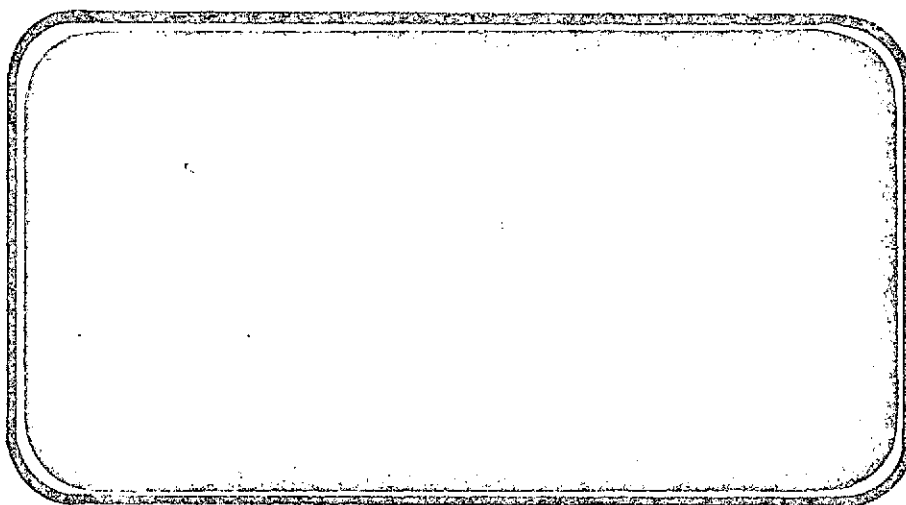




NATIONAL AERONAUTICS AND SPACE ADMINISTRATION



NASA-CR-134076) HEAT TRANSFER PHASE
CHANGE PAINT TEST (OH-42) OF A ROCKWELL
INTERNATIONAL SSV ORBITER IN THE NASA/LRC
MACH 8 VARIABLE DENSITY WIND (Chrysler
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SPACE SHUTTLE

AEROTHERMODYNAMIC DATA REPORT



JOHNSON SPACE CENTER

HOUSTON, TEXAS

DATA Management services

SPACE DIVISION



CHRYSLER CORPORATION

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HEAT TRANSFER PHASE CHANGE PAINT TEST (OH-42)
OF A ROCKWELL INTERNATIONAL SSV ORBITER IN THE
NASA/LRC MACH 8 VARIABLE DENSITY WIND TUNNEL

By

NASA Project Engineers	Rockwell International Engineers	
R. Jones	M. Quan	H. Gorowitz
T. Creel	W. Dye	C. Craig
P. Lawing	J. Cummings	G. Rich

Prepared under NASA Contract Number NAS9-13247

by

Data Management Services
Chrysler Corporation Space Division
New Orleans, La. 70189

for

Engineering Analysis Division

Johnson Space Center
National Aeronautics and Space Administration
Houston, Texas

TEST PURPOSE: To determine underbody aerodynamic heating rates of various orbiter wing configurations during simulated entry conditions.

TESTING AGENCY: NASA/LRC Variable Density Hypersonic Wind Tunnel

TEST NO'S AND DATES: OH-42A - 5/14/73 to 5/18/73

OH-42B - 5/24/73 to 6/1/73

OH-42C - 6/14/73 to 6/15/73

NASA PROJECT ENGINEERS: R. Jones, Rm 217A

T. Creel, Rm 202

P. Lawing, Rm 215

NASA Langley Research Center
Hampton, Virginia
HVD Aerodynamic & Heating Section
Mail Stop 160A
Bldg. 1247A

ROCKWELL INTERNATIONAL
ENGINEERS:

M. Quan

W. Dye

J. Cummings

H. Gorowitz

C. Craig


G. Rich

12214 Lakewood Blvd.,
Mail Code AC07
Downey, California

DATA MANAGEMENT SERVICES:

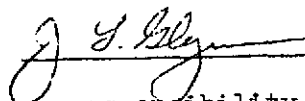
This document has been prepared by:

G. G. McDonald
Data Operations



This document has been reviewed and is approved for release.

FOR N. D. Kemp
Data Management Services



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SUMMARY

This report presents the results of the phase change paint tests of a Rockwell International .00593-scale Space Shuttle Orbiter conducted in the Langley Research Center's Variable Density Wind Tunnel. The tests were conducted in three parts: OH-42A, B and C from May 14, to May 18, 1973, May 24, to June 1, 1973, and June 14 to June 15, 1973 respectively.

The test objectives of OH-42A and B were to determine the effects of various wing/underbody configurations on the aerodynamic heating rates and boundary layer transition during simulated entry conditions. Several models were constructed. Each varied from the other in either wing cuff radius, airfoil thickness, or wing-fuselage underbody blending. Two ventral fins were glued to the fuselage underside of one model to test the interference heating effects. Simulated Mach 8 entry data were obtained for each configuration at angles of attack ranging from 25 to 40°, and a Reynolds Number variation of 1×10^6 to 8×10^6 . Elevon, bodyflap, and rudder flare deflections were tested on Configuration No. 4.

Oil flow visualization and Schlieren photographs were obtained to aid in reducing the phase change paint data as well as to observe the flow patterns peculiar to each configuration. A total of 22 and 64 runs were conducted during OH-42A and B respectively.

The objective of the OH-42C tests was to determine the effects of 17° and 34° leading edge sweep trimmers on the underbody aerodynamic heating rates during simulated entry conditions. Mach 8 data were obtained for angles of attack of 25, 30, and 35° and Reynolds Numbers of 1, 3, and 6×10^6 . Twenty-four runs were conducted during OH-42C.

SUMMARY - Continued

This report makes no attempt to analyze the data obtained, but outlines the model description, testing procedure, data reduction, and presents the phase change point data.

Cognizant personnel include:

M. Quan	Wind Tunnel Operations
W. Dye	Wind Tunnel Operations
J. Cummings	Wind Tunnel Operations
C. Craig	Aerothermodynamics
H. Gorowitz	Aerothermodynamics

INDEX OF MODEL PHOTOGRAPHS AND SKETCHES

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Sketch 16

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PHASE CHANGE PAINT DATA - TOP CAMERA

OH42A runs 4084 to 4105	14 to 30
OH42B runs 4130 to 4193	31 to 86
OH42C runs 4271 to 4295	87 to 102

PHASE CHANGE PAINT DATA - SIDE CAMERA

OH42A runs 4084 to 4105	103 to 120
OH42B runs 4130 to 4193	121 to 175
OH42C runs 4271 to 4288	176 to 186

LIST OF TABLES

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NOMENCLATURE

- C_p = Specific heat of model material (BTU/LB°F)
 g = Gravitational constant (32.2 lb_m/lb_f ft/sec²)
 h = Model thin film heat transfer coefficient (BTU/FT²-sec-°F)
 h_s = Theoretical thin film heat transfer coefficient (BTU/FT²-sec-°F)
 k = Thermoconductivity of model material (BTU/FT-sec-°F) or as noted
 M_{∞} = Tunnel freestream Mach Number
 N_r = Model nose radius (Ft)
 P_{TOTAL} = Tunnel total pressure (psi)
 \dot{q} = Model aerodynamic heating rate
 R = Universal gas constant = 53.35 $\frac{FT-lb_f}{lb_m - ^\circ R}$
 t = Time in seconds
 T_{aw} = Model adiabatic wall temperature (°F)
 T_{IN} = Model initial temperature (°F)
 $T_o = T_{TOTAL}$ = Tunnel stagnation temperature (°F)
 T_{PC} = Phase change point melting temperature (°F)
 Pr = Prandtl number

Greek Symbols

- α = Angle of attack, degrees
 γ = Ratio of specific heats (1.4)
 ρ_s = Tunnel stagnation density (lb_m/ft³)
 ρ_w = Air density along model wall (lb_m/ft³)
 μ_s = Stagnation air viscosity (lb_m/ft-sec)
 μ_w = Air viscesity along model wall (lb_m/ft-sec)

NOMENCLATURE - Continued

Subscripts

- s = Theoretical
- ∞ = Freestream
- o = Stagnation conditions
- aw = Adiabatic wall
- IN = initial
- w = model wall
- β = angle of sideslip, degrees,
unless subscripted otherwise

TEST FACILITY DESCRIPTION

The Langley Mach 8 Variable-Density Hypersonic Tunnel is located in Building 1247D and is under the direction of the Aero-Physics Division. This tunnel is used for fundamental aerodynamic and fluid dynamic investigations over large Reynolds number ranges using pressure and heat transfer measurements. The test medium is air and is heated by a combination of Dowtherm and electrical resistance. Model mounting consists of sting mount with injection mechanism. The tunnel has an axially symmetric contoured nozzle. The test section diameter is 18 inches with a core of 4 to 14 inches depending on pressure. It exhausts into a vacuum tank or the atmosphere.

Examples of operating conditions are as follows:

Stagnation pressure (PSIA).....	15 to 2930
Stagnation temperature ($^{\circ}$ R).....	1160 to 1510
Mach Number.....	7.5 to 8.0
Reynolds number per foot (1/ft)	0.1×10^6 to 12.0×10^6
Running time (SEC), for	
Exhausting into vacuum tank	90
Exhausting into atmosphere	600

46-0 MODEL DESCRIPTION

The models tested were .00593 scale, full-span models of various Rockwell International Space Shuttle Orbiter Configurations (Models 46-0).

Eight orbiter models were provided in six different configurations defined by the reference drawings below. Configuration #1 uses the 139 Orbiter Configuration. Configuration #2 differs from #1 only by the 500-inch leading edge cuff radius. Configuration #3 is the same as #1, except for airfoil thickness, Configuration #4 is the same as #1, except that the underside of the wing-body is smoothly faired to an saucer shape. Configuration #5 and #6 are the same as Configuration #4, except with the addition of a 17° and a 34° trimmer respectively. Of the eight models, seven were actual test articles, and one was painted with a stripe-reference system to facilitate the data reduction. The models were cast around a steel sting using the Grumman Aerospace Corporation's proprietary Material "G".

In order to obtain valid melting-rate data, the upper surface of each wing was slabbed using two control butt line stations. At B.L. 199.045, the section was slabbed in a straight line from the 40 percent chord to a trailing edge thickness 0.21-inch. At B.L. 468.34, the slabbing was from the 40 percent chord to a trailing edge thickness of 0.060-inch. The rest of the wing was slabbed from the 40 percent chord to a straight line between these two points on the trailing edge.

The elevon, rudder, and body-flap deflections were separate wedge pieces and were glued on when needed. The control surface deflections tested were as follows:

46-0 MODEL DESCRIPTION - Continued

Elevons (both sides): 0° and +10° (positive deflections are trailing edge down)

Body flap: 0° and +10°

Rudder: 20° flare on starboard side only, port undeflected.

Listed below are the configurations tested:

<u>No. of Models</u>	<u>Model No.</u>	<u>Drawing No.</u>	<u>Components</u>
3	46-1	VL70-000139	B ₁₇ C ₇ M ₄ F ₅ W ₁₀₃ E ₂₂ V ₇ R ₅
1	46-2	VL70-000139 Mod.	B ₁₇ C ₇ M ₄ F ₅ W ₁₀₅ E ₂₂ V ₇ R ₅
1	46-3	VL70-000139A	B ₁₇ C ₇ M ₄ F ₅ W ₁₀₄ E ₂₂ V ₇ R ₅
1	46-4	VL70-000139A Mod.	B ₁₇ C ₇ M ₄ F ₅ W ₁₀₆ E ₂₂ V ₇ R ₅
1	46-5	VL70-000139A +17° trimmer	B ₁₇ C ₇ M ₄ F ₅ W ₁₀₆ E ₂₂ V ₇ R ₅ H ₁₆
1	46-6	VL70-000139A +34° trimmer	B ₁₇ C ₇ M ₄ F ₅ W ₁₀₆ E ₂₂ V ₇ R ₅ H ₁₇

(Reference Sketch 16)



MODEL COMPONENT: Body (B₁₇)

GENERAL DESCRIPTION: Basic fuselage for models 46-1, -2, -3, -4.

Model Scale = 0.00593

DRAWING NUMBER VL70-000139

<u>DIMENSION:</u>	<u>FULL SCALE</u>	<u>MODEL SCALE</u>
Length ~ in.	<u>1290.3</u>	<u>7.65148</u>
Max Width ~ in.	<u>267.6</u>	<u>1.58687</u>
Max Depth ~ in.	<u>244.5</u>	<u>1.44988</u>
Fineness Ratio	<u>4.82175</u>	<u>4.82175</u>
Area ~ ft ²		
Max Cross-Sectional	<u>386.67</u>	<u>0.01360</u>
Planform	<u> </u>	<u> </u>
Wetted	<u> </u>	<u> </u>
Base	<u> </u>	<u> </u>



MODEL COMPONENT: Canopy (C₇)

GENERAL DESCRIPTION: 3 configurations per lines VL70-000139. Insufficient information to complete dimensional data at this time.

Model Scale = 0.0175

DRAWING NUMBER VL70-000139

<u>DIMENSION:</u>	<u>FULL SCALE</u>	<u>MODEL SCALE</u>
Length (Sta. Fwd. Bulkhead)	432.70	7.57225
Max Width (T.E. Bulkhead)	571.40	9.99950
Max Depth (WPZ ₀ = _____ to Z ₀ = 501)		
Fineness Ratio		
Area		
Max Cross-Sectional		
Planform		
Wetted		
Base		

MODEL COMPONENT: OMS Pod (M₄)

GENERAL DESCRIPTION: OMS Pods located on the aft orbiter fuselage.

Model Scale = 0.00593

DRAWING NUMBER VL70-000139

<u>DIMENSION:</u>	<u>FULL SCALE</u>	<u>MODEL SCALE</u>
Length ~ in.	<u>346.0</u>	<u>2.05178</u>
Max Width ~ in.	<u>108.0</u>	<u>0.64044</u>
Max Depth ~ in.	<u>113.0</u>	<u>113.0</u>
Fineness Ratio	<u> </u>	<u> </u>
Area		
Max Cross-Sectional	<u> </u>	<u> </u>
Planform	<u> </u>	<u> </u>
Wetted	<u> </u>	<u> </u>
Base	<u> </u>	<u> </u>

G_L of OMS Pod

WP = 463.9 in. F.S.: WP 400 + 63.9 = 463.9

BP = 80.0 in. F.S.

Length 1214.0 to 1560.0 = 346.0 in. F.S.

NOTE: M₄ identical to M₃ of 2A configuration except intersection to body

MODEL COMPONENT: Body Flap (F₅)

GENERAL DESCRIPTION: Body flap located on the lower aft end of the orbiter fuselage.

Model Scale = 0.00593

DRAWING NUMBER VL70-000139

<u>DIMENSION:</u>	<u>FULL SCALE</u>	<u>MODEL SCALE</u>
Length ~ in.	<u>84.70</u>	<u>0.50227</u>
Max Width ~ in.	<u>267.6</u>	<u>1.58687</u>
Max Depth	<u> </u>	<u> </u>
Fineness Ratio	<u> </u>	<u> </u>
Area ~ ft ²	<u> </u>	<u> </u>
Max Cross-Sectional Planform	<u>142.5195</u>	<u>0.00501</u>
Wetted	<u> </u>	<u> </u>
Base	<u>38.0958</u>	<u>0.00134</u>

MODEL COMPONENT: Wing (W₁₀₃)—New lightweight orbiter

GENERAL DESCRIPTION: Orbiter wing for model 46-1

NOTE: Dihedral angle is defined at the lower surface of the wing at the 75.33 percent element line projected into a plane perpendicular to the FRL.

Model Scale = 0.00593

TEST NO. _____ DWG. NO. VL70-000139

DIMENSIONS: FULL-SCALE MODEL SCALE

TOTAL DATA

Area, (Theo.) ft ²		
Planform	2690.00	0.09459
Span, (Theo.) in.	936.68	5.55451
Aspect Ratio	2.265	2.265
Rate of Taper	1.177	1.177
Taper Ratio	0.200	0.200
Dihedral Angle, degrees (@ T.E. of Elevon)	3.500	3.500
Incidence Angle, degrees	3.000	3.000
Aerodynamic Twist, degrees	+3.000	+3.000
Sweepback angles, degrees		
Leading Edge	45.000	45.000
Trailing Edge	-10.24	-10.24
0.25 Element Line	35.209	35.209
Chords:		
Root, (Theo.) B.P.O.O.	689.24	4.08719
Tip, (Theo.) B.P.	137.85	0.81745
MAC	474.81	2.81562
Fus. Sta. of 0.25 MAC	1136.89	6.74176
W.P. of 0.25 MAC	299.20	1.77426
B.L. of 0.25 MAC	182.13	1.08003

EXPOSED DATA

Area, (Theo.) ft ²	1752.29	0.06162
Span, (Theo.) in. BP108	720.68	4.27363
Aspect Ratio	2.058	2.058
Taper Ratio	0.2451	0.2451
Chords		
Root BP108	562.40	3.33503
Tip 1.00 b/2	137.85	0.81745
MAC	393.03	2.33067
Fus. Sta. of 0.25 MAC	1185.31	7.02889
W.P. of 0.25 MAC	300.20	1.78019
B.L. of 0.25 MAC	143.76	0.85250
Airfoil Section (Rockwell Mod NASA) XXXX-64		
Root b/2 = 0.425	0.10	0.10
Tip b/2 =	0.12	0.12

Data for (1) of (2) Sides

Leading Edge Cuff		
Planform Area ft ²	120.33	0.00423
Leading Edge Intersects Fus M. L. @ Sta	560.0	3.32080
Leading Edge Intersects Wing @ Sta	1035.0	6.13755



MODEL COMPONENT: Wing (W₁₀₄)—New lightweight orbiter

GENERAL DESCRIPTION: Orbiter wing for Model 46-3.

NOTE: Dihedral

angle is defined at the lower surface of the wing at the 75.33-percent element line projected into a plane perpendicular to the FRL.

Model Scale = 0.00593

TEST NO.

DWG. NO. VL70-000139A

DIMENSIONS:

FULL-SCALE

MODEL SCALE

TOTAL DATA

Area, (Theo.) ft ²	2690.00	0.09459
Planform	936.68	5.55451
Span, (Theo.) in.	2.265	2.265
Aspect Ratio	1.177	1.177
Rate of Taper	0.200	0.200
Taper Ratio	3.500	3.500
Dihedral Angle, degrees (@ T.E. of Elevon)	3.000	3.000
Incidence Angle, degrees	+3.000	+3.000
Aerodynamic Twist, degrees		
Sweepback Angles, degrees	45.000	45.000
Leading Edge	-10.24	-10.24
Trailing Edge	35.209	35.209
0.25 Element Line		
Chords:		
Root, (Theo.) B.P.O.O.	689.24	4.08719
Tip, (Theo.) B.P. 468.341	137.85	0.81745
MAC	474.81	2.81562
Fus. Sta. of 0.25 MAC	1136.89	6.74176
W.P. of 0.25 MAC	299.20	1.77426
B.L. of 0.25 MAC	182.13	1.08003

EXPOSED DATA

Area, (Theo.) ft ²	1752.29	0.06162
Span, (Theo.) in. BP108 + 468.341	720.68	4.27363
Aspect Ratio	2.058	2.058
Taper Ratio	0.2451	0.2451
Chords		
Root BP108	562.40	3.33503
Tip 1.00 b/2	137.85	0.81745
MAC	393.03	2.33067
Fus. Sta. of 0.25 MAC	1185.31	7.02889
W.P. of 0.25 MAC	300.20	1.78019
B.L. of 0.25 MAC	143.76	0.85250
Airfoil Section (Rockwell Mod NASA)		
XXXX-64	0.12	0.12
Root b/2 = 0.425		
Tip b/2 = 1.00	0.12	0.12

Data for (1) of (2) Sides

Leading Edge Cuff	1	
Planform Area ft ²	120.33	0.00423
Leading Edge Intersects Fus M. L. @ Sta	560.0	3.32080
Leading Edge Intersects Wing @ Sta	1035.0	6.13755

NOTE: W₁₀₄ identical to W₁₀₃ except airfoil thickness. SD 73-SH-0122



MODEL COMPONENT: Wing (W₁₀₅)—New lightweight orbiter

GENERAL DESCRIPTION: Orbiter wing for Model 46-2.

NOTE: W₁₀₅ identical to W₁₀₃ except 500-inch radius used to connect cuff to wing.

Model Scale = 0.00593

TEST NO.

DWG. NO. VL70-000139 MOD

DIMENSIONS:

FULL-SCALE

MODEL SCALE

TOTAL DATA

Area, (Theo.) ft²

Planform

2690.00

0.09459

Span, (Theo.) in.

936.68

5.55451

Aspect Ratio

2.265

2.265

Rate of Taper

1.177

1.177

Taper Ratio

0.200

0.200

Dihedral Angle, degrees

3.500

3.500

Incidence Angle, degrees

3.000

3.000

Aerodynamic Twist, degrees

+3.000

+3.000

Sweepback Angles, degrees:

Leading Edge

45.000

45.000

Trailing Edge

-10.24

-10.24

0.25 Element Line

35.209

35.209

Chords:

Root, (Theo.) B.P.O.O.

689.24

4.08719

Tip, (Theo.) B.P.

137.85

0.81745

MAC

474.81

2.81562

Fus. Sta. of 0.25 MAC

1136.89

6.74176

W.P. of 0.25 MAC

299.20

1.77426

B.L. of 0.25 MAC

182.13

1.08003

EXPOSED DATA

Area, (Theo.) ft²

1752.29

0.06162

Span, (Theo.) in. BP108

720.68

4.27363

Aspect Ratio

2.058

2.058

Taper Ratio

0.2451

0.2451

Chords

Root BP108

562.40

3.33503

Tip 1.00 b/2

137.85

0.81745

MAC

393.03

2.33067

Fus. Sta. of 0.25 MAC

1185.31

7.02889

W.P. of 0.25 MAC

300.20

1.78019

B.L. of 0.25 MAC

143.76

0.85250

Airfoil Section (Rockwell Mod NASA)

XXXX-64

0.10

0.10

Root b/2 = 0.425

0.12

0.12

Tip b/2 =

Data for (1) of (2) Sides

Leading Edge Cuff ²

122.67

0.00431

Planform Area ft²

569.50

3.3771

Leading Edge Intersects Fus M. L. @ Sta

1135.4

6.7329

Leading Edge Intersects Wing @ Sta

MODEL COMPONENT: Wing (W106)--Data not available

GENERAL DESCRIPTION: Same as W104 except that the underside of the wing-body is smoothly faired to a saucer shape.

TEST NO. _____ DWG. NO. _____

DIMENSIONS: _____ FULL-SCALE _____ MODEL SCALE _____

TOTAL DATA

Area (Theo) Ft²

Planform

Span (Theo In.

Aspect Ratio

Rate of Taper

Taper Ratio

Dihedral Angle, degrees

Incidence Angle, degrees

Aerodynamic Twist, degrees

Sweep Back Angles, degrees

Leading Edge

Trailing Edge

0.25 Element Line

Chords:

Root (Theo) B.P.O.O.

Tip, (Theo) B.P.

MAC

Fus. Sta. of .25 MAC

W.P. of .25 MAC

B.L. of .25 MAC

EXPOSED DATA

Area (Theo) Ft²

Span, (Theo) In. BP108

Aspect Ratio

Taper Ratio

Chords

Root BP108

Tip 1.00 $\frac{b}{2}$

MAC

Fus. Sta. of .25 MAC

W.P. of .25 MAC

B.L. of .25 MAC

Airfoil Section (Rockwell Mod NASA)
XXXX-64

Root $\frac{b}{2}$ = _____

Tip $\frac{b}{2}$ = _____

Data for (1) of (2) Sides

Leading Edge Cuff 2

Planform Area Ft²

Leading Edge Intersects Fus M. L. @ Sta. _____

Leading Edge Intersects Wing @ Sta. _____

MODEL COMPONENT: Elevon (E₂₂)

GENERAL DESCRIPTION: Elevon for W₁₀₃, W₁₀₄, W₁₀₅, W₁₀₆

VL70-000139 data for (1) of (2) sides

Model Scale = 0.00593

DRAWING NUMBER: VL70-000139

<u>DIMENSIONS:</u>	<u>FULL-SCALE</u>	<u>MODEL SCALE</u>
Area ~ Ft ²	<u>205.52</u>	<u>0.00723</u>
Span (equivalent) ~ in.	<u>353.34</u>	<u>2.09531</u>
Inb'd equivalent chord	<u>114.78</u>	<u>0.68064</u>
Outb'd equivalent chord	<u>55.00</u>	<u>0.32615</u>
Ratio movable surface chord/ total surface chord		
At Inb'd equiv. chord	<u>0.208</u>	<u>0.208</u>
At Outb'd equiv. chord	<u>0.400</u>	<u>0.400</u>
Sweepback Angles, degrees		
Leading Edge	<u>0.00</u>	<u>0.00</u>
Trailing Edge	<u>-10.24</u>	<u>-10.24</u>
Hinge Line	<u>0.00</u>	<u>0.00</u>
Area Moment (Normal to hinge line) ~ ft ³	<u>1548.07</u>	<u>0.00032</u>
Product of Area Moment		



MODEL COMPONENT: Vertical (V₇)—Lightweight orbiter configuration.

GENERAL DESCRIPTION: Centerline vertical tail, double-wedge airfoil with rounded leading edge.

Model Scale = 0.00593

DRAWING NUMBER:

VL70-0000139

VL70-000095

DIMENSIONS:

FULL-SCALE

MODEL SCALE

TOTAL DATA

Area, (Theo.) ft ²	<u>425.92</u>	<u>0.01498'</u>
Planform		
Span, (Theo.) in.	<u>315.72</u>	<u>1.87222</u>
Aspect Ratio	<u>1.675</u>	<u>1.675</u>
Rate of Taper	<u>0.507</u>	<u>0.507</u>
Taper Ratio	<u>0.404</u>	<u>0.404</u>
Sweepback Angles, degrees		
Leading Edge	<u>45.000</u>	<u>45.000</u>
Trailing Edge	<u>26.249</u>	<u>26.249</u>
0.25 Element Line	<u>41.130</u>	<u>41.130</u>
Chords:		
Root, (Theo.) WP	<u>268.50</u>	<u>1.59220</u>
Tip, (Theo.) WP	<u>108.47</u>	<u>0.64323</u>
MAC	<u>199.81</u>	<u>1.18487</u>
Fus. Sta. of 0.25 MAC	<u>1463.50</u>	<u>8.67856</u>
W.P. of 0.25 MAC	<u>635.522</u>	<u>3.76864</u>
B.L. of 0.25 MAC	<u>0.00</u>	<u>0.00</u>
Airfoil Section		
Leading Wedge Angle, degrees	<u>10.000</u>	<u>10.000</u>
Trailing Wedge Angle, degrees	<u>14.920</u>	<u>14.920</u>
Leading Edge Radius ~ in.	<u>2.00</u>	<u>0.01186</u>
Void Area	<u>13.17</u>	<u>0.00046</u>
Blanketed Area		

MODEL COMPONENT: Rudder (R₅)

GENERAL DESCRIPTION: Rudder for V₇

Model Scale = 0.00593

DRAWING NUMBER: VL70-000139
VL70-000095

<u>DIMENSIONS:</u>	<u>FULL-SCALE</u>	<u>MODEL SCALE</u>
Area, ~ ft ²	<u>106.38</u>	<u>0.00374</u>
Span, (equivalent) ~ in.	<u>201.0</u>	<u>1.19193</u>
Inb'd equivalent chord	<u>91.585</u>	<u>0.54310</u>
Outb'd equivalent chord	<u>50.833</u>	<u>0.30144</u>
Ratio movable surface chord/ total surface chord		
At Inb'd equiv. chord	<u>0.400</u>	<u>0.400</u>
At Outb'd equiv. chord	<u>0.400</u>	<u>0.400</u>
Sweepback Angles, degrees.		
Leading Edge	<u>34.83</u>	<u>34.83</u>
Trailing Edge	<u>26.25</u>	<u>26.25</u>
Hinge Line	<u>34.83</u>	<u>34.83</u>
Area Moment (Normal to hinge line) Ft ³	<u>526.13</u>	<u>0.00011</u>
Product of area and mean chord		

MODEL COMPONENT: Trimmer H₁₆

GENERAL DESCRIPTION: Trimmer for configuration 3, per lines

VL70-000139/SS-H-00381

Model Scale = .00593

DRAWING NUMBER _____

<u>DIMENSION:</u>	<u>FULL SCALE</u>	<u>MODEL SCALE</u>
Length	<u>285.96</u>	<u>1.696</u>
Max Width	<u>80.192</u>	<u>.476</u>
Max Depth	_____	_____
Fineness Ratio	_____	_____
Area		
Max Cross-Sectional		
Planform	<u>84.25</u>	<u>.0029</u>
Wetted	_____	_____
Base	_____	_____
Sweep Back Angle - Degrees	<u>17.0</u>	<u>17.0</u>
Leading Edge Intersects Fus @ Sta	<u>566.0</u>	<u>3.356</u>
Leading Edge Intersects Glove @ Sta	<u>847.62</u>	<u>5.026</u>

MODEL COMPONENT: Trimmer H17

GENERAL DESCRIPTION: Trimmer for Configuration 3, per lines

VL70-000139/SS-H-00381

Model Scale = .00593

DRAWING NUMBER _____

<u>DIMENSION:</u>	<u>FULL SCALE</u>	<u>MODEL SCALE</u>
Length	<u>285.96</u>	<u>1.696</u>
Max Width	<u>148.995</u>	<u>.884</u>
Max Depth	_____	_____
Fineness Ratio	_____	_____
Area		
Max Cross-Sectional	_____	_____
Planform	<u>168.494</u>	<u>.0059</u>
Wetted	_____	_____
Base	_____	_____
Sweep Back Angle - Degrees	<u>34.0°</u>	<u>34.0</u>
Leading Edge Intersects Fus @ Sta	<u>566.0</u>	<u>3.356</u>
Leading Edge Intersects Glove @ Sta	<u>847.62</u>	<u>5.026</u>

INSTRUMENTATION

- (1) Two 35mm cameras with a shutter speed of 1/10-second were used during the tests; one recorded the paint melting characteristics on the model bottom surface and the other recorded the melting on the models left side (pilot left).
- (2) Phase change paint was used with a temperature sensitivity range of 150°F to 550°F. The paint was thinned with acetone and spray painted on the model. Acetone was also used as the cleaning solvent.
- (3) White lead oil mixed with a small amount of motor oil to decrease the viscosity was used for the oil flow visualization tests.
- (4) A polaroid camera was used for detailed photographs after the test.
- (5) A contact thermometer was used for determining the model initial temperature.

Test Procedure

The general procedures used during the test are outlined below:

- (1) Prior to each run, the model was cleaned with a solvent, dried, and spray painted with phase change paint and installed in the injection chamber.
- (2) The model initial temperature was recorded by touching a contact thermometer against the model surface.
- (3) After flow was established, two 35mm cameras were initiated just prior to injection. This was done to enable the film readers to determine when injection started. Continuous pictures were taken throughout the entire run until the model was retracted from the test section. The duration of the model in the test section was determined by the operating conditions and the paint temperature, but usually averaged 10 to 12 seconds.
- (4) The model was then removed from the injection chamber and more detailed photographs of interesting flow or paint melt patterns not clearly visible to the 35mm cameras were taken with a polaroid camera. These photographs were taken to enhance the 35mm photo coverage.
- (5) After each model attitude change, the paint stripe model was photographed with the 35mm cameras for use as an aid in data reduction. The paint striping clearly located various X/L locations as well as water planes, chords, and spun locations that would have been difficult to locate on the bottom camera due to the angle of attack setting. These photos are also used for drawing the model outline during the film reading process.

DATA REDUCTION

The isotherm data (data Figures 1 through 184) were obtained by tracing the photographed time history of the paint melt lines. The model outline was first drawn from the grid model photographs. During the OH-42C test, it was found that by making a cardboard cutout of the model tracing, the time required to draw one complete isotherm map (one run) was reduced 300% to 400% providing there were more than two runs at the same angle of attack.

The frame number of each melt line drawn was recorded which, in turn, indicated the elapsed time of the model from the instant injection started. The time at which the model reached the tunnel centerline was also recorded and usually occurred around frame 8 or 9.

The thin film heat transfer coefficients and heating rates were calculated as follows:

First, the adiabatic wall temperature (T_{AW}) was determined. To obtain this, the ratio of adiabatic wall temperature to stagnation temperature was calculated by:

$$\frac{T_{AW}}{T_o} = .867 + .133 (\sin \delta)^{1.55} \quad \delta = \text{angle between local surface and free stream flow, degrees}$$

where $\delta = \alpha \pm \theta$. α is the angle of attack and θ is the surface deflection relative to the model centerline (usually zero).

Given T_o , T_{AW} was determined as follows:

$$T_{AW} = \frac{T_{AW}}{T_o} \times T_o$$

DATA REDUCTION - Continued

After T_{AW} was determined, the parameter \bar{T} was calculated:

$$\bar{T} = \frac{T_{PC} - T_{IN}}{T_{AW} - T_{IN}}$$

With \bar{T} calculated above, β_h was calculated by iterating the following expression:

$$1 - \bar{T} = e^{\beta_h^2} (1 - \text{erf } \beta_h) \quad \text{where erf} = \text{error function}$$

Now using β_h determined above, the thin film heat transfer coefficient (h) was calculated:

$$h = \beta_h k \frac{\rho C_p}{t}$$

The aerodynamic heating rate (\dot{q}) was then determined by:

$$\dot{q} = h (T_{AW} - T_{PC})$$

The theoretical thin film heat transfer coefficients and stagnation point heating rates were calculated using the equations given below:

$$h_s = (.678) (C_p) (P_r^{-.6}) (\rho_w M_w)^{.1} (\rho_s M_s)^{.4} \frac{dV_e}{dx}$$

Where:

$$P_r = \frac{M C_p}{k} \quad (M, C_p \text{ and } k \text{ for air})$$

$$\text{and: } \frac{dV_e}{dx} = \frac{1}{N_r} \left[2 R_g T_o \left(1 - \frac{1}{P_1 P_2} \right) \right]^{\frac{1}{2}} = \text{velocity gradient}$$

and:

$$P_1 = \frac{\gamma+1}{2} M_\infty^2 \frac{\gamma}{\gamma-1}$$

$$P_2 = \frac{\gamma+1}{2\gamma M_\infty^2 - (\gamma-1)} \frac{1}{\gamma-1}$$

The theoretical stagnation point heating rate \dot{q} then:

$$\dot{q} = h_s (T_{AW} - T_{PC})$$

PHASE CHANGE PAINT DATA

The test results are shown in Figures 1 through 184 in the form of heating contours. These contours are correlated to heat transfer coefficient ratios (h/h_s), the ratio of local heat transfer coefficient on the model surface to the heat transfer coefficient at the stagnation point of a one-foot radius sphere at model scale. A list of the tunnel conditions for each run is presented in Table 5 in chronological order.

REFERENCES

1. Jones, R.A. and Hunt, T.L., "Use of Fusible Temperature Indicators for Obtaining Quantitative Aerodynamic Heat Transfer Data", NASA TR-R-230, February 1966
2. Carslan, H.S. and Jaeger, T.C. "Conduction of Heat in Solids", Oxford Clarendon Press, 1959

TABLE 1. MODEL MATERIAL PROPERTIES

T _{PC} (°F)	$\frac{\sqrt{k \rho C_p}}{T_{PC}}$ (BTU/FT ² -SEC ^{0.5} - °F) [*]	
	Tests OH-42A	Tests OH-42B and C
150	.0466	-
156	-	.0513
175	.0472	.0515
200	.0478	.0525
250	.0489	.0529
275	.0493	.0537
300	.0496	.0546
350	.0500	.0557
400	.0503	.0570
450	-	.0580
500	.0506	.0592
550	-	.0604

*NOTE: The material properties listed above were calculated as follows:

$$\sqrt{k \rho C_p} \Big|_{T_{PC}} = \frac{\sqrt{k \rho C_p} \Big|_T + \sqrt{k \rho C_p} \Big|_{T_{IN}}}{2}$$

Where: $\sqrt{k \rho C_p} \Big|_T$ = Material property calculated at the Grumman Aerospace Corporation's thermal laboratory for material wall temperature.

$\sqrt{k \rho C_p} \Big|_{T_{IN}}$ = Material property at T_{IN} (assumed to be 75°F).

TABLE 2 . DATA REDUCTION RECOVERY FACTORS

Angle of Attack,	Recovery Factor, T_{AW}/T_0	
	Windward View	Profile View
25	.900	.900
30	.910	.900
35	.920	.900
40	.932	.900

TABLE 3. MODEL DESIGNATIONS FOR SUMMARY SHEETS

46-1	=	Configuration #1
46-2	=	Configuration #2
46-3	=	Configuration #3
46-4	=	Configuration #4
46-4V	=	Configuration #4 + ventral fins
46-4EEBF	=	Configuration #4 less ventral; plus elevons and body flap*
46-4BEF	=	Configuration #4 body flap only*
46-4A	=	Second model Configuration #4
46-4ABF	=	4A plus body flap*
46-4AEEBF	=	4ABF plus elevons*

* body flaps and elevons were tested at 10° on these configurations.

TABLE 4

PHASE CHANGE COATING TEST DATA SUMMARY SHEET

TEST TITLE: SPACE SHUTTLE ORBITER PHASE CHANGE PAINT TESTTEST NUMBER: OH42A TEST FACILITY: LRC/VDTTEST DATE: 5/14/73 TEST ENGINEER: M. QUAN

Run No.	Model Configuration Identification	Model Scale	Free Stream Mach Number	Total Pressure (psig)	Total Temp. (°F)	INITIAL Temp. (°F)	RNX10 ⁶ Ft	Phase Change Temp. (°F)	Model Position (degrees)			Camera Location	
									α	β	ϕ	TOP	SIDE
4084	46-4	.00593	8	620	900	76	3	300	30	0	0		
85				630	880	77	3	200					
86				1400	925	78	6	400					
87				1400	925	77	6	250					
88				1935	935	78	8	400					
89				163	750	81	1	150					
90				625	OIL FLOW		3	—	↓				
91				1390	930	78	6	400	40				
92				1400	940	77	6	500					
93				150	760	81	1	200					
94*				160	800	78	1	150					
95				160	OIL FLOW		1	—	↓				
4096		↓	↓	1395	900	78	6	400	35	↓	↓	↓	↓

X axis parallel to stream (+downstream, -upstream)

Y axis (+right, -left, as viewed from the rear)

Z axis (+up, -down)

*NO TOP ISOTHERM DRAWN.

TABLE 4 (CONTINUED)
PHASE CHANGE COATING TEST DATA SUMMARY SHEET

TEST TITLE: SPACE SHUTTLE ORBITER PHASE CHANGE PAINT TEST

TEST NUMBER: ΦH42A TEST FACILITY: LRC/YDT

TEST DATE: 5/14/73 TEST ENGINEER: H. QUAN

Run No.	Model Configuration Identification	Model Scale	Free Stream Mach Number	Total Pressure (psig)	Total Temp. (°F)	Initial Temp. (°F)	RNX10 ⁶ Ft	Phase Change Temp. (°F)	Model Position (degrees)			Camera Location	
									α	β	φ	TOP	SIDE
4097	46-4	.00593	8	1385	925	79	6	200	35	0	0		
4098				160	760	77	1	175					
4099				160	014	FLOW	1	—					
4100				1420	985	81	6	350	25				
4101				1375	950	81	6	275					
4102				160	735	82	1	150					
4103				170	014	FLOW	1	—					
4104				1390	910	78	6	300	30				
4105				1940	970	82	8	350					

X axis parallel to stream (+downstream, -upstream)
Y axis (+ right, - left, as viewed from the rear)
Z axis (+up, -down)

TE

TABLE 4 (CONTINUED)

PHASE CHANGE COATING TEST DATA SUMMARY SHEET

TEST TITLE: SPACE SHUTTLE ORBITER PHASE CHANGE PAINT TESTTEST NUMBER: ØH 42B TEST FACILITY: LRC/YDTTEST DATE: 5/24/73 TEST ENGINEER: W.DYE, M. QUAN

Run No.	Model Configuration Identification	Model Scale	Free Stream Mach Number	Total Pressure (psig)	Total Temp. (°F)	Initial Temp. (°F)	RN _X 10 ⁶ Ft	Phase Change Temp. (°F)	Model Position (degrees)			Camera** Location (in)		
									α	β	φ	TOP	SIDE	
4130	46-1	.00593	8	1390	980	78	6	400	35	0	0			
4131	46-4A			625	910	74	3	300						
4132	46-2			1390	925	76	6	500						
4133	46-4A			635	880	78	3	250						
4134	46-2			625	875	75	3	300						
4135	46-2			154	765	77	1	175						
4136	46-2			1355	890	75	6	450						
4137	46-2			850	925	81	4	300	↓					
4138	*ψ 46-4V			615	935	78	3	300	30					
4139	*ψ 46-4V			625	925	75	3	350						
4140	46-4A			1615	930	75	7	350						
4141	46-2			635	875	76	3	300						
4142	46-4A	↓	↓	1120	925	76	5	300	↓	↓	↓	↓	↓	↓

X axis parallel to stream (+downstream, -upstream)

Y axis (+right, -left, as viewed from the rear)

Z axis (+up, -down)

* NO TOP ISOTHERM DRAWN

ψ NO SIDE ISOTHERM DRAWN

TABLE 4 (CONTINUED)
 PHASE CHANGE COATING TEST DATA SUMMARY SHEET

TEST TITLE: SPACE SHUTTLE ORBITER PHASE CHANGE PAINT TEST
 TEST NUMBER: QH 42B TEST FACILITY: LRC/VDT
 TEST DATE: 5/24/73 TEST ENGINEER: W. DYE, M. QUAN

Run No.	Model Configuration Identification	Model Scale	Free Stream Mach Number	Total Pressure (psig)	Total Temp. (°F)	Initial Temp. (°F)	RN _X 10 ⁶ Ft	Phase Change Temp. (°F)	Model Position (degrees)			Camera Location	
									α	β	φ	Top	Side
4143	46-2	.00593	8	1390	915	76	6	350	30	0	0		
4144	46-4A			165	760	75	1	175					
4145	46-2			1615	915	77	7	400					
4146	46-4A			1380	935	77	6	350					
4147	46-2			615	910	78	3	300					
4148	46-2			165	810	81	1	175					
4149	46-2			157	820	014	1	014					
4150	46-4ABF			635	900	79	3	350					
4151	46-2			1395	875	014	6	014					
4152	46-4ABF			1405	900	83	6	400					
4153	46-1			640	920	85	3	300					
4154	46-4ABF			160	795	84	1	200					
4155	46-4ABF	Y	Y	630	910	85	3	400	Y	Y	Y	Y	Y

X axis parallel to stream (+downstream, -upstream)
 Y axis (+right, -left, as viewed from the rear)
 Z axis (+up, -down)

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TABLE 4. (CONTINUED)
PHASE CHANGE COATING TEST DATA SUMMARY SHEET

TEST TITLE: SPACE SHUTTLE ORBITER PHASE CHANGE PAINT TEST

TEST NUMBER: ØH 42B TEST FACILITY: LRC/VDT

TEST DATE: 5/24/73 TEST ENGINEER: W. DYE, M. QUAN

Run No.	Model Configuration Identification	Model Scale	Free Stream Mach Number	Total Pressure (psig)	Total Temp. (°F)	Initial Temp. (°F)	RNX10 ⁶ Ft	Phase Change Temp. (°F)	Model Position (degrees)			Camera Location	
									α	β	φ	Top	Side
4156	46-4ABF	.00993	8	1385	915	83	6	450	30	0	0		
4157	46-4ABF			630	880	014	3	-					
4158	46-1			163	780	86	1	175					
4159	46-3			620	920	86	3	300					
4160	46-1			160	805	86	1	156					
4161	46-3			165	800	84	1	175					
4162	46-1			1385	915	84	6	350					
4163	46-3			1385	870	85	6	350					
4164	46-3			635	955	83	3	250					
4165	46-1			640	930	83	3	250					
4166	46-3			1390	920	83	6	400					
4167	46-1			1625	885	83	7	400					
4168	46-3			1930	985	80	8	400	✓	✓	✓	✓	✓

X axis parallel to stream (+downstream, -upstream)

Y axis (+right, -left, as viewed from the rear)

Z axis (+up, -down)

PHASE CHANGE COATING TEST DATA SUMMARY SHEET

TEST TITLE: SPACE SHUTTLE ORBITER PHASE CHANGE PAINT TESTTEST NUMBER: PH 42B TEST FACILITY: LRC/VDTTEST DATE: 5/24/73 TEST ENGINEER: W. DYE, M. QUAN

Run No.	Model Configuration Identification	Model Scale	Free Stream Mach Number	Total Pressure (psig)	Total Temp. (°F)	Initial Temp. (°F)	RN _X 10 ⁶ Ft	Phase Change Temp. (°F)	Model Position (degrees)			Camera Location	
									α	β	ϕ	Top	Side
4169	46-1	00593	8	157	755	014	1	—	30	0	0		
4170	46-3			155	765	014	1	—					
4171	46-1			1380	910	014	6	—					
4172	46-1			650	886	83	3	300	35				
4173	46-2			1390	915	82	6	350					
4174	46-1			158	780	83	1	175					
4175	46-1			1390	935	83	6	400					
4176	46-1			1380	915	83	6	350					
4177	46-4ERF			625	940	83	3	400	30				
4178	46-2			635	925	83	3	500					
4179	46-4AEBF			164	820	83	1	350					
4180	46-2			625	910	81	3	300					
4181	46-4AEBF	↓	↓	157	810	82	1	250	↓	↓	↓	↓	↓

X axis parallel to stream (+downstream, -upstream)

Y axis (+right, -left, as viewed from the rear)

Z axis (+up, -down)

TABLE 4. (CONTINUED)

PHASE CHANGE COATING TEST DATA SUMMARY SHEET

TEST TITLE: SPACE SHUTTLE ORBITER PHASE CHANGE PAINT TEST

TEST NUMBER: PH 42B TEST FACILITY: LRC/VDT

TEST DATE: 5/24/73 TEST ENGINEER: W. DYE, M. QUAN

Run No.	Model Configuration Identification	Model Scale	Free Stream Mach Number	Total Pressure (psi.)	Total Temp. (°F)	Initial Temp. (°F)	RN _X 10 ⁶ Ft	Phase Change Temp. (°F)	Model Position (degrees)			Camera Location	
									α	β	φ	Top	Side
4182	46-4AEBF	.00593	8	170	780	82	1	175	30	0	0		
4183	46-4AEBF			160	790	83	1	200					
4184	46-4AEBF			635	910	79	3	350					
4185	46-4AEBF			640	890	81	3	250					
4186	46-4BF			630	890	80	3	450					
4187	46-4AEBF			625	900	01L	3	01L					
4188	46-4BF			675	890	80	3	250					
4189	46-4BF			625	885	82	3	550					
4190	46-4BF			630	895	82	3	500					
4191	46-5			164	805	80	1	250					
4192	46-5			157	795	81	1	200					
4193	46-5			625	910	82	3	350					

X axis parallel to stream (+downstream, -upstream)
 Y axis (+right, -left, as viewed from the rear)
 Z axis (+up, -down)

TABLE A. (CONTINUED)
PHASE CHANGE COATING TEST DATA SUMMARY SHEET

TEST TITLE: SPACE SHUTTLE ORBITER PHASE CHANGE PAINT TEST
 TEST NUMBER: OH42C TEST FACILITY: LRC/VDT
 TEST DATE: 6/14/73 TEST ENGINEER: W. DYE, J. CUMMINGS

Run No.	Model Configuration Identification	Model Scale	Free Stream Mach Number	Total Pressure (psi)	Total Temp. (°F)	Initial Temp. (°F)	RNX10 ⁶ Ft	Phase Change Temp. (°F)	Model Position (degrees)			Camera Location	
									α	β	φ	TOP	SIDE
4271	*ψ 46-5	00593	8	635	945	85	3	156	30	0	0		
4272	*ψ 46-6			645	915	91	3	156					
4273	46-5			635	895	91	3	275					
4274	46-6			655	900	91	3	300					
4275	46-5			1395	920	89	6	400					
4276	46-6			620	950	90	3	350					
4277	*ψ 46-5			1380	940	88	6	175					
4278	*ψ 46-6			168	810	90	1	125					
4279	46-5			1395	940	92	6	300					
4280	46-6			160	785	89	1	200					
4281	46-5			640	915	014	3	—					
4282	46-6			635	915	014	3	—					
4283	46-6	↓	↓	160	788	83	1	250	↓	↓	↓	↓	↓

X axis parallel to stream (+downstream, -upstream)

Y axis (+right, -left, as viewed from the rear)

Z axis (+up, -down)

* NO TOP ISOTHERMS DRAWN

ψ NO SIDE ISOTHERMS DRAWN

TABLE 4. (CONCLUDED)
PHASE CHANGE COATING TEST DATA SUMMARY SHEET

TEST TITLE: SPACE SHUTTLE ORBITER PHASE CHANGE PAINT TEST

TEST NUMBER: ØH42C TEST FACILITY: LRC/VDT

TEST DATE: 6/14/73 TEST ENGINEER: W. DYE, J. CUMMINGS

Run No.	Model Configuration Identification	Model Scale	Free Stream Mach Number	Total Pressure (psi)	Total Temp. (°F)	Initial Temp. (°F)	RN _X 10 ⁶ Ft	Phase Change Temp. (°F)	Model Position (degrees)			Camera Location	
									α	β	φ	Top	Side
4284	46-6	.00593	8	1400	920	85	6	350	30	0	0		
4285	*ψ 46-6			1390	910	89	6	175	↓				
4286	46-5			155	730	87	1	250	35				
4287	46-6			152	760	82	1	250					
4288	46-5			625	875	84	3	350					↓
4289	46-6			640	925	84	3	300					
4290	* 46-5			160	785	81	1	125					
4291	* 46-5			650	915	85	3	156					
4292	46-5			1400	925	89	6	350	↓				
4293	46-5			160	760	84	1	156	25				
4294	46-5			630	895	85	3	200					
4295	46-5			1390	920	84	6	300	↓	↓	↓	↓	

X axis parallel to stream (+downstream, -upstream)

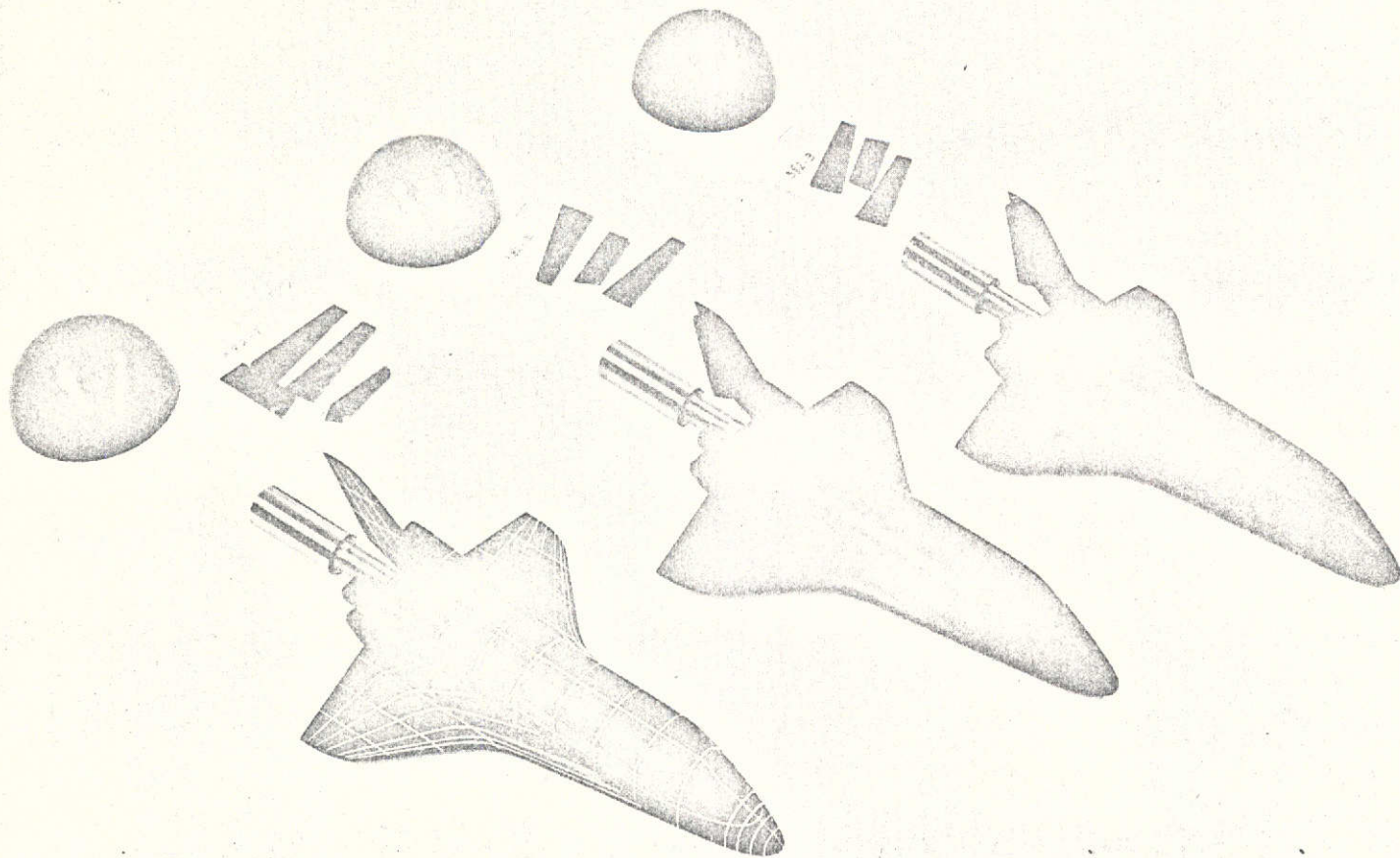
Y axis (+right, -left, as viewed from the rear)

Z axis (+up, -down)

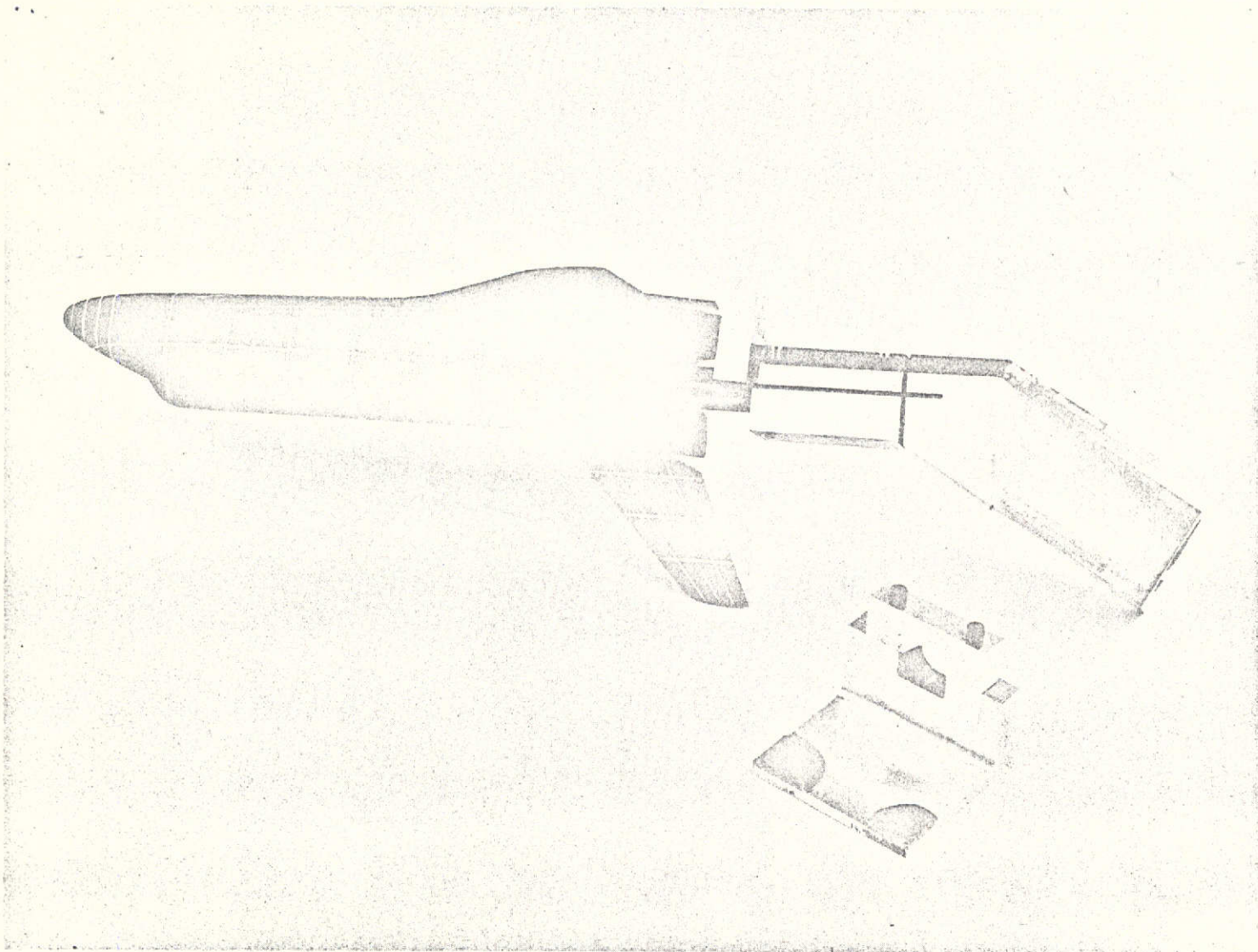
* NO TOP ISOTHERMS DRAWN

ψ NO SIDE ISOTHERMS DRAWN

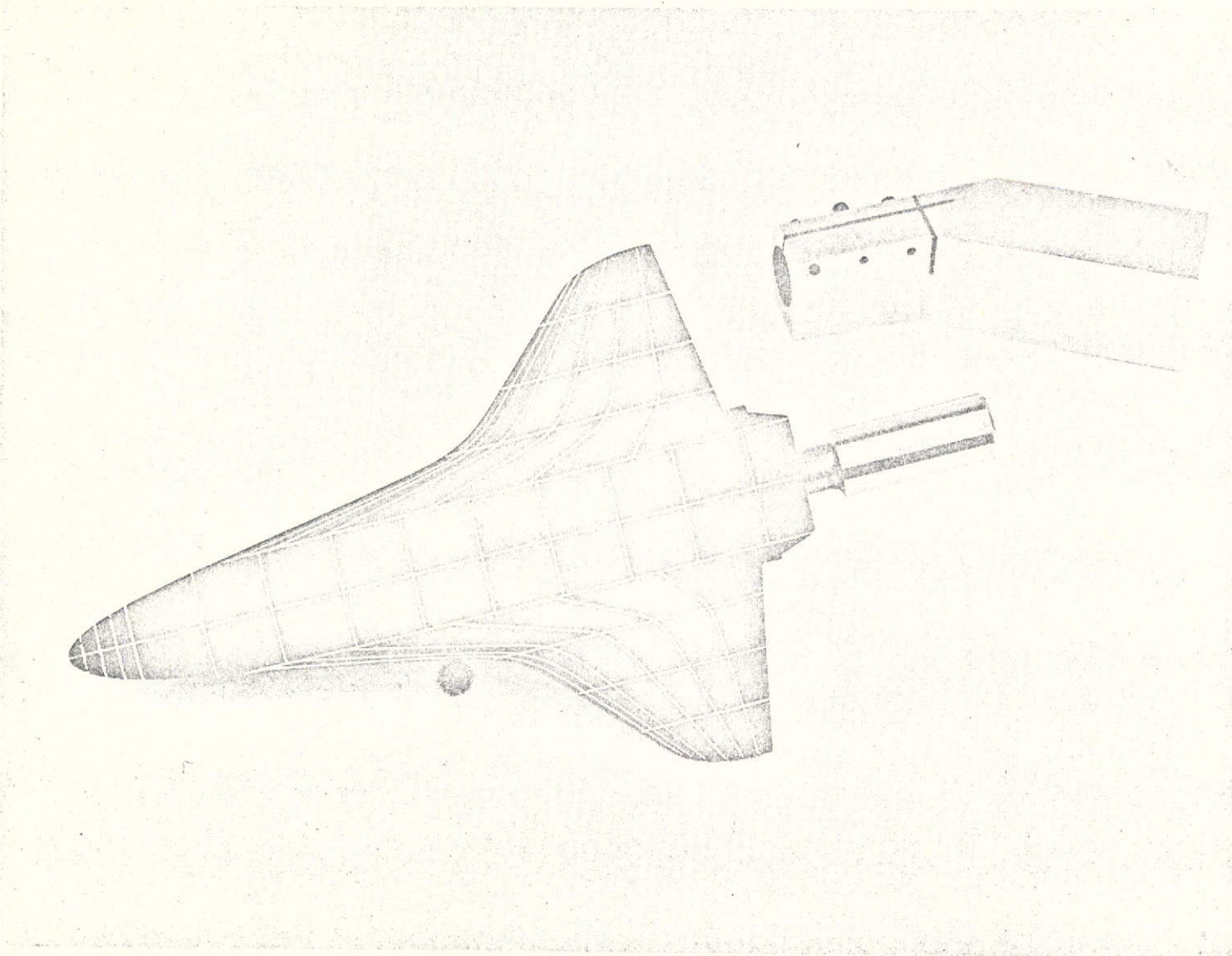
42



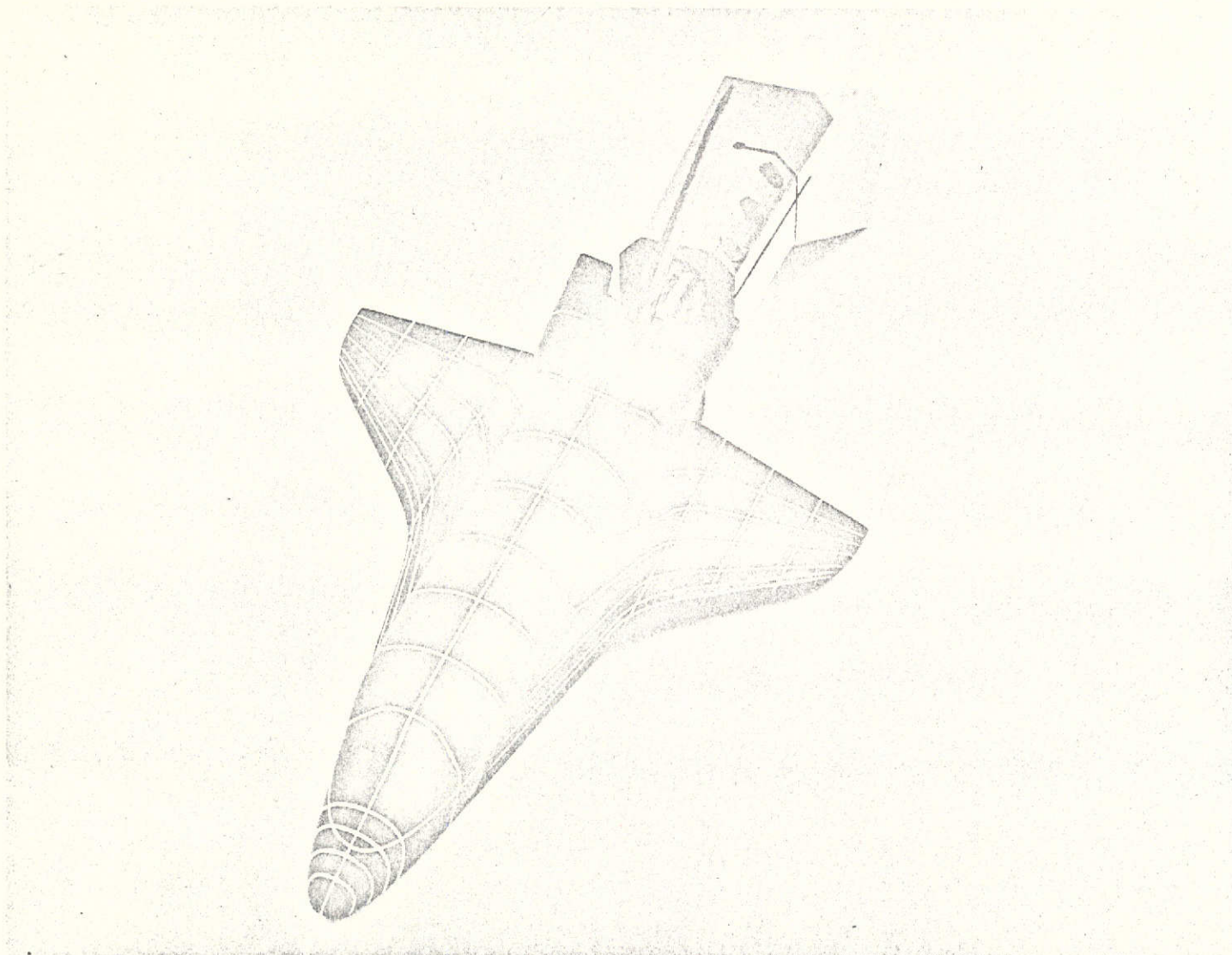
Photograph 1. - Model #46-0 Configuration #1 SS-H-00382-1, -2, and -3.



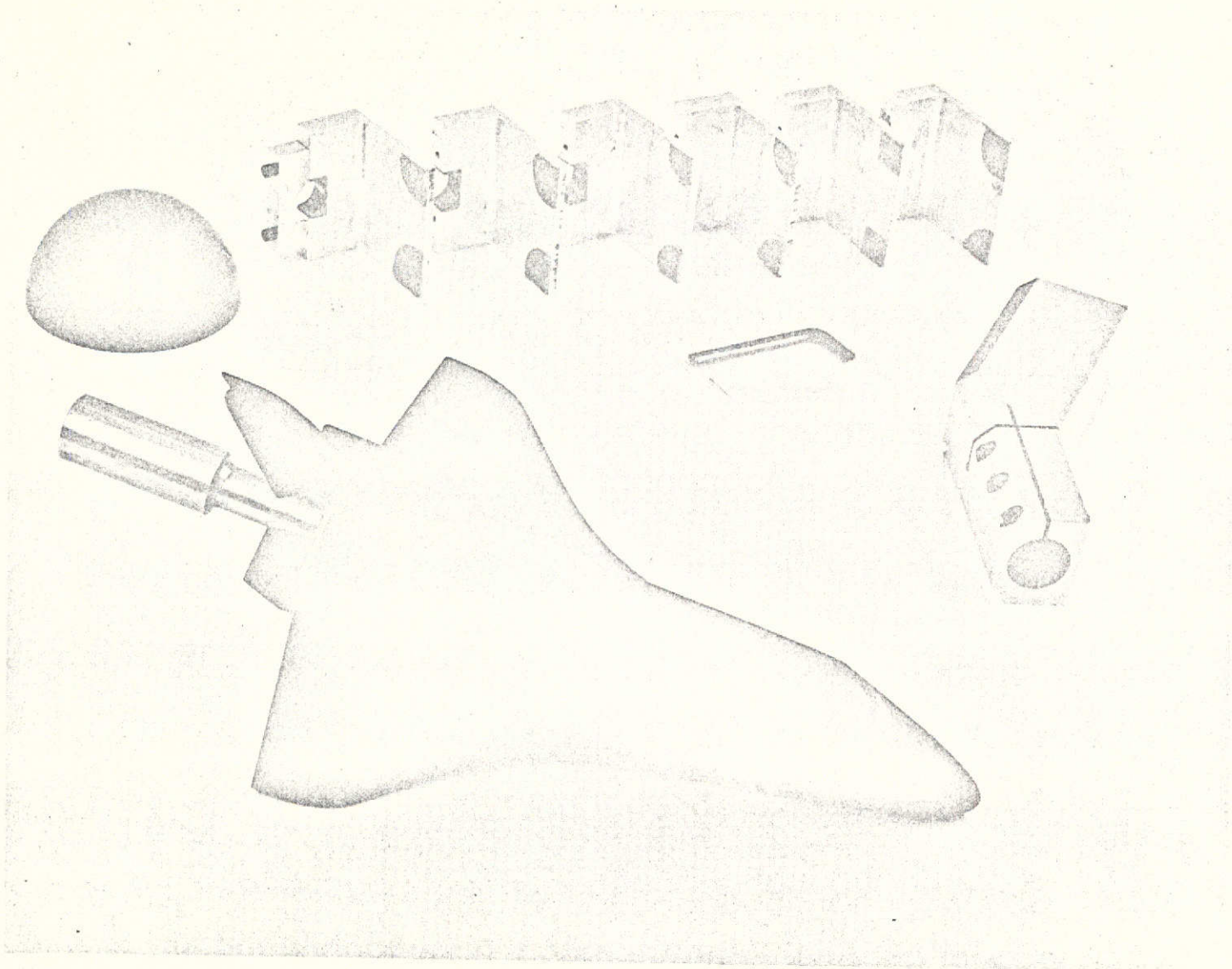
Photograph 2. - Paint Stripe - Model 46-0, Configuration #1 SS-H-00382-1.



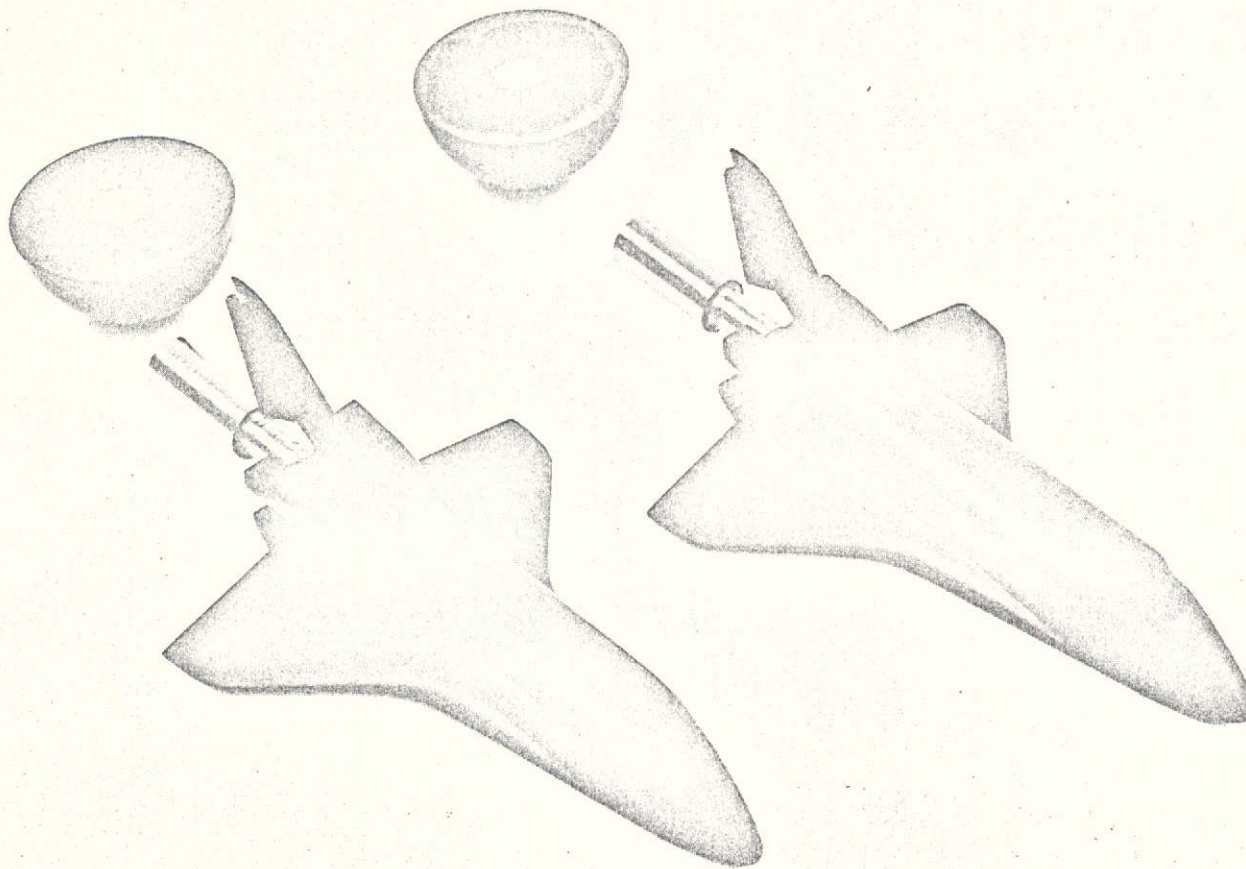
Photograph 3. - Paint Stripe - Model 46-0, Configuration #1 SS-H-00382-1.



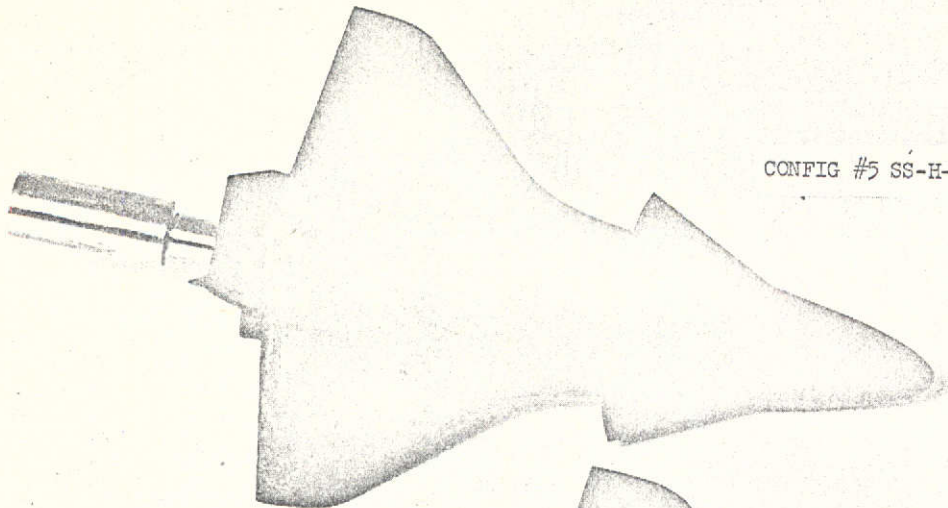
Photograph 4. - Paint Stripe - Model 46-0, Configuration #1 SS-H-00382-1.



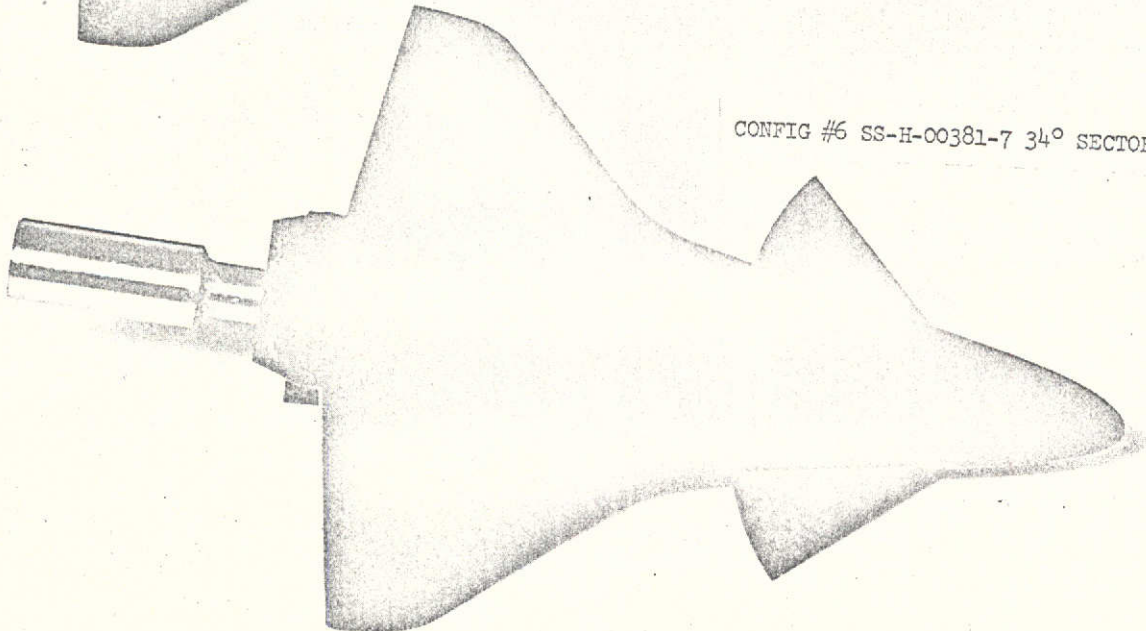
Photograph 5. - Model #46-0, Configuration #2 SS-H-00383-2.



Photograph 6. - Model #46-0, Configurations #3 and #5 SS-H-00381-3 and -5.

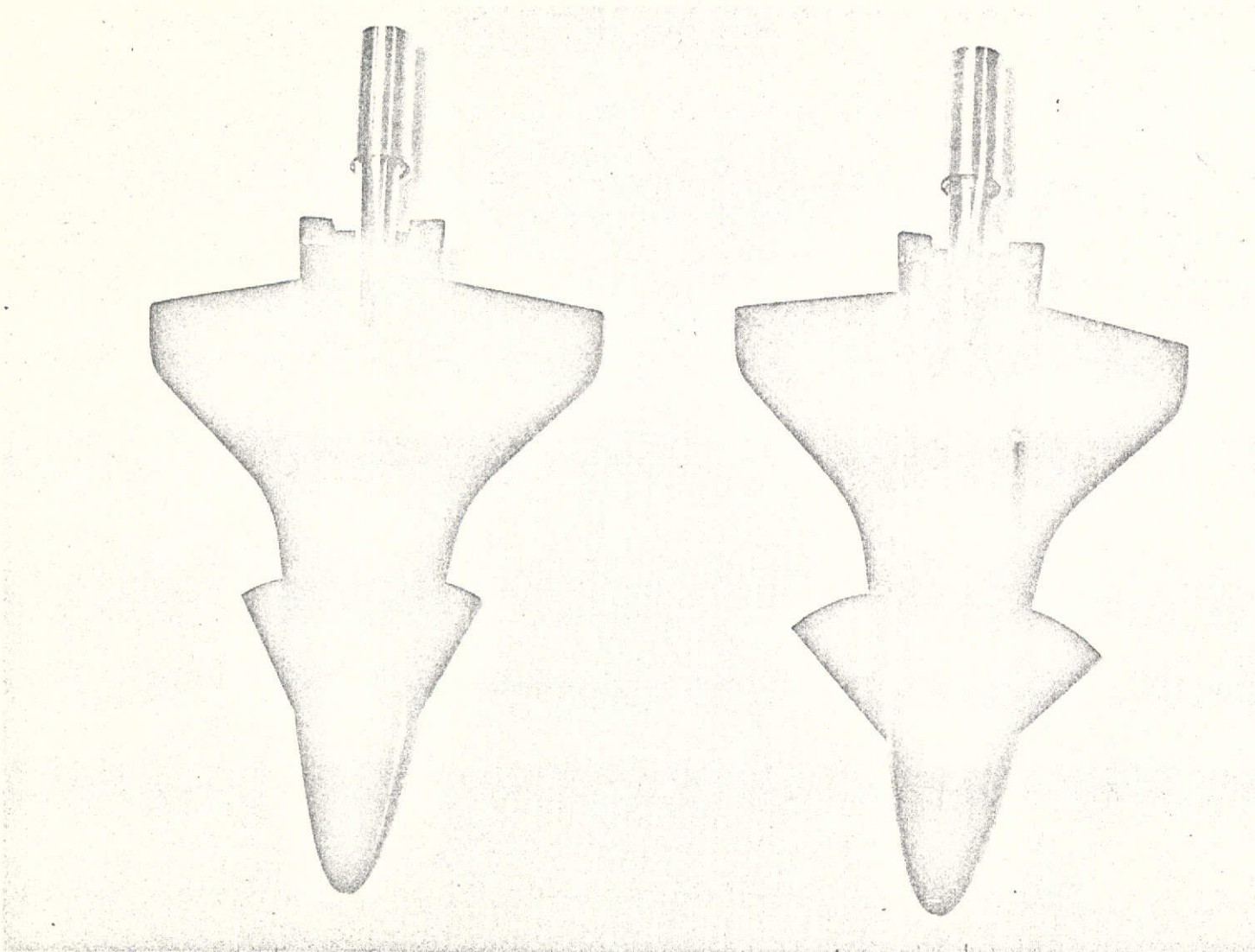


CONFIG #5 SS-H-00381-6 17° SECTOR

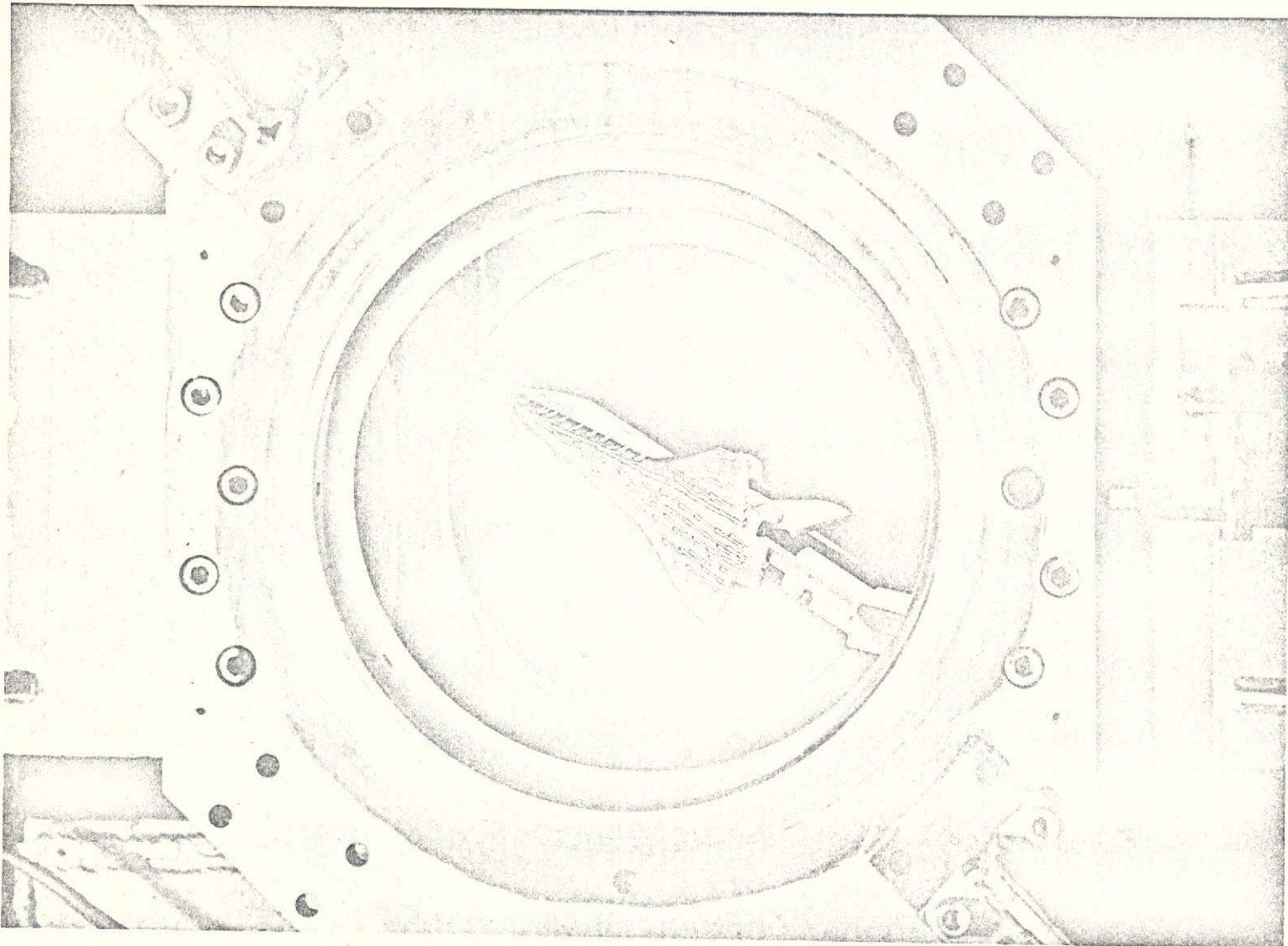


CONFIG #6 SS-H-00381-7 34° SECTOR

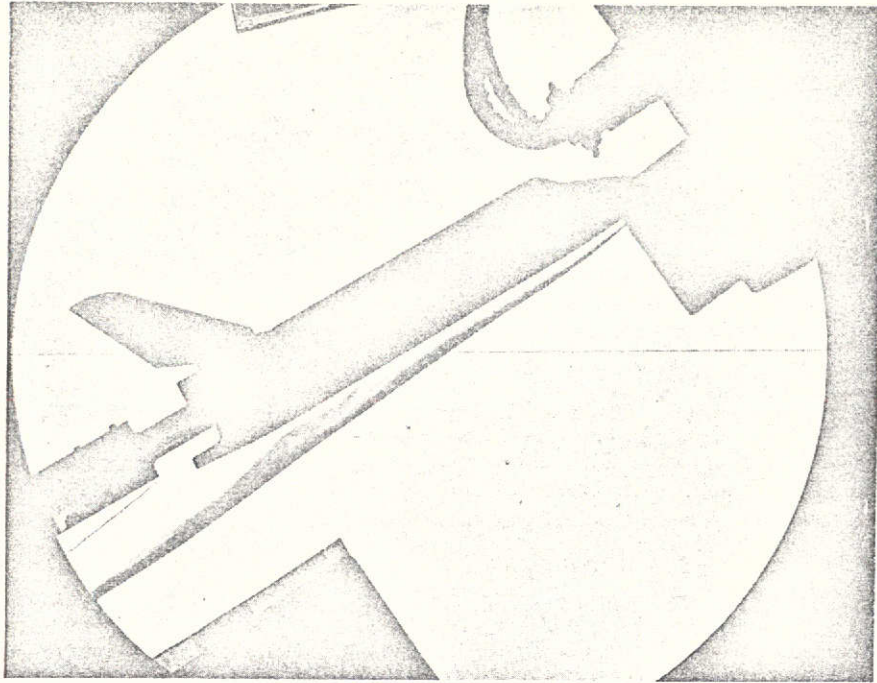
Photograph 7. - Model #46-0, Configurations #5 and #6.



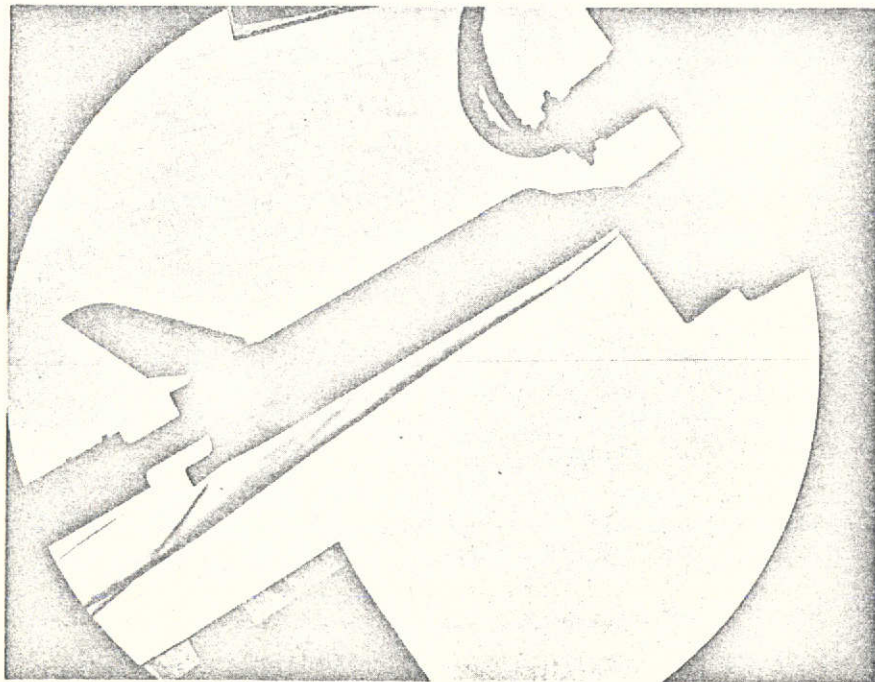
Photograph 8. - Model #46-0, Configurations #5 and #6.



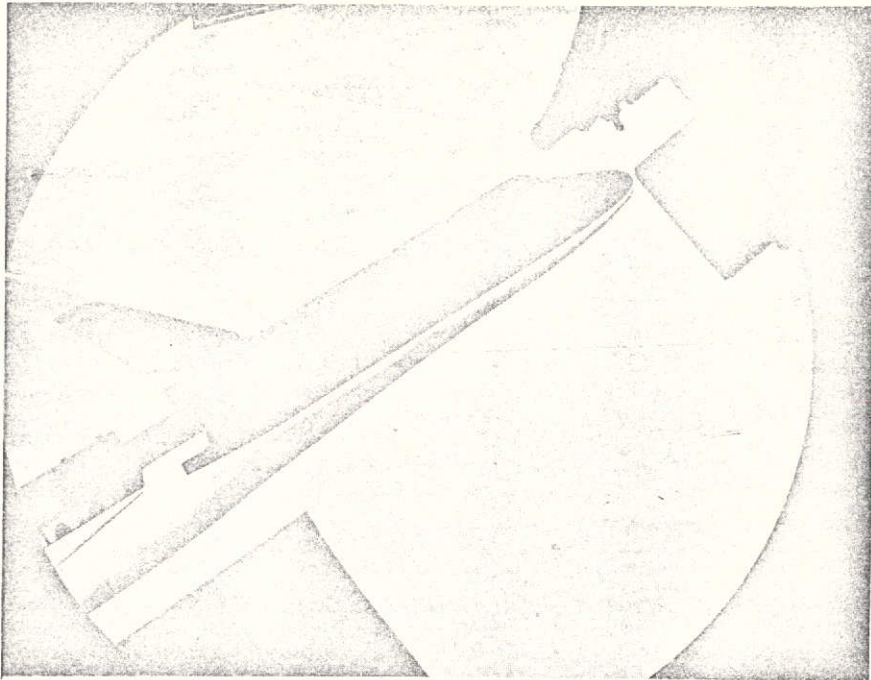
Photograph 9. - OH42A Oil Flow.



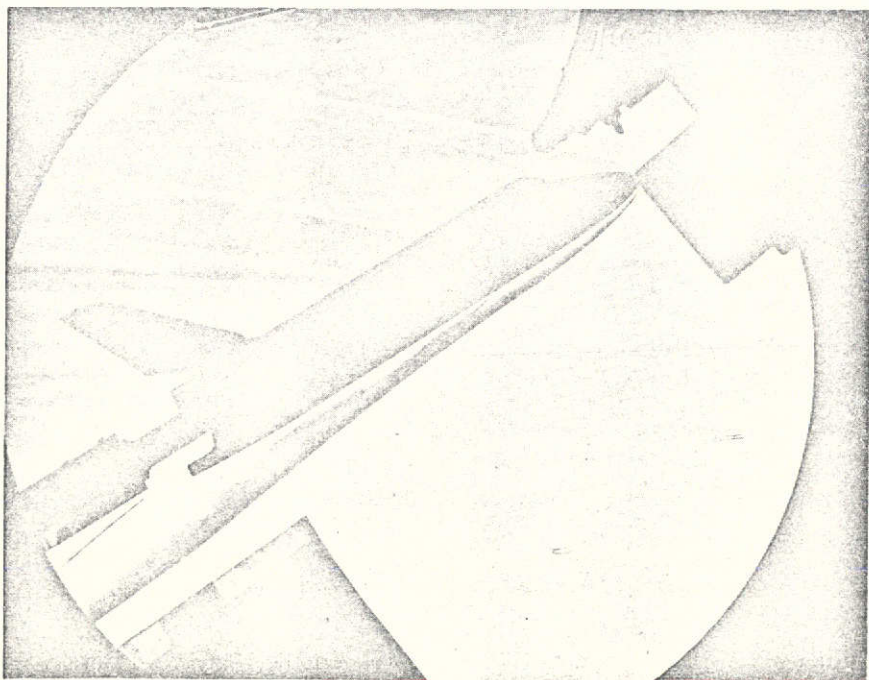
Photograph 10. - Model #46-4, $\alpha = 30^\circ$, $Re/ft = 5 \times 10^6$, Run 4142.



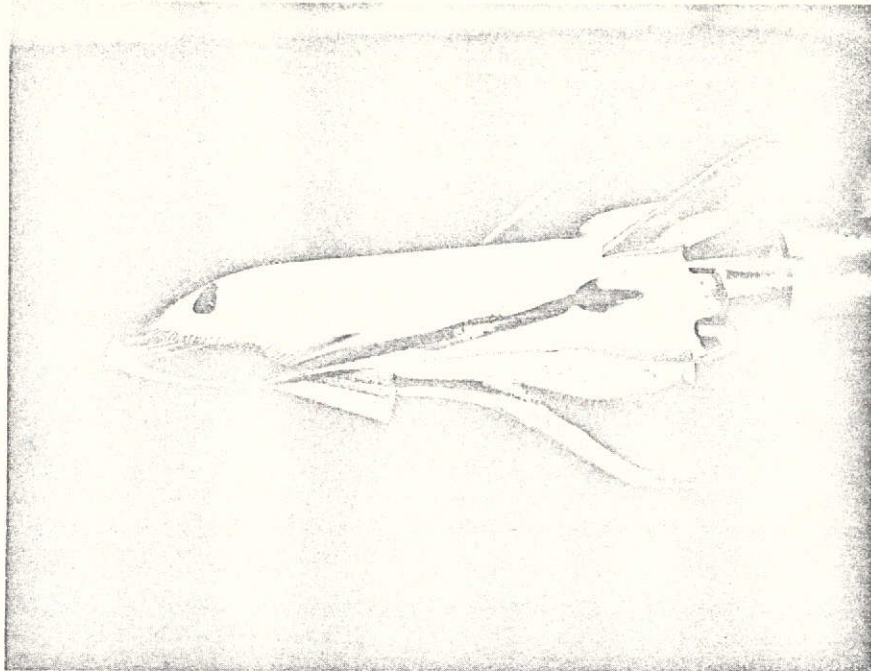
Photograph 11. - Model #46-4BF, $\alpha = 30^\circ$, $Re/ft = 3 \times 10^6$, Run 4150.



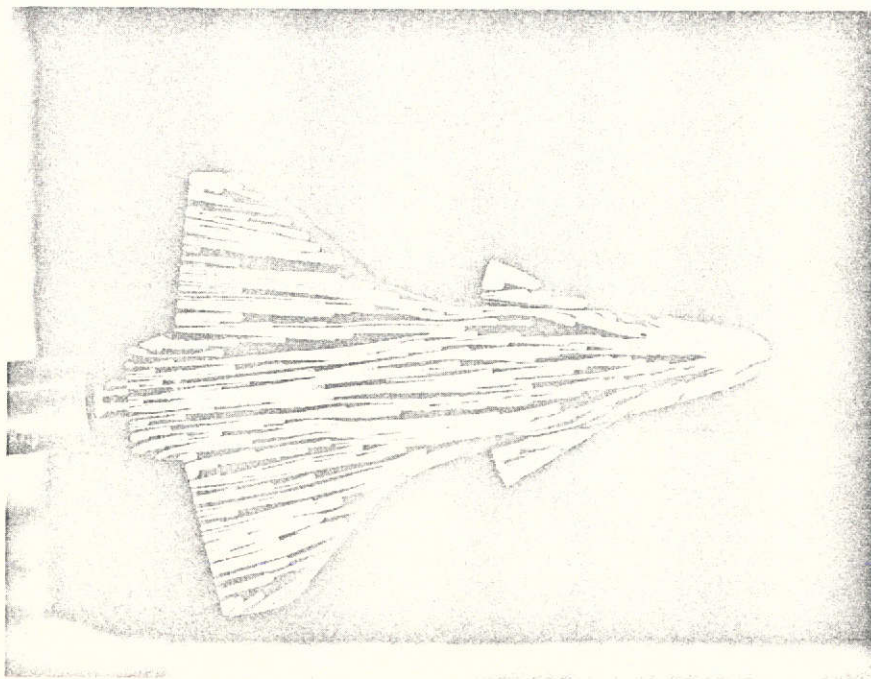
Photograph 12. - Model #46-5 (17° Trimmer) $\alpha = 30^\circ$,
 $Re/ft = 3 \times 10^6$, Run 4273.



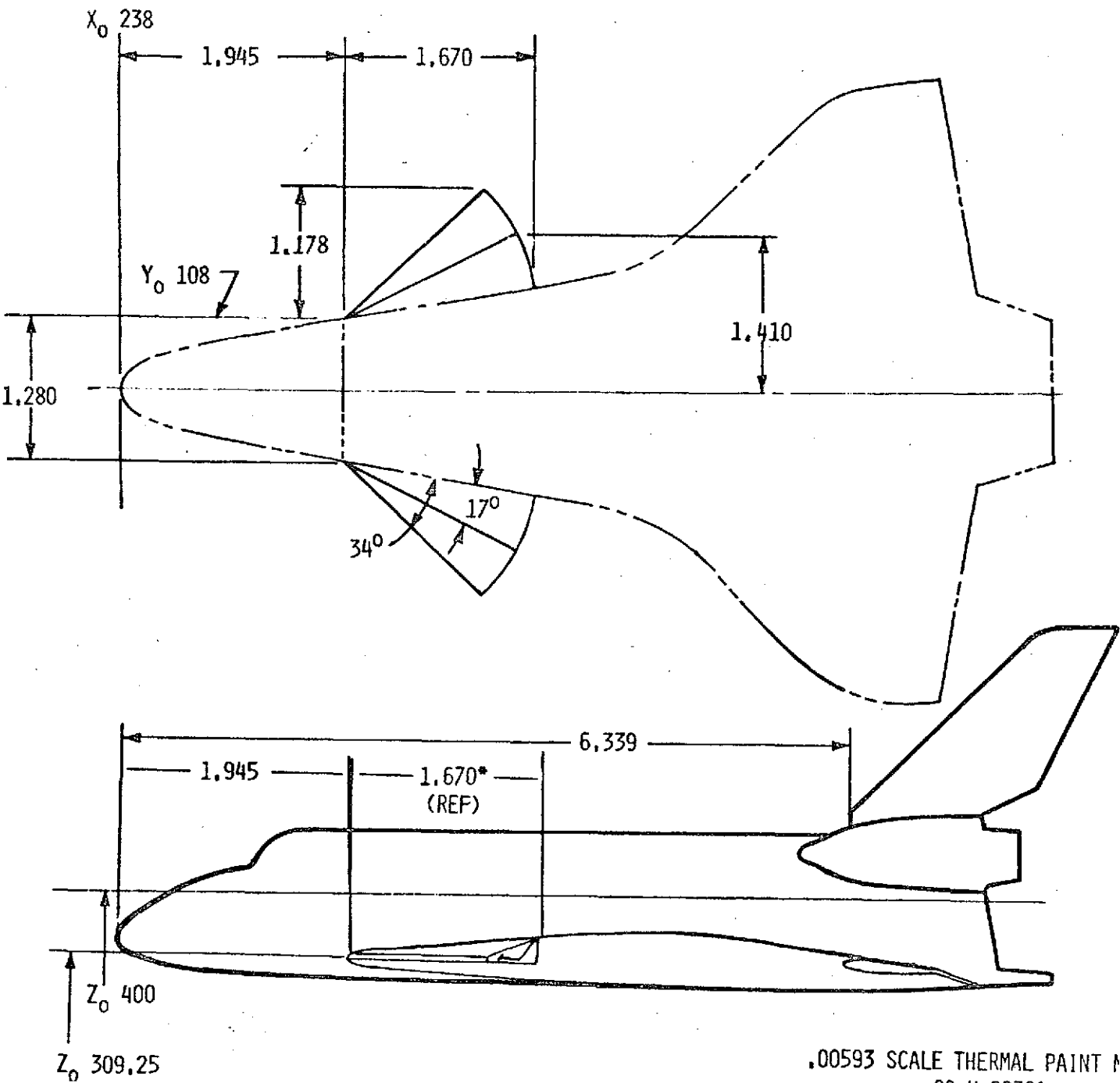
Photograph 13. - Model #46-6 (34° Trimmer) $\alpha = 30^\circ$,
 $Re/ft = 3 \times 10^6$, Run 4274.



Photograph 14. - Model #46-5, $\alpha = 30^\circ$, $Re/ft = 3 \times 10^6$,
15° Paint, Run 4271, $T_{pc} = 156^\circ F$.



Photograph 15. - Model #46-5, $\alpha = 30^\circ$, $Re/ft = 3 \times 10^6$,
Oil Flow, Run 4281.

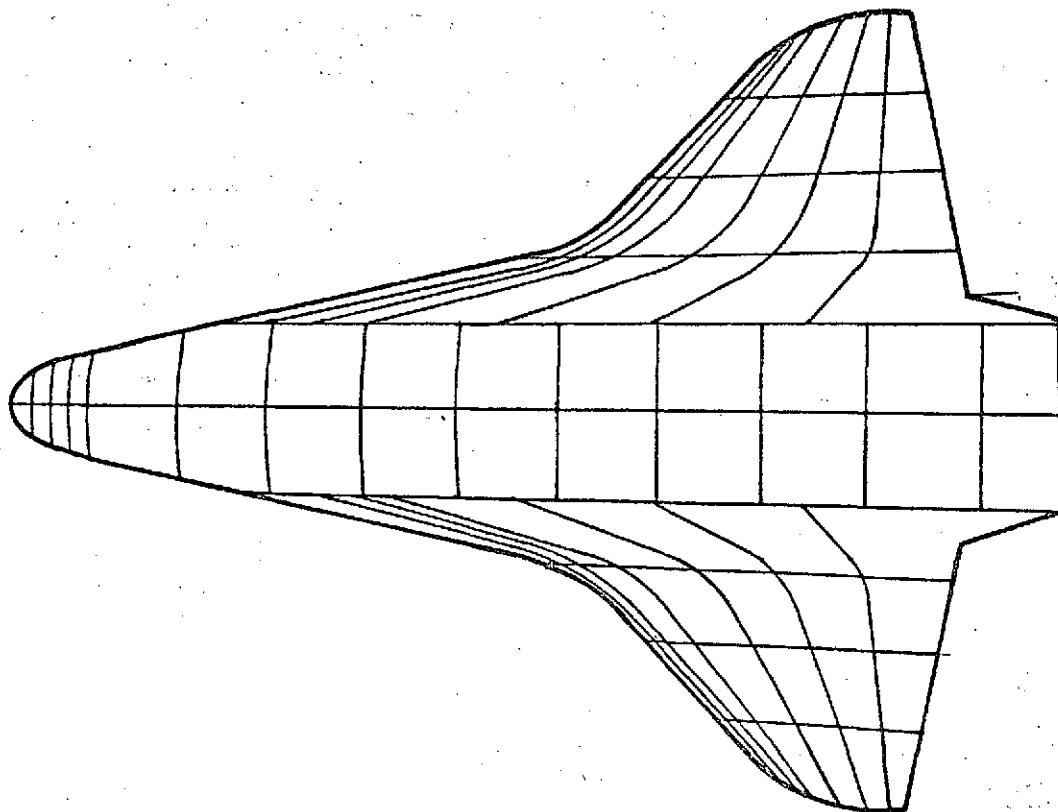


(Dimensions are inches unless noted otherwise)

Sketch 16. - Model 46-0 Configurations (#1 through #6).

DATA FIGURES

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

FIG 1

CONFIG.

LENGTH (R) =

SCALE .00593

FACILITY LRC/VDT

TEST GRID

RUN 4130 to 4137

$M_\infty =$

P_{total} (psia) =

T_{total} ($^{\circ}R$) =

$T_{aw}/T_{total} =$

R_N per foot =

$T_{phase\ change}$ ($^{\circ}F$) =

$\alpha = 35^{\circ}$

$\beta =$

$\phi =$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

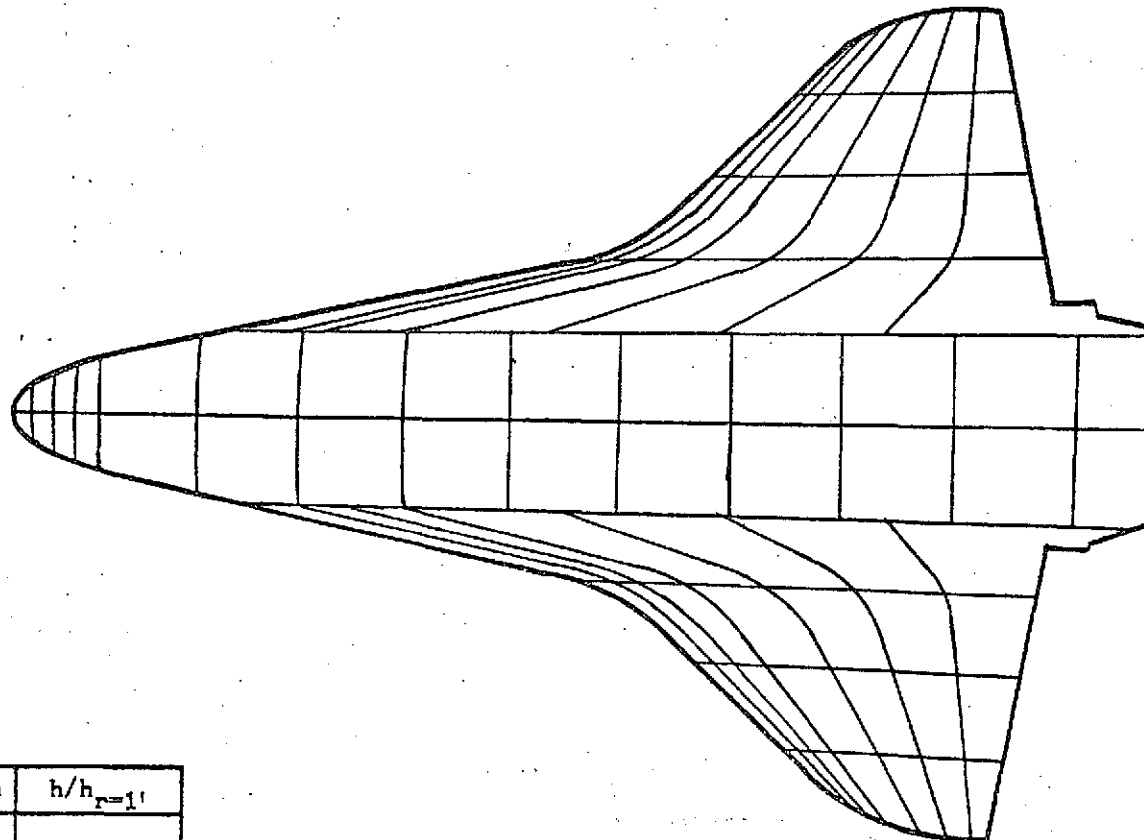
x (in) =

y (in) =

z (in) =

5-0

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

FIG 2

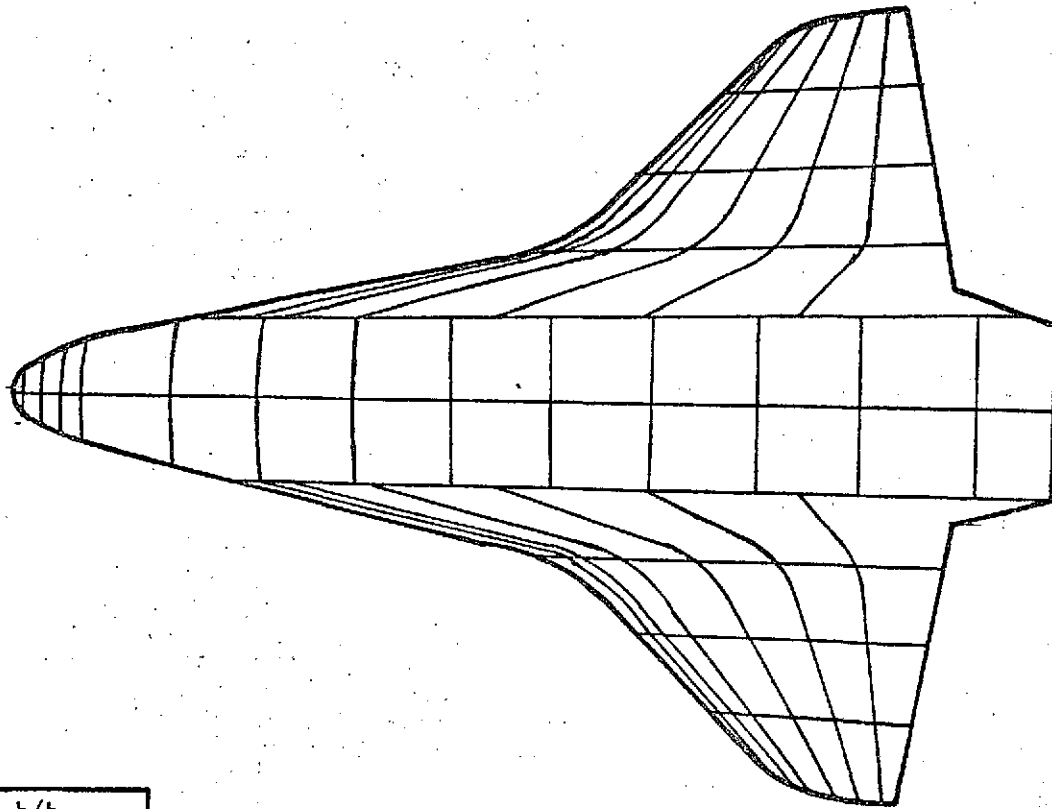
CONFIG.
LENGTH (R) =
SCALE .00593
FACILITY LRC/VDT
TEST GRID
RUN 4138 to 4171
$M_\infty =$
P_{total} (psia) =
T_{total} ($^{\circ}$ R) =
$T_{aw}/T_{total} =$
R_N per foot =
$T_{phase\ change}$ ($^{\circ}$ F) =
$\alpha = 30^{\circ}$
$\beta =$
$\phi =$
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)
x (in) =
y (in) =
z (in) =

w/D

Runs 4138-4171

HVD-EVCS

PHASE CHANGE TEST



isotherm	$h/h_{p=1}$
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

FIG. 3

CONFIG.

LENGTH (ft) =

SCALE ,00593

FACILITY LRC/YDT

TEST OH42-GRID

RUN 4172 to 4176

M_∞ =

P_{total} (psia) =

T_{total} ($^{\circ}$ R) =

T_{aw}/T_{total} =

R_N per foot =

$T_{phase\ change}$ ($^{\circ}$ F) =

$\alpha = 35^{\circ}$

$\beta =$

$\phi =$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

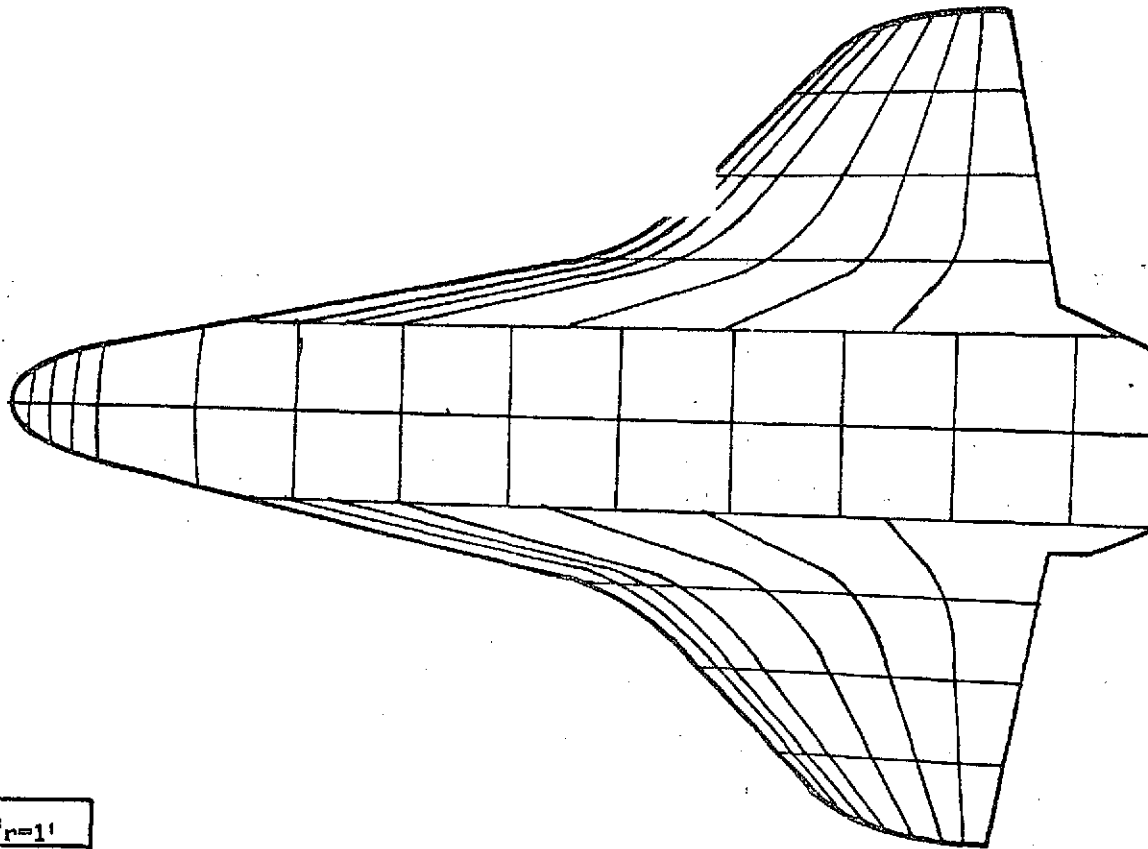
y (in) =

z (in) =

DDS

BVD-EVCS

PHASE CHANGE TEST

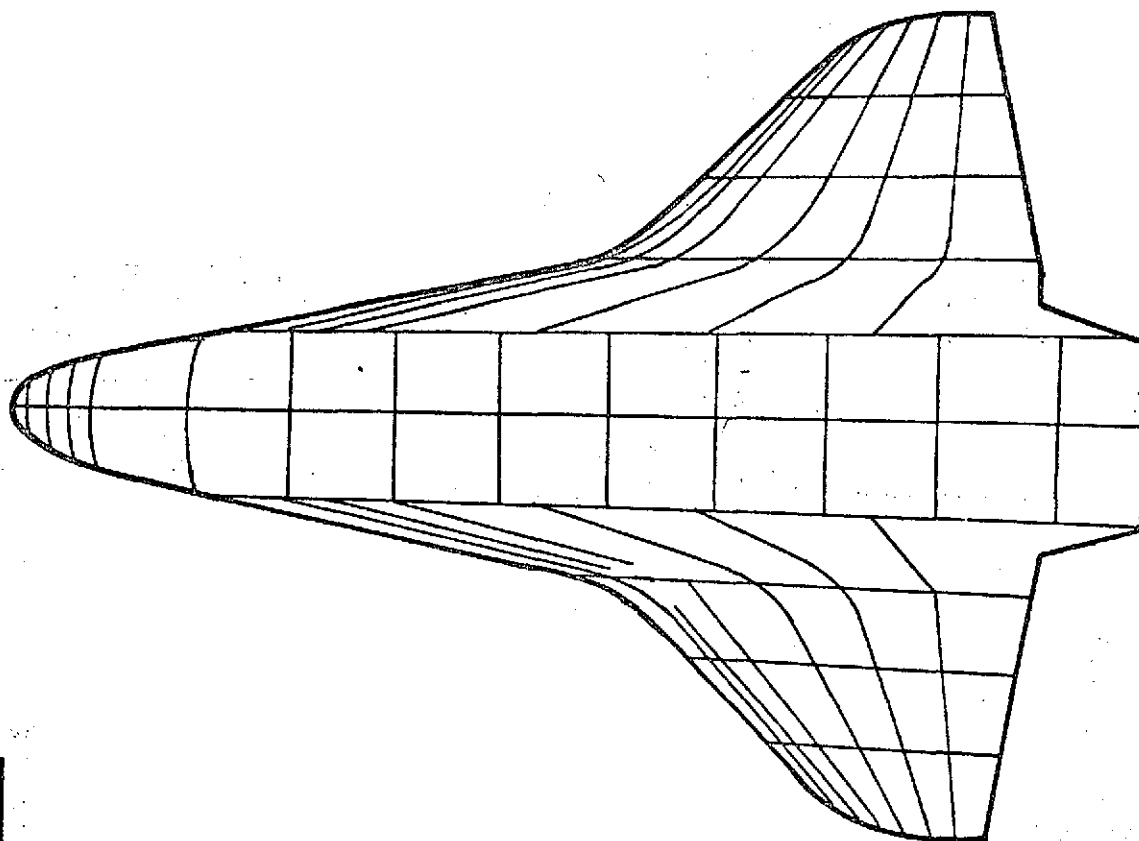


Isotherm	$h/h_{r=1}$
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

FIG. 4

CONFIG.
LENGTH (ft) =
SCALE ;00593
FACILITY LRC/VOT
TEST $\phi H42$
RUN 4177 to 4193
$M_\infty =$
P_{total} (psia) =
T_{total} ($^{\circ}R$) =
$T_{aw}/T_{total} =$
R_N per foot =
$T_{phase\ change}$ ($^{\circ}F$) =
$\alpha = 30^{\circ}$
$\beta =$
$\phi =$
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)
x (in) =
y (in) =
z (in) =

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

FIG. 5

CONFIG.

LENGTH (ft) =

SCALE .00593

FACILITY LRC/VDT

TEST ϕ H42 GRID

RUN 4271 to 4285

M_∞ =

P_{total} (psia) =

T_{total} ($^{\circ}$ R) =

T_{aw}/T_{total} =

R_N per foot =

$T_{phase\ change}$ ($^{\circ}$ F) = 156

$\alpha = 30^{\circ}$

$\beta =$

$\phi =$

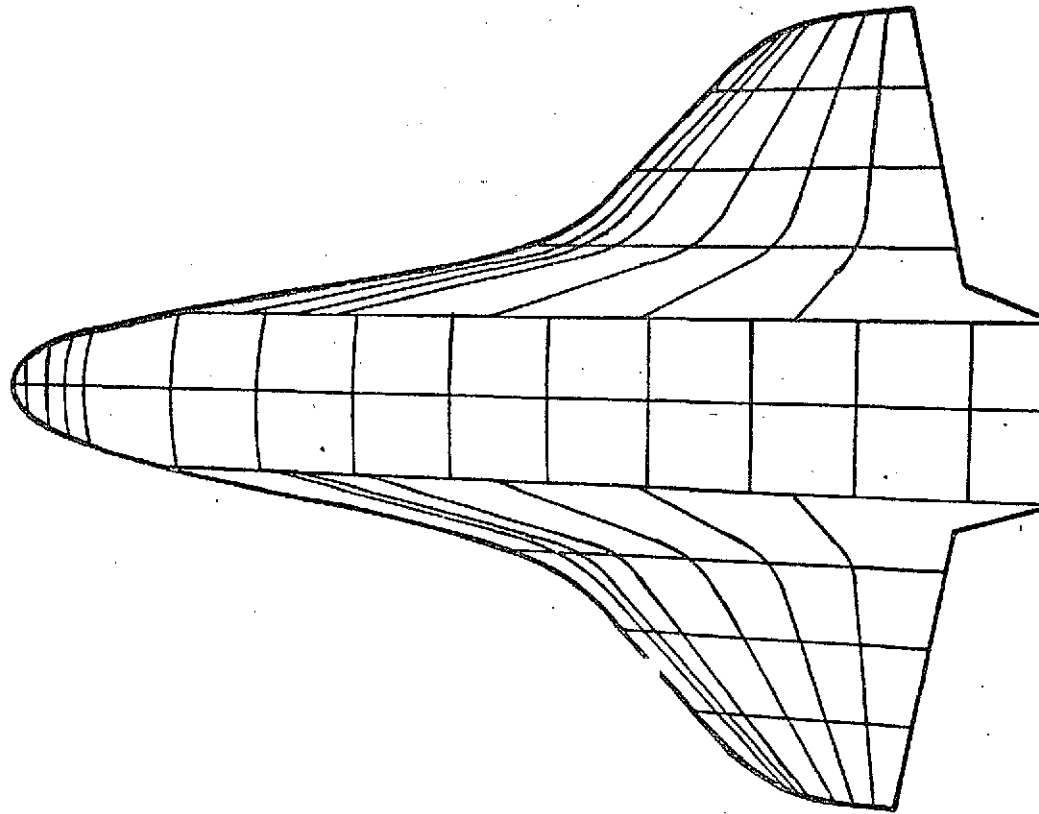
Camera Coordinates (from
model center, x-axis
parallel w/ stream,
+ downstream)

x (in) =

y (in) =

z (in) =

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

FIG. 6

CONFIG.

LENGTH (ft) =

SCALE

FACILITY

TEST *OH42-GRID*

RUN *4286 to 4292*

$M_\infty =$

P_{total} (psia) =

T_{total} ($^{\circ}R$) =

$T_{aw}/T_{total} =$

R_N per foot =

$T_{phase\ change}$ ($^{\circ}F$) =

$\alpha = 35^{\circ}$

$\beta =$

$\phi =$

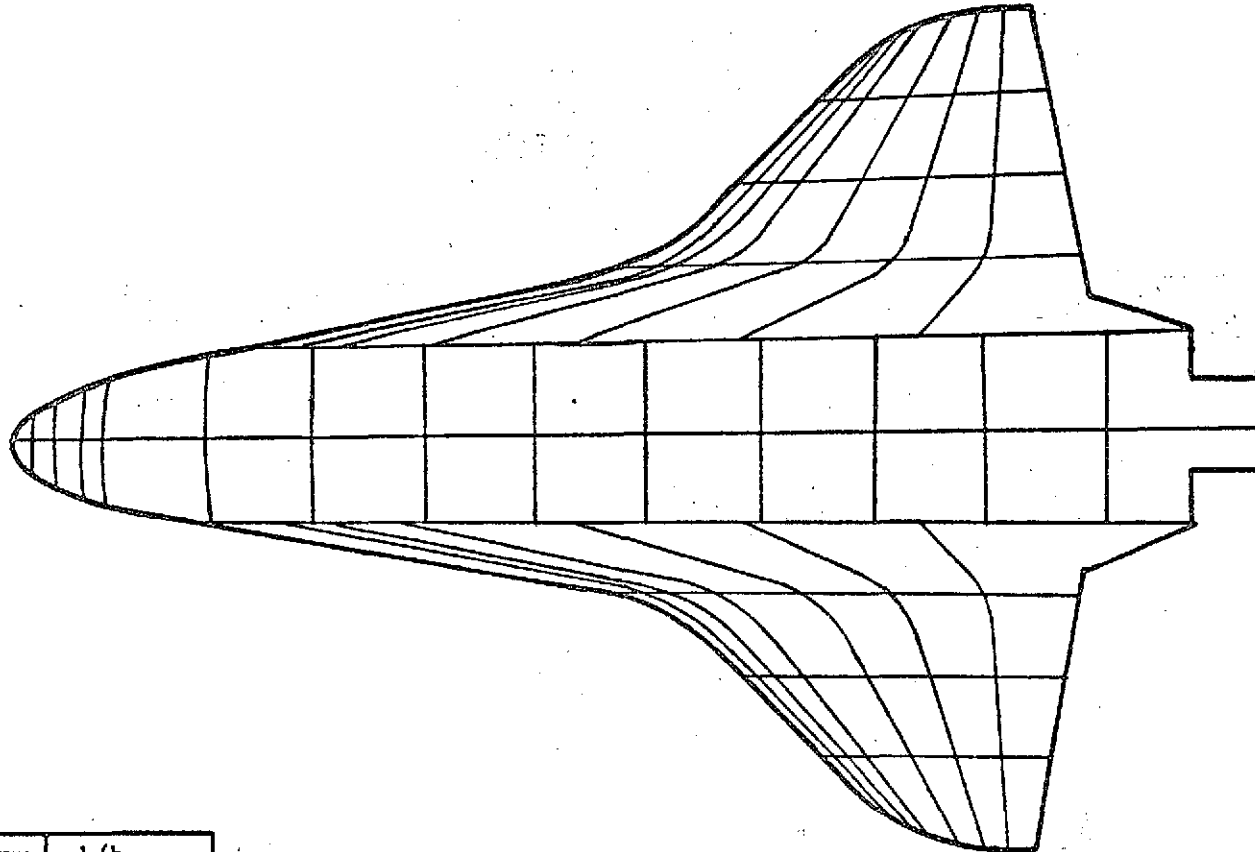
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

FIG. 7

CONFIG.

LENGTH (ft) =

SCALE .00593

FACILITY LRC/VDT

TEST OH42

RUN GRID 9293 to 4295

M_∞ =

P_{total} (psia) =

T_{total} ($^{\circ}R$) =

T_{aw}/T_{total} =

R_N per foot =

$T_{phase\ change}$ ($^{\circ}F$) =

$\alpha = 25^{\circ}$

$\beta =$

$\phi =$

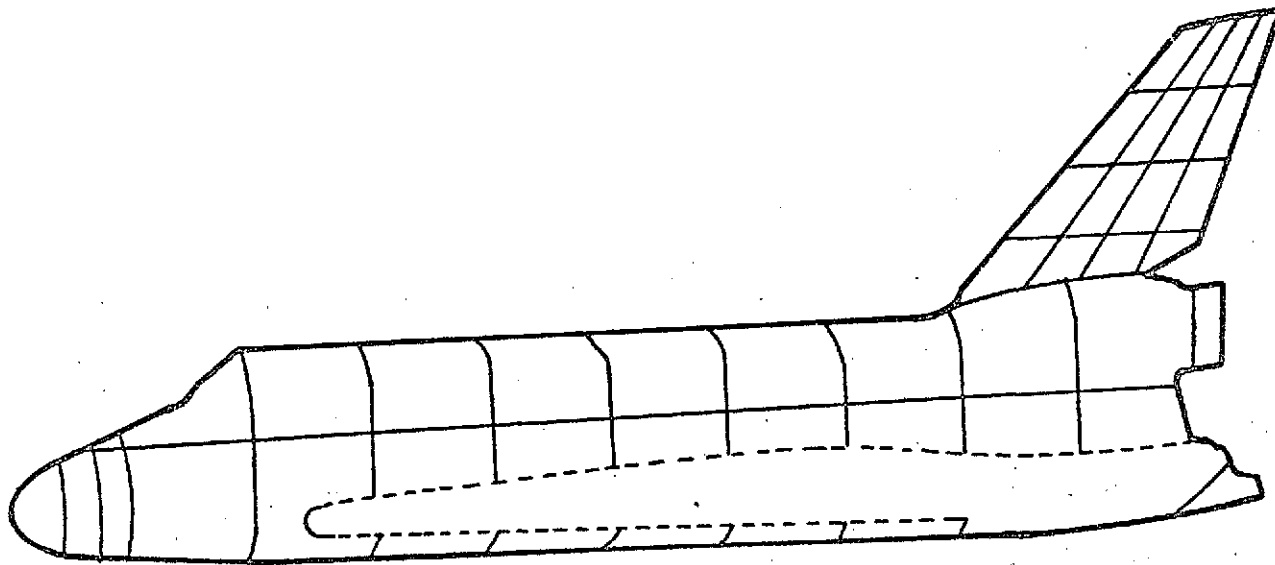
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

FIG. 8

CONFIG.

46-1

LENGTH (ft) =

SCALE .00593

FACILITY LRC/VDT

TEST OH 42

RUN 4130 to 4137

M_∞ =

P_{total} (psia) =

T_{total} ($^{\circ}R$) =

T_{aw}/T_{total} =

R_N per foot =

$T_{phase\ change}$ ($^{\circ}F$) =

α = 35°

β =

ϕ =

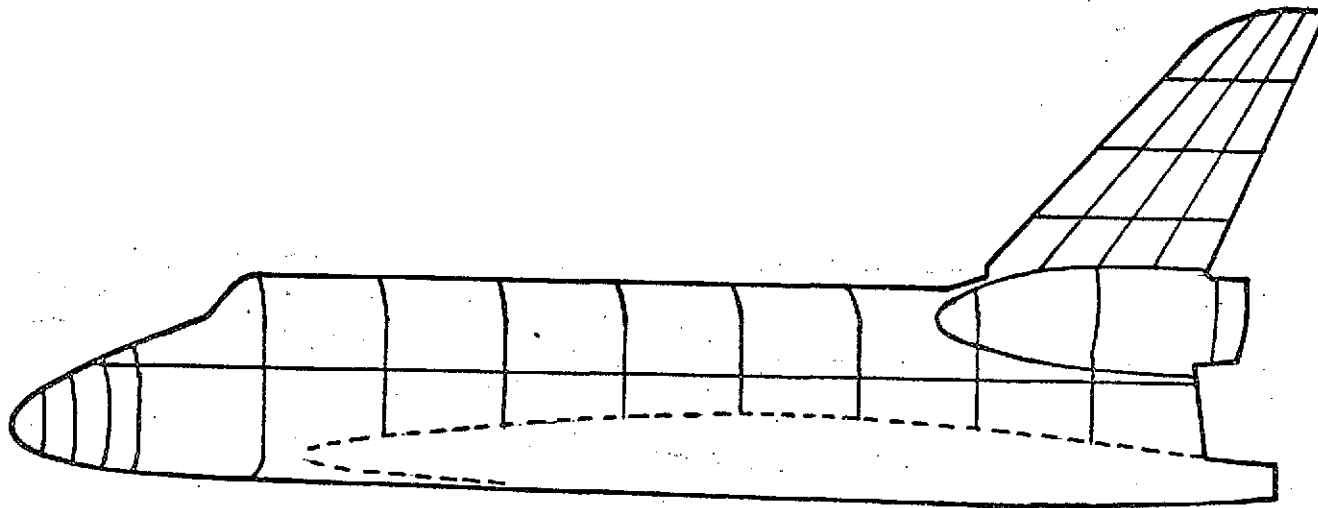
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

PHASE CHANGE TEST

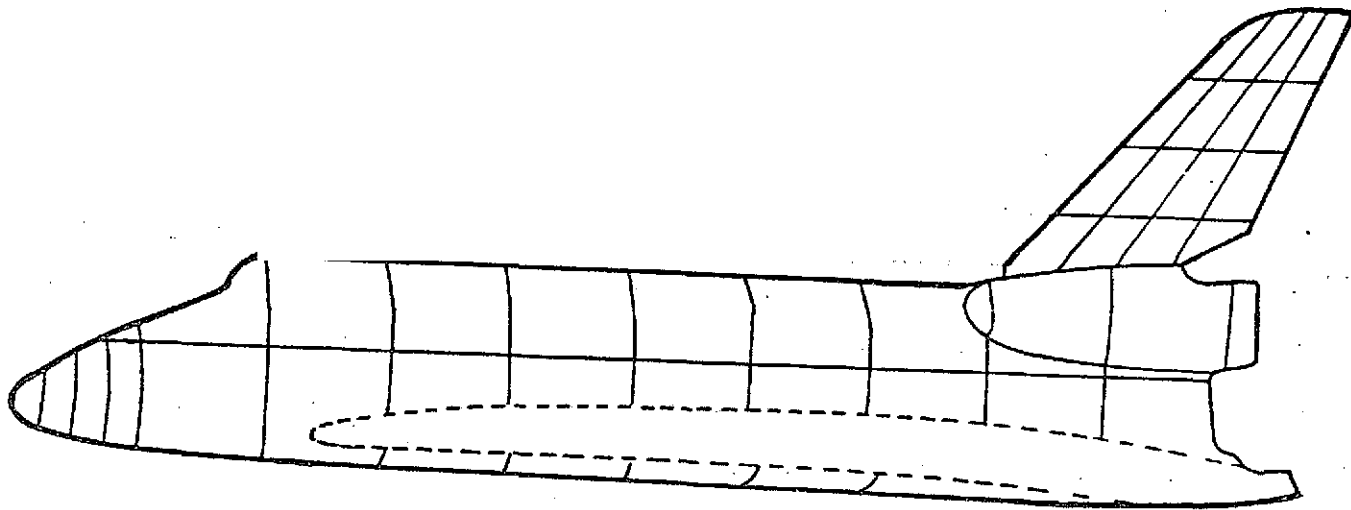


Isotherm	$h/h_{r=1}$
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

CONFIG. 1
LENGTH (ft) =
SCALE .00593
FACILITY LRC/YDT
TEST OH42
RUN 4138 to 4171
$M_\infty =$
P_{total} (psia) =
T_{total} ($^{\circ}R$) =
$T_{aw}/T_{total} =$
R_N per foot =
$T_{phase\ change}$ ($^{\circ}F$) =
$\alpha = 30^{\circ}$
$\beta =$
$\phi =$
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)
x (in) =
y (in) =
z (in) =

FIG. 9

PHASE CHANGE TEST

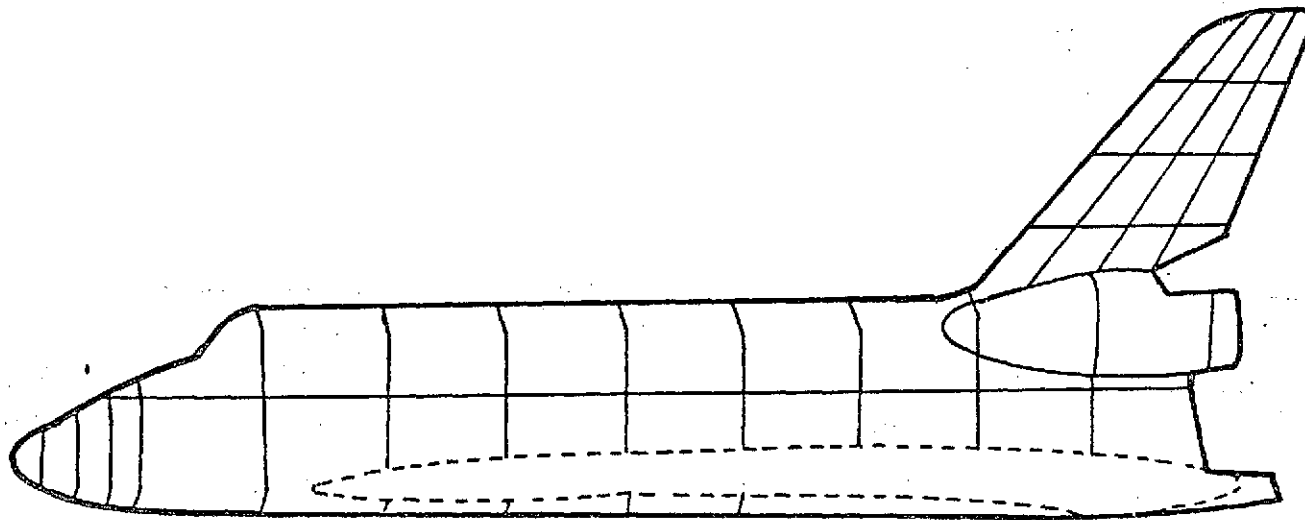


Isotherm	$h/h_{r=1}$
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

FIG. 10.

CONFIG.
LENGTH (ft) =
SCALE .00593
FACILITY LRC/VDT
TEST 0H42
RUN 4172 to 4176
$M_\infty =$
P_{total} (psia) =
T_{total} ($^{\circ}$ R) =
$T_{aw}/T_{total} =$
R_N per foot =
$T_{phase\ change}$ ($^{\circ}$ F) =
$\alpha = 35^{\circ}$
$\beta =$
$\phi =$
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)
x (in) =
y (in) =
z (in) =

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

CONFIG. 46-1

LENGTH (ft) =

SCALE .00593

FACILITY LRC/VDT

TEST OH92

RUN 4177 to 4193

M_∞ =

P_{total} (psia) =

T_{total} ($^{\circ}R$) =

T_{aw}/T_{total} =

R_N per foot =

$T_{phase\ change}$ ($^{\circ}F$) =

α = 30°

β =

ϕ =

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

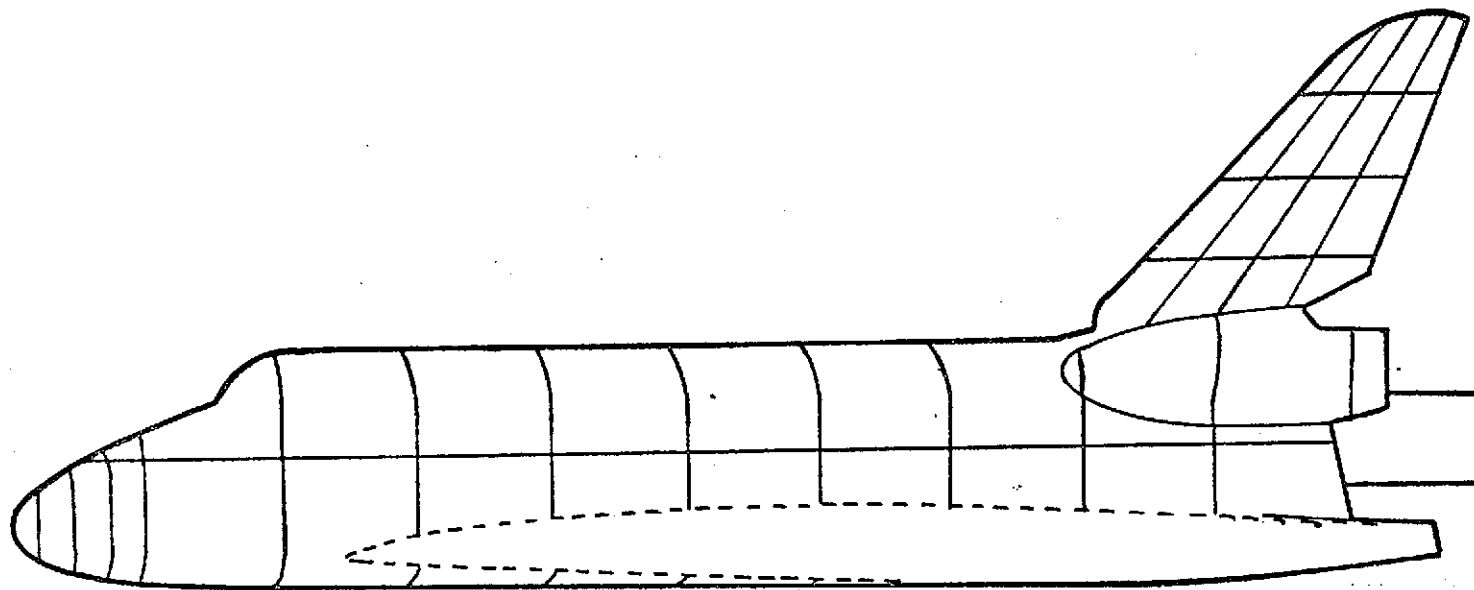
x (in) =

y (in) =

z (in) =

FIG. 11

PHASE CHANGE TEST

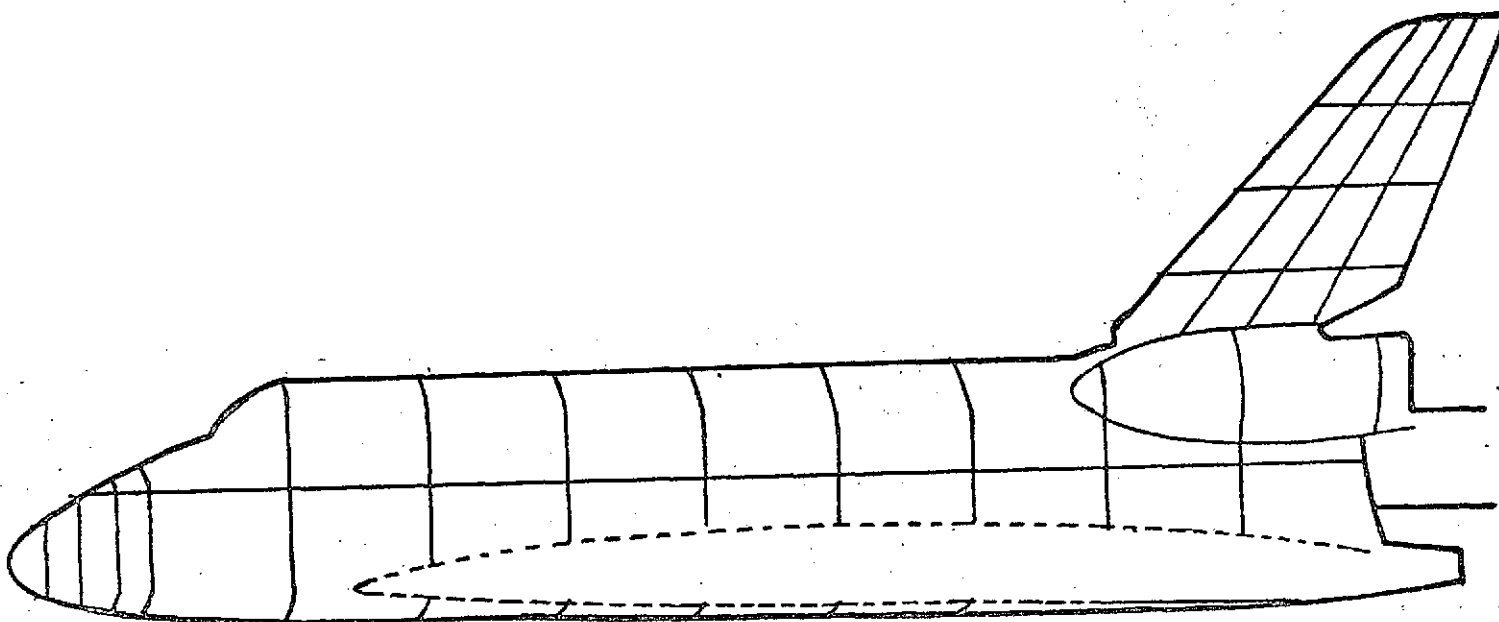


Isotherm	$h/h_{r=1}$
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

FIG. 12

CONFIG.
LENGTH (ft) =
SCALE .00593
FACILITY LRC/YDT
TEST OH42
RUN 4271 to 4285
$M_\infty =$
P_{total} (psia) =
T_{total} ($^{\circ}R$) =
$T_{aw}/T_{total} =$
R_N per foot =
$T_{phase\ change}$ ($^{\circ}F$) =
$\alpha = 30^{\circ}$
$\beta =$
$\phi =$
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)
x (in) =
y (in) =
z (in) =

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

FIG. 13

CONFIG.

LENGTH (ft) =

SCALE .00593

FACILITY LRC/VDT

TEST OH42

RUN 4286 to 4292

M_∞ =

P_{total} (psia) =

T_{total} ($^{\circ}$ R) =

T_{aw}/T_{total} =

R_N per foot =

$T_{phase\ change}$ ($^{\circ}$ F) =

α = 35°

β =

ϕ =

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

CONFIG. 46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST ϕ H42A (RPA)

RUN 4084

$M_\infty = 8$

P_{total} (psig) = 620

T_{total} ($^{\circ}$ F) = 900

$T_{aw}/T_{total} = 0.91$

R_N per foot = 3.0×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 300

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream):

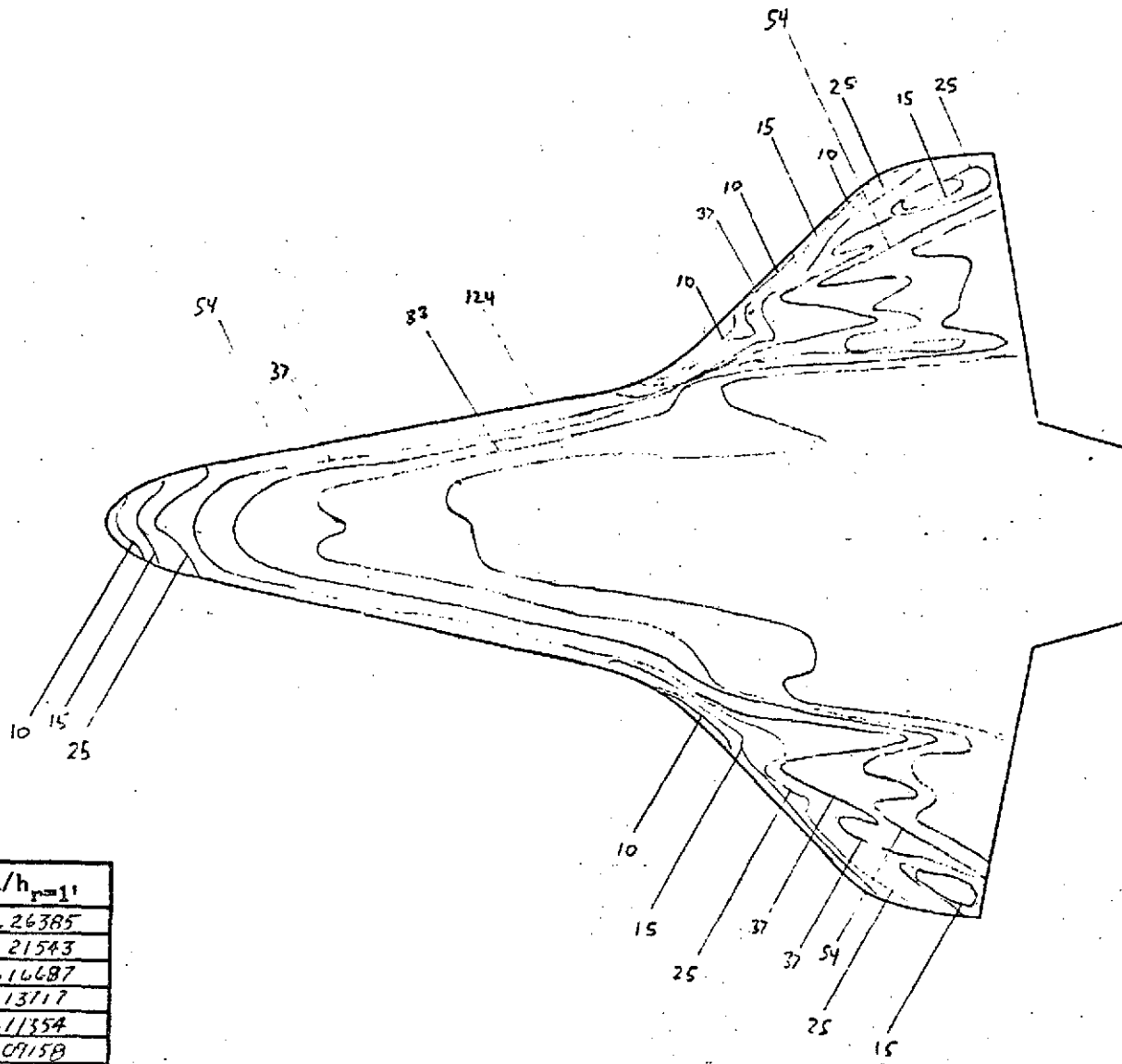
x (in) =

y (in) =

z (in) =

HS = .07207

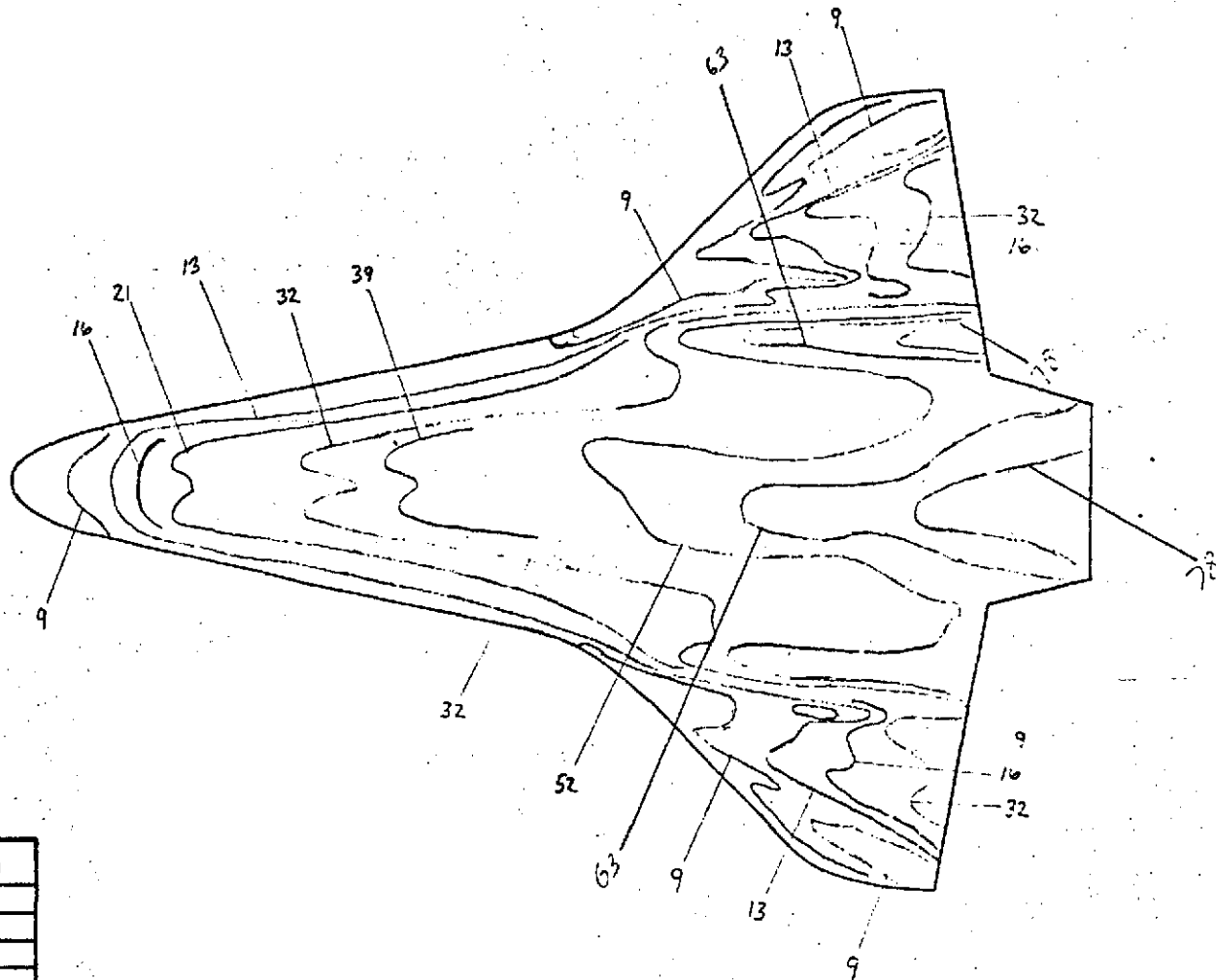
$\sqrt{C_{f, \tau}} = .0496$



Isotherm	$h/h_{r=1}$
10	.26385
15	.21543
25	.16687
37	.13717
54	.11354
83	.09158
124	.07493

FIG. 14

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
9	.830203
13	.108336
16	.0976526
21	.085238
32	.069051
39	.06255
52	.05417
63	.04921
78	.04432

FIG. 15

CONFIG. 46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42A (RPA)

RUN 4085

$M_\infty = 8$

P_{total} (psi) = 630

T_{total} (°F) = 880

$T_{aw}/T_{total} = .91$

R_N per foot = 3.0

$T_{phase\ change}$ (°F) = 200

$\alpha = 30$

$\beta =$

$\phi =$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

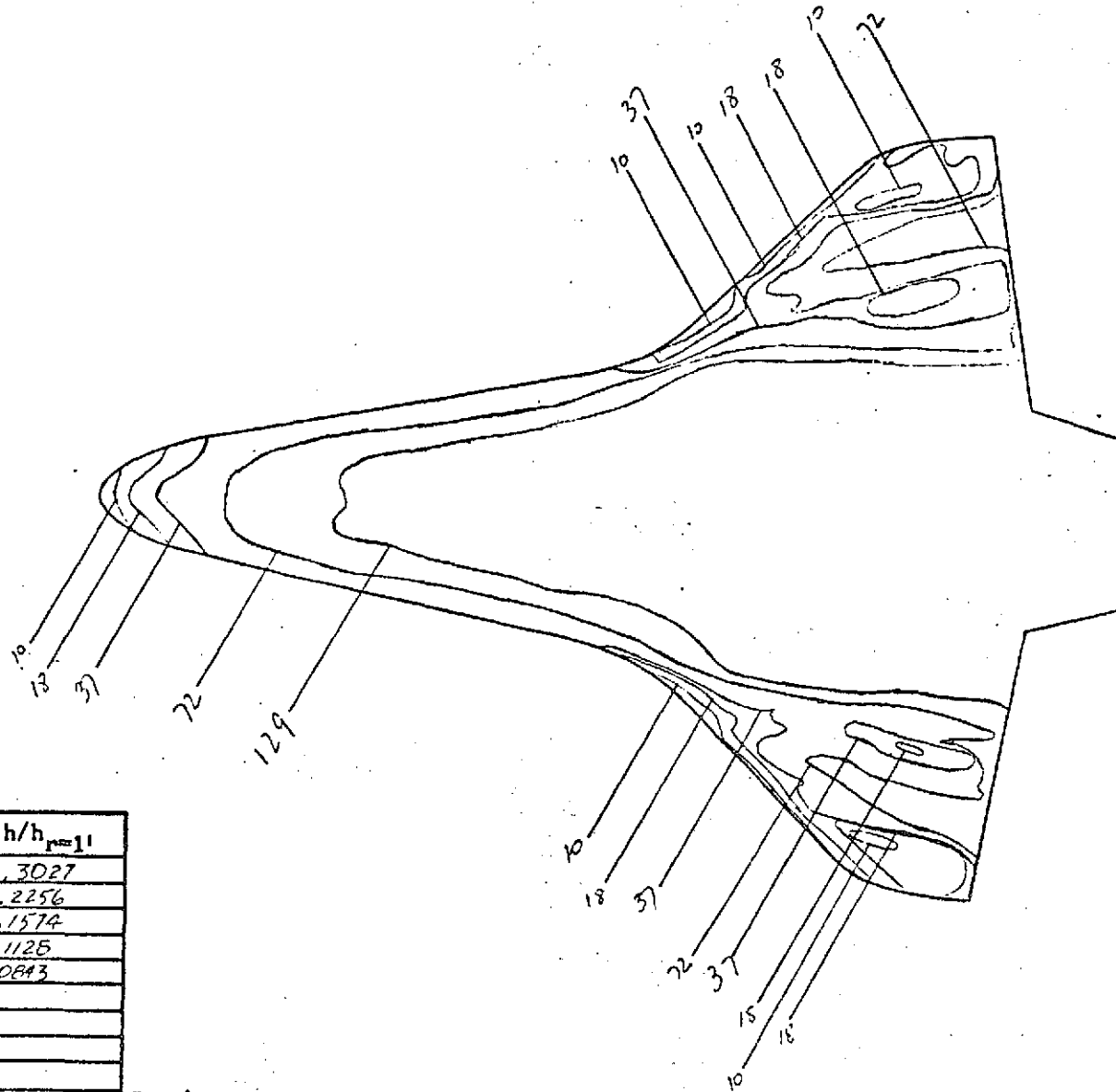
y (in) =

z (in) =

$HS = .072288$

$\sqrt{\rho q} = .0478$

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
10	.3027
18	.2256
37	.1574
72	.1125
129	.0843

FIG 16

CONFIG. 46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42A (RPA)

RUN 4086

$M_\infty = 8$

P_{total} (psig) = 1400

T_{total} ($^{\circ}F$) = 925

$T_{aw}/T_{total} = .91$

R_N per foot = 6×10^6

$T_{phase\ change}$ ($^{\circ}F$) = 400

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

$HS = .104839 \frac{BTU}{FT \cdot SEC \cdot ^{\circ}F}$
 $\sqrt{\rho c_p k} = .0503$

PHASE CHANGE TEST

FRAME 8: FIRST FRAME IN TUNNEL
CENTER TRIPPED THROUGH B.L.

CONFIG. 46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/JDT

TEST 0442A (RPA)

RUN 4087

$M_\infty = 8$

$P_{total} \text{ (psig)} = 1400$

$T_{total} \text{ (}^\circ\text{F)} = 925$

$T_{aw}/T_{total} = .91$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 250$

$\alpha = 30^\circ$

$\beta = 0$

$\phi = 0$

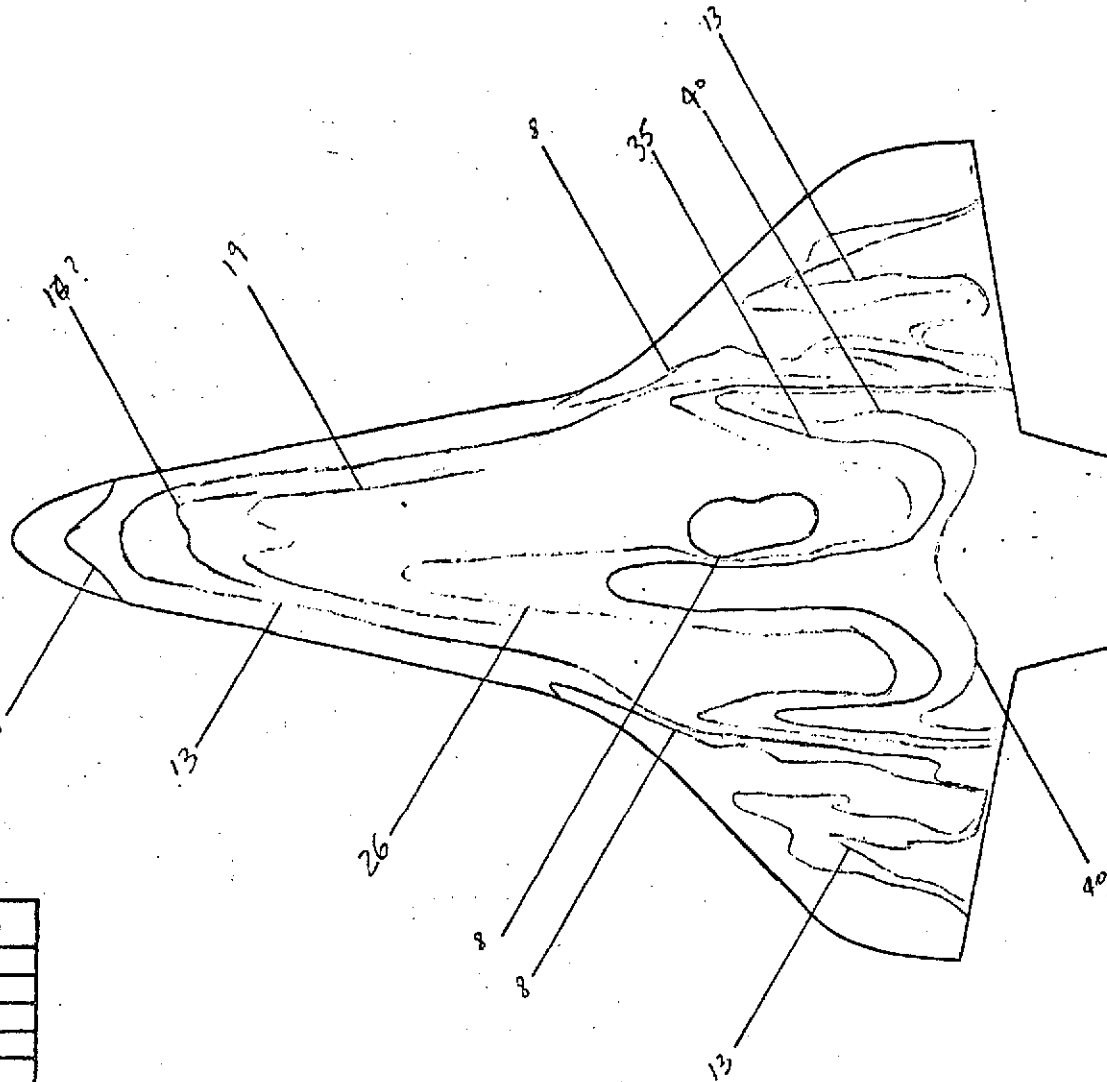
Camera Coordinates (from
model center, x-axis
parallel w/ stream,
+ downstream)

x (in) =

y (in) =

z (in) =

$HS = .10475 \text{ BTU/FT}^2\text{-SEC-}^\circ\text{F}$
 $\sqrt{C_p k} = .0489$



Isotherm	$h/h_{T=250}$
8	.13722
13	.10765
16	.09703
19	.08905
26	.07612
35	.06561
40	.06137

FIG. 17

PHASE CHANGE TEST

CONFIG.

46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDI

TEST OH42A (RPA)

RUN 4088

$M_\infty = 8$

$P_{total} \text{ (psig)} = 1935$

$T_{total} \text{ (}^\circ\text{F)} = 935$

$T_{aw}/T_{total} = .91$

$R_N \text{ per foot} = 8 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 400$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

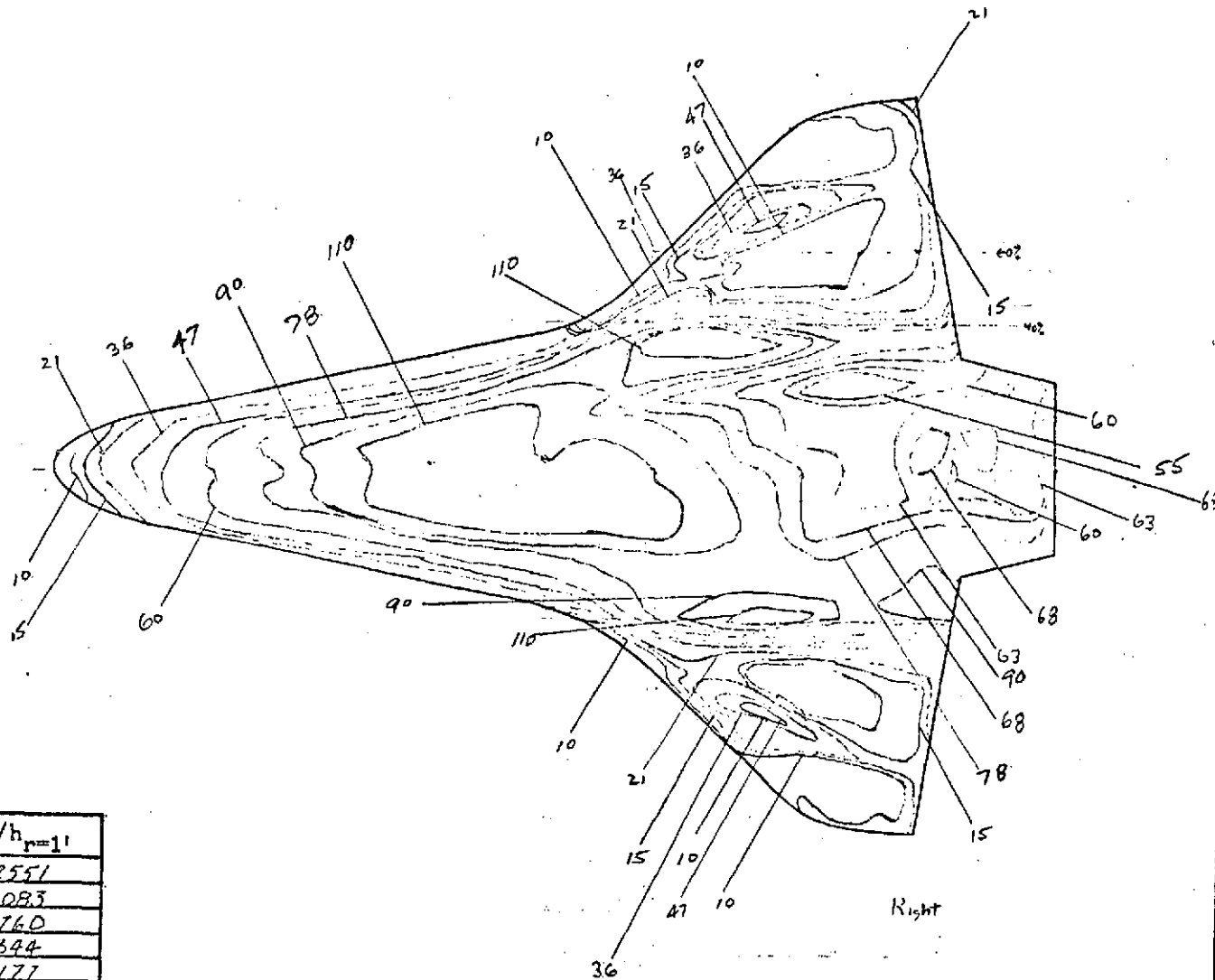
x (in) =

y (in) =

z (in) =

$HS = .1219 \text{ BTU/FT}^2\text{-SEC} \cdot \eta$

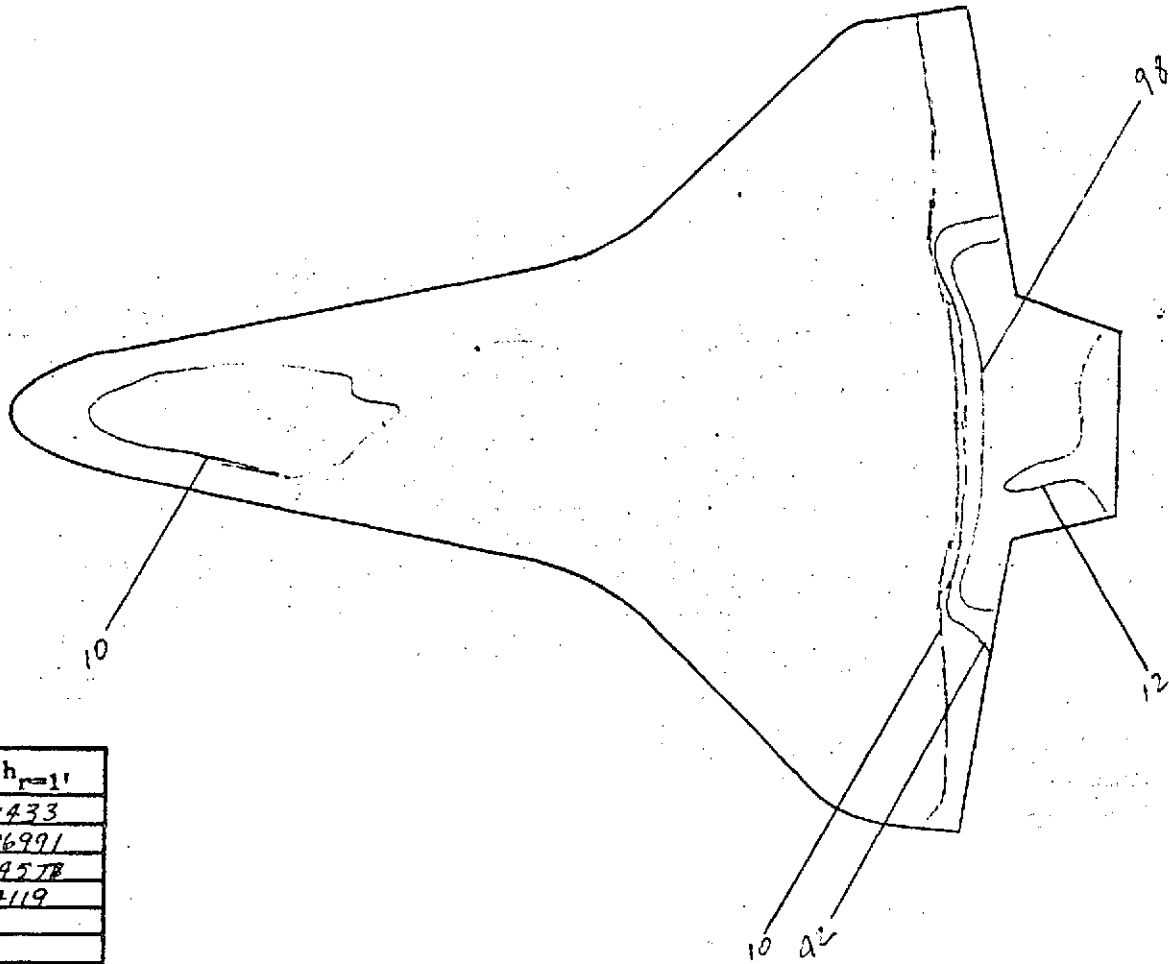
$\sqrt{PC_p k} = .0503$



Isotherm	$h/h_{p=1}$
10	.2551
15	.2083
21	.1760
36	.1344
47	.1177
55	.1088
60	.1041
63	.1016
68	.0978
78	.0913
90	.0850
110	.0769

FIG. 18

PHASE CHANGE TEST



Isotherm	h/h_{ref}
10	.1433
42	.06991
98	.04578
121	.04119

FIG. 19

CONFIG.

46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/YDT

TEST OH42A (RPA)

RUN 4089

$M_\infty = 8$

P_{total} (psig) = 163

T_{total} ($^{\circ}$ F) = 750

$T_{aw}/T_{total} = .91$

R_N per foot = 1×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 150

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from
model center, x-axis
parallel w/ stream,
+ downstream)

x (in) =

y (in) =

z (in) =

$HS = .03938 \frac{BTU}{FT^2 \cdot SEC \cdot ^{\circ}F}$

PHASE CHANGE TEST

CONFIG. 46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42A (RPA)

RUN 4091

$M_\infty = 8$

P_{total} (psig) = 1390

T_{total} (°F) = 930

$T_{aw}/T_{total} = .932$

R_N per foot = 6×10^6

$T_{phase\ change}$ (°F) = 400

$\alpha = 40^\circ$

$\beta = 0$

$\phi = 0$

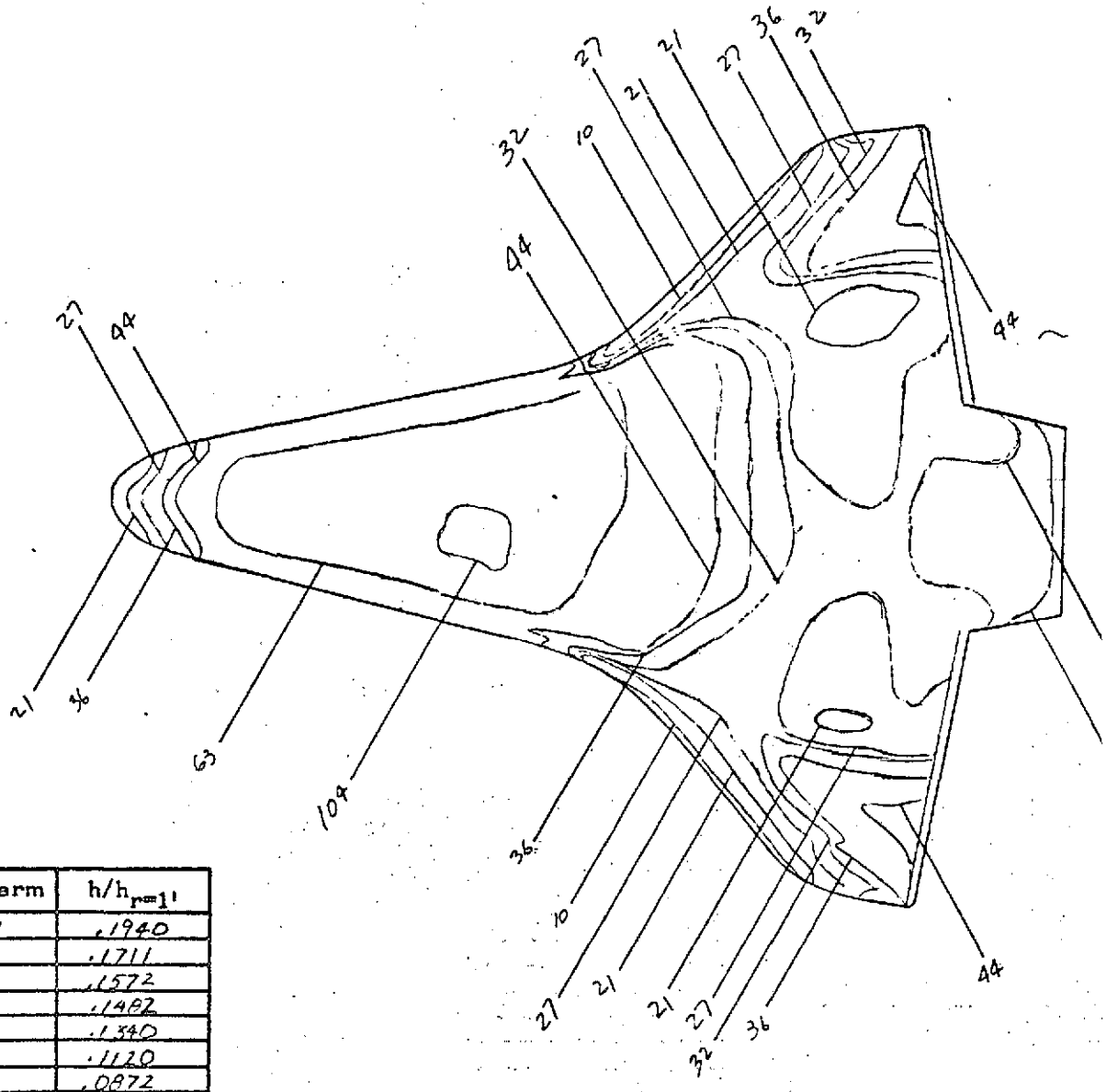
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

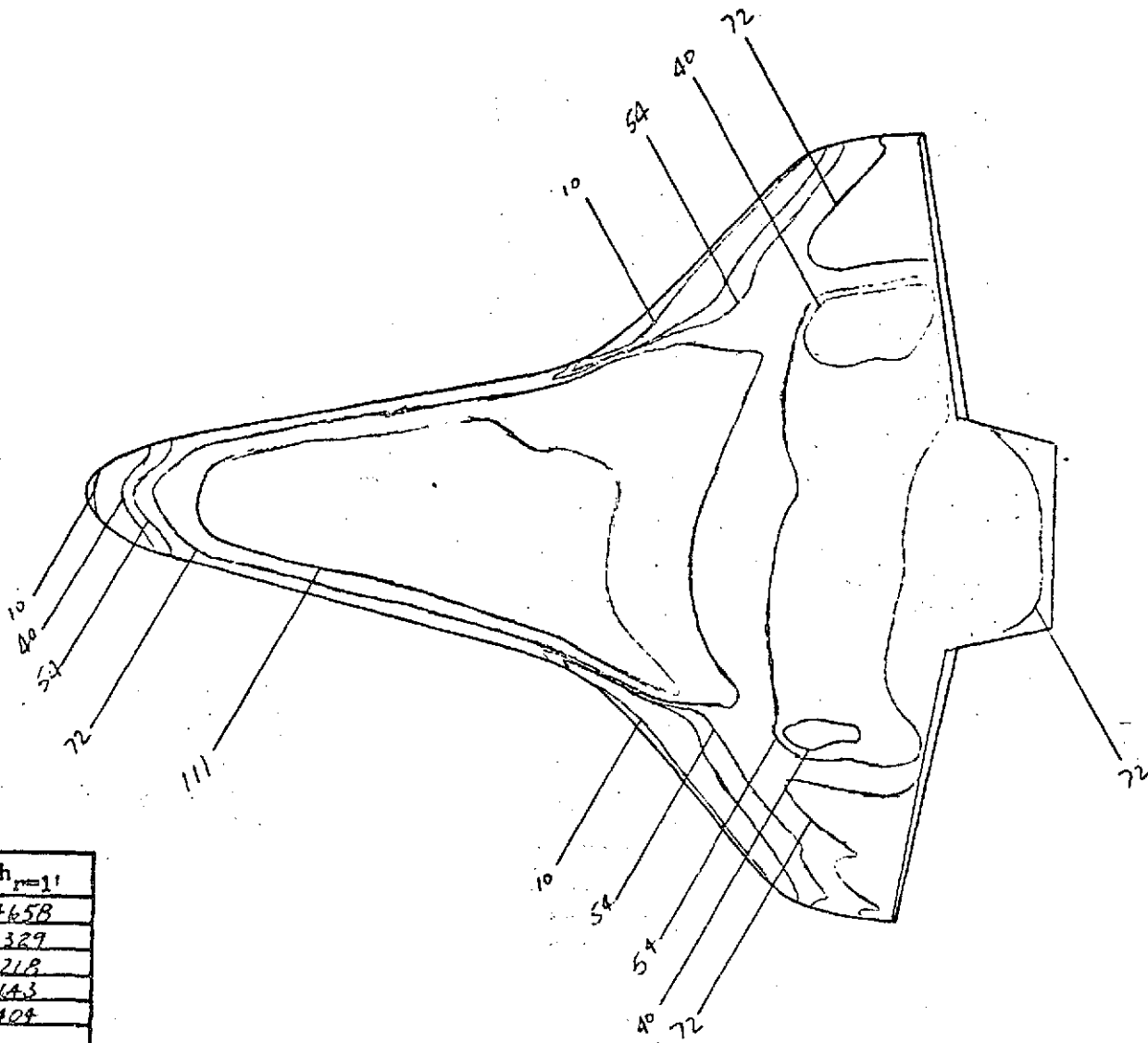
$HS = .10453 \frac{BTU}{FT^2 \cdot SEC \cdot ^\circ F}$



Isotherm	$h/h_{r=1}$
21	.1940
27	.1711
32	.1572
36	.1482
44	.1390
63	.1120
104	.0872

FIG. 20

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
10	.44658
40	.122329
54	.19218
72	.16643
111	.13404

FIG. 21

CONFIG.

LENGTH (ft) = .638

SCALE 1:00593

FACILITY LRC/VDT

TEST OHAZA (RPA)

RUN 4092

$M_\infty = 8$

P_{total} (psi) = 1400

T_{total} ($^{\circ}F$) = 940

$T_{aw}/T_{total} = .932$

R_N per foot = 1×10^6

$T_{phase\ change}$ ($^{\circ}F$) = 200

$\alpha = 40^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

$HS = .10477 \frac{BTU}{FT^2-SEC-^{\circ}F}$

PHASE CHANGE TEST

CONFIG. 46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OHAZA (RPA)

RUN 4093

$M_\infty = 0$

P_{total} (psig) = 150

T_{total} (°F) = 760

$T_{aw}/T_{total} = .932$

R_N per foot = 1×10^6

$T_{phase\ change}$ (°F) = 200

$\alpha = 40^\circ$

$\beta = 0$

$\phi = 0$

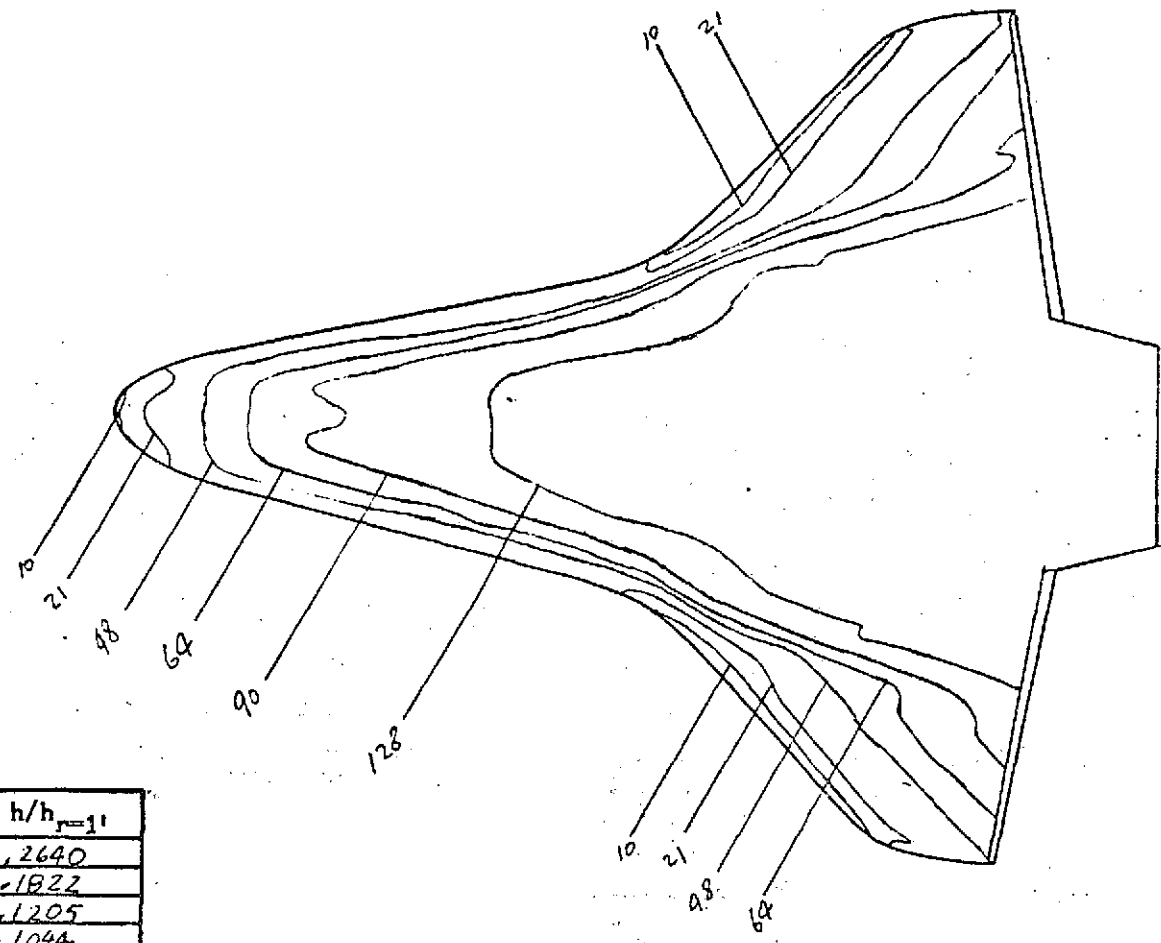
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

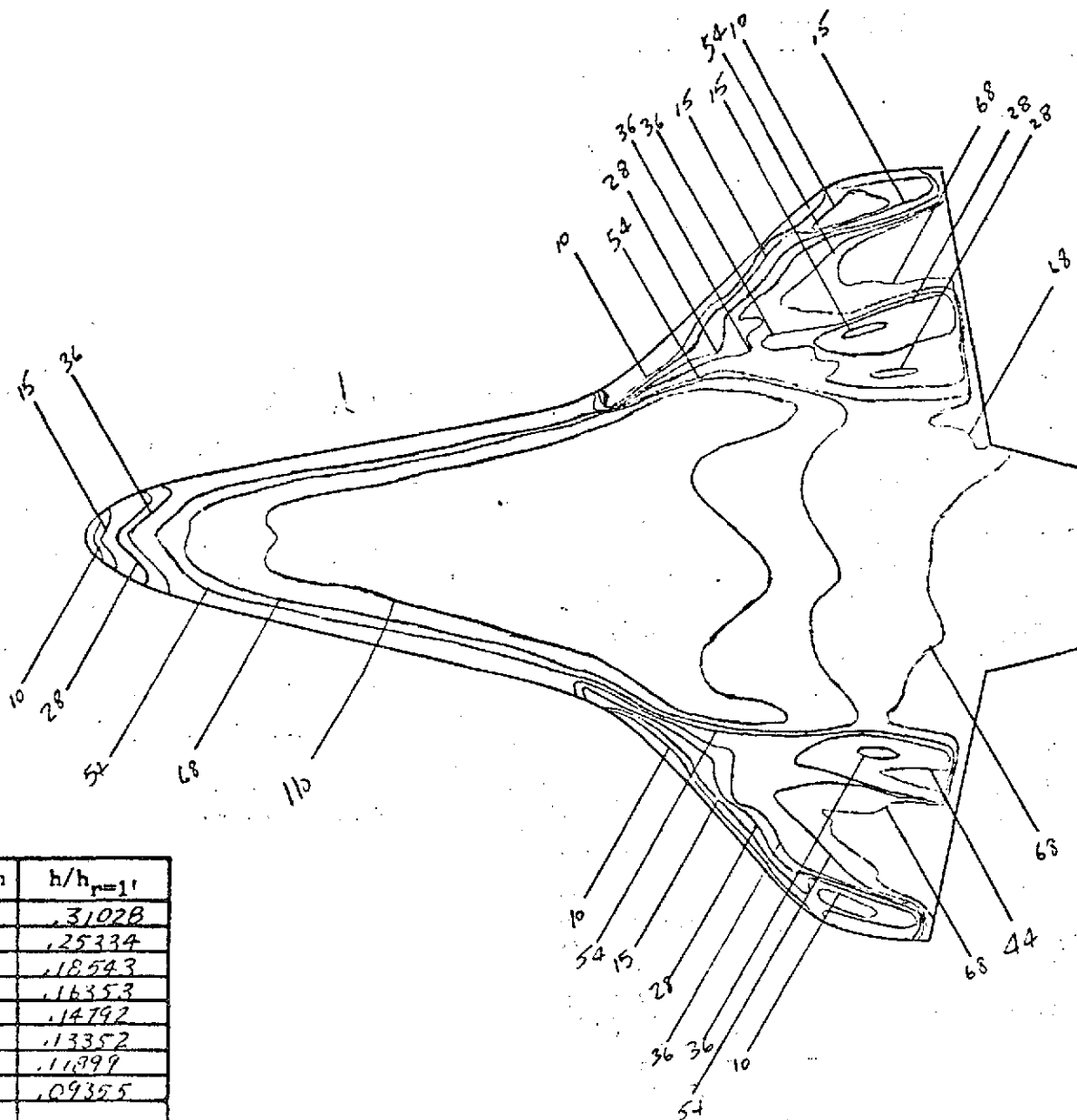
$H_5 = .038176 \text{ BTU} / \text{FT}^2 \text{-SEC-}^\circ\text{F}$



Isotherm	$h/h_{r=1}$
10	.2640
21	.1822
48	.1205
64	.1044
90	.0880
128	.0738

FIG 22

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
10	.31028
15	.25334
28	.18543
36	.16353
44	.14792
54	.13352
66	.11399
11	.09355

FIG. 23

CONFIG.

46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/YDT

TEST OH42A (RPM)

RUN 4096

$M_\infty = 8$

P_{total} (psig) = 1395

T_{total} ($^{\circ}$ F) = 900

$T_{aw}/T_{total} = .92$

R_N per foot = 6×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 400

$\alpha = 35^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

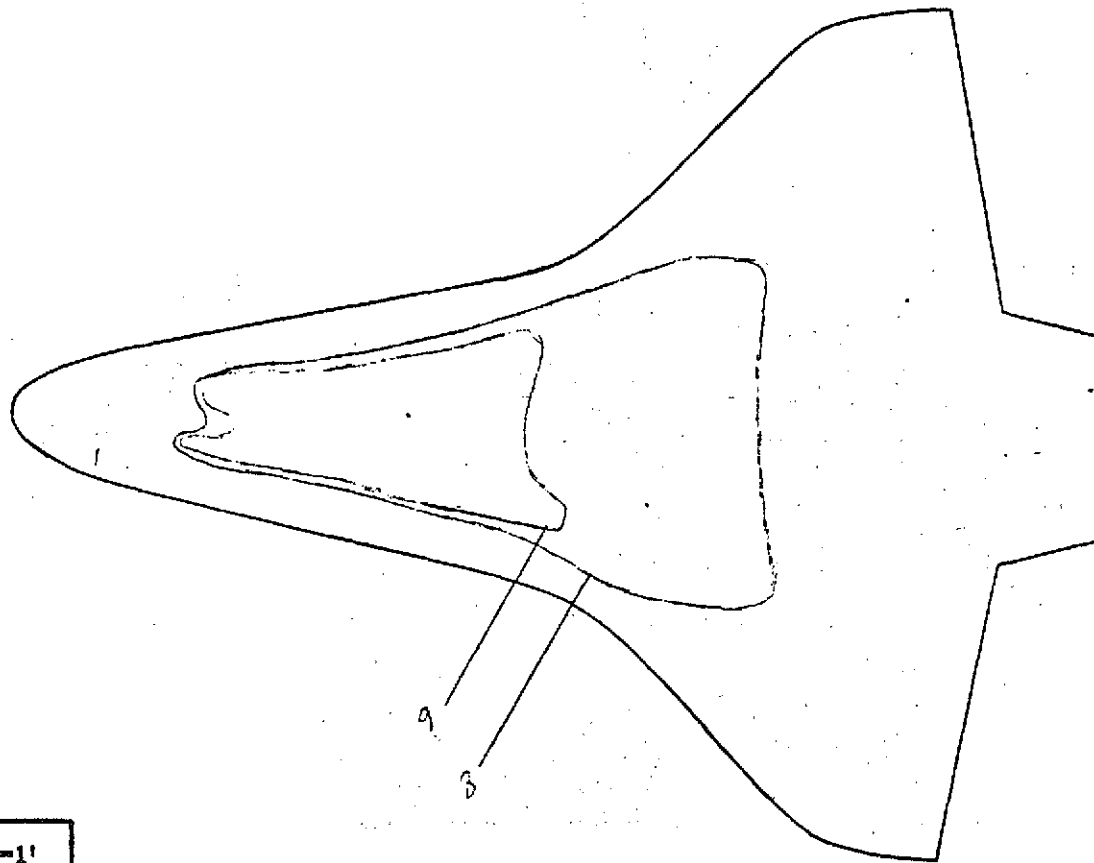
x (in) =

y (in) =

z (in) =

$HS = .10447 \text{ BTU} / \text{FT}^2 \text{-SEC-}^{\circ}\text{F}$

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
8	.08629
9	.08135

FIG. 24

ALL MELTED AT FRAME 10

CONFIG. 46-4

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH 42A (RP)

RUN 4097

$M_\infty = 8$

P_{total} (psig) = 1385

T_{total} (°F) = 925

$T_{aw}/T_{total} = .92$

R_N per foot = 6×10^6

$T_{phase\ change}$ (°F) = 200

$\alpha = 35^\circ$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

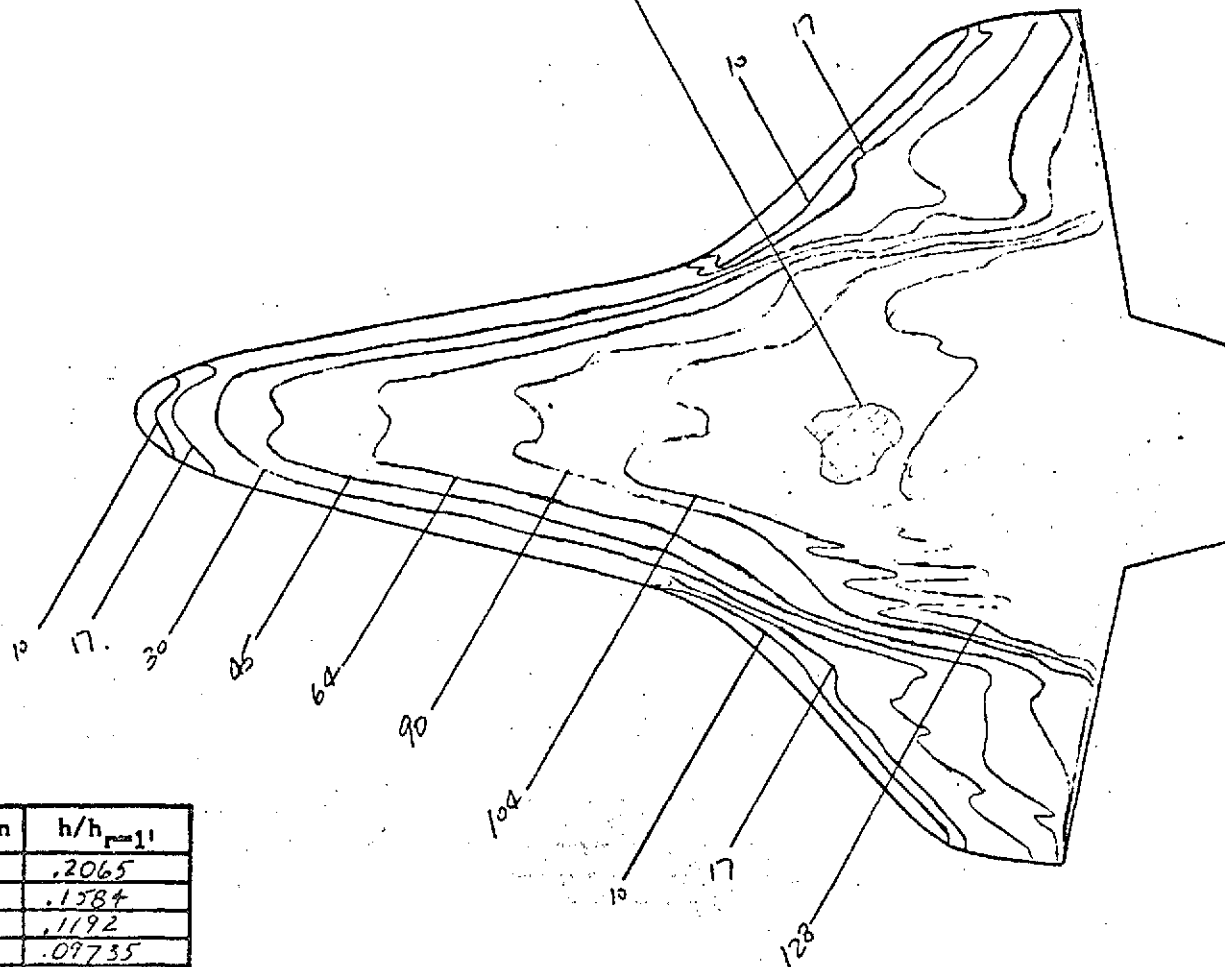
y (in) =

z (in) =

$h_3 = .10407 \frac{BTU}{FT^2-SEC-^\circ F}$

PHASE CHANGE TEST

10 (SEEMED TO BLOW OFF DURING REJECTION)



Isotherm	h/h_{ref}
10	.2065
17	.1584
30	.1192
45	.09735
64	.08163
90	.06884
104	.06404
128	.05772

FIG. 25

CONFIG. 46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/YDT

TEST OH42A (RPA)

RUN 4098

$M_\infty = 8$

P_{total} (psig) = 160

T_{total} ($^{\circ}F$) = 760

$T_{aw}/T_{total} = .92$

R_N per foot = 1×10^6

$T_{phase\ change}$ ($^{\circ}F$) = 175

$\alpha = 35^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

$HS = .039168 \frac{BTU}{FT^2 \cdot SEC \cdot ^{\circ}F}$

PHASE CHANGE TEST

CONFIG. 46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42A (RPA)

RUN 4100

$M_\infty = 8$

P_{total} (psig) = 1420

T_{total} (°F) = 985

$T_{aw}/T_{total} = .898$

R_N per foot = 6×10^6

$T_{phase\ change}$ (°F) = 350

$\alpha = 25^\circ$

$\beta = 0$

$\phi = 0$

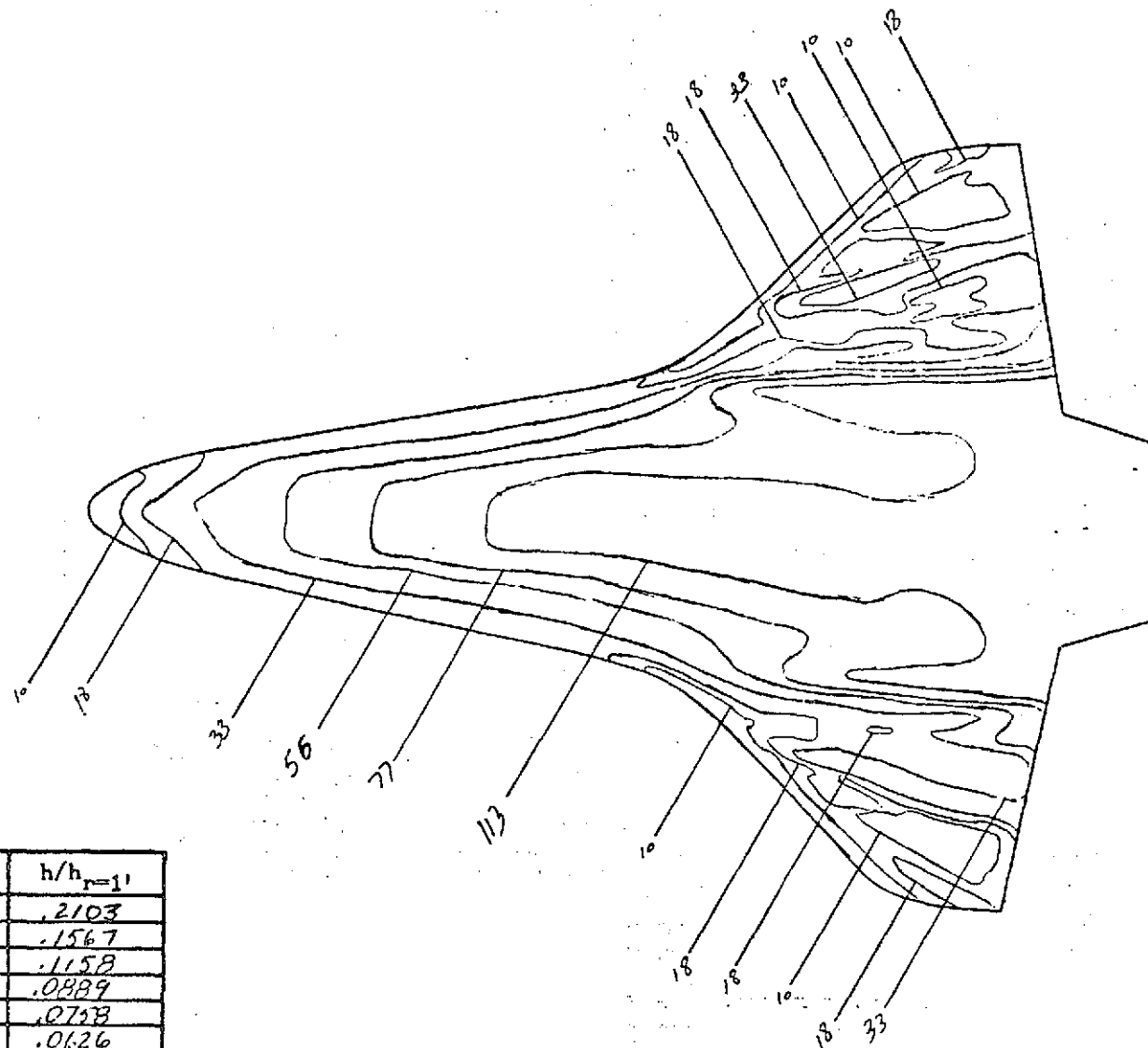
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

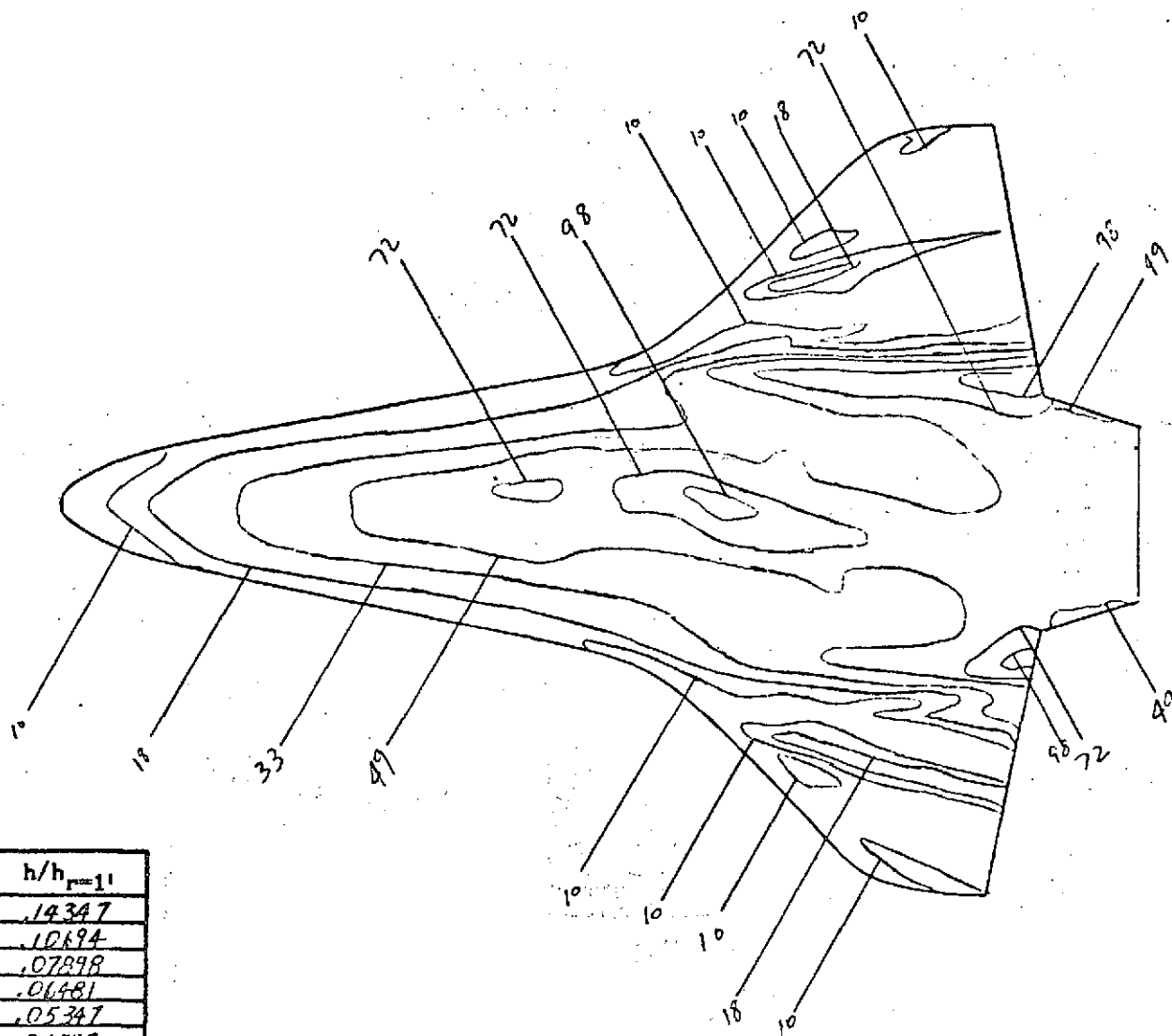
$HS = .10604 \frac{BTU}{FT^2 \cdot SEC \cdot ^\circ F}$



Isotherm	$h/h_{r=1}$
10	.2103
18	.1567
33	.1158
56	.0889
77	.0728
113	.0626

FIG. 26

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
10	.14347
18	.10694
33	.07898
49	.06481
72	.05347
98	.04583

FIG. 27

CONFIG.

46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/YDT

TEST OH42A (KPA)

RUN 4101

$M_\infty = 8$

$P_{total} \text{ (psig)} = 1375$

$T_{total} \text{ (}^\circ\text{F)} = 950$

$T_{aw}/T_{total} = .898$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 275$

$\alpha = 25^\circ$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

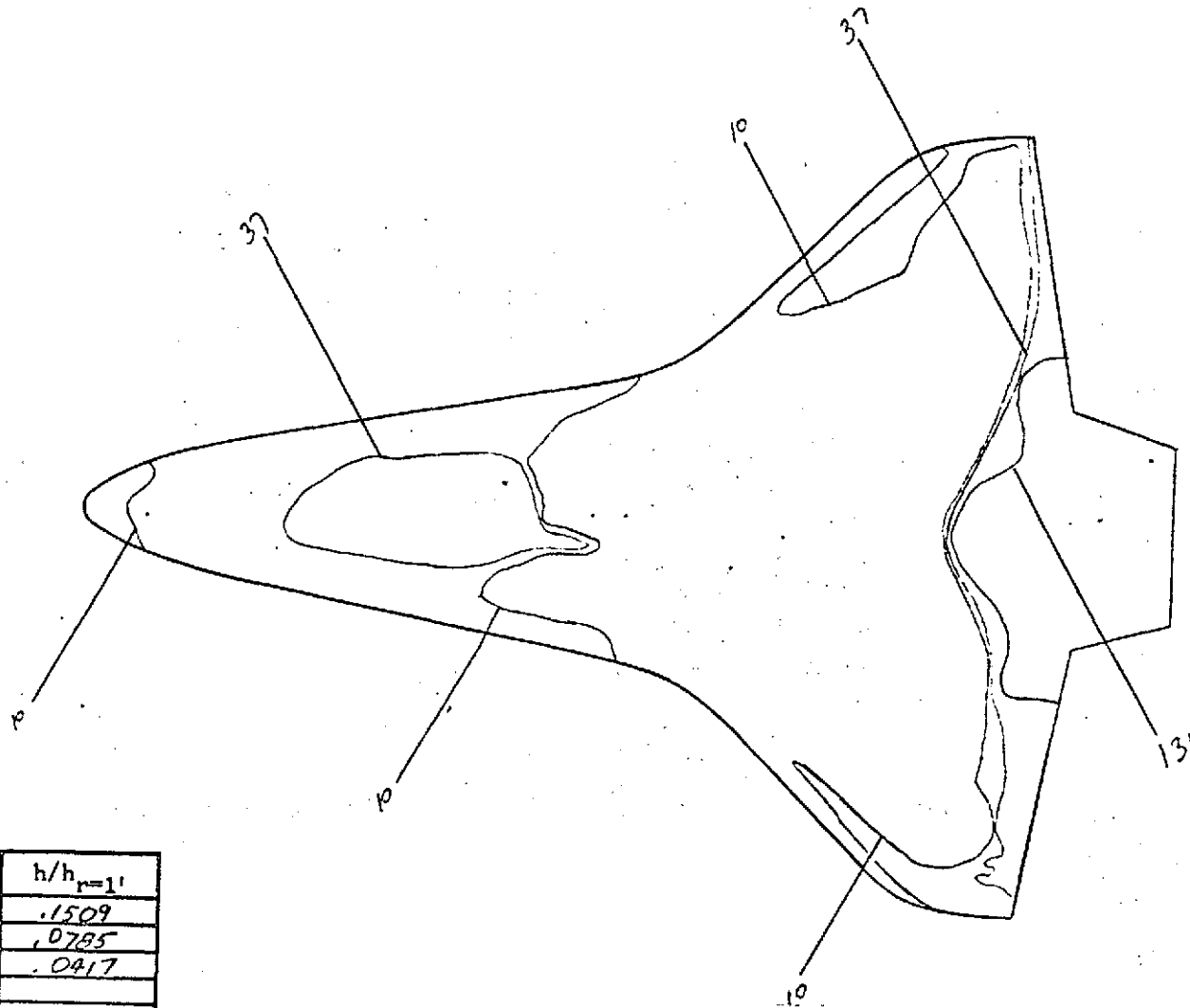
x (in) =

y (in) =

z (in) =

$HS = .10415 \frac{\text{BTU}}{\text{FT}^2\text{-SEC}^\circ\text{F}}$

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
-10	.1509
37	.0785
131	.0417

FIG 28

CONFIG.

46-4

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42A (RPA)

RUN 4102

$M_\infty = 8$

P_{total} (psig) = 160

T_{total} ($^{\circ}$ F) = 735

$T_{aw}/T_{total} = .898$

R_N per foot = 1×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 150

$\alpha = 25^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

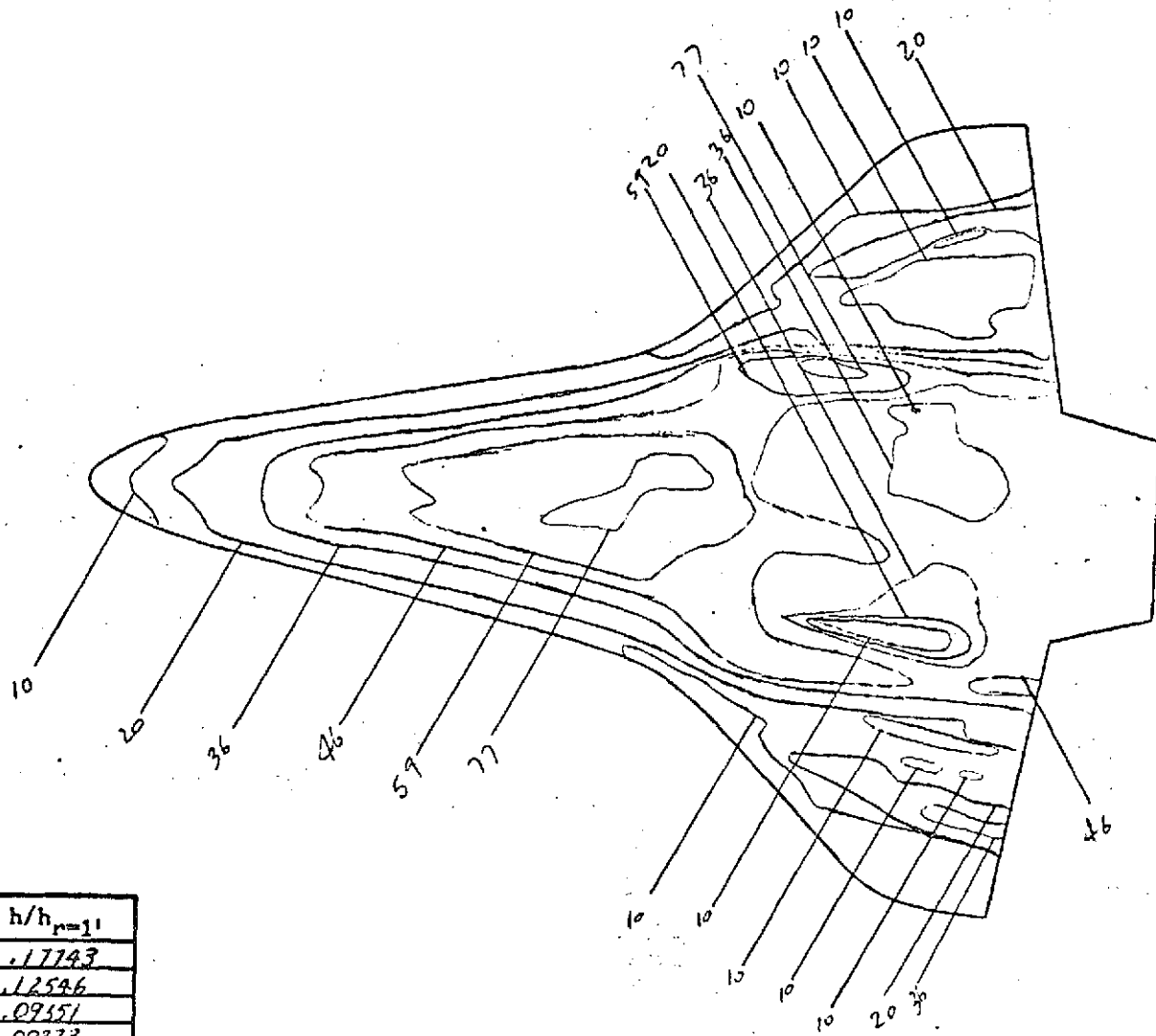
x (in) =

y (in) =

z (in) =

$HS = .03902 \frac{BTU}{FT^2 \cdot SEC \cdot ^{\circ}F}$

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
10	.17743
20	.12546
36	.09451
46	.08273
59	.07305
77	.06394

FIG. 29

CONFIG. 46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY VDT

TEST OH42A (RPA)

RUN 4104

$M_{\infty} = 8$

$P_{total} \text{ (psig)} = 1390$

$T_{total} \text{ (}^{\circ}\text{F)} = 910$

$T_{aw}/T_{total} = .91$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} \text{ (}^{\circ}\text{F)} = 300$

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

$HS = .104425 \text{ BV} / \text{FT}^2\text{-SEC-}^{\circ}\text{F}$

PHASE CHANGE TEST

CONFIG. 46-4

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42A (RPA)

RUN 4105

$M_\infty = 8$

$P_{total} \text{ (psig)} = 1940$

$T_{total} \text{ (}^\circ\text{F)} = 970$

$T_{aw}/T_{total} = .91$

$R_N \text{ per foot} = 8 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 350$

$\alpha = 30^\circ$

$\beta = 0$

$\phi = 0$

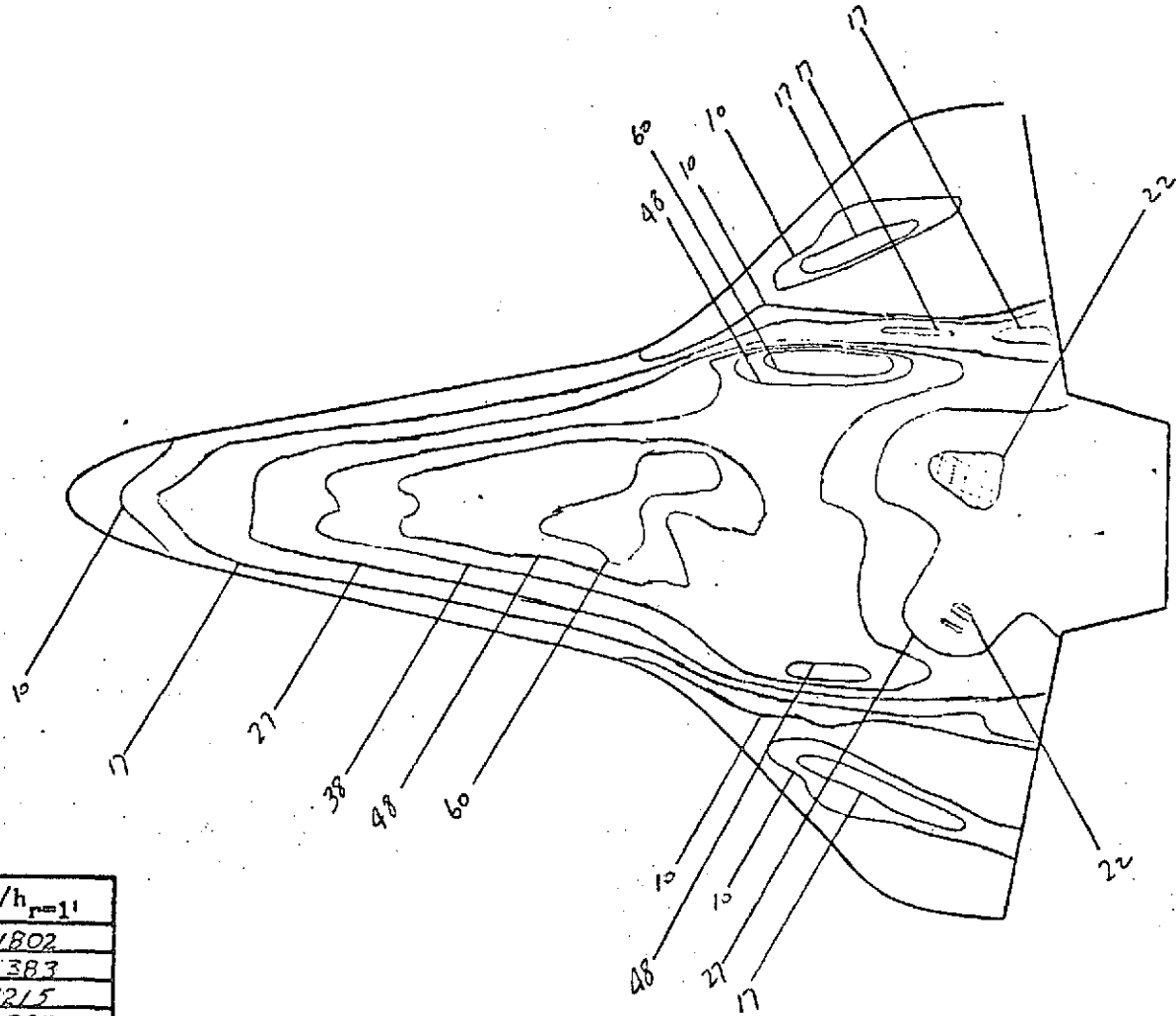
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

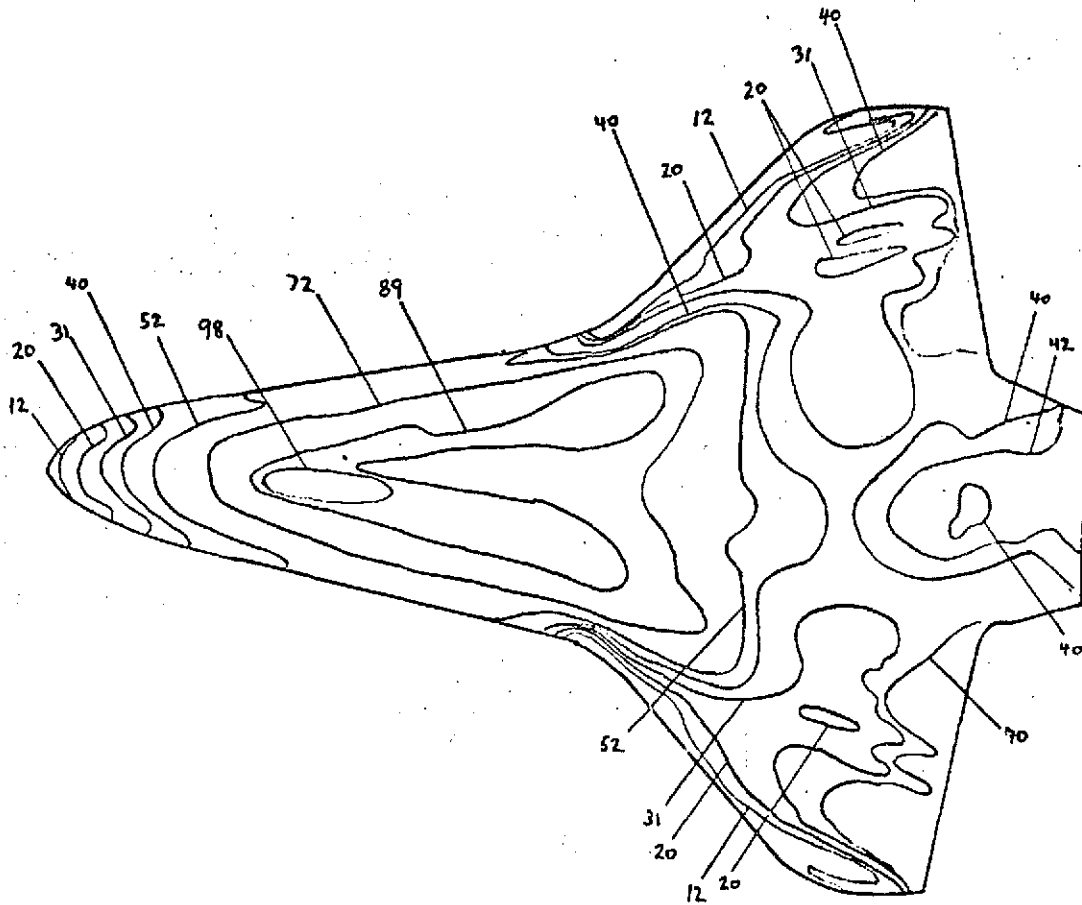
$HS = .1224 \frac{\text{BTU}}{\text{FT}^2 \cdot \text{SEC} \cdot ^\circ\text{F}}$



Isotherm	$h/h_{p=1}$
10	.1802
17	.1383
22	.1215
27	.1097
38	.0925
48	.0823
60	.0736

FIG. 30

PHASE CHANGE TEST



Isotherm	$h/h_{x=1}$
12	.2714
20	.2102
31	.1689
40	.1487
42	.1451
52	.1304
72	.1108
89	.0997
98	.0950

FIG. 31

CONFIG. 46-1

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST 0H42B RPA

RUN 4130

$M_\infty = 8$

$P_{total} \text{ (psi)} = 1390$

$T_{total} \text{ (}^\circ\text{F)} = 980$

$T_{aw}/T_{total} = .92$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 400$

$\alpha = 35^\circ$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

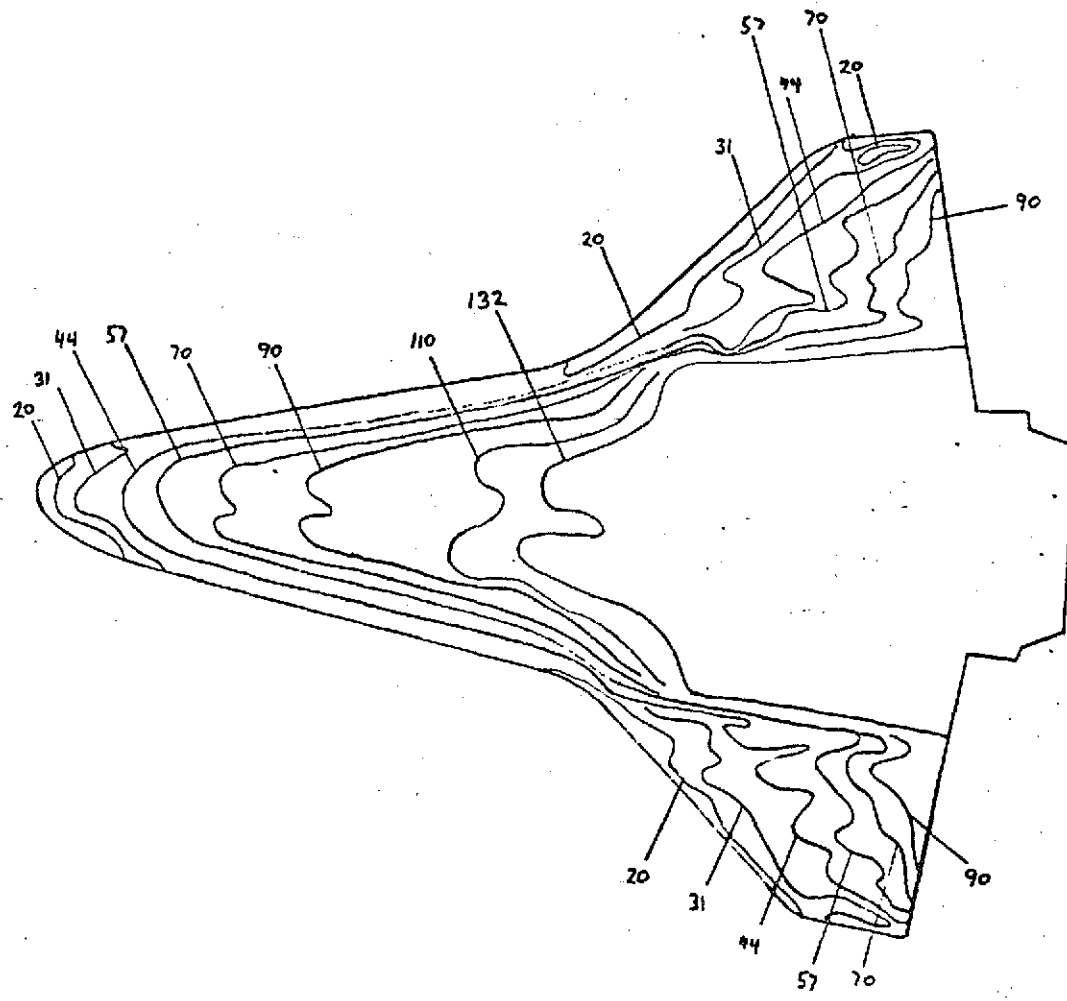
y (in) =

z (in) =

Frame 7 of 8 hit &
 $HS = .10552 \text{ ATU} / \text{FT}^2 \text{ SEC}^{-2}$
 GR
 HVD-EVCS

PHASE CHANGE TEST

CONFIG. 46-4A.



Isotherm	$h/h_{r=1}$
20	.19623
31	.15762
44	.1323
57	.11624
70	.10789
90	.09250
110	.08367
132	.07638

FIG. 32

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42 (RPA)

RUN 4131

$M_{\infty} = 8$

P_{total} (psi) = 625

T_{total} ($^{\circ}$ F) = 910

$T_{aw}/T_{total} = .92$

R_N per foot = 3×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 300

$\alpha = 35$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

$M_5 = .07282 \text{ BTU} / \text{ft}^2 \cdot \text{sec} \cdot \text{of}$
Frame 10 hit

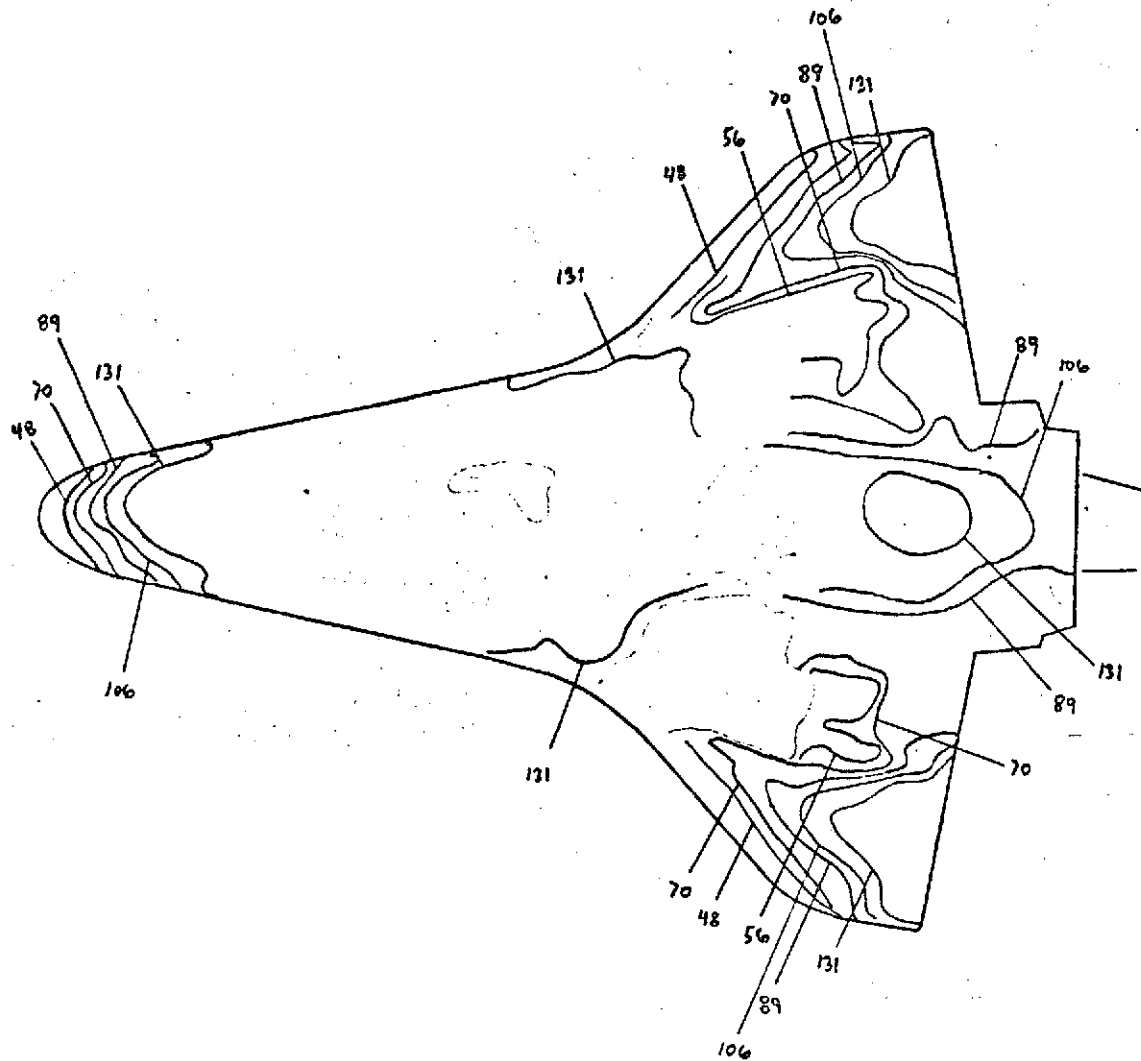
E

G

R

HVD-EVCS

PHASE CHANGE TEST



CONFIG. 46-2

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/VDT

TEST DH42B RPA

RUN 4132

$M_\infty = 8$

$P_{total} \text{ (psi)} = 1390$

$T_{total} \text{ (}^\circ\text{F)} = 925$

$T_{aw}/T_{total} = .92$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 500$

$\alpha = 35^\circ$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

$HS = .104924 \text{ BTU/FT}^2\text{-SEC-}^\circ\text{F}$

Frame 11 hit ϵ

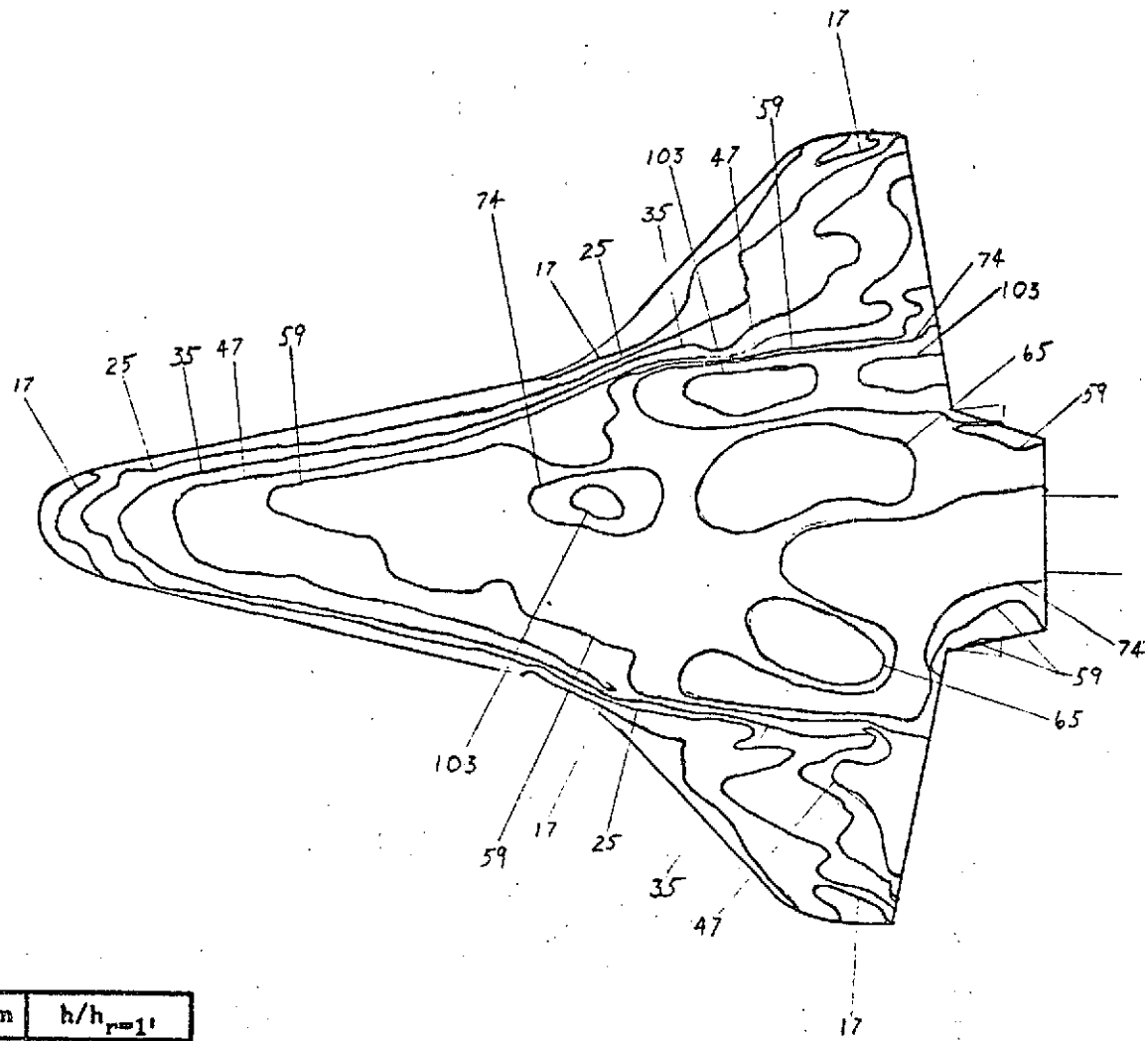
ζ_R

HVD-EVCS

Isotherm	$h/h_{\text{film}1}$
48	.25738
56	.24014
70	.21479
89	.19048
106	.17454
131	.15700

FIG. 33

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
17	.15242
25	.12569
35	.10623
47	.09167
59	.08182
65	.07795
74	.07306
103	.06192

FIG. 34

CONFIG. 46-4A

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B (RPA)

RUN 4133

$M_\infty = 8$

P_{total} (psig) = 635

T_{total} ($^{\circ}F$) = 880

$T_{aw}/T_{total} = .92$

R_N per foot = 3×10^6

$T_{phase\ change}$ ($^{\circ}F$) = 250

$\alpha = 35^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

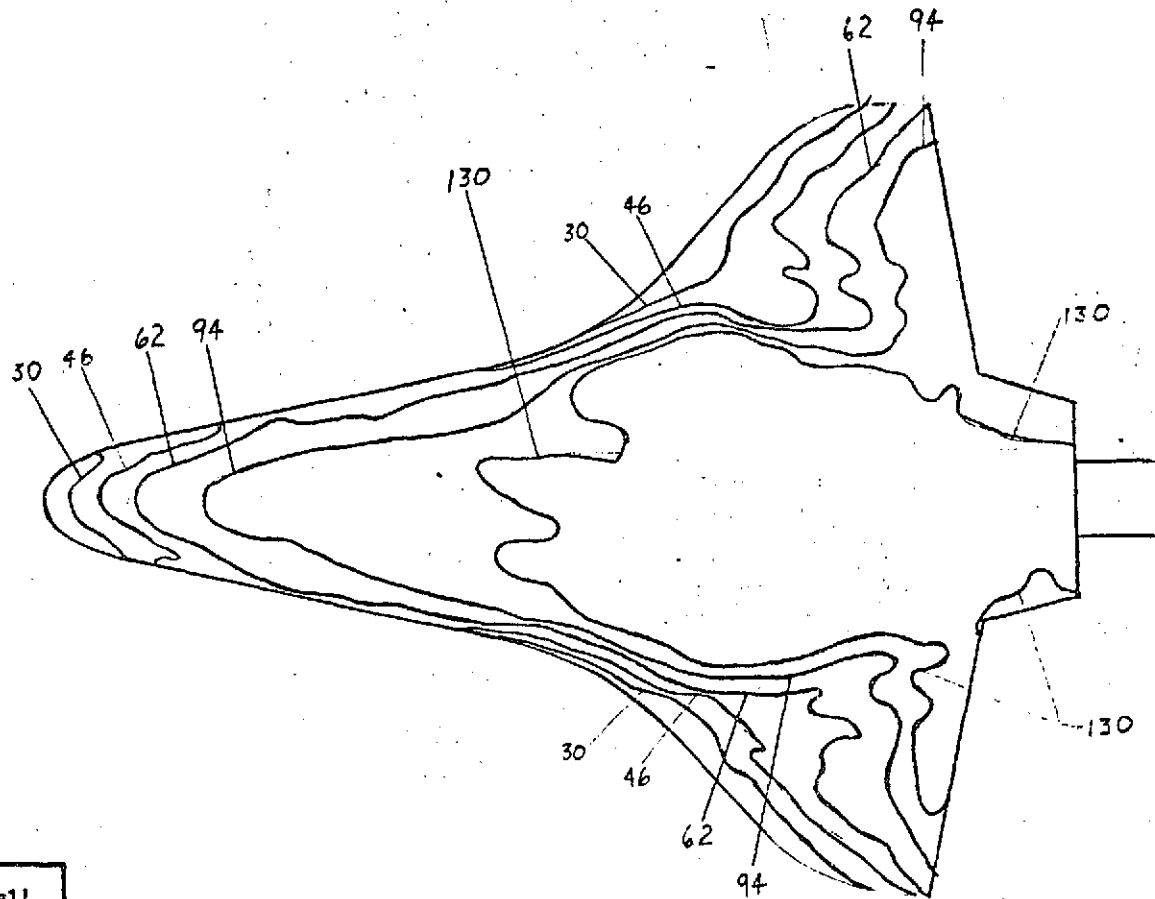
z (in) =

$HS = .07308 \text{ BTU/FT}^2\text{-SEC-}^{\circ}F$
HIT 2 FRAME 9

WIND

RVD-EVCS

PHASE CHANGE TEST



isotherm	$h/h_{x=1}$
30	.16902
46	.13690
62	.11757
94	.0955
130	.0812

FIG. 35

CONFIG.

46-2

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B (RPA)

RUN 4134

$M_\infty = 8$

P_{total} (psig) = 625

T_{total} ($^{\circ}$ F) = 875

$T_{aw}/T_{total} = .92$

R_N per foot = 3×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 300

$\alpha = 35^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from
model center, x-axis
parallel w/ stream,
+ downstream)

x (in) =

y (in) =

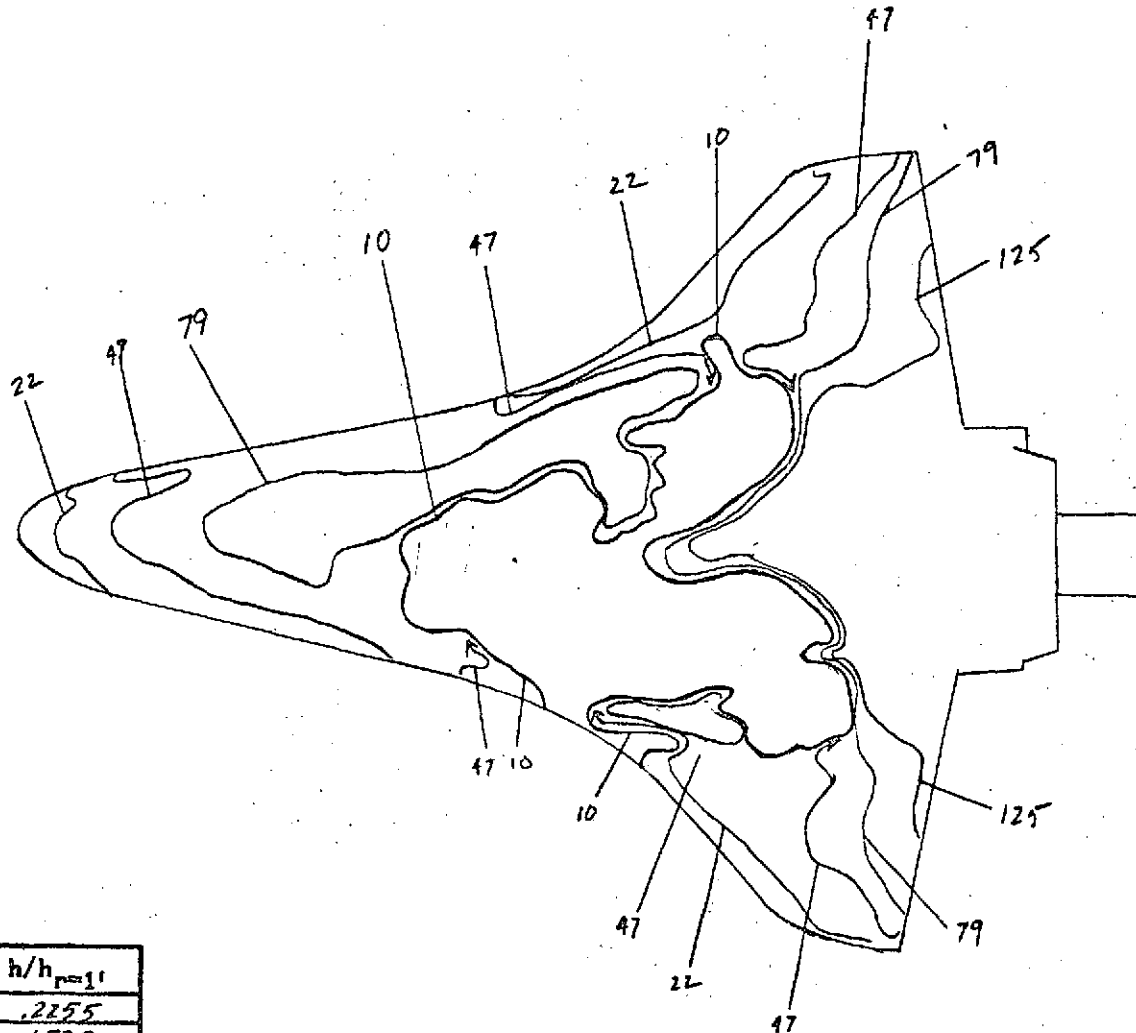
z (in) =

HIT @ FRAME 10

HS = .07315 BTU/FT² SEC-OF
W40

HVD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
10	.2255
22	.1520
47	.1040
79	.0802
125	.0638

FIG. 36

CONFIG. 46-2

LENGTH (ft) = .638

SCALE .00595

FACILITY LRC/VDT

TEST OH42B RPA

RUN 4135

$M_\infty = 0$

P_{total} (psig) = 154

T_{total} ($^{\circ}F$) = 765

$T_{aw}/T_{total} = .92$

R_N per foot = 1×10^6

$T_{phase\ change}$ ($^{\circ}F$) = 175

$\alpha = 35^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from
model center, x-axis
parallel w/ stream,
+ downstream)

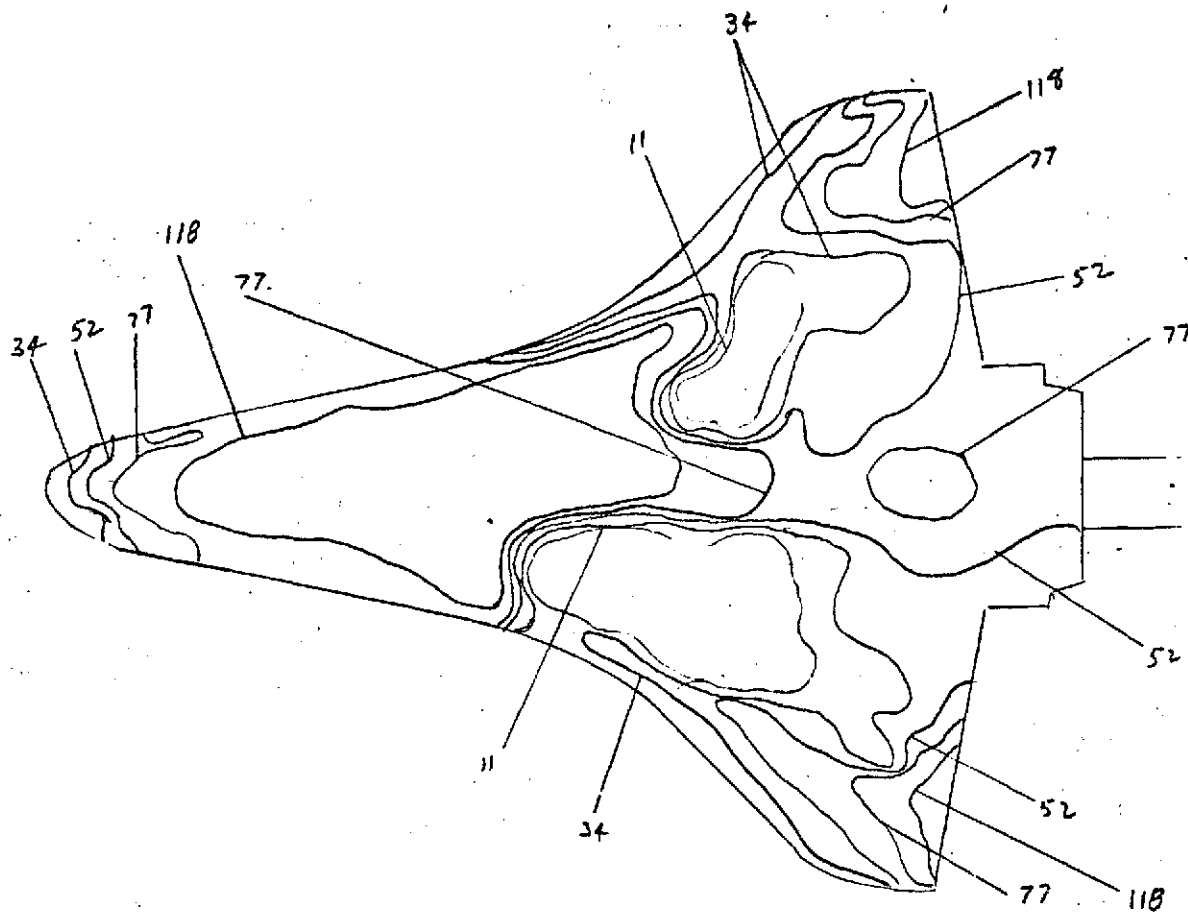
x (in) =

y (in) =

z (in) =

HIT @ FRAME 10
 $HS = .03879 \text{ BTU/FT}^2\text{-SEC}^{\circ}K$
W4D

PHASE CHANGE TEST



Isotherm	$h/h_{p=11}$
11	.45862
34	.26086
52	.21094
77	.17334
118	.14003

FIG. 37

CONFIG. 46-2

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH428 (RPA)

RUN 4136

$M_\infty = 8$

$P_{total} \text{ (psig)} = 1355$

$T_{total} \text{ (}^\circ\text{F)} = 890$

$T_{aw}/T_{total} = .92$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 450$

$\alpha = 35^\circ$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

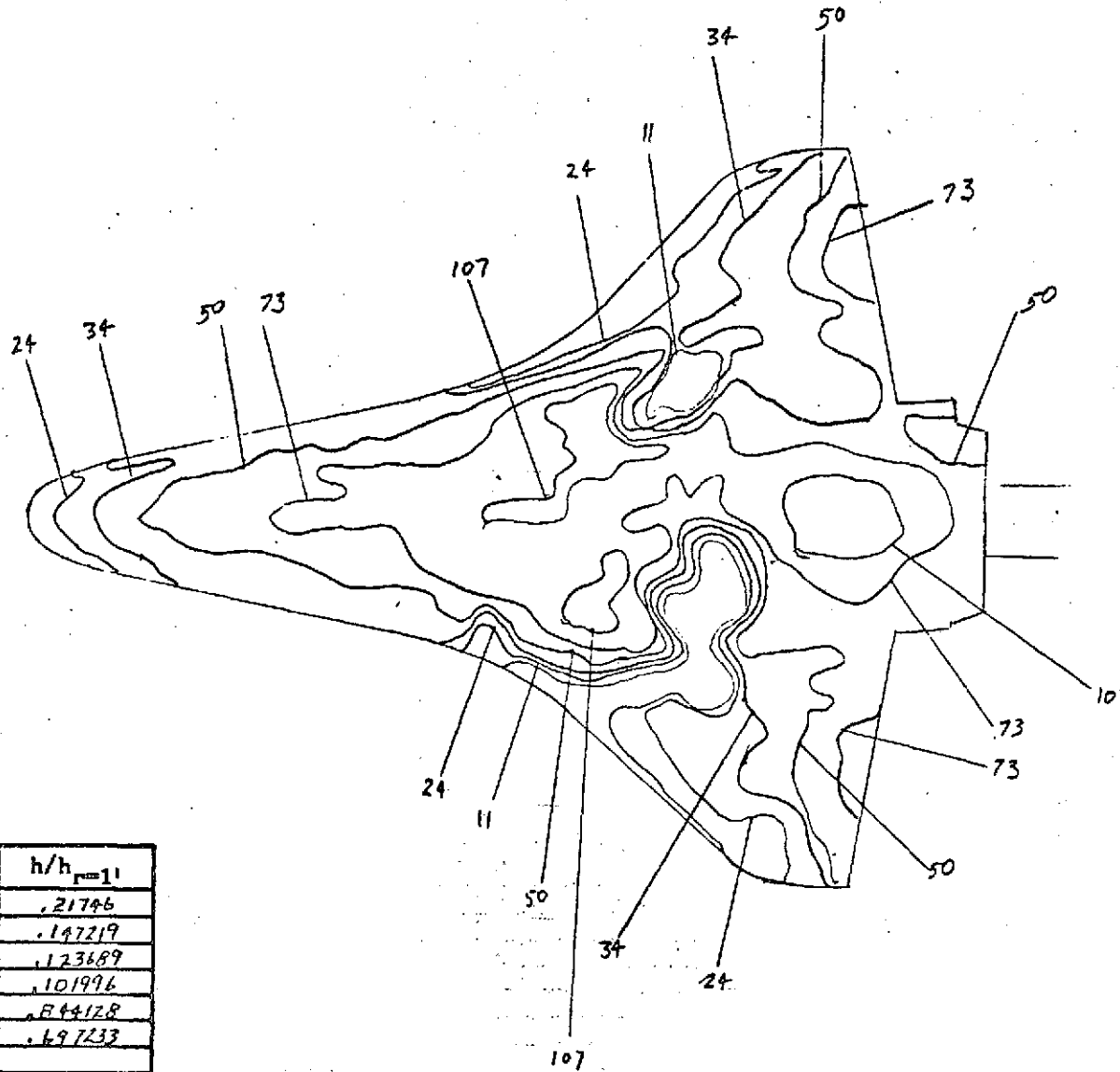
y (in) =

z (in) =

HIT & FRAME 11
 $H_5 = -1055 \text{ BTU/FT}^2\text{-SEC-}^\circ\text{F}$
 (W41)

PHASE CHANGE TEST

CONFIG. 46-2



Isotherm	$h/h_{r=1}$
11	.21746
24	.147219
34	.123689
50	.101996
73	.844128
107	.697233

FIG. 38

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B RPA

RUN 4137

$M_{\infty} = 8$

P_{total} (psig) = 850

T_{total} ($^{\circ}$ F) = 925

$T_{aw}/T_{total} = .92$

R_N per foot = 4×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 300

$\alpha = 35^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

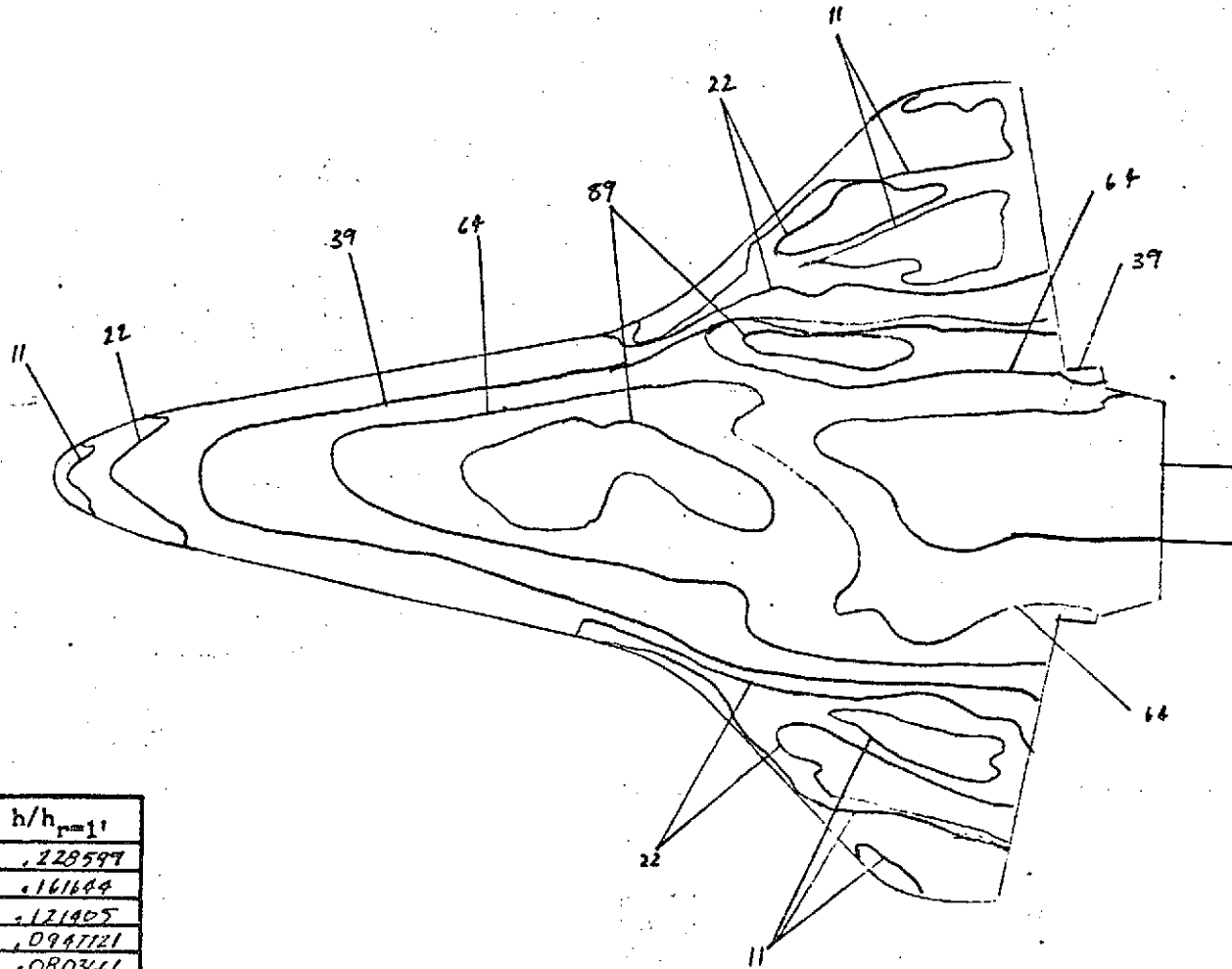
x (in) =

y (in) =

z (in) =

HIT 2 FRAME 11
 $M_2 = .08386$ BTU/FT²-SEC-9F
 WHD

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
11	.228597
22	.161684
39	.121405
64	.094721
89	.080346

FIG. 39

CONFIG. 46-4A

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/NDT

TEST OH42B (RPA)

RUN 4140

$M_{\infty} = 8$

P_{total} (psig) = 1615

T_{total} ($^{\circ}F$) = 930

$T_{aw}/T_{total} = .91$

R_N per foot = 7×10^6

$T_{phase\ change}$ ($^{\circ}F$) = 350

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

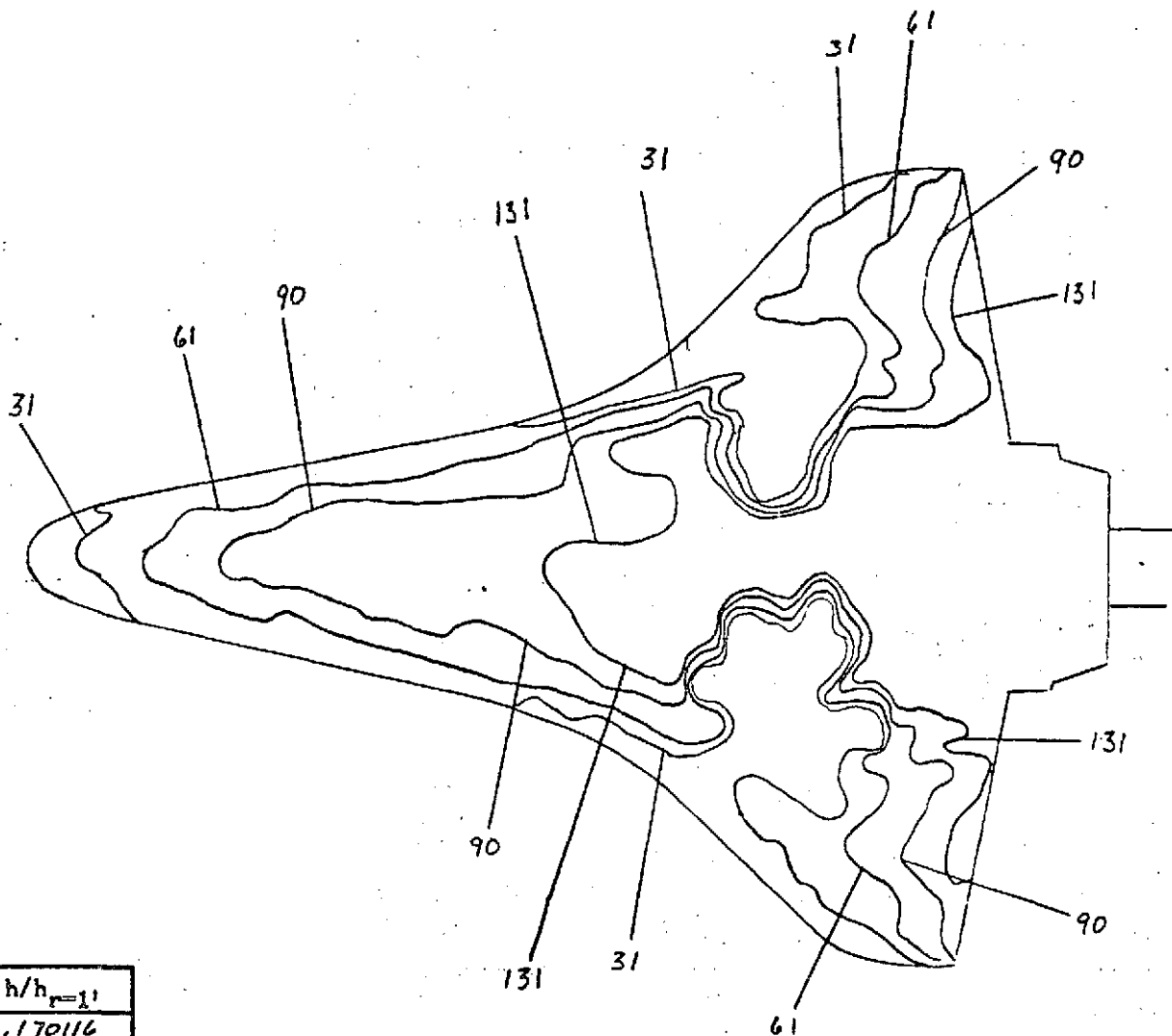
x (in) =

y (in) =

z (in) =

HIT FRAME 11
 $HS = .112775 \text{ BTU} / \text{FT}^2\text{-SEC-}^{\circ}F$
 UNID

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
31	.170116
61	.121272
90	.09984
131	.08275

FIG. 40

CONFIG. 46-2

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDF

TEST OH42B RPV

RUN 4141

$M_{\infty} = 8$

P_{total} (psig) = 635

T_{total} (°F) = 875

$T_{aw}/T_{total} = .91$

R_N per foot = 3×10^6

$T_{phase\ change}$ (°F) = 300

$\alpha = 30^\circ$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

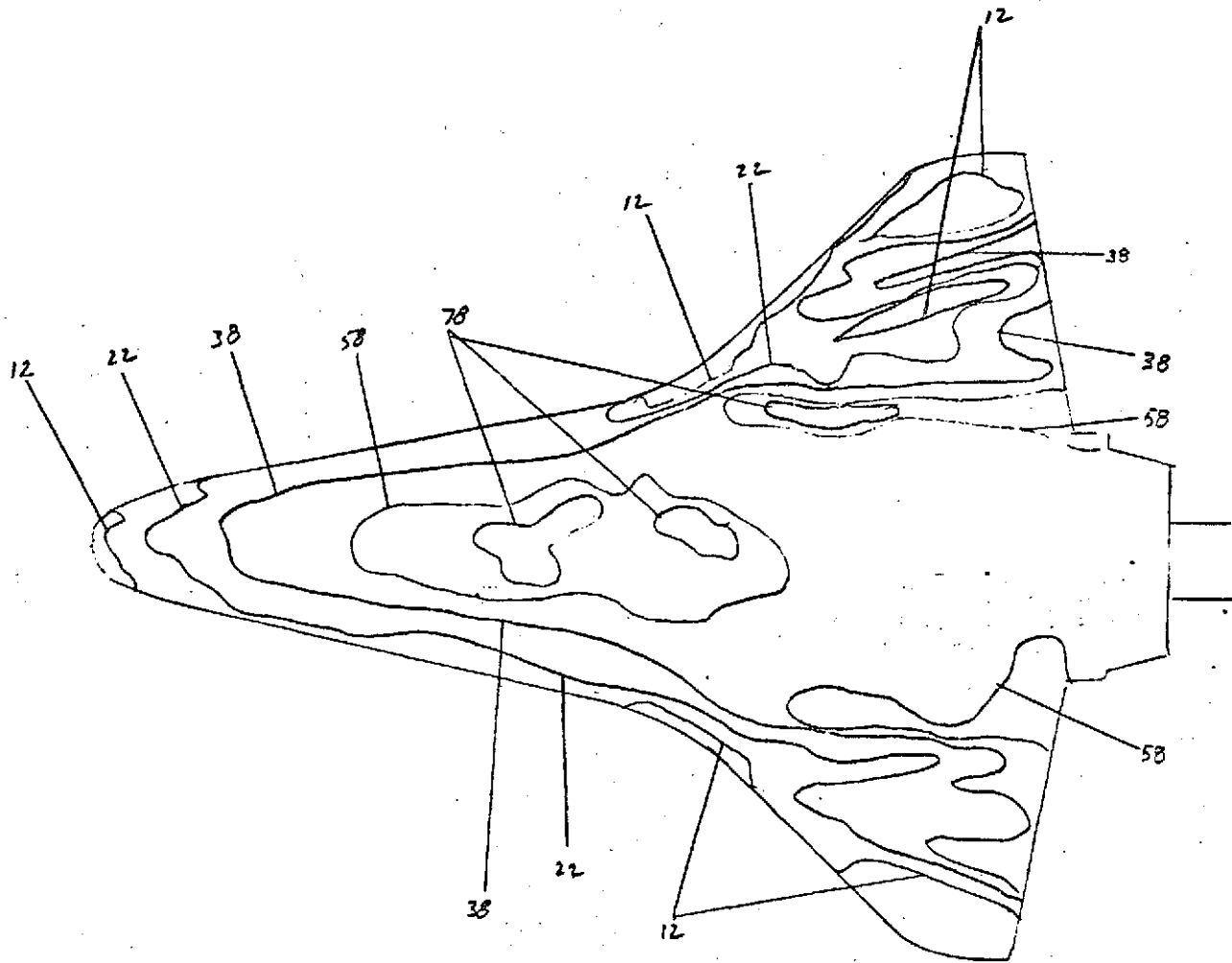
x (in) =

y (in) =

z (in) =

HIT & FRAME LO
 $HS = .0731502 \text{ BTU/FT}^2\text{-SEC}^\circ\text{F}$
W/FLO

PHASE CHANGE TEST



Isotherm	h/h_{film}
12	.19222
22	.141969
38	.108018
58	.087433
78	.07539

FIG. 41

CONFIG. 46-4A

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/VDT

TEST 0H42B (RPA)

RUN 4142

$M_{\infty} = 8$

$P_{\text{total}} \text{ (psig)} = 1120$

$T_{\text{total}} \text{ (}^{\circ}\text{F)} = 925$

$T_{\text{aw}}/T_{\text{total}} = .91$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} \text{ (}^{\circ}\text{F)} = 300$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

HIT & FRAME 11

$HS = .09518 \frac{\text{BTU}}{\text{FT}^2 \cdot \text{SEC} \cdot ^{\circ}\text{F}}$

PHASE CHANGE TEST

CONFIG.

46-2

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B RPA

RUN 4143

$M_\infty = 8$

P_{total} (psig) = 1390

T_{total} (°F) = 915

$T_{aw}/T_{total} = .91$

R_N per foot = 6×10^6

$T_{phase\ change}$ (°F) = 350

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

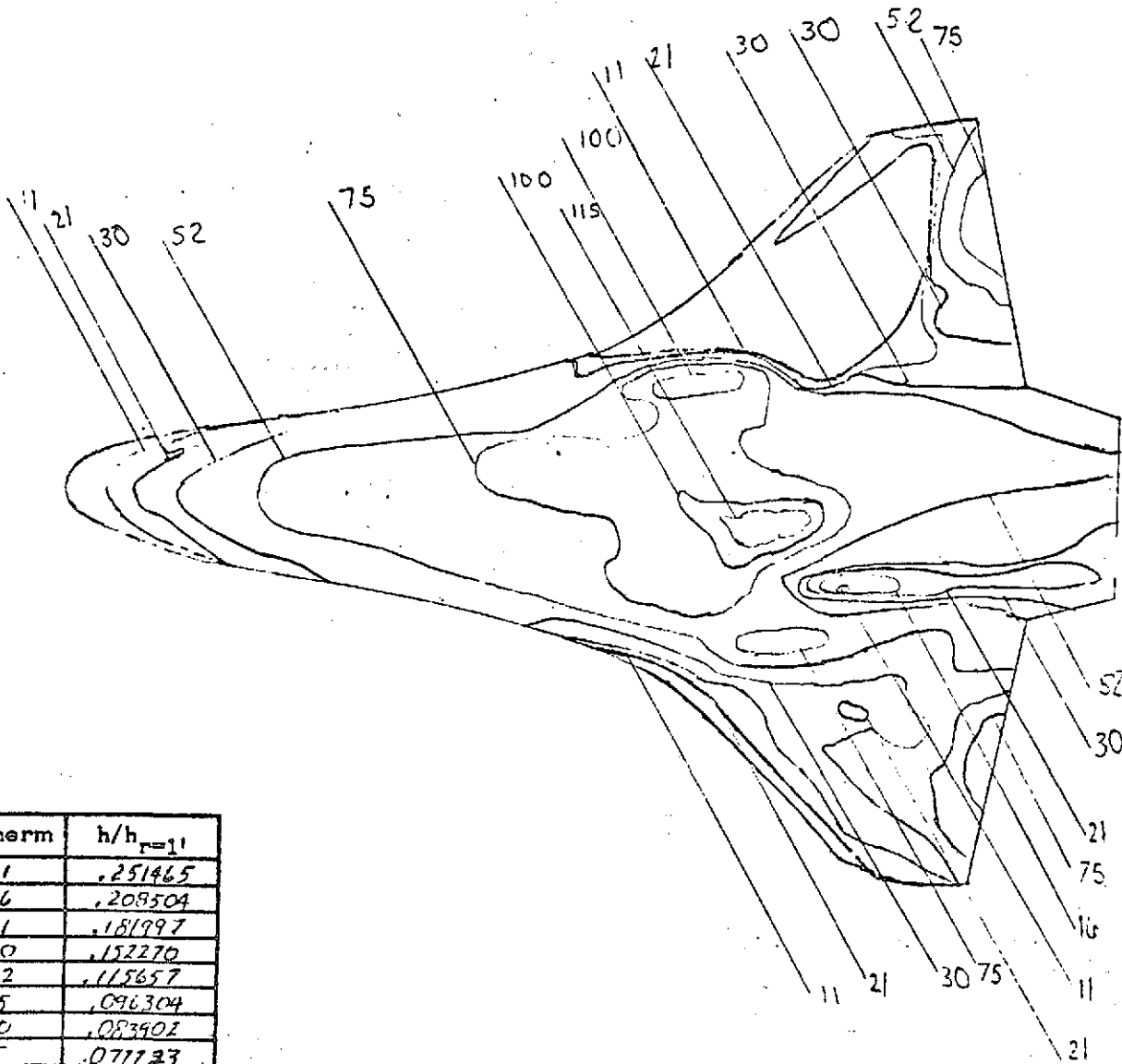
z (in) =

HIT & FRAME #

HS = .105092

MDS

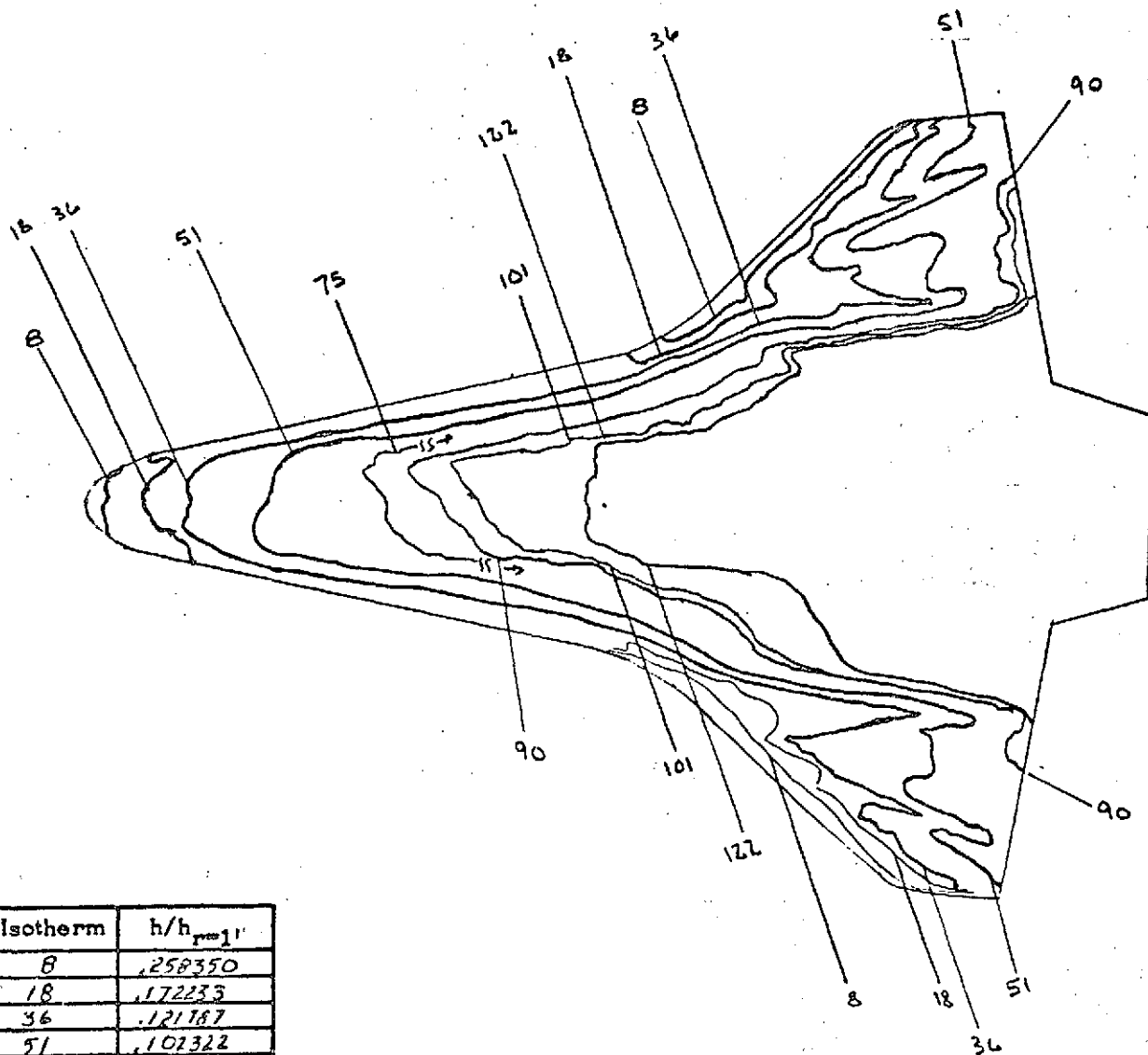
HVD-EVCS



Isotherm	$h/h_{r=1}$
11	.251465
16	.208504
21	.181997
30	.152270
52	.115657
75	.096304
100	.083902
115	.071723

FIG. 42

PHASE CHANGE TEST



Isotherm	h/h_{pm1}
8	.258350
18	.172233
36	.121187
51	.102322
75	.084377
90	.077025
101	.072710
122	.066157

FIG. 43

CONFIG. 46-4A

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/YDT

TEST OH42B (RPA)

RUN 4144

$M_\infty = 8$

P_{total} (psia) = 165

T_{total} ($^{\circ}R$) = 760

$T_{aw}/T_{total} = .91$

R_N per foot = $1. \times 10^6$

$T_{phase\ change}$ ($^{\circ}F$) = 175

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

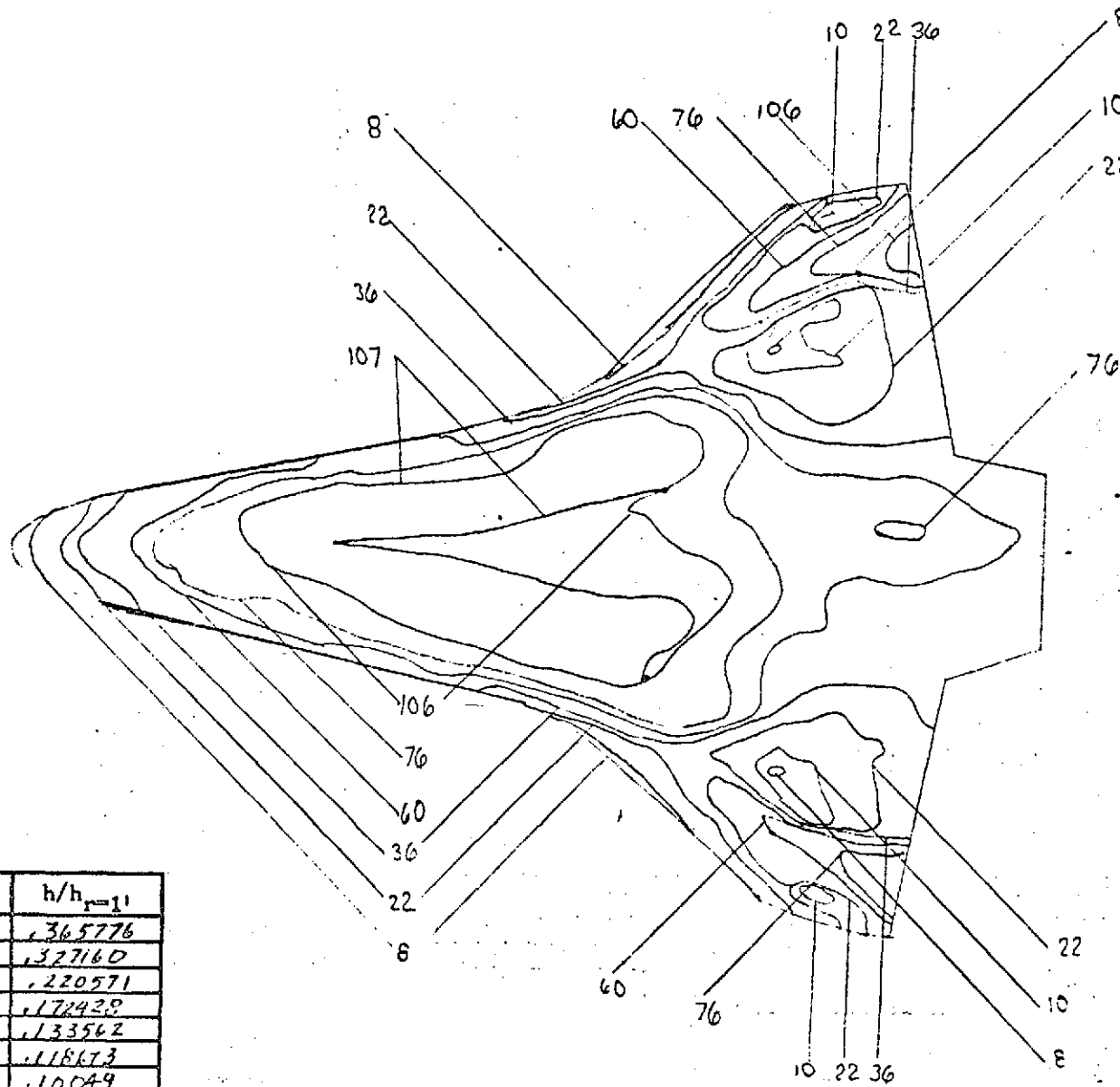
x (in) =

y (in) =

z (in) =

$HS = .039912 \text{ BTU}/\text{FT}^2\text{-SEC}\cdot^{\circ}F$

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
8	.365776
10	.327160
22	.220571
36	.172428
60	.133562
76	.118673
106	.10049
107	.10002

FIG. 44

CONFIG. 46-2

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST 0442B (RPA)

RUN 4145

$M_\infty = \beta$

P_{total} (psig) = 1615

T_{total} ($^{\circ}$ F) = 915

$T_{aw}/T_{total} = .91$

R_N per foot = 7×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 400

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

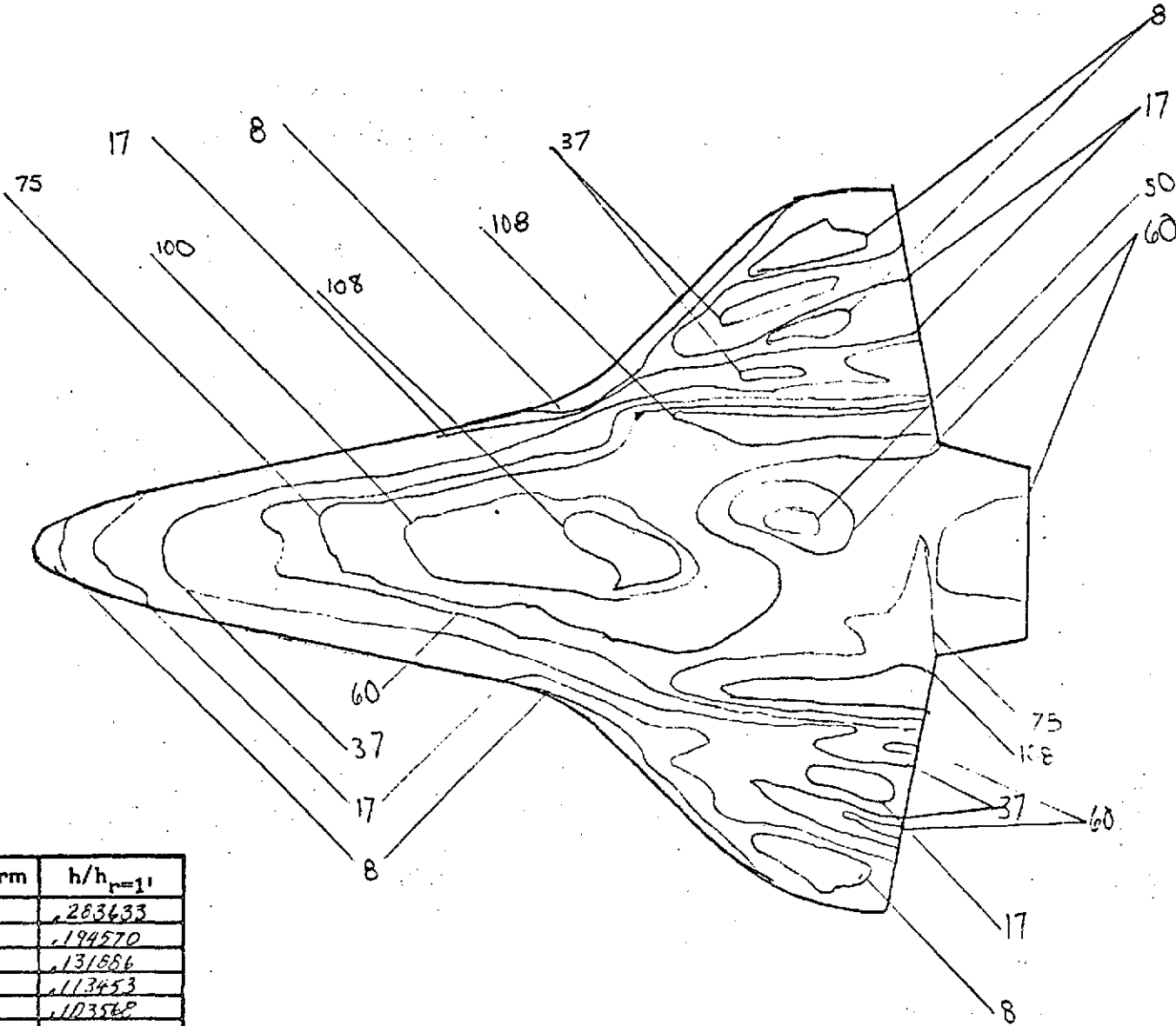
x (in) =

y (in) =

z (in) =

$HS = .112584 \text{ BTU} / \text{FT}^2\text{-SEC-}^{\circ}\text{F}$
MDS

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
8	.283633
17	.194570
37	.131886
50	.113453
60	.103568
75	.092634
100	.080223
108	.077195

FIG. 45

CONFIG. 46-4A

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH92B RPA

RUN 9146

$M_{\infty} = 8$

P_{total} (psig) = 1380

T_{total} ($^{\circ}$ F) = 935

$T_{aw}/T_{total} = .91$

R_N per foot = 6×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 350

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

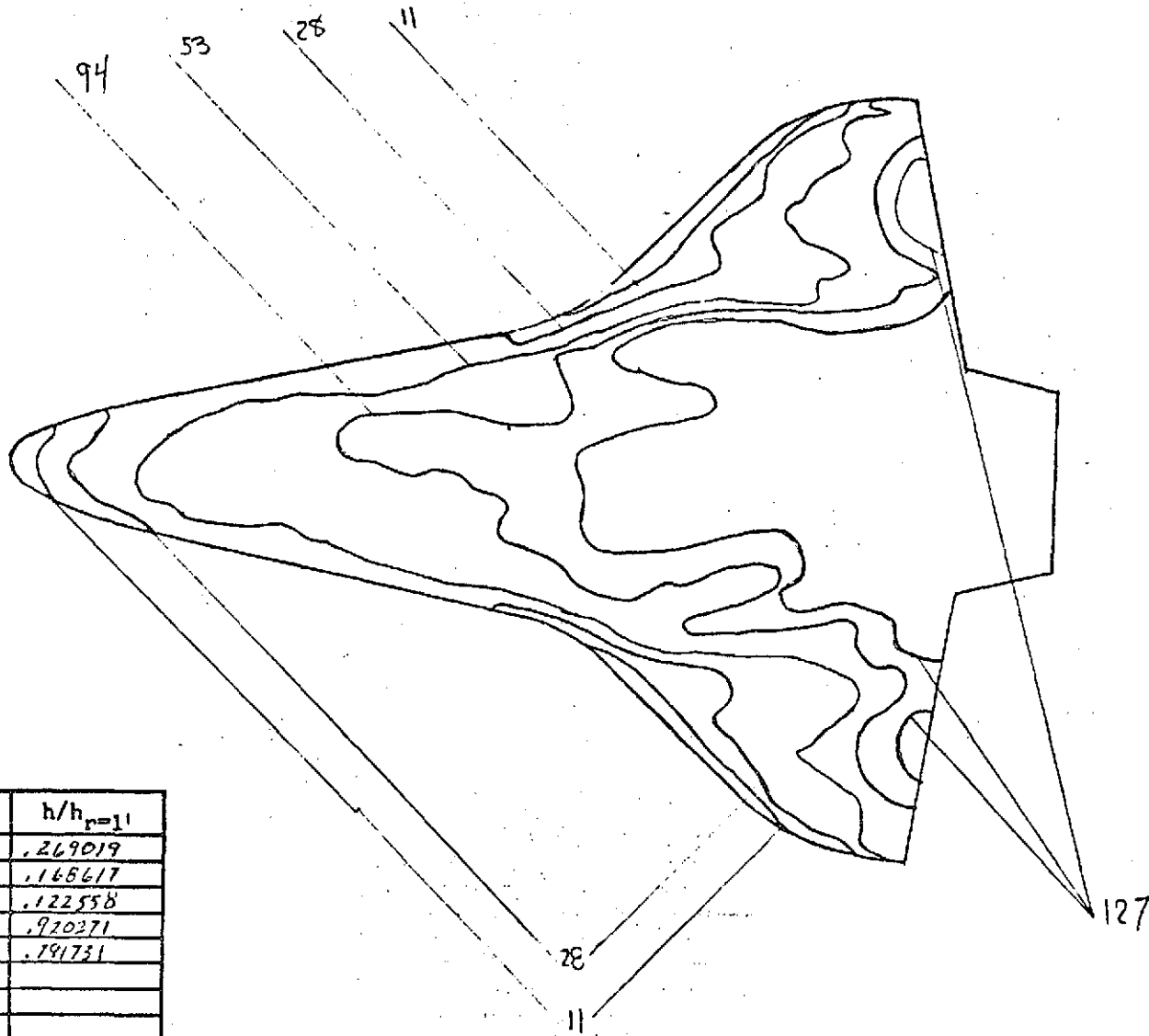
x (in) =

y (in) =

z (in) =

REYNOLDS NUMBER
 $HS = .104895 \text{ BTU} / \text{FT}^2 \text{ SEC} \text{ } ^{\circ}\text{F}$
 MTC

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
11	.269019
28	.168617
53	.122558
94	.920271
127	.191731

FIG. 46

CONFIG. 46-2

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH428 RPA

RUN 4147

$M_\infty = 8$

P_{total} (psig) = 615

T_{total} ($^{\circ}F$) = 910

$T_{aw}/T_{total} = .91$

R_N per foot = 3×10^6

$T_{phase\ change}$ ($^{\circ}F$) = 300

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

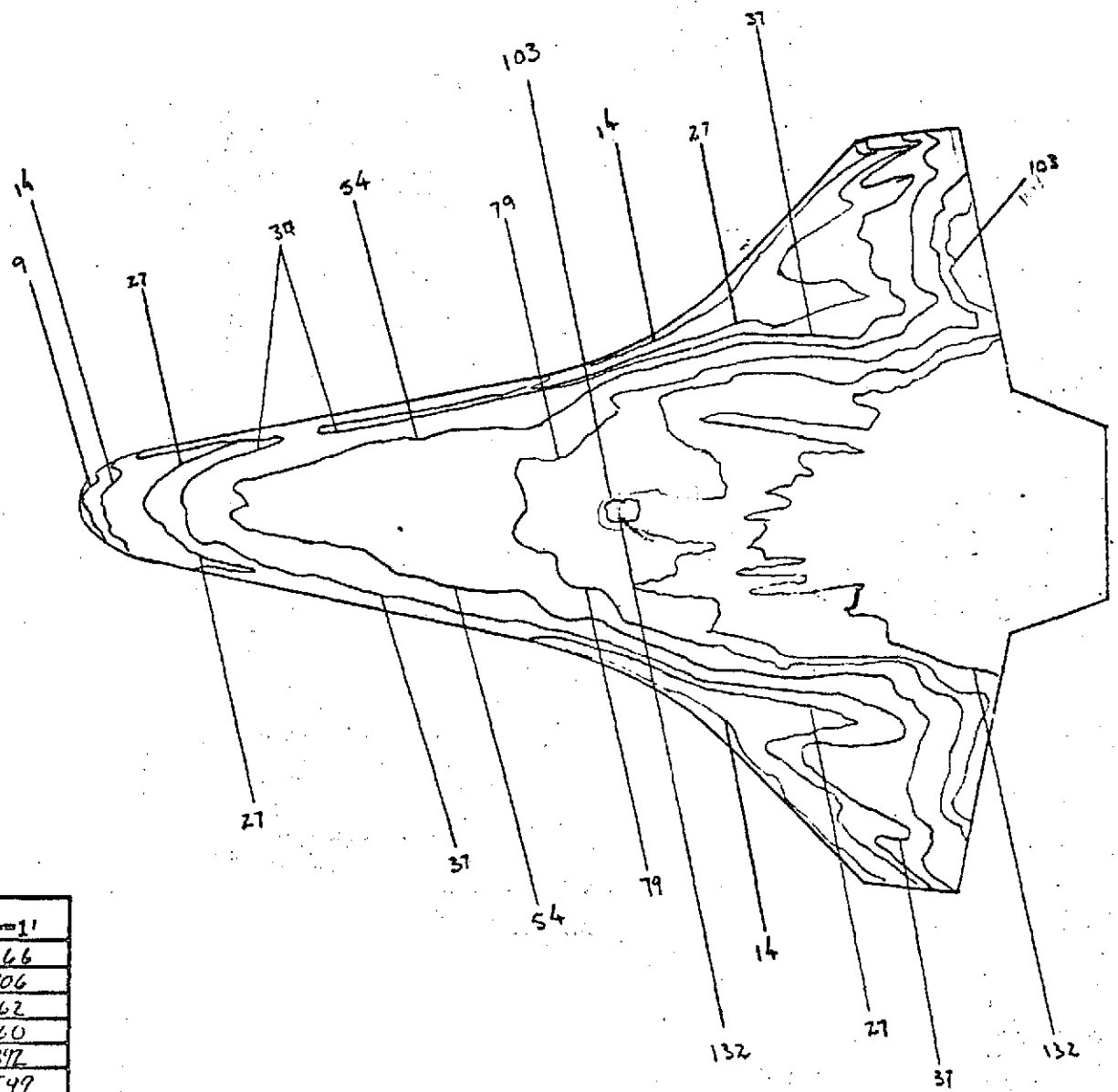
y (in) =

z (in) =

$HS = .072286 \text{ BTU} / \text{FT}^2 \cdot \text{SEC} \cdot ^{\circ}F$
MDS

HVD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
9	.209166
14	.167106
27	.120762
37	.103160
54	.085392
79	.070549
103	.051529
132	.054617

FIG. 47

CONFIG. 46-2

LENGTH (R) =	.638
SCALE	.00593
FACILITY	L/D T
TEST	OH42B-RPA
RUN	4148
$M_\infty =$	β
P_{total} (psig) =	165
T_{total} ($^\circ F$) =	810
$T_{aw}/T_{total} =$.91
R_N per foot =	1×10^6
$T_{phase\ change}$ ($^\circ F$) =	175
$\alpha =$	30
$\beta =$	0
$\phi =$	0
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)	
x (in) =	
y (in) =	
z (in) =	

HITS & ON FINDER
 $H_5 = .04008 \text{ BTU} / \text{FT}^2 \text{ SEC } ^\circ F$

PHASE CHANGE TEST

CONFIG. 46-4ABF

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B RPA

RUN 4150

$M_\infty = 8$

P_{total} (psig) = 635

T_{total} (°F) = 900

$T_{aw}/T_{total} = .91$

R_N per foot = 3×10^6

$T_{phase\ change}$ (°F) = 350

$\alpha = 30^\circ$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

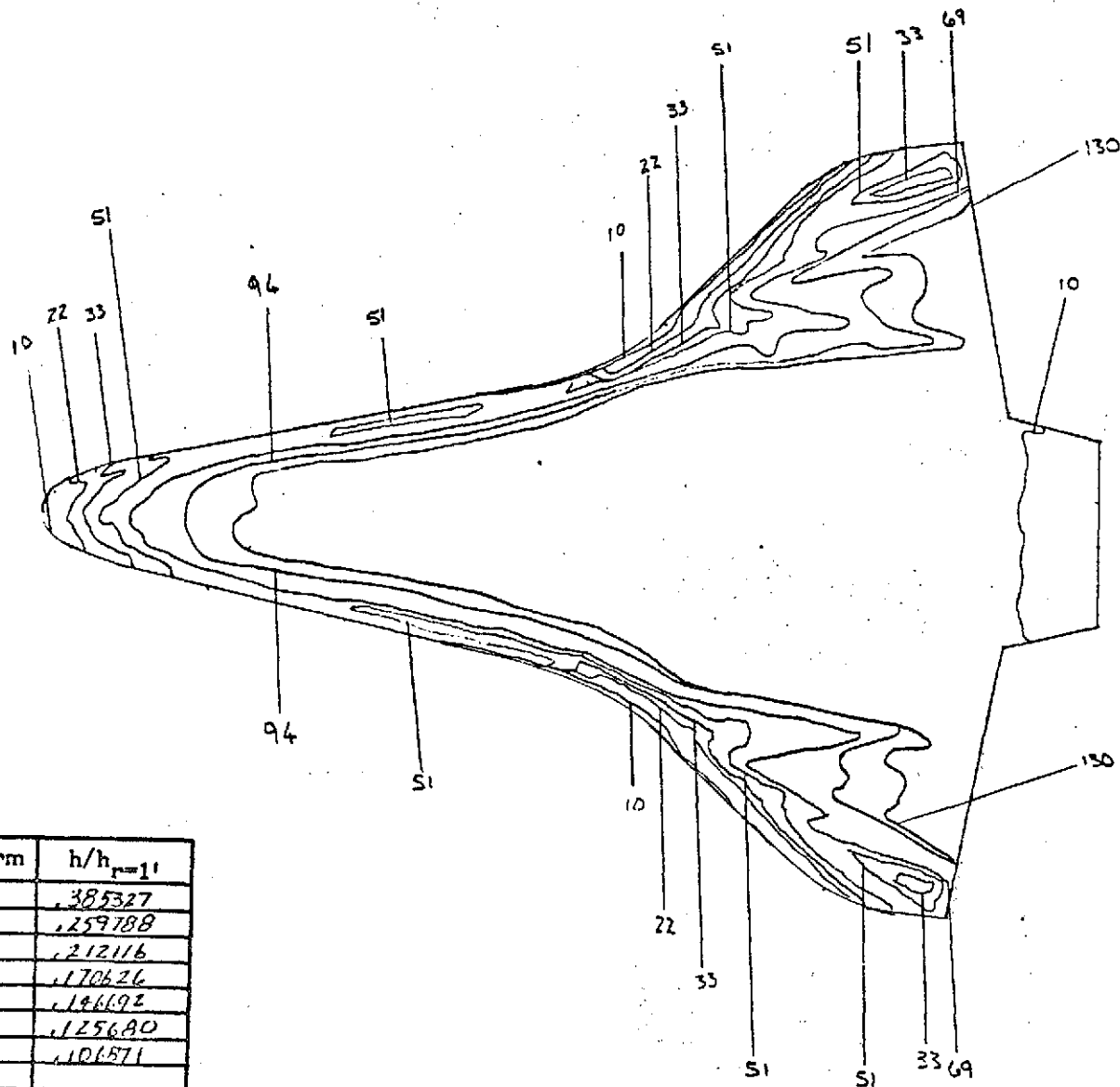
y (in) =

z (in) =

HITS & CN FRAME 10

$H_5 = .0732989 \text{ BTU/FT}^2\text{-500}^\circ\text{R}$

HVD-FVCS



Isotherm	$h/h_{r=1}$
10	.385327
22	.259788
33	.212116
51	.170626
69	.146692
94	.125680
130	.106571

FIG. 48

PHASE CHANGE TEST

CONFIG. 46-4ABF

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B RPM

RUN 4152

$M_\infty = 8$

P_{total} (psig) = 1405

T_{total} (°F) = 900

$T_{aw}/T_{total} = .91$

R_N per foot = 6×10^6

$T_{phase\ change}$ (°F) = 400

$\alpha = 30^\circ$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

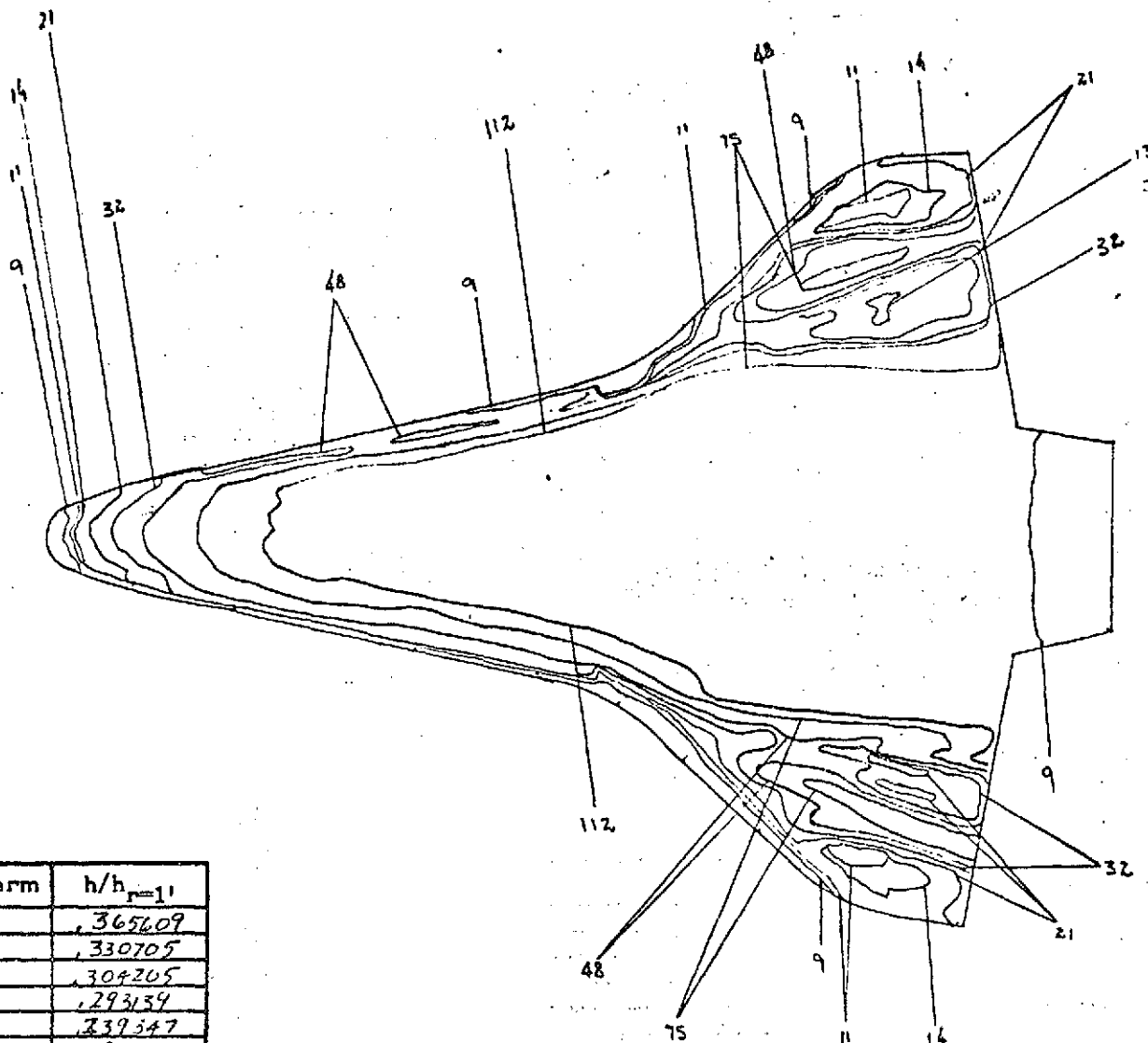
y (in) =

z (in) =

$H_S \in 11.9 \text{ FRENCH}$

$H_S = .105513 \text{ BTU} / \text{FT}^2 \cdot \text{SEC} \cdot ^\circ\text{F}$

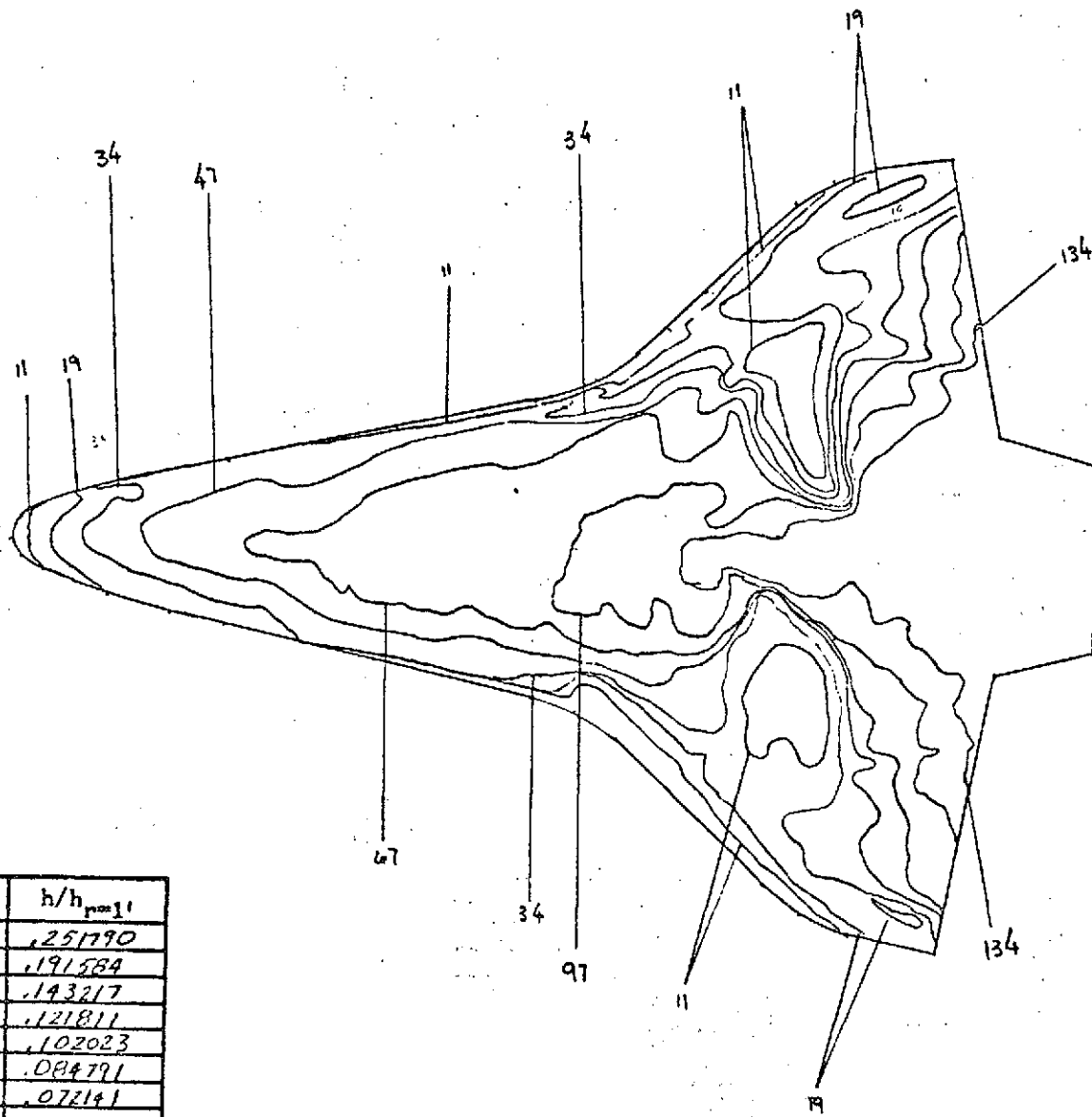
HVD-EVCS



Isotherm	$h/h_{p=1}$
9	.365609
11	.330705
13	.304205
14	.293159
21	.239547
32	.193895
48	.158313
75	.126651
112	.103690

FIG. 49

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
11	.251790
19	.191584
34	.143217
47	.121811
67	.102023
97	.084791
134	.072141

FIG. 50

CONFIG. 46-1

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B RPA

RUN 4153

$M_\infty = 8$

P_{total} (psig) = 640

T_{total} ($^{\circ}$ F) = 920

$T_{aw}/T_{total} = .91$

R_N per foot = 3×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 300

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

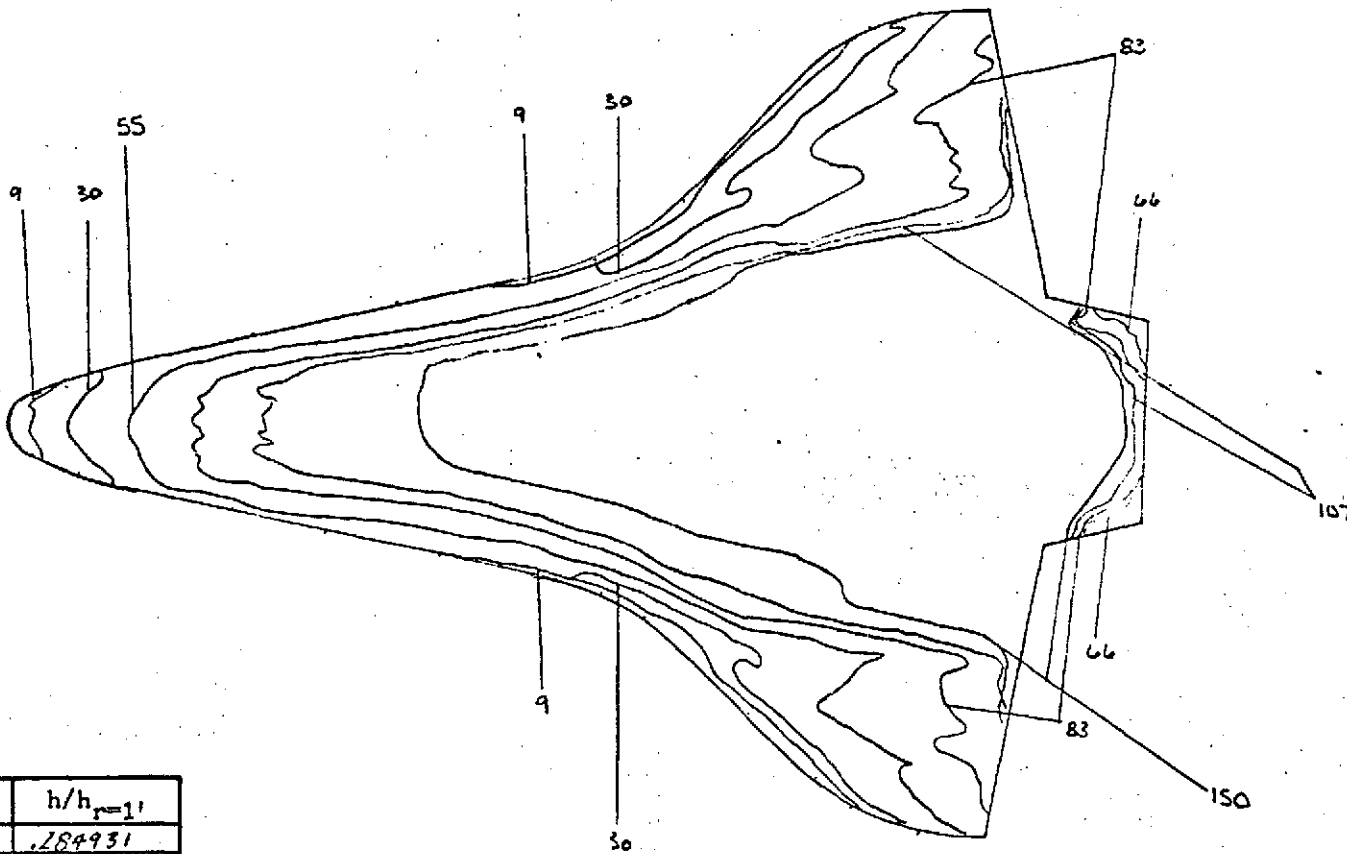
z (in) =

HITS ≤ 100 PER FRAME

$HS = .786593 \text{ BTU/ft}^2\text{-SEC-}^{\circ}\text{F}$

HVD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
9	.284931
30	.156063
55	.115260
66	.105218
83	.093526
107	.087636
150	.069174

FIG. 51

CONFIG. 46-4ABF

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/VDT

TEST 0442B RPA

RUN 4154

$M_\infty = 8$

P_{total} (psig) = 160

T_{total} ($^{\circ}$ F) = 795

$T_{aw}/T_{total} = .91$

R_N per foot = 1×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 200

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

HITS & IN 9 FRAMES

$HS = .039566 \frac{BTU}{FT^2 \cdot SEC \cdot ^{\circ}F}$

PHASE CHANGE TEST

CONFIG. 46-4ABF

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST 0H42B RPA

RUN 4155

$M_\infty = 8$

$P_{total} \text{ (psig)} = 630$

$T_{total} \text{ (}^\circ\text{F)} = 910$

$T_{aw}/T_{total} = .91$

$R_N \text{ per foot} = 3 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 400$

$\alpha = 30^\circ$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

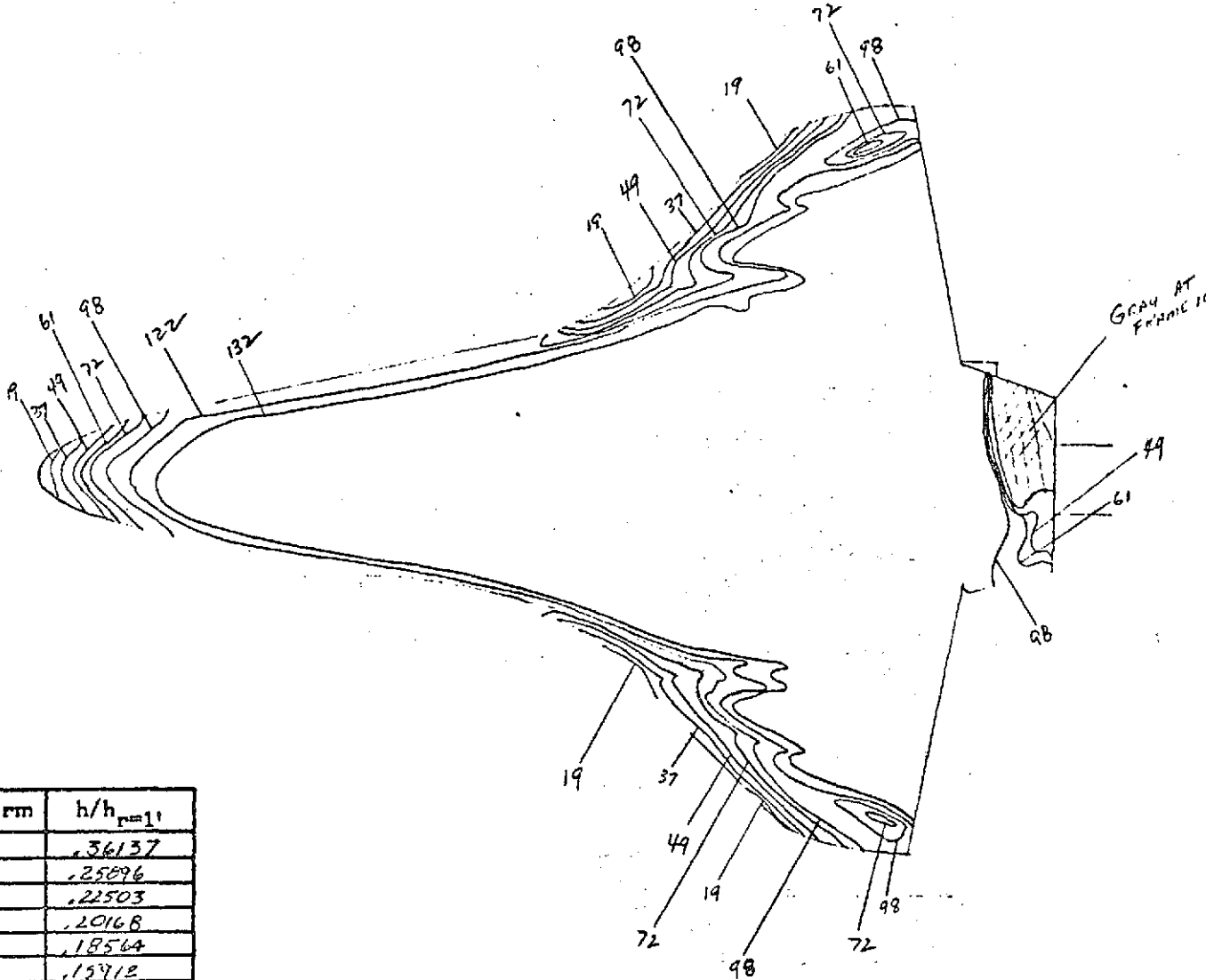
x (in) =

y (in) =

z (in) =

$\epsilon \text{ AT FRAME 10}$

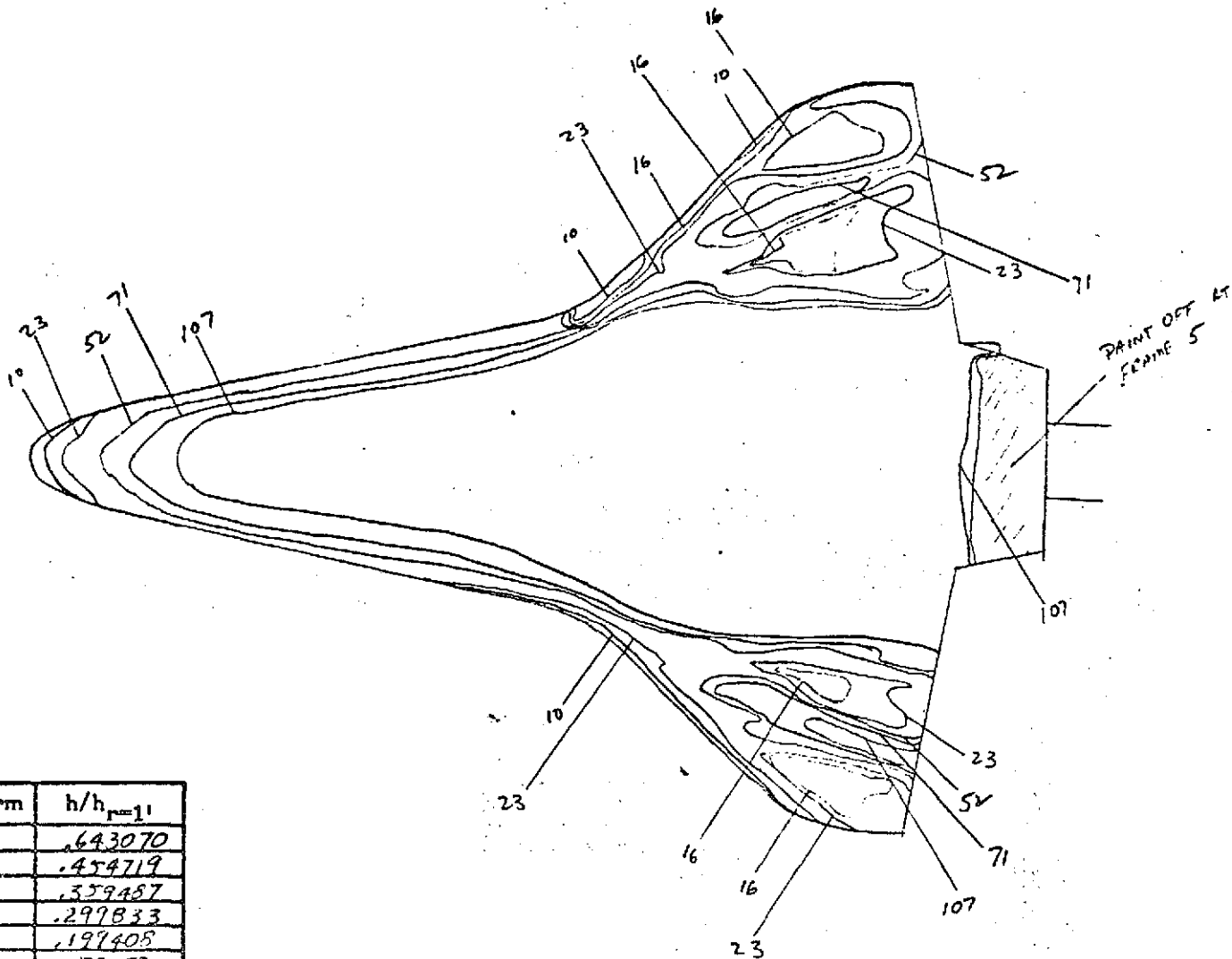
$HS = .0750472 \text{ BTU/ft}^2\text{-SEC-}^\circ\text{F}$



Isotherm	$h/h_{r=1}$
19	.36137
37	.25896
49	.22503
61	.20168
72	.18564
98	.15712
122	.14261
132	.13710

FIG. 52

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
5	.643070
10	.454719
16	.359487
23	.297833
52	.197408
71	.170653
107	.134012

FIG. 53

CONFIG. 46-4ABF

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B RPA

RUN 4156

$M_{\infty} = 8$

P_{total} (psig) = 1385

T_{total} ($^{\circ}F$) = 915

$T_{aw}/T_{total} = .91$

R_N per foot = 6×10^4

$T_{phase\ change}$ ($^{\circ}F$) = 450

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

$HS = .104761 \frac{BTU}{IT^2 \cdot SEC^2}$

PHASE CHANGE TEST

CONFIG. 46-1

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH4213 RPA

RUN 4158

$M_{\infty} = 8$

$P_{total} \text{ (psig)} = 163$

$T_{total} \text{ (}^{\circ}\text{F)} = 780$

$T_{aw}/T_{total} = .91$

$R_N \text{ per foot} = 1 \times 10^6$

$T_{\text{phase change}} \text{ (}^{\circ}\text{F)} = 175$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

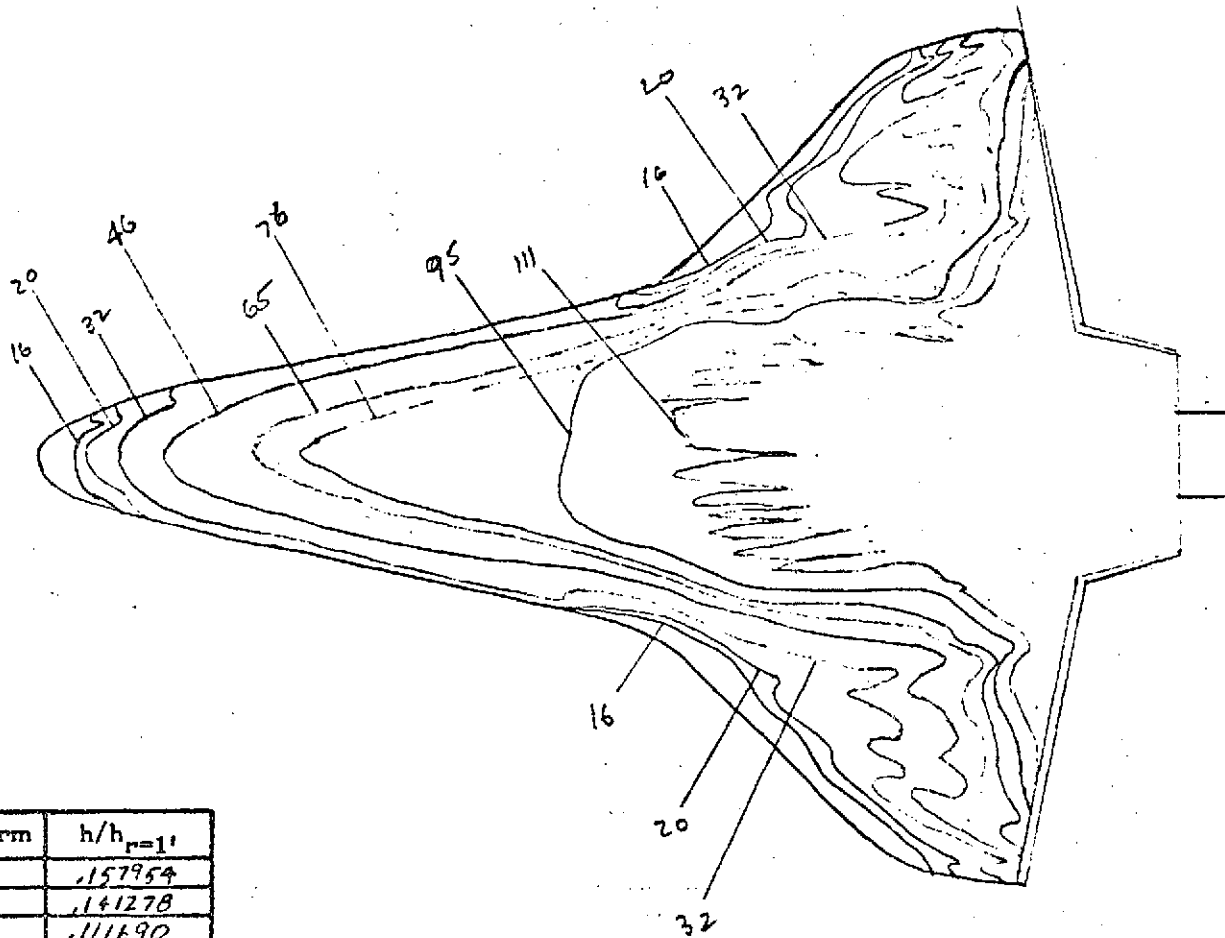
Camera Coordinates (from
modal center, x-axis
parallel w/ stream,
+ downstream)

x (in) =

y (in) =

z (in) =

$Q_F = T_{total} E_{10}$
 $H_5 = .0397758 \text{ BTU}^2/\text{FT}^2\text{-SEC}^{-2}$



Isotherm	$h/h_{r=1}$
16	.157954
20	.141278
32	.111690
46	.093156
65	.070367
76	.071474
95	.064823
111	.059969

FIG. 59

PHASE CHANGE TEST

CONFIG. 46-3

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B RPA

RUN 4159

$M_{\infty} = 8$

$P_{total} \text{ (psig)} = 620$

$T_{total} \text{ (}^{\circ}\text{F)} = 920$

$T_{aw}/T_{total} = .91$

$R_N \text{ per foot} = 3 \times 10^6$

$T_{\text{phase change}} \text{ (}^{\circ}\text{F)} = 300$

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

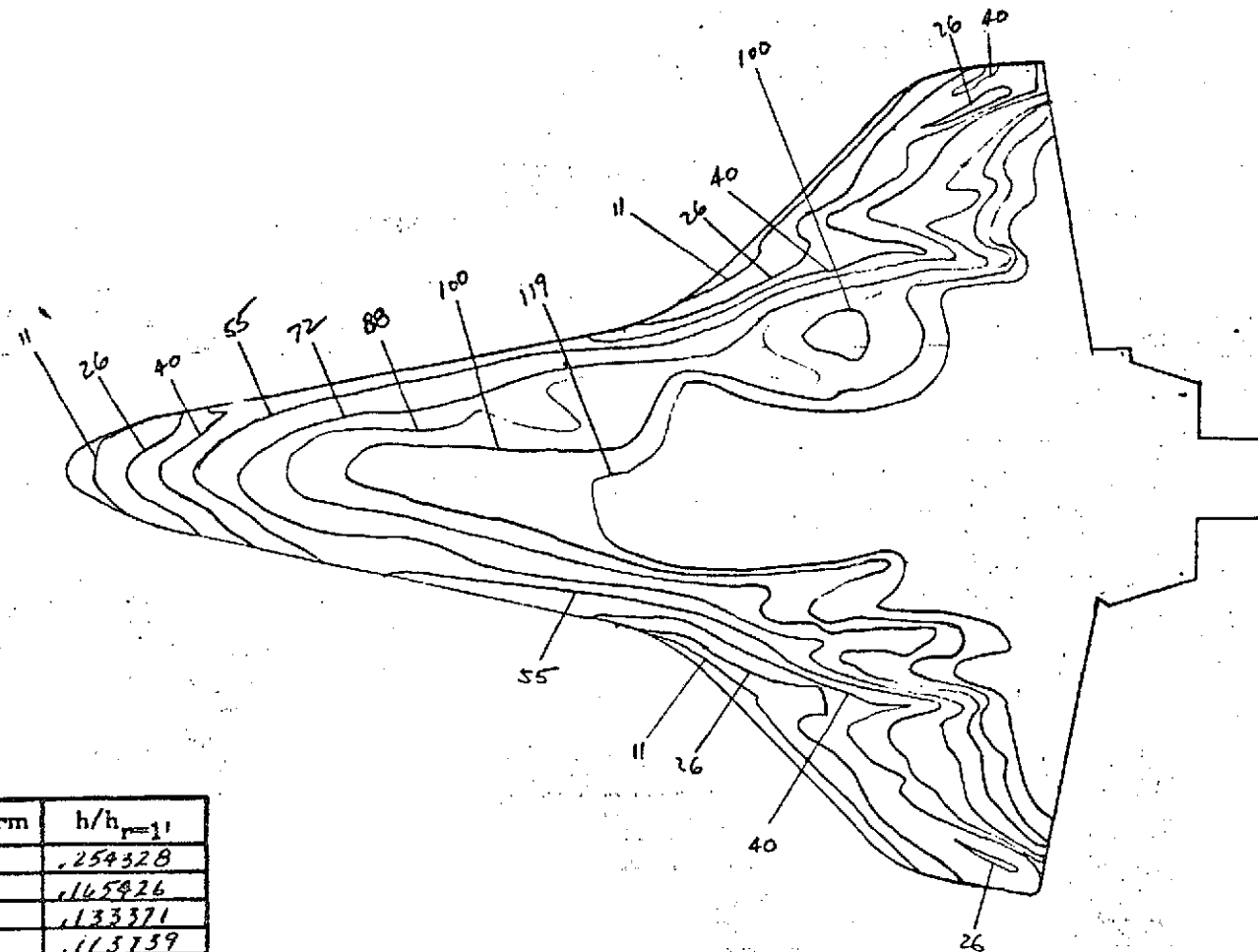
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

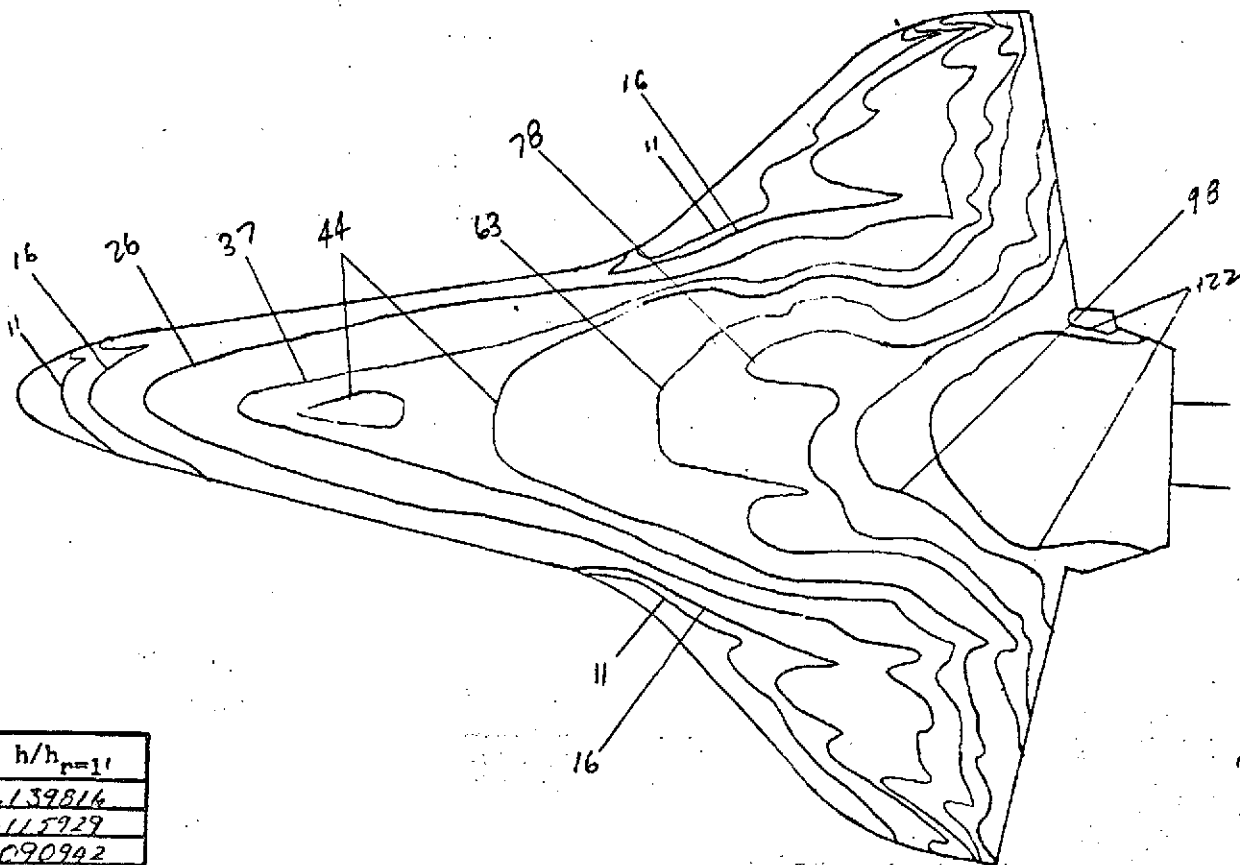
$H_3 = .0726 \text{ BTU/FT}^2\text{-SEC-}^{\circ}\text{F}$



Isotherm	$h/h_{r=1}$
11	.254328
26	.165926
40	.133371
55	.113759
72	.0914087
88	.0899186
100	.0843511
119	.077325

FIG. 55

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
11	.139816
16	.115929
26	.090992
37	.076235
44	.064908
63	.058423
78	.052506
98	.046843
122	.041983

FIG. 56

CONFIG. 46-1

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B RPA

RUN 4160

$M_{\infty} = 8$

$P_{total} \text{ (psig)} = 160$

$T_{total} \text{ (}^{\circ}\text{F)} = 805$

$T_{aw}/T_{total} = .91$

$R_N \text{ per foot} = 1 \times 10^6$

$T_{\text{phase change}} \text{ (}^{\circ}\text{F)} = 156$

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

§ A- Frame 11

$HS = .039504 \text{ BTU} / \text{FT}^2 \cdot \text{SEC} \cdot ^{\circ}\text{F}$

PHASE CHANGE TEST

CONFIG. 46-3

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B RPA

RUN 4161

$M_{\infty} = 8$

$P_{total} \text{ (psig)} = 163$

$T_{total} \text{ (}^{\circ}\text{F)} = 800$

$T_{aw}/T_{total} = .91$

$R_N \text{ per foot} = 1 \times 10^6$

$T_{\text{phase change}} \text{ (}^{\circ}\text{F)} = 175$

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

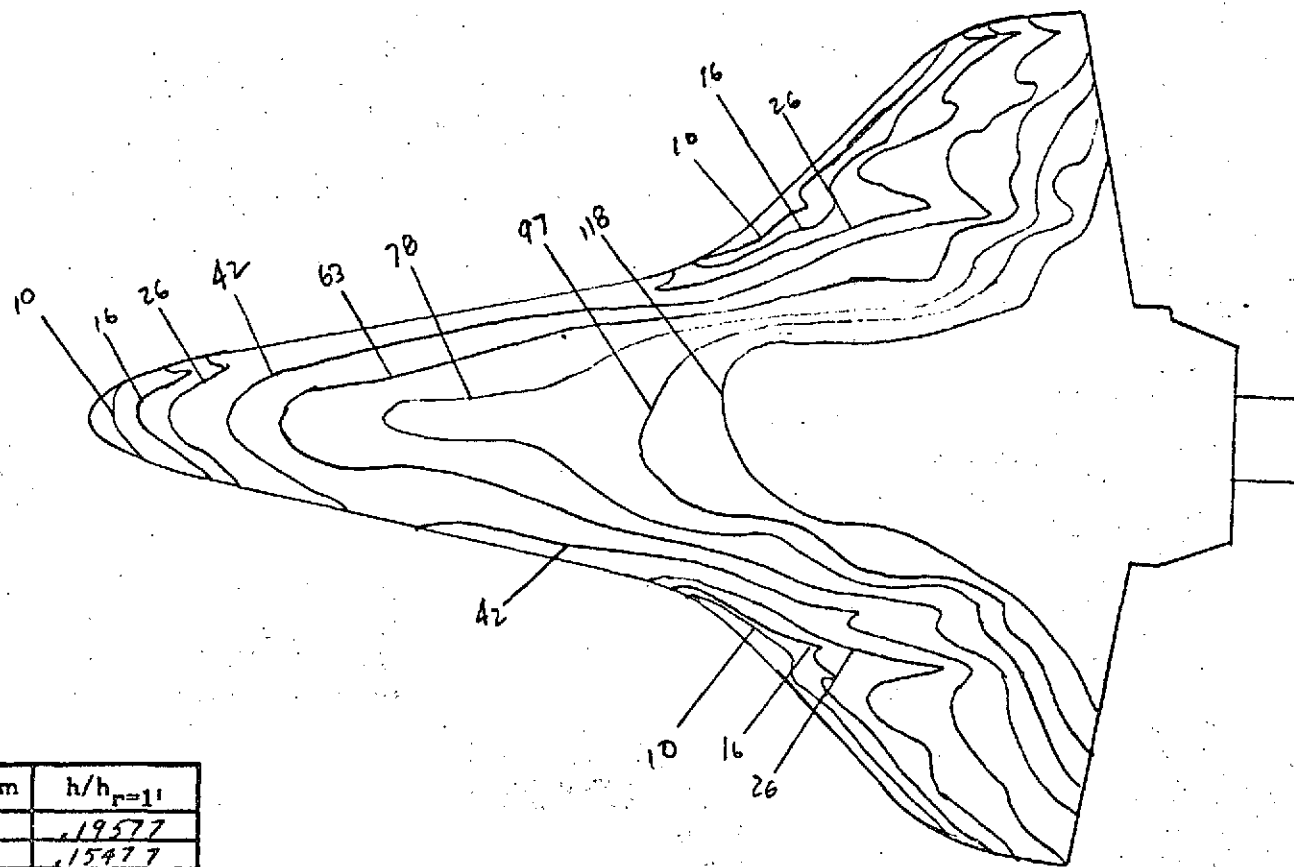
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

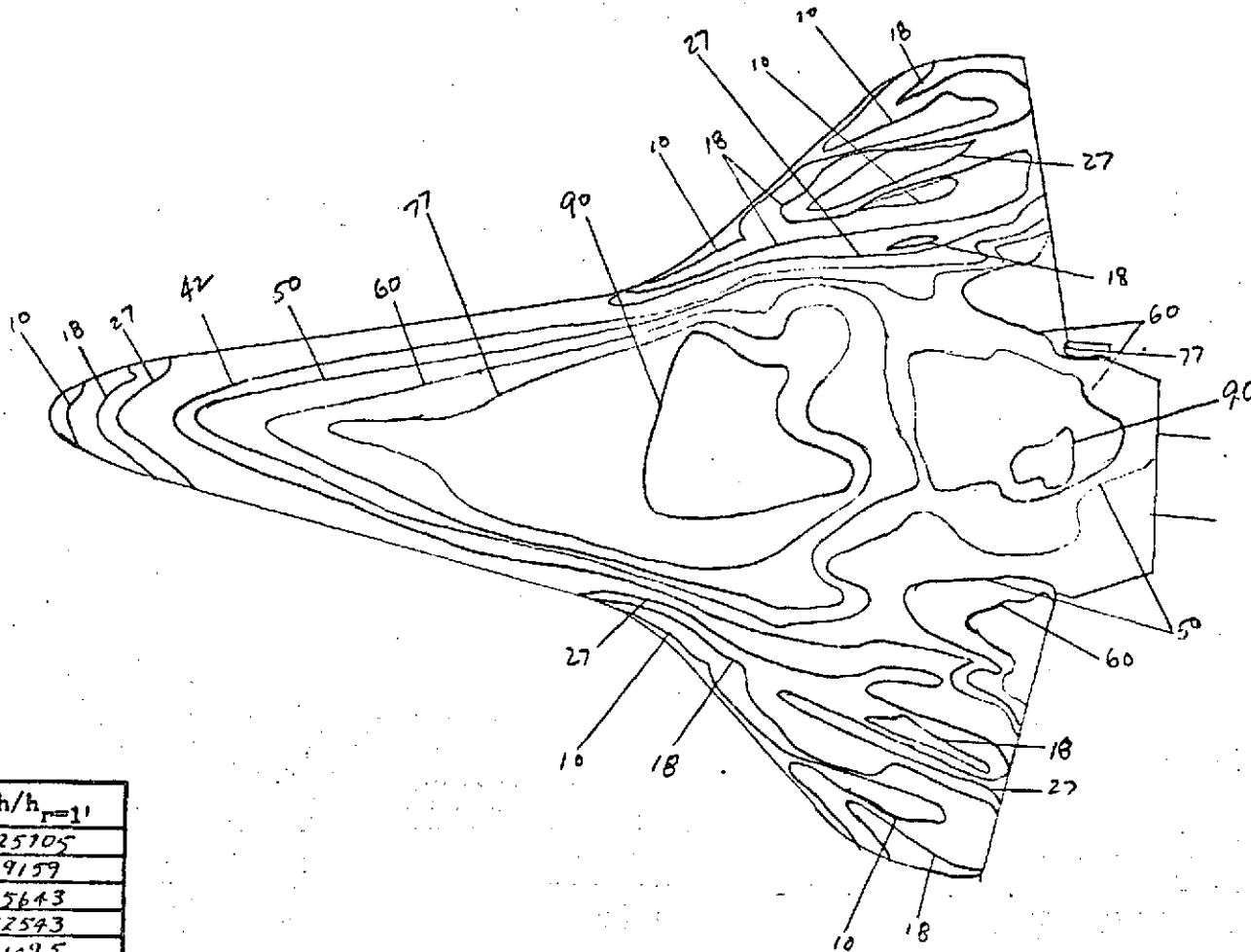
$\dot{q} \text{ at } T_{\text{film}} = 10$
 $H_3 = .0400474 \frac{\text{BTU}}{\text{ft}^2 \cdot \text{sec} \cdot ^{\circ}\text{F}}$



Isotherm	$h/h_{r=1}$
10	.19577
16	.15477
26	.12141
42	.09553
63	.071997
78	.070098
97	.062816
118	.056911

FIG. 57

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
10	.25705
18	.19159
27	.15643
42	.12543
50	.11495
60	.10494
77	.09263
90	.08568

FIG. 58

CONFIG. 46-1

LENGTH (in) = .638

SCALE .00593

FACILITY LRC/VDT

TEST CHAZB RPA

RUN 4162

$M_{\infty} = 8$

P_{total} (psig) = 1385

T_{total} ($^{\circ}F$) = 915

$T_{aw}/T_{total} = .91$

R_N per foot = 6×10^6

$T_{phase\ change}$ ($^{\circ}F$) = 350

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

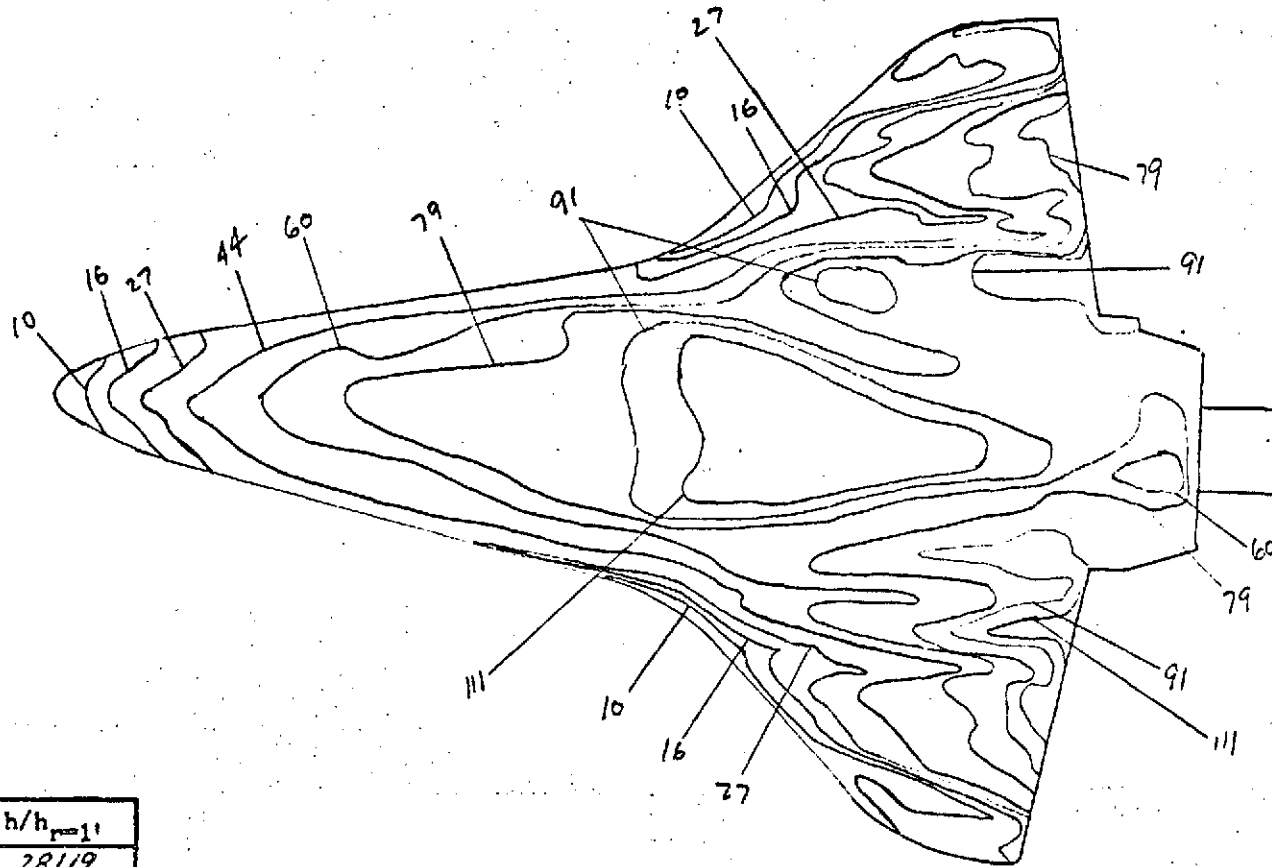
y (in) =

z (in) =

⊕ AT FRAME 10

$HS = .104917 \frac{BTU}{FT^2 \cdot SEC \cdot ^{\circ}F}$

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
10	.28119
16	.2223
27	.1711
44	.1341
60	.1148
79	.1000
91	.0932
111	.0844

FIG. 59

CONFIG. 46-3

LENGTH (in) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B RPA

RUN 4163

$M_{\infty} = 8$

P_{total} (psig) = 1385

T_{total} ($^{\circ}$ F) = 870

$T_{aw}/T_{total} = .91$

R_N per foot = 6×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 350

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

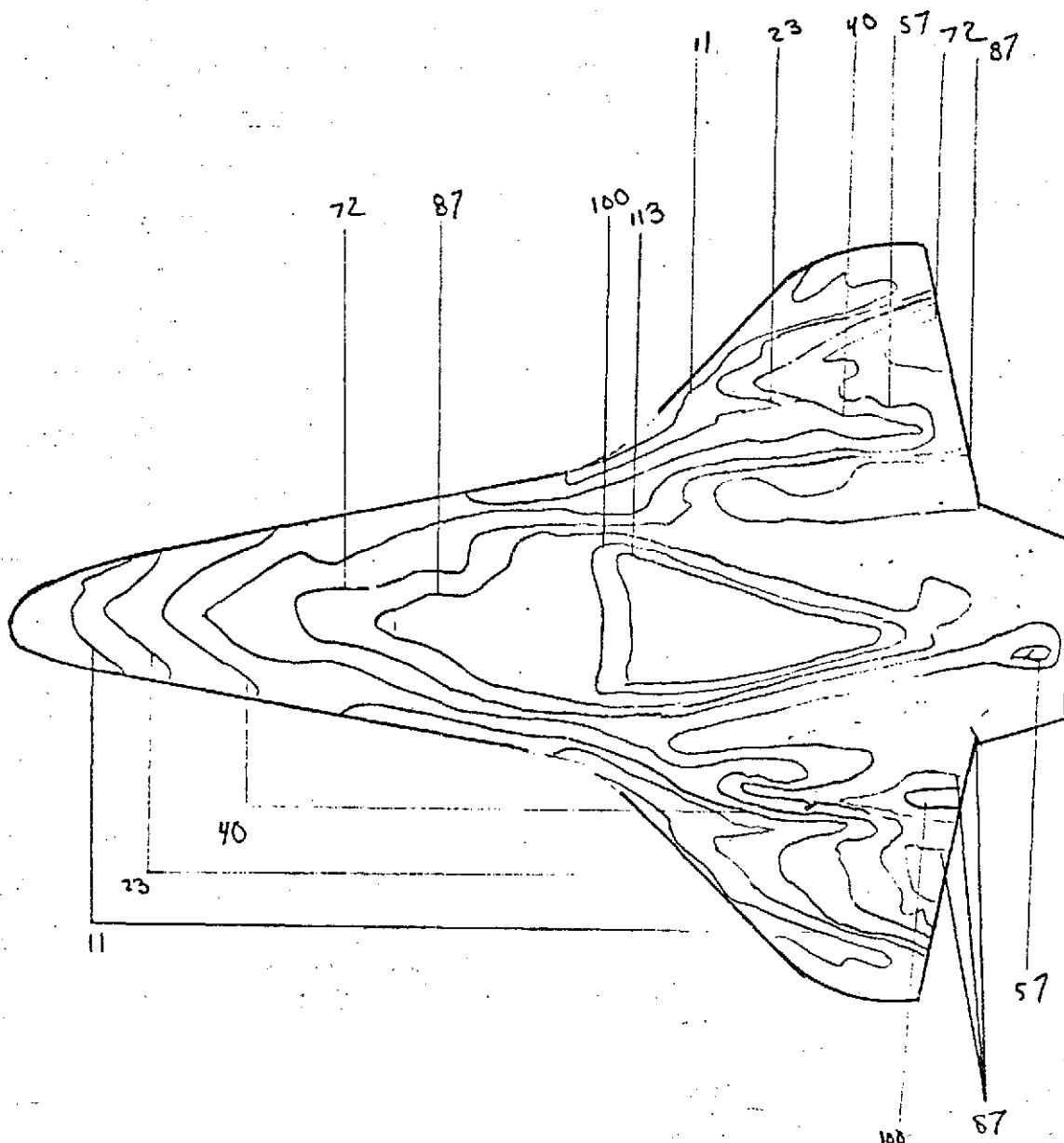
y (in) =

z (in) =

ζ AT FRAME 10

$HS = .10456 \frac{BIU}{FT^2 SEC^2 OF}$

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
11	.26810
23	.18541
40	.14059
57	.11728
72	.10479
87	.09533
100	.08892
113	.08365

FIG. 60

CONFIG. 46-3

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B RPA

RUN 4163 M

$M_\infty = \beta$

$P_{total} \text{ (psig)} = 1385$

$T_{total} \text{ (}^\circ\text{F)} = 870$

$T_{aw}/T_{total} = .91$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 350$

$\alpha = 30^\circ$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

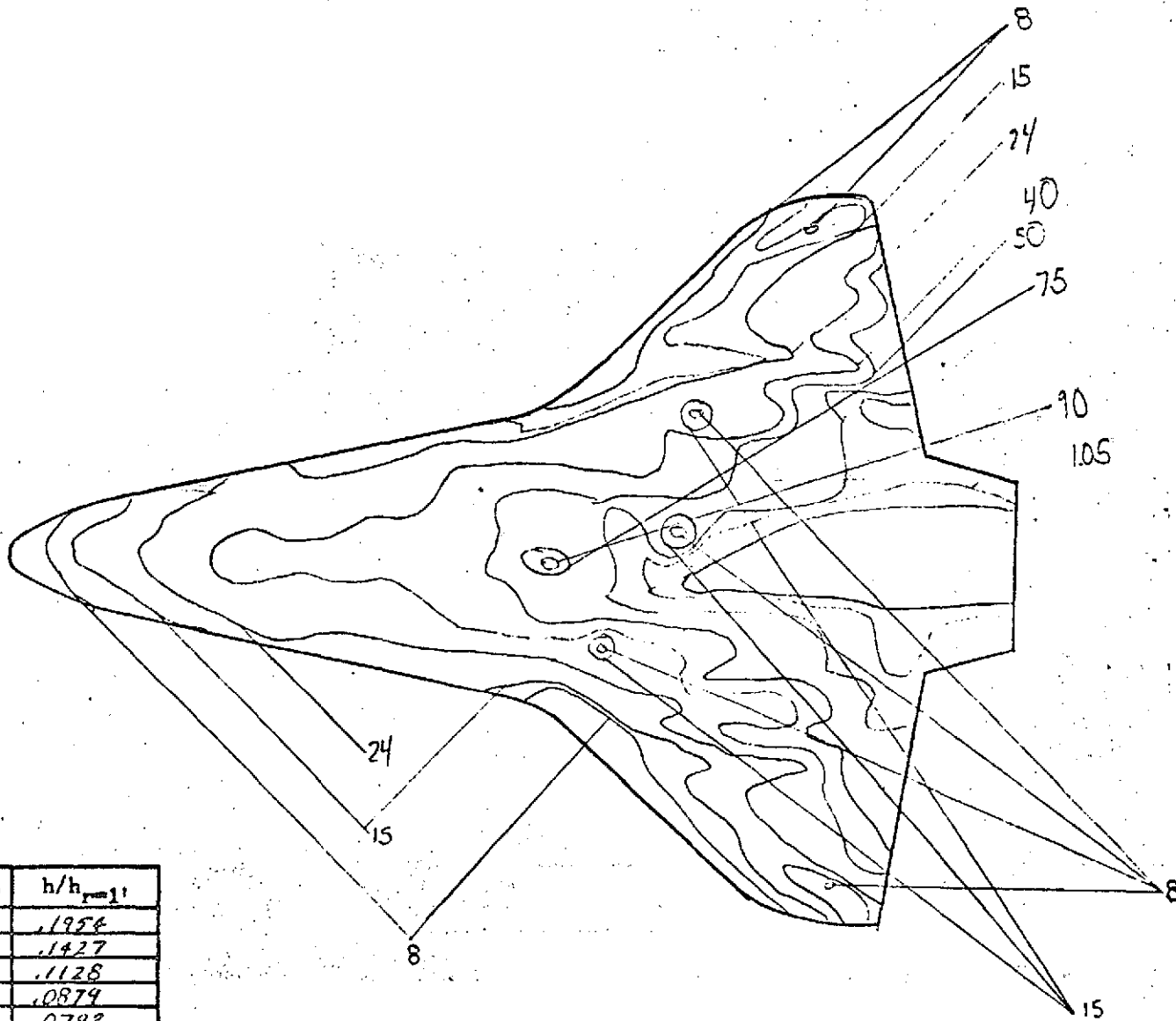
x (in) =

y (in) =

z (in) =

$H_1 = \dots$
 $H_5 = .10456 \text{ BTU FT}^{-2}\text{-SEC-}^\circ\text{F}$

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
8	.1954
15	.1427
24	.1128
40	.0879
50	.0782
75	.0638
90	.0583
105	.0539

FIG. 61

CONFIG. 46-3

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/VDT

TEST 0H42B RPA

RUN 4164

$M_{\infty} = 8$

P_{total} (psig) = 635

T_{total} ($^{\circ}F$) = 955

$T_{aw}/T_{total} = .91$

R_N per foot = 3×10^6

$T_{phase\ change}$ ($^{\circ}F$) = 250

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

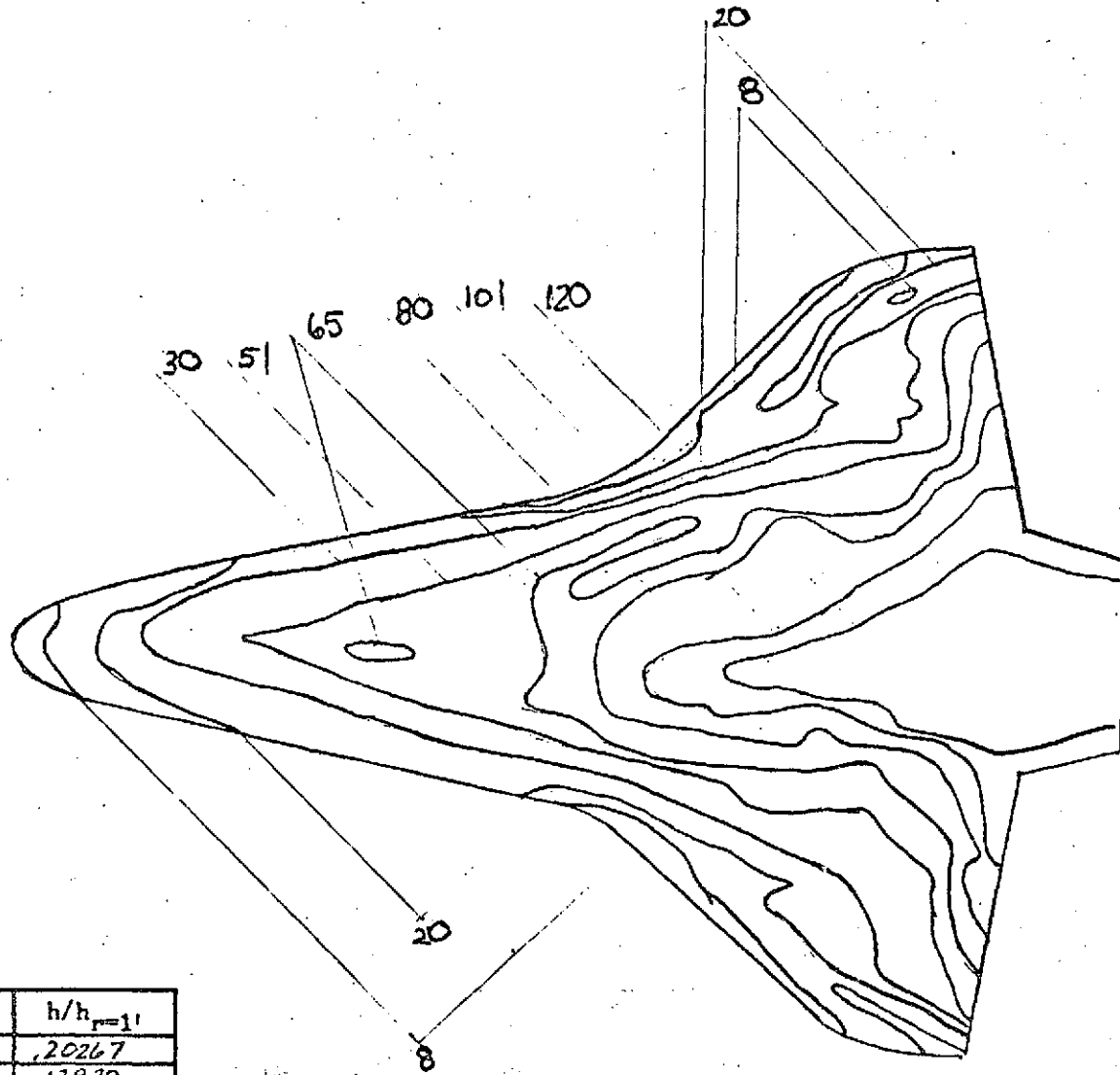
x (in) =

y (in) =

z (in) =

HS = .073487 $\frac{BTU}{FT^2 SEC \cdot ^{\circ}F}$

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
8	.20267
20	.12820
30	.10466
51	.08027
65	.07110
80	.06409
101	.05104
120	.05233

FIG. 62

CONFIG. 46-1

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B RPA

RUN 4165

$M_{\infty} = 8$

P_{total} (psig) = 640

T_{total} (°F) = 930

$T_{aw}/T_{total} = .91$

R_N per foot = 3×10^6

$T_{phase\ change}$ (°F) = 250

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

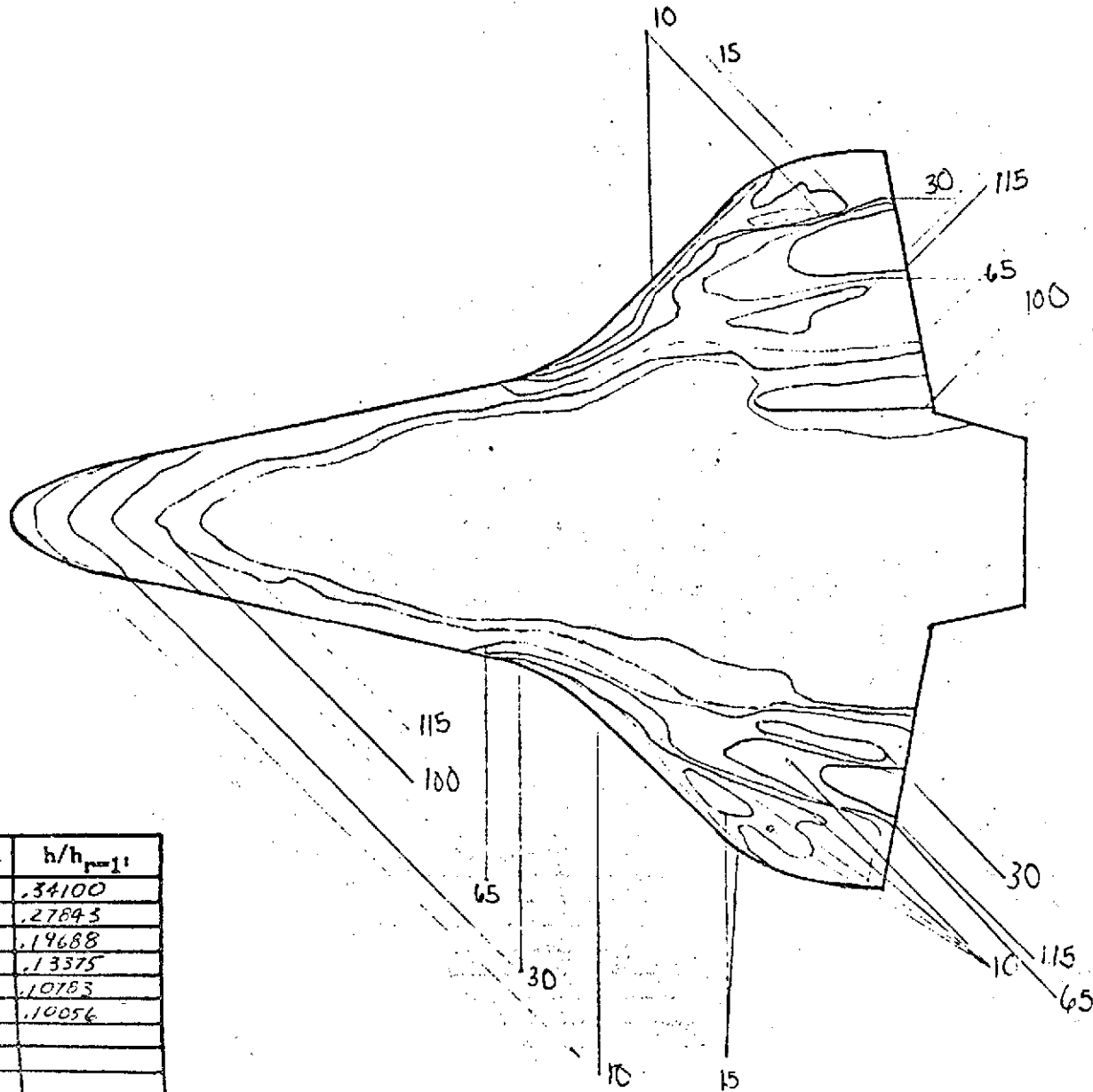
x (in) =

y (in) =

z (in) =

$H_5 = 07362 \text{ BTU/FT}^2 \cdot \text{SEC} \cdot ^\circ\text{F}$

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
10	.34100
15	.27843
30	.14688
65	.13375
100	.10183
115	.10056

FIG. 63

CONFIG. 46-3

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B RPA

RUN 4166

$M_{\infty} = 8$

P_{total} (psig) = 1390

T_{total} ($^{\circ}F$) = 920

$T_{aw}/T_{total} = .91$

R_N per foot = 6×10^6

$T_{phase\ change}$ ($^{\circ}F$) = 400

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

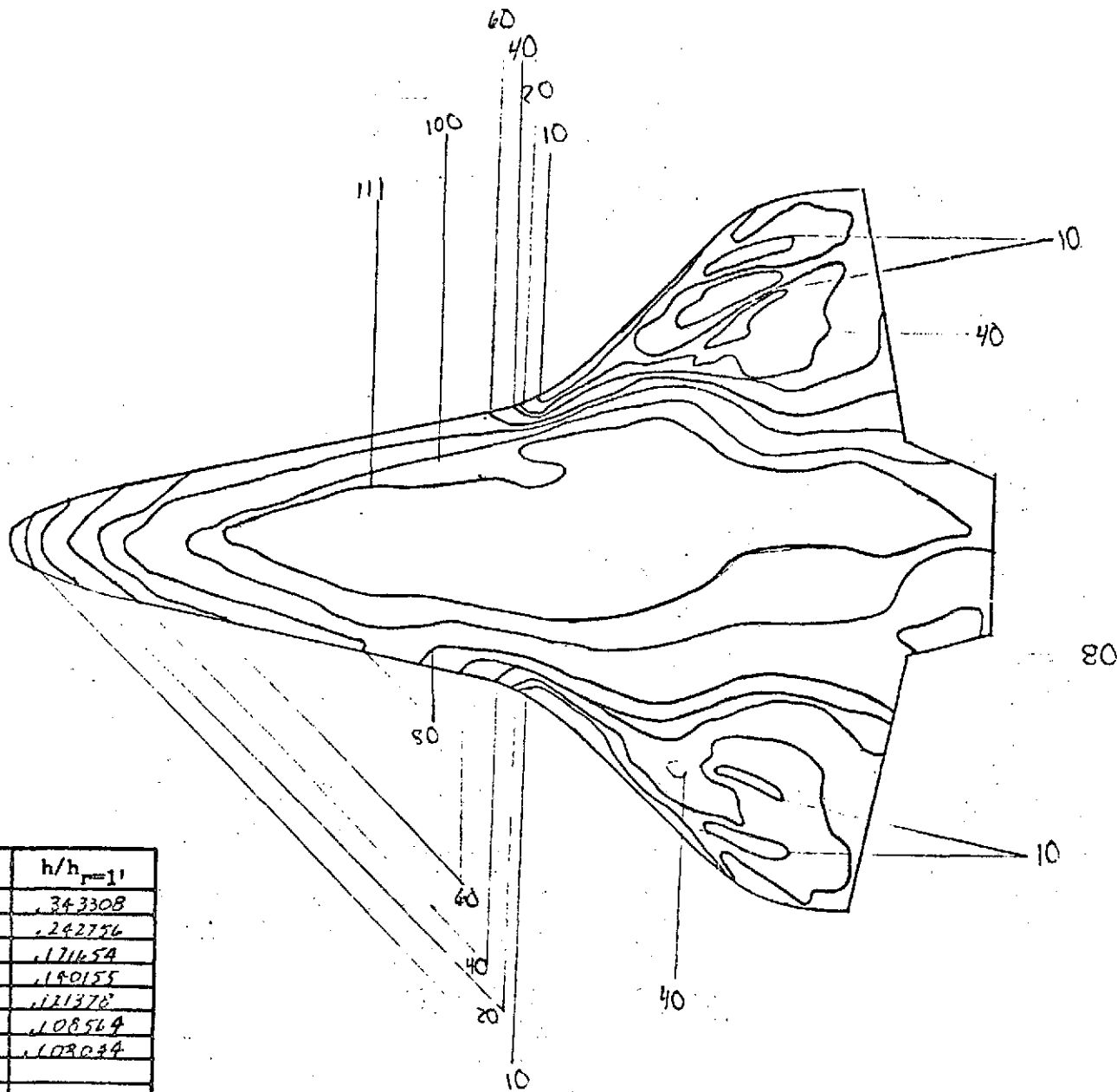
x (in) =

y (in) =

z (in) =

$HS = .11265 \frac{BTU}{FT^2 \cdot SEC \cdot ^{\circ}F}$

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
10	.343308
20	.242756
40	.171654
60	.140155
80	.121378
100	.108564
111	.103034

FIG. 64

CONFIG. 46-1

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B RPA

RUN 4167

$M_{\infty} = 8$

P_{total} (psig) = 1625

T_{total} ($^{\circ}$ F) = 885

$T_{aw}/T_{total} = .91$

R_N per foot = 7×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 400

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

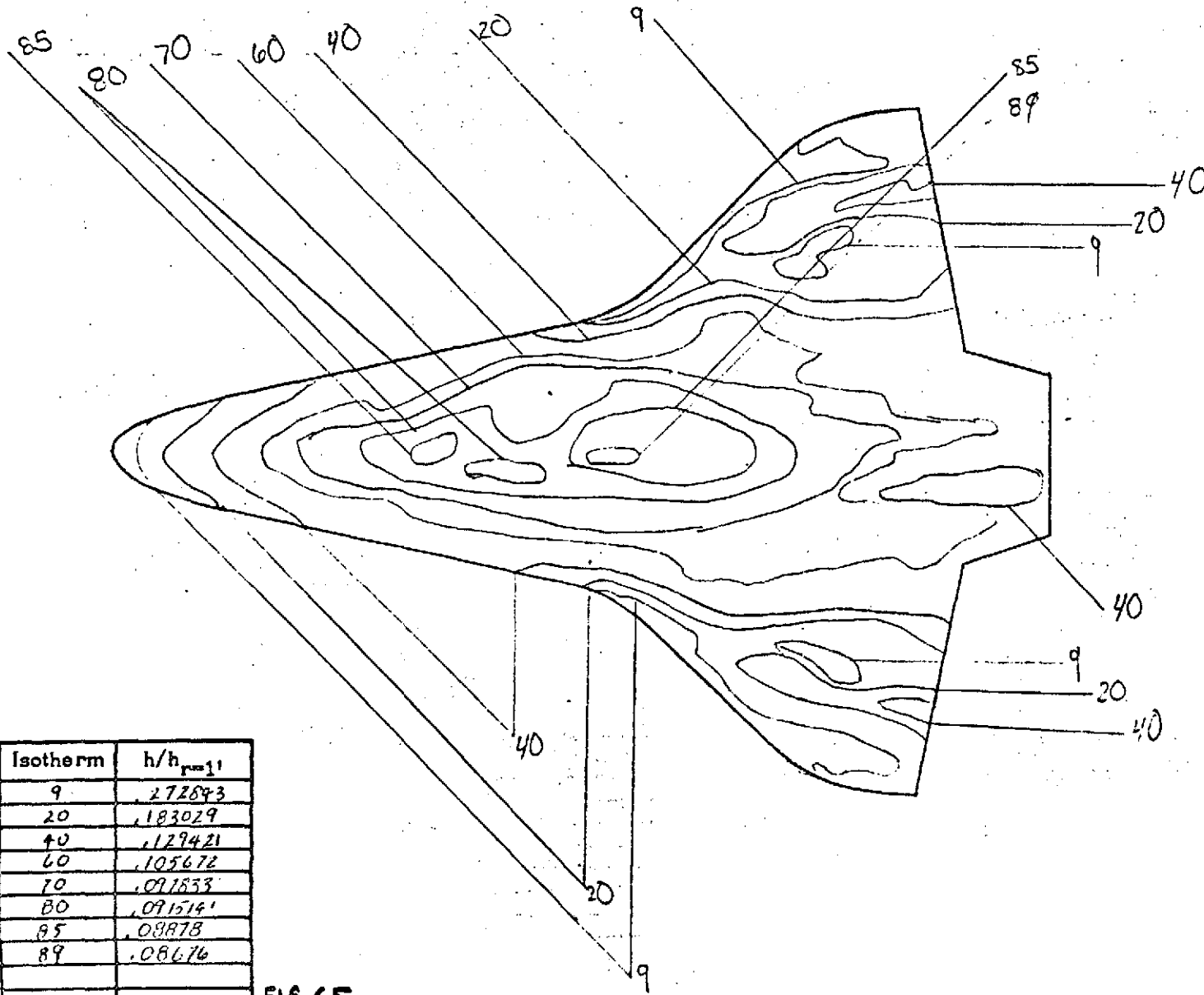
x (in) =

y (in) =

z (in) =

$HS = .11265 \frac{BTU}{FT^2 \cdot SEC \cdot ^{\circ}F}$

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
9	.272843
20	.183029
40	.129421
60	.105672
70	.091833
80	.091514
85	.08878
89	.08676

FIG. 65

CONFIG. 46-3

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST 0442B RPA

RUN 4168

$M_{\infty} = 8$

P_{total} (psig) = 1930

T_{total} ($^{\circ}F$) = 985

$T_{aw}/T_{total} = .91$

R_N per foot = 8

$T_{phase\ change}$ ($^{\circ}F$) =

$\alpha =$

$\beta =$

$\phi =$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

$HS = .122902870$
 $FT^2-SEC.^{\circ}F$

PHASE CHANGE TEST

CONFIG.

46-1

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH428 RPA

RUN 4172

$M_{\infty} = 8$

$P_{total} \text{ (psig)} = 650$

$T_{total} \text{ (}^{\circ}\text{F)} = 886$

$T_{aw}/T_{total} = .92$

$R_N \text{ per foot} = 3 \times 10^3$

$T_{\text{phase change}} \text{ (}^{\circ}\text{F)} = 300$

$\alpha = 35$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from
model center, x-axis
parallel w/ stream,
+ downstream)

x (in) =

y (in) =

z (in) =

HI - 6 ON FRAME 10

HS = .073986 BTU

FT²-SEC-OF
WDS

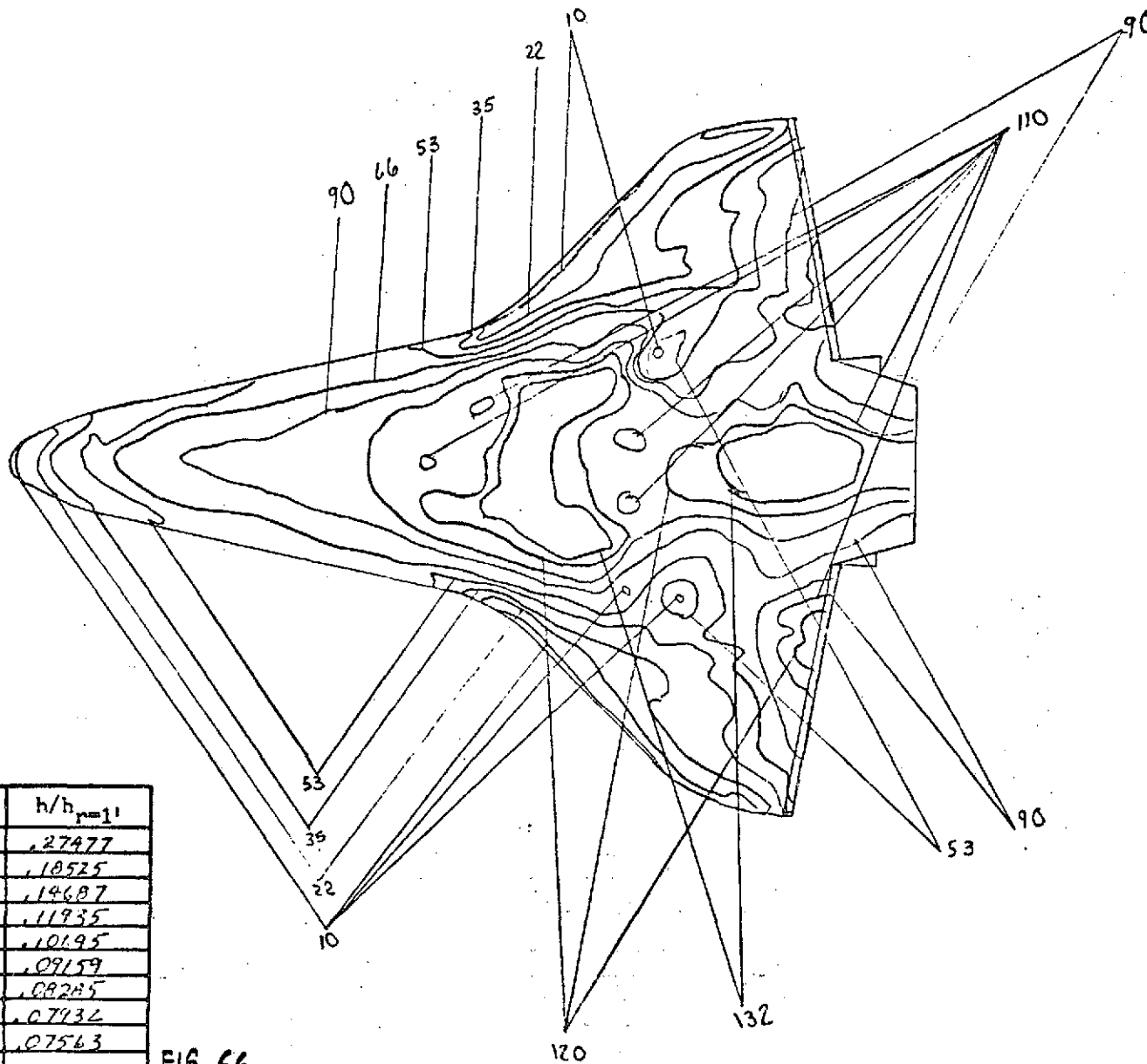
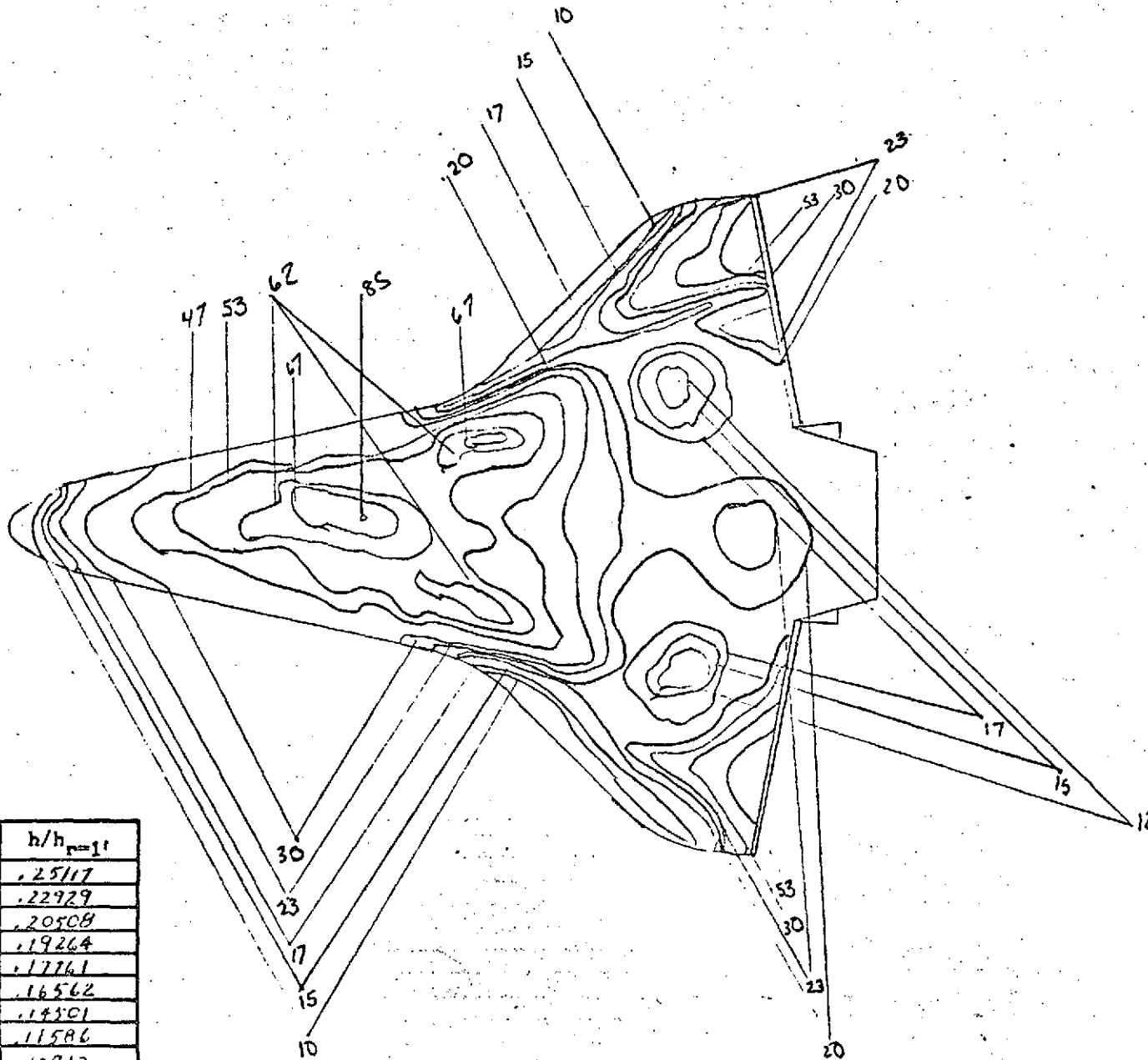


FIG. 66

Isotherm	$h/h_{r=1}$
10	.27477
22	.18525
35	.14687
53	.11935
66	.10195
90	.09159
110	.08285
120	.07932
150	.07563

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
10	.25117
12	.22929
15	.20508
17	.19264
20	.17761
23	.16562
30	.14301
47	.11586
53	.10910
62	.10087
67	.09704
85	.08615

FIG. 67

CONFIG.

46-2

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/YDT

TEST 0H42B (RPA)

RUN 4173

$M_\infty = 8$

P_{total} (psig) = 1390

T_{total} (°F) = 915

$T_{aw}/T_{total} = .92$

R_N per foot = 6×10^6

$T_{phase\ change}$ (°F) = 350

$\alpha = 35$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

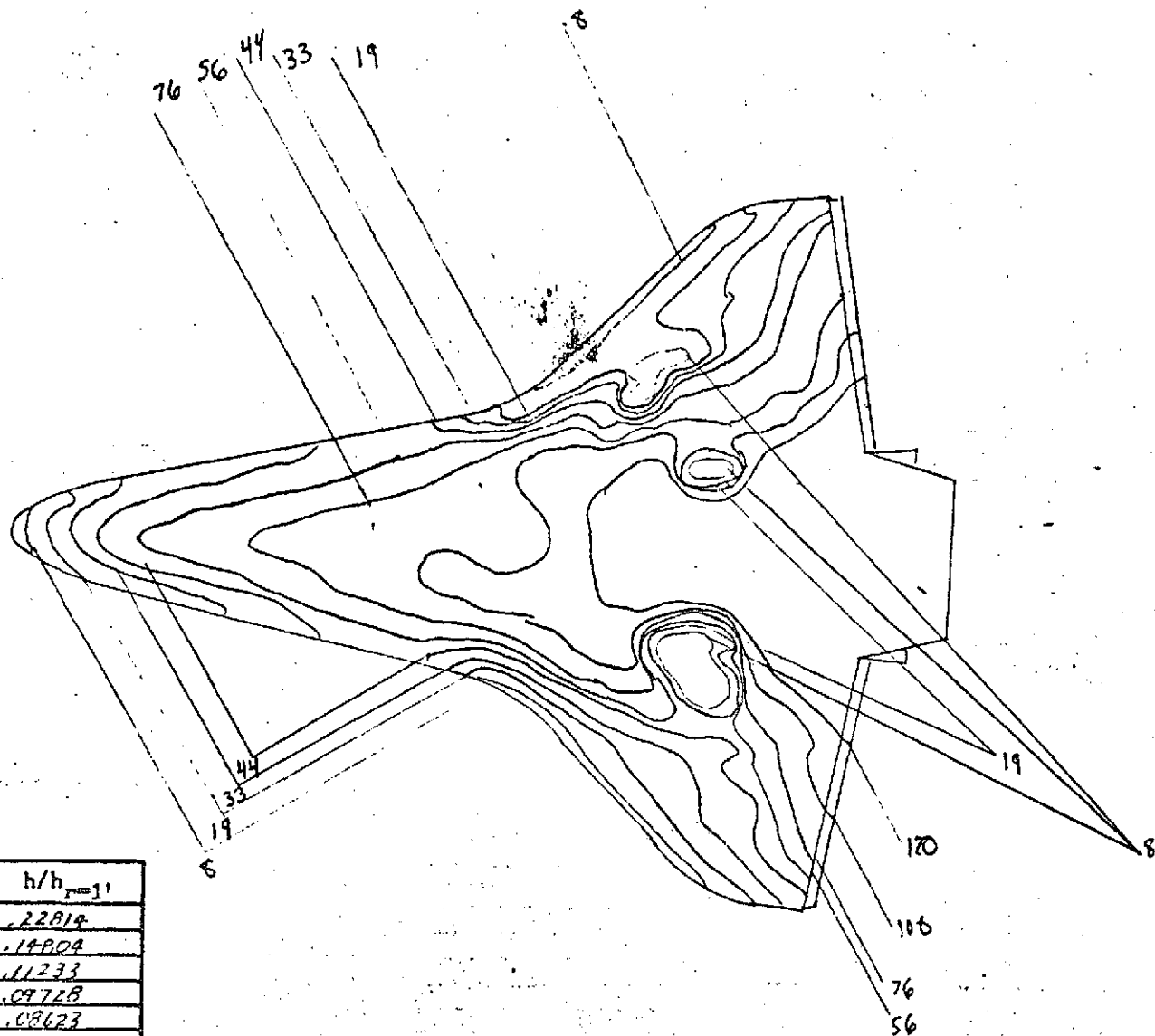
z (in) =

Hit Q on Frame 9

$HS = .10509$ BTU

MS

PHASE CHANGE TEST



Isotherm	$h/h_{T=1}$
8	.22814
19	.14804
33	.11233
44	.09728
56	.08623
76	.07402
100	.06452
120	.05891

HS = .03926 BTU
 FT² SEC⁻² °F
 FIG. 68

CONFIG. 46-1

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/YDT

TEST OH42B (RPA)

RUN 4174

$M_{\infty} = 8$

$P_{total} \text{ (psig)} = 158$

$T_{total} \text{ (°F)} = 780$

$T_{aw}/T_{total} = .92$

$R_N \text{ per foot} = 1 \times 10^6$

$T_{\text{phase change}} \text{ (°F)} = 175$

$\alpha = 35$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from
 model center, x-axis
 parallel w/ stream,
 + downstream)

x (in) =

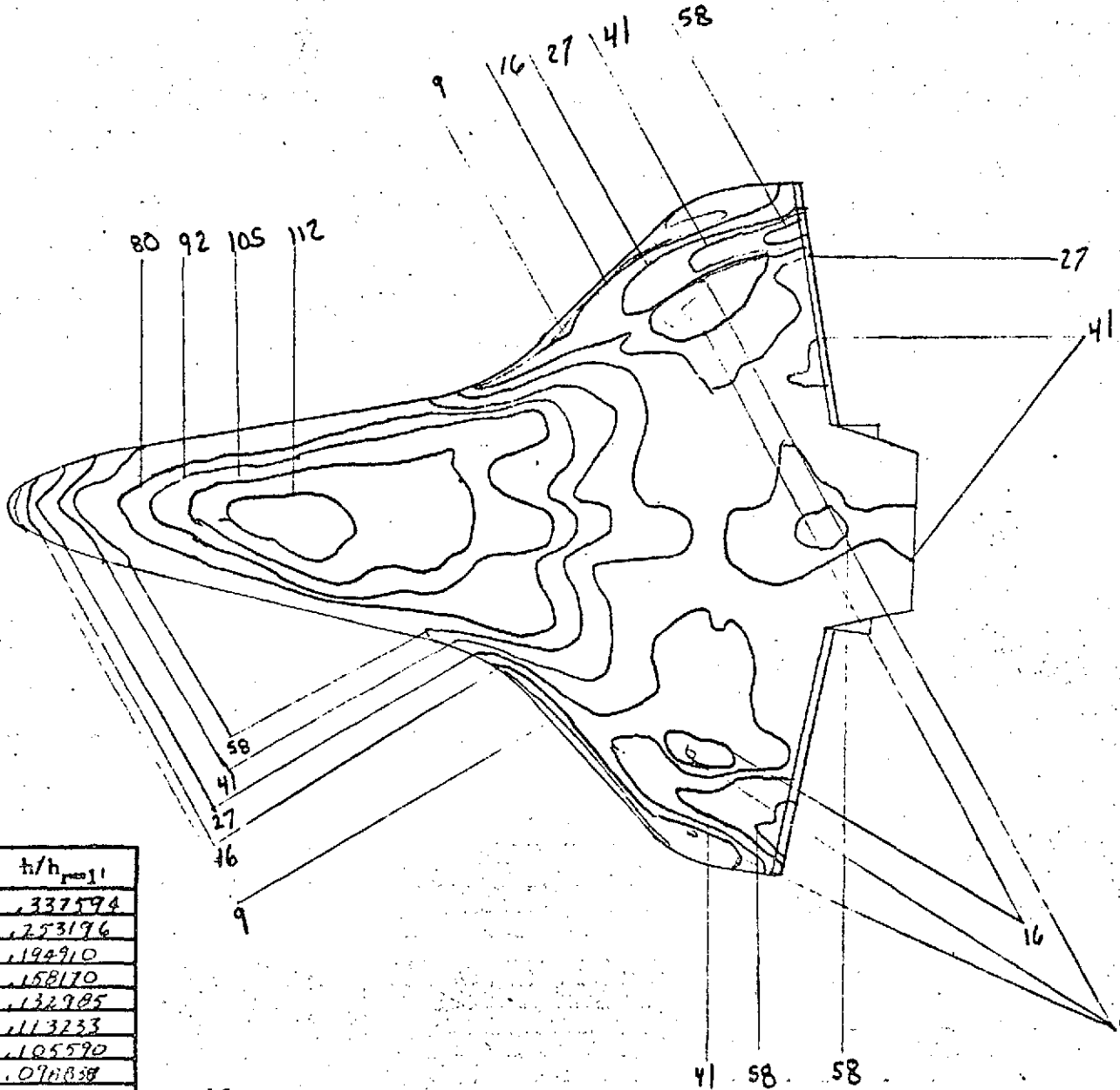
y (in) =

z (in) =

Hi 8 on FRAME 8

MDS

PHASE CHANGE TEST



Isotherm	h/h_{max}
9	.337594
16	.253196
27	.194910
41	.158170
58	.132985
80	.113233
92	.105590
105	.098838
112	.095649

FIG. 69

$HS = .10518 \frac{BTU}{FT^2 \cdot SEC \cdot OF}$

CONFIG.

46-1

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/NDT

TEST OH42B (RPA)

RUN 4175

$M_e = 8$

P_{total} (psig) = 1390

T_{total} ($^{\circ}F$) = 935

$T_{\text{aw}}/T_{\text{total}} = .92$

R_N per foot = 6×10^6

$T_{\text{phase change}}$ ($^{\circ}F$) = 400

$\alpha = 35$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

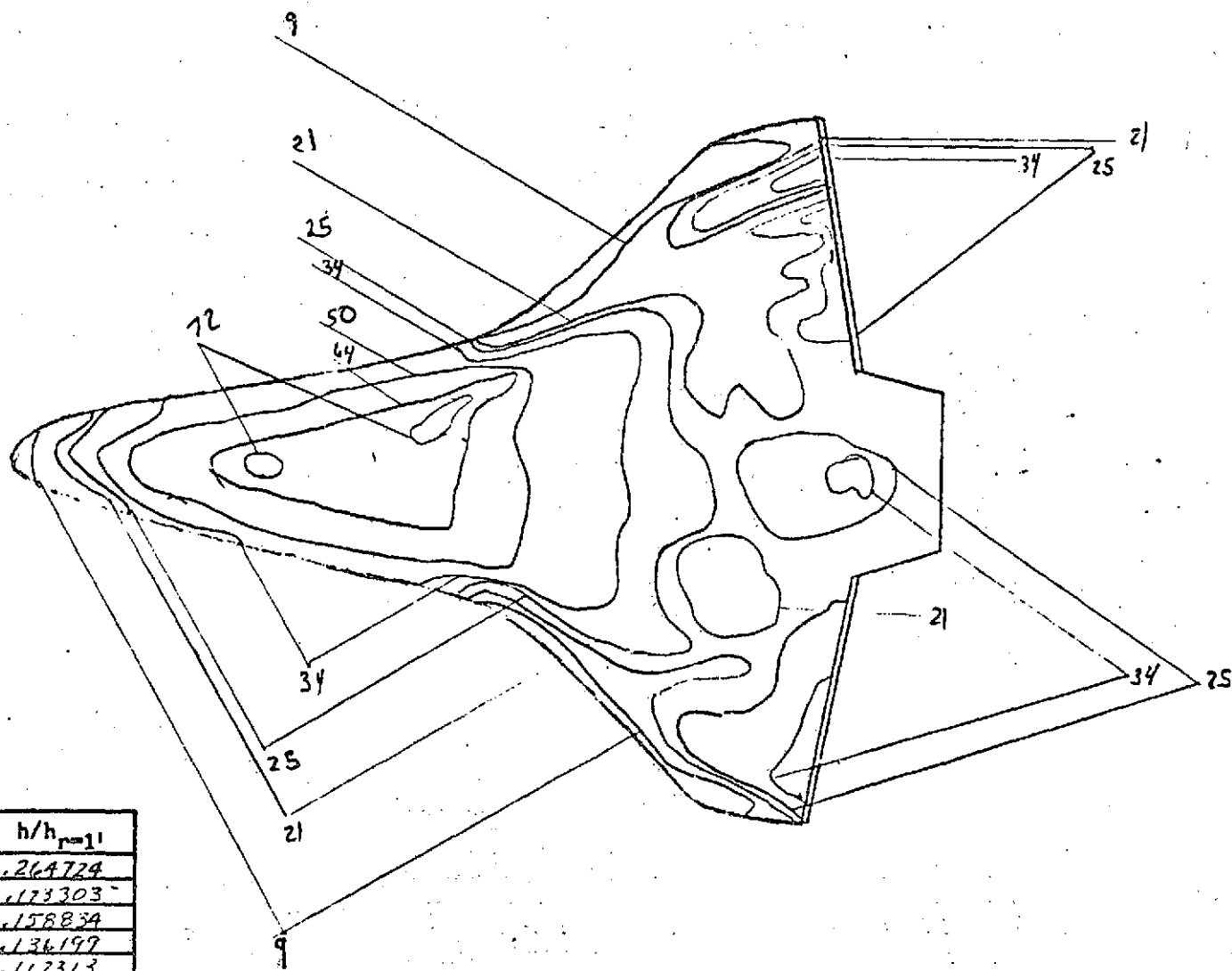
z (in) =

HIT # ON FRAME 9

MPS

PHASE CHANGE TEST

CONFIG. 46-1



Isotherm	$h/h_{p=1}$
9	.264724
21	.173303
25	.158834
34	.136197
50	.112313
64	.089272
72	.093594

FIG. 70

$HS = .1047 BTU$
 $FT^2-SEC-DF$

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B (RPA)

RUN 4176

$M_{\infty} = 8$

P_{total} (psig) = 1380

T_{total} (°F) = 915

$T_{aw}/T_{total} = .92$

R_N per foot = 6×10^6

$T_{phase\ change}$ (°F) = 350

$\alpha = 35^\circ$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

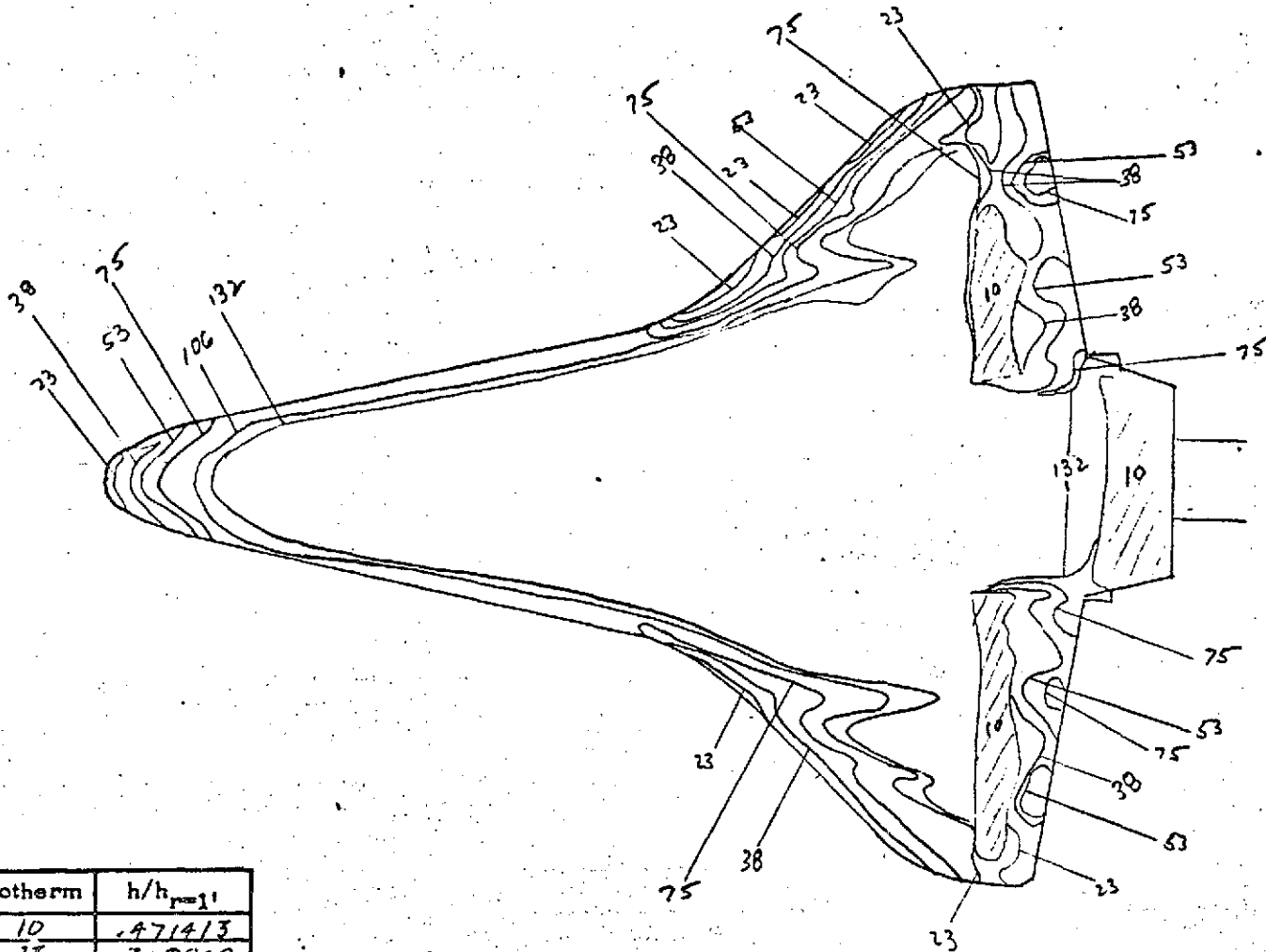
z (in) =

HIT \checkmark ON FRAME 9

MDS

RVD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
10	.471413
23	.310840
38	.241830
53	.204769
75	.172136
106	.144793
132	.127156

HS = .072943 BTU
 FT² SEC · °F

FIG. 71

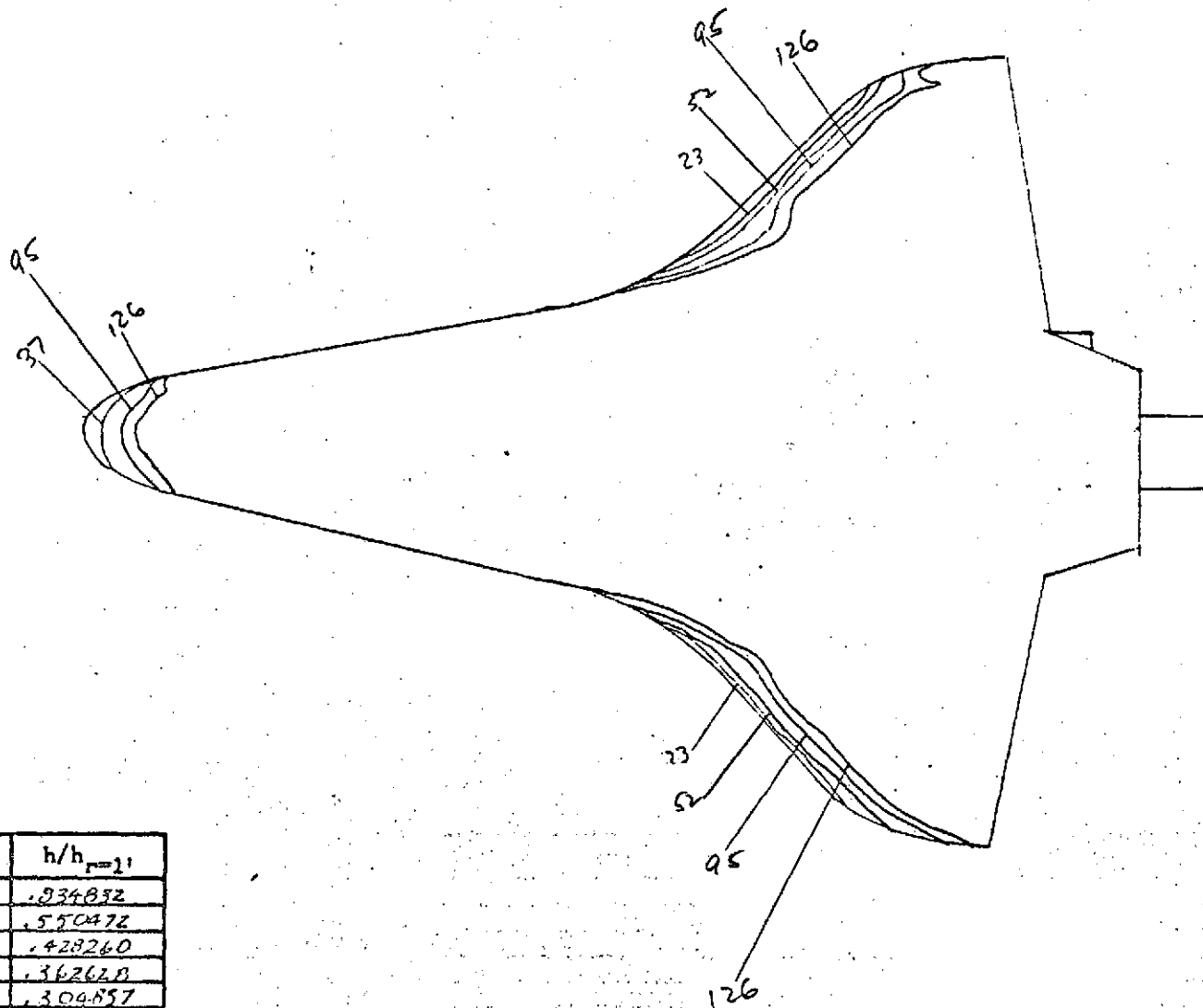
CONFIG.	46-4EBF
LENGTH (ft)	.685
SCALE	.00593
FACILITY	LRC/VDT
TEST	0H42B (RPA)
RUN	4177
M_{∞}	8
P_{total} (psig)	625
T_{total} (°F)	940
T_{aw}/T_{total}	.91
R_N per foot	3×10^6
$T_{phase\ change}$ (°F)	400
α	30°
β	0
ϕ	0
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)	
x (in)	=
y (in)	=
z (in)	=

Frame 9

PHASE CHANGE TEST

CONFIG.

46-2



Isotherm	$h/h_{r=1}$
10	.834832
23	.550472
38	.428260
53	.362628
75	.304857
106	.256416
132	.229780

HS = .0732651 BTU
 FIG. 72 FT²-SEC-°F

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B (RPA)

RUN 4178

$M_\infty = 8$

P_{total} (psig) = 635

T_{total} (°F) = 925

$T_{aw}/T_{total} =$

R_N per foot = 3×10^6

$T_{phase\ change}$ (°F) = 500

$\alpha = 30^\circ$

$\beta = 0$

$\phi = 0$

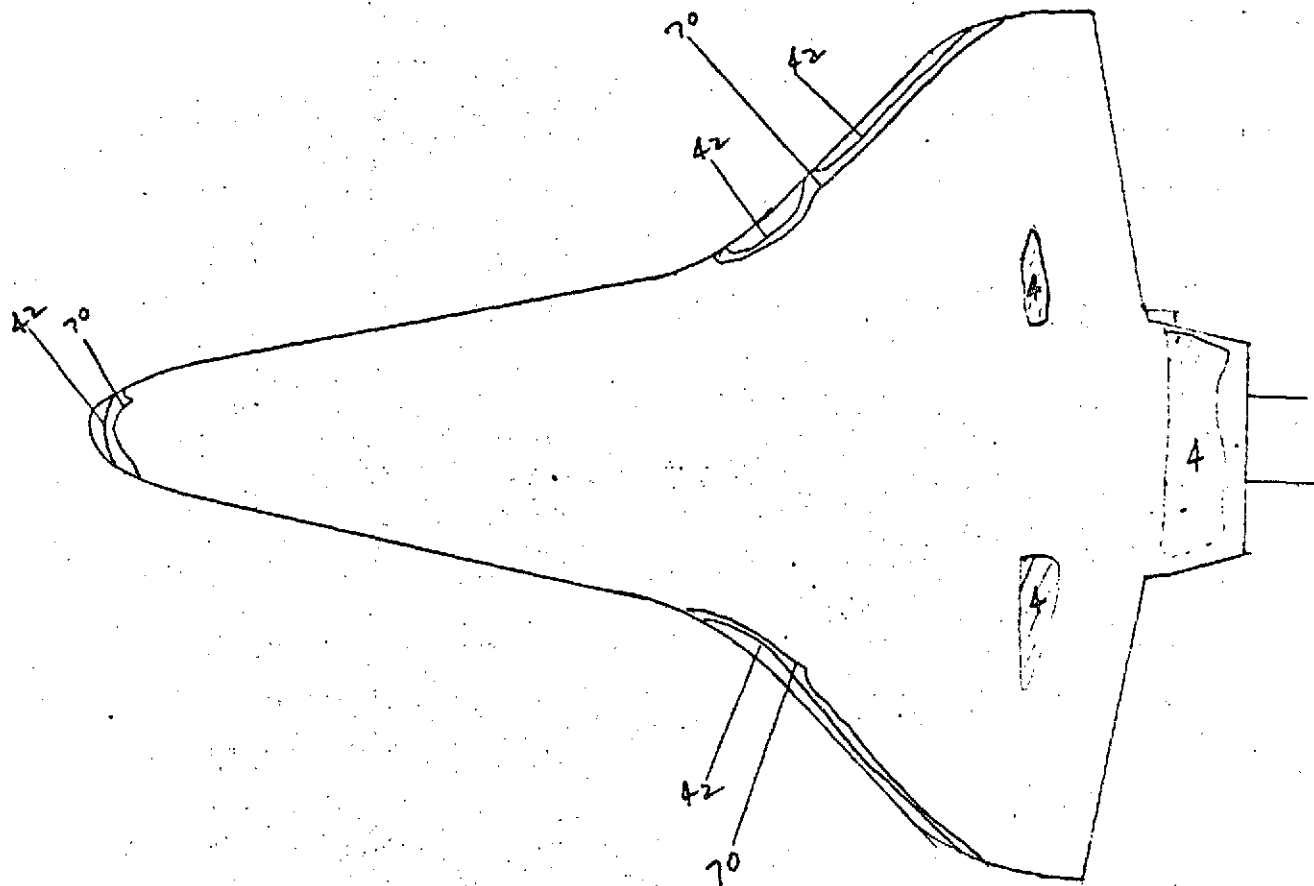
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
4	1.30154
42	.40166
70	.31113

FIG. 73

CONFIG.
46-4AEBF

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/VDT

TEST 0H42B (RPA)

RUN 4179

$M_{\infty} = 8$

P_{total} (psig) = 164

T_{total} (°F) = 820

$T_{aw}/T_{total} =$

R_N per foot = 1×10^6

$T_{phase\ change}$ (°F) = 350

$\alpha = 30^\circ$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

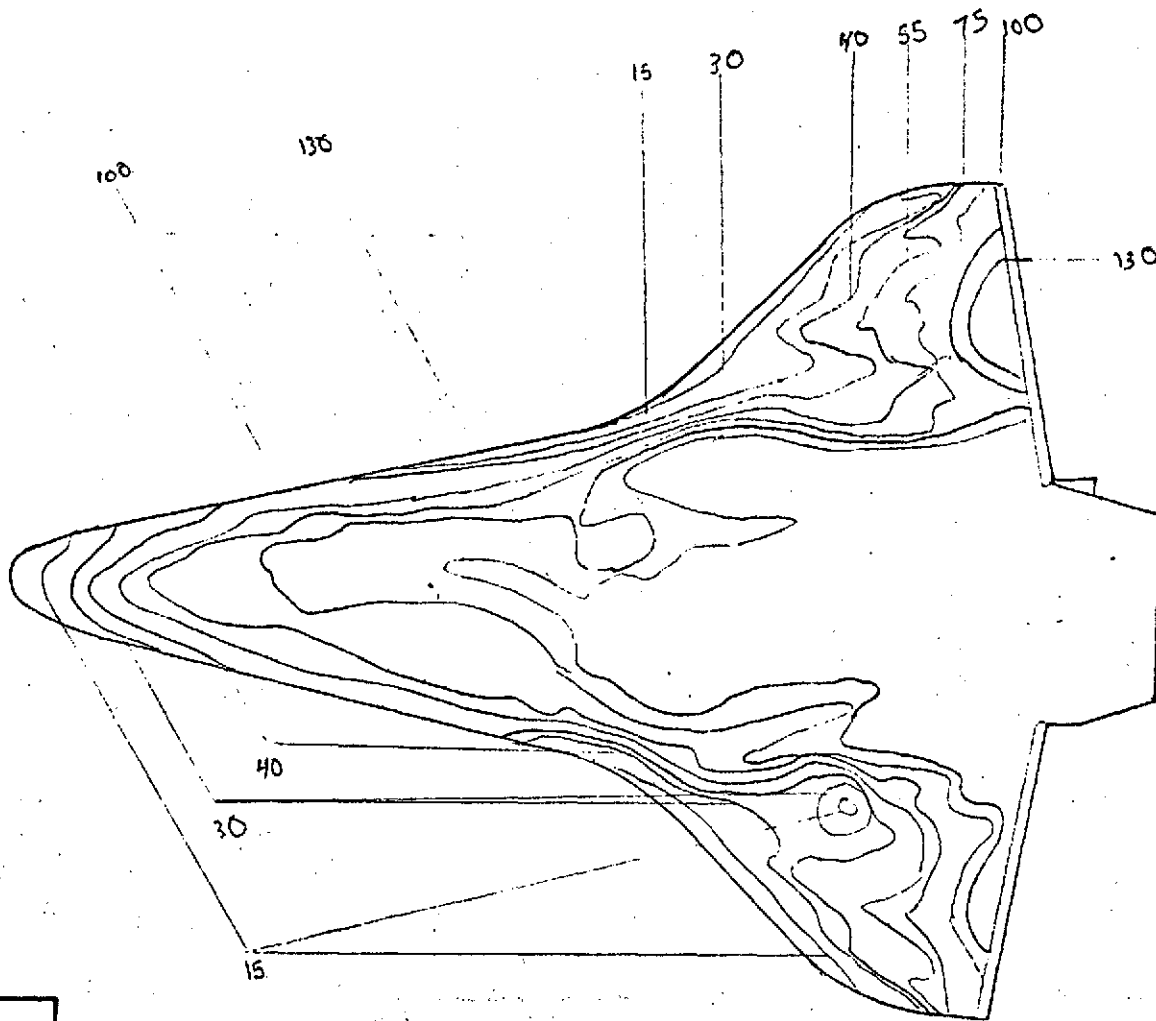
x (in) =

y (in) =

z (in) =

⊘ AT FRAME 9

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
15	.225801
30	.159665
40	.138274
55	.117921
75	.100981
100	.087452
130	.076701

FIG. 74

$H_5 = .0728 \frac{BTU}{FT^2 \cdot SEC \cdot ^\circ F}$

CONFIG. 46-2

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST 0H42B (RPA)

RUN 4180

$M_\infty = 8$

P_{total} (psig) = 625

T_{total} ($^\circ F$) = 910

$T_{aw}/T_{total} = .91$

R_N per foot = 3×10^6

$T_{phase\ change}$ ($^\circ F$) = 300

$\alpha = 30^\circ$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

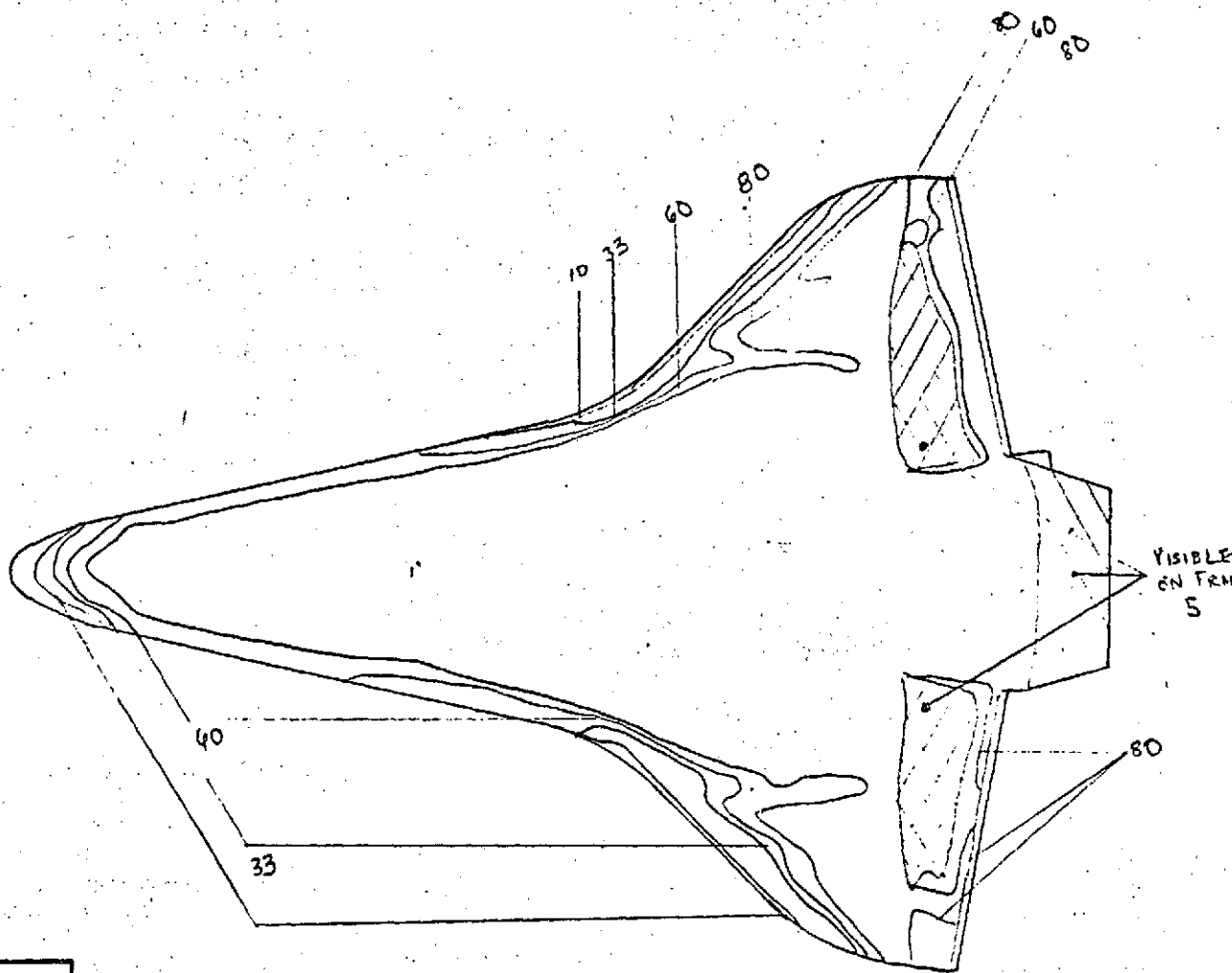
x (in) =

y (in) =

z (in) =

HIT & CONFIRMS ?

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
5	.593474
10	.419649
33	.231009
60	.171321
80	.148369

FIG. 75

MS = .03936 $\frac{BIV}{FT-SFC-0F}$

CONFIG. 46-4AEBF

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST 0H42B (RPA)

RUN 4181

$M_\infty = 8$

P_{total} (psig) = 157

T_{total} ($^{\circ}F$) = 810

$T_{aw}/T_{total} = .91$

R_N per foot = 1×10^6

$T_{phase\ change}$ ($^{\circ}F$) = 250

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

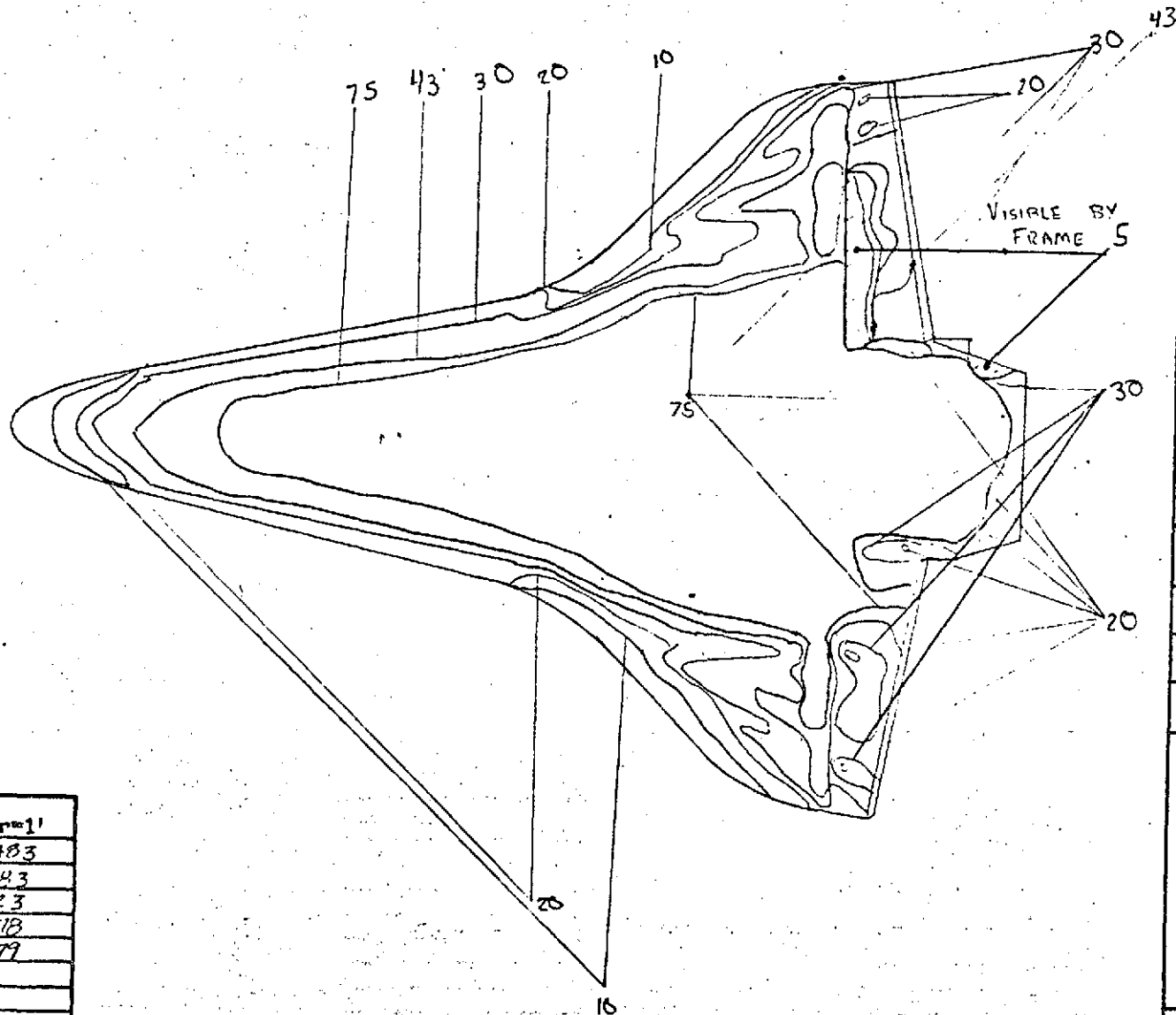
z (in) =

Fit Curve: $h/h_{p=1} = .593474 - .419649 \frac{h}{h_{p=1}} + .231009 \left(\frac{h}{h_{p=1}}\right)^2 - .171321 \left(\frac{h}{h_{p=1}}\right)^3 + .148369 \left(\frac{h}{h_{p=1}}\right)^4$

HVD

HVD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
10	.20483
20	.14983
30	.11823
43	.09818
75	.07479

$H_5 = .040984 \frac{BTU}{FT^2 \cdot SEC}$
FIG. 76

CONFIG. 46-4AEBF

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B (RPA)

RUN 4182

$M_\infty = 8$

P_{total} (psig) = 170

T_{total} ($^{\circ}F$) = 780

$T_{aw}/T_{total} = .91$

R_N per foot = 1×10^6

$T_{phase\ change}$ ($^{\circ}F$) = 175

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

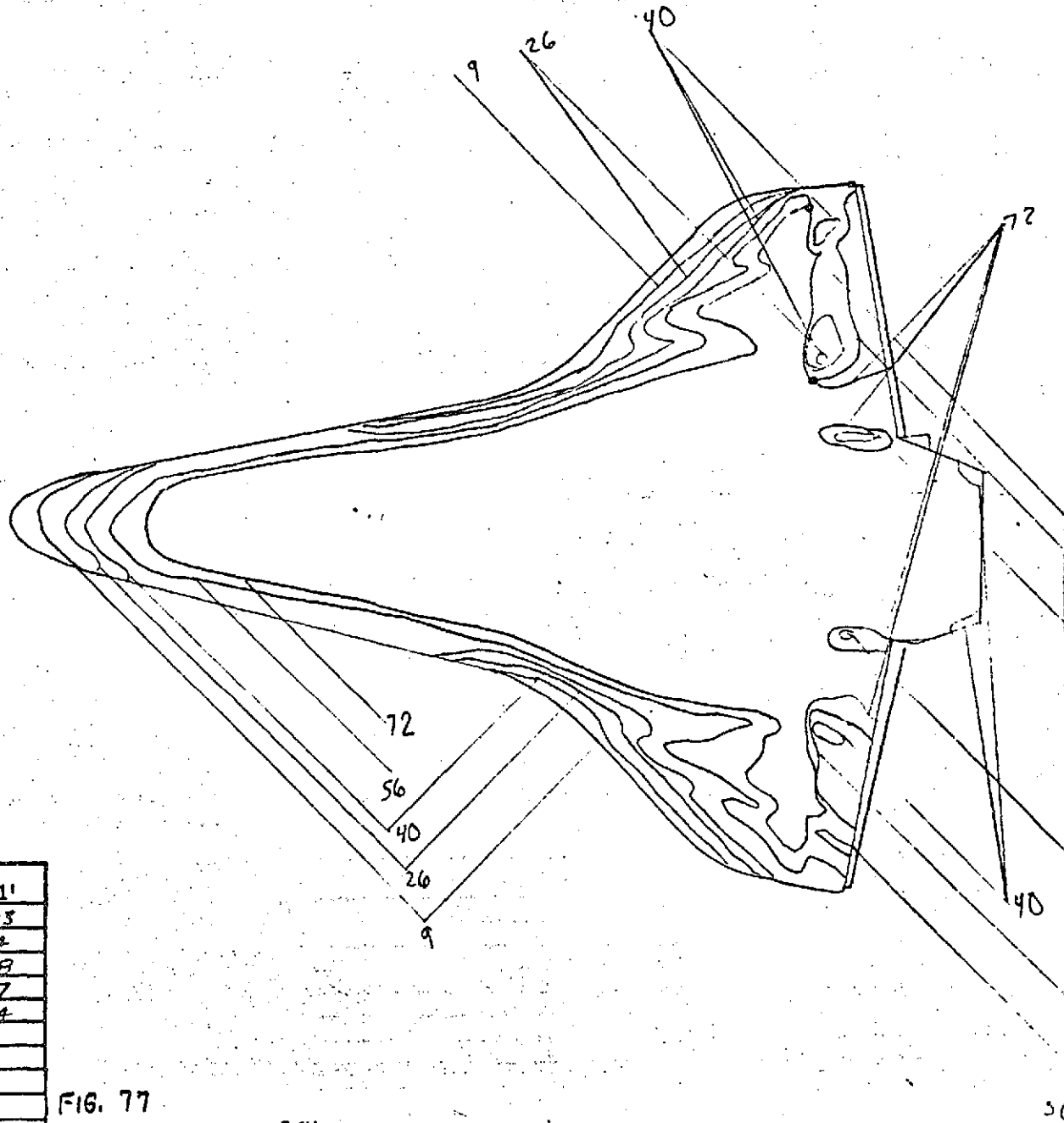
y (in) =

z (in) =

Hit on Frame ?

MPC HVD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
9	.29003
26	.17062
40	.13759
56	.11627
72	.10254

FIG. 77

HS = 1.03955 $\frac{RTV}{PT} = 500^\circ F$

CONFIG.

46-4AEBF

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42 B RPA

RUN 4183

$M_\infty = 8$

P_{total} (psig) = 160

T_{total} ($^\circ F$) = 790

$T_{aw}/T_{total} = .91$

R_N per foot = 1×10^6

$T_{phase\ change}$ ($^\circ F$) = 200

$\alpha = 30^\circ$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

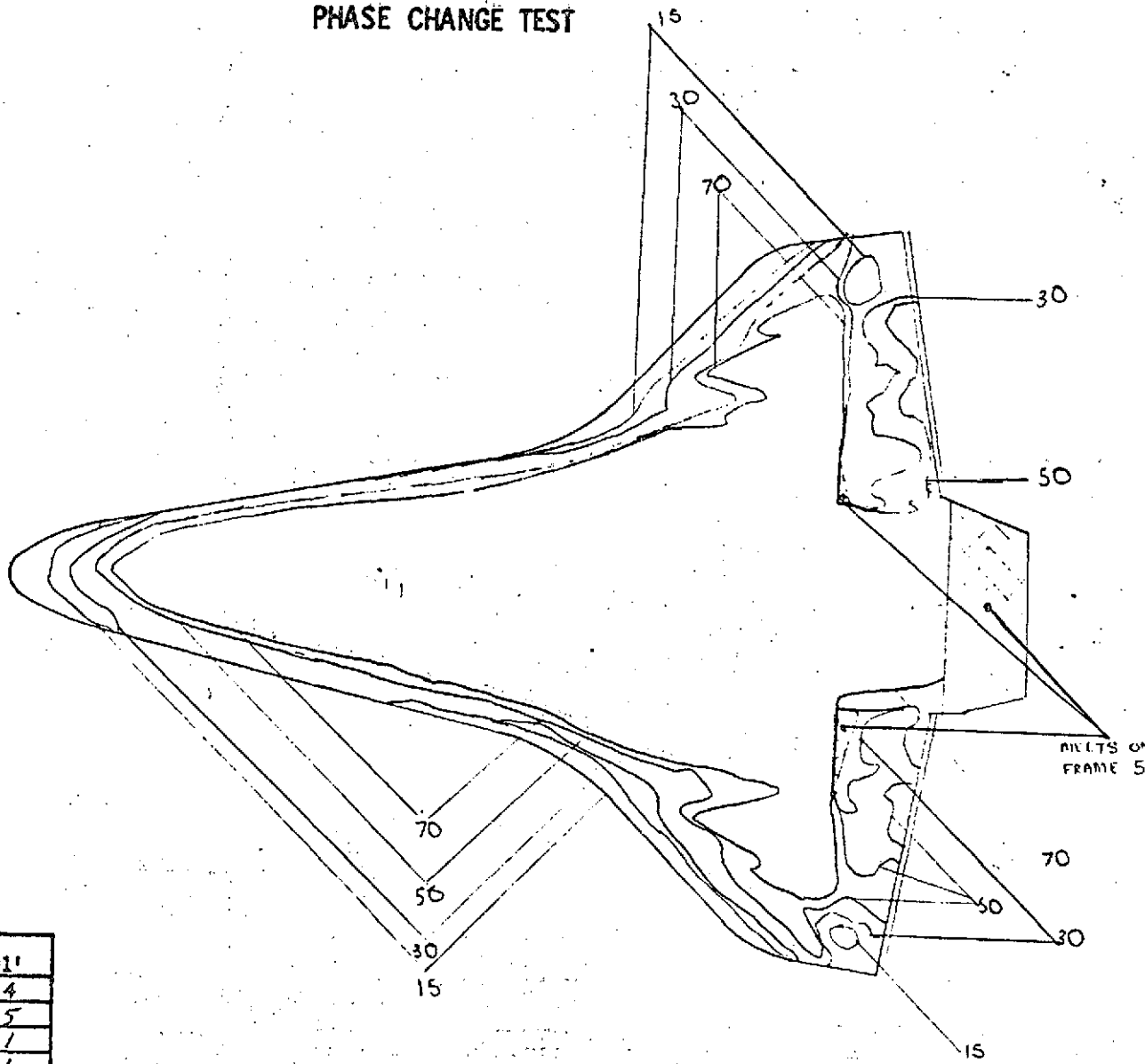
x (in) =

y (in) =

z (in) =

Hit ϕ on Frame 9

PHASE CHANGE TEST



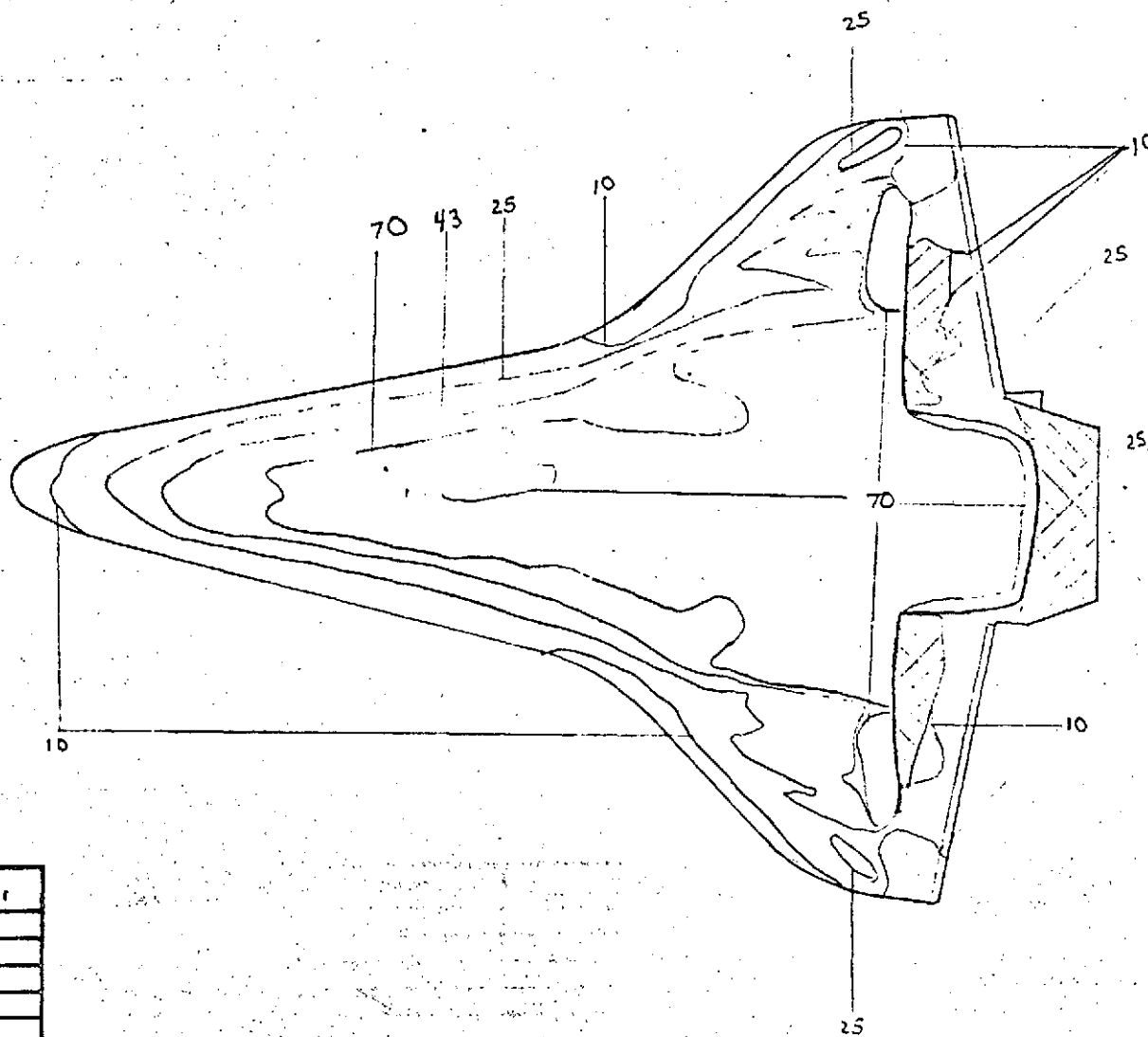
Isotherm	$h/h_{p=1}$
15	.308334
30	.218025
50	.166891
70	.142731

FIG. 78
 $H_5 = .07835 \frac{BDV}{FT \cdot SEC \cdot ^\circ F}$

CONFIG.	46-4AEBF
LENGTH (ft) =	.638
SCALE	.00593
FACILITY	LRC/VDT
TEST	OH42B RPA
RUN	4104
$M_\infty =$	8
P_{total} (psig) =	635
T_{total} ($^\circ F$) =	910
$T_{aw}/T_{total} =$.91
R_N per foot =	3×10^6
$T_{phase\ change}$ ($^\circ F$) =	350
$\alpha =$	30°
$\beta =$	0
$\phi =$	0
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)	
x (in) =	
y (in) =	
z (in) =	

...
 ...
 HVD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
10	.19613
25	.12404
43	.09458
70	.07413

FIG. 79

$HS = .07339 \frac{BTU}{FT^2 \cdot SEC \cdot ^\circ F}$

CONFIG.

46-4AEBF

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST 0H42B RPA

RUN 4185

$M_{\infty} = 8$

$P_{total} (psig) = 640$

$T_{total} (^{\circ}R) = 890$

$T_{aw}/T_{total} = .91$

R_N per foot = 3×10^6

$T_{phase\ change} (^{\circ}F) = 250$

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

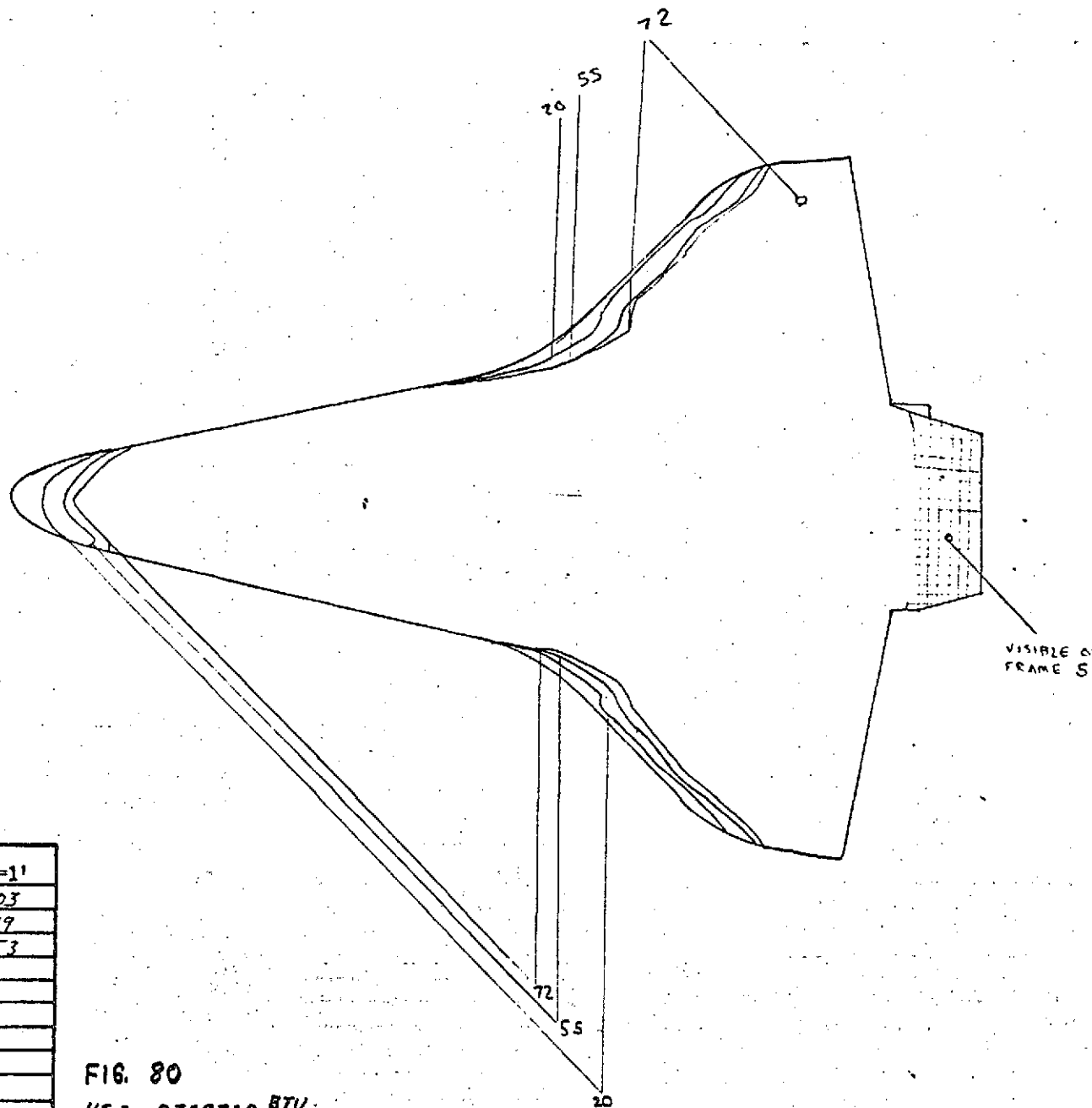
x (in) =

y (in) =

z (in) =

lit. on face of

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
20	.495503
55	.298799
72	.261153

FIG. 80

HS = .0728728 $\frac{BTU}{FT^2 \cdot SEC \cdot ^\circ F}$

CONFIG.

46-4BF

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B (RPA)

RUN 4186

$M_\infty = 8$

P_{total} (psig) = 630

T_{total} ($^\circ F$) = 890

$T_{aw}/T_{total} = .91$

R_N per foot = 3×10^6

$T_{phase\ change}$ ($^\circ F$) = 450

$\alpha = 30^\circ$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

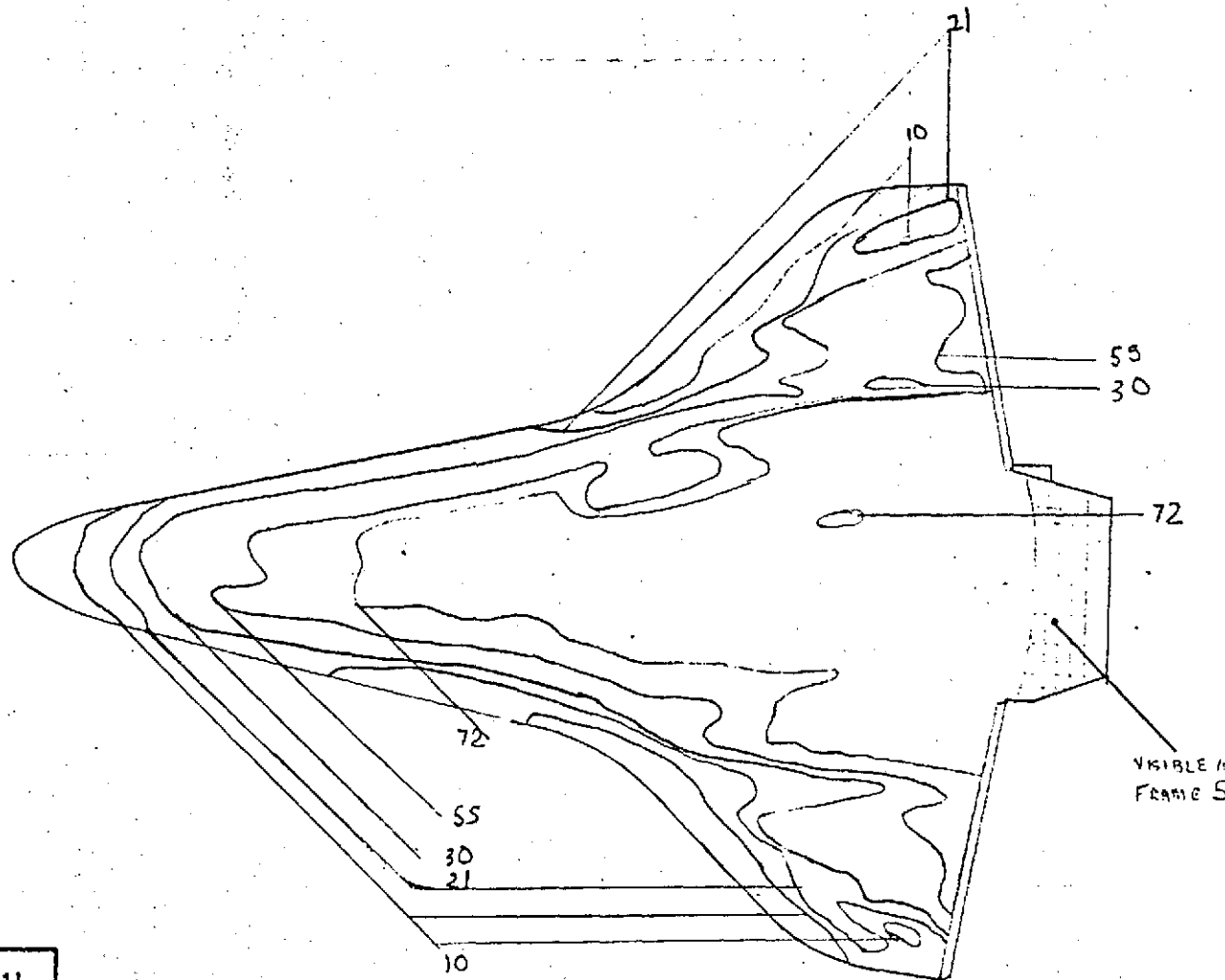
z (in) =

HIT ϕ ON FRAME 9

NDS

HVD-EVCS

PHASE CHANGE TEST

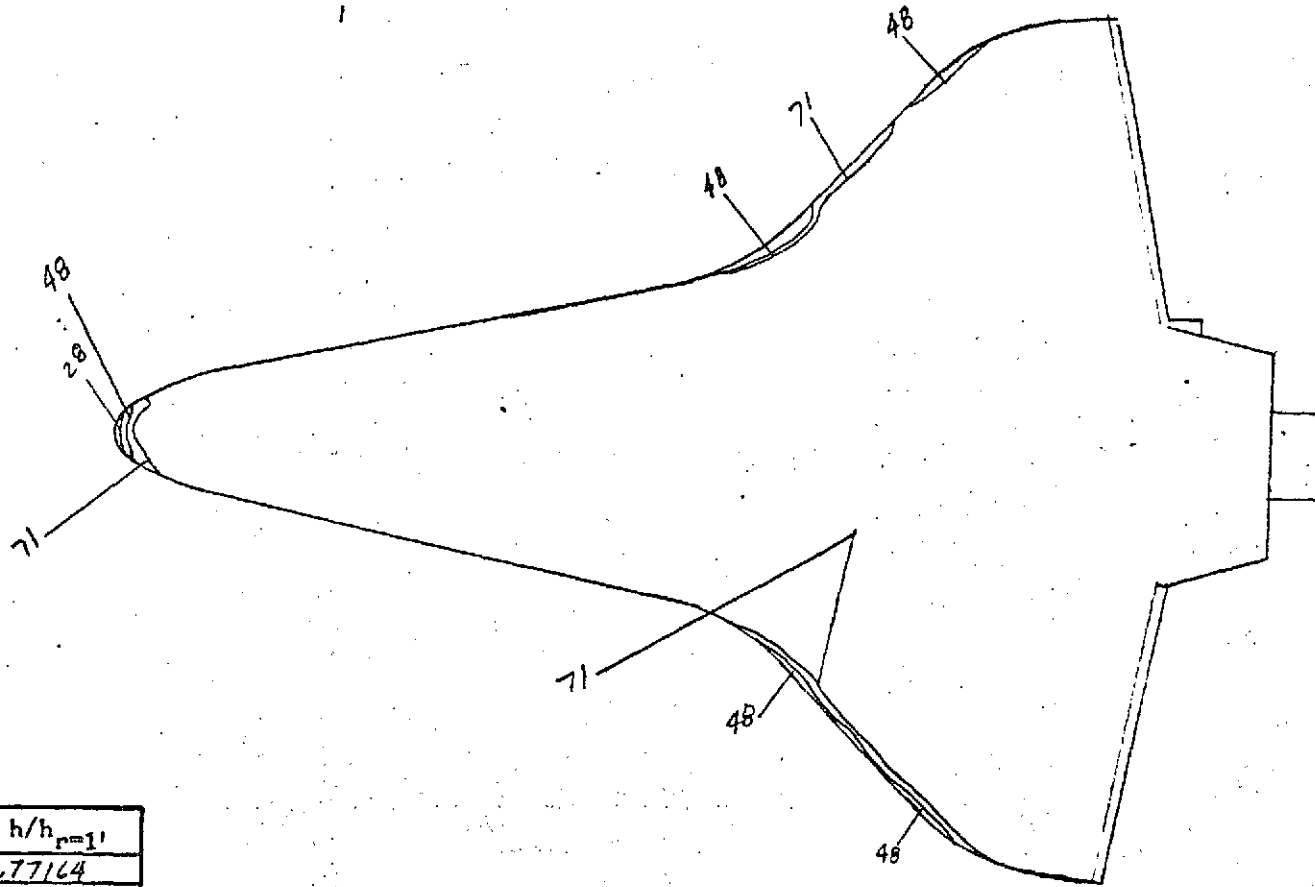


Isotherm	$h/h_{r=1}$
10	.19936
21	.13157
30	.11510
55	.08501
72	.07420

$H_5 = .07261 \text{ BTU}$
 FIG. B1 $FT^2 \text{ SEC}^{-2} \text{ } ^\circ F$

CONFIG.	46-4BF
LENGTH (ft) =	.638
SCALE	.00593
FACILITY	LRC/VDT
TEST	0H42B RPA
RUN	4188
$M_\infty =$	8
P_{total} (psig) =	675
T_{total} ($^\circ F$) =	890
$T_{aw}/T_{total} =$.91
R_N per foot =	3×10^6
$T_{phase\ change}$ ($^\circ F$) =	250
$\alpha =$	30°
$\beta =$	0
$\phi =$	0
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)	
x (in) =	
y (in) =	
z (in) =	

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
28	.77164
48	.58935
71	.48458

FIG. 82

$$HS = .072464 \frac{BTU}{FT^2 \cdot SEC \cdot ^\circ F}$$

CONFIG.

46-4BF

LENGTH (A) = .638

SCALE .00593

FACILITY LRC/VDT

TEST 0H42B (RPA)

RUN 4189

$M_\infty = 8$

P_{total} (psig) = 625

T_{total} ($^\circ F$) = 885

$T_{aw}/T_{total} = .91$

R_N per foot = 3×10^6

$T_{phase\ change}$ ($^\circ F$) = 550

$\alpha = 30^\circ$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

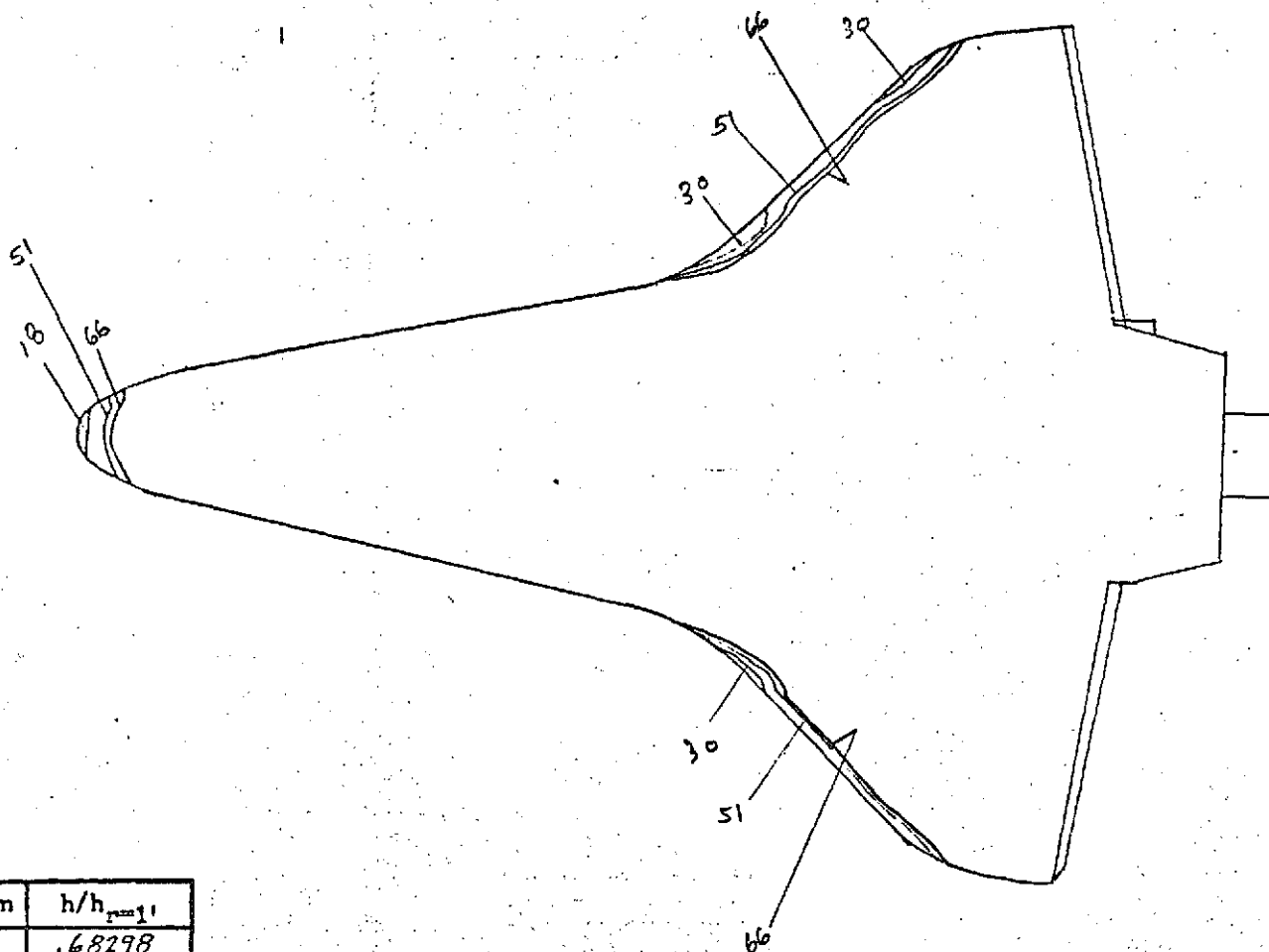
x (in) =

y (in) =

z (in) =

AT FIGURE 10

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
18	.68298
30	.52903
51	.40575
66	.35667

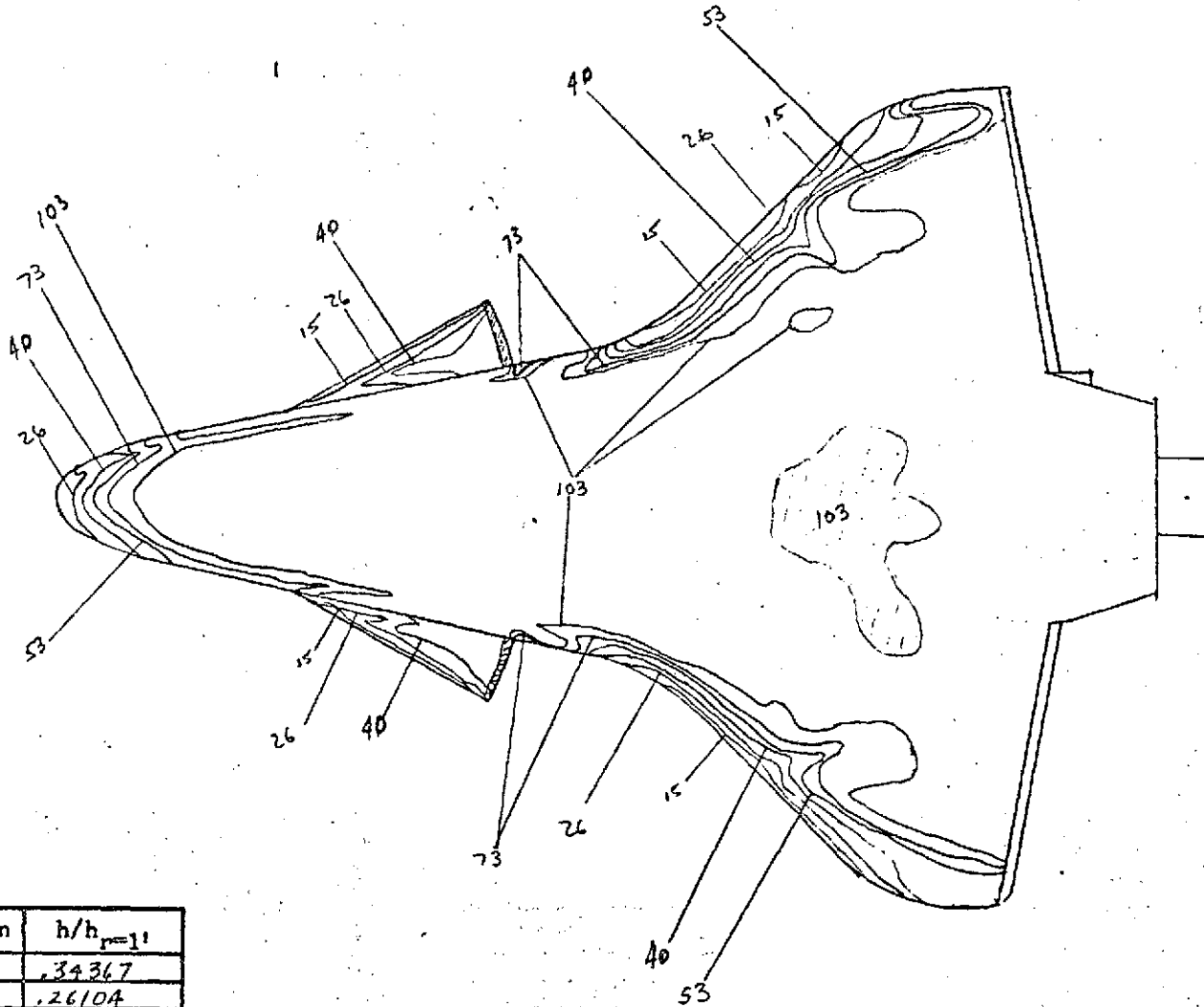
$HS = .07284 \frac{BTU}{FT^2 \cdot SEC \cdot ^\circ F}$

FIG. 83

CONFIG.	46-4BF
LENGTH (ft) =	.638
SCALE	.00593
FACILITY	LRC/VDT
TEST	OH42B (RPA)
RUN	A190
$M_\infty =$	8
P_{total} (psig) =	630
T_{total} ($^\circ F$) =	895
$T_{aw}/T_{total} =$.91
R_N per foot =	3×10^6
$T_{phase\ change}$ ($^\circ F$) =	500
$\alpha =$	30°
$\beta =$	0
$\phi =$	0
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)	
x (in) =	
y (in) =	
z (in) =	

ψ A7 - FRAME 9

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
15	.34367
26	.26104
40	.21045
53	.18283
73	.15578
103	.13115

$HS = .04007 \frac{BTU}{FT^2 \cdot SEC \cdot OF}$

FIG. 84

CONFIG. 46-5

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST 0428 (RPA)

RUN 4191

$M_\infty = 8$

$P_{total} \text{ (psig)} = 164$

$T_{total} \text{ (}^\circ\text{F)} = 805$

$T_{aw}/T_{total} = .91$

$R_N \text{ per foot} = 1 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 250$

$\alpha = 30^\circ$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

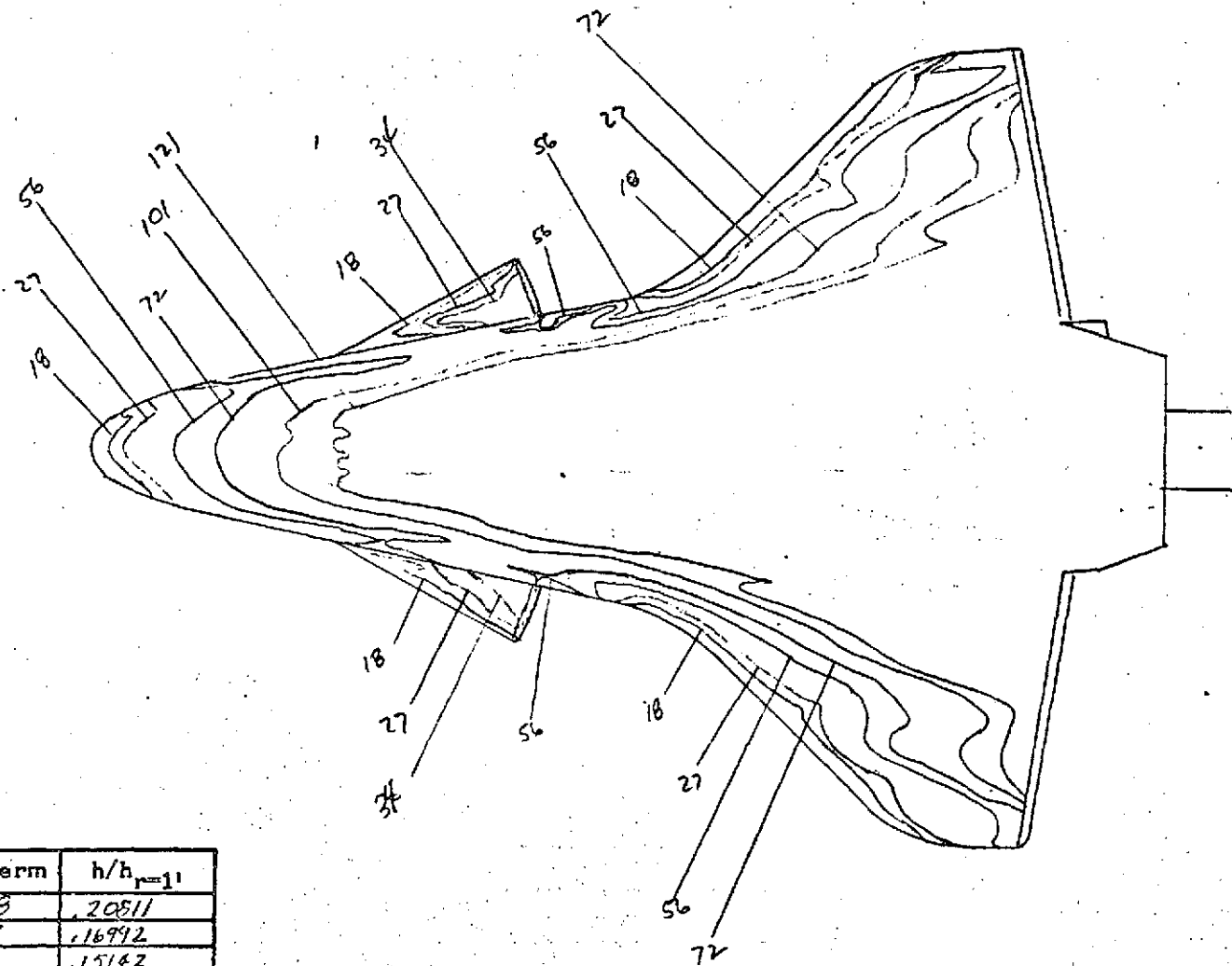
x (in) =

y (in) =

z (in) =

☐ or FRAME 9

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
18	.20811
27	.16992
34	.15192
56	.11799
72	.10406
101	.08756
121	.08027

$HS = .03925 \frac{BTU}{FT^2 \cdot SEC \cdot ^\circ F}$
 FIG. 85

CONFIG.

46-5

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST 0442 B KPA

RUN 4192

$M_\infty = 8$

$P_{total} \text{ (psig)} = 164$

$T_{total} \text{ (}^\circ\text{F)} = 805$

$T_{aw}/T_{total} = .91$

$R_N \text{ per foot} = 1 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 260$

$\alpha = 30^\circ$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

ϕ AT Frame 10

PHASE CHANGE TEST

CONFIG. 46-5

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST 0442B RPA

RUN 4193

$M_{\infty} = 8$

$P_{total} \text{ (psig)} = 625$

$T_{total} \text{ (}^{\circ}\text{F)} = 910$

$T_{aw}/T_{total} = .91$

$R_N \text{ per foot} = 3 \times 10^6$

$T_{\text{phase change}} \text{ (}^{\circ}\text{F)} = 350$

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

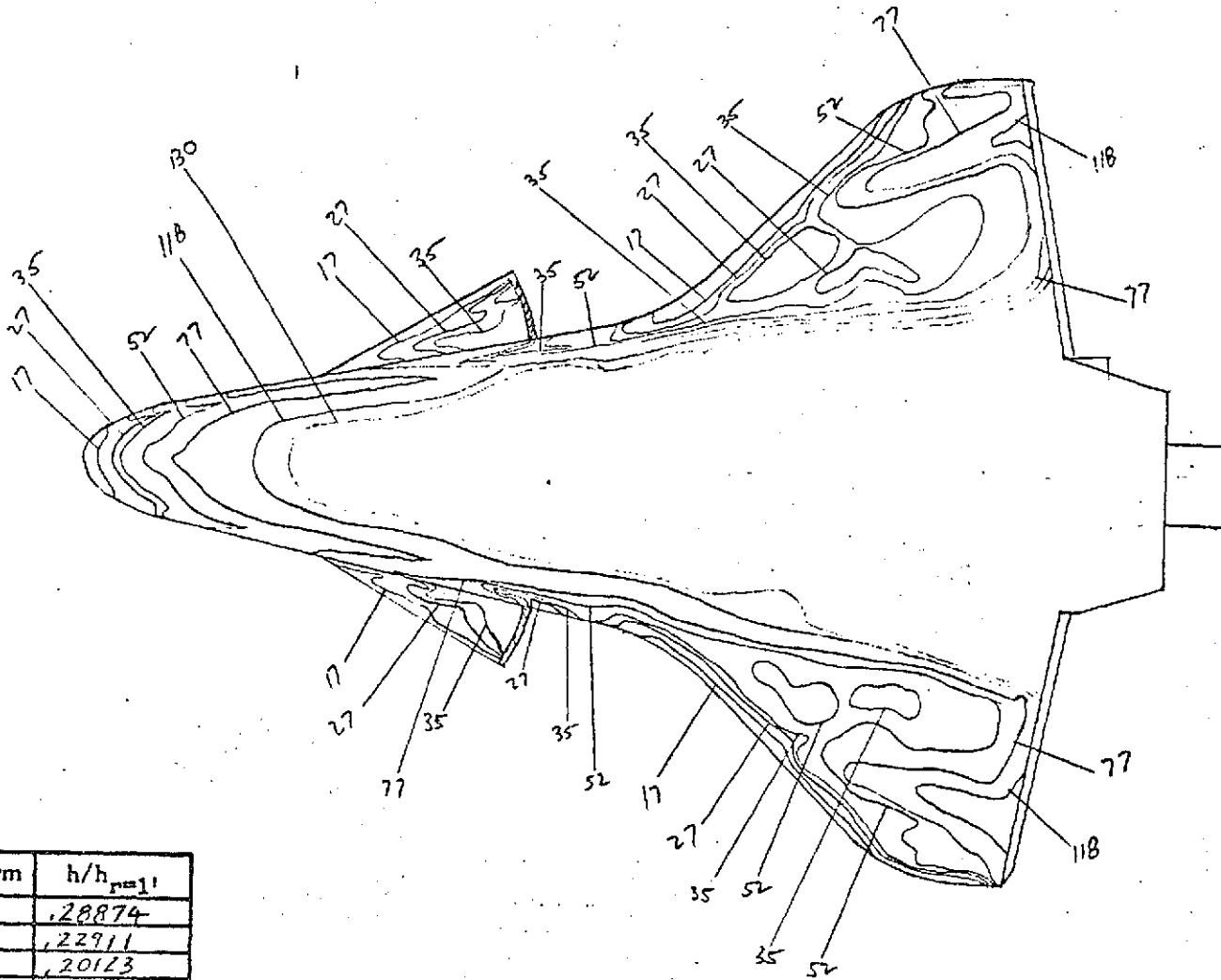
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

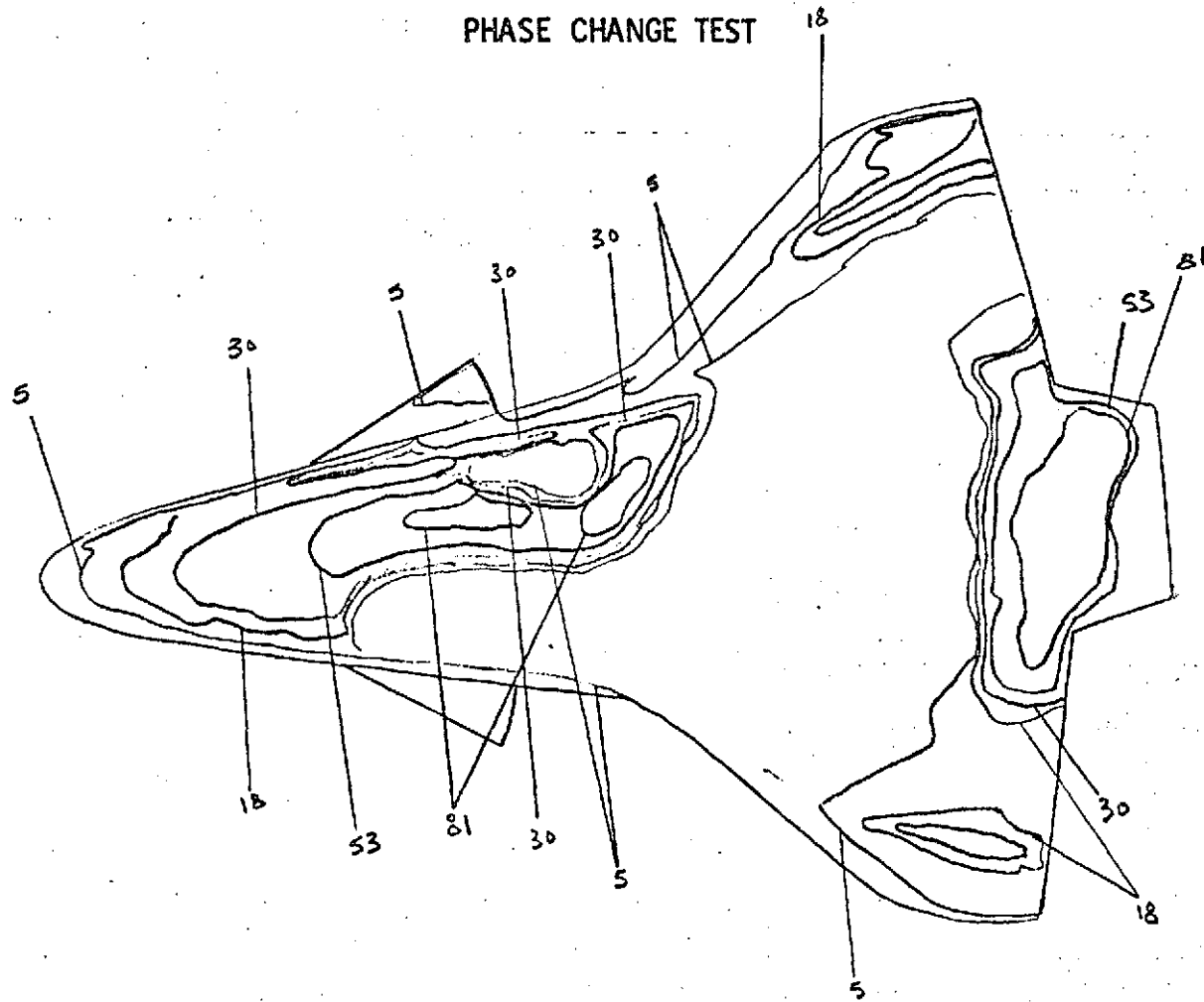
FRAME 9



Isotherm	$h/h_{r=1}$
17	.28874
27	.22911
35	.20123
52	.16509
77	.13567
118	.10959
130	.10441

FIG. 86
 $MS = .07283 \frac{BTU}{FT^2 \cdot SEC \cdot ^{\circ}F}$

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
5	.31964
18	.16847
30	.13049
53	.09818
81	.07942

FIG. 87

CONFIG. 46-5

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42C (RPA)

RUN 4273

$M_\infty = 8$

P_{total} (psig) = 635

T_{total} ($^{\circ}$ F) = 895

$T_{aw}/T_{total} = .91$

R_N per foot = 3×10^4

$T_{phase\ change}$ ($^{\circ}$ F) = 275

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

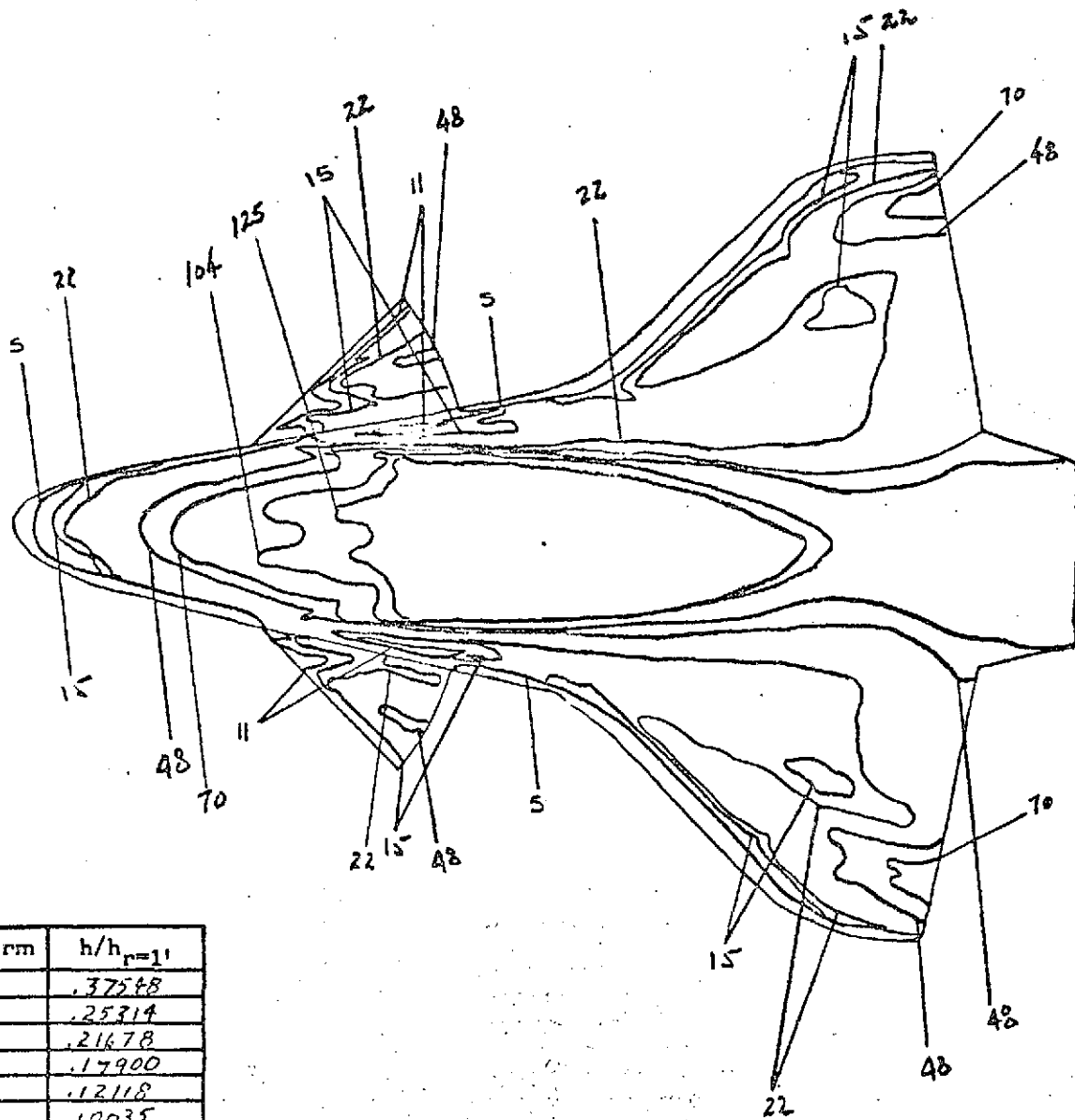
z (in) =

MODEL HIT = E \odot FRAMES

$HS = .072795 \frac{BTU}{FT^2 \cdot SEC \cdot ^{\circ}F}$

PHASE CHANGE TEST

CONFIG. 46-6



Isotherm	$h/h_{p=11}$
5	.37588
11	.25314
15	.21678
22	.17900
48	.12118
70	.10035
104	.08232
125	.07509

FIG. 88

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42C RPA

RUN 4274

$M_\infty = 8$

P_{total} (psi) = 655

T_{total} ($^{\circ}$ F) = 900

$T_{aw}/T_{total} = .91$

R_N per foot = 3×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 300°

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

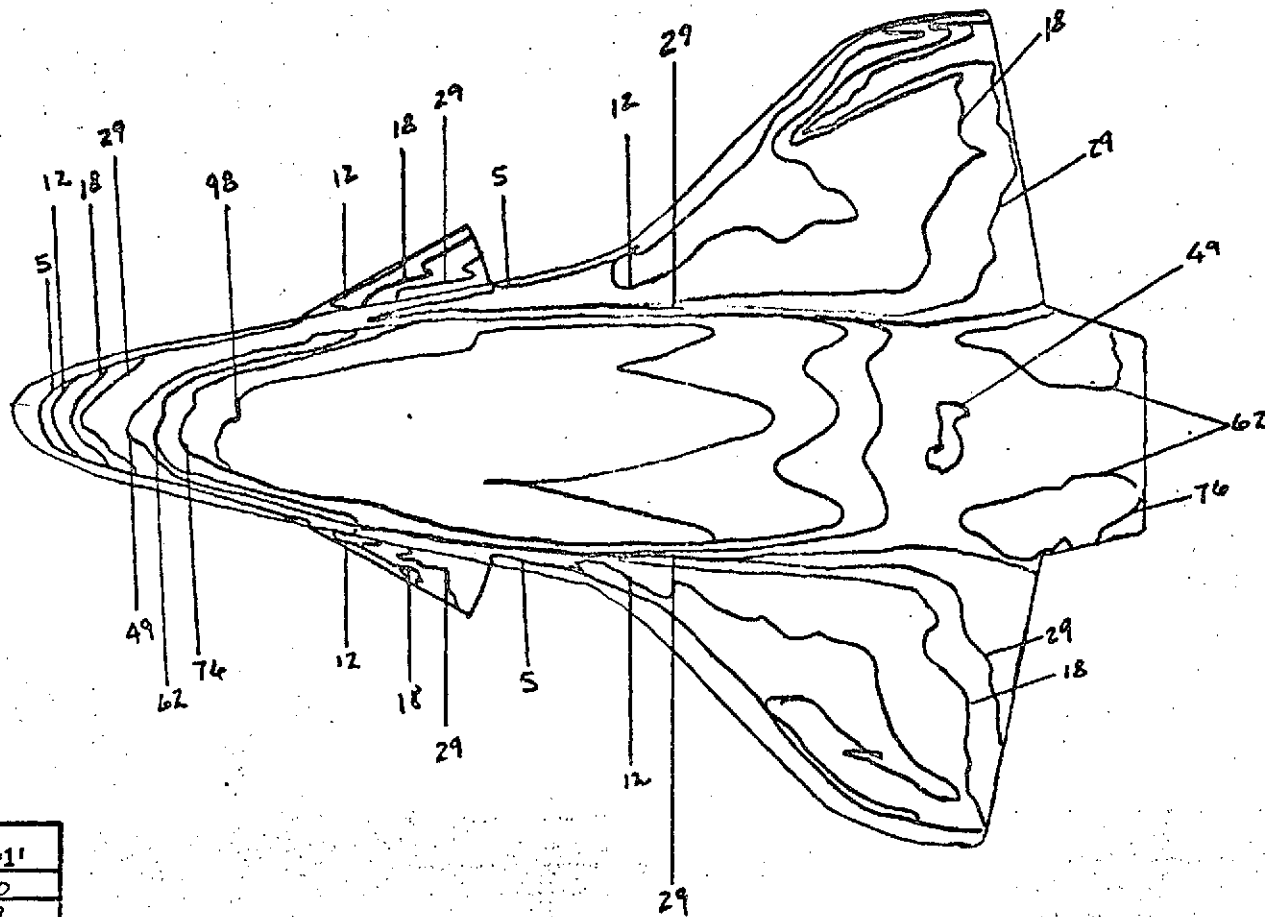
z (in) =

MODEL Hits & @ 5 Frames

$HS = .073694 \frac{BT^{\circ}}{FT^2-SEC-^{\circ}R}$

HVD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
5	.47590
12	.30719
18	.25082
29	.19761
49	.15202
62	.13515
76	.12207
98	.10750

FIG. 89

CONFIG. 46-5

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42C RPA

RUN 4275

$M_\infty = 8$

P_{total} (psi) = 1395

T_{total} ($^{\circ}$ F) = 920

$T_{aw}/T_{total} = .91$

R_N per foot = 6×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 400

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

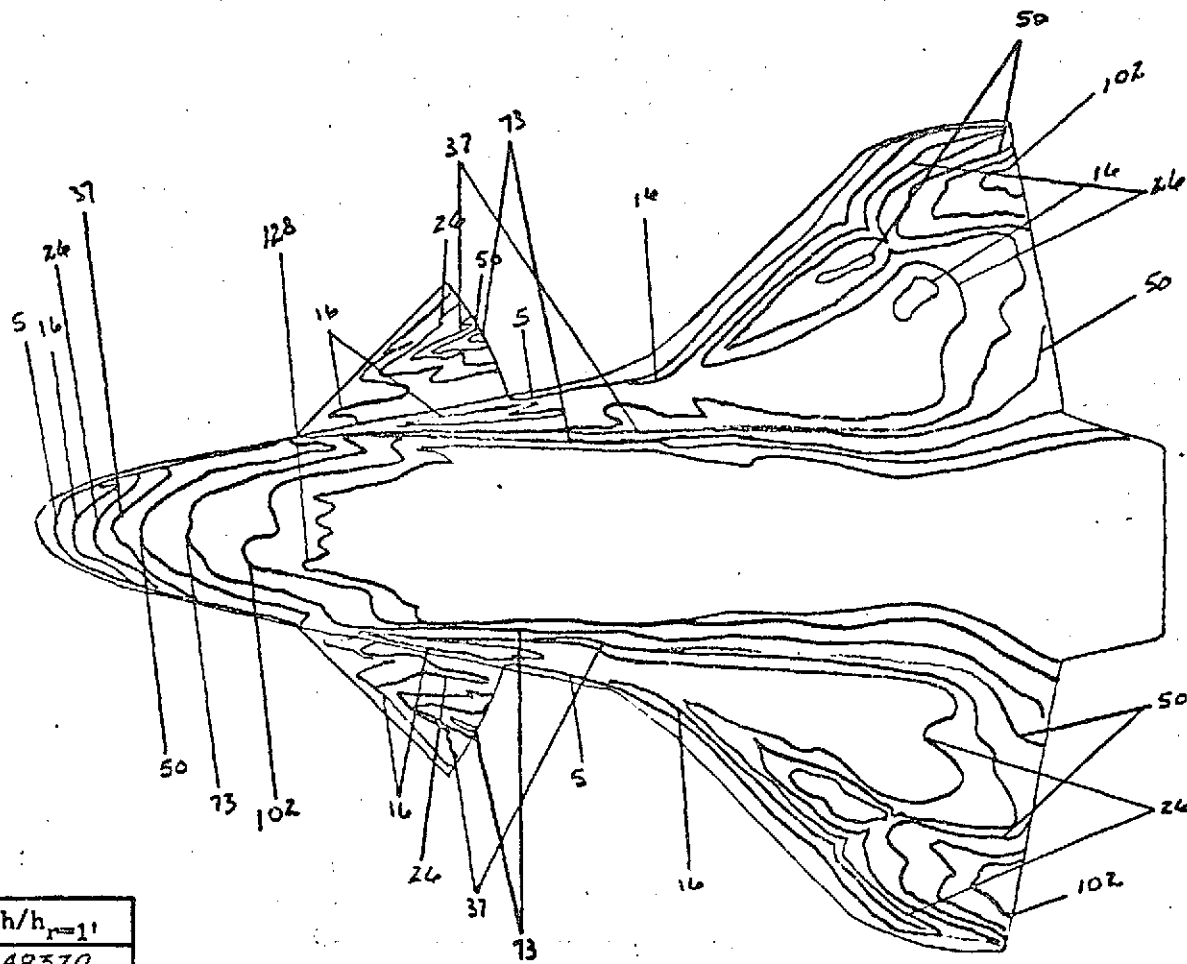
y (in) =

z (in) =

MODEL HITS @ FR 5

$H_5 = .10463 \frac{BFU}{FT^2 \cdot SEC^{\circ}F}$

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
5	.48570
16	.27039
26	.21211
37	.17181
50	.15276
73	.12657
102	.10109
128	.09580

FIG. 90

CONFIG. 46-6

LENGTH (ft) = .638

SCALE .60593

FACILITY LRC/VDT

TEST OH42C RPA

RUN 4276

$M_{\infty} = 8$

$P_{total} \text{ (psig)} = 620$

$T_{total} \text{ (}^{\circ}\text{F)} = 950$

$T_{aw}/T_{total} = .91$

$R_N \text{ per foot} = 3 \times 10^6$

$T_{\text{phase change}} \text{ (}^{\circ}\text{F)} = 350$

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from
model center, x-axis
parallel w/ stream,
+ downstream)

x (in) =

y (in) =

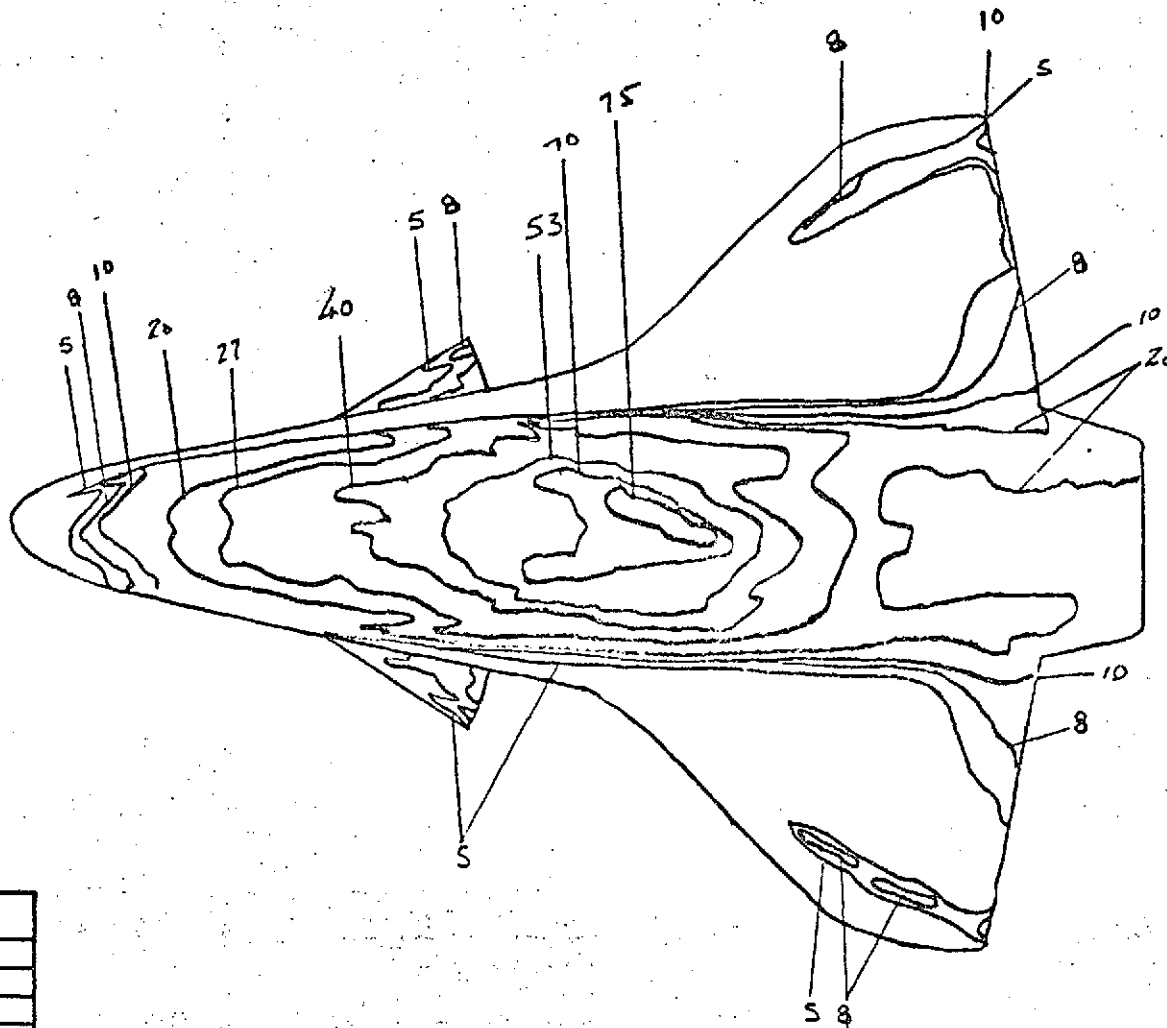
z (in) =

MODEL HITS @ FINE S

$HS = .072373 \frac{\text{BTU}}{\text{FT}^2\text{-SEC-}^{\circ}\text{F}}$

HVD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
5	.24555
8	.19412
10	.17363
20	.12277
27	.10567
40	.07182
53	.05292
70	.04563
75	.04340

FIG. 91

CONFIG. 46-5

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDI

TEST OH42C RPA

RUN 4279

$M_{\infty} = 3.0$

$P_{total} \text{ (psig)} = 1395$

$T_{total} \text{ (}^{\circ}\text{F)} = 940$

$T_{aw}/T_{total} = .91$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} \text{ (}^{\circ}\text{F)} =$

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from
model center, x-axis
parallel w/ stream,
+ downstream)

x (in) =

y (in) =

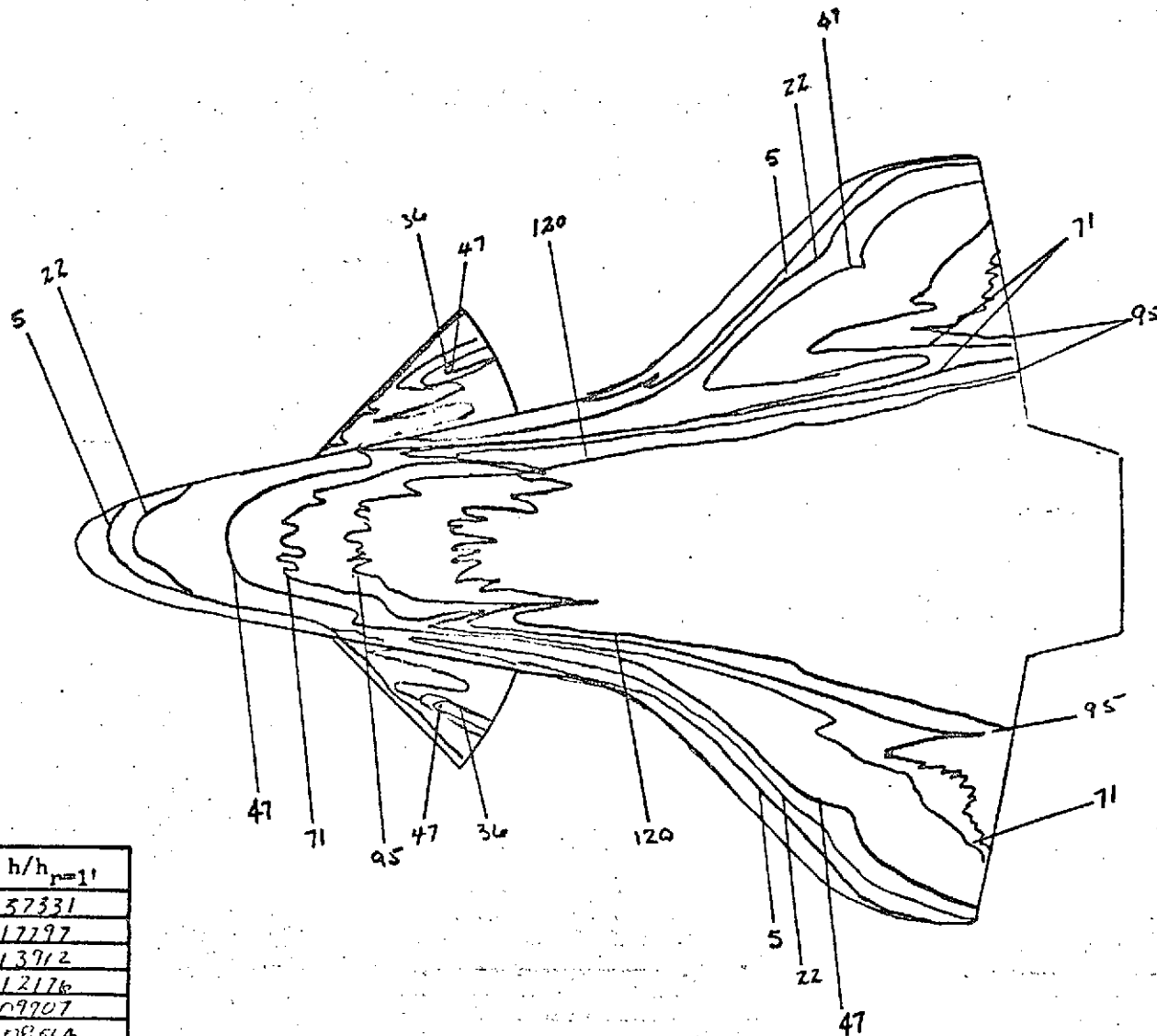
z (in) =

Model No. 46-5

$HS = .10498 \frac{BTU}{FT^2 \cdot SEC \cdot ^{\circ}F}$

PHASE CHANGE TEST

CONFIG. 46-6



Isotherm	$h/h_{r=1}$
5	.57531
22	.17297
36	.13712
47	.12176
71	.09907
95	.08564
120	.07620

FIG. 92

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42C (RPA)

RUN 4280

$M_\infty = 8$

P_{total} (psig) = 160

T_{total} ($^{\circ}$ F) = 785

$T_{aw}/T_{total} = .91$

R_N per foot = 1×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 200

$\alpha = 30^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

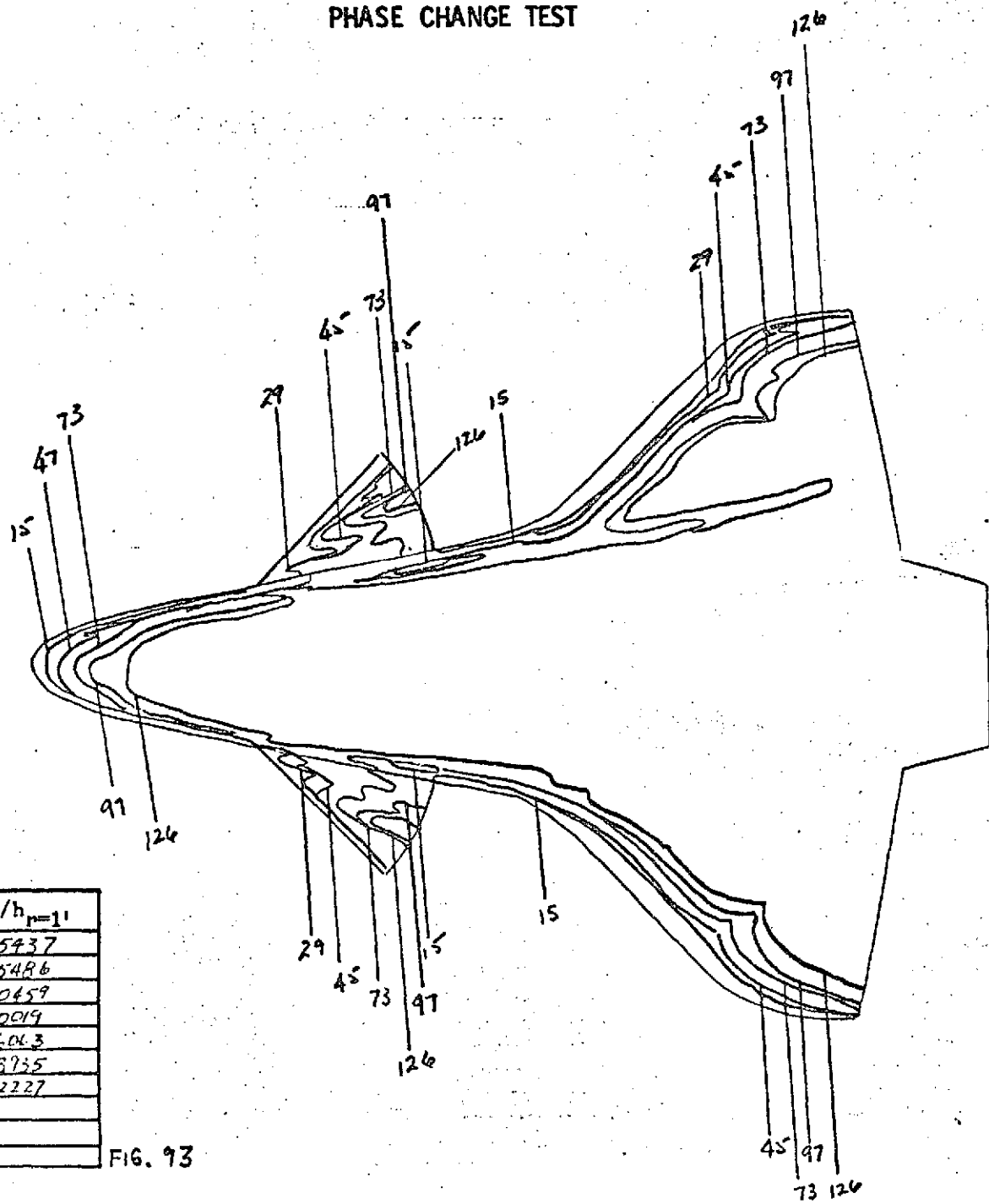
MODEL HITS @ FRAMES

H5 = .03956 BIV

FR2-SEC-00F

HVD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
15	.35437
29	.25486
45	.20459
47	.20019
73	.16063
97	.13735
126	.12227

FIG. 93

CONFIG. 46-6

LENGTH (ft) = .638
SCALE .00593
FACILITY ARC/UDT
TEST OH42C RPA
RUN 4283
$M_\infty = 8$
P_{total} (psig) = 160
T_{total} ($^{\circ}F$) = 788
$T_{aw}/T_{total} = .91$
R_N per foot = 1×10^6
$T_{phase\ change}$ ($^{\circ}F$) = 250 $^{\circ}$
$\alpha = 30^{\circ}$
$\beta = 0$
$\phi = 0$
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)
x (in) =
y (in) =
z (in) =

MODEL HITS @ AT 5 FRAMES

$$HS = .039522 \frac{BTU}{FT^2-SEC-^{\circ}F}$$

PHASE CHANGE TEST

CONFIG. 46-6

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42C RPA

RUN 4184

$M_\infty = 8$

$P_{total} \text{ (psi) } = 1400$

$T_{total} \text{ (}^\circ\text{F) } = 920$

$T_{aw}/T_{total} = .91$

$R_N \text{ per foot } = 6 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F) } = 350$

$\alpha = 30^\circ$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

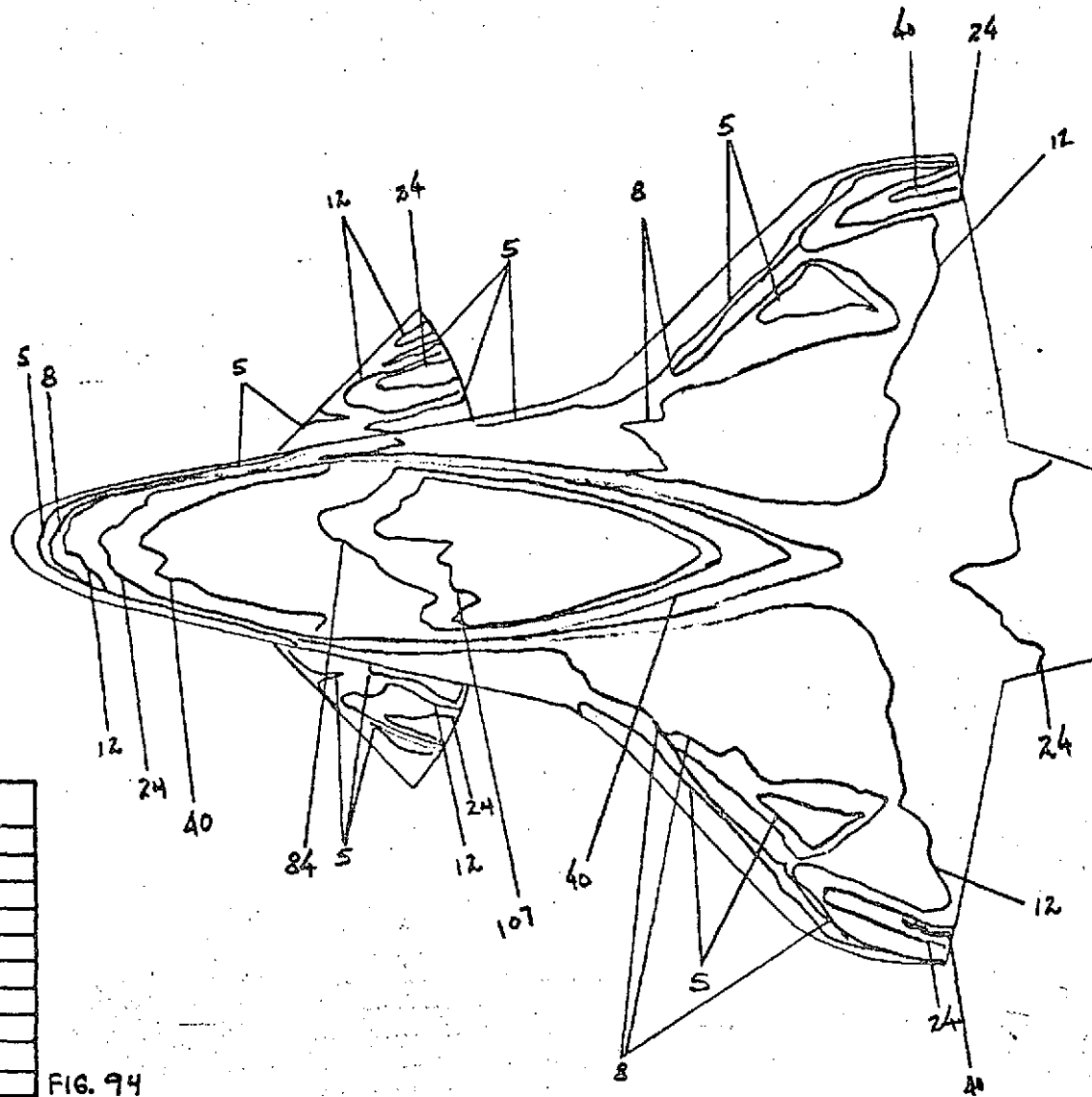
y (in) =

z (in) =

MODEL HITS @ FRAME 5

$HS = .10490 \frac{BTU}{FT^2 \cdot SEC \cdot ^\circ F}$

HVD-EVCS

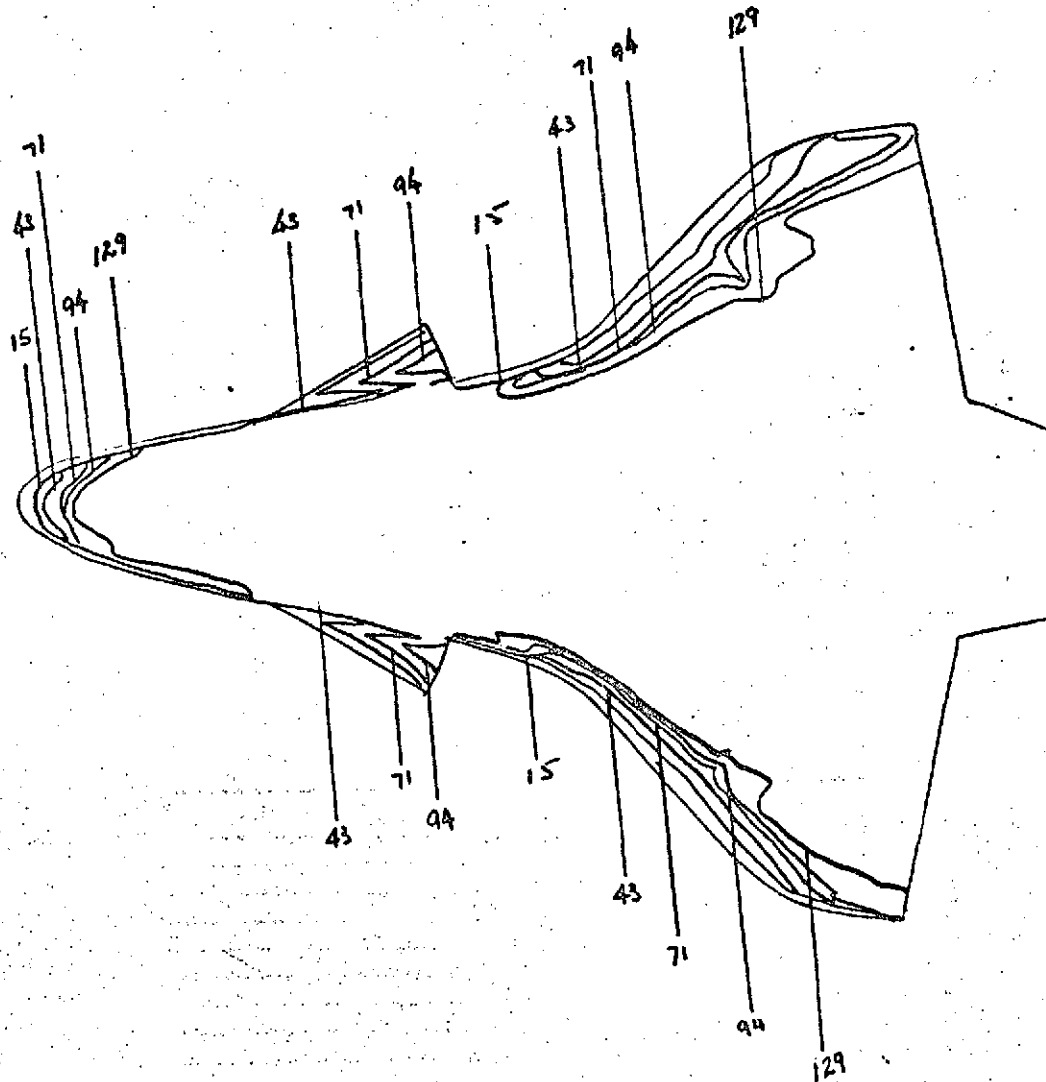


Isotherm	$h/h_{r=1}$
5	.35889
8	.28373
12	.23166
24	.16381
40	.12687
84	.087560
107	.07758

FIG. 94

PHASE CHANGE TEST

CONFIG. 46-5



Isotherm	h/h_{ref}
15	.38793
43	.22912
71	.17831
94	.15497
129	.13228

FIG. 95

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42C RPA

RUN 4286

$M_\infty = 8.0$

P_{total} (psig) = 155

T_{total} ($^{\circ}F$) = 730

$T_{aw}/T_{total} = .92$

R_N per foot = 1×10^6

$T_{phase\ change}$ ($^{\circ}F$) = 250

$\alpha = 35^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

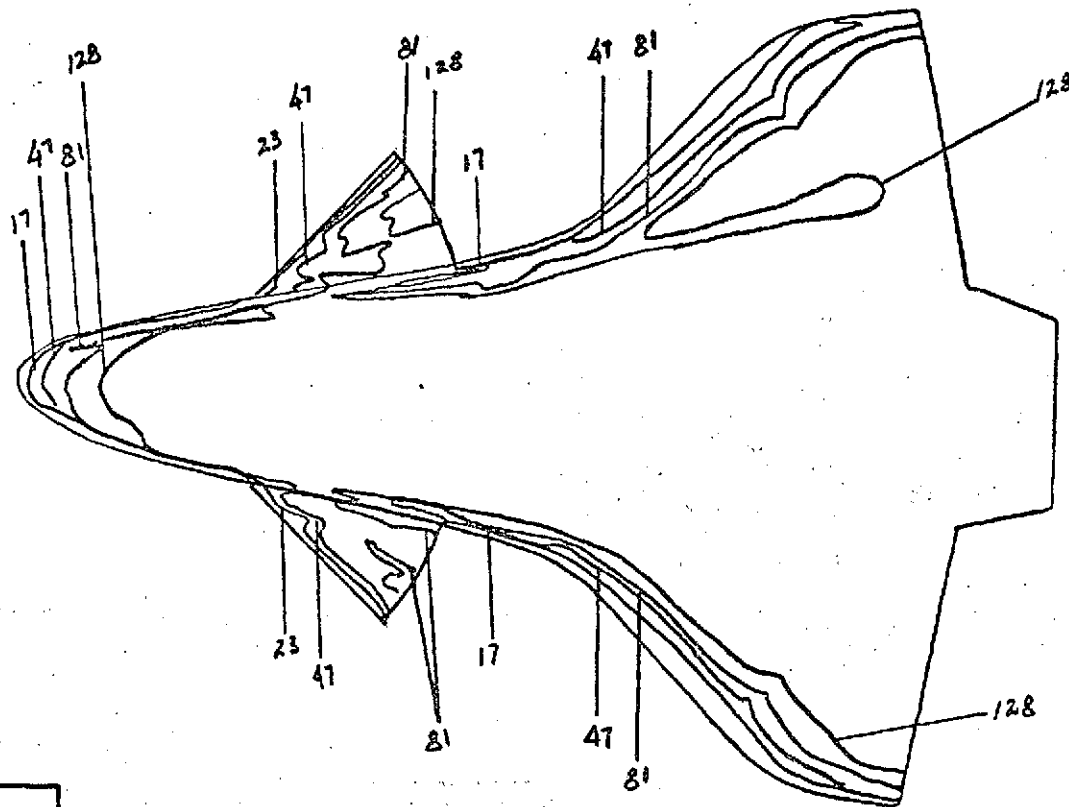
y (in) =

z (in) =

MODEL DATA & REFINES

$HS = .038804 \text{ ft}^2/\text{SEC}^2$

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
17	.35319
23	.30365
47	.21241
81	.16180
128	.12811

FIG. 96

CONFIG. 46-6

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/JDT

TEST OH42C RPA

RUN 4287

$M_\infty = 8.0$

P_{total} (psig) = 152

T_{total} ($^{\circ}$ F) = 760

$T_{aw}/T_{total} = .92$

R_N per foot = 1×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 250

$\alpha = 350$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

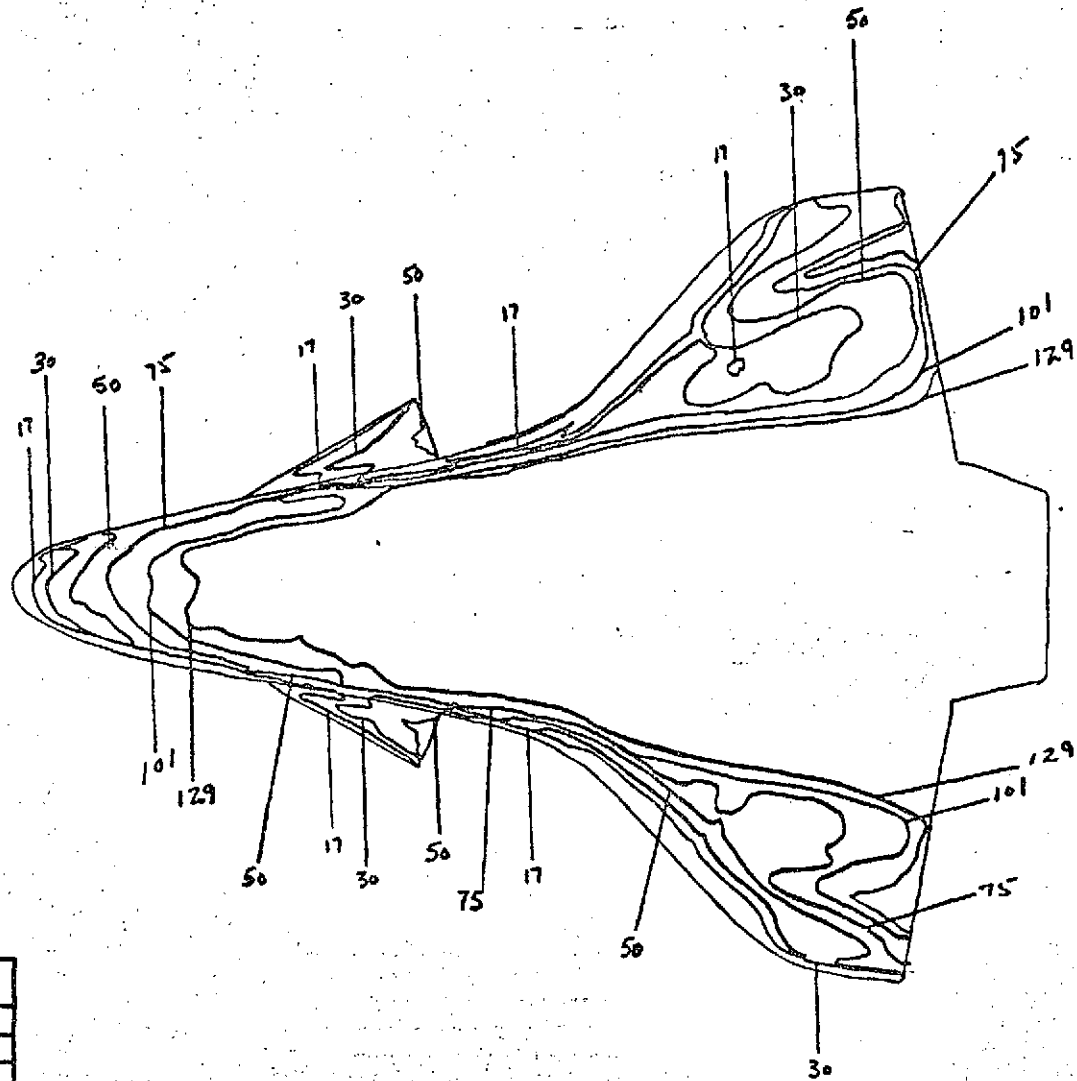
z (in) =

Model Units @ 1/2 INCHES

$HS = .038592 \frac{ft}{in}$
 $FT^2 SEC^{-2}$

HVD-EVCS

PHASE CHANGE TEST



isotherm	$h/h_{r=1}$
17	.30088
30	.22697
50	.17544
75	.14325
101	.12344
129	.10922

FIG. 97

CONFIG. 46-5

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDI

TEST OH42C RPA

RUN 4288

$M_{\infty} = 8.0$

$P_{total} (psig) = 625$

$T_{total} (^{\circ}F) = 875$

$T_{aw}/T_{total} = .92$

$R_N \text{ per foot} = 3 \times 10^6$

$T_{phase \ change} (^{\circ}F) = 350$

$\alpha = 35^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

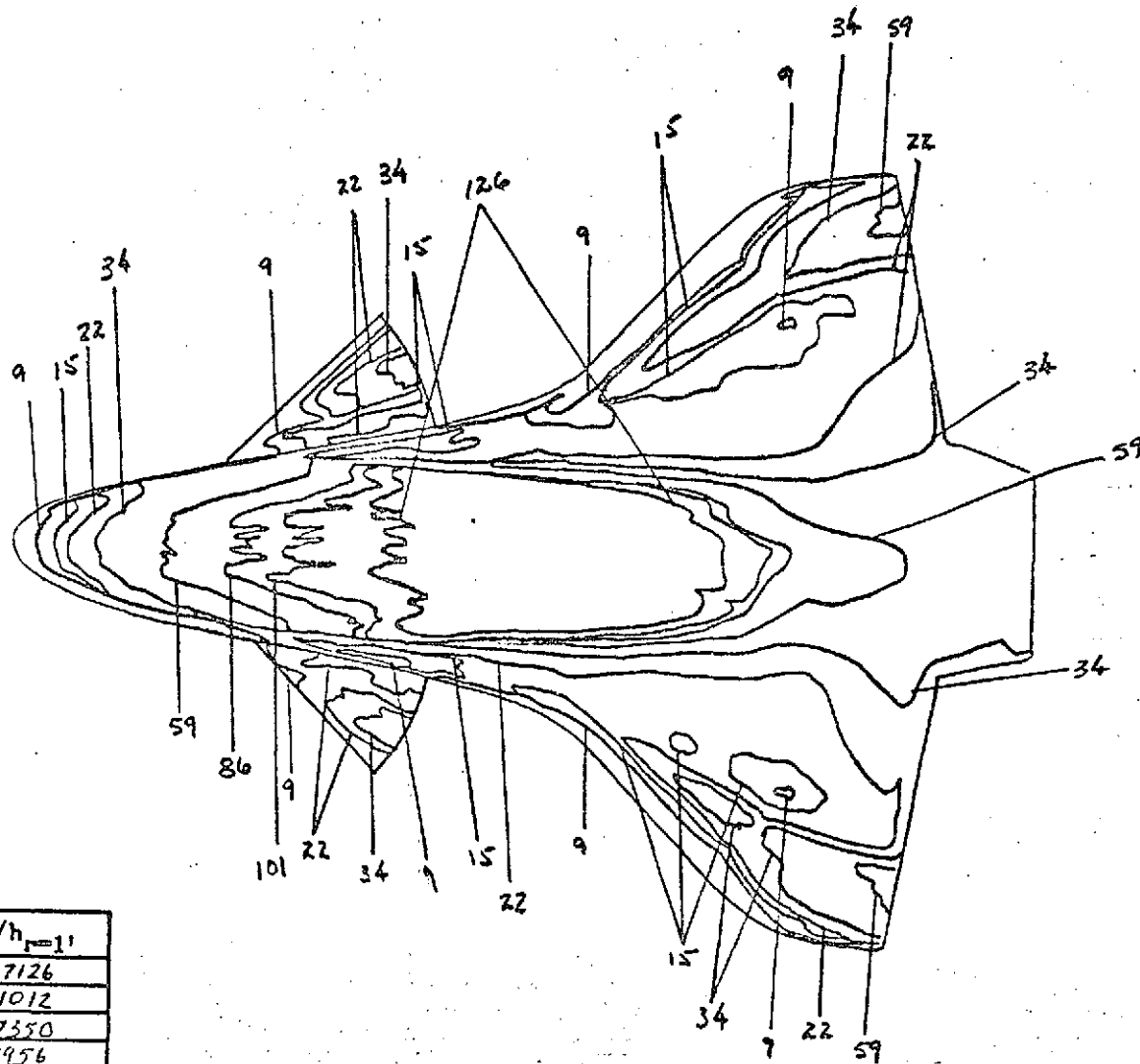
y (in) =

z (in) =

MODEL Hits @ 5 Frames

$HS = .072236 \frac{BTU}{FT^2 \cdot SEC \cdot OF}$

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
9	.27126
15	.21012
22	.17350
34	.13956
59	.10545
86	.08115
101	.05980
126	.07250

FIG. 98

CONFIG. 46-6

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42C RPA

RUN 4289

$M_\infty = 8.0$

P_{total} (psig) = 640

T_{total} ($^{\circ}$ F) = 925

$T_{aw}/T_{total} = .92$

R_N per foot = 3×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 300

$\alpha = 35^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

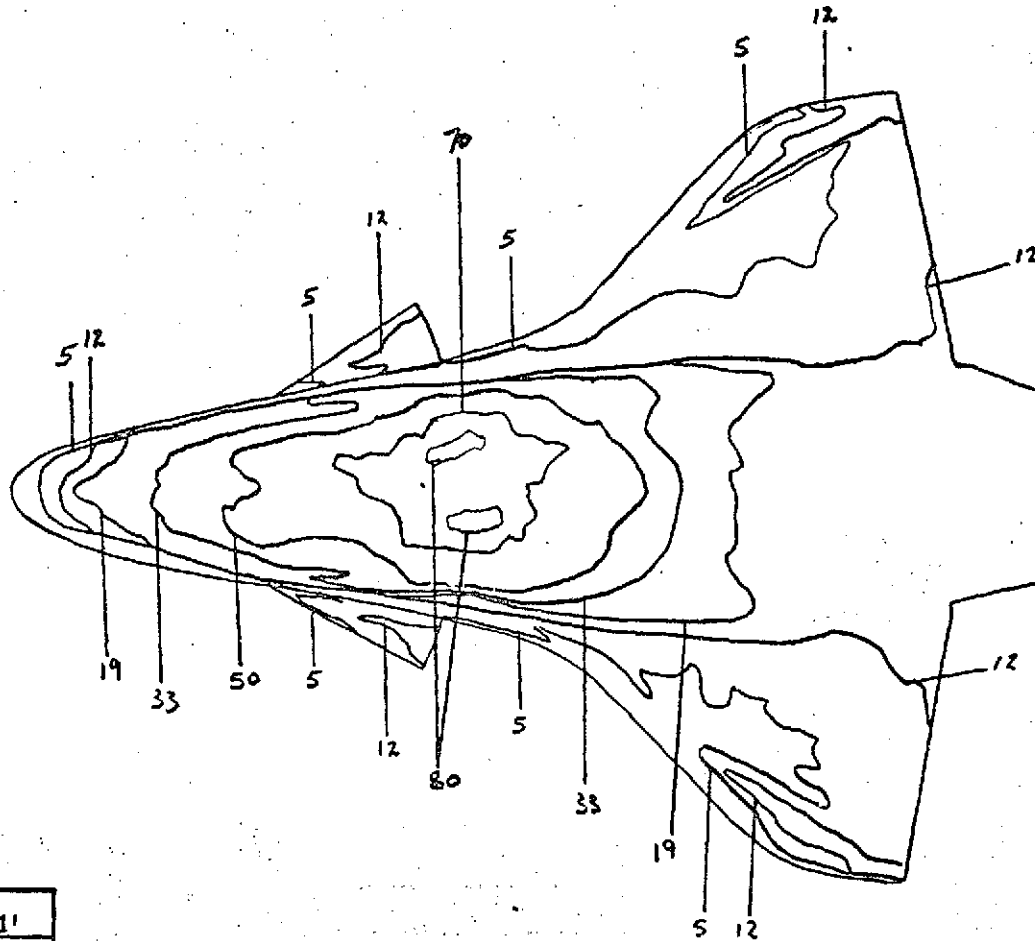
z (in) =

Model with 60 frames

$HS = .073365 \frac{BTU}{FT^2-SEC-^{\circ}F}$

HVD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{r=11}$
5	.34073
12	.21794
19	.17479
33	.13263
50	.10775
70	.09107
80	.08518

FIG. 99

CONFIG. 46-5

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42C RPA

RUN 4292

$M_\infty = 8.0$

$P_{total} \text{ (psig)} = 1400$

$T_{total} \text{ (}^\circ\text{F)} = 925$

$T_{aw}/T_{total} = .92$

$R_N \text{ per foot} = 6 \times 10^4$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 350$

$\alpha = 25^\circ$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

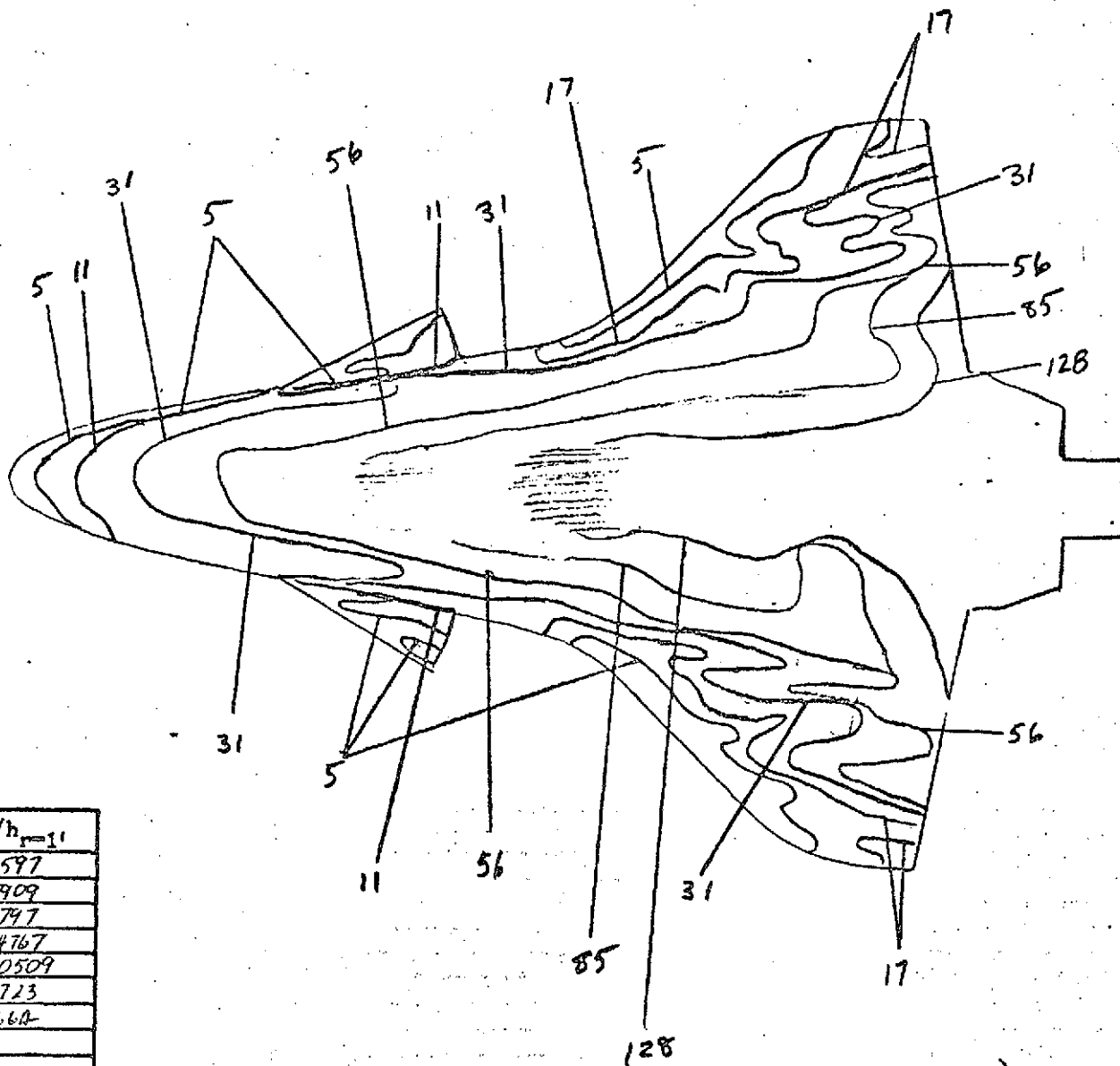
y (in) =

z (in) =

MODEL HITS @ 5 FRAMES

$HS = .1049 \frac{BTU}{FT^2 \cdot SEC \cdot OF}$

PHASE CHANGE TEST



Isotherm	$h/h_{p=11}$
5	.23597
11	.15909
17	.12797
31	.09467
56	.070509
85	.05723
128	.04662

FIG. 100

CONFIG. 46-5

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42C RPA

RUN 4293

$M_\infty = 8$

P_{total} (psi) = 160

T_{total} ($^{\circ}F$) = 760

$T_{aw}/T_{total} = .90$

R_N per foot = 1×10^6

$T_{phase\ change}$ ($^{\circ}F$) =

$\alpha = 25^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

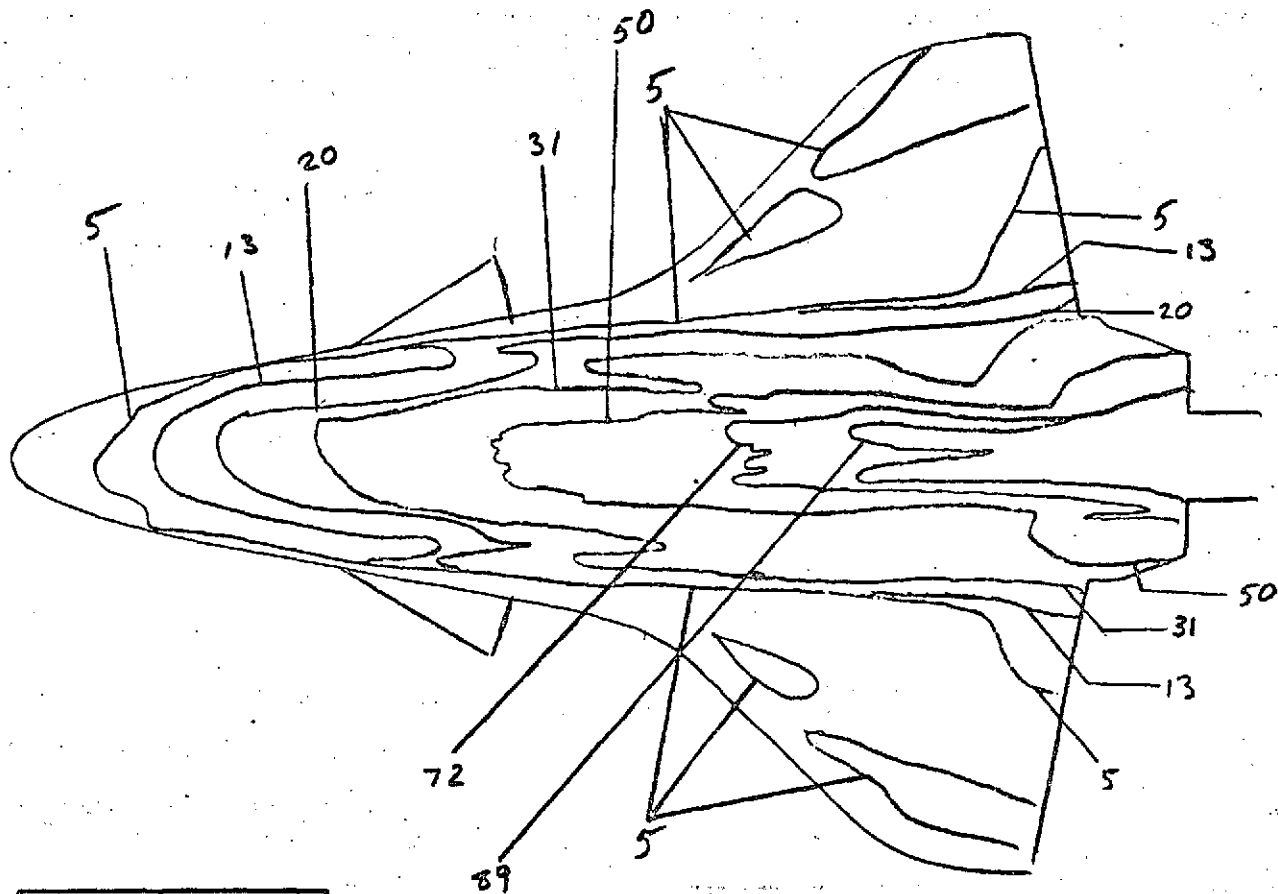
y (in) =

z (in) =

$\phi = \text{FRAME 5}$

WHD
 $HS = .039511 \frac{ft}{FT-SEC} \text{ OF HYD-EVCS}$

PHASE CHANGE TEST



Isotherm	$h/h_{\text{pin}1}$
5	.17644
13	.11016
20	.08922
31	.07166
50	.056427
72	.04702
89	.04229

FIG. 101

CONFIG. 46-5

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST 0442C RPA

RUN 4294

$M_{\infty} = 8$

P_{total} (psig) = 630

T_{total} ($^{\circ}$ F) = 895

$T_{\text{aw}}/T_{\text{total}} = .90$

R_N per foot = 3×10^6

$T_{\text{phase change}}$ ($^{\circ}$ F) =

$\alpha = 25^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

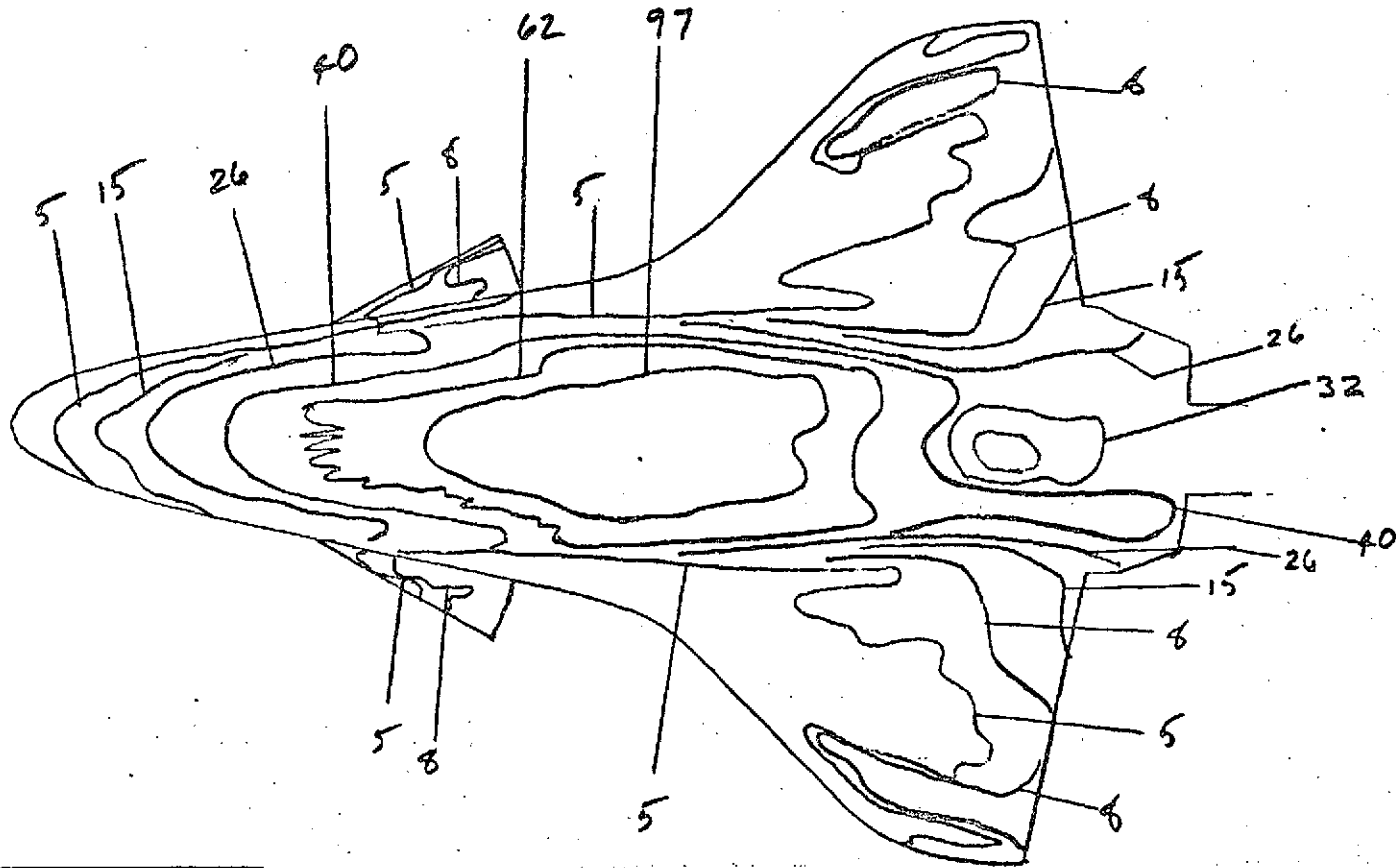
y (in) =

z (in) =

$HS = .072839 \frac{BLV}{FT^2 \cdot SEC^2 \cdot OF}$

PHASE CHANGE TEST

CONFIG. 46-5



Isotherm	$h/h_{r=1}$
5	.27107
8	.21430
15	.15650
26	.11887
32	.10715
40	.09589
62	.07698
97	.06159

F16.102

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42C RPA

RUN 4295

$M_{\infty} = 8$

$P_{total} \text{ (psi)} = 1390$

$T_{total} \text{ (}^{\circ}\text{F)} = 920$

$T_{aw}/T_{total} = .90$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} \text{ (}^{\circ}\text{F)} =$

$\alpha = 25^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

FRAME 5 =

WHD
 $HS = .10466 \frac{BTU}{FT^2} - 580^{\circ}\text{F}$
 HVD-EVCS

PHASE CHANGE TEST

CONFIG. 46-4

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42A (RPA)

RUN 4084

$M_{\infty} = 8$

P_{total} (psi) = 620

T_{total} (°F) = 900

$T_{aw}/T_{total} =$

R_N per foot = 3×10^6

$T_{phase\ change}$ (°F) = 300

$\alpha = 30$

$\beta = 0$

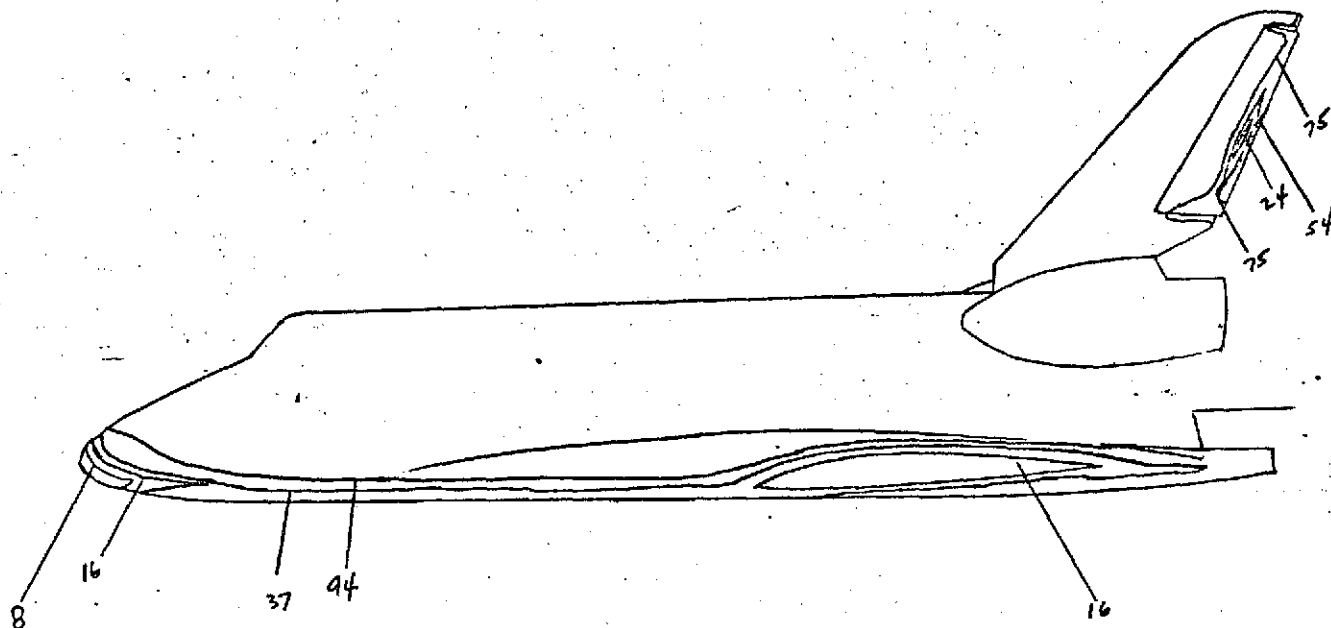
$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

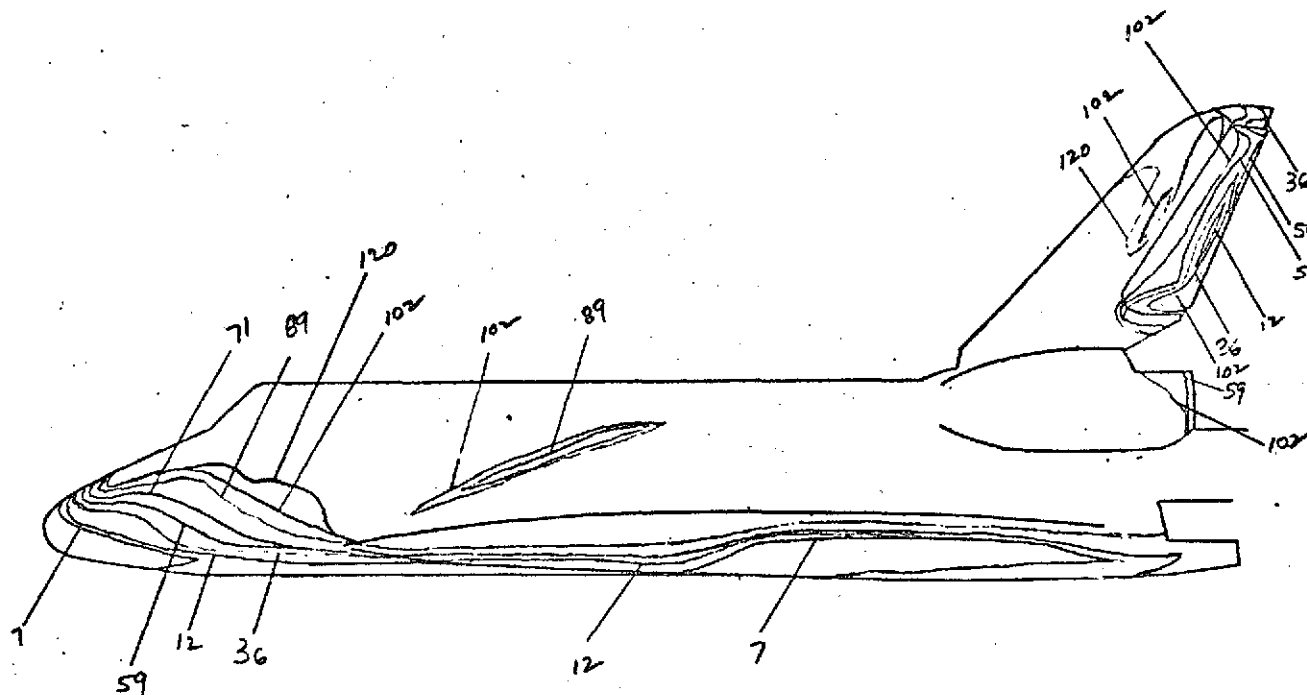
z (in) =



Isotherm	$h/h_{r=1}$
8	.30306
16	.21429
24	.17497
37	-.14092
54	.11665
75	.09848
97	.08841

FIG. 103

PHASE CHANGE TEST



Isotherm	$h/h_{x=1}$
7	.15112
12	.11282
36	.06664
59	.05205
71	.04765
89	.04238
102	.03957
120	.03647

FIG. 104

CONFIG. 46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42A (RPA)

RUN 4085

$M_\infty = 8$

P_{total} (psi) = 630

T_{total} ($^{\circ}$ F) = 280

$T_{aw}/T_{total} = .90$

R_N per foot = 3×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 200

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from
model center, x-axis
parallel w/ stream,
+ downstream)

x (in) =

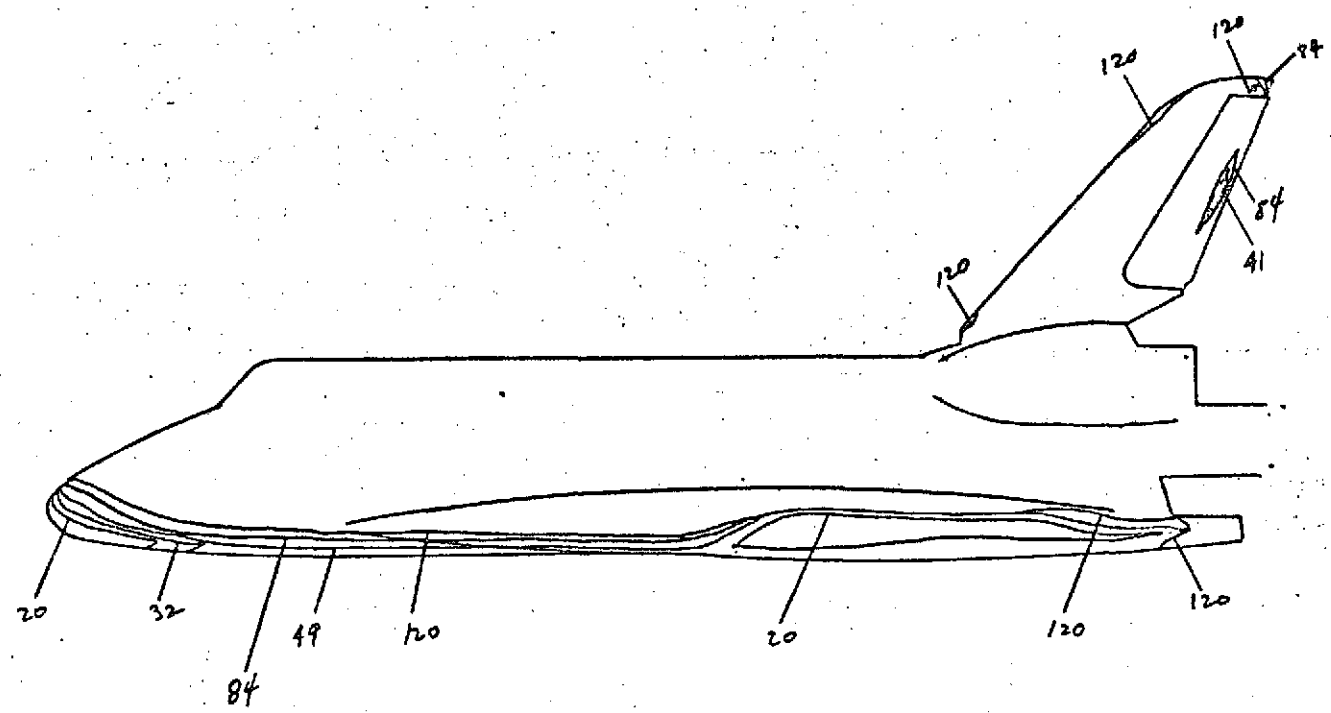
y (in) =

z (in) =

$HS = .072288 \text{ Btu}$
 $\text{ft}^{-3}\text{sec}^2 \text{ of}$

PHASE CHANGE TEST

CONFIG. 46-4



LENGTH (ft) = .638
SCALE .00593
FACILITY LRC/UDT
TEST OH42A (RPA)
RUN 4036
$M_\infty = 8$
$P_{total} \text{ (psi)} = 1400$
$T_{total} \text{ (}^\circ\text{F)} = 925$
$T_{aw}/T_{total} = .90$
$R_N \text{ per foot} = 6 \times 10^6$
$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 400$
$\alpha = 30$
$\beta = 0$
$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

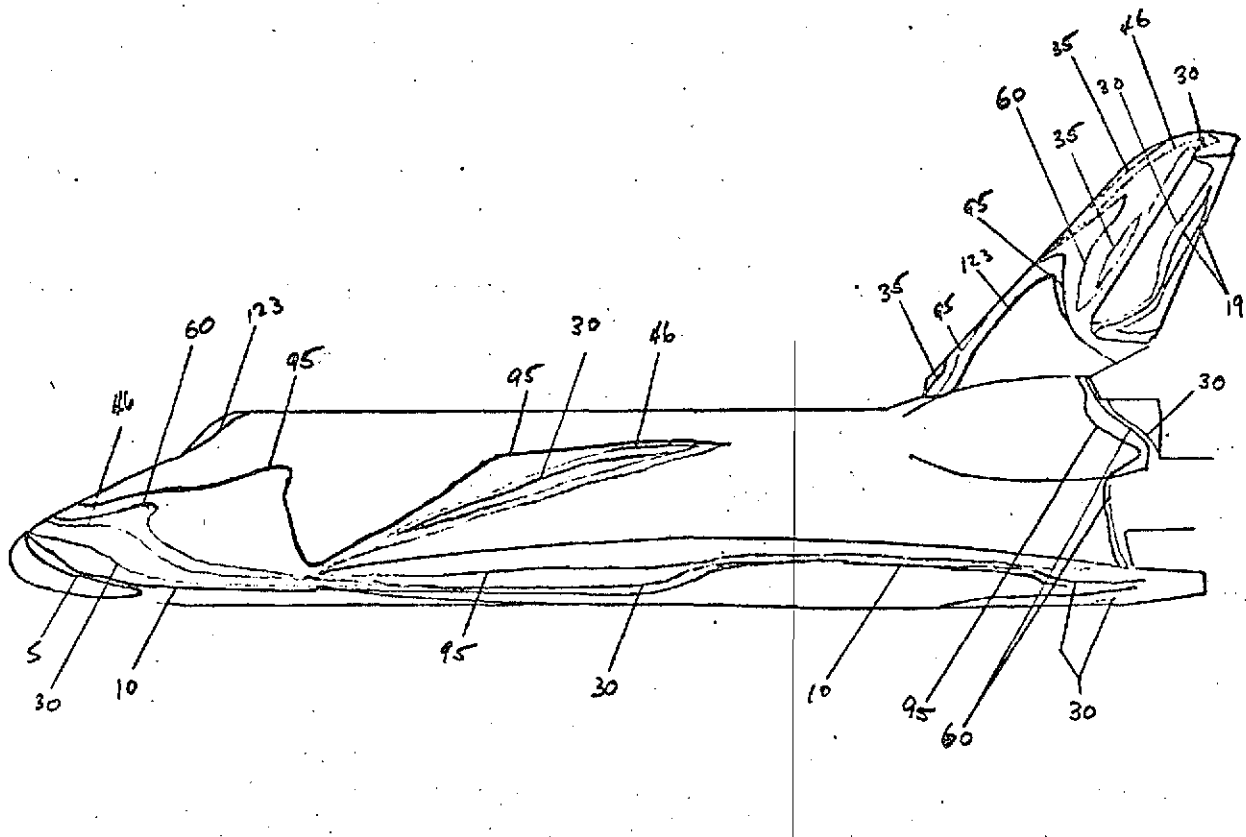
Isotherm	$h/h_{p=1}$
20	.221056
32	.17476
41	.15437
49	.141228
84	.107865
120	.09025

FIG. 105

$$NS = .104839 \frac{BTU}{FT^2-SEC-^{\circ}F}$$

PHASE CHANGE TEST

CONFIG. 46-4



LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42A (RPA)

RUN 4087

$M_\infty = 8$

$P_{total} \text{ (psi) } = 1400$

$T_{total} \text{ (}^\circ\text{F) } = 925$

$T_{aw}/T_{total} =$

$R_N \text{ per foot } = 6 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F) } = 250$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

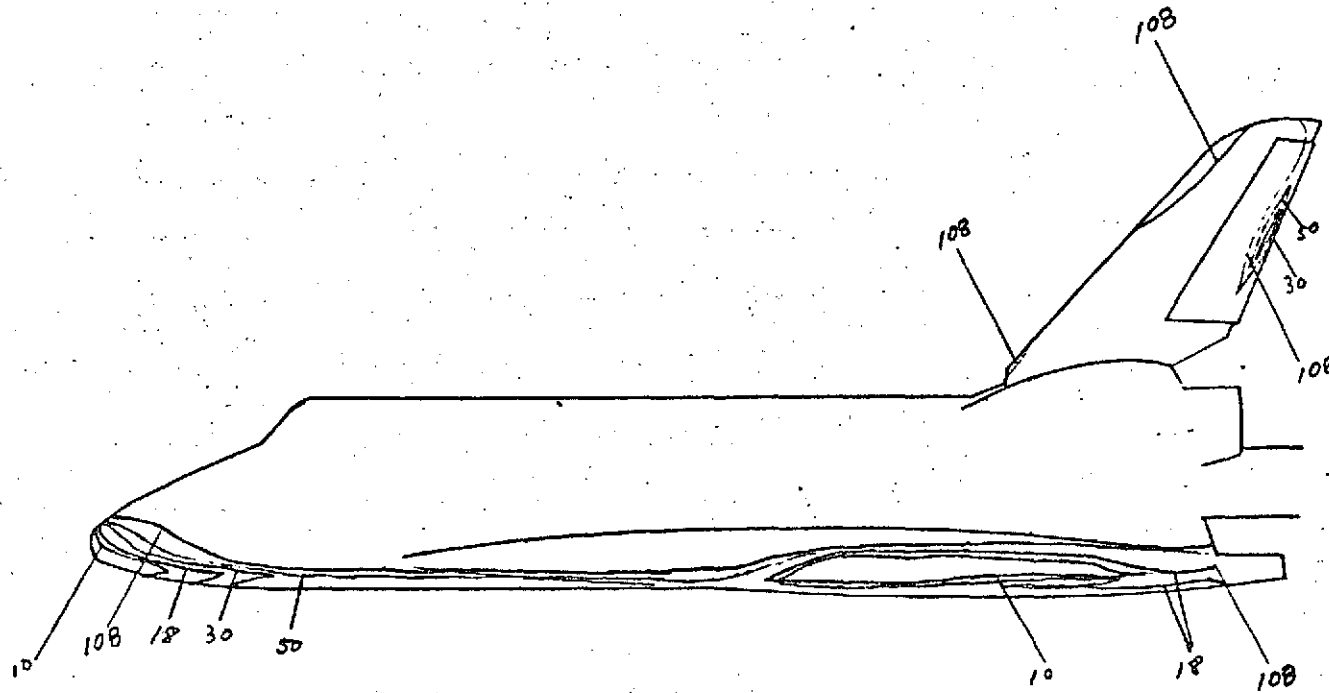
z (in) =

$$HS = .104751 \frac{BTU}{FT^2-SEC-^\circ F}$$

Isotherm	$h/h_{r=1}$
5	.17783
10	.12575
19	.07123
30	.07260
35	.06728
46	.05863
60	.05134
95	.04080
123	.03585

FIG. 106

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
10	.26328
18	.19624
30	.15201
50	.11274
108	.08011

FIG. 107

CONFIG. 46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42A (RPA)

RUN 4088

$M_\infty = 8$

P_{total} (psi) = 1935

T_{total} ($^{\circ}$ F) = 935

$T_{aw}/T_{total} = .90$

R_N per foot = 8×10^4

$T_{phase\ change}$ ($^{\circ}$ F) = 400

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

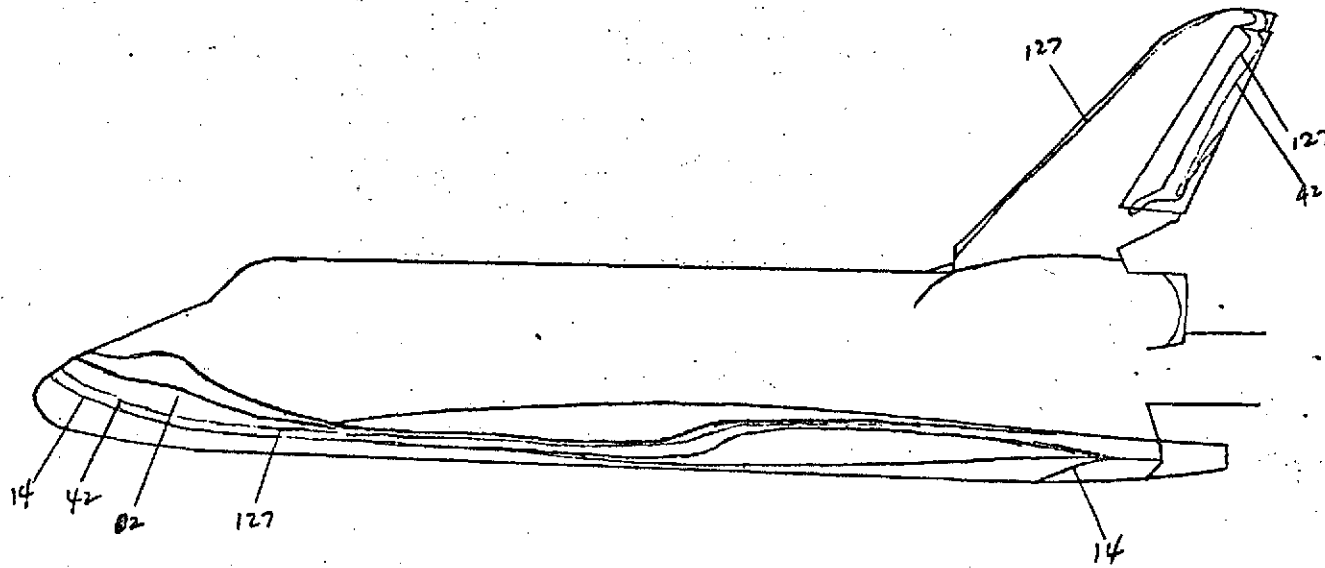
x (in) =

y (in) =

z (in) =

$HS = .12190 \frac{BIV}{FT^2-350.0F}$

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
14	.12407
42	.07163
82	.05126
127	.04119

FIG. 108

CONFIG. 46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDI

TEST 0H42A (RPA)

RUN 4089

$M_\infty = 8$

$P_{total} \text{ (psi)} = 163$

$T_{total} \text{ (}^\circ\text{F)} = 750$

$T_{aw}/T_{total} = .90$

$R_N \text{ per foot} = 1 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 150$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from
model center, x-axis
parallel w/ stream,
+ downstream)

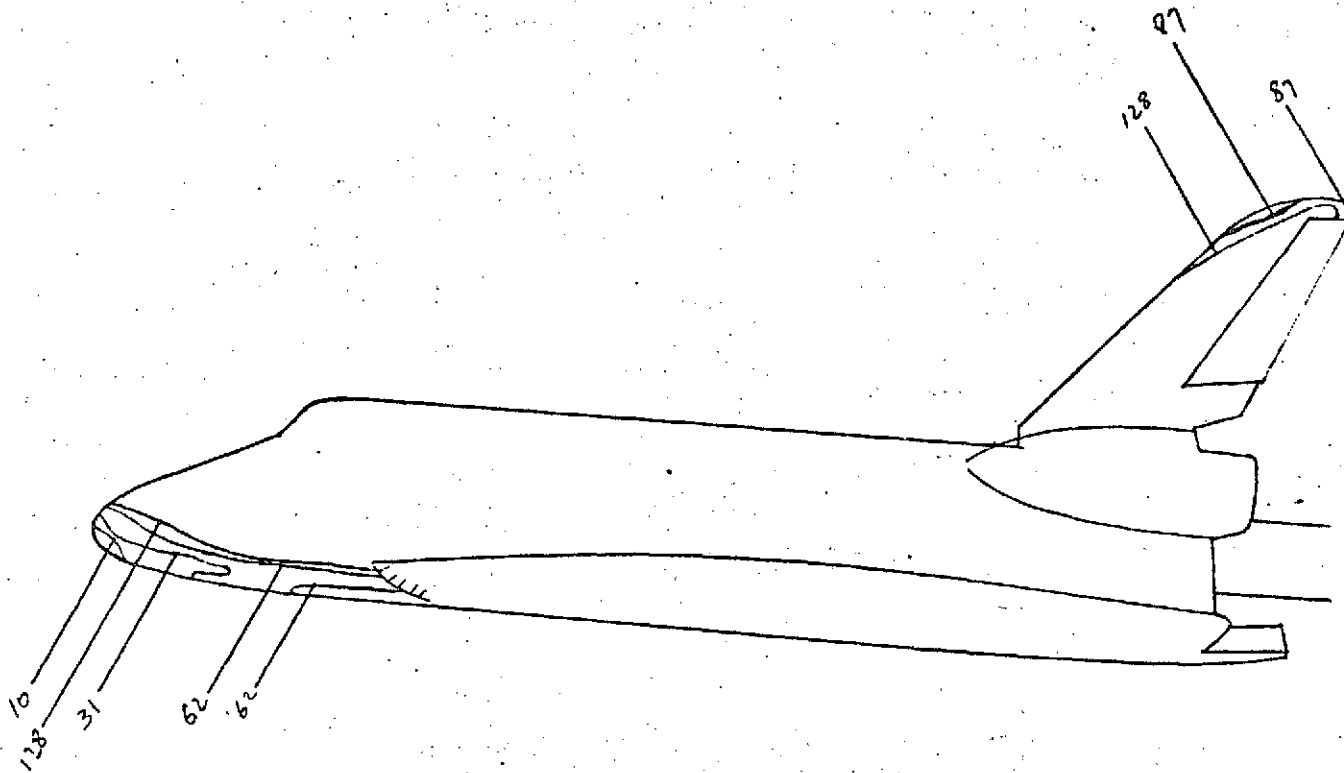
x (in) =

y (in) =

z (in) =

$HS = .03938 \frac{BTU}{FT^2-SEC-OF}$

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
10	.31025
31	.17621
62	.12460
87	.10519
128	.08679

FIG. 109

CONFIG. 46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42A (RPA)

RUN 4091

$M_\infty = 8$

P_{total} (psi) = 1390

T_{total} (°F) = 930

$T_{aw}/T_{total} = .90$

R_N per foot = 6×10^6

$T_{phase\ change}$ (°F) = 400

$\alpha = 40$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

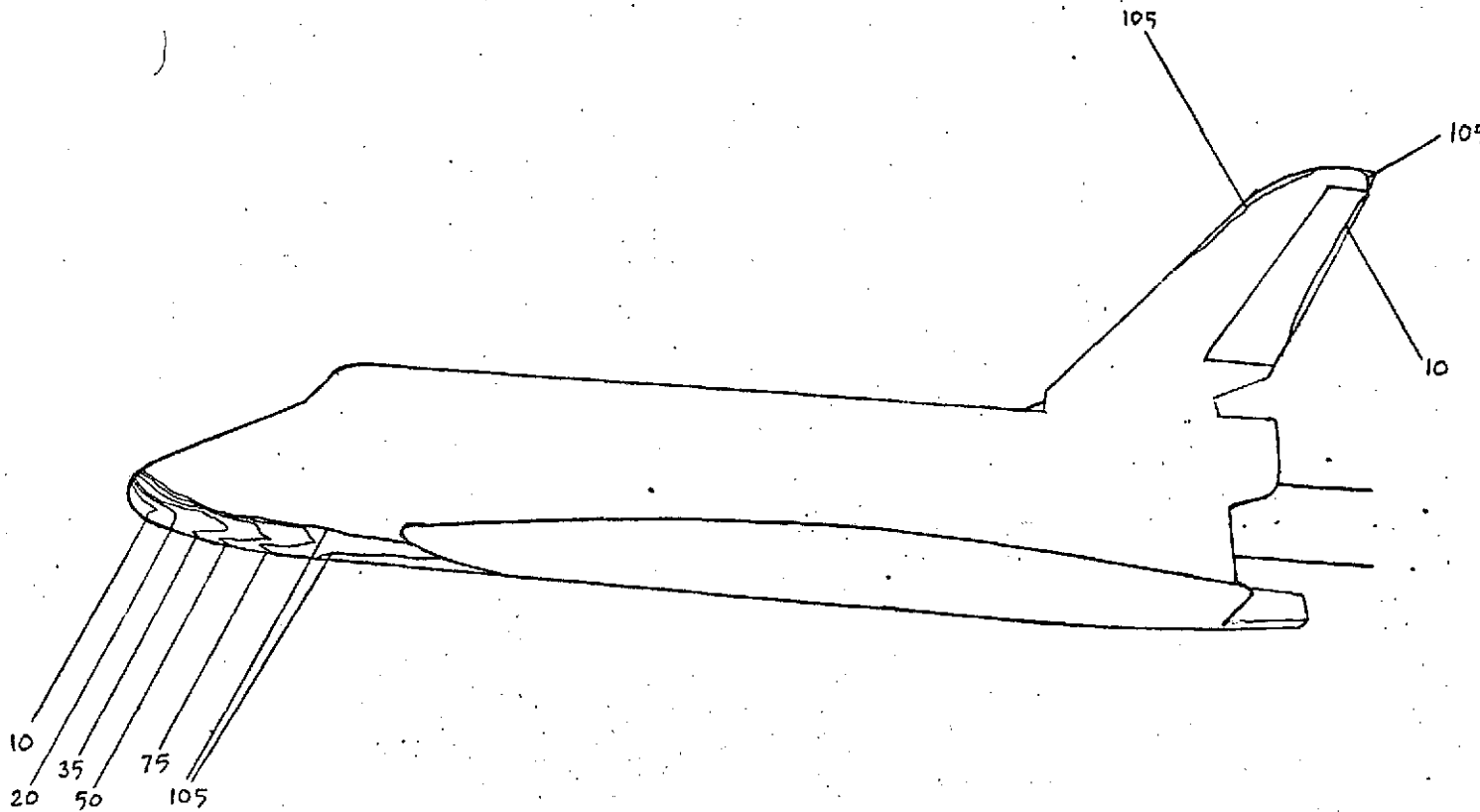
x (in) =

y (in) =

z (in) =

$HS = .10453 \frac{BTU}{FT^2-SEC-^{\circ}R}$

PHASE CHANGE TEST



Isotherm	$h/h_{x=1}$
10	.50592
20	.35774
35	.27082
50	.22625
75	.18474
105	.15613

FIG. 110

CONFIG. 46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42A (RPA)

RUN 4092

$M_\infty = 8$

P_{total} (psi) = 1400

T_{total} ($^{\circ}$ F) = 940

$T_{aw}/T_{total} = .90$

R_N per foot = 6×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 500

$\alpha = 40$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from
model center, x-axis
parallel w/ stream,
+ downstream)

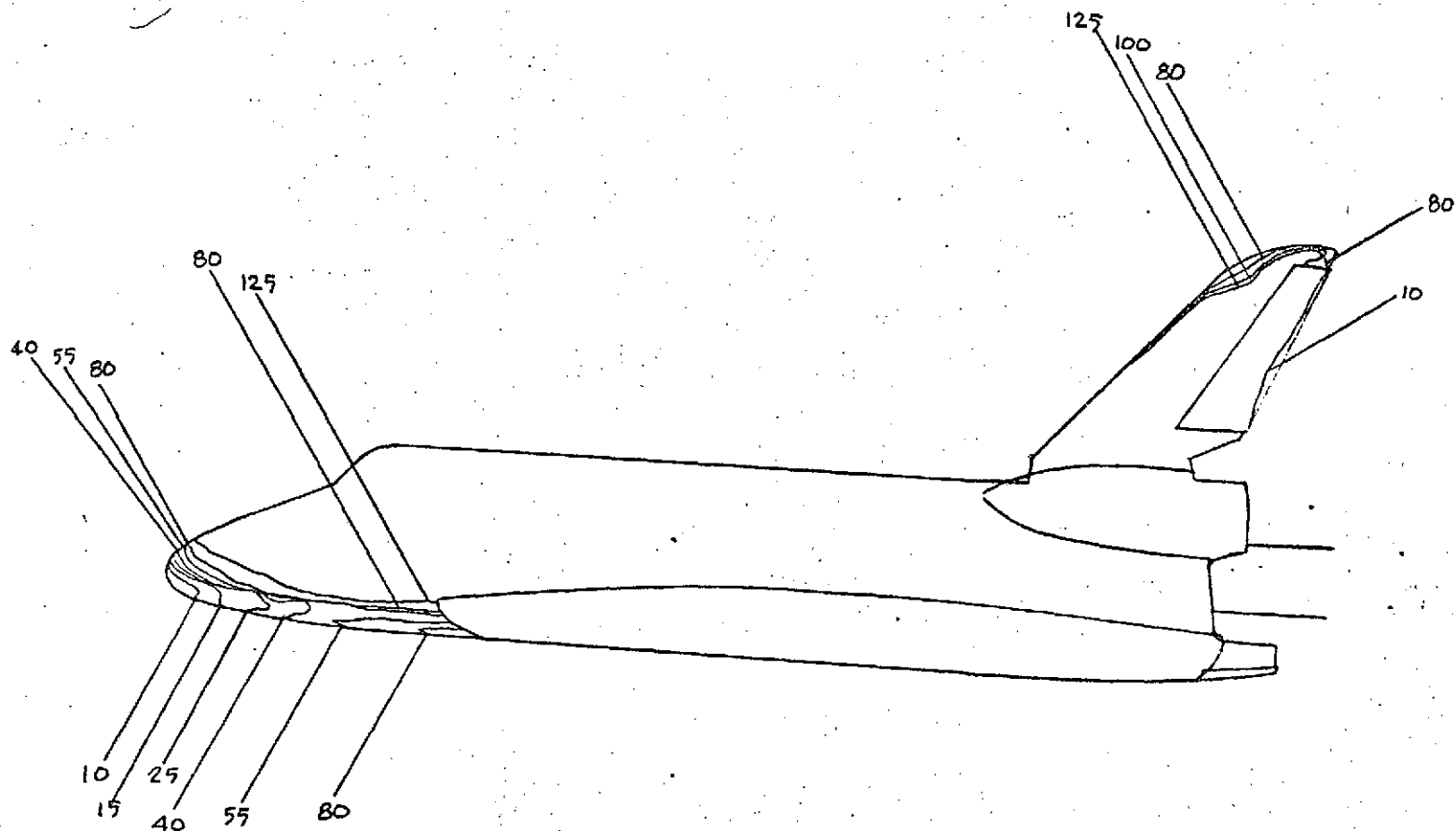
x (in) =

y (in) =

z (in) =

$HS = .10477 \frac{BTU}{FT^2 SEC-^{\circ}F}$

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
10	.28650
15	.23393
25	.18120
40	.14325
55	.12217
80	.10129
100	.09060
125	.08104

FIG. III

CONFIG. 46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42A (RPA)

RUN 4093

$M_\infty = 8$

P_{total} (psi) = 150

T_{total} ($^{\circ}$ F) = 760

$T_{aw}/T_{total} = .90$

R_N per foot = 1×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 200

$\alpha = 40$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

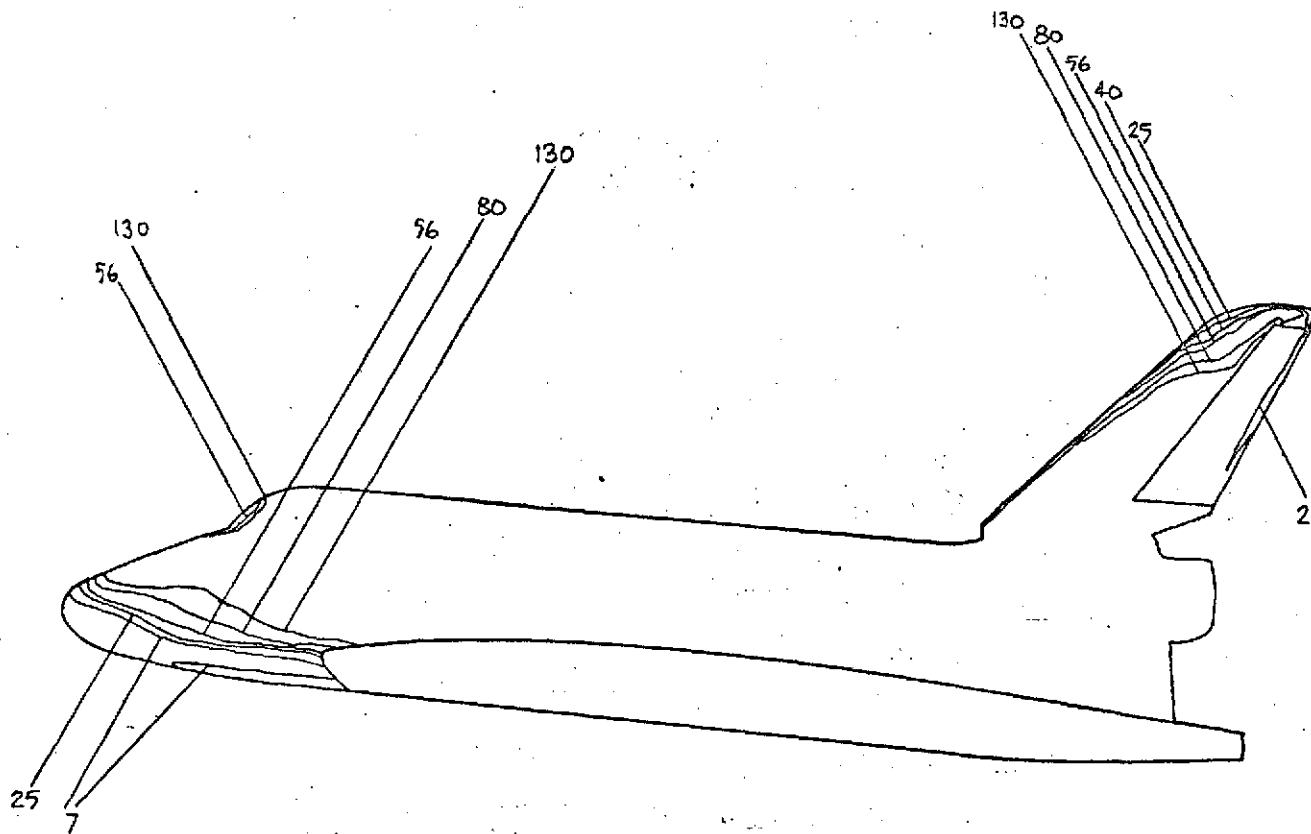
y (in) =

z (in) =

$h_5 = .038176 \text{ BTU}$
 $\text{FT}^2\text{-SEC-}^{\circ}\text{F}$

PHASE CHANGE TEST

CONFIG. 46-4



Isotherm	$h/h_{r=1}$
7	.16815
25	.08898
40	.07034
56	.05945
80	.04974
130	.03902

FIG. 112

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42A (RPA)

RUN 4094

$M_\infty = 8$

$P_{total} \text{ (psi)} = 160$

$T_{total} \text{ (}^\circ\text{F)} = 800$

$T_{aw}/T_{total} = .90$

$R_N \text{ per foot} = 1 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 150$

$\alpha = 40$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

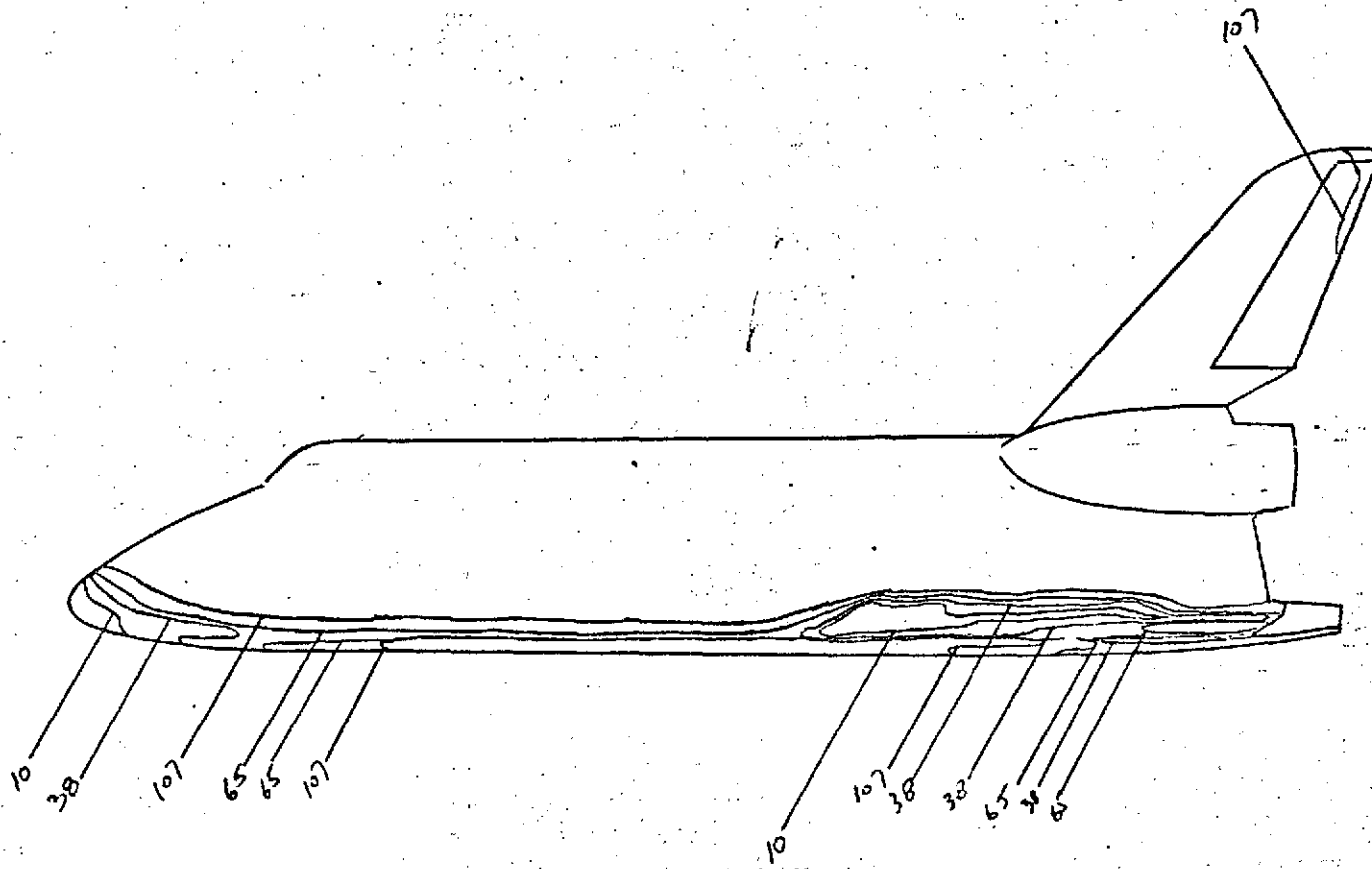
y (in) =

z (in) =

$$NS = .03924 \frac{BTU}{FT^2 \cdot SEC \cdot OF}$$

HVD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
10	.33132
38	.16996
65	.12996
107	.10129

FIG. 113

CONFIG. 46-4

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42A (RPA)

RUN 4096

$M_\infty = 8$

P_{total} (psi) = 1395

T_{total} (°F) = 900

$T_{aw}/T_{total} = .90$

R_N per foot = 6×10^6

$T_{phase\ change}$ (°F) = 400

$\alpha = 35^\circ$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

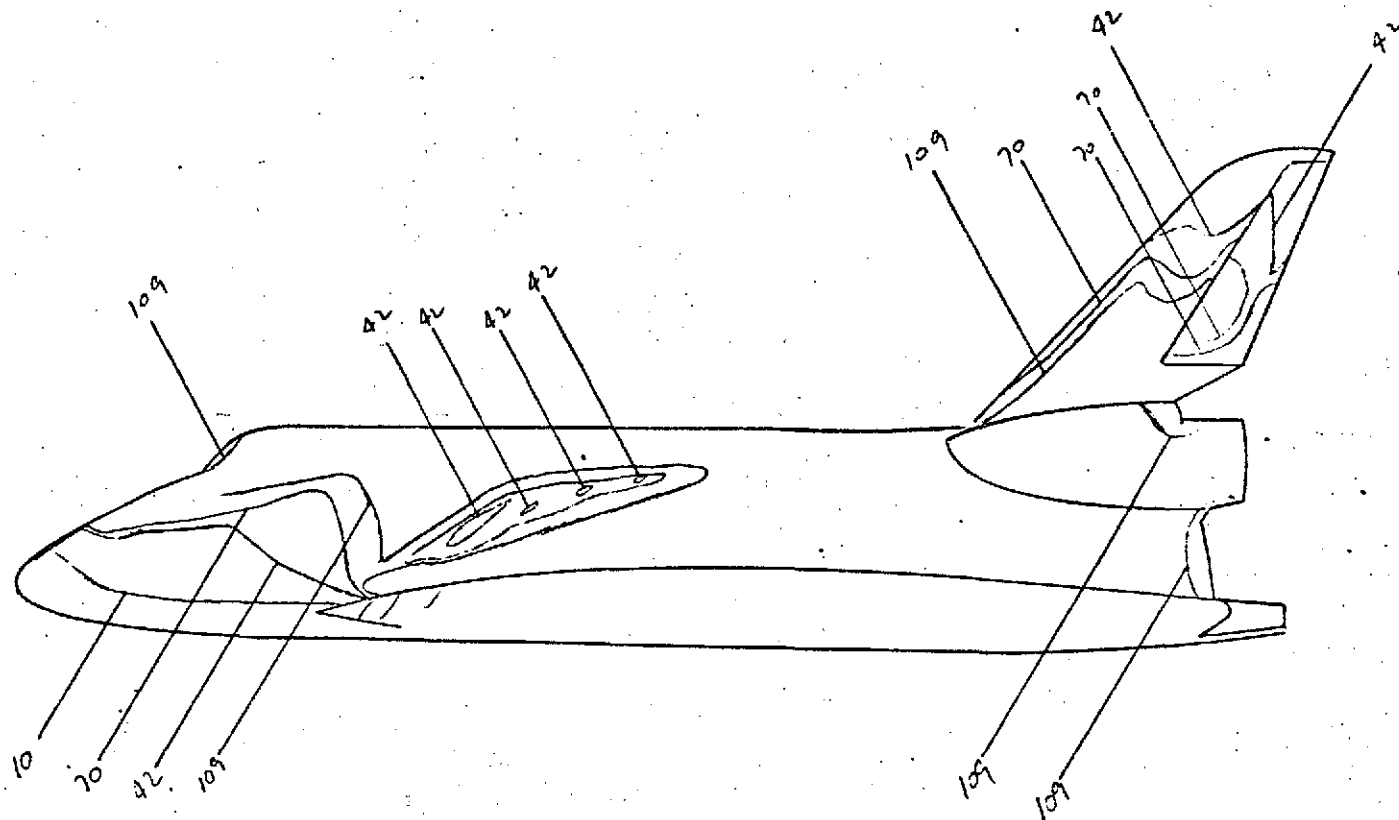
y (in) =

z (in) =

$HS = .104472 \frac{BTU}{FT^2-SEC-^{\circ}F}$

PHASE CHANGE TEST

CONFIG. 46-4



Isotherm	$h/h_{r=1}$
10	.08069
42	.03937
70	.03050
109	.02449

FIG. 114

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42A (RPA)

RUN 4097

$M_{\infty} = 8$

$P_{total} (psi) = 1385$

$T_{total} (^{\circ}F) = 925$

$T_{aw}/T_{total} = .90$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} (^{\circ}F) = 200$

$\alpha =$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

$H_5 = .10408 \frac{Btu}{FT^2 \cdot SEC \cdot OF}$

PHASE CHANGE TEST

CONFIG. 46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42A (RPA)

RUN 4098

$M_\infty = 8$

$P_{total} \text{ (psi)} = 160$

$T_{total} \text{ (}^\circ\text{F)} = 760$

$T_{aw}/T_{total} = .90$

$R_N \text{ per foot} = 1 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 175$

$\alpha = 35$

$\beta = 0$

$\phi = 0$

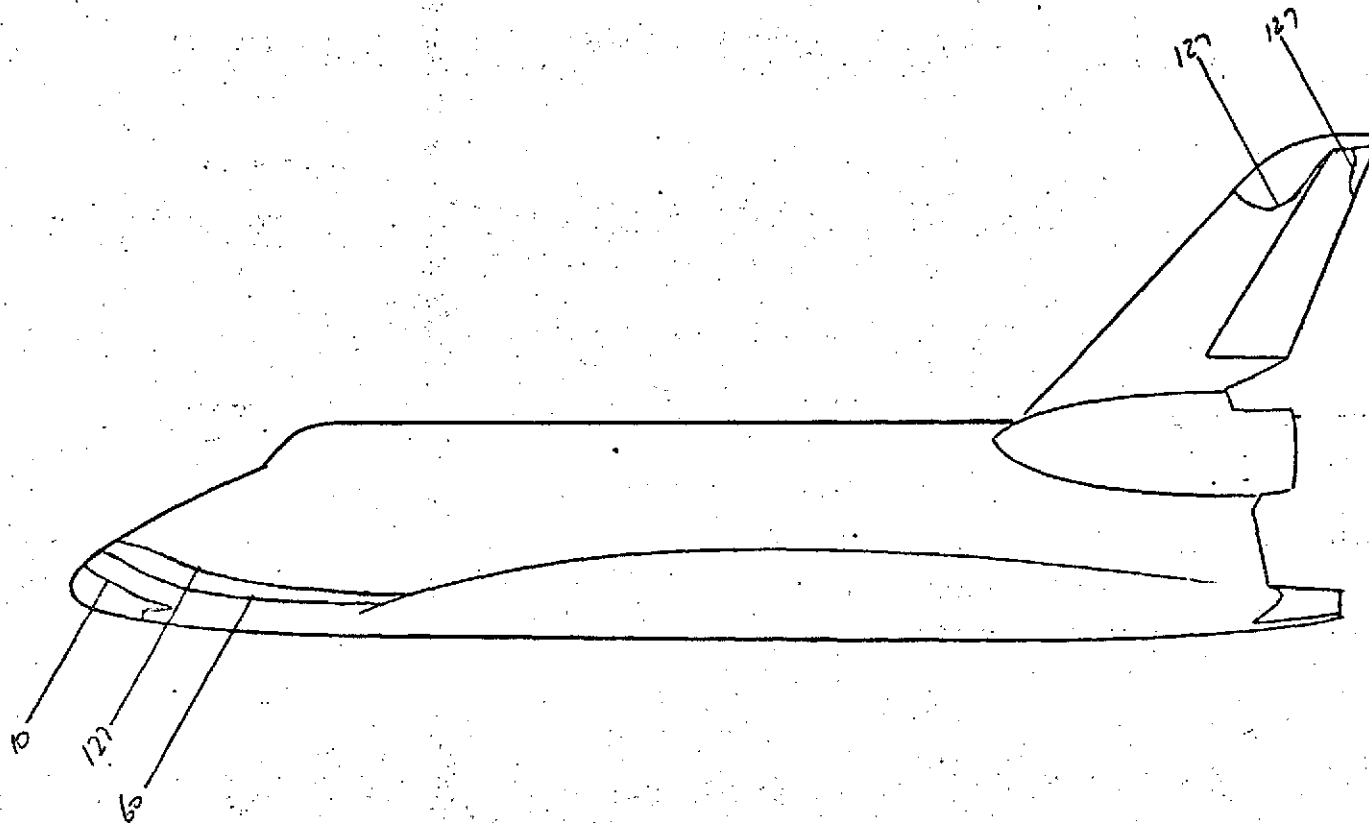
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

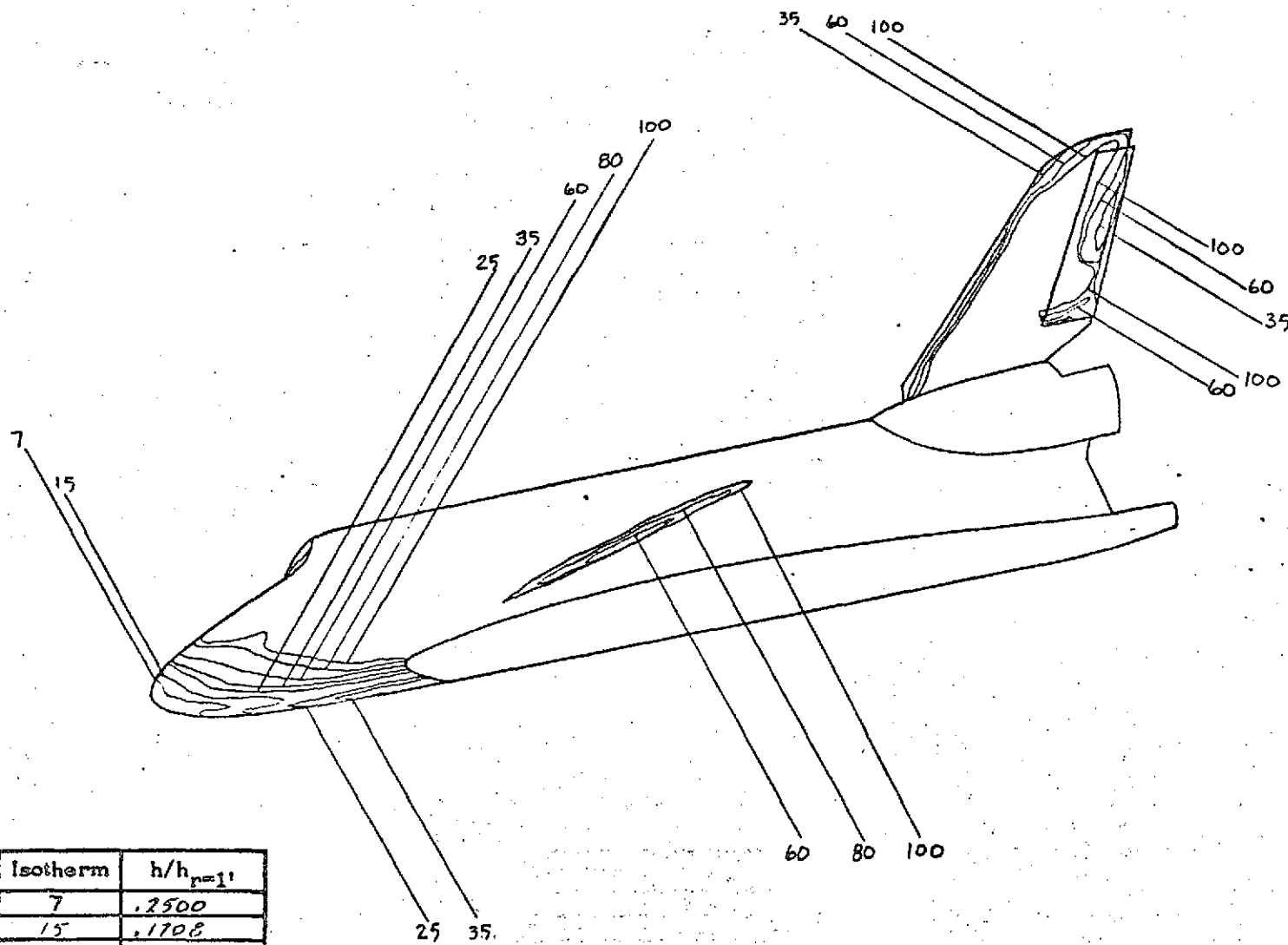
$h_s = .039169 \frac{\text{BTU}}{\text{ft}^2 \cdot \text{SEC} \cdot \text{OF}}$



Isotherm	$h/h_{r=1}$
10	.21700
60	.08854
127	.01089

FIG. 115

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
7	.2500
15	.1708
25	.1323
35	.1177
60	.0854
80	.0739
100	.06674

FIG. 116

CONFIG. 46-4

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42A (RPA)

RUN 4100

$M_o = 8$

P_{total} (psi) = 1420

T_{total} (°F) = 985

$T_{aw}/T_{total} = .90$

R_N per foot = 6×10^6

$T_{phase\ change}$ (°F) = 350

$\alpha = 25$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from
model center, x-axis
parallel w/ stream,
+ downstream)

x (in) =

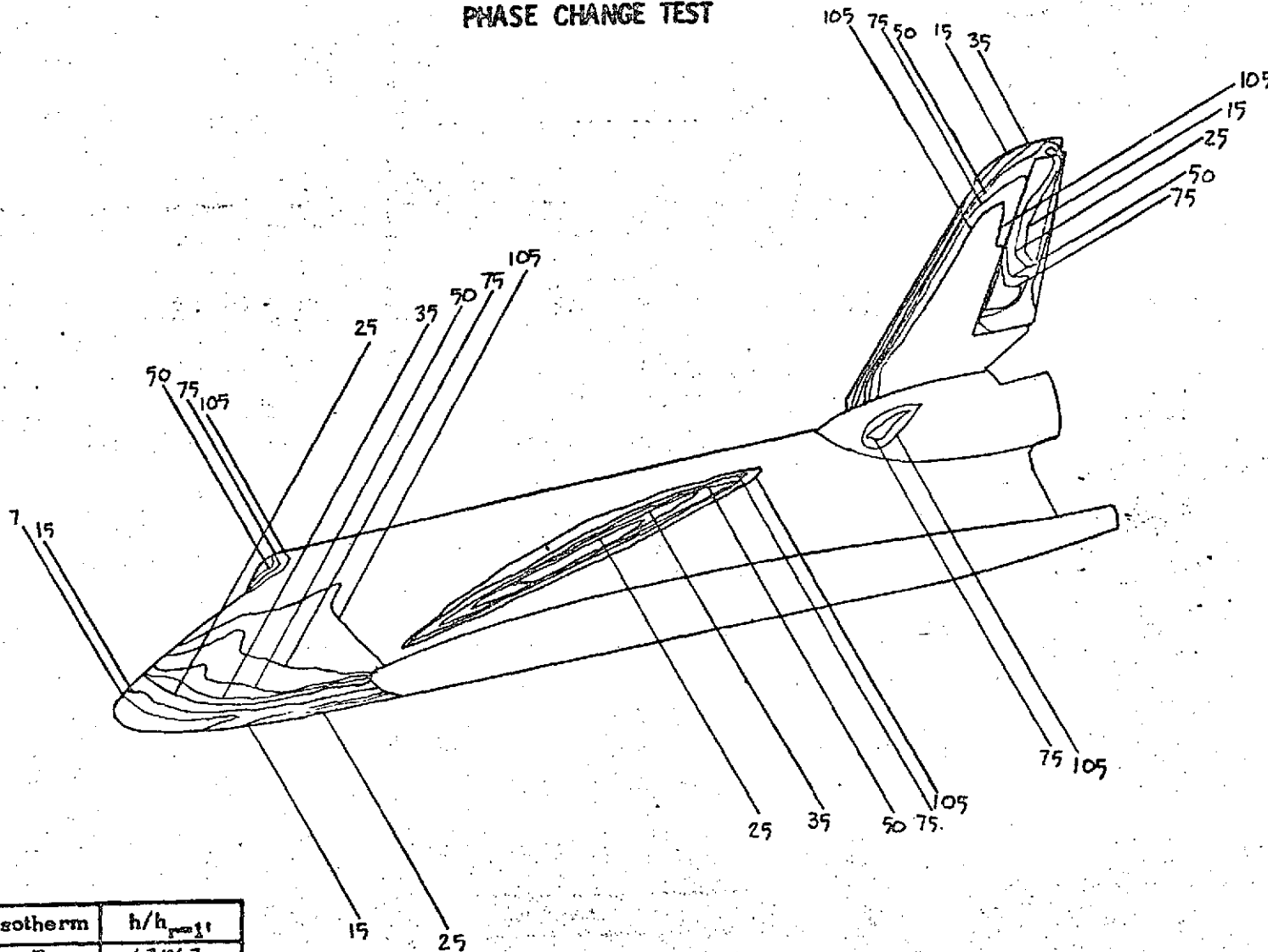
y (in) =

z (in) =

$HS = .1060 \frac{BTU}{FT^2-SEC-^{\circ}F}$

HVD-EVCS

PHASE CHANGE TEST



Isotherm	h/h_{max}
7	.17062
15	.11656
25	.09029
35	.07630
50	.06384
75	.05213
105	.04405

FIG 117

CONFIG. 46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42A (RPA)

RUN 4101

$M_{\infty} = 8$

$P_{\text{total}} (\text{psi}) = 1375$

$T_{\text{total}} (^{\circ}\text{F}) = 950$

$T_{\text{aw}}/T_{\text{total}} = .90$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} (^{\circ}\text{F}) =$

$\alpha = 25$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

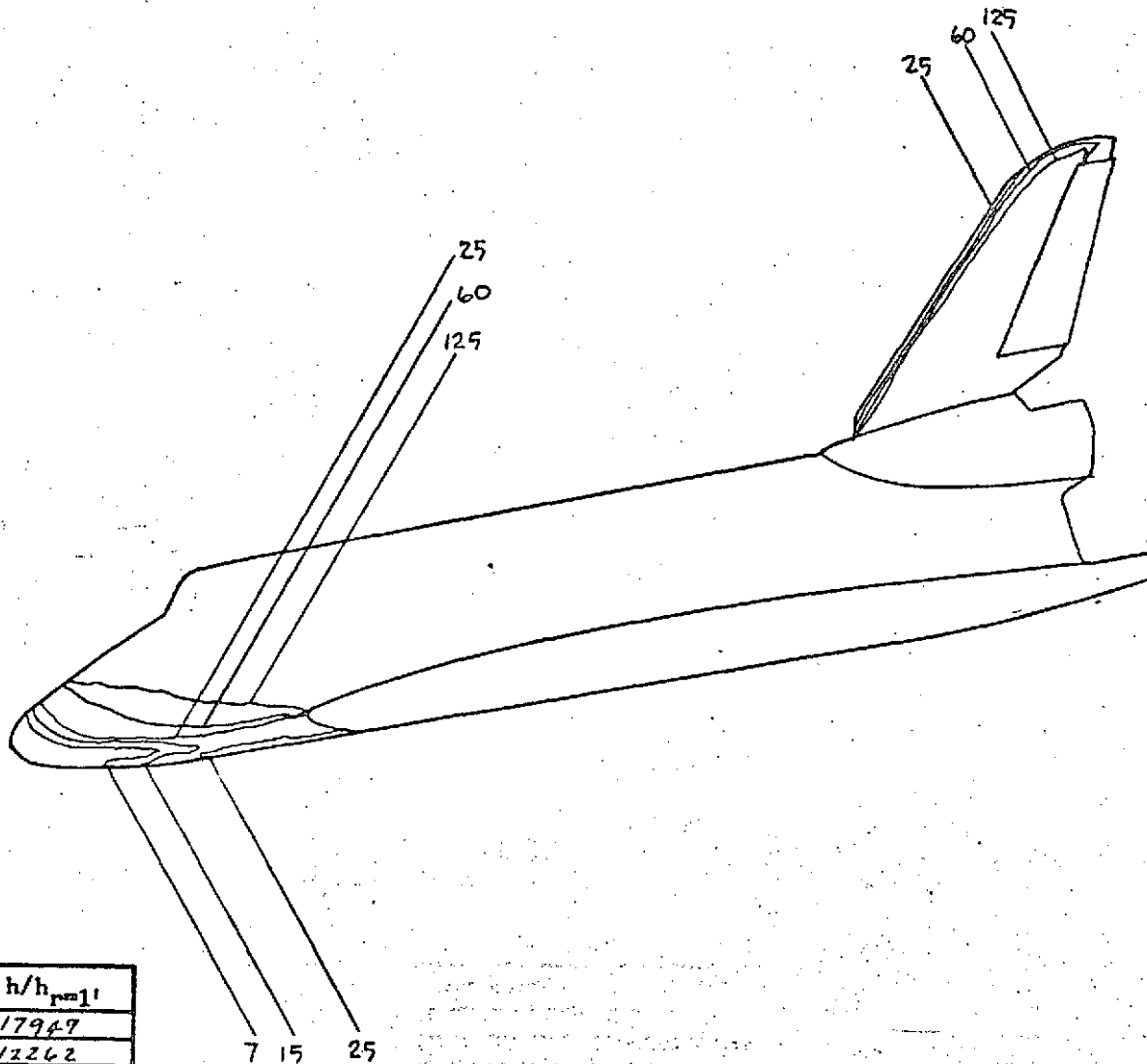
x (in) =

y (in) =

z (in) =

$$H_5 = .10915 \frac{\text{BTU}}{\text{FT}^2 \cdot \text{SEC} \cdot ^{\circ}\text{F}}$$

PHASE CHANGE TEST



Isotherm	$h/h_{ps}1'$
7	.17949
15	.12262
25	.09498
60	.06131
125	.04247

FIG. 118

CONFIG. 46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42A (RPA)

RUN 4102

$M_\infty = 8$

$P_{total} (psi) = 160$

$T_{total} (^\circ F) = 735$

$T_{aw}/T_{total} = .90$

$R_N \text{ per foot} = 1 \times 10^6$

$T_{\text{phase change}} (^\circ F) = 150$

$\alpha = 25$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

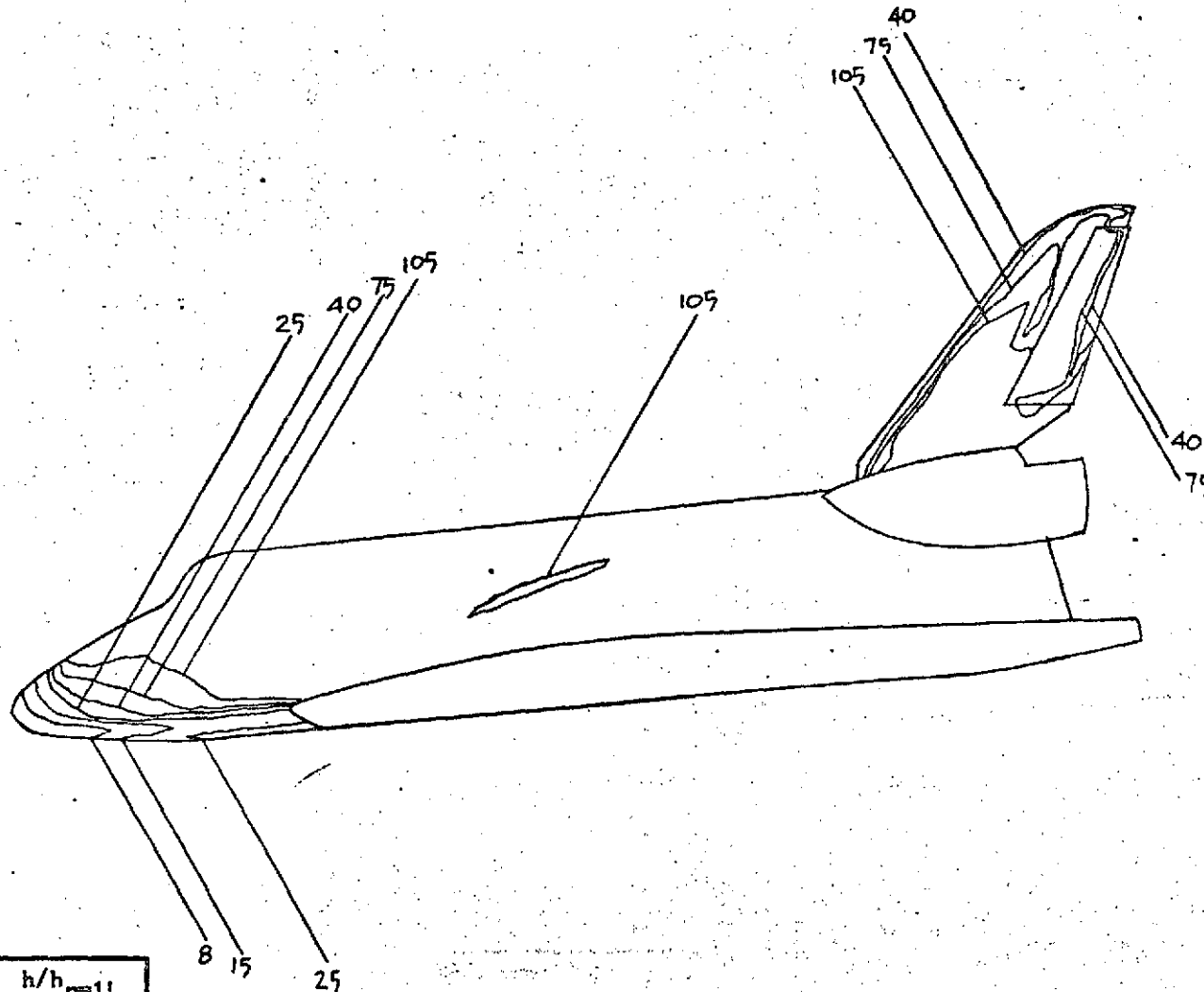
x (in) =

y (in) =

z (in) =

$HS = .03902 \frac{BTU}{FT^2 \cdot SEC \cdot ^\circ F}$

PHASE CHANGE TEST



Isotherm	h/h_{max}
8	.20379
15	.14879
25	.11525
40	.09111
75	.06654
105	.05624

FIG. 119

CONFIG. 46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42A (RPA)

RUN 4104

$M_\infty = 8$

$P_{total} \text{ (psi)} = 1390$

$T_{total} \text{ (}^\circ\text{F)} = 910$

$T_{aw}/T_{total} = .90$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 300$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

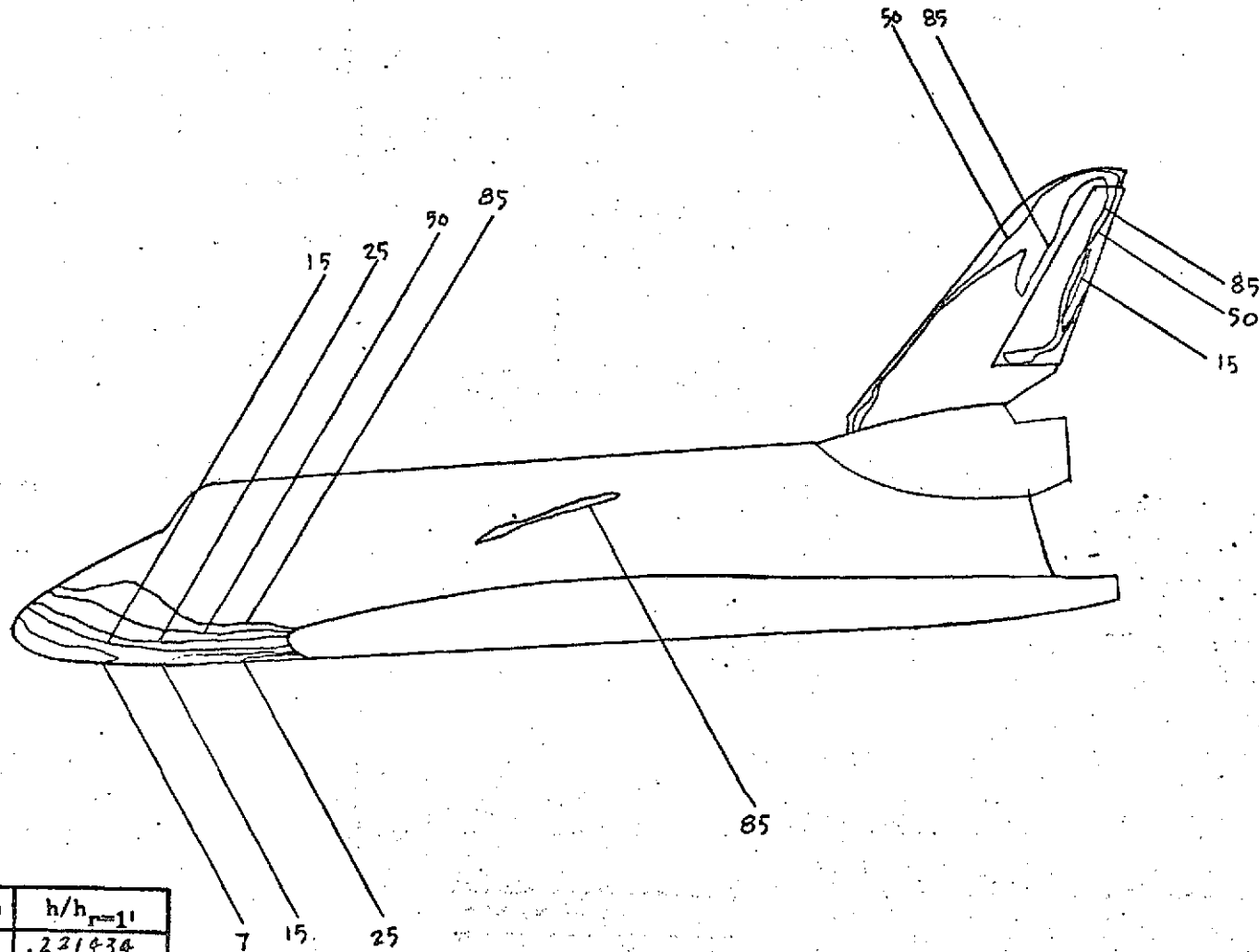
x (in) =

y (in) =

z (in) =

$HS = .10443 \frac{BTU}{FT^2 \cdot SEC \cdot ^\circ F}$

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
7	.221434
15	.151268
25	.117172
50	.082853
85	.063545

FIG. 120

CONFIG. 46-4

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42A (RPA)

RUN 4105

$M_\infty = 8$

P_{total} (psi) = 1940

T_{total} ($^{\circ}$ F) = 970

$T_{aw}/T_{total} = .90$

R_N per foot = 8×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 350

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

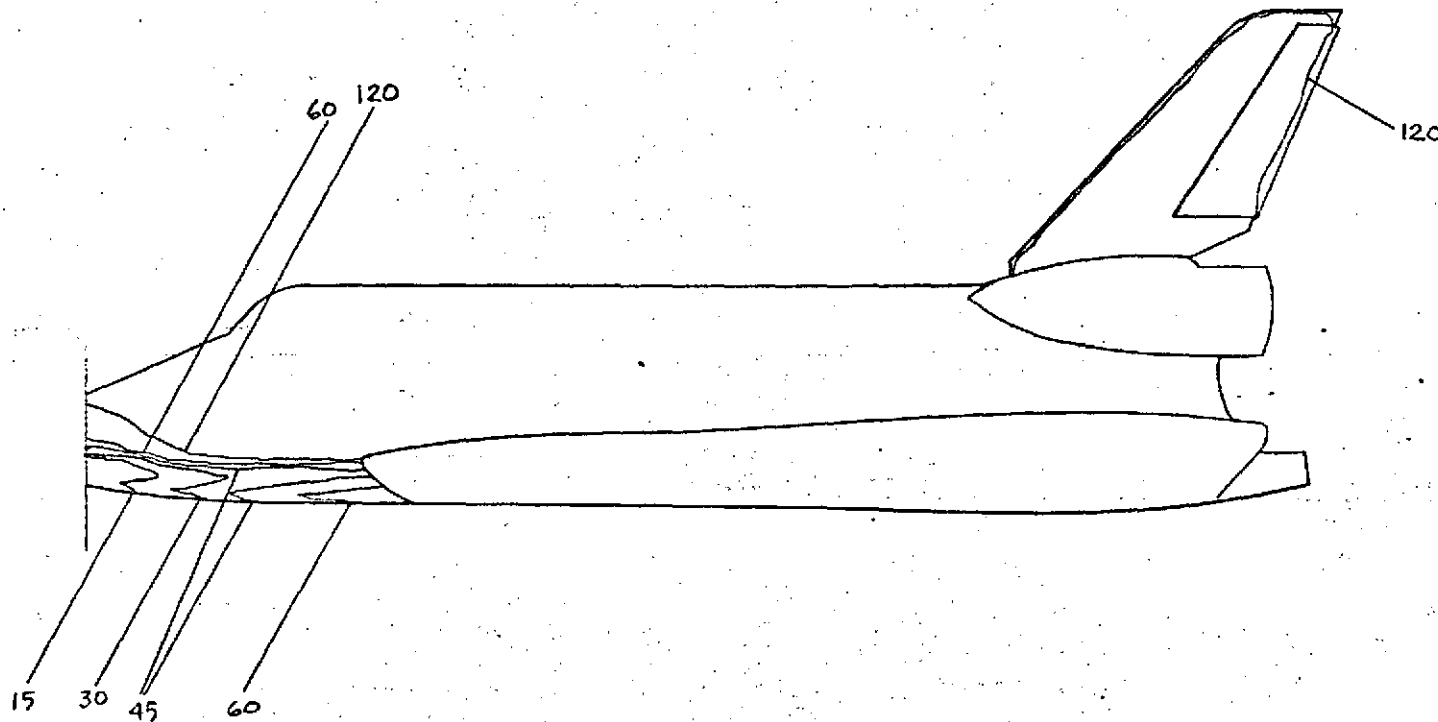
x (in) =

y (in) =

z (in) =

$$HS = .1224 \frac{BTU}{FT^2-SEC-^{\circ}F}$$

PHASE CHANGE TEST



Isotherm	h/h_{ref}
15	.257427
30	.102028
45	.148625
60	.128713
120	.091014

FIG. 121

CONFIG. 46-1

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42B (RPA)

RUN 4130

$M_\infty = 8$

$P_{total} \text{ (psi)} = 1390$

$T_{total} \text{ (}^\circ\text{F)} = 980$

$T_{aw}/T_{total} = .90$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 400$

$\alpha = 35$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

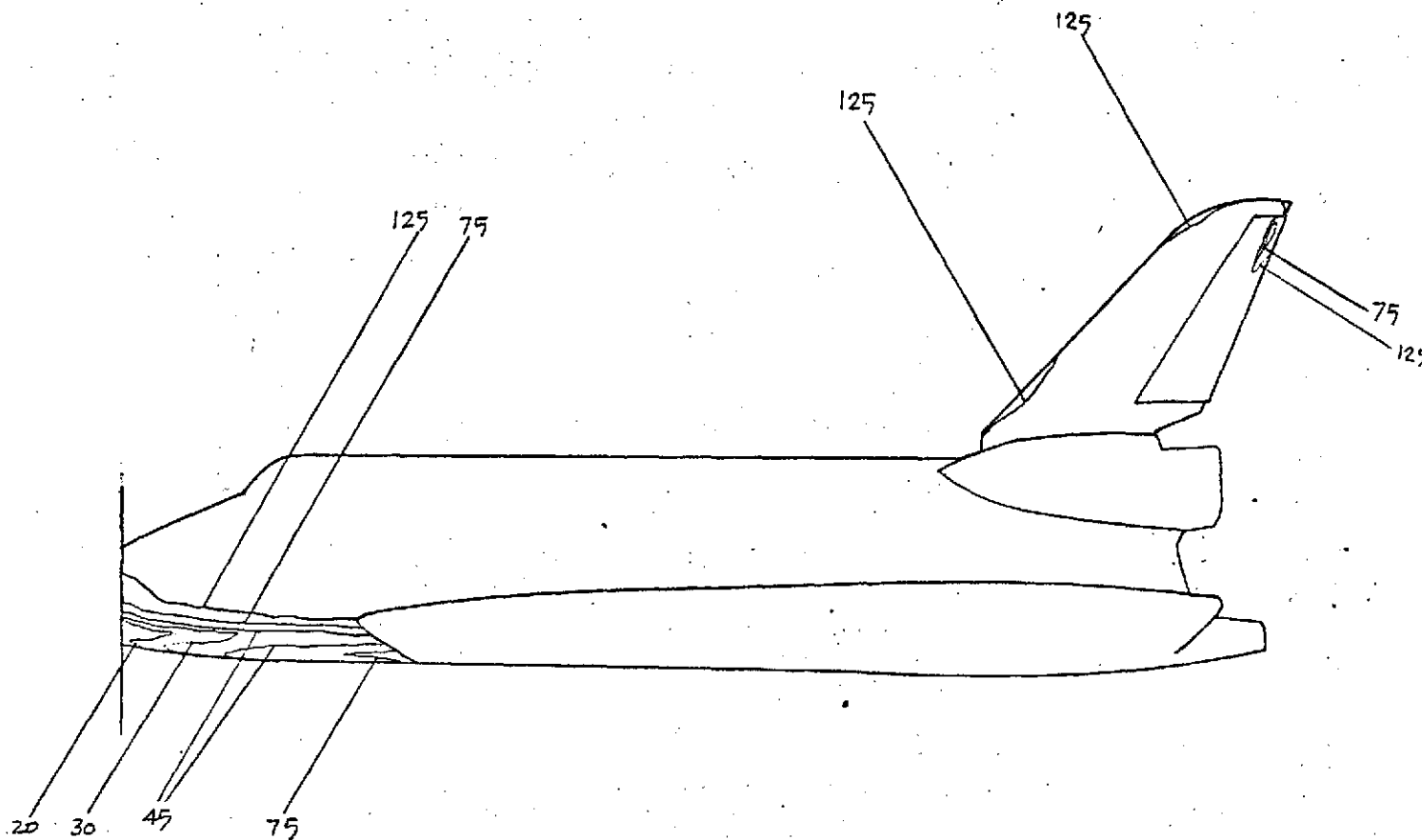
x (in) =

y (in) =

z (in) =

$NS = .105517 \frac{BTU}{FT^2 \cdot SEC \cdot ^\circ F}$

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
20	.206840
30	.168884
45	.137893
75	.106812
125	.082736

FIG. 122

CONFIG. 46-4A

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42B (RPA)

RUN 4131

$M_\infty = 8$

P_{total} (psi) = 625

T_{total} (°F) = 910

$T_{aw}/T_{total} = .90$

R_N per foot = 3×10^6

$T_{phase\ change}$ (°F) = 300

$\alpha = 35$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from
model center, x-axis
parallel w/ stream,
+ downstream)

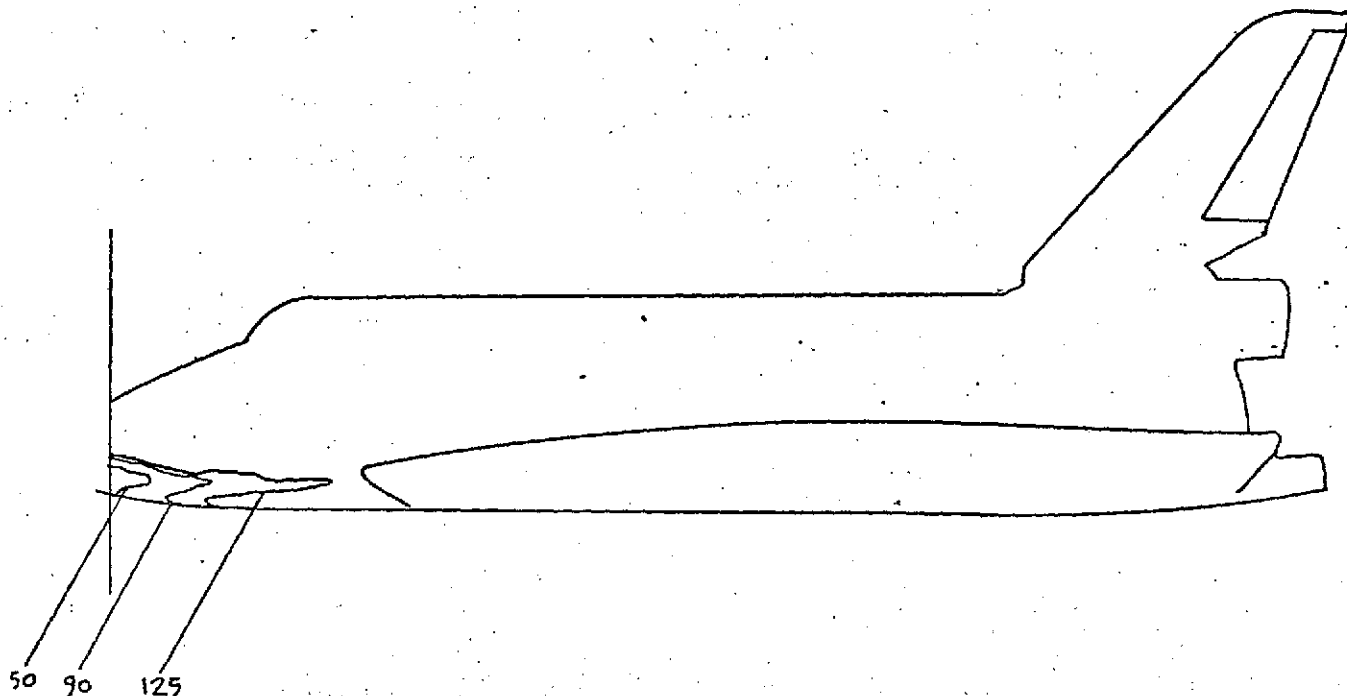
x (in) =

y (in) =

z (in) =

$H_5 = \frac{BTU}{FT^2 \cdot SEC \cdot OF}$

PHASE CHANGE TEST



Isotherm	h/h_{∞}
50	0.27608
90	0.205725
125	0.179563

FIG. 123

CONFIG. 46-2

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42B

RUN 4132

$M_{\infty} = 8$

$P_{total} (psi) = 1390$

$T_{total} (^{\circ}F) = 925$

$T_{aw}/T_{total} = .90$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} (^{\circ}F) = 500$

$\alpha = 35$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

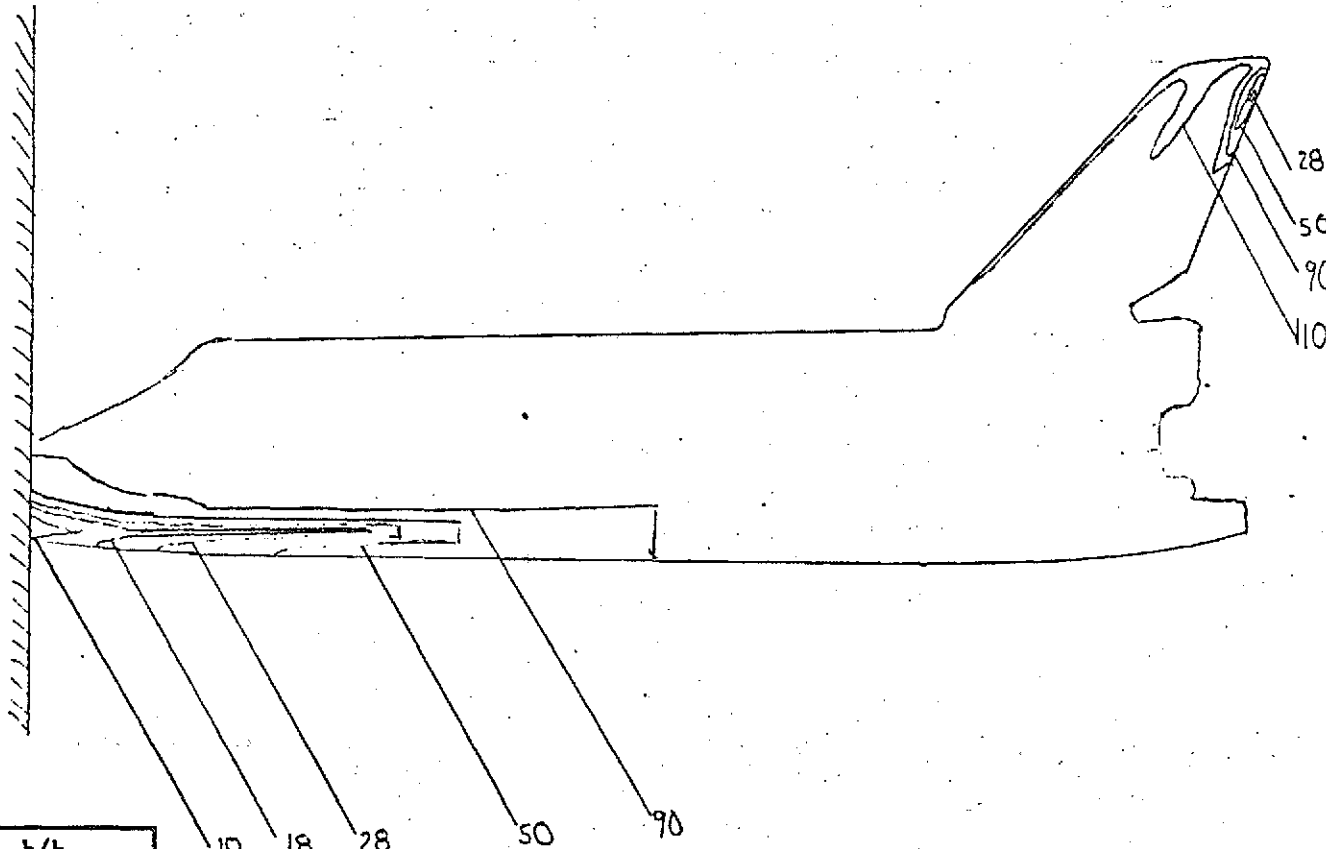
y (in) =

z (in) =

$HS = .109924$ *BTU*
FT²-SEC-²OF

PHASE CHANGE TEST

CONFIG. 46-4A



Isotherm	$h/h_{p=1}$
10	0.208809
18	0.155697
28	0.124835
50	0.093482
90	0.0696298
110	0.0629625

FIG. 124

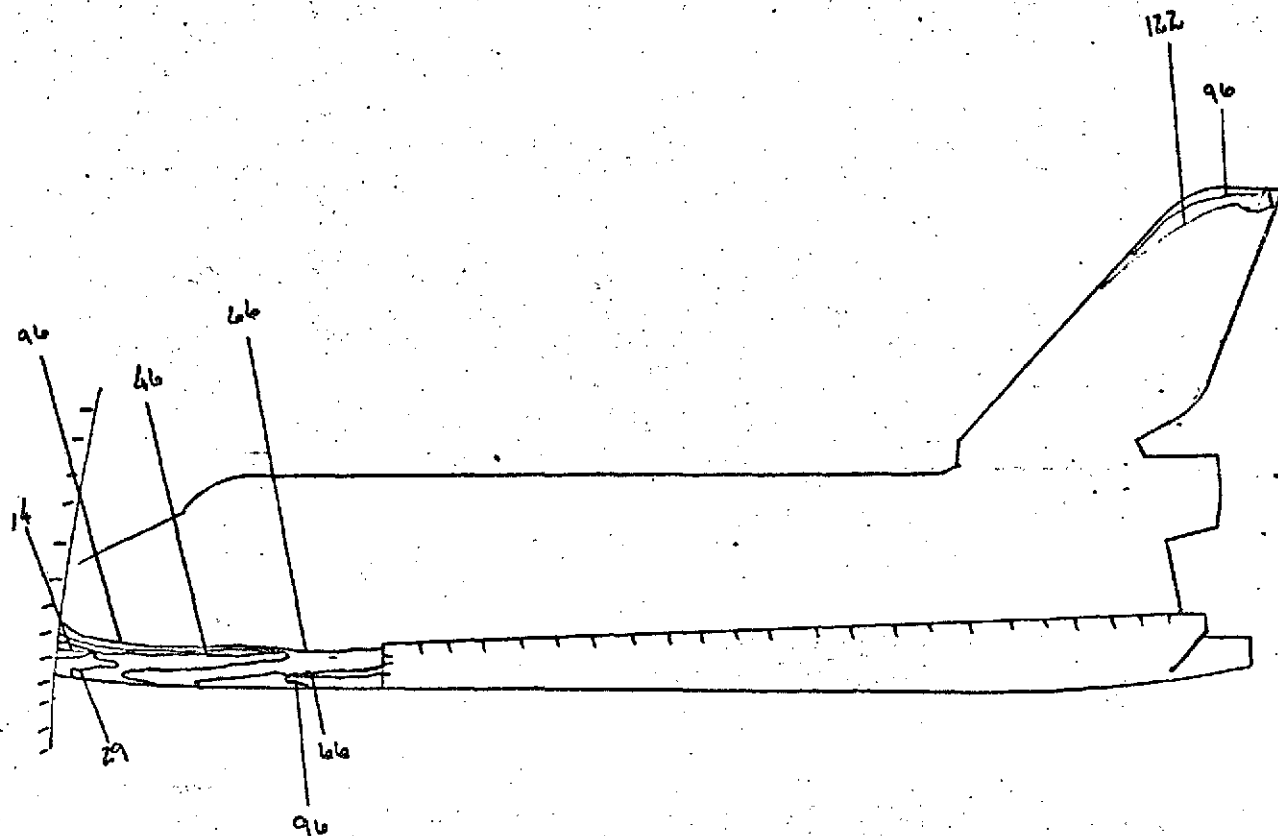
LENGTH (ft) = .638
SCALE .00593
FACILITY LRC/UDT
TEST OH428 (RFA)
RUN 4133
$M_\infty = 8$
$P_{total} \text{ (psi)} = 635$
$T_{total} \text{ (}^\circ\text{F)} = 880$
$T_{aw}/T_{total} = 0.90$
$R_N \text{ per foot} = 3 \times 10^6$
$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 250$
$\alpha = 35^\circ$
$\beta = 0$
$\phi = 0$
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)
x (in) =
y (in) =
z (in) =

HS = 0.0730835 $\frac{\text{BTU}}{\text{FT}^2 \cdot \text{Sec} \cdot ^\circ\text{F}}$

MDS

HVD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
14	0.261351
29	0.181589
46	0.149182
66	0.120370
96	0.092052
122	0.085338

FIG. 125

CONFIG. 46-2

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42B (RPA)

RUN 4134

$M_\infty = 8$

P_{total} (psi) = 625

T_{total} ($^{\circ}$ F) = 875

$T_{aw}/T_{total} = 0.90$

R_N per foot = 3×10^6

$T_{phase\ change}$ ($^{\circ}$ F) =

$\alpha = 35^{\circ}$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

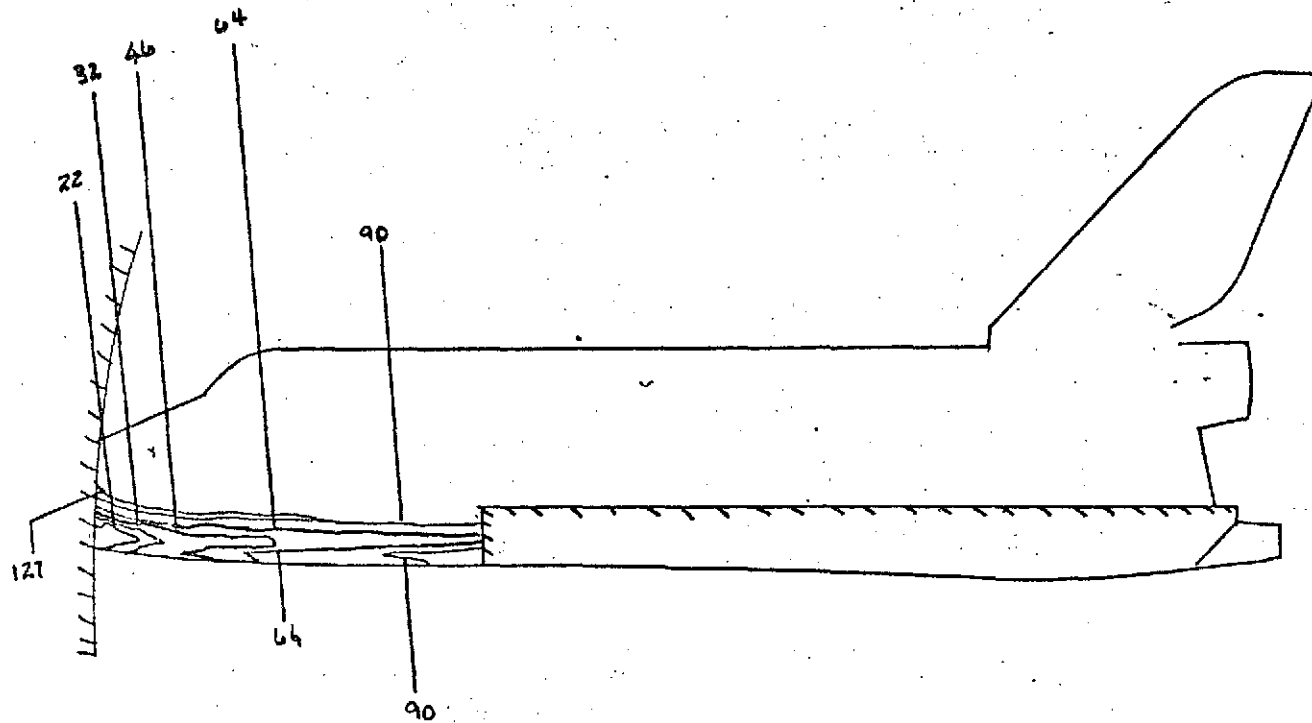
y (in) =

z (in) =

CFE/MOSTO ϵ

HS = 0.0731502 $\frac{BTU}{FT^2 \cdot SEC \cdot ^{\circ}F}$

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
22	0.159686
32	0.132409
46	0.110933
64	0.0936291
90	0.0789508
127	0.0664624

FIG. 126

CONFIG. 46-2

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42B (RPA)

RUN 4135

$M_{\infty} = 8$

$P_{total} (psi) = 154$

$T_{total} (°F) = 765$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 1 \times 10^6$

$T_{\text{phase change}} (°F) = 175$

$\alpha = 35$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

STRAINS TO $\frac{1}{2}$

HS = 0.0387924 $\frac{BTU}{Ft^2 \cdot SEC} \cdot °F$

HVD-EVCS

PHASE CHANGE TEST

CONFIG. 46-2

LENGTH (in) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42B (RPA)

RUN 4136

$M_\infty = 8$

$P_{total} \text{ (psi)} = 1355$

$T_{total} \text{ (}^\circ\text{F)} = 890$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 450$

$\alpha = 35$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

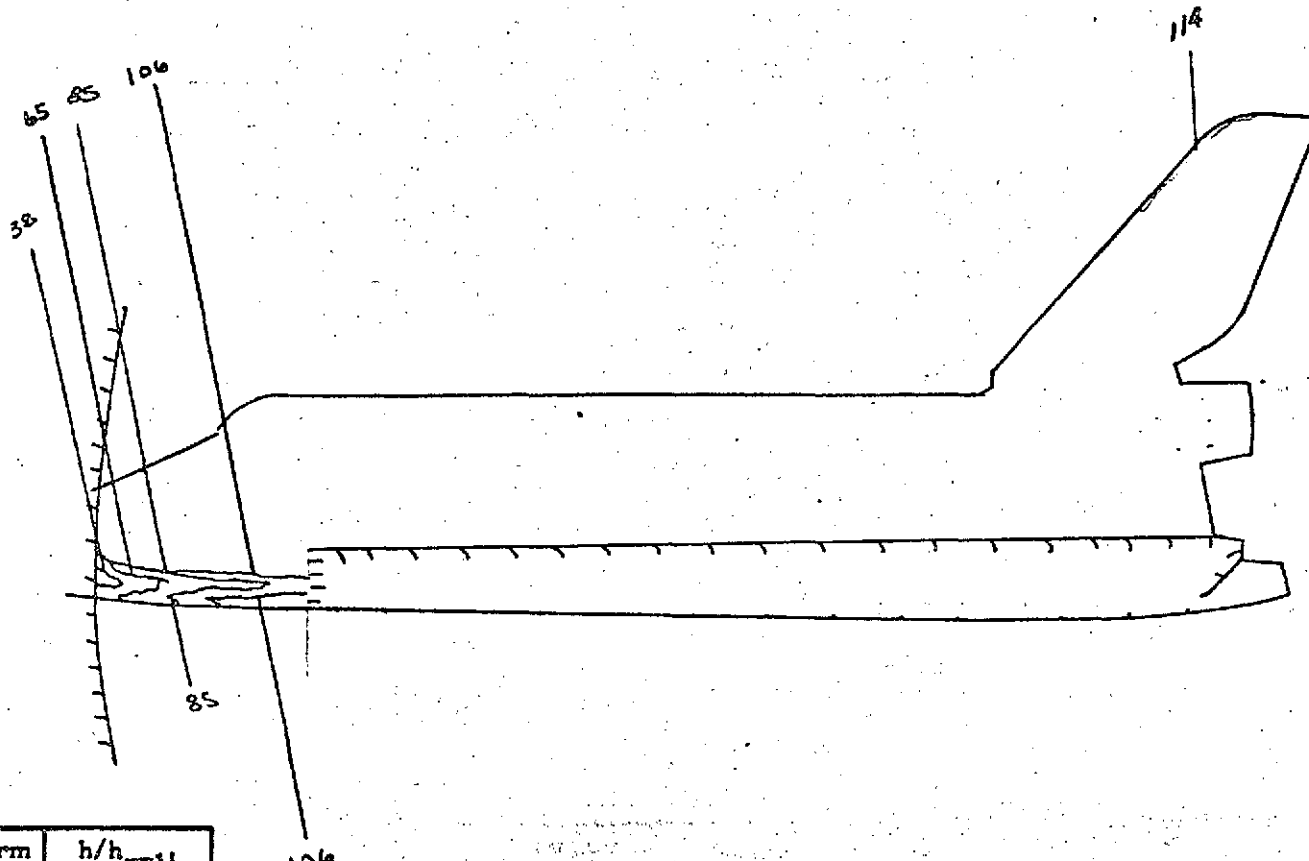
x (in) =

y (in) =

z (in) =

SPRINGS TO \leftarrow

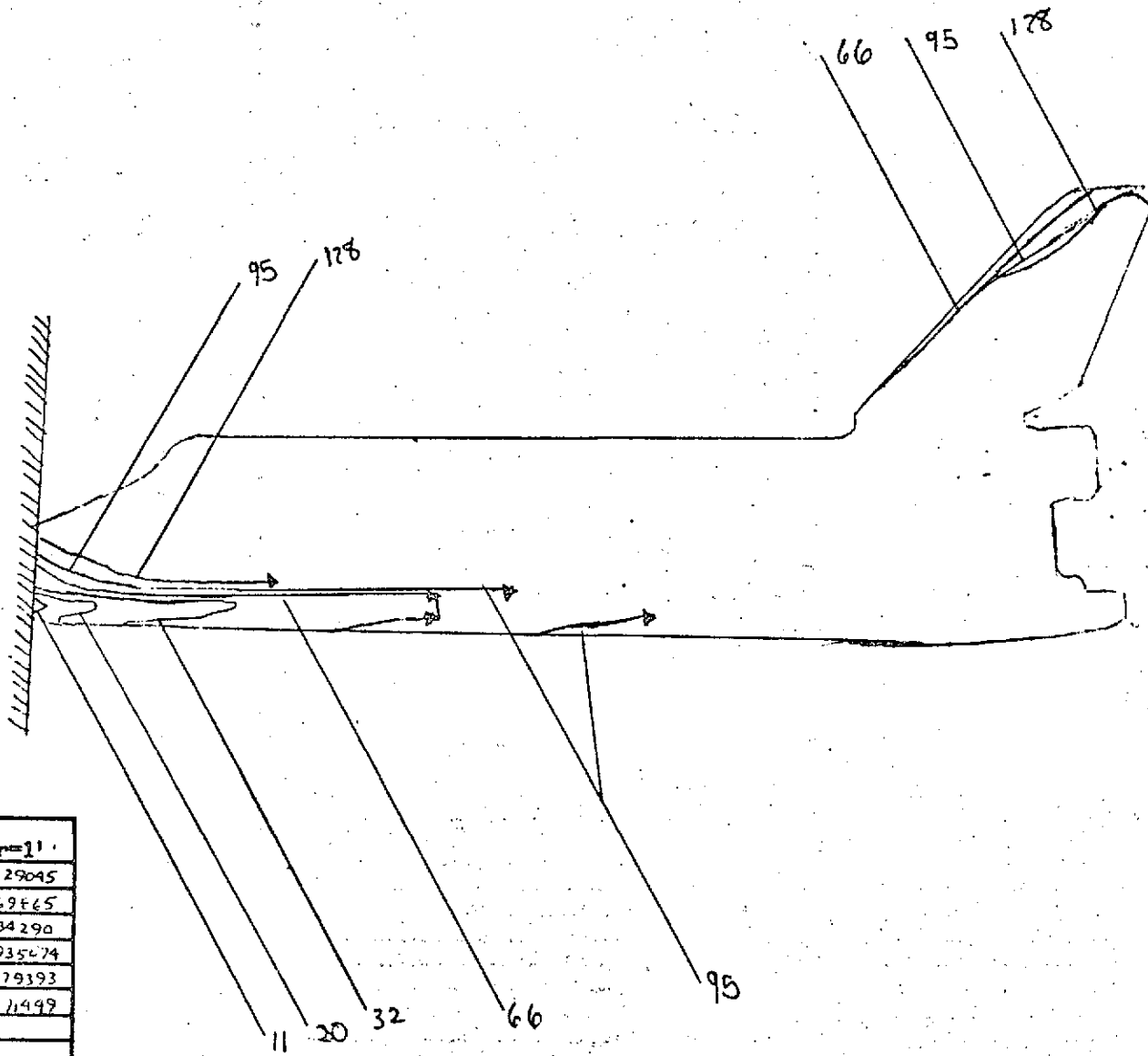
$MS = 0.103513 \frac{g \cdot in}{ft^2 \cdot sec \cdot ^\circ F}$



Isotherm	$h/h_{r=1}$
38	0.266312
65	0.203423
85	0.176013
106	0.159452
114	0.153755

FIG. 127

PHASE CHANGE TEST



Isotherm	$h/h_{p=11}$
11	0.229045
20	0.169465
32	0.134290
66	0.0935074
95	0.0779393
178	0.04611499

FIG. 128

CONFIG. 46-2

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDI

TEST OH42 (RPA)

RUN 4137

$M_{\infty} = 8$

$P_{total} \text{ (psi) } = 850$

$T_{total} \text{ (}^{\circ}\text{F) } = 925$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot } = 4 \times 10^6$

$T_{\text{phase change}} \text{ (}^{\circ}\text{F) } = 300$

$\alpha = 35$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

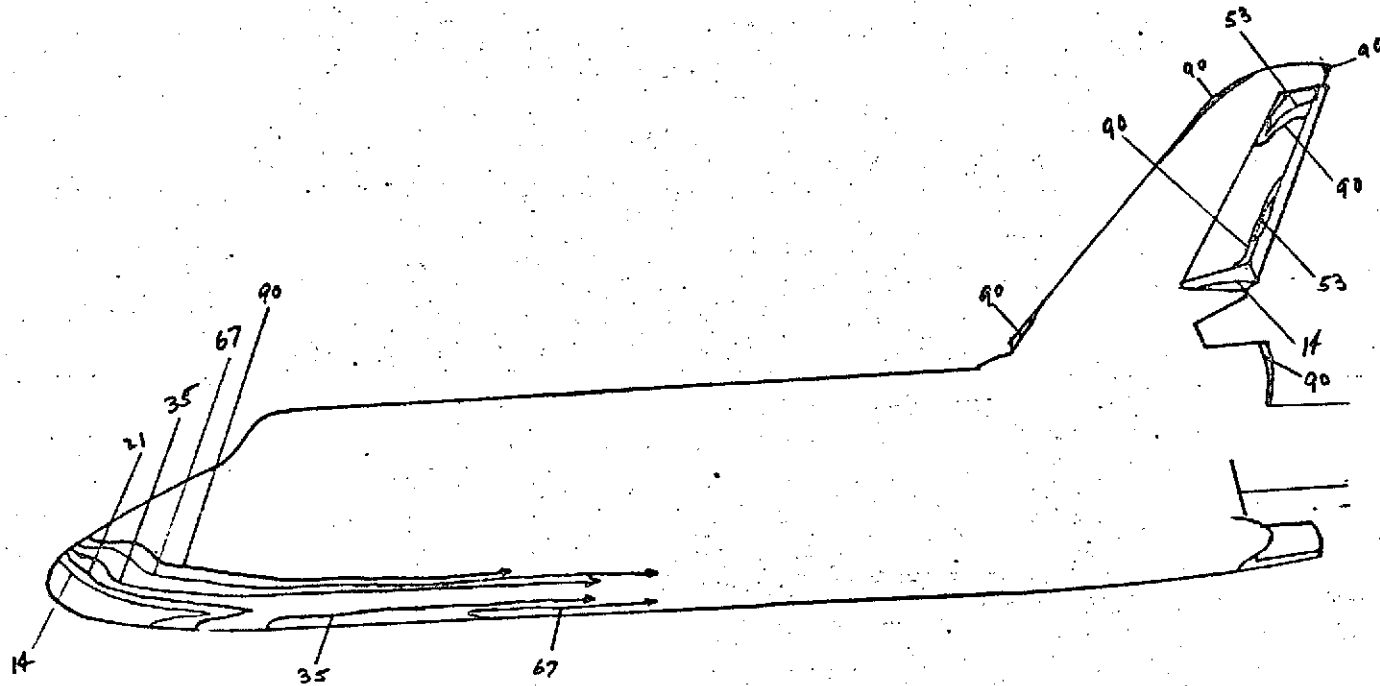
y (in) =

z (in) =

PRINTER \dot{C} IN 5 FEET/5
 $HS = 0.08386 \frac{BTU}{FT^2 \cdot SEC} \cdot ^{\circ}\text{F}$

ARDS

PHASE CHANGE TEST



Isotherm	h/h_{max}
14	0.208524
21	0.170259
35	0.131882
53	0.107172
67	0.0953197
90	0.0822429

FIG. 129

CONFIG. 46-4A

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/JDT

TEST OH42B

RUN 4140

$M_{\infty} = 8$

$P_{\text{total}} (\text{psi}) = 1615$

$T_{\text{total}} (^{\circ}\text{F}) = 930$

$T_{\text{aw}}/T_{\text{total}} = 0.90$

$R_N \text{ per foot} = 7 \times 10^6$

$T_{\text{phase change}} (^{\circ}\text{F}) = 350$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

ζ at Frame 5
 $MS = 0.112725 \frac{\text{BTU} \cdot \text{sec} \cdot ^{\circ}\text{F}}{\text{FT}^2}$

PHASE CHANGE TEST

CONFIG. 46-2

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42B (RPA)

RUN 4141

$M_\infty = 8$

$P_{total} \text{ (psi)} = 635$

$T_{total} \text{ (}^\circ\text{F)} = 875$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 3 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 300$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

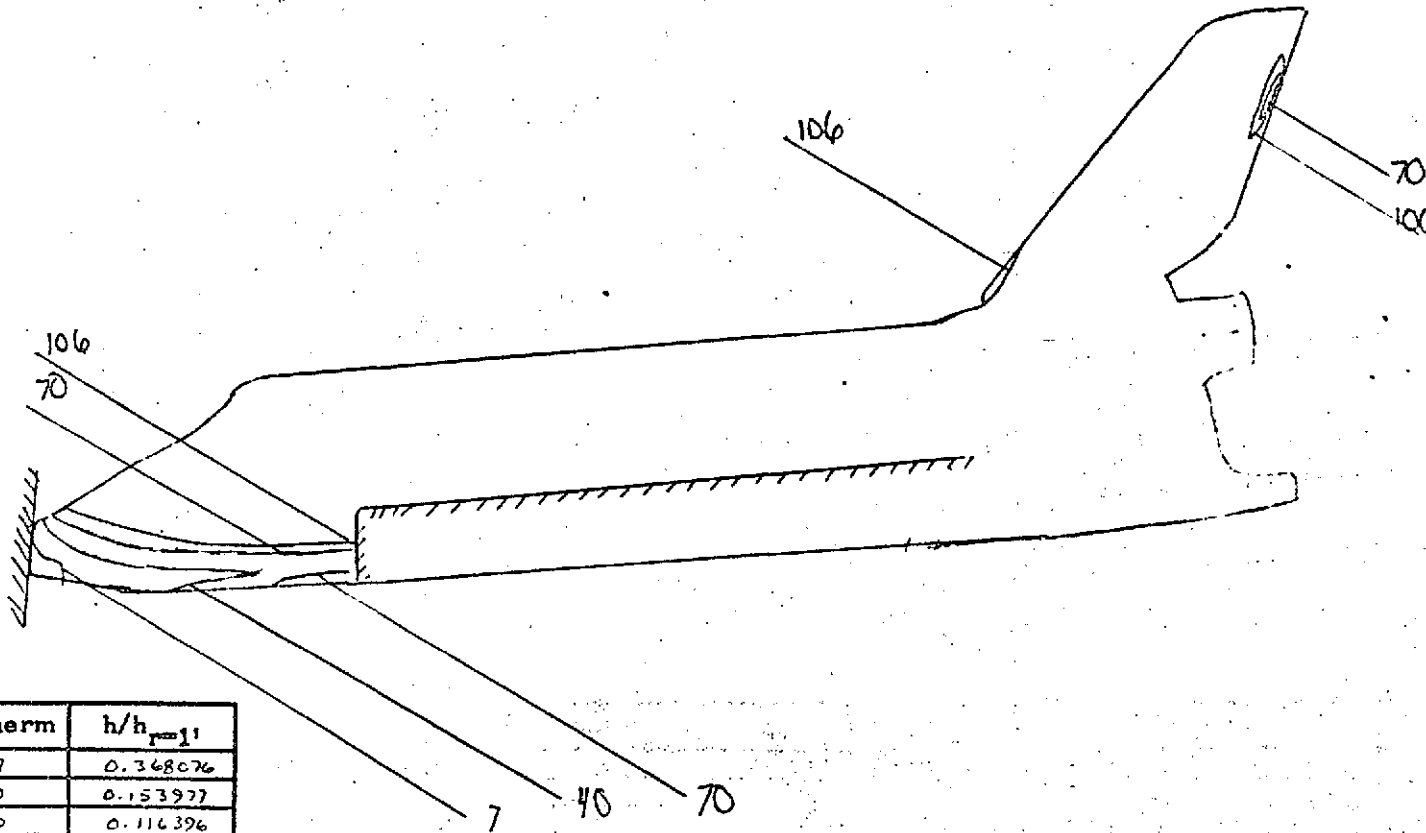
y (in) =

z (in) =

HIT ϕ on FRAME 6

AIDS
HS: 0.0731502 $\frac{875}{\text{FT}^2}$ - SEC. F

HVD-EVCS



Isotherm	$h/h_{p=1}$
7	0.368076
40	0.153977
70	0.116396
106	0.0945875

FIG. 130

PHASE CHANGE TEST

CONFIG. 46-4A

LENGTH (ft) = .658

SCALE .00593

FACILITY LRC/VDT

TEST OH42B (RPA)

RUN 4147

$M_\infty = 8$

$P_{total} \text{ (psi)} = 1120$

$T_{total} \text{ (}^\circ\text{F)} = 925$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 5 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 300$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

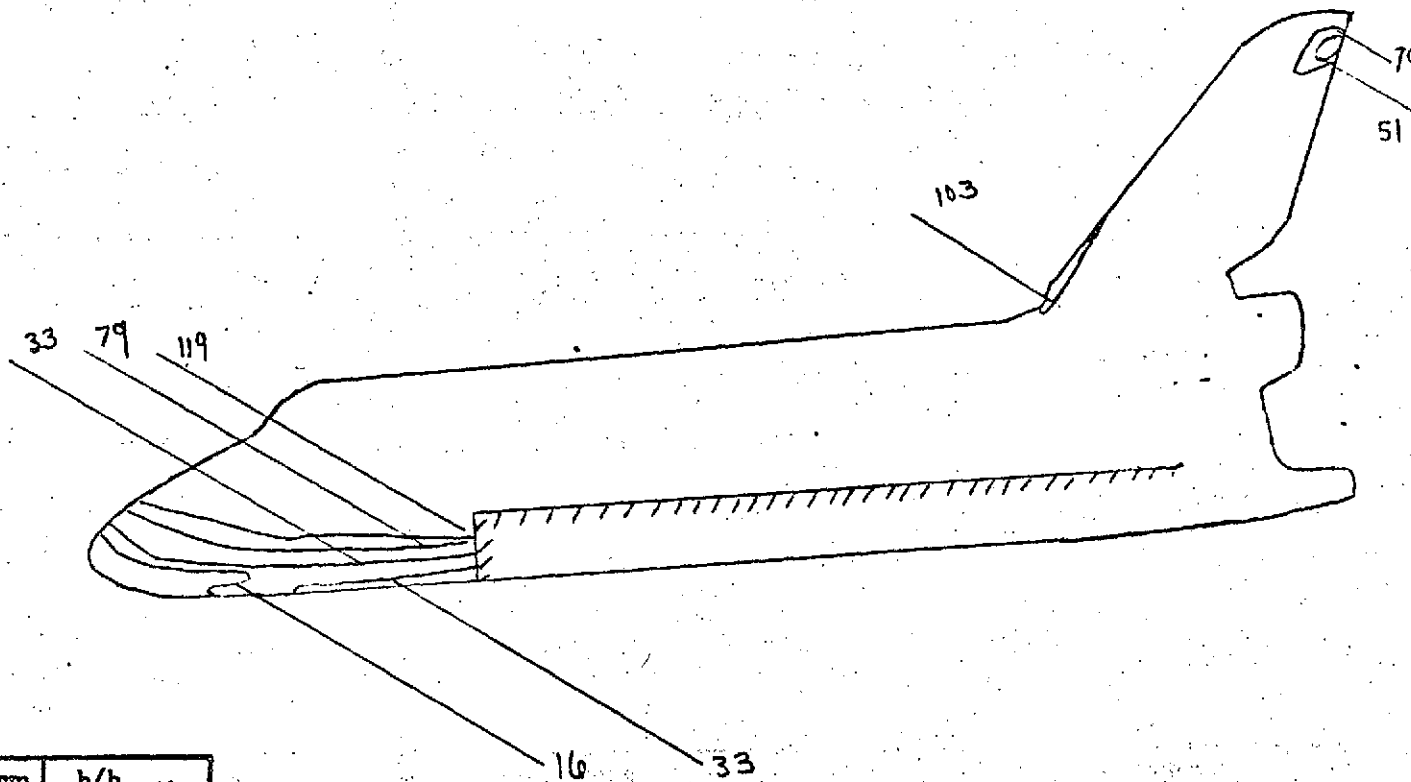
y (in) =

z (in) =

HIT Low Frame

MS
HS = 0.0951807 $\frac{BTU}{ft^2 \cdot sec \cdot ^\circ F}$

HVD-EVCS



Isotherm	$h/h_{r=1}$
16	0.170899
33	0.118999
51	0.0957229
79	0.0769108
103	0.0673569
119	0.0626653

FIG. 131

PHASE CHANGE TEST

CONFIG. 46-2

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42B (RPA)

RUN 4143

$M_\infty = 8$

P_{total} (psi) = 1390

T_{total} (°F) = 915

$T_{aw}/T_{total} = 0.90$

R_N per foot = 6×10^6

$T_{phase\ change}$ (°F) = 350

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

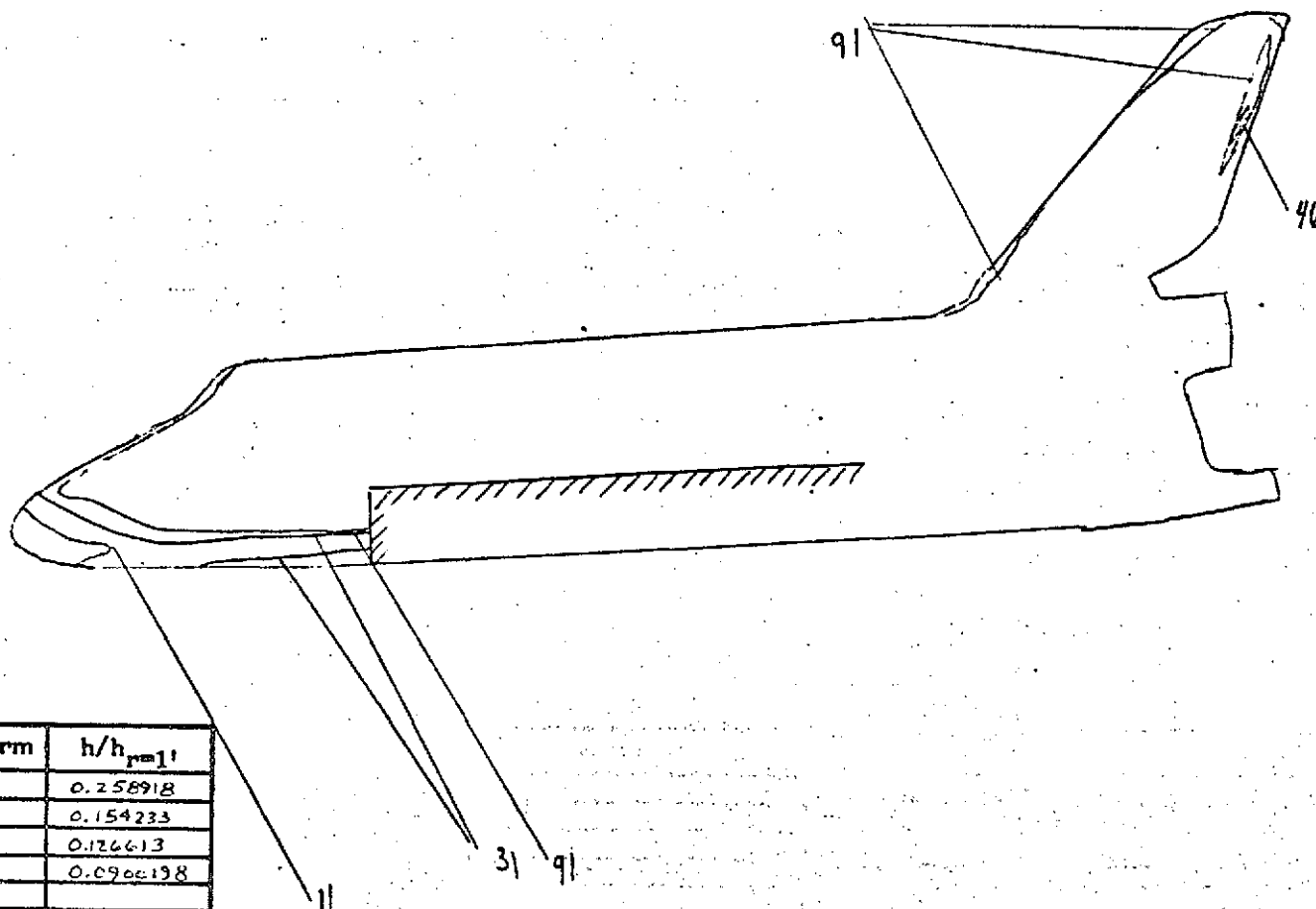
z (in) =

HIT ON 15 FEB 68

NS = 0.105092 $\frac{BTU}{FT^2 \cdot SEC \cdot ^\circ F}$

NS

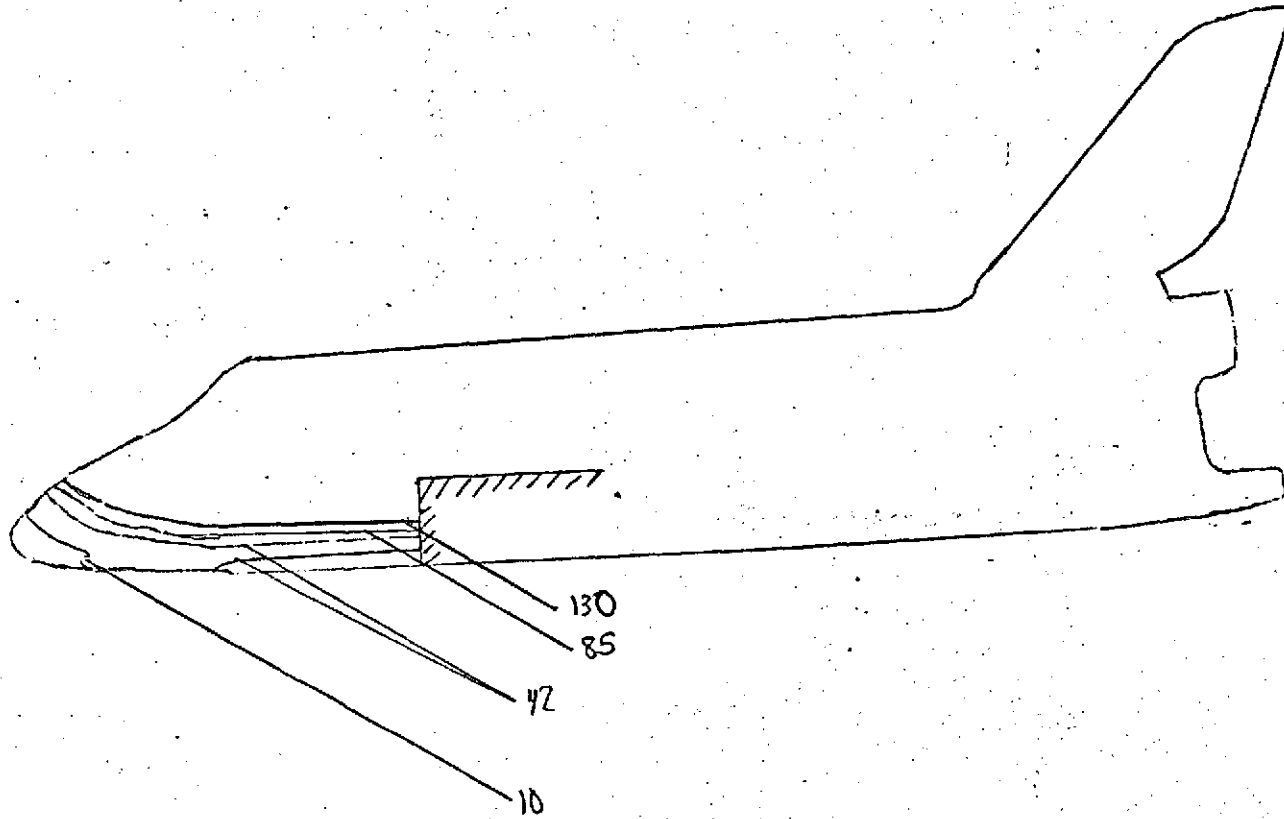
EVD-EVCS



Isotherm	h/h_{pm1}
11	0.258918
31	0.154233
46	0.126613
91	0.0900198

FIG. 132

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
10	0.236936
42	0.115613
85	0.0812644
130	0.0657143

FIG. 133

CONFIG. 46-4A

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/JDT

TEST OH42B CRPA

RUN 4144

$M_\infty = 8$

$P_{total} \text{ (psi)} = 165$

$T_{total} \text{ (}^\circ\text{F)} = 760$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 1 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 175$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from
model center, x-axis
parallel w/ stream,
+ downstream)

x (in) =

y (in) =

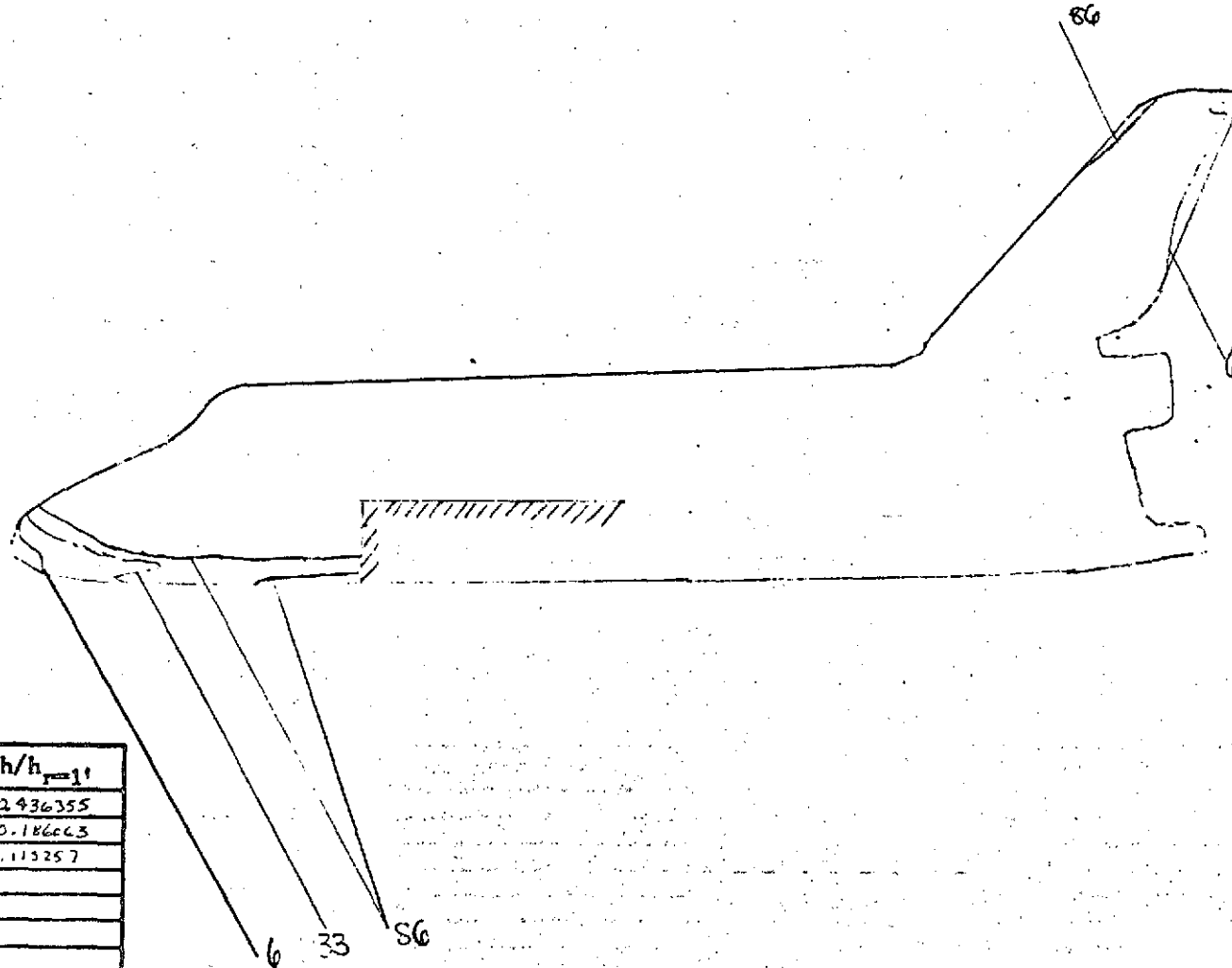
z (in) =

1175

HS = 0.0399106 $\frac{814}{\text{FT}^2} \text{ - SEC - }^\circ\text{F}$

HVD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{x=1}$
6	0.436355
33	0.186663
86	0.11257

FIG. 134

CONFIG. 46-2

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42B (RPA)

RUN 4145

$M_\infty = 8$

$P_{total} \text{ (psi)} = 1615$

$T_{total} \text{ (}^\circ\text{F)} = 915$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 7 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 400$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

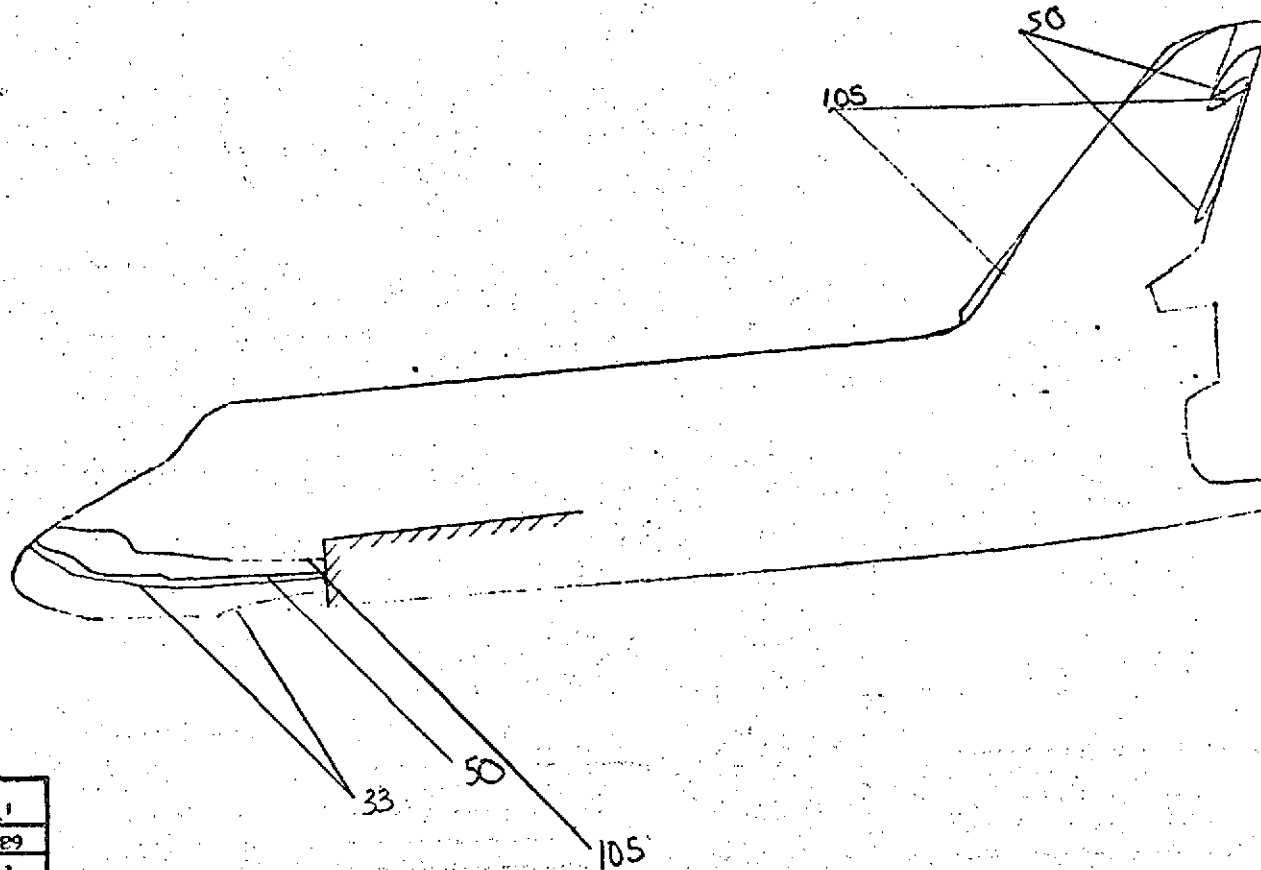
z (in) =

REMARKS: ϵ in F_{rms} C

HS = 0.112584 $\frac{BTU}{FT^2 \cdot \text{sec} \cdot ^\circ\text{F}}$

PHASE CHANGE TEST

CONFIG. 46-4A



LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH428 (RPA)

RUN 4146

$M_{\infty} = 8$

$P_{total} (psi) = 1380$

$T_{total} (^{\circ}F) = 935$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} (^{\circ}F) = 350$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

Refractive Index of Frame Glass
 $n_s = 0.109895 \frac{BTU}{FT^2 \cdot SEC \cdot ^{\circ}F}$

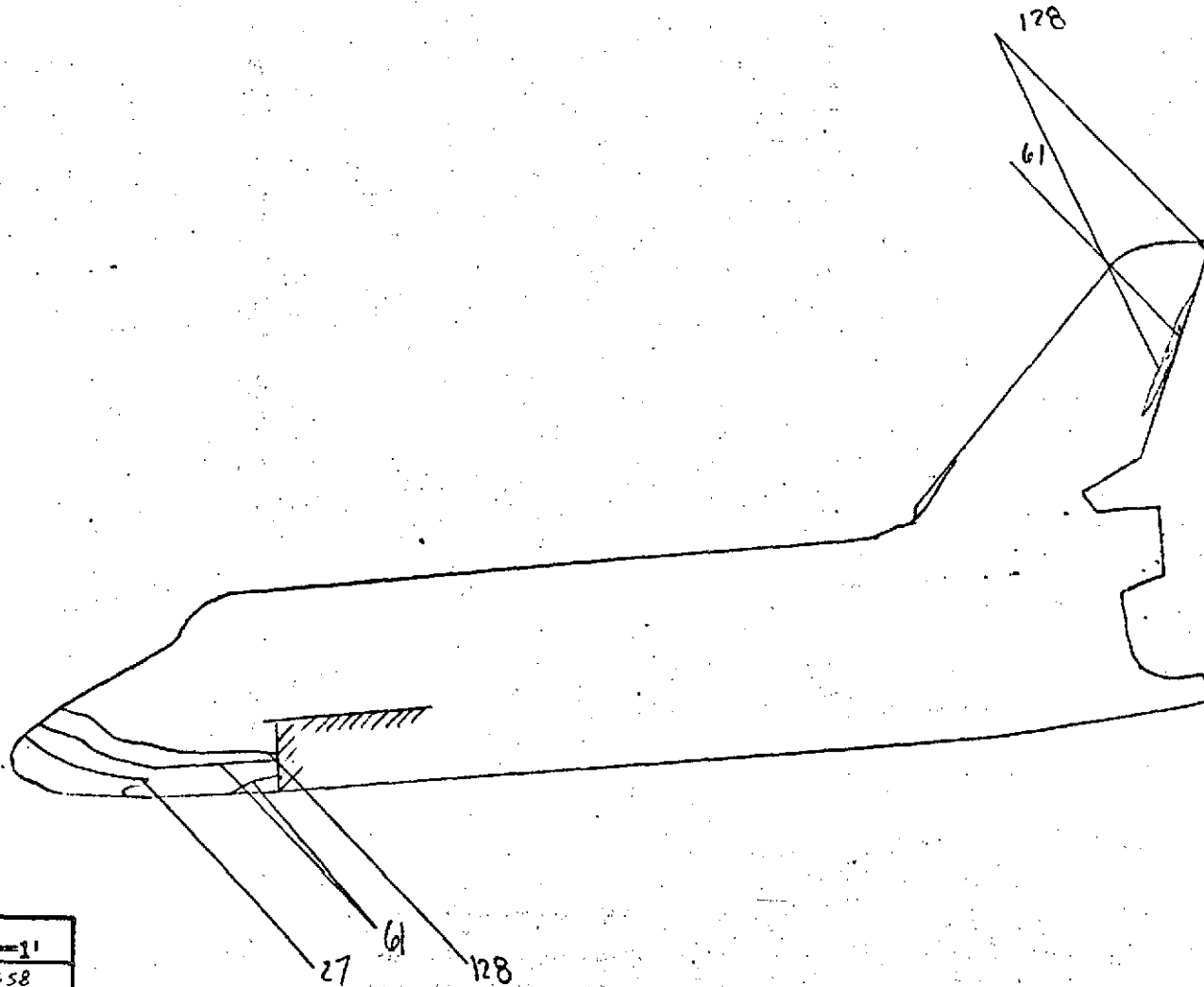
M.S.

HVD-EVCS

Isotherm	$h/h_{r=1}$
33	0.143689
50	0.116733
105	0.086537

FIG. 135

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
27	0.174358
61	0.117331
128	0.0809978

FIG. 136

CONFIG. 46-2

LENGTH (ft) = .638

SCALE .00593

FACILITY LRL/VDT

TEST OH42B (RPA)

RUN 4147

$M_{\infty} = 8$

$P_{total} (psi) = 615$

$T_{total} (^{\circ}F) = 910$

$T_{aw}/T_{total} = 0.90$

R_N per foot = 3×10^6

$T_{phase\ change} (^{\circ}F) = 300$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

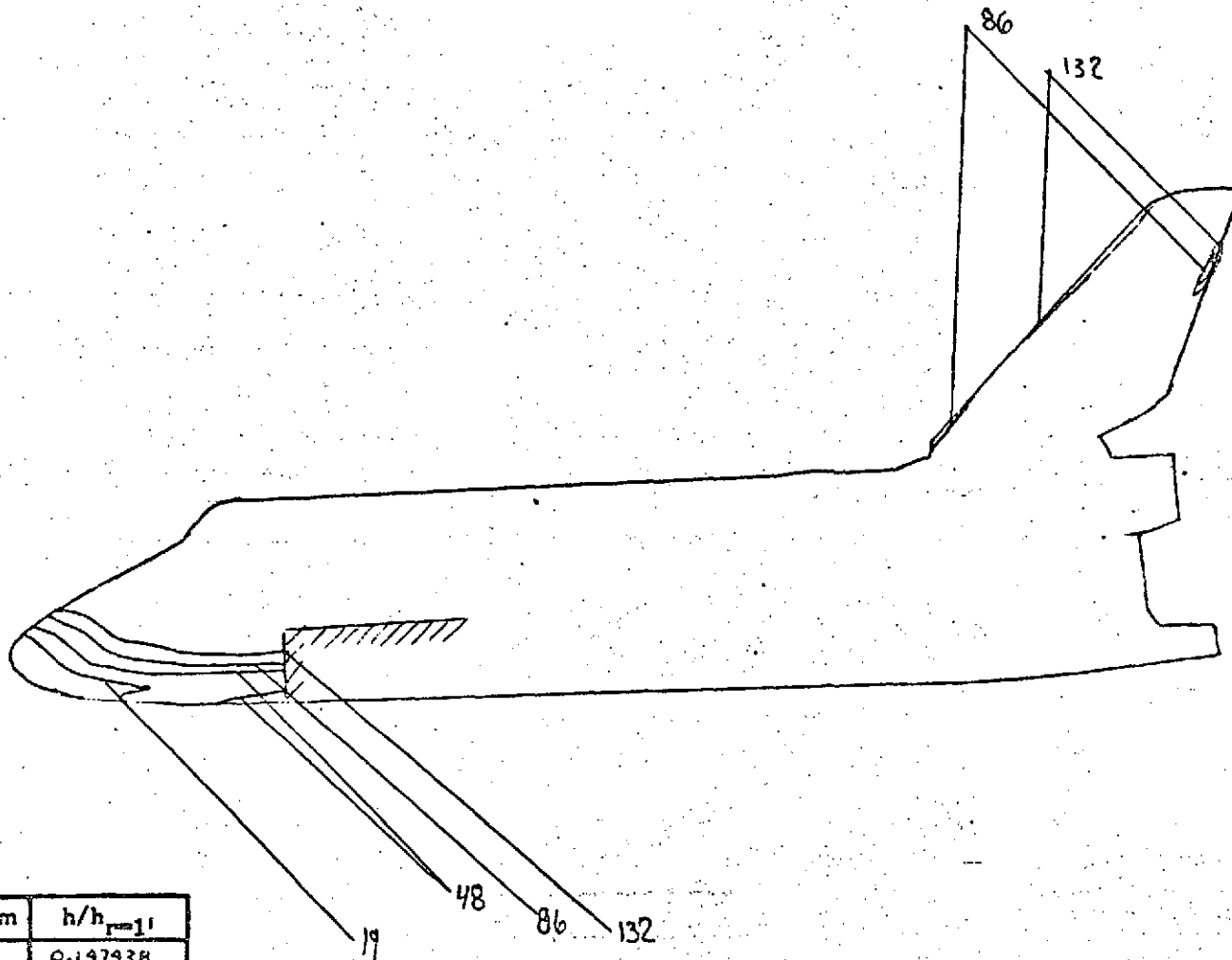
z (in) =

RECOVER ϕ ON FIG. 6
 $MS = 0.0722867 \frac{BTU}{FT^2} - SEC - ^{\circ}F$

MPS

HVD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{\text{ref}}=1$
19	0.147938
48	0.0977612
86	0.0693007
132	0.0559371

FIG. 137

CONFIG. 46-2

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42B (RPA)

RUN 4148

$M_{\infty} = 8$

$P_{\text{total}} (\text{psi}) = 165$

$T_{\text{total}} (^{\circ}\text{F}) = 810$

$T_{\text{aw}}/T_{\text{total}} = 0.90$

$R_N \text{ per foot} = 1 \times 10^6$

$T_{\text{phase change}} (^{\circ}\text{F}) = 175$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

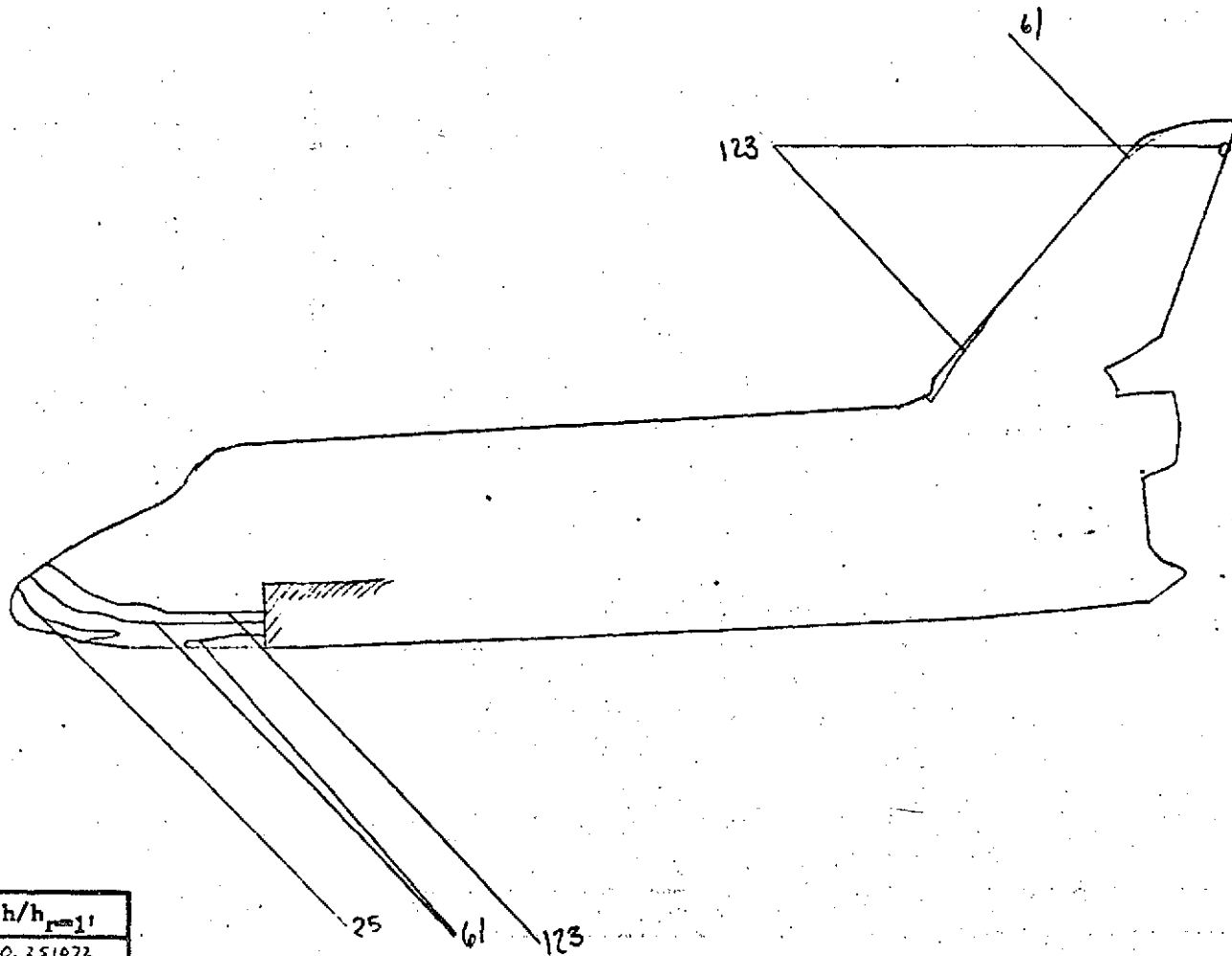
z (in) =

Re = 2.0900807 $\frac{\text{BTU}}{\text{FT}^2 \cdot \text{SEC} \cdot ^{\circ}\text{F}}$

MS = 0.0900807 $\frac{\text{BTU}}{\text{FT}^2 \cdot \text{SEC} \cdot ^{\circ}\text{F}}$

MS

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
25	0.251072
61	0.166732
123	0.113192

FIG. 138

CONFIG. 46-4ABF

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/JDT

TEST OH42B (RPA)

RUN 4150

$M_\infty = 8$

P_{total} (psi) = 635

T_{total} (°F) = 900

$T_{aw}/T_{total} = 0.90$

R_N per foot = 3×10^6

$T_{phase\ change}$ (°F) = 350

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

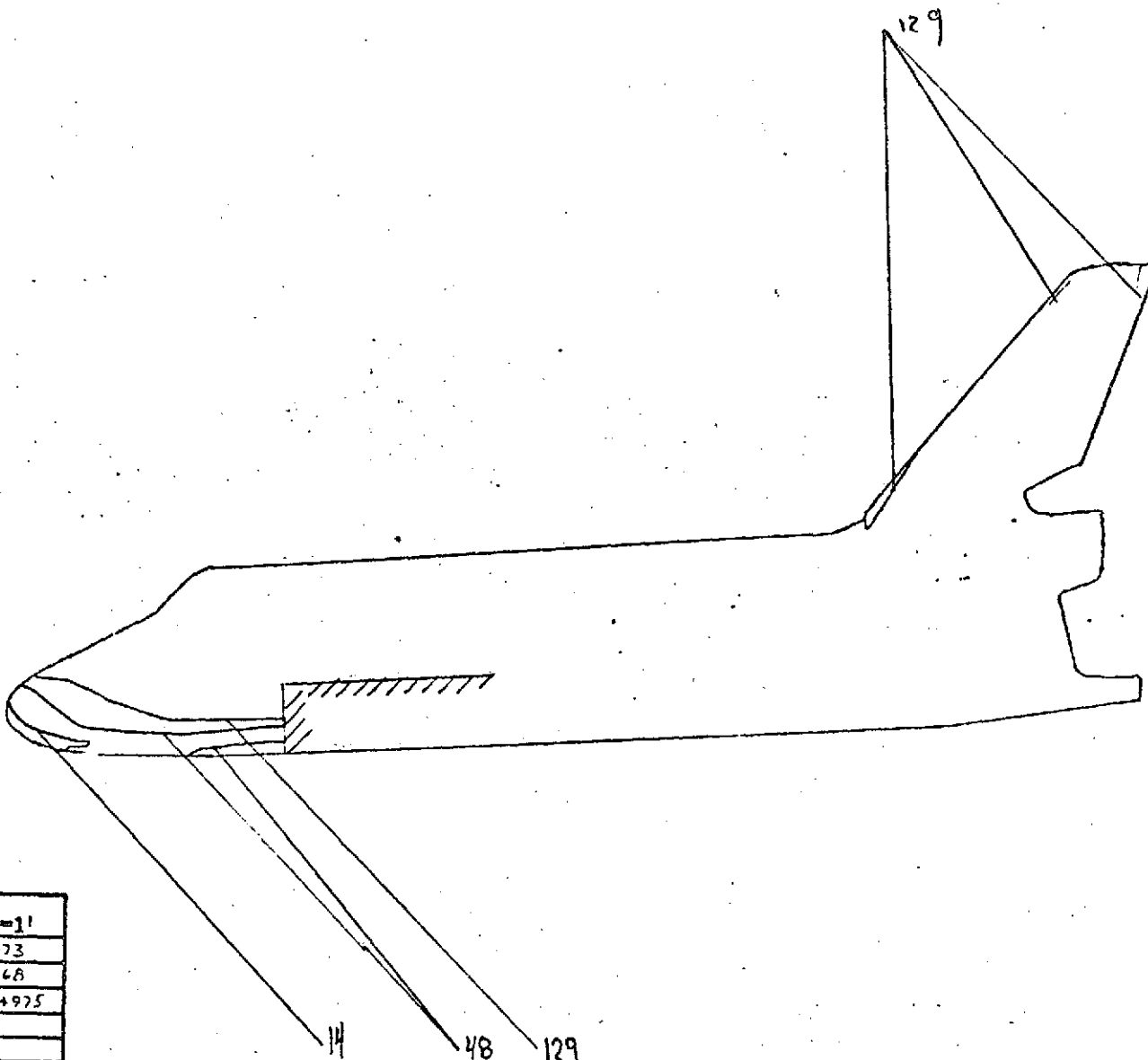
x (in) =

y (in) =

z (in) =

1/17/55
 HS 0.013298 BTM-38C-°F
 FT
 HVD-EVCS

PHASE CHANGE TEST



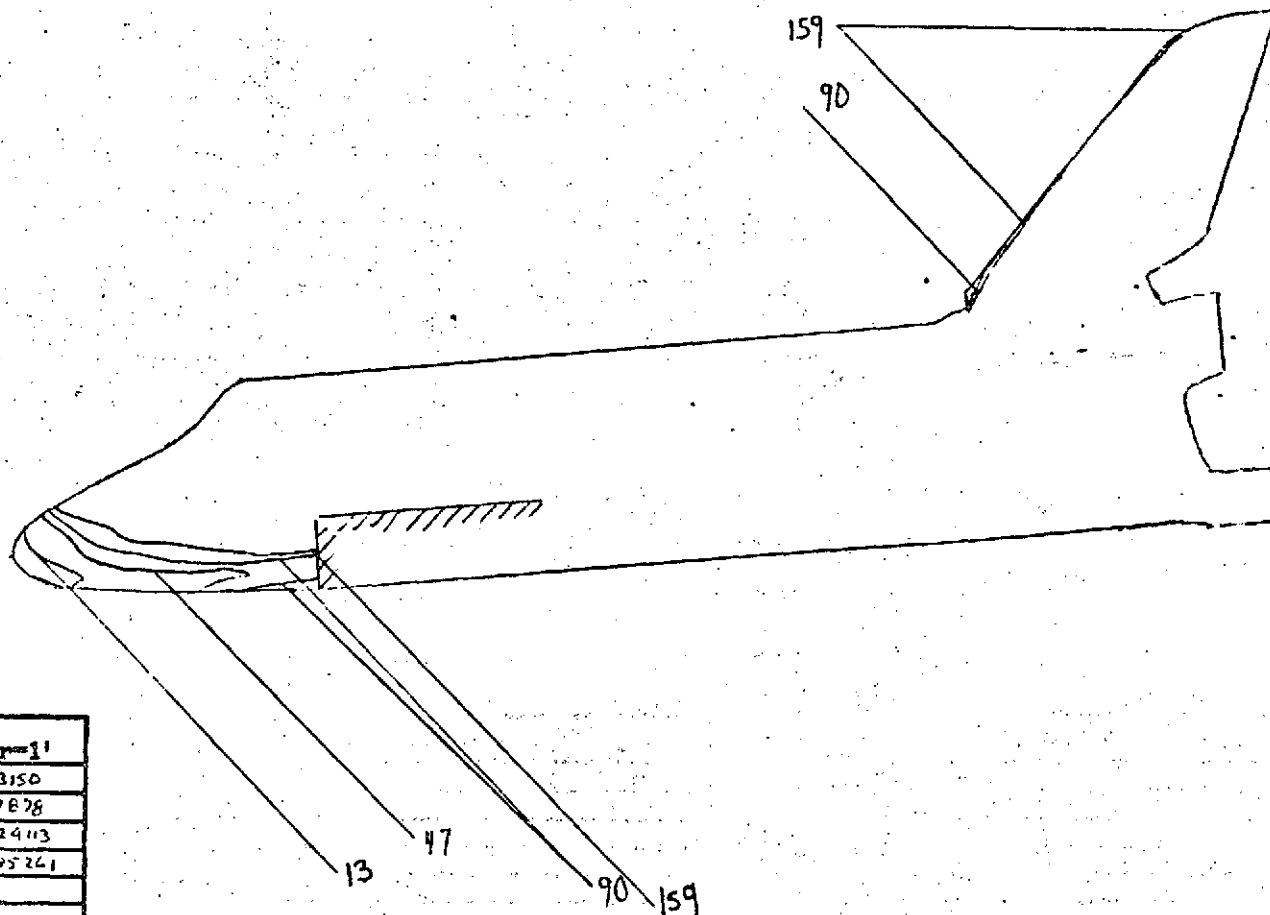
CONFIG. 46-1
LENGTH (ft) = .638
SCALE .00593
FACILITY LRC/UDT
TEST OH42B (RPA)
RUN 4153
$M_{\infty} = 8$
$P_{total} \text{ (psi)} = 640$
$T_{total} \text{ (}^{\circ}\text{F)} = 920$
$T_{aw}/T_{total} = 0.90$
$R_N \text{ per foot} = 3 \times 10^4$
$T_{\text{phase change}} \text{ (}^{\circ}\text{F)} = 300$
$\alpha = 30$
$\beta = 0$
$\phi = 0$
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)
x (in) =
y (in) =
z (in) =

Isotherm	$h/h_{p=1}$
14	0.229173
48	0.123768
129	0.06754975

FIG. 140

PRINTED ON SPINE 6
 1.05
 $H_2 = 0.0736592 \frac{BTU}{FT^2 \cdot SEC \cdot ^{\circ}F}$

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
13	0.243150
47	0.127878
90	0.692413
159	0.0695261

FIG. 141

CONFIG. 46-4ABF

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42B (RPA)

RUN 4154

$M_\infty = 8$

P_{total} (psi) = 160

T_{total} ($^{\circ}$ F) = 795

$T_{aw}/T_{total} = 0.90$

R_N per foot = 1×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 200

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

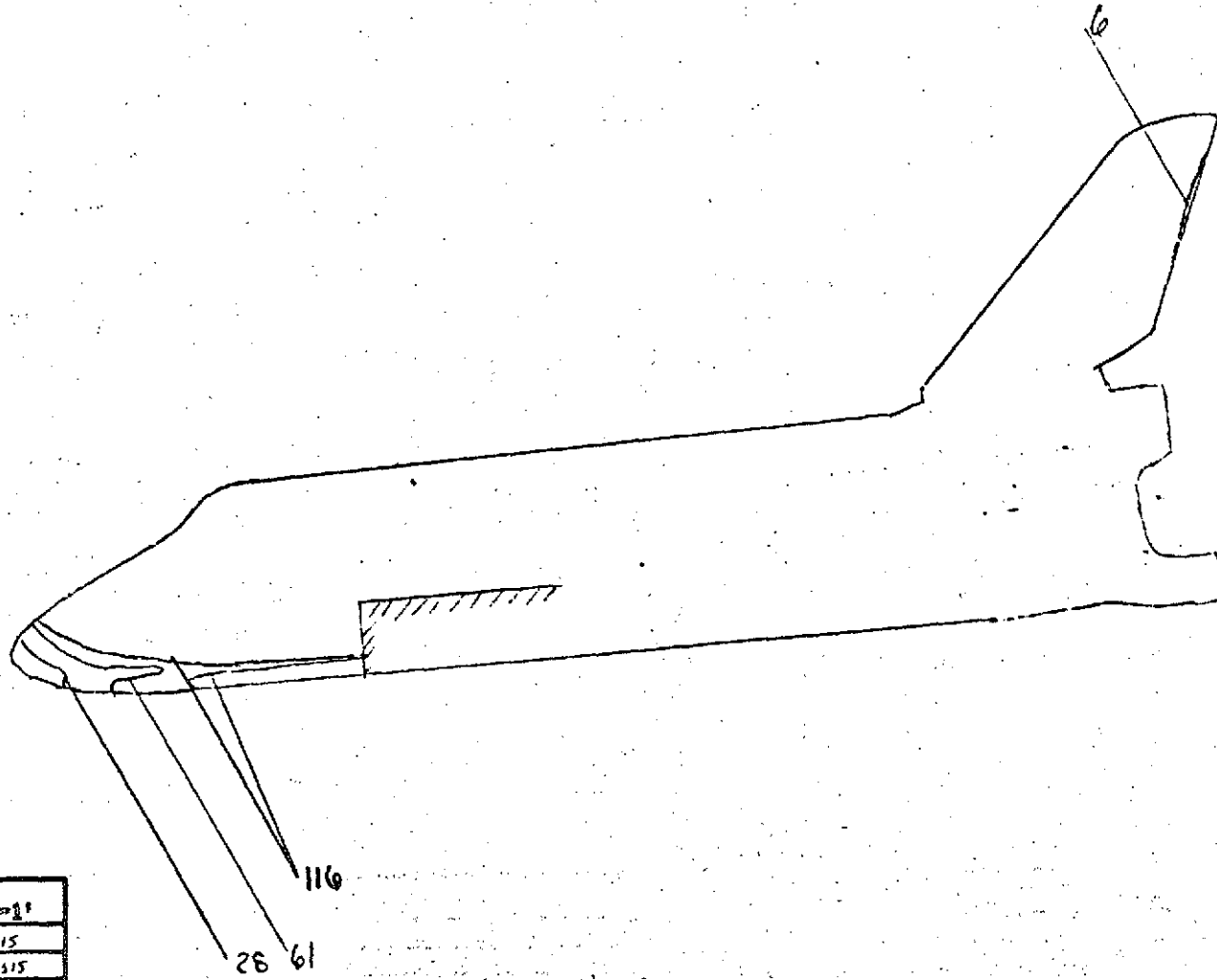
y (in) =

z (in) =

REPRODUCED FROM PHOTOGRAPH

MS-0.0395666 $\frac{BTU}{FT^2 \cdot SEC \cdot ^{\circ}F}$

PHASE CHANGE TEST



Isotherm	h/h_{max}
6	0.661715
28	0.306315
61	0.267530
116	0.156493

FIG. 142

CONFIG. 46-4ABF

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST 0H42B (RPA)

RUN 4155

$M_{\infty} = 8$

P_{total} (psi) = 630

T_{total} ($^{\circ}$ F) = 910

$T_{\text{aw}}/T_{\text{total}} = 0.90$

R_N per foot = 3×10^6

$T_{\text{phase change}}$ ($^{\circ}$ F) = 400

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

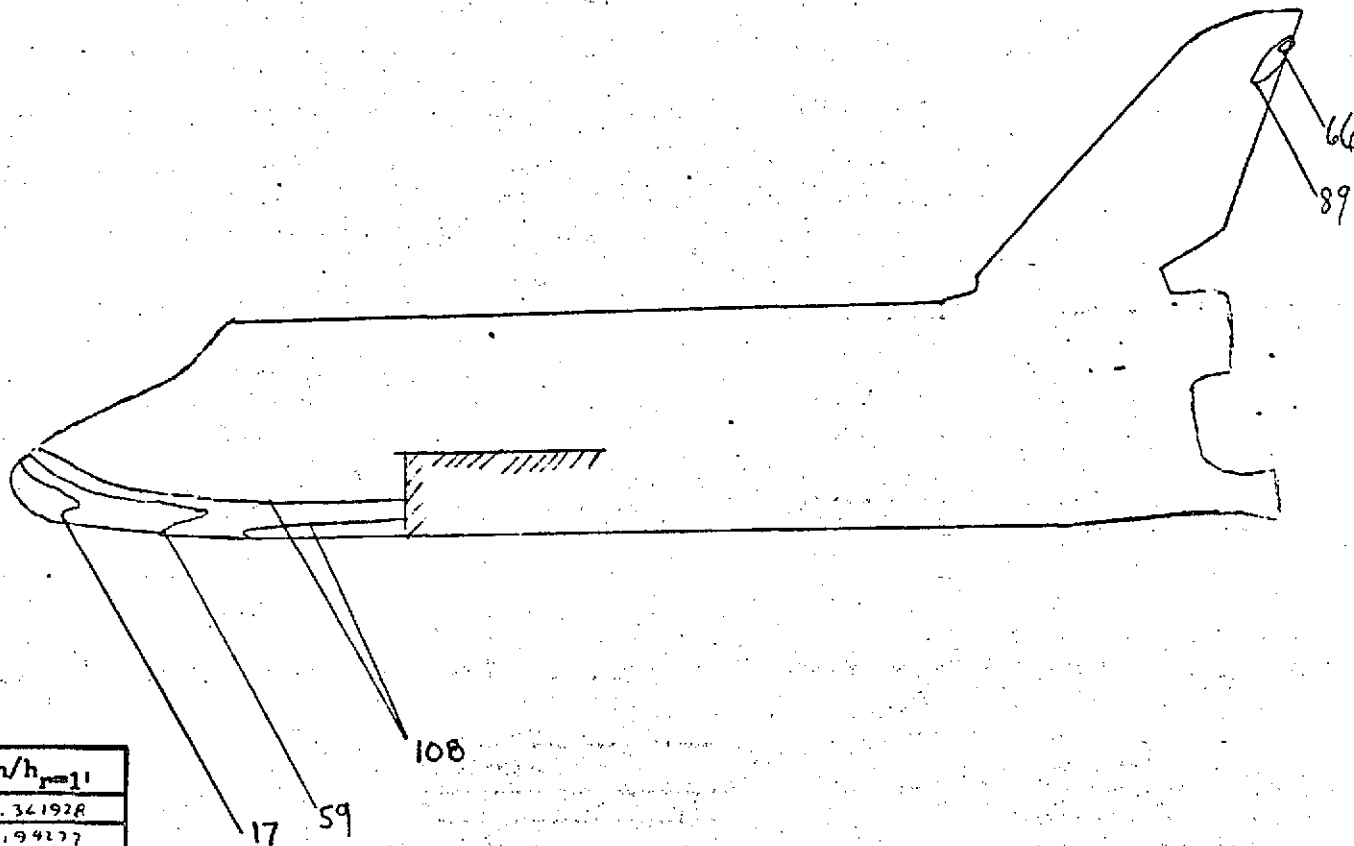
z (in) =

Revised 11/10/66

HS = 0.073362 $\frac{\text{BTU}}{\text{FT}^2 \cdot \text{SEC} \cdot ^{\circ}\text{F}}$

11/10/66

PHASE CHANGE TEST



Isotherm	$h/h_{p=11}$
17	0.34192R
59	0.194277
66	0.183684
89	0.158180
108	0.193594

FIG. 143

CONFIG. 46-4ABF

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/JDT

TEST OH42B (RPA)

RUN 4156

$M_{\infty} = 8$

$P_{total} (psi) = 1385$

$T_{total} (^{\circ}F) = 915$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} (^{\circ}F) = 450$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

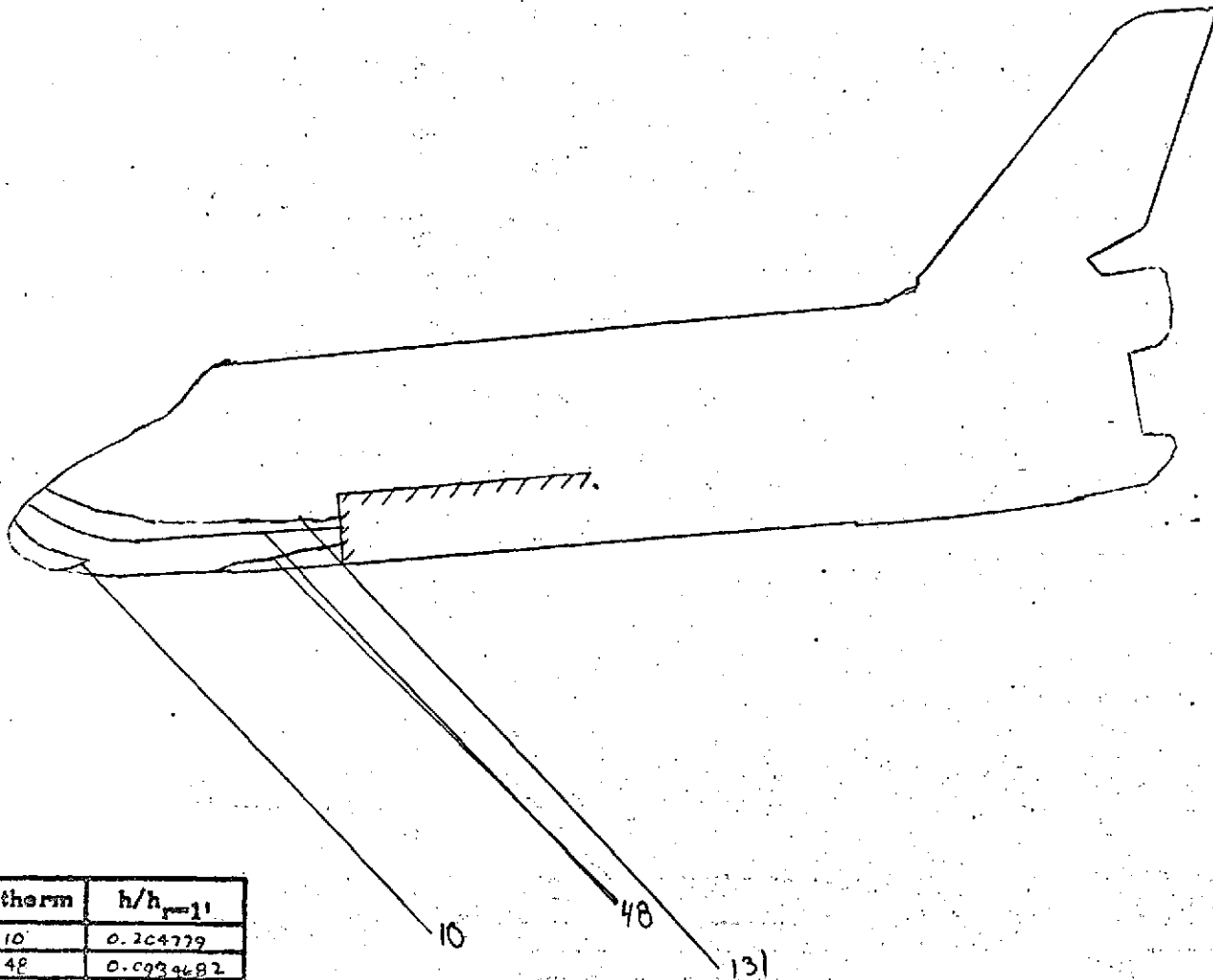
x (in) =

y (in) =

z (in) =

Revised & corrected 6
 HS-0-104761 $\frac{BTU}{FT^2 \text{ SEC} \cdot ^{\circ}F}$
 HSC

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
10	0.264779
48	0.0934682
131	0.0565782

FIG. 144

CONFIG. 46-1

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42B (RPA)

RUN 4158

$M_\infty = 8$

$P_{total} \text{ (psi)} = 163$

$T_{total} \text{ (}^\circ\text{F)} = 780$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 1 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 175$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

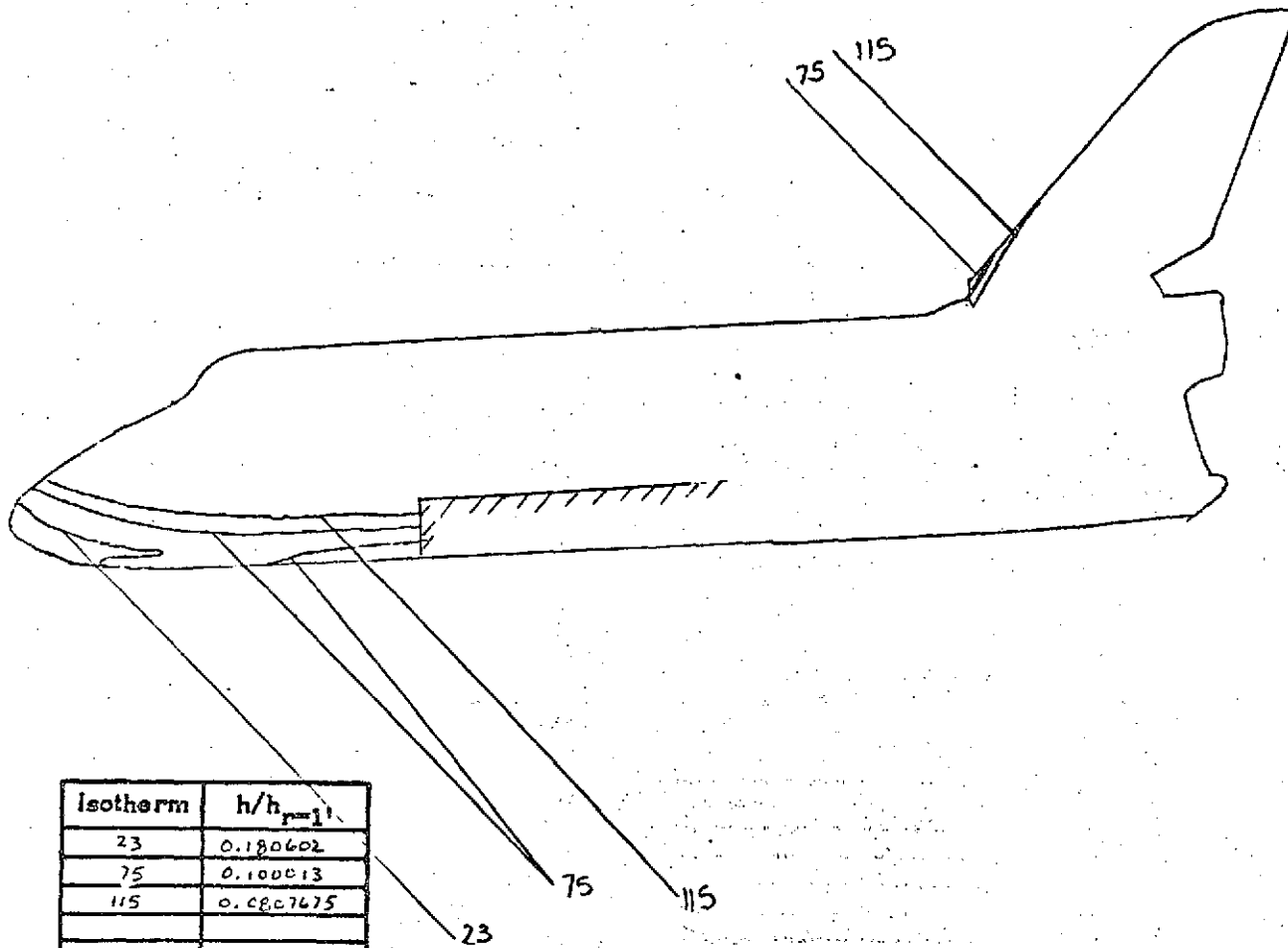
z (in) =

Trace - Con. Figure

HS = 0.0397758 $\frac{\text{BTU}}{\text{FT}^2 \cdot \text{SEC} \cdot ^\circ\text{F}}$

RVD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
23	0.180602
75	0.100813
115	0.0807675

FIG. 145

CONFIG. 46-3
LENGTH (ft) = .638
SCALE .00593
FACILITY LRC/UDT
TEST OH42B (RPA)
RUN 4159
$M_\infty = 8$
$P_{total} \text{ (psi)} = 620$
$T_{total} \text{ (}^\circ\text{F)} = 920$
$T_{aw}/T_{total} = 0.90$
$R_N \text{ per foot} = 3 \times 10^6$
$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 300$
$\alpha = 30$
$\beta = 0$
$\phi = 0$
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)
x (in) =
y (in) =
z (in) =

REF. 10 & - 100006
 $HS = 0.0726060 \frac{\text{BTU}}{\text{FT}^2 \cdot \text{SEC} \cdot ^\circ\text{F}}$
 1120

PHASE CHANGE TEST

CONFIG. 46-1

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B (RPA)

RUN 4160

$M_\infty = 8$

P_{total} (psi) = 160

T_{total} (°F) = 805

$T_{aw}/T_{total} = 0.90$

R_N per foot = 1×10^6

$T_{phase\ change}$ (°F) = 156

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

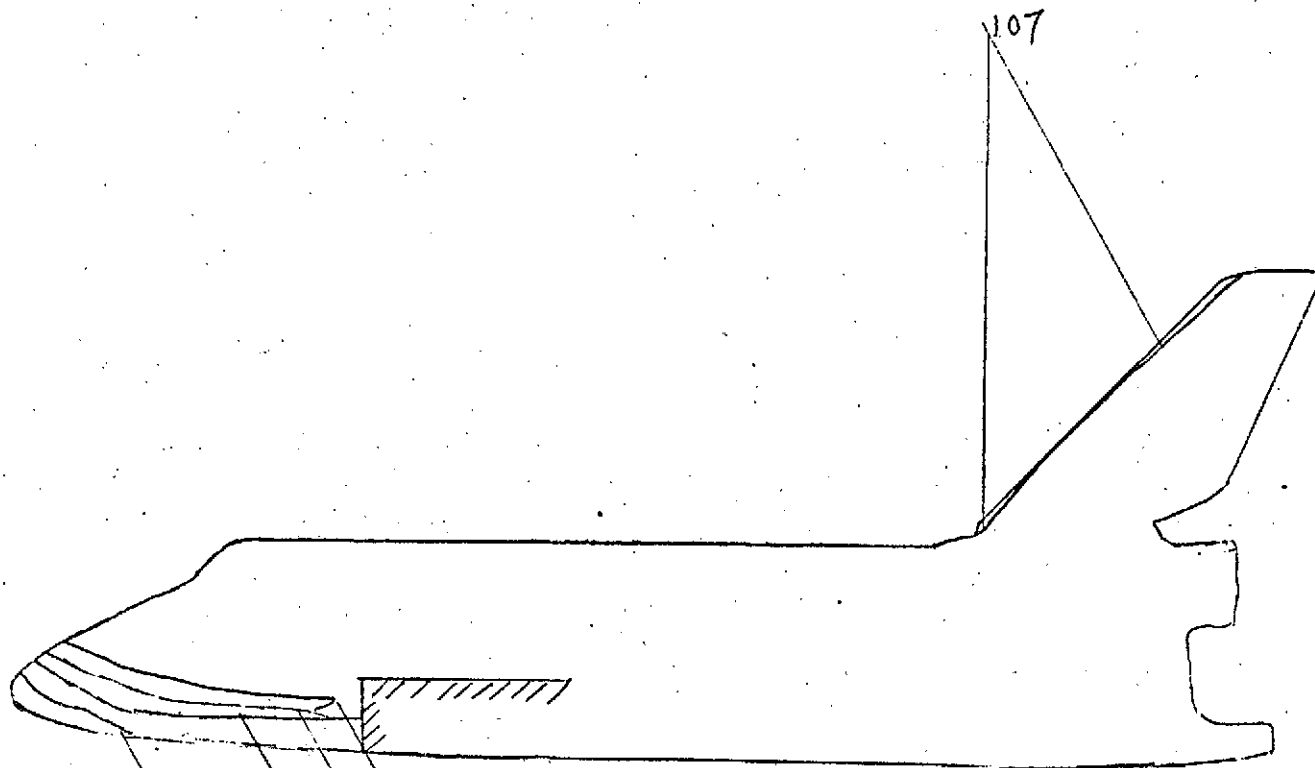
x (in) =

y (in) =

z (in) =

Reynolds $\#$ in Freestream 6
 $MS = 0.0395039 \frac{BTU}{FT^2 \cdot SEC \cdot ^\circ F}$
 AIDS

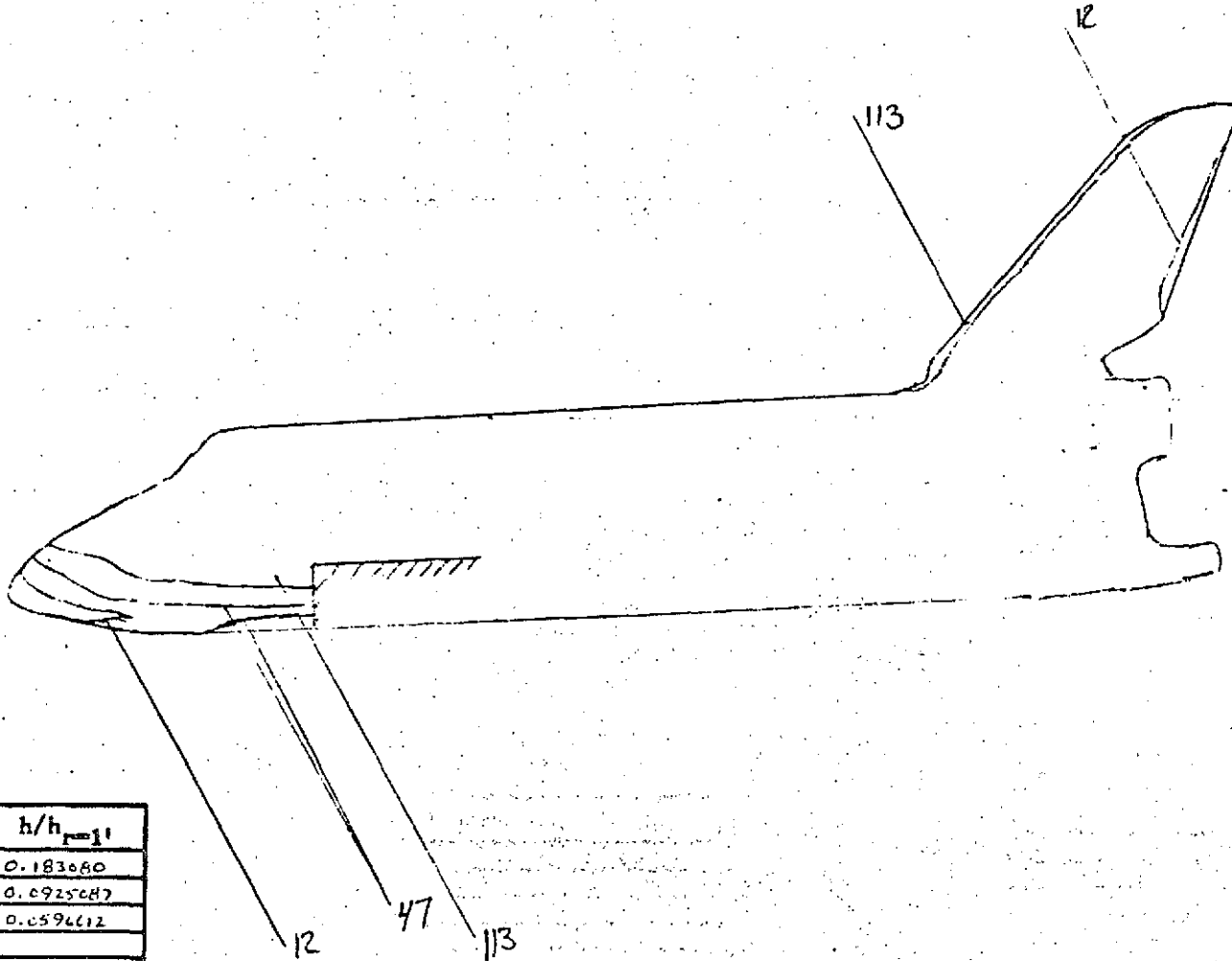
HVD-EVCS



Isotherm	$h/h_{p=1}$
10	0.150101
38	0.0770003
65	0.0542796
107	0.0454873

FIG. 146

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
12	0.183080
47	0.0925087
113	0.0594612

FIG. 147

CONFIG. 46-3

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42B (RPA)

RUN 4161

$M_\infty = 8$

$P_{total} \text{ (psi)} = 165$

$T_{total} \text{ (}^\circ\text{F)} = 800$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 1 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 175$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

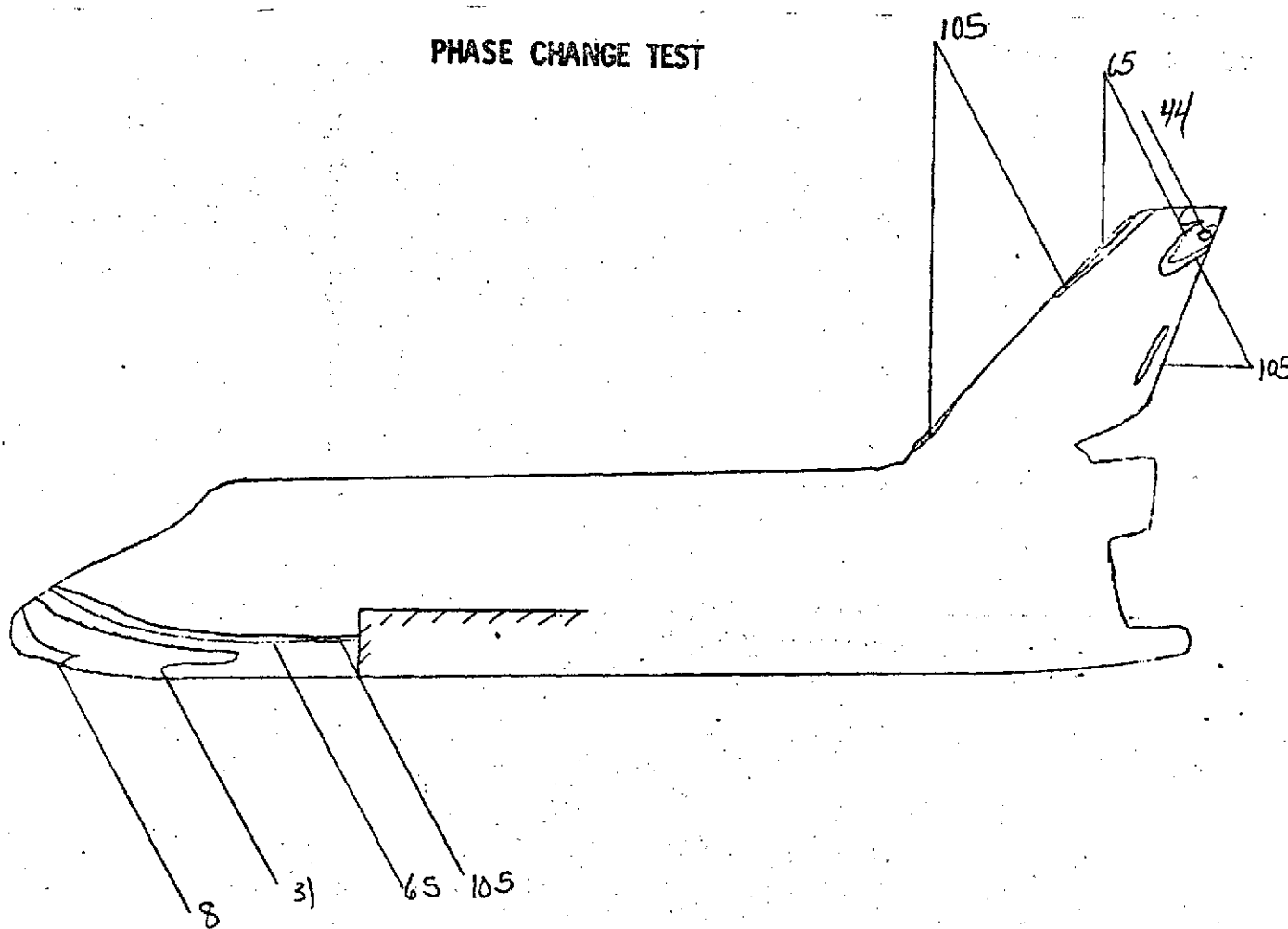
x (in) =

y (in) =

z (in) =

DRIFT & CONVERSION
 $HS = 0.0400924 \frac{\text{BTU}}{\text{FT}^2 \cdot \text{SEC} \cdot ^\circ\text{F}}$

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
8	0.295914
31	0.150324
44	0.126178
65	0.102413
105	0.0816799

FIG. 148

CONFIG. 46-1

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B (RPA)

RUN 4162

$M_{\infty} = 8$

$P_{total} \text{ (psi)} = 1385$

$T_{total} \text{ (}^{\circ}\text{F)} = 915$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} \text{ (}^{\circ}\text{F)} = 350$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

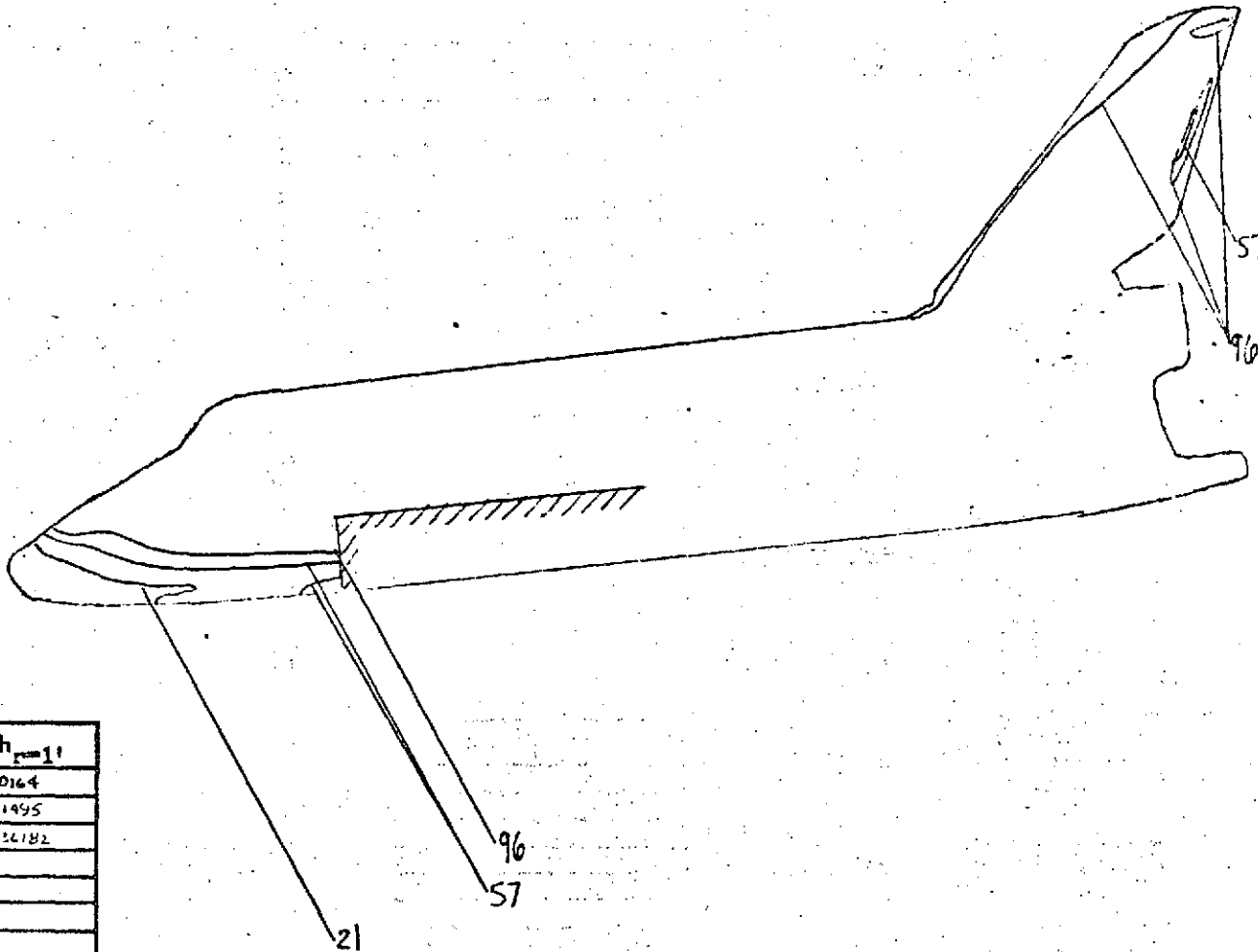
z (in) =

Material: $d = 0.006$
 $k_s = 0.104917 \frac{\text{BTU}}{\text{FT}^2 \cdot \text{Sec} \cdot ^{\circ}\text{F}}$

MDS

HVD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{x=1}$
21	0.200164
57	0.121495
96	0.0934182

FIG. 149

CONFIG. 46-3

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42B (RPA)

RUN 4163

$M_\infty = 8$

$P_{total} \text{ (psi)} = 1385$

$T_{total} \text{ (}^\circ\text{F)} = 870$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 350$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

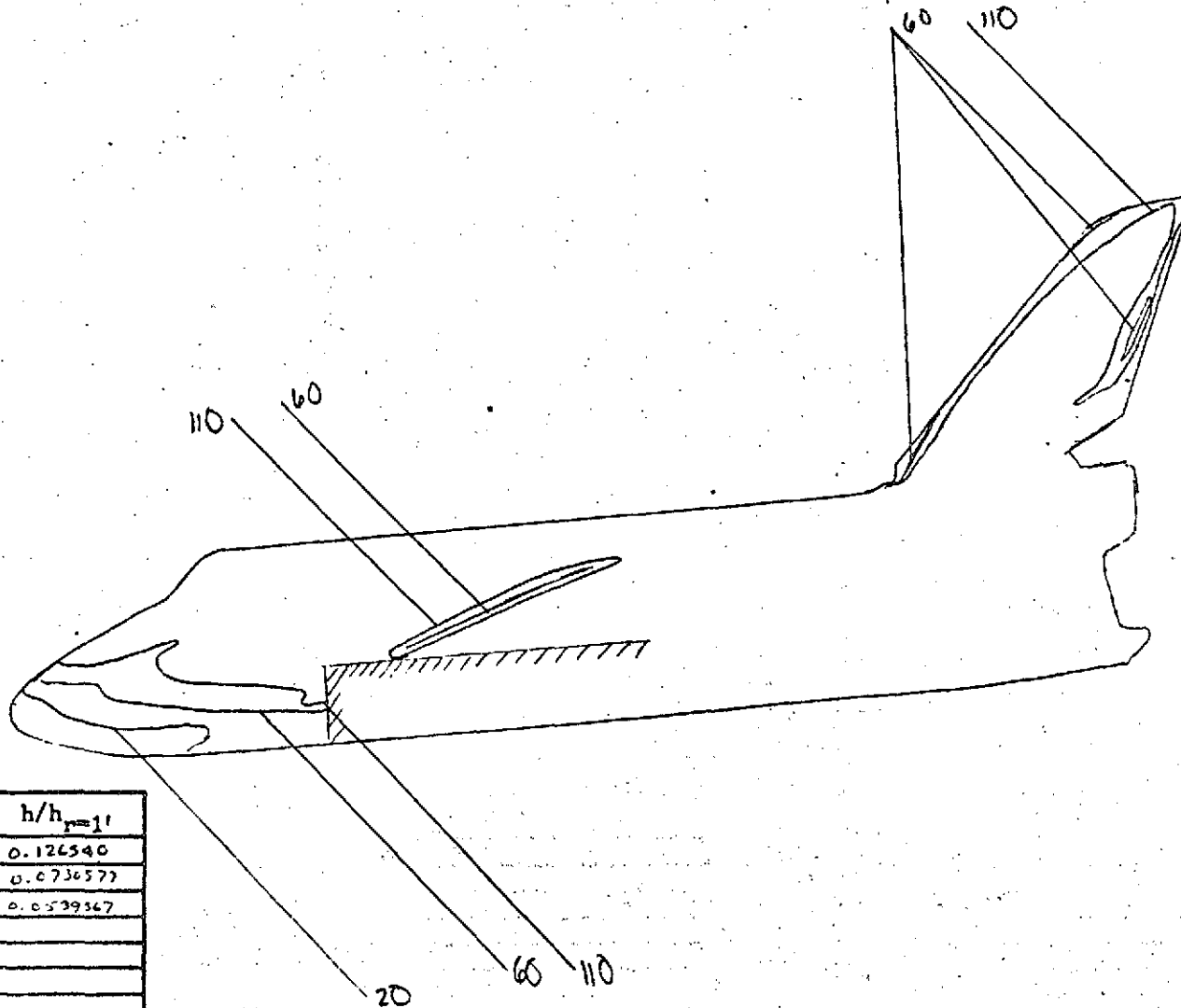
x (in) =

y (in) =

z (in) =

HS = 0.104562 $\frac{BTU}{FT^2 \cdot SEC \cdot ^\circ F}$

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
20	0.126540
60	0.6730577
110	0.8539367

FIG. 150

CONFIG. 46-3

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST 0H42B (RPA)

RUN 4164

$M_\infty = 8$

$P_{total} \text{ (psi)} = 635$

$T_{total} \text{ (}^\circ\text{F)} = 955$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 3 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 250$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

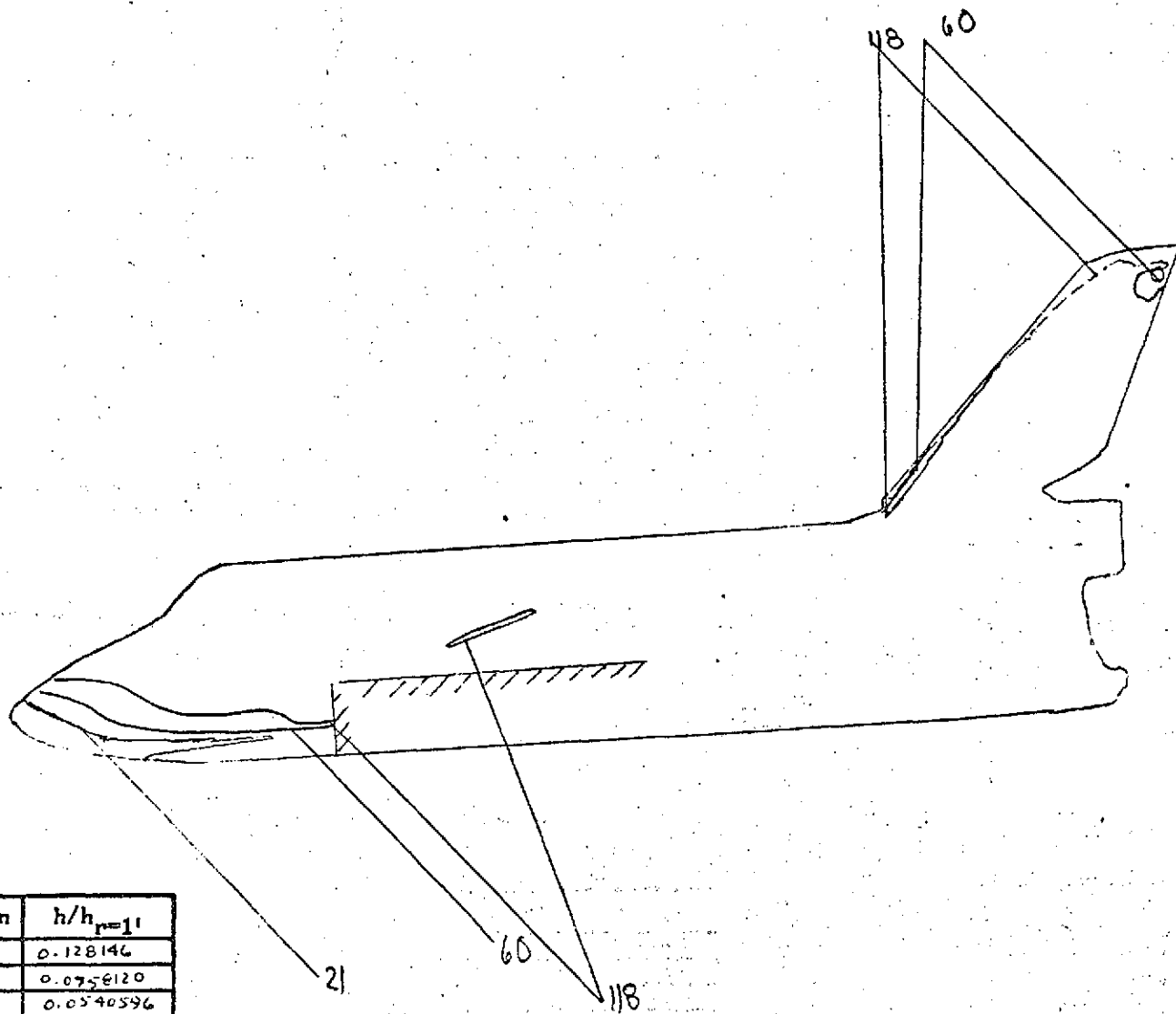
x (in) =

y (in) =

z (in) =

Revised 5/01/66
 HS-140739873 $\frac{BTU}{FT^2 \cdot sec \cdot ^\circ F}$
 NPS

PHASE CHANGE TEST



Isotherm	$h/h_{p=11}$
21	0.128146
60	0.0756120
118	0.0540596

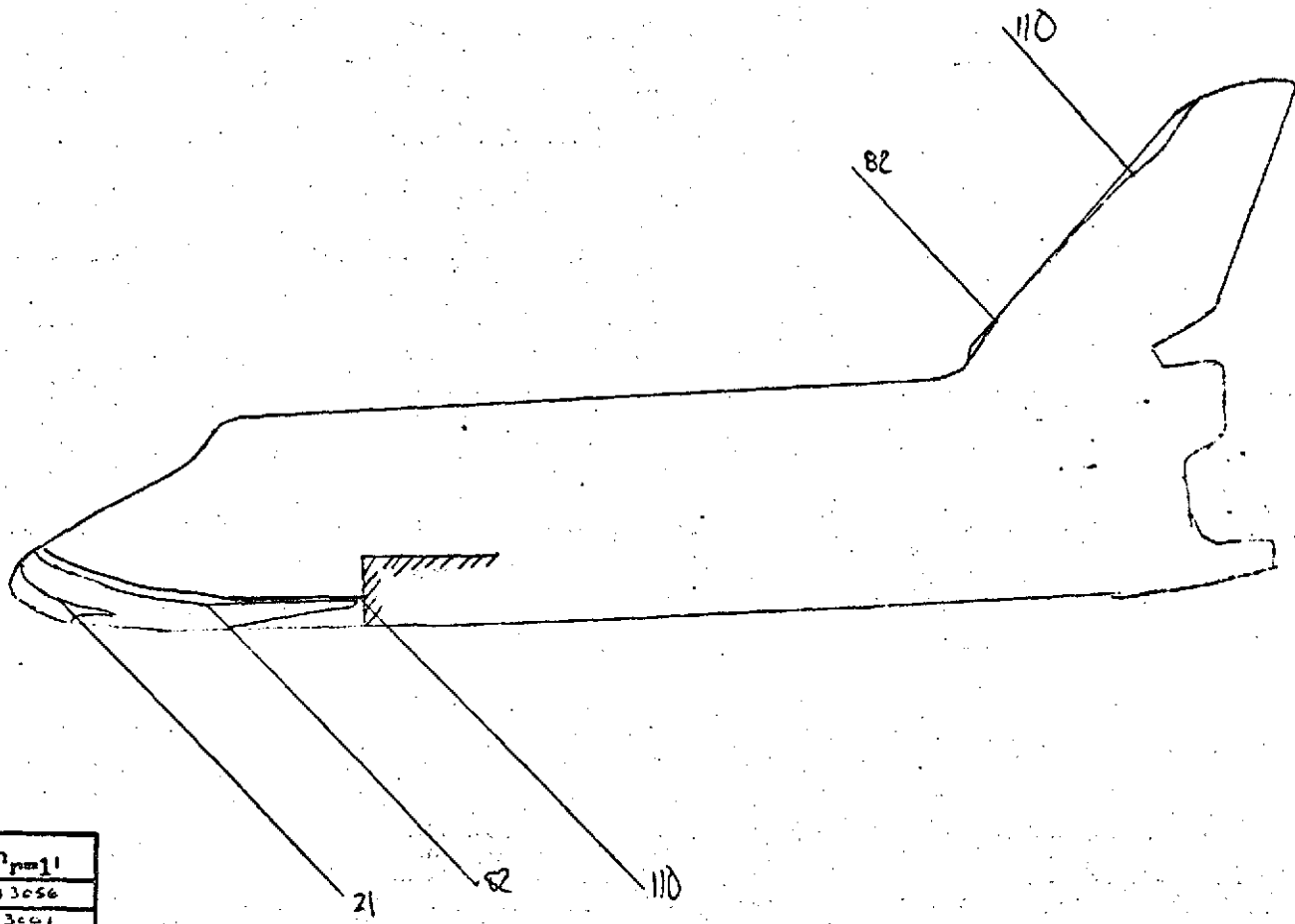
FIG. 151

CONFIG. 46-1

LENGTH (ft) = .638
SCALE .00593
FACILITY LRC/UDT
TEST OH42B (RPA)
RUN 4165
$M_{\infty} = 8$
$P_{total} \text{ (psi)} = 640$
$T_{total} \text{ (}^{\circ}\text{F)} = 930$
$T_{aw}/T_{total} = 0.90$
$R_N \text{ per foot} = 3 \times 10^6$
$T_{\text{phase change}} \text{ (}^{\circ}\text{F)} = 250$
$\alpha = 30$
$\beta = 0$
$\phi = 0$
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)
x (in) =
y (in) =
z (in) =

NS-0.0736175 $\frac{BTU}{FT^2 \cdot SEC \cdot ^{\circ}F}$

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
21	0.243056
82	0.123001
110	0.104199

FIG. 152

CONFIG. 46-3

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42B (CPA)

RUN 4166

$M_{\infty} = 8$

$P_{total} (psi) = 1390$

$T_{total} (^{\circ}F) = 920$

$T_{aw}/T_{total} = 0.90$

R_N per foot = 6×10^4

$T_{phase\ change} (^{\circ}F) = 400$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

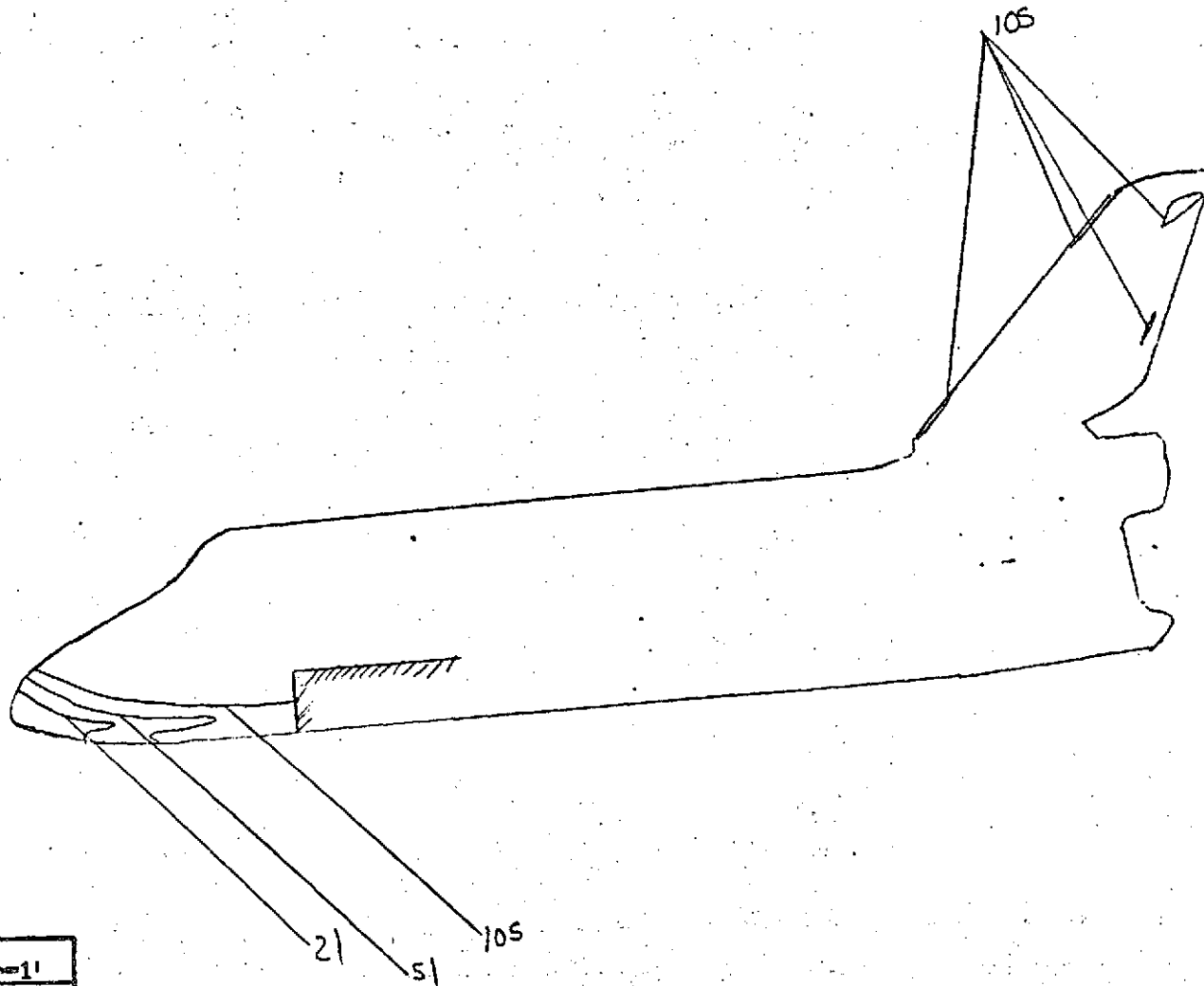
x (in) =

y (in) =

z (in) =

HS = 0.105068 $\frac{114}{FT}$ SEC - $^{\circ}F$

PHASE CHANGE TEST



Isotherm	$h/h_{p=11}$
21	0.245155
51	0.157313
105	0.109437

FIG. 153

CONFIG. 46-1

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/VDI

TEST OH42B (RPA)

RUN 4167

$M_{\infty} = 8$

$P_{total} (psi) = 1625$

$T_{total} (^{\circ}F) = 885$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 7 \times 10^6$

$T_{\text{phase change}} (^{\circ}F) = 400$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

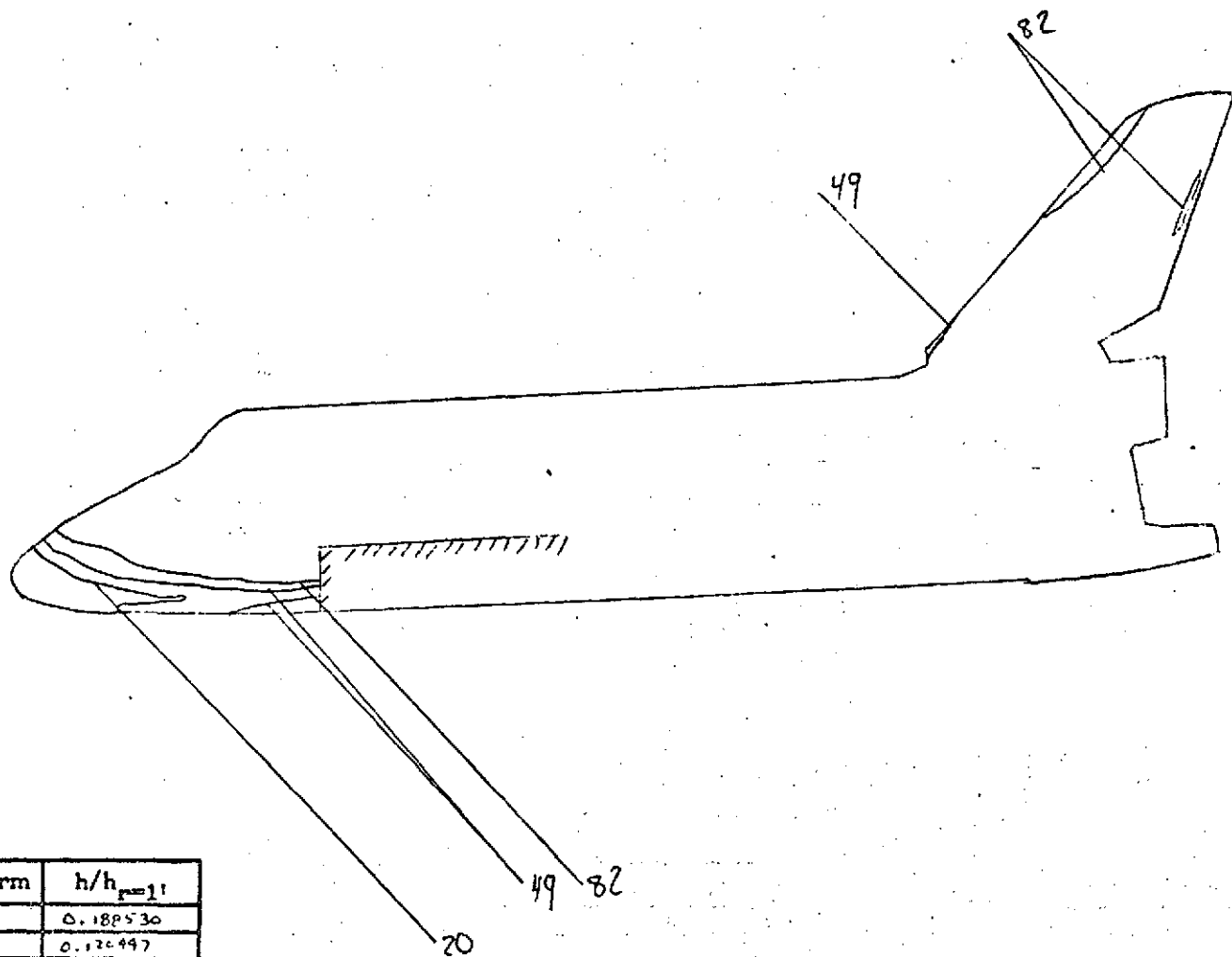
x (in) =

y (in) =

z (in) =

$HS = 0.112654 \frac{BTU}{FT^2 \cdot sec \cdot ^{\circ}F}$
 MD 5

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
20	0.182530
49	0.120497
82	0.0931024

FIG. 154

CONFIG. 46-3

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/UDT

TEST 0H42B (RPA)

RUN 4168

$M_\infty = 8$

P_{total} (psi) = 1930

T_{total} (°F) = 985

$T_{aw}/T_{total} = 0.90$

R_N per foot = 8×10^6

$T_{phase\ change}$ (°F) = 400

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

Flow at 200 ft/sec

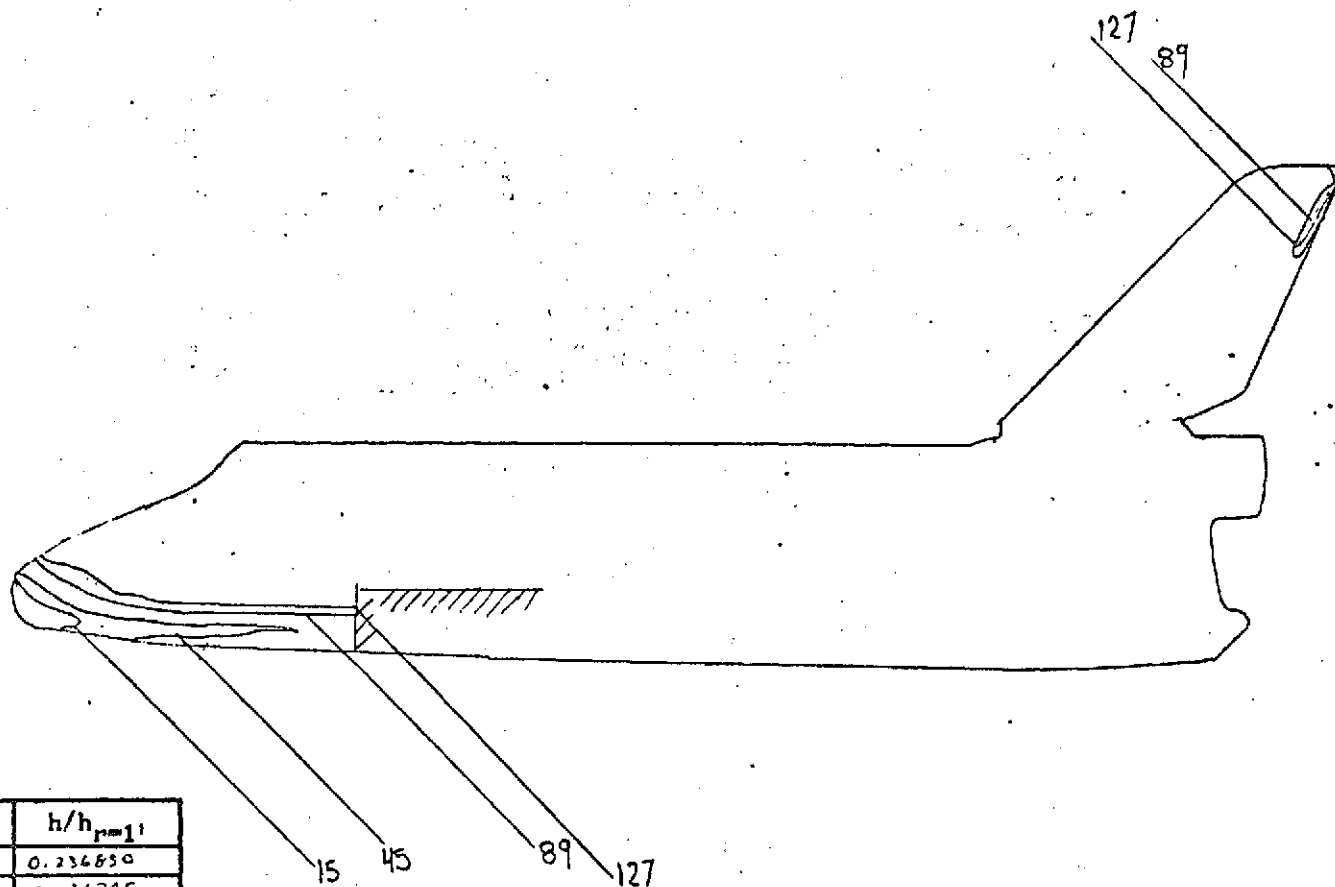
$h_5 = 0.122902$ RTV-sec-°F

NDS

HVD-EVCS

PHASE CHANGE TEST

CONFIG. 46-1



Isotherm	$h/h_{p=1}$
15	0.236850
45	0.136745
89	0.0772352
127	0.0213985

FIG. 155

LENGTH (ft) = .638
SCALE .00593
FACILITY LRC/VDI
TEST OH42B (RPA)
RUN 4172
$M_\infty = 8$
$P_{total} \text{ (psi)} = 650$
$T_{total} \text{ (}^\circ\text{F)} = 886$
$T_{aw}/T_{total} = 0.90$
$R_N \text{ per foot} = 3 \times 10^6$
$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 300$
$\alpha = 35$
$\beta = 0$
$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

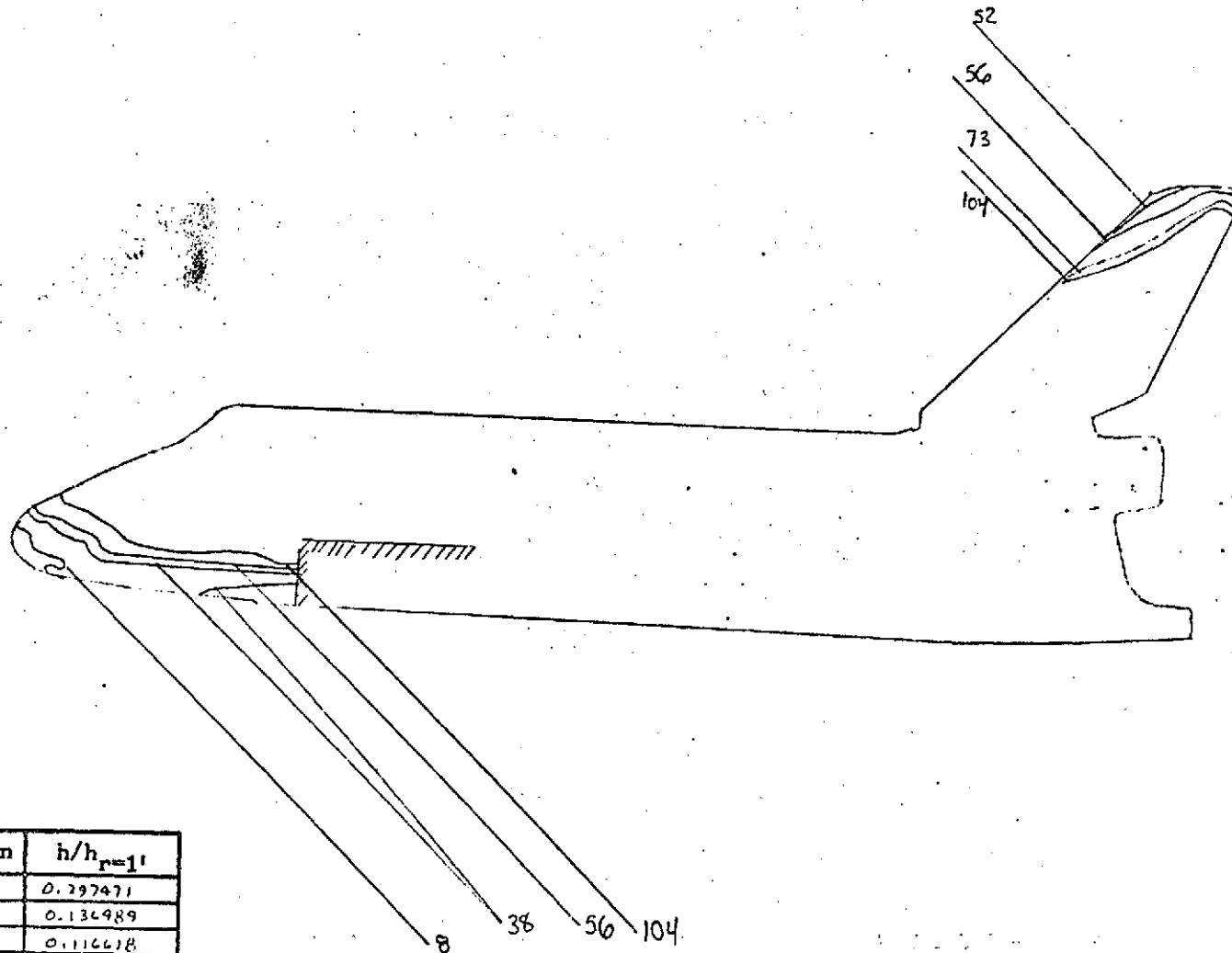
y (in) =

z (in) =

$h_{11} = 4 \text{ on Form 6}$
 $MS = 0.0739861 \frac{RTU}{FT^2} - SEC - ^\circ F$

PHASE CHANGE TEST

CONFIG. 46-2



Isotherm	$h/h_{r=1}$
8	0.297471
38	0.134989
52	0.116618
56	0.112433
73	0.494753
104	0.0825435

FIG. 156

LENGTH (ft) =	.638
SCALE	.00593
FACILITY	LRC/UDT
TEST	OH428 (RPA)
RUN	4173
M_{∞} =	8
P_{total} (psi) =	1390
T_{total} (°F) =	915
T_{aw}/T_{total} =	0.90
R_N per foot =	6×10^4
$T_{phase\ change}$ (°F) =	350
α =	35
β =	0
ϕ =	0

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

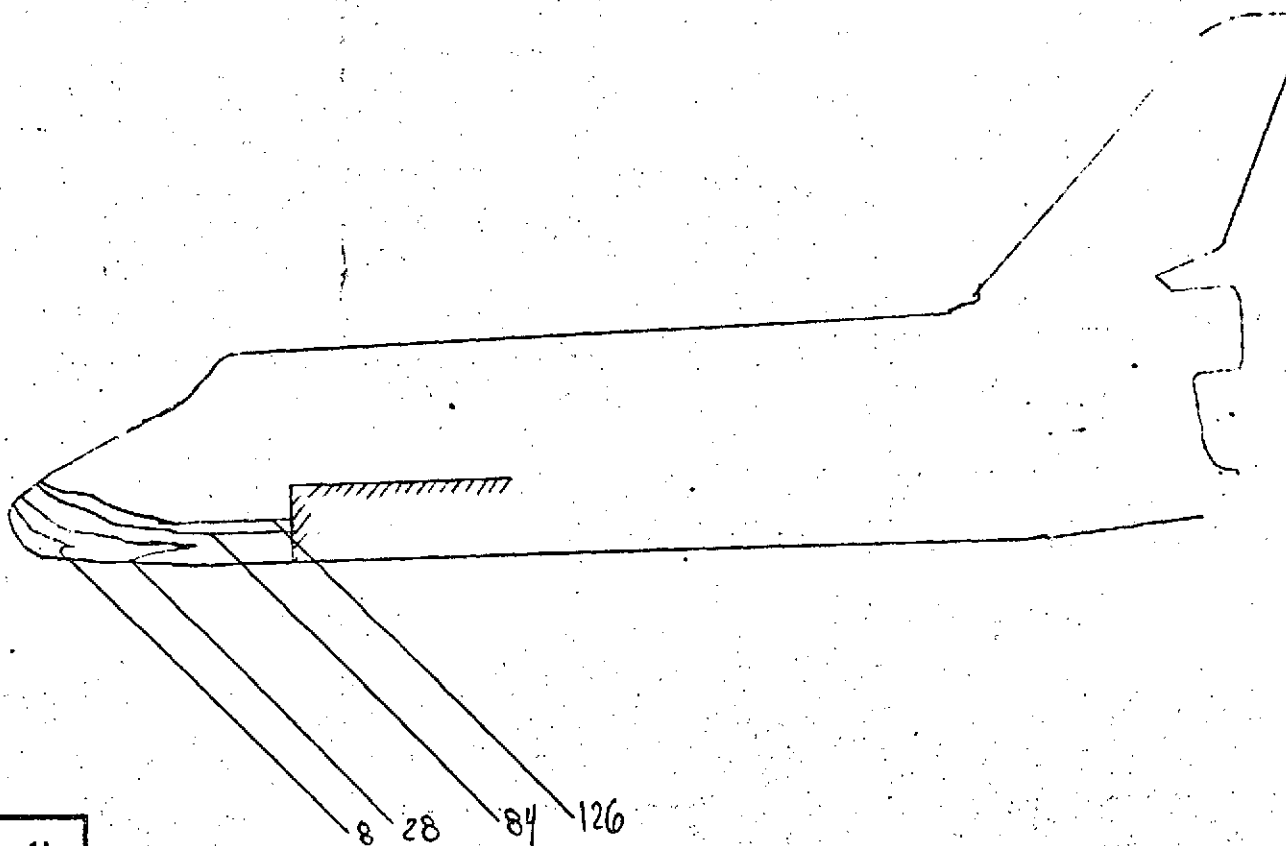
x (in) =

y (in) =

z (in) =

11/15/71
 NS-0.105092 814 - sec-°F
 11/15/71

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
8	0.239508
28	0.128022
84	0.0739137
126	0.0603503

FIG. 157

CONFIG. 46-1

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B (RPA)

RUN 4174

$M_{\infty} = 8$

$P_{total} \text{ (psi) } = 158$

$T_{total} \text{ (}^{\circ}\text{F) } = 780$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot } = 1 \times 10^6$

$T_{\text{phase change}} \text{ (}^{\circ}\text{F) } = 175$

$\alpha = 35$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

1117 8 10 5 10 10 6
 $Ms = 0.0392605$ $RT_{\infty} = 520^{\circ}\text{R}$
 FT

PHASE CHANGE TEST

CONFIG. 46-1

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B (RPA)

RUN 4175

$M_\infty = 8$

$P_{total} \text{ (psi)} = 1390$

$T_{total} \text{ (}^\circ\text{F)} = 935$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 400$

$\alpha = 35$

$\beta = 0$

$\phi = 0$

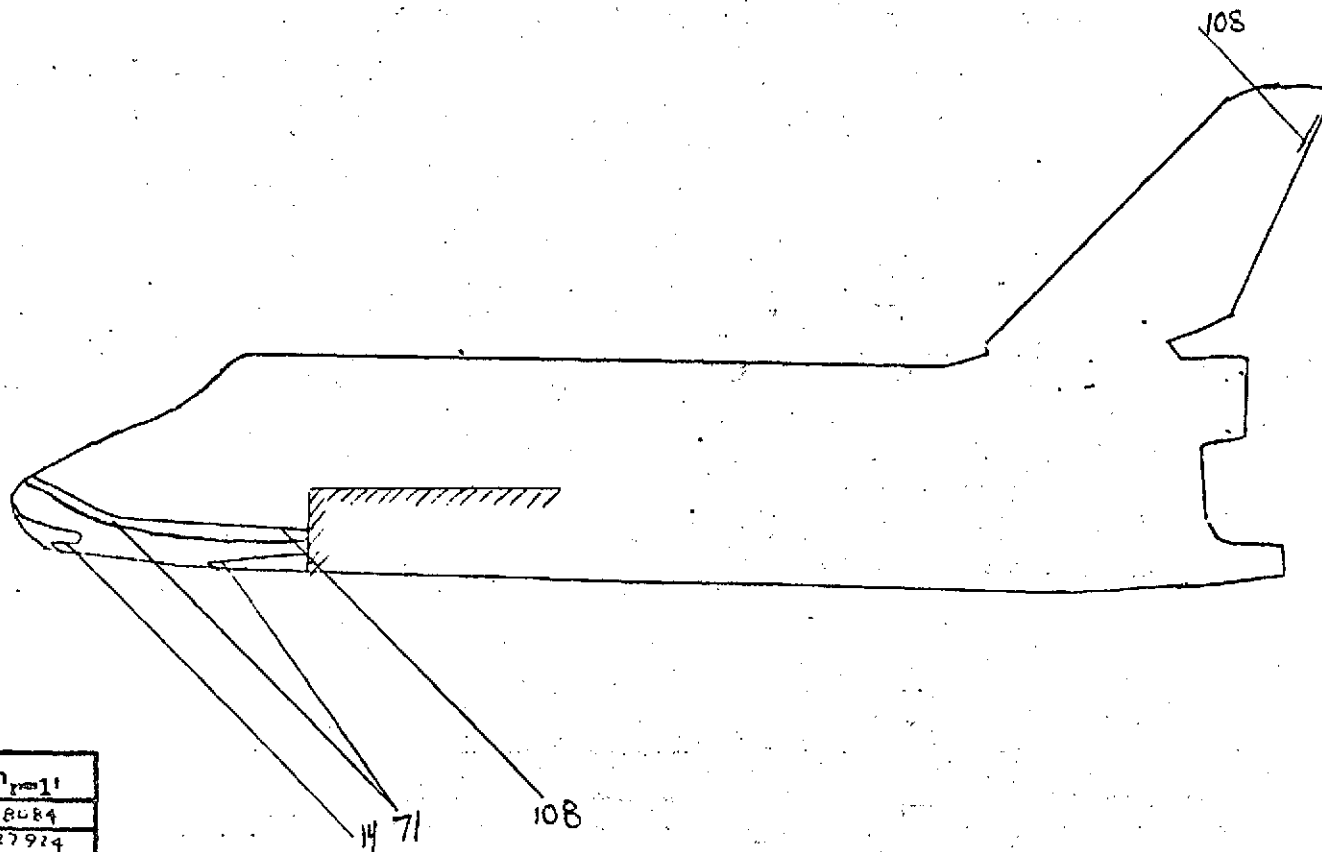
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

H17 2 ON FRAME 6
 $MS = 0.105103 \frac{ft}{sec} - Sec^{-1} F$
 NOS

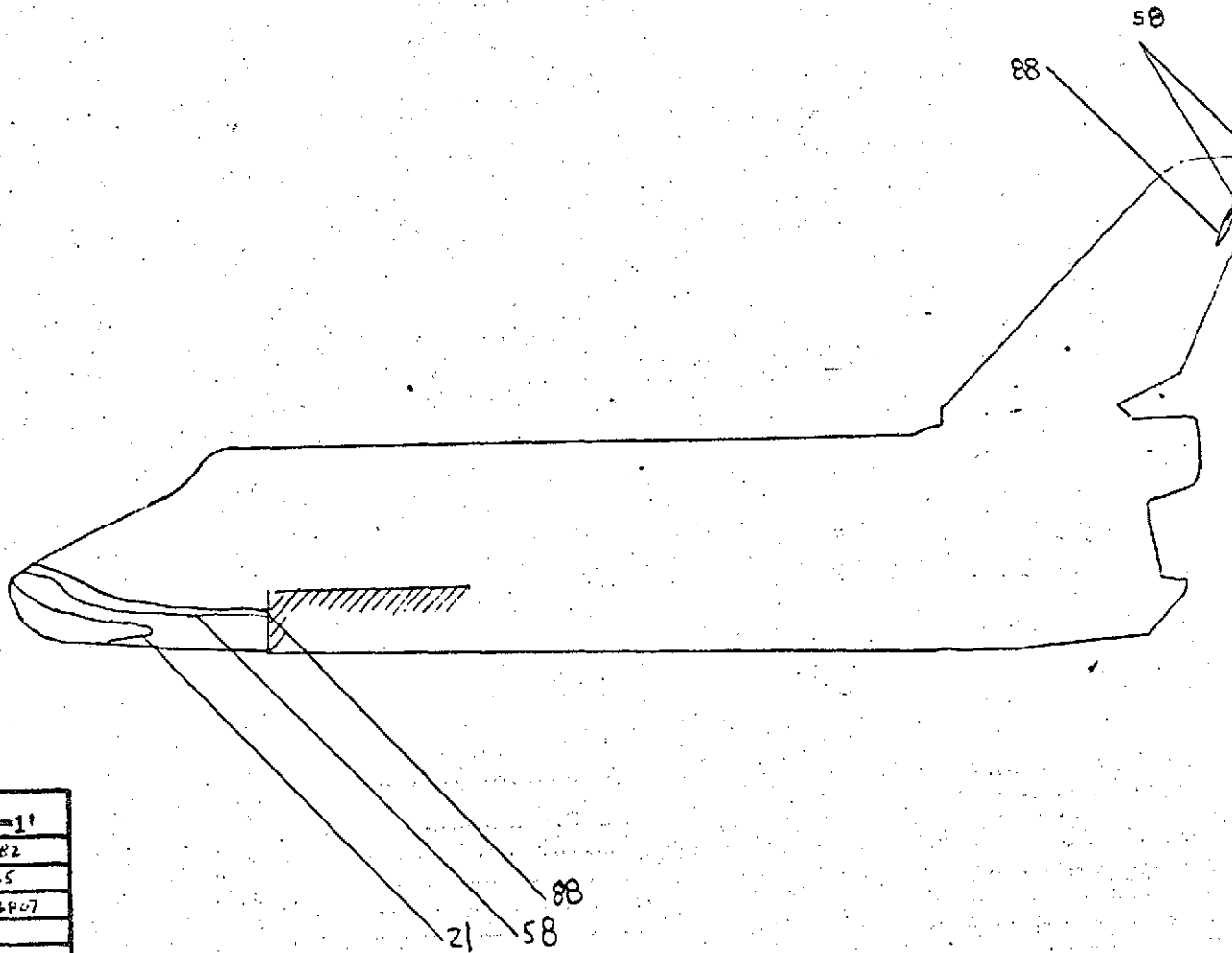


Isotherm	$h/h_{p=1}$
14	0.288084
71	0.127924
108	0.103722

FIG. 158

PHASE CHANGE TEST

CONFIG. 746-1



Isotherm	h/h_{ref}
21	0.163582
58	0.110465
88	0.0896807

FIG. 159

LENGTH (R) = .638
SCALE .00593
FACILITY LRC/UDT
TEST OH42B (KPA)
RUN 4176
$M_{\infty} = 8$
$P_{\text{total}} \text{ (psi)} = 1380$
$T_{\text{total}} \text{ (}^{\circ}\text{F)} = 915$
$T_{\text{aw}}/T_{\text{total}} = 0.90$
$R_N \text{ per foot} = 6 \times 10^6$
$T_{\text{phase change}} \text{ (}^{\circ}\text{F)} = 350$
$\alpha = 35$
$\beta = 0$
$\phi = 0$
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)
x (in) =
y (in) =
z (in) =

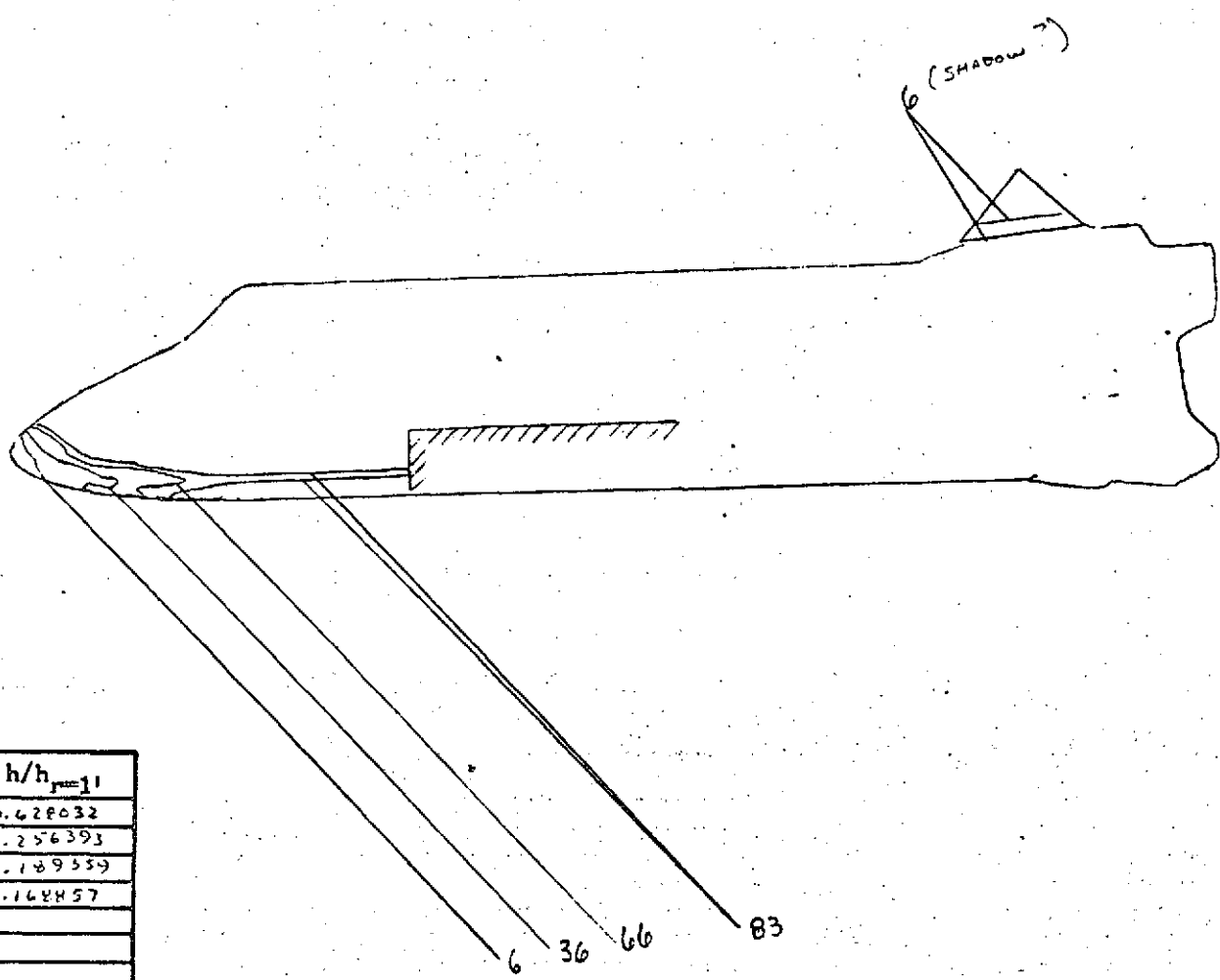
HIT 1 ON FRAME 6
 $HS = 0.104792 \frac{\text{ft}^2}{\text{sec}^2}$

0000

HVD-EVCS

PHASE CHANGE TEST

CONFIG. 46-4EBF



Isotherm	h/h_{ref}
6	0.428032
36	0.256393
66	0.189559
83	0.148857

FIG. 160

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B (RPA)

RUN 4177

$M_{\infty} = 8$

$P_{\text{total}} (\text{psi}) = 625$

$T_{\text{total}} (^{\circ}\text{F}) = 940$

$T_{\text{aw}}/T_{\text{total}} = 0.90$

$R_N \text{ per foot} = 3 \times 10^6$

$T_{\text{phase change}} (^{\circ}\text{F}) = 400$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

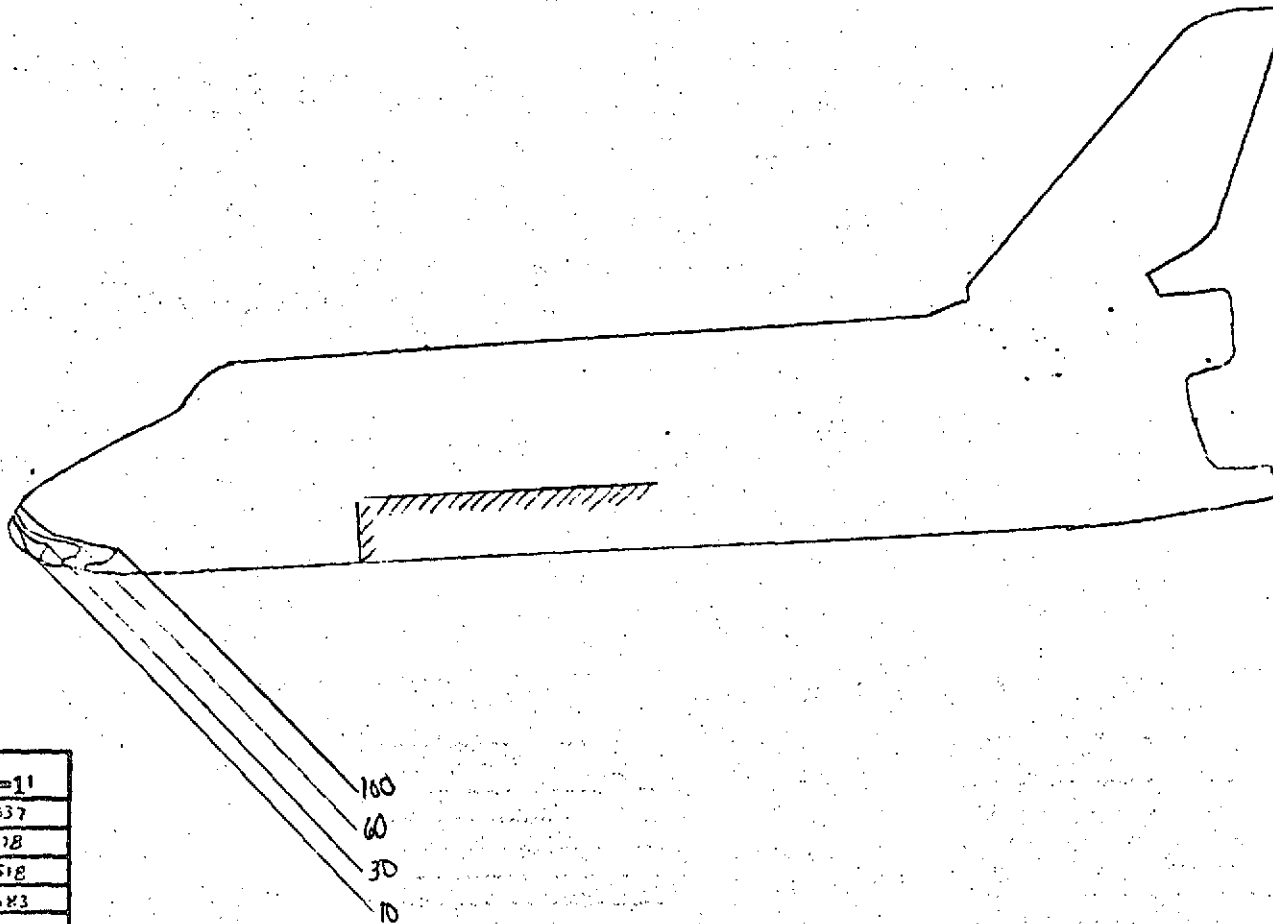
z (in) =

WIND TUNNEL FORCE 8

HS = 0.0729429 $\frac{\text{BTU}}{\text{FT}^2 \text{ SEC} \cdot ^{\circ}\text{F}}$

EVD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{p=11}$
10	0.870837
30	0.562778
60	0.355518
100	0.275383

FIG. 161

CONFIG. 46-2

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/VDI

TEST OH42B (RPA)

RUN 4178

$M_{\infty} = 8$

$P_{total} \text{ (psi)} = 635$

$T_{total} \text{ (}^{\circ}\text{F)} = 925$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 3 \times 10^4$

$T_{\text{phase change}} \text{ (}^{\circ}\text{F)} = 500$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

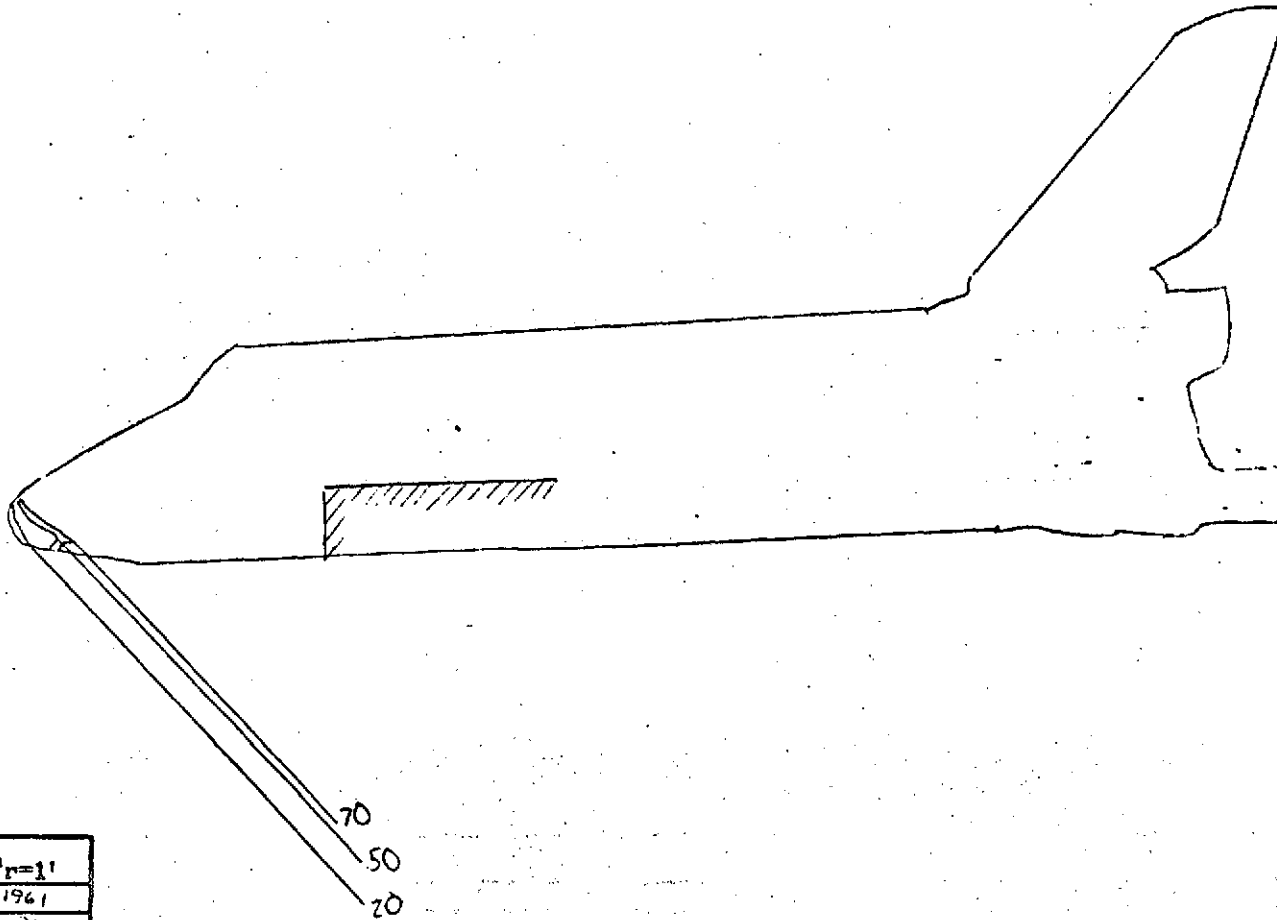
y (in) =

z (in) =

MIT 2-60-5000-5

MS = 0.073262, $\frac{RTV}{FT} = 1.0$

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
20	0.601961
50	0.38714
70	0.321762

FIG. 162

CONFIG. 46-4AEBF

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDT

TEST OH42B (RPA)

RUN 4179

$M_\infty = 8$

$P_{total} \text{ (psi)} = 164$

$T_{total} \text{ (}^\circ\text{F)} = 820$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 1 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 350$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from
model center, x-axis
parallel w/ stream,
+ downstream)

x (in) =

y (in) =

z (in) =

BIT & ON FRAME C

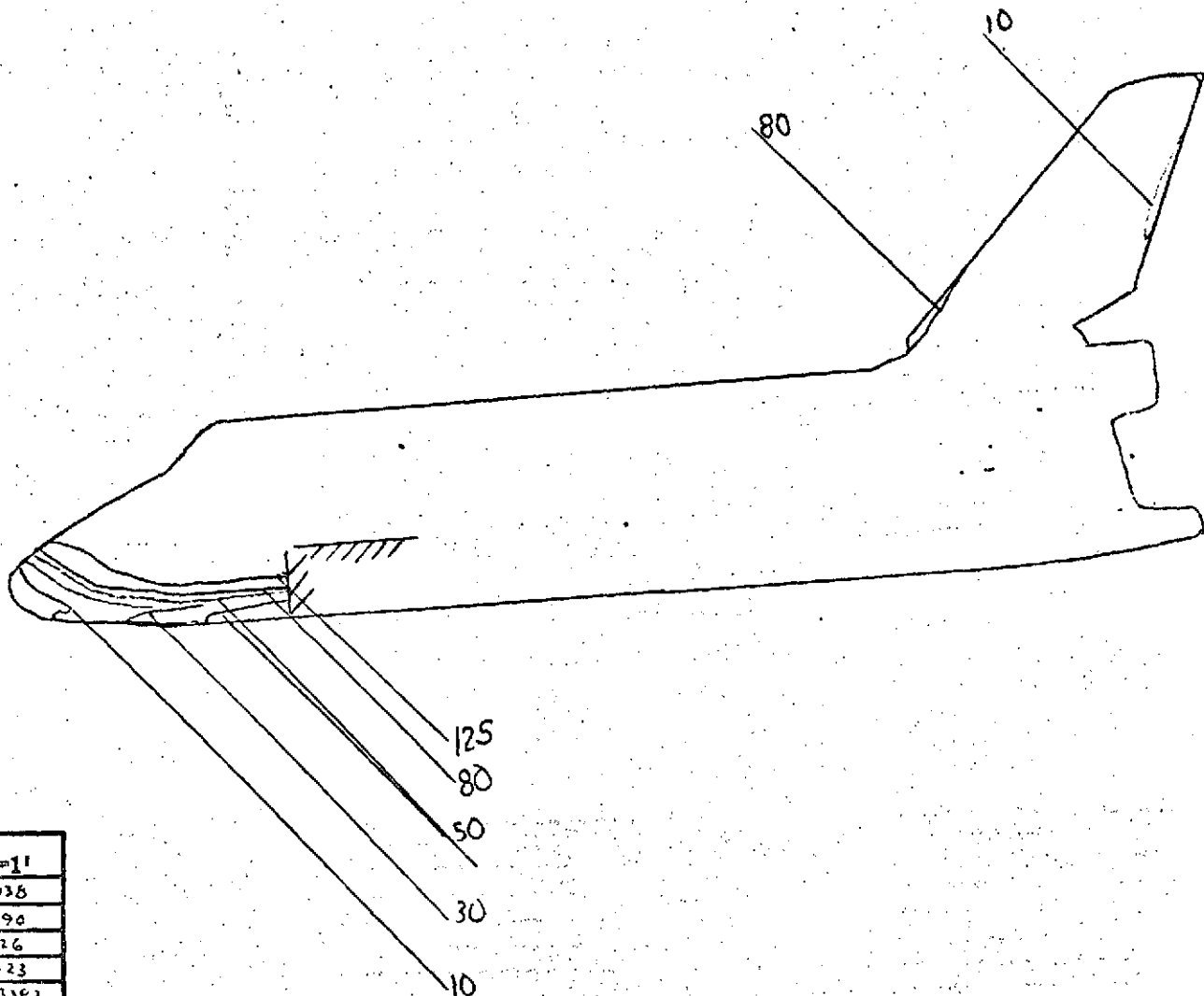
11003

NS = 0.040178 $\frac{874 \text{ sec} \cdot ^\circ\text{F}}{\text{FT}}$

HVD-EVCS

PHASE CHANGE TEST

CONFIG. 46-2



Isotherm	$h/h_{p=11}$
10	0.284038
30	0.163990
50	0.127026
80	0.100423
125	0.0803382

FIG. 163

LENGTH (ft) = .638
SCALE .00593
FACILITY LRC/UDT
TEST DH42B (RPA)
RUN 4180
$M_0 = 8$
P_{total} (psi) = 625
T_{total} (°F) = 910
$T_{aw}/T_{total} = 0.90$
R_N per foot = 3×10^6
$T_{phase\ change}$ (°F) = 300
$\alpha = 30$
$\beta = 0$
$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =
y (in) =
z (in) =

$MS = 0.0726173 \frac{BTU}{FT^2 \cdot sec \cdot ^\circ F}$

BVD-EVCS

PHASE CHANGE TEST

CONFIG. 46-4AEBF

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/JDT

TEST OH42B (RPA)

RUN 4181

$M_{\infty} = 8$

$P_{total} \text{ (psi)} = 157$

$T_{total} \text{ (}^{\circ}\text{F)} = 810$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 1 \times 10^6$

$T_{\text{phase change}} \text{ (}^{\circ}\text{F)} = 250$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

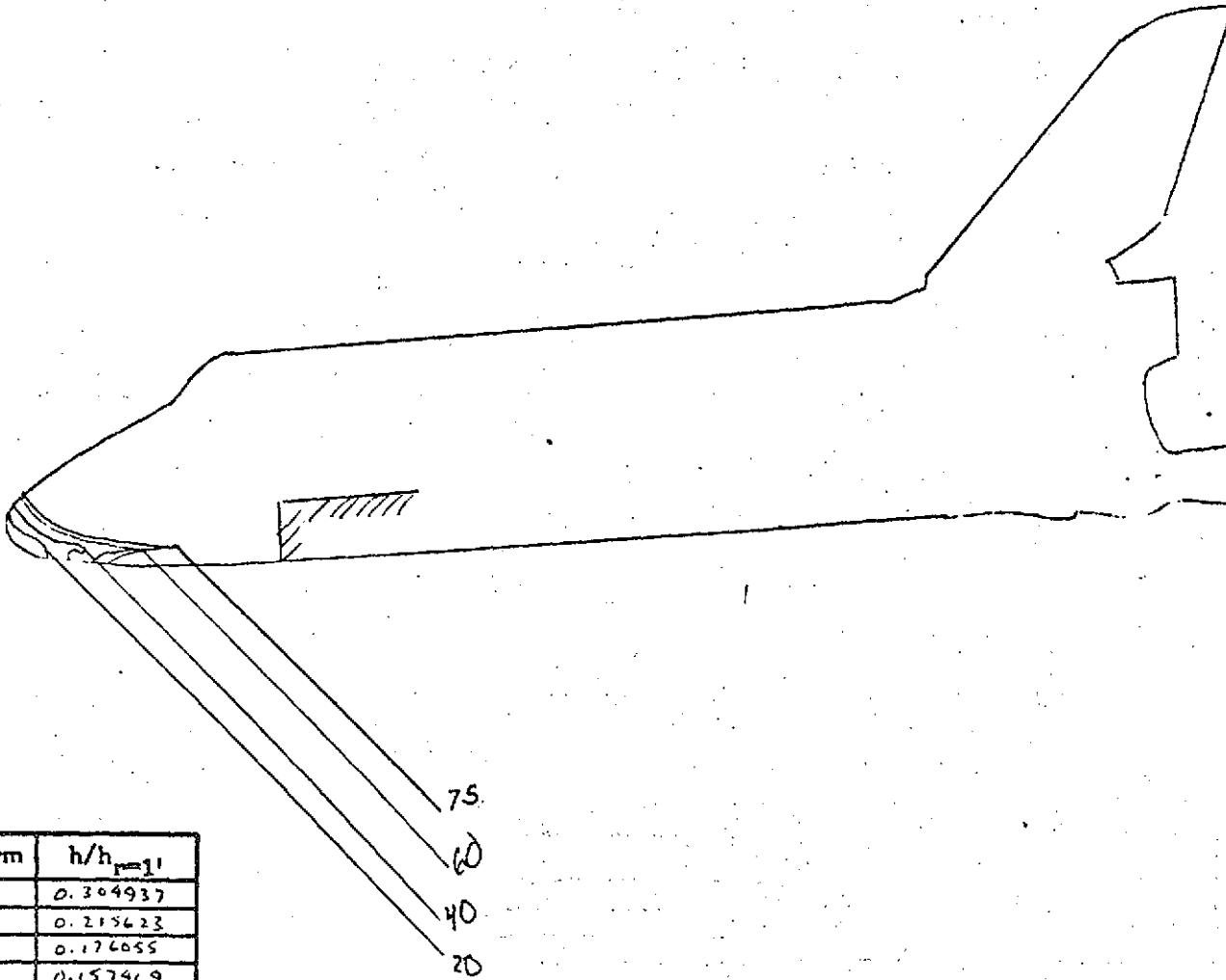
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

Revised 10/1/71
 $MS = 0.0393622 \frac{BTU}{FT^2 \cdot SEC \cdot ^{\circ}F}$



Isotherm	$h/h_{r=1}$
20	0.304937
40	0.215623
60	0.176055
75	0.157469

FIG. 164

PHASE CHANGE TEST

CONFIG. 46-4AEBF

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/NDT

TEST OH42B (RPA)

RUN 418Z

$M_\infty = 8$

$P_{total} \text{ (psi)} = 170$

$T_{total} \text{ (}^\circ\text{F)} = 780$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 1 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 175$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

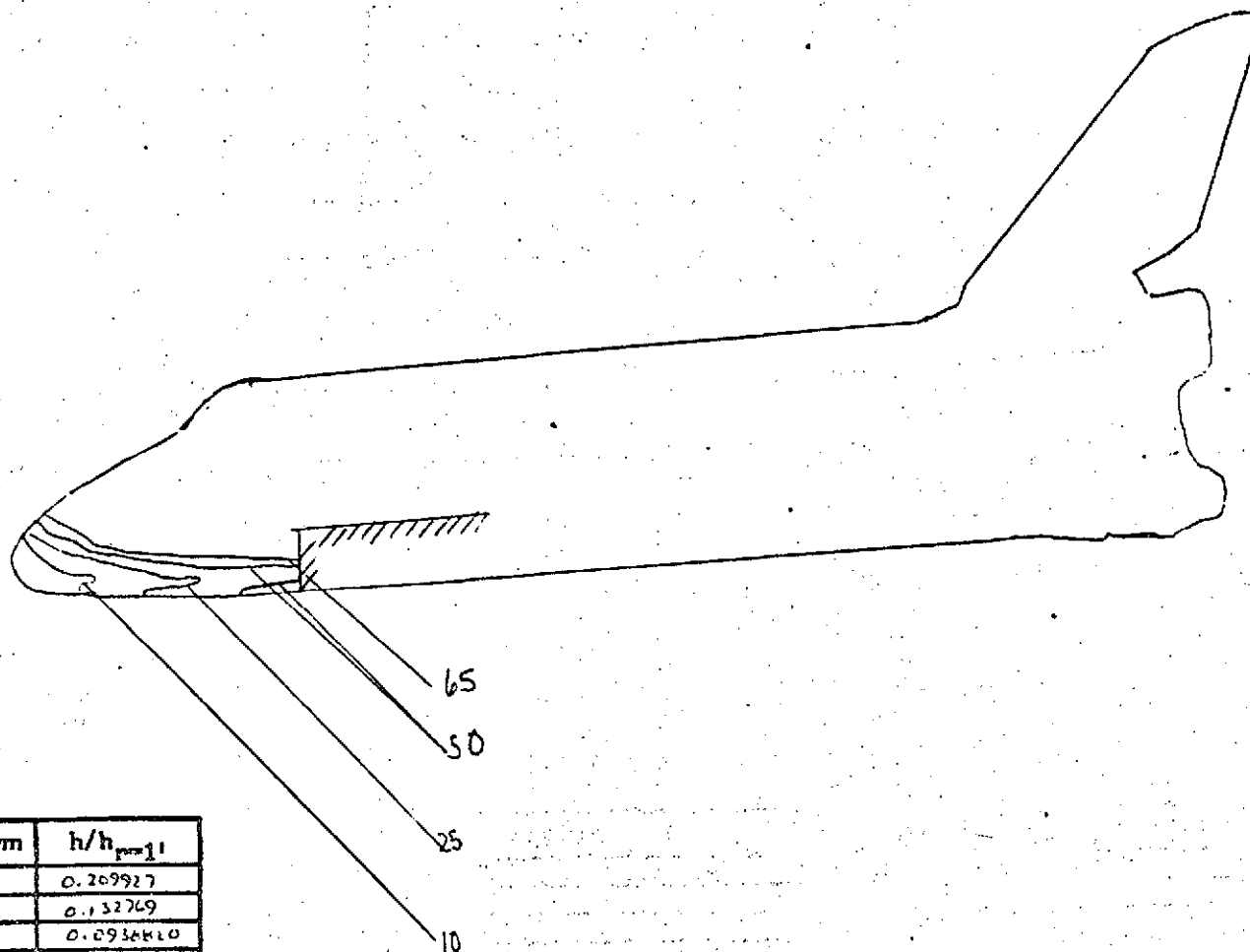
y (in) =

z (in) =

EXPOSED ON FRAME 5
 $MS = 0.0404845 \frac{ft}{sec} \cdot ^\circ F$
FTC

MUST

HVD-EVCS

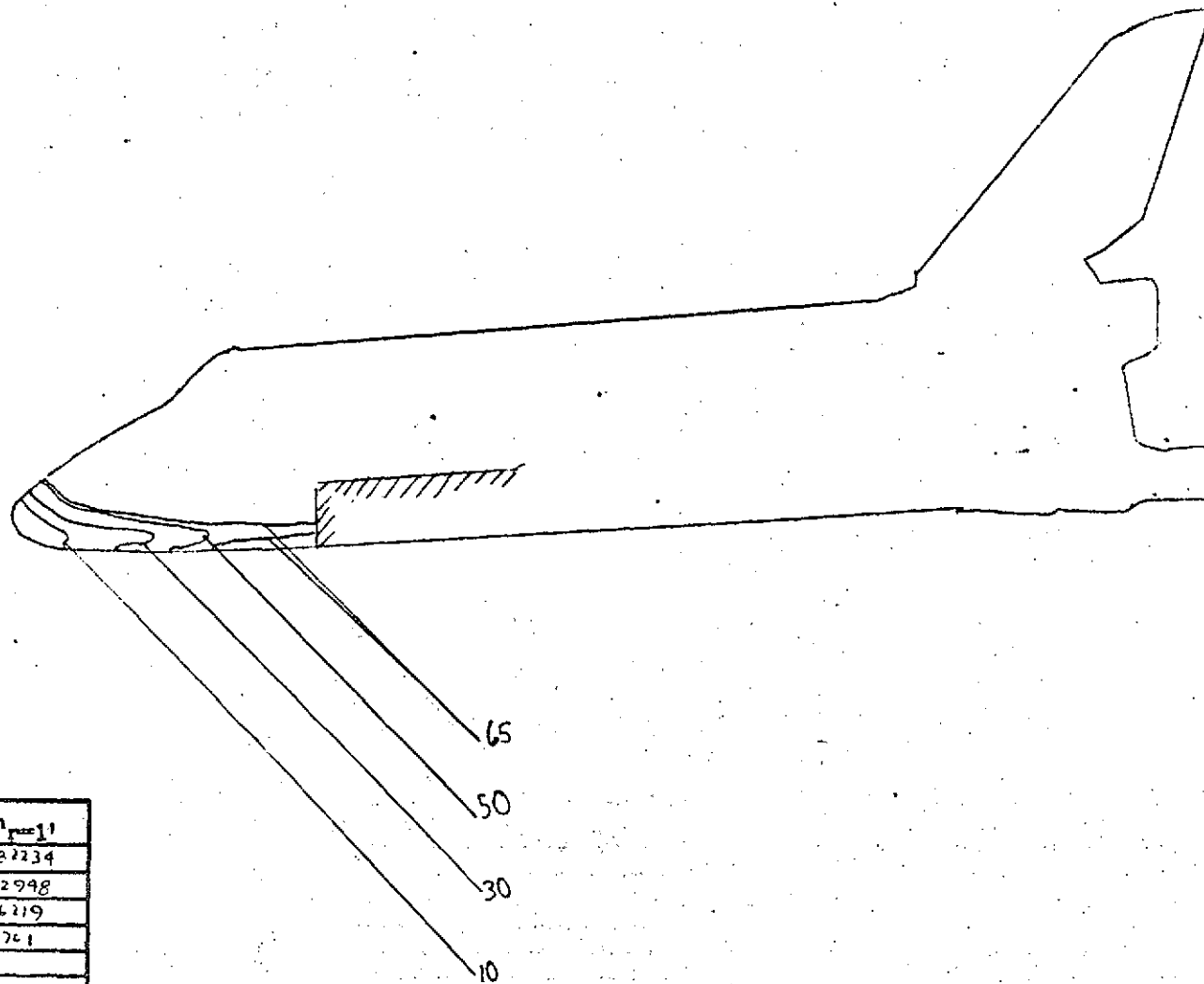


Isotherm	$h/h_{p=1}$
10	0.269927
25	0.132769
50	0.0936410
65	0.0823400

FIG. 165

PHASE CHANGE TEST

CONFIG. 46-4AEBF



isotherm	h/h_{max}
10	0.282234
30	0.162998
50	0.126219
65	0.110741

FIG. 166

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VDI

TEST OH42B (RPA)

RUN 4/83

$M_\infty = 8$

$P_{\text{total}} (\text{psi}) = 160$

$T_{\text{total}} (^\circ\text{F}) = 790$

$T_{\text{aw}}/T_{\text{total}} = 0.90$

$R_N \text{ per foot} = 1 \times 10^4$

$T_{\text{phase change}} (^\circ\text{F}) = 200$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

REAR VIEW 4 IN FRONT 5

AIDS

$MS = 0.0395499 \frac{\text{ft}^2}{\text{sec}^2}$

ft^2

HVD-EVCS

PHASE CHANGE TEST

CONFIG. 46-4AEBF

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42B (CPA)

RUN 4184

$M_{\infty} = 8$

$P_{total} \text{ (psi)} = 635$

$T_{total} \text{ (}^{\circ}\text{F)} = 910$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 3 \times 10^6$

$T_{\text{phase change}} \text{ (}^{\circ}\text{F)} = 350$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

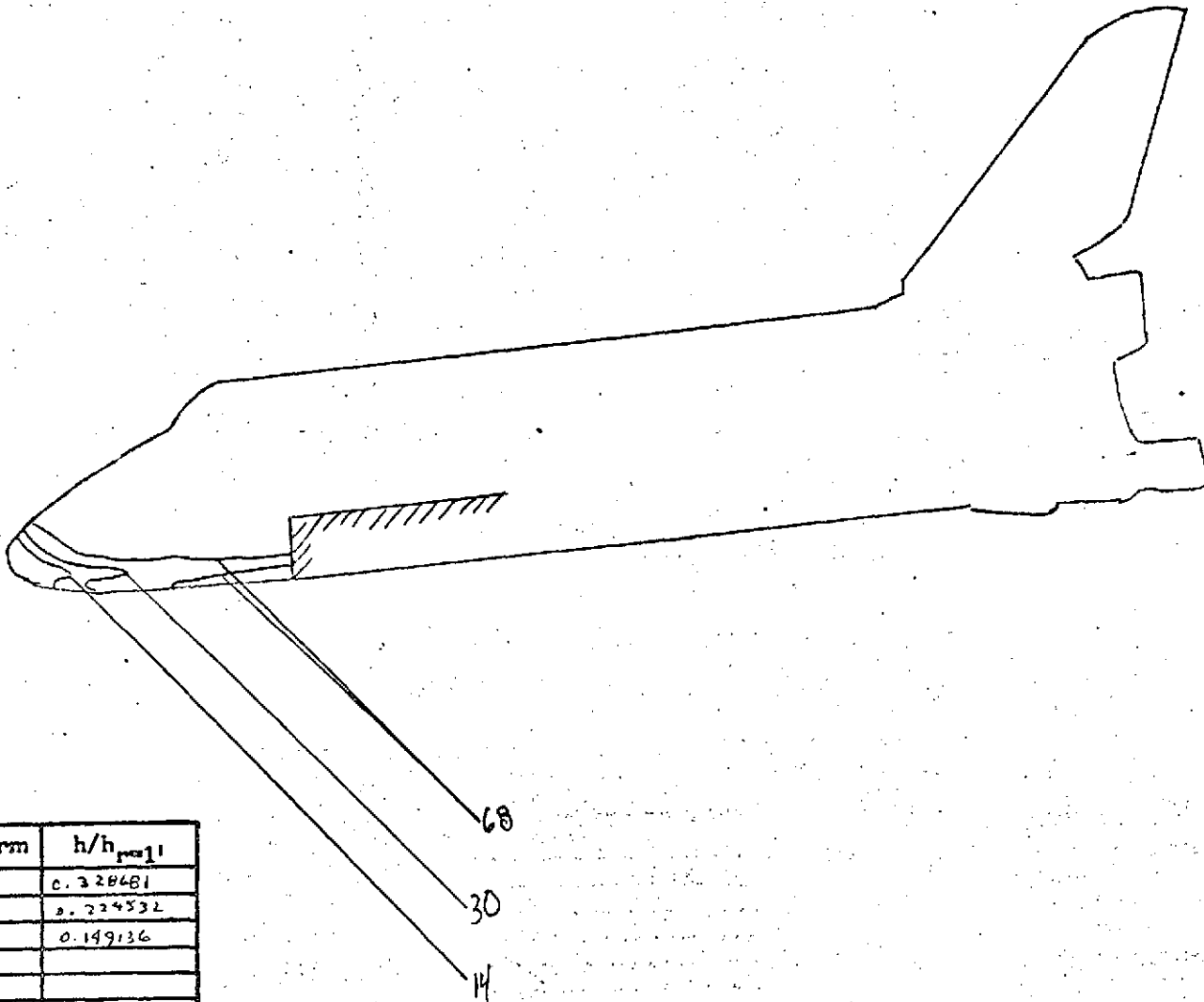
z (in) =

417 ϕ on Frame 5

HS = 0.0733534 $\frac{RTU - \text{sec} - \text{in}}{FT^2}$

110

HYD-EVCS



Isotherm	h/h_{ref}
14	0.320481
30	0.224532
68	0.149136

FIG. 167

PHASE CHANGE TEST

CONFIG. 46-4AEBF

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42B (RPA)

RUN 4185

$M_{\infty} = 8$

$P_{total} (psi) = 640$

$T_{total} (^{\circ}F) = 890$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 3 \times 10^6$

$T_{phase \ change} (^{\circ}F) = 250$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

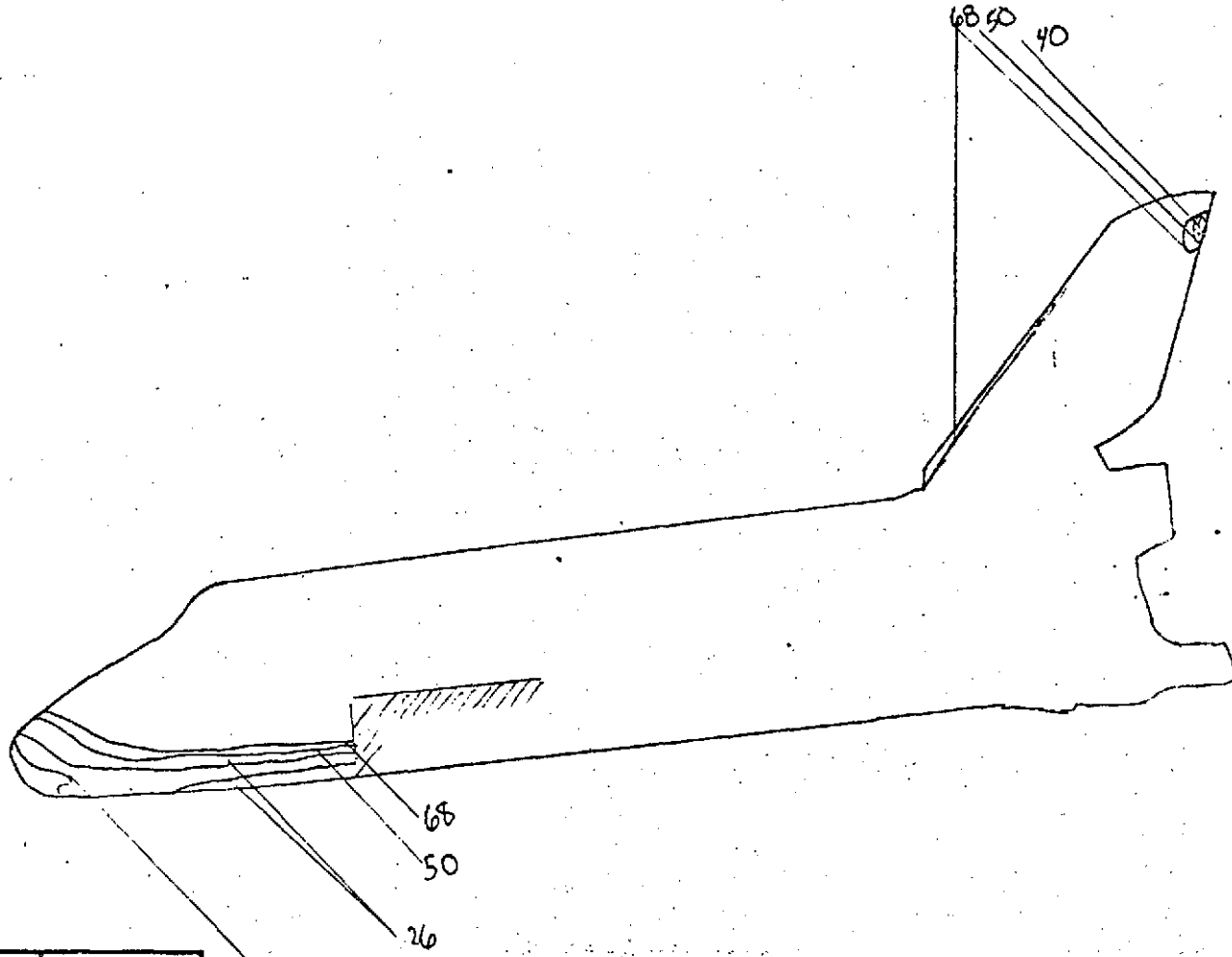
x (in) =

y (in) =

z (in) =

46-4AEBF

HDS
 $H_2 = 0.0737119 \frac{BTU-SEC-^{\circ}F}{FT^2}$ HVD-EVCS



Isotherm	$h/h_{r=1}$
6	0.258516
26	0.114187
40	0.100123
50	0.0495526
68	0.0767907

FIG. 168

PHASE CHANGE TEST

CONFIG. 46-4BF

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42B (RPA)

RUN 4186

$M_{\infty} = 8$

$P_{total} (psi) = 630$

$T_{total} (°F) = 890$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 3 \times 10^6$

$T_{\text{phase change}} (°F) = 450$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

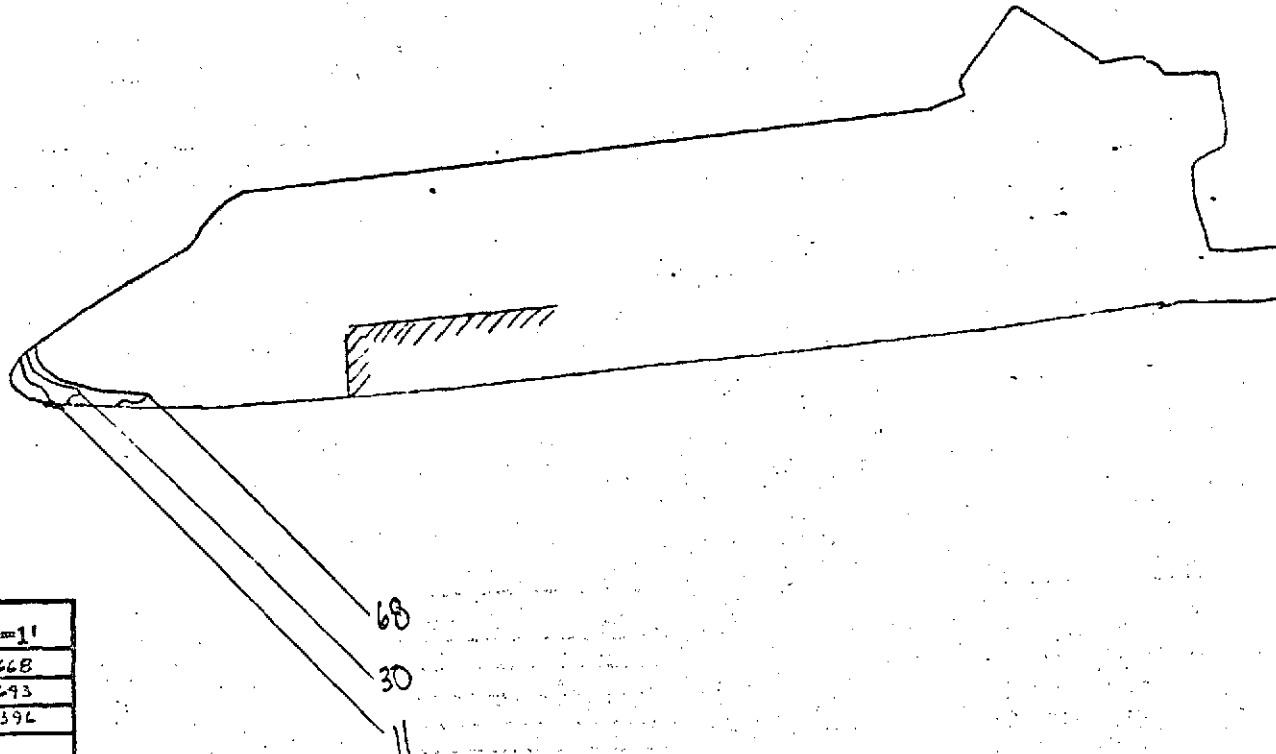
y (in) =

z (in) =

Hit 2 on Frame 5

$MS = 0.0728728 \frac{ft^2}{sec^2} - sec^2 - °F$

FVD-EVCS



Isotherm	$h/h_{r=1}$
11	0.694668
30	0.426693
68	0.279392

FIG. 169

PHASE CHANGE TEST

CONFIG. 46-48F

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/VD7

TEST 0H42B (RPA)

RUN 4188

$M_{\infty} = 8$

$P_{total} \text{ (psi)} = 675$

$T_{total} \text{ (}^{\circ}\text{F)} = 890$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 3 \times 10^6$

$T_{\text{phase change}} \text{ (}^{\circ}\text{F)} = 250$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

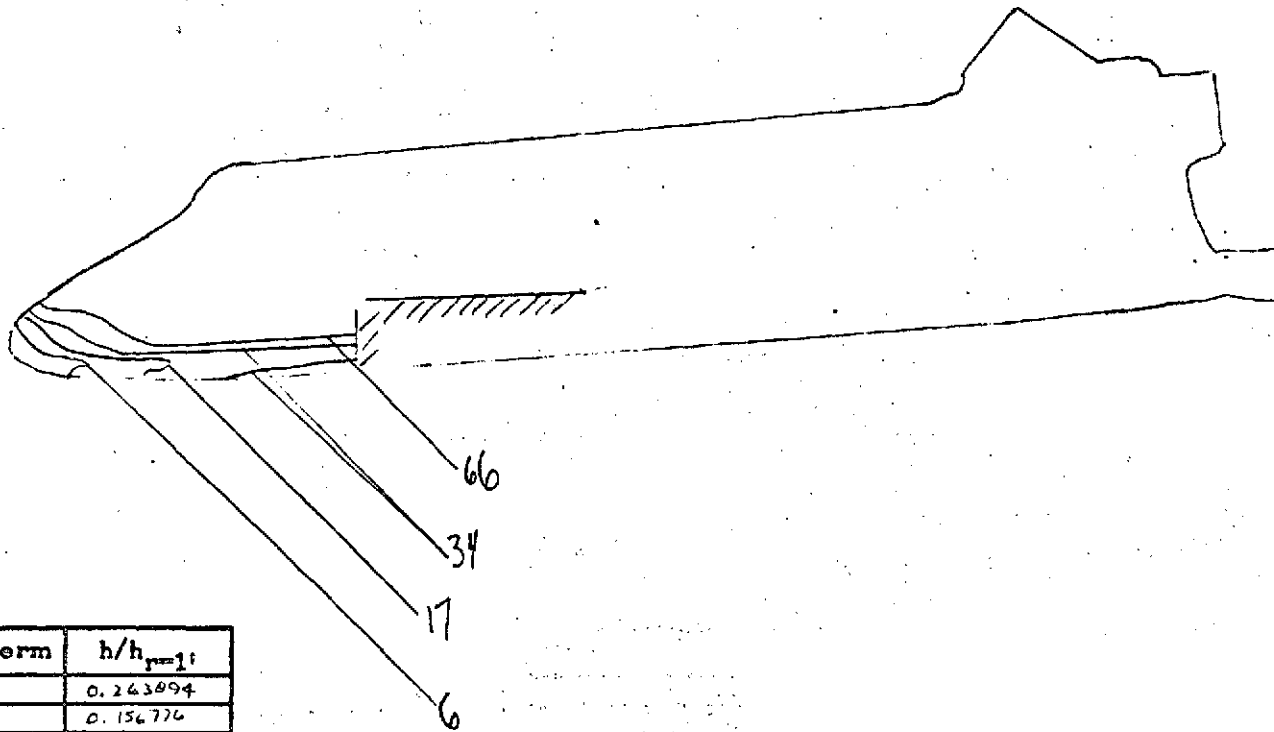
y (in) =

z (in) =

Photo of Figure 5
 $NS = 0.0726193 \frac{\text{BTU}}{\text{FT}^2 \cdot \text{SEC} \cdot ^{\circ}\text{F}}$

END

HVD-EVCS



Isotherm	h/h_{film}
6	0.243094
17	0.156776
34	0.110858
66	0.0795669

FIG. 170

PHASE CHANGE TEST

CONFIG. 46-4BF

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42B (RPA)

RUN 4/89

$M_\infty = 8$

$P_{total} \text{ (psi)} = 625$

$T_{total} \text{ (}^\circ\text{F)} = 885$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 3 \times 10^4$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 550$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

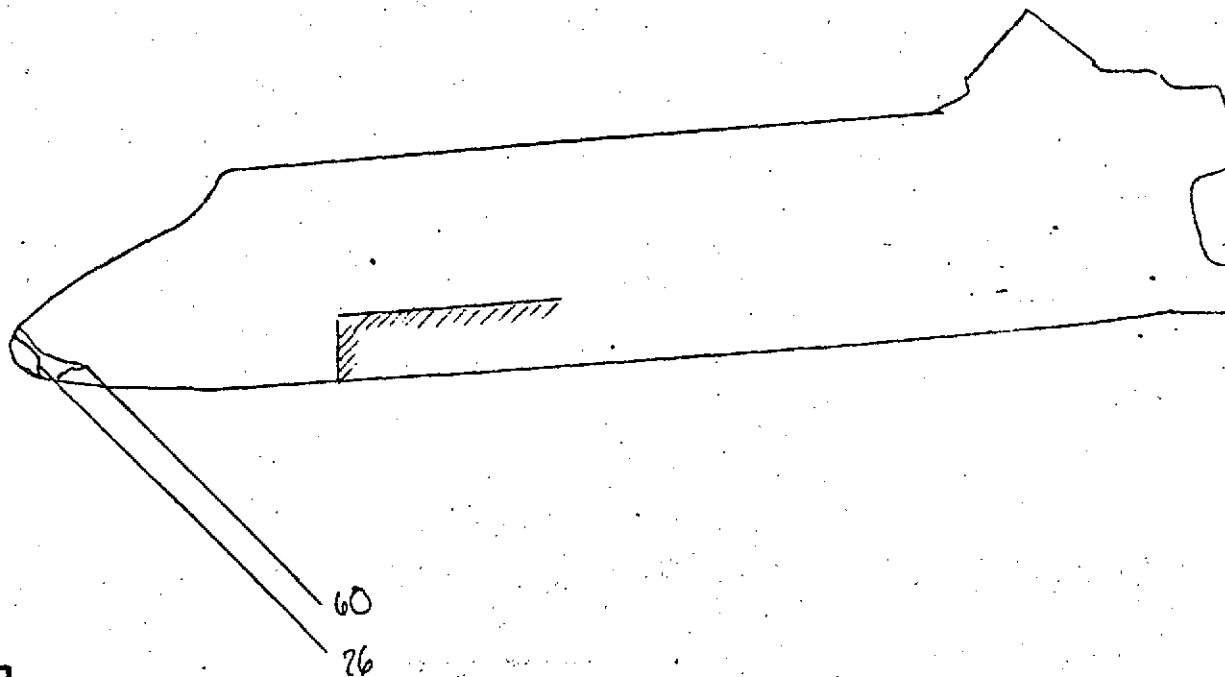
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

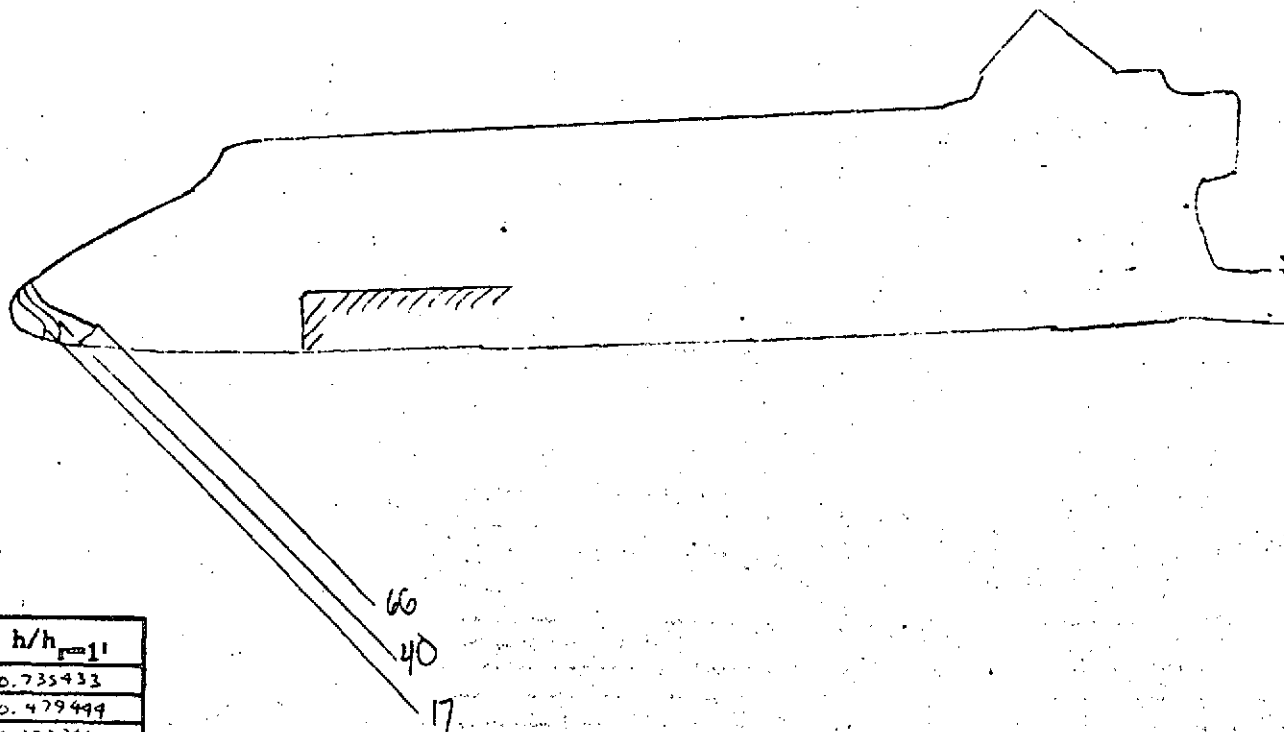
NS = 0.0224639 $\frac{BTU-SEC-^\circ F}{FT^2}$



Isotherm	$h/h_{p=1}$
26	0.848333
60	0.558991

FIG. 171

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
17	0.735433
40	0.479449
66	0.373246

FIG. 172

CONFIG. 46-4BF

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42B (RPA)

RUN 4190

$M_{\infty} = 8$

$P_{total} (psi) = 630$

$T_{total} (°F) = 895$

$T_{aw}/T_{total} = 0.90$

R_N per foot = 3×10^6

$T_{phase\ change} (°F) = 500$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from
model center, x-axis
parallel w/ stream,
+ downstream)

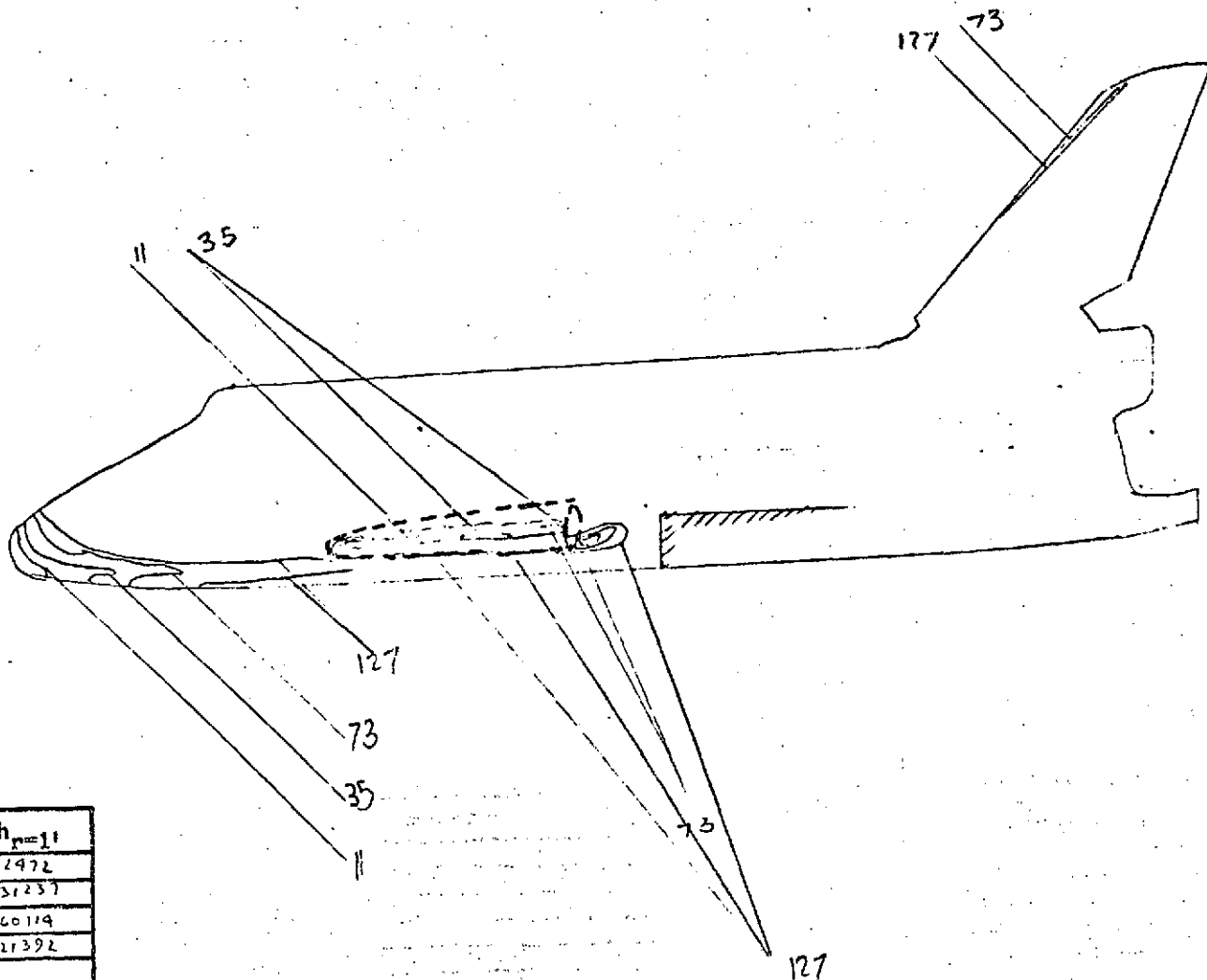
x (in) =

y (in) =

z (in) =

111 f on F. 5000 G
MS = 0.0728389 $\frac{BTU}{FT^2 \cdot SEC \cdot °F}$

PHASE CHANGE TEST



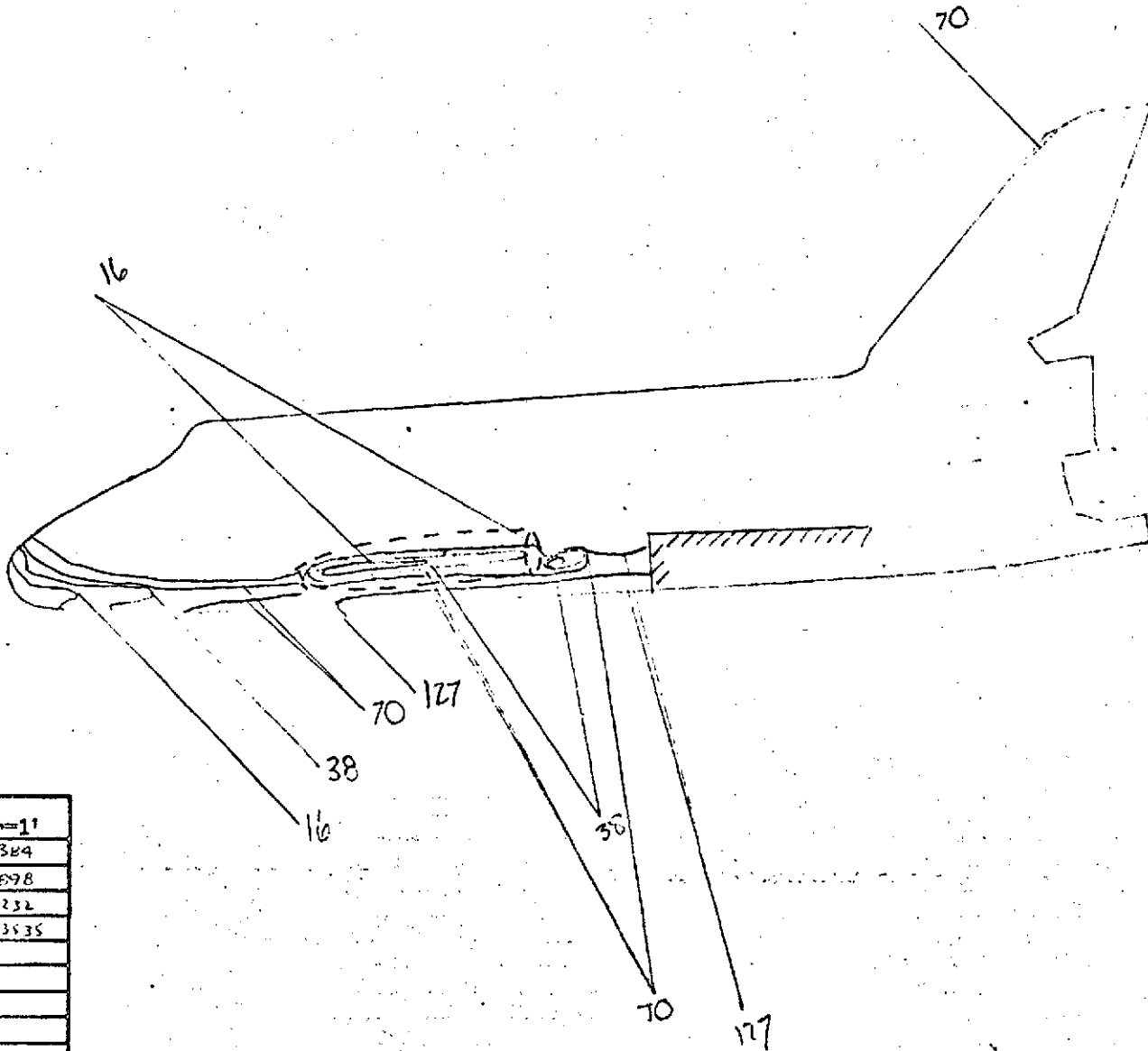
Isotherm	$h/h_{p=1}$
11	0.412972
35	0.231237
73	0.160119
127	0.127392

FIG. 173

CONFIG. 46-5
LENGTH (ft) = .638
SCALE .00595
FACILITY LRC/UDT
TEST OH42B (RPA)
RUN 4191
$M_{\infty} = 8$
$P_{total} \text{ (psi)} = 164$
$T_{total} \text{ (}^{\circ}\text{F)} = 805$
$T_{aw}/T_{total} = 0.90$
$R_N \text{ per foot} = 1 \times 10^6$
$T_{\text{phase change}} \text{ (}^{\circ}\text{F)} = 250$
$\alpha = 30$
$\beta = 0$
$\phi = 0$
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)
x (in) =
y (in) =
z (in) =

$W_{\text{in}} \text{ of orifice } \phi$
 $W_S = 0.0400708 \text{ BTU-SEC}^{-1}$
 PT.

PHASE CHANGE TEST



Isotherm	$h/h_{p=1}$
16	0.226384
35	0.196898
70	0.108232
127	0.0943535

FIG. 174

CONFIG. 46-5

LENGTH (R) = .638

SCALE .00593

FACILITY LRC/UDT

TEST 0H42B (RPA)

RUN 4192

$M_{\infty} = 8$

$P_{total} \text{ (psi)} = 157$

$T_{total} \text{ (}^{\circ}\text{F)} = 795$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 1 \times 10^6$

$T_{\text{phase change}} \text{ (}^{\circ}\text{F)} = 200$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from
model center, x-axis
parallel w/ stream,
+ downstream)

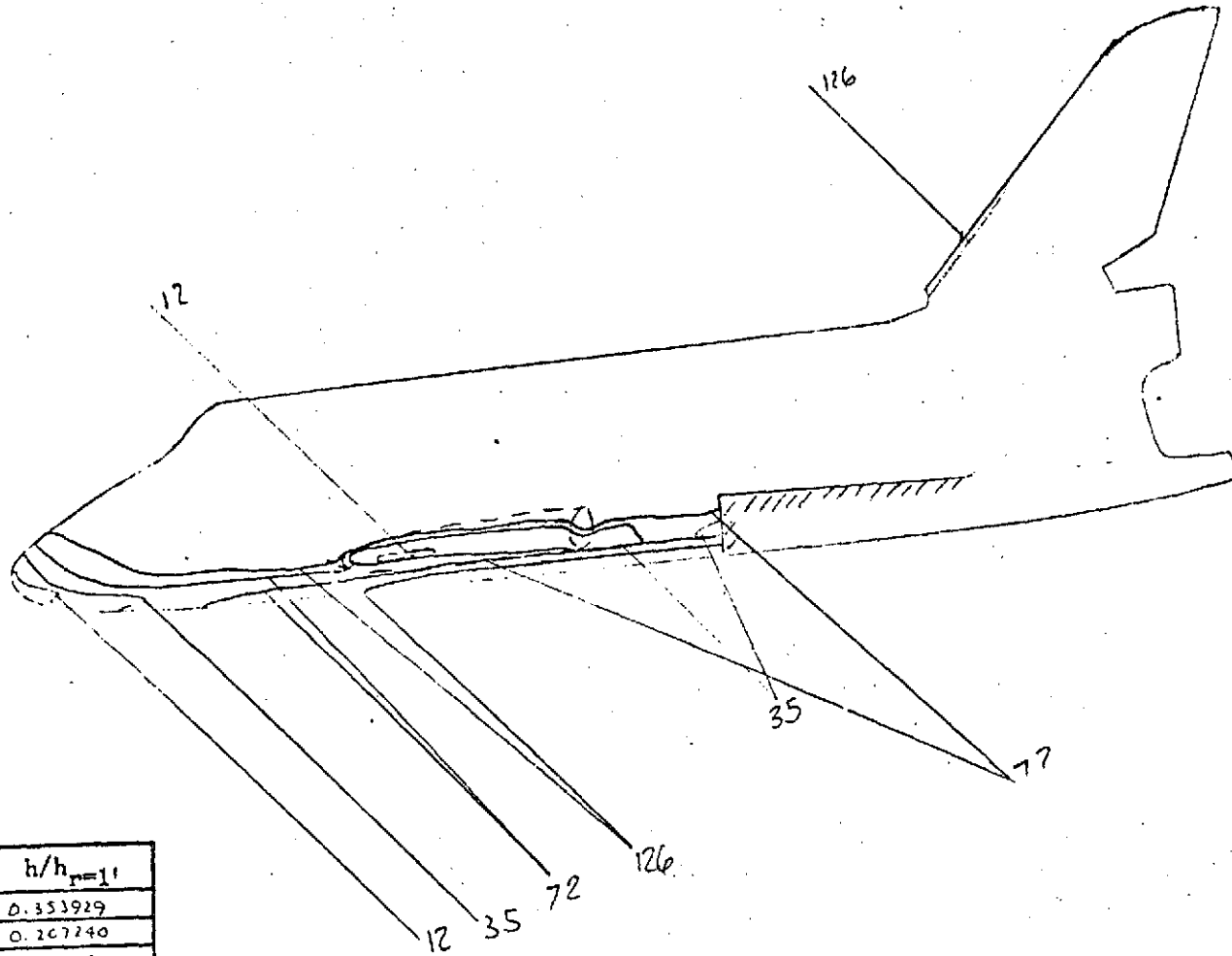
x (in) =

y (in) =

z (in) =

MS = 0.0392547 $\frac{814}{F_{T1}} - 388 - ^{\circ}\text{F}$

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
12	0.353929
35	0.207240
72	0.144991
126	0.169125

FIG. 175

CONFIG. 46-5

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST CH42B (RPA)

RUN 4193

$M_\infty = 8$

$P_{total} \text{ (psi)} = 625$

$T_{total} \text{ (}^\circ\text{F)} = 910$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 3 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 350$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

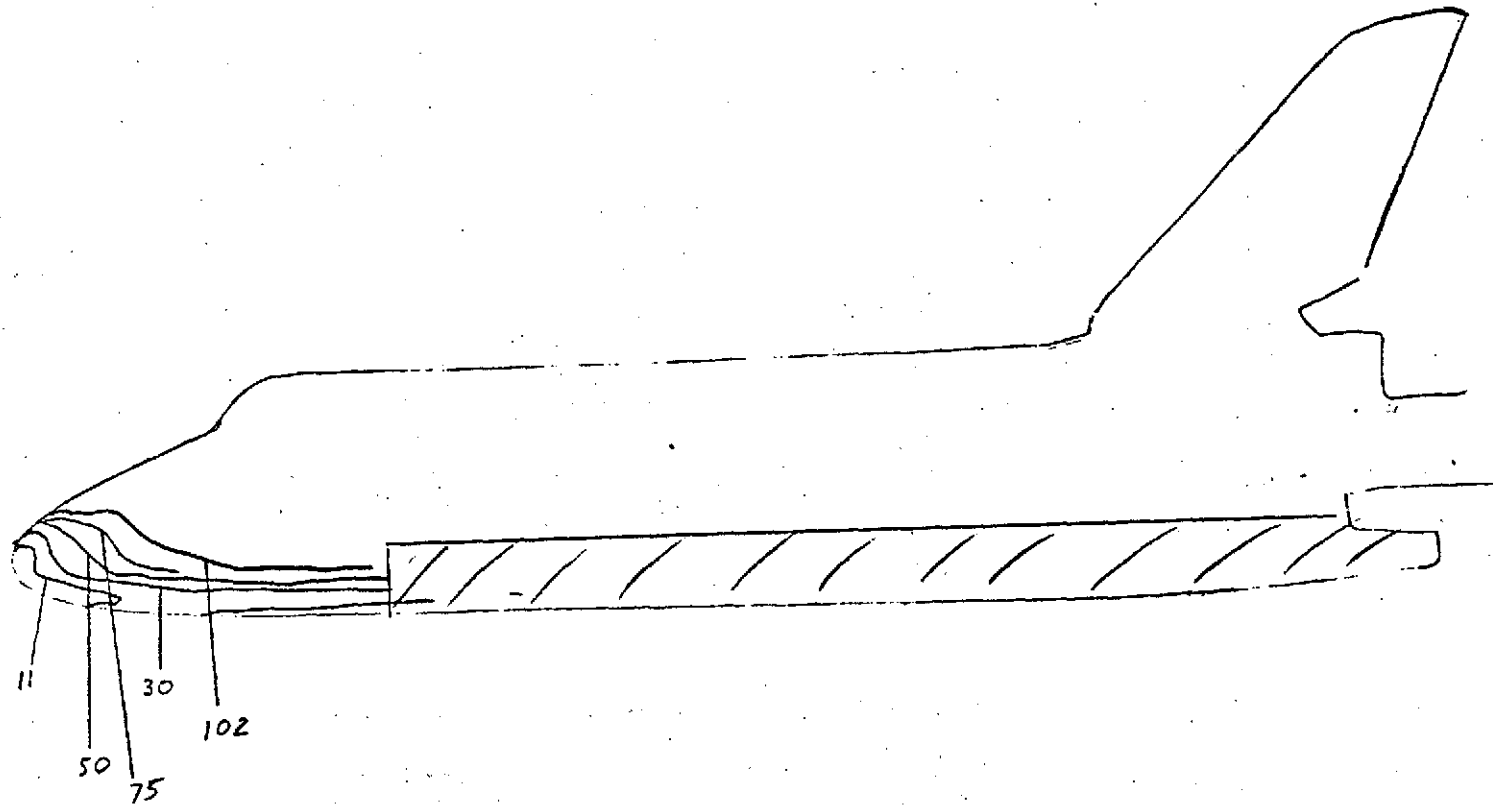
y (in) =

z (in) =

$NS = 0.0728271 \frac{BTU}{FT^2 \cdot SEC \cdot ^\circ F}$

PHASE CHANGE TEST

CONFIG. 46-5



Isotherm	$h/h_{r=1}$
11	0.22188
30	0.133936
50	0.103747
75	0.0897027
102	0.0726371

FIG. 176

LENGTH (ft) = .638
SCALE .00593
FACILITY LRC/UDT
TEST OH42C (RPA)
RUN 4273
$M_\infty = 8$
P_{total} (psi) = 635
T_{total} (°F) = 895
$T_{aw}/T_{total} = 0.90$
R_N per foot = 3×10^6
$T_{phase\ change}$ (°F) = 275
$\alpha = 30$
$\beta = 0$
$\phi = 0$
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)
x (in) =
y (in) =
z (in) =

FRAME 5 = 8

WHD
 $MS = 0.022996 \frac{BTU \cdot SEC \cdot ^\circ F}{FT^2}$
 HD-EVCS

PHASE CHANGE TEST

CONFIG. 46-6

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST 0M42C (RPA)

RUN #274

$M_\infty = 8$

$P_{total} \text{ (psi)} = 655$

$T_{total} \text{ (}^\circ\text{F)} = 900$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 3 \times 10^4$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 300$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

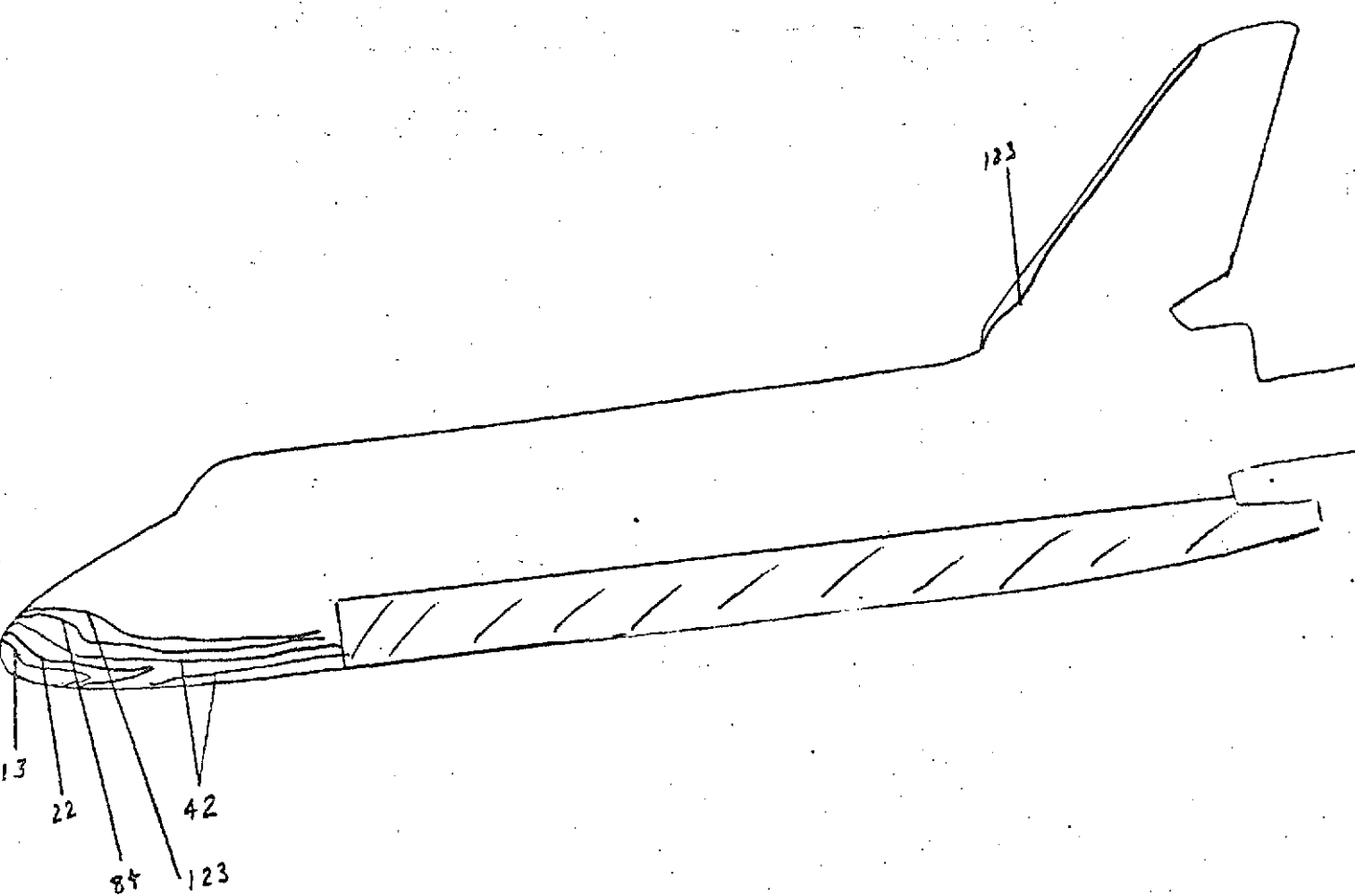
z (in) =

FRAME 5 = \checkmark

WHD

MS = 0.0736932 $\frac{\text{SEC} - \text{OF}}{\text{FT}}$

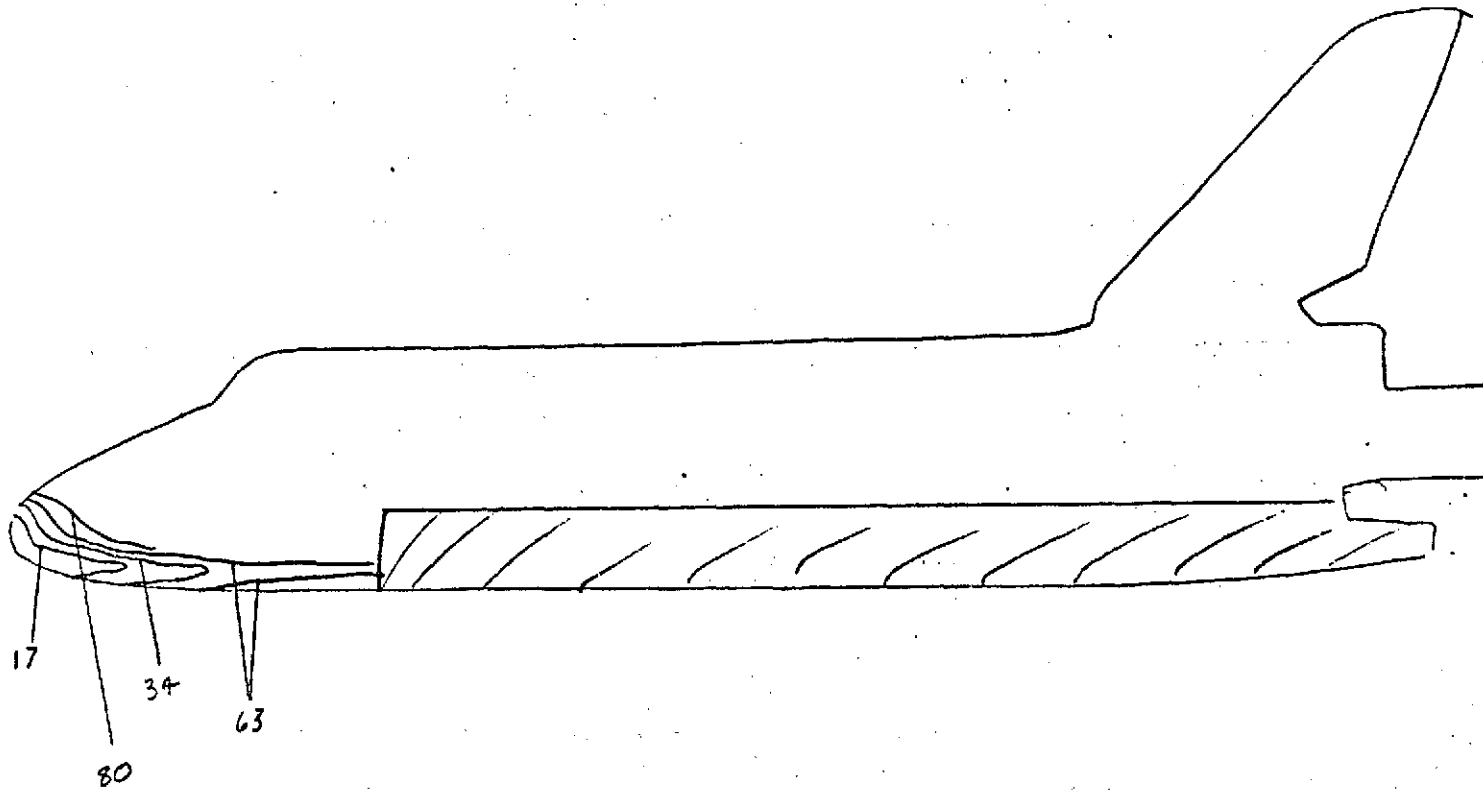
HVD-EVCS



Isotherm	$h/h_{r=1}$
13	0.239247
22	0.183911
42	0.133105
84	0.099194
123	0.077797

FIG. 177

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
17	0.766594
34	0.186510
63	0.13848
FL	0.122294

FIG. 170

CONFIG. 46-5

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42C (RPA)

RUN 4275

$M_\infty = 8$

P_{total} (psi) = 1395

T_{total} (°F) = 920

$T_{aw}/T_{total} = 0.90$

R_N per foot = 6×10^4

$T_{phase\ change}$ (°F) = 400

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

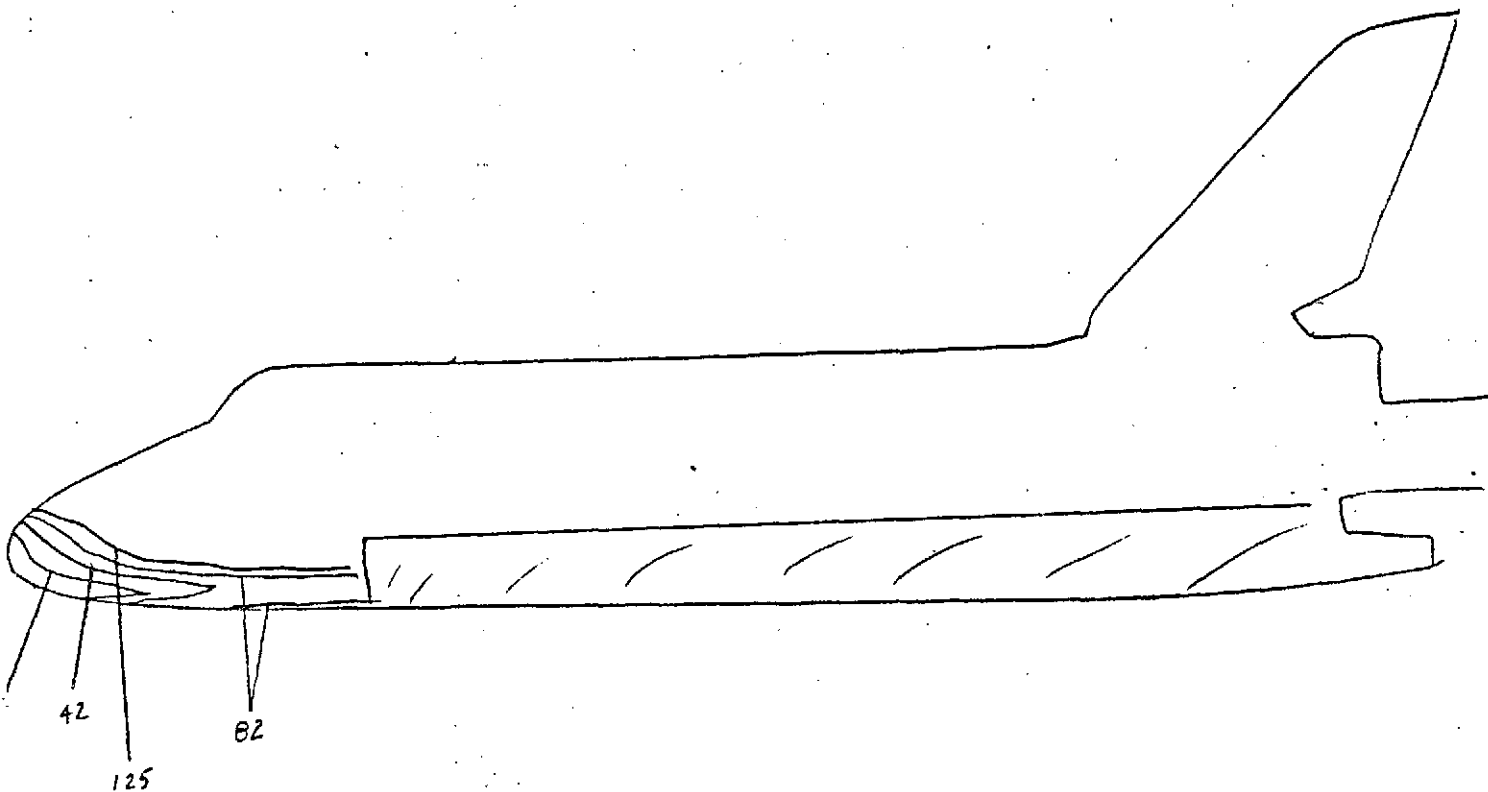
z (in) =

FRAME 5 = 8

MS = 0.104677 $\frac{BTU}{FT^2 \cdot SEC} \cdot ^\circ F$
WHD

HYD-FI05

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
21	0.242626
42	0.171704
82	0.122825
125	0.099529

FIG. 179

CONFIG. 46-6

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST CH42C (RPA)

RUN 4276

$M_{\infty} = 8$

P_{total} (psi) = 620

T_{total} ($^{\circ}$ F) = 950

$T_{aw}/T_{total} = 0.90$

R_N per foot = 3×10^6

$T_{phase\ change}$ ($^{\circ}$ F) = 350

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

$\phi = \text{FRAMES}$

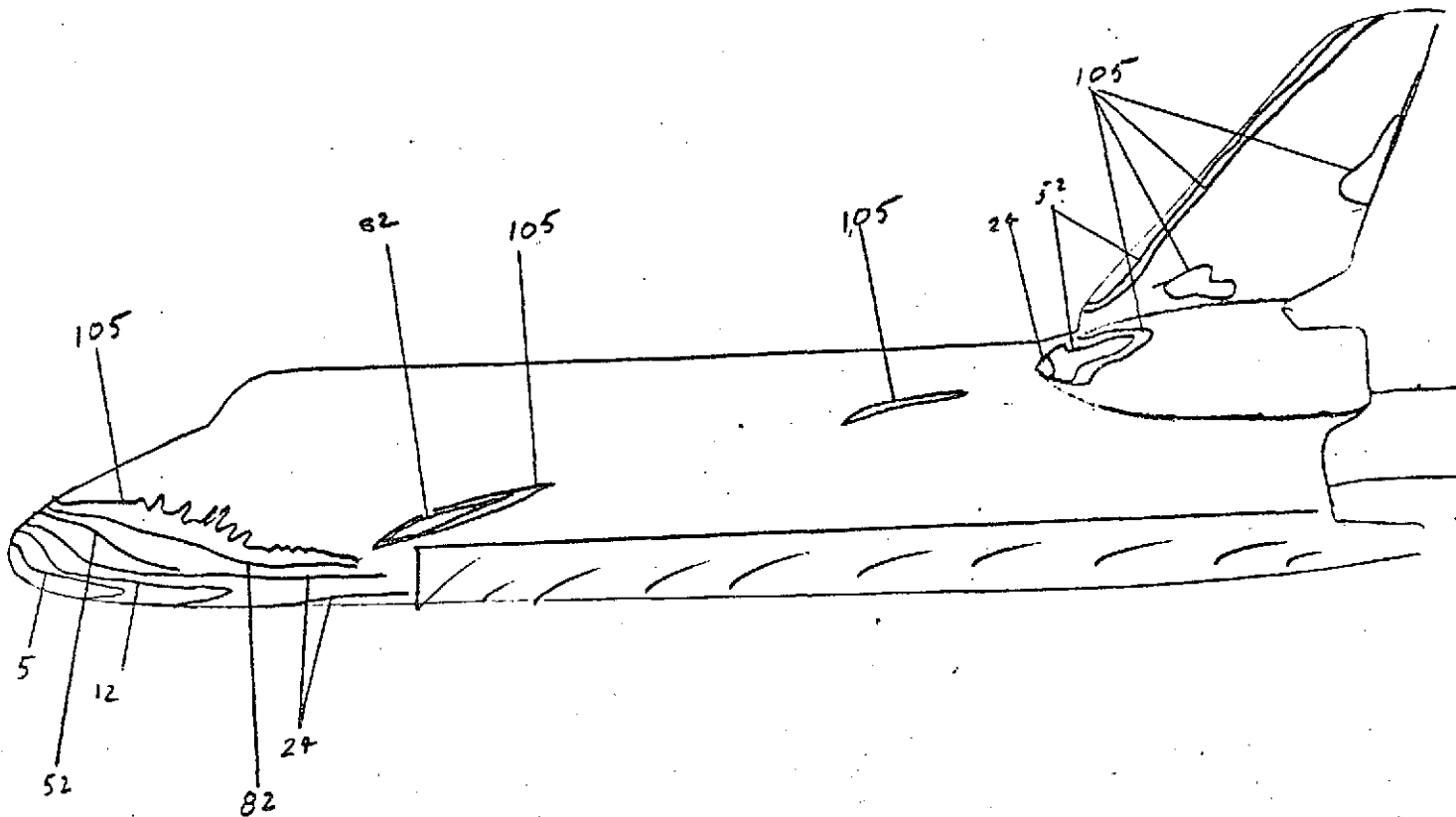
WHD

$NS = 0.0723973 \frac{819 \text{ SEC} \cdot ^{\circ}\text{F}}{\text{FT}}$

H/D-EVCS

PHASE CHANGE TEST

CONFIG. 46-5



Isotherm	$h/h_{r=1}$
5	0.252368
12	0.161916
24	0.115199
52	0.0781611
82	0.0613227
105	0.0550736

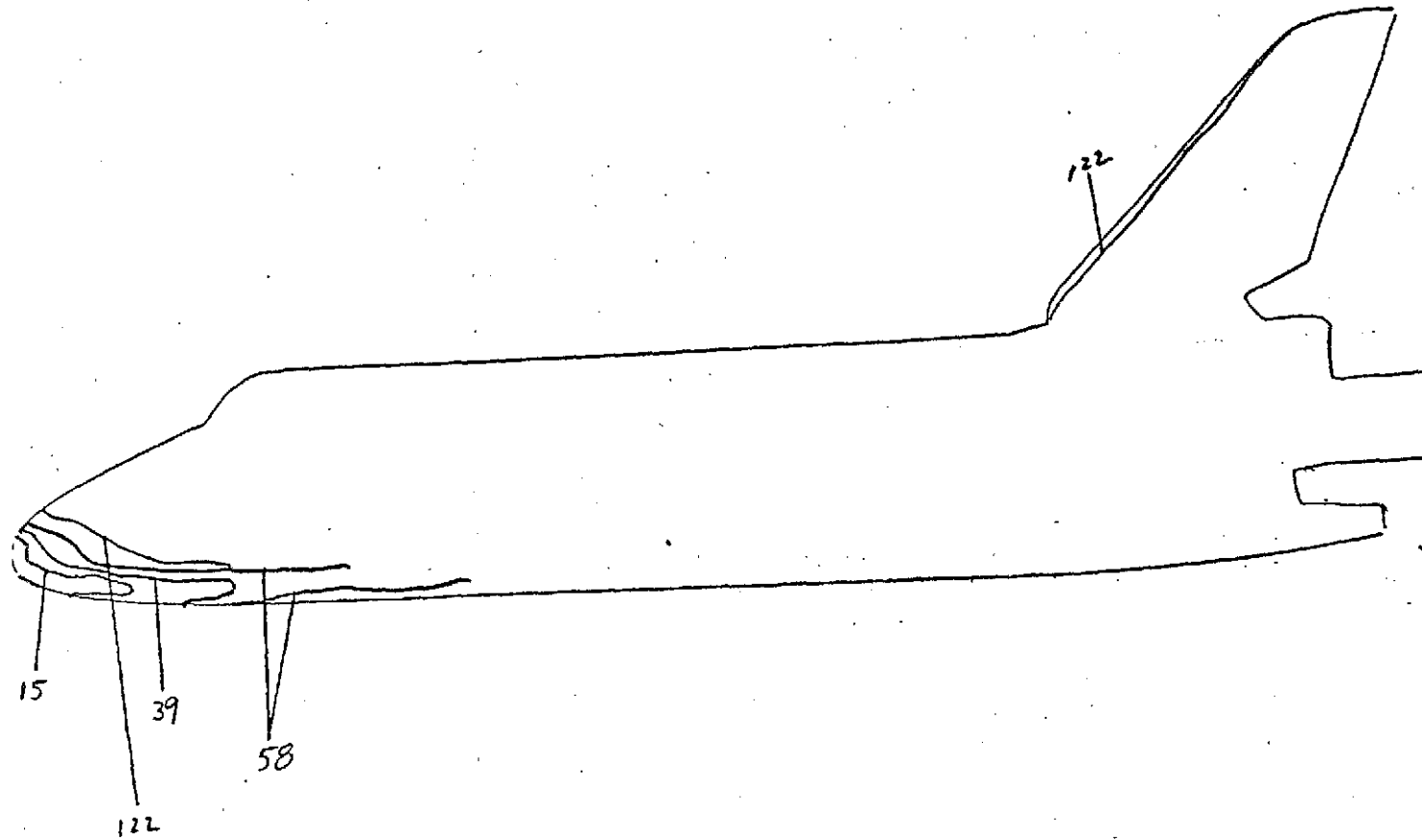
FIG. 180

LENGTH (ft) =	.638
SCALE	.00593
FACILITY	LRC/UDT
TEST	OH42C (RPA)
RUN	f279
M_{∞} =	8
P_{total} (psi) =	1395
T_{total} (°F) =	940
T_{aw}/T_{total} =	0.90
R_N per foot =	6×10^6
$T_{phase\ change}$ (°F) =	300
α =	30
β =	0
ϕ =	0
Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)	
x (in) =	
y (in) =	
z (in) =	

ϕ = FRAME 5

UDT
 HS = 0.104627 BTU-SFC-°F
 FT* HYD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{p=11}$
15	0.222550
39	0.138440
58	0.113177
122	0.076056

FIG. 101

CONFIG. 46-6

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42C (RPA)

RUN #280

$M_\infty = 8$

$P_{total} \text{ (psi)} = 160$

$T_{total} \text{ (}^\circ\text{F)} = 785$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 1 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 200$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

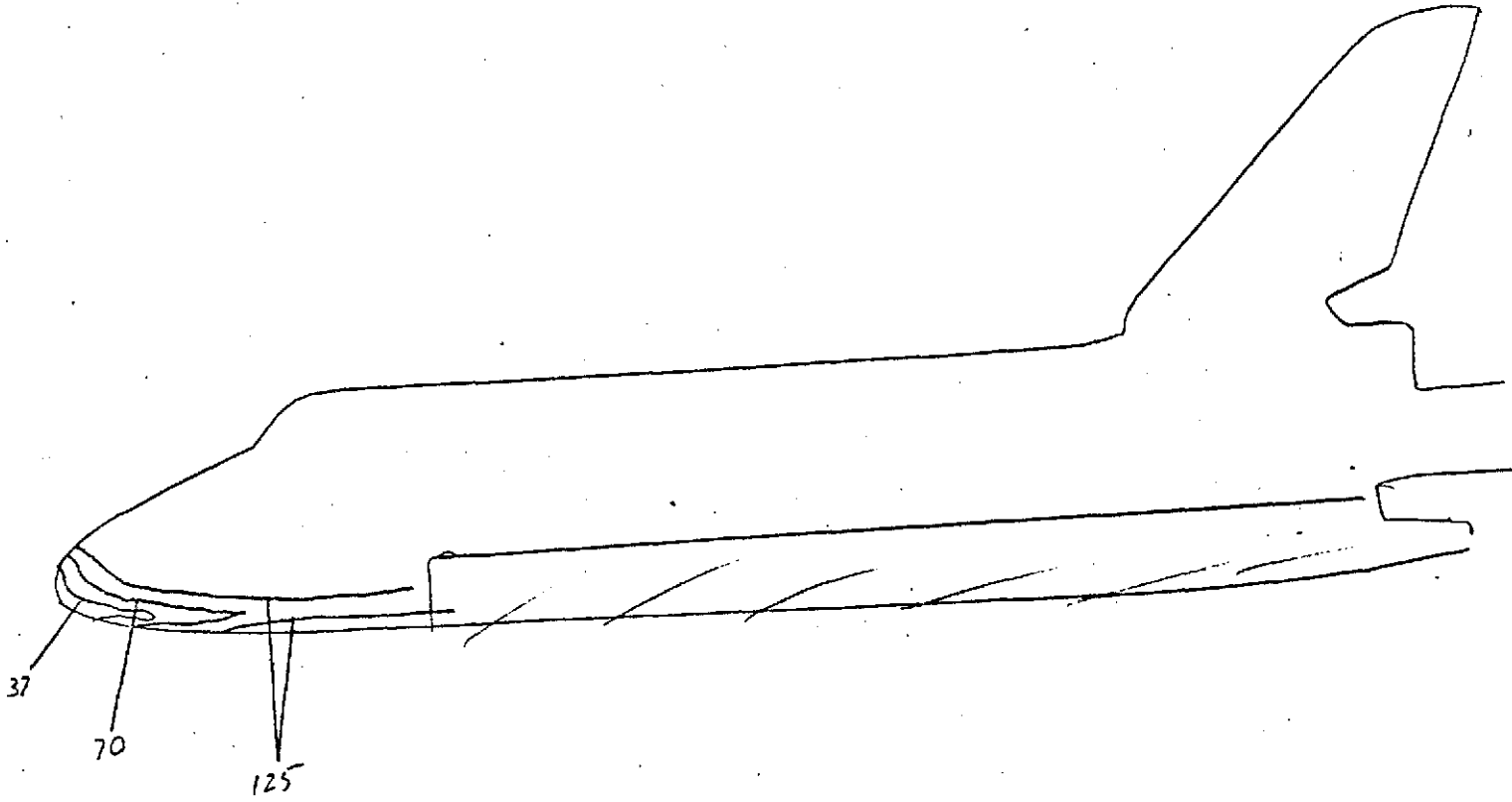
y (in) =

z (in) =

$\phi = \text{FRAME 5}$

LJH D
MS# 0.0193018 REV - SEC 7
E/D-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
37	0.237933
70	0.169350
125	0.126730

FIG. 182

CONFIG. 46-6

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST CH42C (RPA)

RUN 4283

$M_\infty = 8$

$P_{total} \text{ (psi)} = 160$

$T_{total} \text{ (}^\circ\text{F)} = 788$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 1 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 250$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

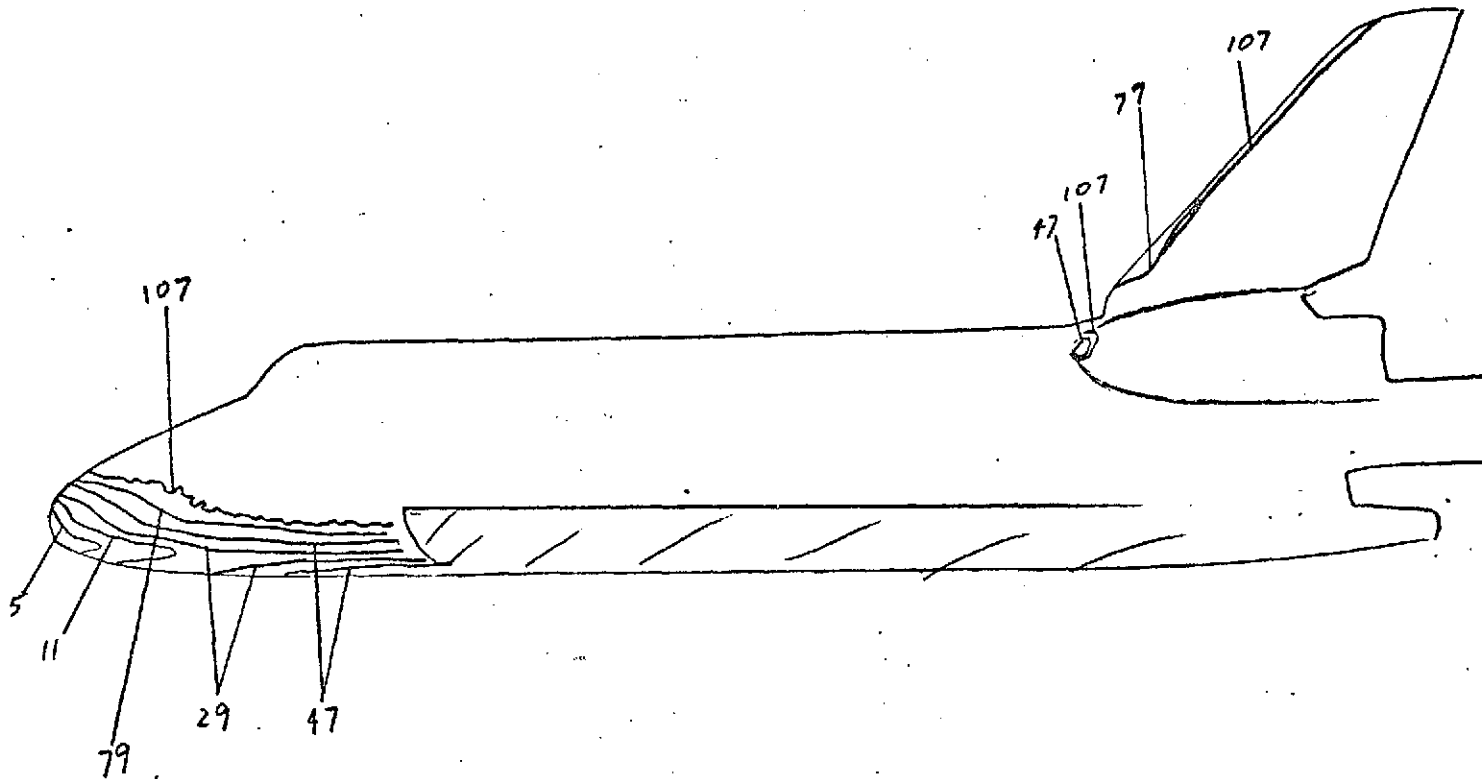
z (in) =

Q = FRAME 5

WHD

$HS = 0.0393703 \frac{\text{ft}^2 \cdot \text{sec} \cdot ^\circ\text{F}}{\text{BTU}}$ HVD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
5	0.369607
11	0.249189
29	0.153971
47	0.126553
77	0.0919848
107	0.0798976

FIG. 183

CONFIG. 46-6

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST 0H42C (RPA)

RUN 4284

$M_\infty = 8$

$P_{total} \text{ (psi)} = 1400$

$T_{total} \text{ (}^\circ\text{F)} = 920$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 6 \times 10^6$

$T_{\text{phase change}} \text{ (}^\circ\text{F)} = 350$

$\alpha = 30$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

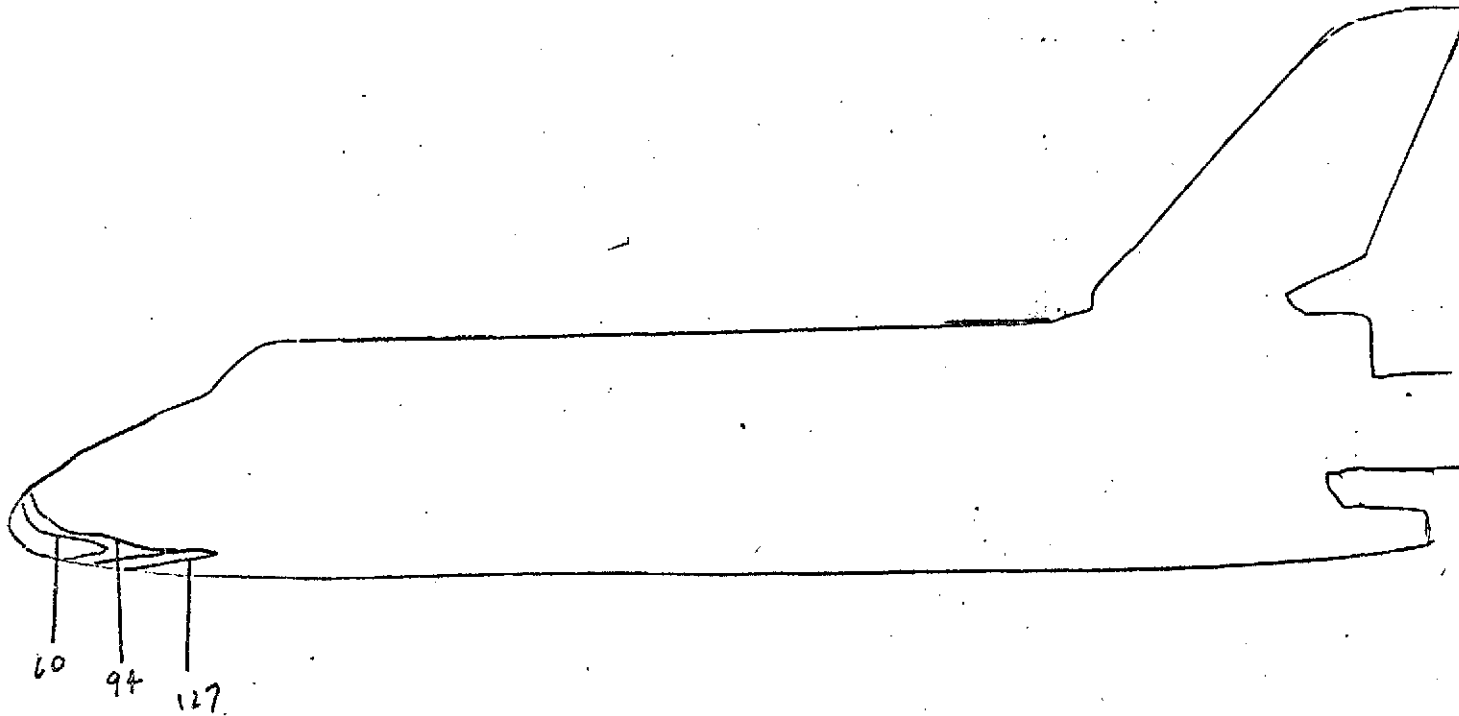
y (in) =

z (in) =

$\phi = \text{FRAME 5}$

WHD
 $H_3 = 0.104863 \frac{BTU \cdot \text{sec} \cdot ^\circ F}{FT^2}$ HVD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
60	0.206726
94	0.165161
127	0.192092

FIG. 184

CONFIG. 46-5

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42C (RPA)

RUN 4286

$M_\infty = 8$

P_{total} (psi) = 155

T_{total} (°F) = 730

$T_{aw}/T_{total} = 0.90$

R_N per foot = 1×10^6

$T_{phase\ change}$ (°F) = 250

$\alpha = 35$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

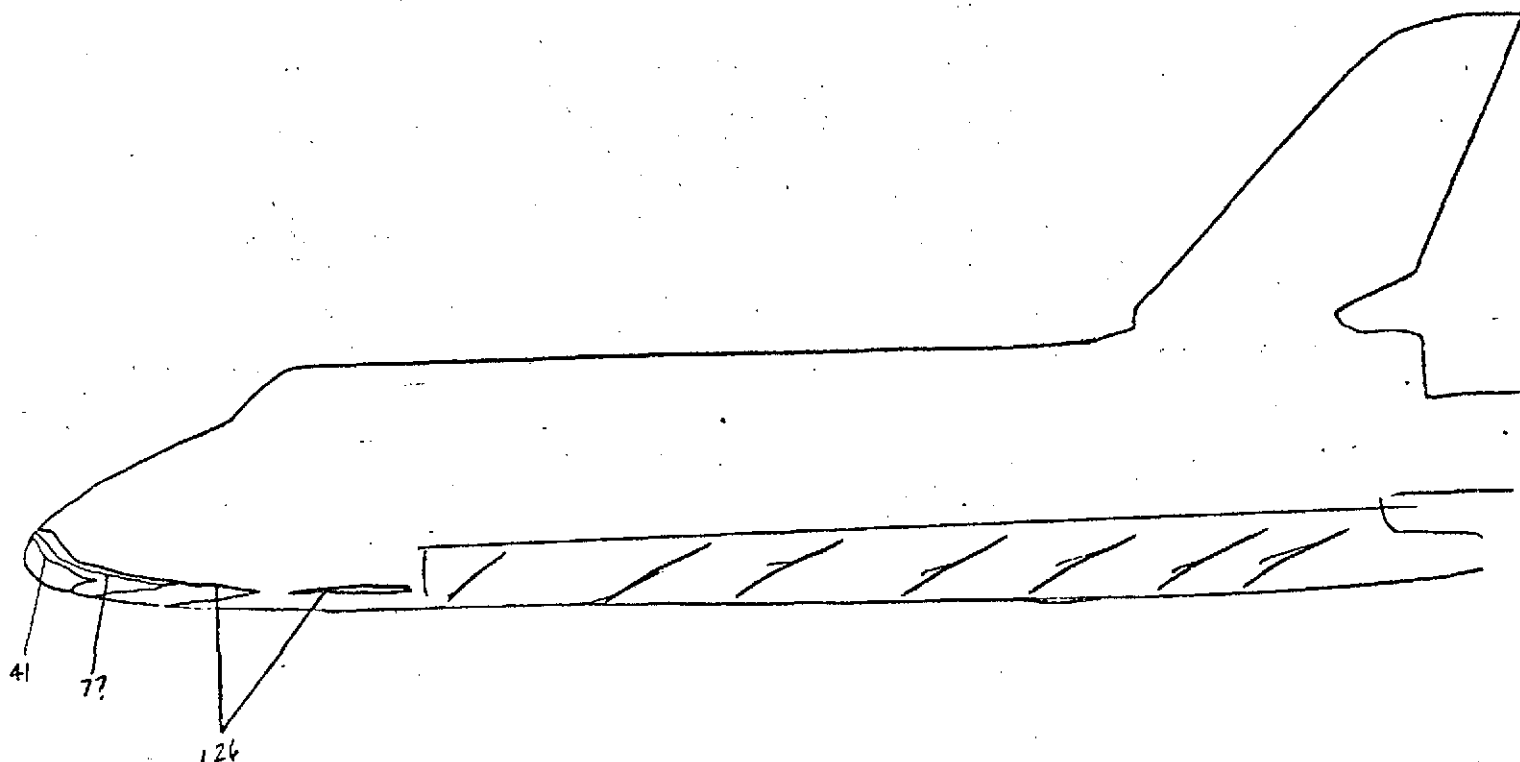
y (in) =

z (in) =

② @ FRAME 5
 $HS = 0.0386545 \frac{BTU}{FT^2 \cdot SEC} \cdot ^\circ F$
 WMD

HVD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
41	0.241766
77	0.176417
126	0.137912

FIG. 185

CONFIG. 46-6

LENGTH (ft) = .638

SCALE .00593

FACILITY LRC/UDT

TEST OH42C (RPA)

RUN 4207

$M_\infty = 8$

P_{total} (psi) = 152

T_{total} (°F) = 760

$T_{aw}/T_{total} = 0.90$

R_N per foot = 1×10^6

$T_{phase\ change}$ (°F) = 250

$\alpha = 35$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

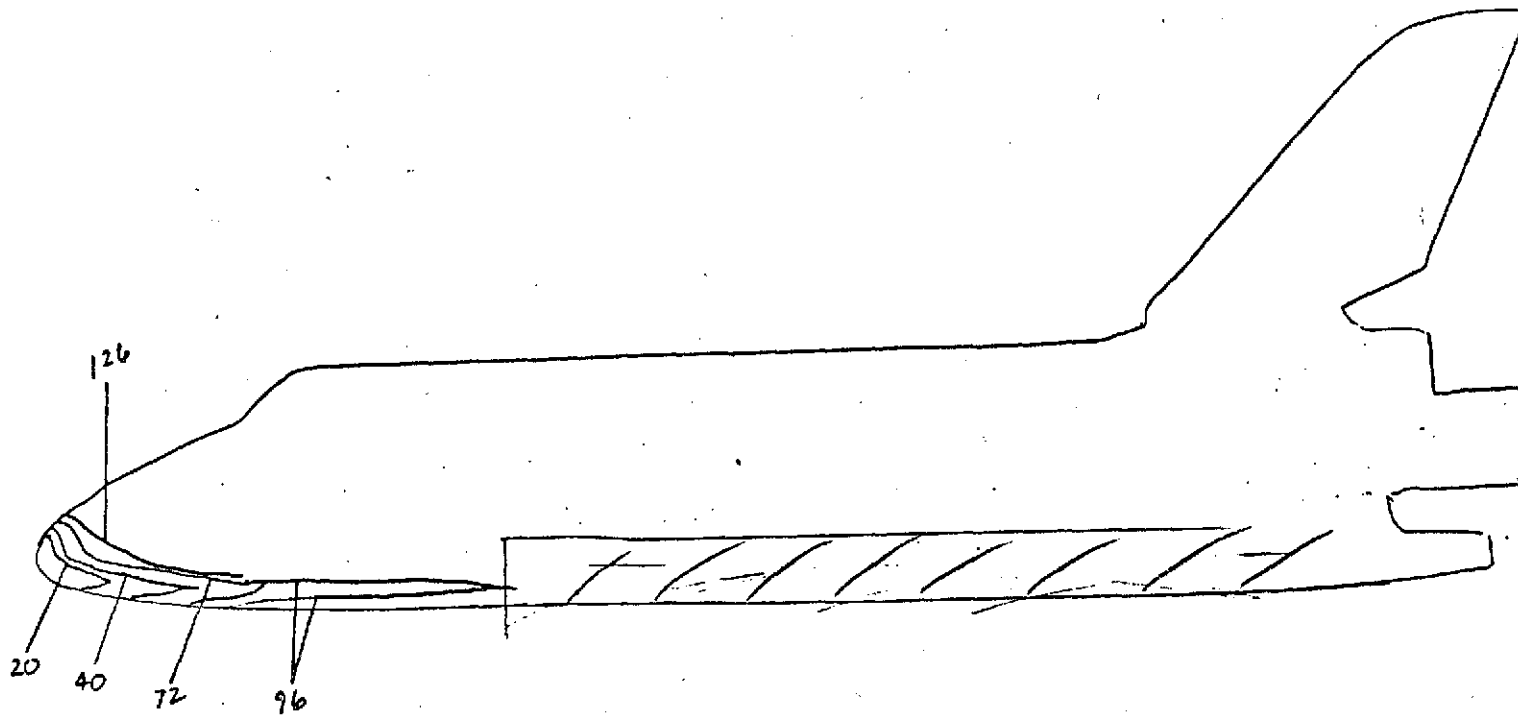
y (in) =

z (in) =

2@FRAME 5

WHD
MS-0.03E4937 810-566-7F
F71 HFD-EVCS

PHASE CHANGE TEST



Isotherm	$h/h_{r=1}$
20	0.299879
40	0.208511
72	0.155415
96	0.134593
126	0.117483

FIG. 186

CONFIG. 46-5

LENGTH (R) = .638

SCALE = .00593

FACILITY LRC/VDI

TEST OH42C (RPA)

RUN 4288

$M_\infty = 8$

$P_{total} (psi) = 625$

$T_{total} (^\circ F) = 875$

$T_{aw}/T_{total} = 0.90$

$R_N \text{ per foot} = 3 \times 10^6$

$T_{phase \ change} (^\circ F) = 350$

$\alpha = 35$

$\beta = 0$

$\phi = 0$

Camera Coordinates (from model center, x-axis parallel w/ stream, + downstream)

x (in) =

y (in) =

z (in) =

Q @ FRAME 5
 MS = 0.0227102 $\frac{BIV}{RTA} - SEC - ^\circ F$
 WHID