PERFORMANCE, STATIC STABILITY AND CONTROL EFFECTIVENESS OF A PARAMETRIC SPACE SHUTTLE LAUNCH VEHICLE

by

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SADSAC/SPACE SHUTTLE

WIND TUNNEL TEST DATA REPORT

CONFIGURATION: PARAMETRIC SPACE SHUTTLE LAUNCH VEHICLE

TEST PURPOSE: PERFORMANCE, STATIC STABILITY, AND CONTROL EFFECTIVENESS OF A PARAMETRIC SPACE SHUTTLE LAUNCH VEHICLE.

TEST FACILITY: NASA/MSFC 14 x 14 - INCH TRISONIC WIND TUNNEL

TESTING AGENCY: Lockheed Missiles & Space Company

TEST NO. & DATE: MSFC TWT 544X - July 25 - August 7, 1972

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PROJECT ENGINEER(S): ROBERT E. BUCHHOLZ

MICKEY GAMBLE

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LIAISON: V. W. SPARKS

DATA OPERATIONS: W. M. HALE

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CONTRACT NAS 8-4016 AMENDMENT 174 DRL 397 - 84b

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<td>45</td>
</tr>
</tbody>
</table>
This test was run as a continuation of a prior investigation* of aero-
dynamic performance and static stability for a parametric space shuttle launch
vehicle. The purposes of this test were:

1. To obtain a more complete set of data in the transonic flight
region.

2. To investigate new H-O tank noseshapes and tank diameters.

3. To obtain control effectiveness data for the orbiter at 0
degree incidence and with a smaller diameter H-O tank.

4. To determine the effects of varying solid rocket motor-to-HO
tank gap size.

Experimental data were obtained for angles of attack from -10 to +10
degrees and for angles of sideslip from +10 to -10 degrees at Mach numbers
ranging from .6 to 4.96.

* (Published as SADSAC report DMS-DR-1256)
# NOMENCLATURE

## General

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>SADSAC SYMBOL</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>CP</td>
<td>speed of sound; (m/sec, ft/sec)</td>
</tr>
<tr>
<td>(C_p)</td>
<td>MACH</td>
<td>pressure coefficient; ((P_l - P_o)/q)</td>
</tr>
<tr>
<td>(M)</td>
<td></td>
<td>Mach number; (V/a)</td>
</tr>
<tr>
<td>(p)</td>
<td>Q(NSM) Q(PSF)</td>
<td>pressure; (N/m^2, psf)</td>
</tr>
<tr>
<td>(q)</td>
<td></td>
<td>dynamic pressure; (1/2\rho V^2, N/m^2, psf)</td>
</tr>
<tr>
<td>(RN/L)</td>
<td></td>
<td>unit Reynolds number; per (m, ft)</td>
</tr>
<tr>
<td>(V)</td>
<td></td>
<td>velocity; (m/sec, ft/sec)</td>
</tr>
<tr>
<td>(\alpha)</td>
<td>ALPHA</td>
<td>angle of attack, degrees</td>
</tr>
<tr>
<td>(\beta)</td>
<td>BETA</td>
<td>angle of sideslip, degrees</td>
</tr>
<tr>
<td>(\psi)</td>
<td>PSI</td>
<td>angle of yaw, degrees</td>
</tr>
<tr>
<td>(\phi)</td>
<td>PHI</td>
<td>angle of roll, degrees</td>
</tr>
<tr>
<td>(\rho)</td>
<td></td>
<td>mass density; (kg/m^3, slugs/ft^3)</td>
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</tbody>
</table>

## Reference & C.G. Definitions

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A_b)</td>
<td>base area; (m^2, ft^2)</td>
</tr>
<tr>
<td>(b)</td>
<td>wing span or reference span; (m, ft)</td>
</tr>
<tr>
<td>c.g.</td>
<td>center of gravity</td>
</tr>
<tr>
<td>(c_{REF})</td>
<td>reference length or wing mean aerodynamic chord; (m, ft)</td>
</tr>
<tr>
<td>(S)</td>
<td>wing area or reference area; (m^2, ft^2)</td>
</tr>
<tr>
<td>MRP</td>
<td>moment reference point</td>
</tr>
<tr>
<td>XMRP</td>
<td>moment reference point on (X) axis</td>
</tr>
<tr>
<td>YMRP</td>
<td>moment reference point on (Y) axis</td>
</tr>
<tr>
<td>ZMRP</td>
<td>moment reference point on (Z) axis</td>
</tr>
</tbody>
</table>

## Subscripts

<table>
<thead>
<tr>
<th>SUBSCRIPTS</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>(b)</td>
<td>base</td>
</tr>
<tr>
<td>(l)</td>
<td>local</td>
</tr>
<tr>
<td>(s)</td>
<td>static conditions</td>
</tr>
<tr>
<td>(t)</td>
<td>total conditions</td>
</tr>
<tr>
<td>(\infty)</td>
<td>free stream</td>
</tr>
</tbody>
</table>
### Body-Axis System

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>SADSAC SYMBOL</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_N$</td>
<td>$CN$</td>
<td>normal-force coefficient; $\frac{\text{normal force}}{q_S}$</td>
</tr>
<tr>
<td>$C_A$</td>
<td>$CA$</td>
<td>axial-force coefficient; $\frac{\text{axial force}}{q_S}$</td>
</tr>
<tr>
<td>$C_Y$</td>
<td>$CY$</td>
<td>side-force coefficient; $\frac{\text{side force}}{q_S}$</td>
</tr>
<tr>
<td>$C_{Ab}$</td>
<td>$CAB$</td>
<td>base-force coefficient; $\frac{\text{base force}}{q_S}$ (-A_p(p_b - p_a)/q_S)</td>
</tr>
<tr>
<td>$C_{Ar}$</td>
<td>$CAF$</td>
<td>forebody axial force coefficient; $C_A - C_{Ab}$</td>
</tr>
<tr>
<td>$C_m$</td>
<td>$CIM$</td>
<td>pitching-moment coefficient; $\frac{\text{pitching moment}}{q_{Sf_{\text{REF}}}}$</td>
</tr>
<tr>
<td>$C_n$</td>
<td>$CYN$</td>
<td>yawing-moment coefficient; $\frac{\text{yawing moment}}{q_{Sb}}$</td>
</tr>
<tr>
<td>$C_f$</td>
<td>$CBL$</td>
<td>rolling-moment coefficient; $\frac{\text{rolling moment}}{q_{Sb}}$</td>
</tr>
<tr>
<td>Symbol</td>
<td>SADSAC Symbol</td>
<td>Definition</td>
</tr>
<tr>
<td>------------</td>
<td>---------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>$C_{A\alpha} = 0$</td>
<td>CAALFO</td>
<td>axial force coefficient at alpha equal zero degrees</td>
</tr>
<tr>
<td>$C_{A_{f\alpha}} = 0$</td>
<td>CAFAFO</td>
<td>forebody axial force coefficient at alpha equal zero degrees</td>
</tr>
<tr>
<td>$CLM_{\alpha}$</td>
<td>D(CLM)</td>
<td>pitching moment coefficient slope, $(\alpha \pm 5^\circ)$; per degree</td>
</tr>
<tr>
<td>$CN_{\alpha}$</td>
<td>D(CN)</td>
<td>normal force coefficient slope, $(\alpha \pm 5^\circ)$; per degree</td>
</tr>
<tr>
<td>$CLM_{\alpha}/CN_{\alpha}$</td>
<td>DCLM/DCN</td>
<td>longitudinal static stability slope, pitching moment coefficient slope divided by the normal force coefficient slope, $D(CLM)/D(CN)$</td>
</tr>
<tr>
<td>$C_{y\beta}$</td>
<td>D(CY)</td>
<td>side force coefficient slope, $(\beta \pm 5^\circ)$; per degree</td>
</tr>
<tr>
<td>$C_{n\beta}$</td>
<td>D(CYN)</td>
<td>yawing moment coefficient slope, $(\beta \pm 5^\circ)$; per degree</td>
</tr>
<tr>
<td>$C_{\ell\beta}$</td>
<td>D(CBL)</td>
<td>rolling moment coefficient slope, $(\beta \pm 5^\circ)$; per degree</td>
</tr>
<tr>
<td>Symbol</td>
<td>SADSAC Symbol</td>
<td>Definition</td>
</tr>
<tr>
<td>--------</td>
<td>---------------</td>
<td>------------</td>
</tr>
<tr>
<td>$x_s$</td>
<td>XS</td>
<td>longitudinal location of the nose of the solid rocket motors relative to HO tank nose</td>
</tr>
<tr>
<td>$y_s$</td>
<td>YS</td>
<td>lateral distance between solid rocket motors and HO tank</td>
</tr>
<tr>
<td>$i$</td>
<td>ORBINC</td>
<td>orbiter incidence angle relative to HO tank longitudinal $C_L$; positive when nose up; deg</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>GAMZ</td>
<td>SRM nozzle position relative to HO tank longitudinal centerline</td>
</tr>
<tr>
<td>$\phi_s$</td>
<td>PHIS</td>
<td>radial position of solid rocket motors relative to the vertical plane, deg</td>
</tr>
<tr>
<td>$\delta$</td>
<td></td>
<td>control surface deflection angle; deg positive deflections are:</td>
</tr>
<tr>
<td></td>
<td>ELEVTR</td>
<td>elevator - trailing edge down</td>
</tr>
<tr>
<td></td>
<td>RUDDER</td>
<td>rudder - trailing edge to the left</td>
</tr>
</tbody>
</table>
CONFIGURATIONS INVESTIGATED

The launch configuration consists of the double delta wing orbiter with one large liquid hydrogen-oxygen tank (HO) and two solid rocket motors (SRM) underslung beneath the orbiter (see Figure 2). Configuration components investigated were:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>baseline orbiter with abort solid rocket motors</td>
</tr>
<tr>
<td>02</td>
<td>baseline orbiter without abort solid rocket motors</td>
</tr>
<tr>
<td>T1</td>
<td>346-in. diam. HO tank with 22-deg nosecone</td>
</tr>
<tr>
<td>T3</td>
<td>346-in. diam. HO tank with 17-deg nosecone</td>
</tr>
<tr>
<td>T8</td>
<td>346-in. diam. HO tank with Generalized nosecone</td>
</tr>
<tr>
<td>T9</td>
<td>312-in. diam. HO tank with 17-deg nosecone</td>
</tr>
<tr>
<td>T10</td>
<td>346-in. diam. HO tank with modified Apollo nosecone</td>
</tr>
<tr>
<td>S1</td>
<td>156-in. diam. solid rocket motor with 17-deg nosecone</td>
</tr>
<tr>
<td>S6</td>
<td>156-in. diam. solid rocket motor with 17-deg nosecone without rocket nozzle</td>
</tr>
</tbody>
</table>

TEST FACILITY DESCRIPTION

The Marshall Space Flight Center 14" x 14" Trisonic Wind Tunnel is an intermittent blowdown tunnel which operates by high pressure air flowing from storage to either vacuum or atmospheric conditions. A Mach number range from .2 to 5.85 is covered by utilizing two interchangeable test sections. The transonic section permits testing at Mach 0.20 through 2.50, and the supersonic section permits testing at Mach 2.74 through 5.85. Mach numbers between .2 and .9 are obtained by using a controllable diffuser. The range from .95 to 1.3 is achieved through the use of plenum suction and perforated walls. Mach numbers of 1.44, 1.93 and 2.50 are produced by interchangeable sets of fixed contour nozzle blocks. Above Mach 2.50 a set of fixed contour nozzle blocks are tilted and translated automatically to produce any desired Mach number in .25 increments.

Air is supplied to a 6000 cubic foot storage tank at approximately -40°F dew point and 500 psi. The compressor is a three-stage reciprocating unit driven by a 1500 hp motor.
The tunnel flow is established and controlled with a servo actuated gate valve. The controlled air flows through the valve diffuser into the stilling chamber and heat exchanger where the air temperature can be controlled from ambient to approximately 180°F. The air then passes through the test section which contains the nozzle blocks and test region.

Downstream of the test section is a hydraulically controlled pitch sector that provides a total angle of attack range of 20° (+ 10°). Sting offset and extensions are available for obtaining various maximum angles of attack up to 90°.

MODEL DESCRIPTION

The model geometry is specified in Figs. 2 through 8. The SRM boosters and HO tanks are constructed of aluminum. The orbiter wing and body are aluminum and the elevons, fins and rudder flares are 17-4 PH stainless steel. The launch configuration has a complete build-up and parametric capability (SRM and HO tank nose shape, body diameter, body length, SRM longitudinal and radial location, HO tank vertical fin size, and orbiter incidence). In addition, the orbiter control surfaces can be deflected to provide additional control for the launch configuration. The launch vehicle SRM's and HO tanks were manufactured at MSFC and the orbiter was manufactured at Lockheed-Huntsville. All model components are available at the MSFC 14 x 14-inch Wind Tunnel facility.

DATA REDUCTION

All model forces and moments were resolved in the body axis system and are presented in the form of non-dimensional coefficients. Model reference dimensions used in the data reduction are:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Full Scale</th>
<th>Model Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference Area (S_{\text{ref}})</td>
<td>3420.0 ft.²</td>
<td>7.880 in.²</td>
</tr>
<tr>
<td>(Wing Theoretical Area)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reference Length (l_{\text{ref}})</td>
<td>507.0 in.</td>
<td>2.028 in.</td>
</tr>
<tr>
<td>(M.A.C.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reference Span (b_{\text{ref}})</td>
<td>1115.0 in.</td>
<td>4.460 in.</td>
</tr>
<tr>
<td>(Wing Span)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moment Reference Point (MRP)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>from base</td>
<td>840.0 in.</td>
<td>3.360 in.</td>
</tr>
<tr>
<td>above HO tank centerline</td>
<td>62.0 in.</td>
<td>0.248 in.</td>
</tr>
</tbody>
</table>
Base pressure coefficients were calculated using the following equations:

\[ \text{CAB}_O = -\text{CPB}_1 \frac{A_{bO}}{S_{\text{ref}}} \] (Orbiter base axial force coefficient)

\[ \text{CAB}_S = -\text{CPB}_2 \frac{A_{bS}}{S_{\text{ref}}} \] (SRM base axial force coefficient)

\[ \text{CAB}_{HO} = -\text{CPB}_3 \frac{A_{bHO}}{S_{\text{ref}}} \] (HO tank base axial force coefficient)

where:

\[ \text{CPB}_1 = \frac{(P_{bO} - P\infty)}{q} \]

\[ \text{CPB}_2 = \frac{(P_{bS} - P\infty)}{q} \]

\[ \text{CPB}_3 = \frac{(P_{bHO} - P\infty)}{q} \]

The following combinations of SRM and HO tank required the following base areas to be used for axial force corrections.

<table>
<thead>
<tr>
<th>Configuration</th>
<th>( A_{bO} ) (in.(^2))</th>
<th>( A_{bS} ) (in.(^2))</th>
<th>( A_{bHO} ) (in.(^2))</th>
</tr>
</thead>
<tbody>
<tr>
<td>T101S1</td>
<td>0.732</td>
<td>0.306</td>
<td>1.504</td>
</tr>
<tr>
<td>T301S1</td>
<td>0.732</td>
<td>0.306</td>
<td>1.504</td>
</tr>
<tr>
<td>T801S1</td>
<td>0.732</td>
<td>0.306</td>
<td>1.504</td>
</tr>
<tr>
<td>T901S1</td>
<td>0.732</td>
<td>0.306</td>
<td>1.223</td>
</tr>
<tr>
<td>T1001S1</td>
<td>0.732</td>
<td>0.306</td>
<td>1.504</td>
</tr>
<tr>
<td>T301S6</td>
<td>0.732</td>
<td>0.306</td>
<td>1.504</td>
</tr>
</tbody>
</table>
## TABLE I

**TEST CONDITIONS**

**TEST MSFC TWT 544X**

<table>
<thead>
<tr>
<th>MACH NUMBER</th>
<th>REYNOLDS NUMBER per unit length</th>
<th>DYNAMIC PRESSURE (pounds/sq. inch)</th>
<th>STAGNATION TEMPERATURE (degrees Fahrenheit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>.60</td>
<td>$4.4 \times 10^6$/Ft.</td>
<td>3.91</td>
<td>100°</td>
</tr>
<tr>
<td>.80</td>
<td>$5.3 \times 10^6$/Ft.</td>
<td>5.94</td>
<td>100°</td>
</tr>
<tr>
<td>.90</td>
<td>$5.6 \times 10^6$/Ft.</td>
<td>6.73</td>
<td>100°</td>
</tr>
<tr>
<td>1.00</td>
<td>$5.8 \times 10^6$/Ft.</td>
<td>7.40</td>
<td>100°</td>
</tr>
<tr>
<td>1.10</td>
<td>$5.9 \times 10^6$/Ft.</td>
<td>7.94</td>
<td>100°</td>
</tr>
<tr>
<td>1.20</td>
<td>$5.9 \times 10^6$/Ft.</td>
<td>8.30</td>
<td>100°</td>
</tr>
<tr>
<td>1.46</td>
<td>$5.9 \times 10^6$/Ft.</td>
<td>8.60</td>
<td>100°</td>
</tr>
<tr>
<td>1.96</td>
<td>$6.8 \times 10^6$/Ft.</td>
<td>9.91</td>
<td>100°</td>
</tr>
<tr>
<td>3.48</td>
<td>$6.4 \times 10^6$/Ft.</td>
<td>6.86</td>
<td>140°</td>
</tr>
<tr>
<td>4.96</td>
<td>$5.0 \times 10^6$/Ft.</td>
<td>3.07</td>
<td>140°</td>
</tr>
</tbody>
</table>

**BALANCE UTILIZED:** MSFC 232

**CAPACITY:**

- **NF** 300 lbs.
- **SF** 143 lbs.
- **AF** 50 lbs.
- **PM** 400 in-lbs.
- **YM** 192 in-lbs.
- **RM** 100 in-lbs.

**ACCURACY:**

- ± 1.5 lbs.
- ± 0.72 lbs.
- ± 0.25 lbs.
- ± 2.0 in-lbs.
- ± 0.96 in-lbs.
- ± 0.50 in-lbs.

**COEFFICIENT TOLERANCE:** $q = 9.2$

**TOLERANCE:**

- ± 0.0207
- ± 0.0136
- ± 0.0035
- ± 0.0099
- ± 0.0030
- ± 0.0016

**COMMENTS:**
## TABLE II

TEST TWT544x DATA SET COLLATION SHEET

<table>
<thead>
<tr>
<th>DATA SET IDENTIFIER</th>
<th>CONFIGURATION</th>
<th>SCHED.</th>
<th>PARAMETERS/VALUES</th>
<th>NO. OF RUNS</th>
<th>MACH NUMBERS (OR ALTERNATE INDEPENDENT VARIABLE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R71029 T30151</td>
<td>A O</td>
<td>Y</td>
<td>0.0</td>
<td>C</td>
<td>6 339 240 74 244 25 262</td>
</tr>
<tr>
<td>R71029 T30151</td>
<td>O A</td>
<td></td>
<td></td>
<td>G</td>
<td>6 250 239 218 216 216 347</td>
</tr>
<tr>
<td>R71029 T30151</td>
<td>A O</td>
<td>Y</td>
<td></td>
<td>5</td>
<td>494 554 433 276 374</td>
</tr>
<tr>
<td>R71029 T30151</td>
<td>O A</td>
<td></td>
<td></td>
<td>5</td>
<td>494 554 433 276 374</td>
</tr>
<tr>
<td>R71029 T30151</td>
<td>A O</td>
<td></td>
<td></td>
<td>5</td>
<td>584 556 426 387 381</td>
</tr>
<tr>
<td>R71029 T30151</td>
<td>O A</td>
<td></td>
<td></td>
<td>5</td>
<td>584 556 426 387 381</td>
</tr>
<tr>
<td>R71029 T30151</td>
<td>A O</td>
<td>Y</td>
<td></td>
<td>6</td>
<td>584 490 592 489 455 583</td>
</tr>
<tr>
<td>R71029 T30151</td>
<td>O A</td>
<td></td>
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SCHEDULES

- A: \( \alpha = 2 \)
- B: \( \alpha = 7 \)

Reproduced from best available copy.
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COEFFICIENTS:

\( a = -10^\circ \) to \( 10^\circ \) by \( \Delta a = 2^\circ \)

\( b \) or \( \beta \)

SCHEDULES

\( \gamma = 0^\circ - 45^\circ\) by \( \Delta \gamma = 15^\circ\)

IDPVAR(1) IDPVAR(2) NDV

MSPC - Form 363-2 (February 1972)
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COEFFICIENTS:

α or β

SCHEDULES

α: A = -10^-10 A = 10^-10 β: A = 10^-10 A = -10^-10

MSFC - Form 385-2 (February 1972)
### Table II (Continued)

**TEST TWT54x** DATA SET COLLATION SHEET

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**Coefficients:**

- α or β
- Schedules

**MSPC - Form 263-2 (February 1972)**
TABLE III
DIMENSIONAL DATA

Configuration 01
Double Delta Winged Orbiter. Consists of the following components:

- B1
- W4
- V11
- A1
- E1
- R1

Dimensional Data for these components is shown on the following pages.
TABLE III (CONTINUED)

MODEL COMPONENT: **BODY - B1**

GENERAL DESCRIPTION: Basic orbiter body including canopy and manipulator arm housing.

DRAWING NUMBER:

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<th>ACTUAL MEASURED</th>
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<td>1315 in.</td>
<td>5.260 m.</td>
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<td>Max. Width (P.L. Bay/Base)</td>
<td>208/120 in.</td>
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<td>Max. Depth</td>
<td>235 in.</td>
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<td>Base Projected</td>
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### TABLE III (CONTINUED)

**MODEL COMPONENT:** W4

**GENERAL DESCRIPTION:** Double Delta Wing

**DRAWING NUMBER:**

**DIMENSIONS:**

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<td>Sweep Back Angles, degrees</td>
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</tr>
</tbody>
</table>
### TABLE III (CONTINUED)

**MODEL COMPONENT:** V11  

**GENERAL DESCRIPTION:** Twin vertical tails (Dimensions are for a single panel.)

**DRAWING NUMBER:**

**DIMENSIONS:**

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<thead>
<tr>
<th>TOTAL DATA</th>
<th>THEORETICAL</th>
<th>ACTUAL MEASURED</th>
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<tbody>
<tr>
<td><strong>Area</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planform</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wetted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Span (equivalent)</td>
<td>525 ft$^2$</td>
<td>1.21 in$^2$</td>
</tr>
<tr>
<td>Aspect Ratio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate of Taper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taper Ratio</td>
<td></td>
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<tr>
<td>Diehedral Angle, degrees</td>
<td>75°</td>
<td>75°</td>
</tr>
<tr>
<td>Incidence Angle, degrees</td>
<td>0°</td>
<td>0°</td>
</tr>
<tr>
<td>Aerodynamic Twist, degrees</td>
<td>0°</td>
<td>0°</td>
</tr>
<tr>
<td>Toe-In Angle</td>
<td>0°</td>
<td>0°</td>
</tr>
<tr>
<td>Cant Angle</td>
<td>15°</td>
<td>15°</td>
</tr>
<tr>
<td>Sweep Back Angles, degrees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leading Edge</td>
<td>45°</td>
<td>45°</td>
</tr>
<tr>
<td>Trailing Edge</td>
<td>20°</td>
<td>20°</td>
</tr>
<tr>
<td>0.25 Element Line</td>
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<td></td>
</tr>
<tr>
<td>Chords: Root (Wing Sta. 0.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tip, (equivalent)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fus. Sta. of .25 MAC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W.P. of .25 MAC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.L. of .25 MAC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Airfoil Section Root</td>
<td>5° wedge (60°)</td>
<td>5° wedge (60°)</td>
</tr>
<tr>
<td>Tip</td>
<td>5° wedge (60°)</td>
<td>5° wedge (60°)</td>
</tr>
</tbody>
</table>

**EXPOSED DATA**

| **Area** | 250 ft$^2$ | 250 ft$^2$ |
| Span, (equivalent) | 760 in. | 760 in. |
| Aspect Ratio | 1.6 | 1.6 |
| Taper Ratio | 0.35 | 0.35 |
| Chords Root |             |                 |
| Tip | 230 in. | 0.920 in. |
| MAC |             |                 |
| Fus. Sta. of .25 MAC |             |                 |
| W.P. of .25 MAC |             |                 |
| B.L. of .25 MAC |             |                 |
MODEL COMPONENT: BODY - A1

GENERAL DESCRIPTION: About SRM pole. Cone cylinder with a 22.5° half angle nose cone. Raked nozzle is a 22.5° cone. Nose radius is .035 in. model scale and 2.5 in. full scale.

DRAWING NUMBER: 

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<th>ACTUAL MEASURED</th>
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<tbody>
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<td>FULL-SCALE</td>
<td>MODEL SCALE</td>
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<tr>
<td>Length</td>
<td>342 in.</td>
<td>1.563 in.</td>
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<tr>
<td>Max. Width</td>
<td>62 in.</td>
<td>24.6 in.</td>
</tr>
<tr>
<td>Max. Depth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fineness Ratio</td>
<td>5.52</td>
<td>5.52</td>
</tr>
<tr>
<td>Area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Cross-Sectional</td>
<td>22.3 ft.²</td>
<td>.0515 in.²</td>
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<tr>
<td>Planform</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wetted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MODEL COMPONENT:</td>
<td>El</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>----</td>
<td></td>
</tr>
<tr>
<td>GENERAL DESCRIPTION:</td>
<td>Wing elevon. Dimensions refer to a single panel.</td>
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<td>DRAWING NUMBER:</td>
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<th>MODEL SCALE</th>
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<tr>
<td>Area, ft²</td>
<td>371.3 ft²</td>
<td>0.855 in²</td>
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<tr>
<td>Span (equivalent), inches</td>
<td>399.0 in.</td>
<td>1.596 in.</td>
</tr>
<tr>
<td>Inb'd equivalent chord, inches</td>
<td>204.0 in.</td>
<td>0.816 in.</td>
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<tr>
<td>Outb'd equivalent chord, inches</td>
<td>64.0 in.</td>
<td>0.256 in.</td>
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<tr>
<td>Ratio Elevator chord/horizontal tail chord</td>
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<td></td>
</tr>
<tr>
<td>At Inb'd equiv. chord</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>At Outb'd equiv. chord</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sweep Back Angles, degrees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leading Edge</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Tailing Edge</td>
<td>-19°36'</td>
<td>-19°36'</td>
</tr>
<tr>
<td>Hingeline</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Area Moment (Normal to hinge line) ft³</td>
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### TABLE III (CONTINUED)

**MODEL COMPONENT:** R1

**GENERAL DESCRIPTION:** Rudder

**DRAWING NUMBER:**

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<th>MODEL SCALE</th>
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<tr>
<td>Area, ft</td>
<td>102.4 ft²</td>
<td>.236 in²</td>
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<td>Span (equivalent), inches</td>
<td>233.3 in.</td>
<td>.933 in.</td>
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<tr>
<td>Inb'd equivalent chord, inches</td>
<td>94.5 in.</td>
<td>.378 in.</td>
</tr>
<tr>
<td>Outb'd equivalent chord, inches</td>
<td>32.0 in.</td>
<td>.128 in.</td>
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<tr>
<td>Ratio Rudder chord/horizontal tail chord</td>
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<td></td>
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<tr>
<td>At Inb'd equiv. chord</td>
<td>.40</td>
<td>.40</td>
</tr>
<tr>
<td>At Outb'd equiv. chord</td>
<td>.40</td>
<td>.40</td>
</tr>
<tr>
<td>Sweep Back Angles, degrees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leading Edge</td>
<td>32° 36'</td>
<td>32° 36'</td>
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<tr>
<td>Tailing Edge</td>
<td>20° 34'</td>
<td>20° 34'</td>
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<tr>
<td>Hingeline</td>
<td>32° 36'</td>
<td>32° 36'</td>
</tr>
<tr>
<td>Area Moment (Normal to hinge line) ft³</td>
<td></td>
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</table>
Configuration 02

Double Delta Winged Orbiter. Same as 01 except does not have abort SRM's (A1).
TABLE III (CONTINUED)

MODEL COMPONENT:  BODY - T1

GENERAL DESCRIPTION:  Hydrogen-Oxygen Tank with 22° nosecone.

DRAWING NUMBER:

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<th>ACTUAL MEASURED</th>
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<tr>
<td></td>
<td>FULL-SCALE</td>
<td>MODEL SCALE</td>
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<tr>
<td>Length</td>
<td>1876.75in.</td>
<td>7.507in.</td>
</tr>
<tr>
<td>Max. Width</td>
<td>346 in.</td>
<td>1.384 in.</td>
</tr>
<tr>
<td>Max. Depth</td>
<td>346 in.</td>
<td>1.384 in.</td>
</tr>
<tr>
<td>Fineness Ratio</td>
<td>5.42</td>
<td>5.42</td>
</tr>
<tr>
<td>Area</td>
<td></td>
<td></td>
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<tr>
<td>Max. Cross-Sectional</td>
<td>652.95 ft²</td>
<td>1.504 in²</td>
</tr>
<tr>
<td>Planform</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Wetted</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Base</td>
<td>652.95 ft²</td>
<td>1.504 in²</td>
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TABLE III (CONTINUED)

MODEL COMPONENT: BODY - T3

GENERAL DESCRIPTION: Hydrogen-Oxygen Tank with 15° nose cone

DRAWING NUMBER:

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<th>ACTUAL MEASURED</th>
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<td>FULL-SCALE</td>
<td>MODEL SCALE</td>
</tr>
<tr>
<td>Length</td>
<td>2031.75 in.</td>
<td>8.127 in.</td>
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<tr>
<td>Max. Width</td>
<td>344 in.</td>
<td>1.384 in.</td>
</tr>
<tr>
<td>Max. Depth</td>
<td>346 in.</td>
<td>1.384 in.</td>
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<tr>
<td>Fineness Ratio</td>
<td>5.87</td>
<td>5.87</td>
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<td>Area</td>
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<tr>
<td>Max. Cross-Sectional</td>
<td>1652.75 ft²</td>
<td>1.506 ft²</td>
</tr>
<tr>
<td>Planform</td>
<td></td>
<td></td>
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<tr>
<td>Wetted</td>
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<tr>
<td>Base</td>
<td>1652.75 ft²</td>
<td>1.506 ft²</td>
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TABLE III (CONTINUED)

MODEL COMPONENT: BODY - T8

GENERAL DESCRIPTION: Hydrogen-Oxygen Tank with Generalized Nose Shape

DRAWING NUMBER: 

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<th>ACTUAL MEASURED</th>
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<tbody>
<tr>
<td></td>
<td>FULL-SCALE</td>
<td>MODEL SCALE</td>
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<tr>
<td>Length</td>
<td>19.35 in.</td>
<td>7.740 in.</td>
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<td>Max. Width</td>
<td>34.6 in.</td>
<td>1.364 in.</td>
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<tr>
<td>Max. Depth</td>
<td>34.6 in.</td>
<td>1.364 in.</td>
</tr>
<tr>
<td>Fineness Ratio</td>
<td>5.59</td>
<td>5.59</td>
</tr>
<tr>
<td>Area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Cross-Sectional</td>
<td>6529.5 ft.$^2$</td>
<td>1504 in.$^2$</td>
</tr>
<tr>
<td>Planform</td>
<td></td>
<td></td>
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<tr>
<td>Wetted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base</td>
<td>6529.5 ft.$^2$</td>
<td>1504 in.$^2$</td>
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TABLE III (CONTINUED)

MODEL COMPONENT: BODY - 79

GENERAL DESCRIPTION: 3/12” Hydrogen-Oxygen Tank with 17° nose cone

DRAWING NUMBER:

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<th>ACTUAL MEASURED</th>
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<tbody>
<tr>
<td></td>
<td>FULL-SCALE</td>
<td>MODEL SCALE</td>
</tr>
<tr>
<td>Length</td>
<td>2328.5 in.</td>
<td>9.314 in.</td>
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<tr>
<td>Max. Width</td>
<td>312 in.</td>
<td>1.248 in.</td>
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<tr>
<td>Max. Depth</td>
<td>312 in.</td>
<td>1.248 in.</td>
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<tr>
<td>Fineness Ratio</td>
<td>7.46</td>
<td>7.46</td>
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<tr>
<td>Area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Cross-Sectional</td>
<td>530.8 ft²</td>
<td>1.223 in²</td>
</tr>
<tr>
<td>Planform</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wetted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base</td>
<td>530.8 ft²</td>
<td>1.223 in²</td>
</tr>
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TABLE III (CONTINUED)

MODEL COMPONENT: BODY - T10

GENERAL DESCRIPTION: Hydrogen-Oxygen Tank with Modified Apollo Nosecone. Include external entry-point.

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</table>

<table>
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</thead>
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<tr>
<td></td>
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<td>MODEL SCALE</td>
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<td>2162 in.</td>
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<td>Max. Width</td>
<td>346 in.</td>
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<tr>
<td>Max. Depth</td>
<td>346 in.</td>
<td>1.384 in.</td>
</tr>
<tr>
<td>Fineness Ratio</td>
<td>6.25</td>
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</tr>
<tr>
<td>Area</td>
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<td></td>
</tr>
<tr>
<td>Max. Cross-Sectional</td>
<td>652.95 ft²</td>
<td>1.504 in²</td>
</tr>
<tr>
<td>Planform</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wetted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base</td>
<td>652.95 ft²</td>
<td>1.504 in²</td>
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TABLE III (CONTINUED)

MODEL COMPONENT: BODY - S1

GENERAL DESCRIPTION: SOLID ROCKET MOTOR

DRAWING NUMBER: 

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<th>DIMENSIONS:</th>
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<th>ACTUAL MEASURED MODEL SCALE</th>
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<tr>
<td>Length</td>
<td>1743 in.</td>
<td>6.972 in.</td>
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</tr>
<tr>
<td>Max. Width</td>
<td>156 in.</td>
<td>0.624 in.</td>
<td></td>
</tr>
<tr>
<td>Max. Depth</td>
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<td>0.624 in.</td>
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<tr>
<td>Fineness Ratio</td>
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<td>11.17</td>
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<tr>
<td>Area</td>
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</tr>
<tr>
<td>Max. Cross-Sectional</td>
<td>132.5 ft.²</td>
<td>0.306 in.²</td>
<td></td>
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<tr>
<td>Planform</td>
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<tr>
<td>Base</td>
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<td>0.306 in.²</td>
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TABLE III (CONTINUED)

MODEL COMPONENT: BODY - 56

GENERAL DESCRIPTION: SOLID ROCKET MOTOR WITH NO WINGS

DRAWING NUMBER: 

<table>
<thead>
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<tr>
<td>Max. Width</td>
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<tr>
<td>Max. Depth</td>
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</tr>
<tr>
<td>Fineness Ratio</td>
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<tr>
<td>Area</td>
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</tr>
<tr>
<td>Max. Cross-Sectional</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planform</td>
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</tr>
<tr>
<td>156 in</td>
<td>0.624 in</td>
<td></td>
</tr>
<tr>
<td>156 in</td>
<td>0.624 in</td>
<td></td>
</tr>
<tr>
<td>11.17</td>
<td>11.17</td>
<td></td>
</tr>
<tr>
<td>132.5 ft²</td>
<td>0.306 ft²</td>
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29
<table>
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<tr>
<th>Figure</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Axis System</td>
<td>33</td>
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<tr>
<td>2</td>
<td>Launch Vehicle</td>
<td>34</td>
</tr>
<tr>
<td>3</td>
<td>General Arrangement, Space Shuttle Orbiter</td>
<td>35</td>
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<tr>
<td>4</td>
<td>Baseline Solid Rocket Motor</td>
<td>36</td>
</tr>
<tr>
<td>5</td>
<td>346-Inch Diameter HO Tank with 17-Degree Nosecone</td>
<td>37</td>
</tr>
<tr>
<td>6</td>
<td>T8, 346-Inch HO Tank Nosecone</td>
<td>38</td>
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<tr>
<td>7</td>
<td>T9, 346-Inch Diameter HO Tank</td>
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<td>8</td>
<td>T10, 346-Inch HO Tank Nosecone</td>
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<td>9</td>
<td>Photograph of Configuration T9 O₁ S₁</td>
<td>41</td>
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<tr>
<td>10</td>
<td>Photograph of Configuration T9 O₁ S₁ Tunnel Installation</td>
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<tr>
<td>11</td>
<td>Photograph of Configuration T₁₀ O₂ S₁</td>
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<tr>
<td>12</td>
<td>Photograph of Configuration T₁₀ O₂ S₁ Tunnel Installation</td>
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<td>PLOTTED COEFFICIENTS SCHEDULE</td>
<td>CONDITIONS VARYING</td>
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<td>EFFECT OF HO TANK NOSE SHAPE</td>
<td>(A)</td>
<td>MACH</td>
</tr>
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<td></td>
<td>(B)</td>
<td>CONFIGURATION</td>
</tr>
<tr>
<td>EFFECT OF HO TANK DIAMETER</td>
<td>(A)</td>
<td>MACH</td>
</tr>
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<td>(B)</td>
<td>CONFIGURATION</td>
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<tr>
<td>VARIATION OF SRM-HO TANK GAP</td>
<td>(A)</td>
<td>MACH</td>
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<td>(B)</td>
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<td>VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK</td>
<td>(A)</td>
<td>MACH</td>
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<td>EFFECT OF SRM ROCKET NOZZLES</td>
<td>(A)</td>
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<tr>
<td>EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE</td>
<td>(A)</td>
<td>MACH</td>
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<td>(B)</td>
<td>ELEVTR</td>
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<td>(C)</td>
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<td>EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK</td>
<td>(A)</td>
<td>MACH</td>
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<td>(B)</td>
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<td>(C)</td>
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<tr>
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<td>MACH</td>
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<td>TITLE</td>
<td>PLOTTED COEFFICIENTS SCHEDULE</td>
<td>CONDITIONS VARYING</td>
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<td>EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK</td>
<td>(A) (D) (B)</td>
<td>MACH</td>
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<tr>
<td>EFFECT OF MACH NUMBER FOR VARYING HO TANK NOSE SHAPES</td>
<td>(E) (F)</td>
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<td>(E) (F)</td>
<td>CONFIGURATION</td>
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PLOTTED COEFFICIENTS SCHEDULE

(A) CLM, CN, CA, CAF, CAB VERSUS ALPHA
CLM VERSUS CN

(B) CY, CYN, CBL VERSUS BETA

(C) CLM, CN, CA VERSUS BETA

(D) CY, CYN, CBL VERSUS ALPHA

(E) D(CL), D(CN), DCLM/DCN, CAALFO, CAFAFO VERSUS MACH

(F) D(CY), D(CYN), D(CBL) VERSUS MACH
Notes:
1. Positive directions of force coefficients, moment coefficients, and angles are indicated by arrows.

2. For clarity, origins of wind and stability axes have been displaced from the center of gravity.

Figure 1. Axis systems, showing direction and sense of force and moment coefficients, angle of attack, and sideslip angle.
Note: All dimensions in inches (model scale)

Figure 2 - Launch Vehicle T3 3/46 Inch HO Tank
Fig. 3 - General Arrangement, Space Shuttle Orbiter
Note: All dimensions in inches (model scale)

Fig. 4 - Baseline Solid Rocket Motor
NOTE: All dimensions in inches.
(model scale)

Fig. 5 - 346-Inch Diameter HO Tank with 17-Degree Nosecone
Note: All dimensions in inches

Figure 6 – T8 346 Inch HO Tank Nose Cone
Dimensions are in Inches

Figure 7 - T9, 346 Inch Diameter HO Tank
Figure 8 - T10 346 Inch HO Tank Nose Cone
Figure 10 - Photograph of Configuration T9 O1 S1 Tunnel Installation
Figure 11 - Photograph of Configuration T_{10} O_{2} S_{1}
Tabulations of the plotted data and corresponding source data are available from SADSAC Operations.
EFFECT OF NO TANK NOSE SHAPE

PITCHING MOMENT COEFFICIENT, CLM

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDGER REFERENCE INFORMATION
(B71096) HSFC TWT 544X LAUNCH VEHICLE STUDIES T30181 0.000 0.023 0.000 0.000 SREP 7.6600 SQ.IN.
(B71096) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREP 4.0206 IN.
(B71818) HSFC TWT 544X LAUNCH VEHICLE STUDIES T30181 1.500 0.233 0.000 0.000 SREP 3.3600 IN.
(B71818) DATA NOT AVAILABLE FOR ALL CONDITIONS 1.500 0.233 0.000 0.000 LREP 3.3600 IN.
(B71187) DATA NOT AVAILABLE FOR ALL CONDITIONS 1.500 0.233 0.000 0.000 ZREP 0.0000 IN.
(B71187) HSFC TWT 544X LAUNCH VEHICLE STUDIES T100181 1.500 0.233 0.000 0.000 ZREP 0.2480 IN.

MACH .60

PAGE 1
EFFECT OF HO TANK NOSE SHAPE

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  RUDDER  REFERENCE INFORMATION
(B71080)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T30181  0.000  0.023  0.000  0.000  SREF  T.8800 SQ. IN.
(B71091)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  LREF  2.0280 IN.
(B71091)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T30181  -1.500  0.023  0.000  0.000  NMRP  3.3600 IN.
(B71123)  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.500  0.023  0.000  0.000  XMRP  0.0000 IN.
(B71125)  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.500  0.023  0.000  0.000  ZMRP  0.2480 IN.
(B71127)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T100181  -1.500  0.023  0.000  0.000  SCALE  0.0040 SCALE

MACH  .80  PAGE  2
EFFECT OF H-TANK NOSE SHAPE

DATA SET SYMBOL | CONFIGURATION DESCRIPTION | ORIGIN X, EMNTR | RUMER | REFERENCE INFORMATION
(B71069) | 544X LAUNCH VEHICLE STUDIES T3001S1 | 0.000 0.000 0.000 SREP 7.8800 SQ. IN.
(B71091) | DATA: NOT AVAILABLE FOR ALL CONDITIONS | 0.000 0.000 0.000 LREP 2.0300 IN.
(B71091) | 544X LAUNCH VEHICLE STUDIES T3001S1 | -1.000 0.000 0.000 BREF 4.4600 IN.
(B71123) | DATA: NOT AVAILABLE FOR ALL CONDITIONS | -1.500 0.000 0.000 XHRP 3.3500 IN.
(B71123) | 544X LAUNCH VEHICLE STUDIES T3001S1 | -1.500 0.000 0.000 YHRP 0.0000 IN.
(B71127) | DATA: NOT AVAILABLE FOR ALL CONDITIONS | -1.500 0.000 0.000 ZHRP 0.0400 IN.

SCALE 0.0050 SCALE

MACH .90

PAGE 3
EFFECT OF H0 TANK NOSE SHAPE

PITCHING MOMENT COEFFICIENT, CLM

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOl CONFIGURATION DESCRIPTION
(671009) MSFC TIT 344X LAUNCH VEHICLE STUDIES T901S1
(671051) DATA NOT AVAILABLE FOR ALL CONDITIONS
(671121) MSFC TIT 344X LAUNCH VEHICLE STUDIES T601S1
(671123) DATA NOT AVAILABLE FOR ALL CONDITIONS
(671125) MSFC TIT 344X LAUNCH VEHICLE STUDIES T1001S1

ORBING 0.000 0.023 0.000 0.000
YR 0.000 0.000 0.000 0.000
ELEVTR 0.000 0.000 0.000 0.000
RUDER 0.000

REFERENCE INFORMATION
SREF 7.8800 SQ.IN.
LREF 2.0280 IN.
BREF 4.4800 IN.
XHMR 3.3600 IN.
YHMR 0.0000 IN.
ZMR 0.2480 IN.
SCALE 0.0040 SCALE

MACH 1.00

PAGE 4
EFFECT OF HO TANK NOSE SHAPE

ANGLE OF ATTACK, ALPHA, DEGREES

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBIND YB ELEVTR RUDDER REFERENCE INFORMATION

(071090) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30121 0.000 0.023 0.000 0.000 0.000 SREF 7.800 SQ. IN.

(071091) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30221 0.000 0.000 0.000 0.000 0.000 LREF 2.0280 IN.

(071132) MSFC TWT 544X LAUNCH VEHICLE STUDIES T60121 -1.500 0.023 0.000 0.000 0.000 BREF 4.4800 IN.

(071122) MSFC TWT 544X LAUNCH VEHICLE STUDIES T60221 -1.500 0.000 0.000 0.000 0.000 ZMP 0.0000 IN.

(071129) MSFC TWT 544X LAUNCH VEHICLE STUDIES T100121 -1.500 0.000 0.000 0.000 0.000 SREF 0.2400 IN.

(071127) MSFC TWT 544X LAUNCH VEHICLE STUDIES T100221 -1.500 0.000 0.000 0.000 0.000 SCALE 0.0040 SCALE

MACH 1.20

PAGE 6
EFFECT OF HO TANK NOSE SHAPE

ANGLE OF ATTACK, ALPHA, DEGREES

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  TS  ELEVTR  RUGGER  REFERENCE INFORMATION
(B71099)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  SREP  7.8600  SQ. IN.
(B71091)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T302S1  0.000  0.023  0.000  0.000  SREP  2.0280  IN.
(B71123)  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.500  0.023  0.000  0.000  SREP  4.4600  IN.
(B71125)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T100281  -1.500  0.023  0.000  0.000  XHRP  3.3600  IN.
(B71127)  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.500  0.023  0.000  0.000  ZHRP  0.8400  IN.

MACH 1.46

PAGE 7
EFFECT OF HO TANK NOSE SHAPE

MACH 3.48

PAGE 9
EFFECT OF HO TANK NOSE SHAPE

DATA SET SYMBOL | CONFIGURATION DESCRIPTION | ORBINC | YS | ELEVTR | RUDDER | REFERENCE INFORMATION
--- | --- | --- | --- | --- | ---
(S71099) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 0.000 | SREP 7.8000 SQ. IN.
(S71091) | MSFC TWT 944X LAUNCH VEHICLE STUDIES T50281 | 0.000 | 0.023 | 0.000 | 0.000 | LREP 2.0280 IN.
(S71121) | DATA NOT AVAILABLE FOR ALL CONDITIONS | -1.500 | 0.023 | 0.000 | 0.000 | NREP 4.4600 IN.
(S71122) | MSFC TWT 944X LAUNCH VEHICLE STUDIES T90281 | -1.500 | 0.023 | 0.000 | 0.000 | XFRP 3.3600 IN.
(S71125) | DATA NOT AVAILABLE FOR ALL CONDITIONS | -1.500 | 0.023 | 0.000 | 0.000 | YFRP 0.0000 IN.
(S71127) | DATA NOT AVAILABLE FOR ALL CONDITIONS | -1.500 | 0.023 | 0.000 | 0.000 | ZFRP 0.2400 IN.

SCALE 0.0040 SCALE

MACH 4.96
EFFECT OF HO TANK NOSE SHAPE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR Rudder REFERENCE INFORMATION
(S71095) MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1 0.000 0.023 0.000 0.000 SREF 7.0600 SQ. IN.
(S71091) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 2.0300 IN.
(S71121) MSFC TWT 544X LAUNCH VEHICLE STUDIES T801S1 -1.500 0.023 0.000 0.000 SREF 3.9600 IN.
(S71122) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 LREF 0.0000 IN.
(S71123) MSFC TWT 544X LAUNCH VEHICLE STUDIES T1001S1 -1.500 0.023 0.000 0.000 XMRP 0.2480 IN.
(S71127) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 ZMRP 0.2480 IN.

SCALE 0.0040 SCALE

MACH .80 PAGE 12
EFFECT OF HO TANK NOSE SHAPE

ANGLE OF ATTACK, ALPHA, DEGREES

NORMAL FORCE COEFFICIENT, CN

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC TS ELEVTR RUDDER REFERENCE INFORMATION

(DF1069) MAFC TWT 944X LAUNCH VEHICLE STUDIES T30181 0.000 0.023 0.000 0.000 SREF 2.0280 IN.

(DF3961) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 2.0280 IN.

(DF1121) MAFC TWT 944X LAUNCH VEHICLE STUDIES T30181 -1.500 0.023 0.000 0.000 SREF 4.4600 IN.

(DF1123) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 LREF 4.4600 IN.

(DF1125) MAFC TWT 944X LAUNCH VEHICLE STUDIES T10081 -1.500 0.023 0.000 0.000 XHBP 3.3820 IN.

(DF1127) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 ZHBP 0.2480 IN.

SCALE 0.0040 SCALE

MACH 0.90
EFFECT OF NO TANK NOSE SHAPE

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(S71059) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 0.000 0.000 BREF 7.8800 SQ. IN.
(S71091) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 2.0280 IN.
(S71123) MSFC TWT 544X LAUNCH VEHICLE STUDIES T80151 -1.500 0.023 0.000 0.000 YHNP -1.500 0.000 IN.
(S71125) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 ZMNP 0.0240 IN.
(S71127) MSFC TWT 544X LAUNCH VEHICLE STUDIES T100151 -1.500 0.023 0.000 0.000 SCALE 0.0040 SCALE

MACH 1.00
EFFECT OF HO TANK NOSE SHAPE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTIR RUDDER REFERENCE INFORMATION

(M71029) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 0.000 0.000 SREF 7.8800 SQ. IN.

(M71021) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251 0.000 0.023 0.000 0.000 LREF 2.0280 IN.

(M71123) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 -1.500 0.023 0.000 0.000 HREF 4.4600 IN.

(M71125) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251 -1.500 0.023 0.000 0.000 XMREF 3.3600 IN.

(M71127) MSFC TWT 544X LAUNCH VEHICLE STUDIES T100151 -1.500 0.023 0.000 0.000 YMRP 0.0000 IN.

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EFFECT OF HO TANK NOSE SHAPE

ANGLE OF ATTACK, ALPHA, DEGREES

NORMAL FORCE COEFFICIENT, CN

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORIGIN YS ELEVTR RUDDER REFERENCE INFORMATION
(B71089) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.8600 80.0 IN.
(B71081) HBFC TWT 544X LAUNCH VEHICLE STUDIES T902S1 0.000 0.023 0.000 0.000 SREF 2.0280 IN.
(B71121) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 XREF 4.4800 IN.
(B71123) HBFC TWT 544X LAUNCH VEHICLE STUDIES T902S1 -1.500 0.023 0.000 0.000 YREF 3.3800 IN.
(B71127) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 ZREF 0.0000 IN.

SCALE 0.0040 SCALE

MACH 1.46
EFFECT OF HO TANK NOSE SHAPE

ANGLE OF ATTACK, ALPHA, DEGREES

NORMAL FORCE COEFFICIENT, CN

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(871080) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 0.000 SREF 7.6800 SQ.IN.
(871091) MSFC TWT 544X LAUNCH VEHICLE STUDIES 7502B1 0.000 0.000 0.000 0.000 SREF 2.0280 IN.
(871121) MSFC TWT 544X LAUNCH VEHICLE STUDIES 7502B1 0.000 0.000 0.000 0.000 SREF 4.4600 IN.
(871123) MSFC TWT 544X LAUNCH VEHICLE STUDIES 7502B1 0.000 0.000 0.000 0.000 XRHP 3.3600 IN.
(871129) MSFC TWT 544X LAUNCH VEHICLE STUDIES 7502B1 0.000 0.000 0.000 0.000 YNRP 0.0000 IN.
(871127) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 XRHP 0.2480 IN.

SCALE 0.0040 SCALE

MACH 1.95

PAGE 18
EFFECT OF HO TANK NOSE SHAPE

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

(B7)089 DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 BREF 7.4500 SQ.IN.

(B7)091 MSFC TWT 54X LAUNCH VEHICLE STUDIES T30281 0.000 0.023 0.000 0.000 LREF 2.0800 IN.

(B7)121 DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 BREF 4.4600 IN.

(B7)123 MSFC TWT 54X LAUNCH VEHICLE STUDIES T30281 -1.500 0.023 0.000 0.000 LREF 3.3600 IN.

(B7)125 DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 XHPR 3.3600 IN.

(B7)127 MSFC TWT 54X LAUNCH VEHICLE STUDIES T30281 -1.500 0.023 0.000 0.000 ZHPR 0.0400 IN.

SCALE 0.0040 SCALE

MACH 3.48
EFFECT OF HO TANK NOSE SHAPE

AXIAL FORCE COEFFICIENT, CA

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION

(BF7098) NSFC TWT 844X LAUNCH VEHICLE STUDIES TSO1S1 0,000 0,023 0,000 0,000 SREF 7,8500 58,IN.

(BF71006) DATA NOT AVAILABLE FOR ALL CONDITIONS 0,000 0,000 0,000 0,000 SREF 7,8500 58,IN.

(BF7121) NSFC TWT 844X LAUNCH VEHICLE STUDIES TSO1S1 -1,500 0,023 0,000 0,000 SREF 4,4800 59,IN.

(BF712123) DATA NOT AVAILABLE FOR ALL CONDITIONS -1,500 0,000 0,000 0,000 SREF 3,3800 59,IN.

(BF7112) NSFC TWT 844X LAUNCH VEHICLE STUDIES TSO1S1 -1,500 0,023 0,000 0,000 SREF 3,3800 59,IN.

(BF71127) DATA NOT AVAILABLE FOR ALL CONDITIONS -1,500 0,023 0,000 0,000 SREF 0,0000 59,IN.

(RUDDER) REFERENCE INFORMATION

SREF 7,8500 58,IN.

SREF 4,4800 59,IN.

SREF 3,3800 59,IN.

SREF 0,0000 59,IN.

SCALE 0,0040 SCALE

MACH .60
EFFECT OF HO TANK NOSE SHAPE

AXIAL FORCE COEFFICIENT, CA

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORING YS ELEVTR RUDDER REFERENCE INFORMATION
(B71099) MSFC TWT 544X LAUNCH VEHICLE STUDIES T0011 0.000 0.023 0.000 0.000 SREF 7.8600 SQ.IN.
(B71099) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 2.0280 IN.
(B71123) MSFC TWT 544X LAUNCH VEHICLE STUDIES T0011 -1.500 0.023 0.000 0.000 XREF 5.3600 IN.
(B71123) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 YREF 0.0000 IN.
(B71127) MSFC TWT 544X LAUNCH VEHICLE STUDIES T10011 -1.500 0.023 0.000 0.000 ZREF 0.2480 IN.
(B71127) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 SCALE 0.0000 SCALE

MACH .80 PAGE 22
EFFECT OF HO TANK NOSE SHAPE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORIGIN YR ELEVTR RUGDER REFERENCE INFORMATION
(D71089) NSC TWT 544X LAUNCH VEHICLE STUDIES T90181 0.000 0.023 0.000 0.000 SREP 7.8600 SQ. IN.
(D71091) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREP 2.0260 IN.
(D71121) NSC TWT 544X LAUNCH VEHICLE STUDIES T90181 -1.500 0.023 0.000 0.000 SREP 4.4600 IN.
(D71123) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 SREP 3.3600 IN.
(D71125) NSC TWT 544X LAUNCH VEHICLE STUDIES T90181 -1.500 0.023 0.000 0.000 XHNP 3.3200 IN.
(D71127) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 XHNP 0.0000 IN.

REFERENCE INFORMATION
SREF 7.8600 SQ. IN.
LREP 2.0260 IN.
XHNP 3.3600 IN.
XHNP 3.3200 IN.
ZREP 0.0230 IN.
SCALE 0.0040 SCALE

MACH .90

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EFFECT OF HO TANK NOSE SHAPE

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  RUDDER  REFERENCE INFORMATION
(BF1085)  STFC TWT 544X LAUNCH VEHICLE STUDIES T80151  0.000  0.023  0.000  0.000  LREF  7.6800  0.00 IN.
(BF1105)  DATA NOT AVAILABLE FOR ALL CONDITIONS
(BF1121)  STFC TWT 544X LAUNCH VEHICLE STUDIES T80151
(BF1123)  DATA NOT AVAILABLE FOR ALL CONDITIONS
(BF1128)  STFC TWT 544X LAUNCH VEHICLE STUDIES T100181
(BF1127)  DATA NOT AVAILABLE FOR ALL CONDITIONS

MACH  1.10  

PAGE 25
EFFECT OF HO TANK NOSE SHAPE

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION

MACH 1.46
EFFECT OF HO TANK NOSE SHAPE

ANGLE OF ATTACK, ALPHA, DEGREES

AXIAL FORCE COEFFICIENT, CA

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(BF1069) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.8800 SQ.IN.
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(BF1123) MSFC TWT 544X LAUNCH VEHICLE STUDIES T102851 -1.500 0.023 0.000 0.000 XHYP 3.3600 IN.
(BF1125) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 ZHYP 0.0000 IN.
(BF1127) MSFC TWT 544X LAUNCH VEHICLE STUDIES T1102851 -1.500 0.023 0.000 0.000 ZMRP 0.2480 IN.

SCALE 0.0040 SCALE

MACH 1.95

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EFFECT OF HO TANK NOSE SHAPE

AXIAL FORCE COEFFICIENT, CA

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL
BY1099
BY1091
BY1121
BY1123
BY1125
BY1127

CONFIGURATION DESCRIPTION
DATA NOT AVAILABLE FOR ALL CONDITIONS
HSFC TWT 544X LAUNCH VEHICLE STUDIES T90281
DATA NOT AVAILABLE FOR ALL CONDITIONS
HSFC TWT 544X LAUNCH VEHICLE STUDIES T90281
DATA NOT AVAILABLE FOR ALL CONDITIONS

ORBINC VS ELEVTR Rudder Reference Information
0.000 0.000 0.000
0.000 0.000 0.000
-1.500 0.000 0.000
-1.500 0.000 0.000
-1.500 0.000 0.000
-1.500 0.000 0.000

SREF 4.480 0.2480 0.2480 3N.
SREF 3.800 0.2480 0.2480 3N.
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SREF 3.800 0.2480 0.2480 3N.
SREF 3.800 0.2480 0.2480 3N.
SREF 3.800 0.2480 0.2480 3N.

SCALE 0.0040 SCALE

MACH 3.48
EFFECT OF H0 TANK NOSE SHAPE

DATA SET SYMBOL
CONFIGURATION DESCRIPTION
DATA NOT AVAILABLE FOR
ALL CONDITIONS
STUDIES

REFERENCE INFORMATION
SREF 2.0800 IN.
XREF 3.3600 IN.
ZREF 0.2480 IN.
SCALE 0.0040 IN.

ANGLE OF ATTACK, ALPHA, DEGREES

AXIAL FORCE COEFFICIENT, CA

MACH 4.96
EFFECT OF HO TANK NOSE SHAPE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORSINC YS ELEVTR Rudder REFERENCE INFORMATION

(M71096) MSFC TWT 944X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 0.000 0.000 SREF 7.8800 56.00 IN.

(M71091) MSFC TWT 944X LAUNCH VEHICLE STUDIES T30151 DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 2.0240 IN.

(M71121) MSFC TWT 944X LAUNCH VEHICLE STUDIES T30151 DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 XREF 4.4400 IN.

(M71123) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 YMRP 5.3600 IN.

(M71125) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 ZMIG 0.2440 IN.

(M71127) MSFC TWT 944X LAUNCH VEHICLE STUDIES T30151 ORSINC YS ELEVTR Rudder REFERENCE INFORMATION

MACH .60

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EFFECT OF H0 TANK NOSE SHAPE

ANGLE OF ATTACK, ALPHA, DEGREES

FOREBODY AXIAL FORCE COEFFICIENT, CAF

DATA GET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  RUGGER  REFERENCE INFORMATION
(D71089)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T30181  0.000  0.023  0.000  0.000  LREF  7.8400  .00 IN.
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SCALE  0.0040 SCALE

MACH  .80

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EFFECT OF HO TANK NOSE SHAPE

DATA SET   SYMBOL  CONFIGURATION DESCRIPTION  ORBITC  YS  ELEVTR  RUDDEr  REFERENCE INFORMATION
(B71099)   MSFC TWT 544X LAUNCH VEHICLE STUDIES T30011  0.000  0.023  0.000  0.000  BREF  7.6800  SQ. IN.
(B71091)   DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  LREF  2.0280  IN.
(B71121)   MSFC TWT 544X LAUNCH VEHICLE STUDIES T30011  -1.500  0.023  0.000  0.000  BREF  4.4600  IN.
(B71123)   DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.500  0.023  0.000  0.000  XMRP  3.3600  IN.
(B71129)   DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.500  0.023  0.000  0.000  YMRP  0.0000  IN.
(B71127)   MSFC TWT 544X LAUNCH VEHICLE STUDIES T30011  -1.500  0.023  0.000  0.000  ZMRP  0.0040  IN.

MACH .90

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EFFECT OF HO TANK NOSE SHAPE

DATA SET SYMBOL CONFIGURATION DESCRIPTION

(B71099) NSFC TWT 544X LAUNCH VEHICLE STUDIES T1001S1 DATA NOT AVAILABLE FOR ALL CONDITIONS

(B71001) NSFC TWT 544X LAUNCH VEHICLE STUDIES T1001S1

(B71221) NSFC TWT 544X LAUNCH VEHICLE STUDIES T1001S1

(B71223) NSFC TWT 544X LAUNCH VEHICLE STUDIES T1001S1

ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

0.000 0.023 0.000 0.000 SREF 7.4000 SQ.IN.

0.000 0.023 0.000 0.000 LREF 2.0280 IN.

-1.500 0.023 0.000 0.000 BREF 4.4600 IN.

-1.500 0.023 0.000 0.000 XHYP 3.3600 IN.

-1.500 0.023 0.000 0.000 YHYP 0.0000 IN.

-1.500 0.023 0.000 0.000 ZHYP 0.2460 IN.

SCALE 0.0040 SCALE

MACH 1.00

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EFFECT OF HO TANK NOSE SHAPE

ANGLE OF ATTACK, ALPHA, DEGREES

FOREBODY AXIAL FORCE COEFFICIENT, CAF

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(871094) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30381 0.000 0.023 0.000 0.000 SREF 7.8800 SQ.IN.
(871096) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30381 -1.500 0.023 0.000 0.000 LREF 4.6000 IN.
(871121) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30281 0.000 0.023 0.000 0.000 XNRP 3.3600 IN.
(871123) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30281 -1.500 0.023 0.000 0.000 YNRP 0.0000 IN.
(871125) MSFC TWT 544X LAUNCH VEHICLE STUDIES T100281 0.000 0.023 0.000 0.000 ZNRP 0.2460 IN.
(871127) MSFC TWT 544X LAUNCH VEHICLE STUDIES T100281 -1.500 0.023 0.000 0.000 SCALE 0.0040 SCALE

MACH 1.20
EFFECT OF HO TANK NOSE SHAPE

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(B71099)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  SREP  7.0600  IN.
(B71091)  NASA TWT 944X LAUNCH VEHICLE STUDIES T90251  0.000  0.023  0.000  0.000  RREP  0.0280  IN.
(B71121)  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.800  0.023  0.000  0.000  BREP  4.4600  IN.
(B71123)  NASA TWT 944X LAUNCH VEHICLE STUDIES T60251  -1.800  0.023  0.000  0.000  XREP  3.3400  IN.
(B71125)  NASA TWT 944X LAUNCH VEHICLE STUDIES T100251  -1.200  0.023  0.000  0.000  YNRP  0.0000  IN.
(B71127)  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.800  0.023  0.000  0.000  ZNRP  0.0400  IN.

MACH  1.46  SCALE  0.0040  SCALE

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EFFECT OF HO TANK NOSE SHAPE

FOREBODY AXIAL FORCE COEFFICIENT, CAF

ANGLE OF ATTACK, ALPHA, DEGREES

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(871101) NSFC TWT 544X LAUNCH VEHICLE STUDIES T50251 | 0.000 | 0.023 | 0.000 | 0.000 | SREF 2.0280 IN.
(871121) NSFC TWT 544X LAUNCH VEHICLE STUDIES T50251 | -1.500 | 0.023 | 0.000 | 0.000 | SREF 4.4600 IN.
(871122) NSFC TWT 544X LAUNCH VEHICLE STUDIES T80251 | -1.500 | 0.023 | 0.000 | 0.000 | XNRP 3.3600 IN.
(871127) NSFC TWT 544X LAUNCH VEHICLE STUDIES T100251 | -1.500 | 0.023 | 0.000 | 0.000 | YNRP 0.0000 IN.
DATA NOT AVAILABLE FOR ALL CONDITIONS | -1.500 | 0.023 | 0.000 | 0.000 | ZNRP 0.2400 IN.
SCALE 0.0040 SCALE

MACH 1.95

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### Dimensions

- REFERENCE INFORMATION
  - LREP 2.0280
  - BREP 4.4600
  - XNRP 3.3600
  - YNRP 0.0000
  - Z2RP 0.2480

### Scale
- SCALE 0.0040

### Mach
- 3.48
EFFECT OF HO TANK NOSE SHAPE

FOREBODY AXIAL FORCE COEFFICIENT, C_A

ANGLE OF ATTACK, ALPHA, DEGREES

MACH 4.96
EFFECT OF HO TANK NOSE SHAPE

DATA SET SYMBOLE CONFIGURATION DESCRIPTION ORIGIN Y8 ELEVTR Rudder REFERENCE INFORMATION

(S71089) MSFC TW-544X LAUNCH VEHICLE STUDIES 730181 0.000 0.023 0.000 0.000 LREF 2.2220 IN.

(S71091) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 BREF 7.8490 SQ.IN.

(S71121) MSFC TW-544X LAUNCH VEHICLE STUDIES 730181 -1.500 0.023 0.000 0.000 LREF 2.2220 IN.

(S71125) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 BREF 4.4440 IN.

(S71325) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 ZHRP 0.0000 IN.

(S71327) MSFC TW-544X LAUNCH VEHICLE STUDIES 7100181 -1.500 0.023 0.000 0.000 ZHRP 0.0000 IN.

SCALE 0.0040 SCALE

MACH 0.60

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EFFECT OF HO TANK NOSE SHAPE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(S71099) MSFC TW5 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 0.000 0.000 SREF 7.8800 SQ. IN.
(S71091) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 2.0260 IN.
(S71121) MSFC TW5 544X LAUNCH VEHICLE STUDIES T60151 -1.500 0.023 0.000 0.000 BREF 4.4800 IN.
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(S71125) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 YMRP 0.0000 IN.
(S71127) MSFC TW5 544X LAUNCH VEHICLE STUDIES T100151 -1.500 0.023 0.000 0.000 ZMRP 0.0000 IN.
SCALE 0.0040 SCALE

MACH .80 PAGE 42
EFFECT OF HO TANK NOSE SHAPE

ANGLE OF ATTACK, ALPHAL ALPHAT DEGREES

BASE AXIAL FORCE COEFFICIENT, CAB

DATA SET SYMBOL CONFIGURATION DESCRIPTION OBLINCS YS ELEVTR Rudder REFERENCE INFORMATION

(SF1013) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90181 0.000 0.023 0.000 0.000 SREF 7.0000 SQ.IN.

(SF1011) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 4.4800 IN.

(SF1125) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90181 -1.500 0.023 0.000 0.000 BREF 4.4800 IN.

(SF1125) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 REF 4.4800 IN.

(MACH .90)

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EFFECT OF HO TANK NOSE SHAPE

ANGLE OF ATTACK, ALPHA, DEGREES

BASE AXIAL FORCE COEFFICIENT, CAB

MACH 1.00

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EFFECT OF HO TANK NOSE SHAPE

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(BT1089) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30181
(BT1091) DATA NOT AVAILABLE FOR ALL CONDITIONS
(BT1121) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30181
(BT1123) DATA NOT AVAILABLE FOR ALL CONDITIONS
(BT1127) MSFC TWT 544X LAUNCH VEHICLE STUDIES T100181

ORBING YS ELEVTR RUDDER REFERENCE INFORMATION
0.000 0.023 0.000 0.000 1REF 7.0800 $6.98 IN.
-1.500 0.023 0.000 0.000 1REF 4.6000 IN.
-1.500 0.023 0.000 0.000 1XREF 5.9600 IN.
-1.500 0.023 0.000 0.000 2REF 0.0000 IN.
-1.500 0.023 0.000 0.000 2XREF 0.0440 IN.

SCALE 0.0000 SCALE

MACH 1.10

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EFFECT OF HO TANK NOSE SHAPE

**ANGLE OF ATTACK, ALPHA, DEGREES**

**BASE AXIAL FORCE COEFFICIENT, CAB**

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**DATA SET SYMBOL** | **CONFIGURATION DESCRIPTION** | **ORBING** | **YS** | **ELEVTTR** | **RUDDER** | **REFERENCE INFORMATION**
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(B71099) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.003 | 0.000 | 0.000 | LREF 7.9800 IN.
(B71091) | HSPC TWT 544X LAUNCH VEHICLE STUDIES T30281 | 0.000 | 0.023 | 0.000 | 0.000 | BREF 4.4600 IN.
(B71123) | HSPC TWT 544X LAUNCH VEHICLE STUDIES T80281 | -1.500 | 0.023 | 0.000 | 0.000 | XHPR 3.2800 IN.
(B71125) | HSPC TWT 544X LAUNCH VEHICLE STUDIES T100281 | -1.500 | 0.023 | 0.000 | 0.000 | YHPR 0.0000 IN.
(B71127) | DATA NOT AVAILABLE FOR ALL CONDITIONS | -1.500 | 0.023 | 0.000 | 0.000 | ZHPR 0.0400 IN.

**SCALE** 0.0040 SCALE

**MACH** 1.46

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**PAGE** 47
EFFECT OF HO TANK NOSE SHAPE

BASE AXIAL FORCE COEFFICIENT, CAB

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  RUDDER  REFERENCE INFORMATION
(ST1095)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  SRF  7.8800 SQ.IN.
(ST1095)  MSFC TWT 944X LAUNCH VEHICLE STUDIES T902S1  0.000  0.023  0.000  0.000  LREF  2.0260 IN.
(ST1121)  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.500  0.023  0.000  0.000  BREF  4.4600 IN.
(ST1123)  MSFC TWT 944X LAUNCH VEHICLE STUDIES T902S1  -1.500  0.023  0.000  0.000  XMRP  5.3600 IN.
(ST1125)  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.500  0.023  0.000  0.000  YMRP  0.0000 IN.
(ST1127)  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.500  0.023  0.000  0.000  ZHRP  0.2480 IN.

SCALE  0.0040 SCALE

MACH  1.95

PAGE  48
### EFFECT OF HO TANK NOSE SHAPE

#### DATA SET SYMBOL | CONFIGURATION DESCRIPTION | ORBINC | VS | ELEVTR | RUGGER | REFERENCE INFORMATION
--- | --- | --- | --- | --- | ---
(B7T099) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 0.000 | SREF 7.8800 59.1 IN.
(B7T091) | MSCP TWT 544X LAUNCH VEHICLE STUDIES T30201 | 0.000 | 0.023 | 0.000 | 0.000 | SREF 2.0200 IN.
(B7T123) | MSCP TWT 544X LAUNCH VEHICLE STUDIES T30201 | -1.500 | 0.023 | 0.000 | 0.000 | SREF 4.4600 IN.
(B7T122) | MSCP TWT 544X LAUNCH VEHICLE STUDIES T100201 | -1.500 | 0.023 | 0.000 | 0.000 | XHRP 3.3600 IN.
(B7T125) | MSCP TWT 544X LAUNCH VEHICLE STUDIES T100201 | -1.500 | 0.023 | 0.000 | 0.000 | SREF 0.0000 IN.
(B7T127) | DATA NOT AVAILABLE FOR ALL CONDITIONS | -1.500 | 0.023 | 0.000 | 0.000 | ZHRP 0.8400 IN.

**SCALE** 0.0040 SCALE

**MACH** 3.48

**PAGE** 49
EFFECT OF HO TANK NOSE SHAPE

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL CONFIGURATION DESCRIPTION
101 0201 NSFC TWT 544X LAUNCH VEHICLE STUDIES 100181 0.000 0.000 0.000 BREF 7.8800IN.
102 0201 NSFC TWT 544X LAUNCH VEHICLE STUDIES 100181 0.000 0.000 0.000 REF 2.0200IN.
103 0201 DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 XMP 3.3600IN.
104 0201 DATA NOT AVAILABLE FOR ALL CONDITIONS -1.200 0.023 0.000 YMP 0.0000IN.
105 0201 NSFC TWT 544X LAUNCH VEHICLE STUDIES 100181 -1.200 0.023 0.000 ZMP 0.2480IN.
106 0201 SCALE 0.0040 SCALE

MACH .60
### EFFECT OF H0 TANK NOSE SHAPE

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**MACH 1.00**
EFFECT OF HO TANK NOSE SHAPE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORDINC YS ELEVTR RUDDER REFERENCE INFORMATION

MACH 1.20 PAGE 56
EFFECT OF HO TANK NOSE SHAPE

PITCHING MOMENT COEFFICIENT, CLM

NORMAL FORCE COEFFICIENT, CN

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  OBSINC  YS  ELEVTR  RUDDER  REFERENCES INFORMATION

19871099  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  SREF  7.6800  83.5 IN.

19871091  HSFC TWT 5444 Launch Vehicle Studies T30281  0.000  0.023  0.000  0.000  LREF  2.0280  IN.

19871121  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.500  0.023  0.000  0.000  BREP  4.4600  IN.

19871123  HSFC TWT 5444 Launch Vehicle Studies T30281  -1.500  0.023  0.000  0.000  XNRP  3.3600  IN.

19871127  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.500  0.023  0.000  0.000  YNRP  0.0000  IN.

19871127  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.500  0.023  0.000  0.000  ZNRP  0.2480  IN.

SCALE  0.0040 SCALE

MACH  1.46  PAGE  57
EFFECT OF HO TANK NOSE SHAPE

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  RUDDER  REFERENCE INFORMATION
(SP1009)       DATA NOT AVAILABLE FOR ALL CONDITIONS   0.000  0.023  0.000  0.000  SREF  7.8800  SQ.IN.
(SP1091)       MSFC TWT 544X LAUNCH VEHICLE STUDIES T902S1 -1.500  0.023  0.000  0.000  LREF  2.0260  IN.
(SP1121)       DATA NOT AVAILABLE FOR ALL CONDITIONS   0.000  0.023  0.000  0.000  BREF  4.4400  IN.
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(SP1123)       MSFC TWT 544X LAUNCH VEHICLE STUDIES T1002S1 -1.500  0.023  0.000  0.000  YMRP  0.0000  IN.
(SP1127)       DATA NOT AVAILABLE FOR ALL CONDITIONS   0.000  0.023  0.000  0.000  ZMRP  0.2460  IN.

SCALE  0.0040  SCALE

MACH  1.95  PAGE  58
EFFECT OF HO TANK NOSE SHAPE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

MACH .60

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EFFECT OF HO TANK NOSE SHAPE

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<td>0.023</td>
<td>0.000</td>
<td>0.000</td>
<td>BREF 4.4000 IN.</td>
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<td>(A71124)</td>
<td>DATA NOT AVAILABLE FOR ALL CONDITIONS</td>
<td>-1.500</td>
<td>0.023</td>
<td>0.000</td>
<td>0.000</td>
<td>XHRP 3.3000 IN.</td>
</tr>
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<td>(A71126)</td>
<td>NSFC TWT 544X LAUNCH VEHICLE STUDIES T100181</td>
<td>-1.500</td>
<td>0.023</td>
<td>0.000</td>
<td>0.000</td>
<td>YHRP 0.0000 IN.</td>
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MACH .80
EFFECT OF HO TANK NOSE SHAPE

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  VS  ELEVTR  RUDDER  REFERENCE INFORMATION

(A71090)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T30181  0.000  0.023  0.000  0.000  SREF  7.6600  SQ. IN.

(A71092)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  LREF  2.0000  IN.

(A71122)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T30181  -1.500  0.023  0.000  0.000  SREF  4.4600  IN.

(A71124)  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.500  0.023  0.000  0.000  LREF  3.5600  IN.

(A71126)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T120181  -1.500  0.023  0.000  0.000  XMRP  0.0000  IN.

(A71128)  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.500  0.023  0.000  0.000  YMRP  0.2400  IN.

MACH  .90  PAGE  63
EFFECT OF HO TANK NOSE SHAPE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVT RUDGER REFERENCE INFORMATION

MACH 1.00

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EFFECT OF HO TANK NOSE SHAPE

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBITC  Y8  ELEVTR  RUDFER  REFERENCE INFORMATION
(471090)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  SREP  7.6600  50.0 IN.
(471092)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251  0.000  0.023  0.000  0.000  LREP  2.0800  IN.
(471122)  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.500  0.023  0.000  0.000  BREP  4.4400  IN.
(471124)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251  -1.500  0.023  0.000  0.000  YMRP  3.2600  IN.
(471128)  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.500  0.023  0.000  0.000  ZMRP  0.2400  IN.
(471129)  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.500  0.023  0.000  0.000  SCALE  0.0040  SCALE

MACH  1.46  PAGE  67
EFFECT OF HO TANK NOSE SHAPE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

(A71090) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 BREF 7.8500 SQ. IN.

(A7102) MSFC TWT 544X LAUNCH VEHICLE STUDIES T302S1 0.000 0.023 0.000 0.000 LREF 2.0280 IN.

(A7102) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 BREF 4.4600 IN.

(A7102) MSFC TWT 544X LAUNCH VEHICLE STUDIES T802S1 -1.500 0.023 0.000 0.000 XMRP 3.3600 IN.

(A7102) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 YMRP 0.0000 IN.

(A7102) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 ZMRP 0.2480 IN.

SCALE 0.0040 SCALE

MACH 4.96 PAGE 70
EFFECT OF HO TANK DIAMETER

ANGLE OF ATTACK, ALPHA, DEGREES

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORSINCS YELEVTR RUDDER REFERENCE INFORMATION
(871068) NSFC TWT 544X LAUNCH VEHICLE STUDIES T9Q151 0.000 0.023 0.000 0.000 BREF 7.8800 30. IN.
(871068) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREP 0.0000 IN.
(871133) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 BREP 8.4000 IN.
(871133) NSFC TWT 544X LAUNCH VEHICLE STUDIES T9Q151 0.000 0.023 0.000 0.000 BREP 8.4000 IN.

SCALE 0.0040 SCALE

MACH .60 PAGE 71
EFFECT OF HO TANK DIAMETER

PITCHING MOMENT COEFFICIENT, Cm

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBLING VS ELEVTR RUGGER REFERENCE INFORMATION
(871089) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T9O181 0.000 0.023 0.000 0.000 SREF 7.8800 SQ.IN.
(87109) □ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 2.0200 IN.
(871139) □ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 MREF 4.4600 IN.
(871139) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T9O181 0.000 0.023 0.000 0.000 XHRP 3.3600 IN.
YHPR 0.0000 IN.
ZHPR 0.2480 IN.
SCALE 0.0000 SCALE

MACH .80

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EFFECT OF LO TANK DIAMETER

PITCHING MOMENT COEFFICIENT, CLM

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR Rudder REFERENCE INFORMATION
(B1056) NSFC TWT 5434 LAUNCH VEHICLE STUDIES T90181 0.000 0.023 0.000 0.000 SREF 7.9800 SQ. IN.
(B1091) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 XREF 2.0200 IN.
(B1131) NSFC TWT 5434 LAUNCH VEHICLE STUDIES T90181 0.000 0.023 0.000 0.000 YREF 4.4600 IN.
(B1155) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 XNRP 3.3600 IN.
(B1155) NSFC TWT 5434 LAUNCH VEHICLE STUDIES T90181 0.000 0.023 0.000 0.000 YNRP 0.2480 IN.
SCALE 0.0040 SCALE

MACH 1.00

PAGE 74
EFFECT OF HO TANK DIAMETER

PITCHING MOMENT COEFFICIENT, CLM

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORISINC YS ELEVTR Rudder REFERENCE INFORMATION

MACH 1.20

PAGE 76
EFFECT OF HO TANK DIAMETER

![Graph showing the effect of Ho tank diameter on pitching moment coefficient.](image)

**Data Set Symbol**: 

- **orbinc vs elevtr rudder reference information**: 
  - (e1o069) Data not available for all conditions
  - (e1o069) NSFC TWT 944X LAUNCH VEHICLE STUDIES T90251
  - (e1o069) NSFC TWT 944X LAUNCH VEHICLE STUDIES T90251

**Reference Information**: 

- Orbinc: 0.000 0.023 0.000 0.000
- Elevtr: 0.000 0.000 0.000 0.000
- Rudder: 0.000 0.000 0.000 0.000
- Sref: 7.6800 56.00 IN.
- Lref: 2.0280 IN.
- Xnfrp: 3.3800 IN.
- Ynfrp: 4.0000 IN.
- Znfrp: 0.0000 IN.
- Scale: 0.0040 SCALE

**Mach**: 1.46
EFFECT OF HO TANK DIAMETER

ANGLE OF ATTACK, ALPHA, DEGREES

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  Rudder  Reference Information
(BY1009):  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.000  0.000  0.000  SRef  7.0000  90.1H.  
(BY1195)  HPFC TWT 544X LAUNCH VEHICLE STUDIES 750851  0.000  0.000  0.000  0.000  LRef  8.0000  IN.  
(BY1195)  HPFC TWT 544X LAUNCH VEHICLE STUDIES 750851  0.000  0.000  0.000  0.000  BRef  4.4000  IN.  
(BY1187)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.000  0.000  0.000  XMrp  3.8000  IN.  
(BY1187)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.000  0.000  0.000  YMrp  0.0000  IN.  
(SCALE  0.0000  SCALE  0.0000  SCALE  0.0000  SCALE

MACH  3.48

PAGE  79
EFFECT OF HO TANK DIAMETER

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBING YS ELEVTR RUDDER REFERENCE INFORMATION
(SF1006) □ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 0.000 SREF 7,680 sq. in.
(SF1091) ★ MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251 0.000 0.023 0.000 0.000 LREF 2.0280 in.
(SF1133) ★ MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 0.000 0.000 BREF 4.4600 in.
(SF1133) ★ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 YMRP 3.3600 in.
ZMRP 0.2480 in.
SCALE 0.000 SCALE

MACH 4.96
EFFECT OF HO TANK DIAMETER

Data Set Symbol: Configuration Description

Symbol: NSFC TWT 544X LAUNCH VEHICLE STUDIES 730131
Configuration: ORING YS ELEVTR Rudder
Reference Information:
- REF 7.8000 IN.
- LREF 5.0280 IN.
- YHRE 1.8800 IN.
- ZHRE 0.2480 IN.
- SCALE 0.0040 SCALE

MACH .60
EFFECT OF HO TANK DIAMETER

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

MNSFC TWT 544X LAUNCH VEHICLE STUDIES T901S1 0.000 0.023 0.000 0.000 SRP 7.8800 SQ.IN.
DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 2.0260 IN.
DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 RREF 4.4600 IN.
MNSFC TWT 544X LAUNCH VEHICLE STUDIES T901S1 0.000 0.023 0.000 0.000 XHRE 5.3600 IN.
0.000 0.000 IN.
0.000 0.000 IN.
0.000 0.000 IN.
0.000 0.000 IN.
MACH .80
PAGE 82
EFFECT OF H O TANK DIAMETER

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC TS ELEVTR Rudder REFERENCE INFORMATION

(B71089) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 0.000 LREF 7.8800 66 IN.

(B71089) MSFC TWT 544X LAUNCH VEHICLE STUDIES T9021S 0.000 0.023 0.000 0.000 0.000 XREF 5.8800 IN.

(B71133) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 0.000 TREF 4.4800 IN.

(B71133) MSFC TWT 544X LAUNCH VEHICLE STUDIES T9021S 0.000 0.023 0.000 0.000 0.000 NLREF 2.0800 IN.

SCALE 0.0040 SCALE

MACH 1.46

PAGE 87
EFFECT OF HO TANK DIAMETER

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION

(B71065) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.8800 SQ.IN.
(B71065) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251 0.000 0.023 0.000 0.000 LREF 2.0260 IN.
(B71135) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 0.000 0.000 BREF 4.6600 IN.
(B71135) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 XMRP 3.3600 IN.

DATA NOT AVAILABLE FOR ALL CONDITIONS

MACH 1.95
EFFECT OF HO TANK DIAMETER

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION

(B71099) □ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.6600 SQ.IN.

(B711091) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 0.000 0.023 0.000 0.000 SREF 2.0280 IN.

(B711133) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 0.000 0.023 0.000 0.000 SREF 4.4000 IN.

(B711135) □ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 XREP 3.3600 IN.

YREP 0.0000 IN.
ZRNP 0.0000 IN.
SCALE 0.0040 IN.

MACH 3.48

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EFFECT OF HO TANK DIAMETER

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR Rudder REFERENCE INFORMATION
(B71091) □ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.0560 IN.
(B71091) MSFC TMT 544X LAUNCH VEHICLE STUDIES T90281 0.000 0.023 0.000 0.000 LREF 2.0280 IN.
(B71133) □ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 4.4600 IN.
(B71133) MSFC TMT 544X LAUNCH VEHICLE STUDIES T90281 0.000 0.023 0.000 0.000 LREF 3.3660 IN.
(B711135) □ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 XNRP 0.1260 IN.
(B711135) MSFC TMT 544X LAUNCH VEHICLE STUDIES T90281 0.000 0.023 0.000 0.000 YNRP 0.0000 IN.
SCALE 0.0040 SCALE

MACH 4.96

PAGE 90
EFFECT OF HOT TANK DIAMETER

ANGLE OF ATTACK, ALPHA, DEGREES

AXIAL FORCE COEFFICIENT, CA

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION

(871089) NSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.000 0.000 0.000 REF 7.8800 SQ. IN.

(071018) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 0.000 REF 4.4600 IN.

(871135) NSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 0.000 0.000 0.000 0.000 REF 3.3600 IN.

DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 0.000 REF 0.0000 IN.

SCALE 0.0040 SCALE

MACH .60

PAGE 91
EFFECT OF HO TANK DIAMETER

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(B71089) □ MSFC TWT S44X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 0.000 0.000 SREP 7.8800 SQ.IN.
(B71091) □ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREP 2.0280 IN.
(B71133) □ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREP 4.4600 IN.
(B71133) □ MSFC TWT S44X LAUNCH VEHICLE STUDIES T90151 0.000 0.023 0.000 0.000 XMRP 0.2460 IN.

SCALE 0.0040 SCALE

MACH .80
EFFECT OF HO TANK DIAMETER

ANDE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUGGER REFERENCE INFORMATION

(HSFC TWT 544X LAUNCH VEHICLE STUDIES T90155) 0.000 0.023 0.000 0.000 SREF 7.6900 SLIN.

DATA NOT AVAILABLE FOR ALL CONDITIONS

(HSFC TWT 544X LAUNCH VEHICLE STUDIES T90155) 0.000 0.023 0.000 0.000 XREF 2.0300 IN.

DATA NOT AVAILABLE FOR ALL CONDITIONS

(HSFC TWT 544X LAUNCH VEHICLE STUDIES T90155) 0.000 0.023 0.000 0.000 YNRP 4.4800 IN.

HAR 0.2480 IN.

SCALE 0.0040 SCALE

MACH .90

PAGE 93
EFFECT OF H2 TANK DIAMETER

AXIAL FORCE COEFFICIENT, CA

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION

(M970903) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30181 0.000 0.023 0.000 0.000 SREF 7.8300 IN.

DATA NOT AVAILABLE FOR ALL CONDITIONS

(M9711891) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90181 0.000 0.023 0.000 0.000 SREF 4.4600 IN.

DATA NOT AVAILABLE FOR ALL CONDITIONS

(M9711835) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90181 0.000 0.023 0.000 0.000 SREF 3.3600 IN.

YHRP 0.0000 IN.

ZNRP 0.0000 IN.

SCALE 0.0040 SCALE

MACH 1.00

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EFFECT OF HO TANK DIAMETER

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  RUDDER  REFERENCE INFORMATION
(B71135)  NSFC TWT 544X LAUNCH VEHICLE STUDIES  T90181  0.000  0.000  0.000  0.000  SREF  7.8800 SQ. IN.
(B71135)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.000  0.000  0.000  LREF  2.0280 IN.
(B71135)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.000  0.000  0.000  BREF  4.4800 IN.
(B71135)  NSFC TWT 544X LAUNCH VEHICLE STUDIES  T90181  0.000  0.000  0.000  0.000  XHHP  3.8600 IN.
(B71135)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.000  0.000  0.000  YHHP  0.0000 IN.
(B71135)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.000  0.000  0.000  ZHHP  0.0460 IN.
(B71135)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.000  0.000  0.000  SCALE  0.0040 SCALE

MACH  1.10  PAGE  95
EFFECT OF HO TANK DIAMETER

ANGLE OF ATTACK, ALPHA, DEGREES

AXIAL FORCE COEFFICIENT, CA

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR Rudder REFERENCE INFORMATION
(B71009) O MSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 0.000 0.023 0.000 0.000 SREF 7.8800 SQ. IN.
(B71009) O MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 0.000 0.000 LREF 2.0280 IN.
(B71133) O MSFC TWT 544X LAUNCH VEHICLE STUDIES T90351 0.000 0.023 0.000 0.000 BREF 4.4600 IN.
(B71133) O MSFC TWT 544X LAUNCH VEHICLE STUDIES T90451 0.000 0.023 0.000 0.000 XMRP 3.3600 IN.
(B71133) O MSFC TWT 544X LAUNCH VEHICLE STUDIES T90551 0.000 0.023 0.000 0.000 ZMRP 0.2460 IN.
SCALE 0.0040 SCALE

MACH 1.20

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EFFECT OF HO TANK DIAMETER

AXIAL FORCE COEFFICIENT, CA

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  VS  ELEVTR  RUDDER  REFERENCE INFORMATION
(B71069)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  SREF  7.000  0.000  IN.
(B71091)  MSFC TWT 944X LAUNCH VEHICLE STUDIES T9O281  0.000  0.023  0.000  0.000  LREF  2.000  0.000  IN.
(B71133)  MSFC TWT 944X LAUNCH VEHICLE STUDIES T9O281  0.000  0.023  0.000  0.000  SREF  4.000  0.000  IN.
(B71135)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  YNRP  0.000  0.000  IN.
SCALE  0.000  0.000  SCALE

MACH  1.46

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EFFECT OF HO TANK DIAMETER

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(871090) \( \bigcirc \) DATA NOT AVAILABLE FOR ALL CONDITIONS
(871091) \( \square \) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251
(871133) \( \bigtriangleup \) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251
(871135) \( \bigtimes \) DATA NOT AVAILABLE FOR ALL CONDITIONS

ORIGIN YS ELEVTR RUDDER REFERENCE INFORMATION
0.000 0.023 0.000 0.000 SREF 7.8800 50.00 IN.
0.000 0.023 0.000 0.000 LREF 2.0200 IN.
0.000 0.023 0.000 0.000 UREF 4.8000 IN.
0.000 0.023 0.000 0.000 XMRP 3.3600 IN.
2NRP 0.0000 IN.
2NRP 0.2400 IN.
SCALE 0.0040 SCALE

MACH 1.95
EFFECT OF HO TANK DIAMETER

AXIAL FORCE COEFFICIENT, CA

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  Rudder  REFERENCE INFORMATION

(B71099)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  SRCF  9.6800  SQ.IN.
(B71091)  MSFC TWT 544X LAUNCH VEHICLE STUDIES  T902S1  0.000  0.023  0.000  0.000  LEPF  3.2400  IN.
(B71133)  MSFC TWT 544X LAUNCH VEHICLE STUDIES  T902S1  0.000  0.023  0.000  0.000  XNRP  3.3600  IN.
(B71135)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  ZMRF  0.2480  IN.

SCALE  0.0040  SCALE

MACH  3.48  PAGE  99
EFFECT OF HO TANK DIAMETER

AXIAL FORCE COEFFICIENT, CA

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(D71069) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.6800 SQ. IN.
(B71061) HSFC TWT 344X LAUNCH VEHICLE STUDIES 730231 0.000 0.023 0.000 0.000 LREF 2.0260 IN.
(B71133) HSFC TWT 344X LAUNCH VEHICLE STUDIES 790231 0.000 0.023 0.000 0.000 SREF 4.4400 IN.
(B71135) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 XHLP 5.3600 IN.
BRHP 0.0000 IN.
ZWRP 0.0400 IN.
SCLAE 0.0040 SCALE

MACH 4.96
EFFECT OF HO TANK DIAMETER

DATA SET  SYMBOL  CONFIGURATION DESCRIPTION  ORSINC  YS  ELEVTR  Rudder  REFERENCE INFORMATION

(BY1090)  O  NSFC TWT 544X LAUNCH VEHICLE STUDIES  190181  0.000  0.000  0.000  0.000  SREF  7.9000  48.1N.
(BY1091)  O  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.000  0.000  0.000  LREF  5.0300  1N.
(BY1133)  O  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.000  0.000  0.000  4.4600  1N.
(BY1133)  O  NSFC TWT 544X LAUNCH VEHICLE STUDIES  190181  0.000  0.000  0.000  0.000  XNRP  3.9600  1N.

SCALE  0.0040  SCALE

MACH  .60  PAGE  101
### EFFECT OF HO TANK DIAMETER

<table>
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<th>CONFIGURATION DESCRIPTION</th>
<th>ORBINC</th>
<th>YS</th>
<th>ELEVTR</th>
<th>RUDGER</th>
<th>REFERENCE INFORMATION</th>
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<td>MSFC TWT 544X LAUNCH VEHICLE STUDIES T901S1</td>
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<td>0.000</td>
<td>0.000</td>
<td>LREF 2.0200 IN.</td>
</tr>
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<td>0.000</td>
<td>0.000</td>
<td>BREF 4.6000 IN.</td>
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**MACH** .80

**PAGE 102**
EFFECT OF HOT TANK DIAMETER

DATA SET SYMBOL | CONFIGURATION DESCRIPTION | ORBINC | Y6 | ELEVTR | RUDDER | REFERENCE INFORMATION
--- | --- | --- | --- | --- | ---
(B71099) | NSFC TVT 544X LAUNCH VEHICLE STUDIES T9018S | 0.000 | 0.023 | 0.000 | 0.000 | BREF 7.6800 36.00 IN.
(B71099) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 0.000 | LREF 2.0680 IN.
(B71099) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 0.000 | ZNRP 4.4000 IN.
(B71099) | NSFC TVT 544X LAUNCH VEHICLE STUDIES T9018S | 0.000 | 0.023 | 0.000 | 0.000 | XNRP 3.3600 IN.

MACH .90
EFFECT OF NO TANK DIAMETER

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVT RUDDER REFERENCE INFORMATION
(071060) MSFC TWT S44X LAUNCH VEHICLE STUDIES T30191 0.000 0.023 0.000 0.000 8REP 7.8800 SQ. IN.
(071061) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 8REP 2.0280 IN.
(071133) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 8REP 4.4600 IN.
(071135) MSFC TWT S44X LAUNCH VEHICLE STUDIES T90131 0.000 0.023 0.000 0.000 8REP 3.3600 IN.

MACH 1.00
EFFECT OF HO TANK DIAMETER

FOREBODY AXIAL FORCE COEFFICIENT, CAF

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  RUDDER  REFERENCE INFORMATION
(BFY1089)  MSFC TWI 944X LAUNCH VEHICLE STUDIES T90181  0.000  0.023  0.000  0.000  BREF  7.6800 SQ. IN.
(BFY1091)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  LREF  2.0200 IN.
(BFY1133)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  BREFF  4.4600 IN.
(BFY1135)  MSFC TWI 944X LAUNCH VEHICLE STUDIES T90181  0.000  0.023  0.000  0.000  XNRP  3.3600 IN.
              0.000  0.023  0.000  0.000  YNRP  0.0000 IN.
              0.000  0.023  0.000  0.000  ZNRP  0.2400 IN.
SCALE  0.0040 SCALE

MACH  1.10  PAGE  105
EFFECT OF H0 TANK DIAMETER

FOREBODY AXIAL FORCE COEFFICIENT, CAF

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION
10710606 M3FC TWT 544X LAUNCH VEHICLE STUDIES 300S1
10710607 M3FC TWT 544X LAUNCH VEHICLE STUDIES 300S1
10711033 M3FC TWT 544X LAUNCH VEHICLE STUDIES 302S1
10711034 M3FC TWT 544X LAUNCH VEHICLE STUDIES 302S1

DATA DESCRIPTION
ORBINC YS ELEVTR Rudder REFERENCE INFORMATION
0.000 0.023 0.000 0.000 SREF 7.6800 SQ. IN.
0.000 0.023 0.000 0.000 BREF 4.4600 IN.
0.000 0.023 0.000 0.000 XMRP 3.3600 IN.
0.000 0.023 0.000 0.000 YMRP 0.0000 IN.
0.000 0.023 0.000 0.000 ZMRP 0.0400 IN.
0.000 0.023 0.000 0.000 SCALE 0.0040 SCALE

SCALE 1.20

MACH 1.20
EFFECT OF HO TANK DIAMETER

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC Y5 ELEVTR Rudder REFERENCE INFORMATION

(B71069) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 0.000 SREF 7.0000 50.000 IN.

(B71091) MSFC TWT 544X LAUNCH VEHICLE STUDIES T0001 0.000 0.000 0.000 0.000 LREF 2.0000 24.000 IN.

(B711231) MSFC TWT 544X LAUNCH VEHICLE STUDIES T0001 0.000 0.000 0.000 0.000 BREF 4.4000 12.000 IN.

(B71139) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 0.000 XHPRP 3.0000 12.000 IN.

THRP 0.0000 IN.

ZHRP 0.2400 IN.

SCALE 0.0040 SCALE

MACH 1.46

PAGE 107
EFFECT OF HO TANK DIAMETER

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(BY1000) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 BREF 7.0000 30. IN.
(BY1001) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30281 0.000 0.023 0.000 0.000 LREF 2.0200 IN.
(BY1133) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 0.000 0.023 0.000 0.000 SREF 4.4600 IN.
(BY1135) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 3.3600 IN.

MACH 1.95

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EFFECT OF H0 TANK DIAMETER

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  RUDDER  REFERENCE INFORMATION
(871091)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  BSEP  7.6000  IN.
(871091)  MSFC TWT S4X LAUNCH VEHICLE STUDIES T902B1  0.000  0.023  0.000  0.000  LREP  4.4400  IN.
(871155)  MSFC TWT S4X LAUNCH VEHICLE STUDIES T902B1  0.000  0.023  0.000  0.000  BREP  4.4400  IN.
(871091)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  YHRP  0.0000  IN.
  0.0000  IN.
  0.0000  IN.
  0.0000  IN.
  0.0040  SCALE

MACH  3.48

PAGE  109
EFFECT OF H0 TANK DIAMETER

FOREBODY AXIAL FORCE COEFFICIENT, CAF

ANALOG OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORING YS ELEVTR RUDDER REFERENCE INFORMATION
(071065) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 BREF 7.8800 SQ. IN.
(071091) MŚFC TWT 544X LAUNCH VEHICLE STUDIES T30231 0.000 0.023 0.000 0.000 LREF 2.0260 IN.
(071133) MŚFC TWT 544X LAUNCH VEHICLE STUDIES T90231 0.000 0.023 0.000 0.000 BREF 4.4800 IN.
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YHPR 0.0000 IN.
ZHPR 0.0000 IN.
SCALE 0.0040 SCALE

MACH 4.96

PAGE 110
EFFECT OF H0 TANK DIAMETER

BASE AXIAL FORCE COEFFICIENT - CAB

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION
(BP1089) HSFC TWT 544X LAUNCH VEHICLE STUDIES T90181 0.000 0.000 0.000 0.000 0.000 SREF 7.8800 SQ. IN.
(BP1091) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 0.000 0.000 LREF 2.0280 IN.
(BP1133) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 0.000 0.000 XHMRP 3.3200 IN.
(BP1135) HSFC TWT 544X LAUNCH VEHICLE STUDIES T90181 0.000 0.000 0.000 0.000 0.000 YHMRP 0.0000 IN.
SCALE 0.0040 SCALE

MACH .60

PAGE 111
EFFECT OF HO TANK DIAMETER

BASE AXIAL FORCE COEFFICIENT, CAB

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVR RUDDER REFERENCE INFORMATION
(871098) ○ NSFC TWT 944X LAUNCH VEHICLE STUDIES T90151 0.000 0.023 0.000 0.000 SREF 7.8800 SQ. IN.
(871098) ○ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 2.0280 IN.
(871132) ○ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 4.4600 IN.
(871132) ○ NSFC TWT 944X LAUNCH VEHICLE STUDIES T90151 0.000 0.023 0.000 0.000 XHLP 3.5600 IN.
ZHLP 0.0000 IN.
SCALE 0.0040 SCALE

MACH .80

PAGE 112
EFFECT OF HO TANK DIAMETER

BASE AXIAL FORCE COEFFICIENT, CAB

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  RUGDER  REFERENCE INFORMATION

(DT1099)  NSFC TWT S44x LAUNCH VEHICLE STUDIES T90181  0.000  0.023  0.000  0.000  REF  7.8800 SQ. IN.

(DT1095)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  LREF  2.0800 IN.

(DT1133)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  BREF  4.4600 IN.

(BT1135)  NSFC TWT S44x LAUNCH VEHICLE STUDIES T90181  0.000  0.023  0.000  0.000  HKBP  3.3800 IN.

MACH  .90

PAGE 113
EFFECT OF HO TANK DIAMETER

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

(971099) HSF C TWT 544X LAUNCH VEHICLE STUDIES T901S1 0.000 0.023 0.000 0.000 SREF 7.8000 SQ.IN. (971099) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 2.0950 IN. (971133) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 BREF 4.4600 IN. (971133) HSF C TWT 544X LAUNCH VEHICLE STUDIES T901S1 0.000 0.023 0.000 0.000 XNRP 3.3600 IN. YNRP 0.2000 IN. ZNRP 0.2460 IN. SCALE 0.0040 SCALE

MACH 1.00 PAGE 114
EFFECT OF HO TANK DIAMETER

BASE AXIAL FORCE COEFFICIENT, CAB

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC TO ELEVT Rudder Reference Information
(S71098) MSPC TWT 944X LAUNCH VEHICLE STUDIES T301581 0.000 0.023 0.000 0.000 REF 7.000 FG. IN.
(S71091) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 REF 5.000 IN.
(S71133) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 REF 4.000 IN.
(S71133) MSPC TWT 944X LAUNCH VEHICLE STUDIES T301581 0.000 0.023 0.000 0.000 REF 3.000 IN.

MACH 1.10

PAGE 115
EFFECT OF HO TANK DIAMETER

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  Rudder  REFERENCE INFORMATION
(871090)  HSFC  TWT  344X  LAUNCH VEHICLE STUDIES  T01S1  0.000  0.023  0.000  0.000  SREF  7.6990  88.0 IN.
(871091)  HSFC  TWT  344X  LAUNCH VEHICLE STUDIES  T02S1  0.000  0.023  0.000  0.000  LREF  2.0280  IN.
(871133)  HSFC  TWT  344X  LAUNCH VEHICLE STUDIES  T901S1  0.000  0.023  0.000  0.000  SREF  7.0900  88.0 IN.
(871133)  HSFC  TWT  344X  LAUNCH VEHICLE STUDIES  T902S1  0.000  0.023  0.000  0.000  LREF  2.0280  IN.
(871133)  HSFC  TWT  344X  LAUNCH VEHICLE STUDIES  T903S1  0.000  0.023  0.000  0.000  XRMR  3.6360  IN.
SMR  0.0000  IN.
ZRMR  0.0260  IN.
SCALE  0.0040  SCALE

MACH  1.20

PAGE  116
EFFECT OF HO TANK DIAMETER

BASE AXIAL FORCE COEFFICIENT, CAB

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

(Y71069) ○ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 0.000 0.000 7.8800 60.00 IN.

(Y71091) ○ MSFC TWT 544X LAUNCH VEHICLE STUDIES TS0801 0.000 0.023 0.000 0.000 0.000 0.000 6.6000 40.00 IN.

(Y71135) ○ MSFC TWT 544X LAUNCH VEHICLE STUDIES TS0801 0.000 0.023 0.000 0.000 0.000 0.000 3.3600 30.00 IN.

(Y71135) ○ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 0.000 0.000 0.0000 0.0000 IN.

SCALE 0.0040 SCALE

MACH 1.46

PAGE 117
EFFECT OF HO TANK DIAMETER

![Graph showing the effect of angle of attack on base axial force coefficient.]

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MACH 1.95

PAGE 118
EFFECT OF HO TANK DIAMETER

ANGLE OF ATTACK, ALPHA, DEGREES

BASE AXIAL FORCE COEFFICIENT, CAB

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC TS ELEVTR RUDDER REFERENCE INFORMATION
(81011) □ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.003 0.000 0.000 0.000 LREF 7.8600 50.00 IN.
(81011) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T30281 0.000 0.003 0.000 0.000 0.000 LREF 2.0200 10.00 IN.
(81011) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 0.000 0.003 0.000 0.000 0.000 LREF 4.4600 10.00 IN.
(81011) □ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.003 0.000 0.000 0.000 XNRP 0.0000 10.00 IN.
ZNRP 0.0000 10.00 IN.
SCALE 0.0000 SCALE

MACH 3.48
EFFECT OF HQ TANK DIAMETER

![Graph](image-url)

### DATA SET SYMBOL CONFIGURATION DESCRIPTION

- **MSPC TWT 544X LAUNCH VEHICLE STUDIES T30181**
  - DATA NOT AVAILABLE FOR ALL CONDITIONS
  - REFERENCES
    - **LREP** 7.4800 80. IN.
    - **HRP** 3.3600 IN.
    - **ZRP** 0.1460 IN.
    - **SCALE** 0.0040 SCALE

### MACH 0.90

**PAGE 123**
EFFECT OF HO TANK DIAMETER

PITCHING MOMENT COEFFICIENT, CLM

NORMAL FORCE COEFFICIENT, CN

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTY RUDDER REFERENCE INFORMATION

1 (SB71069) MSFC TWT 944X LAUNCH VEHICLE STUDIES T90181 0.000 0.023 0.000 0.000 SREF 7.8800 SQ. IN.
2 (SB71091) MSFC TWT 944X LAUNCH VEHICLE STUDIES T90181 0.000 0.023 0.000 0.000 LREF 4.4600 IN.
3 (SB71335) MSFC TWT 944X LAUNCH VEHICLE STUDIES T90181 0.000 0.023 0.000 0.000 BREF 3.2600 IN.
4 (SB71335) MSFC TWT 944X LAUNCH VEHICLE STUDIES T90181 0.000 0.023 0.000 0.000 UREF 4.4600 IN.
SCALE 0.0040 SCALE

MACH 1.00

PAGE 124
EFFECT OF HO TANK DIAMETER

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORB INC VS ELEV TR RUDDER REFERENCE INFORMATION
(B71099) NSFC TWT 544X LAUNCH VEHICLE STUDIES T30181 0.000 0.025 0.000 0.000 SREF 7.8600 SQ. IN.
(B71100) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.025 0.000 0.000 LREF 2.0800 IN.
(B71101) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.025 0.000 0.000 SREF 4.4600 IN.
(B71102) NSFC TWT 544X LAUNCH VEHICLE STUDIES T30181 0.000 0.025 0.000 0.000 XHRP 3.3600 IN.

MACH 1.10

PAGE 125
EFFECT OF HOT TANK DIAMETER

NORMAL FORCE COEFFICIENT, CN

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(871029) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30131 0.000 0.023 0.000 0.000 SREF 7.8800 SQ. IN.
(871029) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30231 0.000 0.023 0.000 0.000 LREF 2.0400 IN.
(871029) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90131 0.000 0.023 0.000 0.000 LREF 4.5600 IN.
(871029) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90231 0.000 0.023 0.000 0.000 LREF 3.5000 IN.
2REF 0.0000 IN.
2REF 0.0000 IN.
SCALE 0.0000 SCALE

MACH 1.20

PAGE 126
EFFECT OF HI TANK DIAMETER

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(B71099) O DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.8000 50 IN.
(B71091) O HSFC TWT 544X LAUNCH VEHICLE STUDIES T30251 0.000 0.023 0.000 0.000 SREF 4.4000 IN.
(B71131) O DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 3.6000 IN.
(B71135) O DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 XNRP 0.0000 IN.

MACH 1.46

PAGE 127
EFFECT OF H2 TANK DIAMETER

PITCHING MOMENT COEFFICIENT, CLM

NORMAL FORCE COEFFICIENT, CN

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(871089) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 7.8800 SQ. IN.
(B711091) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30281 0.000 0.023 0.000 0.000 BREF 2.0280 IN.
(B711133) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 0.000 0.023 0.000 0.000 BREF 4.4800 IN.
(B711135) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 XMRP 3.3600 IN.
          YMRP 0.0000 IN.
          ZMRP 0.2460 IN.
          SCALE 0.0040 SCALE

MACH 1.95

PAGE 128
EFFECT OF HO TANK DIAMETER

NORMAL FORCE COEFFICIENT, CN

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  RUDDER  REFERENCE INFORMATION

(B711099)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  LREF  7.4800  80.00 IN.

(B711091)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T302S1  0.000  0.023  0.000  0.000  LREF  6.0200  80.00 IN.

(B711335)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T302S1  0.000  0.023  0.000  0.000  XREF  4.4600  80.00 IN.

(B711338)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  YRHP  0.0000  IN.

VERS  0.2860  IN.

SCALE  0.0040  SCALE

MACH  3.48

PAGE 129
EFFECT OF HO TANK DIAMETER

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTU Rudder REFERENCE INFORMATION
(SF1099) O DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.6800 80. IN.
(SF1191) O MSFC TWT 544X LAUNCH VEHICLE STUDIES 3902851 0.000 0.023 0.000 0.000 LREF 4.6600 IN.
(SP1133) O DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 BREF 4.4400 IN.
(SF1133) O MSFC TWT 544X LAUNCH VEHICLE STUDIES 3902851 0.000 0.023 0.000 0.000 XHPR 3.3000 IN.
(SF1133) O DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 YHPR 0.0000 IN.
(SF1133) O DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 ZHPR 0.2440 IN.
SCALE 0.0040 SCALE

MACH 4.96

PAGE 130
EFFECT OF HO TANK DIAMETER

DATA SET SYMBOL CONFIGURATION DESCRIPTION
\( \text{AT1001} \) MSFC TTV 5442 LAUNCH VEHICLE STUDIES T30141
\( \text{AT1021} \) DATA NOT AVAILABLE FOR ALL CONDITIONS
\( \text{AT11041} \) DATA NOT AVAILABLE FOR ALL CONDITIONS
\( \text{AT11341} \) MSFC TTV 5442 LAUNCH VEHICLE STUDIES T90131

ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
0.000 0.023 0.000 0.000 SREF 7.8900 SQ. IN.
0.000 0.023 0.000 0.000 LREF 2.0280 IN.
0.000 0.023 0.000 0.000 BREF 4.4600 IN.
0.000 0.023 0.000 0.000 XNRP 3.5000 IN.
0.000 0.023 0.000 0.000 YNRP 0.2480 IN.
0.000 0.023 0.000 0.000 ZNRP 0.0040 SCALE

MACH .80
PAGE 132
DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  Y3  ELEVTR  RUDDER  REFERENCE INFORMATION
(AY1090)  MSFC TW T544X LAUNCH VEHICLE STUDIES T90181  0.000  0.023  0.000  0.000  SREF  7.6400  80. IN.
(AY1092)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  LREF  2.0260  IN.
(AY1134)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  BREF  4.4800  IN.
(AY1136)  MSFC TW T544X LAUNCH VEHICLE STUDIES T90181  0.000  0.023  0.000  0.000  XMRP  3.3600  IN.
                                          YMRP  0.0000  IN.
                                          ZMRP  0.2460  IN.
                                          SCALE  0.0040  SCALE

MACH  .90
**EFFECT OF HO TANK DIAMETER**

**DATA SET SYMBOL** | **CONFIGURATION DESCRIPTION** | **ORBING** | **YS** | **ELEVTR** | **RUDDER** | **REFERENCE INFORMATION**
---|---|---|---|---|---|---
(A71092) | NSFC TWT 544X LAUNCH VEHICLE STUDIES T901S1 | 0.000 | 0.023 | 0.000 | 0.000 | SREP 7.6800 SQ.IN.
(A71096) | NSFC TWT 544X LAUNCH VEHICLE STUDIES T902S1 | 0.000 | 0.023 | 0.000 | 0.000 | LREP 3.0280 IN.
(A71134) | NSFC TWT 544X LAUNCH VEHICLE STUDIES T902S1 | 0.000 | 0.023 | 0.000 | 0.000 | BREP 4.8600 IN.
(A71136) | NSFC TWT 544X LAUNCH VEHICLE STUDIES T901S1 | 0.000 | 0.023 | 0.000 | 0.000 | XHREP 3.3600 IN.
| | | | | | ZHREP 0.0000 IN.
| | | | | | SCALE 0.0040 SCALE

**MACH** 1.20
EFFECT OF HO TANK DIAMETER

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

(A71090) (A71092) MSFC TWT 944X LAUNCH VEHICLE STUDIES T30281 0.000 0.023 0.000 0.000 SREF 7.6600 SQ. IN.

DATA NOT AVAILABLE FOR ALL CONDITIONS

MACH 1.95
DATA SET SYMBOL  CONFIGURATION DESCRIPTION
(AP1090)   □ DATA NOT AVAILABLE FOR ALL CONDITIONS
(AP1102)   □ MSCP TWT S44X LAUNCH VEHICLE STUDIES T302S1
(AP1134)   □ MSCP TWT S44X LAUNCH VEHICLE STUDIES T302S1
(AP1136)   □ DATA NOT AVAILABLE FOR ALL CONDITIONS

ORBINC  YS  ELEVTR  Rudder  Reference Information
0.000  0.023  0.000  0.000  BREP  7.8000  SQ.IN.
0.000  0.023  0.000  0.000  BREP  4.4500  IN.
0.000  0.023  0.000  0.000  ZMPR  3.3600  IN.
0.000  0.023  0.000  0.000  ZMPR  3.2400  IN.
0.000  0.023  0.000  0.000  SCALE  0.0040  SCALE

MACH  3.48

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EFFECT OF HO TANK DIAMETER

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(A71090) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 BREF 7.6800 30 IN.
(A71092) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251 0.000 0.023 0.000 0.000 LREF 2.0280 IN.
(A71134) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 0.000 0.000 BREF 4.4600 IN.
(A71136) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 XHRP 3.3600 IN.

THRP 0.0000 IN.
SCALE 0.0040 SCALE

MACH 4.96

PAGE 140
VARIATION OF SRM - HO TANK GAP

PITCHING MOMENT COEFFICIENT, C.M.

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBITIC TS ELEVT Rudder REFERENCE INFORMATION
(DY1050) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 0.000 0.000 0.000 SREF 7.8800 50. IN.
(DY1057) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.045 0.000 0.000 0.000 LREF 2.0250 IN.
(DY1050) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.123 0.000 0.000 0.000 SREF 7.8800 50. IN.
(SY1050) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.223 0.000 0.000 0.000 SREF 7.8800 50. IN.

SCALE 0.0040 SCALE

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VARIATION OF SRM - HO TANK GAP

ANGLE OF ATTACK, ALPHA, DEGREES

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL CONFIGURATION DESCRIPTION

ANGLE OF ATTACK, ALPHA, DEGREES

ORDINC YS ELEVTR Rudder REFERENCE INFORMATION

SCALE 0.0040 SCALE

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VARIATION OF SRM - H0 TANK GAP

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR Rudder REFERENCE INFORMATION
(071059) MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1 0.000 0.023 0.000 0.000 SREF 7.8000 SQ. IN.
(071103) MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1 0.000 0.073 0.000 0.000 LREF 2.0200 IN.
(071109) MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1 0.000 0.123 0.000 0.000 HREF 4.4600 IN.

MACH .60

PAGE 144
VARIATION OF SRM - HO TANK GAP

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORIGIN VS ELEVTR Rudder Reference Information

MACH .80

PAGE 145
VARIATION OF SRM - HO TANK GAP

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR Rudder REFERENCE INFORMATION
(S1109) MSFC TWT 944X LAUNCH VEHICLE STUDIES T301S1 0.000 0.023 0.000 0.000 BREP 7.8800 30.0 IN.
(S1110) MSFC TWT 944X LAUNCH VEHICLE STUDIES T301S1 0.000 0.073 0.000 0.000 LREP 2.0280 IN.
(S1111) MSFC TWT 944X LAUNCH VEHICLE STUDIES T301S1 0.000 0.123 0.000 0.000 HREP 4.4800 IN.
(S1112) MSFC TWT 944X LAUNCH VEHICLE STUDIES T301S1 0.000 0.222 0.000 0.000 YHREP 3.3600 IN.
                    YMRP 0.0200 IN.  ZMRP 0.2460 IN. SCALE 0.0040 SCALE

MACH .90

PAGE 146
VARIATION OF SRM - HO TANK GAP

AXIAL FORCE COEFFICIENT, CA

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVT Rudder REFERENCE INFORMATION

(B10) DMSF TWT 544X LAUNCH VEHICLE STUDIES 130151 0.000 0.023 0.000 0.000 BREF 7.6800 36 IN.

(B1105) DMSF TWT 544X LAUNCH VEHICLE STUDIES 130151 0.000 0.073 0.000 0.000 LREF 2.0800 IN.

(B1107) DMSF TWT 544X LAUNCH VEHICLE STUDIES 130151 0.000 0.123 0.000 0.000 BREF 4.4600 IN.

(B1109) DMSF TWT 544X LAUNCH VEHICLE STUDIES 130151 0.000 0.223 0.000 0.000 XHREP 3.3600 IN.

MACH .80

PAGE 148
VARIATION OF SRM - HO TANK GAP

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORSINC VS ELEVTR RUGGER REFERENCE INFORMATION

MACH .90

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VARIATION OF SRM - HO TANK GAP

![Graph showing variations of SRM - HO tank gap with angle of attack.]

DATA SET SYMBOL | CONFIGURATION DESCRIPTION | ORBINC | YS | ELEVTR | RUDDER | REFERENCE INFORMATION
--- | --- | --- | --- | --- | --- | ---
(B71089) | MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 | 0.000 | 0.023 | 0.000 | 0.000 | SREF 7.8800 SQ.IN.
(B71099) | MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 | 0.000 | 0.073 | 0.000 | 0.000 | LREF 2.9200 IN.
(B71105) | MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 | 0.000 | 0.073 | 0.000 | 0.000 | SREF 4.4800 IN.
(B71107) | MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 | 0.000 | 0.123 | 0.000 | 0.000 | XMRP 3.3600 IN.
(B71109) | MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 | 0.000 | 0.223 | 0.000 | 0.000 | YMRP 0.0000 IN.
SCALE 0.0040 SCALE

MACH .60

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VARIATION OF SRM - H0 TANK GAP

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  RUDDER  REFERENCE INFORMATION

(871199)  MSFC TW T 544X LAUNCH VEHICLE STUDIES T301S1  0.000  0.023  0.000  0.000  SREF  7.8800  SQ. IN.

(871119)  MSFC TW T 544X LAUNCH VEHICLE STUDIES T301S1  0.000  0.123  0.000  0.000  LREF  2.0200  IN.

MACH .90  PAGE 152
VARIATION OF SRM - NO TANK GAP

BASE AXIAL FORCE COEFFICIENT

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORB INC YS ELEV Rudder REFERENCE INFORMATION

(B1109) MSFC TWT 944X LAUNCH VEHICLE STUDIES T301SI 0.000 0.023 0.000 0.000 REF 7.6000 SQ. IN.

(B1110) MSFC TWT 944X LAUNCH VEHICLE STUDIES T301SI 0.000 0.073 0.000 0.000 LREF 2.0900 IN.

(B1110) MSFC TWT 944X LAUNCH VEHICLE STUDIES T301SI 0.000 0.123 0.000 0.000 BREF 4.4800 IN.

MACH .60

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VARIATION OF SRM - HO TANK GAP

BASE AXIAL FORCE COEFFICIENT, CAB

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(871009) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90131
(871108) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90131
(871109) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90131

ORIGIN YS ELEV TRUDDER REFERENCE INFORMATION
0.000 0.023 0.000 0.000 SREF 7.8800 SQ. IN.
0.000 0.073 0.000 0.000 LREF 2.0280 IN.
0.000 0.123 0.000 0.000 XREF 4.4800 IN.
0.000 0.223 0.000 0.000 YMRP 3.3600 IN.
0.000 0.2480 IN.
1.000 0.000 SCALE 0.0040 SCALE

MACH .80
VARIATION OF SRM - HO TANK GAP

BASE AXIAL FORCE COEFFICIENT, CAB

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION

(BY1005) MSFC TW T944X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 0.000 0.000 SREP 7.6400 30.1N.

(BY1105) MSFC TW T944X LAUNCH VEHICLE STUDIES T30151 0.000 0.073 0.000 0.000 LREP 2.0200 IN.

(BY1109) MSFC TW T944X LAUNCH VEHICLE STUDIES T30151 0.000 0.103 0.000 0.000 BREP 4.4400 IN.

MACH .90

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VARIATION OF SRM - HO TANK GAP

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVT Rudder Reference Information

(071009) X DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.8800 sq. in.

(071107) MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1 0.000 0.073 0.000 0.000 LREF 2.0280 in.

(071109) MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1 0.000 0.123 0.000 0.000 BREF 4.4600 in.

MACH 4.96
VARIATION OF SRM - HO TANK GAP

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(EY11S5)  DATA NOT AVAILABLE FOR ALL CONDITIONS
(EY1105)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1
(EY1107)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1
(EY11S1)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1

ANGLE OF ATTACK, ALPHA, DEGREES

ORIGIN  VS  ELEVTR  RUDDER  REFERENCE INFORMATION
0.000  0.023  0.000  0.000  SREF  7.6000  SQ.IN.
0.000  0.073  0.000  0.000  LREF  2.0280  IN.
0.000  0.123  0.000  0.000  UREF  4.6090  IN.
0.000  0.223  0.000  0.000  XHPR  3.3600  IN.
0.000  0.2480  ZHPR  0.0000  IN.
0.0040  SCALE  0.0000  SCALE

MACH  1.95

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VARIATION OF SRM - HO TANK GAP

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET
SYMBOL CONFIGURATION DESCRIPTION ORINC TS ELEVTR RUDDER REFERENCE INFORMATION
(BY1099) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 0.000 SREF 7.6800 BR. (IN.
(BY1105) NSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.073 0.000 0.000 LREF 2.0000 IN.
(BY1107) NSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.123 0.000 0.000 YHREF 2.9400 IN.
(BY1108) NSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.223 0.000 0.000 ZHREF 0.0000 IN.
SCALE 0.0040 SCALE

MACH 4.96

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VARIATION OF SRM - HO TANK GAP

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION

-12 -10 -8 -6 -4 -2 0 2 4 6 8 10 12

AXIAL FORCE COEFFICIENT, CA

ANGLE OF ATTACK, ALPHA, DEGREES

MACH 1.20

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VARIATION OF SRM - HO TANK GAP

AXIAL FORCE COEFFICIENT, CA

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL | CONFIGURATION DESCRIPTION | ORBINC | YS | ELEVTR | RUDDER | REFERENCE INFORMATION
--- | --- | --- | --- | --- | ---
(X71089) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 0.000 | SREF 7.6800 SQ.IN.
(X71107) | NSPC TWT 544X LAUNCH VEHICLE STUDIES T3O1S1 | 0.000 | 0.073 | 0.000 | 0.000 | LREF 2.0200 IN.
(X71106) | NSPC TWT 544X LAUNCH VEHICLE STUDIES T3O1S1 | 0.000 | 0.123 | 0.000 | 0.000 | XREF 4.4600 IN.
(X71105) | NSPC TWT 544X LAUNCH VEHICLE STUDIES T3O1S1 | 0.000 | 0.223 | 0.000 | 0.000 | XMRP 3.0500 IN.

MACH 1.95
VARIATION OF SRM - HO TANK GAP

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBING YS ELEVTR RUDDER REFERENCE INFORMATION

(BP1099) O DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.8800 SQ.IN.
(BP1105) O MSFC TWT 944X LAUNCH VEHICLE STUDIES 130151 0.000 0.023 0.000 0.000 LREF 2.0580 IN.
(BP1107) O MSFC TWT 944X LAUNCH VEHICLE STUDIES 130151 0.000 0.123 0.000 0.000 BREF 4.4600 IN.
(BP1109) O MSFC TWT 944X LAUNCH VEHICLE STUDIES 130151 0.000 0.223 0.000 0.000 XMRP 3.3800 IN.

YMRP 0.0000 IN.
ZMRP 0.2480 IN.
SCALE 0.0040 SCALE

MACH 4.96
VARIATION OF SRM - HO TANK GAP

FOREBODY AXIAL FORCE COEFFICIENT, CAF

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORING VS ELEVTR RUGDER REFERENCE INFORMATION
(871019) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.083 0.000 0.000 LREF 7.9000 50. IN.
(871105) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.073 0.000 0.000 LREF 6.0200 50. IN.
(871107) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.123 0.000 0.000 SNHP 4.4600 50. IN.
(871109) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.223 0.000 0.000 SNHP 3.3600 50. IN.

MACH 1.20

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VARIATION OF SRM - HO TANK GAP

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR Rudder REFERENCE INFORMATION
(B71109) □ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 BREF 7.9600 IN.
(B71107) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1 0.000 0.073 0.000 0.000 LREF 2.0280 IN.
(B71109) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1 0.000 0.123 0.000 0.000 DREF 4.4600 IN.
(B71109) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1 0.000 0.223 0.000 0.000 XMRP 3.3600 IN.
(B71109) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1 0.000 0.223 0.000 0.000 ZMRP 0.2460 IN.

SCALE 0.0040 SCALE

MACH 1.95

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VARIATION OF SRM - HO TANK GAP

ANGLE OF ATTACK, ALPHA, DEGREES

FOREBODY AXIAL FORCE COEFFICIENT, Caf

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

101) MSFC TW 544X LAUNCH VEHICLE STUDIES T30111 0.000 0.085 0.000 0.000 SREF 7.8000 SQ.IN.

102) MSFC TW 544X LAUNCH VEHICLE STUDIES T30111 0.000 0.125 0.000 0.000 LREF 2.0000 IN.

103) MSFC TW 544X LAUNCH VEHICLE STUDIES T30111 0.000 0.125 0.000 0.000 SREF 4.4000 IN.

104) MSFC TW 544X LAUNCH VEHICLE STUDIES T30111 0.000 0.125 0.000 0.000 MAVR 3.5000 IN.

MACH 4.96

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VARIATION OF SRM - HO TANK GAP

BASE AXIAL FORCE COEFFICIENT, CAB

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(B71109) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.025 0.000 0.000 REF 7.8600 SQ. IN.
(B71103) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.075 0.000 0.000 BREF 2.0280 IN.
(B71107) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.125 0.000 0.000 LREF 4.4600 IN.
(B71109) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.225 0.000 0.000 XMRP 3.3600 IN.
ZMRP 0.0000 IN.
SCALE 0.0040 SCALE

MACH 1.20

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VARIATION OF SRM - HO TANK GAP

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(S71109) ○ MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1
(S71107) ○ MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1
(S71109) ○ MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1

ORBINC YS ELEVRA RUDDER REFERENCE INFORMATION
0.000 0.023 0.000 0.000 SREF 7.6800 SQ. IN.
0.000 0.123 0.000 0.000 LREF 2.0280 IN.
0.000 0.223 0.000 0.000 BREF 4.4800 IN.
0.000 0.323 0.000 0.000 XREF 3.3600 IN.
0.000 0.423 0.000 0.000 YREF 0.0000 IN.
0.000 0.523 0.000 0.000 ZREF 0.2480 IN.
SCALE 0.0040 SCALE

MACH .80

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VARIATION OF SRM - HO TANK GAP

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(071059) O MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1 0.000 0.023 0.000 0.000 SREF 7.6800 92.4N.
(071105) O MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1 0.000 0.073 0.000 0.000 LREF 2.0200 51.
(071107) O MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1 0.000 0.123 0.000 0.000 BREF 4.4600 51.
(071109) O MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1 0.000 0.223 0.000 0.000 XNRP 3.3000 51.

REFERENCE INFORMATION
SREF 7.6800 82.4N.
LREF 2.0200 51.
BREF 4.4600 51.
XNRP 3.3000 51.
ZNRP 0.0000 51.
SCALE 0.0040 SCALE

MACH .90
VARIATION OF SRM - HO TANK GAP

NORMAL FORCE COEFFICIENT, CN

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL

CONFIGURATION DESCRIPTION

ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

(871099)/ORBIT 344X LAUNCH VEHICLE STUDIES T30151
0.000 0.023 0.000 0.000 SREF 7.8800 SQ.IN.

(871097)/ORBIT 344X LAUNCH VEHICLE STUDIES T30151
0.000 0.073 0.000 0.000 LREF 2.0260 IN.

(871109)/ORBIT 344X LAUNCH VEHICLE STUDIES T30151
0.000 0.123 0.000 0.000 BREF 4.4600 IN.

MACH 1.20

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VARIATION OF SRM - HO TANK GAP

MACH 1.95

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VARIATION OF SRM - HO TANK GAP

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

(871109) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.8800 SQ.IN.

(871105) MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1 0.000 0.073 0.000 0.000 LREF 2.0200 IN.

(871107) MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1 0.000 0.123 0.000 0.000 instant 4.4600 IN.

(871108) MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1 0.000 0.223 0.000 0.000 XMRP 3.3600 IN.

MACH 4.96
VARIATION OF SRM - H0 TANK GAP

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  VS  ELEVTR  RUDDER  REFERENCE INFORMATION

MSFC TWT 544X LAUNCH VEHICLE STUDIES T501S1  0.000  0.023  0.000  0.000  SREF  7.6800  56.1 IN.

MSFC TWT 544X LAUNCH VEHICLE STUDIES T501S1  0.000  0.073  0.000  0.000  LREF  2.0000  IN.

MSFC TWT 544X LAUNCH VEHICLE STUDIES T501S1  0.000  0.123  0.000  0.000  BREF  4.4000  IN.

MACH .60
VARIATION OF SRM - HO TANK GAP

DATA SET  SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  Rudder  REFERENCE INFORMATION
(A71090)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151  0.000  0.023  0.000  0.000  SREF 7.8800 SQ.IN.
(CP1106)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151  0.000  0.073  0.000  0.000  LREF 2.0280 IN.
(CP1110)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151  0.000  0.123  0.000  0.000  XMRP 3.5600 IN.
               THRP 0.0000 IN.
               ZMRP 0.2400 IN.
               SCALE 0.0040 SCALE

MACH .80

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### VARIATION OF SRM - HO TANK GAP

<table>
<thead>
<tr>
<th>DATA SET SYMBOL</th>
<th>CONFIGURATION DESCRIPTION</th>
<th>ORBINC</th>
<th>TS</th>
<th>ELEVTR</th>
<th>RUDDER</th>
<th>REFERENCE INFORMATION</th>
</tr>
</thead>
</table>
| (AP100D)        | NSPC TWT 544X LAUNCH VEHICLE STUDIES T501S1 | 0.000  | 0.023 | 0.000  | 0.000  | LREF 7.0880 QN.
| (CP1106)        | NSPC TWT 544X LAUNCH VEHICLE STUDIES T501S1 | 0.000  | 0.073 | 0.000  | 0.000  | LREF 2.0880 IN.
| (CP1110)        | NSPC TWT 544X LAUNCH VEHICLE STUDIES T501S1 | 0.000  | 0.123 | 0.000  | 0.000  | YHRR 3.3930 IN.
| (CP1110)        | NSPC TWT 544X LAUNCH VEHICLE STUDIES T501S1 | 0.000  | 0.229 | 0.000  | 0.000  | YHRR 0.0400 IN.

**SCALE:** 0.0040 SCALE

**MACH:** 0.90

**PAGE:** 179
VARIATION OF SRM - HO TANK GAP

DATA SET SYMBOL | CONFIGURATION DESCRIPTION | ORBINC TS | ELEVTR | RUDDER | REFERENCE INFORMATION
(19) | MPE TWT 344X LAUNCH VEHICLE STUDIES T3011 | 0.000 | 0.000 | 0.000 | SREF 7.6800 IN.
(27) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.000 | 0.000 | LREF 4.4600 IN.
(23) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.000 | 0.000 | XMRP 3.3600 IN.
(47) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.000 | 0.000 | ZMRP 0.2460 IN.
SCALE | 0.0040 SCALE

MACH 1.00
VARIATION OF SRM - LQ TANK GAP

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR Rudder Reference Information

MACH 1.10
### VARIATION OF SRM - HO TANK GAP

#### Data Set Symbol
- **(A71090)**: Data not available for all conditions
- **(CT1106)**: NSFC TWT 344X Launch Vehicle Studies T30131
- **(CT1110)**: NSFC TWT 344X Launch Vehicle Studies T30131

#### Configuration Description
- Orbinc
- Vs
- Elevtr
- Rudder
- Reference Information

<table>
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<th>Vs</th>
<th>Elevtr</th>
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#### Mach Number
- 1.95
VARIATION OF SRM - HQ TANK GAP

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  TS  ELEVTR  Rudder  REFERENCE INFORMATION

(AP1090)  □ DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  SREF  7.6800 SQ. IN.
(CY1106)  □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151  0.000  0.073  0.000  0.000  LREF  2.0000 IN.
(CY1109)  □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151  0.000  0.123  0.000  0.000  BREF  4.4600 IN.
(CY1110)  □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151  0.000  0.223  0.000  0.000  XHRP  3.3600 IN.

DATA NOT AVAILABLE FOR ALL CONDITIONS

MACH  4.96
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBIT INC.  YS  ELEVTR  RUDDER  REFERENCE INFORMATION
(B71129)  MSCP TWT 344X LAUNCH VEHICLE STUDIES 790151  -1.500  0.023  0.000  0.000  SREP  7.6000  80. IN.
(B71130)  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.200  0.023  0.000  0.000  LREP  8.0800  IN.
(B71133)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  RREP  4.4600  IN.
(B71135)  MSCP TWT 344X LAUNCH VEHICLE STUDIES 790151  0.000  0.023  0.000  0.000  XREP  3.3600  IN.
VRP  0.0000  IN.
ZH  0.0000  IN.
SCALE  0.0040  SCALE

MACH  .60

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORB INC YS ELEVTR RUDDER REFERENCE INFORMATION
(B71132) MSFC TWT 544X LAUNCH VEHICLE STUDIES 790181 -1.000 0.023 0.000 0.000 BREF 7.6800 SQ. IN.
(B71133) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.000 0.023 0.000 0.000 LREF 2.0280 IN.
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ZHRP 0.0000 IN.
YHRP 0.0000 IN.
ZNRP 0.2480 IN.
SCALE 0.0040 SCALE

MACH 0.80
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

ANGLE OF ATTACK, ALPHA, DEGREES

PITCHING MOMENT COEFFICIENT, CLM

MACH  .91

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

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<th>CONFIGURATION DESCRIPTION</th>
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MACH 1.00

PAGE 188
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

ANGLE OF ATTACK, ALPHA, DEGREES

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

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3 (BY1135) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 0.000 8.0000 IN.

4 (BY1135) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90131 0.000 0.023 0.000 0.000 0.000 8.0000 IN.

MACH 1.10

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR Rudder REFERENCE INFORMATION
(B71135) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90135 -1.500 0.023 0.000 0.000 SREF 7.8800 SQ. IN.
(B71135) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90235 -1.500 0.023 0.000 0.000 LREF 2.0280 IN.
(B71135) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90135 0.000 0.023 0.000 0.000 NHP 3.3000 IN.
(B71135) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90135 0.000 0.023 0.000 0.000 ZHP 0.0450 IN.
SCALE 0.0040 SCALE

MACH 1.20
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

![Graph showing variation of orbiter incidence for 312 in. diameter tank.]

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MACH 1.47
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

Data set symbol configuration description

- Data not available for all conditions

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<th>Data set</th>
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- SRF 7.8660 IN.
- XNRp 3.3600 IN.
- YNRp 0.0000 IN.
- ZNRp 0.2460 IN.
- Scale 0.0049 SCALE

MACH 1.95
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

PITCHING MOMENT COEFFICIENT, CLM

ANGL OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC vs ELEVT RUDDER REFERENCE INFORMATION
(OS) (0120) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.900 0.025 0.000 0.000 SREF 7.880 IN. 80 IN.
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(OS) (0135) MSFC TWT S42X LAUNCH VEHICLE STUDIES T90231 0.000 0.025 0.000 0.000 SREF 4.4400 IN.
(OS) (0135) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 0.000 SREF 3.3600 IN.

THRP 0.000 IN.
ZHRP 0.8440 IN.
SCALE 0.0040 SCALE

MACH 3.48

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### VARIATION OF ORBITER INCIDENCE FOR 312 IN., DIAMETER TANK

- **Pitching Moment Coefficient, CLM**

#### DATA SET SYMBOL | CONFIGURATION DESCRIPTION | ORBITC | YS | ELEVTR | RUDDER | REFERENCE INFORMATION
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(31110) | NSFC TFW 444X LAUNCH VEHICLE STUDIES T90281 | -1.300 | 0.023 | 0.000 | 0.000 | 2.0000 IN.
(31110) | NSFC TFW 444X LAUNCH VEHICLE STUDIES T90281 | 0.000 | 0.023 | 0.000 | 0.000 | 4.4000 IN.
(31110) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 0.000 | 3.3600 IN.

#### REFERENCE INFORMATION
- SREF 7.8800 SQ. IN.
- MREF 2.0000 IN.
- XMAF 0.0075 IN.
- ZMAF 0.02480 IN.
- SCALE 0.0040 SCALE

**MACH** 4.96

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION
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MACH .60

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

(071129) ◊ HSPC TWT 544X LAUNCH VEHICLE STUDIES T90151 -1.500 0.023 0.000 0.000 SREF 7.8800 SQ. IN.

(071131) ◊ DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 LREF 2.0200 IN.

(071133) ◊ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 BREF 4.4600 IN.

(071135) ◊ HSPC TWT 544X LAUNCH VEHICLE STUDIES T90151 0.000 0.023 0.000 0.000 LMP 3.3600 IN.

MACH .80

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUGDER REFERENCE INFORMATION
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BY1133 DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 MREP 4.1400 IN.
BY1135 MSFC TWT 844X LAUNCH VEHICLE STUDIES T90151 0.000 0.023 0.000 0.000 TREP 3.2000 IN.

MACH .91

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION orbinc ys elevtn rudder reference information
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MACH 1.10

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

ANGLE OF ATTACK, ALPHA, DEGREES

NOMAL FORCE COEFFICIENT, CN

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
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(571131) MSFC TWT S44K LAUNCH VEHICLE STUDIES T90251 -1.500 0.023 0.000 0.000 LREF 2.038 0 IN.
(571133) MSFC TWT S44K LAUNCH VEHICLE STUDIES T90251 0.000 0.023 0.000 0.000 RREF 4.460 0 IN.
(571135) MSFC TWT S44K LAUNCH VEHICLE STUDIES T90151 0.000 0.023 0.000 0.000 XMRP 3.360 0 IN.

MACH 1.20

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

MACH 1.47
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  RUDDER  REFERENCE INFORMATION
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(B71133)  MSFC TWT 544X LAUNCH VEHICLE STUDIES  T90251  0.000  0.023  0.000  0.000  SREP  4.4800  IN.
(B71135)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  XNRP  3.3600  IN.
                                                0.0000  IN.
                                                0.0000  IN.
                                                0.2480  IN.
                                                0.0040  SCALE

MACH 1.95

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

ANGLE OF ATTACK, ALPHA, DEGREES

NORMAL FORCE COEFFICIENT, CN

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBITC  VS  ELEVTR  Rudder  Reference Information
(BY1129)  O  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.000  0.023  0.000  0.000  BREF  7.8800  50. IN.
(BY1331)  O  MSFC TWT 544X LAUNCH VEHICLE STUDIES T90081  -1.000  0.023  0.000  0.000  BREF  8.0000  IN.
(BY1133)  O  MSFC TWT 544X LAUNCH VEHICLE STUDIES T90081  0.000  0.023  0.000  0.000  LREF  4.4000  IN.
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      0.0000  0.0000  0.0000  0.0000  ZHPR  0.0000  IN.
      0.0040  0.0040  SCALE

MACH  3.48  PAGE 203
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL: (DY1129) (DY1131) (DY1133) (DY1135)

CONFIGURATION DESCRIPTION:
- DATA NOT AVAILABLE FOR ALL CONDITIONS
- MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251
- DATA NOT AVAILABLE FOR ALL CONDITIONS

ANGLE OF ATTACK, ALPHAS: DEGREES

NORMAL FORCE COEFFICIENT, CN

MACH 4.96
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

AXIAL FORCE COEFFICIENT, CA

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORING YS  ELEVYR  RUDDER  REFERENCE INFORMATION
(BH1139) NSFC TWT 544X LAUNCH VEHICLE STUDIES T90151  -1.500  0.023  0.000  0.000  SREF  7.0000  80.000  IN.
(BH1133) DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.500  0.023  0.000  0.000  SREF  7.0000  80.000  IN.
(BH1135) DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  SREF  7.0000  80.000  IN.
(BH1135) NSFC TWT 544X LAUNCH VEHICLE STUDIES T90151  0.000  0.023  0.000  0.000  SREF  7.0000  80.000  IN.

MACH .60

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBIT INC. YS ELEVTR RUDDER REFERENCE INFORMATION
(B711129) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 -1.500 0.023 0.000 0.000 SREF 7.6800 50.1 IN.
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(B711133) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 XMRP 3.3600 IN.
(B711133) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 0.000 0.023 0.000 0.000 YMRP 0.0000 IN.

SCALE 0.0040 IN.

MACH .80

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  VS  ELEVTR  RUGDER  REFERENCE INFORMATION
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(B71133)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  MREF  4.000  IN.
(B71135)  MSFC TWT 544X LAUNCH VEHICLE STUDIES 90181  0.000  0.023  0.000  0.000  XNRP  3.3600  IN.
  0.000  0.023  0.000  0.000  YNRP  0.000  IN.
  0.000  0.023  0.000  0.000  ZNRP  0.0400  IN.
  0.000  0.023  0.000  0.000  SCALE  0.0040  SCALE

MACH  .91

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

AXIAL FORCE COEFFICIENT, CA

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINCYS ELEVT RRUDDER REFERENCE INFORMATION
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(B71133) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 XHXP 3.3600 IN.
(B71135) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90131 0.000 0.023 0.000 0.000 ZHXP 0.0000 IN.
SCALE 0.0040 SCALE

MACH 1.00 PAGE 208
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

AXIAL FORCE COEFFICIENT, CA

 ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YE ELEVTR RUDDER REFERENCE INFORMATION
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MACH 1.10

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

ANGLE OF ATTACK, ALPHA, DEGREES

AXIAL FORCE COEFFICIENT, CA

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVIR RUDDER REFERENCE INFORMATION
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(MA1133) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 0.000 0.000 XREF 4.4600 IN.
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(MG1133) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 ZREF 0.0000 IN.
SCALE 0.0040 SCALE

MACH 1.47

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

ANGLE OF ATTACK, ALPHA, DEGREES

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(B71131) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251 -1.800 0.023 0.000 0.000 LREF 2.0000 IN.
(B71133) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 0.000 0.000 SREF 4.4800 IN.
(B71135) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 3.3600 IN.

MACH 1.95

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION
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(B71133) DATA NOT AVAILABLE FOR ALL CONDITIONS

ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION
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0.000 0.023 0.000 0.000 SHP 3.3600 IN.
0.000 0.023 0.000 0.000 ZHSP 0.0000 IN.

SCALE 0.0040 SCALE

MACH 3.48
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

AXIAL FORCE COEFFICIENT, CA

ANGEL OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVT  RUDDER  REFERENCE INFORMATION

(DY1129)  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.500  0.023  0.000  0.000  SREF  7.8000  SQ. IN.

(DY1131)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251  -1.500  0.023  0.000  0.000  LREF  2.0280  IN.

(DY1133)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251  0.000  0.023  0.000  0.000  BREF  4.4800  IN.

(DY1135)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  XHRP  3.3600  IN.

YHRP  0.0000  IN.
ZHPR  0.2480  IN.
SCALE  0.0040  SCALE

MACH  4.96

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(SF1123)  MSFC TW 544X LAUNCH VEHICLE STUDIES T90151
(SF1131)  DATA NOT AVAILABLE FOR ALL CONDITIONS
(SF1133)  DATA NOT AVAILABLE FOR ALL CONDITIONS
(SF1135)  MSFC TW 544X LAUNCH VEHICLE STUDIES T90151

ANGLE OF ATTACK, ALPHA, DEGREES

FOREBODY AXIAL FORCE COEFFICIENT, CAF

MACH .80

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
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(B71135) MSFC TWT 544X LAUNCH VEHICLE STUDIES 790151 0.000 0.023 0.000 0.000 XREF 3.8800 IN.

REFERENCE INFORMATION
REFERENCE 0.0000 IN.
SCALE 0.0040 SCALE

MACH .91 PAGE 217
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

ANGLE OF ATTACK, ALPHA, DEGREES

FOREBODY AXIAL FORCE COEFFICIENT, CAF

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVT Rudder REFERENCE INFORMATION
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(871133) -1.500 0.023 0.000 0.000 ZHLP 0.0000 IN.
(871133) -1.500 0.023 0.000 0.000 SCALE 0.0040 SCALE

MACH 1.00

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VARIIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
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(B71133) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 YMRP 3.3600 IN.
(B71133) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 0.000 0.023 0.000 0.000 ZMRP 0.0000 IN.
SCALE 0.0040 SCALE

MACH 1.10

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

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<th>YS</th>
<th>ELEVTR</th>
<th>RUDDER</th>
<th>REFERENCE INFORMATION</th>
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SCALE 0.0040 SCALE

MACH 1.20

PAGE 220
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORINC TS ELEV TRUDDER REFERENCE INFORMATION
(DY1129) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.023 0.000 0.000 SREF 7.8400 SQ. IN.
(DY1131) MSFC TWT 944X LAUNCH VEHICLE STUDIES T90251 -1.500 0.023 0.000 0.000 LREF 2.0280 IN.
(DY1133) MSFC TWT 944X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 0.000 0.000 MREF 4.4600 IN.
(DY1135) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 ZNRP 3.3600 IN.

SCALE 0.0040 SCALE

MACH 1.47

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

- DATA NOT AVAILABLE FOR ALL CONDITIONS

- NSFC TWT 544X LAUNCH VEHICLE STUDIES T90251

- DATA NOT AVAILABLE FOR ALL CONDITIONS

MACH 1.95
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(D71129)  DATA NOT AVAILABLE FOR ALL CONDITIONS
(D71131)  NSFC TWT 544X LAUNCH VEHICLE STUDIES T90251
(D71133)  NSFC TWT 544X LAUNCH VEHICLE STUDIES T90251
(D71135)  DATA NOT AVAILABLE FOR ALL CONDITIONS

MACH 4.96
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC TS ELEVTR RUDDER REFERENCE INFORMATION
(BT129) MSPC TWT 544X LAUNCH VEHICLE STUDIES T901S1 0.000 0.023 0.000 0.000 SREP 7.8800 IN.
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(BT135) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREFF 2.0800 IN.
(MSPC TWT 544X LAUNCH VEHICLE STUDIES T901S1 0.000 0.023 0.000 0.000 XMRP 3.3600 IN.
THRP 0.0000 IN.
ZMRP 0.2400 IN.
SCALE 0.0000 SCALE

MACH .60 PAGE 225
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(871129) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 -1.500 0.023 0.000 0.000 SREF 7.8800 Sq.In.
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(871133) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 0.000 0.023 0.000 0.000 XNRP 3.3600 In.
MACH .80

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVN Rudder REFERENCE INFORMATION
(DY1129) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 -1.500 0.023 0.000 0.000 SREF 7.8800 SQ. IN.
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SCALE 0.0040 SCALE

MACH .91 PAGE 227
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVR  RUDDER  REFERENCE INFORMATION

(SP1132)  NSFC TWT 544X LAUNCH VEHICLE STUDIES T90151  -1.500  0.023  0.000  0.000  SREF  7.8800  53.1IN.

(SP1133)  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.500  0.023  0.000  0.000  LREF  2.0280  IN.

(SP1134)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  GREF  4.4600  IN.

(SP1135)  NSFC TWT 544X LAUNCH VEHICLE STUDIES T90151  0.000  0.023  0.000  0.000  XMRP  3.3900  IN.

0.0000  IN.

0.2480  IN.

SCALE  0.0040  SCALE

MACH  1.00
VARIATION OF ORBITER INCIDENCE FOR 3!2 IN. DIAMETER TANK

BASE AXIAL FORCE COEFFICIENT, CAB

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUGGER REFERENCE INFORMATION
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(61133) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 4.4600 IN.
(61135) NSFC TWT 544X LAUNCH VEHICLE STUDIES 790151 0.000 0.023 0.000 0.000 3.3600 IN.

MACH 1.10

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBITC YS ELEV Rudder Reference Information
(T71120) O HNSC TWT 544X LAUNCH VEHICLE STUDIES T90151 -1.500 0.023 0.000 0.000 LREF 7.8800 SQ. IN.
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(T91333) O HNSC TWT 544X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 0.000 0.000 LREF 4.4600 IN.
(T97155) O HNSC TWT 544X LAUNCH VEHICLE STUDIES T90151 0.000 0.023 0.000 0.000 LREF 3.3600 IN.

MACH 1.20

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

BASE AXIAL FORCE COEFFICIENT, CAB

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR Rudder REFERENCE INFORMATION
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(S71135) C DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 ZNRP 0.0000 IN.

SCALE 0.0040 SCALE

MACH 1.47

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

BASE AXIAL FORCE COEFFICIENT, CAB

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBING YS ELEVTR Rudder Reference Information

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XMRP 0.0000 IN.

ZMRP 0.2480 IN.

SCALE 0.0040 SCALE

MACH 1.95

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

ANGLE OF ATTACK, ALPHA, DEGREES

BASE AXIAL FORCE COEFFICIENT, CAB

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR Rudder REFERENCE INFORMATION
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THRP 0.0000 IN.
SCALE 0.0040 SCALE

MACH 3.48

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
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(B71135) ☐ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 XMPR 3.3600 IN.
YMPR 0.2480 IN.
ZMPR 0.0000 IN.
SCALE 0.0040 SCALE

MACH 4.96

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVT RUGDER REFERENCE INFORMATION

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DATA NOT AVAILABLE FOR ALL CONDITIONS

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DATA NOT AVAILABLE FOR ALL CONDITIONS

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MHFC TWT 544X LAUNCH VEHICLE STUDIES 790131 DATA NOT AVAILABLE FOR ALL CONDITIONS

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SCALe 0.0040 SCAlE

MACH .60
## VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

### Data Set Symbol | Configuration Description | Orbinc | Ys | Elevtn | Rudder | Reference Information
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(B71133) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 0.000 | BREF 4.4600 IN.
(B71133) | MSFC TWT 544X Launch Vehicle Studies T901S1 | 0.000 | 0.023 | 0.000 | 0.000 | XNRP 3.3600 IN.
| | | | | | YNRP 0.0000 IN.
| | | | | | ZNRP 0.2480 IN.
| | | | | | SCALE 0.0040 SCALE

### Mach

.80

### Page

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
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MACH 1.00

REFERENCE INFORMATION
SREF 7.4800 SQ. IN.
LREF 2.0280 IN.
HREF 4.4600 IN.
VREF 2.0280 IN.
SCALE 0.0040 SCALE
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBITE TS ELEVTR Rudder REFERENCE INFORMATION
(071125) Q MGFC TWT 944X LAUNCH VEHICLE STUDIES 90151 -1.500 0.000 0.000 0.000 SREF 7.8400 IN.
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(071135) Q MGFC TWT 944X LAUNCH VEHICLE STUDIES 90151 0.000 0.000 0.000 0.000 THER 3.3600 IN.
SCALE 0.0040 SCALE

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

PITCHING MOMENT COEFFICIENT, CLM

DATA, SET, SYMBOL, CONFIGURATION, DESCRIPTION

MACH 1.20  PAGE 240
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

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0.000 LREF 2.0280 IN.

0.000 XREF 4.4600 IN.

0.000 YREF 3.3600 IN.

0.000 ZREF 0.2480 IN.

SCALE 0.0040 SCALE

MACH 1.95
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORDEINC VS ELEVTR RUDDER REFERENCE INFORMATION
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REFERENCE INFORMATION
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- LREF 4.0000 IN.
- XNRP 3.3800 IN.
- YNRP 0.0000 IN.
- SCALE 0.0040 SCALE

MACH 3.48

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  RUDDER  REFERENCE INFORMATION
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(B71135)  MSFC TWT 944x LAUNCH VEHICLE STUDIES T902S1  0.000  0.023  0.000  0.000  SREF  0.0000 IN.
(B71135)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  SREF  0.2480 IN.

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SREF  7.8800 SQ.IN.
LREF  2.0280 IN.
BREF  4.4600 IN.
XHRP  3.3600 IN.
YMRP  0.0000 IN.
ZMRP  0.2480 IN.
SCALE  0.0040 SCALE

MACH  4.96
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORB INC  YS  ELEVTRA  Rudder  REFERENCE INFORMATION
(A71130)  NSFC TW 544X LAUNCH VEHICLE STUDIES T901S1  -1.800  0.023  0.000  0.000  BREF  9.6600 SQ.IN.
(A71132)  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.800  0.023  0.000  0.000  LREF  2.0860 IN.
(A71134)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  BREF  4.4600 IN.
(A71136)  NSFC TW 544X LAUNCH VEHICLE STUDIES T901S1  0.000  0.023  0.000  0.000  XMRP  3.8600 IN.
  ZMRP  0.0000 IN.
  SCALE  0.0040 SCALE

MACH  .60

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL | CONFIGURATION DESCRIPTION | ORBINC | YS | ELEVTR | RUDDER | REFERENCE INFORMATION
---|---|---|---|---|---|---
(A71130) | MSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 | -1.500 | 0.023 | 0.000 | 0.000 | SREF 7.8800 SQ. IN.
(A71132) | DATA NOT AVAILABLE FOR ALL CONDITIONS | -1.500 | 0.023 | 0.000 | 0.000 | LREF 2.0280 IN.
(A71134) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 0.000 | BREF 4.4600 IN.
(A71136) | MSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 | 0.000 | 0.023 | 0.000 | 0.000 | XRPN 3.3600 IN.
| | | | | | | YMRP 3.3600 IN.
| | | | | | | ZMRP 0.2480 IN.
| | | | | | | SCALE 0.0040 SCALE

MACH .80
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  RUDDER  REFERENCE INFORMATION
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(A71332)  DATA NOT AVAILABLE FOR ALL CONDITIONS  -1.500  0.023  0.000  0.000  LREF  8.0280  IN.
(A71341)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  BREF  4.4880  IN.
(A71333)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T90151  0.000  0.023  0.000  0.000  XMPR  3.3800  IN.

MACH .90  PAGE 247
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

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<tr>
<th>DATA SET SYMBOL</th>
<th>CONFIGURATION DESCRIPTION</th>
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<th>ELEVTR</th>
<th>RUGGER</th>
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MACH 1.10

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION

(A71130) MSFC TWT 944X LAUNCH VEHICLE STUDIES T901S1 ORBINC YS ELEVTR Rudder REFERENCE INFORMATION

(MACH 1.20)

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR Rudder REFERENCE INFORMATION
(A71130) DATA NOT AVAILABLE FOR ALL CONDITIONS -1.500 0.025 0.000 0.000 BREF 7.6000 SQ. IN.
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(A71134) HSFC TWT 544X LAUNCH VEHICLE STUDIES T90251 0.000 0.025 0.000 0.000 VREF 4.4800 IN.
(A71136) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.025 0.000 0.000 VMRP 3.3600 IN.

DATA NOT AVAILABLE FOR ALL CONDITIONS

MACH 1.45

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION

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MACH 1.95

PAGE 252
VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

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(AY1134) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 0.000 0.025 0.000 0.000 SREP 4.4900 IN.
(AY1136) Data Not Available For All Conditions 0.000 0.025 0.000 0.000 HRP 3.3600 IN.

MACH 3.48

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VARIATION OF ORBITER INCIDENCE FOR 312 IN. DIAMETER TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION
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MACH 4.96
EFFECT OF SRM ROCKET NOZZLES

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(BP1069)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1  0.000 0.023 0.000 0.000  BREF 7.8800 SQ. IN.
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(BP1117)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000 0.023 0.000 0.000  XREF 3.3800 IN.
(BP1117)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S6  0.000 0.023 0.000 0.000  YMRP 0.0000 IN.
           0.0000 IN.  0.0000 IN.  0.0000 IN.  0.0040 SCALE  0.0040 SCALE

MACH  .90
EFFECT OF SRM ROCKET NOZZLES

ANGLE OF ATTACK, ALPHA, DEGREES

FOREBODY AXIAL FORCE COEFFICIENT, CAF

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

(071099) MSFC TWT 544X LAUNCH VEHICLE STUDIES T501S1 0.000 0.023 0.000 0.000 SREF 7.6800 SQ.IN.

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(671117) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 XNRP 3.3600 IN.

MACH .90
EFFECT OF SRM ROCKET NOZZLES

ANGLE OF ATTACK, ALPHA, DEGREES

BASE AXIAL FORCE COEFFICIENT, CAB

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  RUDDER  REFERENCE INFORMATION

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071119  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  YHCP  0.0000  IN.

ZREF  0.0400  IN.

SCALE  0.0040  SCALE

MACH  .90

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EFFECT OF SRM ROCKET NOZZLES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

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(HSFC TWT 544X LAUNCH VEHICLE STUDIES T30156) 0.000 0.023 0.000 0.000 ZMRP 0.2400 IN.

SCALE 0.0040 SCALE

MACH 1.20

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EFFECT OF SRM ROCKET NOZZLES

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  RUDDER  REFERENCE INFORMATION
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BY1117  MSFC TWT 5443 LAUNCH VEHICLE STUDIES T30236  0.000  0.023  0.000  0.000  DREP  4.4600 IN.
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                     ZHRP  0.0000 IN.
                     SCLIE  0.0040 SCALE

MACH  1.46  PAGE 261
EFFECT OF SRM ROCKET NOZZLES

ANGLE OF ATTACK, ALPHA, DEGREES

PITCHING MOMENT COEFFICIENT, C\(M\)

DATA SET, SYMBOL  CONFIGURATION DESCRIPTION  OMBING  YS  ELEVTR  RUDDER  REFERENCE INFORMATION

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(07)097  NSFC TWT 544X LAUNCH VEHICLE STUDIES 130251  0.000  0.023  0.000  0.000  LREF 2.0280 IN.
(07)117  NSFC TWT 544X LAUNCH VEHICLE STUDIES 130256  0.000  0.023  0.000  0.000  BREF 4.4600 IN.
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THRP 0.0000 IN.
ZHBP 0.0240 IN.
SCALE 0.0040 SCALE

MACH 1.95
EFFECT OF SRM ROCKET NOZZLES

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

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(071009) NSFC TWT 944X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 0.000 0.000 BREF 7.6000 SQ. IN.
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 SCALE 0.0040 SCALE

MACH 1.20

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EFFECT OF SRM ROCKET NOZZLES

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

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(B71117) MSFC TWT 944% LAUNCH VEHICLE STUDIES T302S6 0.000 0.000 0.000 0.000 BREF 4.6000 IN.
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YMRP 0.0000 IN.
ZMRP 0.2480 IN.
SCALE 0.0040 SCALE

MACH 1.46
EFFECT OF SRM ROCKET NOZZLES

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

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(SY1119)  DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000  YNRP 0.0000 IN.

SCALE 0.0040 IN.

MACH 1.95

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EFFECT OF SRM ROCKET NOZZLES

AXIAL FORCE COEFFICIENT, CA

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  Rudder  REFERENCE INFORMATION
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                                         0.0000  IN.  ZMRP  0.2450  IN.
                                         SCALE  0.0040  SCALE

MACH  1.20

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EFFECT OF SRM ROCKET NOZZLES

ANGLE OF ATTACK, ALPHA, DEGREES

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(S57099) ○ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.005 0.023 0.000 0.000 LREF 7.8800 SQ. IN.
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(S571117) ○ MSFC TWT 44X LAUNCH VEHICLE STUDIES T30258 0.000 0.023 0.000 0.000 LREF 4,4600 IN.
(S71119) ○ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 3,3600 IN.

MACH 1.46  PAGE 267
EFFECT OF SRM ROCKET NOZZLES

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(871119)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  REF  4.4600 IN.

MACH 1.95

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EFFECT OF SRM ROCKET NOZZLES

ANGLE OF ATTACK, ALPHA, DEGREES

FOREBODY AXIAL FORCE COEFFICIENT, CAF

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REFERENCE INFORMATION

MACH 1.20

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EFFECT OF SRM ROCKET NOZZLES

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BY1117 DATA NOT AVAILABLE FOR ALL CONDITIONS
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ORBINC YS ELEVTR RUGGER REFERENCE INFORMATION
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0.000 0.023 0.000 0.000 XMRP 3.3600 IN.
0.000 0.023 0.000 0.000 YMRP 0.0000 IN.
0.000 0.023 0.000 0.000 ZMRP 0.2480 IN.
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MACH 1.46

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EFFECT OF SRM ROCKET NOZZLES

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                        HNRP  0.0000 IN.
                        ZHMP  0.2400 IN.
                        SCALE  0.0040 SCALE

MACH  1.95

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EFFECT OF SRM ROCKET NOZZLES

BASE AXIAL FORCE COEFFICIENT, CAB

ANGLE OF ATTACK, ALPHA, DEGREES

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(C21920) MSD 3.3600 IN.
(C21920) YMRP 0.2480 IN.
(C21920) ZMRP 0.0040 SCALE
MACH 1.20

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EFFECT OF SRM ROCKET NOZZLES

BASE AXIAL FORCE COEFFICIENT * CAB

ANGLE OF ATTACK, ALPHA, DEGREES

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(G71177) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30258 0.000 0.023 0.000 0.000 LREF 4.4800 IN.
(GY1119) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 XREF 3.3600 IN.
YHP 0.0000 IN.
2HAP 0.0440 IN.
SCALE 0.0040 SCALE

MACH 1.46

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EFFECT OF SRM ROCKET NOZZLES

DATA SET SYMBOL | CONFIGURATION DESCRIPTION | ORBINC | ELEVTR | RUGDER | REFERENCE INFORMATION
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(071117) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 0.000 | BREF 4.4600 IN.
(071119) | MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S8 | 0.000 | 0.023 | 0.000 | 0.000 | XHBP 3.3600 IN.
| | | | | | ZHBP 0.0000 IN.
| | | | | | SCALE 0.0040 SCALE

MACH .90

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EFFECT OF SRM ROCKET NOZZLES

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- MSFC TWT 544X LAUNCH VEHICLE STUDIES T30256 0.000 0.023 0.000 0.000 4.4600 IN.
- DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 3.3600 IN.
- SCALE 0.0040 SCALE

MACH 1.46

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EFFECT OF SRM ROCKET NOZZLES

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBITIC YS ELEVTR Rudder REFERENCE INFORMATION
(SF1099) □ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.8800 SQ. IN.
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(SF1101) △ MSFC TWT 544X LAUNCH VEHICLE STUDIES T30256 0.000 0.023 0.000 0.000 RREF 4.4600 IN.
(SF1119) □ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 XMRP 3.3600 IN.
THRP 0.0000 IN.
ZMRP 0.2480 IN.
SCALE 0.0040 SCALE

MACH 1.95 PAGE 278
DATA SET SYMBOL CONFIGURATION DESCRIPTION
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(AF1100) DATA NOT AVAILABLE FOR ALL CONDITIONS
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(AF1120) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30156

ORE INC V3 ELEVT Rudder REFERENCE INFORMATION
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0.000 0.023 0.000 0.000 LREF 2.0200 IN.
0.000 0.023 0.000 0.000 XMRP 3.3600 IN.
0.000 0.023 0.000 0.000 ZMRP 0.2400 IN.
SCALE 0.0040 SCALE

MACH .90
EFFECT OF SRM ROCKET NOZZLES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTN RUDDER REFERENCE INFORMATION
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(AY1002) MSFC TWT 944X LAUNCH VEHICLE STUDIES T30251 0.000 0.023 0.000 0.000 LREF 8.5400 IN.
(AY1111) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 4.4800 IN.
(AY1120) MSFC TWT 944X LAUNCH VEHICLE STUDIES T30156 0.000 0.023 0.000 0.000 LREF 3.3600 IN.

MACH 1.20
EFFECT OF SRM ROCKET NOZZLES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION

(A1090) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.8600 SQ. IN.

(A1092) MSFC TVT 544X LAUNCH VEHICLE STUDIES T30281 0.000 0.023 0.000 0.000 LREF 2.0840 IN.

(A1118) MSFC TVT 544X LAUNCH VEHICLE STUDIES T30296 0.000 0.023 0.000 0.000 XREF 4.4400 IN.

(A1120) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 XNRP 3.3500 IN.

MACH 1.46
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

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(E71099)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151  0.000  0.023  0.000  0.000  SREF  7.8500  80. IN.

(E71091)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  10.000  0.000  DRP  2.0250  IN.

(E71097)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151  0.000  0.023  10.000  0.000  SREF  4.4600  IN.

(E71103)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  10.000  0.000  YMP  3.8600  IN.

(E71101)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  -10.000  0.000  ZNP  0.2400  IN.

SCALE  0.0040  SCALE

MACH .60  PAGE 283
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, \( \alpha \), DEGREES

PITCHING MOMENT COEFFICIENT, \( C_{m} \)

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S71099 | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 10.000 | 0.000 | LREP 3.3600 IN.
S71103 | HSFC TWT 544X LAUNCH VEHICLE STUDIES T50151 | 0.000 | 0.023 | -10.000 | 0.000 | LREP 0.0000 IN.
S71101 | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | -10.000 | 0.000 | LREP 0.8400 IN.

SCALE 0.0040 SCALE

MACH .90

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

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SCALE  0.0040 SCALE

MACH  1.00

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, ALPHA, DEGREES

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MACH 1.10 PAGE 287
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, ALPHA, DEGREES

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MACH 1.46
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, ALPHA, DEGREES

PITCHING MOMENT COEFFICIENT, CLM

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

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MACH  3.48

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

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MACH 4.96

SCALE 0.0040 SCALE

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

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MACH .60

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, ALPHA, DEGREES

NORMAL FORCE COEFFICIENT, CN

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MACH .90

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, ALPHA, DEGREES

NORMAL FORCE COEFFICIENT, CN

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MACH 1.00

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

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MACH 1.10

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## EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

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MACH 1.95

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

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MACH 3.48

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

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MACH 4.96

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

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MACH  .80  PAGE 304
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

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SCALE 0.0040 SCALE

MACH .90

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACk, ALPHA, DEGREES

AXIAL FORCE COEFFICIENT, CA

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MACH 1.00  PAGE 306
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

MACH 1.10

DATA SET SYMBOL CONFIGURATION DESCRIPTION

REFERENCE INFORMATION

SCALE 0.0040 SCALE
### Effect of Orbiter Elevons at Zero Orbiter Incidence

#### Data Set Symbol | Configuration Description | Orbinc | Ts | Elevtr | Rudder | Reference Information
---|---|---|---|---|---|---
544X LAUNCH VEHICLE STUDIES T30251 | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 0.000 | SREF 2.0280 IN.
544X LAUNCH VEHICLE STUDIES T30251 | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 10.000 | 0.000 | LREF 4.4600 IN.
544X LAUNCH VEHICLE STUDIES T30251 | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | -10.000 | 0.000 | XHRP 3.5600 IN.
544X LAUNCH VEHICLE STUDIES T30251 | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | -10.000 | 0.000 | YHRP 0.0050 IN.
544X LAUNCH VEHICLE STUDIES T30251 | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | -10.000 | 0.000 | ZHRP 0.8460 IN.

**Mach**: 1.46

**Page**: 309
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

AXIAL FORCE COEFFICIENT, CA

ANGLE OF ATTACK, ALPHA, DEGREES

MACH 1.95

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### EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

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<th>Rudder</th>
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**MACH** 3.48

**PAGE** 311
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

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(B71095) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.8800 SQ. IN.
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SCALE 0.0040 SCALE

MACH 4.96
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

MACH .60 PAGE 313
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(B71008) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 10.000 0.000 BREF 4.4600 IN.
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SCALE 0.0040 SCALE

MACH .80

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EFFECT OF ORBITER ELEVATION AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL

COIFIGURATION

DESCRIPTION

(LAUNCH VELOCITY)

DATA NOT AVAILABLE FOR ALL CONDITIONS

STUDIES

CONDITION

ANGLE OF ATTACK, ALPHA, DEGREES

REFERENCE INFORMATION

SCALE

MACH .90

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FOREBODY AXIAL FORCE COEFFICIENT, CF

EFFECT OF ORBITER ELEVATIONS AT ZERO ORBITER INCIDENCE
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

FOREBODY AXIAL FORCE COEFFICIENT, CAF

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORIGIN TS ELEVTR RUDDER REFERENCE INFORMATION
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(MSFC TWT 94X LAUNCH VEHICLE STUDIES T30151) 0.000 0.023 -10.000 0.000 ZHSP 0.0400 IN.
SCALE 0.0040 SCALE

MACH 1.00

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL

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SCALE 0.0040 SCALE

MACH 1.10
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, ALPHA, DEGREES

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SCALE 0.0040 SCALE

MACH 1.20 PAGE 318
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, ALPHA, DEGREES

FOREBODY AXIAL FORCE COEFFICIENT, CA

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUGGER REFERENCE INFORMATION

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REFERENCE INFORMATION
SREF 0.0040 SCALE

MACH 1.46

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

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ORBINC YS ELEV Rudder REFERENCE INFORMATION
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0.000 0.023 -10.000 0.000 YMRP 0.0000 IN.
0.000 0.023 -10.000 0.000 ZMRP 0.2480 IN.

SCALE 0.0040 SCALE

MACH 1.95
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

FOREBODY AXIAL FORCE COEFFICIENT, CAF

ANGLE OF ATTACK, ALPHA, DEGREES

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 SCALE 0.0040 SCALE

MACH 3.48

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

FOREBODY AXIAL FORCE COEFFICIENT, CAF

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC TS ELEVTR RUDDER REFERENCE INFORMATION

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MACH 4.96

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

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MACH .60

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

BASE AXIAL FORCE COEFFICIENT, Cₐₐₐₐ

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBLINC YS ELEVTR RUDDER REFERENCE INFORMATION

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BY11011 DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 YMRP 0.0000 IN.

SCALE 0.0040 SCALE

MACH .80

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

BASE AXIAL FORCE COEFFICIENT, CAB

ANGLE OF ATTACK, ALPHA, DEGREES

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MACH  .90

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

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SCALE 0.0040 SCALE

MACH 1.00

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

BASE AXIAL FORCE COEFFICIENT, CAB

ANGLE OF ATTACK, ALPHA, DEGREES

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SCALE 0.0040 SCALE

MACH 1.10

REFERENCE INFORMATION
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LREF 2.0800 IN.
BREF 4.4600 IN.
XHREF 3.3600 IN.
YHREF 0.0000 IN.
ZHREF 0.2480 IN.
SCALE 0.0040 SCALE

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
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(B71103) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30281 0.000 0.023 10.000 0.000 YMRP 0.06000 IN.
(B71101) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30281 0.000 0.023 -10.000 0.000 ZMRP 0.06000 IN.
                   SCALE 0.00040 SCALE

MACH 1.20
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

BASE AXIAL FORCE COEFFICIENT, CAB

ANGLE OF ATTACK, ALPHA, DEGREES

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  SCALE  0.0000  IN.

MACH  1.46

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

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MACH 1.95

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

BASE AXIAL FORCE COEFFICIENT, CAB

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION

MACH 4.96
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

PITCHING MOMENT COEFFICIENT, CLM

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(BY1095) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 XNRP 3.3600 IN.
(BY1103) MSFC TWT 544X LAUNCH VEHICLE STUDIES T00181 0.000 0.023 -10.000 0.000 YNRP 0.0000 IN.
(BY1101) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 ZNRP 0.0440 IN.
SCALE 0.0040 SCALE

MACH .60

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORINC  VS  ELEVTR  RUDDER  REFERENCE INFORMATION
(SPF109S)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1  0.000  0.025  0.000  0.000  BREF  7.8800  SQ.IN.
(SPF109S)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.025  0.000  0.000  LREF  2.0280  IN.
(SPF109S)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1  0.000  0.025  10.000  0.000  BREF  4.4600  IN.
(SPF109S)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.025  10.000  0.000  XHRP  3.3600  IN.
(SPF109S)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1  0.000  0.025  -10.000  0.000  YHRP  0.0000  IN.
(SPF109S)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.025  -10.000  0.000  ZHRP  0.2480  IN.

SCALE  0.0040  SCALE

MACH .80  PAGE 334
### Effect of Orbiter Elevons at Zero Orbiter Incidence

#### Pitching Moment Coefficient, CLM

- **Data Set Symbol**: Configuration Description
- **Orbinc**: 0.000 0.023 0.000 0.000
- **Elevtr**: 0.000 0.023 0.000 0.000
- **Rudder**: -10.000 -10.000
- **Reference Information**:
  - **T.8600**: 4.4600 IN.
  - **Z.8600**: 3.5600 IN.
  - **Z.8600**: 3.5600 IN.
  - **Scale**: 0.0040 SCALE

- **Mach**: 0.90

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**NORMAL FORCE COEFFICIENT, CN**

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR Rudder REFERENCE INFORMATION
(D71099) NSFC TWI 544X LAUNCH VEHICLE STUDIES T30181 0.000 0.023 0.000 0.000 BREP 7.8800 SQ.IN.
(D71097) NSFC TWI 544X LAUNCH VEHICLE STUDIES T30181 0.000 0.023 10.000 0.000 LREP 2.0280 IN.
(D71098) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 XMRP 3.3600 IN.
(D71103) NSFC TWI 544X LAUNCH VEHICLE STUDIES T30181 0.000 0.023 -10.000 0.000 YMRP 0.2480 IN.
(D71101) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 ZMRP 0.0000 SCALE 0.0040 SCALE

MACH 1.00

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

-1.2 -1.1 -1.0 -0.9 -0.8 -0.7 -0.6 -0.5 -0.4 -0.3 -0.2 -0.1 0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
NORMAL FORCE COEFFICIENT, CN

-1.2 -1.1 -1.0 -0.9 -0.8 -0.7 -0.6 -0.5 -0.4 -0.3 -0.2 -0.1 0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION
(D71099) MSFC TWT 944X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 0.000 0.000 SREF 7.8600 SQ. IN.
(D71097) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 DREF 4.4600 IN.
(D71099) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 WREF 3.3600 IN.
(D71103) MSFC TWT 944X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 -10.000 0.000 XMRP 0.0000 IN.
(D71101) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 ZMRP 0.0000 IN.
SCALE 0.0040 SCALE

MACH 1.10

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC YS  ELEVTR RUDDER  REFERENCE INFORMATION
(B71095)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151  0.000  0.023  0.000  0.000  SREF  7.8800 SQ.IN.
(B71095)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251  0.000  0.023  0.000  0.000  LREF  2.0260 IN.
(B71095)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T30351  0.000  0.023  10.000  0.000  XREF  4.4800 IN.
(B71095)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T30451  0.000  0.023  10.000  0.000  YREF  3.9600 IN.
(B71095)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T30551  0.000  0.023 -10.000  0.000  ZREF  0.0000 IN.
(B71095)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T30651  0.000  0.023 -10.000  0.000  SCALE  0.0040 SCALE

MACH 1.20

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(SY1099) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.6800 56.0 IN.
(SY1091) MSFC TWT 944X LAUNCH VEHICLE STUDIES T302/51 0.000 0.023 10.000 0.000 LREF 5.0800 IN.
(SY1097) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 BREF 4.4800 IN.
(SY1093) MSFC TWT 944X LAUNCH VEHICLE STUDIES T302/51 0.000 0.023 10.000 0.000 XHPP 3.3600 IN.
(SY1101) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 YHPP 0.0000 IN.
(SY1001) MSFC TWT 944X LAUNCH VEHICLE STUDIES T302/51 0.000 0.023 -10.000 0.000 ZHPP 0.2480 IN.
SCALE 0.0040 SCALE

MACH 1.46
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(BY1099) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREP 7.8000 30."
(BY1081) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251 0.000 0.023 0.000 0.000 LREP 2.0280 IN.
(BY1097) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 SREP 4.4800 IN.
(BY1095) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251 0.000 0.023 10.000 0.000 LREP 2.0280 IN.
(BY1103) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 SREP 3.3600 IN.
(BY1101) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251 0.000 0.023 -10.000 0.000 LREP 0.2480 IN.

REFERENCE INFORMATION

SREF 7.8000 30."
LREP 2.0280 IN.
SREP 4.4800 IN.
LREP 2.0280 IN.
SREP 3.3600 IN.
LREP 0.2480 IN.
SCALE 0.0040 SCALE

MACH 1.95

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCINCF

PITCHING MOMENT COEFFICIENT, CLM

NORMAL FORCE COEFFICIENT, CN

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC TS ELEVTR RUDDER REFERENCE INFORMATION
(SF1099) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.8800 SQ.IN.
(SF1091) MSFC TWT 344X LAUNCH VEHICLE STUDIES T302S1 0.000 0.023 0.000 0.000 LREF 2.0280 IN.
(SF1097) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 XREF 4.4600 IN.
(SF1099) MSFC TWT 344X LAUNCH VEHICLE STUDIES T302S1 0.000 0.023 -10.000 0.000 YMRP 5.3600 IN.
(SF1102) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 ZMRP 0.0000 IN.
(SF1101) MSFC TWT 344X LAUNCH VEHICLE STUDIES T302S1 0.000 0.023 -10.000 0.000 SCALE 0.0040 SCALE

MACH 3.48
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET, SYMBOL (os71089)
8(71097)
(871099)

PITCHING MOMENT COEFFICIENT, CLM

DATA NOT AVAILABLE FOR ALL CONDITIONS
MSFC TWT 544X LAUNCH VEHICLE STUDIES T302S
MSFC TWT 544X LAUNCH VEHICLE STUDIES T302S
DATA NOT AVAILABLE FOR ALL CONDITIONS

REFERENCE INFORMATION
SREF 2.8800 IN.
LREF 2.0280 IN.
BREF 3.3600 IN.
XNRP 0.0000 IN.
YMRP 0.0000 IN.
ZMRP 0.2480 IN.
SCALE 0.0040 SCALE

MACH 4.96
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUGGER REFERENCE INFORMATION
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(M71092) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 2.0280 IN.
(M71099) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 10.000 0.000 BREF 4.4600 IN.
(M71103) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 LREF 2.0280 IN.
(M71104) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 -10.000 0.000 XHRP 3.3600 IN.
(M71102) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 YHRP 0.0000 IN.
REFERENCE INFORMATION
SCALE 0.0040 SCALE

MACH .60  PAGE 343
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(A71090) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151
(A71092) DATA NOT AVAILABLE FOR ALL CONDITIONS
(A71098) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151
(A71100) DATA NOT AVAILABLE FOR ALL CONDITIONS
(A71102) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151
(A71104) DATA NOT AVAILABLE FOR ALL CONDITIONS

ORBINC YS ELEVT Rudder REFERENCE INFORMATION
0.000 0.023 0.000 0.000 SREF 7.8600 SQ.IN.
0.000 0.023 10.000 0.000 LREF 2.0280 IN.
0.000 0.023 10.000 0.000 XMRP 3.3600 IN.
0.000 0.023 -10.000 0.000 YMRP 0.0000 IN.
0.000 0.023 -10.000 0.000 ZMRP 0.2480 IN.
SCALE 0.0040 SCALE

MACH .80

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL | CONFIGURATION DESCRIPTION | ORBINC | VS | ELEVTR | RUDDER | REFERENCE INFORMATION  
(AY1090) | MSFC TWT 344X LAUNCH VEHICLE STUDIES T30151 | 0.000 | 0.023 | 0.000 | 0.000 | SREF 7.8800 IN.  
(AY1092) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 0.000 | LREF 2.0000 IN.  
(AY1093) | MSFC TWT 344X LAUNCH VEHICLE STUDIES T30151 | 0.000 | 0.023 | 10.000 | 0.000 | BREF 4.4600 IN.  
(AY1094) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 0.000 | XREF 3.3600 IN.  
(AY1095) | MSFC TWT 344X LAUNCH VEHICLE STUDIES T30151 | 0.000 | 0.023 | -10.000 | 0.000 | YREF 0.0000 IN.  
(AY1096) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 0.000 | ZREF 0.2480 IN.  

SCALE 0.0040 SCALE  

MACH .90  

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  RUDDER  REFERENCE INFORMATION
(A71090)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T501S1  0.000  0.023  0.000  0.000  SREF  7.6800  58. IN.
(A71092)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  10.000  0.000  LREF  2.0290  1N.
(A71093)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T501S1  0.000  0.023  10.000  0.000  SREF  3.3600  1N.
(A71094)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  -10.000  0.000  XMRP  0.0000  1N.
(A71095)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T501S1  0.000  0.023  -10.000  0.000  ZMRP  0.2460  1N.
(A71100)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  -10.000  0.000  SCALE  0.0040  SCALE

MACH  1.00

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(AF1090) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 DATA NOT AVAILABLE FOR ALL CONDITIONS
(AF1092) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 DATA NOT AVAILABLE FOR ALL CONDITIONS
(AF1100) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 DATA NOT AVAILABLE FOR ALL CONDITIONS
(AF1102) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 DATA NOT AVAILABLE FOR ALL CONDITIONS

MACH 1.10
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  VS  ELEVR  Rudder  REFERENCE INFORMATION
(A71090)  NSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1  0.000  0.023  0.000  0.000  BREF  7.0000 SQ.IN.
(A71092)  NSFC TWT 544X LAUNCH VEHICLE STUDIES T302S1  0.000  0.023  0.000  0.000  LREF  2.0280 IN.
(A71099)  NSFC TWT 544X LAUNCH VEHICLE STUDIES T303S1  0.000  0.023  10.000  0.000  BREF  4.4000 IN.
(A11004)  NSFC TWT 544X LAUNCH VEHICLE STUDIES T304S1  0.000  0.023  10.000  0.000  LREF  5.3600 IN.
(A11004)  NSFC TWT 544X LAUNCH VEHICLE STUDIES T304S1  0.000  0.023  10.000  0.000  LREF  5.3600 IN.
(A11004)  NSFC TWT 544X LAUNCH VEHICLE STUDIES T304S1  0.000  0.023  0.000  0.000  BREF  2.0280 IN.

SCALE  0.0040 SCALE

MACH  1.20
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL: CONFIGURATION DESCRIPTION:

(A71090) DATA NOT AVAILABLE FOR ALL CONDITIONS
(A71092) MSFC TWT 944X LAUNCH VEHICLE STUDIES T302S1
(A71094) DATA NOT AVAILABLE FOR ALL CONDITIONS
(A71100) MSFC TWT 944X LAUNCH VEHICLE STUDIES T302S1
(A71102) DATA NOT AVAILABLE FOR ALL CONDITIONS
(A71104) MSFC TWT 944X LAUNCH VEHICLE STUDIES T302S1

MACH 3.48

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVT  Rudder  Reference Information
(AP1100)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  SLFP  7.6800 SQ. IN.
(AP1100)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251  0.000  0.023  0.000  0.000  SLFP  2.0280 IN.
(AP1100)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  10.000  0.000  XHFP  3.3600 IN.
(AP1100)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251  0.000  0.023  10.000  0.000  XHFP  3.3600 IN.
(AP1100)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  -10.000  0.000  XMFP  0.2480 IN.
(AP1100)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251  0.000  0.023  -10.000  0.000  XMFP  0.2480 IN.

SCALE  0.0010 SCALE

MACH  4.96
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC Y3 ELEVTR RUDDER REFERENCE INFORMATION

(M1090) MSFC TWT 344X LAUNCH VEHICLE STUDIES T30181 0.000 0.023 0.000 0.000 SREF 7.8600 SQ.IN.

(M1091) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 2.0280 IN.

(M1092) MSFC TWT 344X LAUNCH VEHICLE STUDIES T30181 0.000 0.023 10.000 0.000 BREF 4.4800 IN.

(M1093) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 XREF 3.3600 IN.

(M1094) MSFC TWT 344X LAUNCH VEHICLE STUDIES T30181 0.000 0.023 -10.000 0.000 YMRH 0.0000 IN.

(M1095) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 ZMRH 0.2480 IN.

SCALE 0.0040 SCALE

MACH 0.60

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORDERING TO ELEVTR RUDDER REFERENCE INFORMATION

(A7109) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 0.000 0.000 SREF 7.8800 SQ. IN.

(A71092) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 2.0280 IN.

(A71108) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 10.000 0.000 BREF 4.4600 IN.

(A71102) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 XMPR 3.3600 IN.

(A71104) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 10.000 0.000 YMPR 0.0000 IN.

(A71102) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 ZMPR 0.2480 IN.

SCALE 0.0040 SCALE

MACH .80

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVR  Rudder  Reference Information
(A71090)         NSC TWT 944X LAUNCH VEHICLE STUDIES  T90151  0.000  0.023  0.000  0.000  SRIF  7.8000  50.15
(A71092)         DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  LREF  5.0250  IN.
(A71106)         NSC TWT 944X LAUNCH VEHICLE STUDIES  T90151  0.000  0.023  10.000  0.000  SREF  4.4800  IN.
(A71108)         DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  10.000  0.000  SREF  3.2600  IN.
(A71104)         NSC TWT 944X LAUNCH VEHICLE STUDIES  T90151  0.000  0.023  -10.000  0.000  YHPR  0.0000  IN.
(A71102)         DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  -10.000  0.000  ZHPR  0.2440  IN.

SCALE  0.0040 SCALE

MACH .90

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(A71090) MSFC TWT 944X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 0.000 0.000 SREF 7.6800 50.000 IN.
(A710902) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 2.0280 IN.
(A710998) MSFC TWT 944X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 10.000 0.000 SREF 7.6800 50.000 IN.
(A711001) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 LREF 2.0280 IN.
(A711041) MSFC TWT 944X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 -10.000 0.000 SREF 7.6800 50.000 IN.
(A711021) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 LREF 2.0280 IN.

SCALE 0.0040 SCALE

MACH 1.00
EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION

(A71090) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151
(A71092) DATA NOT AVAILABLE FOR ALL CONDITIONS

MACH 1.10

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL | CONFIGURATION DESCRIPTION | ORBINC | VS | ELEVTR | RUDDER | REFERENCE INFORMATION
-----------------|--------------------------|--------|-----|--------|--------|-------------------
(AI1099)         | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000  | 0.023 | 0.000  | 0.000  | SREF 7.6600 IN.
(AI10991)        | MSFC TWT 544X LAUNCH VEHICLE STUDIES T302S1 | 0.000  | 0.023 | 10.000 | 0.000  | LREF 2.0200 IN.
(AI10981)        | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000  | 0.023 | 10.000 | 0.000  | XREF 3.3600 IN.
(AI11021)        | MSFC TWT 544X LAUNCH VEHICLE STUDIES T302S1 | 0.000  | 0.023 | -10.000| 0.000  | YMRP 0.0000 IN.
(AI11041)        | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000  | 0.023 | -10.000| 0.000  | ZMRP 0.2400 IN.
(AI11021)        | MSFC TWT 544X LAUNCH VEHICLE STUDIES T302S1 | 0.000  | 0.023 | -10.000| 0.000  | SCALE 0.0040 SCALE

MACH 1.46

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR Rudder REFERENCE INFORMATION
(A71090) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251 0.000 0.023 0.000 0.000 SREF 7.0000 SQ. IN.
(A71092) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 2.0220 IN.
(A71101) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 LREF 4.4800 IN.
(A71102) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 LREF 3.3600 IN.
(A71103) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251 0.000 0.023 0.000 0.000 YMRP 0.0000 IN.
(A71104) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 YMRP 0.2400 IN.
(A71105) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 YMRP 0.2400 IN.

SCALE 0.0040 SCALE

MACH 1.95

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EFFECT OF ORBITER ELEVONS AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR Rudder REFERENCE INFORMATION
(MY1092) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 SREF 7.6600 SQ. IN.
(MY1098) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251 0.000 0.000 0.000 LREF 2.0280 IN.
(MY1104) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 XMRP 3.3400 IN.
(MY1102) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251 0.000 0.000 0.000 YMRP 0.0000 IN.

MACH 3.48

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EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC YS ELEVTR RUGDER  REFERENCE INFORMATION
(Y1135)  NSFC TWT 544X LAUNCH VEHICLE STUDIES T90181  0.000 0.023 0.000 0.000 SREF 7.6600 50. IN.
(Y1135)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000 0.023 0.000 0.000 LREF 2.0280 IN.
(Y1135)  NSFC TWT 544X LAUNCH VEHICLE STUDIES T90181  0.000 0.023 10.000 0.000 BREF 4.4800 IN.
(Y1145)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000 0.023 -10.000 0.000 XHRP 3.3000 IN.
(Y1145)  NSFC TWT 544X LAUNCH VEHICLE STUDIES T90181  0.000 0.023 -10.000 0.000 YHRP 0.0000 IN.
(Y1145)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000 0.023 -10.000 0.000 ZHRP 0.2460 IN.

SCALE 0.0040 SCALE

MACH .60

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### Effect of Orbiter Elevons with 312 in. Ho Tank

#### Data Set Symbol Configuration Description

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<th>Symbol</th>
<th>Configuration Description</th>
<th>ORINC</th>
<th>YS</th>
<th>ELEVTR</th>
<th>RUDDER</th>
<th>REFERENCE INFORMATION</th>
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<td>YMRP 0.0000 in.</td>
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<td>ZMMP 0.2400 in.</td>
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### Mach

Mach = 0.90

---

**Note:** The diagram shows the relationship between the pitching moment coefficient and the angle of attack for different configurations of the Orbiter Elevons. The data is presented in the table format above, detailing the configurations and their corresponding reference information.
EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

MACH 1.20

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EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION          ORBINC VS ELEV TRUDE REFERENCE INFORMATION
(D91135) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.8800 SQ.IN.
(811133) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 10.000 0.000 LREF 2.0280 IN.
(811143) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 XREF 4.4600 IN.
(871143) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 -10.000 0.000 YMRP 5.3600 IN.
(871147) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 ZMRP 0.0000 IN.
(MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 -10.000 0.000 SCALE 0.0040 SCALE

MACH 1.95
EFFECT OF ORBITER ELEVONS WITH 312 IN. H0 TANK

PITCHING MOMENT COEFFICIENT, CLM

ANGLE OF ATTACK, ALPHA, DEGREES

MACH 3.48

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### EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

#### Chart Description
- **Angle of Attack, Alpha, Degrees**
- **Pitching Moment Coefficient, CLM**

#### Data Table
<table>
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<tr>
<th>Data Set Symbol</th>
<th>Configuration Description</th>
<th>Orbinc vs</th>
<th>Elev Ctr</th>
<th>Rudder</th>
<th>Reference Information</th>
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<tbody>
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<td>0.000</td>
<td>ZNRP 0.2400 IN.</td>
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#### Additional Information
- **Mach 4.96**
- **Page 369**
EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

<table>
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<th>DATA SET SYMBOL</th>
<th>CONFIGURATION DESCRIPTION</th>
<th>ORBITC</th>
<th>YS</th>
<th>ELEVTR</th>
<th>Rudder</th>
<th>REFERENCE INFORMATION</th>
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MACH .60

REFERENCE INFORMATION

| SREF 7.800 SQ. IN. |
| LREF 2.0280 IN. |
| BREF 4.4600 IN. |
| XHRP 3.3600 IN. |
| YMRP 0.0000 IN. |
| ZMRP 0.2460 IN. |

SCALE 0.0040 SCALE
EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

![Graph showing the effect of orbiter elevons with 312 in. ho tank. The graph plots the normal force coefficient (CN) against the angle of attack (α) in degrees. The data points are labeled with different symbols and are accompanied by configuration and data set information, including orbital trim (Ys), elevator (ELEV), rudder (RUDDER), reference information (REF), and scale (SCALE).]

DATA SET SYMBOL | CONFIGURATION DESCRIPTION | ORBITAL TRIM (Ys) | ELEVATOR (ELEV) | RUDDER (RUDDER) | REFERENCE INFORMATION
--- | --- | --- | --- | --- | ---
(871135) | MSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 | 0.000 | 0.023 | 0.000 | 0.000 | SREF: 7.8800 IN.
(871135) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 10.000 | 0.000 | SREF: 4.8200 IN.
(871135) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | -10.000 | 0.000 | SREF: 3.3600 IN.
(871135) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 0.000 | SREF: 0.0000 IN.
(871145) | MSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 | 0.000 | 0.023 | -10.000 | 0.000 | SREF: 0.0000 IN.
(871145) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 0.000 | SREF: 0.0000 IN.
(871145) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 0.000 | SREF: 0.0000 IN.
(871145) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 0.000 | SREF: 0.0000 IN.

SCALE: 0.0040
EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL | CONFIGURATION DESCRIPTION | ORBINC | VS | ELEV | Rudder | REFERENCE INFORMATION
(071153) | HSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 | 0.000 | 0.000 | 0.000 | 0.000 | SREF 7.0000 56.0000
(071133) | HSFC TWT 544X LAUNCH VEHICLE STUDIES T90231 | 0.000 | 0.000 | 0.000 | 0.000 | LREF 2.0280 0.0000
(071143) | HSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 | 0.000 | 0.000 | 10.000 | 0.000 | XREF 4.4800 0.0000
(071143) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.000 | 0.000 | 0.000 | YHFRP 3.3600 0.0000
(071143) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.000 | -10.000 | 0.000 | ZHFRP 0.5400 0.0000
(071147) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.000 | -10.000 | 0.000 | SCALE 0.0400 - SCALE

MACH 1.20

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EFFECT OF ORBITER ELEVONS WITH 312 IN. HR TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(D) 0.000 0.023 0.000 0.000 SREP 7.6600 SQ. IN.
(D) 0.000 0.023 0.000 0.000 LREF 2.0800 IN.
(D) 0.000 0.023 10.000 0.000 BREF 4.4600 IN.
(D) 0.000 0.023 -10.000 0.000 YNRP 0.0000 IN.
(D) 0.000 0.023 -10.000 0.000 ZNRP 0.2460 IN.

SCALE 0.0000 SCALE

MACH 1.46
### Data Set Symbol Configuration Description

| DS7133 | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.000 | 0.000 | 0.000 | SREF: 7.6800 SQ. IN. |
| DS7135 | MSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 | 0.000 | 0.000 | 0.000 | 0.000 | LREF: 2.0800 IN. |
| DS7143 | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.000 | 10.000 | 0.000 | HREF: 3.8600 IN. |
| DS7145 | MSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 | 0.000 | 0.000 | 10.000 | 0.000 | XMRP: 0.0000 IN. |
| DS7147 | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.000 | 0.000 | 0.000 | ZHRP: 0.2480 IN. |
| MSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 | 0.000 | 0.000 | -10.000 | 0.000 | SCALE: 0.0040 SCALE |

### Reference Information
- **MACH**: 1.95

**Page**: 374
EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

ANGLE OF ATTACK, ALPHA, DEGREES

NORMAL FORCE COEFFICIENT, CN

MACH 3.48  PAGE 375
EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL | CONFIGURATION DESCRIPTION | ORBINC | YELEV | RUDDER | REFERENCE INFORMATION
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(D71138) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | SREF 7.8800 SQ.IN.
(B71138) | NSFC TWT 944X LAUNCH VEHICLE STUDIES T90281 | 0.000 | 0.023 | 10.000 | LREF 2.0840 IN.
(B71143) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | SREF 7.8800 SQ.IN.
(B71143) | NSFC TWT 944X LAUNCH VEHICLE STUDIES T90281 | 0.000 | 0.023 | 10.000 | LREF 2.0840 IN.
(B71143) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | -10.000 | SREF 7.8800 SQ.IN.
(B71143) | NSFC TWT 944X LAUNCH VEHICLE STUDIES T90281 | 0.000 | 0.023 | -10.000 | LREF 2.0840 IN.

MACH 4.96

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EFFECT OF ORBITER ELEVONS WITH 312 IN. H0 TANK

AXIAL FORCE COEFFICIENT, CA

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUGGER REFERENCE INFORMATION

(SY1133) HSFC TWT 544K LAUNCH VEHICLE STUDIES T90181 0.000 0.023 0.000 0.000 SREP 9.6800 80.1MH.

(SY1143) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREP 2.0280 IN.

(SY1141) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREP 4.4600 IN.

(SY1145) HSFC TWT 544K LAUNCH VEHICLE STUDIES T90181 0.000 0.023 0.000 0.000 SREP 3.3600 IN.

(SY1147) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 SREP 0.2400 IN.

SCALE 0.0040 SCALE

MACH .60

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EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

CONFIGURATION DESCRIPTION

HSFC TWT 544X LAUNCH VEHICLE DATA

REFERENCE INFORMATION
SREF 7.8800 SQ.IN.
LREF 2.0280 IN.
XREF 4.4600 IN.
XHPR 3.3600 IN.
YMRR 0.0280 IN.
ZMRR 0.2480 IN.
SCALE 0.0040 IN.

MACH .90
EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

AXIAL FORCE COEFFICIENT, CA

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(D11135) MSFC TWT 944X LAUNCH VEHICLE STUDIES TS0181 0.000 0.023 0.000 0.000 BREP 7.6000 SQ. IN.
(D71135) MSFC TWT 944X LAUNCH VEHICLE STUDIES TS0281 0.000 0.023 0.000 0.000 LREP 2.0000 IN.
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(D71145) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 YHRR 3.3600 IN.
(D71147) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 ZHRR 0.2480 IN.
SCALC: 0.0040 SCALE

MACH 1.20

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EFFECT OF ORBITER ELEVONS WITH 312 IN. 40 TANK

ANGLE OF ATTACK, ALPHA, DEGREES

AXIAL FORCE COEFFICIENT, CA

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUGDER REFERENCE INFORMATION

(M71133) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.8900 SQ. IN.

(M71134) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 0.000 0.000 LREF 2.0280 IN.

(M71141) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 10.000 0.000 XHRP 3.5800 IN.

(M71145) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 YHRP 0.0000 IN.

(M71147) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 -10.000 0.000 ZHRP 0.2450 IN.

SCALE 0.0040 SCALE

MACH 1.46

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EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC YS ELEVTR RUDDER  REFERENCE INFORMATION
(DT1155)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000 0.025 0.000 0.000  SREF 7.6800 SQ. IN.
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(DT1143)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000 0.025 10.000 0.000  BREF 4.4600 IN.
(DT1141)  MSFC TWT 544X LAUNCH VEHICLE STUDIES 790251  0.000 0.025 -10.000 0.000  XNRP 3.3600 IN.
(DT1145)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000 0.025 -10.000 0.000  ZNRP 0.2460 IN.
(DT1147)  MSFC TWT 544X LAUNCH VEHICLE STUDIES 790251  0.000 0.025 -10.000 0.000  SCALE 0.0040 SCALE

MACH 1.95

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EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

DATA SET SYMBOL          CONFIGURATION DESCRIPTION          ORINCE VS ELEVTU RUDDER REFERENCE INFORMATION  
(Q)135)                    DATA NOT AVAILABLE FOR ALL CONDITIONS      0.000 0.023 0.000 0.000 SREF T.8800 SQ.IN.  
(B)133)                    M&PC TWX 544X LAUNCH VEHICLE STUDIES  T90231      0.000 0.023 0.000 0.000 LREF 5.0200 IN.  
(R)143)                    DATA NOT AVAILABLE FOR ALL CONDITIONS      0.000 0.023 10.000 0.000 SREF 4.4400 IN.  
(R)141)                    M&PC TWX 544X LAUNCH VEHICLE STUDIES  T90231      0.000 0.023 10.000 0.000 XMRP 3.3800 IN.  
(R)145)                    DATA NOT AVAILABLE FOR ALL CONDITIONS      0.000 0.023 -10.000 0.000 XMRP 0.0000 IN.  
(R)147)                    M&PC TWX 544X LAUNCH VEHICLE STUDIES  T90231      0.000 0.023 -10.000 0.000 ZMRP 0.3400 IN.  

SCALE 0.0040 SCALE
EFFECT OF ORBITER ELEVONS WITH 312 IN. H0 TANK

ANGLE OF ATTACK, ALPHA, DEGREES

AXIAL FORCE COEFFICIENT, CA

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(071148) MSFC TWT 944X LAUNCH VEHICLE STUDIES T902S1 0.000 0.023 0.000 0.000 LREF 2.0200 1H.

(071149) MSFC TWT 944X LAUNCH VEHICLE STUDIES T902S1 0.000 0.023 10.000 0.000 MREF 4.4800 1H.

(071149) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 NREF 3.3600 1H.

(071149) MSFC TWT 944X LAUNCH VEHICLE STUDIES T902S1 0.000 0.023 -10.000 0.000 XREF 0.0000 1H.

(071149) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 YREF 0.0000 1H.

SCALE 0.0040 SCALE

MACH 4.96 PAGE 383
EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

ANGLE OF ATTACK, ALPHA, DEGREES

FOREBODY AXIAL FORCE COEFFICIENT, CAJ

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUGDER REFERENCE INFORMATION

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(071147) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 ZHLP 0.2400 IN.
SCALE 0.0040 SCALE

MACH .60

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EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

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(DP7130)  MSFC TWT 344X Launch Vehicle Studies 890181  0.000  0.023  0.000  0.000  SREF  7.6800  30. IN.
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(DP7143)  MSFC TWT 344X Launch Vehicle Studies 890181  0.000  0.023  10.000  0.000  SREF  4.4500  IN.
(DP7144)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  10.000  0.000  LREF  3.3500  IN.
(DP7145)  MSFC TWT 344X Launch Vehicle Studies 890181  0.000  0.023  -10.000  0.000  YMPR  0.0000  IN.
(DP7147)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  -10.000  0.000  ZMPR  0.2480  IN.

MACH  .90  SCALE  0.0040

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EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  TS  ELEVTR  Rudder  REF  SREF  SCALE
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(B71138)  MSFC TWT  544X LAUNCH VEHICLE STUDIES  T90251  0.000  0.023  0.000  0.000  0.000  0.000  0.000  0.000
(B71143)  MSFC TWT  544X LAUNCH VEHICLE STUDIES  T90151  0.000  0.023  10.000  0.000  0.000  0.000  0.000  0.000
(B71141)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  10.000  0.000  0.000  0.000  0.000  0.000
(B71145)  MSFC TWT  544X LAUNCH VEHICLE STUDIES  T90151  0.000  0.023  -10.000  0.000  0.000  0.000  0.000  0.000
(B71147)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  -10.000  0.000  0.000  0.000  0.000  0.000

SCALE 0.0049 SCALE

MACH 1.20  

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EFFECT OF ORBITER ELEVONS WITH 312 IN. HG TANK

FOREBODY AXIAL FORCE COEFFICIENT, CAF

ANGLE OF ATTACK, ALPHA, DEGREES

MACH 1.46

REFERENCE INFORMATION
SREF 7.6600 SQ. IN.
LREF 2.0260 IN.
YREF 4.4600 IN.
ZREF 0.2480 IN.
SCALE 0.0040 SCALE
EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

FOREBODY AXIAL FORCE COEFFICIENT, CAF

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR Rudder REFERENCE INFORMATION
(DY1135) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 7.6000 56.1IN.
(DY1135) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 0.000 0.000 LREF 2.0800 IN.
(DY1143) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 LREF 4.4600 IN.
(DY1143) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 10.000 0.000 YMRP 3.2000 IN.
(DY1143) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 YMRP 0.0000 IN.
(DY1147) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 -10.000 0.000 2MRP 0.2600 IN.
SCALE 0.0040 SCALE

MACH 1.95

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EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORIGIN TO  ELEVON  RUDDER  REFERENCE INFORMATION
(TY133)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  LREF  7.6800 SQ. IN.
(TY143)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T902S1  0.000  0.023  0.000  0.000  LREF  7.0000 IN.
(TY143)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  10.000  0.000  LREF  4.4600 IN.
(TY143)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T902S1  0.000  0.023  0.000  0.000  XHRP  3.3600 IN.
(TY143)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  -10.000  0.000  YHRP  0.0000 IN.
(TY1147)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T902S1  0.000  0.023  -10.000  0.000  ZHRP  0.8480 IN.

SCALE 0.0040 SCALE

MACH 3.48

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EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

ANGLE OF ATTACK, ALPHA, DEGREES

BASE AXIAL FORCE COEFFICIENT, CAB

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVT Rudder REFERENCE INFORMATION
(D71153) HSFC TWT 544X LAUNCH VEHICLE STUDIES T90131 0.000 0.023 0.000 0.000 SREP 7.6800 SQ.IN.
(B71133) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREP 2.0280 IN.
(B71143) HSFC TWT 544X LAUNCH VEHICLE STUDIES T90181 0.000 0.023 10.000 0.000 BREP 4.4680 IN.
(B71143) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 HKRP 3.3600 IN.
(B71147) HSFC TWT 544X LAUNCH VEHICLE STUDIES T90181 0.000 0.023 -10.000 0.000 WHP 0.0000 IN.
(B71147) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 ZHP 0.1280 IN.
SCALE 0.0040 SCALE

MACH .60

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EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

ANGLE OF ATTACK, ALPHA, DEGREES

BASE AXIAL FORCE COEFFICIENT, CAB

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  TS  ELEV  Rudder  REFERENCE INFORMATION

(671135)  HSFC TWT 544X LAUNCH VEHICLE STUDIES T90151  0.000  0.023  0.000  0.000  SUBREF  7.8800  SQ.IN.

(671136)  HSFC TWT 544X LAUNCH VEHICLE STUDIES T90251  0.000  0.023  0.000  0.000  BREF  2.0280  IN.

(671140)  HSFC TWT 544X LAUNCH VEHICLE STUDIES T901S1  0.000  0.023  10.000  0.000  LREF  4.4800  IN.

(671141)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  10.000  0.000  XRMP  5.3600  IN.

(671149)  HSFC TWT 544X LAUNCH VEHICLE STUDIES T901S1  0.000  0.023  -10.000  0.000  YRMP  0.0000  IN.

(671147)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  -10.000  0.000  ZRMP  0.2460  IN.

SCALE  0.0040  SCALE

MACH  1.20  PAGE  393
EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(071135) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.6800 SQ.IN.
(071135) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90231 0.000 0.023 10.000 0.000 SREF 4.4800 IN.
(071143) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 XHPR 3.9800 IN.
(071145) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90231 0.000 0.023 10.000 0.000 YHPR 0.0000 IN.
(071147) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 ZHPR 0.0460 IN.

SCALE 0.0000 SCALE

MACH 1.95

PAGE 395
EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

BASE AXIAL FORCE COEFFICIENT - CAB

MACH 3.48

PAGE 396
EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

DATA SET SYMBOL | CONFIGURATION DESCRIPTION | ORB INC | YS | ELEV | Rudder | REFERENCE INFORMATION
--- | --- | --- | --- | --- | ---
(DY1132) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 0.000 | SREF 7.8600 SQ. IN.
(DY1133) | MSFC TWT 944X LAUNCH VEHICLE STUDIES T902S1 | 0.000 | 0.023 | 0.000 | 0.000 | LREF 9.0280 IN.
(DY1144) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 0.000 | SREF 4.4800 IN.
(DY1145) | MSFC TWT 944X LAUNCH VEHICLE STUDIES T902S1 | 0.000 | 0.023 | 0.000 | 0.000 | XHREF 3.8600 IN.
(DY114F) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 -0.000 | 0.000 | 0.000 | YHREF 0.0000 IN.
 | MSFC TWT 944X LAUNCH VEHICLE STUDIES T902S1 | 0.000 | 0.023 -10.000 | 0.000 | 0.000 | ZHREF 0.0240 IN.
SCALE 0.0040 SCALE

MACH 4.96

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EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(071135) MSFC TWT 544X LAUNCH VEHICLE STUDIES T901S1
(071133) DATA NOT AVAILABLE FOR ALL CONDITIONS
(071145) MSFC TWT 544X LAUNCH VEHICLE STUDIES T901S1
(071145) DATA NOT AVAILABLE FOR ALL CONDITIONS
(071147) DATA NOT AVAILABLE FOR ALL CONDITIONS

ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
0.000 0.023 0.000 0.000 7.8800 SQ.IN.
0.000 0.023 10.000 0.000 2.0280 IN.
0.000 0.023 -10.000 0.000 4.4600 IN.
0.000 0.023 -10.000 0.000 3.3600 IN.
0.000 0.023 0.000 0.000 0.2480 IN.

SCALE 0.0040 SCALE

MACH .60

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EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVR Rudder REFERENCE INFORMATION
(DY1135) MSFC TWT 944X LAUNCH VEHICLE STUDIES T90151 0.000 0.023 0.000 0.000 SREF 7.8800 SQ. IN.
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(DY1143) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 XMRP 3.3600 IN.
(DY1143) MSFC TWT 944X LAUNCH VEHICLE STUDIES T90151 0.000 0.023 -10.000 0.000 YMRP 0.0500 IN.
(DY1147) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 YMRP 0.2480 IN.
SCALER 0.0000 SCALE

MACH .90
EFFECT OF ORBITER ELEVONS WITH 312 IN. TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

(051155) MSFC TWT 544X LAUNCH VEHICLE STUDIES T901S1 0.000 0.023 0.000 0.000 BREF 7.8800 SQ. IN.

(0511155) MSFC TWT 544X LAUNCH VEHICLE STUDIES T902S1 0.000 0.023 0.000 0.000 LREF 2.0280 IN.

(0511143) MSFC TWT 544X LAUNCH VEHICLE STUDIES T901S1 0.000 0.023 10.000 0.000 XREF 3.9400 IN.

(0511143) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 YHRP 0.000 IN.

(0511147) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 ZHRP 0.000 IN.

REFERENCE INFORMATION:

SREF 7.8800 SQ. IN.
LREF 2.0280 IN.
XREF 3.9400 IN.
YHRP 0.000 IN.
ZHRP 0.2480 IN.
SCALE 0.0040 SCALE

MACH 1.20
EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION
(D71135) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.8800 SQ.IN.
(B71135) NHRC TWT 94X LAUNCH VEHICLE STUDIES T90281 0.000 0.023 10.000 0.000 LREF 2.0280 IN.
(B71143) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 XRDP 3.3400 IN.
(B71145) NSFC TWT 94X LAUNCH VEHICLE STUDIES T90281 0.000 0.023 0.000 0.000 THRP 0.0000 IN.
(B71147) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 ZHNP 0.2480 IN.
(B71147) NSFC TWT 94X LAUNCH VEHICLE STUDIES T90281 0.000 0.023 0.000 0.000 SCALE 0.0040 SCALE

MACH 1.46 PAGE 401
EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  Rudder  REFERENCE INFORMATION

(DY1133)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  SREF  7.8800 SQ.IN.

(DY1143)  MSFC TWT 944X LAUNCH VEHICLE STUDIES T90251  0.000  0.023  10.000  0.000  LREF  2.0280 IN.

(DY1141)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  -10.000  0.000  XHAP  3.3600 IN.

(DY1145)  MSFC TWT 944X LAUNCH VEHICLE STUDIES T90251  0.000  0.023  -10.000  0.000  ZHAP  0.0000 IN.

(SY1147)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  -10.000  0.000  SCALE  0.0040 SCALE

MACH  1.95  

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### EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

#### Pitching Moment Coefficient, CLM

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<th>Normal Force Coefficient, CN</th>
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#### Reference Information

- **SREF**: 7.8800 SQ.IN.
- **LREF**: 2.0280 IN.
- **BREF**: 4.4800 IN.
- **XMRP**: 3.3600 IN.
- **YMRP**: 0.0000 IN.
- **ZMRP**: 0.24801 IN.
- **SCALE**: 0.0040 SCALE
- **MACH**: 3.48

---

### MSFC TWT 544X Launch Vehicle Studies

- Data not available for all conditions.

---

### DATA SET SYMBOL CONFIGURATION DESCRIPTION

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<th>ELEVTR</th>
<th>RUDDER</th>
<th>SREF</th>
<th>LREF</th>
<th>BREF</th>
<th>XMRP</th>
<th>YMRP</th>
<th>ZMRP</th>
<th>SCALE</th>
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| BY1323           | 0.000  | 0.023 | 0.000  | 0.000  | 2.0280 IN.
| BY1343           | 0.000  | 0.023 | 10.000 | 0.000  | 4.4800 IN.
| BF1149           | 0.000  | 0.023 | 10.000 | 0.000  | 3.3600 IN.
| BF1147           | 0.000  | 0.023 | -10.000| 0.000  | 0.0000 IN.
| BF1149           | 0.000  | 0.023 | -10.000| 0.000  | 0.2480 IN.
| BF1147           | 0.000  | 0.023 | -10.000| 0.000  | 0.0000 IN.
| BF1149           | 0.000  | 0.023 | -10.000| 0.000  | 0.0000 IN.

---

**PAGE 403**
EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

NORMAL FORCE COEFFICIENT, CN

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

(DY138) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.8800 SQ. IN.

(DY135) MSFC TWT 544x LAUNCH VEHICLE STUDIES T90251 0.000 0.023 0.000 0.000 LREF 2.0280 IN.

(DY143) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 DREF 4.4600 IN.

(DY145) MSFC TWT 544x LAUNCH VEHICLE STUDIES T90251 0.000 0.023 10.000 0.000 XHP 3.3400 IN.

(DY149) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 YHP 0.0000 IN.

(DY147) MSFC TWT 544x LAUNCH VEHICLE STUDIES T90251 0.000 0.023 -10.000 0.000 ZHP 0.0000 IN.

SCALE 0.0040 SCALE

MACH 4.96

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EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(CY1136) MSFC TWT 544X LAUNCH VEHICLE STUDIES 790151 0.000 0.023 0.000 0.000 SREF 7.0000 SQ. IN.
(A71134) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 2.0000 IN.
(A71144) MSFC TWT 544X LAUNCH VEHICLE STUDIES 790151 0.000 0.023 10.000 0.000 HREF 4.4000 IN.
(A71142) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 XMRP 3.3600 IN.
(AY1146) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 YMRP 0.0000 IN.
(AY1148) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 ZMRP 0.2480 IN.
SCALE 0.0040 SCALE

MACH .91
EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  Rudder  REFERENCE INFORMATION
(CY1134)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  SREF  7.8800 SQ. IN.
(AP1144)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251  0.000  0.023  0.000  0.000  LREF  5.0280 IN.
(AP1142)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  10.000  0.000  XHERF  3.3600 IN.
(AP1146)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023 -10.000  0.000  YHREF  0.0000 IN.
(AP1149)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T90251  0.000  0.023 -10.000  0.000  ZHERF  0.0240 IN.
SCALE  0.0040 SCALE

MACH  1.46  PAGE 408
**EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK**

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<th>ORBINC</th>
<th>YS</th>
<th>ELEVTR</th>
<th>RUDDER</th>
<th>REFERENCE INFORMATION</th>
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<td>10.000</td>
<td>0.000</td>
<td>REF: 4.4600  IN.</td>
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<td>0.000</td>
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<td>0.000</td>
<td>SCALE: 0.2040  SCALE</td>
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**REFERENCE INFORMATION:**
- **ORBINC:** Orbital Incidence
- **YS:** Yaw Stability
- **ELEVTR:** Elevon Trim
- **RUDDER:** Rudder Trim
- **REFERENCE:** Reference Information

**MACH:** 1.95
EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(CT1136) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.0000 00. IN.
(AP1134) MSFC TWT 544X LAUNCH VEHICLE STUDIES 790251 0.000 0.023 0.000 0.000 LREF 0.0200 IN.
(AP1144) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 XHRE 4.4600 IN.
(AP1148) MSFC TWT 544X LAUNCH VEHICLE STUDIES 790251 0.000 0.023 10.000 0.000 YHRE 3.3600 IN.
(AP1148) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 ZHRE 0.0000 IN.
(AP1148) MSFC TWT 544X LAUNCH VEHICLE STUDIES 790251 0.000 0.023 10.000 0.000 SCALE 0.0040 SCALE

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(MACH 3.48)

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EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

DATA SET SYMBOL  CONFIGURATION DESCRIPTION                  ORBINC  YS  ELEVT  RUDDER  REFERENCE INFORMATION
(CY1136)            DATA NOT AVAILABLE FOR ALL CONDITIONS         0.000  0.023  0.000  0.000  LREF  7.8600  SQ. IN.
(AT1134)            HSFC TWT 544X LAUNCH VEHICLE STUDIES T902S1     0.000  0.023  10.000  0.000  BREF  2.0200  IN.
(AT1144)            DATA NOT AVAILABLE FOR ALL CONDITIONS         0.000  0.023  10.000  0.000  XHPR  5.3600  IN.
(AT1142)            HSFC TWT 544X LAUNCH VEHICLE STUDIES T902S1     0.000  0.023  -10.000  0.000  YHPR  0.0000  IN.
(AT1146)            DATA NOT AVAILABLE FOR ALL CONDITIONS         0.000  0.023  -10.000  0.000  ZHPR  0.2490  IN.
(AT1148)            HSFC TWT 544X LAUNCH VEHICLE STUDIES T902S1     0.000  0.023  10.000  0.000  SCALE  0.0040  SCALE

MACH  4.96

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EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(CP1136) MSFC TWT 344X LAUNCH VEHICLE STUDIES T901S1
/AP1134) DATA NOT AVAILABLE FOR ALL CONDITIONS
(AP1142) MSFC TWT 344X LAUNCH VEHICLE STUDIES T901S1
(AP1146) DATA NOT AVAILABLE FOR ALL CONDITIONS
(AP1149) MSFC TWT 344X LAUNCH VEHICLE STUDIES T901S1
(AP1149) DATA NOT AVAILABLE FOR ALL CONDITIONS

DATA SET SYM DESCRIPTION
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(AP1142) MSFC TWT 344X LAUNCH VEHICLE STUDIES T901S1
(AP1146) DATA NOT AVAILABLE FOR ALL CONDITIONS
(AP1149) MSFC TWT 344X LAUNCH VEHICLE STUDIES T901S1
(AP1149) DATA NOT AVAILABLE FOR ALL CONDITIONS

ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
0.000 0.023 0.000 0.000 SREP 7.8600 SQ. IN.
0.000 0.023 10.000 0.000 LREP 2.0280 IN.
0.000 0.023 10.000 0.000 XMRP 3.6600 IN.
0.000 0.023 -10.000 0.000 YMRP 0.0000 IN.
0.000 0.023 -10.000 0.000 ZMRP 0.2440 IN.

SCALE 0.0040 SCALE

MACH .60

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EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBIN C TS ELEV TR RUDDER REFERENCE INFORMATION

(CP1134) NSFC TWT 344X LAUNCH VEHICLE STUDIES T901331 0.000 0.023 0.000 0.000 SREP 7.6000 30.1N.
100134) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREP 4.0000 IN.
(CP1144) NSFC TWT 344X LAUNCH VEHICLE STUDIES T901331 0.000 0.023 10.000 0.000 BREP 4.4000 IN.
100144) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 XMRP 3.3000 IN.
(CP1146) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 YMHP 0.0000 IN.
(CP1149) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 10.000 0.000 ZMRP 0.0000 IN.

SCALE 0.0040 SCALE

MACH .91
EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION
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ORBINC  YS  ELEVTR  RUDER  REFERENCE INFORMATION
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0.000  0.023 -10.000  0.000  YHRP  0.2660 IN.
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MACH  1.19
EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBIT VS ELEV Rudder REFERENCE INFORMATION
(AY1134) NSFC TMT 944X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 0.000 0.000 REF 7.6800 SQ.IN.
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(AY1146) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 -10.000 0.000 YHRP 0.0000 IN.
(AY1148) NSFC TMT 944X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 -10.000 0.000 ZHRP 0.2480 IN.
SCALE 0.0040 SCALE

MACH 1.46

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EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

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(CP1184) DATA NOT AVAILABLE FOR ALL CONDITIONS
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0.000 0.023 10.000 0.000 LREP 4.4000 IN.
0.000 0.023 10.000 0.000 YMRP 3.3000 IN.
0.000 0.023 -10.000 0.000 YMRP 0.0000 IN.
0.000 0.023 -10.000 0.000 ZFRP 0.2400 IN.

SCALE 0.0040 SCALE

MACH 1.95
EFFECT OF ORBITER ELEVONS WITH 312 IN. HO TANK

DATA SET SYMBOL: CONFIGURATION DESCRIPTION
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IAP1144: DATA NOT AVAILABLE FOR ALL CONDITIONS
IAP1142: MSFC TMT 944X LAUNCH VEHICLE STUDIES T90251
IAP1146: DATA NOT AVAILABLE FOR ALL CONDITIONS
IAP1149: MSFC TMT 944X LAUNCH VEHICLE STUDIES T90251

ORBING YS ELEV RUDDER REFERENCE INFORMATION
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0.000 0.023 10.000 0.000 HRER 3.2000 IN.
0.000 0.023 -10.000 0.000 YMR 0.0000 IN.
0.000 0.023 -10.000 0.000 YHR 0.0000 IN.
SCALE 0.0040 SCALE

MACH 3.48

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

PITCHING MOMENT COEFFICIENT, CLM

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  TS  ELEVR  RUDDER  REFERENCE INFORMATION
(BF1069)  MSFC THX 544X LAUNCH VEHICLE STUDIES T30181  0.000  0.000  0.000  0.000  SREP  7.8800  50.00 IN.
(BF1061)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  LREP  2.0260  IN.
(BF1059)  MSFC THX 544X LAUNCH VEHICLE STUDIES T30181  0.000  0.000  0.000  30.000  SREP  4.4600  IN.
(BF1053)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  30.000  XNRP  3.3600  IN.
          0.000  0.000  0.000  0.000  YNRP  0.0000  IN.
          0.8460  0.000  0.000  0.000  ZNRP  0.2460  IN.
          0.0040  0.0040  SCALE

MACH .60

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EFFECT OF ORBITER Rudder AT ZERO ORBITER INCIDENCE

PITCHING MOMENT COEFFICIENT, CLM

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBLNC YS ELEVTR Rudder REFERENCE INFORMATION
(B71099) MSFC TWT S44K LAUNCH VEHICLE STUDIES T30151 0.000 0.023 0.000 0.000 SREF 7.8600 80.000
(B71099) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 2.0200 IN.
(B71099) MSFC TWT S44K LAUNCH VEHICLE STUDIES T30151 0.000 0.023 0.000 30.000 NMR 4.0000 IN.
(B71099) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 30.000 NMR 3.5000 IN.

MACH .80

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

PITCHING MOMENT COEFFICIENT, CLM

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  RUDDER  REFERENCE INFORMATION
(BY1099)  NSFC TWT 544X LAUNCH VEHICLE STUDIES T30181  0.000  0.000  0.000  0.000  SREF  7.8800  80.00 IN.
(BY1099)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.000  0.000  0.000  LREF  2.0800  IN.
(BY1099)  NSFC TWT 544X LAUNCH VEHICLE STUDIES T30181  0.000  0.000  0.000  0.000  SREF  4.4400  IN.
(BY1099)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.000  0.000  0.000  LREF  3.3600  IN.

SCALE  0.0040  SCALE

MACH  .90

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

PITCHING MOMENT COEFFICIENT, CLM

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(B71099) HSPC TWT 544X LAUNCH VEHICLE STUDIES T30181
(B71191) DATA NOT AVAILABLE FOR ALL CONDITIONS
(B71195) HSPC TWT 544X LAUNCH VEHICLE STUDIES T30181
(B71099) DATA NOT AVAILABLE FOR ALL CONDITIONS

ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
0.000 0.023 0.000 0.000 SREF 7.6800 SQ. IN.
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0.000 0.023 0.000 0.000 30.000 XREF 3.5600 IN.
0.000 0.023 0.000 0.000 30.000 YREF 0.0000 IN.
0.000 0.023 0.000 0.000 30.000 ZREF 0.2400 IN.
0.000 0.023 0.000 0.000 SCALE 0.0040 SCALE

MACH 1.00 PAGE 422
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORSINC YS ELEVTR RUDDER REFERENCE INFORMATION
BY1089 MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 0.000 0.000 SREF 7.8800 30.100 IN.
BY1091 DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 0.000 LREF 8.0800 IN.
BY1093 MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 0.000 30.000 GREF 4.4400 IN.
BY1093 DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 30.000 XNRP 3.3600 IN.
YMPR 0.0000 IN.
ZMPR 0.0400 IN.
SCALE 0.0040 SCALE

MACH 1.10

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBING YS ELEVTR RUDDER REFERENCE INFORMATION

(871090) NSFC TWT 544X LAUNCH VEHICLE STUDIES T30161 0.000 0.023 0.000 0.000 SREF 7.8800 SQ.IN.
(871091) NSFC TWT 544X LAUNCH VEHICLE STUDIES T30261 0.000 0.023 0.000 0.000 LREF 2.0280 IN.
(871092) NSFC TWT 544X LAUNCH VEHICLE STUDIES T30161 0.000 0.023 0.000 30.000 XREF 4.4800 IN.
(871093) NSFC TWT 544X LAUNCH VEHICLE STUDIES T30261 0.000 0.023 0.000 30.000 XHNP 3.3600 IN.

SCALE 0.0040 IN.

MACH 1.20

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, ALPHA, DEGREES

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL
(BT1095) □ DATA NOT AVAILABLE FOR ALL CONDITIONS
(BT1095) □ NSFC TWT 5443 LAUNCH VEHICLE STUDIES T30251
(BT1095) □ DATA NOT AVAILABLE FOR ALL CONDITIONS
(BT1095) □ NSFC TWT 5443 LAUNCH VEHICLE STUDIES T30251

ORINC VS ELEVTR RUDDER REFERENCE INFORMATION
0.000 0.023 0.000 0.000 SREF 7.8800 80. IN.
0.000 0.023 0.000 0.000 LREF 8.0280 IN.
0.000 0.023 0.000 0.000 RREF 4.4800 IN.
0.000 0.023 0.000 0.000 XREF 3.3600 IN.
0.000 0.023 0.000 0.000 YHPR 0.0000 IN.
0.000 0.023 0.000 0.000 ZHPR 0.2460 IN.
0.000 0.023 0.000 0.000 SCALE 0.0040 SCALE

MACH 1.46

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(B71069) ○ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.6900 SQ. IN.
(B71001) ○ MSFC TWT 544X LAUNCH VEHICLE STUDIES TS0251 0.000 0.023 0.000 0.000 LREF 3.0280 IN.
(B71005) ○ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 30.000 BREF 4.4800 IN.
(B71003) ○ MSFC TWT 544X LAUNCH VEHICLE STUDIES TS0251 0.000 0.023 0.000 30.000 XMRP 5.3600 IN.
                                                   YMRP 0.0000 IN.
                                                   ZMRP 0.2440 IN.
                                                   SCALE 0.0040 SCALE

MACH  1.95
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

**Chart Description**

- **Title:** Effect of Orbiter Rudder at Zero Orbiter Incidence
- **Graph:** Plot of Pitching Moment Coefficient (CL) vs. Angle of Attack (α) in Degrees
- **Axes:**
  - Y-axis: Pitching Moment Coefficient (CL)
  - X-axis: Angle of Attack (α) in Degrees

**Data Set Symbols and Configuration Descriptions**

- **(BS1099)**
  - Symbol: ⫸
  - Configuration Description: Data Not Available for All Conditions
  - Data:
    - Orbinc: 0.000
    - Ts: 0.000
    - Elev: 0.000
    - Rudder: 0.000
    - Sref: 7.6800 sq.in.
    - Lref: 2.0280 in.
    - Xref: 2.7000 in.
    - Yref: 0.0000 in.
    - Zref: 0.1480 in.
    - Scale: 0.0000

- **(BS1090)**
  - Symbol: ■
  - Configuration Description: MSFC TWT 544X Launch Vehicle Studies T30281
  - Data:
    - Orbinc: 0.000
    - Ts: 0.000
    - Elev: 0.000
    - Rudder: 0.000
    - Sref: 7.6800 sq.in.
    - Lref: 2.0280 in.
    - Xref: 2.7000 in.
    - Yref: 0.0000 in.
    - Zref: 0.1480 in.
    - Scale: 0.0000

- **(BS1093)**
  - Symbol: ▲
  - Configuration Description: Data Not Available for All Conditions
  - Data:
    - Orbinc: 0.000
    - Ts: 0.000
    - Elev: 0.000
    - Rudder: 0.000
    - Sref: 7.6800 sq.in.
    - Lref: 2.0280 in.
    - Xref: 2.7000 in.
    - Yref: 0.0000 in.
    - Zref: 0.1480 in.
    - Scale: 0.0000

**Additional Information**

- Mach 3.48

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**Page Reference:** PAGE 427
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, ALPHA, DEGREES

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEV TR  RUDDER  REFERENCE INFORMATION

DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  SREF  7.6000  90.1N.

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DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  30.000  BREF  4.4800  IN.

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YHREF  0.0000  IN.

ZHREF  0.2480  IN.

SCALE  0.0040  SCALE

MACH  4.96

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

NORMAL FORCE COEFFICIENT, Cn

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(BY1099) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151
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MACH .60
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBING YS ELEV TR RUDDER REFERENCE INFORMATION

(B71068) NSFC TWT 544K LAUNCH VEHICLE STUDIES T30151 0.000 0.023 0.000 0.000 SREF 7.8820 SQ.IN.

(B71091) DATA NOT AVAILABLE FOR ALL CONDITIONS

(B71099) NSFC TWT 544K LAUNCH VEHICLE STUDIES T30151 0.000 0.023 0.000 0.000 LREF 2.0220 IN.

(B71093) DATA NOT AVAILABLE FOR ALL CONDITIONS

MACH .80
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, DEGREES
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0

NORTH COEFFICIENT, CN

MACH .90
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

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(B71069) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30131
(B71069) DATA NOT AVAILABLE FOR ALL CONDITIONS
(B71081) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30131
(B71081) DATA NOT AVAILABLE FOR ALL CONDITIONS

ORIGIN YS ELEVTR RUDDER REFERENCE INFORMATION
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0.000 0.023 0.000 30.000 BREP 4.4600 IN.
0.000 0.023 0.000 30.000 LREP 3.3600 IN.
0.000 0.000 0.000 0.000 YMRP 0.2480 IN.
0.000 0.000 0.000 0.000 ZNRP 0.0040 SCALE

SCALE 0.0040 SCALE

MACH 1.00

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION

(B71099) MSFC TTV 544X LAUNCH VEHICLE STUDIES T30181 0.000 0.023 0.000 0.000 BREP 7.8600 50.00 IN.

(B71095) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREP 2.0380 IN.

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(B71095) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 30.000 LREP 3.3500 IN.

XHPR 0.0000 IN.

YHRP 0.2460 IN.

SCALE 0.0040 SCALE

MACH 1.10

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, ALPHA, DEGREES

NORMAL FORCE COEFFICIENT, CN

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION

MSPC TWT 544X LAUNCH VEHICLE STUDIES T501S1 0.000 0.023 0.000 0.000 SREF 7.6000 30.1 IN.
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SCALE 0.0040 SCALE

MACH 1.20

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  VS  ELEVINC  RUDDER  REFERENCE INFORMATION
(SF1095)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  BREP  7.6500  86.0 IN.
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(SF1095)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  30.000  BREP  4.4000  IN.
(SF1095)  MSFC TWT 94AX LAUNCH VEHICLE STUDIES T302S1  0.000  0.023  0.000  30.000  XHNP  5.3600  IN.
SNRP  0.0000  IN.
ZNRP  0.8400  IN.
SCALE  0.0040  SCALE

MACH  1.46  PAGE  435
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, ALPHA, DEGREES

NORMAL FORCE COEFFICIENT, CN

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBING YS ELEVTR RUDDER REFERENCE INFORMATION
(SY1099) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 0.000 LREF 7.8800 56.1N.
(SY1099) MSFC TWT 944X LAUNCH VEHICLE STUDIES T30251 0.000 0.000 0.000 0.000 XREF 4.4800 1N.
(SY1099) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 0.000 YHSP 0.000 0.000 1N.
(SY1099) MSFC TWT 944X LAUNCH VEHICLE STUDIES T30251 0.000 0.000 0.000 0.000 ZHSP 0.000 0.000 1N.

SCALE 0.0040 SCALE

MACH 1.95

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

MACH 3.48
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

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MACH 4.96

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

AXIAL FORCE COEFFICIENT, CA

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOBY CONFIGURATION DESCRIPTION ORBITING VS ELEVATION RUDDER REFERENCE INFORMATION
(BY1099) MSPC TWY 544X LAUNCH VEHICLE STUDIES T3O181 0.000 0.023 0.000 0.000 SREP 7.8800 50.00 IN.
(BY1099) MSPC TWY 544X LAUNCH VEHICLE STUDIES T3O181 0.000 0.023 0.000 0.000 LREP 2.0280 12.00 IN.
(BY1099) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 HNRP 3.3000 12.00 IN.
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(BY1099) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 ZNRP 0.8480 12.00 IN.

SCALE 0.0000 SCALE

MACH .60
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, ALPHA, DEGREES

AXIAL FORCE COEFFICIENT, CA.

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR Rudder  Reference Information
(B71093)  NSFC WHT 544X LAUNCH VEHICLE STUDIES  T30131  0.000  0.023  0.000  0.000  0.000  30.000  0.000  0.000
(B71093)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  30.000
(B71093)  NSFC WHT 544X LAUNCH VEHICLE STUDIES  T30131  0.000  0.023  0.000  0.000  0.000  30.000  0.000  0.000

MACH .80  PAGE 440
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

AXIAL FORCE COEFFICIENT, CA

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(SY1099) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30181
(SY1091) DATA NOT AVAILABLE FOR ALL CONDITIONS
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(SY1099) DATA NOT AVAILABLE FOR ALL CONDITIONS

MACH .90

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, ALPHA, DEGREES

AXIAL FORCE COEFFICIENT, CA

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVR Rudder REFERENCE INFORMATION
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BY1093 DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 30.000 XHHP 3.3800 IN.
BY1093 0.0000 IN.
BY1093 0.0400 IN.
BY1093 0.0400 SCALE

MACH 1.00

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

AXIAL FORCE COEFFICIENT, CA

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVT Rudder REFERENCE INFORMATION
(SY1091) HSFC TWT 544X LAUNCH VEHICLE STUDIES T30181 0.000 0.000 0.000 0.000 BREP 7.6500 50 IN.
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(SY1093) HSFC TWT 544X LAUNCH VEHICLE STUDIES T30181 0.000 0.000 0.000 30.000 BREP 4.4600 IN.
(SY1093) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 30.000 XNRP 3.2400 IN.
XMNR 0.0000 IN.
ZNMR 0.2400 IN.
SCALE 0.0040 SCALE

MACh 1.10

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

1. (BYI089) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T50151 0.000 0.023 0.000 0.000 REF 7.8000 SQ. IN.

2. (BYI095) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T50251 0.000 0.023 0.000 0.000 REF 2.0260 IN.

3. (BYI095) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T50251 0.000 0.023 0.000 0.000 REF 4.4600 IN.

4. (BYI095) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T50251 0.000 0.023 0.000 0.000 REF 3.3400 IN.

5. XHRP 0.0000 IN.

6. ZHRP 0.0000 IN.

7. SCALE 0.0000 SCALE

MACH 1.20

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, ALPHA, DEGREES

AXIAL FORCE COEFFICIENT, CA

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBLNC VS ELEVTR RUDDER REFERENCE INFORMATION

(91390) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 REF 7.6000 IN.

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(913905) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 XNR 3.3600 IN.

(913909) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30281 0.000 0.023 0.000 0.000 ZNR 0.2400 IN.

SCALE 0.0040 SCALE

MACH 1.46

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, ALPHA, DEGREES

AXIAL FORCE COEFFICIENT, CA

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION
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(871092) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 30.000 SREF 4.4500 IN.
(871093) MSFC TWT 544X LAUNCH VEHICLE STUDIES 730251 0.000 0.023 0.000 30.000 XHREF 3.3600 IN.
YHREF 3.3600 IN.
ZHREF 0.0000 IN.
SCALE 0.0040 SCALE

MACH 1.95
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

MACH 3.48
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

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ANGLE OF ATTACK, ALPHA, DEGREES

DATA DESCRIPTION

DATA NOT AVAILABLE FOR ALL CONDITIONS
(SF1099) O

(SF1091) HSFC TWT 544X LAUNCH VEHICLE STUDIES T30251

(SF1095) DATA NOT AVAILABLE FOR ALL CONDITIONS

(SF1093) HSFC TWT 544X LAUNCH VEHICLE STUDIES T30251

ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
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MACH 4.96
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

FOREBODY AXIAL FORCE COEFFICIENT, CAF

ANGL OF ATTACK, ALPHA, DEGREES

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SCALE 0.0040 SCALE

MACH .60

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

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(C1055) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.000 | 0.000 | MREF 3.3600 IN.
 Scale 0.0040 SCALE

MACH .80

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

FOREBODY AXIAL FORCE COEFFICIENT CA

ANGLE OF ATTACK, ALPHA, DEGREES

MACH .90

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, ALPHA, DEGREES

FOREBODY AXIAL FORCE COEFFICIENT, CAF

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MACH 1.00
### Effect of Orbiter Rudder at Zero Orbiter Incidence

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**Mach**

1.10

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

FOREBODY AXIAL FORCE COEFFICIENT, CAF

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
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XREF 0.0000 IN.
YREF 0.0000 IN.
ZWRITE 0.0000 IN.
SCALE 0.0040 SCALE

MACH 1.20

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

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SCALE: 0.0000 IN.

MACH 1.46

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, ALPHA, DEGREES

FOREBODY AXIAL FORCE COEFFICIENT, CAF

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MACH 1.95

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

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1.00 | NSFC LTV 34X LAUNCH VEHICLE STUDIES TS0231 | 0.000 | 0.000 | 0.000 | 0.000 | REF 4.4800 IN.

MACH 3.48

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

FOREBODY AXIAL FORCE COEFFICIENT, CAF

ANGLE OF ATTACK, ALPHA, DEGREES

MACH 4.96
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

MACH .60

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, ALPHA, DEGREES

BASE AXIAL FORCE COEFFICIENT, CAB

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MACH .80  PAGE 460
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

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YHRP 0.0000 IN.
ZHRP 0.2400 IN.
SCALE 0.0040 SCALE

MACH 1.00

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

BASE AXIAL FORCE COEFFICIENT, Cb

ANGLE OF ATTACK, ALPHA, DEGREES

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MACH 1.10

PAGE 463
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

BASE AXIAL FORCE COEFFICIENT, CAB

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

MACH 1.20
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

BASE AXIAL FORCE COEFFICIENT, C\textsubscript{\text{f}}

ANGLE OF ATTACK, ALPHA, DEGREES

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MACH 1.46

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

BASE AXIAL FORCE COEFFICIENT, CAB

ANGLE OF ATTACK, ALPHA, DEGREES

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MACH 1.95

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

ANGLE OF ATTACK, ALPHA, DEGREES

BASE AXIAL FORCE COEFFICIENT, CAB

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MACH  3.48  PAGE 467
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

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MACH .60

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

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MACH .80
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

PITCHING MOMENT COEFFICIENT, CLM

NORMAL FORCE COEFFICIENT, CN

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MACH 0.90 SCALE 0.0040 IN.

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

PITCHING MOMENT COEFFICIENT, CLM

NORMAL FORCE COEFFICIENT, CN

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION

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SCALE 0.0040 SCALE

MACH 1.00

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### EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

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**Page** 473
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

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PITCHING MOMENT COEFFICIENT, CLM

NORMAL FORCE COEFFICIENT, CN

MACH 1.46
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

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MACH  1.95  PAGE  476
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

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REFERENCE INFORMATION
MACH 4.96

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

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MACH  .60  PAGE  479
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

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MACH .80
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

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MACH .90

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

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0.000 0.023 0.000 0.000 ZHMR 0.2480 IN.
SCALE 0.0040 SCALE

MACH 1.00

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

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(SY1099) DATA NOT AVAILABLE FOR ALL CONDITIONS

MACH 1.10 PAGE 483
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

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MACH 1.46
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION
(S71099) • DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.6800 IN.
(S71099) • MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251 0.000 0.023 0.000 0.000 LREF 2.0280 IN.
(S71099) • DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 30.000 BREF 4.4600 IN.
(S71099) • MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251 0.000 0.023 0.000 30.000 XREF 3.3600 IN.

MACH 1.95
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(B71093) ☐ DATA NOT AVAILABLE FOR ALL CONDITIONS
(B71095) ☐ NSFC TWT 544X LAUNCH VEHICLE STUDIES T302S1

ORBING VS ELEVATOR RUDDER REFERENCE INFORMATION
(-0.000 0.023 0.000 0.000 0.000 SREF 7.8800 SQ. IN.)
(-0.000 0.023 0.000 0.000 0.000 LREF 2.0260 IN.)
(-0.000 0.023 0.000 0.000 30.000 BREF 4.4800 IN.)
(-0.000 0.023 0.000 0.000 0.000 XHRP 3.3600 IN.)
(-0.000 0.023 0.000 0.000 0.000 YHRP 0.0000 IN.)
(-0.000 0.023 0.000 0.000 0.000 ZHRP 0.0240 IN.)
SCALE 0.0040 SCALE

MACH 4.96
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(A1Y080) NSFC TMT 544X LAUNCH VEHICLE STUDIES T50151
(A1Y082) DATA NOT AVAILABLE FOR ALL CONDITIONS
(A1Y086) NSFC TMT 544X LAUNCH VEHICLE STUDIES T50151
(A1Y094) DATA NOT AVAILABLE FOR ALL CONDITIONS

MACH .60

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(A41090) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1
(A41092) □ DATA NOT AVAILABLE FOR ALL CONDITIONS
(A41098) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1
(A41094) □ DATA NOT AVAILABLE FOR ALL CONDITIONS

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(A41090) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1
(A41092) □ DATA NOT AVAILABLE FOR ALL CONDITIONS
(A41098) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1
(A41094) □ DATA NOT AVAILABLE FOR ALL CONDITIONS

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(A41090) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1
(A41092) □ DATA NOT AVAILABLE FOR ALL CONDITIONS
(A41098) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T301S1
(A41094) □ DATA NOT AVAILABLE FOR ALL CONDITIONS

MACH .80
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

HSTC THT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.023 0.000 0.000 SREF 7.6800 80.1 IN.
DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 2.0000 1 IN.

MACH 1.00
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

DATA SET SYMBOl CONFIGURATION DESCRIPTION

MACH 1.10
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

Data Set Symbol | Configuration Description  | Orbinc | Ys | Elevin | Rudder | Reference Information
----- | -------------------------- | ------ | --- | ------ | ------ | --------------------------
 1 | MSFC TWT 544x Launch Vehicle Studies T30151 | 0.000 | 0.000 | 0.000 | 0.000 | Reference
 2 | MSFC TWT 544x Launch Vehicle Studies T30251 | 0.000 | 0.000 | 0.000 | 0.000 | Reference
 3 | MSFC TWT 544x Launch Vehicle Studies T30151 | 0.000 | 0.000 | 0.000 | 30.000 | Reference
 4 | MSFC TWT 544x Launch Vehicle Studies T30251 | 0.000 | 0.000 | 0.000 | 30.000 | Reference

MACH 1.20
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(A71090) DATA NOT AVAILABLE FOR ALL CONDITIONS
(A71092) MSFC TWT 944X LAUNCH VEHICLE STUDIES T902S1
(A71094) MSFC TWT 944X LAUNCH VEHICLE STUDIES T902S1

ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION
0.000 0.023 0.000 0.000 SREF 7.800 0 0.1N.
0.000 0.023 0.000 0.000 LREF 5.020 0 IN.
0.000 0.023 0.000 30.000 LREF 5.460 0 IN.
0.000 0.023 0.000 30.000 LREF 5.360 0 IN.
YHPR 0.000 0 IN.
ZHPR 0.000 0 IN.
SCALE 0.0040 SCALE

MACH 1.46
EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORIGINC VS  ELEVRU RUDDER  REFERENCE INFORMATION
(AT1000)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  REFP 7.3800  30.00 IN.
(AT1090)  MSFC TWT 446X LAUNCH VEHICLE STUDIES TS0251  0.000  0.023  0.000  0.000  LREP 4.4000  IN.
(AT1100)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  XREP 3.3000  IN.
(AT1190)  MSFC TWT 446X LAUNCH VEHICLE STUDIES TS0251  0.000  0.023  0.000  0.000  YMRP 0.0000  IN.
                  0.0000  0.0000  0.0000  0.0000  ZMRP 0.2450  IN.
                  SCALE 0.0040 SCALE

MACH 1.95

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION
(TY1090) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 0.000 BREF 7.6400 90 IN.
(TY1092) NSFC TWT 544X LAUNCH VEHICLE STUDIES T30281 0.000 0.000 0.000 0.000 LREF 8.0000 IN.
(TY1096) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 0.000 SREF 4.4400 IN.
(TY1094) NSFC TWT 544X LAUNCH VEHICLE STUDIES T30281 0.000 0.000 0.000 0.000 XHM 3.3000 IN.

MACH 3.48

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EFFECT OF ORBITER RUDDER AT ZERO ORBITER INCIDENCE

DATA SET SYMBOL CONFIGURATION DESCRIPTION
Y11093O DATA NOT AVAILABLE FOR ALL CONDITIONS
Y11092O MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251
Y11095O DATA NOT AVAILABLE FOR ALL CONDITIONS
Y11099O MSFC TWT 544X LAUNCH VEHICLE STUDIES T30251

MACH 4.96
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

PITCHING MOMENT COEFFICIENT, CLM

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORGINC YS ELEVTR RUDDER REFERENCE INFORMATION

(DP1135) HSFC TWT 5443 LAUNCH VEHICLE STUDIES T90181 0.000 0.023 0.000 0.000 SREF 7.8800 SQ. IN.

(B71133) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 2.0280 IN.

(B71137) HSFC TWT 5443 LAUNCH VEHICLE STUDIES T90181 0.000 0.023 0.000 0.000 YHPR 3.3600 IN.

(B71139) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 YHPR 0.0000 IN.

MACH .90

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

SYMBOL

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORSINC TS ELEVR RUDDER REFERENCE INFORMATION

(MSPC TWT 944X LAUNCH VEHICLE STUDIES T90151) 0.000 0.023 0.000 0.000 SREF 7.6800 SQ. IN.

(MSPC TWT 944X LAUNCH VEHICLE STUDIES T90281) 0.000 0.023 0.000 0.000 LREF 5.0290 IN.

(MSPC TWT 944X LAUNCH VEHICLE STUDIES T90152) 0.000 0.023 0.000 30.000 XHPR 5.3600 IN.

DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 30.000 YHPR 0.0000 IN.

SCALE 0.0040 SCALE

MACH 1.20
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

PITCHING MOMENT COEFFICIENT, CLM

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(D71133) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.025 0.000 0.000 ZREP 7.6000 SQ. IN.
(D71133) MBPC TWT 944X LAUNCH VEHICLE STUDIES T90251 0.000 0.025 0.000 0.000 LREP 2.0000 IN.
(D71137) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.025 0.000 30.000 ZREP 4.4000 IN.
(D71139) MBPC TWT 944X LAUNCH VEHICLE STUDIES T90251 0.000 0.025 0.000 30.000 HREP 3.3600 IN.
ZREP 0.0000 IN.
ZHPR 0.2480 IN.
SCALE 0.0040 SCALE

MACH 1.46

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

PITCHING MOMENT COEFFICIENT, CLM

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  VS  ELEVTR  RUDDER  REFERENCE INFORMATION
(DY1135)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.000  0.000  0.000  SHEP  7.6600  SQ.IN.
(DY1135)  NASP C TW 344X LAUNCH VEHICLE STUDIES 190231  0.000  0.000  0.000  0.000  REF  5.0000  IN.
(DY1135)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.000  0.000  0.000  REF  4.5000  IN.
(DY1135)  NASP C TW 344X LAUNCH VEHICLE STUDIES 190231  0.000  0.000  0.000  30.000  REF  5.0000  IN.

MACH  1.05

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

MACH 4.96

REFERENCE INFORMATION

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  VS  ELEVTR  RUDDER  SREF  LREF  XREF  YREF  ZREF  SCALE

| (OPI135) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 0.000 | 9.6800 SQ. IN. |
| (OPI133) | NSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 | 0.000 | 0.023 | 0.000 | 0.000 | 2.0280 IN. |
| (OPI131) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 30.000 | 3.3000 IN. |
| (OPI139) | NSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 | 0.000 | 0.023 | 0.000 | 30.000 | 3.3000 IN. |

SCALE 0.0040 SQ. IN.
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBITIC TS ELEVIT RUDDER REFERENCE INFORMATION
(071135) NSFC TWT 544X LAUNCH VEHICLE STUDIES T9O1S1 0.000 0.023 0.000 0.000 0.000 7.8600 SQ. IN.
(071135) DATA NOT AVAILABLE FOR ALL CONDITIONS
(071137) NSFC TWT 544X LAUNCH VEHICLE STUDIES T901S1 0.000 0.023 0.000 0.000 30.000 4.4800 IN.
(071139) DATA NOT AVAILABLE FOR ALL CONDITIONS

MACH .60

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBITC TS ELEVTR RUDDER REFERENCE INFORMATION
(D71139) NSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 0.000 0.023 0.000 0.000 SREP 7.8800 SQ. IN.
(D71139) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREP 2.0200 IN.
(D71139) NSFC TWT 544X LAUNCH VEHICLE STUDIES T90181 0.000 0.023 0.000 30.000 SREP 4.4800 IN.
(D71139) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 30.000 LREP 3.8500 IN.
THRP 0.0000 IN.
ZMRP 0.0000 IN.
SCALE 0.0000 SCALE

MACH .90

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

ANGLE OF ATTACK, ALPHA, DEGREES

NORMAL FORCE COEFFICIENT, CN

MACH 1.20
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORIGIN VS ELEV VR RUGGER REFERENCE INFORMATION
(OY1135) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 0.000 0.000 LREP 0.0000 IN.
(OY1133) NSFC TWT 544X LAUNCH VEHICLE STUDIES 900281 0.000 0.000 0.000 0.000 0.000 LREP 0.0000 IN.
(OY1137) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.000 0.000 0.000 0.000 LREP 0.0000 IN.
(OY1138) NSFC TWT 544X LAUNCH VEHICLE STUDIES 900281 0.000 0.000 0.000 0.000 0.000 LREP 0.0000 IN.

MACH 1.46
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORINGE YS ELEVTR RUDDER REFERENCE INFORMATION

(SY139) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.0000 SQ. IN.

(SY1135) MSFC TWT S44X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 0.000 30.000 LREF 4.4000 IN.

(SY1139) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 30.000 BREF 3.3600 IN.

MSFC TWT S44X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 0.000 30.000 XMRP 4.2000 IN.

MACH 1.95

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBLNC VS ELEVTR RUDDER REFERENCE INFORMATION

1071351 DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.8800 59.1 IN.

1071351 MSFC TWT 844X LAUNCH VEHICLE STUDIES T90ES1 0.000 0.023 0.000 0.000 LREF 8.0800 1 IN.

1071351 DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 RXRF 4.4800 1 IN.

1071351 MSFC TWT 844X LAUNCH VEHICLE STUDIES T90ES1 0.000 0.023 0.000 30.000 ZMRF 3.3000 1 IN.

1071351 DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 ZREF 0.0000 1 IN.

1071351 SCALE 0.0040 SCALE

MACH 3.48
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(DY1135) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.4800 80.1N.
(DY1135) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 0.000 0.023 0.000 0.000 LREF 2.0200 1N.
(BY1139) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 30.000 BREF 4.4800 1N.
(BY1139) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 0.000 0.023 0.000 30.000 LREF 3.3600 1N.

MACH 4.96

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

AXIAL FORCE COEFFICIENT, CA

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVT Rudder REFERENCE INFORMATION
(DY1139) MSFC TWT 544X LAUNCH VEHICLE STUDIES TG0151 0.000 0.023 0.000 0.000 SRP 7.8400 SQ. IN.
(DY1139) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 2.0840 IN.
(DY1139) MSFC TWT 544X LAUNCH VEHICLE STUDIES TG0151 0.000 0.023 0.000 0.000 XRIP 3.3600 IN.
(DY1139) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 ZHIP 0.0000 IN.
SCALE 0.0040 SCALE

MACH .60

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

DATA SET
(071135)
(871139)

SYMBOL CONFIGURATION DESCRIPTION

ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION

MACH .90

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

ANGLE OF ATTACK, ALPHA, DEGREES

AXIAL FORCE COEFFICIENT, CA

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(DP1139) MSFC TWT 544X LAUNCH VEHICLE STUDIES T901S1 0.000 0.023 0.000 0.000 SREP 7.8600 SQ. IN.
(DP1139) MSFC TWT 544X LAUNCH VEHICLE STUDIES T902S1 0.000 0.023 0.000 0.000 LREP 2.0800 IN.
(DP1139) MSFC TWT 544X LAUNCH VEHICLE STUDIES T903S1 0.000 0.023 0.000 30.000 SREP 4.4820 IN.
(DP1139) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 30.000 SREP 3.8600 IN.

CALC 0.0000 SCALE 0.0040 SCALE

MACH 1.20

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

ANGLE OF ATTACK, ALPHA, DEGREES

AXIAL FORCE COEFFICIENT, CA

DATA SET SYMBOL CONFIGURATION DESCRIPTION

(071139) ☐ DATA NOT AVAILABLE FOR ALL CONDITIONS

(071139) ☐ MSFC TWT 344X LAUNCH VEHICLE STUDIES T90281

(071139) ☐ DATA NOT AVAILABLE FOR ALL CONDITIONS

(071139) ☐ MSFC TWT 344X LAUNCH VEHICLE STUDIES T90281

ORBINC YY ELEVTR RUDDER REFERENCE INFORMATION

- 0.000 0.023 0.000 0.000 SREF 7.8800 SQ.IN.

- 0.000 0.023 0.000 0.000 LREF 2.0800 1N.

- 0.000 0.023 0.000 30.000 XNRP 3.3600 1N.

- 0.000 0.023 0.000 30.000 XNRP 3.3600 1N.

- 0.000 0.023 0.000 30.000 XNRP 3.3600 1N.

- 0.000 0.023 0.000 30.000 XNRP 3.3600 1N.

SCALE 0.0040 SCALE

MACH 1.46

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC TS  ELEVN TS  RUDDER TS  REFERENCE INFORMATION
(DY1159)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  50.000  50.000
(DY1133)  NASA TWT 544X LAUNCH VEHICLE STUDIES T90251  0.000  0.023  0.000  0.000  30.000  30.000
(DY1132)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  30.000  30.000
(DY1139)  NASA TWT 544X LAUNCH VEHICLE STUDIES T90251  0.000  0.023  0.000  0.000  30.000  30.000

ANGLE OF ATTACK, ALPHA, DEGREES

AXIAL FORCE COEFFICIENT, CA

MACH 1.95
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

MACH 3.48
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

DATA SET SYMBOCL CONFIGURATION DESCRIPTION ORBINC VS ELEV Rudder REFERENCE INFORMATION
(071135) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREP 7.6800 SQ. IN.
(071135) NSPC TWT 544X LAUNCH VEHICLE STUDIES T90231 0.000 0.023 0.000 30.000 SREP 4.4400 IN.
(071137) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 30.000 SREP 3.3000 IN.
(071139) NSPC TWT 544X LAUNCH VEHICLE STUDIES T90231 0.000 0.023 0.000 30.000 SREP 3.3000 IN.

MACH 4.96
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

FOREBODY AXIAL FORCE COEFFICIENT, CAF

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION

(D71133) NSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 0.000 0.023 0.000 0.000 SREP 7.6800 56.1N.

(D71133) NSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 0.000 0.023 0.000 0.000 LREP 2.0280 IN.

(D71133) NSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 0.000 0.023 0.000 0.000 XREP 3.3600 IN.

(D71133) NSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 0.000 0.023 0.000 0.000 YREP 0.2480 IN.

XREP 0.0000 SCALE 0.0040 SCALE 0.0000 SCALE

MACH .60 PAGE 520
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

ANGLE OF ATTACK, ALPHA, DEGREES

FOREBODY AXIAL FORCE COEFFICIENT, CALF

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORB INC VS  ELEV VS  RUDDER VS  REFERENCE INFORMATION

(BP1135)  MSFC TWT S44X LAUNCH VEHICLE STUDIES T90161  0.000  0.023  0.000  0.000  REF  5.8800  IN.

(BP1136)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  REF  5.0800  IN.

(BP1137)  MSFC TWT S44X LAUNCH VEHICLE STUDIES T90161  0.000  0.023  0.000  30.000  REF  4.4600  IN.

(BP1138)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  30.000  XMRF  3.5600  IN.

MACH  .90

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

FOREBODY AXIAL FORCE COEFFICIENT, CAF

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION
orbinc y5 elevtr rudder reference information
(071135) msfc tmt 544x launch vehicle studies t90181 0.000 0.023 0.000 0.000 srer 7.8800 sq.in.
(071135) msfc tmt 544x launch vehicle studies t90281 0.000 0.023 0.000 0.000 lref 4.4800 in.
(071135) msfc tmt 544x launch vehicle studies t90181 0.000 0.023 0.000 30.000 bref 4.4800 in.
(071135) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 30.000 xmrp 3.3600 in.
                                              0.0000 0.0000 0.2480 in.

MACH 1.20  PAGE 522
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

FOREBODY AXIAL FORCE COEFFICIENT, CAE

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORING VS ELEVTR RUDDER REFERENCE INFORMATION

(07113S) • DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.8800 SQ. IN.

(07113S) MSFC TWT 344X LAUNCH VEHICLE STUDIES T928231 0.000 0.023 0.000 0.000 30.000 1.46 4.4800 IN.

(07113S) • DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 30.000 BREF 4.4800 IN.

(07113S) MSFC TWT 344X LAUNCH VEHICLE STUDIES T928231 0.000 0.023 0.000 0.000 30.000 XREF 3.3600 IN.

THRP 0.0000 IN.

ZHRP 0.8480 IN.

SCALE 0.0040 SCALE

MACH 1.46

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

ANGLE OF ATTACK, ALPHA, DEGREES

FOREBODY AXIAL FORCE COEFFICIENT, CAF

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
ID1135) □ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREP 7.8600 SQ. IN.
ID1133) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 0.000 0.023 0.000 30.000 LREP 2.0280 IN.
ID1137) □ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 30.000 XREP 4.4600 IN.
ID1139) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 0.000 0.023 0.000 30.000 YNRP 0.0000 IN.
ZNRP 0.2480 IN.
SCALE 0.0040 SCALE

MACH 1.95

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

ANGLE OF ATTACK, ALPHA, DEGREES

FOREBODY AXIAL FORCE COEFFICIENT, CAF

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

(O71339) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 9.8800 SQ.IN.

(O71339) MSFC TWT 944X LAUNCH VEHICLE STUDIES T09281 0.000 0.023 0.000 0.000 LREF 2.0280 IN.

(O71339) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 4.4600 IN.

(O71339) MSFC TWT 944X LAUNCH VEHICLE STUDIES T09281 0.000 0.023 0.000 0.000 LREF 3.3600 IN.

YSR 0.023 IN.

SCALE 0.0040 SCALE

MACH 4.96  PAGE 526
EFFECT OF ORBITER RUDDER WITH 312 IN. H0 TANK

ANGLE OF ATTACK, ALPHA, DEGREES

BASE AXIAL FORCE COEFFICIENT, CAB

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBING YS ELEVTR Rudder REFERENCE INFORMATION
(071136) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90181 0.000 0.023 0.000 0.000 LREF 7.6600 80. IN.
(071133) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 2.0200 1IN.
(071137) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90181 0.000 0.023 0.000 0.000 XNRP 4.4000 1IN.
(071138) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 XNRP 3.5000 1IN.

MACH .60

PAGE 527
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

![Graph showing the effect of orbital rudder with 312 inches.]

**DATA SET SYMBOL CONFIGURATION DESCRIPTION**

<table>
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**REFERENCE INFORMATION**

- SREF: 7,9000 SQ.IN.
- LREF: 4,4000 IN.
- XNRP: 3,3000 IN.
- YNRP: 0,0200 IN.
- ZNRP: 0,2400 IN.
- SCALE: 0,0040 SCALE

**BASE AXIAL FORCE COEFFICIENT, C_A**

**ANGLE OF ATTACK, ALPHA, DEGREES**

**MACH .90**

*PAGE 528*
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

BASE AXIAL FORCE COEFFICIENT, CAB

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(DY1132) MSFC TWT 944X LAUNCH VEHICLE STUDIES T90131 0.000 0.083 0.000 0.000 SREF 7.6800 50 IN.
(DY1132) MSFC TWT 944X LAUNCH VEHICLE STUDIES T90231 0.000 0.083 0.000 0.000 LREF 2.0260 IN.
(DY1132) MSFC TWT 944X LAUNCH VEHICLE STUDIES T90131 0.000 0.083 0.000 30.000 TRHP 3.6600 IN.
(DY1132) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.083 0.000 30.000 ZHRP 0.0000 IN.
MACH 1.20 SCALE 0.0040 SCALE

PAGE 529
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

BASE AXIAL FORCE COEFFICIENT, CAB

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

(DY1139) C DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.6800 SQ.IN.

(DY1139) A MSCF TWT 544X LAUNCH VEHICLE STUDIES T92251 0.000 0.023 0.000 0.000 LREF 2.0260 IN.

(DY1139) C DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 0.000 0.000

(DY1139) A MSCF TWT 544X LAUNCH VEHICLE STUDIES T92251 0.000 0.023 0.000 0.000 0.000 0.000

MACH 1.46

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

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<th>ELEVTR</th>
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MACH 1.95

PAGE 531
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBITING  VS  ELEVTR  RUDDER  REFERENCE INFORMATION
1D1133  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  SREF  7.8800  50. IN.
1D1133  MSFC TWT 544X LAUNCH VEHICLE STUDIES 190251  0.000  0.023  0.000  0.000  LREF  2.0280  IN.
1D1133  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  30.000  BREF  4.4600  IN.
1D1133  MSFC TWT 544X LAUNCH VEHICLE STUDIES 190251  0.000  0.023  0.000  30.000  XREF  3.3600  IN.
X   0.0000  IN.
Y  0.2400  IN.
SCALE  0.0040  SCALE

MACH  3.48

PAGE  532
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

DATA SET SYMBOL | CONFIGURATION DESCRIPTION | ORBINC | YS | ELEV | RUDDER | REFERENCE INFORMATION
---|---|---|---|---|---|---
(bt1133) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 0.000 | REF 7.6800 SQ. IN.
(bt1133) | NSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 | 0.000 | 0.023 | 0.000 | 30.000 | YNRP 0.000 IN.
(bt1133) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 30.000 | XNRP 3.9000 IN.
(bt1133) | NSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 | 0.000 | 0.023 | 0.000 | 30.000 | YNRP 0.000 IN.
(bt1133) | NSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 | 0.000 | 0.023 | 0.000 | 30.000 | XNRP 3.9000 IN.
(bt1133) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 30.000 | YNRP 0.000 IN.
(bt1133) | NSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 | 0.000 | 0.023 | 0.000 | 30.000 | XNRP 3.9000 IN.

MACH 4.96

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION
(DPF1138) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 0.000 0.023 0.000 0.000 SREF 7.8800 sq.in.
(BP1133) □ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LREF 2.0290 in.
(BSP1137) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES T90151 0.000 0.023 0.000 30.000 XRFP 4.4600 in.
(DPF1138) □ DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 30.000 YHFP 0.2460 in.
□ XREF 0.0000 in.
□ ZHFP 0.2460 in.
□ SCALE 0.0040 SCALE

MACH .60
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

**PITCHING MOMENT COEFFICIENT, CLM**

**NORMAL FORCE COEFFICIENT, CN**

| DATA SET SYMBOL | CONFIGURATION DESCRIPTION | ORBING TS | ELEVTR || RUDDER | REFERENCE INFORMATION |
|------------------|---------------------------|-----------|--------|--------|----------------------|
| (DY1139)        | MSCP TWT 544X LAUNCH VEHICLE STUDIES 7801S1 | 0.000 | 0.023 | 0.000 | 0.000 | BREF 4.4600 IN.     |
| (DY1139)        | MSCP TWT 544X LAUNCH VEHICLE STUDIES 7802S1 | 0.000 | 0.023 | 0.000 | 0.000 | LREF 2.0800 IN.     |
| (DY1139)        | MSCP TWT 544X LAUNCH VEHICLE STUDIES 7803S1 | 0.000 | 0.023 | 0.000 | 30.000 | BREF 7.6800 SQ. IN. |
| (DY1139)        | DATA NOT AVAILABLE FOR ALL CONDITIONS | 0.000 | 0.023 | 0.000 | 30.000 |                        |

**SCALE** 0.0040 SCALE

**MACH** 1.20

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

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<th>ELEVTR</th>
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MACH 1.46
EFFECT OF ORBITER RUDDER WITH 312 IN. LO TANK

PITCHING MOMENT COEFFICIENT, CLM

NORMAL FORCE COEFFICIENT, CN

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC YS ELEVTRA RUDDER REFERENCE INFORMATION
(DY1135) O DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 LBEP 7.8000 50.8 IN.
(DY1136) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 0.000 0.023 0.000 0.000 LBEP 4.4000 IN.
(DY1137) O DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 30.000 LRP 2.4000 IN.
(DY1138) MSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 0.000 0.023 0.000 30.000 LRP 3.0000 IN.

SCALE 0.0040 SCALE

MACH 3.48

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBING  YS  ELEVTR  RUDDER  REFERENCE INFORMATION
1071135)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  SREF  7.0000  50.0 IN.
1071135)  MSCP TWT 544X LAUNCH VEHICLE STUDIES T902SI  0.000  0.023  0.000  0.000  LREF  5.0000  IN.
1071135)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  30.000  BREF  4.4600  IN.
1071135)  MSCP TWT 544X LAUNCH VEHICLE STUDIES T902SI  0.000  0.023  0.000  30.000  XREF  3.3600  IN.
1071135)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  30.000  ZRF  0.2480  IN.
1071135)  MSCP TWT 544X LAUNCH VEHICLE STUDIES T902SI  0.000  0.023  0.000  30.000  SCALE  0.0040  SCALE

MACH  4.96   PAGE  540
### Effect of Orbiter Rudder with 312 in. H0 Tank

#### Data Set Symbols

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#### Mach

| MACH | 0.60 |

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Page 541
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

DATA SET SYMBOL | CONFIGURATION DESCRIPTION |
-----------------|----------------------------|
(07/1135)       | NSFC TWT 944X LAUNCH VEHICLE STUDIES T90151 |
(07/1135)       | NSFC TWT 944X LAUNCH VEHICLE STUDIES T90251 |
(07/1135)       | NSFC TWT 944X LAUNCH VEHICLE STUDIES T90351 |
(07/1135)       | DATA NOT AVAILABLE FOR ALL CONDITIONS |

DATA: ORBINC, YS, ELEVTR, RUDDER, REFERENCE INFORMATION

MACH 1.20

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION

(671135) DATA NOT AVAILABLE FOR ALL CONDITIONS
(671135) HSFC TWT 344X LAUNCH VEHICLE STUDIES T90251
(671137) DATA NOT AVAILABLE FOR ALL CONDITIONS
(671139) HSFC TWT 344X LAUNCH VEHICLE STUDIES T90251

ORBINC YS ELEVTR RUDDER REFERENCE INFORMATION

0.000 0.023 0.000 0.000 SREF 7.6800 SQ.IN.
0.000 0.023 0.000 0.000 LREF 2.0280 IN.
0.000 0.023 0.000 0.000 XMRP 4.4600 IN.
0.000 0.023 0.000 0.000 ZMRP 3.3800 IN.
0.000 0.023 0.000 0.000 SCALE 0.0040 SCALE

MACH 1.46

PAGE 544
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(071735) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.025 0.000 0.000 SREF 7.8800 SQ.IN.
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(071735) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 30.000 XMRP 3.3600 IN.
(071735) MSFC TWT S44X LAUNCH VEHICLE STUDIES 90251 0.000 0.023 0.000 30.000 YMRP 0.0000 IN.
(071735) ZMRP 0.2460 IN.
(071735) SCALE 0.0040 SCALE

MACH 3.48 PAGE 546
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION
31231 DATA NOT AVAILABLE FOR ALL CONDITIONS
31234 MSFC TWT 944X LAUNCH VEHICLE STUDIES T90251
31235 MSFC TWT 944X LAUNCH VEHICLE STUDIES T90251

ORDINC VS ELEVT Rudder REFERENCE INFORMATION
0.000 0.023 0.000 0.000 SREF 7.8400 SQ. IN.
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0.000 0.023 0.000 0.000 ZRFP 0.2460 IN.
0.000 0.023 0.000 0.000 SCALC 0.0040 SCALE

MACH 4.96

PAGE 547
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(CP1136) NSFC TWT 944X LAUNCH VEHICLE STUDIES T90151
(4T1136) DATA NOT AVAILABLE FOR ALL CONDITIONS
(4P1140) NSFC TWT 944X LAUNCH VEHICLE STUDIES T90151
(4P1140) DATA NOT AVAILABLE FOR ALL CONDITIONS

MACH .60

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION
1CP136) HSFC TWT 944K LAUNCH VEHICLE STUDIES T90151 0.000 0.023 0.000 0.000 SREP 7.8000 35 IN.
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1AP1140) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 30.000 SCALE 0.0040 SCALE

MACH .91
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION
(C71136) NSFC TWT 544X LAUNCH VEHICLE STUDIES T90131 0.000 0.023 0.000 0.000 SREP 7.8800 SQ.IN.
(AP1134) NSFC TWT 544X LAUNCH VEHICLE STUDIES T90231 0.000 0.023 0.000 0.000 LREP 2.0200 IN.
(AP1140) NSFC TWT 544X LAUNCH VEHICLE STUDIES T90131 0.000 0.023 0.000 0.000 SREP 7.8800 SQ.IN.
(AP1140) NSFC TWT 544X LAUNCH VEHICLE STUDIES T90231 0.000 0.023 0.000 0.000 LREP 2.0200 IN.
(AP1140) NSFC TWT 544X LAUNCH VEHICLE STUDIES T90131 0.000 0.023 0.000 0.000 SREP 7.8800 SQ.IN.
(AP1140) NSFC TWT 544X LAUNCH VEHICLE STUDIES T90231 0.000 0.023 0.000 0.000 LREP 2.0200 IN.
(Data NOT AVAILABLE FOR ALL CONDITIONS)

MACH 1.19

PAGE 550
EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC TS ELEVTR RUDDER REFERENCE INFORMATION
(CT1120) C DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 7.0000 30.0 IN.
(AP1124) MSFC TWT 344X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 0.000 0.000 SREF 8.0000 30.0 IN.
(AP1139) DATA NOT AVAILABLE FOR ALL CONDITIONS 0.000 0.023 0.000 0.000 SREF 8.0000 30.0 IN.
(AP1140) MSFC TWT 344X LAUNCH VEHICLE STUDIES T90251 0.000 0.023 0.000 0.000 SREF 8.0000 30.0 IN.

MACH 1.46

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EFFECT OF ORBITER RUDDER WITH 312 IN. H0 TANK

DATA SET SYMBOL  CONFIGURATION DESCRIPTION
ICY1134   DATA NOT AVAILABLE FOR ALL CONDITIONS
ICY1135   MSFC TWT 344X LAUNCH VEHICLE STUDIES T90251
ICY1140   DATA NOT AVAILABLE FOR ALL CONDITIONS
ICY1141   MSFC TWT 344X LAUNCH VEHICLE STUDIES T90251

ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION
0.000 0.023 0.000 0.000 SREF 7.6800 80. IN.
0.000 0.023 0.000 0.000 LREF 2.0280 IN.
0.000 0.023 0.000 30.000 XREF 4.4600 IN.
0.000 0.023 0.000 30.000 YHPR 3.3600 IN.
0.000 0.023 0.000 30.000 ZHPR 0.0000 IN.
SCALE 0.0040 SCALE

MACH 1.95

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  VS  ELEVTR  RUDDER  REFERENCE INFORMATION
(CP1150)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.000  0.000  0.000  SREP  7.0800  80. IN.
(TA1134)  NASA TWT 544X LAUNCH VEHICLE STUDIES T90251  0.000  0.000  0.000  30.000  LREP  8.0800  IN.
(TA1155)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.000  0.000  0.000  SREP  4.4800  IN.
(TA1140)  NASA TWT 544X LAUNCH VEHICLE STUDIES T90251  0.000  0.000  0.000  30.000  XREP  3.5000  IN.

MACH  3.48

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EFFECT OF ORBITER RUDDER WITH 312 IN. HO TANK

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  RUDDER  REFERENCE INFORMATION
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(C71134)  MSFC TWT 944X LAUNCH VEHICLE STUDIES T90251  0.000  0.023  0.000  0.000  LREF  2.0000  IN.
(C71139)  DATA NOT AVAILABLE FOR ALL CONDITIONS  0.000  0.023  0.000  0.000  XHREF  3.0000  IN.
(C7114D)  MSFC TWT 944X LAUNCH VEHICLE STUDIES T90251  0.000  0.023  0.000  0.000  YHREF  0.0000  IN.

SCALE  0.0040  SCALE

MACH  4.96
EFFECT OF MACH NUMBER FOR VARYING LO TANK NOSE SHAPES

PITCHING MOMENT DERIVATIVE (DCLH) PER DEGREE

MACH NUMBER

DATA SET SYMBOL CONFIGURATION DESCRIPTION OMBINE YS ELEVTU Rudder REFERENCE INFORMATION

(FI1081) MSFC TVT 944X LAUNCH VEHICLE STUDIES T90381 0.000 0.000 0.000 0.000 SREP 7.8800 80. IN.
(FI1181) MSFC TVT 944X LAUNCH VEHICLE STUDIES T90281 0.000 0.000 0.000 0.000 LREP 8.0800 1N.
(FI1181) MSFC TVT 944X LAUNCH VEHICLE STUDIES T90282 0.000 0.000 0.000 0.000 XNRP 3.3600 1N.
(FI1187) MSFC TVT 944X LAUNCH VEHICLE STUDIES T90381 0.000 0.000 0.000 0.000 YNRP 0.0000 1N.

SCALE 0.0040 SCALE
EFFECT OF MACH NUMBER FOR VARYING HO TANK NOSE SHAPES

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(PFY001) NSFC TWI 944X LAUNCH VEHICLE STUDIES T20131 0.000 0.023 0.000 0.000 SREF 1.6800 60.4 IN.
(PFY1001) NSFC TWI 944X LAUNCH VEHICLE STUDIES T90131 -1.200 0.023 0.000 0.000 LREF 4.4000 13.
(PFY1133) NSFC TWI 944X LAUNCH VEHICLE STUDIES T90231 -1.200 0.023 0.000 0.000 XREFP 3.3000 13.
(PFY1129) NSFC TWI 944X LAUNCH VEHICLE STUDIES T10231 -1.200 0.023 0.000 0.000 YRP 0.0000 13.
(PFY1127) NSFC TWI 944X LAUNCH VEHICLE STUDIES T100131 -1.200 0.023 0.000 0.000 ZRP 0.2460 13.
SCALE 0.3048 SCALE
EFFECT OF MACH NUMBER FOR VARYING HO TANK NOSE SHAPES

ZERO ANGLE OF ATTACK AXIAL FORCE COEFFICIENT, CAALFO

MACH NUMBER

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORBINC  YS  ELEVTR  RUDDER  REFERENCE INFORMATION

(FY1098)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T90181  0.000  0.023  0.000  0.000  SREF  7.8800  sq.in.
(FY1101)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T90281  0.000  0.023  0.000  0.000  LREF  2.0200  in.
(FY1121)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T90381 -1.900  0.023  0.000  0.000  SREF  4.4800  in.
(FY1123)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T90481 -1.500  0.023  0.000  0.000  ZNRP  0.2480  in.
(FY1125)  MSFC TWT 544X LAUNCH VEHICLE STUDIES T100281 -1.200  0.023  0.000  0.000  SCALE  0.0049  SCALE

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EFFECT OF MACH NUMBER FOR VARYING HO TANK NOSE SHAPES

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EFFECT OF MACH NUMBER FOR VARYING HO TANK NOSE SHAPES

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ORING T8  ELEVTR RUGDER REFERENCE INFORMATION
(AF1050)  NSFC TWT 544X LAUNCH VEHICLE STUDIES T90151  0.000  0.023  0.000  0.000  LREF  5.0000  IN.
(AF1052)  NSFC TWT 544X LAUNCH VEHICLE STUDIES T90251  0.000  0.023  0.000  0.000  LREF  5.0000  IN.
(AF1150)  NSFC TWT 544X LAUNCH VEHICLE STUDIES T90351  -1.800  0.023  0.000  0.000  LREF  5.0000  IN.
(AF1152)  NSFC TWT 544X LAUNCH VEHICLE STUDIES T100251  -1.800  0.023  0.000  0.000  LREF  5.0000  IN.
(AF1154)  NSFC TWT 544X LAUNCH VEHICLE STUDIES T100351  -1.800  0.023  0.000  0.000  LREF  5.0000  IN.
(SALE 0.0040  SCALE
EFFECT OF MACH NUMBER FOR VARYING HO TANK NOSE SHAPES

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR Rudder Reference Information

(AY1200) MSFC TWT 544X LAUNCH VEHICLE STUDIES T30151 0.000 0.025 0.000 0.000 SREF 7.6800 SQ. IN.
(AY1092) MSFC TWT 544X LAUNCH VEHICLE STUDIES T02851 0.000 0.025 0.000 0.000 LREF 3.2000 IN.
(AY1222) MSFC TWT 544X LAUNCH VEHICLE STUDIES T60151 -1.500 0.025 0.000 0.000 XREF 3.8800 IN.
(AY1134) MSFC TWT 544X LAUNCH VEHICLE STUDIES T100251 -1.500 0.025 0.000 0.000 ZREF 0.0000 IN.
(AY1128) MSFC TWT 544X LAUNCH VEHICLE STUDIES T1000151 -1.500 0.025 0.000 0.000 SCALE 0.0040 SCALE
EFFECT OF MACH NUMBER FOR VARYING HO TANK DIAMETER

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(FPI069) NSFC TWT 544X LAUNCH VEHICLE STUDIES T90181 0.000 0.000 0.000 0.000 SREF T.8800 89.1N.
(FPI069) NSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 0.000 0.000 0.000 0.000 LREF 5.0050 IN.
(FPI133) NSFC TWT 544X LAUNCH VEHICLE STUDIES T90281 0.000 0.000 0.000 0.000 REF 4.6800 IN.
(FPI133) NSFC TWT 544X LAUNCH VEHICLE STUDIES T90181 0.000 0.000 0.000 0.000 XNRP 3.4600 IN.
                     YNRP 0.0000 IN.
                     ZNRP 0.2460 IN.
                     SCALE 0.0040 SCALE

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EFFECT OF MACH NUMBER FOR VARYING H0 TANK DIAMETER

DATA SET SYMBOL CONFIGURATION DESCRIPTION
(PY1069)   MSFC TNT 544X LAUNCH VEHICLE STUDIES T3G151 0.000 0.025 0.000 0.000 SREP 7.8800 SQ. IN.
(PY1091)   MSFC TNT 544X LAUNCH VEHICLE STUDIES T3G251 0.000 0.025 0.000 0.000 LREP 2.0280 IN.
(PY1133)   MSFC TNT 544X LAUNCH VEHICLE STUDIES T902S1 0.000 0.025 0.000 0.000 SREP 4.3400 IN.
(PY1133)   MSFC TNT 544X LAUNCH VEHICLE STUDIES T901S1 0.000 0.025 0.000 0.000 XHPR 3.3600 IN.

REFERENCE INFORMATION
SREP 7.8800 SQ. IN.
LREP 2.0280 IN.
SREP 4.3400 IN.
XHPR 3.3600 IN.
THPR 0.0000 IN.
ZHPR 0.0440 IN.
SCALE 0.0040 SCALE

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EFFECT OF MACH NUMBER FOR VARYING H0 TANK DIAMETER
EFFECT OF MACH NUMBER FOR VARYING HO TANK DIAMETER

ZERO ANGLE OF ATTACK FOREBODY AXIAL FORCE COEFFICIENT. CMAFCO

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR Rudder REFERENCE INFORMATION

(FY1099) NSC TWT 544X LAUNCH VEHICLE STUDIES T90151 0.000 0.025 0.000 0.000 SREP 7.6800 IN.

(FY1099) NSC TWT 544X LAUNCH VEHICLE STUDIES T90251 0.000 0.025 0.000 0.000 LREP 2.0300 IN.

(FY1133) NSC TWT 544X LAUNCH VEHICLE STUDIES T90251 0.000 0.025 0.000 0.000 SREP 4.4600 IN.

(FY1133) NSC TWT 544X LAUNCH VEHICLE STUDIES T90151 0.000 0.025 0.000 0.000 SREP 3.3600 IN.

THRP 0.0000 IN.

ZHRP 0.0000 IN.

SCALE 0.0040 SCALE
EFFECT OF MACH NUMBER FOR VARYING HO TANK DIAMETER

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORSINC VS ELEVTR Rudder REFERENCE INFORMATION
(AP1090) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES TSO131 0.000 0.023 0.000 0.000 SREF 7.8000 SQ. IN.
(AP1092) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES TSO231 0.000 0.023 0.000 0.000 LREF 2.0800 IN.
(AP1134) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES TSO231 0.000 0.023 0.000 0.000 SREF 4.4600 IN.
(AP1136) □ MSFC TWT 544X LAUNCH VEHICLE STUDIES TSO131 0.000 0.023 0.000 0.000 SREF 3.3400 IN.
ZNRP 0.0000 IN.
ZNRP 0.8400 IN.
SCALE 0.0040 SCALE
EFFECT OF MACH NUMBER FOR VARYING H0 TANK DIAMETER

DATA SET SYMBOL CONFIGURATION DESCRIPTION ORBINC VS ELEVTR RUDDER REFERENCE INFORMATION
(A10990) HSPC TWT 944X LAUNCH VEHICLE STUDIES T30165 0.000 0.023 0.000 0.000 SREF 7.8800 SQ. IN.
(A10992) HSPC TWT 944X LAUNCH VEHICLE STUDIES T30285I 3.000 0.023 0.000 0.000 LREF 8.0280 IN.
(A111541) HSPC TWT 944X LAUNCH VEHICLE STUDIES T90285I 0.000 0.023 0.000 0.000 BREF 4.4800 IN.
(A111361) HSPC TWT 944X LAUNCH VEHICLE STUDIES T90165I 0.000 0.023 0.000 0.000 XHFP 3.3600 IN.
YHFP 0.0000 IN.
ZHPF 0.0480 IN.
SCALE 0.0040 SCALE

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