AERODYNAMIC STATIC STABILITY CHARACTERISTICS OF THE MSFC 33-FOOT PUMP FED BOOSTER AT HIGH ANGLES OF ATTACK

by

Thomas Hamilton, NSI

NASA-CR-120051

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MSFC 14X14-INCH TRISONIC WIND TUNNEL

Marshall Space Flight Center

NASA

This document should be referenced as
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SADSAC/SPACE SHUTTLE
WIND TUNNEL TEST DATA REPORT

CONFIGURATION: 0.00340 Scale MSFC 33-Foot Pump Fed Booster

TEST PURPOSE: To Determine the Aerodynamic Static Stability Characteristics of the MSFC 33-Foot Pump Fed Booster at High Angles of Attack

TEST FACILITY: NASA-MSFC 14 x 14 Inch Trisonic Wind Tunnel

TESTING AGENCY: Northrop Services, Inc., Huntsville, Alabama

TEST NO. & DATE: MSFC TWT 529; 10 February 1972

FACILITY COORDINATOR: Jim Weaver, NASA/MSFC

PROJECT ENGINEER(S): Thomas Hamilton, NSI

DATA MANAGEMENT SERVICES

LIAISON: V. W. Sparks

DATA OPERATIONS: Martin J. Lenfrenco

RELEASE APPROVAL: N. D. Kemp

CONTRACT NAS 8-4016

AMENDMENT 153

DRL 184-58

This report has been prepared by Chrysler Corporation Space Division under a Data Management Contract to the NASA. Chrysler assumes no responsibility for the data presented herein other than its display characteristics.
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P. O. Box 29200
Department 2780
New Orleans, Louisiana 70129
Phone: (504) 255-2304
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<tr>
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AERODYNAMIC STATIC STABILITY CHARACTERISTICS OF THE
MSFC 33-FOOT PUMP FED BOOSTER AT HIGH ANGLES OF ATTACK

By: Thomas Hamilton

ABSTRACT

Experimental aerodynamic investigations were conducted in the NASA/MSFC 14 x 14 Inch Trisonic Wind Tunnel during early February 1972 on a 0.00340 scale model of the MSFC 33-foot diameter space shuttle pump fed booster configuration. The basic configuration tested was a 40° cone/cylinder designated the MSFC 33-foot pump fed booster. Six component aerodynamic force and moment data were recorded over a Mach number range from 0.6 to 5.0, angles-of-attack from 50° to 90° at 0° sideslip and over a sideslip range from -10° to +10° at 60° and 80° angles-of-attack. Primary configuration variables were fin area and body cutout size.
## NOMENCLATURE

### General

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>SADSAC SYMBOL</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</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_\infty)/q)</td>
</tr>
<tr>
<td>M</td>
<td>MACH</td>
<td>Mach number; (V/a)</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(PSF)</td>
<td></td>
</tr>
<tr>
<td>RN/L</td>
<td>RN/L</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>
</tr>
</tbody>
</table>

### Reference & C.G. Definitions

- \(A_b\): base area; \(m^2\), \(ft^2\)
- \(b\): wing span or reference span; m, ft
- \(l\): center of gravity
- \(\ell_{REF}\): reference length or wing mean aerodynamic chord; m, ft
- \(S\): wing area or reference area; \(m^2\), \(ft^2\)
- \(S_{REF}\): |
- \(MRP\): moment reference point
- \(X_{MRP}\): moment reference point on X axis
- \(Y_{MRP}\): moment reference point on Y axis
- \(Z_{MRP}\): moment reference point on Z axis

### Subscripts

- \(b\): base
- \(l\): local
- \(s\): static conditions
- \(t\): total conditions
- \(\infty\): free stream
### 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; $\frac{normal\ force}{q_S}$</td>
</tr>
<tr>
<td>$C_A$</td>
<td>CA</td>
<td>axial-force coefficient; $\frac{axial\ force}{q_S}$</td>
</tr>
<tr>
<td>$C_Y$</td>
<td>CY</td>
<td>side-force coefficient; $\frac{side\ force}{q_S}$</td>
</tr>
<tr>
<td>$C_{A_b}$</td>
<td>CAB</td>
<td>base-force coefficient; $\frac{base\ force}{q_S}$</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; $\frac{pitching\ moment}{q_S/REF}$</td>
</tr>
<tr>
<td>$C_n$</td>
<td>CYN</td>
<td>yawing-moment coefficient; $\frac{yawing\ moment}{q_Sb}$</td>
</tr>
<tr>
<td>$C_l$</td>
<td>CBL</td>
<td>rolling-moment coefficient; $\frac{rolling\ moment}{q_Sb}$</td>
</tr>
</tbody>
</table>

**Stability-Axis System**

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>SADSAC SYMBOL</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_L$</td>
<td>CL</td>
<td>lift coefficient; $\frac{lift}{q_S}$</td>
</tr>
<tr>
<td>$C_D$</td>
<td>CD</td>
<td>drag coefficient; $\frac{drag}{q_S}$</td>
</tr>
<tr>
<td>$C_{D_b}$</td>
<td>CDB</td>
<td>base-drag coefficient; $\frac{base\ drag}{q_S}$</td>
</tr>
<tr>
<td>$C_{D_f}$</td>
<td>CDF</td>
<td>forebody drag coefficient; $C_D - C_{D_b}$</td>
</tr>
<tr>
<td>$C_Y$</td>
<td>CY</td>
<td>side-force coefficient; $\frac{side\ force}{q_S}$</td>
</tr>
<tr>
<td>$C_m$</td>
<td>CLM</td>
<td>pitching-moment coefficient; $\frac{pitching\ moment}{q_S/REF}$</td>
</tr>
<tr>
<td>$C_n$</td>
<td>CLN</td>
<td>yawing-moment coefficient; $\frac{yawing\ moment}{q_Sb}$</td>
</tr>
<tr>
<td>$C_l$</td>
<td>CSL</td>
<td>rolling-moment coefficient; $\frac{rolling\ moment}{q_Sb}$</td>
</tr>
<tr>
<td>$L/D$</td>
<td>L/D</td>
<td>lift-to-drag ratio; $C_L/C_D$</td>
</tr>
</tbody>
</table>
### ADDITIONS TO SADSAC NOMENCLATURE

**FOR**

TEST MSFC TWT 529

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>SADSAC SYMBOL</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Gamma )</td>
<td></td>
<td>Fin dihedral angle, degrees. See Figure 6.</td>
</tr>
<tr>
<td>LOC</td>
<td></td>
<td>Fin location on booster. See Figure 2.</td>
</tr>
</tbody>
</table>
CONFIGURATION DESCRIPTION

The basic pump fed booster configuration was a 40° cone/cylinder with a flat at the end of the cylinder on the bottom. The configuration is designated the MSFC 33-foot pump fed booster. Component configuration symbols and descriptions are listed as follows:

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>CONFIGURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>N₁B₆</td>
<td>MSFC 33-foot pump fed booster body with a 40° conical nose and a 33-foot diameter full scale cylindrical body.</td>
</tr>
<tr>
<td>N₁B₇</td>
<td>MSFC 33-foot pump fed booster body with a 40° conical nose and a 33-foot diameter full scale cylindrical body.</td>
</tr>
<tr>
<td>F₂</td>
<td>Two 508 sq. ft. full scale fins located at the end of and in the mid position on the cylindrical body. Fin incidence was zero degrees.</td>
</tr>
<tr>
<td>F₃</td>
<td>Two 339 sq. ft. full scale fins mounted like F₂.</td>
</tr>
</tbody>
</table>

Model dimensional information for these components is given in the model component description sheets.
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 5.85 is covered by utilizing two interchangeable test sections. The transonic section permits testing at Mach 0.20 to 2.50, and the supersonic section permits testing at Mach 2.75 to 5.85. 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

Six component force and moment data were recorded using an internal strain gage balance. Aerodynamic coefficients were calculated for the body and stability axis reference systems. Data reduction included an axial force static tare. No base or cavity pressures were recorded. The model reference dimensions utilized in reducing the data are listed below:

\[ S_{\text{ref}} = \text{Booster Body (N}_1\text{B}_6 \text{ or N}_1\text{B}_7) \]
\[ \text{Cylinder cross section area} = 1.423 \text{ sq. in.} \]

\[ l_{\text{ref}} = b_{\text{ref}} = \text{Booster Body (N}_1\text{B}_6 \text{ or N}_1\text{B}_7) \]
\[ \text{Length (from nose to aft end of cylinder)} = 5.443 \text{ in.} \]

The moment reference center (MRC) is on a line coincident with the body longitudinal centerline 60 per cent of the body length aft of the nose.

\[ \text{MRC} = 60\% l_{\text{ref}} = 3.266 \text{ in.} \]

The moment reference center location is shown in Figure 2.
### TABLE I.
**TEST CONDITIONS**

<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>4.9</td>
<td>4.33</td>
<td>104.6</td>
</tr>
<tr>
<td>0.9</td>
<td>6.3</td>
<td>7.38</td>
<td>102.7</td>
</tr>
<tr>
<td>1.2</td>
<td>6.7</td>
<td>9.15</td>
<td>102.8</td>
</tr>
<tr>
<td>1.46</td>
<td>6.5</td>
<td>9.35</td>
<td>100.8</td>
</tr>
<tr>
<td>2.74</td>
<td>4.7</td>
<td>6.37</td>
<td>138.1</td>
</tr>
<tr>
<td>4.96</td>
<td>5.0</td>
<td>3.07</td>
<td>131.2</td>
</tr>
</tbody>
</table>

**BALANCE UTILIZED:** MSFC No. 201 Balance

**CAPACITY:**

| NF  | 120 lb |
| SF  | 20 lb  |
| AF  | 30 lb  |
| PM  | 60 in-lb|
| YM  | 20 in-lb|
| RM  | 25 in-lb|

**ACCURACY:**

<p>| | |</p>
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<tbody>
<tr>
<td></td>
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</tbody>
</table>

**COEFFICIENT TOLERANCE:**

<p>| | |</p>
<table>
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<tbody>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COMMENTS:**
TABLE III.
DIMENSIONAL DATA

MODEL COMPONENT:  BODY - N\textsubscript{t}B\textsubscript{6}

GENERAL DESCRIPTION:  MSFC Pump Fed Booster Body with Short Cutout on Bottom of Aft End.

DRAWING NUMBER:

<table>
<thead>
<tr>
<th>DIMENSIONS</th>
<th>FULL-SCALE</th>
<th>MODEL SCALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length, ft</td>
<td>133.4</td>
<td>0.453</td>
</tr>
<tr>
<td>Max. Width, in.</td>
<td>395.9</td>
<td>1.346</td>
</tr>
<tr>
<td>Max. Depth, in.</td>
<td>395.9</td>
<td>1.346</td>
</tr>
<tr>
<td>Fineness Ratio</td>
<td>4.044</td>
<td>4.044</td>
</tr>
<tr>
<td>Area, ft\textsuperscript{2}</td>
<td>854.8</td>
<td>1.423</td>
</tr>
<tr>
<td>Max. Cross-Sectional Planform</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wetted Base</td>
<td>854.8</td>
<td>1.423</td>
</tr>
<tr>
<td>Body Diameter, In.</td>
<td>395.6</td>
<td>1.346</td>
</tr>
<tr>
<td>Base Diameter, in.</td>
<td>395.6</td>
<td>1.346</td>
</tr>
<tr>
<td>Conical Nose Angle, degrees</td>
<td>40.0</td>
<td>40.0</td>
</tr>
<tr>
<td>Cutout Angle, degrees</td>
<td>15.0</td>
<td>15.0</td>
</tr>
<tr>
<td>Cutout Length, in.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cutout Height, in.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TABLE III. (CONTINUED)

MODEL COMPONENT: BODY - N1B7

GENERAL DESCRIPTION: MSFC Pump Fed Booster Body with Long Cutout on Bottom of Aft End

<table>
<thead>
<tr>
<th>DIMENSIONS:</th>
<th>FULL-SCALE</th>
<th>MODEL SCALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length, ft.</td>
<td>133.4</td>
<td>0.453</td>
</tr>
<tr>
<td>Max. Width, inches</td>
<td>395.9</td>
<td>1.346</td>
</tr>
<tr>
<td>Max. Depth, inches</td>
<td>395.9</td>
<td>1.346</td>
</tr>
<tr>
<td>Fineness Ratio</td>
<td>4.044</td>
<td>4.044</td>
</tr>
<tr>
<td>Area, ft²</td>
<td>854.8</td>
<td>1.423</td>
</tr>
<tr>
<td>Max. Cross-Sectional Planform</td>
<td>854.8</td>
<td>1.423</td>
</tr>
<tr>
<td>Wetted Base</td>
<td>854.8</td>
<td>1.423</td>
</tr>
<tr>
<td>Body Diameter, inches</td>
<td>395.6</td>
<td>1.346</td>
</tr>
<tr>
<td>Base Diameter, inches</td>
<td>395.6</td>
<td>1.346</td>
</tr>
<tr>
<td>Conical Nose Angle, degrees</td>
<td>40.0</td>
<td>40.0</td>
</tr>
<tr>
<td>Cutout Angle, degrees</td>
<td>15.0</td>
<td>15.0</td>
</tr>
<tr>
<td>Cutout Length, inches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cutout Height, inches</td>
<td></td>
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</tbody>
</table>
TABLE III. (CONTINUED)

MODEL COMPONENT: Fin - F₂

GENERAL DESCRIPTION: Fins for MSFC Pump Fed Booster, Dihedral = 30°

DRAWING NUMBER:

<table>
<thead>
<tr>
<th>DIMENSIONS</th>
<th>FULL-SCALE</th>
<th>MODEL SCALE</th>
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<tbody>
<tr>
<td>Area</td>
<td>508.7</td>
<td>0.0059</td>
</tr>
<tr>
<td>Span (equivalent)</td>
<td>310.3</td>
<td>1.055</td>
</tr>
<tr>
<td>Inb'd equivalent chord</td>
<td>354.1</td>
<td>1.204</td>
</tr>
<tr>
<td>Outb'd equivalent chord</td>
<td>117.9</td>
<td>0.401</td>
</tr>
<tr>
<td>Ratio movable surface chord/total surface chord</td>
<td></td>
<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>45°</td>
<td>45°</td>
</tr>
<tr>
<td>Tailing Edge</td>
<td>13.45°</td>
<td>13.45°</td>
</tr>
<tr>
<td>Hingeline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area Moment (Normal to hinge line)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### TABLE III. (CONTINUED)

**MODEL COMPONENT:** Fin - F3  
**GENERAL DESCRIPTION:** Fins for MSFC Pump Fed Bosoter, Dihedral = 30°

**DRAWING NUMBER:**

<table>
<thead>
<tr>
<th>DIMENSIONS:</th>
<th>FULL-SCALE</th>
<th>MODEL SCALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>339.1</td>
<td>0.00392</td>
</tr>
<tr>
<td>Span (equivalent)</td>
<td>206.8</td>
<td>0.703</td>
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<tr>
<td>Inb'd equivalent chord</td>
<td>354.1</td>
<td>1.204</td>
</tr>
<tr>
<td>Outb'd equivalent chord</td>
<td>117.9</td>
<td>0.401</td>
</tr>
<tr>
<td>Ratio movable surface chord/total surface chord</td>
<td></td>
<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>
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<tr>
<td>Leading Edge</td>
<td>50.0</td>
<td>50.0</td>
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<tr>
<td>Tailing Edge</td>
<td>2.88</td>
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<td>Hingeline</td>
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<td></td>
</tr>
<tr>
<td>Area Moment (normal to hinge line)</td>
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<td></td>
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TABLE IV.
INDEX OF MODEL FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page Number</th>
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<td>Axis System</td>
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<td>2</td>
<td>MSFC Pump Fed Booster</td>
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<td>3</td>
<td>Nose N₁</td>
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<td>4</td>
<td>Body B₆, B₇</td>
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<td>1-54</td>
<td>Effect of Configuration on Longitudinal Characteristics</td>
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<td>55-78</td>
<td>Effect of Configuration on Directional Characteristics</td>
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**PLOTTED CORRELATIONS SCHEDULES:**

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<td>(A) CX, CN, CY vs. ALPHA</td>
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</tr>
</tbody>
</table>

**TITLE:**

TABLE V. INDEX OF DATA FIGURES
MODEL FIGURES
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.
FIGURE 2. MSFC PUMP FED BOOSTER
Figure 3. Nose N1

Notes:
1/2 except as shown
2.0 within .001 T.I.R.

0.250 Dia. Nom. Theu.
Provide light P.F.
W/existing fn.
Locate & Assy. W/
Balance block

0.094 R

1 1/2

1 1/2

1/4 @ 45°

1.346 Dia. Nom. M.tch

Body

R

1 3/8

1 3/8

1 3/8

1 3/8

1 3/8

1/16 ± 0.005 ± 0.05

NOTE: N

All or crbs type opt

± 1/16 ± 0.005 ± 0.05
TABLE

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<th>.070</th>
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<th>15°</th>
<th>1 Ads Shv &amp; 1 Oar Hnd</th>
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<td>45°</td>
<td>13°27'</td>
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<td>1.279</td>
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<td>9°20'</td>
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NOTES:

1. See
2. Break Sharp Edges.
Tabulations of the plotted data and corresponding source data are available from SADSAC Operations.
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

DATA SET SYMBOL | CONFIGURATION DESCRIPTION | MACH | BETA | REFERENCE INFORMATION
(C63001) MSFC TWT 529 33 FOOT BOOSTER | 0.596 | 0.000 | SREF 1.4230 SQ.IN.
(C63004) MSFC TWT 529 33 FOOT BOOSTER | | 0.000 | LREF 5.4330 IN.
(C63008) MSFC TWT 529 33 FOOT BOOSTER | | 0.000 | BREF 5.4330 IN.
(C63012) MSFC TWT 529 33 FOOT BOOSTER | | 0.000 | XHP 3.2660 IN.
| | | | YHP 0.0000 IN.
| | | | ZHP 0.0000 IN.
| | | | SCALE 0.0034

PAGE 1
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

ANGLE OF ATTACK, ALPHA, DEGREES

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL CONFIGURATION DESCRIPTION BETA
(C63051) MSFC TWT 529 33 FOOT BOOSTER NIB6 0.000
(C6305a) MSFC TWT 529 33 FOOT BOOSTER NIB7 0.000
(C63061) MSFC TWT 529 33 FOOT BOOSTER NIB7F2 0.000
(C63012) MSFC TWT 529 33 FOOT BOOSTER NIB7F3 0.000

REFERENCE INFORMATION
SREF 1.4230 SQ. IN.
LREF 5.4330 IN.
BREF 5.4330 IN.
XMRP 3.2660 IN.
YMRP 0.0000 IN.
ZMRP 0.0000 IN.
SCALE 0.0034

MACH 0.897

PAGE 2
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

ANGLE OF ATTACK, ALPHA, DEGREES

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA
(C43001)  MSFC TWT 529  35 FOOT BOOSTER  N186  0.000
(C43004)  MSFC TWT 529  35 FOOT BOOSTER  N187  0.000
(C43008)  MSFC TWT 529  35 FOOT BOOSTER  N187F2  0.000
(C43012)  MSFC TWT 529  35 FOOT BOOSTER  N187F3  0.000

REFERENCE INFORMATION
SREF  1.4230  SQ. IN.
LREF  5.4330  IN.
BREF  5.4330  IN.
XHRP  3.2660  IN.
YHRP  0.0000  IN.
ZHRP  0.0000  IN.
SCALE  0.0034

MACH  1.199
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

ANGLE OF ATTACK, ALPHA, DEGREES

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA
(C63001) □ MSFC TWT S29 33 FOOT BOOSTER N1B6 0.000
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(C63008) □ MSFC TWT S29 33 FOOT BOOSTER N1B7F2 0.000
(C63012) □ MSFC TWT S29 33 FOOT BOOSTER N1B7F3 0.000

REFERENCE INFORMATION
SREF 1.4230  SQ.IN.
LREF 5.4330  IN.
BREF 5.4330  IN.
XHPR 3.2660  IN.
YHPR 0.0000  IN.
ZHPR 0.0000  IN.
SCALE 0.0034

MACH 1.456

PAGE 4
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

ANGLE OF ATTACK, ALPHA, DEGREES

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL | CONFIGURATION DESCRIPTION | BETA | REFERENCE INFORMATION
---|---|---|---
(C63001) | MSFC TWT 529 33 FOOT BOOSTER N1B6 | 0.000 | SREF 1.4230 SQ. IN.
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(C63006) | MSFC TWT 529 33 FOOT BOOSTER N1B7F2 | 0.000 | BREF 5.4330 IN.
(C63012) | MSFC TWT 529 33 FOOT BOOSTER N1B7F3 | 0.000 | XHRP 3.2660 IN.

MACH 2.740

SCALE 0.0034
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

PITCHING MOMENT COEFFICIENT, Cm

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA
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(C63DD4)  MSFC TWT 529 33 FOOT BOOSTER  N1B7  0.000
(C63DDE)  MSFC TWT 529 33 FOOT BOOSTER  N1BTF2  0.000
(C63DD2)  MSFC TWT 529 33 FOOT BOOSTER  N1BTF3  0.000

MACH 4.959

REFERENCE INFORMATION
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LREF  5.4330 IN.
BREF  5.4330 IN.
XMRP  3.2660 IN.
YMRP  0.0000 IN.
ZMRP  0.0000 IN.
SCALE  0.0034

PAGE 6
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION BETA
(C63001) MSFC TWT 529 33 FOOT BOOSTER N1B6 0.000
(C63004) MSFC TWT 529 33 FOOT BOOSTER N1B7 0.000
(C63008) MSFC TWT 529 33 FOOT BOOSTER N1B7F2 0.000
(C63012) MSFC TWT 529 33 FOOT BOOSTER N1B7F3 0.000

REFERENCE INFORMATION
SREF 1.4230 SQ.IN.
LREF 5.4330 IN.
BREF 5.4330 IN.
XMRP 3.2660 IN.
YMRP 0.0000 IN.
ZMRP 0.0000 IN.
SCALE 0.0034

MACH 0.596

PAGE 7
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

DATA SET SYMBOL CONFIGURATION DESCRIPTION BETA
(C63001) MSFC TWT 529 33 FOOT BOOSTER NIB6 0.000
(C63004) MSFC TWT 529 33 FOOT BOOSTER NIB7 0.000
(C63008) MSFC TWT 529 33 FOOT BOOSTER NIB7F2 0.000
(C63012) MSFC TWT 529 33 FOOT BOOSTER NIB7F3 0.000

REFERENCE INFORMATION
SREF 1.4220 SQ.IN.
LREF 5.4330 IN.
BREF 5.4330 IN.
XMRP 3.8660 IN.
YMRP 0.0000 IN.
ZMRP 0.0000 IN.
SCALE 0.0034

MACH 0.897

PAGE 8
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION BETA
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REFERENCE INFORMATION
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BREF 5.4330 IN.
XHPR 3.2660 IN.
YHPR 0.0000 IN.
ZMRP 0.0000 IN.
SCALE 0.0034

MACH 1.199

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EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

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(C63008)  MSFC TWT 529 33 FOOT BOOSTER  N1B7F2  0.000  BREF 5.4330 IN.
(C63012)  MSFC TWT 529 33 FOOT BOOSTER  N1B7F3  0.000  YMRP 3.2660 IN.
                                      ZMRP 0.0000 IN.
                                      SCALE 0.0034

MACH 2.740
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA  REFERENCE INFORMATION
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MACH  4.959  YHRP  0.0000 IN.

SCALE  0.0054  ZHRP  0.0000 IN.

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EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

ANGL OF ATTACK, ALPHA, DEGREES

AXIAL FORCE COEFFICIENT, CA

DATA SET SYMBOL CONFIGURATION DESCRIPTION BETA
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LREF 5.4330 in.
BREF 5.4330 in.
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YNRP 0.0000 in.
ZNRP 0.0000 in.
SCALE 0.0034

MACH 0.596
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

AXIAL FORCE COEFFICIENT, CA

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA
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YMRP  0.0000 IN.
ZMRP  0.0000 IN.
SCALE  0.0034

MACH  0.897

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EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

ANGLE OF ATTACK, ALPHA, DEGREES

AXIAL FORCE COEFFICIENT, CA

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YMRP 0.0000 IN.
ZMRP 0.0000 IN.
SCALE 0.0034

MACH 1.199

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EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

ANGLE OF ATTACK, ALPHA, DEGREES

AXIAL FORCE COEFFICIENT, CA

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(C63006) MSFC TWT 529 33 FOOT BOOSTER N1BF2 0.000 BREF 5.4330 IN.
(C63012) MSFC TWT 529 33 FOOT BOOSTER N1BF3 0.000 XHRP 3.2660 IN.
MACH 1.456 YHRP 0.0000 IN.
SCALE 0.0034 ZHRP 0.0000 IN.

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EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

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(C63008)  MSFC TWT 529 33 FOOT BOOSTER  N187F2  0.000  
(C63012)  MSFC TWT 529 33 FOOT BOOSTER  N187F3  0.000  

REFERENCE INFORMATION  
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BREF  5.4330  IN.  
XMRP  3.2660  IN.  
YMRP  0.0000  IN.  
ZMRP  0.0000  IN.  
SCALE  0.0034  

ANGULAR OF ATTACK, ALPHA, DEGREES

AXIAL FORCE COEFFICIENT, CA

MACH  2.740
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

ANGLE OF ATTACK, ALPHA, DEGREES

LIFT COEFFICIENT, CL

DATA SET SYMBOL CONFIGURATION DESCRIPTION BETA

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(C63004) △ MSFC TWT 529 33 FOOT BOOSTER N1B7 0.000
(C63008) ◊ MSFC TWT 529 33 FOOT BOOSTER N1B7F2 0.000
(C63012) □ MSFC TWT 529 33 FOOT BOOSTER N1B7F3 0.000

REFERENCE INFORMATION

SERF 1.4230 Sq. In.
LREF 5.4330 In.
BREF 5.4330 In.
XHREF 3.2660 In.
ZHREF 0.0000 In.
SCALE 0.0034

MACH 0.596
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA
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(C63008)  ▲  HSFC TWT 529 33 FOOT BOOSTER  N1B7F2  0.000
(C63012)  ●  HSFC TWT 529 33 FOOT BOOSTER  N1B7F3  0.000

MACH  0.897

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BREF  5.4350  IN.
XHRF  5.2660  IN.
YHRP  0.0000  IN.
ZMRP  0.0000  IN.
SCALE  0.0034

PAGE  20
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

ANGLE OF ATTACK, ALPHA, DEGREES

LIFT COEFFICIENT, CL

DATA SET SYMBOL CONFIGURATION DESCRIPTION BETA
(C63001) MSFC TWT 529 33 FOOT BOOSTER N1B6 0.000
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(C63012) MSFC TWT 529 33 FOOT BOOSTER N1B7F3 0.000

REFERENCE INFORMATION
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BREF 5.4330 IN.
XMRP 3.2660 IN.
YMRP 0.0000 IN.
ZMRP 0.0000 IN.
SCALE 0.0034

MACH 1.199

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EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

DATA SET SYMBOL CONFIGURATION DESCRIPTION BETA
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REFERENCE INFORMATION
SREF 1.4230 SQ.IN.
LREF 5.4330 IN.
BREF 5.4330 IN.
XHRP 3.2660 IN.
YHRP 0.0000 IN.
ZHRP 0.0000 IN.
SCALE 0.0034

MACH 2.740

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EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

ANGLE OF ATTACK, ALPHA, DEGREES

LIFT COEFFICIENT, CL

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION BETA REFERENCE INFORMATION
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(C63004) A HSFC TWT 529 33 FOOT BOOSTER NIB7 0.000 LREF 5.4330 IN.
(C63008) O HSFC TWT 529 33 FOOT BOOSTER NIB7F2 0.000 BREF 5.4330 IN.
(C63012) O HSFC TWT 529 33 FOOT BOOSTER NIB7F3 0.000 YHRP 3.2660 IN.

REFERENCE INFORMATION
SREF 1.4230 SQ.IN.
LREF 5.4330 IN.
BREF 5.4330 IN.
YHRP 3.2660 IN.
ZHRP 0.0000 IN.
SCALE 0.0034 IN.

MACH 4.959

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 EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA
(C63001)  MSFC TWT 529 33 FOOT BOOSTER  N1B6  0.000
(C63004)  MSFC TWT 529 33 FOOT BOOSTER  N1B7  0.000
(C63008)  MSFC TWT 529 33 FOOT BOOSTER  N1B7F2  0.000
(C63012)  MSFC TWT 529 33 FOOT BOOSTER  N1B7F3  0.000

REFERENCE INFORMATION
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BREF  5.4330  IN.
XHRA  3.2660  IN.
YHRA  0.0000  IN.
ZHRA  0.0000  IN.
SCALE  0.0034

MACH  0.596

PAGE 25
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION BETA REFERENCE INFORMATION
(C63001) ○ MSFC TWT 529 33 FOOT BOOSTER N186 0.000 SREF 1.4230 SQ. IN.
(C63004) ○ MSFC TWT 529 33 FOOT BOOSTER N187 0.000 LREF 5.4330 IN.
(C63008) ○ MSFC TWT 529 33 FOOT BOOSTER N187F2 0.000 XHRP 3.2660 IN.
(C63012) ○ MSFC TWT 529 33 FOOT BOOSTER N187F3 0.000 YHRP 0.0000 IN.

MACH 0.897 ZHRP 0.0000 IN.

SCALE 0.0034
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

DATA SET SYMBOL CONFIGURATION DESCRIPTION BETA
(C63001) MSFC TWT 529 33 FOOT BOOSTER N1B6 0.000
(C63004) MSFC TWT 529 33 FOOT BOOSTER N1B7 0.000
(C63008) MSFC TWT 529 33 FOOT BOOSTER N1B7F2 0.000
(C63012) MSFC TWT 529 33 FOOT BOOSTER N1B7F3 0.000

REFERENCE INFORMATION
SREF 1.4230 SQ. IN.
LREF 5.4330 IN.
BREF 5.4330 IN.
YHRP 3.2660 IN.
YHRP 0.0000 IN.
ZHRP 0.0000 IN.
SCALE 0.0034

MACH 1.456

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EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA
(C63001)  MSFC TWT 529 33 FOOT BOOSTER NIB6  0.000
(C63004)  MSFC TWT 529 33 FOOT BOOSTER NIB7  0.000
(C63008)  MSFC TWT 529 33 FOOT BOOSTER NIB7F2  0.000
(C63012)  MSFC TWT 529 33 FOOT BOOSTER NIB7F3  0.000

REFERENCE INFORMATION
SREF  1.4230  SQ.IN.
LREF  5.4330  IN.
BREF  5.4330  IN.
XHPP  3.2660  IN.
YHPP  0.0000  IN.
ZHPP  0.0000  IN.
SCALE  0.0034

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EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

DATA SET SYMBOL CONFIGURATION DESCRIPTION BETA
(C630G1) ○ MSFC TWT 529 33 FOOT BOOSTER N186 0.000
(C630G4) ○ MSFC TWT 529 33 FOOT BOOSTER N187 0.000
(C630G8) □ MSFC TWT 529 33 FOOT BOOSTER N187F2 0.000
(C630G9) □ MSFC TWT 529 33 FOOT BOOSTER N187F3 0.000

REFERENCE INFORMATION
SREF 1.4230 SG, IN.
LREF 5.4330 IN.
ZRF 0.0000 IN.

SCALE 0.0034

MACH 4.959

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EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

LIFT-DRAG RATIO, L/D

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION BETA
(C63001) ○ MSFC TWT 529 33 FOOT BOOSTER N1B6 0.000
(C63004) ○ MSFC TWT 529 33 FOOT BOOSTER N1B7 0.000
(C63008) ○ MSFC TWT 529 33 FOOT BOOSTER N1B6F2 0.000
(C63012) O MSFC TWT 529 33 FOOT BOOSTER N1B6F3 0.000

REFERENCE INFORMATION
SREF 1.4230 SQ.IN.
LREF 5.4330 IN.
BREF 5.4330 IN.
XMRP 3.2660 IN.
YMRP 0.0000 IN.
ZHRP 0.0000 IN.
SCALE 0.0034

MACH 0.596

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EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA
(C63001) O  MSFC TWT 529 33 FOOT BOOSTER N1B6  0.000
(C63004) X  MSFC TWT 529 33 FOOT BOOSTER N1B7  0.000
(C63008) □  MSFC TWT 529 33 FOOT BOOSTER N1B7F2  0.000
(C63012) ■  MSFC TWT 529 33 FOOT BOOSTER N1B7F3  0.000

REFERENCE INFORMATION
SREF  1.4230  IN.
LREF  5.4330  IN.
BREF  5.4330  IN.
XHRE  3.2660  IN.
YHRE  0.0000  IN.
ZHRE  0.0000  IN.
SCALE  0.0034

MACH  1.199
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

ANGLE OF ATTACK, ALPHA, DEGREES

LIFT-DRAG RATIO, L/D

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA  REFERENCE INFORMATION
(C63001)  MSFC TWT 529 33 FOOT BOOSTER  N186  0.000  SREF 1.4230 SQ. IN.
(C63004)  MSFC TWT 529 33 FOOT BOOSTER  N187  0.000  LREF 5.4330 IN.
(C63008)  MSFC TWT 529 33 FOOT BOOSTER  N187F2  0.000  BREF 5.4330 IN.
(C63012)  MSFC TWT 529 33 FOOT BOOSTER  N187F3  0.000  XMRP 3.2460 IN.
              BETA  0.000  YMRP 0.0000 IN.
              BETA  0.000  ZMRP 0.0000 IN.
              BETA  0.0034  SCALE 0.0034 IN.

MACH 1.456

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EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

DATA SET SYMBOL | CONFIGURATION DESCRIPTION | BETA | REFERENCE INFORMATION
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(C63001) | MSFC TWT 529 33 FOOT BOOSTER N186 | 0.000 | SREF 1.4230 SQ. IN.
(C63004) | MSFC TWT 529 33 FOOT BOOSTER N187 | 0.000 | LREF 5.4335 IN.
(C63008) | MSFC TWT 529 33 FOOT BOOSTER N187F2 | 0.000 | BREF 5.4335 IN.
(C63012) | MSFC TWT 529 33 FOOT BOOSTER N187F3 | 0.000 | XHRP 3.2660 IN.
| | | | YHRP 0.0000 IN.
| | | | ZHRP 0.0000 IN.
| | | | SCALE 0.0034

MACH 2.740
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

LIFT-DRAG RATIO, L/D

ANGLE OF ATTACK, ALPHA, DEGREES

DATA SET SYMBOL CONFIGURATION DESCRIPTION BETA REFERENCE INFORMATION
(C63001) MSFC TWT 929 33 FOOT BOOSTER NIB6 0.000 SREF 1.4230 SQ. IN.
(C63004) MSFC TWT 929 33 FOOT BOOSTER NIB7 0.000 LREF 5.4330 IN.
(C63508) MSFC TWT 929 33 FOOT BOOSTER NIB7F2 0.000 BREF 5.4330 IN.
(C63012) MSFC TWT 929 33 FOOT BOOSTER NIB7F3 0.000 XHRP 3.2660 IN.

MACH 4.959

SCALE 0.0034
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

NORMAL FORCE COEFFICIENT, CN

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA  REFERENCE INFORMATION
(C63011)  MSFC TWT 529 33 FOOT BOOSTER N1B6 0.000  SREF 1.4230 SQ.IN.
(C63004)  MSFC TWT 529 33 FOOT BOOSTER N1B7 0.000  LREF 5.4330 IN.
(C63008)  MSFC TWT 529 33 FOOT BOOSTER N1B7F2 0.000  BREF 5.4330 IN.
(C63012)  MSFC TWT 529 33 FOOT BOOSTER N1B7F3 0.000  XMRP 5.2660 IN.

MACH 0.596

SCALE 0.0034
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

REFERENCE INFORMATION

SREF 1.4250 SQ. IN.
LREF 5.4330 IN.
BREF 5.4330 IN.
XMRP 3.2000 IN.
ZMRP 0.0000 IN.
SCALE 0.0034

CONFIGURATION DESCRIPTION

DATA SET SYMBOL CONFIGURATION DESCRIPTION BETA
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(C63004) MSFC TWT S29 33 FOOT BOOSTER N187 0.000
(C63008) MSFC TWT S29 33 FOOT BOOSTER N187F2 0.000
(C63012) MSFC TWT S29 33 FOOT BOOSTER N187F3 0.000

MACH 0.697

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EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

DATA SET SYMBOL | CONFIGURATION DESCRIPTION | BETA | REFERENCE INFORMATION
(C63001) | MSFC TWT 529 33 FOOT BOOSTER N186 | 0.000 | SREF 1.4230 SQ. IN.
(C63004) | MSFC TWT 529 33 FOOT BOOSTER N187 | 0.000 | LREF 5.4330 IN.
(C63006) | MSFC TWT 529 33 FOOT BOOSTER N187F2 | 0.000 | BREF 5.4330 IN.
(C63012) | MSFC TWT 529 33 FOOT BOOSTER N187F3 | 0.000 | YHMRP 3.2660 IN.

MACH 1.456
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA  REFERENCE INFORMATION
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(C63008)  MSFC TWT 529 33 FOOT BOOSTER N1B7F2  0.000  XNRP  3.2660 IN.
(C63012)  MSFC TWT 529 33 FOOT BOOSTER N1B7F3  0.000  YNRP  0.0000 IN.
               ZNRP  0.0000 IN.
               SCALE  0.0034

MACH  2.740

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EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

DATA SET SYMBOl | CONFIGURATION DESCRIPTION | BETA
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(C6300312) | MSFC TWT 529 33 FOOT BOOSTER N1B7F2 | 0.000

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BREF 5.4330 IN.
XMRP 3.2660 IN.
ZMRP 0.0000 IN.
SCALE 0.0034

MACH 4.959

PITCHING MOMENT COEFFICIENT, CLM
NORMAL FORCE COEFFICIENT, CN
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  PITCHING MOMENT COEFFICIENT, CLM  BETA  REPORT
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(C63008)  MSFC TWT 529 33 FOOT BOOSTER N1B7F2 0.000  LREF 5.4330 IN.
(C63012)  MSFC TWT 529 33 FOOT BOOSTER N1B7F3 0.000  BREF 5.4330 IN.
MACH 0.596  XMRP 3.2660 IN.
SCALE 0.0034  YMRP 0.0000 IN.
ZMRF 0.0000 IN.

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EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA  REFERENCE INFORMATION
(C630D1)  MSFC TWT 529 33 FOOT BOOSTER  N1B6  0.000  SREF 1.4230  sq.in.
(C630D4)  MSFC TWT 529 33 FOOT BOOSTER  N1B7  0.000  LREF 5.4330  in.
(C630D8)  MSFC TWT 529 33 FOOT BOOSTER  N1B7F2  0.000  BREF 5.4330  in.
(C63012)  MSFC TWT 529 33 FOOT BOOSTER  N1B7F3  0.000  XMRP 3.2660  in.
                          N1B7F3  0.000  YMRP 0.0000  in.
                          N1B7F3  0.000  ZMRP 0.0000  in.
                          N1B7F3  0.000  SCALE 0.0034

MACH 0.897

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### Effect of Configuration on Longitudinal Characteristics

#### Pitching Moment Coefficient, CLM

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**Reference Information**
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- LREF = 5.4330 IN.
- BREF = 5.4350 IN.
- XMRP = 3.8660 IN.
- YMRP = 0.0000 IN.
- ZMRP = 0.0000 IN.
- SCALE = 0.0034

**Mach** 1.199
EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

PITCHING MOMENT COEFFICIENT, CLM

LIFT COEFFICIENT, CL

DATA SET SYMBOL CONFIGURATION DESCRIPTION BETA REFERENCE INFORMATION
(C63001) MSFC TWT 529 33 FOOT BOOSTER N1B6 0.000 SREF 1.4230 SQ.IN.
(C63004) MSFC TWT 529 33 FOOT BOOSTER N1B7 0.000 LREF 5.4330 IN.
(C63008) MSFC TWT 529 33 FOOT BOOSTER N1B7F2 0.000 BREF 5.4330 IN.
(C63012) MSFC TWT 529 33 FOOT BOOSTER N1B7F3 0.000 XMRP 3.2660 IN.

SCALE 0.0034 IN.

MACH 1.456

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EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

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MACH 2.740

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EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

LIFT COEFFICIENT, CL

PITCHING MOMENT COEFFICIENT, CLM

DATA SET SYMBOL CONFIGURATION DESCRIPTION BETA
(C63001) MSFC TWT 529 33 FOOT BOOSTER N186 0.000
(C63004) MSFC TWT 529 33 FOOT BOOSTER N187 0.000
(C63008) MSFC TWT 529 33 FOOT BOOSTER N187F2 0.000
(C63012) MSFC TWT 529 33 FOOT BOOSTER N187F3 0.000

REFERENCE INFORMATION
SREF 1.4230 SQ.IN.
LREF 5.4330 IN.
BREF 5.4330 IN.
XMRP 3.2660 IN.
YMRP 0.0000 IN.
ZMRP 0.0000 IN.
SCALE 0.0034

MACH 4.950

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EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

DATA SET SYMBOL

IC63001) () NSFC TWT 529 33 FOOT BOOSTER
IC630041) () NSFC TWT 529 33 FOOT BOOSTER
IC630081) () NSFC TWT 529 33 FOOT BOOSTER

REFERENCE INFORMATION
SREF 1.4230 SQ.IN.
LREF 5.4330 IN.
BREF 5.4330 IN.
XNRF 3.2660 IN.
YNRF 0.0000 IN.
ZNRF 0.0000 IN.
SCALE 0.0034

DRAG COEFFICIENT, CD

LIFT COEFFICIENT, CL

MACH 1.199

DRAG COEFFICIENT, CD

REFERENCE INFORMATION
SREF 1.4330 SQ.IN.
LREF 5.4330 IN.
BREF 5.4330 IN.
XNRF 3.2660 IN.
YNRF 0.0000 IN.
ZNRF 0.0000 IN.
SCALE 0.0034

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EFFECT OF CONFIGURATION ON LONGITUDINAL CHARACTERISTICS

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA
(C63001)  MSFC TWT 529 33 FOOT BOOSTER N186  0.000
(C63004)  MSFC TWT 529 33 FOOT BOOSTER N187  0.000
(C63008)  MSFC TWT 529 33 FOOT BOOSTER N187F2  0.000
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REFERENCE INFORMATION
SREF 1.4230 SQ. IN.
LREF 5.4330 IN.
BREF 3.4330 IN.
XHPR 3.2650 IN.
YHPR 0.0000 IN.
ZHPR 0.0000 IN.
SCALE 0.0034

MACH 2.740

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EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ALPHA  REFERENCE INFORMATION
(A63006)  DATA NOT AVAILABLE FOR ALL CONDITIONS  60.000  SREF  1.4230  SQ. IN.
(A63007)  DATA NOT AVAILABLE FOR ALL CONDITIONS  80.000  LREF  5.4330  IN.
(A63010)  MSFC TWT 529  33 FOOT BOOSTER N1B7F2  60.000  BREF  5.4330  IN.
(A63011)  MSFC TWT 529  33 FOOT BOOSTER N1B7F2  80.000  XWRP  3.2660  IN.
(A63014)  MSFC TWT 529  33 FOOT BOOSTER N1B7F3  60.000  YHRP  0.0000  IN.
(A63015)  MSFC TWT 529  33 FOOT BOOSTER N1B7F3  80.000  ZHRP  0.0000  IN.

MACH  0.596  SCALE  0.0034

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EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

DATA SET SYMBOL | CONFIGURATION DESCRIPTION | ALPHA
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(A63007) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 60.000
(A63010) | MSFC TWT 529 33 FOOT BOOSTER N1B7F2 | 60.000
(A63011) | MSFC TWT 529 33 FOOT BOOSTER N1B7F2 | 80.000
(A63014) | MSFC TWT 529 33 FOOT BOOSTER N1B7F3 | 60.000
(A63015) | MSFC TWT 529 33 FOOT BOOSTER N1B7F3 | 80.000
MACH 0.904

REFERENCE INFORMATION
SREF 1.4230 SQ. IN.
LREF 5.4330 IN.
BREF 5.4330 IN.
XBRP 3.2660 IN.
YBRP 0.0000 IN.
ZBRP 0.0000 IN.
SCALE 0.0034
EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ALPHA  REFERENCE INFORMATION
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MACH  1.204  SCALE  0.0034

REFERENCE INFORMATION
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### EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

#### Data Set Symbol | Configuration Description | Alpha | Reference Information
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(A63014) | MSFC TWT 529 33 Foot Booster N1B7F2 | 60.000 | YMRP 0.0000 in.
(A63015) | MSFC TWT 529 33 Foot Booster N1B7F3 | 60.000 | SCALE 0.0034 in.

**Legend**
- **LATERAL FORCE COEFFICIENT, CY**
- **SIDE SLIP ANGLE, BETA, DEGREES**

**DATA SET SYMBOL**
- (A63004)
- (A63007)
- (A63001)
- (A63014)
- (A63015)

**MACH**
- 1.466

**REFERENCE INFORMATION**
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- YMRP: 0.0000 in.
- SCALE: 0.0034 in.
EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

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| XMNP | 3.2660 | IN.    |
| YNRP | 0.0000 | IN.    |
| ZNRP | 0.0000 | IN.    |
| SCALE| 0.0034 |        |

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**EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS**

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| MACH | 4.959 |

**REFERENCE INFORMATION**

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- BREF: 5.4330 in.
- XHRP: 3.2660 in.
- YHRP: 0.0000 in.
- ZHRP: 0.0000 in.
- SCALE: 0.0034
EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

ROLLING MOMENT COEFFICIENT, CBL (BODY AXIS)

SIDE SLIP ANGLE, BETA, DEGREES

DATA SET SYMBOL   CONFIGURATION DESCRIPTION   ALPHA   REFERENCE INFORMATION
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(A63014)   MSFC TWT 529 33 FOOT BOOSTER N1B7F3   60,000   YNRP 0.0000 IN.
(A63015)   MSFC TWT 529 33 FOOT BOOSTER N1B7F3   60,000   ZNRP 0.0000 IN.
MACH 0.596   SCALE 0.0034

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EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

ROLLING MOMENT COEFFICIENT, CBL (BODY AXIS)

SIDE SLIP ANGLE, BETA, DEGREES

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ALPHA
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(A63014)  MSFC TWT 529 35 FOOT BOOSTER N187F3  60.000
(A63015)  MSFC TWT 529 35 FOOT BOOSTER N187F3  60.000

REFERENCE INFORMATION
SREF  1.4230  SQ.IN.
LREF  5.4330  IN.
XREF  3.2660  IN.
YMRP  0.0000  IN.
ZMRP  0.0000  IN.
SCALE  0.0034

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EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

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Effect of Configuration on Directional Characteristics

Rolling Moment Coefficient, Cbl (Body Axis)

Side Slip Angle, Beta, Degrees

Data Set Symbol  Configuration Description  Alpha  Reference Information
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(A63007)  MSFT TWT 329 33 Foot Booster N1B7F2  60.000  LREF 5.4330 in.
(A63010)  MSFT TWT 329 33 Foot Booster N1B7F2  60.000  BREF 5.4330 in.
(A63011)  MSFT TWT 329 33 Foot Booster N1B7F3  60.000  XMRF 3.2660 in.
(A63014)  MSFT TWT 329 33 Foot Booster N1B7F3  60.000  YMRP 0.0000 in.
(A63015)  MSFT TWT 329 33 Foot Booster N1B7F3  60.000  ZMRP 0.0000 in.
MACH 1.466  SCALE 0.0034

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### EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

#### Side Slip Angle, Beta, Degrees

<table>
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- SREF: 1.4250 in.
- LREF: 5.4330 in.
- BREF: 5.4330 in.
- XMRP: 3.2460 in.
- YMRP: 0.0000 in.
- ZMRP: 0.0000 in.
- SCALE: 0.0034

**Mach 2.74D**
EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

ROLLING MOMENT COEFFICIENT, CBL (BODY AXIS)

SIDE SLIP ANGLE, BETA, DEGREES

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ALPHA  REFERENCE INFORMATION
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(A63007) □ DATA NOT AVAILABLE FOR ALL CONDITIONS  60.000  LREF 5.4330 IN.
(A63010) □ MSFC TWT 529 33 FOOT BOOSTER N1B7F2  60.000  XHRP 3.2660 IN.
(A63011) □ MSFC TWT 529 33 FOOT BOOSTER N1B7F3  60.000  YHRP 0.0000 IN.
(A63014) □ MSFC TWT 529 33 FOOT BOOSTER N1B7F3  60.000  ZHRP 0.0000 IN.
(A63015) □ MSFC TWT 529 33 FOOT BOOSTER N1B7F3  80.000  SCALE 0.0034 IN.

NACH 4.959

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EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

SIDE SLIP ANGLE, BETA, DEGREES

DATA SET SYMBOL | CONFIGURATION DESCRIPTION | ALPHA | REFERENCE INFORMATION
(A63006) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 60.000 | SREF 1.4230 SQ. IN.
(A63007) | DATA NOT AVAILABLE FOR ALL CONDITIONS | 60.000 | LREF 5.4330 IN.
(A63010) | MSFC TWT S29 33 FOOT BOOSTER N187F2 | 60.000 | NHRP 3.2660 IN.
(A63011) | MSFC TWT S29 33 FOOT BOOSTER N187F2 | 60.000 | ZHRP 0.0000 IN.
(A63014) | MSFC TWT S29 33 FOOT BOOSTER N187F3 | 60.000 | SCALE 0.0034
(MACH 0.596)

YAWING MOMENT COEFFICIENT, CYN (BODY AXIS)
EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

SIDE SLIP ANGLE, BETA, DEGREES

DATA SET SYMBOL  CONFIGURATION DESCRIPTION                  ALPHA
(A63006)       DATA NOT AVAILABLE FOR ALL CONDITIONS      80.000
(A63007)       DATA NOT AVAILABLE FOR ALL CONDITIONS      80.000
(A63010)       MSFC TWT 920 35 FOOT BOOSTER               N187F2
(A63011)       MSFC TWT 929 35 FOOT BOOSTER               N187F2
(A63014)       MSFC TWT 929 35 FOOT BOOSTER               N187F3
(A63015)       MSFC TWT 929 35 FOOT BOOSTER               N187F3
MACI            0.006

REFERENCE INFORMATION
LREF 5.4330 IN.
CREF 5.4330 IN.
XMRP 0.0000 IN.
YMRP 0.0000 IN.
ZMRP 0.0000 IN.
SCALE 0.0034

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EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

SIDE SLIP ANGLE, BETA, DEGREES

Yawing Moment Coefficient, Cyn (Body Axis)

DATA SET SYMBOL CONFIGURATION DESCRIPTION ALPHA
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(A63007) DATA NOT AVAILABLE FOR ALL CONDITIONS 80.000
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(A63011) DATA NOT AVAILABLE FOR ALL CONDITIONS 80.000
(A63014) MSFC TWT S2F 33 FOOT BOOSTER M187F3 60.000
(A63019) MSFC TWT S2F 33 FOOT BOOSTER M187F3 80.000

REFERENCE INFORMATION
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LREF 5.4330 IN.
BREF 5.4330 IN.
XMRP 3.2660 IN.
YMRP 0.0000 IN.
ZMRP 0.0000 IN.
SCALE 0.0034

MACH 1.204
EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

SIDE SLIP ANGLE, BETA, DEGREES

YAWING MOMENT COEFFICIENT, CYN (BODY AXIS)

DATA SET SYMBOL CONFIGURATION DESCRIPTION ALPHA
(A63056) MSFC TWT 529 33 FOOT BOOSTER N187 60.000
(A63077) MSFC TWT 529 33 FOOT BOOSTER N187 60.000
(A63010) MSFC TWT 529 33 FOOT BOOSTER N187F2 60.000
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SREF 1.4235 SQR. IN.
LREF 5.4335 IN.
BREF 5.4335 IN.
XMRP 3.6490 IN.
YMRP 0.0000 IN.
ZMRP 0.0000 IN.
SCALE 0.0034

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EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

SIDE SLIP ANGLE, BETA, DEGREES

YAWING MOMENT COEFFICIENT, CYN (BODY AXIS)

DATA SET SYMBOL CONFIGURATION DESCRIPTION ALPHA
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REFERENCE INFORMATION
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LREF 5.4330 IN.
BREF 5.4330 IN.
XREF 3.2640 IN.
YREF 0.0000 IN.
ZREF 0.0000 IN.
SCALE 0.0034

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EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

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(HSFC TWT 529 33 FOOT BOOSTER N187F3  80.000  ZMPR 0.0000 IN.
(HSFC TWT 529 33 FOOT BOOSTER N187F3  80.000  SCALE 0.0034

SIDE SLIP ANGLE, BETA, DEGREES

YAWING MOMENT COEFFICIENT, CYN (BODY AXIS)
EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

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DATA SET SYMBOL CONFIGURATION DESCRIPTION REFERENCE INFORMATION

EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

LATERAL FORCE COEFFICIENT, CY

YAWING MOMENT COEFFICIENT, CYN (BODY AXIS)
EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

YAWING MOMENT COEFFICIENT, CYN (BODY AXIS)

LATERAL FORCE COEFFICIENT, CY

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ALPHA  REFERENCE INFORMATION
(A65006)  DATA NOT AVAILABLE FOR ALL CONDITIONS  60.000  SREF  1.4230 SQ. IN.
(A65007)  DATA NOT AVAILABLE FOR ALL CONDITIONS  60.000  LREF  5.4330 IN.
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(A63011)  HSFC TWT 529 33 FOOT BOOSTER N1B7F2  60.000  XMRP  3.2660 IN.
(A63016)  HSFC TWT 529 33 FOOT BOOSTER N1B7F3  60.000  YMRP  0.0000 IN.
(A63019)  HSFC TWT 529 33 FOOT BOOSTER N1B7F3  60.000  ZMRP  0.0000 IN.

MACH 0.063

REFERENCE INFORMATION
SREF 1.4230 SQ. IN.
LREF 5.4330 IN.
BREF 5.4330 IN.
XMRP 3.2660 IN.
YMRP 0.0000 IN.
ZMRP 0.0000 IN.
SCALE 0.9936

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EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

ограф показывает влияние конфигурации на направлительные характеристики.

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ALPHA  REFERENCE INFORMATION
(A6506)  DATA NOT AVAILABLE FOR ALL CONDITIONS  60.000  SREF  1.4230  SQ. IN.
(A6507)  DATA NOT AVAILABLE FOR ALL CONDITIONS  60.000  LREF  5.4330  IN.
(A65010) HSFC TWT 529 33 FOOT BOOSTER  N177F2  60.000  BREF  5.4330  IN.
(A65011) DATA NOT AVAILABLE FOR ALL CONDITIONS  60.000  XHMP  3.2660  IN.
(A65014) HSFC TWT 529 33 FOOT BOOSTER  N177F3  80.000  YHMP  0.0000  IN.
(A65015) HSFC TWT 529 33 FOOT BOOSTER  N177F3  80.000  ZHMP  0.0000  IN.

SCALE 0.0034

MACH 1.204

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EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

LATERAL FORCE COEFFICIENT, CY

YAWING MOMENT COEFFICIENT, CYN (BODY AXIS)

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ALPHA  REFERENCE INFORMATION
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(A3G0G7)  MSFC TWT 929 33 FOOT BOOSTER  M1B7  60.000  LREF  5.4330  IN.
(A3G010)  MSFC TWT 929 33 FOOT BOOSTER  M1B7F2  60.000  BREF  5.4330  IN.
(A3G011)  MSFC TWT 929 33 FOOT BOOSTER  M1B7F2  60.000  XHRP  3.2660  IN.
(A3G014)  MSFC TWT 929 33 FOOT BOOSTER  M1B7F3  60.000  THRP  0.0000  IN.
(A3G015)  MSFC TWT 929 33 FOOT BOOSTER  M1B7F3  60.000  ZHRP  0.0000  IN.
MACH  1.486  SCALE  0.0034

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EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

YAWING MOMENT COEFFICIENT, CYN (BODY AXIS)

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  ALPHA  REFERENCE INFORMATION
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CA63007  DATA NOT AVAILABLE FOR ALL CONDITIONS  60.000  LREF  5.4330 IN.
CA63010  MSFC TWT 529 35 FOOT BOOSTER N1B7F2  60.000  BREF  5.4330 IN.
CA63011  MSFC TWT 529 35 FOOT BOOSTER N1B7F3  60.000  XMRP  3.2660 IN.
CA63014  MSFC TWT 529 35 FOOT BOOSTER N1B7F3  60.000  YMRP  0.0000 IN.
CA63015  MSFC TWT 529 35 FOOT BOOSTER N1B7F3  60.000  ZMRP  0.0000 IN.
MACH  2.740  SCALE  0.0034
EFFECT OF CONFIGURATION ON DIRECTIONAL CHARACTERISTICS

DATA SET  SYMBOL  CONFIGURATION DESCRIPTION  ALPHA  REFERENCE INFORMATION
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(A65007)  DATA NOT AVAILABLE FOR ALL CONDITIONS  60.000  LREF  5.4330 IN.
(A65010)  MSFC TWT 529 33 FOOT BOOSTER N187F2  60.000  BREF  5.4330 IN.
(A65011)  MSFC TWT 529 33 FOOT BOOSTER N187F2  60.000  XHPR  5.2660 IN.
(A65014)  MSFC TWT 529 33 FOOT BOOSTER N187F3  60.000  THPR  0.0000 IN.
(A65015)  MSFC TWT 529 33 FOOT BOOSTER N187F3  60.000  ZHPR  0.0360 IN.
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REFERENCE INFORMATION
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