(Gp-4) TEST REPORT

XB-70A

FLIGHT 1-12

(No. 1 Air Vehicle, No. 12 Flight)

7 May 1965

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XB-70 JOINT TEST FORCE (FTTB)

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TABLE OF CONTENTS

		Page No.
I.	SUMMARY	1
II.	TEST LOG	3
III.	DATA	9
	1. Fuel Data	9
IV.	ENGINEERING COMMENTS	12
	1. Structure	12
	2. Engines	12
	(1) No. 1 Engine	12
	(2) No. 2 and No. 3 Engines	13
	(3) No. 4 Engine - S/N 560	13
	(a) Compressor Section	13
	(b) Combustor	13
	(c) Turbine Section	13
	No. 5 Engine - S/N 566	13
	(a) Compressor Section (Figs. 6, 7 & 8)	13
	(b) Combustor	14
	(c) Turbine Section	14
	(5) No. 6 Engine - S/N 565	14
	(a) Compressor Section	14
	(b) Combustor	14
	(c) Turbine Section	14
	3. Electrical	15
	4. Flap System	15
	5. Drag Chute	16
	6. Lake Bed Landing	16

TABLE OF CONTENTS

		Page No.
IV.	ENGINEERING COMMENTS (Cont'd)	
	7. NASA Supersonic Transport Tests and Instrumentation	17
	a. Landing Gear Cameras and Instrumentation	17
	b. Cabin and Ballast Bay Microphones	17
	c. Velocity Acceleration Altitude (VGH) Recorder	17
	d. Sonic Boom	17
V.	OBSERVATIONS AND COMMENTS BY THE COPILOT	18
	1. Introduction	18
	2. Preflight and Flight Preparation	18
	3. In The Cockpit Prior To Taxi	19
	4. Taxi	19
	5. Takeoff and Initial Climb	19
	6. Climb and Accelerate	20
	7. Inlet Unstart Test	21
	8. Duct Performance	22
	9. Emergency Incident	22
	10. Descent and Landing	24
	11. Maintenance Discrepancies	24
	12. Copilot's Summary	26
VI.	CONCLUSIONS	28
VII.	RECOMMENDATIONS	30

I. SUMMARY:

1. (C) The twelfth flight (Flight 1-12) of XB-70 No. 62-001 was completed on 7 May 65. Flight crew was Mr. Al White, North American Aviation, Inc (NAA), Pilot, and Lt Colonel Fitzhugh Fulton, Air Force Flight Test Center (AFFTC), Copilot. Takeoff from Edwards AFB runway 22, at 513,068 pounds gross weight, occurred at 1107 hours PDST. Takeoff gross weight was the heaviest to date. An emergency landing on Rogers Dry Lake runway 18 was made at 1232 hours PDST. Total flight time was one hour and twenty-five minutes (1+25), total supersonic 0+58, total M 2.0 or greater 0+32, and total M 2.5 or greater 0+07. Maximum speed and altitudes were M 2.58 at 65,000 feet.

2. The following aircraft discrepancy "carry over" items existed at preflight:

a. One left unstart light illuminates with inlet started.

b. One left buzz warning light illuminates with inlet started.

c. Both throats off schedule.

d. Inoperative fuel transfer pump in tank No. 1.

e. No. 5 engine susceptible to 520 cps vibration and minimum afterburner instability.

3. The 20 minute engine start period was much longer than normal due to problems in starting No. 6 engine and hydraulic pressure problems. Five starts or attempted starts of No. 6 engine were required before satisfactory operation was obtained. Taxi was delayed when the instrumentation package had to be lowered for maintenance and when a small leak in the U_2 hydraulic system was investigated. Heavy brake chatter occurred just prior to taking the runway.

4. Takeoff power increase and brake release were satis-factory and after a rapid acceleration, lift-off occurred at approx-mately 210 KIAS. Takeoff distance was 8,230 feet. Gear retraction was normal. On first flap retraction the flap pressure warning light flashed "on" and the indicator showed "barberpole". Indications were normal upon flap recycling and tapping the flap indicator. A 400 KIAS, maximum afterburner climb through clear air turbulence was established. Wing tip fold and windshield extension were normal. Turbulence and hot ambient air conditions slowed the climb and acceleration rates considerably and it was apparent that the flight plan would have to be shortened due to the extra fuel used during the slow climb and acceleration. The inlets were started at M 2.0 and 50,000 feet and the climb was continued to M 2.4 at 60,000 feet where inlet unstart

tests were completed. Duct performance data were obtained during 30° banks at M 2.54.

5. (U) After fifty-eight minutes of flight, and while at M 2.58, 64,700 feet, the wing apex (horizontal splitter) separated from the aircraft, struck the vertical splitter, and passed down the right hand duct. Ding, dent, and gouge damage occurred in the right duct and severe foreign object damage (FOD) was suffered by engines No. 4, 5 and 6. Engines No. 1, 2 and 3 received minor FOD. During the ensuing events engines No. 3, 4, 5 and 6 were shut down. Airstart of engines No. 3 and 5 was accomplished and the aircraft proceeded under emergency conditions to Edwards AFB where a straight in approach to lake bed runway 18 was established. The landing gear extended satisfactorily but the flaps would not extend. A no-flap landing was made at approximately 210 KIAS touchdown speed. Although the nose wheel steering did not engage, there was no problem in keeping the aircraft on the runway during the 13,000 foot landing roll. The drag chutes did not deploy.

II. TEST LOG:

0855	Copilot entered cockpit.
0905	Pressure check complete.
0940	AICS check - left inlet set 2.49, right inlet set 2.455, both inlets biased to 2.4 Mach with standby switches.
0946	Began engine starts: Engine No. 4 started O.K. - 530° EGT Engine No. 6 - no start ground reported no fuel drain when throttle off Engine No. 6 - no start drained O.K. Engine No. 3 started O.K. - 500° EGT Engine No. 1 started O.K. - 450° EGT Engine No. 2 started O.K. - 510° EGT Engine No. 6 started O.K. using airstart - 500° EGT - 30 seconds after start hydra pumps stopped pumping (reported from the van), engine was shut off - throttle did not cut engine until slammed shut Engine No. 6 started O.K. using airstart - 510° EGT Engine No. 5 start attempted - when No. 5 starter depressed, the No. 6 hydra pumps failed again - No. 5 and No. 6 throttles were cut Engine No. 6 started O.K. using airstart - 520° EGT hydraulics were slow to come on Engine No. 5 started O.K. - 530° EGT.
1006	All engines were started - tank No. 1 level reduced from 30,700 pounds to 28,500 pounds by going into tank No. 3.
1022	Hydraulic service complete - P_1 = 161, P_2 = 163, U_1 = 158, U_2 = 172. U_2 was service high because of small leak at bay No. 4 in utility pump compensator.
1025	Total fuel = 251,000 pounds.
1030	Control checks.
1035	Began military power checks.
1040	Military power checks complete - No. 6 engine hung up on throttle chop - sump low level on at 20,700 pounds - No. 6 tank placed in auto to refill.
1043	P_1 = 157, P_2 = 152, U_1 = 147, U_2 = 170.
1045	Total fuel = 246,500 pounds - momentary flap press light when extending flaps.
1048	Taxi out started.
1050	Received ATC clearance as filed.
1053	Going through "before takeoff" check list.
1057	Reviewed takeoff data - 170 knots decision, 185 rotate, 205 takeoff.
1101	Total fuel 241.5 - brake chatter heavy on stop.
1102	Flight control check with ground man.
1104	All fuel pumps to auto.

Test Log (Cont'd)

1105	Two minutes to brake release - hydraulics O.K.
1106	Afterburners lit off, 3 and 4, 2 and 5, and then 1 and 6.
1107	Brake release - all engines to maximum afterburner.
1108	Airborne with gear retracting (approximately 25 second gear cycle).
1109	Retracted flaps but indicator showed down - tapping indicator did not help - flap pressure light on - extended flaps and then retracted them again - momentary flap pressure caution light - flap indicator still showed down with flaps up - tapped on indicator and it moved to up - tanks No. 2, 4 and 7 pumps off.
1113	Maximum afterburner power - cabin record to ready - picking up heading 09° - going through "after takeoff check list" - encountering turbulence at 400 KIAS.
1116	Total fuel 201.0 - heavy turbulence - wing tips to 25°.
1117	Unable to read on 351.4 frequency - went to 316.6.
1118	Windshield up - visibility poor.
1119	Mach 1.0 - bypass to 200 square inches.
1120	316.6 frequency has other people on it - back to 351.4 - Data Control and B-58 say Beatty straight ahead - our TACAN shows 20° left - more turbulence.
1121	Cabin record off - tank No. 6 feeding O.K. - 6L = 3.0, 6R = 3.5, total fuel = 184.0 - P_1 = 195, P_2 = 180, U_1 = 198, U_2 = 172.
1122	Moderate turbulence - acceleration slow - will climb to 35,000 feet.
1125	Turning left to 317° near Beatty - tank No. 6 off - 6L = 2.0, 6R = 1.5.
1126	Wing tips to 65 degrees passing 1.4 Mach - setting 400 on bypass - 34,000 feet and starting to climb. Cabin recorder off.
1127	U_1 = 200, U_2 = 175, P_1 = 190, P_2 = 175.
1128	Cabin altitude 6,000 feet - Chase No. 2 (F-104) breaking off - Tanks 8L = 5.8, 8R = 6.4, 1 = 21.2 - total fuel = 155.5
1130	Switch compass to "mag" and 30° error introduced - changed back - 39,000 feet altitude - moderate turbulence.
1131	Ball centered - S/S indicator shows 3/3° left - throats still in manual - 1.66 left, 1.67 right - bypasses 420 L and R. Difficult to set bypasses exactly on 400.
1132	80 miles to Fallon - 41,000 feet.
1134	550 knots climb at 44,000 altitude in light turbulence went to auto throat.
1135	Copilot flying while pilot adjusts microphone.

Test Log (Cont'd)

1135:30	Pilot flying again - in auto throat with airplane at 1.79 Mach left throat shows 1.69 and right shows 1.75 - fuel 8L = 5.7, 8R = .8, 1 = 8.7 - total = 133.5 - tank No. 3 on low sump at 26.4, tank No. 1 still feeding.
1136	1.93 Mach - throats driving 1.83 left and 1.88 right.
1138	Mach 2.0, 545 KIAS at 50,000 feet - starting inlets - shocks back to crosshatch - right inlet started first with left 15 seconds later.
1139	Bypass doors caused slight nose up trim.
1140	Turning right north of Fallon - all engines EGT cut back to around 820° - fuel 8L = .3, 8R = 0 - tank No. 8 turned off - 540 KIAS, 2.07 Mach at 51,300 feet - total temp = 254° - at 2.08 Mach with shocks in top of green left bypass was 1,030 and right 950 - right shock oscillates more than left.
1141	Bypass doors 985 left and 925 right.
1142	Tank No. 1 = .2 and turned off - tanks No. 2, 4 and 7 to auto.
1143	Left throat lagging, airplane Mach 0.1, right lag is .05 - bypass 985 left and 925 right - slight duct phenomena occurring.
1144	Completed turn toward Malad City - have a slight vibration - hydraulics O.K.
1146	Fuel 2 = 25.1, 4 = 26.5, 7 = 20.5, Total = 108.0 Mach 2.2 - the malfunctioning left unstart light came on with everything normal.
1147	Mach 2.27 at 54,500 feet - 550 knots - 312° total temp - turbulence causing shock to oscillate making them hard to hold steady - especially right side.
1149	Mach 2.27, altitude = 54,500 feet, total temp = 312° - slow climb - shock top of green with 780 left and 720 right bypass - tank No. 2 feeding, tank No. 4 = 20.0, total fuel = 98.0.
1151	Starting right turn to 120° to cut inside Salt Lake because of slow acceleration - tank No. 4 = 18.7 and feeding 4B O.K. - tank No. 2 - 19.2 - turn slowing acceleration.
1152	2.37 Mach at 58,000 feet - starting to climb.
1153	Opening bypass slightly to bring shock down since mach dropped off a little in turn - will cut out purge test because of slow acceleration.
1154	Mach 2.41 at 59,000 feet - throats 2.34 left and 2.36 right.
1155	Leveling at 60,000 feet - cabin recorder to ready with maximum afterburner No. 5 engine, 100% rpm, 818°C, 93% A8 - total temp = 364° = total fuel = 84.0 - 2.42 Mach at 59,000.

Test Log

1157	Run 1 on Card 2 completed - unstarted left inlet as planned - shock was high in red before unstarting - restart completed O.K. in 5 seconds - data off C/N 3502.
1158	Data Control advised to skip to item 5 on Card 2 because of slow acceleration rate - Maximum afterburner set to continue acceleration - will do some duct performance in turns.
1200	Tank No. 4 = .4 and turned off, tank No. 2 feeding, total fuel = 75.0 - maximum afterburner power - speed 2.5 Mach at 60,000 feet - 538 KIAS - 382° total temp.
1201	Starting turn to south - duct performance at 2.53 Mach - bypasses top of green - left 510 square inches and right 490 square inches.
1202	Total fuel = 68.5 - shock mid to high yellow at 2.54 Mach in 30° right bank - bypass 390 square inches left and 450 square inches right C/N 3792 - No. 2 tank is feeding.
1203	Mach 2.55 at 64,300 feet - still turning - shock lower yellow for the turn.
1204	2.54 Mach at 65,000 feet - rolling out on 230° heading.
1205	At 2.55 Mach throats were 2.49 left and 2.50 right.
1205	Out of turn at 2.54 Mach - C/N 3960 - setting shocks to lower green - bypasses 420 or 520 left and 490 right shocks oscillating from crosshatch to upper green.
1206	2.58 Mach at 64,700 feet - maximum afterburner still set - light airframe vibration - No. 5 EGT went momentarily to 1,000°C and A8 opened - right inlet unstarted - No. 5 engine showed high vibrations - right inlet restarted within a few seconds - No. 5 throttle back to military - all engines back to military at 2.57 Mach - 64,500 feet.
1207	Apparent minimum afterburner instability on all engines - EGT's oscillating - then settled down - data is still on - No. 5 EGT normal - 2.47 Mach at 62,000 feet - 60% to 70% vibrations on No. 5 engine.
1208	Total fuel 59,000 - all engines at military power - shocks are in green - more bypass on right - 840 left and 1,300 right - right shock creeping into yellow even with increasing bypass door - right inlet unstarted again - No. 5 vibrations 60%.
1209	Mach 2.2 - No. 6 EGT went over temp and gage pegged A8 went full open and rpm dropped to 96% - No. 6 throttle placed in cut off at 2.1 Mach - turbulence encountered.
1210	No. 5 nozzle 60% - others at 45% - going through Mach 2.0 check list.
1210:30	Pilot reports serious trouble - lateral directional oscillation of fairly high frequency - hydraulics check O.K.

Test Log (Cont'd)

1211	Airplane "going ape" directionally - 1.96 Mach - No. 4 and No. 5 engines went up to approximately 1,000°C and were shutdown - engines No. 1, 2 and 3 back to idle.
1211:30	Problem appears to be buzz - all three engines on right side are shutdown - full left rudder trim applied.
1212	Hydraulics P_1 = 150, P_2 = 190, U_1 = 160, U_2 = 180.
1213	Decelerated to 1.3 Mach and all engine rpm's suddenly dropped to idle since rpm switch was still in the "auto" position. The cockpit appearance was that all engines had cut off when the rpm's dropped. (Cockpit camera later showed rpm's to be 73% on 1, 2 and 3, rpm's on 4 and 5 were 62%) 1.3 Mach at 42,800 feet.
1213:30	Airstart switch placed on - bypass doors opened for engine airstart attempt - since it had momentarily appeared that all left engines were lost, No. 3 throttle was placed in cut off prior to the airstart attempt. When this happened the No. 3 engine was shutdown at 1.24 Mach and 42,000 feet causing cabin pressure to be lost, pressure suits to inflate, No. 3 generator to go off, radio communication and telemetering to be lost.
1214	Data Control could still be heard but XB-70 transmitter was off the air because of power transfer.
1215	Electrical power being supplied by emergency generator - trying to start No. 4 and No. 5 at the same time - have throats open.
1216	No. 5 engine restarted but only 90% rpm with throttle at military position; No. 4 did not start - radio working again and 210° heading home requested by Data Control - no tape instruments working - attempting to start No. 3 but no success - 400 KIAS at 20,000 feet - No. 1 and No. 2 engines in maximum afterburner and No. 5 running at 90% rpm.
1217	Position north of Inyokern - 3 Sisters Dry Lake ahead 75 miles.
1218	No. 5 engine keeping emergency generator on the line - lake bed wind reported as 340 at 10 knots - will land downwind on runway 18 right on north lake bed.
1219	Data Control advises we will probably need manual gear valve placed to U_1 to lower landing gear to keep from losing emergency generator.
1220	Data Control says plan to put gear down normally and if electrical power is lost will have to fire battery.
1221	Trying to start No. 3 engine again - Data Control requested that emergency battery be fired.

Test Log (Cont'd)

1222	No. 3 engine started and left generator out on line, therefore, battery not fired - 60 miles from Edwards - heading 200° - speed 370 KIAS 18,000 feet.
1223	No. 1 and No. 2 at maximum afterburner - No. 3 at military power and No. 5 at 90% rpm - No. 4 and No. 6 are shutdown - sump low level on at 20.0 - No. 7 tank had not fed in with automatic - No. 7 placed to ON and sump refilled - wind on ground now 300/10.
1224	Will still land on lake bed runway 18 - instrument panel is covered with warning lights.
1225	Wing tips are confirmed up - repressurizing cabin - best flare speed is 185 knots - Data Control reminded us to turn emergency generator off before lowering gear on normal system.
1226	Tank No. 7 feeding O.K. - sump level came up to 27,000 or 28,000 pounds - emergency generator off - gear selected down at 270 KIAS.
1227	Gear down and locked - hydraulics O.K. - emergency generator back on.
1228	6,000 feet altitude.
1229	Chase reported flaps did not extend - recycled but no success.
1230	Touchdown - one-half right aileron required - probably due to crosswind from right - landing parachute did not deploy - only drogue chute came out - nose wheel steering engaged but inoperative - brakes are O.K.
1232	Airplane stopped.
1235	Mobile vehicle reported damage to splitter at inlet duct.
	Engines all shutdown departed airplane.

III. DATA:

1. Fuel Data:

Time	0905	1025	1045	1101	1116	1121	1125	1128
Event	Before Engine Start	After Engine Start		On Runway with #6 tank feeding #3	Climbing #1 On #6 & 8 Auto Alt. 25,000' feet	Accel 32,000' #6 feeding #3 #8 in Auto	Tank #6 out #8 in Auto	Tank #8 feeding #3
Tank#								
1	35.0	28.5		28.5				21.2
2	29.0	28.7		28.7				
3	27.0	26.8		31.7				
4	36.6	36.6		36.2				
6L	37.5	37.5		29.2		3.0	2.0	
6R	37.7	37.7		31.5		3.5	1.5	
7L	10.4	10.4		10.5				
7R	10.5	10.5		10.6				
8L	13.7	13.7		13.7				5.8
8R	13.4	13.4		13.6				6.4
Total	260.0	251.0	246.5	241.5	201.0	184.0		155.5

* Fuel quantity times 1,000

Fuel Data (Cont'd)

Time	1136	1140	1142	1146	1149	1151	1156	1201
Event	Tank #1 & Tank #8 feeding #3	#8 Tank Off	#1 Tank Turned Off #2, 4, 7 to Auto	Tank #4 Feeding	#2 Tank Feeding #3	#4 Tank Feeding #3		#4 Tank Off #2 Feeding
Tank*								
1	8.7		.2					
2				25.1		19.2		
3	26.4							
4				26.5	20.0	18.7		.3
6L								
6R								
7L				10.2				
7R				10.3				
8L	5.7	.3						
8R	.8	0						
Total	133.5			108.0	98.0		84.0	75.0

*Fuel quantity times 1,000

Fuel Data (Cont'd)

Time	1202	1208	1223	1226				
Event			Sump Low Level Light On	#7 Tank On Manually				
Tank*								
1								
2								
3			20.0	27.0				
4								
6L								
6R								
7L								
7R								
8L								
8R								
Total	68.5	59.0						

*Fuel quantity times 1,000

IV. ENGINEERING COMMENTS:

1. Structure:

a. During the flight, with the air vehicle near 2.6 Mach and 65,000 feet, a piece of the wing apex structure failed. A section of wing leading edge, lower face sheet and some honeycomb core separated from the airplane as shown in figure 1. The separated section was about 24 inches long. As evidenced by splitter damage between the inlets, the separated piece or pieces hit the splitter, then most of the material entered the right hand inlet duct causing extensive duct and engine damage. Engine No. 5 received the most extensive damage (see figures 2 and 3). Other engine damage is discussed in paragraph IV, 2 of this report.

b. Most of the wing leading edge lodged in the splitter between engines No. 4 and 5. Damage to the duct consisted of dents, creases and tears in the face sheet, and gouging into the core. The duct floor received the most serious damage. Figure 4 shows one of the gouges. The splitter, outboard duct wall, and duct roof also received considerable damage. There was no evidence of progression of any of the face sheet tears or other damages beyond that caused by impact (gouges exposed areas approximately two inches by ten inches of honeycomb to the duct air stream). Duct damage was repaired with doublers and pins and by plasma spray. The wing apex was redesigned to use skin over a single piece frame as shown in figure 5 rather than honeycomb. Other honeycomb panels forward of the inlets were examined using the ultrasonic tester. At the request of the Joint Test Force (JTF), NAA installed percussion pins in the center wing panel forward of the splitter at stations 908, 954 and 999. This is intended to prevent progression of a failure in this panel should one occur. This area is particularly critical since a failure can affect both ducts.

c. Cause of the apex failure was not determined. NAA reports that the apex area had been inspected prior to Flight 1-12 and that only a very small void (about the size of a twenty-five cent piece) was known to exist in the honeycomb brazing.

2. Engines:

a. As a result of the structural failure all engines received some type of FOD. Engines in the left duct received only minor damage to the compressor while all engines on the right received major damage to the compressor and turbine sections. Damage by engine number was as follows:

(1) No. 1 Engine:

No. 1 engine received minor damage to the forward compressor. The damage consisted of 60 nicked compressor rotor blades,

It was necessary to remove both the forward and the aft cases to allow access to blades for inspection as well as for rework. All blades were reworked and none replaced.

(2) No. 2 and No. 3 Engines:

No. 2 and No. 3 engines received minor compressor damage. Damage was confined to the first stage compressor rotor blades and benching was accomplished with the engine assembled and was reinstalled in the aircraft.

(3) No. 4 Engine - S/N 560:

(a) Compressor Section:

Inlet guide vanes --- not repairable.
Compressor rotor blades --- 670 of 700 not repairable.
Compressor stator vanes --- 450 of 700 not repairable.
Front frame --- can be reworked.
Forward and aft stator cases --- can be reworked.
Rear frame outlet guide vanes --- 7 damaged.

(b) Combustor:

Requires some repair.

(c) Turbine Section:

First stage nozzle --- 5 vane separations --- sent to Evendale for repair.
First stage rotor --- 13 buckets damaged.
Second stage rotor --- 2 buckets damaged.
Rotor disc assembly --- serviceable.
Second stage stator --- repairable.
Turbine frame --- repairable.
Four fuel nozzles damaged.

(4) No. 5 Engine - S/N 566:

(a) Compressor Section (Figs. 6, 7 & 8):

Inlet temperature sensor -- beyond repair.
Front frame --- beyond repair.
Rotor blades --- none repairable.
Stator blades --- none repairable.
Forward stator case --- beyond repair. The aft stator case, compressor rear frame, compressor disc and spacers are all serviceable.

(b) Combustor:

25% reusable.

(c) Turbine Section:

First stage turbine nozzle --- beyond repair.
Second stage turbine nozzle and turbine stator case --- serviceable.
First and second stage turbine rotor blades --- none repairable (Figure 9).
Disc assembly --- serviceable.
Turbine frame assembly --- repairable.
Fuel nozzles --- 28 of 32 damaged.

(5) No. 6 Engine - S/N 565:

(a) Compressor Section:

Front frame --- serviceable with repair.
Inlet guide vanes --- approximately 40% recoverable.
Rotor blades --- 39 of 700 salvageable.
Rotor assembly --- shipped to Evendale for check.
Stator vanes --- 132 of 700 salvageable.
Forward and aft cases --- repairable.
Outlet guide vanes --- 90 of 110 salvageable.
Compressor rear frame --- serviceable with repair.

(b) Combustor:

Minor repair.

(c) Turbine Section:

First stage nozzle --- serviceable with rework.
First and second stage nozzle --- serviceable with rework.
First stage rotor blades --- none recoverable.
Second stage rotor blades --- serviceable with rework.
Disc assembly --- serviceable.
Turbine frame assembly --- serviceable with rework.
Fuel nozzles --- two damaged.

3. Electrical:

As a result of the wing apex structure failure during flight, and the resultant engine damage, engine No. 4 was shutdown. Engine No. 3 also was inadvertently (see Copilot's report) shutdown during the deceleration and descent, thus causing the essential buss to be powered by the emergency alternator. Because this emergency alternator is driven from U_2 hydraulic power obtained from pumps on engines No. 4, 5 and 6, which were shutdown subsequent to the structural failure, the aircraft electrical power was supplied from windmill speed of these engines for about two and one-half minutes after engine windmill speed dropped below main alternator cutout rpm. Engine No. 5 was then restarted and delivered U_2 hydraulic power throughout the landing. If none of the shutdown engines could have been started, the engine windmill speed would not have been sufficient during the landing to supply U_2 hydraulic power to the emergency alternator and the emergency battery would have been fired to provide electrical power for landing. However, about eight and one-half minutes after loss of the primary electrical alternators caused the emergency alternator to power the Essential AC Buss, engine No. 3 was restarted causing power to be distributed to both the left primary and the Essential AC Busses from a primary alternator. The right primary AC Buss was not powered for the remainder of the flight because buss-tie contactors to this buss cannot be closed after they have been opened in flight. Loss of engines on the right hand side can cause loss of sufficient U_2 hydraulic power to drive the emergency alternator below approximately 25% rpm engine windmill. This engine windmill speed cannot be maintained below an air vehicle speed of 0.8 to 0.9 Mach and as engines can be airstarted at 12% rpm and 0.5 to 0.7 Mach, an electrical capability from a continuous duty battery for airstarts is desirable.

4. Flap System:

a. Prior to takeoff, a momentary flap pressure light was seen by the pilots during flap extension. After takeoff, the flaps were retracted but the indicator continued to show down and the flap pressure light came on and stayed on. The flaps were cycled and a momentary pressure light was observed. The indicator still showed down but moved to the up position after being tapped. The flaps would not extend for landing.

b. The cause of the flap pressure light, and the failure to extend, was apparently a result of the same problem in the flap system which had existed on flights No. 8, 9 and 11, i.e., one of the two flap selector valves in the P_1 hydraulic system remaining in the de-energized position and porting fluid to return. Since the No. 4 engine was shutdown and the buss-tie contactors were open, the right hand buss was not powered. The P_2 system flap selector valve is powered by the right hand buss in the down direction and was, therefore, not

energized. This combination resulted in the flaps not lowering.

c. The flap selector valve manifold assembly was again removed for bench tests. A .062 inch orifice is being installed on the output lines of both P_1 flap selector valves. This fix is intended to create a back pressure in the pressure line. If the valves do not operate simultaneously, pressure will be dumped into the return line before the second valve actuates. When this occurs there is not sufficient pressure at the late actuating valve to shuttle the valve spool to the down ports.

5. Drag Chute:

a. The drag chute failed to deploy on this flight but nothing was found that would have prevented deployment. The pilot chute deployed pulling the extraction chute. The extraction chute apparently did not have sufficient force to pull the main chute bags. The limited film coverage from this landing shows that the extraction chute was bobbing up and down, was very low behind the aircraft, and would apparently collapse and fill-in in an erratic manner. This was probably a result of void or low airflow areas back of the shutdown engines No. 4 and 6. The low angle of the chute may have been due to a late deployment as evidenced by the location of the pilot chute about 800 feet past nose wheel touchdown. However, the pilot reported that the drag chute was deployed immediately after touchdown at about 210 knots. This apparent late deployment is comparable to flights 1-1 and 1-3 rather than later flights where the pilot chute deployed several hundred feet before nose gear touchdown. The low angle of the pull force with the nose gear down increases the extraction load considerably while pulling the main chutes up the ramp at the aft end of the drag chute cavity. The discrepancy between reported drag chute actuation and the location of the pilot chute bag indicates that air turbulence with engines out may affect the pilot chute deployment also.

b. NAA has proposed using only two drag chutes for flight 1-13 and attaching the extraction bridles to the lower part of the main chute bags to provide a lifting force over the chute compartment ramp.

6. Lake Bed Landing:

The landing was made on lake bed runway 18 with no flaps, no nose wheel steering, and the drag chute did not deploy. Touchdown loads were apparently very low as evidenced by long skid marks indicating gear loads were not high enough to cause immediate spin up. The right gear touched down about thirty feet before the left and then lifted off for a short distance. The nose gear touched down at .35 miles after main gear touchdown and total ground roll was 2.3 miles. Lake bed penetration was about one-half inch except for

isolated soft spots where maximum penetration was one inch. There was no penetration toward the end of the landing roll. The total ground roll, low lake bed penetration, and lack of drag chute indicates that at least a moderate amount of braking was used to stop the aircraft. There was no indication of skidding or rough brake operations as evidenced on flight 1-11 through the ground roll except some skidding in the last few feet before stopping.

7. NASA Supersonic Transport Tests and Instrumentation:

a. Landing Gear Cameras and Instrumentation:

The landing gear cameras were used to photograph the gear retraction. The quality of the pictures is very good. The entire bogie fold, rotate, and retract sequence can be seen. No landing data was obtained with the NASA instrumentation because instrumentation power was off.

b. Cabin and Ballast Bay Microphones:

The cabin recorder was turned on for preflight calibrations and was inadvertently left on. As a result, the tape was completely run off prior to takeoff and no flight data was obtained.

c. Velocity Acceleration Altitude (VGH) Recorder:

The VGH recorder was on from takeoff until electrical power was lost.

d. Sonic Boom:

The XB-70 was subsonic as it passed near the boom recording station located just north of Edwards AFB.

V. OBSERVATIONS AND COMMENTS BY THE COPILOT:

1. Introduction:

a. The flight was scheduled for 1030 hours takeoff. The flight plan called for an acceleration and climb to 2.60 Mach at 65,000 feet. Tests scheduled were an inlet unstart and restart at 2.40 Mach, 60,000 feet; stability and control at 2.50 Mach, 60,000 feet; duct performance at 2.50 Mach, 60,000 feet; duct performance at 2.60 Mach, 65,000 feet; stability and control at 2.60 Mach, 65,000 feet; stability and control at 2.50 Mach, 65,000 feet; and tests of the ram purge system.

b. The flight duration was one hour and twenty-five minutes. Upper air temperatures were much hotter than standard day conditions and these hot temperatures, plus moderate clear air turbulence, slowed the acceleration rate and caused several test objectives to be eliminated. Near the latter part of the flight, a structural failure of a small portion of the leading edge wedge resulted in serious damage to engines No. 4, 5 and 6, which was followed by an emergency landing on the Edwards Dry Lake.

2. Preflight and Flight Preparation:

I arrived at around 0730 and it appeared that the airplane was being readied for the flight as scheduled. I conducted an outside inspection and an inspection of the electronic equipment (EE) bay and crew compartment. No discrepancies were encountered. A review of the airplane status with NAA engineering and maintenance personnel showed that there were several significant "carry over" items. One of the left unstart, and one of the left buzz warning lights were malfunctioning and could be expected to illuminate even when the inlet was started and normal. The No. 5 engine was susceptible to 520 cps vibrations and minimum afterburner instability. Both throats were slightly off schedule and would need to be biased by the electric standby switches during the copilot checks. The most significant malfunction was an inoperative fuel transfer pump in tank No. 1. This meant that an in-flight failure of U_1 hydraulic system would cause the remaining pump to stop and result in trapped fuel in tank No. 1 and a forward center of gravity. The planned fuel sequence was modified to allow tank No. 1 fuel to be used early in the flight. At approximately 0815, Mr. White and I entered the physiological van to don the pressure suits. No suit problems were encountered and at 0905 both of us were in the airplane with all personal equipment checks complete.

3. In The Cockpit Prior To Taxi:

The starting gross weight was 535,000 pounds, which included an indicated 260,000 pounds of fuel. During the "Before Starting Engines" check list, the left inlet was set at 2.49 Mach and the right inlet set at 2.455 Mach. Using the electrical standby switches, both inlets were then biased to 2.40 Mach and remained biased during the flight. Engine starts began at 0946 but were not completed until 1006 because of several problems. The No. 6 engine could not be started on the first and second attempt but was then started using the airstart ignition. However, both No. 6 hydraulic pumps stopped pumping 30 seconds after idle rpm was obtained and the engine had to be cut off. On the fourth attempt, the No. 6 engine started and the hydraulic pumps were normal. When No. 5 engine starter switch was depressed, the No. 6 pumps failed again and No. 5 and No. 6 engines had to be cut off. On the fifth attempt, the No. 6 engine was started O.K. and the hydraulic pumps, though slow to initiate normal pumping action, operated satisfactorily. The No. 5 engine was again started and no problems were encountered. Exhaust gas temperatures (EGT's) during start ranged from 450°C to 530°C. Tank No. 1 fuel was used from 35,900 pounds down to 28,500 to reduce nose reactive load prior to taxiing. A small leak from U_2 hydraulic system was found on a pump compensator in bay No. 4. The leak could not be fixed prior to flight, therefore, U_2 quantity was serviced to 172% when all others were serviced to approximately 160%. Flight control checks and military power runs were completed prior to taxi out. The No. 6 throttle hung up momentarily when retarded from the military power position. The flap pressure warning light flashed on and off several times without any apparent reason.

4. Taxi:

Taxi out was initiated at 1048. Heavy brake chatter occurred when stopping just prior to entering the runway and Mr. White commented that the nose wheel steering authority appeared less than normal during the right turn to line up on the runway. After a flight control check, and an external inspection by the ground crew, the airplane was ready for takeoff.

5. Takeoff and Initial Climb:

The indicated total fuel quantity five minutes prior to brake release was 241,500 pounds. After the hydraulics were checked O.K., all fuel pumps were turned to automatic and the engines were set two at a time into minimum afterburner. Brake release came at 1106 and seemed relatively smooth. Power was advanced to maximum afterburner on all engines. Acceleration appeared rapid and the lift-off came at approximately 210 KIAS. The gear handle was placed up shortly after takeoff at around 240 KIAS and the landing gear retracted in

approximately 25 seconds. The flaps were retracted, however, the indicator went to the "barberpole" position and the flap pressure warning light flashed on. The flaps were extended and retracted again. After the flaps were retracted, the indicator again showed "barberpole." A hard tap on the instrument panel caused the indicator to show the flaps up and the mission was continued. The No. 1 fuel pumps were turned on and No. 6 and No. 8 were set at automatic. Tank Nos. 2, 4 and 7 pumps were turned off to follow the modified fuel sequence.

6. Climb and Accelerate:

a. Maximum afterburner power was set and a 400 KIAS climb started. Considerable turbulence was encountered in the climb. Total fuel was 201,000 pounds nine minutes after lift-off. The wing tips were lowered to 25° at 25,000 feet while climbing and shortly afterward the windshield ramp was raised to the "high speed" position. Visibility over the nose is non-existent with the windshield up and the flight then becomes mainly an instrument flight. Side visibility is still available but it is not very good. At 1.0 Mach, the bypass doors were set at 200 square inches. The Beatty TACAN station was tuned in and a lock-on occurred immediately, however, with the station straight ahead, the azimuth needle showed approximately 20° to the left. The No. 6 fuel tank stopped feeding at 2,000 pounds left and 1,500 pounds right and the pumps were turned off. While passing near Beatty, Nevada at 1.4 Mach, 34,000 feet, the wing tips were set to 65° and the bypass doors were opened to 420 square inches. The desired bypass setting was 400 square inches, however, the wheel controls are so sensitive that it is almost impossible to set an exact number. The compass selection was changed from "great circle" to "magnetic", however, this introduced a 30° error and "great circle" was reselected. Cabin altitude was holding 6,000 feet, therefore, the changes made between Flight 1-11 and this flight have not corrected the small error in cabin pressure schedule. Turbulence and "hot" temperatures continued to slow the acceleration rate. During the 550 KIAS climb, the throats were selected to automatic at 44,000 feet around 1.70 Mach. The throats smoothly followed the airplane mach. The left was 0.10 behind and the right was 0.05 behind. I flew the airplane during the climb for approximately one minute while the pilot adjusted his microphone and again the lateral sensitivity was apparent.

b. At 2.0 Mach and 50,000 feet while still climbing, the inlets were started. The throats were still in automatic and the bypass wheels were rolled aft to bring the shock position indicators down to the cross hatch area. The left inlet started first, followed shortly by the right inlet. The bypass doors were opened to around 1,100 to 1,200 square inches and the shock position indicators were bottomed to make sure that the inlet starts were positive. The pilot

commented on a slight nose up trim change when the bypass doors were opened. The bypass wheels were rolled forward to position the shock position at mid to upper green. The indicators were sensitive and had quite a bit of oscillation in the mid green area. They tended to stabilize out some in the upper green area although the right indicator oscillated more than the left. During the right turn north of Fallon, Nevada at 2.07 Mach, 51,300 feet, tank No. 8 was turned off with 8L = 300 and 8R = 0. All engine EGT's had started to cut back and were approximately 820°C and total temperature indicated 254°. At 2.08 Mach, the left bypass required 1,030 and the right 950 to keep the shock positions at the top of the green. While still in the turn, tank No. 1 = 200 and was turned off. Tanks No. 2, 4 and 7 were turned to automatic and operated satisfactorily. Total fuel was down to 108,000 pounds at 2.2 Mach. The malfunctioning unstart light came on with everything normal, as expected. Turbulence was still being encountered and along with the "hot" temperatures had caused the flight to be considerably behind schedule due to the slow acceleration rate. The turbulence caused the shock position indicators to oscillate more than normal and made them even more difficult to hold at the desired position. The right indicator continued to oscillate more than the left. At 2.27 Mach, 54,500 feet, with the shocks in the top of the green, the bypasses were 780 left and 720 right. Data Control advised us to turn southeast bound on the west side of Salt Lake instead of the east side because of fuel considerations. The flight test plan was also being modified. During the turn, the airplane mach number dropped about 0.01 and the bypass doors had to be opened slightly to prevent the shock positions from going into the yellow area. The throats were still following airplane mach very good with the left showing 2.34 and the right 2.36 with the airplane at 2.41 Mach, 59,000 feet. The airplane was leveled at 60,000 feet approximately 48 minutes after takeoff with total fuel at 84,000 pounds.

7. Inlet Unstart Test:

The airplane was prepared for an inlet unstart on the left side at 2.40 Mach, 60,000 feet. The right inlet was set at a "safe" condition of 2.2 Mach with the shock indicator at the lower green. The left throat remained in automatic and the left bypass was moved toward closed. The shock position moved from the crosshatch area through the green, through the yellow and into the red area. The indicator was at mid to high red before the inlet suddenly unstarted with a mild "bang" which was followed by light continuous buffet. The unstart light illuminated but the buzz light did not. The inlet was restarted in five seconds by opening the bypass doors to move the shock position down to the crosshatch area and then selecting manual on the throat control which opened it to the preset 2.2 position. Both throats were reset to automatic and the shocks were positioned to upper green to continue climbing and accelerating. The total fuel

was down to 75,000 pounds at 2.5 Mach, 60,000 feet, with total temperature at 382°. A turn toward the south was initiated while still o.ccelerating.

8. Duct Performance:

It was decided to obtain some duct performance data in the right hand turn since the slow acceleration rate had put the flight behind schedule. With a bank angle of approximately 25° to 30° at 2.53 Mach, the shock positions were set at the top of the green using 510 square inches left bypass and 490 square inches right and a data burst obtained. With 30° bank, the shocks were set in the mid to high yellow area at 2.54 Mach using 390 square inches left and 450 square inches right and another data burst obtained. The airplane continued to accelerate and climb in the turn with throats still at automatic. The left throat was 2.49 and the right 2.50 with an airplane Mach of 2.55. The airplane was rolled out on a heading of 230° towards Edwards at 2.54 Mach and approximately 65,000 feet. With bypass door openings of approximately 500 square inches, the shock positions were set to the lower green area for a data burst. It was almost impossible to get stabilized shock position indications in this area. The indicator rapidly oscillated from the crosshatch to the upper green area.

9. Emergency Incident:

A few seconds after obtaining duct performance readings, a serious emergency occurred. The airplane was at 2.58 Mach, 64,700 feet, with maximum afterburner power set, throats in automatic and shock positions in the green when a light airframe buffet occurred, followed immediately by high EGT and high vibration on No. 5 engine. An inlet unstart on the right side happened almost simultaneously. The unstart was detected by a mild "bang", shock position moving to high red, an unstart warning light and mild airframe buffet. The right inlet was restarted within four seconds and the No. 5 throttle was retarded to military and all other engines brought back to minimum afterburner power. The inlet restart was accomplished by bringing both shocks back to the crosshatch area and moving the throat mode switches to manual causing the throats to drive to the preset position of 2.3. When all engines but No. 5 were retarded to minimum afterburner, an apparent "min A/B instability" condition developed on them until power was reduced to military on all engines. The throats were reset to automatic following the inlet restart. While decelerating at approximately 2.40 Mach, 60,000 feet, things appeared to be relatively normal although vibration was 60% to 70% on the No. 5 engine and more bypass door opening was required on the right side to keep the shock position in the mid to high green. The bypass doors were set at 840 left and 1,300 right when the right shock position began creeping up into the yellow area even with the

bypass door continuing to be opened. Total fuel was down to 59,000 pounds. Suddenly at 2.2 Mach, the right inlet unstarted again and the No. 6 engine EGT went to almost maximum, the A8 opened fully and the rpm dropped to 96%. The pilot cut No. 6 throttle off while I attempted to restart the right inlet by again opening the bypass doors and the throat as previously done. I could not get the inlet to indicate a restart even with the right bypass door almost fully open. Therefore, the right bypass door was moved toward the closed position. The engine No. 5 A8 indicator was 60% while engines No. 1, 2, 3 and 4 were approximately 45%. At approximately 2.0 Mach, while going through the deceleration check list, a fairly high frequency lateral directional oscillation appeared. The oscillation was of a moderate magnitude for a few seconds. It then subsided for about ten seconds and then began to increase in magnitude. It increased to the point where both pilots were concerned and I felt that if it continued at the same magnitude, and certainly if it increased, there was danger of some type of structural failure of the airplane. During this oscillation the No. 4 and the No. 5 engines EGT went over temperature and the engines were cut off by the pilot. The No. 1, 2 and 3 engines were retarded to idle at about the same time. Also, during the oscillation, it was recognized that inlet buzz was being encountered and that the right buzz lights were on. The bypass doors were opened and the buzz was finally eliminated. The pilot had used full left rudder trim during this period of the deceleration. With Nos. 1, 2 and 3 throttles set at idle while decelerating through 1.3 Mach with the rpm lockup switch still in "automatic", these engine speeds suddenly dropped from 100% down to idle rpm. This rapid rpm drop following so close behind the other problems compounded the situation and gave an initial cockpit impression that the left three engines were failing also. The No. 3 engine is extremely important since it provides electrical generator power, therefore, the No. 3 throttle was quickly placed in cut off to prepare for an airstart attempt. At that time, the No. 3 engine was actually cut off resulting in loss of the No. 3 generator followed by the emergency generator starting and powering the essential busses. Cabin pressure was lost and pressure suits inflated slightly. All instrumentation, tape instruments, and telemetering were lost and all items powered by the left and right primary busses failed. Following the electrical power change over, the UHF transmitter was inoperative for approximately two minutes, however, the receiver continued to operate and calls from Data Control could still be heard. With the bypass doors and throats opened, restart attempts on engines No. 3, 4 and 5 were attempted. Speed and altitude were approximately 400 KIAS and 20,000 feet. The No. 3 and No. 4 engines did not restart, however, the No. 5 engine lit off and accelerated to 90% rpm with the throttle set at military power. Engines No. 1 and 2 were set at maximum afterburner. The No. 5 engine provided hydraulic pressure to power the emergency generator.

10. Descent and Landing:

The airplane was descended on a straight path toward Edwards. The surface wind was reported as 340° at 10 knots. Since the wind velocity was light, a decision was made to land straight in to runway 18 on the north lake bed. Data Control advised that I would probably have to leave the seat and proceed to the EE bay to manually select U_1 hydraulic system when it was time to lower the landing gear. After Mr. White objected to my leaving the seat, the planned procedure was revised. The normal gear extension would be used along with actuating the emergency battery. At 370 KIAS and 18,000 feet, another attempt was made to start the No. 3 engine. Simultaneously, Data Control advised to "fire" the emergency battery. Fortunately, the No. 3 engine restarted and the left generator was placed on the line which negated the need for actuating the emergency battery. The right primary bus was still not powered since the bus tie contractor fails open and cannot be closed after a loss of both primary generators. The airplane was then approximately 60 miles from Edwards with maximum afterburner power on engines No. 1 and 2, military power on engine No. 3 and 90% rpm on engine No. 5. The sump fuel low level light illuminated with 20,000 pounds remaining and it was determined that the automatic fuel sequencing had stopped. The No. 7 tank switch was moved from the "automatic" position to "on" and the sump then refilled. The cabin repressurization switch was depressed in an attempt to regain pressurization and it is my impression that pressurization was regained. In preparation for landing, the "before landing" check list was started. Data Control advised that the flare speed would be 185 KIAS. The emergency generator was turned off prior to extending the landing gear at 270 KIAS. After the gear was down and locked, the emergency generator was turned back on. Shortly after passing 6,000 feet, the flaps were selected down but failed to extend. Recycling the flap switch did not cause them to extend. An extremely smooth touchdown was accomplished at approximately 190 KIAS. The pilot required about one-half right aileron at touchdown, possibly due to a slight crosswind. The landing parachute failed to deploy and the nose wheel steering was inoperative but the airplane was stopped without any problems, since the brakes functioned normally. After stopping, the mobile radio vehicle reported that there was visible damage near the top of the inlet splitter. All engines were shutdown without taxiing and both pilots departed the airplane via the "high lift" vehicle.

11. Maintenance Discrepancies:

a. The inside of the right inlet was damaged when the wing apex separated from the airplane and went down the inlet.

b. All engines need to be inspected for damage and replaced, or repaired, as needed.

c. The flaps failed to extend prior to landing.

d. The No. 3 engine did not airstart on two attempts.

e. One of the two fuel transfer pumps in tank No. 1 was inoperative prior to flight.

f. The copilot's vent flow was inoperative prior to takeoff but began to function prior to termination of the flight.

g. The flap pressure warning light came on during flap retraction.

h. The flap indicator showed "barberpole" after flap retraction. The indicator appeared sticky.

i. The TACAN azimuth needle has a 20° error in direction when flying toward a station.

j. The compass system has approximately 30° error in the "magnetic" position.

k. The cabin altitude was maintained at 6,000 feet instead of 8,000 feet.

l. The nose wheel steering authority appeared to be less than normal while turning right on to the runway with the "taxi" position selected.

m. Prior to engine starts, both throats had to be biased with the standby switches to obtain proper scheduling.

n. One of the left unstart lights and one of the left buzz lights were inoperative prior to flight.

o. Prior to the flight, the No. 5 engine was reported as susceptible to 520 cps vibration and minimum afterburner instability.

p. A small hydraulic leak of the U_2 system on a pump compensator in bay No. 4 was found just before disconnecting the ground hydraulic stands.

q. Ground starts on the No. 6 engine had to be accomplished with the airstart ignition.

r. Several starts of the No. 6 engine were required before proper hydraulic pump operation could be obtained. During start both hydraulic pumps depressurized.

s. The No. 6 throttle hung up momentarily on one attempt to shut the engine off.

t. The sideslip indicator reads three-fourths degree left with ball centered.

u. The drag chutes did not deploy.

v. P_1 hydraulic system nitrogen quantity was low before engine start.

12. Copilot's Summary:

a. The XB-70's rate of climb and acceleration, like other jet airplanes, is greatly affected by changes in the prevailing temperature.

b. The rate of acceleration on this flight was "slow" and caused a requirement to alter the flight plan due to fuel being consumed at a faster rate than planned.

c. The maximum speed observed by the copilot was 2.58 Mach at approximately 65,000 feet.

d. Approximately the forward 24 inches of the wing apex separated from the airplane and went into the engine inlets causing major damage to all engines on the right side and minor damage to two engines on the left side.

e. The three inlet unstarts that occurred on the flight (one planned and two unplanned) were characterized by a mild "bang" followed by light continuous buffet.

f. The intentional unstart on the left inlet did not occur until the shock position indicator was in the mid to high red area.

g. The bypass door control wheels are so sensitive that it is almost impossible to set the exact opening desired.

h. Maintaining the shock position at a desired location is very difficult because of needle oscillation. The lower to mid green area is extremely sensitive. The right shock position indicator was slightly more sensitive than the left.

i. Turbulence has a direct effect on shock position and whenever turbulence was encountered, the shock position indicator began to oscillate approximately ± one-eighth inch.

j. The bypass doors caused a slight nose up trim change when opened to restart the inlet at 2.4 Mach.

k. Inlet buzz was encountered in the right inlet around 2.0 Mach and caused a severe lateral directional oscillation. The oscillation may have been amplified by the FACS system.

l. The throats appeared to smoothly follow the desired schedule when the automatic mode was selected.

m. The No. 5 engine was restarted at approximately 400 KIAS, 20,000 feet, after being severely damaged by a piece of the wing apex.

n. The No. 3 engine was restarted at approximately 370 KIAS, 18,000 feet, after having failed to start at a low supersonic speed and at 400 KIAS, 20,000 feet.

o. The right primary buss could not be repowered after both generators were lost and then the left generator was restarted.

p. The emergency generator came on the line and operated, as advertised, when electrical power from both main generators was lost.

q. The landing parachute failed to deploy.

r. Forward visibility is completely blocked when the windshield ramp is raised.

s. The fuel, hydraulic, electrical, water, ammonia, liquid oxygen, landing gear, windshield ramp, wing tip, and TACAN systems all appeared to operate normally.

VI. CONCLUSIONS:

1. (U) Higher than normal free air temperature and some clear air turbulence required the test plan and route of flight be shortened.

2. Structural failure of the wing apex near 65,000 feet and 2.58 Mach further reduced the number of data points completed.

3. Failure of the wing apex caused extensive damage to the inlet duct and the three engines on the right side. The three engines on the left side showed minor damage.

4. Systems which gave overall satisfactory performance were:

Engines	Environmental (ECS)
Fuel	Flight Instruments
Landing Gear	Radios
Nose Wheel Steering	Hydraulics
Brakes	Oxygen
Instrumentation	Flight Controls
Communications	Wing Fold
Fire Detector (Eng & ADS)	Air Induction Control (except indicators)

5. The shock position indicators were over-sensitive when indicating shock positions in the normal and aft ranges.

6. The inlet unstarts were characterized by a mild "bang" followed by mild continuous airframe buffet.

7. Buzz was encountered in the right inlet near Mach 2.0 and caused severe lateral directional oscillations.

8. The unstart caution lights are armed and disarmed at 39 inches throat width (approximately Mach 2.17) which may be misinterpreted as an inlet start during deceleration.

9. The automatic control of the inlet throat panels per-formed in an excellent manner.

10. No. 5 engine was restarted and ran for the remainder of the flight in spite of severe damage.

11. Right primary AC buss-tie contactors cannot be closed during flight.

12. The emergency alternator cannot be powered from the U_1 hydraulic system.

13. The emergency alternator will not provide electrical power sufficient for engine airstarts with engine windmill rpm below approximately 25% rpm.

14. The drag chute failed to deploy.

VII. RECOMMENDATIONS:

1. Provide a buss-tie contactor reset capability.

2. Provide capability to drive the emergency alternator from U_1 and U_2 hydraulic systems.

3. Install a continuous duty battery to provide an airstart capability after failure of primary and emergency alternators.

4. Eliminate erratic needle movement on the shock position indicators.

5. Modify inlet system so as to arm and disarm the inlet caution light below Mach 2.0.