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ADVANCED TECHNOLOGY TRANSPORT DESIGN WITH		Unclas
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NASA TECHNICAL MEMORANDUM

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EXPERIMENTAL INVESTIGATION OF A LONG RANGE, M = 0.95 ADVANCED TECHNOLOGY TRANSPORT DESIGN WITH FOUR WING-MOUNTED ENGINES

By Harry D. Radcliff and Charles R. Castellano

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May 1973

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EXPERIMENTAL INVESTIGATION OF A LONG RANGE, M = 0.95

ADVANCED TECHNOLOGY TRANSPORT DESIGN

WITH FOUR WING-MOUNTED ENGINES

By Harry D. Radcliff and Charles R. Castellano

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SUMMARY

A wind tunnel investigation was made in the Ames 11- by 11-Foot Transonic Wind Tunnel of a 0.02-scale model of a large, long range four engine transport designed to cruise at Mach 0.95. The test Mach numbers ranged from 0.50 to 0.98. Angle of attack was varied from -1 to +10 degrees, and angle of sideslip from -6 to +8 degrees. Horizontal tail incidences of 0, -1, -3, and -5 degrees were tested. Spoilers were tested at deflection angles of -10 and -25 degrees. Basic longitudinal and lateral-directional aerodynamic characteristics are presented. Wing pressure distributions are presented for the basic wing-body, the full configuration, and for the deflected spoilers.

INTRODUCTION

The NASA Advanced Technology Transport (ATT) systems study was conducted to evaluate the potential application of the most recent technological advances to the next generation of subsonic transport aircraft. As a part of this study the Lockheed Georgia Company was directed to study an advanced transport which carries 400 passengers, has a range of 5500 nautical miles, and cruises at Mach 0.95. Parametric studies were performed to determine the size and shape of the configuration. The resulting configuration has been designated as ATT-95.

The geometry of the ATT-95 is considerably different from other ATTtype configurations being tested. Furthermore, tests of these other configurations have not investigated the impact of configuration details such as flap-track fairings, fuselage canopy shape, wheel wells, etc., on aircraft performance. In order to further optimize the ATT-95 design and to determine the effects of practical configuration details, high subsonic speed wind tunnel tests were conducted. Experimental aerodynamic characteristics of various model configurations over a range of test conditions are presented herein with a minimum of analysis.

NOMENCLATURE

The axis systems and sign conventions are shown in figure 1. Owing to the limitations of the computer notation system in plotting the data, conventional aerodynamic symbols have been replaced by plot symbols in the data figures as noted below.

Symbol	Plot Symbol	Definition
A _b		base area
Ъ	BREF	wing span
с		chord
ā	LREF	mean aerodynamic chord
CA	CA	axial-force coefficient, axial force/qS $_{\rm w}$
C _{Ab}	CAB	base axial-force coefficient (equation 1)
C _{Af}	CAF	forebody axial-force coefficient = $C_A' - C_A_b$
$C_{A_{i}}$		nacelle internal drag coefficient
с _р	CD	drag coefficient, drag/q S_w
с _D		base drag coefficient (equation 2)
C _D c	CDC	cruise drag coefficient (C $_{\rm D}$ @ C $_{\rm L}$ = 0.47)
C _D f	CDF	forebody drag coefficient = $C_D - C_D_b$
C _L	CL	lift coefficient, lift/qS _w
с ^г а	CLALF	lift curve slope

-		
^C L _a	CLALFO	lift curve slope at $\alpha = 0$
^C L ð _H	DCL/DH	lift due to horizontal tail deflection
CL SL	DCL/DS	lift due to spoiler deflection
° l	CSL	rolling-moment coefficient, rolling moment/ $qS_W^{}b$
$^{C}l_{\beta}$	DCSLDB	rolling-moment coefficient slope
ClosL	DCSLDS	rolling moment due to spoiler deflection
C _m	CIM	pitching-moment coefficient, pitching moment/ qS_w^{-c}
C _{mO}	CLMCLO	pitching moment at $C_L = 0$
^C m $\boldsymbol{\delta}_{\mathrm{H}}$	DCLMDH	pitching moment due to horizontal tail deflection
^C m ð SL	DCIMDS	pitching moment due to spoiler deflection
$\frac{\partial C_{m}}{\partial C_{L}} \bigg _{a=0}$	DCMCLO	slope of pitching moment vs. lift coefficient curve at $\alpha = 0$
C _N	CN	normal-force coefficient, normal force/ qS_w
C _n	CLN	yawing-moment coefficient, yawing moment/ qS_wb
^C n β	DCLNDB	yawing-moment coefficient slope
^C n ð SL	DCLNDS	yawing moment due to spoiler deflection
Cp	CP	pressure coefficient, (p - p_{∞})/q

by:

		,
С _Y	CY	side-force coefficient, side force/ qS_w
^C Y $\boldsymbol{\beta}$	DCY/DB	side-force coefficient slope
CYðSL	DCY/DS	side-force due to spoiler deflection
L/D	L/D	lift-drag ratio
$(L/D)_{max}$	L/DMAX	maximum lift-drag ratio
Μ	MACH	free-stream Mach number
	PCTCRD	percent local chord
p _c		model base cavity pressure
P_{∞}		free-stream static pressure
q		free-stream dynamic pressure
Rn/ft	RN/L	unit Reynolds number, million per foot
S _W	SREF	reference wing area
	TRANS	wing transition grit locations; 0 = transition free, l = subcritical transition location, 2 = super- critical transition location
α.	TRANS	wing transition grit locations; 0 = transition free, l = subcritical transition location, 2 = super- critical transition location angle of attack
α β	TRANS ALPHA BETA	<pre>wing transition grit locations; 0 = transition free, l = subcritical transition location, 2 = super- critical transition location angle of attack angle of sideslip</pre>
α β Δβ	TRANS ALPHA BETA DBETA	<pre>wing transition grit locations; 0 = transition free, l = subcritical transition location, 2 = super- critical transition location angle of attack angle of sideslip incremental angle of sideslip</pre>
α β Δβ δΗ	TRANS ALPHA BETA DBETA HORIZT	<pre>wing transition grit locations; 0 = transition free, l = subcritical transition location, 2 = super- critical transition location angle of attack angle of sideslip incremental angle of sideslip horizontal tail deflection</pre>
α β Δβ δΗ δSL	TRANS ALPHA BETA DBETA HORIZT SPLR-L	<pre>wing transition grit locations; 0 = transition free, l = subcritical transition location, 2 = super- critical transition location angle of attack angle of sideslip incremental angle of sideslip horizontal tail deflection left spoiler deflection</pre>
α β Δβ δΗ δSL ε	TRANS ALPHA BETA DBETA HORIZT SPLR-L	<pre>wing transition grit locations; 0 = transition free, l = subcritical transition location, 2 = super- critical transition location angle of attack angle of sideslip incremental angle of sideslip horizontal tail deflection left spoiler deflection nacelle centerline cant</pre>
α β Δβ δΗ δSL ε η	TRANS ALPHA BETA DBETA HORIZT SPLR-L	<pre>wing transition grit locations; 0 = transition free, l = subcritical transition location, 2 = super- critical transition location angle of attack angle of sideslip incremental angle of sideslip horizontal tail deflection left spoiler deflection nacelle centerline cant fraction of semispan</pre>
α β Δβ δΗ δSL ε η λ	TRANS ALPHA BETA DBETA HORIZT SPLR-L	<pre>wing transition grit locations; 0 = transition free, l = subcritical transition location, 2 = super- critical transition location angle of attack angle of sideslip incremental angle of sideslip horizontal tail deflection left spoiler deflection nacelle centerline cant fraction of semispan taper ratio, tip chord/root chord</pre>
α β Δβ δΗ δSL ε η λ	TRANS ALPHA BETA DBETA HORIZT SPLR-L	<pre>wing transition grit locations; 0 = transition free, l = subcritical transition location, 2 = super- critical transition location angle of attack angle of sideslip incremental angle of sideslip horizontal tail deflection left spoiler deflection nacelle centerline cant fraction of semispan taper ratio, tip chord/root chord sweep angle</pre>
α β Δβ δΗ δSL ε η λ λ	TRANS ALPHA BETA DBETA HORIZT SPLR-L	<pre>wing transition grit locations; 0 = transition free, l = subcritical transition location angle of attack angle of attack angle of sideslip incremental angle of sideslip horizontal tail deflection left spoiler deflection nacelle centerline cant fraction of semispan taper ratio, tip chord/root chord sweep angle roll angle</pre>

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Configuration Code

Bl	Bl	fuselage
Wl	Wl	wing
N ¹	Nl	inboard nacelle
\mathbb{N}^2	N2	outboard nacelle
ĸl	Kl	inboard pylon
к2	K5	outboard pylon
vl	Vl	vertical tail
Hl	Hl	horizontal tail
bl	Bl	empennage bullet (integral part of V^1)
z ^{wl}		wing fillet (integral part of B^{l})
sl	Sl	wing spoilers, 2 panels left side
z^{f}	SF	wing flap track fairings

TEST FACILITY

The tests were conducted in the Ames 11- by 11-Foot Transonic Wind Tunnel. This tunnel is a variable density, continuous flow type with an adjustable nozzle (two flexible walls) and a slotted test section (four walls) to permit transonic testing over a Mach number range continuously variable from 0.4 to 1.4.

MODEL DESCRIPTION

The model used in this investigation was an 0.020-scale model of the Lockheed ATT-95 airplane design. Model details and the cross-sectional area distribution of the model are shown in figure 2. Model dimensional data are presented in table 1.

The maximum diameter and length of the fuselage were 6.34 inches and 55.17 inches respectively. The aft 10 inches of fuselage contours were extensively modified to accommodate the sting support.

The nose section of the fuselage housed a support for a gang of 3 scanning pressure transducers which were connected to 114 wing pressure orifices. These orifices were located at four spanwise stations on the upper and lower surfaces of the left wing as shown in table 2.

The vertical and horizontal tails had straight line surface elements and were of the supercritical airfoil type. No provisions were made for rudder or elevator deflection. Horizontal tail incidence could be set at $0, \pm 1, \pm 2, \pm 3, -4$, and -5 degrees.

Four swept-inlet nacelles and pylons were mounted at wing stations $\eta = 0.4$ and 0.7.

TESTING AND PROCEDURE

The model was sting mounted as shown in figure 2(b). Force and moment data were obtained from an internally mounted six-component strain gage balance over a Mach number range of 0.50 to 0.98 at a free-stream Reynolds number per foot of 4.0×10^6 . Angle of attack was varied from -1 to +10 degrees and angle of sideslip was varied from -6 to +8 degrees. Wing pressure distributions were measured for representative Mach numbers and angles of attack.

Boundary layer transition was fixed on all model components using strips of glass beads sized and located as shown in figure 2(j). The upper surface forward location (TRANS=1) was used for both subcritical and supercritical Mach numbers while the upper surface aft location (TRANS=2) was used only on two configurations and only at supercritical Mach numbers.

Luminescent oil flow visualization studies of both upper and lower wing surfaces were made. Free transition locations and transition strip effectiveness were determined using a sublimation technique.

DATA REDUCTION

Forces and moments were reduced to standard coefficient form in both the body and stability axis systems using the basic reference dimensions of:

wing	area, S _w	1.8979 ft ²
mean	aerodynamic chord, c	6.3853 in
wing	span, b	45.695 in

The moment reference center was located at 38.21 percent of the mean aerodynamic chord in the plane of symmetry.

The data were adjusted to the conditions of free-stream static pressure acting within the fuselage cavity and over the model fuselage base and no momentum or pressure losses (i.e., internal drag) in the four nacelle ducts. The fuselage cavity pressure was used to determine the base pressure corrections using the following relations:

$$C_{A_{b}} = -A_{b} \frac{p_{c} - p_{\infty}}{qS_{w}}$$
(1)
$$C_{D_{b}} = C_{A_{b}} \cos \alpha$$
(2)

The nacelle internal drag corrections were assumed to correspond to friction losses in a straight duct and are listed below.

Rn/ft	4.0 x 10 ⁶
C _A (per nacelle) i	0.00031
$C_{A_{i}}$ (total of 4 nacelles)	0.00125

Wing pressure data were reduced to standard coefficient form, C p.

The model angle of attack was referenced to the wing reference chord plane which was along a waterline. The measured angle of attack has been corrected for model support sting and balance deflections and tunnel airflow angularity. The latter correction was determined from tests of the model upright and inverted.

RESULTS AND DISCUSSION

A complete index of data figures is given in table 3. Figures 4 through 13 contain plots of the basic aerodynamic coefficients. Figures 14 through 18 are summary plots of the coefficients presented as a function of Mach number. Wing pressure distributions are presented in figures 19 through 26.

Results of the test include the drag characteristics of the wing-body and the wing mounted pylon/nacelles. Interference drag for the four pylon/nacelles was small over the Mach number range indicating the feasibility of using wing mounted engines on a high subsonic transport without upsetting the favorable drag-rise characteristics of the supercritical type airfoil.

The configuration design and sizing was based on a Mach number of 0.93 as it was felt that this increment (from 0.93 to 0.95) was consistent with improvements to the drag divergence Mach number normally possible through wind tunnel optimization programs. Drag divergence Mach number is defined as the free stream Mach number for which $\Im_D^2 / \Im M = 0.1$. Test results indicate a drag divergence Mach number of 0.925 which is in excellent agreement with that predicted for the configuration.

A secondary, forward wing shock system was observed with the aid of luminescent oil flow visualization studies. This shock extended from the wing body junction near the wing leading edge to about 60% span where it intersected the primary (rearward) wing shock. As it was believed that the secondary shock was the result of insufficient lift compensation (local body area rule), a modification was made to the B¹ fuselage which was designated as B³. As the modification was made during the test, and decreasing the body area in question was impractical, fill material was added (see figure 2(i)) in hopes of obtaining the reverse effect of moving the shock even farther forward and strengthening it. Force and pressure data, figures 13 and 25, indicate that this indeed was the result. Futhermore, the pressure data show the extensive span-wise effect of the local body area ruling.

Drag increments associated with the vertical and horizontal tails were very close to the calculated skin friction increments and contributed very little to the drag rise with Mach number. Cruise trim drag was essentially zero and horizontal tail effectiveness was maintained over the Mach number and angle of attack ranges tested.

Effects of spoiler deflection (left wing only) on longitudinal and lateral aerodynamics are shown in figures 10 and 11 respectively. Spoiler effectiveness remained relatively constant to an angle of attack of 6

degrees at M = 0.8, and to about 4 degrees at M = 0.95. Pitch and roll control was maintained to the highest angle tested (10 degrees). Figure 21 shows the effects of spoiler deflection on the upper surface wing pressure distributions.

CONCLUDING REMARKS

From a wind tunnel investigation of a large, long range ATT aircraft configuration it is concluded that:

1. Satisfactory drag-rise characteristics have been demonstrated on a configuration including fuseLage canopy, flap-track fairings, and four wing-mounted engines.

2. Drag-rise characteristics of the wing-body combination may be improved by proper optimization of the local body area ruling.

3. The configuration exhibited adequate longitudinal and lateraldirectional stability over the Mach number and attitude ranges tested.

4. Horizontal tail effectiveness was maintained over the range of conditions tested.

5. Spoiler control was constant up to at least 4 degrees angle of attack over the range of Mach numbers tested.

Ames Research Center

National Aeronautics and Space Administration Moffett Field, Calif., 94035

May 11, 1973





TABLE 1. - MODEL DIMENSIONAL DATA

Fuselage B^{\perp}		
Length Maximum diameter Maximum frontal area Fuselage reference line Nose location Wing W ¹ (basic panel)	W.L. F.S.	55.17 in 6.34 in 25.625 in ² 1.660 8.753
Planform area, S _W Span, b Mean aerodynamic chord length, c Location of 0.25 M.A.C.	F.S. W.L.	1.8979 ft ² 45.695 in 6.3853 in 38.2426 0.5045
Aspect ratio Taper ratio, λ Dihedral (50% chord), $\eta = 0.130$ to $\eta = 0.186$ Dihedral (50% chord), $\eta = 0.186$ to $\eta = 1.0$ Twist (total washout about 50% chord) Root chord length Tip chord length Root chord incidence Leading edge sweep, $\eta = 0.130$ to $\eta = 0.40$, Λ_{LE} Leading edge sweep, $\eta = 0.40$ to $\eta = 1.0$, Λ_{LE} Trailing edge sweep inboard panel, Λ_{TE}	B.L.	9.7088 7.640 0.379 2.0° 5.0° 7.97° 8.674 in 3.288 in 2.97° 71.0° 41.78° 0.0° 33.5°
Vertical Tail V ¹		
Area, S Span, b Mean aerodynamic chord length Sweep of 35% chord, $\Lambda_{0.35}$ Tip chord Root chord Aspect ratio Taper ratio, λ		48.441 in ² 6.960 in 6.989 in 42.5° 6.187 in 7.733 in 0.991 0.8

TABLE 1. - MODEL DIMENSIONAL DATA - Concluded.

Horizontal Tail H1

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Area, S_H	45.957 in ²
Span, b_h	13.558 in
Mean aerodynamic chord length	3.597 in
Sweep of 35% chord, $\Lambda_{0.35}$	39.04°
Tip chord	1.937 in
Root chord	4.842 in
Aspect ratio	4.0
Taper ratio, λ	0.4
Horizontal tail arm	28.728 in
Nacelle length	5.47 in
Maximum diameter	1.85 in
Inlet capture area	1.96 in ²
Inboard nacelle centerline location, $\eta = 0.40$	B.L. 9.139
Outboard nacelle centerline location, $\eta = 0.70$	B.L. 15.993
Nacelle centerline cant, ε	-2.00°
toeout, σ	0.0°
roll, ϕ	0.0°
Pylon; inboard K ¹ , outboard K ²	
Inboard maximum length	9.84 in
Outboard maximum length	8.35 in



E c =	.L. 4 ∶15.0	.250 31 in		l c	3.L. 7 = 7.4	.768 66 in		B.L. 11.424 c = 5.981 in				B.L. 18.278 c = 4.366 in			
Upp	er	Low	er	Upj	per	Low	er	Upı	per	Low	er	Uppe	Upper		r
%с	tube no.	%c	tube no.	%с	tube no.	%c	tube no.	%c	tube no.	%c	tube no.	%c	tube no.	%с	tube no.
0	l			0	32			0 ·	63						
2	2	2.5	19	2	33	2.5	50	2	64	2.5	80	2	93	5	105.
5	3	7.•5	20	5	34	7.5	51	5	65	7.5	81	6.5	94		
10	4	12.5	21	10	35	12.5	52	10	66	12.5	82	12.5	95	12.5	106
15	5		·	15	36			15	67			20	96	20	107
20	6	20	22	20	37	20	53	20	68	20	83	30	97	30	108
25	7			25	38			30	69	30	84	40	98	40	109
30	8	30	23	30	39	30	5 <u>.</u> 4	40	7.0	40	85	50	99 [.]	50	110
40	9.	4 <u>0</u>	24	40,	40	40	55	50	71	: . 50	86	60	100	60	111
50	10	50	25	50	41 [.]	50	56.	56	72	⁻ 60	87	68	101	, 7 0	112
56.	11 .	60	26	- 56	42	60	57	62	73	67.5	88	76	102	80	113
62	12 .	67.5	27	62	43	67.5	58	68	74	75	89	84	103	90	114

TABLE 2. - PRESSURE TUBE LOCATIONS (LEFT WING)

c i	B.L. 4.250 = 15.031 in B.L. 7.768 c = 7.466 in							B.L. 11.424 c = 5.981 in				B.L. 18.278 c = 4.366 in			
Up	per	Lov	ver	Up	Upper		Lower		per	Lower		Upper		Lower	
%c	tube no.	%c	tube no.	%с	tube no	%c	tube no.	%с	tube no.	%с	tube no.	%c	tube no.	%с	tube no.
68	13	75	28	68	կկ	75	59	74	75	82.5	90.	92	104		·
74	1¥	82.5	29	74	45	82.5	60	80	76	90	91		•••		'
80	15	90	30	80	46	90	61	86	77	95	92				
86	16	95	31	86	47	95	62	92	78						
92	17			92	48			98	79						
98	18			98	49										

TABLE 2. - PRESSURE TUBE LOCATIONS (LEFT WING) - Concluded.

TABLE 3. - INDEX OF DATA FIGURES

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TABLE 3. - INDEX OF DATA FIGURES - Concluded.

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24	Effect of transition strip location on wing pressure distributions, wing lower surface.	220
25	Effect of body area rule on wing pressure distributions, wing upper surface.	228
26	Effect of body area rule on wing pressure distributions, wing lower surface.	236

Notes:

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16

- Positive directions of force cofficients, moment coefficients, and angles are indicated by arrow
- 2. For clarity, origins of wind and stability axes have been displaced from the center of gravity

Cm

m

Ys

Cl.w

C_{D,w}

Cl,s

×w

Figure 1. - Axis systems.

D

CN

- a

zs

C_{n,s}

Z

Cn

C_{m,w}

β

Y_w

Z

C_{n,w}

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(a) Three-view drawing

Figure 2. - Model details.



(b) Sting support

Figure 2. - Continued.

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(c) Wing planform

Figure 2. - Continued.

- BL 2.970 FWD -OUTED -2.190 0.635 BL 9.868 SPOILER (s1) ---(0°, 10° & 25°) -25° MAX BL 15.264 0.508 SPOILER (s1) (L.H. WING UPPER. SURFACE ONLY) 11.868 1.552-SECTION A-A 0.473 BL 16.72 Note: All dimensions are model BL 20.307 0.389 scale in inches. 1.469

- BLO

(d) Spoilers Figure 2. - Continued.

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Figure 2. - Continued.





(f) Typical pylon/nacelle assembly

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Figure 2. - Continued.

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scale in inches

- (h) Horizontal tail
- Figure 2. Continued.



(i) Model cross-sectional area distributions





Figure 2. - Concluded.

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(a) Front view

Figure 3. - Model installed in Ames 11- by 11-Foot Transonic Wind Tunnel.



(b) Rear view Figure 3. - Concluded.

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DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
(HAF024)	0	W1 B1	0.000		0.000	1.000
(RAF007)	Σ	DATA NOT AVAILABLE	0.000	-1.000	0.000	1.000
(RAF013)	\diamond	W1 B1 V1 H1 K1 N1 K2 N2 ZF1	0.000	-1.000	0.000	1.000



CL

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L/D

DATA SET	SYMBOL		NFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
(HAF024) (RAF007) (RAF013)	020	W1 W1 W1	1 1 V1 H1 1 V1 H1 K1 N1 K2 N2 ZF1	0.000 0.000 0.000	-1.000	0.000	1.000



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CONFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
DATA SET STABLE CONTROLATION DESCRIPTION	0.000		0,000	1.000
(HAF024) WI BI	0.000	-1.000	0.000	1.000
(RAF007) 🛆 W1 B1 V1 H1	0.000	-1 000	0.000	1.000
(RAF013) 🛇 W1 B1 V1 H1 K1 N1 K2 N2 ZF1	0.000	1.000		



(C)MACH = 0.85

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PAGE 3

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DATA SET	SYMBOL	0	ONF	IGUR	TIO	N DE	SCR	IPT	ION		BETA	HORIZT	SPLR-L	TRANS
(HAF024) (RAF007) (RAF013)	Q10	W1 W1 W1	B1 B1 B1	V1 H1 V1 H1	K1	N1	K2	NZ	ZF1	marine	0.000 0.000 0.000	-1.000	0.000	1,000



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8 P.-
DATA SET SYMBOL CONFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
(HAF024) () W1 B1	0,000		0.000	1.000
(RAF007) A W1 B1 V1 H1	0.000	-1.000	0.000	1.000
(RAF013) VI BI VI HI KI NI KE NE ZFI				



(E)MACH = 0.92

С

170

DATA SET S	MBOL	CONFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS	
(HAF024) (RAF007) (RAF013)	020	W1 B1 W1 B1 V1 H1 W1 B1 V1 H1 K1 N1 K2 N2 ZF1	0.000 0.000 0.000	-1.000	0.000	1.000	



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DATA SET SYMBOL CONFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
(HAE024) W1 B1	0.000		0.000	1.000
(RAF007) X W1 B1 V1 H1	0.000	-1.000	0.000	1.000
(RAF013) 🛇 W1 B1 V1 H1 K1 N1 K2 N2 ZF1	0.000	-1.000	0.000	1.000



(G)MACH = 0.95

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DATA SET SYMBO	CONFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
(HAF024) (RAF007) (RAF013)	W1 B1 W1 B1 V1 H1 DATA NOT AVAILABLE	0.000 0.000 0.000	-1.000 -1.000	0.000	1.000



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DATA SET SYMBOL CONFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
(HAED24) O WI BI	0.000		0.000	1.000
(RAFDUZ) X DATA NOT AVAILABLE	0.000	-1.000	0.000	1.000
(RAF013) 🚫 W1 B1 V1 H1 K1 N1 K2 N2 ZF1	0.000	-1.000	0.000	1.000

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(C)MACH - 0.05

PAGE 11

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DATA SET SYMBOL CONFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
	0.000		0.000	1.000
(HAFU24) WI DI	0.000	-1.000	0.000	1.000
(RAF013) O W1 B1 V1 H1 K1 N1 K2 N2 ZF1	0.000	-1.000	0.000	1.000



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(E)MACH - 0.92



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DATA SET SYMBOL CONFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
(HAED24) O WI BI	0.000		0.000	1,000
(RAF007) X W1 B1 V1 H1	0.000	-1.000	0.000	1.000
(RAF013) 🚫 W1 B1 V1 H1 K1 N1 K2 N2 ZF1	0.000	-1.000	0.000	1.000



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DATA SET SYMBOL	CONFIGURATION DESCRIPTION	BETA	MORIZI	SPLK-L	IKANS	
(RAF010) (RAF011)	W1 B1 V1 H1 W1 B1 V1 H1 K1 N1 K2 N2 ZF1	0.000	-1.000	0.000	2.000	



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FIG 5 EFFECT OF ADDITION OF MAJOR COMPONENTS ON LONG. AERODYNAMICS. GRIT TYPE 2 (A)MACH = 0.90 PAGE 17





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DATA SET SYMBOL CONFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
(RAF010) W1 B1 V1 H1 (RAF011) W1 B1 V1 H1 K1 N1 K2 N2 ZF1	0.000	-1.000	0.000	2.000



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(C)MACH = 0.94

PAGE 19

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(D)MACH = 0.95

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DATA SET SYMBO	L CONFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
(RAF010)	W1 B1 V1 H1 W1 B1 V1 H1 K1 N1 K2 N2 ZF1	0.000	-1.000	0.000	2.000



(E)MACH = 0.96

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DATA SET	SYMBOL	CON	FIG	JRATIC	N D	ESCRIP	TION	A State of the second	BETA	HORIZT	SPLR-L	TRANS	
(RAF010) (RAF011)	8	W1 B1 W1 B1	V1 V1	H1 H1 K1	N1	K2 N2	ZF1		0.000	-1.000	0.000	2.000	



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DATA SE	T SYMBOL		CONF	IGU	RATIO	ON DE	SCR	IPT	ION			BETA	HORIZT	SPLR-L	TRANS
RAF010	3 8	W1 W1	B1 B1	V1 V1	H1 H1 K	1 N1	KZ	NZ	ZF1			0.000	-1.000	0.000	2.000



 DATA SET SYMBOL
 CONFIGURATION DESCRIPTION

 (RAFD10)
 W1 B1 V1 H1

 (RAFD11)
 W1 B1 V1 H1

 W1 B1 V1 H1 K1 N1 K2 N2 ZF1

 BETA
 HORIZT
 SPLR-L
 TRANS

 0.000
 -1.000
 0.000
 2.000

 0.000
 -1.000
 0.000
 2.000

DATA SE	T SYMBOL	CONFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
(RAF010	, 0	W1 B1 V1 H1	0.000	-1.000	0.000	2.000
(RAF011) ()	W1 B1 V1 H1 K1 N1 K2 N2 ZF1	0,000	-1.000	0,000	2.000



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DATA SET SYMBOL CONFIGURATION DESCRIPTION	ALPHA	HORIZT	SPLR-L	TRANS
(RAE025) W1 81	3.400		0.000	1.000
(RAF009) X W1 B1 V1 H1	3.400	-1.000	0.000	1.000
(RAFD15) 🚫 W1 B1 V1 H1 K1 N1 K2 N2 ZF1	3.400	-1.000	0.000	1.000



(A)MACH = 0.80

DATA SET S	MBOL	col	FIGU	IRAT	ION	DESC	RIP	TION				AL	PHA	HORIZT	SPLR-L	TRANS	
(RAF025) (RAF009) (RAF015)	000	W1 B W1 B W1 B	V1 V1	H1 H1	K1 N	1 K2	NZ	ZF1				3 3 3	.400	-1.000	0.000	1.000	



(B)MACH = 0.95

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DATA SE	T SYMBOL	CON	FIG	URA	TION	DESC	RIP	TION	BETA	HORIZT	SPLR-L	TRANS
(RAFOD8 (RAFO14	; 8	W1 81 W1 81	V1 V1	H1 H1	K1	N1 K2	NZ	ZF1	3.000	-1.000	0.000	1.000



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ATA SET SYMBOL	CONFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
(RAFOD8)	W1 B1 V1 H1 W1 B1 V1 H1 K1 N1 K2 N2 ZF1	3,000	-1.000	0.000	1.000



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DATA SET SYMBOL CONFIGU	RATION DESCRIPTION	DBETA	HORIZT	SPLR-L	TRANS
(FAF008) Q W1 B1 V1 (FAF014) Q W1 B1 V1	H1 H1 K1 N1 K2 N2 ZF1	3.000	-1.000	0.000	1.000

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TRANS CONFIGURATION DESCRIPTION DBETA HORIZT SPLR-L DATA SET SYMBOL 0.000 1,000 3.000 -1.000 (FAFOO8) W1 B1 V1 H1 8 1.000 -1.000 3.000 W1 B1 V1 H1 K1 N1 K2 N2 ZF1 (FAFD14)



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DATA SET	SYMBOL	1	CON	FIG	URA	TIO	N DI	ESC	RIP	TION	BETA	HORIZT	SPLR-L	TRANS
(HAF013)	Q	W1	B1	V1	H1	K1	N1	K2	N2	ZF1	0.000	-1.000	0.000	1.000
(RAF016)	X	W1	B1	V1	H1	K1	N1	K2	N2	ZF1	.0.000	-3.000	0.000	1.000
(RAF017)	\diamond	W1	B1	V1	H1	K1	N1	K2	N2	ZF1	0.000	-5.000	0.000	1.000



(A)MACH = 0.80

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DATA SET	SYMBOL		CONF	IGI	URA	NOIT	D	ESCI	RIPI	TION
(HAF013)	Q	W1	B1	V1	H1	K1	N1	K2	NZ	ZF1
(RAF016)	Z	W1	B1	V1	H1	K1	N1	KZ	N2	ZF1
(RAF017)	\diamond	W1	B1	V1	H1	K1	N1	K2	N2	ZF1

BETA	HORIZT	SPLR-L	TRANS
0.000	-1,000	0.000	1.000
0.000	-3.000	0.000	1.000
0.000	-5.000	0.000	1.000



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DATA SET S	YMBOL	co	NFI	GUR	TIO	N D	ESCI	RIP	TION	BETA	HORIZT	SPLR-L	TRANS
(HAF013) (RAF016) (RAF017)	QAO	W1 B W1 B W1 B	1 V 1 V 1 V	1 H1 1 H1 1 H1	K1 K1 K1	N1 N1 N1	K2 K2 K2	N2 N2 N2	ZF1 ZF1 ZF1	0.000 0.000 0.000	-1.000 -3.000 -5.000	0.000	1.000



(C)MACH = 0.95





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DATA SET SYM	BOL CONFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
(HAF013) (RAF016) (RAF017)	W1 B1 V1 H1 K1 N1 K2 N2 ZF1 W1 B1 V1 H1 K1 N1 K2 N2 ZF1 W1 B1 V1 H1 K1 N1 K2 N2 ZF1	0.000 0.000 0.000	-1.000 -3.000 -5.000	0.000	1.000



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DATA SET SY	MBOL	0	CONF	FIG	URATION	DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
(HAF007) (RAF006)	8	W1 W1	B1 B1	V1 V1	H1 H1		0.000	-1.000	0.000	1.000



(A)MACH = 0.80

DATA SET SYMBOL	CONFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS	
(HAF007) 8	W1 B1 V1 H1 W1 B1 V1 H1	0.000	-1.000	0.000	1.000	



(B)MACH = 0.90

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DATA SET	SYMBOL	- 1	CON	FIG	URATIO	N DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
(HAF007) (RAF006)	8	W1 W1	81 81	V1 V1	H1 H1		0.000	-1:000	0.000	1.000



(C)MACH = 0.95

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DATA SET	SYMBOL		CONI	FIG	URA	TION	DESCRIPTION		BETA	HORIZT	SPLR-L	TRANS
(HAF007)	Q	W1	81	V1	H1				0.000	-1.000	0.000	1.000
(RAF006)		W1	B1	V1	H1				0.000	-3.000	0.000	1.000

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(A)MACH = 0.80

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(B)MACH = 0.90

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(C)MACH = 0.95

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DATA SET	SYMBOL	(ONF	FIG	JRA	TIO	DI	ESCR	RIP	TION		BETA	HORIZT	SPLR-L	TRANS
(HAF013) (RAF018) (RAF019)	QQ	W1 W1 W1	B1 B1 B1	V1 V1 V1	H1 H1 H1	K1 K1 K1	N1 N1 N1	K2 K2 K2	N2 N2 N2	ZF1 ZF1 ZF1	S1 S1	0.000 0.000 0.000	-1.000 -1.000 -1.000	0.000	1.000







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DATA SET	SYMBOL	C	ONF	GUR	ATI	ON	DE	SCR	IP	TION		BETA	HORIZT	SPLR-L	TRANS
(HAF013) (RAF018) (RAF019)		W1 W1 W1	B1 1 B1 1 B1 1	/1 H /1 H /1 H	1 K 1 K 1 K	1 1	N1 N1 N1	K2 K2 K2	N2 N2 N2	ZF1 ZF1 ZF1	S1 S1	0.000 0.000 0.000	-1.000 -1.000 -1.000	0.000	1.000



(A)MACH = 0.80





(B)MACH = 0.90

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BATA SET SYMBOL CONFIGURATION DESCRIPTION BET	A HORIZT	SPLR-L	TRANS
CHAF013) W1 B1 V1 H1 K1 N1 K2 N2 ZF1 0.0 (RAF018) W1 B1 V1 H1 K1 N1 K2 N2 ZF1 S1 0.0	$\begin{array}{rrrr} 000 & -1.000 \\ 000 & -1.000 \\ 000 & -1.000 \end{array}$	0.000	1.000



(C)MACH = 0.95

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DATA SET	SYMBOL		CON	FIG	URA	TIO	N DI	ESC	RIP	TION	BETA	HORET	SPLR-L	TRANS
(RAF013) (RAF021) (RAF022) (HAF024)	0200	W1 W1 W1 W1	81 81 81 81	V1 K1 K1	H1 N1 N1	K1 K2 K2	N1 N2 N2	K2 ZF	N2	ZF1	0.000 0.000 0.000 0.000	~1.000	0.000	1.000 1.000 1.000 1.000



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(P)MACH = 0.80

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DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
(RAF013) (RAF021) (RAF022) (HAF024)	0200	W1 B1 V1 H1 K1 N1 K2 N2 ZF1 DATA NOT AVAILABLE DATA NOT AVAILABLE W1 B1	0.000 0.000 0.000 0.000	-1.993	0.000 0.000 0.000 0.000	1.000 1.000 1.000 1.000



(C)MACH = 0.85

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DATA SET	SYMBOL		CONF	FIG	URA	TIO	N D	ESCRIP	TION	
(RAF013)	Q	W1	81	V1	H1	K1	N1	K2 N2	ZF1	
(RAF021)	Δ	W1	81	K1	N1	K2	N2	ZF1		
(RAF022)	2	W1	B1	K1	N1	K2	N2			
(HAF024)		W1	B1							

BETA	HORIZT	SPLR-L	TRANS
0.000	-1.000	0.000	1.000
0.000		0.000	1.000
0.000		0.000	1.000
0.000		0.000	1.000



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DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	BETA	HORIZI	SPLR-L	IRANS
(RAF013) (RAF021) (RAF022) (HAF024)	CA CO	W1 B1 V1 H1 K1 N1 K2 N2 ZF1 W1 B1 K1 N1 K2 N2 ZF1 W1 B1 K1 N1 K2 N2 W1 B1	0.000	-1.000	0.000	1.000



(F)MACH = 0.94

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1220			HETC		TION	DE	SCRIPTION		BETA	HORIZT	SPLR-L	TRANS	
DATA SET S (RAF013) (RAF021) (RAF022) (HAF024)	RAD	W1 B W1 B W1 B W1 B	1 V1 1 K1 1 K1 1	H1 N1 N1	K1 K2 K2	N1 N2 N2	K2 N2 ZF1 ZF1		0.000 0.000 0.000	-1,000	0.000 0.000 0.000 0.000	1.000 1.000 1.000 1.000	



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DATA SET SYMBO	L CONFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
(RAF013) (RAF021) (RAF022) (HAF024)	DATA NOT AVAILABLE W1 B1 K1 N1 K2 N2 ZF1 W1 B1 K1 N1 K2 N2 W1 B1	0.000 0.000 0.000 0.000	-1,000	0.000 0.000 0.000 0.000	1.000



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DATA SET SYMBOL CONFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
(RAF013) (RAF021) (RAF021) (RAF021) (RAF022) (RAF022) (RAF022) (RAF022) (RAF024) (RAF024) <td< th=""><th>0.000 0.000 0.000 0.000</th><th>-1,000</th><th>0.000 0.000 0.000 0.000</th><th>1.000</th></td<>	0.000 0.000 0.000 0.000	-1,000	0.000 0.000 0.000 0.000	1.000



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DATA SET	SYMBOL	C	ONFI	GURA	TIO	N DI	ESCRIP	TION		BETA	-1.000	0.000	1.0
(RAF013) (RAF021) (RAF022)	CA CA	W1 W1 W1	B1 V B1 K B1 K B1 K	1 H1 1 N1 1 N1	K1 K2 K2	N1 N2 N2	K2 N2 ZF1	ZF1		0.000		0.000 0.000 0.000	1.0



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DATA SET SY	MBOL CONFIGURATION DESCRIPTION	BETA HORIZT	SPLR-L	TRANS
(RAF013)	DATA NOT AVAILABLE	0.000 -1.000	0,000	1.000
(RAF021) (RAF022)	△ W1 B1 K1 N1 K2 N2 ZF1 ◇ W1 B1 K1 N1 K2 N2	0.000	0.000	1.000
(HAF024)	W1 B1	0.000		



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ATA SET	SYMBOL		CONF	IG	URATION	DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
XAF007) RAF027)	8	W1 W1	B1 B3	V1 V1	H1 H1		0.000	-1.000	0.000	1.000



(A)MACH = 0.90

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DATA	SET	SYMBOL	1	CON	FIG	URATI	ON DESCRIPTION	B	ETA	HORIZT	SPLR-L	TRANS
(XAFO	(07) (27)	8	W1 W1	B1 B3	V1 V1	H1 H1			0.000	-1.000	0.000	1.000



(B)MACH = 0.92

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TRANS

SPLR-L

HORIT

BETA

A STATE AND A STAT	BETA HORI	ZT SPLK-L	IKANS
DATA SET SYMBOL CONFIGURATION DESCRIPTION	0.000 -1.0	0.000	1.000
(RAF007) 🛆 W1 B3 V1 H1	0.000 -1.0	10 0.000	1.000

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DATA SET SYMBOL	CONFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
(XAF007) Q 4	11 B1 V1 H1	0.000	-1.000	0.000	1.000
(PAF027) () W	1 83 V1 H1				



(C)MACH - 0.95

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FIG 14A EFFECT OF MACH NUMBER ON LONGITUDINAL AERODYNAMICS

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DATA SET SYNBOL CONFIGURATION DESCRIPTION		BETA	HORIZT	SPLR~L	TRANS
(TAF003) W1 B1 V1 H1 (TAF005) W1 B1 V1 H1 (TAF007) W1 B1 V1 H1 (TAF010) W1 B1 V1 H1	. ·	0.000 0.000 0.000 0.000	0,000 0,000 -1,009 -1,005	0.000 0.000 0.000 0.000	0.000 1.000 1.000 2.000







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DACE 70

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DATA SET	SYMBOL		CON	FIG	URA	TIO	N D	ESCI	RIP	TION		BETA
(TAF013) (TAF011)	8	W1 W1	81 81	V1 V1	H1 H1	K1 K1	N1 N1	K2	N2 N2	ZF1 ZF1		0.0

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DATA SET SYMBOL CONFIGURATION DESCRIPTION W1 B1 V1 H1 K1 N1 K2 N2 ZF1

BETA HORIZT SPLR-L TRANS 0.000 1.000 -1,000 0.000

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DATA SET	SYMBOL		CONI	FIG	URA	TIO	N DI	SCR	IPI	TION	BE	ATA	HORIZT	SPLR-L	1.000
(TAF013) (TAF020)	8	W1 W1	B1 B1	V1 V1	H1 K1	K1 N1	N1 K2	K2 1	N2 ZF1	ZF1	0	.000		0.000	1.000
(TAF021)	0	W1	81	K1	IN 1	VC.	146	21 4							



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DATA SET SYMBOL CONFIGURATION DESCRIPTION	BETA HORIZT SPLR-L	TRANS
(TAF021) W1 B1 K1 N1 K2 N2 ZF1 (TAF022) W1 B1 K1 N1 K2 N2 (TAF023) W1 B1 K1 N1 (TAF024) W1 B1 K1 N1	0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	1,000 1,000 1,000 1,000



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DATA SET S	YMBOL	CONF	FIGU	RATIO	N DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS
(TAF021) (TAF022) (TAF023) (TAF024)	000	/1 B1 /1 B1 /1 B1 /1 B1	K1 K1 K1	N1 K2 N1 K2 N1	N2 ZF1 N2	0.000 0.000 0.000 0.000		0.000 0.000 0.000 0.000	1.000 1.000 1.000 1.000



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(FAF016)

W1 B1 V1 H1 K1 N1 K2 N2 ZF1

SYMBOL	ALPHA		PARAMETR	IC VALUES		
0	0.000	BETA	0.000	HORIZT	-	3.000
X	4.000	SPLR-L	0.000	TRANS		1.000
0	8.000	RN/L	4.000			

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(GAF018)

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W1 B1 V1 H1 K1 N1 K2 N2 ZF1 S1

SYMBOL	ALPHA		PARAMETRI	C VALUES	
0	0.000	BETA	0.000	HORIZT	- 1,000
Δ	4.000	SPLR-L	- 10.000	TRANS	1.000
0	8.000	RN/L	4.000		

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(FAF018)

W1 B1 V1 H1 K1 N1 K2 N2 ZF1 S1



DATA SET SYMBOL	CONFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS	
(KAF013) (KAF018) (KAF019) (KAF019)	W1 B1 V1 H1 K1 N1 K2 N2 ZF1 W1 B1 V1 H1 K1 N1 K2 N2 ZF1 S1 W1 B1 V1 H1 K1 N1 K2 N2 ZF1 S1 W1 B1 V1 H1 K1 N1 K2 N2 ZF1 S1	1 0,000 1 0,000 1 0,000	-1.000 -1.000 -1.000	0.000	1.000 1.000 1.000	



DATA SET	SYMBOL	co	NFIG	URA	TIO	N D	ESC	RIP	TION	í .	BETA	HORIZT	SPLR-L	1,000
(KAF013) (KAF018)	QQ	W1 B	1 V1 1 V1 1 V1	H1 H1 H1	K1 K1 K1	N1 N1 N1	K2 K2 K2	N2 N2 N2	ZF1 ZF1 ZF1	S1 S1	0.000	-1.000	-10.000 -25.000	1.000



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ATA SET SYMB	OL CONFIGURATION DESCRIPTION	BETA	HORIZT	SPLR-L	TRANS	
(KAF013) (KAF018) (KAF019)	W1 B1 V1 H1 K1 N1 K2 N2 ZF1 W1 B1 V1 H1 K1 N1 K2 N2 ZF1 S1 W1 B1 V1 H1 K1 N1 K2 N2 ZF1 S1	0.000 0.000 0.000	-1.000 -1.000 -1.000	0.000 -10.000 -25.000	1.000 1.000 1.000	



(C)ALPHA = 4.00

DATA SET SYMBO	CONFIGURATION DESCRIPTION	BETA HOR	ZT SPLR-L TRANS
(KAF013) (KAF018) (KAF018) (KAF019)	W1 B1 V1 H1 K1 N1 K2 N2 ZF1	0.000 -1.0	00 0.000 1.000
	W1 B1 V1 H1 K1 N1 K2 N2 ZF1 S1	0.000 -1.0	00 -10.000 1.000
	W1 B1 V1 H1 K1 N1 K2 N2 ZF1 S1	0.000 -1.0	00 -25.000 1.000



(D)ALPHA = 5.00



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SYMBOL ALPHA BL MACH

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 PARAMETRIC VALUES

 BETA
 0.000
 SPLR-L
 0.000

 TRANS
 1.000
 RN/L
 4.000

SYMBOL	ALPHA	BL	MACH
0	3.510	4.250	0.500

	PARAMETR	PARAMETRIC VALUES		
BETA	0.000	SPLR-L	0.000	
TRANS	1.000	RN/L	4.000	





FIG. 19 WING PRESSURE DISTRIBUTION FOR BASIC WING-BODY

ALPHA

BL

SYMBOL

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MACH

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PARAMETRIC VALUES

SYMBOL ALPHA BL MACH

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	PARAMETR	PARAMETRIC VALUES	
BETA	0.000	SPLR-L	0.000
TRANS	1.000	RN/L	4.000







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	PARAMETR	PARAMETRIC VALUES	
BETA	0.000	SPLR-L	0.000
TRANS	1.000	RN/L	4.000



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	PARAMETRIC VALUES		
BETA	0.000	SPLR-L	0.000
TRANS	1.000	RN/L	4.000





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SYMBOL ALPHA BL MACH 0 4.510 11.424 0.500

1 1

 PARAMETRIC VALUES

 BETA
 0.000
 SPLR-L
 0.000

 TRANS
 1.000
 RN/L
 4.000



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SYMBOL ALPHA BL MACH 3.510 18.278 0.500

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 PARAMETRIC VALUES

 BETA
 0.000
 SPLR-L
 0.000

 TRANS
 1.000
 RN/L
 4.000



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SYMBOL ALPHA BL MACH

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 PARAMETRIC VALUES

 BETA
 0.000
 SPLR-L
 0.000

 TRANS
 1.000
 RN/L
 4.000



SYMBOL ALPHA BL MACH

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CP

 PARAMETRIC VALUES

 BETA
 0.000
 SFLR-L
 0.000

 TRANS
 1.000
 RN/L
 4.000



MACH BL SYMBOL ALPHA 0 4.250 0.801 7.990

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PARAMETRIC VALUES

1.000

BETA

TRANS

0.000 0.000 SFLR-L 4.000 RN/L

PARAMETRIC VALUES				
BETA	0.000	SPLR-L	0.000	
TRANS	1.000	RN/L	4.000	

SYMBOL ALPHA BL MACH

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 PARAMETRIC VALUES

 BETA
 0.000
 SPLR-L
 0.000

 TRANS
 1.000
 RN/L
 4.000



SYMBOL ALPHA BL MACH 7.990 7.768 0.801
 PARAMETRIC VALUES

 BETA
 0.000
 SPLR-L
 0.000

 TRANS
 1.000
 RN/L
 4.000

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SYMBOL ALPHA BL MACH

PARAMETRIC VALUES BETA 0.000 SPLR-L 0.000 TRANS 1.000 RN/L 4.000 SYMBOL ALPHA BL MACH 3.530 11.424 0.801

	PARAMETR		
BETA	0.000	SPLR-L	0.000
TRANS	1.000	RN/L	4.000





SYMBOL ALPHA BL MACH 7,990 11.424 0.801

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 PARAMETRIC VALUES

 BETA
 0.000
 SPLR-L
 0.000

 TRANS
 1.000
 RN/L
 4.000


SYMBOL ALPHA BL MACH - 0.040 18.278 0.801



WING UPPER SURFACE

CONFIGURATION DESCRIPTION

SYMBOL ALPHA BL MACH 3.530 18.278 0.801

DATA SET

(XAF024)

SYMBOL

OPEN

W1 B1

PARAMETRIC VALUES BETA 0.000 SPLR-L 0.000 TRANS 1.000 RN/L 4.000



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PARAMETRIC VALUES				
BETA	0.000	SPLR-L	0.000	
TRANS	1.000	RN/L	4.000	





SYMBOL ALPHA BL MACH 0 0.000 4.250 0.902



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SYMBOL ALPHA BL MACH 0 0.000 7.768 0.902

						PARAMETR	IC VALUES	
O	ALPHA 3.550	8L 7.768	0.902	E	BETA TRANS	0.000	SPLR-L RN/L	0.000

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SYMBOL ALPHA BL MACH 0.000 11.424 0.902

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 PARAMETRIC VALUES

 BETA
 0.000
 SPLR-L
 0.000

 TRANS
 1.000
 RN/L
 4.000

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SYMBOL ALPHA BL MACH 3.550 11.424 0.902

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 SYMBOL
 ALPHA
 BL
 MACH
 PARAMETRIC VALUES

 O
 - 0.040
 4.250
 0.952
 BETA
 0.000
 SPLR-L

 TRANS
 1.000
 RN/L

0.000



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	PARAMETR		
BETA	0.000	SPLR-L	0.000
TRANS	1.000	RN/L	4.000





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SYMBOL	ALPHA	BL	MACH	
0	7.980	4.250	0.952	



FIG. 19 WING PRESSURE DISTRIBUTION FOR BASIC WING-BODY

PAGE 127

SYMBOL ALPHA BL MACH 0 - 0.040 7.768 0.952

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CP





SYMBOL ALPHA BL MACH

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O	SPLR-L 0.000
4	RN/L 4.000
	RN/L

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PAGE 129

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0,000 4.000



SYMBOL	ALPHA	BL	MACH		PARAMETR	IC VALUES	
0	3.510	11.424	0.952	BETA	0.000	SPLR-L	
~				TRANS	1.000	RN/L	



SYMBOL ALPHA BL MACH 7.980 11.424 0.952

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SYMBOL ALPHA BL MACH - 0.040 18.278 0.952

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	PARAMETRIC VALUES			
BETA	0.000	SPLR-L	0.000	
TRANS	1.000	RN/L	4.000	

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	PARAMETRIC VALUES			
BETA	0.000	SPLR-L	0.000	
TRANS	1.000	RN/L	4.000	



PAGE 134

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FIG. 19 WING PRESSURE DISTRIBUTION FOR BASIC WING-BODY

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PAGE 135

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SYMBOL ALPHA BL MACH

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 PARAMETRIC VALUES

 BETA
 0.000
 HORIZT
 1.000

 SPLR-L
 0.000
 TRANS
 1.000

 RN/L
 4.000
 1.000
 1.000



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PAGE 137

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SYMBOL ALPHA BL MACH 4.470 4.250 0.500

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 PARAMETRIC VALUES

 BETA
 0.000
 HORIZT
 - 1.000

 SPLR-L
 0.000
 TRANS
 1.000

 RN/L
 4.000

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MACH SYMBOL ALPHA BL

1

PARAMETRIC VALUES 0.000 HORIZT - 1.000

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SYMBOL ALPHA BL MACH 3.450 7.768 0.500

. . .

 PARAMETRIC VALUES

 BETA
 0.000
 HORIZT - 1.000

 SPLR-L
 0.000
 TRANS
 1.000

 RN/L
 4.000
 1.000
 1.000



SYMBOL ALPHA BL MACH 4.470 7.768 0.500
 PARAMETRIC VALUES

 BETA
 0.000
 HORIZT
 - 1.000

 SPLR-L
 0.000
 TRANS
 1.000

 RN/L
 4.000



SYMBOL ALPHA BL MACH

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PAGE 143



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PARAMETRIC VALUES

MACH SYMBOL ALPHA BL 4.470 11.424



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	PARAMETRIC VALUES				
BETA	0.000	HORIZT	-	1.000	
SPLR-L	0.000	TRANS		1.000	
RN/L	4.000				





SYMBOL ALPHA BL MACH 3.450 18.278 0.500



SYMBOL ALPHA BL MACH 4.470 18.278 0.500

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CP

PARAMETRIC VALUES 0.000 HORIZT - 1.000

0.000

4.000

BETA

RN/L

SPLR-L

Summer States

1.000

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TRANS



- 0.050 4.250 0.800

SYMBOL

0

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PAGE 148

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BL MACH SYMBOL ALPHA

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PARAMETRIC VALUES



SYMBOL ALPHA BL MACH 7.900 4.250 0.800

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SYMBOL ALPHA BL MACH - 0.050 7.768 0.800

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PAGE 152

PARAMETRIC VALUES

0.000

HORIZT - 1.000

SYMBOL ALPHA BL 7.768

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MACH



PARAMETRIC VALUES 0.000 BETA 0.000 TRANS SPLR-L RN/L

HORIZT - 1.000 1.000 4.000

MACH SYMBOL ALPHA BL 0 7.900 7.768 0.800



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SYMBOL ALPHA BL MACH 0 - 0.050 11.424 0.800





BL MACH SYMBOL ALPHA 11.424 0.800 0 3.440

PARAMETRIC VALUES HORIZT - 1.000 0.000 BETA 0.000 TRANS 1.000 SPLR-L 4.000 RN/L

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CP



SYMBOL ALPHA BL MACH 7.900 11.424 0.800

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SYMBOL	ALPHA	BL	MACH	
0	- 0.050	18,278	0.800	

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	PARAMETR	IC VALUES		
ETA	0.000	HORIZT	-	1.000
PLR-L	0.000	TRANS		1.000
N/L	4.000			

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SYMBOL ALPHA BL MACH 3.440 18.278 0.800

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 PARAMETRIC VALUES

 BETA
 0.000
 HORIZT
 1.000

 SPLR-L
 0.000
 TRANS
 1.000

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MACH

0.800

SYMBOL

0

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ALPHA

7.900

BL

18.278

PARAMETRIC VALUES BETA 0.000 0.000 TRANS SPLR-L RN/L

HORIZT - 1.000 1.000 4.000

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	PARAMETRIC VALUES				
BETA	0.000	HORIZT	-	1.000	
SPLR-L	0.000	TRANS		1.000	
RN/L	4.000				





ALPHA

3.460

SYMBOL

0

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SYMBOL ALPHA BL MACH 7.890 4.250 0.901

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 PARAMETRIC VALUES

 BETA
 0.000
 HORIZT
 1.000

 SPLR-L
 0.000
 TRANS
 1.000

 RN/L
 4.000
 1.000
 1.000

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	PARAMETR	IC VALUES		
ETA	0.000	HORIZT	-	1.000
PLR-L	0.000	TRANS		1.000
N/L	4.000			

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BL. SYMBOL ALPHA 3.460 7,768 0

MACH

PARAMETRIC VALUES 0.000 HORIZT 1.000

BETA

SYMBOL	ALPHA	BL	MACH
0	7.890	7.768	0.901

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	PARAMETRIC VALUES				
BETA	0.000	HORIZT	-	1.000	
SPLR-L	0.000	TRANS		1.000	
RN/L	4.000				





SYMBOL ALPHA BL MACH

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 PARAMETRIC VALUES

 BETA
 0.000
 HORIZT
 - 1.000

 SPLR-L
 0.000
 TRANS
 1.000

 RN/L
 4.000



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PAGE 168

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SYMBOL ALPHA BL MACH 7.890 11.424 0.901

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 PARAMETRIC VALUES

 BETA
 0.000
 HORIZT
 1.000

 SPLR-L
 0.000
 TRANS
 1.000

 RN/L
 4.000
 1.000
 1.000



SYMBOL		ALPHA	BL	MACH
0	-	0.090	18.278	0.901

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	PARAMETR			
BETA	0.000	HORIZT	-	1.000
SPLR-L	0.000	TRANS		1.000
RN/L	4.000			



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SYMBOL ALPHA BL MACH 3.460 18.278 0.901

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 PARAMETRIC VALUES

 BETA
 0.000
 HORIZT
 1.000

 SPLR-L
 0.000
 TRANS
 1.000

 RN/L
 4.000
 1.000



SYMBOL ALPHA BL MACH 7.890 18.278 0.901

CP

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RN/L

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SYMBOL ALPHA BL MACH 3.440 7.768 0.800

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0 3.440 11.424 0.800

SYMBOL ALPHA BL MACH

PARAMETRIC VALUES BETA 0.000 RN/L 4.000

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SYMBOL ALPHA BL MACH 3.440 18.278 0.800

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PARAMETRIC VALUES 0.000 RN/L 4.000

BETA

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FIG. 21 EFFECT OF SPOILERS ON WING PRESSURE DIST .- WING UPPER SURFACE



SYMBOL ALPHA BL MACH 3.460 11.424 0.902

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PARAMETRIC VALUES BETA 0.000 RN/L 4.000

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HACH BL. ALPHA SYMBOL 0,902 18.278 0 3,460

PARAMETRIC VALUES 0.000 BETA

4.000

RN/L



4.

MACH SYMBOL ALPHA BL 0,800 4,000 4.250

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PARAMETRIC VALUES RN/L 0.000 BETA

4.000



BETA

4,000





SYMBOL ALPHA BL HACH 4.000 11.424 0.800 PARAMETRIC VALUES BETA 0.000 RN/L 4.000 ł

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BETA








SYMBOL ALPHA BL MACH

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PARAMETRIC VALUES · BETA 0.000 RN/L 4.000



MACH

SYMBOL

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ALPHA

BL

PAGE 186

PARAMETRIC VALUES



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FIG. 21 EFFECT OF SPOILERS ON WING PRESSURE DIST.-WING UPPER SURFACE

PAGE 187

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PAGE 188

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PARAMETRIC VALUES

ALPHA BL

SYMBOL

MACH



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FIG. 21 EFFECT OF SPOILERS ON WING PRESSURE DIST.-WING UPPER SURFACE

PAGE 189

4.000

RN/L



ALPHA SYMBOL 0 3.980 11,424

MACH BL 0,949

PARAMETRIC VALUES 4.000 RN/L 0.000 BETA

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FIG. 21 EFFECT OF SPOILERS ON WING PRESSURE DIST.-WING UPPER SURFACE

PAGE 191



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PAGE 192



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FIG. 22 EFFECT OF SPOILERS ON WING PRESSURE DIST.-WING LOWER SURFACE

PAGE 193

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MACH ALPHA BL 7,768 0.800 3.440

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SYMBOL

0

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PARAMETRIC VALUES 0,000 RN/L

BETA

4,000



SYMBOL ALPHA HACH BL 0.800 0 11.424 3.440

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PARAMETRIC VALUES BETA 0.000 RN/L

PAGE 195

FIG. 22 EFFECT OF SPOILERS ON WING PRESSURE DIST.-WING LOWER SURFACE



MACH SYMBOL ALPHA BL. 18,278 0.800 0 3.440

PARAMETRIC VALUES 0.000 BETA

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RN/L

4.000

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MACH SYMBOL ALPHA Ū, 3,460 4.250

0.902

PARANETRIC VALUES 0.000 RN/L BETA



SYMBOL ALPHA BL MACH

t.

PARAMETRIC VALUES 0.000 RN/L

BETA

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4.000

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PAGE 199



SYMBOL. ALPHA 0 4.000 4,250

MACH

PARAMETRIC VALUES RN/L 0.000 BETA





ALPHA BL MACH SYMBOL 0,800 0 4.000 7,768

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PARAMETRIC VALUES BETA 0.000

SPLR-L HORIZT

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TRANS

RN/L



SYMBOL ALPHA BL MACH

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PARAMETRIC VALUES Beta 0.000 RN/L 4

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BETA

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FIG. 22 EFFECT OF SPOILERS ON WING PRESSURE DIST.-WING LOWER SURFACE

PAGE 203



PAGE 204

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SYMBOL ALPHA BL MACH 4.000 4.250 0,902

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PARAMETRIC VALUES Beta 0.000 RN/L 4.000

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BETA

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4,000



PAGE 205



206 PAGE

PARAMETRIC VALUES 4.000 RN/L

0.000

MACH SYMBOL ALPHA BL.

4.000 11,424 .

1



PAGE 207

RN/L

4,000



PAGE 208

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8YMBOL ALPHA BL MACH

.

PARAMETRIC VALUES 0.000 RN/L

BETA

PARAMETRI	C VALUES
0 000	RN/L

BETA

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PAGE 209

4.000

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PAGE 210

HACH SYMBOL ALPHA 8L 0,949 3,980 11,424

0

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PARAMETRIC VALUES BETA 0,000 RN/L



SYMBOL ALPHA BL MACH 3.980 18.278 0.949

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PARAMETRIC VALUES BETA 0.000 RN/L

4.000

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PAGE

211



HACH SYMBOL ALPHA 0.899 0 3,630 4.250

PARAMETRIC VALUES BETA 0.000

4.000

RN/L

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BETA

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PAGE 213



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PARAMETRIC VALUES

PARAMETRIC VALUES 0.000 _ RN/L

BETA

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HACH SYMBOL ALPHA BL. 0.899



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FIG. 23 EFFECT OF TRANS. STRIP LOCATION ON WING PRESSURE DIST .- WING UPPER SURF. PAGE 215



MACH ALPHA 4,250 0,951 3.580

SYMBOL

PARAMETRIC VALUES 0,000 RN/L

BETA

PARAMETRIC VALUES 0.000 RN/L 4.000

BETA

SYMBOL ALPHA BL MACH

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PAGE 217



SYMBOL ALPHA BL MACH

3,580 11.424

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PARAMETRIC VALUES 0,000 RN/L

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PAGE 219

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SYMBOL ALPHA BL MACH PARAMETRIC VALUES 3.630 4.250 0.899 BETA 0.000 RN/L

4.000

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MACH SYMBOL ALPHA BL 0,899 3,630 0 7,768

0,000 BETA

PARAMETRIC VALUES 4,000

RN/L



PARAMETRIC VALUES BETA 0,000

4.000

RN/L

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MACH ALPHA BL 0.899

SYMBOL

3,630 11.424



FIG. 24 EFFECT OF TRANS. STRIP LOCATION ON WING PRESSURE DIST.-WING LOWER SURF.

SYMBOL ALPHA BL MACH 3.630 18.278 0.899

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PARAMETRIC VALUES BETA 0.000 RN/L

4.000



MACH 81

SYMBOL ALPHA 4,250 3,580

PARAMETRIC VALUES 0.000 RN/L

4,000

PARAMETRIC VALUES 0.000 RN/L

BETA

SYMBOL ALPHA BL MACH 3.580 7.768 0.951

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PAGE 225

4,000

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BETA

4,000

MACH SYMBOL BL ALPHA 0,951 3,580 11,424 0





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	PARAMETR	IC VALUES		
BETA	0.000	HORIZT	-	1.000
SPLR-L	0.000	TRANS		1.000
RN/L	4,000			





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SYMBOL ALPHA BL MACH 3.630 11.424 0.899 PARAMETRIC VALUES BETA 0.000 HORIZT - 1.000 SPLR-L 0.000 TRANS 1.000 RN/L 4.000





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FIG. 25 EFFECT OF BODY AREA RULE ON WING PRESSURE DIST .- WING UPPER SURFACE

PAGE 231

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	PARAMETR			
BETA	0.000	HORIZT	-	1.000
SPLR-L	0.000	TRANS		1.000
RN/L	4.000			



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FIG. 25 EFFECT OF BODY AREA RULE ON WING PRESSURE DIST.-WING UPPER SURFACE



	PARAMETR			
BETA	0.000	HORIZT	-	1.000
SPLR-L	0.000	TRANS		1.000
RN/L	4.000			





	D1	MACH					PARAMETRIC VALUES				
3,580	18.278	D.951		BETA	0.000	HORIZT	-	1,000			
					SPLK-L	4.000	IRANS				
						41000					

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SYMBOL

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PAGE 235

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MACH ALPHA BL, 0.899 4.250 3,630

SYMBOL

PARAMETRIC VALUES 1,000 BETA 0.000 HORIZT

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BYNBOL ALPHA BL MACH 3.630 7.768 0.899

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 		MACH	PAR				PARAMETR	AMETRIC VALUES			
ALPHA 3.580	BL 18,278	0,951				BETA SPLR-L	0.000	HOR I Z T TRANS	-	1.000 1.000	
						RN/L	4,000				



