WIND TUNNEL TEST RESULTS FOR THE DIRECTION CONTROLLED ANTITANK (DCAT) MISSILE AT MACH NUMBERS FROM 0.64 TO 2.50

T. A. Martin, et al

Chrysler Corporation

Prepared for:

Army Missile Command
National Aeronautics and Space Administration

12 October 1973

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<td>Chrysler Corporation Space Division</td>
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<td>Data Management Group</td>
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<td>Wind tunnel test results are presented to show aerodynamic characteristics over the Mach number range of 0.64 to 2.50 of the DCAT missile. Data are presented showing the interference created by the rear mounted reaction control system. Two candidate fins were installed on the model during tests: a flat folding fin and a curved wrap around fin.</td>
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PLOTTED COEFFICIENTS SCHEDULE: (A): CN, CLM vs. ALPHA; CN vs. CLM; CY vs. ALPHA
The Direction Controlled Anti-Tank Missile (DCAT) is a shoulder-fired weapon with a rear located jet reaction control system. The control system utilizes four bi-stable fluidic valves powered by a portion of the exhaust gases during the post eject, boost phase of the missile's flight. Two candidate fins are proposed to afford tube launch capability, a flat folding fin \((F_f)\) and a curved wrap around fin \((F_w)\). The model was tested with the control system operated at two conditions; at de-Ion level (supply pressure to ambient pressure ratio = 86) and an over pressure level (pressure ratio = 130).

Tests were conducted at the NASA-Ames facility in the 14 Foot Transonic and the 6 x 7 Foot Supersonic Tunnels. Test Mach number range was from \(M = 0.64\) to 1.5 and the model was tested over the angle-of-attack range 44 degrees.
MODEL DESCRIPTION

External Geometry:

A 1.5 percent scale model of the BCAT was used during the tests. Photographs of the model are shown in figures 4 and 5. Details of the external geometry are given in figure 7. Cut outs shown in the fins are intended to accommodate the mechanism used to extend the fins after launch. Both fins (fold down fin, F4 & wrap around fin, F5) were tested with simulated "pop up" springs installed in these cut outs. The trailing edge of each fin extended one-half inch beyond the model base when installed. The launch tube bore riders shown attached to F4 are in practice installed on the missile surface, but for ease of fabrication were mounted on this fin. Fin F5 was not tested with the bore rider installed. The fin retaining band is utilized to provide structural support to the forward fin mounting pads and was tested installed with F4 only. The four conduits located 90° apart and oriented between the fins simulated wiring tunnels on the missile used to route electrical leads from the gyro guidance package forward of the motor to the fluidic control package near the missile base. These conduits were installed on all configurations tested.

Fluidic Valves:

The four single stage jet reaction control valves were located in the model with the exhaust ports located as shown in figure 2. These valves are flight hardware valves modified to fit the oversize model and to accept commands from a remote device rather than a gyro package. Each
valve is a bi-stable fluidic device which may be switched by closing the appropriate control port. Switching of these valves is controlled at 60 cycles per sec. Control is produced by biasing the flow in the desired direction during a portion of each cycle. Cold air was supplied to the valves during testing to simulate the hot gases employed during flight.

It was necessary to adjust the operating concept of the control system in the wind tunnel to afford matching flight conditions. In flight, the hot gas is supplied to the valves at 1350 psi (86 times ambient air pressure). In the reduced atmosphere, both the supply pressure level and pressure ratio could not be maintained. The parameter selected to be matched was pressure ratio. Maintaining this ratio allowed duplicating the external flow characteristics developed due to the interaction between the control jet flow and the free stream. However, the flight thrust of the valves was not duplicated at the reduced pressure level. A determination of the "scaled" thrust was made by calibrating the model with the tunnel evacuated to test pressures but with no free stream flow. This information is presented in figure 3.

CONFIGURATIONS INVESTIGATED

A summary of the configurations and conditions investigated is given in table I. Configuration B2PwC is the configuration of primary interest and testing of B2PwC and off-design control pressurization ($F_{o_j}/F_P = 130$) was accomplished only to the extent of test time available. Extensive
testing was done to determine if operating the control system in a plane interfered with control system operation in the opposite plane. Testing of the control system-on condition was not done at Mach numbers 2.20 and 1.50 since no effect of the control system was found as this range was approached.

TEST FACILITY DESCRIPTION

The 9-by-7 Foot Supersonic Tunnel is a component of the Ames Unitary Plan Wind Tunnel. This test facility is a closed-loop, continuous flow, variable-density tunnel. The Mach number range of the 9-by-7 leg of this tunnel is from 1.4 to 2.6. The test was conducted under the Mach numbers from 1.55 to 2.50 at stagnation pressure of 16 to 22 psia.

The 14 Foot Transonic Tunnel is a closed-loop, continuous flow with a constant stagnation pressure (14.7 psi). Mach number range of this facility is from 0.6 to 1.7. Testing was conducted from 0.64 to 1.10 Mach number.
DATA REDUCTION

Forces and moments were reduced to non-dimensional coefficient form in the missile axis system. Reference dimensions used in the reduction are:

\[ S_{\text{ref}} = 0.11 \text{ sq. ft.} \]
\[ l_{\text{ref}} = 0.375 \text{ ft.} \]
\[ B_{\text{ref}} = 0.375 \text{ ft.} \]
\[ X_{\text{MRP}} = 0.0 \]
\[ Y_{\text{MRP}} = 0.0 \]
\[ Z_{\text{MRP}} = 0.0 \]

The data accuracy is considered to be reflected by the repeatability of the data in the pitch plane \((C_N \& C_m)\). The measurement in the yaw plane \((C_y)\) was strongly influenced by the dynamic response of the sting-balance-model. Therefore, this data usefulness is limited to determining levels and trends.
### NOMENCLATURE

#### General

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<th>SYMBOL</th>
<th>DEFINITION</th>
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<td>( u )</td>
<td>( \phi )</td>
<td>speed of sound; m/sec, ft/sec</td>
</tr>
<tr>
<td>( \phi_p )</td>
<td>( C_p )</td>
<td>pressure coefficient; ((p_1 - p_0)/\rho)</td>
</tr>
<tr>
<td>M</td>
<td>MACH</td>
<td>Mach number; ( V/c )</td>
</tr>
</tbody>
</table>
| \( 
\) | \( p \) | pressure; N/m\(^2\), psf |
| \( q \) | \( q_{(RSF)} \) | dynamic pressure; \( 1/\rho V^2 \), N/m\(^2\), psf |
| \( RN/L \) | \( RN/L \) | unit Reynolds number; per m, per ft |
| \( V \) | \( \alpha \) | velocity; m/sec, ft/sec |
| \( \alpha \) | \( \beta \) | angle of attack, degrees |
| \( \beta \) | \( \psi \) | angle of sideslip, degrees |
| \( \psi \) | \( \phi \) | angle of yaw, degrees |
| \( \phi \) | \( \rho \) | angle of roll, degrees |
| \( \rho \) | mass density; kg/m\(^3\), slugs/ft\(^3\) |

#### Reference & C.G. Definitions

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<td>( A_b )</td>
<td>base area; m(^2), ft(^2)</td>
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<td>BREF</td>
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<td>( c_g )</td>
<td>C.G.</td>
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<td>( L_{RBF} )</td>
<td>LREF</td>
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<tr>
<td>( c )</td>
<td>JREF</td>
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<tr>
<td>( MRP )</td>
<td>MRP</td>
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<td>( X_{MRP} )</td>
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<td>CN</td>
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<td>normal-force coefficient; ( \frac{\text{normal force}}{qS} )</td>
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<tr>
<td>CA</td>
<td>CA</td>
<td>axial-force coefficient; ( \frac{\text{axial force}}{qS} )</td>
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<tr>
<td>CY</td>
<td>CY</td>
<td>side-force coefficient; ( \frac{\text{side force}}{qS} )</td>
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<td>( C_{Ab} )</td>
<td>( CA_b )</td>
<td>yaw-force coefficient; ( \frac{\text{base force}}{qS} ) ( \frac{\rho (f_b - p_a)}{qS} )</td>
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<td>( C_{Af} )</td>
<td>( CA_f )</td>
<td>forebody axial force coefficient; ( C_A - CA_b )</td>
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<td>C( \theta )</td>
<td>C( \theta )</td>
<td>pitching-moment coefficient; ( \frac{\text{pitching moment}}{qS_{\text{Ref}}} )</td>
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<tr>
<td>C( \phi )</td>
<td>C( \phi )</td>
<td>yawing-moment coefficient; ( \frac{\text{yawing moment}}{qS_b} )</td>
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<tr>
<td>C( \psi )</td>
<td>C( \psi )</td>
<td>rolling-moment coefficient; ( \frac{\text{rolling moment}}{qS_b} )</td>
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<td>$P_f$</td>
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<td>free stream static pressure, psia.</td>
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<td>$P_{o,j}$</td>
<td>control system supply pressure, psia.</td>
</tr>
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<td>$P_{o,j}/P_f$</td>
<td>$P_{o,j}/P_f$</td>
<td>ratio of control system pressure to free stream pressure.</td>
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<td>$P_{mod}$</td>
<td>$P_{MOD}$</td>
<td>control system modulation in pitch plane.</td>
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<tr>
<td>$Y_{mod}$</td>
<td>$Y_{MOD}$</td>
<td>control system modulation in yaw plane.</td>
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<td>$B_2$</td>
<td>$B_2$</td>
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<tr>
<td>C</td>
<td>MOD</td>
<td>conduits spaced 90° apart</td>
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<td>MOD</td>
<td>MOD</td>
<td>modulation, a positive modulation is a force that causes a positive moment; a modulated force is a portion of the total reactive force acting in a selected direction, for a 60% modulation flow is biased in the desired direction for 80% of a cycle and for 20% of the cycle the flow is directed in the opposite direction yielding a net force in the desired direction for 60% of the cycle.</td>
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<td>CPB</td>
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<td>base pressure coefficient.</td>
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\( \alpha \) or \( \beta \) \( A \times x - 4^\circ \rightarrow +4^\circ \) COEFFICIENTS

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For α or β schedules:

\[ A(\alpha) : -4^\circ \rightarrow +4^\circ \]
FLOW

NOTE: ARROWS INDICATE POSITIVE DIRECTION OF ANGLES, FORCES, AND MOMENTS. FORCES AND MOMENTS WILL BE REDUCED TO BODY AXES COEFFICIENTS.

Figure 1. Axis Systems.
a. Model Geometry \((B_2F_4C)\)

Figure 2. - Model Details.
FIN CANT ANGLE TO PRODUCE CLOCKWISE ROLL, 0.15° (NOT SHOWN)

Dimensions are inches unless otherwise noted.

FIN DETAILS, $F_4$

b. Fin Details, $F_4$

Figure 2. - Continued.
c. Fin Details, \( F_5 \)

Figure 2. - Continued.

Dimensions are inches unless otherwise noted.
Dimensions are inches unless otherwise noted.

Figure P. - Concluded.

d. Fin Retaining Ring
Figure 3. - DCAT Scaled Thrust Levels ($P_{03}/P_F = 86$).
Figure 4. - Photograph of Tunnel Installation of Model.
a. Front Oblique View

Figure 5. - Photographs of Model.
b. Rear Oblique View

Figure 5. - Concluded.
Tabulations of the plotted data and corresponding source data are available from Data Management Services Operations.
MACH NUMBER EFFECT - CONFIGURATION B2 F4 C
MACH NUMBER EFFECT - CONFIGURATION B2 F4 C
### MACH NUMBER EFFECT - CONFIGURATION B2 F4 C

<table>
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<th>MACH</th>
<th>BETA</th>
<th>PARAMETRIC VALUES</th>
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**SCALE**: 125,000 PERCENT

**REFERENCE INFORMATION**

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

**PITCHING MOMENT COEFFICIENT, \( C_{LM} \)**
MACH NUMBER EFFECT - CONFIGURATION B2 F4 C
MACH NUMBER EFFECT - CONFIGURATION B2 F4 C
MACH NUMBER EFFECT - CONFIGURATION B2 F4 C

SYMBOL | MACH | BETA | PARAMETRIC VALUES
---|---|---|---
| .623 | | .000 |
| .798 | | |
| .945 | | |
| .997 | | |
| 1.090 | | |

REFERENCE INFORMATION
- SRF: .1100 S.FT.
- LRF: .3500 FT.
- RRF: .0000 FT.
- ZRF: .0000 FT.
- SCALE: 125,000 PERCENT

ANGLE OF ATTACK, ALPHA, DEGREES

SIDE FORCE COEFFICIENT, CY
MACH NUMBER EFFECT - CONFIGURATION B2 F4 C
PITCH MODULATION EFFECT

\( (A) \text{MACH} = 0.64 \)
PITCH MODULATION EFFECT

(Technical data and graph showing the relationship between angle of attack and normal force coefficient.)
PITCH MODULATION EFFECT
(C)MACH = 0.95
PITCH MODULATION EFFECT

(D) MACH = 1.00

PAGE 12
PITCH MODULATION EFFECT

\( \text{E} \)MACH = 1.10
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PITCH MODULATION EFFECT

\( \text{F\#MACH} = 1.56 \)

**PAGE 14**
PITCH MODULATION EFFECT

(G)MACH = 1.80
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### Pitch Modulation Effect

**MACH = 2.20**

**Scale:** 125,000 PERCENT
### DATA SET SUMMARY

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### NORMAL FORCE COEFFICIENT, CN

**ANGLE OF ATTACK, ALPHA, DEGREES**

**PITCH MODULATION EFFECT**

\( \text{MACH} = 2.50 \)

**SCALE** 125.000 PERCENT

---

**PAGE 17**
PITCH MODULATION EFFECT

MACH = 0.64
PITCH MODULATION EFFECT

(B) MACH = 0.80
PITCH MODULATION EFFECT
DATA SET SYMBOL CONFIGURATION DESCRIPTION
(BX1002) DCAT 603/604 B2 F4 C
(BX1003) DCAT 603/604 B2 F4 C
(BX1004) DCAT 603/604 B2 F4 C
(BX1005) DCAT 603/604 B2 F4 C

REFERENCE INFORMATION
BETA P-MOD Y-MOD POL/AY
1.00 0.00 0.00 56,000 (REF) 1100 50 FT.
1.00 40,000 0.00 56,000 (REF) 3750 FT.
1.00 60,000 0.00 56,000 (REF) 3750 FT.
1.00 100,000 0.00 56,000 (REF) 3750 FT.

SINGLE 125,000 PERTM

PITCH MODULATION EFFECT
(MACH = 1.56)

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DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA  P-MOD  Y-MOD  PQ1/PF  REFERENCE INFORMATION
(BX1002)  DCAT ARC 603/604  B2 F4 C  .000  .000  .000  60.000  SREF .1100  92.FT.
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(BX1004)  DCAT ARC 603/604  B2 F4 C  .000  60.000  .000  60.000  BREF .3750  92.FT.
(BX1005)  DCAT ARC 603/604  B2 F4 C  .000  80.000  .000  60.000  MREF .0000  92.FT.

PITCH MODULATION EFFECT
DATA SET SYMBOL  CONFIGURATION DESCRIPTION  
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(BX1004)  DATA NOT AVAILABLE  
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PITCH MODULATION EFFECT

\[ \text{CLM} = \frac{C}{\text{MACH}} \]

\[ \text{MACH} = 2.20 \]

PAGE 25
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**PITCH MODULATION EFFECT**

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<td>66.000</td>
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PITCH MODULATION EFFECT

\[(A)MACH = 0.64\]
### Pitch Modulation Effect

**Mach = 0.80**

The graph illustrates the relationship between the normal force coefficient ($C_N$) and the pitching moment coefficient ($C_{LM}$) for various data sets and symbols. The table provides the details of each data set, including symbols, configuration descriptions, BETA, PH-MOD, YM-MOD, PMU/FF, and reference information.

<table>
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<th>Data Set</th>
<th>Symbol</th>
<th>Configuration Description</th>
<th>Beta</th>
<th>PH-MOD</th>
<th>YM-MOD</th>
<th>PMU/FF</th>
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The graph shows a linear relationship between $C_N$ and $C_{LM}$, with the data points aligned along a straight line, indicating the pitch modulation effect at a Mach number of 0.80.
PITCH MODULATION EFFECT

(C)MACH = 0.95
PITCH MODULATION EFFECT

\( \text{MACH} = 1.10 \)
### DATA SET SYMBOL CONFIGURATION DESCRIPTION

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### PITCHING MOMENT COEFFICIENT, CLM

- Normal Force Coefficient, Cn

**PITCH MODULATION EFFECT**

\( \text{\texttt{F1MACH = 1.56}} \)

\( \text{\texttt{PAGE 22}} \)
PITCH MODULATION EFFECT

(1) MACH = 2.50
<table>
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<th>CONFIGURATION DESCRIPTION</th>
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PITCH MODULATION EFFECT

(B)MACH = 0.80

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### Data Set Symbol Configuration Description

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### Scale 125.000 Percent

- Angle of Attack, Alpha, Degrees

- Pitch Modulation Effect
PITCH MODULATION EFFECT

\( (D)MACH = 1.00 \)
SIDE FORCE COEFFICIENT, CY

ANGLE OF ATTACK, ALPHA, DEGREES

PITCH MODULATION EFFECT
(E)MACH = 1.10
PITCH MODULATION EFFECT

(F) MACH = 1.56
PITCH MODULATION EFFECT

\( MACH = 1.80 \)
SIDE FORCE COEFFICIENT, CY

ANGLE OF ATTACK, ALPHA, DEGREES

PITCH MODULATION EFFECT

(M)ACH = 2.20

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**Pitch Modulation Effect**

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PITCH MODULATION EFFECT

\( \text{MACH} = 0.64 \)

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DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA  P-MOD  Y-MOD  POLAR  REFERENCE INFORMATION
IBX10061  DCAT ARC 603/604 B2 F4 C  .000  .000  40.000  66.000  REF  .1000  50.00 FT.
IBX10071  DCAT ARC 603/604 B2 F4 C  .000  40.000  40.000  66.000  REF  .1250  FT.
IBX10081  DCAT ARC 603/604 B2 F4 C  .000  100.000  40.000  66.000  REF  .3750  FT.

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

PITCH MODULATION EFFECT
DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA  P-MOD  Y-MOD  PSI/PF  REFERENCE INFORMATION
(LX10CS)  DCAT ARC 603/604  B2 F4 C  .000  .000  .040  68.000  LREF  .3750  FT.
(LX1027)  DCAT ARC 603/604  B2 F4 C  .000  40.000  40.000  68.000  BREF  .3750  FT.
(LX10CS)  DCAT ARC 603/604  B2 F4 C  .000  100.000  40.000  68.000  XREF  .3750  FT.

PITCH MODULATION EFFECT
(MACH = 0.95)
PITCH MODULATION EFFECT

(D)MACH = 1.00
PITCH MODULATION EFFECT

\( (E)MACH = 1.10 \)
PITCH MODULATION EFFECT

(F)MACH = 1.56

PAGE 50
PITCH MODULATION EFFECT

(G)MACH = 1.80
Angle of Attack, \( \alpha \), Degrees

Pitch Modulation Effect

\( \alpha_{\text{MACH}} = 0.64 \)
PITCH MODULATION EFFECT

MACH = 0.80

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PITCH MODULATION EFFECT
(MACH = 0.95)
PITCHING MOMENT COEFFICIENT, CLm

PITCH MODULATION EFFECT

MACH = 1.00

PAGE 55
PITCH MODULATION EFFECT

$F/F_{m} = 1.10$
DATA SET SYMBOL | CONFIGURATION DESCRIPTION | BETA | P-MOD | Y-MOD | PIN/AVF | REFERENCE INFORMATION
--- | --- | --- | --- | --- | ---
(BX1001) | DCA ARC 603/604 B2 F4 C | 0.000 | 0.000 | 40.000 | 85.000 | SPEC: 0.1700 FT.
(BX1002) | DCA ARC 603/604 R2 F4 C | 0.000 | 0.000 | 40.000 | 85.000 | LSR: 0.9400 FT.
(BX1003) | DCA ARC 603/604 R2 F4 C | 0.000 | 0.000 | 40.000 | 85.000 | LSR: 0.9400 FT.

PITCH MODULATION EFFECT

(MACH = 1.56)
PITCH MODULATION EFFECT

\( M = 1.8 \)
DATA SET SYMBOL  CONFIGURATION DESCRIPTION  
(BX1005)  DCAT ARC 602/604  B2 F4 C  
(BX1007)  DCAT ARC 602/604  B2 F4 C  
(BX1009)  DCAT ARC 602/604  B2 F4 C  

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SCALE 125,0000 PERCENT

PITCH MODULATION EFFECT

(C)MACH = 0.95

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### Pitch Modulation Effect

**PITCHING MENT COEFFICIENT, CLM**

**NORMAL FORCE COEFFICIENT, CN**

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**SCALE** 125.000 PERCENT
PITCH MODULATION EFFECT

(G)MACH = 1.80
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BETA P-MOD Y-MOD POL/PH REFERENCE INFORMATION

| .000 | .000 | 40.000 | 85.000 | SHEE | .1100 | 99 FT. |
| .000 | 40.000 | 40.000 | 85.000 | LREF | .3750 | FT. |
| .000 | 100.000 | 40.000 | 85.000 | BREF | .2500 | FT. |

PITCH MODULATION EFFECT

\[ \text{mach} = 0.64 \]
DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA  P-MOD  V-MOD  COURT  DIFFERENCE INFORMATION
(BX1009)  DCAT  ARC  603/604  92  F4  C  .000  .000  40.000  40.000  40.000  .000  .000  .000  .000  50  FT.
(BX1007)  DCAT  ARC  603/604  92  F4  C  .000  40.000  40.000  40.000  .000  .000  3750  FT.
(BX1009)  DCAT  ARC  603/604  92  F4  C  .000  100.000  40.000  40.000  .000  .000  3750  FT.

SIDE FORCE COEFFICIENT, CY

ANGLE OF ATTACK, ALPHA, DEGREES

PITCH MODULATION EFFECT

(MACH = 0.80)
PITCH MODULATION EFFECT

\[ \text{MACH} = 0.95 \]
PITCH MODULATION EFFECT

\( \text{MACH} = 1.00 \)
PITCH MODULATION EFFECT

MACH = 1.10
PITCH MODULATION EFFECT

(F)MACH = 1.56
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ANGLE OF ATTACK, ALPHA, DEGREES

PITCH MODULATION EFFECT
PITCH MODULATION EFFECT

(A) MACH = 0.64
### Angle of Attack (α) vs. Normal Force Coefficient (Cn)

#### Pitch Modulation Effect

**Mach = 0.80**

**Data Set Symbol** | **Configuration Description** | **β** | **P-Mod** | **Y-Mod** | **Pon/off** | **Reference Information**
--- | --- | --- | --- | --- | --- | ---
(BX1009) | DCAT ARC 603/604 - F4 C | 0.000 | 0.000 | 60.000 | 85.000 | SREF 3.180 FT.
(BX1010) | DCAT ARC 603/604 B2 F4 C | 0.000 | 80.000 | 60.000 | 85.000 | LREF 3.180 FT.
(BX1011) | DCAT ARC 603/604 B2 F4 C | 0.000 | 100.000 | 60.000 | 85.000 | BREF 3.750 FT.

**Scale:** 125,000 Percent
PITCH MODULATION EFFECT

MACH = 0.95

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PITCH MODULATION EFFECT
PITCH MODULATION EFFECT

E)MACH = 1.09
PITCH MODULATION EFFECT
PITCH MODULATION EFFECT

GE MACH = 1.80
Pitching moment coefficient, CLM vs. angle of attack, α, degrees.
PITCH MODULATION EFFECT

MACH = 1.00
PITCH MODULATION EFFECT

MACH = 1.56

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PITCH MODULATION EFFECT

(G)MAC: = 1.80
PITCH MODULATION EFFECT

(a) MACH = 0.64
Pitch Modulation Effect
PITCH MODULATION EFFECT

(C)MACH = 0.95
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### Pitch Modulation Effect

**Pitching Moment Coefficient, CLM**

**Normal Force Coefficient, CN**

**Pitching Moment Coefficient, CLM**

(D)MACH = 1.00
PITCH MODULATION EFFECT

\( \text{MACH} = 1.09 \)
PITCH MODULATION EFFECT

\( \text{MACH} = 1.80 \)
PITCH MODULATION EFFECT

\[ \text{PITCH MODULATION EFFECT} \]

\[ (\text{MACH} = 0.64) \]
PITCH MODULATION EFFECT

(B)MACH = 0.80
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### SCALE

- 125,000
- PERCENT

---

### PITCH MODULATION EFFECT

\( C_{1234} = 0.95 \)
PITCH MODULATION EFFECT

(D)MACH = 1.00
PITCH MODULATION EFFECT

\( \text{MACH} = 1.09 \)
PITCH MODULATION EFFECT

MACH = 1.56

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| SCALE 125.0000 PERCENT |

**Pitch Modulation Effect**

\[ \text{G Mach} = 1.80 \]

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PITCH MODULATION EFFECT

MACH = 0.80
DATA SET SYMBOL CONFIGURATION DESCRIPTION
(BX1012) DCAT ARC 603/604 02 F4 C
(BX1013) DCAT ARC 603/604 02 F4 C
(BX1014) DCAT ARC 603/604 02 F4 C
(BX1015) DCAT ARC 603/604 02 F4 C

ANGLE OF ATTACK, DEGREES

NORMAL FORCE COEFFICIENT, Cn

PITCH MODULATION EFFECT
(MACH = 0.95)

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PITCH MODULATION EFFECT

MACH = 1.10
PITCH MODULATION EFFECT

\( \text{F} \text{MACH} = 1.56 \)
PITCH MODULATION EFFECT

MACH = 1.80
### Pitch Modulation Effect

**Mach = 0.64**

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<table>
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**PITCH MODULATION EFFECT**

\( \text{(B)MACH = 0.80} \)
PITCH MODULATION EFFECT

MACH = 0.95

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### Pitch Modulation Effect

**Mach = 1.00**

#### Data Set Symbols and Configuration Descriptions

<table>
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#### Diagram Details

- **Pitching Moment Coefficient, CLM** vs **Angle of Attack, Alpha, Degrees**
- **Scale**: 125,000 Percent
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**PITCHING MOMENT COEFFICIENT, CLM**

**PITCH MODULATION EFFECT**

(E)MACH = 1.10
PITCH MODULATION EFFECT

(F)MACH = 1.56
PITCH MODULATION EFFECT

\[ \text{MACH} = 1.80 \]
PITCH MODULATION EFFECT
(A) MACH = 0.64
PITCH MODULATION EFFECT

(B) MACH = 0.80

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PITCH MODULATION EFFECT

(C) MACH = 0.95
### Pitch Modulation Effect

**D) Mach = 1.00**

#### Data Set Symbol, Configuration, Description

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#### Beta, Pitch Moment Coefficient, CLM

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#### Reference Information

- Ref. 1100 ft.
- Ref. 3750 ft.
- Ref. 100,000 ft.
- Ref. 60,000 ft.

---

**Normal Force Coefficient, CN**

- Scale: 125,000 percent

---

**Pitch Modulation Effect**

- **Normal Force Coefficient, CN**
- **Pitching Moment Coefficient, CLM**
DATA SET SYMBOL  CONFIGURATION DESCRIPTION         RETA  P-MOD  Y-MOD  P/Q/PF   REFERENCE INFORMATION
(BX1012)   DCAT AR603/04 B2 F4 C  .000  .000  100.000  85.000  SREF .1100  50 FT.
(BX1013)   DCAT AR603/04 B2 F4 C  .000  40.000  100.000  85.000  LREF .2750  75 FT.
(BX1014)   DCAT AR603/04 B2 F4 C  .000  60.000  100.000  85.000  HREF .0250  50 FT.
(BX1015)   DCAT AR603/04 B2 F4 C  .000 100.000 100.000  85.000  VREF .0000  75 FT.

SCALE 120.0000 PERCENT

PITCHING MOMENT COEFFICIENT, CLM

NORMAL FORCE COEFFICIENT, CN

PITCH MODULATION EFFECT

E)MACH = 1.10
### DATA SET SYMBOL CONFIGURATION DESCRIPTION ETA P-MOD Y-MOD POL/FF REFERENCE INFORMATION

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>CONFIGURATION</th>
<th>DESCRIPTION</th>
<th>ETA</th>
<th>P-MOD</th>
<th>Y-MOD</th>
<th>POL/FF</th>
<th>REFERENCE INFORMATION</th>
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<tbody>
<tr>
<td>BX1012</td>
<td>EAT ARC 603/624 B2 F4 C</td>
<td>0.000</td>
<td>0.000</td>
<td>100.000</td>
<td>88.000</td>
<td>SFREF</td>
<td>1100 SQ FT.</td>
</tr>
<tr>
<td>BX1013</td>
<td>EAT ARC 603/624 B2 F4 C</td>
<td>0.000</td>
<td>40.000</td>
<td>100.000</td>
<td>88.000</td>
<td>LREF</td>
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<tr>
<td>BX1014</td>
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<td>0.000</td>
<td>60.000</td>
<td>100.000</td>
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<td>LREF</td>
<td>1200 FT.</td>
</tr>
<tr>
<td>BX1015</td>
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<td>88.000</td>
<td>LREF</td>
<td>1200 FT.</td>
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</tbody>
</table>

PITCH MODULATION EFFECT

\( \text{F} \) \text{MACH} = 1.56

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DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA  P-MOD  Y-MOD  P/D/PF  REFERENCE INFORMATION
(BX1012)  O  OCAT ARC 603/604  B2 F4 C  .000  .000  100.000  66.000  SREF  .1000  50.00 FT.
(BX1013)  X  OCAT ARC 603/604  B2 F4 C  .000  40.000  100.000  66.000  LREF  .3750  FT.
(BX1014)  D  OCAT ARC 603/604  B2 F4 C  .000  66.000  100.000  66.000  AREF  .7500  FT.
(BX1015)  A  OCAT ARC 603/604  B2 F4 C  .000  100.000  100.000  66.000  YHP  .8000  FT.

PITCH MODULATION EFFECT

MACH = 1.80
DATA SET SYMBOL CONFIGURATION DESCRIPTION
(BX1012) D CAT ARC 603/604 B2 F4 E
(BX1013) X CAT ARC 603/604 B2 F4 E
(BX1014) X CAT ARC 603/604 B2 F4 E
(BX1015) X CAT ARC 603/604 B2 F4 E

PITCH MODULATION EFFECT
MACH = 0.64
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<tr>
<th>DATA SET SYMBOL</th>
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<th>BETA</th>
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<th>Y-MOD</th>
<th>ROLL/PH</th>
<th>REFERENCE INFORMATION</th>
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<tbody>
<tr>
<td>(BX1012)</td>
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<td>85.000</td>
<td>.1100 90 FT.</td>
</tr>
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<td>(BX1014)</td>
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<td>.1100 90 FT.</td>
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<td>100.00</td>
<td>85.000</td>
<td>.1100 90 FT.</td>
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**PITCH MODULATION EFFECT**

(B)MACH = 0.80
PITCH MODULATION EFFECT

(C) MACH = 0.95
PITCH MODULATION EFFECT

(D) MACH = 1.00
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<tr>
<th>DATA SET SYMBOL</th>
<th>CONFIGURATION DESCRIPTION</th>
<th>( \beta )</th>
<th>( P-\text{MOD} )</th>
<th>( Y-\text{MOD} )</th>
<th>REF/MID</th>
<th>REFERENCE INFORMATION</th>
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<tbody>
<tr>
<td>(EK1012)</td>
<td>DCAT ARC 603/604</td>
<td>.000</td>
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<td>100.000</td>
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<tr>
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<td>100.000</td>
<td>85.000</td>
<td>3750 FT.</td>
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<td>3750 FT.</td>
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<td>3750 FT.</td>
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**Pitch Modulation Effect**

\( \text{MACH} = 1.10 \)
PITCH MODULATION EFFECT

\((F)\text{MACH} = 1.56\)
PITCH MODULATION EFFECT

(G)MACH = 1.80
YAW MODULATION EFFECT

MACH = 0.64
YAW MODULATION EFFECT

B)MACH = 0.80
DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA  P-MOD  Y-MOD  POL/PFF  REFERENCE INFORMATION
(BX1002)  @  OCAT ARC 603/604  82 F4 C  .000  .000  .000  66.000  SREF  .1100  50 FT.
(BX1003)  @  OCAT ARC 603/604  82 F4 C  .000  .000  40.000  66.000  LREF  .3750  FT.
(BX1009)  ®  OCAT ARC 603/604  82 F4 C  .000  .000  80.000  66.000  BREF  .3750  FT.
(BX1012)  ®  OCAT ARC 603/604  82 F4 C  .000  .000  100.000  66.000  XREP  .0000  FT.

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

YAW MODULATION EFFECT
(MACH = 0.95)

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YAW MODULATION EFFECT

\( \text{MACH} = 1 \)
YAW MODULATION EFFECT

\( \text{MACH} = 1.10 \)
YAW MODULATION EFFECT

\[ \text{(F) Mach} = 1.56 \]
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<tr>
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<th>Y-VALUE</th>
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<td>BX10073</td>
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<tr>
<td>BX10074</td>
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<td>65.000</td>
<td>.1200 FT.</td>
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**Graph:**

**NORMAL COEFFICIENT, CN**

**ANGLE OF ATTACK, ALPHA, DEGREES**

**YAW MODULATION EFFECT**

MACH = 1.80
YAW MODULATION EFFECT

DATA SET SYMBOL CONFIGURATION DESCRIPTION REFERENCE INFORMATION
(BX1002) C1 CAT ARC 603/604 124 F4 C REF .1100 90 FT.
(BX1003) DATA NOT AVAILABLE
(BX1003) DATA NOT AVAILABLE
(BX1012) DATA NOT AVAILABLE

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

-1.0 -0.8 -0.6 -0.4 -0.2 0.2 0.4 0.6 0.8 1.0

-5 -4 -3 -2 -1 0 1 2 3 4 5
DATA SET SYMBOL CONFIGURATION DESCRIPTION
(BX1032) DCAT ARC 603/604 P2 F4 E
(BX1008) DCAT ARC 603/604 L2 F4 E
(BX1029) DCAT ARC 603/604 L2 F4 E
(BX1012) DCAT ARC 603/604 B2 F4 E

REFERENCE INFORMATION
BETA P-MOD Y-MOD RO/D/P
0.000 0.000 0.000 85.000 SREF .1100 50 FT.
0.000 0.000 40.000 85.000 LREF .3700 FT.
0.000 0.000 60.000 85.000 XREF .3700 FT.
0.000 0.000 100.000 85.000 YSP .0000 FT.
0.000 0.000 86.000 XSP .0000 FT.

SCALE 125,000 FT.

ANGLE OF ATTACK, ALPHA, DEGREES
PITCHING MOMENT COEFFICIENT, CLM

YAW MODULATION EFFECT
(MACH = 0.64)
DATA SET SYMBOL CONFIGURATION DESCRIPTION
(BX1002) OCAT ARC 603/604 B2 F4 C
(BX1003) OCAT ARC 603/604 B2 F4 C
(BX1004) OCAT ARC 603/604 B2 F4 C
(BX1005) OCAT ARC 603/604 B2 F4 C

ANGLE OF ATTACK, ALPHA, DEGREES

PITCHING MOMENT COEFFICIENT, CLM

YAW MODULATION EFFECT

MACH = 0.80

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DATA SET SYMBOL CONFIGURATION, DESCRIPTION BETA P-MOD Y-MOD POLAR REFERENCE INFORMATION
(BX1003) DCAT ARC 033/604 B F C 0.000 0.000 0.000 86.000 REF -1.000 500 FT.
(BX1003) DCAT ARC 033/604 B F C 0.000 0.000 0.000 86.000 REF -1.000 500 FT.
(BX1003) DCAT ARC 033/604 B F C 0.050 0.050 100.000 86.000 REF -1.000 500 FT.

yaw modulation effect
MACH = 0.95
DATA SET SYMBOL CONFIGURATION DESCRIPTION
(BX1002) O DCAT ARC 603/604 B2 F4 C
(BX1003) O DCAT ARC 603/604 B2 F4 C
(BX1003) O DCAT ARC 603/604 B2 F4 C
(BX1012) △ DCAT ARC 603/604 B2 F4 C

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<th>Y-MOD</th>
<th>RQ/MF</th>
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<td>REF .0000 50.0 FT.</td>
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SCALE 125.000 PERCENT

PITCHING MOMENT COEFFICIENT, CLM

ANGLE OF ATTACK, ALPHA, DEGREES

YAW MODULATION EFFECT
(D)MACH = 1.00
DATA SET SYMBOL CONFIGURATION DESCRIPTION BETA P-MOD Y-MOD POLY/PR REFERENCE INFORMATION
1 BX1023 D CAT ARC 603/604 B2 F4 C .000 .000 .000 86.000 SREF .1100 50 FT.
1 BX1026 D CAT ARC 603/604 B2 F4 C .000 .000 40.000 86.000 LREF .3750 FT.
1 BX1029 D CAT ARC 603/604 B2 F4 C .000 .000 60.000 86.000 RREF .2750 FT.
1 BX1021 D CAT ARC 603/604 B2 F4 C .000 .000 100.000 86.000 RHP .0000 FT.

YAW MODULATION EFFECT
(F)MACH = 1.56

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<table>
<thead>
<tr>
<th>DATA SET SYMBOL</th>
<th>CONFIGURATION DESCRIPTION</th>
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<td>BX(032)</td>
<td>CAT ARC 603/604 B2 F4 C</td>
<td>$REF = 11103 $9 FT.</td>
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<td>BX(036)</td>
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<td>$REF = 11103 $9 FT.</td>
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<td>BX(038)</td>
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**YAW MODULATION EFFECT**

\( \text{MACH} = 1.80 \)
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<th>CONFIGURATION DESCRIPTION</th>
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<th>Y-MOD</th>
<th>PD/FF</th>
<th>REFERENCE INFORMATION</th>
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<td>(BK1002)</td>
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<td>(BK1012)</td>
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<td>100.000</td>
<td>86.000</td>
<td>REF 31.50 FT.</td>
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**Pitching Moment Coefficient, CLM**

**YAW MODULATION EFFECT**

\[ \text{MACH} = 2.50 \]
NORMAL FORCE COEFFICIENT, CN

THERMAL MODULATION EFFECT

PITCHING MOMENT COEFFICIENT, CLM

CNDMACH = 0.64

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<table>
<thead>
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<th>DATA SET SYMBOL</th>
<th>CONFIGURATION DESCRIPTION</th>
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<th>P-MOD</th>
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<th>POU/PF</th>
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<td>.000</td>
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<tr>
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<td>.000</td>
<td>100,000</td>
<td>66,000</td>
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</table>

**YAW MODULATION EFFECT**

PITCHING MOMENT COEFFICIENT, CLM

NORMAL FORCE COEFFICIENT, CN

SCALE 125,000 PERCENT
PITCHING MOMENT COEFFICIENT, CLM

NORMAL FORCE COEFFICIENT, CN

YAW MODULATION EFFECT

\( \text{MACH} = 0.95 \)
YAW MODULATION EFFECT

\(\text{MACH} = 1.00\)
YAW MODULATION EFFECT

(E)MACH = 1.10
YAW MODULATION EFFECT

MACH = 1.56

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Normal Force Coefficient, \( C_n \) vs. Pitching Moment Coefficient, \( C_{LM} \)

\[ C_{LM} = \begin{cases} 2.20 & \text{Mach} = 2.20 \end{cases} \]
YAW MODULATION EFFECT

MACH = 2.50
YAW MODULATION EFFECT

\( \alpha = 0.64 \)
YAW MODULATION EFFECT

(MACH = 0.80)
DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA  P-MOD  Y-MOD  PQL/PAF  REFERENCE INFORMATION
(8X1002)  OCAT ARC 603/604 B2 F4 C  .000  .000  .000  66.000  SREF  .1100  50.00 FT.
(8X1005)  OCAT ARC 603/604 B2 F4 E  .000  .000  40.000  66.000  LREF  .3750  FT.
(8X1006)  OCAT ARC 603/604 B2 F4 E  .000  .000  60.000  66.000  XREF  .3750  FT.
(8X1010)  OCAT ARC 603/604 B2 F4 E  .000  .000  100.000  66.000  XREFP  .0000  FT.
(8X1012)  OCAT ARC 603/604 B2 F4 E  .000  .000  100.000  66.000  YREFP  .0000  FT.

SCALE  125.0000 PERCENT

SIDE FORCE COEFFICIENT, CY

ANGLE OF ATTACK, ALPHA, DEGREES

YAW MODULATION EFFECT
(MACH = 0.95)
YAW MODULATION EFFECT

MACH = 1.00

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YAW MODULATION EFFECT

(E)MACH = 1.10
YAW MODULATION EFFECT

(MACH = 1.56)
YAW MODULATION EFFECT

MACH = 1.80

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DATA SET SYMBOL  CONFIGURATION DESCRIPTION                  BETA  P-MOD  Y-MOD  POH/Y  CONFERENCE INFORMATION
(BX1002)  O  Dcat arc 603/604  B2 F4 C                       .000  .000  49.000  5.000  -1.100  150 FT.
(BX1006)  O  DATA NOT AVAILABLE                               .000  .000  49.000  5.000  -1.100  150 FT.
(BX1009)  △  DATA NOT AVAILABLE                               .000  .000  60.000  5.000  -1.100  150 FT.
(BX1012)  △  DATA NOT AVAILABLE                               .000  .000  100.000  5.000  -1.100  150 FT.

YAW MODULATION EFFECT
\(\text{MACH} = 2.20\)
DATA SET SYMBOL  CONFIGURATION DESCRIPTION  EETA  P-MOD  Y-MOD  PDU/FF  REFERENCE INFORMATION
(BX102)  DAT ARC 823/826  B2 F4 C  .000  .000  .000  68.000  SREF  .1100  50.000  SF.
(BX1006)  DATA NOT AVAILABLE  .000  .000  40.000  68.000  LREF  .7250  FT.
(BX1009)  DATA NOT AVAILABLE  .000  .000  66.000  66.000  BRFF  .3750  FT.
(BX1012)  DATA NOT AVAILABLE  .000  .000  166.000  66.000  VREF  .0000  FT.

SCALE 125.0000 PERCENT

SIDE FORCE COEFFICIENT, CY

ANGLE OF ATTACK, ALPHA, DEGREES

YAW MODULATION EFFECT

(1)MACH = 2.50
YAW MODULATION EFFECT

(MACH = 0.64)

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DATA SET SYMBOL CONFIGURATION DESCRIPTION BETA P-MOD Y-MOD PDJ PF REFERENCE INFORMATION
(BX1008) DCAT ARC 603/604 B2 F4 C .000 100.000 40.000 85.000 SRF 1.100 50.0 FT.
(BX1009) DCAT ARC 603/604 B2 F4 C .000 100.000 40.000 85.000 UREF 3.250 FT.
(BX1011) DCAT ARC 603/604 B2 F4 C .000 100.000 100.000 85.000 XREF 3.250 FT.
(BX1013) DCAT ARC 603/604 B2 F4 C .000 100.000 100.000 85.000 XREF 3.250 FT.

YAW MODULATION EFFECT
(MACH = 0.80) PAGE 166
YAW MODULATION EFFECT
(C)MACH = 0.95
DATA SET SYMBOL CONFIGURATION DESCRIPTION Beta P-MOD Y-MOD RMS/PT REFERENCE INFORMATION
(BK1025) OCAT ARC 603/604 B2 F4 C 0.000 100.000 0.000 65.000 SRF 0.1100 SQ. FT.
(BK10GB) OCAT ARC 603/604 B2 F4 C 0.000 100.000 40.000 65.000 LREF 0.3720 FT.
(BK1011) OCAT ARC 603/604 B2 F4 C 0.000 100.000 60.000 65.000 BRP 0.3720 FT.
(BK1015) OCAT ARC 603/604 B2 F4 C 0.000 100.000 100.000 65.000 YMP 0.0000 FT.

SCALE 125.000 PERCENT
Yaw Modulation Effect

(E) Mach = 1.10
DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA  P-MCD  Y-MCD  P01/AF  REFERENCE INFORMATION
(BX100S)  O CAT ARC 603/604 B2 F4 C  .000  100.000  .000  86.000  REF  .1100  50 FT.
(BX100B)  O CAT ARC 603/604 B2 F4 C  .000  100.000  40.000  68.000  REF  .3750  FT.
(BX101S)  x CAT ARC 603/604 B2 F4 C  .000  100.000  61.000  68.000  REF  .3750  FT.
(BX101S)  x CAT ARC 603/604 B2 F4 C  .000  100.000  100.000  68.000  REF  .3750  FT.

SCALE 125.0000 PERCENT

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

YAW MODULATION EFFECT

MACH = 1.56
DATA SET SYMBOL CONFIGURATION DESCRIPTION  |   BETA  | P-MOD | Y-MOD | RPM/FF | REFERENCE INFORMATION
---|---|---|---|---|---
1 | BK(05) | D | CAT ARC 603/604 B2 F4 C | .000 | 100.000 | .000 | 85.000 | SREF | .4100 | SQ.FT.
2 | BK(06) | D | CAT ARC 603/604 B2 F4 C | .000 | 100.000 | 40.000 | 80.000 | LREF | .3750 | FT.
3 | BK(11) | D | CAT ARC 603/604 B2 F4 C | .000 | 100.000 | 60.000 | 80.000 | BREF | .3750 | FT.
4 | BK(15) | D | CAT ARC 603/604 B2 F4 C | .000 | 100.000 | 100.000 | 60.000 | WREF | .0000 | FT.

SCALE 125.000 \% PERCENT

NORMAL FORCE COEFFICIENT, CN

ANGLE OF ATTACK, ALPHA, DEGREES

YAW MODULATION EFFECT

\[ \text{MACH} = 1.80 \]
PITCHING MOMENT COEFFICIENT, CLM

ANGLE OF ATTACK, ALPHA, DEGREES

YAW MODULATION EFFECT

MACH = 0.64

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YAW MODULATION EFFECT

(B) MACH = 0.80
DATA SET SYMBOL
CONFIGURATION DESCRIPTION
(BX1005) D CAT AR 603/604 B2 F4 C
(BX1008) D CAT AR 603/604 B2 F4 C
(BX1011) Δ CAT AR 603/604 B2 F4 C
(BX1015) Δ CAT AR 603/604 B2 F4 C

BETA P-HOD Y-HOD P33/P4 REFERENCE INFORMATION
.000 100.000 40.000 85.000 SREF .1100 20.0 FT.
.000 100.000 40.000 85.000 LREF .3750 FT.
.000 100.000 40.000 85.000 BREF .3750 FT.
.000 100.000 40.000 85.000 XHSG .0000 FT.
.0000 FT.
.0000 FT.
.0000 FT.
.0000 FT.
.0000 FT.

SCALE 125.0000 DEG PITCHING
MOMENT COEFFICIENT, CLM

YAW MODULATION EFFECT
(MACH = 1.00)

ANGLE OF ATTACK. ALPHA. DEGREES.
YAW MODULATION EFFECT

\( \text{(S)MACH} = 1.80 \)
DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA  P-MOD  Y-MOD  PQY/PF  REFERENCE INFORMATION

(BX105)  DCAT ARC 620/624 B2 F4 C  0.000  100.000  0.000  66.000  REF  0.1100 SQ.FT.

(BX106)  DCAT ARC 620/624 B2 F4 C  0.000  100.000  10.000  66.000  UREF  0.3750 FT.

(BX107)  DCAT ARC 620/624 B2 F4 C  0.000  100.000  80.000  66.000  BRCP  0.3750 FT.

(NX108)  DCAT ARC 620/624 B2 F4 C  0.000  100.000  100.000  66.000  WHSP  0.0000 FT.

SCALE 125.0000 PERCENT

NORMAL FORCE COEFFICIENT, CN

PITCHING MOMENT COEFFICIENT, CLM

YAW MODULATION EFFECT

(A)MACH = 0.64
## Yaw Modulation Effect

(MACH = 0.95)

---

**DATA SET SYMBOL**  | **CONFIGURATION DESCRIPTION** | **REFERENCE INFORMATION**
---|---|---
(6X(005) | O CCA ARC 603/604 B2 F4 C | .000 100.000 86.000 SREF .1100 50 FT.
(6X(006) | O CCA ARC 603/604 B2 F4 C | .000 100.000 86.000 SREF .2750 50 FT.
(6X(011) | D CCA ARC 603/604 B2 F4 C | .000 100.000 86.000 SREF .3750 50 FT.
(6X(015) | D CCA ARC 603/604 B2 F4 C | .000 100.000 86.000 SREF .0000 50 FT.

**SCALE** 125.0000 PERCENT

---

**NORMAL FORCE COEFFICIENT, CN**

**PITCHING MOMENT COEFFICIENT, CLM**
DATA SET SYMBOL CONFIGURATION DESCRIPTION
(BX1005) O CAT ARC 603/604 B2 F4 C
(BX1006) O CAT ARC 603/604 B2 F4 C
(BX1011) X CAT ARC 603/604 B2 F4 C
(BX1015) X CAT ARC 603/604 B2 F4 C

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SCALE 125.0000 PERCNT

YAW MODULATION EFFECT

MACH = 1.00

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DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA  P-MOD  Y-MOD  POI/FF  REFERENCE INFORMATION
(BX1009)  O  DAC AT  A  603/604  B2  F4  C  .000  0.000  0.000  0.000  REF  1,100  30,000 F.T.
(BX1011)  O  DAC AT  A  603/604  B2  F4  C  .000  0.000  0.000  0.000  REF  3750  FT.
(BX1015)  A  DAC AT  A  603/604  B2  F4  C  .000  0.000  0.000  0.000  REF  3750  FT.

NORMAL FORCE COEFFICIENT, CN

PITCHING MOMENT COEFFICIENT, CLM

YAW MODULATION EFFECT
(MACH = 1.10)
DATA SET  SYMBOL  CONFIGURATION DESCRIPTION  
[ ]  DCAT  ARC  603/604  B2  F4  C 
[ ]  DCAT  ARC  603/604  E2  F4  C 
[ ]  DCAT  ARC  603/604  B2  F4  C 
[ ]  DCAT  ARC  603/604  B2  F4  C 

REFERENCE INFORMATION  
SREF  .1000  30.FT. 
LREF  .1000  30.FT. 
XREF  .1000  30.FT. 
YREF  .1000  30.FT. 
ZREF  .1000  30.FT. 
SCALE  125.0000  PERCENT 

NORMAL FORCE COEFFICIENT, CN 

PITCHING MOMENT COEFFICIENT, CLM 

YAW MODULATION EFFECT 

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DATA SET    SYMBOL  CONFIGURATION DESCRIPTION  
(BX1005)  回  DAT ARC 603/604  B2 F4 C  
(BX1010) ▲  DAT ARC 603/604  B2 F4 C  
(BX1015) △  DAT ARC 603/604  B2 F4 C  

REFERENCE INFORMATION  
SREF = .1100 SQR FT.  
LREF = .3750 FT.  
XREF = .0000 FT.  
YREF = .0000 FT.  
ZREF = .0000 FT.  

SCALE = 125.000 PERCENT  

SIDE FORCE COEFFICIENT, CY  

ANGLE OF ATTACK, ALPHA, DEGREES  

YAW MODULATION EFFECT  
CARMACH = 0.84  

PAGE 186
YAW MODULATION EFFECT

MACH = 0.80
DATA SET SYMBOL CONFIGURATION DESCRIPTION BETA P-MD Y-MD P sim/FF REFERENCE INFORMATION
((B)055) □ DCA 600/600 62 F 4 C .000 100.000 0.000 85.000 REF 1.100 50 FT.
((B)108) □ DCA 600/600 62 F 4 C .000 100.000 40.000 85.000 REF 3.250 FT.
((B)131) □ DCA 600/600 62 F 4 C .000 100.000 60.000 85.000 REF 3.250 FT.
((B)107) □ DCA 600/600 62 F 4 C .000 100.000 100.000 85.000 REF 3.250 FT.

SIDE FORCE COEFFICIENT, CY

ANGLE OF ATTACK, ALPHA, DEGREES

YAW MODULATION EFFECT

(MACH = 1.00)
DATA SET SYMBOL | CONFIGURATION DESCRIPTION | BETA | P-MOD | Y-MOD | PSD/FF | REFERENCE INFORMATION
--- | --- | --- | --- | --- | ---
BX1005 | DCAT ARC 603/604 B2 F4 E | 0.000 | 100.000 | 0.000 | 65.000 | SREF = 1100 FT
BX1009 | DCAT ARC 603/604 B2 F4 E | 0.000 | 100.000 | 49.000 | 65.000 | LREF = 3725 FT
BX1010 | DCAT ARC 603/604 B2 F4 E | 0.000 | 100.000 | 65.000 | 65.000 | BREF = 3725 FT
BX1015 | DCAT ARC 603/604 B2 F4 E | 0.000 | 100.000 | 100.000 | 65.000 | XREF = 3725 FT

YAW MODULATION EFFECT
(MACH = 1.10)
YAW MODULATION EFFECT

\( \text{(F)MACH} = 1.56 \)

\[ \text{ANGLE OF ATTACK, } \alpha \text{ DEGREES} \]

\[ \text{SIDE FORCE COEFFICIENT, } C_y \]
PITCH MODULATION EFFECT AT INCREASED PRESSURE RATIO (POJ/PF = 130)

\( \text{MACH} = 0.64 \)
PITCH MODULATION EFFECT AT INCREASED PRESSURE RATIO (P0J/PF = 130)

(B) Mach = 1.55
PITCH MODULATION EFFECT AT INCREASED PRESSURE RATIO (POJ/PF = 130)

(C)MACH = 1.80
PITCH MODULATION EFFECT AT INCREASED PRESSURE RATIO (POJ/PF = 130)

MACH = 0.64

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Pitch Modulation Effect at Increased Pressure Ratio (P0J/PF = 130)

\( (8) \text{MACH} = 1.56 \)
PITCH MODULATION EFFECT AT INCREASED PRESSURE RATIO (POJ/PF = 130)

MACH = 1.80
PITCH MODULATION EFFECT AT INCREASED PRESSURE RATIO (P0J/PR = 130)

(MACH = 0.64)
PITCH MODULATION EFFECT AT INCREASED PRESSURE RATIO (POJ/PF = 130)
PITCH MODULATION EFFECT AT INCREASED PRESSURE RATIO (P0J/PIF = 130)

(C)MACH = 1.80

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PITCH MODULATION EFFECT AT INCREASED PRESSURE RATIO (\(\frac{P_{01}}{P_F} = 130\))
PITCH MODULATION EFFECT AT INCREASED PRESSURE RATIO (P0J/PF = 130)

\( \text{MACH} = 1.36 \)
PITCH MODULATION EFFECT AT INCREASED PRESSURE RATIO (P0J/PF = 130)
YAW MODULATION EFFECT AT INCREASED PRESSURE RATIO (POJ/PF = 130)

ANGLE OF ATTACK, ALPHA DEGREES

NORMAL FORCE COEFFICIENT, CN

MACH = 0.64

REFERENCE INFORMATION

DATA SET SYMBOL CONFIGURATION DESCRIPTION

(BX1022) DCAT ARC 603/604 B2 F4 C
(BX1023) DCAT ARC 603/604 B2 F4 C

SETA P-MOD Y-MOD POJ/PF

REFERENCE INFORMATION

100.000 100.000 100.000 100.000

MACH = 0.64
DATA SET SYMBOL  CONFIGURATION DESCRIPTION  Beta  P-MOD  Y-MOD  POJ/PF  REFERENCE INFORMATION
(BX1022)  DCAT ARC 603/604  B2 F4 C  .000 100.000 150.000 130.000  SREF  .1100  SD.FT.
(BX1023)  DCAT ARC 603/604  B2 F4 C  .000 100.000 100.000 150.000  LREF  .3750  FT.
       |       |       |       |   BRF  .3750  FT.
       |       |       |       |   XRP  .0000  FT.
       |       |       |       |   YRP  .0000  FT.
       |       |       |       |   ZRP  .0000  FT.
       |       |       |       |   SCALE  125.0000  PERCENT

NORMAL FORCE COEFFICIENT  CN

ANGLE OF ATTACK, ALTH DEGREES

YAW MODULATION EFFECT AT INCREASED PRESSURE RATIO (POJ/PF = 130)

(MACH = 1.56)
YAW MODULATION EFFECT AT INCREASED PRESSURE RATIO (P0J/PF = 130)

C)MACH = 1.80
DATA SET SYMBOL CONFIGURATION DESCRIPTION
(BX1022) DCA/ARC 603/604 F2 F4 C
(BX1023) DCA/ARC 603/604 F2 F4 C

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YAW MODULATION EFFECT AT INCREASED PRESSURE RATIO (POJ/PF = 130)
PITCILING MOMENT COEFFICIENT, CLm

ANGLE OF ATTACK, ALPHA, DEGREES

YAW MODULATION EFFECT AT INCREASED PRESSURE RATIO (POJ/PF = 130)

(B)MACH = 1.56
DATA SET SYMBOL   CONFIGURATION DESCRIPTION

(BX1022)  DCAY ARC 600/604  B2 F4 C
(BX1023)  DCAY ARC 600/604  B2 F4 C

BETA  P-MOD  Y-MOD  POL/PF

REFERENCE INFORMATION

SCALE 125.000 PERCENT

PITCHING MOMENT COEFFICIENT, CLM

ANGLE OF ATTACK, ALPHA, DEGREES

YAW MODULATION EFFECT AT INCREASED PRESSURE RATIO (POJ/PF = 130)

MACH = 1.80

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### DATA SET SYMBOL | CONFIGURATION DESCRIPTION | BETA | P-MOD | Y-MOD | POJ/PF | REFERENCE INFORMATION
---|---|---|---|---|---|---
(6X1022) | DCAT ARC 603/604 B2 F4 C | .000 | .000 | 100.000 | 120.000 | SQ, FT.
(6X1023) | DCAT ARC 603/604 B2 F4 C | .000 | 100.000 | 100.000 | 120.000 | FT.

**PITCHING MOMENT COEFFICIENT, CLM**

**NORMAL FORCE COEFFICIENT, CN**

**YAW MODULATION EFFECT AT INCREASED PRESSURE RATIO (POJ/PF = 130)**

\[
\text{MACH} = 0.64
\]
YAW MODULATION EFFECT AT INCREASED PRESSURE RATIO (POJ/PF = 130)

MACH = 1.5
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<th>Y-MOD</th>
<th>P0J/PF</th>
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**Pitching Moment Coefficient, CLM vs. Normal Force Coefficient, CN**

**Yaw Modulation Effect at Increased Pressure Ratio (P0J/PF = 130)**

(C)MACH = 1.80

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YAW MODULATION EFFECT AT INCREASED PRESSURE RATIO (POJ/PE = 130)

\( \text{\textsc{Mach} = 0.64} \)
SIDE FORCE COEFFICIENT, CY

ANGLE OF ATTACK, ALPHA, DEGREES

YAW MODULATION EFFECT AT INCREASED PRESSURE RATIO (POJ/PF = 130)

MACH = 1.56

PAGE 215
BETA

P-mD

Y-HM

Pdf/PF

IsmTIm

MTA SET

SmBOL

CONFlGLdZATIUN

MSCRIPT

ION

[8x10^22] 1

OChT

ARC

503/604

B2

F4

E

(BX1022)  OCAT ARC 503/604  B2 F4 E

(BX1023)  OCAT ARC 603/604  J2 F4 E

DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA  P-MOD  Y-MOD  POJ/PF  REFERENCE INFORMATION

.000  .000  100.000  130.000  .1100  99.FT.

.000  100.000  100.000  130.000  .3750  FT.

.000  100.000  100.000  130.000  .0000  FT.

.000  100.000  100.000  130.000  .0000  FT.

SCALE  125.0000  PERCENT

ANGLE OF ATTACK, ALPHA, DEGREES

SIDE FORCE COEFFICIENT, CY

YAW MODULATION EFFECT AT INCREASED PRESSURE RATIO (POJ/PF = 130)

CONCNS = 1 0.00

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MACH NUMBER EFFECT - CONFIGURATION B2 F5 C
MACH NUMBER EFFECT - CONFIGURATION B2 F5 C
PITCH MODULATION EFFECT

(MACH = 0.64)
**DATA SET SYMBOL CONFIGURATION DESCRIPTION**

| SXK1264 | DCA ARC 603/604 B2 F5 C... |
| SXK1266 | DCA ARC 603/604 B2 F5 C... |

**REFERENCE INFORMATION**

- **SCALE**: 125,000
- **PERCENT**: 100
- **EFFECT**: FRMAH = 0.95

---

### Pitch Modulation Effect

**NORMAL FORCE COEFFICIENT, CN**

**ANGLE OF ATTACK, ALPHA, DEGREES**

-8.0 -7.0 -6.0 -5.0 -4.0 -3.0 -2.0 -1.0 0.0 1.0 2.0 3.0 4.0 5.0

**Diagram**

- Graph showing the relationship between normal force coefficient and angle of attack for different values of pitch modulation effect.

**Page 222**
PITCH MODULATION EFFECT

(C)MACH = 1.00
### DATA SET SYMBOL CONFIGURATION DESCRIPTION

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<th>Y-MOD</th>
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### PITCH MODULATION EFFECT

![Graph showing pitch modulation effect](image)

**ANGLE OF ATTACK, ALPHA, DEGREES**

**PITCHING MOMENT COEFFICIENT, CLM**

**PAGE 224**
DATA SET SYMBOL  CONFIGURATION DESCRIPTION  REFERENCE INFORMATION
(BX1024)  DCAT-TC 603/694  B2 F5 C  REF .1100  60 FT.
(BX1026)  DCAT-TC 603/694  B2 F5 C  REF .750  10 FT.
(BX1028)  DCAT-TC 603/694  B2 F5 C  REF .000  .000  .000  .000  .000  .000  125.000  PERCENT

PITCH MODULATION EFFECT
MACH = 0.95

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DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA  P-MOD  Y-MOD  PDW/PF  REFERENCE INFORMATION
(BXI024)  DCAT ARC 603/604  B2 F5 E  .000  .000  .000  66.000  SREF  .1100  50 FT.
(BXI025)  DCAT ARC 603/604  B2 F5 E  .000  40.000  .000  66.000  LREF  .3750  FT.
(BXI026)  DCAT ARC 603/604  B2 F5 E  .000  100.000  .000  66.000  LREF  .3750  FT.

PITCH MODULATION EFFECT
(MACH = 0.64)
PITCH MODULATION EFFECT

(C) MACH = 1.00
DATA SET SYMBOL | CONFIGURATION DESCRIPTION | BETA | P-MOD | Y-MOD | POLAR | REFERENCE INFORMATION
--- | --- | --- | --- | --- | ---
(BX1024) | DCAT ARC 803/664 82 FS C | 0.000 | 0.000 | 83.000 | EREF | 1100 90 FT.
(BX1025) | DCAT ARC 803/664 82 FS C | 0.001 | 40.000 | 83.000 | LREF | 9750 FT.
(BX1026) | DCAT ARC 803/664 82 FS C | 0.009 | 100.000 | 85.000 | REF | 9750 FT.

PITCH MODULATION EFFECT

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<th>BETA</th>
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PITCH MODULATION EFFECT

MACH = 0.95

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PITCH MODULATION EFFECT
(MACH = 1.00)
PITCH MODULATION EFFECT

MACH = 0.85
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PITCH MODULATION EFFECT

MACH = 1.00

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PITCH MODULATION EFFECT

ANGLE OF ATTACK, ALPHA, DEGREES

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PITCH MODULATION EFFECT

\[ \alpha \]

\[
\begin{array}{c|c|c|c|c|c|c}
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\hline
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\text{BX1028} & \text{DAT ARC 603/604 82 FS C} & \text{REF} & \text{SREF} & \text{REFERENCE INFORMATION} \\
\text{BX1029} & \text{DAT ARC 603/604 82 FS C} & \text{REF} & \text{SREF} & \text{REFERENCE INFORMATION} \\
\hline
\end{array}
\]

\[
\begin{align*}
\text{ANGLE OF ATTACK, } \alpha, \text{ DEGREES} \\
\text{PITCHING MOMENT COEFFICIENT, CLM}
\end{align*}
\]

\[
\begin{align*}
\text{PITCH MODULATION EFFECT}
\end{align*}
\]

\[
\begin{align*}
\text{SPEED} & = 100 \\
\text{WIND} & = 0 \\
\text{SCALE} & = 125 \\
\text{PERCENT}
\end{align*}
\]

\[
\begin{align*}
\text{ANGLE OF ATTACK, } \alpha, \text{ DEGREES} \\
\text{PITCHING MOMENT COEFFICIENT, CLM}
\end{align*}
\]
DATA SET SYMBOL  CONFIGURATION DESCRIPTION  BETA  P-MOD  Y-MOD  PSW/PP  REFERENCE INFORMATION
(BX1027) OCAT ARC 603/604 B2 FS C  .000  .000  100.000  86.000  YEPF  .1100  500 FT.
(BX1028) OCAT ARC 603/604 B2 FS C  .000  40.000  100.000  65.000  YEPF  .3450  FT.
(BX1029) OCAT ARC 603/604 B2 FS C  .000  100.000  100.000  65.000  YEPF  .7750  FT.

NORMAL FORCE COEFFICIENT, CN

PITCH MODULATION EFFECT

MACH = 0.64

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PITCHING MOMENT COEFFICIENT, CLM

NORMAL FORCE COEFFICIENT, CN

PITCH MODULATION EFFECT

MACH = 0.95
PITCH MODULATION EFFECT

MACH = 1.00
PITCH MODULATION EFFECT

\( \text{MACH} = 0.64 \)
DATA SET SYMBO CONFIGURATION DESCRIPTION

[BM1027] DCAT ARC 603/624 B2 FS C
[BM1028] DCAT ARC 603/604 B2 FS C
[BM1029] DCAT ARC 603/604 B2 FS C

F-LC B-CH MOD % FREE

REFERENCE INFORMATION

SREF .11100 50 FT.
LREF .3750 FT.
WREF .0000 FT.
ZREF .0000 FT.
SCALE .125.0000 PERCENT

SIDE FORCE COEFFICIENT, CY

ANGLE OF ATTACK, ALPHA, DEGREES

PITCH MODULATION EFFECT

B)MACH = 0.95

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PITCH MODULATION EFFECT

(C)MACH = 1.00