SPACE SHUTTLE-

ABORT STAGING CHARACTERISTICS OF AN EXTERNAL OXYGEN TANK SEPARATING FROM THE SPACE SHUTTLE 040-A ORBITER (.006 SCALE MODEL) AT MACH NUMBERS OF 0.6, 2.0 AND 4.0

by

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Paul Cole, NSI

MARSHALL SPACE FLIGHT CENTER

NASA
SADSAC/SPACE SHUTTLE

WIND TUNNEL TEST DATA REPORT

CONFIGURATION: Space Shuttle 040-A Orbiter in Presence of External Oxygen Tank

TEST PURPOSE: To Determine Abort Staging Characteristics of External Oxygen Tank from the 040-A Orbiter.

TEST FACILITY: NASA/MSFC 14"x14" Trisonic Wind Tunnel

TESTING AGENCY: NASA/MSFC

TEST NO. & DATE: MSFC-TWT 531

FACILITY COORDINATOR: Jim Weaver, MSFC

PROJECT ENGINEER(S): Ivy Fossler, MSC
Paul Cole, Northrop Services, Inc.

DATA MANAGEMENT SERVICES

LIAISON: John E. Vaughn

DATA OPERATIONS: L. L. Gough

RELEASE APPROVAL: D. Kemp, Supervisor
Aero Thermo Data Group

CONTRACT NAS 6-4016

AMENDMENT 158

DRL 297 - 84a

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ABORT STAGING CHARACTERISTICS OF AN EXTERNAL OXYGEN TANK
SEPARATING FROM THE SPACE SHUTTLE O40-A ORBITER (.006 SCALE MODEL)
AT MACH NUMBERS OF 0.6, 2.0 AND 4.0

By Ivy Fossler and Paul Cole

SUMMARY

Experimental aerodynamic investigations were conducted on a .006 scale model of the space shuttle O40-A orbiter and its external fuel tank utilizing the NASA/MSFC dual sting support system in the MSFC 14 x 14 inch Trisonic Wind Tunnel. Normal force, pitching moment and axial force components were recorded simultaneously on the orbiter and the tank at selected tank field positions beneath the orbiter as both models were pitched through an angle of attack range of -5° to 20°. Incidence angles between orbiter and tank of 0°, 5°, 10° and 15° were investigated. During these tests Mach number was set at 0.6, 2.0 and 4.0.
### NOMENCLATURE

#### General

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>SADSAC SYMBOL</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>$e$</td>
<td></td>
<td>speed of sound; m/sec, ft/sec</td>
</tr>
<tr>
<td>$C_p$</td>
<td>CP</td>
<td>pressure coefficient; $(p_1 - p_0)/q$</td>
</tr>
<tr>
<td>$M$</td>
<td>MACH</td>
<td>Mach number; $V/s$</td>
</tr>
<tr>
<td>$p$</td>
<td></td>
<td>pressure; N/m$^2$, psf</td>
</tr>
<tr>
<td>$q$</td>
<td>Q(NSM)</td>
<td>dynamic pressure; $1/2\rho V^2$, N/m$^2$, psf</td>
</tr>
<tr>
<td></td>
<td>Q(PF)</td>
<td></td>
</tr>
<tr>
<td>$Rn/L$</td>
<td></td>
<td>unit Reynolds number; per m, per 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>
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<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>$L_{REF}$</td>
<td></td>
</tr>
<tr>
<td>$c$</td>
<td>reference chord length</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>$X_{MRP}$</td>
<td></td>
</tr>
<tr>
<td>$Y_{MRP}$</td>
<td></td>
</tr>
<tr>
<td>$Z_{MRP}$</td>
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#### Subscripts

<table>
<thead>
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<th>SUBSCRIPTS</th>
<th>DEFINITION</th>
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<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>
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</table>
NOMENCLATURE
(Continued)

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_{A_b} )</td>
<td>CAB</td>
<td>base-force coefficient; ( \frac{\text{base force}}{q_s} )</td>
</tr>
<tr>
<td>( C_{A_f} )</td>
<td>CAF</td>
<td>forebody axial force coefficient; ( C_A - C_{A_b} )</td>
</tr>
<tr>
<td>( C_m )</td>
<td>CLM</td>
<td>pitching-moment coefficient; ( \frac{\text{pitching moment}}{Q_{s/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_l )</td>
<td>CRL</td>
<td>rolling-moment coefficient; ( \frac{\text{rolling moment}}{Q_{sb}} )</td>
</tr>
</tbody>
</table>

\( q_s \) refers to the farce coefficient; \( q_{sb} \) refers to the farce coefficient.
### ADDITIONS TO NOMENCLATURE FOR MSFC TWT 531

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>SADSAC SYMBOL</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔX</td>
<td>DELTAX</td>
<td>Horizontal separation distance from orbiter moment reference center (MRC) to tank MRC, positive forward.</td>
</tr>
<tr>
<td>ΔZ</td>
<td>DELTAZ</td>
<td>Vertical separation distance from orbiter moment reference center (MRC) to tank MRC, positive down.</td>
</tr>
<tr>
<td>Cₙₐ</td>
<td>dCN/da</td>
<td>Normal Force Coefficient Derivative with respect to Angle of Attack, per degree, dCₙ/da</td>
</tr>
<tr>
<td>Cₘₐ</td>
<td>DCLMDA</td>
<td>Pitching Moment Coefficient Derivative with respect to Angle of Attack, per degree, dCₘ/da</td>
</tr>
<tr>
<td>Cₐₐ</td>
<td>DCA/DA</td>
<td>Axial Force Coefficient Derivative with respect to Angle of Attack, per degree, dCₐ/da</td>
</tr>
<tr>
<td>Cₙ(α=0)</td>
<td>CNAFO</td>
<td>Normal Force Coefficient at Zero Degrees Angle of Attack</td>
</tr>
<tr>
<td>Cₘ(α=0)</td>
<td>CLMAFO</td>
<td>Pitching Moment Coefficient at Zero Degrees Angle of Attack</td>
</tr>
<tr>
<td>Cₐ(α=0)</td>
<td>CAAFO</td>
<td>Axial Force Coefficient at Zero Degrees Angle of Attack</td>
</tr>
</tbody>
</table>
CONFIGURATIONS INVESTIGATED

0.006 scale models of the 040-A space shuttle orbiter and its external oxygen tank (EOT) were each sting mounted in the MSFC-14 x 14 inch tunnel utilizing the MSFC dual sting support system for captive separation testing (see Figure 1). Sketches of these models are shown in Figures 2 through 6. Pertinent dimensional information is also given in Table II. A complete run summary is contained in Table I, the Data Set Collation Sheets.

Figure 7 depicts the tank separation field mapped during these investigations. Since the plotted data are shown non-dimensionalized by the wing mean aerodynamic chord (E), a table is included on this figure to relate the dimensional value to the non-dimensional value.

TEST CONDITIONS

Table III lists the tunnel conditions prevailing during the tests. Testing procedure consisted of setting the EOT moment reference center (MRC) at a particular predetermined field position (see Figure 7) beneath the orbiter and at some relative incidence angle to the orbiter. The tunnel would then be started and the two models pitched together through an orbiter angle of attack range of -5\(^\circ\) to 20\(^\circ\) (the tank angle of attack would vary depending on the relative incidence angle between the two vehicles). At the end of an alpha sweep the tunnel would be stopped and the EOT moved to another position or incidence angle and the process repeated.
TEST FACILITY DESCRIPTION

The MSFC 14 x 14 Inch 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 0.2 to 5.05 is covered by utilizing two interchangeable test sections. The transonic section permits testing at Mach 2.75 to 5.35. Mach numbers between 0.2 and 0.9 are obtained by using a controllable diffuser. The range from 0.95 to 1.3 is achieved through the use of plenum suction and perforated walls. Mach numbers of 1.46, 1.96 and 2.48 are produced by interchangeable sets of fixed contour nozzle blocks. Above Mach 2.48 a set of fixed contour nozzle blocks are tilted and translated automatically to produce any desired Mach number in 0.25 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 offsets and extensions are available for obtaining various maximum angles of attack up to 90°.
DATA REDUCTION

The aerodynamic forces and moments measured by the internal strain gauge balance have been reduced to coefficient form utilizing the following reference information:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>ORBITER</th>
<th>TANK</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S_{REF}$ = Reference Area (sq. in.)</td>
<td>16.357</td>
<td>16.357</td>
</tr>
<tr>
<td>$l_{REF}$ = Reference Length (in.)</td>
<td>3.657</td>
<td>3.657</td>
</tr>
<tr>
<td>$b_{REF}$ = Reference Span (in.)</td>
<td>5.292</td>
<td>5.292</td>
</tr>
</tbody>
</table>

Moment Reference Centers:

- $X_{cg}$ (inches aft of nose) |
  - ORBITER: 5.207
  - TANK: 6.222

- $Z_{cg}$ (inches) |
  - ORBITER: 0.6 below upper surface
  - TANK: 0.288 above tank centerline

- $Y_{cg}$ |
  - ORBITER: On orbiter centerline
  - TANK: On tank centerline

- Base Areas (sq. in.) |
  - ORBITER: 0.919
  - TANK: 0.0

- Cavity Areas (sq. in.) |
  - ORBITER: 0.627
  - TANK: 2.163
## TABLE I.

**TEST** MBRI 531 **DATA SET/RUN NUMBER**

**COLLATION SUMMARY**

<table>
<thead>
<tr>
<th>DATA SET IDENTIFIER</th>
<th>CONFIGURATION</th>
<th>SCHED.</th>
<th>PARAMETERS/VALUES</th>
<th>NO. OF RUNS</th>
<th>VERTICAL SEPARATION DISTANCE (A/E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R6O621</td>
<td>ORBITER (IN PER-</td>
<td>0</td>
<td>4.0 15 289</td>
<td></td>
<td>65 67 69 70</td>
</tr>
<tr>
<td>R6O622</td>
<td>SENSE OF TANKS</td>
<td>0</td>
<td>4.0 15 457</td>
<td></td>
<td>66 68</td>
</tr>
<tr>
<td>R6O701</td>
<td>TANK (IN PRESENCE OF CRATER)</td>
<td>0</td>
<td>0.6 0 1.142</td>
<td>13 7 10</td>
<td>11 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>02</td>
<td>5 1.452</td>
<td>14 15 16</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>03</td>
<td>0 1.033</td>
<td>18 17 19</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>04</td>
<td>0 0.389</td>
<td>8 9 12</td>
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<tr>
<td></td>
<td></td>
<td>05</td>
<td>0 0.389</td>
<td>45 39 41</td>
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<td></td>
<td></td>
<td>06</td>
<td>0 0.389</td>
<td>38 40 42</td>
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<td>07</td>
<td>0 1.433</td>
<td>30 38 35</td>
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<td>5 1.433</td>
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<td>09</td>
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<td>44 45 33</td>
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<td>5 1.433</td>
<td>97 79 102</td>
<td>6</td>
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<td>4.0 0 1</td>
<td>100 101</td>
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<td>21 103 104</td>
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<td>50 81 53</td>
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<td>5 1.433</td>
<td>46 47</td>
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<tr>
<td></td>
<td></td>
<td>15</td>
<td>5 1.433</td>
<td>13 20 33</td>
<td></td>
</tr>
</tbody>
</table>

**SCHEDULES**

- A) -5°, -3°, 2°, 4°, 6°, 8°, 10°, 12°, 14°, 16°, 20° (GND ANGLE OF ATTACK)

**COEFFICIENTS:**

- [IDPVAR(1)] [IDPVAR(2)] [IDPVAR(3)]

**COMMENTS:**

NASS-MPIC-3AP1
<table>
<thead>
<tr>
<th>DATA SET IDENTIFIER</th>
<th>CONFIGURATION</th>
<th>SCMD.</th>
<th>PARAMETERS/VALUES</th>
<th>NO. OF RUNS</th>
<th>VERTICAL SEPARATION DISTANCE - Z/E</th>
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<tbody>
<tr>
<td>RLQ814w1</td>
<td>TANK (In Presence of Device)</td>
<td>A</td>
<td>4.0</td>
<td>5</td>
<td>5.12</td>
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<tr>
<td>17</td>
<td></td>
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</tr>
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<td>18</td>
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<td>22</td>
<td></td>
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<td></td>
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</tbody>
</table>

COEFFICIENTS:

A) -0.3, 0.2, 0.2, 0.6, 0.8, 1.0, 1.2, 1.4, 1.6, 1.8, 2.0 (CUR ANGLE OR ANGLE)

NASA-MSFC-MSF
**TABLE II. MODEL COMPONENT DESCRIPTIONS**

**MODEL COMPONENT: BODY - B**

**GENERAL DESCRIPTION:** 040A Orbiter Body

**DRAWING NUMBER:** JLP SDD 9-24-71

**DIMENSIONS:**

<table>
<thead>
<tr>
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<th>FULL-SCALE</th>
<th>MODEL SCALE</th>
<th>ACTUAL MEASURED</th>
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<tr>
<td>Length</td>
<td>1315.</td>
<td>7.89</td>
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</tr>
<tr>
<td>Max. Width</td>
<td>204.</td>
<td>1.224</td>
<td></td>
</tr>
<tr>
<td>Max. Depth</td>
<td>238.</td>
<td>1.427</td>
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</tr>
<tr>
<td>Fineness Ratio</td>
<td>7.07</td>
<td>7.07</td>
<td></td>
</tr>
<tr>
<td>Area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Cross-Sectional</td>
<td>306.2 ft²</td>
<td>1.590 in²</td>
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</tr>
<tr>
<td>Planform</td>
<td>1676. ft²</td>
<td>8.68 in²</td>
<td></td>
</tr>
<tr>
<td>Wetted</td>
<td>6530. ft²</td>
<td>33.8 in²</td>
<td></td>
</tr>
<tr>
<td>Base</td>
<td>798. ft²</td>
<td>1.546 in²</td>
<td></td>
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</tbody>
</table>
### TABLE II. MODEL COMPONENT DESCRIPTIONS (Continued)

**MODEL COMPONENT:** WING, \( W_M \)

**GENERAL DESCRIPTION:** 040A Orbiter clipped delta wing

**DRAWING NUMBER:**

**DIMENSIONS:**

<table>
<thead>
<tr>
<th>TOTAL DATA</th>
<th>THEORETICAL</th>
<th>ACTUAL MEASURED</th>
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<tr>
<td></td>
<td>FULL-SCALE</td>
<td>MODEL SCALE</td>
</tr>
<tr>
<td>Area</td>
<td>3155.3 ( \text{ft}^2 )</td>
<td>16.357 ( \text{ft}^2 )</td>
</tr>
<tr>
<td>Wetted Span (equivalent)</td>
<td>5360. ( \text{ft}^2 )</td>
<td>27.8 ( \text{in}^2 )</td>
</tr>
<tr>
<td>Aspect Ratio</td>
<td>1.712</td>
<td>1.712</td>
</tr>
<tr>
<td>Rate of Taper</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Taper Ratio</td>
<td>1.986</td>
<td>1.986</td>
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<td>Dihedral Angle, degrees</td>
<td>7.0</td>
<td>9.0</td>
</tr>
<tr>
<td>Incidence Angle, degrees</td>
<td>1.5</td>
<td>1.5</td>
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<tr>
<td>Aerodynamic Twist, degrees</td>
<td>8.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Toe-In Angle</td>
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<td>--</td>
</tr>
<tr>
<td>Cant Angle</td>
<td>--</td>
<td>--</td>
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<td>Sweep Back Angles, degrees</td>
<td>60.0</td>
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<td>Leading Edge</td>
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<td>Trailing Edge</td>
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<td>0.0</td>
</tr>
<tr>
<td>0.25 Element Line</td>
<td>52.4</td>
<td>52.4</td>
</tr>
<tr>
<td>Chords:</td>
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<td></td>
</tr>
<tr>
<td>Root (Wing Sta. 0.0)</td>
<td>897.0</td>
<td>5.38</td>
</tr>
<tr>
<td>Tip, (equivalent)</td>
<td>133.3</td>
<td>53.3</td>
</tr>
<tr>
<td>MAC</td>
<td>809.6</td>
<td>3.657</td>
</tr>
<tr>
<td>Fus. Sta. of .25 MAC</td>
<td>1057.5</td>
<td>6.38</td>
</tr>
<tr>
<td>W.P. of .25 MAC</td>
<td>302.3</td>
<td>1.812</td>
</tr>
<tr>
<td>B.L. of .25 MAC</td>
<td>185.7</td>
<td>0.996</td>
</tr>
<tr>
<td>Airfoil Section</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Root</td>
<td>NACA 0008-64</td>
<td>NACA 0008-64</td>
</tr>
<tr>
<td>Tip</td>
<td>NACA 0008-64</td>
<td>NACA 0008-64</td>
</tr>
</tbody>
</table>

**EXPOSED DATA**

| Area                        | 2010. \( \text{ft}^2 \) | 14.45 \( \text{in}^2 \) |
| Span, (equivalent)          | 678.0       | 4.07             |
| Aspect Ratio                | 1.590       | 1.590            |
| Taper Ratio                 | 1.850       | 1.850            |
| Chords:                     |             |                 |
| Root                        | 720.0       | 4.32             |
| Tip                         | 133.3       | 53.3             |
| MAC                         | 424.0       | 2.97             |
| Fus. Sta. of .25 MAC        | 1145.5      | 6.87             |
| W.P. of .25 MAC             | 308.3       | 1.87             |
| B.L. of .25 MAC             | 232.8       | 1.397            |

MSFC - Page 3 of 9 (February 1973)
### TABLE II. MODEL COMPONENT DESCRIPTIONS (Continued)

**MODEL COMPONENT:** ELEVONS, \( W_{1W} \)

**GENERAL DESCRIPTION:**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Full-Scale</th>
<th>Model Scale</th>
<th>Model Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>456 ft(^2)</td>
<td>2.36 in(^2)</td>
<td></td>
</tr>
<tr>
<td>Span (equivalent)</td>
<td>556</td>
<td>3.33</td>
<td></td>
</tr>
<tr>
<td>Inb'd equivalent chord</td>
<td>118</td>
<td>.708</td>
<td></td>
</tr>
<tr>
<td>Outb'd equivalent chord</td>
<td>118</td>
<td>.708</td>
<td></td>
</tr>
<tr>
<td>Ratio movable surface chord/total surface chord</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At Inb'd equiv. chord</td>
<td>.1662</td>
<td>.1662</td>
<td></td>
</tr>
<tr>
<td>At Outb'd equiv. chord</td>
<td>.517</td>
<td>.517</td>
<td></td>
</tr>
<tr>
<td>Sweep Back Angles, degrees</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leading Edge</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Tailing Edge</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Hingeline</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Area Moment (Normal to hinge line)</td>
<td>2240 ft(^3)</td>
<td>.835 in(^2)</td>
<td></td>
</tr>
</tbody>
</table>
TABLE II. MODEL COMPONENT DESCRIPTIONS (Continued)

MODEL COMPONENT: VERTICAL TAIL - V,  
GENERAL DESCRIPTION: CENTERLINE STABILIZER  

DRAWING NUMBER: JLP SDD 9-24-71

<table>
<thead>
<tr>
<th>DIMENSIONS:</th>
<th>THEORETICAL</th>
<th>ACTUAL MEASURED</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL DATA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area</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></td>
<td></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>
<td></td>
</tr>
<tr>
<td>Diehedral Angle, degrees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incidence Angle, degrees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aerodynamic Twist, degrees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toe-In Angle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cant Angle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweep Back Angles, degrees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leading Edge</td>
<td></td>
<td>95</td>
</tr>
<tr>
<td>Trailing Edge</td>
<td></td>
<td>45</td>
</tr>
<tr>
<td>0.25 Element Line</td>
<td>39.23</td>
<td>39.23</td>
</tr>
<tr>
<td>Chords:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>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</td>
<td>V MACA 0012-64</td>
<td>0012-64</td>
</tr>
<tr>
<td>Root</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXPOSED DATA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area</td>
<td>51,030.051</td>
<td>1.837</td>
</tr>
<tr>
<td>Span, (equivalent)</td>
<td>270.0</td>
<td>1.520</td>
</tr>
<tr>
<td>Aspect Ratio</td>
<td>1.42857</td>
<td>1.42857</td>
</tr>
<tr>
<td>Taper Ratio</td>
<td>0.31250</td>
<td>0.31250</td>
</tr>
<tr>
<td>Chords:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Root</td>
<td>288.0</td>
<td>1.728</td>
</tr>
<tr>
<td>Tip</td>
<td>90.0</td>
<td>0.540</td>
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<tr>
<td>MAC</td>
<td>206.286</td>
<td>1.238</td>
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<td>Fus. Sta. of .25 MAC</td>
<td>1.42857</td>
<td>8.528</td>
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<tr>
<td>W.P. of .25 MAC</td>
<td>511.426</td>
<td>1.652</td>
</tr>
<tr>
<td>B.L. of .25 MAC</td>
<td></td>
<td></td>
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</table>
TABLE II. MODEL COMPONENT DESCRIPTIONS (Continued)

MODEL COMPONENT: \( V,\) RUDDER

GENERAL DESCRIPTION:

<table>
<thead>
<tr>
<th>DIMENSIONS:</th>
<th>THEORETICAL</th>
<th>ACTUAL MEASURED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FULL-SCALE</td>
<td>MODEL SCALE</td>
</tr>
<tr>
<td>Area</td>
<td>135.6 ft(^2)</td>
<td>.702 in.(^2)</td>
</tr>
<tr>
<td>Span (equivalent)</td>
<td>246.3</td>
<td>1.475</td>
</tr>
<tr>
<td>Inb'd equivalent chord</td>
<td>115.</td>
<td>.690</td>
</tr>
<tr>
<td>Outb'd equivalent chord</td>
<td>43.8</td>
<td>.263</td>
</tr>
<tr>
<td>Ratio movable surface chord/total surface chord</td>
<td>At Inb'd equiv. chord</td>
<td>.40</td>
</tr>
<tr>
<td></td>
<td>At Outb'd equiv. chord</td>
<td>.40</td>
</tr>
<tr>
<td>Sweep Back Angles, degrees</td>
<td>Leading Edge</td>
<td>29.1</td>
</tr>
<tr>
<td></td>
<td>Tailing Edge</td>
<td>15.0</td>
</tr>
<tr>
<td></td>
<td>Hingeline</td>
<td>29.1</td>
</tr>
<tr>
<td>Area Moment (Normal to hinge line)</td>
<td>448 ft(^3)</td>
<td>.145 in.(^3)</td>
</tr>
</tbody>
</table>

DRAWING NUMBER: JLP SDD 9-24-71
### TABLE II. MODEL COMPONENT DESCRIPTIONS (Continued)

**MODEL COMPONENT:**  BODY - HO Tank - T

**GENERAL DESCRIPTION:**

Blunt cone-cylinder centerline tank with aft boat tail.

\[ \theta_{cone} = 15^\circ \]. Nose radius = 22 in. full-scale.

Diameter at base = 274 in. full-scale.

**DRAWING NUMBER:**

**DIMENSIONS:**

<table>
<thead>
<tr>
<th></th>
<th>THEORETICAL</th>
<th>ACTUAL MEASURED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>1867 in.</td>
<td>11.205 in.</td>
</tr>
<tr>
<td>Max. Width</td>
<td>301 in.</td>
<td>1.806 in.</td>
</tr>
<tr>
<td>Max. Depth</td>
<td>301 in.</td>
<td>1.806 in.</td>
</tr>
<tr>
<td>Fineness Ratio</td>
<td>6.2</td>
<td>6.2</td>
</tr>
<tr>
<td>Max. Cross-Sectional Area</td>
<td>494 ft^2</td>
<td>2.562 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>422 in. (^2)</td>
<td>2.125 in. (^2)</td>
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</table>

MSFC - Form 265-6 (February 1978)
<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>0.6</td>
<td>4.7</td>
<td>4.35</td>
<td>100</td>
</tr>
<tr>
<td>1.96</td>
<td>7.5</td>
<td>10.97</td>
<td>100</td>
</tr>
<tr>
<td>4.00</td>
<td>6.2</td>
<td>5.53</td>
<td>140</td>
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BALANCE UTILIZED: MSFC BALANCE NO. 232 AND 227

CAPACITY:  

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<th>NF</th>
<th>SF</th>
<th>AF</th>
<th>PM</th>
<th>TH</th>
<th>RN</th>
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</thead>
</table>

ACCURACY:  

<table>
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<th>SF</th>
<th>AF</th>
<th>PM</th>
<th>TH</th>
<th>RN</th>
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</table>

COEFFICIENT TOLERANCE:  

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<th>SF</th>
<th>AF</th>
<th>PM</th>
<th>TH</th>
<th>RN</th>
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</table>

COMMENTS:  

18
<table>
<thead>
<tr>
<th>FIGURE</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Space Shuttle Parallel Staging System for the MSFC 1(\frac{3}{4}) x 1(\frac{3}{4})-Inch Trisonic Wind Tunnel</td>
<td>21</td>
</tr>
<tr>
<td>2</td>
<td>General Arrangement, MSC O40-A Orbiter</td>
<td>22</td>
</tr>
<tr>
<td>3</td>
<td>B(_1), Baseline Fuselage</td>
<td>23</td>
</tr>
<tr>
<td>4</td>
<td>Wing Flap and Elevon - (W_{1W})</td>
<td>24</td>
</tr>
<tr>
<td>5</td>
<td>(V_{1}), Vertical Tail and Rudder</td>
<td>25</td>
</tr>
<tr>
<td>6</td>
<td>HO Tank, (T_1)</td>
<td>26</td>
</tr>
<tr>
<td>7</td>
<td>Separation Variable Grid</td>
<td>27</td>
</tr>
<tr>
<td>8</td>
<td>Base and Cavity Pressure Locations</td>
<td>28</td>
</tr>
</tbody>
</table>
TABLE V
INDEX TO DATA FIGURES

<table>
<thead>
<tr>
<th>TITLE</th>
<th>COEFFICIENTS PLOTTED</th>
<th>CONDITIONS VARYING</th>
<th>PAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effect of Tank Separation Distance on Orbiter Longitudinal Characteristics</td>
<td>A</td>
<td>$\Delta z/c$</td>
<td>1-66</td>
</tr>
<tr>
<td>Effect of Orbiter Separation Distance on Tank Longitudinal Characteristics</td>
<td>A</td>
<td>$\Delta z/c$</td>
<td>67-132</td>
</tr>
<tr>
<td>Summary Stability Data for Orbiter in Proximity of Tank</td>
<td>B</td>
<td>$\Delta x/c$</td>
<td>133-148</td>
</tr>
<tr>
<td>Summary Stability Data for Tank in Proximity of Orbiter</td>
<td>B</td>
<td>$\Delta x/c$</td>
<td>149-174</td>
</tr>
</tbody>
</table>

COEFFICIENTS PLOTTED:

A) CN, CLM, CA vs $\alpha$

B) DCN/DA, DCLMDA, DCA/DA, CNAF$, \ CMAF$, CAAF$ vs \Delta z/c$. 
Fig. 1 - Space Shuttle Parallel Staging System for the MSFC 14 x 14-Inch Trisonic Wind Tunnel
FIGURE 2 - GENERAL ARRANGEMENT, MSC 040 A ORBITER

Note: All dimensions are model scale inches.
FIGURE 3 - B1 BASELINE FUSELAGE

Note: All dimensions are model scale in inches.
FIGURE 4 - WING, FLAP AND ELEVON - W1Y

Notes: All dimensions are model scale in inches.
Surface flaps shown in undeflected position.

50% b_{exp.}
B.L. 1.669

0.044
(const.)

0.611

0.305

Hingeline

1.577

1.048

0.708

0.648

2.316

5.292

B.L. 0.00
60°

5.38

B.L. 2.100

0.800

5% Chord

35% Chord

7°
FIGURE 5 - V1  VERTICAL TAIL AND RUDDER

\[ S_v = 1.837 \text{ in.}^2 \quad C_R = 1.728 \]
\[ b = 1.626 \quad C_T = 0.540 \]
\[ \bar{c} = 1.238 \quad \lambda = 0.31 \]
\[ AR = 1.43 \quad \lambda_{L.E.} = 45^\circ \]

Notes: All dimensions are model scale in inches.
Vertical tail attached at B.L. 0.00.
FIGURE 6. HO TANK, T₁

Moment reference center

0.132 rad.

15°

3.000

6.222

11.11

0.640

288

1.66

1.806

All dimensions are model scale, in inches.
Notes:
1. Tank shown in "mated" position.
2. Dimensions are in feet full scale.

<table>
<thead>
<tr>
<th>X, full scale, ft measured from &quot;mated&quot; position</th>
<th>X/Ś measured from Orbiter MRC to tank MRC</th>
<th>Z, full scale, ft measured from &quot;mated&quot; position</th>
<th>Z/Ś measured from Orbiter MRC to tank MRC</th>
</tr>
</thead>
<tbody>
<tr>
<td>-50</td>
<td>-1.232</td>
<td>0</td>
<td>.3949</td>
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<tr>
<td>-35</td>
<td>.2705</td>
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<td>-25</td>
<td>.3690</td>
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<td>.5918</td>
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<td>-20</td>
<td>.4674</td>
<td>12</td>
<td>.6312</td>
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<td>-10</td>
<td>.6629</td>
<td>15</td>
<td>.7493</td>
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<td>0</td>
<td>.8612</td>
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<td>.7887</td>
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<td>10</td>
<td>1.0536</td>
<td>30</td>
<td>.9896</td>
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<tr>
<td>20</td>
<td>1.2549</td>
<td>40</td>
<td>1.1825</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50</td>
<td>1.3754</td>
</tr>
</tbody>
</table>

Figure 7 - Separation Variable Grid.
FIGURE 8. BASE AND CAVITY PRESSURE LOCATIONS
Tabulations of the plotted data and corresponding source data are available from SADSAC Operations.
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION
1 0.000 BETA 0.000 MACH 0.000 GREF 10.000
2 0.083 DELTA 0.001 ALPHAI 0.001 ENST 9.000
3 0.000
4 0.700
5 0.000

DATA HIST. CODE 86

MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (S60001) 08 JUN 72 PAGE 1
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

PITCHING MOMENT COEFFICIENT, CLM

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES
0.000 BETA 0.000 MACH 0.000
0.599 DELTAZ 0.001 ALPHA 0.000
0.900
0.700
0.500

REFERENCE INFORMATION
GREF 15.2770 58. IN.
LREF 3.5700 IN.
SHF 5.2070 IN.
THF 0.0000 IN.
SCALE 0.0000 SCALE

DATA MNR. CODE 99

MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (S60001) 08 JUN 72 PAGE 2
EFFECT OF TANK SEPARATION DISTANCE (DELTA Z) ON ORBITER LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

ORBITER ANGLE OF ATTACK, ALPH: DEGREES

PARAMETER VALUES
0.4000
0.8000

DATE
06 JUN 72

PAGE
3
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

NORMAL FORCE COEFFICIENT, CN

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION
A 0.992 DELTAZ 1.254 ALPHA 0.000 REF 10.0000 80. IN.
D 0.992 DELTAZ 1.254 ALPHA 0.000 LDF 5.0000 IN.
D 0.750 DELTAZ 1.254 ALPHA 0.000 BRF 4.0000 IN.
D 0.000 DELTAZ 1.254 ALPHA 0.000 TDF 0.0000 IN.
D 0.000 DELTAZ 1.254 ALPHA 0.000 WRF 0.0000 IN.
D SCALE 0.0000 SCALE

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (AG0004) 10 MAY 72 PAGE 4
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

SYMBOLE DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION

-0.055 BETA 0.000 MACH 0.000 LEFP 18.5370 18.1N.

-0.020 DELTAZ 1.004 ALPHA1 0.000 LEPF 5.6510 IN.

-0.005 BETA 0.000 MACH 0.000 THF 5.0200 IN.

0.000 BETA 0.000 MACH 0.000 TNP 0.0000 IN.

REFERENCE FILE

MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60004) 10 MAY 72 PAGE 5
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

AXIAL FORCE COEFFICIENT, CA

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION

MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A6004) 10 MAY 72 PAGE 6
EFFECT OF TANK SEPARATION DISTANCE (DELTA Z) ON ORBITER LONG. CHARACTERISTICS

NORMAL FORCE COEFFICIENT, CN

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTA PARAMETRIC VALUES REFERENCE INFORMATION

0.000 BETA 0.000 MACH 0.600 BREF 16.2970 66. IN.

0.000 DELTA 0.000 ALPHA 0.600 LREF 2.0970 IN.

0.000 DELTA 0.600 ALPHA 0.800 XREF 0.0070 IN.

0.000 DELTA 0.000 MACH 0.800 YREF 0.0000 IN.

REFERENCE FILE

MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60002) 10 MAY 72 PAGE 7
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

SYMBOL | DELTAZ | PARAMETRIC VALUES | REFERENCE INFORMATION
-------|--------|-------------------|-----------------------
X      | 0.000  | DELTAZ 0.000 MACH 0.000 | REF 10.575 76.1 IN.
O      | 0.769  | DELTAZ 0.000 MACH 0.000 | RELF 5.2850 76.1 IN.
L      | 0.000  | DELTAZ 0.000 MACH 0.000 | VHEL 5.2070 76.1 IN.
|       |       |                  | THMP 0.0000 76.1 IN.
|       |       |                  | EMEF 0.0000 76.1 IN.
|       |       |                  | SCALE 0.0000 SCALE

REFERENCE FILE
MSC TWT 531 ORBITER IN PROXIMITY TO TANK (AG0002) 10 MAY 72 PAGE 8
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA.

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION
\( \triangle \) 0.993 \( \beta \) 0.000 MACH 0.600 REF 16.2570 80.1 IN.
\( \Delta \) 0.992 DELTA 0.641 ALPHA 8.000
\( \circ \) 0.700
\( \bullet \) 0.000

REFERENCE FILE
MSC 1WT 531 ORBITER IN PROXIMITY TO TANK (AG0007) 10 MAY 72 PAGE 9
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

NORMAL FORCE COEFFICIENT, CN

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION
0.000 0.000 0.000
0.700 1.000 0.000
0.709 0.000

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60003) 10 MAY 72 PAGE 10
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

SYMBOL DELTAZ PARAMETRIC VALUES
0.033 BETA 0.000 MACH 0.600
0.033 DELTA 1.234 ALPHA 9.000

REFERENCE INFORMATION
BREK 15.3750 84.1IN.
LRF 5.6570 1IN.
SNAP 1.2070 1IN.
TANK 6.0000 1IN.
SCALE 0.0000 1IN.

REFERENCE FILE
MSFC TWI 531 ORBITER IN PROXIMITY TO TANK (A60003) 10 MAY 72 PAGE 11
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

NORMAL FORCE COEFFICIENT, CN

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES
O 0.750 BETA 0.000 MACH 1.000
O 0.750 DELTAZ - 0.185 ALPHA 0.000
O 0.000

REFERENCE INFORMATION
MAR 10.3970 MM.1M.
LREF 10.3970 MM.1M.
EREF 10.3970 MM.1M.
NREF 10.3970 MM.1M.
ZREF 0.0000 MM.1M.
SCALE 0.0000 SCALE

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60007) 10 MAY 72 PAGE 13
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

SYMBOl DELTAZ  PARAMETER VALUES  REFERENCE INFORMATION
O  0.700  DELTA  0.000  MACH  1.000  SREF  16,975  0 IN.
O  0.875  DELTAZ  0.125  ALPHA1  6.000  LREF  6.075  IN.
O  8.600  DELTAZ  0.250  ALPHA1  6.000  SREF  8.075  IN.
O  0.600  DELTAZ  0.375  ALPHA1  6.000  ZREF  0.000  IN.
O  0.000  DELTAZ  0.500  ALPHA1  6.000  SCALE  0.0000  SCALE

REFERENCE FILE
MSFC  TWT  531  ORBITER IN PROXIMITY TO TANK  (AG0007)  10 MAY 72  PAGE 15
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

-NORMAL FORCE COEFFICIENT, CN

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ BETA MACH

0.769 0.000 5.000

0.000 0.000 0.000

REFERENCE INFORMATION

MSFC TWI 531 ORBITER IN PROXIMITY TO TANK (A60006) 10 MAY 72 PAGE 16
EFFECT OF TANK SEPARATION DISTANCE (DELTA Z) ON ORBITER LONG. CHARACTERISTICS

---

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

PITCHING MOMENT COEFFICIENT, CLM

SYMBOL DELTA Z PARAMETRIC VALUES

0.700 BETA 0.000 MACH 1.960

1.375 DELTA Z 0.240 ALPHA 0.000

9.000

REFERENCE INFORMATION

BREF 10.0070 IN.

LREF 12.0070 IN.

DREF 14.0070 IN.

THRP 0.0000 IN.

SCALE 0.0000 SCALE

REFERENCE FILE

MSFC IWT 531 ORBITER IN PROXIMITY TO TANK (A6000G) 10 MAY 72 PAGE 17
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT CA.

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

REFERENCE INFORMATION
BREF 16.3570 80 IN.
LBF 3.0570 IN.
LHP 0.3900 1N.
MHP 0.0000 1N.
SCALE 0.0000 SCALE

REFERENCE FILE
MSFC T 531 ORBITER IN PROXIMITY TO TANK (A60006) 10 MAY 72 PAGE 18
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

SYMBOL DELTAZ PARAMETRIC VALUES

\[
\begin{array}{llll}
0.398 & \text{DETA} & 0.000 & \text{MACH} \quad 1.960 \\
0.393 & \text{DETA} & 0.885 & \text{ALPHAI} \quad 0.000 \\
0.769 & \text{DETA} & 0.885 & \text{ALPHAI} \quad 0.000 \\
1.375 & \text{DETA} & 0.885 & \text{ALPHAI} \quad 0.000 \\
5.000 & \text{DETA} & 0.885 & \text{ALPHAI} \quad 0.000 \\
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REFERENCE INFORMATION

SREF 16.9570 IN.
LREF 5.0000 IN.
SNRP 0.0000 IN.
SCALE 0.0000 SCALE

REFERENCE FILE

MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60005) 10 MAY 72
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

SYMBOL: DELTAZ  PARAMETRIC VALUES

0 0.900  GSI  0.000  MACH  1.000
0.950  DELTAZ  0.001  ALPHA  0.000
0.700
1.970
5.000

REFERENCE INFORMATION

MSFC TWI 531 ORBITER IN PROXIMITY TO TANK  (A60005)  10 MAY 72 PAGE 20
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION
C 0.395 BETA 0.000 MACH 1.980 SCALE 0.0000 SCALE
O 0.593 DELTAK 0.881 ALPHA 0.000 SELL 16.3570 60.1 IN.
O 0.789
O 1.373
O 9.000 LREF 6.9590 IN.
O 0.4000 IN.
O 0.0000 IN.
O 0.0000 IN.
O 0.0000 IN.

REFERENCE FILE

MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A600CS) 10 MAY 72 PAGE 21
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

SYMBOL DELTAZ PARAMETRIC VALUES
O 0.759 BETA 0.007 MACH 5.000
A 1.975 DELTAZ - 0.129 ALPHA 5.000
O 5.000

REFERENCE INFORMATION
SREF 10.2270 60. IN.
LSEF 9.3270 IN.
SREP 5.0070 IN.
SNRP 6.0000 IN.
SREP 6.0000 IN.
SCALE 0.0000 SCALE

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60008) 10 MAY 72 PAGE 23
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

SYMBOL  DELTAZ  PARAMETRIC VALUES
  O   9,792  BETA  0.000  RACH  1.200
  X   1,979  DELTAX  0.000  ALPHA  0.000

REFERENCE INFORMATION
  NREF  16.0700  IN.
  LREI  1.0070  IN.
  ZREI  1.0000  IN.
  THR  0.0000  IN.
  SCALE  0.0000  SCALE

REFERENCE FILE
MSFC  IWT 531  ORBITER IN PROXIMITY TO TANK  (A60009)  10 MAY 72  PAGE 25
EFFECT OF TANK SEPARATION DISTANCE (DELTAz) ON ORBITER LONG. CHARACTERISTICS

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL  DELTAz  PARAMETRIC VALUES  REFERENCE INFORMATION
O   0.789  BETA  0.000  MACH  1.900  BREF 10.5570  SEC IN.
A   1.975  DELTAz  0.000  ALFA  5.000  BREF 8.2570  IN.
O   0.060

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60009) 10 MAY 72 PAGE 26
EFFECT OF TANK SEPARATION DISTANCE (DELTAT) ON ORBITER LONG. CHARACTERISTICS
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

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REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60010) 10 MAY 72 PAGE 29
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

SYMBOL DELTAZ PARAMETRIC VALUES

O 0.250 BETA 0.000 Mach 1.818
O 0.750 DELTAZ 0.001 Alpha 9.000
O 1.250 0.000
O 1.750

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60010) 10 MAY 72 PAGE 30
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

SYMBOL DELTAZ PARAMETER VALUES
0.200 DELTA 0.000 4.000
0.500 DELTA 0.661 4.000
0.800 DELTA 0.900 4.000
1.000 DELTA 1.000 4.000

REFERENCE INFORMATION
REFF 10.000 80.0 IN.
LEFF 3.000 11.0 IN.
BEFF 0.000 16.0 IN.
LEFF 0.000 16.0 IN.
SNAP 0.000 16.0 IN.
SCALE 0.0000 16.0 IN.

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60011) 10 MAY 72 PAGE 34
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

SYMBOL: DELTA  PARAMETRIC VALUES: REFERENCE INFORMATION

O 0.000  BETA  0.000  MACH  4.000  REF  60.25  IN.
\ 0.000  DELTAX  0.000  ALPHA1  0.000  LREF  3.8570  IN.
D 0.000  O  0.000  BREF  3.2070  IN.
\ 0.000  TREF  2.2070  IN.
\ 0.000  TIMP  0.0000  IN.
\ 0.000  SCALE  0.0000  SCALE

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (AG00211) 10 MAY 72 PAGE 35
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION

0.000 DETA 0.000 MACH 0.000 SREP 10.0000 IN.

0.000 DETA 0.000 MACH 0.000 SREP 2.0000 IN.

0.000 DELTA 0.041 ALPHA 0.000 TREP 0.0000 IN.

REFERENCE FILE

MSFC TVT 531 ORBITER IN PROXIMITY TO TANK  (AG0011) 10 MAY 72 PAGE 36
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

SYMBOL DELTAZ PARAMETRIC VALUES
\(\Delta\) 0.00 0.00 0.00 0.00 0.00
\(\Delta\) 0.000 DELTA 0.000 MACH 4.000
\(\Delta\) 0.000 DELTA 0.000 ALPHA 0.000

REFERENCE INFORMATION

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60012) 10 MAY 72 PAGE 37
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

SYMBOL DELTAZ PARAMETRIC VALUES
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| LNP | 2.000 | LN. |
| LFNP | 0.000 | LN. |
| SCALE | 0.000 | SCALE |

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK

(A60012) 10 MAY 72 PAGE 38
EFFECT OF TANK SEPARATION DISTANCE (DELTZ) ON ORBITER LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTA PARAMETRIC VALUES
△ 0.993 DELTA 0.000 RACH 4.000
◇ 0.992 DELTAX 1.686 ALPHA1 0.000

REFERENCE INFORMATION
MEP 10.3170 66 IN.
LREF 3.6370 IN.
DEF 1.6390 IN.
THP 0.0070 IN.
SHP 0.0080 IN.
SCALE 0.0000 SCALE

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60012) 10 MAY 72 PAGE 39
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

PITCHING MOMENT COEFFICIENT, CLM

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

REFERENCE INFORMATION
SREF 16.3570 66.9 IN.
LEEF 6.6570 IN.
MEDF 9.6570 IN.
THEP 5.1070 IN.
THEP 0.0000 IN.
SCALE 0.0000 SCALE

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60017) 10 MAY 72 PAGE 41
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

NORMAL FORCE COEFFICIENT, CN

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

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REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60014) 10 MAY 72 PAGE 43
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION
O 0.000 BETA 0.000 MACH 4.000 BREF 16.3370 80. IN.
O 0.001 DELTAZ 0.000 ALPHA 5.000 LREF 3.8570 IN.
O 0.000 BETA 0.000 MACH 4.000 NREF 8.2070 IN.
O 0.000 BETA 0.000 MACH 4.000 SNREF 0.0000 IN.
O 0.000 BETA 0.000 MACH 4.000 SCALE 0.0000 SCALE

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (AG60014) 10 MAY 72 PAGE 44
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

SYMBOL DELTAZ PARANMETRIC VALUES REFERENCE INFORMATION
O 0.033 BETA 0.000 MACH 4.000 SPRI 10.3790 10.1IN.
A 0.031 DELTAZ 0.002 ALPHA 5.000 LREF 5.9790 IN.
D 0.031 BETA 0.000 MACH 4.000 BREF 5.9790 IN.
E 0.000 BETA 0.000 MACH 4.000 NREF 5.8070 IN.
F 0.000 DELTAZ 0.002 ALPHA 5.000 NRFP 5.8070 IN.
G 0.000 DELTAZ 0.002 ALPHA 5.000 ZRFP 0.0000 IN.
H 0.000 DELTAZ 0.002 ALPHA 5.000 SCALE 0.0000 SCALE

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60014) 10 MAY 72 PAGE 45
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

SYMBOL DELTAZ PARAMETRIC VALUES

REF 1.0, 0.0, 0.0, 0.0

REFERENCE INFORMATION

REF 1.0, 0.0, 0.0, 0.0

REFERENCE FILE

MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60016) 10 MAY 72 PAGE 46
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION

\[\bullet\] 0.000 0.000 BETA 0.000 RACH 0.000 BREF 2.00 IN.

\[\diamondsuit\] 0.000 0.000 DELTAZ 0.000 ALPHA1 0.000 LREF 2.00 IN.

\[\triangle\] 0.000 0.000 G.000 M.000 UREF 2.00 IN.

\[\square\] 0.000 0.000 N.000 T.000 TREF 0.00 IN.

\[\circ\] 0.000 0.000 O.000 Z.000 S.000 SREF 0.00 IN.

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (AG0016) 10 MAY 72 PAGE 40
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION
○ 0.573 BETA 0.000 MACH 4.000 SHEPP 2.000 IN.
○ 0.592 DELTA 1.000 ALPHA 5.000 SHEPP 1.8750 IN.
○ 0.000

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60015) 10 MAY 72 PAGE 49
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

PITCHING MOMENT COEFFICIENT, CLM

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A600151) 10 MAY 72 PAGE 50
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

NORMAL FORCE COEFFICIENT, CN

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION
0.740 BETA 0.000 MACH 4.000 REF 16.317C 66.1N.
0.790 DELTA 0.875 ALPHA 10.000 LSEF 3.9560 IN.
0.840
1.163 ZHP 0.000 IN.
2.000 ZHP 0.000 IN.
5.000 SCALE 0.0000 SCALE

DATA: MIST. CODE: N
MSFC TWI 531 ORBITER IN PROXIMITY TO TANK (F60020) 08 JUN 72 PAGE 52
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

SYMBOL  DELTAZ  PARAMETRIC VALUES  REFERENCE INFORMATION
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   0.806  I.193  5.000  XMREF 1.8070  IN.
   8.000  VMREF 0.0000  IN.
   8.000  ZMREF 0.0000  IN.
   8.000  SCALE 0.0000  SCALE

DATA HIST. CODE M

MSFC  TWT 531 ORBITER IN PROXIMITY TO TANK  (F60020)  08 JUN 72  PAGE 53
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

PITCHING MOMENT COEFFICIENT, CLM

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A6001B) 10 MAY 72 PAGE 56
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

SYMBOL DELTAZ PARAMETRIC VALUES ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

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MSFC TWI 531 ORBITER IN PROXIMITY TO TANK (AG0018) 10 MAY 72 PAGE 57
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

NORMAL FORCE COEFFICIENT, CN

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES

REFERENCE INFORMATION

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60019) 10 MAY 72 PAGE 58
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONGITUDINAL CHARACTERISTICS

PITCHING MOMENT COEFFICIENT, CLM

ORBITER ANGLE OF ATTACK, ALPHAI, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION
○ 0.631 DEBT 0.000 MACH 4.000 BRF 16.5520 20.7 IN.
△ 0.789 DELTAZ 0.002 ALPHAI 10.000 LRF 0.9770 IN.
● 0.002 DEBT 0.000 MACH 4.000 HRF 9.8600 IN.
THDP 0.0000 IN.
ZHP 0.0000 IN.
SCALE 0.0625 SCALE

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60019) 10 MAY 72 PAGE 59
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION

O 0.251 BETA 0.000 MACH 4.000 REF 16.5170 50. IN.

A 0.749 DELTAZ 0.000 ALPHA 10.000 REF 5.6250 IN.

° 0.000 REF 5.000 IN.

REFERENCE FILE
MSFC T11 531 ORBITER IN PROXIMITY TO TANK (A60019) 10 MAY 72 PAGE 60
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

NORMAL FORCE COEFFICIENT, Cn

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL  DELTAZ  PARAMETRIC VALUES  REFERENCE INFORMATION
0.749  BETA  0.000  MACH  4.000  REF  10.3570  60, IN.
0.700  DELTAX  0.870  ALPHA1  10.000  LREF  3.0537  IN.
0.588  DELTAX  0.870  ALPHA2  10.000  XREF  0.0000  IN.
0.105  DELTAX  0.870  ALPHA3  10.000  YHP  0.0000  IN.
0.000  DELTAX  0.870  ALPHA4  10.000  ZHP  0.0000  IN.

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60021) 10 MAY 72 PAGE 61
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

PITCHING MOMENT COEFFICIENT, CLM

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION
0.749 BETA 0.000 MACH 4.000 REF 16.35 IN.
0.749 DELTA 0.270 ALPHA 15.000 REF 1.09 IN.
0.988 ALPH 0.270 BETA 15.000 REF 1.09 IN.
1.603 BETA 0.000 MACH 4.000 TNSP 0.000 IN.
5.000 DELTA 0.270 ALPHA 15.000 ZNRP 0.000 IN.

REFERENCE FILE
MSFC TWI 531 ORBITER IN PROXIMITY TO TANK (A60021) 10 MAY 72 PAGE 62
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION
0.749 BETA 0.000 MACH 4.000 BREF 55.3570 60.00 IN.
0.799 DELTA 0.000 ALPHA 15.000 LREF 5.0070 IN.
0.999 DELTA 0.000 ALPHA 15.000 SHR 5.0070 IN.
1.103 BETA 0.000 ALPHA 15.000 SHR 0.0000 IN.
5.000 DELTA 0.000 ALPHA 15.000 SCALE 0.0000 SCALE

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60021) 10 MAY 72 PAGE 63
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

NORMAL FORCE COEFFICIENT, CN

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL  DELTAZ  PARAMETRIC VALUES  REFERENCE INFORMATION
☐  0.700  BETA  0.000  MACH  4.000  BREF  16.3576  SQ. IN.
☐  0.506  DELTAZ  0.497  ALPHA  16.000
☐  0.000

REFERENCE FILE
MSFC  TWT 531  ORBITER IN PROXIMITY TO TANK  (A60022)  10 MAY 72  PAGE 64
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

SYMBOL DELTAS DELTA PARAMETRIC VALUES REFERENCE INFORMATION
Ο 0.750 0.000 4.000 REF 16.3970 20 IN.
Ο 0.666 0.467 10.000 REF 1.0000 IN.
Ο 0.000 0.000 REF 0.0000 IN.
Ο 0.000 0.000 SCALE 0.0000 SCALE

REFERENCE FILE
MSFC TWT 531 ORBITER IN PROXIMITY TO TANK (A60022) 10 MAY 72 PAGE 65
EFFECT OF TANK SEPARATION DISTANCE (DELTAZ) ON ORBITER LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

ORBITER ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES

REFERENCE INFORMATION

SCALE 0.0005 SCALE

REFERENCE FILE

MSFC TWI 531 ORBITER IN PROXIMITY TO TANK (A60022) 10 MAY 72 PAGE 66
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

NORMAL FORCE COEFFICIENT, CN

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAS PARAMETRIC VALUES REFERENCE INFORMATION

0.999 BETA 0.000 MACH 0.000 BREF 3.2570 86.1N.

0.692 DELTAX 0.661 ALPHA 0.000 LREF 3.0670 IN.

0.792 N.000 MREF 2.0000 IN.

0.800 N.000 THERM 0.0000 IN.

0.000 SCALE 0.0000 SCALE

DATA HIST. CODE M

MSFC TWI 531 TANK IN PROXIMITY TO ORBITER (C60T01) 08 JUN 72 PAGE 67
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

SYMBOL DELTAZ BETA DELTAX ALPHA MACH REF

0.306 0.000 0.000 0.000 0.820
0.305 0.000 0.001 0.000 0.820
0.502 0.000 0.001 0.000 0.820
0.700 0.000 0.001 0.000 0.820

DATA SHEET: CODE: MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (CG0101) 08 JUN 72 PAGE 68
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

TANK ANGLE OF ATTACK, ALPHA, DEGREES

AXIAL FORCE COEFFICIENT, CA

SYMBOL DELTAZ PARAMETRIC VALUES

0.900 BETA 0.992 MACH 0.800

0.992 DELTAL 0.901 ALPHA 0.000

0.792

DATA HIST. CODE N

MSFC 1WI 531 TANK IN PROXIMITY TO ORBITER (C60T01) 08 JUN 72 PAGE 69
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

NORMAL FORCE COEFFICIENT, CN

TANK ANGLE OF ATTACK, ALPHA, DEGREES

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MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60T04) 08 JUN 72 PAGE 70
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

PITCHING MOMENT COEFFICIENT, CLM

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION
0.000 BETA 0.000 MACH 0.000 REF 6.3970 50. IN.
0.000 DELTAZ 1.254 ALPHA 0.000 LREF 6.3970 IN.
0.000 BETA 0.000 MACH 0.000 ERR 1.2550 IN.
0.000 DELTAZ 1.254 ALPHA 0.000 TRASP 0.0000 IN.
0.000 BETA 0.000 MACH 0.000 ERR 0.0000 IN.
0.000 DELTAZ 1.254 ALPHA 0.000 SCALE 0.0000 SCALE

DATA HIST. CODE NL
MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60704) 08 JUN 72 PAGE 71
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES

X 0.933 BETA 0.000 Mach 0.600

O 0.992 DELTAX 1.254 ALPHA 0.000

\n
REFERENCE INFORMATION

BREF 10.000 IN.

LEEF 5.0000 IN.

SNP 6.0000 IN.

ZMP 0.0000 IN.

SCALE 0.0000 SCALE

DATA HEAT. CODE NL

MSFC W1 531 TANK IN PROXIMITY TO ORBITER (C60104) 08 JUN 72 PAGE 72
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

PITCHING MOMENT COEFFICIENT, CLM

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES
○ 0.093 BETA 0.000 MACR 0.000
△ 0.092 DELTA 0.001 ALPHA 0.000
□ 0.090
△ 0.000
△

DATA HIST. CODE NL
MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (CG0T02) 08 JUN 72 PAGE 74
EFFECT OF ORBITER SEPARATION DISTANCE (DELTZ) ON TANK LONG. CHARACTERISTICS

NORMAL FORCE COEFFICIENT, CN

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES

-0.995 BETA 0.000 MACA 0.000
-0.995 DELTA 1.000 ALPHA 0.000
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0.995
0.995
0.995

REFERENCE INFORMATION
BREF 16.000 64.1N.
LAB 2.000 24.1N.
SHP 0.000 1N.
SHP 0.000 1N.
SCALE 0.0000 SCALE

DATA HIST. CODE ML
MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60T03) 08 JUN 72 PAGE 76
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

PITCHING MOMENT COEFFICIENT, CLH

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAX PARAMETRIC VALUES

REFERENCE INFORMATION

DATA SHEET CODE NL

MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60T03) 08 JUN 72 PAGE 77
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION
O 0.700 BETA 0.000 MACH 1.000 LREF 10.3570 IN.
Δ 1.375 DELTAX - 0.125 ALPHA1 0.000 UREF 1.8920 IN.
O 0.000

DATA HIST. CODE NL
MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60T07) 08 JUN 72 PAGE 79
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION
O 0.750 BETA 0.000 MACH 1.000 S8570 88. IN.
A 1.575 DELTAZ - 0.125 ALPHA 0.000 S8570 88. IN.
O 9.000

DATA SHEET CODE NL
MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60107) 08 JUN 72 PAGE 81
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION

-○○- 0.779 DETA 0.000 MACH 0.000 OFF 16.3570 60, IN.

-△△- 1.979 DELTA 0.000 ALPHA 0.000 OFF 16.3570 IN.

-□□- 6.000 DELTA 0.000 ALPHA 0.000 OFF 16.3570 IN.

-△△- 6.000 DELTA 0.000 ALPHA 0.000 OFF 16.3570 IN.

DATA MISS. CODE NL

MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60T06) 08 JUN 72 PAGE 83
EFFECT OF ORBITER SEPARATION DISTANCE (DELTA Z) ON TANK LONG. CHARACTERISTICS

NORMAL FORCE COEFFICIENT, CN

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOLS:
- DELTA Z
- PARAMETRIC VALUES
- REFERENCE INFORMATION

DATA MGT. CODE: N

MSFC 3153 TANK IN PROXIMITY TO ORBITER

(C60T05) 08 JUN 72 PAGE 85
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAz) ON TANK LONG. CHARACTERISTICS

SYMBOL DELTAz PARAMETRIC VALUES REFERENCE INFORMATION
0.800 DELTA 0.000 MACH 1.000
0.825 DELTA 0.041 ALPHA 0.600
0.700
1.275
0.000

DATA HIST. CODE
MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C50T05) 08 JUN 72 PAGE 86
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION
\( \Delta \) 0.250 BETA 0.000 MACH 1.000
\( \bullet \) 0.350 DELTAX 0.001 ALPHA 0.000
\( \circ \) 0.700
\( \bullet \) 1.370
\( \circ \) 2.000

DATA HIST. CODE N

MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60105) 08 JUN 72 PAGE 87

\( \Delta \)
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAz) ON TANK LONG. CHARACTERISTICS

SYMBOL DELTAz PARAMETRIC VALUES REFERENCE INFORMATION
X 0.290 DELTAz - 0.000 MACH 5.000 BREF 10.5070 IN.
O 0.000 DELTAz - 0.123 ALPHA 5.000 LREF 5.0070 IN.

DATA HIST. CODE NL
MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (CG0108) 08 JUN 72 PAGE 88
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

SYMBOL  DELTAZ  PARAMETRIC VALUES
\( \Delta \)  0.750  BETA  0.000  MACH  1.000
\( \bigtriangleup \)  1.375  DELTAX - 0.125  ALPHAI  0.000
\( \bigcirc \)  9.000

REFERENCE INFORMATION
BREF 10.3570 IN.
LEEF 1.6570 IN.
SHREF 0.0982 IN.
SNHP 0.0982 IN.
SNHP - 0.0000 IN.
SCALE 0.0060 SCALE

DATA HIST. CODE  ML
MSFC TWT 531 TANK IN PROXIMITY TO ORBITER  (C60T08) 08 JUN 72  PAGE 89
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION
○ 0.000 BETA 0.000 MACH 1.000 L/REF 10.2570 0.841 IN.
△ 0.123 DELTAZ - 0.123 ALPHA 9.000 L/REF 0.0900 IN.
○ 0.000 DATA MISC. CODE RL

MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60T08) 08 JUN 72 PAGE 90
Effect of Orbiter Separation Distance (Delta z) on Tank Long Characteristics

Symbol: Delta z
Parametric Values:
- 0.750 DELTA 0.000 Mach 1.000
- 1.275 DELTA 0.360 Alpha 1.000
- 9.000

Reference Information:
- LREF 10.2470 in.
- LREF 0.2570 in.
- DRF 0.2570 in.
- TRAP 0.0000 in.
- SCALE 0.0000 in.

Data Miss. Code: NL

MSFC TWT 531 Tank in Proximity to Orbiter (C60T09) 08 Jun 72 Page 91
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

PITCHING MOMENT COEFFICIENT, CL/M

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION

Δ 0.750 DELTA 0.000 RACK 1.000 REF 16.3976 80. IN.

Δ 1.250 DELTA 0.500 ALPHA 5.000

◊ 0.000 SHIP - 0.000 SCALE 0.0000 SCALE

DATA HIST. CODE HL

MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60T09) 08 JUN 72 PAGE 92
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

NORMAL FORCE COEFFICIENT, CN

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION
- △ -0.000 BETA 6.000 MACH 1.000 Ref 15.9270 32.1N.
× -0.700 QZLTA 6.861 ALPHA1 9.000 Ref 5.3170 IN.
□ -0.900 QZLTA 6.861 ALPHA2 9.000 Ref 5.6200 IN.
○ -0.900 QZLTA 6.861 ALPHA2 9.000 ZHBP 6.2000 IN.
□ -0.900 QZLTA 6.861 ALPHA2 9.000 SCALE 0.0000 SCALE

DATA NEST. CODE NL

MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60110) 08 JUN 72 PAGE 94
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAE PARAMETRIC VALUES

REFERENCE INFORMATION

SCALE 5.0000 SCALE

MSFC TWI 531 TANK IN PROXIMITY TO ORBITER

(CG0T10) 08 JUN 72 PAGE 96
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

SYMBOL | DELTA | PARAMETRIC VALUES | REFERENCE INFORMATION
--- | --- | --- | ---
O | 0.685 | BETA 0.000 | BREF 5.3170 60.1 IN.
A | 0.651 | DELTAX 0.082 | ALPHAI 0.000
D | 0.700 |
- | 0.900 |

DATA HIST. CODE: NL
MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60T13) 08 JUN 72 PAGE 98
EFFECT OF ORBITE R SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAX PARAMETRIC VALUES
A 0.000 BETA 0.000 MACH 6.000
N 0.600 DELTAX 0.46E ALPHA 0.006
K 0.700
M 0.000

REFERENCE INFORMATION
ARF 16.3170 50.1 IN.
LEFP 8.8570 IN.
SEFP 8.2460 IN.
SHFP 8.2460 IN.
ZHP - 0.0000 IN.
SCALE 0.0000 SCALE

DATA HIST. CODE NL
MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60113) 08 JUN 72 PAGE 99
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

NORMAL FORCE COEFFICIENT, CN

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES
○ 0.000 DETA 0.000 MACH 4.000
○ 0.050 DELTA 0.001 ALPHAI 0.000
○ 0.020
○ 0.000

DATA HIST. CODE N
MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60T111) 08 JUN 72 PAGE 100

REFERENCE INFORMATION
SREF 10.3970
LREF 5.9370
SREP 0.0000
LREP 0.0000
SCALE 0.0000
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

PITCHING MOMENT COEFFICIENT, CLM

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL: DELTAZ

PARAMETRIC VALUES

0.066 DELTA 0.030 MAC 4.000

REFERENCE INFORMATION

BREF 1.0670 0.00 IN.

LREF 0.0000 0.00 IN.

TREF 0.0000 0.00 IN.

SCALE 0.0000 0.00 SCALE

DATA MSTR. CODE N

MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60T11) 08 JUN 72 PAGE 101
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

TANK ANGLE OF ATTACK, ALPHA, DEGREES

DATA HIST. CODE N

MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60T11) 08 JUN 72 PAGE 102
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION
O 0.000 BETA 0.000 MACH 4.000 JREF 10.2570 50 IN.
A 0.002 DELTA 1.000 ALPHA 0.000 LREF 0.0000 IN.
O 0.000 MACH 0.000 N. 0.000 ZREF 0.0000 IN.

DATA REPORT CODE ML
MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60T12) 08 JUN 72 PAGE 105
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

NORMAL FORCE COEFFICIENT, CN

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES
O 0.094 BETA 0.008 RADIAL 4.000
O 0.000 DELTAZ 0.067 ALPHA - 5.000
O 0.000

REFERENCE INFORMATION
DREF 14.3770 60. IN.
LEFF 1.4570 IN.
BEFF 0.2500 IN.
THEF 0.2800 IN.
SNEP 0.5600 IN.
SCALE 0.0040 SCALE

DATA HIST. CODE NL
MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (CG60T17) 08 JUN 72 PAGE 106
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

SYMBOL DELTAZ PARA METRIC VALUES REFERENCE INFORMATION
□ 0.000 BETA 0.000 MACH 4.000 BREF 10.370 IN.
□ 0.001 DELTA 0.000 ALPHAI 9.000 LREF 3.8670 IN.
□ 0.700 BETA 0.000 IN.
□ 9.000

DATA HIST. CODE RL
MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60T14) 08 JUN 72 PAGE 111
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

PITCHING MOMENT COEFFICIENT, CLM

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAX  PARAMETRIC VALUES  REFERENCE INFORMATION
0.000 BETA 0.000 MACH 4.000  LREF 0.3000 IN.
0.002 DELTAX 0.002 ALPHAI 9.000  MREF 0.2000 IN.
0.000 SCALE 0.0000 SCALE

DATA HIST. CODE NL
MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (CG0116) 08 JUN 72 PAGE 113
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

SYMBOL DELTAZ PARAMETRIC VALUES

- 0.50  DELTA  0.000  MACH  4.000
- 0.00  DELTAAX  0.000  ALPHA  5.000

REFERENCE INFORMATION
BREP 10.3570  IN.
CREP 5.5570  IN.
SREP 9.8620  IN.
TREP 0.0000  IN.
ZREP - 0.0000  SCALE
SCLAE 0.0000  SCALE

DATA HIST. CODE NL
MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60116) 08 JUN 72 PAGE 114
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

NORMAL FORCE COEFFICIENT, CN

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAX PARAMETRIC VALUES REFERENCE INFORMATION
\( \Delta \) 0.000 BETA 0.000 MACH 4.000 LPF 16.3570 88.1 N.
\( \bigcirc \) 0.000 DELTAX 0.000 ALPHA 5.000 LPF 16.3570 88.1 N.
\( \bigtriangleup \) 5.000 LPF 16.3570 88.1 N.

DATA HIST. CODE HL

MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60T15) 08 JUN 72 PAGE 115
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

SYMBOL DELTAZ PARAMETRIC VALUES
\( \bullet \) 0.000 BETA 0.000 MACH 4.000
\( \bigcirc \) 0.000 DELTAS 1.000 ALPHA 5.000

REFERENCE INFORMATION

DATA HIST. CODE NL

MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C6015) 08 JUN 72 PAGE 116
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES

△ 0.000 BETA 0.000 NACV 4.000

○ 0.500 DELTAK 4.000 ALPHA 9.000

REFERENCE INFORMATION

REFT 14.3173 60.14.

LENF 1.0075 IN.

LENK 1.0075 IN.

WRF 0.0000 IN.

WMF - 0.0000 IN.

SCALE 0.0000 SCALE

DATA SHEET CODE NL

MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60115) 08 JUN 72 PAGE 117
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

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TWT 531 TANK IN PROXIMITY TO ORBITER  (C60T20) 08 JUN 72  PAGE 119
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTA Z PARAMETRIC VALUES REFERENCE INFORMATION
0.700 0.000 MACH 4.000 LEPF 16.3770 IN.
0.700 0.040 ALPHA 10.000 LEPF 3.5800 IN.
0.600
0.100
0.000

DATA HIST. CODE RL
MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60120) 08 JUN 72 PAGE 120
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60118) 08 JUN 72 PAGE 121
**EFFECT OF ORBITER SEPARATION DISTANCE (DELTAz) ON TANK LONG. CHARACTERISTICS**

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MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (CG018) 08 JUN 72 PAGE 122
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION

- Δ 0.000 0.000 4.000 REF 10.3070 00.00 IN.

- Δ 0.700 0.000 10.000 REF 5.0000 IN.

- Δ 0.800 0.000 0.0000 IN.

- Δ 0.200 0.000 0.0000 IN.

DATA HIST. CODE NL

MSFC TWI 531 TANK IN PROXIMITY TO ORBITER (C60T19) 08 JUN 72 PAGE 124
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

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MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60T19) 08 JUN 72 PAGE 125
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION

DATA HIST. CODE RL

MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60T19) 08 JUN 72 PAGE 126
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

NORMAL FORCE COEFFICIENT, CN

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION
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0.750 DELTAX 0.871 ALPHA 16.000 BREF 16.3570 IN.
0.980 0.000 1N.
1.183 0.000 1N.
5.000 0.000 1N.

DATA HIST. CODE NL

MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60T21) 08 JUN 72 PAGE 127
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAz) ON TANK LONG. CHARACTERISTICS

TANK ANGLE OF ATTACK, ALPHA, DEGREES

PITCHING MOMENT COEFFICIENT, CL/M

REFERENCE INFORMATION
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- BREF: 1.5070, 0.1 IN.
- WNP: 0.0000, 0.0 IN.
- SCALE: 0.0000, SCALE

MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60721) 08 JUN 72 PAGE 129
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION

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0.700 DELTA 0.071 ALPHA 18.000

0.000

1.000 9.000

DATA HIST. CODE ML

MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60721) 08 JUN 72 PAGE 129
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

TANK ANGLE OF ATTACK, ALPHA, DEGREES

PITCHING MOMENT COEFFICIENT, CLM

SYMBOL DELTAZ PARAMETRIC VALUES REFERENCE INFORMATION

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\( \Delta \) 0.680 DELTA 0.449 ALPHA 18.000 BREF 3.6170 IN.

\( \Delta \) 0.680 DELTA 0.449 ALPHA 18.000 MREF 9.9900 IN.

\( \Delta \) 0.680 DELTA 0.449 ALPHA 18.000 TREF 0.0000 IN.

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DATA HIST. CODE NL

MSFC TWT 531 TANK IN PROXIMITY TO ORBITER (C60T22) 08 JUN 72 PAGE 131
EFFECT OF ORBITER SEPARATION DISTANCE (DELTAZ) ON TANK LONG. CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

TANK ANGLE OF ATTACK, ALPHA, DEGREES

SYMBOL DELTAZ PARAMETRIC VALUES

-0.005 BETA 0.005 MACH 4.000

0.000 DELTA 0.007 ALPHA 19.000

0.005

DATA HIST. CODE HL

MSFC TMT 531 TANK IN PROXIMITY TO ORBITER (C60122) 08 JUN 72 PAGE 132
SUMMARY STABILITY DATA FOR ORBITER IN PROXIMITY OF TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION MACH DELTAZ ALPHA REFERENCE INFORMATION

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SUMMARY STABILITY DATA FOR ORBITER IN PROXIMITY OF TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION MACH DELTAZ ALPHA  REFERENCE INFORMATION
(Q00001) Q HSFC TUT 531 ORBITER IN PROXIMITY TO TANK 0.000 0.000 0.000 BREF 16.3370 80.1 IN.
(Q00002) A HSFC TUT 531 ORBITER IN PROXIMITY TO TANK 0.000 1.004 0.000 LREF 2.0070 IN.
(Q00003) D HSFC TUT 531 ORBITER IN PROXIMITY TO TANK 0.000 1.004 0.000 TREF 1.0070 IN.
(Q00004) H HSFC TUT 531 ORBITER IN PROXIMITY TO TANK 0.000 1.004 0.000 ZREF 0.0000 IN.

SCALE 0.0080 SCALE

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SUMMARY STABILITY DATA FOR ORBITER IN PROXIMITY OF TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION MACH DELTAZ ALPHA REFERENCE INFORMATION
(1960005) ♦ NASA TVT 331 ORBITER IN PROXIMITY TO TANK 0.000 0.000 0.000 REFP 10.3970 80.0 IN.
(1960005) ♦ NASA TVT 331 ORBITER IN PROXIMITY TO TANK 0.000 1.000 5.000 LREF 3.4570 IN.
(1960005) ♦ NASA TVT 331 ORBITER IN PROXIMITY TO TANK 0.000 1.294 5.000 MREF 0.0000 IN.
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SUMMARY STABILITY DATA FOR ORBITER IN PROXIMITY OF TANK

DATA SHEET SYMBOL CONFIGURATION DESCRIPTION

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SUMMARY STABILITY DATA FOR ORBITER IN PROXIMITY OF TANK

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SUMMARY STABILITY DATA FOR ORBITER IN PROXIMITY OF TANK

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(S00006) ± NSFC TUT 931 ORBITER IN PROXIMITY TO TANK 1.660 0.200 0.000 BREF 3.0500 IN.
(S00006) ± NSFC TUT 931 ORBITER IN PROXIMITY TO TANK 1.660 0.200 0.000 THRF 2.2070 IN.
(S00006) ± NSFC TUT 931 ORBITER IN PROXIMITY TO TANK 1.660 0.200 0.000 ZHFP 2.0000 IN.
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SUMMARY STABILITY DATA FOR ORBITER IN PROXIMITY OF TANK
Summary Stability Data for Orbiter in Proximity of Tank

DATA SET SYMBOL CONFIGURATION DESCRIPTION MACH DELTAZ ALPHA
(1600-028) O NSFC TMT SSI ORBITER IN PROXIMITY TO TANK 1.960 -0.125 5.000 SREF 19.5570 50.0 IN.
(1650-028) O NSFC TMT SSI ORBITER IN PROXIMITY TO TANK 1.960 0.365 9.000 LREF 5.6570 IN.
(1660-010) O NSFC TMT SSI ORBITER IN PROXIMITY TO TANK 1.960 0.991 9.000 BREF 3.2380 IN.
THPMF 0.0000 IN.
SCALE 0.0000 SCALE

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SUMMARY STABILITY DATA FOR ORBITER IN PROXIMITY OF TANK

DATA SET | SYMBOL | CONFIGURATION DESCRIPTION | MACH | DELTAX | DELTA | REFERENCE INFORMATION
---|---|---|---|---|---|---
(660013) | O | NASA TF5 SBS ORBITER IN PROXIMITY TO TANK | 4.000 | 0.400 | 0.000 | REF 16,3570 90 IN.
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(660012) | O | NASA TF5 SBS ORBITER IN PROXIMITY TO TANK | 4.000 | 1.000 | 0.000 | IN.
(660012) | O | NASA TF5 SBS ORBITER IN PROXIMITY TO TANK | 4.000 | 1.000 | 0.000 | IN.

SCALE 0.0000 0.0000
SUMMARY STABILITY DATA FOR ORBITER IN PROXIMITY OF TANK

DATA SET SYMBOL CONFIGURATION DESCRIPTION Mach Delta 8 Alpha Reference Information

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### Summary Stability Data for Orbiter in Proximity of Tank

#### Data Set Symbol | Configuration Description | Mach | ΔMach | Ref
---|---|---|---|---
(b86012) | RF4C/TWT/SBI Orbiter in Proximity to Tank | 4.000 | 0.167 | 5.000
(b86014) | RF4C/TWT/SBI Orbiter in Proximity to Tank | 4.000 | 0.364 | 5.000
(b86016) | RF4C/TWT/SBI Orbiter in Proximity to Tank | 4.000 | 0.681 | 5.000
(b86018) | RF4C/TWT/SBI Orbiter in Proximity to Tank | 4.000 | 1.096 | 5.000

Reference Information:
- LEFF 3.4270 IN.
- JHPR 3.6000 IN.
- JMU 3.6000 IN.
- SCALE 0.0000 SCALE

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#### Diagrams

1. DCN/DA vs. DELTAZ
2. DCL/MDA vs. DELTAZ
3. DCN/DA vs. DELTAZ
SUMMARY STABILITY DATA FOR ORBITER IN PROXIMITY OF TANK

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SUMMARY STABILITY DATA FOR ORBITER IN PROXIMITY OF TANK

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(960002) A  NAPC TVT #91 ORBITER IN PROXIMITY TO TANK  4.000  0.000  15.000  BREF  15.2370  22. IN.
(960002) A  NAPC TVT #91 ORBITER IN PROXIMITY TO TANK  4.000  0.467  15.000  LREF  3.0970  IN.
(960002) A  NAPC TVT #91 ORBITER IN PROXIMITY TO TANK  4.000  0.770  15.000  SREF  3.0970  IN.
(960002) A  NAPC TVT #91 ORBITER IN PROXIMITY TO TANK  4.000  0.000  15.000  ZRE  0.0000  IN.
SCALE  0.0000  SCALE

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SUMMARY STABILITY DATA FOR ORBITER IN PROXIMITY OF TANK

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(S60023) O MPFC TNT 531 ORBITER IN PROXIMITY TO TANK 1.000 0.270 10.000 BREF 16.3670 50.1 IN.
(S60022) Δ MPFC TNT 531 ORBITER IN PROXIMITY TO TANK 4.000 0.457 19.000 LREF 1.0000 IN.
BREF 1.0000 IN.
SNRP 1.0000 IN.
THRP 0.0000 IN.
SCALE 0.0000 SCALE

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SUMMARY STABILITY DATA FOR TANK IN PROXIMITY OF ORBITER

DATA SET SYMBOL CONFIGURATION DESCRIPTION MACH DELTAX ALPHA REFERENCE INFORMATION
(660701) G MDC TWT H31 TANK IN PROXIMITY TO ORBITER 0.600 0.891 0.000 LREF 16.3170 56.1 IN.
(660794) G MDC TWT H31 TANK IN PROXIMITY TO ORBITER 0.600 1.254 0.000 LREF 5.6370 55.1 IN.
SCALE 0.0000 56.1 IN.

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SUMMARY STABILITY DATA FOR TANK IN PROXIMITY OF ORBITER

DATA SET SYMBOL CONFIGURATION DESCRIPTION MACH DELTAZ ALPHA
(108037) O HPF TWT 951 TANK IN PROXIMITY TO ORBITER 0.400 0.841 5.000
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SCALE 0.0000 SCALE
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(B50T98)         | HFPF TNT 885 TANK IN PROXIMITY TO ORBITER | 0.600 | 0.000  | 5.000  | BREF 16.5970 60.000 IN, DREF 9.3570 IN,
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SUMMARY STABILITY DATA FOR TANK IN PROXIMITY OF ORBITER

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11811111181 | ! | HPFC TWF SSI TANK IN PROXIMITY TO ORBITER | 1.800 | -0.100 | 0.000 | Ref 1.18578 66.10.
11111111111 | @ | HPFC TWF SSI TANK IN PROXIMITY TO ORBITER | 1.800 | 0.100 | 0.000 | Ref 1.18578 66.10.
11111111111 | # | HPFC TWF SSI TANK IN PROXIMITY TO ORBITER | 1.800 | 0.001 | 0.000 | Ref 1.18578 66.10.
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SCALE 0.0000 0.0000 IN.

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SUMMARY STABILITY DATA FOR TANK IN PROXIMITY OF ORBITER

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(0.00) ○ HSF TWT SSI TANK IN PROXIMITY TO ORBITER 4.000 1.000 0.000 lref 0.0010 IN.

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SUMMARY STABILITY DATA FOR TANK IN PROXIMITY OF ORBITER

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(660116)  X  MSFC T51 T51 TANK IN PROXIMITY TO ORBITER  4.000  0.662  10.000  SREF  10.3170  86. IN.
(660119)  O  MSFC T51 T51 TANK IN PROXIMITY TO ORBITER  4.000  0.667  10.000  LREF  3.9370  IN.
(660119)  X  MSFC T51 T51 TANK IN PROXIMITY TO ORBITER  4.000  0.662  10.000  SREF  6.0200  IN.
(660119)  O  MSFC T51 T51 TANK IN PROXIMITY TO ORBITER  4.000  0.662  10.000  ZHP  0.0900  IN.
SCALE  0.0000  SCALE

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SUMMARY STABILITY DATA FOR TANK IN PROXIMITY OF ORBITER

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جب (shod) Q NSPC TWT SB TANK IN PROXIMITY TO ORBITER

MACH DELTAS ALPHA

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SHP 0.0000 IN.
SCALE 0.0000 SCALE

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