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HYPERSONIC AERODYNAMIC CHARACTERISTICS OF NR-ATP ORBITER, ORBITER WITH EXTERNAL TANK, AND ASCENT CONFIGURATION

By

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Prepared under NASA Contract Number NAS9-13247

by

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for

Aerodynamics Section
Flight Technology Branch
Engineering Analysis Division

Manned Spacecraft Center
National Aeronautics and Space Administration
Houston, Texas

WIND TUNNEL TEST SPECIFICS

Test Number: LaRC 22"-409
NASA Series No.: MA2
Test Date: November 6, 1972
Occupancy Hours: 80

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HYPERSONIC AERODYNAMIC CHARACTERISTICS
OF NR-ATP ORBITER, ORBITER WITH
EXTERNAL TANK, AND ASCENT CONFIGURATION

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ABSTRACT

A .0045 scale model of the North American Rockwell ATP Orbiter with and without the external tank has been tested in the Langley 22-Inch Helium Tunnel at Mach 20 and a Reynolds number based on model length, of 2.14×10^6. Longitudinal and lateral-directional data were determined for the orbiter alone while only longitudinal characteristics and elevon roll effectiveness were investigated for the orbiter/tank combination. Oil flow and electron beam flow visualization studies were conducted for the orbiter alone, orbiter with external tank and the ascent configuration.

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C) DCY/DA, DCYNDA, DCBLDA vs ALPHA

NOMENCLATURE
General

SYMBOL	SADSAC SYMBOL	DEFINITION
a		speed of sound; m/sec, ft/sec
C_p	CP	pressure coefficient; $(p_l - p_\infty)/q$
M	MACH	Mach number; V/a
p		pressure; N/m^2, psf
q	Q(NSM) Q(PSF)	dynamic pressure; $1/2\rho V^2$, N/m^2, psf
RN/L	RN/L	unit Reynolds number; per m, per ft
V		velocity; m/sec, ft/sec
α	ALPHA	angle of attack, degrees
β	BETA	angle of sideslip, degrees
ψ	PSI	angle of yaw, degrees
ϕ	PHI	angle of roll, degrees
ρ		mass density; kg/m^3, $slugs/ft^3$

Reference & C.G. Definitions

SYMBOL	SADSAC SYMBOL	DEFINITION
A_b		base area; m^2, ft^2
b	BREF	wing span or reference span; m, ft
c.g.		center of gravity
ℓ_{REF} $\bar{c}$	LREF	reference length or wing mean aerodynamic chord; m, ft
S	SREF	wing area or reference area; m^2, ft^2
	MRP	moment reference point
	XMRP	moment reference point on X axis
	YMRP	moment reference point on Y axis
	ZMRP	moment reference point on Z axis

SUBSCRIPTS

b	base
l	local
s	static conditions
t	total conditions
∞	free stream

NOMENCLATURE (Continued)

Body-Axis System

SYMBOL	SADSAC SYMBOL	DEFINITION
C_N	CN	normal-force coefficient; $\frac{\text{normal force}}{qS}$
C_A	CA	axial-force coefficient; $\frac{\text{axial force}}{qS}$
C_Y	CY	side-force coefficient; $\frac{\text{side force}}{qS}$
C_{A_b}	CAB	base-force coefficient; $\frac{\text{base force}}{qS}$ $-A_b(p_b - p_\infty)/qS$
C_{A_f}	CAF	forebody axial force coefficient, $C_A - C_{A_b}$
C_m	CLM	pitching-moment coefficient; $\frac{\text{pitching moment}}{qS\ell_{REF}}$
C_n	CYN	yawing-moment coefficient; $\frac{\text{yawing moment}}{qSb}$
C_ℓ	CBL	rolling-moment coefficient; $\frac{\text{rolling moment}}{qSb}$

Stability-Axis System

SYMBOL	SADSAC SYMBOL	DEFINITION
C_L	CL	lift coefficient; $\frac{\text{lift}}{qS}$
C_D	CD	drag coefficient; $\frac{\text{drag}}{qS}$
C_{D_b}	CDB	base-drag coefficient; $\frac{\text{base drag}}{qS}$
C_{D_f}	CDF	forebody drag coefficient; $C_D - C_{D_b}$
C_Y	CY	side-force coefficient; $\frac{\text{side force}}{qS}$
C_m	CLM	pitching-moment coefficient; $\frac{\text{pitching moment}}{qS\ell_{REF}}$
C_n	CLN	yawing-moment coefficient; $\frac{\text{yawing moment}}{qSb}$
C_ℓ	CSL	rolling-moment coefficient; $\frac{\text{rolling moment}}{qSb}$
L/D	L/D	lift-to-drag ratio; C_L/C_D
L/D_f	L/DF	lift to forebody drag ratio; C_L/C_{D_f}

NOMENCLATURE (Continued)

ADDITIONS TO STANDARD LIST

SYMBOL	PLOT SYMBOL	DEFINITION
C_{Y_β}	DCY/DB	side force coefficient derivative with respect to beta. Algebraic difference of the side force coefficient of two runs divided by the algebraic difference of the side slip angle of the runs; per degree.
C_{n_β}	DCYNDB	yawing moment coefficient derivative with respect to beta. Algebraic difference of the yawing moment coefficient of two runs divided by the algebraic difference of the side slip angle of the runs; body axis system; per degree.
C_{ℓ_β}	DCBLDB	rolling moment coefficient derivative with respect to beta. Algebraic difference of the rolling moment coefficient of two runs divided by the algebraic difference of the side slip angle of the runs; body axis system; per degree.
$C_{Y_{\delta_a}}$	DCY/DA	side force coefficient derivative with respect to total aileron deflection. Algebraic difference of the side force coefficients of two runs divided by the algebraic difference of the total aileron deflection angle of the runs; per degree.
$C_{n_{\delta_a}}$	DCYNDA	yawing moment coefficient derivative with respect to total aileron deflection. Algebraic difference of the yawing moment coefficient of two runs divided by the algebraic difference of the total aileron deflection angle of the runs; body axis system, per degree.
$C_{\ell_{\delta_a}}$	DCBLDA	rolling moment coefficient derivative with respect to total aileron deflection. Algebraic difference of the rolling moment coefficient of two runs divided by the algebraic difference of the total aileron deflection angle of the runs; body axis system; per degree.
δ_e	ELEVTR	elevator deflection, degrees; determined by: $(\delta_{e_L} + \delta_{e_R})/2$
δ_a	AILRON	aileron deflection, degrees; determined by: $(\delta_{e_L} - \delta_{e_R})/2$

NOMENCLATURE (Concluded)

ADDITIONS TO STANDARD LIST

SYMBOL	PLOT SYMBOL	DEFINITION
δ_r	RUDDER	rudder deflection angle, degrees; positive direction trailing edge left.
δ_{BF}	BDFLAP	body flap deflection, degrees; positive direction trailing edge down.
δe_L	ELVN-L	left elevon deflection, degrees; positive direction trailing edge down.
δe_R	ELVN-R	right elevon deflection, degrees; positive direction trailing edge down.
$\Delta\beta$	DLTBTA	incremental difference in sideslip angle between two test runs; degrees.
$\Delta\delta_a$	DLTALN	incremental difference in aileron deflection angle between two test runs; degrees.

HYPERSONIC AERODYNAMIC CHARACTERISTICS

OF NR-ATP ORBITER, ORBITER WITH

EXTERNAL TANK, AND ASCENT CONFIGURATION

By

George C. Ashby, Jr.

SUMMARY

A .0045 scale model of the North American Rockwell ATP orbiter with and without the external tank has been tested in the Langley 22-inch helium tunnel at Mach 20 and a Reynolds number based on model length, of 2.14×10^6. Six component aerodynamic force and moment data were recorded over an angle of attack range from -1.5° to 54° for the orbiter alone and ±15° for the orbiter/tank configuration. Both longitudinal and lateral-directional data were determined for the orbiter alone. For the orbiter/tank combination only the longitudinal characteristics and elevon roll effectiveness were investigated.

Additionally, oil flow and electron beam flow visualization studies were conducted on the orbiter alone, orbiter with external tank, and orbiter with external tank and solid rocket boosters (ascent configuration).

The orbiter attains the design L/D of 1.32 at $\alpha = 34°$; however, it has nearly neutral stability at trim and requires an entry c.g. somewhat rearward of design (65% ℓ) for minimum up elevon/maximum C_L at trim. A slight pitchup occurs for up elevons ($\delta_e = -20°$ and $-40°$) beyond angles of attack of about 45°. Reference 1 shows a similar result for a delta

wing with a full span trailing-edge flap at M = 6.8 and α = 50° to 55° in air. A companion publication of reference 1, reference 2, shows the effects to be caused by flow overexpansion on the flap. It should be noted, however, that the 5° angle of attack difference between the angle where the pitchup occurs at M = 6.83 in air (reference 1) and M = 20 in helium is also the difference in conical shock detachment angle for the two cases.

The directional instability ($-C_{n_\beta}$) and positive dihedral effect ($-C_{\ell_\beta}$) observed in this test are similar to the results obtained for other delta-wing orbiter designs.

The orbiter-external tank combination data are referenced to the orbiter geometric parameters and can be somewhat misleading. For instance, the instability of the combination about the orbiter c.g. is reduced when the tank fuel c.g. is taken into account. It is interesting to note that the orbiter and orbiter/tank combination have the same level of normal force from α = 0° to 12°. The roll control of the orbiter elevon for the orbiter/tank combination was determined for the setting, δ_{e_L} = 0° and δ_{e_R} = -40°; it shows a proverse yawing moment which is equal to or greater than 50 percent of the rolling moment.

The orbiter was originally tested with a .0047 scale wing on the .0045 body. Comparison of the data to that of the .0045 wing/body with both reduced on the smaller wing geometric parameters, showed only the lift and drag values to be significantly different. The L/D and trim characteristics were approximately the same. Because of these similarities, roll effectiveness and the effect of body flap deflection were not obtained for the .0045 wing/body. Those data obtained for the .0047 wing/ .0045 body are presented herein based on .0045 wing geometric parameters.

CONFIGURATIONS INVESTIGATED

These tests utilized a .0045 scale model of the NR-ATP space shuttle orbiter, external tank and solid rocket boosters. Force tests were conducted on the orbiter alone (figure 1) and on the orbiter with external tank (figure 2). Several initial investigations, aileron effectiveness and body flap deflection tests, were made with a .0047 scale model wing on a .0045 scale model body (figure 1).

The oil flow and electron beam flow visualization studies were conducted on the .0045 scale model orbiter alone (figure 4), orbiter with external tank (figure 5) and orbiter with external tank and solid rocket boosters (ascent configuration, figure 6).

Orbiter dimensions were obtained from NR lines drawing VL70-000001 while external tank and solid rocket booster lines and assembly locations were scaled from NR sketch 102SSV319.

The model components tested are listed below. Pertinent dimensional information for these components is given in table II. Table I delineates the various configurations these components were tested in during this investigation.

ORBITER:

B_1 - basic ATP fuselage

C_1 - canopy

D_1 - manipulator arm housing

F_1 - body flap

M_1 - orbital maneuvering system pod

W_1 - basic delta wing (.0045 scale)

W_{1x} - basic delta wing (.0047 scale)

E_1 - full span elevons for W_1

V_1 - basic fuselage centerline mounted vertical tail

K_1 - cooling air inlet

R_1 - rudder for vertical tail V_1

External tank:

T_1 - orbiter external fuel tank

Solid rocket booster:

S_1 - two 156 inch diameter solid rocket boosters attached to the external tank

TEST FACILITY DESCRIPTION

The LaRC 22-inch helium tunnel is a blowdown-type tunnel with a normal operational time of 30 seconds for aerodynamic force and moment tests. Studies are conducted in the 22-inch diameter test section at Mach numbers from 19 to 22.2 at stagnation pressures from 500 to 3000 psi, and at stagnation temperatures from 520° to 960°R. These test conditions allow Reynolds number variations from 2.5×10^6 to 11.5×10^6 per foot. Operational characteristics of the contoured nozzle flow characteristics are available in reference 3.

TEST CONDITIONS

For this report, all tests were conducted at a stagnation pressure of 1000 psi gage and at a stagnation temperature of 85°F. These test conditions resulted in a Mach number of 20.3 and a Reynolds number of 2.14×10^6 based on model length (5.977 in.)

The technique used for the surface oil-flow studies was to splatter a mixture of lamp black and silicone oil onto a light colored model that had been initially coated with a thin film of clear silicone oil. Simultaneous photographs of the oil-flow patterns and the electron-beam illuminated flow field were then made during a run. Additional photographs of the oil-flow patterns were taken after the models were removed from the tunnel. Although a model shield device was used, these patterns were subjected to flow shut-down disturbances. These disturbances have been observed to be small, but they can cause a slight rearward movement in heavy oil accumulation regions such as along separation lines.

DATA REDUCTION

The aerodynamic forces and moments have been reduced to coefficients by using the following reference values:

S_{ref} = total or theoretical wing projected area = 60.58 cm^2 = .06524 ft^2

ℓ_{ref} = wing MAC = 5.9436 cm = 2.34 in.

b_{ref} = wing span (projected) = 11.52 cm = 4.535 in.

The moments have been reduced about a center of gravity located at a fuselage station which is .65 body length.

The angles of attack, -1.5° to 54°, were measured by an optical method using a prism mounted in the model to reflect light from a point (located adjacent to the test-section window) onto electric eyes set at calibrated intervals. Sideslip angles tested were 0°, -2.25° and -4.47°.

All axial force and drag data have been corrected for base pressure. The measured base pressures are unavailable for this report. All data calculations and axis system conversions used the corrected values of axial force and drag.

REFERENCES

1. Fetterman, David E., and Neal, Luther Jr.: An Analysis of the Delta-Wing Hypersonic Stability and Control Behavior at Angles of Attack Between 30° and 90°. NASA TN D-1602, March 1963.

2. Neal, Luther Jr., and Fetterman, David E.: Control-Surface Interaction Effects on Delta-Wing Windward Pressure at a Mach Number of 6.83 at High Angles of Attack. NASA TN D-2332, June 1964.

3. Arrington, James P., Joiner, Roy C., Jr., and Henderson, Arthur, Jr.: Longitudinal Characteristics of Several Configurations at Hypersonic Mach Numbers in Conical and Contoured Nozzles. NASA TN D-2489, 1964.

TABLE I.

TEST 22" He-409 DATA SET COLLATION SHEET

☐ PRETEST

☒ POSTTEST

DATA SET IDENTIFIER	CONFIGURATION	SCHD. α	SCHD. β	PARAMETERS/VALUES δ_{eL}	δ_{eR}	δ_e	δ_a	δ_{BF}	MACH NUMBERS (OR ALTERNATE INDEPENDENT VARIABLE)											
											203									
RØS 001	$(B_1C_1D_1F_1M_1)(W_{1x}E_1)(V_1K_1R_1)$	A	0	0	0	0	0	0			1									
02		A	0	-20	-20	-20	0	0			2									
03		A	0	-40	-40	-40	0	0			3									
04		A	0	-40	-40	-40	0	-18°			5									
05		A	0	0	0	0	0	-18°			6									
06		A	0	-20	-40	-30	-10	0			7									
07		A	0	0	-40	-20	20	0			4									
08		A	-3	0	0	0	0	0			8									
15	$(B_1C_1D_1F_1M_1)(W_1E_1)(V_1K_1R_1)$	A	0	0	0	0	0	0			15									
16		A	0	-20	-20	-20	0	0			16									
17		A	0	-40	-40	-40	0	0			17									
20		B	0	0	0	0	0	0			20									
26		C	-4.5	0	0	0	0	0			26									
27		D	-2.25	0	0	0	0	0			27									
30	$\phi + T_1$	E	0	10	-10	0	10	0			30									
31		F	0	0	0	0	0	0			31									

1 7 13 19 25 31 37 43 49 55 61 67 75 76

IDPVAR(1) | IDPVAR(2) | NDV

COEFFICIENTS:

α or β SCHEDULES

A) 18° → 54°, Δα = 3° D) 18° → 33°

B) -1.5° → 26° E) -15° → 12°

C) -1.5° → 18° F) -15° → 15°

NASA-MSFC-MAF

TABLE II. MODEL DIMENSIONAL DATA

MODEL COMPONENT : BODY - B1

GENERAL DESCRIPTION : Basic Delta Wing Fuselage per NAR Lines, Dwg. VL70-000001

Model Scale = .0045

DRAWING NUMBER : VL000001

DIMENSIONS :	FULL SCALE	MODEL SCALE
Length	1328.33	5.977
Max Width	237.96	1.0708
Max Depth	238.00	1.0710
Fineness Ratio	5.527	.0249
Area		
Max. Cross-Sectional	326.0	.0066
Planform	--	--
Wetted	--	--
Base	--	--

MODEL DIMENSIONAL DATA

MODEL COMPONENT : BODY - CANOPY - C1

GENERAL DESCRIPTION : Canopy used with Basic Delta Wing Fuselage per NAR Lines, Dwg. VL70-000001

Model Scale = .0045

DRAWING NUMBER : VL70-000001

DIMENSIONS :	FULL SCALE	MODEL SCALE
STA Fwd Bulkhead - in.	340.00	1.530
STA Trailing Edge - in.	560.00	2.520
Max Depth		
Fineness Ratio		
Area		
Max. Cross-Sectional		
Planform		
Wetted		
Base		

Windshield Consists of Six (6) Panels
Pilots Eye is at the Following Points:

Fus. STA - in.	408.00	1.836
B.P. - in.	24.00	.108
W.P. - in.	455.00	2.0475
View Angle Available:		
Deg Upward	20.00	
Deg Downward	24.00	

MODEL DIMENSIONAL DATA

MODEL COMPONENT : BODY - MANIPULATOR HOUSING - D1

GENERAL DESCRIPTION :

Model Scale = .0045

DRAWING NUMBER : VL70-000001

DIMENSIONS :

	FULL SCALE	MODEL SCALE
Length - in.	967.00	4.351
Max Width - in.	53.32	.2399
Max Depth - in.	20.00	.0900
Fineness Ratio	--	--
Area		
Max. Cross-Sectional	--	--
Planform	--	--
Wetted	--	--
Base	--	--

MODEL DIMENSIONAL DATA

MODEL COMPONENT : BODY - ORBITAL MANEUVERING SYSTEM POD-M1

GENERAL DESCRIPTION :

Model Scale = .0045

DRAWING NUMBER : VL70-000001

DIMENSIONS :	FULL SCALE	MODEL SCALE
Length - in.	290.67	1.3080
Max Width - in.	67.33	.3030
Max Depth - in.	104.00	.4680
Fineness Ratio	--	--
Area		
Max. Cross-Sectional	--	--
Planform	--	--
Wetted	--	--
Base	--	--

TABLE II. MODEL COMPONENT DIMENSIONS - Continued

MODEL COMPONENT: WING - W1

GENERAL DESCRIPTION: DELTA WING WITH -5° TWIST & ROUNDED WING TIPS. WING BENDS INTO BODY, FOLLOWS NAR LINES, V70-000001. EQUIV. SPAN IS 78.604% OF THEORETICAL DELTA WING MODEL SCALE = 0.0045

DRAWING NUMBER: VL70-000001

DIMENSIONS:	FULL-SCALE	MODEL SCALE
TOTAL DATA		
Area in. (in. R.P.) - Ft^2		
Planform	3221.92	.06524
Wetted	--	--
Span (equivalent)	1007.8	4.535
Aspect Ratio	2.144	2.144
Rate of Taper	1.191	1.191
Taper Ratio	0.219	0.219
Diehedral Angle, degrees	3.500	3.500
Incidence Angle, degrees	3.000	3.000
Aerodynamic Twist, degrees	-5.00	-5.00
Toe-In Angle	3.00	3.00
Cant Angle	-2.00	-2.00
Sweep Back Angles, degrees		
Leading Edge	49.910	49.910
Trailing Edge	-0.183	-0.183
0.25 Element Line	41.675	41.675
Chords:		
Root (Wing Sta. 0.0)	760.56	3.4225
Tip, (equivalent)	159.72	.7187
MAC	525.4	2.364
Fus. Sta. of .25 MAC	1132.98	5.098
W.P. of .25 MAC	304.55	1.370
B.L. of .25 MAC	196.09	.8824
Airfoil Section		
Root	--	--
Tip	--	--
EXPOSED DATA		
Area in (W.R.P) - Ft^2	2203.0	0.0446
Span, (equivalent)	795.86	3.5814
Aspect Ratio	1.966	1.966
Taper Ratio	0.260	0.260
Chords		
Root	641.57	2.887
Tip	166.68	.7501
MAC	450.63	2.028
Fus. Sta. of .25 MAC	1190.82	5.359
W.P. of .25 MAC	305.47	1.375
B.L. of .25 MAC	260.80	1.174
Leading Edge Cuff		
Planform Area (W.F.P.) - Ft^2	271.39	.00549
Leading Edge Intersects Fus ML @ STA. - in.	540.00	2.430
Leading Edge Intersects Fus ML @ Sta. - in.	1114.0	5.013

TABLE II. MODEL COMPONENT DIMENSIONS - Continued

MODEL COMPONENT: ELEVON - E1 (DATA FOR 1 of 2 SIDES)

GENERAL DESCRIPTION: FULL SPAN CONSTANT CHORD ELEVON LOCATED ON WING - W1

MODEL SCALE = 0.0045

DRAWING NUMBER: VL70-000001

DIMENSIONS:	FULL-SCALE	MODEL SCALE
Area (True) - Ft^2	347.2	.0070
Span (equivalent) - in.	384.0	1.728
Inb'd equivalent chord - in.	134.38	.6047
Outb'd equivalent chord	134.38	.6047
Ratio movable surface chord/ total surface chord		
At Inb'd equiv. chord	0.209	0.209
At Outb'd equiv. chord	0.805	0.805
Sweep Back Angles, degrees		
Leading Edge	-0.183	-0.183
Tailing Edge	-0.183	-0.183
Hingeline	-0.183	-0.183
Area Moment (Normal to hinge line) - Ft^3	4164.4	.00038

(Product of Area & Mean Chord)

TABLE II. MODEL COMPONENT DIMENSIONS - Continued

MODEL COMPONENT: VERTICAL TAIL - V1

GENERAL DESCRIPTION: CENTERLINE VERTICAL DELTA WING CONFIGURATION

MODEL SCALE = 0.0045

DRAWING NUMBER: VL70-000001

DIMENSIONS:	FULL-SCALE	MODEL SCALE
TOTAL DATA		
Area - Ft^2	415.25	.0084
*Void (Included Above)	1.29	.00003
Blanketed (Included Above)	19.93	.00040
Span (equivalent)	323.9	1.4575
Aspect Ratio	1.675	1.675
Rate of Taper	0.504	0.504
Taper Ratio	0.424	0.424
Diehedral Angle, degrees	--	--
Incidence Angle, degrees	--	--
Aerodynamic Twist, degrees	--	--
Toe-In Angle	0.0	0.0
Cant Angle	0.0	0.0
Sweep Back Angles, degrees		
Leading Edge	45.00	45.00
Trailing Edge	26.361	26.361
0.25 Element Line	41.150	41.150
Chords:		
Root (Wing Sta. 0.0)	275.52	1.240
Tip, (equivalent)	111.4	.5013
MAC	205.0	.922
Fus. Sta. of .25 MAC	1462.2	6.580
W.P. of .25 MAC	639.0	2.876
B.L. of .25 MAC	0.0	0.0
Airfoil Section 5° Half Angle		
Root Double Wedge with		
Tip Rounded L.E.		
EXPOSED DATA		
Area		
Span, (equivalent)		
Aspect Ratio		
Taper Ratio		
Chords		
Root		
Tip		
MAC		
Fus. Sta. of .25 MAC		
W.P. of .25 MAC		
B.L. of .25 MAC		

*Void Area Located at the Lower Aft Portion of the Surface

TABLE II. MODEL COMPONENT DIMENSIONS - Continued

MODEL COMPONENT: RUDDER - R1

GENERAL DESCRIPTION: RUDDER ON CENTER LINE VERTICAL

MODEL SCALE = 0.0045

DRAWING NUMBER: VL70-000001

DIMENSIONS:	FULL-SCALE	MODEL SCALE
Area - Ft^2	117.7	.00238
Span (equivalent) - in.	226.0	1.017
Inb'd equivalent chord - in.	97.09	.4369
Outb'd equivalent chord - in.	52.02	.2341
Ratio movable surface chord/ total surface chord		
At Inb'd equiv. chord	0.400	0.400
At Outb'd equiv. chord	0.400	0.400
Sweep Back Angles, degrees		
Leading Edge	34.889	34.889
Tailing Edge	26.361	26.361
Hingeline	34.889	34.889
Area Moment (Normal to hinge line) - Ft^3	647.71	.00006
(Product of Chord and Mean Chord)		

TABLE II. MODEL COMPONENT DIMENSIONS - Continued

MODEL COMPONENT: BODY - T_1

GENERAL DESCRIPTION: EXTERNAL TANK (BASELINE DIAMETER) WITH 30° HALF ANGLE NOSE CONE AND RETROROCKET

DRAWING NUMBER

DIMENSION:	FULL SCALE	MODEL SCALE
Length	2184 in.	9.828 in.
Max Width	318 in.	1.431
Max Depth	318 in.	1.431
Fineness Ratio	6.87	6.87
Area		
Max Cross-Sectional	551.54 ft^2	.011169 ft^2
Planform	--	--
Wetted	--	--
Base	551.54 ft^2	.011169 ft^2

TABLE II. MODEL COMPONENT DIMENSIONS - Continued.

MODEL COMPONENT: BODY - S_1

GENERAL DESCRIPTION: SOLID ROCKET MOTOR (BASELINE DIAMETER) WITH HOLDDOWN ARMS

DRAWING NUMBER

DIMENSION:	FULL SCALE	MODEL SCALE
Length	2217 in.	9.976 in.
Max Width	156 in.	.702 in.
Max Depth	156 in.	.702 in.
Fineness Ratio	14.21	14.21
Area		
Max Cross-Sectional	132.5 ft^2	.002683 ft^2
Planform	--	--
Wetted	--	--
Base	132.5 ft^2	.002683 ft^2

TABLE II. MODEL DIMENSIONAL DATA - Concluded.

MODEL COMPONENT : Body Flap, F1

GENERAL DESCRIPTION : Rectangular body flap located on lower aft portion of body and extending aft of body.

DRAWING NUMBER :

DIMENSIONS :	FULL SCALE	MODEL SCALE
Length, in.		1.08186
Max Width, in.		.41242
Max Depth		
Fineness Ratio		
Area		
Max. Cross-Sectional		
Planform		
Wetted		
Base		

MODEL FIGURES

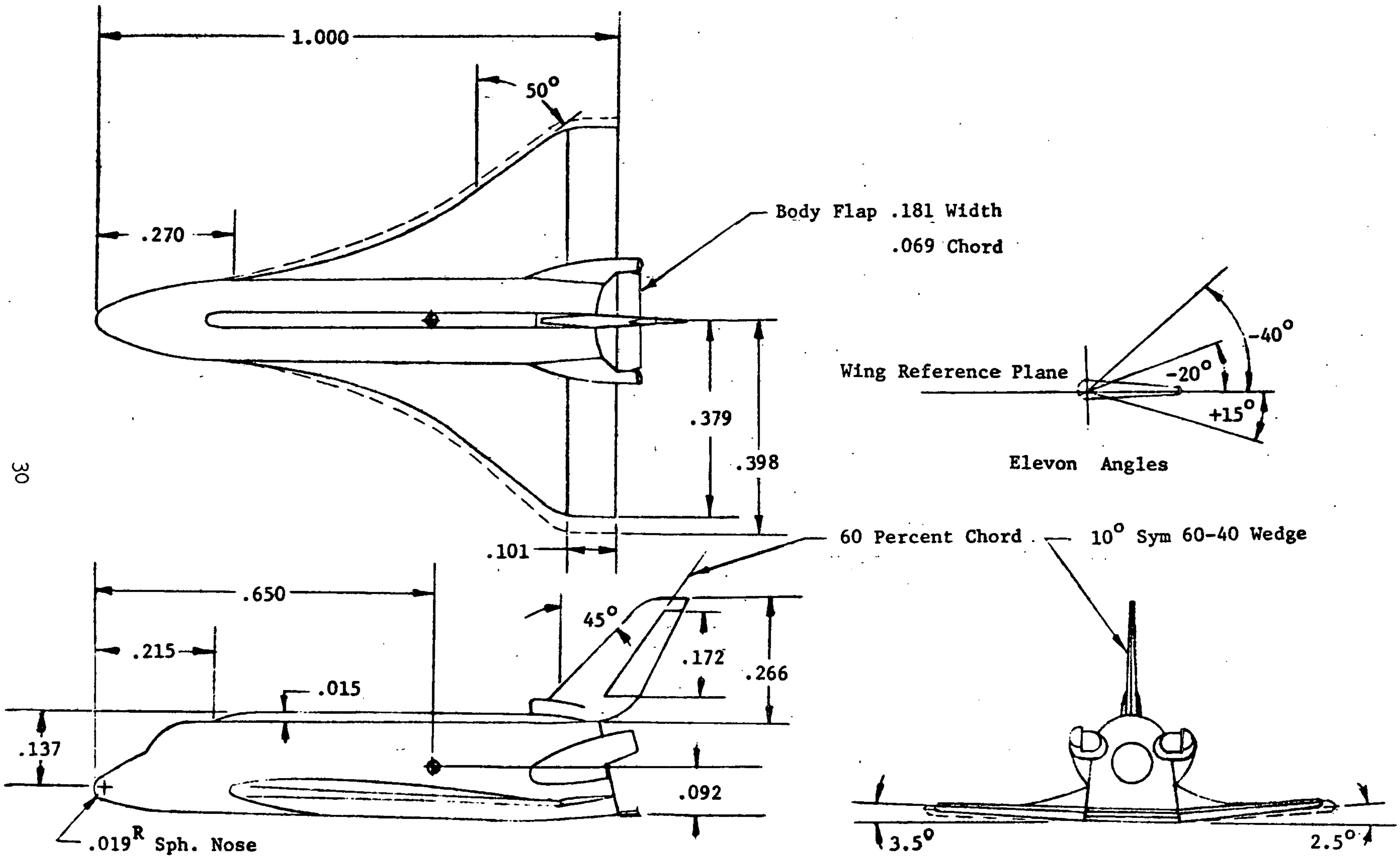


Figure 1. North American Rockwell baseline (.0045 scale) delta-wing orbiter (ATP) with .0047 scale wing superimposed. All linear dimensions are in terms of orbiter body length (15.182cm).

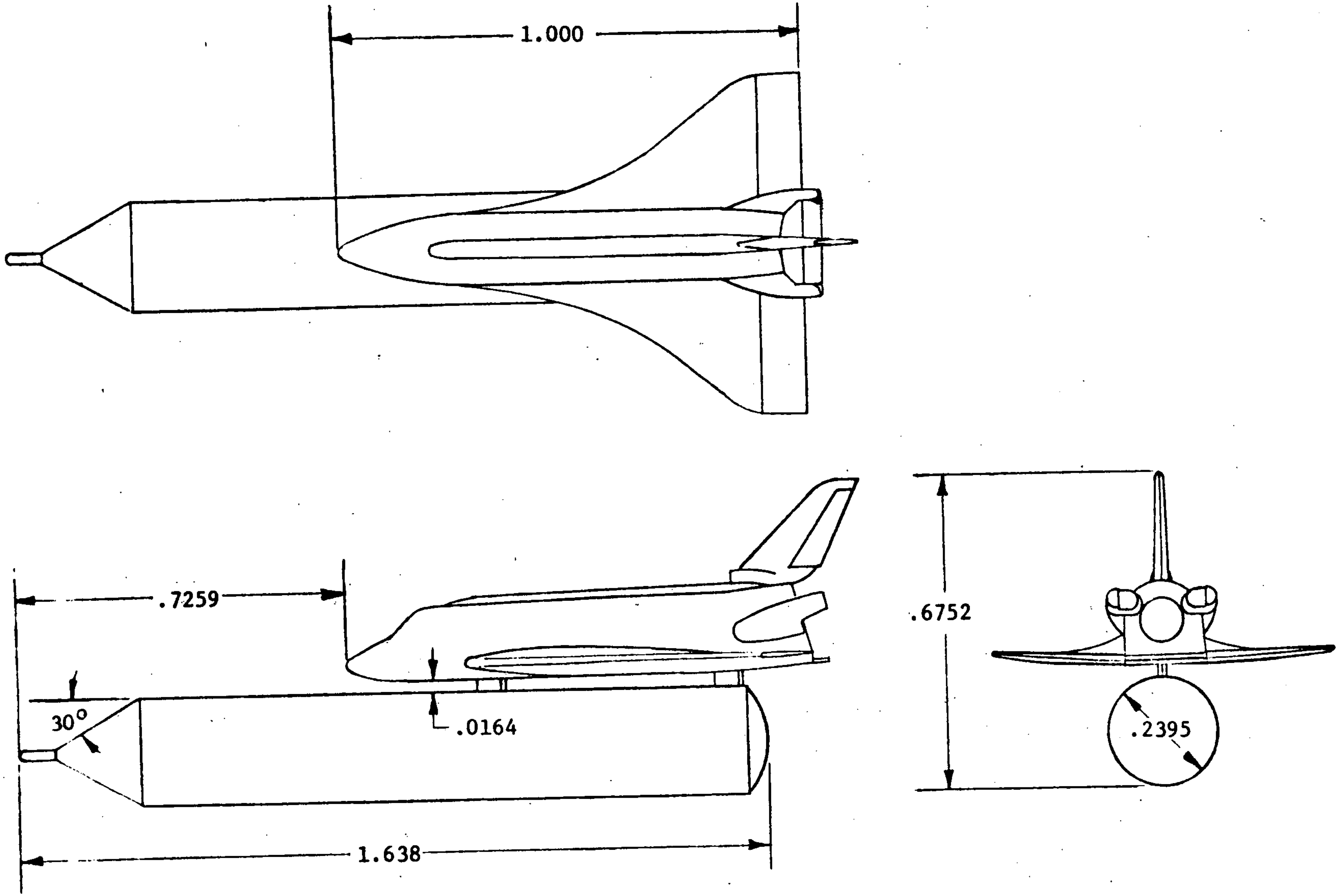


Figure 2. NR-ATP baseline orbiter with external tank (.0045 Scale). All dimensions are in terms of orbiter body length (15.182 cm)

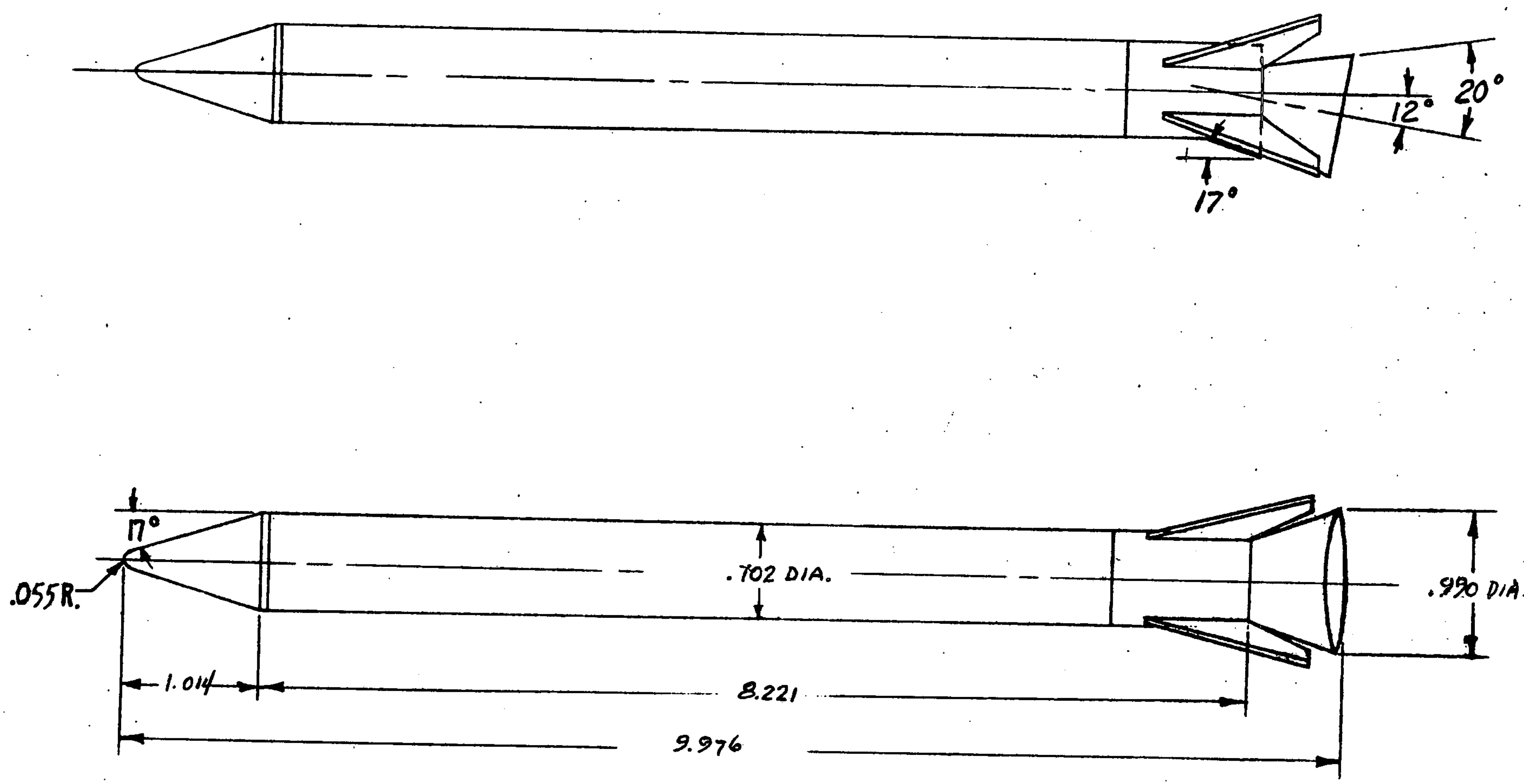
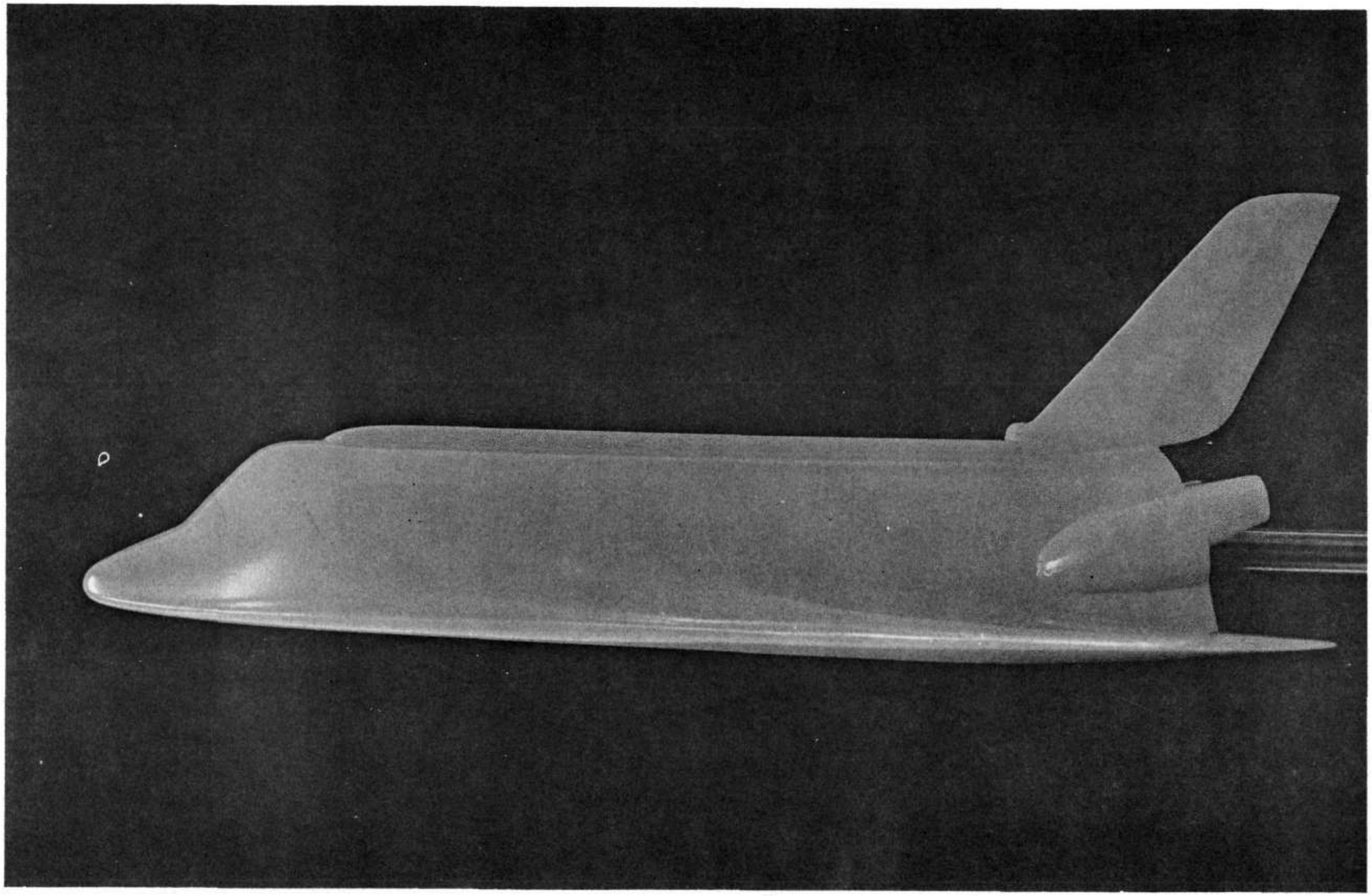
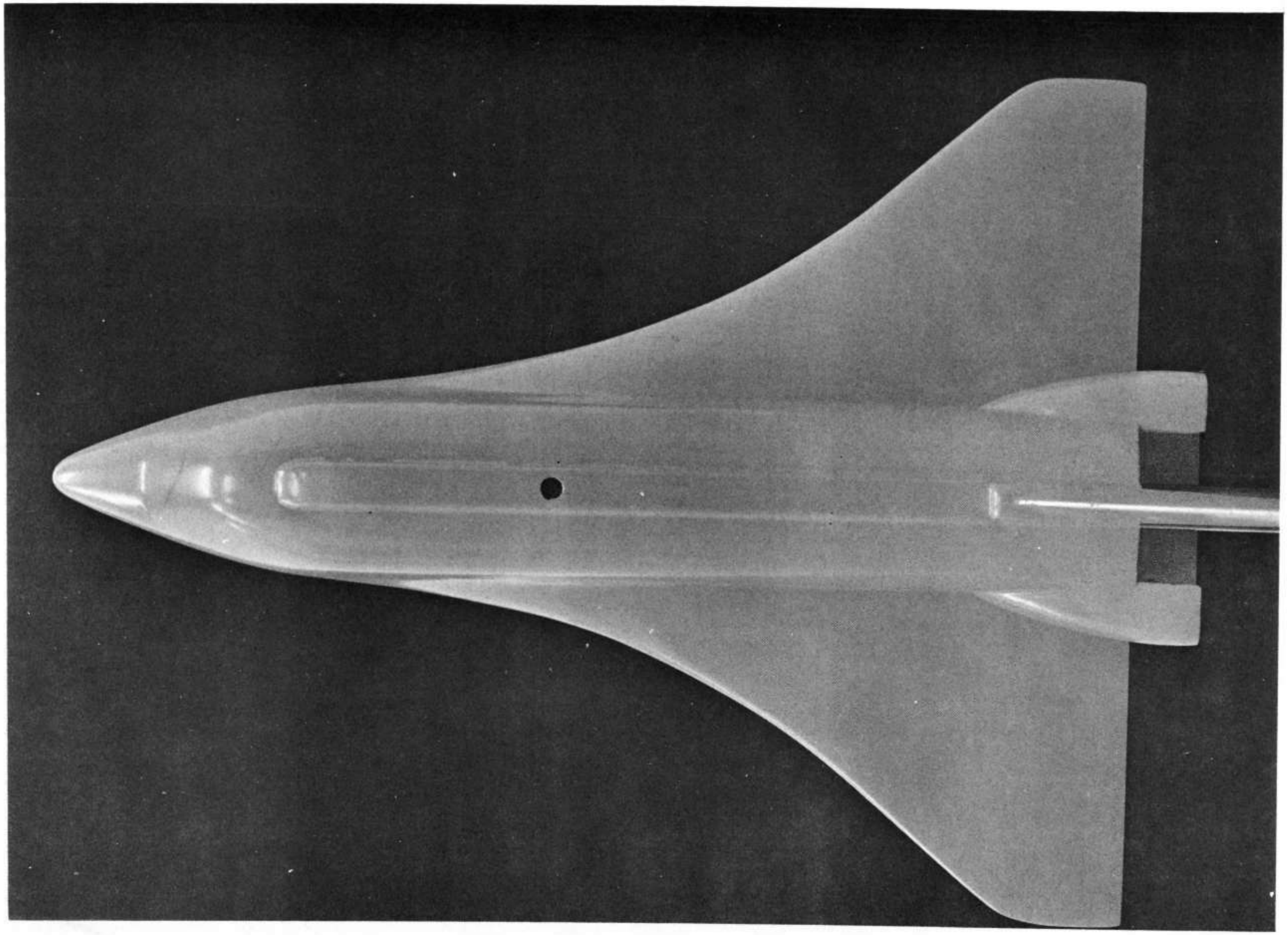


Figure 3. SRB general arrangement.
All dimensions are in inches.



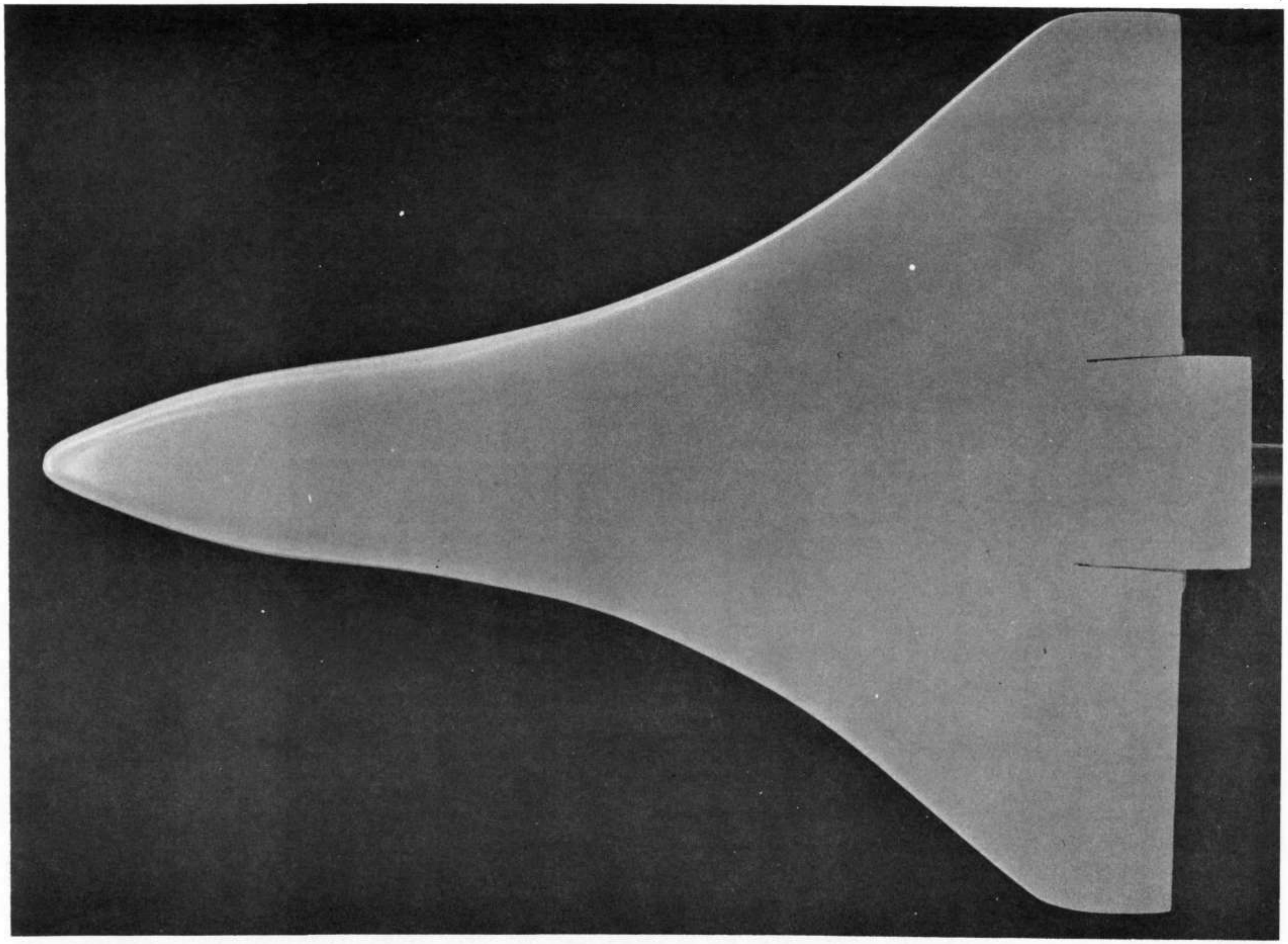
A) Left side view

Figure 4. - Photograph of .0045 Scale NR (ATP) Orbiter Configuration.



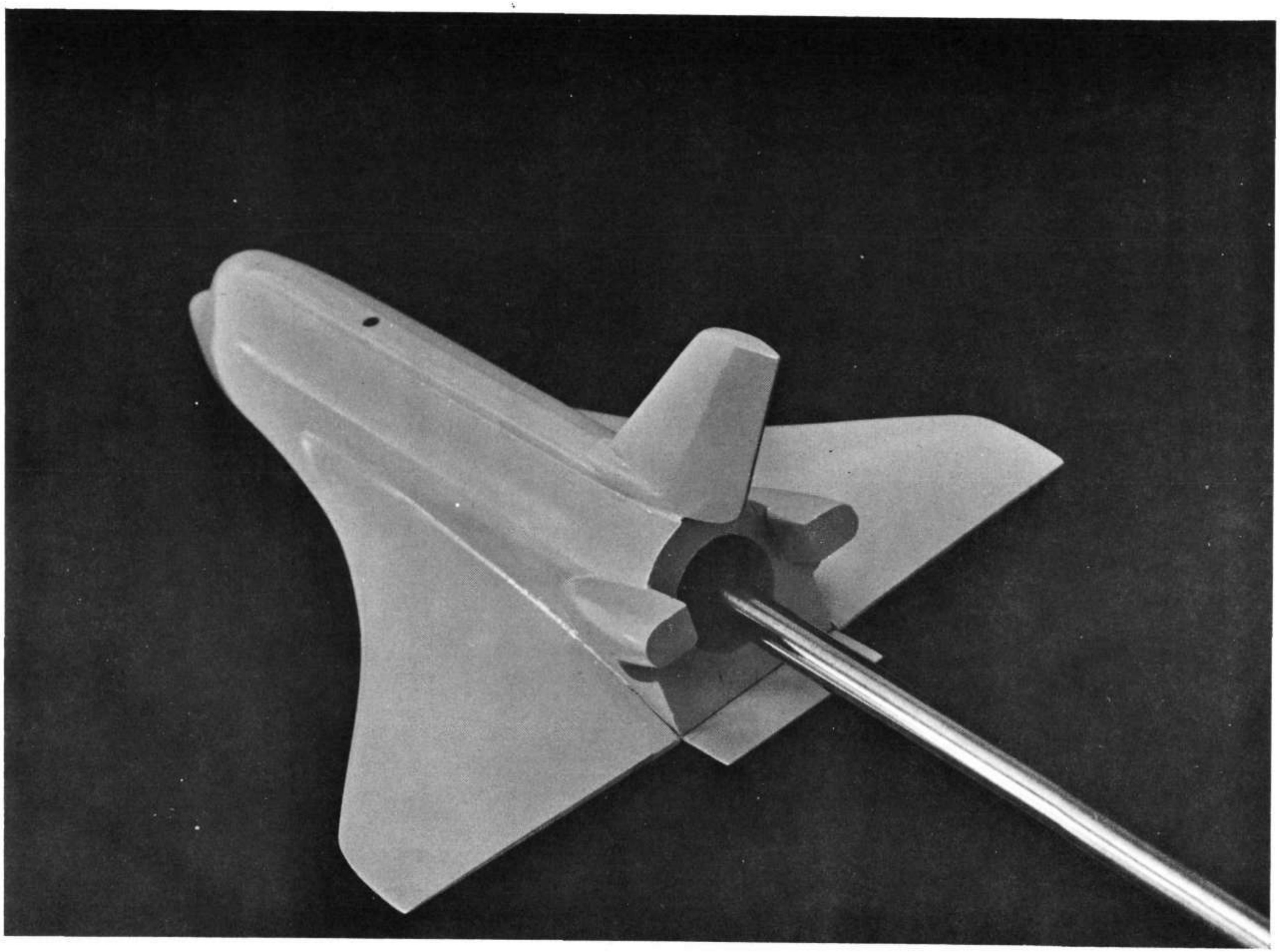
B) Top view

Figure 4. - Photograph of .0045 Scale NR (ATP) Orbiter Configuration.



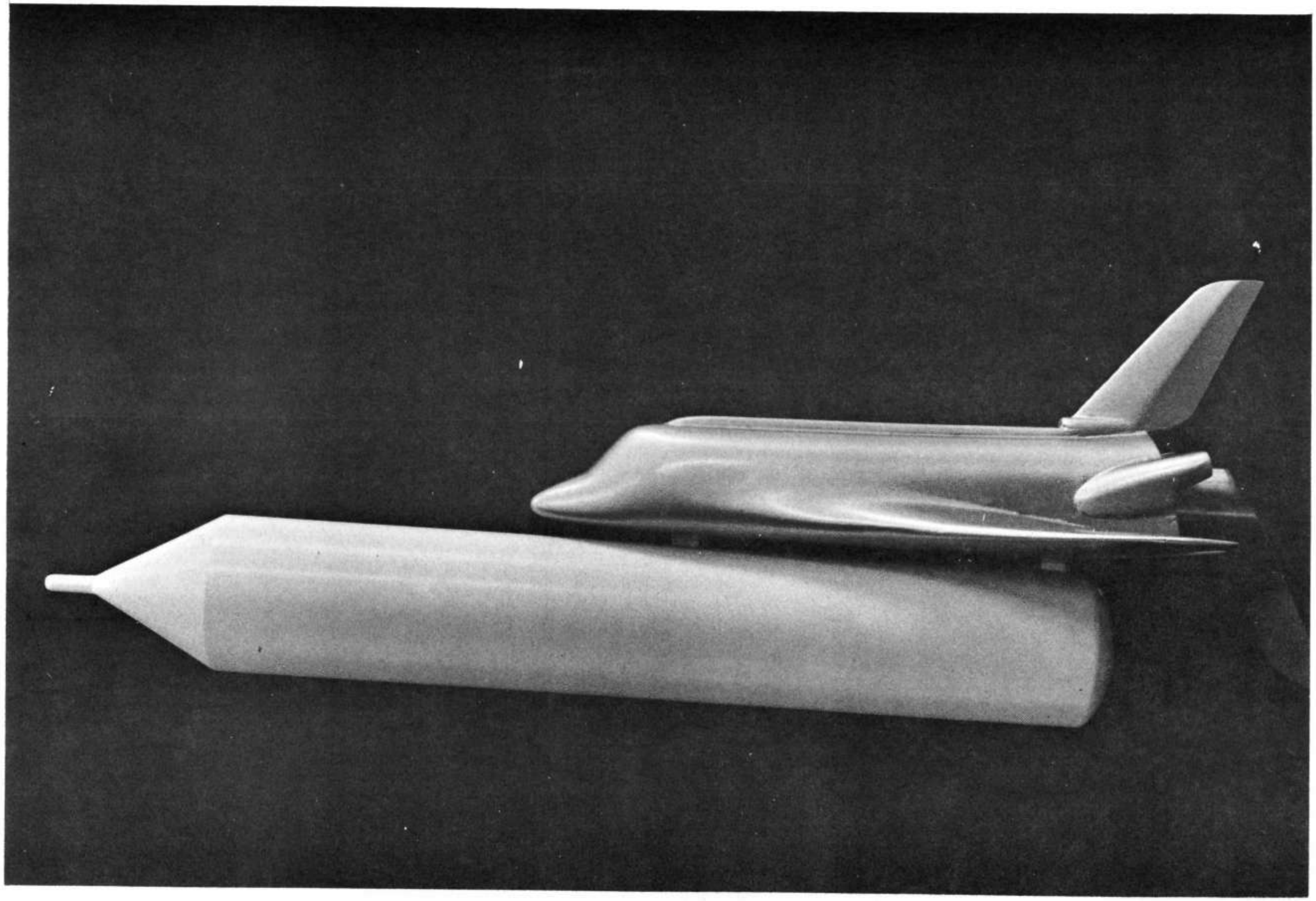
C) Bottom view

Figure 4. - Photograph of .0045 Scale NR (ATP) Orbiter Configuration.



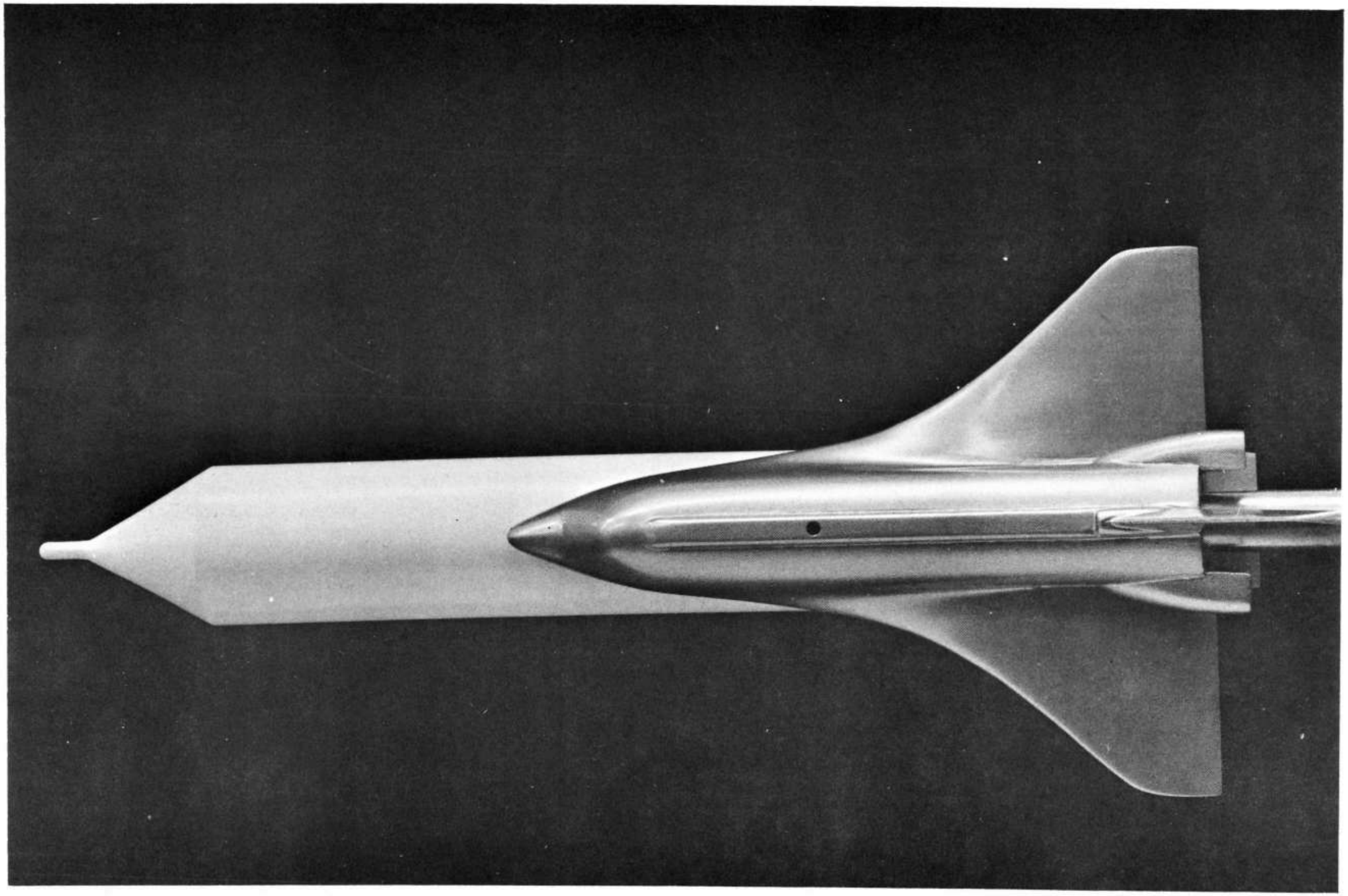
D) Rear oblique view

Figure 4. - Photograph of .0045 Scale NR (ATP) Orbiter Configuration.



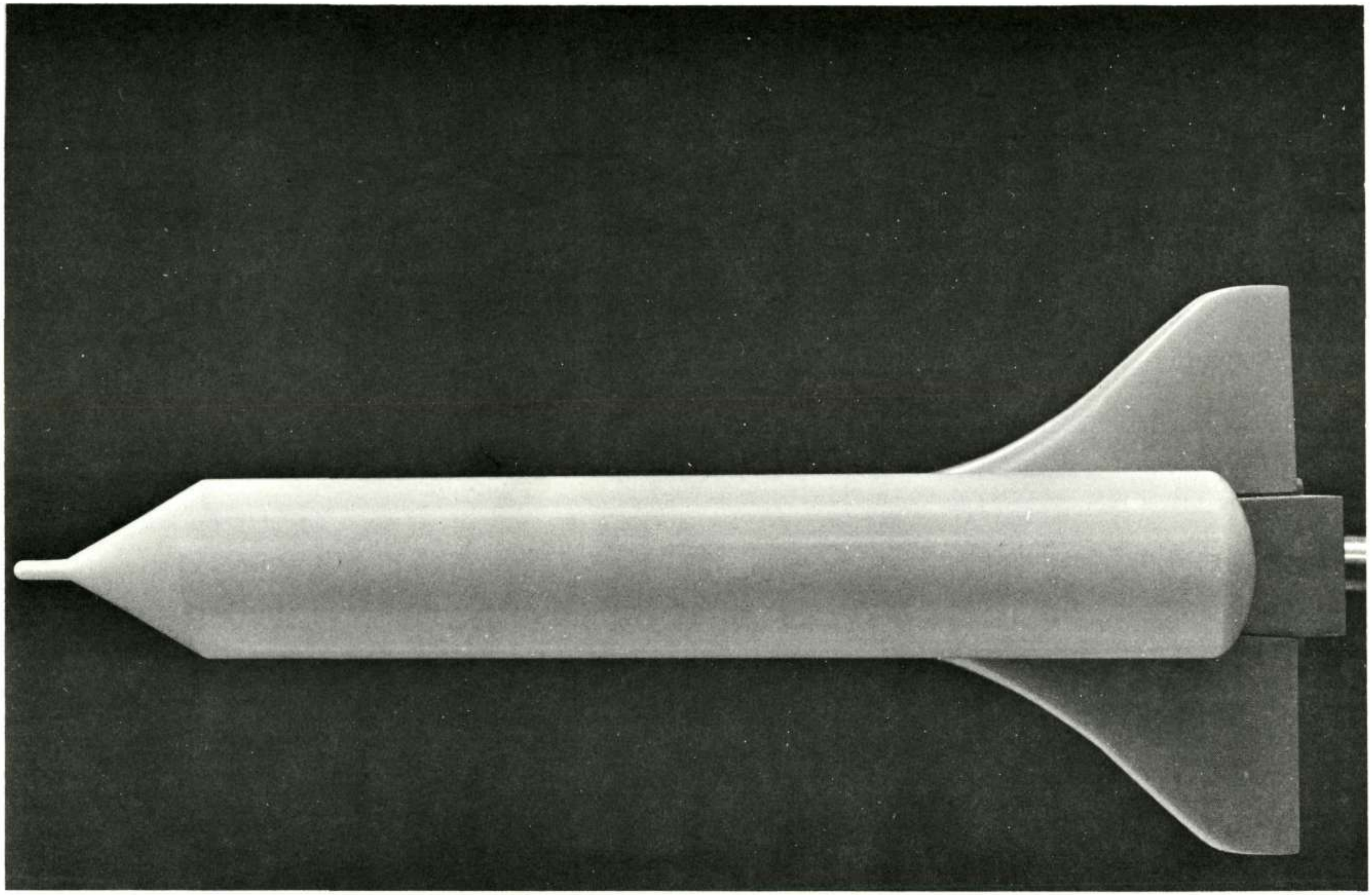
A) Left side view

Figure 5. - Photograph of .0045 Scale NR (ATP) Orbiter With External Tank Configuration.



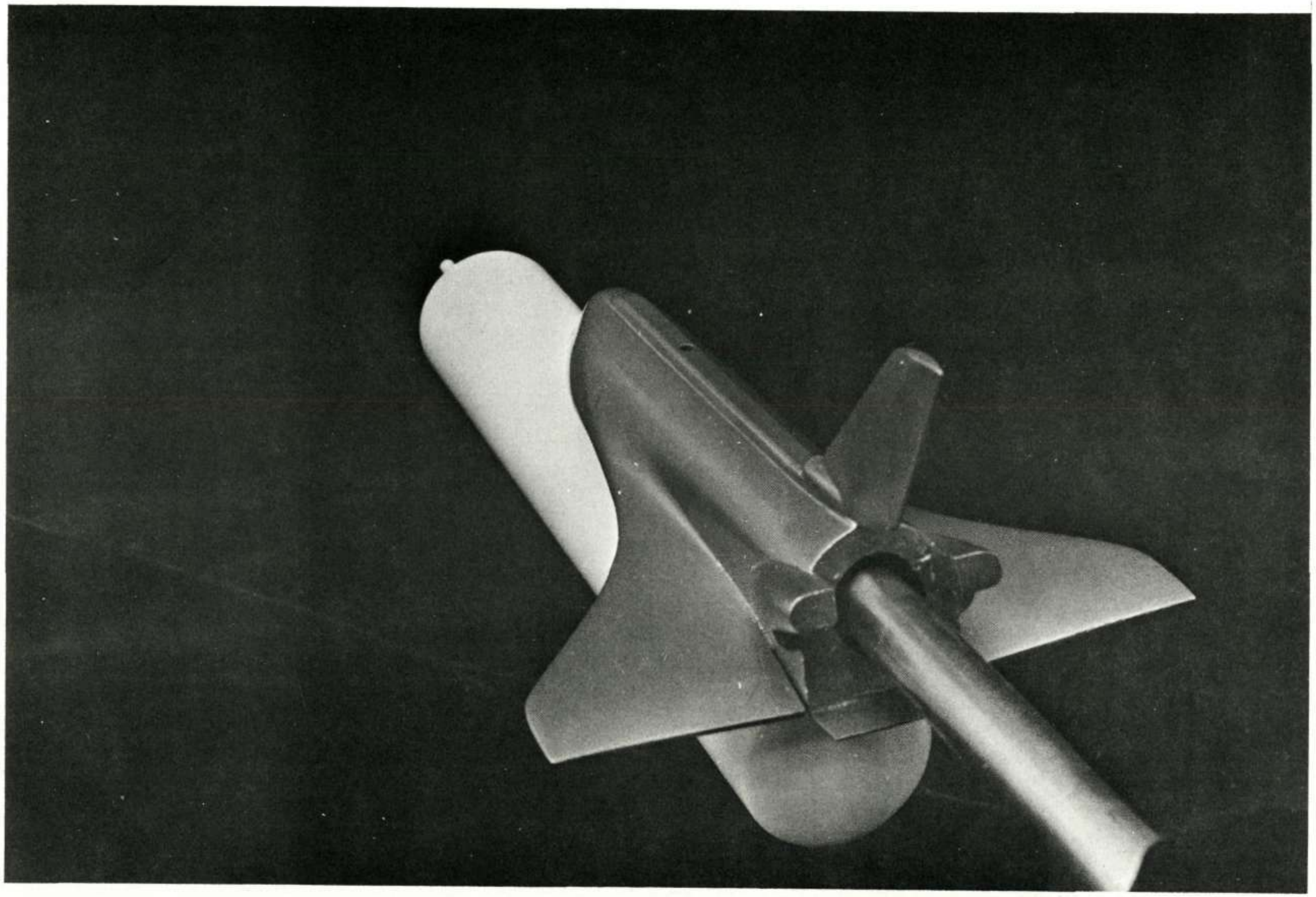
B) Top view

Figure 5. - Photograph of .0045 Scale NR (ATP) Orbiter
With External Tank Configuration.



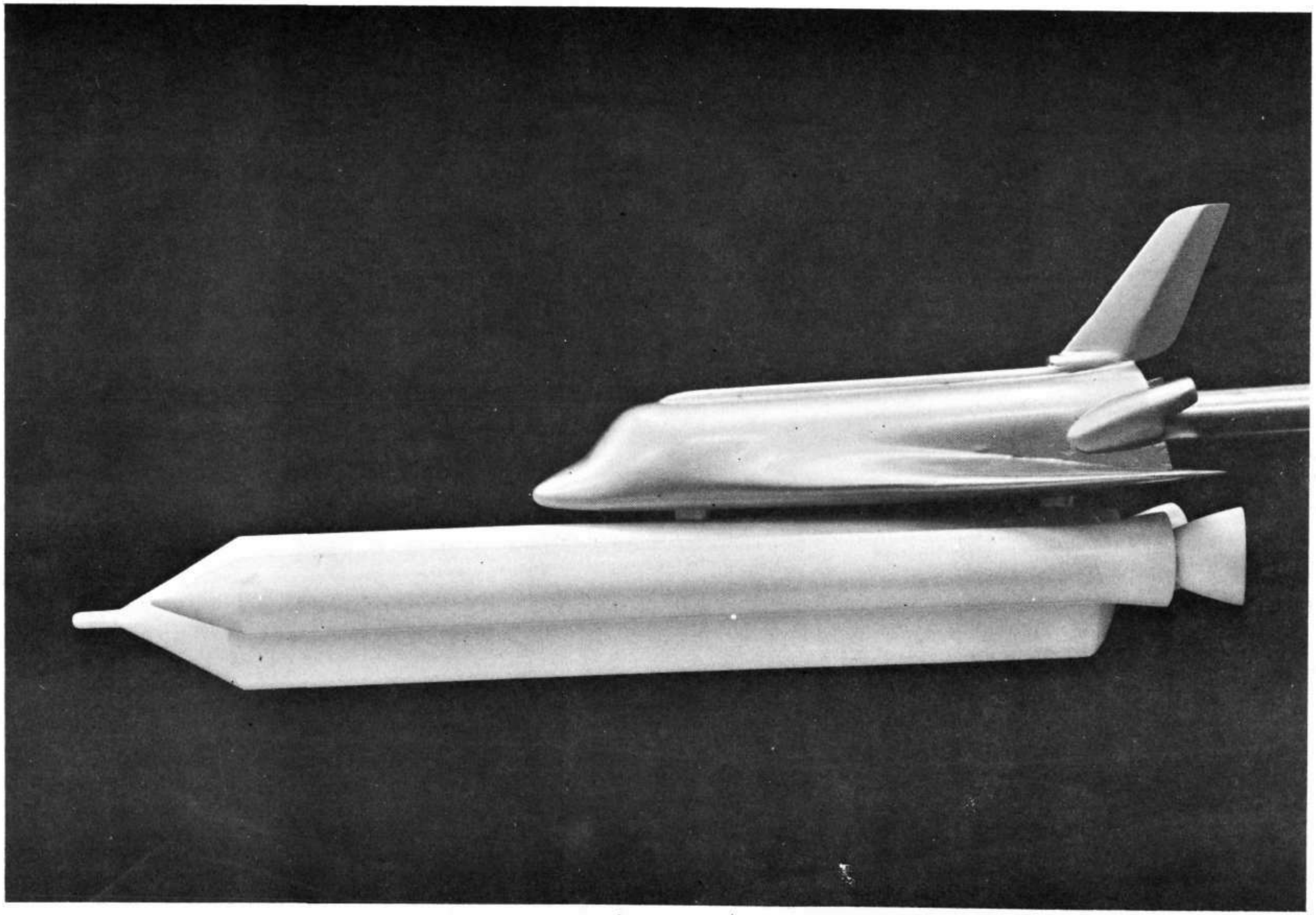
C) Bottom view

Figure 5. - Photograph of .0045 Scale NR (ATP) Orbiter
With External Tank Configuration.



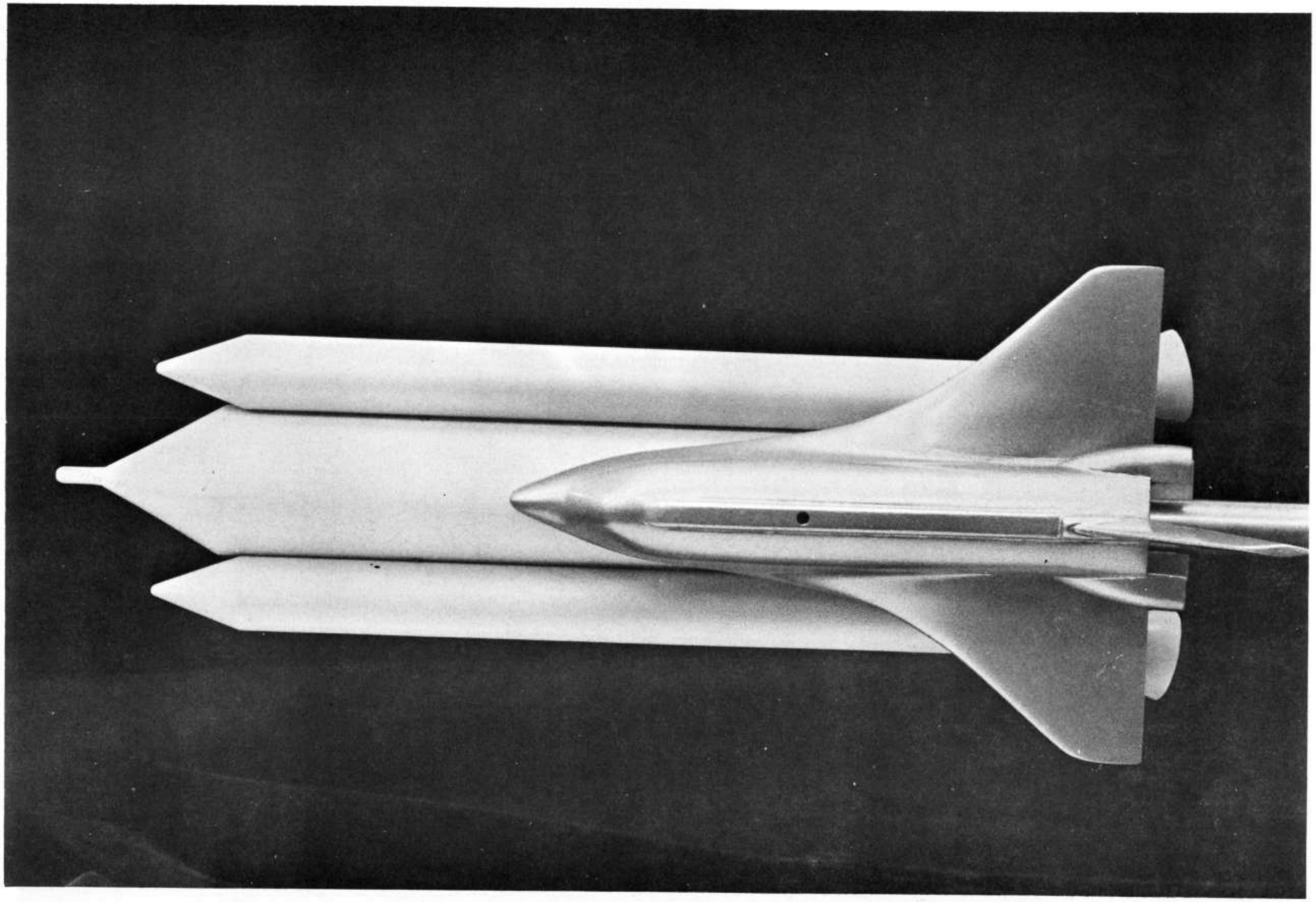
D) Rear oblique view

Figure 5. - Photograph of .0045 Scale NR (ATP) Orbiter With External Tank Configuration.



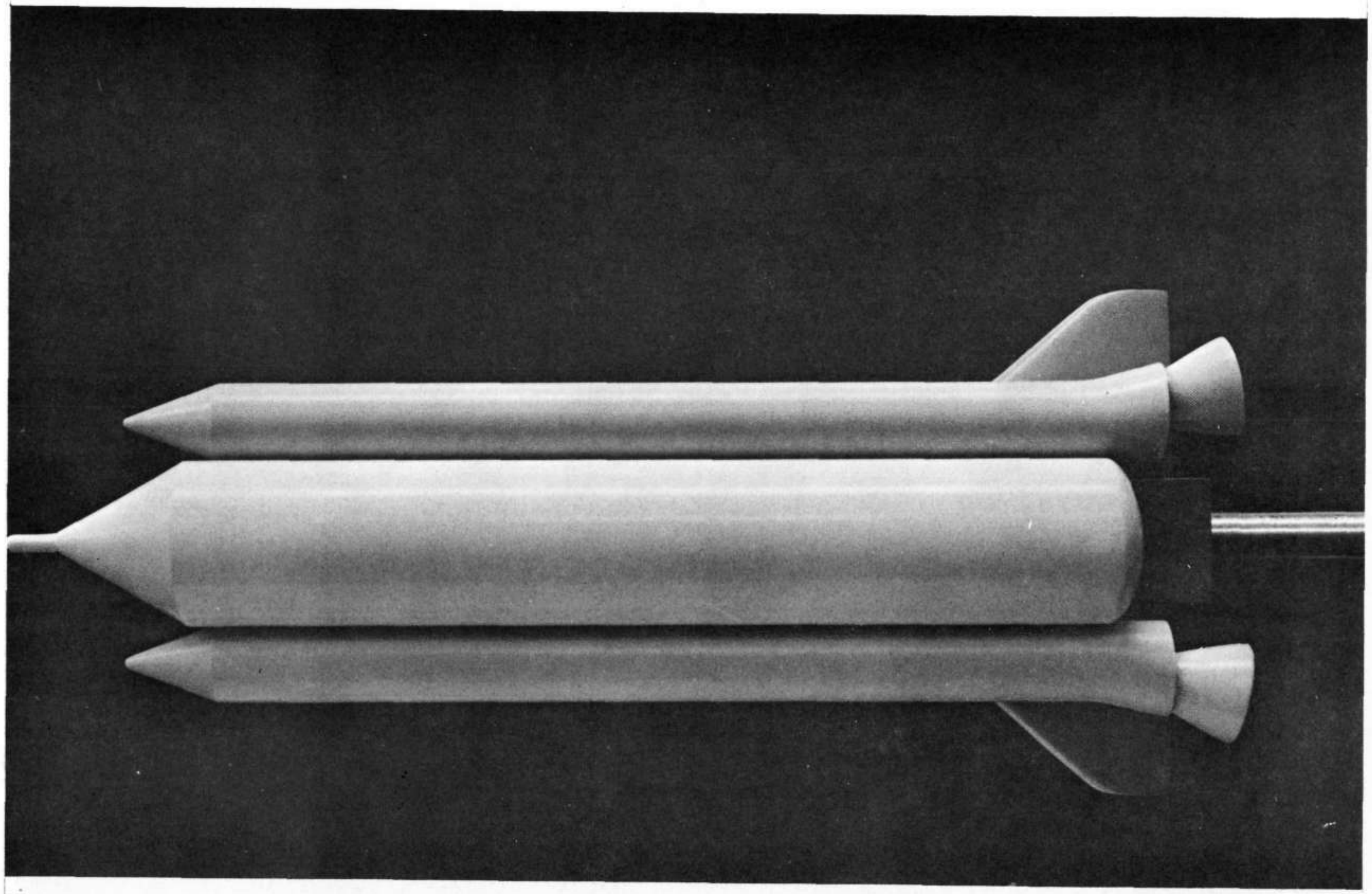
A) Left side view

Figure 6. - Photograph of .0045 Scale NR (ATP) Ascent Configuration.



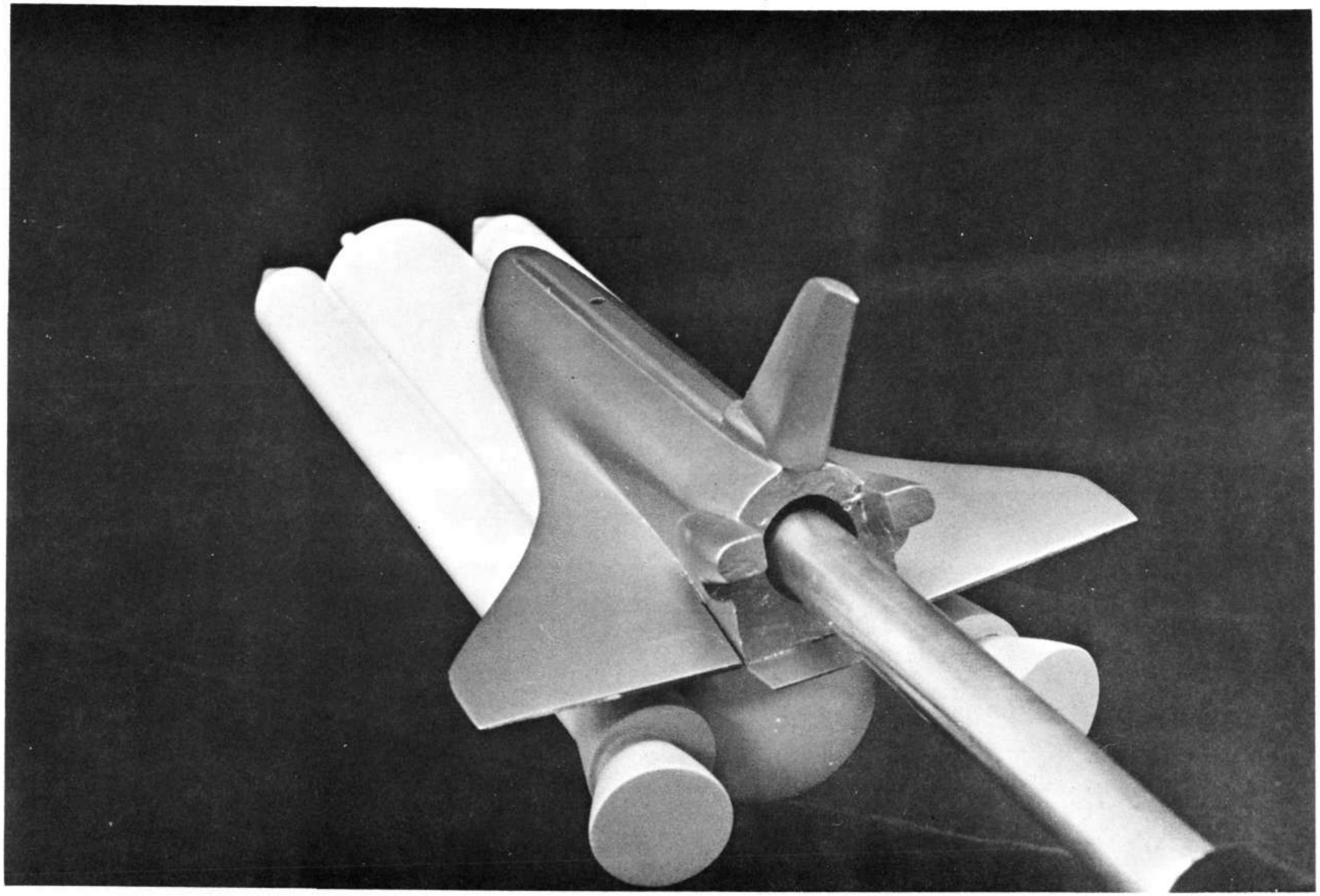
B) Top view

Figure 6. - Photograph of .0045 Scale NR (ATP) Ascent Configuration.



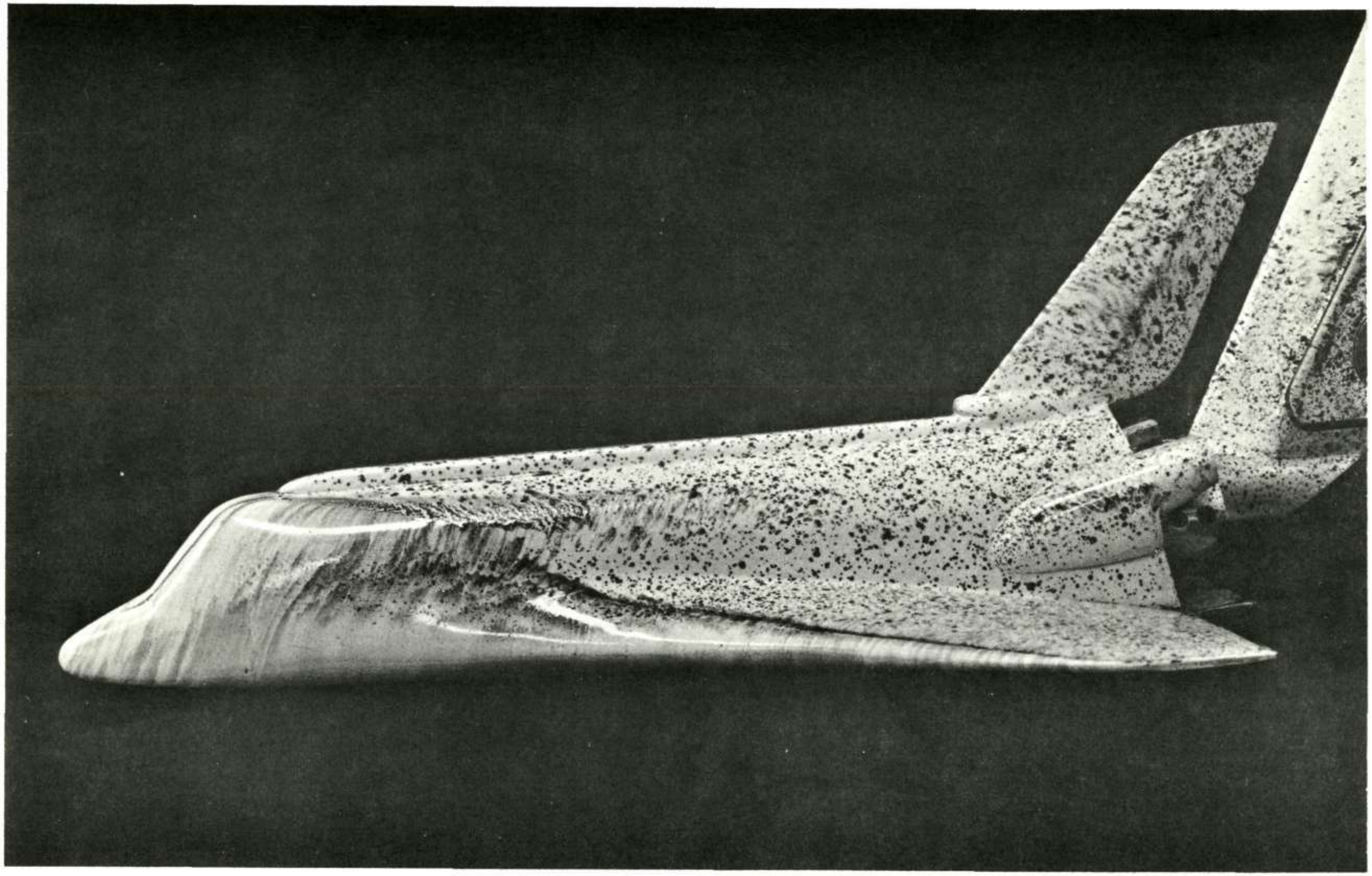
C) Bottom view

Figure 6. - Photograph of .0045 Scale NR (ATP) Ascent Configuration.



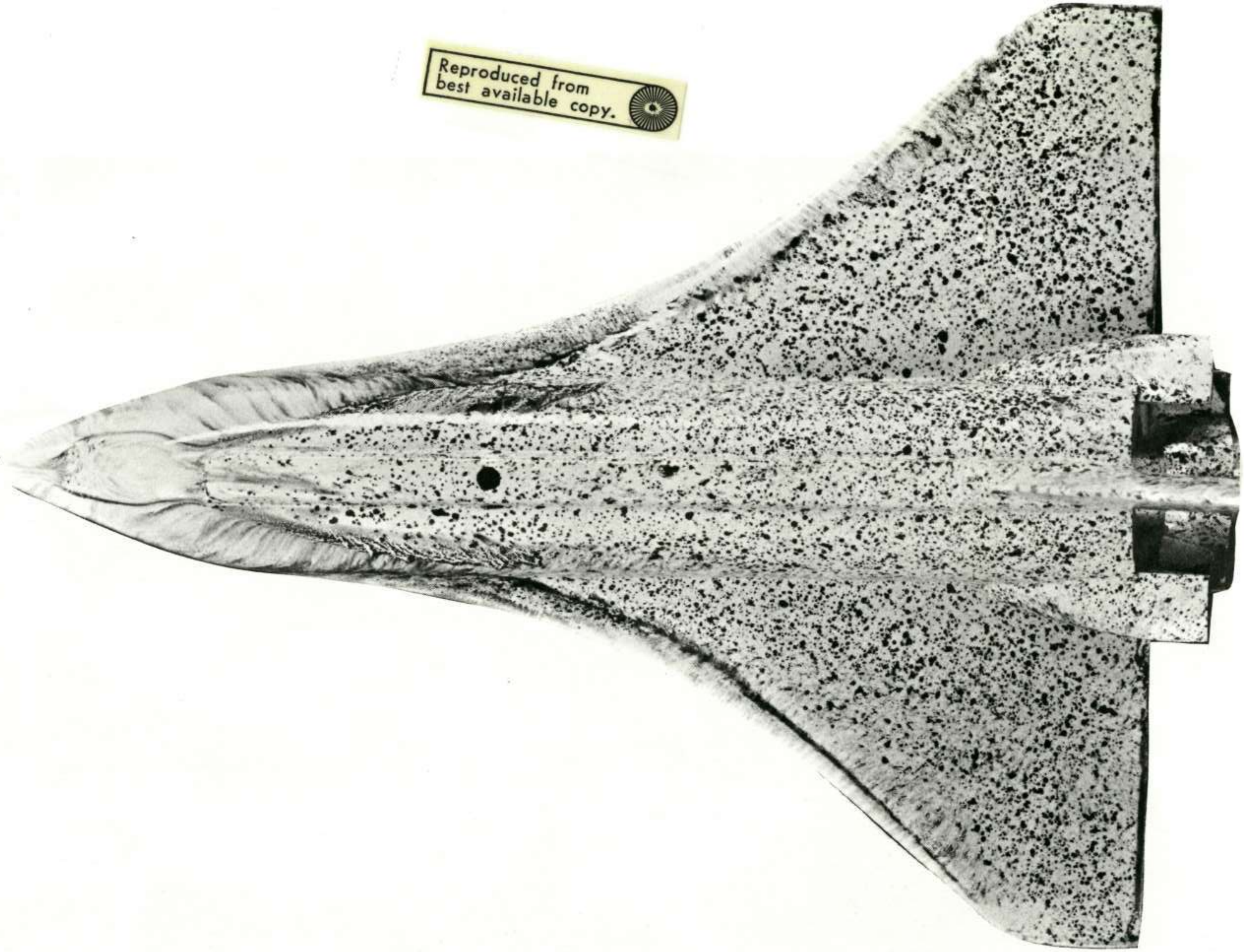
D) Rear oblique view

Figure 6. - Photograph of .0045 Scale NR (ATP) Ascent Configuration.



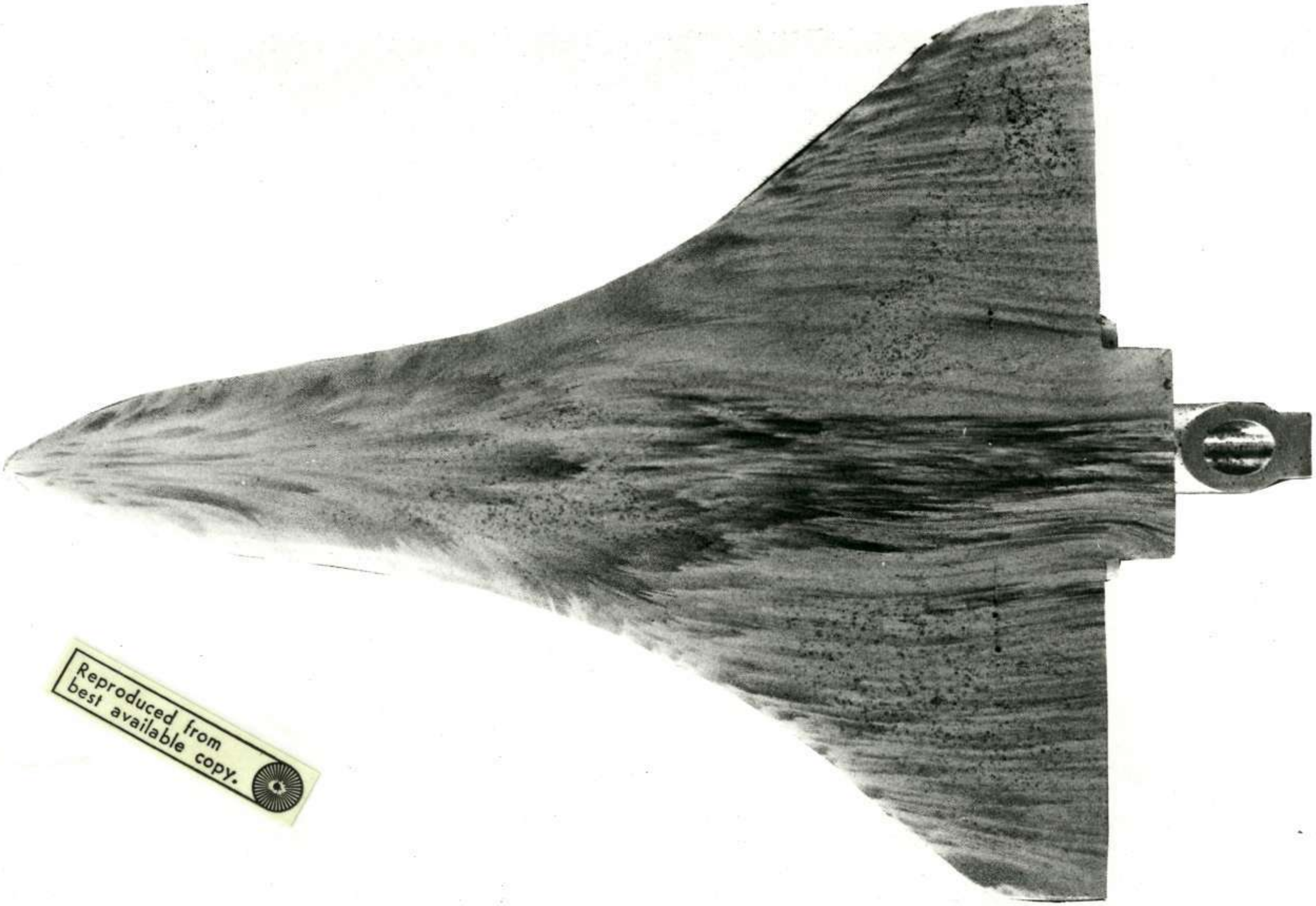
A) Left side view

Figure 7. - Photograph of Oil Flow Pattern After Tunnel Shutdown on the .0045 Scale NR (ATP) Orbiter at $M = 20.3$ and $\alpha = 51^{\circ}$; $\delta_e = 0^{\circ}$



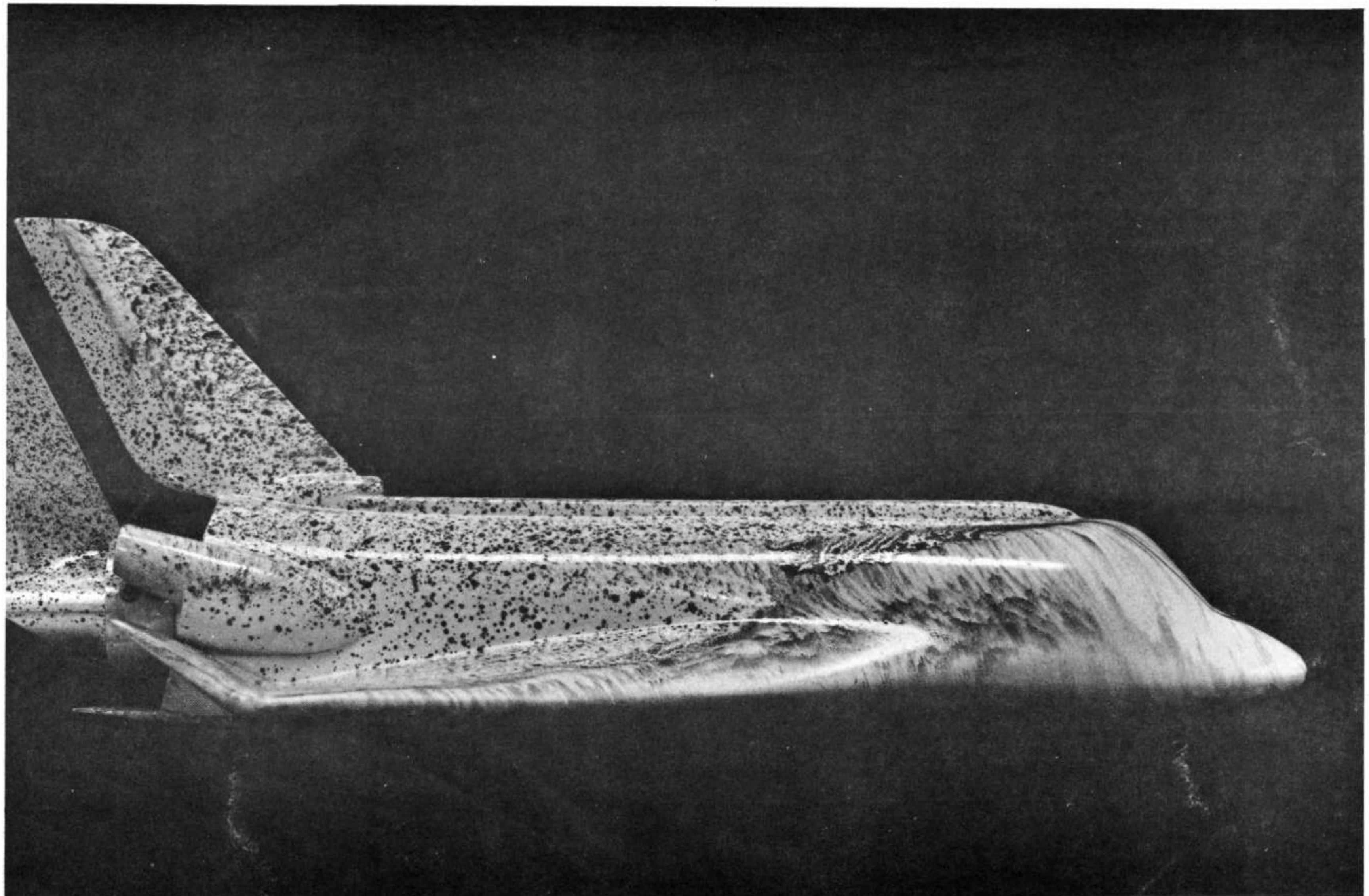
B) Top view

Figure 7. - Photograph of Oil Flow Pattern After Tunnel Shutdown on the .0045 Scale NR (ATP) Orbiter at $M = 20.3$ and $\alpha = 51^{\circ}$; $\delta_e = 0^{\circ}$.



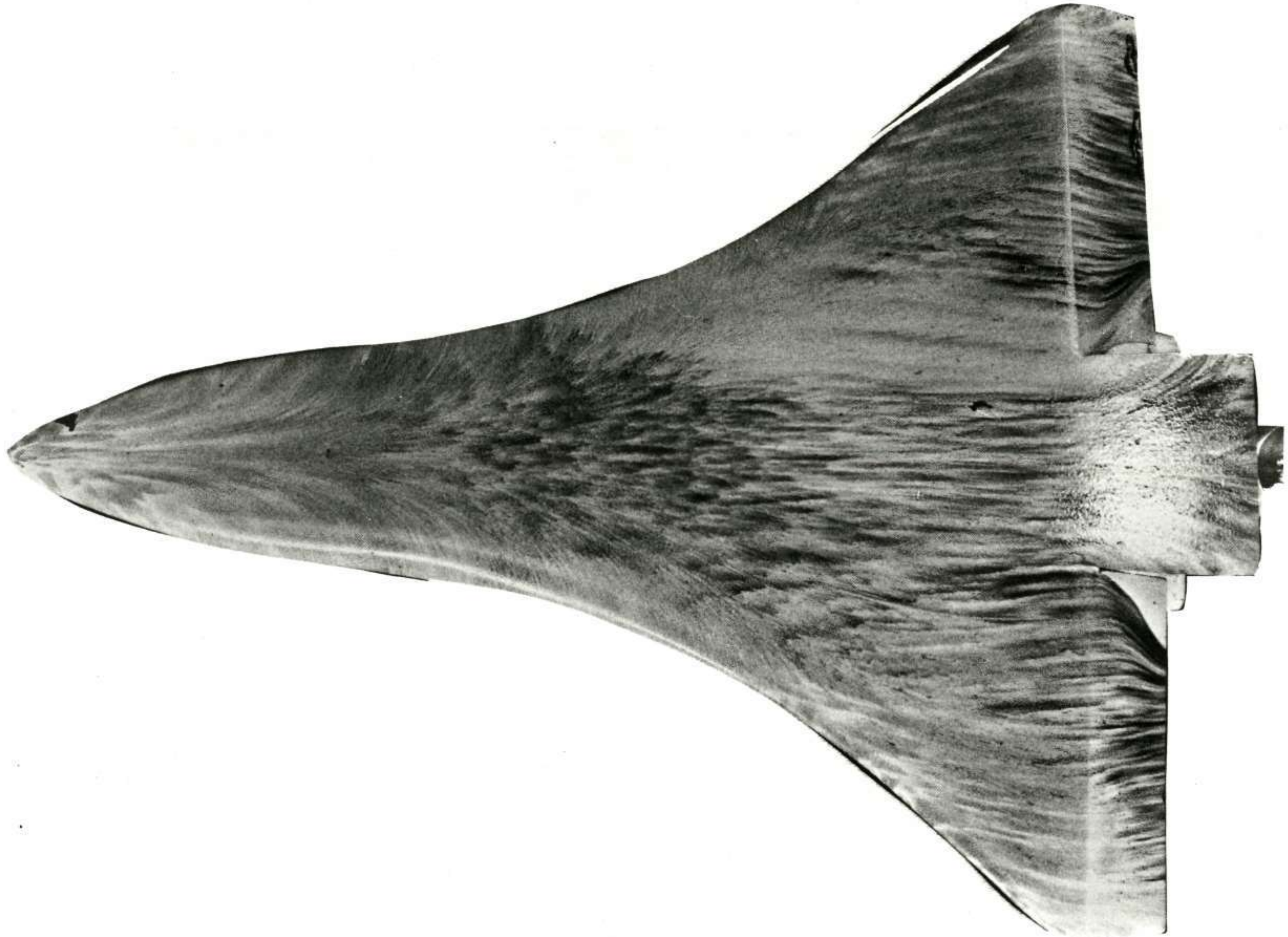
c) Bottom view

Figure 7. - Photograph of Oil Flow Pattern After Tunnel Shutdown on the .0045 Scale NR (ATP) Orbiter at $M = 20.3$ and $\alpha = 51^{\circ}$; $\delta_e = 0^{\circ}$.



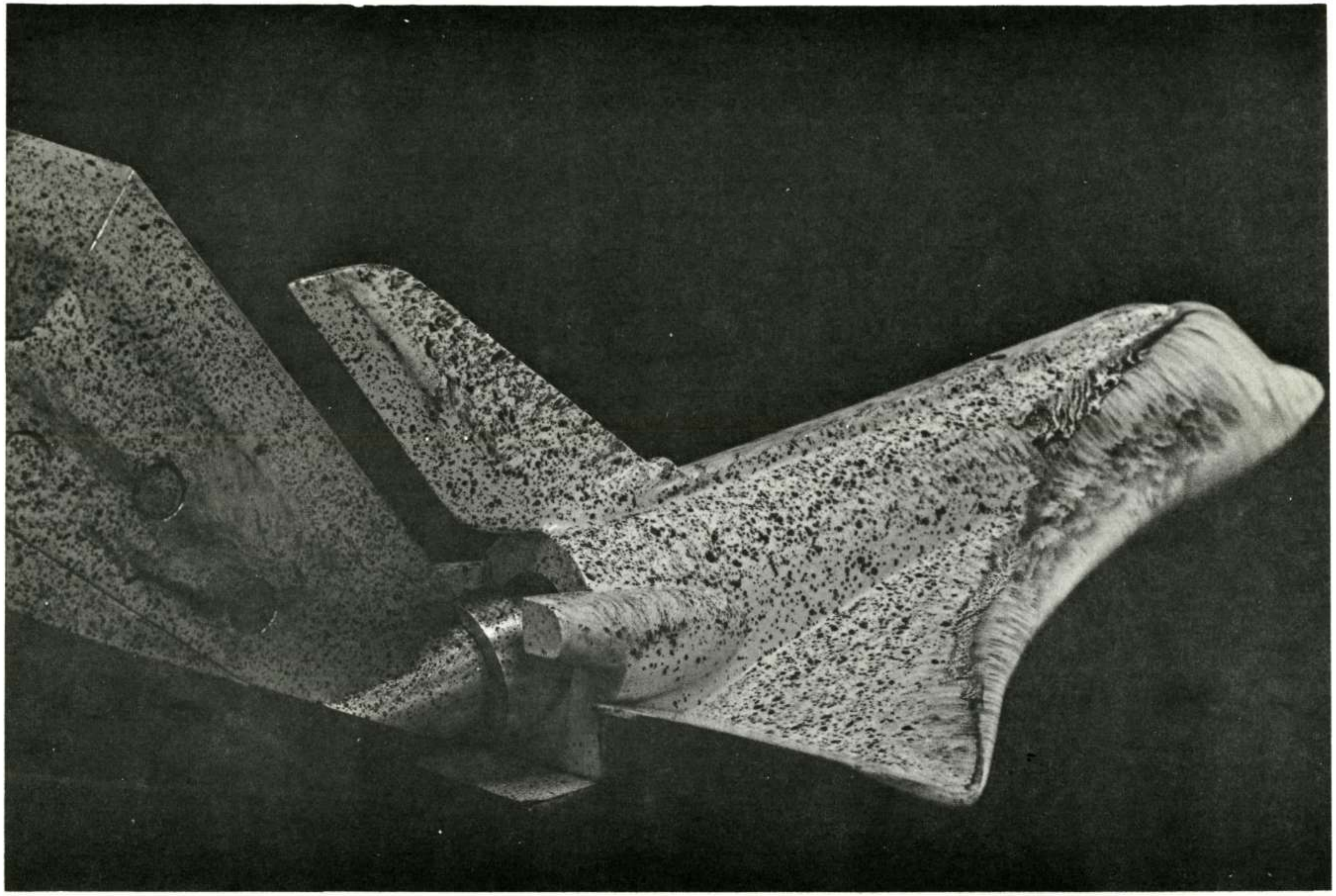
A) Right side view

Figure 8. - Photograph of Oil Flow Pattern After Tunnel Shutdown on the .0045 Scale NR (ATP) Orbiter at $M = 20.3$ and $\alpha = 51^{o}$; $\delta_e = -40^{o}$.



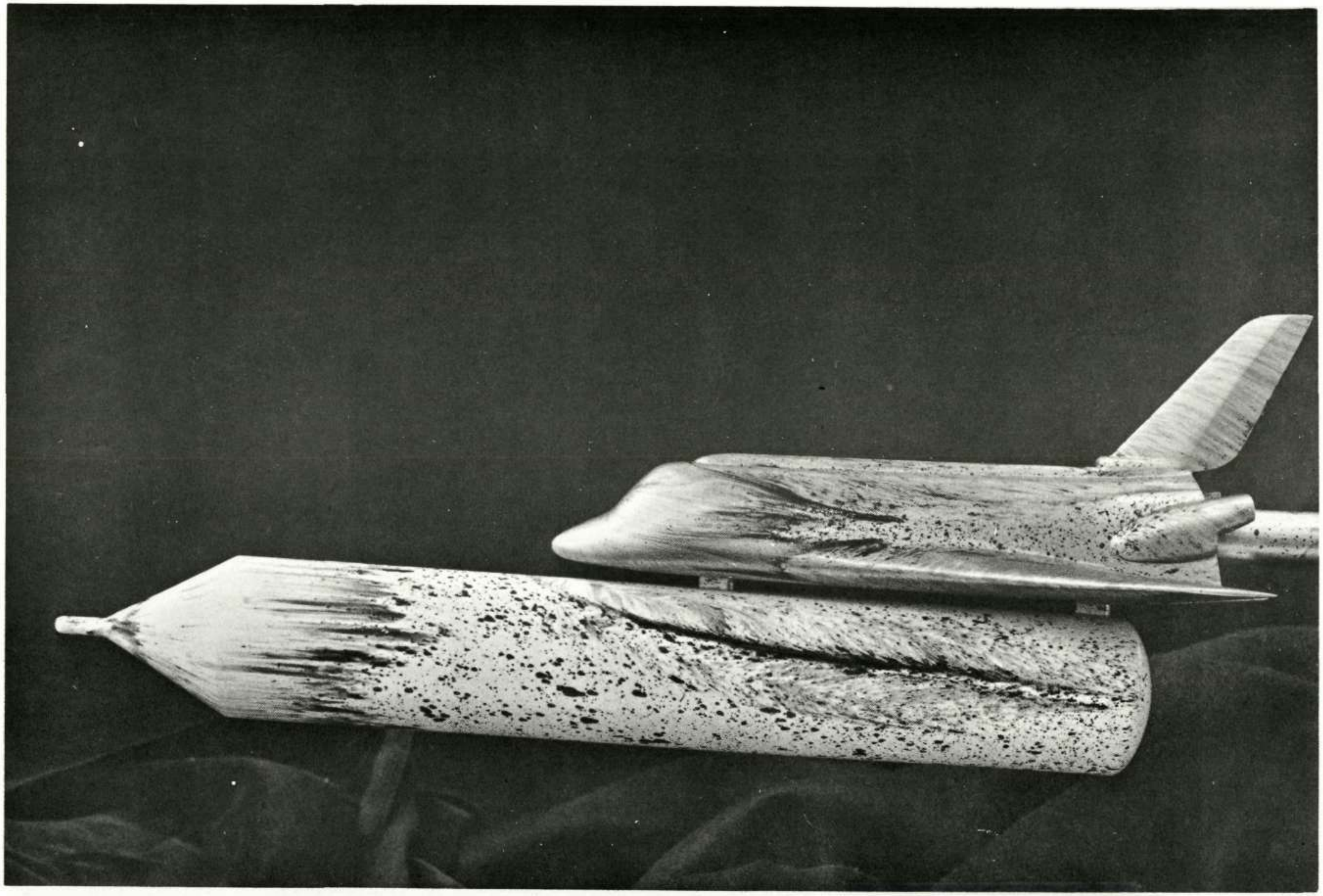
B) Bottom view

Figure 8. - Photograph of Oil Flow Pattern After Tunnel Shutdown on the .0045 Scale NR (ATP) Orbiter at M = 20.3 and $\alpha = 51^{\circ}$; $\delta_e = -40^{\circ}$.



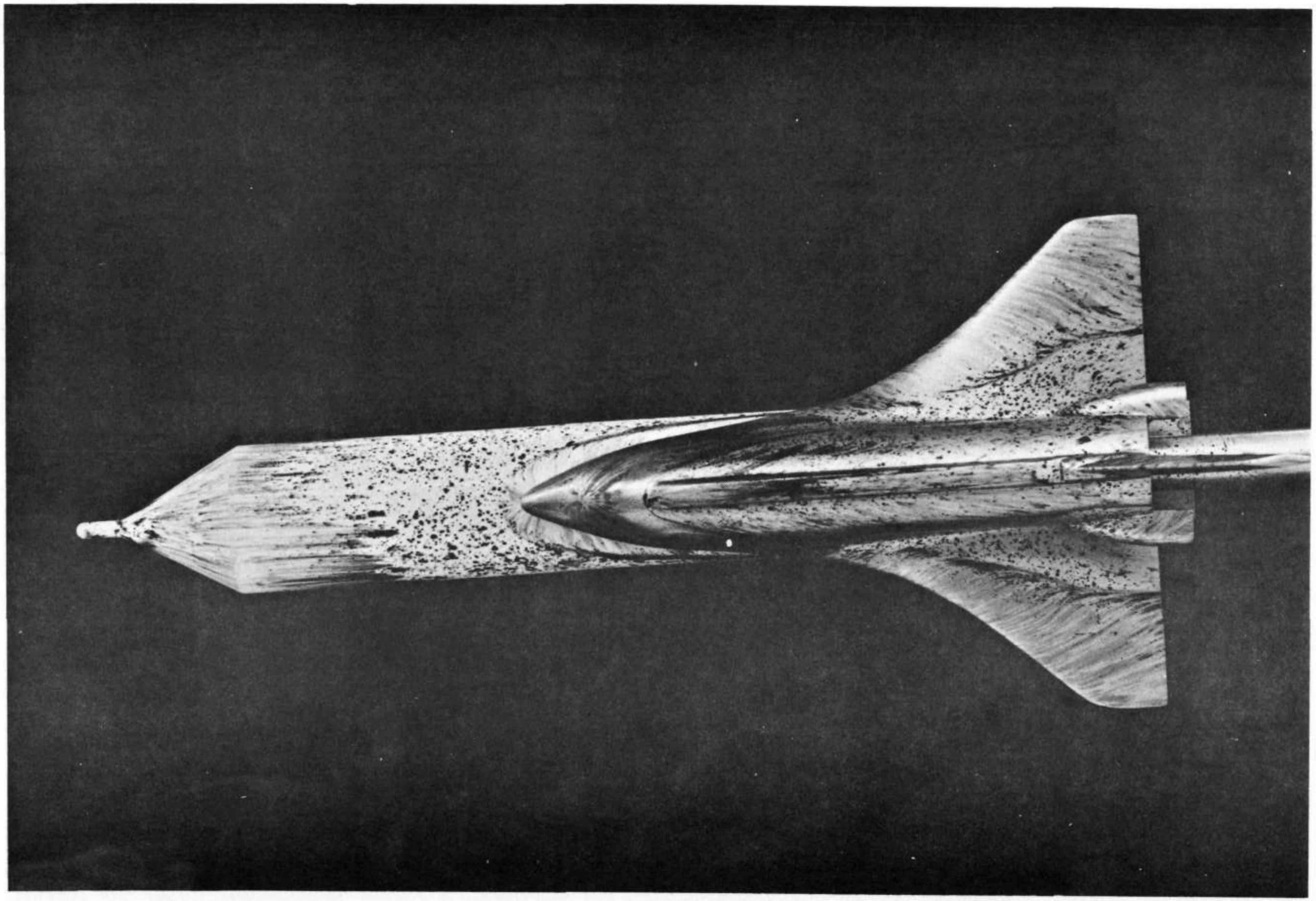
C) Right side rear oblique view

Figure 8. - Photograph of Oil Flow Pattern After Tunnel Shutdown on the .0045 Scale NR (ATP) Orbiter at $M = 20.3$ and $\alpha = 51^{\circ}$; $\delta_e = -40^{\circ}$.



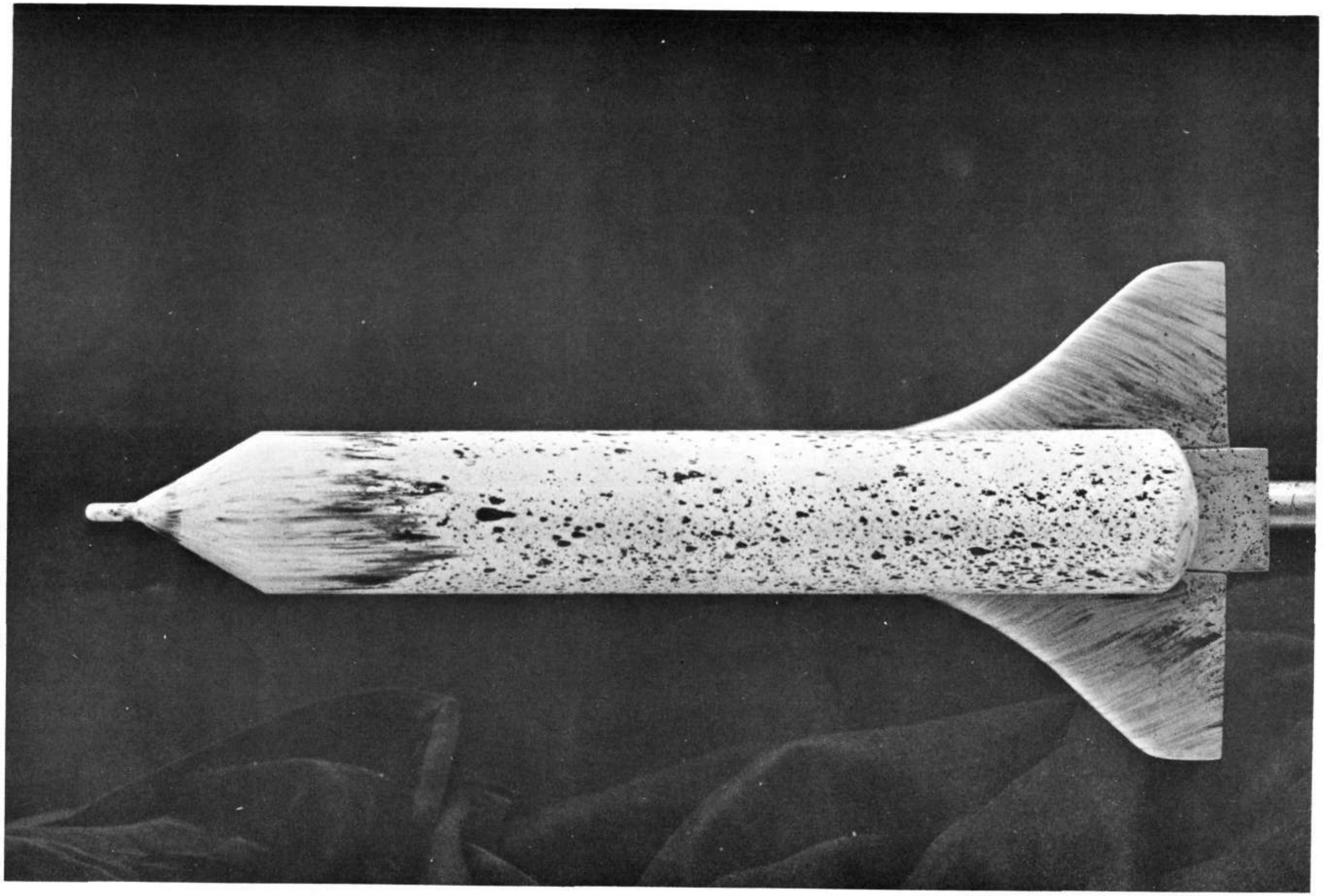
A) Side view

Figure 9. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Orbiter with External Tank at M = 20.3 and $\alpha = 0^{\circ}$.



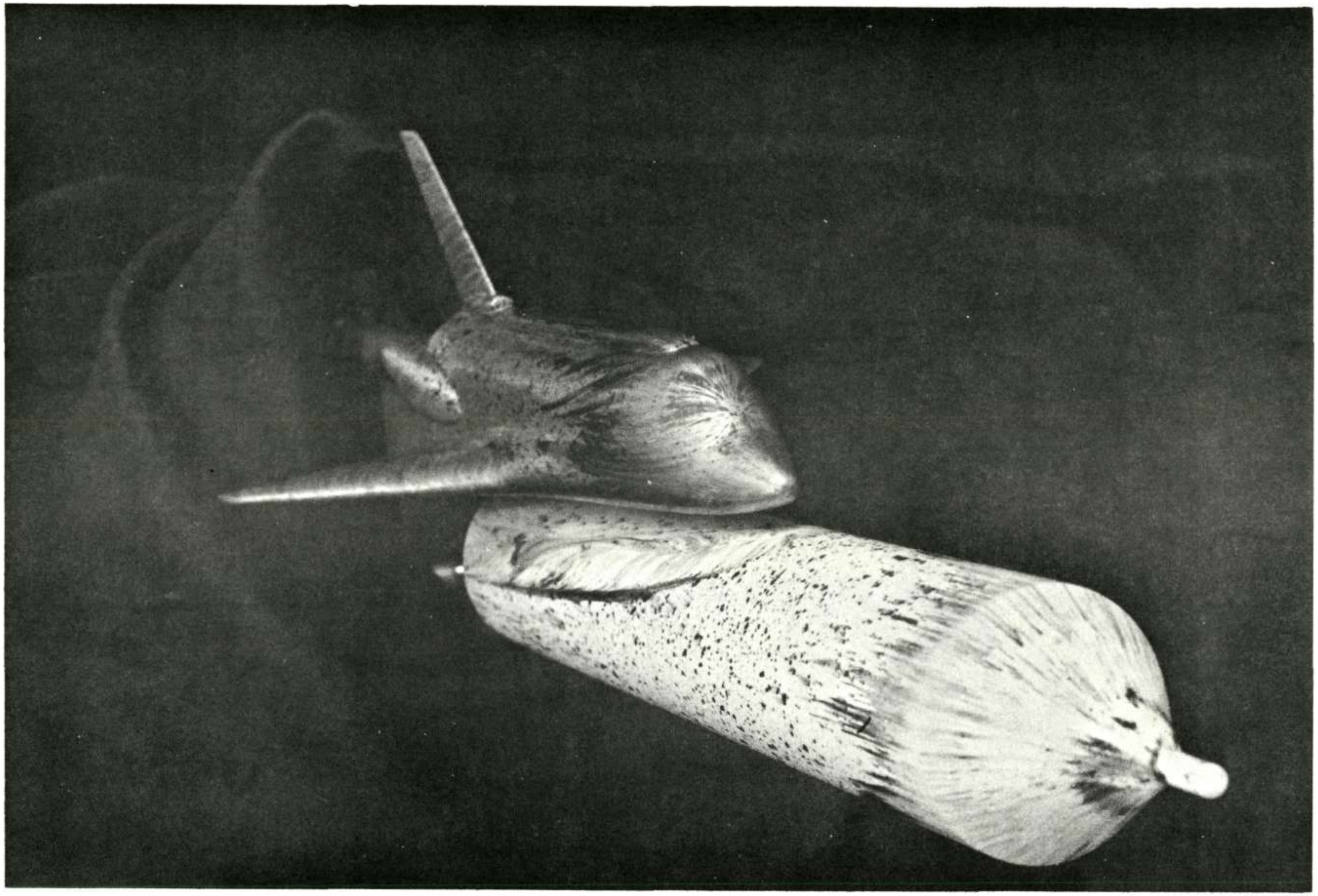
B) Top view

Figure 9. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Orbiter with External Tank at M - 20.3 and $\alpha = 0^{\circ}$.



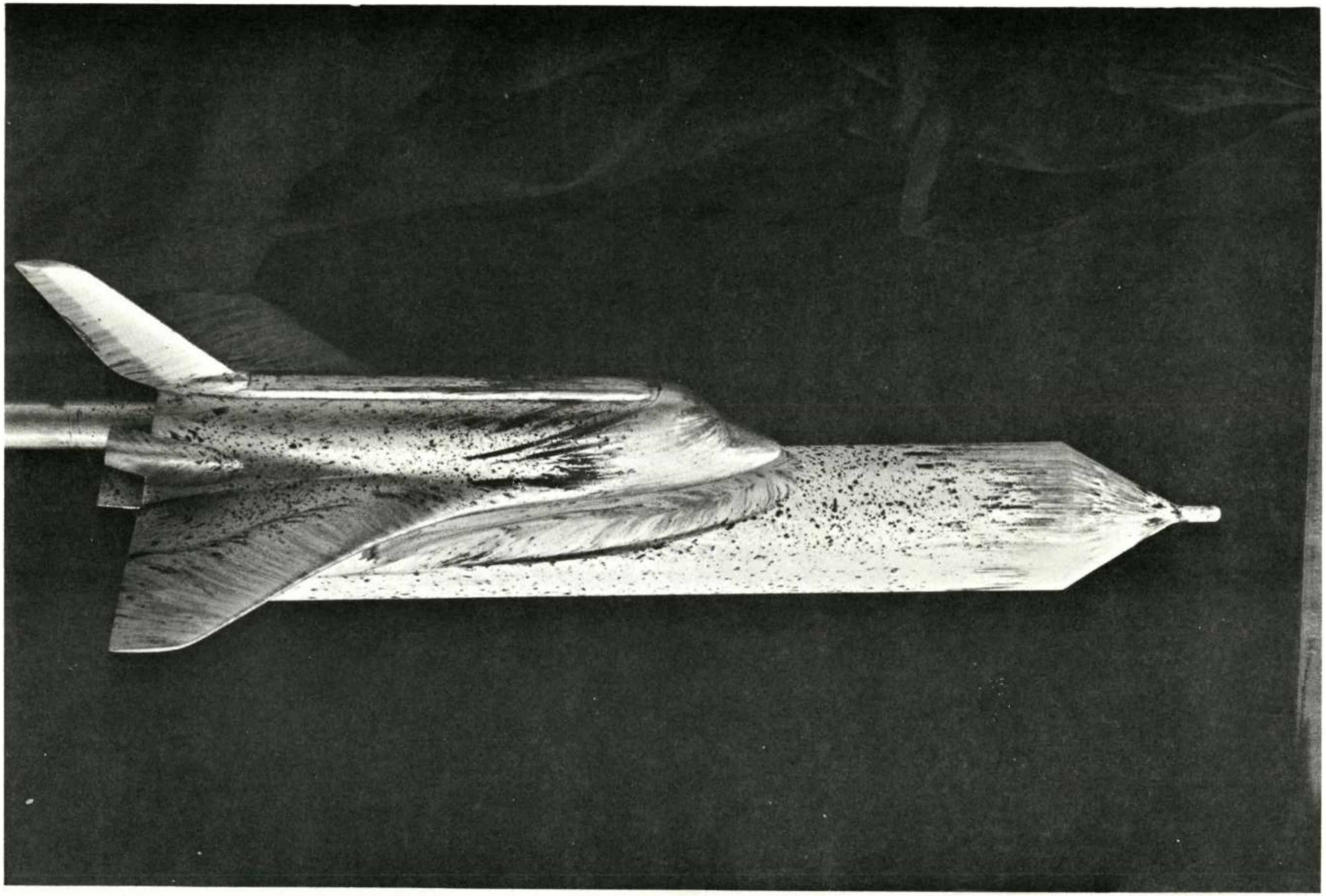
C) Bottom view

Figure 9. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Orbiter with External Tank at M = 20.3 and $\alpha = 0^{\circ}$.



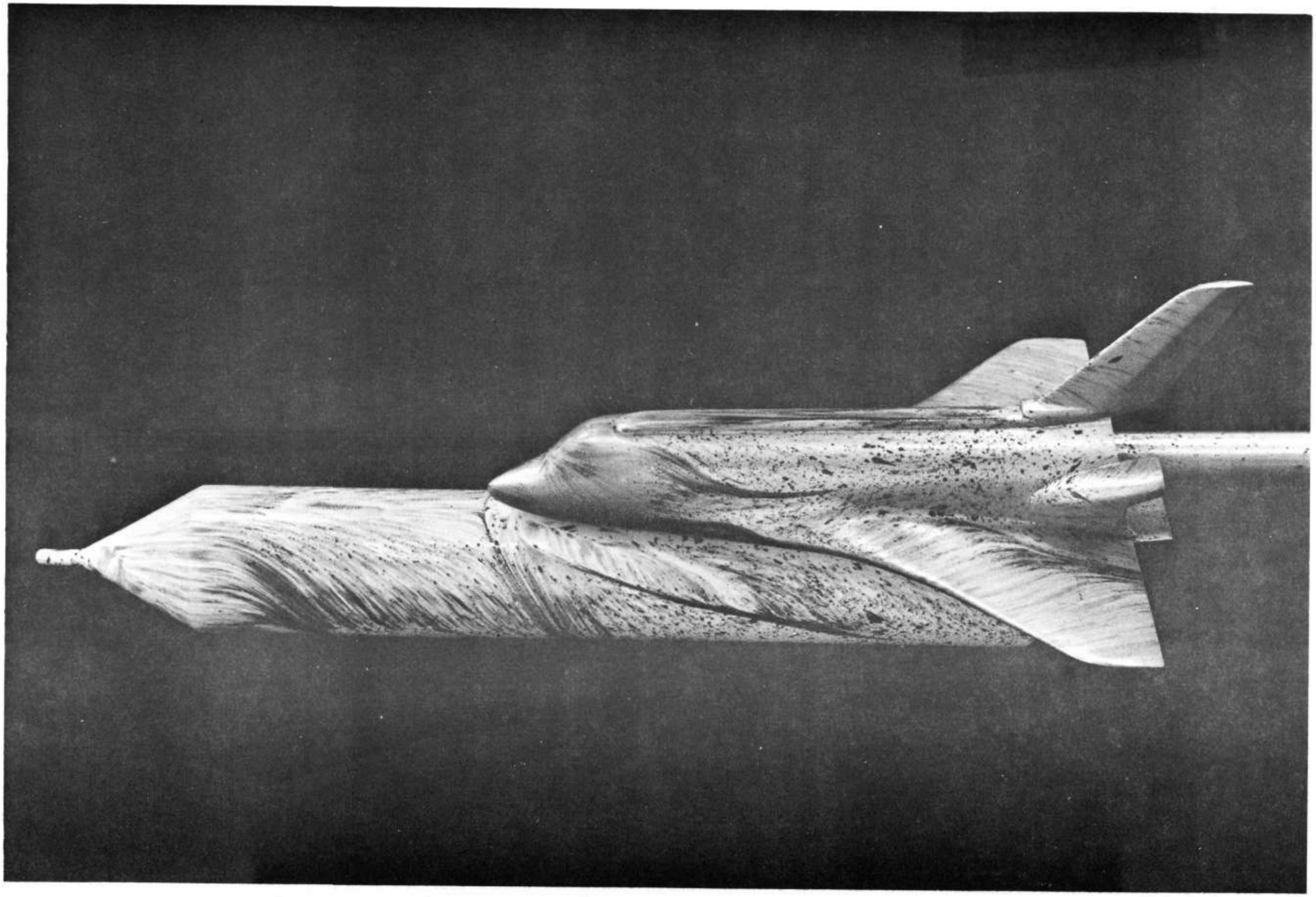
D) Oblique front side view

Figure 9. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Orbiter with External Tank at $M = 20.3$ and $\alpha = 0^{o}$.



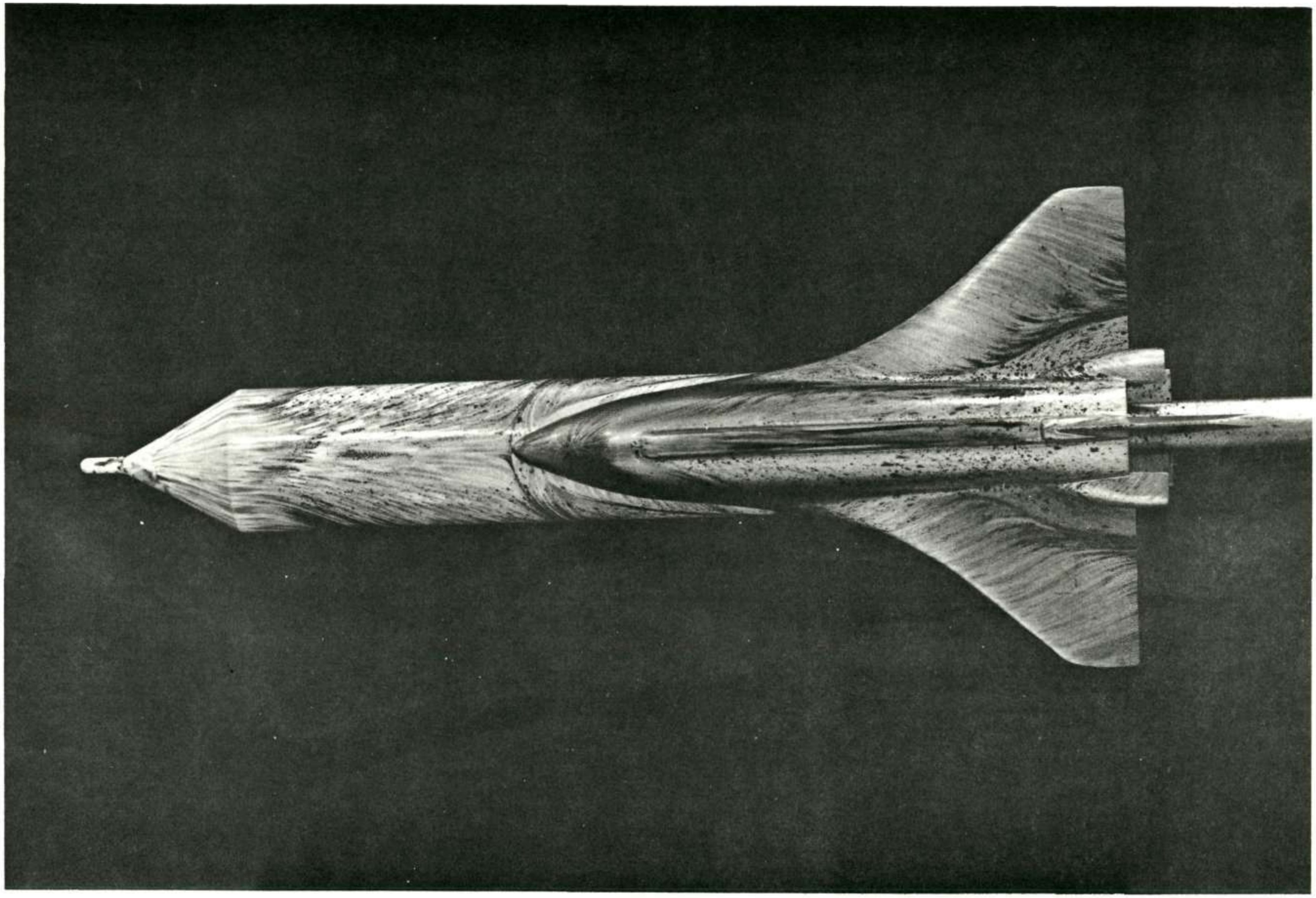
E) Oblique top side view

Figure 9. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Orbiter with External Tank at M = 20.3 and $\alpha = 0^{o}$.



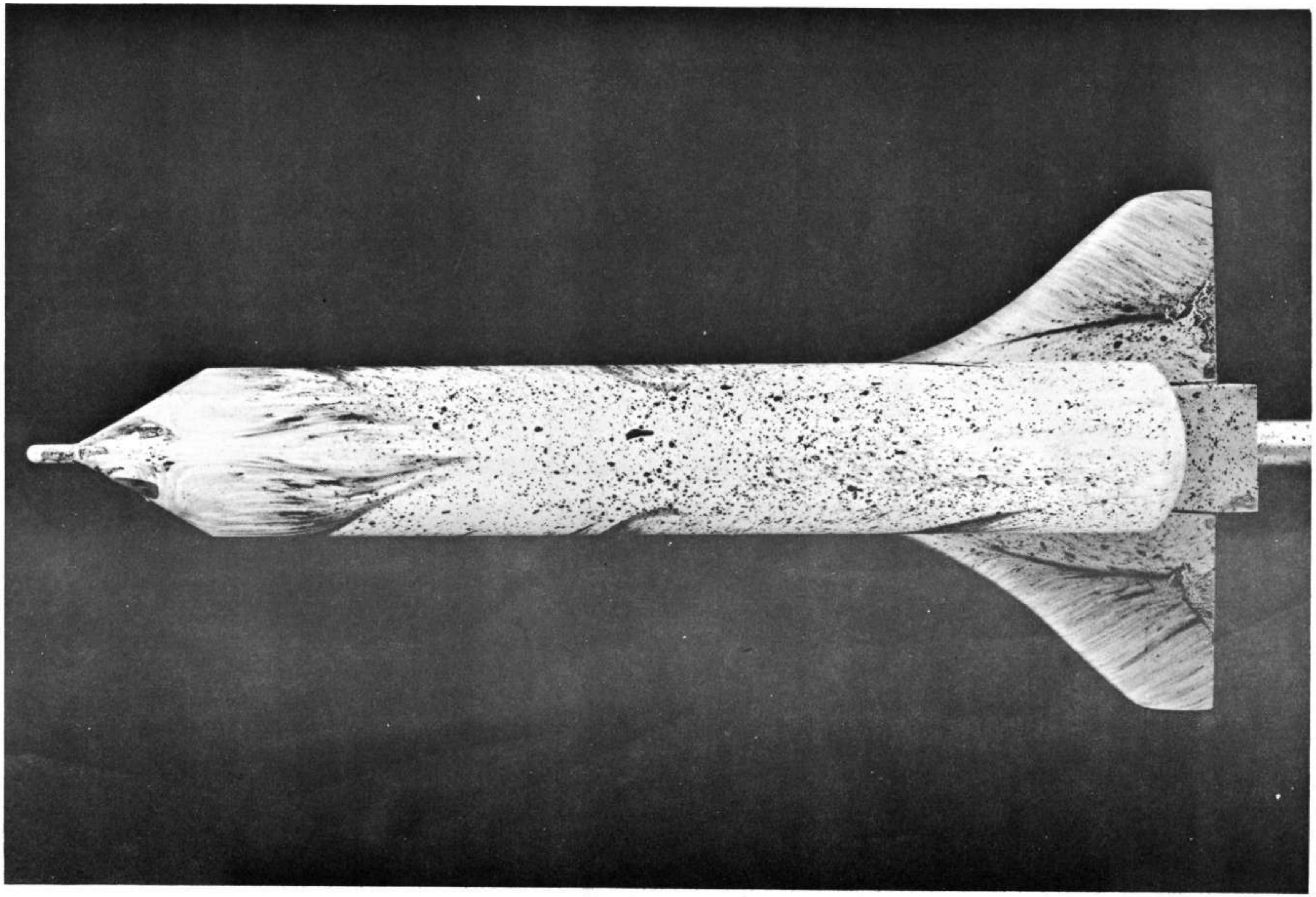
A) Side view (rolled)

Figure 10. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Orbiter with External Tank at M = 20.3 and $\alpha = -5^{\circ}$.



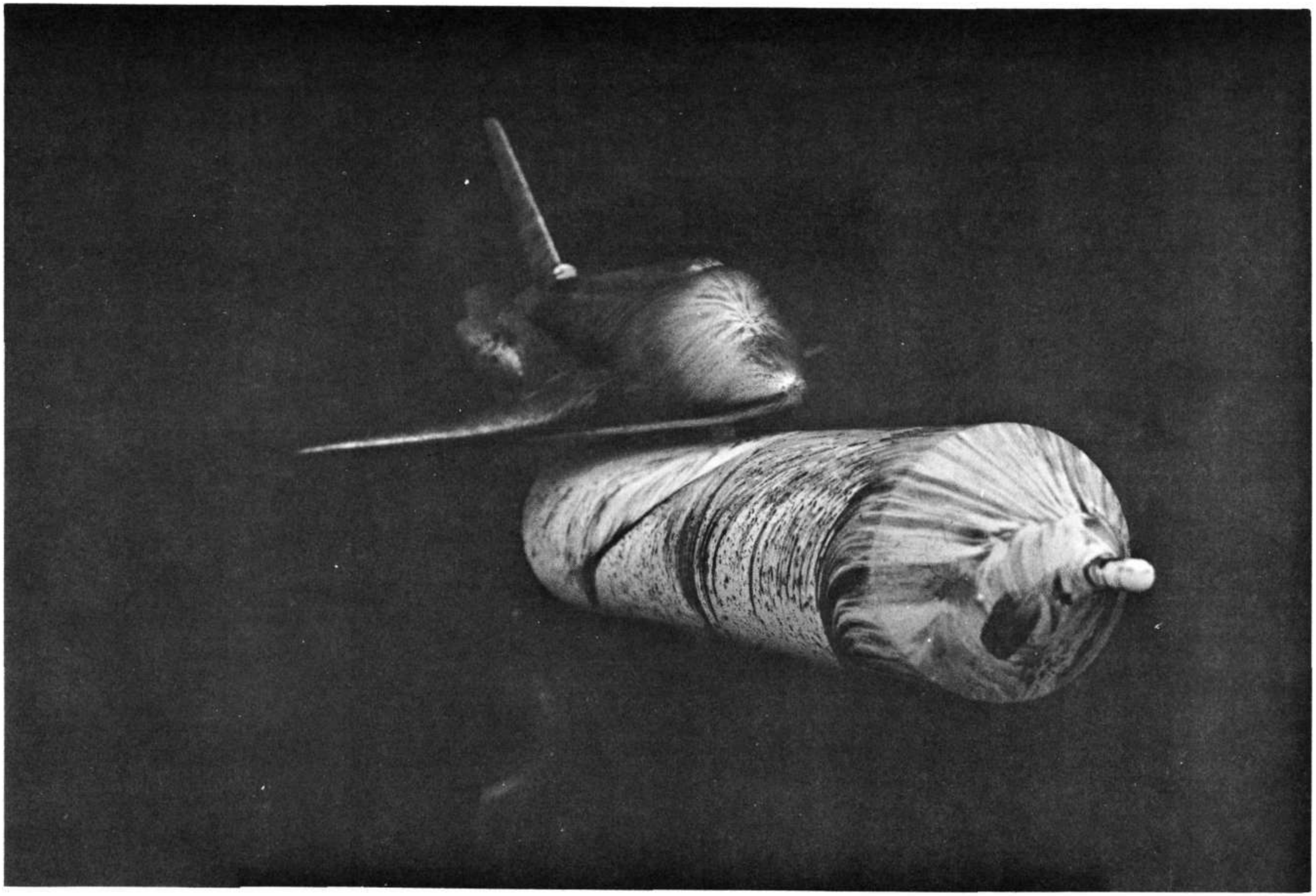
B) Top view

Figure 10. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Orbiter with External Tank at $M = 20.3$ and $\alpha = -5^{\circ}$.



C) Bottom view

Figure 10. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Orbiter with External Tank at M = 20.3 and α = -5°.

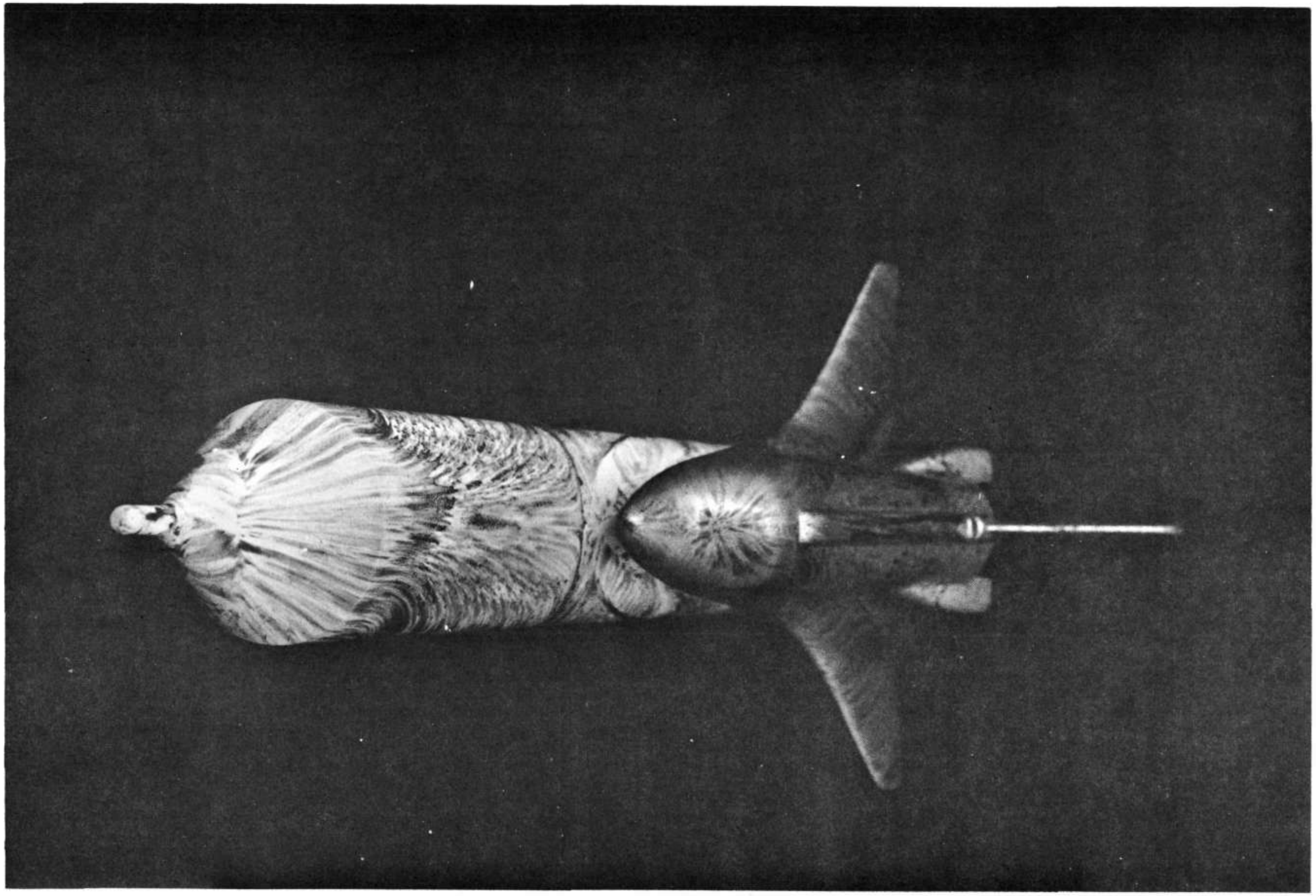


D) Front oblique view

Figure 10. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Orbiter with External Tank at M = 20.3 and $\alpha = -5^{\circ}$.

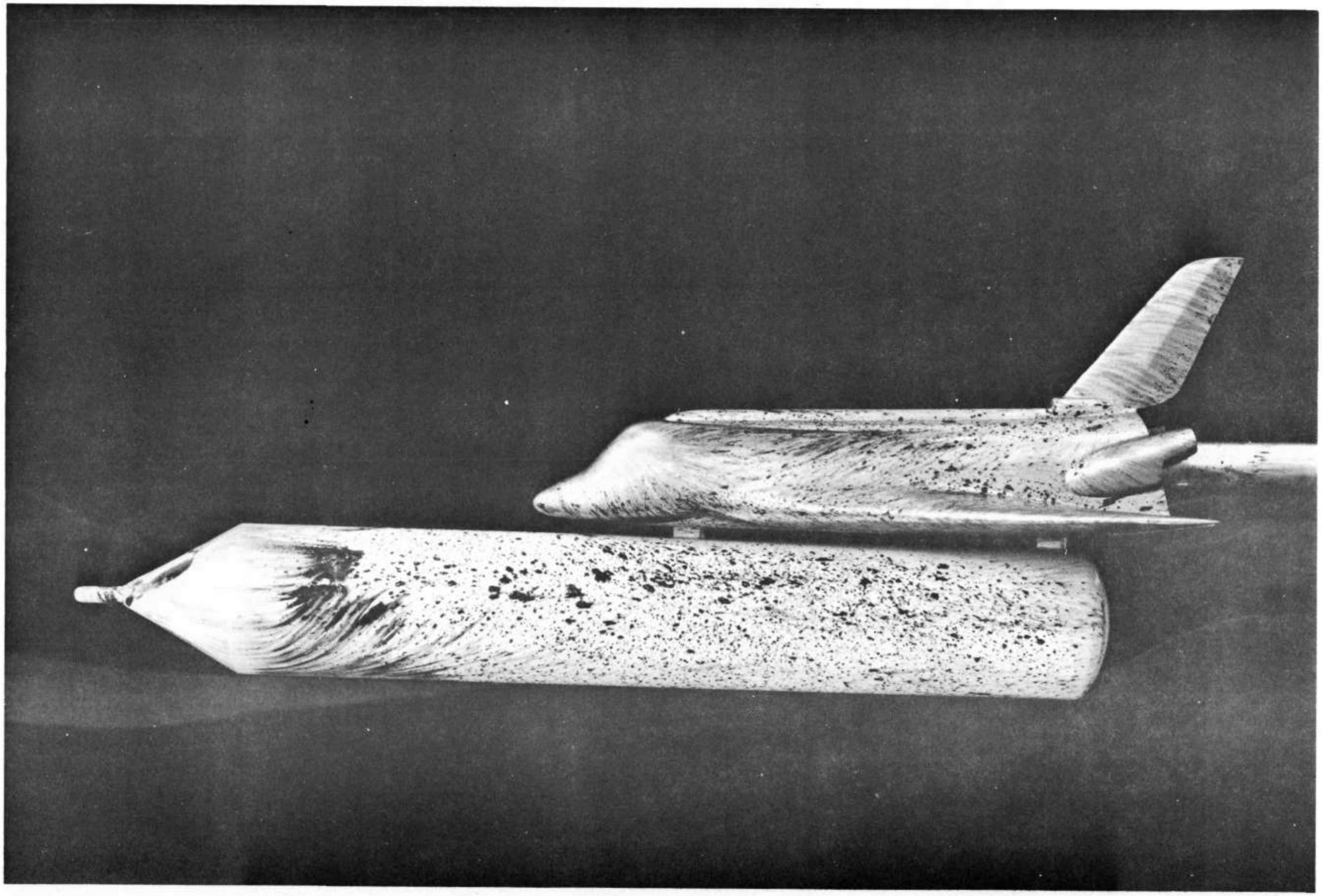
E) Top-side oblique view

Figure 10. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Orbiter with External Tank at M = 20.3 and $\alpha = -5^{o}$.



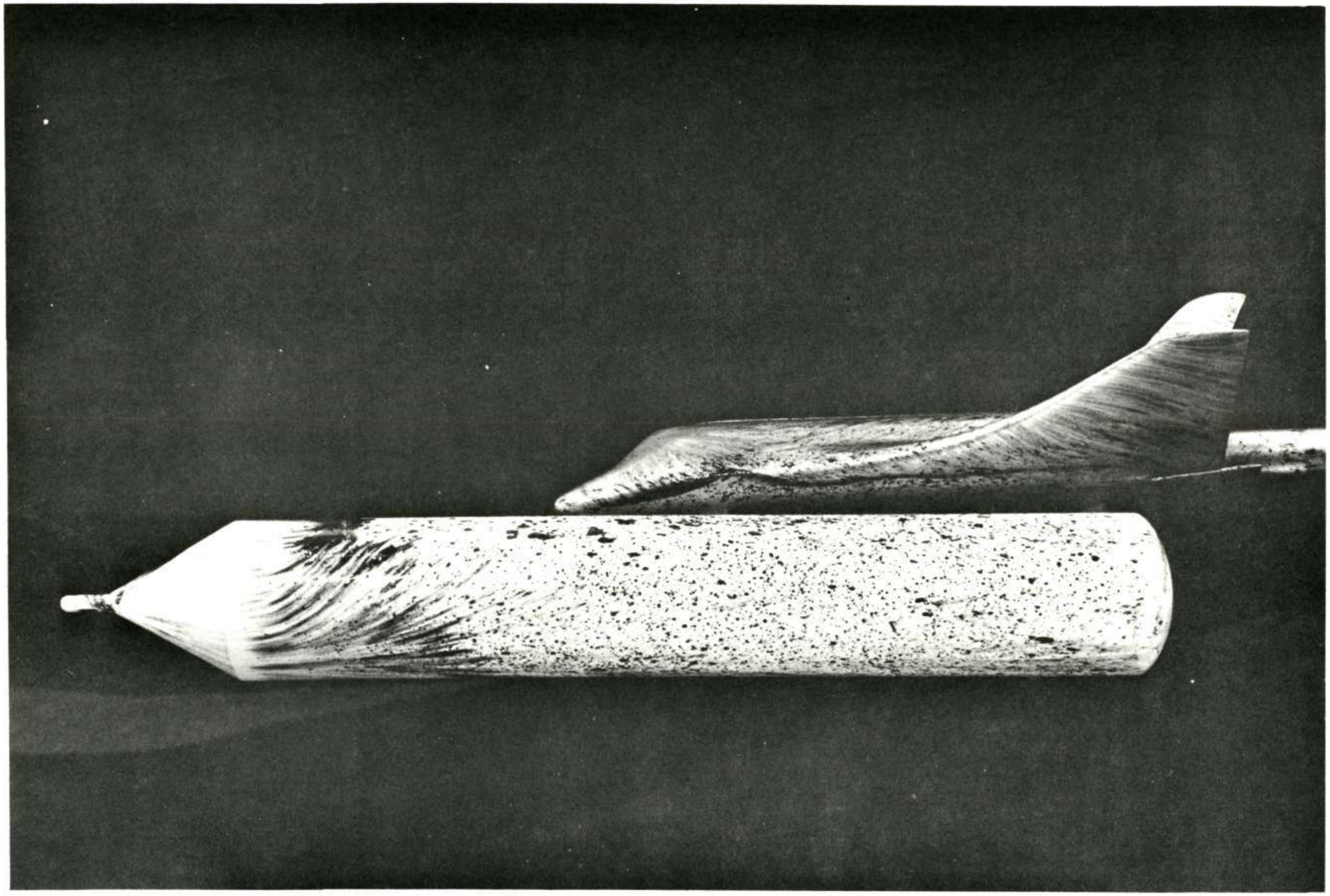
F) Top oblique view

Figure 10. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Orbiter with External Tank at $M = 20.3$ and $\alpha = -5^{\circ}$.



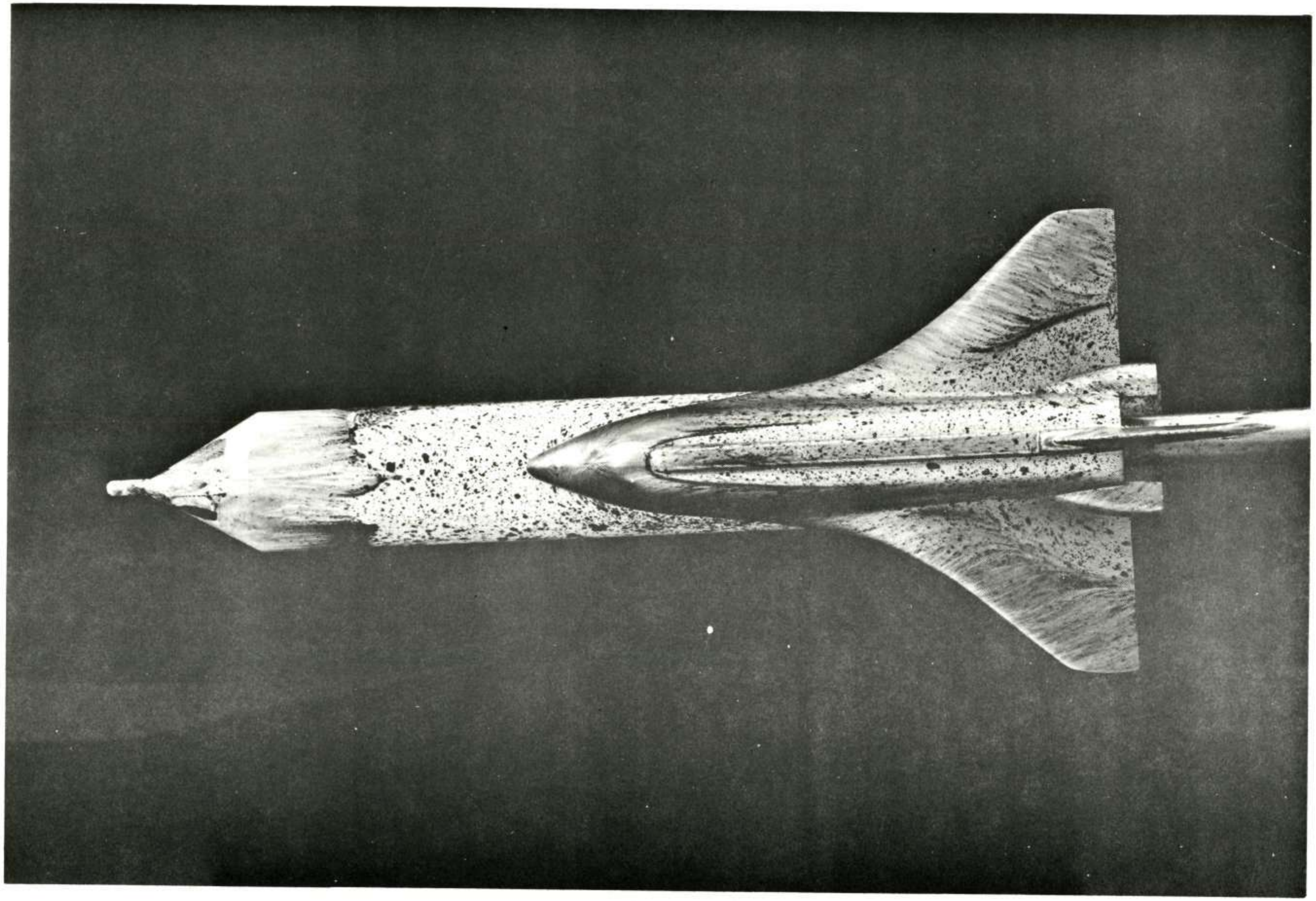
A) Side View

Figure 11. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Orbiter with External Tank at M = 20.3 and $\alpha = +5^{\circ}$.



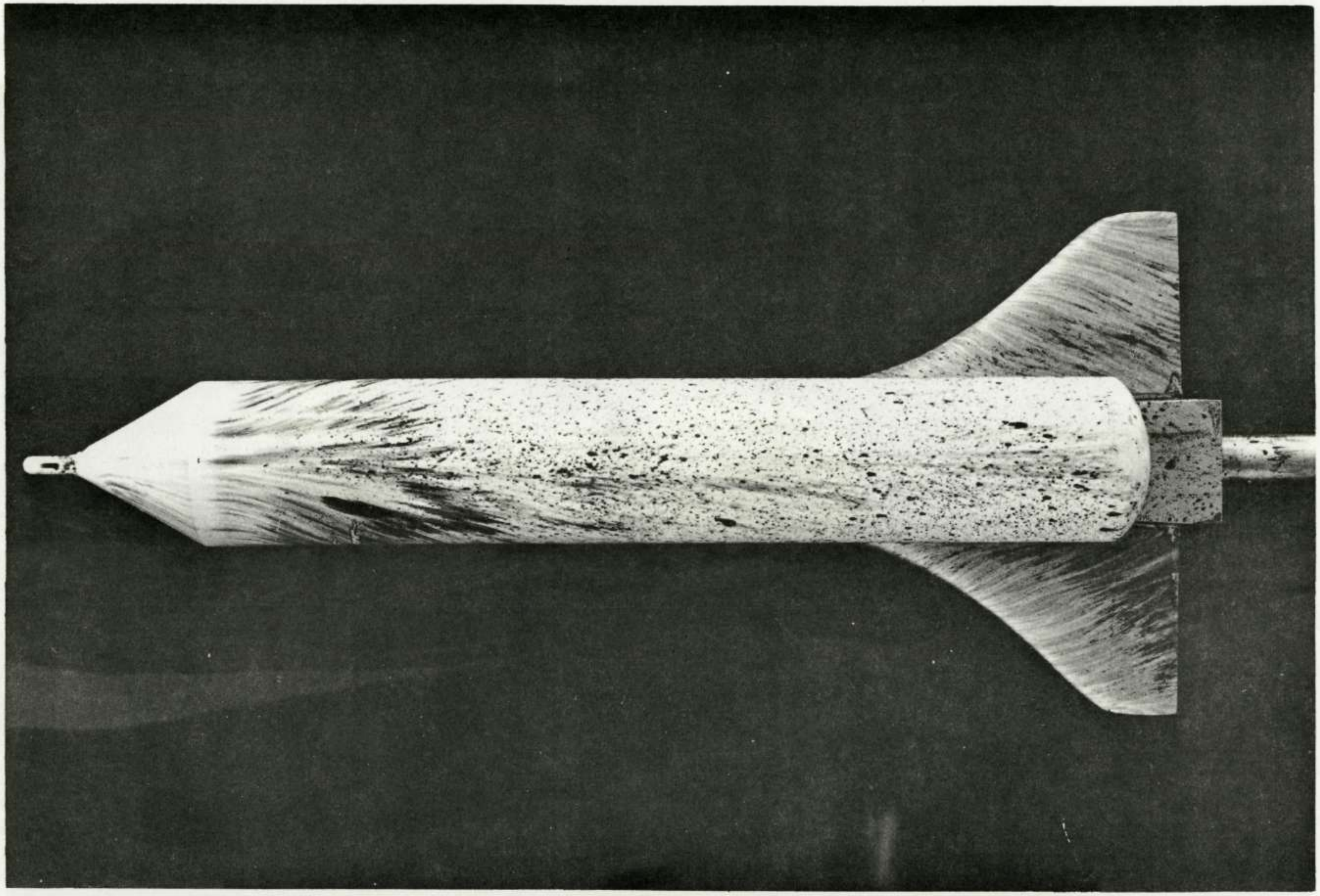
B) Side view (rolled)

Figure 11. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Orbiter with External Tank at M = 20.3 and α = +5°.



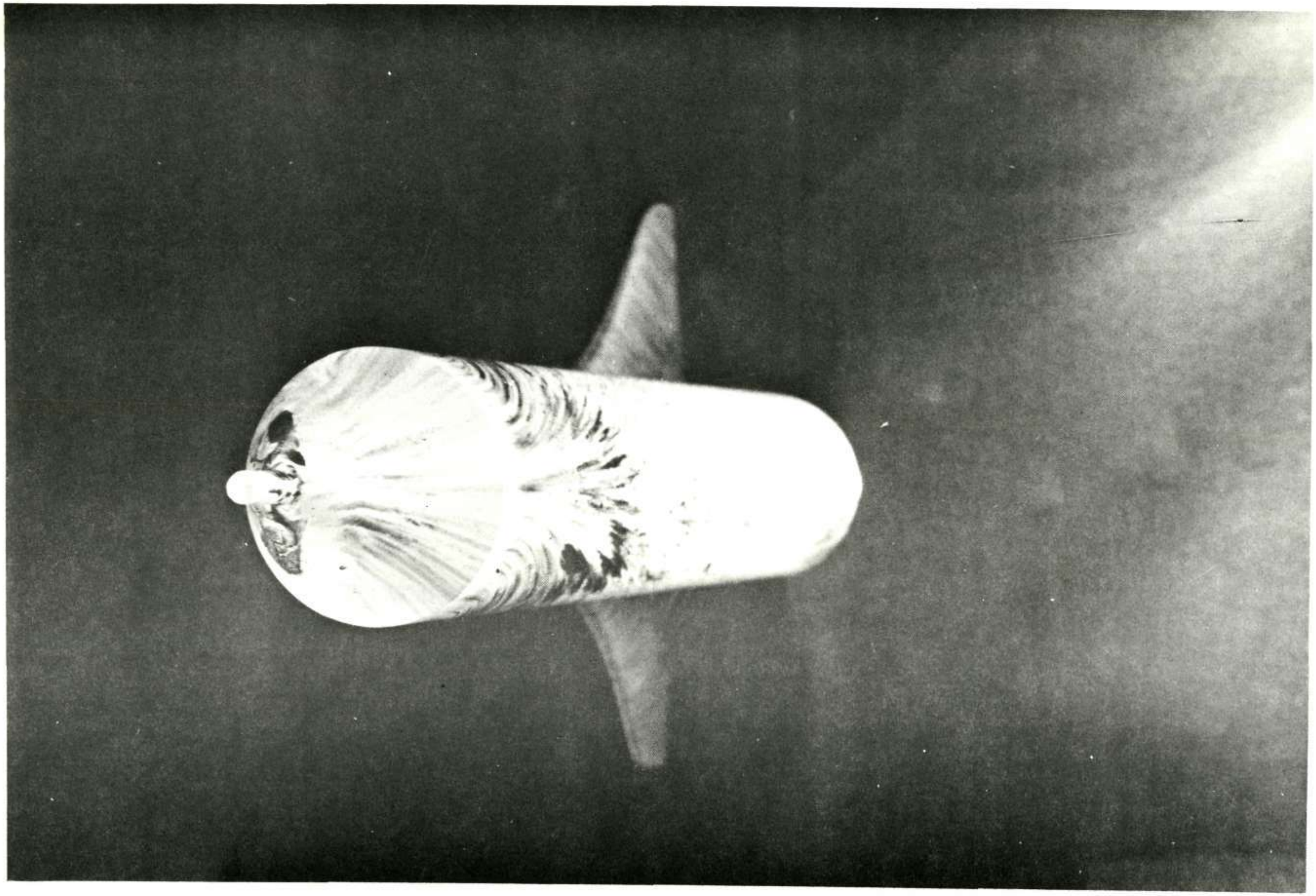
C) Top view

Figure 11. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Orbiter with External Tank at $M = 20.3$ and $\alpha = +5^{o}$.



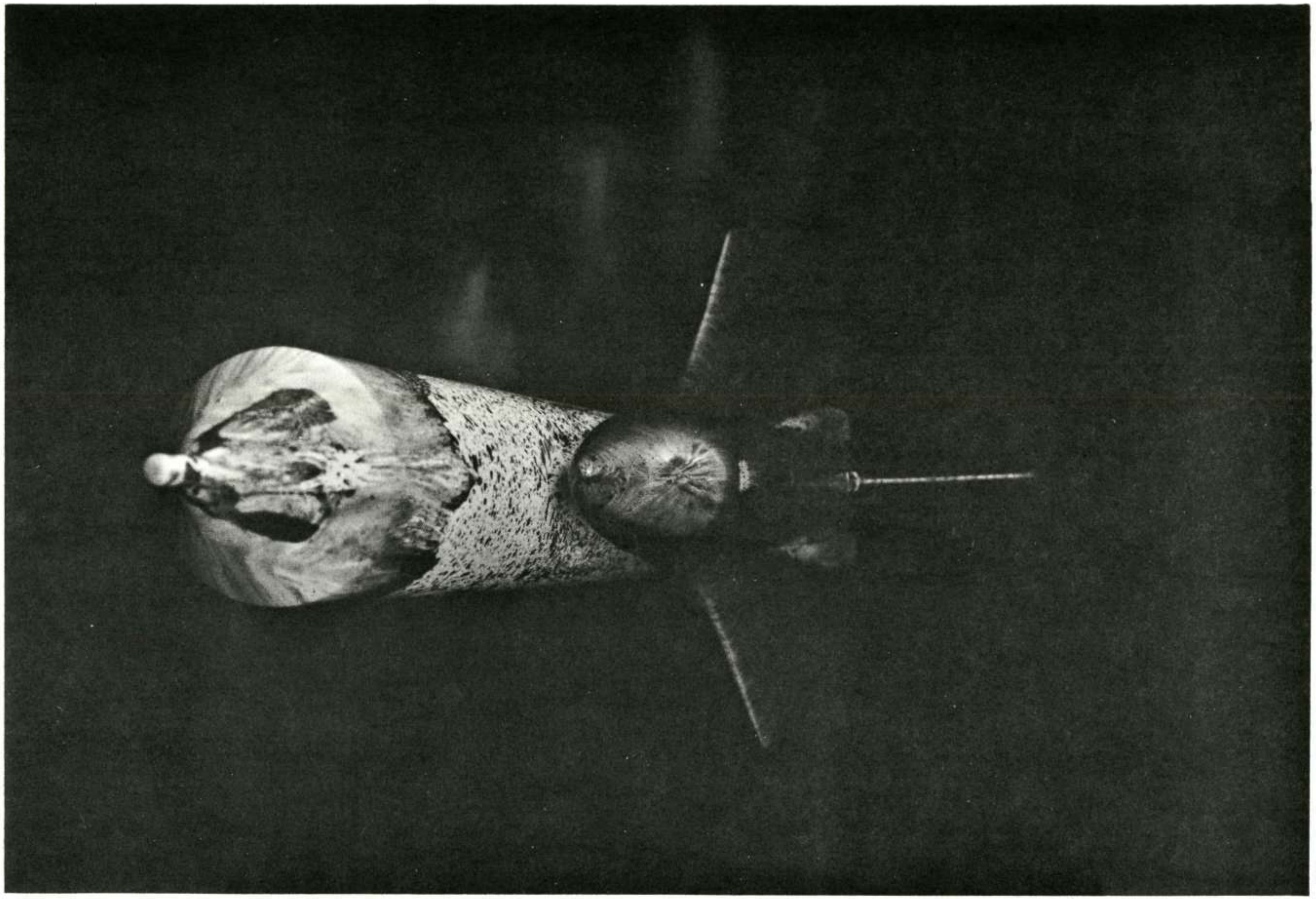
D) Bottom view

Figure 11. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Orbiter with External Tank at M = 20.3 and $\alpha = +5^{\circ}$.



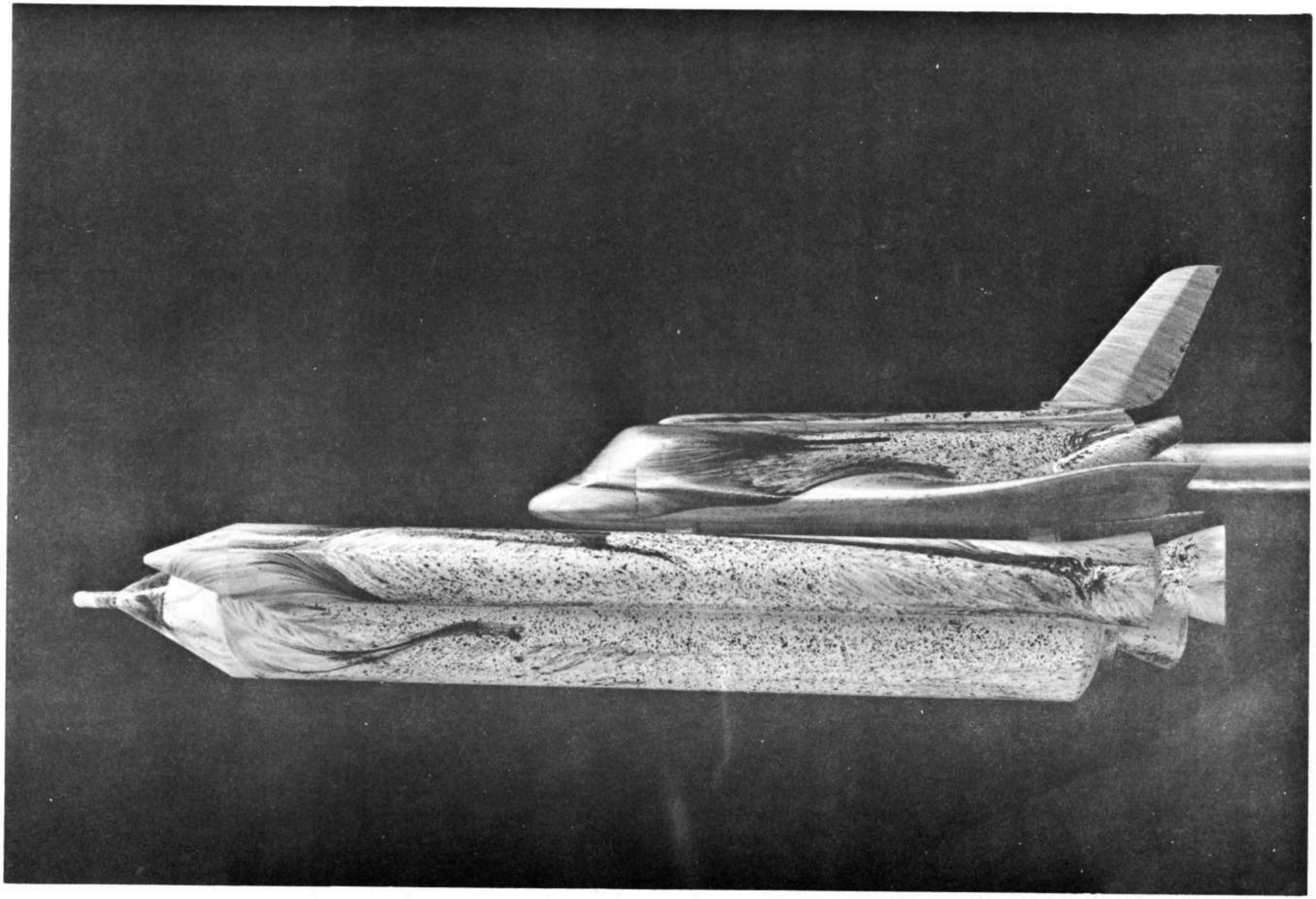
E) Front-lower surface view

Figure 11. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Orbiter with External Tank at M = 20.3 and $\alpha = +5^{\circ}$.



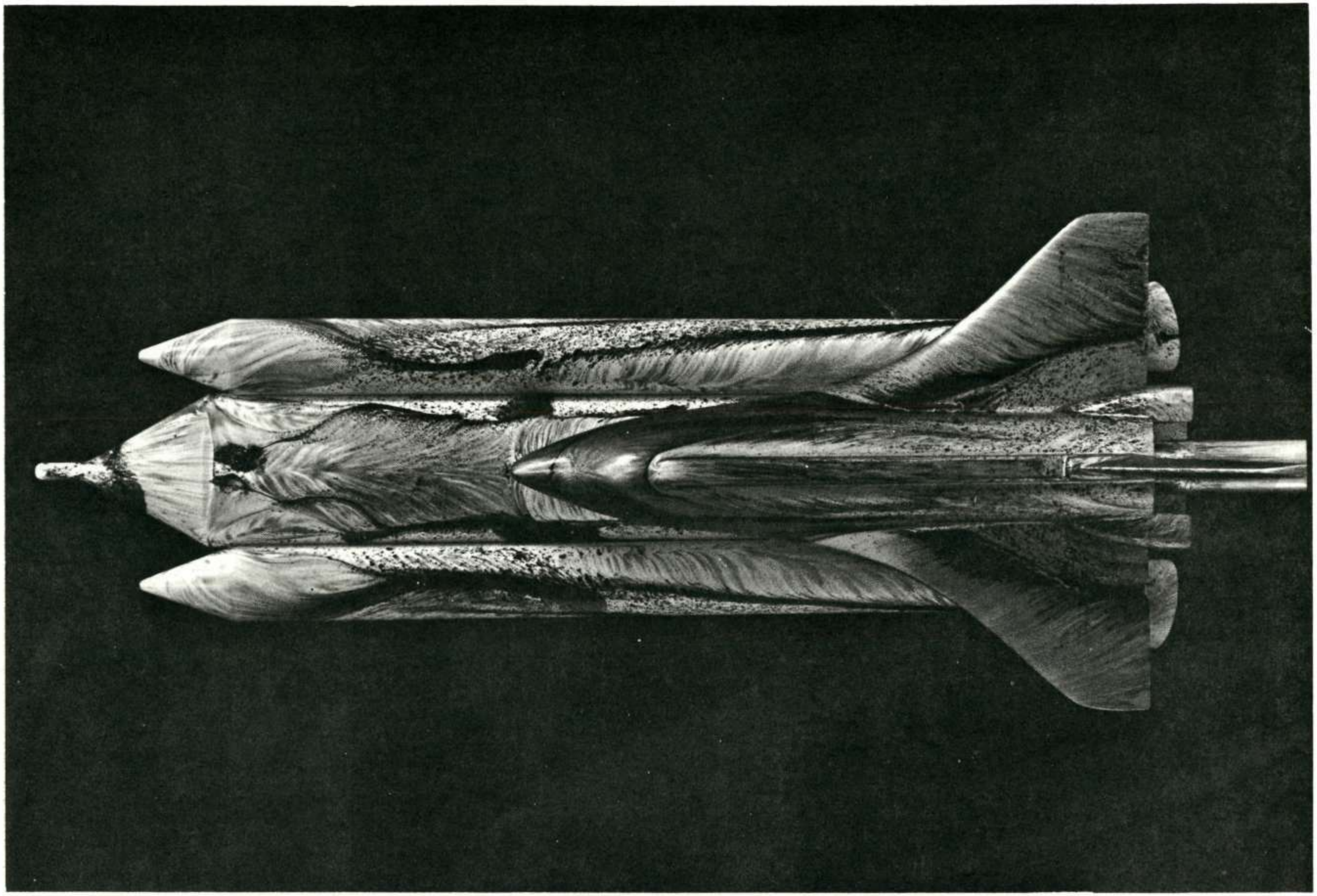
F) Top oblique view

Figure 11. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Orbiter with External Tank at $M = 20.3$ and $\alpha = +5^{\circ}$.



A) Left side view

Figure 12. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Orbiter with External Tank at M = 20.3 and $\alpha = 0^{\circ}$.

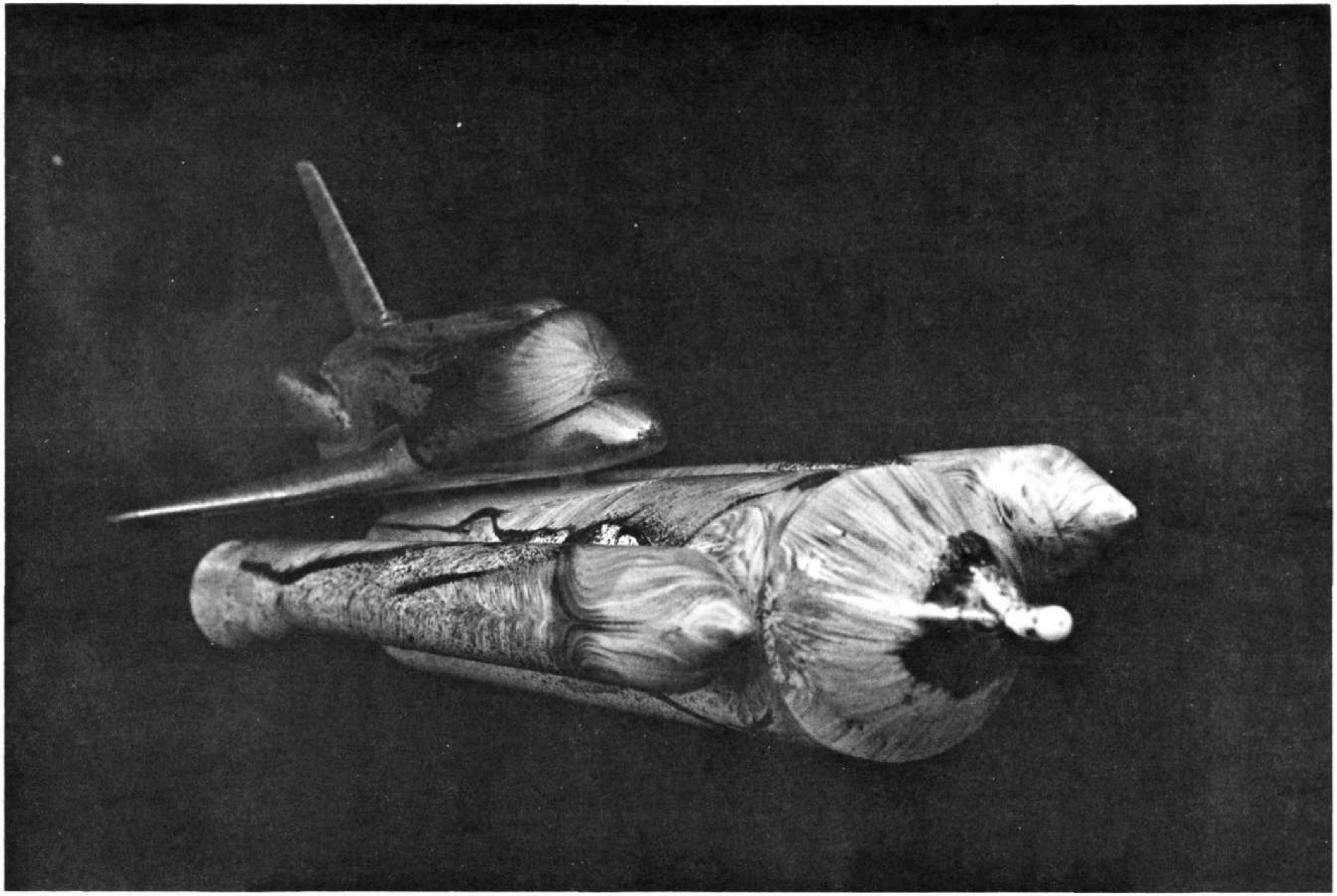


B) Top view

Figure 12. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Orbiter with External Tank at M = 20.3 and $\alpha = 0^{o}$.

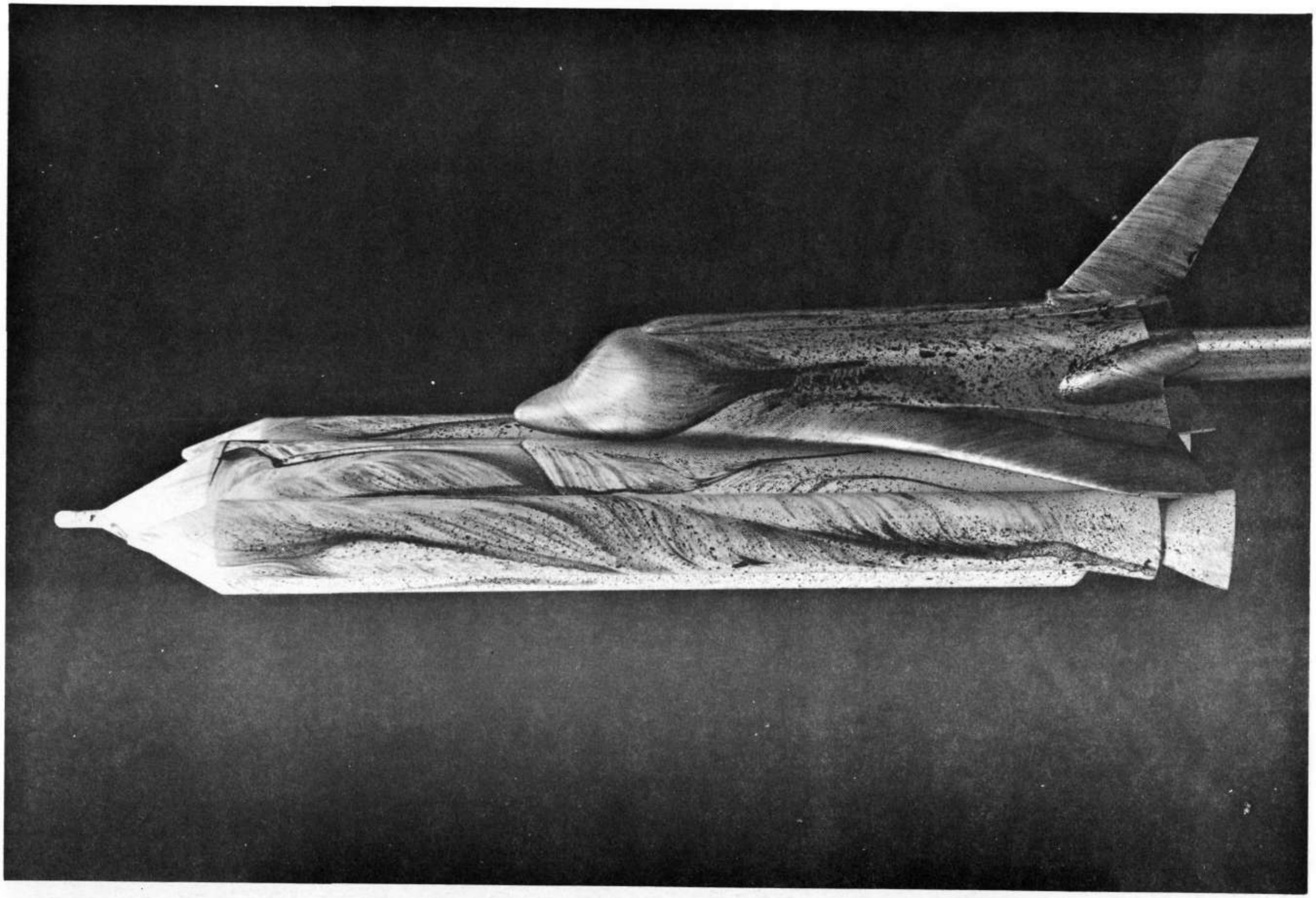
C) Bottom view

Figure 12. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Orbiter with External Tank at M = 20.3 and $\alpha = 0^{\circ}$.



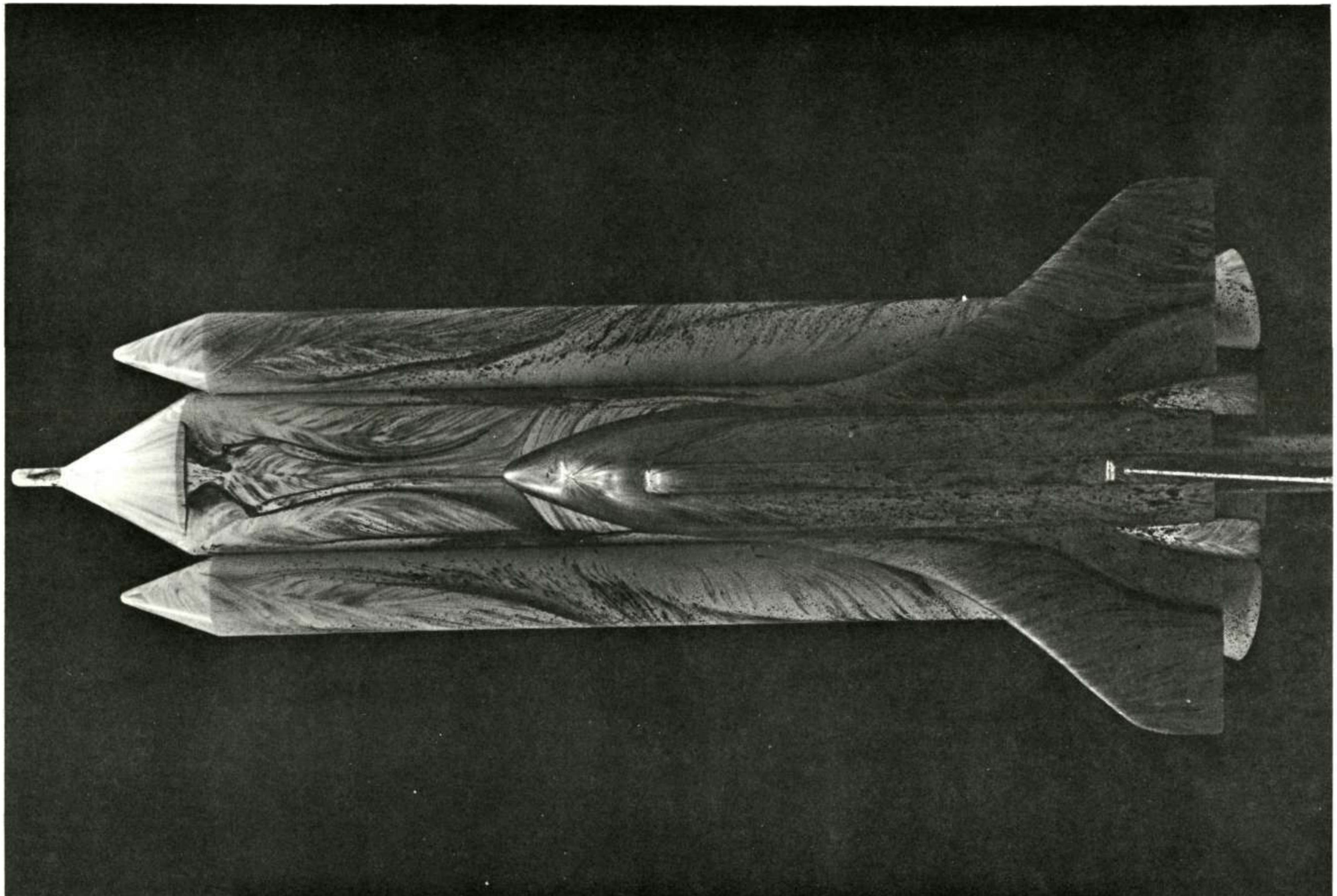
D) Front oblique view

Figure 12. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Orbiter with External Tank at $M = 20.3$ and $\alpha = 0^{\circ}$.



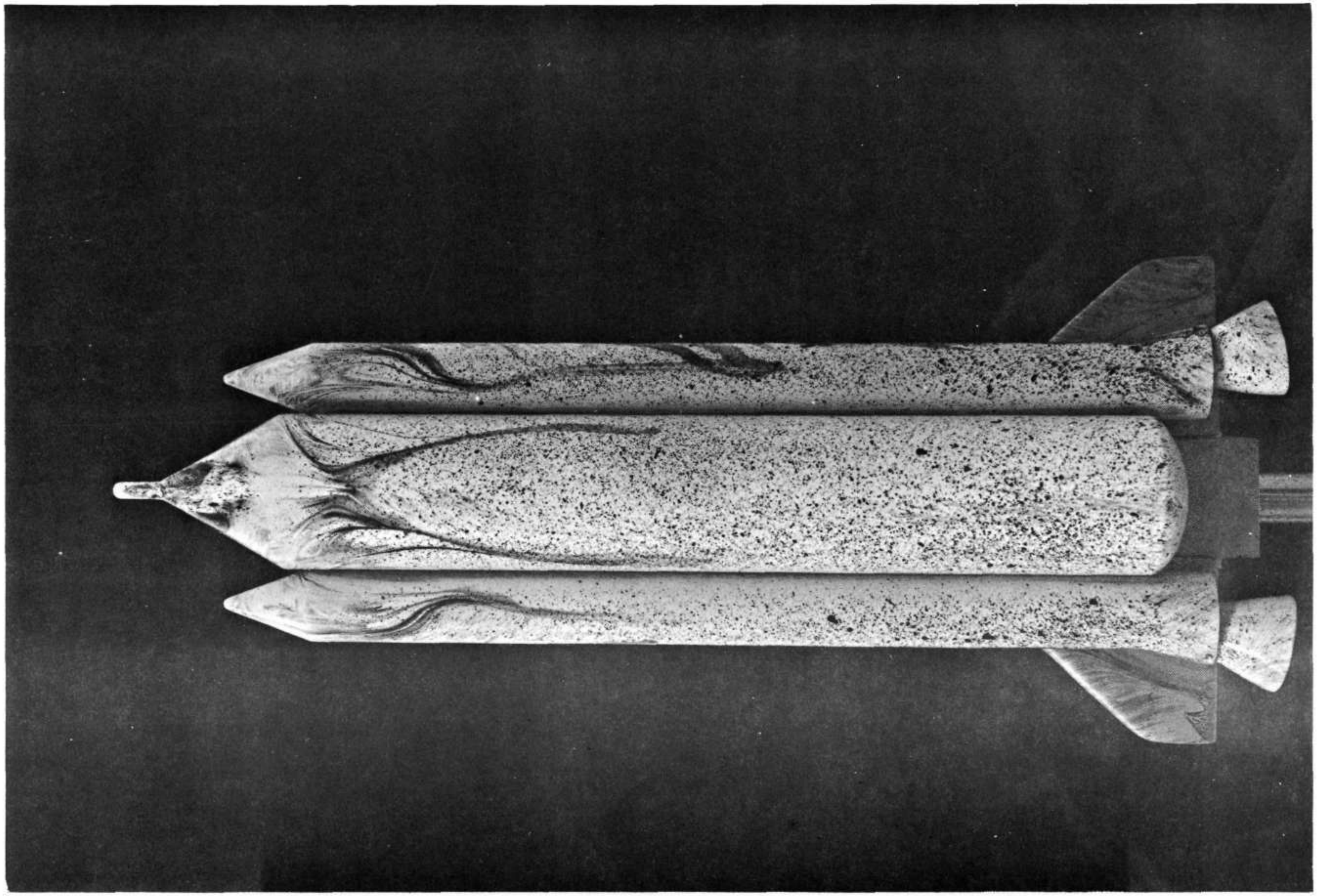
A) Left side view (rolled)

Figure 13. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Ascent Configuration at $M = 20.3$, $\alpha = -5^{\circ}$.



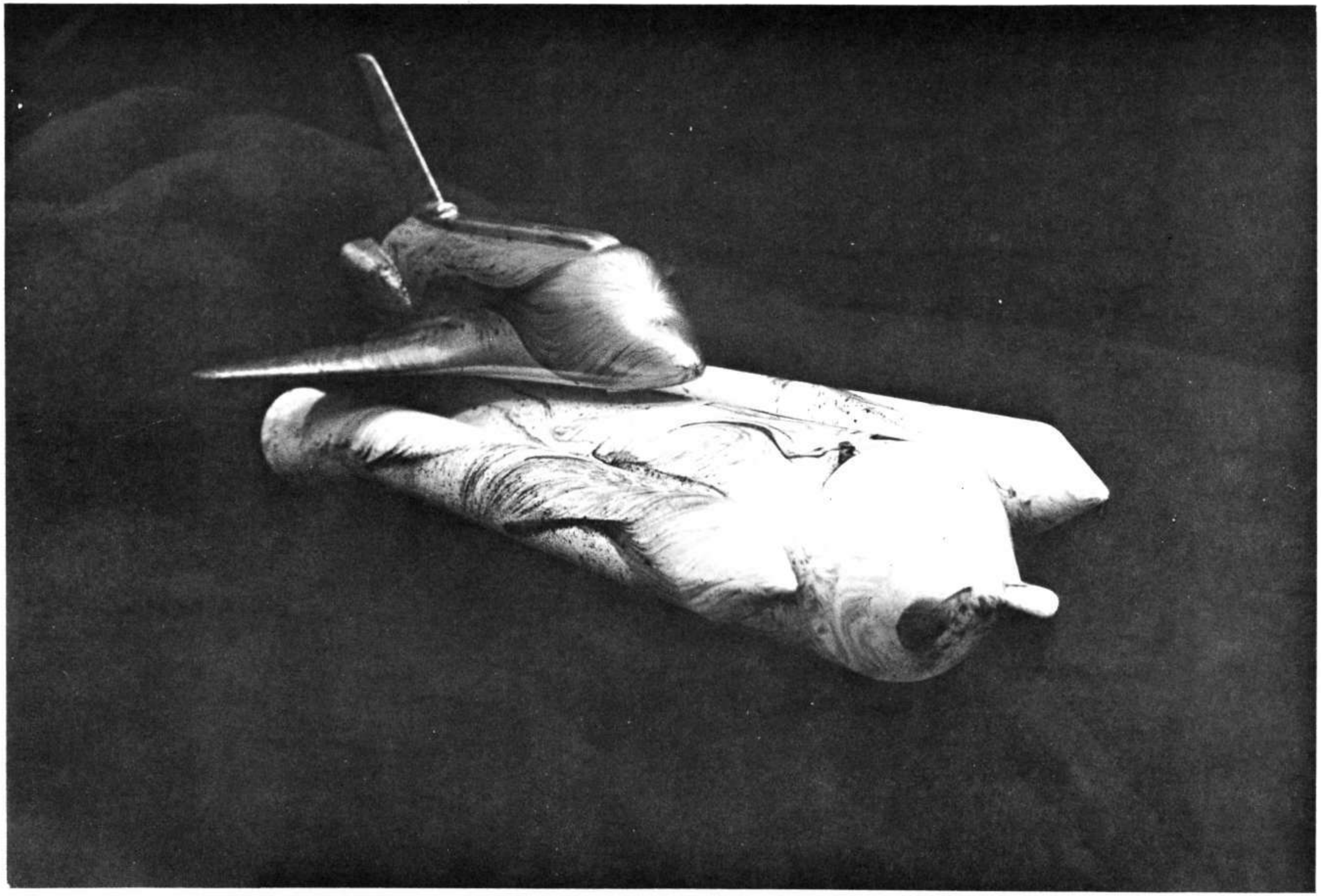
B) Top view

Figure 13. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Ascent Configuration at $M = 20.3$, $\alpha = -5^{\circ}$.



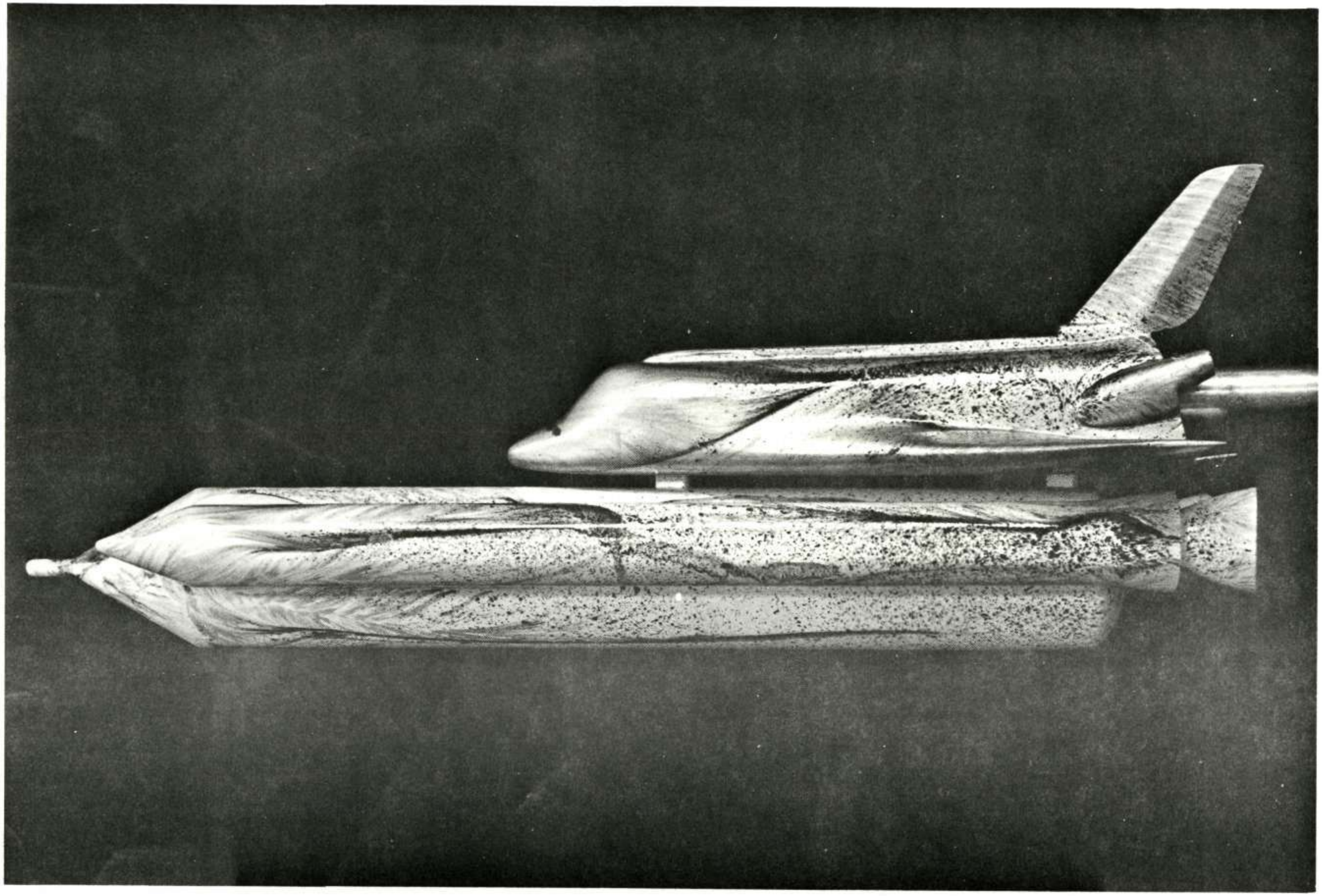
C) Bottom view

Figure 13. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Ascent Configuration at $M = 20.3$, $\alpha = -5^{o}$.



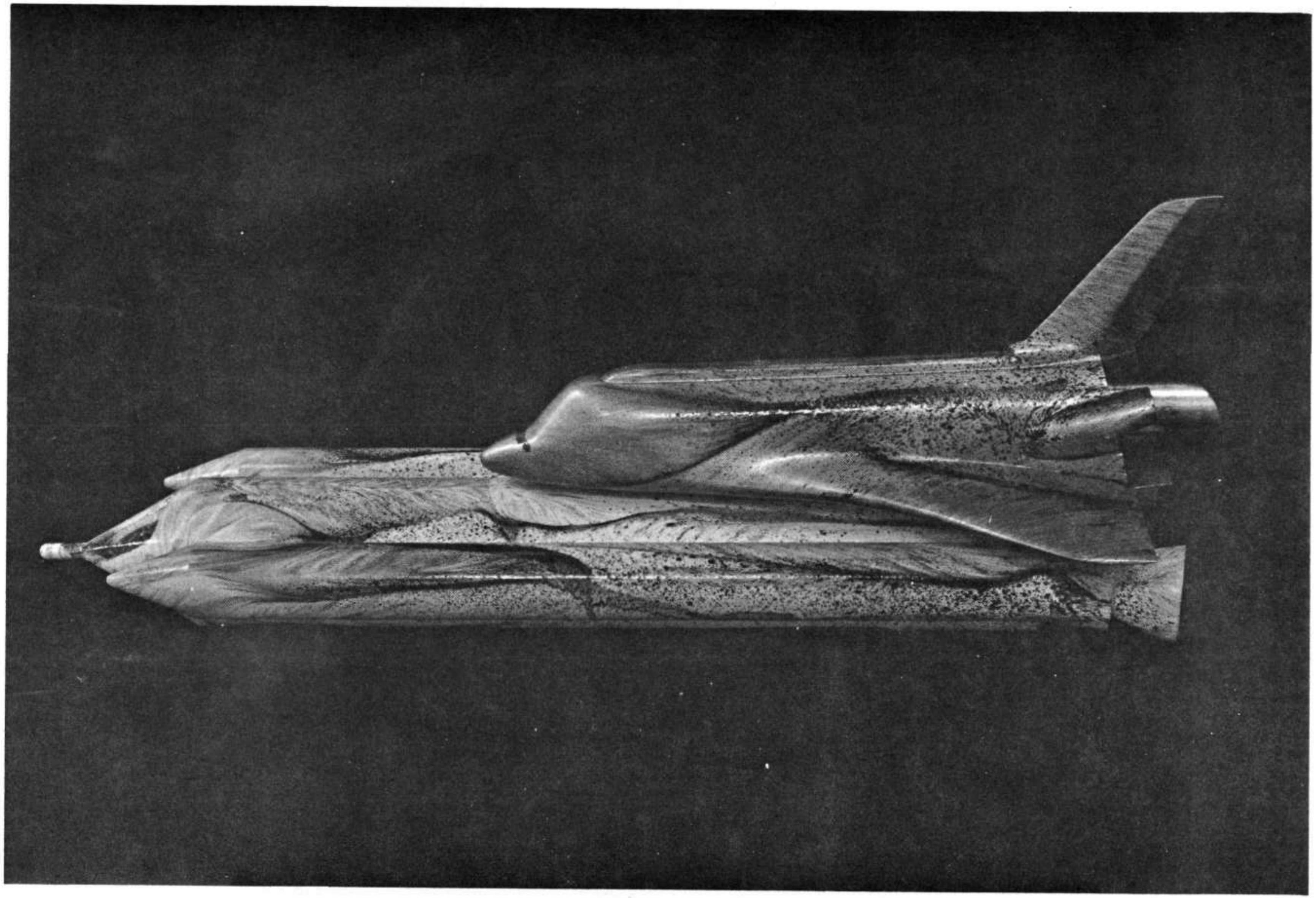
D) Front oblique view

Figure 13. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Ascent Configuration at M = 20.3, $\alpha = -5^{\circ}$.



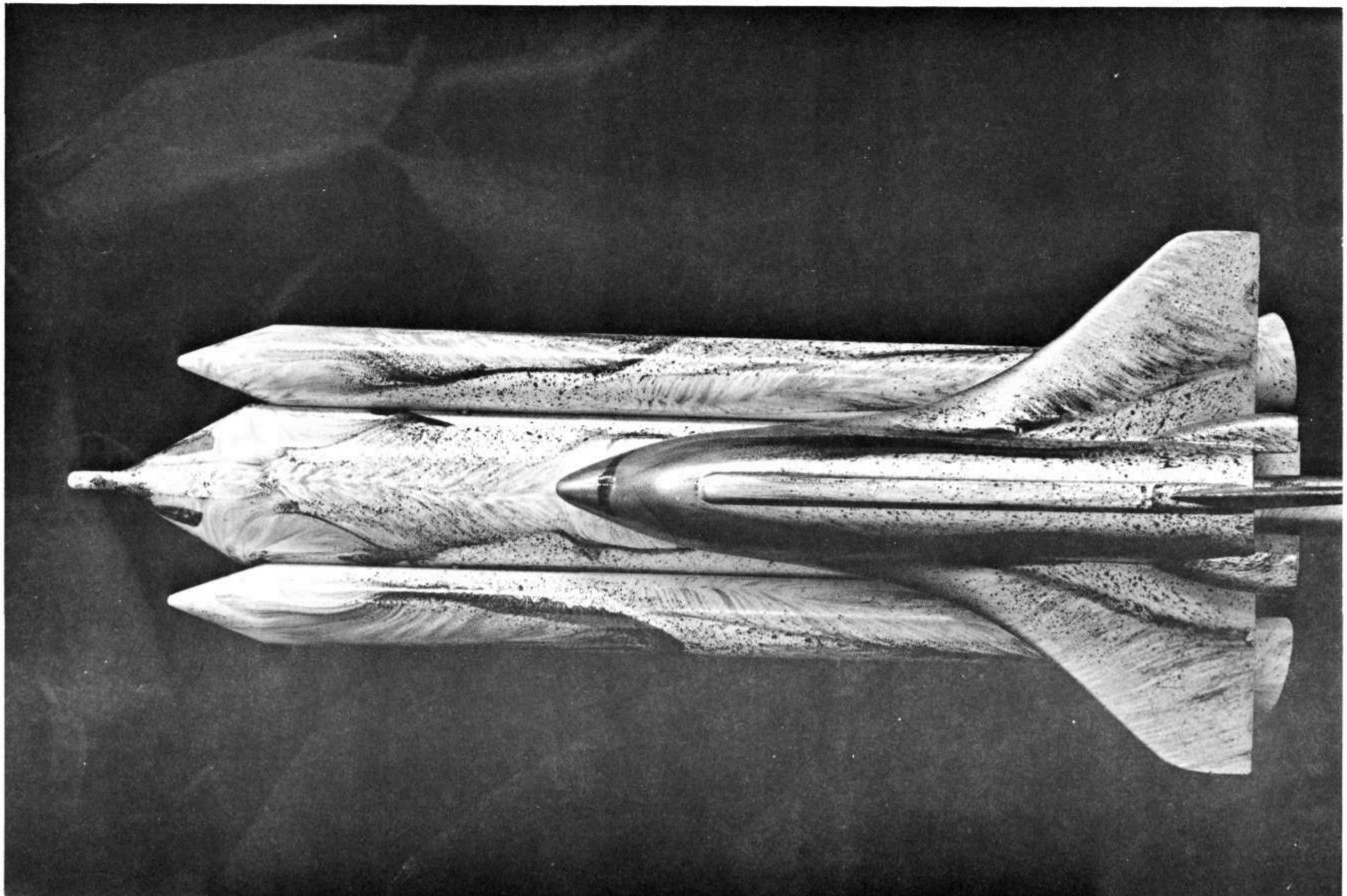
A) Left side view

Figure 14. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Ascent Configuration at M = 20.3, $\alpha = +5^{\circ}$.



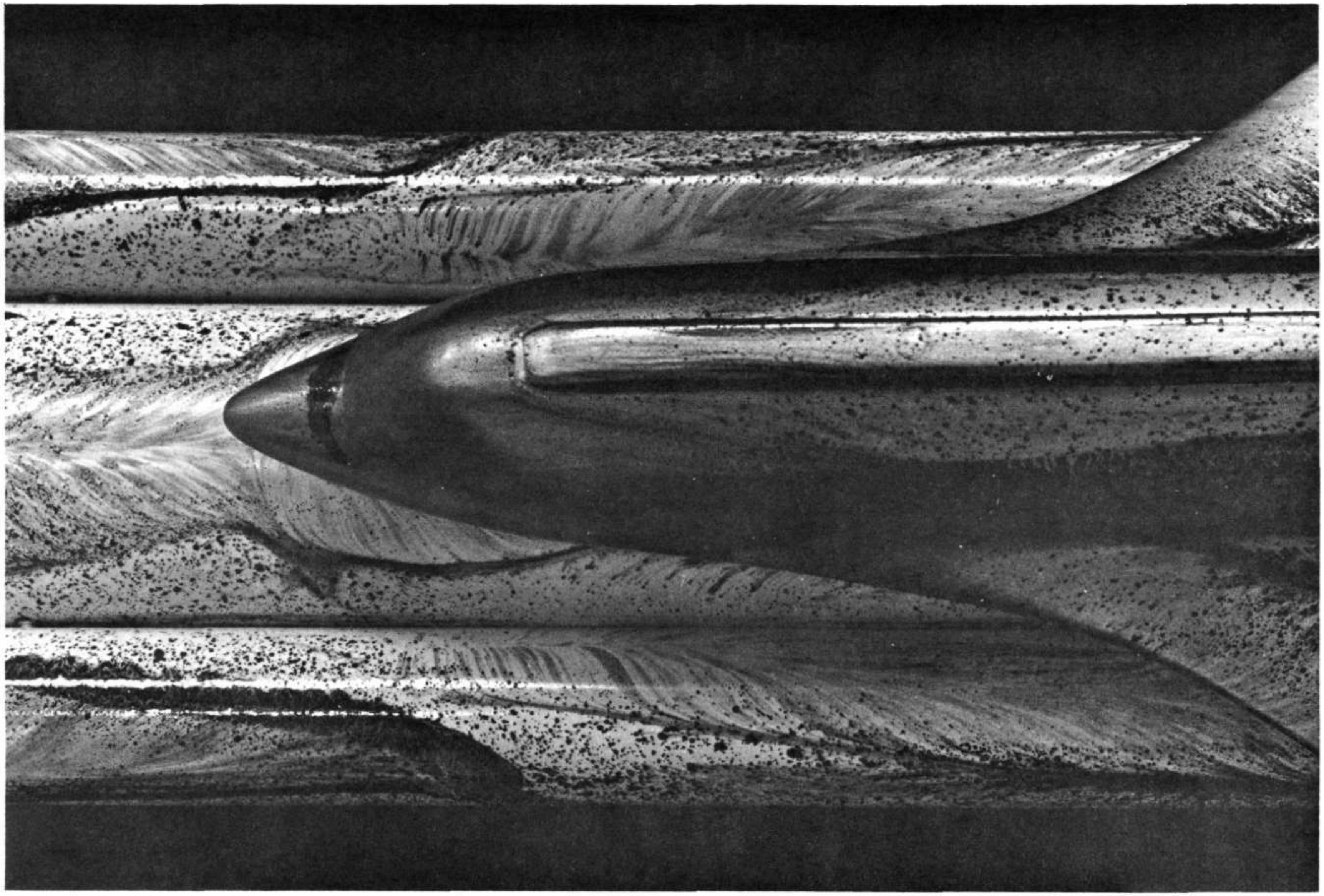
B) Left side view (rolled)

Figure 14. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Ascent Configuration at $M = 20.3$, $\alpha = +5^{\circ}$.



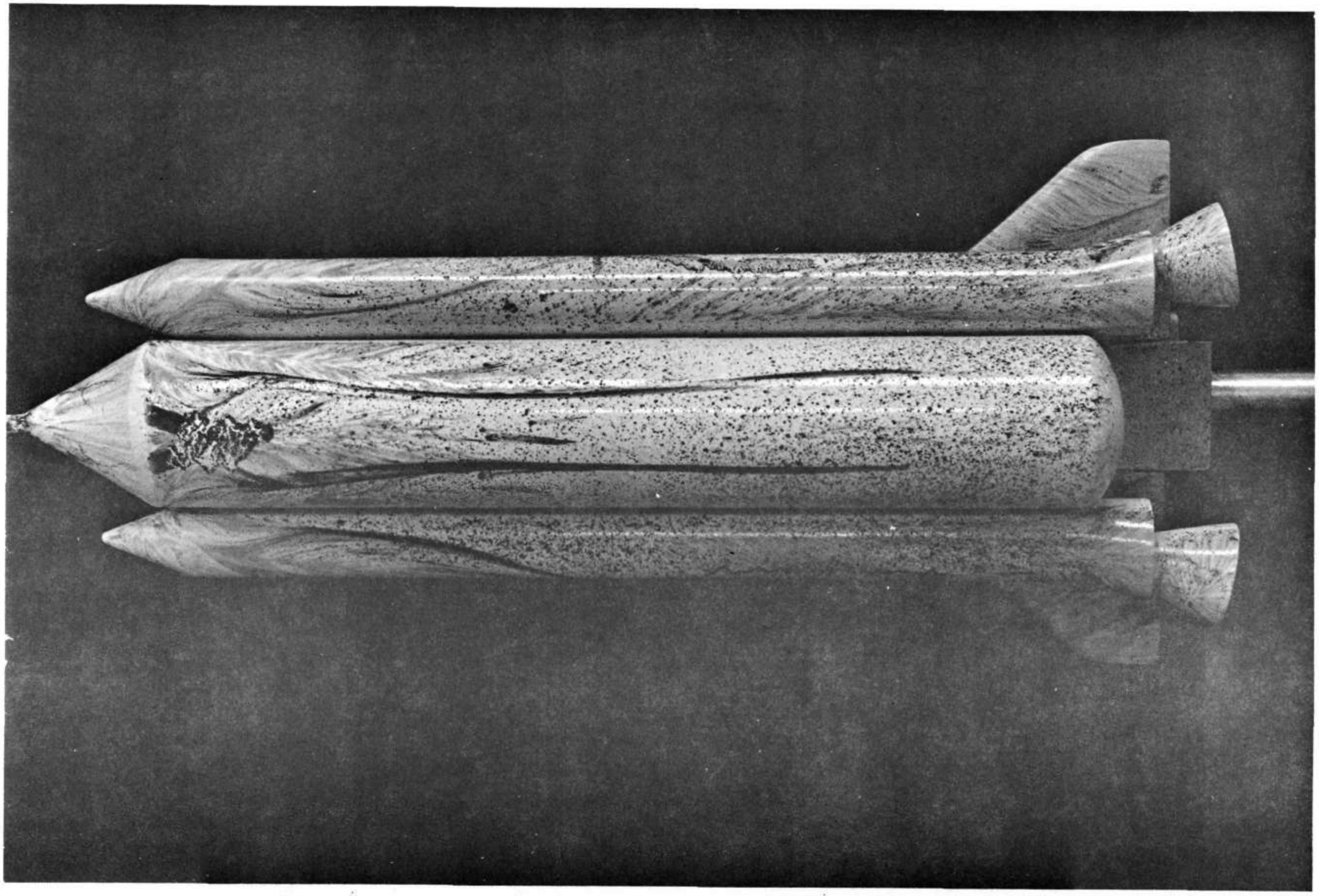
C) Top view

Figure 14. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Ascent Configuration at $M = 20.3$, $\alpha = +5^{\circ}$.



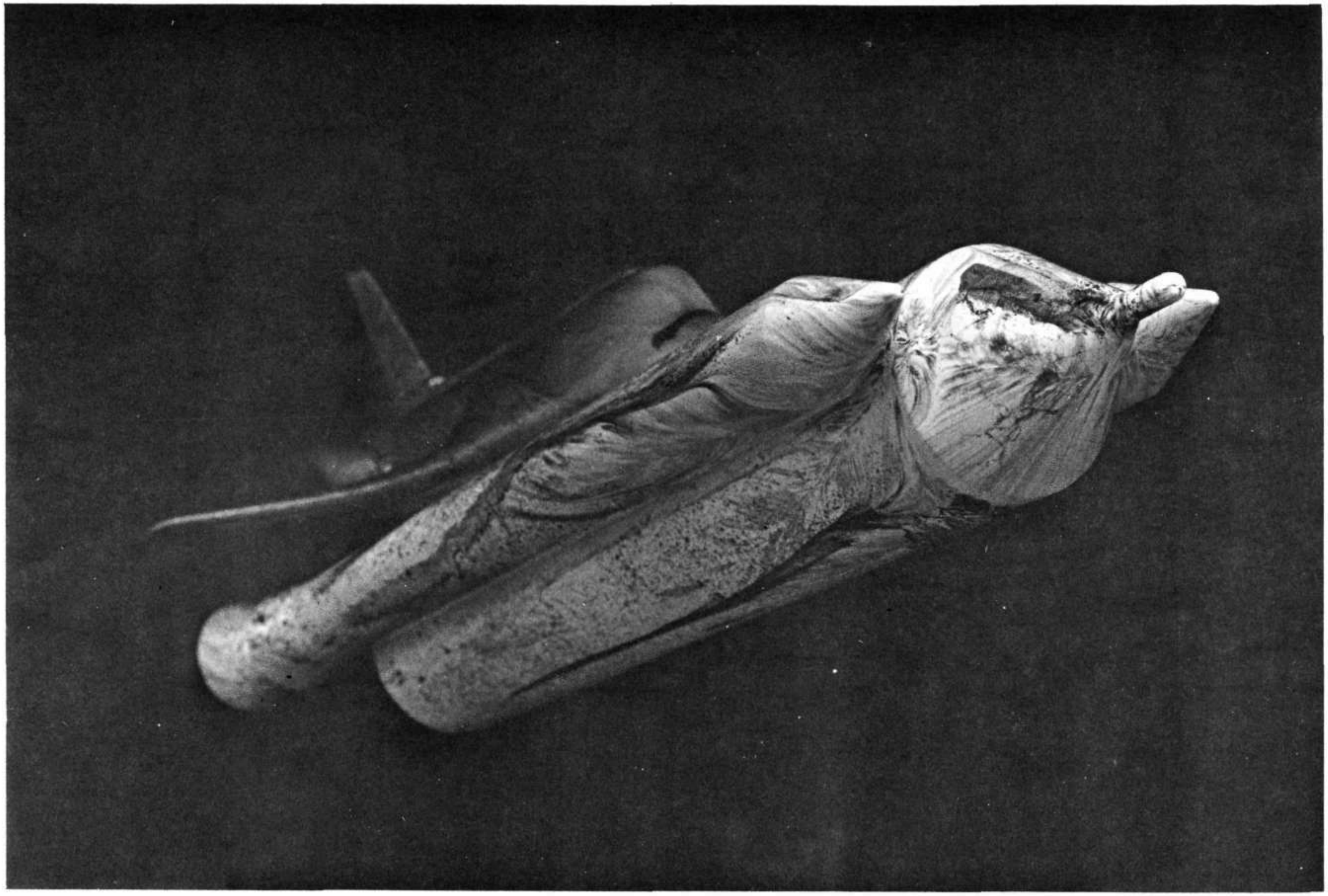
D) Top view close-up

Figure 14. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Ascent Configuration at $M = 20.3$, $\alpha = +5^{\circ}$.



E) Bottom view

Figure 14. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Ascent Configuration at $M = 20.3$, $\alpha = +5^{\circ}$.



F) Front oblique view

Figure 14. - Photograph of Oil Flow Pattern After Removal from Tunnel on a .0045 Scale NR (ATP) Ascent Configuration at $M = 20.3$, $\alpha = +5^{\circ}$.

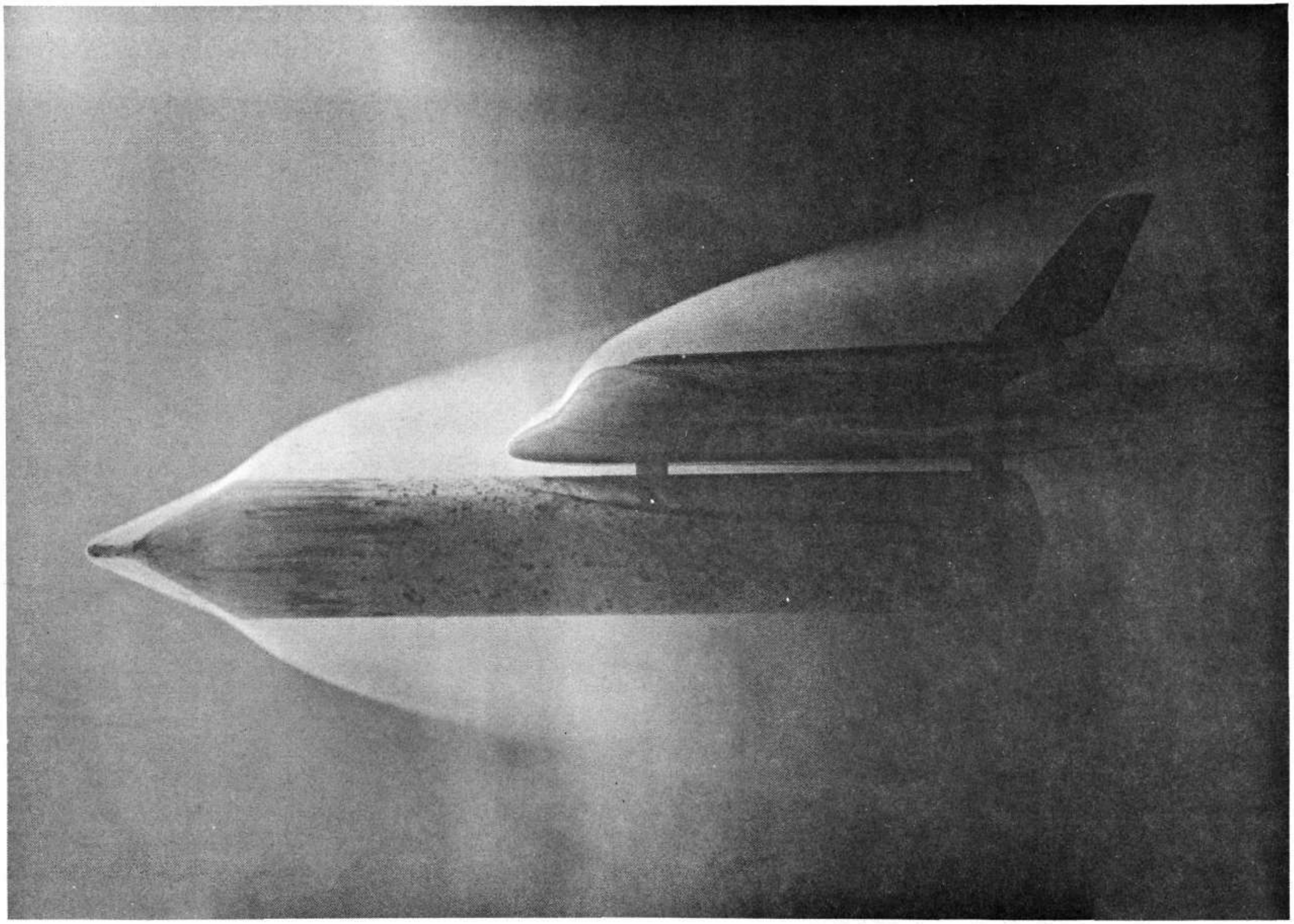


Figure 15. - Photograph of Electron Beam Illuminated Oil Flow Pattern on a .0045 Scale NR (ATP) Orbiter with External Tank at $M = 20.3$ and $\alpha = 0^{\circ}$.

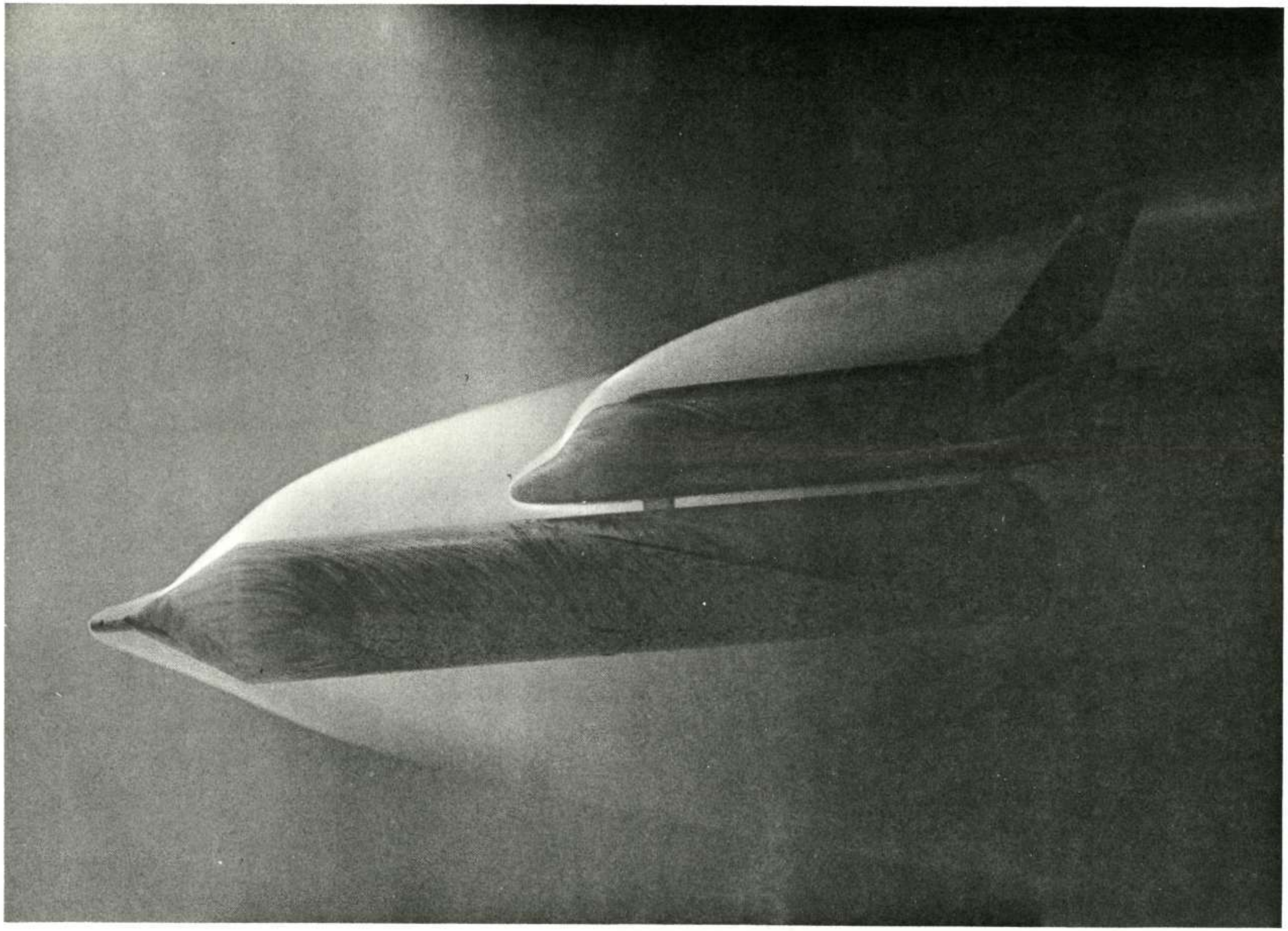


Figure 16. - Photograph of Electron Beam Illuminated Oil Flow Pattern on a .0045 Scale NR (ATP) Orbiter with External Tank at $M = 20.3$ and $\alpha = -5^{\circ}$.

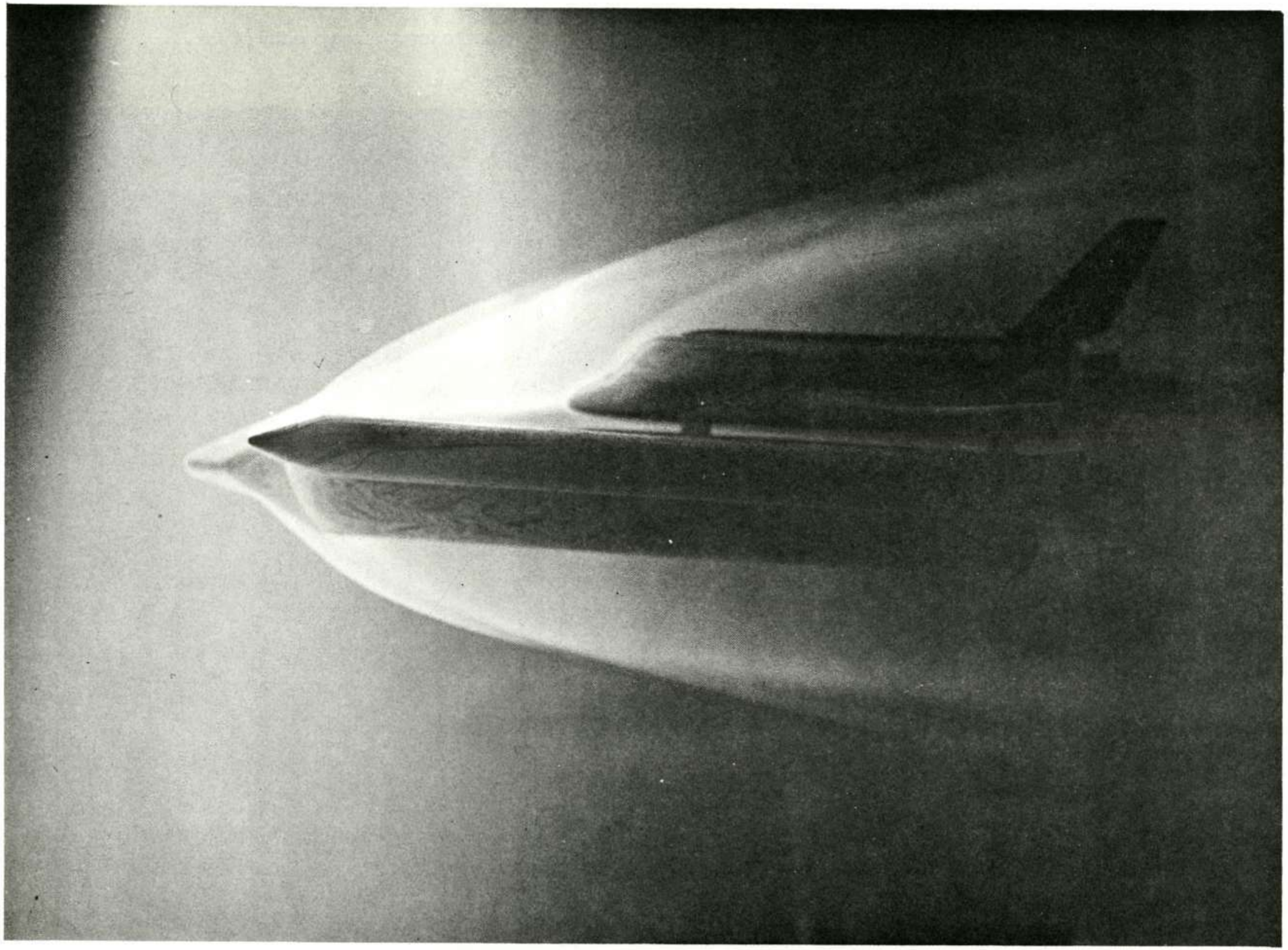


Figure 17. - Photograph of Electron Beam Illuminated Oil Flow Pattern on a .0045 Scale NR (ATP) Ascent Configuration at $M = 20.3$, $\alpha = +5^{\circ}$.

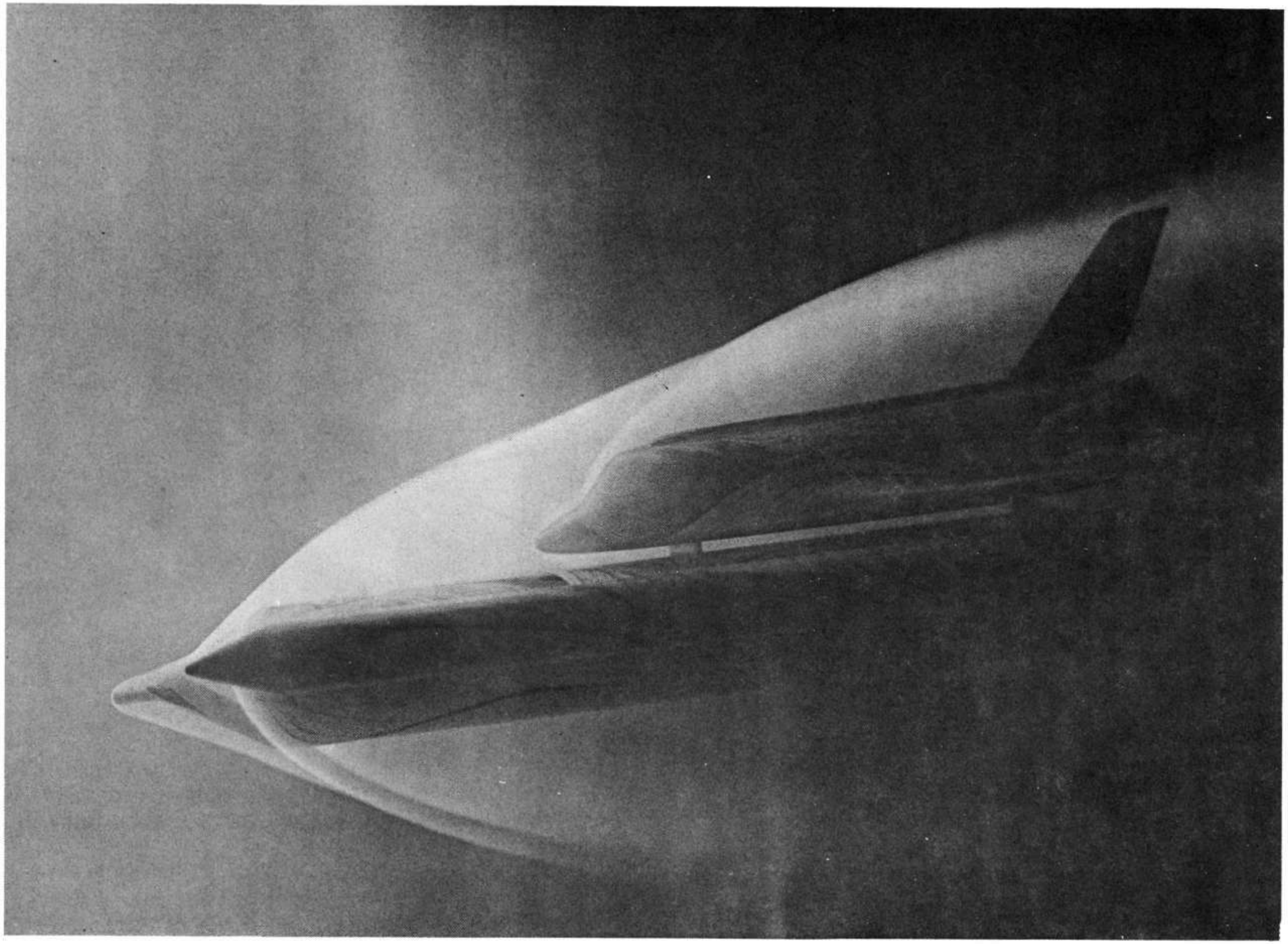


Figure 18. - Photograph of Electron Beam Illuminated Oil Flow Pattern on a .0045 Scale NR (ATP) Ascent Configuration at $M = 20.3$, $\alpha = -5^{\circ}$.

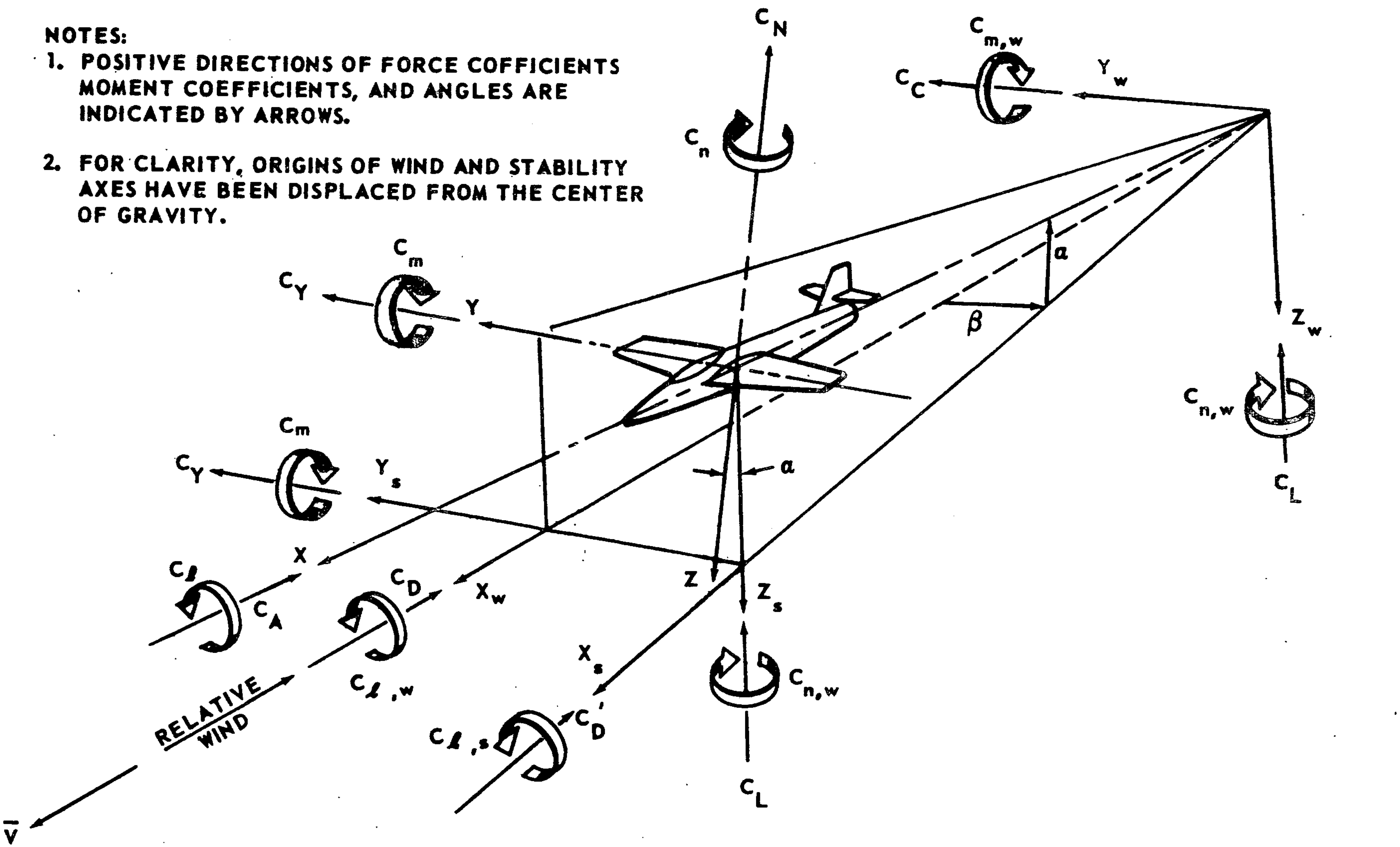


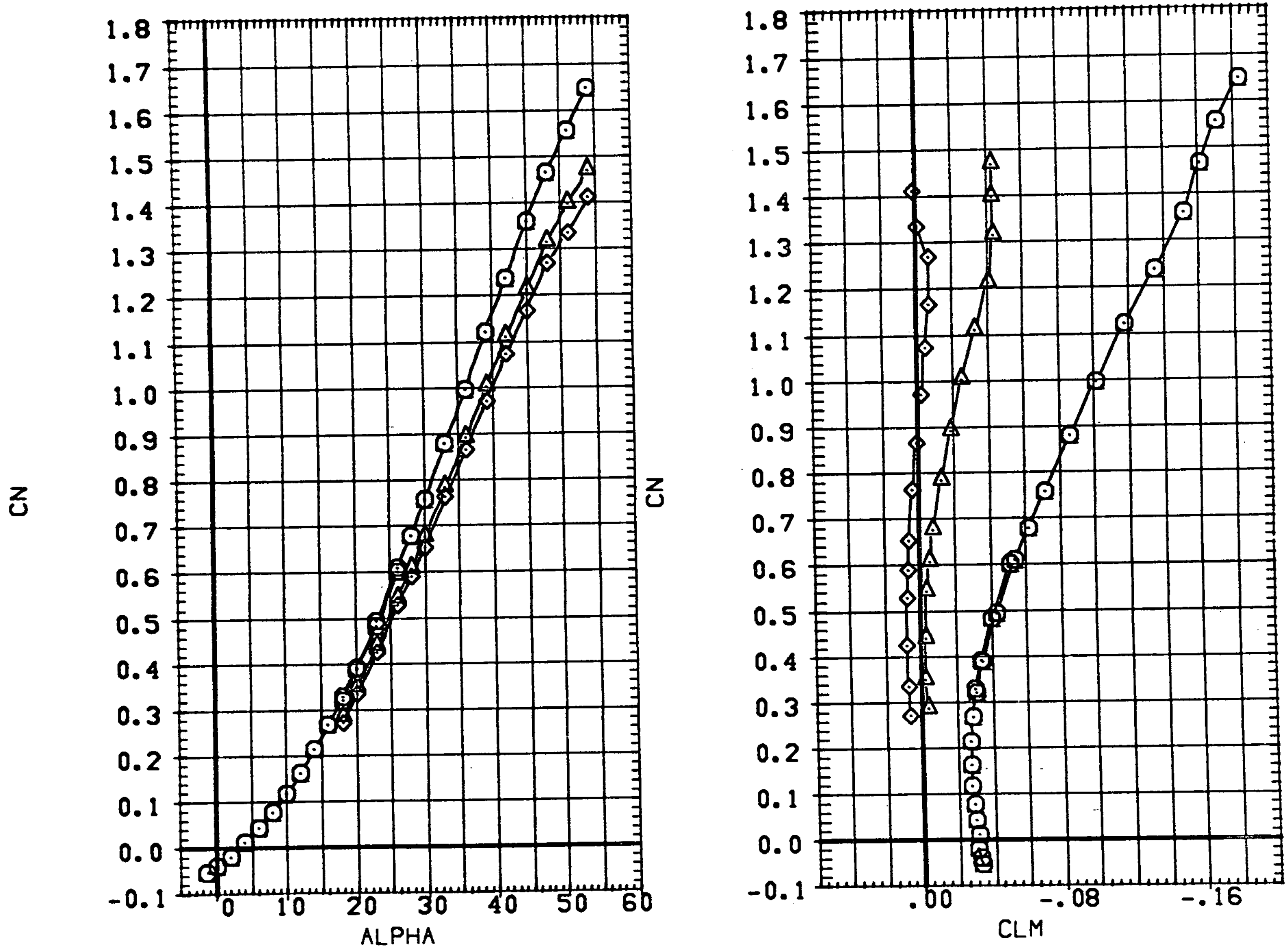
Figure 19. - Axis systems.

DATA FIGURES

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	AILRON	RUDDER	BDFLAP
(SOS020)	○	HE.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	0.000	0.000	0.000	0.000
(SOS015)	⊡	HE.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	0.000	0.000	0.000	0.000
(SOS016)	△	HE.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	-20.000	0.000	0.000	0.000
(SOS017)	◇	HE.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	-40.000	0.000	0.000	0.000

REFERENCE INFORMATION

SREF	9.3900	SQ.IN.
LREF	2.3400	INCHES
BREF	4.5300	INCHES
XMRP	3.8850	INCHES
YMRP	0.0000	INCHES
ZMRP	0.0000	INCHES
SCALE	0.0045	SCALE



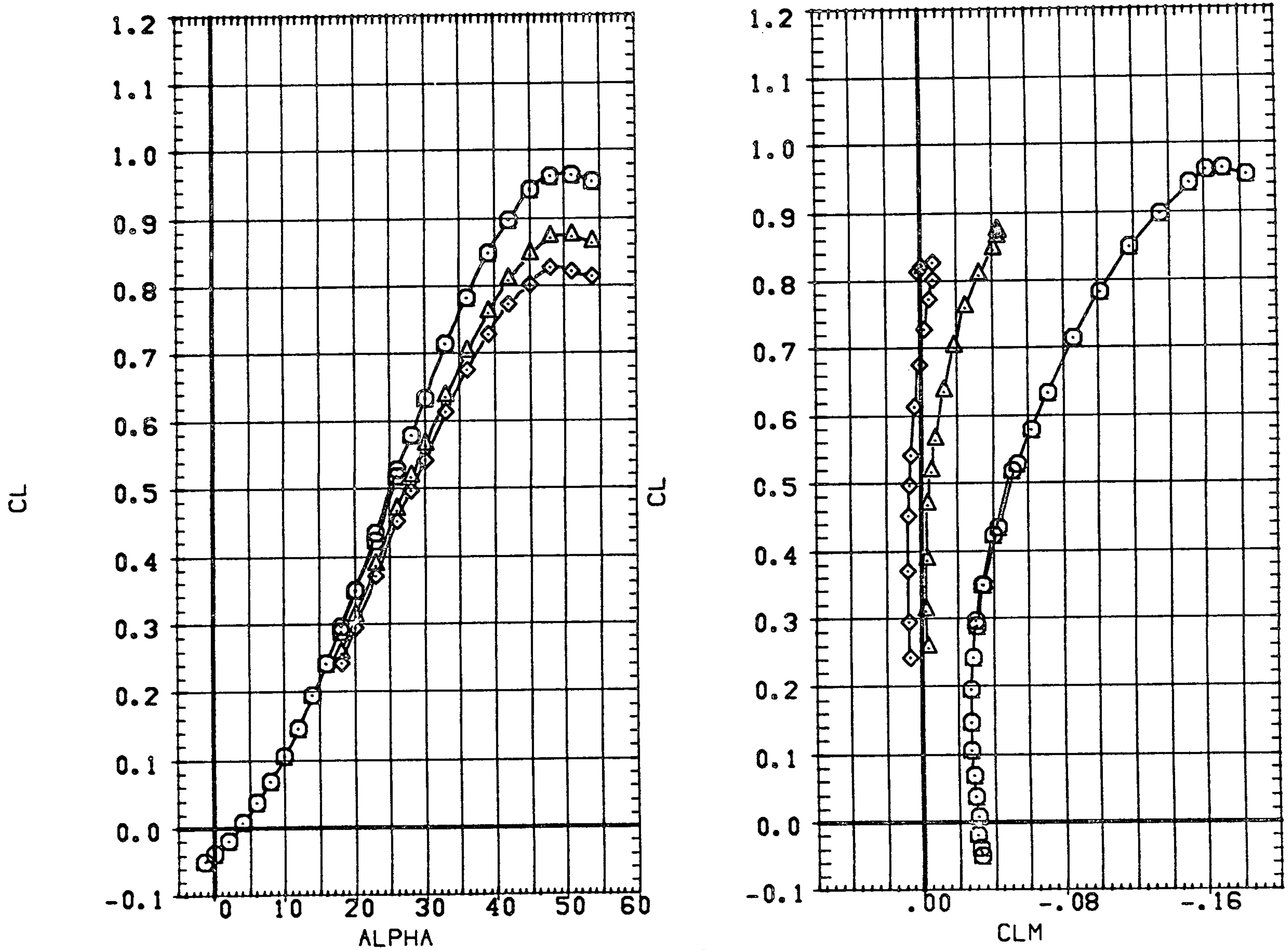
EFFECT OF ELEVATOR DEFLECTION ON LONGITUDINAL CHARACT. OF BASELINE ORBITER

(A)MACH = 20.30

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	AILRON	RUDDER	BDFLAP
(SOS020)	○	HE.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	0.000	0.000	0.000	0.000
(SOS015)	□	HE.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	0.000	0.000	0.000	0.000
(SOS016)	△	HE.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	-20.000	0.000	0.000	0.000
(SOS017)	◇	HE.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	-40.000	0.000	0.000	0.000

REFERENCE INFORMATION

SREF	9.3900	SQ.IN.
LREF	2.5400	INCHES
BREF	4.5300	INCHES
XMRP	3.8850	INCHES
YMRP	0.0000	INCHES
ZMRP	0.0000	INCHES
SCALE	0.0045	SCALE

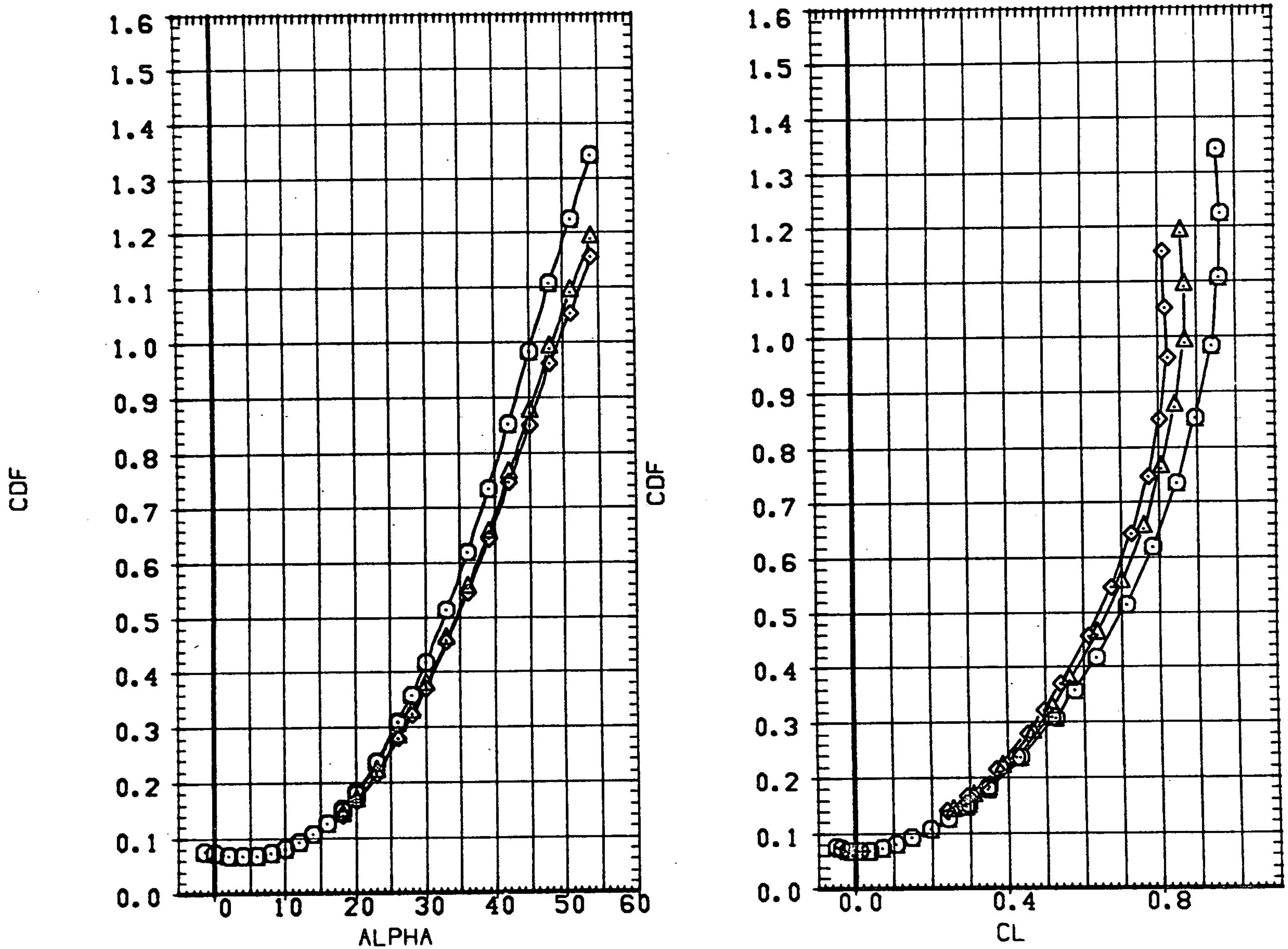


EFFECT OF ELEVATOR DEFLECTION ON LONGITUDINAL CHARACT. OF BASELINE ORBITER

(A)MACH = 20.30

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	AILRON	RUDDER	BDFLAP
(SOS020)	○	ME.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	0.000	0.000	0.000	0.000
(SOS015)	□	ME.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	0.000	0.000	0.000	0.000
(SOS016)	△	ME.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	-20.000	0.000	0.000	0.000
(SOS017)	◇	ME.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	-40.000	0.000	0.000	0.000

REFERENCE INFORMATION		
SREF	9.3900	SQ.IN.
LREF	2.3400	INCHES
BREF	4.5300	INCHES
XMRP	3.8850	INCHES
YMRP	0.0000	INCHES
ZMRP	0.0000	INCHES
SCALE	0.0045	SCALE

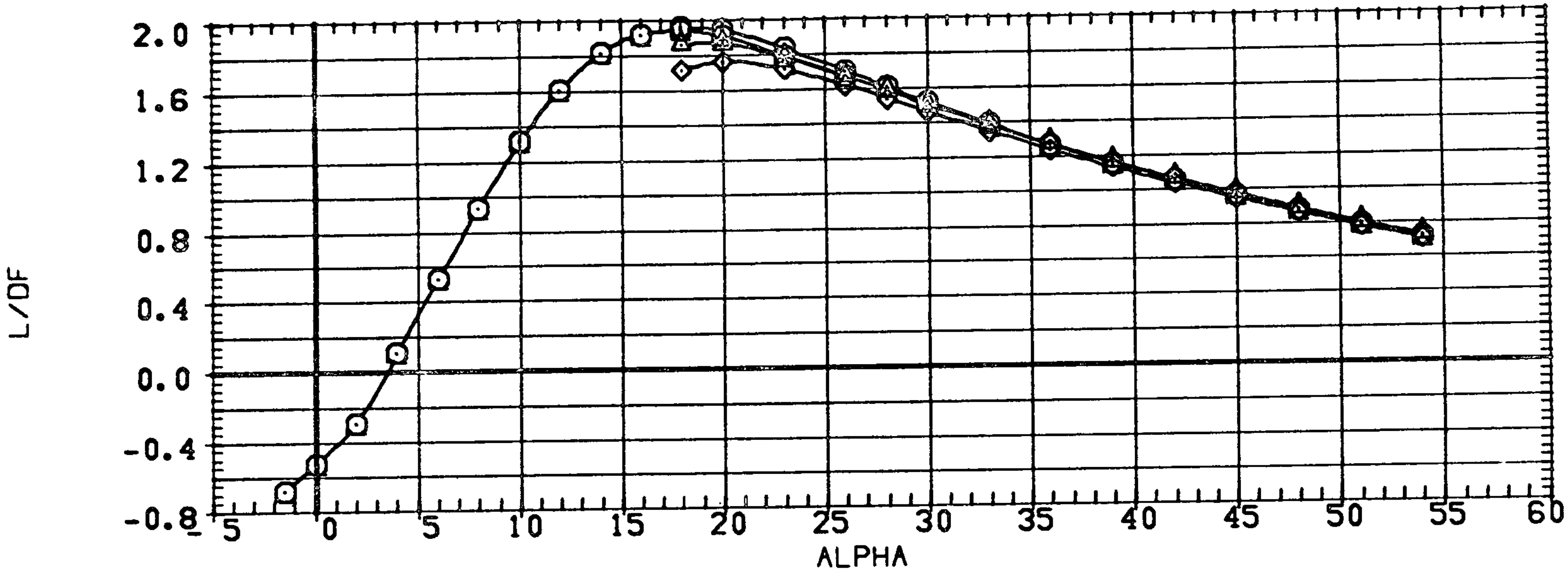


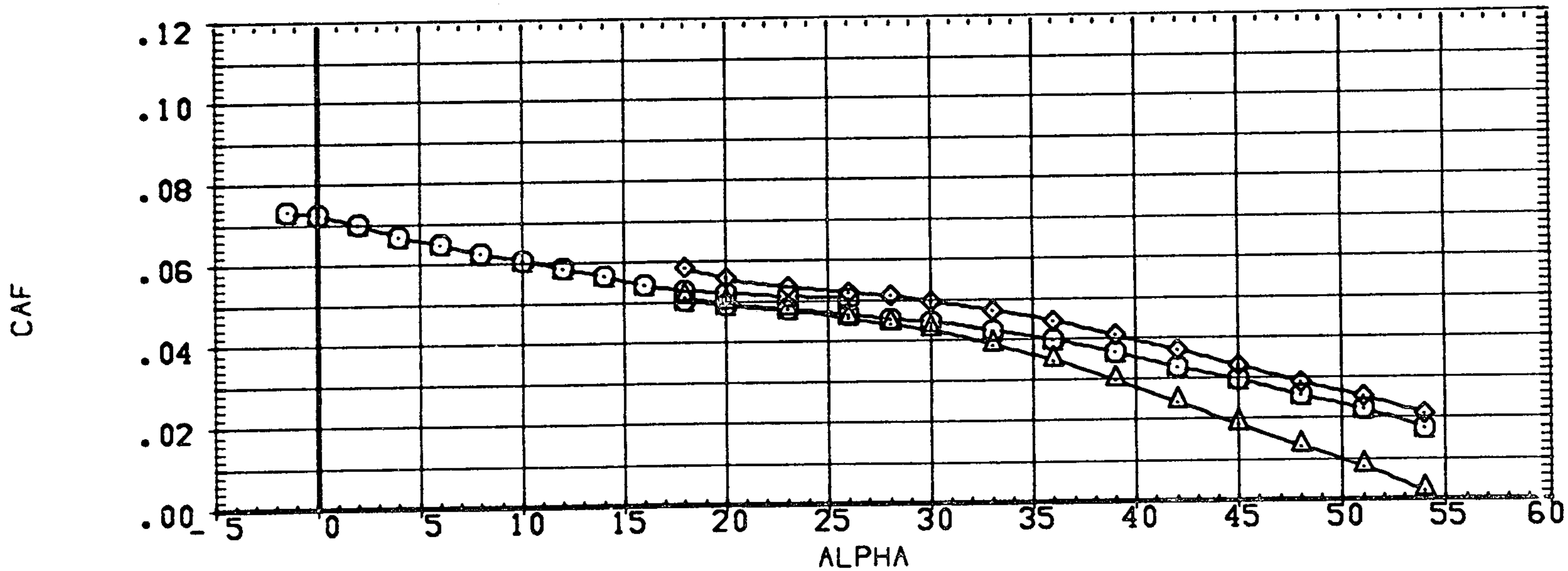
EFFECT OF ELEVATOR DEFLECTION ON LONGITUDINAL CHARACT. OF BASELINE ORBITER

(A)MACH = 20.30

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	AILRON	RUDDER	BDFLAP
(SOS020)	○	HE.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	0.000	0.000	0.000	0.000
(SOS015)	○	HE.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	0.000	0.000	0.000	0.000
(SOS016)	△	HE.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	-20.000	0.000	0.000	0.000
(SOS017)	◇	HE.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	-40.000	0.000	0.000	0.000

REFERENCE INFORMATION		
SREF	9.3900	SQ.IN.
LREF	2.3400	INCHES
BREF	4.3300	INCHES
XMRP	3.8850	INCHES
YMRP	0.0000	INCHES
ZMRP	0.0000	INCHES
SCALE	0.0045	SCALE





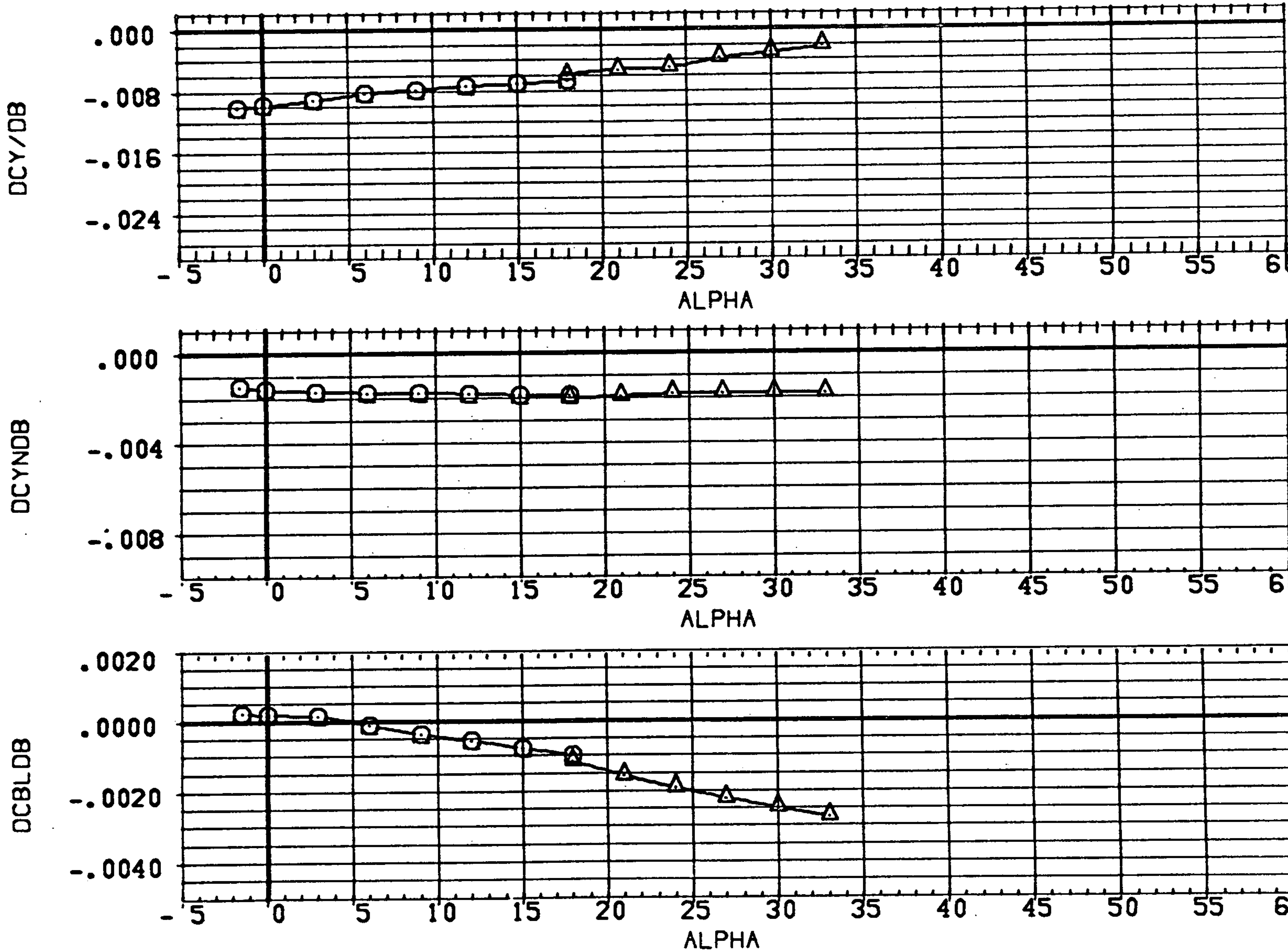
EFFECT OF ELEVATOR DEFLECTION ON LONGITUDINAL CHARACT. OF BASELINE ORBITER

(A)MACH = 20.30

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	DLTBTA	ELEVTR	AILRON	BDFLAP
(AOSC26)	○	ME.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	-4.500	0.000	0.000	0.000
(AOSC27)	△	ME.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	-2.250	0.000	0.000	0.000

REFERENCE INFORMATION

SREF	9.3900	SQ.IN.
LREF	2.3400	INCHES
BREF	4.5300	INCHES
XMRP	3.8850	INCHES
YMRP	0.0000	INCHES
ZMRP	0.0000	INCHES
SCALE	0.0045	SCALE



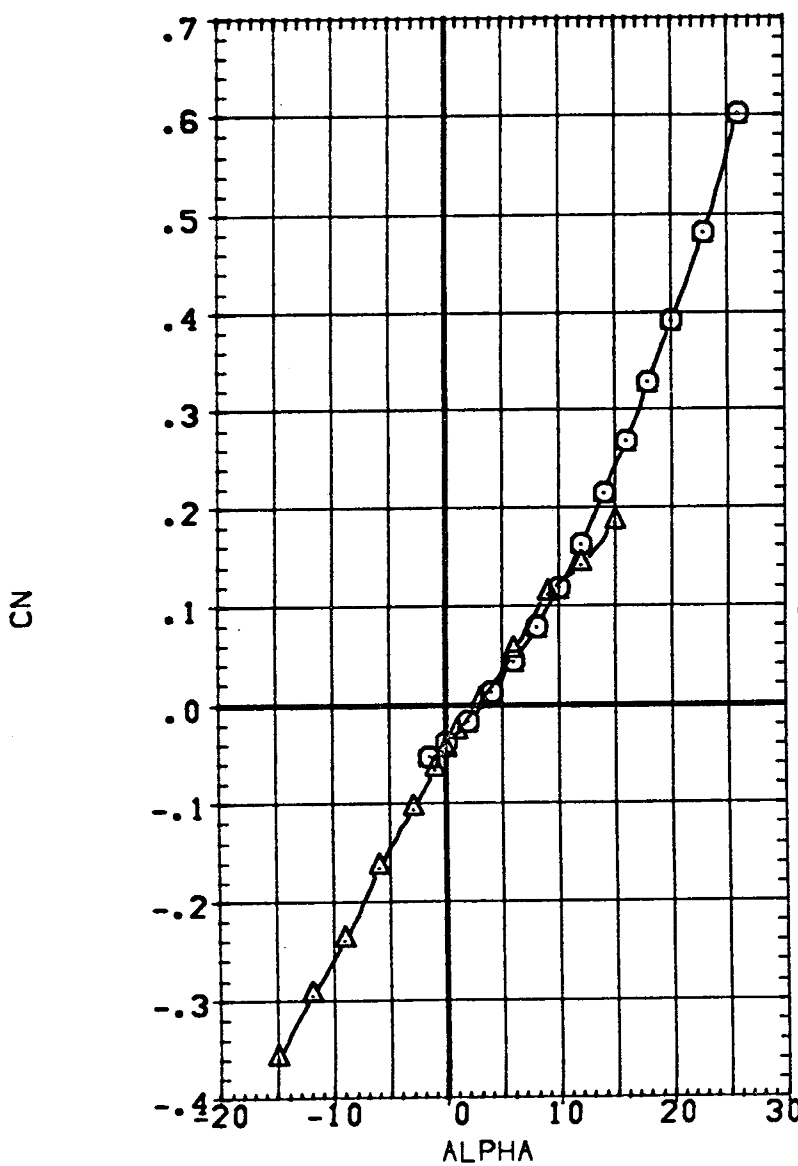
LATERAL-DIRECTIONAL CHARACTERISTICS OF BASELINE ORBITER

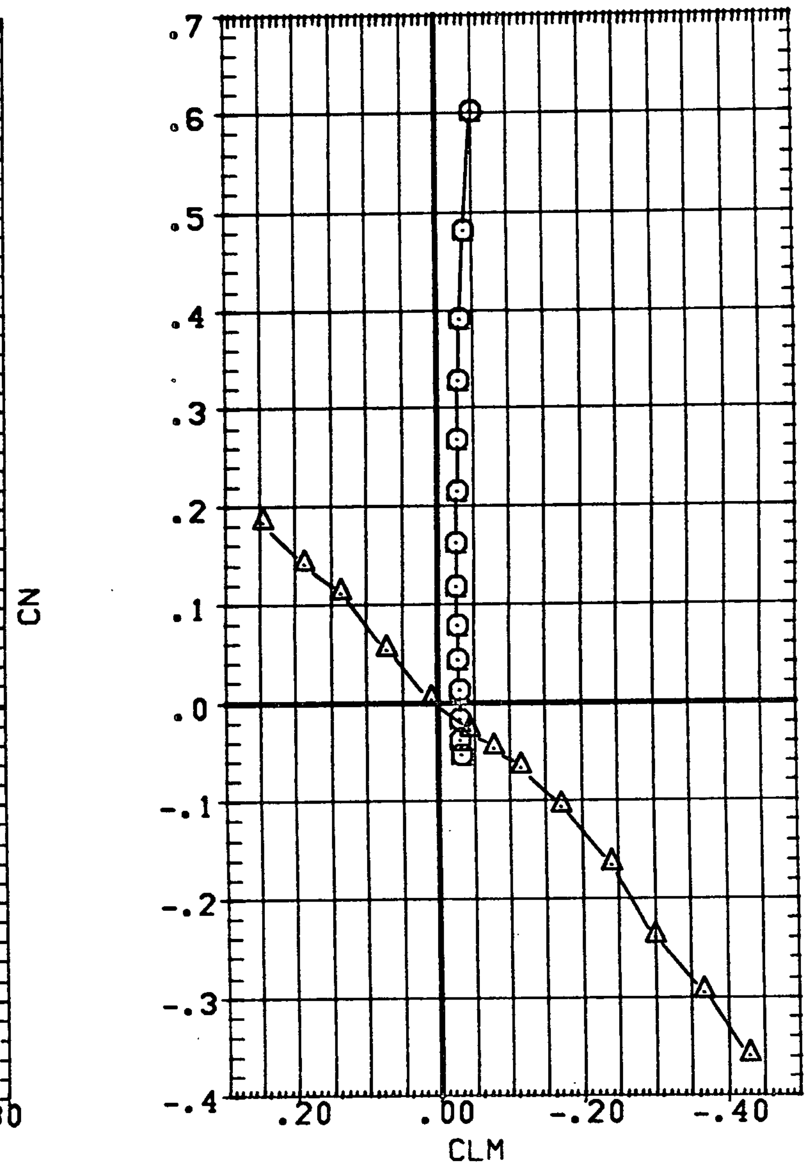
(A)MACH = 20.30

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	AILRON	RUDDER	BDFLAP
(SOS020)	○	HE.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	0.000	0.000	0.000	0.000
(SOS031)	△	LRC 22HE-409, ATP ORBITER + EXTERNAL TANK (T1)	0.000	0.000	0.000	0.000

REFERENCE INFORMATION

SREF	9.3900	SQ.IN.
LREF	2.3400	INCHES
BREF	4.5300	INCHES
XMRP	3.8850	INCHES
YMRP	0.0000	INCHES
ZMRP	0.0000	INCHES
SCALE	0.0045	SCALE





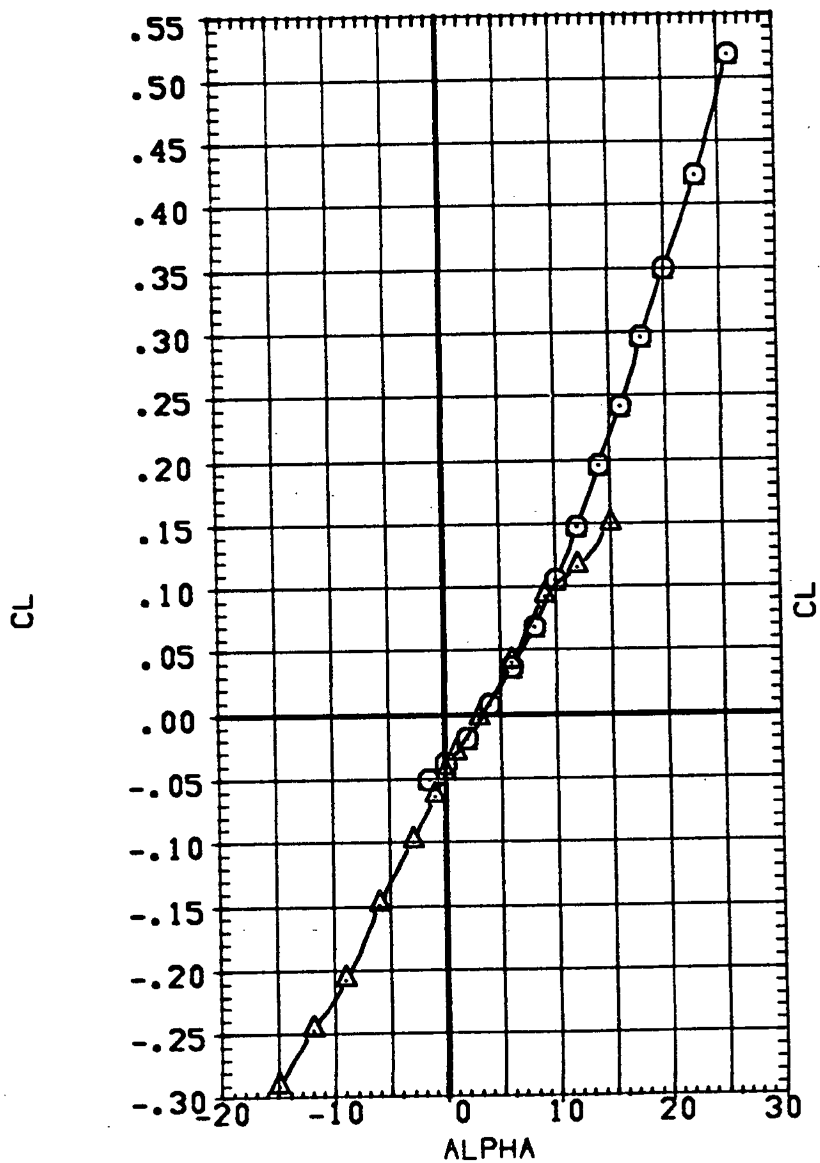
EFFECT OF EXTERNAL TANK ON ORBITER LONGITUDINAL CHARACTERISTICS

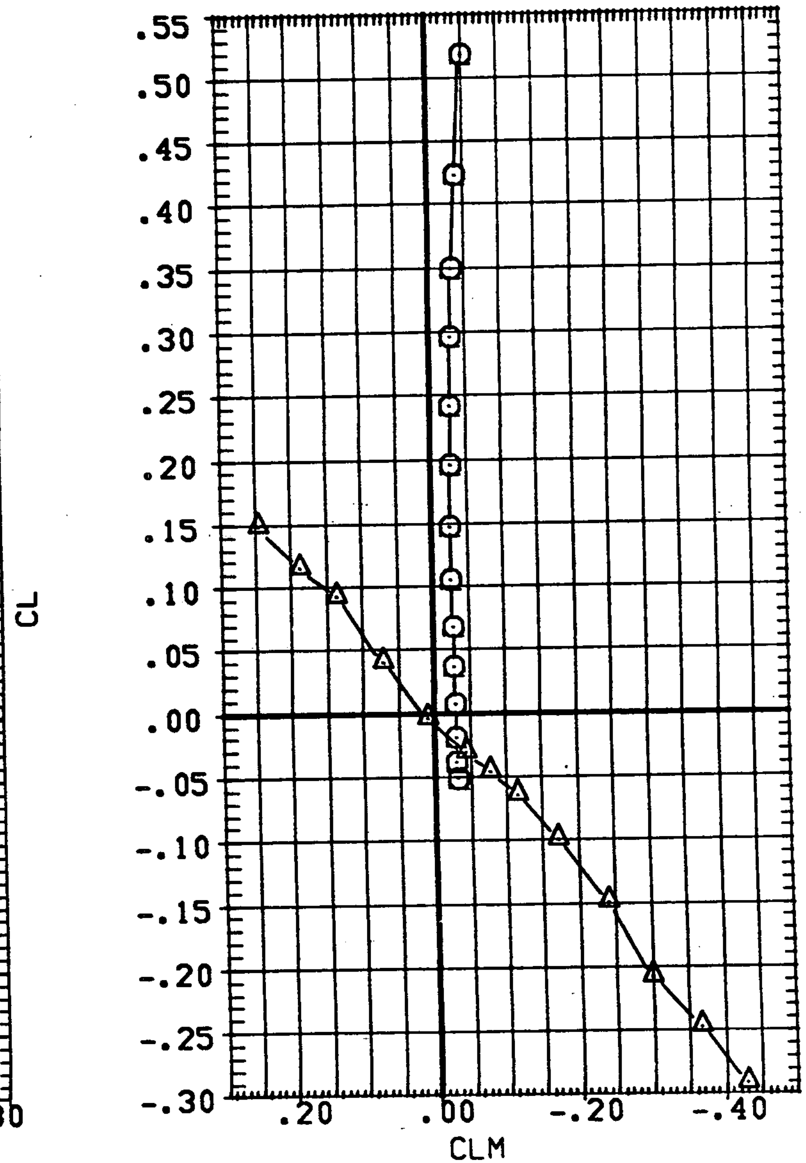
(A)MACH = 20.30

C-2

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	AILRON	RUDDER	BDFLAP
(SOS020)	○	HE.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	0.000	0.000	0.000	0.000
(SOS031)	△	LRC 22HE-409, ATP ORBITER + EXTERNAL TANK (T1)	0.000	0.000	0.000	0.000

REFERENCE INFORMATION		
SREF	9.3900	SQ.IN.
LREF	2.3400	INCHES
BREF	4.5300	INCHES
XMRP	3.8850	INCHES
YMRP	0.0000	INCHES
ZMRP	0.0000	INCHES
SCALE	0.0045	SCALE





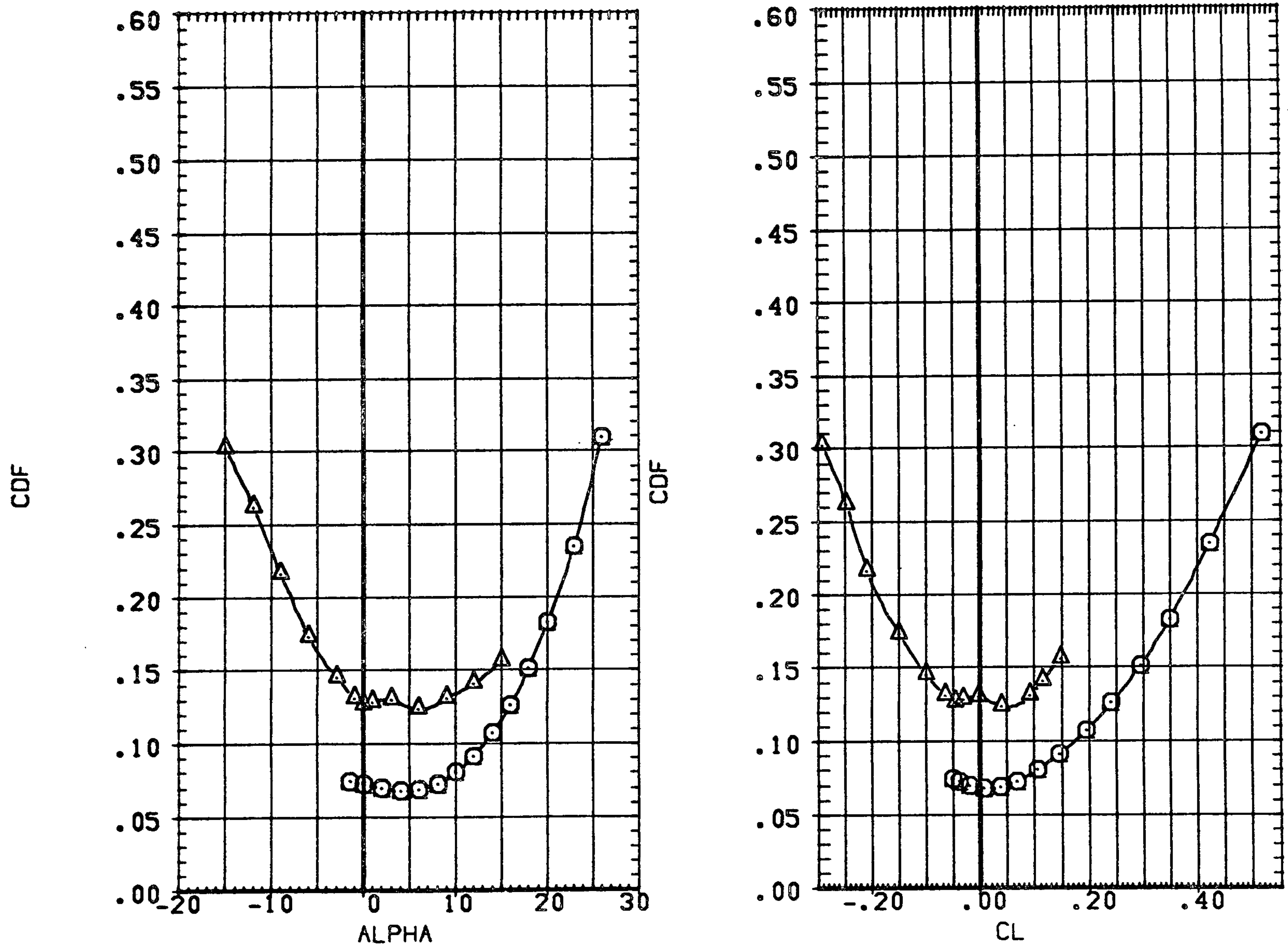
EFFECT OF EXTERNAL TANK ON ORBITER LONGITUDINAL CHARACTERISTICS

(A)MACH = 20.30

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	AILRON	RUDDER	BDFLAP
(SOS020)	⊙	ME.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	0.000	0.000	0.000	0.000
(SOS031)	△	LRC 22ME-409, ATP ORBITER + EXTERNAL TANK (T1)	0.000	0.000	0.000	0.000

REFERENCE INFORMATION

SREF	9.3900	SQ.IN.
LREF	2.3400	INCHES
BREF	4.5300	INCHES
XMRP	3.8850	INCHES
YMRP	0.0000	INCHES
ZMRP	0.0000	INCHES
SCALE	0.0045	SCALE

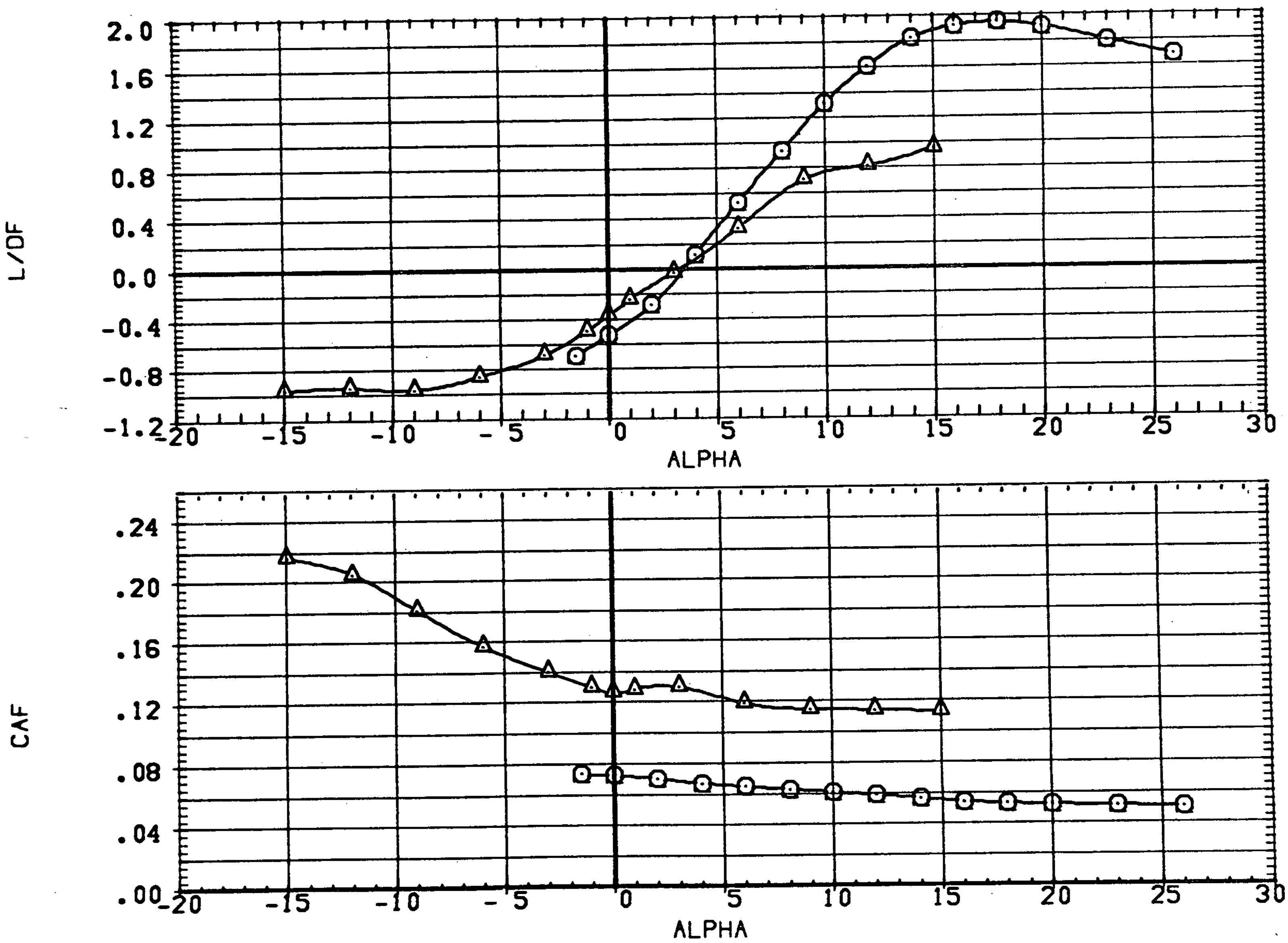


EFFECT OF EXTERNAL TANK ON ORBITER LONGITUDINAL CHARACTERISTICS

(A)MACH = 20.30

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	AILRON	RUDDER	BDFLAP
(SOS020)	○	HE.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1)	0.000	0.000	0.000	0.000
(SOS031)	△	LRC 22HE-409, ATP ORBITER + EXTERNAL TANK (T1)	0.000	0.000	0.000	0.000

REFERENCE INFORMATION		
SREF	9.3900	SQ.IN.
LREF	2.3400	INCHES
BREF	4.5300	INCHES
XMRP	3.8850	INCHES
YMRP	0.0000	INCHES
ZMRP	0.0000	INCHES
SCALE	0.0045	SCALE



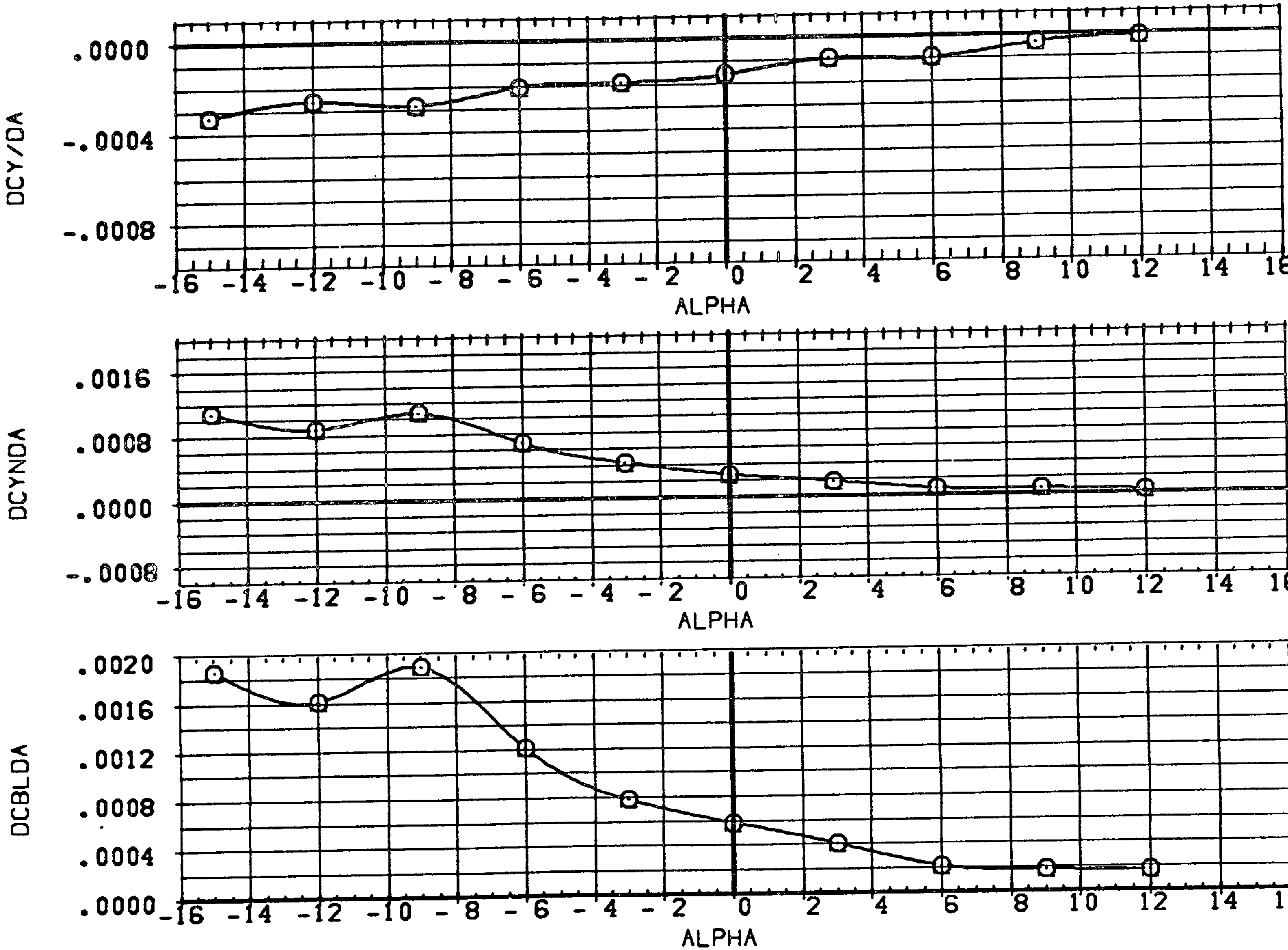
EFFECT OF EXTERNAL TANK ON ORBITER LONGITUDINAL CHARACTERISTICS

(A)MACH = 20.30

LRC 22HE-409. ATP ORBITER + EXTERNAL TANK (T1) (AOSC30)

SYMBOL	MACH	PARAMETRIC VALUES			
○	20.300	BETA	0.000	ELEVTR	0.000
		DLTALN	20.000	RUDDER.	0.000
		BDFLAP	0.000		

REFERENCE INFORMATION		
SREF	9.3900	SQ.IN.
LREF	2.3400	INCHES
BREF	4.5300	INCHES
XMRP	3.8850	INCHES
YMRP	0.0000	INCHES
ZMRP	0.0000	INCHES
SCALE	0.0045	SCALE

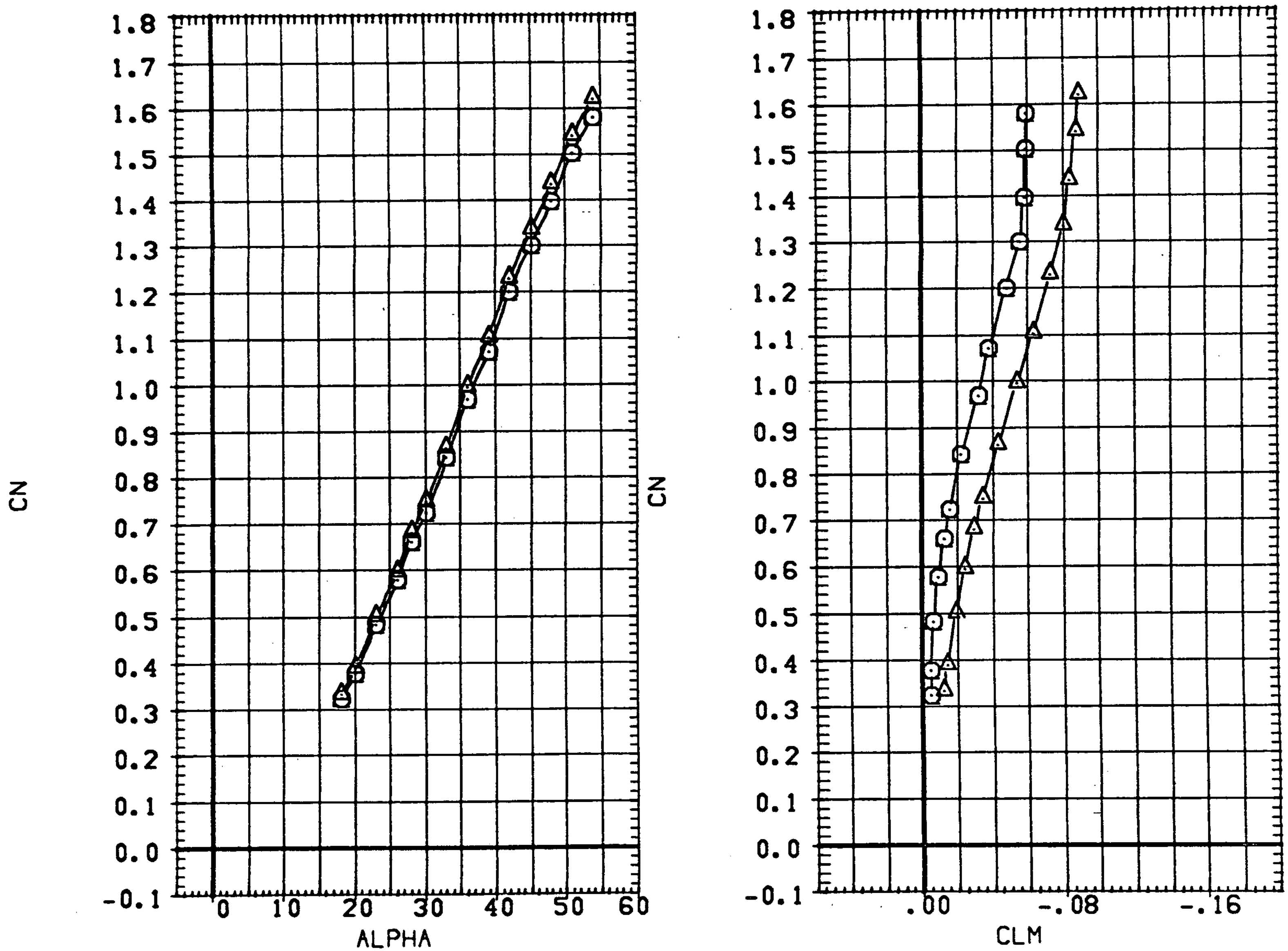


AILERON EFFECTIVENESS FOR ORBITER WITH EXTERNAL TANK

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	AILRON	RUDDER	BDFLAP
(SOS002)	⊙	LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	-20.000	0.000	0.000	0.000
(SOS007)	△	LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	-20.000	20.000	0.000	0.000

REFERENCE INFORMATION

SREF	9.3900	SQ.IN.
LREF	2.3400	INCHES
BREF	4.7630	INCHES
XMRP	3.8850	INCHES
YMRP	0.0000	INCHES
ZMRP	0.0000	INCHES
SCALE	0.0045	



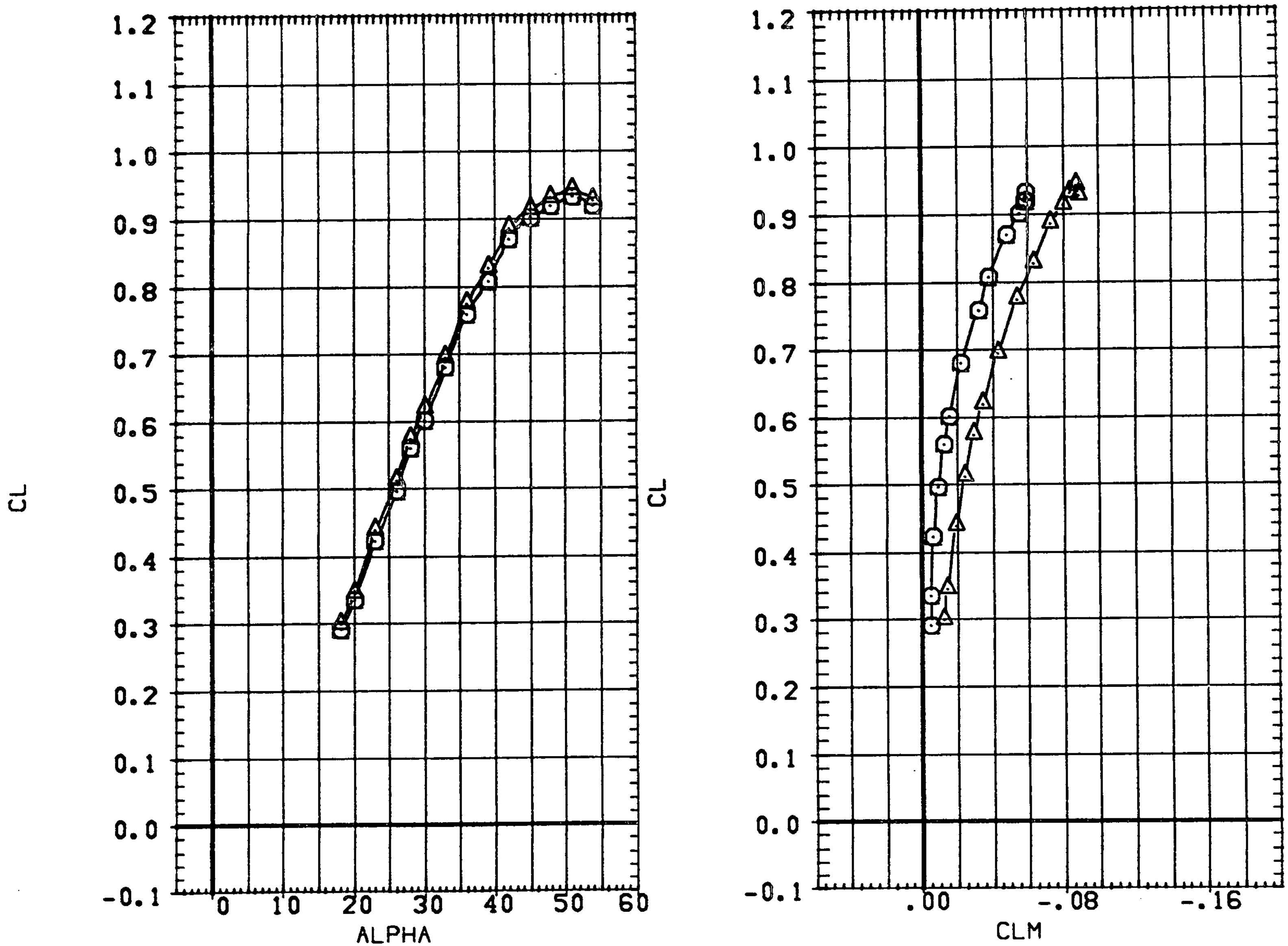
EFFECT OF AILERON DEFLECTION ON LONGITUDINAL CHARACT. OF MODIFIED ORBITER

(A)MACH = 20.30

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	AILRON	RUDDER	BDFLAP
(SOS002)	○	LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	-20.000	0.000	0.000	0.000
(SOS007)	△	LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	-20.000	20.000	0.000	0.000

REFERENCE INFORMATION

SREF	9.3900	SQ.IN.
LREF	2.3400	INCHES
BREF	4.7630	INCHES
XMRP	3.8850	INCHES
YMRP	0.0000	INCHES
ZMRP	0.0000	INCHES
SCALE	0.0045	



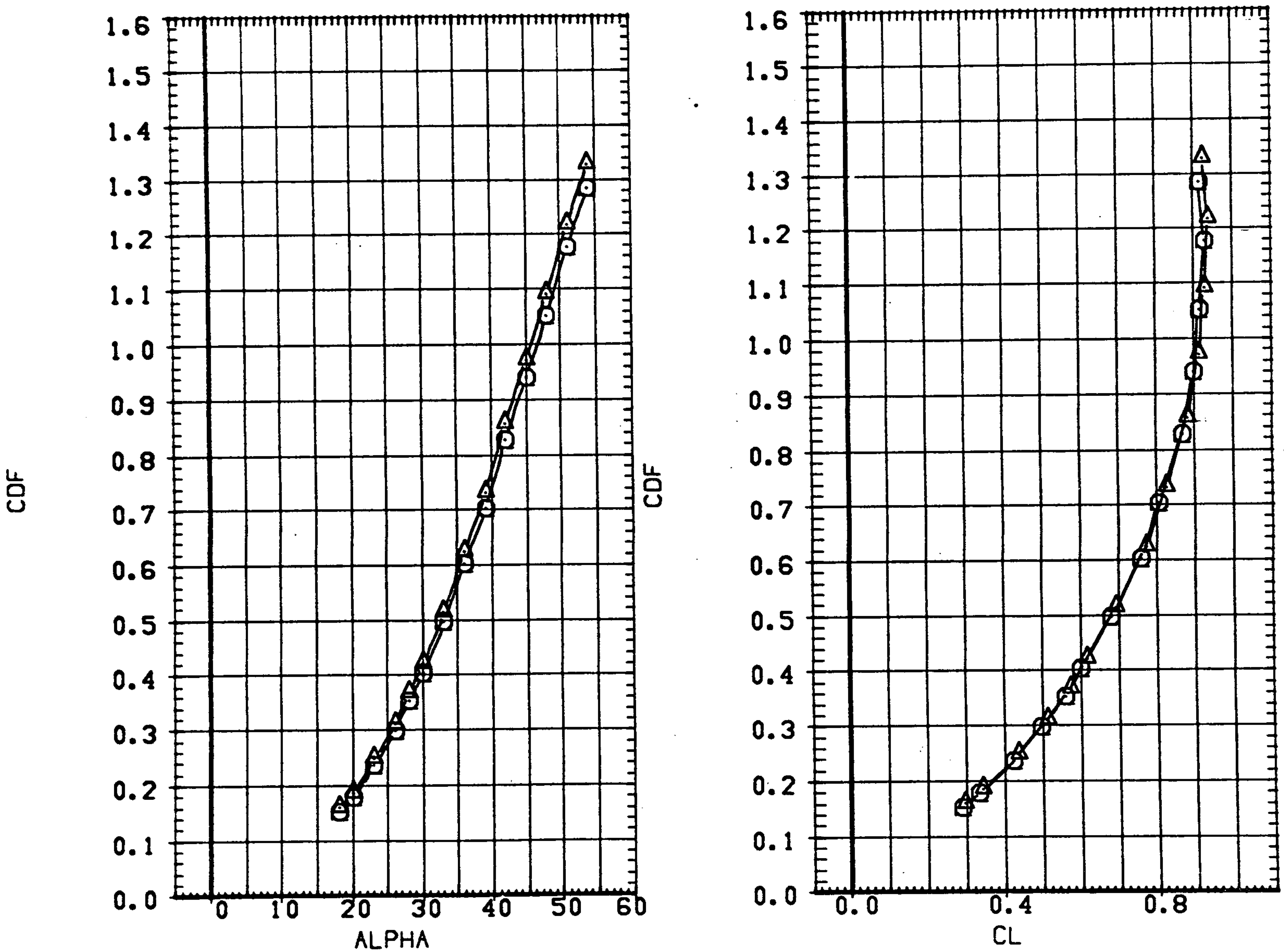
EFFECT OF AILERON DEFLECTION ON LONGITUDINAL CHARACT. OF MODIFIED ORBITER

(A)MACH = 20.30

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	AILRON	RUDDER	BDFLAP
(SOS002)	○	LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	-20.000	0.000	0.000	0.000
(SOS007)	△	LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	-20.000	20.000	0.000	0.000

REFERENCE INFORMATION

SREF	9.3900	SQ.IN.
LREF	2.3400	INCHES
BREF	4.7630	INCHES
XMRP	3.8850	INCHES
YMRP	0.0000	INCHES
ZMRP	0.0000	INCHES
SCALE	0.0045	



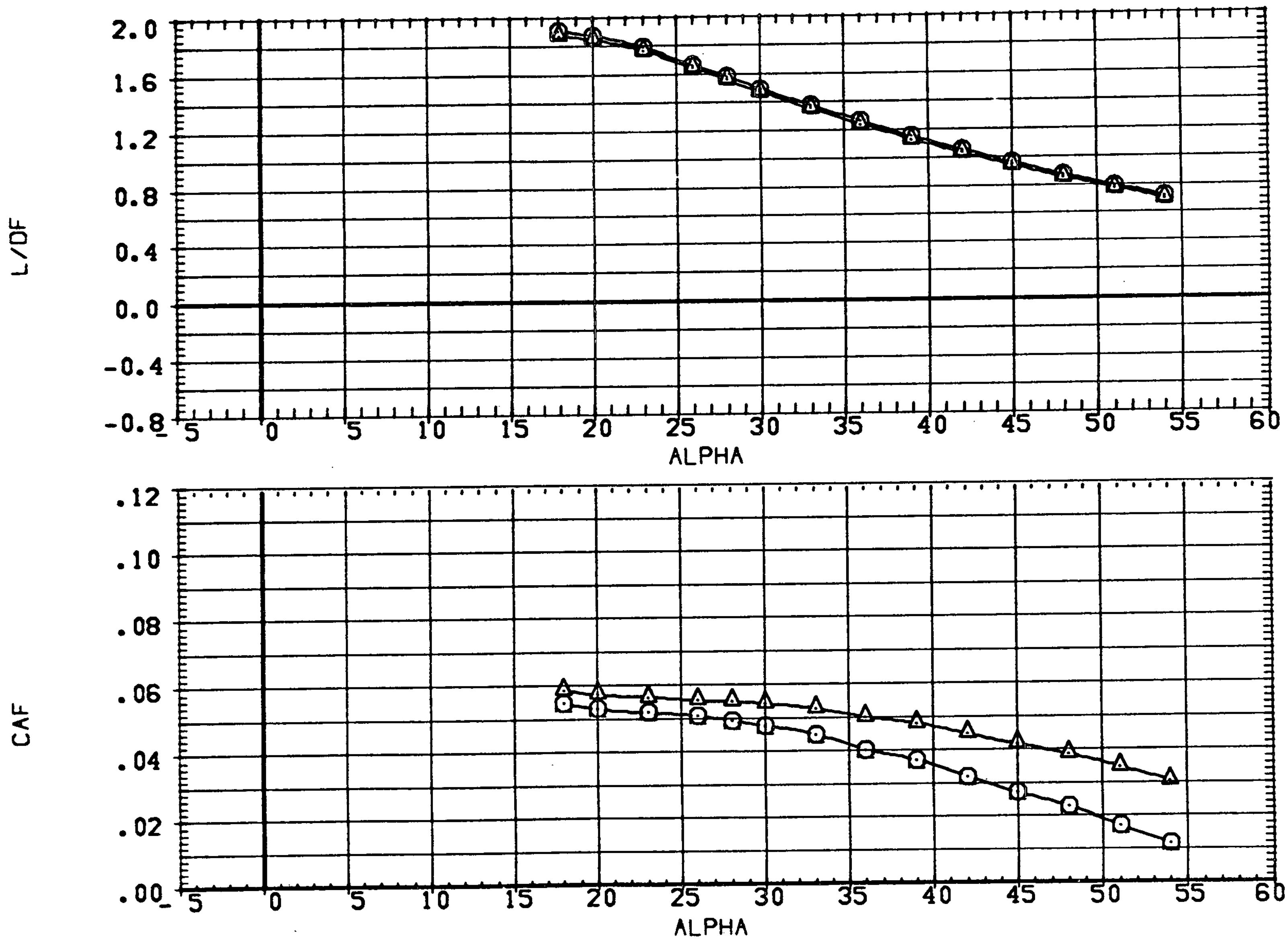
EFFECT OF AILERON DEFLECTION ON LONGITUDINAL CHARACT. OF MODIFIED ORBITER

(A)MACH = 20.30

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	AILRON	RUDDER	BDFLAP
(SOS002)	O	LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	-20.000	0.000	0.000	0.000
(SOS007)	Δ	LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	-20.000	20.000	0.000	0.000

REFERENCE INFORMATION

SREF	9.3900	SQ.IN.
LREF	2.3400	INCHES
BREF	4.7630	INCHES
XMRP	3.8850	INCHES
YMRP	0.0000	INCHES
ZMRP	0.0000	INCHES
SCALE	0.0045	

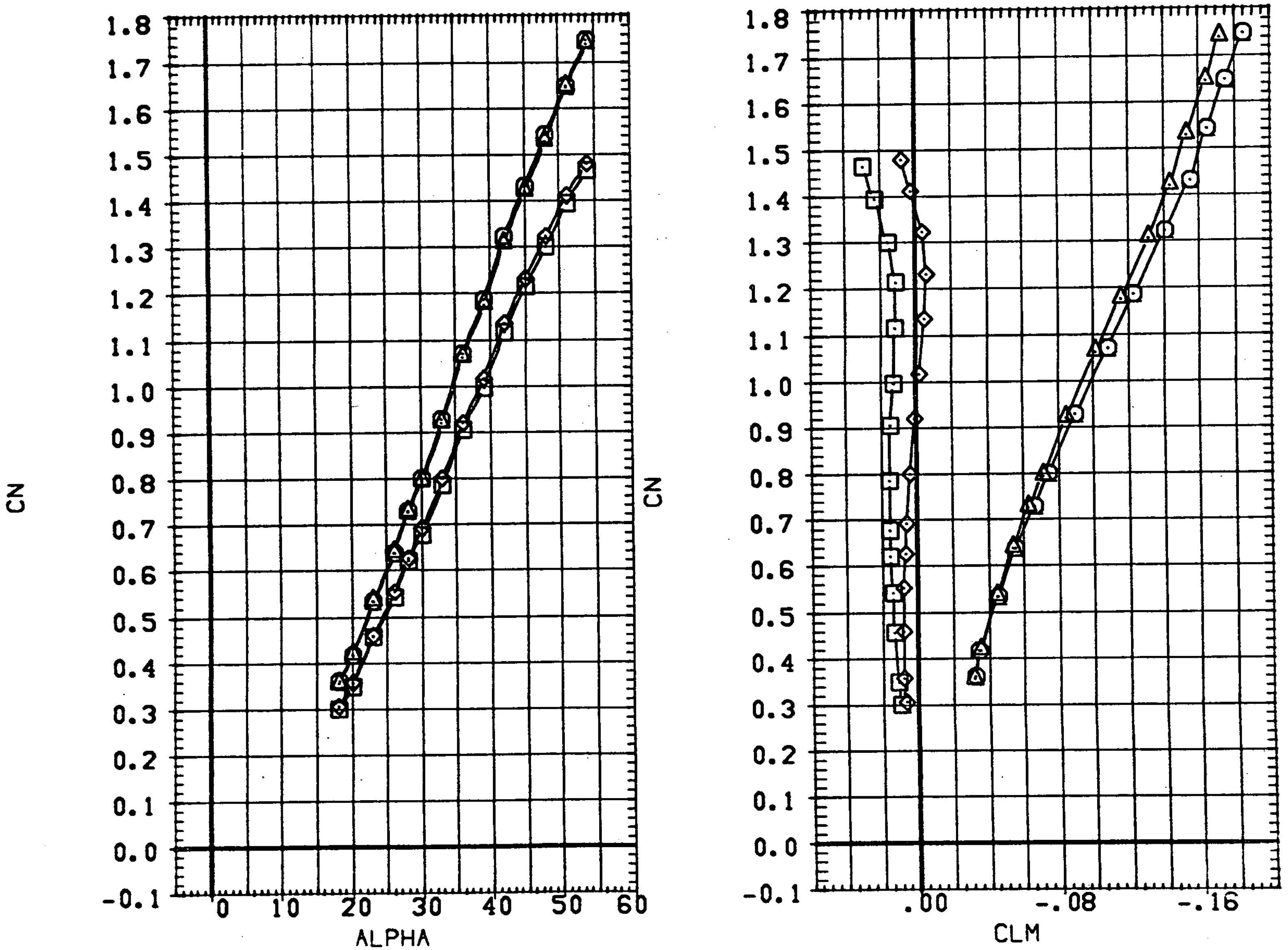


EFFECT OF AILERON DEFLECTION ON LONGITUDINAL CHARACT. OF MODIFIED ORBITER

(A)MACH = 20.30

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	AILRON	RUDDER	BDFLAP
(SOS001)	○	LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	0.000	0.000	0.000	0.000
(SOS005)	△	LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	0.000	0.000	0.000	-18.000
(SOS003)	◇	LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	-40.000	0.000	0.000	0.000
(SOS004)	□	LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	-40.000	0.000	0.000	-18.000

REFERENCE INFORMATION		
SREF	9.3900	SQ.IN.
LREF	2.3400	INCHES
BREF	4.7630	INCHES
XMRP	3.8850	INCHES
YMRP	0.0000	INCHES
ZMRP	0.0000	INCHES
SCALE	0.0045	

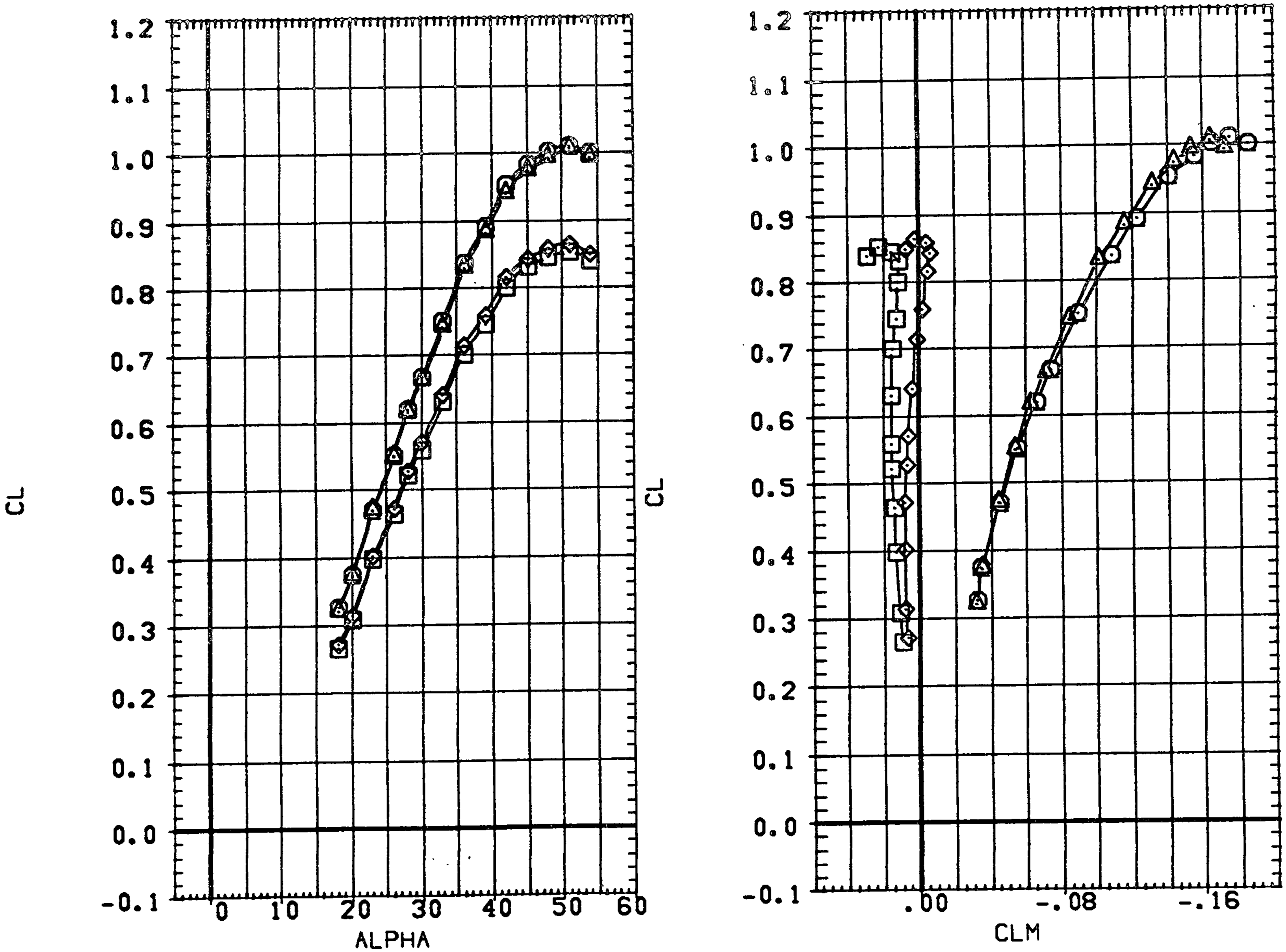


EFFECT OF BODY FLAP ON LONGITUDINAL CHARACTERISTICS OF MODIFIED ORBITER

(A)MACH = 20.30

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	AILRON	RUDDER	BDFLAP
(SOS001)	○	LRC 22ME-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	0.000	0.000	0.000	0.000
(SOS002)	△	LRC 22ME-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	0.000	0.000	0.000	-18.000
(SOS003)	◇	LRC 22ME-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	-40.000	0.000	0.000	0.000
(SOS004)	□	LRC 22ME-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	-40.000	0.000	0.000	-18.000

REFERENCE INFORMATION		
SREF	9.3900	SQ.IN.
LREF	2.3400	INCHES
BREF	4.7030	INCHES
XMRP	3.8050	INCHES
YMRP	0.0000	INCHES
ZMRP	0.0000	INCHES
SCALE	0.0045	



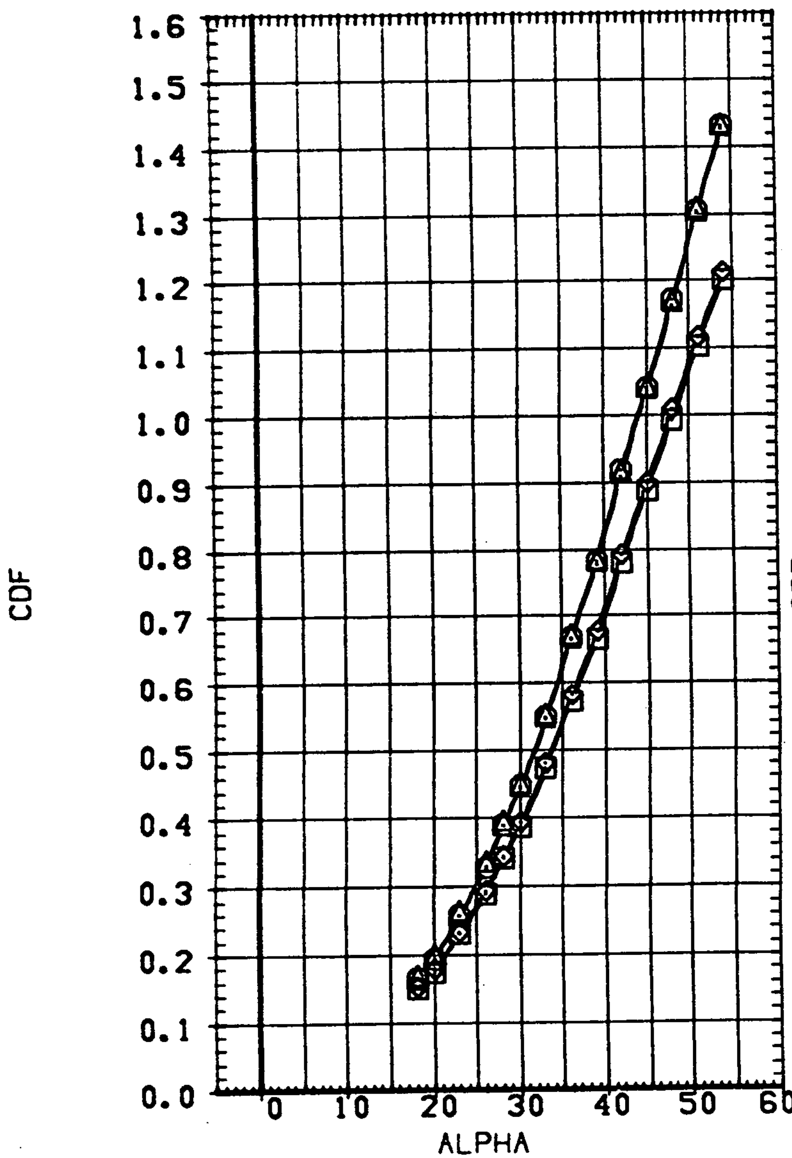
EFFECT OF BODY FLAP ON LONGITUDINAL CHARACTERISTICS OF MODIFIED ORBITER

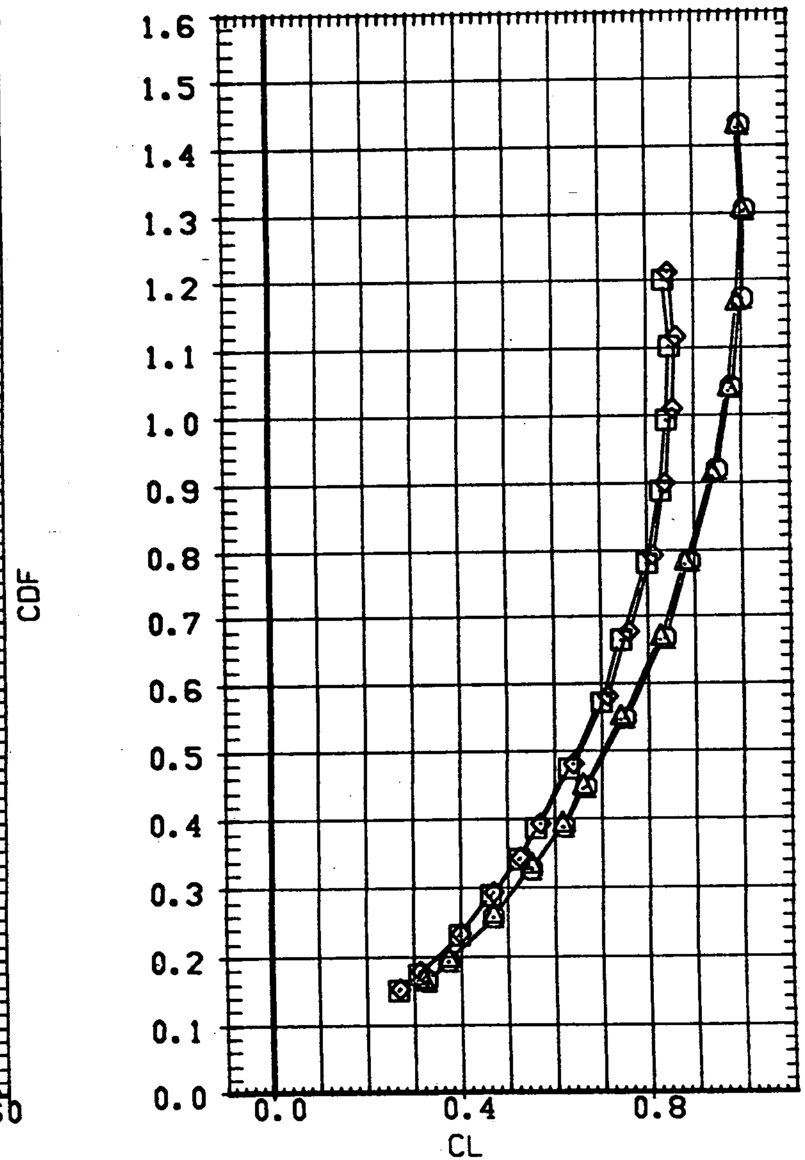
(A)MACH = 20.30

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	AILRON	RUDDER	BDFLAP
(SOS001)	○	LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	0.000	0.000	0.000	0.000
(SOS005)	△	LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	0.000	0.000	0.000	-18.000
(SOS003)	◇	LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	-40.000	0.000	0.000	0.000
(SOS004)	□	LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	-40.000	0.000	0.000	-18.000

REFERENCE INFORMATION

SREF	9.3900	SQ.IN.
LREF	2.3400	INCHES
BREF	4.7630	INCHES
XMRP	3.8650	INCHES
YMRP	0.0000	INCHES
ZMRP	0.0000	INCHES
SCALE	0.0045	



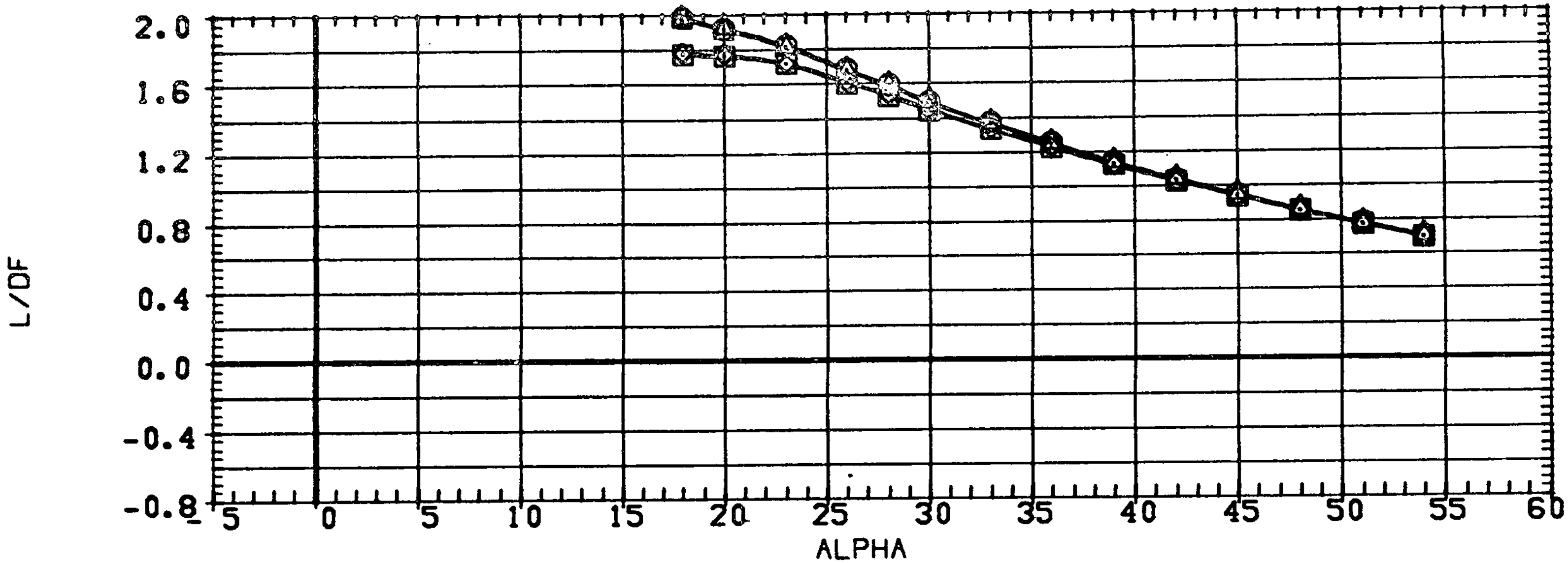


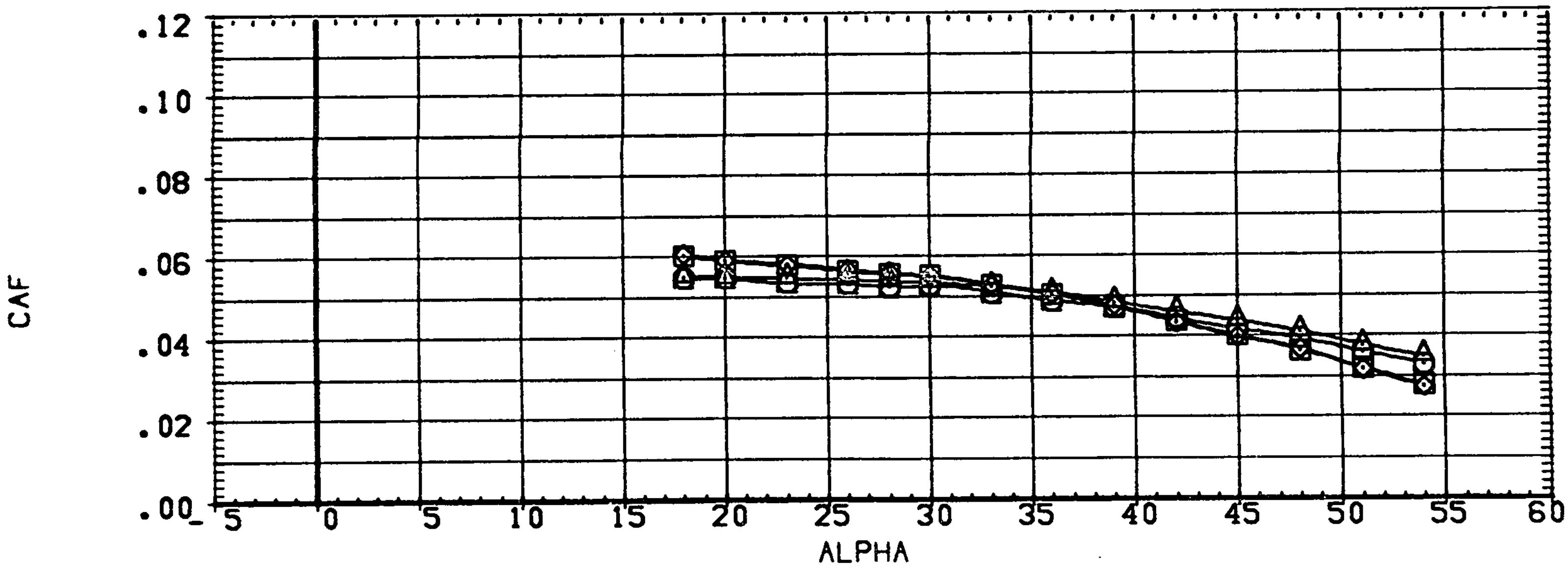
EFFECT OF BODY FLAP ON LONGITUDINAL CHARACTERISTICS OF MODIFIED ORBITER

(A)MACH = 20.30

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	AILRON	RUDDER	BDFLAP
(SOS001)	○	LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	0.000	0.000	0.000	0.000
(SOS005)	△	LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	0.000	0.000	0.000	-18.000
(SOS003)	◇	LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	-40.000	0.000	0.000	0.000
(SOS004)	□	LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1)	-40.000	0.000	0.000	-18.000

REFERENCE INFORMATION		
SREF	9.3000	SQ.IN.
LREF	2.3400	INCHES
BREF	4.7650	INCHES
XMRP	3.0850	INCHES
YMRP	0.0000	INCHES
ZMRP	0.0000	INCHES
SCALE	0.0045	





EFFECT OF BODY FLAP ON LONGITUDINAL CHARACTERISTICS OF MODIFIED ORBITER

(A)MACH = 20.30

APPENDIX

TABULATED SOURCE DATA

Page 1

Plotted data tabulations available on request from the DMS.

LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1) (RO6001) (27 NOV 72)

REFERENCE DATA

SREF = 9.3900 SQ.IN. XMRP = 3.8850 INCHES
LREF = 5.9720 INCHES YMRP = .0000 INCHES
BREF = 4.7630 INCHES ZMRP = .0000 INCHES
SCALE = .0045

PARAMETRIC DATA

BETA = .000 ELEVTR = .000
AILRON = .000 RUDDER = .000
BDFLAP = .000

RUN NO. 1/ 0 RN/L = 4.30 GRADIENT INTERVAL = 18.00/ 30.00

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	L/DF
20.300	18.000	.00000	.35912	.05488	-.01257	-.00099	.00048	-.00210	.32459	.16317	1.98923
20.300	20.000	.00000	.41690	.05465	-.01352	-.00114	.00049	-.00262	.37306	.19395	1.92354
20.300	23.000	.00000	.53330	.05334	-.01780	-.00161	.00054	-.00334	.47006	.25747	1.82569
20.300	26.000	.00000	.63939	.05316	-.02175	-.00209	.00053	-.00388	.55138	.32808	1.68064
20.300	28.000	.00000	.72930	.05241	-.02601	-.00253	.00054	-.00498	.61933	.38866	1.59349
20.300	30.000	.00000	.80118	.05260	-.02901	-.00245	.00058	-.00463	.66754	.44614	1.49625
20.300	33.000	.00000	.92817	.05098	-.03503	-.00310	.00066	-.00606	.75066	.54828	1.36913
20.300	36.000	.00000	1.06938	.04891	-.04247	-.00329	.00065	-.00647	.83640	.66814	1.25183
20.300	39.000	.00000	1.18583	.04718	-.04815	-.00370	.00070	-.00745	.89187	.78293	1.13915
20.300	42.000	.00000	1.32226	.04442	-.05528	-.00406	.00084	-.00816	.95291	.91777	1.03828
20.300	45.000	.00000	1.43161	.04161	-.06095	-.00471	.00087	-.00910	.98288	1.04173	.94351
20.300	48.00G	.00000	1.54297	.03928	-.06450	-.00480	.00090	-.00937	1.00326	1.17293	.85535
20.300	51.000	.00000	1.64921	.03596	-.06846	-.00471	.00101	-.01038	1.00993	1.30430	.77431
20.300	54.000	.00000	1.74621	.03291	-.07257	-.00399	.00114	-.01013	.99977	1.43205	.69814
	GRADIENT	.00000	.03737	-.00021	-.00142	-.00014	.00001	-.00023	.02917	.02370	-.04129

LRC 22HE-409,ATP CRB (B1C1D1F1M1)(W1XE1)(V1K1R1) (RO6002) (27 NOV 72)

REFERENCE DATA

SREF = 9.3900 SQ.IN. XMRP = 3.8630 INCHES
LREF = 3.9720 INCHES YMRP = .0000 INCHES
BREF = 4.7630 INCHES ZMRP = .0000 INCHES
SCALE = .0045

PARAMETRIC DATA

BETA = .000 ELEVTR = -20.000
AILRON = .000 RUDDER = .000
BDFLAP = .000

RUN NO. 2/ 0 RN/L = 4.30 GRADIENT INTERVAL = 18.00/ 30.00

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	L/DF
20.300	18.000	.00000	.32225	.05465	-.00188	.00078	-.00026	.00013	.28959	.15156	1.91072
20.300	20.000	.00000	.37510	.05300	-.00175	.00079	-.00024	.00004	.33435	.17810	1.87735
20.300	23.000	.00000	.46059	.05183	-.00259	.00079	-.00034	.00047	.42213	.23549	1.79259
20.300	26.000	.00000	.57772	.05036	-.00366	.00068	-.00034	.00080	.49704	.29878	1.66354
20.300	28.000	.00000	.66045	.04932	-.00509	.00045	-.00069	.00071	.55999	.35361	1.58365
20.300	30.000	.00000	.72248	.04769	-.00612	.00062	-.00074	.00135	.60184	.40254	1.49512
20.300	33.000	.00000	.84191	.04490	-.00872	.00043	-.00096	.00129	.68163	.49620	1.37371
20.300	36.000	.00000	.96859	.04032	-.01273	.00018	-.00112	.00152	.75991	.60194	1.26243
20.300	39.000	.00000	1.07051	.03710	-.01484	.00024	-.00131	.00184	.80859	.70253	1.15097
20.300	42.000	.00000	1.20079	.03194	-.01887	.00017	-.00151	.00256	.87099	.82722	1.05290
20.300	45.000	.00000	1.30221	.02711	-.02186	-.00022	-.00172	.00276	.90163	.93997	.95921
20.300	48.000	.00000	1.39753	.02284	-.02281	-.00022	-.00176	.00349	.91816	1.05385	.87124
20.300	51.000	.00000	1.50144	.01692	-.02320	-.00031	-.00178	.00361	.93174	1.17749	.79130
20.300	54.000	.00000	1.58027	.01169	-.02304	.00008	-.00183	.00387	.91940	1.28534	.71530
	GRADIENT	.00000	.03395	-.00053	-.00037	-.00002	-.00005	.00010	.02662	.02113	-.03542

LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1) (ROS003) (27 NOV 72)

REFERENCE DATA

SREF = 9.3900 SQ.IN. XMRP = 3.8850 INCHES
LREF = 5.9720 INCHES YMRP = .0000 INCHES
BREF = 4.7630 INCHES ZMRP = .0000 INCHES
SCALE = .0045

PARAMETRIC DATA

BETA = .000 ELEVTR = -40.000
AILRON = .000 RUDDER = .000
BDFLAP = .000

RUN NO. 3/ 0 RN/L = 4.30 GRADIENT INTERVAL = 18.00/ 30.00

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	L/DF
20.300	18.000	.00000	.30460	.06058	.00259	.00071	.00016	-.00069	.27097	.15174	1.78577
20.300	20.000	.00000	.35600	.05910	.00321	.00043	.00009	-.00069	.31432	.17730	1.77280
20.300	23.000	.00000	.46003	.05797	.00333	.00037	-.00007	-.00046	.40081	.23311	1.71938
20.300	26.000	.00000	.55185	.05658	.00315	.00018	-.00018	-.00037	.47120	.29277	1.60943
20.300	28.000	.00000	.62600	.05569	.00268	.00009	-.00029	-.00039	.52835	.34400	1.53587
20.300	30.000	.00000	.69154	.05500	.00234	-.00003	-.00040	-.00010	.57139	.39341	1.45242
20.300	33.000	.00000	.79921	.05294	.00153	-.00020	-.00051	-.00032	.64144	.47968	1.33722
20.300	36.000	.00000	.91936	.05024	.00026	-.00036	-.00072	-.00009	.71425	.58103	1.22929
20.300	39.000	.00000	1.01662	.04763	-.00071	-.00033	-.00082	-.00015	.76009	.67680	1.12307
20.300	42.000	.00000	1.13574	.04340	-.00199	-.00068	-.00090	.00029	.81498	.79221	1.02874
20.300	45.000	.00000	1.23129	.03981	-.00249	-.00110	-.00110	.00034	.84250	.89880	.93736
20.300	48.000	.00000	1.32462	.03665	-.00147	-.00114	-.00109	.00032	.85910	1.00891	.85152
20.300	51.000	.00000	1.41198	.03175	.00083	-.00103	-.00120	.00068	.86391	1.11730	.77321
20.300	54.000	.00000	1.47994	.02730	.00292	-.00080	-.00123	.00104	.84780	1.21334	.69874
	GRADIENT	.00000	.03266	-.00045	-.00003	-.00006	-.00005	.00005	.02549	.02025	-.02843

LRC 22HE-409,ATP ORB (B1C1D1F1M1)(W1E1)(V1K1R1) (RO6004) (27 NOV 72)

REFERENCE DATA

SREF	=	9.3900 SQ.IN.	XMRP	=	3.0850 INCHES
LREF	=	5.9720 INCHES	YMRP	=	.0000 INCHES
BREF	=	4.7630 INCHES	ZMRP	=	.0000 INCHES
SCALE	=	.0049			

PARAMETRIC DATA

BETA	=	.000	ELEVTR	=	-40.000
AILRON	=	.000	RUDDER	=	.000
BDFLAP	=	-18.000			

RUN NO. 5/ 0 RN/L = 4.30 GRADIENT INTERVAL = 18.00/ 30.00

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	L/DF
20.300	18.000	.00000	.29862	.06009	.00587	.00046	-.00011	-.00042	.26543	.14945	1.77632
20.300	20.000	.00000	.34926	.05885	.00448	.00054	-.00015	-.00065	.30807	.17476	1.76286
20.300	23.000	.00000	.45546	.05772	.00515	.00016	-.00025	-.00102	.39670	.23109	1.71660
20.300	26.000	.00000	.54263	.05629	.00560	.00012	-.00032	-.00057	.46304	.28847	1.60514
20.300	26.000	.00000	.62158	.05564	.00599	.00000	-.00037	-.00076	.52270	.34094	1.53310
20.300	30.000	.00000	.67728	.03493	.00594	-.00007	-.00051	-.00017	.55906	.38620	1.44759
20.300	33.000	.00000	.78580	.03207	.00592	-.00017	-.00067	-.00002	.63023	.47232	1.33434
20.300	36.000	.00000	.90411	.05044	.00569	-.00063	-.00088	-.00059	.70179	.57223	1.22642
20.300	39.000	.00000	.99762	.04728	.00504	-.00071	-.00098	-.00013	.74554	.66457	1.12184
20.300	42.000	.00000	1.11556	.04363	.00476	-.00088	-.00117	-.00071	.79981	.77889	1.02686
20.300	45.000	.00000	1.21484	.04001	.00428	-.00129	-.00137	-.00045	.83073	.88731	.93624
20.300	48.000	.00000	1.30183	.03646	.00603	-.00140	-.00147	.00007	.84400	.99185	.85093
20.300	51.000	.00000	1.39406	.03192	.00882	-.00146	-.00157	-.00031	.85250	1.10348	.77256
20.300	54.000	.00000	1.46508	.02763	.01147	-.00140	-.00164	.00014	.83880	1.20151	.69812
	GRADIENT	.00000	.03216	-.00042	.00018	-.00004	-.00003	.00001	.02509	.01993	-.02791

LRC 22ME-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1) (ROS005) (27 NOV 72)

REFERENCE DATA

SREF = 9.3900 SQ.IN. XMRP = 3.8850 INCHES
LREF = 5.9720 INCHES YMRP = .0000 INCHES
BREF = 4.7630 INCHES ZMRP = .0000 INCHES
SCALE = .0045

PARAMETRIC DATA

BETA = .000 ELEVTR = .000
AILRON = .000 RUDDER = .000
BDFLAP = -18.000

RUN NO. 6/ 0 RN/L = 4.30 GRADIENT INTERVAL = 18.00/ 30.00

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	L/DF
20.300	18.000	.00000	.35437	.05498	-.01233	-.00012	-.00023	-.00025	.32003	.16180	1.97802
20.300	20.000	.00000	.41563	.05469	-.01377	-.00025	-.00021	-.00012	.37179	.19374	1.91905
20.300	23.000	.00000	.53290	.05451	-.01744	-.00074	-.00034	-.00002	.46924	.25840	1.81592
20.300	26.000	.00000	.63785	.05419	-.02127	-.00083	-.00043	.00031	.54954	.32832	1.67377
20.300	28.000	.00000	.72593	.05383	-.02469	-.00098	-.00043	.00035	.61569	.38834	1.58545
20.300	30.000	.00000	.79498	.05344	-.02791	-.00109	-.00054	.00110	.66175	.44377	1.49119
20.300	33.000	.00000	.91861	.05230	-.03305	-.00148	-.00061	.00033	.74192	.54417	1.36341
20.300	36.000	.00000	1.06118	.05079	-.03966	-.00204	-.00076	.00066	.82866	.66484	1.24640
20.300	39.000	.00000	1.17479	.04844	-.04519	-.00225	-.00093	.00058	.88250	.77697	1.13583
20.300	42.000	.00000	1.30787	.04601	-.05164	-.00215	-.00098	.00109	.94115	.90933	1.03500
20.300	45.000	.00000	1.42055	.04370	-.05643	-.00253	-.00101	.00136	.97358	1.03538	.94031
20.300	48.000	.00000	1.52868	.04106	-.06015	-.00303	-.00102	.00170	.99237	1.16351	.85291
20.300	51.000	.00000	1.64442	.03763	-.06418	-.00307	-.00107	.00200	1.00562	1.30164	.77258
20.300	54.000	.00000	1.73791	.03482	-.06746	-.00270	-.00102	.00236	.99335	1.42646	.69637
	GRADIENT	.00000	.03722	-.00013	-.00131	-.00008	-.00003	.00010	.02901	.02364	-.04105

LRC 22ME-409,ATP ORB (B1C1D1F1M1)(W1XE1)(V1K1R1) (RO6006) (27 NOV 72)

REFERENCE DATA

SREF = 9.3900 SQ.IN. XMRP = 3.8850 INCHES
LREF = 5.9720 INCHES YMRP = .0000 INCHES
BREF = 4.7630 INCHES ZMRP = .0000 INCHES
SCALE = .0045

PARAMETRIC DATA

BETA = .000 ELEVTR = -30.000
AILRON = 10.000 RUDDER = .000
BDFLAP = .000

RUN NO. 7/ 0 RN/L = 4.30 GRADIENT INTERVAL = 18.00/ 30.00

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	L/DF
20.300	18.000	.00000	.31291	.05781	.00041	.00345	.00119	-.00077	.27973	.15168	1.84426
20.300	20.000	.00000	.36471	.05872	.00088	.00342	.00110	-.00019	.32332	.17804	1.81602
20.300	23.000	.00000	.47121	.05529	.00048	.00350	.00086	-.00056	.41215	.23501	1.75375
20.300	26.000	.00000	.58397	.05408	-.00023	.00375	.00058	.00027	.48318	.29583	1.63332
20.300	28.000	.00000	.64477	.05307	-.00088	.00430	.00043	.00072	.54438	.34956	1.55733
20.300	30.000	.00000	.70462	.05193	-.00198	.00445	.00029	.00078	.58423	.39732	1.47041
20.300	33.000	.00000	.81980	.04967	-.00373	.00497	.00007	.00111	.66049	.48815	1.35305
20.300	36.000	.00000	.94311	.04637	-.00596	.00567	-.00018	.00127	.73573	.59186	1.24308
20.300	39.000	.00000	1.03136	.04336	-.00805	.00645	-.00035	.00201	.78977	.69534	1.13581
20.300	42.000	.00000	1.17108	.03674	-.01057	.00731	-.00049	.00220	.84436	.81240	1.03935
20.300	45.000	.00000	1.27057	.03420	-.01213	.00790	-.00061	.00242	.87424	.92261	.94758
20.300	48.000	.00000	1.36989	.03087	-.01226	.00899	-.00077	.00325	.89369	1.03868	.86041
20.300	51.000	.00000	1.46040	.02560	-.01089	.00992	-.00084	.00406	.89916	1.15106	.78116
20.300	54.000	.00000	1.54139	.02123	-.00918	.01098	-.00102	.00453	.88883	1.25949	.70570
	GRADIENT	.00000	.03323	-.00047	-.00020	.00009	-.00008	.00013	.02598	.02066	-.03165

LRC 22HE-409,ATP ORB (B1C1D1F1M1) (W1XE1) (V1K1R1) (ROS007) (27 NOV 72)

REFERENCE DATA

SREF = 9.3900 SQ.IN. XMRP = 3.8850 INCHES
LREF = 5.9720 INCHES YMRP = .0000 INCHES
BREF = 4.7630 INCHES ZMRP = .0000 INCHES
SCALE = .0045

PARAMETRIC DATA

BETA = .000 ELEVTR = -20.000
AILRON = 20.000 RUDDER = .000
BDFLAP = .000

RUN NO. 4/ 0 RN/L = 4.30 GRADIENT INTERVAL = 18.00/ 30.00

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	L/DF
20.300	18.000	.00000	.33179	.05854	-.00485	.00905	.00062	.00027	.29747	.15820	1.88031
20.300	20.000	.00000	.38688	.05728	-.00553	.00993	.00026	.00108	.34396	.18615	1.84778
20.300	23.000	.00000	.49915	.05644	-.00755	.01168	-.00021	.00185	.43742	.24699	1.77101
20.300	26.000	.00000	.59638	.05534	-.00954	.01357	-.00070	.00256	.51176	.31117	1.64462
20.300	28.000	.00000	.67971	.05494	-.01157	.01508	-.00104	.00283	.57436	.36762	1.56238
20.300	30.000	.00000	.74529	.05428	-.01364	.01638	-.00135	.00350	.61830	.41965	1.47336
20.300	33.000	.00000	.86225	.05273	-.01695	.01859	-.00192	.00435	.69442	.51384	1.35144
20.300	36.000	.00000	.99366	.05007	-.02128	.02122	-.00257	.00557	.77446	.62457	1.23998
20.300	39.000	.00000	1.10304	.04808	-.02481	.02332	-.00309	.00587	.82696	.73153	1.13046
20.300	42.000	.00000	1.23094	.04477	-.02860	.02535	-.00359	.00675	.88481	.85692	1.03254
20.300	45.000	.00000	1.33359	.04159	-.03151	.02719	-.00413	.00755	.91358	.97240	.93951
20.300	48.000	.00000	1.43348	.03866	-.03293	.02895	-.00466	.00882	.93045	1.09116	.85272
20.300	51.000	.00000	1.53881	.03469	-.03419	.03183	-.00517	.00975	.94145	1.21771	.77313
20.300	54.000	.00000	1.61950	.03048	-.03470	.03342	-.00577	.01076	.92726	1.32812	.69818
	GRADIENT	.00000	.03497	-.00034	-.00073	.00062	-.00016	.00025	.02728	.02194	-.03456

LRC 22HE-409,ATP ORB (B1C1D1F1M1) (W1XE1) (V1K1R1) (ROS008) (27 NOV 72)

REFERENCE DATA

SREF = 9.3900 SQ.IN. XMRP = 3.8850 INCHES
LREF = 5.9720 INCHES YMRP = .0000 INCHES
BREF = 4.7630 INCHES ZMRP = .0000 INCHES
SCALE = .0045

PARAMETRIC DATA

BETA = -3.000 ELEVTR = .000
AILRON = .000 RUDDER = .000
BDFLAP = .000

RUN NO. 8/ 0 RN/L = 4.30 GRADIENT INTERVAL = 18.00/ 30.00

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	L/DF
20.300	18.023	-2.85304	.35420	.05661	-.01308	.00184	.00629	.00310	.31930	.16342	1.95385
20.300	20.025	-2.81893	.41896	.05620	-.01488	.00212	.00607	-.00023	.37439	.19627	1.90749
20.300	23.028	-2.76132	.52367	.05546	-.01833	.00269	.00614	-.00491	.46025	.25589	1.79859
20.300	26.031	-2.69615	.63975	.05494	-.02307	.00324	.00634	-.01029	.55074	.33012	1.66827
20.300	28.033	-2.64858	.73265	.05423	-.02754	.00352	.00656	-.01496	.62121	.39219	1.58394
20.300	30.034	-2.59778	.81563	.05397	-.03154	.00381	.00689	-.01877	.67910	.45496	1.49266
20.300	33.036	-2.51567	.93688	.05328	-.03736	.00415	.00731	-.02519	.75637	.55542	1.36181
20.300	36.037	-2.42667	1.06495	.05152	-.04391	.00431	.00768	-.03117	.83085	.66819	1.24344
20.300	39.038	-2.33102	1.20462	.04915	-.05099	.00461	.00812	-.03783	.90470	.79690	1.13527
20.300	42.039	-2.22898	1.33631	.04687	-.05794	.00487	.00842	-.04417	.96108	.92965	1.03381
20.300	45.039	-2.12084	1.44179	.04464	-.06258	.00490	.00863	-.05038	.98721	1.05175	.93864
20.300	48.039	-2.00689	1.56217	.04236	-.06660	.00505	.00877	-.05626	1.01301	1.18995	.85130
20.300	51.038	-1.88744	1.66959	.03903	-.07143	.00519	.00899	-.06074	1.01948	1.32276	.77072
	GRADIENT	.02043	.03793	-.00023	-.00142	.00017	.00003	-.00177	.02995	.02270	-.03772

HE.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1) (RO8015) (20 NOV 72)

REFERENCE DATA

SREF = 9.3900 SQ.IN. XMRP = 3.8850 INCHES
LREF = 5.9720 INCHES YMRP = .0000 INCHES
BREF = 4.5300 INCHES ZMRP = .0000 INCHES
SCALE = .0045 SCALE

PARAMETRIC DATA

BETA = .000 ELEVTR = .000
AILRON = .000 RUDDER = .000
BDFLAP = .000

RUN NO. 15/ 0 RN/L = 4.30 GRADIENT INTERVAL = -5.00/ 5.00

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	L/DF
20.300	18.000	.00000	.32012	.05054	-.01203	-.00133	.00036	-.00325	.28884	.14699	1.96504
20.300	20.000	.00000	.38606	.04908	-.01352	-.00172	.00034	-.00325	.34788	.17885	1.94511
20.300	23.000	.00000	.49208	.04785	-.01685	-.00218	.00031	-.00343	.43426	.23632	1.83760
20.300	26.000	.00000	.60883	.04661	-.02113	-.00274	.00026	-.00427	.52681	.30880	1.70597
20.300	28.000	.00000	.67854	.04539	-.02437	-.00290	.00016	-.00395	.57781	.35864	1.61113
20.300	30.000	.00000	.75737	.04464	-.02806	-.00320	.00010	-.00445	.63358	.41734	1.51813
20.300	33.000	.00000	.87935	.04235	-.03373	-.00354	-.00004	-.00483	.71442	.51445	1.38871
20.300	36.000	.00000	.99721	.03993	-.03965	-.00396	-.00016	-.00505	.78329	.61845	1.26655
20.300	39.000	.00000	1.12219	.03648	-.04628	-.00400	-.00024	-.00559	.84915	.73456	1.15599
20.300	42.000	.00000	1.23764	.03288	-.05292	-.00403	-.00035	-.00582	.89775	.85258	1.05298
20.300	45.000	.00000	1.36106	.02946	-.05948	-.00431	-.00043	-.00599	.94158	.98324	.95763
20.300	48.000	.00000	1.46662	.02569	-.06313	-.00445	-.00055	-.00629	.96227	1.10710	.86918
20.300	51.000	.00000	1.55815	.02209	-.06678	-.00519	-.00060	-.00662	.96341	1.22481	.78658
20.300	54.000	.00000	1.64796	.01745	-.07192	-.00498	-.00061	-.00680	.95453	1.34348	.71049
	GRADIENT	.00000	.03802	-.00090	-.00178	-.00010	-.00003	-.00011	.01985	.03422	-.03703

HE.T. 409 NAR ATP ORB (B1C1D1F1M1) (W1E1) (V1K1R1) (RO5016) (20 NOV 72)

REFERENCE DATA

SREF =	9.3900 SQ.IN.	XMRP =	3.8850 INCHES
LREF =	5.9720 INCHES	YMRP =	.0000 INCHES
BREF =	4.5300 INCHES	ZMRP =	.0000 INCHES
SCALE =	.0045 SCALE		

PARAMETRIC DATA

BETA =	.000	ELEVTR =	-20.000
AILRON =	.000	RUDDER =	.000
BDFLAP =	.000		

RUN NO. 16/ 0 RN/L = 4.30 GRADIENT INTERVAL = -5.00/ 5.00

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	L/DF
20.300	18.000	.00000	.28496	.05108	-.00143	-.00128	.00016	-.00306	.25523	.13664	1.86792
20.300	20.000	.00000	.34692	.04952	-.00092	-.00147	.00015	-.00359	.30906	.16518	1.87103
20.300	23.000	.00000	.43975	.04790	-.00093	-.00184	.00013	-.00357	.38608	.21591	1.78813
20.300	26.000	.00000	.54275	.04560	-.00145	-.00237	.00003	-.00420	.46783	.27891	1.67734
20.300	28.000	.00000	.60682	.04399	-.00218	-.00255	-.00004	-.00456	.51513	.32372	1.59128
20.300	30.000	.00000	.67512	.04258	-.00307	-.00294	-.00010	-.00500	.56338	.37443	1.50462
20.300	33.000	.00000	.78293	.03878	-.00514	-.00350	-.00028	-.00545	.63550	.45894	1.38470
20.300	36.000	.00000	.89089	.03482	-.00728	-.00371	-.00032	-.00586	.70028	.55183	1.26902
20.300	39.000	.00000	1.00117	.02957	-.00990	-.00414	-.00053	-.00652	.75945	.65303	1.16296
20.300	42.000	.00000	1.10994	.02416	-.01306	-.00412	-.00058	-.00657	.80868	.76065	1.06315
20.300	45.000	.00000	1.21239	.01856	-.01607	-.00457	-.00078	-.00707	.84417	.87041	.96985
20.300	48.000	.00000	1.31632	.01325	-.01734	-.00481	-.00086	-.00725	.87094	.98708	.88234
20.300	51.000	.00000	1.39614	.00816	-.01692	-.00512	-.00096	-.00756	.87228	1.09014	.80016
20.300	54.000	.00000	1.46851	.00199	-.01679	-.00538	-.00102	-.00757	.86156	1.18922	.72448
	GRADIENT	.00000	.03402	-.00138	-.00056	-.00012	-.00004	-.00013	.01814	.03019	-.03432

HE.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1R1R1) (RO6017) (20 NOV 72)

REFERENCE DATA

SREF = 9.3900 SQ.IN. XMRP = 3.8850 INCHES
LREF = 3.9720 INCHES YMRP = .0000 INCHES
BREF = 4.5300 INCHES ZMRP = .0000 INCHES
SCALE = .0045 SCALE

PARAMETRIC DATA

BETA = .000 ELEVTR = -40.000
AILRON = .000 RUDDER = .000
BDFLAP = .000

RUN NO. 17/ 0 RN/L = 4.30 GRADIENT INTERVAL = -5.00/ 5.00

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	L/DF
20.300	18.000	.00000	.27227	.05859	.00269	-.00119	-.00007	-.00297	.24084	.13986	1.72204
20.300	20.000	.00000	.33295	.05572	.00305	-.00126	-.00004	-.00300	.29381	.16623	1.76747
20.300	23.000	.00000	.42378	.05358	.00312	-.00153	.00002	-.00321	.36916	.21490	1.71778
20.300	26.000	.00000	.52790	.05201	.00284	-.00183	-.00001	-.00372	.45168	.27816	1.62379
20.300	28.000	.00000	.58911	.05109	.00275	-.00208	-.00007	-.00401	.49616	.32168	1.54240
20.300	30.000	.00000	.65368	.04966	.00233	-.00220	-.00015	-.00445	.54127	.36984	1.46352
20.300	33.000	.00000	.76272	.04739	.00143	-.00240	-.00026	-.00465	.61386	.45515	1.34869
20.300	36.000	.00000	.86687	.04455	.00036	-.00273	-.00034	-.00499	.67512	.54557	1.23746
20.300	39.000	.00000	.97037	.04080	-.00063	-.00283	-.00048	-.00539	.72844	.64238	1.13397
20.300	42.000	.00000	1.07286	.03709	-.00192	-.00281	-.00060	-.00523	.77247	.74545	1.03625
20.300	45.000	.00000	1.16838	.03313	-.00276	-.00267	-.00076	-.00615	.80274	.84959	.94485
20.300	48.000	.00000	1.26887	.02889	-.00282	-.00304	-.00093	-.00610	.82757	.96229	.86000
20.300	51.000	.00000	1.33539	.02522	-.00025	-.00309	-.00110	-.00671	.82079	1.05367	.77898
20.300	54.000	.00000	1.41267	.02094	.00080	-.00300	-.00118	-.00633	.81340	1.15518	.70414
	GRADIENT	.00000	.03267	-.00102	-.00015	-.00005	-.00003	-.00011	.01705	.02912	-.03176

HE.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1) (ROS020) (20 NOV 72)

REFERENCE DATA

SREF = 9.3900 SQ.IN. XMRP = 3.8850 INCHES
LREF = 5.9720 INCHES YMRP = .0000 INCHES
BREF = 4.5300 INCHES ZMRP = .0000 INCHES
SCALE = .0045 SCALE

PARAMETRIC DATA

BETA = .000 ELEVTR = .000
AILRON = .000 RUDDER = .000
BDFLAP = .000

RUN NO. 20/ 0 RN/L = 4.30 GRADIENT INTERVAL = -5.00/ 5.00

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	L/DF
20.300	-1.500	.00000	-.05319	.07313	-.01279	.00086	.00047	-.00500	-.05126	.07450	-.68800
20.300	.000	.00000	-.03801	.07225	-.01252	.00076	.00027	-.00476	-.03801	.07225	-.52615
20.300	2.000	.00000	-.01753	.06986	-.01187	.00035	-.00012	-.00336	-.01995	.06921	-.28830
20.300	4.000	.00000	.01209	.06696	-.01197	.00024	-.00020	-.00227	.00739	.06764	.10925
20.300	6.000	.00000	.04392	.06482	-.01150	.00009	-.00024	-.00125	.03691	.06906	.53442
20.300	8.000	.00000	.07767	.06253	-.01112	-.00017	-.00023	-.00093	.06821	.07273	.93786
20.300	10.000	.00000	.11793	.06078	-.01078	-.00039	-.00017	-.00079	.10558	.08033	1.31429
20.300	12.000	.00000	.16273	.05863	-.01057	-.00056	-.00004	-.00047	.14698	.09118	1.61198
20.300	14.000	.00000	.21531	.05657	-.01082	-.00085	.00009	-.00041	.19523	.10698	1.82488
20.300	16.000	.00000	.26706	.05426	-.01128	-.00101	.00012	.00001	.24176	.12577	1.92230
20.300	18.000	.00000	.32797	.05293	-.01190	-.00123	.00008	.00034	.29556	.15168	1.94855
20.300	20.000	.00000	.39055	.05215	-.01310	-.00151	.00003	.00085	.34916	.18258	1.91240
20.300	23.000	.00000	.48104	.05119	-.01567	-.00181	-.00007	.00151	.42280	.23508	1.79857
20.300	26.000	.00000	.60126	.05057	-.02014	-.00251	-.00019	.00229	.51824	.30902	1.67703
	GRADIENT	.00000	.01174	-.00114	.00017	-.00012	-.00013	.00052	.01054	-.00127	.14311

HE.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1) (ROS026) (20 NOV 72)

REFERENCE DATA

SREF = 9.3900 SQ.IN. XMRP = 3.8850 INCHES
LREF = 5.9720 INCHES YMRP = .0000 INCHES
BREF = 4.5300 INCHES ZMRP = .0000 INCHES
SCALE = .0045 SCALE

PARAMETRIC DATA

BETA = -4.500 ELEVTR = .000
AILRON = .000 RUDDER = .000
BDFLAP = .000

RUN NO. 26/ 0 RN/L = 4.30 GRADIENT INTERVAL = -5.00/ 5.00

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	L/DF
20.300	-1.505	-4.46847	-.05490	.07425	-.01250	-.00016	.00687	.04048	-.05293	.07567	-.69953
20.300	.000	-4.47000	-.04020	.07253	-.01239	-.00001	.00734	.03931	-.04020	.07253	-.55425
20.300	2.006	-4.46727	-.01686	.06927	-.01216	-.00027	.00721	.03899	-.01928	.06864	-.28084
20.300	4.012	-4.45909	.00833	.06707	-.01208	-.00007	.00738	.03700	.00362	.06749	.05363
20.300	6.018	-4.44546	.03770	.06558	-.01178	.00067	.00745	.03572	.03061	.06917	.44259
20.300	8.024	-4.42641	.07398	.06383	-.01140	.00120	.00748	.03429	.06434	.07354	.87499
20.300	10.030	-4.40196	.11341	.06203	-.01135	.00165	.00765	.03300	.10087	.08083	1.24791
20.300	12.036	-4.37213	.15567	.06064	-.01145	.00199	.00781	.03181	.13961	.09177	1.52127
20.300	14.041	-4.33696	.20567	.05886	-.01184	.00239	.00802	.03106	.18524	.10700	1.73121
20.300	16.046	-4.29651	.26179	.05661	-.01220	.00262	.00812	.02966	.23595	.12677	1.86129
20.300	18.051	-4.25081	.32268	.05534	-.01301	.00306	.00790	.02897	.28965	.15260	1.89807
	GRADIENT	.00172	.01152	-.00134	.00008	-.00000	.00007	-.00058	.01031	-.00152	.13737

HE.T. 409 NAR ATP ORB(B1C1D1F1M1)(W1E1)(V1K1R1) (ROS027) (20 NOV 72)

REFERENCE DATA

SREF = 9.3900 SQ.IN. XMRP = 3.6850 INCHES
LREF = 5.9720 INCHES YMRP = .0000 INCHES
BREF = 4.5300 INCHES ZMRP = .0000 INCHES
SCALE = .0045 SCALE

PARAMETRIC DATA

BETA = -2.250 ELEVTR = .000
AILRON = .000 RUDDER = .000
BDFLAP = .000

RUN NO. 27/ 0 RN/L = 4.30 GRADIENT INTERVAL = -5.00/ 5.00

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	L/DF
20.300	18.013	-2.13982	.33185	.05165	-.01160	.00123	.00464	.00941	.29961	.15174	1.97454
20.300	20.014	-2.11424	.39581	.05027	-.01281	.00137	.00444	.00810	.35470	.18270	1.94147
20.300	23.016	-2.07105	.48412	.04888	-.01510	.00159	.00416	.00715	.42647	.23427	1.82044
20.300	26.017	-2.02219	.59781	.04693	-.01891	.00158	.00389	.00463	.51664	.30440	1.69725
20.300	28.018	-1.98652	.67548	.04590	-.02211	.00169	.00378	.00266	.57475	.35783	1.60622
20.300	30.019	-1.94843	.74220	.04437	-.02505	.00169	.00359	.00166	.62045	.40973	1.51428
20.300	33.020	-1.88686	.85390	.04226	-.03059	.00167	.00333	-.00054	.69295	.50075	1.38381
	GRADIENT	.01676	.03497	-.00061	-.00125	.00003	-.00009	-.00067	.02656	.02315	-.04055

LRC 22HE-409, ATP ORBITER + EXTERNAL TANK (T1) (ROS030) (27 NOV 72)

REFERENCE DATA

SREF = 9.3900 SQ.IN. XMRP = 3.6850 INCHES
LREF = 5.9720 INCHES YMRP = .0000 INCHES
BREF = 4.5300 INCHES ZMRP = .0000 INCHES
SCALE = .0045 SCALE

PARAMETRIC DATA

BETA = .000 ELEVTR = .000
AILRON = 20.000 RUDDER = .000
BDFLAP = .000

RUN NO. 30/ 0 RN/L = 4.30 GRADIENT INTERVAL = -5.00/ 5.00

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	L/DF
20.300	-15.000	.00000	-.46763	.26830	-.13914	.04237	.02242	-.00659	-.38226	.38019	-1.00543
20.300	-12.000	.00000	-.38804	.24827	-.11945	.03672	.01814	-.00573	-.32794	.32352	-1.01365
20.300	-9.000	.00000	-.33805	.22941	-.09039	.04260	.02274	-.00796	-.29801	.27947	-1.06634
20.300	-6.000	.00000	-.23109	.18695	-.07677	.02698	.01425	-.00618	-.21023	.21008	-1.00096
20.300	-3.000	.00000	-.14733	.15877	-.05643	.01740	.00878	-.00547	-.13882	.16627	-.83494
20.300	-1.000	.00000	-.10040	.14447	-.03651	.01382	.00742	-.00488	-.09787	.14620	-.66940
20.300	.000	.00000	-.07669	.13995	-.02253	.01250	.00659	-.00487	-.07669	.13995	-.54800
20.300	1.000	.00000	-.05898	.13825	-.00939	.01150	.00592	-.00584	-.06138	.13720	-.44738
20.300	3.000	.00000	-.02040	.13801	.00948	.00865	.00201	-.00548	-.02759	.13675	-.20176
20.300	6.000	.00000	.04042	.12183	.03133	.00442	-.00134	-.00580	.02746	.12538	.21903
20.300	9.000	.00000	.10091	.11625	.05592	.00313	-.00240	-.00621	.08148	.13060	.62390
20.300	12.000	.00000	.13251	.11525	.07661	.00271	-.00375	-.00774	.10565	.14028	.75311
20.300	15.000	.00000	.18220	.15817	.09449	.00278	-.01173	.00113	.13506	.19994	.67549
	GRADIENT	.00000	.02111	-.00342	.01124	-.00143	-.00109	-.00005	.01851	-.00488	.10608

LRC 22ME-409, ATP ORBITER + EXTERNAL TANK (T1) (ROS031) (27 NOV 72)

REFERENCE DATA

SREF = 9.3900 SQ.IN. XMRP = 3.8850 INCHES
LREF = 5.9720 INCHES YMRP = .0000 INCHES
BREF = 4.5300 INCHES ZMRP = .0000 INCHES
SCALE = .0045 SCALE

PARAMETRIC DATA

BETA = .000 ELEVTR = .000
AILRON = .000 RUDDER = .000
BDFLAP = .000

RUN NO. 31/ 0 RN/L = 4.30 GRADIENT INTERVAL = -5.00/ 5.00

MACH	ALPHA	BETA	CN	CAF	CLM	CBL	CYN	CY	CL	CDF	L/DF
20.300	-15.000	.00000	-.35943	.21634	-.16820	.00522	.00050	-.00004	-.29119	.30200	-.96420
20.300	-12.000	.00000	-.29567	.20474	-.14377	.00455	.00045	-.00061	-.24664	.26174	-.94229
20.300	-9.000	.00000	-.23910	.18051	-.11753	.00495	.00134	-.00235	-.20792	.21569	-.96399
20.300	-6.000	.00000	-.16597	.15674	-.09439	.00284	.00060	-.00214	-.14867	.17323	-.85823
20.300	-3.000	.00000	-.10670	.13992	-.06735	.00188	.00018	-.00178	-.09924	.14532	-.68290
20.300	-1.000	.00000	-.06653	.12964	-.04519	.00117	.00070	-.00196	-.06425	.13078	-.49132
20.300	.000	.00000	-.04622	.12580	-.03003	.00089	.00115	-.00171	-.04622	.12580	-.36745
20.300	1.000	.00000	-.02826	.12827	-.01700	.00058	.00094	-.00260	-.03049	.12776	-.23866
20.300	3.000	.00000	.00281	.12938	.00358	.00056	-.00151	-.00365	-.00396	.12935	-.03063
20.300	6.000	.00000	.05290	.11831	.02843	.00016	-.00279	-.00391	.04024	.12319	.32663
20.300	9.000	.00000	.11134	.11444	.05368	-.00034	-.00344	-.00555	.09206	.13045	.70574
20.300	12.000	.00000	.14156	.11363	.07389	-.00057	-.00432	-.00758	.11484	.14058	.81686
20.300	15.000	.00000	.18406	.11246	.09596	-.00081	-.00467	-.00799	.14868	.15626	.95150
	GRADIENT	.00000	.01834	-.00165	.01205	-.00023	-.00024	-.00031	.01598	-.00255	.11047