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RESEARCH MEMORANDUM

for the

U. S. Air Force

Unclassified
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Changed by H. L. Mumme Date 3/3/75

INVESTIGATION OF EJECTION RELEASES OF AN MB-1 ROCKET FROM A 0.04956-SCALED MODEL OF THE CONVAIR F-106A AIRPLANE AT SEVERAL MACH NUMBERS AND SIMULATED ALTITUDES

GROUP 3
Downgraded at 12 year intervals; not automatically declassified

COORD NO. AF-AM-57

By John B. Lee and Robert C. Basford

Langley Aeronautical Laboratory
Langley Field, Va.

Restriction/Classification Cancelled

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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

RESEARCH MEMORANDUM

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INVESTIGATION OF EJECTION RELEASES OF AN MB-1 ROCKET FROM A 0.04956-SCALED MODEL OF THE CONVAIR F-106A AIRPLANE AT SEVERAL MACH NUMBERS AND SIMULATED ALTITUDES

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By authority of NASA TD 75-370
Changed by O. Huckerbeide Date 5/16/75
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SUMMARY

As a continuation of an investigation of the ejection release characteristics of an internally carried MB-1 rocket in the Convair F-106A airplane, fin modifications at additional Mach numbers and simulated altitudes have been studied in the 27- by 27-inch preflight jet of the Langley Pilotless Aircraft Research Station at Wallops Island, Va. The MB-1 rocket was ejected with fins open, fins closed, fins closed with a shroud around the fins, and fins folded with a "boattail" placed in between the fins. Dynamically scaled models (0.04956 scale) were tested at simulated altitudes of 12,000, 18,850, and 27,500 feet at subsonic Mach numbers and at 18,850, 27,500, and 40,000 feet for Mach numbers of 1.39, 1.59, and 1.98.

Successful ejections can be obtained for over 10 store diameters from release point by the use of a shroud around the folded fins with the proper ejection velocity and nose-down pitching moment at release. In one case investigated it was found desirable to close off the front one-third of the bomb bay. It appeared that the fins should be opened after release and within 5 to 6 rocket diameters if no modifications are made on the rocket. An increase in fuselage angle of attack caused higher nose-up pitch rates after release.

INTRODUCTION

A previous investigation (ref. 1) showed that large nose-down pitching moments were necessary during the ejection stroke to eject successfully the MB-1 rocket with fins folded from the bomb bay of the Convair F-106A airplane at high values of dynamic pressure. The purpose of the present investigation was to find and study MB-1 configurations which would require smaller ejection moments and meet the specifications of the contractor. The configurations that were tested incorporated modifications to the original MB-1 rocket which were intended to increase the static stability. The modifications tested included: folded fins with a shroud, folded fins with a "boattailed" afterbody, and extended fins. The ejection characteristics were studied over a range of subsonic Mach numbers and at supersonic Mach numbers of 1.39, 1.59, and 1.98 at simulated altitudes of 12,000 to 40,000 feet and at Reynolds numbers per foot from 3×10^6 to 14×10^6. This investigation was made with 0.04956-scaled models in the preflight jet of the Langley Pilotless Aircraft Research Station at Wallops Island, Va. The models were dynamically scaled according to the light-model method outlined in reference 2.

SYMBOLS

d	diameter, 0.859 inch for rocket model
h_p	simulated altitude, ft
I_y	moment of inertia in pitch plane, lb-in.^{2}
M	free-stream Mach number
q	free-stream dynamic pressure, lb/sq ft
r	radius, in.
t	time, sec
Δt	time interval of stroboscopic photographs, sec
W	rocket weight, lb
x	horizontal displacement of center of gravity with origin at point of release, positive downstream, in.

z vertical displacement of center of gravity with origin at point of release, positive down, in.

$\dot{z}_o$ ejection velocity at release, ft/sec

α_f angle of attack of airplane fuselage, deg

θ pitch angle in reference to free-stream direction, deg

$\dot{\theta}_o$ pitch rate at release, radians/sec

$\ddot{\theta}_o$ pitch acceleration at release, radians/sec^2

Subscripts:

P prototype

M model

MODELS, APPARATUS, AND TESTS

A sketch of the basic MB-1 rocket with retracted or folded fin tips is shown in figure 1(a) and the rocket-model ordinates are shown in table I. Sketches of the rocket with fins extended, fins retracted with a shroud, and fins retracted with a "boattail," are shown in figures 1(b), (c), and (d), respectively. Figure 2 is a photograph of the four models investigated. A bottom view of the F-106A bomb bay with the MB-1 rocket, Falcon missiles, and baffle in place is shown in figure 3. A full-scale weight of 800 pounds, an inertia of 720,000 lb-in.^{2}, and a radius of gyration of 30 inches were simulated within ±5 percent. All models were supplied by Convair, Division of General Dynamics Corp.

A sketch of the 0.04956-scaled model of the Convair F-106A airplane for this investigation is shown in reference 1. The ejection mechanism, with which a pitching moment could be applied to the store at point of release, was the same as used in reference 1. A break link that passed through the rocket-model center of gravity and connected to the top of the missile bay was used in this investigation to hold the model securely in place until the ejection force was applied.

This investigation was made in the 27- by 27-inch preflight jet of the Langley Pilotless Aircraft Research Station at Wallops Island, Va. A description of this jet is given in reference 2.

Stroboscopic photographs were obtained by using a spinning disk with slits in front of the camera lens (ref. 2). The time interval between exposures was approximately 0.002 second.

RESULTS AND DISCUSSION

This investigation was made to determine some conditions necessary to maintain near level flight attitude of the rocket for a distance of 8 or 10 store diameters below the rocket release point. This condition was to be obtained with an ejection velocity of 31 feet per second and a pitch rate at release of -8.0 radians per second or less for model scale at $M = 1.59$. An altitude of 18,850 feet was simulated, corresponding to a full-scale dynamic pressure of approximately 1,800 pounds per square foot. The successful methods under these conditions were to be repeated at altitudes of 27,500 and 40,000 feet through a subsonic range of Mach numbers and at $M = 1.39$ and 1.98. The fuselage angle of attack was varied from 1° to 6° depending on the expected flight attitude of the full-scale airplane at the Mach number and dynamic-pressure conditions simulated. The missile bay included either no Falcon missiles or four Falcon missiles since these combinations represented the extreme conditions in reference 1. For most of the tests a baffle was added to the missile bay in between the front and rear Falcon missiles (fig. 3).

Table II lists the configurations and pertinent conditions of each test. Figures 4 to 15 present the stroboscopic pictures and plots of the rocket-model pitch oscillations and trajectory. Distances divided by the maximum rocket-model diameter of $d = 0.859$ inch are used in the motion plots to nondimensionalize the results.

Ejections at $M = 1.59$

Ejections of several rocket models at a simulated altitude of 18,850 feet and a Mach number of 1.59 are shown in figure 4. An initial nose-down pitch rate of $\dot{\theta}_{o,M} = -5.5$ radians per second was not sufficient to obtain a favorable pitch trajectory at near release with fins folded either without or with Falcon missiles in the missile bay (tests 1 and 2). The addition of a baffle in the missile bay (test 3) showed a small improvement in the store pitch rate (fig. 4(b)). The baffle was used for the remainder of this investigation. A favorable ejection was obtained with fins extended (test 4). The rocket remained within a range of $\theta_M = \pm 10^\circ$ for 10 store diameters below the rocket release point. It should be noted at this point that the initial nose-up pitch rate after release is higher for the fins-open model (test 4) than for the fins-closed model (test 3). Their pitch angles are equal

at $\frac{t}{d} \approx 0.0126$ second per inch where the rocket is 5 store diameters below the release point. This indicates downwash at the rear of the bomb bay which acts on the increased fin area size, causing a higher nose-up pitching moment until the model is far enough into the airstream for the fins to become effective and stabilize the rocket in reference to the free-stream direction. Thus it may be favorable to attempt to open the fins after release and within 4 to 5 store diameters below the release point.

The effects of the addition of a shroud and a boattail to the folded fin configuration are shown in figure 5 (tests 5 and 6). With the addition of the shroud, the rocket experienced pitch angles less than $\pm 5^{\circ}$ for $\frac{t}{d} = 0.021$ second per inch where the rocket is 10 store diameters below the airplane. The rocket then diverged to a high angle of attack. The boattail rocket pitched to $\theta_M = -16^{\circ}$ and back to a high positive angle of attack. This model was eliminated from the remainder of this investigation in favor of the shrouded rocket model.

Tests were also made with one and two triangular spoilers placed 2 inches upstream from the leading edge of the bomb bay. No improvement in the MB-1 rocket release was noted from use of the spoilers over test 2 so they are not reported herein.

The simulated altitude, fuselage angle of attack, and initial nose-down pitch rate were increased in tests 7, 8, and 9. Good release conditions were obtained (fig. 6) with the shrouded rocket model (test 9) producing an excellent trajectory. The initial nose-down pitch rate of -11.3 radians per second for $h_p = 40{,}000$ feet was greater than desired and apparently a lower-pitch rate could be used successfully.

Ejections at M = 1.39

Successful ejections were made at $M = 1.39$, at $h_p = 18{,}850$ feet with fins folded, fins folded with shroud, and fins extended (fig. 7, tests 10, 11, and 12, respectively). Here again the fins-extended model (test 12) had a higher nose-up pitch rate immediately after release and pitched to a maximum positive angle of attack within 5 store diameters of the release point. It appears that the time to open the fins could be increased to $\frac{t}{d} \geq 0.020$ second per inch where the rocket is 7 store diameters below the release point at this lower Mach number. An increase in the fuselage angle of attack to 5°, however, caused the model to diverge

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rapidly with the same initial pitch rate of $\dot{\theta}_{o,M}$ = -5.5 radians per second (fig. 8, test 13). An excellent release was obtained by changing the test conditions to an altitude of 27,500 feet; α_f = 2° and $\dot{\theta}_{o,M}$ = -7.0 radians per second.

Ejections at M = 1.98

Ejections were made at M = 1.98, simulating an altitude of 27,500 feet with $\dot{\theta}_{o,M}$ = -7.0 radians per second (fig. 9, tests 15, 16, 17, and 18). For the fins-folded ejection (test 15) the initial pitch rate was in excess of the amount needed whereas for the fins-folded-with-shroud model (test 16) the trajectory was very satisfactory. Again the fins-extended model (test 17) nosed up immediately after release, reaching a maximum pitch attitude of 22° within 5 to 6 store diameters after release. The model obtained enough lift at this high angle of attack to cause its trajectory to pass close to the airplane fuselage.

In test 18 the front third of the missile bay was closed off with a plate. The missile-bay doors were not changed. A high nose-down pitch rate was obtained, indicating that by blocking off some of the missile bay the amount of flow in the missile bay was restricted.

Comparisons at Supersonic Mach Numbers

Figures 10, 11, and 12 are plots comparing the fins-folded, fins-folded-with-shroud, and fins-extended configurations, respectively, tested at the three supersonic Mach numbers and at several conditions of dynamic pressure. The use of the shroud (fig. 11) yielded satisfactory trajectories for the highest Mach number and dynamic-pressure conditions for these tests. For the fins-extended tests (fig. 12), the higher Mach numbers and dynamic pressure conditions give higher initial nose-up pitching moments immediately after release. It would thus appear that the most satisfactory trajectories could be obtained over the range of Mach numbers and dynamic-pressure conditions by opening the fins after release within 5 to 6 store diameters and within 10 store diameters after release if a shroud is used.

Subsonic Mach Numbers

Good releases were obtained at high subsonic Mach numbers, simulating 18,850 feet, and $\dot{\theta}_{o,M}$ = -5.5 radians per second with fins folded, fins folded with shroud, and with fins extended (fig. 13, tests 19, 20, and 21, respectively). An increase in simulated altitude

to 27,500 feet, $\alpha_f = 2^\circ$, and $\dot{\theta}_{o,M}$ to -7.0 radians per second also produced a satisfactory trajectory with fins folded (fig. 11, test 22). A decrease in altitude to 12,000 feet and a decrease in pitch rates to -4.5 radians per second caused the rocket model to diverge at a faster rate (fig. 14, test 23) than at higher altitudes and pitching moments (fig. 14, tests 19 and 22). A small increase in initial pitch rate would possibly be sufficient to obtain a satisfactory trajectory at this altitude. At a simulated altitude of 18,850 feet, satisfactory trajectories were obtained with ejections at $M = 0.68$, $\alpha_f = 3^\circ$ and at $M = 0.41$ with $\alpha_f = 6^\circ$ (fig. 15, tests 24 and 25). It thus appears that the shroud is not needed to obtain successful ejections at subsonic speeds under the conditions of the tests.

CONCLUDING REMARKS

The second phase of an experimental investigation was conducted in a free jet to determine the ejection release characteristics and flight behavior of the MB-1 rocket in close vicinity to the fuselage of a model of the Convair F-106A airplane. The tests were made over a range of subsonic and supersonic Mach numbers, and simulated altitudes from 12,000 to 40,000 feet, with several rocket-model modifications.

The results of this investigation indicate that the rocket model could be satisfactorily ejected at a velocity of 31 feet per second for all Mach numbers and dynamic-pressure conditions of the investigation if the fins of the model are opened after release and within 5 to 6 store diameters after release. Satisfactory trajectories were obtained for over 10 store diameters by the use of a shroud around the folded fins for all cases investigated. An increase in fuselage angle of attack caused higher nose-up pitch rates after release. A higher nose-down pitching rate after release was obtained by closing off the front one-third of the bomb bay at a free-stream Mach number of 1.98.

Langley Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., August 22, 1957.

John B. Lee
Aeronautical Research Engineer

Robert C. Basford
Aerodynamics Test Technician

Approved:

Joseph A. Shortal
Chief of Pilotless Aircraft Research Division

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REFERENCES

1. Lee, John B.: Investigation of Ejection Releases of an MB-1 Rocket From a 0.04956-Scaled Model of the Convair F-106A Airplane at Mach Number 1.59 - COORD. NO. AF-AM-57. NACA RM SL57E07, U. S. Air Force, 1957.

2. Sandahl, Carl A., and Faget, Maxime A.: Similitude Relations for Free-Model Wind-Tunnel Studies of Store-Dropping Problems. NACA TN 3907, 1957.

[redacted]

TABLE I.- MB-1 ROCKET MODEL ORDINATES

x, in.	r, in.
0.248	0.166
.497	.248
.744	.312
.991	.362
1.239	.398
1.497	.421
1.927	.429
2.212	.429
2.618	.372
4.139	.372
4.701	.359
5.495	.279

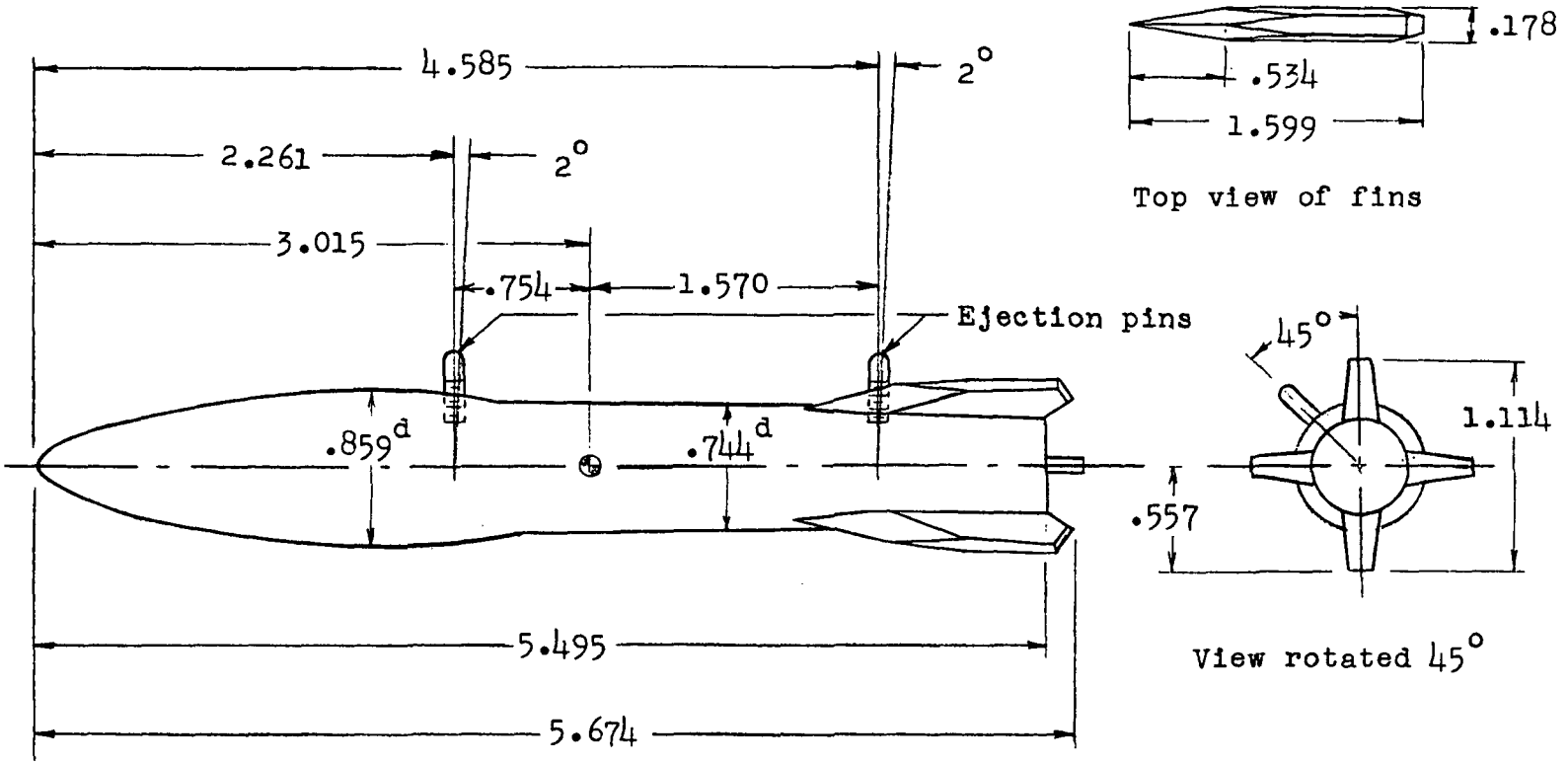
[redacted]

TABLE II.- TEST SEQUENCE

[Scale = 0.04956; d_M = 0.859 in.; $\dot{z}_o$ = 31 ft/sec; W_P = 800 lb; $I_{y,P}$ = 720,000 lb-in.^{2}; K_P = 30 in.; K_M = 1.49 in.]

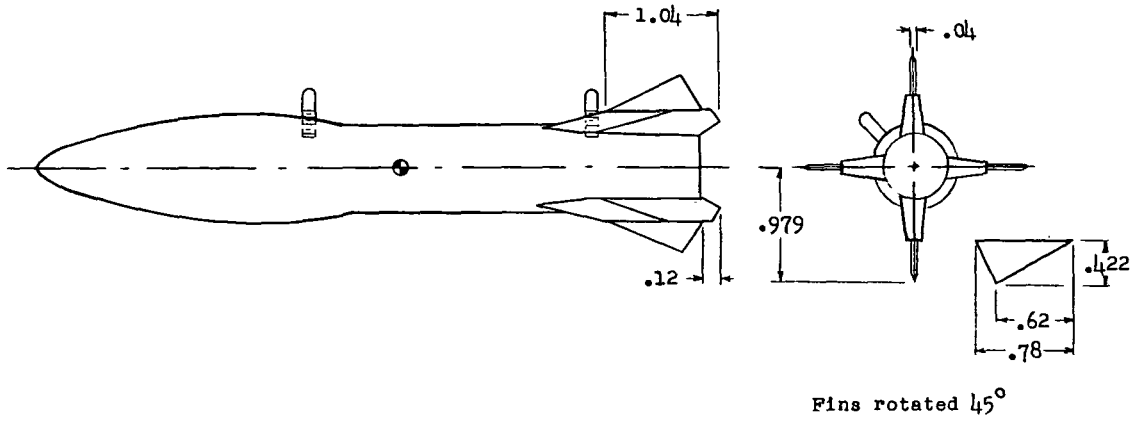
Test	Figure	Mach number	h_p, ft	Store (a)	Falcons	α_f, deg	W_M, lb	$I_{y,M}$, lb-in.^{2}	$\dot{\theta}_M$, radians/sec	$\ddot{\theta}_M$, radians/sec^2	$\ddot{\theta}_P$, radians/sec^2	M_P, ft-lb	q_P, lb/ft^2	Δt, sec	Remarks
1	4	1.59	18,850	FF	0	1	0.203	0.450	-5.5	-2050	-5.04	-750	1807	0.00212	No baffle
2	4	1.59	18,850	FF	4	1	.203	.450	-5.5	-2050	-5.04	-750	1807	.00216	No baffle
3	4	1.59	18,850	FF	0	1	.203	.450	-5.5	-2050	-5.04	-750	1807	.00203	
4	4	1.59	18,850	FE	0	1	.203	.450	-5.5	-2050	-5.04	-750	1807	.00206	
5	5	1.59	18,850	FFS	4	1	.203	.450	-5.5	-2050	-5.04	-750	1807	.00205	
6	5	1.59	18,850	Boattail	4	1	.203	.450	-5.5	-2050	-5.04	-750	1807	.00212	
7	6	1.59	27,500	FF	4	2	.295	.655	-7.0	-2610	-6.41	-960	1240	.00206	
8	6	1.59	40,000	FF	4	3	.522	1.160	-11.3	-4220	-10.35	-1550	533	.00209	
9	6	1.59	40,000	FFS	4	3	.522	1.160	-11.3	-4220	-10.35	-1550	533	.00209	
10	7	1.39	18,850	FF	4	1	.203	.450	-5.5	-2050	-5.04	-750	1378	.00209	
11	7	1.39	18,850	FFS	4	1	.203	.450	-5.5	-2050	-5.04	-750	1378	.00206	
12	7	1.39	18,850	FE	0	1	.203	.450	-5.5	-2050	-5.04	-750	1378	.00206	
13	8	1.39	18,850	FF	4	5	.203	.450	-5.5	-2050	-5.04	-750	1378	.00203	
14	8	1.39	27,500	FF	4	2	.295	.655	-7.0	-2610	-6.41	-960	945	.00207	
15	9	1.98	27,500	FF	4	2	.295	.655	-7.0	-2610	-6.41	-960	1920	.00212	
16	9	1.98	27,500	FFS	4	2	.295	.655	-7.0	-2610	-6.41	-960	1920	.00208	
17	9	1.98	27,500	FE	0	2	.295	.655	-7.0	-2610	-6.41	-960	1920	.00210	
18	9	1.98	27,500	FF	4	2	.295	.655	-7.0	-2610	-6.41	-960	1920	.00208	2/3 missile bay
19	13	.93	18,850	FF	4	2	.203	.450	-5.5	-2050	-5.04	-750	616	.00207	
20	13	.94	18,850	FFS	4	2	.203	.450	-5.5	-2050	-5.04	-750	630	.00207	
21	13	.90	18,850	FE	0	2	.203	.450	-5.5	-2050	-5.04	-750	578	.00205	
22	14	.92	27,500	FF	4	2	.295	.655	-7.0	-2610	-6.41	-960	415	.00205	
23	14	.92	12,000	FF	4	1	.153	.340	-4.5	-1670	-4.10	-615	797	.00204	
24	15	.68	18,850	FF	4	3	.203	.450	-5.5	-2050	-5.04	-750	330	.00204	
25	15	.41	18,850	FF	4	6	.203	.450	-5.5	-2050	-5.04	-750	120	.00202	

[a] FF - Fins folded; FE - Fins extended; FFS - Fins folded with shroud.

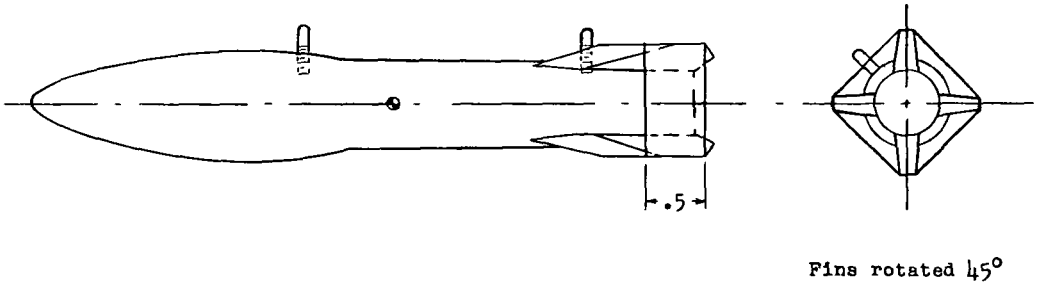


(a) Basic MB-1 rocket model with fins retracted.

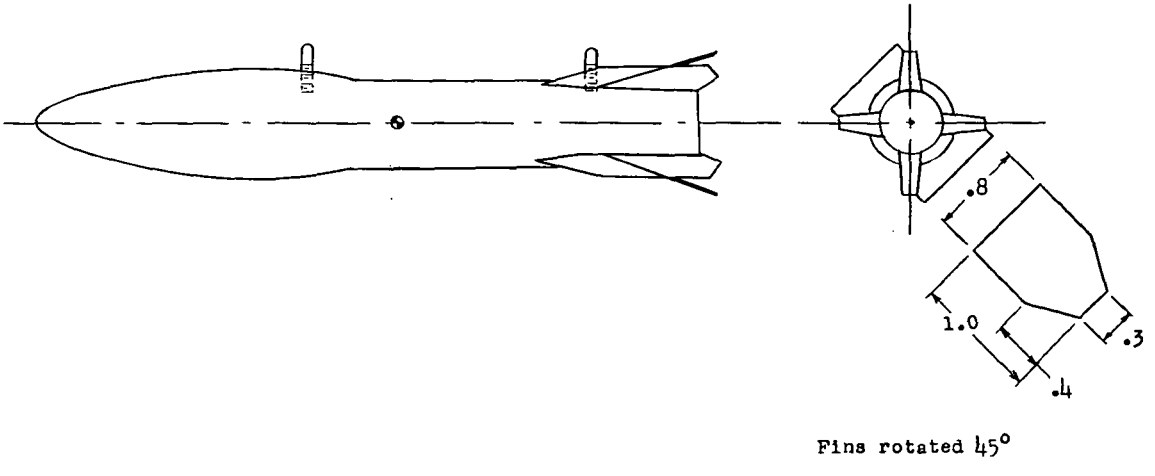
Figure 1.- The 0.04956-scale models of the MB-1 rocket. All dimensions are in inches.



(b) Fins extended.

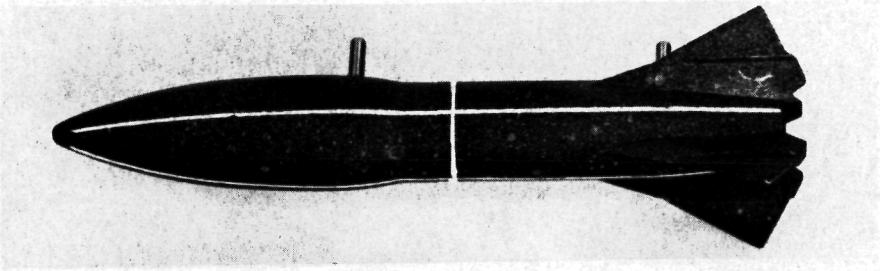


(c) Fins retracted with shroud.

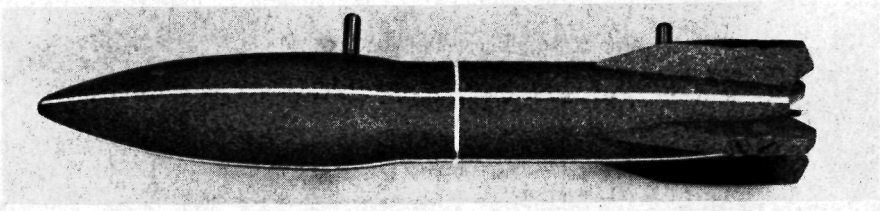


(d) Fins retracted with boattail.

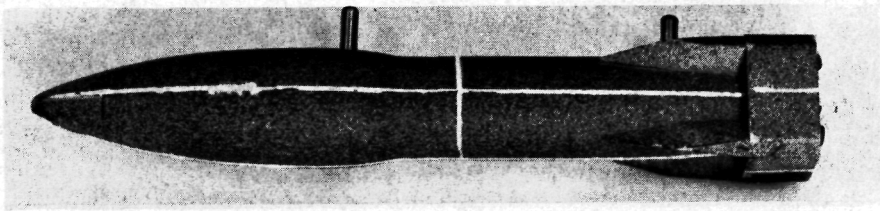
Figure 1.- Concluded.



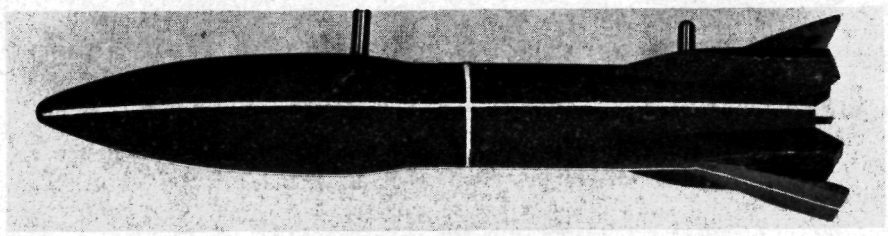
(a) Fins extended.



(b) Fins retracted.



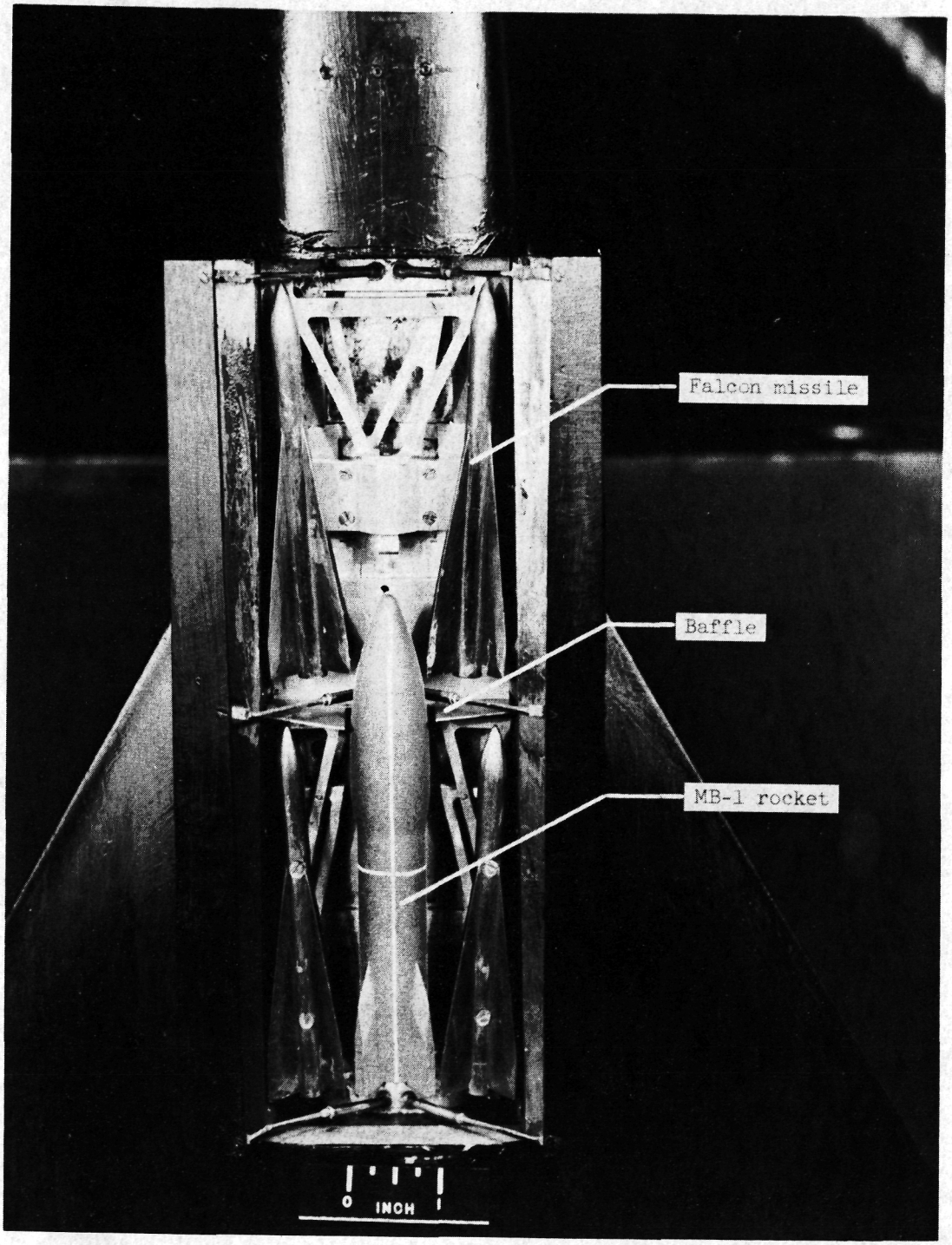
(c) Fins retracted with shroud.



(d) Fins retracted with boattail.

Figure 2.- Photograph of the MB-1 rocket models. L-57-912.1

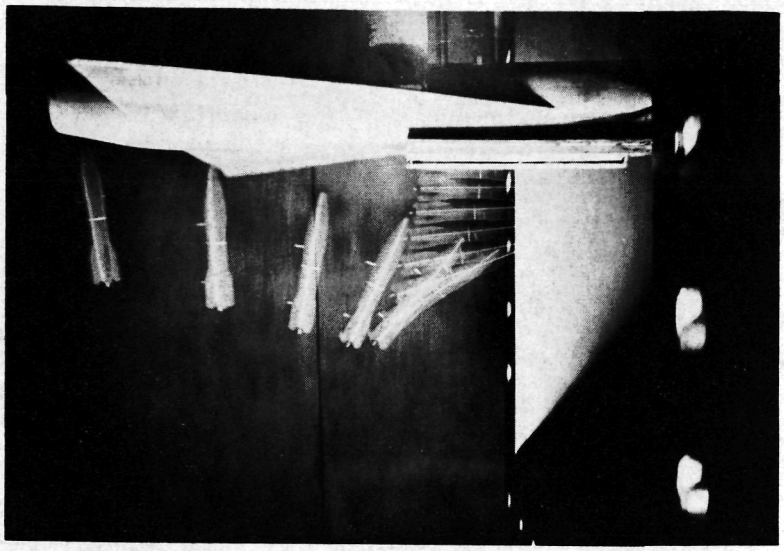
[redacted]



L-57-1067.1

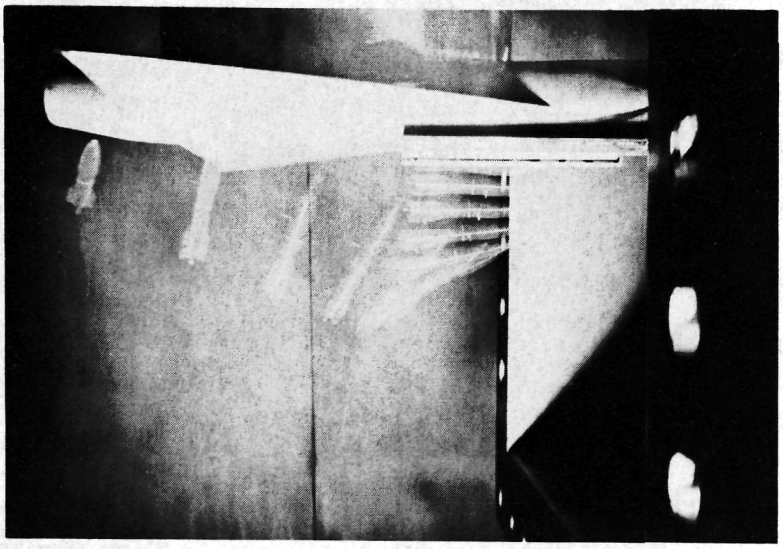
Figure 3.- Bottom view of 0.04956-scaled model of the Convair F-106A with MB-1 rocket, Falcon missiles, and baffle in place in the bomb bay.

[redacted]



L-57-1268

Test 1; missile bay with no baffle; 0 Falcon missiles; fins folded



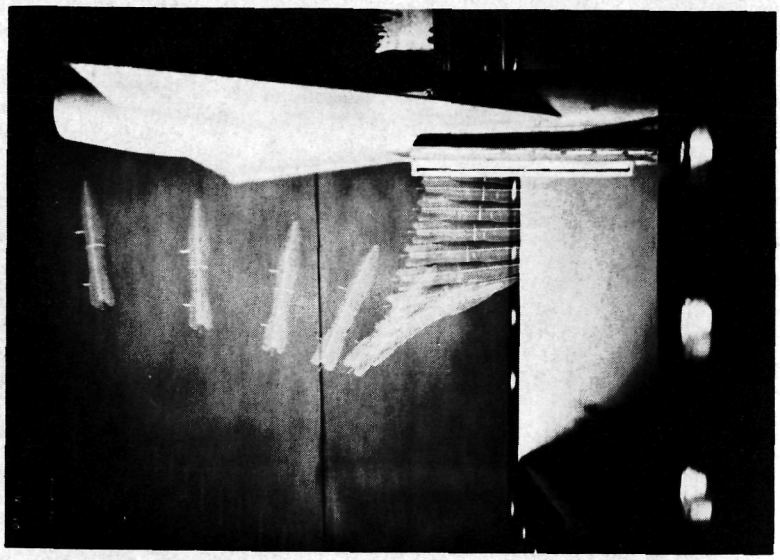
Test 2; missile bay with no baffle; 4 Falcon missiles; fins folded.

(a) Stroboscopic photographs.

L-57-1267

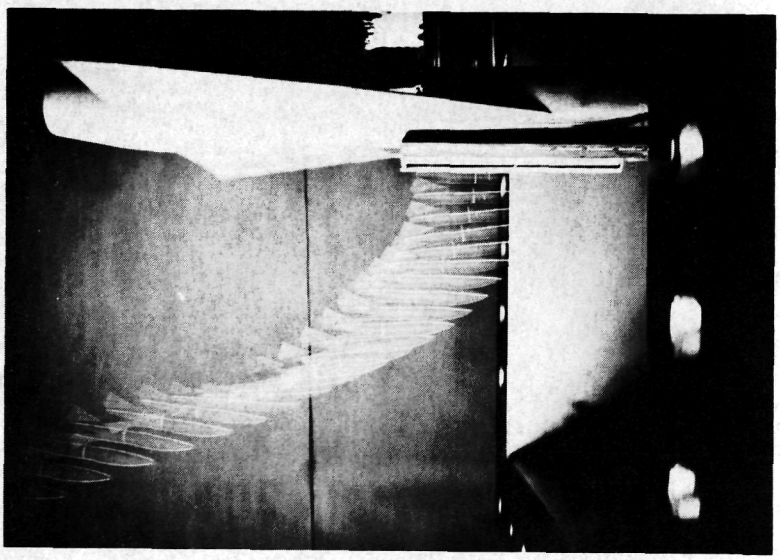
Figure 4.- MB-1 rocket ejections with missile bay, Falcon missiles, and rocket fin changes at $M = 1.59$, $h_p = 18{,}850$ feet, $\alpha_f = 1^\circ$, and $\dot{\theta}_{o,M} = -5.5$ radians per second.

[redacted]



L-57-1271

Test 3; missile bay with baffle; 0 Falcon missiles; fins folded.

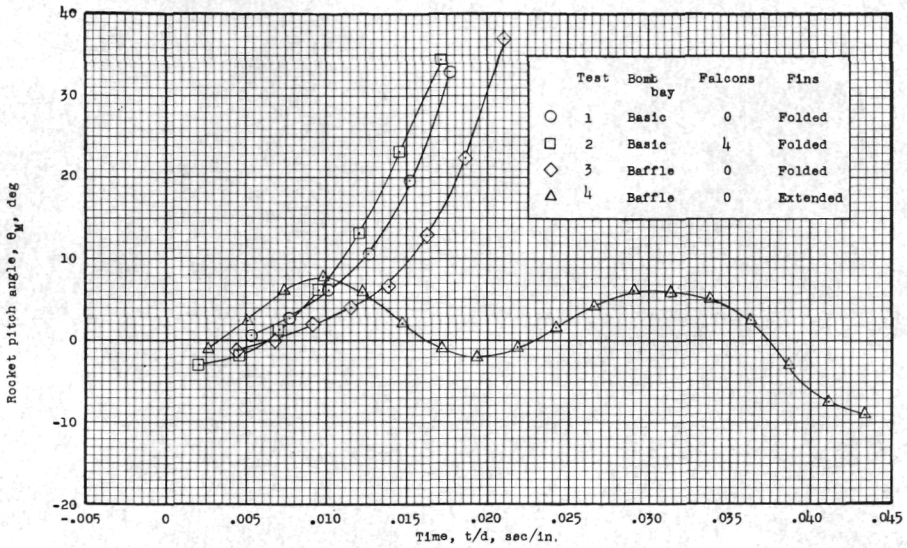


L-57-1269

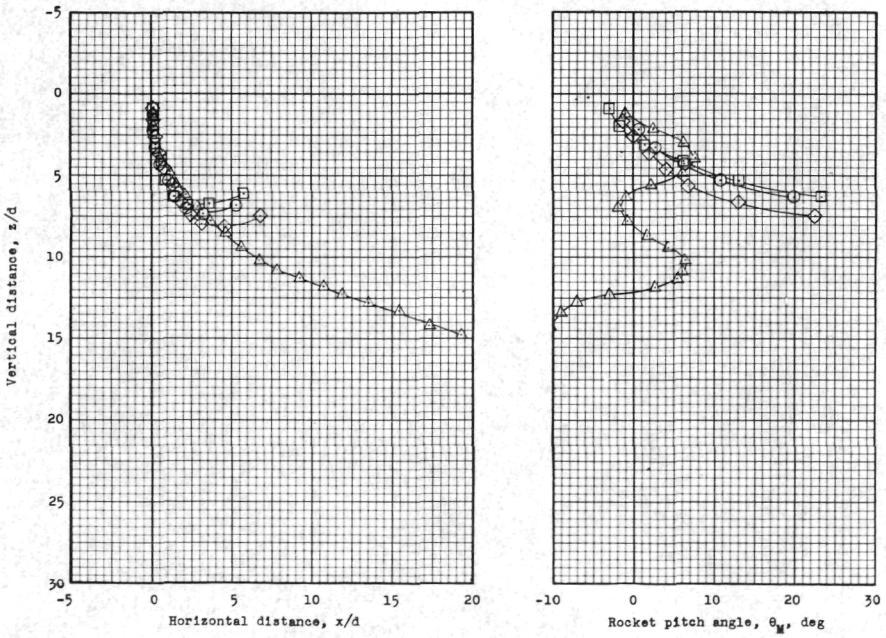
Test 4; missile bay with baffle; 0 Falcon missiles; fins extended.

(a) Concluded.

Figure 4.- Continued.

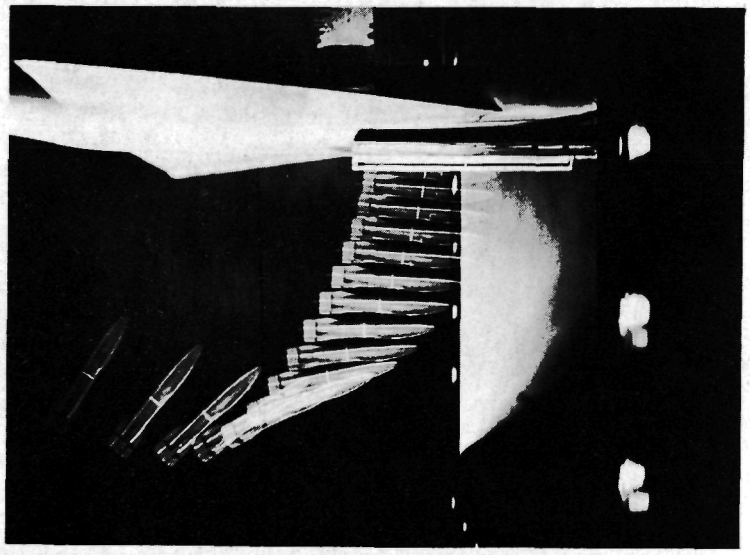


(b) Oscillations.



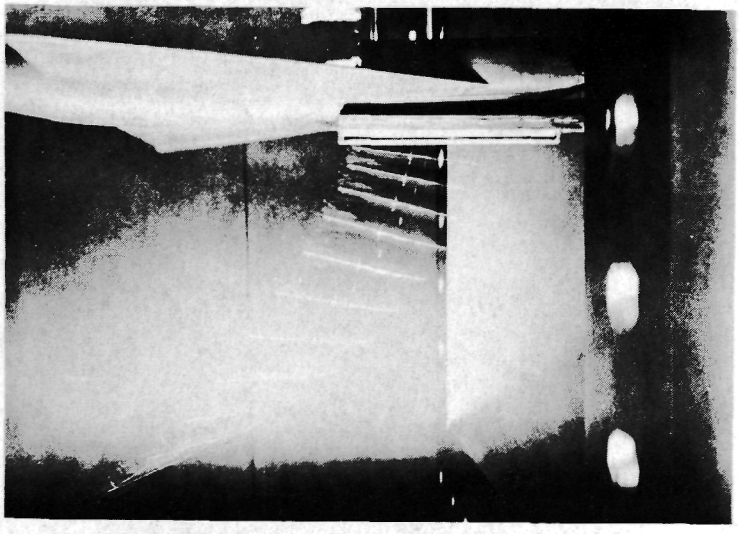
(c) Trajectories. (d) Pitch trajectories.

Figure 4.- Concluded.



L-57-1272

Test 5; fins folded with shroud.

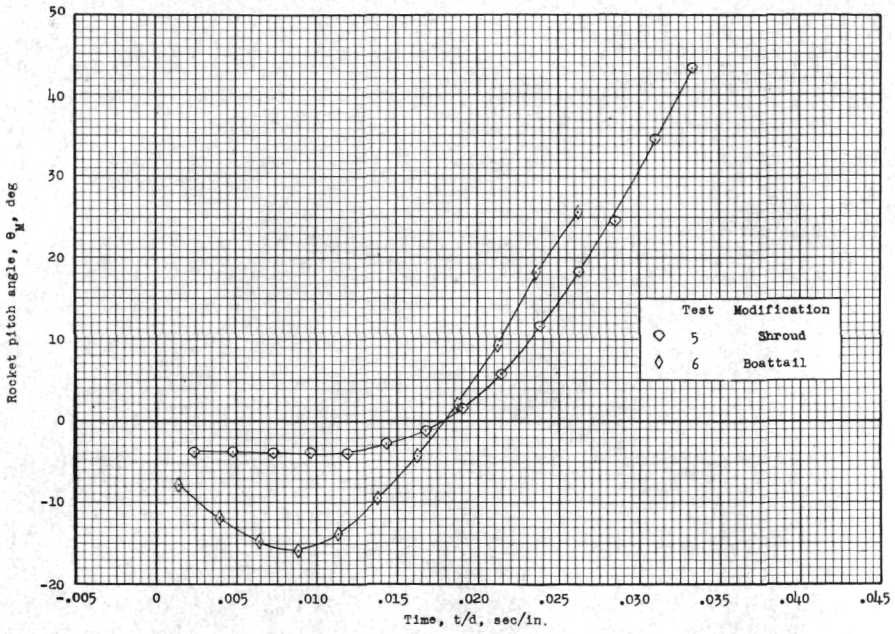


Test 6; fins folded with boattail. L-57-1273

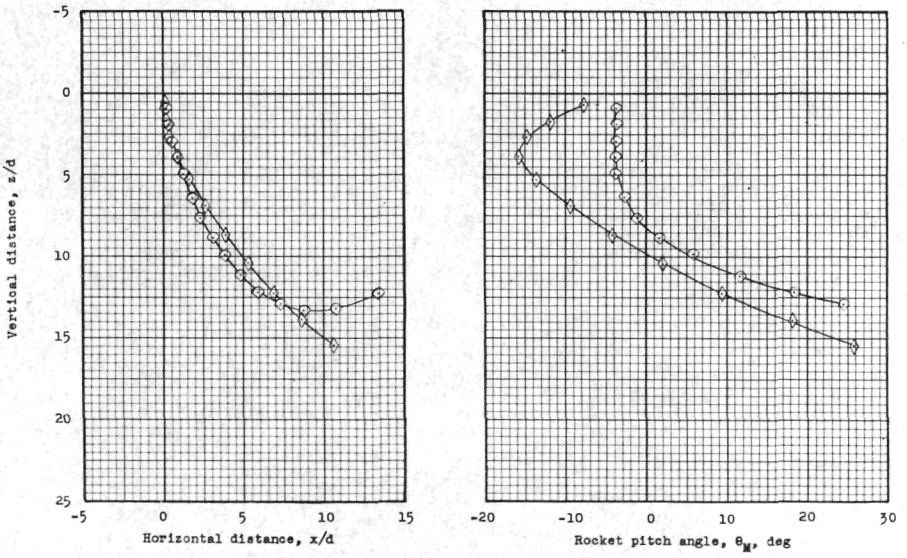
(a) Stroboscopic photographs.

Figure 5.- MB-1 rocket ejections with modifications on base of model with baffle and Falcon missiles in place at $M = 1.59$, $h_p = 18{,}850$, $\alpha_f = 1^\circ$, and $\dot{\theta}_{o,M} = -5.5$ radians per second.

[redacted]



(b) Oscillations.

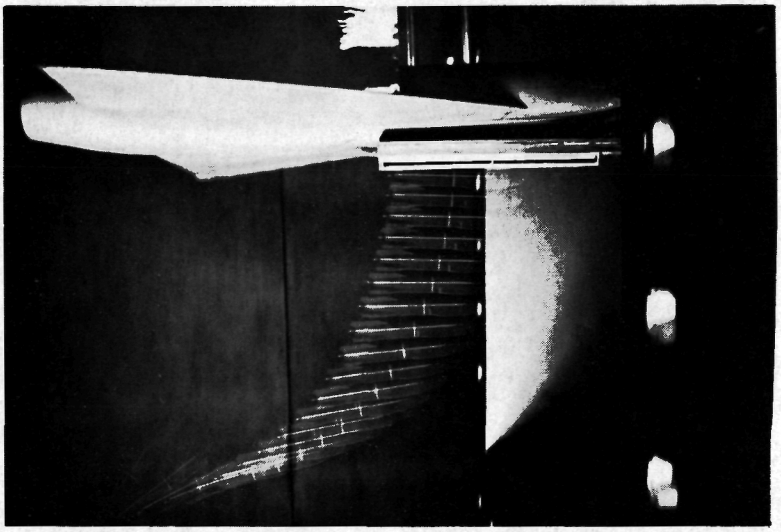


(c) Trajectories.

(d) Pitch trajectories.

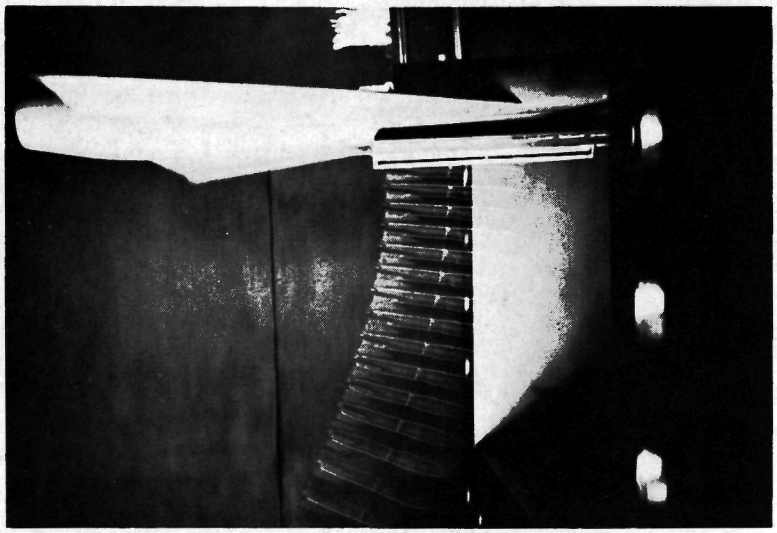
Figure 5.- Concluded.

[redacted]



L-57-1275

Test 7; h_p = 27,500 feet; α_f = 1°; $\dot{\theta}_{o,M}$ = -7.0 radians per second.



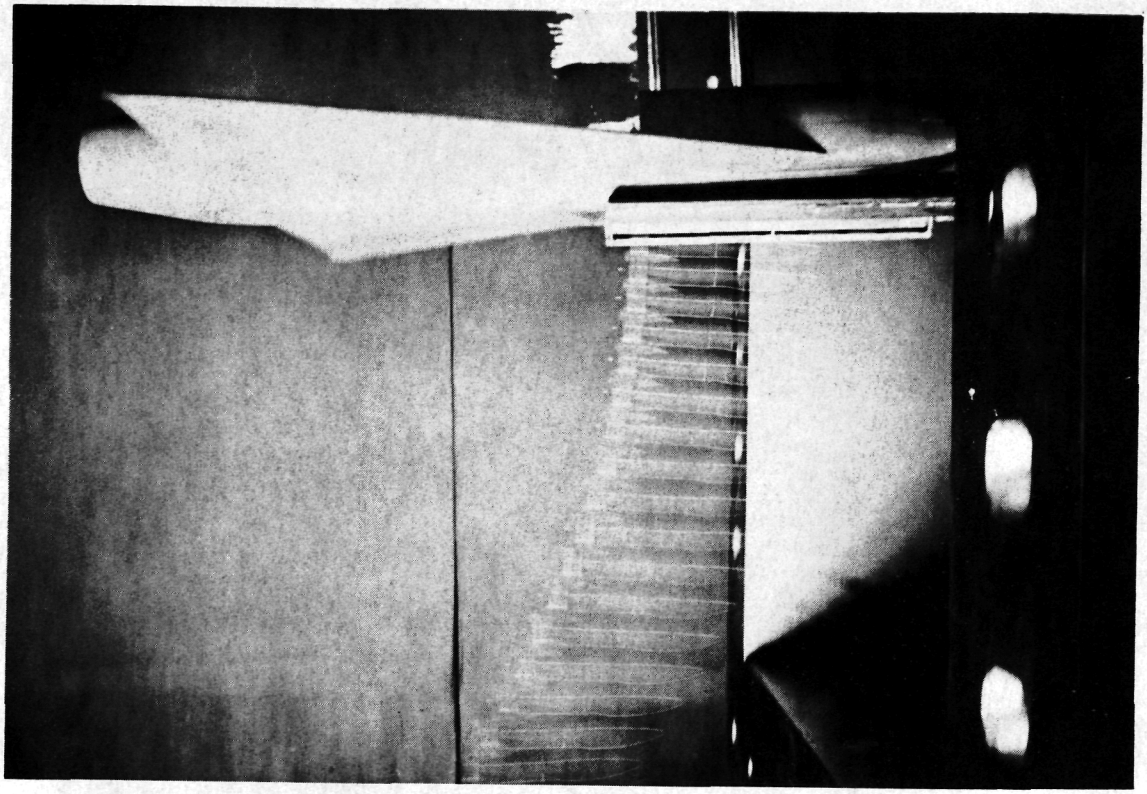
L-57-1276

Test 8; h_p = 40,000 feet; α_f = 3°; $\dot{\theta}_{o,M}$ = -11.3 radians per second.

(a) Stroboscopic photographs.

Figure 6.- MB-1 rocket ejections with changes in altitudes and pitching moments with Falcon missiles and baffle in place at M = 1.59.

[redacted]

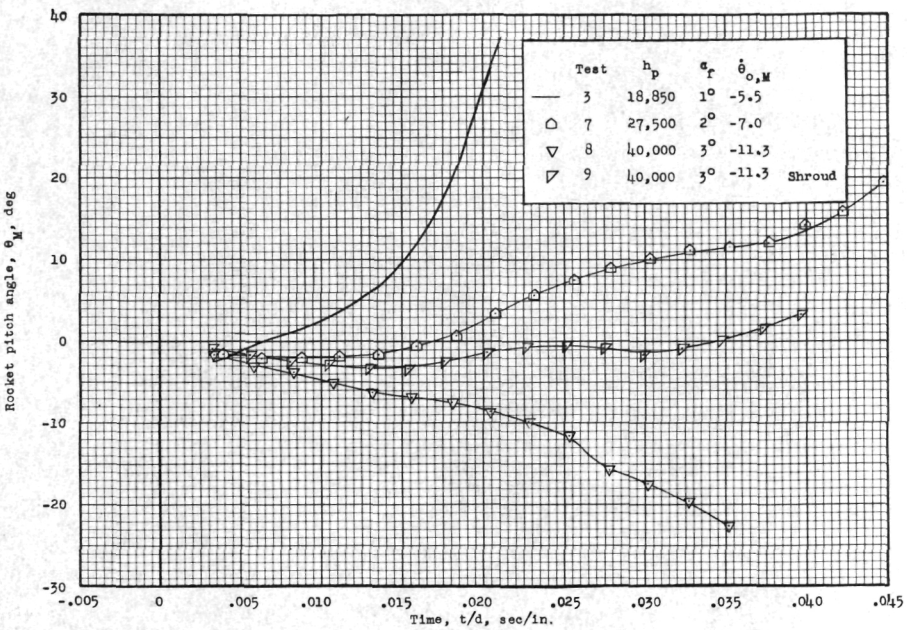


L-57-1277

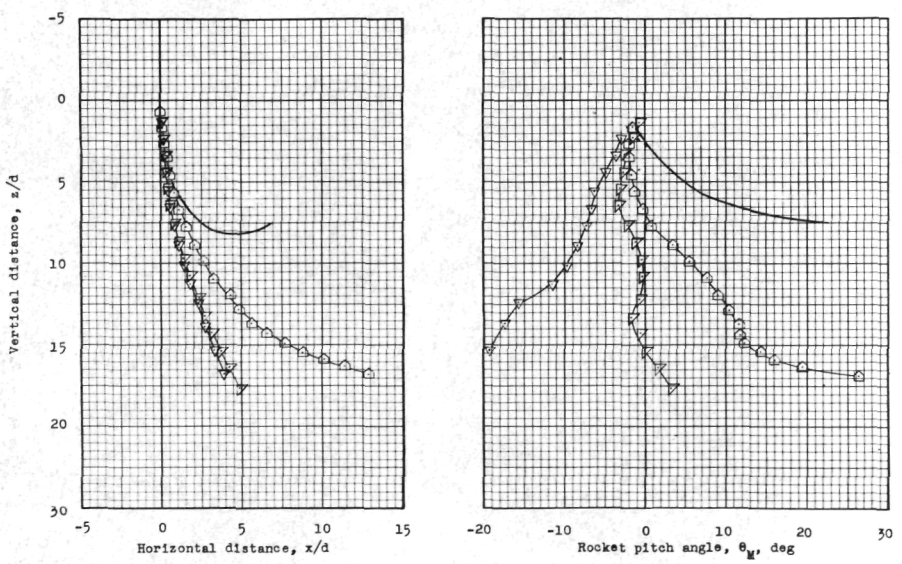
Test 9; h_p = 40,000 feet; α_f = 3°; $\dot{\theta}_{o,M}$ = -11.3 radians per second; fins folded with shroud.

(a) Concluded.

Figure 6.- Continued.



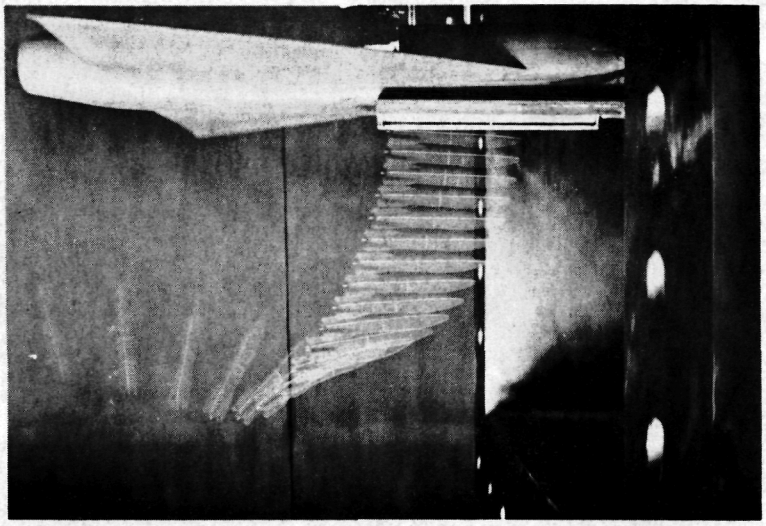
(b) Oscillations.



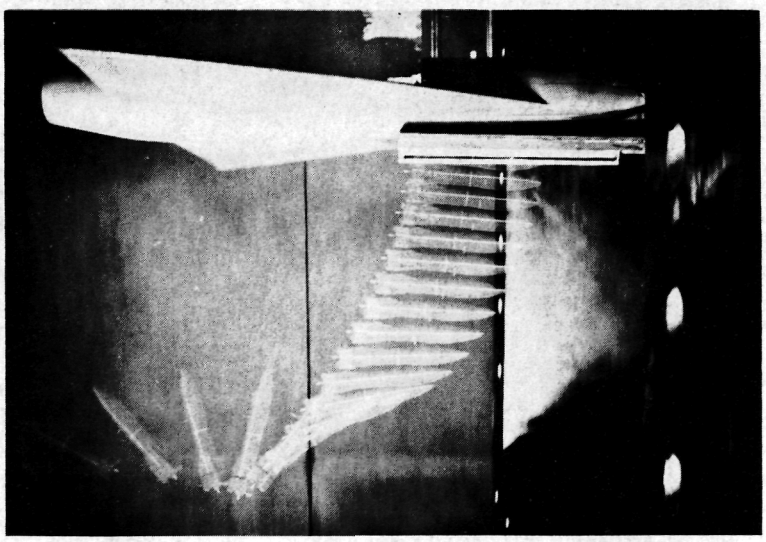
(c) Trajectories.

(d) Pitch trajectories.

Figure 6.- Concluded.



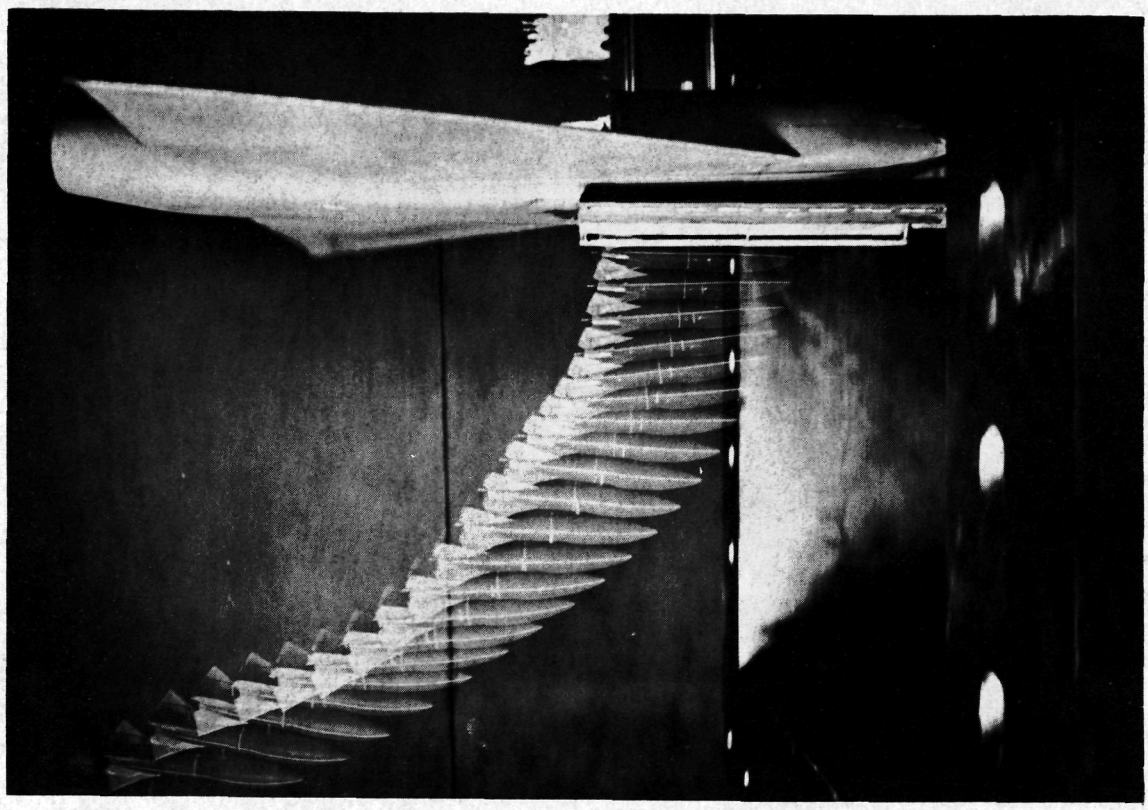
Test 10; 4 Falcon missiles; fins folded. L-57-1281



Test 11; 4 Falcon missiles; fins folded with shroud. L-57-1278

(a) Stroboscopic photographs.

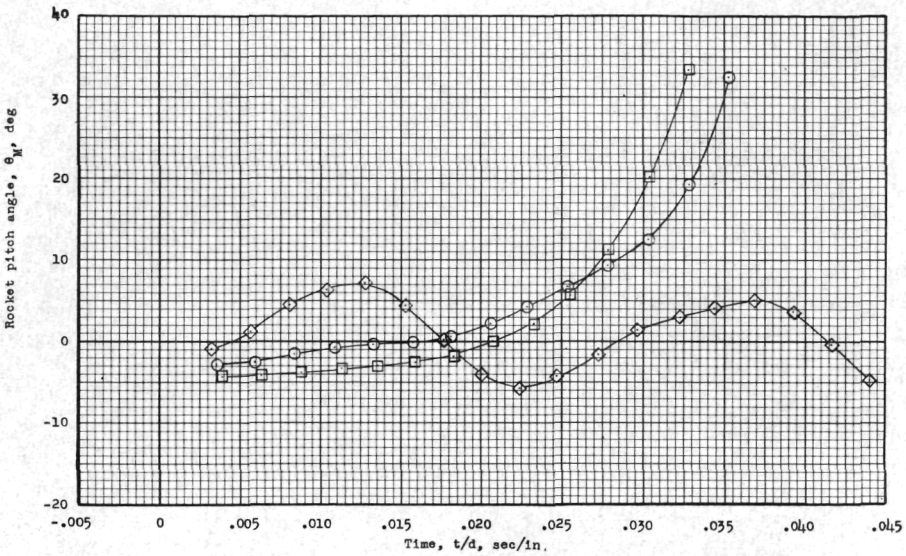
Figure 7.- MB-1 rocket ejections with baffle in place at $M = 1.39$, $h_p = 18{,}850$ feet, $\alpha_f = 1^\circ$, and $\dot{\theta}_{o,M} = -5.5$ radians per second.



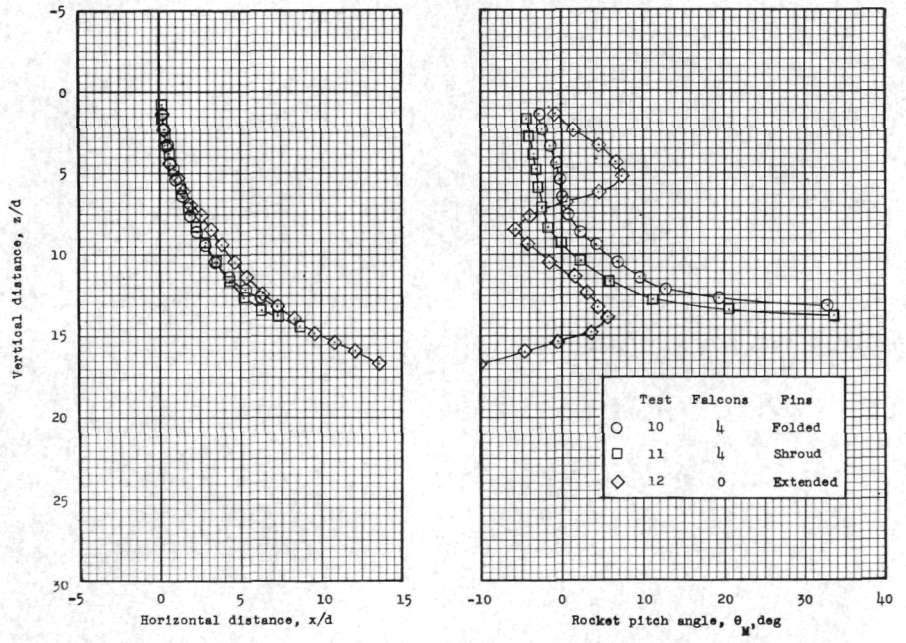
Test 12; 0 Falcon missiles; fins extended. L-57-1280

(a) Concluded.

Figure 7.- Continued.



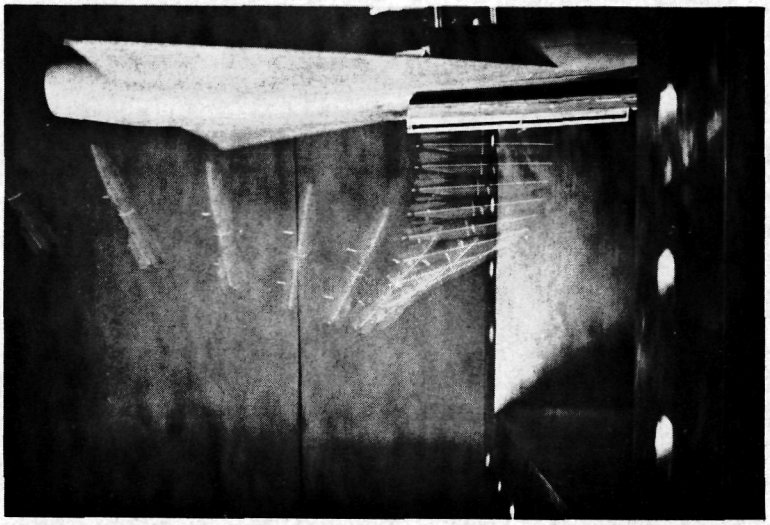
(b) Oscillations.



(c) Trajectories. (d) Pitch trajectories.

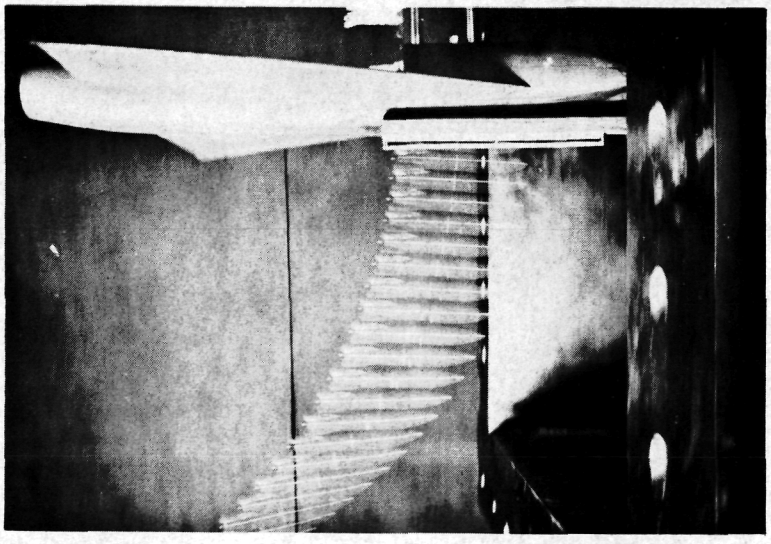
Figure 7.- Concluded.

[redacted]



L-57-1285

Test 13; h_p = 18,850 feet; α_f = 5°; $\dot{\theta}_{o,M}$ = -5.5 radians per second.

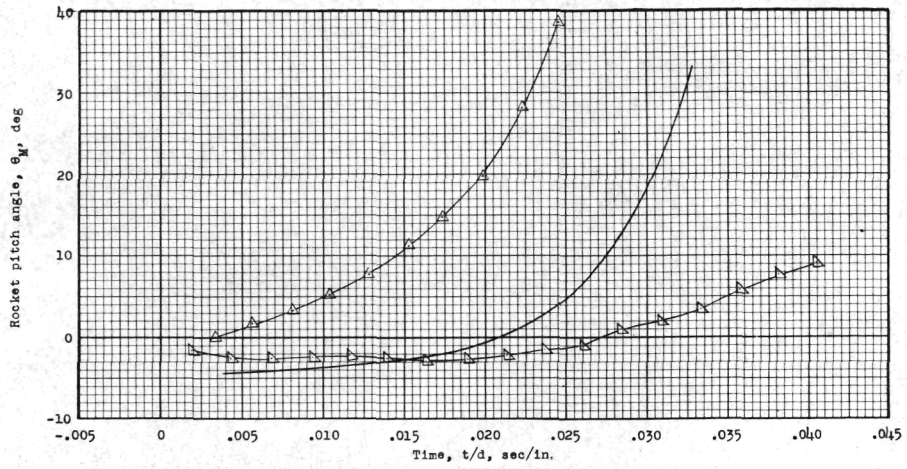


L-57-1283

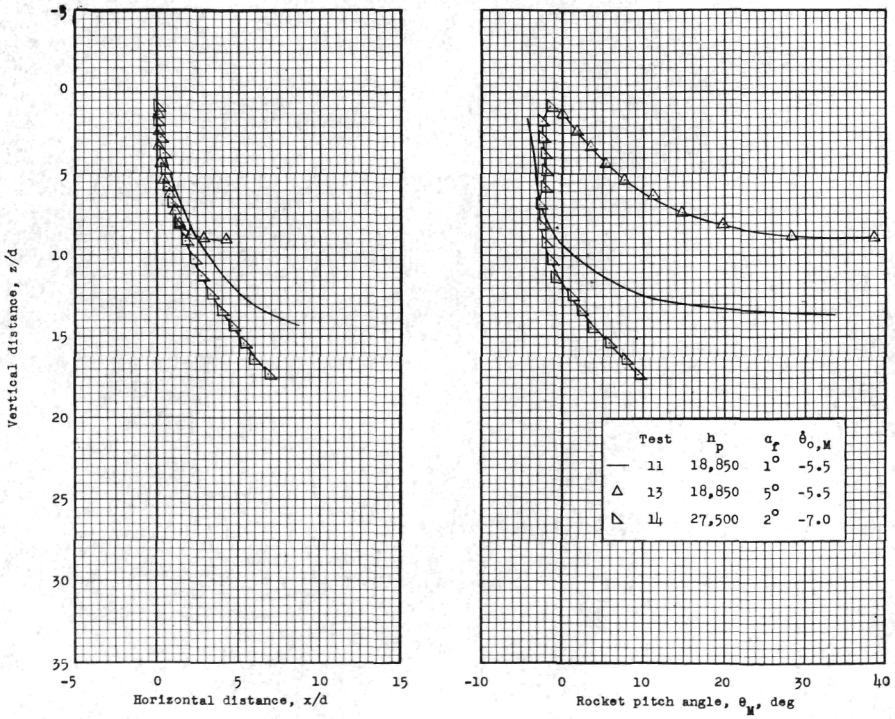
Test 14; h_p = 27,500 feet; α_f = 2°; $\dot{\theta}_{o,M}$ = -7.0 radians per second.

(a) Stroboscopic photographs.

Figure 8.- MB-1 rocket ejections with angle of attack and altitude changes with fins folded, Falcon missiles, and baffle in place at M = 1.39.



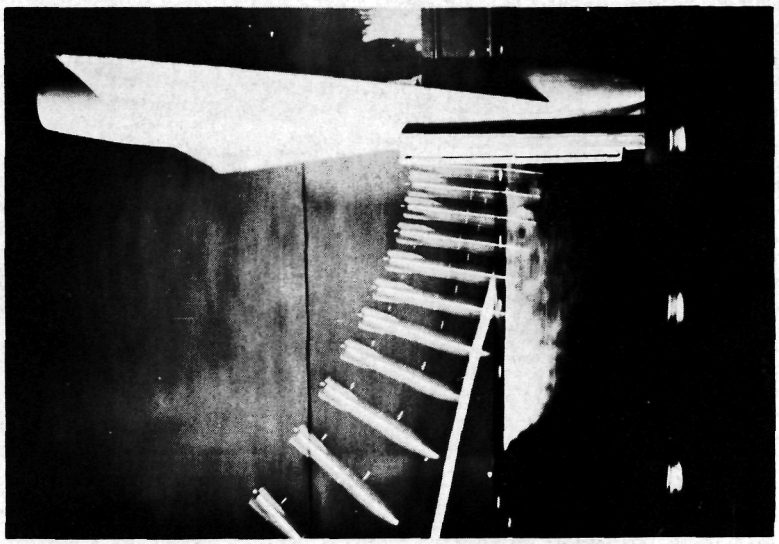
(b) Oscillations.



(c) Trajectories.

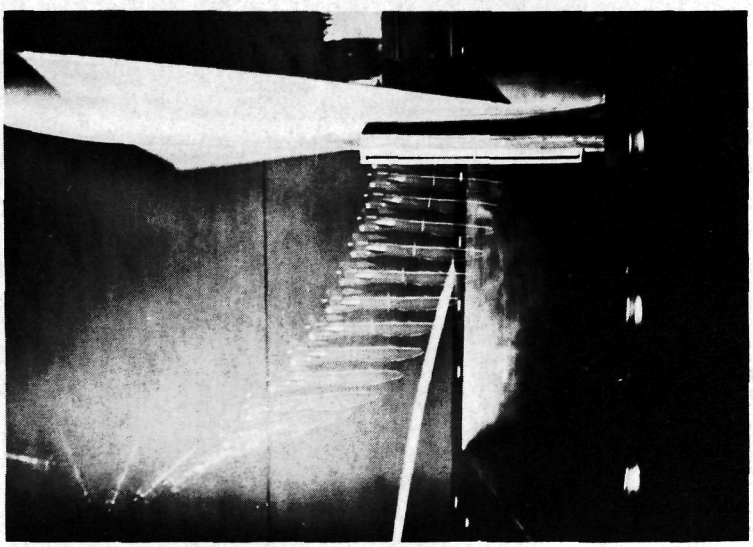
(d) Pitch trajectories.

Figure 8.- Concluded.



L-57-1286

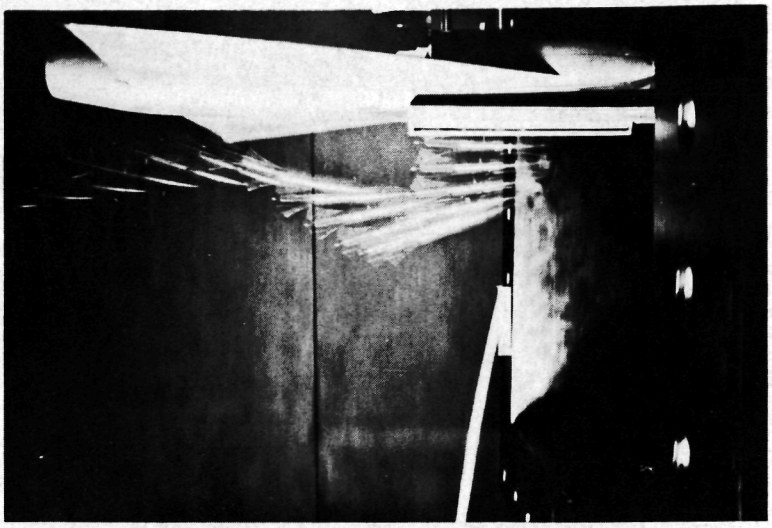
Test 15; 4 Falcon missiles; fins folded.



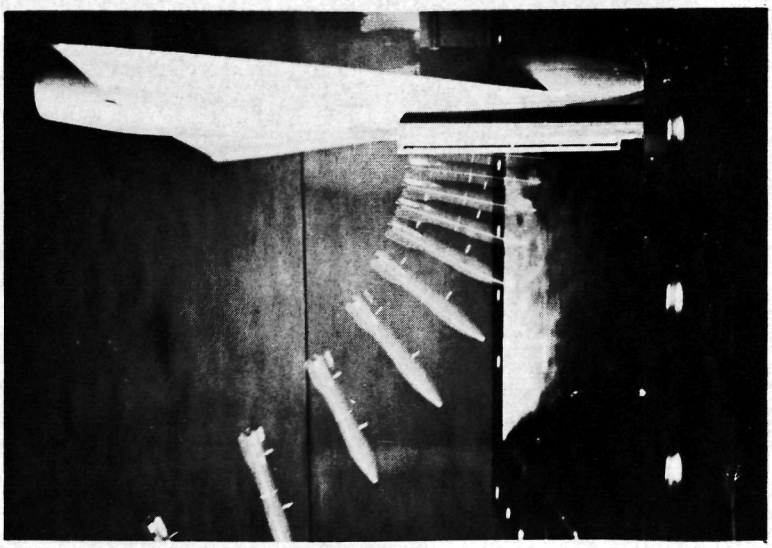
Test 16; 4 Falcon missiles; fins folded with shroud. L-57-1287

(a) Stroboscopic photographs.

Figure 9.- MB-1 rocket ejections at $M = 1.98$, $h_p = 27{,}500$ feet, $\alpha_f = 2^\circ$, and $\dot{\theta}_{o,M} = -7.0$ radians per second with baffle in place.



Test 17; 0 Falcon missiles; fins extended. L-57-1288

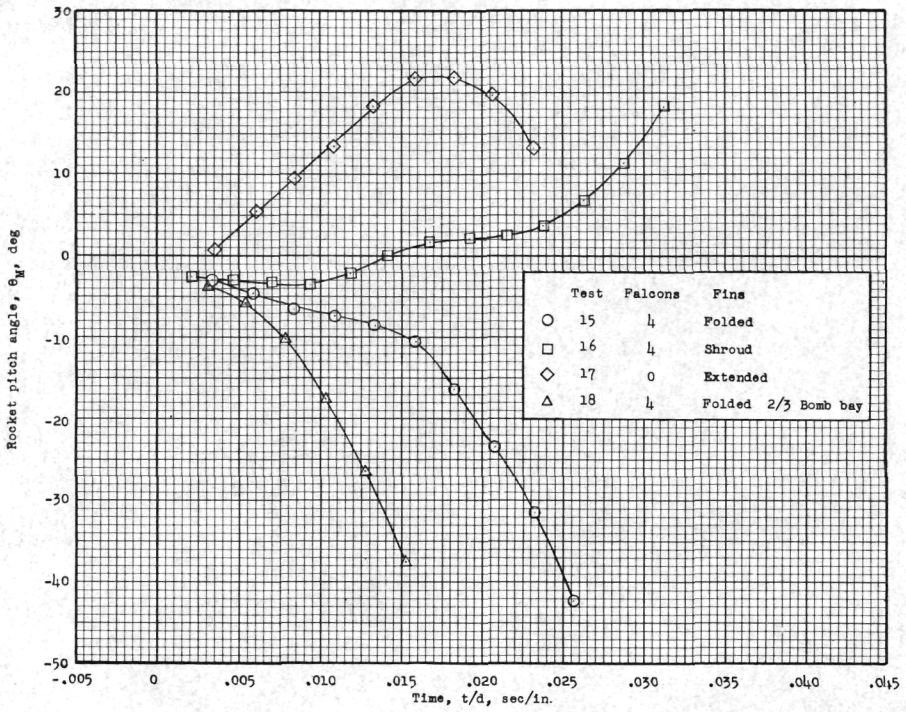


L-57-1289

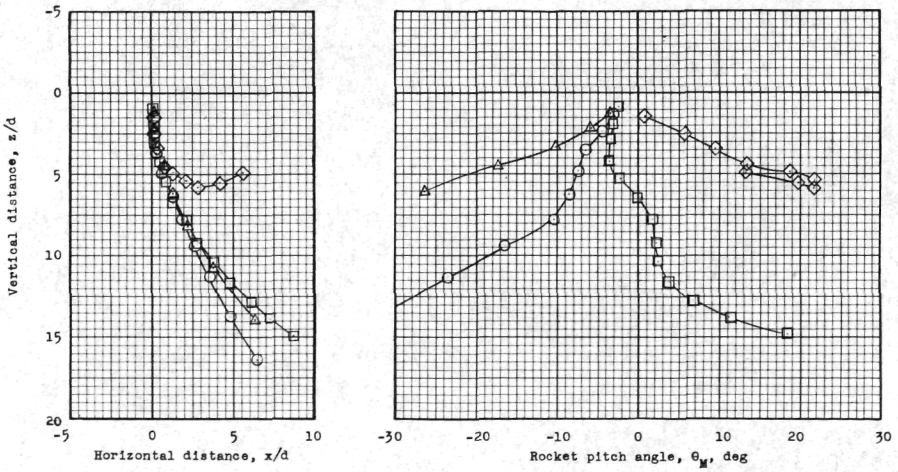
Test 18; 4 Falcon missiles; fins folded; 2/3 missile bay.

(a) Concluded.

Figure 9.- Continued.

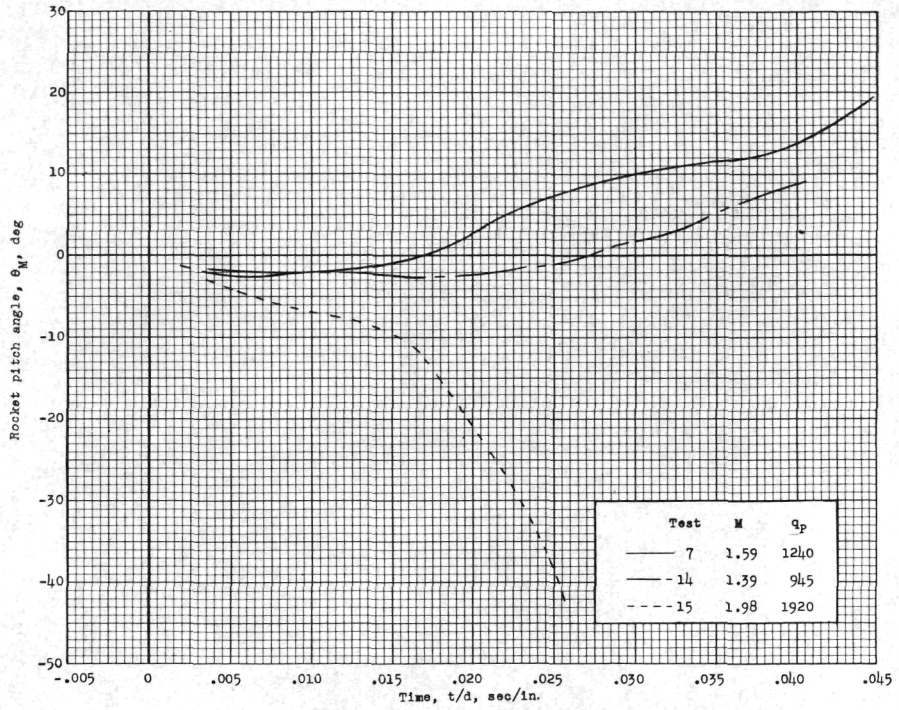


(b) Oscillations.

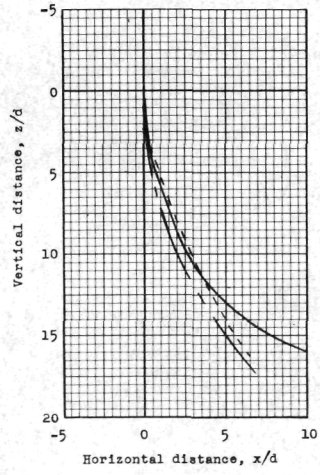


(c) Trajectories. (d) Pitch trajectories.

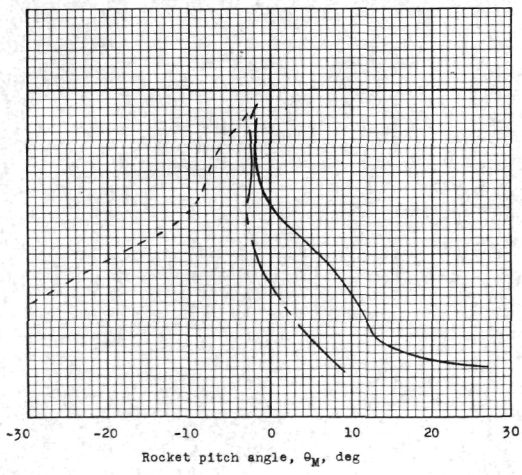
Figure 9.- Concluded.



(a) Oscillations.



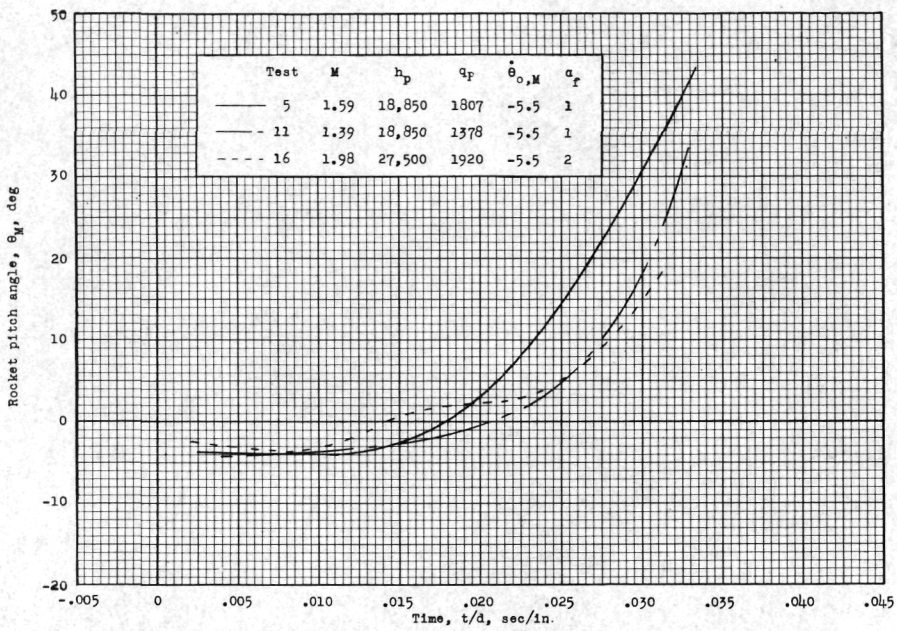
(b) Trajectories.



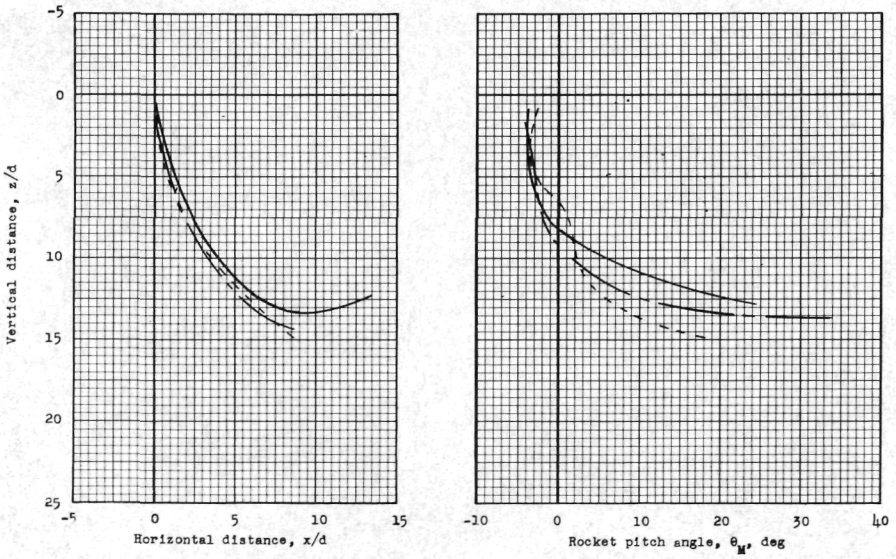
(c) Pitch trajectories.

Figure 10.- MB-1 rocket ejections with fins folded, with changes in Mach number and simulated dynamic-pressure conditions at h_p = 27,500 feet and $\alpha_f = 2^\circ$ with 4 Falcon missiles in missile bay at $\dot{\theta}_{o,M}$ = -7.0 radians per second.

[redacted]

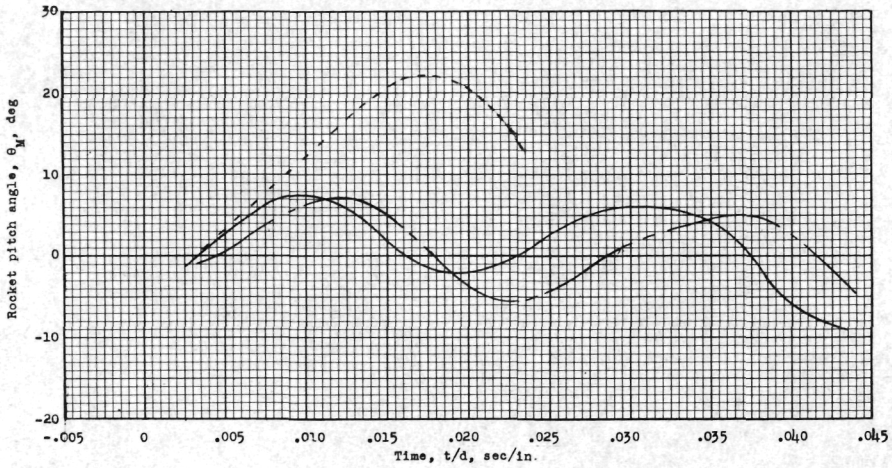


(a) Oscillations.

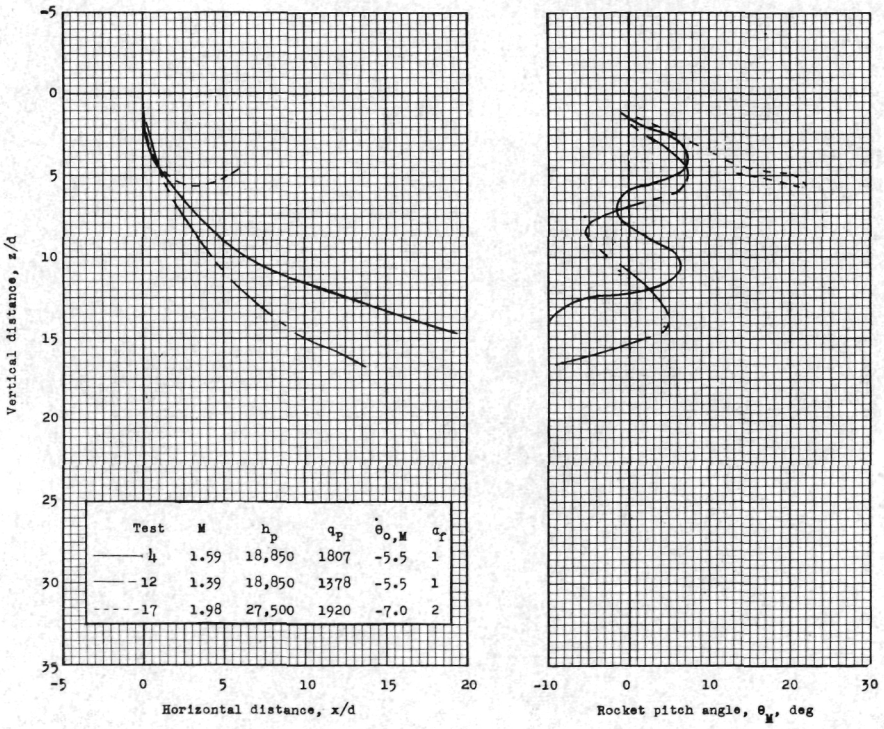


(b) Trajectories. (c) Pitch trajectories.

Figure 11.- MB-1 rocket ejections with shrouded fins with changes in Mach number and simulated dynamic-pressure conditions.



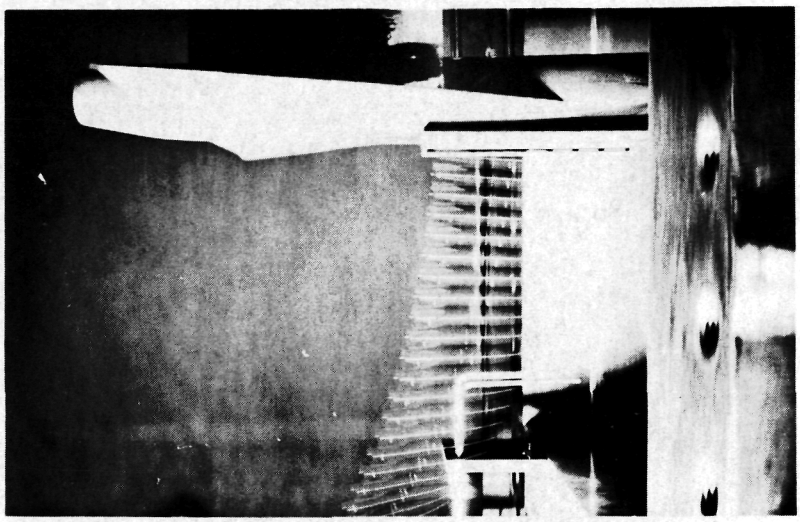
(a) Oscillations.



(b) Trajectories.

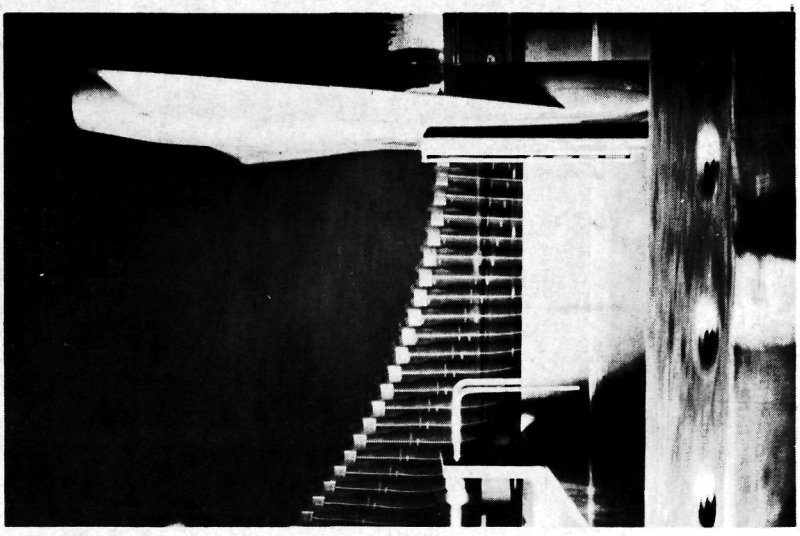
(c) Pitch trajectories.

Figure 12.- MB-1 rocket ejections with fins extended with changes in Mach number and simulated dynamic-pressure conditions.



L-57-1291

Test 19; 4 Falcon missiles; fins folded; M = 0.93.

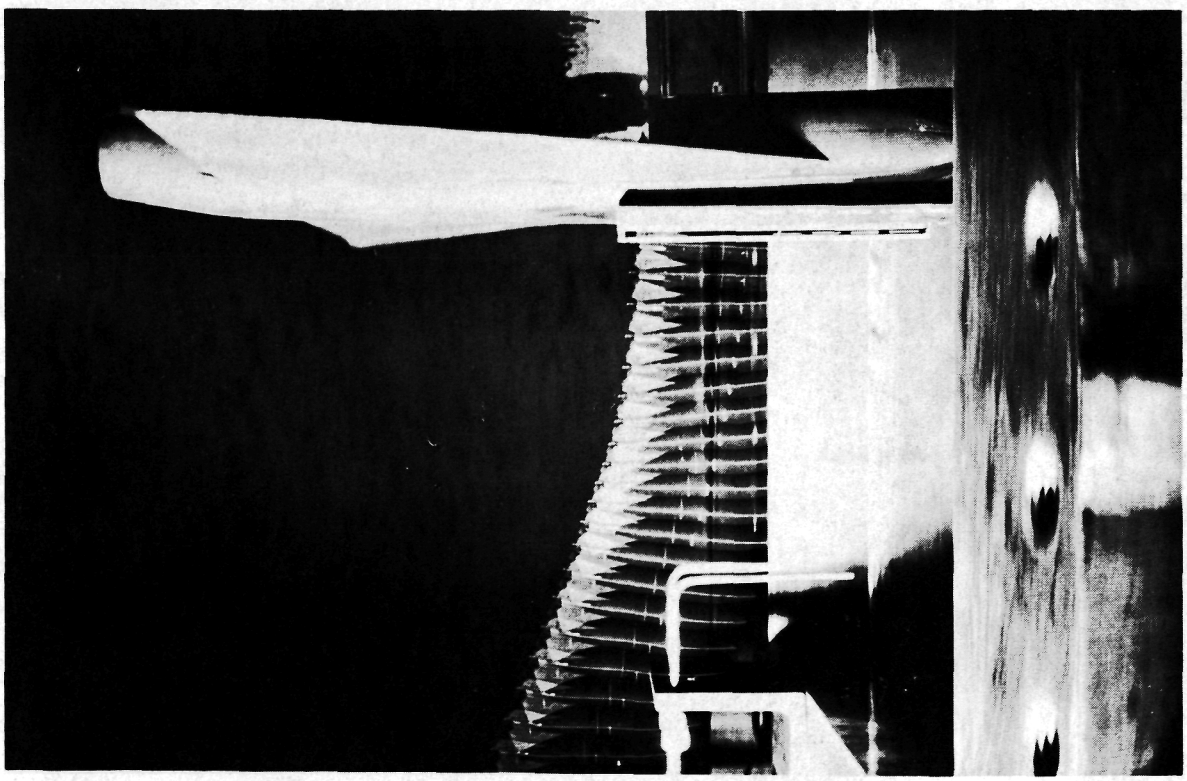


L-57-1292

Test 20; 4 Falcon missiles; fins folded with shroud; M = 0.94.

(a) Stroboscopic photographs.

Figure 13.- MB-1 rocket ejections with changes in fin configurations at subsonic Mach numbers, h_p = 18,850 feet, $\alpha_f = 2^\circ$, and $\dot{\theta}_{o,M}$ = -5.5 radians per second with baffle in place.

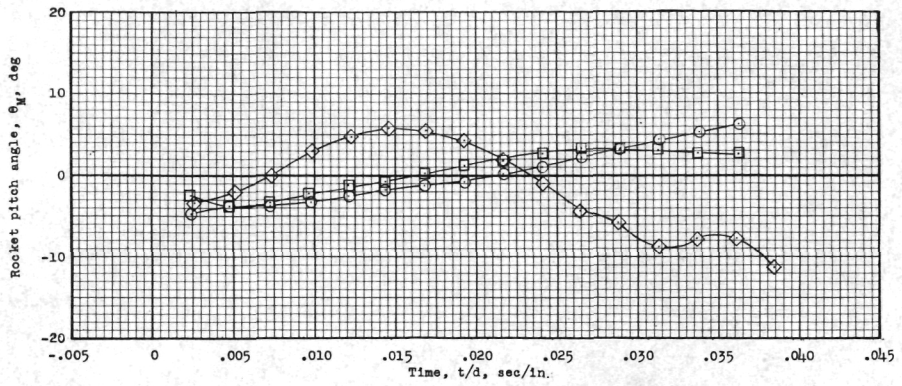


L-57-1293

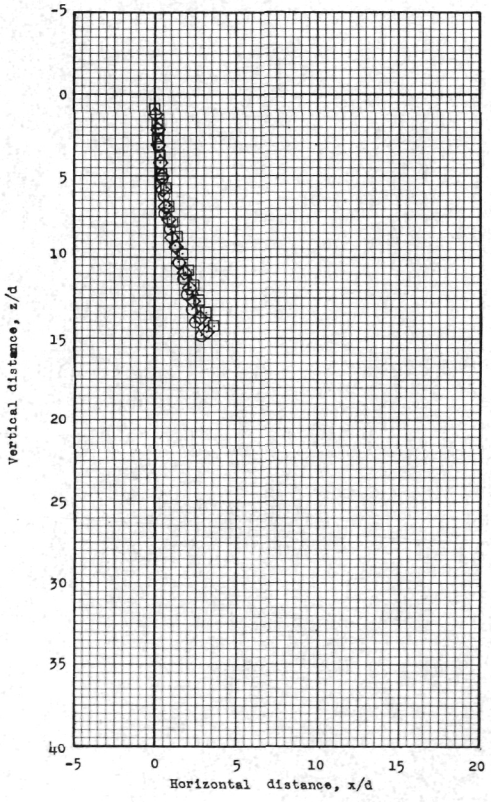
Test 21; 0 Falcon missiles; fins extended; M = 0.90.

(a) Concluded.

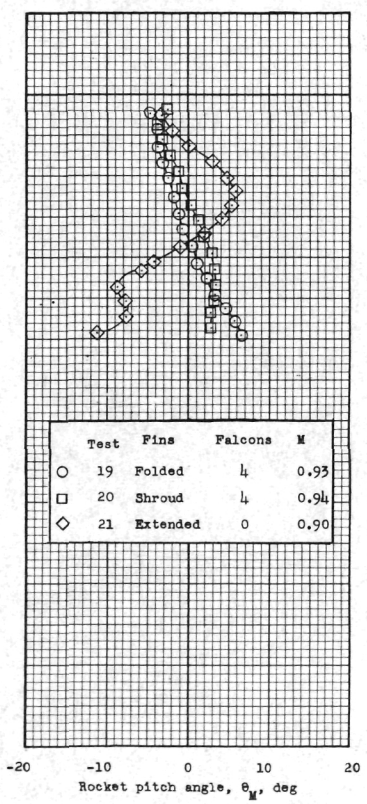
Figure 13.- Continued.



(b) Oscillations.

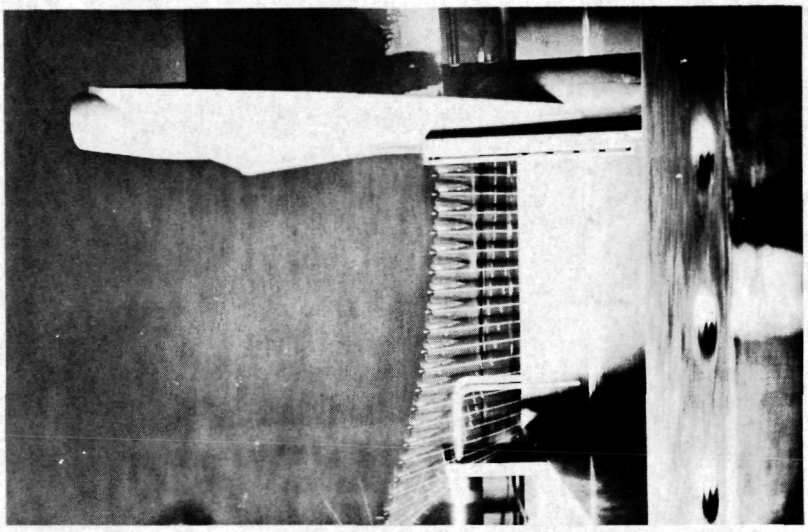


(c) Trajectories.



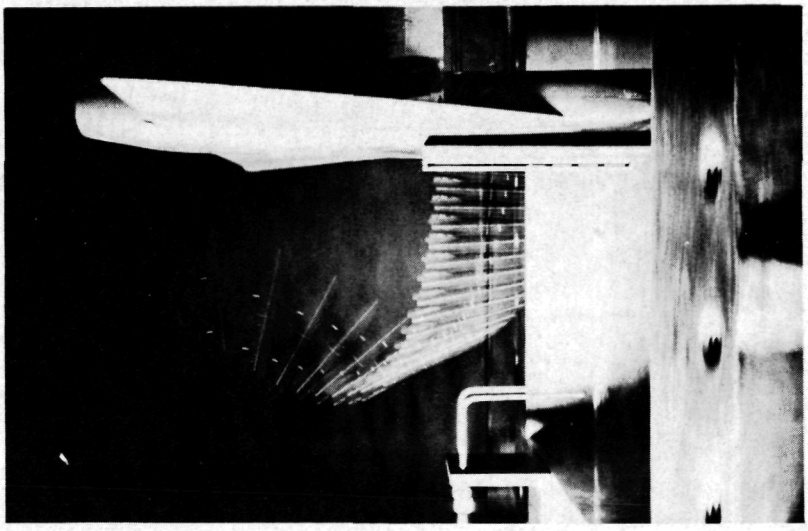
(d) Pitch trajectories.

Figure 13.- Concluded.



L-57-1294

Test 22; h_p = 27,000 feet; α_f = 2°; $\dot{\theta}_{o,M}$ = -7.0 radians per second.

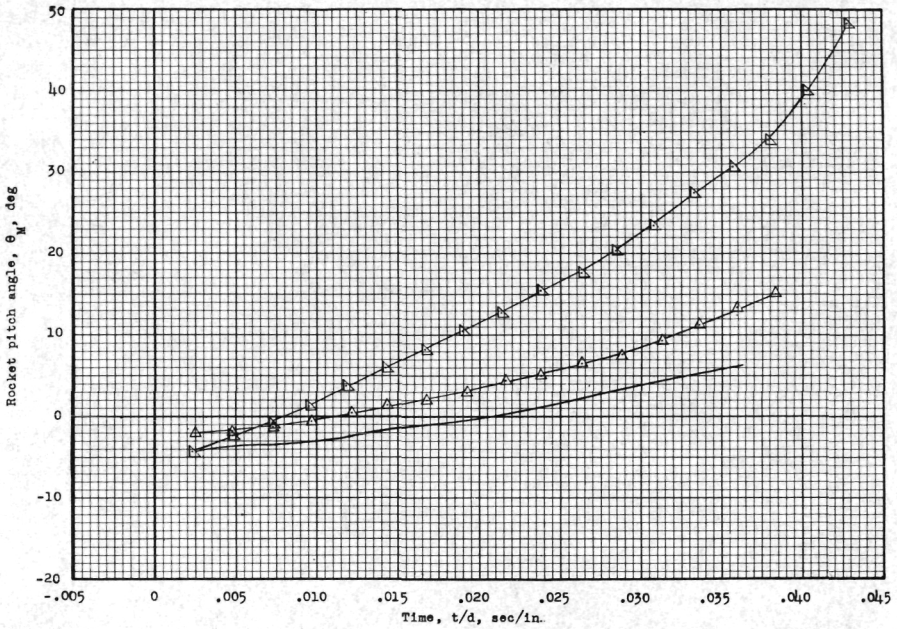


L-57-1296

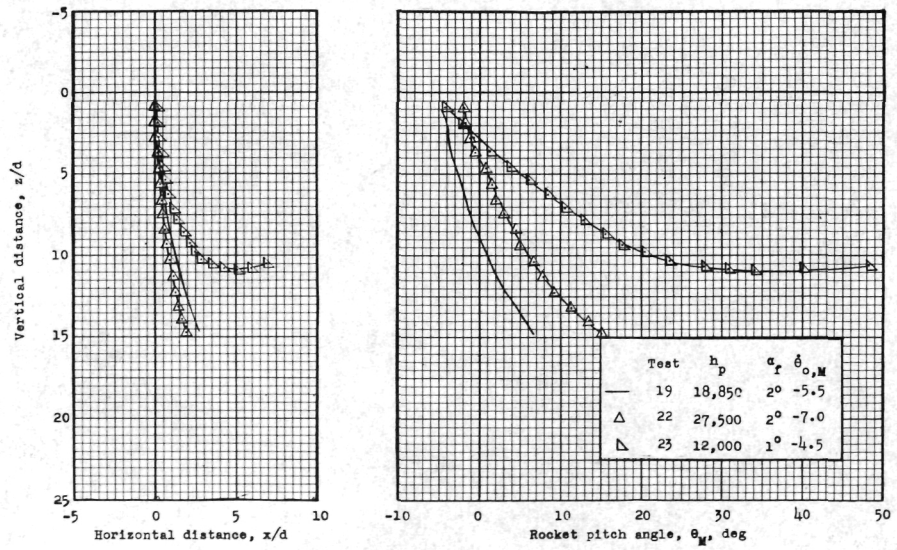
Test 23; h_p = 12,000 feet; α_f = 1°; $\dot{\theta}_{o,M}$ = -4.5 radians per second.

(a) Stroboscopic photographs.

Figure 14.- MB-1 rocket ejections with changes in altitudes and pitching moments at M = 0.92 with Falcon missiles and baffle in place.

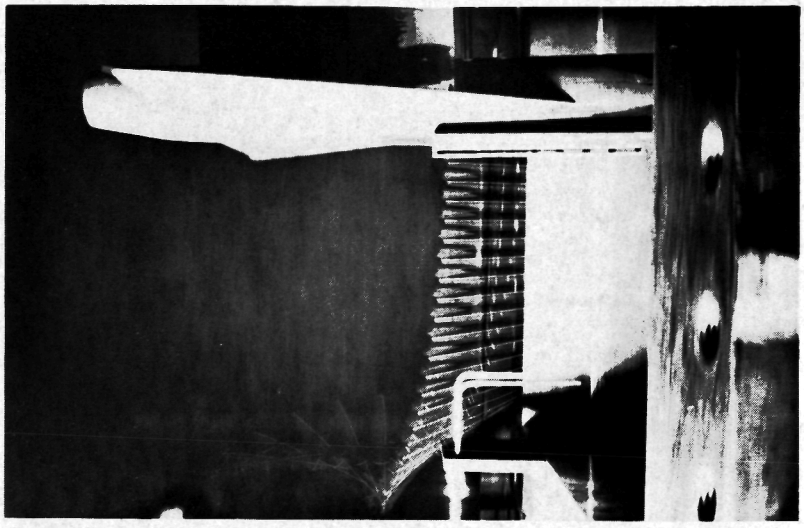


(b) Oscillations.

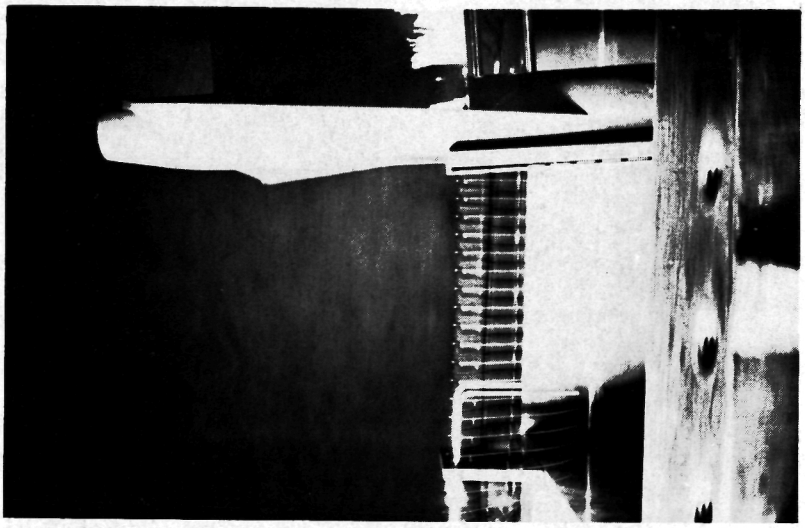


(c) Trajectories. (d) Pitch trajectories.

Figure 14.- Concluded.



Test 24; $\alpha_f = 3^\circ$; M = 0.68. L-57-1295

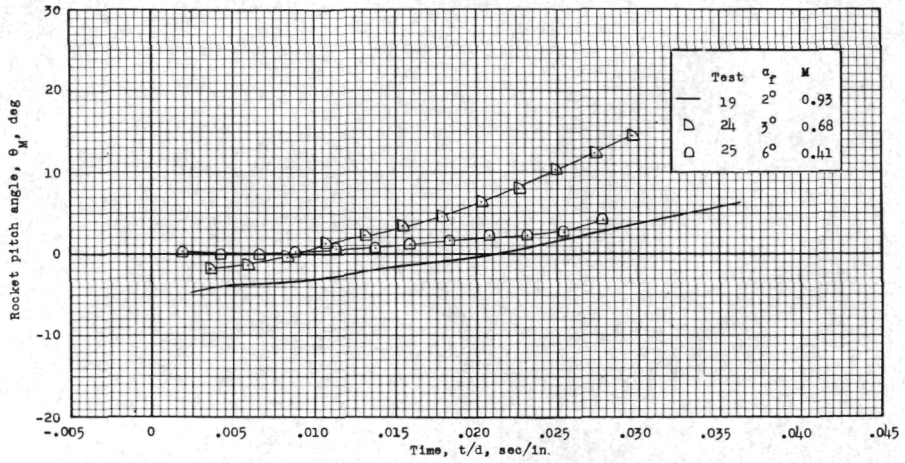


Test 25; $\alpha_f = 6^\circ$; M = 0.41. L-57-1297

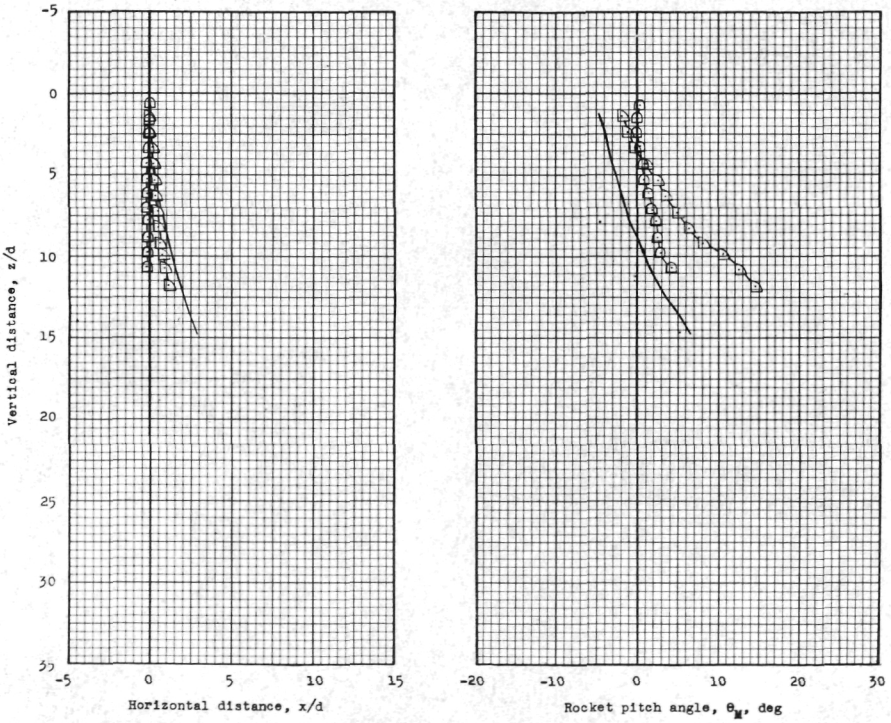
(a) Stroboscopic photographs.

Figure 15.- MB-1 rocket ejections with changes in subsonic Mach numbers and fuselage angle of attack at h_p = 18,850 feet, and $\dot{\theta}_{o,M}$ = -5.5 radians per second with Falcon missiles and baffle in place.

[redacted]



(b) Oscillations.



(c) Trajectories. (d) Pitch trajectories.

Figure 15.- Concluded.

INVESTIGATION OF EJECTION RELEASES OF AN MB-1 ROCKET FROM A 0.04956-SCALED MODEL OF THE CONVAIR F-106A AIRPLANE AT SEVERAL MACH NUMBERS AND SIMULATED ALTITUDES

COORD NO. AF-AM-57

By John B. Lee and Robert C. Basford

ABSTRACT

An investigation has been conducted in the 27- by 27-inch preflight jet of the Langley Pilotless Aircraft Research Station at Wallops Island, Va., of the ejection release characteristics of a rocket from the missile bay of a model of an airplane. This report covers the second phase in which a range of subsonic and supersonic Mach numbers and simulated altitudes was investigated. The purpose of the investigation was to determine the rocket-model modifications necessary to obtain successful ejections at an ejection velocity of 31 feet per second and a nose-down pitching moment at release of -8.0 radians per second or less with the fin tips retracted. Successful ejections were made by placing a shroud around the folded fins and closing off the front one-third of the missile bay.

INDEX HEADINGS

Flow, Supersonic	1.1.2.3
Stores - Airplane Components	1.7.1.1.5
Aerodynamic Loads, Bodies	4.1.1.3

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