LT COL FULTON

File 8 MGA

(Gp-4) TEST REPORT

XB-70A

FLIGHT 1-4

(No. 1 Air Vehicle, No. 4 Flight)

24 October 1964

PREPARED BY

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I. SUMMARY:

1. The fourth flight for 001, conducted from 0902 to 1027 hours on 24 Oct 64, originated at Edwards AFB and terminated, as planned, at Palmdale, California. Flight time 1 hour and 25 minutes.

2. The flight schedule was delayed on several occasions. Initially, it was scheduled for 17 October, but was cancelled and rescheduled late on 16 October when high vibration was discovered on the No. 2 engine during post installation runs. The rescheduled flight on 19 October was aborted during the initial takeoff roll because of engine compressor stalls. Subsequently, a hydraulic tube failed, the engines were shutdown on the taxiway and the airplane was towed to the runup area.

3. While defueling to permit search for the source of the primary No. 1 hydraulic system leak, an explosion and fire occurred in one of the defueling tankers. The airplane damage, which consisted of a few minor dings and dents, was negligible. A Formal Accident Board has been appointed to investigate and report circumstances involved in this ground accident.

4. Engine start began at 0712 and was completed in a little less than six minutes; however, the engines were shutdown when the utility hydraulic systems fluid was depleted as a result of a failure in a hydraulic ground power unit. Engine start began again at 0758. Taxi to the west end of the Edwards AFB runway began at 0836. A maximum power takeoff was accomplished at 0903. About one-half minute after takeoff, the landing gear and then the flaps were retracted.

5. A climb was made to 35,000 feet where the wing tips were folded down 25 degrees. Following a series of stability and control data at .95 and 1.1 Mach number, the airplane was climbed at Mach 1.1 to 40,000 feet, where flutter data were obtained at Mach 1.2, 1.3 and 1.4 as was stability and control data at Mach 1.1 and 1.4. Directional stability was significantly improved by folding the tips to 25° and the longitudinal trim requirements at Mach 1.4 were close to estimated. The yaw damper was satisfactorily engaged during the acceleration to Mach 1.2.

6. The airplane was then climbed at Mach 1.4 to 45,000 feet where a level flight deceleration for longitudinal trim data was made to Mach 1.1. During the descent to 40,000 feet, the yaw damper was disengaged because it was inducing inputs to the rudder pedals. Stability data were obtained at Mach 1.06 at 40,000 feet, after which the tips were retracted at Mach 0.95 and 35,000 feet.

7. The ram air scoop was satisfactorily extended at .95 and 35,000 feet, but the cabin could not be repressurized when the scoop was retracted. This condition, plus insufficient fuel to complete the tests programmed for this flight, dictated a descent and return to base.

8. Flap and gear extension were normal. The low approach and the landing was made on Palmdale Runway 25. Initial touchdown was firm and

occurred slightly short of the runway on the asphalt transition strip. The drag chutes were deployed, but again one did not develop properly.

9. Following several days of preparation, the airplane will undergo Phase II structural loads.

II TEST LOG

FLIGHT NO: 1-4 24 OCT 64

0530 PREFLIGHT START
0645 PILOTS IN COCKPIT TOTAL TEMP 25° VS 52°
0700 C/N 15235
0710 INTERNAL CHECK COMPLETE
0711 TANK #2 ON WINDSHIELD 1 ON
0712 #4 START LIGHT 15% 460° OK
0713:20 #3 " " 15% 530° OK COOLANT LOOP PUMP LIGHT OUT
0714:25 #1 " " 15% 460 OK
0715:35 #2 MANUAL START RESET 17% 550° OK
0716:50 #6 START 560° OK
0717:55 #5 START LIGHT 15% 470 OK
0719 HYD GPU LEAK
0720 CUT 4,5 & 6 U_2 FLUID LEVEL DROP
0720:30 CUT 1,2 & 3 U_1 STATUS INDICATORS YELLOW
0730 C/N 17030
0757 COMPLETE SWITCHING HYD GPU AND SERVICING UTIL SYS
BOTH SIGHT GAGES IN UTIL GPU WERE BLOWN.
0758:15 #4 START LIGHT 15% 480° OK
0759:40 #3 START LIGHT 15½% 530° OK
0800:35 #1 START " 16% 470° OK
0801:45 #2 MANUAL START RESET 17% 580° OK
0802:50 #6 START 575° OK
0803:35 #5 520° OK
0812 #4 GEN ON
0813 #3 GEN ON
EMER. GEN. CHECK
0815 COMPLETE HYD SERVICE - REMOVE GPU
0820 COOLANT CIRC ON FLAPS DOWN 14.8 SEC.
0822:25 SLOW ACCEL → 100% → IDLE EACH ENGINE
0823 P_1 185 U_1 165
P_2 180 U_2 160
0826:45 AUX COOL ON
0827:25 DOOR CLOSED - FANS ON
0830 C/N 20630 P_1 182 U_1 164
P_2 171 U_2 162
0831 TOWER WIND 210° 5K
0833 TANK #1 OFF #4 ON
0835:45 C/N 20980 START TAXI
0838 TANK 4 OFF
0840 TANK #6 AUTO
0841 BRAKES FROM MAN. TO AUTO
0843 LEFT TURN TO DIAGONAL TAXIWAY C/N 21420
15 MPH TAXI SPEED. UP & DOWN BOUNCE WORSE
ON DIAGONAL TAXIWAY

TEST LOG FLT 1-4 CONT'D

0847:30 LINED UP - STOP ON RUNWAY - SKID ON RIGHT REAR WHEELS USED REAR BRAKES ONLY - MODERATE BRAKING.
0848 EMER GEN ON -
0852 FLAPS UP FLIGHT CONTROL CHECKS
0853 FLAPS DOWN
0853:07 C/N 0000 RESET
0858 GROUND INSPECTION P_1 179 U_1 179
P_2 168 U_2 190
0900 C/N 413
0901 CREW AIR T ½ DOWN
0901:45 C/N 515
0902 ADVANCE THROTTLES REFER ON
0902:30 BRAKES RELEASED
ROTATE 175 KTS 37 SEC
LIFT OFF 200 KTS 44 SEC.
0903½ C/N 259 GEAR UP
C/N 676 DATA OFF TO 15 SEC
C/N 701 FLAPS UP
0905 C/N 738 6 OFF 4 ON HYD ALL AT 205%
0906 382 KT 13,000' ENG COOLING DOORS CLOSING
L/B INDICATES 3/4° LEFT L/Q -2°

0909	#1	#2	#3	#4	#5	#6
	100%	100.2%	100.6	100.2%	109.5	100.3%
	900°	870°	880°	900	870	890
	8.1	8.1	8.2	8.2	8.0	8.1

0909:40 THROTTLES TO 72° LEFT TURN
0912 " TO 60°
0912½ #2 MIN A/B INSTABILITY
#2 ADS 50-55% VIBRATION - LIGHT
0913½ C/N 1224 TIPS TO 25° OFF 1260
34,600' CABIN 7000' 330 KT
C/N 1305 #2 UNSTABLE
0915 C/N 1328 332 KT 34,000' .95 M PULL & RELEASE (DEADBEAT), EVENT RT RUDDER (ZERO = 2/3°) EVENT - RELEASE FOR DYN - (CONTROLS FREE) OFF 1412
0916 AUX COOL OFF EE 38°
0917 C/N 1427 WINDUP LEFT TO 1.4g 34,500' 332 KT .945 M
DATA OFF C/N 1468
0918 C/N 1495 A/B LIGHTS 70° T/A
C/N 1536 TO MAX A/B
0920 AIRSPEED JUMP 376 KT 35,000'
NO 4 900-912° EGT A_8 OPEN
0921 C/N 1693 EVENT, PULL UP (FREE) 367 KT 34,300' DECEL THRU JUMP OFF C/N 1715, NO 4 TANK OFF NO 8 ON FOR 1 MIN.
0922 MAX A/B C/N 1758 RT RUDDER @ 2½°. NOT FULL δ_R EVENT BACK OFF - WALLOW & ROLL LEFT DATA OFF

TEST LOG FLT 1-4 CONT'D

0924 DATA ON 1857 WINDUP TURN
0925 TANK #6 ON TEMP WARM
0926 ACCEL TO M1.1 C/N 1979 DATA ON PULL UP & RELEASE 391KT 34850' EVENT FULL RUDDER 2.6°, EVENT RELEASE 2 CYCLES & ROLL LEFT DATA OFF
0927½ C/N 2076 1.11M LEFT WINDUP TURN 396KT 35,000' DATA OFF 2112 CLIMB @ 1.1M MAX A/B.
0929 CLIMBING THRU 36,000'
0932 C/N 2350 1.1M, 350KT. 39,800' PULL UP
0933 C/N 2395 1.1M 350KT 39,300' SIDE SLIP, FULL RUD. 1.8° RELEASE DATA OFF C/N 2432 CABIN @ 7000'
0935 P_1 FULL U_1 FULL
P_2 195% U_2 205%
0936 C/N 2568 1.1M 355KT 39500 WINDUP TO LEFT 1.4g DAT OFF C/N 2610 TURNING SOUTH
0937 TANK #2 AUTO FLYS NICE @ 1.1M TIPS @ 25° No 2 ADS 40-50% VIB.
0938½ C/N 2735 YAW AUG ON. LOST ALT IN TURN - CLIMB & ACCEL. TO 40,000' & 1.2M.
0939½ C/N 2800 40,000' 1.18M
C/N 2823 TURBULANCE, PULSES 1.2M OFF C/N 2848. SHOWS 1° LEFT β BALL CENTERED.
0941½ C/N 2923 1.3M, 40,500', 420 KT. FLUTTER PULSES
0943 C/N 3010 1.4M 41,100' 445KT FLUTTER PULSES DATA OFF 3027. SIDESLIP STILL SHOWS LEFT. CLIMB TO 45000' @ 1.4M.
0944½ C/N 3100 1.41M 401 KT, 46,100' MIN A/B INSTABILITY #2. ONLY 3 & 4 IN A/B P_1 163% P_2 165% TANK 6 OFF.
0946½ M 1.3 & DECEL IN MIL PWR.
0947 DATA OFF C/N 3246 DESCENDING START SLOW RT. TURN.
0948 BUZZ IN RUDDER PEDALS YAW AUG OFF.
0949 C/N 3349 LIGHT 3 & 4, 2 & 5, 1 & 6 MOMENTARILY WENT SUBSONIC. 50% DATA REMAINING. α -2 TO -3°.
0951 C/N 3488 1.06M, 40,400' 333KT, EVENT PULL UP; β 2.8° FULL RUDDER, BACK OFF TO 1.7° β RELEASE; SIDE SLIP 1.4g EVENT DATA OFF.
0952½ THROTTLES TO MIL DECEL & DESCEND NO 2 UNSTABLE AT MIN A/B. #2 ADS VIB 55-60% #2 TO 20° T/A FOR VIBS α -1½°, .96M, β 3/4° LEFT
0955 C/N 3737 TIPS UP 20.3 SEC. INDICATES UP OK. 336 KT, 35,200'. DATA OFF 3780. ALL TO MIL.

TEST LOG FLT 1-4 CONT'D

0958 COMMUNICATION PROBS. BLDG 3940.

CABIN PURGE AT C/N 3897 CABIN ALT. STABILIZED AT 31,000' @ 23.8 SEC. EE TEMP 36° @ 2½ MIN.

DATA ON C/N 4133 TO REPRESS, CABIN ALT INCREASED TO APPROX 35,000'. CHASE SAYS SCOOP CLOSED BUT DOOR STILL OPEN.

1010 28,000' ALT 350 KT CABIN 26,000'.
1013 15,000' FLAPS DOWN
1013½ 225 KT GEAR DOWN OK
C/N 5129 GO AROUND 205 KT RT TURN, LOW BUFFET.
C/N 5282 DATA OFF

1025 C/N 5517 ON FINAL 200°/9 KT
@ 3½, 198 KT.

1026 LAND SHUTDOWN NO. 3 FOR U PUMP STATUS LIGHT. AFTER DEPLOYING DRAG CHUTES. GEAR CAMERA ON.
1027 STOP. DRAG CHUTE JETISON APPEARED TO BE AT A LOW SPEED.
1034 SHUT DOWN NO. 6
1038 " NO. 1.
1040 " NO. 2 & 5
1041 " NO. 4 FANS OFF.

III. INSTRUMENTATION:

1. All systems performed very well. There were no major failures. Approximately 35 minutes from the total 46 minutes of data time available were used. Time correlation between A/V time and time of day may be obtained by adding 8 hours 53 minutes and 12 seconds to A/V elapsed time. This is valid from brake release thru engine shutdown.

2. The cockpit sideslip indicator was reading approximately 1° left sideslip with the ball centered. This resulted from correcting the original $1/2^{\circ}$ right sideslip error coupled with reversing the direction of sideslip on the indicator scale. The net result was a compounded error of opposite sign.

3. Indicated angle of attack read -2° during initial climbout and $+3\frac{1}{2}^{\circ}$ on final. Digital data recorded during flight and processed by NAA-LA did not corroborate these cockpit readings. The LA data confirms the fact that the cockpit indicator was reading approximately 8° low. Apparently the indicator was improperly referenced prior to flight.

4. The NASA VGH recorder worked fine and recorded data throughout all but the last seven minutes of flight, at which time it ran out of paper. All four SST cameras operated properly, although NASA indicated that the cameras were started too late to obtain adequate sink rate data.

IV. DATA:

FUEL QUANTITY DATA
XB-70A 62-001

TEST FLIGHT 4 DATE 24 OCT 64

TIME	0746	0815	0853	1040		
C/N		19730	22010	6440		
Per	NONE	1 ON	6 AUTO	OFF		
Cond	PRIOR	PRIOR	LINED	STOPPED		
	START	TAKE	UP			
1	12350	6050	800	550		
2	29325	29300	29500	125		
3	29300	29150	33100	25650		
4	37675	37050	29800	650		
6L	38900	38975	37200	2300		
6R	38750	38800	36400	1200		
7L	100	275	400	450		
7R	-450	-450	-400	-400		
8L	950	1600	3000	700		
8R	0	050	300	-400		
Tot	188000	181750	172000	32500		
N_2	25/32	3/4	23/32	1/4		
OAT	25/52½	N5	15	0	← INOP 24.	
NH_3	530	530	495	410		
H_2O	4550	4550	4550	3800		
LOX	17½	17½	16.8	15.5		
EE	49	51	61	60		
		0833				
		#1 OFF	21.6%			
		100 lb.				
		0833:30				
		TANK 4				
		ON				

V. ENGINEERING COMMENTS:

1. Flight Control System:

a. Prior to this flight, the elevon rig position was revised from zero to three degrees trailing edge down (TED) by lengthening rod assembly 259-520025-3. This change resulted from aerodynamic estimates and simulator tests which project the results of Flight 1-3 in to the revised trim requirements with the tips in the intermediate down position for the maximum Mach number programmed for this flight. On one simulator test witnessed by C. O. Johnson, there was only about 3 to 4 degrees of down elevator control available after the simulator was trimmed (mid cg).

b. The revised rig position results in nominally 22° TEU and 18° TED elevator control for full aft and forward column respectively. It also changes the trim-for-takeoff position to 2° TED and the relation between canard and elevator positions. The canard deflection vs. elevon deflection plot (Page 10) shows the canard-elevator position relationship for the flaps up configuration.

c. Stick force recordings of the new configuration did not indicate any adverse effects on control forces.

2. Propulsion:

a. No serious engine malfunctions occurred during the flight, however, the following discrepancies were noted:

(1) Exhaust gas temperature (EGT) on engine No. 4 oscillated 10° to 15° at the rate of 2 to 3 cycles per second at approximately 900°C.

(2) Engine No. 2 was unstable in minimum afterburner whenever the minimum afterburner power setting was made.

(3) Engine No. 4 nozzle oscillated occasionally.

b. The post flight inspection revealed FOD on engine No. 2. The FOD occurred on the leading edge of the first stage compressor blade. The blade seems bent and part of the tip is missing. The missing part of the tip left a depression, triangular in shape, approximately 1/8 inch long and 1/16 inch deep.

c. A post flight engine run was made with the finer mesh FOD screen installed on engine No. 1. Preliminary results indicate that the pressure drop across the screen is approximately 5% greater than obtained by using the coarser mesh screen. Although the screen was not loaded to its maximum stress level, a small part of the screen was missing after the run. It is assumed that this missing part caused a small dent, approximately 1/64 inch deep, on the leading edge of a first stage compressor blade one inch from the blade tip. The dent can be polished out.

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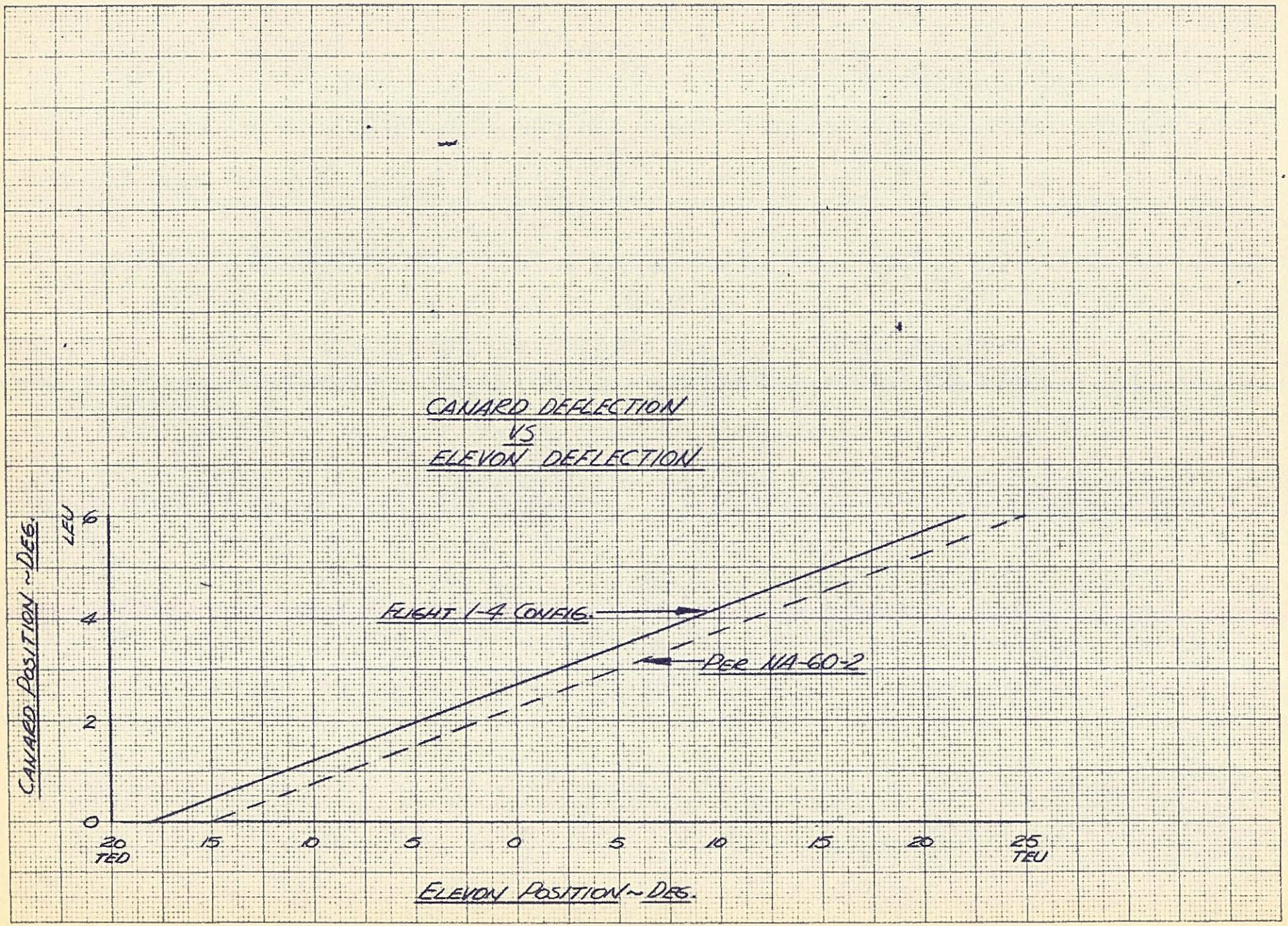

d. All engines will be removed prior to structural tests and dummy engines will be installed in the airframe. Engine No. 2 will be sent to the General Electric Edwards facility for FOD repair and to check the minimum afterburner instability problem. Since the data on flight No. 4 abort shows that engine No. 2 was the first engine to stall, test cell runs will also be made. The acceleration schedule, the afterburner minimum fuel schedule, and the effect of fuel pressure oscillations on the stator schedule (B_1 and B_2) will be checked.

3. Hydraulic Stand Failure During Engine Start:

A hydraulic ground power unit (GPU) being used to pressurize the utility hydraulic systems was electrically powered by the same electrical GPU that supplied power to the aircraft. Consequently, when power was removed from the aircraft it was also removed from the hydraulic GPU which caused it to dump pressure to return. A pressure surge resulted in the return, breaking the glass sight gages in both systems of the GPU. This condition will be avoided in the future by using a separate electrical power source for the hydraulic GPU's.

4. Landing:

The pilot reported the landing at Palmdale was harder than previous landings and that the main gear touched down on the blacktop just short of the runway. Touchdown was approximately 65 feet short of the runway and there were no depressions in the blacktop. There was, however, a 30-inch buckle at fuselage station 1736 adjacent to the right wheel well and a crack in the inboard well of the right wheel well. Data indicates that actual touchdown sink rate was about 2 ft/sec and therefore should not have caused structural failure. The failure apparently was a result of a defective panel. This failure and repair are identified in DMD 86805. A portion of the panel is being replaced by a plug repair.

5. No. 3 ADS Hydraulic Pumps:

On landing, both the Primary and Utility pump status lights turned yellow and the engine was immediately shutdown without incident. Data showed that the engine had actually shutdown seconds before the throttle was moved to the OFF position. The No. 3 throttle had probably been accidentally lifted and moved slightly aft (determined from cockpit camera film) far enough to close the fire wall shutoff valve. The engine was decelerating and the caution lights came on normally. The throttle spring load and the fire wall shutoff switch setting are being investigated.

6. Drag Chutes:

The drag chutes performed similar to previous flights in that the lower chute did not blossom. Drag chute jettison appeared to be at a much lower speed than previous tests, however, there was no damage to the aircraft.

7. Ram Purge Operation:

The ram air scoop door failed to retract upon termination of the cabin air purge test because of a failure in the linkage of the ram air scoop door mechanism. In addition, the cabin failed to repressurize after the ram air scoop closed. An overpressure of 1 psi from the ram scoop door can cause the Engine Extraction Air Duct System (EEADS) pressure sensing switch to close the main EEADS shutoff valve, thus making repressurization impossible. However, the exact nature of the difficulty is still obscured because, even though data indicates the pressure sensing switches transmitted a command to close the main EEADS shutoff valve, this valve remained open. Therefore, as the cabin would not repressurize and from 31,000 feet to the actual aircraft altitude of 35,000 feet, an additional failure is indicated and this is still being investigated. As surges from the ram air scoop affected the EEADS shutoff sensing switches, and because these switches cannot be reset while the air vehicle is airborne, further confidence that the ram air scoop door operations will not affect these EEADS pressure sensors should be demonstrated.

8. Ice Formation - Forward Fuselage:

During the flight, ice formed at the Water Drain (#4) and the Water Boiler Drain (#7) ports. This ice can cause an engine hazard as pieces fall toward the inlets. In addition, the ice indicates a possibility of drains freezing over. The shutoff valve for this water flow is controlled by a signal through the landing gear lockout relay which opens the valve when the air vehicle is airborne. The water flow serves no useful purpose when the air vehicle is at low velocities, but is necessary to cool the ram air when above 150 degrees. North American Engineering is modifying the design to provide for water shutoff valve activation by another means.

VI. OBSERVATIONS AND COMMENTS BY THE COPILOT:

1. Pre-Flight and Engine Start:

The external preflight inspection was started at 0530. The leak ahead of the weapons bay was much greater than I had ever seen before. At 0645, Mr. Al White and I entered the cockpit and started the internal cockpit inspection. We made comment that the total fuel temperature was in error as it was 25° and the Mobilcom was observing 52°. The counter number (C/N) was 15235 at time 0700. At 0710 the internal checks were complete and we were ready for engine start. At 0711 I turned tank No. 1 fuel pump switch on. Engine start was initiated at 0712 and at 0718:40 all six engines were idling. The starting order and initial peak EGTs were as follows: 4 - 460°, 3 - 530°, 1 - 460°, 2 (manual) - 550°, 6 - 560° and 5 - 470°. At 0720 Al shut down engines 4, 5 and 6 due to a rapid drop in the utility 2 fluid level. At 0720:30 he also cut engines 1, 2 and 3 when we observed the utility 1 system status lights going yellow. This fluid level drop was a result of a leak in the ground hydraulic servicing unit. At 0730 the C/N was 17030. Hydraulic system servicing was completed at 0757. Engine start was initiated at 0758:15 and all six were idling at 0804:10. Start sequence and respective EGTs were: 4 - 480°, 3 - 530°, 1 - 470°, 2 - 580°, 6 - 575° and 5 - 520°. At 0815 Al was completing the flight control check and the hydraulic carts were disconnected. At 0820 I turned COOLANT CIRC on and Al put the flaps down - I timed them at 14.8 seconds. Starting at 0822 it took 3 minutes to run the engines individually to 100% and have telemetering (T/M) check pump stability. I turned AUX COOL on at 0826:45. The external door was closed and the fans turned on at 0827:25. The C/N at 0830 was 20630. At 0833 tank 1 was turned off indicating 100 lbs. and No. 4 was turned on. Tower reported a wind of 5 knots from 210 degrees. Ground intercom was disconnected at 0834, C/N 20870.

2. Taxi:

At 0835:45, C/N 20980, we started to taxi - fuel totalizer was 173500 lbs. The brakes didn't chatter in turns but ground observers reported the right rear wheels smoked and skidded when brakes were applied. This was in the manual mode so at 0841, AUTO braking was selected. At 0843, C/N 21420, we turned on to the diagonal taxiway enroute to runway 4. Taxi speed was reported by a pacing vehicle at 15 mph. The up and down cockpit motions were smooth and mild on the ramp but increased significantly on the diagonal taxiway. At 0847:30 Al brought us to a stop on the runway using only the rear brakes. The chatter was moderate and the right brake again left a skid mark. We received clearance to operate in SOA Alpha from Flight Level 240 to 400 and outside SOA Alpha at block altitudes 370 to 430. Al completed the flight controls checks and reset the instrumentation counter to ZERO at time 0853:07. The CG was 21.6% with a totalizer of 172,000 lbs. At 0858 the ground inspection and internal check list was complete. At 0900 the C/N was 413. At 0901 I placed the crew air shutoff "T" handle down against a temporary stop at the 1/2 position. Tower reported wind at 210 degrees and 6 knots. Estimated takeoff data was rotation speed 175 KIAS, liftoff 195, takeoff distance at 6000 ft. in 37 seconds.

3. Takeoff and Climb:

Data was turned on continuous at 0901:45, C/N 515. I turned the REFER on at 0902 as A1 stabilized power at military. I watched carefully for overspeeding and abnormal nozzle action or temperatures but saw none. At 20 seconds to brake release A1 put 3 and 4 into MIN afterburner. At 10 seconds to go he advanced 2 and 5 to MIN A/B and just prior to brake release advanced 1 and 6 into MIN A/B. Brake release was at 0902:30. A1 advanced all six throttles to MAX A/B during initial roll. All engine instruments looked OK throughout the takeoff roll. I timed rotation at 175 knots at 37 seconds and off the ground near 200 knots in 44 seconds. Engine instruments and hydraulic quantities were OK and the gear was retracted at 259 KIAS. There was light turbulence in the initial climb and the cockpit movements were of small magnitude. Chase reported the gear up and doors closed in my time of 44 seconds and data was turned off at C/N 676. Data was on for part of the flap retraction and was turned off at C/N 701. I turned tank 6 off and 4 on at C/N 738. Totalizer was 143,000 lbs. We were all amazed that we had used 29,000 lbs. in approximately eleven (11) minutes. At 0905 tank 3 was 29,600 and 4 was 23,000 lbs. ADS vibration on 2 and 4 were 40% - these were the highest. Time was 0906, 13,000 ft., 382 KIAS, chase reported all ground cooling doors closed, sideslip needle was to the left 3/4 of a degree and my angle of attack was a minus 2 degrees as we approached Harpers Dry Lake. We were just south of Three Sisters at .95 Mach climbing through 31,000 feet. Tank 6 left and right were 26,800 and 26,000 lbs. respectively. At 0909 the following engine instruments were recorded:

Engine	1	2	3	4	5	6
RPM	100	100.2	100.6	100.2	100.5	100.3
EFT	900	870	880	900	870	890
Nozzle	8.1	8.1	8.2	8.2	8.0	8.1

At .95 Mach a left turn was initiated to head southwest toward Cuddeback Dry Lake when the chase planes reported some vibrations in the outboard two elevon segments.

4. Level Off:

At 0909:50 A1 reduced the throttles to 72° throttle angle (T/A). I observed all rpms near 100%, EGTs OK and nozzles 60% ± 1. Near 0910 totalizer was 132,000 lbs. At 0912 A1 reduced throttles to 60°T/A and observed MIN A/B instability on #2 engine. At 0912:30 throttles 1, 2, 5 and 6 were pulled out of A/B. The high vibe light was on intermittently which was caused by #2 ADS at 50 to 55%. At 0913:30, C/N 1224, A1 selected the tips to the 25° position and chase reported fold occurring evenly and without delay. Both indicators showed down and data was turned off at C/N 1260. There was no buffet, rolloff or significant trim or airspeed changes. The altitude was 34,600 ft., 330 KIAS and cabin altitude 7000 feet when over Cuddeback. A1 advanced 2 and 5 into A/B and observed instability in MIN A/B on #2 engine at C/N 1305 - 2 and 5 were reduced to military. At C/N 1328, 34,600 feet, 332 KIAS, .95 Mach a pull up and release was completed and data off at C/N 1412. Time 0916, I turned AUX COOL off, EE temp was 38°. Next event was a right rudder sideslip starting with 2/3 of a degree on the indicator and going out to 2-1/2°. There was very little aileron held, light turbulence was observed and after backing off some on the rudder it was released with controls free, data off C/N 1412. At C/N 1427, windup turn to the left at .945 Mach

332 KIAS, 34,500 feet, to 1.4G and data off C/N 1468. Continued the left turn toward Three Sisters and advanced all throttles to 70° T/A at 0918, C/N 1495. Fuel totalizer - 123,000 lbs. At C/N 1536 all engines were advanced to MAX A/B.

5. Supersonic:

At 0920 we were still in a turn at 35,000 feet, 376 KIAS, and indicating 1.0 Mach. I observed engine 4 at 100% with the EGT oscillating from 900° to 912° and the nozzle open a bit more than the other engines, at 8.3%. Chase reported water vapor coming from the right side above the "S" - a normal condition. Fuel totalizer was 120,000 lbs. Chase reported ice forming behind hole 7 on the right side and a thin veneer of ice falling back over the leading edge of the wing a distance of 15 to 16 feet. Data on at 0921, C/N 1693, 367 KIAS, 34,300 feet, a pull-up and controls free during which we went subsonic. Data off 0922:22, C/N 1715. Al advanced power to MAX A/B, I saw no roll back on RPM and EGTs and nozzles checked OK. We were then over Three Sisters. Data on, 0923:05, C/N 1758, controls were freed, then full right rudder to almost 3° on the indicator before backing off to 2° and release. There was a positive return from the yawed condition, some wallowing and a roll left. Continued into a windup turn to the left to 1.4G and rolled out - data off at 0924:44, C/N 1857. In MAX A/B No. 4 engine held 100% and EGT oscillated between 900 and 912°. Fuel totalizer 110,000 lbs. Card 4 completed and accelerated to 1.1 Mach. Time 0925, cockpit temperature was a bit too warm and I positioned the control knob to the 12 o'clock position. Death Valley dead ahead. Data on at 0926, C/N 1979, pull up at Mach 1.1, 391 KIAS at 34,850 feet. Sideslip using full rudder and backed off to 2.6° indicated, and data off at 0926:46, C/N 2025. I observed two cycles to damp and a rolloff to the left. Data on at 0927:30, C/N 2076, controls were freed followed by a windup turn to the left at Mach 1.1, 396 KIAS at 35,000 feet and data off at 0928, C/N 2112. At MAX A/B the engines and hydraulics looked very good and Al started a climb at 1.1 Mach. He asked how the wings looked and the right chase reported right wing looked good and solid. No. 3 tank was holding steady at 32,700 lbs. and the totalizer reading was 95,000 lbs. While climbing through 36,800 feet, No. 4 engine EGT was constantly oscillating between 900 and 912°, nozzle 8.4 and its ADS was 35 and 40%. At this time No. 2 ADS vibration was 40% and all engines vibrations were below 20%. Data on at 0932, C/N 2350, pull up at Mach 1.1, 350 KIAS and 39,800 feet. Time 0933, C/N 2395, Mach 1.1, completed a windup turn and a sideslip using full rudder to 1.8° and release at 0933:37, C/N 2432. Data Control was not receiving 001 or the chase aircraft during this period and there was an extensive amount of radio conversation in an attempt to establish contact. At this time all aircraft were receiving Data Control. The cabin altitude was 7,000 feet. Data on 0936, C/N 2568, windup turn to the left at Mach 1.1, 355 KIAS, 39,500 feet to 1.4G and data off at C/N 2610. Still in MAX A/B and turning to a heading of 155°. Fuel totalizer was 86,000 lbs. Al remarked that the airplane handled very nicely at this speed, which was Mach 1.1 with the tips at 25°. At 0938:30, C/N 2735 yaw augmentation was turned on. Totalizer reading was 83,000 lbs. I observed and reported all systems looking good. Al lost some altitude in the turn and climbed back to 40,000 feet while accelerating to 1.2 Mach. Data Control reported it appeared there would not be sufficient fuel to accomplish the 45,000 ft. data points. At 0939:30, C/N 2800, Mach 1.18, 40,000 feet I observed the elevator control column at 5° down. Time 0939:58, C/N 2823, Mach 1.2 we experienced some turbulence while Al

accomplished control pulses and ~~data was~~ turned off at C/N 2848. Data Control advised us to get the 45,000 ft. data and we would skip some points later. Fuel totalizer was 78,000 lbs. as chase reported 1.23 Mach in acceleration and Al remarked he didn't know if we would make it to 1.4 or not. I observed the sideslip indicator holding at 1° when Al reported his ball was centered. Data on 0941:30, C/N 2923, Mach 1.3, 420 KIAS, at 40,500 feet. Control pulses were completed and data off at C/N 2942. We were still in MAX A/B and Al reported he could not trim out the 3/4 to 1° of sideslip. Al reported 1.4 Mach, and chase 1 reported 1.34. Data on 0943, C/N 3010, roll pulses were completed at Mach 1.4, 445 KIAS at 41,000 feet, and data turned off at C/N 3027. At this time I observed a total temp of 23° which was certainly incorrect. Continued MAX A/B climb to 45,000 feet and leveled off at 1.4 Mach. Al commented that the bird really wanted to accelerate at this altitude and speed. Data on 0944:30, C/N 3100, 45,000 feet, Mach 1.42 at 406 KIAS when Al reported MIN A/B instability on No. 2 engine which he could feel in the airplane, causing him to reduce to military power on both engines 2 and 5. He later retarded power on 1 and 6 to military as we were holding 1.41 Mach and 46,100 feet. Tank 6 was turned off and tank 2 placed in automatic with a totalizer reading of 68,000 lbs. I observed the primary hydraulic fluid levels approximately 164% as we slowed to 1.3 Mach in MIL power. No. 1 tank was observed at 3,800 lbs. At 1.2 Mach, data was turned off at 0946:56, C/N 3246. We were descending and both of us wished we could see where we were going. At 0947, primary 2 fluid level was 162% and holding. Fuel totalizer 67,500 lbs. Al commented the forward visibility was bad so he started a slow turn to the right during the descent. He reported some bounce in the rudder pedals, evidently from the yaw dampers which occurred occasionally when we hit light turbulence and at 0948, Mach 1.1, he turned the yaw damper off. The fuel totalizer at this time was 66,000 lbs. We went subsonic momentarily, turned data on at 0948:56, C/N 3349 and went into A/B with 3 and 4 engines, got the jump going supersonic again and advanced to A/B on 2 and 5 then 1 and 6 and then advanced to MAX A/B on all engines. The sump was holding at 39,900 lbs. and data was turned off with 50% of the instrumentation tape remaining on the counter. I observed an angle of attack of minus 3°. Data Control advised us to decelerate to .95 Mach at 35,000 ft. and get the wing tips up. Data was on at 0951, C/N 3474, controls were freed for a trim shot followed by a pullup and sideslip at Mach 1.07 using full rudder to an indicated 2.8° and backing off to 1.3° and release of all controls. Continued on into a windup turn to 1.4G and turned data off at C/N 3558.

6. Subsonic and Descent:

Fuel totalizer was 60,000 lbs. We went subsonic and at 0952:30 all engines were pulled out of A/B. No. 2 was again unstable in MIN A/B. No. 2 ADS vibration was 55 to 60% and Al retarded it to 20° throttle angle. Angle of attack was minus 1-1/2° at Mach .96 with the sideslip indicator still at 3/4 deg. left. Data Control reported telemetering showed the No. 2 engine hydraulic pumps were stable. All engines were in military, primary 2 hydraulic level was 175 and Al commented it was bumpy at this point. Time 0955:30, C/N 3737, wing tips were selected to up at 336 KIAS, Mach .95 at 35,200 feet and in 20.3 seconds I observed both indicators showed up. Chase reported elevon segments are working again. Data off C/N 3780. Fuel totalizer 57,000 lbs. At this point we initiated the ram purge checklist and recorded the following: EE Temp - 45°, Ammonia - 460 lbs., Cabin Alt. - 7,000, Water - 4200 lbs. Data on 0957:42, C/N 3875, cabin air switch was placed to PURGE on countdown

and chase reported the ram scoop door coming open. We were coming up on Owens Dry Lake. Cabin altitude was observed at 30,000 ft. in 23.8 seconds at C/N 3897. The flood flow and cabin over 10,000 ft. caution lights were both on. The EE temp was 40° and a second observation of the cabin altitude revealed 30,500 ft. Data was turned off at 0959:25, C/N 3978. Per instructions, we started a stabilized four minute data run. A1 had to light off 3 and 4 to MIN A/B to maintain altitude. Fuel totalizer - 54,000 lbs. Cabin altitude remained at 30,500 feet. Within approximately a minute, the EE temp was observed at 36° and the cabin altitude increased to 31,000 ft. In right turn to head home, fuel totalizer was 53,000 lbs., cabin altitude 31,000 ft., EE temp further reduced to 34° and ammonia quantity was observed at 460 lbs. as we approached the 3 minute stabilized point. Data Control advised 3 minutes stabilized was sufficient, data was turned on continuous at time 1002, C/N 4133. A1 held the cabin air switch to REPRESSURE and the cabin altitude went up to 35,000 ft. It should have gone down to 26,500 ft. where he would have released the switch. Chase reported the scoop was in, but the door was still open. We observed the cabin altitude at 35,000 ft., the EE overtemp light ON, and the EE temp at 32°. A1 called for the emergency procedures and was instructed to hold the repressure switch down until the cabin altitude reduced to 26,500 ft. A1 confirmed he was again holding the repressure switch down but it still made no difference and the cabin altitude remained at 35,000 ft. Chase reconfirmed for Data Control that the scoop went in, but the door was still open. A1 reported that he had been holding the switch to REPRESSURE for two minutes and the cabin was still at 35,000 ft. We elected not to go through the EE bay circuit breaker pulling exercise. Data Control instructed us to proceed for landing in the ram purge mode. A1 positioned the switch to PURGE and chase reported the scoop coming open. At this point, data was turned off, we did not observe or call C/N. Fuel totalizer was 49,000 lbs. A1 throttled back, I advised him to maintain at least 240 KIAS, confirmed cabin air switch in PURGE, crew air shutoff CLOSED and ammonia 455 lbs. I turned AUX COOL on and advised ground I would wait until the gear was extended before turning the REFER off. Fuel totalizer was 48,000 lbs. As we descended through 32,000 ft. the cabin altitude was 29,000 ft. and at 30,000 ft. the cabin altitude was 27,000 ft. Palmdale tower reported the wind at 220° at 5 knots. Tank 2 was feeding, its level was 11,100 lbs. and the sump tank strip was holding at low level. Primary 2 hydraulic system level, which I had been concerned about for some time, was holding at 135%. Approximately 1010, we were descending through 27,500 ft. at 350 KIAS and chase 1 (TB-58) reported his airspeed 347 KIAS. Totalizer was still 48,000 lbs., tank 2 was remaining at 11,100. I verified No. 2 fuel tank switch was ON and cautioned that we should watch these levels as they had remained the same for several minutes during the descent. P_1, U_1 and U_2 hydraulic fluid levels were OK but P_2 continued to drive down. At 23,000 ft., .8 Mach, I started turning tank 8 on for periods of one minute. Primary 2 hydraulic level was holding 140%. At 20,500 ft., the cabin was 19,000 ft. Engines 3 and 4 were maintained at about 87% rpm. Tank 8L remained at 3300 lbs. in spite of my attempt to reduce it with momentary pump operation. At 14,800 ft. A1 started to slow down for flap and gear extension, totalizer was 46,000 lbs.

7. Flap & Gear Extension, Approach & Landing:

Flaps were extended at 1013 and the gear was extended at 225 KIAS at 1013:30. We had three green lights and chase reported gear and doors looked OK. Chase also reported some ice broke off and went below the

wing. Palmdale tower approved a straight in approach. I turned REFER off and observed hydraulic quantities, pressures and status lights were all OK. I verified crew air shutoff handle in the UP position, REFER off and AUX COOL on. A1 asked if we had sufficient fuel for a go-around and I replied in the affirmative as the totalizer was 46,000 lbs. and the sump was being maintained at low level. Tank 2 was still feeding, quantity 6800 lbs., and I continued to attempt to reduce 8L quantity by momentary pump operation in that tank. C.G. was 21%. Brakes were selected automatic and data was turned on continuous, time 1035:19, C/N 5129, for the low approach. Palmdale tower reported wind 230° at 8 knots. Best flare speed was 183 with a total of 42,000 lbs. After the low approach, a right turn was made onto the downwind and we experienced low speed buffet at 205 KIAS. On the downwind, fuel totalizer was 40,000 lbs., with a final approach speed of 188, best flare 178 and touchdown 162. The gear was rechecked down and data was turned off since we had only 12% tape remaining on one system. A1 commented on the poor atmospheric visibility. Electrical system looked good, check list was completely reviewed again and ammonia quantity was 460 lbs. Approaching base leg, fuel totalizer 38,000 lbs. as I turned No. 2 tank off at 100 lbs. A1 was making a right turn onto final approach and commented that he couldn't see well in this type pattern. Chase reported he was rolling out on final in good shape. On final, the sump was 29,600 and the totalizer was 36,000. Palmdale tower reported wind 200° at 9 knots and cleared us to land on runway 25. Data on continuous, C/N 5517. At 198 KIAS I observed an angle of attack of 3-1/2°. I called out airspeed as follows: 197, 193, 190, 190, 191, 190 (chase called out 30 ft. above the ground) 190 KIAS and chase calls 10 ft., 5 ft., then 2 ft. I turned the SST camera switch on at touchdown. The tourchdown was a firm one and at my best estimate on the asphalt overrun just short of the runway. I called standing by chute and A1 called for deployment - not sure of the speed. Chase reported chute deployment and A1 jettisoned it under 40 knots. Shep called for fans to override and I asked A1 to shut down No. 3 engine because it's hydraulic status indicators had just gone yellow since touchdown. A1 selected the fans to OVERRIDE and cabin air switch to REPRESSURE and we definitely had air flow in the cabin. Data off. The ground crew reported the scoop was retracted, but the door was still open. Palmdale tower reported landing time of 1027. A1 requested a careful look by the ground crew before taxiing in and they reported all looked well. EE temp was 62° and while taxiing to the run pad area it reduced to 59°. No. 6 engine was shut down at 1034. No. 1 engine shut down at 1038. At 1040, engines 2 and 5 were shut down and at 1041, No. 4 engine and the FANS were cut off.

8. Hydraulic System:

Time	P_1	P_2	U_1	U_2	Condition
0823	185	180	165	160	All engines running
0830	182	171	164	162	Prior to taxi
0835	175	170	162	162	prior to taxi
0858	179	168	179	190	Ground crew inspection
0935	*205	195	205	205	39,000 ft. - Mach 1.1
0947	163	162	-	-	Mach 1.4
0955	-	175	-	-	Subsonic
1010	-	135	-	-	Letting down

* 205 is max level - indicates full

9.0 FUEL SYSTEM LOG

Time	C/N	Totalizer	1	2	3	4	6L	6R	7L	7R	8L	8R	Comments
0711			ON										
0746		188,000	12350	29325	39300	37675	38900	38750	100	-450	950	0	All Xfr Pumps OFF
0815	19730	181,750	ON 6050	29300	29150	37050	38975	38800	275	-450	1600	50	
0833			OFF 100			ON							
0838					33000	OFF 29600							
0840							--AUTO--						
0853	22010	172,000	800	29500	33100	29800	--AUTO-- 27200	36400	400	-400	3000	300	CG=21.6%
0900					33100								
--		143,000				ON	--OFF--						After T.O.
0905					29600	23000							
--			2000				26800	2600					Left turn 3 Sisters
Aprx. 0910		132,000				OFF					--ON-- 4000		
0914						ON					--OFF--		
0918	1495	123,000	2200		32200						1900		
0922		120,000				OFF 600					--ON--		
0924											--OFF-- 700		
0925		110,000			24100		--ON--						

9.0 FUEL SYSTEM LOG (Con't.)

Time	C/N	Totalizer	1	2	3	4	6L	6R	7L	7R	8L	8R	Comments
Aprx. 0931			3000	28500	32700	0	16600	15800			1400		
0937		86,000		AUTO			10000	9500					
0938:30		83,000											
0940		78,000											
0941:30	2923	75,000		AUTO	32300		--ON-- 3900	2200					
0943:30		73,000					3000						
0945:30		68,000		AUTO			--OFF--	1400					
0947		67,500	3800										
0949		66,000		25300									
0950					29900								
0951		60,000									2200		
0953				18000									
	3780	57,000	3000										
1000		54,000		13100									
1001			ON	OFF 12200									
1004			1000										No.1 off at 3000 lbs. No. 2 turned ON
		48,000		11000	low level								
1040	6440	32,500	550	125	25650	650	2300	1200	450	-400	700	-400	Shutdown

10. Pilot Squawks:

a. High vibration light was on with #2 ADS vibes reaching 60 to 65% on indicator intermittently during the flight.

b. Minimum afterburner instability occurred in #2 engine each time MIN A/B was selected.

c. Total temp indicator was inoperative.

d. Vertical tape accelerometer was inoperative.

e. Ram air scoop malfunctioned and aircraft failed to repressurize after ram purge test.

11. Opinions and Conclusions:

a. Total aircraft time logged was 1:25 hours. Brakes were released at 0902 and the landing was logged at 1027.

b. Supersonic flight was achieved four times for a total of approximately 30 minutes.

c. Highest indicated Mach and altitude I observed was 1.42 and 46,100 feet.

d. The flight was a very successful one although it was terminated before all data could be obtained because of low fuel. However, we attained established goals which allowed us to enter the Phase II Proof Loading.

e. The aircraft systems performed very well. Those systems which gave overall satisfactory operation were:

Nose Wheel Steering	Wing Fold
Fuel	Flaps
Radios	Hydraulics
IFF	Flight Controls
Oxygen	Brakes
Fire Detector	Instrumentation
Engines	Electrical
Landing Gear	

f. During the external preflight inspection, I observed a significant increase in the amount of fuel leaking from the lower fuselage ahead of the weapons bay.

g. Capsule seat safety pin streamers have lost their stiff-ness and as a result twist and bind, preventing proper winding on the takeup spool.

h. Hydraulic servicing unit leak developed after engine start, required shutdown and delayed takeoff.

i. Right rear brake skidded and smoked during manual brake application while taxiing and when stopping in the auto mode.

j. The emergency generator was turned from AUTO to ON at lineup and resulted in loss of holding brakes and momentary loss of radio.

k. Between brake release and the first in-flight fuel reading (11 minutes), the fuel quantity indicating system showed 29,000 pounds of fuel used (172,000 to 143,000 pounds).

l. The initial climb was made in light turbulence. There was very little cockpit lateral or vertical movement. The entire flight was much smoother than previous ones.

m. In a left bank at .95 Mach, 34,000 feet and 390,000 pounds gross weight, chase reported vibration of the outboard elevon segments but no buffet could be felt in the cockpit.

n. Wing fold operation was symmetrical and smooth. No distinguishable roll or pitch trim changes were experienced. Control, stability and performance characteristics with the wing tips folded were very encouraging.

o. Rudder pedal feedback (buzz) was experienced in turbulence while supersonic and was sufficiently disconcerting as to require yaw augmentation to be turned off.

p. Ram air scoop door failed to close and aircraft could not be repressurized.

q. Chase reported a visible detached shock aft of the aircraft as well as ice build up on lower fuselage in the vicinity of water vents.

r. No. 2 ADS showed intermittent high vibration. No. 2 engine was unstable in minimum afterburner.

s. No. 4 engine EGT oscillated almost continuously between 900 and 912° C.

t. In a right turn after the low approach at Palmdale, gross weight was 297,000 lbs., light buffet was felt in the cockpit at 205 KIAS.

u. No. 3 ADS primary and utility hydraulic status indicators went yellow soon after touchdown and No. 3 engine was shut down.

v. Again, only two of the main drag chutes developed during the landing roll.

w. Fuel used, based on totalizer readings, from engine start to shutdown was 155,500 lbs.

x. The patched up paint job stayed on better than the original paint did on the previous two flights.

y. Background hum or whine is present during playback of aircraft voice recorder tape.

z. Angle of attack indicator was unreliable - indicated minus 2 and 3 degrees in climb and cruise and +3-1/2° on final approach.

aa. Pilot's sideslip instrument indicated a consistent 1/2 to 1 degree left sideslip.

ab. Total temperature indication was unreliable throughout the flight, i.e. indicated 25°F when true outside temperature was 52°F.

ac. Tank 1 and 8L fuel levels increased prior to and during flight requiring special fuel management.

VII. RECOMMENDATIONS:

1. Implement a comprehensive program to eliminate engine foreign object damage.

2. Eliminate inter-tank fuel leakage.

3. Determine origin of and correct fuel leaks.

4. Eliminate brake chatter present during the low speed portion of stops.

5. Correct unreliability and inconsistencies of cockpit, angle of attack, and tape accelerometer.

6. Correct erroneous indication of the total temperature indicator.

7. Investigate source of background "hum" in voice recorder playback.

8. Study methods of increasing data recording time available.

9. Restiffen capsule seat safety pin streamers so that they retract properly.

10. Repeat Items:

The following discrepancies have been written up on previous flights and were again unsatisfactory on this flight. It is recommended that action be taken to correct these discrepancies:

a. Pilot's sideslip indicator shows constant sideslip in straight flight.

b. Only two drag chutes develop properly when deployed on landing.

c. Rudder pedal feedback (buzz) exists during gear extension (Flight 1-3) and during supersonic flight (Flight 1-4).