QCX
Avro
CF105
P-WT-137

C-105 ~~SECRET~~ P/Wind Tunnel/137

PROGRAM OF SPARROW AND CANOPY ~~TESTS~~

AND SPARROW JETTISONING

Copy 4

Templin

SECRET

CF-105

SPARROW TRAJECTORY TESTS.

OBJECT

To Determine:

(a) Missile characteristics at various trajectory positions along the fuselage

(b) Errors due to manufacturing inaccuracies of missile models. (For example: 1° distortion of Sparrow tail-plane yields $\Delta C_M = 0.21$ $\Delta C_N = 0.054$)

In order to fulfill these conditions it is considered necessary to obtain 5 points in pitch and 5 in yaw. To eliminate inaccuracies at least 2 additional points will be needed at each trajectory position with the missile inverted.

METHOD

A proposed solution to the mechanical difficulties involved is to use a combination of rotatable eccentric sting and concentrically and eccentrically drilled missiles.

The following will be required for each missile at each trajectory station:

(a) Sting that can be rotated and locked in four positions (θ = 0, 90, 180, and 270°) carrying a 4 component strain gauge on an eccentric spindle (giving α = 1.0, β = -1.0, α = -1.0, β = +1.0) in the 4 positions.

(b) Missile model with a 1.0° eccentric mounting hole

(c) Missile model with a concentric mounting hole. With these, the combinations in the following table can be achieved giving 5 points in pitch and 5 in yaw.

Possible errors can be eliminated by averaging runs 7 and 8 (for the concentric missile) and 5 and 6 (for the eccentric missile) and applying the corrections to all other runs.

C.A.L. WIND TUNNEL PROGRAM

1. ARMAMENT

Instrumentation: 4 component missile balance
2 component main balance

$\psi = 0$, α range: -4, -2, 0, 2, 4, 6, 8, 10, 12

(a) High Trajectory - Missile No. 1

Mach No.: .95 and 1.20
Stations: 1, 2, 3 and 4
Angles: α, $\psi = 0, \pm 1, \pm 2$ (9) — 80 runs
(plus 8 check points)

(b) High Trajectory - Missile No. 2

As in 1(a) — 80 runs.

(c) Low Trajectory - Missile No. 3

As in 1(a) — 80 runs

(d) Low Trajectory - Missile No. 4

As in 1(a) — 80 runs

(e) Missile No. 3 - Rolled 45°

Mach No.: .95 and 1.20
Station: 3
Angles: α, $\psi = 0, \pm\sqrt{2}$ (5) — 10 runs

330 runs.

2. CANOPY

(a) Hinge Moment in Yaw

Instrumentation: 4 hinge moment balances
2 canopy static pressure taps
(6 component main balance)

$\alpha = 2 \not< 10$, ψ range: -2, -1, 0, 1, 2, 4, 6

i. Forward closed, rear opening in stages

M = .80, .95, 1.00, 1.05, 1.10, 1.20
Positions: 1/3 and 2/3 open — 24 runs.

ii. Rear open, forward opening in stages

As in 2(a)i — 24 runs

SECRET

iii. Rear closed, forward opening in stages

M = .80, .95, 1.05, 1.20
Positions: 1/3 and 2/3 Open

16 runs

iv. Forward open, rear opening in stages

M = .95 and 1.20
Positions: 1/3 and 2/3 open

8 runs

v. Both opening in stages

As in 2(a) iv. 8 runs

2. (b) Effect on Directional Stability

Instrumentation: 4 hinge moment balances
2 canopy static pressure taps
6 component main balance

$\alpha = 2 \not\in 10$, ψ range: -4, -2, -1, 0, 1, 2, 4, 6, 8, 10, 12
M = .80, .95, 1.00, 1.05, 1.10, 1.20

i. Both closed 12 runs

ii. Both open 12 runs

iii. Front open, rear closed 12 runs

iv. Rear open, front closed 12 runs

(c) Hinge Moment in Pitch

Instrumentation: 4 hinge moment balances
2 canopy static pressure taps

α = -4, -2, 0, 2, 4, 6, 8, 10, 12
M = .95 and 1.20
ψ = 0

With positions 1/3 and 2/3 Open

i. Forward closed, rear opening in stages

ii. Rear open, forward opening in stages

iii. Rear closed, forward opening in stages

iv. Forward open, rear opening in stages

v. Both opening in stages.

2. (c) With no intermediate positions:

vi. Both closed

vii. Both open

viii. Front open, rear closed

ix. Rear open, front closed

All of section 2(c) to be run in conjunction with 1.

128 runs.

3. DIRECTIONAL STABILITY

Instrumentation: 6 component main balance

M = .80, .95, 1.00, 1.05, 1.10, 1.20
ψ = -4, -2, -1, 0, 1, 2, 4, 6, 8, 10, 12.
α = 2 and 10

(a) Missiles in Stowed Position 12 runs

(b) Boundary Layer Bleed Exhausts Removed 12 runs

24 runs

4. AILERON EFFECTIVENESS

Instrumentation: 6 component main balance
1 hinge moment balance

M = .95 and 1.20
α = -4, -2, 0, 2, 4, 6, 8, 10, 12
δ_A = -10, -5, 0, 5

To be run in conjunction with 1

0 runs.

5. RUDDER EFFECTIVENESS WITH CANOPY

Instrumentation: 3 component tail balance
1 hinge moment balance

M = .95 and 1.20
α = -4, -2, 0, 2, 4, 6, 8, 10, 12
δ_r = 20, 10, 5, 0, -5

(a) Both canopies closed

(b) Both open

(c) Front open, rear closed

(d) Rear open, front closed.

To be included in 1.

0 runs.

SECRET

6. FIN PITOT-STATIC PRESSURES

Instrumentation: 2 pressure pick-ups

(a) In Yaw

M =	.80, .95, 1.00, 1.05, 1.10, 1.20
α =	2 and 10
ψ =	-4, -2, -1, 0, 1, 2, 4, 6, 8, 10, 12

i. Upper combination only: short static and dynamic head

ii. Upper and Lower combinations: short static and dynamic head

To be included in 3.

(b) In Pitch

M =	.95 and 1.20
ψ =	0
α =	-4, -2, 0, 2, 4, 6, 8, 10, 12

i. Upper combination only:

Short and long static heads
short and long dynamic heads

ii. Upper and lower combinations:

short and long static heads
short and long dynamic heads

To be included in 1. 0 runs.

7. TUFTS

Instrumentation: Camera

M =	.80, .95, 1.00, 1.05, 1.10, 1.20
ψ =	-4, -2, -1, 0, 1, 2, 4, 6, 8, 10, 12
α =	2 and 10

To be included in 2.

INSTRUMENTATION

N.B. Instrumentation in parentheses relatively unimportant.

Section 1: Armament Only

4 component missile balance
2 main balance components
6

238 Runs.

Section 2(a) Canopy Hinge Moment in Yaw Only

- intermediate positions

4 hinge moment balance
2 canopy pressure
(6 component main balance)
6 + (6)

68 Runs.

Section 2(b) Effect of Canopy on Directional Stability

- no intermediate positions

4 hinge moment balances
2 canopy pressures
3 component tail balance
1 rudder hinge moment
6 component main balance
16

48 Runs.

Runs Included in Section 1

Section 2(c) Canopy Hinge Moment in Pitch

i thru v - intermediate positions
vi thru ix - no intermediate positions

2 main balance components
4 component missile balance
4 canopy hinge moments
2 canopy pressures
12

28 Runs.

Section 4 Aileron Effectiveness

6 component main balance
4 component missile balance
1 aileron hinge moment
11

8 Runs.

SECRET

Section 5 Rudder Effectiveness with Canopy

- no intermediate positions

2	main balance components
4	component missile balance
3	component tail balance
1	rudder hinge moment
10	

40 Runs.

Section 6(b) Fin Pitot-Static Pressures in Pitch

2	main balance components
4	component missile balance
2	pressures (1 only for 6(b)i)
8	

16 Runs.

Runs Included in Section 2(a)

Section 7 Tufts

4	hinge moment balance
2	canopy pressures
6	(plus camera)

12 Runs.

Runs Included in Section 3

Section 6(a) Fin Pitot-Static Pressures in Yaw

6	component main balance
2	pressures
8	

24 Runs.

RUN	BALANCE			MISSILE TYPE.	MIS. ATTITUDE			TOTAL ATTITUDE		
	α		Sym.		α		Sym.	α		Symbol
1	1.0	0	B_u	Eccentric	1.0	0	S_{BU}	2.0	0	B_U S_{BU}
2	0	1.0	B_R	Eccentric	0	1.0	S_{BR}	0	2.0	B_R S_{BR}
3	-1.0	0	B_D	Eccentric	-1.0	0	S_{BD}	-2.0	0	B_D S_{BD}
4	0	-1.0	B_L	Eccentric	0	-1.0	S_{BL}	0	-2.0	B_L S_{BL}
5	1.0	0	B_U	Eccentric	1.0	0	S_{BD}	0	0	B_U S_{BD}
6	-1.0	0	B_D	Eccentric	1.0	0	S_{BU}	0	0	B_D S_{BU}
7	1.0	0	B_U	Concentric	0	0	S_{WD}	1.0	0	B_U S_{WD}
8	1.0	0	B_U	Concentric	0	0	S_{WU}	1.0	0	B_U S_{WU}
9	0	1.0	B_R	Concentric	0	0	S_{WR}	0	1.0	B_R S_{WR}
10	-1.0	0	B_D	Concentric	0	0	S_{WU}	-1.0	0	B_D S_{WU}
11	0	-1.0	B_L	Concentric	0	0	S_{WL}	0	-1.0	B_L S_{WL}

1 ✕

7 ✕ 8

4 ✕ 11 ✕ 5 ✕ 6 ✕ 9 ✕ 2

10 ✕

3 ✕

SECRET

CF-105

SPARROW JETTISONING TESTS.

February 1957

FACILITY

N.A.E. Low Speed Tunnel - Ottawa

PURPOSE

To evaluate jettisoning of Sparrow Missiles from C-105 aircraft under different flight conditions.

To establish sequence of jettisoning such that no interference is present (missile to airframe or missile to missile).

To prove release mechanism.

MODEL

.07 Scale C-105 Model

+ 100 Models of Sparrow missiles

32 weighing .148 lb.
32 weighing .278 lb.
36 weighing .606 lb.

INSTRUMENTATION

Angle of attack and yaw indicator. Recording photographic cameras.