File 8 MGA

(Gp-4) TEST REPORT

XB-70A

FLIGHT 1-6

(No. 1 Air Vehicle, No. 6 Flight)

25 February 1965

PREPARED BY:

Joseph F. Cotton
Colonel Joseph F. Cotton
Test Director

Ira L. Plummer
Major Ira L. Plummer
Chief Project Engineer

XB-70 JOINT TEST FORCE (FTTB)

REVIEWED AND APPROVED:

GUY M. TOWNSEND
Colonel, USAF
Deputy for Systems Test

AIR FORCE FLIGHT TEST CENTER
EDWARDS AF BASE, CALIFORNIA

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I. SUMMARY:

1. The sixth flight (Flight 1-6) of XB-70, No. 001, crewed by Mr. Al White, North American Aviation, Inc (NAA), Pilot and Lt Colonel Fitzhugh Fulton, AFFTC, Copilot, was accomplished on 25 Feb 65. Takeoff from Edwards AFB runway 04, at a gross weight of approximately 450,000 pounds, occurred at 1117 hours PST. An emergency landing on lakebed runway 17 was made at 1210 hours. Total flight time was 53 minutes, maximum speed and altitude were Mach 0.97, 35,000 feet.

2. A repeat of the Flight 1-5 rough and unsymmetrical take-off brake release and abnormally slow landing gear retraction cycle was experienced. During climb out to 34,500 feet, Mach 0.97 the instrumentation system cooling warning light illuminated and the instrumentation system automatically shut down. Crew attempts to recycle and activate the system were unsuccessful. Only eleven minutes of data were gathered prior to the loss of the instrumentation system.

3. Twenty-three minutes after takeoff the crew noted that the Utility No. 1 (U_1) hydraulic system fluid level was 20% and dropping. The U_1 status caution lights came on shortly thereafter and an emergency was declared. The aircraft was turned toward base, decelerated, and the gear was extended by the electrical emergency system. While descending between the altitudes of 19,000 and 14,000 feet, at a gross weight of 290,000 pounds, chase reported the loss of the right wing tip light and fairing.

4. After the loss of the U_1 hydraulic system and the emergency extension of the landing gear, there was a gradual decrease in Utility No. 2 (U_2) hydraulic system fluid level from 90% to 71%. While on the final approach to landing the electrical emergency gear extension switch was again placed in the down position. U_2 fluid level then rapidly decreased, reaching 0% at touchdown. The aircraft rolled to an uneventful stop on the lakebed.

5. Due to the emergency condition, the mission objectives for the flight were not achieved.

II. TEST LOG:

0915	Pilot in cockpit.
0945	Copilot in cockpit after considerable trouble getting pressure suit visor heat, which required changing helmets.
1014	All engine starts manual - total fuel 207,500 pounds. Start No. 4 - EGT 510° - EDV 36% - pump status O.K., at idle.
1016	Start No. 3 - EGT 510° - EDV 34% - pump status O.K., at idle.
1017	Start No. 1 - EGT 510° - EDV 34% - U_1 status light hung up at idle.
1018	Start No. 2 - EGT 510° - EDV 35%.
1019	Start No. 6 - EGT 460° - EDV 31%.
1020	Start No. 5 - EGT 500° - EDV 34%.
1021:30	Generators on and check.
1030	Hydraulics serviced - P_1-170%, P_2-164%, U_1-174%, U_2-167%. GN_2 - 95 92 95 93. ADS Vibs. - #1 - 45%, #2 - 45%, #3 - 40%.
1031	Beginning flight control checks.
1041	Entrance door being closed, EE Temp. 59 degrees.
1043	Nose steering checked O.K.
1045	Total fuel - 201,500 pounds.
1048	Engine runs - each engine to Mil power - one at a time.
1052	Ground interphone being disconnected.
1053	Getting taxi instructions from tower - UHF No. 2 noisy.
1055	Start taxi - heavy brake chatter occurred on brake check.
1056	The increase in gross weight is noticeable in taxi response.
1057	Cockpit bouncing during taxi.
1058	With vent on cool and face plate heater set second position, Al White was too hot around face - setting face plate heat to first position.
1059	OAT - 52°F - P.A. - 2,054 feet.
1100	Engine and ADS fire warning system check - previous problem on No. 3 engine has cleared up.
1101	ADS vibration test causes No. 3 to go to 100% position.
1102	Turning left onto west taxiway near Base Operations - No. 3 ADS vibration - 5%, No. 6 ADS vibration is highest one at 18%.
1104	Going through "before lineup" checklist.
1105	Heavy brake chatter when stopping.
1107	Lining up on Runway 4.
1108	C/N 3338 - Control movements total fuel 193.5.
1111	Elevons even and set 10" down on each side - flaps down Hydraulics P_1-160%, P_2-153%, U_1-168%, U_2-167%.
1111:30	Fuel sequence normal. Total 192.5. No. 2 tank 800 lbs., less than start. Ammonia 470. Water 4,500. LN_2 3/4 plus.
1112:45	Four minute warning for takeoff - data counter reset.
1113	Cockpit camera to ready, VGH recorder on and cabin recorder ready.
1114	Total fuel 191.5.

Test Log, Flight 1-6 (Cont'd)

1115	Hydraulics O.K.
1116	Data on C/N 0167. Setting engines to minimum afterburner (T/A 70°) two at a time.
1116:45	Brake release. Brakes released very rough and uneven. Power increased to maximum afterburner, engines look good. Rotation at 180 KIAS and airborne at approximately 200 KIAS. Landing gear selected up at 250 KIAS. Retraction time 55 seconds. Master caution light blinks - no apparent reason.
1117:30	All throttles reduced to 88 degree T/A.
1119	Landing gear indicates up and confirmed up by chase. Flaps retracted and confirmed up by chase.
1119:30	C/N 385 - data off. Heading 55 degrees with B-58 reporting showing 35 degrees. Slewed heading to agree with B-58. Master caution light blinking for no apparent reason.
1120	Cabin reported as 8,000 feet. (This was erroneous, actually it was only 5,000 feet). No. 3 ADS vibration 10%. Altitude 10,000 feet - speed 385 KIAS. E.E. temperature 44 degrees - Aux cool off.
1121	Ground cooling doors coming closed - reported by chase. Increasing to full throttle, EGT good. Instrumentation cooling malfunction light on. No. 2 cool light on. Climbing through thin cloud layer.
1123	22,000 feet - top of cloud layer. The airframe buffet smoothed out.
1123:30	Instrumentation cooling malfunction light still on. Lost instrumentation again. Coming up on .95 Mach and 26,000 feet. Turning left slightly toward Las Vegas. Instrumentation off light still on. Cooling malfunction light still on.
1124:30	Requested to manually switch to No.1 instrumentation cooling system. Instrumentation off light still on. Cooling system No. 1 is on.
1125	Throttling back. All hydraulic systems 190 - 200%.
1126	Minimum afterburner instability on No. 5 engine - copilot throttled No. 5 back to Mil power.
1126:30	Nos. 1, 2, 5 and 6 engines at Mil power. Instrumentation is still off.
1127	Speed .97 Mach and altitude 34,500 feet. No. 2 instrumentation cooling system selected; system to restart.
1128	Instrumentation restarted. Cooling malfunction light on. 60 N.M. to Las Vegas on TACAN - starting left turn.

Test Log, Flight 1-6 (Cont'd)

1130	Total fuel 150,500 pounds. C/N 1027 - FACS coming on.
1130:30	FACS "belting" aircraft - uncomfortable feeling. Disengaging FACS.
1131	The yaw damper was "walking" the airplane.
1131:30	No. 1 instrumentation cooling system selected. Cooling malfunction light is on. Pressed restart and instrumentation now working. It will cut out again in two minutes if the problem still exists.
1132	Beatty 55 N.M. on TACAN - appears to be slightly left of course.
1132:30	TACAN heading indication appears to be erroneous.
1133:30	Lt Colonel Fulton now flying the airplane.
1134:30	Lost instrumentation again - Data control reports T.M., inoperative.
1139:30	U_1 quantity 20% and dropping. All engines out of afterburner.
1140	No. 2 engine utility pump status light blinking between green and amber and finally went solid amber.
1140:30	All U_1 status lights blinking yellow.
1141	Gear handle selected down at 260 KIAS and .7 Mach. Chase reported right main gear door open - no gear yet. U_1 pressure shows 500 pounds.
1142	Landing gear electrical emergency switch selected to "down".
1143	Gear confirmed down by chase and shows down in cockpit - landing gear doors open.
1144	Total fuel 138,000 pounds - tank four has not yet started to feed.
1145	Landing gear electrical emergency switch selected to "normal".
	U_2 quantity now showing 90%. Landing gear doors closing.
1145:30	U_2 quantity 88%.
1146:30	U_2 quantity 75%.
	Altitude 19,000 feet.
	Both primary hydraulic system quantities and pressures O.K.
1148	Pressure suit visor causing much glare for pilot.
	U_2 quantity 90%.
	Military power on all engines - lighting afterburners on No. 3 and No. 4 engines.
	Panamint Springs Dry Lake bed just ahead.
1150	U_2 quantity 92%. Both primary quantities O.K.
	No. 4 fuel tank transferring, No. 6 tank pumps off. Total fuel 129,000 pounds.
1151	Chase reported all cooling doors open.
1153	P_1 quantity 200% - P_2 quantity 195% - U_2 quantity holding 90%.
1154	Fuel system O.K. - No. 4 tank transferring. Total fuel quantity 121,000 pounds.

Test Log, Flight 1-6 (Cont'd)

1156:30	Chase No. 2 reports portion of right wing tip came off.
1157	Slowing airplane down - lateral control is O.K. Chase No. 2 reports no fluid coming from wing tip.
1157:30	Engines all out of afterburner. Chase No. 1 (TB-58) confirms that it was the wing tip light.
1158	Total fuel 116,500 pounds. Data Control advises that electrical emergency switch only and not manual gear handle will be required before landing. Chase No. 1 confirms that nose gear door is still open.
1158:30	Fuel sequencing is normal.
1159	Cabin altitude 5,000 feet - both pilots raising helmet visors.
1200	Total fuel 115,000 pounds. No. 4 tank 20,600 pounds. U_2 quantity 71%. Both primary hydraulic quantities O.K.
1201	Altitude 14,000 feet.
1202	Altitude 10,500 feet.
1203:30	U_2 quantity holding at 71%, P_1 -192% and P_2 level O.K. Flaps selected down.
1205	No. 2 fuel tank transferring on schedule. No. 4 tank at 20,500 pounds. Total fuel 109,000 pounds. Master caution on for no apparent reason.
1206:30	Speed 247 KIAS - pacer shows 244 KIAS.
1207	Turbulence encountered at approximately 6,000 feet altitude. Hydraulics O.K.
1208	Turned aux cool on and refer off.
1208:30	Total fuel is 107,000 pounds.
1209	Cockpit hot - Refer back on and aux cool off. Lining up on lakebed runway 17 O.K. Landing gear electrical emergency switch to down at 235 KIAS.
1210	Losing U_2 quantity - indicates zero.
1210:30	Pacer called touchdown.
1211	U_2 pressure - 4,000 psi. Shutting down engines No. 1 and No. 2. Jettisoned drag chute - approximately 40 knots.
1212	Shutting down engines No. 5 and No. 6. Ground installing gear safety pins - performing after landing checklist.
1214	Ground man on interphone - shutting down No. 3 engine. Radios off.
1214:30	No. 4 engine off - lost all power.

III. DATA:

1. Fuel Data:

Time	1015	1108	1130	1135	1143	1149	1153	1157	1159	1205	1208	1215
Event	Before Engine Start	Before Lineup	35,000' Subsonic Cruise	Over Beatty	Just After Hyd Emergency	17,000' Descent	16,500' Descent	15,500' Descent	15,000' Descent	9,000' Descent	Approx. 5,000' Descent	After Flight
Transfer Condition	None	Auto #6 Transferring	Auto #6 Transferring	Auto #6 Transferring	Auto #6 Transferring	Auto #4 Transferring	Auto #4 Transferring	Auto	Auto	Auto #2 Transferring	Auto	None
TANK *												
1	10.2	10.4	10.2	10.2								10.4
2	28.3	27.5	27.3	27.3								19.9
3	33.4	33.3	33.2	33.2								29.9
4	37.2	37.0	37.4	37.4					20.6	20.5		20.5
6L	38.6	32.0		12.1								1.5
6R	38.7	31.8		10.3								1.0
7L	10.2	10.3	9.8	9.8								10.2
7R	10.1	10.2	10.1	10.1								10.3
8L	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty	.2
8R	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty	.3
Total	207.5	193.5	150.5		138.0	129.0	121.0	116.5	115.0	109.0	107.0	105.5

* Fuel quantity times 1,000

2. Landing:

a. tabulated Information regarding the lakebed runway landing is below. Touchdown weight was approximately 370,000 pounds.

Distance	Remarks
0	Touchdown right main gear.
	NOTE:- Left gear down 60 feet later. Right gear lifts off from approximately 210 to 270 feet.
.2 mile	Rut depth increases.
.65 mile	Nose wheel touchdown.
1.9 mile	Stopped.

b. Initial touchdown was approximately 1.4 miles south of the lakebed extension of main runway 04/22 on lakebed runway 17. Penetration into the lakebed was 1 to 2 inches. The lakebed surface hardness varied considerably along the landing path as indicated by variations in penetration.

IV. ENGINEERING COMMENTS:

1. Instrumentation:

Early in the flight the instrumentation package cooling light No. 2 indicated a malfunction in the instrumentation package cooling system. The instrumentation system then automatically shut down. Attempts to reset the system were unsuccessful and, as a result, only seven minutes of data were obtained during the flight. Post-flight inspection revealed that the malfunction was due to loss of instrumentation package pressurization caused by a seal failure.

2. Utility No. 1 Hydraulic System Failure:

a. Twenty-two minutes after takeoff the pilots noted that U_1 hydraulic system quantity had dropped to 20%. Very shortly thereafter, the U_1 pump No. 2 pressure warning indicator went amber followed almost immediately by amber warning indications on pumps 1 and 3. Emergency procedures were begun immediately, and the landing gear was extended with the electrical emergency system. The aircraft was returned to base, and a precautionary lakebed landing was made.

b. After the loss of the U_1 hydraulic system, and during the return to base, a decrease in Utility No. 2 hydraulic system fluid from 90 to 71% was noted. The fluid level held constant at 71% until the electrical emergency landing gear switch was again selected down during the final landing approach (approximately 1 minute to touchdown). The U_2 fluid level then immediately began to drop and indicated zero just prior to touchdown. U_2 system pressure maintained 4,000 psi until the aircraft stopped and the engines were shut down.

c. During the post-flight inspection it was found that the 0.014 inch (wall thickness) hydraulic pressure supply line to the lower No. 6 right fuel tank pump had failed at the pump manifold. All three U_1 pumps suffered internal damage. U_2 pumps were not damaged. All 0.014 inch tubing at No. 6 right and left fuel pumps are being changed to 0.025 inch tubing. The loss of fluid from the U_2 system has been attributed to fluid flow into the failed U_1 system.

d. It should be noted that a similar hydraulic line failure occurred in the No. 6 left fuel tank during Flight 1-2. Possible cause factors relating to the failures include:

(1) The proximity of these failures to the landing gear which suffers strut walk and violent vibrations produced by the heavy brake chatter.

(2) The fact that both failures occurred in flight when the tanks in which the failures occurred were approaching empty.

3. Ice From Steam Vent:

During the flight, the chase pilot reported ice in the vicinity of the right-hand steamport. Droplets of water were assumed to be vented out this steamport because condensation of steam to ice would probably not constitute a problem. If the water level control valve in the bleed air water boiler were to stick, resulting in a boiler overfill, then droplets of water could be ported out this steamport. In addition, these valves have stuck during past operations. To resolve the problem the needle valves have been removed and coated with Teflon in an attempt to provide a better valve seal than the previous metal-to-metal seal.

4. Propulsion:

No engine malfunctions occurred during the flight. Post-flight Inspections revealed no Foreign Object Damage (FOD); however, the bullet nose on engine No. 5 was indented in the upper right quadrant. On previous flights, similar indentations were attributed either to ice breaking off the air vehicle around the water drain ports and coming through the inlet duct or to a pressure differential across the bullet nose. Tests with two bullet noses were made in the North American Aviation, Inc (NAA) laboratory to check the pressure differential. One bullet nose, which had been indented in flight, was checked at the design limit of 8.5 psi differential. No indentations occurred. Another bullet nose, which seemed to be made of thinner material, was tested to approximately 9.25 psi differential where it failed. The investigation to determine the cause of the bullet nose indentations will continue. The bullet nose from engine No. 5 has been removed in order to take pictures of the indentations. Prior to reinstallation it will be strengthened by placing doublers inside the nose.

5. Wing Light Fairing:

The right wing light fairing was lost during the flight at approximately 270 KIAS. The gear had been extended, flight altitude was between 14,000 and 19,000 feet and the gross weight was in the vicinity of 290,000 pounds. These flight conditions resulted in airframe buffet felt by the flight crew and wing tip vibrations observed by the chase pilots. The fairing, which is approximately 34 inches in length by 3.4 inches in width, is secured to the wing tip by two 3/8 inch bolts. The failure has been attributed to the bolts shearing due to high stress levels which occur during low speed flight. The forward bolt failed first. The repair consists of fusion welding of a 1/2 inch spacer block 3.25 inches long to the frame where the original bolts were secured. The bolts which are to be used with the spacer are the same diameters as the original bolts but their length has been shortened. The spacer block has been drilled and tapped to

a depth of 5/8 inches. Thread length on the bolts is 3/16 inches.

6. Master Caution Light:

Intermittent master caution light warning occurred again as in the previous flight. The difficulty was again isolated to the Cook 1/2 ampere universal relays. Five of these relays were replaced after this flight and the utilization circuits for these relays are being investigated in bench checks.

7. TACAN:

The AN/ARN-65 TACAN set indicated erroneous bearings in flight of 10 to 15 degrees. This was suspected by the flight crew and confirmed by the TB-58 chase crew. After the flight the azimuth rate card in the gate generator set was replaced.

8. No. 3 Accessory Drive System (ADS) Vibration:

During pilot preflight checks, the No. 3 ADS vibration tested high. During flight, however, there were no abnormal vibration indications. The vibration pickup was found bad. All ADS vibration pickups were removed for calibration, as planned, prior to this flight.

9. Inoperative Fuel Pumps:

Tank No. 8 right hand transfer pump (P_1) and tank No. 4 (U_1) transfer pump were inoperative on this flight (tank No. 8 pump was inoperative prior to this flight). Tank No. 8 pump was jammed by a piece of safety wire and the tank No. 4 pump by pieces of an Apex screwdriver tip.

10. UHF Radio Communications:

With both UHF radio receivers on the same flight frequency (361.4 MC.), some sidetone resulted as audible interference in UHF set No. 2. Bench check of UHF set No. 2 revealed no discrepancies. On the next flight the UHF radio sets will be operated on different frequencies.

11. NASA Supersonic Transport Tests and Instrumentation:

a. Landing Gear Cameras:

The cameras were turned on prior to touchdown, but with instrumentation power off the main gear cameras were inoperative. The nose gear and drift angle cameras are not powered by the instrumentation system; therefore, they functioned and provided good data.

b. Landing Gear Rate of Sink Sensors (arms):

The arms functioned well mechanically, but no data was recorded since instrumentation power was off.

c. Cabin and Ballast Bay Microphones:

The data was not usable due to an intermittent wire connection.

d. Velocity Acceleration Altitude (VGH) Recorder:

The VGH drum had been incorrectly loaded with only a 38 minute supply of film. The record ran out during flight approximately at the time the wing tip navigation light fell off.

e. Runway Noise:

Acoustical measurements were made at several stations along the runway during takeoff. No landing noise measurements were obtained since the landing was on the lakebed.

f. Sonic Boom:

No supersonic flight was achieved.

V. OBSERVATIONS AND COMMENTS BY THE COPILOT:

1. Introduction:

The flight was scheduled for 1100 hours takeoff on 25 Feb 65. Tests scheduled were stability and control at supersonic speeds up to 1.8 Mach, operation of the Ram Purge system at 1.68 Mach, engine shutdowns and restarts at 1.4 Mach, operations of the throat and bypass systems and calibration of the airspeed system.

2. Preflight and Flight Preparation:

I arrived at the airplane at 0730 and things were progressing normally although some minor instrumentation problems had caused the schedule to fall slightly behind. Mr. White and I conducted an external inspection of the airplane without discovering any unknown discrepancies. One transfer pump in the No. 4 tank and one transfer pump in the No. 8 tank were inoperative prior to flight. One loop of the No. 3 engine fire warning system was known to check faulty. Inspection of the electronic equipment (EE) bay revealed no discrepancies; however, some circuit breakers were still being reset by a maintenance technician. At approximately 0815, Mr. White and I met with North American Aviation, Inc., (NAA) and General Electric (GE) personnel for a final discussion of expected engine performance. At 0845, we entered the physiological van which was parked next to the XB-70 and began putting on the full pressure suits. The suits had been checked out in the airplane on the previous day, therefore, no complications were expected. Mr. White completed his checkout of the pressure suit and entered the airplane at approximately 0915. Considerable difficulty was experienced in obtaining satisfactory visor heat on my helmet. I finally had to use the spare helmet and was delayed getting in the cockpit until 0945.

3. In the Cockpit Prior to Taxi:

The pressure suit restricts mobility somewhat but all controls and switches can be satisfactorily operated while the pressure suit is not inflated. The "Before Starting Engines" checklist was completed and included a check of the throat and bypass door controls. All checks were satisfactory. The gross weight was approximately 474,000 pounds which included 207,500 pounds of fuel. Engine starts began at 1015 hours and were completed seven minutes later. All starts were using the "manual" technique and exhaust gas temperatures (EGT) were well within the normal range. Following the flight control checks, the entrance door was closed and a military power check of each engine obtained.

4. Taxi:

Taxi out was initiated at 1055 hours and heavy brake chatter occurred as the brakes were checked. During taxi out it was noted that the cockpit has a "hard" ride and that at some speeds the bounce of the airplane nose appears to get in frequency with the concrete blocks that are being traversed. This causes a slightly amplified oscillation of the cockpit which can be reduced by increasing or decreasing the taxi speed.

5. Takeoff and Climb:

a. The total fuel just prior to brake release was 191,500 pounds. Engine power was set to minimum afterburner (throttle angle 70°) two at a time. Brake release was approximately 1117 hours and the release was extremely rough and punishing on the airplane. The brakes appeared to release unevenly and must have imposed much strain on the landing gear. The throttles were advanced to maximum afterburner as the airplane began to roll. The airplane accelerated rapidly and rotation was started at 180 knots and lift-off occurred at approximately 200 KIAS. After checking hydraulic pressures and quantities and accelerating to approximately 250 KIAS, the gear handle was selected up. A slow (55 second) retraction cycle of the gear occurred. After flap retraction, a normal climb was initiated. The heading indicator was approximately 20 degrees in error after takeoff and had to be slewed to the proper heading (heading obtained from TB-58). All the ground cooling doors were reported to be coming closed at 10,000 feet with 385 KIAS. Visibility during the climb was not particularly good due to the nose high attitude. The nose blocked out most of the forward visibility when attempting to view the ground.

b. Approximately five minutes after takeoff, the instrumentation "cooling malfunction" light illuminated and two minutes later the instrumentation system automatically cut off. Numerous attempts were made to re-establish satisfactory operation of the instrumentation system. Manual selections of the No. 1 and No. 2 instrumentation cooling systems were accomplished but satisfactory cooling could not be obtained and the instrumentation package would cut itself off. During the climb, a slight airframe buffet was noticeable until it smoothed out around 24,000 feet and .92 Mach. All hydraulic systems were showing 4,000 psi and between 190% and 200% fluid quantity during the climb. After throttling back to minimum afterburner at 30,000 feet, afterburner instability manifested itself on engine No. 5 but was stopped by retarding the throttle to military power.

6. Cruise:

The airplane was leveled at 35,000 feet with No. 3 and No. 4 engines set at minimum afterburner and all others at military power. The speed stabilized at .95 to .97 Mach. The TACAN locked on Las Vegas at slightly over 100 nautical miles; however, the directional needle appeared to be in error by 15 to 20 degrees. After turning in Beatty Nevada, the TACAN distance measuring equipment (DME) operated fine but the directional needle was again in error. The Flight Augmentation Control System (FACS) was engaged for approximately 30 seconds but caused abnormal directional oscillations; therefore, it was disengaged. Several more unsuccessful attempts were made to obtain satisfactory instrumentation operation and Data Control recommended an alternate flight plan on which qualitative information could be obtained up to 1.4 Mach. Plans for supersonic flights were dropped when Mr. White advised that the yaw indicator was not operating. I flew the airplane for a short time during the .95 to .97 Mach cruise at 35,000 feet and noted that the lateral control was very sensitive and responsive. It is particularly easy to cause a pilot induced lateral oscillation. After 10 to 15 seconds, I was able to damp the oscillation but the light forces and high sensitivity can cause it to easily recur. Directionally, the airplane seemed to be stable with only small amounts of yaw associated with the aileron control movements. The longitudinal control appeared to be solid; however, since only level flight at a constant speed was attempted, the assessment of flying qualities is rudimentary at best.

7. Descent:

a. Approximately 20 minutes after takeoff, the U_1 quantity was seen to be at 20% and still decreasing. An immediate deceleration and descent was initiated in order that the landing gear could be extended. Approximately one minute after the hydraulic problem was detected, the U_1 quantity had dropped to zero and all U_1 pump status lights had changed to amber. The No. 2 pump status light was the first to illuminate. As the airplane was slowed to gear limit speed, light to moderate airframe buffet was encountered. When airspeed dropped below 270 KIAS, the landing gear handle was selected "down" and U_1 system residual pressure helped to start the landing gear down. The gear did not fully extend until the electrical emergency gear switch was selected "down". Less than four minutes after the leak in U_1 was noted, the three landing gears were locked down with the gear doors remaining open. Fuel quantity at that time was approximately 138,000 pounds with the system operating normally using automatic sequencing. After the landing gear was fully extended, the electrical emergency switch was moved back to "normal" to conform with checklist procedures. This caused the main landing gear doors to retract and lock up. U_2 hydraulic quantity was then found to be down to 90% and the flight crew reviewed procedures for possible double utility system failure. The airplane

was approximately 150 nautical miles north of Edwards when the emergency occurred and was immediately turned to proceed on a direct course to the Rogers Dry Lake. At approximately 1155 hours, Chase No. 2 reported a portion of the right wing tip had separated from the airplane. Chase No. 1 (TB-58) checked and advised that missing portion was the navigation light assembly and also advised that no other damage was apparent. The course to Edwards was such that the pilots faced into the sun and considerable glare on the helmet visors was encountered. Since cabin altitude was only 5,000 feet, both pilots raised their visors to improve visibility and reduce the objectionable glare. Raising the visors caused the suit vent flow pressure (gaseous nitrogen) to flow around the face seal and into the nose breathing area. Vent flow was turned off to eliminate any possibility of breathing excess nitrogen. This caused Mr. White, who was piloting the airplane, to become overheated.

b. A straight in approach and landing was planned for Runway 17 on the Rogers south lakebed. This seven mile long runway had been checked prior to flight and was known to be in good repair. The wind was calm. Both primary hydraulic quantities stayed above 190% for the remainder of the flight. The U_2 quantity held 90% until approximately 15 minutes prior to the landing when it dropped to 71% and again held constant. Just prior to landing, the total fuel quantity was 107,000 pounds with a computed flare speed of 207 KIAS. Fuel was sequencing automatically. The No. 6 tank was essentially empty, No. 4 tank down to 20,500 pounds and the No. 2 tank feeding into the No. 3 tank which was holding at the low level point. Flaps were extended and confirmed down by Chase No. 1 and No. 2. Passing approximately 6,000 feet mean sea level (MSL) moderate turbulence was encountered for about 30 seconds and this turbulence was very noticeable in the cockpit.

8. Approach and Landing:

The final approach was flown at 235 KIAS with a gradual speed decrease as the lakebed runway threshold was neared. One minute prior to the landing, the electrical emergency landing gear switch was selected down and the landing gear doors opened as expected. The U_2 quantity immediately began to drop and went to zero just prior to the touchdown although U_2 pressure held 4,000 pounds until engine shutdown. The touchdown was extremely smooth and occurred at approximately 195 to 200 knots. The drag chute was deployed at 180 knots and the deceleration was very apparent in the cockpit even though only two of the canopies inflated. The chute was jettisoned at 40 knots. The airplane slowed rapidly on the lakebed runway and was stopped in less than two miles even though the wheel brakes were not used until after the chute jettison. All engines were shut down without taxiing and both pilots left the airplane via the "high lift" vehicle.

9. Maintenance Discrepancies:

a. The instrumentation cooling system failed in flight.

b. The U_1 hydraulic quantity gage dropped to zero and the system became inoperative.

c. The U_2 quantity level dropped to approximately 90% when the landing gear was extended using the electrical emergency switch. The quantity then dropped to zero just before landing although pressure was normal.

d. The master caution light blinked on frequently for no apparent reason.

e. The No. 2 UHF transmissions were noisy and caused excessive side tone to the copilot.

f. The FACS system caused abnormal directional oscilla-tions when engaged.

g. The No. 3 engine aft fire warning loop checked faulty prior to engine start but checked O.K., during taxi and flight.

h. The right wing tip navigational light assembly was lost in flight.

i. The No. 3 auxiliary drive system (ADS) vibration indicator went to 100% when checked prior to takeoff.

j. The TACAN heading indicator had a 15 to 20 degree error.

10. Copilot's Summary:

a. Riding qualities on the ground were not particularly good. The airplane has very little cockpit cushioning when traversing the concrete blocks on the taxiways and the cockpit motion can get in frequency with the bumps. Heavy brake chatter exists when slowing down below 5 or 6 knots speed. The brakes release uneven and very rough when beginning the takeoff roll.

b. The lateral control appears to be very sensitive with light forces. Pilot induced lateral oscillations are easily started. Airplane stability appears to be good with the FACS off during sub-sonic flight.

c. The instrumentation cooling system failed five minutes after takeoff causing the instrumentation package to shut down. This failure would have prevented mission objectives being accomplished.

d. The primary hydraulic systems operated satisfactorily; however, both utility systems dropped to quantity readings of zero prior to landing.

e. Engine operation was excellent although minimum after-burner instability was encountered once on the No. 5 engine.

f. The full pressure suit does not significantly restrict mobility when not inflated. It will restrict mobility to an appreciable degree when inflated near XB-70A design cruise altitude. The pressure suit visor causes excessive glare. Visor heat is susceptible due to problems in the helmet. Nitrogen vent flow is undesirable and blows around the face seal with the visor raised.

g. The landing gear extended satisfactorily following a U_1 hydraulic system failure.

h. Airframe buffet with the gear extended was strong enough to cause the right wing navigation light assembly to separate from the airplane.

i. Visibility during climb was not good and is somewhat restricted even during level flight. During approach and landing it is acceptable and appears to be equal to that available in the B-58.

j. There was no satisfactory place in the cockpit to place pencils, checklists, or data cards.

k. The landing parachute decelerating force was very effective even though only two of the three parachutes inflated.

l. The airplane slowed rapidly on the dry lake bed runway and could have probably been stopped in less than three miles even without wheel brakes.

m. The fuel system operated in an excellent manner. Tanks No. 6, 4 and 2 all transferred fuel using the automatic sequencing.

n. The environmental control system gave satisfactory operation.

o. The electrical system gave satisfactory operation.

VI. CONCLUSIONS:

1. Mission objectives were not met due to failure of the Utility No. 1 hydraulic system and loss of data recording by the instrumentation package.

2. The aircraft systems which gave overall satisfactory operation were:

Nose wheel steering	Flaps
Fuel	Environmental
ARC-50 radios	Electrical power supply
Intercom	Flight controls
Oxygen	Landing gear
Engines	

3. Heavy brake chatter existed when stopping the aircraft. Brake release was uneven and rough at the beginning of the takeoff roll.

4. Cockpit visibility in the climb was not good, was somewhat restricted in level flight and was acceptable during approach and landing.

5. Master caution light illumination occurred without apparent reason.

6. Lateral control was very sensitive and the forces were light.

7. Ice flow from the steam vent or excessive pressure differentials may have caused the indentation of the bullet nose on No. 5 engine.

8. Pressure suit operation and protection were generally satisfactory. Helmet visor glare and nitrogen flow across the face with visor raised are undesirable.

9. Following failure of the Utility No. 1 hydraulic system and landing gear extension, the indicated Utility No. 2 quantity dropped until the quantity was zero when the emergency lakebed landing was made.

10. Airframe buffet with the gear extended caused the right wing navigation light assembly to separate from the airplane.

11. Only two of the three drag chutes inflated.

VII. RECOMMENDATIONS:

1. Eliminate the hydraulic line failures in the utility system. Investigate the fluid transfer between U_1 and U_2 hydraulic systems in an effort to limit excessive cross flow.

2. Redesign the brakes to allow a smooth release when beginning the takeoff roll. Eliminate the heavy brake chatter which occurs when slowing to a stop.

3. Investigate the stress levels imposed by wing buffeting on the air vehicle structure and components resulting from heavy weight subsonic flight.

4. Continue investigations to define the cause of the Cook 1/2 ampere universal relay failures in the master caution light circuit.

5. Increase lateral control forces.

6. Consider changing the pressure suit vent system from nitrogen pressure to air pressure.

7. Make necessary changes to the drag chute system to insure all three chutes will inflate at deployment.