20-15 X MAC  
 RILEGON PPS -J8 DEG  
 FLAP PPS 0.00 DEG

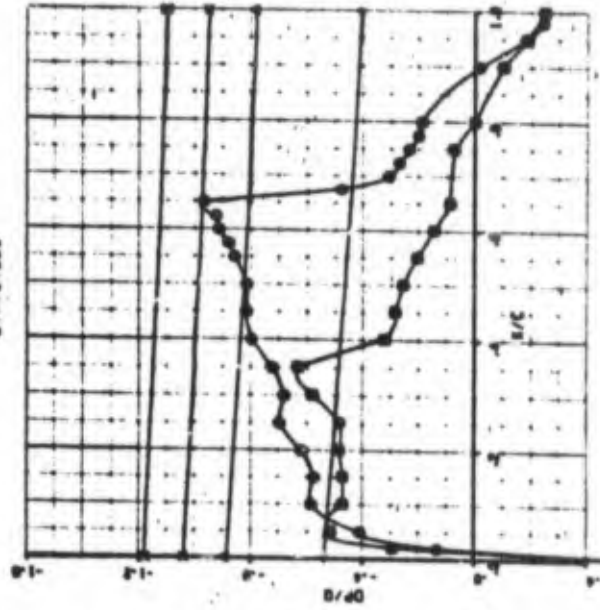
ETW-8-300

UPPER SURFACE  
 LOWER SURFACE  
 MACH LOCN.-1.0  
 MACH LOCN.-1.2  
 MACH LOCN.-1.3  
 MACH LOCN.-1.4

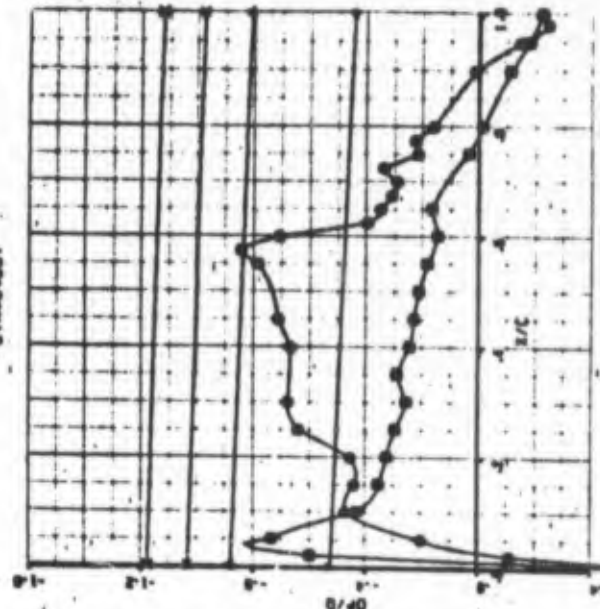
ETW-8-337



CL = 0.000  
 CR = 0.000



CL = .253  
 CR = -.141



CL = .210  
 CR = -.122

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 2C  
 MACH NO .822

### RAKE LOCATIONS

○ 30 %  
 △ 55 %  
 × 80 %  
 \* 80 % (AFT)

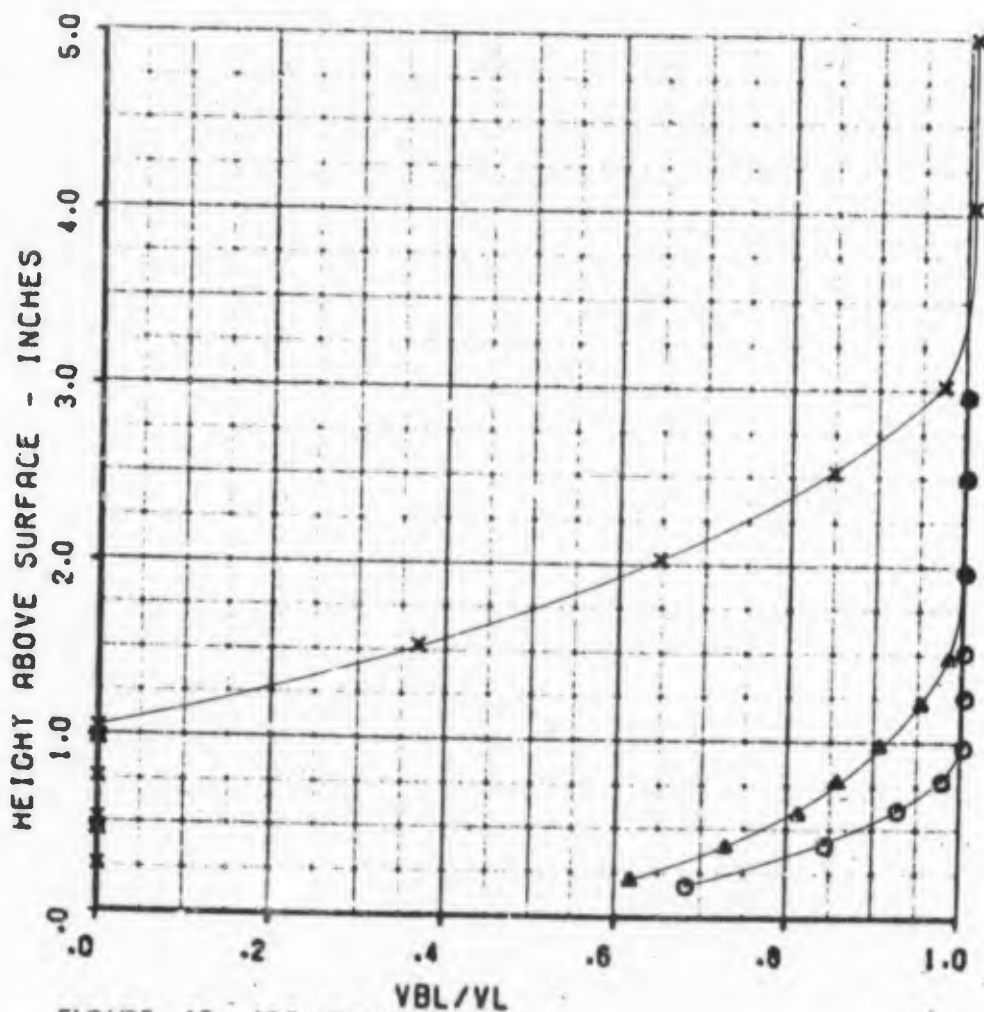


FIGURE 12 (CONTINUED).  
 (f) CORRECTED ALPHA = -1.27

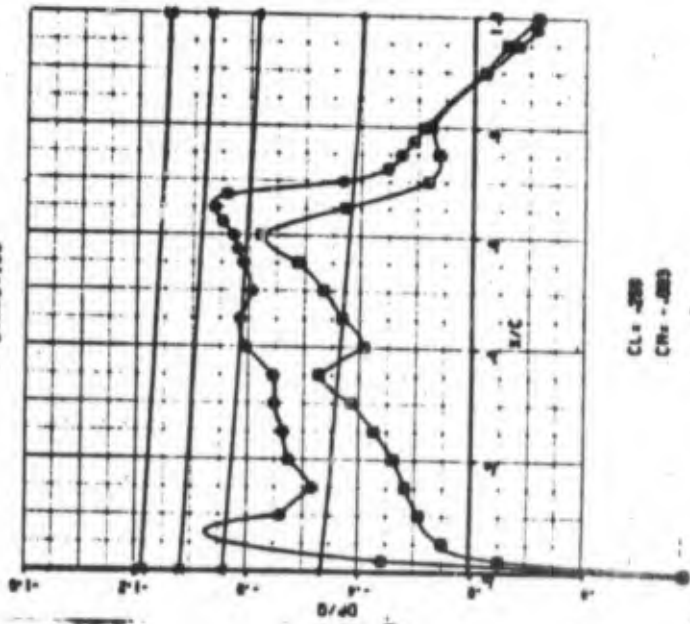
# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 549  
RUN NO 2C  
MACH NO .822

$\theta$  ALPH  
T/M

S-02 PSI  
-2.01 DEG  
-35.4 DEG C

ETR-0-183

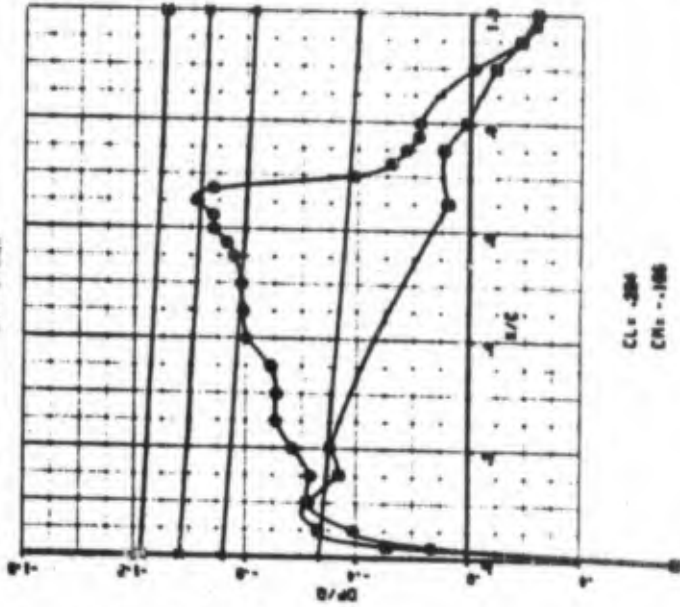


CL-209  
CR-023

ALTITUDE 21500 FT  
WEIGHT 200000 LB  
MZ 1.00

CG 39.35 I MAC  
WILLIAM PWS -1.52 DEG  
FLAP PWS 0.00 DEG

ETR-0-209

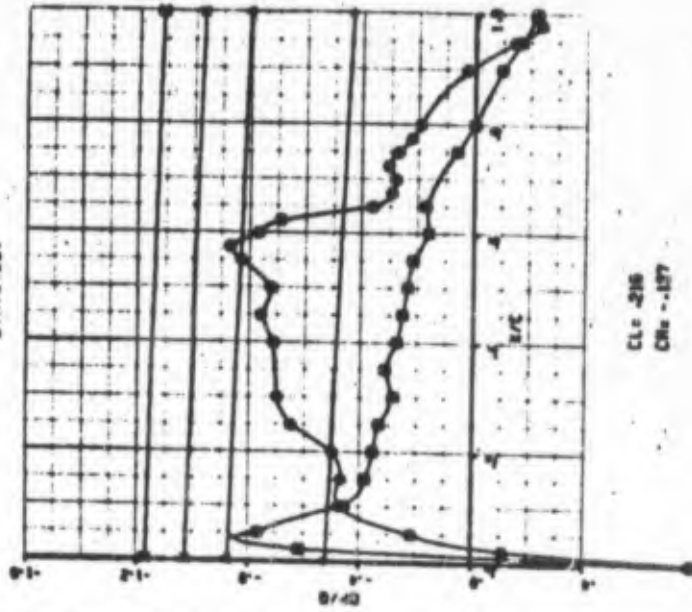


CL-204  
CR-106

UPPER SURFACE  
LOWER SURFACE  
MACH LCNL-1.0

MACH LCNL-1.2  
MACH LCNL-1.5  
MACH LCNL-1.8

ETR-0-237



CL-216  
CR-137

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 546  
 RUN NO 1E3  
 MACH NO .820

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 60 %  
 ✱ 60 % (AFT)

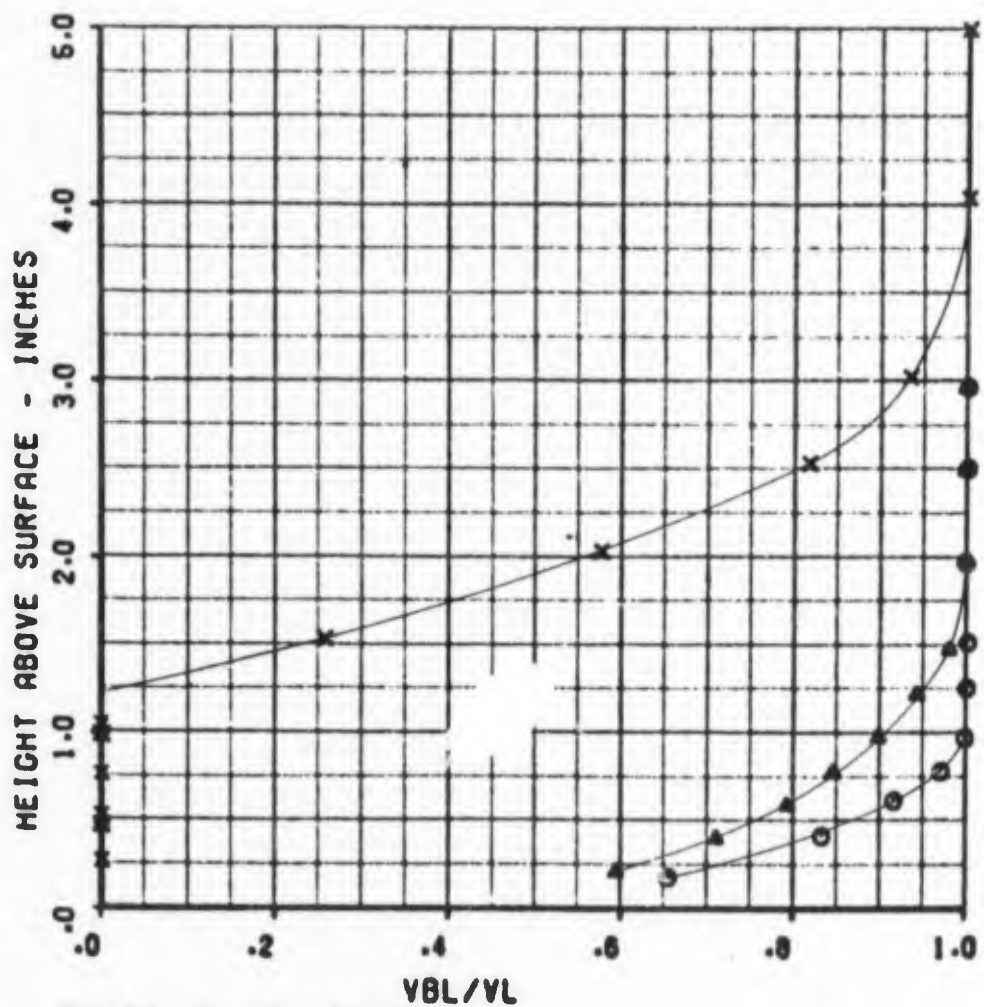
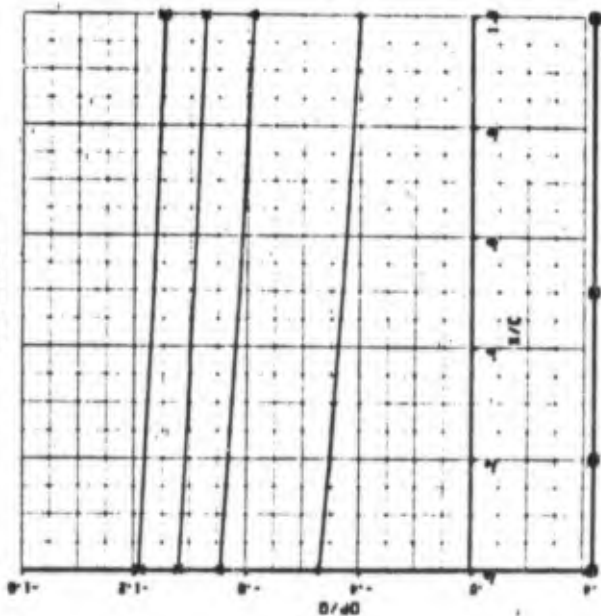


FIGURE 12 (CONTINUED)  
 (g) CORRECTED ALPHA = -0.78

LOCKHEED C-141A  
PRESSURE DISTRIBUTION

FLIGHT NO 546 Q 2.02 PSI  
 RUN NO 1E3 ALPHA -1.43 DEG  
 MACH NO .820 TRM -23.8 DEG C

ETR=0.183

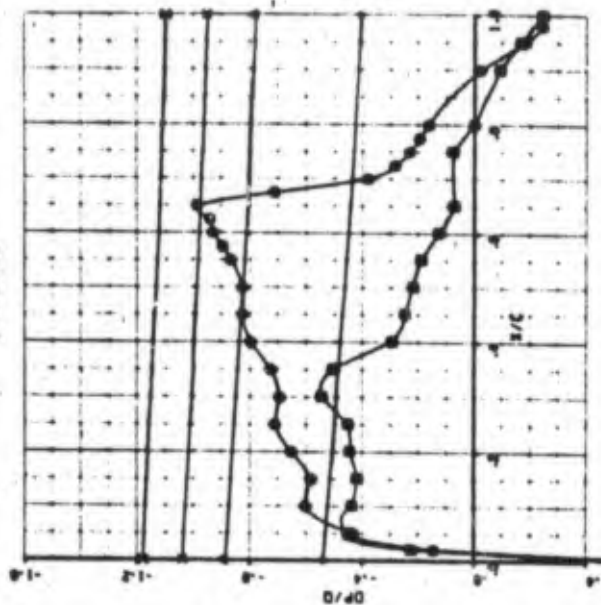


CL=0.000  
 CR=-0.000

ALTITUDE 22760. FT  
 WEIGHT 246500. LB  
 NZ 1.36

CO 20.15 Z MRC  
 AILERON POS -.67 DEG  
 FLAP POS 0.00 DEG

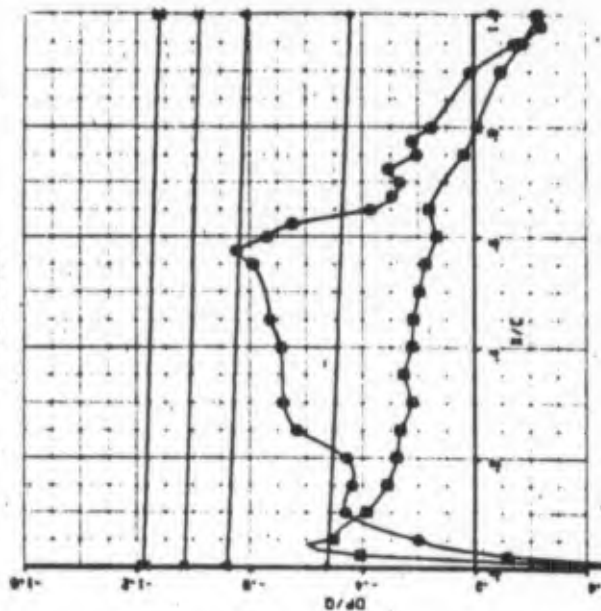
ETR=0.389



CL=-.209  
 CR=-.168

O UPPER SURFACE  
 □ LOWER SURFACE  
 + MACH LOCAL-1.0  
 \* MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 Z MACH LOCAL-1.4

ETR=0.637



CL=-.245  
 CR=-.130

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS.**

FLIGHT NO 548  
 RUN NO 2C1  
 MACH NO .822

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

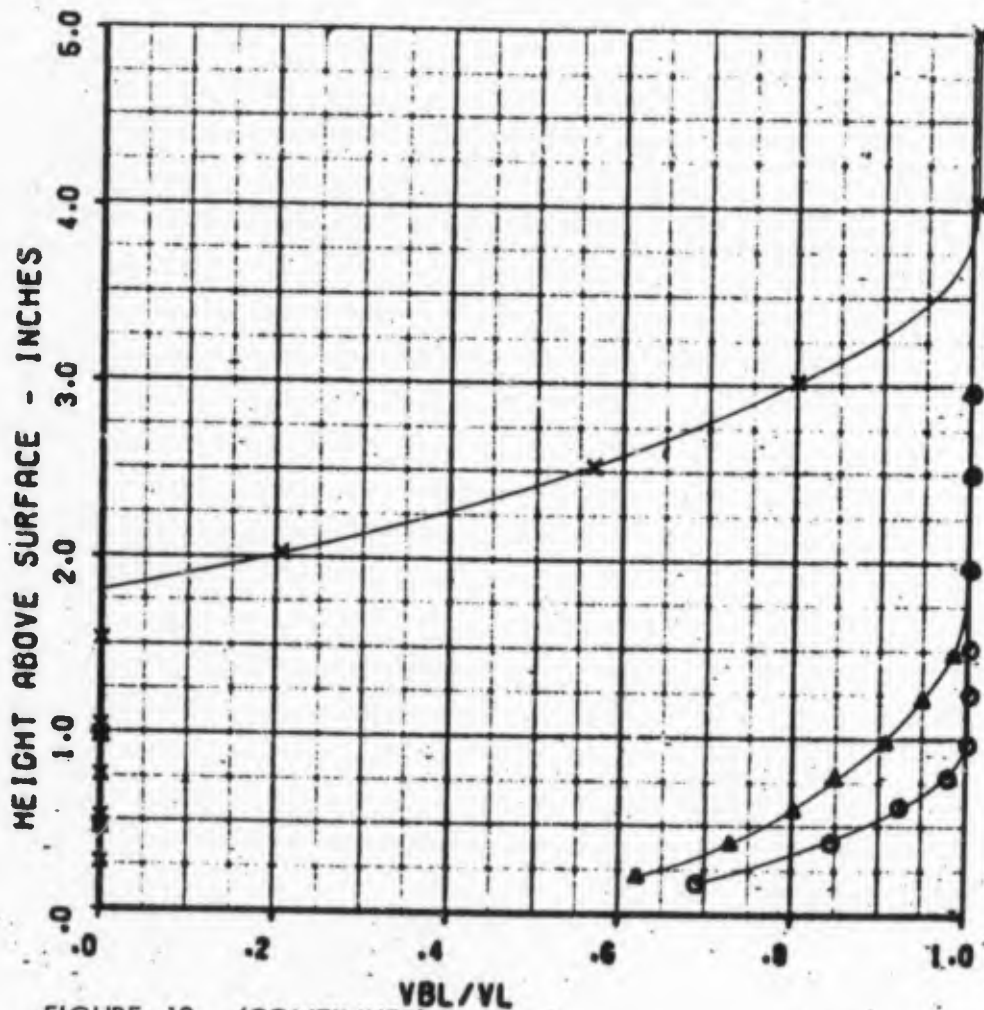


FIGURE 12 (CONTINUED)  
 (h) CORRECTED ALPHA = -0.70

# LOCKHEED C-141A PRESSURE DISTRIBUTION

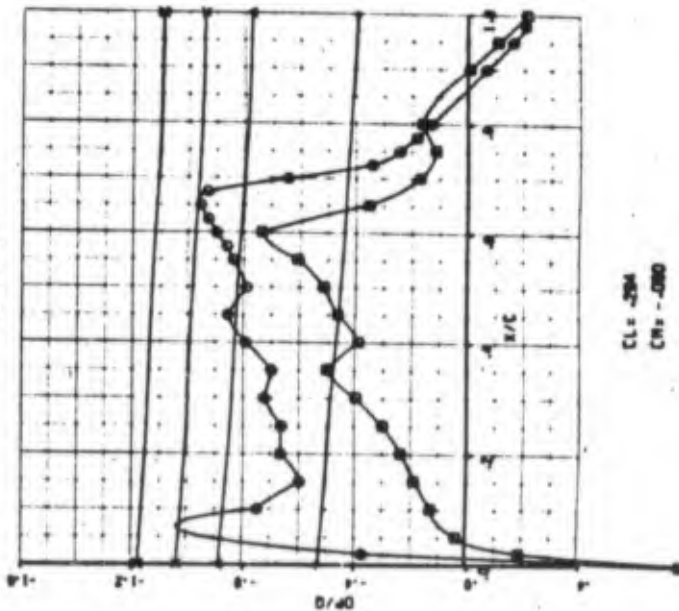
FLIGHT NO 548  
RUN NO 2C1  
MACH NO .822

ALTITUDE 20800. FT  
WEIGHT 255700. LB  
MZ 1.42

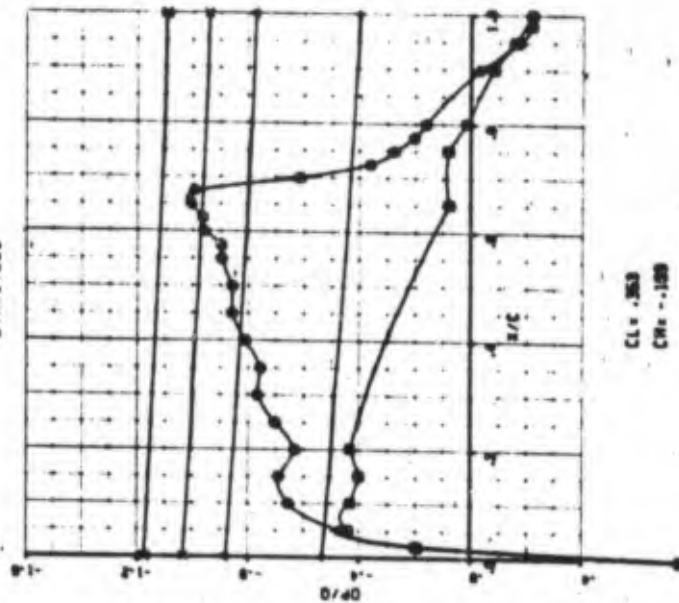
CO. 28.34 X MAC  
AILERON POS .34 DEG  
FLAP POS 0.00 DEG

○ UPPER SURFACE  
□ LOWER SURFACE  
+ MACH LOCAL-1.0  
△ MACH LOCAL-1.2  
× MACH LOCAL-1.3  
⊗ MACH LOCAL-1.4

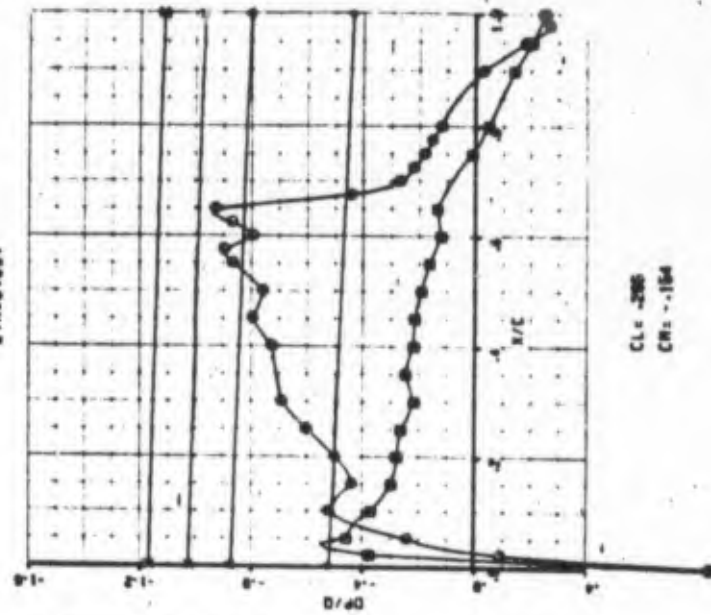
ETA=0.193



ETA=0.388



ETA=0.637



# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 546  
 RUN NO 1E4  
 MACH NO .822

## RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 X 80 %  
 \* 80 % (AFT)

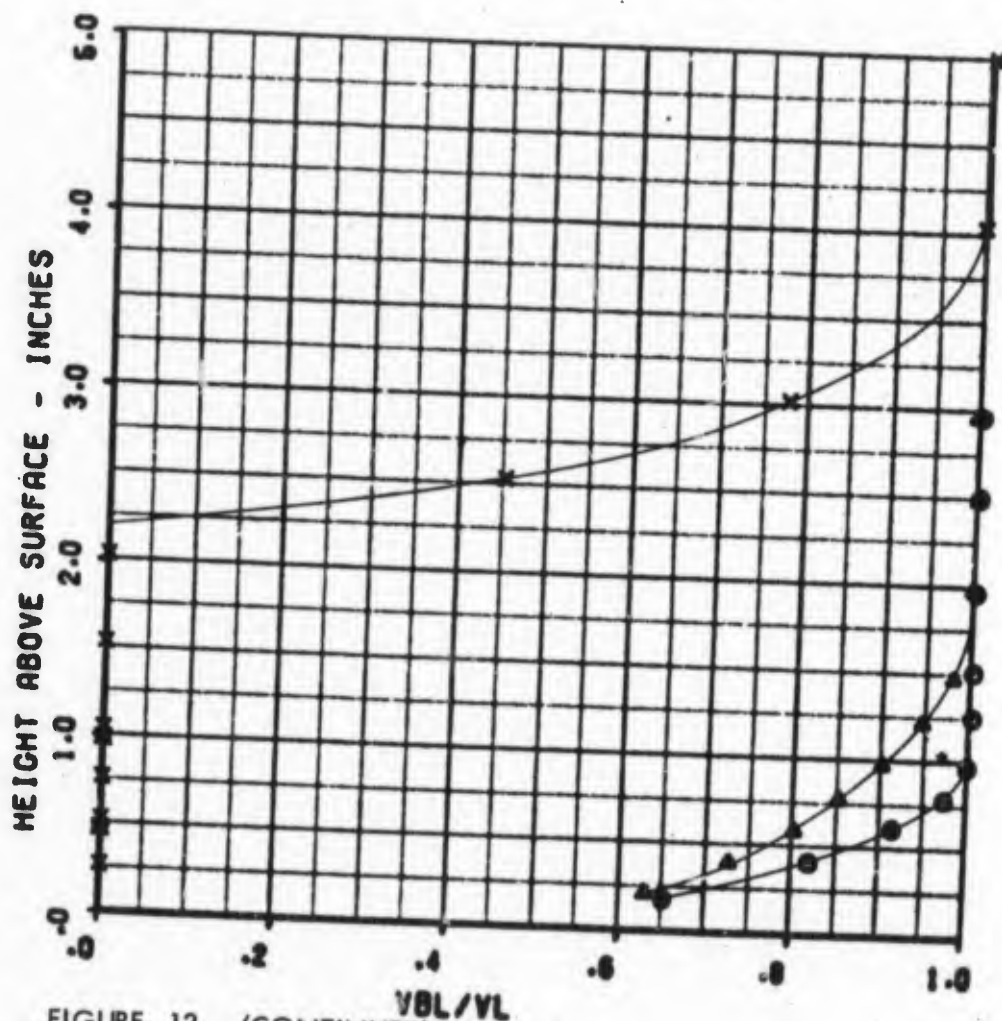


FIGURE 12 (CONTINUED)  
 (k) CORRECTED ALPHA = -0.35

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 545  
RUN NO 1E4  
MACH NO .822

0  
ALPHA  
TRW

2.88 PSI  
-.95 DEG  
-22.7 DEG C

ETA=0.193

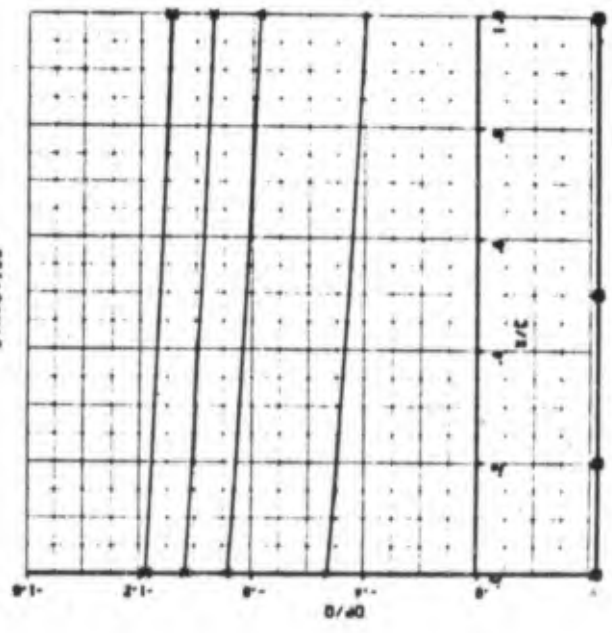
ALTITUDE 22310. F1  
WEIGHT 245000. LB  
MZ 1.55

CO  
AILERON POS  
FLAP POS

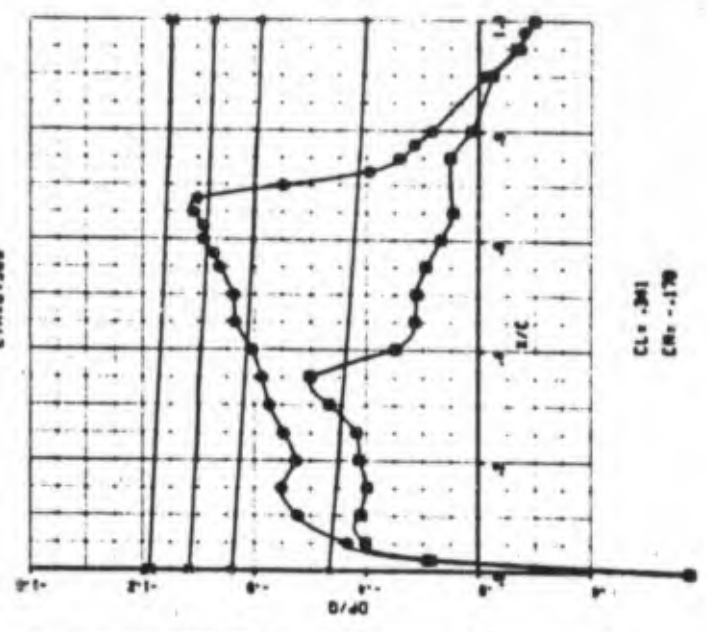
28.15 Z MAC  
-2.59 DEG  
0.00 DEG

O UPPER SURFACE  
□ LOWER SURFACE  
+ MACH LOCAL-1.0

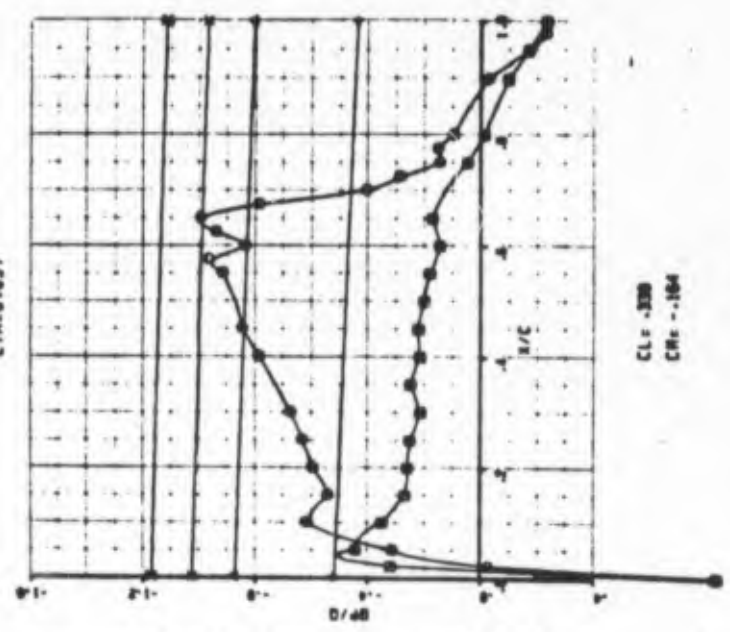
▲ MACH LOCAL-1.2  
X MACH LOCAL-1.3  
Σ MACH LOCAL-1.4



CL = 0.008  
CR = 0.000



CL = .341  
CR = -.179



CL = .338  
CR = -.164

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 2C2  
 MACH NO .820

## RAKE LOCATIONS

○ 30 %  
 △ 55 %  
 × 80 %  
 \* 80 % (AFT)

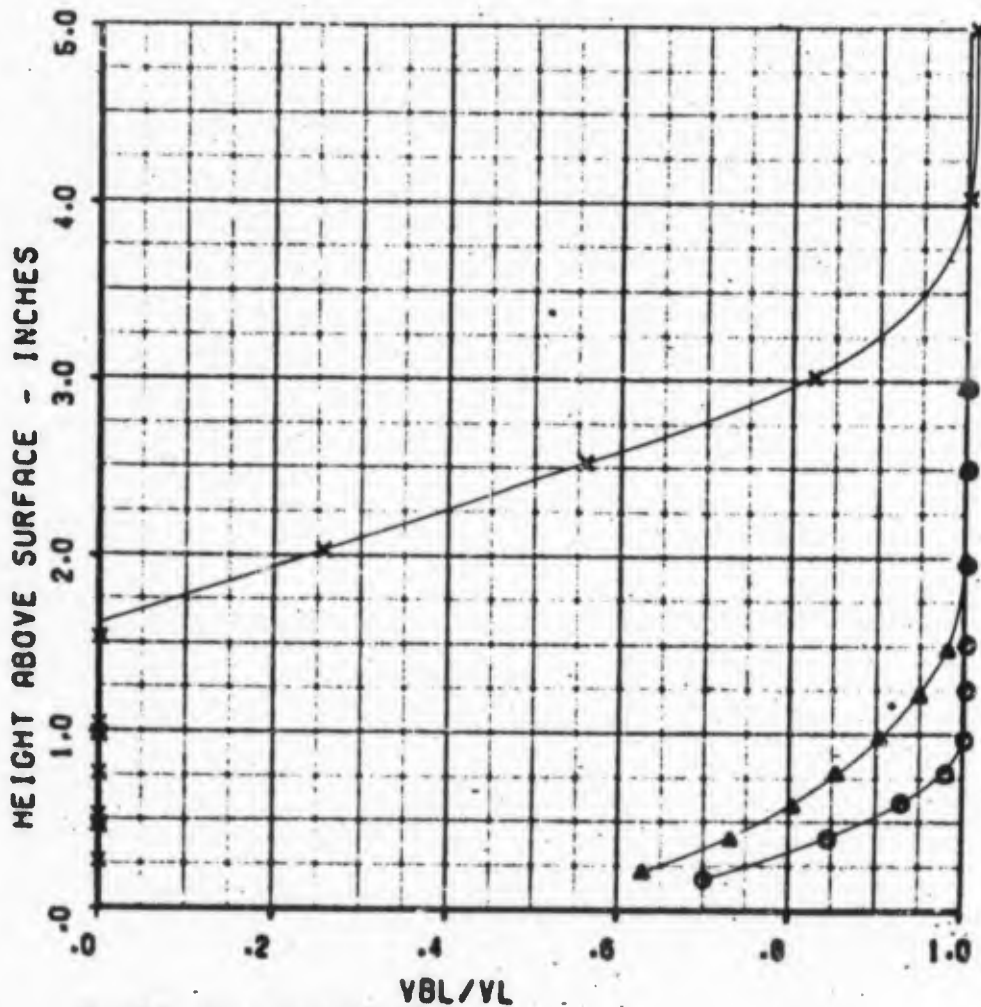


FIGURE 12 (CONTINUED)  
 (I) CORRECTED ALPHA = -0.20

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 540  
 RUN NO 2C2  
 MACH NO .820

Q 3.05 PSI  
 ALPHA -7.77 DEG  
 TAN -33.8 DEG C

ALTITUDE 20910. FT  
 WEIGHT 255000. LB  
 NZ 1.71

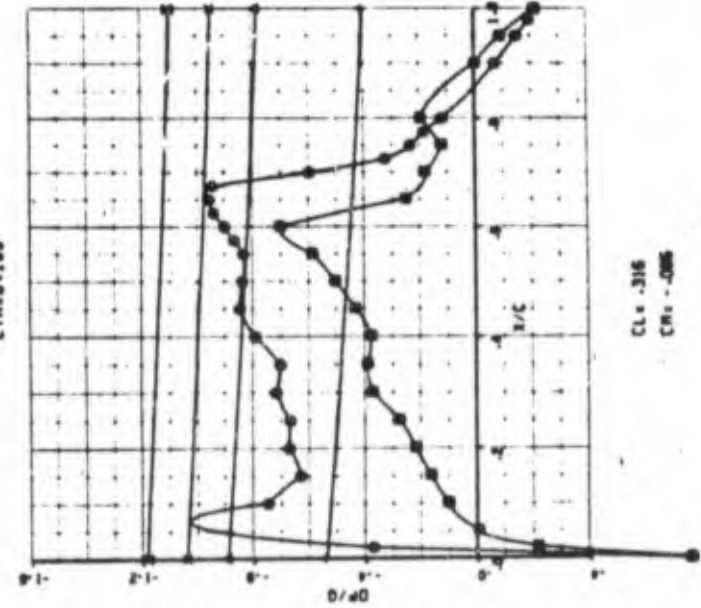
CO 28.32 2 MAC  
 MILLON POS -1.01 DEG  
 FLAP POS 0.00 DEG

UPPER SURFACE  
 LOWER SURFACE  
 MACH LOCAL-1-0  
 MACH LOCAL-1-2  
 MACH LOCAL-1-3  
 MACH LOCAL-1-4

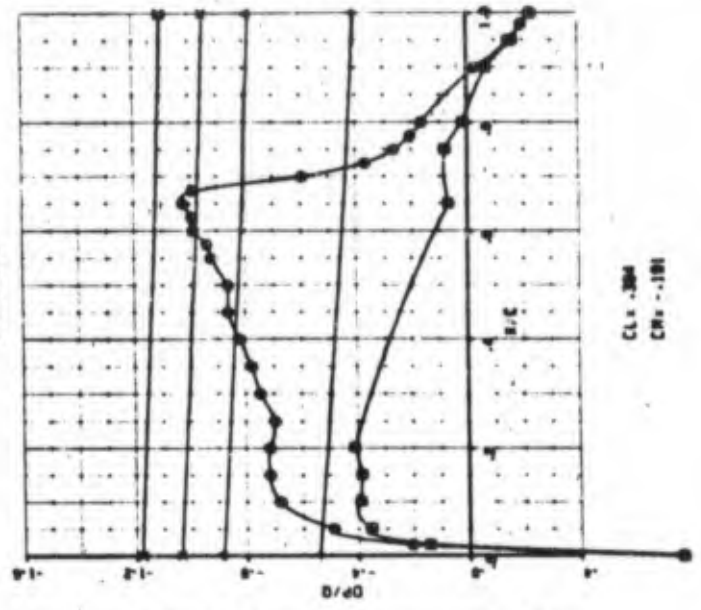
ETA=0.193

ETA=0.389

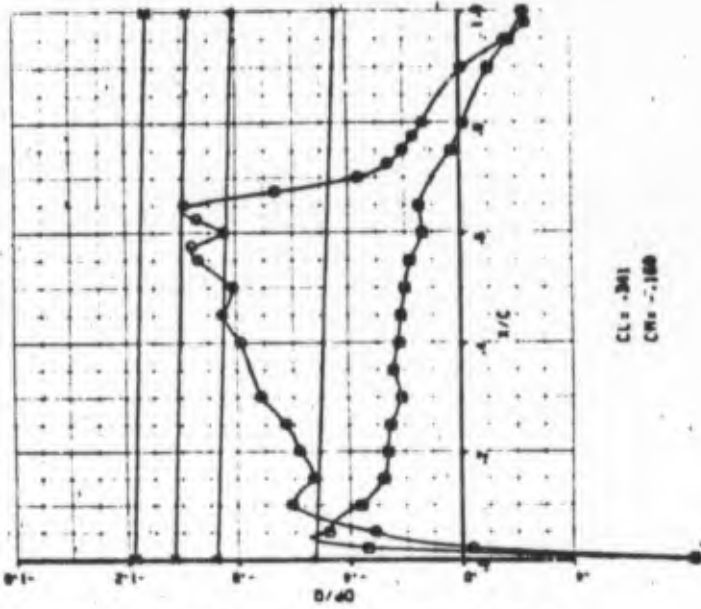
ETA=0.637



CL = .316  
 CR = .085



CL = .384  
 CR = .181



CL = .381  
 CR = .188

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 2C3  
 MACH NO .820

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

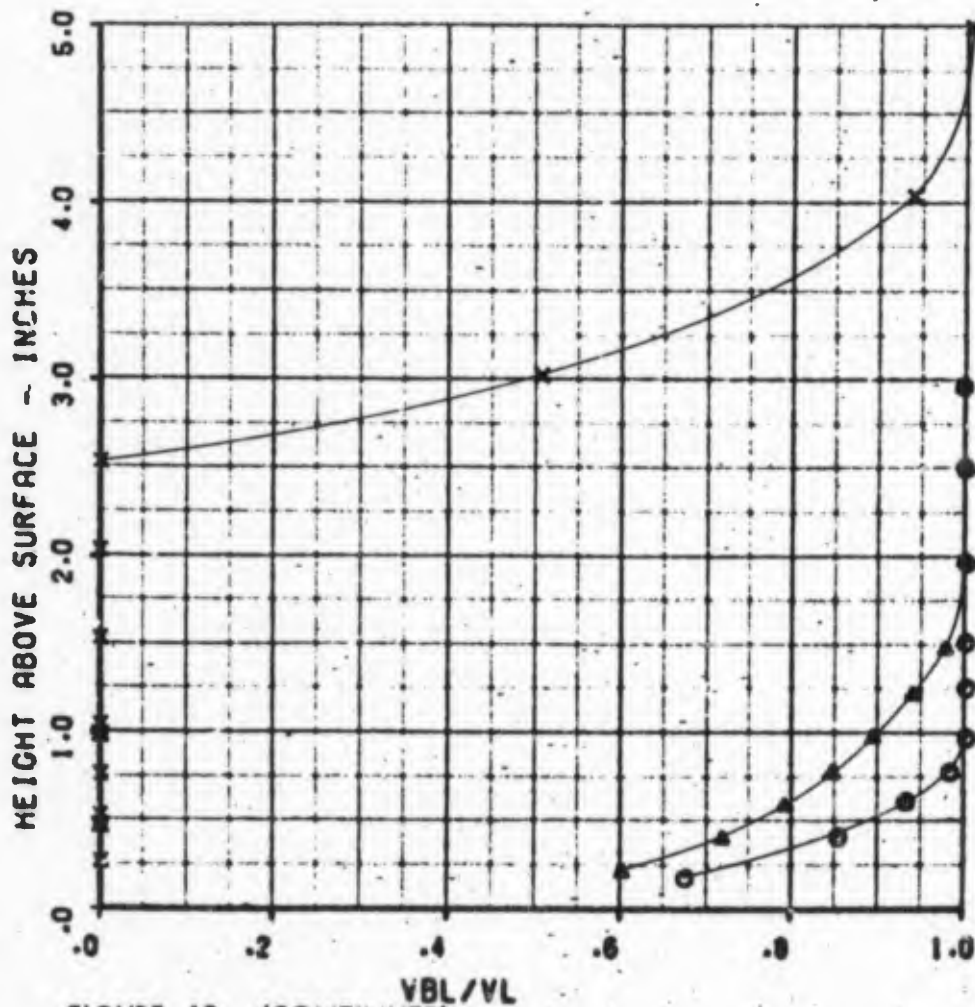


FIGURE 12 (CONTINUED)  
 (m) CORRECTED ALPHA = 0.22

LOCKHEED C-141A

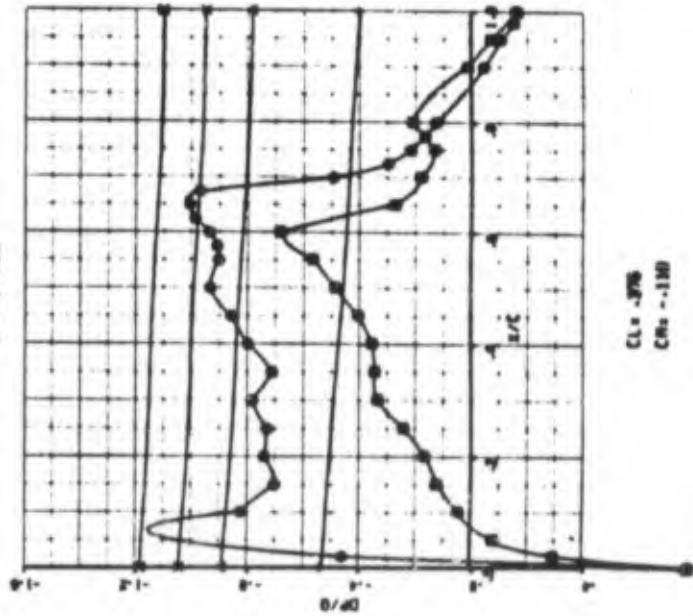
PRESSURE DISTRIBUTION

FLIGHT NO 548  
 RUN NO 2C3  
 MACH NO .820

0  
 ALPHA  
 TAN

3.07 PSI  
 -29 DEG  
 -33.2 DEG C

ETA=0.193

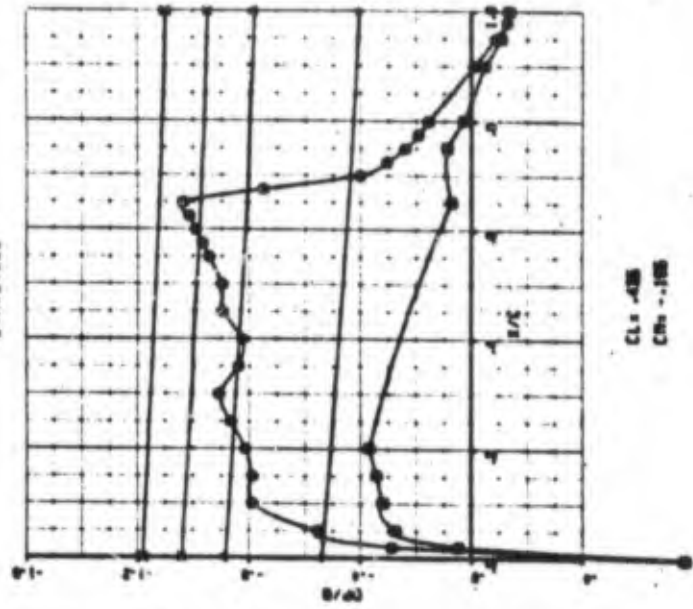


CLs -J78  
 CRs -J10

ALTITUDE 20766. FT  
 WEIGHT 254200. LB  
 SZ 1.35

26-30% MAC  
 RILEYON POS -.42 DEG  
 FLAP POS 0.00 DEG

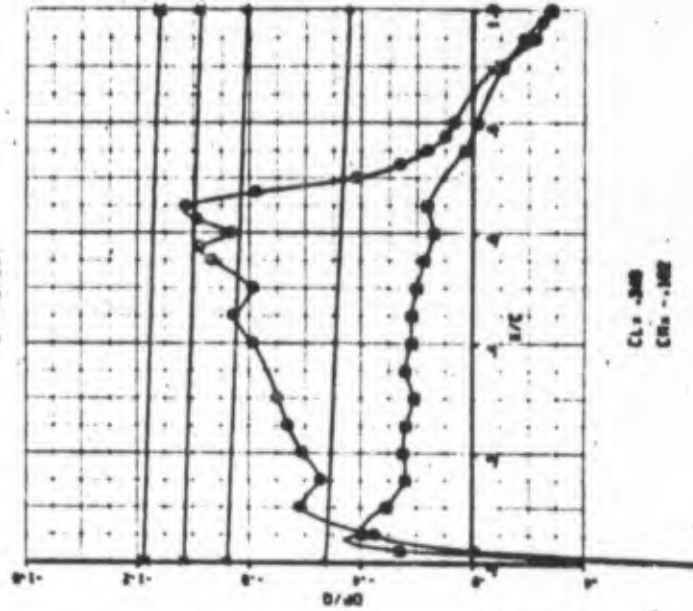
ETA=0.309



CLs -J85  
 CRs -J15

UPPER SURFACE  
 LOWER SURFACE  
 MACH LOCAL-1.0

ETA=0.637



CLs -J99  
 CRs -J22

MACH LOCAL-1.2  
 MACH LOCAL-1.3  
 MACH LOCAL-1.4

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 546  
 RUN NO 1E5  
 MACH NO .820

## RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

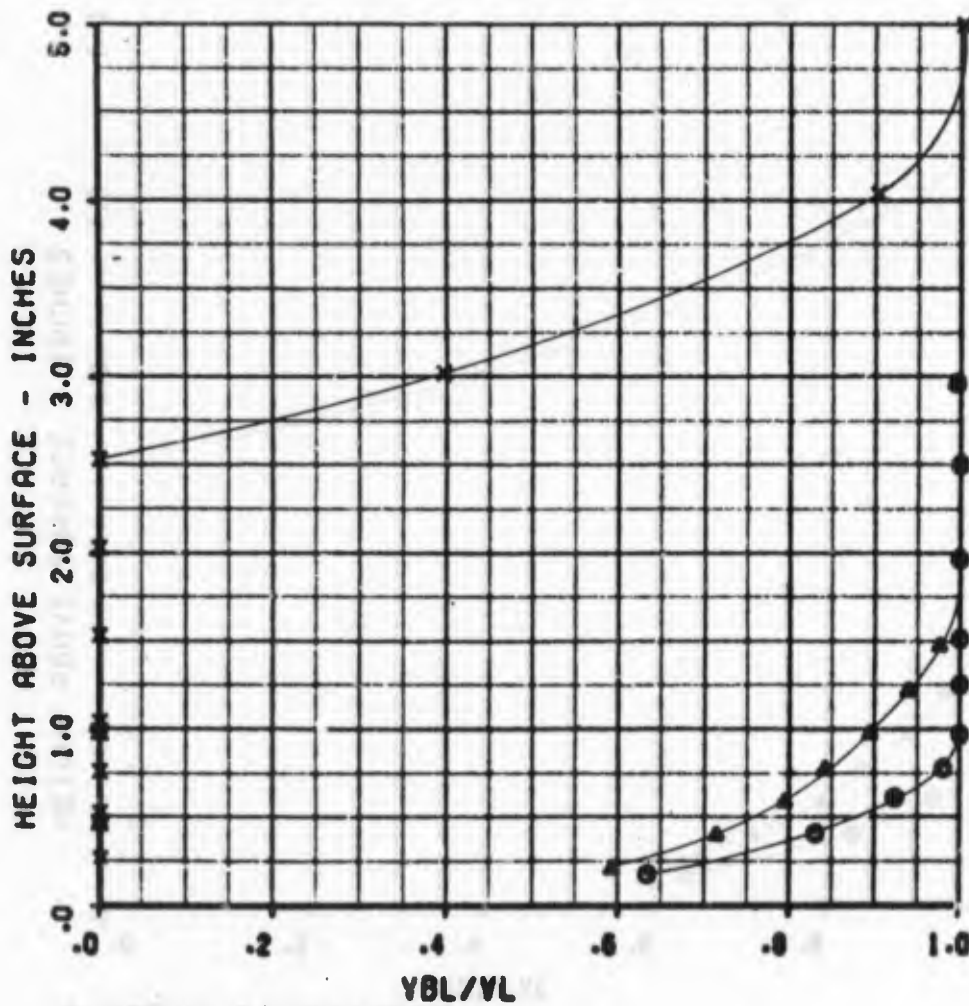


FIGURE 12 (CONCLUDED)  
 (n) CORRECTED ALPHA = 0.22

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 546  
 RUN NO 1E5  
 MACH NO .820

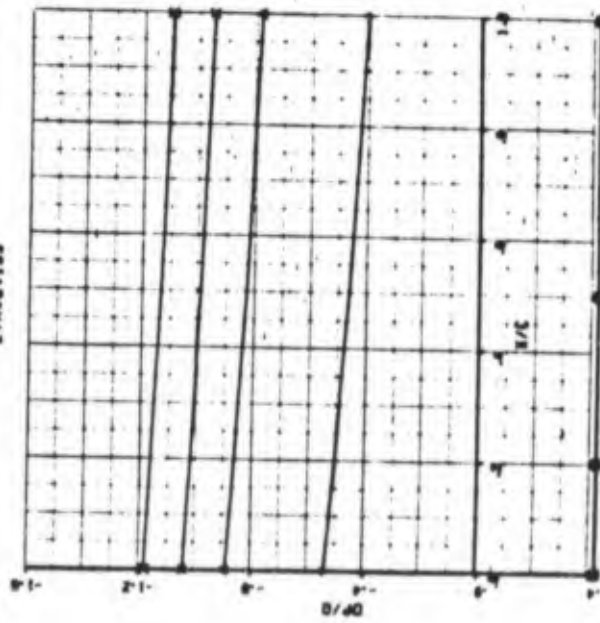
Q 2.30 PSI  
 ALPHA -29 DEG  
 TAW -21.8 DEG C

ALTITUDE 22150. FT  
 WEIGHT 244000. LB  
 NZ 1.99

CO 29.15 X MAC  
 MILLERON POS -67 DEG  
 FLAP POS 0.00 DEG

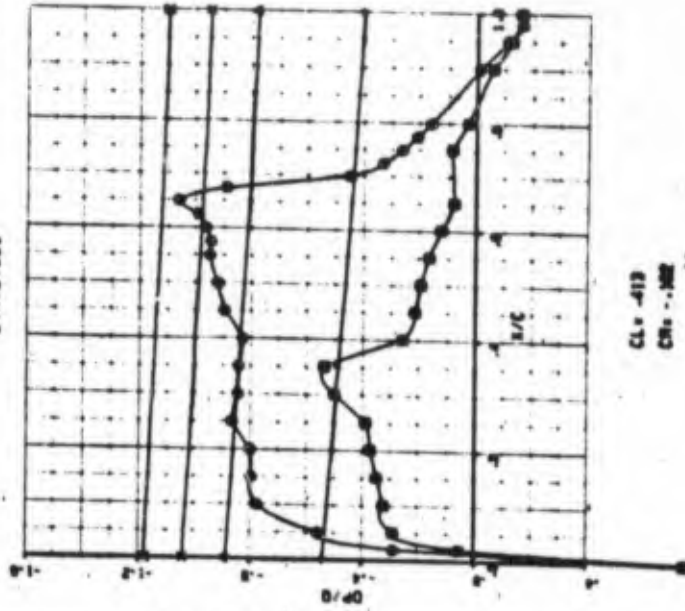
O UPPER SURFACE  
 □ LOWER SURFACE  
 + MACH LOCPL-1.0  
 X MACH LOCRL-1.3  
 △ MACH LOCRL-1.2  
 ⊗ MACH LOCRL-1.4

ETA=0.183



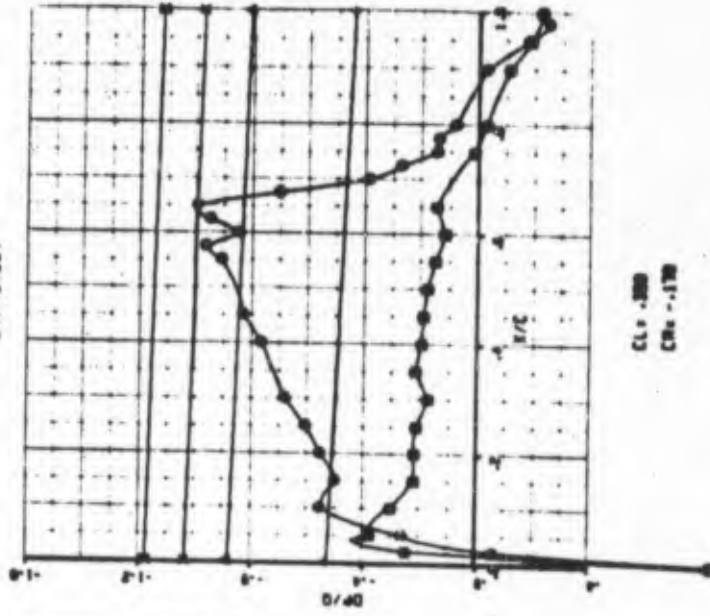
CL=0.000  
 CR=0.000

ETA=0.309



CL=-.413  
 CR=-.182

ETA=0.537



CL=.300  
 CR=-.170

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 2A5  
 MACH NO .860

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

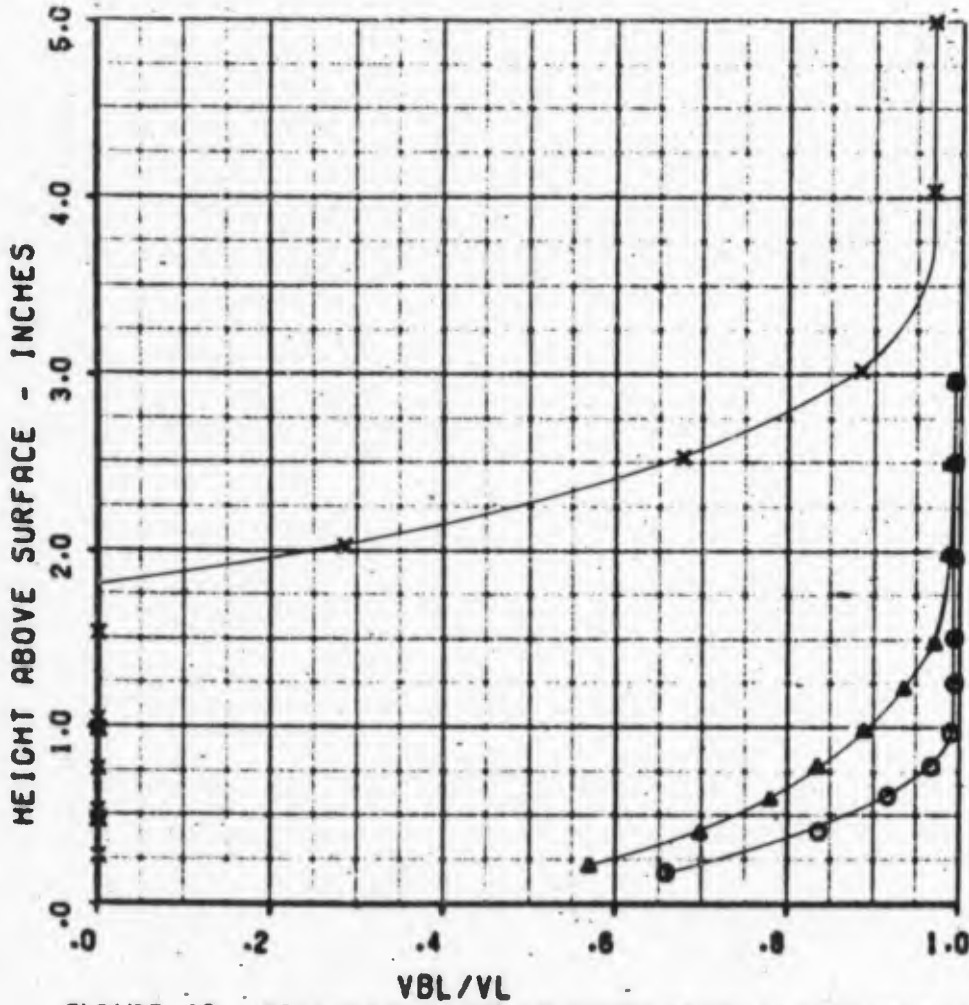


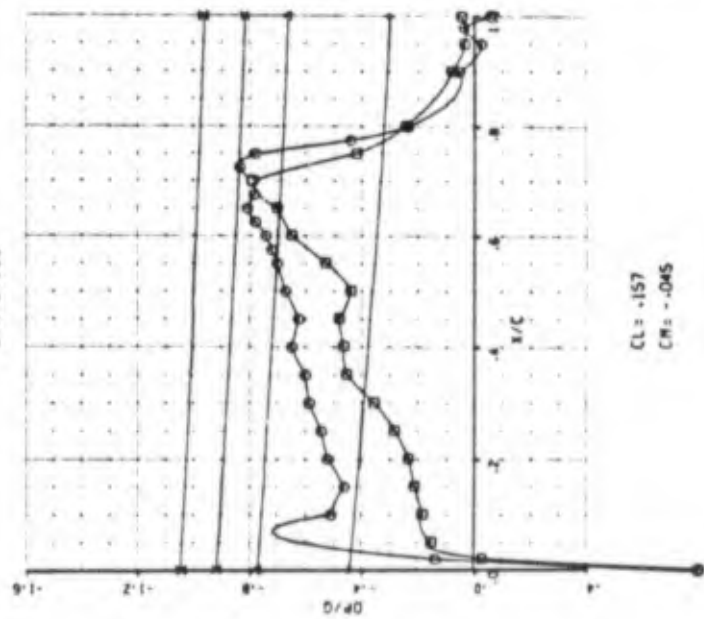
FIGURE 13 BOUNDARY LAYER VELOCITY PROFILES AND PRESSURE DISTRIBUTIONS MACH .840 TO .860  
 (a) CORRECTED ALPHA = -2.24

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 547 0 2-65 PSI  
 RUN NO 285 ALPHA -3.09 DEG  
 MACH NO .860 TAN -44.0 DEG C

ETA:0.193

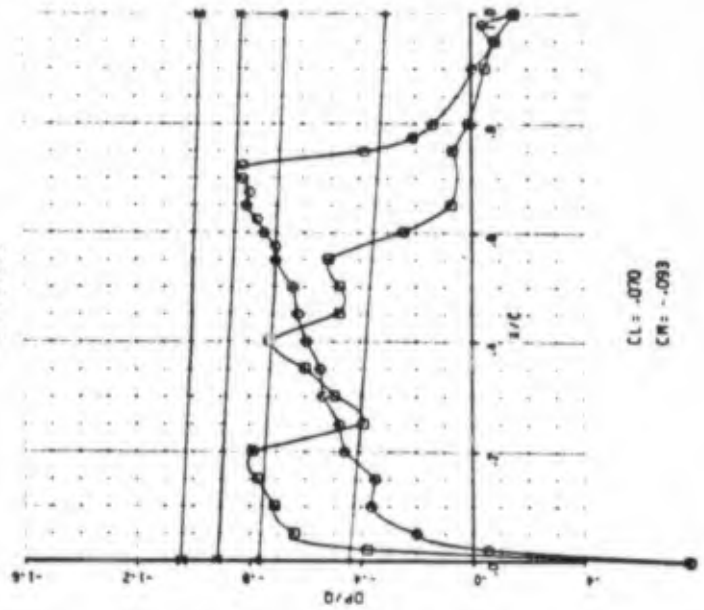


CL = .157  
 CM = -.045

ALTITUDE 26115.71  
 WEIGHT 244000.18  
 NZ .06

CO 27.70 Z MAC  
 AILERON POS 1.11 DEG  
 FLAP POS 0.00 DEG

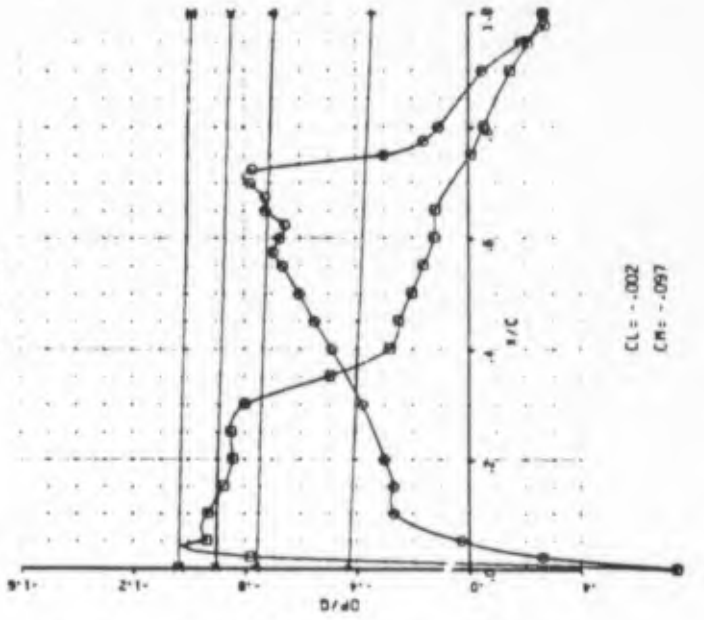
ETA:0.389



CL = .070  
 CM = -.093

UPPER SURFACE  
 LOWER SURFACE  
 MACH LOCAL 1.0  
 MACH LOCAL 1.4

ETA:0.637



CL = -.002  
 CM = -.087

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 2A4  
 MACH NO .855

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

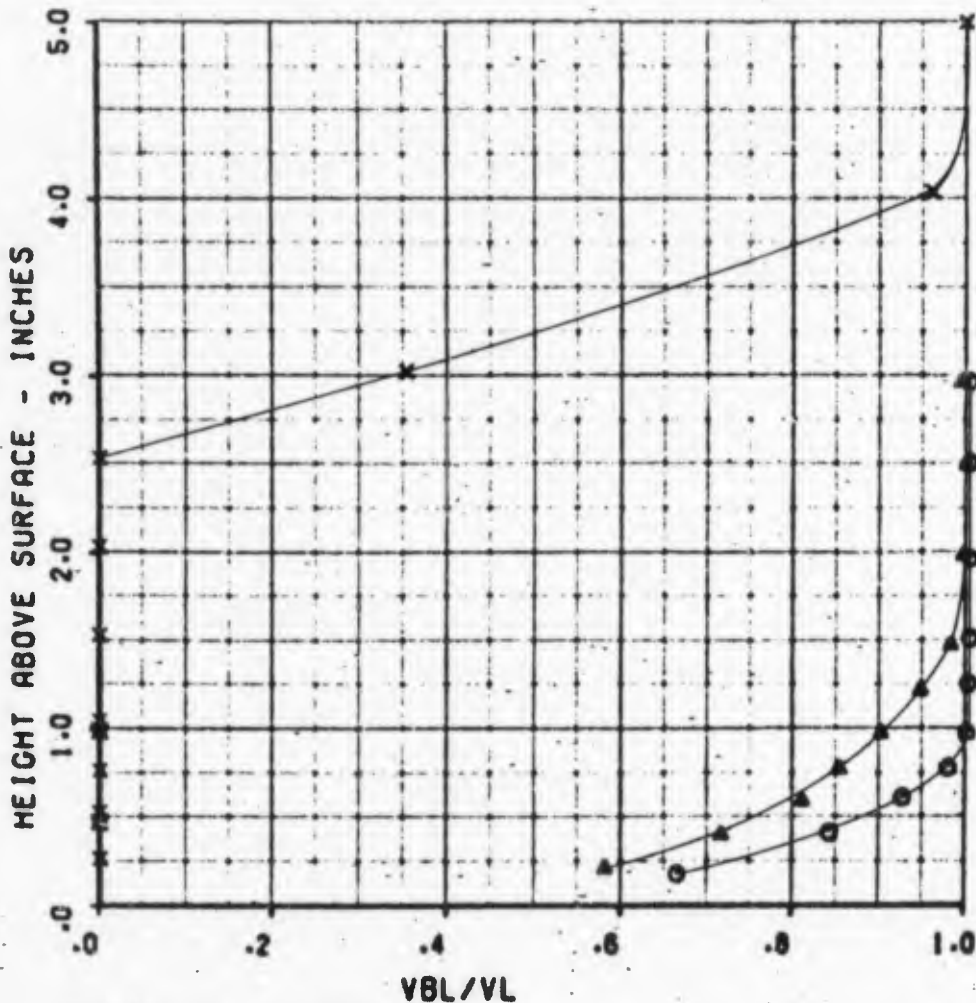


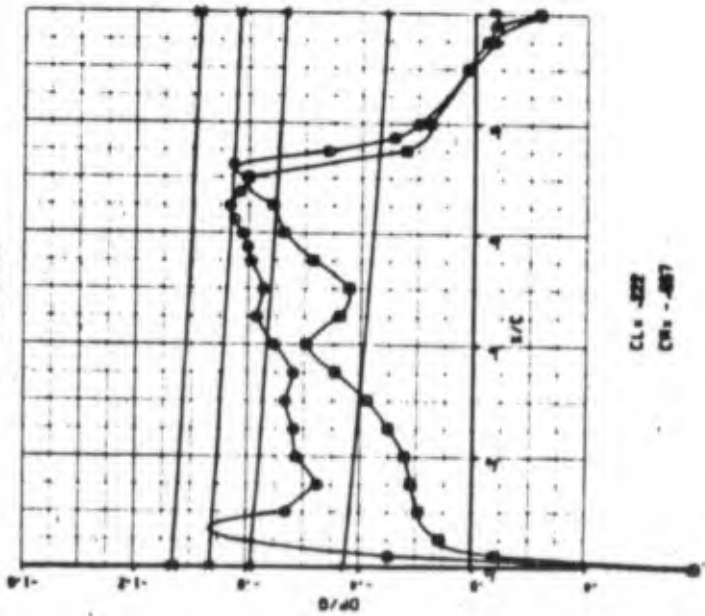
FIGURE 13 (CONTINUED)  
 (b) CORRECTED ALPHA = -1.30

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 547  
RUN NO 284  
MACH NO .855

Q 7.52 PSI  
ALPHA -2.03 DEG  
TAH -43.5 DEG C

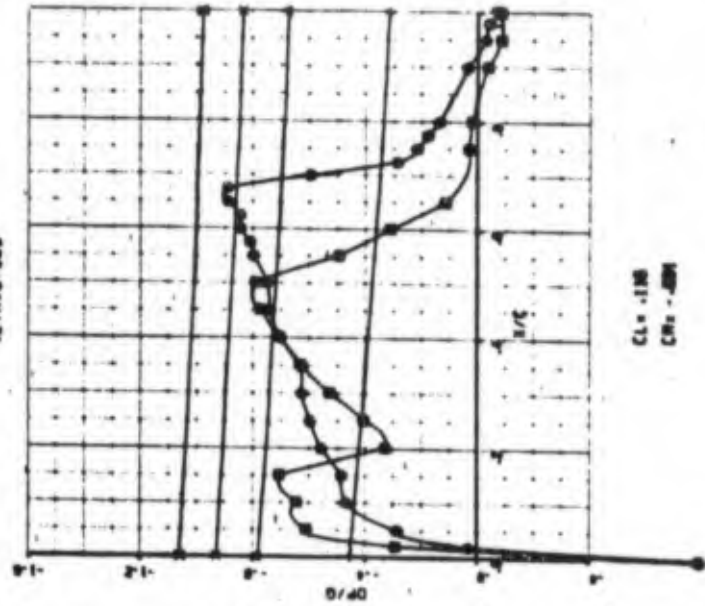
ETA-0-193



ALTITUDE 27000. FT  
METOH1 244000. LB  
NZ -48

CD 27.75 X MAC  
AILERON POS -.26 DEG  
FLAP POS 0.00 DEG

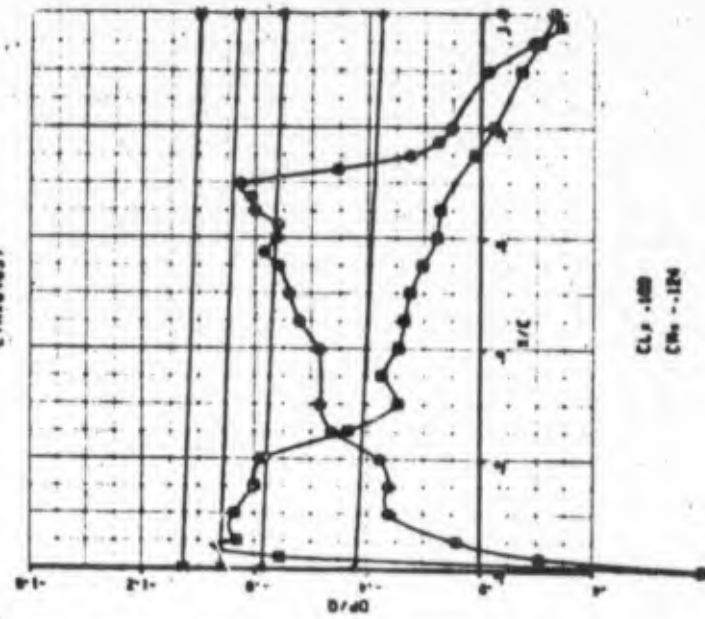
ETA-0-309



O UPPER SURFACE  
D LOWER SURFACE  
+ MACH LOCAL -1.0

A MACH LOCAL -1.2  
X MACH LOCAL -1.3  
Z MACH LOCAL -1.4

ETA-0-837



# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 2A  
 MACH NO .845

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 X 80 %  
 ✱ 80 % (AFT)

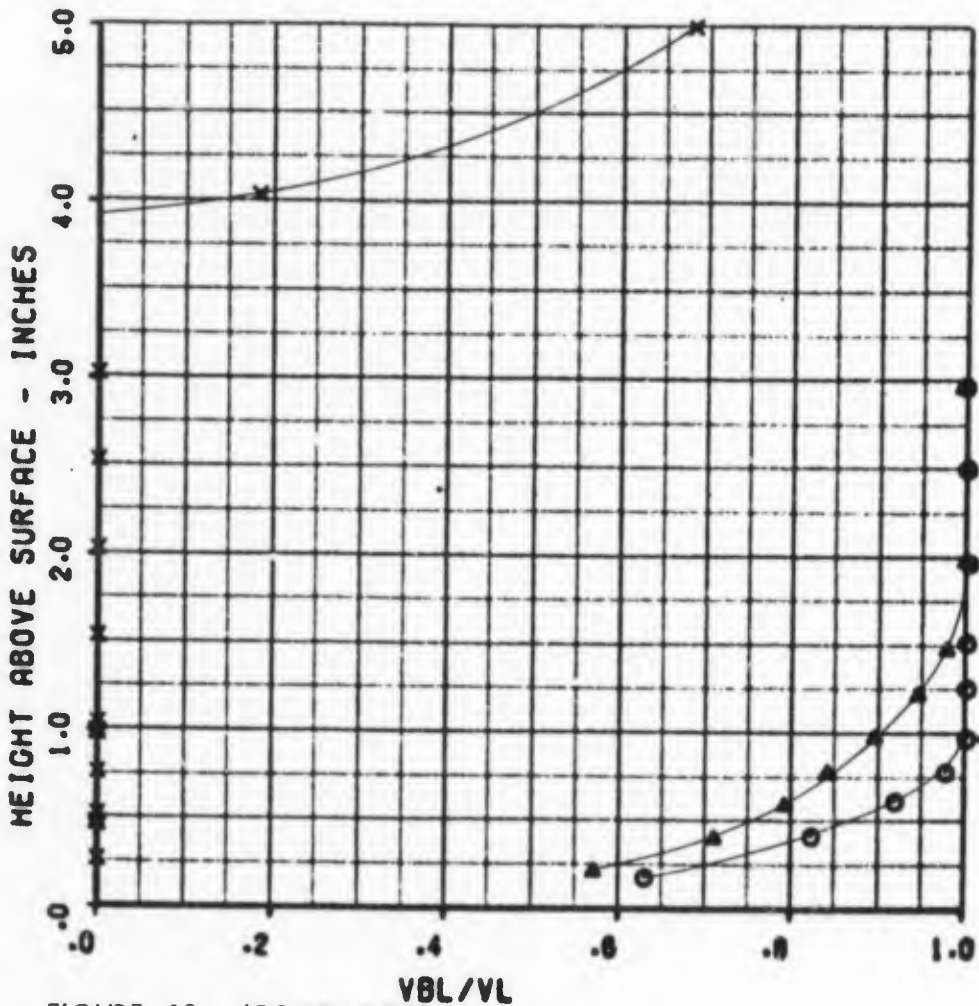


FIGURE 13 (CONTINUED)  
 (c) CORRECTED ALPHA = 0.13

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 847  
RUN NO 2A  
MACH NO .845

2.42 PSI  
-40 DEG  
-43.1 DEG C

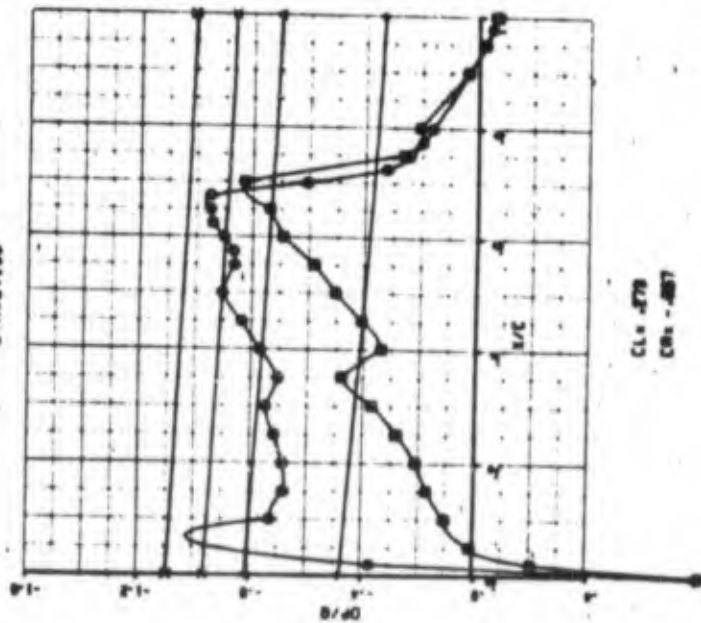
0  
ALPHA  
TRM

ALTITUDE 27055. FT  
WEIGHT 249500. LB  
WZ 1.00

CO 29.05 ± MAC  
AILERON POS -.08 DEG  
FLAP POS 0.00 DEG

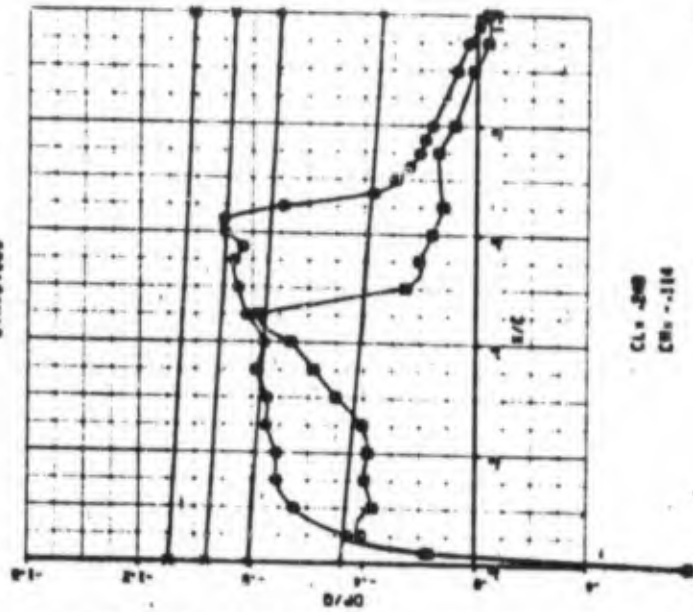
O UPPER SURFACE  
□ LOWER SURFACE  
+ MACH LOCAL-1.0  
△ MACH LOCAL-1.2  
X MACH LOCAL-1.3  
Σ MACH LOCAL-1.4

ETA=0.193



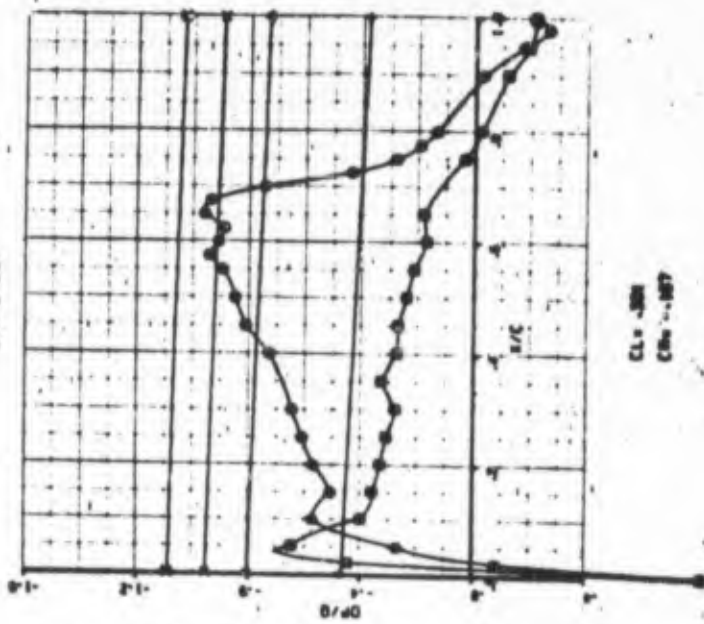
CL = .79  
CM = -.887

ETA=0.309



CL = .80  
CM = -.814

ETA=0.637



CL = .80  
CM = -.887

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 547  
 RUN NO 2A1  
 MACH NO .840

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 X 80 %  
 \* 80 % (AFT)

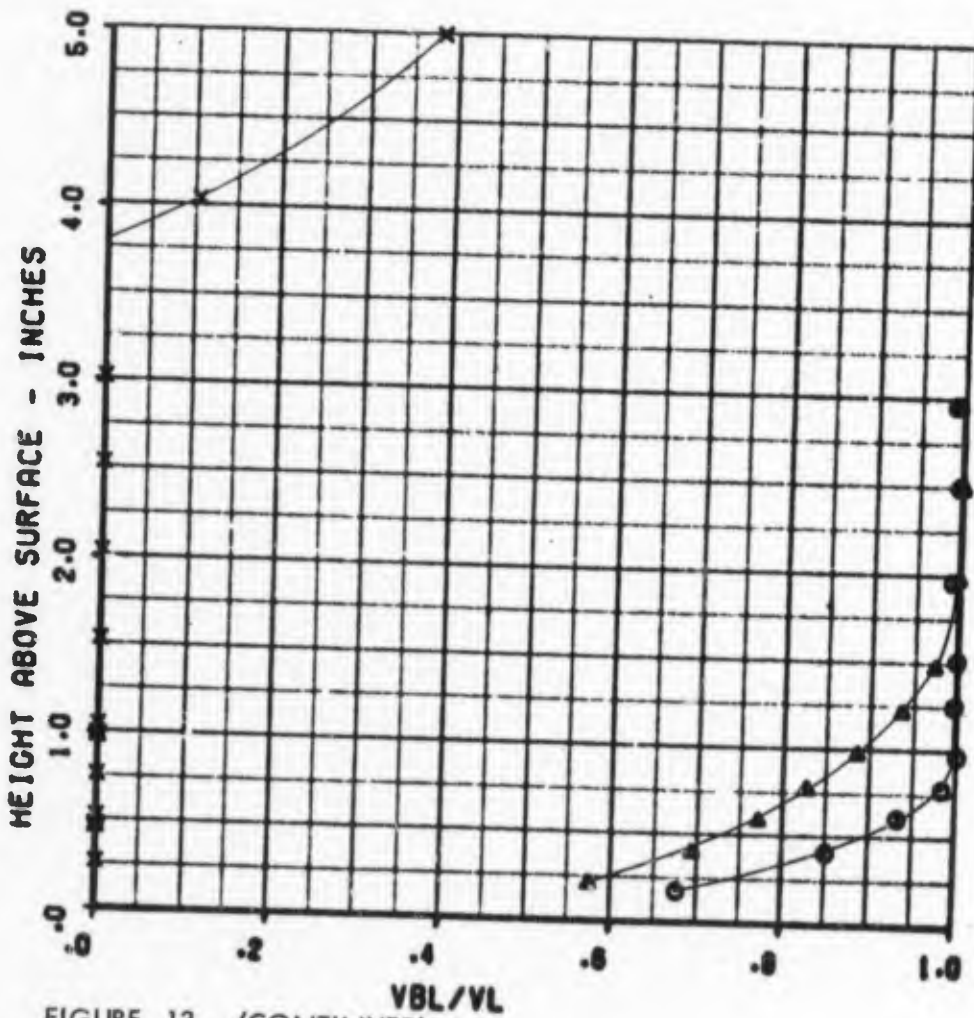


FIGURE 13 (CONTINUED)  
 (d) CORRECTED ALPHA = 1.00

LOCKHEED C-141R

PRESSURE DISTRIBUTION

FLIGHT NO 847  
 RUN NO 291  
 MACH NO .840

0  
 ALPHA  
 TRN

2.30 PSI  
 .58 DEG  
 -44.0 DEG C

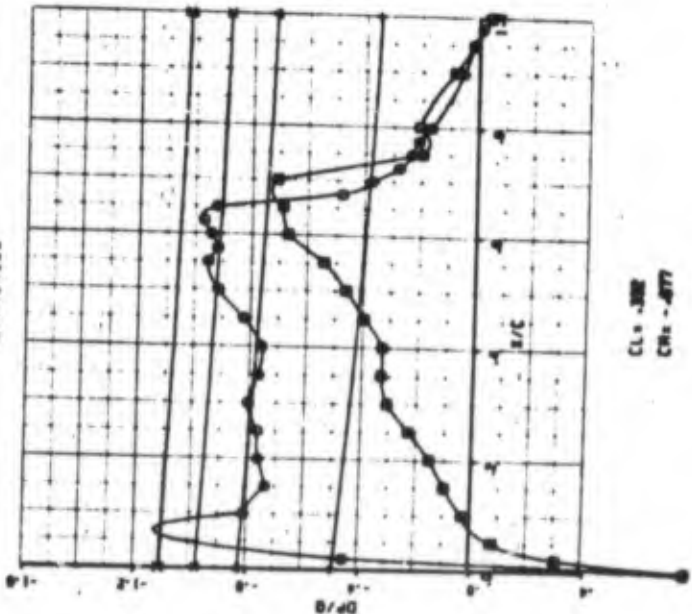
ALTITUDE 27715. FT  
 WEIGHT 249500. LB  
 NZ 1.43

CO 28.00 2 HMC  
 AILERON POS .51 DEG  
 FLAP POS 0.00 DEG

UPPER SURFACE  
 LOWER SURFACE

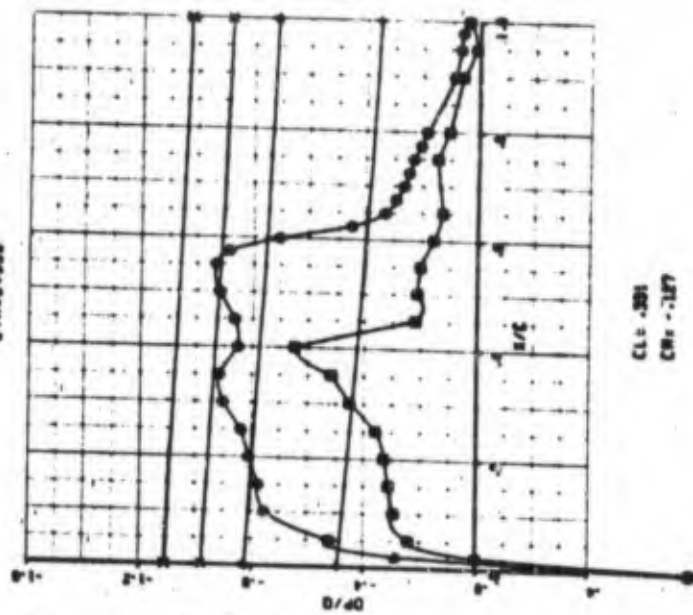
▲ MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 ■ MACH LOCAL-1.4

ETR=0.183



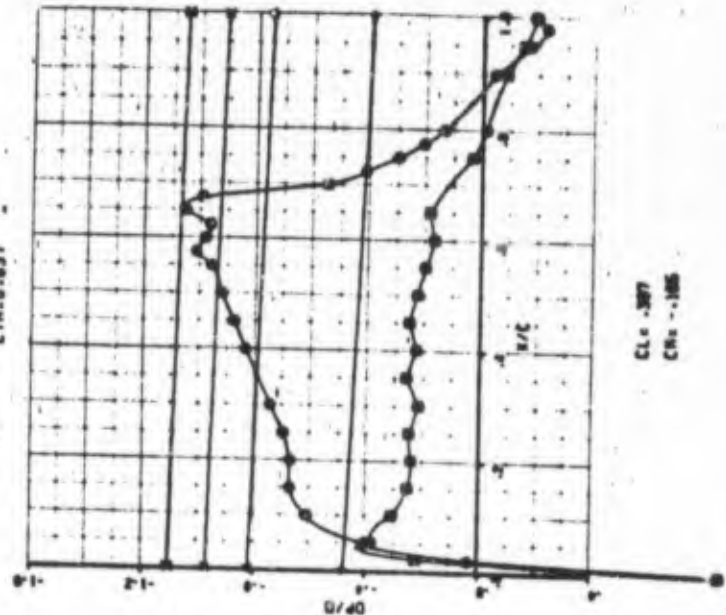
CL= .388  
 CR= -.477

ETR=0.299



CL= .381  
 CR= -.327

ETR=0.837



CL= .387  
 CR= -.185

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 547  
 RUN NO 2A3  
 MACH NO .844

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

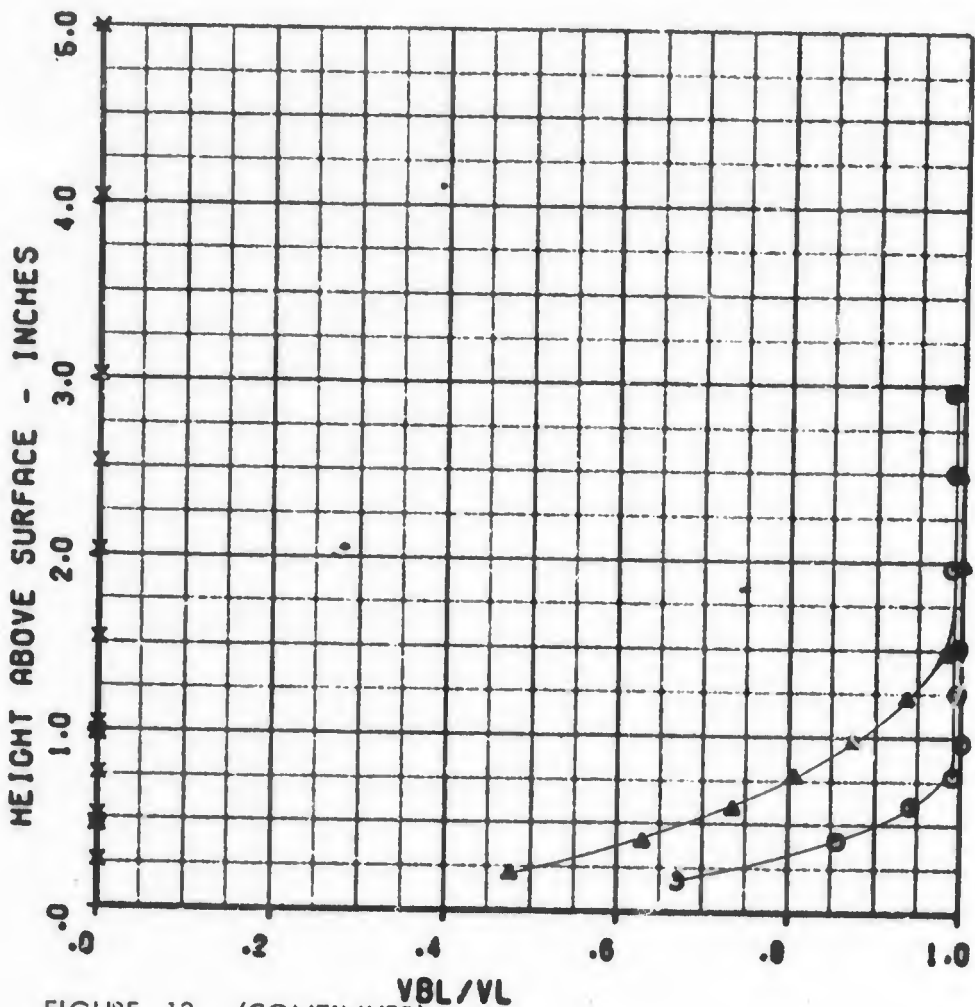


FIGURE 13 (CONTINUED)  
 (e) CORRECTED ALPHA = 1.35

LOCKHEED C-141R

PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN NO 283  
 MACH NO .844

0  
 ALPHA  
 TRN

2.43 PSI  
 .87 DEG  
 -42.8 DEG C

ETA=0.193

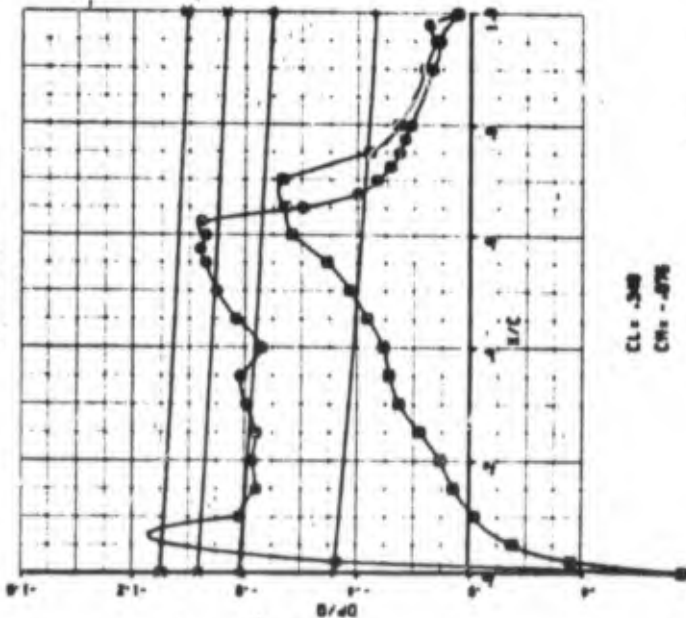
ALTITUDE 27000. FT  
 WEIGHT 246500. LB  
 NZ 1.35

CS 27.05 2 MAC  
 RIL-ERON POS -.60 DEG  
 FLAP POS 0.00 DEG

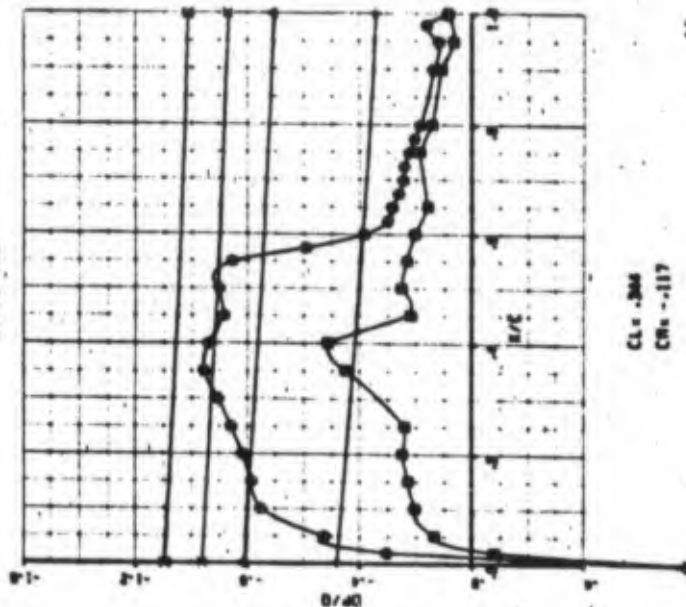
ETA=0.209

O UPPER SURFACE  
 D LOWER SURFACE  
 + MACH LOCAL-1.0  
 A MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 Z MACH LOCAL-1.4

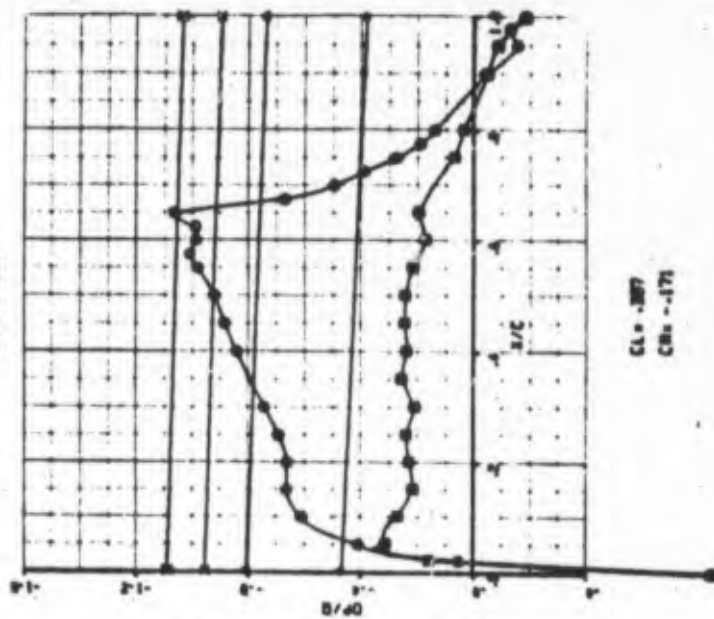
ETA=0.837



CL= .308  
 CR= -.476



CL= .304  
 CR= -.417



CL= .307  
 CR= -.477

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 2A2  
 MACH NO .840

## RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ⊗ 80 % (AFT)

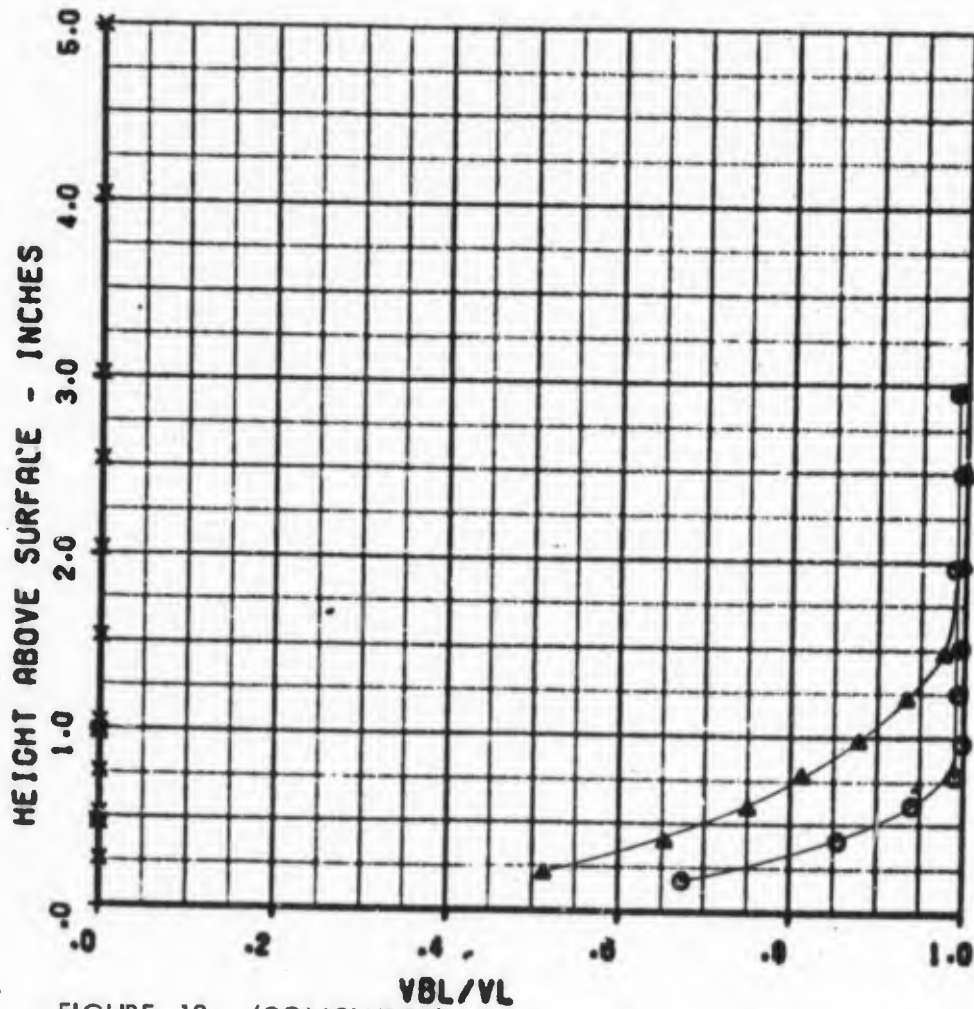


FIGURE 13 (CONCLUDED)  
 (f) CORRECTED ALPHA = 1.62

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN NO 242  
 MACH NO .940

0  
 ALPHA  
 TAN

2.49 PSI  
 1.25 DEG  
 -42.6 DEG C

ALTITUDE 20740. FT  
 HEIGHT 24000. LB  
 WZ 1.64

CO

27.95 Z MAC  
 AILERON POS 1.10 DEG  
 FLAP POS 0.00 DEG

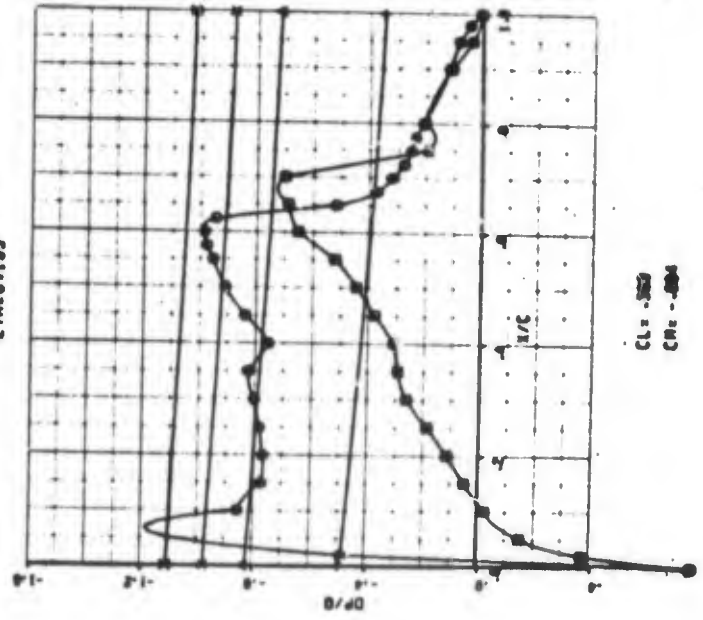
○ UPPER SURFACE  
 □ LOWER SURFACE  
 + MACH LOCAL-1.0

▲ MACH LOCAL-1.2  
 × MACH LOCAL-1.3  
 ⊞ MACH LOCAL-1.4

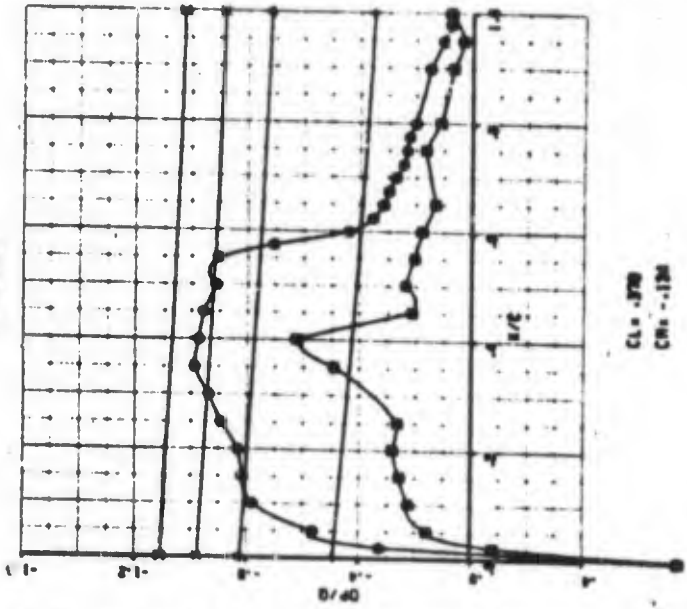
ETA=0.193

ETA=0.309

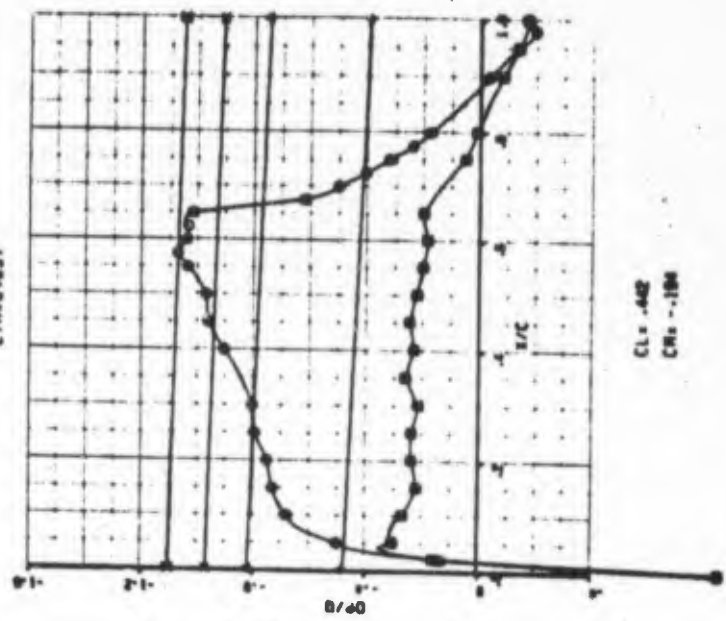
ETA=0.837



CLx = .359  
 CMx = -.084



CLx = .379  
 CMx = -.134



CLx = .442  
 CMx = -.194

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 647  
 RUN NO 3A5  
 MACH NO .690

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

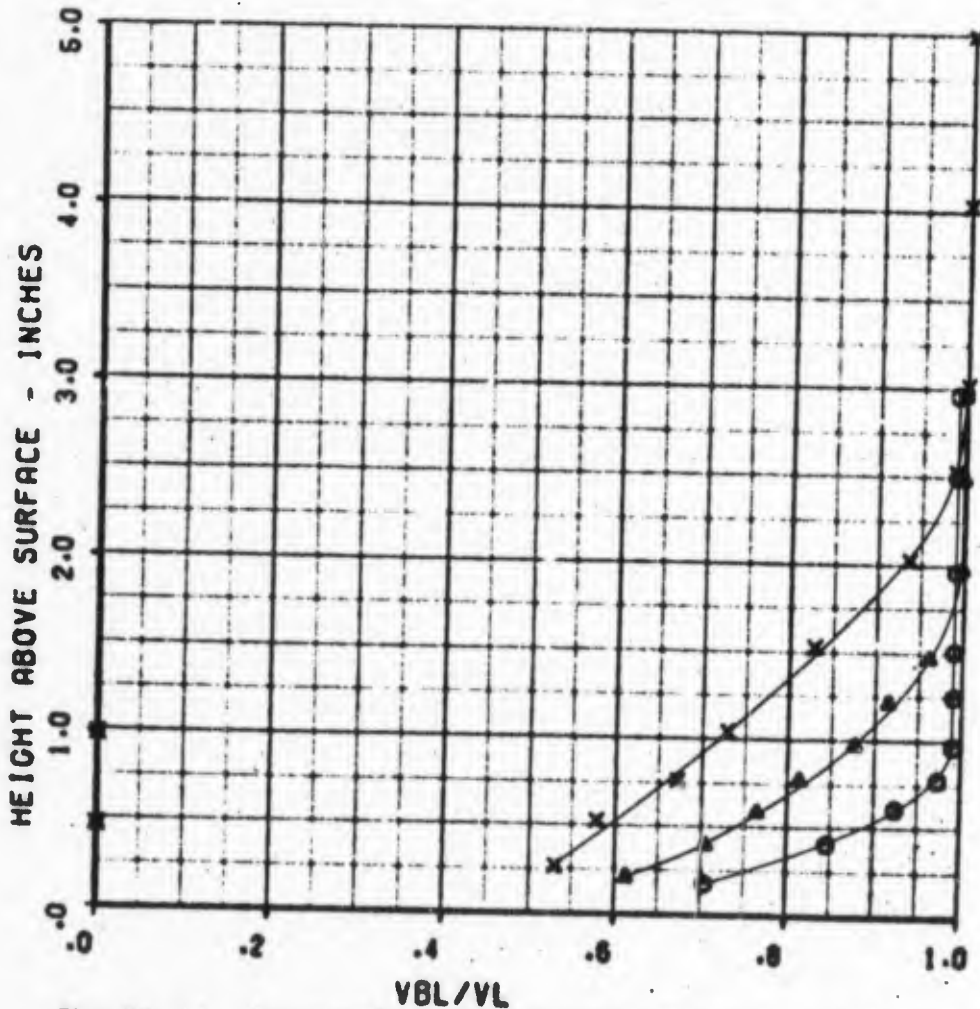


FIGURE 14 BOUNDARY LAYER VELOCITY PROFILES AND PRESSURE DISTRIBUTIONS  
 MACH .690 TO .702  
 (a) CORRECTED ALPHA = -2.40

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN NO 345  
 MACH NO .680

0  
 ALPHA  
 TRN

.91 PSI  
 -3.29 DEG  
 -52.0 DEG C

ETA:0.193

ALTITUDE 30010. FT  
 WEIGHT 239950. LB  
 NZ 0.00

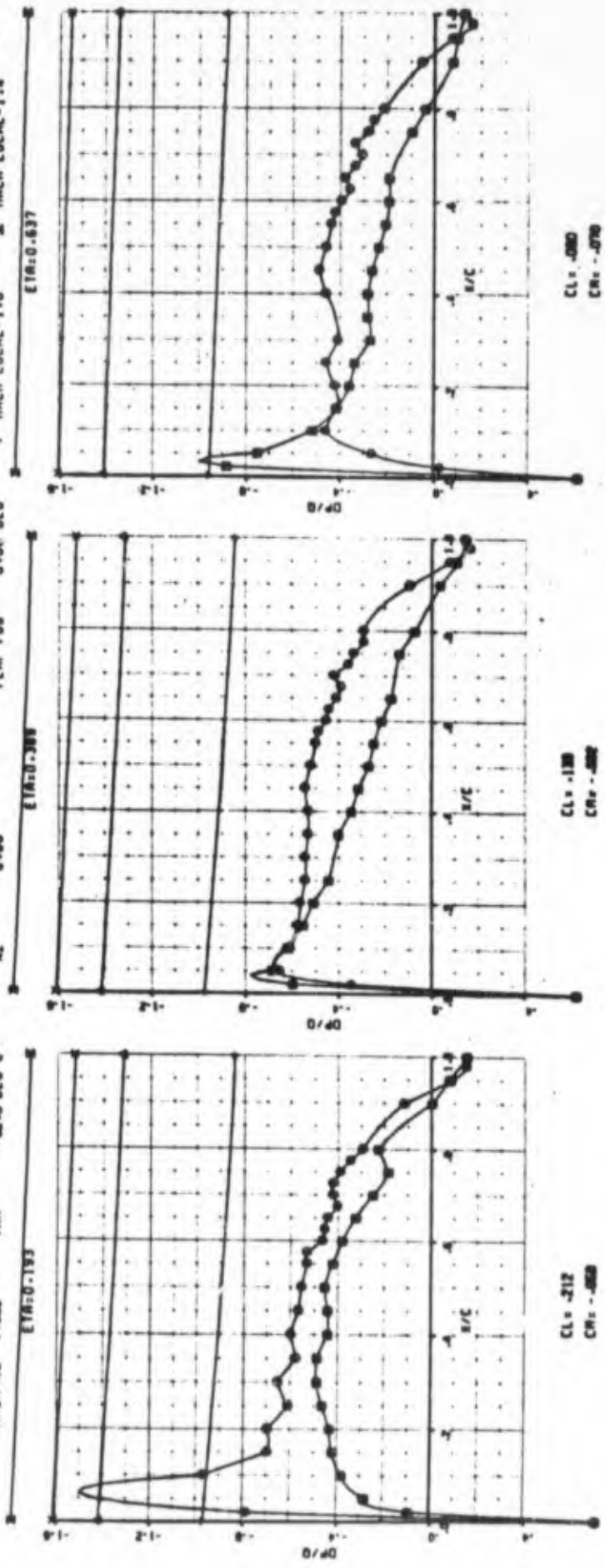
CO 27.45 Z MAC  
 AILERON POS .51 DEG  
 FLAP POS 0.00 DEG

ETA:0.388

UPPER SURFACE  
 LOWER SURFACE

▲ MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 ✕ MACH LOCAL-1.4

ETA:0.637



CL: -212  
 CR: -500

CL: -138  
 CR: -500

CL: -280  
 CR: -570

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 3A4  
 MACH NO .695

## RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✖ 80 % (AFT)

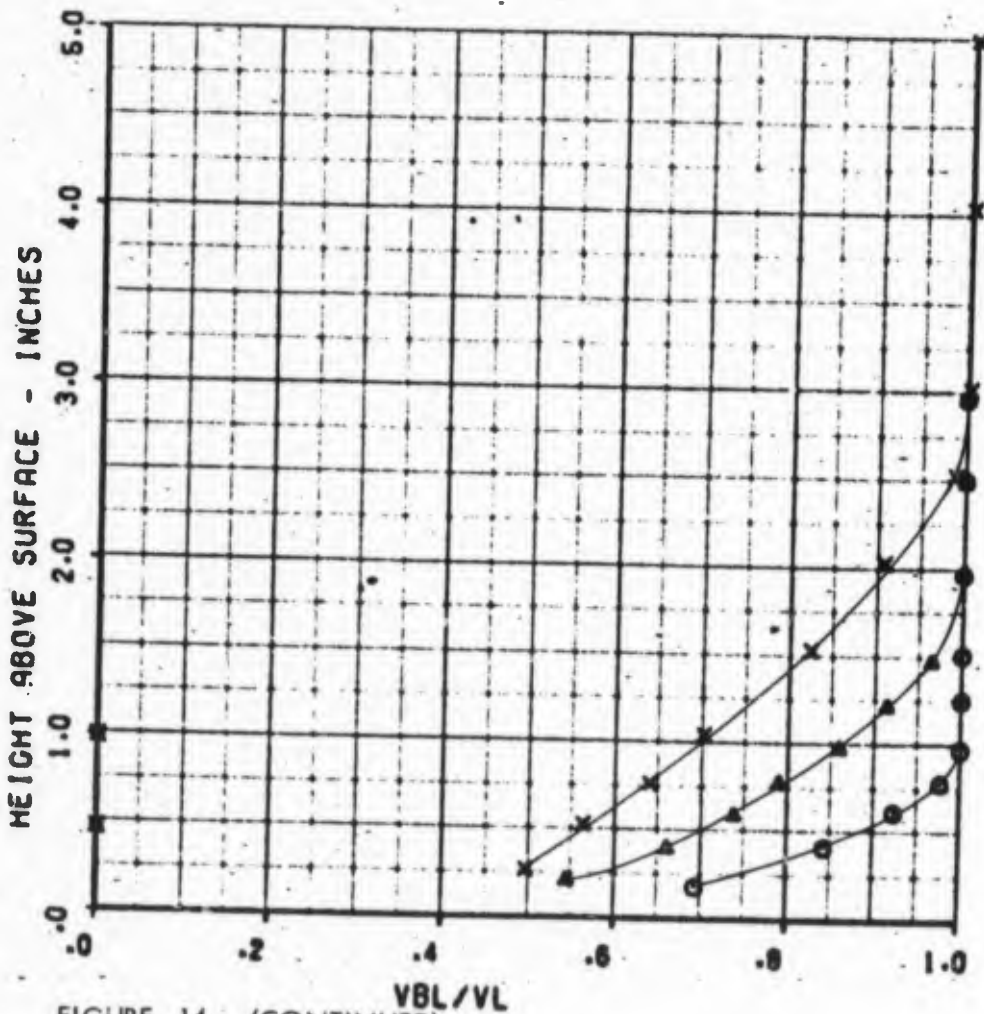


FIGURE 14 (CONTINUED)  
 (b) CORRECTED ALPHA = -1.90

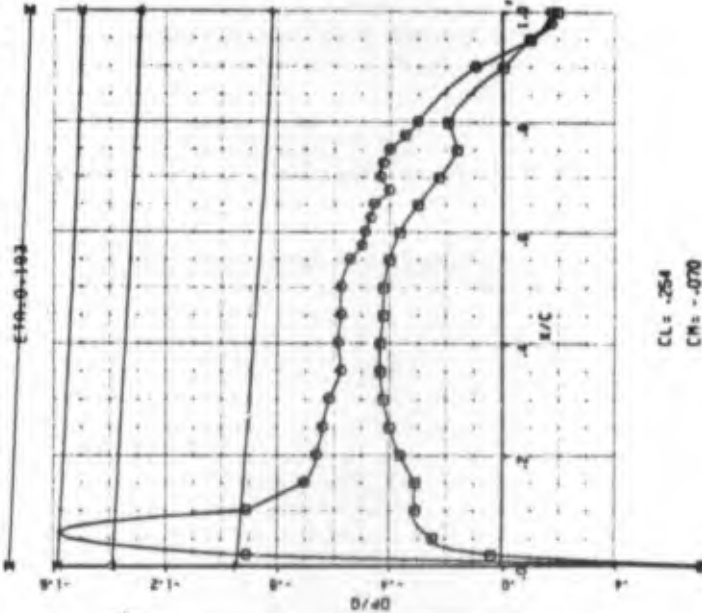
LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN NO 314  
 MACH NO .685

G  
 ALPHA  
 TDM

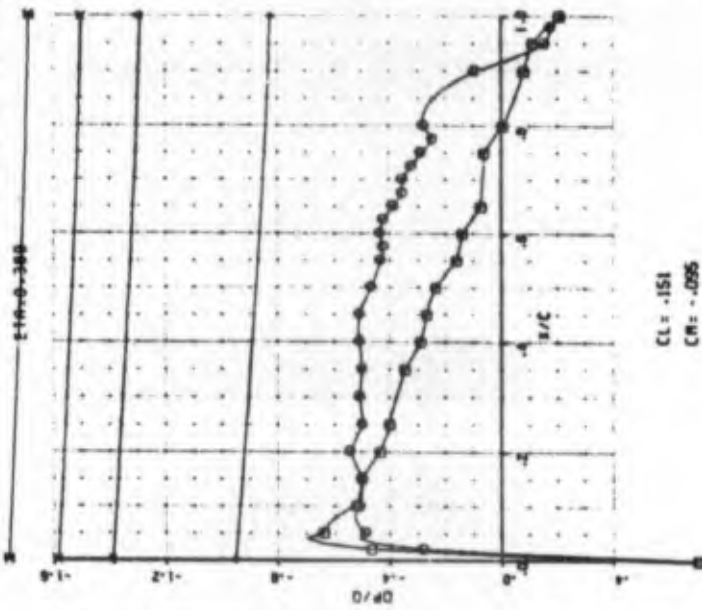
-91 PSI  
 -2.71 DEG  
 -52.5 DEG C



CL = .254  
 CM = -.070

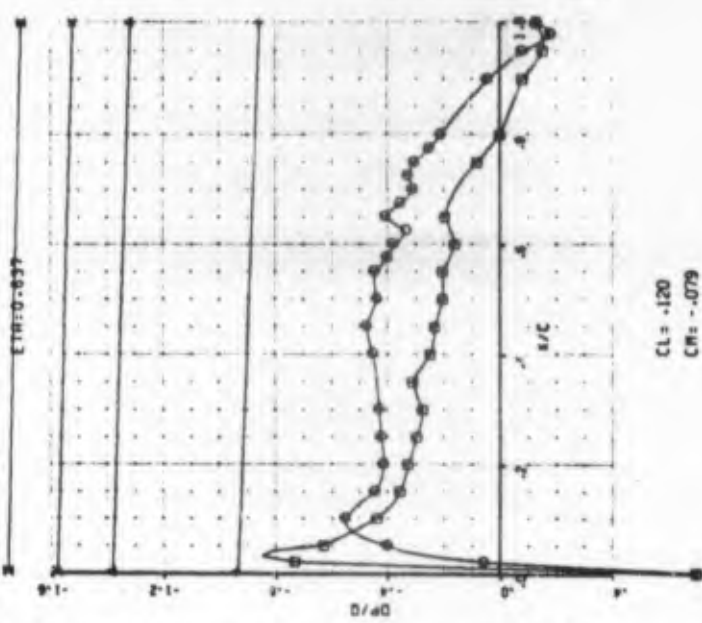
ALTITUDE 40000. FT  
 WEIGHT 240000. LB  
 NZ .09

CO 27.46 Z MAC  
 AILERON POS .43 DEG  
 FLAP POS 0.00 DEG



CL = .151  
 CM = -.085

UPPER SURFACE  
 LOWER SURFACE  
 MACH LOCAL-1.0  
 MACH LOCAL-1.2  
 MACH LOCAL-1.3  
 MACH LOCAL-1.4



CL = .120  
 CM = -.079

# LOCKHEED C-141A

## BOUNDARY-LAYER-RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 3A1  
 MACH NO .700

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

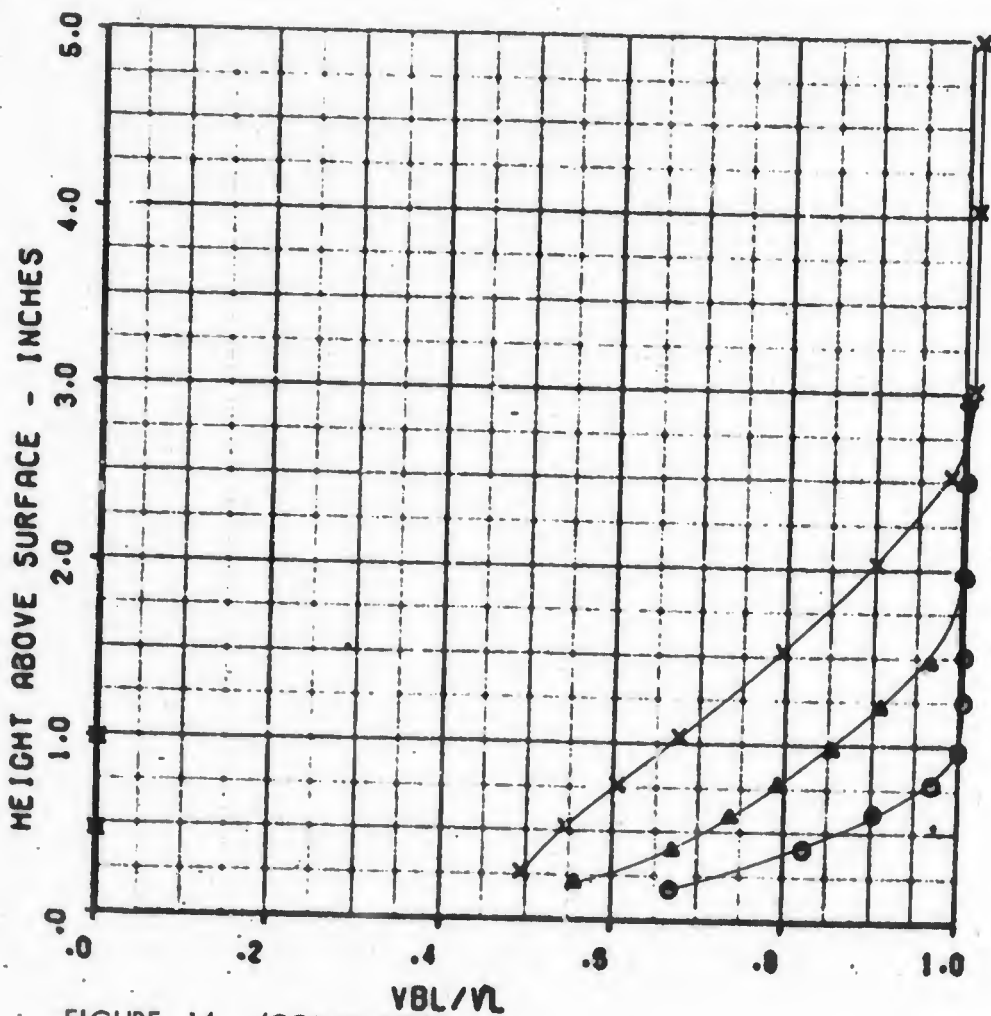


FIGURE 14 (CONTINUED)  
 (c) CORRECTED ALPHA = -0.87

LOCKHEED C-141A

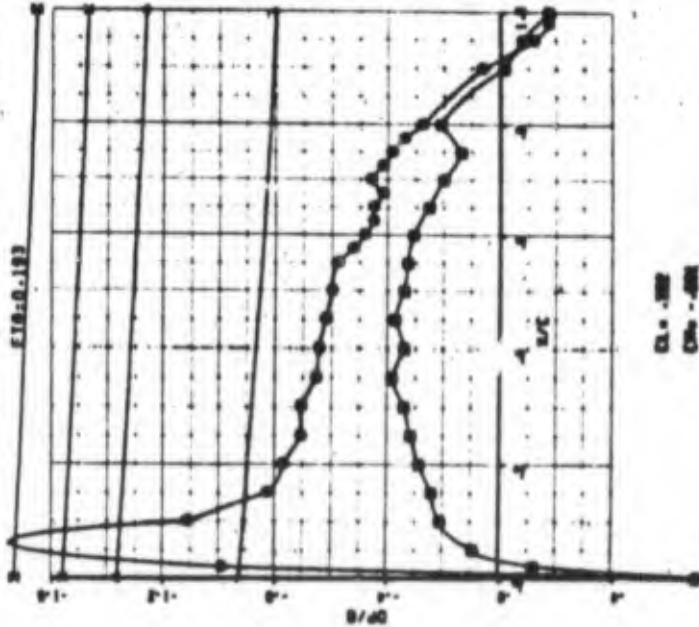
PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN NO 381  
 MACH NO .700

0  
 ALPHA  
 TAP

.82 PSI  
 -1.56 DEG  
 -51.8 DEG C

E18-0.183



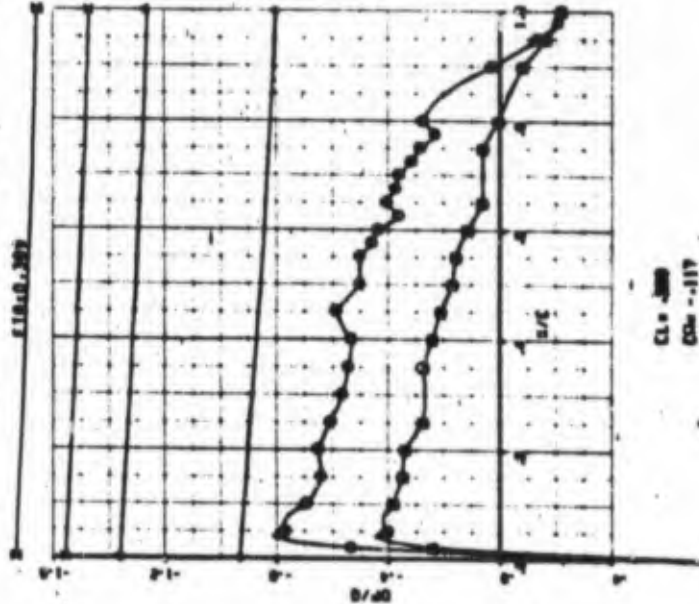
CL = .382  
 CM = .081

ALTITUDE 40000 FT  
 WEIGHT 240100 LB  
 NZ .30

C0

27.47 % MAC  
 AILERON POS .34 DEG  
 FLAP POS 0.00 DEG

E18-0.209

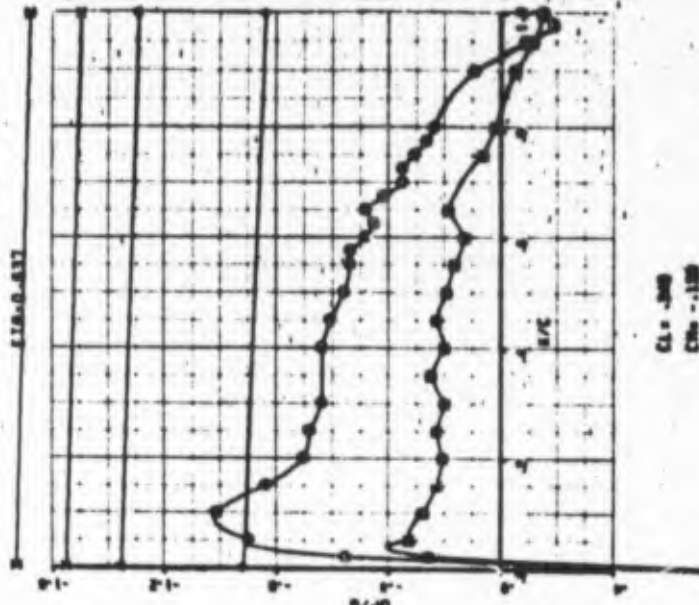


CL = .380  
 CM = .117

U UPPER SURFACE  
 L LOWER SURFACE

A MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 Z MACH LOCAL-1.4

E18-0.837



CL = .380  
 CM = .120

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 547  
 RUN NO 3A3.2  
 MACH NO .700

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

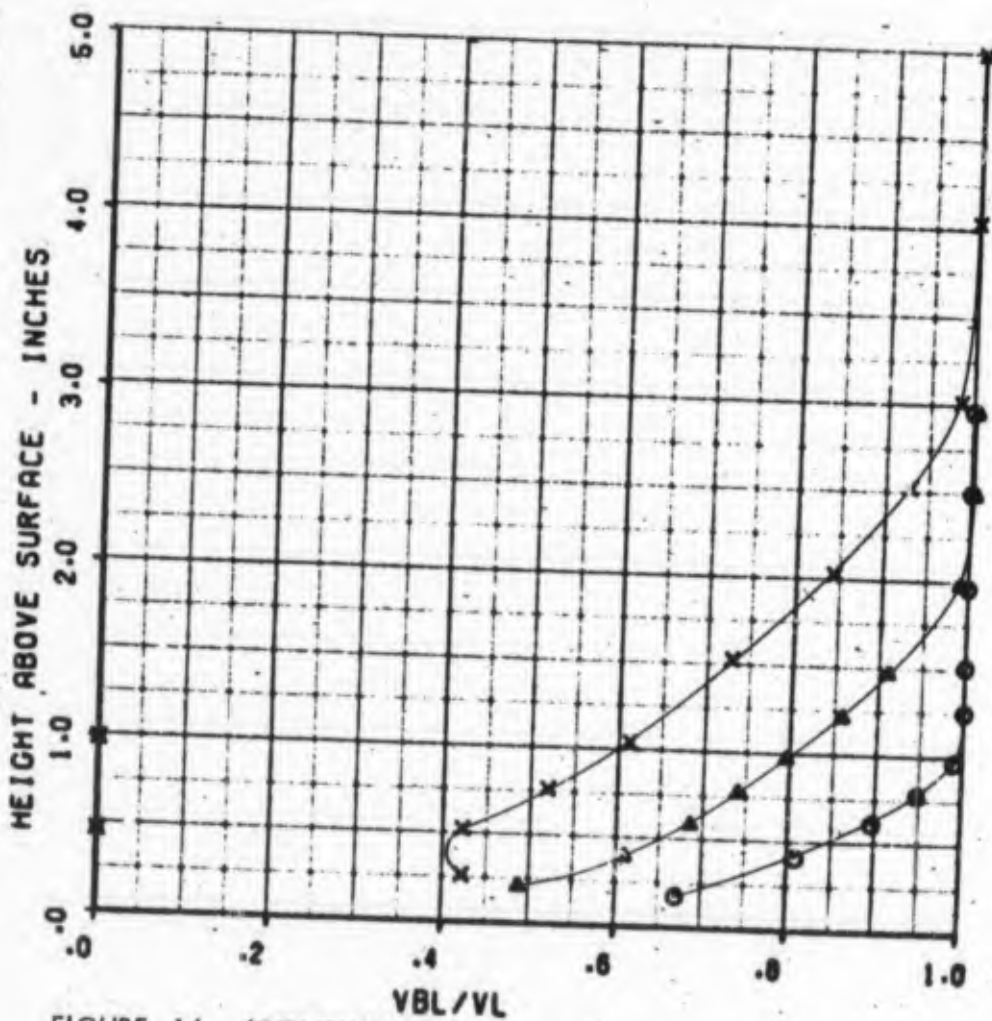
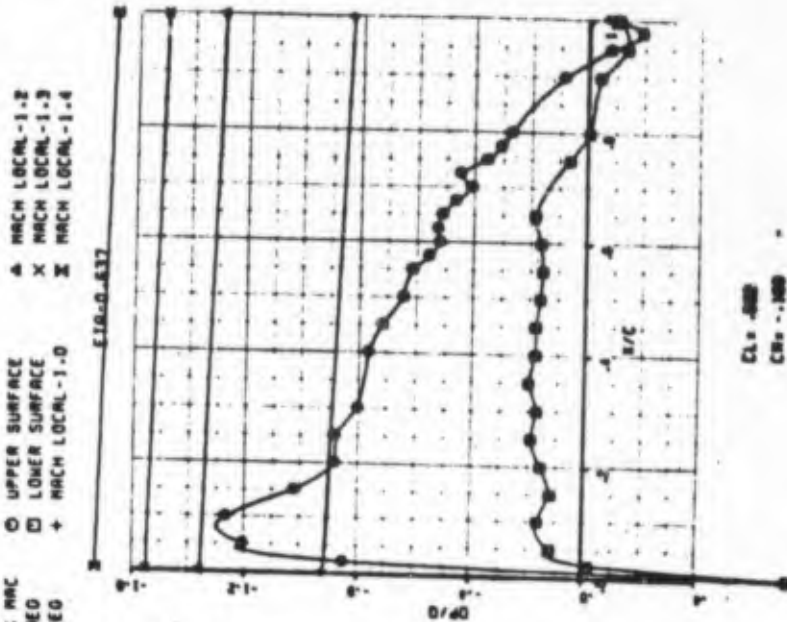
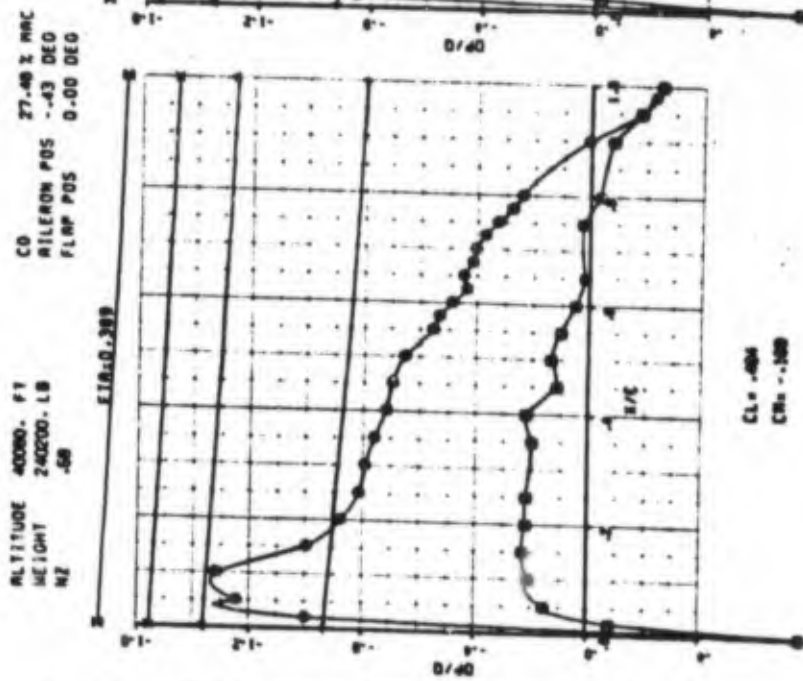
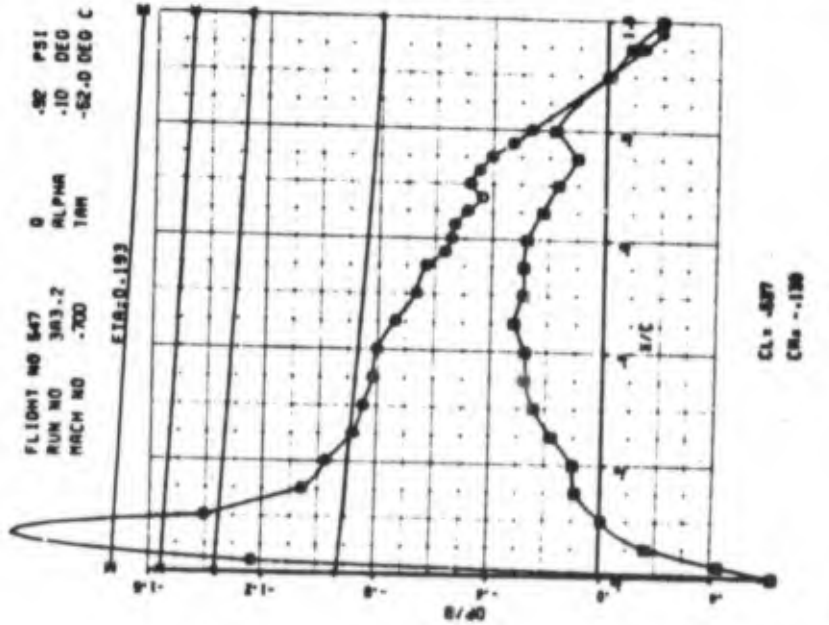


FIGURE 14 (CONTINUED)  
 (d) CORRECTED ALPHA = 0.57

# LOCKHEED C-141A PRESSURE DISTRIBUTION



# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 547  
 RUN NO 3A2  
 MACH NO .702

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 X 80 %  
 \* 80 % (AFT)

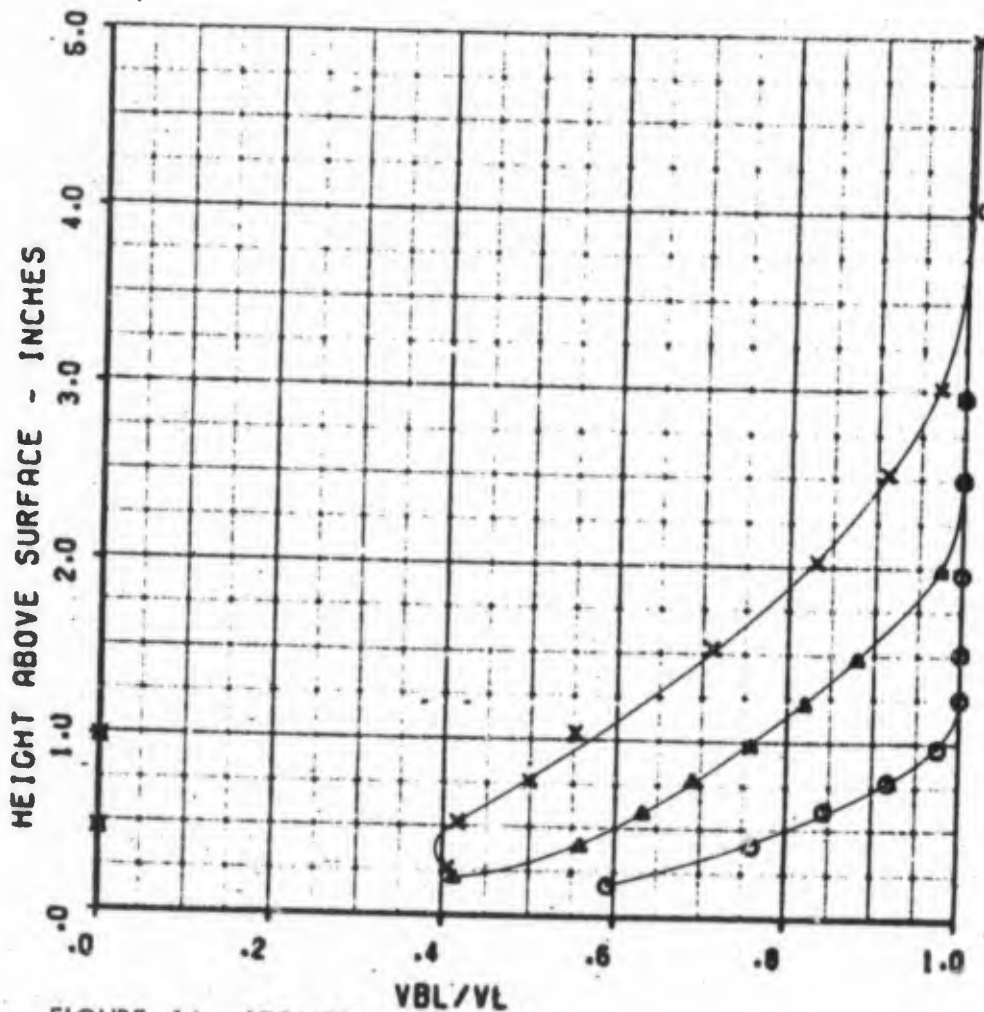


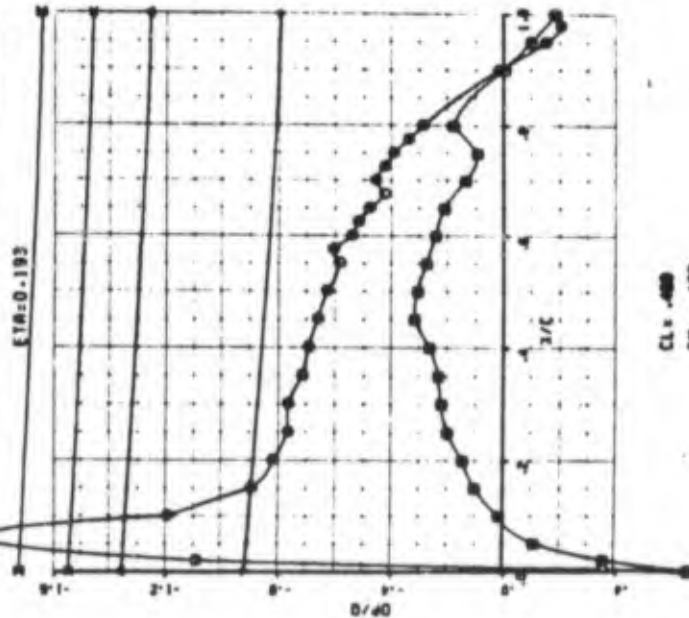
FIGURE 14 (CONTINUED)  
 (e) CORRECTED ALPHA = 1.17

LOCKHEED C-141A  
PRESSURE DISTRIBUTION

FLIGHT NO 547  
RUN NO 3A2  
MACH NO .702

Q  
ALPHA  
TAN

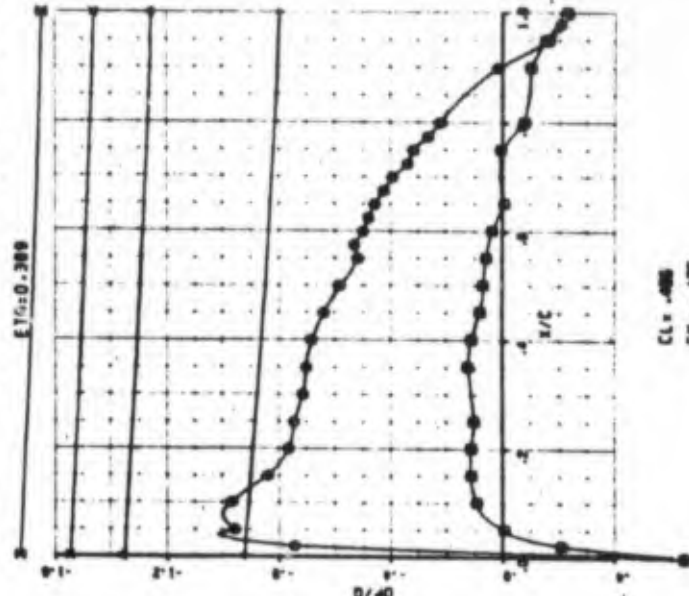
-93 PSI  
-77 DEG  
-52.8 DEG C



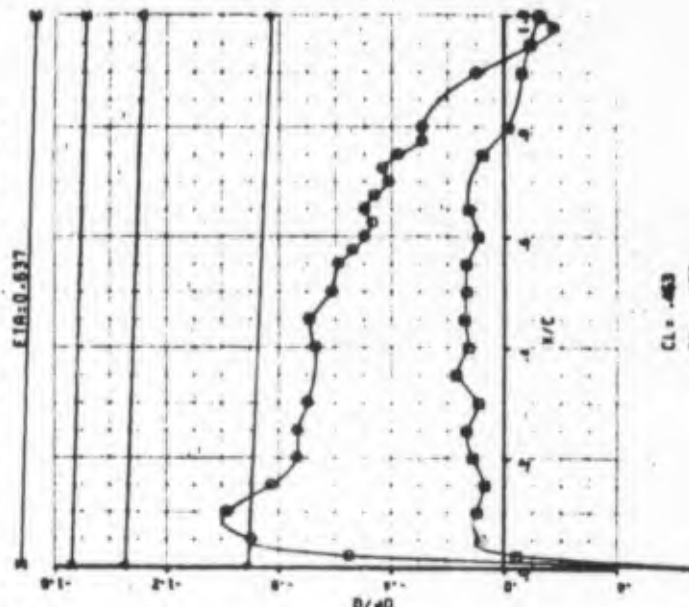
ALTITUDE 40000. FT  
WEIGHT 240300. LB  
MZ .71

CO

27.50 2 MAC  
AILERON POS -.09 DEG  
FLAP POS 0.00 DEG



O UPPER SURFACE  
□ LOWER SURFACE  
+ MACH LOCAL -1.0  
A MACH LOCAL -1.2  
X MACH LOCAL -1.3  
Z MACH LOCAL -1.4



# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 3A3.1  
 MACH NO .700

## RAKE LOCATIONS

○ 30 %  
 △ 55 %  
 × 80 %  
 \* 80 % (AFT)

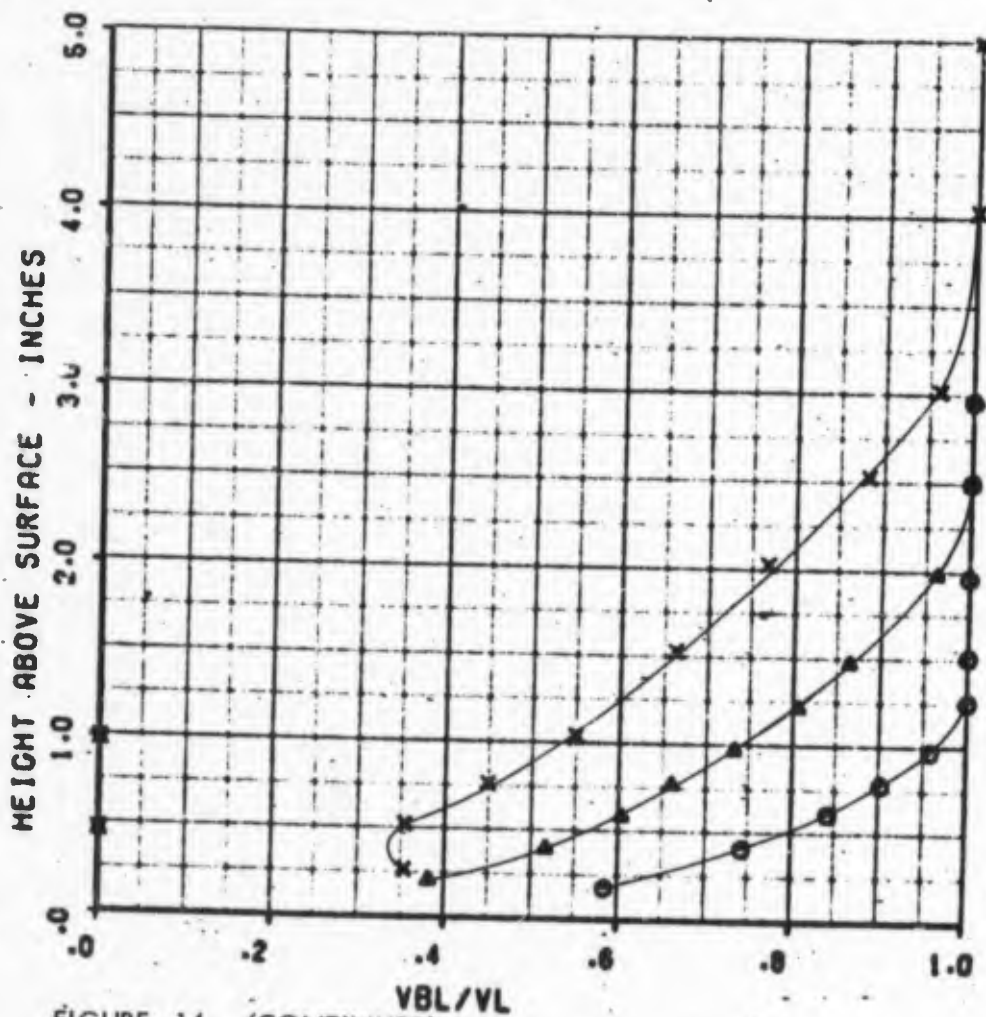


FIGURE 14. (CONTINUED)  
 (f) CORRECTED ALPHA = 1.93

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN NO 303.1  
 MACH NO .700

0  
 ALPHA  
 TAN

.52 PSI  
 1.64 DEG  
 -51.0 DEG C

EIR=0.183

ALTITUDE 40100. FT  
 WEIGHT 240900. LB  
 WZ .86

CO  
 AILERON PDS  
 FLAP PDS

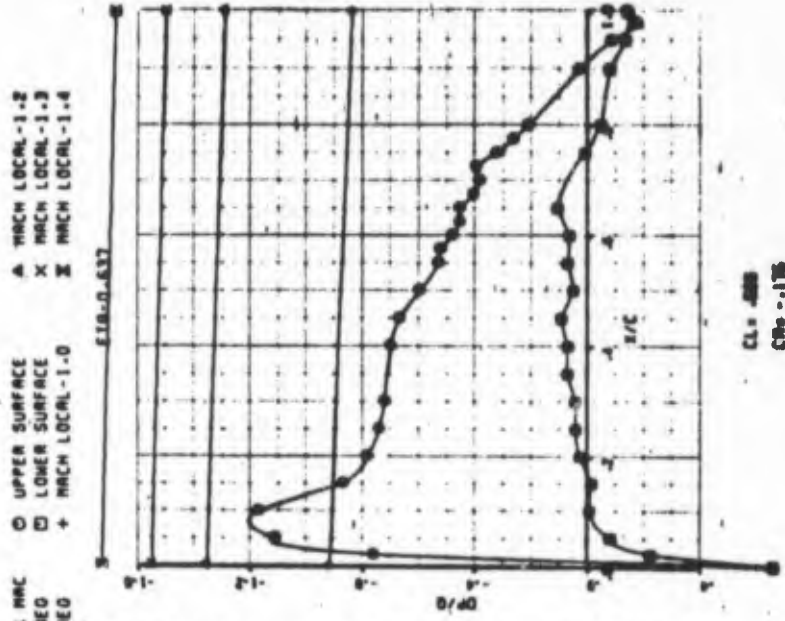
27.54 X MRC  
 -1.36 DEG  
 0.00 DEG

EIR=0.389

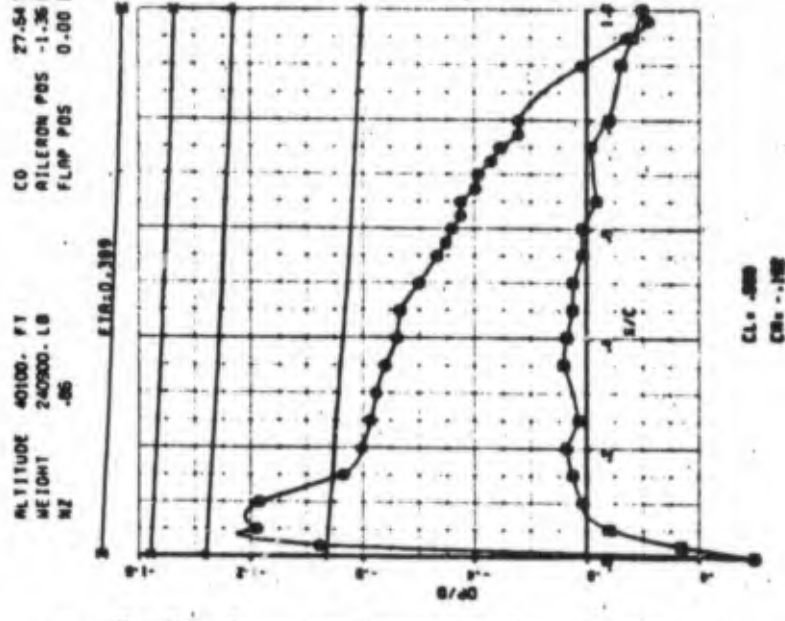
UPPER SURFACE  
 LOWER SURFACE  
 MACH LOCAL-1.0

A MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 Z MACH LOCAL-1.4

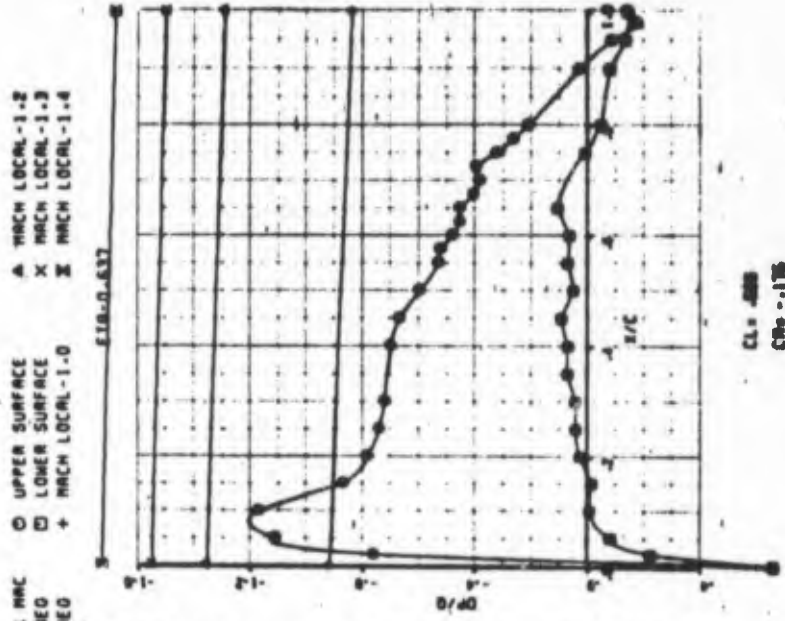
EIR=0.637



CLs = .000  
 CRs = -.134



CLs = .000  
 CRs = -.182



CLs = .000  
 CRs = -.176

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 3A  
 MACH NO .700

## RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

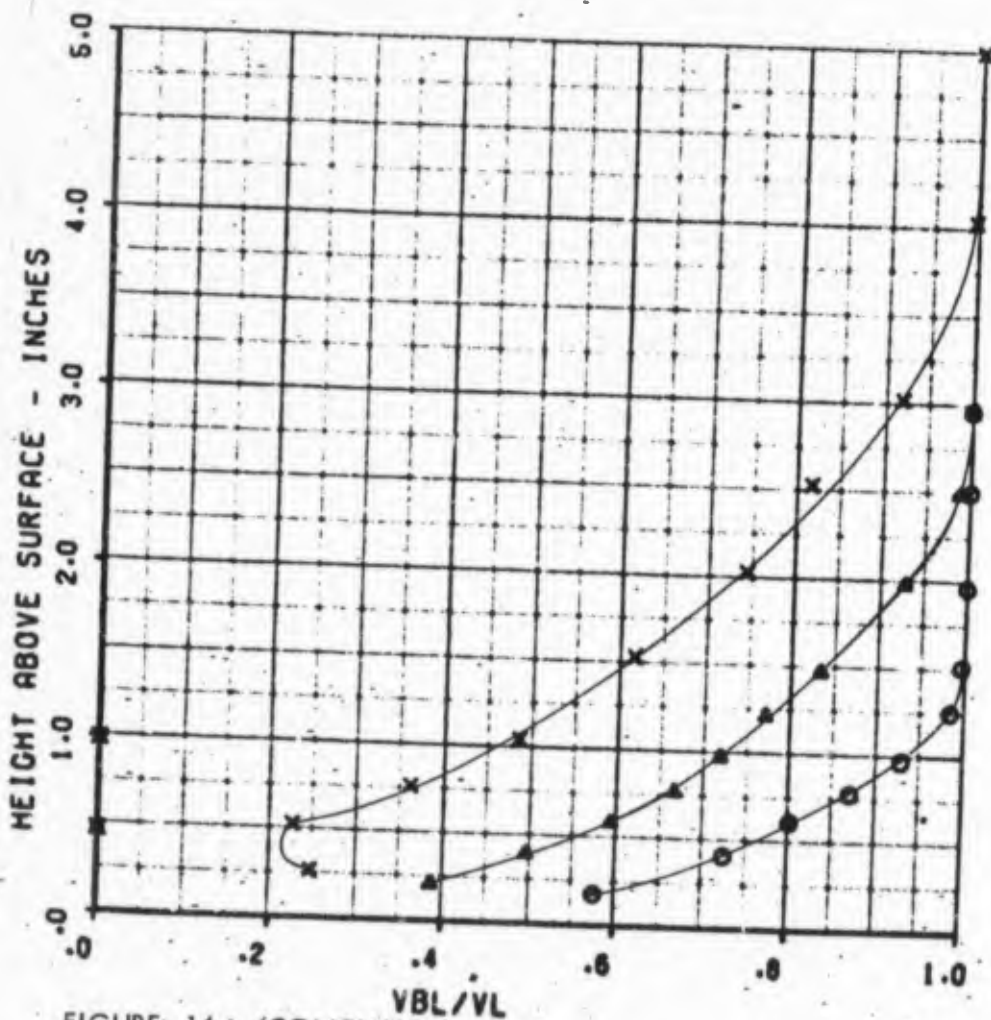


FIGURE 14 (CONCLUDED)  
 (g) CORRECTED ALPHA = 2.63

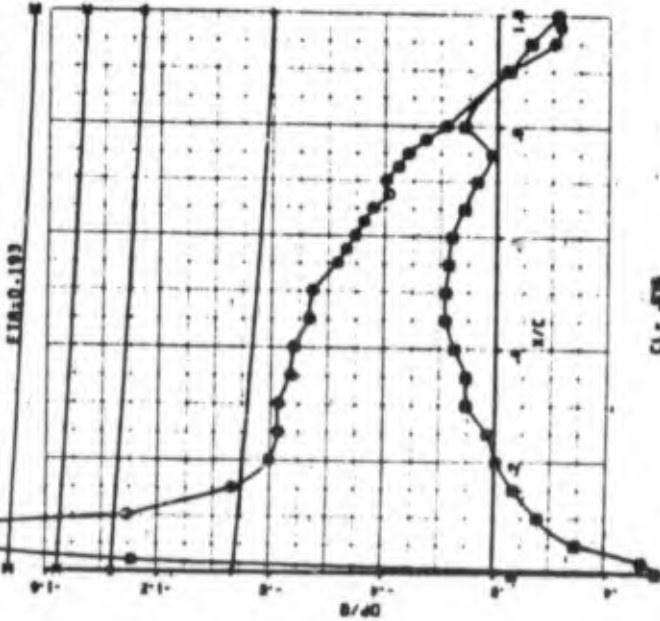
LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 647  
 RUN NO 3A  
 MACH NO .700

Q -82 PSI  
 ALPHA 2.42 DEG  
 TAN -51.6 DEG C

E18:0.193



CL = .878  
 CM = -.104

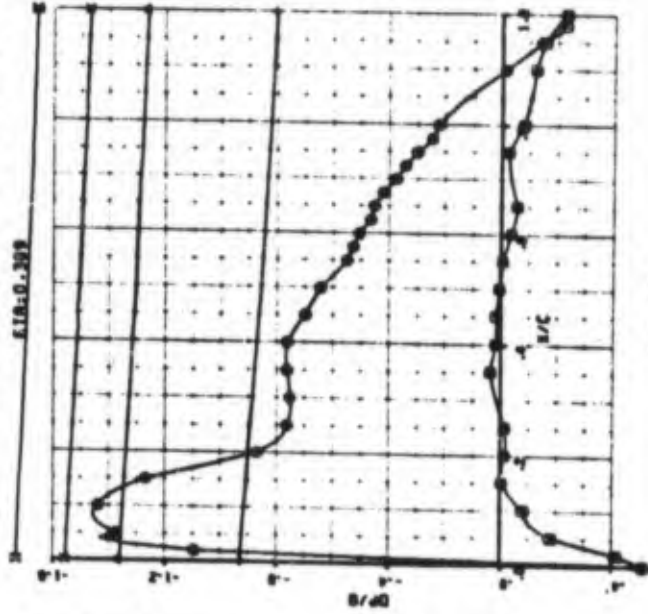
ALTITUDE 40120. FT  
 WEIGHT 240500. LB  
 NZ .99

CO  
 AILERON POS .43 DEG  
 FLAP POS 0.00 DEG

O UPPER SURFACE  
 □ LOWER SURFACE  
 + MACH LOCAL-1.0

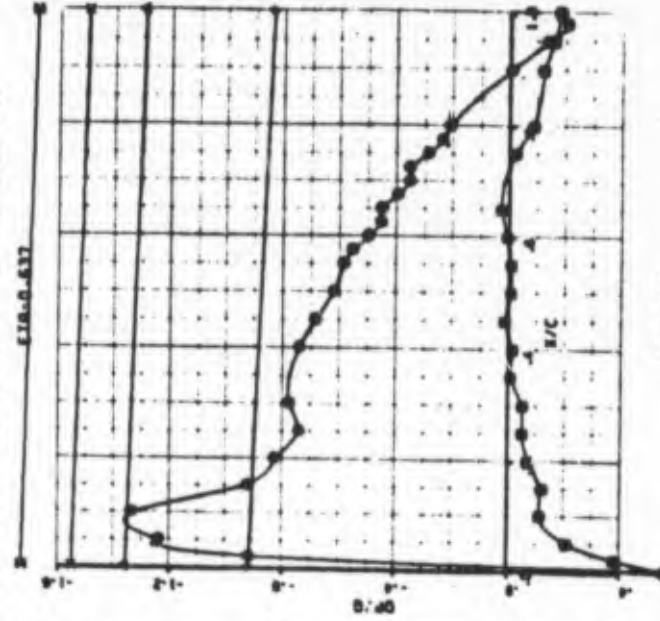
△ MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 Z MACH LOCAL-1.4

E18:0.399



CL = .881  
 CM = -.209

E18:0.437



CL = .888  
 CM = -.205

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 547  
 RUN NO 385  
 MACH NO .751

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✖ 80 % (AFT)

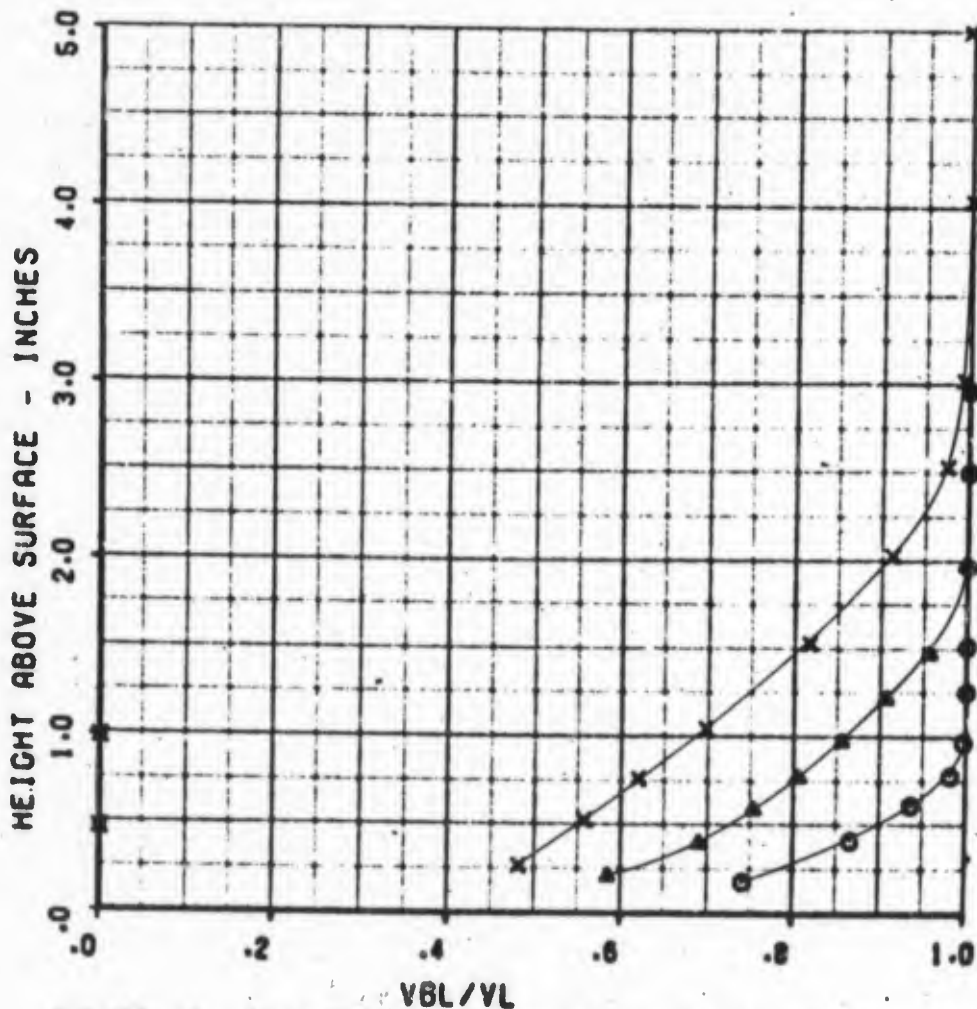


FIGURE 15 BOUNDARY LAYER VELOCITY PROFILES AND PRESSURE DISTRIBUTIONS MACH .748 TO .754

(a) CORRECTED ALPHA = -2.40

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN NO 385  
 MACH NO .751

0  
 ALPHA  
 TAP

1.15 PSI  
 -3.22 DEG  
 -53.4 DEG C

ETA=0.193

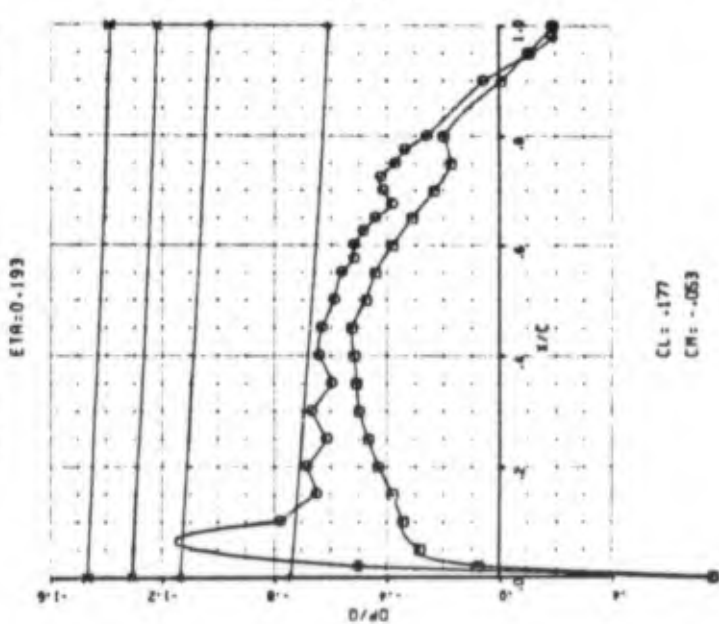
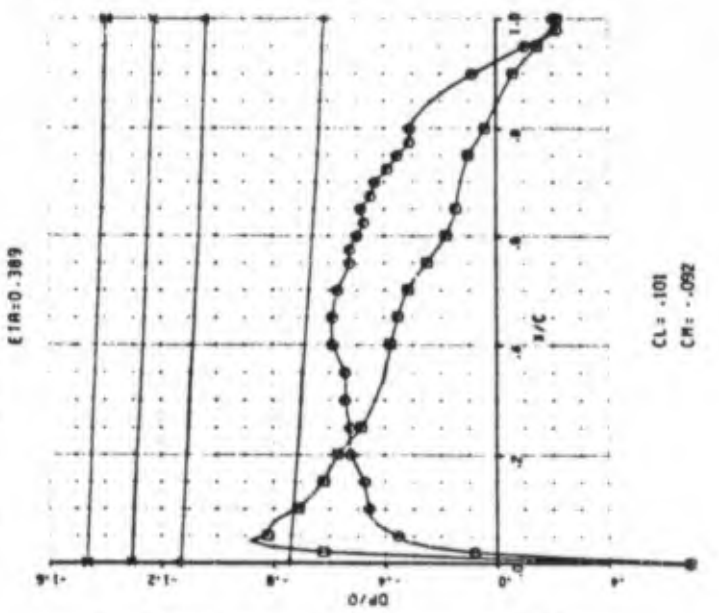
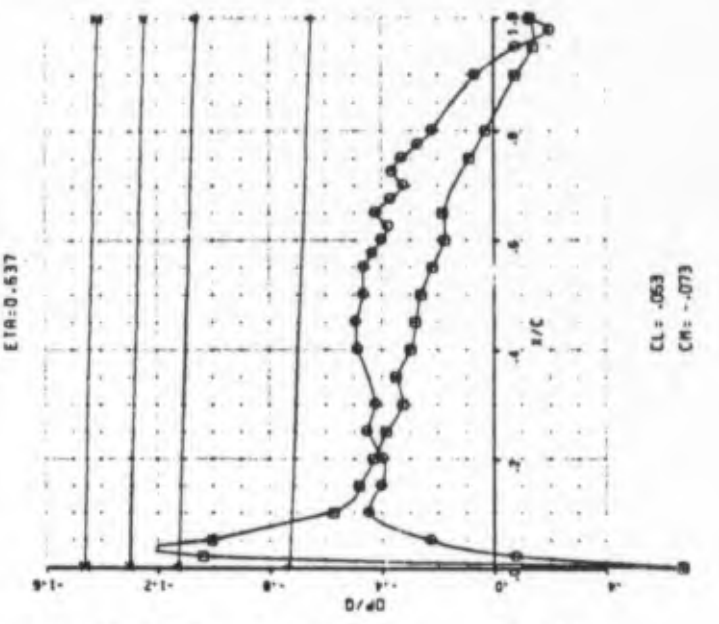
ALTITUDE 30500. FT  
 WEIGHT 236700. LB  
 NZ 0.00

CO  
 AILSRON POS  
 FLAP POS

27.27 % MAC  
 -1.45 DEG  
 0.00 DEG

O UPPER SURFACE  
 □ LOWER SURFACE  
 + MACH LOCAL-1.0

△ MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 Σ MACH LOCAL-1.4



# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 384  
 MACH NO .750

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✖ 80 % (AFT)

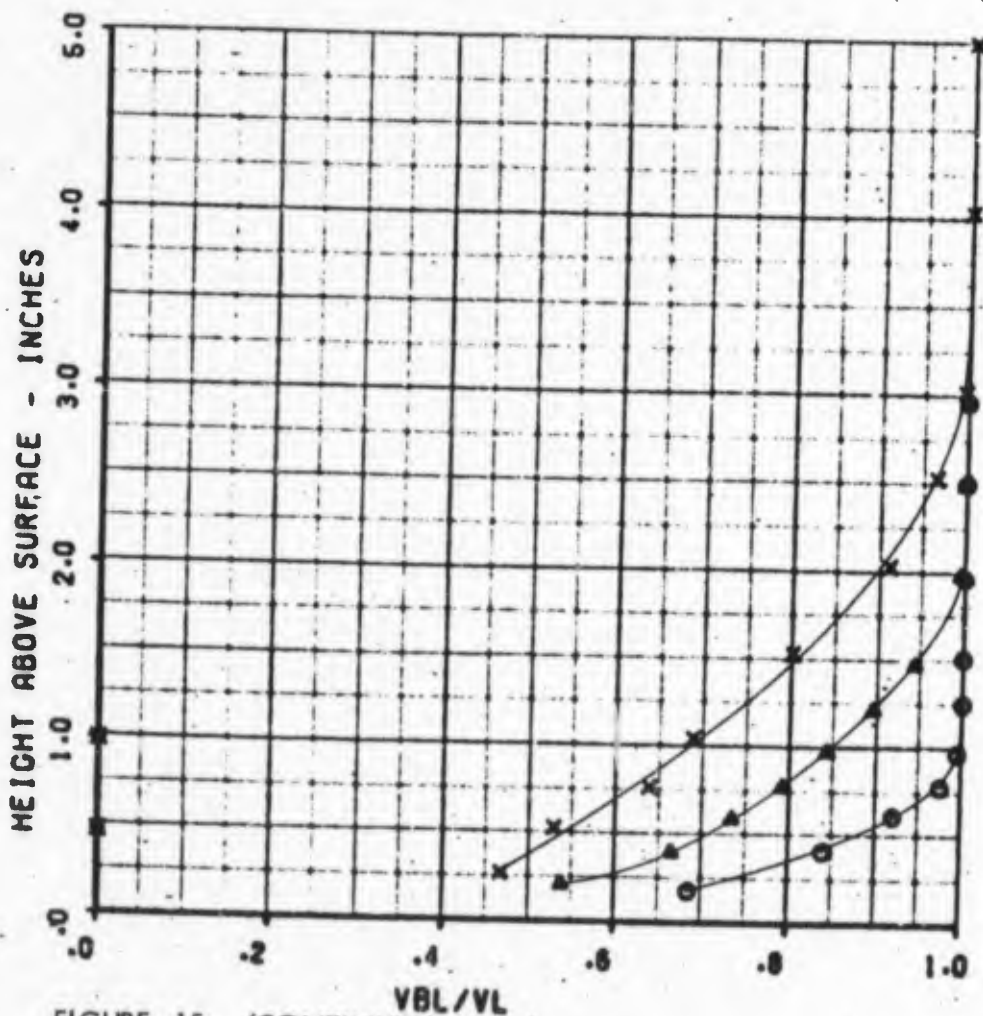


FIGURE 15 (CONTINUED)  
 (b) CORRECTED ALPHA = -1.64

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN NO 384  
 MACH NO .750

B  
 1-23 P61  
 ALPHA  
 TMS

-2.42 DEG  
 -54.3 DEG C

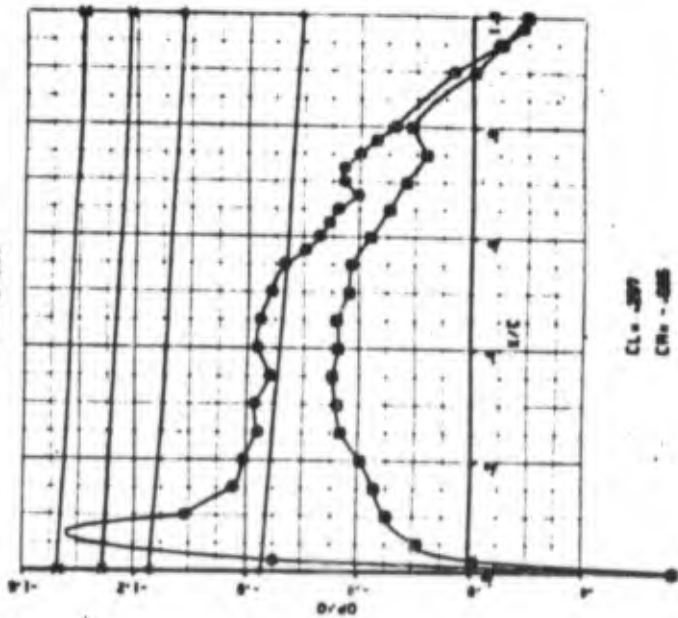
ALTITUDE 37000. FT  
 WEIGHT 23000. LB  
 NZ -.16

CO  
 AILERON POS  
 FLAP POS

27.32 Z RMC  
 .09 DEG  
 0.00 DEG

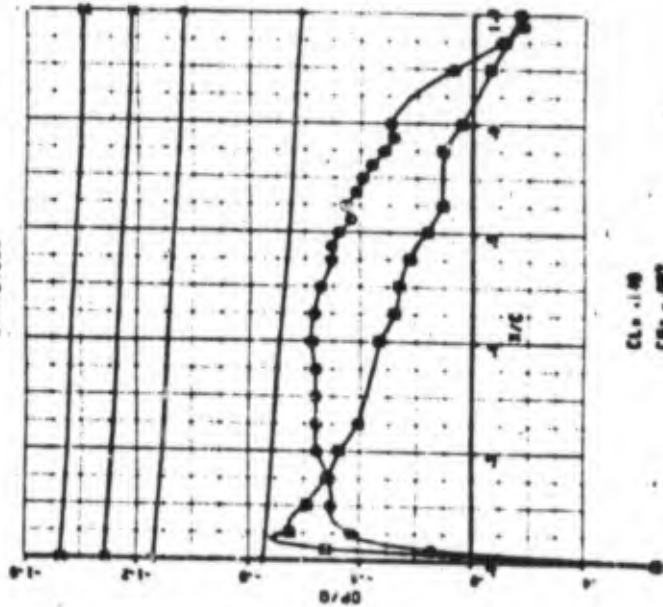
O UPPER SURFACE  
 □ LOWER SURFACE  
 + MACH LOCAL-1.0  
 △ MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 ⊗ MACH LOCAL-1.4

ETA=0.193



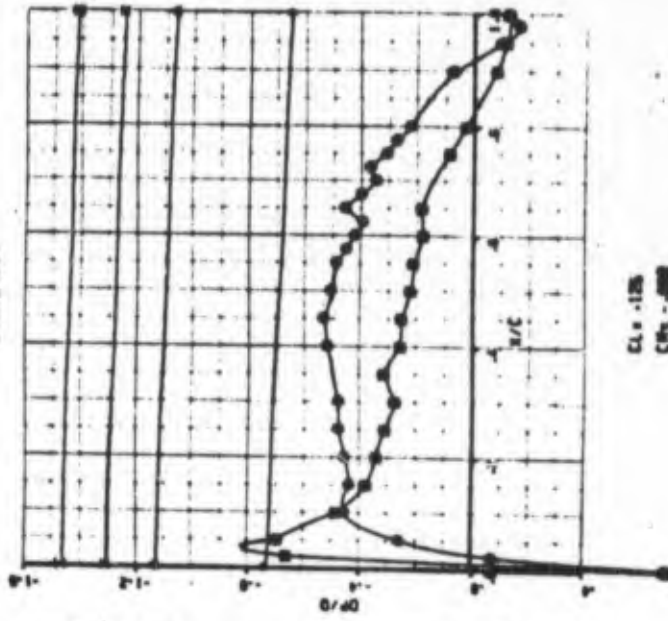
CLx = .097  
 CRx = -.005

ETA=0.209



CLx = .149  
 CRx = -.007

ETA=0.837



CLx = .125  
 CRx = -.008

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 381  
 MACH NO .748

## RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

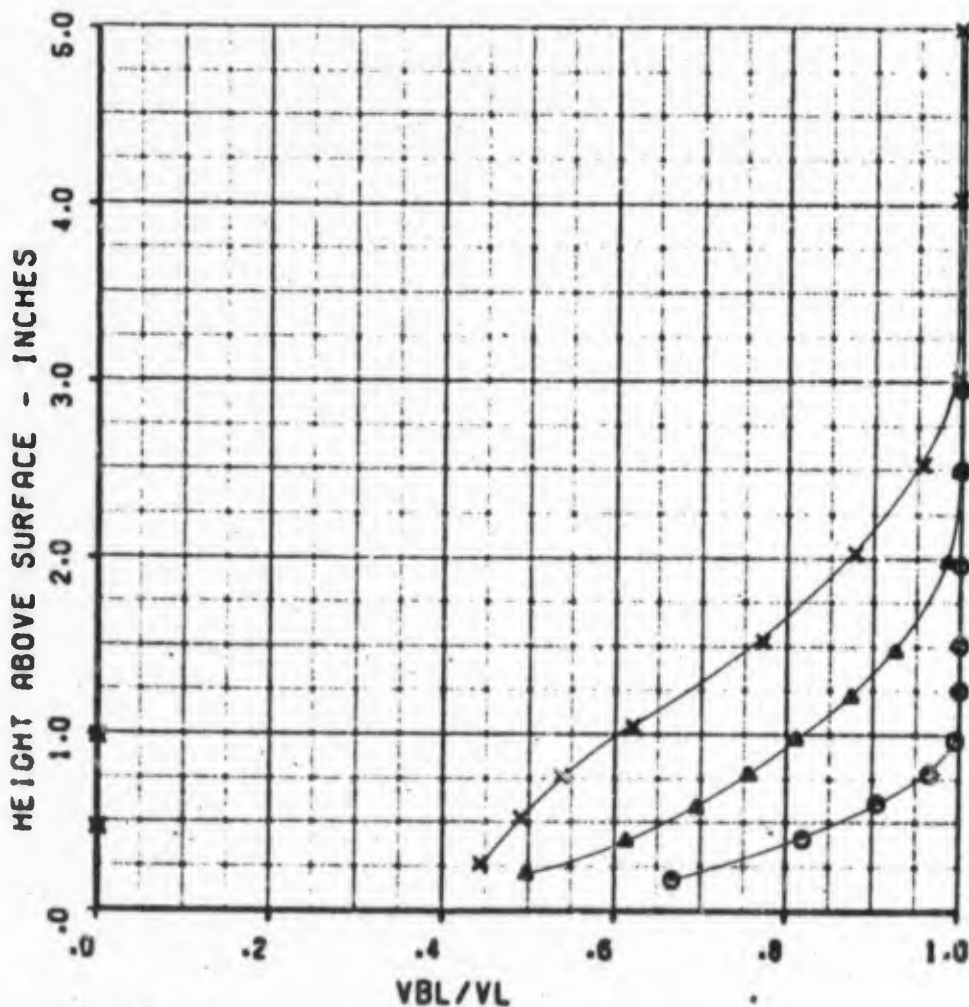


FIGURE 15 (CONTINUED)  
 (c) CORRECTED ALPHA = -0.97

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUCR NO 381  
 MACH NO .749

0  
 ALTITUDE 38000. FT  
 WEIGHT 236100. LB  
 NZ -.36

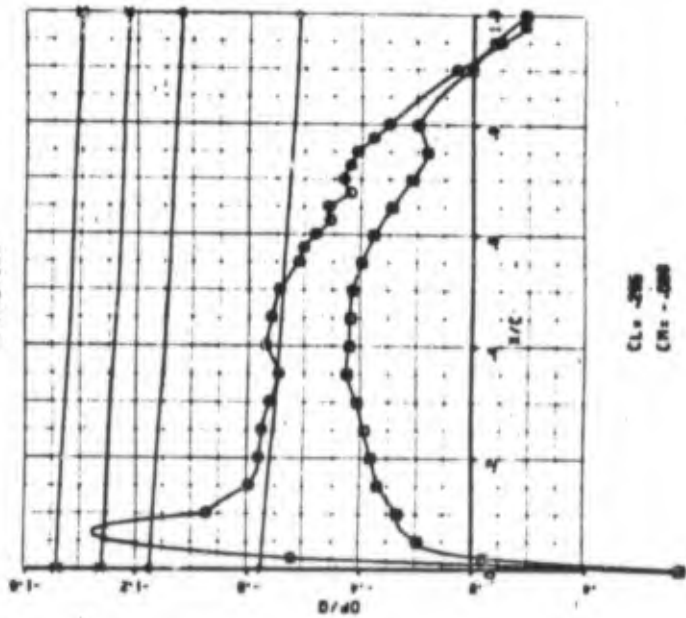
CO 27.33 Z MAC  
 AILERON POS -1.28 DEG  
 FLAP POS 0.00 DEG

0 UPPER SURFACE  
 O LOWER SURFACE  
 + MACH LOCAL-1.0  
 X MACH LOCAL-1.3  
 A MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 X MACH LOCAL-1.4

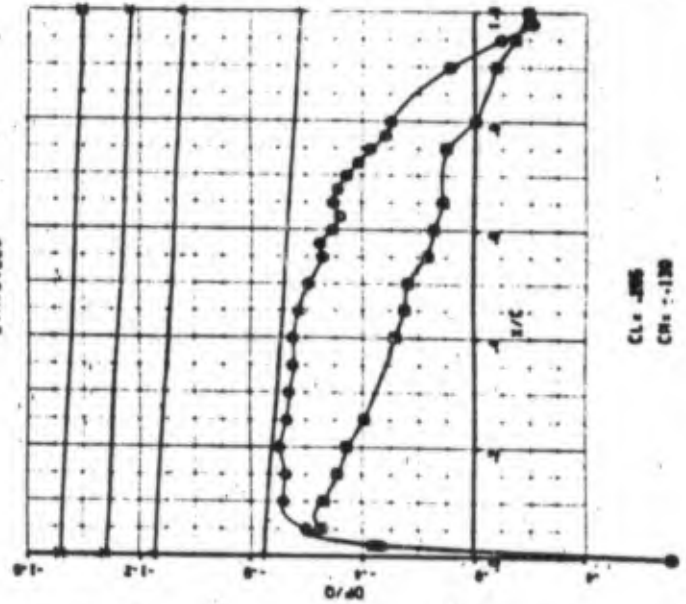
ETA=0.183

ETA=0.389

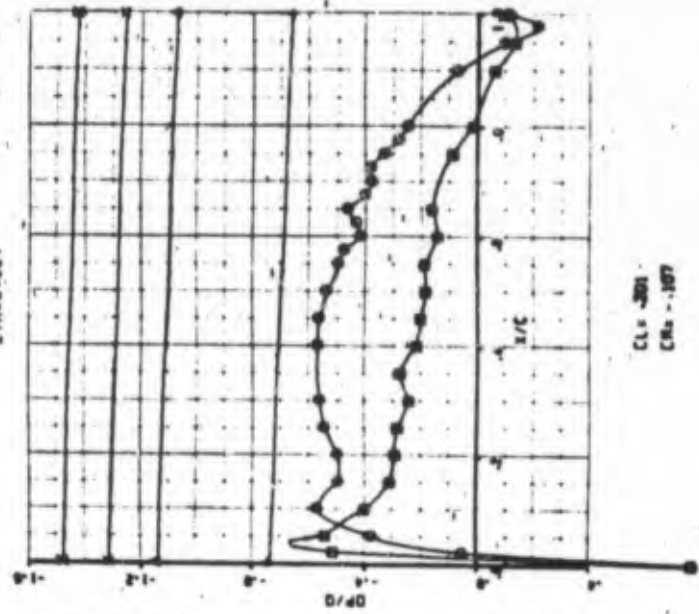
ETA=0.637



CL=J05  
 CR=J058



CL=J06  
 CR=J138



CL=J01  
 CR=J187

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 3C1  
 MACH NO .754

## RAKE LOCATIONS

○ 30 %  
 △ 55 %  
 × 80 %  
 \* 80 % (AFT)

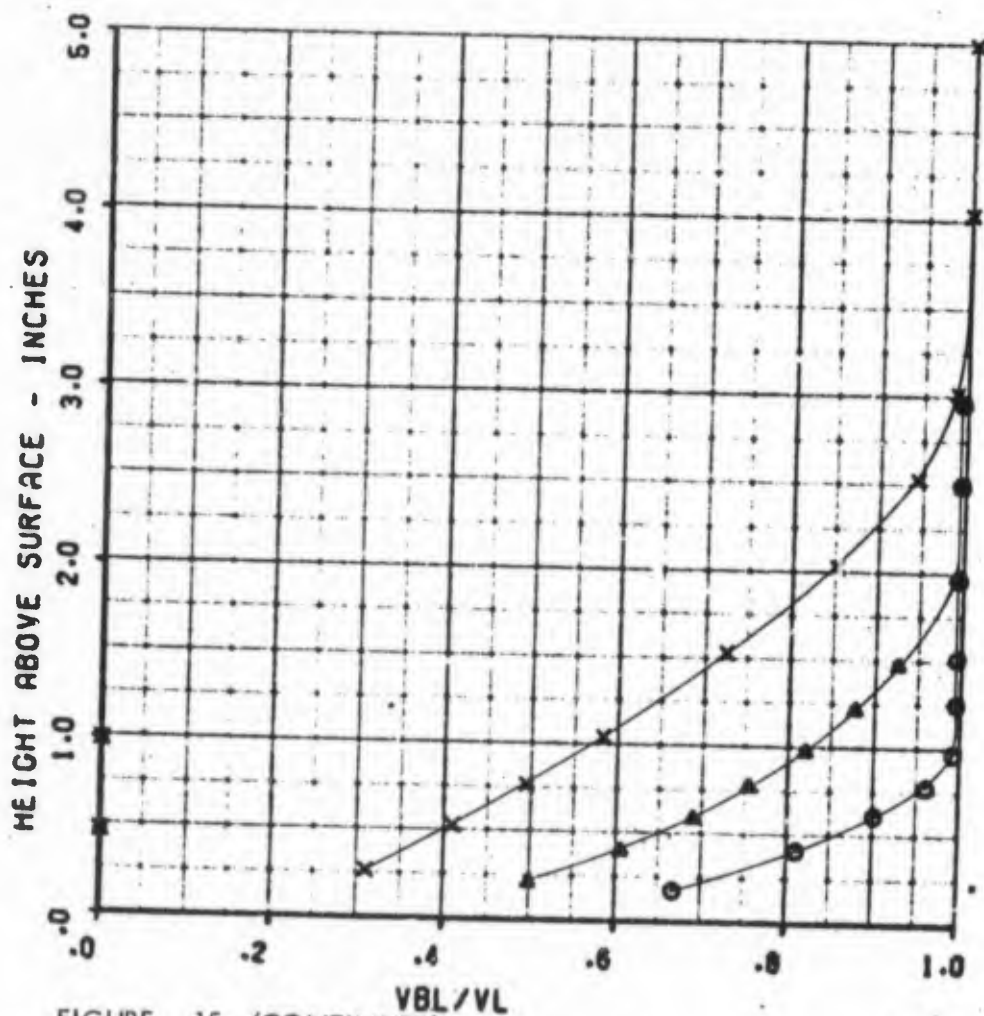


FIGURE 15 (CONTINUED)  
 (d) CORRECTED ALPHA = -0.97

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN NO 3C1  
 MACH NO .754

Q 1.12 PSI  
 ALPHA -1.64 DEG  
 TRN -53.5 DEG C

ETA=0.193

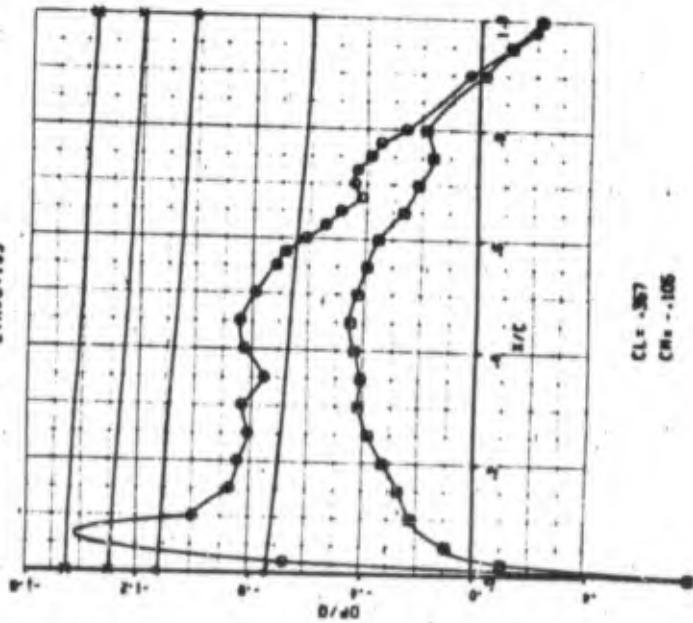
ALTITUDE 39100. FT  
 WEIGHT 234500. LB  
 NZ .37

CO 27.17 Z MRC  
 AILERON POS 0.00 DEG  
 FLAP POS 0.00 DEG

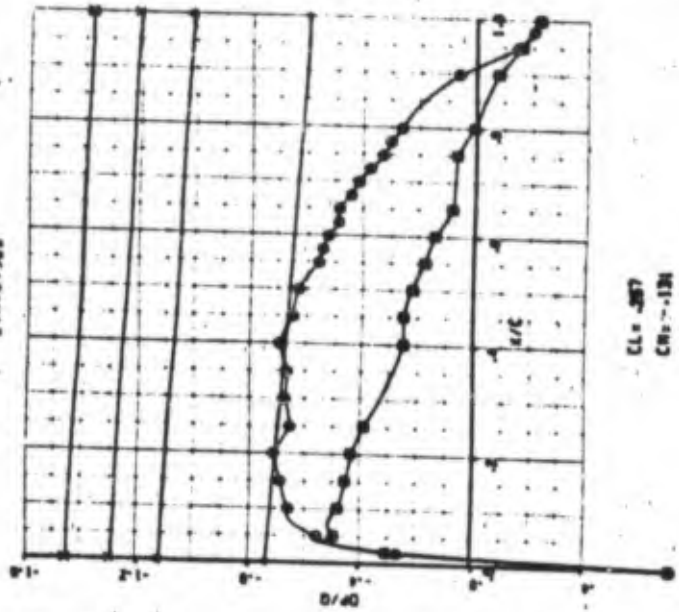
ETA=0.389

UPPER SURFACE  
 LOWER SURFACE  
 MACH LOCAL-1.0  
 MACH LOCAL-1.4

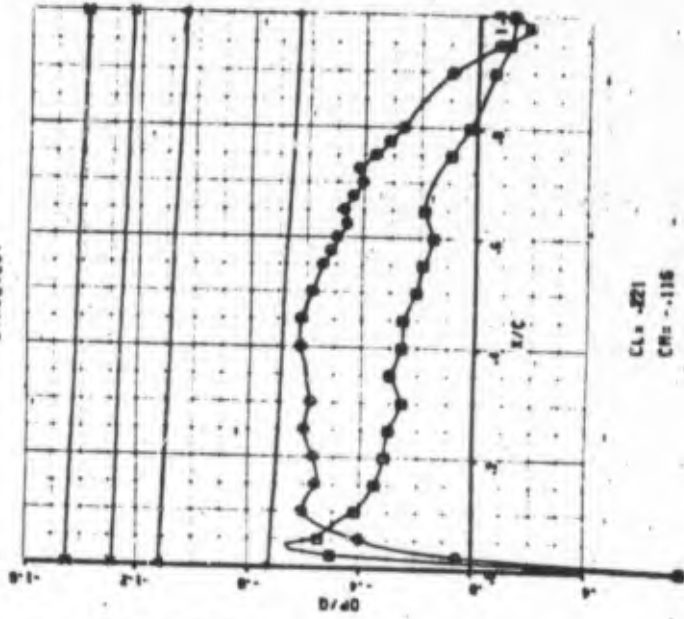
ETA=0.637



CL = .387  
 CM = -.105



CL = .387  
 CM = -.134



CL = .421  
 CM = -.116

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 382  
 MACH NO .754

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

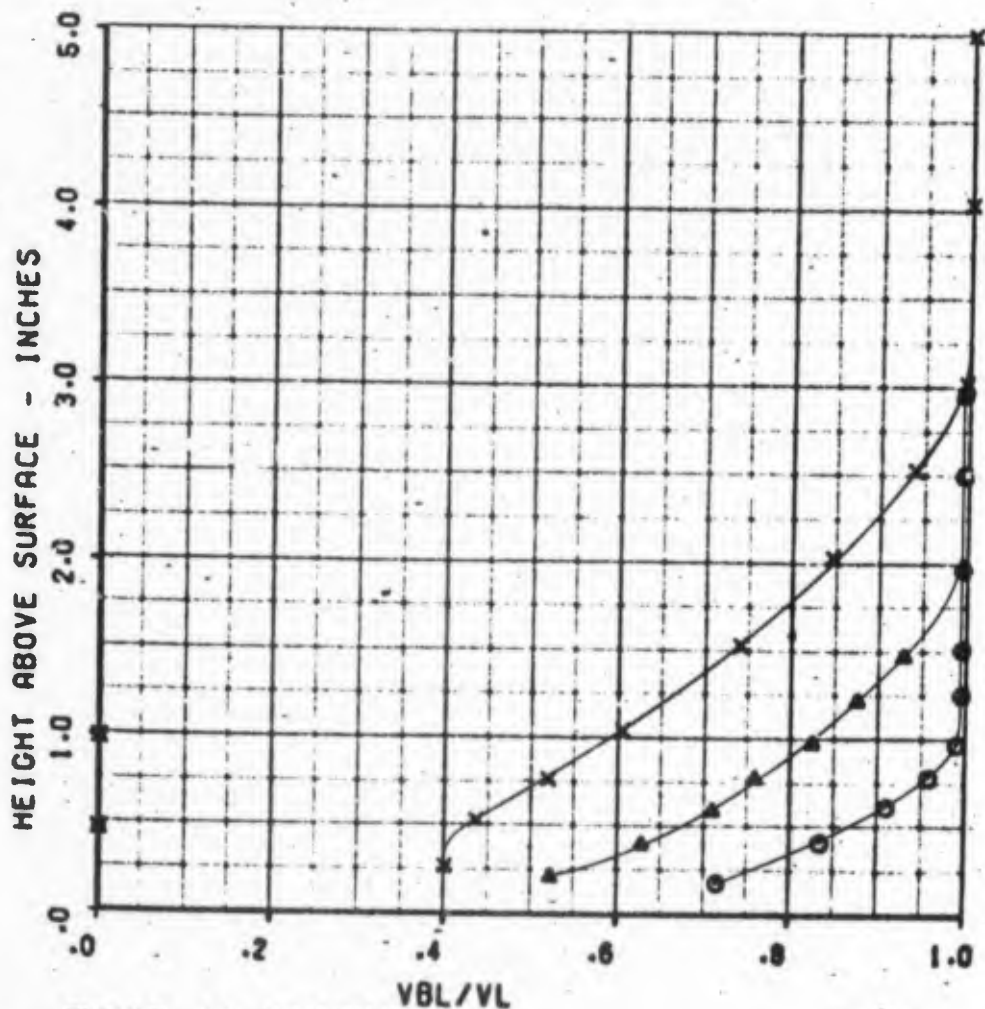


FIGURE 15 (CONTINUED)  
 (e) CORRECTED ALPHA = -0.37

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN NO 382  
 MACH NO .754

0  
 ALPHA  
 TAN

1.16 PSI  
 -.97 DEG  
 -53.0 DEG C

ALTITUDE 38460. FT  
 WEIGHT 230300. LB  
 NZ .52

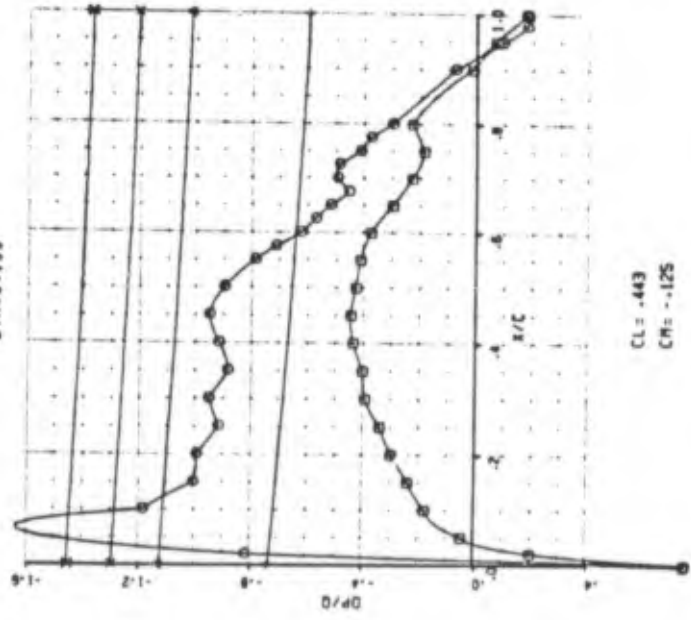
CO 27.34 Z MAC  
 AILERON POS -.04 DEG  
 FLAP POS 0.00 DEG

O UPPER SURFACE  
 X LOWER SURFACE  
 + MACH LOCAL-1.0  
 A MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 X MACH LOCAL-1.4

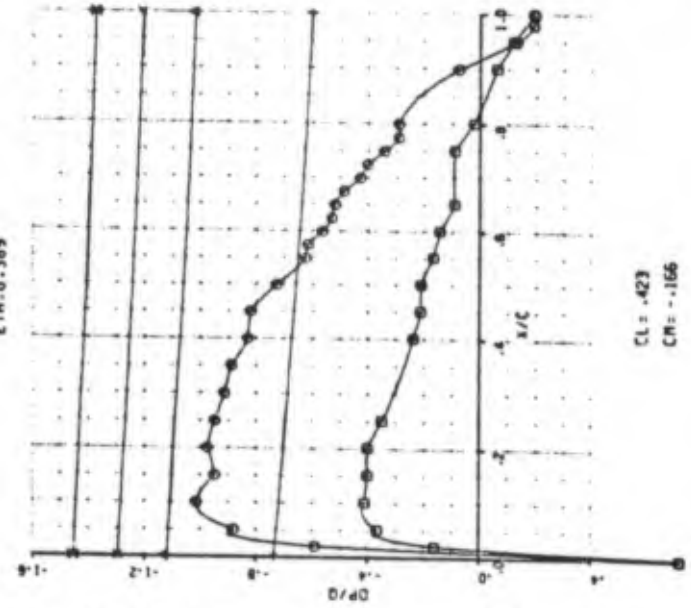
ETA=0.193

ETA=0.389

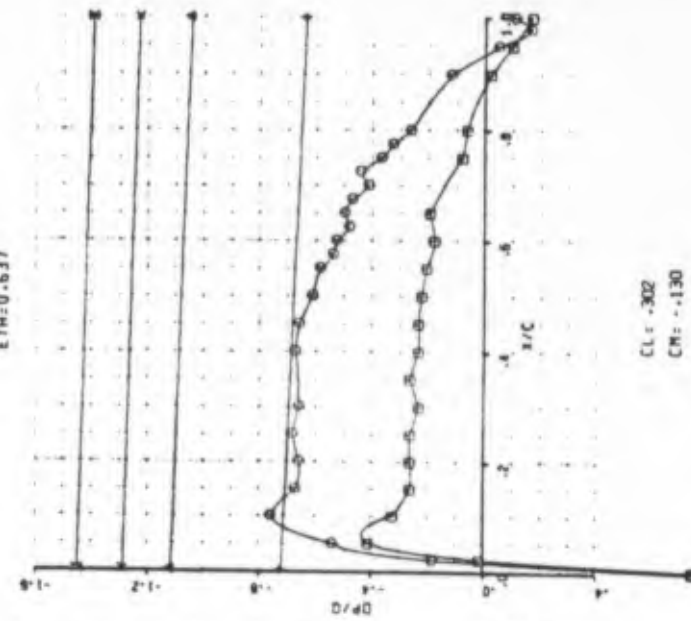
ETA=0.637



CL = .443  
 CM = -.125



CL = .423  
 CM = -.166



CL = .302  
 CM = -.130

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 383  
 MACH NO .748

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

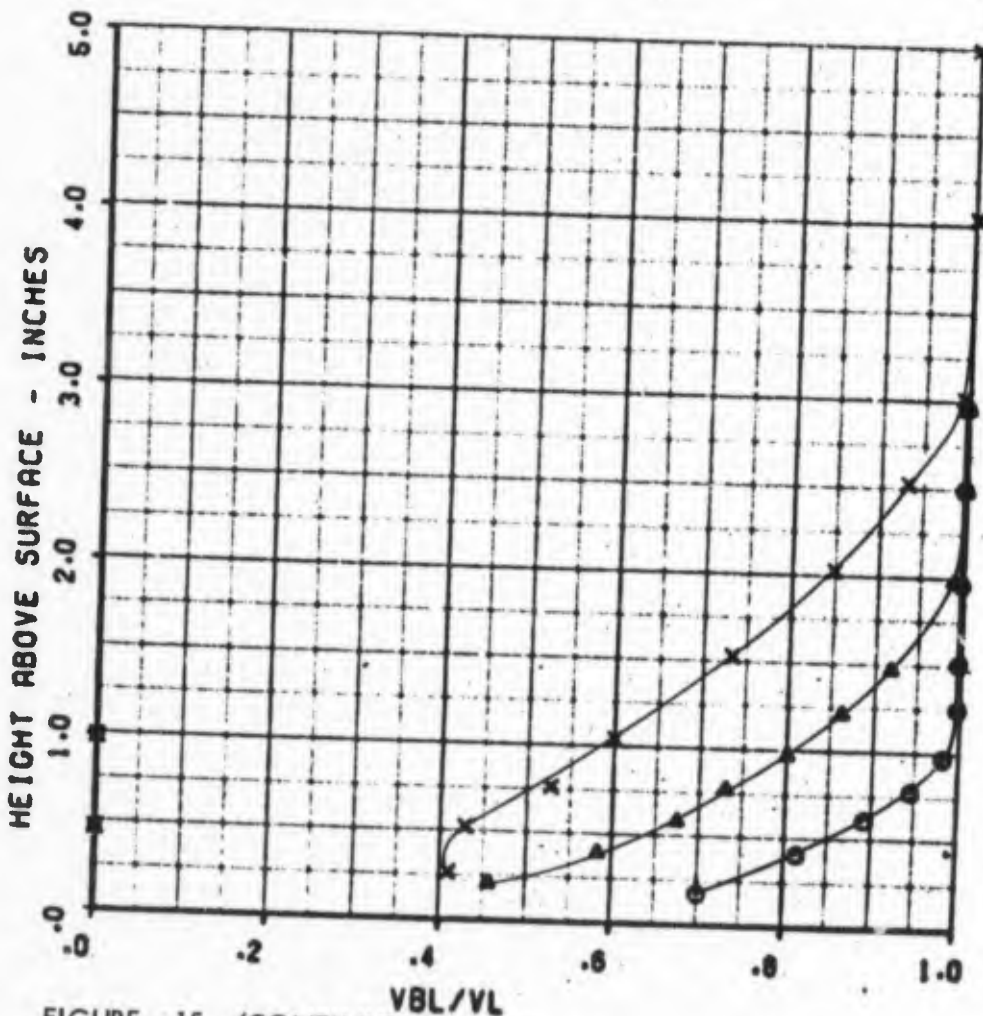


FIGURE 15 (CONTINUED)  
 (f) CORRECTED ALPHA = 0.65

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN NO 383  
 MACH NO -.748

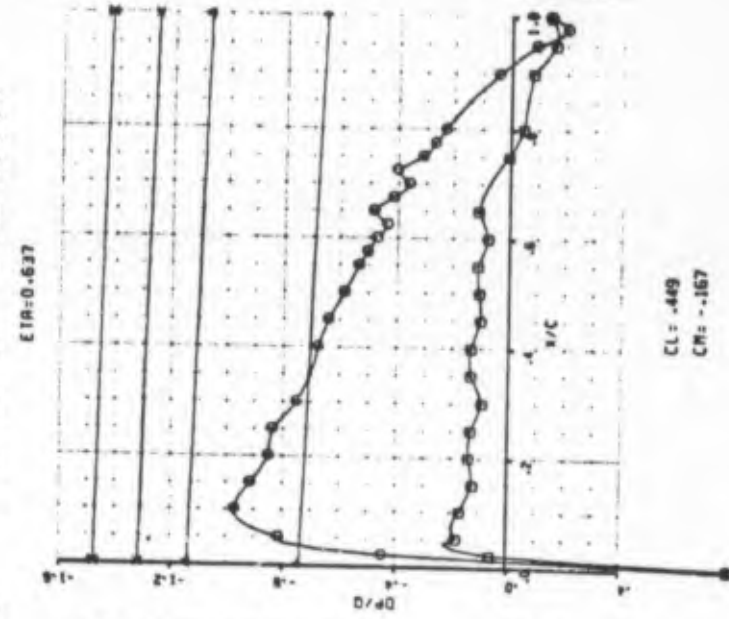
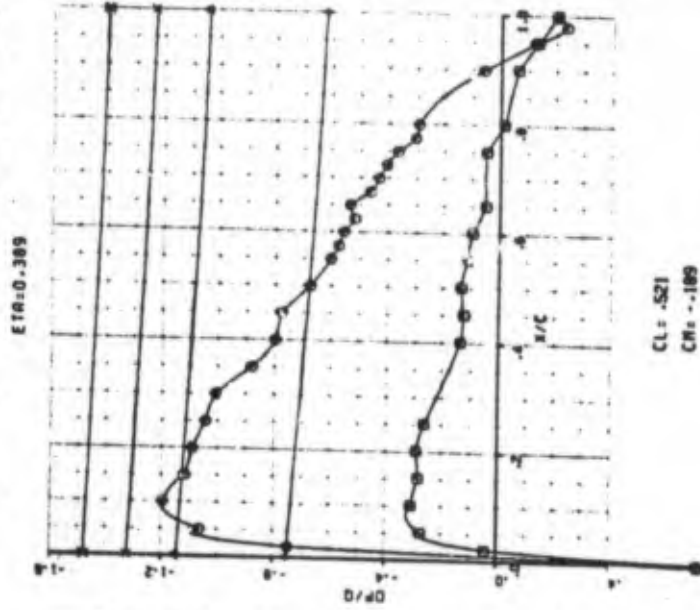
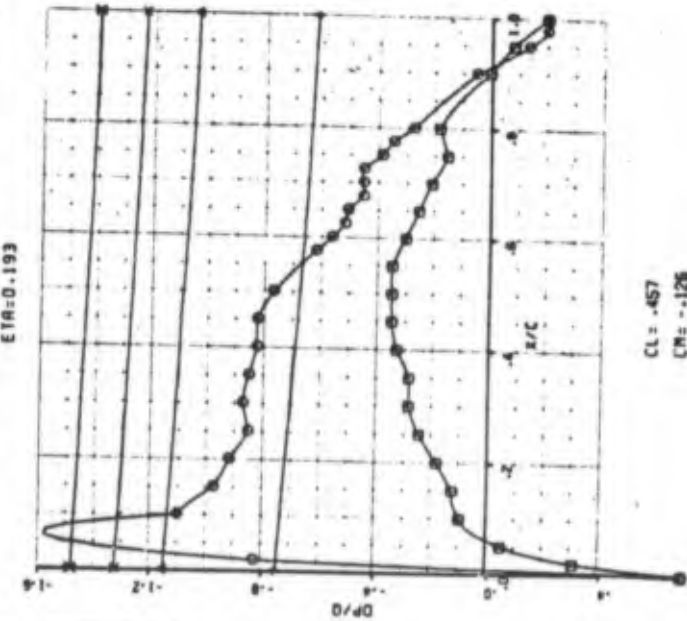
0  
 ALPHA  
 TRN

1.07 PSI  
 -19 DEG  
 -52.3 DEG C

ETA=0.193

ALTITUDE 39620. FT  
 WEIGHT 236650. LB  
 NZ .72

CO 27.35 % MAC  
 AILERON POS -.09 DEG  
 FLAP POS 0.00 DEG



# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 38  
 MACH NO .750

## RAKE LOCATIONS

○ 30 %  
 △ 55 %  
 × 80 %  
 ✕ 80 % (AFT)

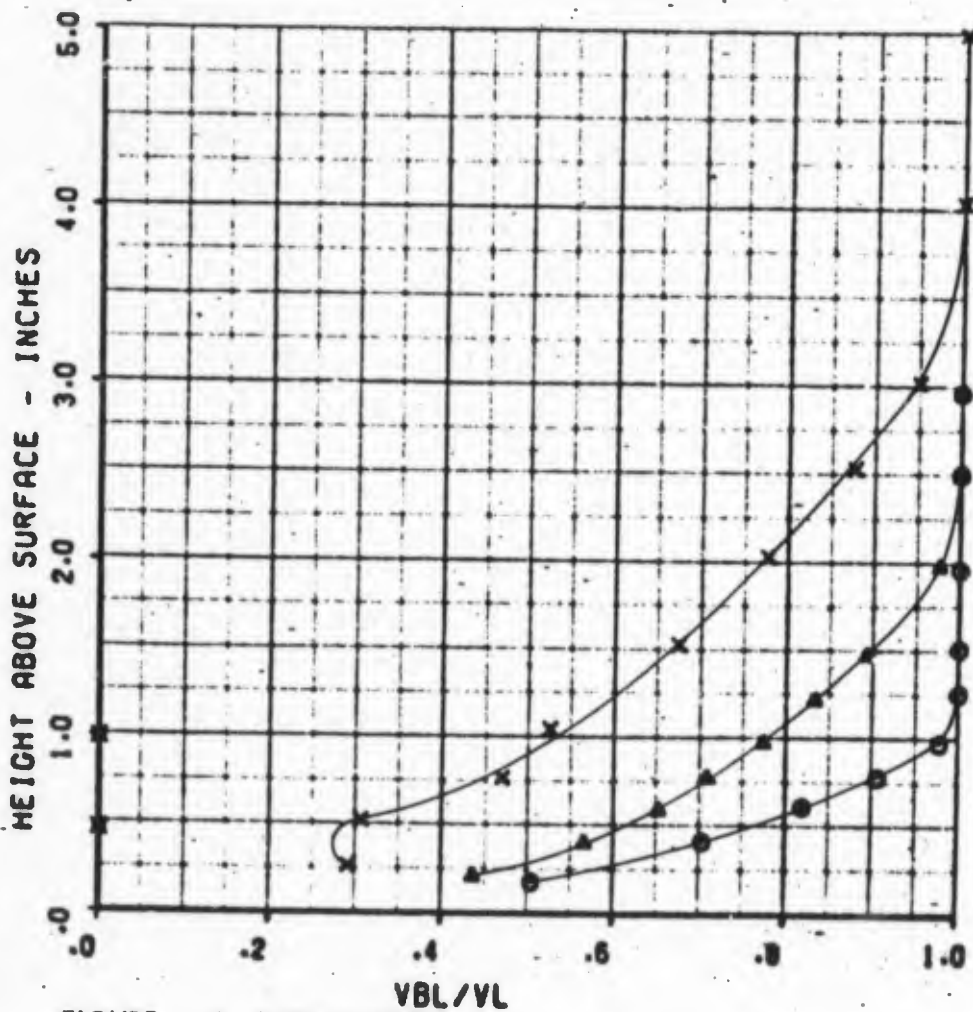
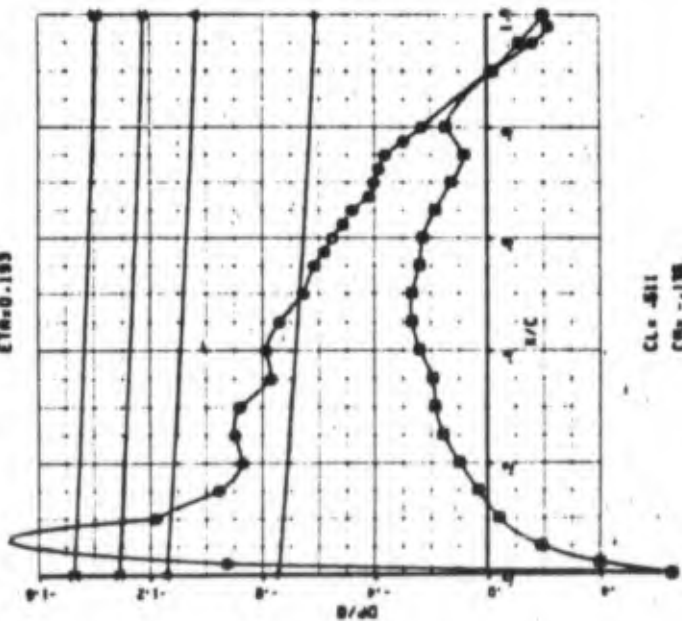


FIGURE 15 (CONCLUDED)  
 (g) CORRECTED ALPHA = 1.77

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 547      0      1.05 P51  
 RUN NO 38      ALPHA      1.45 DEG  
 MACH NO .760      TRN      -51.8 DEG C

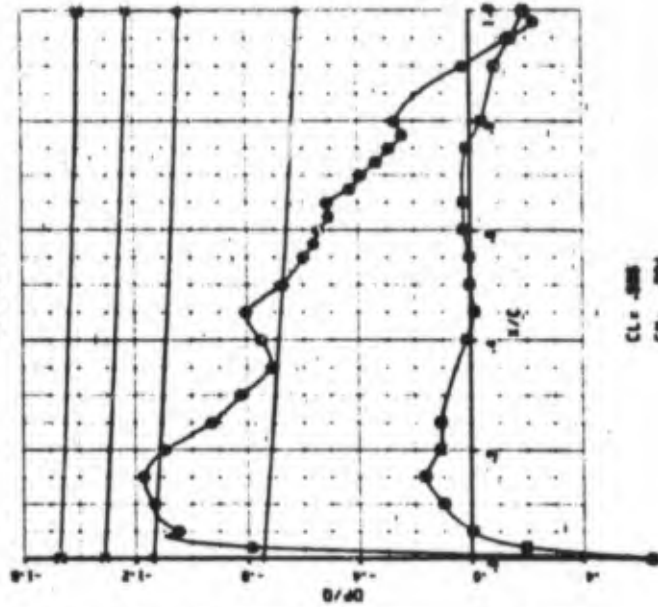
ETR=0.193



CL= .811  
 CR= -.128

ALTITUDE 40180. F1  
 WEIGHT 230000. LB  
 NZ .97

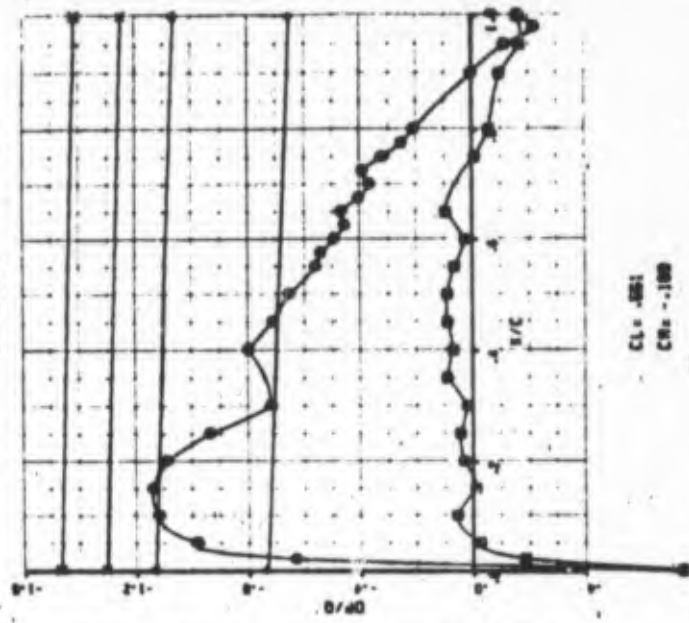
ETR=0.309



CL= .808  
 CR= .204

C0 27.42 Z RMC  
 AILERON POS --.34 DEG  
 FLAP POS 0.00 DEG

ETR=0.637



CL= .881  
 CR= -.108

UPPER SURFACE      4 MACH LOCAL-1.2  
 LOWER SURFACE      X MACH LOCAL-1.3  
 MACH LOCAL-1.0      Z MACH LOCAL-1.4

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 3C4  
 MACH NO .780

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

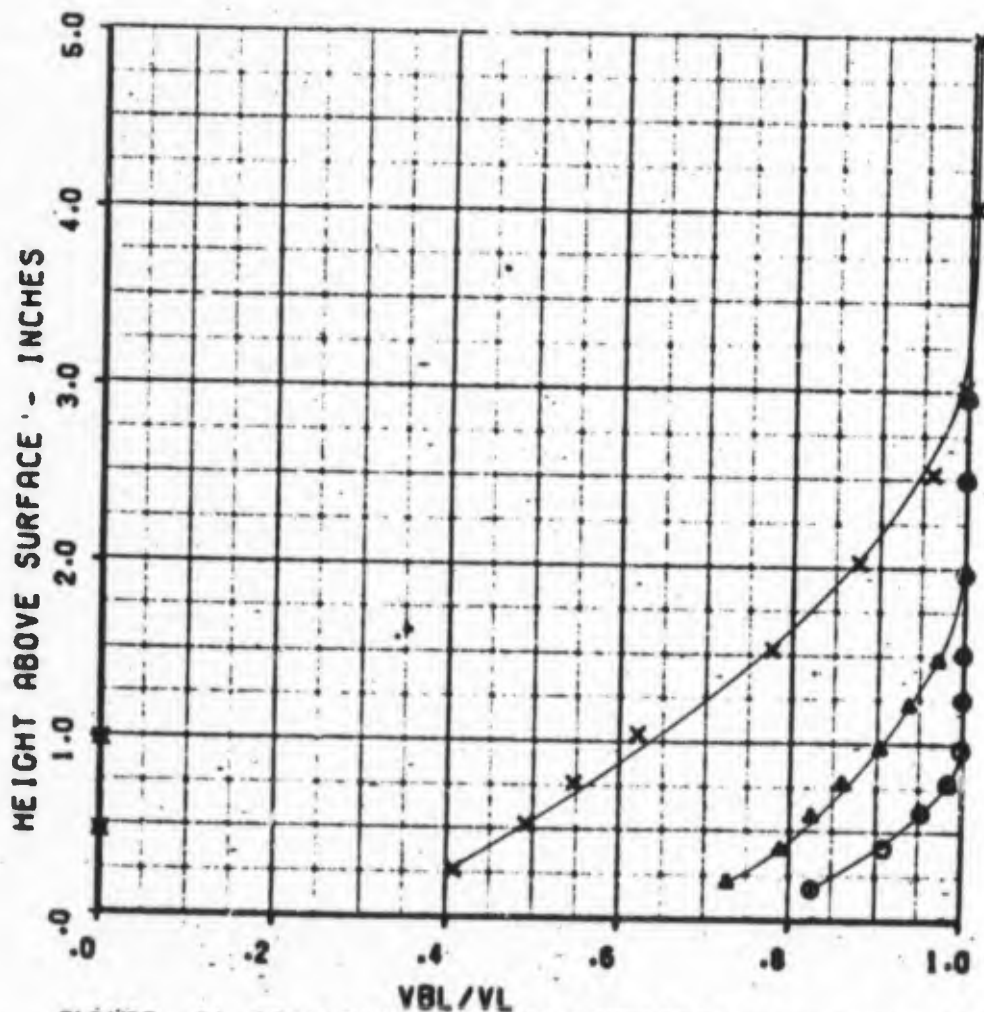


FIGURE 16 BOUNDARY LAYER VELOCITY PROFILES AND PRESSURE DISTRIBUTIONS  
 MACH .765 TO .780

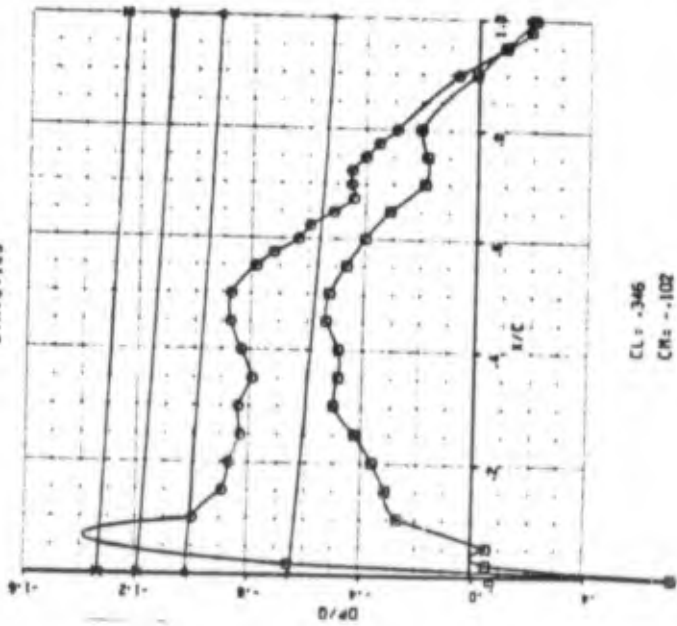
(a) CORRECTED ALPHA = -1.55

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN NO 3C4  
 MACH NO -780

Q  
 1-27 PSI  
 ALPHA  
 -2-32 DEG  
 TRN  
 -54-5 DEG C

ETA=0.193

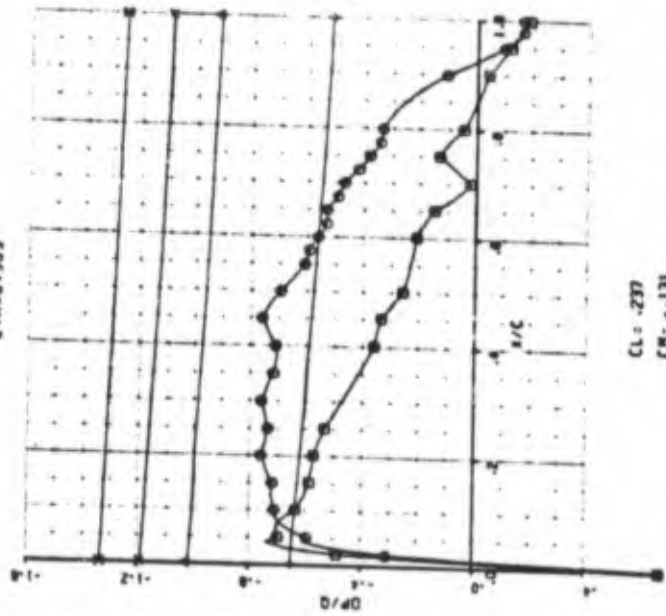


CL = .346  
 CR = -.102

ALTITUDE 30000. FT  
 WEIGHT 234000. LB  
 NZ -21

CO 27.15 X MAC  
 AILERON POS -.09 DEG  
 FLAP POS 0.00 DEG

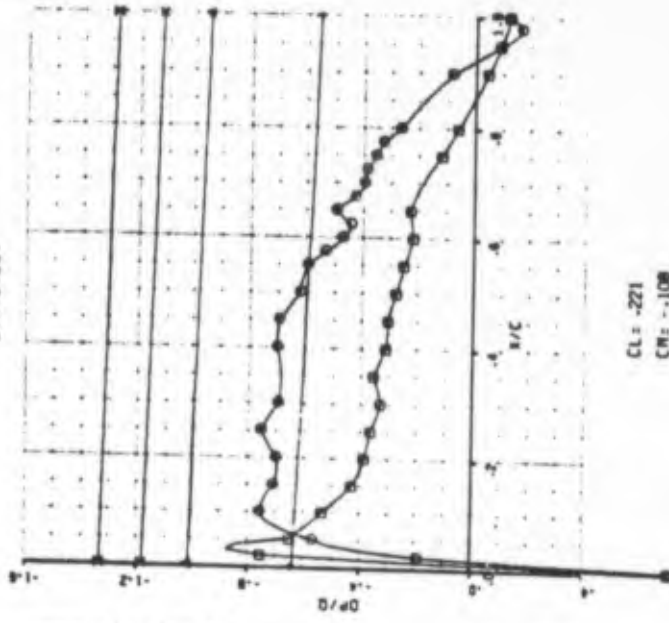
ETA=0.389



CL = .237  
 CR = -.131

O UPPER SURFACE  
 □ LOWER SURFACE  
 + MACH LOCAL-1.0  
 A MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 Z MACH LOCAL-1.4

ETA=0.637



CL = .221  
 CR = -.108

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 3C2  
 MACH NO .765

## RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

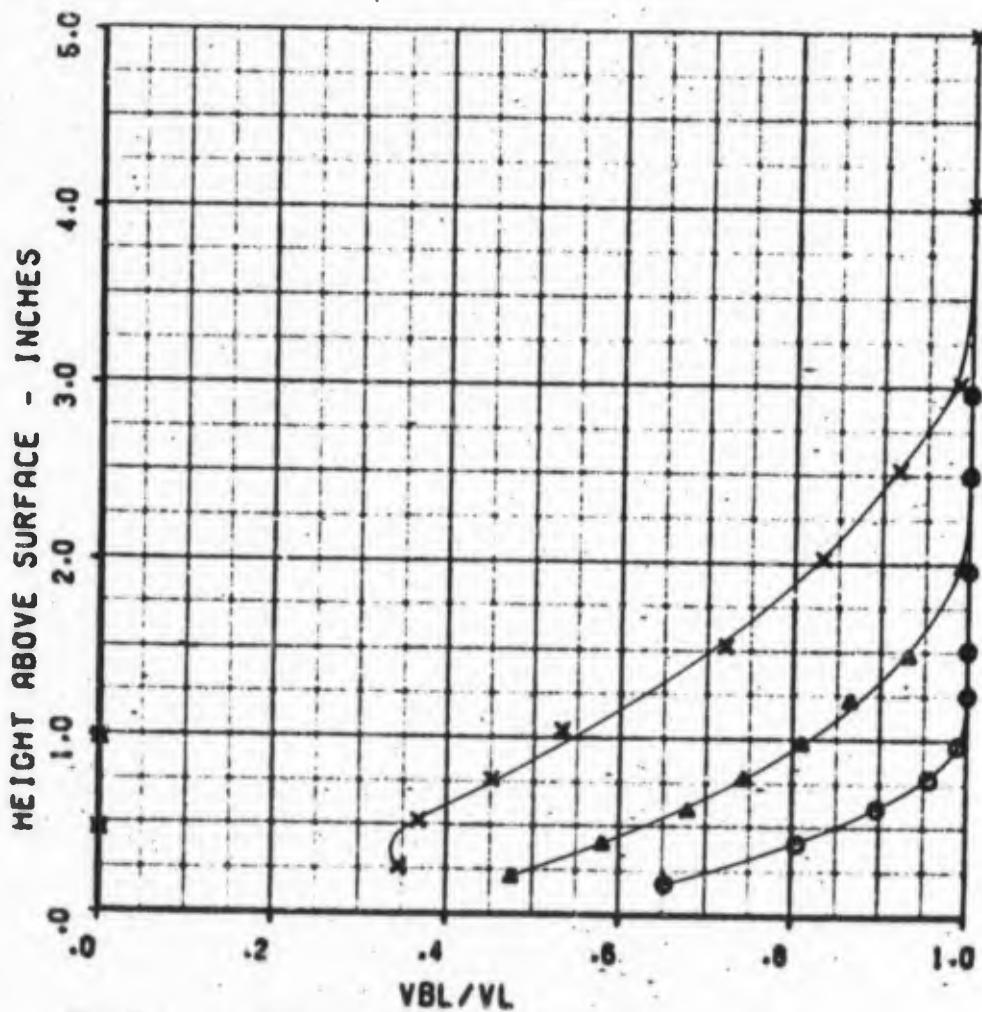


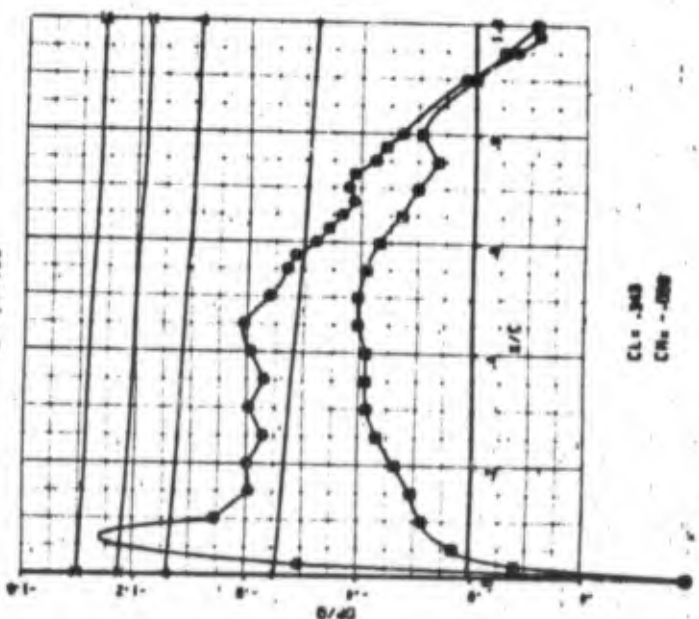
FIGURE 16 (CONTINUED)  
 (b) CORRECTED ALPHA = -0.37

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN NO 3C2  
 MACH NO .765

Q 1.15 PSI  
 ALPHA -57 DEG  
 TARR -52.5 DEG C

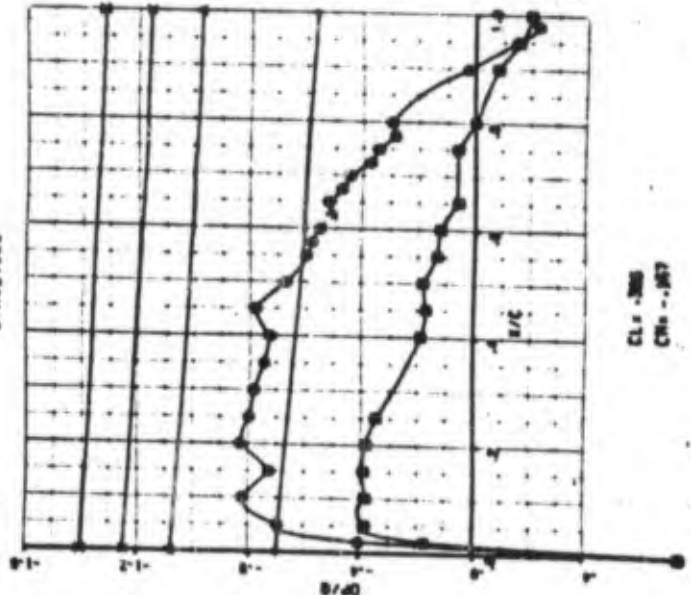
ETR=0.193



CL= .343  
 CM= -.028

ALTITUDE 20350. FT  
 WEIGHT 234000. LB  
 NZ -.54

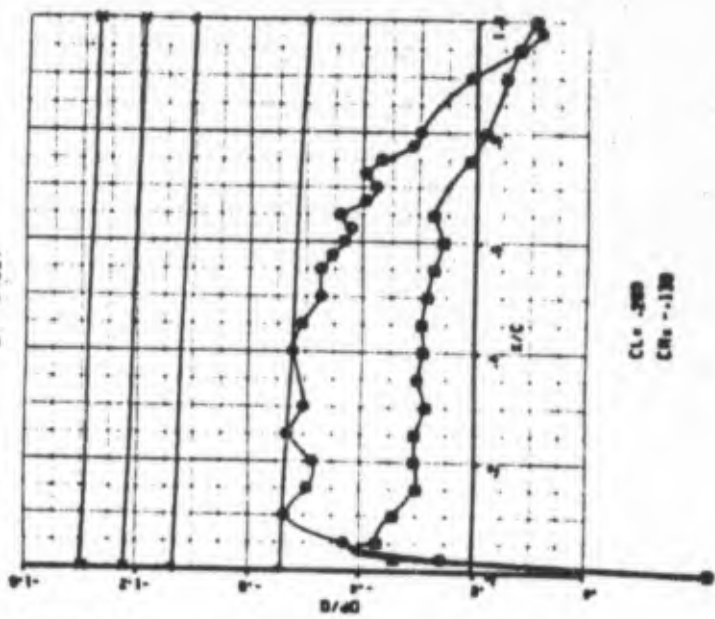
ETR=0.209



CL= .305  
 CM= -.057

CO 27.18 1/2 MAC  
 AILERON POS -.43 DEG  
 FLAP POS 0.00 DEG

ETR=0.837



CL= .289  
 CM= -.138

O UPPER SURFACE  
 □ LOWER SURFACE  
 + MACH LOCAL-1.0  
 △ MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 ⊞ MACH LOCAL-1.4

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 3C3  
 MACH NO .770

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

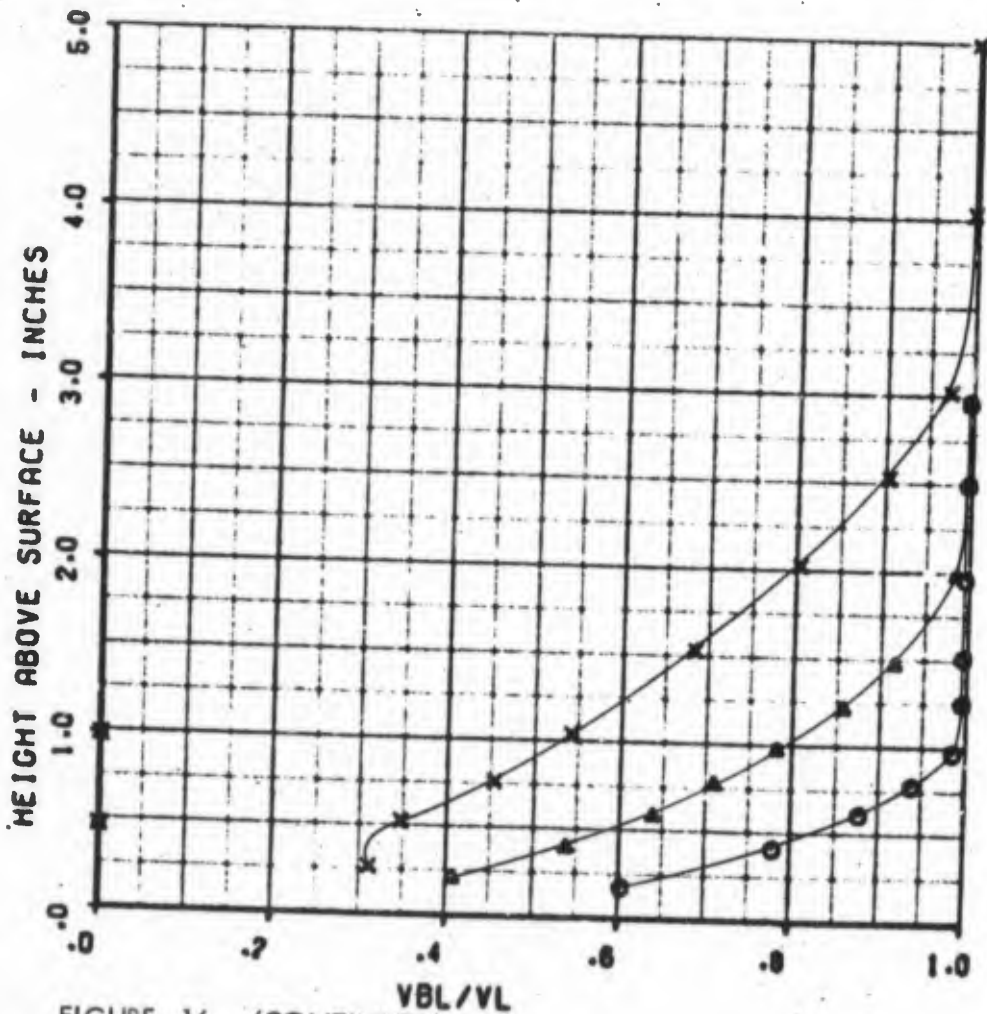
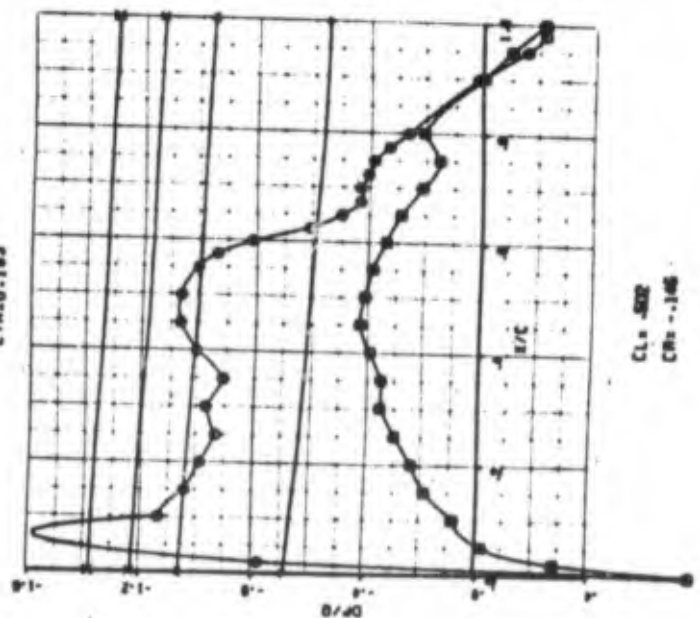


FIGURE 16 (CONTINUED)  
 (c) CORRECTED ALPHA = 0.13

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 547      0      1.14 PSI  
 RUN NO 3C3      ALPHA      -.39 DEG  
 MACH NO .770      TRN      -52.8 DEG C

ETA=0.193

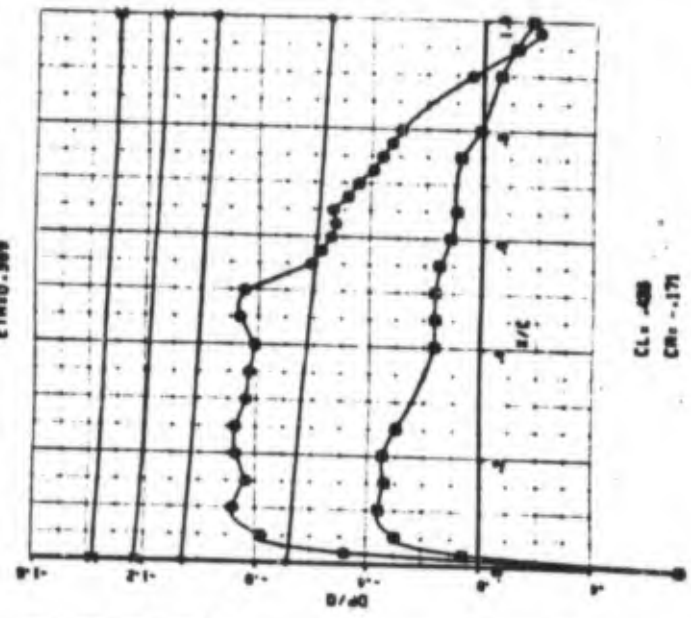


CL= .502  
 CM= -.146

ALTITUDE 38750. FT  
 WEIGHT 23000. LB  
 NZ .71

CO 27.19 Z MAC  
 AILERON POS -.09 DEG  
 FLAP POS 0.00 DEG

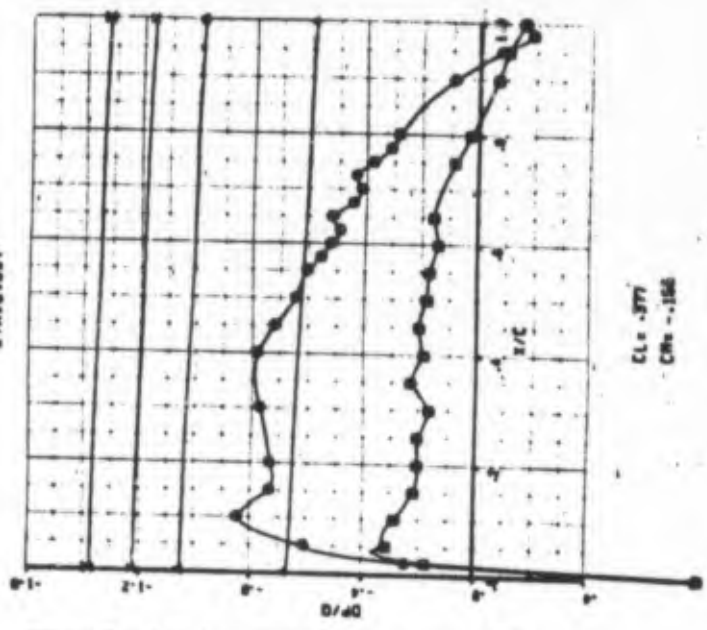
ETA=0.309



CL= .488  
 CM= -.171

O UPPER SURFACE      A MACH LOCAL-1.2  
 □ LOWER SURFACE      X MACH LOCAL-1.3  
 + MACH LOCAL-1.0      Z MACH LOCAL-1.4

ETA=0.637



CL= .377  
 CM= -.166

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 3C  
 MACH NO .770

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

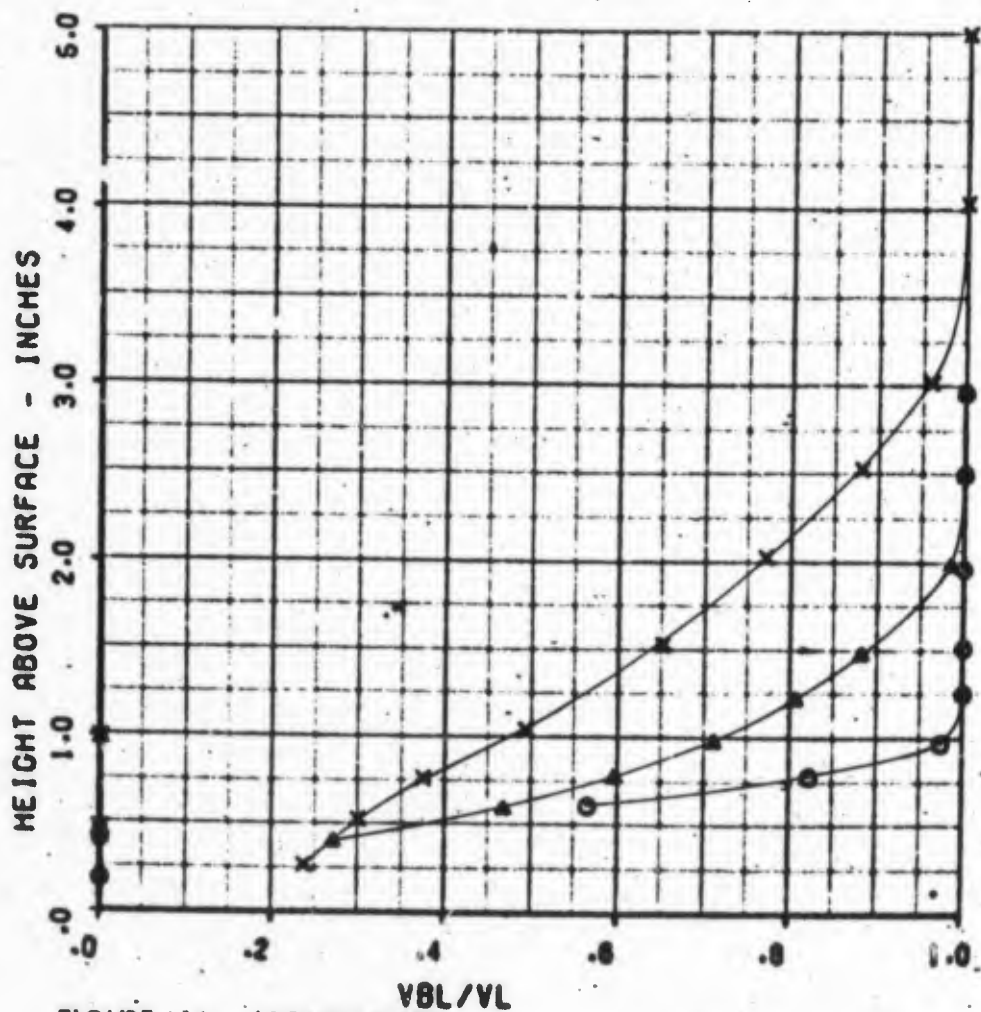


FIGURE 16 (CONTINUED)  
 (d) CORRECTED ALPHA = 1.25

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN NO 3C  
 MACH NO .770

$\alpha$   
 ALPHA  
 TAN

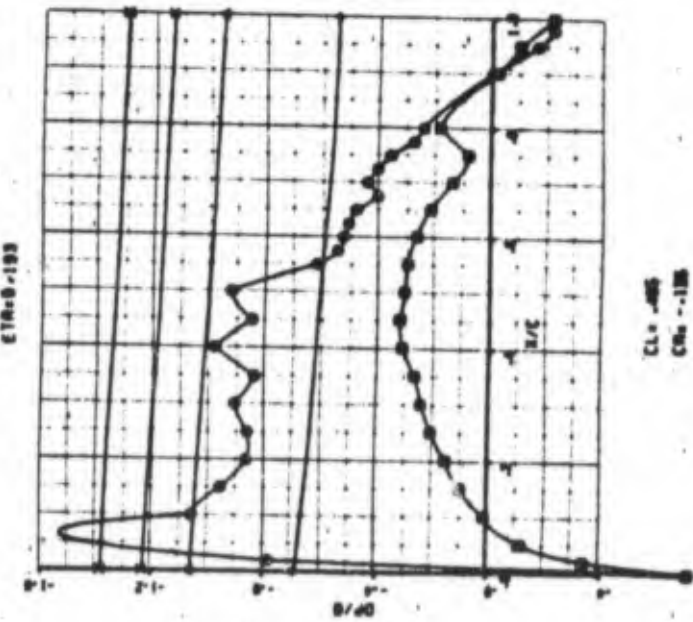
1.17 PSI  
 .87 DEG  
 -53.0 DEG C

ALTITUDE 40000. FT  
 WEIGHT 235000. LB  
 NZ .75

CG 27.20 3 MAC  
 RILLON POS -.77 DEG  
 FLAP POS 0.00 DEG

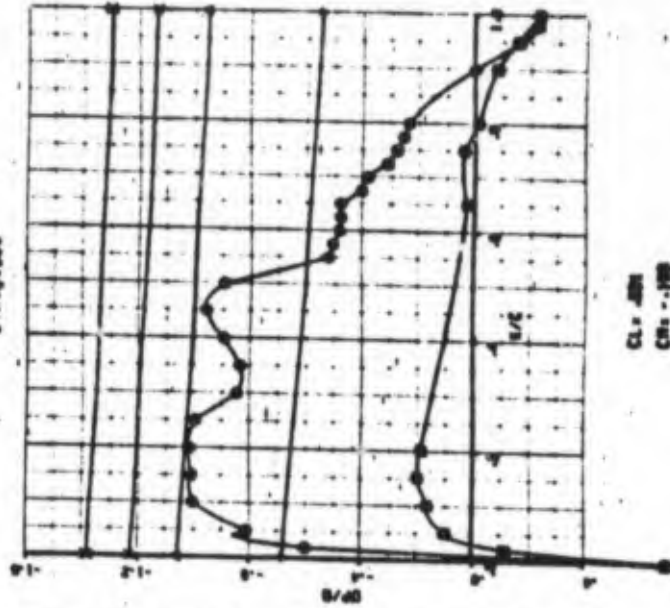
○ UPPER SURFACE  
 □ LOWER SURFACE  
 + MACH LOCAL-1.0  
 △ MACH LOCAL-1.2  
 × MACH LOCAL-1.3  
 ⊗ MACH LOCAL-1.4

ETA-0.193



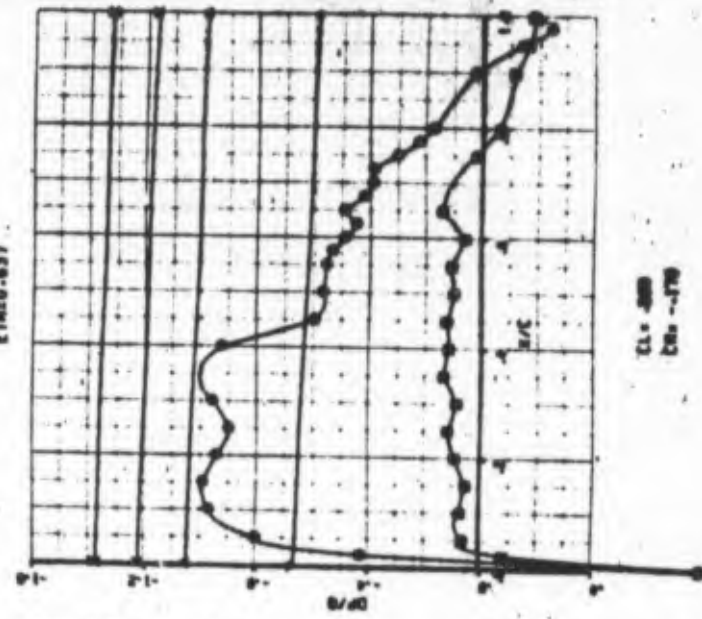
CL = .485  
 CR = -.125

ETA-0.200



CL = .481  
 CR = -.125

ETA-0.637



CL = .489  
 CR = -.178

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 549  
 RUN NO 2A  
 MACH NO .780

### RAKE LOCATIONS

○ 30 %  
 △ 55 %  
 × 80 %  
 \* 80 % (AFT)

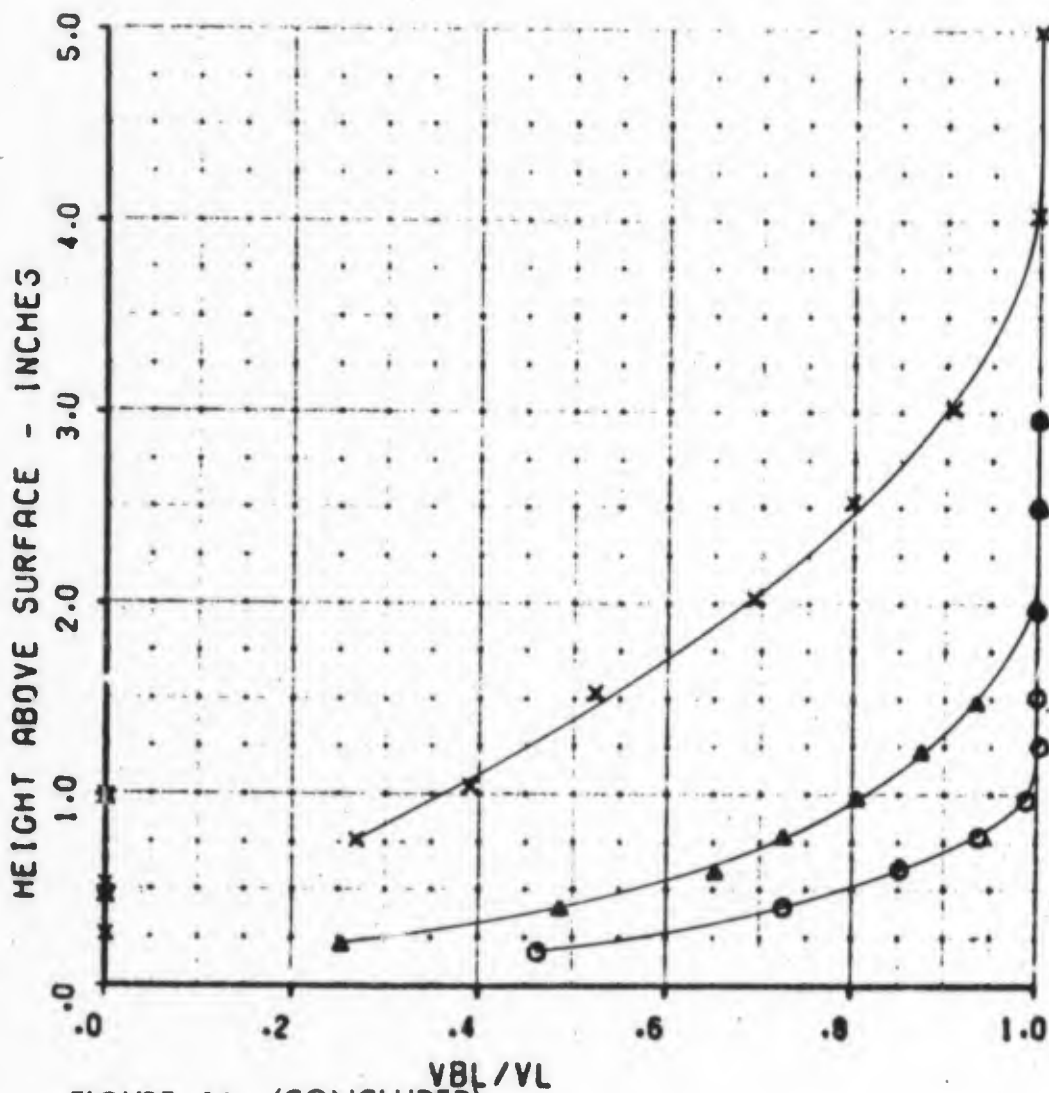
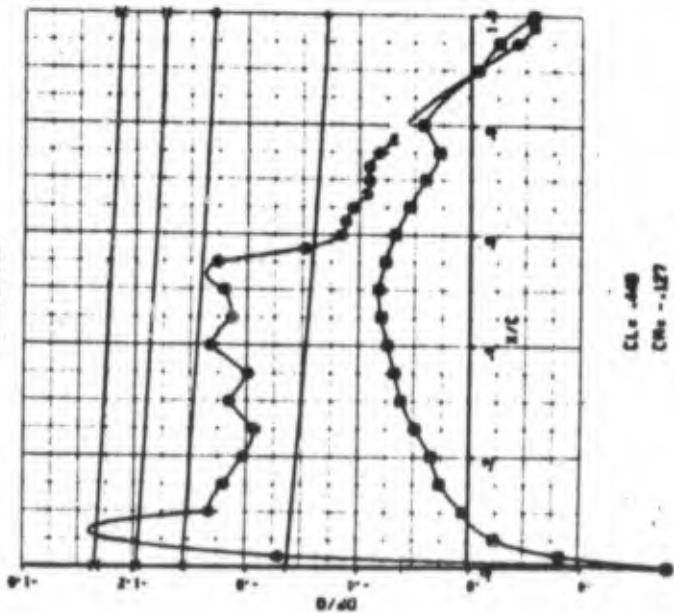


FIGURE 16 (CONCLUDED)  
 (e) CORRECTED ALPHA = 1.51

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 549      0      1.19 PSI  
 RUN NO 2A      ALPHA      1.15 DEG  
 MACH NO .700      TAN      -49.5 DEG C

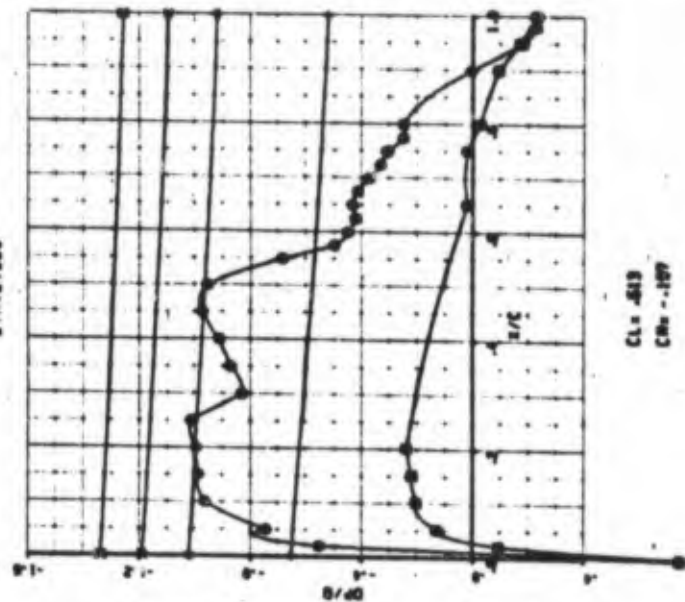
ETA=0.193



CL= .408  
 CM= -.127

ALTITUDE 30000. FT      CO      23.70 X MAC  
 WEIGHT 230000. LB      AILERON POS      .08 DEG  
 NZ      .08      FLAP POS      0.00 DEG

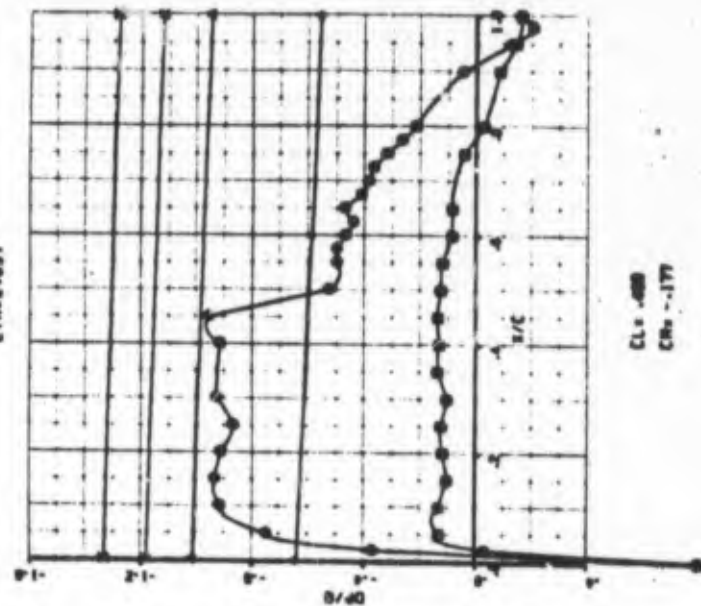
ETA=0.308



CL= .413  
 CM= -.127

UPPER SURFACE      A MACH LOCAL=1.2  
 LOWER SURFACE      X MACH LOCAL=1.3  
 MACH LOCAL=1.0      + MACH LOCAL=1.4

ETA=0.637



CL= .408  
 CM= -.177

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 3C5  
 MACH NO .790

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

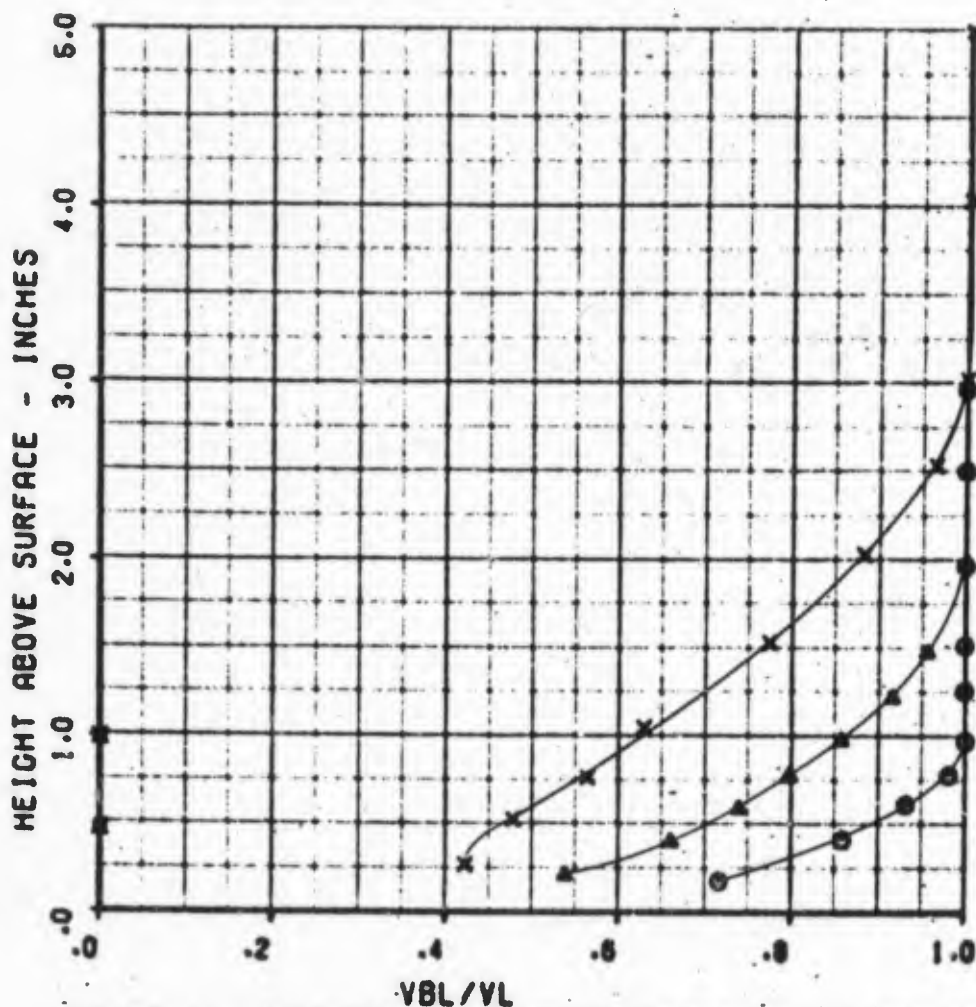


FIGURE 17 BOUNDARY LAYER VELOCITY PROFILES AND PRESSURE DISTRIBUTIONS MACH .790 TO .810  
 (a) CORRECTED ALPHA = -2.31

LOCKHEED C-141A

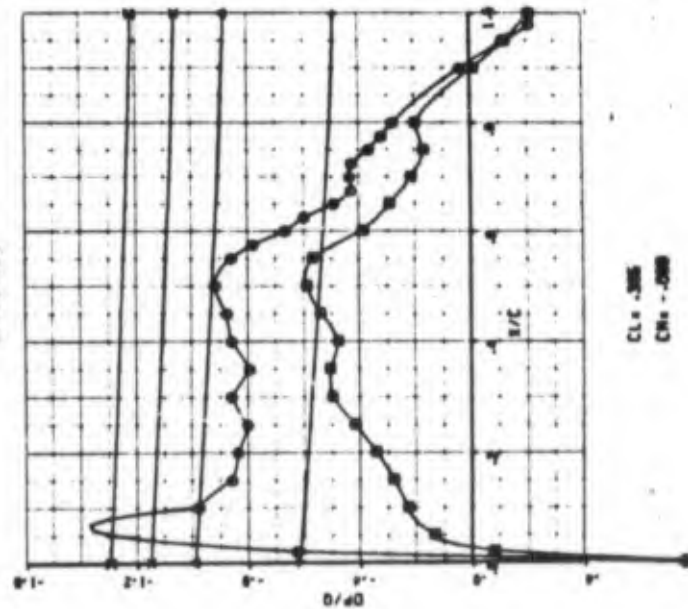
PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN NO 3CS  
 MACH NO .750

Q  
 ALPHA  
 TMR

1.37 PSI  
 -3.19 DEG  
 -55.3 DEG C

ETA=0.193

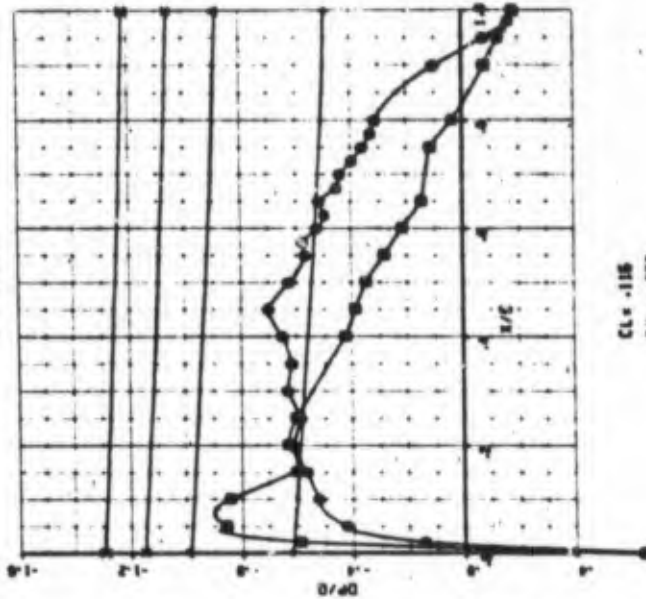


CLx = .385  
 CLy = .000

ALTITUDE 37010. FT  
 WEIGHT 234250. LB  
 NZ 0.00

C/D 27.15 X MAC  
 AILERON POS .09 DEG  
 FLAP POS 0.00 DEG

ETA=0.269

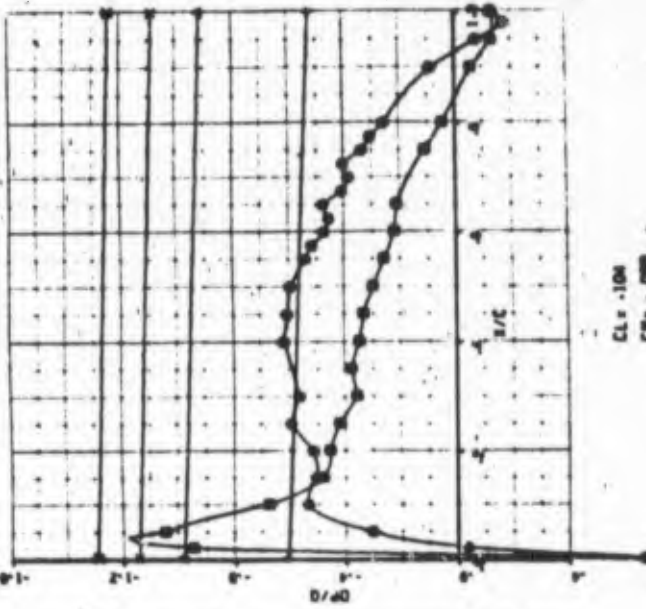


CLx = .116  
 CLy = .000

UPPER SURFACE  
 LOWER SURFACE

MACH LOCAL-1.0  
 MACH LOCAL-1.2  
 MACH LOCAL-1.3  
 MACH LOCAL-1.4

ETA=0.637



CLx = .104  
 CLy = .000

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 305  
 MACH NO .900

## RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✖ 80 % (AFT)

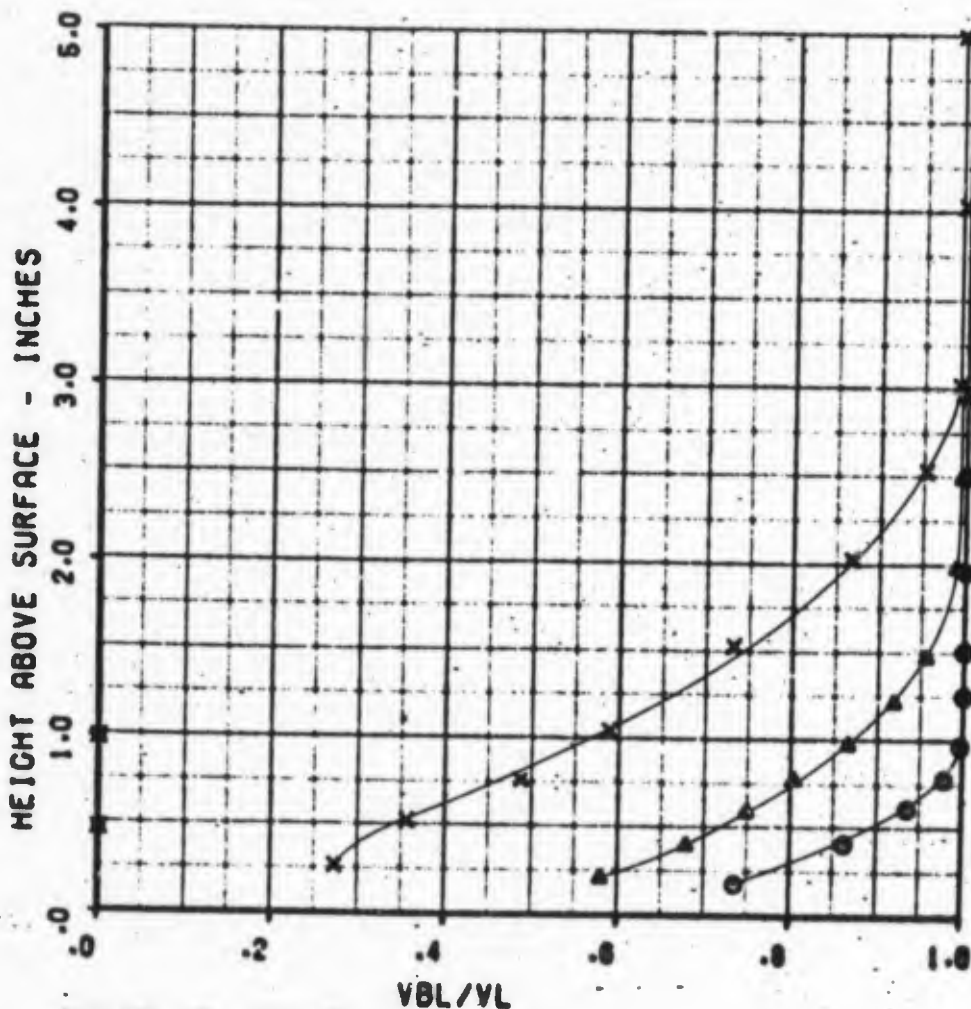


FIGURE 17 (CONTINUED)  
 (b) CORRECTED ALPHA = -2.14

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 547      Q      1.44 PSI  
 RUN NO 305      ALPHA      -3.00 DEG  
 MACH NO .800      TAN      -54.0 DEG C

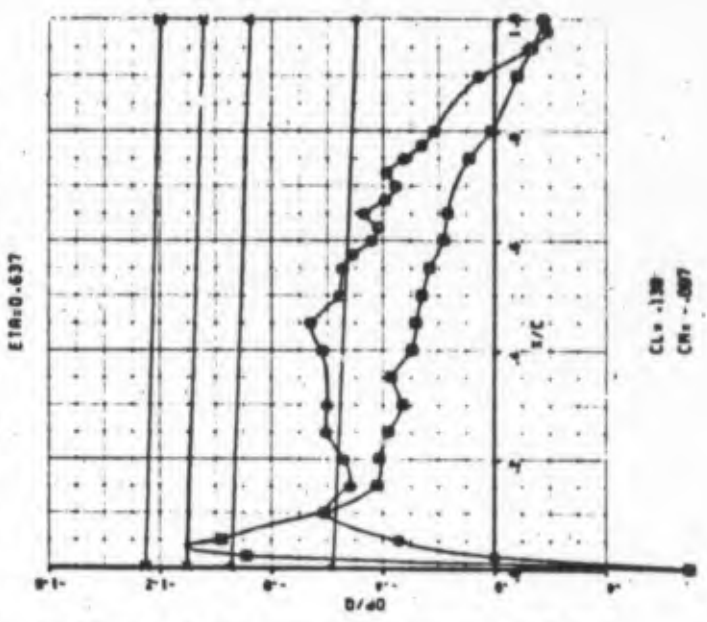
ETA=0.193

ALTITUDE 36430. FT  
 WEIGHT 231400. LB  
 NZ 0.00

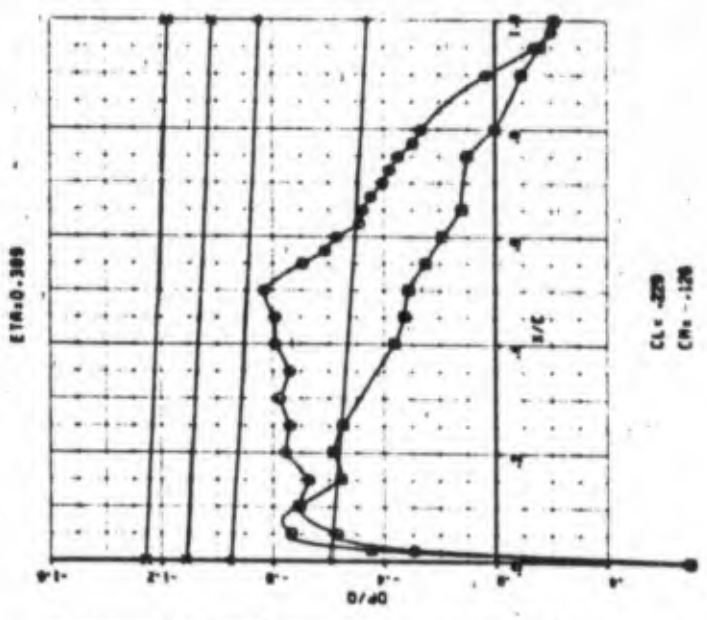
CO 26.95 Z RAC  
 AILERON POS -.85 DEG  
 FLAP POS 0.00 DEG

UPPER SURFACE      A MACH LOCAL-1.2  
 LOWER SURFACE      X MACH LOCAL-1.3  
 MACH LOCAL-1.0      + MACH LOCAL-1.4

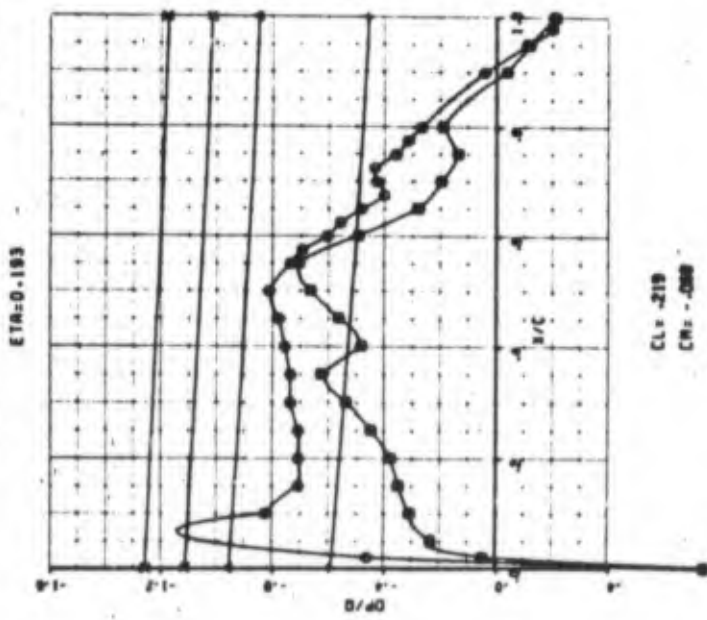
ETA=0.637



CLx = .219  
 CRz = -.089



CLx = .229  
 CRz = -.126



CLx = .139  
 CRz = -.097

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 301  
 MACH NO .796

## RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 90 % (AFT)

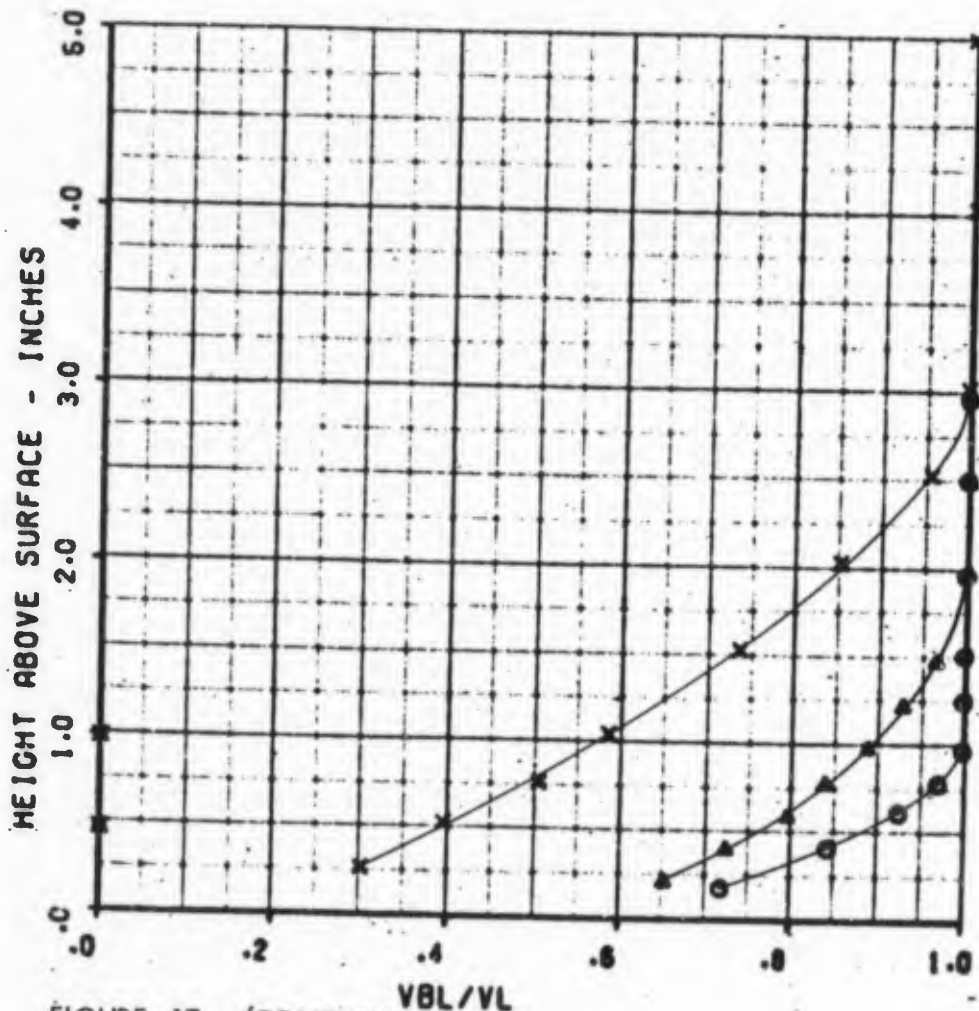


FIGURE 17 (CONTINUED)  
 (c) CORRECTED ALPHA = -1.30

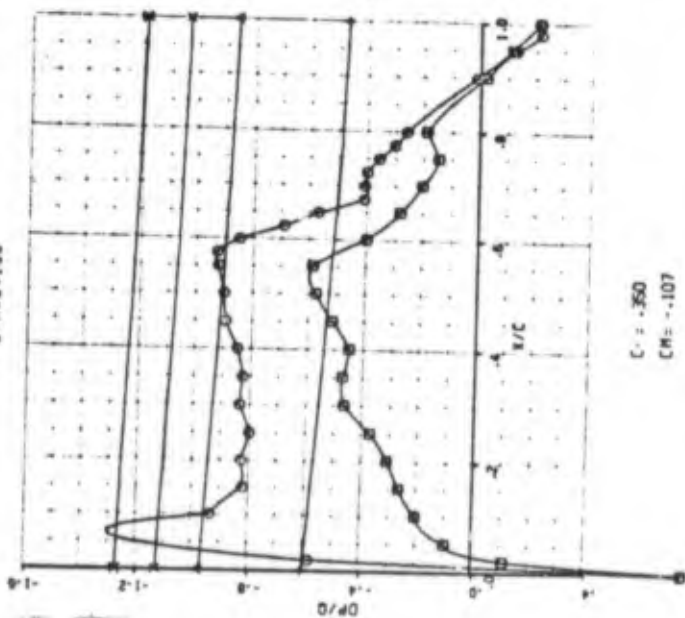
LOCKHEED C-141A  
PRESSURE DISTRIBUTION

FLIGHT NO 547  
RUN NO 301  
MACH NO .735

Q  
ALPHA  
TRN

1.42 PSI  
-2.03 DEG  
-54.2 DEG C

ETA=0.193



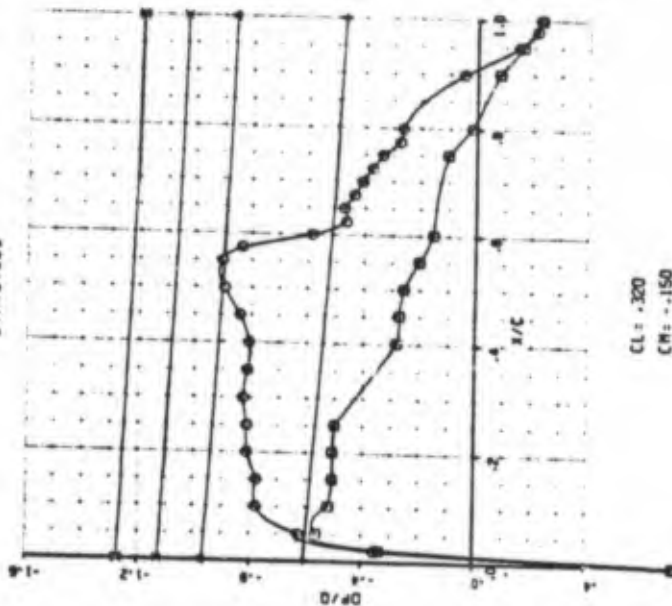
C<sub>L</sub> = .350  
C<sub>M</sub> = -.107

ALTITUDE 36600. FT  
WEIGHT 232450. LB  
MZ .34

C<sub>D</sub>

27.03 X MAC  
AILERON POS -1.36 DEG  
FLAP POS 0.00 DEG

ETA=0.389

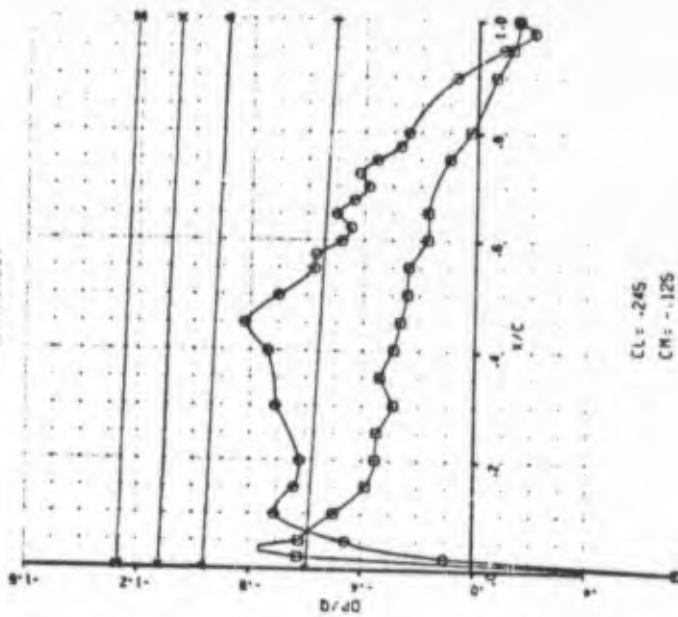


C<sub>L</sub> = .320  
C<sub>M</sub> = -.150

UPPER SURFACE  
LOWER SURFACE  
MACH LOCAL-1.0

MACH LOCAL-1.2  
MACH LOCAL-1.3  
MACH LOCAL-1.4

ETA=0.637



C<sub>L</sub> = .245  
C<sub>M</sub> = -.125

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 302  
 MACH NO .810

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✖ 80 % (RFT)

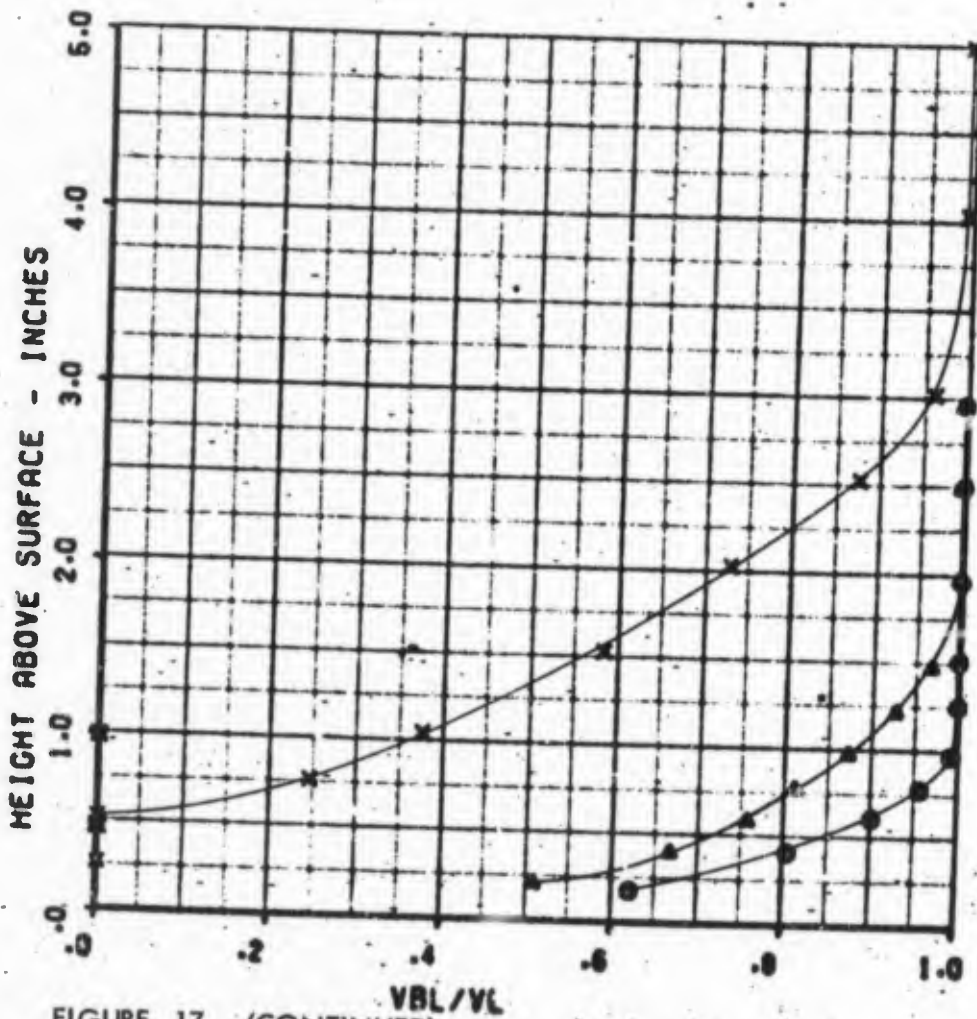


FIGURE 17 (CONTINUED)  
 (d) CORRECTED ALPHA = -0.70

LOCKHEED C-141A

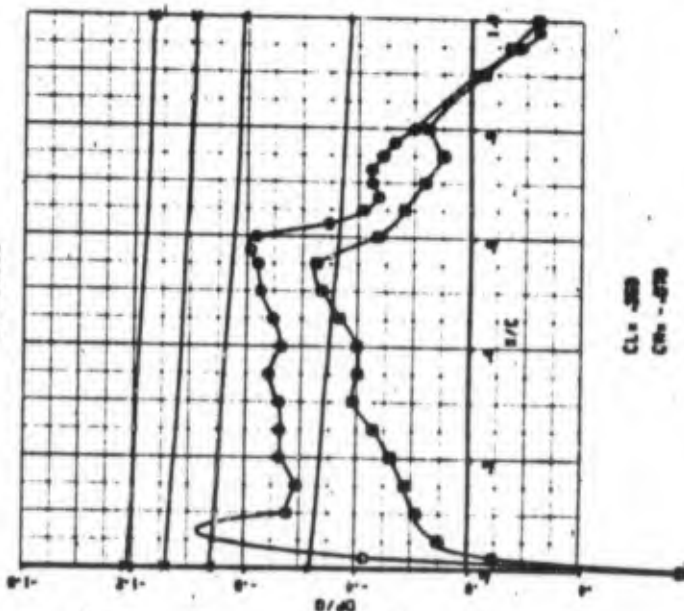
PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN NO 302  
 MACH NO .310

0  
 ALPHA  
 TAN

1.25 PSI  
 -1.35 DEG  
 -87.0 DEG C

ETA=0.183

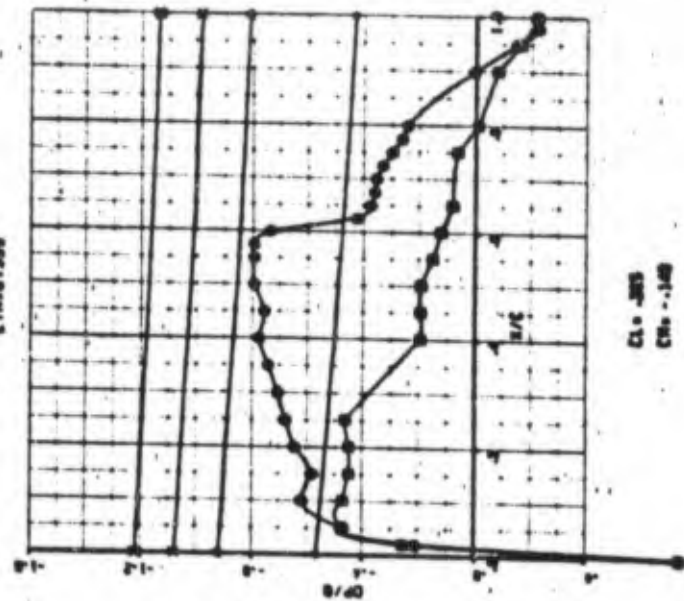


CL = .209  
 CM = -.079

ALTITUDE 37000. FT  
 WEIGHT 23000. LB  
 NZ .40

CG 27.04 X MAC  
 -0.15000 POS  
 FLAP POS 0.00 DEG

ETA=0.309

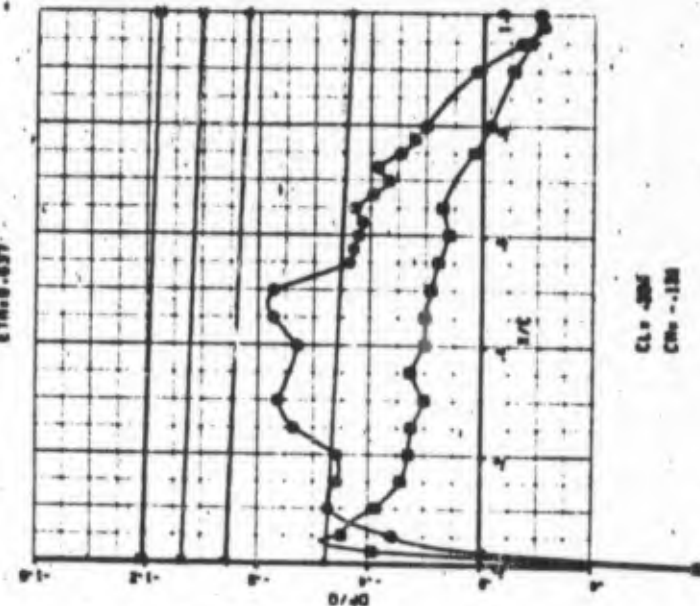


CL = .205  
 CM = -.140

O UPPER SURFACE  
 X LOWER SURFACE

+ MACH LOCAL-1.0  
 X MACH LOCAL-1.3  
 X MACH LOCAL-1.4

ETA=0.837



CL = .206  
 CM = -.126

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 3A1  
 MACH NO .810

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

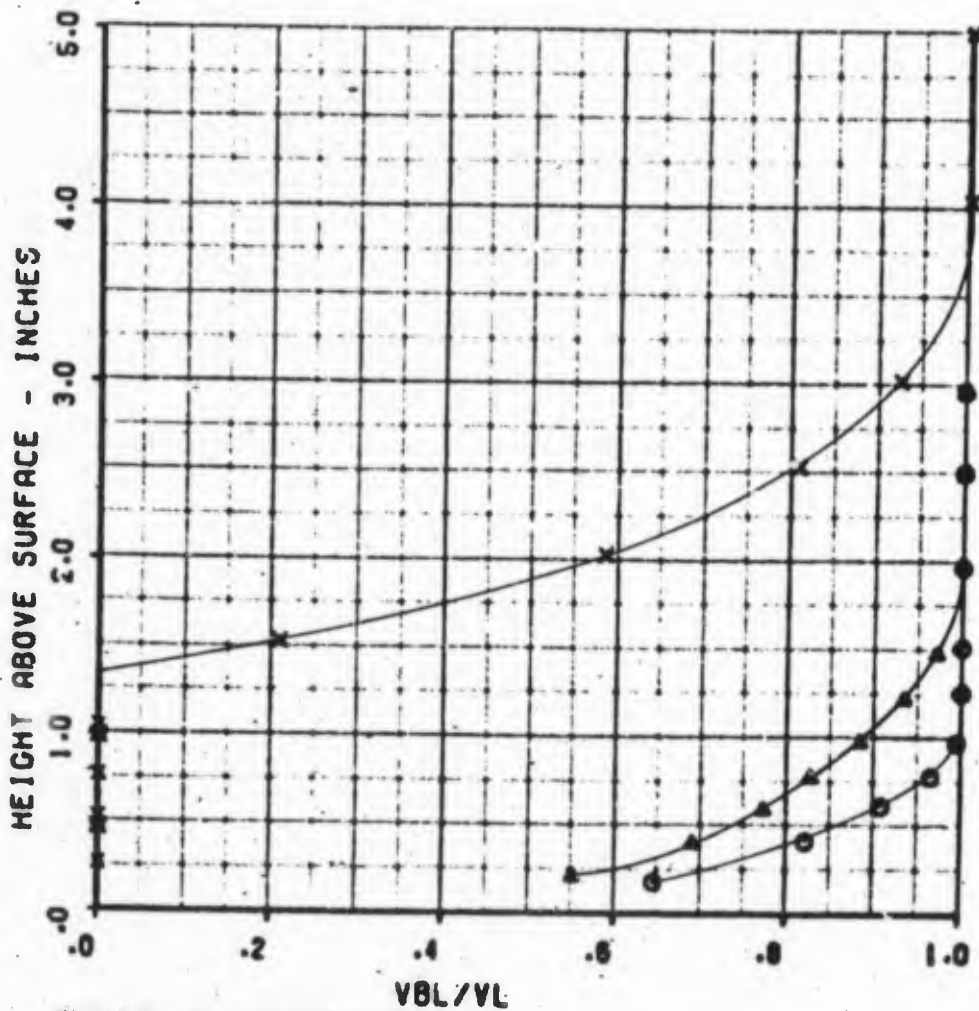


FIGURE 17 (CONTINUED)  
 (e) CORRECTED ALPHA = -0.60

# LOCKHEED C-141R PRESSURE DISTRIBUTION

FLIGHT NO 548  
RUN NO 391  
MACH NO .810

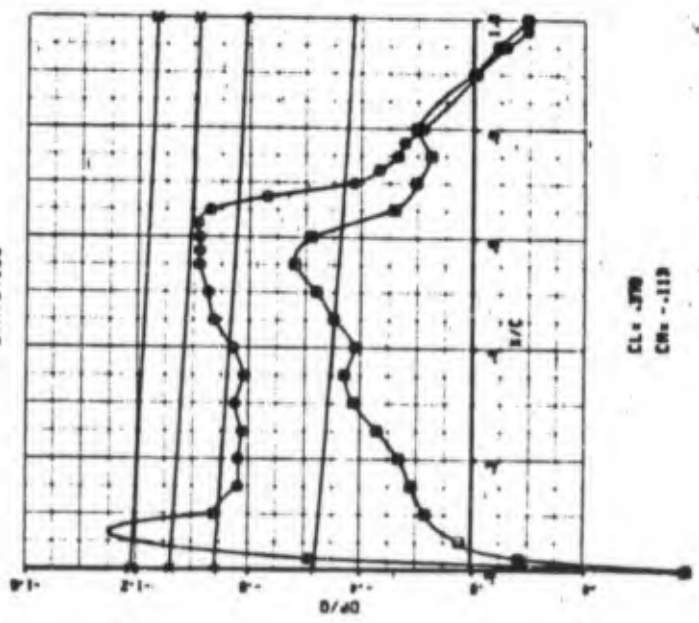
$\alpha$  1.54 PSI  
ALPHA -1.25 DEG  
TRW -54.5 DEG C

ALTITUDE 30540. FT  
WEIGHT 226500. LB  
NZ .87

CO<sup>2</sup> 21.34 X MAC  
AILERON POS -2.03 DEG  
FLAP POS 0.00 DEG

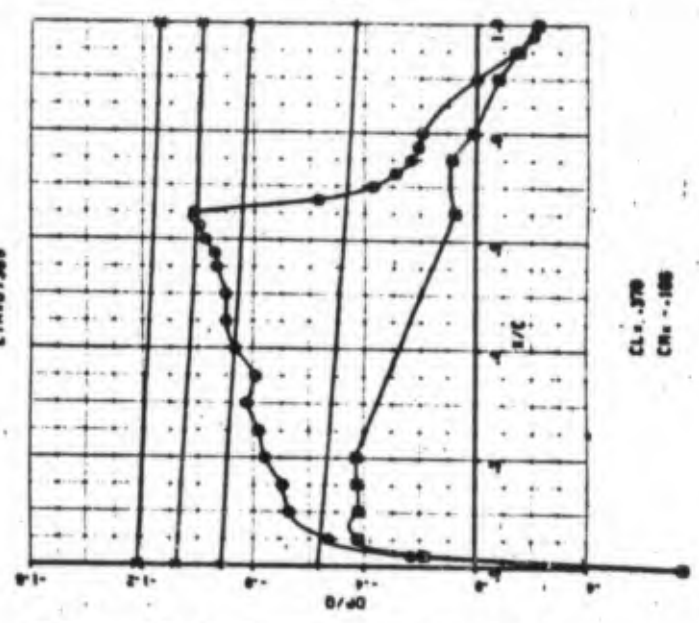
UPPER SURFACE  
LOWER SURFACE  
MACH LOCAL-1.0  
MACH LOCAL-1.2  
MACH LOCAL-1.3  
MACH LOCAL-1.4

ETA=0.193



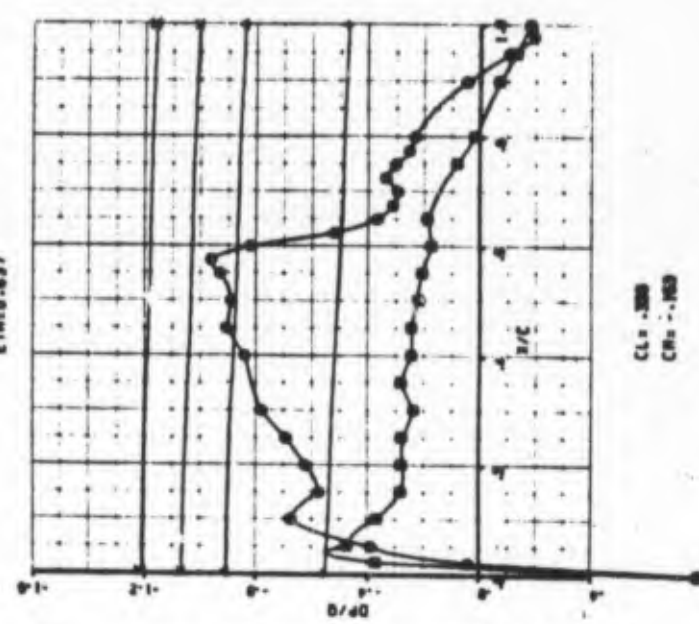
CLx .378  
CMx -.113

ETA=0.309



CLx .378  
CMx -.106

ETA=0.637



CLx .388  
CMx -.103

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 303  
 MACH NO .800

## RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✖ 80 % (AFT)

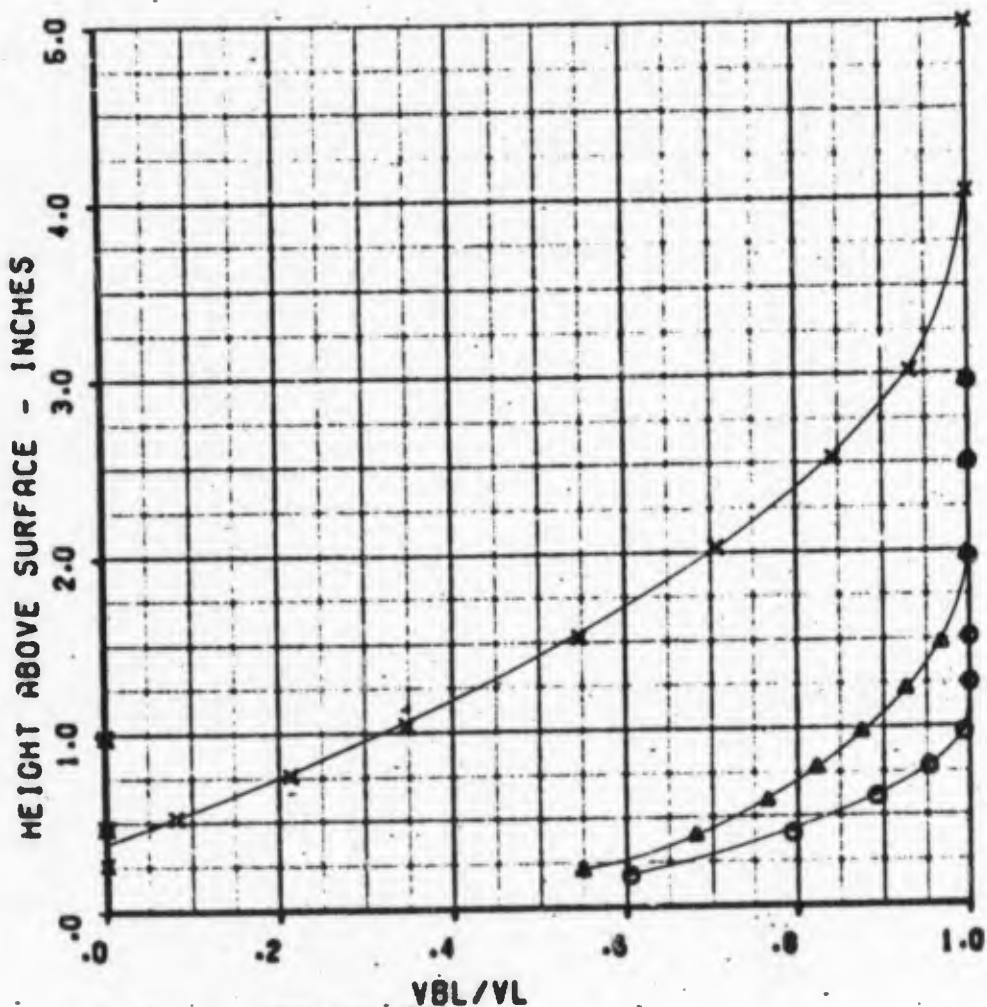
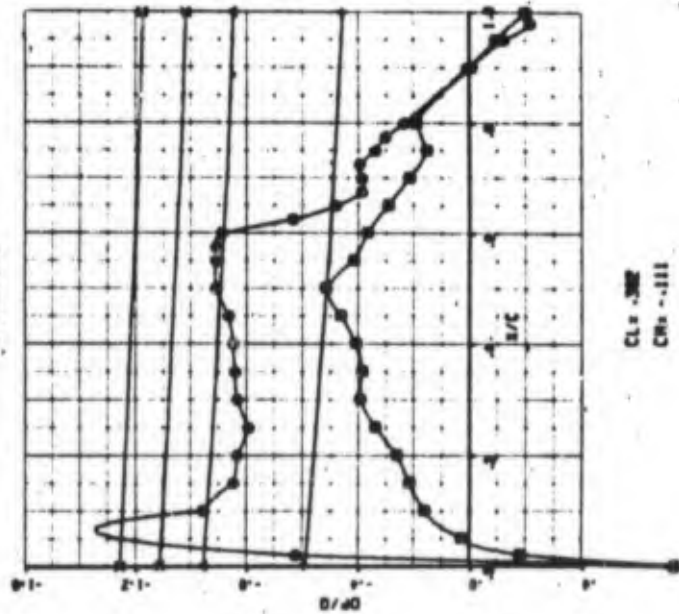


FIGURE 17 (CONTINUED)  
 (f) CORRECTED ALPHA = -0.18

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 547      0      1.29 PSI  
 RUN NO 303      ALPHA      -.77 DEG  
 MACH NO .800      TRN      -53.8 DEG C

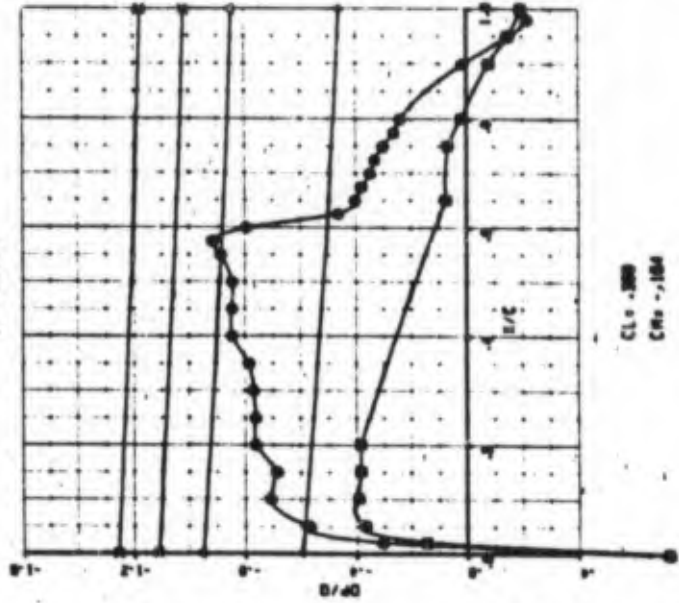
ETA=0.193



CLx .302  
 CWx -.111

ALTITUDE 30700. FT  
 WEIGHT 232760. LB  
 WZ .49

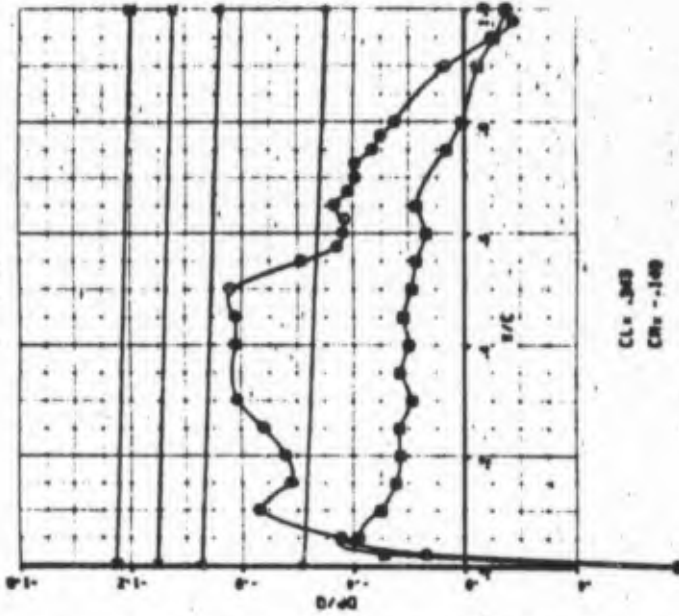
ETA=0.309



CLx .309  
 CWx -.104

CD 27.05 ± MACH  
 AILERON POS -17 DEG  
 FLAP POS 0.00 DEG

ETA=0.837



CLx .343  
 CWx -.149

○ UPPER SURFACE      ▲ MACH LOCAL-1-2  
 □ LOWER SURFACE      × MACH LOCAL-1-3  
 + MACH LOCAL-1-0      ⊗ MACH LOCAL-1-4

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 304  
 MACH NO .792

## RAKE LOCATIONS

○ 30 %  
 △ 55 %  
 × 80 %  
 ⊚ 80 % (AFT)

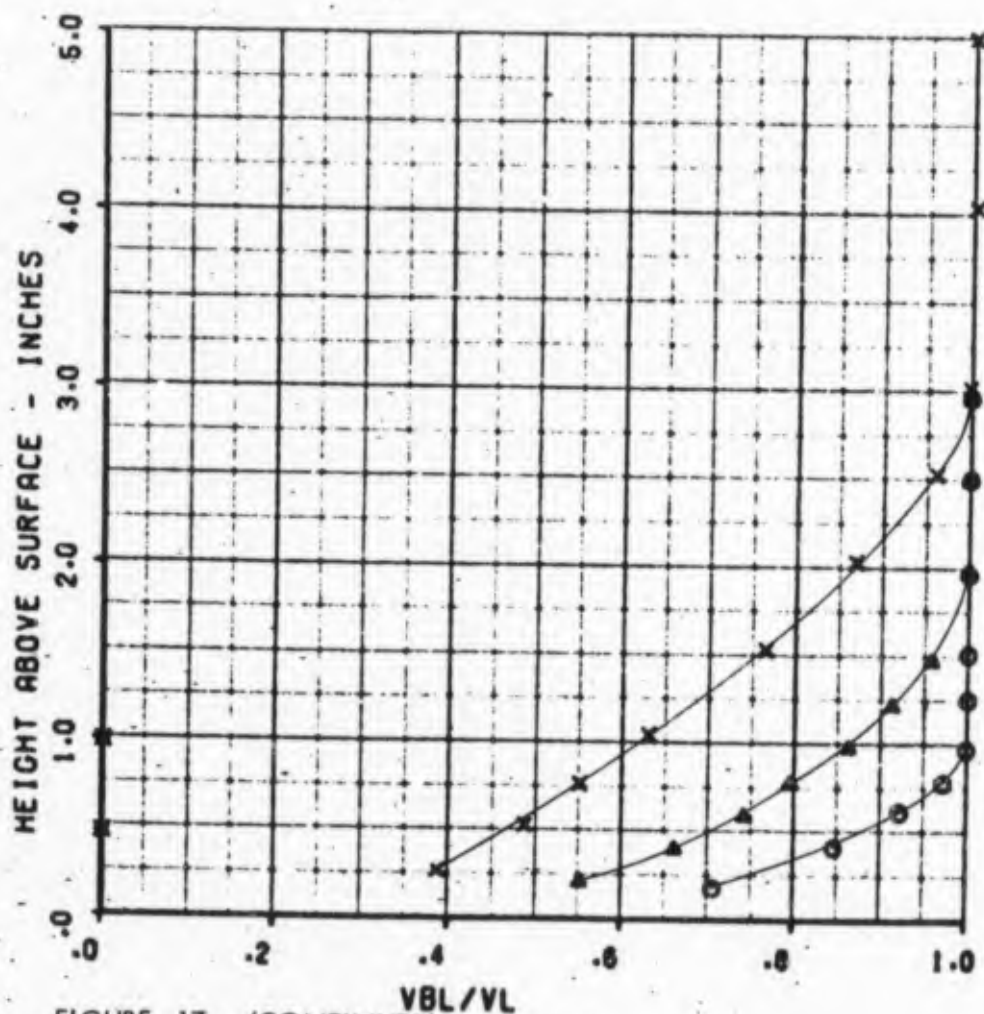


FIGURE 17 (CONTINUED)  
 (g) CORRECTED ALPHA = 0.04

LOCKHEED C-141A

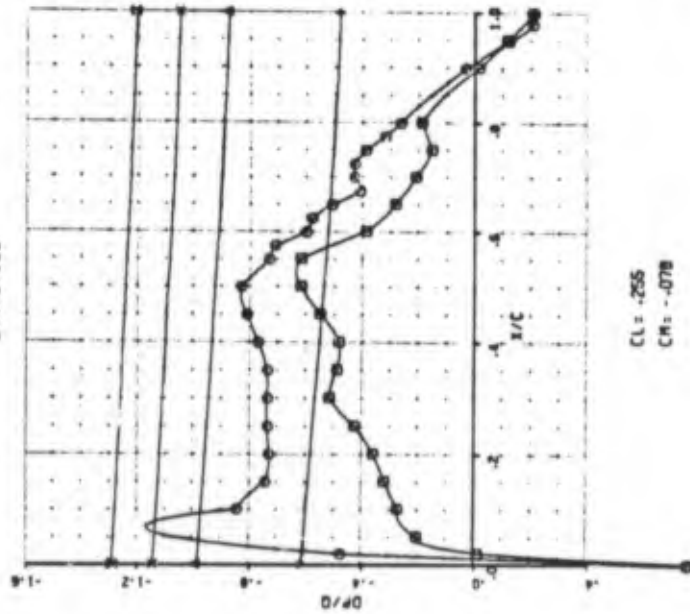
PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN NO 304  
 MACH NO .792

0  
 ALPHA  
 TAN

1.46 PSI  
 -.48 DEG  
 -53.8 DEG C

ETA=0.193



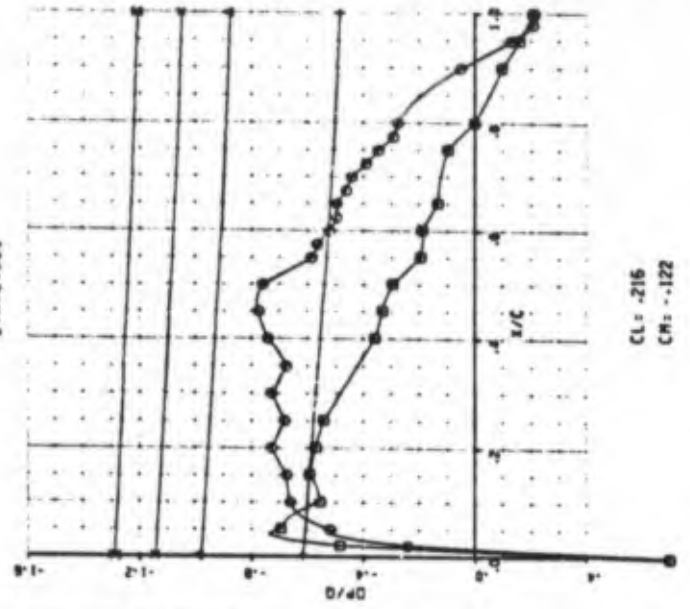
CL = .255  
 CM = -.078

ALTITUDE 35810. FT  
 WEIGHT 232350. LB  
 NZ .19

CO  
 AILERON POS  
 FLAP POS

27.02 % MAC  
 -.60 DEG  
 0.00 DEG

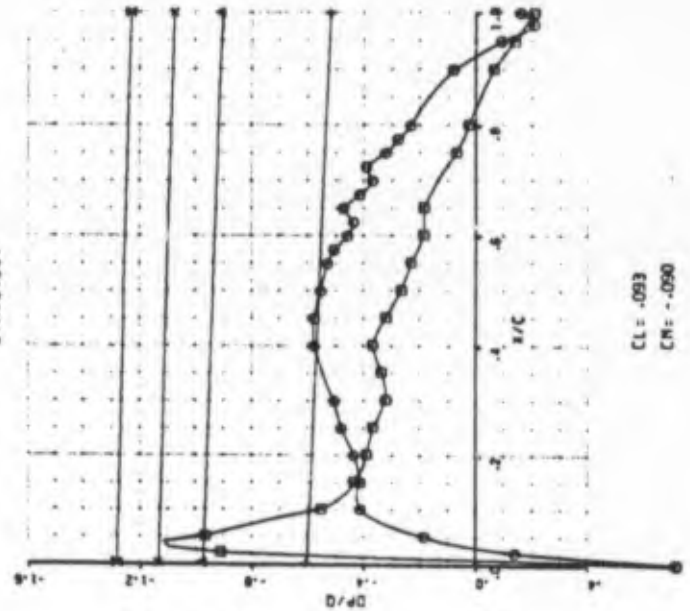
ETA=0.389



CL = .216  
 CM = -.122

O UPPER SURFACE  
 X LOWER SURFACE  
 A MACH LOCAL-1.0  
 X MACH LOCAL-1.4

ETA=0.637



CL = .093  
 CM = -.050

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 30  
 MACH NO .800

## RAKE LOCATIONS -

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

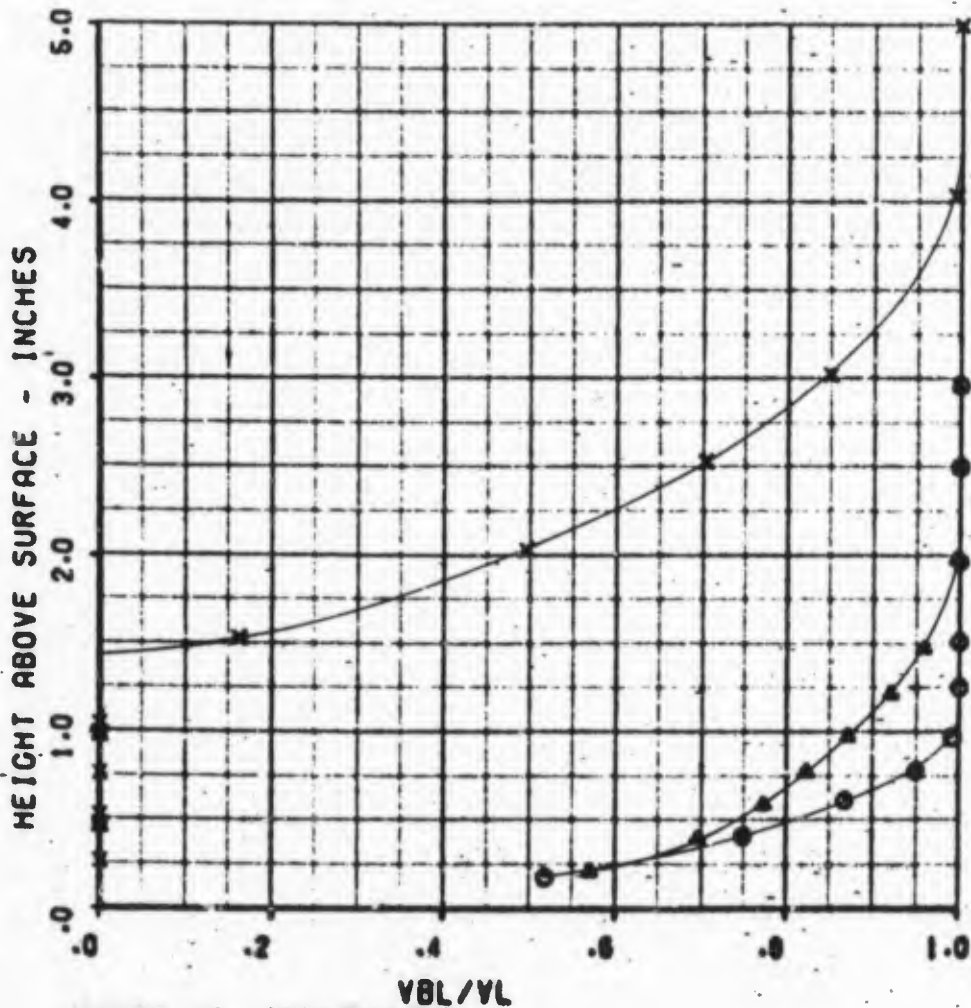


FIGURE 17 (CONTINUED)  
 (h) CORRECTED ALPHA = 0.74

LOCKHEED C-141A  
PRESSURE DISTRIBUTION

FLIGHT NO 547  
RUN NO 30  
MACH NO .800

0  
ALPHA  
TAN

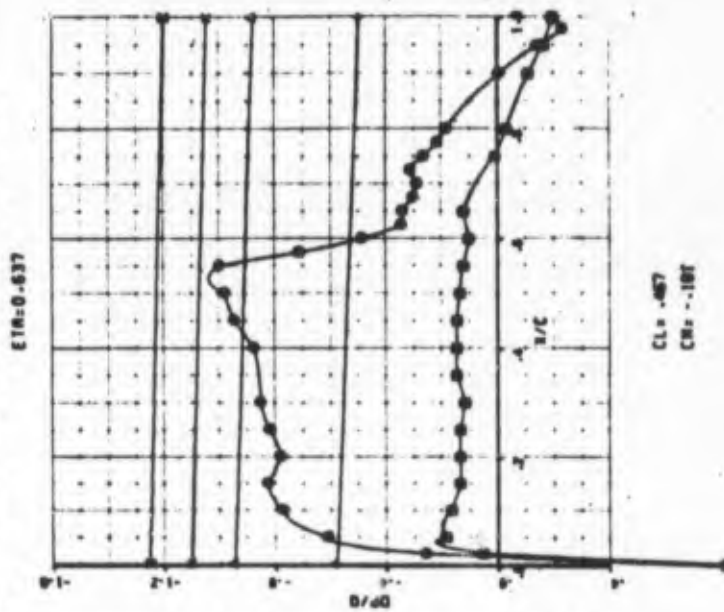
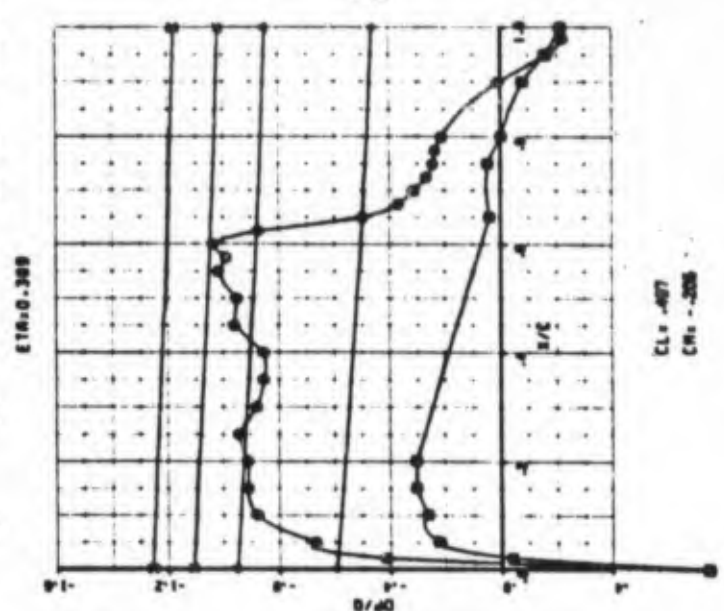
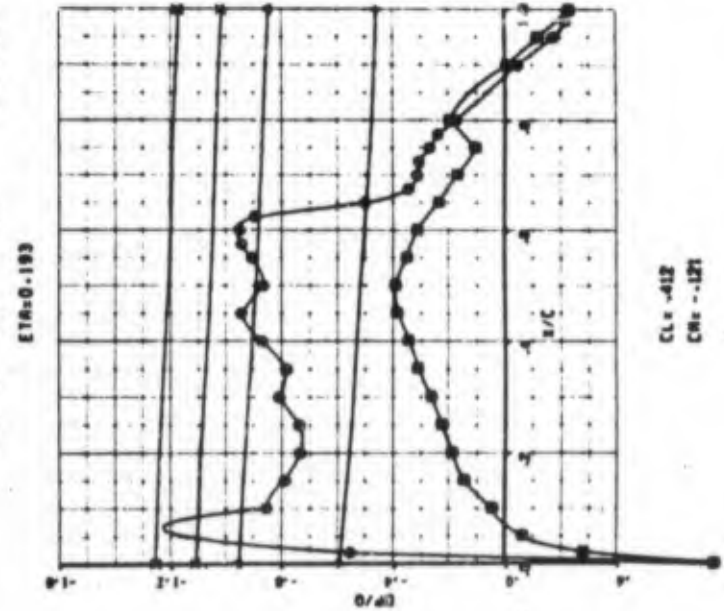
1.25 PSI  
-29 DEG  
-52.6 DEG C

ALTITUDE 39650. FT  
WEIGHT 233000. LB  
NZ .99

CO 27.06 2 MAC  
AILERON POS -26 DEG  
FLAP POS 0.00 DEG

UPPER SURFACE  
LOWER SURFACE  
MACH LOCAL-1.0

MACH LOCAL-1.2  
MACH LOCAL-1.3  
MACH LOCAL-1.4



# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 549  
 RUN NO 2B  
 MACH NO .800

**RAKE LOCATIONS**

○ 30 %  
 △ 55 %  
 × 80 %  
 \* 80 % (AFT)

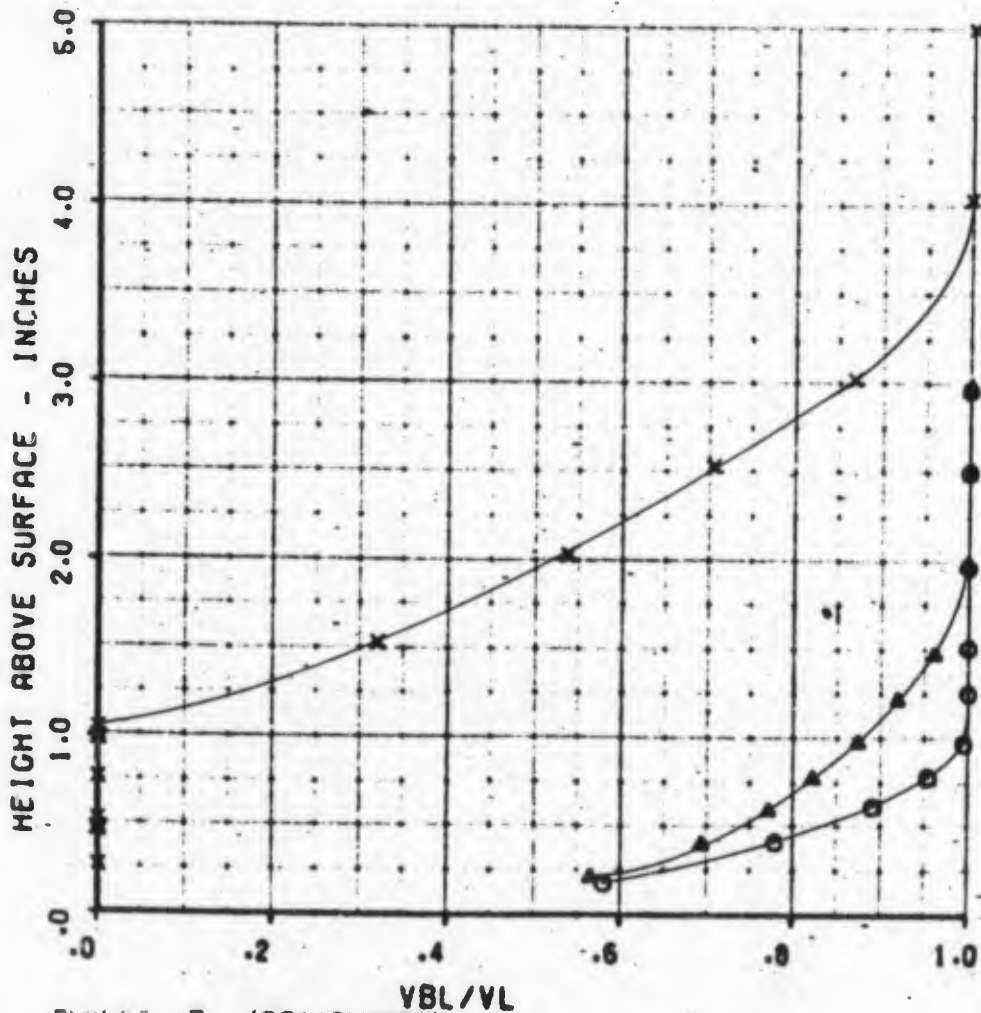


FIGURE 17 (CONCLUDED)  
 (k) CORRECTED ALPHA = 1.25.

LOCKHEED C-141A  
PRESSURE DISTRIBUTION

FLIGHT NO 549  
RUN NO ZB  
MACH NO .800

Q  
ALPHA  
TRN

1.27 PSI  
.87 DEG  
-88.4 DEG C

ALTITUDE 30000. FT  
WEIGHT 232550. LB  
MZ .99

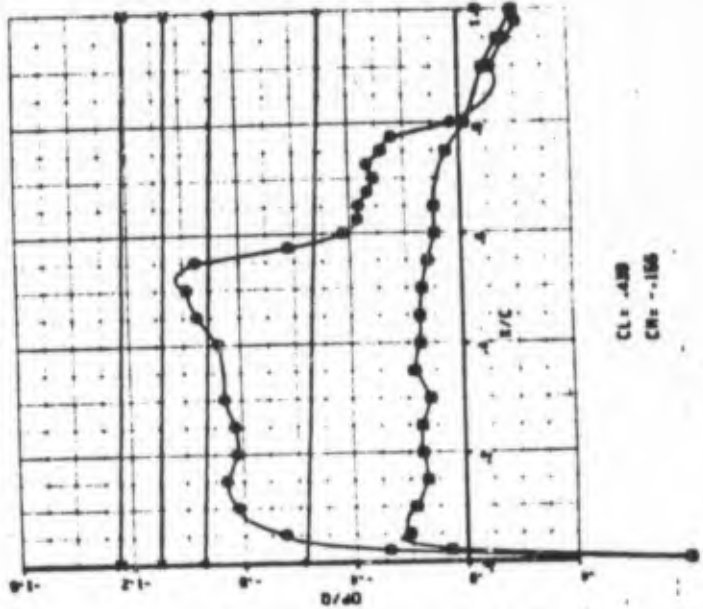
CO 23.65 X MAC  
AILERON POS .25 DEG  
FLAP POS 0.00 DEG

UPPER SURFACE  
LOWER SURFACE  
MACH LOCAL-1.0  
MACH LOCAL-1.2  
MACH LOCAL-1.3  
MACH LOCAL-1.4

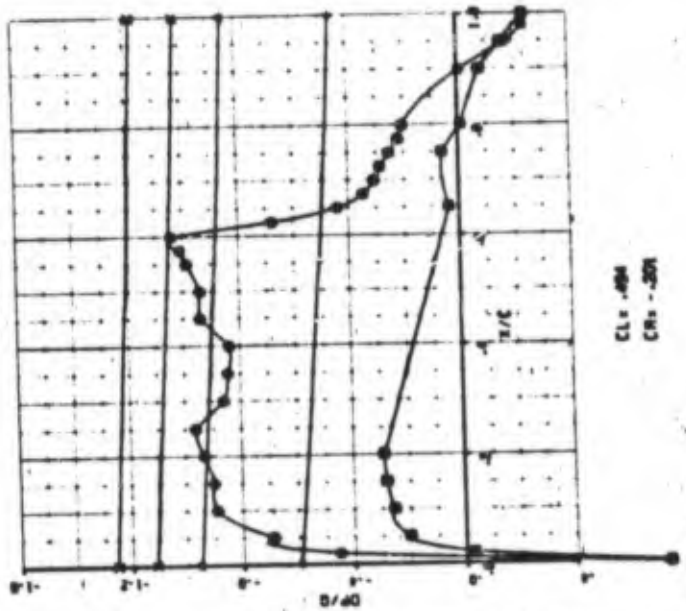
ETA=0.837

ETA=0.388

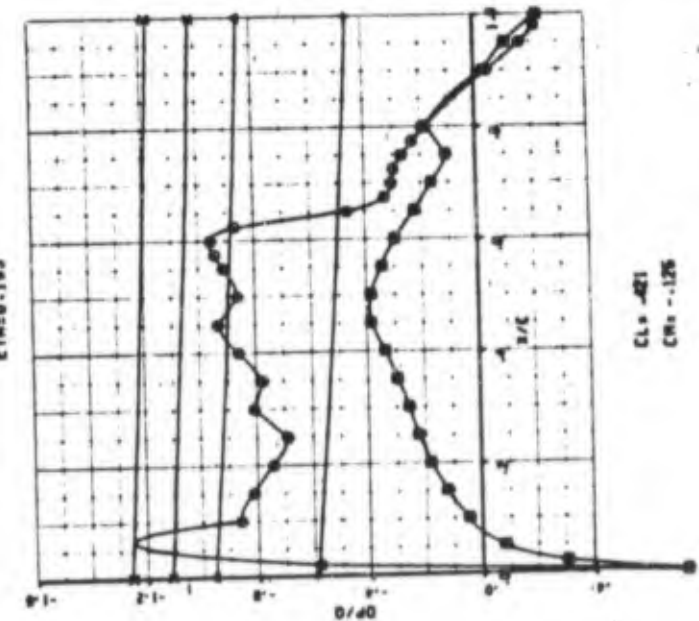
ETA=0.193



CL= .421  
CR= -.125



CL= .421  
CR= -.125



CL= .421  
CR= -.125

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 3A5  
 MACH NO .826

## RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AF1)

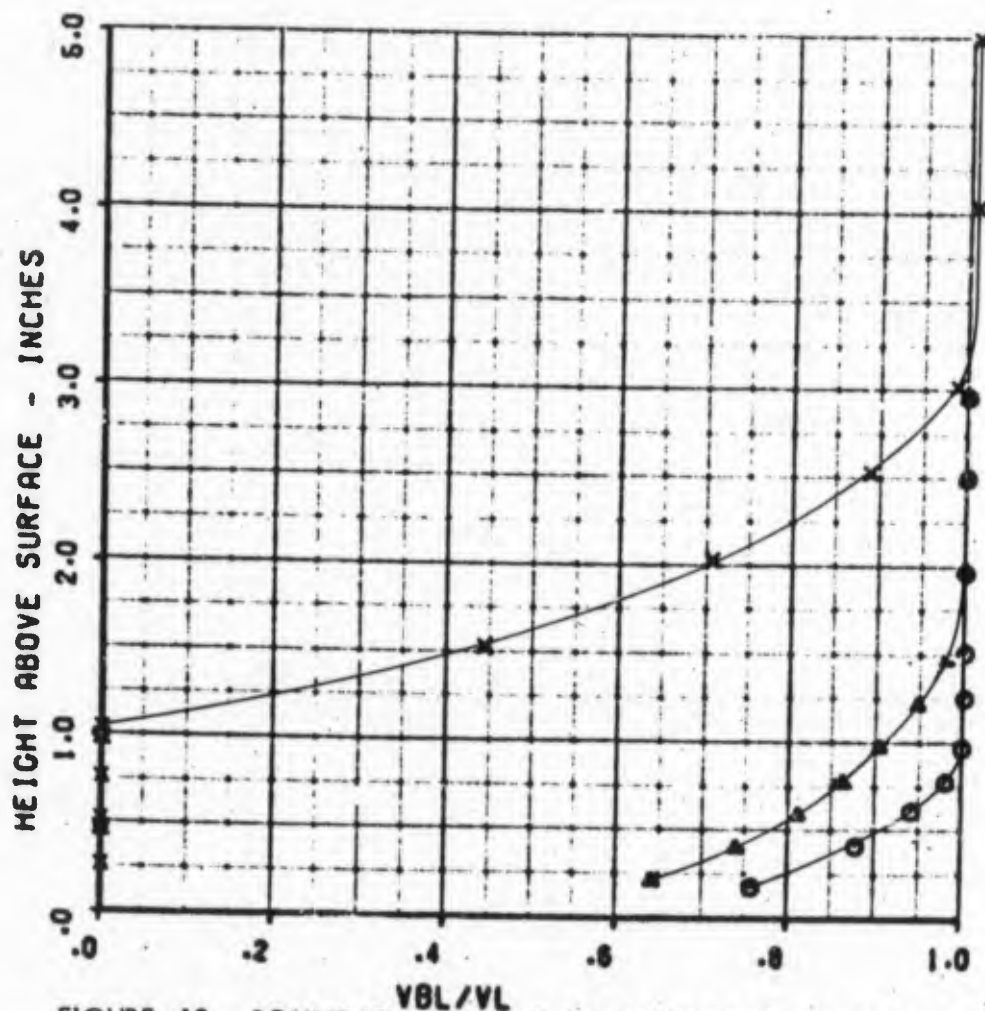


FIGURE 18 BOUNDARY LAYER VELOCITY PROFILES AND PRESSURE DISTRIBUTIONS  
 MACH .820 TO .830

(a) CORRECTED ALPHA = -2.55

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 548  
 RUN NO 345  
 MACH NO .825

0  
 ALPMA  
 TRN

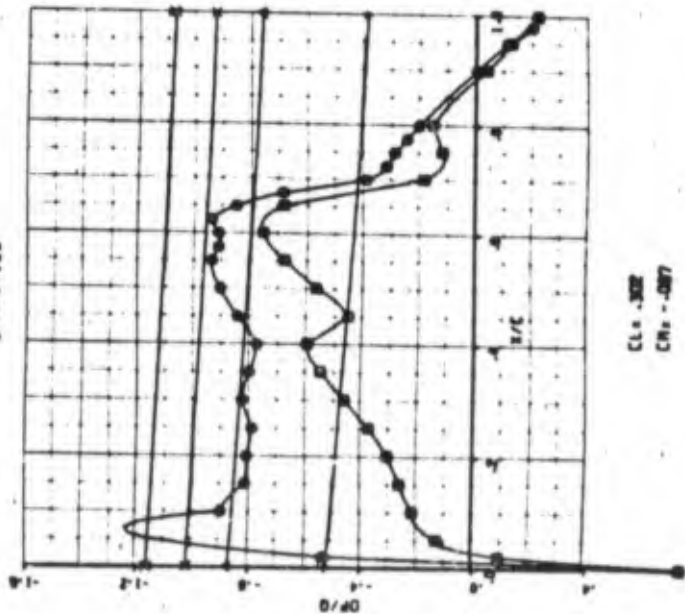
1-61 DEG  
 -3-45 DEG  
 -57-0 DEG C

ALTITUDE 36470. FT  
 WEIGHT 221650. LB  
 NZ .14

CO 20.52 Z MAC  
 AILERON POS -56 DEG  
 FLAP POS 0.00 DEG

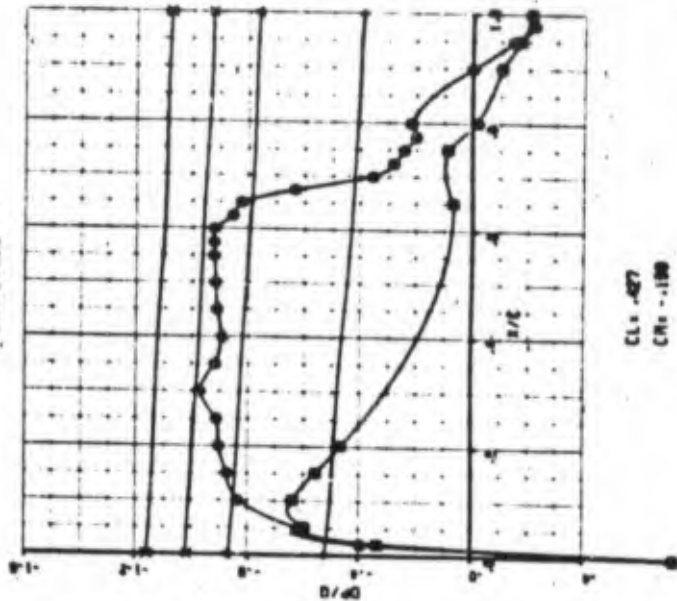
O UPPER SURFACE  
 □ LOWER SURFACE  
 + MACH LOCAL-1.0  
 Δ MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 ⊞ MACH LOCAL-1.4

ETA=0.193



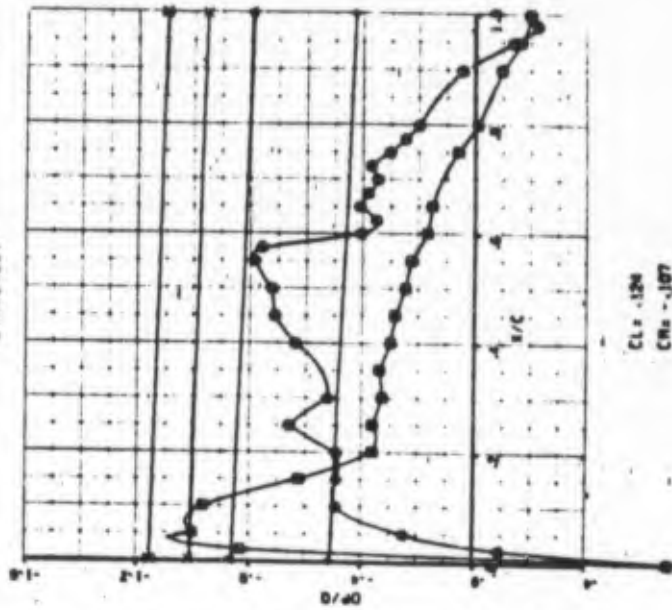
CL = .302  
 CR = -.087

ETA=0.308



CL = .427  
 CR = -.188

ETA=0.637



CL = .124  
 CR = -.107

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 3A4  
 MACH NO .822

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

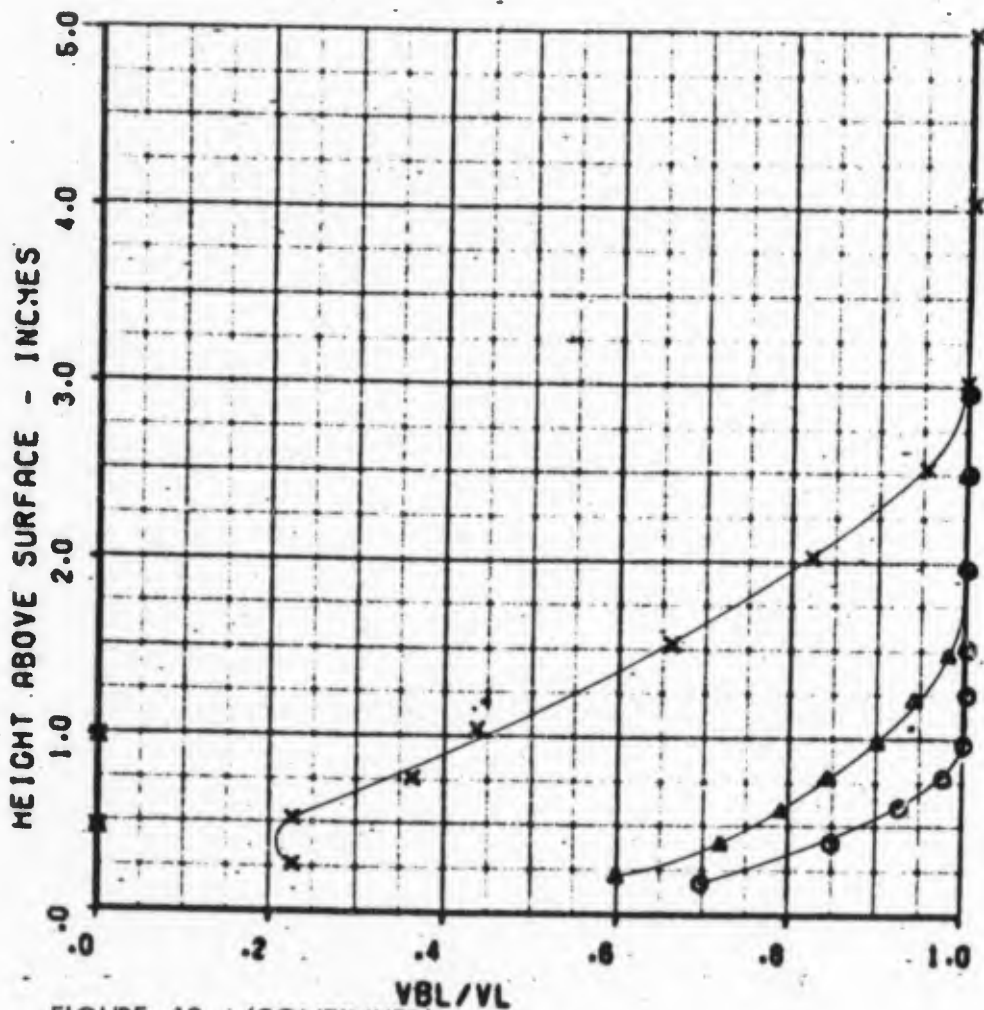


FIGURE 18 (CONTINUED)  
 (b) CORRECTED ALPHA = -2.28

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 548  
 RUN NO 344  
 MACH NO .822

0  
 ALPHA  
 TAP

1.55 PSI  
 -3.16 DEG  
 -55.2 DEG C

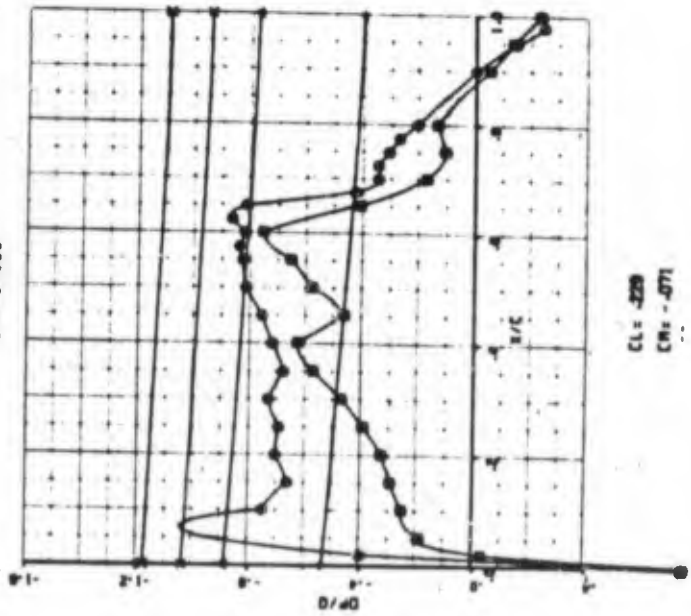
ALTITUDE 30050. FT  
 HEIGHT 22200. LB  
 NZ -.21

C0  
 AILERON POS  
 FLAP POS

20.66 Z MAC  
 -.08 DEG  
 0.00 DEG

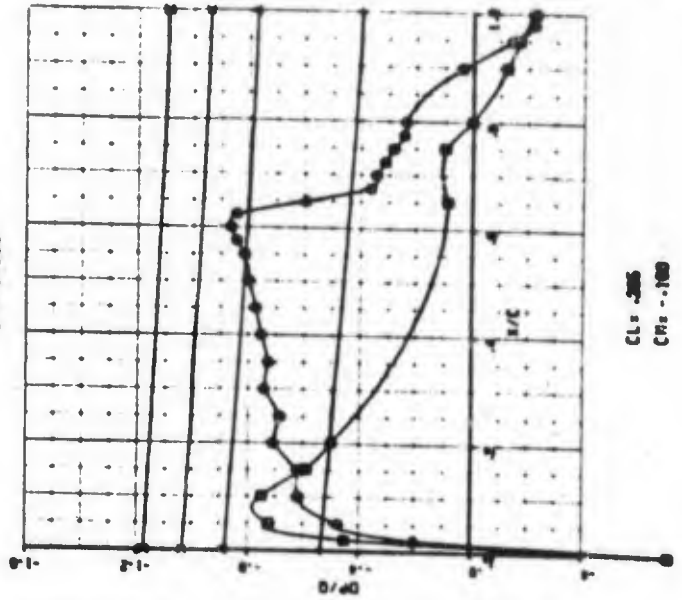
○ UPPER SURFACE  
 □ LOWER SURFACE  
 + MACH LOCAL-1.0  
 △ MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 ⊗ MACH LOCAL-1.4

ETA=0.193



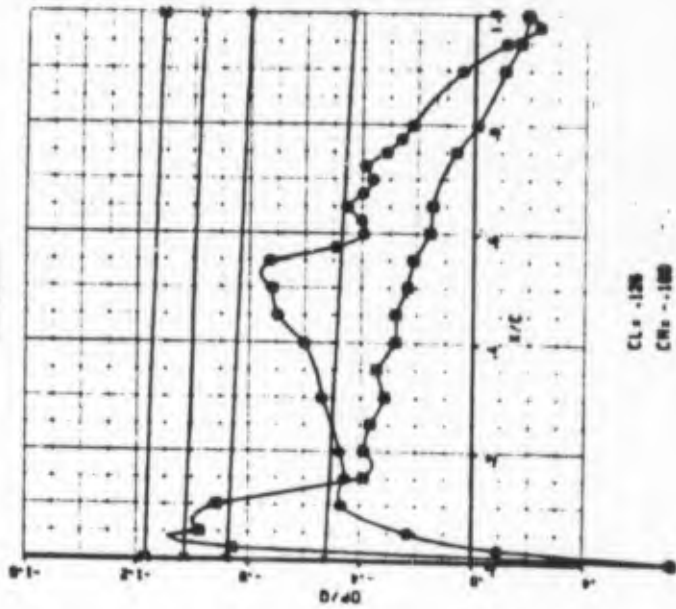
CL= .229  
 CM= -.071

ETA=0.388



CL= .285  
 CM= -.100

ETA=0.637



CL= .128  
 CM= -.188

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 548  
 RUN NO 3A3  
 MACH NO .820

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

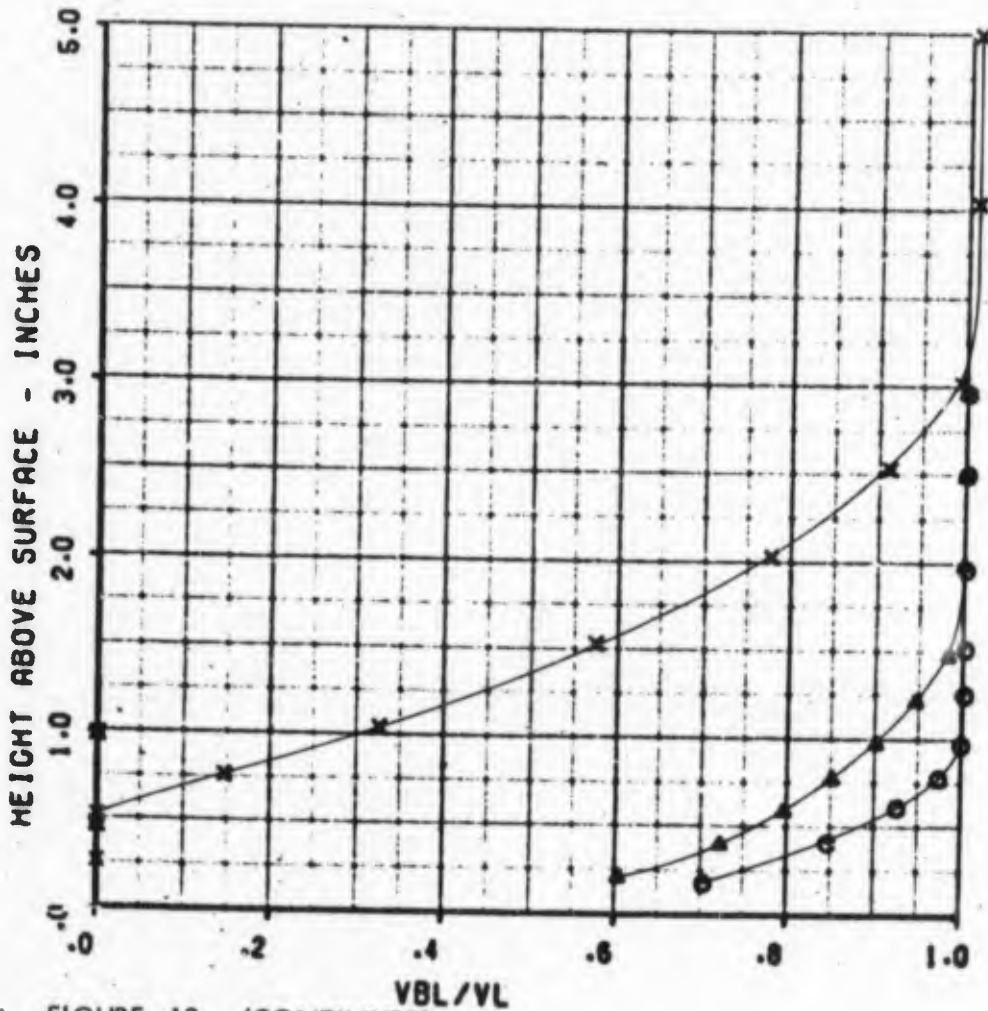


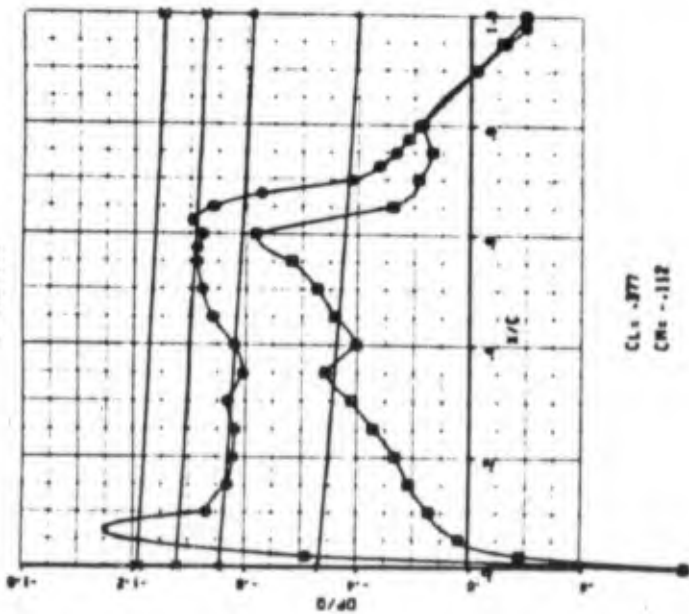
FIGURE 18 (CONTINUED)  
 (c) CORRECTED ALPHA = -1.62

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 548 Q 1.06 PSI  
 RUN NO 383 ALPHR -2.40 DEG  
 MACH NO .820 TAN -57.2 DEG C

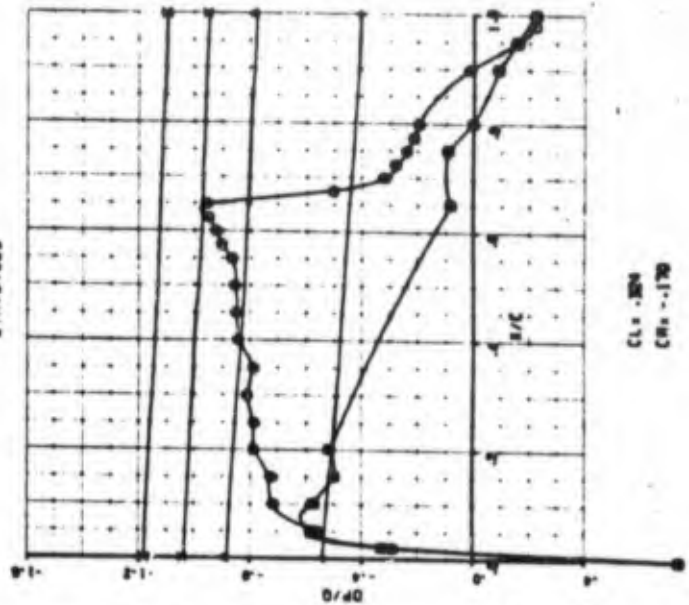
ETA=0.193



ALTITUDE 34560. FT  
 WEIGHT 22300. LB  
 NZ .51

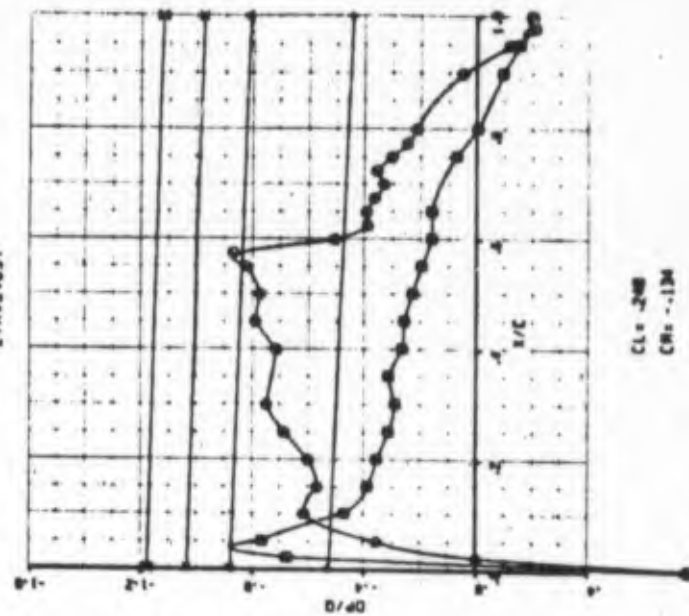
CO 20.80 Z MACH  
 AILERON POS -.08 DEG  
 FLAP POS 0.00 DEG

ETA=0.389



O UPPER SURFACE  
 X LOWER SURFACE  
 + MACH LOCAL-1.0  
 A MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 Z MACH LOCAL-1.4

ETA=0.637



# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 3A2  
 MACH NO .822

## RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

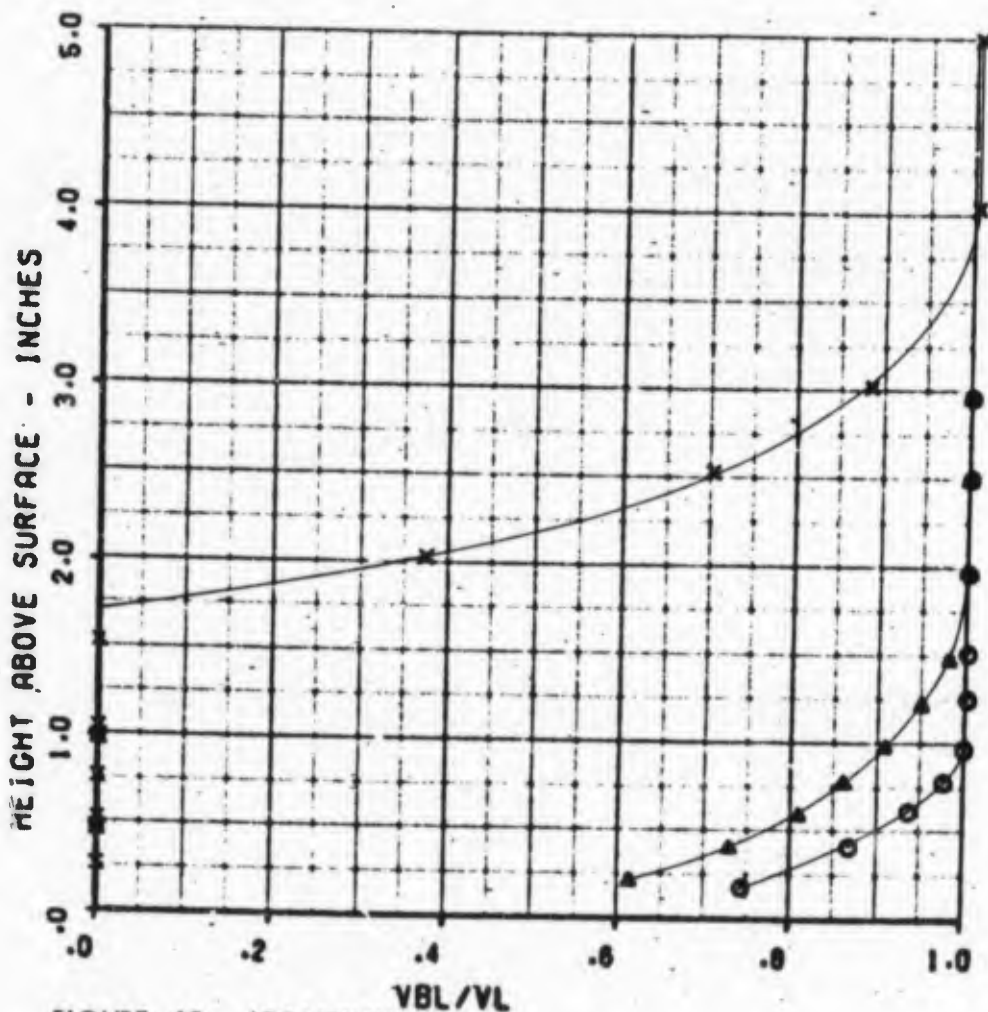


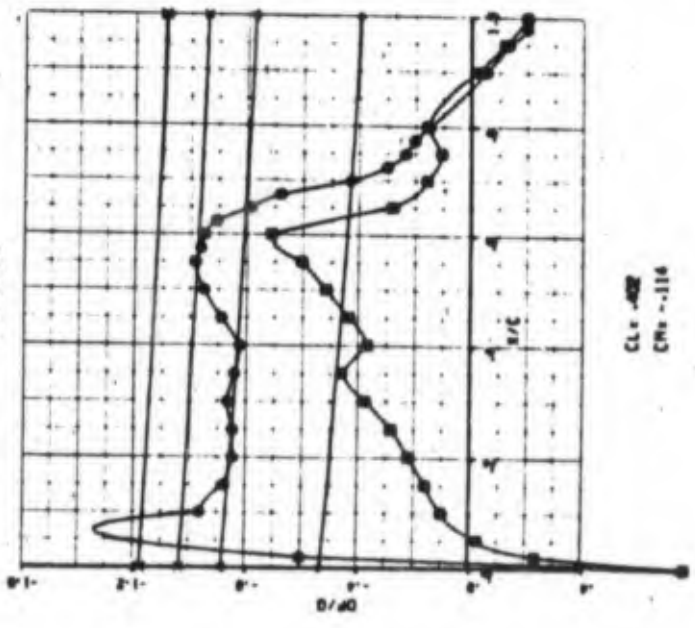
FIGURE 18 (CONTINUED)  
 (d) CORRECTED ALPHA = -1.27

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 548  
RUN NO 3A2  
MACH NO .822

$\alpha$  1.83 PSI  
ALPHA -2.01 DEG  
TAN -55.8 DEG C

ETA=0.193

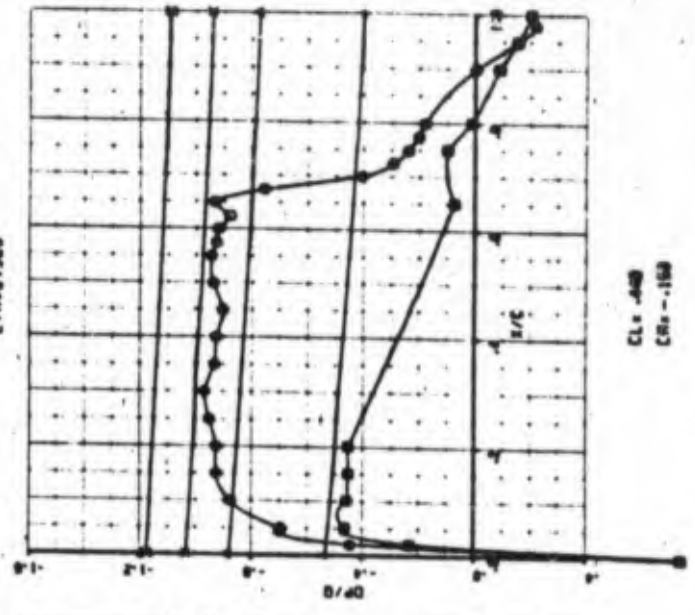


CLx .402  
CMy -.114

ALTITUDE 34970. FT  
WEIGHT 22600. LB  
MZ .83

CO 21-12 1/2 MAC  
AILERON POS -.42 DEG  
FLAP POS 0.00 DEG

ETA=0.389

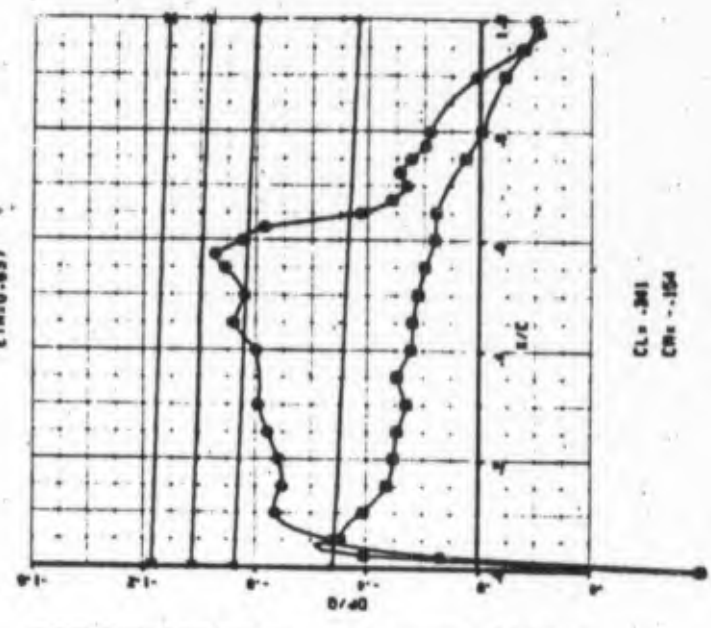


CLx .448  
CMy -.159

UPPER SURFACE  
LOWER SURFACE

MACH LOCAL-1.2  
MACH LOCAL-1.3  
MACH LOCAL-1.4

ETA=0.537



CLx .361  
CMy -.154

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 3A  
 MACH NO .824

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AF1)

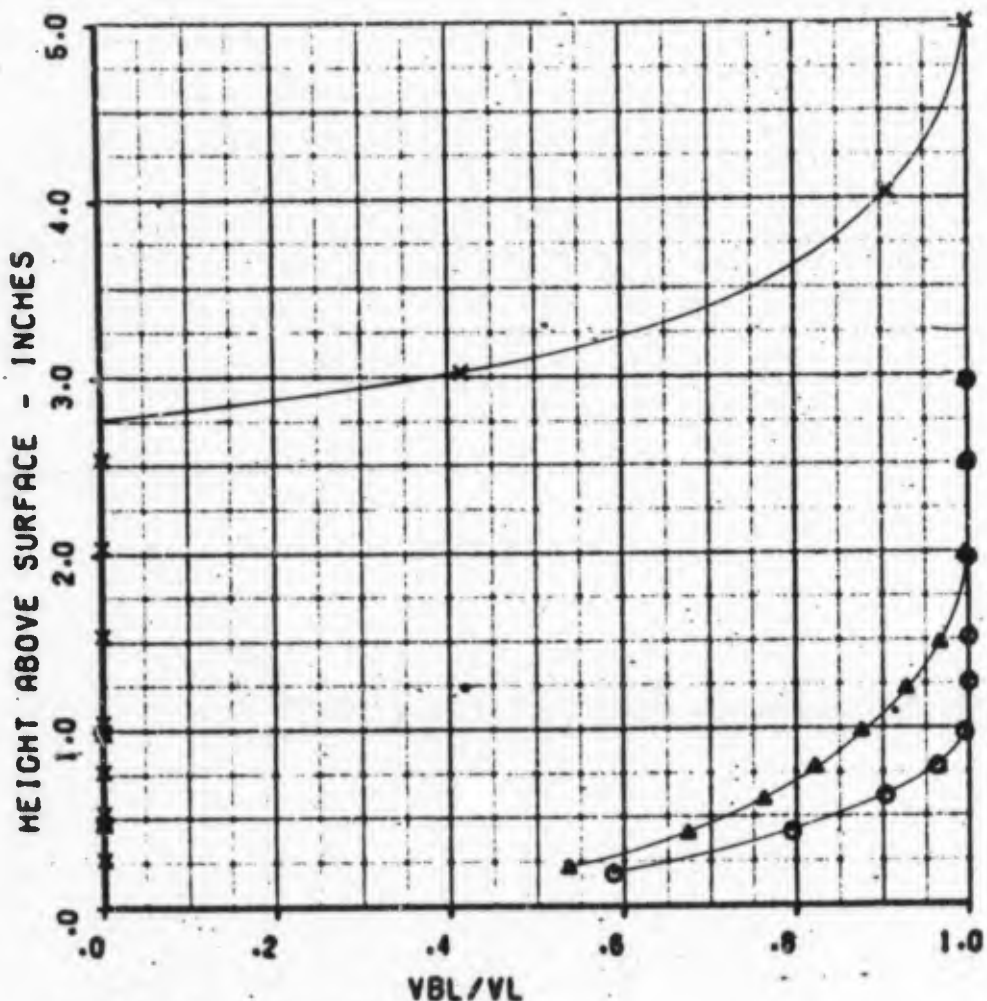
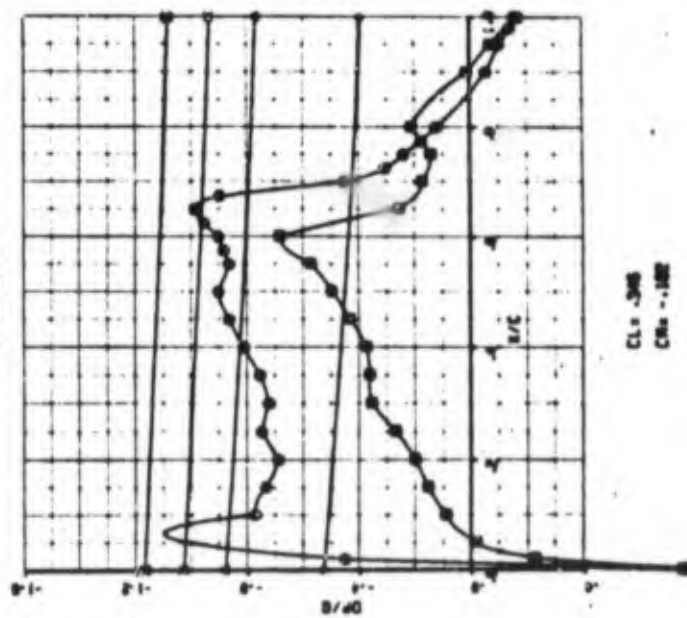


FIGURE 18. (CONTINUED)  
 (e) CORRECTED ALPHA = -0.10

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 548      0      1.54 PSI  
 RUN NO 3A      ALPHA      -57 DEG  
 MACH NO .824      TRN      -54.3 DEG C

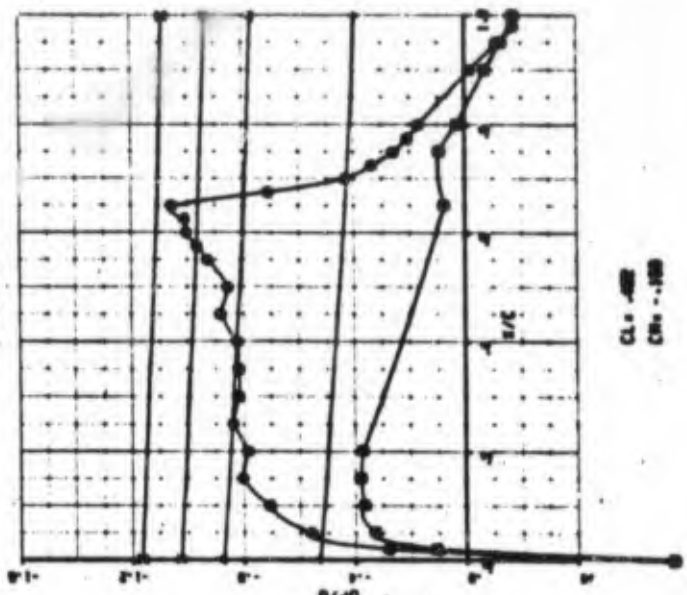
ETR=0.183



CL= .305  
 CR= -.182

ALTITUDE 36250. FT  
 WEIGHT 227000. LB  
 NZ 1.00

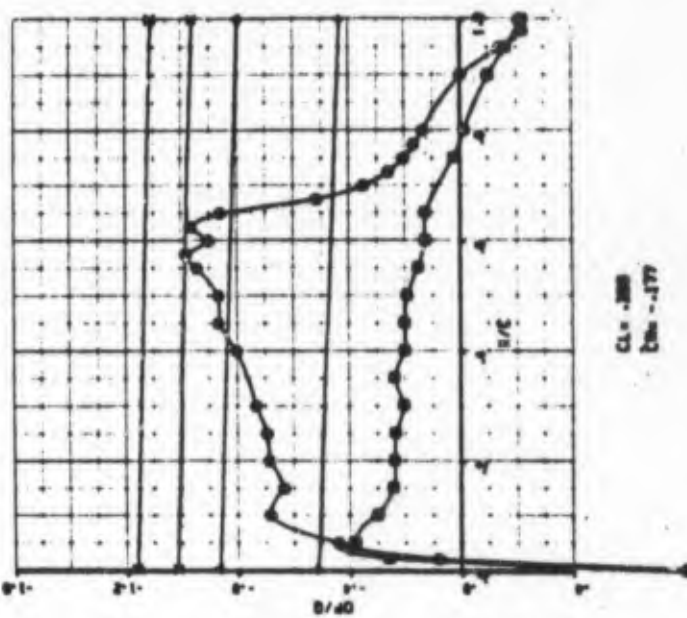
ETR=0.399



CL= .482  
 CR= -.189

CO 21.40 X MAC  
 MILLON POS 0.00 DEG  
 FLAP POS 0.00 DEG

ETR=0.837



CL= .289  
 CR= -.177

O UPPER SURFACE      A MACH LOCAL-1.2  
 X LOWER SURFACE      X MACH LOCAL-1.3  
 + MACH LOCAL-1.0      X MACH LOCAL-1.4

# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 3E  
 MACH NO .825

### RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✖ 80 % (AFT)

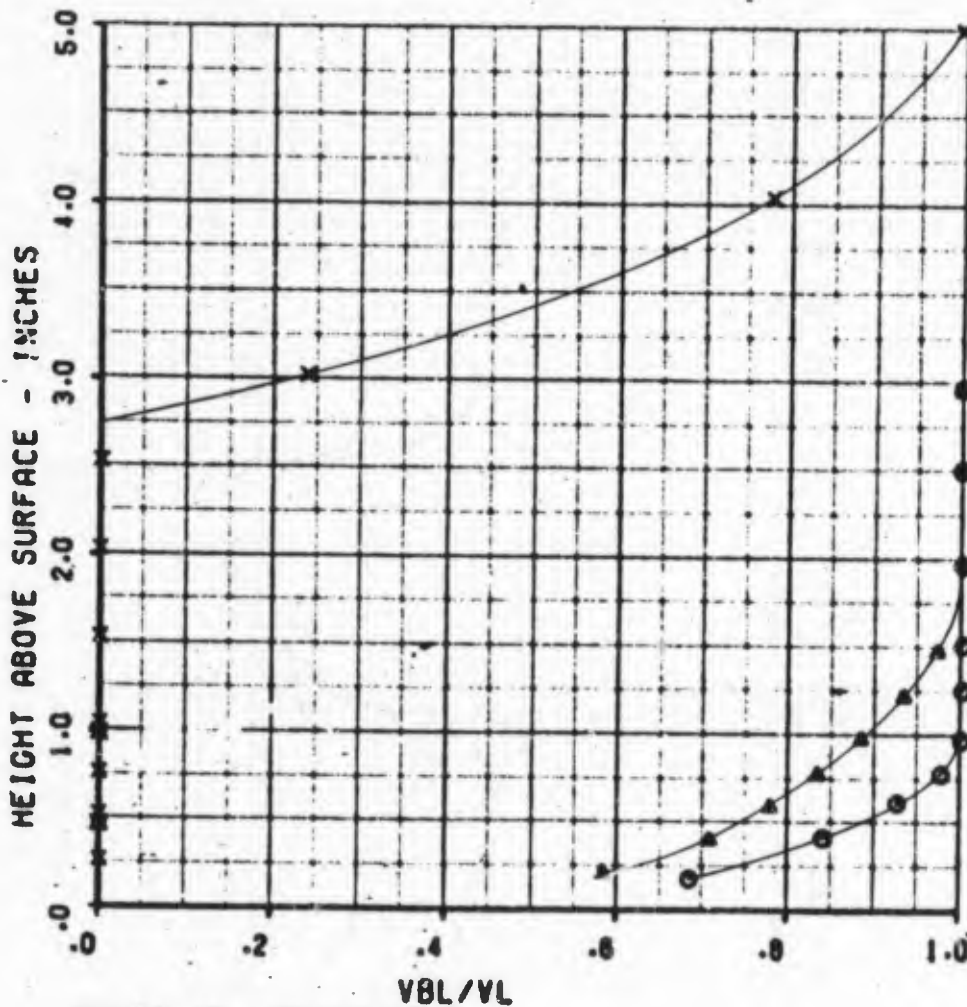


FIGURE 18 (CONTINUED)  
 (f) CORRECTED ALPHA = 0.83

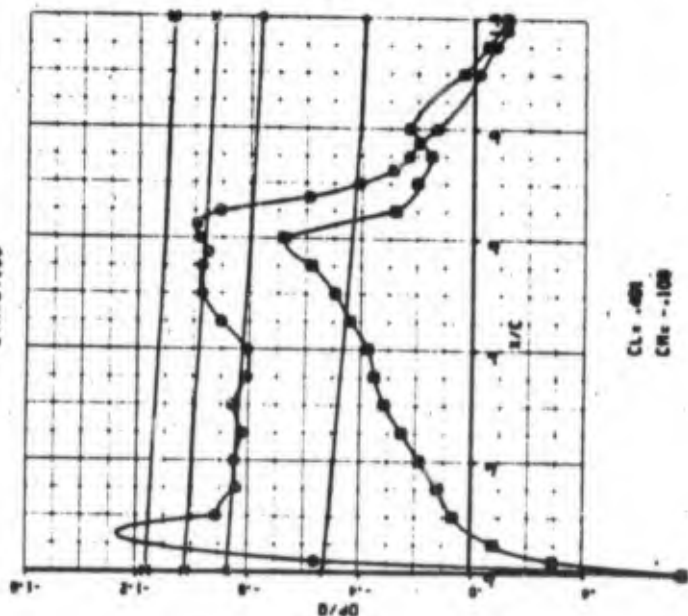
# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 547  
 RUN NO 3E  
 MACH NO .825

Q  
 ALPHA  
 °RH

1.39 PSI  
 .39 DEG  
 -55.4 DEG C

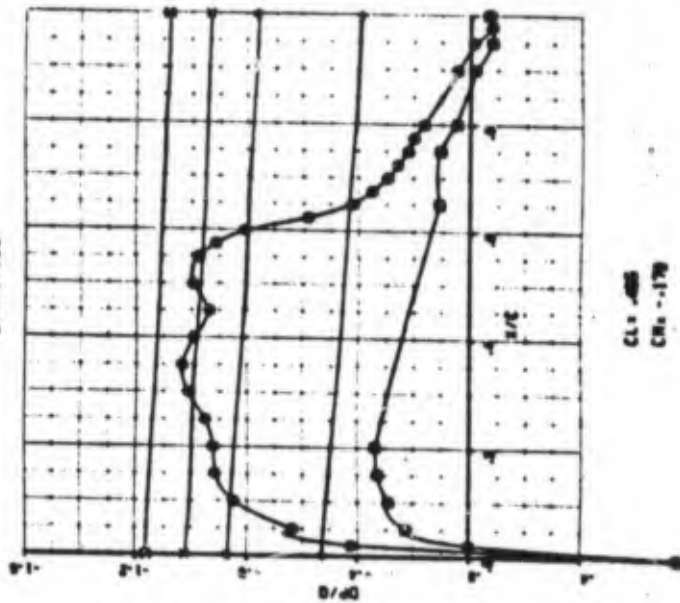
ETA=0.193



ALTITUDE 30440. FT  
 WEIGHT 230000. LB  
 ME 1.02

CO 26.86 ° MACH  
 AILERON POS -1.36 DEG  
 FLAP POS 0.00 DEG

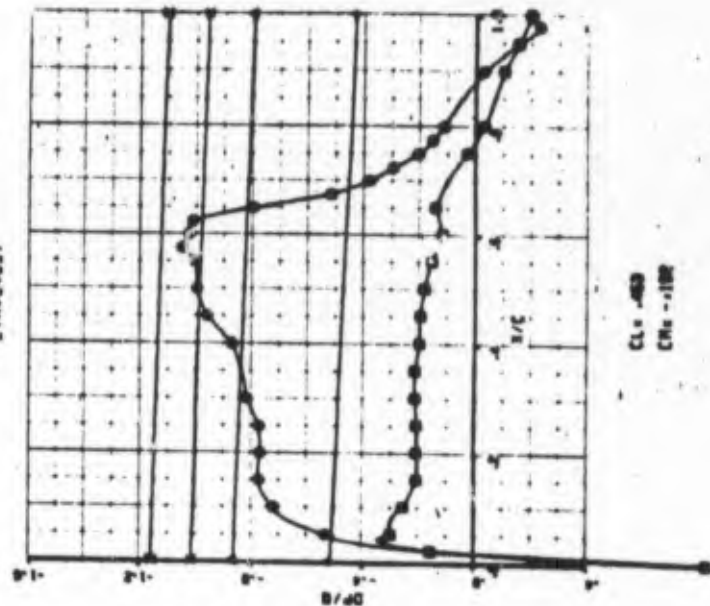
ETA=0.309



UPPER SURFACE  
 LOWER SURFACE

MACH LOCAL-1.2  
 MACH LOCAL-1.3  
 MACH LOCAL-1.4

ETA=0.837



# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 549  
 RUN NO 2C  
 MACH NO .820

## RAKE LOCATIONS

○ 30 %  
 △ 55 %  
 × 80 %  
 \* 80 % (AFT)

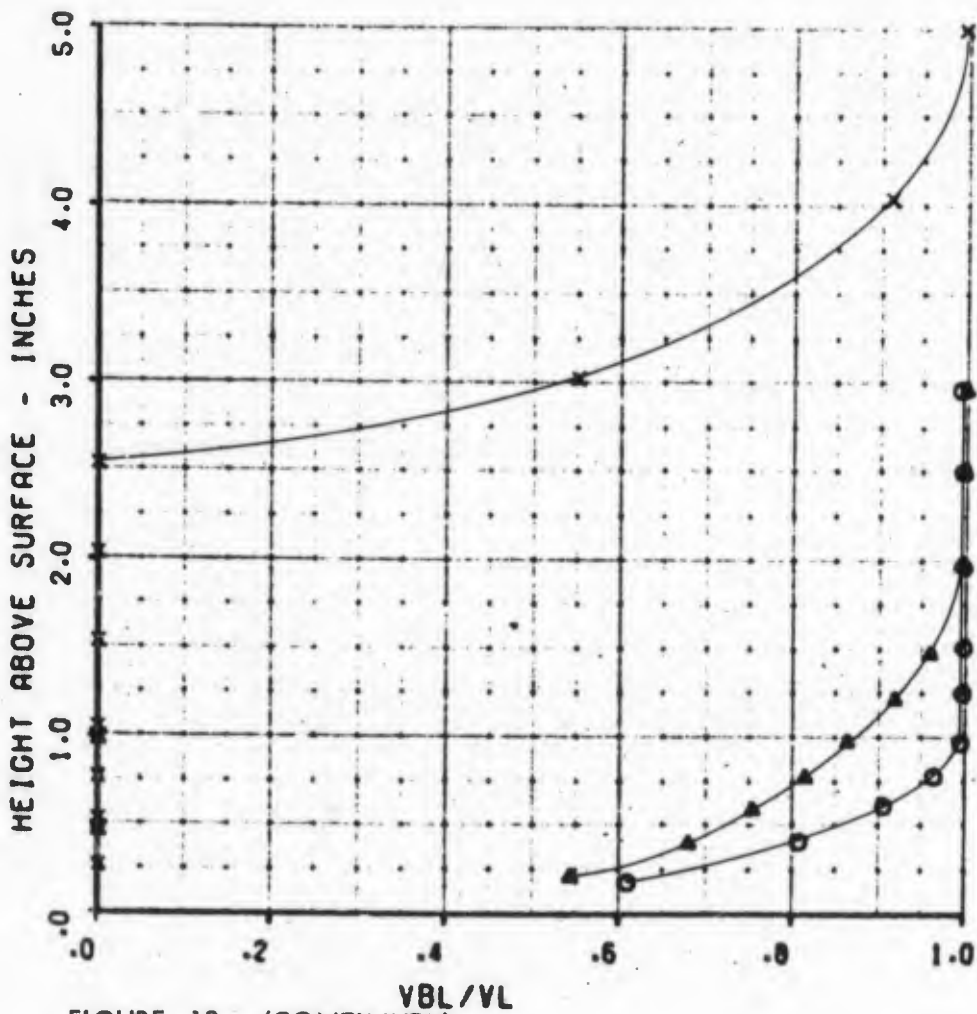


FIGURE 18 (CONTINUED)  
 (g) CORRECTED ALPHA = 1.10

LOCKHEED C-141A  
PRESSURE DISTRIBUTION

FLIGHT NO 549  
RUN NO 2C  
MACH NO .820

0  
ALPHA  
TRN

38570. FT  
WEIGHT 23000. LB  
MZ .98

23-50 Z MAC  
AILERON POS .34 DEG  
FLAP POS 0.00 DEG

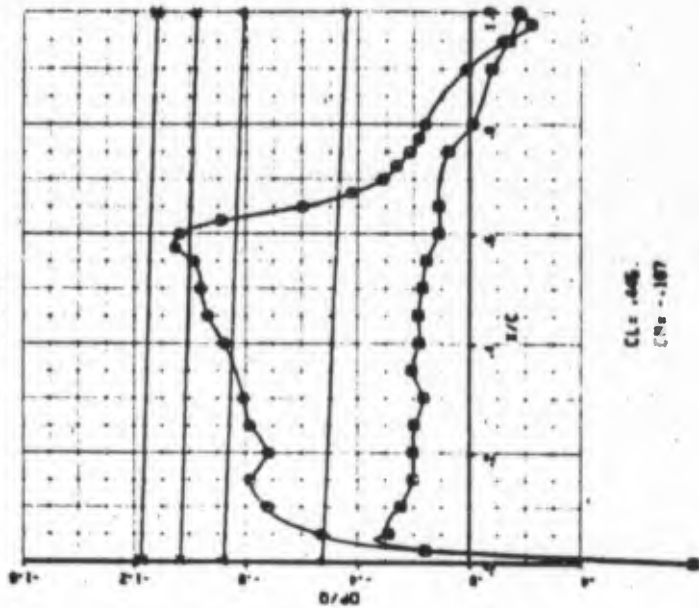
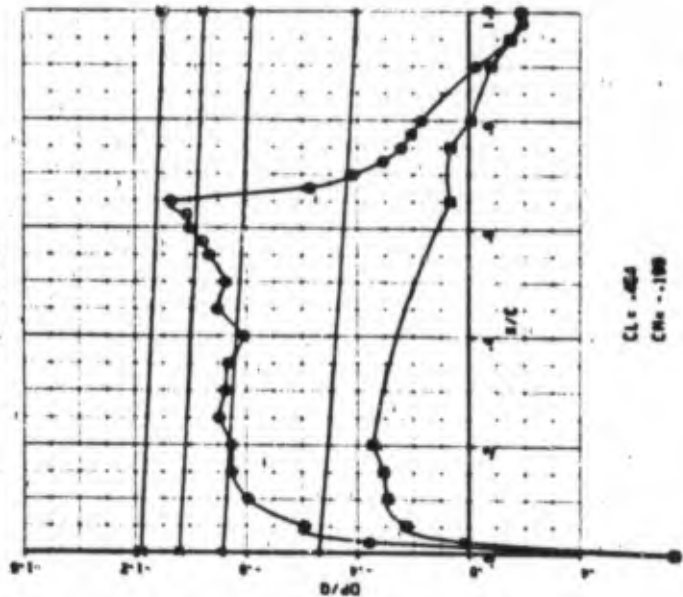
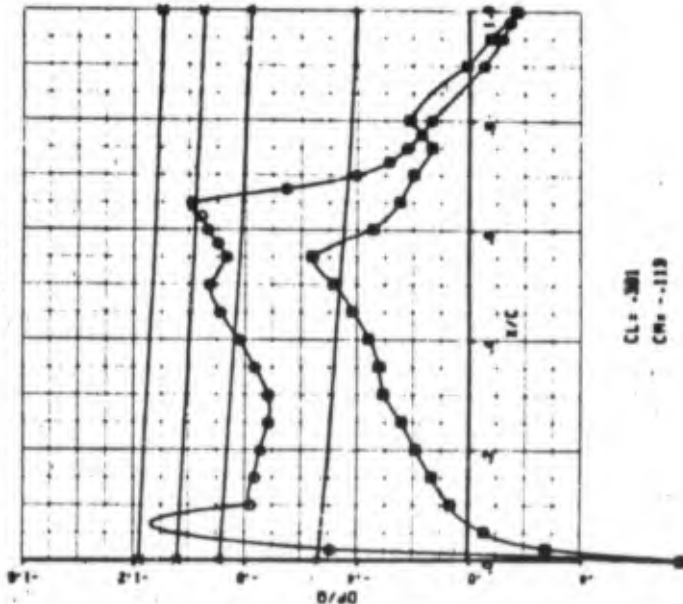
UPPER SURFACE  
LOWER SURFACE  
MACH LOCAL-1.0

MACH LOCAL-1.2  
MACH LOCAL-1.3  
MACH LOCAL-1.4

ETA=0.193

ETA=0.389

ETA=0.637



# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 549  
 RUN NO 20  
 MACH NO .830

## RAKE LOCATIONS

○ 30 %  
 △ 55 %  
 × 80 %  
 \* 80 % (AFT)

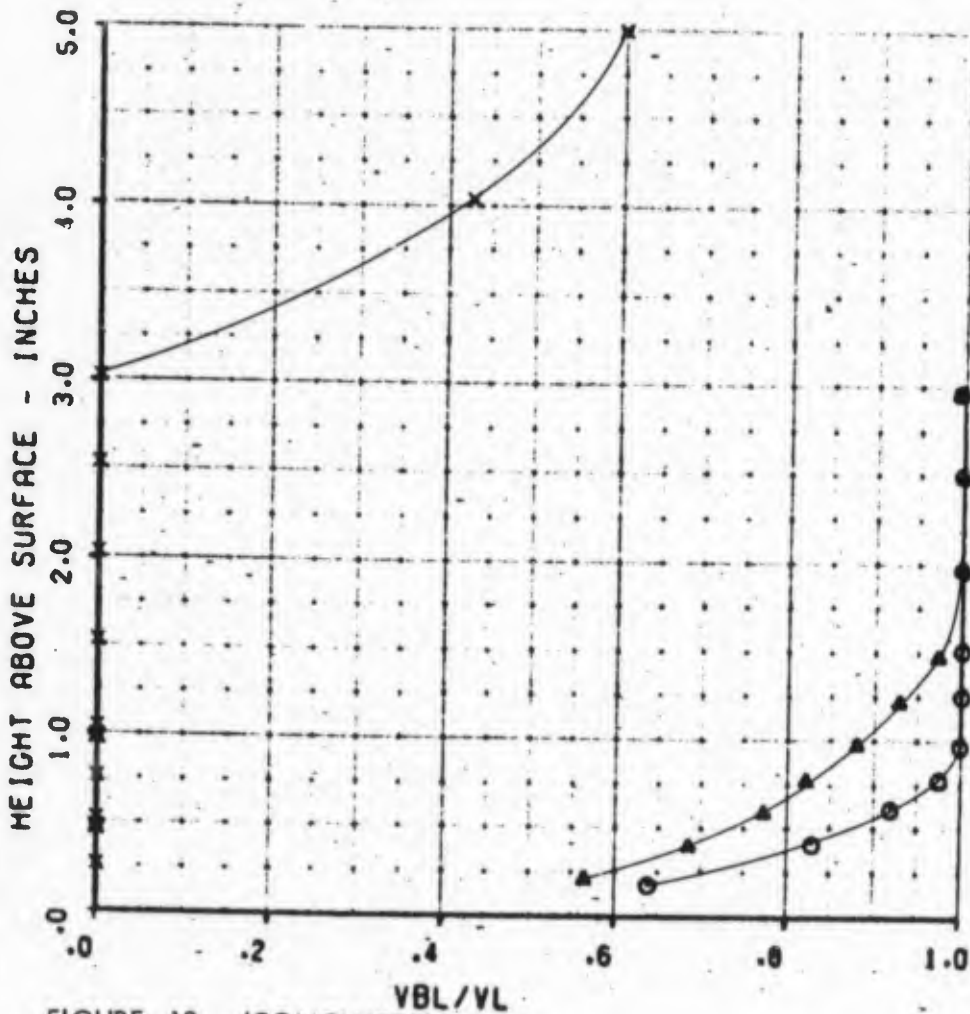


FIGURE 18 (CONCLUDED)  
 (h) CORRECTED ALPHA = 1.16

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 549  
 RUN NO 20  
 MACH NO .830

1.56 PSI  
 .77 DEG  
 49.0 DEG C

0  
 ALPHA  
 TWR

ALTITUDE 38330. FT  
 WEIGHT 231600. LB  
 NZ 1.00

CO

23.55 X MAC

AILERON POS -.25 DEG

FLAP POS 0.00 DEG

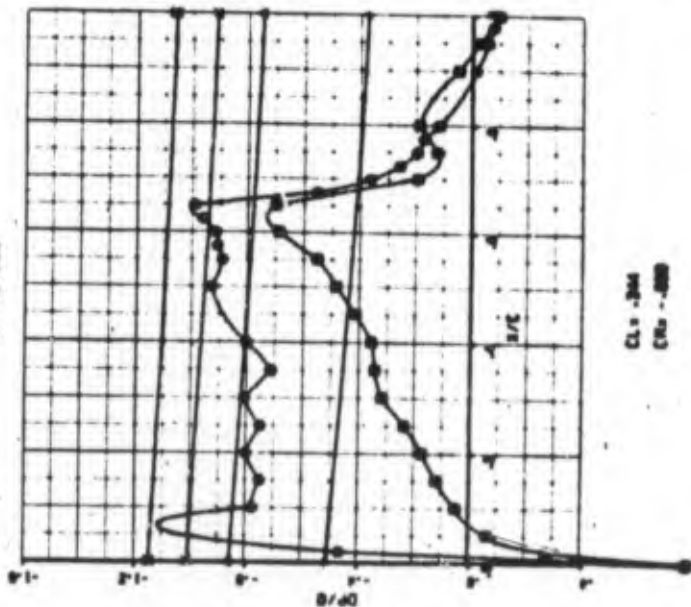
O UPPER SURFACE  
 □ LOWER SURFACE

+ MACH LOCAL-1.0  
 X MACH LOCAL-1.2  
 Δ MACH LOCAL-1.3  
 ⊞ MACH LOCAL-1.4

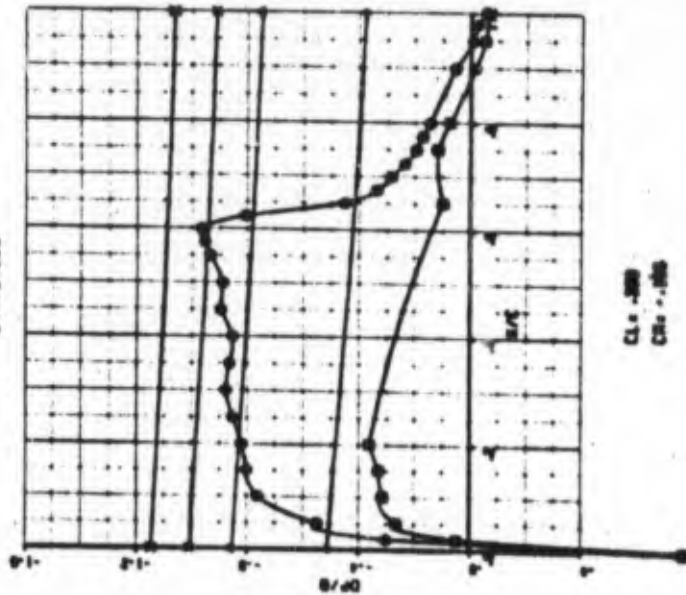
ETA=0.183

ETA=0.309

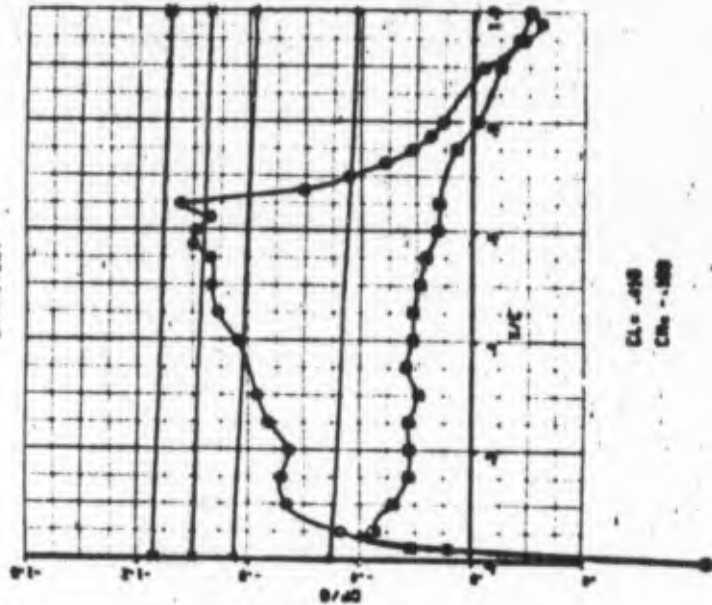
ETA=0.837



CL = .344  
 CM = -.089



CL = .289  
 CM = -.165



CL = .478  
 CM = -.189

# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 548  
 RUN NO 384  
 MACH NO .850

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

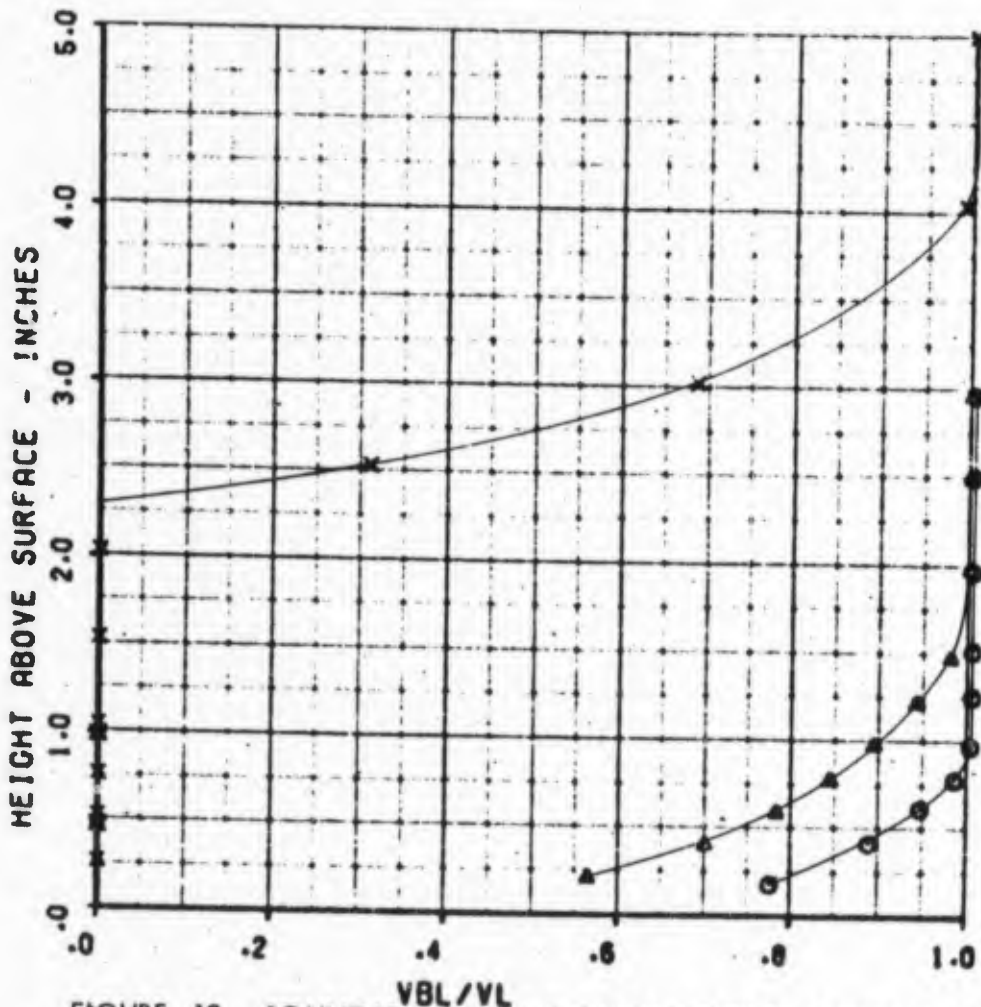


FIGURE 19 BOUNDARY LAYER VELOCITY PROFILES AND PRESSURE DISTRIBUTIONS MACH .840 TO .850

(a) CORRECTED ALPHA = -2.20

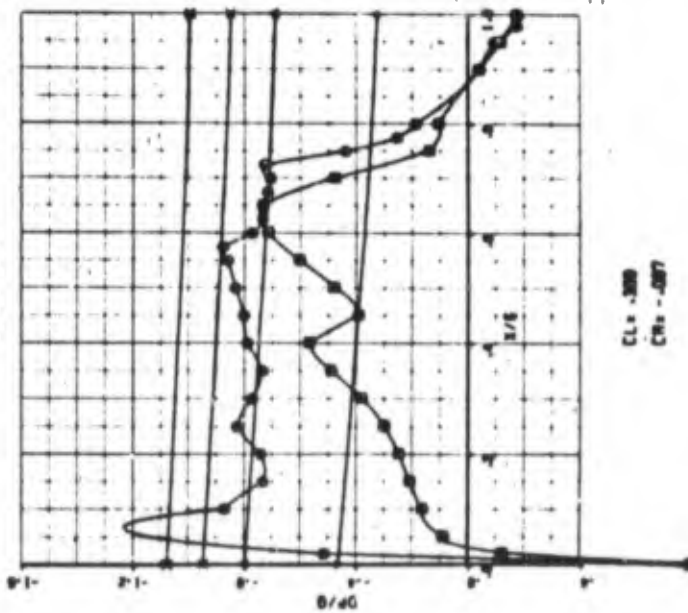
LOCKHEED C-141A  
PRESSURE DISTRIBUTION

FLIGHT NO 548  
RUN NO 394  
MACH NO .860

0  
ALPHA  
TAN

1.74 PSI  
-3.07 DEG  
-55.9 DEG C

ETA=0.193

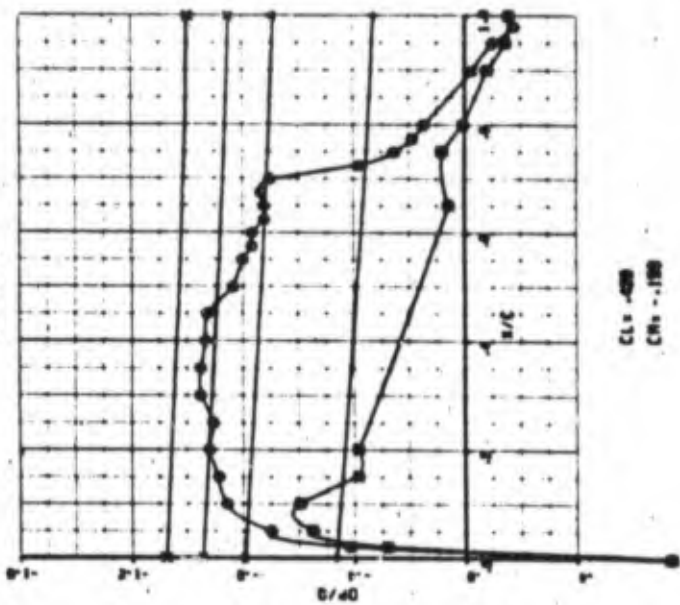


ALTITUDE 36040. FT  
WEIGHT 217000. LB  
MZ .28

CG  
AILERON POS .08 DEG  
FLAP POS 0.00 DEG

20.00 ± MAC

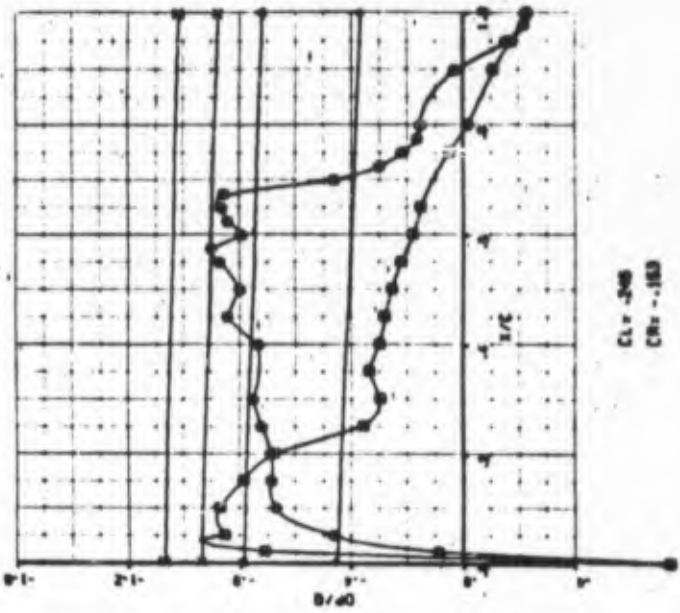
ETA=0.309



UPPER SURFACE  
LOWER SURFACE  
MACH LOCAL-1.0

MACH LOCAL-1.2  
MACH LOCAL-1.3  
MACH LOCAL-1.4

ETA=0.637



# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 382  
 MACH PD .850

### RAKE LOCATIONS

○ 30 Z  
 ▲ 55 Z  
 × 80 Z  
 \* 80 Z (AFT)

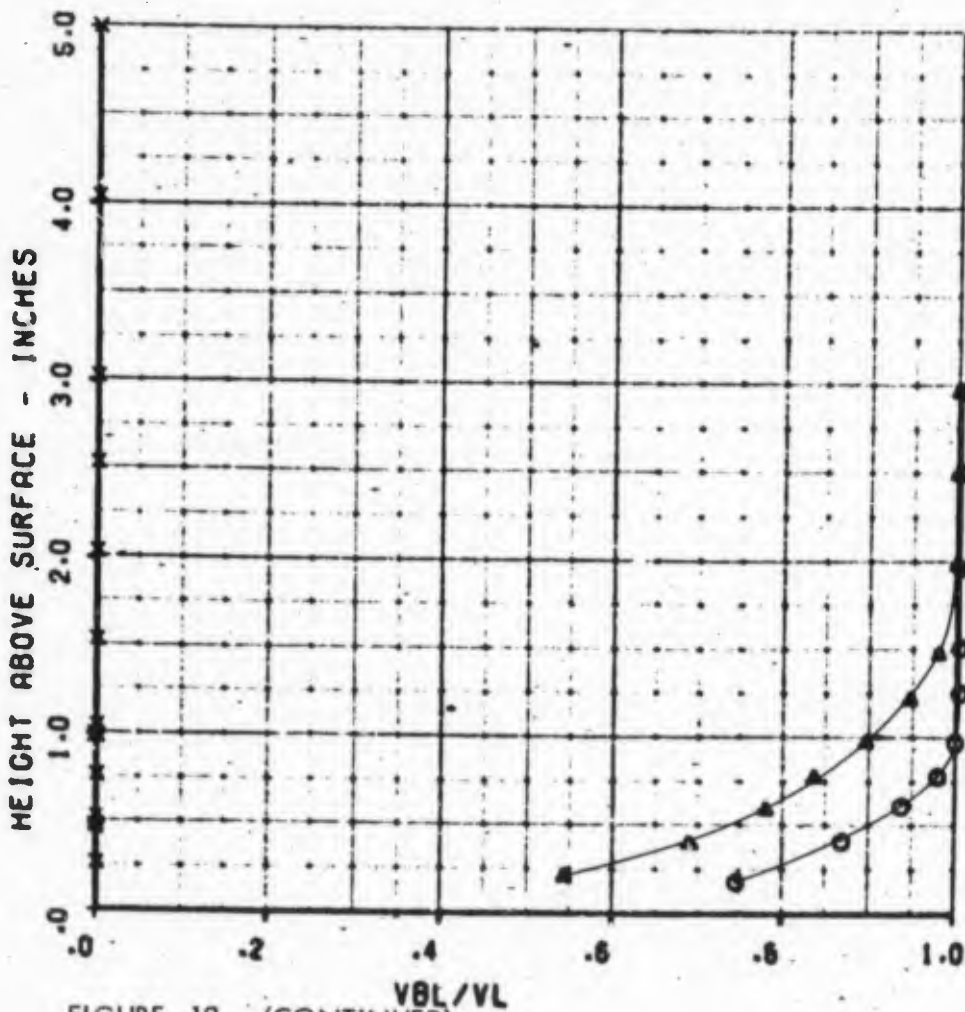


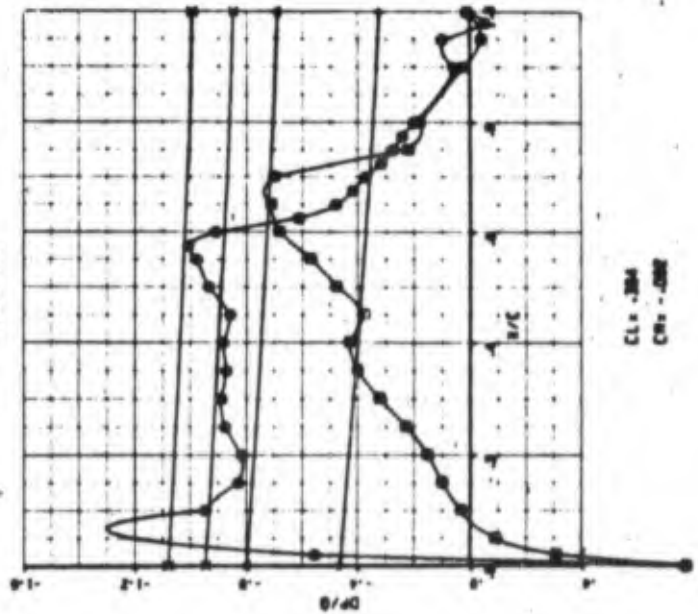
FIGURE 19 (CONTINUED)  
 (b) CORRECTED ALPHA = -1.12

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 540  
RUN NO 382  
MACH NO .850

Q 1.69 PSI  
ALPHA -1.82 DEG  
TRN -55.9 DEG C

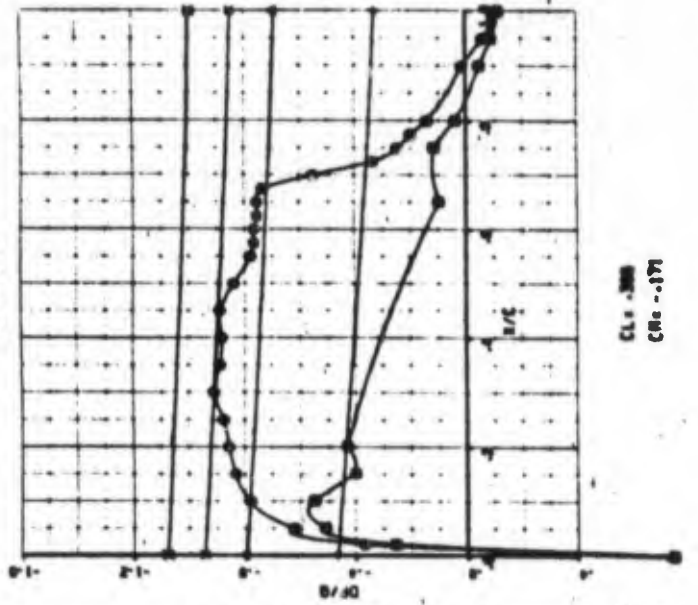
ETA=0.193



ALTITUDE 36000. FT  
WEIGHT 217000. LB  
NZ .81

CO 20.08 2 MAC  
MILLEN POS -17 DEG  
FLAP POS 0.00 DEG

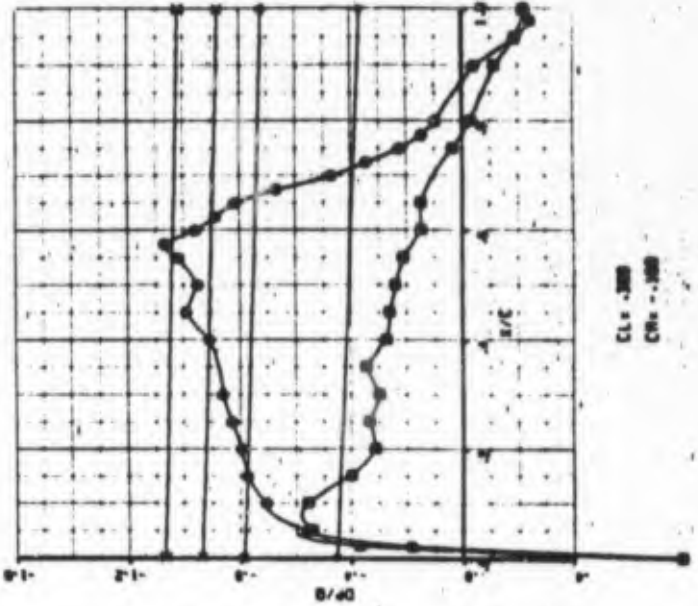
ETA=0.299



O UPPER SURFACE  
□ LOWER SURFACE  
+ MACH LOCAL-1.0

△ MACH LOCAL-1.2  
X MACH LOCAL-1.3  
Σ MACH LOCAL-1.4

ETA=0.637



# LOCKHEED C-141A BOUNDARY-LAYER PAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 549  
 RUN NO 2E1  
 MACH NO .840

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✕ 80 % (AFT)

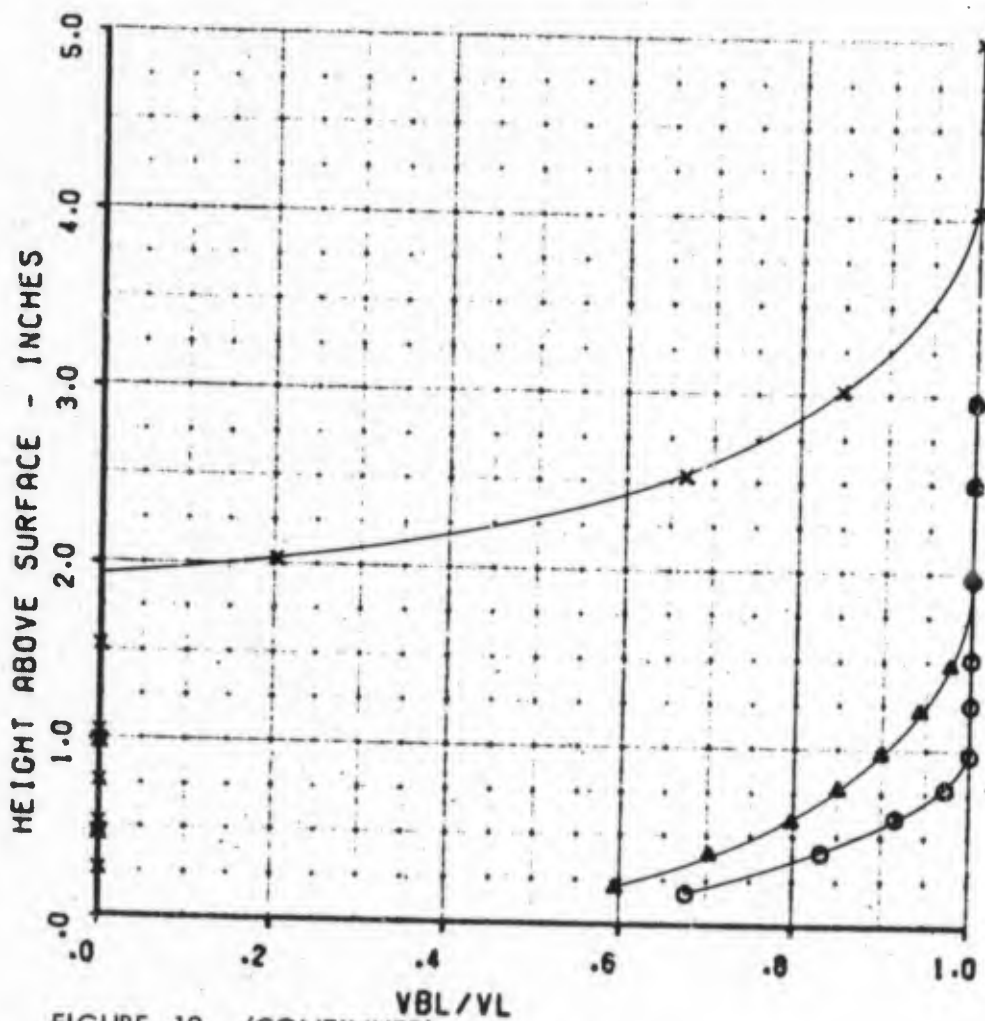


FIGURE 19 (CONTINUED)  
 (c) CORRECTED ALPHA = -0.87

LOCKHEED C-141A

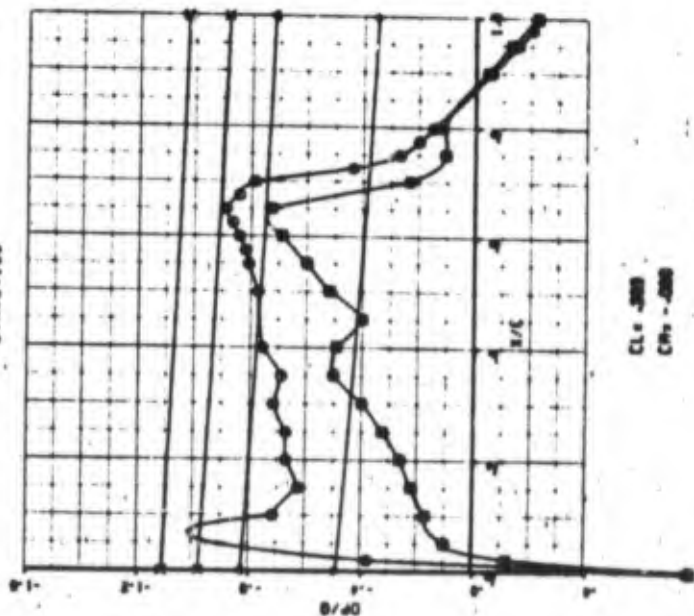
PRESSURE DISTRIBUTION

FLIGHT NO 549  
 RUN NO 2E1  
 MACH NO .840

Q  
 ALPHA  
 TRN

1973 PSI  
 -1.66 DEG  
 -61.4 DEG C

ETA=0.183

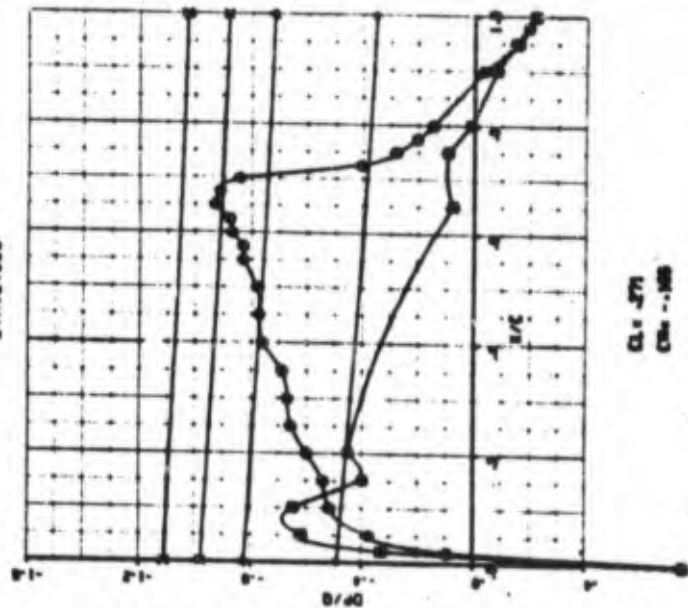


ALTITUDE 34000. FT  
 WEIGHT 231500. LB  
 NZ .46

CO  
 AILERON POS  
 FLAP POS

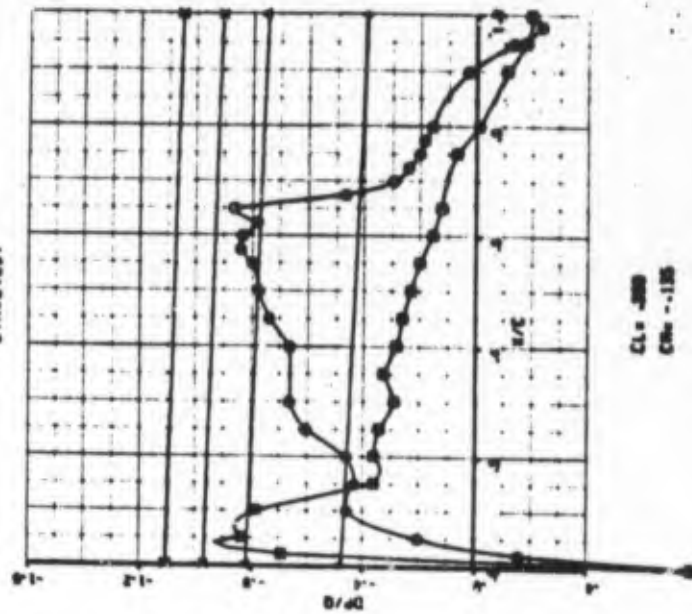
23.60 Z MAC  
 -84 DEG  
 0.00 DEG

ETA=0.209



O UPPER SURFACE  
 □ LOWER SURFACE  
 + MACH LOCAL-1.0  
 A MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 Z MACH LOCAL-1.4

ETA=0.637



# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 549  
 RUN NO 2E2  
 MACH NO .840

### RAKE LOCATIONS

○ 30 %  
 △ 55 %  
 × 80 %  
 \* 80 % (AFT)

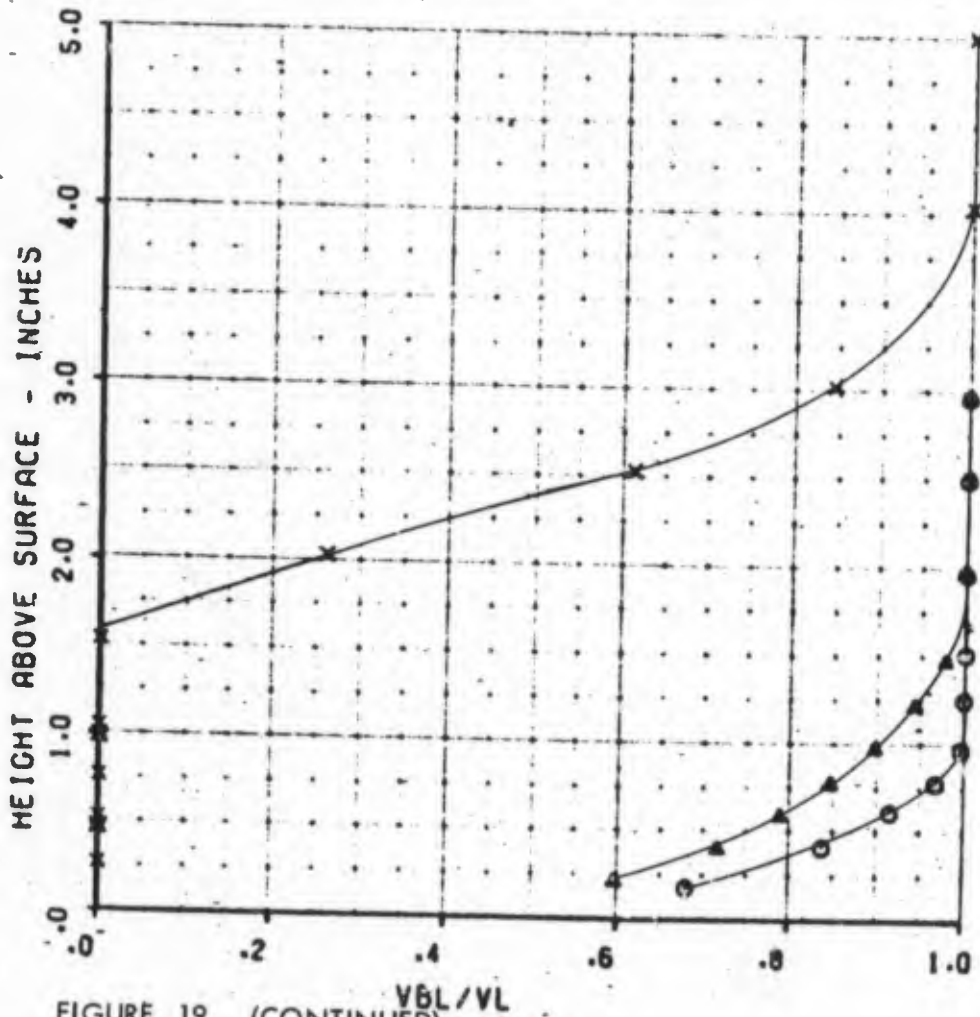


FIGURE 19 (CONTINUED)  
 (d) CORRECTED ALPHA = -0.70

LOCKHEED C-141A

PRESSURE DISTRIBUTION

FLIGHT NO 549  
 RUN NO 2E2  
 MACH NO .840

ETA=0.193

$\alpha$  1.87 PSI  
 ALPNA -1.35 DEG  
 TRN -50.0 DEG C

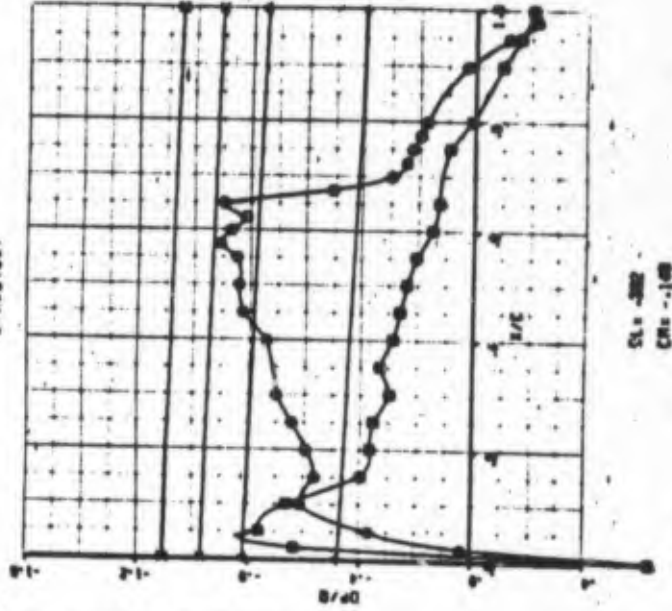
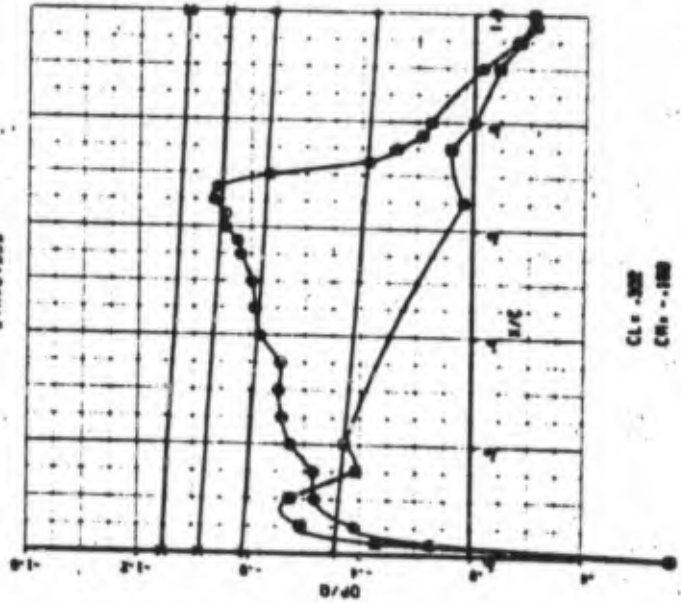
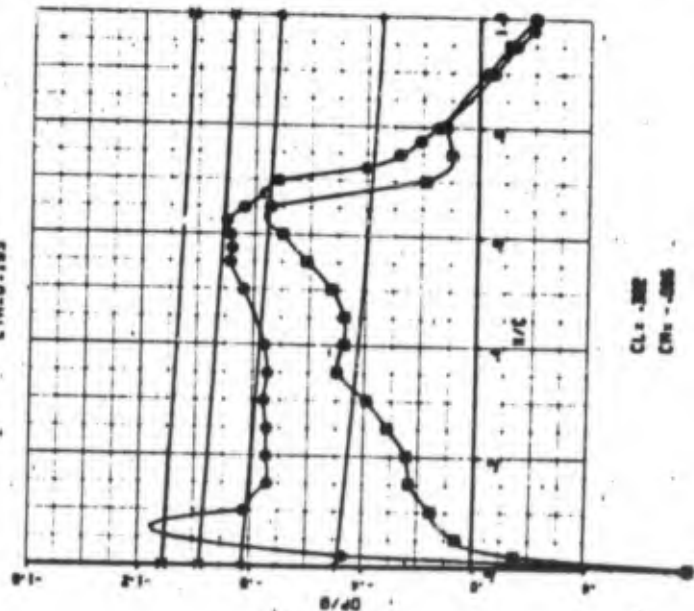
ALTITUDE 35300. FT  
 WEIGHT 229000. LB  
 NZ .51

ETA=0.399

CO 23.45 X MAC  
 AILERON POS -.34 DEG  
 FLAP POS 0.00 DEG

O UPPER SURFACE  
 □ LOWER SURFACE

▲ MACH LOCAL-1.2  
 X MACH LOCAL-1.3  
 ■ MACH LOCAL-1.4



# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

**RUN CONDITIONS**

FLIGHT NO 548  
 RUN NO 381  
 MACH NO .848

**RAKE LOCATIONS**

○ 30 %  
 ▲ 55 %  
 × 80 %  
 \* 80 % (AFT)

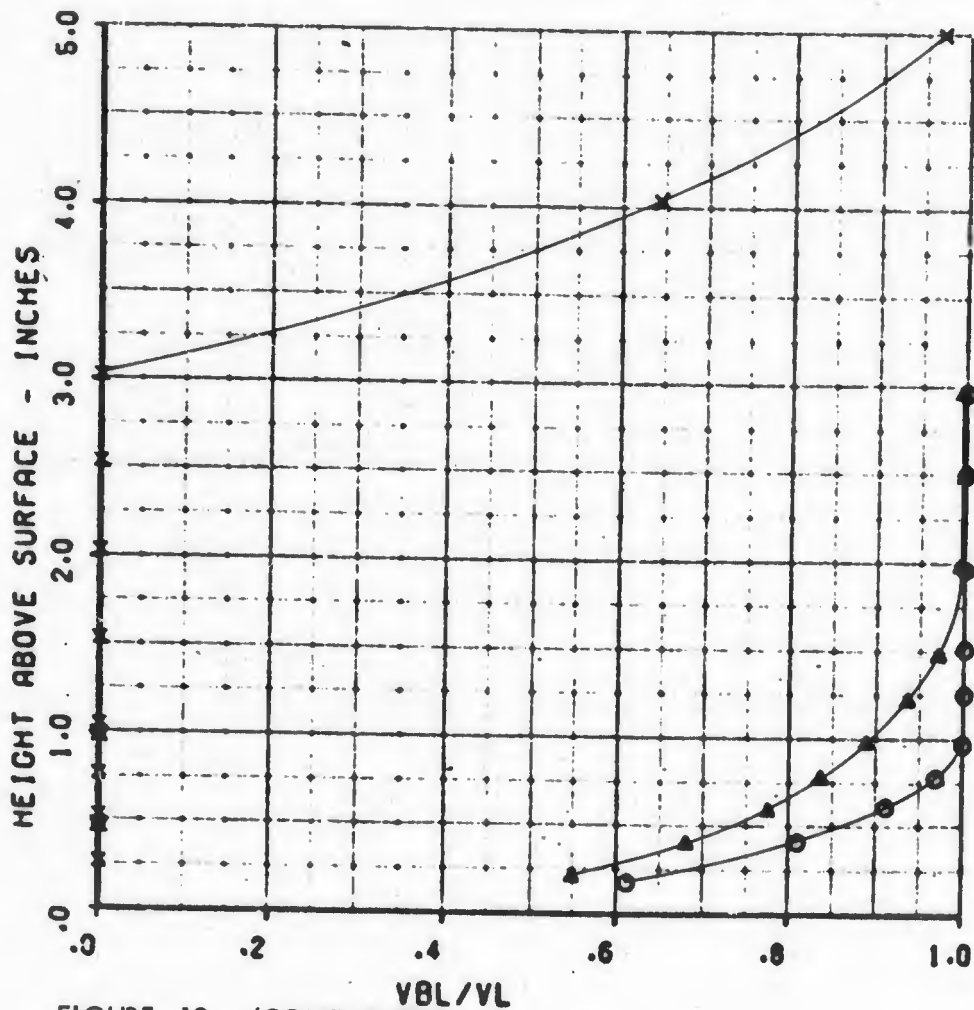


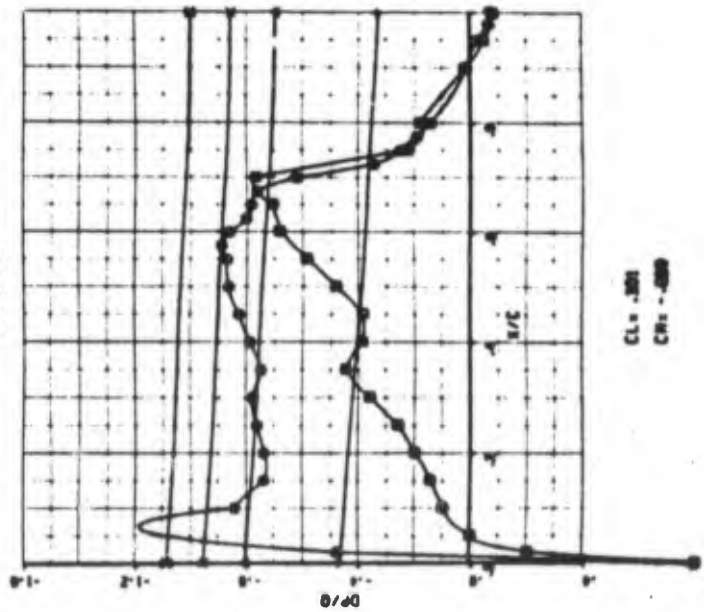
FIGURE 19 (CONTINUED)  
 (e) CORRECTED ALPHA = -0.60

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 549  
RUN NO 381  
MACH NO .040

Q 1.76 PSI  
ALPHA -1.25 DEG  
TRN -55.7 DEG C

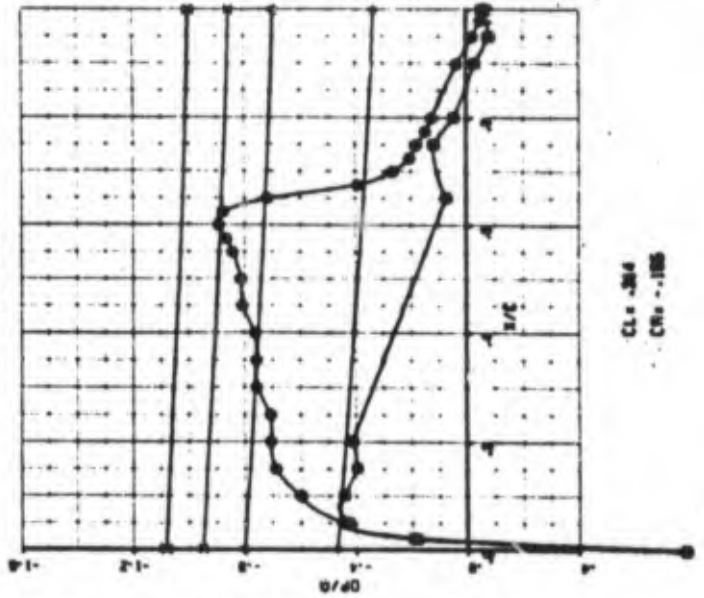
ETA: 0.193



ALTITUDE 34700. FT  
WEIGHT 219100. LB  
NZ .78

CO 20.772 MAC  
AILERON POS -.25 DEG  
FLAP POS 0.00 DEG

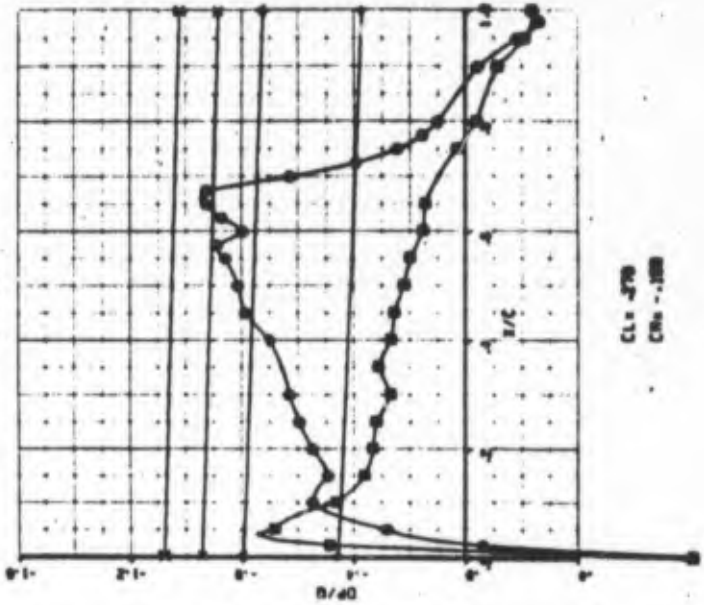
ETA: 0.369



O UPPER SURFACE  
□ LOWER SURFACE  
+ MACH LOC NL-1-0

A MACH LOC NL-1-2  
X MACH LOC NL-1-3  
Z MACH LOC NL-1-4

ETA: 0.637



# LOCKHEED C-141A BOUNDARY-LAYER RAKE SURVEY

## RUN CONDITIONS

FLIGHT NO 548  
 RUN NO 38  
 MACH NO .840

## RAKE LOCATIONS

○ 30 %  
 ▲ 55 %  
 × 80 %  
 ✱ 80 % (AFT)

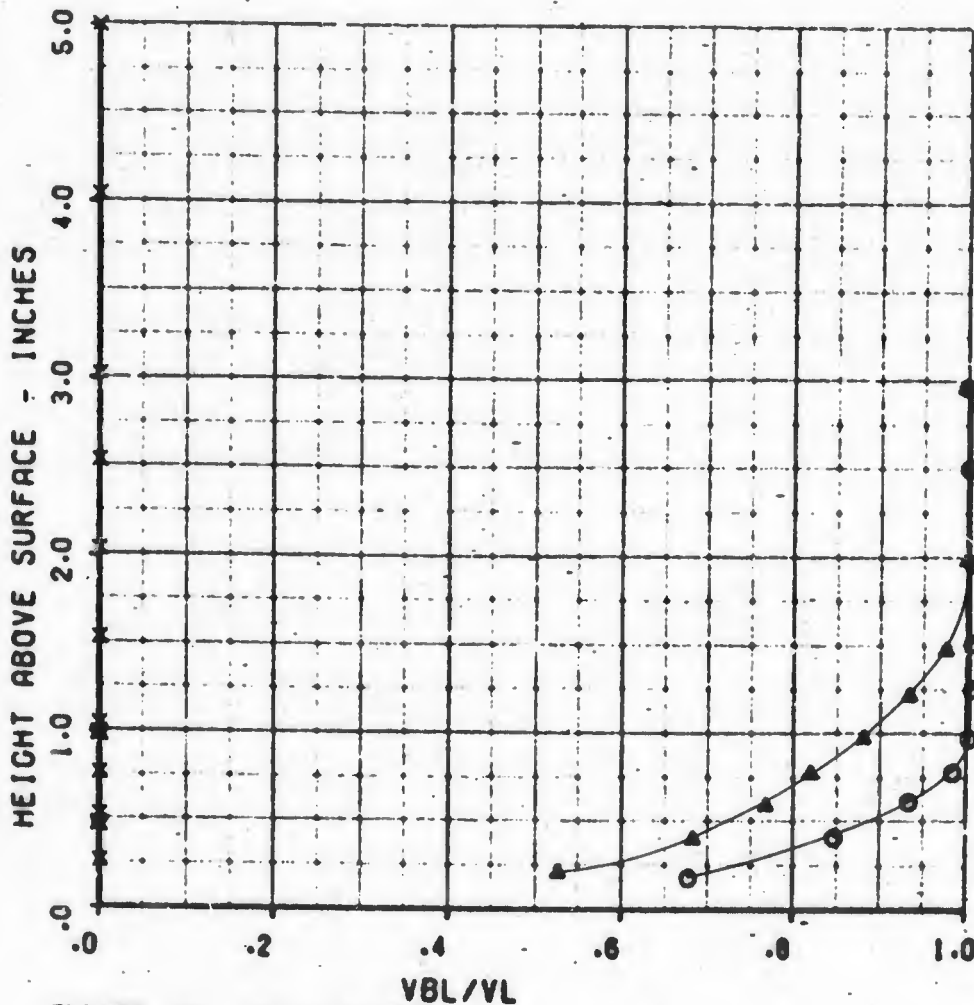
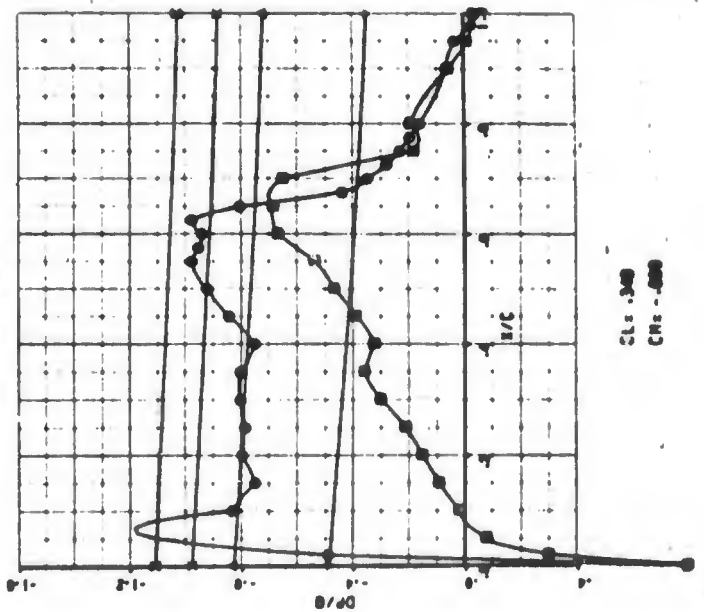


FIGURE 19 (CONTINUED)  
 (f) CORRECTED ALPHA = 0.31

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 540      0      1.00 PSI  
 RUN NO 38      ALPHA      -19 DEG  
 MACH NO .840      TAN      -55.4 DEG C

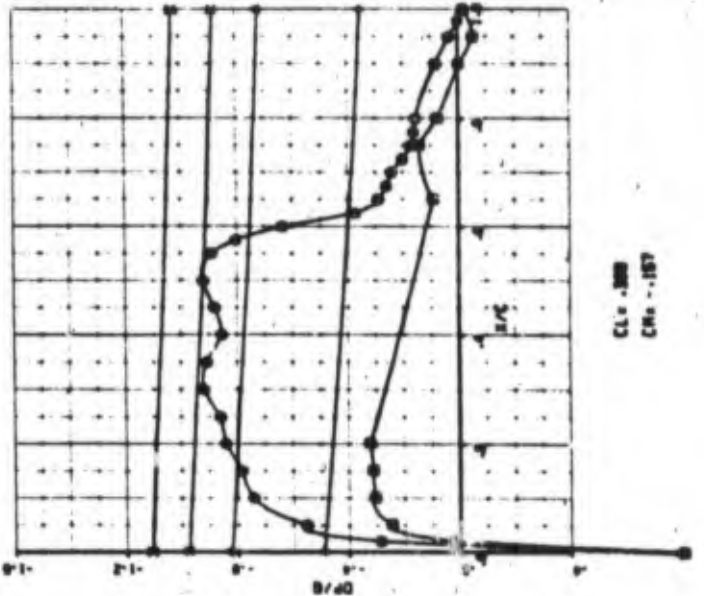
ETA=0.193



ALTITUDE 35200. FT  
 WEIGHT 21900. LB  
 WZ 1.04

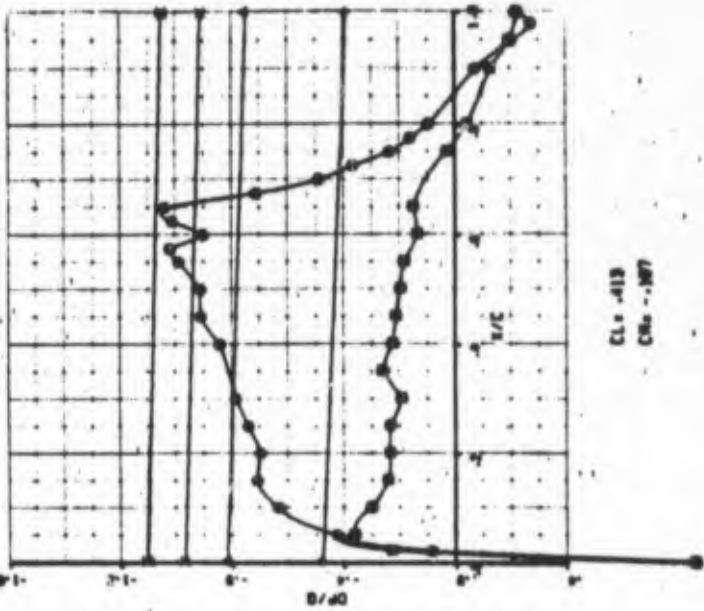
CO .00 ± 30% MAC  
 AILERON POS -1.01 DEG  
 FLAP POS 0.00 DEG

ETA=0.308



○ UPPER SURFACE      ▲ MACH LOCAL-1-2  
 □ LOWER SURFACE      × MACH LOCAL-1-3  
 + MACH LOCAL-1.0      ⊖ MACH LOCAL-1.4

ETA=0.637



# LOCKHEED C-141A

## BOUNDARY-LAYER RAKE SURVEY

### RUN CONDITIONS

FLIGHT NO 547  
 RUN NO 3F  
 MACH NO .850

### RAKE LOCATIONS

○ 30 %  
 △ 55 %  
 × 80 %  
 \* 80 % (AET)

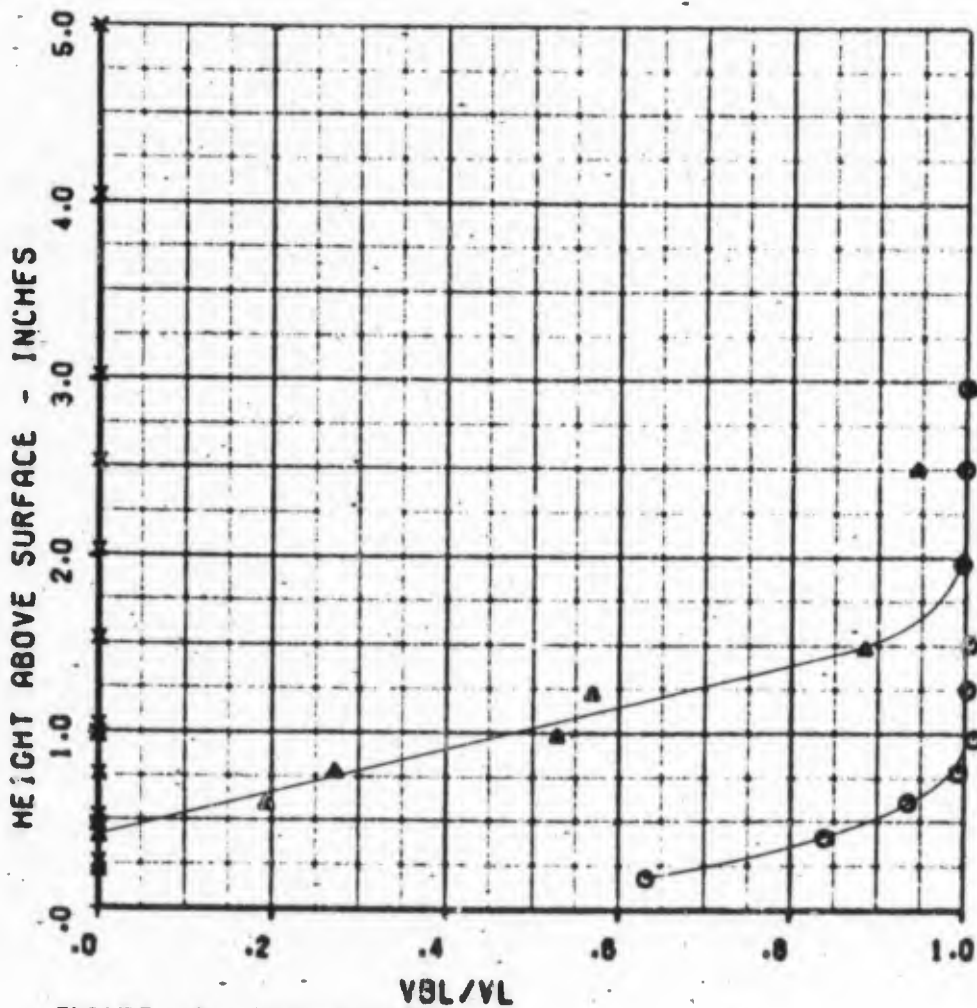
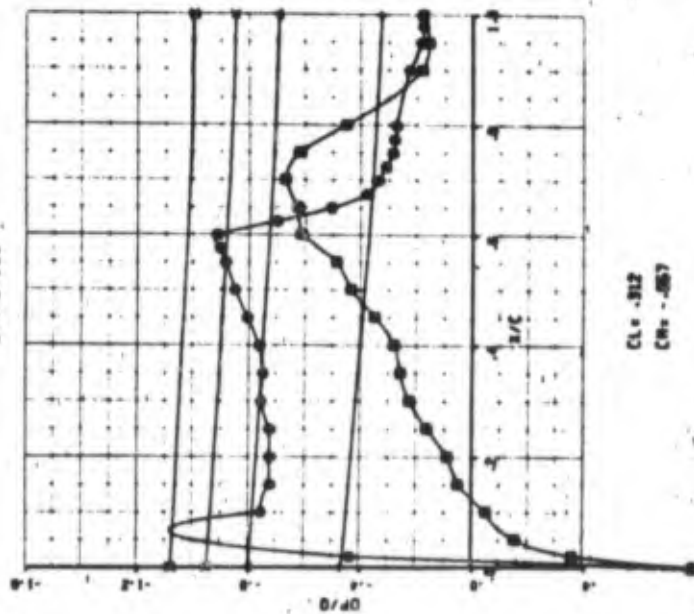


FIGURE 19 (CONCLUDED)  
 (g) CORRECTED ALPHA = 1.77

# LOCKHEED C-141A PRESSURE DISTRIBUTION

FLIGHT NO 547      0      1.54 PS:  
 RUN NO 3F      ALPHA      1.46 DEG  
 MACH NO .850      TRM      -53.3 DEG C

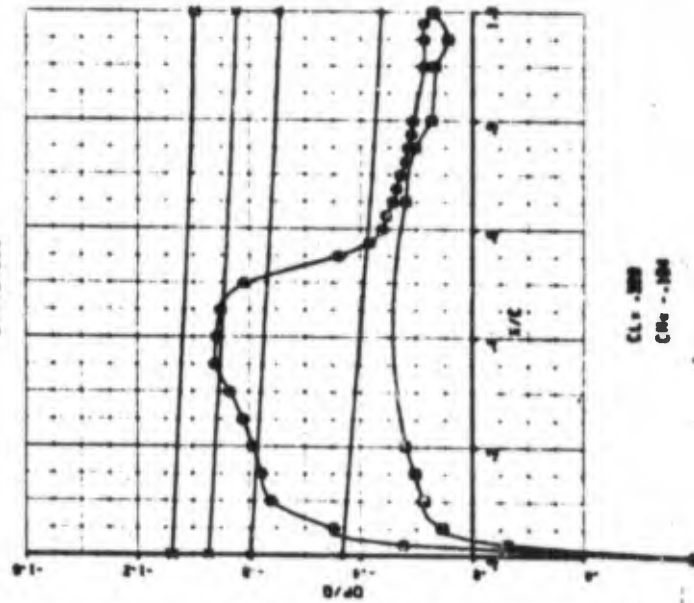
ETA=0.193



CL = .312  
 CM = -.057

ALTITUDE 37500. FT  
 WEIGHT 229900. LB  
 NZ 1.04

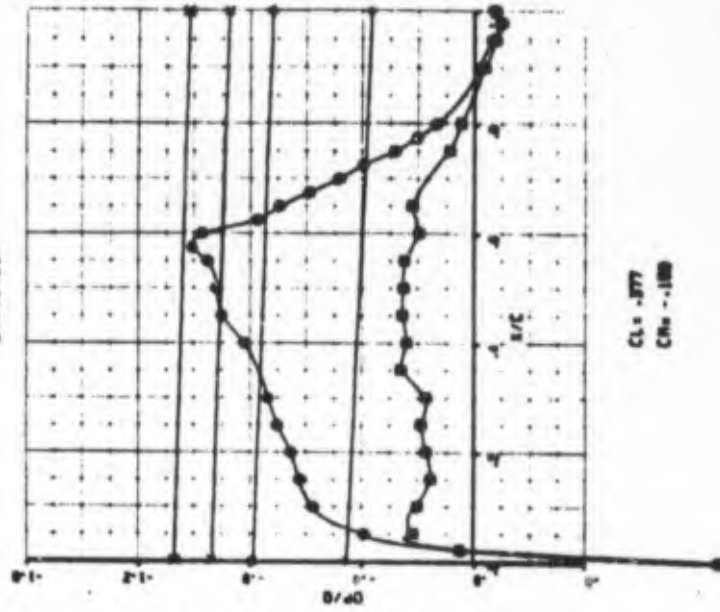
ETA=0.309



CL = .289  
 CM = -.104

CO 26.84 X MAC  
 AILERON POS -2.89 DEG  
 FLAP POS 0.00 DEG

ETA=0.537



CL = .377  
 CM = -.100

UPPER SURFACE      O      MACH LOCAL-1.2  
 LOWER SURFACE      □      MACH LOCAL-1.3  
 MACH LOCAL-1.0      +      MACH LOCAL-1.4

## REFERENCES

1. Whittel, W. T., Cooper, B.L., "Redefined Aerodynamic Data for Structural Design Based On Inflight Measurements", Lockheed-Georgia Company ER-8211, February 1966.
2. Wright, J. M., "Development of Testing Technique Required to Duplicate Full Scale Wing Shock Location On A Wind Tunnel Model", Lockheed-Georgia Company, LG1T6-1-16, May 1966.

Unclassified

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13. ABSTRACT A flight test investigation was made using a Lockheed C-141 airplane to obtain data related to scale effects on transonic shock-boundary layer interactions. The primary measurements consisted of wing surface chordwise pressure distributions at three spanwise stations, and boundary layer profiles for three chordwise positions at one spanwise station. Volume I contains the data analysis and discussions of the test results. Volume II contains a detailed discussion of the data acquisition and reduction procedures plus a complete presentation of the basic data. Results obtained, when compared with previously available wind tunnel data, showed that large scale effects on chordwise pressure distribution can occur with turbulent boundary layers on a wing having small Mach number gradients forward of the shock. A shock-induced separation, followed by flow reattachment, was shown to occur when the shock pressure rise reached a value approximately equal to that indicated in NACA Report 1356. For wing sections of the type used on the C-141, scale effects on buffet phenomena should be anticipated also. Distribution of this abstract is unlimited.			

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Unclassified

Security Classification

## ERRATA

FLIGHT TEST INVESTIGATION OF TRANSONIC  
SHOCK-BOUNDARY LAYER PHENOMENA

As an unfortunate and unforeseen side effect of the use of a computer-coupled automatic plotting system, the reproduction of some basic data figures in this report is rather poor. The enclosed pages list the section lift and pitching moment coefficients obtained from integration of the surface pressure distributions measured in this program. Section pitching moments are referenced to the section leading edge point.

AIR FORCE FLIGHT DYNAMICS LABORATORY  
AIR FORCE SYSTEMS COMMAND  
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

HD 836  
289

- 2 -

FIG. NO.	MACH NO.	ETA .193		ETA .389		ETA .637	
		$C_l$	$C_m$	$C_l$	$C_m$	$C_l$	$C_m$
8a	.704	.130	-.045	.075	-.082	.034	-.067
8b	.706	.185	-.060	.182	-.106	.136	-.090
8c	.700	.318	-.090	.382	-.141	.291	-.127
8d	.700	.399	-.109	.437	-.169	.394	-.154
8e	.700	.440	-.117	.477	-.177	.447	-.165
8f	.700	.506	-.133	.567	-.200	.525	-.181
9a	.750	.062	-.031	.060	-.082	-.009	-.061
9b	.750	.165	-.056	.172	-.106	.119	-.089
9c	.752	.279	-.080	.302	-.138	.253	-.121
9d	.742	.266	-.077	.268	-.129	.231	-.116
9e	.742	.267	-.079	.271	-.128	.236	-.116
9f	.750	.339	-.096	.371	-.152	.318	-.140
9g	.750	.391	-.107	.415	-.166	.368	-.152
9h	.752	.451	-.120	.480	-.181	.455	-.172
10a	.762	0.0	0.0	0.59	-.085	-.004	-.042
10b	.770	.197	-.062	.149	-.120	.024	-.078
10c	.770	0.0	0.0	.140	-.098	.093	-.082
10d	.770	.172	-.058	.165	-.116	.115	-.091
10e	.770	0.0	0.0	.268	-.129	.220	-.113
10f	.770	.266	-.080	.280	-.140	.239	-.121
10g	.780	0.0	0.0	.366	-.157	.342	-.143
10h	.778	.329	-.094	.347	-.158	.337	-.146
10k	.770	0.0	0.0	.421	-.171	.389	-.155
10l	.772	.359	-.102	.434	-.181	.401	-.162
10m	.772	0.0	0.0	.455	-.177	.421	-.164
10n	.775	.394	-.111	.449	-.181	.420	-.170
11a	.795	0.0	0.0	.081	-.094	.041	-.081
11b	.794	.099	-.033	.193	-.127	-.007	-.069
11c	.794	0.0	0.0	.174	-.114	.133	-.100
11d	.802	.178	-.056	.195	-.134	.126	-.099
11e	.800	.253	-.078	.284	-.150	.228	-.120

AIR FORCE FLIGHT DYNAMICS LABORATORY  
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- 3 -

FIG. NO.	MACH NO.	ETA .193		ETA .389		ETA .637	
		$C_l$	$C_m$	$C_l$	$C_m$	$C_l$	$C_m$
11f	.802	0.0	0.0	.268	-.136	.221	-.114
11g	.798	.246	-.077	.263	-.139	.198	-.115
11h	.800	.251	-.078	.265	-.135	.232	-.122
11k	.802	0.0	0.0	.351	-.161	.318	-.146
11l	.800	.327	-.098	.366	-.173	.326	-.147
11m	.795	0.0	0.0	.396	-.171	.335	-.141
11n	.800	.343	-.102	.386	-.178	.324	-.149
11o	.800	.374	-.111	.428	-.191	.405	-.172
11p	.802	0.0	0.0	.456	-.196	.403	-.166
12a	.820	.151	-.050	.288	-.151	.034	-.084
12b	.817	0.0	0.0	.089	-.095	-.011	-.072
12c	.820	0.0	0.0	.189	-.126	.086	-.096
12d	.820	.224	-.068	.275	-.163	.119	-.108
12e	.820	0.0	0.0	.258	-.141	.210	-.122
12f	.822	.258	-.083	.284	-.166	.216	-.127
12g	.820	0.0	0.0	.299	-.153	.245	-.130
12h	.822	.294	-.090	.353	-.183	.296	-.154
12k	.822	0.0	0.0	.341	-.170	.338	-.164
12l	.820	.316	-.095	.384	-.191	.341	-.169
12m	.820	.375	-.110	.436	-.195	.348	-.162
12n	.820	0.0	0.0	.413	-.182	.350	-.170
13a	.860	.157	-.045	.070	-.093	-.002	-.097
13b	.855	.222	-.067	.116	-.091	.108	-.124
13c	.845	.273	-.067	.248	-.114	.301	-.167
13d	.840	.332	-.077	.331	-.127	.397	-.185
13e	.844	.348	-.076	.344	-.117	.387	-.171
13f	.840	.363	-.084	.370	-.134	.442	-.194
14a	.690	.212	-.058	.133	-.082	.080	-.070
14b	.695	.254	-.070	.151	-.095	.120	-.079
14c	.700	.352	-.091	.269	-.117	.348	-.130
14d	.700	.537	-.133	.494	-.169	.500	-.169

- 4 -

FIG. NO.	MACH NO.	ETA .193		ETA .389		ETA .637	
		$C_1$	$C_m$	$C_1$	$C_m$	$C_1$	$C_m$
14e	.702	.469	-.122	.486	-.175	.453	-.166
14f	.700	.526	-.134	.559	-.192	.526	-.175
14g	.700	.576	-.144	.651	-.209	.626	-.204
15a	.751	.177	-.053	.101	-.092	.053	-.073
15b	.750	.297	-.086	.149	-.097	.125	-.088
15c	.748	.295	-.088	.255	-.130	.201	-.107
15d	.754	.367	-.105	.267	-.131	.221	-.116
15e	.754	.443	-.125	.423	-.166	.302	-.130
15f	.748	.457	-.126	.521	-.189	.449	-.167
15g	.750	.511	-.136	.586	-.204	.561	-.189
16a	.780	.346	-.102	.237	-.131	.221	-.108
16b	.765	.343	-.099	.366	-.157	.293	-.130
16c	.770	.502	-.146	.426	-.171	.377	-.155
16d	.770	.485	-.135	.531	-.193	.509	-.179
16e	.780	.448	-.127	.513	-.197	.468	-.177
17a	.790	.335	-.099	.115	-.099	.104	-.090
17b	.800	.219	-.068	.229	-.126	.139	-.097
17c	.796	.350	-.107	.320	-.150	.245	-.125
17d	.810	.253	-.079	.286	-.143	.264	-.131
17e	.810	.378	-.113	.379	-.186	.328	-.153
17f	.800	.382	-.111	.359	-.164	.343	-.149
17g	.792	.255	-.078	.216	-.122	.093	-.090
17h	.800	.412	-.121	.497	-.205	.467	-.181
17k	.800	.421	-.125	.494	-.201	.439	-.156
18a	.826	.302	-.087	.427	-.199	.124	-.107
18b	.822	.229	-.071	.285	-.160	.126	-.108
18c	.820	.377	-.112	.324	-.170	.248	-.134
18d	.822	.402	-.114	.440	-.198	.341	-.154
18e	.824	.346	-.102	.442	-.193	.389	-.177
18f	.825	.401	-.109	.456	-.179	.453	-.192
18g	.820	.381	-.113	.464	-.199	.445	-.187
18h	.830	.344	-.088	.390	-.166	.410	-.183

AIR FORCE FLIGHT DYNAMICS LABORATORY  
 AIR FORCE SYSTEMS COMMAND  
 WRIGHT-PATTERSON AIR FORCE BASE, OHIO

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FIG. NO.	MACH NO.	ETA .193		ETA .389		ETA .637	
		$C_l$	$C_m$	$C_l$	$C_m$	$C_l$	$C_m$
19a	.850	.309	-.087	.428	-.193	.246	-.153
19b	.850	.364	-.082	.366	-.171	.388	-.190
19c	.840	.263	-.080	.271	-.166	.200	-.135
19d	.840	.302	-.086	.302	-.180	.262	-.148
19e	.848	.301	-.069	.314	-.155	.279	-.158
19f	.840	.348	-.083	.388	-.157	.413	-.187
19g	.850	.312	-.057	.320	-.104	.377	-.159

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